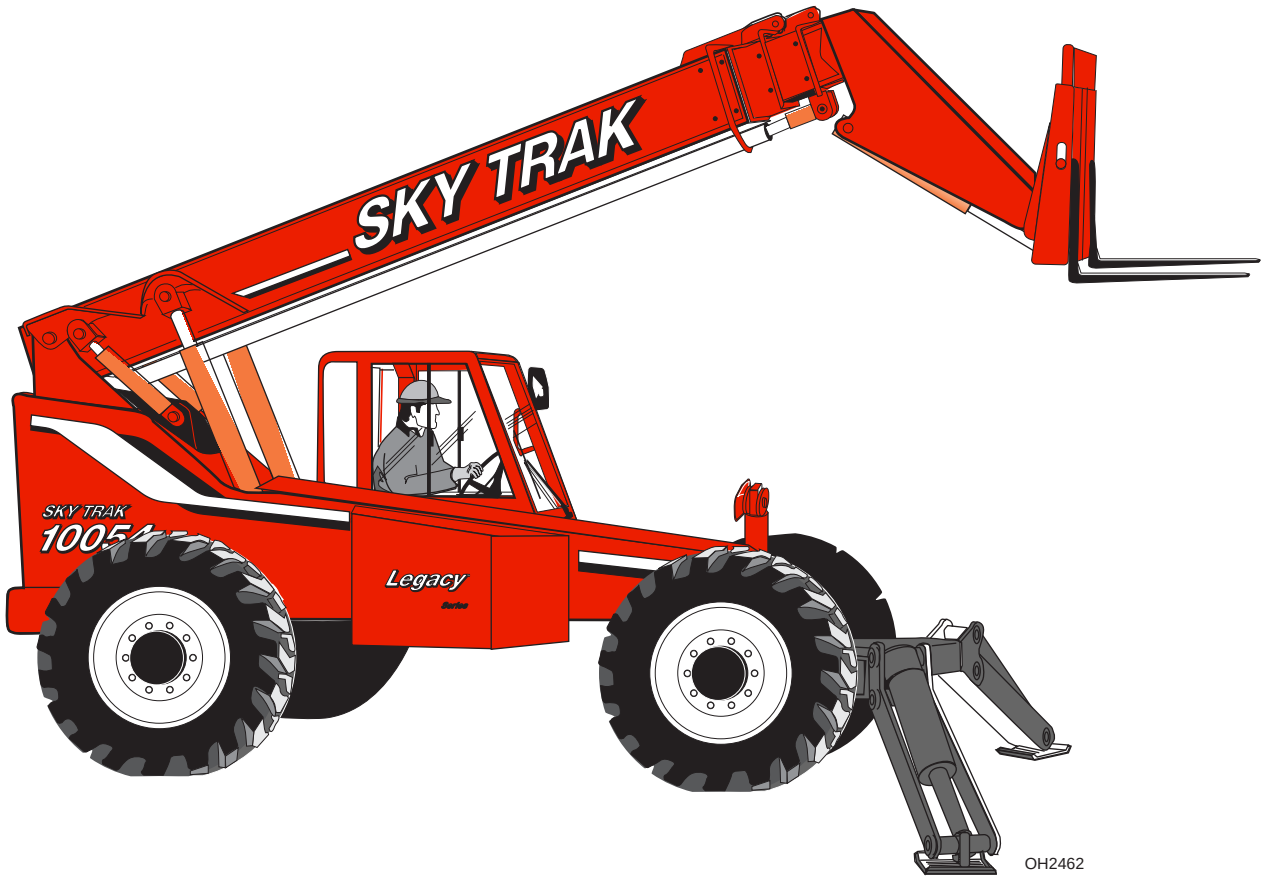
Sky Trak

LEGACY SERIES

Models: 8042, 10042, 10054

S/N 13198 thru 19987 and 0160002332 thru 0160029592



SERVICE MANUAL

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Printed in U.S.A. 02/07

SECTION CONTENTS

Section 1
Safety Practices

Contents

1.1 INTRODUCTION

JLG Industries, Inc. (hereafter, **JLG**) products meet all applicable industry safety standards. **JLG** actively promotes safe practices in the use and maintenance of its products through training programs, instructional manuals and the pro-active efforts of all employees involved in engineering, design, manufacture, marketing and service.

This manual is designed to provide service technicians with complete information on the maintenance and repair of the Sky Trak 8042, 10042 and 10054 Legacy Telescopic Material Handler.

Particular effort has been made to produce a manual to serve as a reference handbook for the experienced service technician, but also provides essential step-by-step procedures for the professional development of the less experienced person. Remember, even the best manual in the world is no substitute for an appropriate education, skill development that comes through experience alone, safety, wise and judicious discernment, and ultimately, proper performance of service procedures.

This service manual provides general directions for accomplishing service and repair procedures with tested, effective techniques. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws. Prior to performing any maintenance on the vehicle, consider all factors, circumstances and conditions which can have an effect upon the safety of personnel and equipment, and take appropriate action to ensure the safety of all involved.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired to satisfy a situation not covered sufficiently, consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. Although equipment damage can usually be repaired in a brief period of time, death and irreparable injury are permanent. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the vehicle. All references to the right side, left side, front and rear are given from the operator's seat looking in a forward direction.

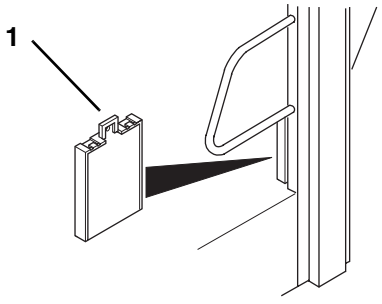
Provisions for supplementary information are made by **JLG** in the form of Service Bulletins, Service Campaigns, Service Training Schools, the JLG website, other literature, and through updates to the manual itself. Comments and suggestions for improvement are welcome and encouraged.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication approval. **JLG** reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.2 OWNERS/OPERATORS MANUAL

The vehicle must be driven and operated as a consequence of, or when performing, service, maintenance and test procedures. The service technician must, therefore, thoroughly read, understand, and follow the *Sky Trak 8042, 10042 and 10054 Legacy Telescopic Material Handler Owners/Operators Manual*.

An owners/operators manual is supplied with each vehicle and must be kept in the owners/operators manual holder (**1**).



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In the event that the owners/operators manual is missing, consult the local **Sky Trak** distributor or the **JLG** Service Department before proceeding.

1.3 TRAINING MECHANICS AS OPERATORS

Because it is necessary to move the vehicle to service or maintain the vehicle, it is necessary that all mechanics are OSHA trained and certified as operators. A mechanic trained in the proper operation of the vehicle can better determine whether all functions are operating correctly.

At the time of original purchase, the purchaser of this vehicle was instructed by the seller on its proper use. When this vehicle is to be serviced or maintained by someone other than the purchaser, make certain that the mechanic is trained, in accordance with the OSHA regulations listed in the NOTICE below, and reads and understands the SKY TRAK Model 8042, 10042 and 10054 Legacy Telescopic Material Handler Owners/ Operators Manual before operating or maintaining the vehicle.

NOTICE: Under OSHA rules, it is the responsibility of the employer to provide operator training. Successful completion and certification of Safety Training for Rough Terrain Forklifts is required. Operator Training Kits are available by calling the Ken Cook Company at 414-466-6060. An order form for these kits is available through our website, http://www.jlg.com.

In addition, make sure that the mechanic has completed a walk-around inspection of the vehicle, is familiar with all decals and/or decal plates on the vehicle, and has demonstrated the correct use of all controls.

1.4 SAFETY INFORMATION

The following information provides general safety instructions, including examples of hazard statements with signal words, notification of hazards, methods to help avoid hazards, and the consequences of failing to follow the safety information. To avoid possible death or injury, carefully read and follow all safety messages. Fully understand the potential causes of death and injury.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

The information in this manual does not replace any other safety rules or proper judgement. Governmental authorities and employers also have their own sets of rules, codes, regulations and laws. Before starting work at a site, check with the supervisor or safety coordinator and ask about the safety policy. Learn the safety requirements in effect before operating, maintaining, testing or servicing the vehicle. Safety depends on following safety requirements.

1.4.1 Safety Alert Symbol

The exclamation mark within a triangle is the Safety Alert Symbol. This symbol is used to indicate a potential **personal injury hazard** only. The symbol will not be used to indicate property-damage-only hazards.

MC0700

This symbol means “**Attention! Become Alert! Your Safety is Involved!**” The symbol is used to attract attention to safety hazards found on the vehicle safety decals and throughout this manual.

1.4.2 Hazard Statements

Signal words and messages are used in conjunction with the safety alert symbol to create hazard statements. These hazard statements convey important information about SAFETY.

Four types of hazard statements are used within this manual. Each statement indicates the existence and degree of relative risk of the hazard described within the statement that follows a signal word.

Explanations of the types of hazard statements are as follows:

DANGER:

The signal word "**DANGER**" indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:

The signal word "**WARNING**" indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION:

The signal word "**CAUTION**" indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION:

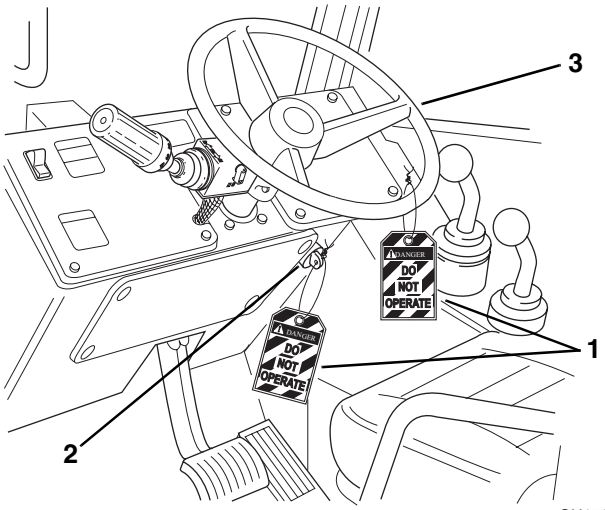
The signal word "**CAUTION,**" used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, may result in property damage.

For safe maintenance of the vehicle, read, understand and follow all DANGER, WARNING and CAUTION information.

1.5 ACCIDENT PREVENTION TAGS

MC0690

Before beginning any maintenance or service, place an Accident Prevention Tag (**1**) on both the starter key switch (**2**) and the steering wheel (**3**), stating that the vehicle should not be operated. Actual Accident Prevention Tags, which can be punched out and used, are included as the last page in this manual. Retain these Accident Prevention Tags for reuse at a later date.



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1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider ***before*** performing maintenance procedures on a vehicle. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions ***before*** proceeding.

1.6.1 Personal Hazards

HAIR and CLOTHING: **DO NOT** wear loose clothing or jewelry. Tie up or restrain hair. Wear the correct safety equipment for the job (including, but not limited to: hard hat; safety shoes; safety glasses, goggles, or face shield; heavy gloves; hearing protection; reflective clothing; wet-weather gear; respirator or filter mask).

EYE PROTECTION: Always wear appropriate eye protection when chiseling, grinding, sanding, welding, painting, repairing hydraulic systems, or checking, testing or charging the battery.

BREATHING PROTECTION: Wear respiratory protection when grinding or painting.

HEARING PROTECTION: Always wear hearing protection in a high noise area.

FOOT PROTECTION: Wear protective footwear with reinforced toe caps and slip-resistant soles.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

OWNERS/OPERATORS MANUAL: Before operating the vehicle, carefully read, understand and follow the owners/operators manual.

OPERATIONAL PROTECTION: Before operating the vehicle, or returning it for operational use, check that the Operator's Protective Structure is intact, undamaged, unmodified and secure.

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load. A hoist or jack failure can allow the equipment to tip or fall.

COMPRESSED AIR: Before and during the use of compressed air, wear eye protection and advise all other personnel in the work area that compressed air is about to be used.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.

1.6.3 General Hazards

SOLVENTS: Only use approved solvents, and solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator's cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection, and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the vehicle to capture fluid run-off.

1.6.4 Operational Hazards

OPERATIONAL CONSIDERATIONS: Before operating the vehicle, carefully read, understand and follow the Owners/Operators manual.

ENGINE: Stop the engine before performing any service.

DANGEROUS START: Place Accident Prevention Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Disconnect battery leads. Place a warning sign on a vehicle that is dangerous to start, if leaving vehicle unattended.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

RADIATOR CAP: Always wear steam-resistant, heat protective gloves when opening the radiator cap. Cover the cap with a clean, thick cloth and turn slowly to the first stop to relieve pressure.

SOFT SURFACES AND SLOPES: **NEVER** work on a vehicle that is parked on a soft surface or slope (inclined ground or hills). The vehicle must be on a hard level surface, with the wheels blocked when performing any service. Obtain assistance, block all wheels, and add supports if necessary before beginning any work.

SUPPORTS AND STRAPS: Install safe, stable supports, slings or straps beneath or around a component or structural member before beginning any work.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an appropriate container and dispose of in accordance with prevailing environmental regulations.

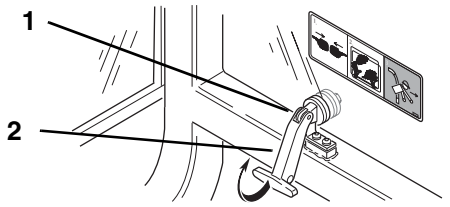
PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING VEHICLE: Lower the attachment to the ground before leaving the vehicle.

TIRE PRESSURE: Always keep tires inflated to the proper pressure to help prevent dangerous travel and load-handling situations. **DO NOT** over-inflate tires.

1.7 EMERGENCY EXIT REAR WINDOW (ENCLOSED CABS ONLY)

The rear window in the enclosed cab can be used as an emergency exit by removing the latch pin (**1**) located on the window latch (**2**). Once the latch pin is removed, the window is free to swing open.



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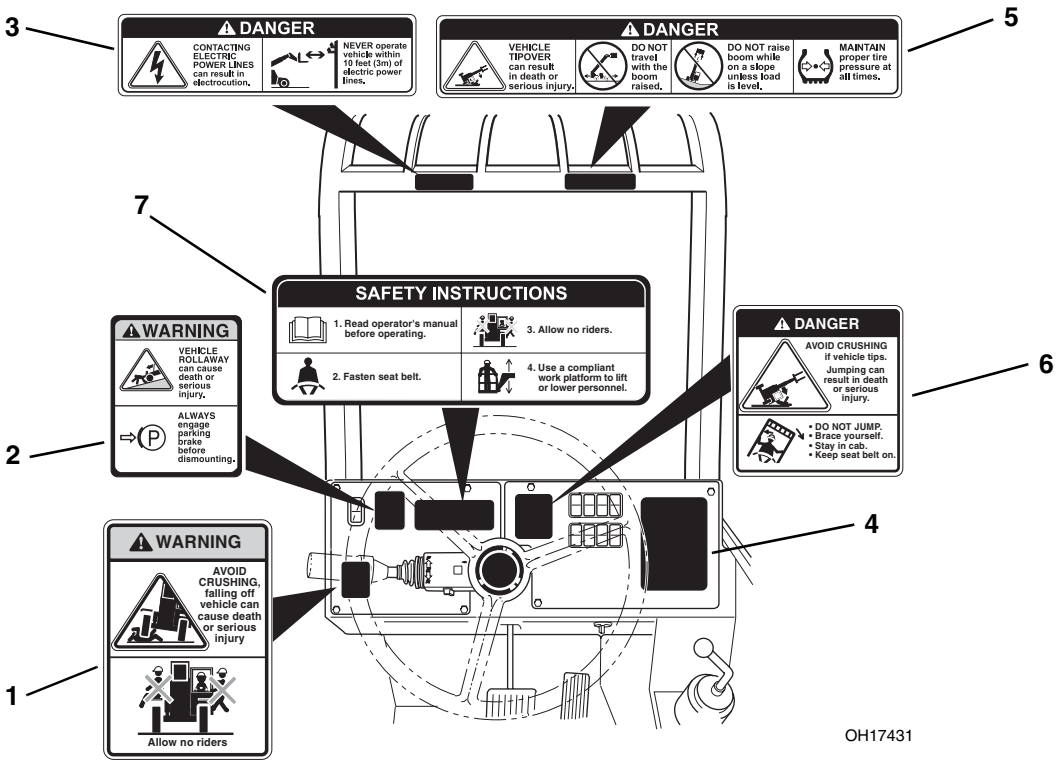
1.8 HAZARD/EMERGENCY INFORMATION DECAL LOCATIONS

Locations of vehicle hazard and other emergency information decals are shown on this page and the following pages. As part of routine maintenance, check that ALL hazard and emergency information decals on the vehicle are present and readable. Keep all decals clean.

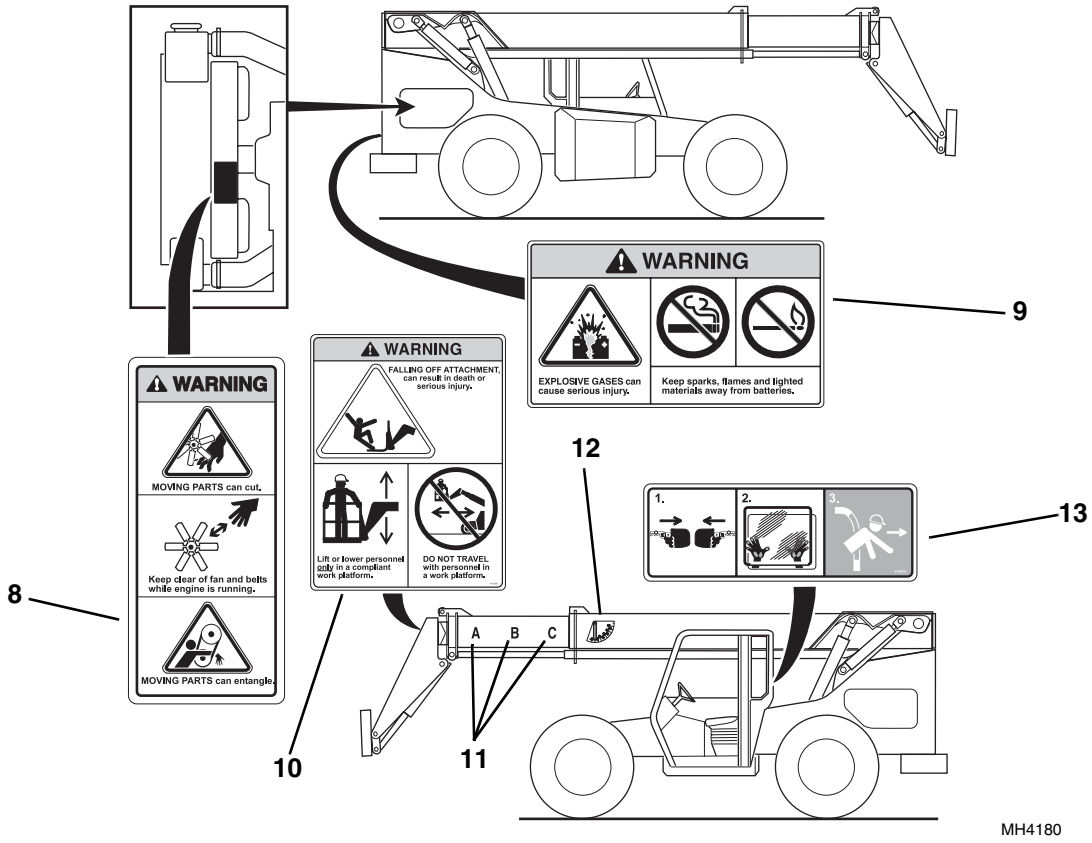
If a replacement decal is needed, refer to the Owners/ Operators manual or parts manual for the latest part number and ordering information, or, contact JLG Parts Department directly at:

1-717-485-6472

Model 8042 (S/N 13198 thru 18990)

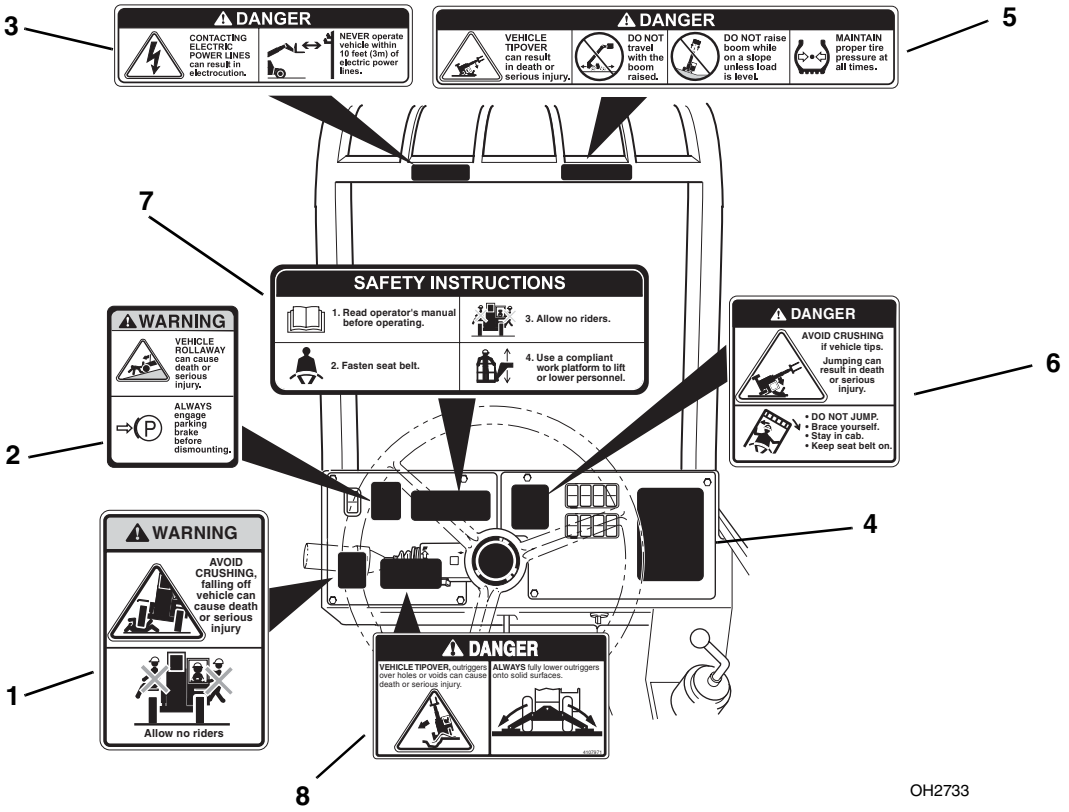


1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7139071 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)

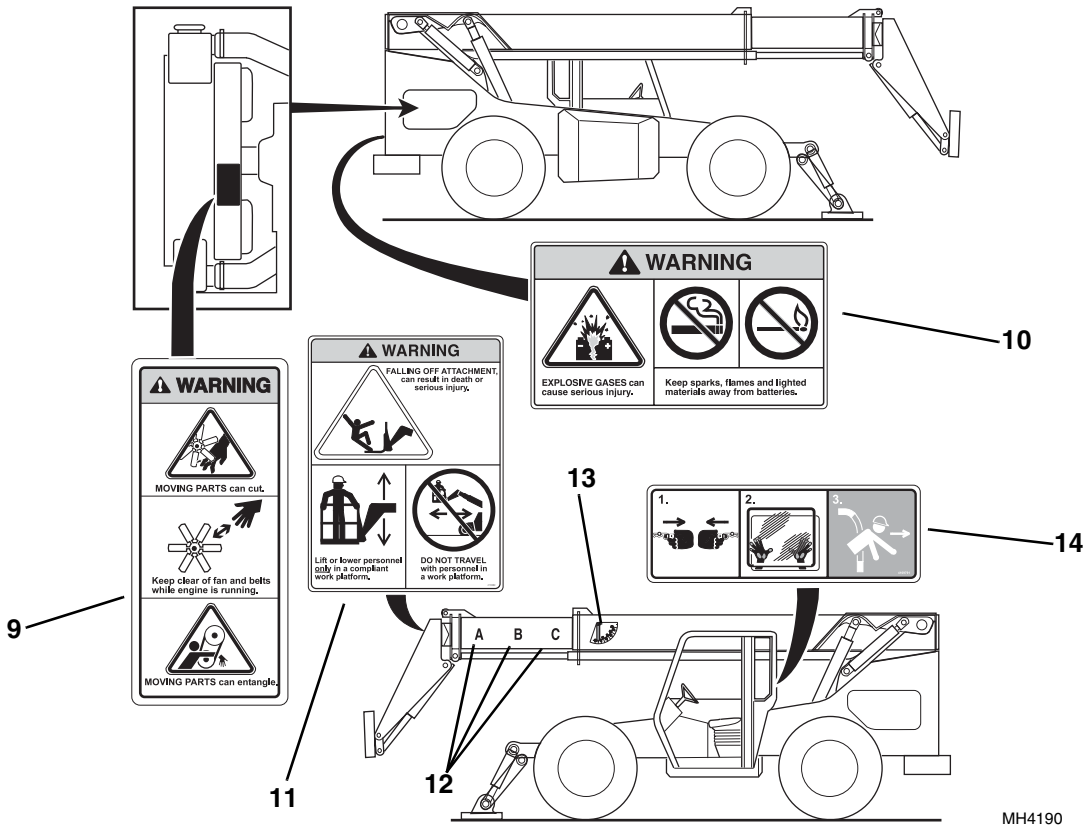


8. 4110184 Moving Parts Warning (2)
9. 4110172 Explosive Gases Warning (1)
10. 4110389 Carrying Personnel Warning (1)
11. 4107442 Boom Extend Letters (1)
12. 4105262 Boom Angle Indicator (1)
13. 4109791 Emergency Exit - Enclosed Cab Only (1)

Model 10042 (S/N 13198 thru 19030)

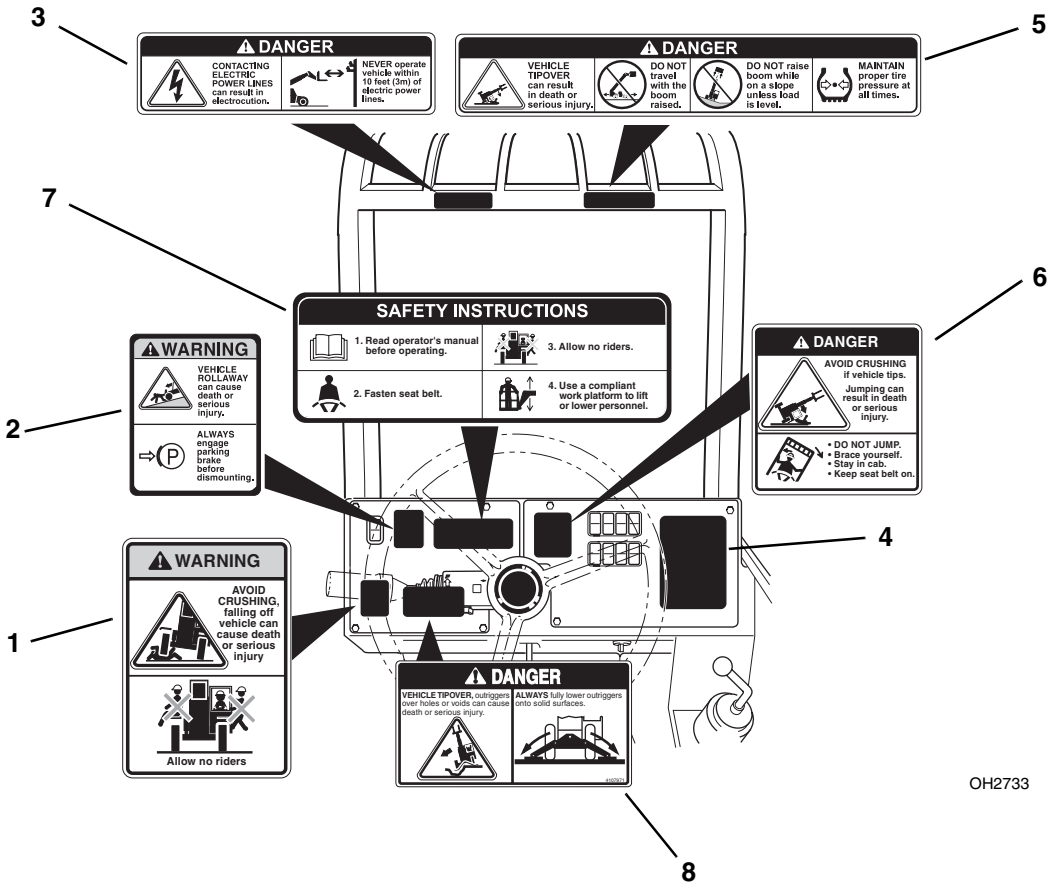


1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7139072 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)
8. 4107971 Outrigger Over Holes Danger (1)

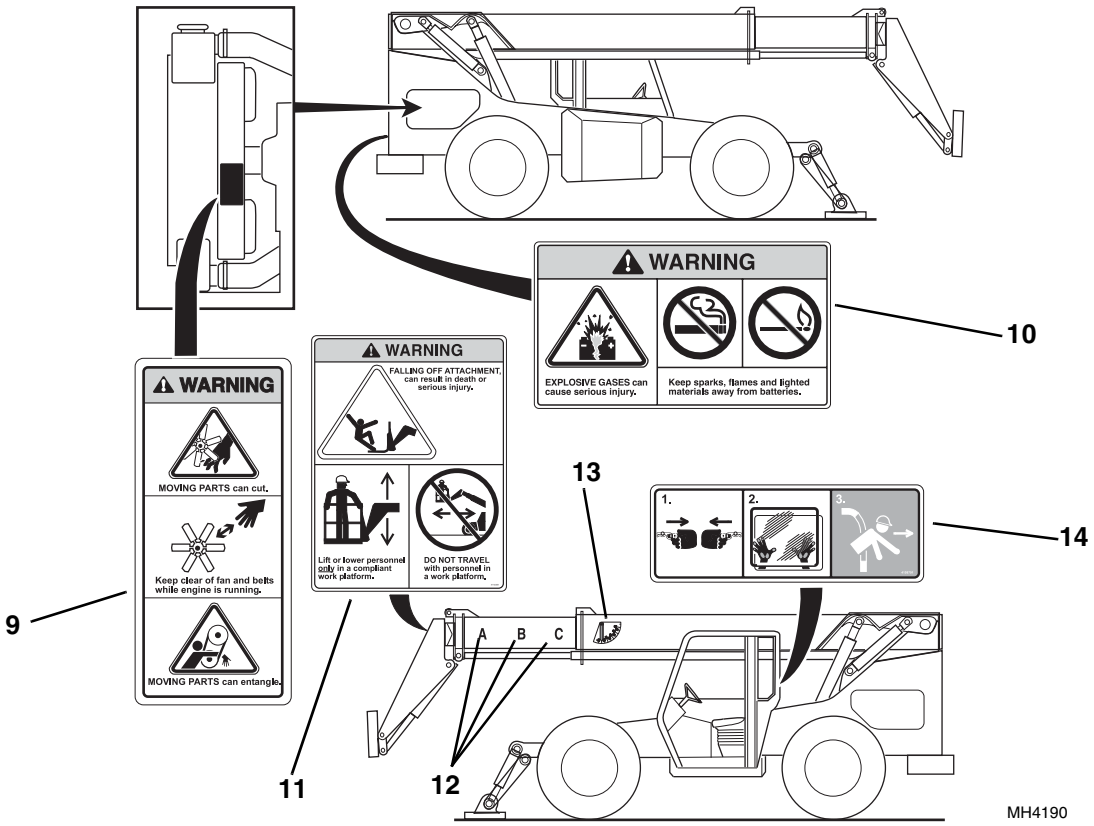


9. 4110184 Moving Parts Warning (2)
10. 4110172 Explosive Gases Warning (1)
11. 4110389 Carrying Personnel Warning (1)
12. 4107442 Boom Extend Letters (1)
13. 4105262 Boom Angle Indicator (1)
14. 4109791 Emergency Exit - Enclosed Cab Only (1)

Model 10054 (S/N 13198 thru 19079)

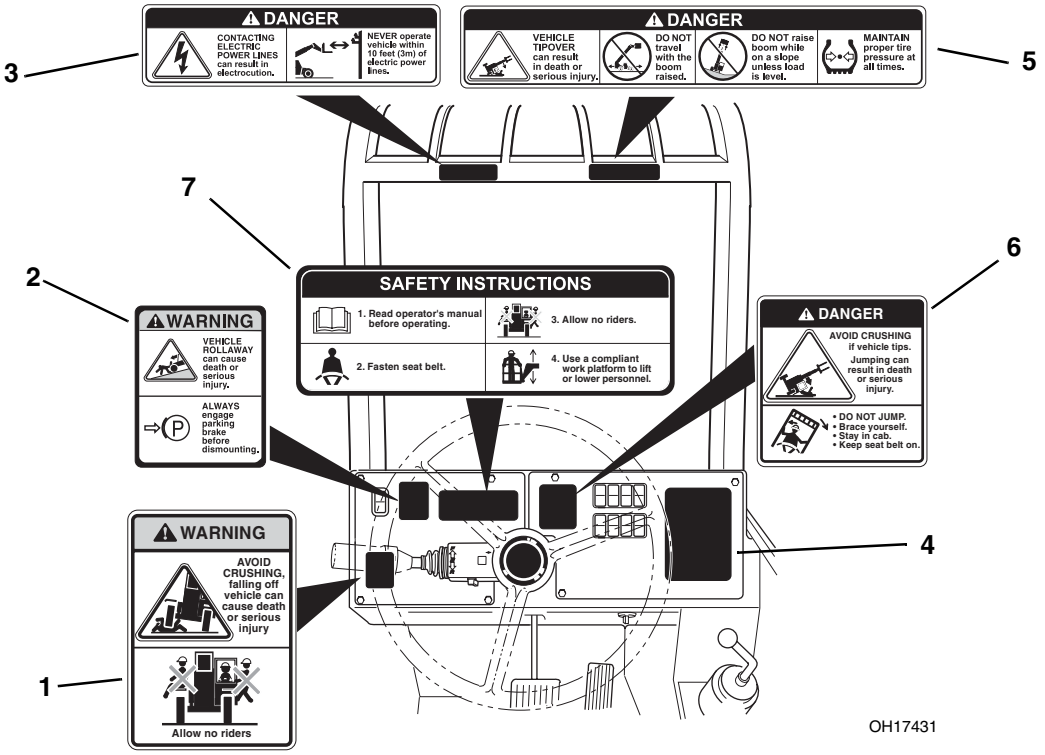


1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7139073 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)
8. 4107971 Outrigger Over Holes Danger (1)

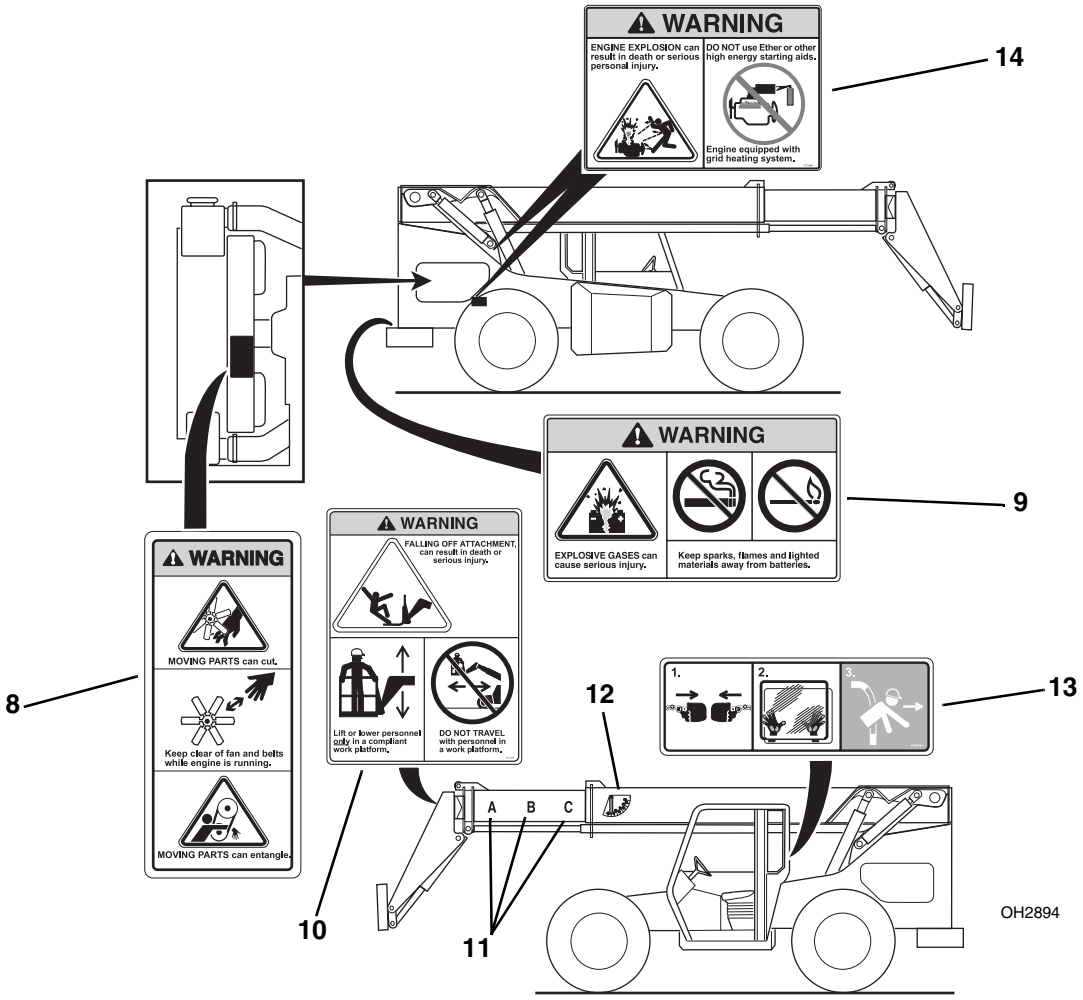


9. 4110184 Moving Parts Warning (2)
10. 4110172 Explosive Gases Warning (1)
11. 4110389 Carrying Personnel Warning (1)
12. 4107442 Boom Extend Letters (1)
13. 4105262 Boom Angle Indicator (1)
14. 4109791 Emergency Exit - Enclosed Cab Only (1)

Model 8042 (S/N 18991 & After)

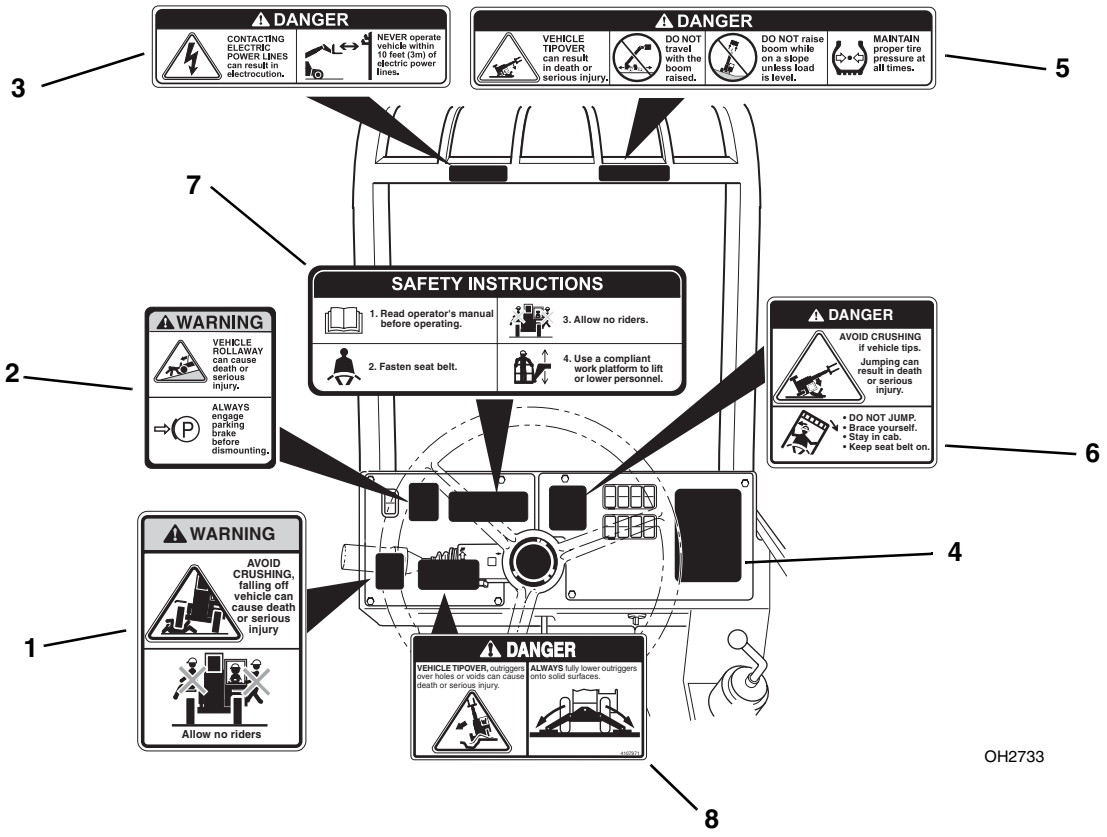


1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7301676 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)

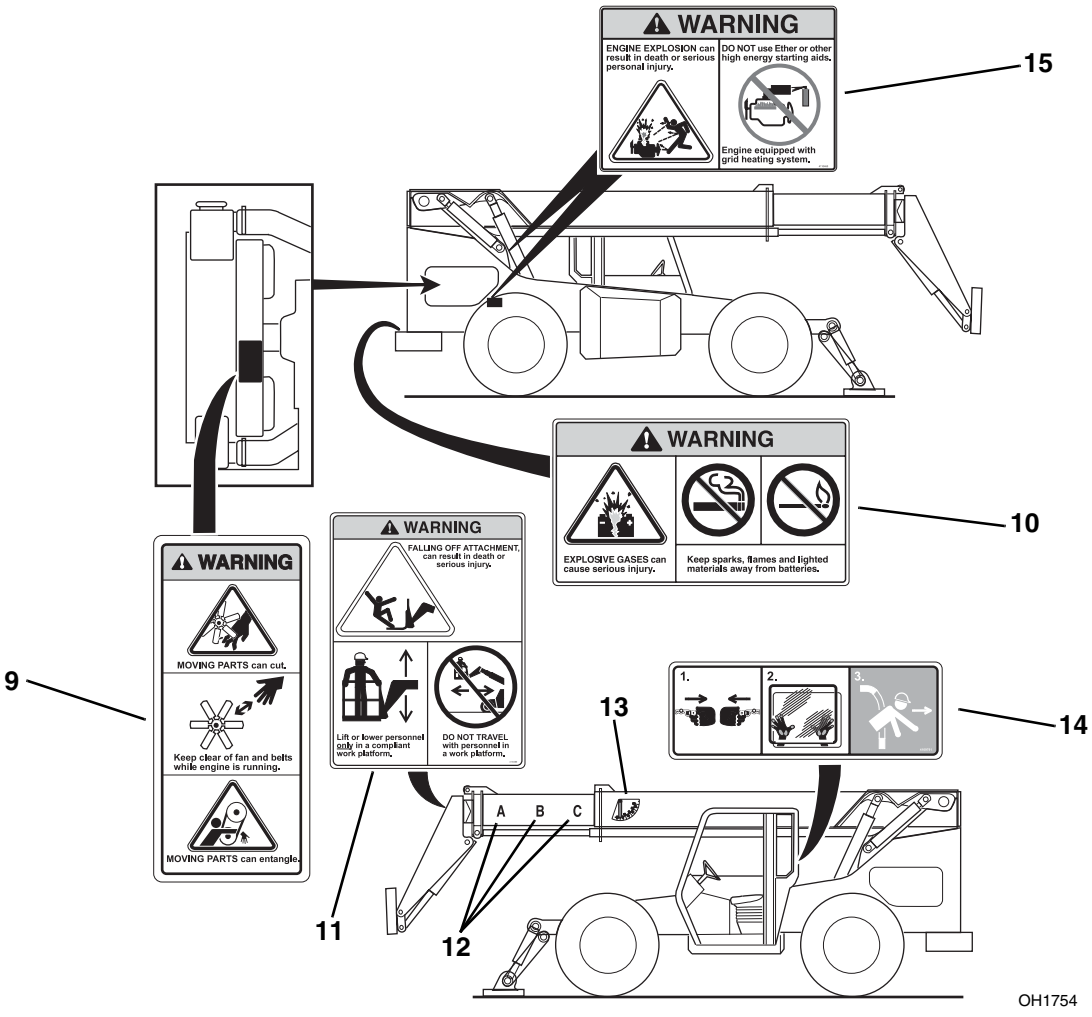


8. 4110184 Moving Parts Warning (2)
9. 4110172 Explosive Gases Warning (1)
10. 4110389 Carrying Personnel Warning (1)
11. 4107442 Boom Extend Letters (1)
12. 4105262 Boom Angle Indicator (1)
13. 4109791 Emergency Exit - Enclosed Cab Only (1)
14. 4110460 Ether Starting Warning (2)

Model 10042 (S/N 19031 & After)

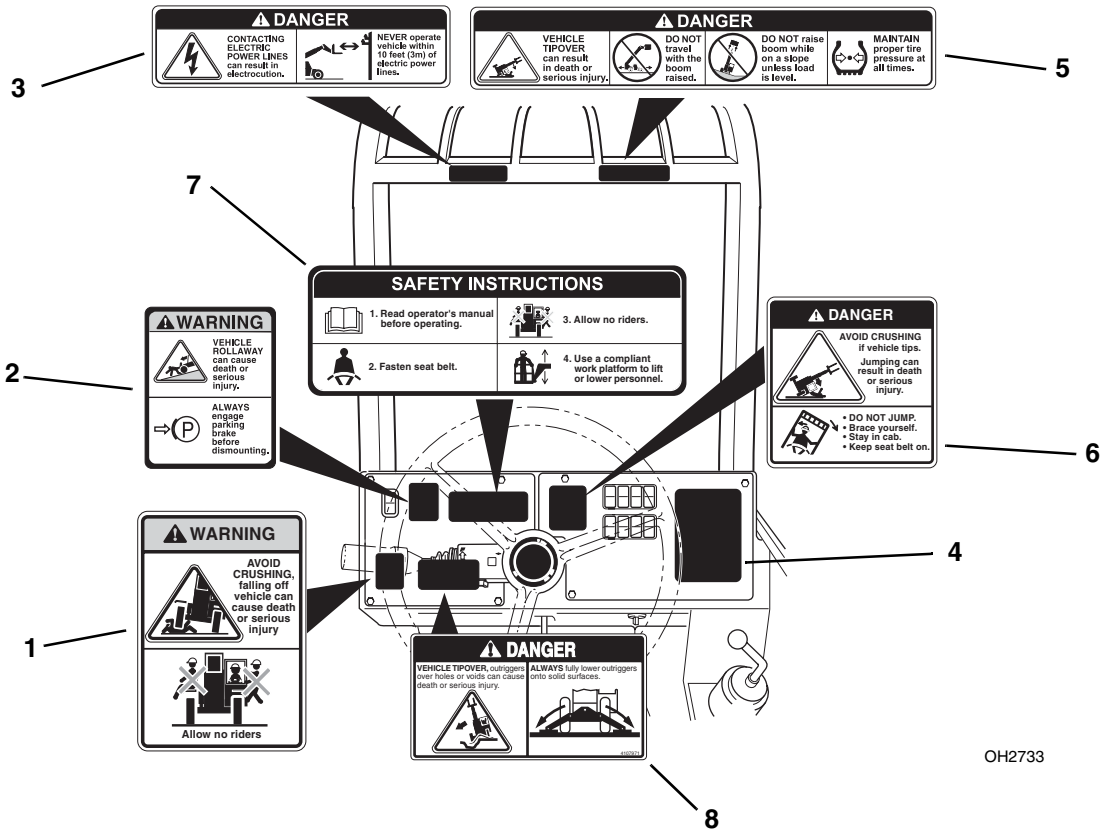


1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7301677 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)
8. 4107971 Outrigger Over Holes Danger (1)

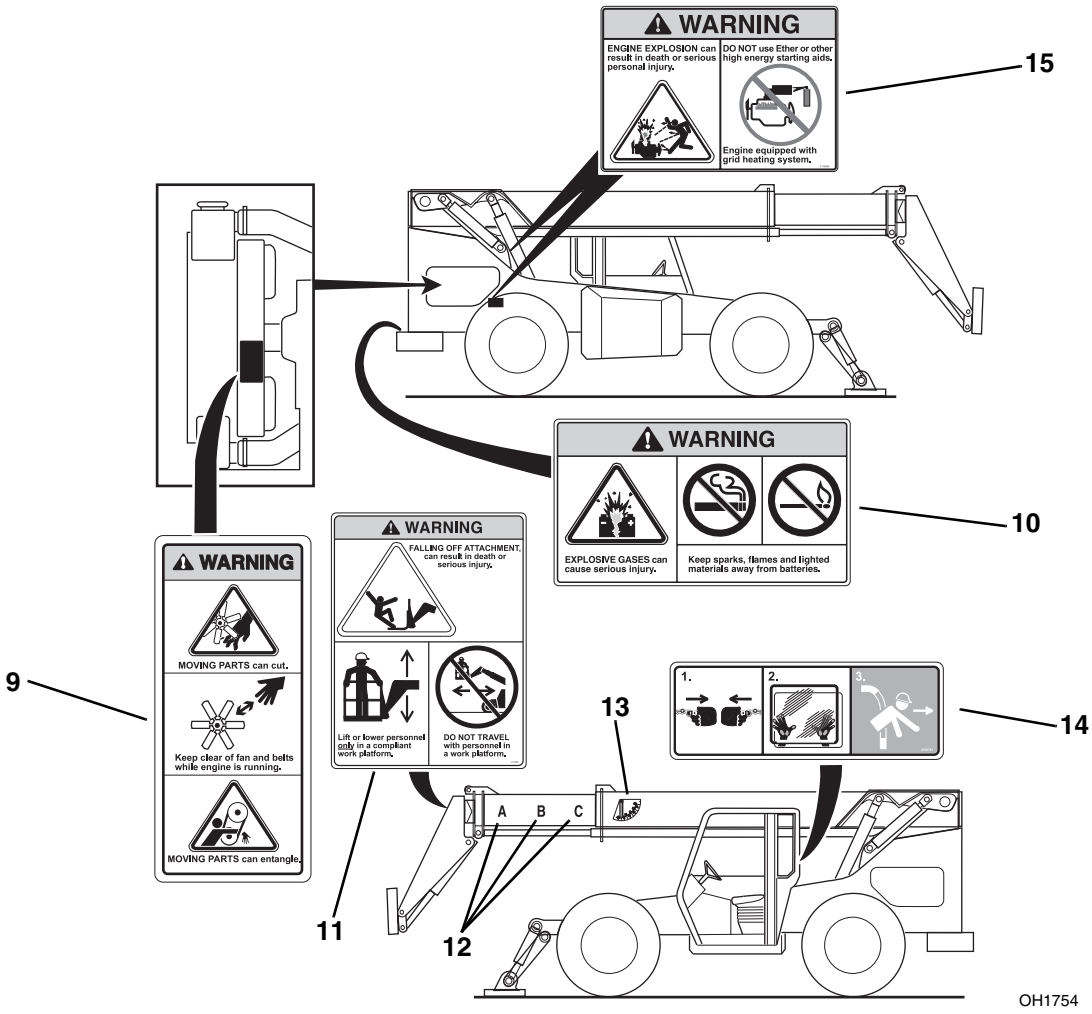


9. 4110184 Moving Parts Warning (2)
10. 4110172 Explosive Gases Warning (1)
11. 4110389 Carrying Personnel Warning (1)
12. 4107442 Boom Extend Letters (1)
13. 4105262 Boom Angle Indicator (1)
14. 4109791 Emergency Exit - Enclosed Cab Only (1)
15. 4110460 Ether Starting Warning (2)

Model 10054 (S/N 19080 & After)



1. 4110188 No Riders Warning (1)
2. 4110188 Vehicle Rollaway Warning (1)
3. 4108991 Electrocution Danger (1)
4. 7301678 Load Chart Booklet (1)
5. 4110137 Tipover Danger (1)
6. 4110187 Do Not Jump Danger (1)
7. 4110188 Safety Instructions (1)
8. 4107971 Outrigger Over Holes Danger (1)



9. 4110184 Moving Parts Warning (2)
10. 4110172 Explosive Gases Warning (1)
11. 4110389 Carrying Personnel Warning (1)
12. 4107442 Boom Extend Letters (1)
13. 4105262 Boom Angle Indicator (1)
14. 4109791 Emergency Exit - Enclosed Cab Only (1)
15. 4110460 Ether Starting Warning (2)

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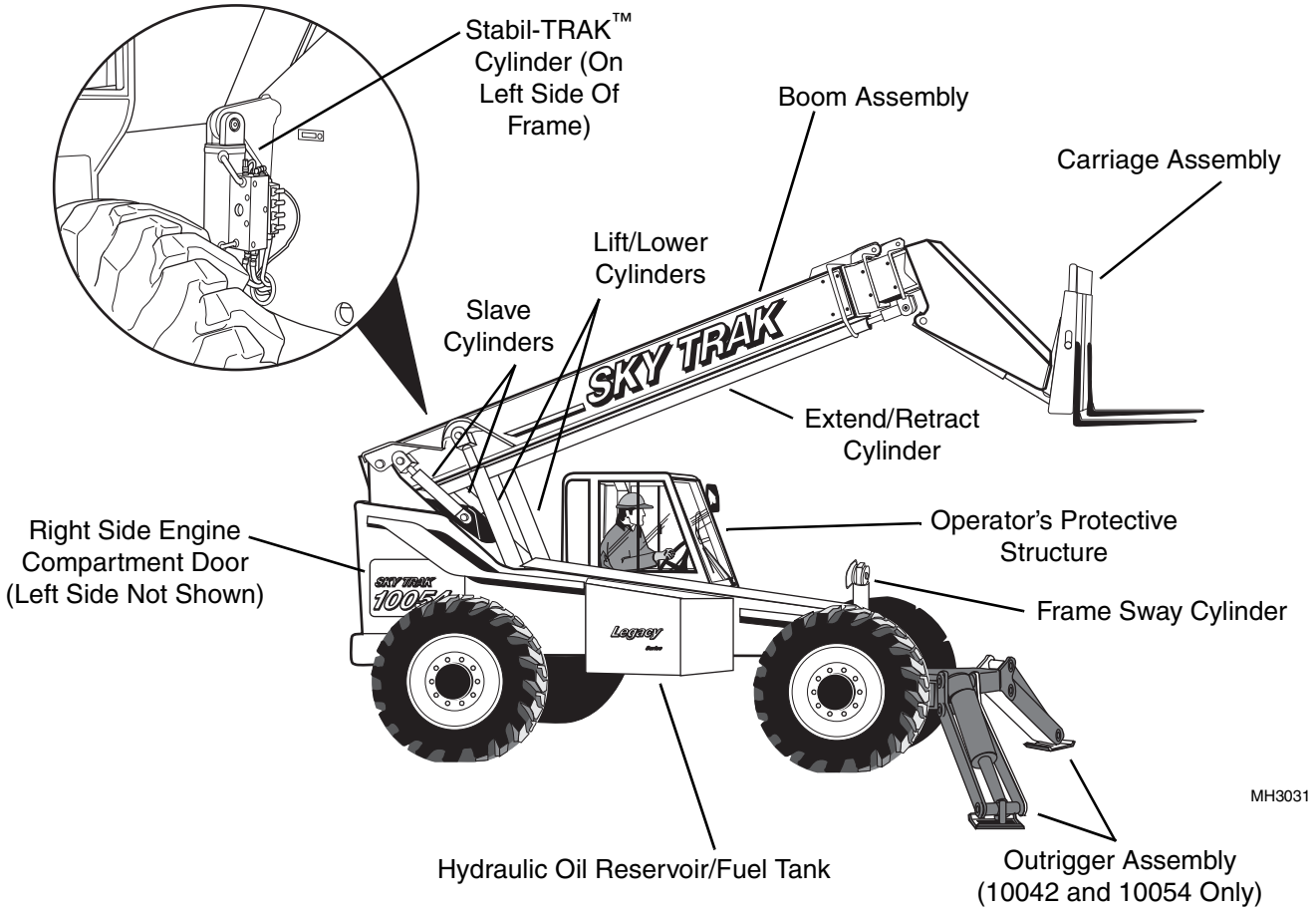
Section 2
General Information and Specifications

Contents

2.1 8042, 10042, 10054 COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this manual, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies on this vehicle. The following illustration identifies the components that are referred to throughout this manual.

Model 10054 Shown



2.2 INTRODUCTION

2.2.1 Service Methods

Appropriate service methods and proper repair procedures are essential for safe, reliable operation of this vehicle and the safety of the individual doing the work. This Service Manual provides general direction for accomplishing service and repair work with tested, effective techniques. Following them will assure reliability.

There are many variations in procedures, techniques, tools and parts for servicing vehicles, as well as work skills. This manual cannot possibly anticipate all such variations and provide advice or cautions for each one. Accordingly, anyone who intends to depart from the instructions in this Manual must first consider personal safety and then vehicle integrity.

IMPORTANT: ***JLG*** *recommends the use of environmentally sound waste storage and disposal practices.* ***NEVER*** *drain fluids on the ground or into a sewer or catch basin. Use suitable collection containers, then store and/or dispose of waste products in an approved and safe manner. Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.*

2.2.2 The Owners/Operators Manual

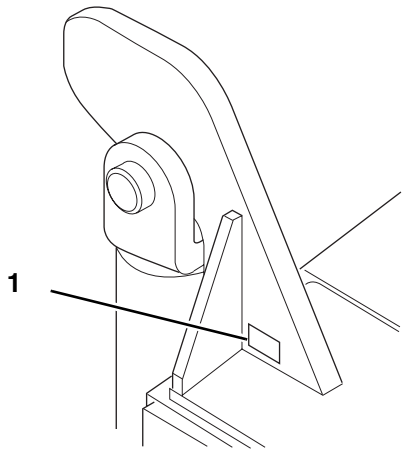
The Owners/Operators Manual provides information you need to properly operate and maintain this vehicle.

IMPORTANT: *Before you operate this vehicle, read the manual completely and carefully, so that you will understand the safety instructions and the operation of the controls and safety equipment. You must comply with all Danger, Warning and Caution notices. They are for your benefit.*

2.2.3 Replacement Parts and Warranty Information

For reference when ordering replacement parts or making service inquiries about the vehicle, the vehicle serial number is required to help assure the provision of correct parts and information. Before ordering parts or initiating service inquiries, make note of the serial number.

The vehicle serial number plate (**1**) is located at the front of the vehicle, on the frame sway cylinder upright.



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IMPORTANT: *The replacement of any part on this vehicle with any other than an* ***JLG*** *authorized replacement part can adversely affect the performance, durability, or safety of the vehicle, and will void the warranty.* ***JLG*** *disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.*

A warranty registration form must be filled out by the **Sky Trak** distributor, signed by the purchaser and returned to **JLG** when the vehicle is sold and/or put into use.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed. To guarantee full warranty service, verify that the distributor has returned the business reply card of the warranty registration form to **JLG**.

2.2.4 Disclaimer

JLG reserves the right to make changes to and to add improvements upon its product at any time, without public notice or obligation. **JLG** also reserves the right to discontinue manufacturing any product at its discretion at any time.

2.3 TORQUES

2.3.1 Fasteners

All fasteners (nuts, bolts, washers, etc.) are equal to SAE Grade 5 (PC8.8) and are plated, unless otherwise specified.

2.3.2 Bolts and Nuts

Unless otherwise specified, the following values apply for Grade 5 (PC8.8) nuts and bolts:

Size	Torque		Size	Torque	
Inch	lb-ft	Nm	mm	Nm	lb-ft
1/4	9	12	6,0	10	7
5/16	17	24	8,0	25	18
3/8	31	42	10,0	50	37
7/16	50	68	--	--	--
1/2	75	102	12,0	80	59
9/16	110	150	14,0	130	95
5/8	150	203	16,0	200	146
3/4	250	340	20,0	360	263
7/8	380	515	22,0	510	372
1.0	585	793	24,0	650	475

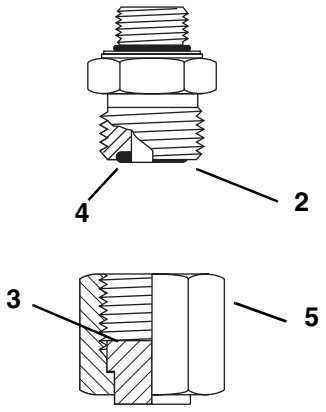
2.3.3 SAE Flat Face O-Ring Seal Hydraulic Fittings

a. Assembly Procedure

Improper assembly of this type of joint will result in leaking joints. Under tightening will result in the joint loosening during normal usage. Foreign material on either seal surfaces will cause damage to one or both mating parts when the joint is tightened resulting in a leaking joint. The absences of the fitting o-ring will cause the joint to leak.

1. Inspect both the male (**2**) and female (**3**) sealing surfaces for burrs, scratches, dents, other damage, or foreign material. If any damage is found on either surface, the part is to be rejected as unusable. Clean off any foreign material from the sealing surfaces before assembly.
2. Inspect the male fitting for the presence of the seal o-ring (**4**). Inspect the o-ring for any sign of damage. If the o-ring is missing or damaged replace it.
3. Apply clean petroleum based oil to the male thread.
4. Place the flat surface of the female connector (**2**) in full contact with the o-ring (**4**) in the male connector.
5. Finger tighten the nut (**5**) onto the fitting.
6. Complete the joint by tightening the nut to the torque specified in the table. For hoses and swivel fittings use a second wrench to keep the female connector from moving during tightening.

O-Ring Boss Fittings To Flat Face Fittings	
SAE Size	Torque lb-ft (Nm)
4	19 ± 5 (26 ± 7)
6	35 ± 5 (47 ± 7)
8	52 ± 7 (70 ± 10)
10	83 ± 17 (112 ± 23)
12	120 ± 20 (163 ± 27)
16	165± 35 (224 ± 47)
20	215 ± 65 (292 ± 88)
24	252 ± 77 (342 ± 104)



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b. Straight O-Ring Boss Fittings To O-Ring Boss Ports

Improper assembly of this joint will result in leaking joints. Under tightening of the fitting will result in the fitting loosening during normal operation and the joint leaking. Damaging the o-ring during assembly will result in immediate joint leakage.

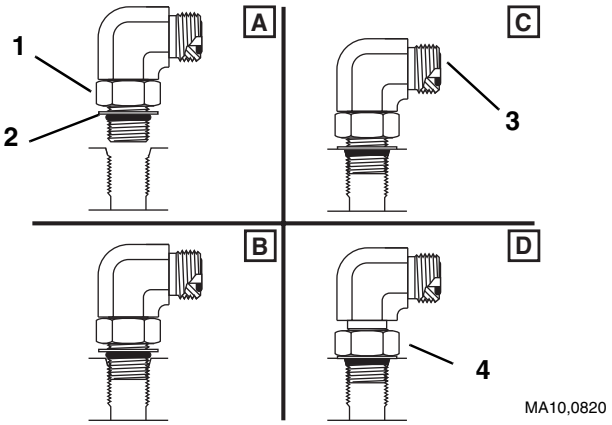
1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, or scratches, or any foreign material. If any damage is found the bad part must not be used. Clean any foreign material from the mating parts before assembly.
2. Lubricate the o-ring and male thread with a clean petroleum based lubricant.
3. Screw the fitting into the port.
4. Torque the fitting to the values found in table.

O-Ring Boss Fittings To O-Ring Boss Ports	
SAE Size	**Torque lb-ft (Nm)**
4	15 ± 1 (20 ± 1)
6	25 ± 1 (34 ± 1)
8	55 ± 5 (75 ± 7)
10	76 ± 5 (103 ± 7)
12	130 ± 5 (176 ± 7)
16	210± 10 (285 ± 14)
20	245 ± 35 (332 ± 47)
24	315 ± 45 (427 ± 61)

c. Adjustable (Angle) O-Ring Boss Fittings To O-Ring Boss Ports

Improper assembly of this joint will result in a leaking joint. Failure to position the locknut properly will result in damage to the o-ring. Under tightening of the fitting will result in the fitting loosening during normal operation and the joint leaking. Damaging the o-ring during assembly will result in immediate joint leakage.

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, or scratches, or any foreign material. If any damage is found the bad part must not be used. Clean any foreign material from the mating parts before assembly.



2. Back off the locknut as far as possible (**1**). Make sure the back-up washer is not loose. If the back-up washer is loose the fitting must be rejected.
3. Lubricate the o-ring (**2**) and male thread with clean petroleum based lubricant.
4. Screw the fitting into the port as far as possible by hand (B & C).
5. To align the tube end (**3**) of the fitting to accept the mating tube or hose, unscrew the fitting as required but not more than one turn.
6. Using two wrenches, hold the fitting in the desired position and tighten the locknut (**4**) to the appropriate torque value listed in the table in Section 2.3.3, b. “Straight O-Ring Boss Fittings To O-Ring Boss Ports.”

d. Pipe Fittings to Pipe Ports

Improper assembly of this joint will result in a leaking joint and possible damage to the port.

1. Inspect the port and fitting to insure that there are no burrs, nicks, or foreign material. If any thread damage is found the part must not be used. Clean off any foreign material.
2. Apply sealant/lubricant to male pipe thread. If Teflon tape is used it should be wrapped 1.5 to 2 turns in a clockwise direction when viewed from the pipe thread end. With any sealant the first 1 to 2 threads should be left uncovered to avoid system contamination.
3. Screw the connector into the port finger tight.
4. Wrench tighten the fitting to the appropriate Turns From Finger Tight (TFFT) from following table. Make sure that angle fittings are aligned with the mating tube or hose within the listed number of turns. Never back off (loosen) pipe thread connectors to achieve alignment.

Pipe Fittings To Pipe Ports	
Pipe Thread Size	**Turns From Finger Tight (T.F.F.T.)**
1/8"	2 - 3
1/4"	2 - 3
3/8"	2 - 3
1/2"	2 - 3
3/4"	2 - 3
1"	1-1/2 - 2-1/2
1-1/4"	1-1/2 - 2-1/2
1-1/2"	1-1/2 - 2-1/2
2"	1-1/2 - 2-1/2

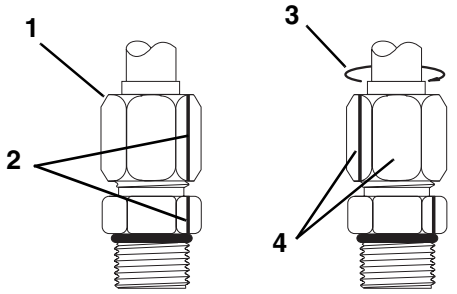
2.3.4 SAE 37° Flare Hydraulic Fittings

a. Assembly Procedure

Follow these steps when tightening hose ends, tube ends and fitting swivel ends onto fitting male end connections

Improper assembly of this type of joint will result in leaking joints. Over tightening can result in cracking of the female swivel seat or deformation of the male fitting tapered seat. Under tightening will result in the joint loosening during normal usage. Foreign material on either seal surfaces will cause damage to one or both mating parts when the joint is tightened, resulting in a leaking joint.

1. Inspect both the male and female sealing cone surfaces for burrs, scratches, dents, other damage, or foreign material. If any damage is found on the seat the part is to be rejected as unusable. Clean off any foreign material from the sealing surfaces before assembly.
2. Align the mating parts and check to see that the flare seats properly on the nose of the fitting.
3. Finger tighten the nut onto the fitting. If necessary a wrench may be used to snug the nut against the fitting (30 lb-in maximum torque). This is considered the “finger tight” (**1**) condition.



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4. Using a permanent type ink marker, make a mark (**2**) on one of the flats on the nut and continue it onto the static fitting or port.
5. Complete the joint by wrench tightening (**3**) the nut the number of flats (**4**) specified in the table for the size and type of fitting. This assembly procedure is referred to as Flats From Finger Tight (FFFT).
6. A less desirable tightening method is nut torque. First follow steps 1 & 2. Apply clean petroleum based oil to the male thread. Finger tighten the nut onto the fitting. Torque the nut to the value listed in the table.

Hose Ends, Tube Ends and Fitting Swivel Ends To Fitting Male Ends			
SAE Size	**Tube Conn. (FFFT)**	**Swivel Nut or Hose Conn. (FFFT)**	**Torque lb-ft (Nm) w/Oiled Threads**
4	2	2	16 ± 3 (22 ± 4)
5	2	2	19 ± 4 (26 ± 5)
6	1-1/2	1-1/4	25 ± 5 (34 ± 7)
8	1-1/2	1	49 ± 10 (66 ± 14)
10	1-1/4	1	74 ± 11 (100 ± 15)
12	1-1/4	1	103 ± 15 (140 ± 20)
14	1	1	121 ± 18 (164 ± 24)
16	1	1	135 ± 35 (183 ± 47)
20	1	1	166 ± 33 (225 ± 45)
24	1	1	210 ± 40 (285 ± 54)
32	1	1	314 ± 54 (426 ± 73)

Straight & Adjustable O-Ring Boss Fittings To O-Ring Boss Ports	
SAE Size	**Torque lb-ft (Nm)**
4	14 ± 1 (19 ± 1)
6	23 ± 1 (31 ± 1)
8	41 ± 1 (56 ± 1)
10	45 ± 3 (61 ± 4)
12	72 ± 3 (98 ± 4)
16	118± 5 (160 ± 7)
20	154 ± 7 (209 ± 9)
24	162 ± 8 (220 ± 11)

2.4 METRIC CONVERSION FACTORS

2.4.1 Approximate American to Metric Conversions

When this is known	*Multiply by*	*To find*
TORQUE (moment of force)		
Pound/feet (lb-ft)	1.356	Newton meters (Nm)
Pound/inches (lb-in)	0.113	Newton meters (Nm)
POWER		
Horsepower (hp)	745.7	Watts
SPEED (velocity)		
Miles per hour (mph)	1.609	Kilometers per hour (km/hr; kph)
LENGTH (distance)		
Inches (in)	25.4	Millimeters (mm)
Inches (in)	2.5	Centimeters (cm)
Feet (ft)	30.5	Centimeters (cm)
Feet (ft)	0.305	Meters (m)
Yards (yd)	0.9	Meters (m)
Miles (mi)	1.6	Kilometers (km)
AREA		
Square inches (in^2)	6.5	Square centimeters (cm^2)
Square feet (ft^2)	0.09	Square meters (m^2)
Square yards (yd^2)	0.8	Square meters (m^2)
Square miles (mi^2)	2.6	Square kilometers (km^2)
Acres	0.4	Hectares (ha)
MASS (weight)		
Ounces (oz)	28.3	Grams (g)
Pounds (lb)	0.4536	Kilograms (kg)
Short tons (2000 lb)	0.9	Metric ton (t)

When this is known	*Multiply by*	*To find*
VOLUME		
Teaspoons (tsp)	5	Milliliters (ml)
Tablespoons (Tbsp)	15	Milliliters (ml)
Cubic inches (in^3)	16	Milliliters (ml)
Fluid ounces (fl oz)	30	Milliliters (ml)
Cups (c)	0.24	Liters
Pints (pt)	0.47	Liters
Quarts (qt)	0.95	Liters
Gallons (gal)	3.8	Liters
Cubic feet (ft^3)	0.03	Cubic meters (m^3)
Cubic yards (yd^3)	0.76	Cubic meters (m^3)
AIR PRESSURE		
Pounds per square inch (psi)	6.895	Kilopascals (kPa)
HYDRAULIC PRESSURE		
Pounds per square inch (psi)	0.069	Bar

TEMPERATURE (exact)

To determine degrees Celsius (° C), subtract 32, then multiply by 0.56; (° F -32) x 0.56 = ° C.

2.4.2 Approximate Metric to American Conversions

When this is known	*Multiply by*	*To find*
TORQUE (moment of force)		
Newton meters (Nm)	0,738	Pounds/feet (lb-ft)
Newton meters (Nm)	8,85	Pounds/inches (lb-in)
POWER		
Watts	0,0013	Horsepower (hp)
SPEED (velocity)		
Kilometers per hour (km/hr; kph)	0,621	Miles per hour (mph)
LENGTH (distance)		
Millimeters (mm)	0,0394	Inches (in)
Centimeters (cm)	0,394	Inches (in)
Meters (m)	3,281	Feet (ft)
Meters (m)	1,1	Yards (yd)
Kilometers (km)	0,621	Miles (mi)
AREA		
Square centimeters (cm^2)	0,4	Square inches (in^2)
Square meters (m^2)	1,1	Square yards (yd^2)
Square kilometers (km^2)	0,6	Square miles (mi^2)
Hectares (10000 m^2)	2,5	Acres
MASS (weight)		
Grams (g)	0,035	Ounces (oz)
Kilograms (kg)	2,2	Pounds (lb)
Metric ton (1000 kg) (t)	1,1	Short tons
VOLUME		
Milliliters (ml)	0,03	Fluid ounces (fl oz)
Milliliters (ml)	0,06	Cubic inches (in^3)
Liters	2,1	Pints (pt)
Liters	1,06	Quarts (qt)
Liters	0,26	Gallons (gal)
Cubic meters (m^3)	35	Cubic feet (ft^3)
Cubic meters (m^3)	1,3	Cubic yards (yd^3)
AIR PRESSURE		
Kilopascals (kPa)	0,145	Pounds per square inch (psi)
HYDRAULIC PRESSURE		
Bar	14,5	Pounds per square inch (psi)

TEMPERATURE (exact)

To determine degrees Fahrenheit (° F), multiply degrees Celsius (° C) by 1.8, then add 32; (° C x 1.8) + 32 = ° F.

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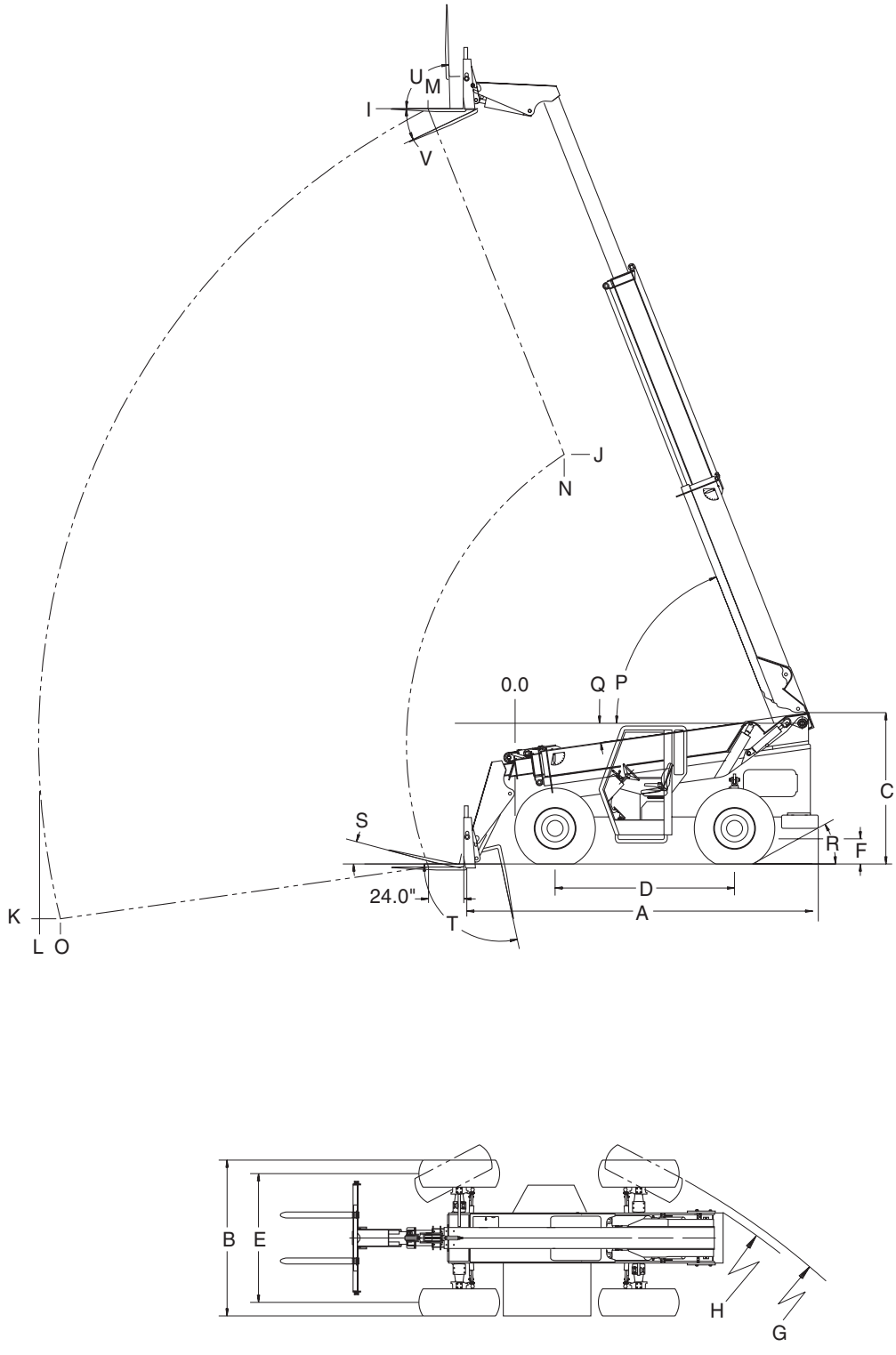
2.5 SPECIFICATIONS

2.5.1 Vehicle Dimensions

a. Model 8042 (With Standard 12-Ply, 13.00-24 Tires)

Description	
(A) Length (Without Attachment)	225.25" (5.721 mm)
(B) Width	98.25" (2.495 mm)
(C) Height (Boom Lowered)	99.4" (2.525 mm)
(D) Wheelbase	119.5" (3.035 mm)
(E) Tread Center	84.0" (2.134 mm)
(F) Ground Clearance	17.25" (438 mm)
(G) Turning Radius, Curb to Curb	156.0" (3.962 mm)
(H) Turning Radius, Clearance	158.3" (4.021 mm)
(I) Maximum Lift Height, Boom Extended	41' 11" (12,8 m)
(J) Maximum Lift Height, Boom Retracted	21' 6" (6,5 m)
(K) Maximum Below Grade Depth, Boom Extended	3' 8" (1.105 mm)
(L) Maximum Reach, from Front of Front Tires	26' 8" (8,1 m)
(M) Maximum Reach at Maximum Lift Angle, Boom Extended	58.0" (1,7 m)
(N) Maximum Reach at Maximum Lift Angle, Boom Retracted	-36.5" (-927 mm)
(O) Maximum Reach at Minimum Lift Angle, Boom Extended	25' 7" (7,8 m)
(P) Maximum Boom Lift Angle	68.5°
(Q) Minimum Boom Lift Angle	-8.0°
(R) Angle of Departure	26°
Attachment Tilt Angle:	
(S) At Minimum Boom Angle - UP	11.9°
(T) At Minimum Boom Angle - DOWN	-102.0°
(U) At Maximum Boom Angle - UP	88.4°
(V) At Maximum Boom Angle - DOWN	-25.5°
Frame Sway Angle (Not Shown):	
Right	10.0°
Left	10.0°



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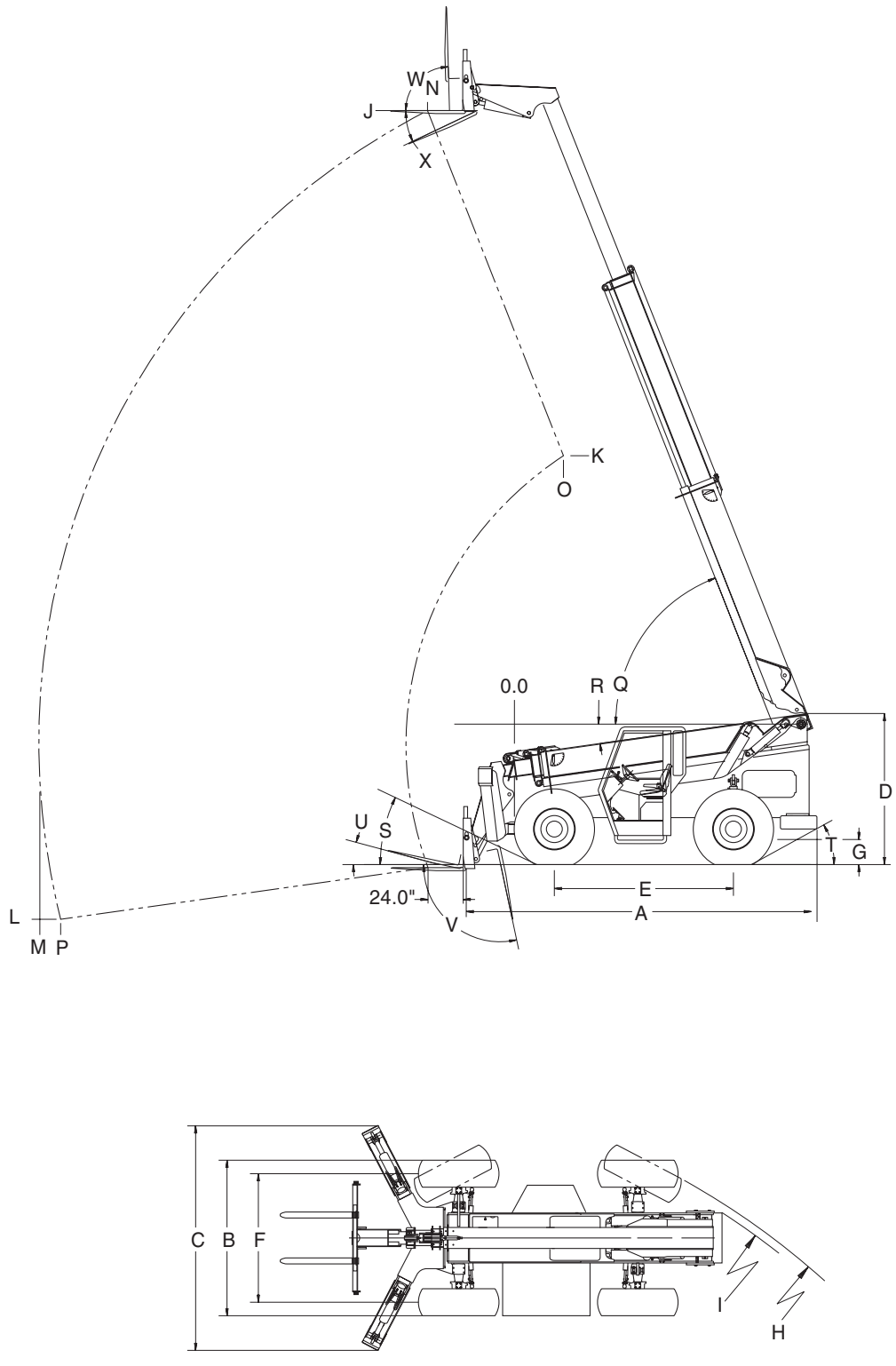
b. Model 10042 (With Standard 12-ply, 17.5-25 Tires)

Description	
(A) Length (Without Attachment)	225.25" (5.721 mm)
(B) Width (Outriggers UP)	102.0" (2.591 mm)
(C) Width (Outriggers DOWN)	156.75" (3.981 mm)
(D) Height (Boom Lowered)	100.1" (2.542 mm)
(E) Wheelbase	119.5" (3.035 mm)
(F) Tread Center	84.25" (2.140 mm)
(G) Ground Clearance	18.0" (457 mm)
(H) Turning Radius, Curb to Curb	170.0" (4.318 mm)
(I) Turning Radius, Clearance	182.0" (4.323 mm)
(J) Maximum Lift Height, Boom Extended	42' 1.5" (12,8 m)
(K) Maximum Lift Height, Boom Retracted	23' 3" (7,1 m)
(L) Maximum Below Grade Depth, Boom Extended	3' 2" (965 mm)
(M) Maximum Reach, from Front of Front Tires	26' 6" (8,1 m)
(N) Maximum Reach at Maximum Lift Angle, Boom Extended	56.3" (1.430 mm)
(O) Maximum Reach at Maximum Lift Angle, Boom Retracted	-29.2" (-742 mm)
(P) Maximum Reach at Minimum Lift Angle, Boom Extended	25' 4" (7.7 m)
(Q) Maximum Boom Lift Angle	68.5°
(R) Minimum Boom Lift Angle	-8.0°
(S) Angle of Approach	25.1°
(T) Angle of Departure	26°
Attachment Tilt Angle:	
(U) At Minimum Boom Angle - UP	11.9°
(V) At Minimum Boom Angle - DOWN	-102.0°
(W) At Maximum Boom Angle - UP	88.4°
(X) At Maximum Boom Angle - DOWN	-25.5°
Frame Sway Angle (Not Shown):	
Right	10.0°
Left	10.0°



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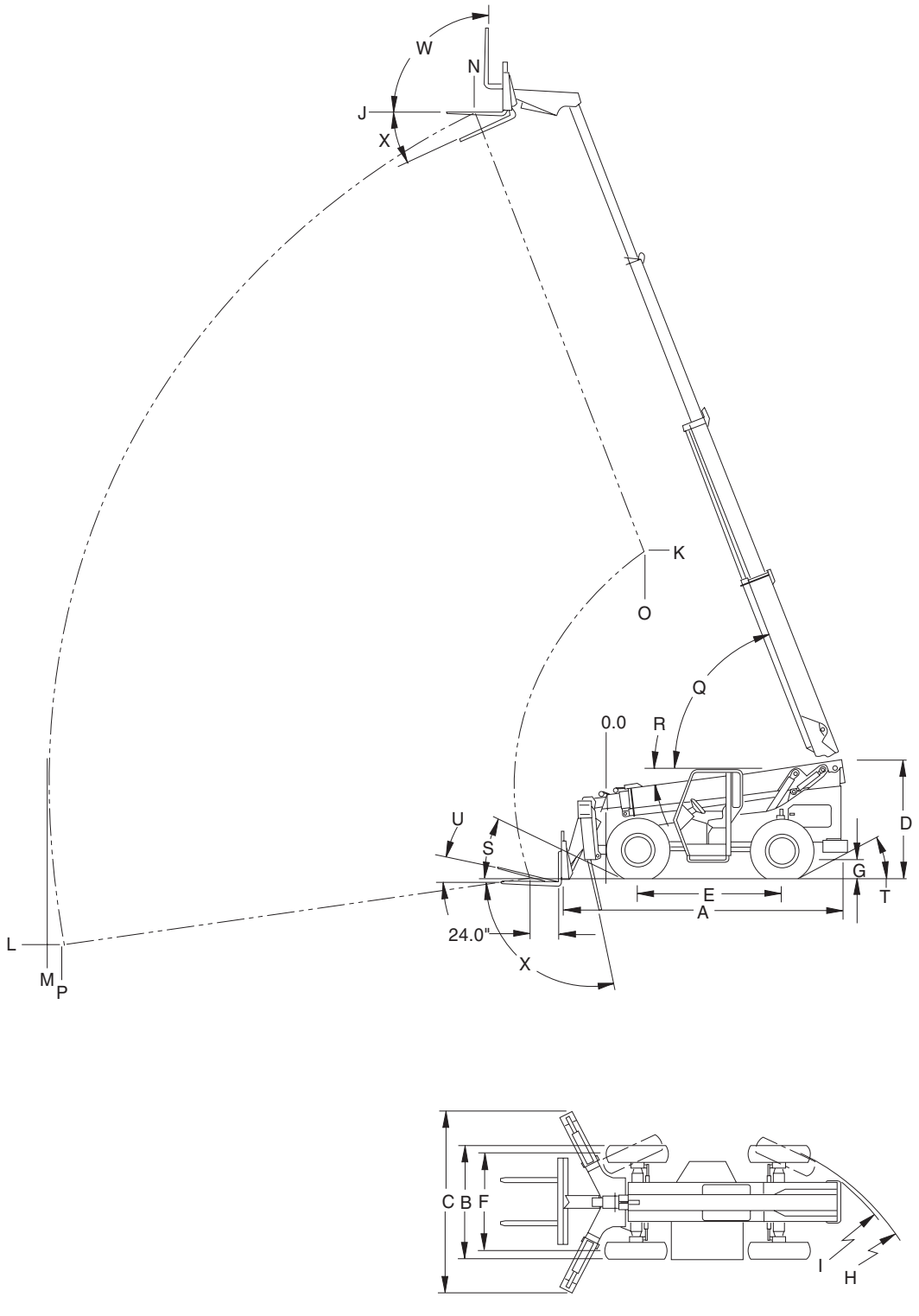
c. Model 10054 (With Standard 12-Ply, 17.5-25 Tires)

Description	
(A) Length (Without Attachment)	239.0" (6.071 mm)
(B) Width (Outriggers UP)	102.0" (2.591 mm)
(C) Width (Outriggers DOWN)	156.75" (3.981 mm)
(D) Height (Boom Lowered)	101.0" (2.565 mm)
(E) Wheelbase	119.5" (3.035 mm)
(F) Tread Center	84.25" (2.140 mm)
(G) Ground Clearance	18.0" (457 mm)
(H) Turning Radius, Curb to Curb	170.0" (4.318 mm)
(I) Turning Radius, Clearance	182.0" (4.323 mm)
(J) Maximum Lift Height, Boom Extended	53' 2" (16,2 m)
(K) Maximum Lift Height, Boom Retracted	22' 11" (6,9 m)
(L) Maximum Below Grade Depth, Boom Extended	4' 11" (1.499 mm)
(M) Maximum Reach, from Front of Front Tires	38' 9" (11,8 m)
(N) Maximum Reach at Maximum Lift Angle, Boom Extended	113" (2.870 mm)
(O) Maximum Reach at Maximum Lift Angle, Boom Retracted	-30.8" (-782 mm)
(P) Maximum Reach at Minimum Lift Angle, Boom Extended	37' 6" (11.43 m)
(Q) Maximum Boom Lift Angle	68.5°
(R) Minimum Boom Lift Angle	-8.0°
(S) Angle of Approach	25.1°
(T) Angle of Departure	26°
Attachment Tilt Angle:	
(U) At Minimum Boom Angle - UP	11.9°
(V) At Minimum Boom Angle - DOWN	-102.0°
(W) At Maximum Boom Angle - UP	88.4°
(X) At Maximum Boom Angle - DOWN	-25.5°
Frame Sway Angle (Not Shown):	
Right	10.0°
Left	10.0°



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2.5.2 Vehicle Weights

Description	8042	10042	10054
Curb Weight (Open Cab)	25,356 lb (11.505 kg)	26,323 lb (11.940 kg)	27,323 lb (12.393 kg)
Curb Weight (Enclosed Cab)	25,565 lb (11.596 kg)	26,523 lb (11.940 kg)	27,523 lb (12.523 kg)
Operating Load	8,000 lb (3.629 kg)	10,000 lb (4.536 kg)	10,000 lb (4.536 kg)
Working Weight (Machine working weight is figured with 48" [1.219 mm] carriage, two 48" (1.219 mm) pallet forks, full fuel tank, and standard bias ply tires [no hydrofill]):			
Open Cab:			
Front Axle	8,344 lb (3.785 kg)	9,317 lb (4.226 kg)	10,325 lb (4.683 kg)
Rear Axle	17,021 lb (7.720 kg)	17,006 lb (7.714 kg)	16,998 lb (7.710 kg)
Total (Open Cab)	25,365 lb (11.505 kg)	26,323 lb (11.940 kg)	27,323 lb (12.393 kg)
Enclosed Cab:			
Front Axle	8,442 lb (3.829 kg)	9,414 lb (4.270 kg)	10,423 lb (4.728 kg)
Rear Axle	17,123 lb (7.767 kg)	17,109 lb (7.759 kg)	17,100 lb (7.756 kg)
Total (Enclosed Cab)	25,565 lb (11.596 kg)	26,523 lb (12.031 kg)	27,523 lb (12.484 kg)

2.5.3 Attachment Weights

Note: *Attachments listed below are for all models, except where specified.*

Std 48" Carriage with Shaft	456 lb (205 kg)
Std 60" Carriage with Shaft	526 lb (239 kg)
Std 72" Carriage with Shaft	677 lb (307 kg)
48" Side Tilt Carriage with Shaft and Cylinders	687 lb (312 kg)
60" Side Tilt Carriage with Shaft and Cylinders	752 lb (341 kg)
72" Side Tilt Carriage with Shaft and Cylinders	770 lb (347 kg)
52" Swing Carriage with Shaft and Cylinders	950 lb (428 kg)
72" Swing Carriage with Shaft and Cylinders	1,135 lb (511kg)
Bucket, 1.125 yd^3 (0,860 m^3)	760 lb (345 kg)
Broom, 8 ft (2,4 m)	1,100 lb (499 kg)
Pallet Forks (8042 only) 2" x 4" x 48" (5 x 10 x 122 cm), quantity: 2	278 lb (127 kg)
Pallet Forks (10042 and 10054) 2.25" x 4" x 48" (5,7 x 10 x 122 cm), quantity: 2	312 lb (141 kg)
Block Forks 2" x 2" x 48" (5 x 5 x 122 cm), quantity: 6	480 lb (218 kg)
Lumber Forks, 1.75" x 7" x 60" (4 x 18 x 152 cm), quantity: 2	466 lb (211 kg)
12 ft Truss Boom (8042 only)	470 lb (213 kg)
15 ft Truss Boom (10042 and 10054)	525 lb (238 kg)
Auger Drive Unit	285 lb (129 kg)
Auger Mounting Frame	180 lb (82 kg)
Auger (Various Sizes Available)	Varies
Auger Extension (Various Sizes Available)	Varies

2.5.4 Performance Specifications

Note: *Performance criteria is based on full throttle engine speed unless otherwise specified or not applicable.*

Travel Speed (Standard Tires, No Load)	All Models
First Gear	0-3.5 mph (0-5,6 km/hr)
Second Gear	0-6 mph (0-9,7 km/hr)
Third Gear	0-14 mph (0-21,7 km/hr)
Fourth Gear	0-20 mph (0-32,2 km/hr)

2.5.5 Hydraulic Cylinder Performance Specifications

Note: *Vehicle with no load, engine at full throttle, hydraulic oil above 130° F (54° C) minimum, engine at operating temperature.*

Function	Approximate Times, in Seconds		
	8042	10042	10054
Boom Extend	Less than 19.0	Less than 19.0	Less than 19.0
Boom Retract	Less than 17.0	Less than 17.0	Less than 17.0
Boom Lift Retracted	Less than 17.5	Less than 17.5	Less than 17.5
Boom Lower Retracted	Less than 15.5	Less than 15.5	Less than 15.5
Attachment Tilt - UP	Less than 8.0	Less than 8.0	Less than 8.0
Attachment Tilt - DOWN	Less than 11.0	Less than 11.0	Less than 11.0
Frame Sway Left to Right with Boom Down	5.5-12.0	5.5-12.0	3-6
Frame Sway Left to Right with Boom Above 40° and Emergency Brake Engaged	23.0-33.0	23.0-33.0	23.0-33.0
Frame Sway Right to Left with Boom Down	4.0-8.0	4.0-8.0	4.0-8.0
Frame Sway Right to Left with Boom Above 40° and Emergency Brake Engaged	26.0-52.0	26.0-52.0	26.0-52.0
Outrigger - Left or Right, UP or DOWN	—	4.0-9.0	4.0-9.0
Outrigger - Left and Right, UP or DOWN	—	4.0-10.0	4.0-10.0

2.5.6 Electrical System

Battery:	
Type, Rating	12 VDC, Negative (-) Ground, Maintenance Free
Quantity (Cummins 4BT3.9 & 4BTA3.9 Engine)	1
Quantity (Cummins QSB4.5T Engine)	2
Reserve Capacity (Cummins 4BT3.9 & 4BTA3.9 Engine)	1,000 Cold Cranking Amps @ 0° F (-18° C)
Reserve Capacity (Cummins QSB4.5T Engine)	850 Cold Cranking Amps (Each Battery)
Group/Series (Cummins 4BT3.9 & 4BTA3.9 Engine)	C31XH
Group/Series (Cummins QSB4.5T Engine)	Series 27
Alternator	12V, 95 Amps
Fuses - Standard Blade Style:	
7.5 Amps	Light Switch Relay, Transmission, Outriggers (10042 and 10054), Boom/Outrigger Interlock (10054 Only) ECM Indicator Light (Cummins QSB4.5T Engine Only), ECM System Fuses (Cummins QSB4.5T Engine Only)
10 Amps	Instrument Cluster, Steer Select Switch, Stabil-TRAK System, Washer/Wipers (Optional), ECM System Fuses (Cummins QSB4.5T Engine Only)
15 Amps	Horn/Heater
20 Amps	Optional Lights
40 Amps	Main, Optional Road/Work Lights
Fuses - Mega Bolt Down Style:	
125 Amps	Cold Start Grid Heater (Cummins QSB4.5T Engine Only)

Relays:	
Neutral Start Relay	12 Volt
Park Brake Disengage Relay	12 Volt
Optional Headlight Switch Relay	12 Volt
Back-up Relay	12 Volt
Light Switch Relay	12 Volt
Stabil-TRAK Lock	12 Volt
Boom Switch	12 Volt
Park Brake Interlock (10054 Only)	12 Volt
Boom Extend Interlock (10054 Only)	12 Volt
Outrigger Lockout (10054 Only) (S/N 13198 thru 17984)	12 Volt
Stabil-TRAK Interlock (10054 Only)	12 Volt
Stabil-TRAK Lock Up (10054 Only)	12 Volt
Boom Extend Interlock (10054 Only)	12 Volt
Right Outrigger Lock (10054 Only)	12 Volt
Left Outrigger Lock (10054 Only)	12 Volt

2.5.7 Engine Performance Specifications

Note: *Engine manufacturer's maximum "high idle" setting is lockwired and sealed.* ***DO NOT*** *disturb this setting*

Model 8042 (S/N 13198 thru 18990), 10042 (S/N 13198 thru 19030) & 10054 (S/N 13198 thru 19079).

Description	8042	10042	10054
Engine Make/Model	Cummins 4BT3.9 Turbo	Cummins 4BTA3.9 Aftercooled Turbo	Cummins 4BTA3.9 Aftercooled Turbo
Displacement	239 in^3 (3,9 liters)	239 in^3 (3,9 liters)	239 in^3 (3,9 liters)
Low Idle	1050 ±50 rpm	1050 ±50 rpm	1050 ±50 rpm
High Idle	2750 ±100 rpm	2750 ±100 rpm	2750 ±100 rpm
Horsepower	110 HP @ 2500 rpm	116 HP @ 2500 rpm	116 HP @ 2500 rpm
Peak Torque	278 lb-ft @ 1500 rpm	300 lb-ft @ 1500 rpm	300 lb-ft @ 1500 rpm
Fuel Delivery	Fuel Injection	Fuel Injection	Fuel Injection
Average Fuel Consumption, Depending on Load/Duty	2 gal/hr (1,67 Imp gal/ hr or 7,57 liters/hr)	2 gal/hr (1,67 Imp gal/ hr or 7,57 liters/hr)	2 gal/hr (1,67 Imp gal/ hr or 7,57 liters/hr)
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

Model 8042 (S/N 18991 & After), 10042 (S/N 19031 & After) & 10054 (S/N 19080 & After)

Description	8042, 10042, 10054
Engine Make/Model	Cummins QSB4.5T
Displacement	275 in^3 (4,5 liters)
Low Idle	950 ±50 rpm
High Idle	2650 ±100 rpm
Horsepower	110 HP @ 2500 rpm
Peak Torque	305 lb-ft @ 1500 rpm
Fuel Delivery	Fuel Injection
Average Fuel Consumption, Depending on Load/Duty	2 gal/hr (1,67 Imp gal/hr or 7,57 liters/hr)
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements

2.5.8 Fluid and Lubricant Capacities

Engine Crankcase Oil:	
Capacity with Filter Change	11.0 qt (10,4 liters) Cummins 4BT3.9 & 4BTA3.9 Engine 10.5 qt (10 liters) Cummins QSB4.5T Engine
Filter Capacity	1.0 qt (0,9 liters) Cummins 4BT3.9 & 4BTA3.9 Engine 0.85 qt (0,80 liters) Cummins QSB4.5T Engine
Oil Type	SAE 15W40 Diesel Engine Oil (Refer to Section 2.6.6, “Engine.”)
Fuel Tank:	
Total Capacity	37.0 gal (140 liters)
Usable Capacity	35.6 gal (135 liters)
Type of Fuel Above 32° F (0° C)	Standard #2 Diesel (Refer to Section 2.6.6, “Engine.”)
Type of Fuel Below 32° F (0° C)	50/50 Mix of #1 and #2 Diesel Fuels (Refer to Section 2.6.6, “Engine.”)
Cooling System:	
Capacity w/o Heater (including 1.5 qt [1,4 liters] for overflow bottle)	4.0 gal (15 liters)
Overflow Bottle Capacity	3.0 qt (2,8 liters)
Type of Fluid	50/50-mix of ethylene glycol and water (Refer to Section 2.6.6, “Engine.”)
Transmission:	
Capacity w/Filter Change	3.0 gal (11,8 liters)
Filter Capacity	1.5 qt (1,4 liters)
Type of Oil	Universal Tractor Fluid (Refer to Section 2.6.3, “Transmission.”)
Axle (Differential Housing):	
Capacity	Front Axle - 9.5 qt (9,0 liters) Rear Axle - 10.6 qt (10,0 liters)
Type of Oil	Universal Tractor Fluid. Refer to Section 2.6.1, “Axle (Differential Housing).”

Axle (Wheel Ends):	
Capacity	Front Axle - 1.7 qt (1,6 liters) Rear Axle - 1.3 qt (1,2 liters)
Type of Oil	Universal Tractor Fluid. Refer to Section 2.6.1, “Axle (Differential Housing).”
Hydraulic System:	
System Capacity (8042)	57.5 gal (218 liters)
System Capacity (10042 and 10054)	64 gal (242 liters)
Reservoir Capacity	32.2 gal (122 liters)
Type of Oil	ISO Grade 46 Anti-Wear Hydraulic Oil (Refer to Section 2.6.5, “Hydraulic System.”)

2.5.9 Hydraulic Relief Valve Settings (8042 and 10042)

Port Relief Attachment Tilt (Both Sides)	3,250 ±100 psi (224,0 ±6,9 bar)
Port Relief Auxiliary Hydraulics	3,250 ±100 psi (224,0 ±6,9 bar)
Pressure Reducing Relieving Valve, Stabilizer	75/150 psi (5,2/10,3 bar)
Pressure Reducing Valve, Park Brakes	500-600 psi (34,5-41,4 bar)
Pressure Reducing Valve, Steering	2,500 ±100 psi (172,4 ±6,9 bar)
Relief Valve, Park Brake	650/700 psi (44,8/48,3 bar)
Main Valve Back-up Relief	3,500 ±100 psi (241,3 ±6,9 bar)
Main Valve Unloader Relief at Valve Inlet	3,000 ±100 psi (206,8 ±6,9 bar)
Main Pump Standby Pressure at Pump Outlet	550-600 psi (34-41 bar)
Main Pump Compensator at Pump Outlet	3,300-3,400 psi (228-234 bar)

2.5.10 Hydraulic Relief Valve Settings (10054)

Port Relief Attachment Tilt (Both Sides)	3,250 ±100 psi (224,0 ±6,9 bar)
Pressure Reducing Relieving Valve, Stabilizer	200 ±25 psi (13.7 ±1.8 bar)
Pressure Reducing Valve	500-600 psi (34,5-41,4 bar)

2.5.11 Tires

Description	8042	10042	10054
Wheel Lug Nut Torque	430-470 lb-ft (583-637 Nm)	430-470 lb-ft (583-637 Nm)	430-470 lb-ft (583-637 Nm)
Standard Tire Size	13.00-24, 12-ply	17.5-25, 12-ply	17.5-25, 12-ply
Standard Tire Air Pressure (Minimum)	70 psi (483 kPa)	60 psi (414 kPa)	60 psi (414 kPa)
Optional Tires			
15.5-25, 12-ply	70 psi (483 kPa)	—	—
15.5-25, 12-ply Rock	70 psi (483 kPa)	—	—
15.5R25 One Star Radial	75 psi (517 kPa)	—	—
17.5R25 One Star Radial	—	73 psi (503 kPa)	73 psi (503 kPa)
Foam Filled 13.00-24, 12 ply Tire Ballast (Minimum per Tire)	775 lbs (351 Kg)	—	—
Foam Filled 17.5-25, 12 ply Tire Ballast (Minimum per Tire)	—	1,075 lbs (488 Kg)	1,075 lbs (488 Kg)
Tire Footprint Area (area is established under maximum tip load):			
Vehicle with Rated Load 13.00-24, 12-ply Tires @ 70 psi (483 kPa)	150 in^2 (968 cm^2)	—	—
Vehicle with Rated Load & Optional 15.5-25, 12-ply Tires @ 70 psi (483 kPa)	212 in^2 (1368 cm^2)	—	—
Vehicle with Rated Load & Optional Rock 15.5-25, 12-ply Tires @ 70 psi (483 kPa)	212 in^2 (1368 cm^2)	—	—
Vehicle with Rated Load 17.5-25, 12-ply Tires @ 60 psi (414 kPa)	—	244 in^2 (1.574 cm^2)	—
Vehicle with Rated Load 17.5-25, 12-ply Tires @ 60 psi (414 kPa)	—	—	244 in^2 (1.574 cm^2)
Maximum Ground Pressure (max. ground pressure at tip = (machine weight + load) / (2 x footprint area):			
Vehicle with Rated Load 13.00-24, 12-ply Tires @ 70 psi (483 kPa)	111 psi (765 kPa)	—	—
Vehicle with Rated Load & Optional 15.5-25, 12-ply Tires @ 70 psi (483 kPa)	79 psi (545 kPa)	—	—
Vehicle with Rated Load & Optional Rock 15.5-25, 12-ply Tires @ 70 psi (483 kPa)	79 psi (545 kPa)	—	—
Vehicle with Rated Load 17.5-25, 12-ply Tires @ 60 psi (414 kPa)	—	74 psi (510 kPa)	—
Vehicle with Rated Load 17.5-25, 12-ply Tires @ 60 psi (414 kPa)	—	—	77 psi (531 kPa)

2.5.12 Miscellaneous Specifications (All Models)

Steering Wheel:	
Maximum Number of Turns, Lock to Lock	3.75 turns
Minimum Number of Turns, Lock to Lock	3.00 turns
Breakout Force:	
Utility bucket (calculated at -24° lip angle, max. moment)	24,500 lb (11.113 kg)

2.5.13 Tamper Proofing

A tamper-proof means is in place on the following adjustable components prior to machine shipment. This can either be tamper-proof paint or a steel tamper-proof cap. **DO NOT** attempt to defeat, bypass or alter any tamper-proof device.

- Main Valve Port Relief Valves (5) Standard, or (7) Auxiliary Hydraulics
- Steering Relief Valve (1)
- Attachment Tilt Cylinder Counterbalance Valve (1)
- Lift/Lower Cylinder Counterbalance Valves (2)
- Extend/Retract Cylinder Counterbalance Valve (1)
- Main System Relief Valve (1)
- Parking Brake Relief (1)
- Pump Pressure Compensating Valve (1)

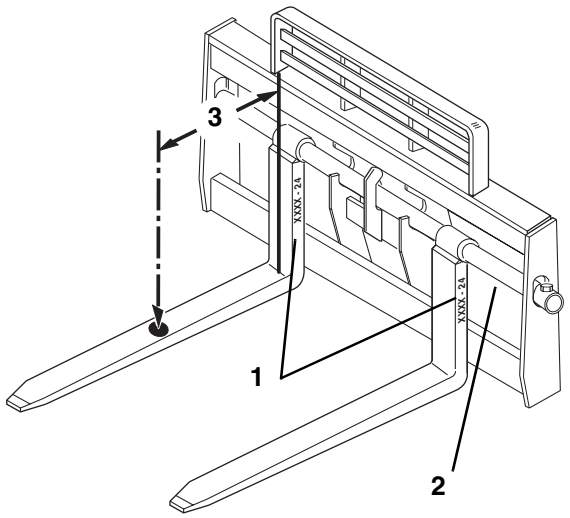
2.5.14 Fork Ratings

All approved forks for this vehicle are marked with a maximum load capacity rating. This rating is stamped on the left edge of the fork (**1**), just below the fork pivot shaft (**2**). The rating is listed in U.S. pounds and based on a 24" (610 mm) load center (**3**).

This rating specifies the maximum load capacity that the individual fork can safely carry at a maximum load center of 24" (610 mm).

Since forks are always used in multiples, the total rating of any combination of forks is the sum of their rated capacities.

Other than block forks, use all forks in matched pairs. Use block forks in matched sets.



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2.6 FLUIDS, LUBRICANTS AND CAPACITIES

2.6.1 Axle (Differential Housing)

a. Axle Differential Housing Lubricants

In general, use a Universal Tractor Fluid that meets the following specifications:

Nominal viscosity at 104° F (40° C)..... 55 cSt

Minimum viscosity at 212° F (100° C) ..... 9.1 cSt

Pour point (Maximum) .....-32° F (-36° C)

Flash point (Minimum)..... 392° F (200° C)

Minimum viscosity index..... 135

Products known to meet these requirements include:

- JOHN DEERE: JDM J20C (HY-GARD)
- FORD/NEW HOLLAND: ESN-M2C134-D (Hydraulic Oil 134)
- MASSEY-FERGUSON: M-1141 (PERMANTRAN III)
- CHEVRON: CHEVRON 1000 THF

b. Axle Differential Housing Capacity

Axle differential housing (front axle) .....9.5 qt (9 liters)

Axle differential housing (rear axle).....10.6 qt (10 liters)

2.6.2 Axle Wheel Ends

a. Axle Wheel End Lubricants

In general, use a Universal Tractor Fluid that meets the following specifications:

Nominal viscosity at 104° F (40° C)..... 55 cSt

Minimum viscosity at 212° F (10° C) ..... 9.1 cSt

Pour point (Maximum) .....-32° F (-36° C)

Flash point (Minimum)..... 392° F (200° C)

Minimum viscosity index..... 135

Products known to meet these requirements include:

- JOHN DEERE: JDM J20C (HY-GARD)
- FORD/NEW HOLLAND: ESN-M2C134-D (Hydraulic Oil 134)
- MASSEY-FERGUSON: M-1141 (PERMANTRAN III)
- CHEVRON: CHEVRON 1000 THF

DO NOT add additional friction modifier to factory-filled wheel ends. All wheel ends are factory-filled by the manufacturer with oil. If a wheel end is drained for service, it should be refilled with the gear oils listed.

***Note: DO NOT** use synthetic oil without the express written consent of the manufacturer.*

b. Axle Wheel End Capacity

The capacity listed below is for one wheel end

Axle wheel end (front axle)..... 1.7 qt (1,6 liters)

Axle wheel end (rear axle) ..... 1.3 qt (1,2 liters)

2.6.3 Transmission

a. Transmission Lubricants

In general, use a Universal Tractor Fluid that meets the following specifications:

Nominal viscosity at 10° F (40° C) ..... 55 cSt

Minimum viscosity at 212° F (100° C)..... 9.1 cSt

Pour point (Maximum)..... -32° F (-36° C)

Flash point (Minimum).....392° F (200° C)

Minimum viscosity index 135

Products known to meet these requirements include:

- JOHN DEERE: JDM J20C (HY-GARD)
- FORD/NEW HOLLAND: ESN-M2C134-D (Hydraulic Oil 134)
- MASSEY-FERGUSON: M-1141 (PERMANTRAN III)
- CHEVRON: CHEVRON 1000 THF

b. Transmission Capacity

Capacity w/filter change ..... 3 gal (11,8 liters)

Filter ..... 1 qt (0,9 liters)

2.6.4 Lubrication Points (Grease Fittings)

a. Lubricants

When lubricating any component via the grease fittings, use multi-purpose, lithium-based grease with EP additives that meets NLGI Grade-2 specifications. Products known to meet these requirements include:

- AMOCO AMOLITH EP2
- ARCO LITHOLINE EP2
- BENZ MOLY-SERVICE EP2
- CHEVRON DUROLITH EP2
- CITGO H EP2
- GULF GULFCROWN EP2
- MOBILE MOBILUX EP2
- SHELL ALVANIA EP2
- SUN PRESTIGE 742EP
- TEXACO MULTIFAX EP2

Note: *Refer to the appropriate Owners/Operators manual for the maintenance schedule and checklist for lubrication intervals and grease fitting locations.*

2.6.5 Hydraulic System

a. Hydraulic Fluids

The hydraulic system is factory-filled with ISO Grade 46 anti-wear hydraulic oil. When filling the hydraulic system, use an anti-wear hydraulic oil meeting ISO Grade 46 with -40° F (-40° C) pour point/ASTM viscosity SUS 215 at 100° F (38° C), or a 10W motor oil that meets the requirements of U.S. ordinance specification MIL-L-2104C. Products known to meet these requirements include:

ISO-46 HYDRAULIC OIL

- GULF HARMONY 46 AW
- AMOCO RYKON 46
- MOBIL DTE-25
- ARCO DURO AW S-215
- SHELL TULLUS 46
- BENZ PETRAULIC 46-7C
- SUN SUNVIS 821 WR
- CHEVRON AW HYDRAULIC OIL 46
- TEXACO RANDO HD 46
- CITGO PACEMAKER XD-46

SAE 10W MOTOR OIL

- CASTROL/DEUSOL CRD
- ESSO ESSOLUBE D-3HP
- ESSO ESSOLUBE XD-3
- CASTROL AGRICASTROL HDD
- SHELL RIMULA CT
- SHELL RIMULA X
- SHELL RIMULA TX

Note: *For -30° F to +70° F (-34° C to +21° C), 5W20 motor oil with -50° F (-45° C) pour point can be substituted. However, above 70° F (21° C), hydraulic system oil must be changed to ISO-46 hydraulic oil or SAE 10W motor oil.*

b. Hydraulic System Capacity

Model 8042:

System Capacity ..... 57.5 gal (218 liters)

Reservoir Capacity to FULL Mark ... 32.2 gal (122 liters)

Model 10042 and 10054:

System Capacity ..... 64 gal (242 liters)

Reservoir Capacity to FULL Mark ... 32.2 gal (122 liters)

2.6.6 Engine

a. Engine Fluids and Lubricants

1. Engine Oil:

Diesel Engine Oil, SAE 15W40

In general, use a premium-quality, 15W40 diesel engine (motor) oil. Additives are not necessary. For most climates, use 15W40 motor oil that at least meets the manufacturers minimum recommended oil specifications as defined in their operator manual. In cold climates where ambient (outside air) temperatures are consistently below 32° F (0° C), refer to the engine manufacturers operator manual for alternative oils.

2. Cooling System (engine coolant):

In general, use a 50/50 mix of premium-quality ethylene glycol (commonly referred to as “anti-freeze/anti-boilover”) and water. Additives are not necessary.

3. Fuel:

In general, use #2 diesel fuel. From November 15 to March 15, when operating in cooler climates where ambient (outside air) temperatures are consistently at or below 32° F (0° C), use a 50/50 mix of #1 and #2 diesel fuels. Use a good quality diesel fuel and change the fuel filter regularly. Additives are not necessary.

b. Engine Capacities

1. Engine Oil Capacity:

Crankcase Capacity (4BT3.9 & 4BTA3.9 Engine)

With filter change.....11 qt (10,4 liters)

Filter Capacity.....1 qt (0,9 liters)

Crankcase Capacity (QSB4.5T Engine Only)

With filter change.....10.5 qt (10 liters)

Filter Capacity.....0.85 qt (0,80 liters)

2. Cooling System Capacity (w/o heater):

Cooling System Capacity .....4 gal (15 liters)

Overflow Bottle Capacity .....3 qt (2,8 liters)

3. Fuel Tank Capacity:

Total Capacity.....37 gal (140 liters)

Usable Capacity .....35.6 gal (135 liters)

2.6.7 Drive Shaft Splines

***IMPORTANT: DO NOT** disassemble any of the drive shafts (refer to Section 5, "Axles, Drive Shafts, Wheels and Tires," of this manual for information covering drive shafts and U-joints). To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly. Refer to the appropriate parts manual for ordering information.*

Respective of the above statement, should it become necessary to coat the transmission input drive shaft splines, use molybdenum disulfide grease. Molybdenum disulfide grease is specifically formulated for this purpose and is marketed by several manufacturers under various names, including:

Aldrich Chemical Co., Inc.
Product name: *Aldrich MOLYBDENUM (IV) SULFIDE*
Catalog Number: 23,484-2
Package Size: 5 g (0.175 oz)
100 g (3.5 oz)
500 g (17.5 oz)
Contact:
Aldrich Chemical Co., Inc.
P.O. Box 335
Milwaukee, WI 53201 USA
Phone: (414) 273-3850

DOW CORNING, INC.
Product name: *MOLYKOTE® 77 Paste*
Contact:
Dow Corning Corporate Center
P.O. Box 994
Midland, MI 48686-0994 USA
Phone: (517) 496-4400

2.6.8 General Anti-Corrosion

a. Anti-Corrosion Compound

For general anti-corrosion protection, use a wax film rust inhibitor that provides a protective film two ten-thousandths of an inch (0.0002" or 0,00005 mm) thick. One such rust inhibitor that is specifically formulated for this purpose is LPS 3. It is marketed by:

LPS Laboratories, Inc.
4647 Hugh Howell Rd.
Tucker, GA 30085-5052
Phone: 1-800-241-8334
Fax: (770) 493-9206

***Note:** Anti-corrosion protection is especially important in frame and stabilizer cylinder pin support bores for protection from corrosion wear.*

b. Anti-Corrosion Need Areas

Coat all unplated pins and all bores for cylinder pins, attachment pivot pins, chain sheave pins, the quick attach lock pin and all quick attach lock pin bores. On the boom, coat the fork shaft and unpainted boom slide pathways.

2.6.9 Electrical

a. Basic Ratings

Battery Rating ..... 12V DC Negative Ground

Battery Type.....Maintenance-Free
4BT3.9 & 4BTA3.9 Engine..1,000 Cold Cranking Amps
QSB4.5T Engine ..... 850 Cold Cranking Amps (Each)

Battery Series (4BT3.9 & 4BTA3.9 Engine)....Series 31

Battery Series (QSB4.5T Engine) .....Series 27

Number of Batteries (4BT3.9 & 4BTA3.9 Engine)... One

Number of Batteries (QSB4.5T Engine)..... Two

Alternator Rating .....65 Amps

b. Fuse Ratings

Model 8042:

Main ..... 40 Amp
Light Switch Relay ..... 7.5 Amp
Instrument Cluster ..... 10 Amp
Horn/Heater ..... 15 Amp
Steer Select Switch ..... 10 Amp
Stabil-TRAK System ..... 10 Amp
Optional Washer/Wipers ..... 10 Amp
Optional Lights ..... 20 Amp
Optional Road/Work Lights ..... 40 Amp
Transmission ..... 7.5 Amp
ECM Indicator Light (QSB4.5T Engine Only) ... 7.5 Amp
Grid Heater (QSB4.5T Engine Only) ..... 125 Amp
ECM System (QSB4.5T Engine Only) ..... 7.5 Amp
ECM System (QSB4.5T Engine Only) ..... 10 Amp

Model 10042:

Main ..... 40 Amp
Light Switch Relay ..... 7.5 Amp
Instrument Cluster ..... 10 Amp
Horn/Heater ..... 10 Amp
Steer Select Switch ..... 10 Amp
Stabil-TRAK System ..... 10 Amp
Optional Washer/Wipers ..... 10 Amp
Outriggers (4BT3.9 & 4BTA3.9 Engine) ..... 7.5 Amp
Outriggers & ECM Indicator Light (QSB4.5T Engine Only) ..... 7.5 Amp
Optional Lights ..... 20 Amp
Optional Road/Work Lights ..... 40 Amp
Transmission ..... 7.5 Amp
Grid Heater (QSB4.5T Engine Only) ..... 125 Amp
ECM System (QSB4.5T Engine Only) ..... 7.5 Amp
ECM System (QSB4.5T Engine Only) ..... 10 Amp

Model 10054:

Main ..... 40 Amp
Light Switch Relay ..... 7.5 Amp
Instrument Cluster ..... 10 Amp
Horn/Heater ..... 15 Amp
Steer Select Switch ..... 10 Amp
Stabil-TRAK System ..... 10 Amp
Optional Washer/Wipers ..... 10 Amp
Outriggers (4BT3.9 & 4BTA3.9 Engine) ..... 7.5 Amp
Outriggers & ECM Indicator Light (QSB4.5T Engine Only) ..... 7.5 Amp
Optional Lights ..... 20 Amp
Optional Road/Work Lights ..... 40 Amp
Transmission ..... 7.5 Amp
Boom/Outrigger Interlock ..... 7.5 Amp
Grid Heater (QSB4.5T Engine Only) ..... 125 Amp
ECM System (QSB4.5T Engine Only) ..... 7.5 Amp
ECM System (QSB4.5T Engine Only) ..... 10 Amp

c. Relay Ratings

Model 8042 and 10042:

Park Brake Disengage 12V
Optional Headlight Switch 12V
Light Switch 12V
Neutral Start 12V
Stabil-TRAK Lock 12V
Boom Switch 12V
Back-up 12V

Model 10054:

Park Brake Disengage 12V
Optional Headlight Switch 12V
Light Switch 12V
Neutral Start 12V
Stabil-TRAK Lock 12V
Boom Switch 12V
Back-up 12V
Park Brake Interlock 12V
Boom Extend Lockout 12V
Stabil-TRAK Interlock 12V
Stabil-TRAK Lock Up 12V
Boom Extend Interlock 12V
Right Outrigger Lock 12V
Left Outrigger Lock 12V
Outrigger Lockout (S/N 13198 thru 17984 Only) 12V

2.6.10 Paint

Unless otherwise specified, paint components as indicated in the following sections.

a. Orange Paint

Durable, premium Sky Trak Orange paint is available in both a convenient 16 ounce (480 ml) spray can for touch-ups and in a production size, one gallon (3,8 liter) container for extensive repainting. Consult the appropriate parts manual for the applicable part number and ordering information. Use orange paint on all vehicle components except as specified in paragraphs 2.6.10 B and C.

b. Black Paint

Durable, premium Sky Trak Black paint is available in both a convenient 16 oz (480 ml) spray can for touch-ups and in a production size, one gallon (3,8 liter) container for extensive repainting. The following components are painted Black:

- Boom Angle Indicator Pointer
- Brake Pedal
- Radiator
- Radiator Shroud
- Oil Cooler
- Axles
- Drive Shafts
- Transmission
- Forks
- Quick Attach (Current Production)
- Carriages (Current Production, refer to appropriate Parts Manual for correct paint part number)
- Mirrors and Mirror Brackets
- Air Cleaner (4BT3.9 & 4BTA3.9 Engine Only)
- Steering Column
- Outriggers (10042 and 10054)
- Outrigger Cylinders (10042 and 10054)

c. White Paint

Durable, premium Sky Trak White paint is available in both a convenient 16 oz (480 ml) spray can for touch-ups and in a production size, one gallon (3,8 liter) container for extensive repainting. The following components are painted White:

- Boom Extend Cylinder
- Wheels

2.6.11 Thread Locking Compound

For general thread locking purposes, Loctite® products, manufactured by Loctite Corporation, are recommended.

Contact:

LOCTITE Corporation
1001 Trout Brook Crossing
Rocky Hill, CT 06067 USA
Phone: 1-800-LOCTITE (1-800-562-8483)
Fax: (860) 571-2460
Internet: http://www.loctite.com

LOCTITE® is a registered trademark of Loctite Corporation.

2.7 CLEANING

Dirt and abrasive dust reduce the efficient working life of parts and systems and lead to the costly replacement of components. To help increase the service life of parts, clean the exterior of all parts before beginning any repairs.

Use cleaning fluids and solvents suitable for cleaning parts that do not create safety hazards. Certain types of cleaning fluid can cause skin irritation and can damage components (such as rubber, electrical parts, etc.).

Servicing the hydraulic system in particular requires cleanliness of the work area, as well as the components on the vehicle.

Follow these suggestions before attempting to service any hydraulic component:

1. Flush hose and tube assemblies with a solvent compatible with hose materials. Blow excess solvent away with shop air.
2. Plug or cap hydraulic fittings, hoses and tube assemblies, and protect the threads until time of installation. Clean up any spilled hydraulic fluid immediately.
3. Flush the hydraulic oil reservoir or fuel tank with a suitable solvent to remove paint, metal chips, etc.
4. Protect hydraulic system components from airborne contaminants. Plug or cap all cylinder, valve, reservoir, tank and pump openings until time of installation.
5. Use clean, filtered oil when filling the system. Maintain the hydraulic system at a minimum cleanliness level of ISO code 18/15-particle ration count.

2.8 REPLACEMENT

ALWAYS use the correct tool when removing or replacing any part or performing any service.

Some procedures may require the use of specialized tools. If needed, many of these tools can be obtained through Snap-On® tool distributors.

Contact:
Snap-On Incorporated
P.O. Box 1410
Kenosha, WI 53141-1410 USA
Phone: (262)-656-5200
Internet: http://www.snapon.com

Snap-On® is a registered trademark of Snap-On Technologies, Inc.

Replace o-rings, seals and gaskets whenever they are disturbed. **NEVER** mix new and old seals or o-rings, regardless of apparent visual condition. **ALWAYS** lubricate new seals and o-rings with hydraulic oil before installation.

ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.

ALWAYS refer to the Parts Manual for proper replacement of appropriate size, type and grade of ALL fasteners.

2.9 HOSES AND TUBES

2.9.1 Hose and Tube Inspection

1. Damaged, dented, crushed or leaking hoses, tubes or fittings restrict oil flow and operation of the system being served. Fittings that show any signs of movement from their original positions have failed and must be replaced. **ALWAYS** replace the entire hose or tube assembly if the fittings are damaged.
2. Hoses must remain in good condition. Obvious signs of external hose wear, or hydraulic fluid leaking or weeping indicate the need to replace the hose assembly. If in doubt, replace the hose.
3. Replace a hose or tube assembly if any of the following conditions exist:
   - Ballooning **(replace hose immediately!)**
   - Kinking, crushing, stretching or deforming
   - Concealed corrosion of wire reinforcement
   - Chafed outer cover

2.9.2 Hose and Tube Installation

1. When installing a new hose, loosely connect each end to verify that the hose takes up the designed position, and is free of twists and unnecessary bends before tightening completely. Tighten any support clamps sufficiently in order to hold the hose in position without crushing it, preventing movement and chafing of the hose.
2. If a hose is replaced on a part that moves, move the part through its entire range of motion to verify that the hose will not make contact with any component. Adjust the hose as necessary.
3. When installing any hose, be sure that the hose does not become kinked or twisted.
4. **NEVER** allow free-moving or unsupported hoses to contact each other or any other components. Such contact causes chafing and reduces hose life.

2.10 BEARINGS

2.10.1 Bearing Removal

1. **NEVER** remove bearings unless absolutely necessary! **ALWAYS** use the recommended size and type of bearing puller to reduce the risk of damage to the bearing or related components.
2. When bearings or bushings are removed, verify that the bearing or bushing is free of discoloration, nicks, scuffing or signs of overheating. If in doubt, replace the bearing or bushing.

2.10.2 Bearing Cleaning

ALWAYS wear safety glasses. Clean the bearings that are acceptable for service in a suitable solvent. **NEVER** spin-dry a bearing with compressed air; this can cause metal-to-metal contact and damage the bearing. Compressed air can also cause a bearing to come apart. After cleaning a bearing, immerse the bearing in clean lubricating oil until needed.

2.10.3 Bearing Installation

1. Always install bearings carefully to help avoid damaging their delicate surfaces.
2. Install bearings using one of the following methods:
   - PRESS FIT for installation on rotating parts such as shafts and gears
   - PUSH FIT into static locations such as reduction gear housings.
3. Always install the bearing into the rotating part first, whenever possible.
4. Use a press or the proper installation tools when installing a bearing or bushing.
5. In the absence of a press or proper installation tools, carefully heat the casing and/or bearing in hot oil to assist in the installation.

2.11 PRESSURE TESTING AND ADJUSTMENT

Prior to pressure testing or adjustment, verify that all hoses and tubes are in good condition and that all fittings are tight.

Use pressure gauges with the proper pressure range and rating to measure the specified pressures.

Use correct test procedures to help prevent personal injury, and damage to the system or test equipment.

Verify that the hydraulic oil is at the proper operating temperature, 80°-120° F (27°-49° C), before testing any pressures or making any adjustments to any valves. If necessary, operate the vehicle to raise the oil temperature up to the operating temperature. In the absence of a temperature gauge, the oil can be checked by placing your hand against the side or the bottom of the hydraulic oil reservoir. If the tank is too hot to keep your hand in contact with the tank, the oil should be within the proper range.

2.12 AFTER SERVICE STARTUP AND CHECKS

2.12.1 After Service Startup

Note: *Refer to the Owners/Operators manual for engine cold start procedures.*

1. Check ALL fluid levels, and add fluid as required.
2. Connect the negative (-) battery cable or cables to the negative (-) battery terminal or terminals if the cable or cables were disconnected.
3. Start and idle the engine. Check for leaks from the hydraulic components, engine, radiator, axles, transmission and brakes. Check for leaks from the hydraulic oil reservoir plugs or fittings; tighten as required. Check the levels of all fluids and lubricants.
4. Purge the hydraulic system of air by operating all vehicle functions through their entire range of motion. Operate all functions several times to ensure all air is purged from the system.
5. Check for proper and smooth operation of all components.
6. Retract all cylinders fully. Turn the engine OFF and check the hydraulic oil level in the hydraulic oil reservoir. Allow the oil to cool and recheck the level. Add oil as required to bring the oil level up to the proper level.

2.12.2 After Electrical Component Service

1. Check the torque of all fasteners securing replaced electrical/electronic components.
2. Check wire connections to electrical components.
3. Verify that wiring components are dry and free of moisture.
4. Check connectors for broken, frayed or loose wires.
5. Check wires and wire harnesses for brittle or frayed wire shielding.
6. Connect the negative (-) battery cable or cables to the negative (-) battery terminal or terminals if the cable or cables were disconnected.
7. Start the engine and purge the hydraulic system of air.
8. Check the operation of the replaced electrical component(s).

2.12.3 After Hydraulic Component Service

1. Check the torque of all fasteners on replaced hydraulic components.
2. Check that the hoses and tubes are properly attached, properly positioned and that all the fittings are properly tightened.
3. If a hydraulic component failed and contaminated the system:
   - Drain the hydraulic oil reservoir
   - Flush the system using clean hydraulic oil
   - Prime the pump
   - Clean the hydraulic oil reservoir
   - Change the hydraulic oil filter
4. After normal hydraulic component maintenance, check the hydraulic oil level and add oil as required.
5. Start the engine and purge the hydraulic system of air. Operate all boom functions through their full range of motion several times. Cycle the hoist and extend cylinders to purge air from the system. Visually check for leaks.
6. Check operation of all systems in the hydraulic circuit by operating the controls through all the functions several times.

2.12.4 After Brake System Service

1. Check the oil level in the axle and replenish with Universal Tractor Fluid as required.
2. Bleed the air from the brake system.
3. Check the brake pressure.
4. Check the brakes for proper operation.

2.12.5 After Fuel System Service

1. Drain and flush fuel tank, if it was contaminated, with clean fuel.
2. Replace all the fuel filters.
3. Fill the fuel tank with fresh, clean fuel as required.
4. Bleed the fuel system of air.

2.12.6 After Transmission Service or Replacement

1. Check transmission oil level and add Universal Tractor Fluid. Refer to Section 2.6.3, “Transmission,” for types of transmission lubricants.
2. Replace transmission filter.
3. Check the torque on the drive shaft yoke retaining strap bolts:
   - Upper driveshaft 35 lb-ft (47 Nm)
   - Lower driveshaft 60 lb-ft (81 Nm)
4. Refer to the ZF 4WG98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for servicing the transmission after overhaul or repair.
5. Wear suitable eye protection. When an overhauled or repaired transmission is installed, thoroughly clean the oil cooler lines to and from the transmission.
6. Drain and flush the entire system.
7. Disconnect and clean all transmission lines. Whenever it is possible, remove the transmission lines from the vehicle for cleaning.
8. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.

	CAUTION: **DO NOT** exceed 165 psi (11,4 bar) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

9. “Back flush” the transmission oil cooler with oil and compressed air until all foreign material is removed. Flushing in the direction of normal flow does not adequately clean the cooler. If needed, remove the transmission oil cooler assembly from the vehicle. **DO NOT** use flushing compounds for cleaning purposes.
10. Reassemble all components and fill the transmission with clean, fresh Universal Tractor Fluid through the filler opening until the fluid reaches the FULL mark on the transmission dipstick.
11. Run the engine at idle for several minutes to help prime the torque converter and fill the transmission cooling lines.
12. Recheck the level of the fluid in the transmission with the engine running at idle.
13. Add Universal Tractor Fluid as necessary to bring the fluid level up to the FULL mark on the transmission dipstick. Install the oil dipstick. Recheck the fluid level when it reaches an operating temperature 180-200° F (83-94° C).
14. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten as required.

2.12.7 After Tire and Wheel Service

1. Check the air pressure in the tires. Maintain proper air pressure at all times. Refer to proper tire size as follows:

Standard Tires

- 8042 (13.00-24, 12 ply) 70 psi (483 kPa)
- 10042/10054 (17.5-25, 12 ply) 60 psi (414 kPa)

Optional Tires - 8042

- 15.5 - 25, 12 ply 70 psi (483 kPa)
- 15.5 - 25, 12 ply, (Rock) 70 psi (483 kPa)
- 15.5R25 One Star (Radial) 75 psi (517 kPa)

Optional Tires - 10042/10054

- 17.5R25 One Star (Radial) 73 psi (503 kPa)

2. Check the wheel nut torque. Torque the wheel nuts to 450 lb-ft (610 Nm).

2.12.8 After Engine Service

Consult a qualified service agent (manufacturer's representative and/or service manual) for proper procedures before engine startup.

2.12.9 After Boom Service

1. Check wear pads.
2. Check chain tension, and adjust as required.
3. Apply grease to all lubrication points (grease fittings).

Note: *Refer to the appropriate Owners/Operators manual for the grease fitting locations.*

4. Check for proper operation by operating all boom functions through their full range of motion several times.

2.12.10 After Axle Service

1. Check the fluid levels in the axle and wheel ends.
2. Check the torque on the driveshaft flange yoke retaining strap bolts. Torque these bolts to 60 lb-ft (81 Nm).
3. Check the torque on the wheel nuts. Torque to 430-470 lb-ft (583-637 Nm).
4. Check and adjust the toe-in if required.
5. Apply grease to all lubrication points (grease fittings).

Note: *Refer to the appropriate Owner/Operators manual for the grease fitting locations.*

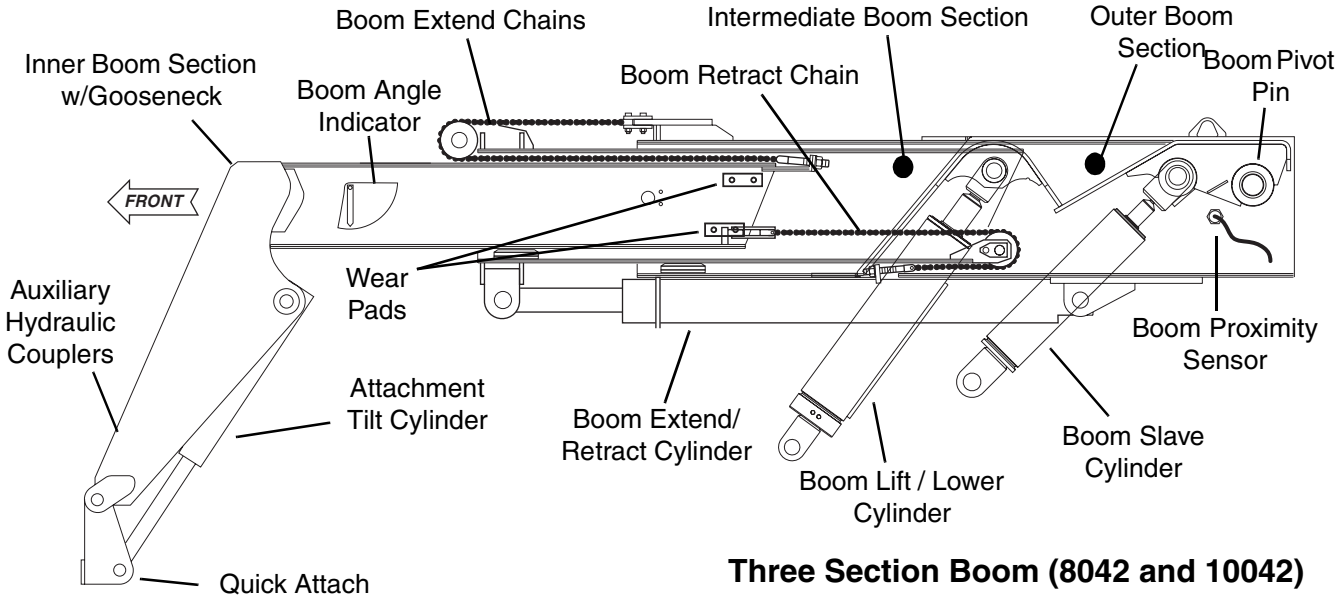
6. Refer to the axle manufacturer's maintenance manual for further information.

Section 3
Boom

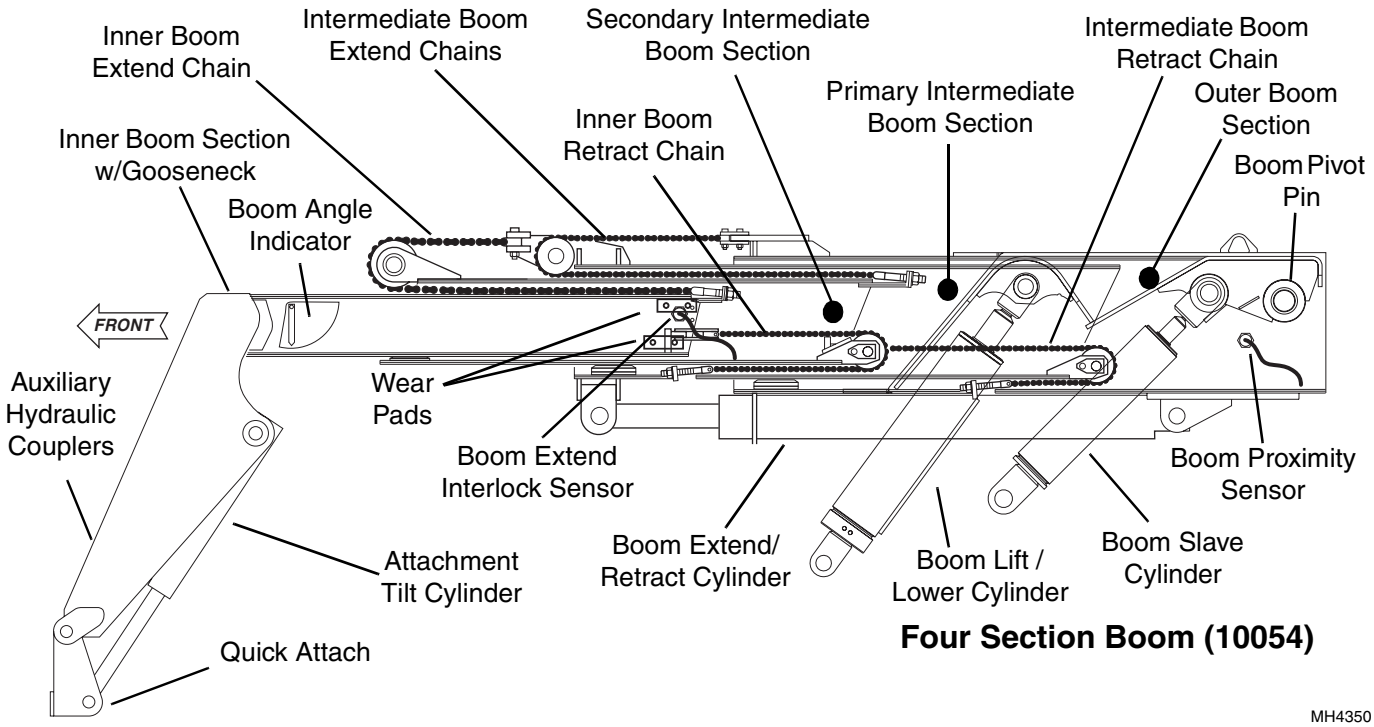
Contents

3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the major assemblies of the boom system. The following illustration identifies the components that are referred to throughout this section.



Three Section Boom (8042 and 10042)



Four Section Boom (10054)

MH4350

WARNING: **DO NOT** service the vehicle without following all safety precautions as outlined in the “Safety Practices” section of this manual. Failure to follow the safety practices may result in death or serious injury.

3.2 BOOM SYSTEM - THREE SECTION BOOMS (8042 AND 10042)

3.2.1 Boom System Description

The boom operates via an interchange among the electrical, hydraulic and mechanical systems. Components involved include the joystick, Attachment Tilt cylinder, Extend/Retract cylinder, Lift/Lower cylinder, Slave cylinders, electronic sensors, extend and retract chains, various pivots, supporting hardware and other components.

3.2.2 Boom System Operation

The three section boom assembly consists of inner, intermediate, and outer boom assemblies with double top boom extend chains and a single retract chain. Boom extension and retraction is accomplished via hydraulic power and chain movement.

As the Extend/Retract hydraulic cylinder, which is anchored at the rear of the intermediate boom and the rear of the outer boom, begins to extend, it forces the intermediate boom out of the outer boom.

The inner and outer booms are connected by extend and retract chains. These chains are routed around sheaves on the intermediate boom. As the intermediate boom is forced out, the extend chain pulls the inner boom out of the intermediate boom.

As hydraulic pressure is applied to the retract port on the Extend/Retract cylinder, the intermediate boom is pulled back into the outer boom, and the retract chain pulls the inner boom back into intermediate boom.

This mechanical linkage formed by the chains and supporting hardware extends and retracts the intermediate and inner booms at the same rate.

The outer boom does not extend or retract, but lifts and lowers via action of the Lift/Lower cylinder.

3.3 BOOM ASSEMBLY MAINTENANCE (8042 AND 10042)

The boom assembly consists of the inner, intermediate and outer booms and supporting hardware.

IMPORTANT: *Boom replacement must be completed in sequence, one boom section at a time, as described in these instructions. Replacement of two or more boom sections as a unit requires special considerations that are not covered in these instructions.*

IMPORTANT: *Before removing the inner boom, the carriage or any other attachment must be removed from the quick attach.*

The inner, intermediate and outer boom removal instructions must be completed in sequence. The inner boom must be removed before removing the intermediate boom. The inner boom and intermediate boom must be removed one at a time before removing the outer boom.

Before beginning, conduct a visual inspection of the vehicle, work area and task about to be undertaken. Read, understand and follow these instructions.

After servicing the boom, perform the following:

1. Check wear pads. (Refer to Model 8042 Legacy Owners/Operators Manual or Model 10042 Legacy Owners/Operators Manual.)
2. Check chain wear and tension adjustment. (Refer to Section 3.4.1, “Boom Chain Inspection,” and Section 3.4.3, “Boom Chain Tension Check.”)
3. Apply grease at all lubrication points (grease fittings). (Refer to Model 8042 Legacy Owners/Operators Manual or Model 10042 Legacy Owners/Operators Manual.)
4. Check for proper operation by operating all boom functions through their full range of motion several times.

3.3.1 Inner Boom Removal

1. Remove any attachment from the quick attach assembly. (Refer to Section 3.10.1, “Disconnecting from an Attachment.”)

Note: *If you are replacing the inner boom with a new inner boom, remove the quick attach from the inner boom. (Refer to Section 3.10.3, “Quick Attach Removal.”)*

> **WARNING:** Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

> **WARNING:** **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

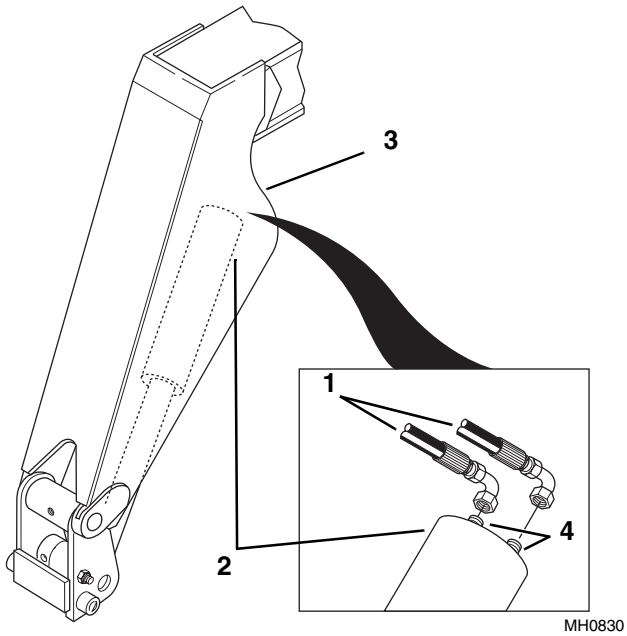
Note: *This procedure will require a clear space of approximately 16 feet at the front of the vehicle.*

1. Park the vehicle on a hard, level surface. Move the boom to a horizontal (level) position. Extend (or Retract) the boom until the boom is extended approximately 2 feet (610 mm). Move the quick attach to the horizontal position. Place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake and shut the engine OFF.
2. Return to the cab, fasten your seat belt and start the engine. Retract the boom slightly until slack is noticed in the extend chain. Shut the engine OFF.
3. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
4. Unlock and open the engine compartment cover. Allow the engine, transmission and hydraulic fluid to cool before proceeding.
5. Disconnect the battery negative (-) cable at the battery negative (-) terminal to prevent the engine from starting accidentally.
6. Move the Attachment Tilt joystick in both directions to relieve any trapped pressure in the Attachment Tilt system. If your vehicle is equipped with optional auxiliary hydraulics, move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.

> **WARNING:** Hydraulic fluid leaking under pressure can penetrate the skin, cause infection, gangrene, and death or serious personal injury. If injured, see a doctor immediately.
>
> Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any parts or component.

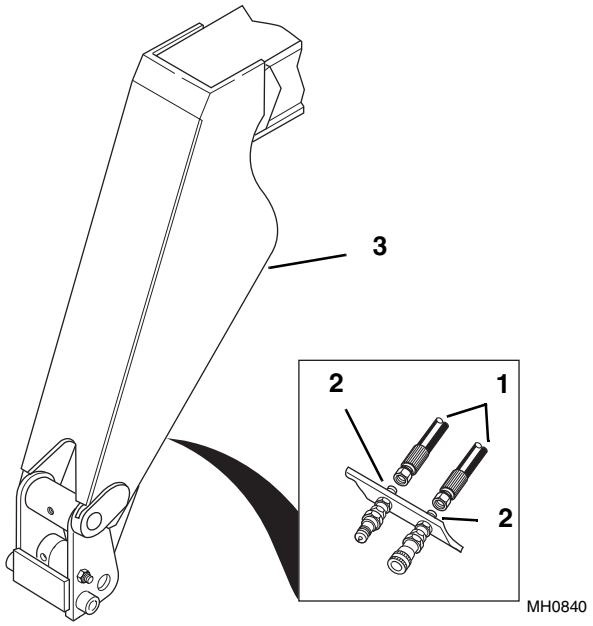
> **WARNING:** Wait for the hydraulic fluid to cool before servicing any hydraulic component. Hot hydraulic oil can cause severe burns.

7. Locate the two hoses (**1**) attached to the base of the Attachment Tilt cylinder (**2**) inside the gooseneck (**3**).
8. Label and remove the hoses (**1**) from the fittings (**4**) on the Attachment Tilt cylinder. Plug the hose ends and cap the fittings on the Attachment Tilt cylinder to prevent dirt and debris from entering the hydraulic system and/or cylinder.

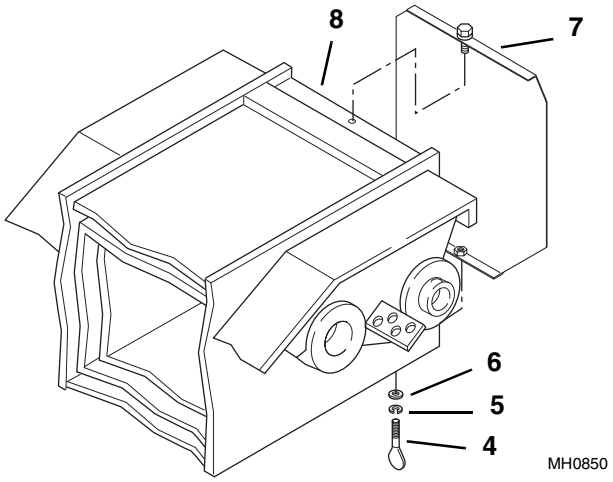


9. If your vehicle is equipped with optional auxiliary hydraulics, label and remove the two hoses (**1**) from the bulkhead fittings (**2**) inside the gooseneck (**3**). Plug the hose ends and cap the bulkhead fittings to prevent dirt and debris from entering the hydraulic system.

   If you are replacing the inner boom with a new inner boom: Remove the female coupler, male nipple and bulkhead fittings from the bulkhead plate inside the gooseneck.

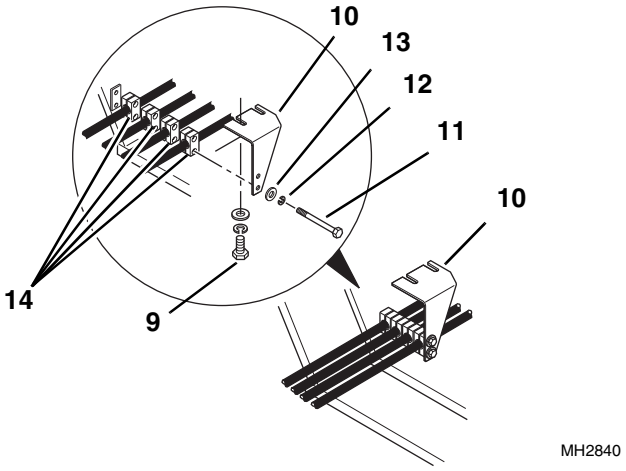


10. Remove the thumbscrew (**4**), lockwasher (**5**) and flat washer (**6**) holding the rear cover (**7**) to the rear of the outer boom (**8**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.

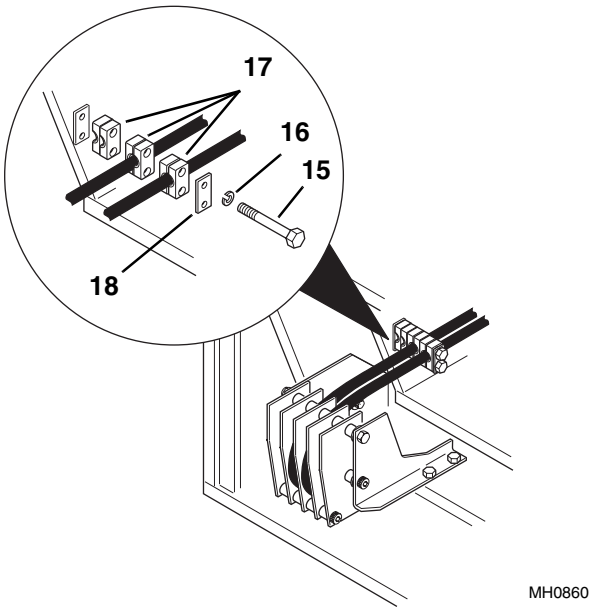


11. **With auxiliary hydraulics:** Inside the inner boom, loosen but **DO NOT** remove the two capscrews (**9**) securing the left side wear pad and hose clamp support bracket (**10**) to the top of the inner boom.

12. Remove the two capscrews (**11**), two lockwashers (**12**) and two flat washers (**13**) holding the stack clamps (**14**) and hose clamp support bracket (**10**) to the left side of the inner boom. Remove the clamps and the clamp support bracket from the inner boom.

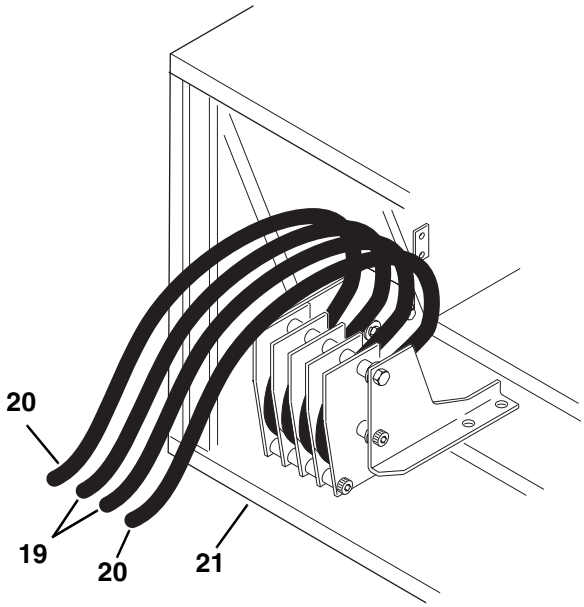


13. **Without optional auxiliary hydraulics:** Inside the inner boom, remove the two capscrews (**15**) and two lockwashers (**16**) holding the stack clamps (**17**) to the left side wall of the inner boom. Remove the clamp cover plate (**18**) and all the clamps.



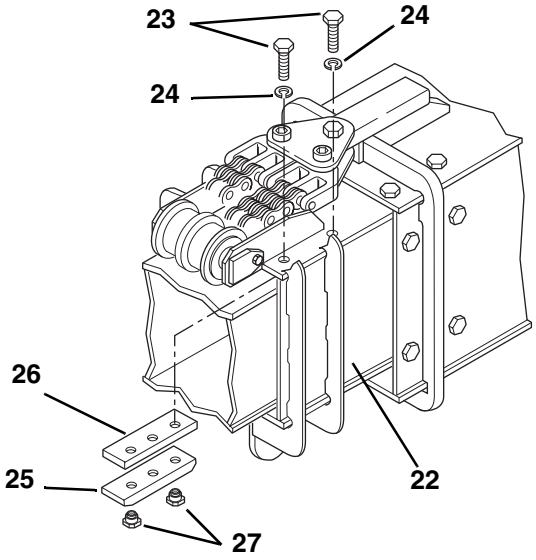
MH0860

14. Pull the free ends of the Attachment Tilt hoses (**19**) and (optional) auxiliary hydraulic hoses (**20**) from inside the inner boom and out the rear of the boom (**21**). Allow the hoses to hang from the rear of the boom.



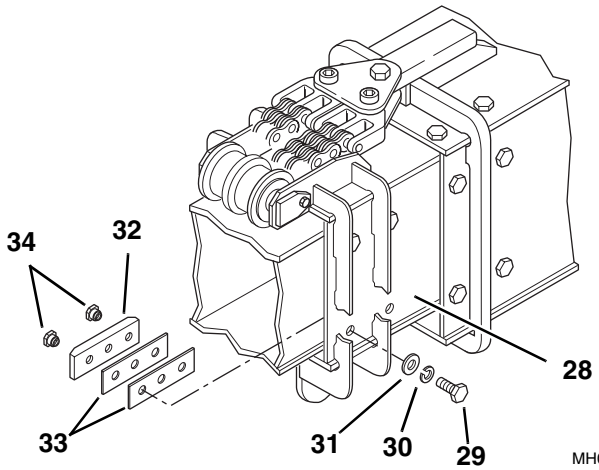
MH0870

15. At the front of the intermediate boom (**22**), remove the capscrews (**23**) and lockwashers (**24**) holding the top wear pads (**25**) and spacers (**26**) to the inside of the intermediate boom. Label the wear pads and spacers as “Top Left” and “Top Right” sides. Save the spacers, capscrews, lockwashers and wear pad inserts (**27**).



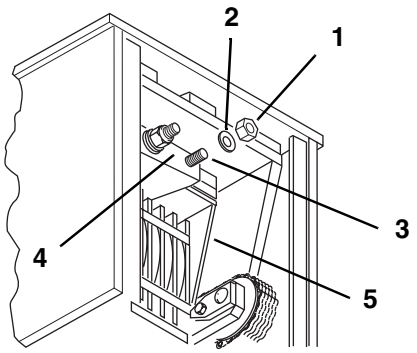
MH0890

16. At the front of the intermediate boom (**28**), remove the capscrews (**29**), lockwashers (**30**) and flat washers (**31**) holding the side wear pads (**32**) and shims (**33**) to the inside of the intermediate boom. Label the wear pads and shims as “Left Upper/Lower” and “Right Upper/Lower.” Save the shims, capscrews, flat washers, lockwashers and wear pad inserts (**34**).



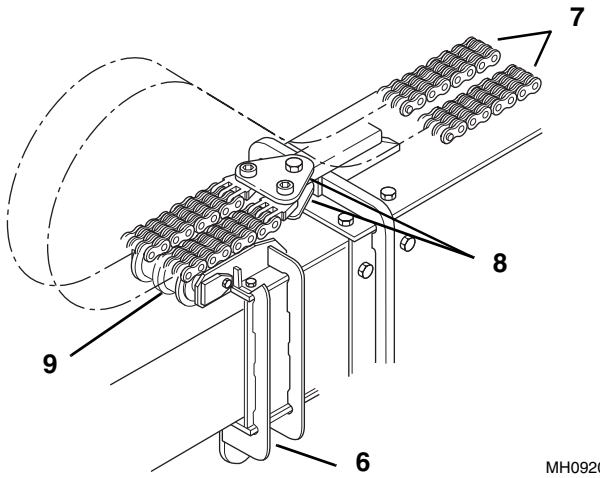
MH0900

17. At the rear of the boom, measure the amount of threads protruding beyond each elastic locknut (**1**) and record that measurement for reassembly. Remove the two elastic locknuts (**1**) and flat washers (**2**) holding both extend chain clevis' (**3**) to the anchor plate (**4**) on the inner boom (**5**). Save the flat washers and discard the elastic locknuts.



MH0911

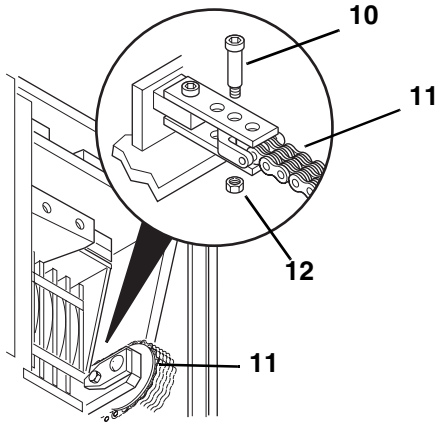
18. At the front of the intermediate boom (**6**), pull both extend chains (**7**) out from between the inner and intermediate boom sections. The extend chains can remain anchored between the yoke plates (**8**) on the outer boom. Loop both chains over the top of the chain sheave (**9**) and lay the chains on top of the outer boom.



MH0920

Note: *Record the location of the shoulder bolt (**10**) to ensure correct installation.*

19. At the rear of the boom, locate the retract chain (**11**) on the right side of the boom. In front of the retract chain sheave, locate the shoulder bolt (**10**) which holds the retract chain to the anchor plates on the inner boom. Remove the elastic locknut (**12**) from the shoulder bolt and remove the shoulder bolt. Save the shoulder bolt and discard the elastic locknut. Allow the retract chain to hang out the rear of the boom.



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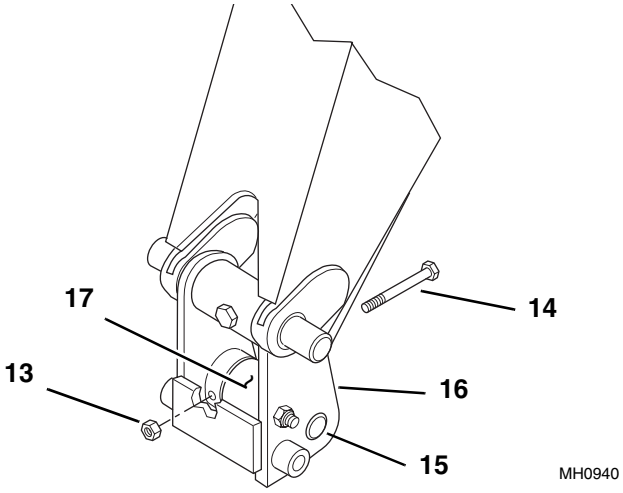
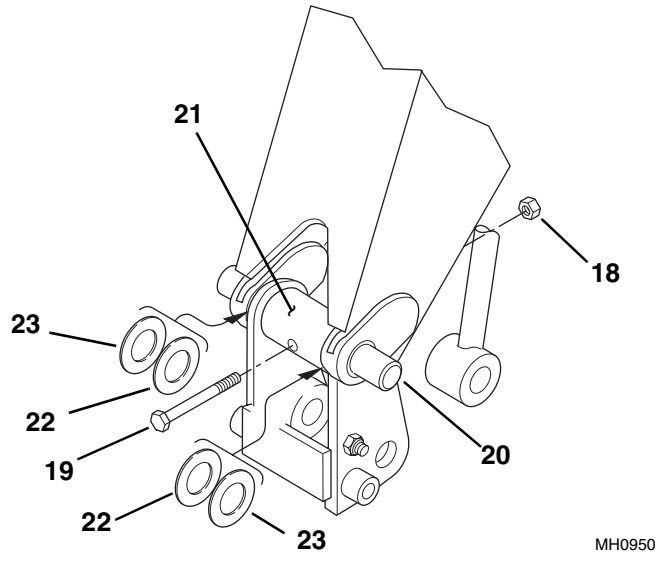
Note: *If replacing the inner boom assembly with a new inner boom, the quick attach assembly and the Attachment Tilt cylinder should be removed at this time.*

If the inner boom is not to be replaced, the quick attach assembly and Attachment Tilt cylinder can remain in place. Proceed to Step 29.

20. Remove the elastic locknut (**13**) and capscrew (**14**) holding the Attachment Tilt cylinder rod end pin (**15**) to the quick attach assembly (**16**). Save the capscrew and discard the elastic locknut.
21. Support the rod end of the Attachment Tilt cylinder (**17**). Use a brass punch and a rawhide hammer to remove the rod end pin (**15**) from the quick attach assembly.
22. Inspect the pin (**15**) for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged and if it cannot be repaired, the pin must be replaced.

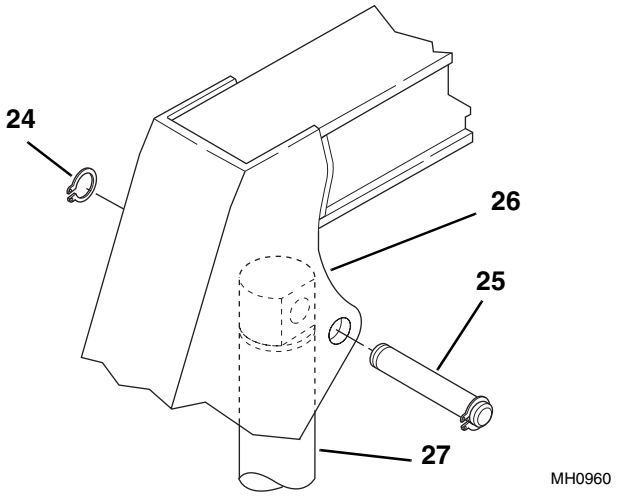


23. Remove the elastic locknut (**18**) and capscrew (**19**) holding the quick attach pivot pin (**20**) to the quick attach assembly (**21**). Save the capscrew and discard the elastic locknut. Place a support under the quick attach assembly to prevent it from dropping when the pivot pin is removed.
24. Use a brass punch and a rawhide hammer to remove the quick attach pivot pin (**20**) from the quick attach assembly and the bushings in the gooseneck. Record the location and quantity of the shim washers (**22** and **23**) as the pin is being removed. Save the washers (**22** and **23**) from each side of the quick attach.
25. Inspect the pin for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged and if it cannot be repaired, the pin must be replaced.



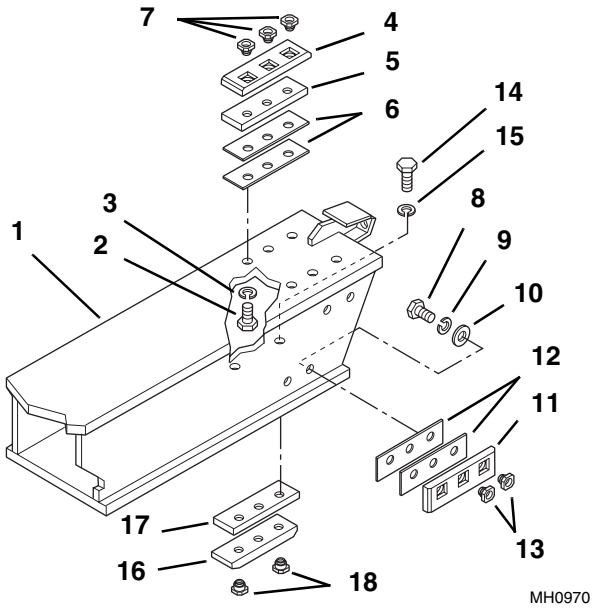
Note: *The Attachment Tilt cylinder is heavy. Use a hoist and sling to support the Attachment Tilt cylinder when the base end pin is removed.*

26. Remove the retaining ring (**24**) from one side of the base end pivot pin (**25**). Save the retaining ring. Use a brass punch and a rawhide hammer to remove the base end pivot pin from the inner boom gooseneck (**26**).
27. Inspect the pin for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged and if it cannot be repaired, the pin must be replaced.



28. Lower the Attachment Tilt cylinder (**27**) with the hoist and remove from the backside of the gooseneck. Place the Attachment Tilt cylinder on a clean, level surface.
29. Pull the inner boom straight out of the intermediate boom. Reposition the slings as needed so the inner boom balances when removed from the intermediate boom. Set the inner boom down on a hard, level surface. Support the boom as needed to prevent it from tipping over.

30. At the rear of the inner boom (**1**), remove the capscrews (**2**) and lockwashers (**3**) holding the top wear pads (**4**), spacers (**5**) and shims (**6**) to the top of the inner boom. Label the wear pads, spacers and shims as “Top Left” and “Top Right” sides. Save the spacers, shims, capscrews, lockwashers and wear pad inserts (**7**).
31. Remove the capscrews (**8**), lockwashers (**9**) and flat washers (**10**) holding the side wear pads (**11**) and shims (**12**) to the sides of the inner boom. Label the wear pads and shims as “Left Side Upper/Lower” and “Right Side Upper/Lower.” Save the shims, capscrews, lockwashers, flat washers and wear pad inserts (**13**).
32. Remove the capscrews (**14**) and lockwashers (**15**) holding the bottom wear pad (**16**) and spacer (**17**) to the bottom of the inner boom. Label the wear pad and spacer as “Bottom.” Save the spacer, capscrews, lockwashers and wear pad inserts (**18**).



33. Carefully lower the inner boom onto suitable supports or to the ground.

> **WARNING:** **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or serious personal injury.

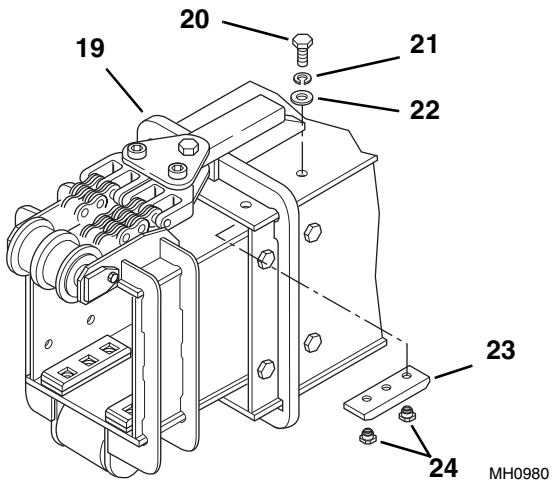
34. Inspect the boom and welds. Consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
35. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the inner boom removed. Replace if damaged.
36. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

3.3.2 Intermediate Boom Removal

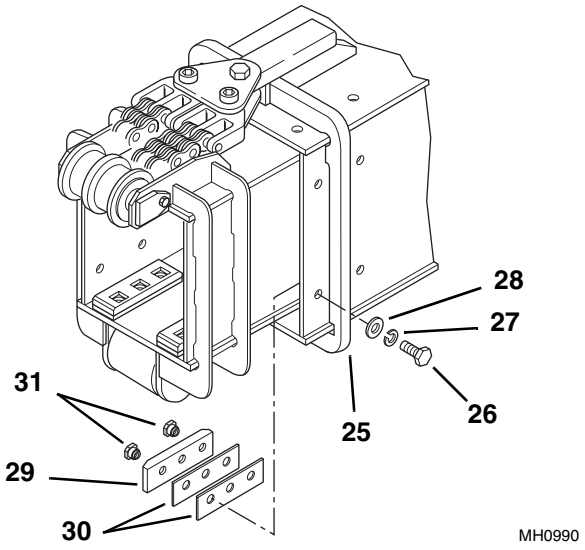
WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

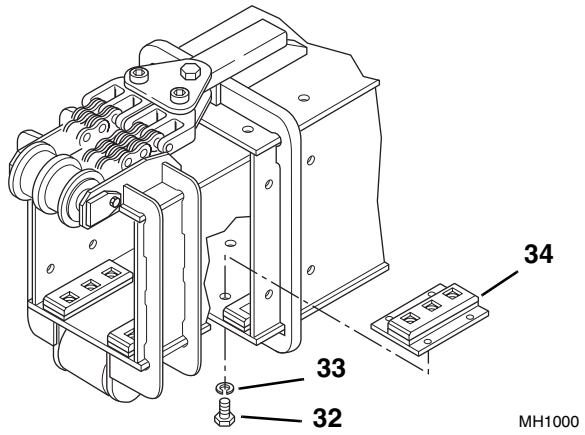
1. Remove the inner boom as described in Section 3.3.1, “Inner Boom Removal.”
2. At the front of the outer boom (**19**), remove the capscrews (**20**), lockwashers (**21**) and flat washers (**22**) holding the top wear pads (**23**) to the inside of the outer boom. Label the wear pads as “Top Left” and “Top Right” sides. Save the capscrews, lockwashers, flat washers and wear pad inserts (**24**).



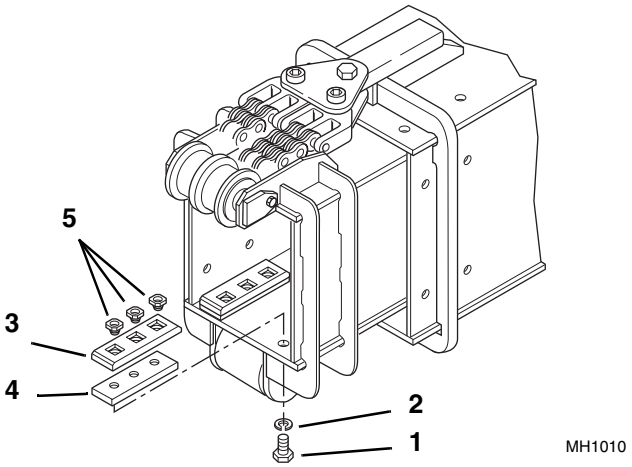
3. At the front of the outer boom (**25**), remove the capscrews (**26**), lockwashers (**27**) and flat washers (**28**) holding the side wear pads (**29**) and shims (**30**) to the inside of the outer boom. Label the wear pads as “Left Side Upper/Lower” and “Right Side Upper/Lower.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**31**).



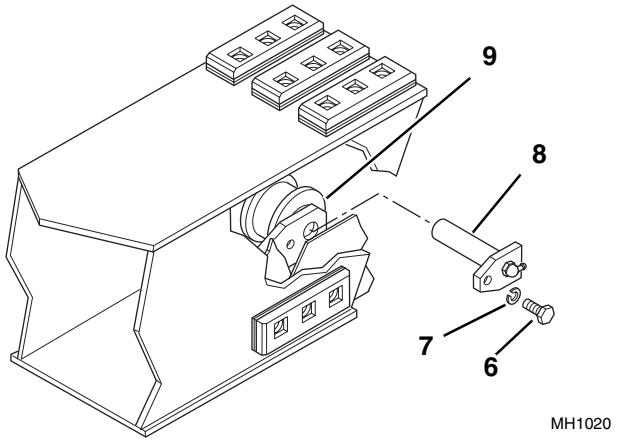
4. Remove the capscrews (**32**) and lockwashers (**33**) holding the center wear pad spacer mount (**34**) to the front of the outer boom. Save the capscrews and the lockwashers.



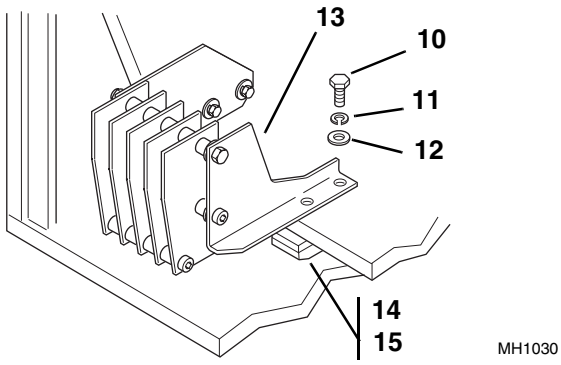
5. **If replacing the intermediate boom with a new boom section:** Remove the lower wear pads at the front of the boom. Remove the capscrews (**1**) and lockwashers (**2**) holding the lower wear pads (**3**) and spacers (**4**) to the inside of the boom. Label the wear pads and spacers as “Left” or “Right” sides. Save the capscrews, lockwashers, spacers and wear pad inserts (**5**).



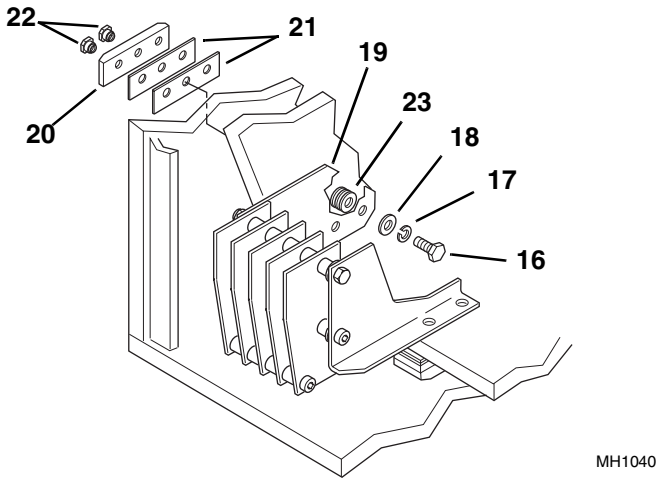
6. At the rear of the intermediate boom, remove the capscrew (**6**) and lockwasher (**7**) holding the retract chain sheave pin (**8**) to the mounting plate inside the boom.
7. Remove the retract chain sheave pin (**8**) from the mount and the retract chain sheave (**9**). Remove the retract chain sheave from the intermediate boom.
8. Inspect the bushings inside the sheave. Replace the bushings if there are any signs of wear. Inspect the pin for wear or damage. Replace the pin if showing signs of wear.



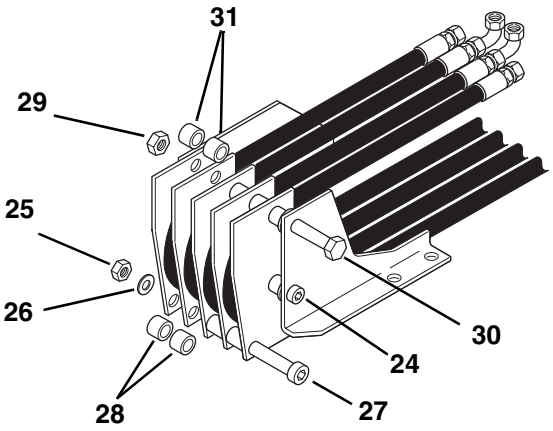
9. At the rear of the intermediate boom, remove the capscrews (**10**), lockwashers (**11**) and flat washers (**12**) holding the hose reel assembly (**13**), lower wear pad (**14**) and spacer (**15**) to the lower plate on the intermediate boom. Reassemble the capscrews, lockwashers and flat washers to hold the lower wear pad in place for intermediate boom removal.



10. Remove the capscrews (**16**), lockwashers (**17**) and flat washers (**18**) holding the hose reel side plate (**19**), lower left side wear pad (**20**) and shims (**21**) to the side of the intermediate boom. Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**22**). Watch for the six washers (**23**) to fall out from between the side plate of the hose reel assembly and the side plate of the intermediate boom.

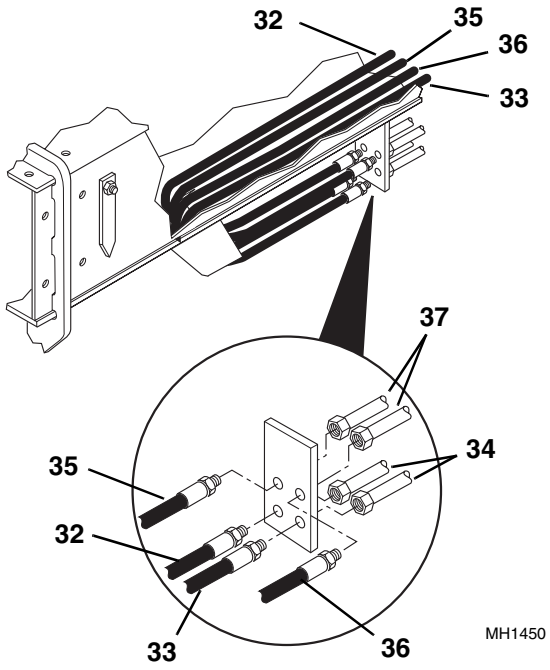


11. Pull the hose reel, with hoses, out the back of the intermediate boom. Allow the hose reel assembly to slide down the hoses and rest it on the floor.
12. Label and remove the hoses from the hose reel. The center bolt (**24**) can remain in place to hold the hose reel and side plates together.
    a. Remove the elastic locknut (**25**) and flat washer (**26**) from the lower retaining shoulder bolt (**27**). While pulling the shoulder bolt out, catch the spacers (**28**) from between the plates as the bolt is removed. Pull the bolt out far enough to remove the hoses from the hose reel.
    b. After the hoses are removed from behind the lower retaining bolt, insert the shoulder bolt (**27**) through the plates, inserting the spacers (**28**) between the plates as the bolt is inserted. Reassemble the flat washer (**26**) and elastic locknut (**25**) to hold the shoulder bolt in place. **DO NOT** fully tighten at this time.
    c. Remove the elastic locknut (**29**) from the upper retaining capscrew (**30**). While pulling the capscrew out, catch the spacers (**31**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to remove the hoses from the hose reel.
    d. After the hoses are removed, insert the capscrew (**30**) through the plates, inserting the spacers (**31**) between the plates as the capscrew is inserted. Reassemble the elastic locknut (**29**) to hold the capscrew in place.



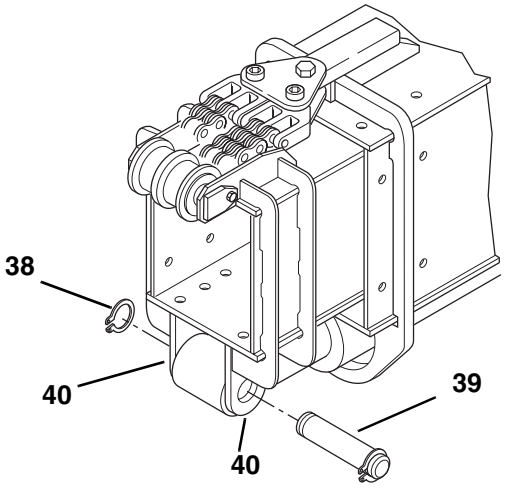
MH1490

13. **With auxiliary hydraulics:** Label and remove the auxiliary hoses (**32** and **33**) from the bottom tube assemblies (**34**) at the mounting plate. Cap the hose ends.
14. **Without auxiliary hydraulics:** At the front of the outer boom, label and remove the Attachment Tilt hoses (**35** and **36**) from the top tube assemblies (**37**) at the mounting plate. Cap the hose ends.



MH1450

15. Pull the hose ends out from between the intermediate boom and the outer boom and out the rear of the boom.
16. Support the front of the Extend/Retract cylinder.
17. Remove the retaining ring (**38**) from one side of the Extend/Retract cylinder rod end mounting pin (**39**). Use a brass punch and a rawhide hammer to remove the rod end pin from the mounting ears (**40**) on the intermediate boom.
18. Inspect the pin (**39**) for wear or damage. Use fine emery cloth to repair minor nicks or corrosion. If the pin is damaged, replace it. Save the retaining ring.

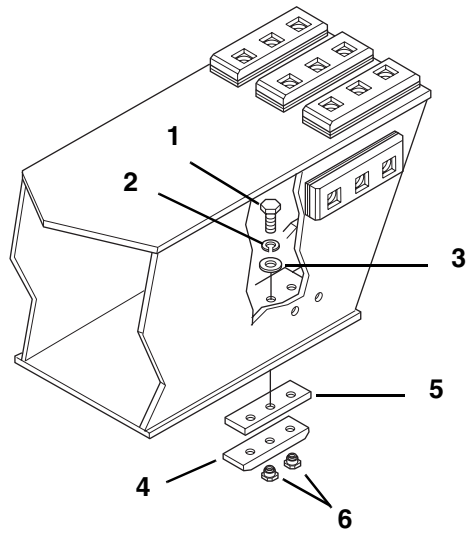


MH1050

19. Pull the intermediate boom straight out of the outer boom. Reposition the slings as needed so the intermediate boom balances when removed from the outer boom. Set the intermediate boom down on blocks on a hard, level surface.

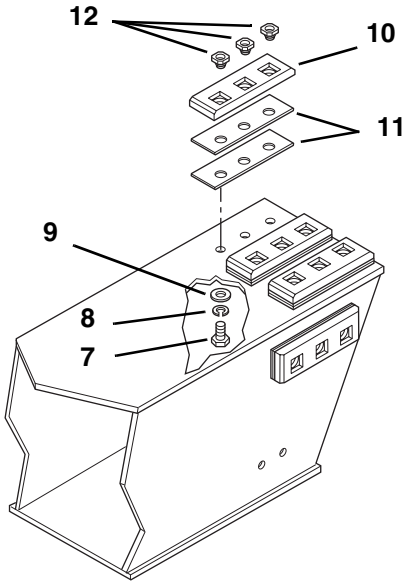
> WARNING: **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or serious personal injury.

20. Inspect the boom and welds. Contact the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
21. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)
22. Inspect hoses, hardware, mounting points, chains and other components visible with the intermediate boom removed. Replace if damaged.
23. If you are replacing the intermediate boom with a new boom section, the following items need to be removed from the intermediate boom:
    a. Remove the capscrews (**1**), lockwashers (**2**) and flat washers (**3**) holding the bottom wear pad (**4**) and spacer (**5**) to the intermediate boom. Label the wear pad and spacer as “Bottom.” Save the capscrews, lockwashers, flat washers, spacer and wear pad inserts (**6**).



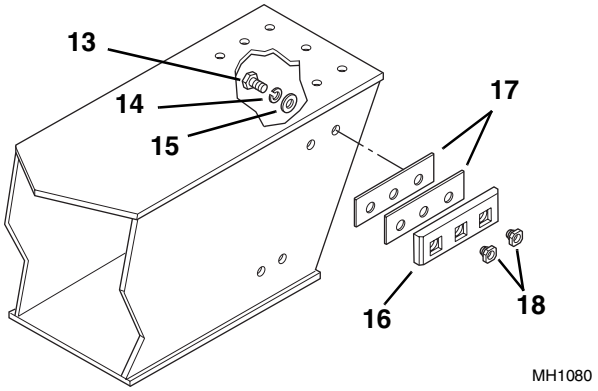
MH1060

    b. Remove the capscrews (**7**), lockwashers (**8**) and flat washers (**9**) holding the upper wear pads (**10**) and shims (**11**) to the intermediate boom. Label the wear pads and shims as “Top Left,” “Top Center” or “Top Right.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**12**).



MH1070

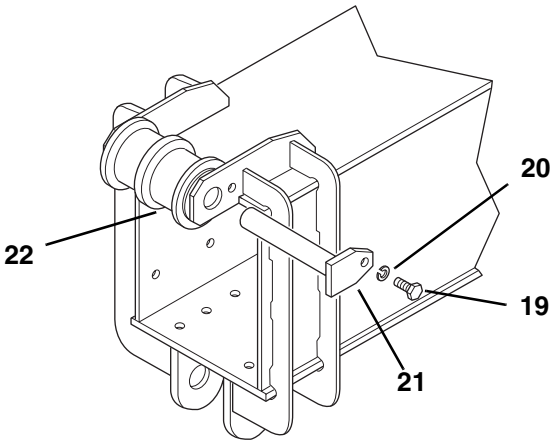
    c. Remove the capscrews (**13**), lockwashers (**14**) and flat washers (**15**) holding the side wear pads (**16**) and shims (**17**) to the intermediate boom. Label the wear pads and shims as “Left Side Top” and “Right Side Top/Bottom.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**18**).



MH1080

d. At the front of the intermediate boom, remove the capscrew (**19**) and lockwasher (**20**) holding the extend chain sheave pin (**21**) to the mounting ears on the intermediate boom. Remove the pin from the mounting ears and the extend chain sheave (**22**). Remove the extend chain sheave and inspect the condition of the sheave bushings. Replace the bushings if showing any signs of wear.

e. Inspect the pin (**21**), and replace it pin if there are any signs of wear.



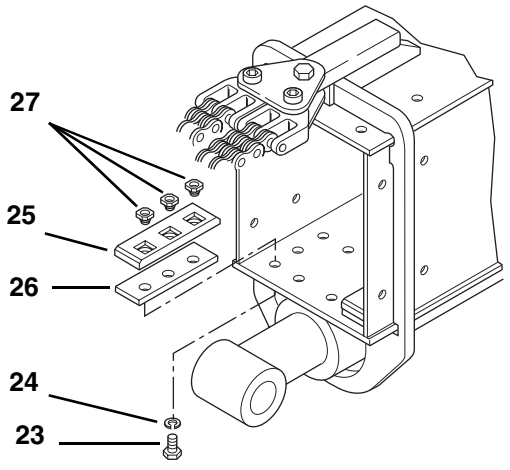
MH1090

3.3.3 Outer Boom Removal

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

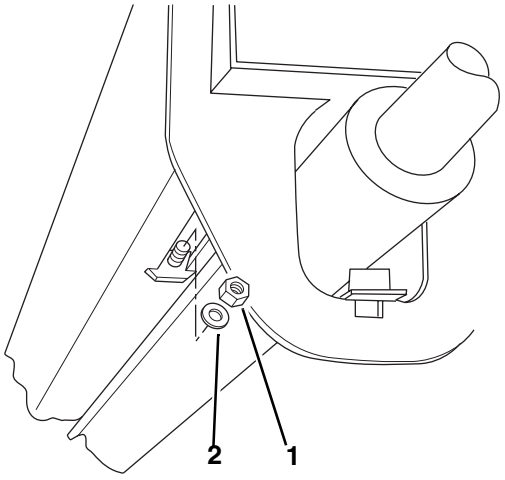
WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

1. Remove both the inner boom and intermediate boom as described in Section 3.3.1, “Inner Boom Removal,” and Section 3.3.2, “Intermediate Boom Removal.”
2. Use a suitable overhead lifting device and sling attached to the Lift/Lower cylinder; remove slack from the sling.
3. Securely block the outer boom section.
4. At the front of the outer boom, remove the capscrews (**23**) and lockwashers (**24**) holding the wear pads (**25**) and spacers (**26**) to the inside of the outer boom. Label the wear pads and spacers as “Lower Left” or “Lower Right.” Save the capscrews, lockwashers, spacers and wear pad inserts (**27**).



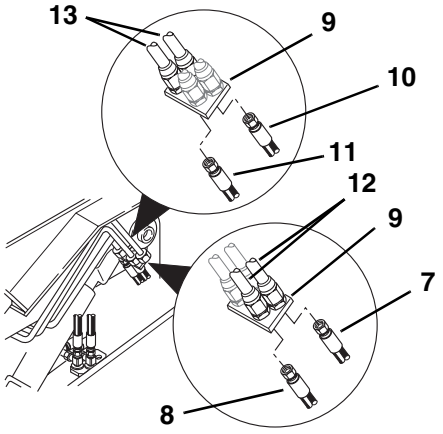
MH1100

5. At the underside of the outer boom, locate the retract chain locknut (**1**). Measure the amount of threads protruding beyond the elastic locknut and record that measurement for reassembly of the chain. Remove the elastic locknut and the flat washer (**2**). Save the flat washer and discard the locknut.



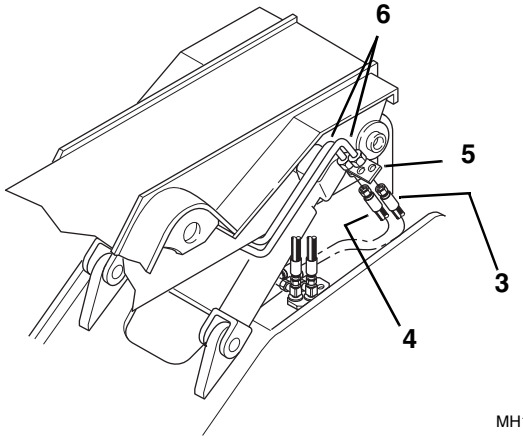
MH1110

6. Remove the retract chain by pulling it out the rear of the boom. Place the retract chain on a clean surface.
7. **With auxiliary hydraulics:** At the rear left side of the outer boom, label and remove the (outer) auxiliary hose for the female coupler (**7**) and the (inner) hose (**8**) for the male nipple from the bulkhead fittings on the mounting plate (**9**).
8. Label and remove the Attachment Tilt retract (outer) hose (**9**) and the extend (inner) hose (**11**) from the bulkhead fittings on the mounting plate (**9**). Plug the hose ends and cap the bulkhead fittings.
9. Remove the auxiliary tube assemblies (**12**) and the attachment tube assemblies (**13**) from the bulkhead fittings.



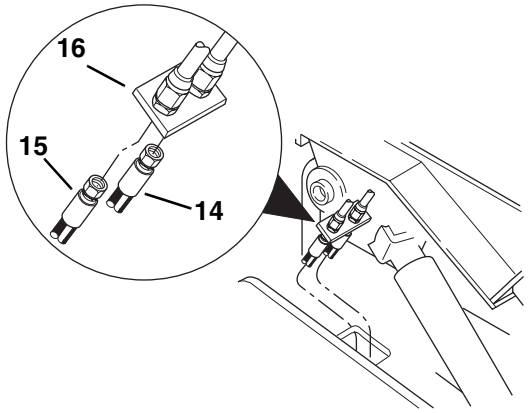
MH1130

10. **Without auxiliary hydraulics:** Label and remove the Attachment Tilt retract (outer) hose (**3**) and the extend (inner) hose (**4**) from the bulkhead fittings on the mounting plate (**5**). Plug the hose ends and cap the bulkhead fittings. Remove the Attachment Tilt tubes (**6**) from the bulkhead fittings.



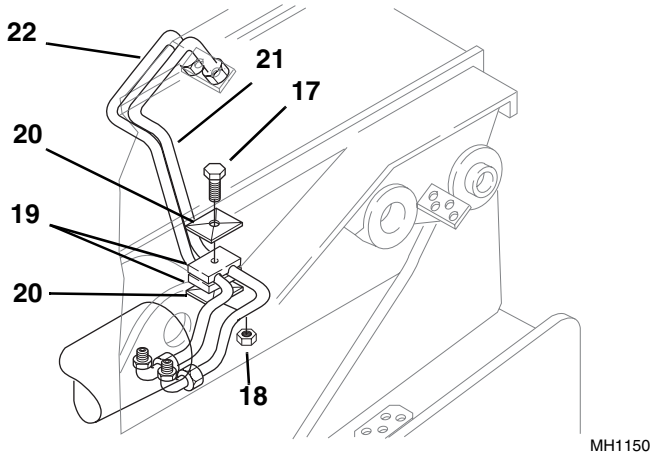
MH1120

11. At the rear right side of the outer boom, label and remove the boom extend hose (**14**) and retract hose (**15**) from the bulkhead fittings on the mounting plate (**16**). Plug the hose ends and cap the bulkhead fittings.

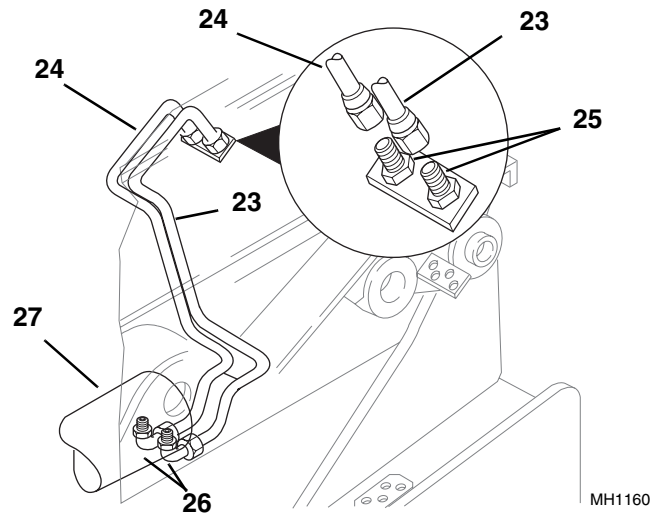


MH1140

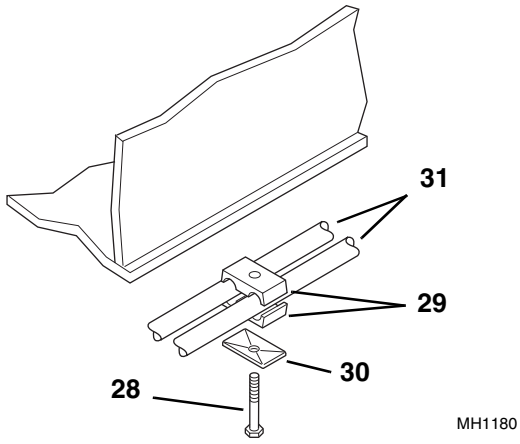
12. Remove the capscrew (**17**) and elastic locknut (**18**) holding the tube clamps (**19**) and clamp covers (**20**) to the extend (**21**) and retract (**22**) tubes under the boom. Discard the elastic locknut and retain the capscrew, covers and clamps.



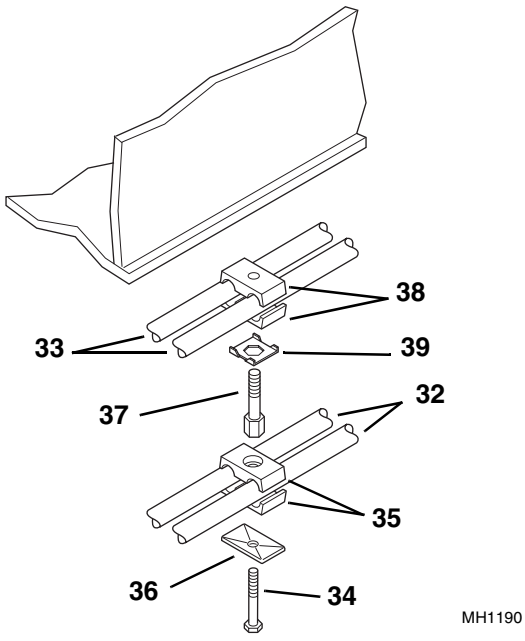
13. At the rear right side of the outer boom, label and remove the extend tube (**23**) and retract tube (**24**) from the bulkhead fittings (**25**). Plug the tube ends and cap the bulkhead fittings.
14. Remove the extend tube (**23**) and retract tube (**24**) from the 90° elbow fittings (**26**) on the rear of the Extend/Retract cylinder (**27**). Plug the tube ends and cap the 90° elbows.



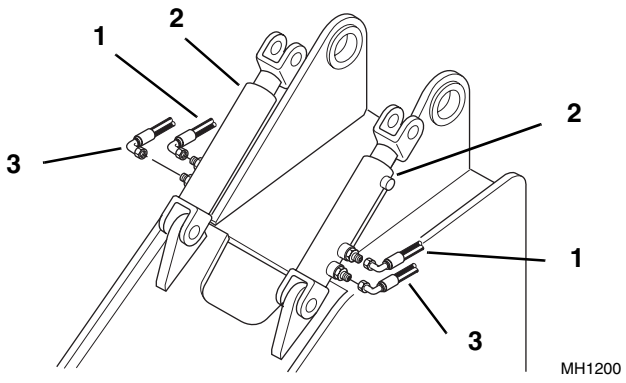
15. **Without auxiliary hydraulics:** Label the Attachment Tilt tube assemblies located under the boom. Remove the capscrews (**28**) holding the tube clamps (**29**), clamp covers (**30**) and Attachment Tilt tubes (**31**) to the underside of the outer boom. Save the capscrews, clamps and clamp covers. Remove the tubes from the boom.
16. Inspect the tubes (**31**) for kinks or crushed areas. If any kinks or crushed areas exist, replace the damaged tube or tubes.



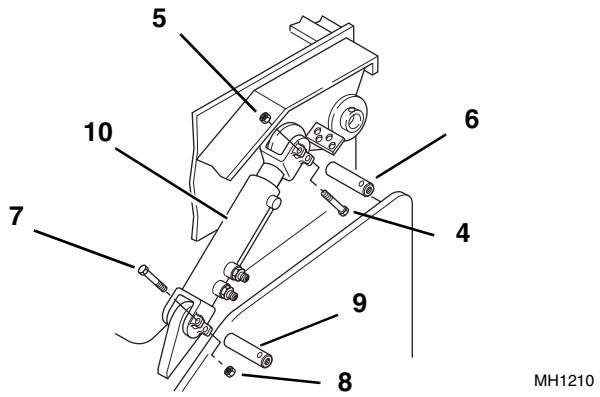
17. **Without auxiliary hydraulics:** Label the auxiliary tube assemblies (**32**) located under the Attachment Tilt tubes (**33**). Remove the capscrews (**34**) holding the tube clamps (**35**) and clamp covers (**36**) to the Attachment Tilt tube clamp stacking bolt (**37**) under the outer boom. Save the capscrews, clamps and clamp covers. Remove the tubes from the boom.
18. Label the Attachment Tilt tube assemblies (**33**) located under the boom. Remove the stacking bolts (**37**) holding the tube clamps (**38**), locking plates (**39**) and Attachment Tilt tubes (**33**) to the underside of the outer boom. Save the stacking bolts, clamps and locking plates. Remove the tubes from the boom.
19. Inspect all tubes (**32** and **33**) for kinks or crushed areas. If any kinks or crushed areas exist, replace the damaged tube or tubes.



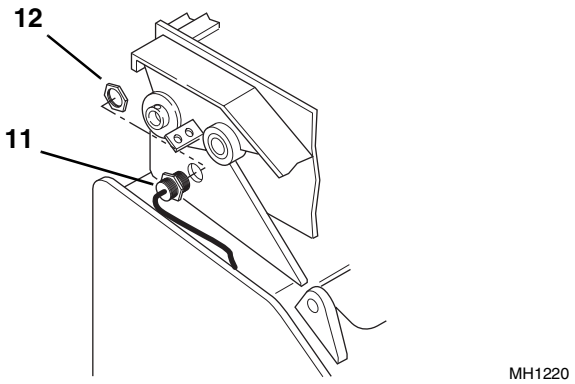
20. Label and remove the retract hoses (**1**) from the straight connectors on both Slave cylinders (**2**).
21. Label and remove the extend hoses (**3**) from the straight connectors on both Slave cylinders (**2**). Plug the hose ends and cap the straight connectors on the Slave cylinders.



22. Remove the capscrew (**1**) and elastic locknut (**2**) holding the upper Slave cylinder pivot pin (**3**) to the outer boom. Use a hoist and a sling to hold the Slave cylinder in position. Remove the pivot pin from the pin mount by pulling the pin out. It may be necessary to use an appropriate puller threaded into the pivot pin to remove the pin. Discard the elastic locknut and retain the capscrew.
23. Remove the capscrew (**7**) and elastic locknut (**8**) holding the lower Slave cylinder pivot pin (**9**) to the mounting ear on the frame. Use a brass punch and a rawhide hammer to remove the lower pivot pin from the mounting ear. Discard the elastic locknut and retain the capscrew.
24. Inspect the pivot pins (**9**) for nicks or damage. If the pins are damaged, they must be replaced.
25. Use the hoist to remove the Slave cylinder (**10**) from the vehicle. Place the Slave cylinder on a clean, flat surface.
26. Repeat Steps 22 thru 25 to remove the other Slave cylinder.

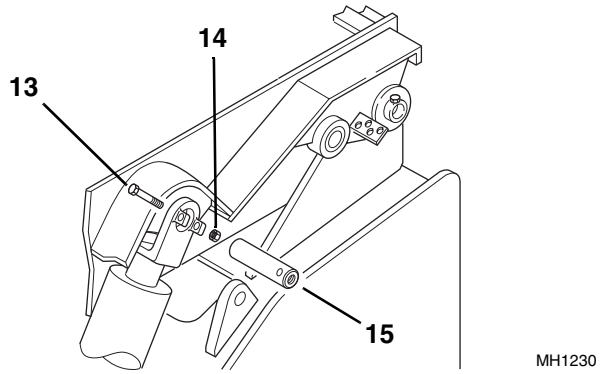


27. On the right side boom pivot mounting plate, locate the boom proximity sensor (**11**). Remove the nut (**12**) on the inside of the mounting plate. Remove the boom proximity sensor from the outside of the plate and allow the sensor to rest on top of the frame, next to the mounting plate. The sensor can remain connected to the harness.

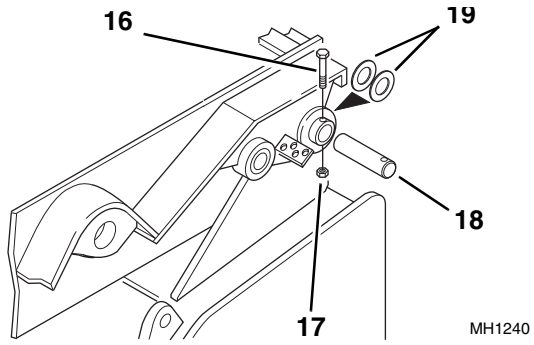


28. Remove the capscrew (**13**) and elastic locknut (**14**) holding the upper Lift/Lower cylinder pivot pin (**15**) to the outer boom. Securely block the Lift/Lower cylinder in position. Remove the pivot pin from the pin mount by pulling the pin out. It may be necessary to use an appropriate puller threaded into the pivot pin to remove the pin. Discard the elastic locknut and retain the capscrew.

29. Inspect the pivot pin (**15**) for nicks or damage. If the pin is damaged, it must be replaced.
30. Repeat Steps 28 and 29 to remove the other Lift/ Lower cylinder.



31. Remove the capscrews (**16**) and elastic locknuts (**17**) holding the boom pivot pins (**18**) to the frame. Use a brass punch and a rawhide hammer to remove the pivot pins from the frame. While removing the pins, note the location and quantity of shims (**19**) between the outer boom and frame.



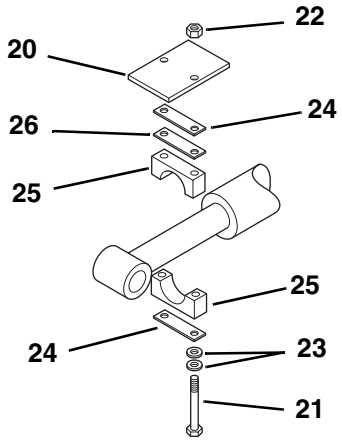
32. Use the hoist to remove the outer boom from the frame. Position the outer boom on a hard, flat surface. Block the boom as required to allow removal of the Extend/Retract cylinder from the underside of the boom.
33. **This step is for Model 10042 S/N 13198 thru 18405 Only:**

Note: *On Model 10042 S/N 18406 & After, the stop plate is an internal component of the extend/retract cylinder.*

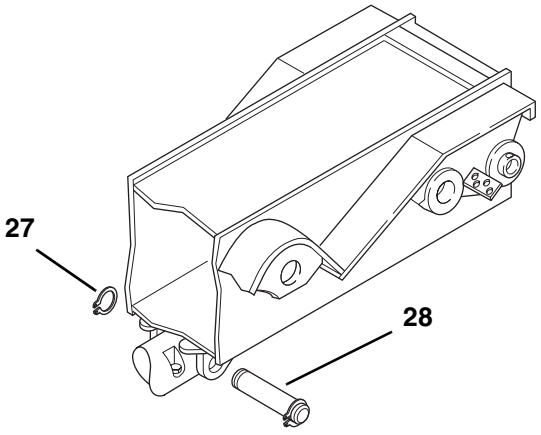
a. Remove the boom stop plate (**20**) from the rod of the Extend/Retract cylinder.

b. Remove the capscrews (**21**), elastic locknuts (**22**) and flat washers (**23**) holding the stop plate (**20**), cover plates (**24**), clamp (**25**) and safety plate (**26**) to the Extend/Retract cylinder rod.

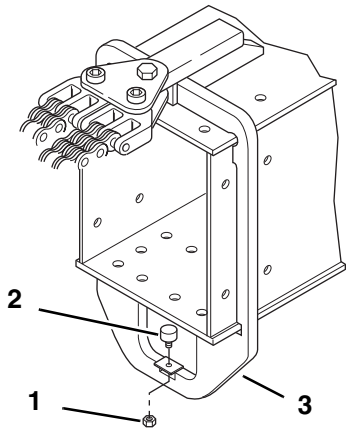
c. Discard the elastic locknuts and retain the capscrews, flat washers, cover plates, clamp, safety plate and stop plate.



34. Use a hoist and slings to support the Extend/Retract cylinder. At the base end of the cylinder, remove a retaining ring (**27**) from one side of the cylinder base end pin (**28**). Use a brass punch and a rawhide hammer to remove the base end pin from the mounting ears on the outer boom.
35. Inspect the pin (**28**) for damage. If the pin is damaged, it should be replaced. Retain the retaining rings for reassembly.
36. Lower the base end of the Extend/Retract cylinder and remove the rod end of the cylinder from the retainer at the front of the boom. Place the Extend/ Retract cylinder on a clean, flat surface.

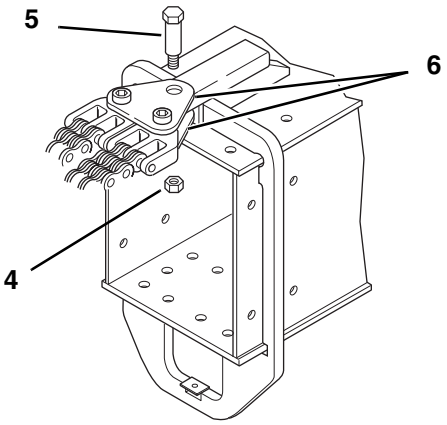


37. At the front of the outer boom, remove the elastic locknut (**1**) holding the rubber bumper (**2**) to the Extend/Retract cylinder retainer (**3**). Discard the elastic locknut.
38. Inspect the rubber bumper (**2**). If it is in good condition, the rubber bumper can be reused. If the rubber bumper is showing signs of cracking or deterioration, it should be replaced.



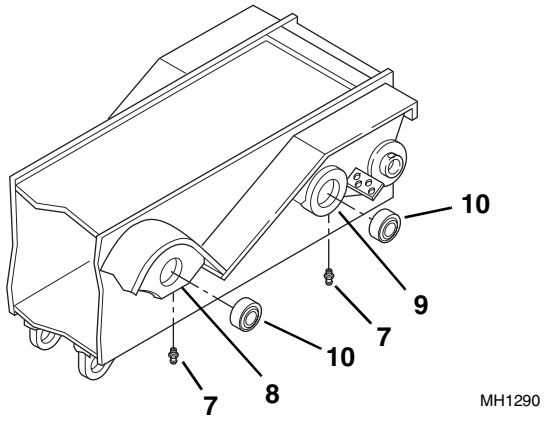
MH1270

39. Remove the elastic locknut (**4**) and shoulder bolt (**5**) holding the two yoke plates (**6**) to the mount at the front of the outer boom. Retain the shoulder bolt and discard the elastic locknut.
40. Inspect the yoke plates (**6**) for wear or distortion. If any wear or distortion is detected, both plates must be replaced. If no wear is detected, the plates can remain assembled to the extend chain clevis.



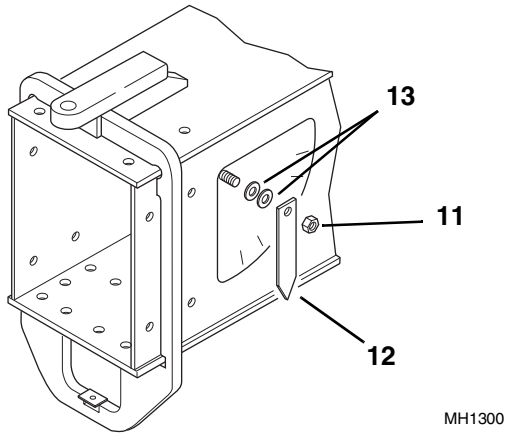
MH1280

41. Remove the grease fittings (**7**) from the Lift/Lower cylinder mounts (**8**) and the Slave cylinder mounts (**9**) on the outer boom. Save the grease fittings for reassembly.
42. Remove the self-aligning bearings (**10**) from the Lift/Lower cylinder mounts (**8**) and the Slave cylinder mounts (**9**).
43. Inspect the bearings (**10**). If the bearing rotates freely inside the outer race, the bearing can be reused.



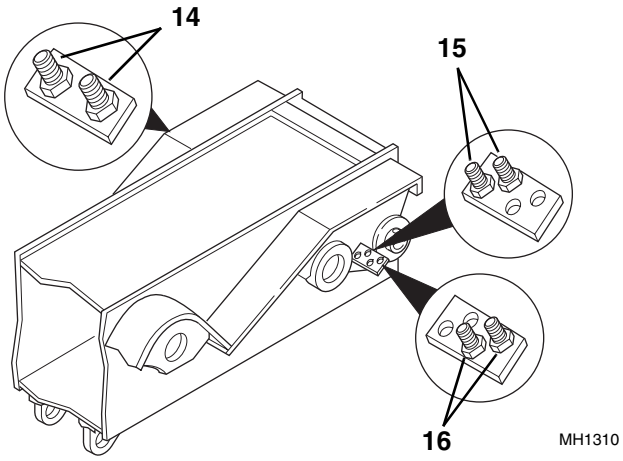
MH1290

44. On the left side of the outer boom, remove the locknut (**11**), angle indicator (**12**) and flat washers (**13**) from the weld stud. Save the angle indicator and all the hardware for reassembly.



MH1300

45. Remove the extend and retract bulkhead fittings (**14**) from the mounting plate on the right side of the outer boom assembly.
46. Remove the Attachment Tilt bulkhead fittings (**15**) from the mounting plate on the left side of the outer boom assembly.
47. If equipped with optional auxiliary hydraulics, remove the auxiliary hydraulic bulkhead fittings (**16**).
48. Inspect all fittings (**14**, **15** and **16**) for damage. If the fittings or threads are damaged, the fittings should be replaced.



49. Inspect the boom and welds. Contact the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
50. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the outer boom removed. Replace if damaged.
51. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

3.3.4 Outer Boom Installation

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

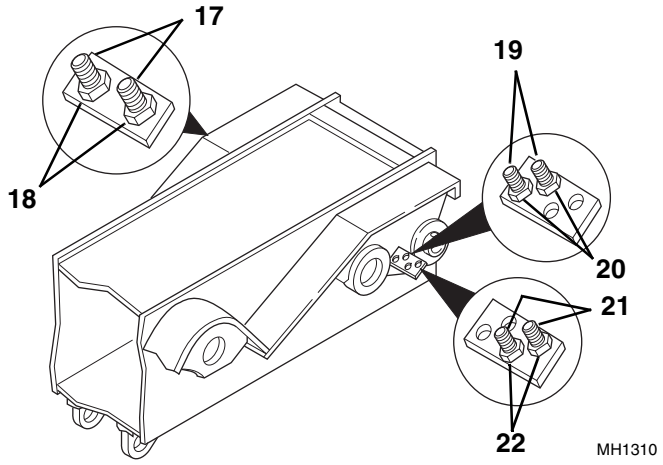
WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

IMPORTANT: *Light lubrication of the boom wear surfaces with a rust inhibitor/lubricant such as LPS 3 or equivalent is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended in salt air climates and when the vehicle is stored, to help prevent rusting.*

1. On the rear of the boom, assemble the extend and retract bulkhead fittings (**17**) to the mounting plate on the right side. Insert the fittings from the bottom up and secure in place with the bulkhead fitting nuts (**18**) on the top side. Tighten securely.

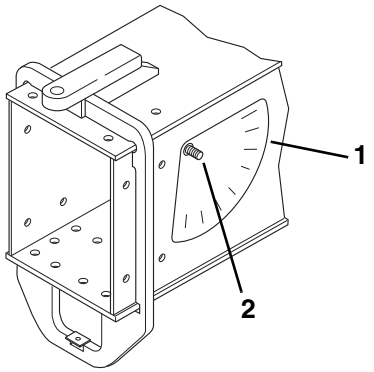
IMPORTANT: *Keep the caps on the threaded ends of the fittings to protect the threads from damage and to keep dirt and debris out of the fittings.*

2. On the rear of the boom, assemble the Attachment Tilt bulkhead fittings (**19**) to the mounting plate on the left side. Insert the fittings from the bottom up into the set of holes closest to the boom and secure in place with the bulkhead fitting nuts (**20**) on the top side. Tighten securely.
3. If equipped with optional auxiliary hydraulics, assemble the auxiliary hydraulic bulkhead fittings (**21**) to the mounting plate on the left side. Insert the fittings from the bottom up into the outer set of holes and secure in place with the bulkhead fitting nuts (**22**) on the top side. Tighten securely.



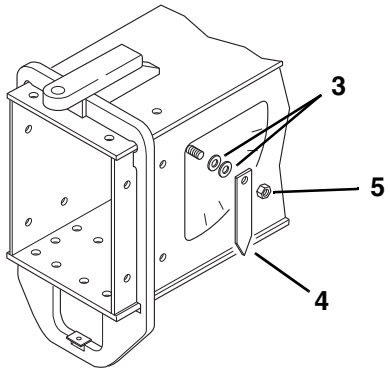
Note: *If you are assembling a new outer boom assembly, continue with Step 4. If reassembling the existing boom assembly, go to Step 5.*

4. Assemble a new angle indicator decal (**1**) to the left side of the boom assembly. Place the hole in the decal around the weld stud (**2**) and line up the upper edge of the decal parallel with the top edge of the boom assembly.



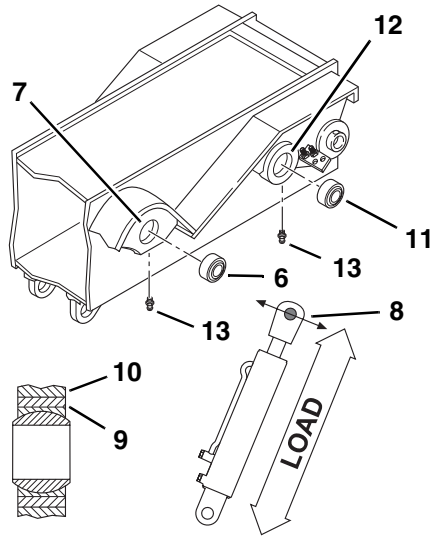
MH1320

5. Place the two flat washers (**3**) and the angle indicator (**4**) onto the weld stud. Secure in place with the locknut (**5**). After tightening the locknut, the angle indicator must pivot freely on the weld stud. If the angle indicator binds, loosen the locknut slightly. Recheck to be sure the angle indicator pivots freely.



MH1300

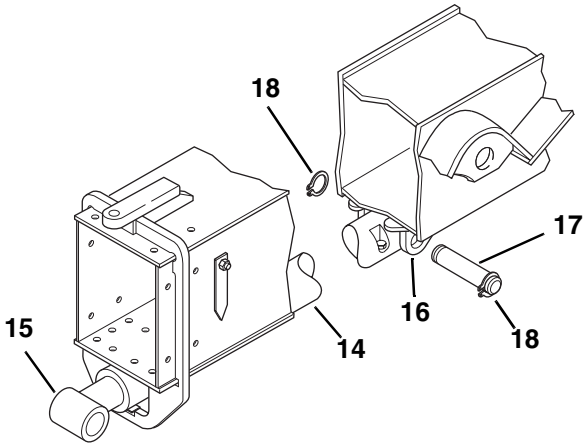
6. Install new or saved Lift/Lower cylinder bearings (**6**) into the Lift/Lower cylinder mounts (**7**) on each side of the boom assembly. Orient the fracture (**8**) in the outer race of each bearing so that it is perpendicular to the force of the load. Press the bearings into position until the edge of the outer race (**9**) of each bearing is flush with the edge of the plate (**10**).
7. Install new or saved Slave cylinder bearings (**11**) into the Slave cylinder mounts (**12**) on each side of the boom assembly. Orient the fracture (**8**) in the outer race of each bearing so that it is perpendicular to the force of the load. Press the bearings into position until the edge of the outer race (**9**) of each bearing is flush with the edge of the plate (**10**).
8. Install grease fittings (**13**) into the Lift/Lower cylinder mounts (**7**) and the Slave cylinder mounts (**12**) on the outer boom. Tighten all the grease fittings.



MH4380

Note: *Slings and a hoist are required to perform the following step.*

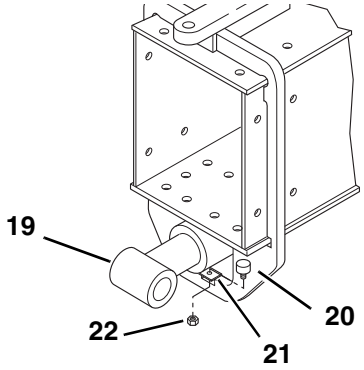
9. Position the Extend/Retract cylinder (**14**) with the extend and retract port elbows facing down. Place the rod end of the Extend/Retract cylinder (**15**) through the Extend/Retract cylinder retainer at the front of the outer boom. At the rear of the Extend/Retract cylinder, align the hole in the base end of the cylinder with the holes in the mounting ears (**16**) under the outer boom.
10. Coat the base end cylinder pin with anti-seize compound. Insert the base end cylinder pin (**17**) through both mounting ears and the base end of the Extend/Retract cylinder. Secure the pin in place with a retaining ring (**18**) on each side of the pin. Be sure the retaining rings are completely seated in the grooves on each side of the pin.



MH1350

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

11. Lift the rod end of the Extend/Retract cylinder (**19**) far enough to insert the threaded stud on the rubber bumper (**20**) into the hole in the Extend/Retract cylinder retainer (**21**). Secure the rubber bumper in place with a new elastic locknut (**22**). Tighten securely. Lower the rod end of the Extend/Retract cylinder, and allow it to rest on the rubber bumper.



MH1360

12. **This step is for Model 10042 S/N 13198 thru 18405 Only:**

Note: *On Model 10042 S/N 18406 & After, the stop plate is an internal component of the extend/retract cylinder.*

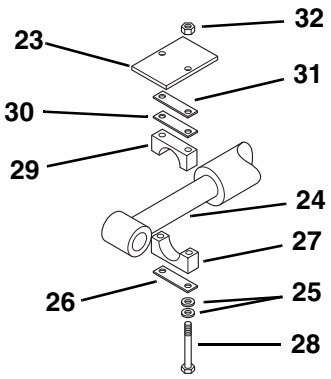
Install the boom stop plate:

a. Extend the boom far enough to reassemble the boom stop plate (**23**) to the extend cylinder rod (**24**).

b. Place the flat washers (**25**), saved, a cover plate (**26**), saved, and a clamp (**27**), saved, onto the capscrews (**28**), saved.

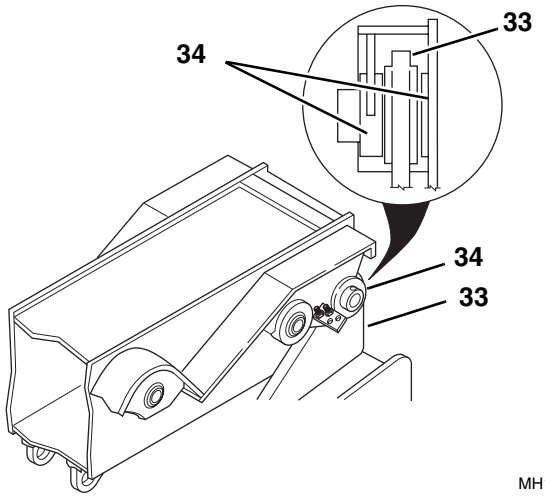
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

c. Place the clamp and capscrews onto the bottom of the extend cylinder rod and place the other clamp (**29**), saved, the safety plate (**30**), saved, the other cover plate (**31**), saved, and the stop plate (**23**) on top of the cylinder rod. Secure the capscrews and clamps in place with two new elastic locknuts (**32**). Be sure the stop plate is lined up with the bottom edge of the outer boom and tighten both elastic locknuts securely.



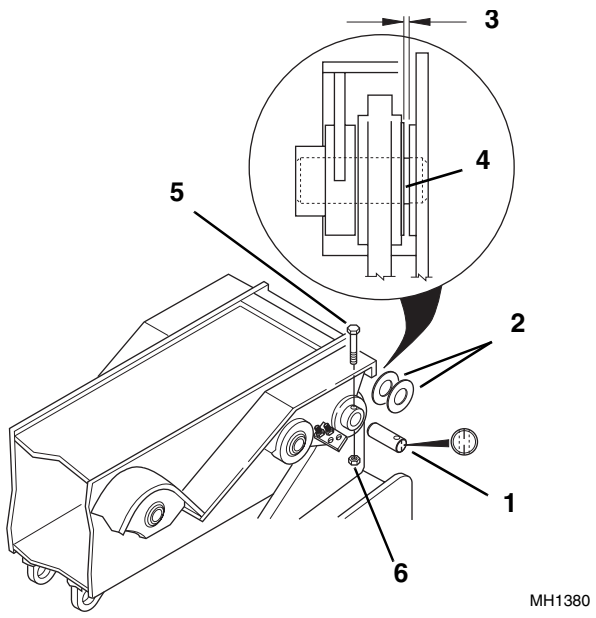
MH1250

13. Using a hoist capable and slings, lift the outer boom assembly and position the boom on the frame. Align the mounting plates (**33**) on the frame between the mounting hubs (**34**) on each side of the boom assembly. Lower the boom assembly until the holes in the boom assembly and the mounting plates align.



MH1370

14. On the end of the boom pivot pin (**1**), closest to the capscrew hole, mark the capscrew mounting hole location. Coat the entire pin with anti-seize compound.
15. Insert the pivot pin (**1**) from the outside of the boom assembly, making sure the marks for the capscrew mounting hole stay in line with the capscrew mounting holes in the boom mounting hub. If necessary, use a rawhide hammer to install the pivot pin.
16. Shim the boom as required using the shims (**2**), saved, to maintain a .10" (2,5 mm) maximum gap (**3**) between the boom mounting hub and the self aligning bearing (**4**) in the frame. If an additional shim is required to maintain the maximum gap, the extra shim MUST be inserted on the right side of the boom.

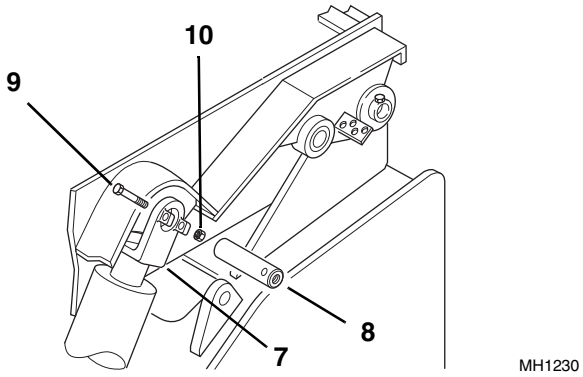


Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

17. After the pivot pin and shims are in place, use a tapered punch to align the capscrew hole in the pin with the mounting holes in the hub. Insert the capscrew (**5**), saved, through the hub and the pin. Secure the capscrew in place with a new elastic locknut (**6**). Tighten the elastic locknut securely.
18. Align the rod end of one of the Lift/Lower cylinders (**7**) with the self-aligning bearing on the outer boom assembly.
19. Coat the entire Lift/Lower cylinder pivot pin (**8**) with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. If necessary, use a rawhide hammer to install the pin.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

20. Use a tapered punch to align the capscrew mounting hole in the pin with the mounting tabs on the rod end of the cylinder. Secure the pin in place with the capscrew (**9**), saved, and a new elastic locknut (**10**). Tighten the elastic locknut securely.
21. Repeat Steps 18 thru 20 to install the Lift/Lower cylinder on the other side of the outer boom.



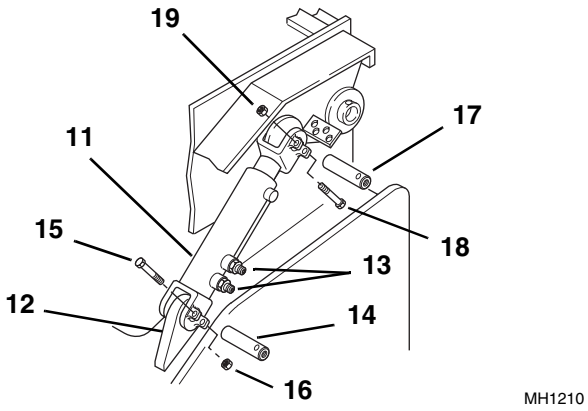
22. Use a hoist and sling to position the Slave cylinder (**11**) onto the lower cylinder mount (**12**) located on the frame. The cylinder should be positioned with the extend and retract port fittings (**13**) to the outside.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

23. Coat the lower pivot pin (**14**) with anti-seize compound. Insert the pin through the base end of the Slave cylinder. Use a tapered punch to align the capscrew hole in the pin with the mounting tabs on the cylinder. Secure the lower pivot pin in place with the capscrew (**15**), saved, and a new elastic locknut (**16**). Tighten the elastic locknut securely.
24. Position the rod end of the Slave cylinder around the self-aligning bearing on the outer boom.

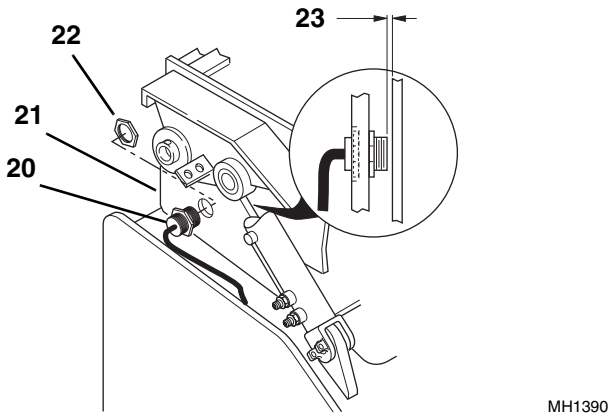
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

25. Coat the upper pivot pin (**17**) with anti-seize compound. Insert the pin through the rod end of the Slave cylinder. If necessary, use a rawhide hammer to install the upper pivot pin. Use a tapered punch to align the capscrew hole in the pin with the mounting tabs on the cylinder. Secure the upper pivot pin in place with the capscrew (**18**), saved, and a new elastic locknut (**19**). Tighten the elastic locknut securely.
26. Repeat Steps 22 thru 25 to install the other Slave cylinder to the other side of the outer boom.



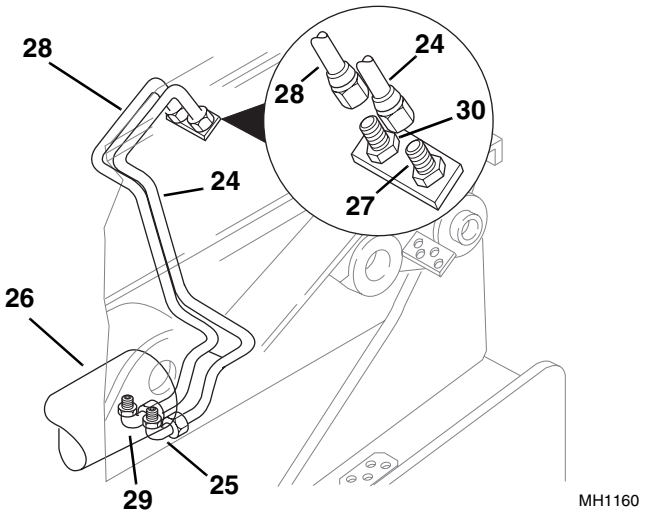
MH1210

27. Install the boom proximity sensor (**20**) on the right side mounting plate. With the boom properly shimmed, position the boom assembly all the way to the right side.
28. Insert the boom proximity sensor (**20**) through the hole in the right side mounting plate (**21**). Install the jam nut (**22**), saved, onto the boom proximity sensor on the inside of the plate. Adjust the inner and outer jam nuts on the boom proximity sensor until the gap (**23**) between the sensor and the boom is .12" (3 mm). Torque the inside jam nut to 36 lb-in (4,1 Nm), to hold the boom proximity sensor in position.



MH1390

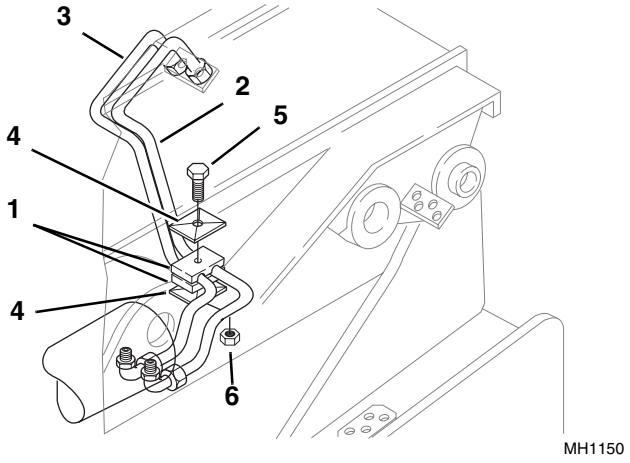
29. Assemble the extend tube (**24**) to the extend port 90° elbow (**25**) on the Extend/Retract cylinder (**26**) and the inside bulkhead fitting (**27**) on the right side of the outer boom. Hand-tighten the tube fitting to the 90° elbow. Reposition the tube as needed to align the other end of the tube with the bulkhead fitting. Tighten the tube end at the bulkhead fitting and then tighten the tube end at the 90° elbow.
30. Assemble the retract tube (**28**) to the retract port 90° elbow (**29**) on the Extend/Retract cylinder (**26**) and the outside bulkhead fitting (**30**) on the right side of the outer boom. Hand-tighten the tube fitting to the 90° elbow. Reposition the tube as needed to align the other end of the tube with the bulkhead fitting. Tighten the tube end at the bulkhead fitting and then tighten the tube end at the 90° elbow.



MH1160

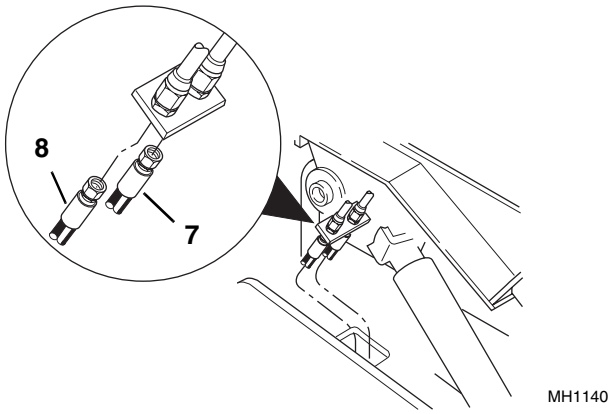
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

31. Assemble the tube clamp halves (**1**) to the extend (**2**) and retract (**3**) tubes under the outer boom. Place one clamp half on top of the tubes and one on the underside of the tubes. Place a clamp cover (**4**) on the top and bottom of the clamps. Secure in place with the capscrew (**5**), saved, and a new elastic locknut (**6**). Position the clamp halves to securely hold the tubes without putting tension on either tube. Tighten the elastic locknut securely.



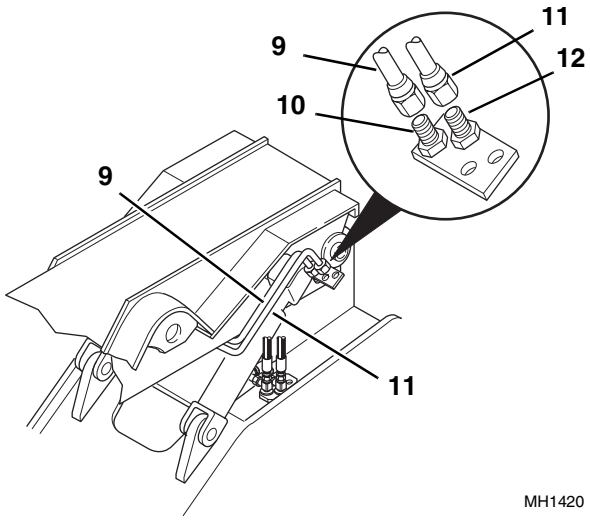
MH1150

32. Assemble the boom extend hose (**7**) to the inside bulkhead fitting (extend tube) on the right side of the boom. Remove all twists from the boom extend hose, and tighten the hose end securely to the bulkhead fitting.
33. Assemble the boom retract hose (**8**) to the outside bulkhead fitting (retract tube) on the right side of the boom. Remove all twists from the boom retract hose, and tighten the hose end securely to the bulkhead fitting.



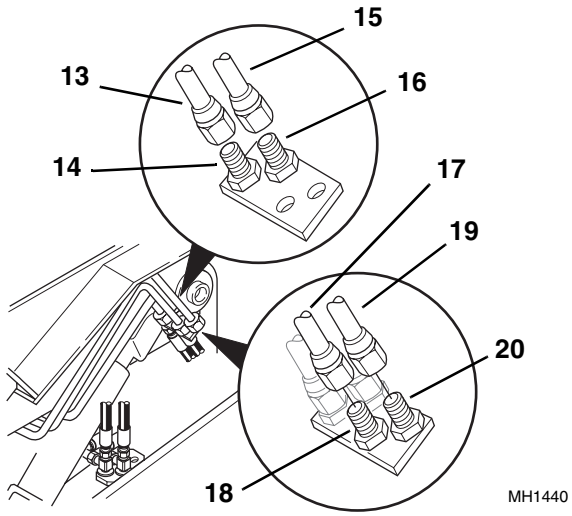
MH1140

34. **Without auxiliary hydraulics:** Position the extend tube assembly (**9**) onto the inner bulkhead fitting (**10**). Loosely assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until both tubes are assembled at both ends.
35. Position the retract tube assembly (**11**) onto the outer bulkhead fitting (**12**). Assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until both tubes are assembled at both ends.

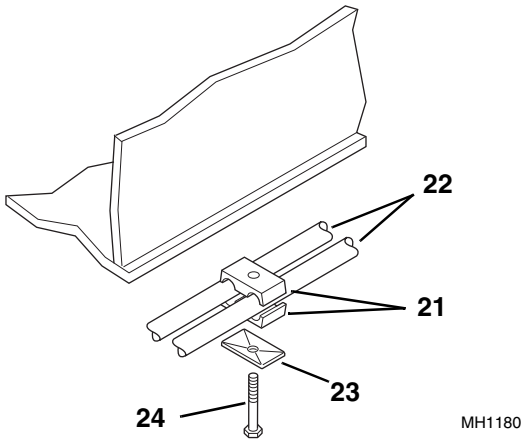


MH1420

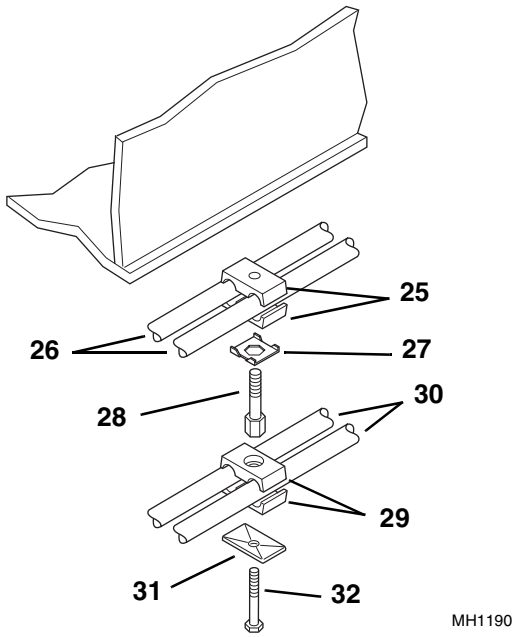
36. **With auxiliary hydraulics:** Position the extend tube assembly (**13**) onto the inner bulkhead fitting (**14**). Assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until all the tubes are assembled at both ends.
37. Position the retract tube assembly (**15**) onto the second bulkhead fitting (**16**). Assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until all the tubes are assembled at both ends.
38. Position the inner auxiliary tube assembly (**17**) onto the third bulkhead fitting (**18**). Assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until all the tubes are assembled at both ends.
39. Position the outer auxiliary tube assembly (**19**) onto the outer bulkhead fitting (**20**). Assemble the nut on the tube assembly to the bulkhead fitting; **DO NOT** fully tighten until all the tubes are assembled at both ends.



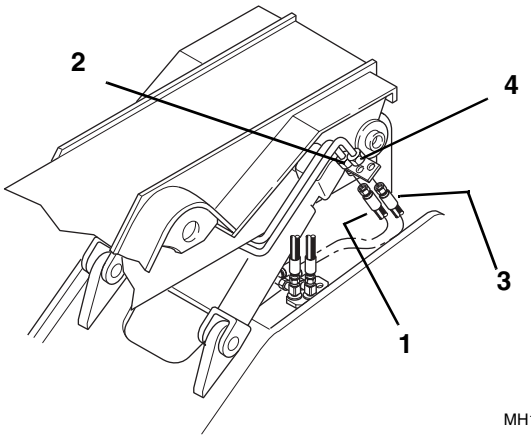
40. **Without auxiliary hydraulics:** Assemble the tube clamp halves (**21**), saved, to the underside of the outer boom. Place a clamp half on each side of the Attachment Tilt tubes (**22**). Secure each set of clamp halves to the boom with a clamp cover (**23**), saved, and a capscrew (**24**), saved. Tighten the capscrew securely to hold the tubes in place. Repeat for the other two clamp locations under the outer boom.



41. **With auxiliary hydraulics:** Assemble the tube clamp halves, saved, to the underside of the outer boom. Place a upper clamp half (**25**) on each side of the Attachment Tilt (upper) tubes (**26**). Secure each set of clamp halves to the boom with a locking plate (**27**), saved, and a stacking bolt (**28**), saved. Tighten the stacking bolt securely to hold the upper tubes in place.
42. Place a lower clamp half (**29**) on each side of the auxiliary hydraulic (lower) tubes (**30**). Secure each set of clamp halves to the stacking bolt with a clamp cover (**31**), saved, and a capscrew (**32**), saved. Tighten the capscrew securely to hold the lower tubes in place.
43. Repeat Steps 41 and 42 to assemble the clamps at the other two clamp locations under the outer boom.

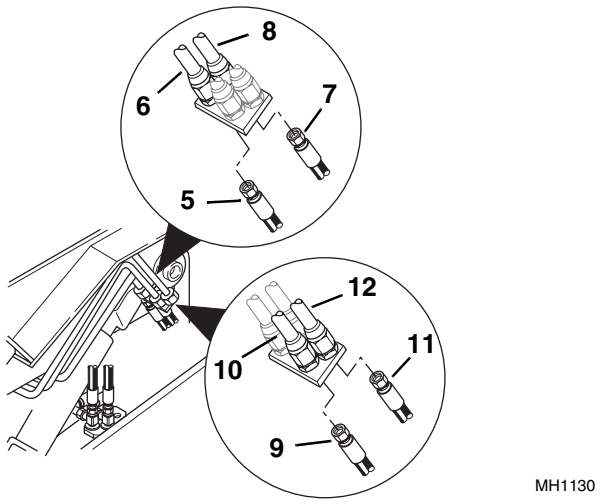


44. **Without auxiliary hydraulics:** At the rear left side of the boom, connect the Attachment Tilt extend (inner) hose (**1**) to the inner bulkhead fitting (**2**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
45. Connect the Attachment Tilt retract (outer) hose (**3**) to the outer bulkhead fitting (**4**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting. Proceed to Step 49.



MH1120

46. **With auxiliary hydraulics:** At the rear left side of the boom, connect the Attachment Tilt extend (inner) hose (**5**) to the inner bulkhead fitting (**6**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
47. Connect the Attachment Tilt retract (second) hose (**7**) to the second bulkhead fitting (**8**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
48. Connect the auxiliary hydraulic (third) hose (**9**) for the male nipple to the third bulkhead fitting (**10**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting. Assemble the auxiliary hydraulic (outer) hose (**11**) for the female coupler to the outer bulkhead fitting (**12**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.

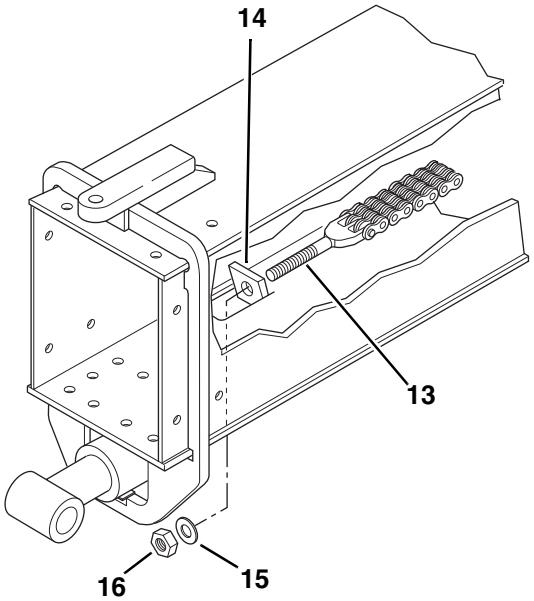


MH1130

49. Inside the rear of the outer boom, slide the threaded clevis end (**13**) of the retract chain down the right side of the boom. Guide the threaded part of the clevis out through the hole in the tab (**14**) on the bottom of the outer boom. Pull threaded part of clevis all the way through the tab.

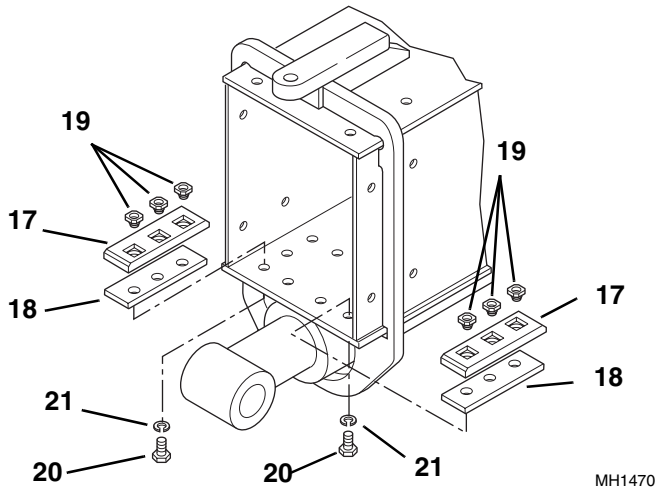
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

50. Coat the entire threaded portion of the clevis (**13**) with multi-purpose grease. Install one flat washer (**15**), saved, onto the threaded clevis and assemble a new elastic locknut (**16**). Thread the nut onto the clevis until the threads are flush with the top of the nut.



MH1460

51. At the front of the outer boom, reassemble the lower outside wear pads (**17**) and wear pad spacers (**18**):
    a. Place the wear pad inserts (**19**) into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities.
    b. Place a wear pad (**17**) and a spacer (**18**) into the outer boom with the hole offset of the wear pad toward the middle of the boom. Align the holes in the spacer and wear pads with the holes in the bottom of the boom.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**20**), saved. Insert the capscrews with lockwashers (**21**), saved, through the bottom of the boom and into the wear pads. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Fill wear pad cavities with a good grade of lithium-based EP grease.
    f. Repeat Steps a thru e to install the lower wear pad on the other side of the outer boom.



52. Install the intermediate boom, retract chain and attaching hardware. (Refer to Section 3.3.5, “Intermediate Boom Installation.”)
53. Install the inner boom, extend chain and attaching hardware. (Refer to Section 3.3.6, “Inner Boom Installation.”)
54. Clean up all debris, hydraulic fluid, etc., in, on, near and around the vehicle.

WARNING: Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious personal injury.

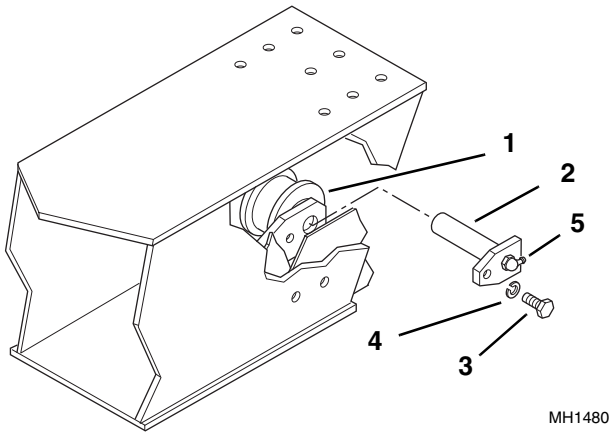
55. Start the engine and operate all boom functions several times. Check the chain tension again and adjust as necessary. Check for leaks, and check the hydraulic fluid level in the tank; add fluid if required.
56. Apply grease at all lubrication points (grease fittings). (Refer to Model 8042 Legacy Owners/Operators Manual or Model 10042 Legacy Owners/Operators Manual.)

3.3.5 Intermediate Boom Installation

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

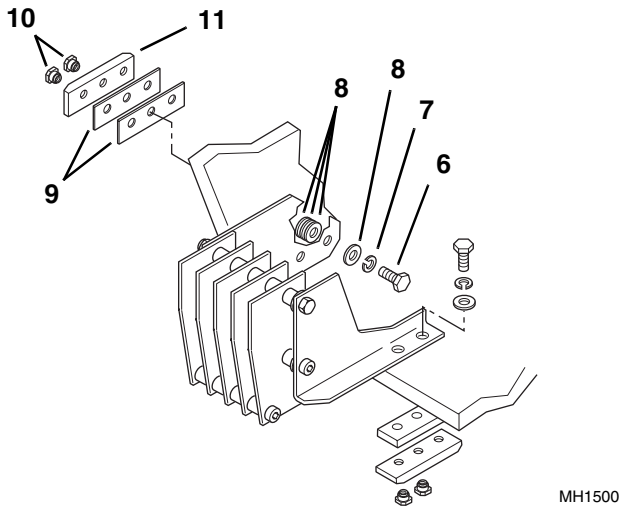
WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

1. At the rear of the intermediate boom, assemble the retract chain sheave (**1**) to the mounting ears on the right side of the boom. Place the sheave between the ears and insert the sheave pin (**2**) from the left side. Align the hole in the pin retainer plate with the threaded hole in the left ear. Secure the pin in place with the capscrew (**3**), saved, and the lockwasher (**4**), saved. Tighten the capscrew securely.
2. Apply grease to the grease fitting (**5**) in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.



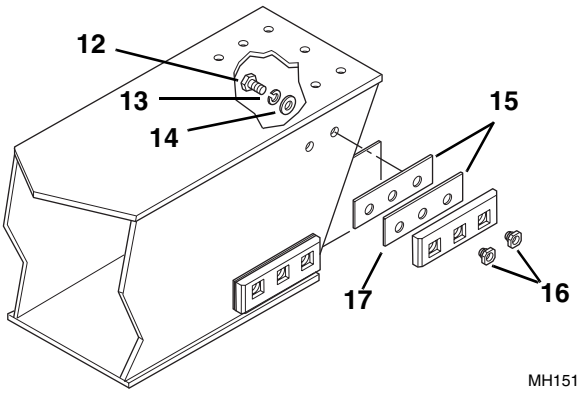
Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

3. Assemble the hose reel assembly, left side and bottom wear pads to the rear of the intermediate boom:
   a. Apply Loctite® 242 threadlocker to the threads of the two capscrews (**6**), saved. Insert a capscrew with a lockwasher (**7**), saved, and a flat washer (**8**), saved, through each of the mounting holes in the left side plate of the hose reel assembly. Place three flat washers (**8**), saved, onto each of the capscrews and insert the capscrews through the mounting holes in the left side of the boom.
   b. Place the wear pad shims (**9**), saved, onto the capscrews. Place the shims onto the capscrews with the holes offset to the top.
   c. Place the wear pad inserts (**10**), saved, into the cavities in the wear pad (**11**). Be sure the inserts are seated completely in the cavities.
   d. Install the wear pad (**11**) onto the capscrews. Be careful not to push the wear pad inserts out of the wear pads.
   e. Apply Loctite® 242 threadlocker to the threads of the two capscrews (**6**), saved. Insert a capscrew with a lockwasher (**7**), saved, and a flat washer (**8**), saved, through each of the mounting holes in the right side plate of the hose reel assembly.
   f. Place the wear pad inserts (**9**), saved, into the cavities in the wear pad (**10**), saved. Be sure the inserts are seated completely into the cavities.
   g. Place the wear pad spacer (**11**), saved, and the wear pad under the intermediate boom. With the holes offset to the left, align the holes and secure the hose reel, wear pad spacer and wear pad to the intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.
   h. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   i. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH1500

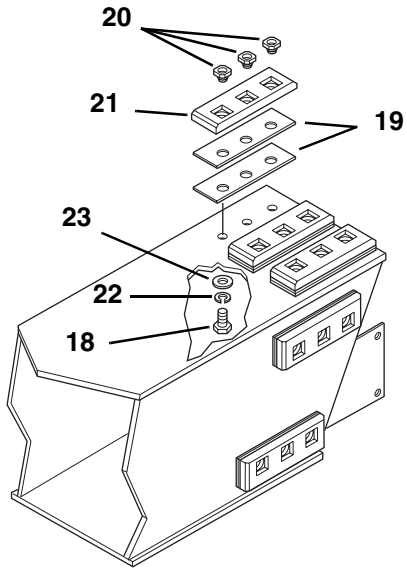
4. Install the intermediate boom side wear pads:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**12**), saved. Insert a capscrew with a lockwasher (**13**), saved, and a flat washer (**14**), saved, through each of the wear pad mounting holes in the side plates of the intermediate boom.
   b. Place the wear pad shims (**15**), saved, onto the capscrews. Place the shims onto the capscrews with the holes offset to the center.
   c. Place the wear pad inserts (**16**), saved, into the cavities in the wear pad (**17**). Be sure the inserts are seated completely in the cavities.
   d. Install the wear pad (**17**) onto the capscrews. Be careful not to push the wear pad inserts out of the wear pads.
   e. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   f. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH1510

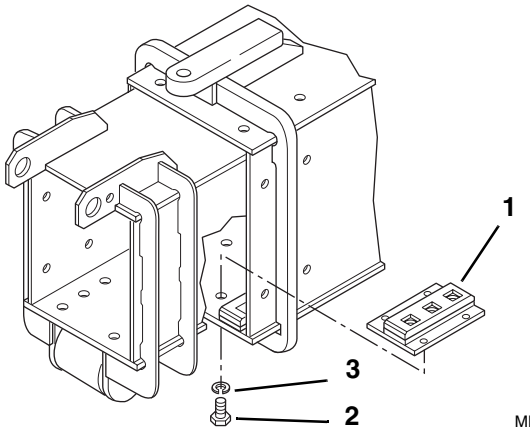
Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the vertical direction.*

5. Assemble the top wear pads to the top of the intermediate boom. Position the wear pads so the outside pads are offset to the outside and the center pad is offset to the right:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**18**), saved.
   b. Place the wear pad shims (**19**), saved, onto the top of the boom. Align the holes in the shims with the holes in the boom.
   c. Place the wear pad inserts (**20**), saved, into the wear pad (**21**) cavities in the wear pad. Be sure the inserts are seated completely in the cavities. Place the wear pads on top of the shims.
   d. Insert a capscrew with a lockwasher (**22**) and a flat washer (**23**), saved, through each of the mounting holes in the top of the intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.
   e. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   f. Fill all wear pad cavities with a good grade of lithium-based EP grease.

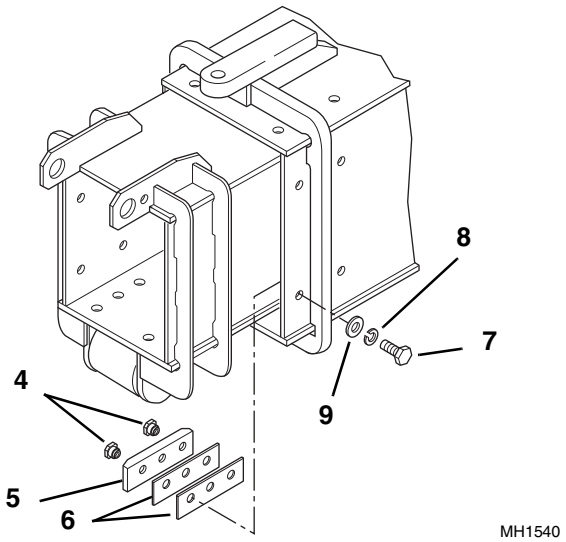


MH1520

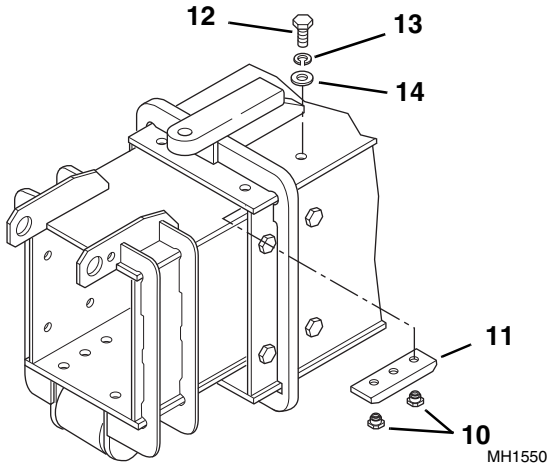
6. Spray the wear pad pathways on the inside of the outer boom, inside of the intermediate boom and the underside of the intermediate boom with LPS3 or equivalent.
7. Before installing the intermediate boom into the outer boom, place a string (heavy enough to pull the Attachment Tilt and auxiliary hydraulic hoses) down the inside of the outer boom. Allow the string to hang out the rear of the boom. Pull the other end out the opening on the left side of the boom where the hoses will exit the boom. Place one string for each hose in the boom. Position the strings all the way to the left side of the outer boom.
8. Use the hoist and slings to slightly lift the front of the intermediate boom to allow installation of the center wear pad:
   a. Fill all wear pad cavities with a good grade of lithium-based EP grease.
   b. Slide the center wear pad mount (**1**) into the outer boom with the wear pad offset toward the right side. Line up the threaded holes in the wear pad mount with the holes in the bottom of the outer boom.
   c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**2**), saved. Secure the wear pad mount to the outer boom with the capscrews (**2**) and lockwashers (**3**), saved.
   d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



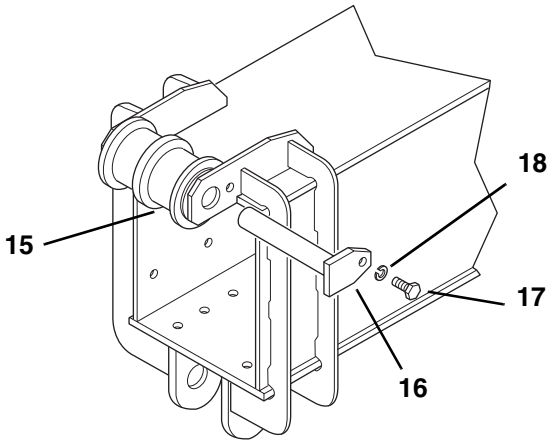
9. Remove the slings and the hoist from the intermediate boom.
10. Install the side wear pads to the outer boom:
    a. Slide the intermediate boom over to one side as far as it will go, to allow wear pad installation.
    b. Place the wear pad inserts (**4**), saved, into the cavities of the side wear pads (**5**), saved. Place the shims (**6**), saved, onto the wear pad and align the holes.
    c. Fill all wear pad cavities with a good grade of lithium-based EP grease.
    d. Apply Loctite® 242 threadlocker to the threads of the capscrews (**7**), saved. Slide the wear pad with shims in between the intermediate boom and the outer boom with the offset of each wear pad away from the center. Align the holes and secure in place with the capscrews (**7**), lockwashers (**8**), saved, and flat washers (**9**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    e. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    f. Repeat Steps a thru e to install the side wear pads on the other side of the outer boom.



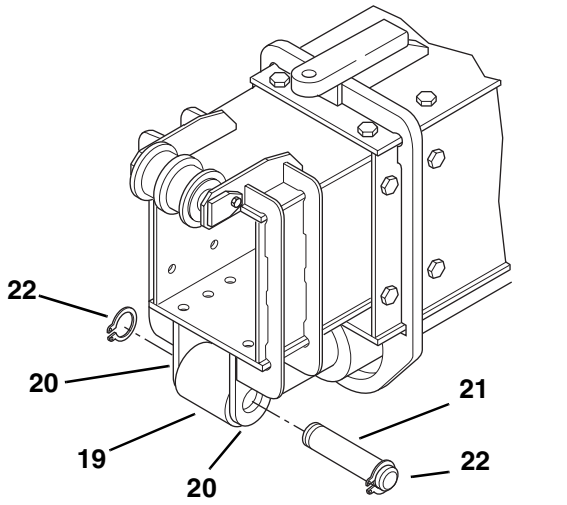
11. Assemble the top wear pads to the inside of the outer boom:
    a. Place the wear pad inserts (**10**), saved, into the cavities of the top wear pads (**11**), saved.
    b. Fill all wear pad cavities with a good grade of lithium-based EP grease.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**12**), saved. Slide the wear pad between the intermediate boom and the outer boom with the offset of each wear pad away from the center. Align the holes and secure in place with the capscrews (**12**), lockwashers (**13**), saved, and flat washers (**14**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



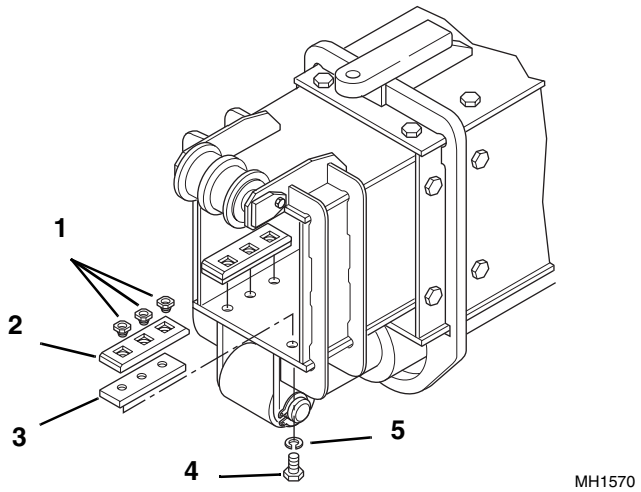
12. Place the double extend chain sheave (**15**), saved, between the mounts at the front of the intermediate boom. Insert the sheave pin (**16**), saved, through the mounts and the double sheave. Align the mounting hole in the sheave pin with the threaded hole in the sheave mount and secure in place with the saved capscrew (**17**) and lockwasher (**18**). Tighten securely.
13. After the sheave is assembled, grease the sheave with a good grade of multi-purpose grease. Turn the sheave by hand to distribute the grease evenly.



14. Use a hoist and sling to lift the rod end of the Extend/Retract cylinder (**19**). Align the rod end of the Extend/Retract cylinder with the mounts (**20**) at the front of the intermediate boom.
15. Coat the Extend/Retract cylinder rod end pin (**21**), saved, with anti-seize compound. Insert the rod end pin through the mounts and secure in place with the retaining rings (**22**), saved. Be sure the retaining rings are securely seated in the rod end pin grooves.



16. Install the intermediate boom front, bottom wear pads:
    a. Place the wear pad inserts (**1**), saved, into the cavities of the front bottom wear pads (**2**), saved.
    b. Place the wear pads and spacers (**3**), saved, into the intermediate boom with the offset of the wear pads toward the outside.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**4**), saved. Align the holes and secure in place with the capscrews (**4**) and lockwashers (**5**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH1570

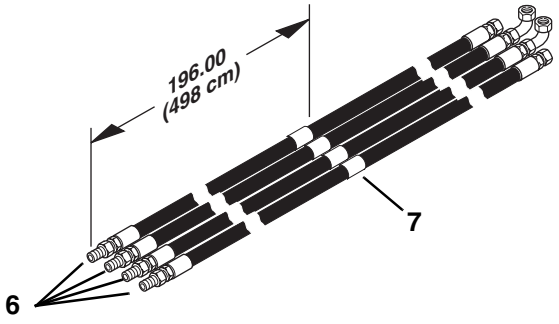
3.3.6 Inner Boom Installation

> **WARNING:** Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

> **WARNING:** **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

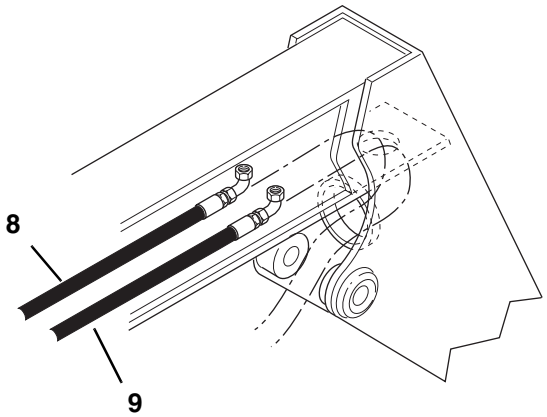
IMPORTANT: *Light lubrication of the boom wear surfaces with a rust inhibitor/lubricant such as LPS 3 or equivalent is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended in salt air climates and when the vehicle is stored, to help prevent rusting.*

1. Stretch the Attachment Tilt and auxiliary hoses out straight on a flat surface. Measure from the male end (**6**) of each hose back 196" (498 cm) and apply tape (**7**) around each hose at that point. The tape is for proper tensioning of the hoses during reassembly of the hose clamps.



MH1400

2. **Without auxiliary hydraulics:** Slide the elbow ends of the two Attachment Tilt hoses (**8** and **9**) down the inner boom and out to the gooseneck. Keep the hoses next to each other as they are being pushed down the inner boom. At the opening in the gooseneck, pull both hoses out. Be careful not to cross the hoses as you pull them out. Label the left side hose (**8**) as “Retract” and the right side hose (**9**) as “Extend.” Label the hoses the same on the male end of each hose.



MH1600

3. **With auxiliary hydraulics:** Slide the elbow ends of the two Attachment Tilt hoses (**10** and **11**) down the inner boom and out to the gooseneck. Keep the hoses next to each other as they are being pushed down the inner boom.

   At the opening in the gooseneck, pull both hoses out. Be careful not to cross the hoses as you pull them out. Label the left side hose (**10**) as “Retract” and the right side hose (**11**) as “Extend.” Label the hoses the same on the male end of each hose.

4. Slide the female end of the two auxiliary hydraulics hoses (**12** and **13**) down the inner boom and out the gooseneck. Keep the auxiliary hoses to the left and right sides of the Attachment Tilt hoses (**10** and **11**).

   At the opening in the gooseneck, pull both hoses out and down toward the bulkhead plate for the couplers. Keep the left side hose (**12**) on the left side and label that hose as “Female Coupler.” Label both ends of the hose. Keep the right side hose (**13**) on the right side and label that hose as “Male Nipple.” Label both ends of the hose.

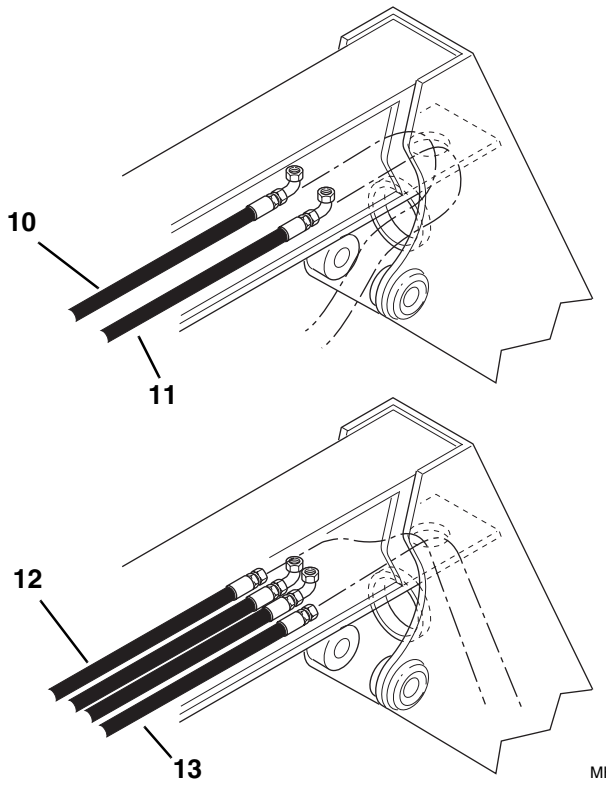
5. **Without auxiliary hydraulics:** Keep the two hoses on the left and right sides as they come out of the rear of the inner boom. Place a lockwasher (**14**), saved, onto each capscrew (**15**), saved, and insert the capscrews through the clamp cover plate (**16**), saved.

6. Place a hose clamp half (**17**), saved, onto the capscrews. Place the right Attachment Tilt hose (**18**) and a hose clamp half (**17**) onto the capscrews.

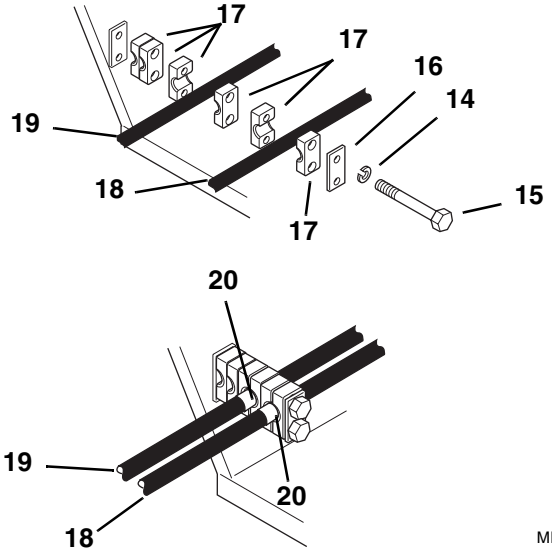
7. Place another hose clamp half (**17**), saved, the left Attachment Tilt hose (**19**) and a hose clamp half (**17**) onto the capscrews.

8. Place two more hose clamp halves (**17**) onto the capscrews positioned as shown. Assemble the capscrews to the left side of the inner boom. Tighten the capscrews only enough to hold the hoses in place.

9. Position the Attachment Tilt hoses (**18** and **19**) with the edge of the tape (**20**) at the hose clamps. Hold the Attachment Tilt hoses in this position and tighten the two capscrews securely to hold the hoses.

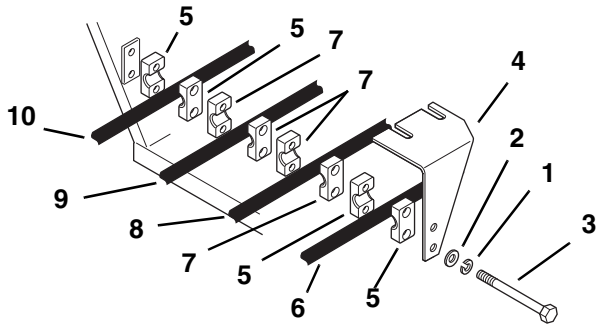


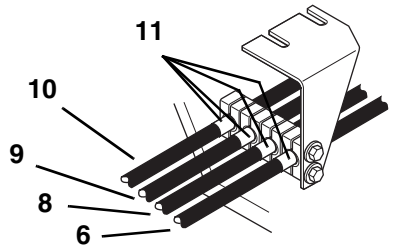
MH1610



MH1620

10. **With auxiliary hydraulics:** Keep the four hoses in line (left to right) as they come out of the rear of the inner boom. Place a lockwasher (**1**), saved, and a flat washer (**2**), saved, onto each capscrew (**3**), saved. Insert the capscrews through the hose clamp support bracket (**4**), saved. Insert the capscrews from the side as shown.
11. Place a 3/4" diameter hose clamp half (**5**), saved, onto the capscrews. Place the right auxiliary hydraulic hose (**6**) and another 3/4" diameter hose clamp half (**5**) onto the capscrews.
12. Place a 5/8" diameter hose clamp half (**7**), saved, the right Attachment Tilt hose (**8**) and another 5/8" diameter hose clamp half (**7**) onto the capscrews.
13. Place two more 5/8" diameter hose clamp halves (**7**), the left Attachment Tilt hose (**9**) and another 5/8" diameter hose clamp half onto the capscrews.
14. Place a 3/4" diameter hose clamp half (**5**), saved, the left auxiliary hydraulic hose (**10**) and another 3/4" diameter hose clamp half (**5**) onto the capscrews. Assemble the capscrews to the left side of the inner boom. Tighten the capscrews only enough to hold the hoses in place.



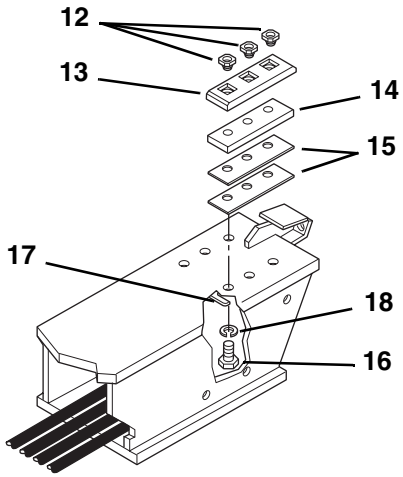


MH1630

15. Assemble the hose clamp support bracket to the top of the inner boom:

Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the vertical direction.*

a. Place the wear pad inserts (**12**), saved, into the cavities of the inner boom top left side wear pad (**13**), saved.
b. Place the wear pad, spacer (**14**), saved, and shims (**15**), saved, onto the inner boom with the offset of the wear pad toward the outside edge.
c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**16**), saved. Align the holes and secure the wear pad and hose clamp support bracket (**17**) in place with the capscrews (**16**) and lockwashers (**18**), saved. Be careful not to push the wear pad inserts out of the wear pads.
d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
e. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH1640

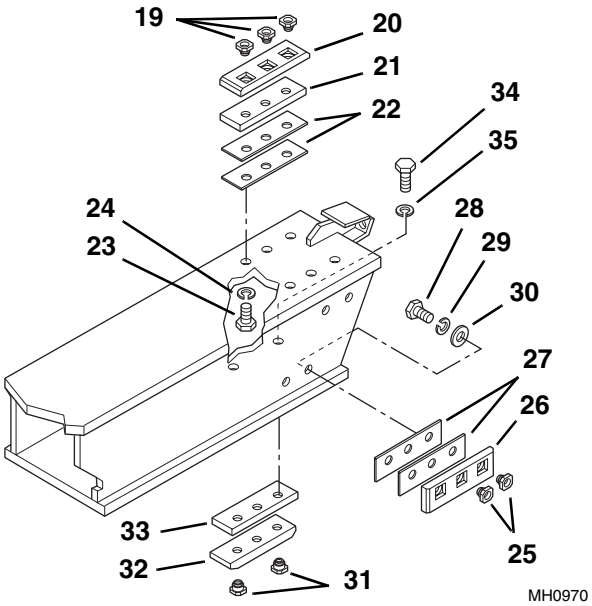
16. Position the Attachment Tilt and auxiliary hydraulic hoses with the edge of the tape (**11**) at the hose clamps. Hold the hoses in this position, and tighten the two capscrews securely to hold the hoses.

17. Assemble the wear pads to the rear of the inner boom. If your vehicle has optional auxiliary hydraulics, the upper left wear pad has been already assembled.

Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the vertical direction.*

Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

a. Place the wear pad inserts (**19**), saved, into the cavities of the inner boom top left and right side wear pads (**20**), saved.



b. Place the wear pads, spacers (**21**), saved, and shims (**22**), saved, onto the inner boom with the offset of the wear pads toward the outside edge.

c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**23**), saved. Align the holes and secure the wear pads in place with the capscrews (**23**) and lockwashers (**24**), saved. Be careful not to push the wear pad inserts out of the wear pads.

d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

e. Place the wear pad inserts (**25**), saved, into the cavities of the inner boom left and right side upper and lower wear pads (**26**), saved.

f. Place the wear pads and shims (**27**), saved, onto the sides of the inner boom with the offset of the wear pads toward the top and bottom edge.

g. Apply Loctite® 242 threadlocker to the threads of the capscrews (**28**), saved. Align the holes and secure the wear pads in place with the capscrews (**28**), lockwashers (**29**), saved, and flat washers (**30**), saved. Be careful not to push the wear pad inserts out of the wear pads.

h. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

i. Place the wear pad inserts (**31**), saved, into the cavities of the inner boom bottom wear pad (**32**), saved.

j. Place the wear pad and spacer (**33**), saved, onto the bottom of the inner boom with the offset of the wear pads toward the right side.

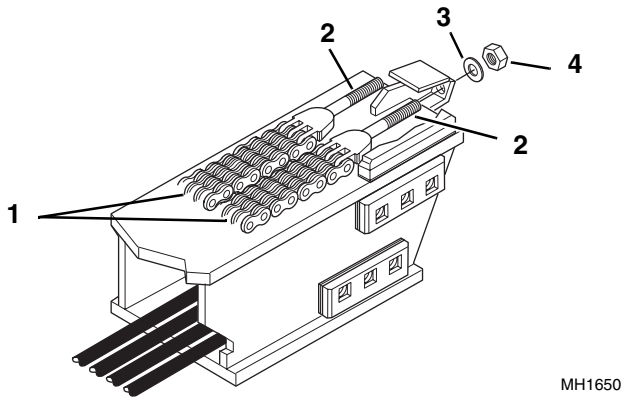
k. Apply Loctite® 242 threadlocker to the threads of the capscrews (**34**), saved. Align the holes and secure the wear pads in place with the capscrews (16) and lockwashers (**35**), saved. Be careful not to push the wear pad inserts out of the wear pads.

l. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

m. Fill all wear pad cavities with a good grade of lithium-based EP grease.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

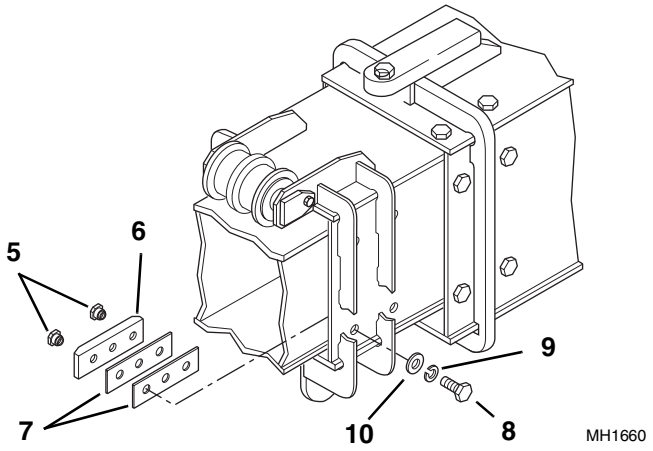
18. Lay the two extend chains (**1**) on the top of the inner boom with the threaded clevis ends (**2**) toward the rear of the boom. Coat the threads on each clevis with multi-purpose grease, and insert the clevis' through the holes in the anchor plate. Install a flat washer (**3**), saved, onto each clevis. Install a new elastic locknut (**4**) onto each clevis. Tighten the elastic locknut far enough so the threads are even with the top of the locknut.



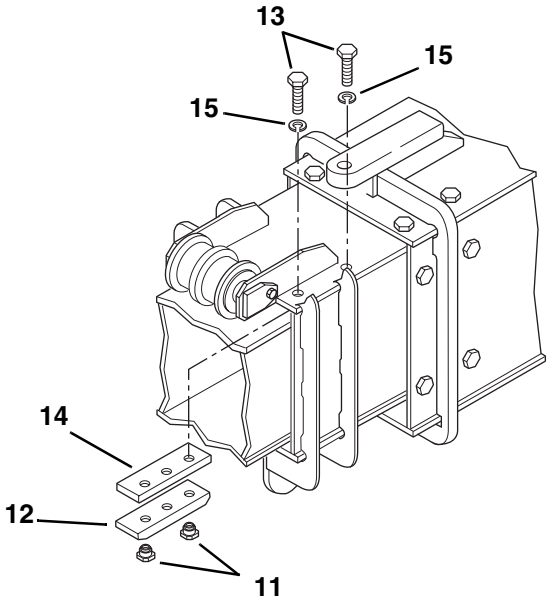
19. At the rear of the inner boom, place the male ends of the hoses (Attachment Tilt and optional auxiliary hydraulics) inside the inner boom. Be sure the hoses are coiled up and inside the boom completely.
20. Spray the wear pad pathways on the underside of the inner boom with LPS3 or equivalent.
21. Assemble the side wear pads to the intermediate boom:

Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

a. Slide the inner boom over to one side as far as it will go, to allow wear pad installation.
b. Place the wear pad inserts (**5**), saved, into the cavities of the side wear pads (**6**), saved. Place the shims (**7**), saved, onto the wear pad and align the holes.
c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**8**), saved. Slide the wear pad with shims between the inner boom and the intermediate boom with the offset of each wear pad away from the center. Align the holes and secure in place with the capscrews (**8**), lockwashers (**9**), saved, and flat washers (**10**), saved. Be careful not to push the wear pad inserts out of the wear pads.
d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
e. Fill all wear pad cavities with a good grade of lithium-based EP grease.
f. Repeat Steps a thru e to install the side wear pads on the other side of the intermediate boom.



22. Install the top wear pads to the inside of the intermediate boom:
    a. Place the wear pad inserts (**11**), saved, into the cavities of the top wear pads (**12**), saved.
    b. Apply Loctite® 242 threadlocker to the threads of the capscrews (**13**), saved. Slide the wear pads with the spacers (**14**), saved, between the inner boom and the intermediate boom, with the offset of each wear pad toward the center. Align the holes and secure in place with the capscrews (**13**) and lockwashers (**15**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    d. Fill all wear pad cavities with a good grade of lithium-base EP grease.



MH1670

23. Pull the male ends of the hoses out the rear of the inner boom. Stretch the hoses out straight behind the vehicle.
24. **Without auxiliary hydraulics:** Assemble the hoses to the hose reel at the back of the boom:

IMPORTANT: *Keep the hoses in the same order as they come from the hose clamps.* ***DO NOT*** *allow the hoses to cross.*

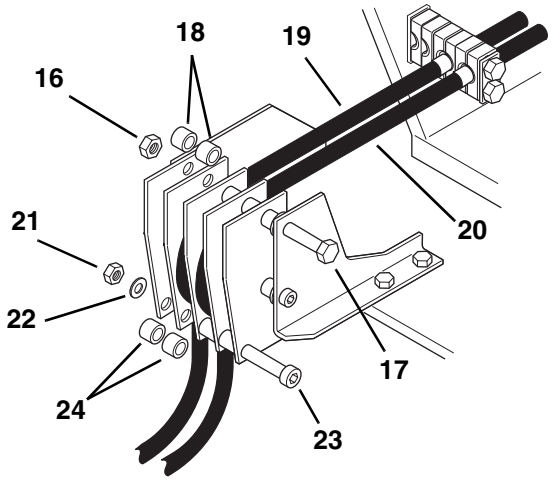
    a. Remove the elastic locknut (**16**) from the upper retaining capscrew (**17**). While pulling the capscrew out, catch the spacers (**18**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to place the hoses around the hose reel.

       Place the left side Attachment Tilt hose (**19**) into the second position from the left on the hose reel.

       Place the right side Attachment Tilt hose (**20**) into the second position from the right on the hose reel.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

    b. Reinsert the retaining capscrew (**17**) back through the plates of the hose reel, inserting the spacers (**18**) back in position between the plates as the capscrew is inserted. Secure the retaining capscrew in place with a new elastic locknut (**16**). Tighten the elastic locknut securely.
    c. Remove the elastic locknut (**21**) and flat washer (**22**) from the lower retaining shoulder bolt (**23**). While pulling the shoulder bolt out, catch the spacers (**24**) from between the plates as the shoulder bolt is removed. Place the Attachment Tilt hoses around the hose reel.
    d. Insert the shoulder bolt (**23**) through the plates of the hose reel, inserting the spacers (**24**) back in position between the plates as the shoulder bolt is inserted. Place the flat washer (**22**) onto the shoulder bolt and secure in place with a new elastic locknut (**21**). Tighten securely.



MH1680

25. **With auxiliary hydraulics:** Assemble the hoses to the hose reel at the back of the boom:

IMPORTANT: *Keep the hoses in the same order as they come from the hose clamps.* ***DO NOT*** *allow the hoses to cross.*

a. Remove the elastic locknut (**1**) from the upper retaining capscrew (**2**). While pulling the capscrew out, catch the spacers (**3**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to place the hoses around the hose reel.

Place the left side auxiliary hydraulic hose (**4**) into the left position on the hose reel. Place the left side Attachment Tilt hose (**5**) into the second position from the left on the hose reel.

Place the right side Attachment Tilt hose (**6**) into the second position from the right on the hose reel.

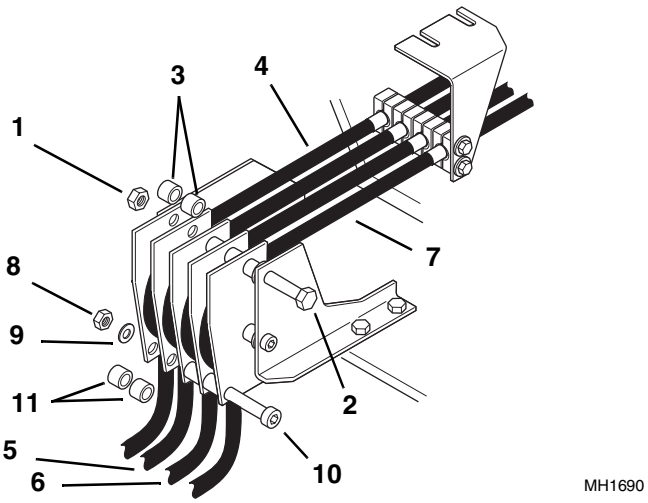
Place the right side auxiliary hydraulic hose (**7**) into the right position on the hose reel.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

b. Insert the retaining capscrew (**2**) back through the plates of the hose reel, inserting the spacers (**3**) back in position between the plates as the capscrew is inserted. Secure the retaining capscrew in place with a new elastic locknut (**1**). Tighten the elastic locknut securely.

c. Remove the elastic locknut (**8**) and flat washer (**9**) from the lower retaining shoulder bolt (**10**). While pulling the shoulder bolt out, catch the spacers (**11**) from between the plates as the shoulder bolt is removed. Place the Attachment Tilt hoses and the auxiliary hydraulic hoses around the hose reel.

d. Insert the shoulder bolt (**10**) through the plates of the hose reel, inserting the spacers (**11**) back in position between the plates as the shoulder bolt is inserted. Place the flat washer (**9**) onto the shoulder bolt and secure in place with a new elastic locknut (**8**). Tighten securely.



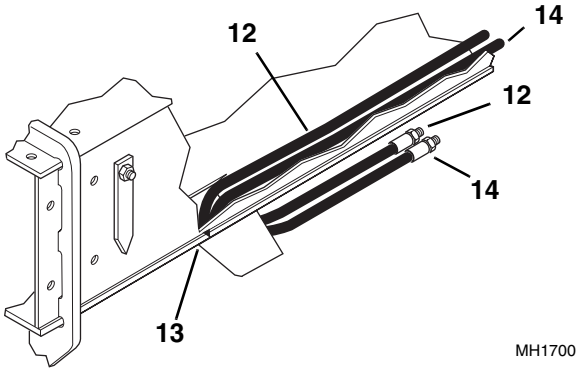
26. **Without auxiliary hydraulics:** Tie the strings (positioned inside the outer boom) to the male end of each of the Attachment Tilt hoses, coming off the bottom of the hose reel assembly.

IMPORTANT: *Keep the hoses in the same order as they come off the hose reel.* ***DO NOT*** *allow the hoses to cross.*

27. Working from the front of the boom, pull each hose through the boom assembly:

a. Pull the right side Attachment Tilt hose (**12**) through the boom assembly. Pull the hose out of the opening (**13**) at the bottom of the outer boom.

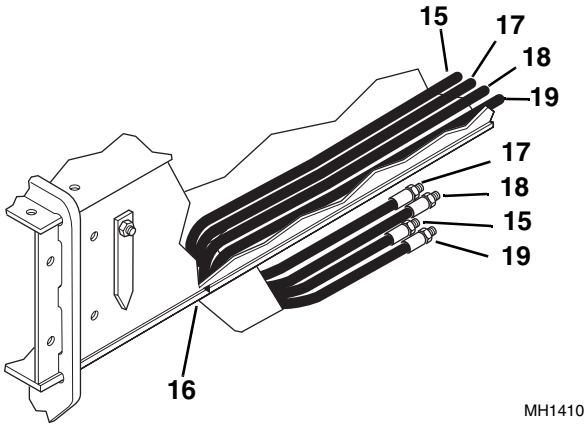
b. Pull the left side Attachment Tilt hose (**14**) through the boom. Keep the left Attachment Tilt hose to the left side of the right side Attachment Tilt hose. Pull the hose out of the opening (**13**) at the bottom of the outer boom.



28. **With auxiliary hydraulics:** Tie the strings (positioned inside the outer boom) to the male end of each of the Attachment Tilt hoses and the auxiliary hydraulic hoses.

IMPORTANT: *Keep the hoses in the same order as they come off the hose reel.* ***DO NOT*** *allow the hoses to cross.*

29. Working from the front of the boom, pull each hose through the boom assembly:
    a. Pull the right side auxiliary hydraulic hose (**15**) through the boom assembly. Pull the hose out of the opening (**16**) at the bottom of the outer boom.
    b. Pull the right side Attachment Tilt hose (**17**) through the boom assembly, keeping the hose to the left of the right side auxiliary hydraulic hose. Pull the hose out of the opening (**16**) at the bottom of the outer boom.
    c. Pull the left side Attachment Tilt hose (**18**) through the boom, keeping the hose to the left of the hoses installed. Pull the hose out of the opening (**16**) at the bottom of the outer boom.
    d. Pull the left side auxiliary hydraulic hose (**19**) through the boom, keeping the hose to the left of the hoses already installed. Pull the hose out of the opening (**16**) at the bottom of the outer boom.



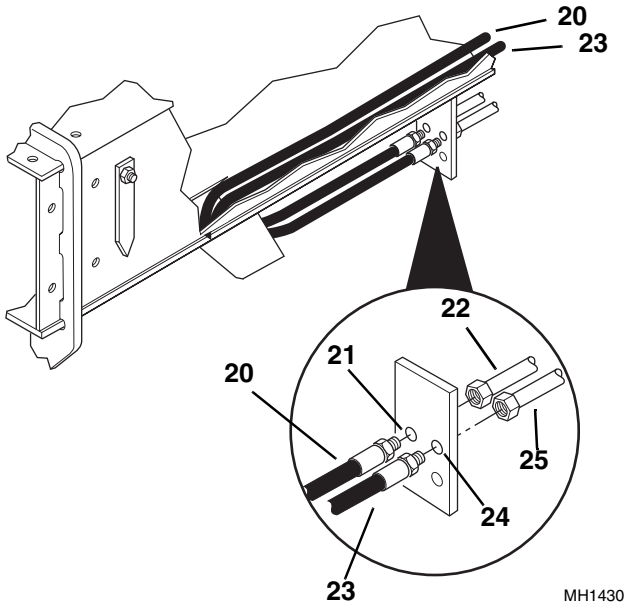
30. Remove the strings from the hoses.

31. **Without auxiliary hydraulics:** At the front of the outer boom, assemble the hose assemblies and tube assemblies to the mounting plate:

Note: *Where the hose assemblies come out of the outer boom, lubricate the radius in the outer boom with soap and water to allow proper tensioning of hoses.*

Note: *ALWAYS use new o-rings when servicing the vehicle.*

    a. Install new o-rings into the fittings. Lubricate o-rings with clean hydraulic oil.
    b. Assemble the right side Attachment Tilt hose (**20**) as it comes down the outer boom to the upper right side hole (**21**) on the mounting plate. Insert the male end of the right side hose through the upper right side hole. Tighten the right side Attachment Tilt tube assembly (**22**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.
    c. Assemble the left side Attachment Tilt hose (**23**) as it comes down the outer boom to the upper left side hole (**24**) on the mounting plate. Insert the male end of the left side hose through the upper left side hole. Tighten the left side Attachment Tilt tube assembly (**25**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.



32. **With auxiliary hydraulics:** At the front of the outer boom, assemble the hose assemblies and tube assemblies to the mounting plate:

Note: *Where the hose assemblies come out of the outer boom, lubricate the radius in the outer boom with soap and water to allow proper tensioning of hoses.*

Note: *ALWAYS use new o-rings when servicing the vehicle.*

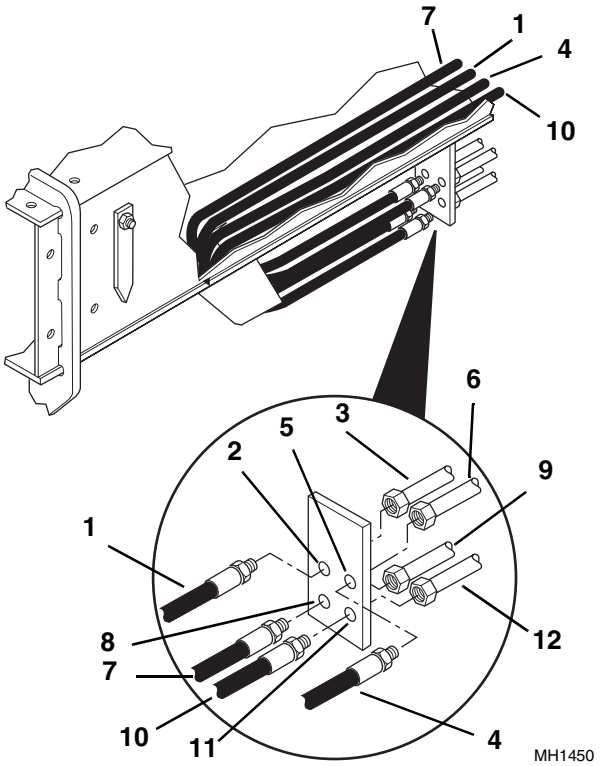
a. Install new o-rings into the fittings. Lubricate o-rings with clean hydraulic oil.

b. Assemble the right side Attachment Tilt hose (**1**) as it comes down the outer boom to the upper right side hole (**2**) on the mounting plate. Insert the male end of the right side hose through the upper right side hole. Tighten the upper right side Attachment Tilt tube assembly (**3**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.

c. Assemble the left side Attachment Tilt hose (**4**) as it comes down the outer boom to the upper left side hole (**5**) on the mounting plate. Insert the male end of the left side hose through the upper left side hole. Tighten the upper left side Attachment Tilt tube assembly (**6**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.

d. Assemble the right side auxiliary hydraulic hose (**7**) as it comes down the outer boom to the lower right side hole (**8**) on the mounting plate. Insert the male end of the right side hose through the lower right side hole. Tighten the lower right side auxiliary hydraulic tube assembly (**9**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.

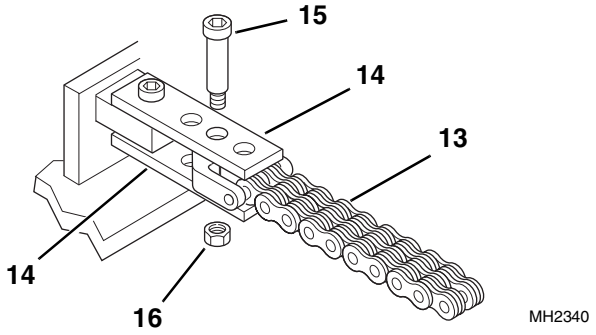
e. Assemble the left side auxiliary hydraulic hose (**10**) as it comes down the outer boom to the lower left side hole (**11**) on the mounting plate. Insert the male end of the left side hose through the lower left side hole. Tighten the lower left side auxiliary hydraulic tube assembly (**12**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly to the bulkhead fitting at the rear of the boom.



33. Place the retract chain (**13**) up around the retract chain sheave on the right side of the boom. Stretch the chain forward and place the clevis between the two anchor plates (**14**). Align the hole in the clevis with the second hole from the rear of the anchor plates.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

34. Insert the shoulder bolt (**15**), saved, from the top down and secure in place with a new elastic locknut (**16**). Tighten the locknut securely.

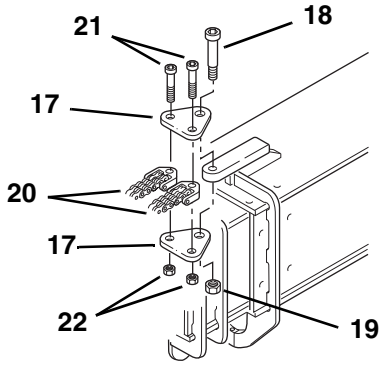


35. Assemble the two extend chains to the outer boom mount if the yoke plates were removed from the extend chains. If the yoke plates were not replaced, proceed to Step 38.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

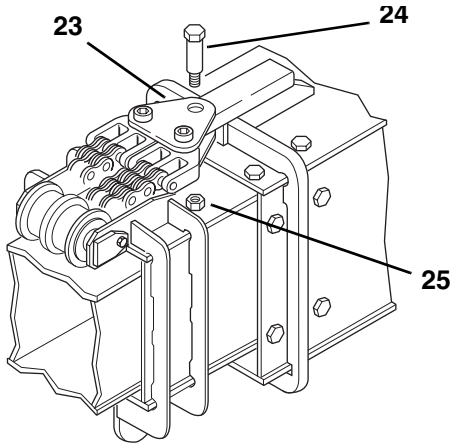
36. Assemble the yoke plates (**17**) to the mount on the front of the outer boom. Coat the shoulder bolt (**18**), saved, with anti-seize compound and insert the shoulder bolt through a yoke plate (**17**), the mount on the boom and through a second yoke plate (**17**) on the bottom. Secure in place with a new elastic locknut (**19**). Tighten the locknut securely; but the yoke plates must pivot freely.

37. Assemble the clevis' on the two extend chains (**20**) between the yoke plates. Align the holes in each clevis with the holes in the yoke plates. Coat the capscrews (**21**), saved, with anti-seize compound and insert the capscrews through the yoke plates and the clevis. Secure in place with new elastic locknuts (**22**). Tighten the locknuts securely; but the extend chain clevis' must pivot freely.



SH1870

38. Align the holes in the yoke plates (**23**) with the hole in the mount on the outer boom. Coat the shoulder bolt (**24**), saved, with anti-seize compound and insert the shoulder bolt through the yoke plates and the mount on the boom. Secure in place with a new elastic locknut (**25**). Tighten the locknut securely; but the yoke plates must pivot freely.

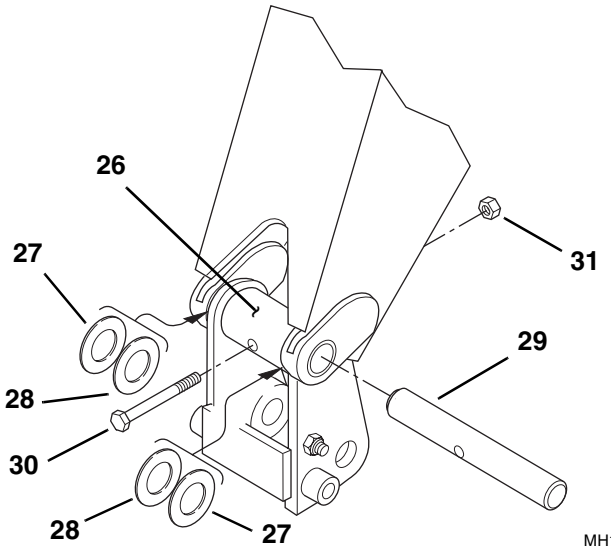


MH1710

39. Assemble the quick attach to the gooseneck. Align the quick attach (**26**) between the mounts on the gooseneck. Assemble a washer (**27**), saved, on each side of the quick attach. Reassemble the shims (**28**), saved, between the quick attach and the gooseneck. **DO NOT** put all the shims on one side. The quick attach should be centered in the gooseneck.

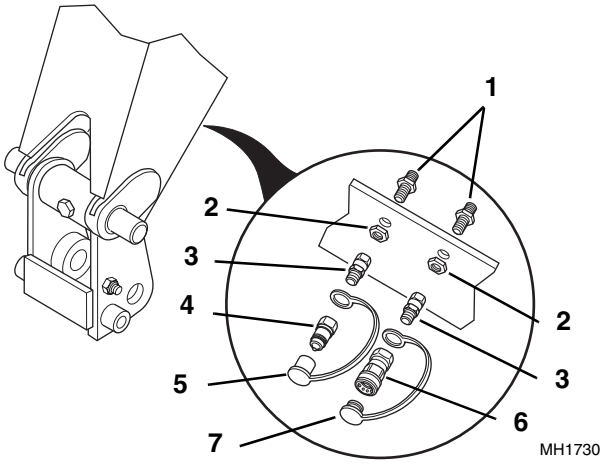
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

40. Coat the quick attach pivot pin (**29**) with anti-seize compound. Insert the quick attach pivot pin through the gooseneck, washers, shims and quick attach. Use a tapered punch to align the hole in the pivot pin with the hole in the quick attach. Insert the capscrew (**30**), saved, through the quick attach and pin. Secure the capscrew in place with a new elastic locknut (**31**). Tighten securely.



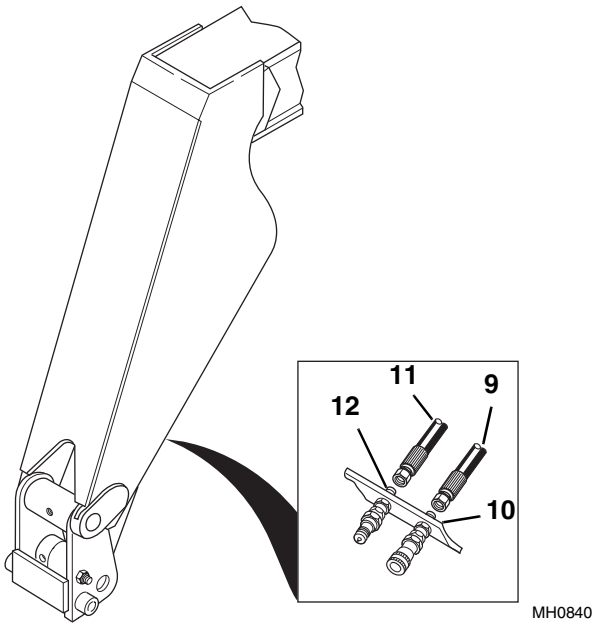
MH1720

41. **With auxiliary hydraulics:** If the inner boom has been replaced with a new boom, the auxiliary hydraulic fittings need to be reassembled:
    a. Assemble the two bulkhead fittings (**1**) from the original boom to the bulkhead plate inside the gooseneck. Insert the bulkhead fittings from the top and secure in place with the bulkhead fitting nut (**2**) on the bottom side. Tighten securely.
    b. Assemble the two swivel straight connectors (**3**) to the two bulkhead fittings.
    c. Assemble the male nipple (**4**) and dust cap (**5**) to the right side swivel connector fitting. Tighten the swivel connector and male nipple securely. Assemble the dust cap onto the male nipple. Assemble the female coupler (**6**) and dust plug (**7**) to the left side swivel connector fitting. Tighten the swivel connector and female coupler securely. Insert the dust plug into the female coupler.



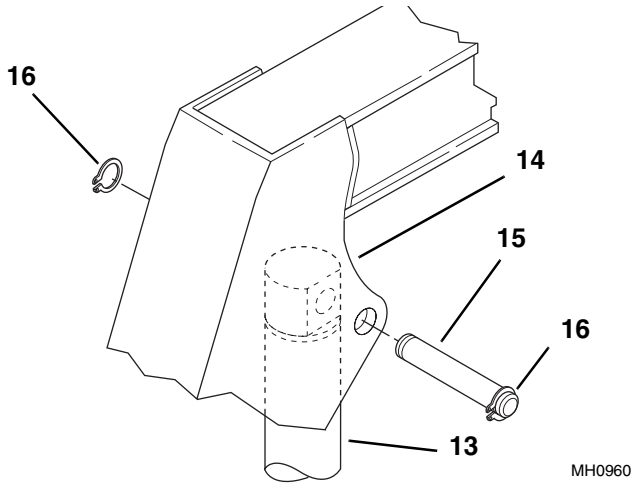
MH1730

    d. Assemble the left auxiliary hydraulic hose (**9**) labeled “Female Coupler” from inside the gooseneck to the female coupler (**10**) bulkhead fitting. Tighten securely.
    e. Assemble the right auxiliary hydraulic hose (**11**) labeled “Male Nipple” from inside the gooseneck to the male nipple (**12**) bulkhead fitting. Tighten securely.



MH0840

42. Use a hoist and slings to position the Attachment Tilt cylinder (**13**) inside the gooseneck (**14**). Be sure the Attachment Tilt cylinder is positioned with the tube for the rod end positioned inside the gooseneck.
43. Coat the base end pivot pin (**15**), saved, with anti-seize compound. Align the hole in the cylinder base end with the mounting holes in the gooseneck and insert the pivot pin through the gooseneck. Secure the pivot pin to the gooseneck with the two retaining rings (**16**), saved. Be sure the retaining rings are resting squarely in the grooves on the pivot pin.

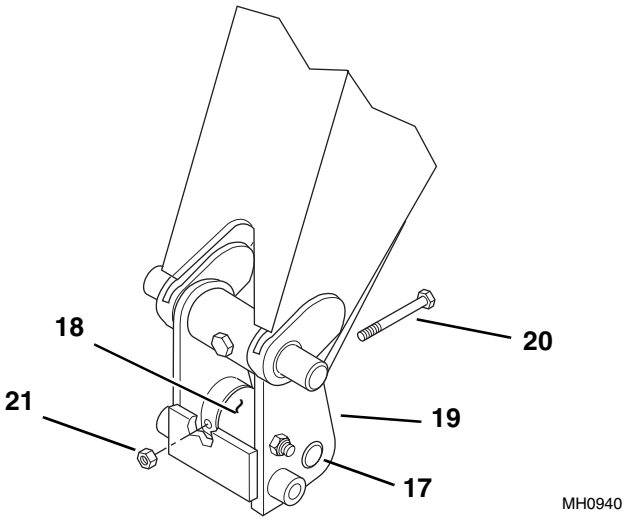


MH0960

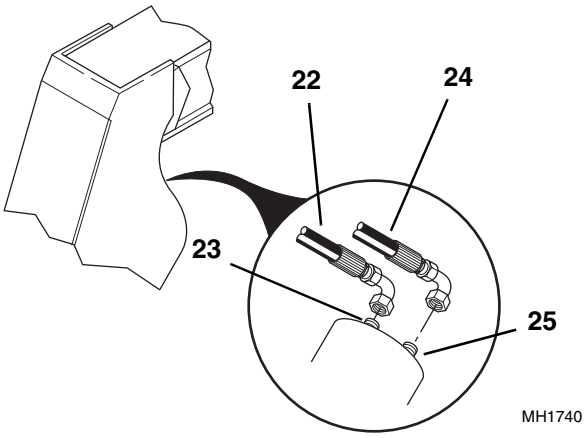
44. Coat the rod end pivot pin (**17**), saved, with anti-seize compound. Swing the rod end (**18**) of the Attachment Tilt cylinder up and line up the rod end with the mounting holes in the quick attach (**19**).

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

45. Insert the rod end pivot pin (**17**) through the lined-up holes. Use a tapered punch to line up the capscrew hole in the pivot pin and the mounting hole in the quick attach hub. Insert the capscrew (**20**), saved, through the quick attach hub from the backside and secure in place with a new elastic locknut (**21**). Tighten securely.



46. Assemble the Attachment Tilt hoses from the backside of the gooseneck to the fittings on the base end of the Attachment Tilt cylinder. Assemble the left side hose (**22**) labeled as “Retract” to the retract port (upper) fitting (**23**) on the base end of the Attachment Tilt cylinder. Index the elbow end of the hose to remove any undo tension and tighten the elbow completely to the fitting on the cylinder.
47. Assemble the right side hose (**24**) labeled as “Extend” to the extend port (lower) fitting (**25**) on the base end of the Attachment Tilt cylinder. Index the elbow end of the hose to remove any undo tension and tighten the elbow completely to the fitting on the cylinder.



48. Clean up all debris, hydraulic fluid, etc., in, on, near and around the vehicle.
49. Connect the battery negative (-) ground cable.

> **WARNING:** Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious personal injury.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check the hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

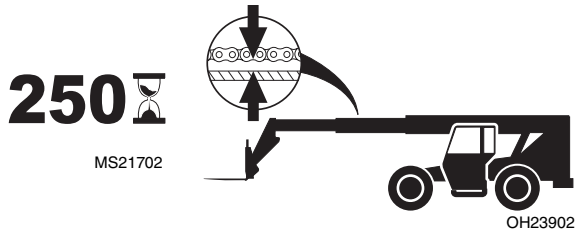
50. Start the engine and operate all boom functions several times. Check the chain tension again and adjust as necessary. Check for leaks, and check the hydraulic fluid level in the tank; add fluid if required.

3.4 BOOM CHAINS - THREE SECTION BOOM (8042 AND 10042)

This vehicle uses double extend chains to extend the boom and a single retract chain to retract the boom. The extend and retract chains are constructed of 3/4" pitch links with 6 x 6 leaf lacing.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.*

3.4.1 Boom Chain Inspection



WARNING: Worn pins, stretched or cracked links or corrosive environments can cause chain failure. A chain failure could result in uncontrolled boom movement, loss of load or vehicle instability, and could cause death or serious injury and/or property damage.

Under normal operating conditions the extend chains will need to be inspected every 250 hours of operation. The retract chain will need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

Environments in which material handling vehicles operate can vary widely, from outdoor moisture to mildly corrosive or highly corrosive industrial atmospheres, in addition to abrasive exposures such as sand and grit. Some effects can be as follows:

- Moisture - Corrosive rusting reduces chain strength by pitting and cracking.
- Temperature - Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.
- Chemical Solutions or Vapors - Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Going from microscopic cracking to complete failure can be either abrupt or may require an extended period of time.
- Abrasives - Accelerated wearing and scoring of the articulating members of the chain (pins and plates), with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of a leaf chain:

- High velocity movement of load, followed by sudden, abrupt stops.
- Carrying loads in suspension over irregular surfaces such as railroad tracks, potholes and rough terrain.
- Attempting to “inch” loads which are beyond the rated capacity of the vehicle.

The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

The boom chain’s normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3% of pitch. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

a. Inspection Guidelines

Expose the extend and retract chains (refer to Section 3.4.1, b. “Expose Extend Chain for Inspection,” or Section 3.4.1, c. “Expose Retract Chain for Inspection.”) and inspect the chains for the following conditions:

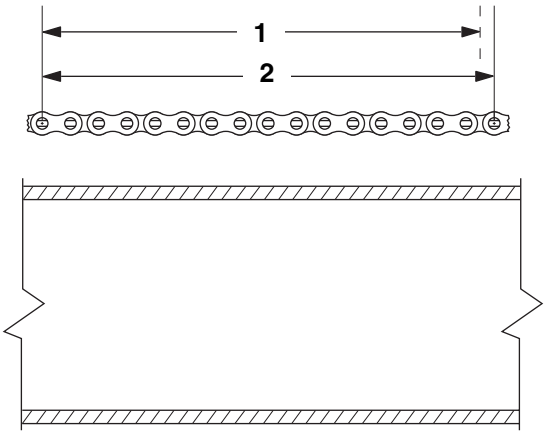
Elongation

When the original length (**1**) of 12" (305 mm) per foot of new chain has elongated from wear to a length (**2**) of 12.36" (313 mm), the chain must be discarded and replaced. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading.

Measure across a span of 17 pins at the center of the extend chain. Measure from pin center to pin center.

The maximum measurement allowed is 12.36" (313 mm). If the measurement is more than 12.36" (313 mm), the chain must be replaced. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

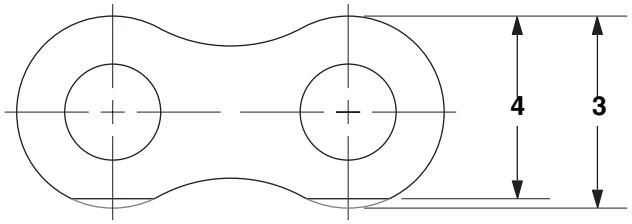


MM2120

Edge Wear

Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material must not exceed 5%. This can be compared to a normal link plate height by measuring a portion of chain that does not run over the sheave.

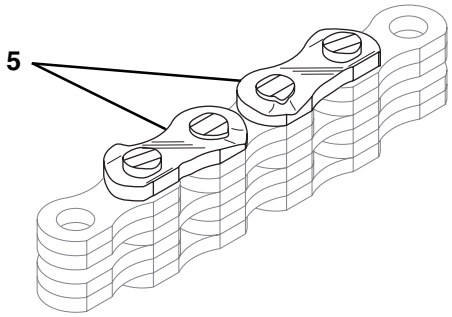
The new chain link measures .713" (18 mm) (**3**). If the measurement of the worn chain is less than .677" (17 mm) (**4**), the chain must be replaced. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)



MM2051

Distorted or Battered Link Plates

Distorted or battered link plates (**5**) on a leaf chain can cause tight joints and prevent flexing.



MA9340

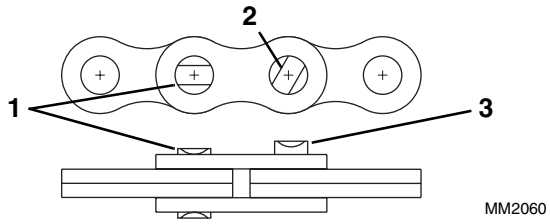
Turning or Protruding Pins

Highly loaded chain, operating with inadequate lubrication, can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure.

Examine the pin head rivets to determine if the “VEE” flats are still in correct alignment (**1**). Chain with rotated/ displaced heads (**2**) or abnormal pin protrusion (**3**) must be replaced immediately. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

DO NOT attempt to repair the chain by welding or driving the pin(s) back into the chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored.

Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and must be corrected.



MM2060

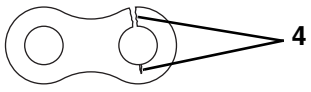
Cracked Plates

Inspect the chains very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain must be replaced in its entirety. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

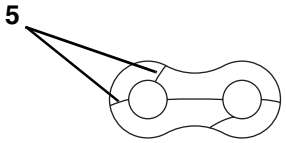
- **Fatigue Cracking -** Fatigue cracks (**4**) are a result of repeated cyclic loading beyond the chain’s endurance limit. The size of the load and the frequency of its occurrence are factors which determine when fatigue failure will occur. The loading can be continuous or intermittent (impulse load).
- **Stress Corrosion Cracking -** The outside link plates are particularly susceptible to stress corrosion cracking (**5**). Like fatigue cracks, these initiate at the point of highest stress but tend to extend in an arc-like path between holes in the pin plate. More than one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere.

Stress corrosion is an environmentally assisted failure. Two conditions must be present: corrosive agent and static stress. In the chain, static stress is present at the aperture due to the press fit pin. No cyclic motion is required, and the plates can crack during idle periods.

- **Corrosion Fatigue Cracking -** Corrosion fatigue cracks are very similar to fatigue cracks (**4**) in appearance. They generally begin at the aperture and grow perpendicular to the chain pitch line. Corrosion fatigue is not the same as stress corrosion. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress, not a static stress alone, as in stress corrosion.



MM2070



MM2080

Other Modes of Failure

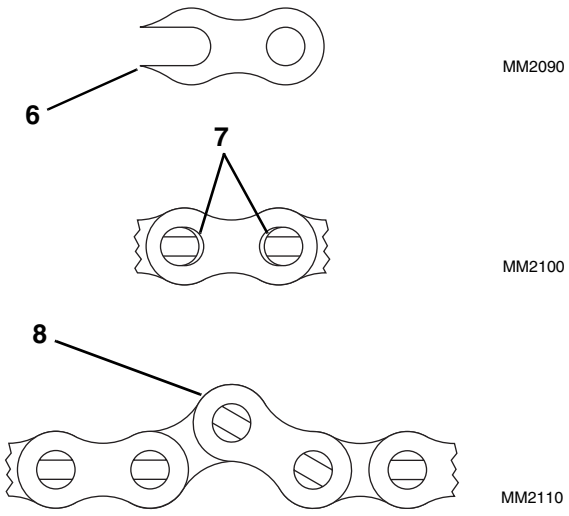
- Ultimate Strength Failure - These types of failures are caused by overloads far in excess of the design load. Either fractured plates (**6**) or enlarged holes (**7**) can occur. If either of these failures occurs, the chain must be replaced immediately. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

Note: *The tight joints inspection must be done with the chain disconnected from the boom. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)*

- **Tight Joints -** All joints in the chain must flex freely. Tight joints (**8**) resist flexing and increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain.

If the problem is caused by corrosion and rust or bent pins, replace the chain. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)



b. Expose Extend Chain for Inspection

1. Park the vehicle on level ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and raise the boom to a horizontal (level) position.
2. Fully extend the boom until the extend chain is taut. Shut the engine OFF.

The extend chains will be visible for inspection with the vehicle in this state.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis’ be replaced at the same time.

Note: DO NOT *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all the chains and clevis’ be replaced at the same time.*

3. If the chain needs to be replaced, refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”
4. If the chain does not need to be replaced, lubricate the chain. (Refer to Section 3.4.2, “Chain Lubrication.”)

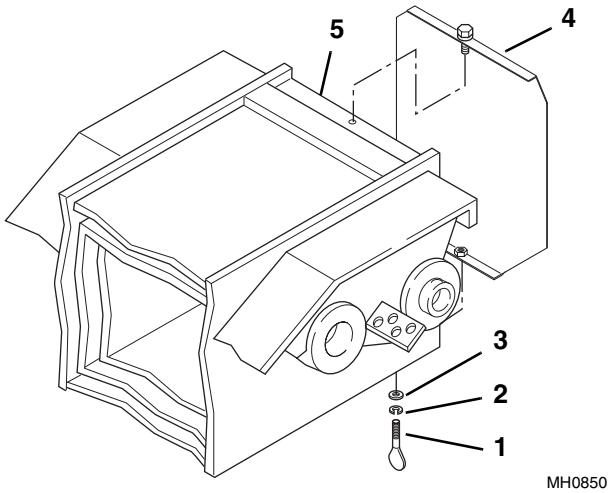
c. Expose Retract Chain for Inspection

The retract chain must be removed from the boom in order to be visually inspected. This must be done every 1000 hours or whenever the retract chain is removed from the boom. (If removal of the chain is required refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

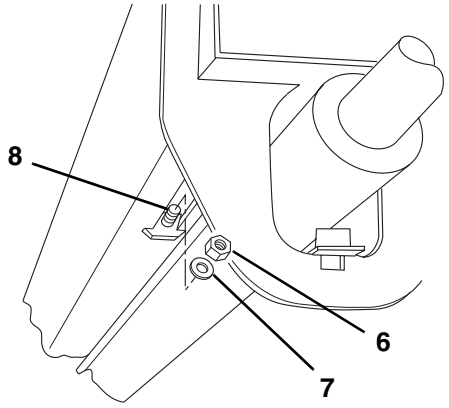
If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis’ be replaced at the same time.

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**1**), lockwasher (**2**) and flat washer (**3**), holding the rear cover (**4**) to the rear of the outer boom (**5**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



MH0850

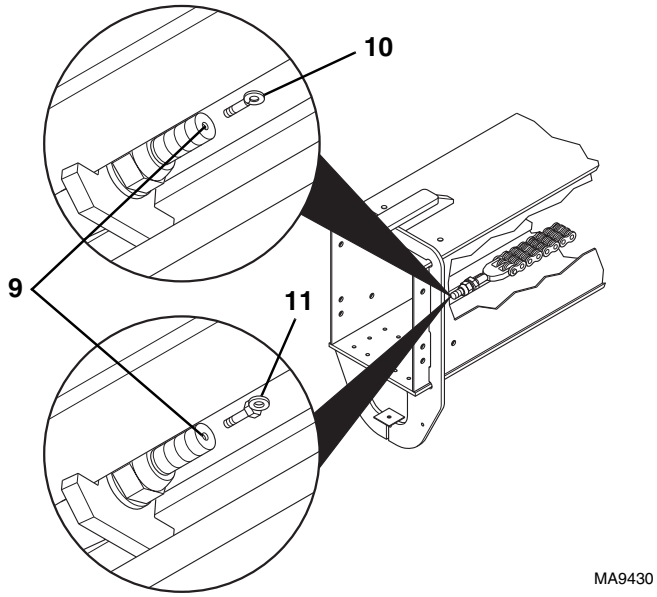
4. At the front underside of the boom, record the amount of threads extending beyond the elastic locknut (**6**). This measurement will be the starting point for adjustment of the boom retract chain.
5. Loosen the elastic locknut (**6**) far enough so that it can be removed by hand.



MH1110

6. If the chain clevis has a threaded hole on the end (**9**), a string or wire can be attached to the retract chain clevis using a threaded eye (**10**) or a flat washer tack welded to a capscrew (**11**). The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The string or wire will be used to pull the chain back through the boom during the reassembly.

   If there is no threaded hole on the end of the clevis, a phillips screwdriver will be needed to catch the countersunk hole in the end of the clevis and guide it through the tab during reassembly.

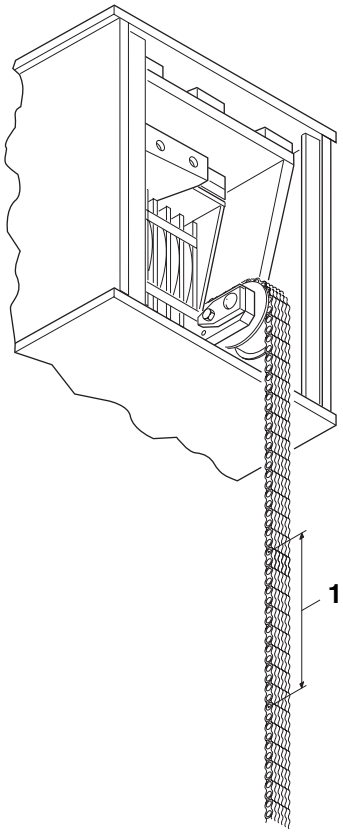


MA9430

7. Remove the elastic locknut (**6**) and flat washer (**7**) holding the retract chain threaded clevis (**8**) to the mounting tab. Save the flat washer and discard the elastic locknut.
8. If a threaded eye or capscrew with flat washer (**10** or **11**) was installed in step 6, attach a string or wire to the end of the retract chain clevis. The string or wire must be long enough to pull the clevis and chain through the outer boom.
9. Place a pan or tarp, free of dirt, at the rear of the vehicle, for the chain to rest on as it is being removed from the boom. From the rear of the boom, pull the retract chain out of the rear of the boom.
10. With the chain hanging from the rear of the boom, inspect wear and condition of the chain, clevis', chain sheaves, chain pins, clevis anchors and all mounting hardware. Replace a worn or damaged chain. **DO NOT** attempt to make any repairs to the chain.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevis' be replaced at the same time.*

11. Measure the chain elongation. Measure across 17 pins (**1**), somewhere between the chain sheave and where the chain is laying in the pan or on the tarp. The maximum measurement allowed is 12.36" (313 mm). If the measurement is more than 12.36" (313 mm), the chain must be replaced. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”)



Note: *Chains and clevis’ are wear items and experience the same stress.* ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis’.*

12. If the chain needs to be replaced, refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement.”

13. Lubricate the chain, while it is exposed, if it does not need to be replaced. (Refer to Section 3.4.2, “Chain Lubrication.”)

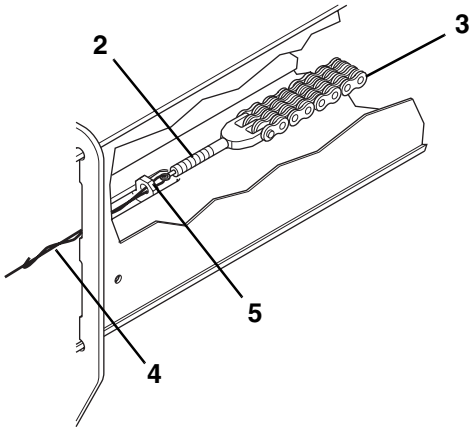
14. Coat the threads of the threaded clevis (**2**) with multi-purpose grease.

Note: *Have a second person help with the installation of the retract chain between the intermediate and outer boom assemblies.*

If a string or wire was installed to the end of the clevis:

15. From the rear of the boom, one person should push the threaded clevis end (**2**) of the retract chain (**3**) under the chain sheave and down between the intermediate boom and the outer boom. The person at the front of the boom should pull the clevis using the string or wire (**4**) attached to the clevis in step 6. Push and pull the threaded clevis down to the tab (**5**) at the front underside of the outer boom.

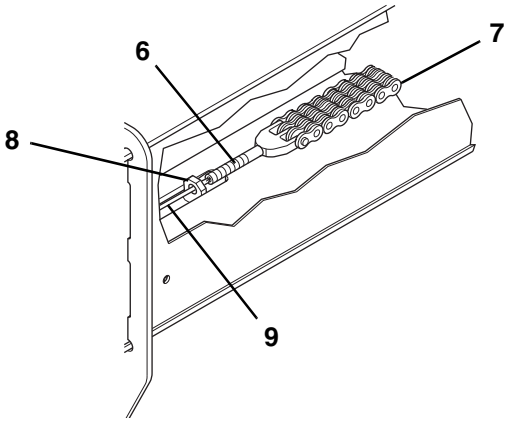
16. The person at the front of the boom should guide the threaded end of the clevis (**2**) through the hole in the tab (**5**).



17. Remove the string or wire, and the threaded eye or capscrew with flat washer, from the end of the clevis.

If no string or wire was installed to the end of the clevis:

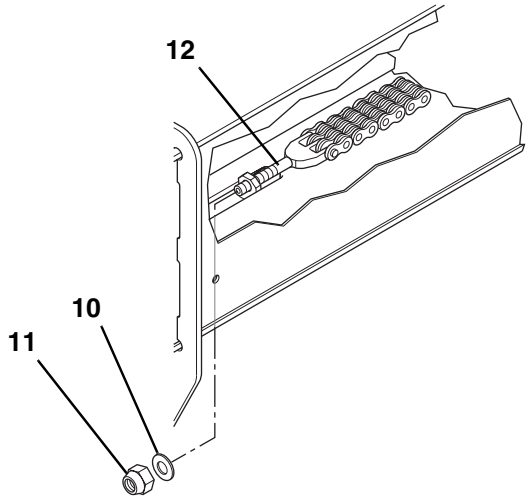
18. From the rear of the boom, one person should push the threaded clevis end (**6**) of the retract chain (**7**) under the chain sheave and down between the intermediate boom and the outer boom. Keep the retract chain (**7**) to the right side of the boom, push the threaded clevis down to the tab (**8**) at the front underside of the outer boom.
19. The person at the front of the boom should guide the threaded end of the clevis (**6**) through the hole in the tab (**8**) using a Phillips screwdriver (**9**). Insert the screwdriver through the hole in the tab and catch the countersunk hole in the end of the clevis. Guide the threaded clevis out as the person at the rear of the boom pushes the retract chain forward.



MA9520

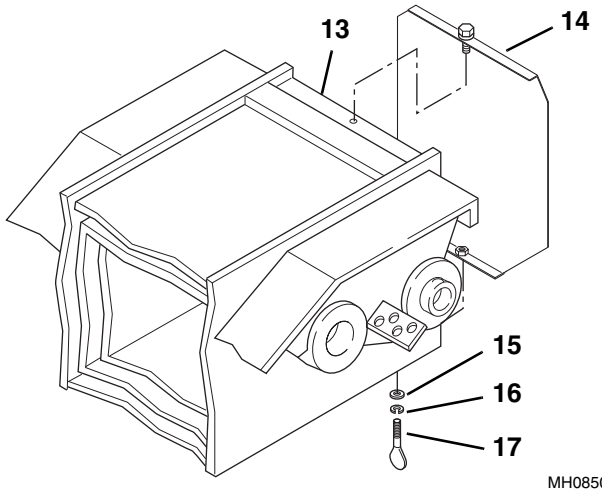
Once the threaded clevis is through the tab on the outer boom:

20. Reassemble the flat washer (**10**), saved, and a new 3/4-16 elastic locknut (**11**) onto the threaded clevis (**12**). Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.
21. Tighten the elastic locknut (**11**) on the retract chain clevis (**12**) until the amount of threads protruding beyond the elastic locknut is the same as the measurement recorded during removal of the retract chain.
22. Adjust retract chain tension. (Refer to Section 3.4.3, “Boom Chain Tension Check.”)



MA9510

23. After adjustment is complete, assemble the rear cover to the rear of the outer boom. At the rear of the outer boom (**13**), position the rear cover (**14**) in place. Secure the cover in place with the saved, 5/16" flat washer (**15**), lockwasher (**16**) and thumbscrew (**17**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



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3.4.2 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated with a quality chain lubricant ("LUBRIPLATE" Chain & Cable Fluid, "LPS3" or equivalent).

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that the lubricant can penetrate to the working surfaces.

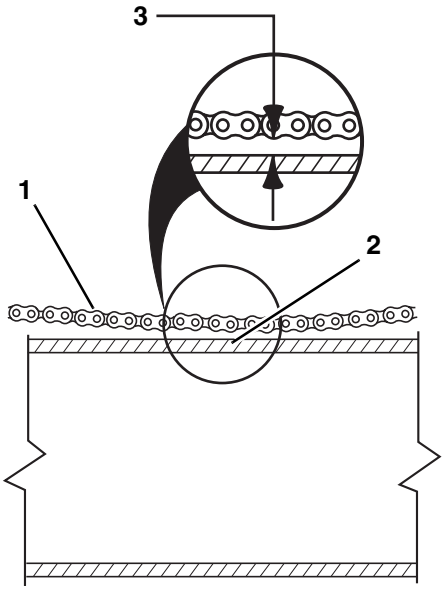
Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant, and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. **DO NOT** use a solvent for this wiping operation.

Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. It is important that a reputable lubrication specialist, consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, for guidance.

3.4.3 Boom Chain Tension Check

1. Make sure the carriage is attached to the gooseneck before doing the tension check.
2. Start the engine. If necessary, attach carriage to gooseneck. Park the vehicle on level ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and raise the boom to a horizontal (level) position.
3. Slowly, fully extend the boom and retract it about halfway. Fully extend the boom, then retract it 2" (51 mm) (one inch per section). Turn the engine OFF.
4. Measure the sag in the top boom extend chains (**1**) between the bottom of the extend chains and the top of the intermediate boom at their closest point (**2**). Acceptable boom chain sag (**3**) is between 1.5" (38 mm) and 2.5" (64 mm).



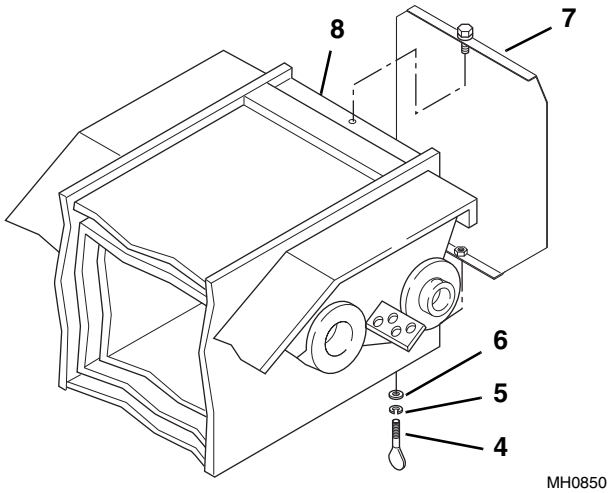
If the measurement is either less than, or greater than the range given, the boom chains need to be adjusted. Continue with Section 3.4.4, "Boom Chain Tension Adjustment," to adjust the chain system.

5. Start the engine, retract the boom completely and turn the engine OFF.

3.4.4 Boom Chain Tension Adjustment

Note: *Always perform Section 3.4.3, "Boom Chain Tension Check" before adjusting the boom chain tension.*

1. Remove the thumbscrew (**4**), lockwasher (**5**) and flat washer (**6**), holding the rear cover (**7**) to the rear of the outer boom (**8**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.

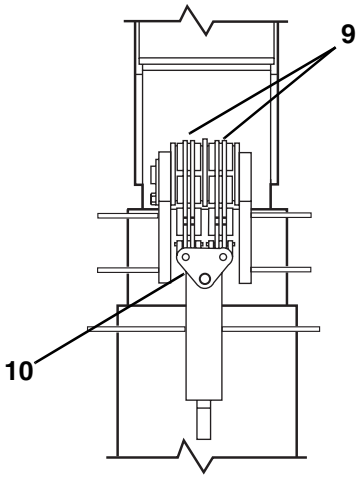


MH0850

2. Adjust the two boom extend chains (**9**).

   If the chain sag measurement (**3**) is less than 1.5" (38 mm), tighten the two extend chain adjustment locknuts (**11**).

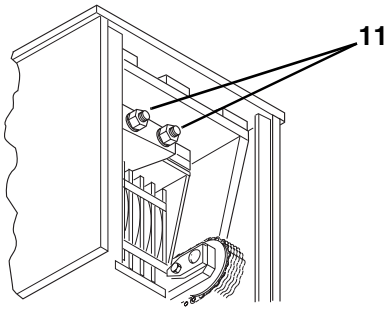
   If the chain sag measurement (**3**) is more than 2.5" (64 mm), loosen the two extend chain adjustment locknuts (**11**).



OH0240

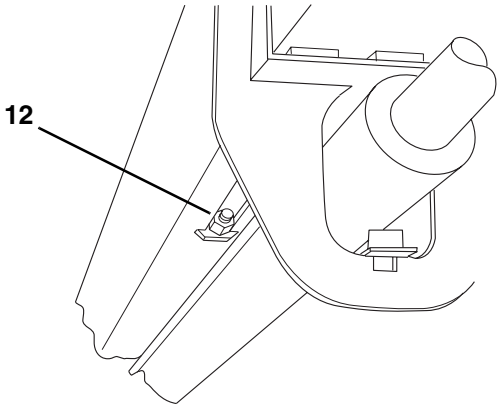
3. Tighten or loosen the two extend chain adjustment locknuts (**11**) located at the rear of the boom. Be sure each of the locknuts are adjusted equally so that each extend chain maintains the same tension.

   Equal chain tension can be checked by the position of the yoke (**10**) on the outer boom. The front of the yoke should be parallel with the front edge of the outer boom.



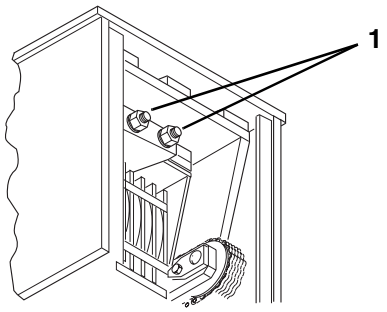
MH1751

4. If there is no adjustment left on the extend chains, tighten the retract chain locknut (**12**) at the front on the underside of the outer boom.

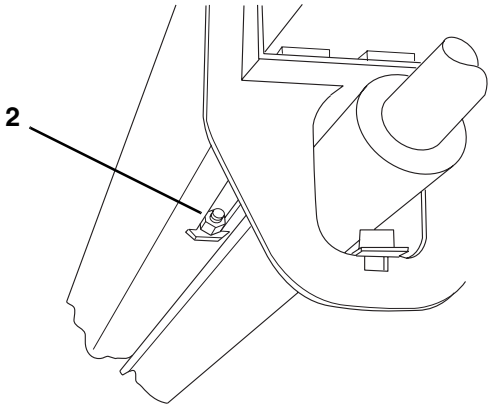


OA0512

5. Recheck chain tension. (Refer to Section 3.4.3, “Boom Chain Tension Check.”)
6. Further chain adjustment can be achieved by loosening all three chain locknuts (**1** and **2**) and moving the rear retract chain clevis (**3**) from the original mounting hole (**4**) in the anchor plate to the next hole (**5**).



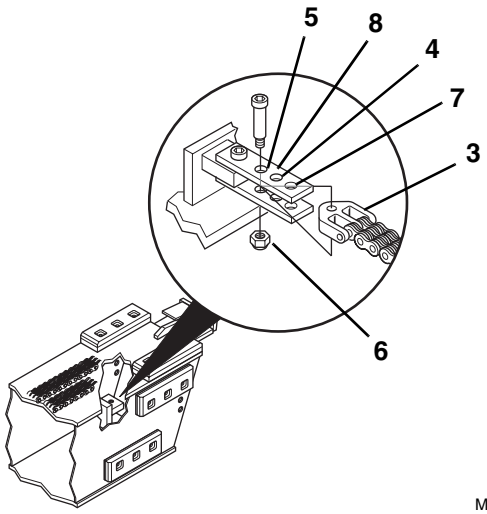
MH1751



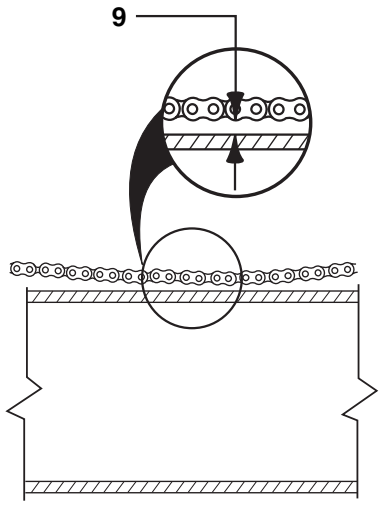
OA0512

This is only acceptable when boom chain sag (**9**) cannot be acquired and the chain elongation measurement is still less than 12.36" (313 mm). Make sure to use a new 3/8-16 elastic locknut (**6**) to re-secure the chain clevis to the anchor plate. Follow the instructions in Section 3.4.4, a. “Component/ Assembly Verification.”

7. Recheck chain tension. (Refer to Section 3.4.3, “Boom Chain Tension Check.”)

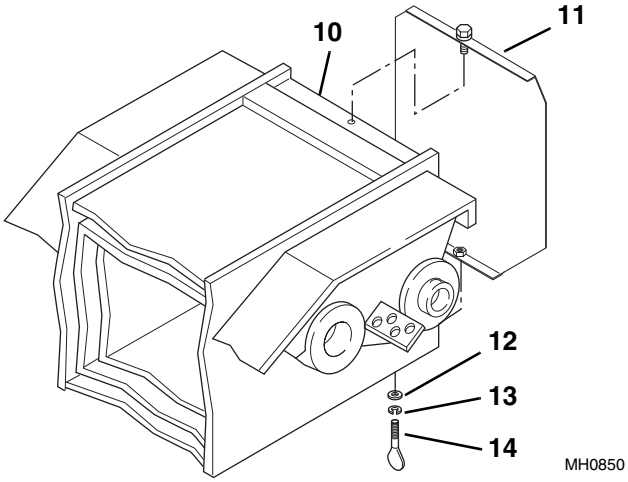


MA9450



OA0492

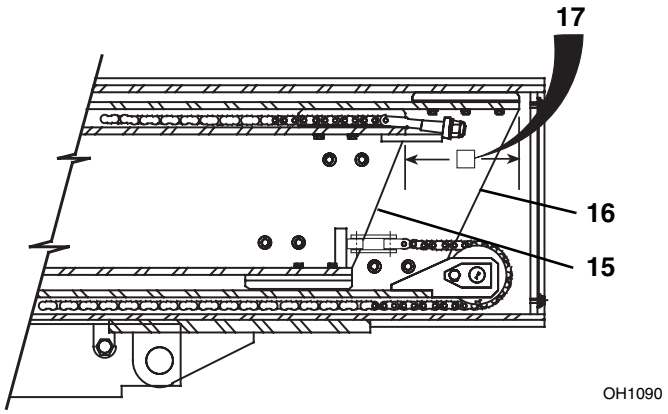
8. Assemble the rear cover to the rear of the outer boom. On the rear of the outer boom (**10**), position the rear cover (**11**) in place. Secure the cover in place with the saved 5/16" flat washer (**12**), lockwasher (**13**), and thumbscrew (**14**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



a. Component/Assembly Verification

The inner (**15**) to intermediate (**16**) boom separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.

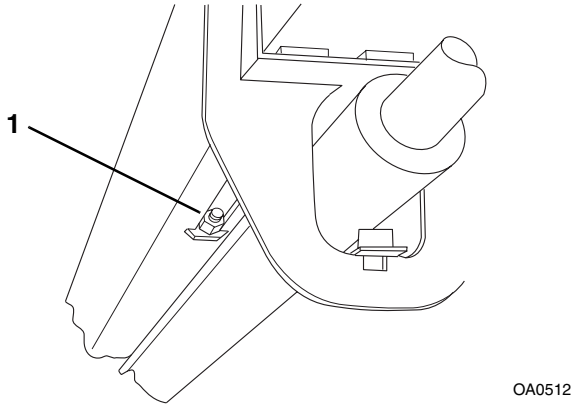
Measure the separation between the inner and intermediate boom top plates (**17**). The distance should be at least 8.5" (216 mm) and not greater than 11" (279 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 8.5" (216 mm) could result in interference and cause damage to boom components.



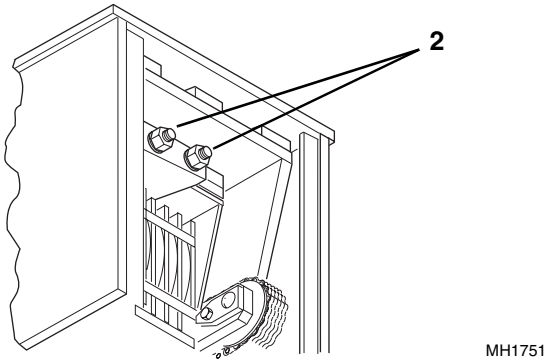
If the distance is less than 8.5" (216 mm) or greater than 11" (279 mm):

1. Verify that the retract chain clevis (**3**) is not mounted in the last hole (**7**) in the anchor plate (**8**).
2. Make sure that the chain system is properly tensioned. Refer to Section 3.4.3, “Boom Chain Tension Check,” and Section 3.4.4, “Boom Chain Tension Adjustment.”

3. **To increase the separation distance:** Loosen the retract chain locknut (**1**) on the bottom of the outer boom one or two turns and tighten the two extend chain locknuts (**2**) equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknuts (**2**) at the rear of boom equally one or two turns and tighten the retract chain locknut (**1**) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.
5. Assemble the rear cover (**3**) to the rear of the outer boom. On the rear of the outer boom (**4**), position the rear cover (**3**) in place. Secure the cover in place with the saved 5/16" flat washer (**5**), lockwasher (**6**), and thumbscrew (**7**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



OA0512



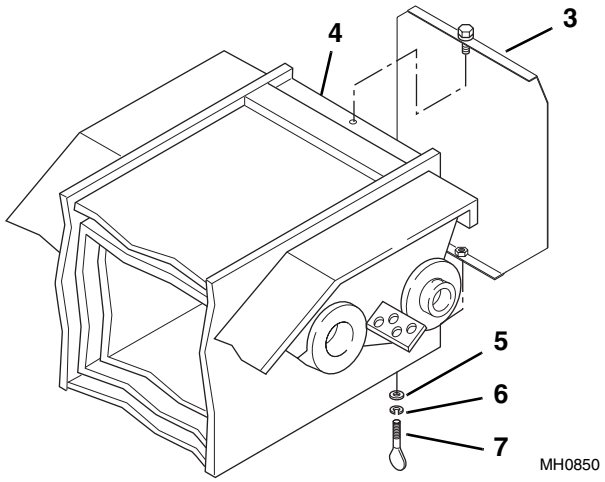
MH1751

Note: *If the inner to intermediate boom separation distance cannot be achieved, contact the local* ***Sky Trak*** *distributor or the* ***JLG*** *Service Department at 1-877-554-5438 or 1-717-485-6657.*

3.4.5 Boom Extend and Retract Chains Removal and Replacement

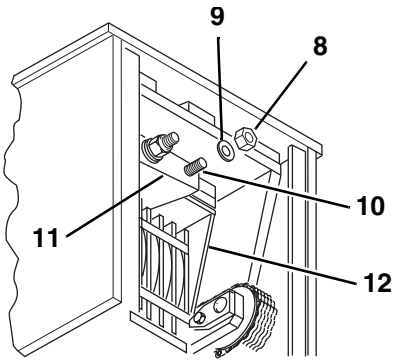
a. Extend Chains Removal and Replacement

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**7**), lockwasher (**6**) and flat washer (**5**) holding the rear cover (**3**) to the rear of the outer boom (**4**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



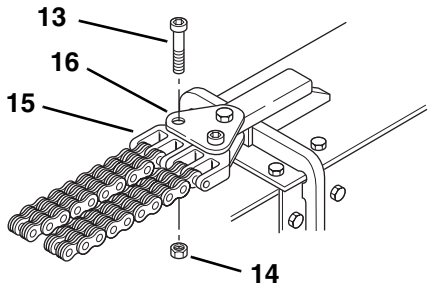
MH0850

4. At the rear of the boom, locate the extend chain elastic locknuts (**8**). Record the amount of threads extending beyond both the elastic locknuts. These measurements will be the starting point for adjustment of the extend chains after installation.
5. Remove and replace the extend chains one at a time. Remove the right side elastic locknut (**8**) and flat washer (**9**), holding the right side extend chain clevis (**10**) to the anchor plate (**11**) on the inner boom (**12**). Save the flat washer and discard the elastic locknut.



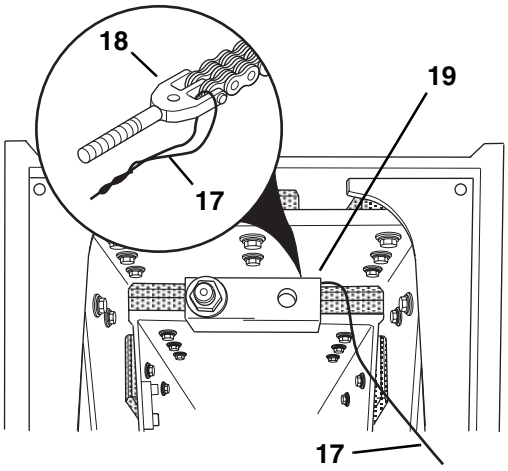
MH0911

6. At the front of the outer boom, remove the hex socket head capscrew (**13**) and elastic locknut (**14**), holding the right side extend chain clevis (**15**) to the yoke plates (**16**). Discard the elastic locknut. Inspect the hex socket head capscrew for signs of wear or damage. Replace with a new hex-socket head capscrew if damaged or worn.



SH1810

7. At the rear of the boom, attach one end of a wire (**17**) to the threaded clevis (**18**) on the right side extend chain. Loop the wire around and twist together to form a loop. Route the wire around the right side of the clevis anchor plate (**19**).



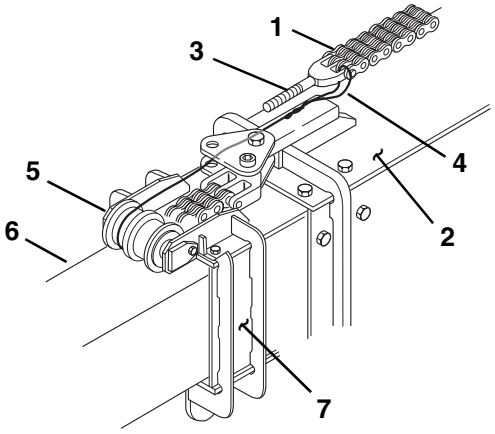
SH1830

8. Have a second person assist with the removal of the extend chain. One person should pull the chain from the front of the boom while the second person guides the wire into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
9. Inspect wear and condition of the booms, chains, clevis', chain sheaves, extend/retract cylinder, chain rods, clevis anchors and all mounting hardware. Replace any worn or damaged parts. **DO NOT** attempt to make any repairs to the chain.

IMPORTANT: *Chains and clevis' are wear items and experience the same stress.* ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis'.*

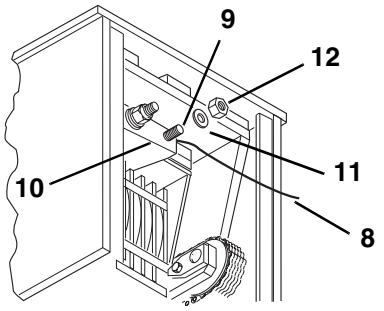
10. Coat the threads of the threaded clevis (**18**) with multi-purpose grease.

11. Lay the new extend chain (**1**) on top of the outer boom (**2**) with the threaded clevis (**3**) toward the front of the boom.
12. Attach the wire (**4**) to the threaded clevis (**3**) of the new extend chain. Loop the wire through the clevis and twist together to form a loop.
13. Pull the extend chain forward and place over the right side of the chain sheave (**5**). Guide the wire and the threaded clevis into the boom by placing the threaded clevis under the chain sheave, and between the top of the inner boom (**6**) and the intermediate boom (**7**).



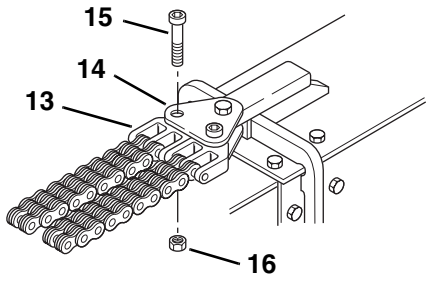
SH1851

14. While one person guides the extend chain into the front of the boom, a second person should pull the wire (**8**) and threaded clevis toward the rear of the boom. Guide the threaded clevis (**9**) into the hole in the anchor plate (**10**).
15. Place the 3/4" flat washer (**11**), saved, onto the threaded end of the threaded clevis and assemble a new 3/4-16 elastic locknut (**12**). Thread the elastic locknut onto the threaded clevis until the threads are flush with the top of the nut.



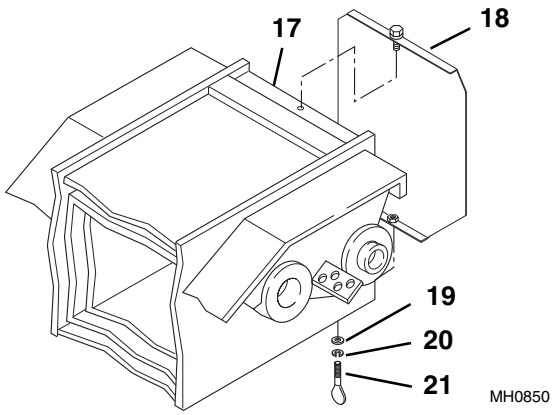
SH1861

16. Pull the anchor clevis (**13**) up around the double chain sheave and position the clevis between the yoke plates (**14**).
17. Coat the hex-socket head capscrew (**15**), saved, with anti-seize compound. Insert the capscrew through the yoke plates and clevis and secure in place with a new 3/8-16 elastic locknut (**16**). Tighten securely; but the chain clevis must pivot freely.



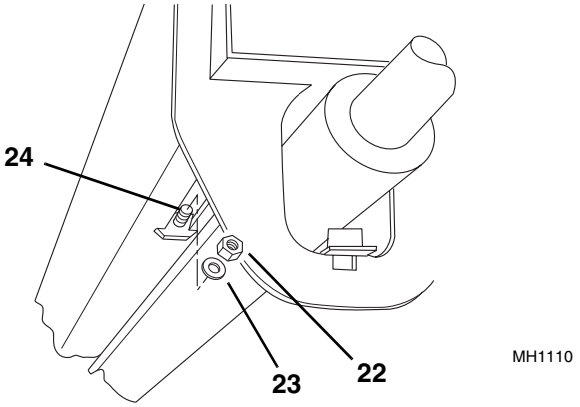
SH1810

18. Cut the loop in the wire and remove the wire from the clevis.
19. Repeat Section 3.4.5, a. “Extend Chains Removal and Replacement,” starting with Step 5, to remove and replace the left side extend chain.
20. At the rear of the boom, tighten the two elastic locknuts (**12**) on the extend chain clevis’ until the amount of threads protruding beyond each elastic locknut is the same as the measurement recorded during removal of the extend chains.
21. Adjust extend chain tension. (Refer to Section 3.4.4, “Boom Chain Tension Adjustment.”)
22. After adjustment is complete, assemble the rear cover to the rear of the outer boom. At the rear of the outer boom (**17**), position the rear cover (**18**) in place. Secure the cover in place with the saved 5/16" flat washer (**19**), lockwasher (**20**), and thumbscrew (**21**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



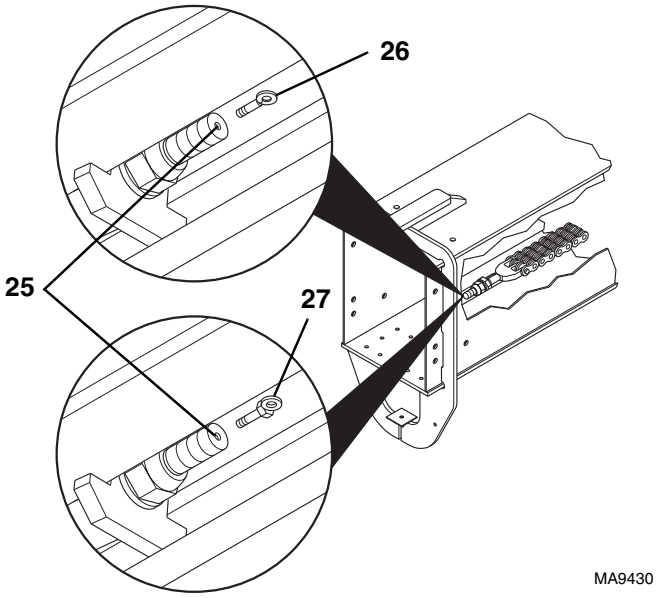
b. Retract Chain Removal and Replacement

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**21**), lockwasher (**20**) and flat washer (**19**), holding the rear cover (**18**) to the rear of the outer boom (**17**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.
4. At the front underside of the boom, record the amount of threads extending beyond the elastic locknut (**22**). This measurement will be the starting point for adjustment of the boom retract chain.
5. At the front underside of the outer boom, loosen the elastic locknut (**22**) far enough so that it can be removed by hand.



6. If the chain clevis has a threaded hole on the end (**25**), a string or wire can be attached to the retract chain clevis using a threaded eye (**26**) or a flat washer tack welded to a capscrew (**27**). The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The string or wire will be used to pull the chain back through the boom during the reassembly.

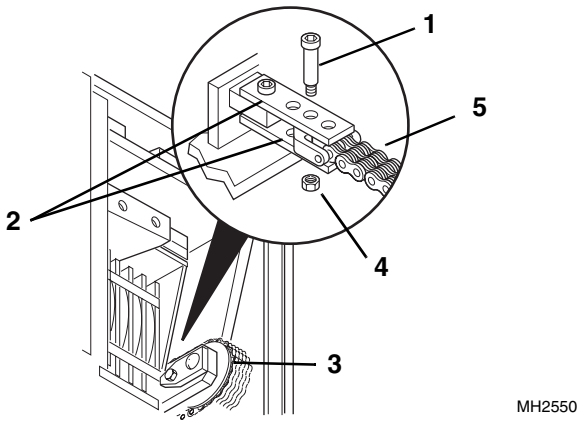
   If there is not threaded hole on the end of the clevis, you will need to use a phillips screwdriver to catch the end of the clevis and guide it through the tab during reassembly.



7. Remove the elastic locknut (**22**) and flat washer (**23**) holding the retract chain threaded clevis (**24**) to the mounting tab. Save the flat washer and discard the elastic locknut.
8. If a threaded eye or capscrew with flat washer (**26** or **27**) was installed in step 6, attach a string or wire to the eye or flat washer on the end of the retract chain clevis. The string or wire must be long enough to pull the clevis and chain through the outer boom.

Note: *Record the location of the shoulder bolt (**1**) to ensure correct installation.*

9. At the rear of the boom, locate the two retract chain anchor plates (**2**) holding the retract chain to the inner boom just in front of the retract chain sheave (**3**). Remove the elastic locknut (**4**) and shoulder bolt (**1**) holding the retract chain clevis to the anchor plates. Discard the elastic locknut and save the shoulder bolt. The two anchor plates can remain in place on the inner boom.



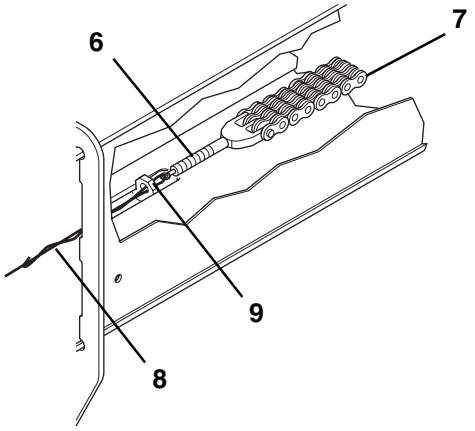
10. From the rear of the boom, pull the retract chain out of the rear of the boom.
11. Inspect wear and condition of the booms, chains, clevis', chain sheaves, extend/retract cylinder, chain rods, clevis anchors and all mounting hardware. Replace a worn or damaged chain. **DO NOT** attempt to make any repairs to the chain.

Note: *Chains and clevis' are wear items and experience the same stress. **DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis'.*

Note: *Have a second person help with the installation of the new retract chain between the intermediate and outer boom assemblies.*

If a string or wire was installed to the end of the clevis:

12. If the new chain has a clevis with a threaded hole, remove the string from the old chain and attach it to the new clevis. If the new chain does not have the threaded hole, you will need to pull the string out of the boom and follow the instructions under the **"If no sting or wire was installed to the end of the clevis:"** heading.
13. Coat the threads of the threaded clevis (**6**) with multi-purpose grease.
14. From the rear of the boom, one person should push the threaded clevis end (**6**) of the retract chain (**7**) under the chain sheave and down between the intermediate boom and the outer boom. The person at the front of the boom should pull the front clevis using the string or wire (**8**) attached to the clevis in step 6. Keep the retract chain (**7**) to the right side of the boom, push the threaded clevis down to the tab (**9**) at the front underside of the outer boom.
15. The person at the front of the boom should guide the threaded end of the clevis (**6**) through the hole in the tab (**9**).

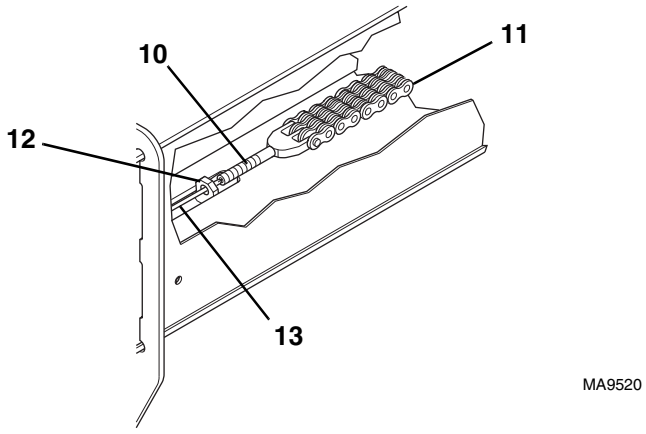


16. Remove the string or wire from the end of the clevis.

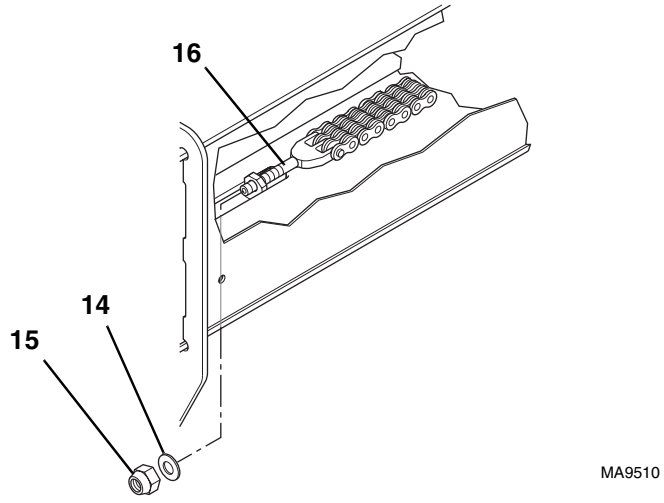
If no string or wire was installed to the end of the clevis:

17. Coat the threads of the threaded clevis (**10**) with multi-purpose grease.
18. From the rear of the boom, one person should push the threaded clevis end (**10**) of the retract chain (**11**) under the chain sheave and down between the intermediate boom and the outer boom. Keep the retract chain (**11**) to the right side of the boom, push the threaded clevis down to the tab (**12**) at the front underside of the outer boom.

19. The person at the front of the boom should guide the threaded end of the clevis (**10**) through the hole in the tab (**12**) using a Phillips screwdriver (**13**). Insert the screwdriver through the hole in the tab and catch the countersunk hole in the end of the clevis. Guide the threaded clevis out as the person at the rear of the boom pushes the retract chain.



20. Reassemble the flat washer (**14**), saved, and a new 3/4-16 elastic locknut (**15**) onto the threaded clevis (**16**). Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.



21. At the rear of the boom, place the retract chain (**5**) up and over the chain sheave (**3**). Place the clevis between the two anchor plates (**2**).

22. If re-installing a used chain insert the saved shoulder bolt (**1**), in the same position in the plates and clevis recorded during removal.

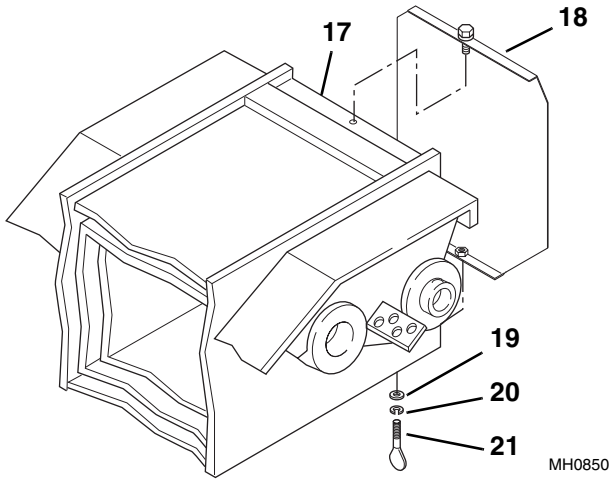
23. If installing a new chain, line up the hole in the clevis with the second hole from the rear of the anchor plates. Insert the shoulder bolt (**1**), saved during removal of the old chain.

24. Secure the shoulder bolt in place with a new 3/8-16 elastic locknut (**4**). Tighten the locknut securely.

25. Tighten the elastic locknut (**15**) on the retract chain clevis (**16**) until the amount of threads protruding beyond the elastic locknut is the same as the measurement recorded during removal of the retract chain.

26. Adjust retract chain tension. (Refer to Section 3.4.4, a. “Component/Assembly Verification.”)

27. After adjustment is complete, assemble the rear cover to the rear of the outer boom. At the rear of the outer boom (**17**), position the rear cover (**18**) in place. Secure the cover in place with the saved 5/16" flat washer (**19**), lockwasher (**20**) and thumbscrew (**21**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



3.5 BOOM SYSTEM - FOUR SECTION BOOM (10054)

3.5.1 Boom System Description

The boom operates via an interchange among the electrical, hydraulic and mechanical systems. Components involved include the joystick, Attachment Tilt cylinder, Extend/Retract cylinder, Lift/Lower cylinder, Slave cylinders, electronic sensors, extend and retract chains, various pivots, supporting hardware and other components.

3.5.2 Boom System Operation

The four section boom consists of the inner, secondary intermediate, primary intermediate and outer boom assemblies with double intermediate boom extend chains, a single inner boom extend chain, a single inner boom retract chain and a single intermediate boom retract chain.

As the Extend/Retract hydraulic cylinder, which is anchored at the front of the primary intermediate boom, and the rear of the outer boom begins to extend, it forces the primary intermediate boom out of the outer boom.

The inner, secondary intermediate, primary intermediate and outer booms are connected by extend and retract chains. These chains are routed around sheaves on the secondary and primary intermediate booms. As the primary and secondary intermediate booms are forced out, the extend chain pulls the inner boom out of the secondary intermediate boom.

As hydraulic pressure is applied to the retract port on the Extend/Retract cylinder, the secondary intermediate boom is pulled back into the outer boom, and the retract chain pulls the secondary intermediate and inner booms back into the primary intermediate boom.

This mechanical linkage formed by the chains and supporting hardware, extends and retracts the primary and secondary intermediate booms and inner boom at the same rate.

The outer boom does not extend or retract, but lifts and lowers via action of the Lift/Lower cylinders.

3.6 BOOM ASSEMBLY MAINTENANCE (10054)

The boom assembly consists of the inner, secondary and primary intermediate, and outer booms and supporting hardware.

IMPORTANT: *Boom replacement must be completed in sequence, one boom section at a time, as described in these instructions. Replacement of two or more boom sections as a unit requires special considerations that are not covered in these instructions.*

IMPORTANT: *Before removing the inner boom, the carriage or any other attachment must be removed from the quick attach.*

The inner, secondary and primary intermediate, and outer boom removal instructions must be completed in sequence. The inner boom must be removed before removing the secondary and primary intermediate booms. The inner boom, and secondary and primary intermediate booms must be removed one at a time before removing the outer boom.

Before beginning, conduct a visual inspection of the vehicle and work area, and review the task about to be undertaken. Read, understand and follow these instructions.

After servicing the boom, perform the following:

1. Check wear pads. (Refer to Model 10054 Legacy Owners/Operators Manual.)
2. Check chain wear and tension adjustment. (Refer to Section 3.7.1, “Boom Chain Inspection,” and Section 3.7.3, “Boom Chain Tension Check.”)
3. Apply grease at all lubrication points (grease fittings). (Refer to Model 10054 Legacy Owners/Operators Manual.)
4. Check for proper operation by operating all boom functions through their full ranges of motion several times.

3.6.1 Inner Boom Removal

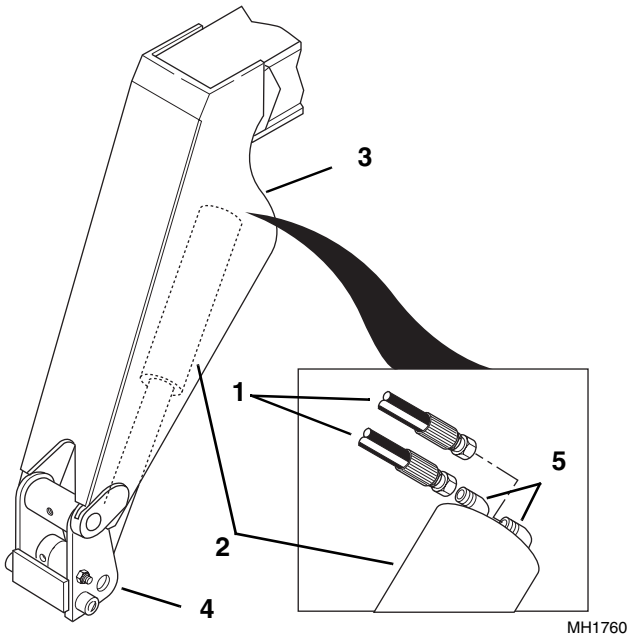
1. Remove any attachment from the quick attach assembly. (Refer to Section 3.10.1, “Disconnecting from an Attachment.”)

Note: *If you are replacing the inner boom with a new inner boom, remove the quick attach from the inner boom. (Refer to Section 3.10.3, “Quick Attach Removal.”)*

> **WARNING:** Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

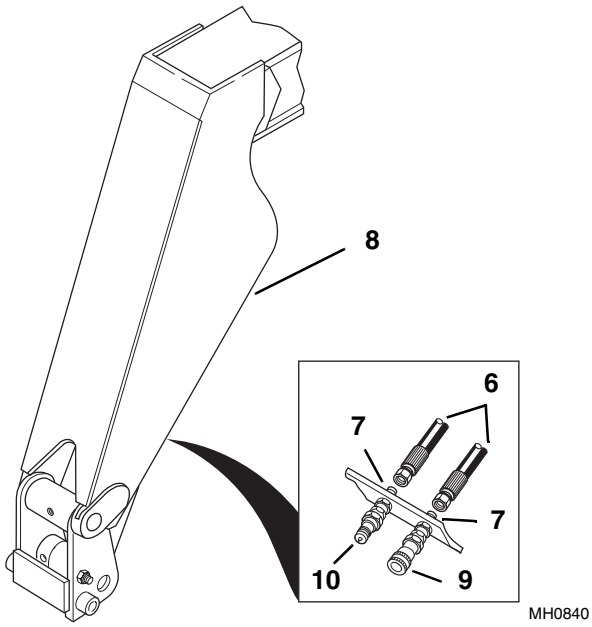
> **WARNING:** **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

2. Park the vehicle on a hard, level surface. Be sure there is enough room in front of the vehicle to allow the inner boom section to be removed from the front of the boom assembly.
3. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to the NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF. Allow the hydraulic oil to cool before proceeding.



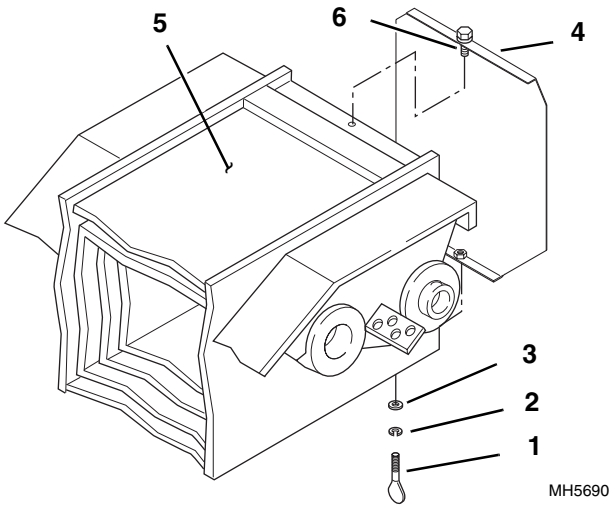
MH1760

4. Move the Attachment Tilt joystick in both directions to relieve any trapped pressure in the Attachment Tilt system. Move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.
5. Locate the two hoses (**1**) attached to the base of the Attachment Tilt cylinder (**2**) inside the gooseneck (**3**).
6. Label and remove the hoses (**1**) from the elbow fittings (**5**) on the Attachment Tilt cylinder. Plug the hose ends and cap the elbow fittings on the Attachment Tilt cylinder to prevent dirt and debris from entering the hydraulic system and/or cylinder.
7. Label and remove the two auxiliary hydraulic hoses (**6**) from the bulkhead fittings (**7**) inside the gooseneck (**8**). Plug the hose ends and cap the bulkhead fittings to prevent dirt and debris from entering the hydraulic system.
8. If you are replacing the inner boom with a new inner boom, remove the female coupler (**9**) male nipple (**10**) and bulkhead fittings (**7**) from the bulkhead plate inside the gooseneck. Save all the hardware for reassembly.

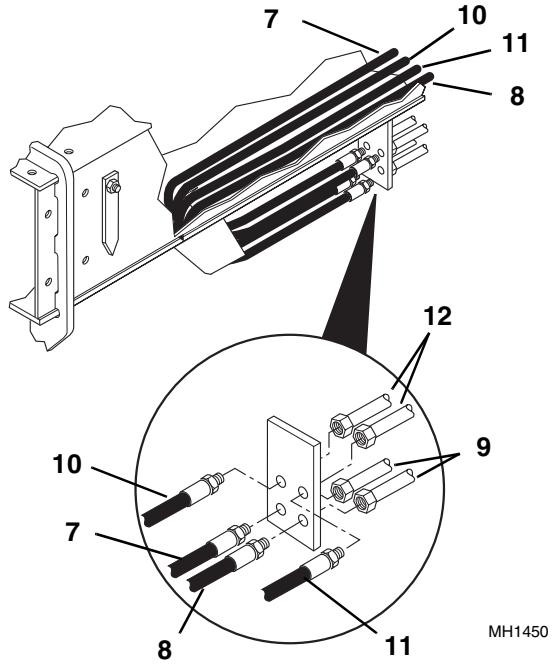


MH0840

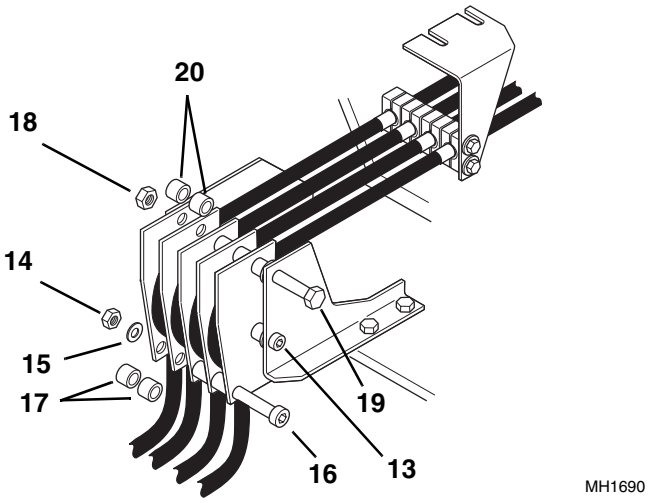
9. Remove the thumbscrew (**1**), lockwasher (**2**) and flat washer (**3**) holding the rear cover (**4**) to the rear of the outer boom (**5**). Lift the rear cover straight up until the capscrew (**6**) in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



10. At the front of the outer boom, label and remove the auxiliary hoses (**7** and **8**) from the bottom tube assemblies (**9**) at the mounting plate. Cap the hose ends.
11. Label and remove the Attachment Tilt hoses (**10** and **11**) from the top tube assemblies (**12**) at the mounting plate. Cap the hose ends.

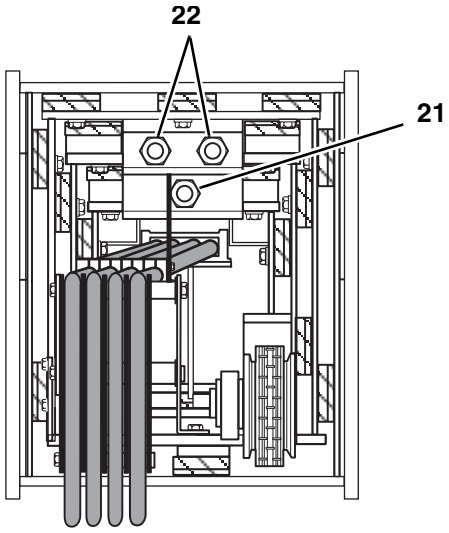


12. Label and remove the four hoses from the hose reel. The center bolt (**13**) can remain in place to hold the hose reel and side plates together:
    a. Remove the elastic locknut (**14**) and flat washer (**15**) from the lower retaining shoulder bolt (**16**). While pulling the shoulder bolt out, catch the spacers (**17**) from between the plates as the bolt is removed. Pull the bolt out far enough to remove the hoses from the hose reel.
    b. Pull the four hoses from the lower part of the hose reel out from between the outer boom and the primary intermediate boom sections. Carefully lay the hoses out behind the back of the boom.
    c. After the hoses are removed from between the outer and primary intermediate boom sections, reinsert the shoulder bolt (**16**) through the plates, inserting the spacers (**17**) between the plates as the bolt is inserted. Reassemble the flat washer (**15**) and elastic locknut (**14**) to hold the shoulder bolt in place. **DO NOT** fully tighten at this time.
    d. Remove the elastic locknut (**18**) from the upper retaining capscrew (**19**). While pulling the capscrew out, catch the spacers (**20**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to remove the hoses from the hose reel.
    e. After the hoses are removed, reinsert the capscrew (**19**) through the plates, inserting the spacers (**20**) between the plates as the capscrew is inserted. Reassemble the elastic locknut (**18**) to hold the capscrew in place. **DO NOT** fully tighten.



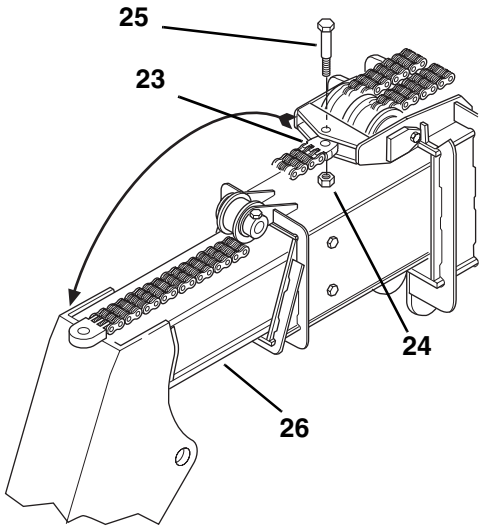
MH1690

13. At the rear of the boom, locate the inner boom extend chain locknut (**21**). Measure the amount of threads protruding beyond the elastic locknut and record that measurement for reassembly.
14. Using a 1-7/16" socket and a 12" extension, loosen the elastic locknut (**21**) until the nut is held on by a couple of threads. **DO NOT** remove the elastic locknut at this time.
15. At the rear of the boom, locate the two secondary intermediate boom extend chain locknuts (**22**). Measure the amount of threads protruding beyond each elastic locknut and record these measurements for reassembly.
16. Using a 1-1/16" socket and a 12" extension, loosen both elastic locknuts (**22**) until each nut is held on by at least two full threads. **DO NOT** remove these elastic locknuts at this time.



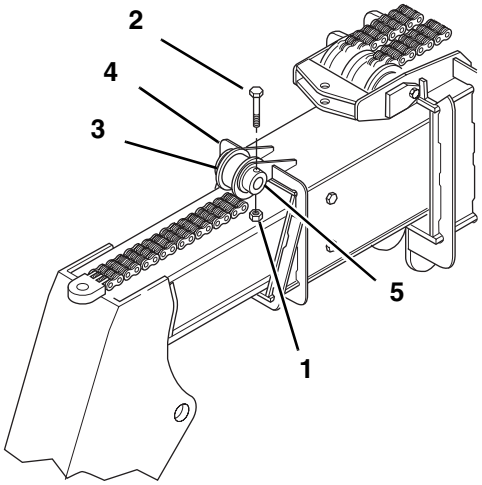
MH1780

17. Return to the operator's cab, start the engine and extend the boom approximately 2" (51 mm). Retract the boom slightly until there is slack in the inner boom extend chain. Shut the engine OFF, and exit the cab using the hand holds.
18. At the front of the boom, disconnect the inner boom extend chain clevis (**23**) from the anchor plates on the primary intermediate boom. Remove the elastic locknut (**24**) holding the shoulder bolt (**25**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the inner boom (**26**). Save the shoulder bolt and discard the elastic locknut.



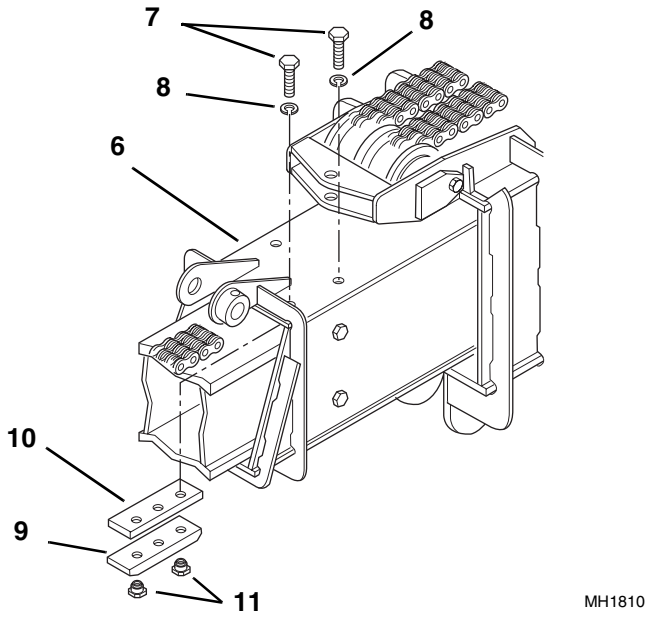
MH1790

19. Remove the elastic locknut (**1**) and capscrew (**2**) holding the inner boom extend chain sheave (**3**) to the front of the secondary intermediate boom (**4**). Use a brass punch and a rawhide hammer to remove the sheave pin (**5**).
20. Inspect the sheave pin (**5**) for corrosion or damage. If the pin is damaged, it should be replaced. Minor corrosion can be repaired with fine emery cloth. Save the chain sheave, pin and capscrew. Discard the elastic locknut.



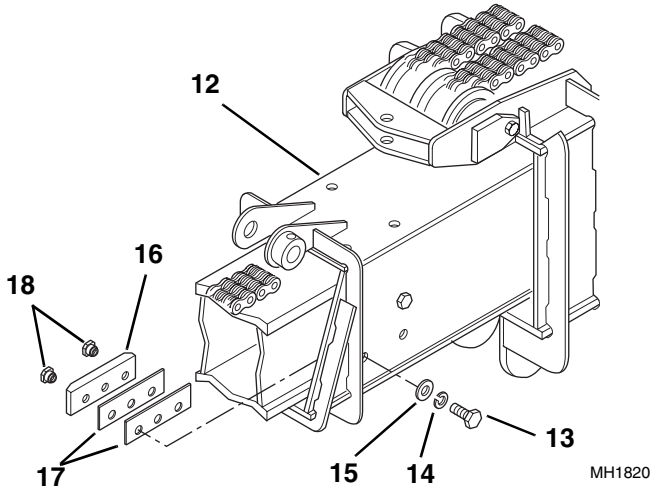
MH1800

21. At the front of the secondary intermediate boom (**6**), remove the capscrews (**7**) and lockwashers (**8**) holding the top wear pads (**9**) and spacers (**10**) to the inside of the secondary intermediate boom. Label the wear pads and spacers as “Secondary Intermediate Boom Top Left” and “Secondary Intermediate Boom Top Right” sides. Save the spacers, capscrews, lockwashers and wear pad inserts (**11**).

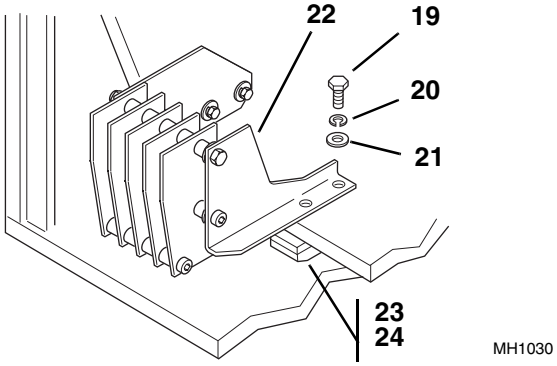


MH1810

22. At the front of the secondary intermediate boom (**12**), remove the capscrews (**13**), lockwashers (**14**) and flat washers (**15**) holding the side wear pads (**16**) and shims (**17**) to the inside of the secondary intermediate boom. Label the wear pads and shims as “Secondary Intermediate Boom Left Upper/Lower” and “Secondary Intermediate Boom Right Upper/Lower.” Save the shims, capscrews, flat washers, lockwashers and wear pad inserts (**18**).

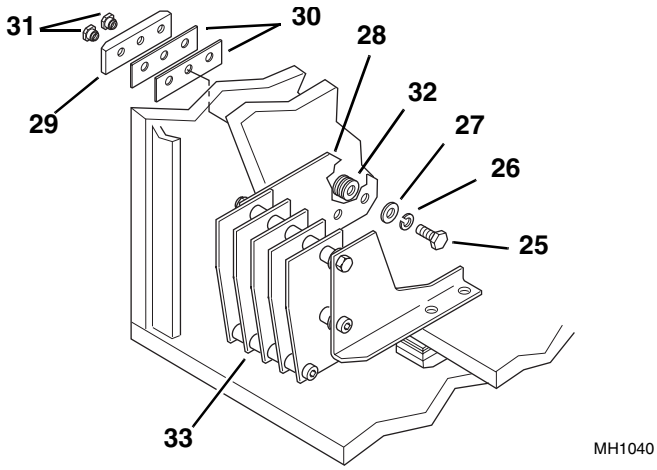


23. At the rear of the boom, remove the capscrews (**19**), lockwashers (**20**) and flat washers (**21**) holding the hose reel assembly (**22**), lower wear pad (**23**) and spacer (**24**) to the lower plate on the primary intermediate boom. Reassemble the capscrews, lockwashers and flat washers to hold the lower wear pad in place for primary intermediate boom removal.



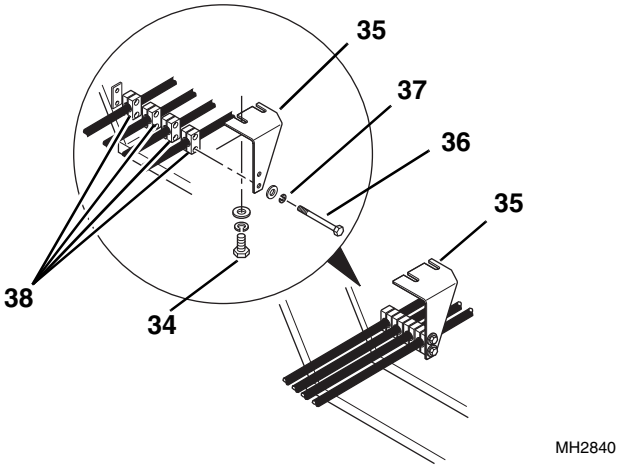
24. Remove the capscrews (**25**), lockwashers (**26**) and flat washers (**27**) holding the hose reel side plate (**28**), lower left side wear pad (**29**) and shims (**30**) to the side of the primary intermediate boom. Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**31**). Watch for the six washers (**32**) to fall out from between the side plate of the hose reel assembly and the side plate of the primary intermediate boom.

25. Remove the hose reel (**33**) as an assembly, from the rear of the boom.



26. Inside the secondary intermediate boom, loosen, but **DO NOT** remove the two capscrews (**34**) securing the upper left side wear pad and hose clamp support bracket (**35**) to the top of the secondary intermediate boom.

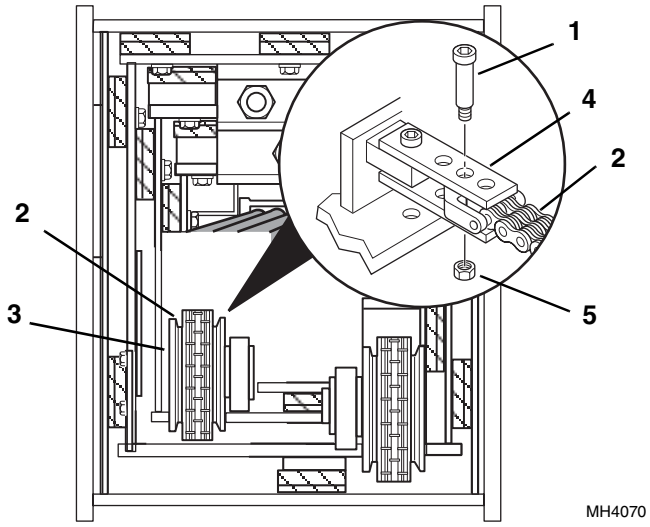
27. Remove the two capscrews (**36**) and lockwashers (**37**) holding the stack clamps (**38**) and hose clamp support bracket (**35**) to the left side of the secondary intermediate boom. Remove the clamps and the clamp support bracket from the secondary intermediate boom.



28. Return to the operator's cab, start the engine and fully retract the boom slowly. Shut the engine OFF, and exit the cab using the hand holds.

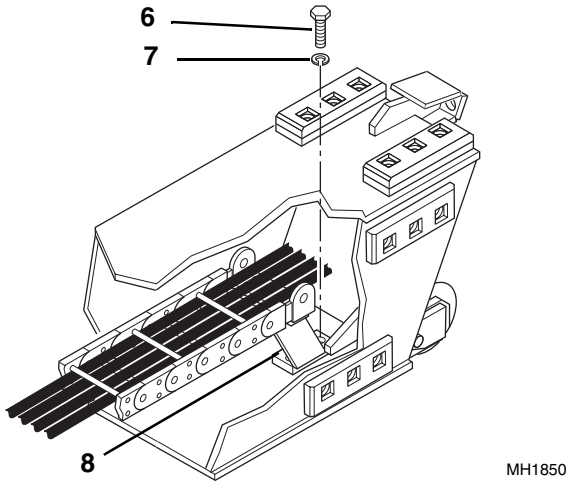
Note: *Record the location of the shoulder bolt (**1**) to ensure correct installation.*

29. At the rear of the boom, locate the inner boom retract chain (**2**) on the left side of the boom, just in front of where the hose reel was located. In front of the inner boom retract chain sheave (**3**), locate the shoulder bolt (**1**) which holds the retract chain (**2**) to the anchor plates (**4**). Remove the elastic locknut (**5**) from the shoulder bolt and remove the shoulder bolt. Save the shoulder bolt and discard the elastic locknut. Let the inner boom retract chain hang out the rear of the boom.

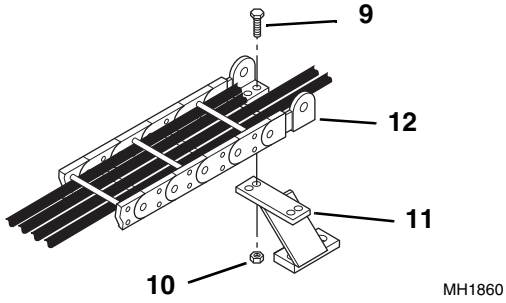


30. Remove the two capscrews (**6**) and lockwashers (**7**) holding the hose carrier support (**8**) and the lower wear pad to the secondary intermediate boom.

31. Pull the hose carrier support with hose carrier attached toward the rear of the boom. Reinstall the capscrews (**6**) and lockwashers (**7**) back through the holes in the bottom of the secondary intermediate boom to hold the wear pad in place. **DO NOT** fully tighten the capscrews.



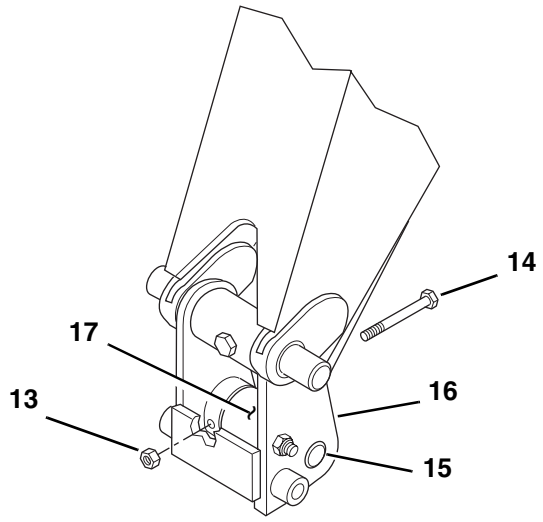
32. Remove the four capscrews (**9**) and locknuts (**10**) holding the hose carrier support (**11**) to the hose carrier (**12**). To access the capscrews, it is necessary to move the hoses to the side. Save the capscrews and hose carrier support, and discard the locknuts.



Note: *If replacing the inner boom assembly with a new inner boom, the quick attach assembly and the Attachment Tilt cylinder should be removed at this time.*

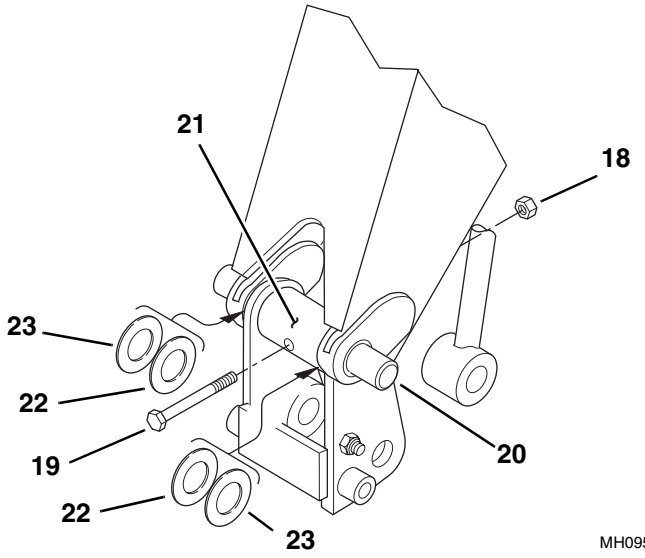
If the inner boom is not to be replaced, the quick attach assembly and Attachment Tilt cylinder can remain in place. Proceed to Step 42.

33. Remove the elastic locknut (**13**) and capscrew (**14**) holding the Attachment Tilt cylinder rod end pin (**15**) to the quick attach assembly (**16**). Save the capscrew and discard the elastic locknut.
34. Support the rod end of the Attachment Tilt cylinder (**17**). Use a brass punch and rawhide hammer to remove the rod end pin (**15**) from the quick attach assembly.
35. Inspect the pin (**15**) for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged or if it cannot be repaired, the pin must be replaced.



MH0940

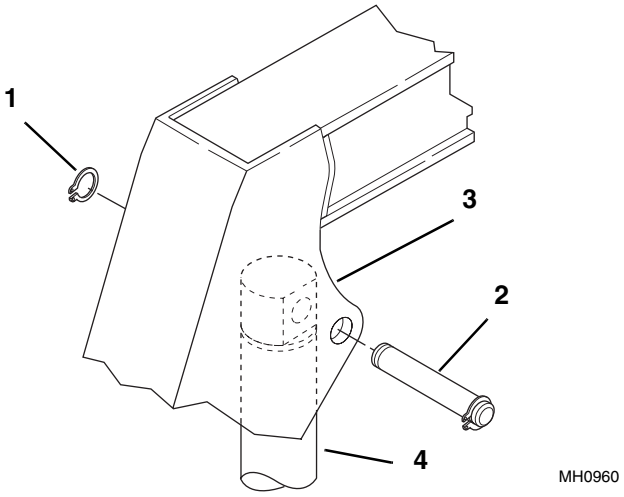
36. Remove the elastic locknut (**18**) and capscrew (**19**) holding the quick attach pivot pin (**20**) to the quick attach assembly (**21**). Save the capscrew and discard the elastic locknut. Place a support under the quick attach assembly to prevent it from dropping when the pivot pin is removed.
37. Use a brass punch and rawhide hammer to remove the quick attach pivot pin (**20**) from the quick attach assembly and the bushings in the gooseneck. Record the location and quantity of the shim washers (**22** and **23**) as the pin is being removed. Save the washers (**22** and **23**) from each side of the quick attach.
38. Inspect the pivot pin (**20**) for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged and if it cannot be repaired, the pin must be replaced.



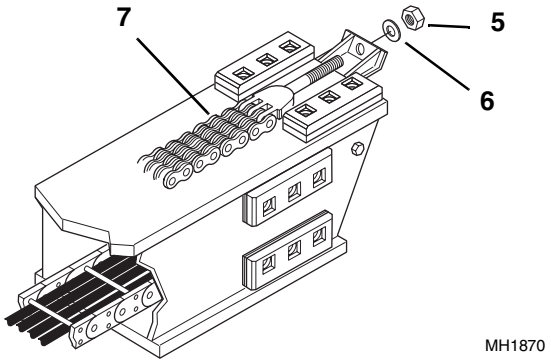
MH0950

Note: *The Attachment Tilt cylinder is heavy. Use a hoist and sling to support the Attachment Tilt cylinder when the base end pin is removed.*

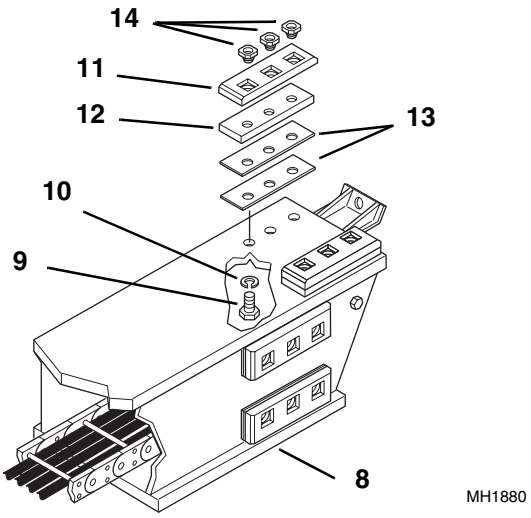
39. Remove the retaining ring (**1**) from one side of the base end pivot pin (**2**). Save the retaining ring. Use a brass punch and rawhide hammer to remove the base end pivot pin from the inner boom gooseneck (**3**).
40. Inspect the pivot pin (**2**) for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged and if it cannot be repaired, the pin must be replaced.
41. Lower the Attachment Tilt cylinder (**4**) down with the hoist and remove from the rear of the gooseneck. Place the Attachment Tilt cylinder on a clean, level surface until installation.



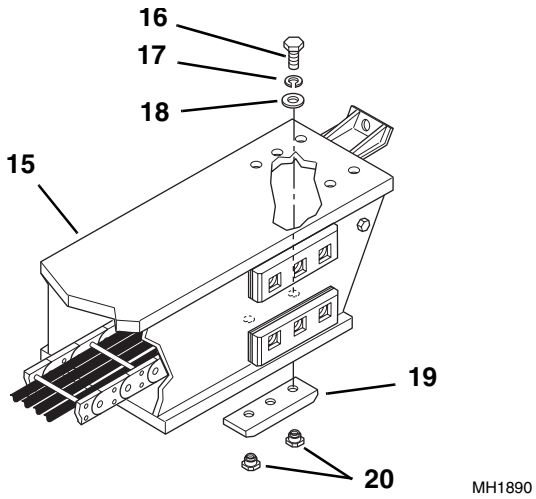
42. Pull the inner boom straight out of the secondary intermediate boom. Guide the four hose ends into the rear of the boom as the inner boom is being removed. Reposition the slings as needed so that the inner boom balances when removed from the secondary intermediate boom. Set the inner boom down on a level hard surface. Support the boom as needed to prevent it from tipping over.
43. At the rear of the inner boom, remove the elastic locknut (**5**) and flat washer (**6**) holding the threaded clevis on the inner boom extend chain (**7**) to the clevis anchor. Pull the threaded clevis from the anchor, and remove the extend chain from the inner boom. Save the flat washer and discard the elastic locknut.



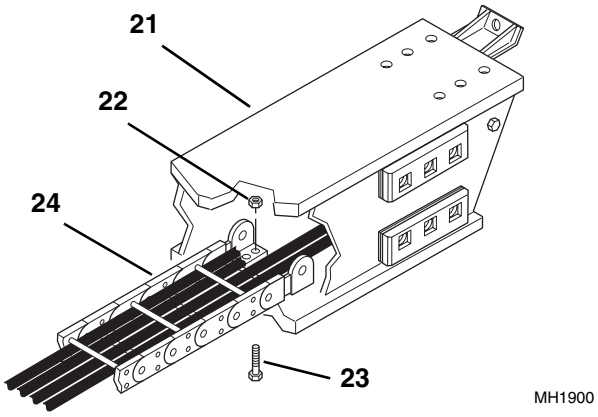
44. At the rear of the inner boom (**8**), remove the capscrews (**9**) and lockwashers (**10**) holding the top wear pads (**11**), spacer (**12**) and shims (**13**) to the top of the inner boom. Label the wear pads, spacers and shims as “Inner Boom Top Left” and “Inner Boom Top Right” sides. Save the spacers, capscrews, lockwashers and wear pad inserts (**14**).



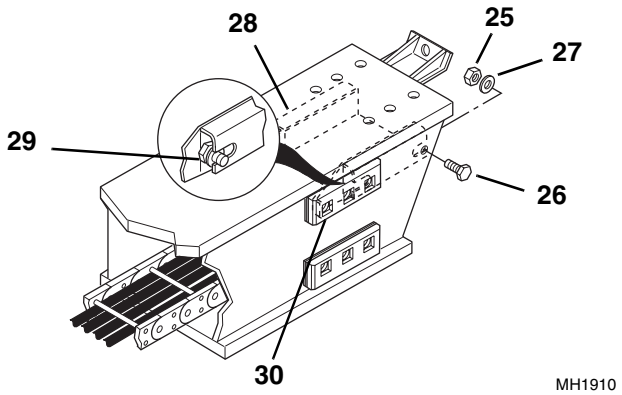
45. At the rear of the inner boom (**15**), remove the capscrews (**16**), lockwashers (**17**) and flat washers (**18**) holding the lower wear pad (**19**) to the bottom of the inner boom. Label the wear pad as "Inner Boom Bottom." Save the capscrews, lockwashers, flat washers and wear pad inserts (**20**).



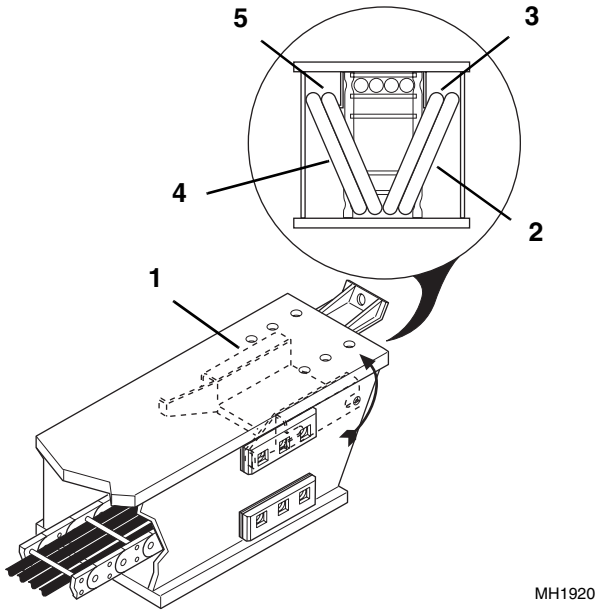
46. Inside the rear of the inner boom (**21**), remove the four elastic locknuts (**22**) and capscrews (**23**) holding the hose carrier assembly (**24**) to the bottom of the inner boom. Save the capscrews and discard the locknuts.



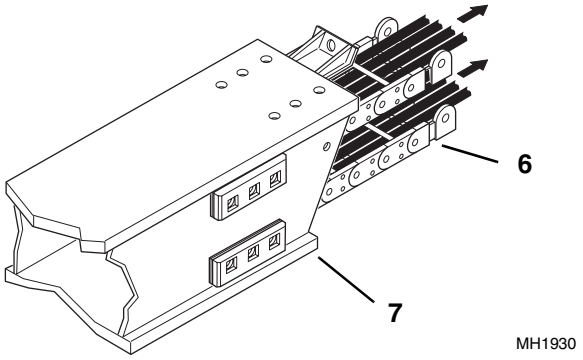
47. On each side of the inner boom, remove the rear elastic locknuts (**25**), capscrews (**26**) and flat washers (**27**) holding the rear of the hose carrier guide (**28**) in place. Save the capscrews and flat washers. Discard the locknuts.
48. Loosen, but **DO NOT** remove the capscrews (**29**) holding the front of the hose carrier guide and the top wear pad (**30**) to each side of the inner boom.



49. Tilt the back of the hose carrier guide (**1**) up. Use a light and look inside the inner boom and note which hoses go into which channels on either side of the boom. Label the right side outer hose (**2**) as “Auxiliary Female Coupler” and the right side inner hose (**3**) as “Attachment Tilt Extend.” Label the left side outer hose (**4**) as “Auxiliary Male Nipple” and the left side inner hose (**5**) as “Attachment Tilt Retract.” While holding the back of the hose carrier guide up, pull the hoses from the channels inside the inner boom. Lay the hoses out behind the inner boom.
50. After the hoses are removed from the boom, remove the hose carrier guide (**1**) by pulling the guide out the rear of the boom.

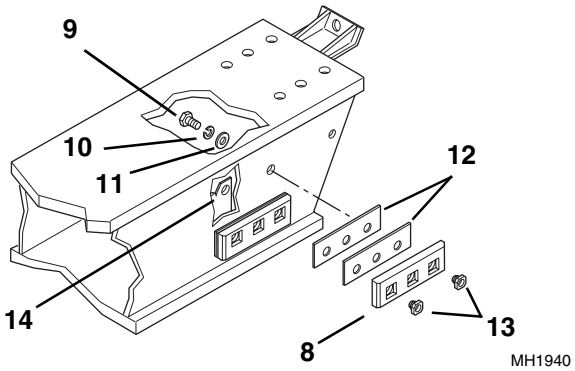


51. Remove the hose carrier assembly (**6**) from the inner boom by carefully pulling the hose carrier straight out the rear of the inner boom (**7**). Pull both the upper and lower portion of the hose carrier assembly out at the same time. Once the hose carrier is out of the boom, carefully lay the hose carrier on a flat surface, being careful not to bend the hose carrier too sharply, which will cause damage to the carrier.

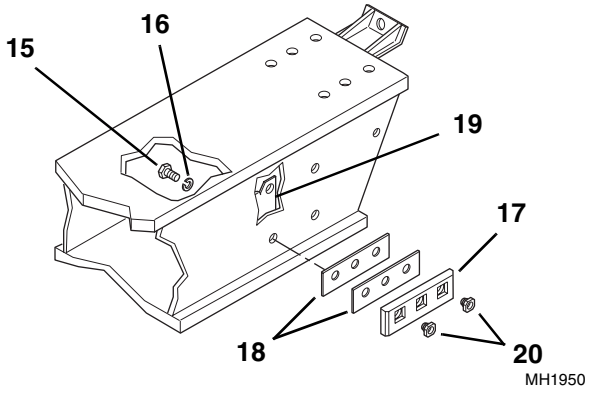


52. Remove the upper side wear pads from the inner boom. On the upper wear pads (**8**), remove the capscrews (**9**), lockwashers (**10**) and flat washers (**11**) holding the wear pads (**8**) and shims (**12**) to the side of the boom. The front capscrews will not have a flat washer under the lockwasher. Label the wear pads and shims as “Inner Boom Upper Side.” Save the shims, capscrews, lockwashers, flat washers and wear pad inserts (**13**).

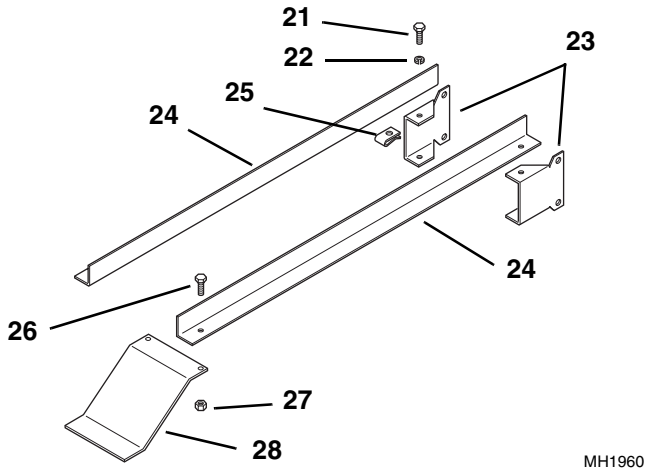
Note: *The front capscrews also hold the mount clips (**14**) for the hose channel assembly to the side of the inner boom.*



53. Remove the capscrews (**15**) and lockwashers (**16**) holding the lower side wear pads (**17**) and shims (**18**) to the side of the inner boom. The front capscrews will also hold the mounting clips (**19**) for the hose channel assembly to the side of the inner boom. Label the wear pads and shims as “Inner Boom Lower Side.” Save the shims, capscrews, lockwashers and wear pad inserts (**20**).



54. Carefully slide the hose channel assembly out the rear of the inner boom. Place the hose channel assembly on a level surface. Unless the hose channel assembly has been damaged, there is no need to disassemble the hose channel assembly.
55. If the hose channel has been damaged, disassemble the hose channel assembly to replace any parts that are bent or twisted:
    a. Remove the capscrews (**21**) and lockwashers (**22**) holding the mounting clips (**23**) to the channels (**24**). Remove the retainer nuts (**25**) from the mounting clips.
    b. At the front of the hose channel assembly, remove the capscrews (**26**) and elastic locknuts (**27**) holding the channels to the front guide (**28**). Save all hardware and discard the elastic locknuts.



56. Carefully lower the inner boom onto suitable supports, or to the ground.

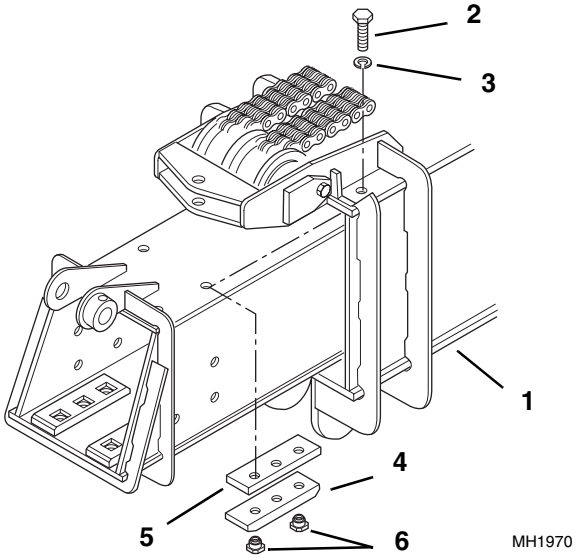
> **WARNING:** **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or serious personal injury.

57. Inspect the boom and welds. Consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
58. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the inner boom removed. Replace if damaged.
59. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

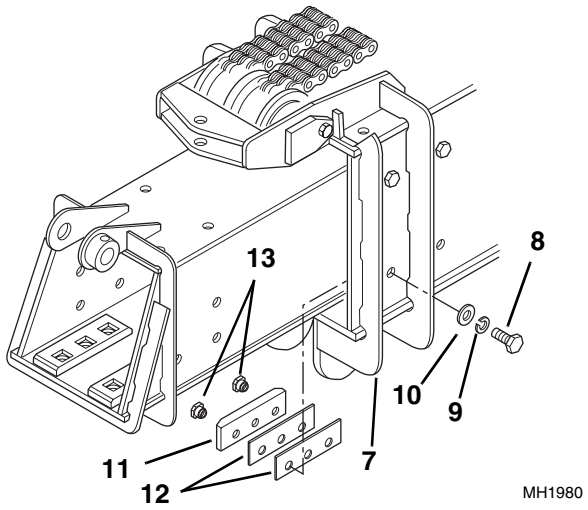
3.6.2 Secondary Intermediate Boom Removal

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

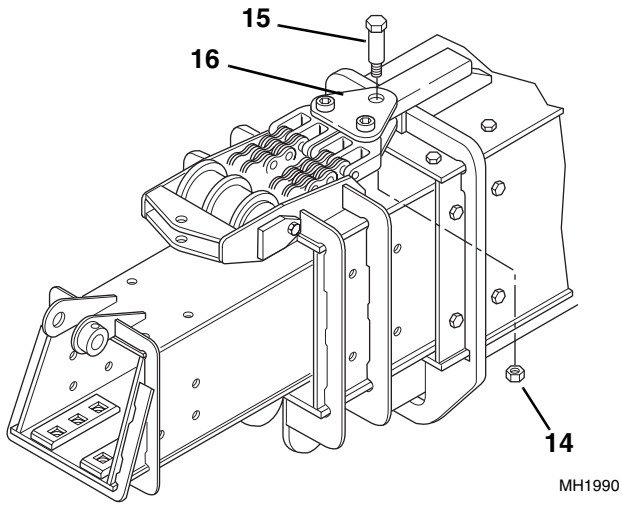
1. Remove the inner boom as described in Section 3.3.1, “Inner Boom Removal.”
2. At the front of the primary intermediate boom (**1**) remove the capscrews (**2**) and lockwashers (**3**) holding the upper wear pads (**4**) and spacers (**5**) to the inside of the primary intermediate boom. Label the wear pads and spacers as “Primary Intermediate Boom Top Left” and “Primary Intermediate Boom Top Right” sides. Save the capscrews, lockwashers, spacers and wear pad inserts (**6**).



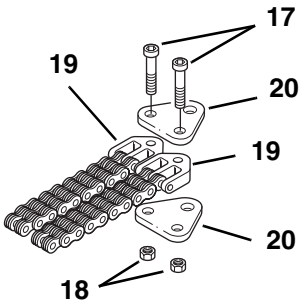
3. At the front of the primary intermediate boom (**7**) remove the capscrews (**8**), lockwashers (**9**) and flat washers (**10**) holding the side wear pads (**11**) and shims (**12**) to the inside of the primary intermediate boom. Label the wear pads and shims as “Primary Intermediate Boom Left Upper/Lower” and “Primary Intermediate Boom Right Upper/Lower”. Save the shims, capscrews, flat washers, lockwashers and wear pad inserts (**13**).



4. At the front of the boom, remove the elastic locknut (**14**) and shoulder bolt (**15**) holding the two yoke plates (**16**) to the mount at the front of the outer boom. Retain the shoulder bolt and discard the elastic locknut.

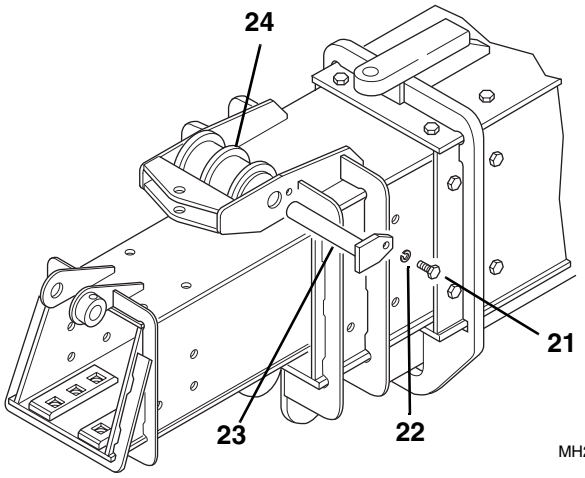


5. Remove the socket head capscrews (**17**) and elastic locknuts (**18**) holding the extend chain clevis' (**19**) to the yoke plates (**20**).
6. Inspect the yoke plates (**20**) for wear or distortion. If any wear or distortion is detected, both plates must be replaced. If no wear or distortion is detected, save the plates. Save the socket head capscrews and discard the elastic locknuts.



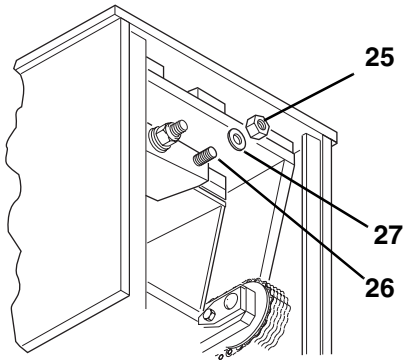
MH2330

7. At the front of the primary intermediate boom, remove the capscrew (**21**) and lockwasher (**22**) holding the extend chain sheave pin (**23**) to the sheave mount bracket on the primary intermediate boom. Remove the pin from the mount bracket and the extend chain sheave (**24**). Remove the extend chain sheave and inspect the condition of the bushings. Replace the bushings if there are any signs of wear. Inspect the pin, and replace it if there are any signs of wear.



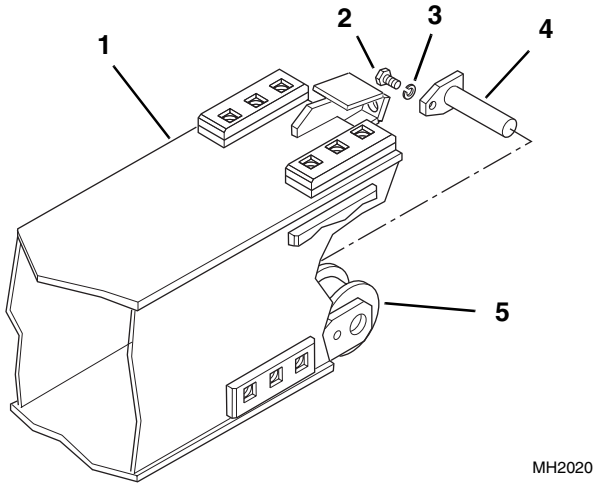
MH2000

8. At the rear of the boom, remove the two elastic locknuts (**25**) holding the threaded clevis' (**26**) of the extend chains to the anchor bracket on the secondary intermediate boom. Save the flat washers (**27**) and discard the elastic locknuts.



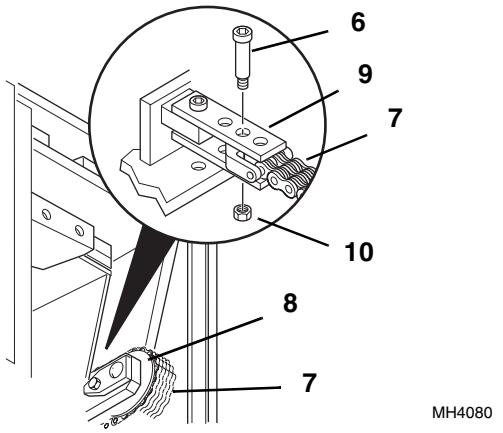
MH2011

9. From the front of the boom, pull both extend chains out from between the secondary intermediate boom and the primary intermediate boom.
10. At the rear of the secondary intermediate boom (**1**), remove the capscrew (**2**) and lockwasher (**3**) holding the retract chain sheave pin (**4**) to the mounting plate on the left side of the secondary intermediate boom.
11. Remove the retract chain sheave pin (**4**) from the mount and the retract chain sheave (**5**). Remove the retract chain sheave from the secondary intermediate boom.
12. Inspect the bushings inside the sheave (**5**). Replace the bushings if there are any signs of wear.
13. Inspect the pin (**4**) for wear or damage. Replace the pin if there are any signs of wear.



Note: *Record the location of the shoulder bolt (**6**) to ensure correct installation.*

14. At the rear of the boom, locate the secondary intermediate boom retract chain (**7**) on the right side of the boom. In front of the retract chain sheave (**8**), locate the shoulder bolt (**6**) which holds the two anchor plates (**9**) to the mount on the secondary intermediate boom. Remove the elastic locknut (**10**) from the shoulder bolt and remove the shoulder bolt. Save the shoulder bolt and discard the elastic locknut. Let the retract chain hang out the rear of the boom.



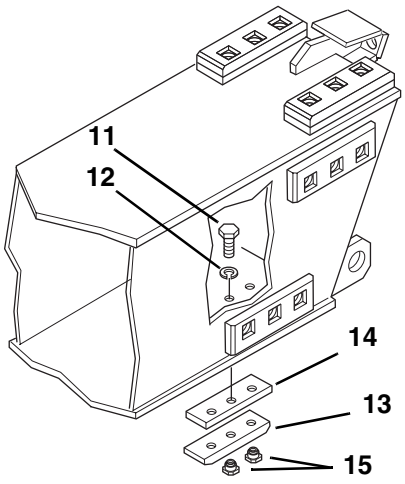
15. Pull the secondary intermediate boom straight out of the primary intermediate boom. Reposition the slings as needed so the secondary intermediate boom balances when removed from the primary intermediate boom. Set the secondary intermediate boom down on blocks on a hard, level surface.

> **WARNING:** **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or severe personal injury.

16. Inspect the boom and welds. Consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
17. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the intermediate boom removed. Replace if damaged.
18. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

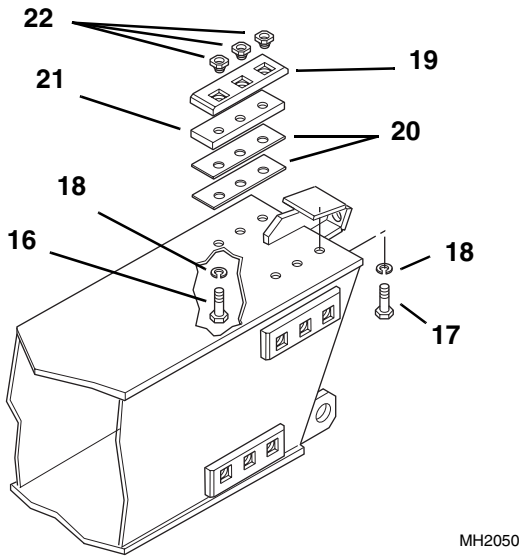
19. If you are replacing the secondary intermediate boom with a new boom section, the following items need to be removed from the secondary intermediate boom:

    a. Remove the capscrews (**11**) and lockwashers (**12**) holding the bottom wear pad (**13**) and spacer (**14**) to the secondary intermediate boom. Label the wear pad and spacer as Secondary Intermediate Boom Bottom." Save the capscrews, lockwashers, spacer and wear pad inserts (**15**).



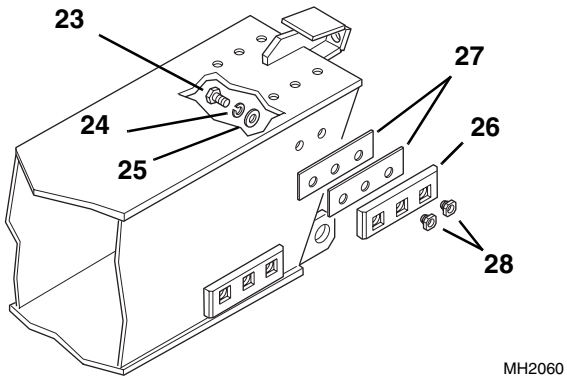
MH2040

    b. Remove the capscrews (**16**) for the right side wear pad, the capscrews (**17**) for the left side wear pad and lockwashers (**18**) holding the upper wear pad (**19**), shims (**20**) and spacer (**21**) to the secondary intermediate boom. Label the wear pads, shims and spacers as "Secondary Intermediate Boom Top Right" and "Secondary Intermediate Boom Top Left." Save the capscrews, lockwashers, spacers, shims and wear pad inserts (**22**).



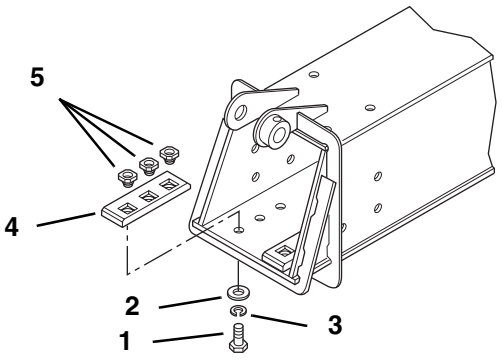
MH2050

    c. Remove the capscrews (**23**), lockwashers (**24**) and flat washers (**25**) holding the side wear pads (**26**) and shims (**27**) to the secondary intermediate boom. Label the wear pads and shims as "Secondary Intermediate Boom Left Side Upper" and "Secondary Intermediate Boom Right Side Upper/Lower." Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**28**).



MH2060

d. Remove the capscrews (**1**), flat washers (**2**) and lockwashers (**3**) holding the lower wear pads (**4**) to the inside of the secondary intermediate boom. Label the wear pads as “Secondary Intermediate Boom Left” or “Secondary Intermediate Boom Right” sides. Save the capscrews, flat washers, lockwashers and wear pad inserts (**5**).



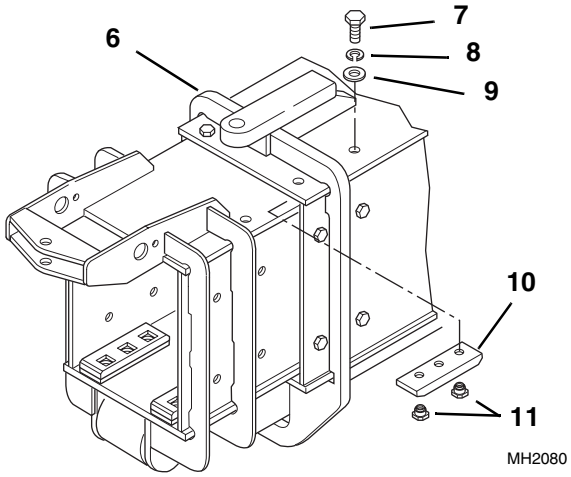
20. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

3.6.3 Primary Intermediate Boom Removal

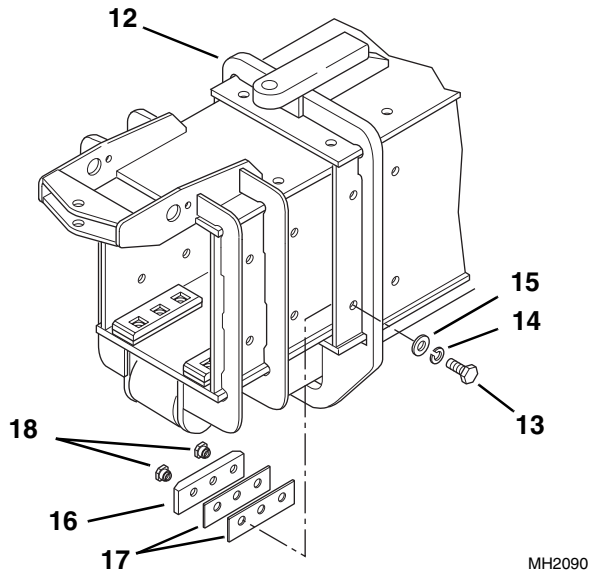
WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

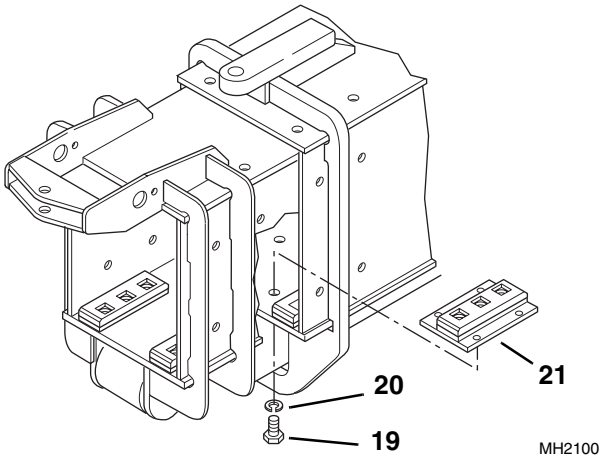
1. At the front of the outer boom (**6**), remove the capscrews (**7**), lockwashers (**8**) and flat washers (**9**) holding the top wear pads (**10**) to the inside of the outer boom. Label the wear pads as “Primary Intermediate Boom Top Left” and “Primary Intermediate Boom Top Right” sides. Save the capscrews, lockwashers, flat washers and wear pad inserts (**11**).



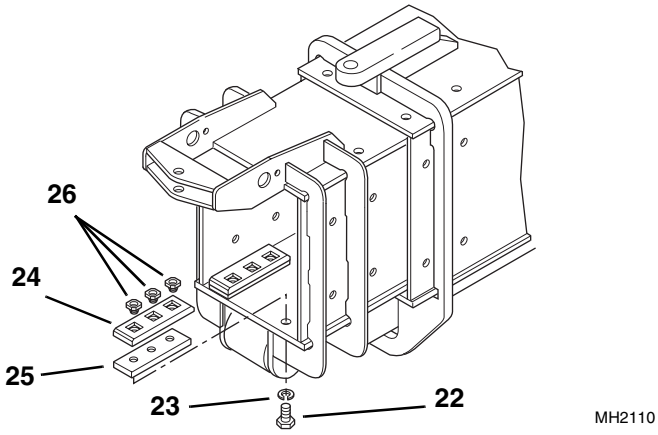
2. At the front of the outer boom (**12**), remove the capscrews (**13**), lockwashers (**14**) and flat washers (**15**) holding the side wear pads (**16**) and shims (**17**) to the inside of the outer boom. Label the wear pads as “Primary Intermediate Boom Left Side Upper/Lower” and “Primary Intermediate Boom Right Side Upper/Lower.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**18**).



3. Remove the capscrews (**19**) and lockwashers (**20**) holding the center wear pad spacer mount (**21**) to the front of the outer boom. Save the capscrews and lockwashers.



4. If replacing the primary intermediate boom with a new boom section, remove the lower wear pads at the front of the boom:
   a. Remove the capscrews (**22**) and lockwashers (**23**) holding the lower wear pads (**24**) and spacers (**25**) to the inside of the boom. Label the wear pads and spacers as “Outer Boom Left” or “Outer Boom Right” sides. Save the capscrews, lockwashers, spacers and wear pad inserts (**26**).

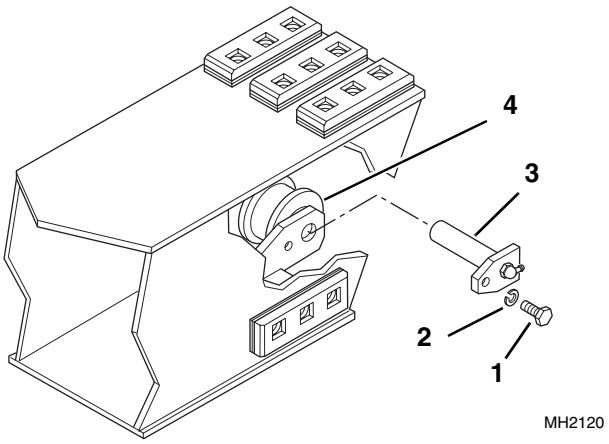


b. At the rear of the boom, remove the capscrew (**1**) and lockwasher (**2**) holding the retract chain sheave pin (**3**) to the mounting plate inside the intermediate boom.

c. Remove the retract chain sheave pin (**3**) from the mount and the retract chain sheave (**4**). Remove the retract chain sheave from the intermediate boom.

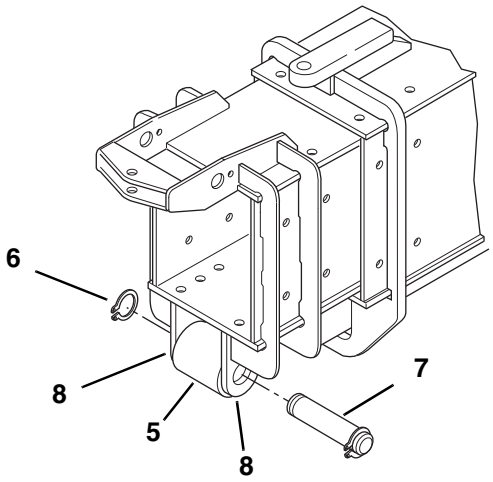
d. Inspect the bushings inside the sheave (**4**). Replace the bushings if there are any signs of wear.

e. Inspect the sheave pin (**3**) for wear or damage. Replace the pin if there are any signs of wear.



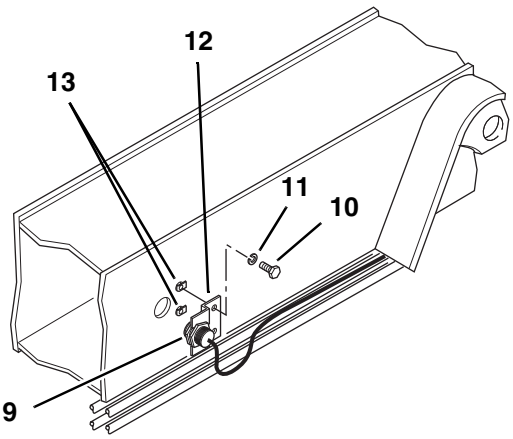
MH2120

5. Support the front of the Extend/Retract cylinder (**5**).
6. Remove the retaining ring (**6**) from one side of the Extend/Retract cylinder rod end mounting pin (**7**). Use a brass punch and a rawhide hammer to remove the rod end pin from the mounting ears (**8**) on the primary intermediate boom.
7. Inspect the pin (**7**) for wear or damage. Use fine emery cloth to repair minor nicks or corrosion. If pin is damaged, replace it. Save the retaining ring.



MH2130

8. On the left side of the outer boom assembly, locate the boom extend sensor (**9**). Remove the two capscrews (**10**) and lockwashers (**11**) holding the boom extend interlock proximity sensor mounting bracket (**12**) to the side of the outer boom. The boom proximity sensor can remain assembled to the mounting bracket.
9. Remove the tie wraps holding the boom extend interlock proximity sensor wires to the hydraulic tubes. Secure the boom extend interlock proximity sensor and wires out of the way, at the rear of the frame. Remove the retainer nuts (**13**) from the holes in the outer boom. Save all hardware.



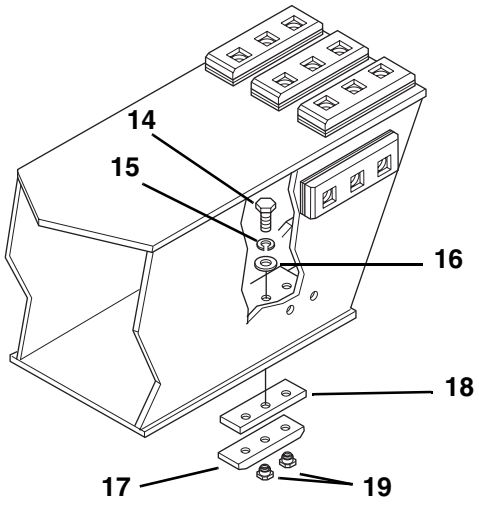
MH2170

10. Pull the primary intermediate boom straight out of the outer boom. Reposition the slings as needed so the primary intermediate boom balances when removed from the outer boom. Set the primary intermediate boom down on blocks on a hard, level surface.

11. While pulling the primary intermediate boom out of the outer boom, guide the retract chain into the rear of the boom.
12. Carefully lower the primary intermediate boom onto suitable supports or to the ground.

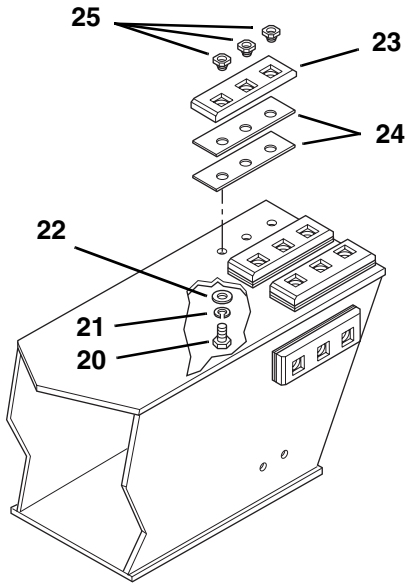
> **WARNING:** **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or serious personal injury.

13. Inspect the boom and welds. Consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
14. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the primary intermediate boom removed. Replace if damaged.
15. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)
16. If you are replacing the primary intermediate boom with a new boom section, the following items need to be removed from the primary intermediate boom:
    a. Remove the capscrews (**14**), lockwashers (**15**) and flat washers (**16**) holding the bottom wear pad (**17**) and spacer (**18**) to the primary intermediate boom. Label the wear pad and spacer as “Primary Intermediate Boom Bottom.” Save the capscrews, lockwashers, flat washers, spacer and wear pad inserts (**19**).



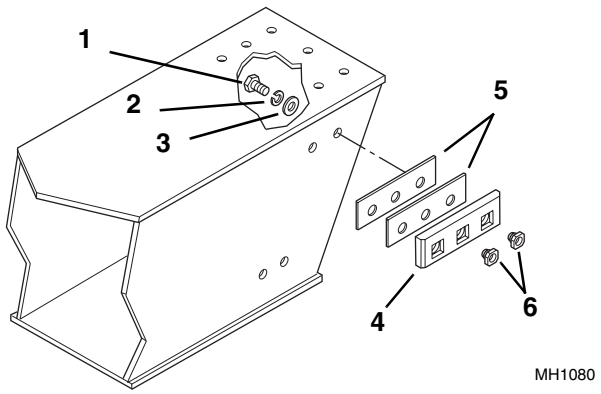
MH1060

    b. Remove the capscrews (**20**), lockwashers (**21**) and flat washers (**22**) holding the upper wear pads (**23**) and shims (**24**) to the primary intermediate boom. Label the wear pads and shims as “Primary Intermediate Boom Top Left,” “Primary Intermediate Boom Top Center” or “Primary Intermediate Boom Top Right.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**25**).



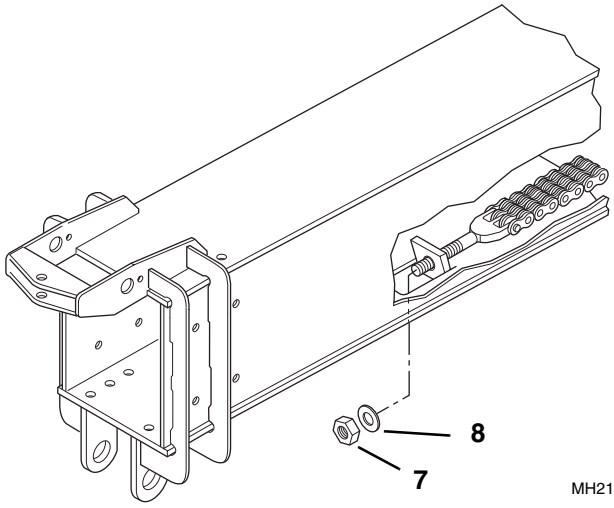
MH1070

17. Remove the capscrews (**1**), lockwashers (**2**) and flat washers (**3**) holding the side wear pads (**4**) and shims (**5**) to the primary intermediate boom. Label the wear pads and shims as “Primary Intermediate Boom Left Side Upper” and “Primary Intermediate Boom Right Side Upper/Lower.” Save the capscrews, lockwashers, flat washers, shims and wear pad inserts (**6**).



MH1080

18. At the underside of the primary intermediate boom, locate the retract chain locknut (**7**). Measure the amount of threads protruding beyond the elastic locknut, and record that measurement for reassembly of the chain. Remove the elastic locknut and the flat washer (**8**). Save the flat washer and discard the locknut.



MH2140

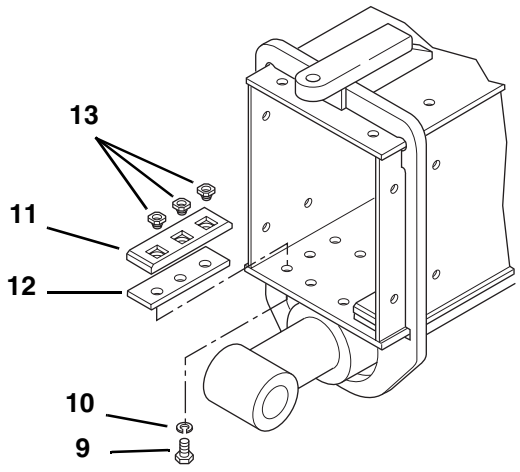
19. Remove the retract chain by pulling it out the rear of the primary intermediate boom. Place the retract chain on a clean surface.

3.6.4 Outer Boom Removal

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

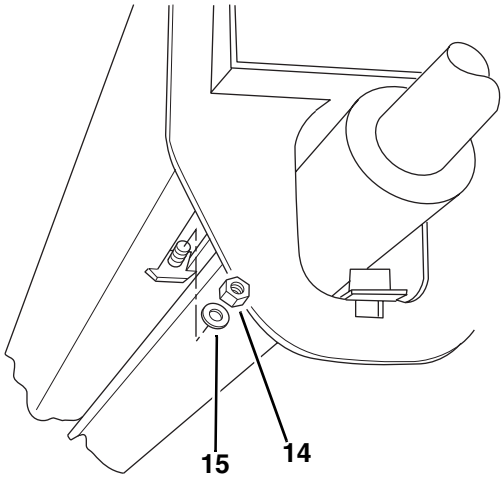
WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

1. Remove the inner boom, secondary intermediate boom and primary intermediate boom as described in Section 3.6.1, “Inner Boom Removal,” Section 3.6.2, “Secondary Intermediate Boom Removal,” and Section 3.6.3, “Primary Intermediate Boom Removal.”
2. Attach a suitable overhead lifting device and sling to the Lift/Lower cylinder, and remove slack from the sling.
3. Securely support the outer boom section.
4. At the front of the outer boom, remove the capscrews (**9**) and lockwashers (**10**) holding the wear pads (**11**) and spacers (**12**) to the inside of the outer boom. Label the wear pads and spacers as “Outer Boom Lower Left” or “Outer Boom Lower Right.” Save the capscrews, lockwashers, spacers and wear pad inserts (**13**).

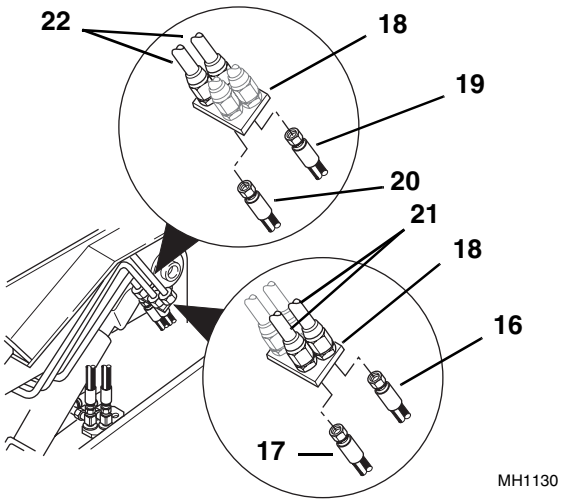


MH2150

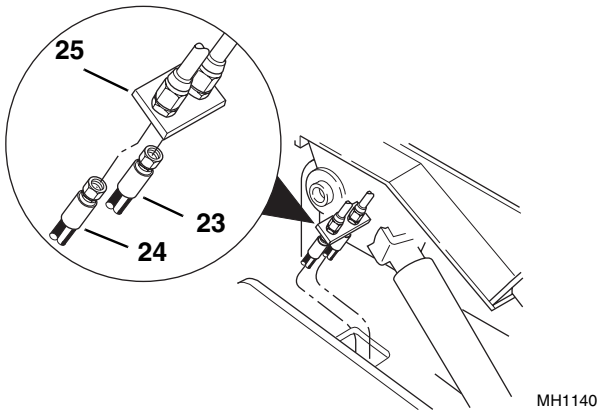
5. At the underside of the outer boom, locate the retract chain locknut (**14**). Measure the amount of threads protruding beyond the elastic locknut, and record that measurement for reassembly of the chain. Remove the elastic locknut and the flat washer (**15**). Save the flat washer and discard the locknut.



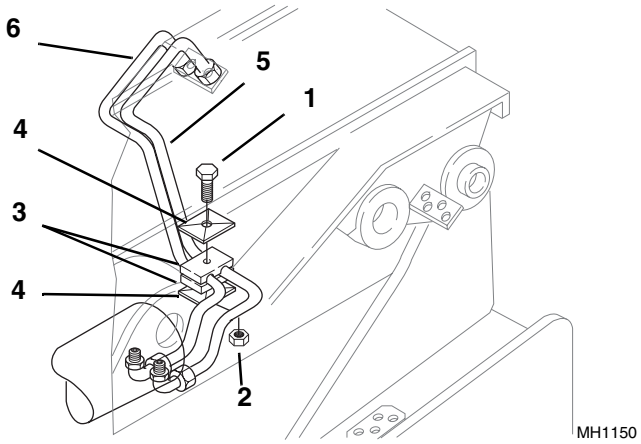
6. Remove the retract chain by pulling it out the rear of the outer boom. Place the retract chain on a clean surface.
7. Label and remove the (outer) auxiliary hose for the female coupler (**16**) and the (inner) hose (**17**) for the male nipple from the bulkhead fittings on the mounting plate (**18**).
8. Label and remove the Attachment Tilt retract (outer) hose (**19**) and the extend (inner) hose (**20**) from the bulkhead fittings on the mounting plate (**18**). Plug the hose ends and cap the bulkhead fittings.
9. Remove the auxiliary tube assemblies (**21**) and the attachment tube assemblies (**22**) from the bulkhead fittings.



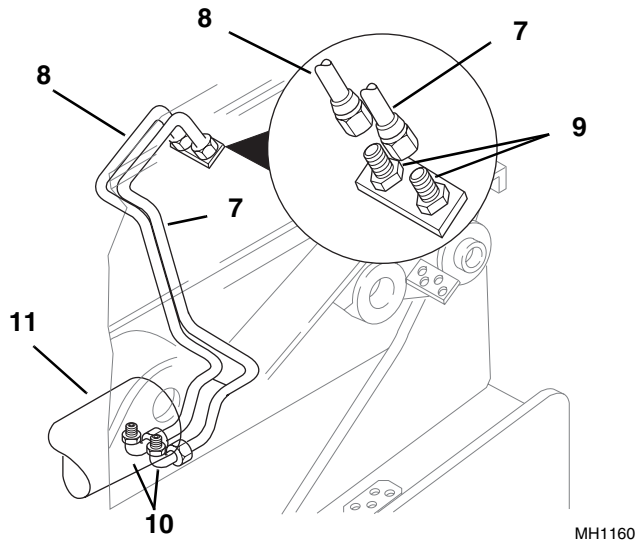
10. At the rear right side of the outer boom, label and remove the boom extend hose (**23**) and retract hose (**24**) from the bulkhead fittings on the mounting plate (**25**). Plug the hose ends and cap the bulkhead fittings.



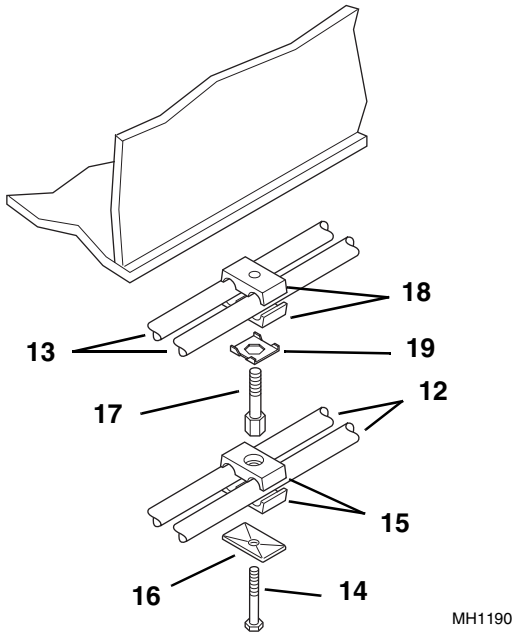
11. Remove the capscrew (**1**) and elastic locknut (**2**) holding the tube clamp (**3**) and clamp covers (**4**) to the extend (**5**) and retract (**6**) tubes under the boom. Discard the elastic locknut and retain the capscrew, covers and clamps.



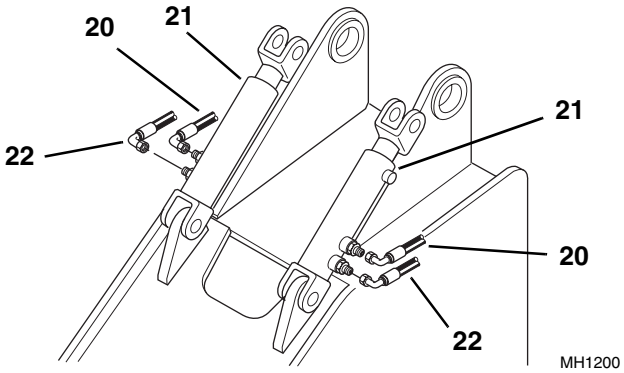
12. At the rear right side of the outer boom, label and remove the extend tube (**7**) and retract tube (**8**) from the bulkhead fittings (**9**). Plug the tube ends and cap the bulkhead fittings.
13. Remove the extend tube (**7**) and retract tube (**8**) from the 90° elbow fittings (**10**) on the rear of the Extend/ Retract cylinder (**11**). Plug the tube ends and cap the 90° elbows.



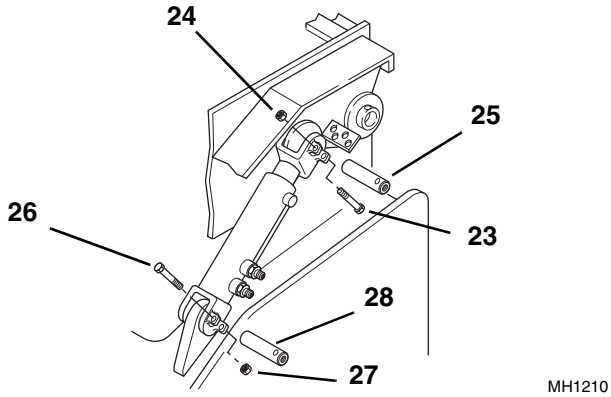
14. Label the auxiliary tube assemblies (**12**) located under the Attachment Tilt tubes (**13**). Remove the capscrews (**14**) holding the tube clamps (**15**) and clamp covers (**16**) to the Attachment Tilt tube clamp stacking bolt (**17**) under the outer boom. Save the capscrews, clamps and clamp covers. Remove the tubes from the boom.
15. Label the Attachment Tilt tube assemblies (**13**) located under the boom. Remove the stacking bolts (**17**) holding the tube clamps (**18**), locking plates (**19**) and Attachment Tilt tubes (**13**) to the underside of the outer boom. Save the stacking bolts, clamps and locking plates. Remove the tubes from the boom.
16. Inspect the tubes (**12** and **13**) for kinks or crushed areas. If any kinks or crushed areas exist, replace the damaged tube or tubes.



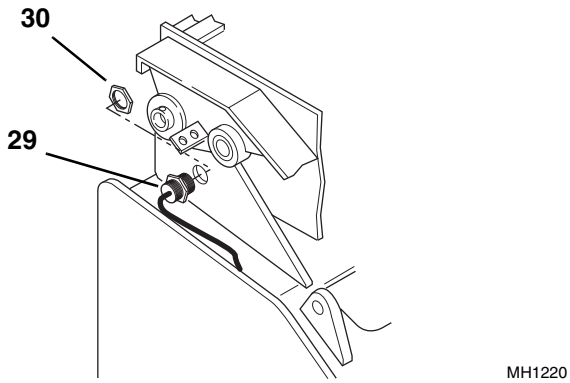
17. Label and remove the retract hoses (**20**) from the straight connectors on both Slave cylinders (**21**). Label and remove the extend hoses (**22**) from the straight connectors on both Slave cylinders (**21**). Plug the hose ends and cap the straight connectors on the Slave cylinders.



18. Remove the capscrew (**23**) and elastic locknut (**24**) holding the upper Slave cylinder pivot pin (**25**) to the outer boom. Use a hoist and a sling to hold the Slave cylinder in position. Remove the pivot pin from the pin mount by pulling the pin out. It may be necessary to use an appropriate puller threaded into the pivot pin to remove the pin. Discard the elastic locknut and retain the capscrew.
19. Remove the capscrew (**26**) and elastic locknut (**27**) holding the lower Slave cylinder pivot pin (**28**) to the mounting ear on the frame. Use a brass punch and a rawhide hammer to remove the lower pivot pin from the mounting ear. Discard the elastic locknut and retain the capscrew.
20. Inspect the pivot pins (**25** and **28**) for nicks or damage. If the pins are damaged, they must be replaced.
21. Use the hoist to remove the Slave cylinder from the vehicle. Place the Slave cylinder on a clean, flat surface.
22. Repeat Steps 18 thru 21 and remove the other Slave cylinder.

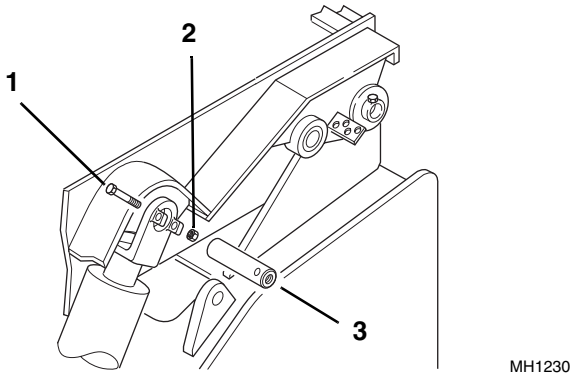


23. On the right side boom pivot mounting plate, locate the boom proximity sensor (**29**). Remove the nut (**30**) on the inside of the mounting plate. Remove the boom proximity sensor from the outside of the plate, and let the sensor rest on top of the frame, next to the mounting plate. The sensor can remain connected to the harness.

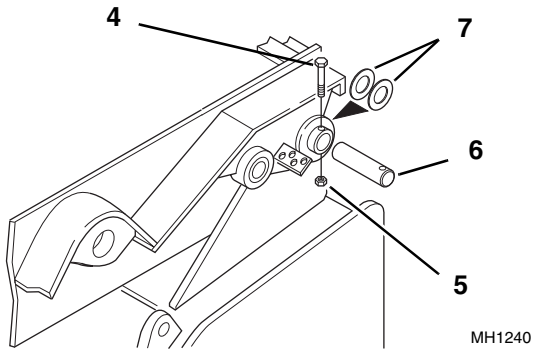


24. The slings should be placed far enough apart on the outer boom so the boom will balance when the boom Lift/Lower cylinder mounting pins and pivot pins are removed in the following steps.

25. Remove the capscrew (**1**) and elastic locknut (**2**) holding the upper Lift/Lower cylinder pivot pin (**3**) to the outer boom. Securely block the Lift/Lower cylinder in position. Remove the pivot pin from the pin mount by pulling the pin out. It may be necessary to use an appropriate puller threaded into the pivot pin to remove the pin. Discard the elastic locknut and retain the capscrew. Repeat for the other Lift/Lower cylinder.
26. Inspect the pivot pins (**3**) for nicks or damage. If the pins are damaged, they must be replaced.



27. Remove the capscrews (**4**) and elastic locknuts (**5**) holding the boom pivot pins (**6**) to the frame. Use a brass punch and a rawhide hammer to remove the pivot pins from the frame. While removing the pins, note the location and quantity of shims (**7**) between the outer boom and the frame.

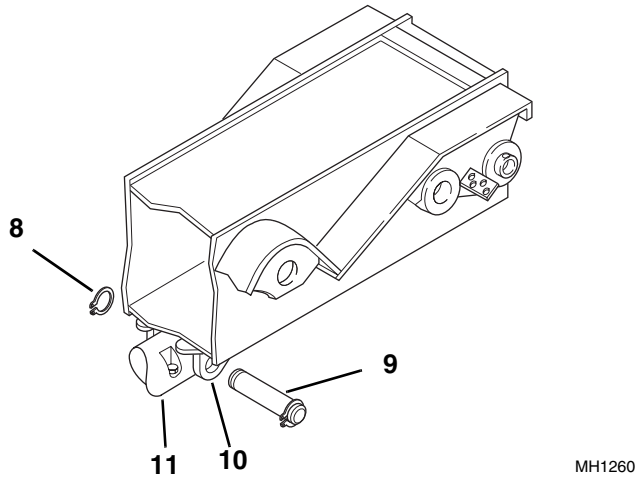


28. Use the hoist to remove the outer boom from the frame. Position the outer boom on a flat, hard surface. Block up the boom as required to allow removal of the Extend/Retract cylinder from the underside of the boom.
29. Carefully lower the outer boom onto suitable supports or to the ground.

WARNING: **NEVER** weld or drill the boom. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling. Failure to comply can result in death or serious personal injury.

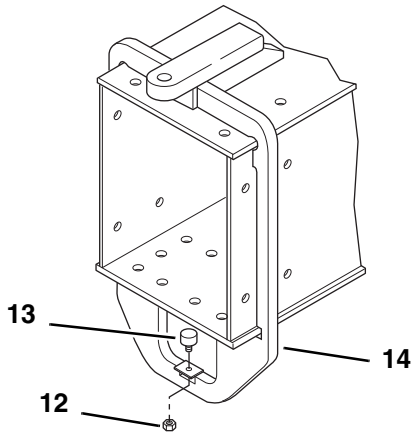
30. Inspect the boom and welds. Consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if structural damage is detected.
31. Inspect hoses, hardware, wear pads, mounting points, chains and other components visible with the outer boom removed. Replace if damaged.
32. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)

33. Use a hoist and slings to support the Extend/Retract cylinder. At the base end of the Extend/Retract cylinder, remove a retaining ring (**8**) from one side of the Extend/Retract cylinder base end pin (**9**). Use a brass punch and a rawhide hammer to remove the base end pin from the mounting ears (**10**) on the outer boom.
34. Lower the base end (**11**) of the Extend/Retract cylinder and remove the rod end of the cylinder from the retainer at the front of the boom. Place the Extend/Retract cylinder on a clean, flat surface.
35. Inspect the pin (**9**) for damage. If the pin is damaged, it should be replaced. Retain the retaining rings for reassembly.



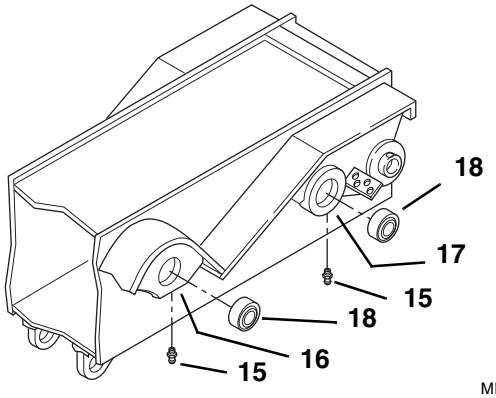
MH1260

36. At the front of the outer boom, remove the elastic locknut (**12**) holding the rubber bumper (**13**) to the Extend/Retract cylinder retainer (**14**). Discard the elastic locknut.
37. Inspect the rubber bumper (**13**). If it is in good condition, the rubber bumper can be reused. If the rubber bumper is showing signs of cracking or deterioration, it should be replaced.



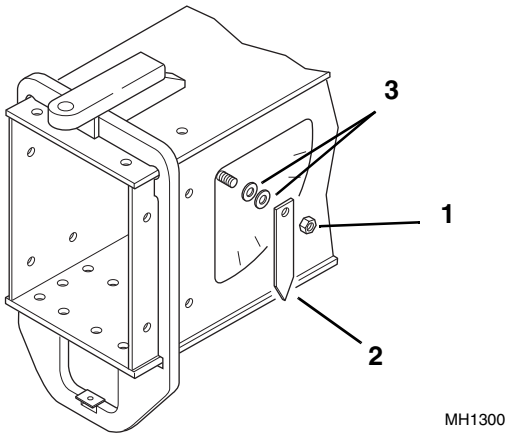
MH2160

38. Remove the grease fittings (**15**) from the Lift/Lower cylinder mounts (**16**) and the Slave cylinder mounts (**17**) on the outer boom. Save the grease fittings for reassembly.
39. Remove the self-aligning bearings (**18**) from the Lift/Lower cylinder mounts (**16**) and the Slave cylinder mounts (**17**).
40. Inspect the bearings (**18**). If the bearing rotates freely inside the outer race, the bearing can be reused.

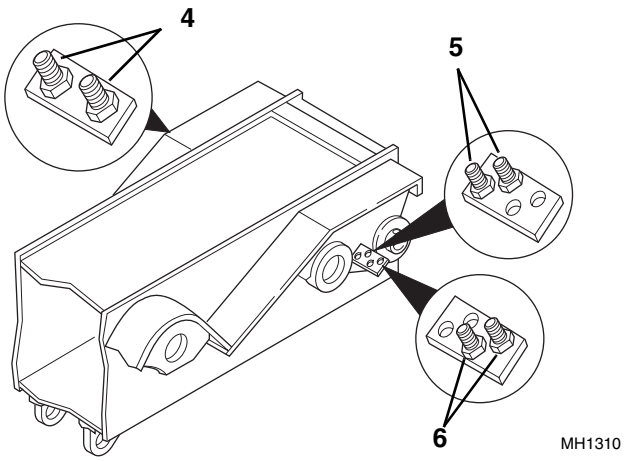


MH1290

41. On the left side of the outer boom, remove the locknut (**1**), angle indicator (**2**) and flat washers (**3**) from the weld stud. Save the angle indicator and all the hardware for reassembly.



42. Remove the extend and retract bulkhead fittings (**4**) from the mounting plate on the right side of the outer boom assembly.
43. Remove the Attachment Tilt bulkhead fittings (**5**) from the mounting plate on the left side of the outer boom assembly.
44. Remove the auxiliary hydraulic bulkhead fittings (**6**).
45. Inspect all fittings (**4**, **5** and **6**) for damage. If the fittings or threads are damaged, the fittings should be replaced.

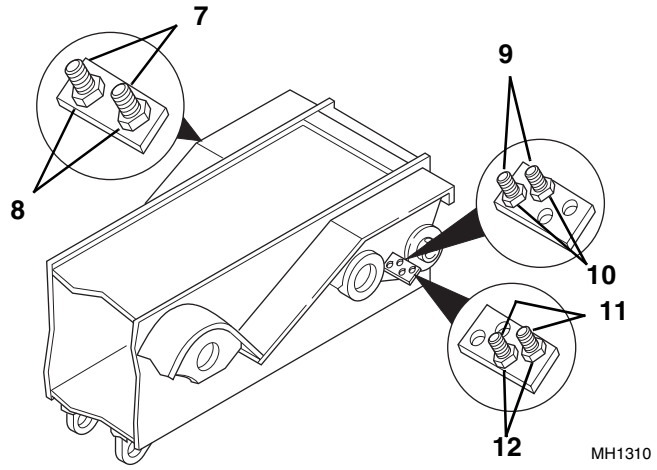


3.6.5 Outer Boom Installation

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

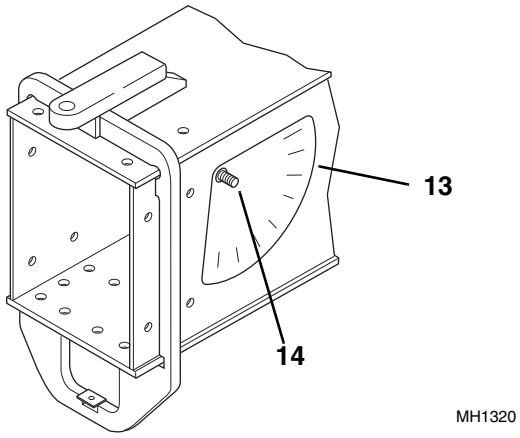
1. On the rear of the boom, assemble the extend and retract bulkhead fittings (**7**) to the mounting plate on the right side. Insert the fittings from the bottom up and secure in place with the bulkhead fitting nuts (**8**) on the top side. Tighten securely. Keep the caps on the threaded ends of the fittings to protect the threads from damage and to keep dirt and debris out of the fittings.



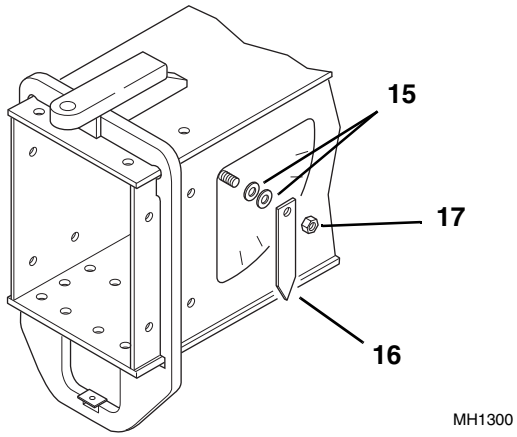
2. On the rear of the boom, assemble the Attachment Tilt bulkhead fittings (**9**) to the mounting plate on the left side. Insert the fittings from the bottom, into the set of holes closest to the boom and secure in place with the bulkhead fitting nuts (**10**) on the top side. Tighten securely. Keep the fittings capped to protect the threads from damage and to keep dirt and debris out of the fittings.
3. Assemble the auxiliary hydraulics bulkhead fittings (**11**) to the mounting plate on the left side. Insert the fittings from the bottom, into the outer set of holes and secure in place with the bulkhead fitting nuts (**12**) on the top side. Tighten securely. Keep the fittings capped to protect the threads from damage and to keep dirt and debris out of the fittings.

Note: *If you are assembling a new outer boom assembly, continue with Step 4. If reassembling the existing boom assembly proceed to Step 5.*

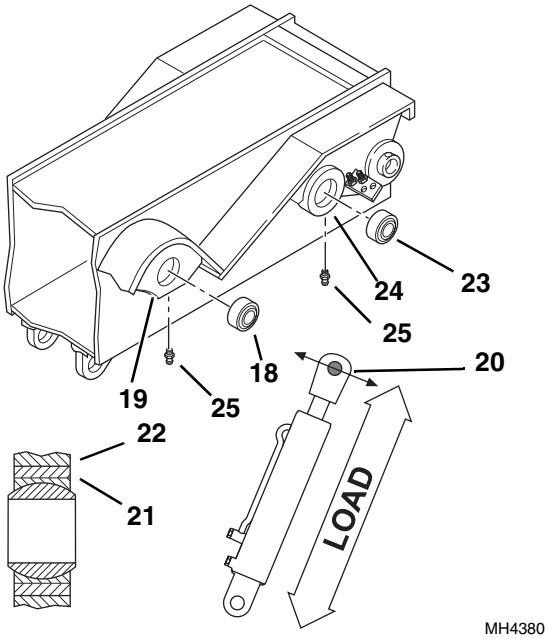
4. Assemble a new angle indicator decal (**13**) to the left side of the boom assembly. Place the hole in the decal around the weld stud (**14**) and align the upper edge of the decal parallel with the top edge of the boom assembly.



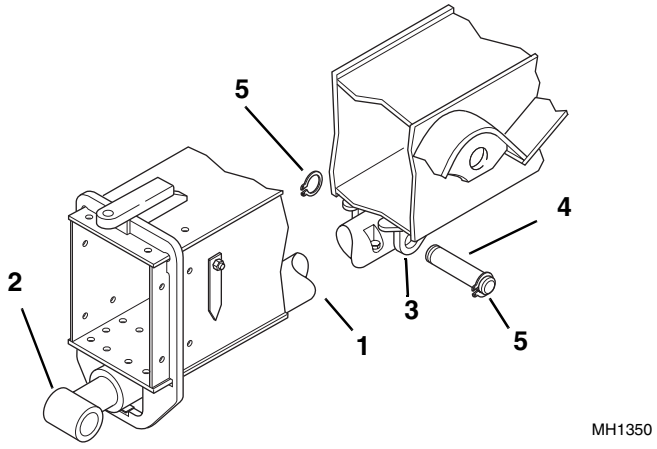
5. Place the two flat washers (**15**) and the angle indicator (**16**) onto the weld stud. Secure in place with the locknut (**17**). After tightening the locknut, the angle indicator must pivot freely on the weld stud. If the angle indicator binds, loosen the locknut slightly. Recheck to be sure the angle indicator pivots freely.



6. Assemble new or saved Lift/Lower cylinder bearings (**18**) into the Lift/Lower cylinder mounts (**19**) on each side of the boom assembly. Orient the fracture (**20**) in the outer race of each bearing at the 3 o'clock position. Press the bearings into position until the edge of the outer race (**21**) of each bearing is flush with the edge of the plate (**22**).
7. Assemble new or saved Slave cylinder bearings (**23**) into the Slave cylinder mounts (**24**) on each side of the boom assembly. Orient the fracture (**20**) in the outer race of each bearing so that it is perpendicular to the force of the load. Press the bearings into position until the edge of the outer race (**21**) of each bearing is flush with the edge of the plate (**22**).
8. Assemble the grease fittings (**25**) into the Lift/Lower cylinder mounts (**19**) and the Slave cylinder mounts (**24**) on the outer boom. Tighten all grease fittings.



9. Slings and a hoist are required for this step. Position the Extend/Retract cylinder (**1**) with the extend and retract port elbows facing down. Place the rod end of the Extend/Retract cylinder (**2**) through the Extend/Retract cylinder retainer at the front of the outer boom.
10. At the rear of the Extend/Retract cylinder, align the hole in the base end of the cylinder with the holes in the mounting ears (**3**) under the outer boom.
11. Coat the base end cylinder pin with anti-seize compound. Insert the base end cylinder pin (**4**) through both mounting ears and the base end of the Extend/Retract cylinder. Secure the pin in place with a retaining ring (**5**) on each side of the pin. Be sure the retaining rings are securely seated in the grooves on each side of the pin.

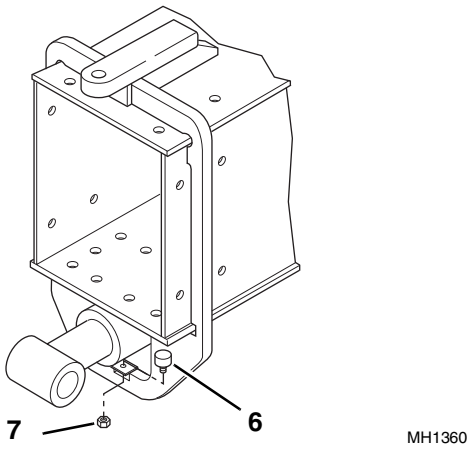


MH1350

12. Lift the rod end of the Extend/Retract cylinder up far enough to insert the threaded stud on the rubber bumper (**6**) into the hole in the Extend/Retract cylinder retainer.

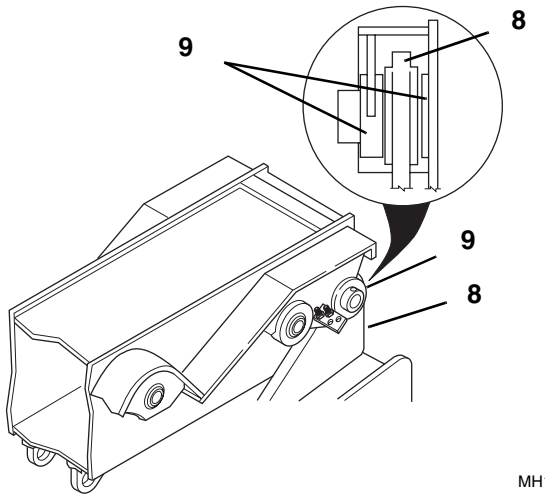
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

13. Secure the rubber bumper (**6**) in place with a new elastic locknut (**7**). Tighten securely. Lower the rod end of the Extend/Retract cylinder, and allow it to rest on the rubber bumper.



MH1360

14. Lift the outer boom assembly and position the boom on the frame. Align the mounting plates (**8**) on the frame between the mounting hubs (**9**) on each side of the boom assembly. Lower the boom assembly until the holes in the boom assembly and the mounting plates align.

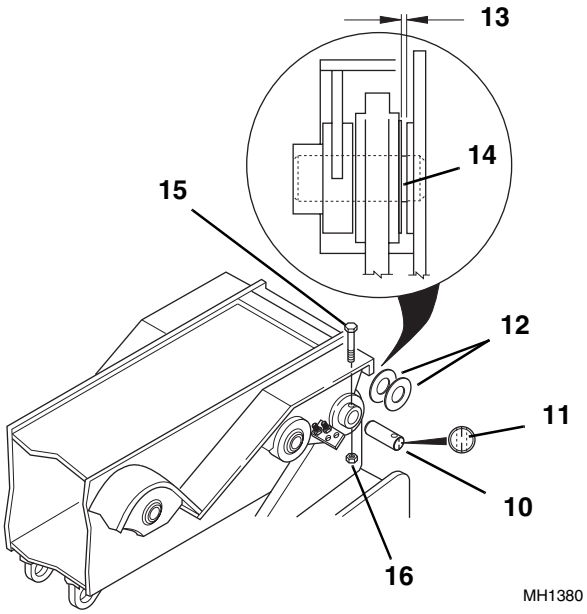


MH1370

15. On the end of the boom pivot pin (**10**) closest to the capscrew hole, mark the capscrew mounting hole location. Coat the entire pin with anti-seize compound.
16. Insert the pin (**10**) from the outside of the boom assembly, making sure the marks (**11**) for the capscrew mounting hole stay in line with the capscrew mounting holes in the boom mounting hub. If necessary, use a rawhide hammer to install the pivot pin.
17. Shim the boom as required using the shims (**12**), saved, to maintain a .10" (2,5 mm) maximum gap (**13**) between the boom mounting hub and the self-aligning bearing (**14**) in the frame. If an additional shim is required to maintain the maximum gap, the extra shim MUST be inserted on the right side of the boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

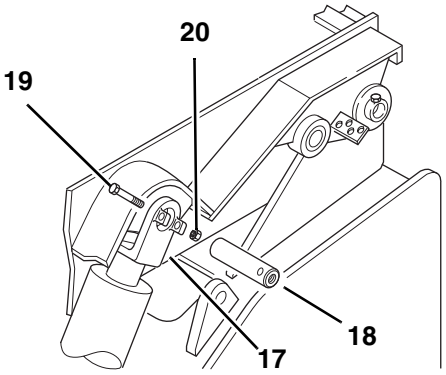
18. After the pivot pin and shims are in place, use a tapered punch to line up the capscrew hole in the pin with the mounting holes in the hub. Insert the capscrew (**15**), saved, through the hub and the pin. Secure the capscrew in place with a new elastic locknut (**16**). Tighten the elastic locknut securely.



19. Line up the rod end of one of the Lift/Lower cylinders (**17**) with the self-aligning bearing on the outer boom assembly.
20. Coat the entire Lift/Lower cylinder pivot pin (**18**) with anti-seize compound. Insert the pin through the rod end of the cylinder and the self-aligning bearing. If necessary, use a rawhide hammer to install the pin.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

21. Use a tapered punch to line up the capscrew mounting hole in the pin with the mounting tabs on the rod end of the cylinder. Secure the pin in place with the capscrew (**19**), saved, and a new elastic locknut (**20**). Tighten the elastic locknut securely.

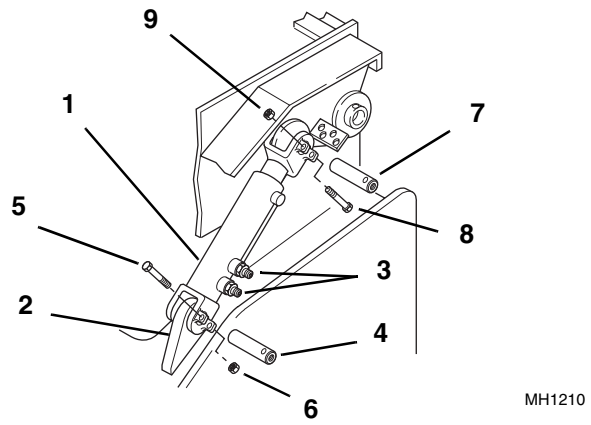


22. Repeat Steps 19 thru 21 to assemble the Lift/Lower cylinder to the other side of the outer boom.

23. Use a hoist and sling to position the Slave cylinder (**1**) onto the lower cylinder mount (**2**) located on the frame. The cylinder should be positioned with the extend and retract port fittings (**3**) to the outside.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

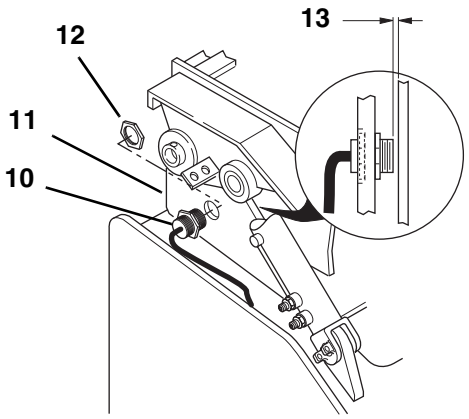
24. Coat the lower pivot pin (**4**) with anti-seize compound. Insert the pin through the base end of the Slave cylinder. Use a tapered punch to line up the capscrew hole in the pin with the mounting tabs on the cylinder. Secure the lower pivot pin in place with the capscrew (**5**), saved, and a new elastic locknut (**6**). Tighten the elastic locknut securely.
25. Position the rod end of the Slave cylinder around the self-aligning bearing on the outer boom.
26. Coat the upper pivot pin (**7**) with anti-seize compound. Insert the pin through the rod end of the Slave cylinder. If necessary, use a rawhide hammer to install the upper pivot pin. Use a tapered punch to line up the capscrew hole in the pin with the mounting tabs on the cylinder.



MH1210

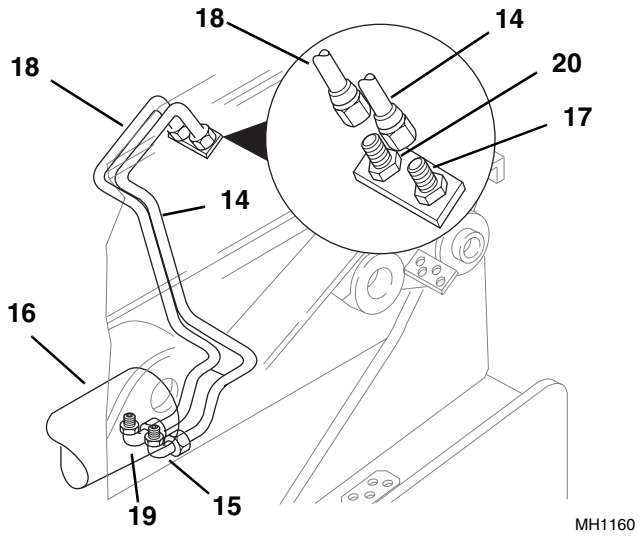
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

27. Secure the upper pivot pin (**7**) with the capscrew (**8**), saved, and a new elastic locknut (**9**). Tighten the elastic locknut securely.
28. Repeat Steps 23 thru 26 to assemble the other Slave cylinder to the other side of the outer boom.
29. Reassemble the boom proximity sensor (**10**) to the right side mounting plate. With the boom properly shimmed, position the boom assembly all the way to the right side.
30. Insert the boom proximity sensor (**10**) through the hole in the right side mounting plate (**11**). Assemble the jam nut (**12**), saved, onto the boom proximity sensor on the inside of the plate.
31. Adjust the inner and outer jam nuts on the boom proximity sensor until the gap (**13**) between the sensor and the boom is .12" (3 mm). Tighten the inside jam nut to hold the boom proximity sensor in position. Torque the jam nut to 36 lb-in (4,1 Nm).



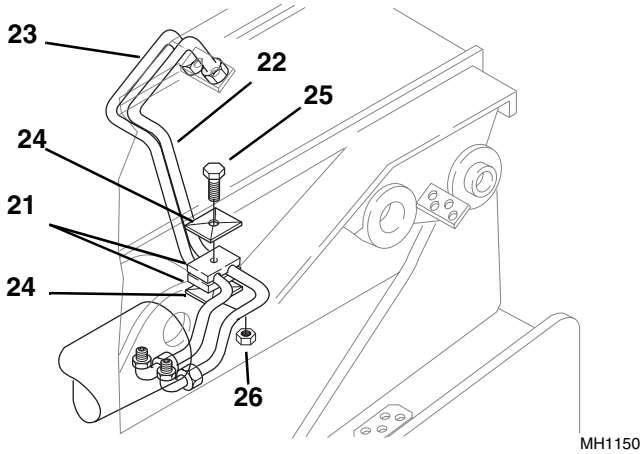
MH1390

32. Assemble the extend tube (**14**) to the extend port 90° elbow (**15**) on the Extend/Retract cylinder (**16**) and the inside bulkhead fitting (**17**) on the right side of the outer boom. Hand-tighten the tube fitting to the 90° elbow. Reposition the tube as needed to align the other end of the tube with the bulkhead fitting. Tighten the tube end at the bulkhead fitting and then tighten the tube end at the 90° elbow.
33. Assemble the retract tube (**18**) to the retract port 90° elbow (**19**) on the Extend/Retract cylinder (**16**) and the outside bulkhead fitting (**20**) on the right side of the outer boom. Hand-tighten the tube fitting to the 90° elbow. Reposition the tube as needed to align the other end of the tube with the bulkhead fitting. Tighten the tube end at the bulkhead fitting and then tighten the tube end at the 90° elbow.



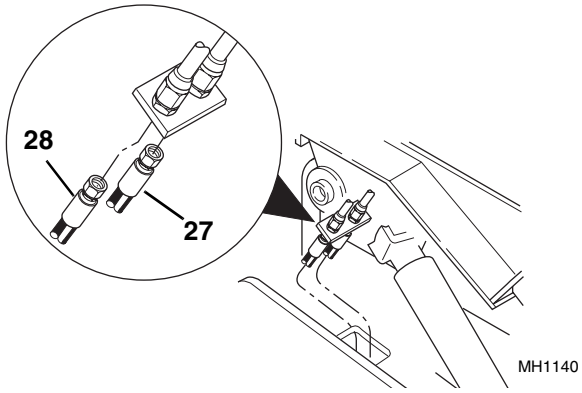
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

34. Assemble the tube clamp halves (**21**) to the extend (**22**) and retract (**23**) tubes under the outer boom. Place one clamp half on top of the tubes and one on the underside of the tubes. Place a clamp cover (**24**) on the top and bottom of the clamps. Secure in place with the capscrew (**25**), saved, and a new elastic locknut (**26**). Position the clamp halves to securely hold the tubes without putting tension on either tube. Tighten the elastic locknut securely.



35. Assemble the boom extend hose (**27**) to the inside bulkhead fitting (extend tube) on the right side of the boom. Remove all twists from the boom extend hose, and tighten the hose end securely to the bulkhead fitting.

36. Assemble the boom retract hose (**28**) to the outside bulkhead fitting (retract tube) on the right side of the boom. Remove all twists from the boom retract hose, and tighten the hose end securely to the bulkhead fitting.



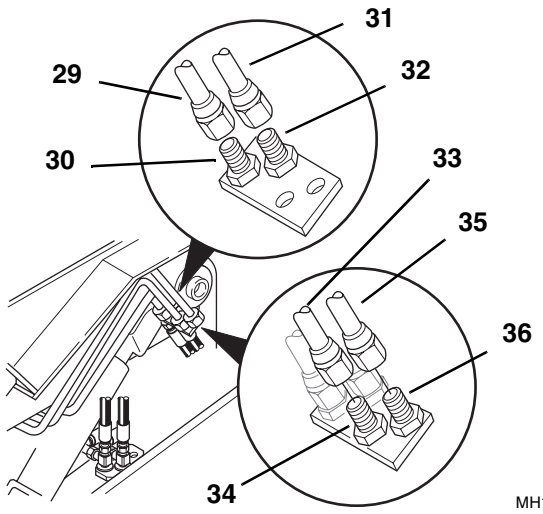
IMPORTANT: DO NOT *fully tighten the tube connections, until all tubes are assembled at both ends.*

37. Position the extend tube assembly (**29**) onto the inner bulkhead fitting (**30**). Assemble the nut on the tube assembly to the bulkhead fitting.

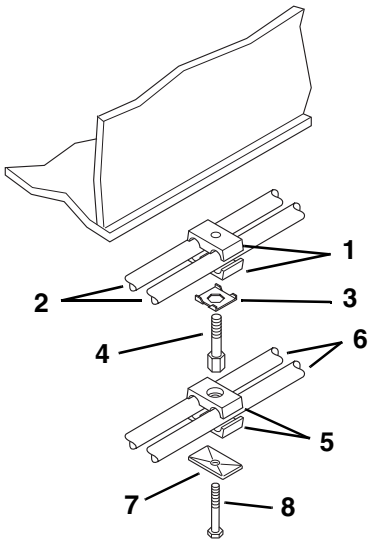
38. Position the retract tube assembly (**31**) onto the second bulkhead fitting (**32**). Assemble the nut on the tube assembly to the bulkhead fitting.

39. Position the inner (to male nipple) auxiliary tube assembly (**33**) onto the third bulkhead fitting (**34**). Assemble the nut on the tube assembly to the bulkhead fitting.

40. Position the outer (to female coupler) tube assembly (**35**) onto the outer bulkhead fitting (**36**). Assemble the nut on the tube assembly to the bulkhead fitting.

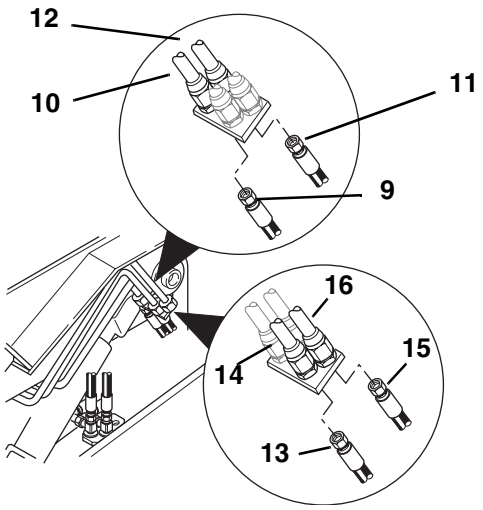


41. Assemble the tube clamp halves, saved, to the underside of the outer boom. Place an upper clamp half (**1**) on each side of the Attachment Tilt (upper) tubes (**2**). Secure each set of clamp halves to the boom with a locking plate (**3**), saved, and a stacking bolt (**4**), saved. Tighten the stacking bolt securely to hold the upper tubes in place.
42. Place a lower clamp half (**5**) on each side of the auxiliary hydraulic (lower) tubes (**6**). Secure each set of clamp halves to the stacking bolt with a clamp cover (**7**), saved, and a capscrew (**8**), saved. Tighten the capscrew securely to hold the lower tubes in place.
43. Repeat Steps 41 and 42 to assemble the clamps at the other two clamp locations under the outer boom.



MH1190

44. At the rear left side of the boom, assemble the Attachment Tilt extend (inner) hose (**9**) to the inner bulkhead fitting (**10**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
45. Assemble the Attachment Tilt retract (second) hose (**11**) to the second bulkhead fitting (**12**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
46. Assemble the auxiliary hydraulic (third) hose (**13**) for the male nipple to the third bulkhead fitting (**14**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.
47. Assemble the auxiliary hydraulic (outer) hose (**15**) for the female coupler to the outer bulkhead fitting (**16**). Remove all twists from the hose, and tighten the hose end securely to the bulkhead fitting.

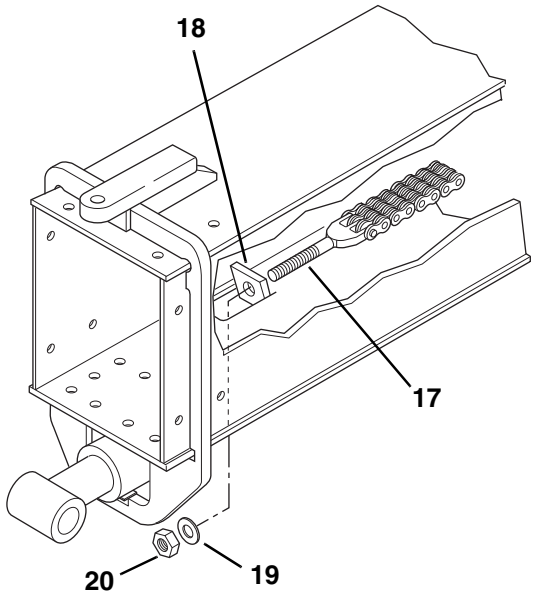


MH1130

48. Inside the rear of the outer boom, slide the threaded clevis end (**17**) of the retract chain down the right side of the boom. Guide the threaded part of the clevis out through the hole in the tab (**18**) on the bottom of the outer boom. Pull the threaded part of the clevis all the way through the tab.

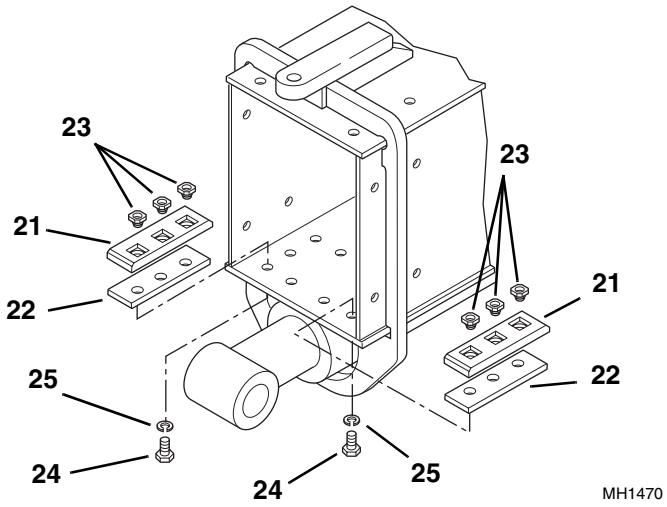
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

49. Coat the entire threaded portion of the clevis (**17**) with multi-purpose grease. Install the flat washer (**19**), saved, onto the threaded clevis and assemble a new elastic locknut (**20**). Thread the nut onto the clevis until the threads are flush with the top of the nut.



MH1460

50. At the front of the outer boom, reassemble the lower outside wear pads (**21**) and wear pad spacers (**22**):
    a. Place the wear pad inserts (**23**) into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities. Fill each cavity with a good grade of lithium-based EP grease.
    b. Place a wear pad (**21**) and a spacer (**22**) into the outer boom with the hole offset of the wear pad toward the middle of the boom. Line up the holes in the spacer and wear pads with the holes in the bottom of the boom.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**24**), saved. Insert the capscrews with lockwashers (**25**), saved, through the bottom of the boom and into the wear pads. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Repeat Steps a thru d to assemble the lower wear pad on the other side of the outer boom.



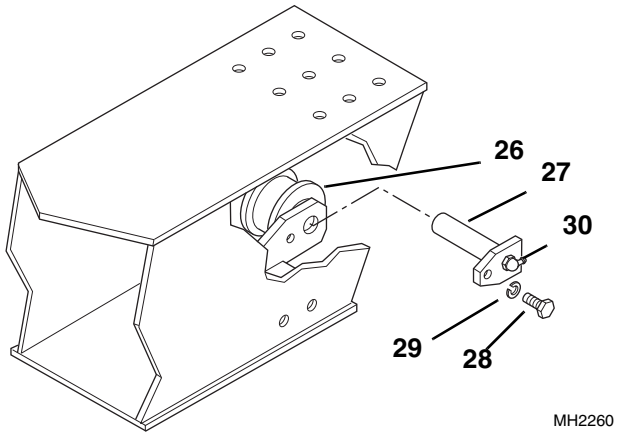
MH1470

3.6.6 Primary Intermediate Boom Installation

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

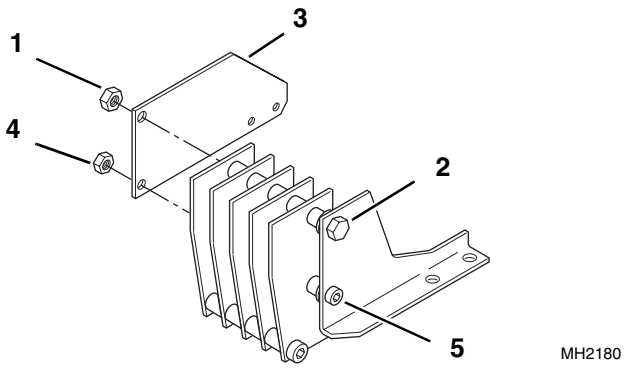
WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

1. At the rear of the primary intermediate boom, assemble the retract chain sheave (**26**) to the mounting ears on the right side of the boom. Place the sheave between the ears and insert the sheave pin (**27**) from the left side. Line up the hole in the pin retainer plate with the threaded hole in the left ear.
2. Secure the pin (**27**) with the capscrew (**28**), saved, and the lockwasher (**29**), saved. Tighten the capscrew securely.
3. Grease the sheave using the grease fitting (**30**) in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.



MH2260

4. Remove the left side mounting plate from the hose reel assembly. Remove the elastic locknut (**1**) from the upper retaining capscrew (**2**).
5. Rotate the left side mounting plate (**3**) out of the way and reassemble the elastic locknut loosely onto the retaining capscrew.
6. Remove the elastic locknut (**4**) from the center shoulder bolt (**5**). Remove the left side plate and reassemble the elastic locknut loosely onto the shoulder bolt.



MH2180

7. Assemble the left side mounting plate and lower left side wear pad to the side of the primary intermediate boom:

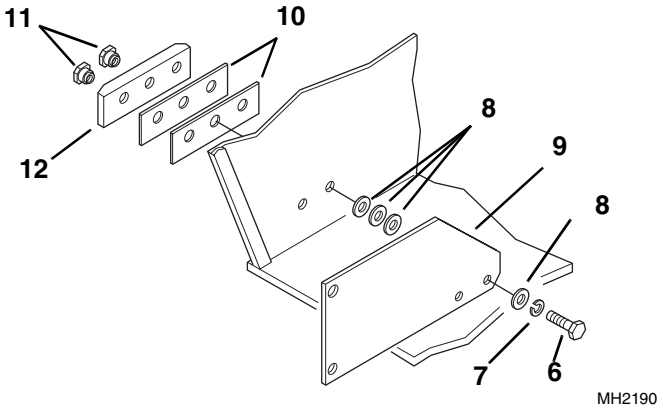
Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

a. Apply Loctite® 242 threadlocker to the threads of the two capscrews (**6**), saved. Insert a capscrew with a lockwasher (**7**), saved, and a flat washer (**8**), saved, through each of the mounting holes in the left side mounting plate (**9**). Place three flat washers (**8**), saved, onto each of the capscrews and insert the capscrews through the mounting holes in the left side of the boom.

b. Place the wear pad shims (**10**), saved, onto the capscrews. Place the shims onto the capscrews with the holes offset to the top. Place the wear pad inserts (**11**), saved, into the cavities in the wear pad (**12**). Be sure the inserts are seated completely in the cavities. Be careful not to push the wear pad inserts out of the wear pads.

c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

d. Fill each cavity with a good grade of lithium-based EP grease.

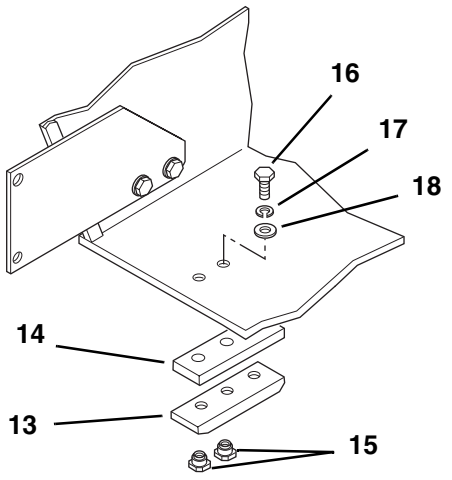


MH2190

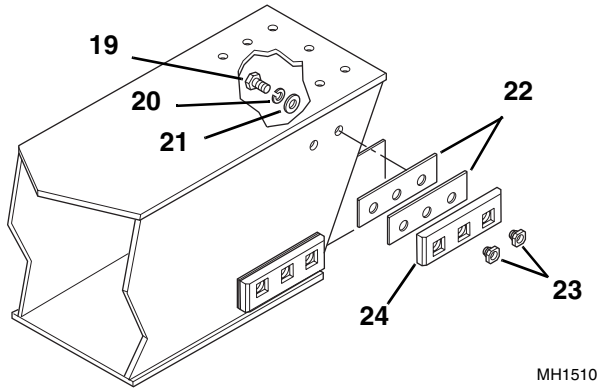
8. Assemble the lower wear pad (**13**), saved, and wear pad spacer (**14**), saved, to the bottom of the primary intermediate boom:
   a. Place the wear pad inserts (**15**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely into the cavities.

Note: ***DO NOT*** *apply Loctite to the capscrews (**16**), saved. The capscrews will be removed later to finish assembling the hose reel assembly.*

   b. With the holes offset to the left, line up the holes in the wear pad spacer (**14**) and wear pad (**13**) with the holes in the primary intermediate boom. Insert a capscrew with a lockwasher (**17**), saved, and a flat washer (**18**), saved, through the holes. Be careful not to push the inserts out of the wear pads and snug up the capscrews.
   c. Check to be sure the capscrews (**17**) **DO NOT** protrude past the wear pads. If the capscrews protrude past the wear pads, add additional flat washers (**18**) under the capscrew.
   d. Fill all wear pad cavities with a good grade of lithium-based EP grease.

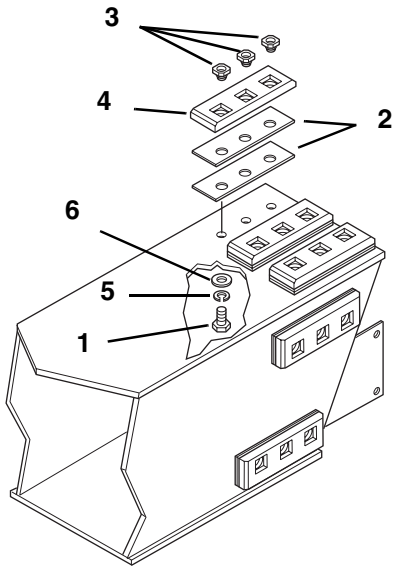


9. Assemble the side wear pads:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**19**), saved. Insert a capscrew with a lockwasher (**20**), saved, and a flat washer (**21**), saved, through each of the wear pad mounting holes in the side plates of the primary intermediate boom.
   b. Place the wear pad shims (**22**), saved, onto the capscrews with the holes offset to the center. Place the wear pad inserts (**23**), saved, into the cavities in the wear pad (**24**). Be sure the inserts are seated completely in the cavities. Be careful not to push the wear pad inserts out of the wear pads
   c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   d. Fill all wear pad cavities with a good grade of lithium-based EP grease.



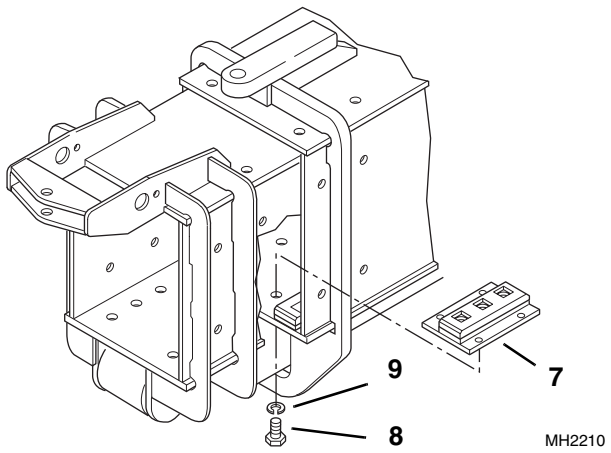
Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the vertical direction.*

10. Assemble the top wear pads to the top of the intermediate boom. Position the wear pads so the outside pads are offset to the outside and the center pad is offset to the right as seen in the following illustration.
    a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**1**), saved.
    b. Place the wear pad shims (**2**), saved, onto the top of the boom. Line up the holes in the shims with the holes in the boom. Place the wear pad inserts (**3**), saved, into the cavities in the wear pad (**4**). Be sure the inserts are seated completely in the cavities.
    c. Insert a capscrew with a lockwasher (**5**), saved, and a flat washer (**6**), saved, through each of the mounting holes in the top of the intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH1520

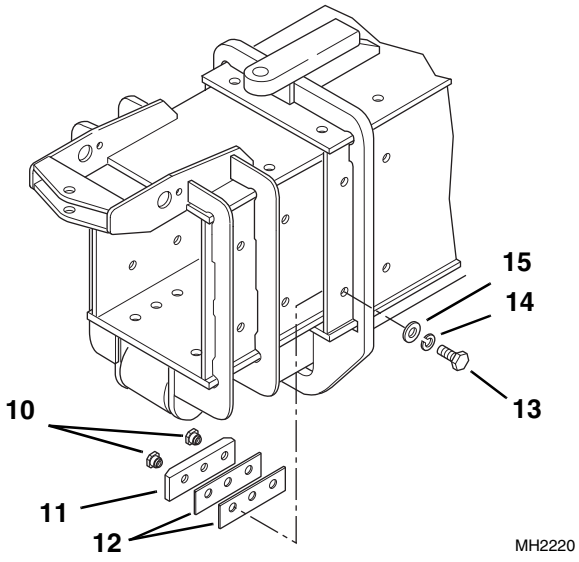
11. On the inside of the outer boom and the inside of the primary intermediate boom, spray the wear pad pathways with LPS3 or equivalent. Spray the wear pad pathways on the underside of the primary intermediate boom with LPS3 or equivalent.
12. Before installing the primary intermediate boom into the outer boom, place a string (heavy enough to pull the Attachment Tilt and auxiliary hydraulic hoses) down the inside of the outer boom. Let the string hang out the rear of the boom. Pull the other end out the opening on the left side of the boom where the hoses will exit the boom. Place a string for each hose in the boom. Position the strings all the way to the left side of the outer boom.
13. Lift the primary intermediate boom. Carefully slide the primary intermediate boom into the front of the outer boom. Push the boom in until the rod end of the Extend/Retract cylinder aligns with the mounts on the primary intermediate boom.
14. Use the hoist and slings to slightly lift the front of the primary intermediate boom to allow installation of the center wear pad:
    a. Fill the cavities of the wear pad with a good grade of lithium-based EP grease.
    b. Slide the center wear pad mount (**7**) into the outer boom with the wear pad offset toward the right side. Line up the threaded holes in the wear pad mount with the holes in the bottom of the outer boom.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**8**), saved. Secure the wear pad mount to the outer boom with the capscrews (**8**) and lockwashers (**9**), saved. Torque the capscrews to 31 ±3 lb-ft (42 ±4 Nm).



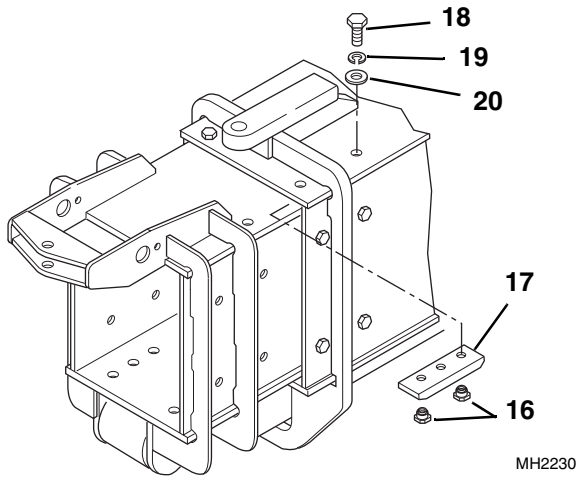
MH2210

15. Remove the slings and the hoist from the primary intermediate boom.

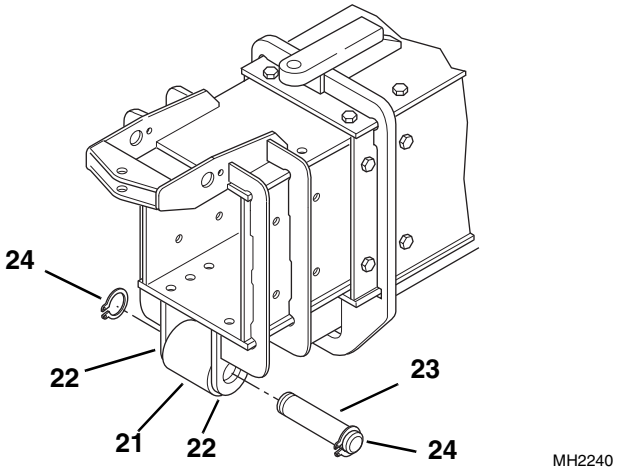
16. Assemble the side wear pads to the outer boom:
    a. Slide the primary intermediate boom over to one side as far as it will go, to allow wear pad installation.
    b. Place the wear pad inserts (**10**), saved, into the cavities of the side wear pads (**11**), saved. Fill the cavities of the wear pad with a good grade of lithium-based EP grease. Place the shims (**12**), saved, onto the wear pad and line up the holes.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**13**), saved. Slide the wear pad with shims in between the primary intermediate boom and the outer boom with the offset of each wear pad away from the center. Line up the holes and secure in place with the capscrews (**13**), lockwashers (**14**), saved, and flat washers (**15**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Repeat Steps a-d to install the side wear pads on the other side of the outer boom.



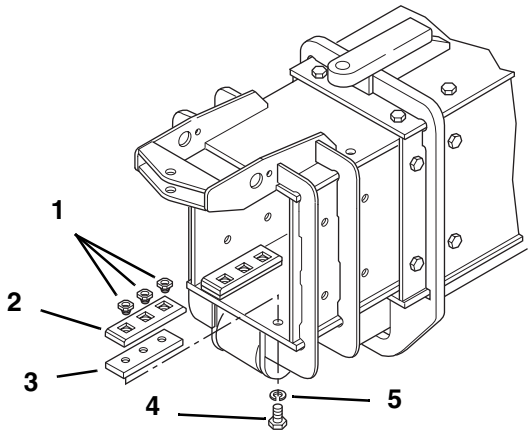
17. Assemble the top wear pads to the inside of the outer boom:
    a. Place the wear pad inserts (**16**), saved, into the cavities of the top wear pads (**17**), saved. Fill the cavities of the wear pad with a good grade of lithium-based EP grease.
    b. Apply Loctite® 242 threadlocker to the threads of the capscrews (**18**), saved. Slide the wear pad in between the primary intermediate boom and the outer boom with the offset of each wear pad away from the center. Line up the holes and secure in place with the capscrews (**18**), lockwashers (**19**), saved, and flat washers (**20**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



18. Use a hoist and sling to lift the rod end of the Extend/Retract cylinder (**21**) up. Align the rod end of the extend cylinder with the mounts (**22**) at the front of the primary intermediate boom.
19. Coat the extend cylinder rod end pin (**23**), saved, with anti-seize compound. Insert the rod end pin through the mounts and secure in place with the retaining rings (**24**), saved. Be sure the retaining rings are securely seated in the grooves on the pin.

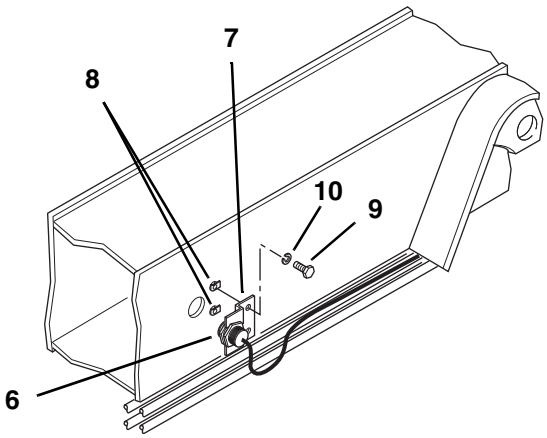


20. Install the primary intermediate boom front lower wear pads:
    a. Place the wear pad inserts (**1**), saved, into the cavities of the front bottom wear pads (**2**), saved.
    b. Place the wear pads and spacers (**3**), saved, into the primary intermediate boom with the offset of the wear pads toward the outside.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**4**), saved. Line up the holes and secure in place with the capscrews (**4**) and lockwashers (**5**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    e. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH2250

21. On the left side of the outer boom, reassemble the boom extend interlock sensor (**6**) with mounting bracket (**7**). Place the two retainer nuts (**8**), saved, into the holes in the side of the outer boom. Align the holes in the mounting bracket with the retainer nuts. Secure in place with the capscrews (**9**), saved, and lockwashers (**10**), saved. Tighten securely.



MH2170

22. Secure the boom extend interlock sensor wire to the Attachment Tilt tubes under the boom with new tie wraps.

3.6.7 Secondary Intermediate Boom Installation

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

IMPORTANT: *Light lubrication of the boom wear surfaces with a rust inhibitor/lubricant such as LPS 3 or equivalent is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended in salt air climates and when the vehicle is stored, to help prevent rusting.*

1. Install the secondary intermediate boom lower wear pad:

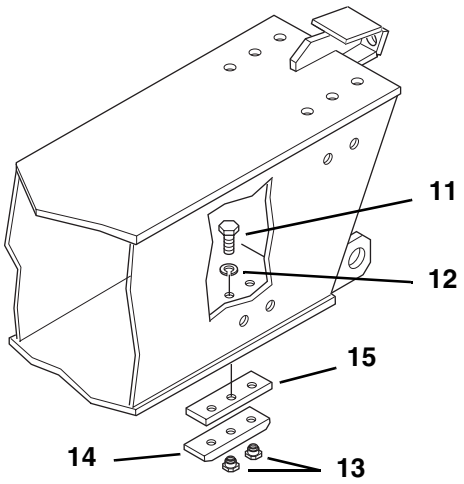
Note: ***DO NOT*** *apply threadlocker to the threads of the two wear pad capscrews (**11**). The capscrews will be removed to assemble the hose carrier support in place after the inner boom has been installed.*

   a. Insert a capscrew with a lockwasher (**12**), saved, through each of the mounting holes in the bottom of the secondary intermediate boom.

   b. Place the wear pad inserts (**13**), saved, into the cavities in the wear pad (**14**), saved. Be sure the inserts are seated completely into the cavities. Place the wear pad spacer (**15**), saved, and the wear pad under the secondary intermediate boom. With the holes offset to the left, line up the holes and secure the wear pad spacer and wear pad to the secondary intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.

   c. Tighten the capscrews only enough to hold the wear pad in place.

   d. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH2270

Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07"-.13" (1,8 to 3,3 mm) in the horizontal direction.*

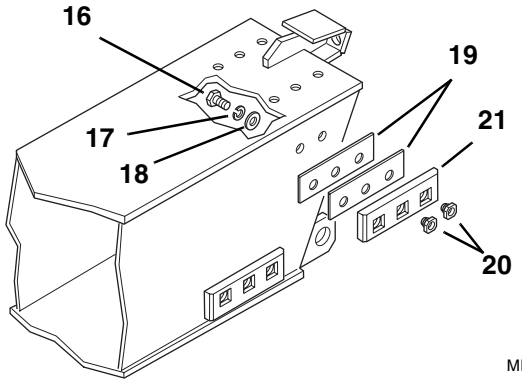
2. Install the secondary intermediate boom side wear pads:

   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**16**), saved. Insert a capscrew with a lockwasher (**17**), saved, and a flat washer (**18**), saved, through each of the wear pad mounting holes in the side plates of the secondary intermediate boom.

   b. Place the wear pad shims (**19**), saved, onto the capscrews with the holes offset to the center. Place the wear pad inserts (**20**), saved, into the cavities in the wear pad (**21**). Be sure the inserts are seated completely in the cavities. Be careful not to push the wear pad inserts out of the wear pads.

   c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

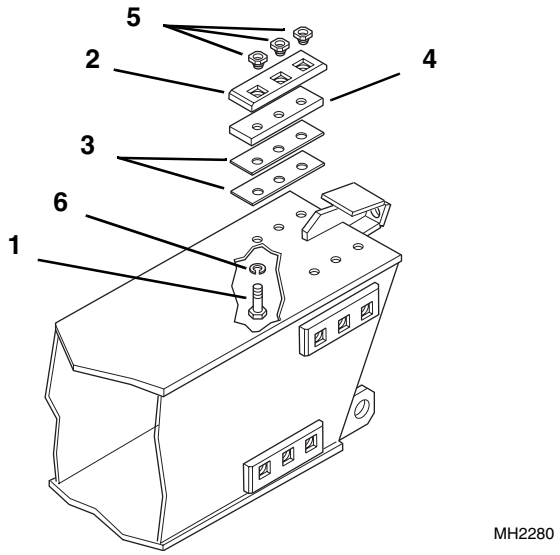
   d. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH2060

Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the vertical direction.*

3. Install the secondary intermediate boom upper rear wear pads:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**1**), saved, for the right side wear pad (**2**).
   b. Place the wear pad shims (**3**), saved, and wear pad spacer (**4**) onto the top of the boom with the offset toward the outside of the boom. Line up the holes in the shims, spacer and wear pad with the holes in the boom. Place the wear pad inserts (**5**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities.
   c. Insert a capscrew with a lockwasher (**6**), saved, through each of the mounting holes in the top of the secondary intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.
   d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   e. Fill all wear pad cavities with a good grade of lithium-based EP grease.

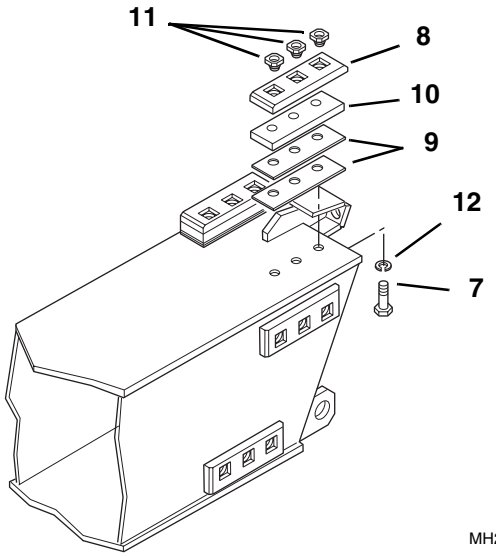


MH2280

4. Install the secondary intermediate boom upper left rear side wear pad:

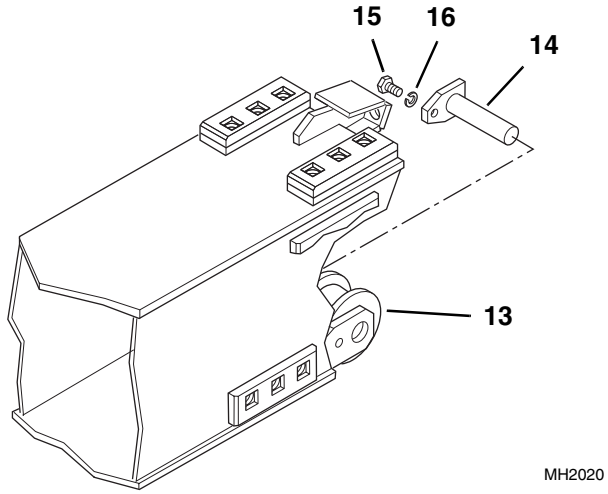
Note: ***DO NOT*** *apply Loctite® 242 threadlocker to the threads of the capscrews (**7**), saved, for the left side wear pad (**8**). The capscrews will need to be removed to assemble the hose clamp support bracket later.*

   a. Place the wear pad shims (**9**), saved, and wear pad spacer (**10**) onto the top of the boom with the offset toward the outside of the boom. Line up the holes in the shims, spacer and wear pad with the holes in the boom.
   b. Place the wear pad inserts (**11**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities.
   c. Insert a capscrew with a lockwasher (**12**), saved, through each of the mounting holes in the top of the secondary intermediate boom. Be careful not to push the wear pad inserts out of the wear pads.
   d. Tighten the capscrews only enough to hold the wear pads in place.
   e. Fill all wear pad cavities with a good grade of lithium-base EP grease.



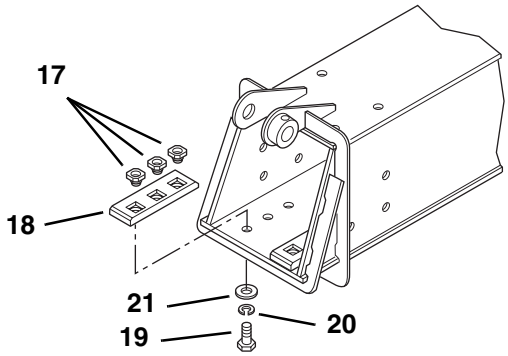
MH2290

5. At the rear of the secondary intermediate boom, assemble the retract chain sheave (**13**) to the mounting ears on the left side of the boom. Place the sheave between the ears and insert the sheave pin (**14**) from the right side. Line up the hole in the pin retainer plate with the threaded hole in the right ear. Secure the pin in place with the capscrew (**15**), saved, and the lockwasher (**16**), saved. Tighten the capscrew securely.
6. Grease the sheave using the grease fitting in the pin. Spin the sheave by hand to ensure the sheave spins freely on the pin and to distribute grease evenly.



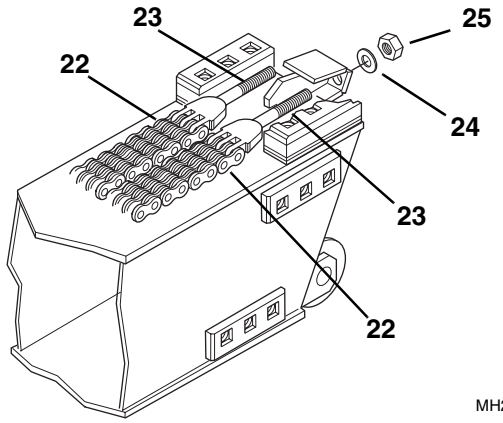
MH2020

7. Install the lower front wear pads:
   a. Place the wear pad inserts (**17**), saved, into the cavities of the lower front secondary intermediate boom wear pads (**18**), saved.
   b. Place the wear pads (**18**), saved, into the secondary intermediate boom with the offset of the wear pads toward the outside.
   c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**19**), saved. Line up the holes and secure in place with the capscrews (**19**), lockwashers (**20**), saved, and flat washers (**21**), saved. Be careful not to push the wear pad inserts out of the wear pads.
   d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   e. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH2070

8. Lay the two extend chains (**22**) on the top of the secondary intermediate boom with the threaded clevis ends (**23**) toward the rear of the boom.
9. Coat the threads on each clevis (**23**) with multi-purpose grease and insert the clevis' through the holes in the anchor plate.
10. Install a flat washer (**24**), saved, and a new elastic locknut (**25**) onto each clevis. Tighten the elastic locknut far enough so the threads are even with the top of the locknut.

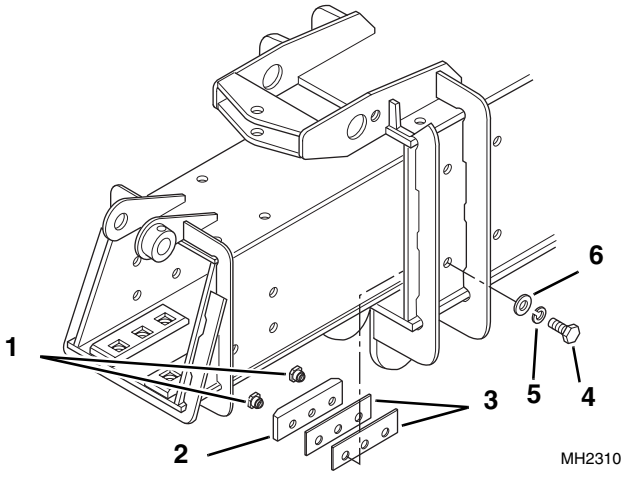


MH2300

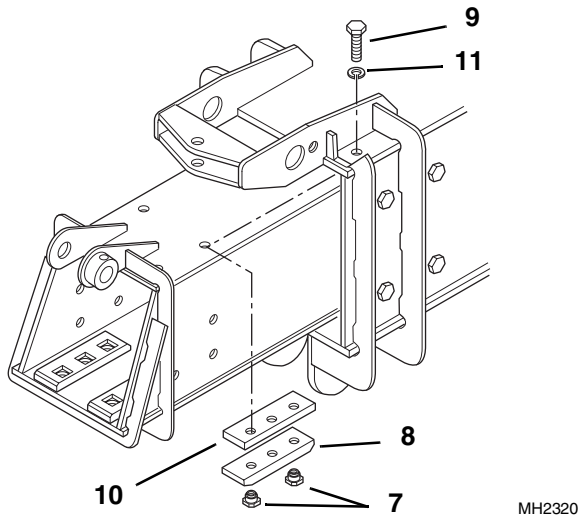
11. On the inside of the secondary intermediate boom, spray the wear pad pathways with LPS3 or equivalent. Spray the wear pad pathways on the underside of the secondary intermediate boom with LPS3 or equivalent.
12. Lift the secondary intermediate boom up. Carefully slide the secondary intermediate boom into the front of the primary intermediate boom. Push the boom all the way in.

Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

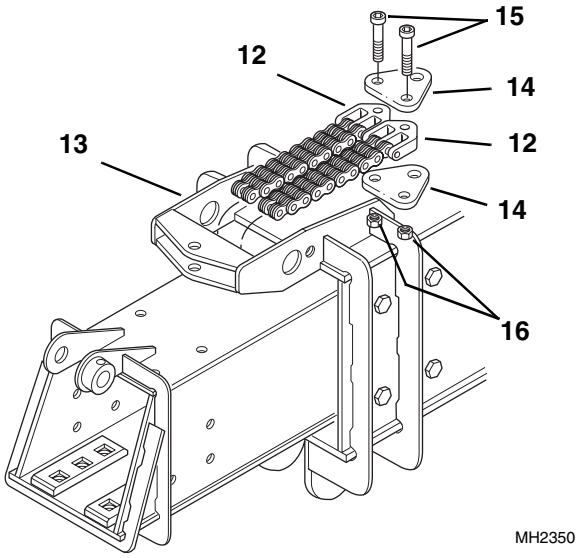
13. Assemble the side wear pads to the primary intermediate boom:
    a. Slide the secondary intermediate boom over to one side as far as it will go, to allow wear pad installation.
    b. Place the wear pad inserts (**1**), saved, into the cavities of the side wear pads (**2**), saved. Fill the cavities of the wear pad with a good grade of lithium-based EP grease.
    c. Place the shims (**3**), saved, onto the wear pad and line up the holes.
    d. Apply Loctite® 242 threadlocker to the threads of the capscrews (**4**), saved. Slide the wear pad with shims in between the secondary intermediate boom and the primary intermediate boom with the offset of each wear pad toward the center. Line up the holes and secure in place with the capscrews (**4**), lockwashers (**5**), saved, and flat washers (**6**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    e. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    f. Repeat Steps a-e to install the wear pads on the other side of the primary intermediate boom.



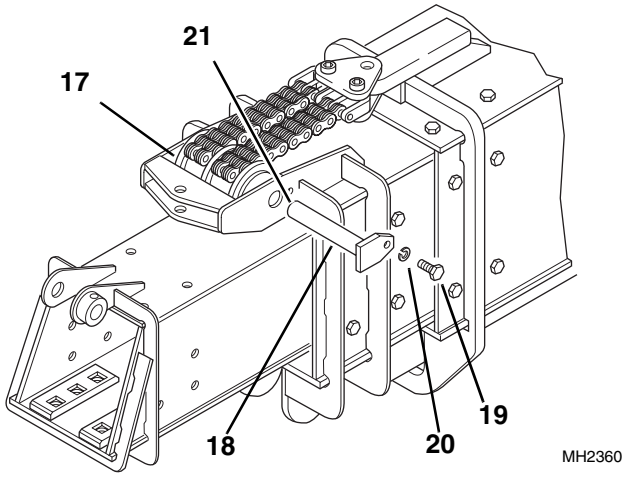
14. Assemble the top wear pads to the inside of the primary intermediate boom:
    a. Place the wear pad inserts (**7**), saved, into the cavities of the top wear pads (**8**), saved.
    b. Fill all wear pad cavities with a good grade of lithium-based EP grease.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**9**), saved. Slide the wear pad and spacer (**10**), saved, between the secondary intermediate boom and the primary intermediate boom with the offset of each wear pad toward the center. Line up the holes and secure in place with the capscrews (**9**) and lockwashers (**11**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



15. Place the two extend chains (**12**) up through the double sheave mounting bracket (**13**) on the front of the primary intermediate boom.
16. Assemble the two yoke plates (**14**) to the extend chains. Line up the holes in each clevis with the holes in the yoke plates.
17. Coat the socket head capscrews (**15**), saved, with anti-seize compound and insert the capscrews through the yoke plates and the clevis. Secure in place with new elastic locknuts (**16**). Tighten the locknuts securely, but the extend chain clevis' must pivot freely.

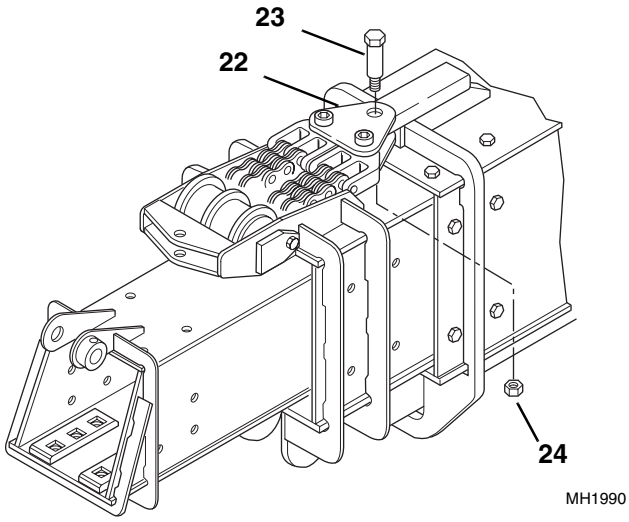


18. Place the double extend chain sheave (**17**), saved, between the mounts and under the extend chains at the front of the primary intermediate boom. Insert the sheave pin (**18**), saved, through the mounts and the double sheave. Align the mounting hole in the sheave pin with the threaded hole in the sheave mount, and secure in place with the capscrew (**19**), saved, and the lockwasher (**20**), saved. Tighten securely.
19. After the sheave is assembled, apply a good grade of multi-purpose grease to the grease fitting at the end of the pin (**21**). Turn the sheave by hand to distribute the grease evenly.



Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

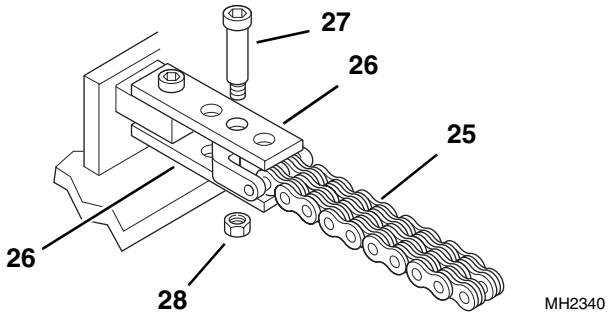
20. Align the holes in the yoke plates (**22**) with the hole in the mount on the outer boom. Coat the new shoulder bolt (**23**), with anti-seize compound, and insert the shoulder bolt through the yoke plates and the mount on the boom. Secure in place with a new elastic locknut (**24**). Tighten the locknut securely, but the yoke plates must pivot freely.



21. Place the retract chain (**25**) around the retract chain sheave on the right side of the boom. Stretch the chain forward and place the clevis between the two anchor plates (**26**). Align the hole in the clevis with the hole location recorded in the removal procedure.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

22. Insert the shoulder bolt (**27**), saved, from the top down and secure in place with a new elastic locknut (**28**). Tighten the locknut securely.



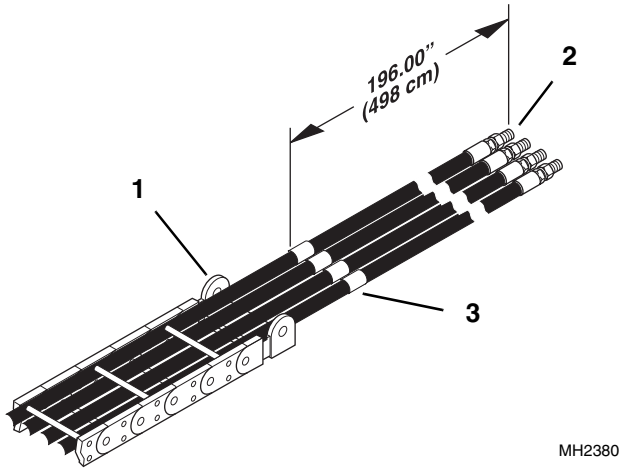
3.6.8 Inner Boom Installation

> **WARNING:** Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot or other bodily injury from crushing, slipping or falling.

> **WARNING:** **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist. Failure to comply can result in death or serious personal injury.

IMPORTANT: *Light lubrication of the boom wear surfaces with a rust inhibitor/lubricant such as LPS 3 or equivalent is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended in salt air climates and when the vehicle is stored, to help prevent rusting.*

1. Lay the hose carrier assembly (**1**) out flat on a level surface. Stretch the four “male” ends of the hoses out straight from the hose carrier assembly. Measure from the male end (**2**) of each hose back toward the hose carrier assembly 196" (498 cm) and apply tape (**3**) around each hose at that point. The tape is for proper tensioning of the hoses during reassembly of the hose clamps.

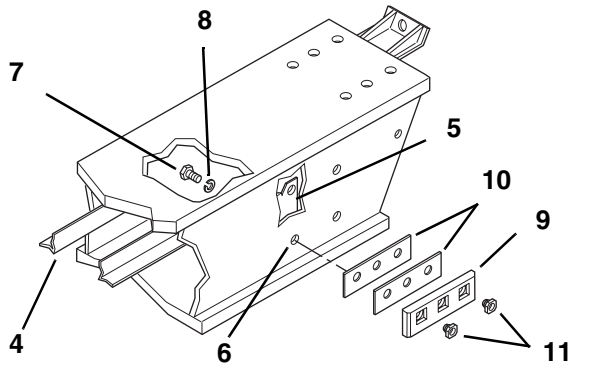


MH2380

2. Insert the hose channel assembly (**4**) into the rear of the inner boom. Slide the hose channel assembly into the boom and line up the holes in the mounting clips (**5**) with the front mounting holes (**6**) for the side wear pads.

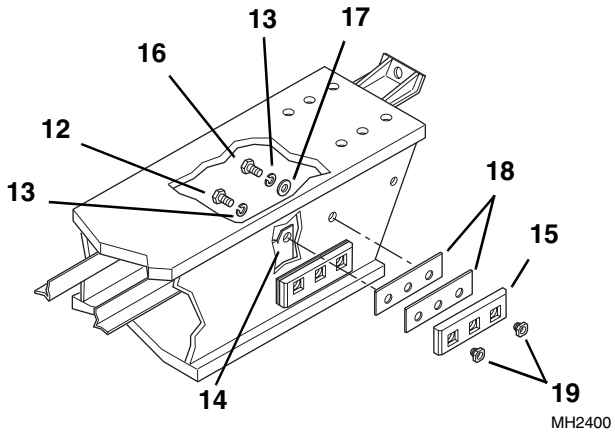
Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

3. Assemble the lower side wear pads and hose channel assembly to the inner boom:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**7**), saved. Insert a capscrew with a lockwasher (**8**), saved, through the lower hole in the mounting clip (**5**) and the front mounting hole of the lower wear pad (**9**) in the side plates of the inner boom. Insert the other capscrew and lockwasher through the rear hole.
   b. Place the wear pad shims (**10**), saved, onto the capscrews with the holes offset to the center. Place the wear pad inserts (**11**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities. Be careful not to push the wear pad inserts out of the wear pads
   c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   d. Fill each cavity with a good grade of lithium-based EP grease.
   e. Repeat Steps a thru d to install the lower wear pad on the other side of the inner boom.



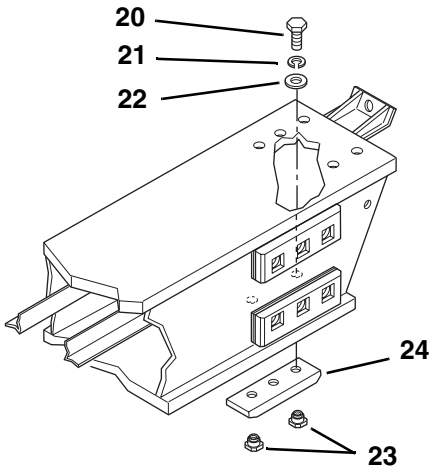
MH2390

4. Assemble the upper side wear pads and hose channel assembly to the inner boom:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**12**), saved. Insert a capscrew with a lockwasher (**13**), saved, through the upper hole in the mounting clip (**14**) and the front mounting hole of the upper wear pad (**15**) in the side plates of the inner boom.
   b. Insert the capscrew (**16**), saved (without threadlocker applied to the threads), lockwasher (**13**), saved, and a flat washer (**17**), saved, through the rear hole.
   c. Place the wear pad shims (**18**), saved, onto the capscrews with the holes offset to the center. Place the wear pad inserts (**19**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities. Be careful not to push the wear pad inserts out of the wear pads.
   d. Torque the front wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   e. Fill all wear pad cavities with a good grade of lithium-based EP grease.
   f. Turn the rear capscrew in far only enough to hold the wear pad insert in place.
   g. Repeat Steps a thru f to install the upper wear pad to the other side of the inner boom.



MH2400

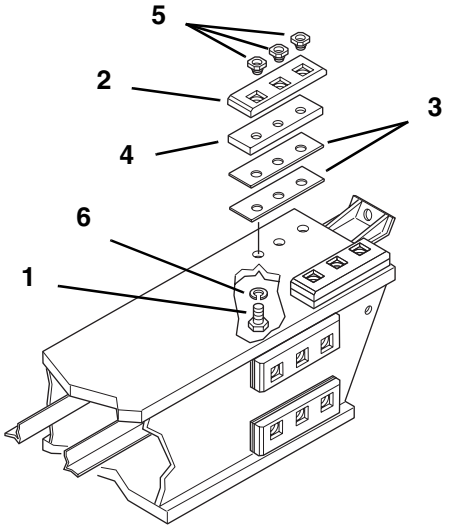
5. Install the inner boom lower wear pad:
   a. Apply Loctite® 242 threadlocker to the threads of the two capscrews (**20**), saved. Insert a capscrew with a lockwasher (**21**), saved, and a flat washer (**22**), saved, through each of the mounting holes in the bottom of the inner boom.
   b. Place the wear pad inserts (**23**), saved, into the cavities in the wear pad (**24**), saved. Be sure the inserts are seated completely in the cavities. Place the wear pad (**24**) under the inner boom. With the holes offset to the right, line up the holes and secure the wear pad to the inner boom. Be careful not to push the wear pad inserts out of the wear pads.
   c. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   d. Fill all wear pad cavities with a good grade of lithium-based EP grease.



MH2420

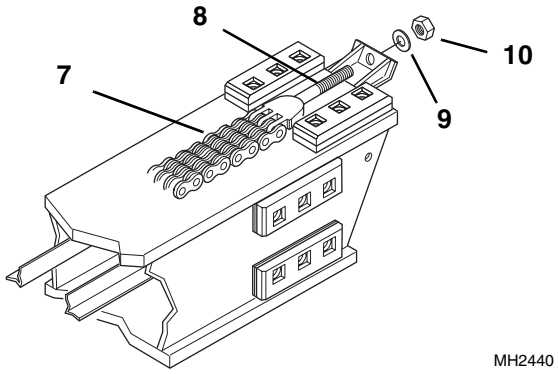
Note: *Shim ALL upper rear wear pads as needed to maintain a total maximum gap of .06" (1,5 mm) at the rear of the pads and maintain a total minimum gap of .07 to.13" (1,8 to 3,3 mm) in the vertical direction.*

6. Install the inner boom upper wear pads:
   a. Apply Loctite® 242 threadlocker to the threads of the capscrews (**1**), saved, for the upper wear pads (**2**).
   b. Place the wear pad shims (**3**), saved, and wear pad spacer (**4**) onto the top of the boom with the offset toward the outside of the boom. Line up the holes in the shims, spacer and wear pad with the holes in the boom. Place the wear pad inserts (**5**), saved, into the cavities in the wear pad. Be sure the inserts are seated completely in the cavities.
   c. Insert a capscrew with a lockwasher (**6**), saved, through each of the mounting holes in the top of the inner boom. Be careful not to push the wear pad inserts out of the wear pads.
   d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
   e. Fill each cavity with a good grade of lithium-based EP grease.



MH2430

7. Lay the inner boom extend chain (**7**) on the top of the inner boom with the threaded clevis end (**8**) toward the rear of the boom.
8. Coat the threads on the clevis (**8**) with multi-purpose grease and insert the clevis through the hole in the anchor plate.
9. Install a flat washer (**9**), saved, and a new elastic locknut (**10**) onto the clevis. Tighten the elastic locknut far enough so the threads are even with the top of the locknut.

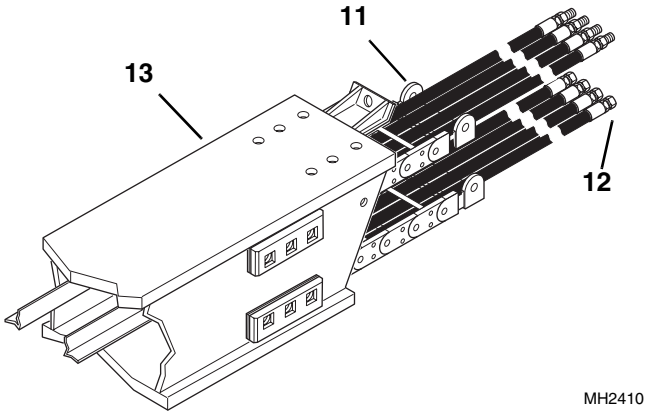


MH2440

10. Fold the hose carrier assembly (**11**) in half and slide into the inner boom. Be careful while folding the hose carrier in half.

IMPORTANT: *The hose carrier only folds one way;* ***DO NOT*** *force it.* ***DO NOT*** *twist the hose carrier while folding.*

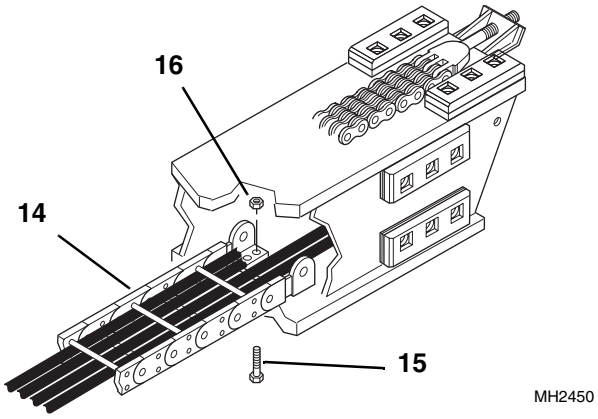
11. Ensure the “female” ends (**12**) of the hoses are on the bottom, and carefully slide the folded hose carrier into the inner boom (**13**). Guide the hose carrier assembly between the channels of the hose channel assembly.



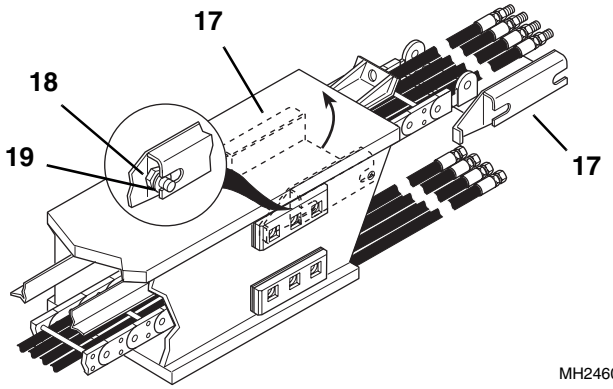
MH2410

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

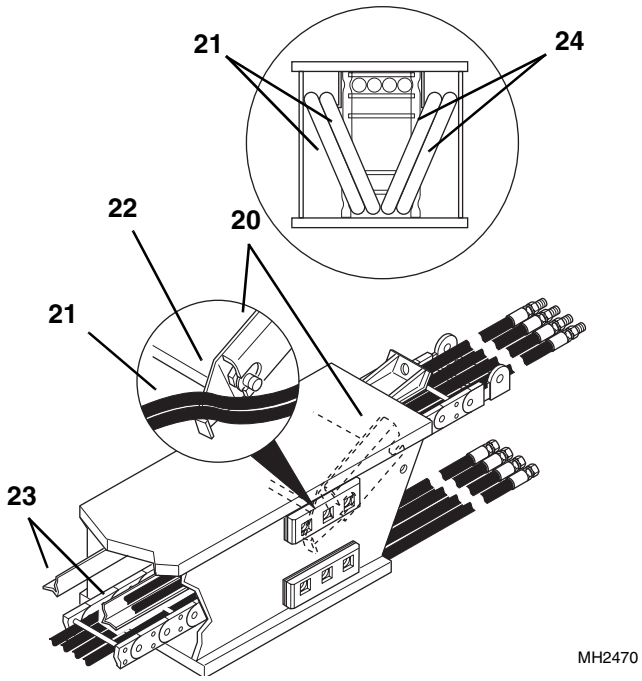
12. Line up the lower mounting holes in the hose carrier assembly (**14**) with the holes in the bottom of the inner boom. Insert the four capscrews (**15**), saved, through the bottom boom plate and up through the hose carrier mounts. Secure the capscrews in place with new elastic locknuts (**16**). Tighten all four locknuts securely.



13. Lift the upper part of the hose carrier assembly and place the hose carrier guide (**17**) under the hose carrier with the angled guides toward the front. Slide the hose guide into the inner boom, and place the front notches onto the rear wear pad mounting capscrew (**18**). Be sure the notch in the side of the hose guide is under the flat washer (**19**) on each side of the boom.
14. Rotate the back of the hose guide up toward the top of the inner boom as far as it will go. Tighten the rear wear pad mounting capscrews (**18**) enough to hold the hose guide.



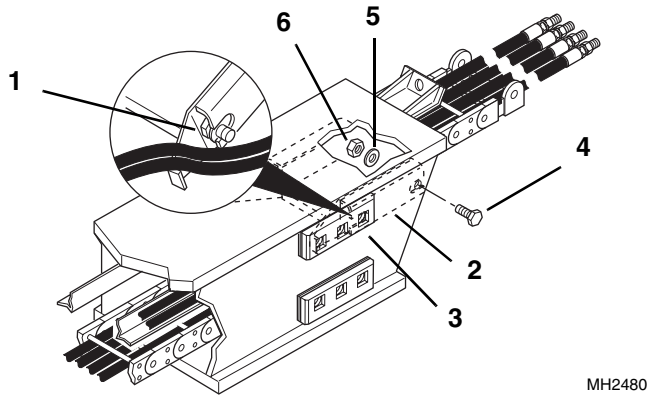
15. With the hose guide (**20**) tilted up in the back, insert the female ends of the two left side hoses (**21**) (from the hose carrier) one at a time over the top of the angled guide (**22**) on the front side of the hose guide. Push the hoses into the hose channel (**23**) on the left side of the inner boom and down to the front of the inner boom. Repeat this procedure to insert the two right side hoses (**24**) into the hose channel on the right side of the inner boom.



16. Loosen the wear pad mounting bolts (**1**) holding the hose guide (**2**) and wear pads (**3**) to the side of the inner boom. Remove the wear pad mounting bolts (one at a time) with washers.
17. Apply Loctite® 242 threadlocker to the threads of the hose guide and wear pad mounting bolt (**1**). Reinsert the bolts with washers, but **DO NOT** fully tighten. Swing the back of the hose guide down to line up the rear notches with the holes in each side of the inner boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

18. Insert a capscrew (**4**), saved, through the hole in the inner boom. Secure the hose guide in place with a flat washer (**5**), saved, and a new elastic locknut (**6**).
19. Torque all wear pad/hose guide mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

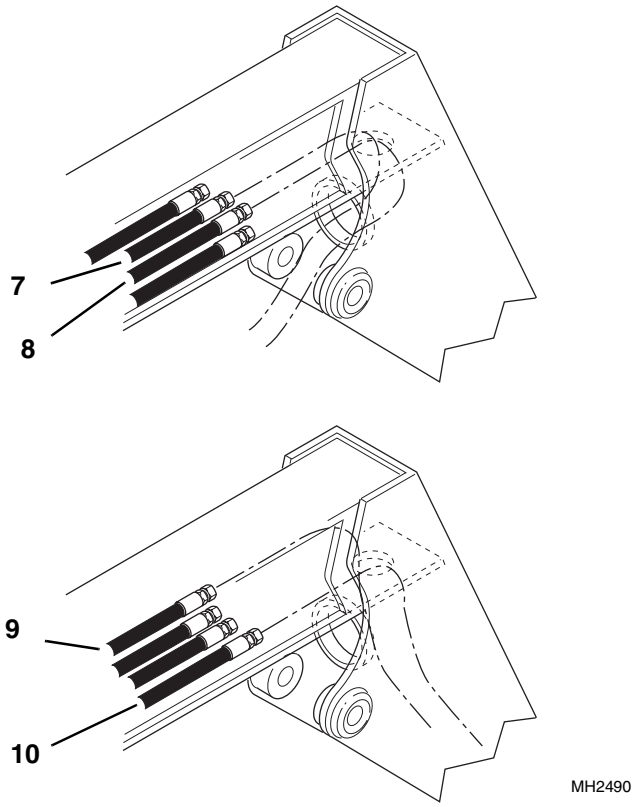


MH2480

20. Run the hose carrier out and in by hand to check for interference.

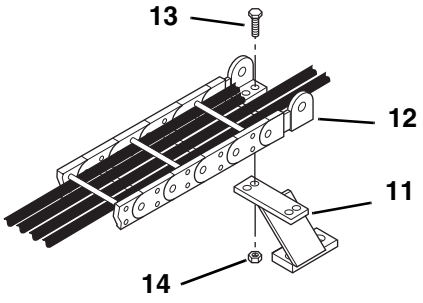
IMPORTANT: DO NOT *allow the Attachment Tilt and auxiliary hydraulic hoses to cross inside the inner boom.*

21. At the front of the inner boom, pull the two hoses that were labeled “Attachment Tilt - Retract” (**7**) left side and “Attachment Tilt - Extend” (**8**) right side out the opening in the back of the gooseneck. Let the hoses hang out the back of the gooseneck.
22. At the front of the inner boom, pull the two hoses that were labeled “Auxiliary - Female Coupler” (**9**) left side and “Auxiliary - Male Nipple” (**10**) right side out the opening in the gooseneck and down to the bulkhead plate, where the auxiliary hydraulic couplers are to be mounted. Let the hoses hang inside the gooseneck.



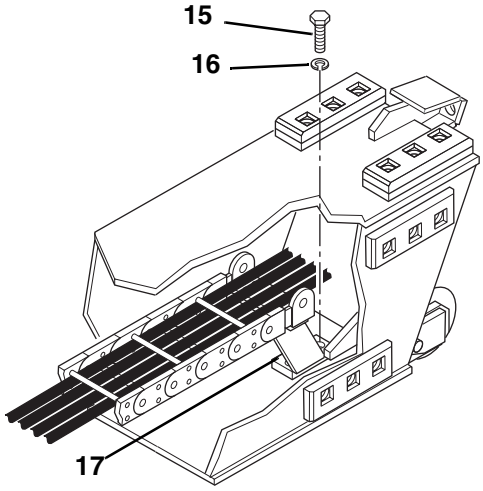
MH2490

23. Spray the wear pad pathways on the underside of the inner boom with LPS3 or equivalent.
24. Lift the inner boom. While guiding the hoses into the secondary intermediate boom, carefully slide the inner boom into the front of the secondary intermediate boom.
25. Have a second person guide the “male” ends of the four hoses from the hose carrier into the secondary intermediate boom. Have the second person pull the hoses out the rear of the boom as the inner boom is being inserted.
26. Reassemble the hose carrier support (**11**), saved, to the hose carrier (**12**). Inside the inner boom, pull the hose carrier out enough to gain access to the mounting pivot on the end of the carrier.
27. With the lower mounting plate on the hose carrier support (**11**) on the right side, line up the four holes in the top plate with the holes in the pivot mount of the hose carrier (**12**).
28. Insert the capscrews (**13**), saved, through the hose carrier pivot mount and the support bracket. Secure in place with new elastic locknuts (**14**). Tighten securely.



MH1860

29. Remove the capscrews (**15**) and lockwashers (**16**) holding the lower wear pad to the bottom of the secondary intermediate boom.
30. Apply Loctite® 242 threadlocker to the threads of the capscrews. Line up the holes in the lower mounting plate on the hose carrier support (**17**) and reinsert the capscrews and lockwashers. Be careful not to push the wear pad inserts out of the wear pads.
31. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

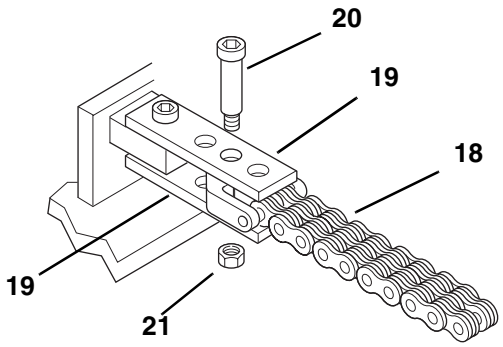


MH1850

32. Place the retract chain (**18**) up around the retract chain sheave on the left side of the boom. Stretch the chain forward and place the clevis between the two anchor plates (**19**). Line up the hole in the clevis with the anchor plate hole location recorded during removal.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

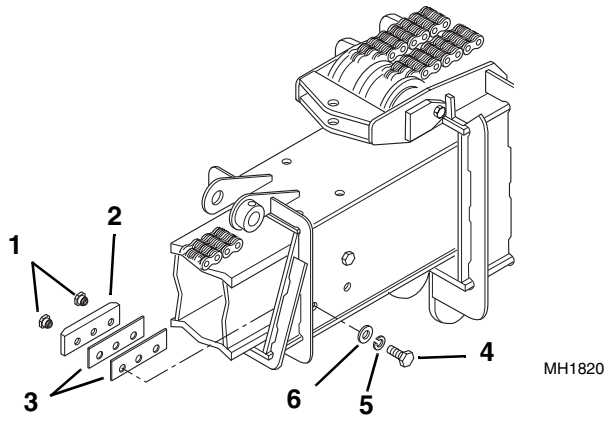
33. Insert the shoulder bolt (**20**), saved, from the top down and secure in place with a new elastic locknut (**21**). Tighten the locknut securely.



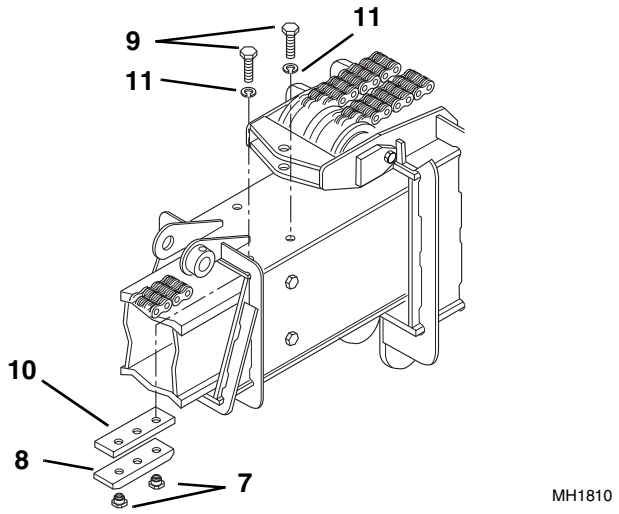
MH2340

Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

34. Assemble the side wear pads to the secondary intermediate boom:
    a. Slide the inner boom over to one side as far as it will go, to allow wear pad installation.
    b. Place the wear pad inserts (**1**), saved, into the cavities of the side wear pads (**2**), saved.
    c. Fill the cavities of the wear pad with a good grade of lithium-based EP grease. Place the shims (**3**), saved, onto the wear pad and line up the holes.
    d. Apply Loctite® 242 threadlocker to the threads of the capscrews (**4**), saved. Slide the wear pad with shims between the inner boom and the secondary intermediate boom with the offset of each wear pad toward the top of the boom. Line up the holes and secure in place with the capscrews (**4**), lockwashers (**5**), saved, and flat washers (**6**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    e. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    f. Repeat Steps a thru e to install the side wear pads on the other side of the secondary intermediate boom.

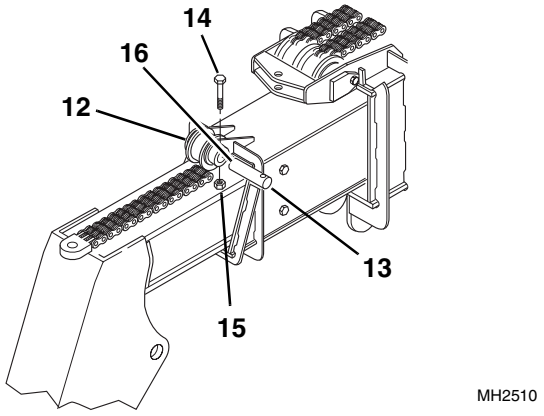


35. Assemble the top wear pads to the inside of the secondary intermediate boom:
    a. Place the wear pad inserts (**7**), saved, into the cavities of the top wear pads (**8**), saved.
    b. Fill the cavities of the wear pad with a good grade of lithium-based EP grease.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**9**), saved. Slide the wear pad and spacer (**10**), saved, between the inner boom and the secondary intermediate boom with the offset of each wear pad toward the center. Line up the holes and secure in place with the capscrews (**9**) and lockwashers (**11**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

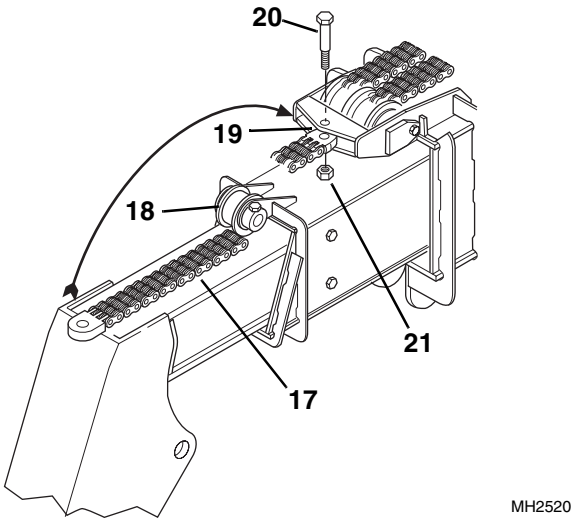
36. Place the inner boom extend chain sheave (**12**), saved, between the mounts at the front of the secondary intermediate boom. Insert the sheave pin (**13**), saved, through the mounts and the sheave. Use a tapered punch to line up the mounting hole in the pin with the mounting hole in the hub. Secure in place with the capscrew (**14**), saved, and a new elastic locknut (**15**). Tighten securely.
37. After the sheave is assembled, apply a good grade of multi-purpose grease to the grease fitting at the end of the pin (**16**). Turn the sheave by hand to distribute the grease evenly.



38. Place the inner boom extend chain (**17**) up and around the sheave (**18**) at the front of the secondary intermediate boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

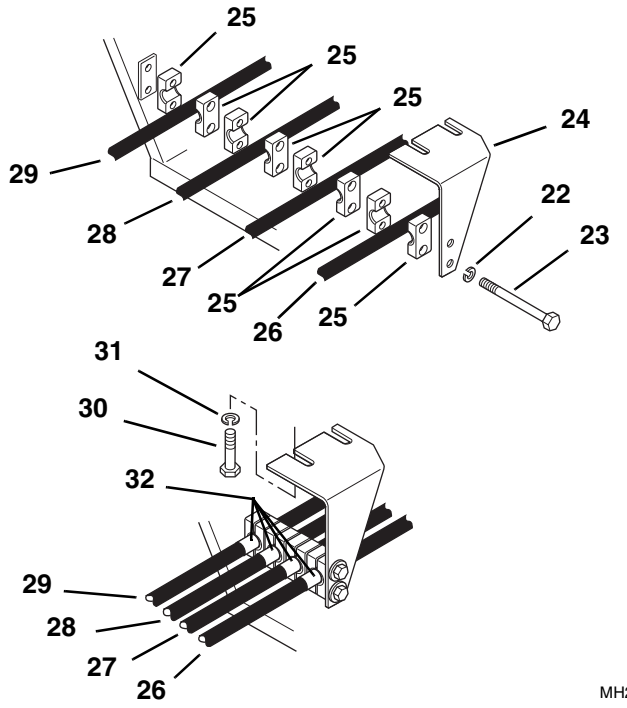
39. Place the extend chain clevis (**19**) between the mounting plates at the front of the secondary intermediate boom. Coat the shoulder bolt (**20**), saved, with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a new elastic locknut (**21**). Tighten securely, but the chain clevis should pivot freely.



MH2520

IMPORTANT: *Keep the four hoses in line (left to right) as they come out of the hose carrier assembly at the rear of the secondary intermediate boom.* ***DO NOT*** *allow the hoses to cross.*

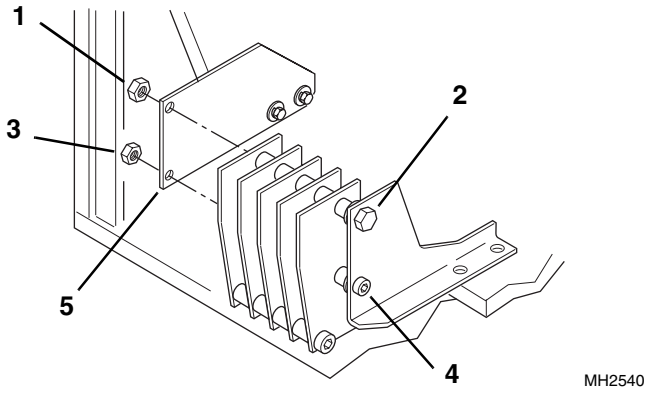
40. Place a lockwasher (**22**), saved, onto each capscrew (**23**), saved. Insert the capscrews through the hose clamp support bracket (**24**), saved. Insert the capscrews from the side as shown.
41. Place a hose clamp half (**25**), saved, onto the capscrews. Place the right auxiliary hydraulic hose (**26**) and another hose clamp half (**25**) onto the capscrews.
42. Place another hose clamp half (**25**), saved, the right Attachment Tilt hose (**27**) and another hose clamp half (**25**) onto the capscrews.
43. Place two more hose clamp halves (**25**), the left Attachment Tilt hose (**28**) and another hose clamp half onto the capscrews.
44. Place another hose clamp half (**25**), saved, the left auxiliary hydraulic hose (**29**) and another hose clamp half (**25**) onto the capscrews. Assemble the capscrews to the left side of the inner boom. Tighten the capscrews only enough to hold the hoses in place.
45. Remove the capscrews (**30**) and lockwashers (**31**) holding the upper left side wear pad to the secondary intermediate boom.
46. Apply Loctite® 242 threadlocker to the threads of the capscrews (**30**), and insert the capscrews with lockwashers through the notches in the hose clamp support bracket (**24**) and into the wear pad inserts. Be careful not to push the wear pad inserts out of the wear pads.
47. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
48. Position each of the four hoses with the edge of the tape (**32**) at the hose clamps. Hold the hoses in this position, and tighten the two capscrews securely to hold the hoses.



MH2530

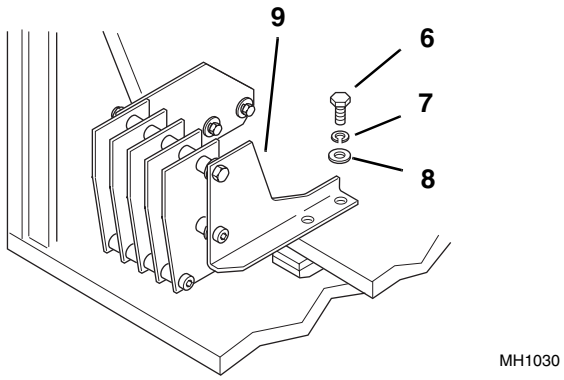
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

49. Assemble the hose reel assembly to the left side mounting plate inside the primary intermediate boom:
    a. Remove the elastic locknut (**1**) from the upper retaining capscrew (**2**). Discard the locknut.
    b. Remove the elastic locknut (**3**) from the center shoulder bolt (**4**). Discard the locknut.
    c. Insert the center shoulder bolt through the lower hole in the left side mounting plate (**5**). Secure the center shoulder bolt in place with a new elastic locknut (**3**). Tighten securely. **DO NOT** reassemble the locknut to the upper retaining capscrew at this time.



MH2540

    d. Remove the capscrews (**6**), lockwashers (**7**) and flat washers (**8**) holding the lower wear pad to the bottom of the primary intermediate boom.
    e. Apply Loctite® 242 threadlocker to the threads of the capscrews (**6**), and insert the capscrews with lockwashers and flat washers through the holes in the right side hose reel mounting bracket (**9**) and into the wear pad inserts. Be careful not to push the wear pad inserts out of the wear pads.
    f. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



MH1030

IMPORTANT: *Keep the hoses in the same order as they come from the hose clamps.* ***DO NOT*** *allow the hoses to cross.*

    g. While pulling the upper retaining capscrew (**10**) out, catch the spacers (**11**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to place the hoses around the hose reel.

       Place the left side auxiliary hydraulic hose (**12**) into the left position on the hose reel.

       Place the left side Attachment Tilt hose (**13**) into the second position from the left on the hose reel.

       Place the right side Attachment Tilt hose (**14**) into the second position from the right on the hose reel.

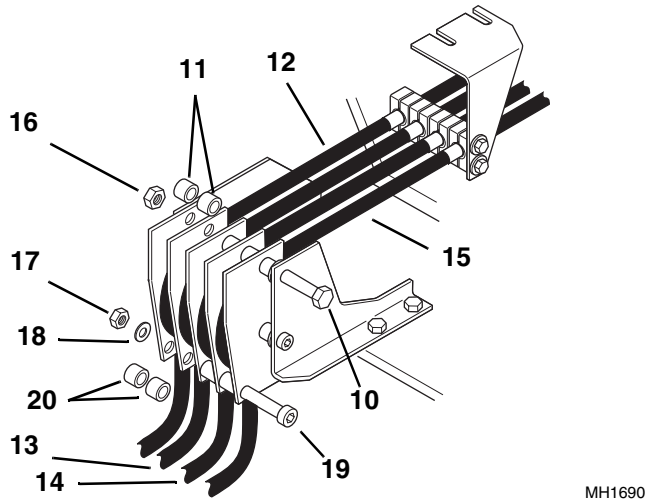
       Place the right side auxiliary hydraulic hose (**15**) into the right position on the hose reel.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

    h. Insert the retaining capscrew (**10**) through the plates of the hose reel, inserting the spacers (**11**) back in position between the plates as the capscrew is inserted. Secure the retaining capscrew in place with a new elastic locknut (**16**). Tighten the elastic locknut securely.
    i. Remove the elastic locknut (**17**) and flat washer (**18**) from the lower retaining shoulder bolt (**19**). While pulling the shoulder bolt out, catch the spacers (**20**) from between the plates as the shoulder bolt is removed. Place the Attachment Tilt hoses and the auxiliary hydraulic hoses around the hose reel.

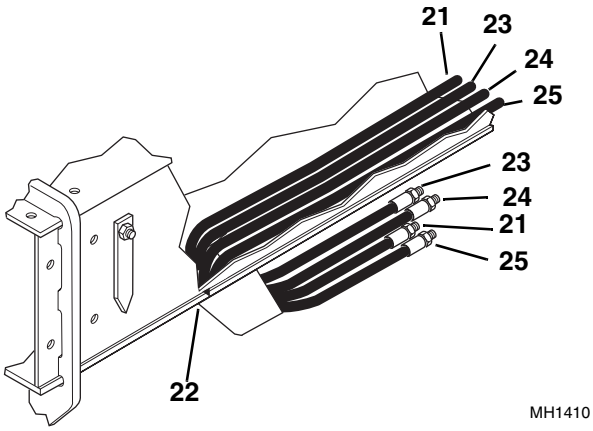
j. Insert the shoulder bolt (**19**) back through the plates of the hose reel, inserting the spacers (**20**) back in position between the plates as the shoulder bolt is inserted. Place the flat washer (**18**) onto the shoulder bolt and secure in place with a new elastic locknut (**17**). Tighten securely.

50. Tie the strings (positioned inside the outer boom during the outer boom installation) to the male end of each of the Attachment Tilt and auxiliary hydraulic hoses coming off the bottom hose reel assembly.



IMPORTANT: *Keep the hoses in the same order as they come off the hose reel.* ***DO NOT*** *allow the hoses to cross.*

51. Working from the front of the boom, pull each hose through the boom assembly:
    a. Pull the right side auxiliary hydraulic hose (**21**) through the boom assembly. Pull the hose out the opening (**22**) at the bottom of the outer boom.
    b. Pull the right side Attachment Tilt hose (**23**) through the boom assembly. Keep the right side Attachment Tilt hose to the left of the right side auxiliary hydraulic hose. Pull the hose out the opening (**22**) at the bottom of the outer boom.
    c. Pull the left side Attachment Tilt hose (**24**) through the boom assembly, using the hoses already down the boom as a guide. Keep the left side Attachment Tilt hose to the left of the hoses already installed. Pull the hose out the opening (**22**) at the bottom of the outer boom.
    d. Pull the left side auxiliary hydraulic hose (**25**) through the boom assembly, using the hoses already down the boom as a guide. Keep the left side auxiliary hydraulic hose to the left of the hoses already installed. Pull the hose out the opening (**22**) at the bottom of the outer boom.



52. Remove the strings from the hoses.
53. At the front of the outer boom, assemble the hose assemblies and tube assemblies to the mounting plate:

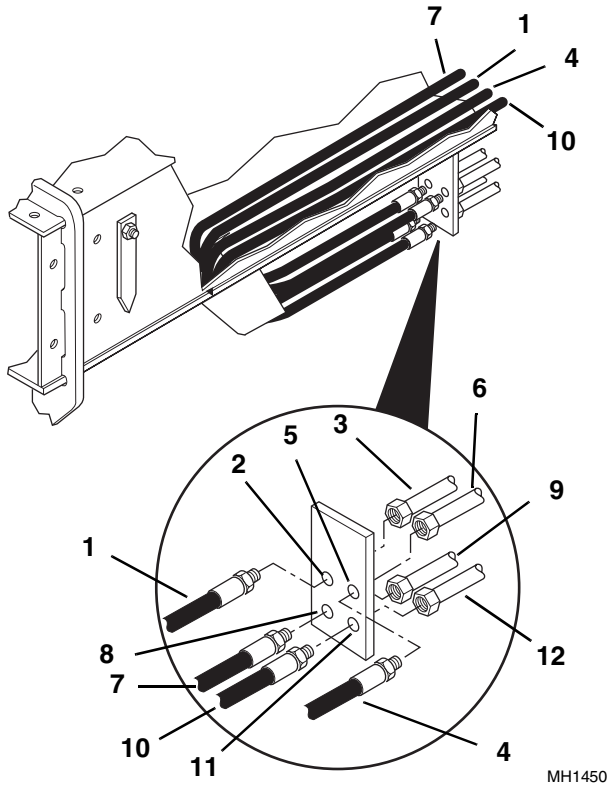
Note: *Lubricate the radius at the opening in the bottom of the outer boom with soap and water, to allow the hoses to slide easily when tensioning the hoses.*

a. Assemble the right side Attachment Tilt hose (**1**) to the upper right side hole (**2**) on the mounting plate. Insert the male end of the right side hose through the upper right side hole. Tighten the upper right side Attachment Tilt tube assembly (**3**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly securely to the bulkhead fitting at the rear of the boom.

b. Assemble the left side Attachment Tilt hose (**4**) to the upper left side hole (**5**) on the mounting plate. Insert the male end of the left side hose through the upper left side hole. Tighten the upper left side Attachment Tilt tube assembly (**6**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly securely to the bulkhead fitting at the rear of the boom.

c. Assemble the right side auxiliary hydraulic hose (**7**) to the lower right side hole (**8**) on the mounting plate. Insert the male end of the right side hose through the lower right side hole. Tighten the lower right side auxiliary hydraulic tube assembly (**9**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly securely to the bulkhead fitting at the rear of the boom.

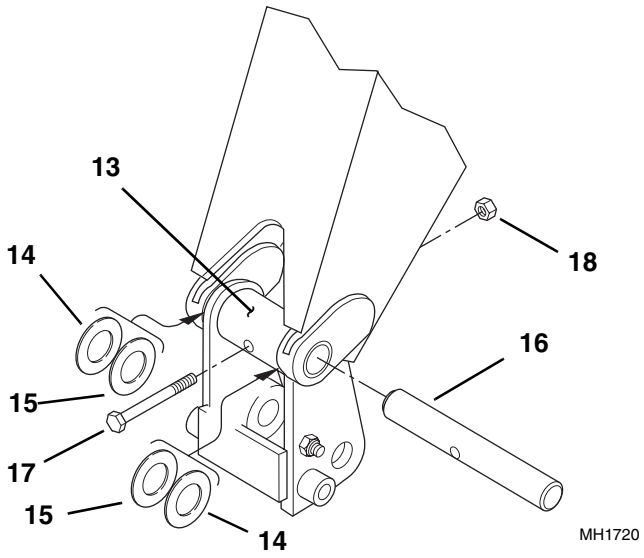
d. Assemble the left side auxiliary hydraulic hose (**10**) to the lower left side hole (**11**) on the mounting plate. Insert the male end of the left side hose through the lower left side hole. Tighten the lower left side auxiliary hydraulic tube assembly (**12**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate. Tighten the other end of the tube assembly securely to the bulkhead fitting at the rear of the boom.



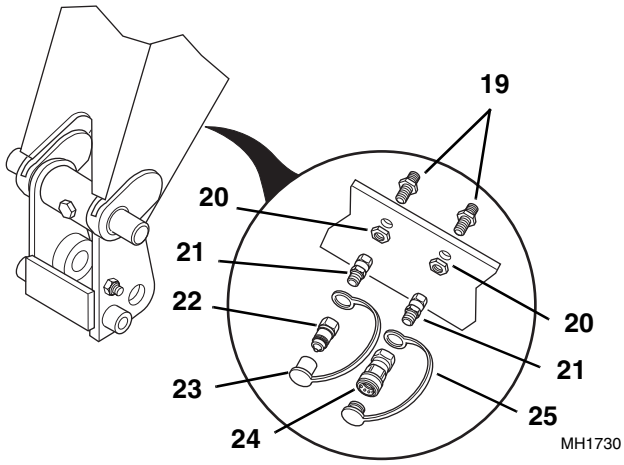
54. Assemble the quick attach to the gooseneck. Line up the quick attach (**13**) between the mounts on the gooseneck. Assemble a washer (**14**), saved, on each side of the quick attach. Reassemble the shims (**15**), saved, between the quick attach and the gooseneck. **DO NOT** put all the shims on one side. The quick attach should be centered in the gooseneck.
55. Coat the quick attach pivot pin (**16**) with an anti-seize compound. Insert the quick attach pivot pin through the gooseneck, washers, shims and quick attach. Use a tapered punch to line up the hole in the pivot pin with the hole in the quick attach.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

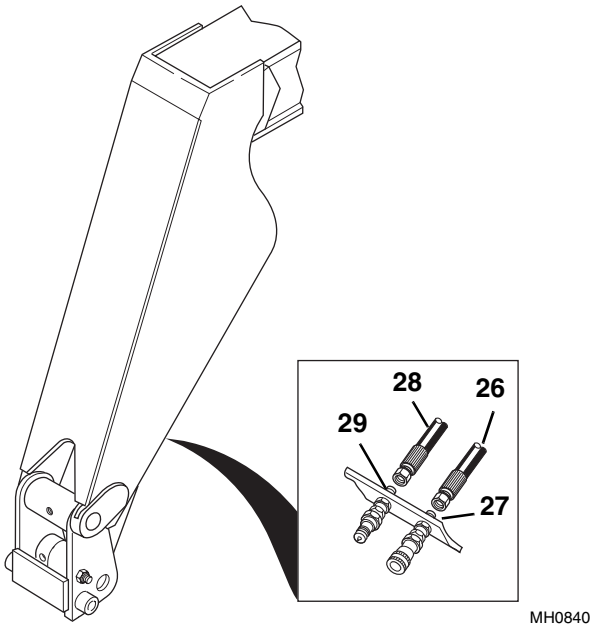
56. Insert the capscrew (**17**), saved, through the quick attach and pin. Secure the capscrew in place with a new elastic locknut (**18**). Tighten securely.



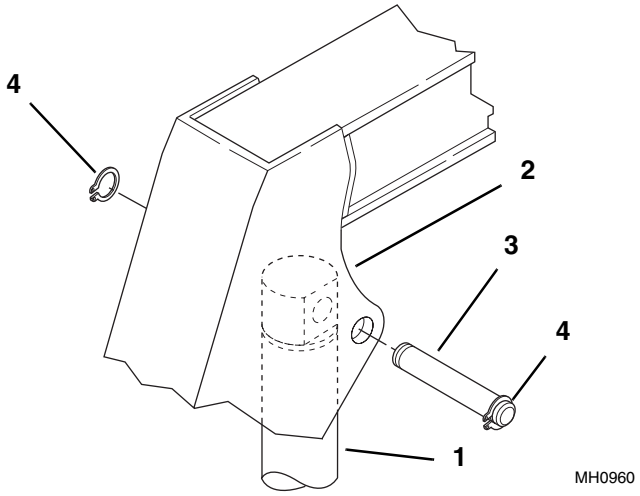
57. If the inner boom has been replaced with a new boom, the auxiliary hydraulic fittings need to be reassembled:
    a. Assemble the two bulkhead fittings (**19**) from the original boom to the bulkhead plate inside the gooseneck. Insert the bulkhead fittings from the top and secure in place with the bulkhead fitting nut (**20**) on the bottom side. Tighten securely.
    b. Assemble the two straight swivel connectors (**21**) to the two bulkhead fittings.
    c. Assemble the male nipple (**22**) and dust cap (**23**) to the right side swivel connector fitting. Tighten the swivel connector and male nipple securely. Assemble the dust cap onto the male nipple.
    d. Assemble the female coupler (**24**) and dust plug (**25**) to the left side swivel connector fitting. Tighten the swivel connector and female coupler securely. Insert the dust plug into the female coupler.



58. Assemble the left auxiliary hydraulic hose (**26**) labeled “Female Coupler” from inside the gooseneck to the female coupler (**27**) bulkhead fitting. Tighten securely.
59. Assemble the right auxiliary hydraulic hose (**28**) labeled “Male Nipple” from inside the gooseneck to the male nipple (**29**) bulkhead fitting. Tighten securely.



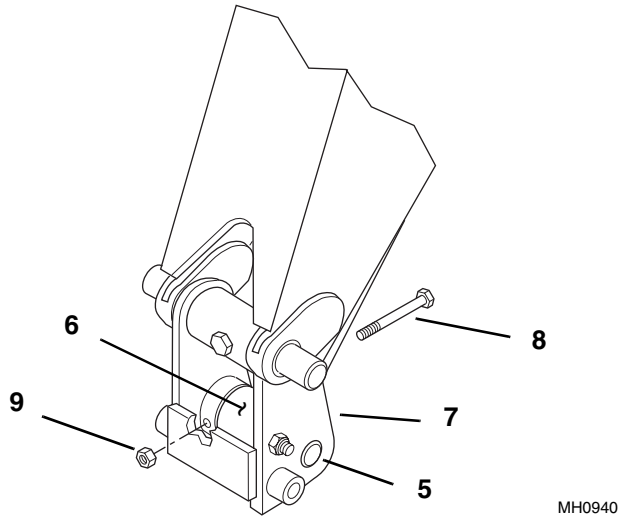
60. Use a hoist and slings to position the Attachment Tilt cylinder (**1**) inside the gooseneck (**2**). Be sure the Attachment Tilt cylinder is positioned with the tube for the rod end positioned inside the gooseneck.
61. Coat the base end pivot pin (**3**), saved, with anti-seize compound. Line up the hole in the cylinder base end with the mounting holes in the gooseneck, and insert the pivot pin through the gooseneck. Secure the pivot pin to the gooseneck with the two retaining rings (**4**), saved. Be sure the retaining rings are securely seated in the pivot pin grooves.



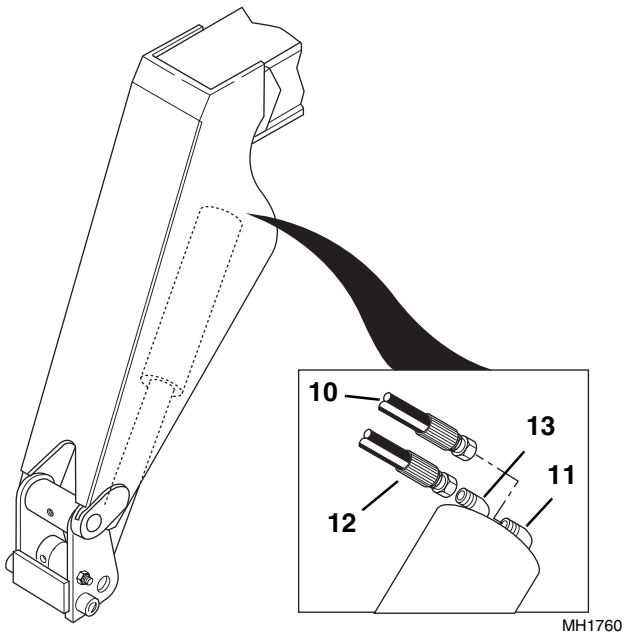
62. Coat the rod end pivot pin (**5**), saved, with an anti-seize compound. Swing the rod end (**6**) of the Attachment Tilt cylinder up and line up the rod end with the mounting holes in the quick attach (**7**).

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

63. Insert the rod end pivot pin (**5**) through the lined-up holes. Use a tapered punch to line up the capscrew hole in the pivot pin and the mounting hole in the quick attach hub. Insert the capscrew (**8**), saved, through the quick attach hub from the backside and secure in place with a new elastic locknut (**9**). Tighten securely.



64. Connect the Attachment Tilt hoses from the rear of the gooseneck to the fittings on the base end of the Attachment Tilt cylinder:
    a. Connect the left side hose (**10**) labeled as “Retract” to the retract port (upper) elbow (**11**) on the base end of the Attachment Tilt cylinder. Index the hose to remove any undo tension and tighten the hose end completely.
    b. Connect the right side hose (**12**) labeled as “Extend” to the extend port (lower) elbow (**13**) on the base end of the Attachment Tilt cylinder. Index the hose to remove any undo tension and tighten the hose end completely.



65. Clean up all debris, hydraulic fluid, etc., in, on, near and around the vehicle.

> **WARNING:** Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious personal injury.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

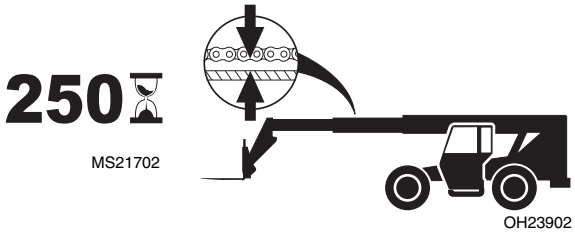
66. Start the engine and operate all boom functions several times. Check the chain tension again and adjust as necessary. Check for leaks, and check the hydraulic fluid level in the tank; add fluid if required.

3.7 BOOM CHAINS - FOUR SECTION BOOM (10054)

This vehicle uses double extend chains to extend the intermediate boom, a single extend chain to extend the inner boom and two single retract chains to retract the intermediate booms and the inner boom. The two intermediate extend chains and both retract chains are constructed of 3/4" pitch links with 6 x 6 leaf lacing. The inner boom extend chain is constructed of 1" pitch links with 6 x 6 leaf lacing.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.*

3.7.1 Boom Chain Inspection



> **WARNING:** Worn pins, stretched or cracked links or corrosive environments can cause chain failure. A chain failure could result in uncontrolled boom movement, loss of load or vehicle instability, and could cause death or serious injury and/or property damage.

Under normal operating conditions the extend chains will need to be inspected every 250 hours of operation. The retract chain will need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

Environments in which material handling vehicles operate can vary widely, from outdoor moisture to mildly corrosive or highly corrosive industrial atmospheres, in addition to abrasive exposures such as sand and grit. Some effects can be as follows:

- Moisture - Corrosive rusting reduces chain strength by pitting and cracking.
- Temperature - Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.
- Chemical Solutions or Vapors - Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Going from microscopic cracking to complete failure can be either abrupt or may require an extended period of time.
- Abrasives - Accelerated wearing and scoring of the articulating members of the chain (pins and plates), with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of a leaf chain:

- High velocity movement of load, followed by sudden, abrupt stops.
- Carrying loads in suspension over irregular surfaces such as railroad tracks, potholes and rough terrain.
- Attempting to “inch” loads which are beyond the rated capacity of the vehicle.

The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

The boom chain’s normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3% of pitch. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

a. Inspection Guidelines

Expose the extend and retract chains (refer to Section 3.7.1, b. “Expose Extend Chains for Inspection,” Section 3.7.1, c. “Expose Intermediate Boom Retract Chain for Inspection,” or Section 3.7.1, d. “Expose Inner Boom Retract Chain for Inspection.”) and inspect the chains for the following conditions:

Elongation

When the original length (**1**) of 12" (305 mm) per foot of new chain has elongated from wear to a length (**2**) of 12.36" (313 mm), the chain must be discarded and replaced. (Refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)

It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading.

Intermediate Extend Chains and Retract Chains

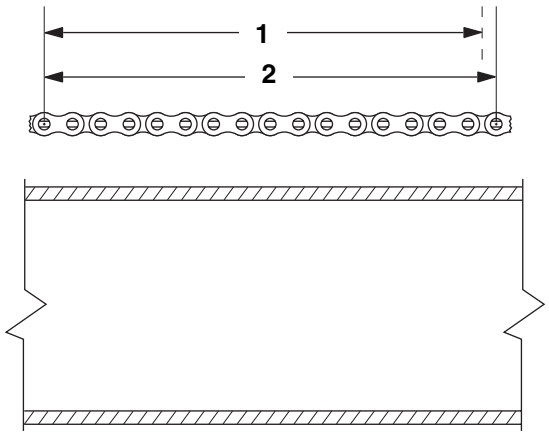
Measure across a span of 17 pins at the center of the chain. Measure from pin center to pin center.

Inner Extend Chain

Measure across a span of 13 pins at the center of the extend chain. Measure from pin center to pin center.

All Chains

The maximum measurement allowed is 12.36" (313 mm). If the measurement is more than 12.36" (313 mm), the chain must be replaced. (Refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)



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Edge Wear

Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material must not exceed 5%. This can be compared to a normal link plate height by measuring a portion of chain that does not run over the sheave.

Intermediate Extend Chains and Retract Chains

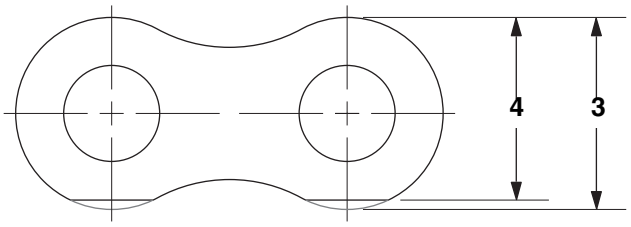
The new chain link measures .713" (18 mm) (**3**). If the measurement of the worn chain is less than .677" (17 mm) (**4**), the chain must be replaced.

Inner Extend Chain

The new chain link measures .950" (24 mm) (**3**). If the measurement of the worn chain is less than .903" (23 mm) (**4**), the chain must be replaced.

All Chains

For replacement instructions refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”



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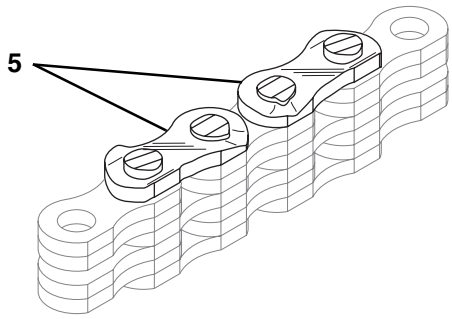
Distorted or Battered Link Plates

Distorted or battered link plates (**5**) on a leaf chain can cause tight joints and prevent flexing.



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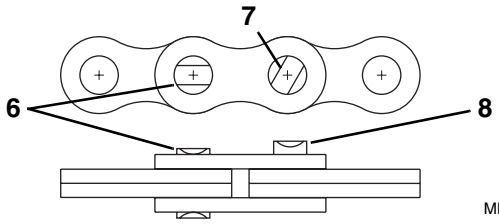
Turning or Protruding Pins

Highly loaded chain, operating with inadequate lubrication, can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure.

Examine the pin head rivets to determine if the “VEE” flats are still in correct alignment (**6**). Chain with rotated/ displaced heads (**7**) or abnormal pin protrusion (**8**) must be replaced immediately. (Refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)

DO NOT attempt to repair the chain by welding or driving the pin(s) back into the chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored.

Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and must be corrected.



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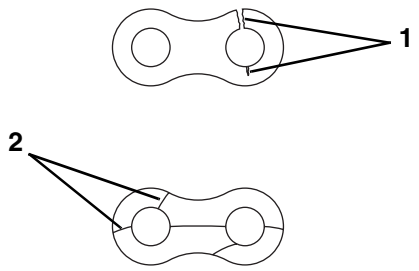
Cracked Plates

Inspect the chains very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain must be replaced in its entirety. (Refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)

- **Fatigue Cracking -** Fatigue cracks (**1**) are a result of repeated cyclic loading beyond the chain's endurance limit. The size of the load and the frequency of its occurrence are factors which determine when fatigue failure will occur. The loading can be continuous or intermittent (impulse load).
- **Stress Corrosion Cracking -** The outside link plates are particularly susceptible to stress corrosion cracking (**2**). Like fatigue cracks, these initiate at the point of highest stress but tend to extend in an arc-like path between holes in the pin plate. More than one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere.

Stress corrosion is an environmentally assisted failure. Two conditions must be present: corrosive agent and static stress. In the chain, static stress is present at the aperture due to the press fit pin. No cyclic motion is required, and the plates can crack during idle periods.

- **Corrosion Fatigue Cracking -** Corrosion fatigue cracks are very similar to fatigue cracks (**1**) in appearance. They generally begin at the aperture and grow perpendicular to the chain pitch line. Corrosion fatigue is not the same as stress corrosion. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress, not a static stress alone, as in stress corrosion.



Other Modes of Failure

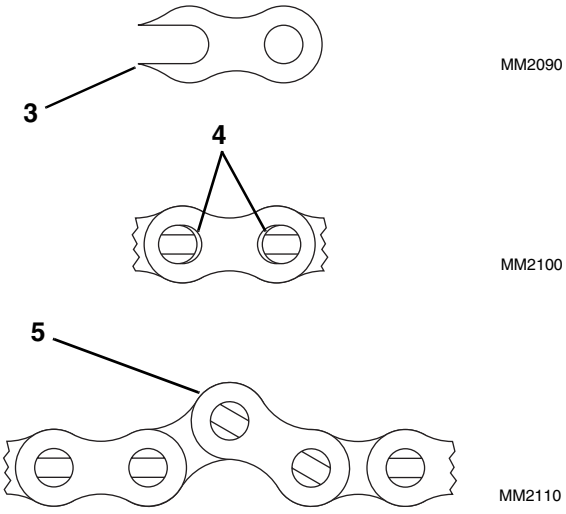
- **Ultimate Strength Failure** - These types of failures are caused by overloads far in excess of the design load. Either fractured plates (**3**) or enlarged holes (**4**) can occur. If either of these failures occurs, the chain must be replaced immediately. (Refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement.")

Note: *The tight joints inspection must be done with the chain disconnected from the boom. (Refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement.")*

- **Tight Joints -** All joints in the chain must flex freely. Tight joints (**5**) resist flexing and increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain.

If the problem is caused by corrosion and rust or bent pins, replace the chain. (Refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement.")



b. Expose Extend Chains for Inspection

1. Park the vehicle on level ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and raise the boom to a horizontal (level) position.
2. Lower both outriggers completely
3. Fully extend the boom until both extend chains are taut. Shut the engine OFF.

The extend chains will be visible for inspection with the vehicle in this state.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.*

4. If the chain needs to be replaced, refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement."
5. If the chain does not need to be replaced, lubricate the chain. (Refer to Section 3.7.2, "Chain Lubrication.")

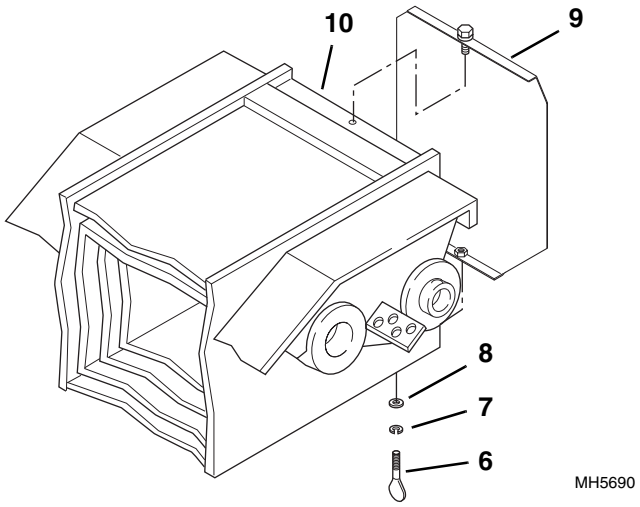
c. Expose Intermediate Boom Retract Chain for Inspection

The retract chain must be removed from the boom in order to be visually inspected. This must be done every 1000 hours or whenever the retract chain is removed from the boom. (If removal of the chain is required refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement.")

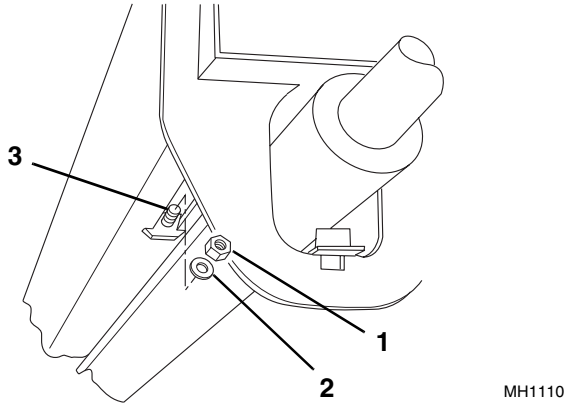
While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**6**), lockwasher (**7**) and flat washer (**8**), holding the rear cover (**9**) to the rear of the outer boom (**10**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



4. At the front underside of the boom, record the amount of threads extending beyond the elastic locknut (**1**). This measurement will be the starting point for adjustment of the boom retract chain.
5. Loosen the elastic locknut (**1**) far enough so that it can be removed by hand.



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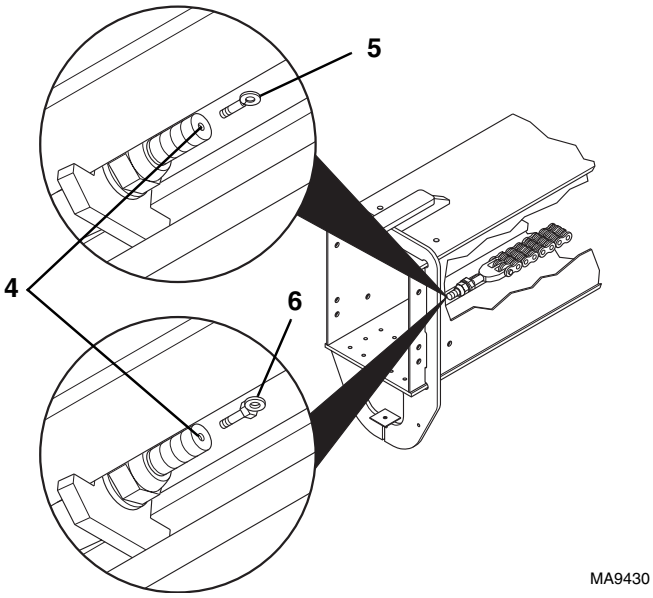
6. If the chain clevis has a threaded hole on the end (**4**), a string or wire can be attached to the retract chain clevis using a threaded eye (**5**) or a flat washer tack welded to a capscrew (**6**). The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The string or wire will be used to pull the chain back through the boom during the reassembly.

   If there is no threaded hole on the end of the clevis, a phillips screwdriver will be needed to catch the countersunk hole in the end of the clevis and guide it through the tab during reassembly.

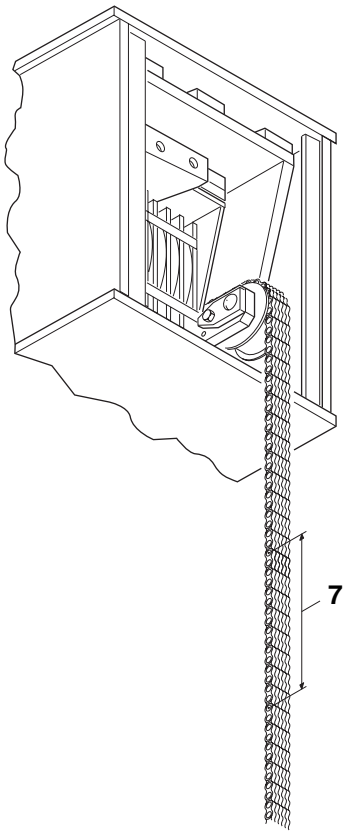


MA9430

7. Remove the elastic locknut (**1**) and flat washer (**2**) holding the retract chain threaded clevis (**3**) to the mounting tab. Save the flat washer and discard the elastic locknut.
8. If a threaded eye or capscrew with flat washer (**5** or **6**) was installed in step 6, attach a string or wire to the end of the retract chain clevis. The string or wire must be long enough to pull the clevis and chain through the outer boom.
9. Place a pan or tarp, free of dirt, at the rear of the vehicle, for the chain to rest on as it is being removed from the boom. From the rear of the boom, pull the retract chain out of the rear of the boom.
10. With the chain hanging from the rear of the boom, inspect wear and condition of the chain, clevis', chain sheaves, chain pins, clevis anchors and all mounting hardware. Replace a worn or damaged chain. **DO NOT** attempt to make any repairs to the chain.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevis' be replaced at the same time.*

11. Measure the chain elongation. Measure across 17 pins (**7**), somewhere between the chain sheave and where the chain is laying in the pan or on the tarp. The maximum measurement allowed is 12.36" (313 mm). If the measurement is more than 12.36" (313 mm), the chain must be replaced. (Refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)



Note: *Chains and clevis’ are wear items and experience the same stress.* ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis’.*

12. If the chain needs to be replaced, refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”

13. Lubricate the chain, while it is exposed, if it does not need to be replaced. (Refer to Section 3.7.2, “Chain Lubrication.”)

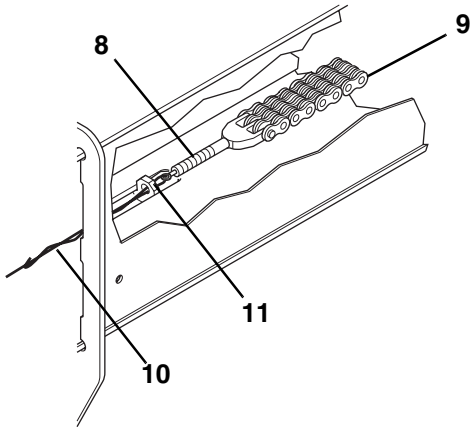
14. Coat the threads of the threaded clevis (**8**) with multi-purpose grease.

Note: *Have a second person help with the installation of the retract chain between the intermediate and outer boom assemblies.*

If a string or wire was installed to the end of the clevis:

15. From the rear of the boom, one person should push the threaded clevis end (**8**) of the retract chain (**9**) under the chain sheave and down between the intermediate boom and the outer boom. The person at the front of the boom should pull the clevis using the string or wire (**10**) attached to the clevis in step 6. Push and pull the threaded clevis down to the tab (**11**) at the front underside of the outer boom.

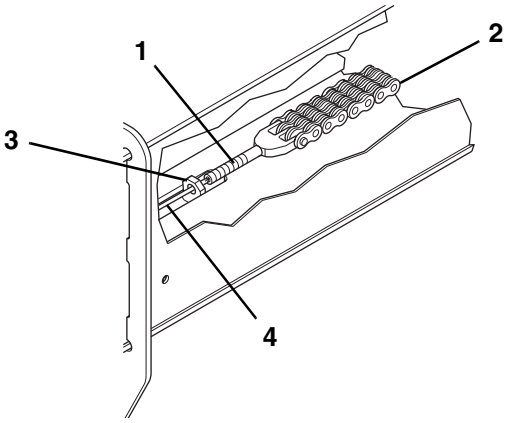
16. The person at the front of the boom should guide the threaded end of the clevis (**8**) through the hole in the tab (**11**).



17. Remove the string or wire, and the threaded eye or capscrew with flat washer, from the end of the clevis.

If no string or wire was installed to the end of the clevis:

18. From the rear of the boom, one person should push the threaded clevis end (**1**) of the retract chain (**2**) under the chain sheave and down between the intermediate boom and the outer boom. Keep the retract chain (**2**) to the right side of the boom, push the threaded clevis down to the tab (**3**) at the front underside of the outer boom.
19. The person at the front of the boom should guide the threaded end of the clevis (**1**) through the hole in the tab (**3**) using a Phillips screwdriver (**4**). Insert the screwdriver through the hole in the tab and catch the countersunk hole in the end of the clevis. Guide the threaded clevis out as the person at the rear of the boom pushes the retract chain forward.

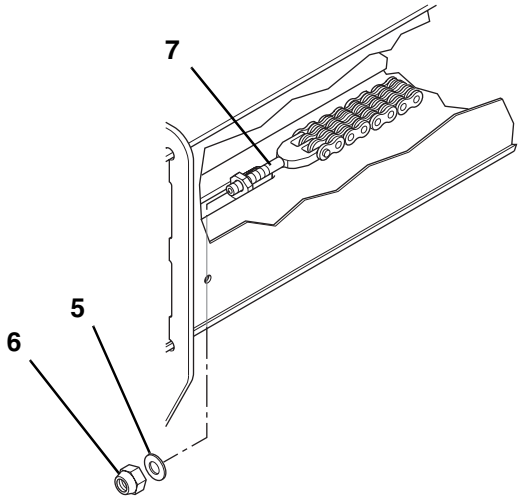


MA9520

Once the threaded clevis is through the tab on the outer boom:

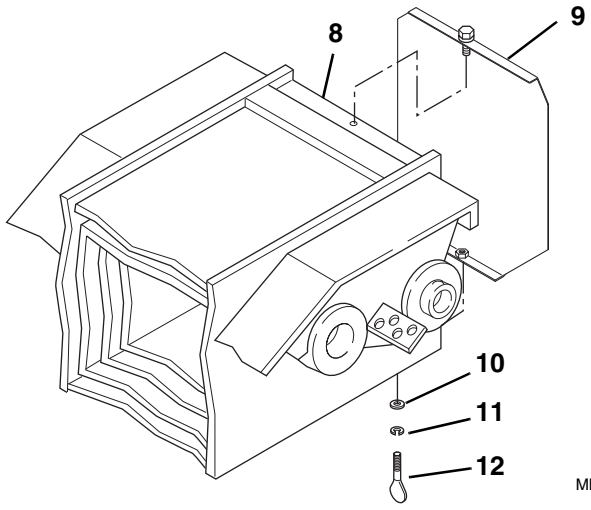
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

20. Reassemble the saved flat washer (**5**), and a new 3/4-16 elastic locknut (**6**) onto the threaded clevis (**7**). Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.
21. Tighten the elastic locknut (**6**) on the retract chain clevis (**7**) until the amount of threads protruding beyond the elastic locknut is the same as the measurement recorded during removal of the retract chain.
22. Adjust retract chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)



MA9510

23. After adjustment is complete, assemble the rear cover to the rear of the outer boom. At the rear of the outer boom (**8**), position the rear cover (**9**) in place. Secure the cover in place with the saved, 5/16" flat washer (**10**), lockwasher (**11**) and thumbscrew (**12**). Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely to hold the cover in place.



MH5690

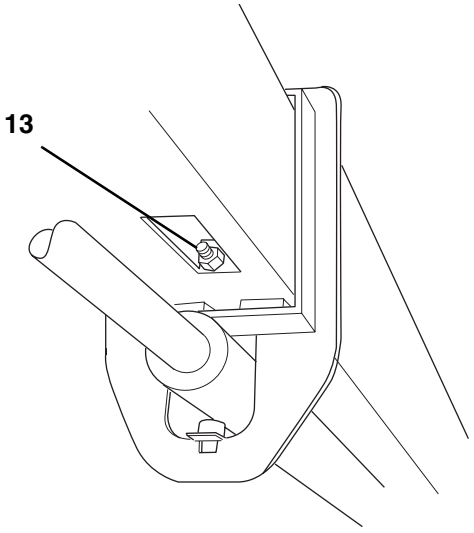
d. Expose Inner Boom Retract Chain for Inspection

The retract chain must be removed from the boom in order to be visually inspected. This must be done every 1000 hours or whenever the retract chain is removed from the boom. (If removal of the chain is required refer to Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement.”)

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

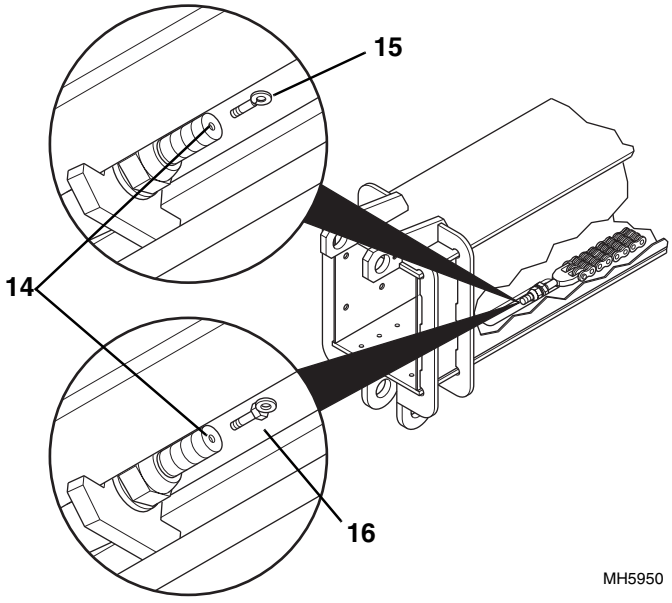
If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**12**), lockwasher (**11**) and flat washer (**10**), holding the rear cover (**9**) to the rear of the outer boom (**8**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.
4. Start the engine, slowly extend the boom until the clevis end (**13**) of the inner boom retract chain is exposed on the under side of the primary intermediate boom. Turn the engine OFF.
5. At the front underside of the primary intermediate boom, record the amount of threads extending beyond the elastic locknut (**13**). This measurement will be the starting point for adjustment of the boom retract chain.
6. Loosen the elastic locknut (**13**) far enough so that it can be removed by hand.



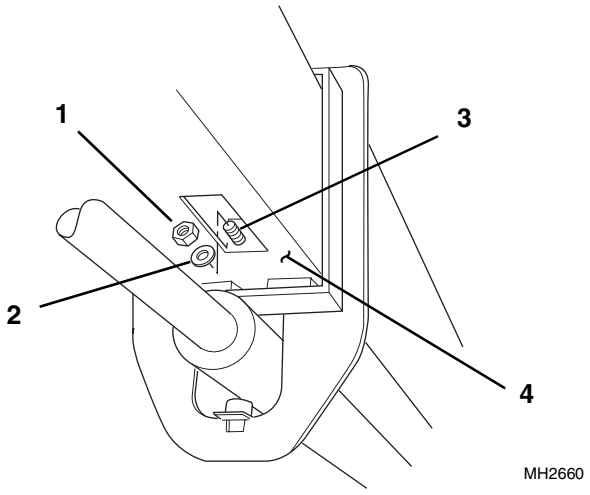
OH0660

7. If the chain clevis has a threaded hole on the end (**14**), 17 gauge wire can be attached to the retract chain clevis using a threaded eye (**15**) or a flat washer tack welded to a capscrew (**16**). The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.



MH5950

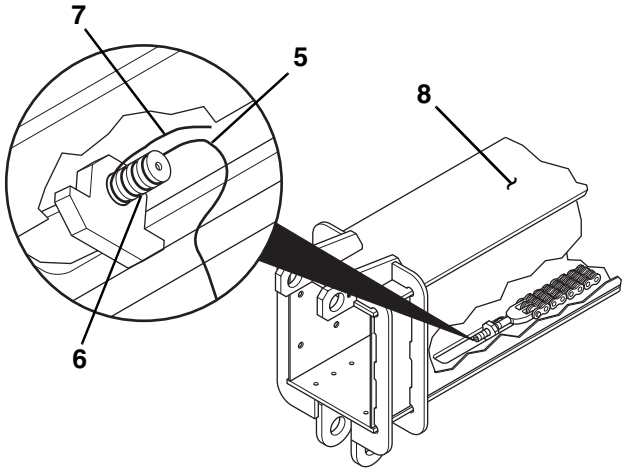
8. Remove the elastic locknut (**1**) and flat washer (**2**) holding the retract chain threaded clevis (**3**) to the mounting tab on the primary intermediate boom (**4**). Save the flat washer and discard the elastic locknut.



MH2660

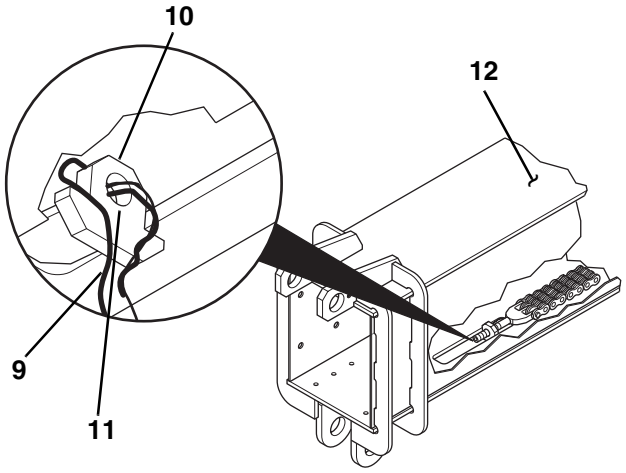
9. If a threaded eye or capscrew with flat washer was installed in step 7, attach a 17 gauge wire to the end of the retract chain clevis. The wire must be long enough to pull the clevis and chain through the outer boom. The wire must be heavy enough, 17 gauge or heavier, to pull the weight of the entire chain back through the boom during the reassembly.

   If there is no threaded hole on the end of the clevis, a tow wire and guide wire will need to be attached to the clevis before pulling the chain out of the boom. Both wires must be long enough to pull the clevis and chain through the outer boom. The tow wire must be heavy enough, 17 gauge or heavier, to pull the weight of the entire chain back through the boom during the reassembly. The guide wire is used only to guide the threaded end of the clevis into the tab on the primary intermediate boom (**4**) during reassembly.



MH5960

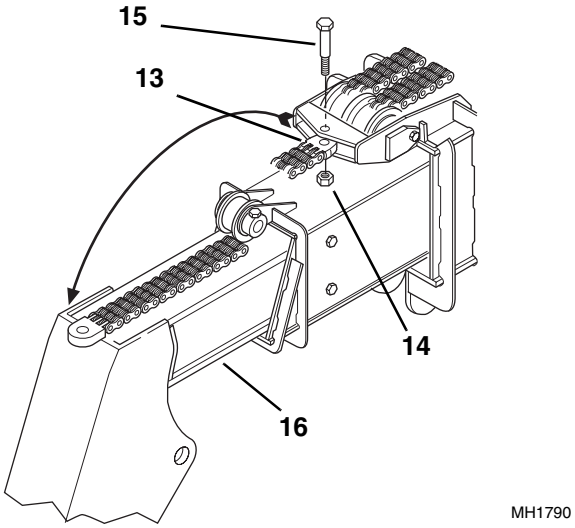
Wrap 24 gauge steel wire (**5**) tightly into the grooves of the threads of the clevis (**6**). Start the coils as close to the tab as possible. Make sure the end (**7**) has enough of a tail to wrap into a knot at the top of the clevis. Push the clevis (**6**) and guide wire (**5**) into the primary intermediate boom (**8**), so that only the guide wire is hanging out of the tab.



MH5970

Loop the tow wire (**9**), 17 gauge or heavier, over the top of the tab (**10**) and back through the hole (**11**) and twist the end securely onto the guide wire. This will allow the tow wire to be pulled back through the primary intermediate boom (**12**) along with the guide wire attached to the chain clevis.

10. Place a pan or tarp, free of dirt, at the rear of the vehicle, for the chain to rest on as it is being removed from the boom. From the rear of the boom, pull the retract chain out the rear of the boom. Pull the chain through the middle of the two center hoses on the chain reel and over the top of the chain reel.
11. The part of the chain that is still inside the boom must be exposed for inspection. Have another person assist with this step.
12. At the front of the boom, disconnect the inner boom extend chain clevis (**13**) from the anchor plates on the primary intermediate boom. Remove the elastic locknut (**14**) holding the shoulder bolt (**15**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the inner boom (**16**). Save the shoulder bolt and discard the elastic locknut.



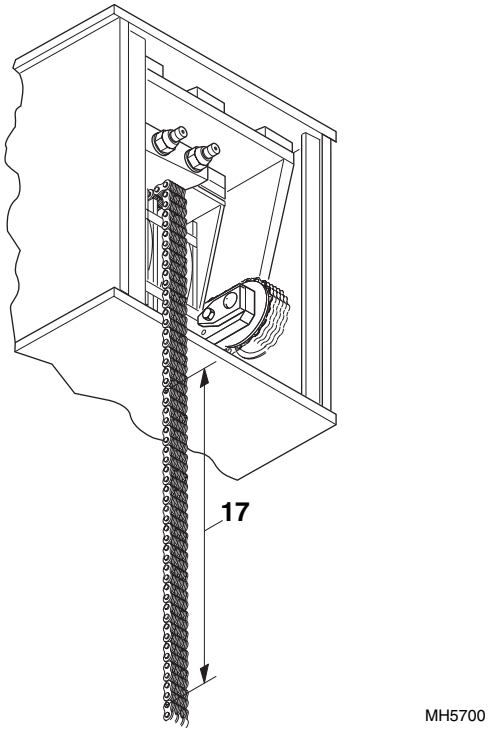
13. Return to the operator's compartment and start the engine and slowly retract the boom. To avoid having the inner boom retract chain becoming entangled, keep tension on the chain coming out the back of the boom. Retract the boom as far as possible with the extend/retract cylinder. Turn the engine OFF.
14. The inner boom will not retract completely and must be manually pushed in. To avoid having the inner boom retract chain becoming entangled, keep tension on the chain coming out the back of the boom while the inner boom is pushed in.

IMPORTANT: *Care should be taken not to push the inner boom in too far. If the inner boom is pushed in too far it could damage the hose reel at the back of the boom.*

15. With the chain hanging from the rear of the boom, inspect wear and condition of the chain, clevis', chain sheaves, chain pins, clevis anchors and all mounting hardware. Replace a worn or damaged chain. **DO NOT** attempt to make any repairs to the chain.

Note: ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevis' be replaced at the same time.*

16. Measure the chain elongation. Measure across 17 pins (**17**), somewhere between the chain sheave and where the chain is laying in the pan or on the tarp. The maximum measurement allowed is 12.36" (313 mm). If the measurement is more than 12.36" (313 mm), the chain must be replaced. (Refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement.")



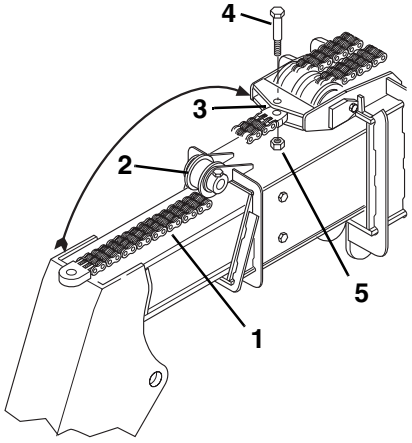
Note: *Chains and clevis' are wear items and experience the same stress.* ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis'.*

17. If the chain needs to be replaced, refer to Section 3.7.6, "Boom Extend and Retract Chains Removal and Replacement."

18. Lubricate the chain, while it is exposed, if it does not need to be replaced. (Refer to Section 3.7.2, “Chain Lubrication.”)
19. Pull the inner boom extend chain (**1**) up and around the sheave (**2**) at the front of the secondary intermediate boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

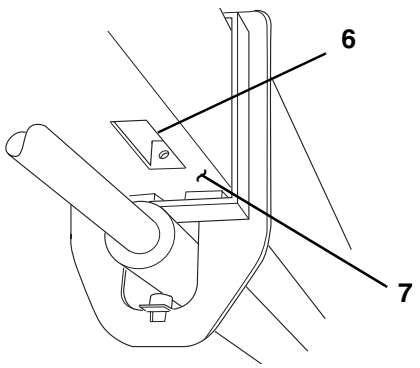
20. Place the extend chain clevis (**3**) between the mounting plates at the front of the secondary intermediate boom. Coat the saved shoulder bolt (**4**) with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a new elastic locknut (**5**). Tighten securely, but the chain clevis should pivot freely.



MH2520

Note: *Have a second person help with the installation of the retract chain between the primary and secondary intermediate boom assemblies.*

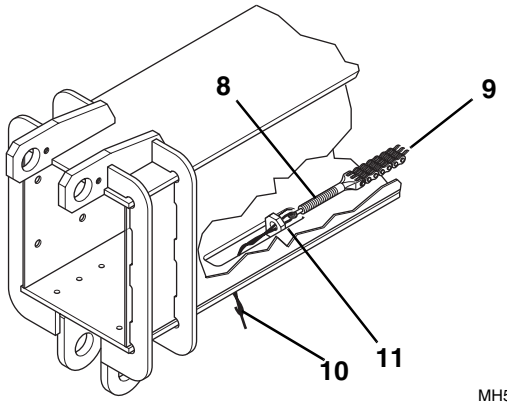
21. One person should start the engine, and slowly extend the boom until the rectangular slot (**6**) on the under side of the primary intermediate boom (**7**) is exposed. A second person should be at the rear of the boom making sure that the inner boom retract chain does not catch on anything while the boom is being extended. Turn the engine OFF.



MH6030

If a threaded eye or capscrew with flat washer was installed to the end of the clevis:

22. Coat the threads of the threaded clevis (**8**) with multi-purpose grease.
23. From the rear of the boom, one person should push the threaded clevis end (**8**) of the retract chain (**9**) under the chain sheave and down between the primary intermediate boom and the secondary intermediate boom. The person at the front of the boom should pull the clevis using the 17 gauge wire (**10**) attached to the clevis in step 7. Push and pull the threaded clevis down to the tab (**11**) at the front underside of the primary intermediate boom.
24. The person at the front of the boom should guide the threaded end of the clevis (**8**) through the hole in the tab (**11**) on the primary intermediate boom.

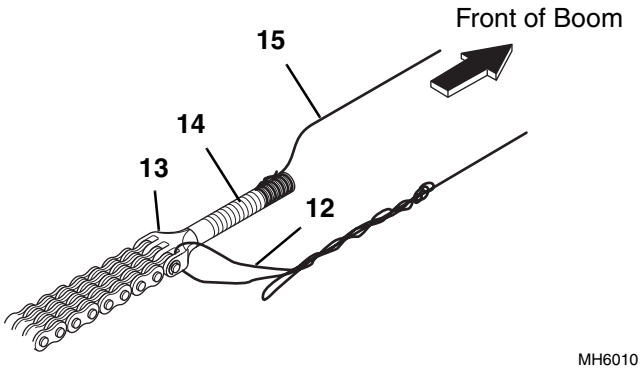


MH5990

25. Remove the wire, and the threaded eye or capscrew with flat washer, from the end of the clevis.

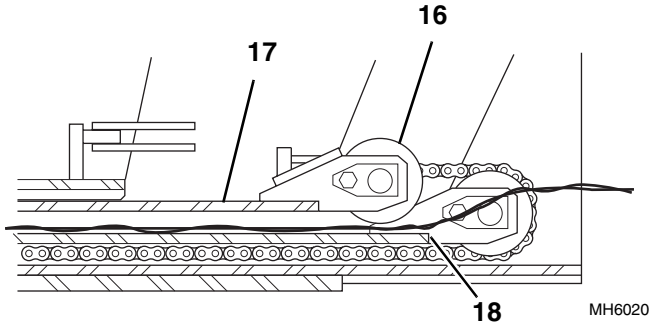
If no threaded eye or capscrew with flat washer was installed to the end of the clevis:

26. The tow wire and clevis guide wire will be hanging out the rear of the boom along with the chain.
27. Loop the end of the tow wire (**12**) through the right side of the threaded clevis (**13**) as seen from the assembled position. This will allow the tow wire to guide the threaded clevis down the left side of the primary intermediate boom and close to the hole in the mounting tab. Leave a long enough loop so that after the clevis is re-assembled into the tab on the primary intermediate boom, one side of the loop can be cut and the remainder of the wire can be pulled out of the boom.

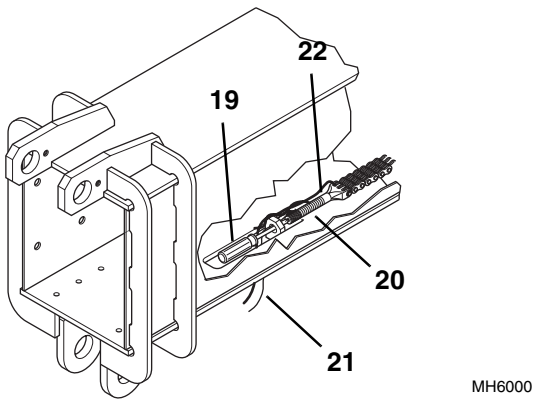


28. Coat the threads of the threaded clevis (**14**) with multi-purpose grease.
29. Have a second person assist with the next steps. From the front of the boom, one person should pull on the tow wire (**12**) while the person at the rear of the boom guides the chain clevis between the two center hoses of the hose reel and under the chain sheave (**16**), on the left side of the boom (in front of the hose reel assembly not shown for clarity) and down the boom between the secondary intermediate boom (**17**) and the primary intermediate boom (**18**).

    The person at the front of the boom will need to pull on both the tow wire (**12**) and the guide wire (**15**) at the same time. Use the tow wire to take the weight of the chain and the guide wire to guide the end of the clevis through the boom.
30. The person at the back of the boom should keep the retract chain lined up squarely with the chain sheave and help feed the retract chain in while the second person pulls on the wires from the front of the boom.



31. Once the clevis is near the tab on the underside of the primary intermediate boom, using a phillips screwdriver (**19**) in the countersunk hole in the end of the clevis (**20**), may help to center the clevis in the hole, while pulling on the guide wire (**21**).

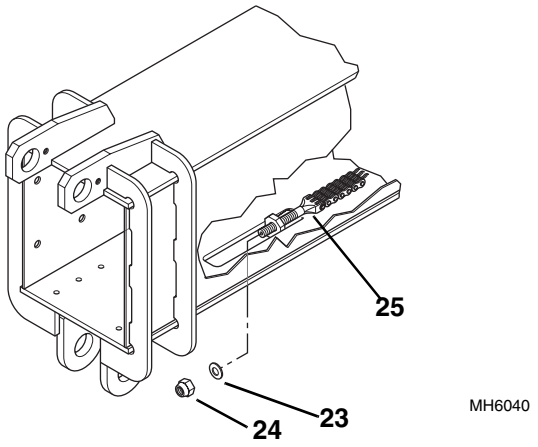


32. Clip the guide (**21**) and tow (**22**) wires and remove the wires from the boom clevis and the boom.

Once the threaded clevis is through the tab on the primary intermediate boom:

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

33. Reassemble the saved flat washer (**23**), and a new 3/4-16 elastic locknut (**24**) onto the threaded clevis (**25**). Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.
34. Tighten the elastic locknut (**24**) on the retract chain clevis (**25**) until the amount of threads protruding beyond the elastic locknut is the same as the measurement recorded during removal of the retract chain.
35. Adjust retract chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)



3.7.2 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated with a quality chain lubricant ("LUBRIPLATE" Chain & Cable Fluid, "LPS3" or equivalent).

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that the lubricant can penetrate to the working surfaces.

Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant, and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. **DO NOT** use a solvent for this wiping operation.

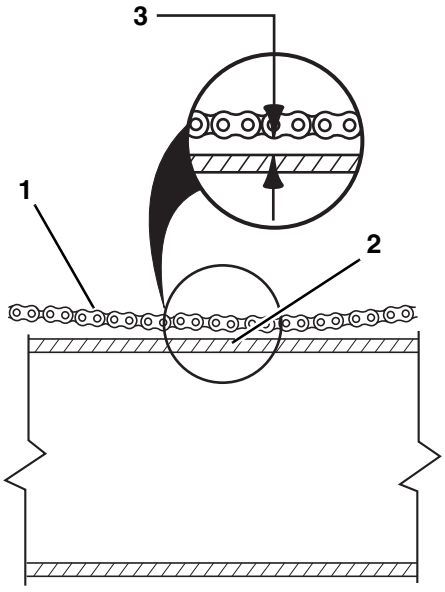
Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. It is important that a reputable lubrication specialist, consult the local **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, for guidance.

3.7.3 Boom Chain Tension Check

1. Make sure the carriage is attached to the gooseneck before doing the tension check.
2. Start the engine. If necessary, attach carriage to gooseneck. Park the vehicle on level ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and raise the boom to a horizontal (level) position.
3. Lower both outriggers completely
4. Slowly, fully extend the boom and retract it about halfway. Fully extend the boom again, then retract it 2" (51 mm) (one inch per section). Turn the engine OFF.
5. Measure the sag in each of the three boom extend chains (**1**) between the bottom of the extend chains and the top of the boom at their closest point (**2**). Acceptable boom chain sag (**3**) is between 1.5" (38 mm) and 2.5" (64 mm).

   If the measurement is either less than, or greater than the range given, the boom chains need to be adjusted. Continue with Section 3.7.4, "Intermediate Boom Chains Tension Adjustment," or to adjust the chain system.



6. Start the engine, retract the boom completely and turn the engine OFF.

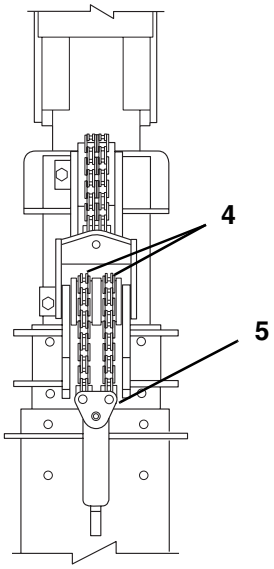
3.7.4 Intermediate Boom Chains Tension Adjustment

Note: *Always perform Section 3.7.3, "Boom Chain Tension Check," before adjusting the boom extend chain tension.*

1. Adjust the two intermediate boom extend chains (**4**).

   If the chain sag measurement (**3**) is less than 1.5" (38 mm), tighten the two extend chain adjustment locknuts (**6**).

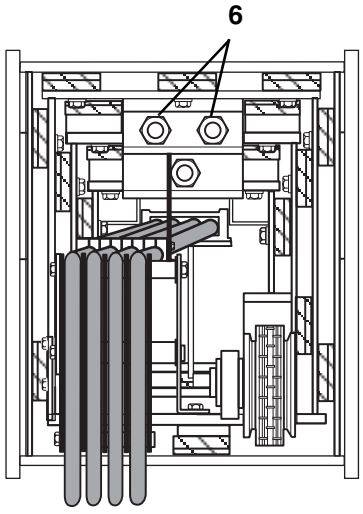
   If the chain sag measurement (**3**) is more than 2.5" (64 mm), loosen the two extend chain adjustment locknuts (**6**).



OH0551

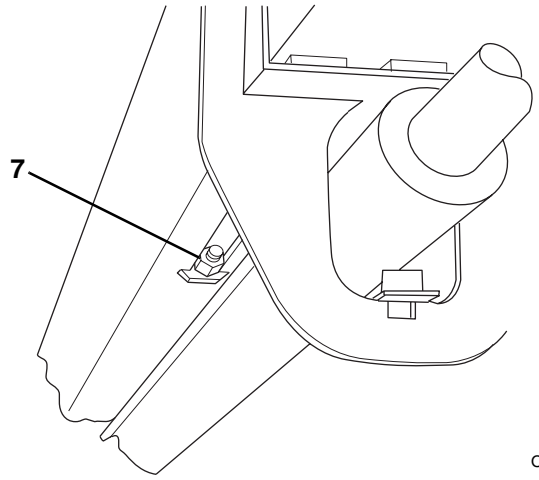
2. Tighten or loosen the two extend chain adjustment locknuts (**6**) located at the rear of the boom. Be sure each of the locknuts are adjusted equally so that each extend chain maintains the same tension.

   Equal chain tension can be checked by the position of the yoke (**5**) on the outer boom. The front of the yoke should be parallel with the front edge of the outer boom.



MH1780

3. If there is no adjustment left on the extend chains, tighten the retract chain locknut (**7**) at the front on the underside of the outer boom.
4. Recheck chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)

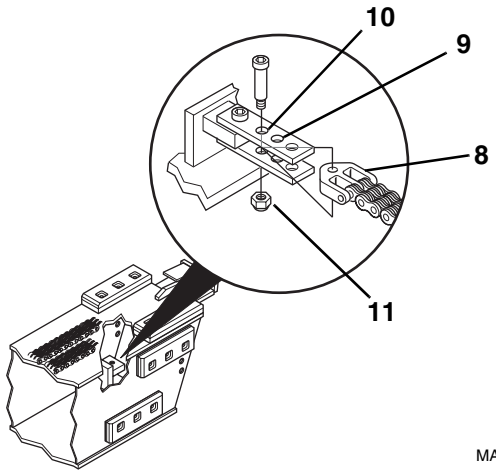


OA0512

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

5. Further chain adjustment can be achieved by loosening all three chain locknuts (**6** and **7**) and moving the rear intermediate retract chain clevis (**8**) from the original mounting hole (**9**) in the anchor plate to the next hole (**10**).

   This is only acceptable when boom chain sag (**3**) cannot be acquired and the chain elongation measurement is still less than 12.36" (313 mm). Make sure to use a new 3/8-16 elastic locknut (**11**) to re-secure the chain clevis to the anchor plate. Follow the instructions in Section 3.7.4, a. “Component/ Assembly Verification.”
6. Recheck chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)

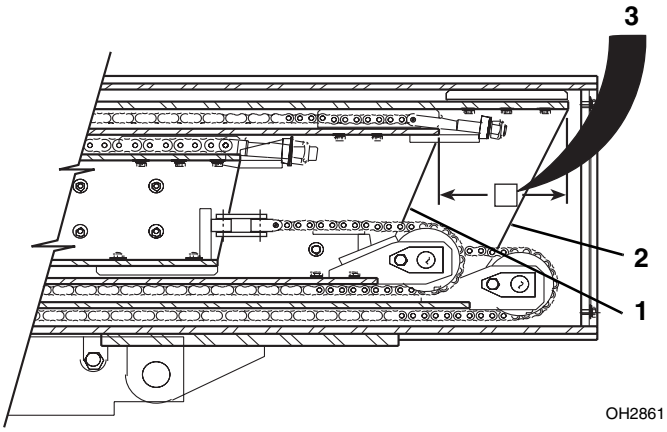


MA9450

a. Component/Assembly Verification

The secondary intermediate (**1**) to primary intermediate (**2**) boom separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.

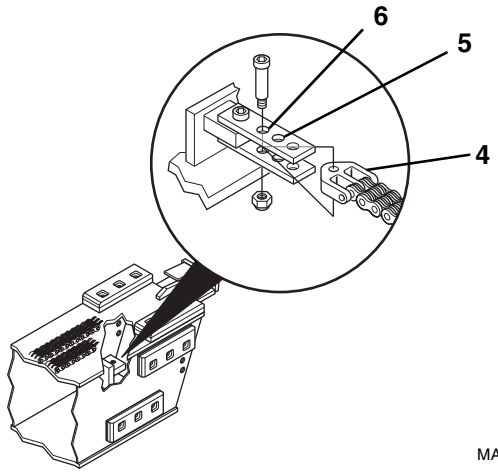
Measure the separation between the secondary intermediate and primary intermediate boom top plates. The distance (**3**) should be at least 8.5" (216 mm) and not greater than 11" (279 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 8.5" (216 mm) could result in interference and cause damage to boom components.



OH2861

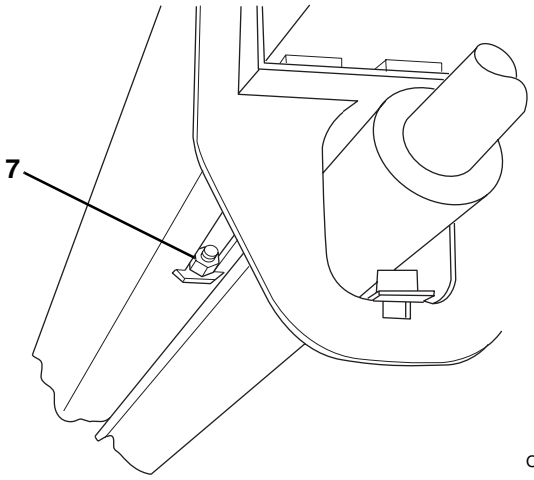
If the distance is less than 8.5" (216 mm) or greater than 11" (279 mm):

1. Verify that the retract chain clevis (**4**) is not mounted in the last hole (**5**) in the anchor plate (**6**) .



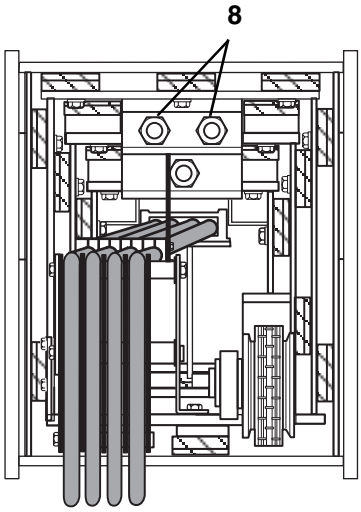
MA9450

2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.3, “Boom Chain Tension Check,” and Section 3.7.4, “Intermediate Boom Chains Tension Adjustment.”



OA0512

3. **To increase the separation distance:** Loosen the retract chain locknut (**7**) on the bottom of the outer boom one or two turns and tighten the two extend chain locknuts (**8**) equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.



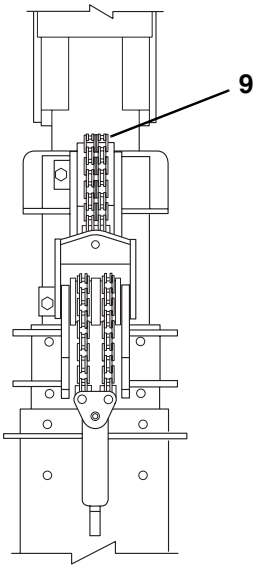
MH1780

4. **To decrease the separation distance:** Loosen the extend chain locknuts (**8**) at the rear of boom equally one or two turns and tighten the retract chain locknut (**7**) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.

Note: *If the secondary intermediate to primary intermediate boom separation distance cannot be achieved, contact the local* ***Sky Trak*** *distributor or the* ***JLG*** *Service Department at 1-877-554-5438 or 1-717-485-6657.*

3.7.5 Inner Boom Chain Tension Adjustment

Note: *Always perform the Section 3.7.3, "Boom Chain Tension Check," before adjusting the inner boom extend chain tension.*

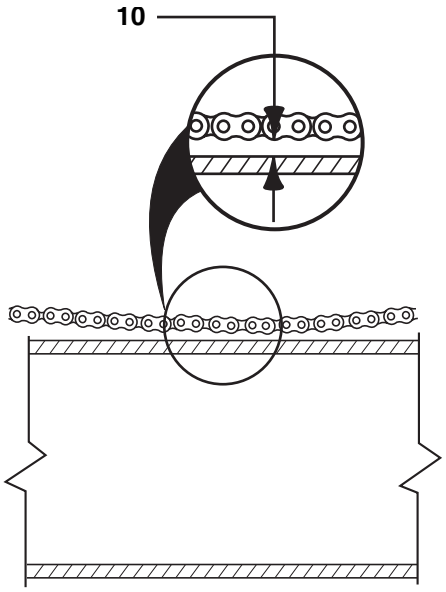


OH0551

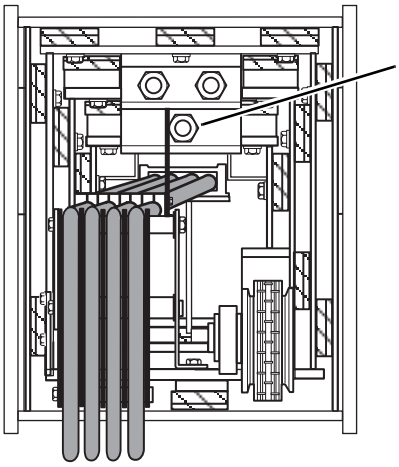
1. Adjust the inner boom extend chain (**9**):

   If the chain sag measurement (**10**) is less than 1.5" (38 mm), tighten the extend chain adjustment locknut (**11**).

   If the chain sag measurement (**10**) is more than 2.5" (64 mm), loosen the extend chain adjustment locknut (**11**).

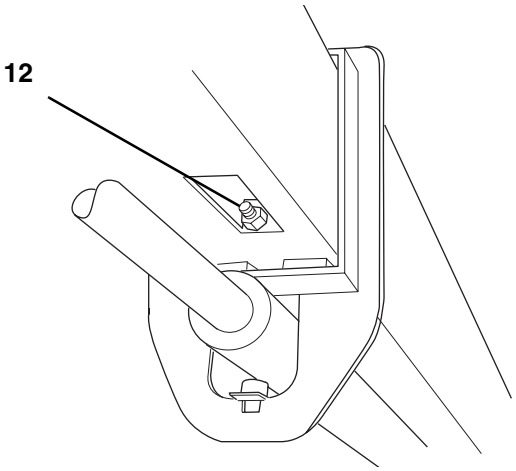


OA0492



MH1780

2. If there is no adjustment left on the extend chains, tighten the retract chain locknut (**12**) on the bottom of the primary intermediate boom several turns.



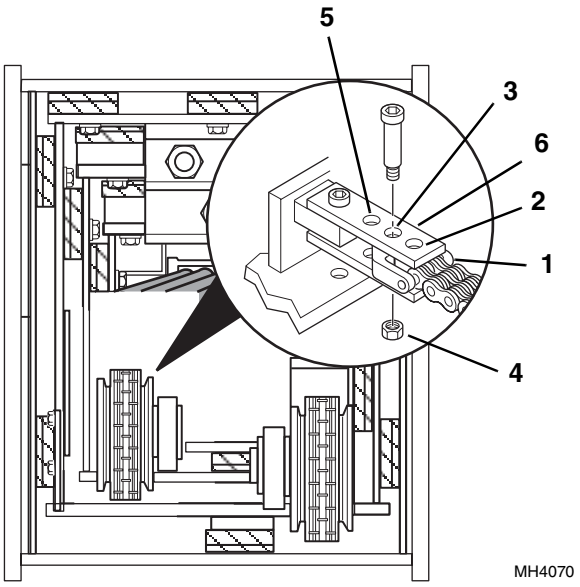
OH0660

3. Recheck chain tension. (Refer to Section 3.7.3, "Boom Chain Tension Check.")

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

4. Further chain adjustment can be achieved by loosening both chain locknuts (**11** and **12**) and moving the rear retract chain clevis (**1**) from the original mounting hole (**2**) in the anchor plate to the next hole (**3**).

   This is only acceptable when boom chain sag (**10**) cannot be acquired and the chain elongation measurement is still less than 12.36" (313 mm). Make sure to use a new 3/8-16 elastic locknut (**4**) to re-secure the chain clevis to the anchor plate. Follow the instructions in Section 3.7.5, a. "Component/ Assembly Verification."

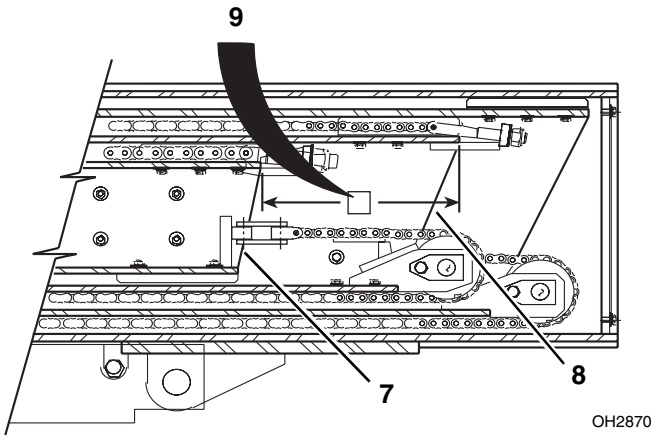


5. Recheck chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)

a. Component/Assembly Verification

The inner (**7**) to secondary intermediate (**8**) boom separation should be checked when assembling new boom sections or chains, or when the rear retract chain clevis has been moved forward on the anchor plate.

Measure the separation between the secondary intermediate and inner boom top plates. The distance (**9**) should be at least 13.75" (349 mm) and not greater than 14.25" (362 mm) with the boom fully retracted and the chains properly tensioned. A distance of less than 13.75" (349 mm) could result in interference and cause damage to boom components.



If the distance is less than 13.75" (349 mm) or greater than 14.25" (362 mm):

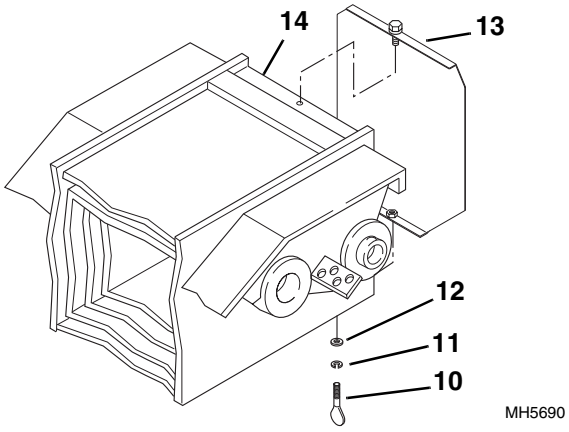
1. Verify that the retract chain clevis (**1**) is not mounted in the last hole (**5**) in the anchor plate (**6**) .
2. Make sure that the chain system is properly tensioned. Refer to Section 3.7.3, “Boom Chain Tension Check,” and Section 3.7.5, “Inner Boom Chain Tension Adjustment.”
3. **To increase the separation distance:** Loosen the retract chain locknut (**12**) on the bottom of the primary intermediate boom one or two turns and tighten the extend chain locknut (**11**) the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.
4. **To decrease the separation distance:** Loosen the extend chain locknut (**11**) at the rear of boom one or two turns and tighten the retract chain locknut (**12**) on the bottom of the primary intermediate boom the same number of turns. A minimum of one full thread on the clevis must protrude beyond the elastic collar of the locknut.

Note: *If the secondary intermediate to primary intermediate boom separation distance cannot be achieved, contact the local* ***Sky Trak*** *distributor or the* ***JLG*** *Service Department at 1-877-554-5438 or 1-717-485-6657.*

3.7.6 Boom Extend and Retract Chains Removal and Replacement

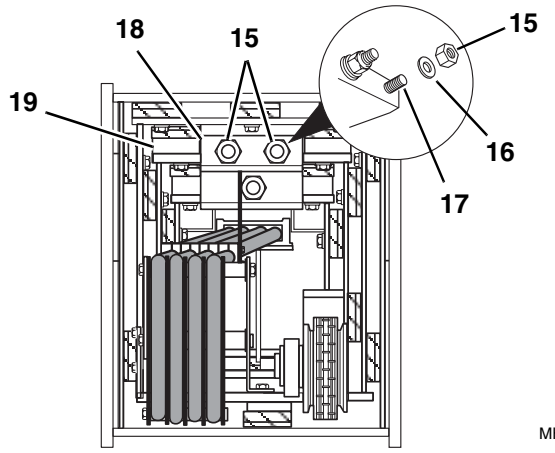
a. Intermediate Boom Extend Chains Removal and Replacement

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**10**), lockwasher (**11**) and flat washer (**12**) holding the rear cover (**13**) to the rear of the outer boom (**14**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



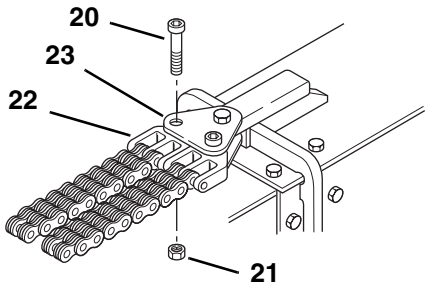
MH5690

4. At the rear of the boom, locate the intermediate boom extend chain elastic locknuts (**15**). Record the amount of threads extending beyond the elastic locknuts. This measurement will be the starting point for adjustment of the extend chains after installation.



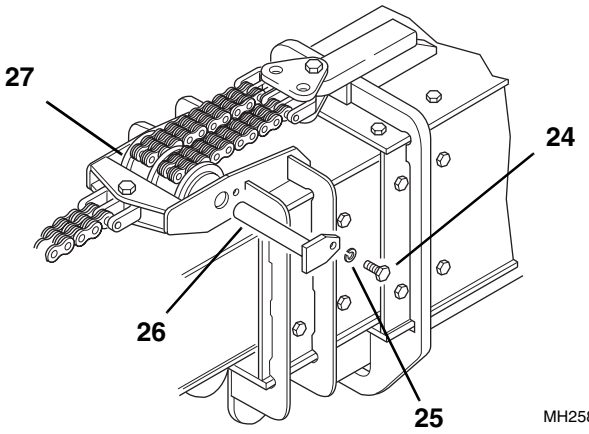
MH2570

5. Remove and replace the intermediate boom extend chains one at a time. Remove the right side elastic locknut (**15**) and flat washer (**16**) holding the right side intermediate boom extend chain clevis (**17**) to the anchor plate (**18**) on the secondary intermediate boom (**19**). Save the flat washer and discard the elastic locknut.
6. At the front of the outer boom, remove the capscrews (**20**) and elastic locknuts (**21**) holding the intermediate boom extend chain clevis' (**22**) to the yoke plates (**23**). Discard the elastic locknuts.
7. Inspect the capscrews (**20**) for signs of wear or damage. Replace with new capscrews if damaged or worn.



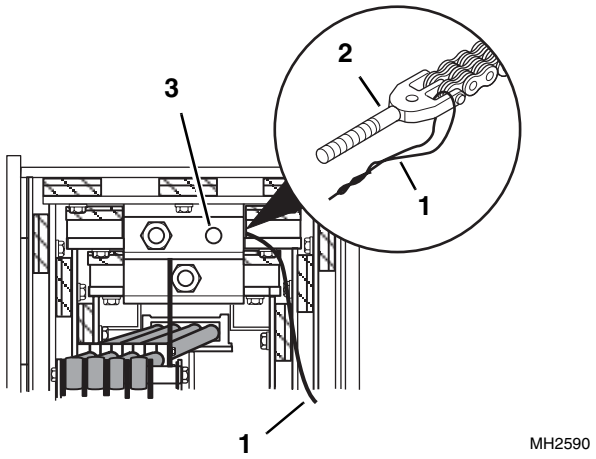
SH1810

8. At the front of the primary intermediate boom, remove the capscrew (**24**) and lockwasher (**25**) holding the extend chain sheave pin (**26**) to the sheave mount bracket on the primary intermediate boom. Remove the pin from the mount bracket and the extend chain sheave (**27**). Remove the extend chain sheave from the mount.



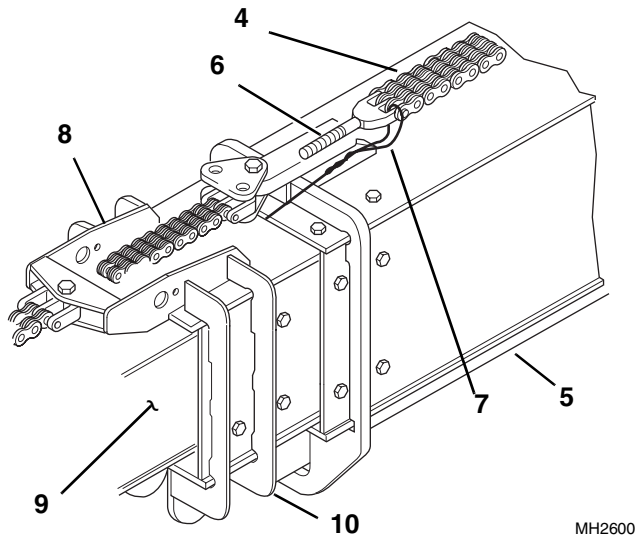
MH2580

9. At the rear of the boom, attach one end of a wire (**1**) to the threaded clevis (**2**) on the right side intermediate boom extend chain. Loop the wire around and twist together to form a loop. Route the wire around the right side of the clevis anchor plate (**3**).



MH2590

10. Have a second person assist with the removal of the intermediate boom extend chain. One person should pull the chain from the front of the boom while the second person guides the wire into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
11. Coat the threads of the threaded clevis (**6**) with multi-purpose grease.
12. Lay the new intermediate boom extend chain (**4**) on top of the outer boom (**5**) with the threaded clevis (**6**) toward the front of the boom.
13. Attach the wire (**7**) to the threaded clevis (**6**) of the new intermediate boom extend chain. Loop the wire through the clevis and twist together to form a loop.
14. Pull the intermediate boom extend chain forward and place in between the chain sheave mounts (**8**). Guide the wire and the threaded clevis into the boom by placing the threaded clevis between the top of the secondary intermediate boom (**9**) and the primary intermediate boom (**10**).

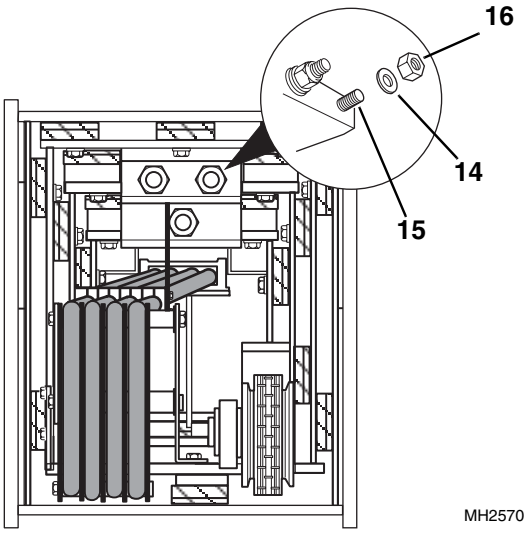


MH2600

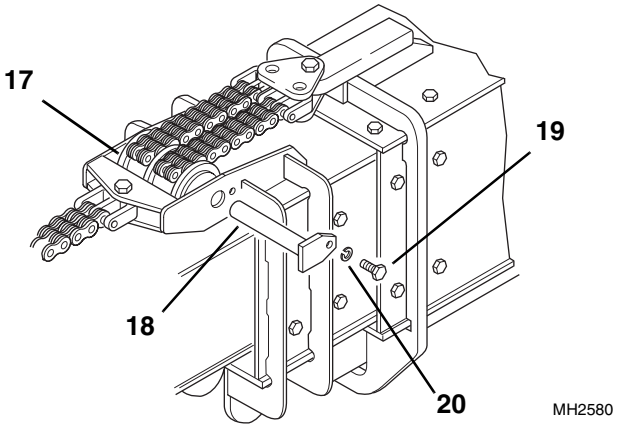
15. While one person guides the intermediate boom extend chain into the front of the boom, a second person should pull the wire (**1**) and threaded clevis toward the rear of the boom. Guide the threaded clevis (**2**) into the hole in the anchor plate (**3**).

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

16. Place the flat washer (**14**), saved, onto the threaded end of the threaded clevis (**15**) and assemble a new elastic locknut (**16**). Thread elastic locknut onto the threaded clevis until the threads are flush with the top of the nut.
17. Cut the loop in the wire and remove the wire from the clevis.



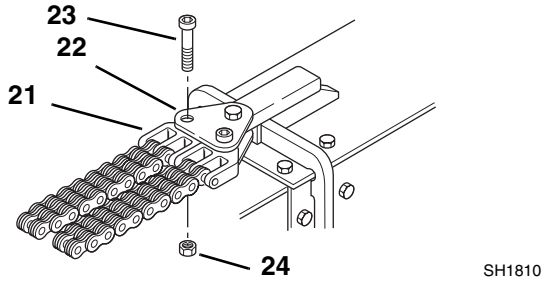
18. Repeat Steps 9 thru 17 and remove and replace the left side intermediate boom extend chain.
19. After both of the chains are replaced inside the boom, assemble the double sheave to the mount at the front of the primary intermediate boom.
20. Place the double extend chain sheave (**17**), saved, between the mounts and under the extend chains at the front of the primary intermediate boom. Insert the sheave pin (**18**), saved, through the mounts and the double sheave. Line up the mounting hole in the sheave pin with the threaded hole in the sheave mount and secure in place with the capscrew (**19**), saved, and the lockwasher (**20**), saved. Tighten securely.



21. Pull the anchor clevis' (**21**) up around the double chain sheave and position the clevis' one at a time between the yoke plates (**22**).

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

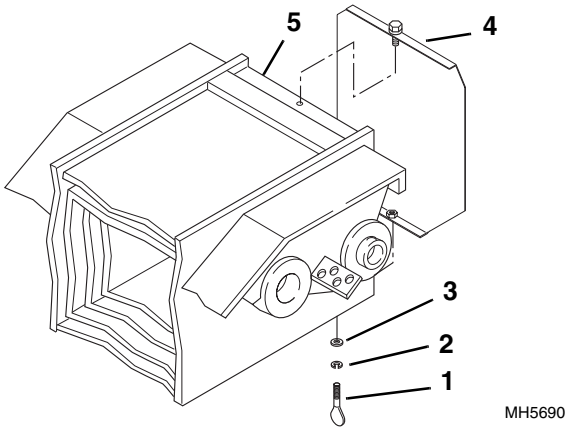
22. Coat the capscrews (**23**), saved, with anti-seize compound. Insert the capscrews through the yoke plates and clevis' and secure in place with new elastic locknuts (**24**). Tighten each locknut securely, but the chain clevis' must pivot freely.



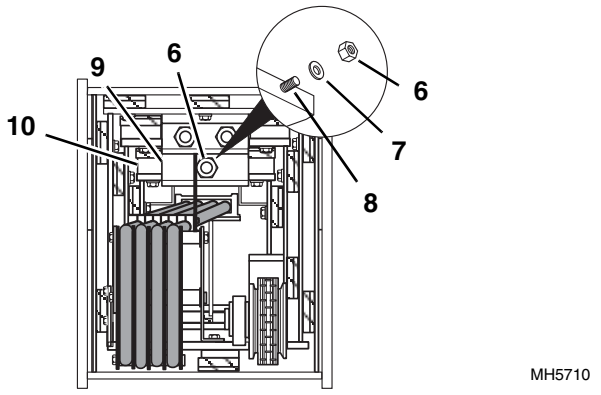
23. At the rear of the boom, tighten the two elastic locknuts (**15**) on the secondary intermediate boom extend chain clevis' until the amount of threads protruding beyond each elastic locknut is the same as the measurement recorded during removal of the extend chains.
24. Check and adjust the intermediate boom retract chain tension. (Refer to Section 3.7.3, "Boom Chain Tension Check.")

b. Inner Boom Extend Chains Removal and Replacement

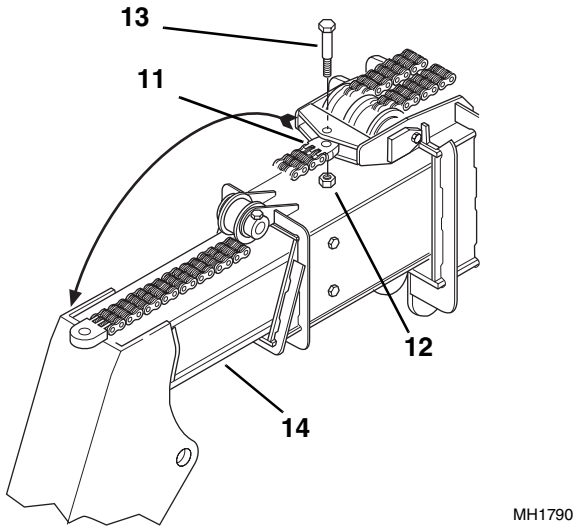
1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**1**), lockwasher (**2**) and flat washer (**3**) holding the rear cover (**4**) to the rear of the outer boom (**5**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



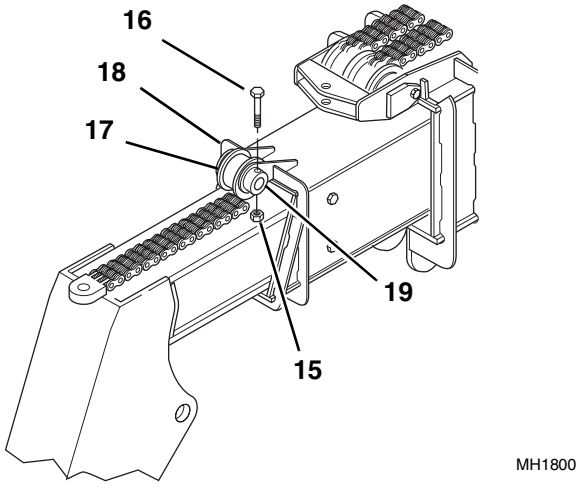
4. At the rear of the boom, locate the inner boom extend chain elastic locknut (**6**). Record the amount of threads extending beyond the elastic locknut. This measurement will be the starting point for adjustment of the extend chain after installation.



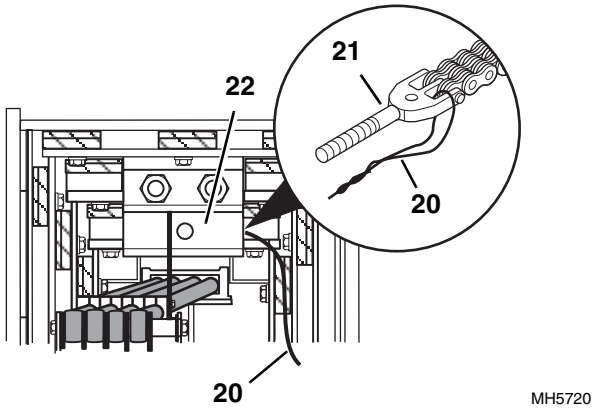
5. Remove the elastic locknut (**6**) and flat washer (**7**) holding the inner boom extend chain clevis (**8**) to the anchor plate (**9**) on the boom (**10**). Save the flat washer and discard the elastic locknut.
6. At the front of the boom, disconnect the inner boom extend chain clevis (**11**) from the anchor plates on the primary intermediate boom. Remove the elastic locknut (**12**) holding the shoulder bolt (**13**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the inner boom (**14**). Save the shoulder bolt and discard the elastic locknut.



7. Remove the elastic locknut (**15**) and capscrew (**16**) holding the inner boom extend chain sheave (**17**) to the front of the secondary intermediate boom (**18**). Use a brass punch and a rawhide hammer to remove the sheave pin (**19**).
8. Inspect the sheave pin (**19**) for corrosion or damage. If the pin is damaged, it should be replaced. Minor corrosion can be repaired with fine emery cloth. Save the chain sheave (**17**), pin (**19**) and capscrew (**16**). Discard the elastic locknut.

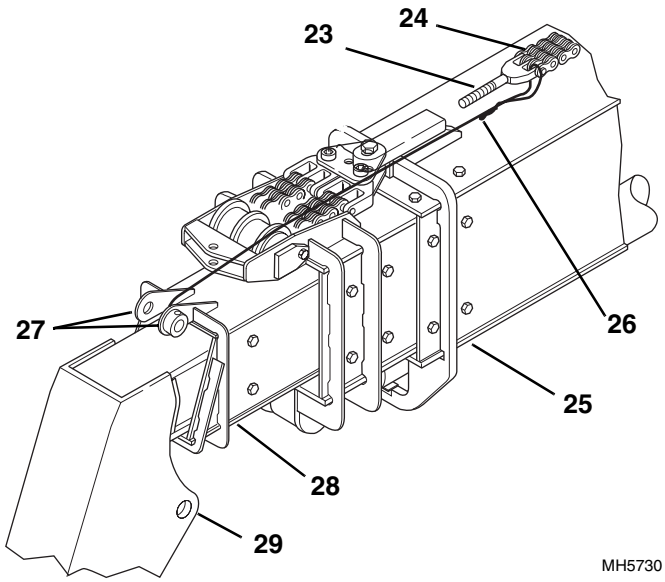


9. At the rear of the boom, attach one end of a wire (**20**) to the threaded clevis (**21**) on the inner boom extend chain. Loop the wire around and twist together to form a loop. Route the wire around the right side of the clevis anchor plate (**22**).



MH5720

10. Have a second person assist with the removal of the inner boom extend chain. One person should pull the chain from the front of the boom while the second person guides the wire into the boom from the rear. Remove the wire from the clevis, but not from inside the boom.
11. Coat the threads of the threaded clevis (**23**) with multi-purpose grease.
12. Lay the new inner boom extend chain (**24**) on top of the outer boom (**25**) with the threaded clevis (**23**) toward the front of the boom.
13. Attach the wire (**26**) to the threaded clevis (**23**) of the new inner boom extend chain. Loop the wire through the clevis and twist together to form a loop.
14. Pull the inner boom extend chain forward and place in between the chain sheave mounts (**27**). Guide the wire and the threaded clevis into the boom by placing the threaded clevis between the secondary intermediate boom (**28**) and the top of the inner boom (**29**).



MH5730

15. While one person guides the inner boom extend chain into the front of the boom, a second person should pull the wire (**20**) and threaded clevis toward the rear of the boom. Guide the threaded clevis (**21**) into the hole in the anchor plate (**22**).

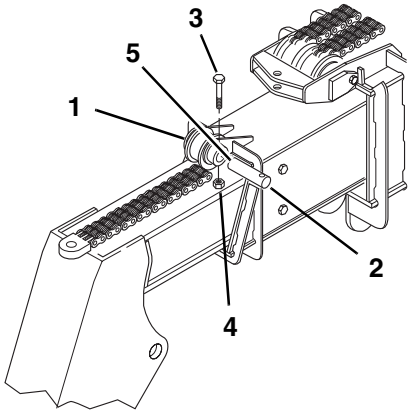
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

16. Place the saved flat washer (**7**) onto the threaded end of the threaded clevis (**8**) and assemble a new elastic locknut (**6**). Thread the elastic locknut onto the threaded clevis until the threads are flush with the top of the nut.
17. Cut the loop in the wire and remove the wire from the clevis.

18. After the chain is replaced inside the boom, assemble the sheave to the mount at the front of the secondary intermediate boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

19. Place the saved inner boom extend chain sheave (**1**) between the mounts at the front of the secondary intermediate boom. Insert the sheave pin (**2**), saved, through the mounts and the sheave. Use a tapered punch to line up the mounting hole in the pin with the mounting hole in the hub. Secure in place with the capscrew (**3**), saved, and a new elastic locknut (**4**). Tighten securely.
20. After the sheave is assembled, apply a good grade of multi-purpose grease to the grease fitting (**5**) at the end of the pin (**2**). Turn the sheave by hand to distribute the grease evenly.

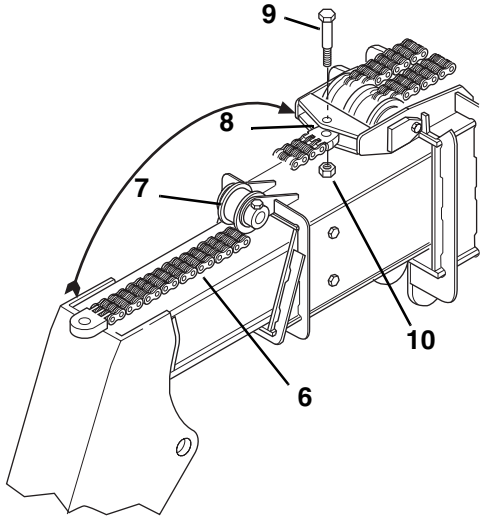


MH2510

21. Pull the inner boom extend chain (**6**) up and around the sheave (**7**) at the front of the secondary intermediate boom.

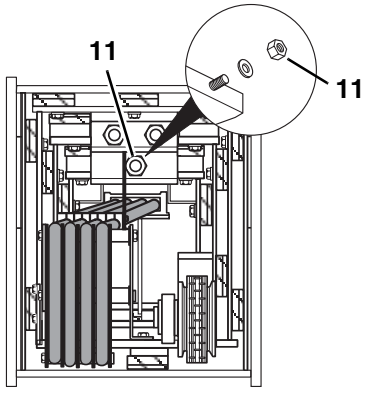
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

22. Place the extend chain clevis (**8**) between the mounting plates at the front of the secondary intermediate boom. Coat the saved shoulder bolt (**9**) with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a new elastic locknut (**10**). Tighten securely, but the chain clevis should pivot freely.



MH2520

23. At the rear of the boom, tighten the elastic locknut (**11**) on the inner boom extend chain clevis until the amount of threads protruding beyond the elastic locknut is the same as the measurement recorded during removal of the extend chain.

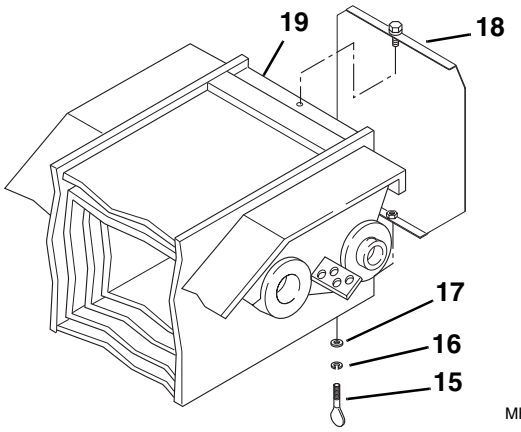


MH5710

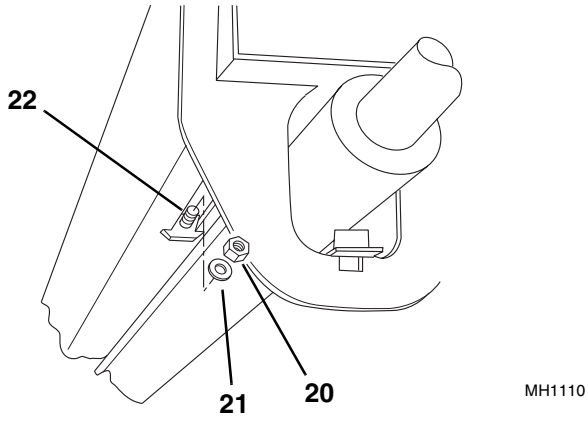
24. Check and adjust the inner boom extend chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)

c. Secondary Intermediate Boom Retract Chain Removal and Replacement

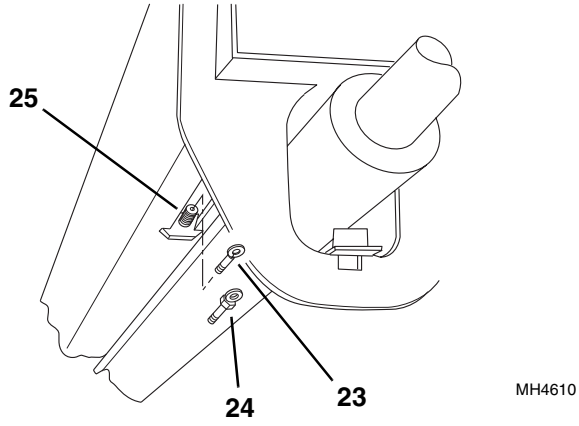
1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**15**), lockwasher (**16**) and flat washer (**17**) holding the rear cover (**18**) to the rear of the outer boom (**19**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



4. At the front underside of the boom, locate the intermediate boom retract chain elastic locknut (**20**). Record the amount of threads extending beyond the elastic locknut. This measurement will be the starting point for adjustment of the retract chain after installation.
5. At the front underside of the outer boom, remove the elastic locknut (**20**) and flat washer (**21**) holding the retract chain threaded clevis (**22**) to the mounting tab. Save the flat washer and discard the elastic locknut.



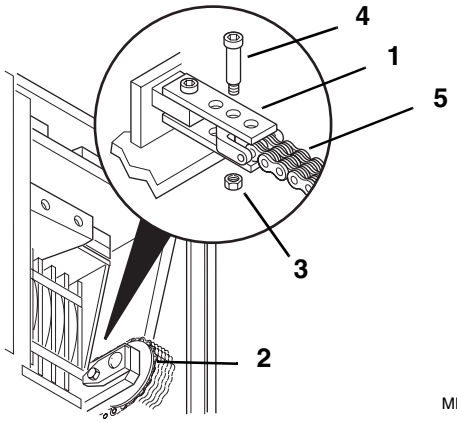
6. The chain clevis may have a threaded hole on the end of the clevis (**25**). A string or wire can be attached to the retract chain clevis using a threaded eye (**23**) or a flat washer tack welded to a capscrew (**24**) or through the clevis fingers. The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis. The string or wire will be used to pull the chain back through the boom during the reassembly.



7. Attach a string or wire to the threaded eye (**23** or **24**), that was installed in Step 6. The string or wire must be long enough to pull the clevis and chain through the outer boom.

Note: *Record the location of the shoulder bolt to ensure correct installation.*

8. At the rear of the boom, locate the two retract chain anchor plates (**1**) holding the secondary intermediate boom retract chain to the secondary intermediate boom, just in front of the retract chain sheave (**2**). Remove the elastic locknut (**3**) and shoulder bolt (**4**) holding the secondary intermediate boom retract chain clevis to the anchor plates. Discard the elastic locknut and save the shoulder bolt. The two anchor plates can remain in place on the secondary intermediate boom.

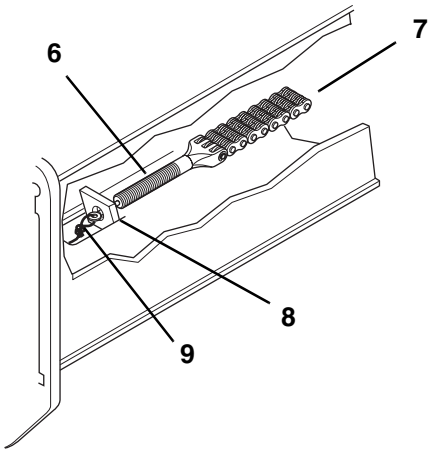


MH2550

9. From the rear of the boom, pull the secondary intermediate boom retract chain out of the rear of the boom.
10. Disconnect the string, wire or rod from the retract chain clevis, and allow it to hang out the rear of the boom.
11. Coat the threads of the threaded clevis (**6**) with multi-purpose grease.

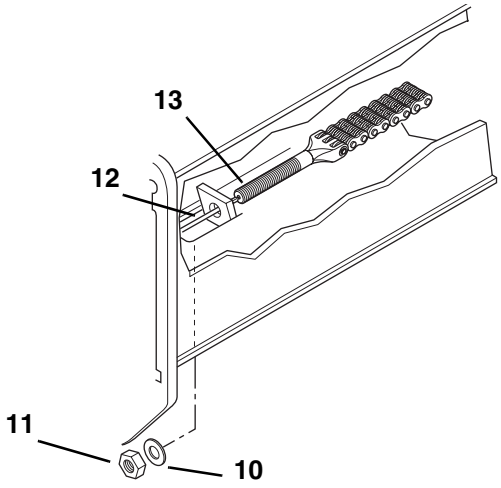
Note: *Have a second person help with the installation of the new secondary intermediate boom retract chain in between primary intermediate and outer boom assemblies.*

12. At the rear of the boom, attach the string, wire or rod to the retract chain threaded clevis end (**6**).
13. From the rear of the boom, a person should push the threaded clevis end (**6**) of the new retract chain (**7**) under the chain sheave and down between the intermediate boom and the outer boom, while another person pulls the retract chain through the boom using the previously attached string or wire (**9**). If the string or wire was attached to the clevis, the person at the front of the boom can guide the clevis through tab (**8**) using a Phillips screwdriver (**12**). Insert the screwdriver though the tab and catch the countersunk hole (**13**) in the end of the clevis. Guide the threaded clevis out as the person at the rear of the boom pushes the retract chain. Keep the retract chain (**7**) to the right side of the boom, push and pull the threaded clevis down to the tab (**8**) at the front underside of the outer boom.



MH4630

14. Reassemble the flat washer (**10**), saved, and a new elastic locknut (**11**) onto the threaded clevis. Tighten the locknut until the threaded end of the clevis is flush with the top of the locknut.



MH2560

15. At the rear of the boom, place the retract chain (**5**) up and over the chain sheave (**2**). Place the clevis between the two anchor plates (**1**). Line up the hole in the clevis with the anchor plate hole position recorded during removal.

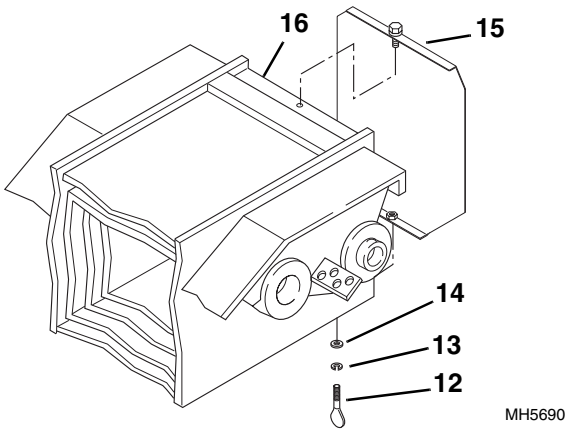
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

16. Insert the shoulder bolt (**4**), saved, through the plates and clevis and secure in place with a new elastic locknut (**3**). Tighten the locknut securely.

17. Check and adjust the secondary intermediate boom retract chain tension. (Refer to Section 3.7.3, “Boom Chain Tension Check.”)

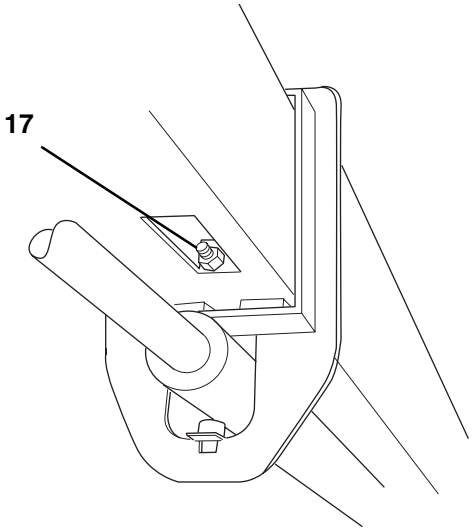
d. Inner Boom Retract Chain Removal and Replacement

1. Park the vehicle on a hard, level surface.
2. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
3. Remove the thumbscrew (**12**), lockwasher (**13**) and flat washer (**14**) holding the rear cover (**15**) to the rear of the outer boom (**16**). Lift the rear cover straight up until the capscrew in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.



MH5690

4. Start the engine and extend the boom until the inner boom retract chain adjustment nut (**17**) on the bottom of the primary intermediate boom is visible. Shut the engine OFF.
5. At the front underside of the boom, locate the intermediate boom retract chain elastic locknut (**17**). Record the amount of threads extending beyond the elastic locknut. This measurement will be the starting point for adjustment of the retract chain after installation.
6. Loosen the elastic locknut (**17**) on the inner boom retract chain clevis. **DO NOT** remove the elastic locknut at this time, but loosen the nut as far as possible to gain as much slack as possible in the retract chain.

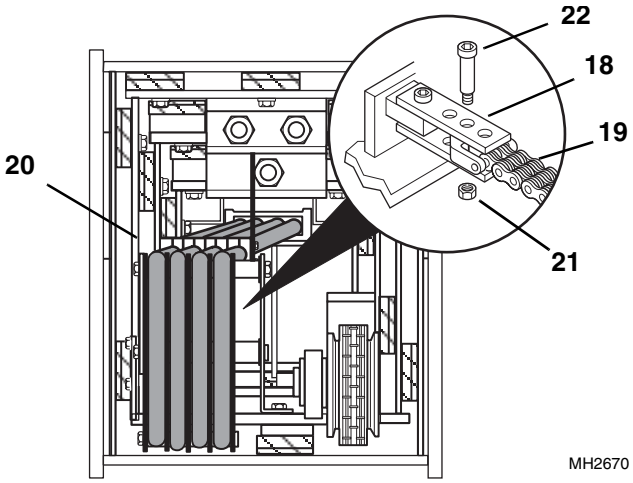


OH0660

7. Return to the operator’s cab, start the engine and slowly retract the boom all the way back, and then extend the boom approximately 1" (25 mm) or just until all the tension on the inner boom retract chain is relieved. Shut the engine OFF.

Note: *Record the location of the shoulder bolt to ensure correct installation.*

8. At the rear of the boom, locate the two retract chain anchor plates (**18**) holding the inner boom retract chain (**19**) to the inner boom, just in front of the hose reel assembly (**20**). Remove the elastic locknut (**21**) and shoulder bolt (**22**) holding the inner boom retract chain clevis to the anchor plates. Discard the elastic locknut and save the shoulder bolt. The two anchor plates can remain in place on the inner boom.

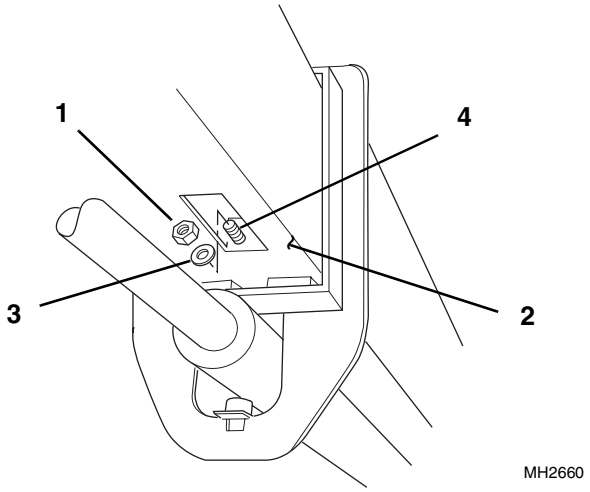


MH2670

9. Pull the inner boom retract chain clevis toward the rear of the boom, through the middle of the two center hoses on the chain reel and over the top of the chain reel. Let the clevis end of the retract chain hang out the rear of the boom. Use a piece of 17 gauge wire that is approximately 6 feet long and tie it to the clevis end of the inner boom retract chain. This wire will be used to guide the chain back into the boom when the boom is extended to expose the other end for removal.

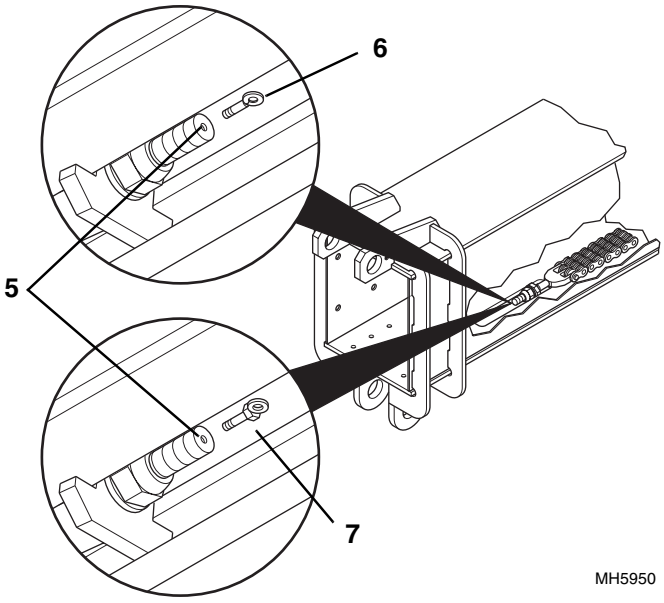
Note: *Have a second person help with the installation of the retract chain between the primary and secondary intermediate boom assemblies.*

10. One person should start the engine, slowly extend the boom while the second person guides the inner boom retract chain with the wire attached into the back of the boom. Extend the boom until the inner boom retract chain adjustment nut (**1**) on the lower left side of the primary intermediate boom (**2**) can be accessed and removed. Turn the engine OFF.



MH2660

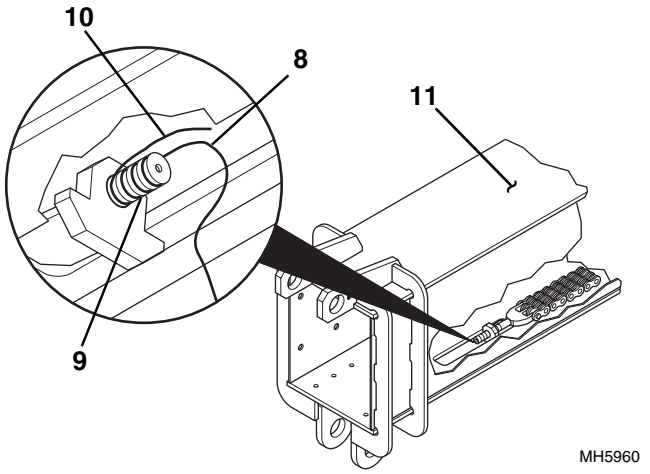
11. If the chain clevis has a threaded hole on the end (**5**), 17 gauge wire can be attached to the retract chain clevis using a threaded eye (**6**) or a flat washer tack welded to a capscrew (**7**). The outside diameter of the eye or flat washer must be smaller than the diameter of the threads on the clevis.
12. Remove the elastic locknut (**1**) and flat washer (**3**) holding the threaded clevis (**4**) on the inner boom retract chain to the tab in the primary intermediate boom. Save the flat washer and discard the elastic locknut.



MH5950

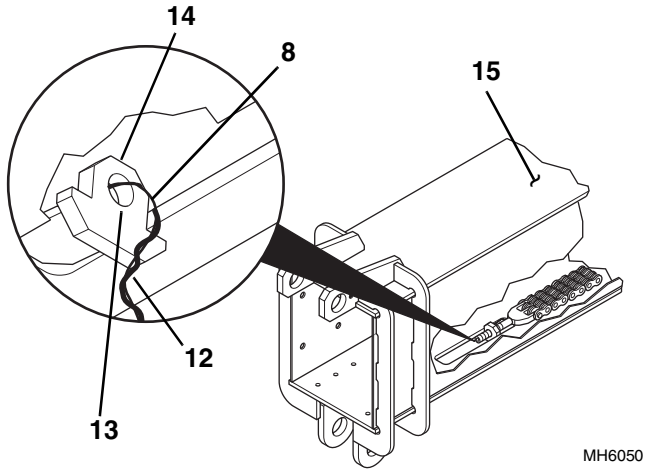
13. If a threaded eye or capscrew with flat washer was installed in step 7, attach a 17 gauge wire to the end of the retract chain clevis. The wire must be long enough to pull the clevis and chain through the outer boom. The wire must be heavy enough, 17 gauge or heavier, to pull the weight of the entire chain back through the boom during the reassembly.

    If there is no threaded hole on the end of the clevis, a tow wire and guide wire will need to be attached to the clevis before pulling the chain out of the boom. The tow wire must be long enough to pull the clevis and chain through the length of the primary intermediate boom and must be heavy enough, 17 gauge or heavier, to pull the weight of the entire chain back through the boom during the reassembly. The guide wire is used only to pull the tow wire through the boom to be used for installing the new chain.



MH5960

Wrap 24 gauge steel wire (**8**) tightly into the threads of the clevis (**9**). Start the coils as close to the tab as possible. Make sure the end (**10**) has enough of a tail to wrap into a knot at the top of the clevis. Push the clevis (**9**) and guide wire (**8**) into the primary intermediate boom (**11**), so that only the guide wire is hanging out of the tab.



Twist the tow wire (**12**), 17 gauge or heavier, securely onto the guide wire (**8**). This will allow the tow wire to be pulled back through the hole (**13**) in the tab (**14**) on the primary intermediate boom (**15**) along with the guide wire attached to the chain clevis.

14. From the rear of the boom, using the wire attached to the rear anchor clevis, pull the inner boom retract chain through the middle of the two center hoses on the chain reel and over the top of the chain reel and out of the rear of the boom.

If a threaded eye or capscrew with flat washer was installed to the end of the clevis:

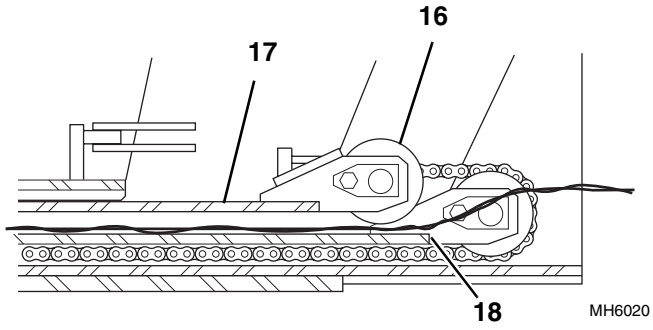
15. Remove the threaded eye (**6**) or capscrew with flat washer (**7**), with the 17 gauge wire still attached, from the clevis on the old chain.
16. Install the threaded eye or capscrew with flat washer, with the 17 gauge wire still attached, to the new chain clevis.

If no threaded eye or capscrew with flat washer was installed to the end of the clevis:

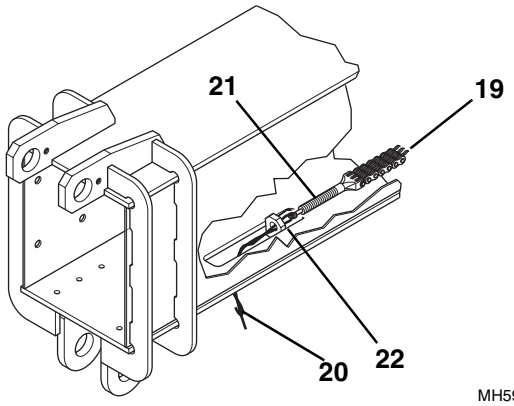
17. Remove the 17 gauge tow wire (**12**) from the guide wire (**8**) attached to the clevis on the old chain.
18. Install a threaded eye or capscrew with flat washer into the threaded hole in the end of the clevis on the new chain.
19. Attach the tow wire (**12**) to the threaded eye or capscrew with flat washer, installed on the new chain.

Once the 17 gauge wire is installed to the end of the clevis of the new chain:

20. Remove the 6 foot piece of wire attached to the rear anchor clevis of the old chain and attach it to the rear anchor clevis of the new chain.
21. Coat the threads of the threaded clevis on the new chain with multi-purpose grease.
22. Have a second person assist with the next steps. From the front of the boom, one person should pull on the tow wire (**12**) while the person at the rear of the boom guides the chain clevis between the two center hoses of the hose reel and under the chain sheave (**16**), on the left side of the boom (in front of the hose reel assembly not shown for clarity) and down the boom between the secondary intermediate boom (**17**) and the primary intermediate boom (**18**).



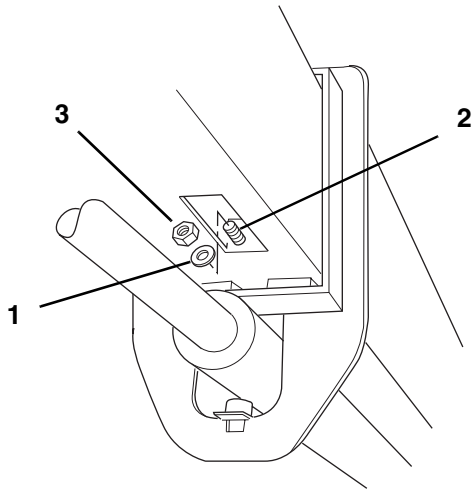
23. The person at the back of the boom should keep the retract chain (**19**) lined up squarely with the chain sheave and help feed the retract chain in while the second person pulls on the wire (**20**) from the front of the boom.
24. The person at the front of the boom should guide the threaded end of the clevis (**21**) through the hole in the tab (**22**) on the primary intermediate boom.



25. Remove the wire, and the threaded eye or capscrew with flat washer, from the end of the clevis.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

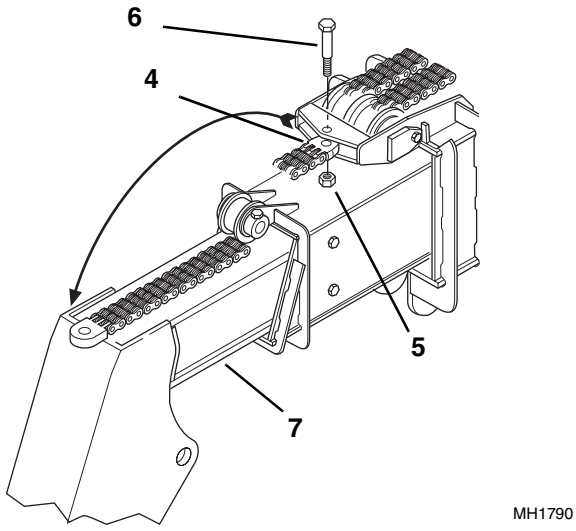
26. Place the flat washer (**1**), saved, onto the threaded clevis (**2**). Assemble a new elastic locknut (**3**) onto the threaded clevis. Turn the elastic locknut only 2 or 3 turns onto the clevis to allow assembly of the other end of the retract chain.



MH2660

27. At the front of the boom, disconnect the inner boom extend chain clevis (**13**) from the anchor plates on the primary intermediate boom. Remove the elastic locknut (**14**) holding the shoulder bolt (**15**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the inner boom (**16**). Save the shoulder bolt and discard the elastic locknut.
28. Return to the operator's compartment and start the engine and slowly retract the boom. To avoid having the inner boom retract chain becoming entangled, keep tension on the chain coming out the back of the boom. Retract the boom as far as possible with the extend/retract cylinder. Turn the engine OFF.
29. The inner boom will not retract completely and must be manually pushed in. To avoid having the inner boom retract chain becoming entangled, keep tension on the chain coming out the back of the boom while the inner boom is pushed in.

IMPORTANT: *Care should be taken not to push the inner boom in too far. If the inner boom is pushed in too far it could damage the hose reel at the back of the boom.*

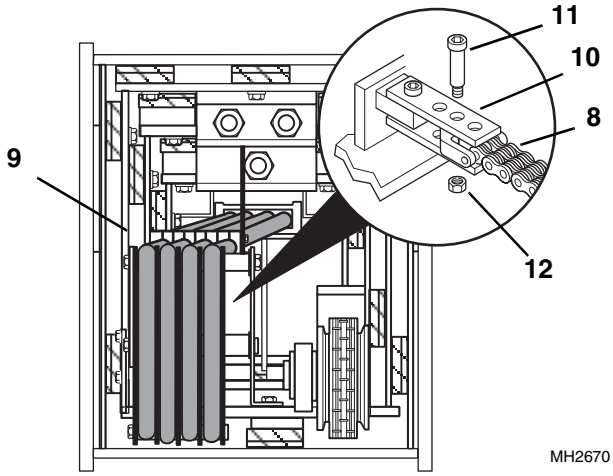


MH1790

30. Remove the wire from the anchor clevis at the rear of the boom. At the rear of the boom, place the retract chain (**8**) up and over the chain sheave in front of the hose reel assembly (**9**). Place the clevis between the two anchor plates (**10**). Line up the hole in the clevis with the anchor plate hole position recorded during removal.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

31. Insert the shoulder bolt (**11**), saved, through the plates and clevis and secure in place with a new elastic locknut (**12**). Tighten the locknut securely.

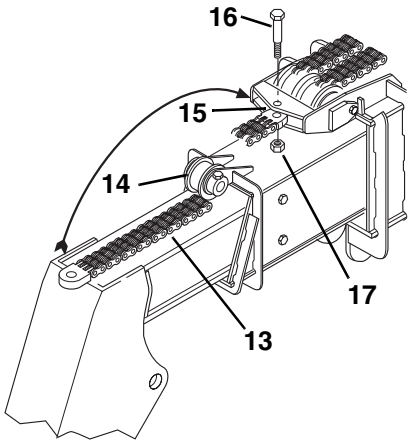


MH2670

32. Pull the inner boom extend chain (**1**) up and around the sheave (**2**) at the front of the secondary intermediate boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

33. Place the extend chain clevis (**3**) between the mounting plates at the front of the secondary intermediate boom. Coat the saved shoulder bolt (**4**) with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a new elastic locknut (**5**). Tighten securely, but the chain clevis should pivot freely.



MH2520

34. Return to the operator's compartment and start the engine. Slowly extend the boom to gain access to the inner boom retract chain adjustment nut (**3**) on the lower left side of the primary intermediate boom. Shut the engine OFF.
35. Tighten the adjustment nut until the threads of the threaded clevis are flush with the top edge of the nut. This will be a starting point for adjustment of the inner boom retract chain.
36. Check and adjust the inner boom retract chain tension. (Refer to Section 3.7.3, "Boom Chain Tension Check.")

3.8 HOSE CARRIER ASSEMBLY - FOUR SECTION BOOM (10054)

3.8.1 Hose Carrier Assembly Removal

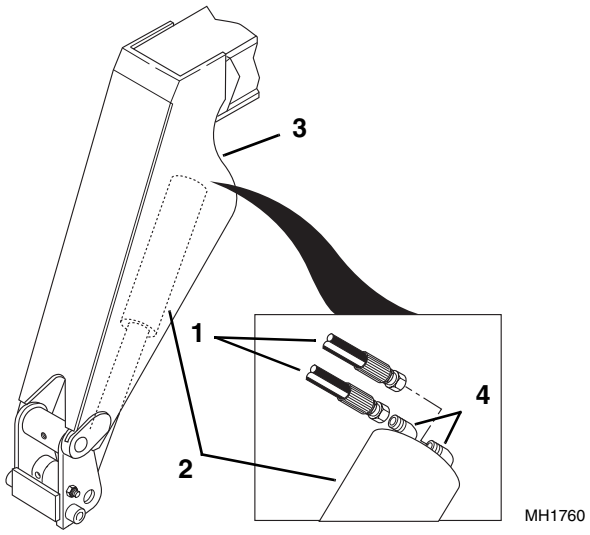
1. Remove any attachment from the quick attach assembly. (Refer to Section 3.10.1, "Disconnecting from an Attachment.")

> **WARNING:** Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot injury from falling objects or other bodily injury from slipping or falling.

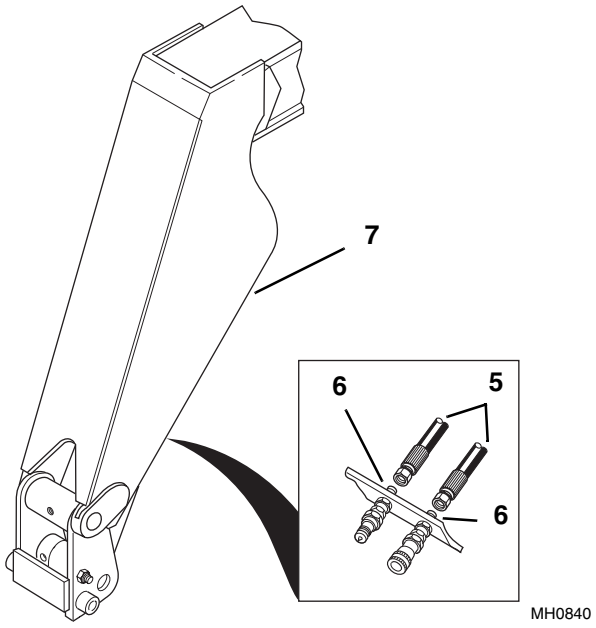
> **WARNING:** **NEVER** lift a heavy object without the help of an assistant or a suitable sling and hoist. Failure to comply can result in serious personal injury.

2. Park the vehicle on a hard, level surface. Be sure there is enough room in front of the vehicle to allow the inner boom section to be removed from the front of the boom assembly.
3. Fully retract the boom and raise the boom to a horizontal position. Place the travel select lever in (N) NEUTRAL, move the neutral lock lever to NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF. Allow the hydraulic oil to cool before proceeding.
4. Move the Attachment Tilt joystick in both directions to relieve any trapped pressure in the Attachment Tilt system. Move the auxiliary hydraulic joystick in both directions to relieve any trapped pressure in the auxiliary hydraulic system.

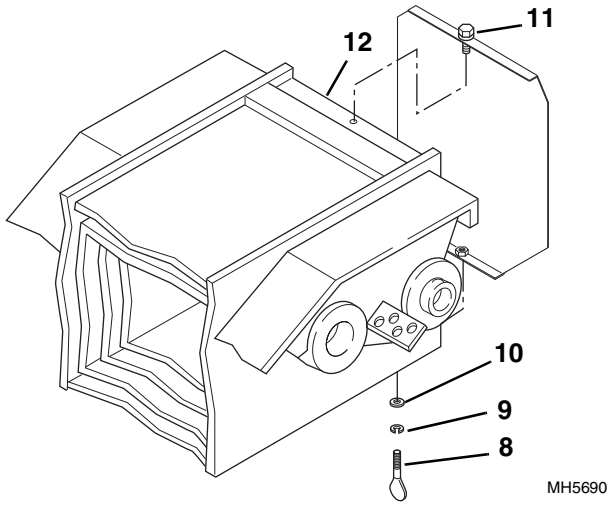
5. Locate the two hoses (**1**) attached to the base of the Attachment Tilt cylinder (**2**) inside the gooseneck (**3**).
6. Label and remove the hoses (**1**) from the elbow fittings (**4**) on the Attachment Tilt cylinder. Plug the hose ends and cap the elbow fittings on the Attachment Tilt cylinder to prevent dirt and debris from entering the hydraulic system and/or cylinder.



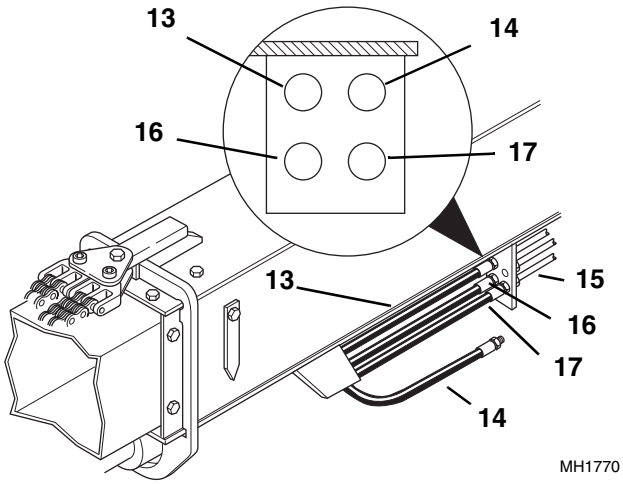
7. Label and remove the two auxiliary hydraulic hoses (**5**) from the bulkhead fittings (**6**) inside the gooseneck (**7**). Plug the hose ends and cap the bulkhead fittings to prevent dirt and debris from entering the hydraulic system.



8. Remove the thumbscrew (**8**), lockwasher (**9**) and flat washer (**10**) holding the rear cover to the rear of the outer boom (**12**). Lift the rear cover straight up until the capscrew (**11**) in the top of the cover clears the retaining hole in the top of the outer boom. Remove the cover from the outer boom.

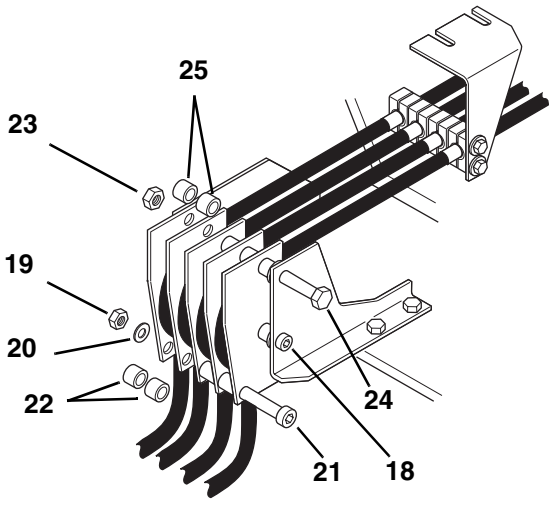


9. At the front of the outer boom, label and remove the Attachment Tilt hoses (**13** and **14**) from the tube assemblies (**15**) at the mounting plate. Cap the hose ends. Tie a string to each of the hoses to aid in the installation of the new hoses.



10. Label and remove the auxiliary hoses (**16** and **17**) from the tube assemblies (**15**) at the mounting plate. Cap the hose ends. Tie a string to each of the hoses to aid in the installation of the new hoses.
11. Label and remove the four hoses from the hose reel. The center bolt (**18**) can remain in place to hold the hose reel and side plates together.
12. Remove the elastic locknut (**19**) and flat washer (**20**) from the lower retaining shoulder bolt (**21**). While pulling the shoulder bolt out, catch the spacers (**22**) from between the plates as the bolt is removed. Pull the bolt out far enough to remove the hoses from the hose reel.
13. Pull the four hoses from the lower part of the hose reel out from between the outer boom and the primary intermediate boom sections. Remove the strings from the hoses, but leave the strings inside the boom. Carefully lay the hoses out behind the back of the boom.

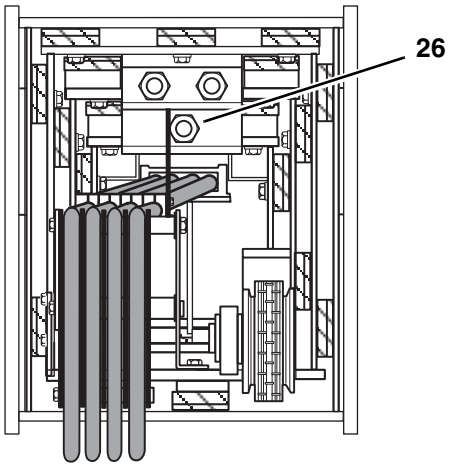
    After the hoses are removed from between the outer and primary intermediate boom sections, insert the shoulder bolt (**21**) through the plates, inserting the spacers (**22**) between the plates as the bolt is inserted. Reassemble the flat washer (**20**) and elastic locknut (**19**) to hold the shoulder bolt in place; **DO NOT** fully tighten at this time.



MH1690

14. Remove the elastic locknut (**23**) from the upper retaining capscrew (**24**). While pulling the capscrew out, catch the spacers (**25**) from between the plates as the capscrew is removed. Pull the capscrew out far enough in order to remove the hoses from the hose reel.

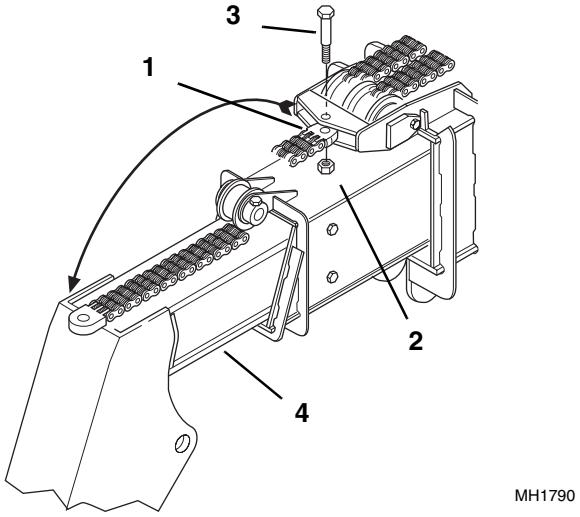
    After the hoses are removed, insert the capscrew (**24**) through the plates, inserting the spacers (**25**) between the plates as the capscrew is inserted. Reassemble the elastic locknut (**23**) to hold the capscrew in place; **DO NOT** fully tighten.
15. At the rear of the boom, locate the inner boom extend chain locknut (**26**). Measure the amount of threads protruding beyond the elastic locknut and record that measurement for reassembly.
16. Using a 1-7/16" socket and a 12" extension, loosen the elastic locknut (**26**) until the nut is held on by a couple of threads. **DO NOT** remove the elastic locknut at this time.



MH1780

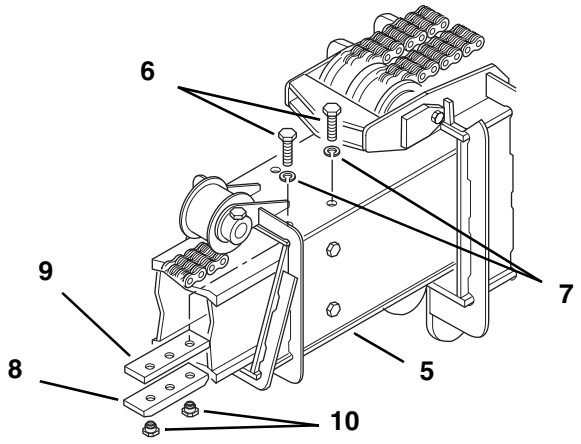
17. Return to the operator's cab, start the engine and extend the boom approximately 2" (51 mm). Retract the boom slightly until there is slack in the inner boom extend chain. Shut the engine OFF.

18. At the front of the boom, disconnect the inner boom extend chain clevis (**1**) from the anchor plates on the primary intermediate boom. Remove the elastic locknut (**2**) holding the shoulder bolt (**3**) to the anchor plates. Pull the extend chain clevis from between the plates and lay over the front of the inner boom (**4**). Save the shoulder bolt and discard the elastic locknut.



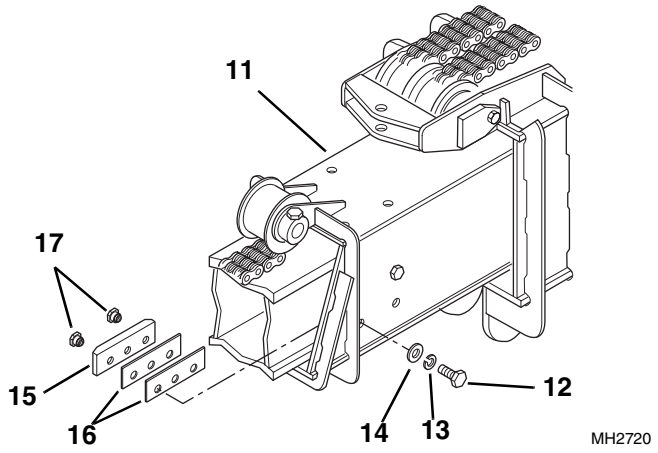
MH1790

19. At the front of the secondary intermediate boom (**5**), remove the capscrews (**6**) and lockwashers (**7**) holding the top wear pads (**8**) and spacers (**9**) to the inside of the secondary intermediate boom. Label the wear pads and spacers as “Secondary Intermediate Top Left” and “Secondary Intermediate Top Right” sides. Save the spacers, capscrews, lockwashers and wear pad inserts (**10**).



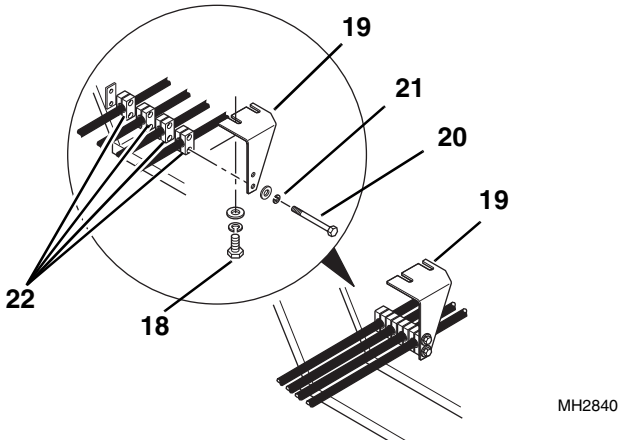
MH2710

20. At the front of the secondary intermediate boom (**11**), remove the capscrews (**12**), lockwashers (**13**) and flat washers (**14**) holding the side wear pads (**15**) and shims (**16**) to the inside of the secondary intermediate boom. Label the wear pads and shims as “Secondary Intermediate Left Upper/Lower” and “Secondary Intermediate Right Upper/Lower”. Save the shims, capscrews, flat washers, lockwashers and wear pad inserts (**17**).



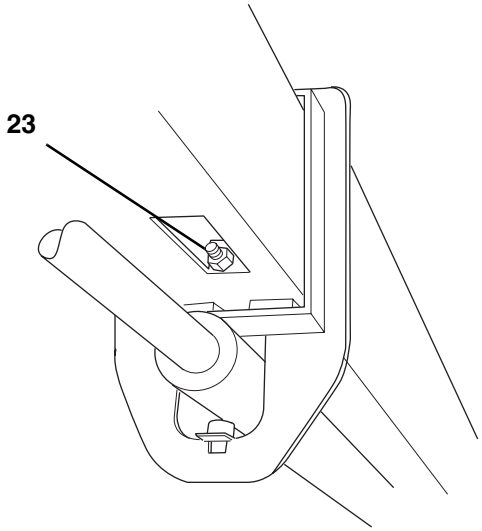
MH2720

21. Inspect all wear pads for wear. (Refer to Section 3.9.1, “Wear Pad Inspection.”)
22. Inside the secondary intermediate boom, loosen, but **DO NOT** remove the two capscrews (**18**) securing the upper left side wear pad and hose clamp support bracket (**19**) to the top of the secondary intermediate boom.
23. Remove the two capscrews (**20**) and lockwashers (**22**) holding the stack clamps (**22**) and hose clamp support bracket (**18**) to the left side of the secondary intermediate boom. Remove the clamps and the clamp support bracket from the secondary intermediate boom.



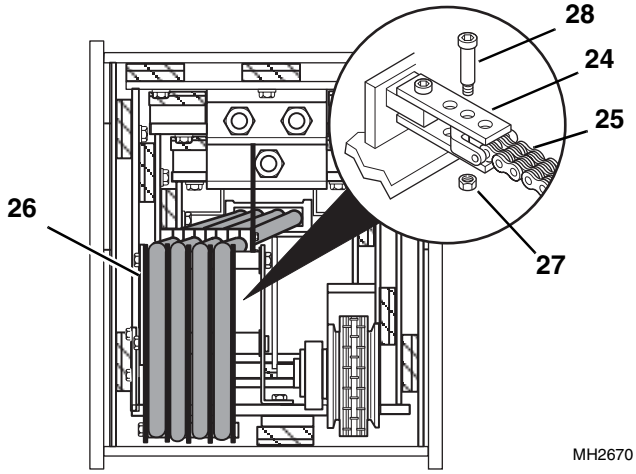
MH2840

24. Start the engine and extend the boom until the inner boom retract chain adjustment nut (**23**) on the bottom of the primary intermediate boom is visible. Shut the engine OFF.
25. Loosen the elastic locknut (**23**) on the inner boom retract chain clevis. **DO NOT** remove the elastic locknut at this time, but loosen the nut as far as possible to gain as much slack as possible in the retract chain.



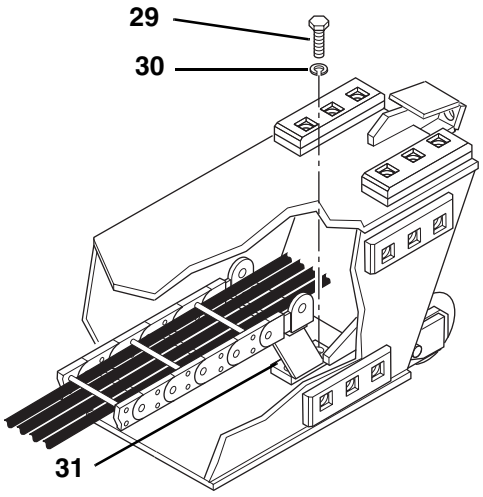
OH0660

26. Return to the operator's cab, start the engine and slowly retract the boom all the way back and then extend the boom approximately 1" (25 mm) or just until all the tension on the inner boom retract chain is relieved. Shut the engine OFF.
27. At the rear of the boom, locate the two retract chain anchor plates (**24**) holding the inner boom retract chain (**25**) to the inner boom, just in front of the hose reel assembly (**26**). Remove the elastic locknut (**27**) and shoulder bolt (**28**) holding the inner boom retract chain clevis to the anchor plates. Discard the elastic locknut and save the shoulder bolt. The two anchor plates can remain in place on the inner boom.



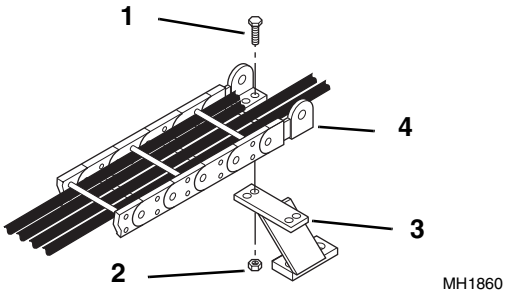
MH2670

28. Remove the two capscrews (**29**) and lockwashers (**30**) holding the hose carrier support (**31**) and the lower wear pad to the secondary intermediate boom.
29. Pull the hose carrier support with the hose carrier attached toward the rear of the boom. Reinstall the capscrews (**29**) and lockwashers (**30**) back through the holes in the bottom of the secondary intermediate boom to hold the wear pad in place. **DO NOT** fully tighten the capscrews.

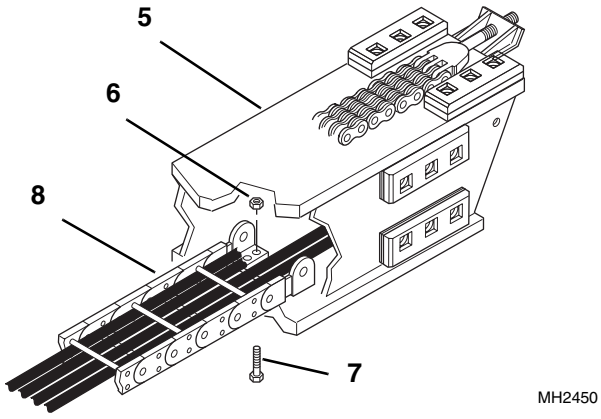


MH1850

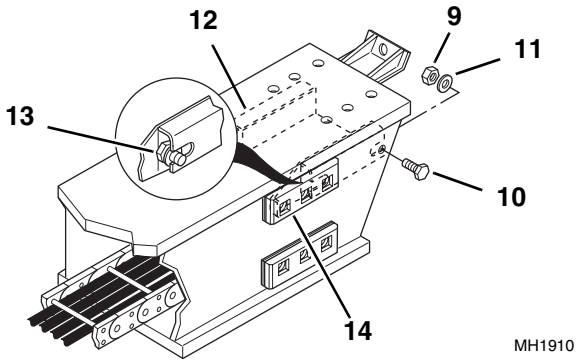
30. Remove the four capscrews (**1**) and locknuts (**2**) holding the hose carrier support (**3**) to the hose carrier (**4**). To access the capscrews, it will be necessary to move the hoses to the side. Save the capscrews and hose carrier support. Discard the locknuts.



31. Pull the inner boom straight out of the secondary intermediate boom. Guide the four hose ends into the rear of the boom as the inner boom is being removed. Reposition the slings as needed so that the inner boom balances when removed from the secondary intermediate boom. Set the inner boom down on a hard, level surface. Support the boom as needed to prevent it from tipping over.
32. Inside the rear of the inner boom (**5**), remove the four elastic locknuts (**6**) and capscrews (**7**) holding the hose carrier assembly (**8**) to the bottom of the inner boom. Save the capscrews and discard the locknuts.

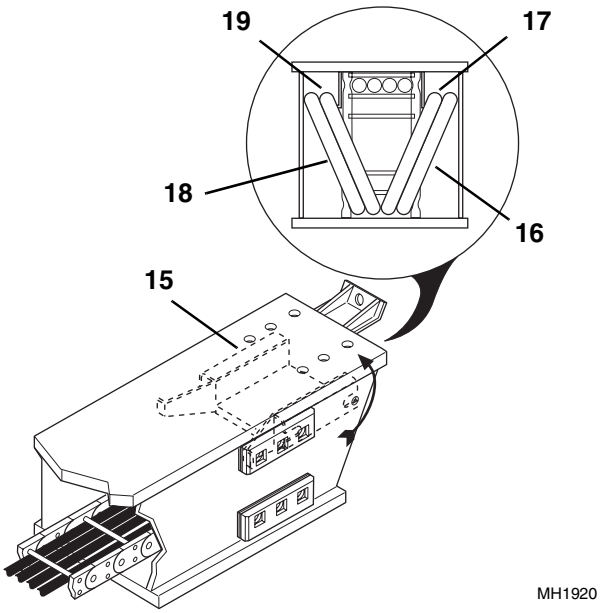


33. On each side of the inner boom, remove the rear elastic locknuts (**9**), capscrews (**10**) and flat washers (**11**) holding the rear of the hose carrier guide (**12**) in place. Save the capscrews and flat washers. Discard the locknuts.
34. Loosen, but **DO NOT** remove the capscrews (**13**) holding the front of the hose carrier guide and the top wear pad (**14**) to each side of the inner boom.

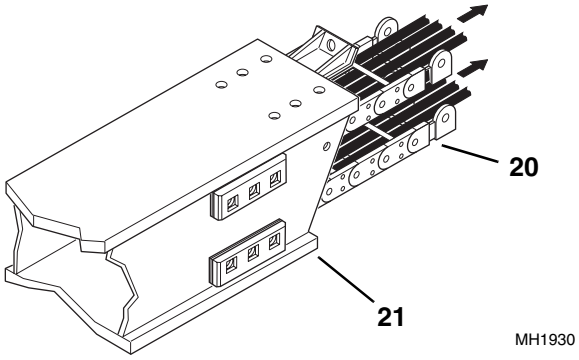


Note: *Record the hose locations before removing them from the hose carrier assembly, to ensure correct installation.*

35. Tilt the back of the hose carrier guide (**15**) up. Use a light to look inside the inner boom, and note which hoses go into which channels on either side of the boom:
    a. Right side outer hose (**16**) goes to “Auxiliary Female Coupler” and the right side inner hose (**17**) goes to “Attachment Tilt Extend.”
    b. Left side outer hose (**18**) goes to “Auxiliary Male Nipple” and the left side inner hose (**19**) goes to “Attachment Tilt Retract.”
36. Hold the rear of the hose carrier guide up, pull the hoses from the channels inside the inner boom. Lay the hoses out behind the inner boom.
37. After the hoses are removed from the boom, remove the hose carrier guide (**15**) by pulling the guide out the back of the boom.



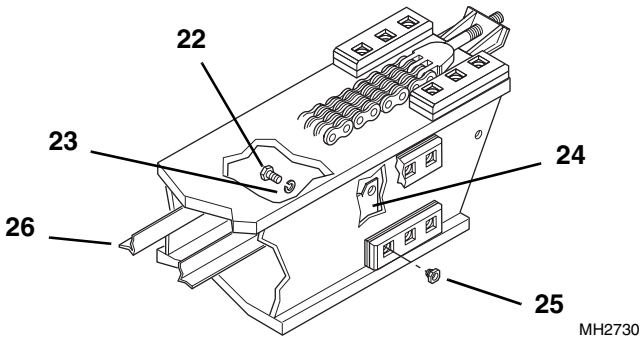
38. Remove the hose carrier assembly (**20**) from the inner boom by carefully pulling the hose carrier straight out the rear of the inner boom (**21**). Pull both the upper and lower portion of the hose carrier assembly out at the same time.



39. Use a light to inspect the hose channel assembly inside the inner boom. If no damage is noted, proceed to Section 3.8.2, “Hose Carrier Assembly Replacement.”

    If the hose channel assembly is damaged, remove and disassemble the channel assembly.

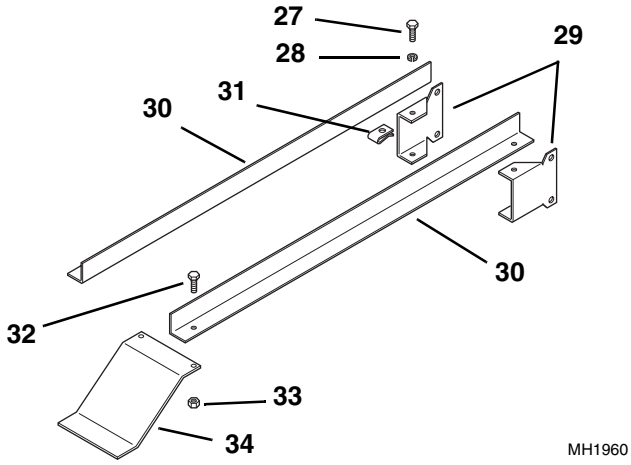
40. Remove the capscrews (**22**) and lockwashers (**23**) holding the hose channel assembly mounting clips (**24**) to the sides of the inner boom. Remove only the capscrews holding the hose channel assembly mounting clips to the boom. The rear wear pad mounting bolts can remain in place. Save the capscrews, lockwashers and wear pad inserts (**25**).



41. Carefully slide the hose channel assembly out the rear of the inner boom.

42. Disassemble the hose channel assembly to replace any parts that are bent, twisted or damaged. Remove the capscrews (**27**) and lockwashers (**28**) holding the mounting clips (**29**) to the channels (**30**). Remove the retainer nuts (**31**) from the mounting clips.

43. At the front of the hose channel assembly, remove the capscrews (**32**) and elastic locknuts (**33**) holding the channels to the front guide (**34**). Save all hardware and discard the elastic locknuts. Replace any damaged parts with new parts and reassemble the hose channel assembly.



44. Carefully slide the hose channel assembly (**26**) into the rear of the inner boom.

45. Apply Loctite® 242 threadlocker to the threads of the capscrews (**22**), saved. Insert a capscrew with a lockwasher (**23**), saved, through the lower hole in the mounting clip (**24**) and the front mounting hole of the lower wear pad in the side plates of the inner boom.

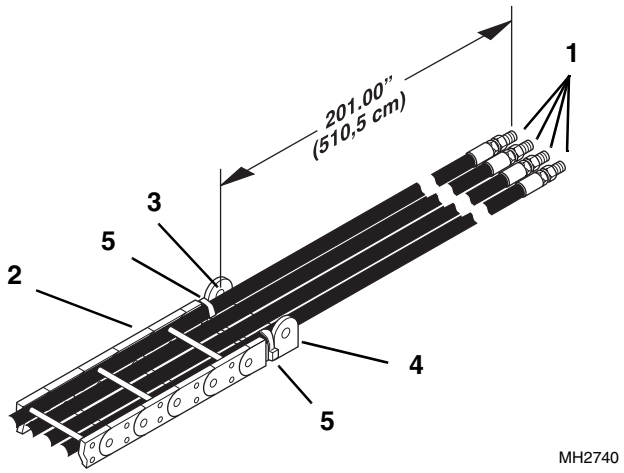
46. Place the wear pad inserts (**25**), saved, into the wear pad cavity. Be careful not to push the wear pad inserts out of the wear pad.

47. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).

48. Repeat Steps 45 thru 47 to install the upper mounting capscrews on both sides.

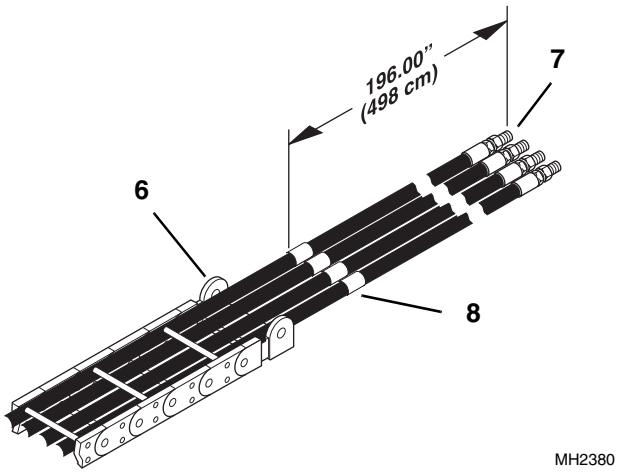
3.8.2 Hose Carrier Assembly Replacement

1. Carefully lay the new hose carrier assembly out flat on a hard surface.
2. Stretch the “male” ends (**1**) of the hoses out straight from the end of the hose carrier assembly (**2**). Measure back from the end of the “male” end of each hose to the center of the pivot point (**3**) of the hose carrier mount (**4**). This measurement should be 201" (510,5 cm). All four hoses MUST be equal in length from the hose carrier.
3. If the hoses are not equal in length or not to the specified dimension, the hoses must be repositioned in the hose carrier assembly. Cut the tie wraps (**5**) holding the hoses to the hose carrier and reposition the hoses as required in either direction. Be sure all the hoses are to the specified dimension and assemble new tie wraps back in place.



MH2740

4. With the hose carrier assembly (**6**) laid out flat on a level surface, stretch the four “male” ends of the hoses out straight from the hose carrier assembly. Measure from the end of the male end (**7**) of each hose back toward the hose carrier assembly 196" (498 cm) and apply tape (**8**) around each hose at that point. The tape is for proper tensioning of the hoses during reassembly of the hose clamps.

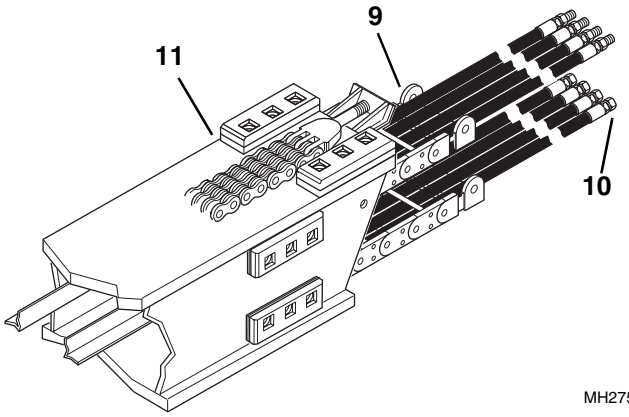


MH2380

5. Fold the new hose carrier assembly (**9**) in half and slide into the inner boom. Be careful while folding the hose carrier in half.

IMPORTANT: *The hose carrier only folds one way,* ***DO NOT*** *force it.* ***DO NOT*** *twist the hose carrier while folding.*

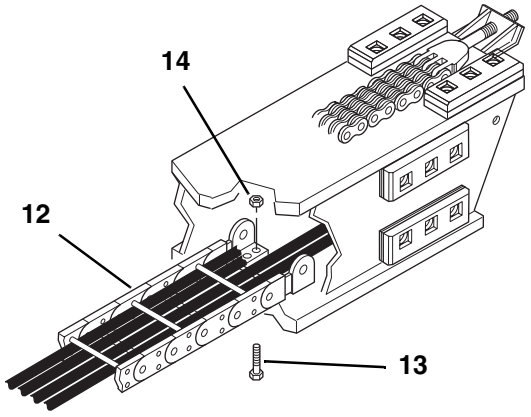
6. Ensure the “female” ends (**10**) of the hoses are on the bottom and carefully slide the folded hose carrier into the inner boom (**11**). Guide the hose carrier assembly in between the channels of the hose channel assembly.



MH2750

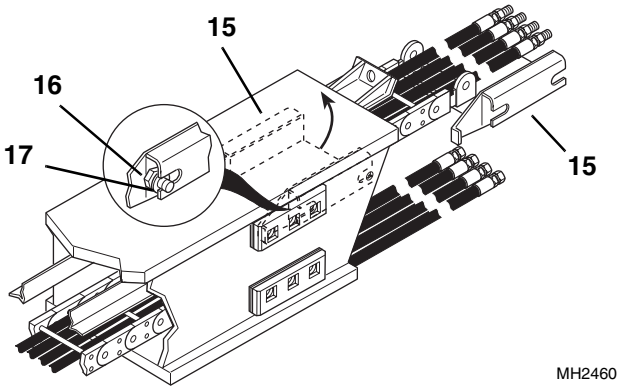
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

7. Line up the lower mounting holes in the hose carrier assembly (**12**) with the holes in the bottom of the inner boom. Insert the four capscrews (**13**), saved, through the bottom boom plate and up through the hose carrier mounts. Secure the capscrews in place with new elastic locknuts (**14**). Tighten all four locknuts securely.



MH2450

8. Lift up the upper part of the hose carrier assembly and place the hose carrier guide (**15**) under the hose carrier with the angled guides toward the front. Slide the hose guide into the inner boom and place the front notches onto the rear wear pad mounting capscrew (**16**). Be sure the notch in the side of the hose guide is under the flat washer (**17**) on each side of the boom.
9. Rotate the back of the hose guide up toward the top of the inner boom as far as it will go. Tighten the rear wear pad mounting capscrews (**16**) only enough to hold the hose guide in this position.

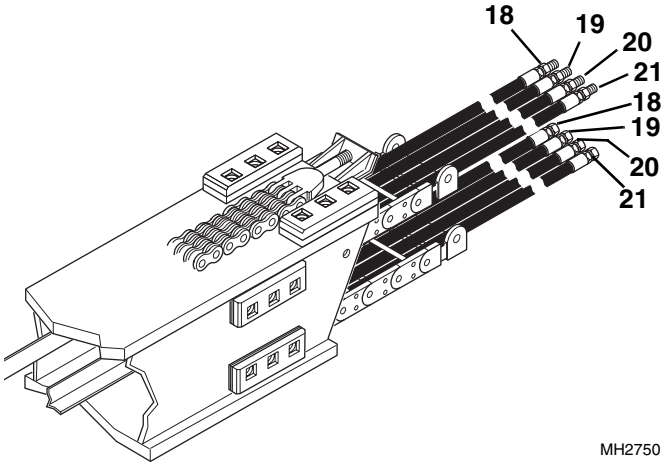


MH2460

10. Label each end of the hoses of the new hose carrier assembly for proper identification during reassembly:

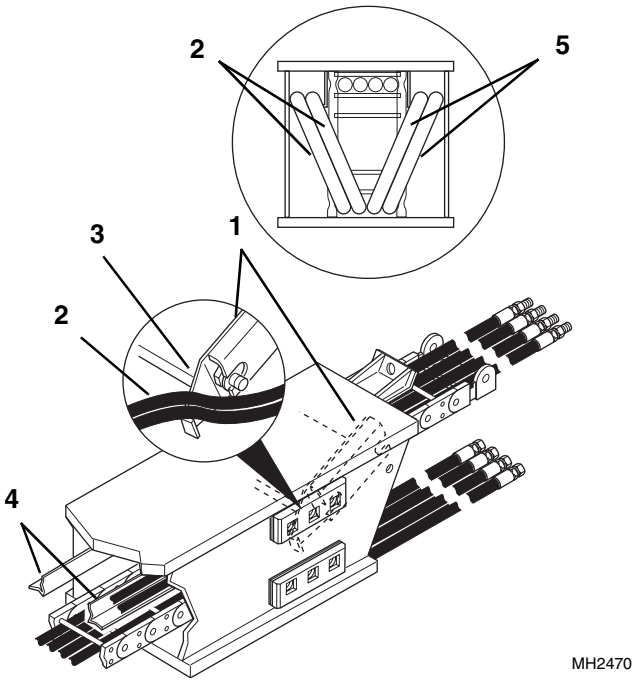
    Right side outer hose (**18**) goes to “Auxiliary Female Coupler” and the right side inner hose (**19**) goes to “Attachment Tilt Extend.”

    Left side outer hose (**20**) goes to “Auxiliary Male Nipple” and the left side inner hose (**21**) goes to “Attachment Tilt Retract.”



MH2750

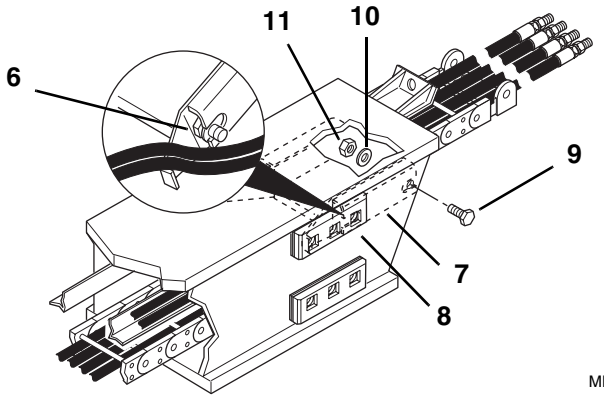
11. With the hose guide (**1**) tilted up in the back, insert the female ends of the two left side hoses (**2**) (from the hose carrier) one at a time over the top of the angled guide (**3**) on the front side of the hose guide. Push the hoses into the hose channel (**4**) on the left side of the inner boom and down to the front of the inner boom. Repeat this procedure to insert the two right side hoses (**5**) into the hose channel on the right side of the inner boom.



12. Loosen the wear pad mounting bolts (**6**) holding the hose guide (**7**) and wear pads (**8**) to the side of the inner boom. Remove the wear pad mounting bolts (one at a time) with washers.
13. Apply Loctite® 242 threadlocker to the threads of the the hose guide and wear pad mounting bolt (**6**). Reinsert the bolts with washers but **DO NOT** fully tighten. Swing the back of the hose guide down to line up the rear notches with the holes in each side of the inner boom.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

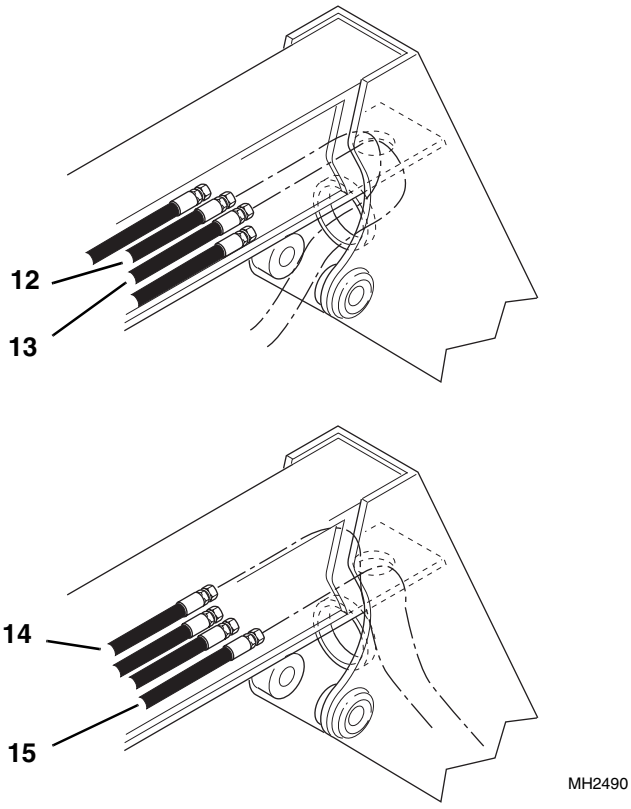
14. Insert a capscrew (**9**), saved, through the hole in the inner boom. Secure the hose guide in place with a flat washer (**10**), saved, and a new elastic locknut (**11**). Tighten securely.
15. Tighten the wear pad and hose guide capscrews. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



16. Run the hose carrier out and in by hand to check for interference.

***IMPORTANT: DO NOT** allow the hoses to cross inside the inner boom.*

17. At the front of the inner boom, pull the two hoses that were labeled “Attachment Tilt - Retract” (**12**) left side and “Attachment Tilt - Extend” (**13**) right side out of the opening in the back of the gooseneck. Let the hoses hang out of the back of the gooseneck.
18. At the front of the inner boom, pull the two hoses that were labeled “Auxiliary - Female Coupler” (**14**) left side and “Auxiliary - Male Nipple” (**15**) right side out the opening in the gooseneck and down to the bulkhead plate where the auxiliary hydraulic couplers are to be mounted. Let the hoses hang inside the gooseneck.



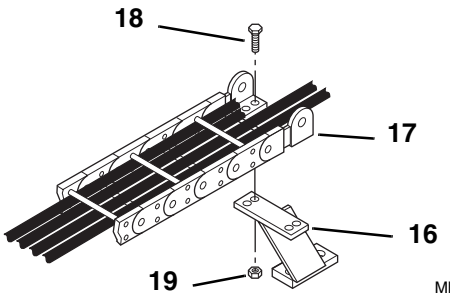
MH2490

e. Reassemble Inner Boom

1. Spray the wear pad pathways on the underside of the inner boom with LPS3 or equivalent.
2. Lift the inner boom up. While guiding the hoses into the secondary intermediate boom, carefully slide the inner boom into the front of the secondary intermediate boom.
3. Have a second person guide the “male” ends of the four hoses from the hose carrier into the secondary intermediate boom. Have the second person pull the hoses out the rear of the boom as the inner boom is being inserted.
4. Reassemble the hose carrier support (**16**), saved, to the hose carrier (**17**). Inside the inner boom, pull the hose carrier out enough to gain access to the mounting pivot on the end of the carrier.
5. With the lower mounting plate on the hose carrier support (**16**) on the right side, line up the four holes in the top plate with the holes in the pivot mount of the hose carrier (**17**).

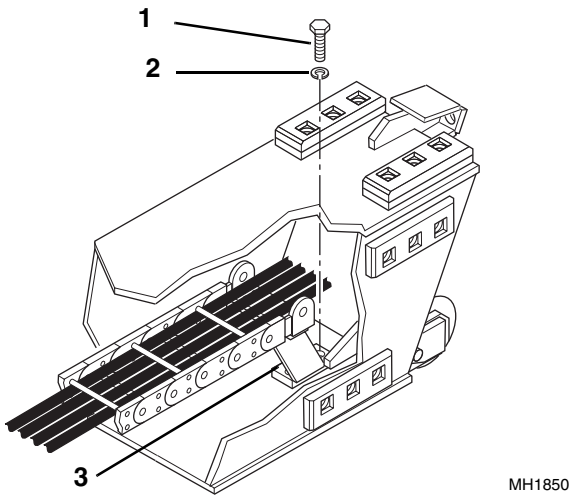
***Note:** ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

6. Insert the capscrews (**18**), saved, through the hose carrier pivot mount and the support bracket. Secure in place with new elastic locknuts (**19**). Tighten securely.



MH1860

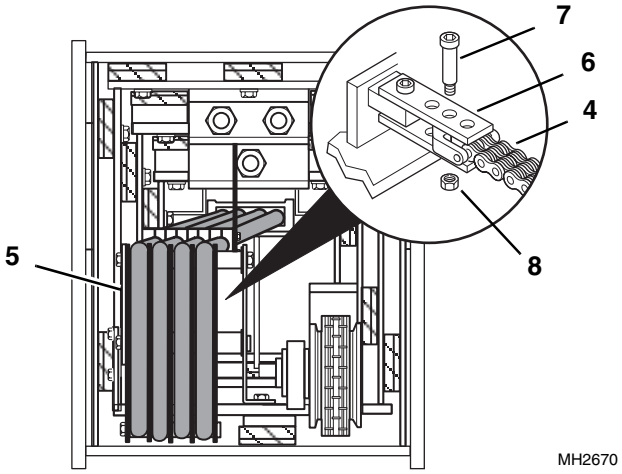
7. Remove the capscrews (**1**) and lockwashers (**2**) holding the lower wear pad to the bottom of the secondary intermediate boom.
8. Apply Loctite® 242 threadlocker to the threads of the capscrews. Line up the holes in the lower mounting plate on the hose carrier support (**3**) and reinsert the capscrews and lockwashers. Be careful not to push the inserts out of the wear pads.
9. Torque all wear pad mounting capscrews to 31 ±3 lb ft (42 ±4 Nm).



10. At the rear of the boom, place the retract chain (**4**) up and over the chain sheave in front of the hose reel assembly (**5**). Place the clevis between the two anchor plates (**6**). Line up the hole in the clevis with the second hole from the rear of the anchor plates.

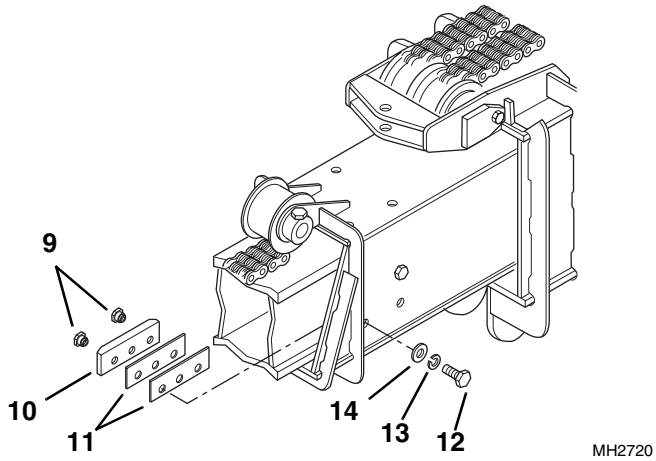
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

11. Insert the shoulder bolt (**7**), saved, through the plates and clevis, and secure in place with a new elastic locknut (**8**). Tighten the locknut securely.

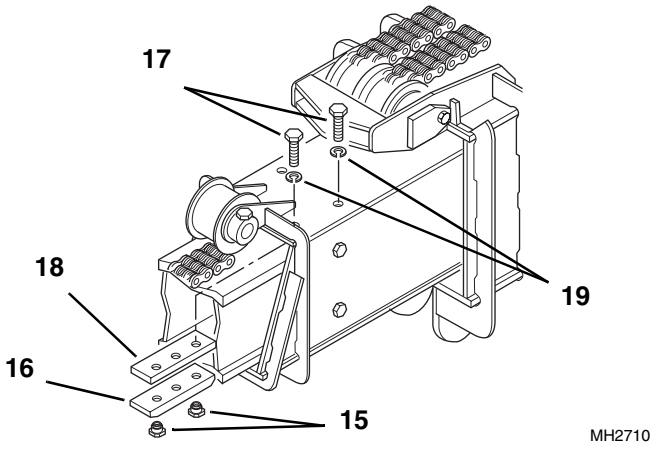


Note: *Shim ALL side wear pads as needed to maintain a total minimum gap of .07 to .13" (1,8 to 3,3 mm) in the horizontal direction.*

12. Install the side wear pads to the secondary intermediate boom:
    a. Slide the inner boom over to one side as far as it will go, to allow wear pad installation.
    b. Place the wear pad inserts (**9**), saved, into the cavities of the side wear pads (**10**), saved.
    c. Fill all wear pad cavities with a good grade of lithium-based EP grease.
    d. Place the shims (**11**), saved, onto the wear pad and line up the holes.
    e. Apply Loctite® 242 threadlocker to the threads of the capscrews (**12**), saved. Slide the wear pad (**10**) with shims (**11**) in between the inner boom and the secondary intermediate boom with the offset of each wear pad toward the top of the boom. Line up the holes and secure with the capscrews (**12**), lockwashers (**13**), saved, and flat washers (**14**), saved. Be careful not to push the wear pad inserts (**9**) out of the wear pads.
    f. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
    g. Repeat Steps a thru f to install the wear pads on the other side of the secondary intermediate boom.



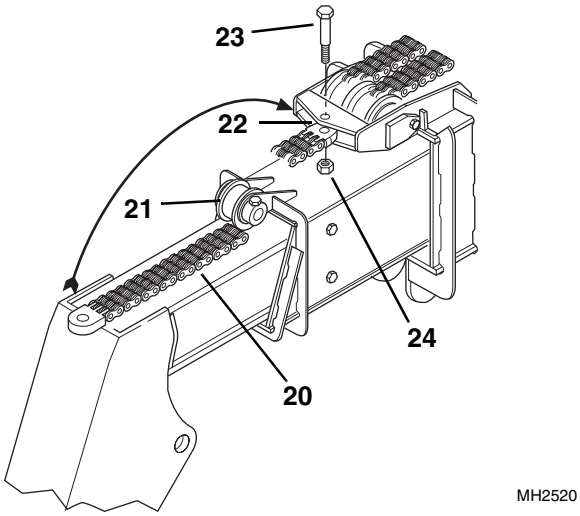
13. Assemble the top wear pads to the inside of the secondary intermediate boom:
    a. Place the wear pad inserts (**15**), saved, into the cavities of the top wear pads (**16**), saved.
    b. Fill the cavities of the wear pad with a good grade of lithium-based EP grease.
    c. Apply Loctite® 242 threadlocker to the threads of the capscrews (**17**), saved. Slide the wear pad and spacer (**18**), saved, between the inner boom and the secondary intermediate boom with the offset of each wear pad toward the center. Line up the holes and secure in place with the capscrews (**17**) and lockwashers (**19**), saved. Be careful not to push the wear pad inserts out of the wear pads.
    d. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).



14. Place the inner boom extend chain (**20**) up and around the sheave (**21**) at the front of the secondary intermediate boom.

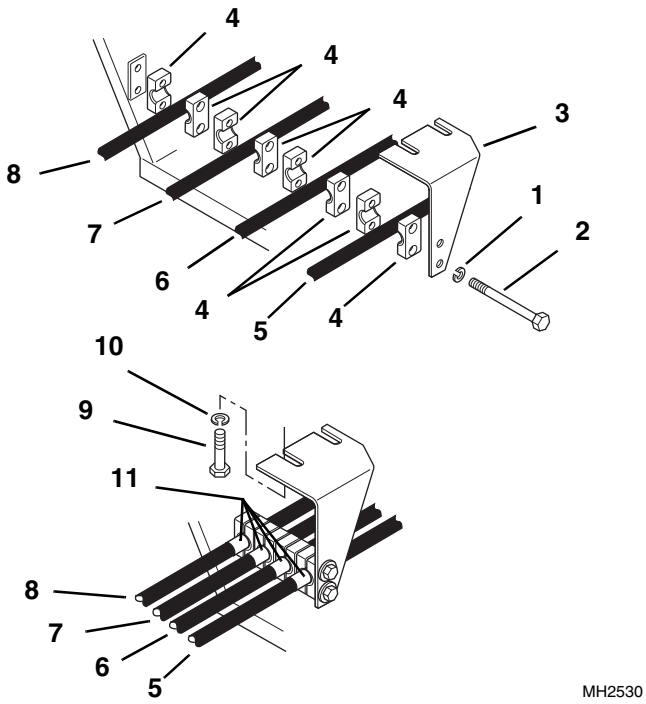
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

15. Place the extend chain clevis (**22**) between the mounting plates at the front of the secondary intermediate boom. Coat the shoulder bolt (**23**), saved, with anti-seize compound and insert through the plates and clevis. Secure the shoulder bolt in place with a new elastic locknut (**24**). Tighten securely; but the chain clevis should pivot freely.



IMPORTANT: *Keep the four hoses in line (left to right) as they come out of the hose carrier assembly at the rear of the secondary intermediate boom.*

16. Place a lockwasher (**1**), saved, onto each capscrew (**2**), saved. Insert the capscrews through the hose clamp support bracket (**3**), saved. Insert the capscrews from the side as shown.
17. Place a hose clamp half (**4**), saved, onto the capscrews. Place the right auxiliary hydraulic hose (**5**) and another hose clamp half (**4**) onto the capscrews.
18. Place another hose clamp half (**4**), saved, the right Attachment Tilt hose (**6**) and another hose clamp half (**4**) onto the capscrews.
19. Place two more hose clamp halves (**4**), the left Attachment Tilt hose (**7**) and another hose clamp half onto the capscrews.
20. Place another hose clamp half (**4**), saved, the left auxiliary hydraulic hose (**8**) and another hose clamp half (**4**) onto the capscrews. Assemble the capscrews to the left side of the inner boom. Tighten the capscrews only enough to hold the hoses in place.
21. Remove the capscrews (**9**) and lockwashers (**10**) holding the upper left side wear pad to the secondary intermediate boom.
22. Apply Loctite® 242 threadlocker to the threads of the capscrews, and insert the capscrews with lockwashers through the notches in the hose clamp support bracket (**3**) and into the wear pad inserts. Be careful not to push the wear pad inserts out of the wear pads.
23. Torque all wear pad mounting capscrews to 31 ±3 lb-ft (42 ±4 Nm).
24. Position each of the four hoses with the edge of the tape (**11**) at the hose clamps. Hold the hoses in this position and tighten the two capscrews securely to hold the hoses in this position.



MH2530

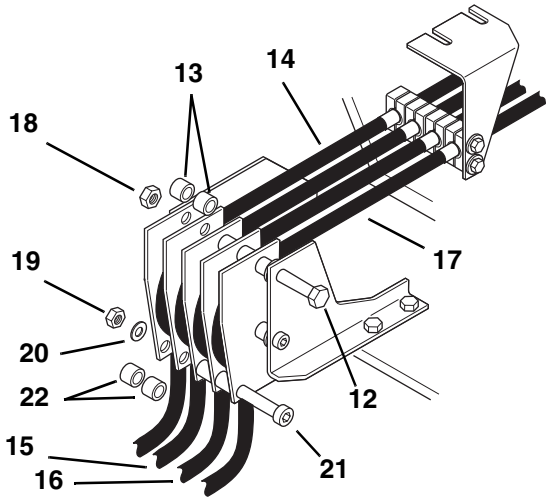
IMPORTANT: *Keep the hoses in the same order as they come from the hose clamps.* ***DO NOT*** *allow the hoses to cross.*

25. While pulling the upper retaining capscrew (**12**) out, catch the spacers (**13**) from between the plates as the capscrew is removed. Pull the capscrew out far enough to place the hoses around the hose reel:
    a. Place the left side auxiliary hydraulic hose (**14**) into the left position on the hose reel.
    b. Place the left side Attachment Tilt hose (**15**) into the second position from the left on the hose reel.
    c. Place the right side Attachment Tilt hose (**16**) into the second position from the right on the hose reel.
    d. Place the right side auxiliary hydraulic hose (**17**) into the right position on the hose reel.
26. Insert the retaining capscrew (**12**) through the plates of the hose reel, inserting the spacers (**13**) back in position between the plates as the capscrew is inserted. Secure the retaining capscrew in place with a new elastic locknut (**18**). Tighten the elastic locknut securely.

27. Remove the elastic locknut (**19**) and flat washer (**20**) from the lower retaining shoulder bolt (**21**). While pulling the shoulder bolt out, catch the spacers (**22**) from between the plates as the shoulder bolt is removed. Place the Attachment Tilt hoses and the auxiliary hydraulic hoses around the hose reel.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

28. Insert the shoulder bolt (**21**) through the plates of the hose reel, inserting the spacers (**22**) between the plates as the shoulder bolt is inserted. Place the flat washer (**20**) onto the shoulder bolt and secure in place with a new elastic locknut (**19**). Tighten securely.

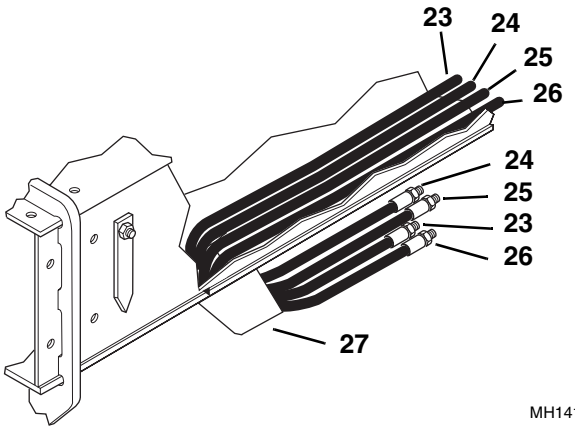


MH1690

29. Tie the strings (positioned inside the outer boom during the outer boom installation) to the male end of each of the Attachment Tilt and auxiliary hydraulic hoses, coming off the bottom hose reel assembly.

IMPORTANT: *Keep the hoses in the same order as they come off the hose reel.* ***DO NOT*** *allow the hoses to cross.*

30. Working from the front of the boom, pull each hose through the boom assembly:
    a. Pull the right side auxiliary hydraulic hose (**23**) through the boom assembly.
    b. Pull the right side Attachment Tilt hose (**24**) through the boom assembly. Keep the right side Attachment Tilt hose to the left of the right side auxiliary hydraulic hose.
    c. Pull the left side Attachment Tilt hose (**25**) through the boom assembly, using the hoses already down the boom as a guide. Keep the left side Attachment Tilt hose to the left of the hoses already installed.
    d. Pull the left side auxiliary hydraulic hose (**26**) through the boom assembly, using the hoses already down the boom as a guide. Keep the left side auxiliary hydraulic hose to the left of the hoses already installed.
    e. Pull the hoses out the opening (**27**) at the bottom of the outer boom.
31. Remove the strings from the hoses.



MH1410

32. At the front of the outer boom, assemble the hose assemblies and tube assemblies to the mounting plate:

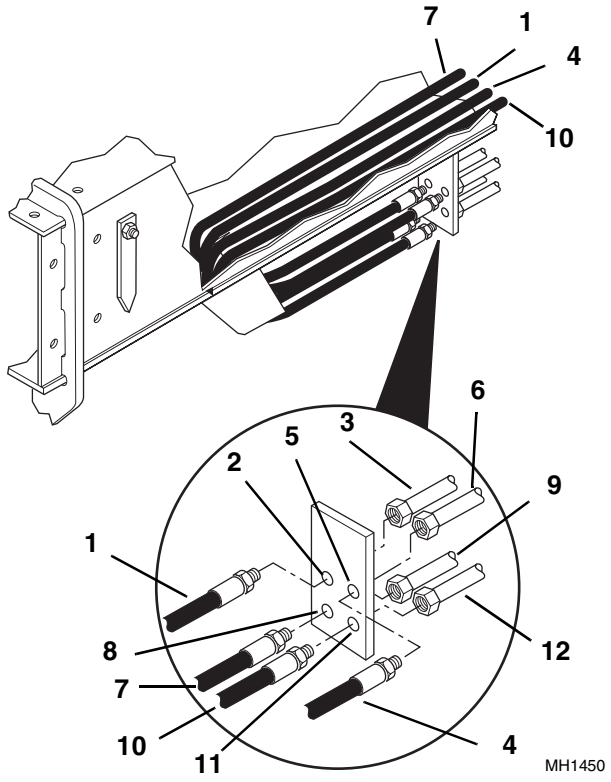
Note: *Where the hose assemblies come out of the outer boom, lubricate the radius in the outer boom with soap and water to allow proper tensioning of hoses.*

a. Assemble the right side Attachment Tilt hose (**1**) as it comes down the outer boom to the upper right side hole (**2**) on the mounting plate. Insert the male end of the right side hose through the upper right side hole. Tighten the upper right side Attachment Tilt tube assembly (**3**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate.

b. Assemble the left side Attachment Tilt hose (**4**) as it comes down the outer boom to the upper left side hole (**5**) on the mounting plate. Insert the male end of the left side hose through the upper left side hole. Tighten the upper left side Attachment Tilt tube assembly (**6**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate.

c. Assemble the right side auxiliary hydraulic hose (**7**) as it comes down the outer boom to the lower right side hole (**8**) on the mounting plate. Insert the male end of the right side hose through the lower right side hole. Tighten the lower right side auxiliary hydraulic tube assembly (**9**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate.

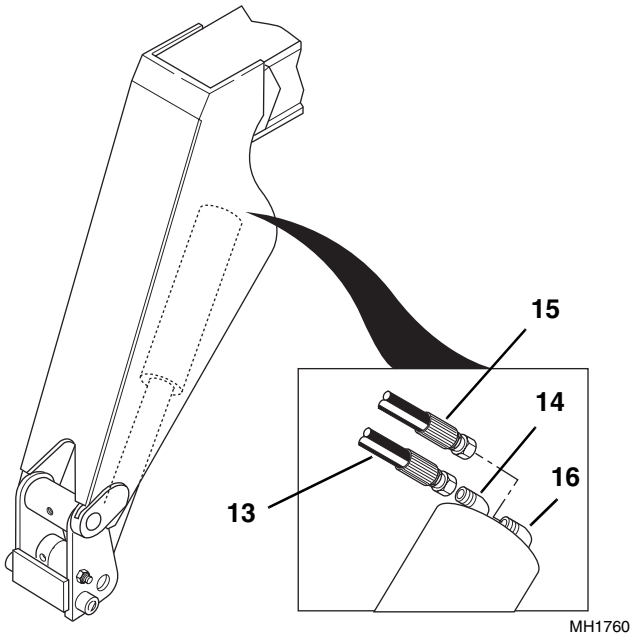
d. Assemble the left side auxiliary hydraulic hose (**10**) as it comes down the outer boom to the lower left side hole (**11**) on the mounting plate. Insert the male end of the left side hose through the lower left side hole. Tighten the lower left side auxiliary hydraulic tube assembly (**12**) to the hose assembly. Tighten the tube assembly nut securely to hold the tube and hose to the plate.



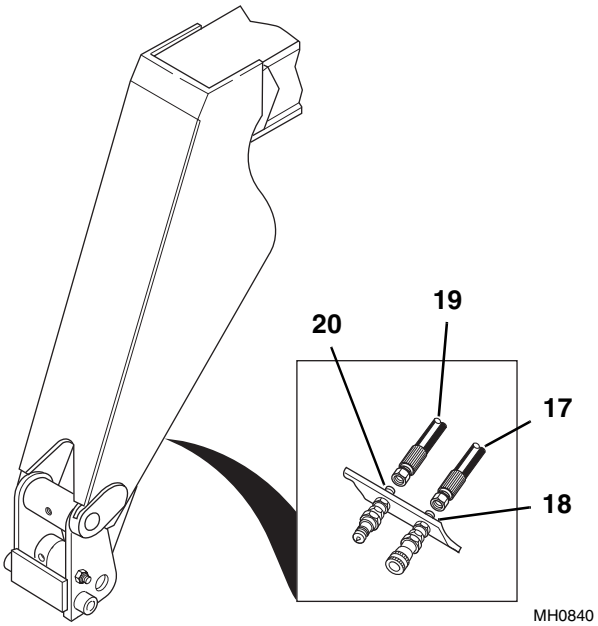
33. Assemble the Attachment Tilt hoses from the backside of the gooseneck to the fittings on the base end of the Attachment Tilt cylinder:

a. Assemble the left side hose (**13**) labeled as “Retract” to the retract port (upper) elbow (**14**) on the base end of the Attachment Tilt cylinder. Index the hose to remove any undo tension and tighten the hose end completely.

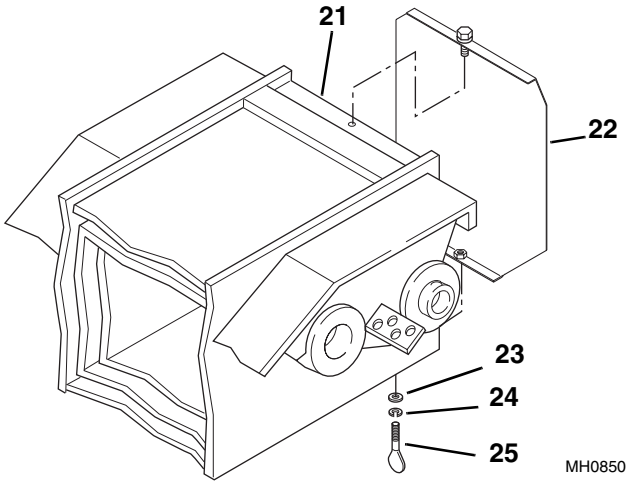
b. Assemble the right side hose (**15**) labeled as “Extend” to the extend port (lower) elbow (**16**) on the base end of the Attachment Tilt cylinder. Index the hose to remove any undo tension and tighten the hose end completely.



34. Assemble the left auxiliary hydraulic hose (**17**) labeled “Female Coupler” from inside the gooseneck to the female coupler (**18**) bulkhead fitting. Tighten securely.
35. Assemble the right auxiliary hydraulic hose (**19**) labeled “Male Nipple” from inside the gooseneck to the male nipple (**20**) bulkhead fitting. Tighten securely.

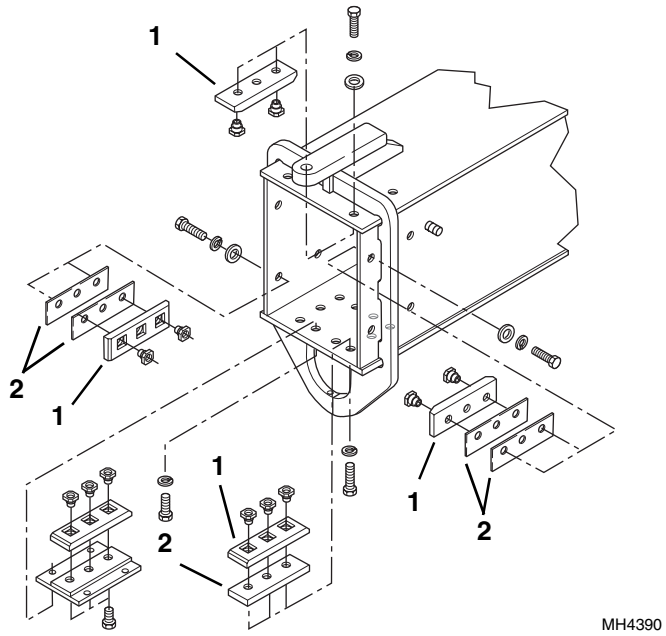


36. Adjust the inner boom extend and retract chains. (Refer to the Section 3.7.5, “Inner Boom Chain Tension Adjustment.”)
37. After adjustment is complete, assemble the rear cover to the rear of the outer boom. On the rear of the outer boom (**21**), position the rear cover (**22**) in place. Secure the cover with the flat washer (**23**), saved, internal-tooth lockwasher (**24**), saved, and thumbscrew (**25**), saved. Insert the thumbscrew through the bottom of the outer boom and into the rear cover. Tighten the thumbscrew securely.



3.9 BOOM WEAR PADS

The wear pads (**1**) on this vehicle are flat rectangular wear pads with metal inserts (**2**).



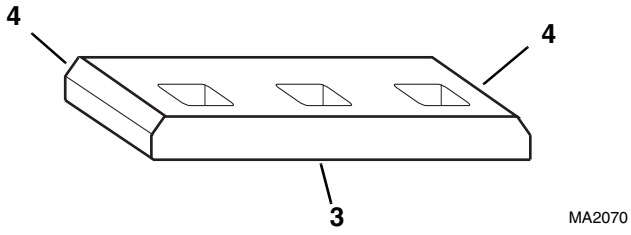
On the 8042 and 10042 a total of 32 wear pads are installed on the outer, intermediate and inner booms. Seven wear pads are attached to the inner boom, 16 to the intermediate boom, and nine to the outer boom.

On the 10054 a total of 47 wear pads are installed on the outer, intermediate and inner booms. Seven wear pads are attached to the inner boom, 16 to the primary intermediate boom, 15 to the secondary intermediate boom and nine to the outer boom.

Note: *All shims are used to maintain a maximum total gap of 0.09" (2,3 mm), between the wear pad and the boom.*

3.9.1 Wear Pad Inspection

Inspect all wear pads (**3**) for wear. If the angle indicators (**4**) on the ends of the wear pads are visible, the wear pads can be reused. If the pads show uneven wear (front to back), they should be replaced. Replace pads as a set if worn or damaged.



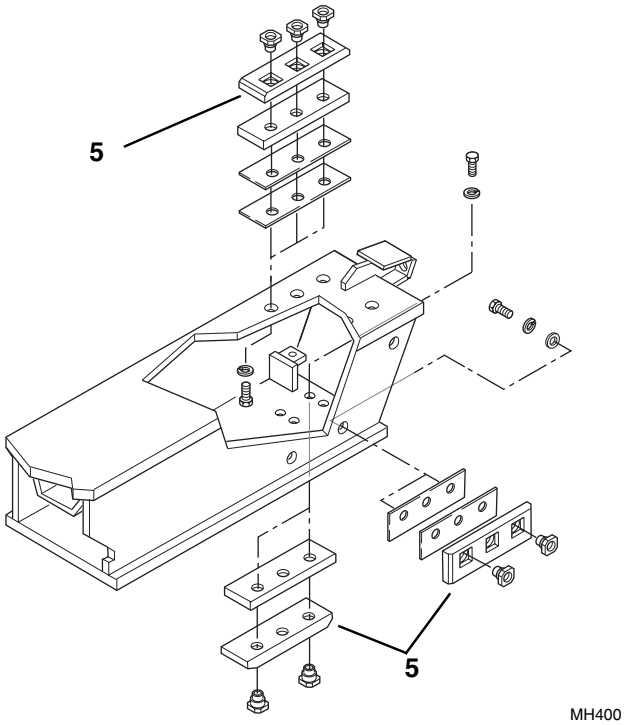
3.9.2 Boom Wear Pad Replacement

When replacing a wear pad on the boom, replace both wear pads on that side of the boom; e.g.: replace top front left and top front right wear pads at the same time.

Usually, shimming will remain the same when installing new wear pads. All wear pads are secured to the boom using different capscrews and washers. When installing new wear pads, apply Loctite® #242 (blue) to all wear pad mounting capscrews and torque to 33 to 38 lb-ft (46 - 52 Nm).

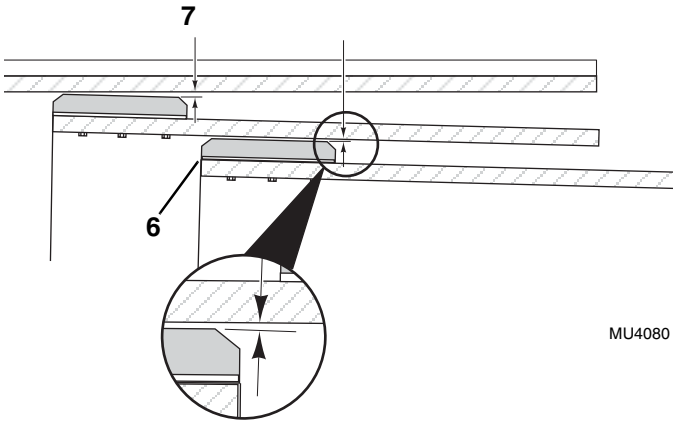
a. Inner Boom

All inner boom wear pads (**5**) are mounted on the rear outside of the inner boom.



Use shims (**6**) under the upper rear wear pads as required to maintain a maximum gap of 0.09" (2,3 mm) (**7**) at the front edge of the top wear pads and maintain a total maximum gap of 0.09" (2,3 mm) on the boom sides.

Shims are available in two thicknesses, 0.06" and 0.13".

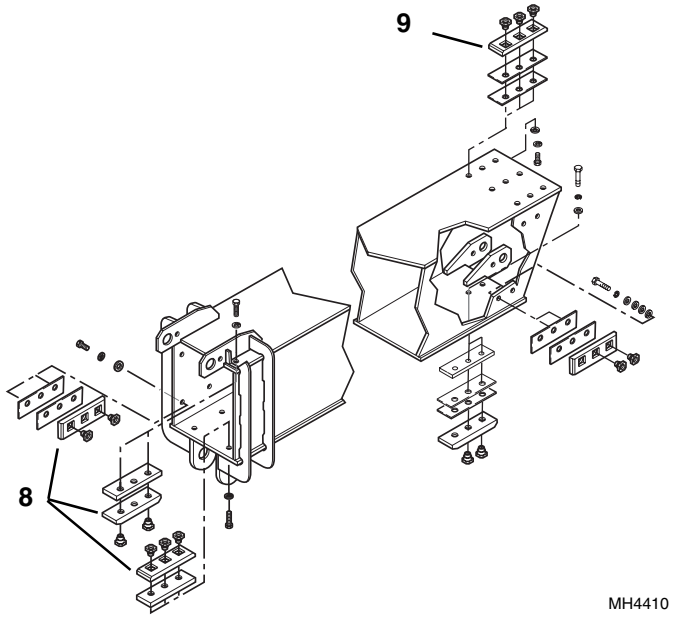


b. 8042/10042 Intermediate Boom

Coat all wear pad capscrews with Loctite 242® (blue) before installation.

The wear pads (**8**) on the front of the intermediate boom can be replaced by removing the fasteners securing them to the top, sides and bottom of the boom.

When removing pads, move the boom sections as needed to gain access for removal and installation of wear pads. Mark or otherwise label each pad, spacer/ shim and hardware set for ease of installation later. Top wear pads are secured to the boom with washers and capscrews; side wear pads are secured with washers and capscrews. Use Loctite® 242 (blue) on all wear pad capscrews.



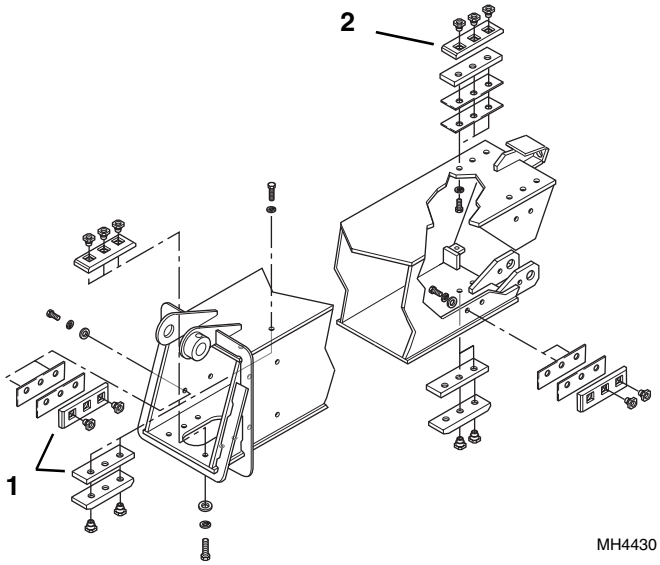
Use shims (**6**) under the upper rear wear pads (**9**) as required, to maintain a maximum gap of 0.09" (2,3 mm) (**7**) at the rear edge of the pads and maintain a minimum gap of 0.09" (2,3 mm) between the wear pad and boom surface.

c. 10054 Secondary Intermediate Boom

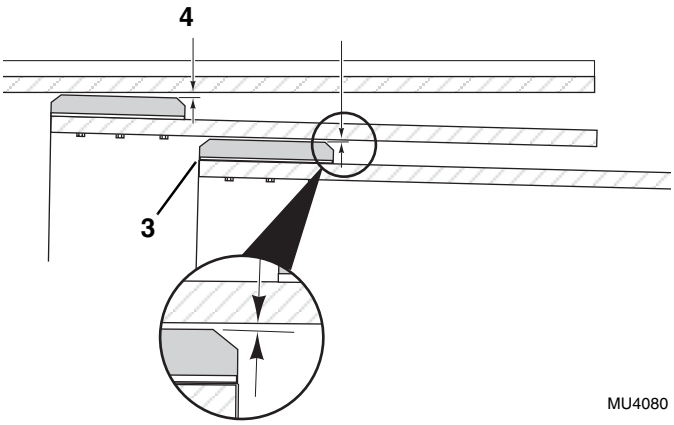
Coat all wear pad capscrews with Loctite 242® (blue) before installation.

The wear pads (**1**) on the front of the intermediate boom can be replaced by removing the fasteners securing them to the top, sides and bottom of the boom.

When removing pads, move the boom sections as needed to gain access for removal and installation of wear pads. Mark or otherwise label each pad, spacer/ shim and hardware set for ease of installation later. Top wear pads are secured to the boom with washers and capscrews; side wear pads are secured with washers and capscrews. Use Loctite® 242 (blue) on all wear pad capscrews.



Use shims (**3**) under the upper rear wear pads (**2**) as required, to maintain a maximum gap of 0.09" (2,3 mm) (**4**) at the rear edge of the pads and maintain a minimum gap of 0.09" (2,3 mm) between the wear pad and boom surface.

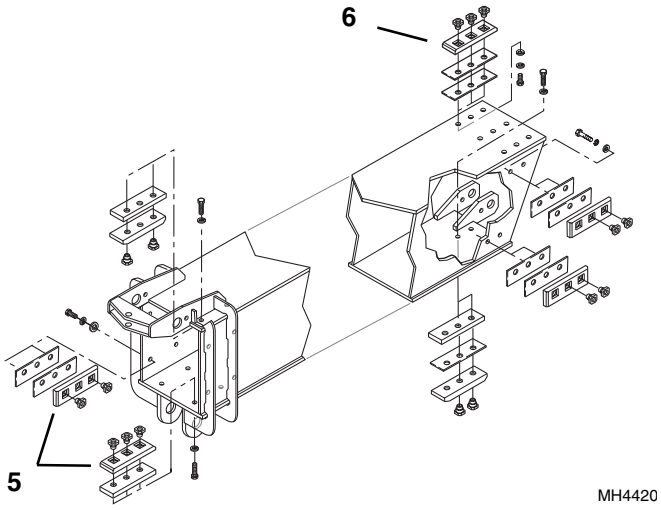


d. 10054 Primary Intermediate Boom

Coat all wear pad capscrews with Loctite 242® (blue) before installation.

The wear pads (**5**) on the front of the intermediate boom can be replaced by removing the fasteners securing them to the top, sides and bottom of the boom.

When removing pads, move the boom sections as needed to gain access for removal and installation of wear pads. Mark or otherwise label each pad, spacer/ shim and hardware set for ease of installation later. Top wear pads are secured to the boom with washers and capscrews; side wear pads are secured with washers and capscrews. Use Loctite® 242 (blue) on all wear pad capscrews.

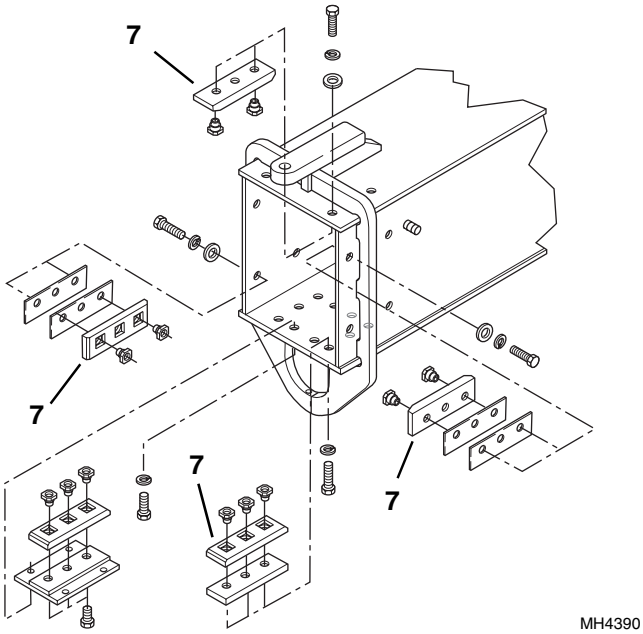


Use shims (**3**) under the upper rear wear pads (**6**) as required, to maintain a maximum gap of 0.09" (2,3 mm) (**4**) at the rear edge of the pads and maintain a minimum gap of 0.09" (2,3 mm) between the wear pad and boom surface.

e. Outer Boom

All outer boom pads (**7**) are mounted on the front of the outer boom. Remove the top wear pads before removing the bottom wear pads. Lower the gooseneck to the ground until the intermediate boom raises up, providing clearance for removing the bottom pads. Fill the grease pockets (**8**) of the top rear boom wear pads with multi-purpose grease. Use Loctite® 242 (blue) on all wear pad capscrews.

Use shims as required to maintain a maximum gap of 0.09" (2,3 mm) between the side wear pad and boom surface.



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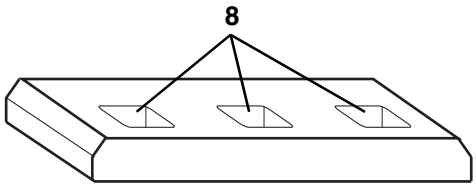


MS0610

3.9.3 Boom Wear Pad Lubrication

The boom has been factory lubricated for proper wear pad break-in and will normally not require further lubrication. However, after replacing any wear pad(s), or after prolonged periods of inoperation, light lubrication of the boom wear surfaces with a rust inhibitor/lubricant such as LPS 3, or equivalent, is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended in salt air climates, and when the vehicle is stored, to help prevent rusting.

3.10 QUICK ATTACH ASSEMBLY

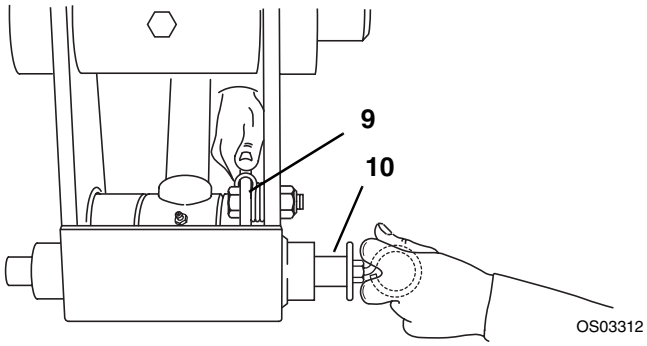
This vehicle is equipped with a quick attach system for easy attachment changes.

3.10.1 Disconnecting from an Attachment

1. Park the vehicle on a hard, level surface.
2. Ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position and engage the parking brake switch.
3. Extend the boom approximately 10 ft (3,05 m) and tilt the carriage backward. Shut the engine OFF.
4. Exit the vehicle using both hand holds.

Note: *If removing a standard carriage with forks, spread the forks apart on the carriage shaft. This will help give the carriage better support to stand alone.*

5. Raise the quick attach pin lock lever (**9**) and pull out the lock pin (**10**) at the bottom of the quick attach.



OS03312

6. Return to the operator's compartment, fasten the seat belt and lower the attachment to the ground in a level position. Tilt the attachment forward. This will rotate the quick attach link back away from the attachment.
7. Lower and then retract the boom until the attachment pivot pins have disconnected from the attachment.

3.10.2 Connecting to an Attachment

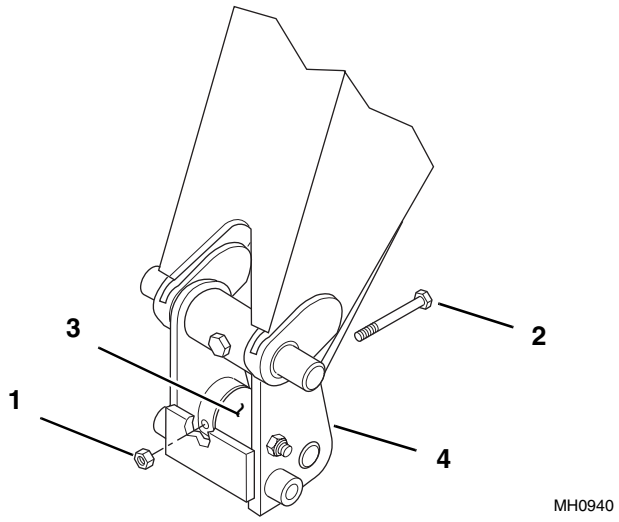
1. Perform this procedure on a hard, level surface only. Position the vehicle directly behind the attachment to be mounted.
2. Tilt the quick attach backward.
3. Extend the boom approximately 10 ft (3,05 m) and drive the vehicle forward until the attachment pivot pins are below and between the two hooks on the attachment.
4. Raise the boom until the attachment pivot pins have seated fully in the hooks on the attachment.
5. Tilt the attachment up slightly. The quick attach link should be tight up against the rear of the attachment, and the holes in the link and the attachment should be aligned.
6. Place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch, unbuckle the seat belt and exit the vehicle using both hand holds.
7. Lift the quick attach lever. Insert the quick attach pin completely through the attachment and the quick attach link. Be sure that the quick attach lock lever has lowered and seated itself into the groove in the quick attach pin.

> **WARNING:** **DO NOT** operate the vehicle unless you are in the operator's seat with the seat belt fastened around you. Death or serious injury could result if the seat belt is not securely fastened.

8. Return to the cab, fasten the seat belt and resume operation.

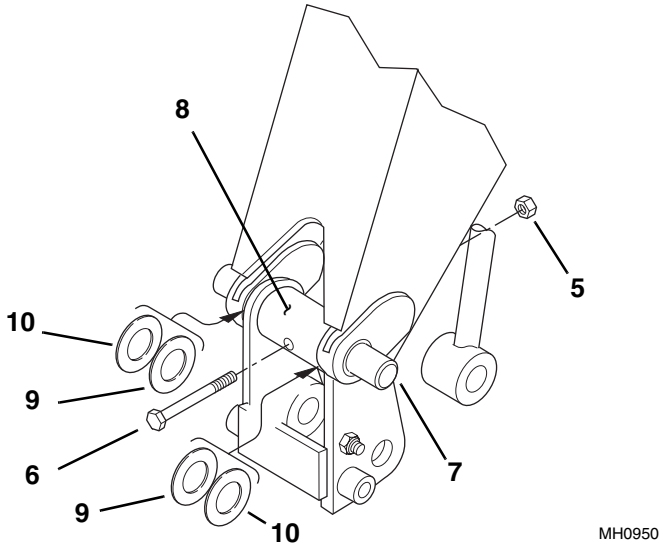
3.10.3 Quick Attach Removal

1. Remove the elastic locknut (**1**) and capscrew (**2**) holding the Attachment Tilt cylinder rod end pin (**3**) to the quick attach assembly (**4**). Save the capscrew and discard the elastic locknut.
2. Support the rod end of the Attachment Tilt cylinder. Use a brass punch and rawhide hammer to remove the rod end pin (**3**) from the quick attach assembly.
3. Inspect the pin (**3**) for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.



MH0940

4. Remove the elastic locknut (**5**) and capscrew (**6**) holding the quick attach pivot pin (**7**) to the quick attach assembly (**8**). Save the capscrew and discard the elastic locknut. Place a support under the quick attach assembly to prevent it from dropping when the pivot pin is removed.
5. Use a brass punch and rawhide hammer to remove the quick attach pivot pin (**7**) from the quick attach assembly and the bushings in the gooseneck. Record the location and quantity of the shim washers (**9**) as the pin is being removed. Save the washers (**10**) from each side of the quick attach.
6. Inspect the pin (**7**) for nicks or surface corrosion. Use fine emery cloth to repair minor nicks or corrosion. If damaged or if it cannot be repaired, the pin must be replaced.



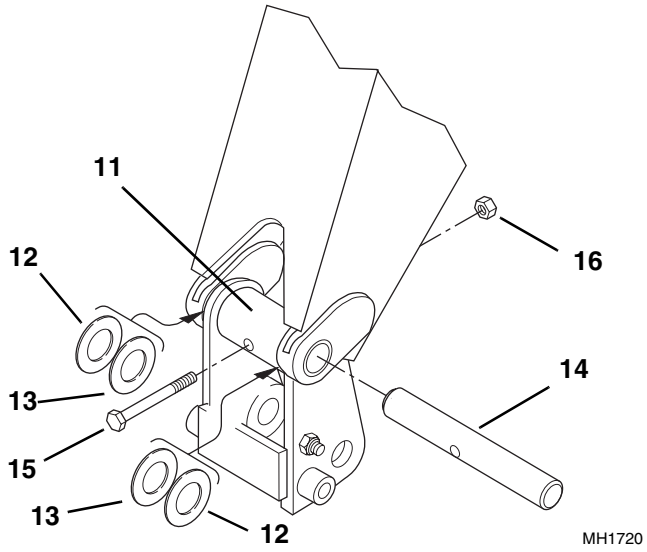
MH0950

3.10.4 Quick Attach Installation

1. Assemble the quick attach to the gooseneck. Line up the quick attach (**11**) between the mounts on the gooseneck. Assemble a washer (**12**), saved, on each side of the quick attach. Reassemble the shims (**13**), saved, between the quick attach and the gooseneck. **DO NOT** put all the shims on one side. The quick attach should be centered in the gooseneck.
2. Coat the quick attach pivot pin (**14**) with an anti-seize compound. Insert the quick attach pivot pin through the gooseneck, washers, shims and quick attach. Use a tapered punch to line up the hole in the pivot pin with the hole in the quick attach.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

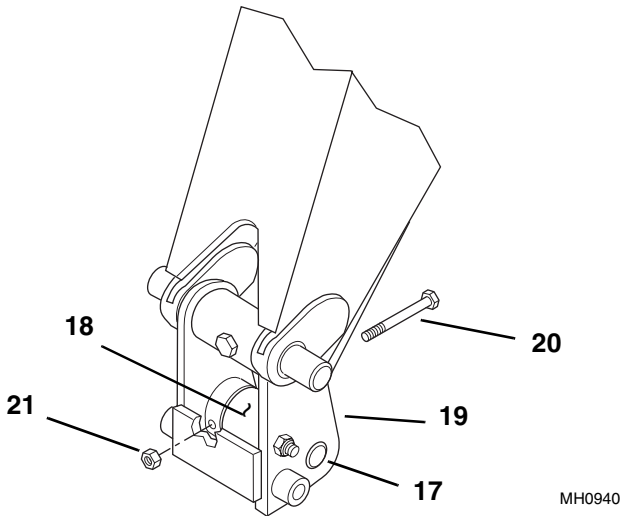
3. Insert the capscrew (**15**), saved, through the quick attach and pin. Secure the capscrew in place with a new elastic locknut (**16**). Tighten securely.



4. Coat the rod end pivot pin (**17**), saved, with an anti-seize compound. Swing the rod end (**18**) of the Attachment Tilt cylinder up and line up the rod end with the mounting holes in the quick attach (**19**).

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

5. Insert the rod end pivot pin (**17**) through the lined-up holes. Use a tapered punch to line up the capscrew hole in the pivot pin and the mounting hole in the quick attach hub. Insert the capscrew (**20**), saved, through the quick attach hub from the backside and secure in place with a new elastic locknut (**21**). Tighten securely.



3.11 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Boom Troubleshooting

Problem	Cause	Remedy
1. Boom will not extend or retract.	1. Broken hydraulic hose(s) or tube(s) and/or connections leaking.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Extend/Retract hydraulic system not operating properly.	2. Refer to Section 8, “Hydraulic System.”
	3. Faulty Extend/Retract cylinder.	3. Repair cylinder (Refer to Section 8.13.6, “Extend/Retract Cylinder.”)
	4. Broken chains or anchors.	4. Replace chains as needed. Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement,” - 8042 & 10042 or Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement,” - 10054.
2. Boom will not fully extend (10054 only).	1. Extend/Retract hydraulic system not operating properly.	1. Refer to Section 8, “Hydraulic System.”
3. Boom shifts to right or left when extending.	1. Boom pivot pin improperly shimmed.	1. Re-shim the boom to a maximum total gap of .10" (2.5 mm) with shims distributed evenly on both sides of the boom pivot pin.
	2. Incorrect wear pad gap or shimming, or wear pads excessively worn.	2. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.9.2, “Boom Wear Pad Replacement.”
4. Excessive boom pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.) Replace worn pins as needed. Refer to Section 3.3.4, “Outer Boom Installation.”
	2. Worn bearing(s).	2. Replace bearing(s) and lubricate at regular intervals (Refer to appropriate owners manual for lubrication points.)

Boom Troubleshooting (Continued)

Problem	Cause	Remedy
5. Excessive Slave cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.) Replace worn pins as needed. Refer to Section 3.3.4, “Outer Boom Installation.”
	2. Worn bearing(s).	2. Replace bearing(s) and lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.)
6. Dropping chain, or jerky boom extend or retract functions.	1. Chain(s) tension not properly adjusted.	1. Adjust chain(s). (Refer to Section 3.4.3, “Boom Chain Tension Check,” - 8042 and 10042 or Section 3.7.3, “Boom Chain Tension Check,” - 10054.)
	2. Chain(s) stretched or binding.	2. Replace chains as needed. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement,” - 8042 and10042 or Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement,” - 10054.)
	3. Wear pads loose, contaminated, excessively worn or damaged.	3. Replace wear pad. Refer to Section 3.9.2, “Boom Wear Pad Replacement.”
	4. Contaminated, corroded or rusted wear pad sliding surfaces.	4. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	5. Extend/Retract hydraulic system not operating properly.	5. Refer to Section 8, “Hydraulic System.”
	6. Damaged boom section.	6. Replace the damaged boom section. (Refer to Section 3.3, “Boom Assembly Maintenance (8042 and 10042),” or Section 3.6, “Boom Assembly Maintenance (10054).”)

Boom Troubleshooting (Continued)

Problem	Cause	Remedy
7. Boom will not raise or lower.	1. Broken hydraulic hoses or tubes and/or connection leaks.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Lift/Lower hydraulic system not operating properly.	2. Refer to Section 8, “Hydraulic System.”
	3. Faulty Lift/Lower cylinders.	3. Repair cylinder. (Refer to Section 8.13.7, “Lift/Lower Cylinder.”)
	4. Seized boom pivot pin bearing.	4. Replace bearing.
8. Excessive Lift/Lower cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.) Replace worn pins as needed. Refer to Section 3.3.4, “Outer Boom Installation.”
	2. Worn self-aligning bearing(s).	2. Replace bearing(s) and lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.)
9. Rapid boom pad wear.	1. Incorrect wear pad gap.	5. Check wear pad gaps and correct as needed. Refer to Section 3.9.2, “Boom Wear Pad Replacement.”
	2. Rapid cycle times with heavy loads.	6. Reduce cycle times.
	3. Contaminated, corroded or rusted wear pad sliding surfaces.	7. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	4. Operating in extremely dusty/ abrasive conditions.	8. Clean equipment frequently.
10. Auxiliary hydraulics will not operate.	1. Auxiliary hydraulic system not operating properly.	1. Refer to Section 8, “Hydraulic System.”

Boom Troubleshooting (Continued)

Problem	Cause	Remedy
11. Excessive chain wear.	1. Improper chain adjustment.	1. Adjust to correct tension. (Refer to Section 3.4.3, “Boom Chain Tension Check,” - 8042 and 10042 or Section 3.7.3, “Boom Chain Tension Check,” - 10054.) Replace chains as needed. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement,” - 8042 and 10042 or Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement,” - 10054.)
	2. Chain sheave(s) not properly lubricated.	2. Lubricate chain sheave. (Refer to appropriate owner’s manual for lubrication points.)
	3. Chain sheave(s) not rotating freely.	3. Lubricate chain sheave. (Refer to appropriate owners manual for lubrication points.) Repair or replace chain sheave(s) as needed.
	4. Improper chain lubrication.	4. Lubricate at regular intervals. (Refer to appropriate owners manual for lubrication points.) Replace chains as needed. (Refer to Section 3.4.5, “Boom Extend and Retract Chains Removal and Replacement,” - 8042 and 10042 or Section 3.7.6, “Boom Extend and Retract Chains Removal and Replacement,” - 10054.)

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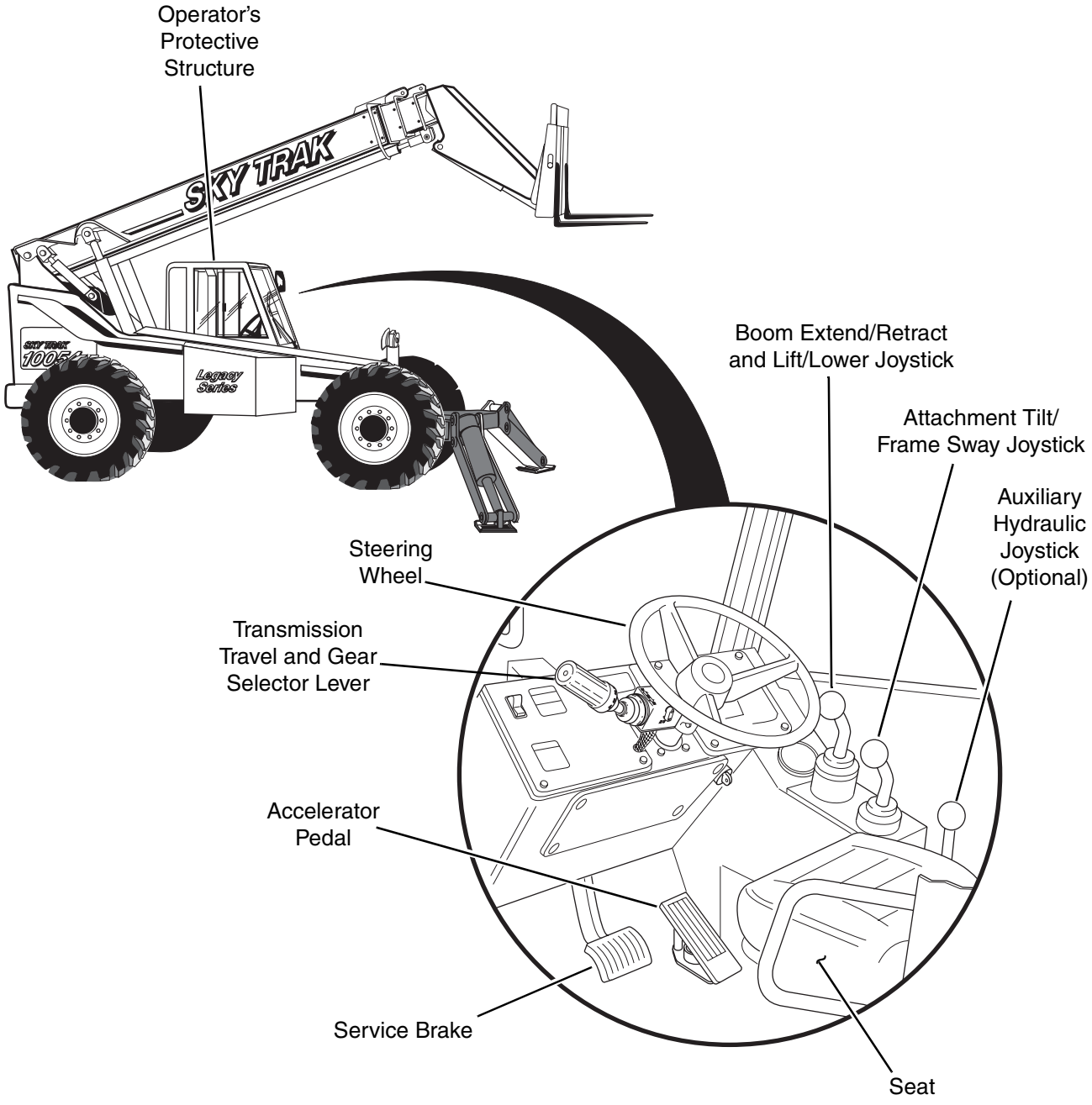
Section 4
Cab and Covers

Contents

4.1 OPERATOR'S CAB AND COVERS COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the vehicle cab and covers. The following illustration identifies the components that are referred to throughout this section.



WARNING: **DO NOT** service the vehicle without following all safety precautions as outlined in the “Safety Practices” section of this manual. Failure to follow the safety practices may result in death or serious injury.

4.2 OPERATOR’S CAB

4.2.1 Operator’s Cab Description

The welded metal cab features a modular design, allowing for a relatively quick, simple exchange of the entire cab and/or component parts. The cab is bolted directly to the frame.

The cab is available in either an open (standard) or enclosed (optional) cab configuration. The enclosed cab option includes a heater/window defroster system, and windshield and roof window wipers.

The operator’s cab is a protective structure. The cab itself contains rollover protective and falling object protective structures (ROPS/FOPS) for the operator.

WARNING: The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

DO NOT weld, grind, drill, repair or modify the cab in any way. Any modification or damage to cab structural components requires cab replacement. The lives of the operator and others are potentially at stake.

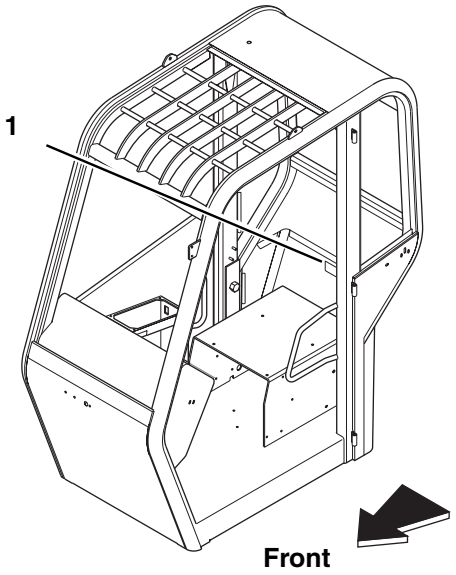
To help ensure optimum safety, protection and performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.

The cab contains the seat, operating controls, numerous panels, steering and brake components, and more.

Covers and mirrors on the vehicle exist for safety, protection and appearance. They are relatively simple to remove and replace.

4.2.2 Serial Number Decal

The cab serial number decal (**1**) is located on the left side of the cab, behind the seat. Information specified on the serial number plate includes the cab model number, the cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.



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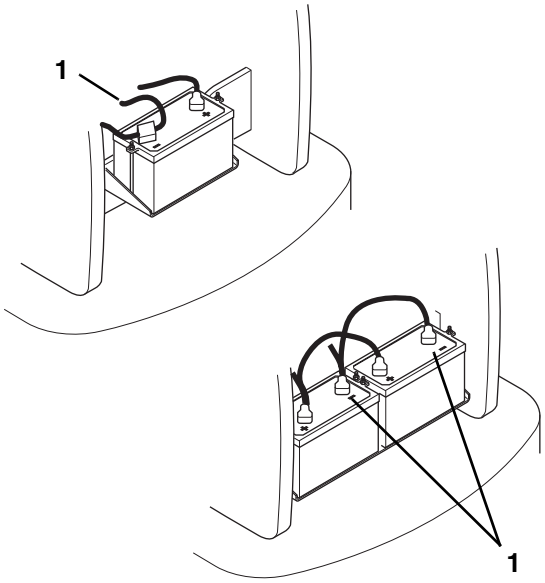
4.3 OPEN CAB COMPONENTS

4.3.1 Seat/Seat Belt

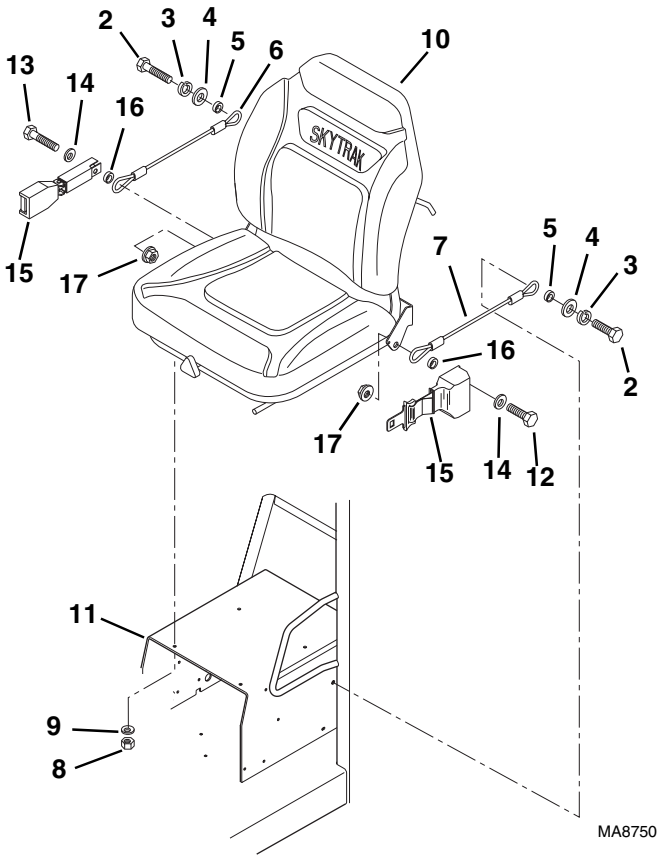
a. Seat Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) ground cable or cables (**1**) at the battery negative (-) terminal.



MH4510

4. Remove the two capscrews (**2**), two lockwashers (**3**), two flat washers (**4**) and two spacers (**5**) securing the tethers (right-**6** and left-**7**) to the seat riser.
5. Remove the four elastic locknuts (**8**) and four flat washers (**9**) securing the seat (**10**) to the seat riser (**11**).
6. Carefully remove the seat (**10**) from the cab.
7. **If the seat is to be replaced:** Remove the two capscrews (**12** and **13**), two washers (**14**), seat belt assembly (**15**), two spacers (**16**) and two flanged hex nuts (**17**). Transfer these parts and two tethers (**6**- right and **7**-left) to the replacement seat with the seat out of the cab.



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b. Seat Installation

Note: *ALWAYS replace elastic-lined nuts with new elastic-lined nuts to help ensure proper fastening.*

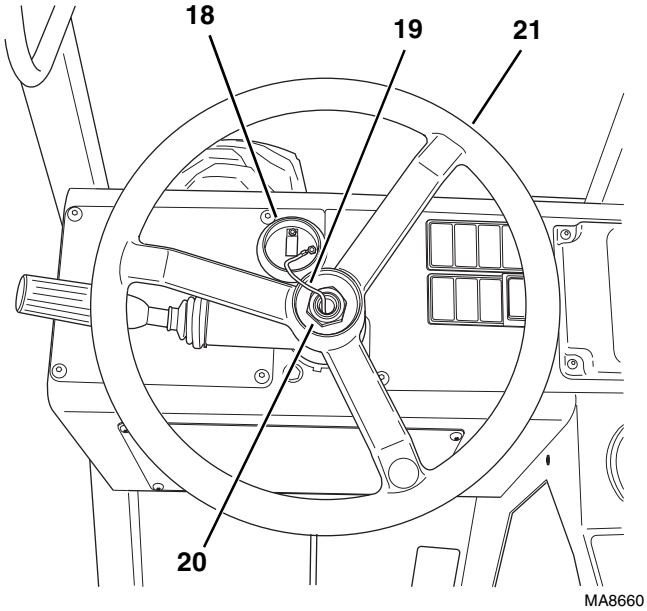
1. Position the seat (**10**) on the seat riser (**11**). Align the studs on the seat with the mounting holes in the seat riser. Secure the seat to the riser with four flat washers (**9**) and four new elastic locknuts (**8**). Torque nuts to 20 lb-ft (27 Nm).
2. Anchor the tethers (right-**6** and left-**7**) to the seat riser (**11**) using two spacers (**5**), two flat washers (**4**), two lockwashers (**3**) and two capscrews (**2**).

4.3.2 Steering Wheel, Column and Shifter

The steering wheel and transmission travel and gear select lever are mounted on the steering column.

a. Steering Wheel Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on the ignition key switch, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
4. Carefully pry the horn button (**18**) out of its recess in the steering wheel. Disconnect the horn switch lead (**19**).
5. Mark the steering wheel and shaft to ensure proper installation. Remove the M18-1,5 thin nut (**20**) securing the steering wheel (**21**) to the splined steering column shaft.
6. Use a steering wheel puller to remove the steering wheel (**21**) from the splined shaft.

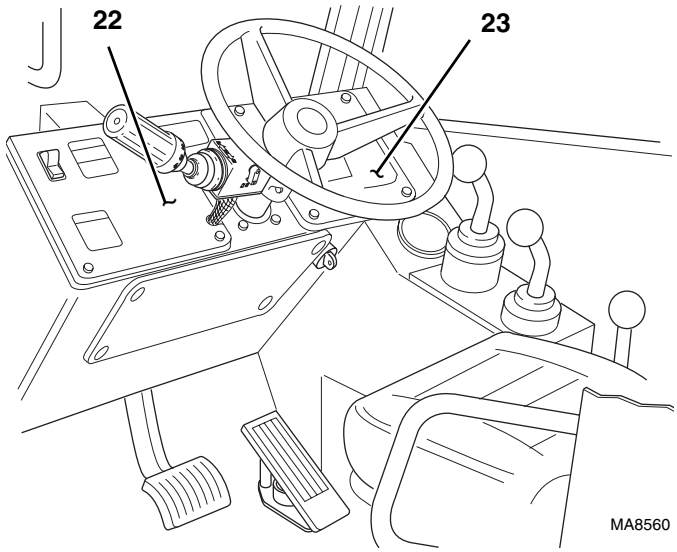


b. Steering Wheel Installation

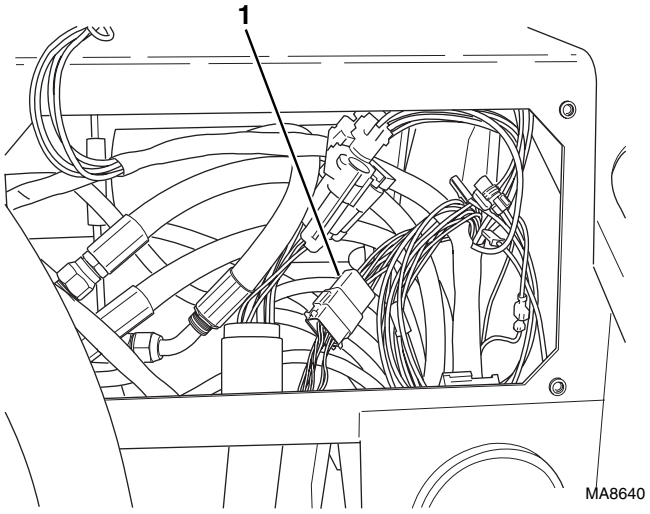
1. Install the steering wheel (**21**) onto the splined steering column shaft.
2. Secure the steering wheel with a M18-1,5 thin nut (**20**). Torque the nut to 50 lb-in (68 Nm).
3. Connect the horn switch lead (**19**), then press the horn button (**18**) into the recess in the steering wheel.
4. Connect the battery negative (-) cable or cables.

c. Transmission Travel and Gear Select Lever Removal

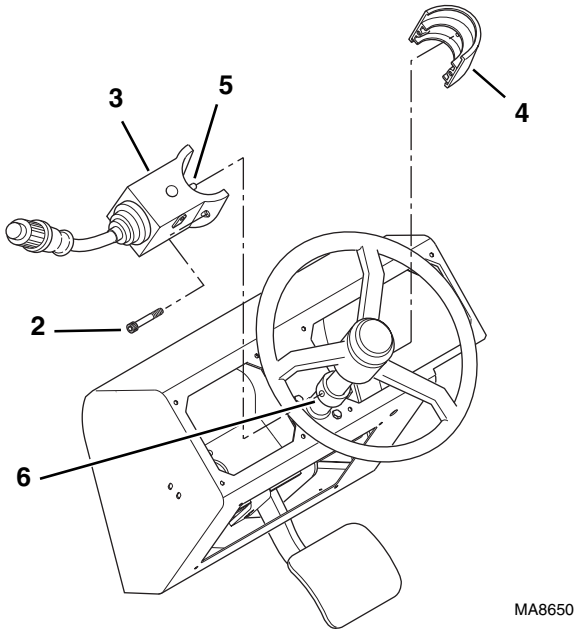
1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
4. Remove the four button-head capscrews securing the left dash panel (**22**) to the cab; **DO NOT** disconnect the wiring connectors. Set the dash panel aside.
5. Remove the four button-head capscrews securing the right dash panel (**23**) to the cab; **DO NOT** disconnect the wiring connectors. Set the dash panel aside.



6. Working through the right dash panel opening, disconnect the transmission travel and gear select lever wiring connector (**1**).

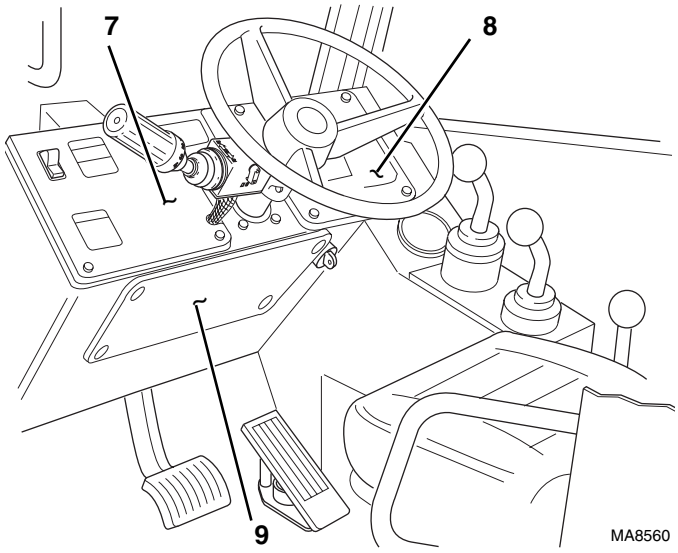


7. Remove two hex socket-head screws (**2**), securing the transmission travel and gear select lever (**3**) to the steering column.
8. Remove the transmission travel and gear select lever (**3**) and collar (**4**).



d. Transmission Travel and Gear Select Lever Installation

1. Position the transmission travel and gear select lever (**3**) onto the steering column, aligning the pin (**5**) with the hole (**6**) in the steering column.
2. Attach the transmission travel and gear select lever with the collar (**4**) and two hex socket-head screws (**2**). Tighten the screws and nuts securely, but **DO NOT** overtighten. Overtightening will cause the select lever to break.
3. Plug the wiring connector (**1**) into the harness connector.
4. Install the left dash panel (**7**), and secure with four button-head capscrews.
5. Install the right dash panel (**8**), and secure with four button-head capscrews.



6. Connect the battery negative (-) cable or cables.

4.3.3 Steering Column/Valve Replacement

a. Steering Column and Valve Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the carriage, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake and turn the engine OFF.
2. Place an Accident Prevention Tag on the ignition key switch, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)

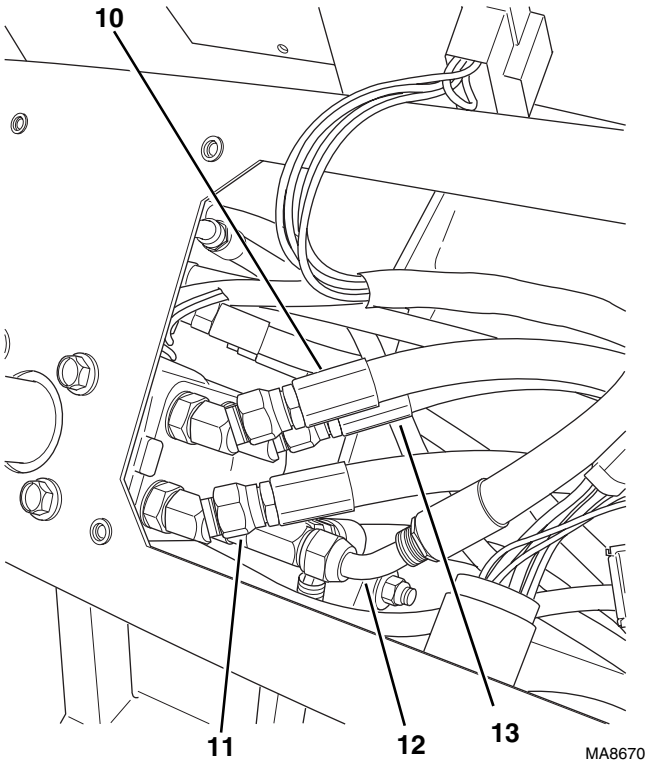
3. Unlock and open the rear door. Allow the engine and hydraulic fluid to cool.
4. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
5. Remove the four button-head screws securing the lower dash panel (**9**) to the cab. Remove the lower dash panel (**9**).
6. Remove the steering wheel. (Refer to Section 4.3.2, a. “Steering Wheel Removal.”)
7. Remove the transmission travel and gear selector lever. (Refer to Section 4.3.2, c. “Transmission Travel and Gear Select Lever Removal.”)

WARNING: Hydraulic fluid leaking under pressure can penetrate the skin, cause infection, gangrene, and death or serious personal injury. If injured, see a doctor immediately.

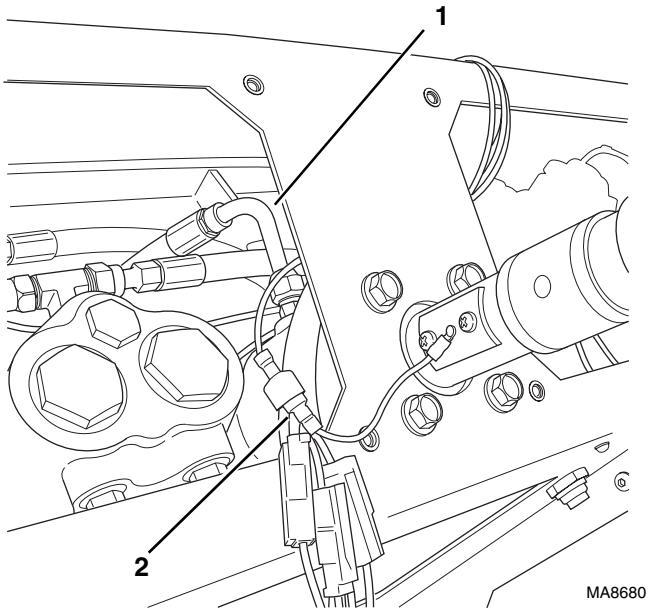
Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any parts or component.

WARNING: Wait for the hydraulic fluid to cool before servicing any hydraulic component. Hot hydraulic oil can cause severe burns.

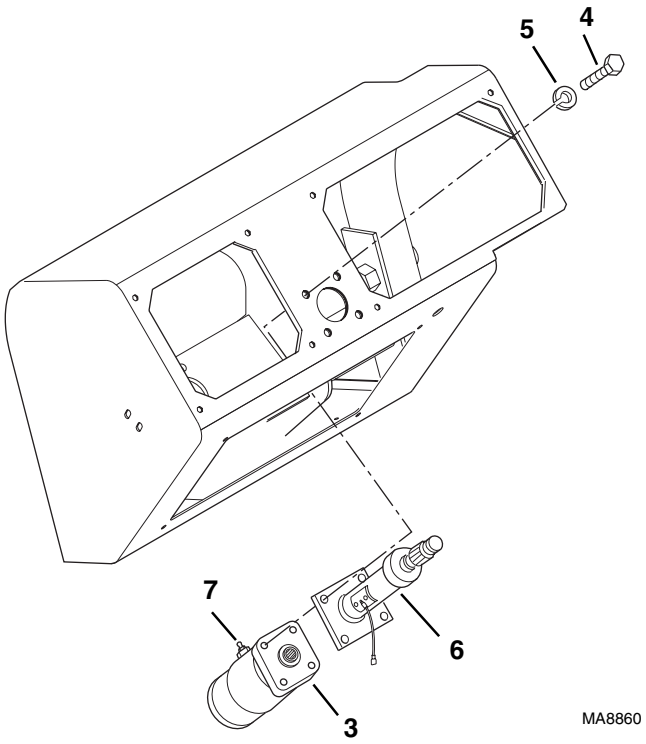
8. Working through the right dash panel opening, label, disconnect and cap the four hoses (**10** thru **13**) from the side of the steering valve. Cap the fittings on the steering valve.



9. Working through the right dash panel opening, label, disconnect and plug the load sense hose (**1**) at the top of the steering valve. Cap the fitting on the steering valve.
10. Disconnect the horn button wire (**2**) from the cab wiring harness.



11. Support the bottom of the steering valve (**3**), and remove the four hex-flange capscrews (**4**) and four lockwashers (**5**). Remove the steering valve through the lower dash panel opening.
12. Remove the steering column (**6**), by pushing it down, and removing it through the lower dash panel opening.



b. Steering Column and Valve Installation

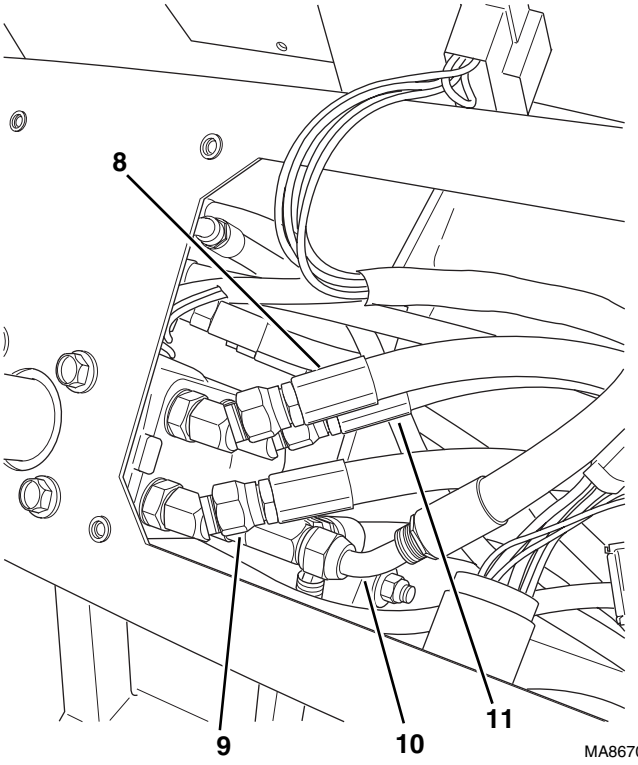
1. Install the steering column (**6**) and steering valve (**3**), by inserting them through the lower dash panel opening. Position steering valve in the cab, with the "LS" port (**7**) pointing forward (away from the operator). Secure the steering valve and column with four hex-flange capscrews (**4**) and four lockwashers (**5**). Torque capscrews to 13 lb-ft (18 Nm).

Note: *ALWAYS use new o-rings when servicing the vehicle.*

2. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
3. Connect the load sense hose (**1**) to the "LS" port at the top of the steering valve.
4. Connect the horn button wire (**2**) to the cab wiring harness.

Note: *ALWAYS use new o-rings when servicing the vehicle.*

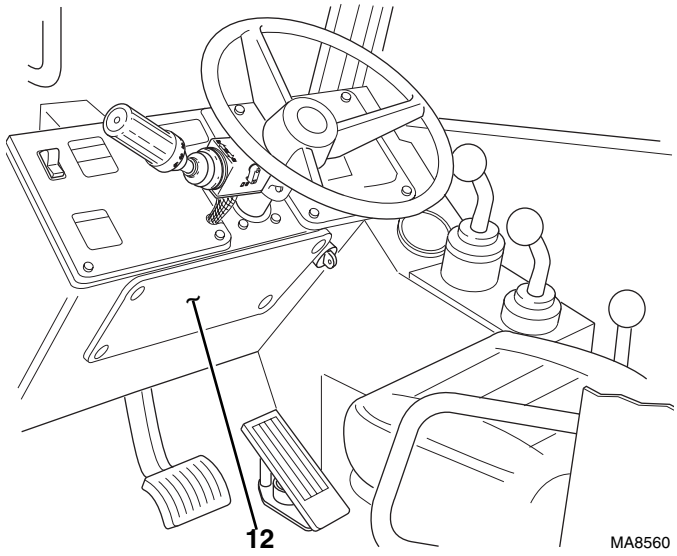
5. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
6. Working through the right dash panel opening, connect the four hoses (**8** thru **11**) to the appropriate ports, as noted in Step 8 of the removal procedure.



7. Install the transmission travel and gear selector lever. (Refer to Section 4.3.2, d. “Transmission Travel and Gear Select Lever Installation.”)
8. Install the steering wheel. (Refer to Section 4.3.2, b. “Steering Wheel Installation.”)
9. Connect the battery negative (-) cable or cables at the battery negative (-) terminal.
10. Carefully examine all connections one last time before engine start-up. Rectify any faulty conditions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

11. Start the engine and check the operation of steering system. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.
12. Install the lower dash panel (**12**) and secure with four button-head capscrews.



4.3.4 Brake Pedal and Valve

a. Brake Valve Removal

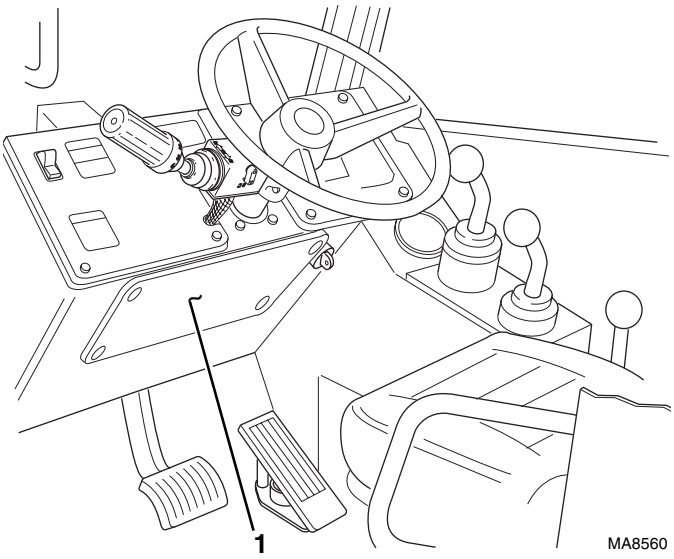
Refer to Section 8.12.3, a. “Service Brake Valve Removal,” for removal information.

b. Brake Valve Installation

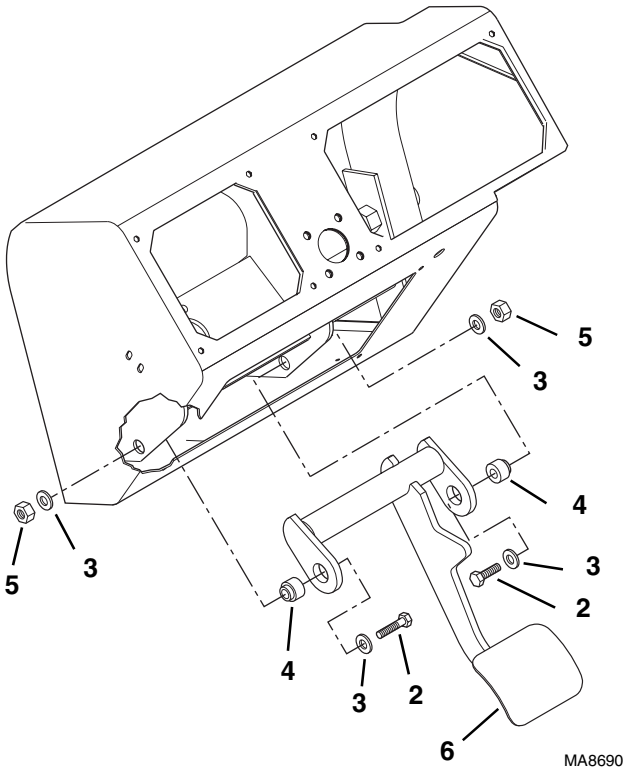
Refer to Section 8.12.3, b. “Service Brake Valve Installation,” for installation information.

c. Service Brake Pedal Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the rear door. Allow the engine and hydraulic fluid to cool.
4. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
5. Remove the four button-head capscrews securing the lower dash panel (**1**) to the cab. Remove the lower dash panel.



6. Remove the two capscrews (**2**), four flat washers (**3**), two pivots (**4**), and two hex nuts (**5**) securing the service brake pedal (**6**) to the cab.
7. Remove the service brake pedal (**6**) from the cab.



d. Service Brake Pedal Installation

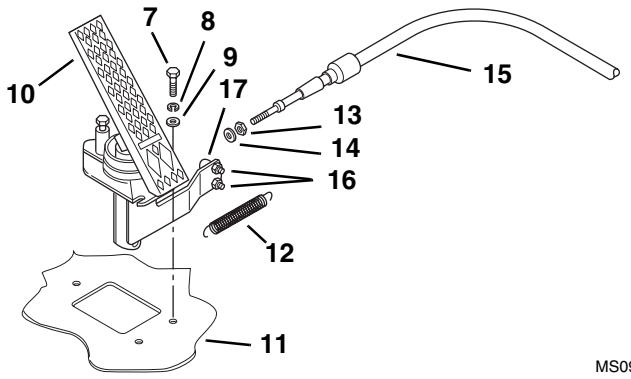
1. Position the service brake pedal (**6**) in its mounting location within the cab.
2. Insert two brake pedal pivots (**4**) into their mounting locations on the service brake pedal.
3. Install one flat washer (**3**) onto a capscrew (**2**). Work the capscrew through one side of the brake pedal-to-cab mounting support. Secure with a flat washer (**3**) and a hex nut (**5**). Repeat for the other side.
4. Adjust the brake switch as needed (refer to Section 9.14.19, c. “Service Brake Switch Adjustment.”)
5. Install and secure the lower dash cover (**1**) with four button-head capscrews.
6. Connect the battery negative (-) cable or cables to the battery negative (-) terminal.

4.3.5 Throttle Pedal Replacement

8042 S/N 13198 thru 18990
10042 S/N 13198 thru 19030
10054 S/N 13198 thru 19079

a. Throttle Pedal Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Remove three capscrews (**7**), three lockwashers (**8**) and three flat washers (**9**) securing the throttle pedal assembly (**10**) to the cab floor (**11**).
5. Remove the extension spring (**12**) from the throttle pedal assembly.
6. Remove the hex jam nut (**13**) and flat washer (**14**) securing the throttle cable (**15**) to the throttle pedal assembly (**10**).
7. Remove two locknuts (**16**), cable clamp (**17**) and extension spring (**12**). Remove the throttle cable from the throttle pedal assembly.
8. Remove the throttle pedal assembly (**10**) from the cab.



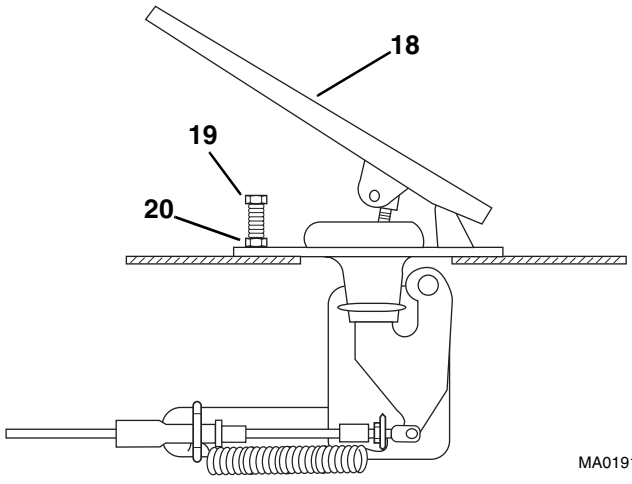
MS0930

b. Throttle Pedal Installation

1. Install the hex jam nut (**13**) and flat washer (**14**) onto the end of the throttle cable (**15**). Secure the cable to the throttle pedal (**10**). Secure the cable to the throttle pedal (**10**), with the cable clamp (**17**) and two locknuts (**16**).
2. Attach one end of the extension spring (**12**) to the throttle pedal lever beneath the pedal. Attach the other end of the spring to the cable clamp (**17**).
3. Align the throttle pedal assembly (**10**) with its mount holes in the cab floor (**11**).
4. Install three capscrews (**7**), three lockwashers (**8**) and three flat washers (**9**) securing the throttle pedal assembly to the cab floor (**11**). Torque the capscrews to 9 lb-ft (12 Nm).
5. Connect the battery negative (-) cable to the battery negative (-) terminal.

c. Throttle Adjustment

1. From within the cab, lightly depress the accelerator pedal (**18**) to the full-throttle position. As needed, adjust the limit-stop screw (**19**) until it touches the pedal. Tighten the locknut (**20**) to 120-125 lb-in (13,6-14,1 Nm).



MA01912

IMPORTANT: *During the full throttle check:*

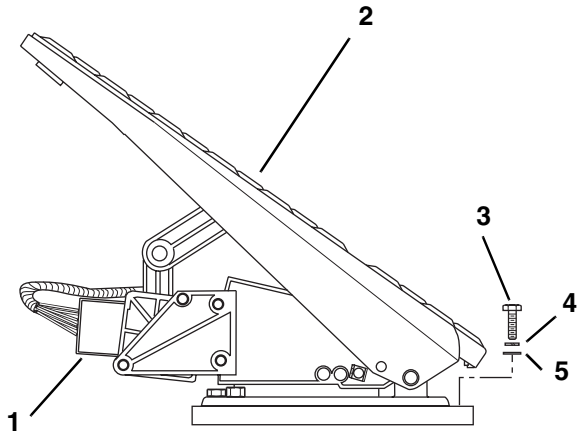
- ***DO NOT*** *operate any hydraulic function.*
- ***DO NOT*** *steer or apply any pressure to the steering wheel.*
- *Keep the transmission in (N) NEUTRAL.*

2. Check the engine rpm at full throttle. If the rpm is not 2600-2800 rpm, readjust the throttle limit-stop screw at the throttle pedal within the cab.

8042 S/N 18991 and After
10042 S/N 19031 and After
10054 S/N 19080 and After

a. Throttle Pedal Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) cables at the battery negative (-) terminals.
4. Disconnect the wire harness plug (**1**) from the front side of the throttle pedal (**2**).
5. Remove the capscrews (**3**), lockwashers (**4**) and flat washers (**5**) holding the throttle pedal (**2**) to the cab floor. Save all hardware for reassembly.
6. Remove the throttle pedal from the cab.



MH4280

b. Throttle Pedal Installation

1. Position the throttle pedal in the cab. Line up the mounting holes in the throttle pedal with the mounting holes in the cab floor.
2. Secure the throttle pedal (**2**) in place with the flat washers (**5**), lockwashers (**4**) and capscrews (**3**). Tighten securely.
3. Reconnect the wire harness plug (**1**) to the front of the throttle pedal (**2**). Snap the plug securely in place.
4. Connect the battery negative (-) cables to the battery negative (-) terminals.

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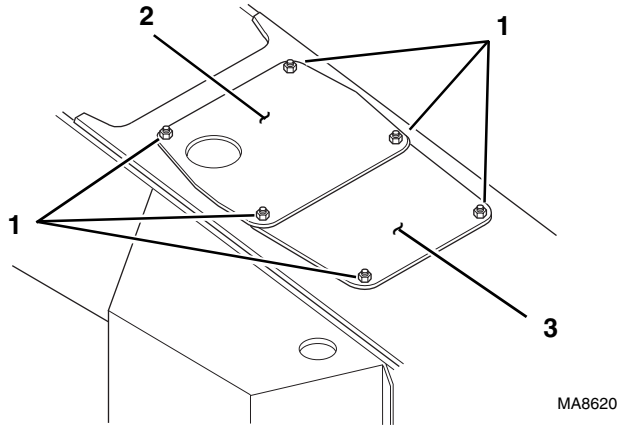
4.3.6 Joystick Assembly Replacement

Joystick Assembly Removal

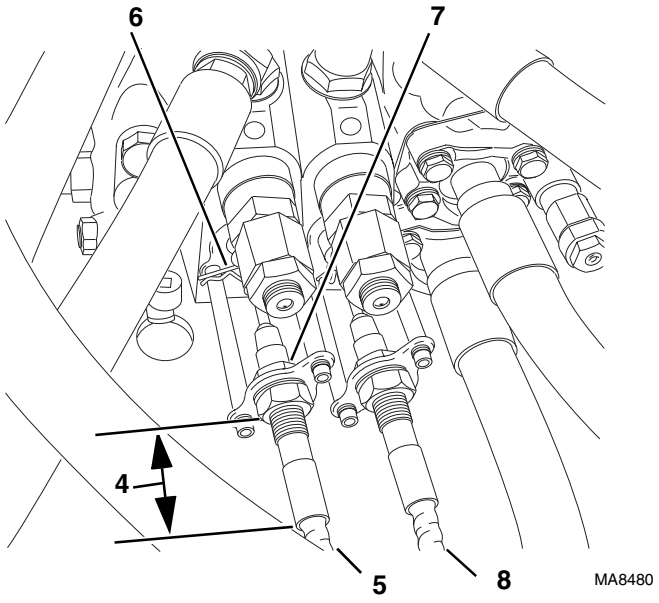
1. Park the vehicle on a firm, level surface. Set the park brake, ground the carriage, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake and turn the ignition OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
4. Remove six hex nuts, six lockwashers and six flat washers (**1**) securing the upper (**2**) and lower (**3**) transmission covers to the frame. Remove the covers.



Note: *Record the distance (**4**) from the outer jam nut to the end of the ferrule on all cables, to ensure correct adjustment when reinstalling cables.*

Note: *Record the location, and label all cables to ensure correct installation.*

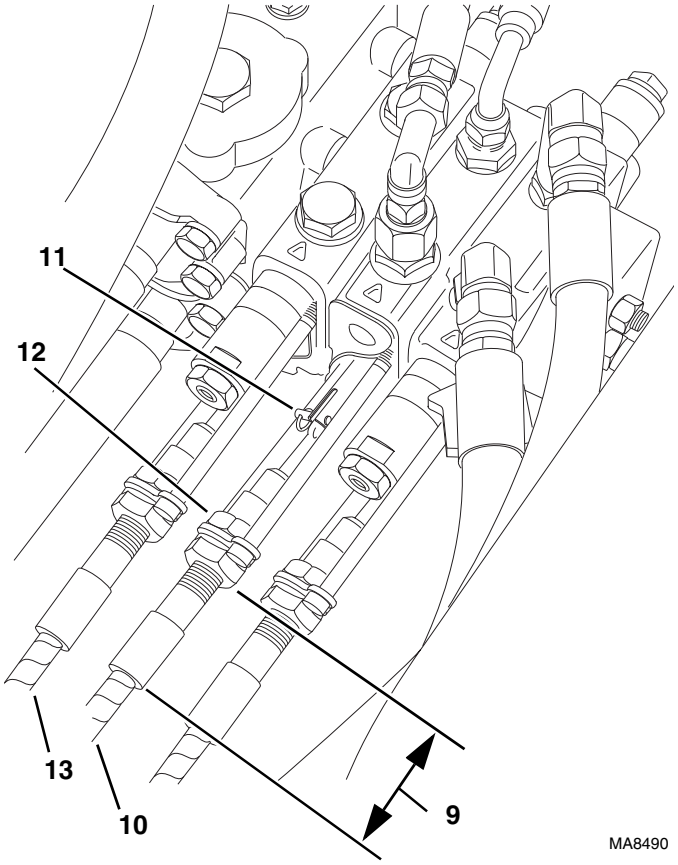
5. Disconnect the boom lift/lower control cable (**5**):
   a. Remove the spring pin (**6**) and anchor pin. Save the spring pin and anchor pin for installation.
   b. Loosen the outer jam nut (**7**), and remove the boom lift/lower control cable from the bracket. Save the jam nut for installation.
   c. Route the cable through the opening at the bottom of the frame.
6. Repeat Step 5 to remove the boom extend/retract control cable (**8**).



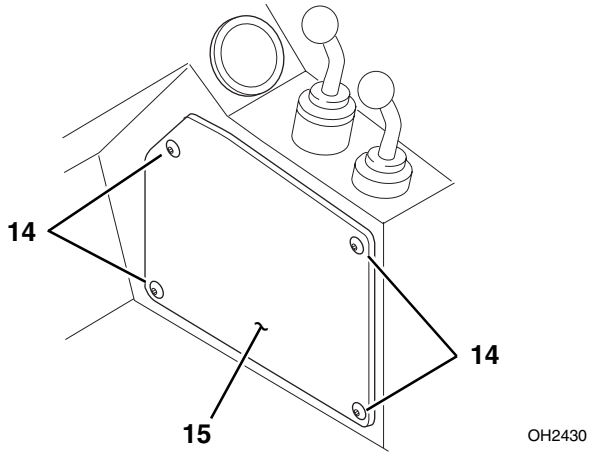
Note: *Record the distance (**9**) from the outer jam nut to the end of the ferrule on all cables, to ensure correct adjustment when reinstalling cables.*

Note: *Record the location, and label all cables to ensure correct installation.*

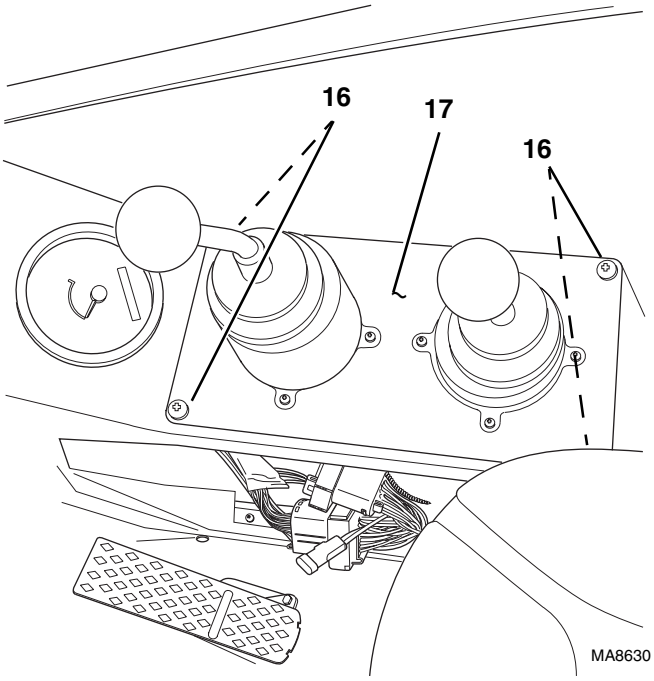
7. Disconnect the attachment tilt control cable (**10**):
   a. Remove the spring pin (**11**) and anchor pin. Save the spring pin and anchor pin for installation.
   b. Loosen and remove the inner jam nut (**12**), and remove the attachment tilt control cable from the bracket. Save the jam nut for installation.
   c. Route the cable through the opening at the bottom of the frame.
8. Repeat Step 7 to remove the frame sway control cable (**13**).



9. Remove four button-head capscrews (**14**) and remove the console panel (**15**).



10. Remove four button-head capscrews (**16**) and remove the joystick panel assembly (**17**) from the vehicle.

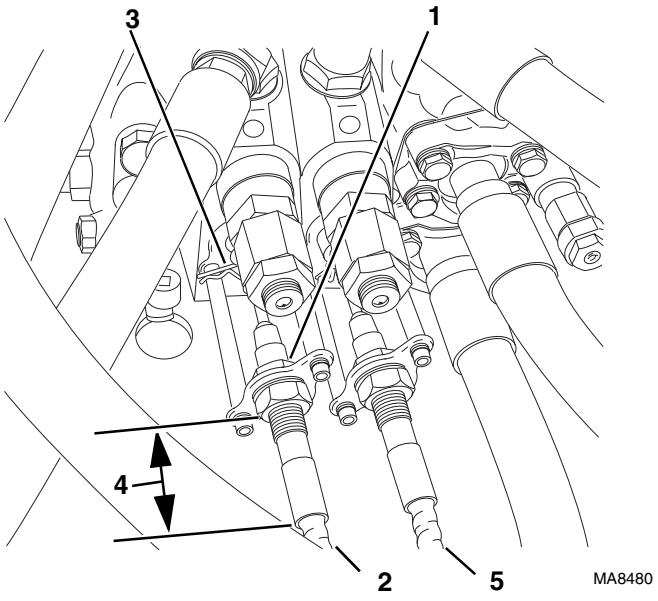


Joystick Assembly Installation

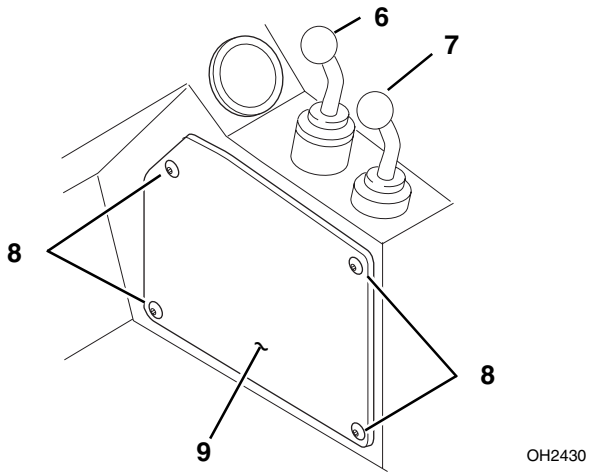
1. Route the control cables through the opening, the console, and through the opening at the bottom of the cab. Secure the joystick panel assembly (**17**) with four button-head capscrews (**16**).
2. Route the control cables through the opening at the bottom of the frame.
3. Connect the frame attachment tilt control cable to the main control valve assembly:
   a. Install the cable in the bracket, and slide the jam nut (**12**) over the end of the attachment tilt control cable (**10**). **DO NOT** tighten the jam nuts at this time.
   b. Connect the end of the cable to the shaft from the control valve. Secure with an anchor pin and spring pin (**11**).
   c. Adjust the jam nuts until the distance (**9**) from the inner jam to the end of the ferrule is the same as recorded during removal. Tighten the jam nuts.
4. Repeat Step 3 to install the frame sway control cable (**13**).

5. Connect the boom lift/lower control cable to the main control valve assembly:
   a. Install the cable in the bracket, and slide the jam nut (**1**) over the end of the boom lift/lower control cable (**2**). **DO NOT** tighten the jam nuts at this time.
   b. Connect the end of the cable to the shaft from the control valve. Secure with an anchor pin and spring pin (**3**).
   c. Adjust the jam nuts until the distance (**4**) from the outer jam to the end of the ferrule is the same as recorded during removal. Tighten the jam nuts.
6. Repeat Step 5 to install the boom extend/retract control cable (**5**).

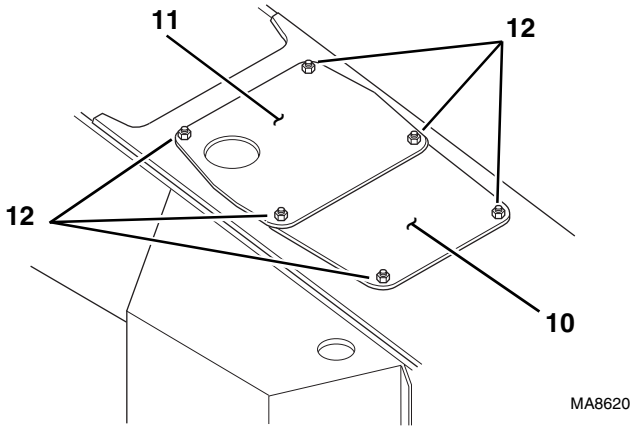
Note: *If any tie wraps were removed from the joystick cables beneath the vehicle frame, bundle the cables and secure with new tie wraps as required to prevent the cables from contacting any sharp edges or moving parts.*



7. Connect the battery negative (-) cable or cables to the battery negative (-) terminal.
8. Start the engine.
9. Test the boom extend/retract and boom lift/lower joystick (**6**) function:
   a. Move the joystick handle rearward, activating the boom lift function. The boom should RISE.
   b. Move the joystick handle forward, activating the boom lower function. The boom should LOWER.
   c. Move the joystick handle to the right, activating the boom extend function. The boom should EXTEND.
   d. Move the joystick handle to the left, activating the boom retract function. The boom should RETRACT.
10. Test the attachment tilt/frame sway joystick (**7**) function:
    a. Move the joystick handle rearward, activating the attachment tilt function. The attachment should TILT UP
    b. Move the joystick handle forward, activating the attachment tilt function. The attachment should TILT DOWN.
    c. Move the joystick handle to the right, activating the frame sway function. The boom should frame SWAY RIGHT.
    d. Move the joystick handle to the left, activating the frame sway function. The boom should frame SWAY LEFT.
11. Install the console panel (**9**) and secure using four button-head capscrews (**8**).



12. Install the upper (**11**) and lower (**10**) transmission covers; secure using six hex nuts, six lockwashers and six flat washers (**12**).



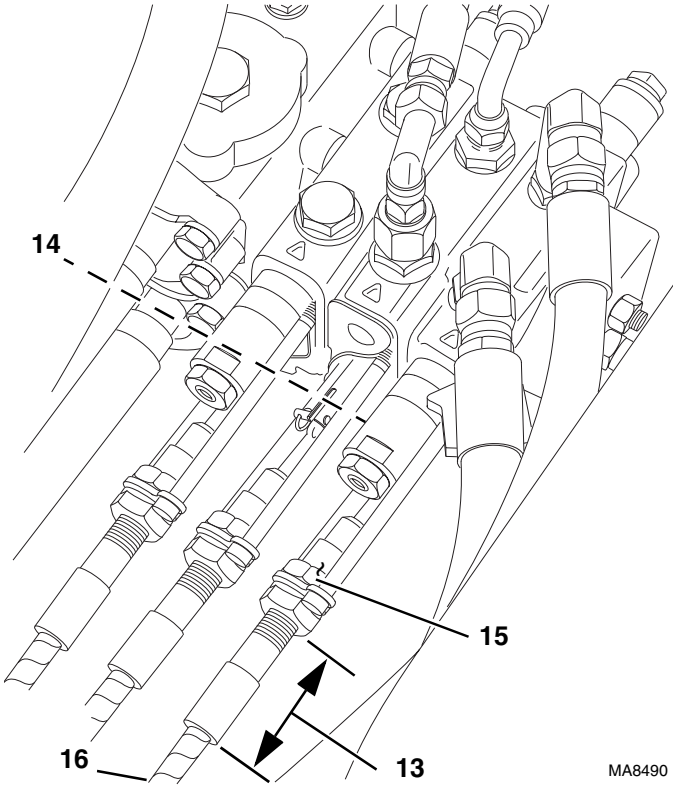
4.3.7 Auxiliary Hydraulic Joystick Assembly Replacement

a. Auxiliary Hydraulic Joystick Removal

1. Park the vehicle on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the rear door. Allow the engine and hydraulic fluid to cool.
4. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.
5. Remove six hex nuts, six lockwashers and six flat washers (**12**) securing the upper (**11**) and lower (**10**) transmission covers to the frame. Remove the covers.

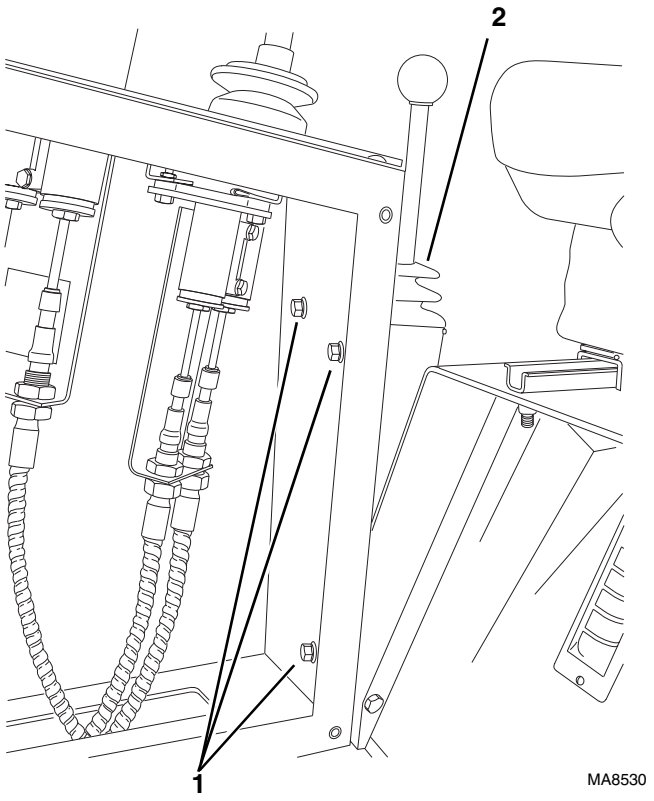
Note: *Record the distance (**13**) from the outer jam nut to the end of the ferrule on cable, to ensure correct adjustment when reinstalling cable.*

6. Disconnect the boom auxiliary hydraulic control cable:
   a. Remove the spring pin (**14**) and anchor pin. Save the spring pin and anchor pin for installation.
   b. Loosen and remove the inner jam nut (**15**), and remove the auxiliary hydraulic control cable (**16**) from the bracket. Save the jam nut for installation.
   c. Route the cable through the opening at the bottom of the frame.



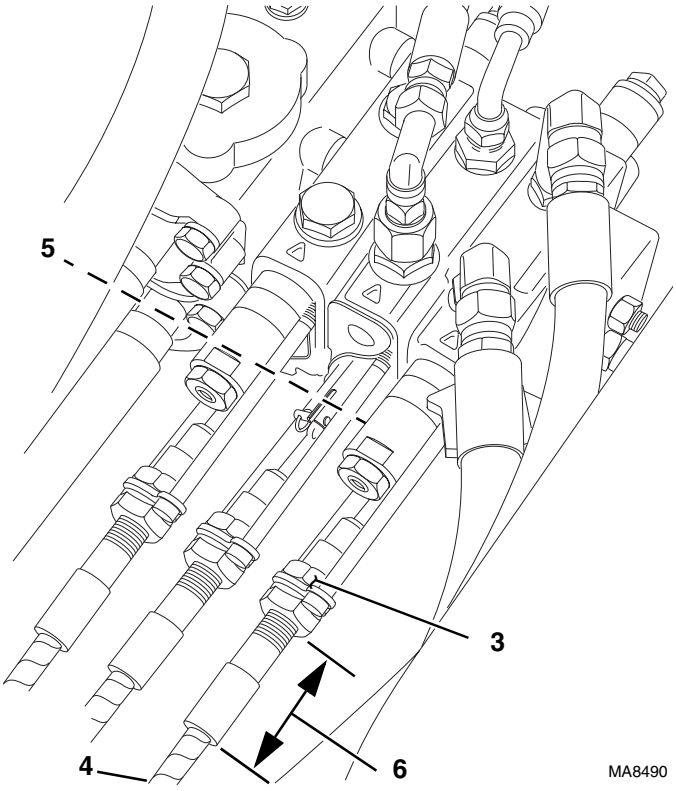
7. Remove four button-head capscrews (**8**) and remove the console panel (**9**).

8. Remove three capscrews (**1**), three lockwashers and three flat washers.
9. Remove the auxiliary hydraulic joystick assembly (**2**) from the vehicle.

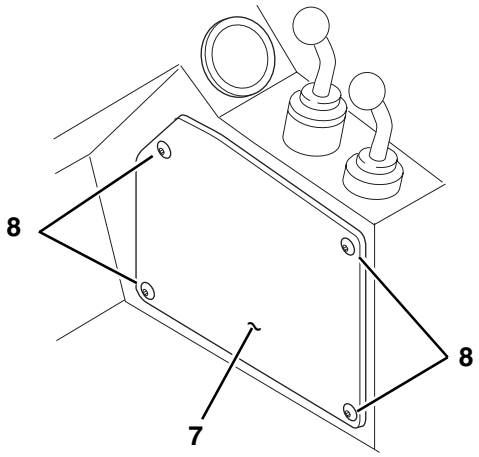


b. Auxiliary Hydraulic Joystick Installation

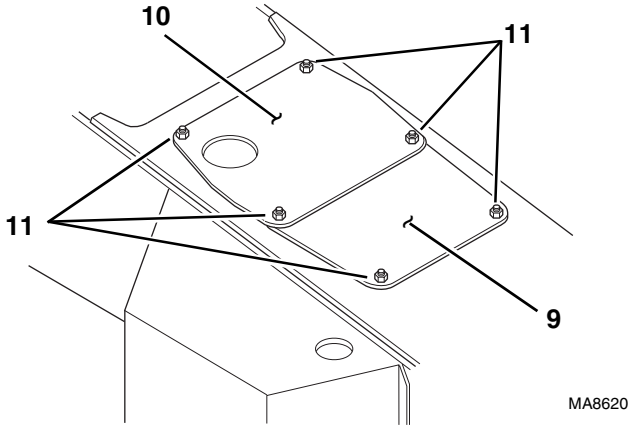
1. Route the control cable through the opening at the bottom of the cab.
2. Secure the auxiliary hydraulic joystick assembly (**2**) to the cab console with three capscrews (**1**), three lockwashers and three flat washers.
3. Connect the auxiliary hydraulic control cable to the main control valve:
   a. Slide the inner jam nut (**3**) over the end of the auxiliary hydraulic control cable (**4**), and install the cable in the bracket with one nut on either side of the bracket. **DO NOT** tighten the jam nuts at this time.
   b. Connect the end of the cable to the shaft from the control valve. Secure with an anchor pin and spring pin (**5**).
   c. Adjust the jam nuts until the distance (**6**) from the outer jam nut to the end of the ferrule is the same as recorded during removal. Tighten the jam nuts.



4. Install the console panel (**7**) and secure using four button-head capscrews (**8**).



5. Install the lower (**9**) and upper (**10**) transmission covers; secure using six hex nuts, six lockwashers and six flat washers (**11**).

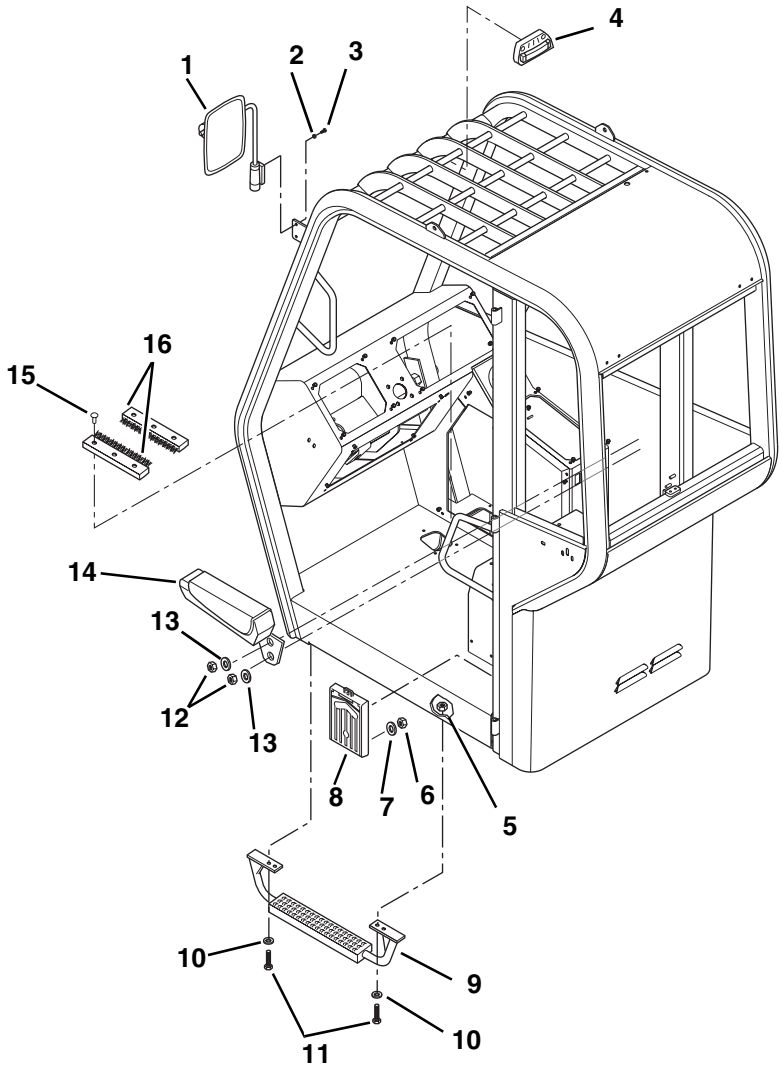


4.3.8 Electrical Components

a. Fuse Panel/Cab Harness

Refer to Section 9.1.1, “General Overview (Cab Harness).”

4.3.9 Miscellaneous Cab Components



1. Mirror Assembly
2. Lockwasher (2)
3. Hex Hd. Capscrew (2)
4. Tilt Angle Gauge
5. Lock Nut (4)
6. Lock Nut (3)
7. Flat Washer (3)
8. Document Holder
9. Step
10. Flat Washer (4)
11. Hex Hd. Capscrew (4)
12. Lock Nut (2)
13. Flat Washer (2)
14. Arm Rest
15. Self-Tapping Screw (6)
16. Brush Strip Assembly (2)

4.4 ENCLOSED CAB (OPTIONAL) COMPONENTS

4.4.1 Windshield Wiper Assembly

Refer to Section 9.12.2, “Windshield Wiper Motor,” for removal and installation information.

4.4.2 Roof Wiper Assembly

Refer to Section 9.12.4, “Skylight Wiper Motor,” for removal and installation information.

4.4.3 Windshield/Skylight Washer Assembly

Refer to Section 9.12.6, “Windshield/Skylight Washer Reservoir and Pump,” for removal and installation information.

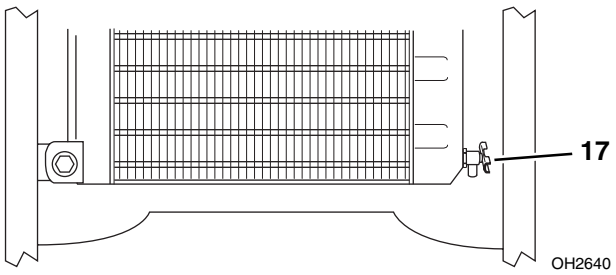
4.4.4 Heater/Defroster System

a. Heater Assembly Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the rear door. Allow the engine and hydraulic fluid to cool. Draining the cooling system while the engine block is hot can cause cracks in the engine block.
4. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.

> **WARNING:** Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

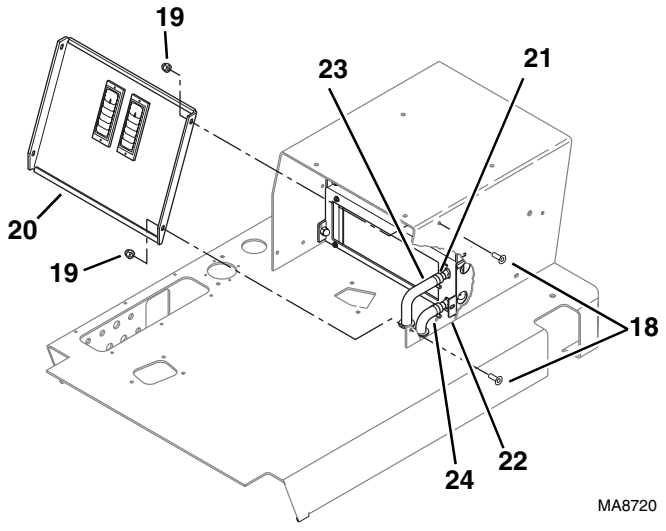
5. Place a suitable container beneath the radiator drain plug (**17**) or petcock. Slowly turn the radiator cap (not shown) to the first stop, and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Open the radiator drain plug or petcock (**17**) located on the right side or the right side bottom of the radiator and allow the coolant to drain. Replace the drain plug, or close the petcock.



7. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.

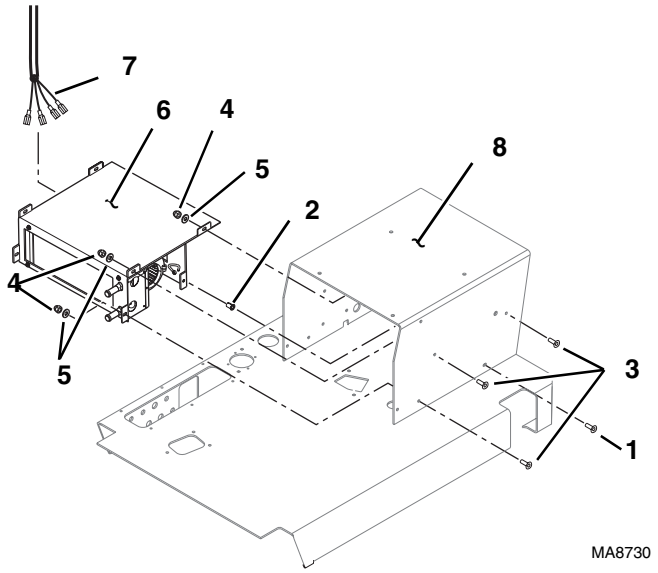
Note: *Label all hoses to ensure correct installation.*

8. Remove four button-head capscrews (**18**) and four acorn nuts (**19**). Remove the heater access panel (**20**).
9. Loosen the hose clamps (**21** and **22**), and disconnect the two heater hoses (**23** and **24**).
10. Pull the hoses (**23** and **24**) through the grommets.

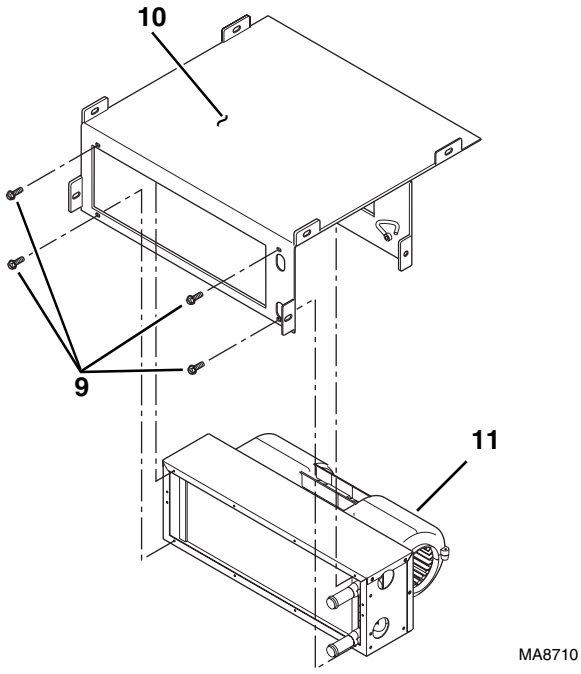


Note: *The button-head capscrew (**1**) at the lower rear position on each side of the heater will be secured with an insert nut (**2**).*

11. Remove eight button-head capscrews (**1** and **3**), six nuts (**4**) and six lockwashers (**5**).
12. Carefully pull the heater assembly (**6**) forward. Label and disconnect the wiring harness connections (**7**) at the blower.
13. Remove the heater assembly (**6**).



14. **If the heater assembly is to be replaced:** Remove four hex-slotted capscrews (**9**), and remove the mounting bracket (**10**) from the heater assembly (**11**).



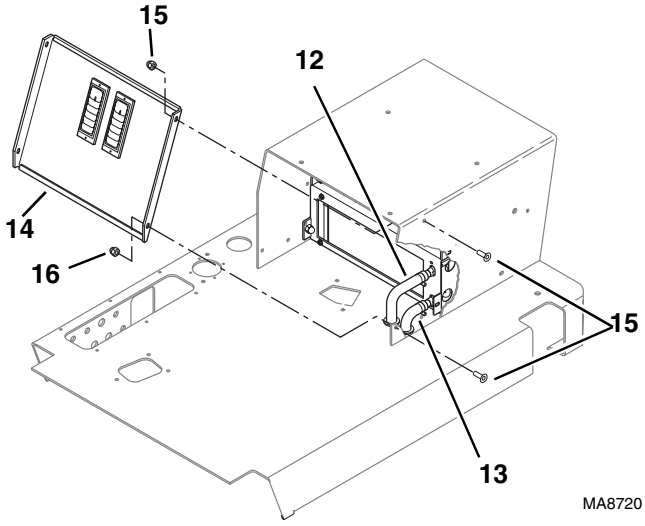
b. Heater Assembly Installation

1. Connect the wiring harness connections (**7**) to the blower.

Note: *The button-head capscrew (**1**) at the lower rear position on each side of the heater will be secured with an insert nut (**2**).*

2. Slide the heater/mounting bracket assembly (**6**) into the seat riser (**8**), and secure with eight button-head capscrews (**1** and **3**), six lockwashers (**5**) and six nuts (**4**).

3. Pull the hoses (**12** and **13**) through the grommets, and connect to the heater. Secure with two hose clamps.
4. Install the heater access panel (**14**) and secure with four button-head capscrews (**15**) and four acorn nuts (**16**).



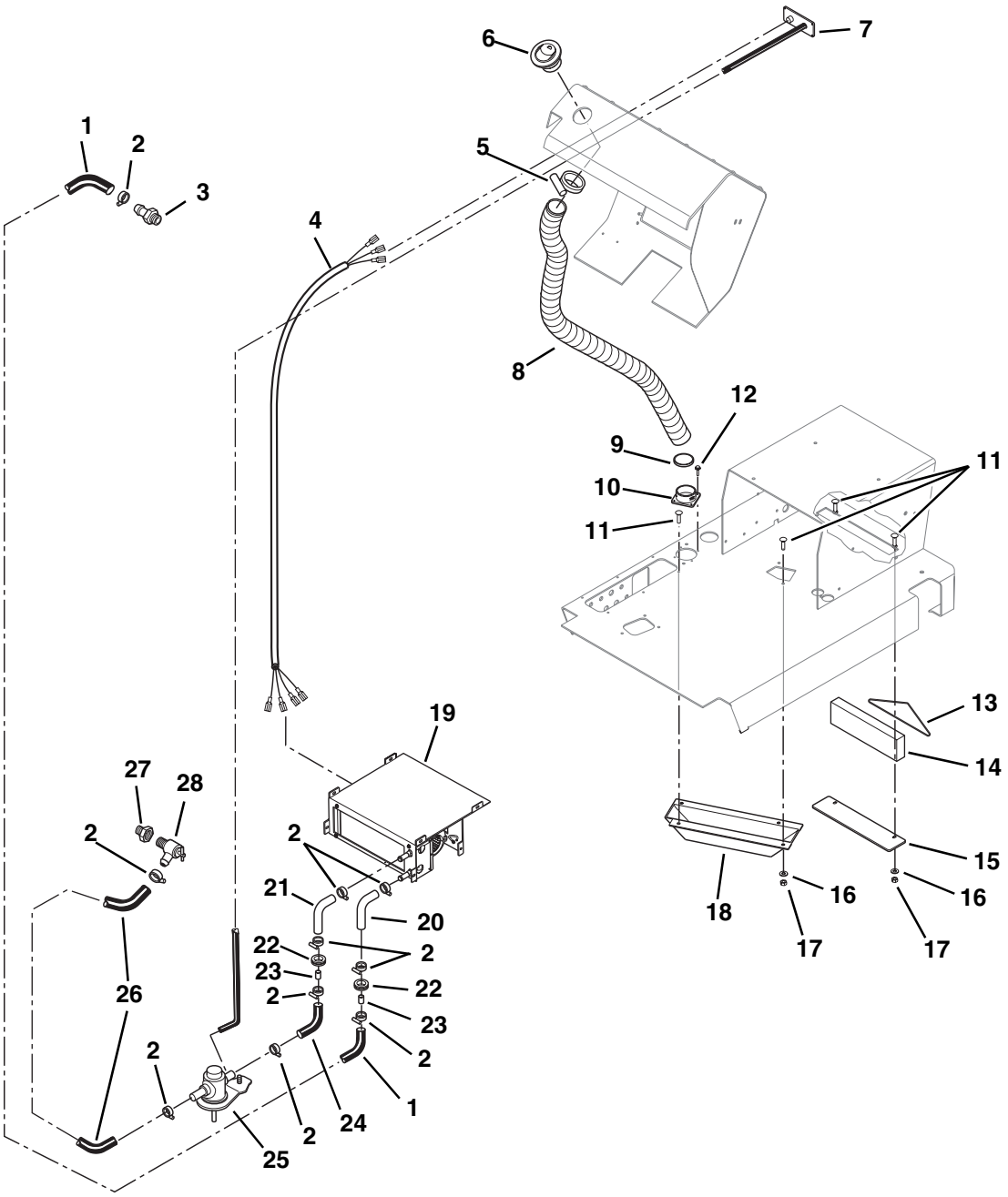
5. Fill the cooling system completely with a 50/50 mixture of ethylene glycol and water, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.5.8, “Fluid and Lubricant Capacities.”
6. Connect the battery negative (-) cable or cables to the battery negative (-) terminal.

IMPORTANT: *When the engine is initially started, run it briefly at low idle and check the vehicle for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.*

WARNING: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, NEVER remove the radiator cap while the cooling system is hot. Wear safety glasses. Turn the radiator cap to the first stop and allow pressure to escape before removing the cap completely.

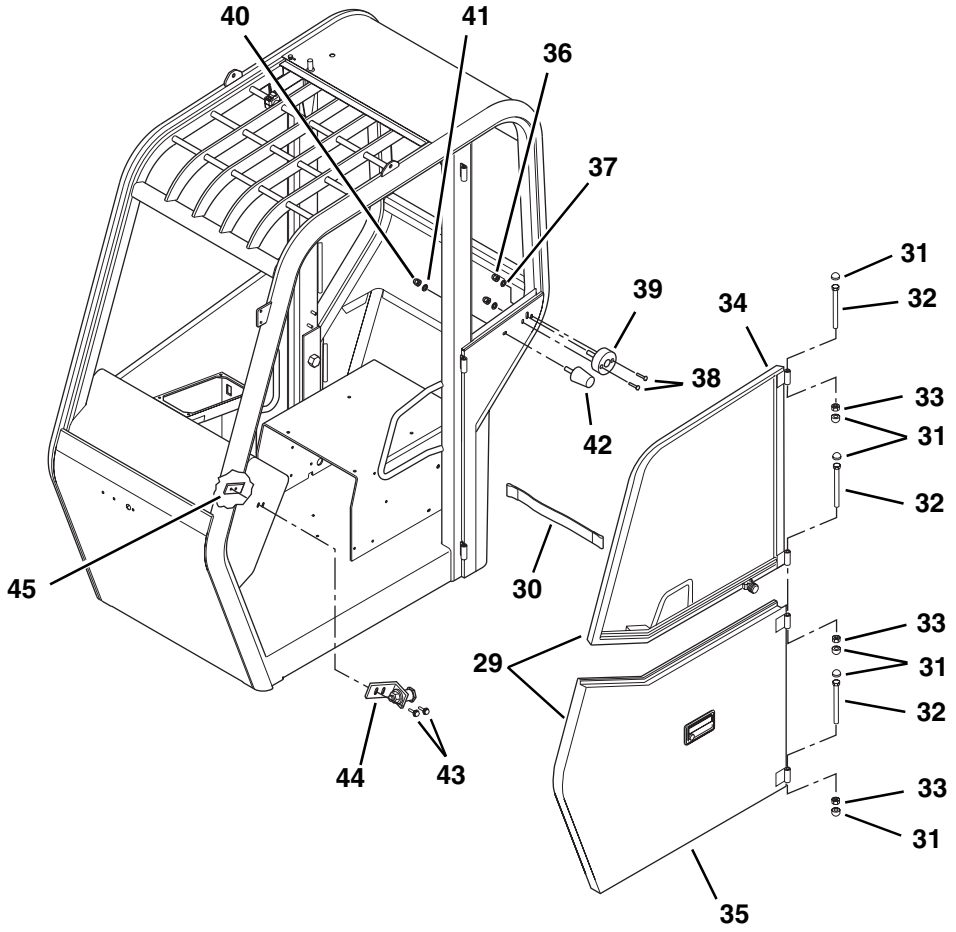
7. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.

4.4.5 Heater/Defroster System Components



1. Heater Hose (return to engine)
2. Hose Clamp (10)
3. Reducer
4. Wiring Harness
5. Hose Clamp
6. Defroster Duct
7. Heater/Fan Control
8. Defroster Hose
9. Wire Tie
10. Hose Adapter
11. Carriage Bolt (6)
12. Self-Drilling Screw (4)
13. O-ring
14. Air Filter
15. Filter Access Plate
16. Lockwasher (6)
17. Acorn Nut (6)
18. Heater Duct
19. Heater Assembly
20. 90° Elbow - Lower Heater Hose
21. 90° Elbow - Lower Heater Hose
22. Grommet (2)
23. 5/8" Copper Spice (2)
24. Heater Hose
25. Heater Control Valve
26. Heater Hose (from engine)
27. Reducer
28. Valve

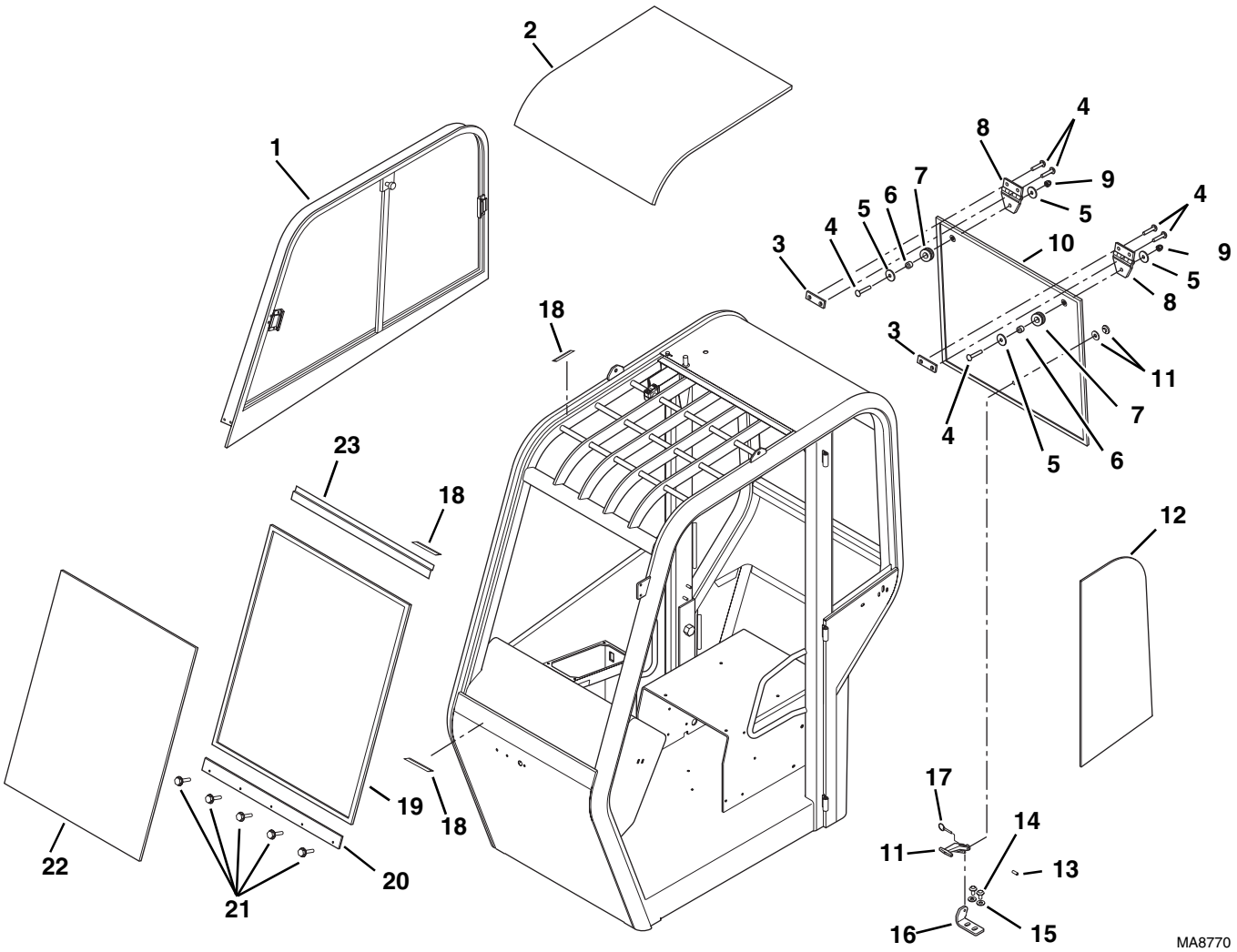
4.4.6 Door and Latches



29. Door Assembly
30. Strap
31. Cap (6)
32. Hex Head Capscrew (3)
33. Hex Nut (3)
34. Upper Door Section
35. Lower Door section
36. Acorn Nut (2)
37. Lockwasher (2)
38. Screw (2)
39. Female Door Retainer
40. Acorn Nut
41. Lockwasher
42. Door Bumper
43. Lockscrew (2)
44. Striker Assembly
45. Nut Plate

4.4.7 Windows

Note: *The slider window assembly (**1**), skylight glass (**2**) and left side rear glass (**12**) are bonded to the cab with adhesive.*



1. Slider Window Assembly
2. Skylight Glass
3. Rear Window Hinge Block (2)
4. Torx Screw (6)
5. Flat Washer (4)
6. Bushing (2)
7. Grommet (2)
8. Hinge (2)
9. Acorn Nut (2)
10. Rear Window
11. T-Handle Latch (with mounting hardware)
12. Left Side Rear Glass
13. Roll Pin
14. Torx Screw (2)
15. Washer (2)
16. Rear Window Mount Latch
17. Dent Ring Pin
18. Setting Block (8)
19. Double “D” Bulb Seal
20. Lower Windshield Plate
21. Self-Tapping Screw (5)
22. Windshield Glass
23. Upper Windshield Clip

4.5 CAB REMOVAL

WARNING: Risk of death or serious personal injury. **NEVER** modify, weld or drill the cab.

WARNING: The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

IMPORTANT: *To help ensure safety and optimum performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.*

Before performing any inspection, maintenance or service operation, thoroughly clean the vehicle. **DO NOT** spray water or cleaning solution in, on, near or around the operator's dash panels and electrical components.

Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, with any questions about the suitability or condition of a cab.

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot injury from falling objects or other bodily injury from slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling or hoist. Failure to comply can result in death or serious personal injury.

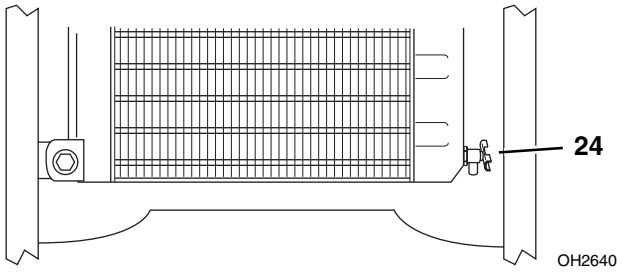
IMPORTANT: *Remove and label cab components as needed before removing the cab from the vehicle. Label, disconnect and cap hydraulic hoses. Transfer cab parts to the replacement cab after the replacement cab is securely mounted on the vehicle.*

1. Park the vehicle on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Unlock and open the rear door. Allow the engine and hydraulic fluid to cool.
3. Disconnect the battery negative (-) cable or cables at the battery negative (-) terminal.

Note: *Steps 4 thru 8 apply to vehicles equipped with optional heater (enclosed cab models only). If your vehicle does not have the optional heater, proceed to Step 9.*

WARNING: Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

4. Place a suitable container beneath the radiator drain plug or petcock (**24**). Slowly turn the radiator cap (not shown) to the first stop, and allow any pressure to escape. Remove the radiator cap.
5. Place a funnel at the base of the radiator to channel the drained coolant into the container. Open the radiator drain plug or petcock (**24**) located on the right side or the right side bottom of the radiator and allow the coolant to drain. Replace the drain plug, or close the petcock.

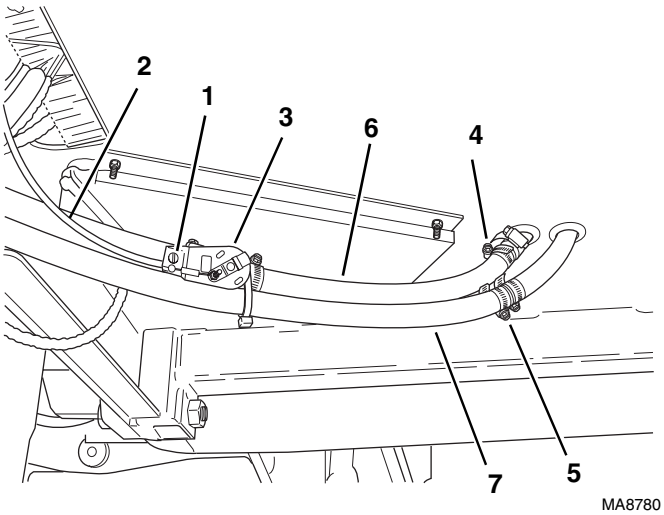


6. Transfer the coolant to a container with a cover, and label as "Used Antifreeze." Dispose of the used coolant at an approved recycling facility.

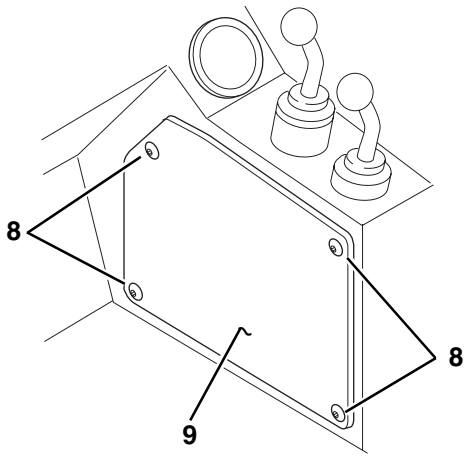
7. Working under the cab, loosen the clamp screw (**1**) and disconnect the heater control cable (**2**) from the heater control valve (**3**).

Note: *Label all hoses to ensure correct installation.*

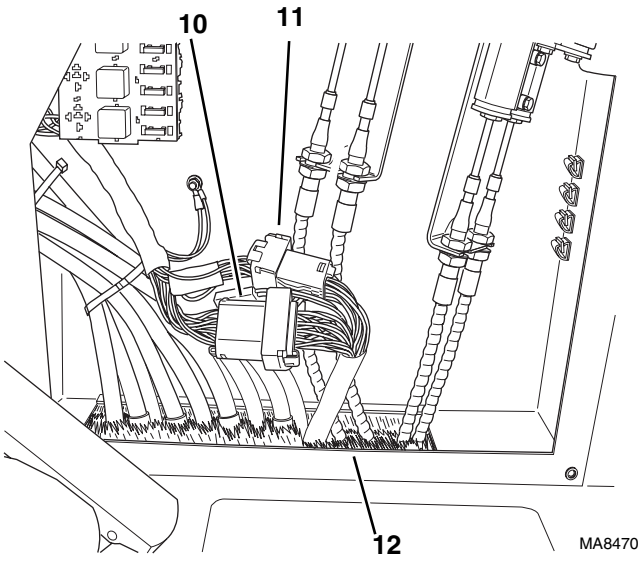
8. Loosen the hose clamps (**4** and **5**), and disconnect the heater hoses (**6** and **7**).



9. Remove four button-head capscrews (**8**) and remove the console panel (**9**).

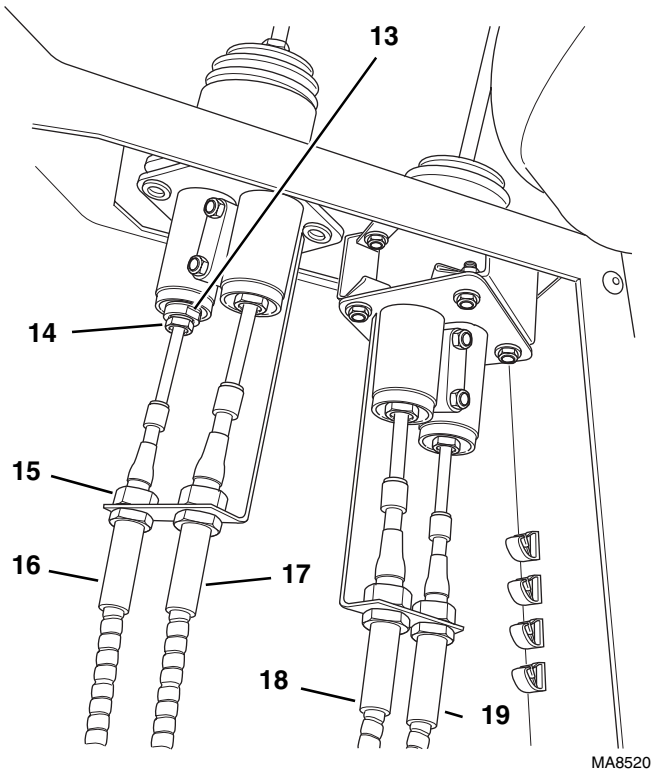


10. Disconnect the two cab-to-wiring harness connectors (**10** and **11**). Push the harness connectors through the opening (**12**) at the bottom of the cab.



Note: *Record the location, and label all cables to ensure correct installation.*

11. Disconnect control cables at the joystick:
    a. Push the control lever to expose the flats (**13**) on the slider head. Place a wrench on the flats to hold the slider head, and loosen the cable nut (**14**).
    b. Loosen the upper jam nut (**15**), and remove the boom extend/retract cable (**16**) from the bracket.
    c. Push the cable through the opening at the bottom of the cab.
    d. Repeat Steps a thru c to disconnect the boom lift/lower (**17**), attachment tilt (**18**) and frame sway (**19**) control cables.

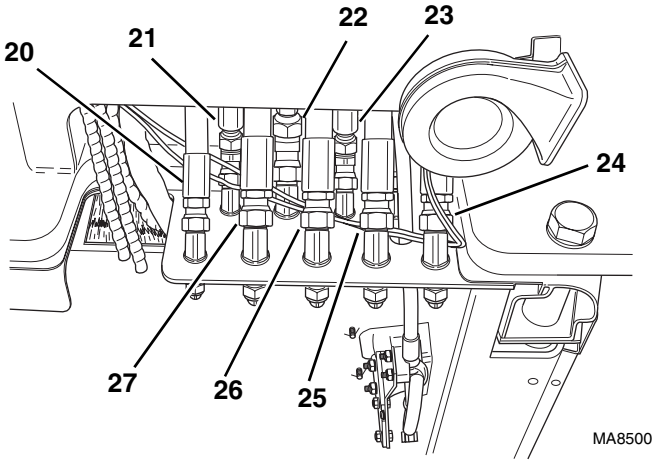


12. **Vehicles equipped with auxiliary hydraulic only**: Remove the auxiliary hydraulic joystick assembly. (Refer to Section 4.3.7, a. “Auxiliary Hydraulic Joystick Removal.”)

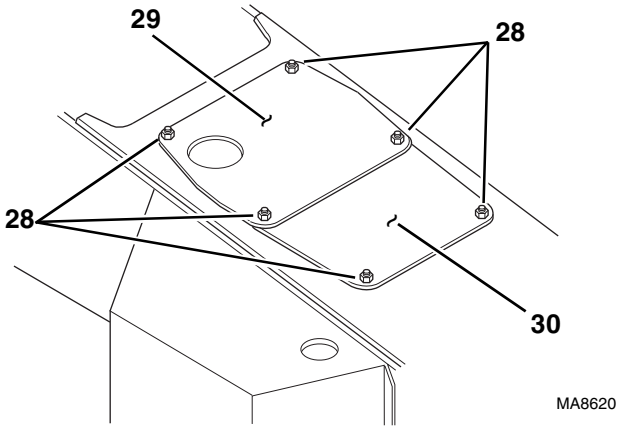
> **WARNING:** Hydraulic fluid leaking under pressure can penetrate the skin, cause infection, gangrene, and death or serious personal injury. If injured, see a doctor immediately.
>
> Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any parts or component.

> **WARNING:** Wait for the hydraulic fluid to cool before servicing any hydraulic component. Hot hydraulic oil can cause severe burns.

13. Working under the cab, label and disconnect the hydraulic hoses (**20** thru **27**) at the cab fittings. Plug the hoses and cap the fittings.



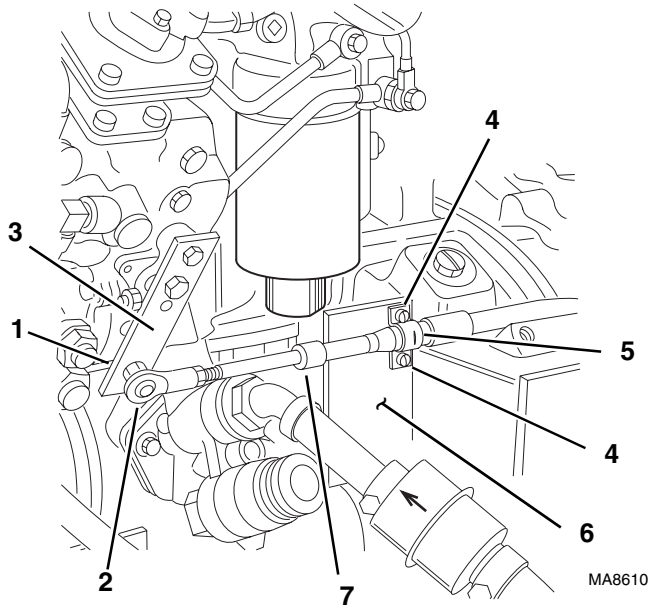
14. Remove six hex nuts, six lockwashers and six flat washers (**28**) securing the upper (**29**) and lower (**30**) transmission covers to the frame. Remove the covers.



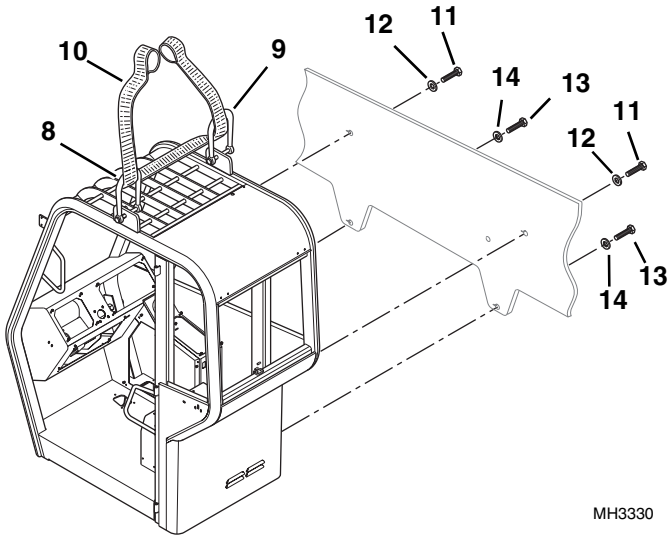
15. Unlock and open the right engine access door.

Follow steps 16 thru 18 for: 8042 S/N 13198 thru 18990, 10042 S/N 13198 thru 19030 or 10054 S/N 13198 thru 19079.

16. Remove one elastic locknut (**1**). Disconnect the throttle cable rod end (**2**) at the throttle lever extension bracket (**3**).
17. Remove two slotted pan-head screws (**4**) two lockwashers, two hex nuts and clamp (**5**) from the throttle cable bracket (**6**).
18. Cut the wire ties securing the throttle cable to the hydraulic hoses on the right side of the frame, and route the throttle cable (**7**) out of the engine compartment and through the opening in the bottom of the frame. Allow the cable to hang beneath the cab.



19. Attach a clevis (**8** and **9**) to each of the cab lifting brackets. Route a sling (**10**) with a suitable lifting capacity to carry the weight of the cab through the clevis' to a hoist or overhead crane. Make sure the sling is centered between the clevis' to ensure even lifting.
20. Remove the two upper cab-to-frame capscrews (**11**) and two flat washers (**12**).
21. Remove the two lower cab-to-frame capscrews (**13**) and two flat washers (**14**).



22. Remove the mirrors and all other cab components, refer to Section 4.4.5, "Heater/Defroster System Components," Section 4.4.6, "Door and Latches," and Section 4.4.7, "Windows," as needed, if not previously removed.
23. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed. If the throttle cable (for 8042 S/N 13198 thru 18990, 10042 S/N 13198 thru 19030 or 10054 S/N 13198 thru 19079) is still attached to the cab, reposition or remove the throttle cable as necessary.
24. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift the cab and remove it from the frame. Readjust the position of the sling as needed to help balance the cab during removal.
25. When the cab is completely clear of the vehicle, carefully lower it to the ground. Block up or support the cab so that it does not move or fall. Assure that no personnel enter the cab while it is being removed from the vehicle.
26. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
27. Inspect and replace other vehicle parts that are exposed with the cab removed. Repair or replace as required.

4.6 CAB INSTALLATION

WARNING: Wear protective footwear with reinforced toe caps and slip-resistant soles. Failure to comply can result in foot injury from falling objects or other bodily injury from slipping or falling.

WARNING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling or hoist. Failure to comply can result in death or serious personal injury.

1. Block all four wheels to help prevent the vehicle from moving. Assure that there is sufficient overhead and side clearance for cab installation.
2. Attach a clevis (**8** and **9**) to each of the cab lifting brackets. Route a sling (**10**) with a suitable lifting capacity to carry the weight of the cab through the clevis' to a hoist or overhead crane. Make sure the sling is centered between the clevis' to ensure even lifting.
3. Use a hoist or overhead crane and sling attached to the cab. Carefully begin to align the cab with the mounting holes in the frame. Stop and check that wiring, hydraulic hoses, cables, etc., will not be pinched or damaged as the cab is positioned. Readjust the position of the sling as needed to help balance the cab during installation.
4. Install the two upper capscrews (**11**) and two flat washers (**12**). Torque the capscrews to 480 lb-ft (651 Nm).
5. Install the two lower capscrews (**13**) and two flat washers (**14**). Torque the capscrews to 480 lb-ft (651 Nm).
6. Route the throttle cable (on serial numbers so equipped) through the opening in the bottom of the frame, along the front of the transmission, along the hydraulic hoses on the right side of the frame and through the openings in the frame to the engine compartment.
7. Secure the throttle cable to the hydraulic hoses using wire ties.
8. Install the throttle cable (**7**) on the throttle cable bracket (**6**), using a clamp (**5**) and two slotted pan-head screws (**4**), two lockwashers and two hex nuts.

Note: *ALWAYS replace elastic-lined nuts with new elastic-lined nuts to help ensure proper fastening.*

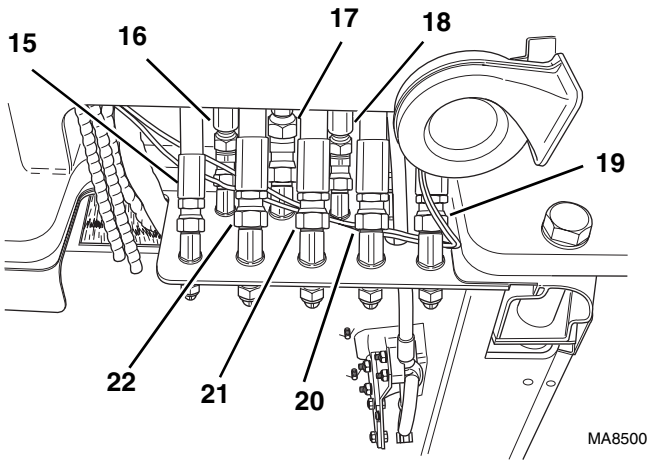
9. Connect the throttle cable rod end (**2**) to the throttle lever extension bracket (**3**) using one new elastic locknut (**1**).

Continue with next step for all serial numbers.

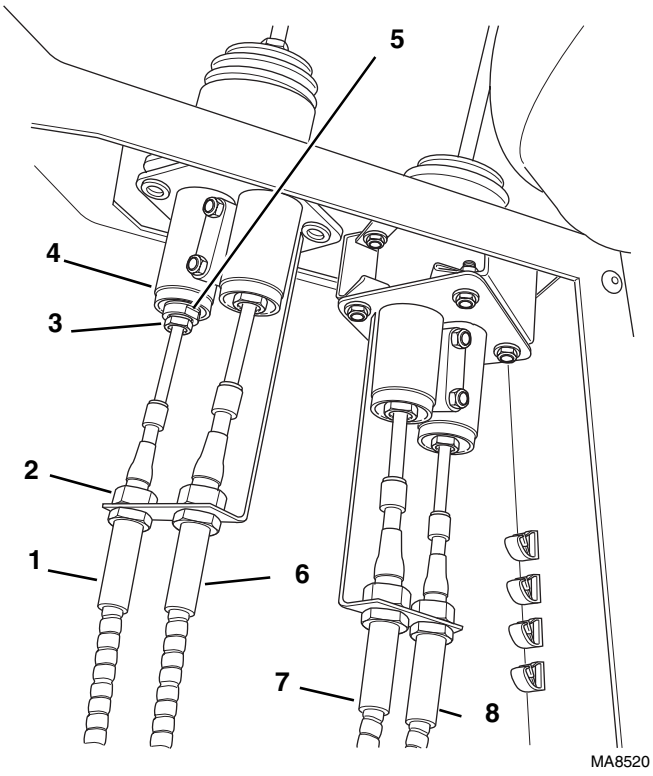
10. **Vehicles equipped with auxiliary hydraulic only**: Install the auxiliary hydraulic joystick assembly. (Refer to Section 4.3.7, b. "Auxiliary Hydraulic Joystick Installation.")

Note: *ALWAYS use new o-rings when servicing the vehicle.*

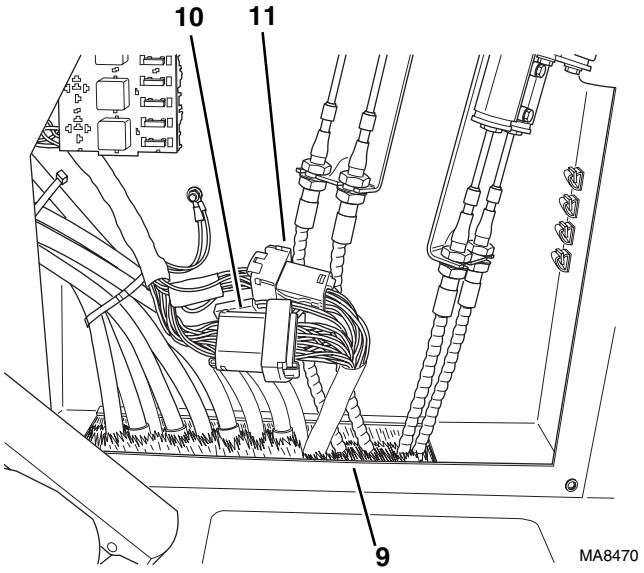
11. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
12. Working under the cab, connect the hydraulic hoses (**15** thru **22**) at the cab fittings.



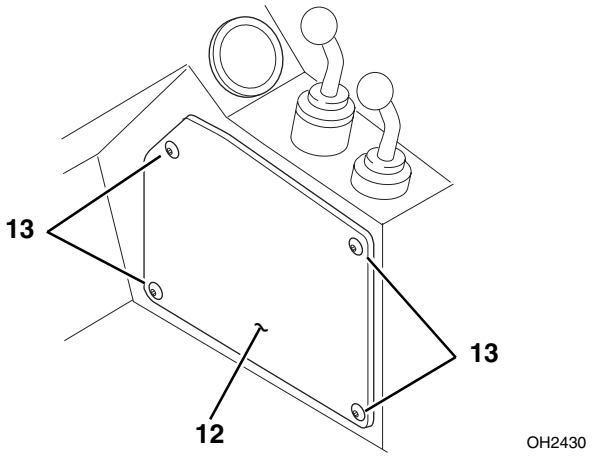
13. Route the control cables through the opening at the bottom of the cab.
14. Connect control cables at the joystick:
    a. Install the end of the boom extend/retract cable (**1**) into the slider head (**4**) as recorded during removal. Tighten the upper jam nut (**2**).
    b. Loosely install the cable nut (**3**) into the slider head (**4**).
    c. Engage the control lever to expose the flats (**5**) on the slider head. Place a wrench on the flats to hold the slider head, and tighten the cable nut (**3**) to a maximum of 55 lb-ft (75 Nm).
    d. Repeat Steps a thru c to connect the boom lift/lower (**6**), attachment tilt (**7**) and frame sway (**8**) control cables.



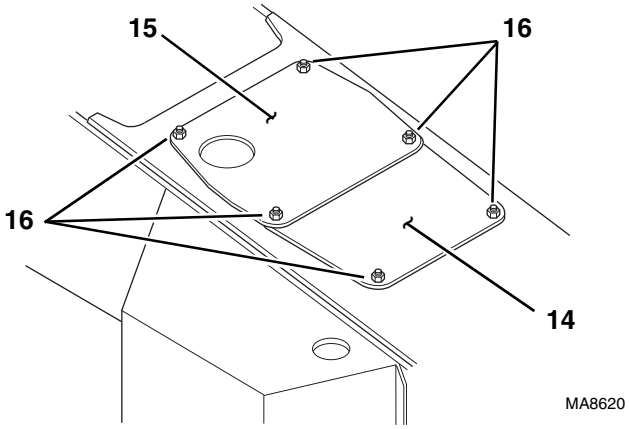
15. Route the wiring harness connectors through the opening (**9**) at the bottom of the cab and up into the side console.
16. Connect the two cab-to-wiring harness connectors (**10** and **11**).



17. Install the console panel (**12**), and secure using four button-head capscrews (**13**).

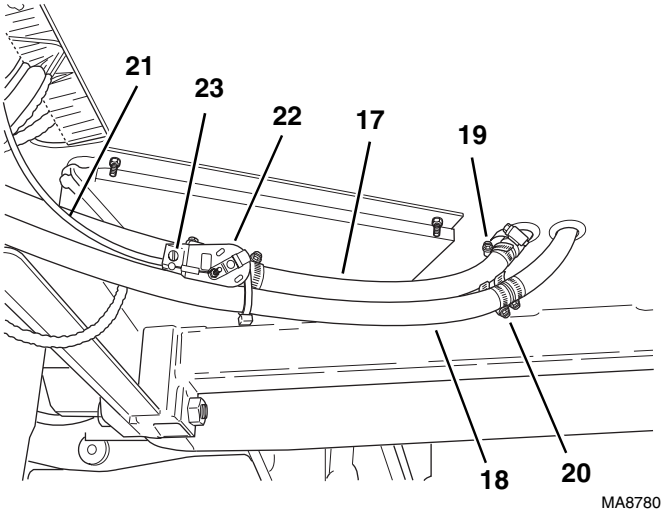


18. Install the lower (**14**) and upper (**15**) transmission covers; secure using six hex nuts, six lockwashers and six flat washers (**16**).



Note: *Steps 19 thru 21 apply to vehicles equipped with optional heater (enclosed cab models only). If your vehicle does not have the optional heater, proceed to Step 22.*

19. Working under the cab, connect the coolant hoses (**17** and **18**) to the heater hoses. Secure with two hose clamps (**19** and **20**).
20. Connect the heater control cable (**21**) to the heater control valve (**22**). Tighten the hose clamp screw (**23**).



21. Fill the cooling system completely with a 50/50 mixture of ethylene glycol and water, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.5.8, “Fluid and Lubricant Capacities.”
22. Connect the battery negative (-) cable or cables to the battery negative (-) terminal.
23. Carefully examine all cab components, fasteners, etc., one last time before engine start-up. Rectify any faulty conditions.

WARNING: Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

24. Start the engine and check the operation of all controls. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.

IMPORTANT: *When the engine is initially started, run it briefly at low idle and check the vehicle for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.*

WARNING: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, NEVER remove the radiator cap while the cooling system is hot. Wear safety glasses. Turn the radiator cap to the first stop and allow pressure to escape before removing the cap completely.

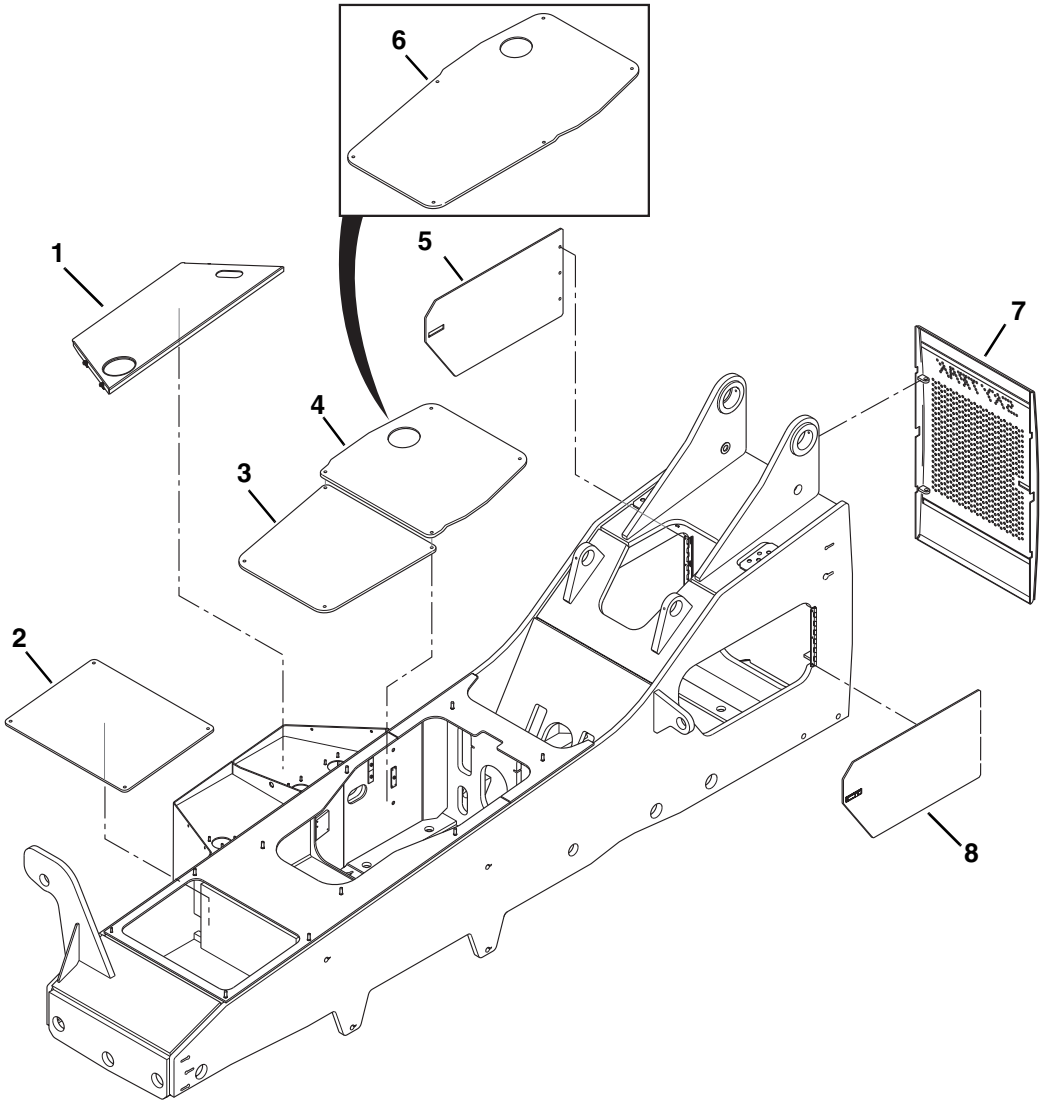
25. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.

4.7 ACCESS PANELS AND COVERS

4.7.1 Access Panel and Cover Replacement

Note: *Refer to appropriate parts manual for mounting hardware.*

The vehicle is equipped with various access panels and covers. Removal and installation are easily accomplished by observing the mounting configurations as shown.



MH3340

1. Hydraulic Oil Reservoir/ Fuel Tank Cover
2. Counterweight Cover
3. Transmission Cover, Lower (Model 8042, 10042, 10054, S/N 14053 & After)
4. Transmission Cover, Upper (Model 8042, 10042, 10054, S/N 14053 & After)
5. Side Door Cover, Right
6. Transmission Cover (Model 8042, 10042, 10054, S/N 14052 & Before)
7. Rear Door Weldment
8. Side Door Cover, Left

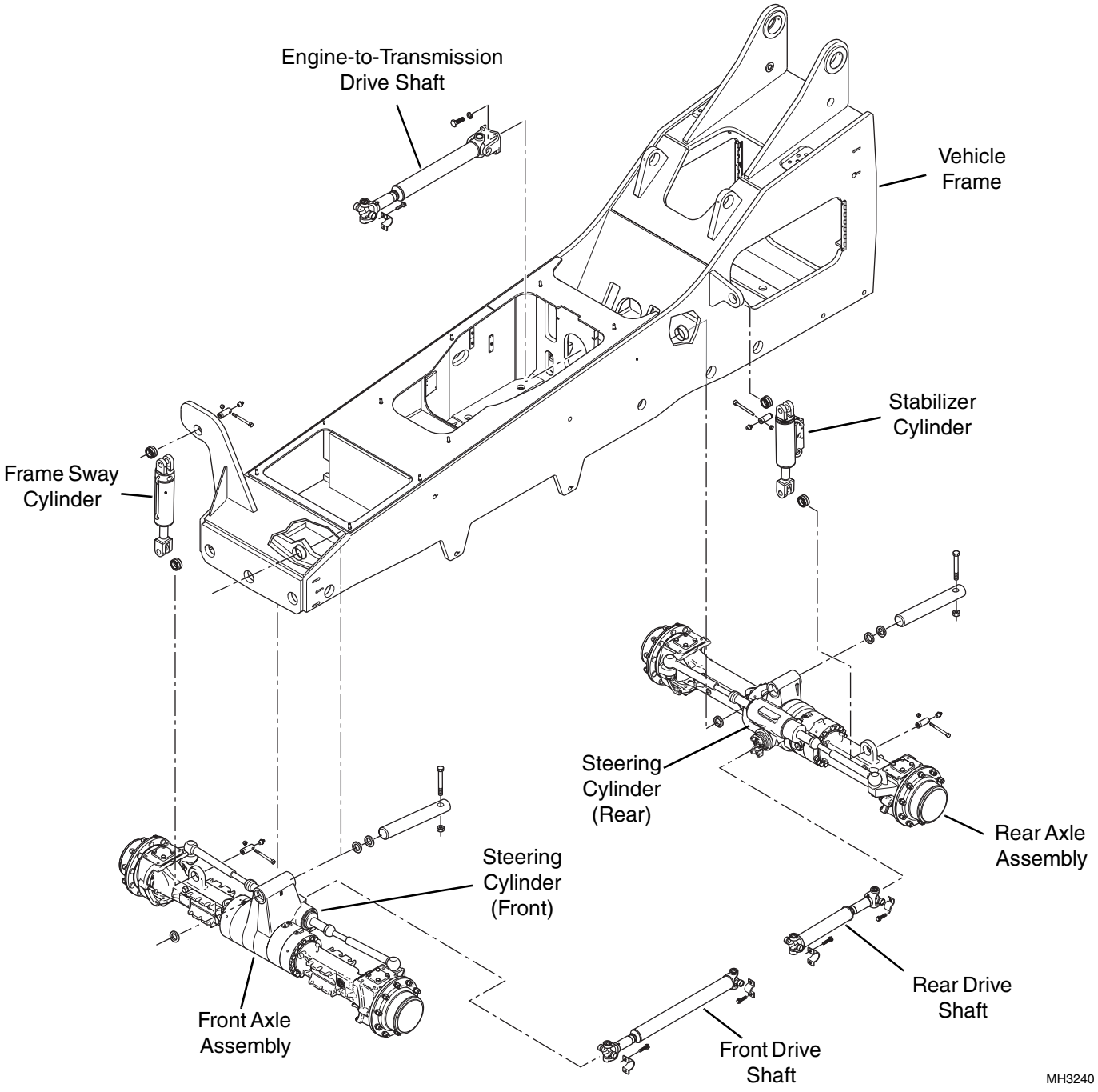
Section 5
Axles, Drive Shafts, Wheels and Tires

Contents

Note: *Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the ZF Axle Repair Manuals. (Refer to Section 5.3.8, "ZF Axle Repair Manuals.")*

5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section.



WARNING: **DO NOT** service the vehicle without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual. Failure to follow the safety practices may result in death or serious injury.

5.2 GENERAL INFORMATION

IMPORTANT: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear. Always replace elastic locknuts and any damaged, worn, cracked, seized or otherwise improper parts that could affect the safe and proper functioning of the vehicle, axles and drive shafts.

5.3 AXLE ASSEMBLIES

5.3.1 Axle Assembly Description

The front (parking brake equipped) and rear (no parking brake) ZF axles are designed for heavy-duty, off-road industrial use. Each axle consists of a beam-type axle case, housing the differential center section, inboard wet-disc brakes, a pair of trumpet-like shaft housings and stub-axle/wheel-hub units at each end. O-rings and oil seals retain fluid within the axle. The axles have a semi-floating mounting configuration. Each axle center is secured to the vehicle frame with a pivot pin, and at one side with a cylinder, anchor and pins.

The frame sway cylinder is mounted on the right side of the front axle, and the stabilizer cylinder is mounted on the left side of the rear axle. Steering cylinders and ball joints are mounted inboard on each axle.

5.3.2 Axle Assembly Operation

Power from the engine is transmitted to the transmission by way of a driveshaft. The transmission distributes power through the output drive shafts to the front and rear axle differentials. The axles work through gearing to turn the wheel and tire assemblies and to ultimately cause the vehicle to move.

The front differential is equipped with limited-slip, self-locking gears supported by bearings. The design of the differential permits adjustment to the bevel gear set. Internal axle service and adjustment procedures are not the scope of this publication and are thoroughly covered in the appropriate ZF axle manual. The beveled ring gear is adjusted by means of ring nuts located opposite each other. The position of the pinion, supported by two bearings, is adjusted through the addition or subtraction of adjusting shims.

The wheel hubs containing the planetary reduction gears are supported by two tapered roller bearings. The oil-bath (wet) disc type brakes are located in the center housing, and are operated by an annular piston. The parking brake is located in the center section of the front axle. The brake is spring-applied, hydraulically released (SAHR). The parking brake uses the same discs as the service brakes.

A double-rod hydraulic steering cylinder is mounted on the differential support. Directional steering input is transmitted to the axles by means of articulated track rods that allow toe-in adjustments.

The axles are attached to the chassis by a pivot pin. The pin allows the axle to pivot freely, each limited by the hydraulic cylinder attached to one of the bridge casting bearing lugs.

Note: *Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the ZF Axle Repair Manuals. (Refer to Section 5.3.8, “ZF Axle Repair Manuals.”)*

The Model 8042 uses a wheel type with nominal dimensions of 9" x 24". An optional wheel type with a nominal dimension of 13" x 25" is available.

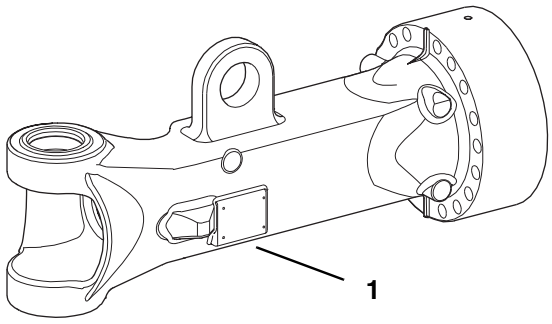
Models 10042 and 10054 uses wheels with nominal dimensions of 13" x 25".

All wheels are a one-piece design with, ten, one-inch diameter holes equally spaced on a 13.18" diameter bolt circle.

A 12-ply (or better) directional-tread tire, 13.00-24 or optional 15.5 x 25 Radial tire can be used on the 8042, and a 17.5 x 25 Radial, 12-ply (or better) directional-tread tire can be used on the 10042/10054. Tires are filled only with air when the vehicle is shipped from the factory.

5.3.3 Axle Serial Number Plate

The front axle serial number plate (**1**) is located on a mounting pad on the inboard portion of the right beam trumpet. The rear axle serial number plate is located on a mounting pad on the inboard portion of the left beam trumpet. Information on the serial number plate is required in correspondence regarding the axle.



Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

5.3.4 Axle Specifications

General axle specifications are found in Section 2, “General Information and Specifications.” Axle (differential housing) fluid information is found in Section 2.6.1, “Axle (Differential Housing).” Wheel end fluid information is found in Section 2.6.2, “Axle Wheel Ends.”

5.3.5 Axle Maintenance

Note: *Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the ZF Axle Repair Manuals. (Refer to Section 5.3.8, “ZF Axle Repair Manuals.”)*

Several special axle service tools are required to properly service the axle assemblies. Contact the local **JLG** parts distributor or ZF dealer for ordering information.

CAUTION: Risk of personal injury. Exercise extreme care when using snap rings or spring-loaded retention devices.

WARNING: Risk of death or serious personal injury if components are assembled improperly, if incompatible, worn or damaged components are used, or if components are used in a non-approved application. Obtain proper training, follow recommended procedures, and use proper tools and safety equipment. Wear safety glasses at all times when working on the vehicle and vehicle components.

WARNING: An improperly supported vehicle can fall, causing death or serious injury. When removing the axle assembly from the vehicle, properly support the vehicle. If servicing axle components with the axle attached to the vehicle, securely support the carrier, differential, pinion assemblies and wheel ends.

IMPORTANT: *When replacing a fastener, replace it with one of equal or higher grade and quality. Torque fasteners to the specified value for the application.*

IMPORTANT: *The use of replacement parts provided by other than the original manufacturer is not recommended, as such use may cause axle failure and affect vehicle safety.*

- Some service operations require the use of tools specifically designed for the purpose. Use the special tools when and as recommended.
- **DO NOT** pound, beat or hammer on end yokes and flanges to remove or to install them. Damage to axle components can occur. Remove and install end yokes and flanges by following the recommended procedures in the appropriate ZF axle service manual.
- **DO NOT** attempt carrier and differential removal and installation, and differential and pinion disassembly and assembly, without thoroughly understanding the instructions in the appropriate ZF publications.

- Before disassembling any parts inside the carrier, remove the entire axle assembly from the vehicle and securely support it with the pinion facing up in an appropriate stand or rack.
- **DO NOT** reuse oil or grease seals.

CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lintless towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, lightly coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the vehicle far enough to cause the drivetrain components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the vehicle has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

Note: *Use a suitable puller for bearing removal. Clean, inspect and lubricate all bearings just prior to reassembly. If replacement of a damaged bearing cup or cone is necessary, replace the cup and cone as a set.*

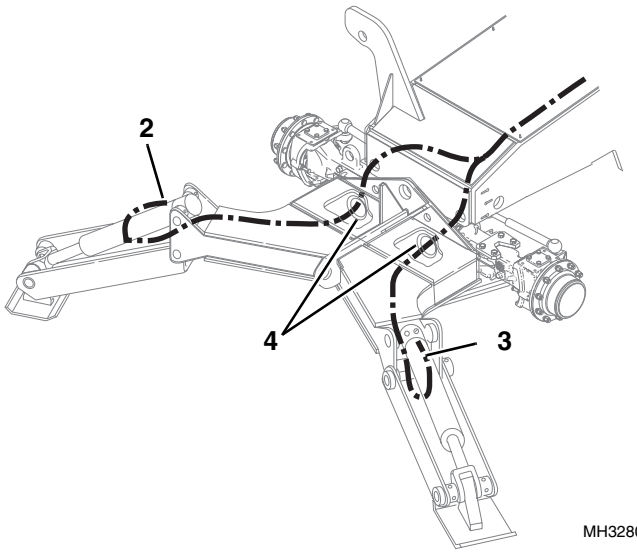
5.3.6 Axle Replacement

a. Outrigger Removal (10042, 10054 Only)

Note: *Proceed to Section 5.3.6, c. "Axle Removal" for Model 8042.*

On Models 10042 and 10054 equipped with outriggers, it is necessary to removal the outrigger assembly before removing the front axle.

1. Park the vehicle on a firm, level surface, level the vehicle, ground the attachment, retract the boom, lower the outriggers; but **DO NOT** allow the outriggers to touch the ground; place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch, straighten all wheels and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, "Accident Prevention Tags.")
3. Unlock and open the engine compartment cover. Allow the engine, transmission and hydraulic fluid to cool.
4. Label and disconnect the wiring harness connectors at both outrigger cylinder pressure switches (**2** and **3**). Remove the wire ties securing the wiring harness to the outrigger cylinders.
5. Tie a length of string to each pressure switch wiring connector, and pull the harness out through the openings (**4**) at the rear of the outrigger housing.
6. Untie the strings from the wiring connectors and tape, or otherwise secure the ends of the strings to the outrigger housing. These strings will be used to pull the harness through the housing during installation.



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7. Label, disconnect and plug the left (**3**) and right (**4**) outrigger cylinder hydraulic hoses. Cap all fittings.
8. Support the outrigger assembly (**5**) using a suitable jack, hoist or overhead crane.
9. Remove the eight capscrews (**6**), eight hex nuts (**7**), eight flat washers (**8**) and two mount plates (**9**).

Note: *Record the number and thickness of shims (**10**) to ensure correct installation.*

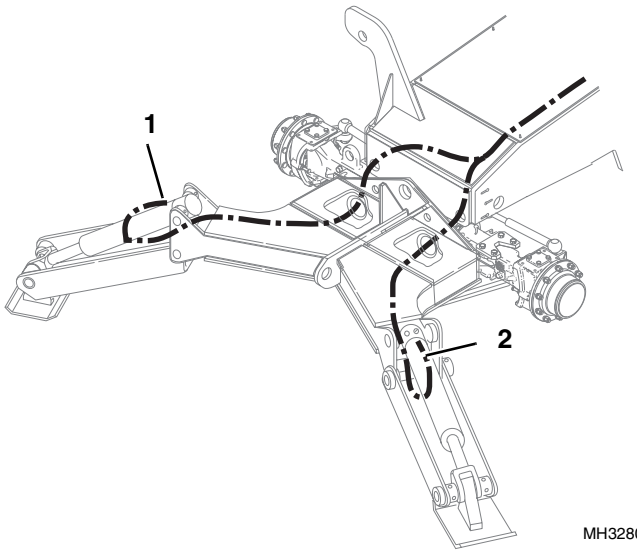
10. Remove the outrigger assembly (**5**) using a suitable jack, hoist or overhead crane. Remove the shims (**10**) from the pivot pin (**11**).
11. Move the outrigger assembly (**5**) away from the vehicle and carefully lower it to the ground. Block up or support the assembly so that it does not move or fall.
12. Inspect the pivot bearing (**12**). Replace the bearing if worn or damaged.

b. Outrigger Installation

1. Using a suitable jack, hoist or overhead crane and sling, remove the outrigger assembly from its supports. Balance the assembly and prevent it from tipping, turning or falling while positioning it on the vehicle. **DO NOT** raise or otherwise disturb the vehicle while installing the outrigger assembly. Keep the assembly supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
2. Place the same number and thickness of shims (**10**) on the pivot pin (**11**), as recorded during removal.
3. Position the outrigger assembly (**5**) onto the vehicle, aligning the hole in the assembly (**5**) on the axle pivot pin (**11**) and the mounting plate (**9**) under the axle flanges.
4. Install the two mount plates (**9**) onto the top of the axle, and secure with eight capscrews (**6**), eight flat washers (**8**) and eight hex nuts (**7**).

Note: *ALWAYS use new o-rings when servicing the vehicle.*

5. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
6. Uncap and connect the left (**4**) and right (**3**) outrigger cylinder hydraulic hoses to the fittings.
7. Tie the strings left in the outrigger housing during removal to each pressure switch wiring connector, and pull the harness through the outrigger housing.
8. Connect the wiring connectors to the outrigger cylinder pressure switches (**1** and **2**). Secure the harnesses to the cylinders with wire ties.

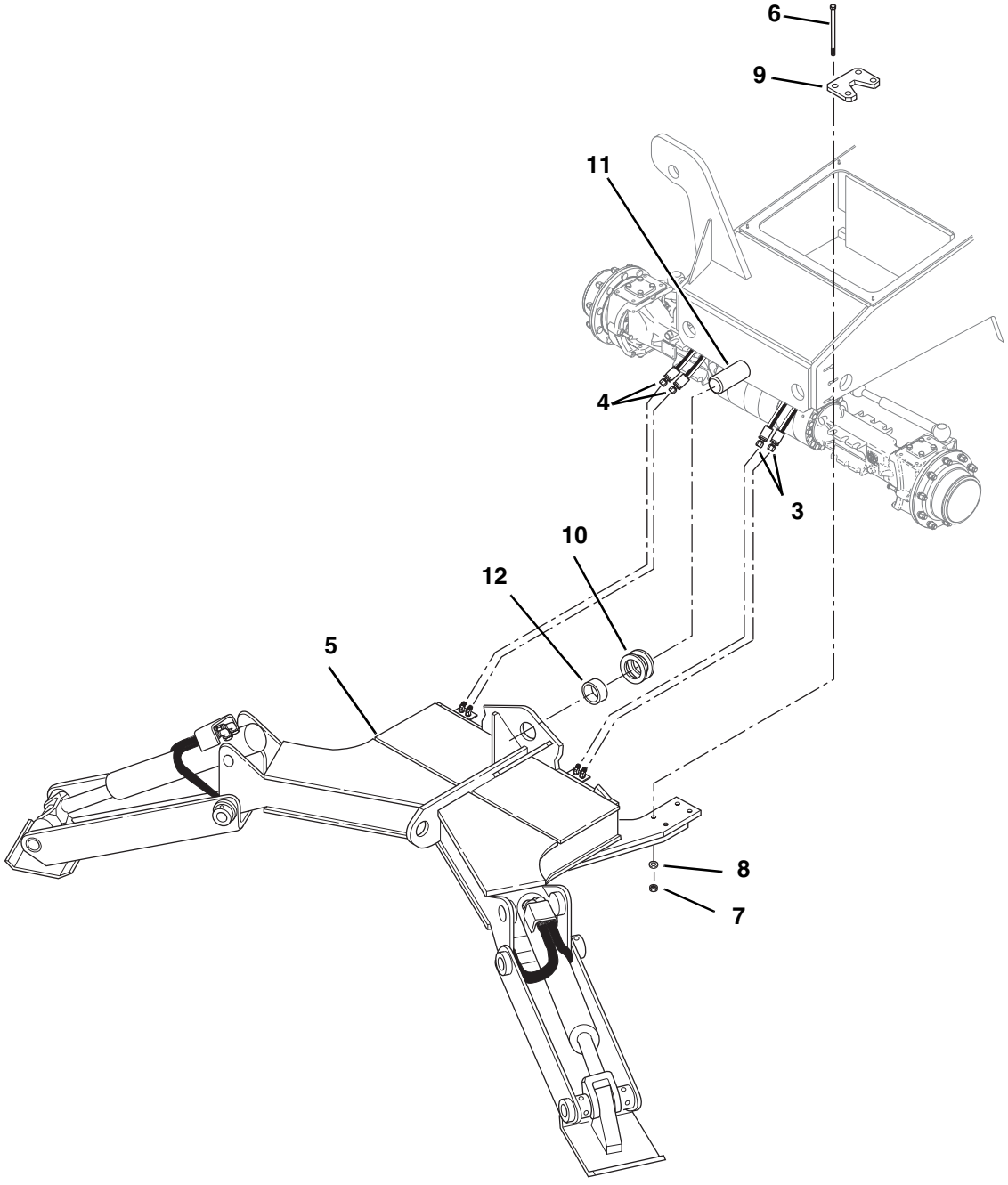


9. Check the hydraulic reservoir oil level.

> **WARNING:** Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or severe personal injury.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Before starting the engine, tighten all hydraulic connections and remove all tools from the vehicle. **NEVER** check for leaks using any part of the human body; use a piece of cardboard or wood instead. Wear heavy, protective gloves and eye protection.

10. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.



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c. Axle Removal

> **WARNING:** An improperly supported vehicle can fall, causing death or severe personal injury. Safely raise and adequately support the vehicle so that it will remain stable and in place before attempting to remove an axle.

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for the hydraulic fluid to cool before servicing any hydraulic component.

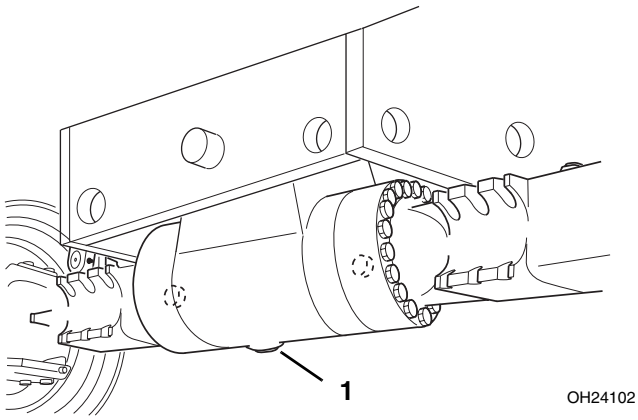
> **WARNING:** Relieve hydraulic pressure before servicing any hydraulic component. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the vehicle. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

IMPORTANT: *Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the vehicle and to remove the axle.*

1. Park the vehicle on a firm, level surface, level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch, straighten all wheels and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the engine compartment cover. Allow the engine, transmission and hydraulic fluid to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal to prevent the engine from starting accidentally.
5. **Models 10042 and 10054, Front Axle Only**: Remove outrigger assembly. Refer to Section 5.3.6, a. “Outrigger Removal (10042, 10054 Only).”
6. If the axle will be disassembled after removal, place a suitable receptacle under the axle drain plug (**1**). Remove the drain plug and allow the axle oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.



7. Label, disconnect and cap the steering and brake lines at the axle. Wipe up any spilled oil.
8. Block the front and rear of both tires on the axle that is not being removed. Ensure that the vehicle will remain in place during axle removal before proceeding.
9. Raise the vehicle using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the vehicle onto the supports. Ensure that the vehicle will remain in place during axle removal.
10. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the vehicle.
11. Mark and remove both wheel and tire assemblies from the axle that is being removed. (Refer to Section 5.5.1, “Removing Wheel and Tire Assembly from Vehicle.”)

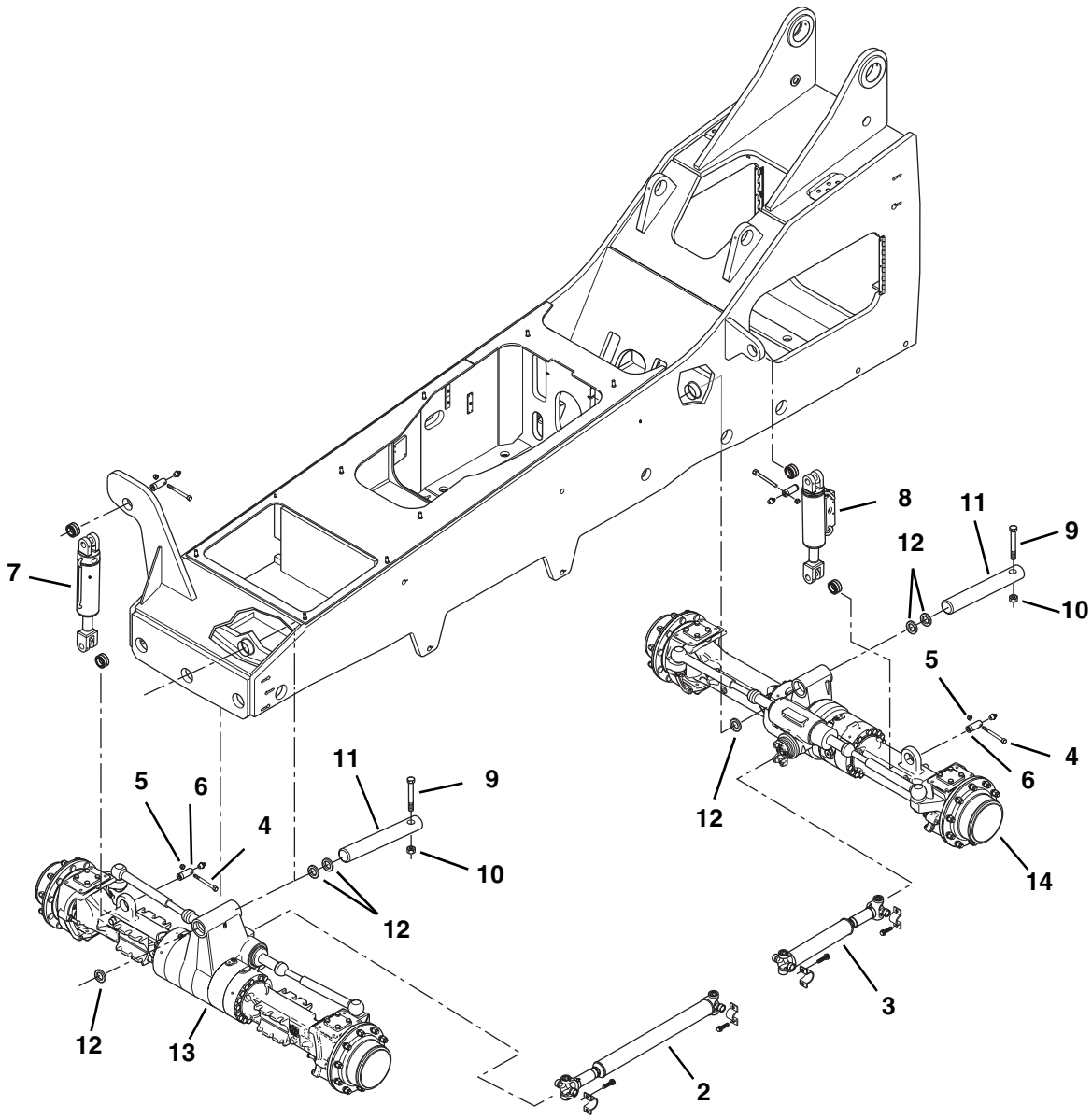
Note: *The wheel and tire assemblies must be re-installed later with the directional tread pattern “arrows” facing in the direction of forward travel.*

12. Remove the drive shaft assemblies (**2**-Front or **3**-Rear). (Refer to Section 5.4.3, “Drive Shaft Removal.”)

13. Remove the capscrew (**4**) and locknut (**5**) securing the lower position cylinder-mount pin (**6**) to the cylinder (**7**-Front or **8**-Rear). Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
14. Remove the capscrew (**9**) and locknut (**10**) securing the axle pivot pin (**11**) to the frame.

Note: *Record the number and location of shims (**12**) to ensure correct installation.*

15. Remove the pivot pin (**11**) and shims (**12**).
16. Remove the axle (**13**-Front or **14**-Rear) from the vehicle using the jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb the vehicle while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the vehicle. Place the axle on a suitable support or holding stand.



d. Axle Inspection, Internal Service and Repair

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the ZF Axle Repair Manuals. (Refer to Section 5.3.8, “ZF Axle Repair Manuals.”)

The axle should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

e. Axle Installation

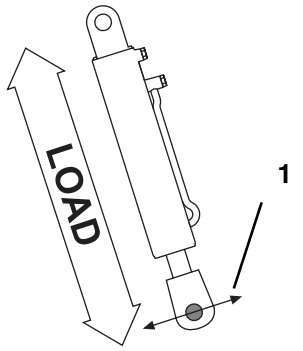
The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and limited-slip feature; the rear axle has neither. The steps below outline a typical axle installation procedure, suitable for either the front or the rear axle assembly.

1. Before proceeding, ensure that the vehicle will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the vehicle.
2. If applicable, raise the vehicle using a suitable jack or hoist. Place suitable supports beneath the frame and lower the vehicle onto the supports, allowing enough room for axle installation. Ensure that the vehicle will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove the axle (**2**-Front or **3**-Rear) from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the vehicle. **DO NOT** raise or otherwise disturb the vehicle while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle (**2**-Front or **3**-Rear) under the frame, and align the pivot pin bearings with the holes in the frame.
5. Coat the axle pivot pin (**4**) with a light film of clean engine or hydraulic oil; **DO NOT** use an anti-seize compound.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

6. Install the axle pivot pin (**4**) and shims (**5**). Add or remove shims until a maximum gap of 0.6" (1.5 mm) is obtained. Balance the number and thickness of shims equally on both sides. Secure the pivot pin with one capscrew (**5**) and a new locknut (**6**).

Note: *If new frame sway (front) or stabilizer (rear) cylinder bearings (**8**) have been installed in the axles or vehicle frame, the fracture (**1**) in the bearing race must be positioned at the 9 o’clock position as shown below.*



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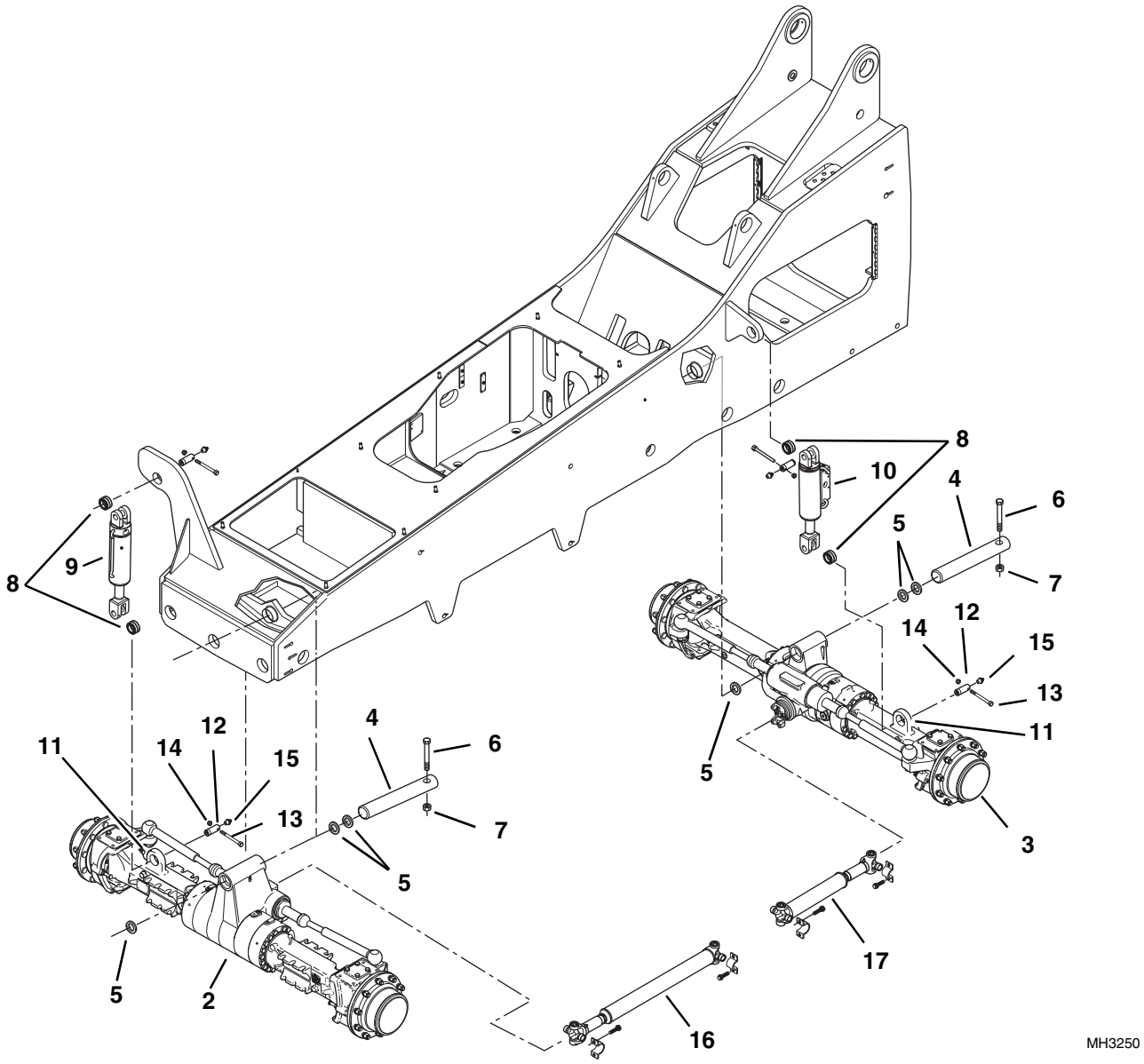
7. Move the cylinder (**9**-Front or **10**-Rear) into position on the axle cylinder anchor (**11**). Insert a cylinder-mount pin (**12**) through the cylinder and cylinder anchor. Secure the cylinder-mount pin (**12**) with one capscrew (**13**) and a new locknut (**14**).
8. Apply multi-purpose grease through the self-tapping lube fitting (**15**) to lubricate the self-align bearing (**8**) and the cylinder-mount pin (**12**).
9. Install the drive shaft assemblies (**16** and **17**). (Refer to Section 5.4.7, “Drive Shaft Installation.”)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10. If reinstalling an axle previously removed from the vehicle, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.
11. Install the wheel and tire assemblies. (Refer to Section 5.5.4, “Installing Wheel and Tire Assembly onto Vehicle.”)
12. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
13. Carefully raise the vehicle using a suitable jack or hoist. Remove the supports from beneath the frame and lower the vehicle to the ground.
14. Remove the blocks from the front and rear of both tires on the other axle.

Note: *ALWAYS use new o-rings when servicing the vehicle.*

15. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
16. Uncap and connect the steering and brake lines at their axle fittings.
17. **Models 10042 and 10054, Front Axle Only**: Install outrigger assembly. Refer to Section 5.3.6, b. “Outrigger Installation.”
18. Check the hydraulic reservoir oil level.

WARNING: Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or severe personal injury.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Before starting the engine, tighten all hydraulic connections and remove all tools from the vehicle. **NEVER** check for leaks using any part of the human body; use a piece of cardboard or wood instead. Wear heavy, protective gloves and eye protection.

19. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.

5.3.7 Axle Service and Troubleshooting

This section provides an easy reference guide covering the most common problems that may occur during operation of the axles.

Note: *Contact the **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if internal axle repair is required during the warranty period.*

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the ZF Axle Repair Manuals. (Refer to Section 5.3.8, “ZF Axle Repair Manuals.”)

The axle should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

5.3.8 ZF Axle Repair Manuals

Model	ZF Model	Axle	P/N	ZF P/N
8042/10042/10054	MS-T 3060	FRONT, with Parking Brake	8990430	5871 560 002
8042	MS-T 3045	REAR, without Parking Brake	8990419	5871 550 002
10042 S/N 13198 thru 17977	MS-T 3045	REAR, without Parking Brake	8990419	5871 550 002
10054 S/N 13198 thru 17974	MS-T 3045	REAR, without Parking Brake	8990419	5871 550 002
10042 S/N 17978 and After	MS-T 3055	REAR, without Parking Brake	8990419	5871 550 002
10054 S/N 17975 and After	MS-T 3055	REAR, without Parking Brake	8990419	5871 550 002

5.3.9 Axle Assembly and Drive Shaft Troubleshooting

Problem	Cause	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. (Refer to appropriate owners/operators manual.)
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/ operators manual.)
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/ operators manual.)
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.

5.3.9 Axle Assembly and Drive Shaft Troubleshooting (Continued)

Problem	Cause	Remedy
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint assembly(ies) incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft(s) damaged/ unbalanced.	3. Replace drive shaft(s) as needed.
4. Oil leaking from axle (differential housing and/or axle housings).	1. Drain and/or inspection plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the ZF Repair Manuals.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 288 lb-ft (390 Nm).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
5. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 41 lb-ft (55 Nm).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).

5.3.9 Axle Assembly and Drive Shaft Troubleshooting (Continued)

Problem	Cause	Remedy
6. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.
7. Axle overheating.	1. Oil level too high.	1. Fill oil to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)
	2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low.	2. Drain axle and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)
8. High steering effort required.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	2. Excessive joint housing swivel bearing preload.	2. Correct bearing preload by adding or removing shims as needed.
	3. Worn or damaged swivel bearings.	3. Replace swivel bearings as needed.
9. Slow steering response.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	2. Steering cylinder leaking internally.	2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	1. Brake discs worn.	1. Check brake discs for wear. (Refer to appropriate owners/operators manual.)
	2. Brake discs damaged.	2. Replace brake discs.
11. Brakes will not engage.	1. Brake (hydraulic) system not operating properly.	1. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	2. Brake piston o-rings and seals damaged (leaking).	2. Replace o-rings and seals.
12. Brakes will not hold the vehicle or braking power reduced.	1. Brake discs worn.	1. Check brake discs for wear. (Refer to appropriate owners/operators manual.)
	2. Brake (hydraulic) system not operating properly.	2. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	3. Brake piston o-rings and seals damaged (leaking).	3. Replace o-rings and seals.

5.3.10 Axle Internal Component Troubleshooting

Note: *The following conditions may be noticed when inspecting parts during axle repair. Perform all remedies that apply to the conditions noticed.*

Problem	Cause	Remedy (See Note)
1. Differential ring gear teeth broken on the heel of the tooth.	1. Incorrect alignment of ring and pinion gears (excessive play). 2. Incorrect pinion (input) shaft bearing preload.	• Replace ring and pinion gears. • Adjust ring and pinion alignment and bearing preload as described in the ZF Repair Manuals.
2. Differential ring gear teeth broken on the toe of the tooth.	1. Incorrect alignment of ring and pinion gears (insufficient play). 2. Incorrect pinion (input) shaft bearing preload.	• Replace ring and pinions gears. • Adjust ring and pinion alignment and bearing preload as described in the ZF Repair Manuals.
3. Rapid differential ring and pinion gear teeth wear.	1. Insufficient lubrication. 2. Lubricant contaminated. 3. Incorrect lubricant.	• Replace ring and pinion gears. • Drain axle and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)
4. Differential ring and pinion gear teeth overheated.	1. Insufficient lubrication. 2. Lubricant contaminated. 3. Incorrect lubricant or level.	• Determine the cause of the problem and correct. • Replace ring and pinions gears. • Drain axle and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)
5. Gear teeth pitted.	1. Insufficient lubrication. 2. Lubricant contaminated. 3. Foreign objects in oil.	• Determine the cause of the problem and correct. • Replace gears. • Drain axle and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)
6. Worn or pitted bearings.	1. Incorrect bearing preload. 2. Insufficient lubrication. 3. Lubricant contaminated.	• Determine the cause of the problem and correct. • Replace bearings. • Adjust bearing preload as described in the ZF Repair Manuals. • Drain axle and fill to correct level with Universal Tractor Fluid. (Refer to appropriate owners/operators manual.)

5.4 DRIVE SHAFTS

5.4.1 Drive Shaft Inspection and Service

Whenever servicing the vehicle, conduct a visual inspection of the drive shafts and cross and bearing assemblies (universal joints, or U-joints). A few moments spent doing this can help prevent further problems and down time later.

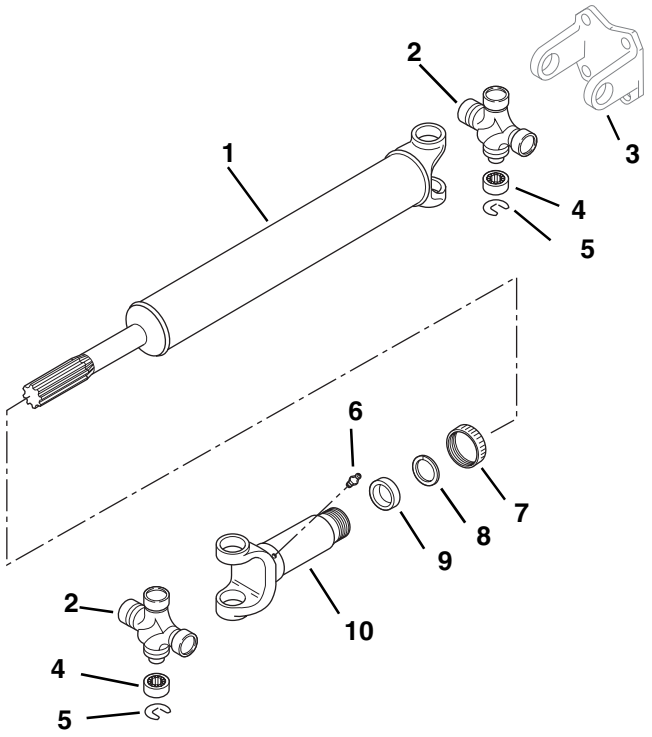
Inspect areas where the drive shaft flange yokes and slip yokes mount to the drive shafts. Attempt to turn each drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shafts (**1**) and cross and bearing assemblies may cause an excessive amount of vibration or noise.

Individually inspect each cross (**2**) the needle bearings and cap (**4**) for signs of wear or for missing parts.

Note: *Replace the cross and bearings as a complete assembly if any parts are worn or missing. If all parts of the cross and bearing assemblies are in good condition, pack the bearing caps with a premium grade of multi-purpose wheel-bearing grease. Reattach the bearing cap to the cross, assuring that all needle bearings are present. Then, reassemble the cross and bearing assembly into the drive shaft yoke.*

Note: *Yoke flange (**3**) is used on the engine-to-transmission drive shaft assembly only.*

1. Replace the felt seal (**9**) if worn or damaged.
2. Replace the entire drive shaft assembly if any flange yoke, slip yoke or drive shaft tube is severely dented or damaged.
3. Cross assemblies should flex and be free from excessive binding. A slight amount of drag or resistance is desirable on a new cross and bearing assembly. Excessive looseness causes unbalance.



1. Yoke shaft (1)
2. Cross (2)
3. Yoke Flange (1)
4. Needle bearings and cap (8)
5. Snap ring (8)
6. Grease fitting (1)
7. Dust cap (1)
8. Washer (1)
9. Felt seal (1)
10. Slip yoke (1)

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5.4.2 Drive Shaft Maintenance

Refer to the appropriate owners/operators manual for information regarding the lubrication of the grease fittings on the drive shafts.

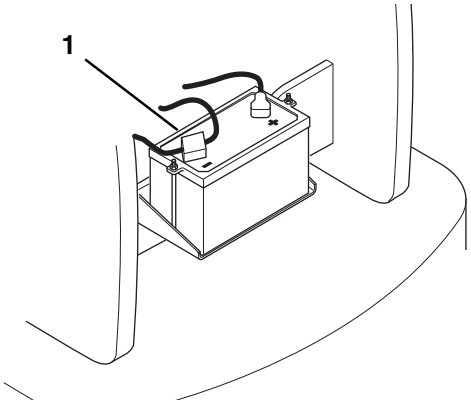
5.4.3 Drive Shaft Removal

IMPORTANT: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Note: *The drive shaft assemblies are balanced assemblies. Mark the yoke and axle, transmission, transfer case, and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

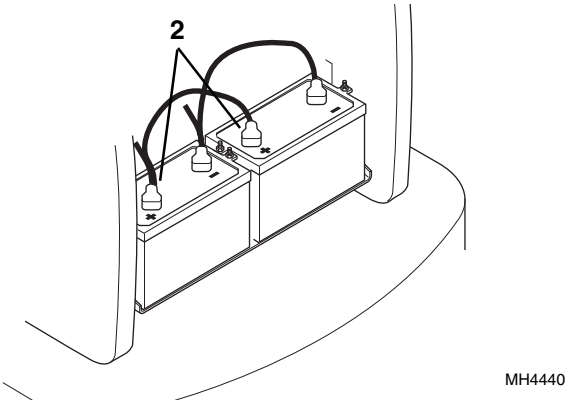
a. Transmission-to-Axle Drive Shafts

1. Level the vehicle, ground the carriage, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the right, left and rear engine compartment access doors. Allow the engine, transmission and hydraulic fluid to cool.
4. **(SN 18990 (8042), 19030 (10042), 19079 (10054) & Before Only)** Disconnect the battery negative (-) ground cable (**1**) at the battery negative (-) terminal to prevent the engine from starting accidentally.



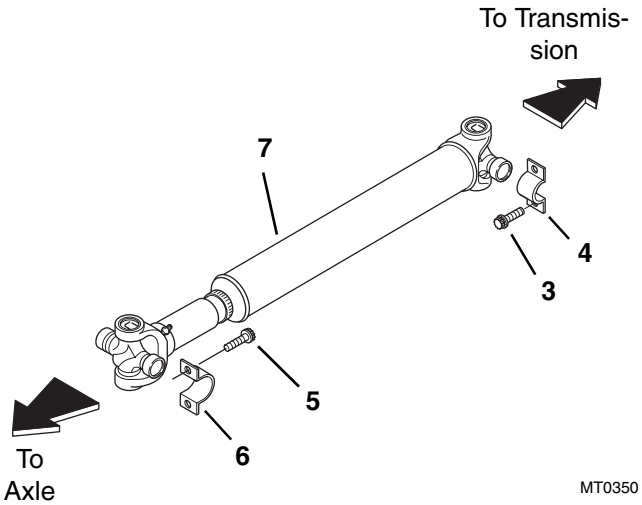
OH2420

5. **(SN 18991 (8042), 19031 (10042), 19080 (10054) & After Only)** Disconnect the battery negative (-) ground cables (**2**) at the battery negative (-) terminals to prevent the engine from starting accidentally.



MH4440

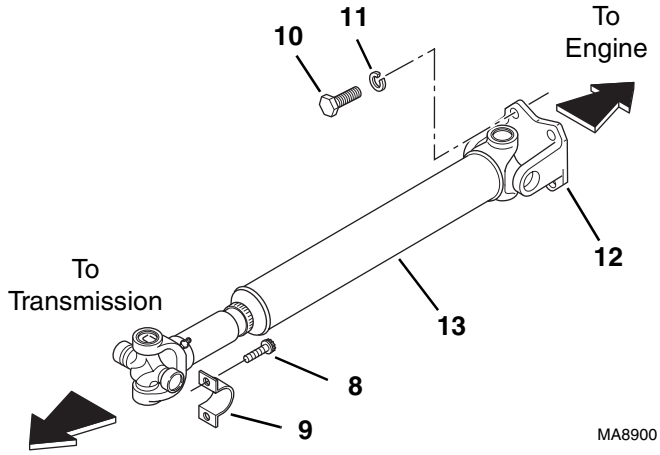
6. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
7. Remove the four 12-point capscrews (**3**) and two straps (**4**) securing the bearing cross to the transmission output shaft flange.
8. Remove the four capscrews (**5**) and two straps (**6**) securing the bearing crosses to the axle.
9. Remove the front drive shaft assembly (**7**).
10. Repeat Steps 6 thru 9 to remove the rear drive shaft.



MT0350

b. Engine-to-Transmission Drive Shaft

1. Level the vehicle, ground the carriage, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Unlock and open the right and left engine compartment access doors. Allow the engine, transmission and hydraulic fluid to cool.
4. **(SN 18990 (8042), 19030 (10042), 19079 (10054) & Before Only)** Disconnect the battery negative (-) ground cable (**1**) at the battery negative (-) terminal to prevent the engine from starting accidentally.
5. **(SN 18991 (8042), 19031 (10042), 19080 (10054) & After Only)** Disconnect the battery negative (-) ground cables (**2**) at the battery negative (-) terminals to prevent the engine from starting accidentally.
6. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
7. Remove the four capscrews (**8**) and two straps (**9**) securing the bearing cross to the transmission input shaft flange.
8. Remove the four capscrews (**10**), four lockwashers (**11**) securing the flange yoke (**12**) to the engine output flange.
9. Remove the drive shaft assembly (**13**).



5.4.4 Drive Shaft Disassembly

IMPORTANT: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke, or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate Parts Manual for ordering information.*

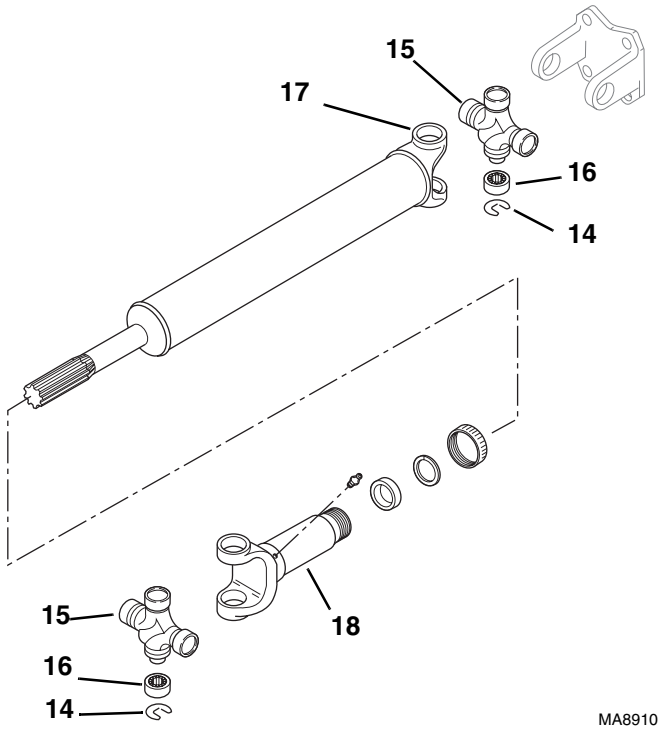
a. Transmission-to-Axle Drive Shafts

1. Use an approved, non-flammable cleaning fluid to thoroughly clean the drive shaft assembly with a brush. Wipe dry before disassembling.

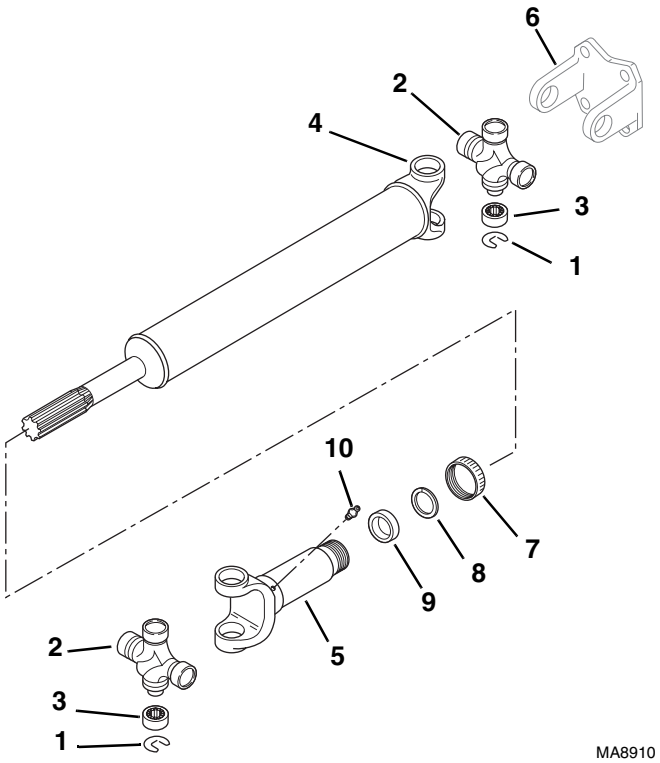
	CAUTION: Avoid using excess force when clamping the drive shaft in a vise. Apply only enough force to hold the drive shaft securely. Excessive force can damage the drive shaft, resulting in an unbalanced condition.

2. Place the drive shaft assembly in a bench vise.
3. Use a pair of pliers to pinch the ends of the snap rings (**14**) securing the cross (**15**) and bearing (**16**) assemblies to the yoke (**17** or **18**). Remove the snap rings from their grooves in the yoke.

Note: *If the snap rings fail to readily snap out of their grooves in the yokes, tap the end of the bearing cap lightly to help relieve pressure against the snap rings.*



4. Use a soft, round drive pin with a flat face approximately 1/32" (0,8 mm) smaller than the hole diameter in the yoke to drive on one end of the cross and bearing assembly until the opposite bearing assembly comes out of the yoke.
5. Turn the yoke over and tap on the exposed end of the cross until the opposite bearing assembly comes out of the yoke.
6. Remove the cross (**2**) from the yoke (**4** or **5**).
7. Repeat Steps 2 thru 6 to remove the cross and bearing assembly on the other end of the drive shaft.
8. **Engine-to-Transmission Drive Shaft Only:** Use a pair of pliers to compress the snap rings holding the cross (**2**) and bearing assemblies (**3**) to the flange yoke (**6**). Remove the snap rings from the grooves in the yokes.
9. Use a soft, round drive pin with a flat face approximately 1/32" (0,8 mm) smaller than the hole diameter in the yoke to drive on one end of the cross and bearing assembly until the opposite bearing assembly comes out of the yoke.
10. Mark the yoke shaft (**4**) and slip yoke (**5**) so that they can be properly aligned when reassembled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
11. Unscrew the dust cap (**7**) and slide the slip yoke (**5**) off of the drive shaft splines.
12. Remove the dust cap (**7**), split retaining ring (**8**) and felt seal (**9**) from the shaft assembly.



5.4.5 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts using an approved cleaning fluid. Allow to dry.
2. Remove any burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.4.6 Drive Shaft Assembly

1. Install the dust cap (**7**), split retaining ring (**8**) and felt seal (**9**) onto the splines of the drive shaft tube assembly.

IMPORTANT: *Ensure that the reference marks made before removal on the drive shaft and slip yoke are aligned. The drive shaft and yokes must be in the same plane to help prevent excessive vibration.*

2. Align the reference marks made previously on the drive shaft and slip yoke.
3. Slide the slip yoke (**5**) onto the splines of the drive shaft and tighten the dust cap (**7**) securely. **DO NOT** overtighten or the cap will break.
4. Install the cross and bearing assembly into the yoke.
5. Secure the cross and bearing assembly into the yoke with snap rings (**1**). Pinch each snap ring with a pliers and insert them into their grooves in the yoke.
6. Apply grease to grease fitting (**10**). (Refer to Section 2.6.7, “Drive Shaft Splines.”)

5.4.7 Drive Shaft Installation

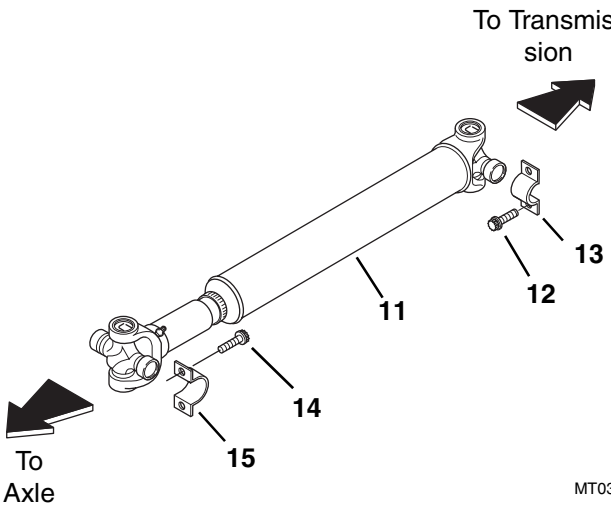
IMPORTANT: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

a. Transmission-to-Axle Drive Shafts

1. Raise the drive shaft assembly (**11**) into position. The slip-yoke end of the drive shaft mounts toward the axle. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.

IMPORTANT: *Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

2. Install the four capscrews (**12**) and two straps (**13**) securing the bearing crosses to the transmission. Torque the capscrews to 60 lb-ft (81 Nm).
3. Install the four capscrews (**14**) and two straps (**15**) securing the bearing crosses to the axle. Torque the capscrews to 60 lb-ft (81 Nm).



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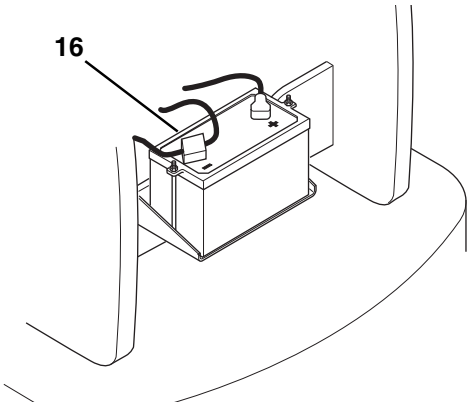
4. **(SN 18990 (8042), 19030 (10042), 19079 (10054) & Before Only)** Connect the battery negative (-) ground cable (**16**) at the battery negative (-) terminal.



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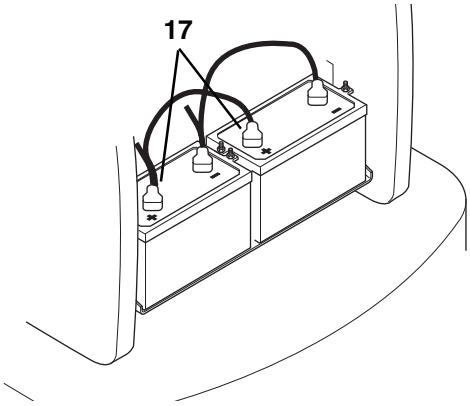
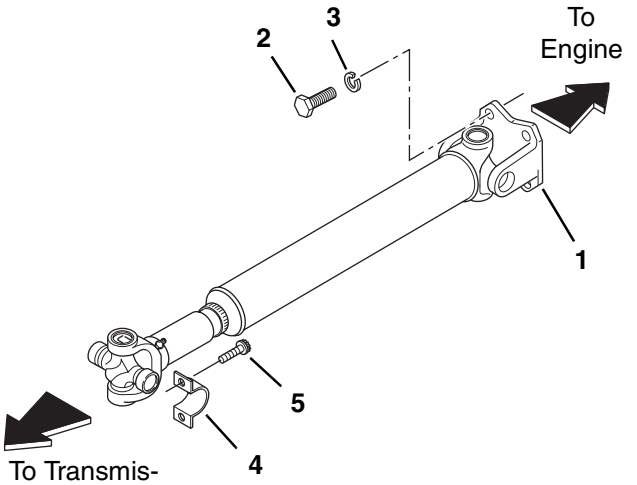
5. **(SN 18991 (8042), 19031 (10042), 19080 (10054) & After Only)** Connect the battery negative (-) ground cables (**17**) at the battery negative (-) terminals.



MH4440

b. Engine-to-Transmission Drive Shaft

6. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
7. Position the flange yoke (**1**) on the engine output flange. Secure the yoke with four capscrews (**2**), four lockwashers (**3**). Torque the capscrews to 48 lb-ft (65 Nm).
8. Raise the slip yoke end of the drive shaft, and position the bearing cross into the transmission input shaft flange. Secure the drive shaft with two straps (**4**) and four capscrews (**5**). Torque the capscrews to 35 lb-ft (47 Nm).



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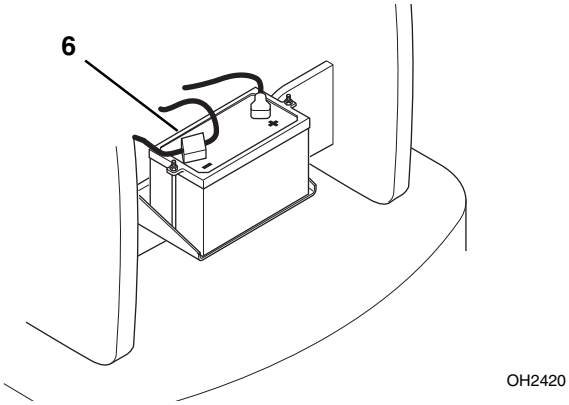
9. **(SN 18990 (8042), 19030 (10042), 19079 (10054) & Before Only)** Connect the battery negative (-) ground cable (**6**) at the battery negative (-) terminal.



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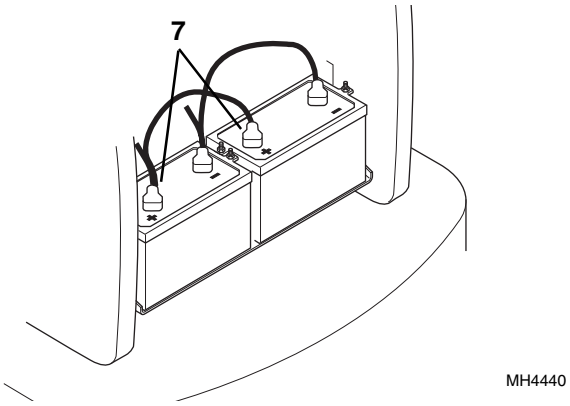
10. **(SN 18991 (8042), 19031 (10042), 19080 (10054) & After Only)** Connect the battery negative (-) ground cables (**7**) at the battery negative (-) terminals.



MH4440

5.5 WHEELS AND TIRES

WARNING: Risk of death or serious personal injury. Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise vehicle stability and may cause vehicle to tip over.

The Model 8042 uses a wheel type with nominal dimensions of 9" x 24". An optional wheel type with a nominal dimension of 13" x 25" is available.

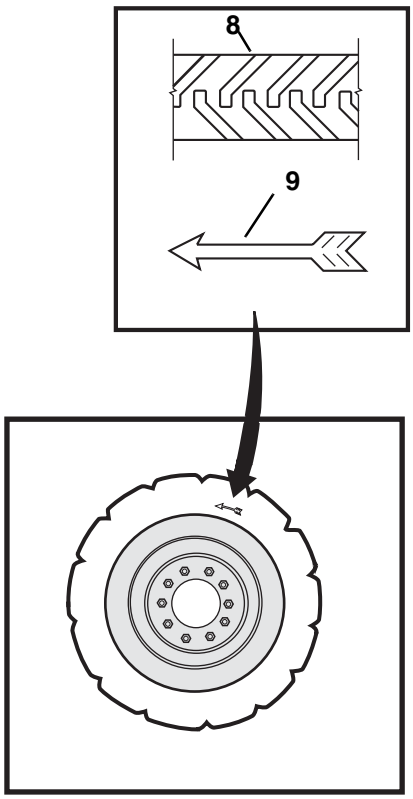
The Model 10042 and 10054 uses wheels with nominal dimensions of 13" x 25".

The specified size and ply rating (star rating for radial tires) for this vehicle is 13.00-24, 12-ply or optional 15.5 x 25 Radial, directional tread (8042), or 17.5 x 25 Radial, directional tread (10042/10054). Make sure the replacement tire is of the same size and ply rating (star rating for radial tires) as all of the other tires. A higher ply rating (star rating for radial tires) can be used, but only when all four tires have the same ply rating.

In standard configuration, the tires are filled with air only when the vehicle leaves the factory. There is a foam fill option available if the use of a tire-filling substance is desired. Having tires filled has a positive effect on the weight, stability and handling characteristics of the vehicle, especially under load. JLG does not recommend the use of hydrofill as a tire-fill substance because of possible environmental impact.

Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.

The wheel and tire assemblies must be installed with the directional tread pattern “arrows” (**8** and **9**) facing in the direction of forward travel.



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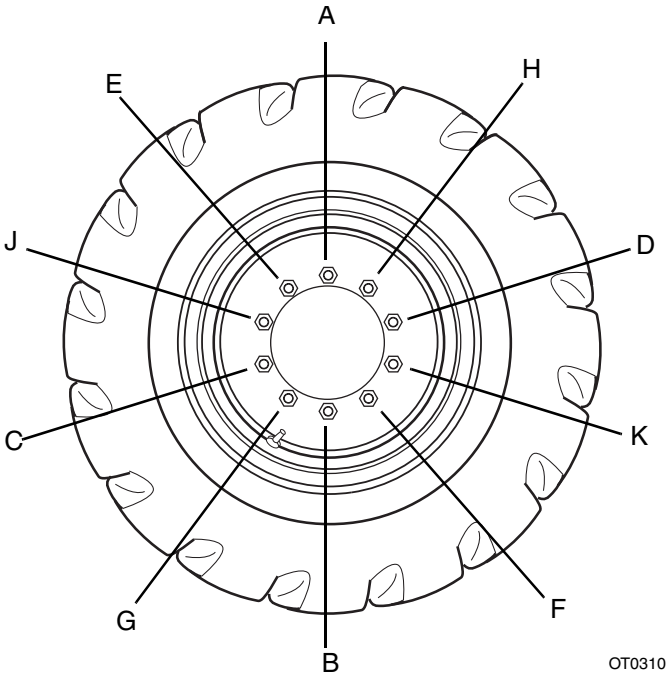
5.5.1 Removing Wheel and Tire Assembly from Vehicle

WARNING: Risk of death or serious personal injury, if proper safety procedures are not followed. When removing the wheel and tire assembly from the vehicle, follow the instructions in the "Wheel Removal Instruction" box that follows:

Wheel Removal Instructions:

- Position the vehicle on a flat, hard surface and support the vehicle with approved jack stands or suitable supports.
- Use appropriate safety glasses, safety shoes and appropriate clothing and equipment.
- **DO NOT** wear rings or jewelry. **DO NOT** wear hair or clothing that could become caught in machinery or pinch points such as those created between the tire and the hub.

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch, straighten all wheels and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, "Accident Prevention Tags.")
3. Disconnect the battery negative (-) ground cable at the battery negative (-) terminal, to prevent the engine from starting accidentally.
4. Loosen but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.
5. Place a suitable jack under the axle pad closest to the wheel being removed. Raise the vehicle and position a suitable support beneath the axle. Allow sufficient room to lower the vehicle onto the support and to remove the wheel and tire assembly.
6. Lower the vehicle onto the support.
7. Remove lug nuts and lug washers in an alternating pattern (A thru K).



8. Remove the wheel and tire assembly from the vehicle.

5.5.2 Wheel Cleaning

WARNING: Dirt and rust prevent the tire from seating properly on the wheel, which could result in an explosive separation. Such explosions could result in death or severe personal injury to the tire installer and to those in the area.

Remove all rust, corrosion, dirt and other foreign material from all metal surfaces. In particular, the bead area (tire-to-wheel mounting surface) must be especially clean.

5.5.3 Wheel Inspection and Replacement

WARNING: Damaged, modified, repaired or mis-matched wheels and tires, or dirt and rust prevent the tire from seating properly on the wheel, which could result in an explosive separation. Such explosions could result in death or severe personal injury.

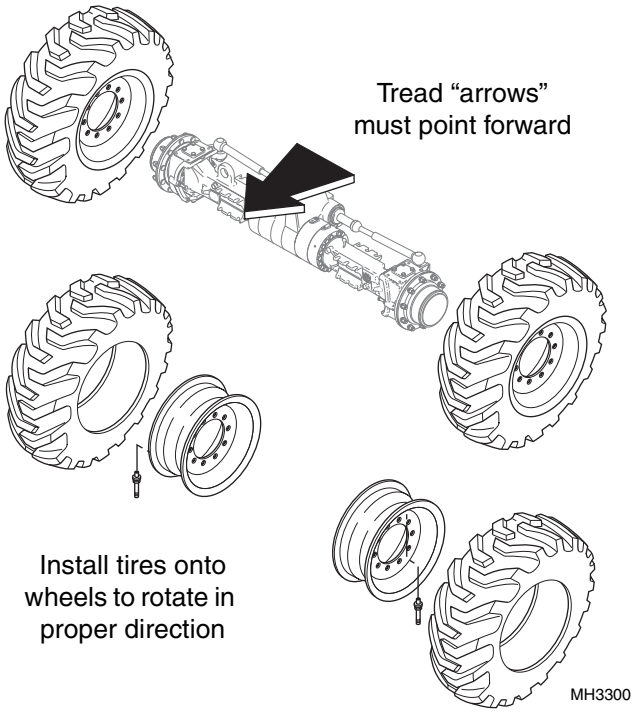
- **NEVER** rework, heat, weld or braze a wheel rim.
- Clean and inspect the wheel rim before installing a new tire. Verify that the wheel rim diameter exactly matches the tire rim diameter molded into the tire.
- Inspect the inside of the tire for dirt, foreign material, loose cords, cuts, penetrating objects, and other damage. **DO NOT** use tires with irreparable damage.

Check all surfaces of the wheel for rust, corrosion, cracks, bent flanges, deep marks or gouges. Replace a damaged, worn or cracked wheel. **NEVER** rework, heat, weld or braze a wheel rim.

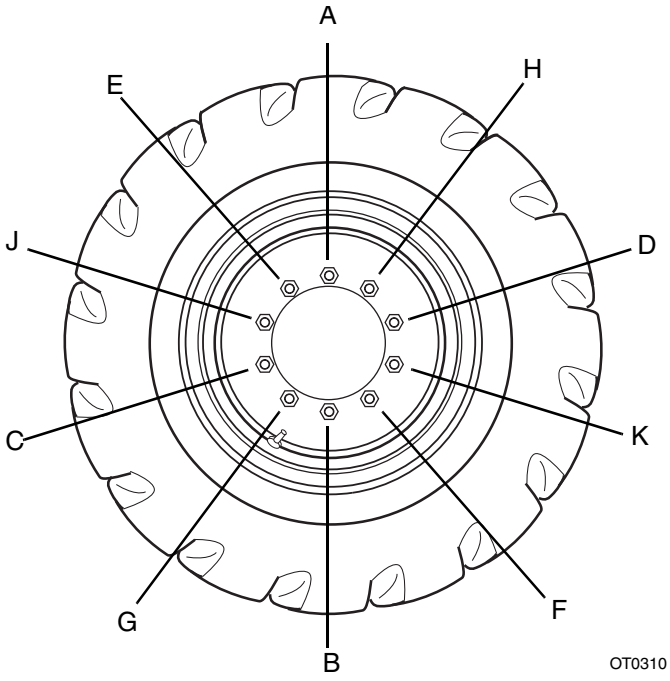
Inspect the valve core and stem. Replace the entire valve if either component is damaged.

5.5.4 Installing Wheel and Tire Assembly onto Vehicle

IMPORTANT: *The wheel and tire assemblies must be installed with the directional tread pattern "arrows" facing in the direction of forward travel.*



1. Position wheel onto studs on wheel end of axle.
2. Install wheel lug washers.
3. Install lug nuts and tighten in an alternating pattern (A thru K). Torque to 430 to 470 lb-ft (583 to 637 Nm).



5.5.5 Tires

a. Dismounting Tire from Wheel

WARNING: Risk of death or serious personal injury. Using incorrect tire mounting methods, or using damaged or dirty components could result in an explosive separation. When dismounting a tire from a wheel, follow the instructions in the "Wheel Dismounting Instruction" box that follows.

Wheel Dismounting Instructions:

- Use safety chains, or place the wheel and tire assembly in a safety cage when deflating a tire or when inflating a newly mounted tire.
- Deflate tire completely before servicing. **NEVER** attempt to unseat the beads of an inflated tire.
- **NEVER** re-inflate a tire that has been run flat or seriously under-inflated, without removing the tire from the wheel and checking for tire and wheel (rim) damage.
- **NEVER** hit a tire or wheel rim with a hammer or ANY object.
- Use the appropriate specialty tools and equipment for mounting a tire to a wheel or for dismounting a tire from a wheel, or have a qualified professional perform the work. **DO NOT** attempt to mount or dismount a tire without the proper tools, training and equipment.
- **NEVER** rework, heat, weld or braze a wheel rim with tire mounted.

b. Wheel Inspection and Replacement

WARNING: Damaged, modified, repaired or mis-matched wheels and tires, or dirt and rust prevent the tire from seating properly on the wheel, which could result in an explosive separation. Such explosions could result in death or severe personal injury.

- **NEVER** rework, heat, weld or braze a wheel rim.
- Clean and inspect the wheel rim before installing a new tire. Verify that the wheel rim diameter exactly matches the tire rim diameter molded into the tire.
- Inspect the inside of the tire for dirt, foreign material, loose cords, cuts, penetrating objects and other damage. **DO NOT** use tires with irreparable damage.

Replace any tire that is worn or cut through the cords. When replacing a tire, follow the recommendations of the tire manufacturer.

c. Tire and Wheel Lubrication

WARNING: Risk of death or serious personal injury. Use an approved tire-mounting lubricant only. **NEVER** use anti-freeze, silicones or petroleum-based lubricants.

Prior to mounting the tire on the rim, apply a suitable lubricant to the bead-seat area of the wheel rim and tire bead. Use a lubricant specified by the wheel and tire manufacturers.

d. Mounting Tire onto Wheel

WARNING: Risk of death or serious personal injury. Using incorrect tire mounting methods, or using damaged or dirty components could result in an explosive separation. When mounting a tire onto a wheel, follow the "Wheel Mounting Instructions" box below.

Wheel Mounting Instructions:

- Use the appropriate specialty tools and equipment for mounting a tire to a wheel or for dismounting a tire from a wheel, or have a qualified professional perform the work. **DO NOT** attempt to mount or dismount a tire without the proper tools, training and equipment.
- Clean and inspect the wheel rim before installing a new tire. Verify that the wheel rim diameter exactly matches the tire rim diameter molded into the tire.
- Inspect the inside of the tire for dirt, foreign material, loose cords, cuts, penetrating objects and other damage. **DO NOT** use tires with irreparable damage.
- Use an approved tire-mounting lubricant only. **NEVER** use anti-freeze, silicones or petroleum-based lubricants.
- Use safety chains, or place the wheel and tire assembly in a safety cage when deflating a tire or when inflating a newly mounted tire.
- Inflate the tire to the cold-operating pressure recommended by the tire manufacturer.

1. Read, understand and follow the above warning messages.
2. Cle]an, inspect and replace the wheel if necessary. **DO NOT** use a damaged or cracked wheel.
3. Orient the tire in the direction of forward travel required.
4. Lubricate the inner tire and rim beads with an approved tire-mounting lubricant only. **NEVER** use anti-freeze, silicones or petroleum-based lubricants.
5. Push the inner bead of the tire over and around as much of the wheel rim as possible. Use tire irons or a suitable, commercially available pneumatic tire installation machine to work the bead completely over the rim in small increments. Be careful not to damage the bead.
6. Lubricate the outer tire and rim beads with an approved tire-mounting lubricant.
7. Starting opposite the valve hole, use tire irons to work the outer tire bead over the wheel rim. Work the bead completely over the rim in small increments (**DO NOT** damage the bead).
8. Install a new valve stem into the valve stem hole on the wheel.
9. Center the tire on the wheel. Inflate the tire until it fully seats on the wheel rim or to 35 psi (241,1 kPa). **DO NOT** exceed 35 psi (241,1 kPa). Use an extension hose with a clip-on air chuck and pressure gauge to permit the installer to stand at a safe distance away from the tire. Each tire bead will usually snap or pop into place, indicating that the bead is seated.

Note: *If either bead should fail to seat at 35 psi (241,1 kPa), the tire may be pinched or another source may be interfering with proper mounting.* ***DO NOT*** *increase inflation pressure to seat the beads. Remove the valve core and completely deflate the tire. Break both beads loose from the rim and inspect the tire, rim and inner tube, if applicable. Lubricate the tire bead, install the valve core and repeat the 35 psi (241,1 kPa) inflation procedure until the beads seat properly.*

10. After the beads have seated, remove the valve core and fully deflate the tire, but **DO NOT** break the bead or separate the tire from the wheel. Re-install the valve core and inflate the tire to 70 psi (438 kPa) (8042), or 60 psi (414 kPa) (10042/10054).

e. Tire Speed and Road Surface Limitations

The tires on this vehicle are designed for low-speed operations not to exceed 25 mph (40 km/hr). If the vehicle is towed at high speeds, high temperatures may develop under the tread bars, causing a shifting of the tread bars and a weakening of the tire material and cord fabric. There may be no visible evidence of this type of damage, but later, a failure can occur. If tires are to operate for any length of time on a paved road, highway or other hard surface, increase pressure in the tire to the maximum amount recommended by the tire manufacturer to help reduce the chances of damage, or arrange to have the vehicle transported on a flat-bed truck.

f. Care and Storage of Tires

Store unmounted tires vertically, standing on their tread. If stored for an extended period of time, rotate the tires periodically to help reduce stress concentrations in the ground contact area of the tread. Tires should not be stored flat or stacked vertically (“stove piped”) as they will become flattened and distorted, making mounting difficult, particularly for tubeless tires.

Store mounted tires as noted above, but reduce the inflation pressure to 10 psi (68,9 kPa).

Store tires indoors in a cool, dark, dry area away from drafts. Heat and light can cause oxidation on the tire surface, which leads to decomposition (“crazing”) and weather checking. **NEVER** store tires on oily surfaces or in contact with oil, grease, petroleum-based substances, anti-freeze or solvents. Tires should not be stored near volatile substances. Tires absorb volatile substances, which damage and weaken the tire.

Tires should not be stored outside or in direct sunlight. If there is no other alternative, tires stored outside must be covered or otherwise protected from sunlight, wind and rain. Use an unbroken, opaque covering to help protect tires stored outdoors.

Store tires away from electric motors, generators, arc welders, etc., as these generate ozone, which attacks rubber and causes crazing and weather checking.

Exposure to weather will also cause cracking or crazing of the rubber as well as deterioration of the tire carcass, particularly where rainwater is permitted to accumulate in the tire.

When extended vehicle storage is anticipated, the vehicle should be placed on suitable supports with the tires raised out of ground contact. Inflation pressure in the tire should then be reduced to 10 psi (68,9 kPa). Keep the tires out of contact with sunlight, wind and rain as noted above.

If it is not possible to raise the vehicle, increase tire inflation pressure by 25 percent. Move the vehicle periodically to change the location of stress concentrations in the tire ground contact area.

5.6 BRAKES

5.6.1 Brake Disk Inspection.

1000 OH2690

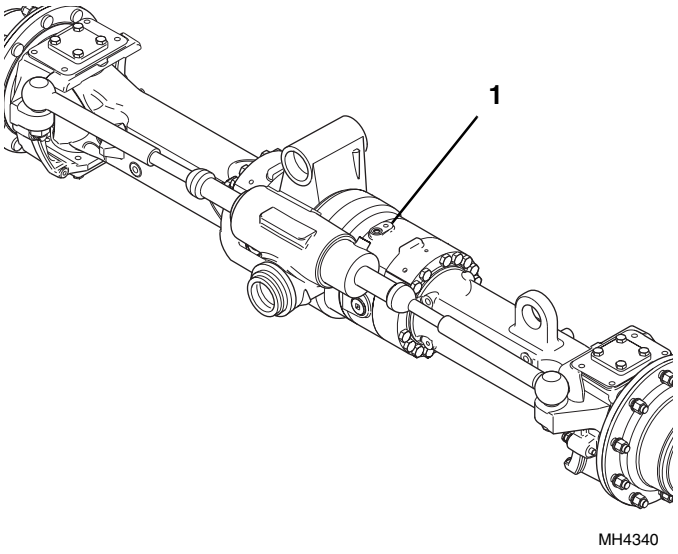
Check the brake disks for wear every 1,000 hours of operation or yearly.

If the brake disks require service due to wear, the axle should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

a. Front Axle

> **WARNING: BLOCK ALL FOUR WHEELS.** Failure to do so could result in death or serious injury from vehicle roll-away

1. **Block all four wheels** to help prevent the vehicle from moving after the parking brake is disabled.
2. Attach a remote portable hydraulic pressurizing unit to the breather port (**1**) on the axle.

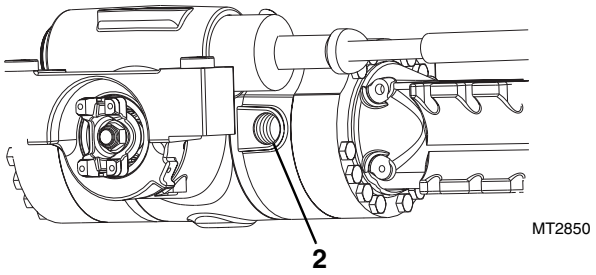


***Note: DO NOT** Turn the key switch to the ON. **DO NOT** Release the parking brake switch. Oil pressure will be lost and Parking Brake will be engaged.*

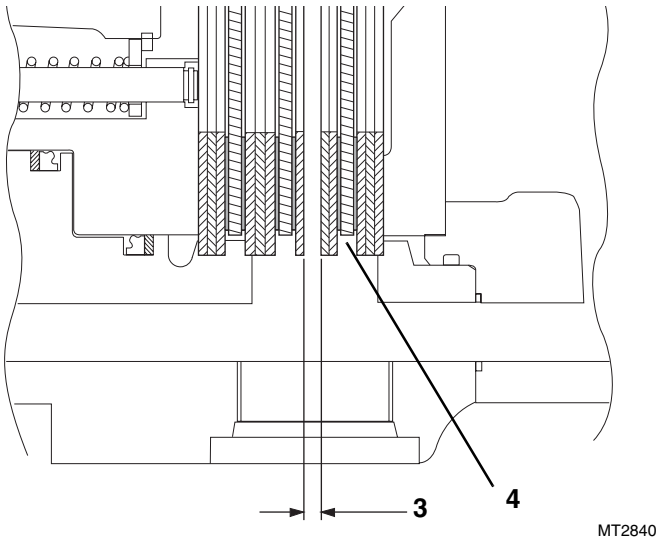
> **CAUTION: DO NOT** exceed 650 psi (45 bar) when pressurizing the park brake. Applying too much pressure may damage the brake seals.

3. Pressurize the parking brake with the pressurizing unit. Close the needle valve on the pressurizing unit.
4. Working through the level plug hole (**2**), carefully use a screwdriver to spread the brake disks apart.

***IMPORTANT: DO NOT** damage the surfaces of the brake disks when spreading the brake disks.*



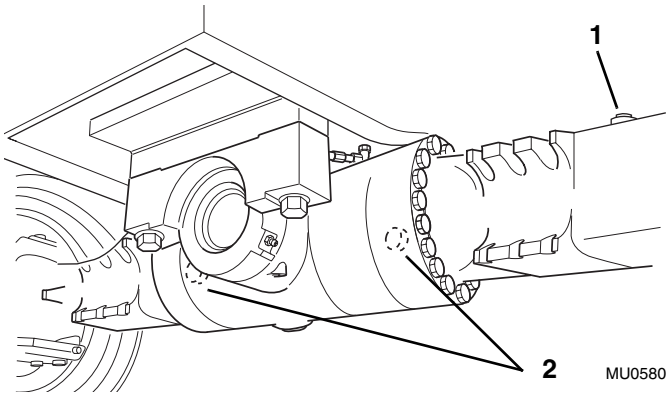
5. Using a feeler gauge, check the gap (**3**) between the brake disks (**4**). **8042 Only**, if the gap is greater than 0.22" (5,6 mm), replace the brake disks. **10042 & 10054 Only**, if the gap is greater than 0.26" (6,75 mm), replace the brake disks.



Note: *If the brake disks are worn beyond their tolerance, the brake disk must be replaced on both sides of the axle at the same time.*

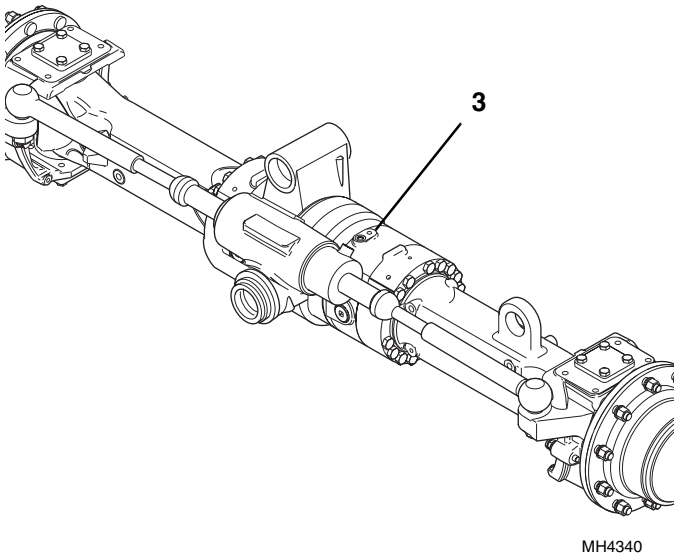
6. Repeat steps 4 and 5 for the other side of the axle.
7. Fill the axle with Universal Tractor Fluid through the axle fill hole (**1**) until the oil level is even with both axle level holes (**2**).

   See chart of approved fluids. The axle capacity is 1.7 qt (1,6 Liters) for the front axle. Fill axle slowly, the oil has to run across the differential. Allow time for the oil to run across the differential. Axle level is correct when oil is up to both level plugs.



Approved Universal Tractor Fluid	
John Deere	JDM J20C (HY-GARD)
Ford/New Holland	ESN-M2C134-D (HYDRAULIC OIL 134)
Massey-Ferguson	M-1141 (PERMANTRAN III)
Chevron	CHEVRON 1000 THF

8. Reassemble the level plugs using new o-rings.
9. Re-install the axle fill plug (**1**) into axle housing.
10. Remove the remote portable hydraulic pressurizing unit on from the port (**3**).

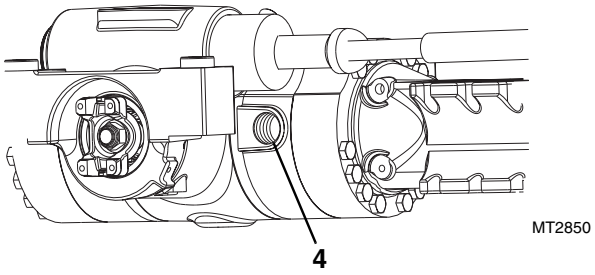


b. Rear Axle

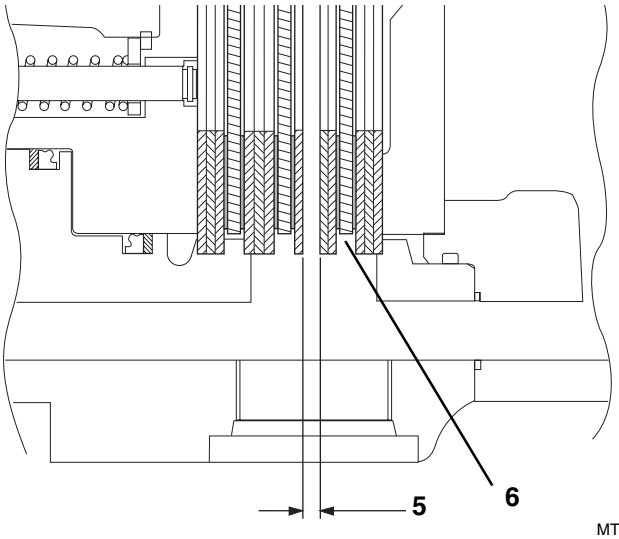
> **WARNING: BLOCK ALL FOUR WHEELS.** Failure to do so could result in death or serious injury from vehicle roll-away

1. **Block all four wheels** to help prevent the vehicle from moving after the parking brake is disabled.
2. Working through the level plug hole (**4**), carefully use a screwdriver to spread the brake disks apart.

***IMPORTANT: DO NOT** damage the surfaces of the brake disks when spreading the brake disks.*



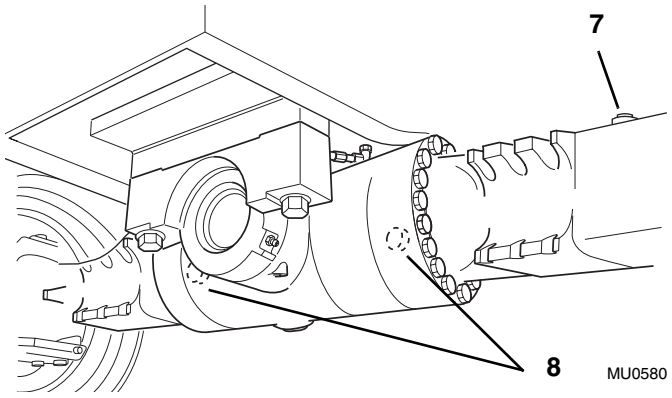
3. Using a feeler gauge, check the gap (**5**) between the brake disks (**6**). If the gap is greater than 0.167" (4,25 mm), replace the brake disks.



***Note:** If the brake disks are worn beyond 0.167" (4,25 mm), the brake disk must be replaced on both sides of the axle at the same time.*

4. Repeat steps 2 and 3 for the other side of the axle.
5. Fill the axle with Universal Tractor Fluid through the axle fill hole (**7**) until the oil level is even with both axle level holes (**8**).

   See chart of approved fluids. The axle capacity is 1.3 qt (1,2 Liters) for the rear axle. Fill axle slowly, the oil has to run across the differential. Allow time for the oil to run across the differential. Axle level is correct when oil is up to both level plugs.



Approved Universal Tractor Fluid	
John Deere	JDM J20C (HY-GARD)
Ford/New Holland	ESN-M2C134-D (HYDRAULIC OIL 134)
Massey-Ferguson	M-1141 (PERMANTRAN III)
Chevron	CHEVRON 1000 THF

6. Reassemble the level plugs using new o-rings.
7. Re-install the axle fill plug (**7**) into axle housing.

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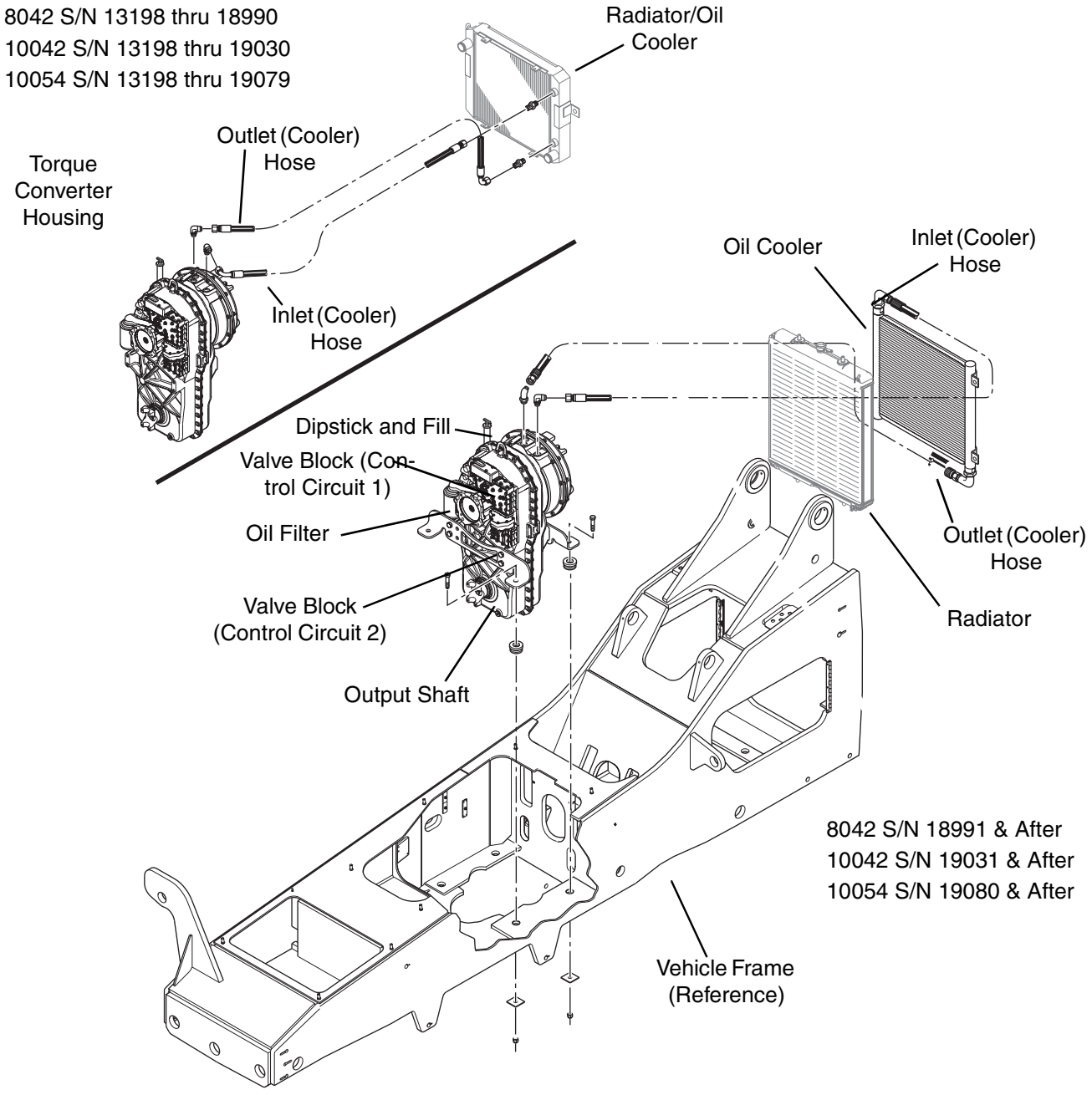
Section 6
Transmission: ZF 4 WG-98 TC

Contents

6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.



WARNING: **DO NOT** service the vehicle without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual. Failure to follow the safety practices may result in death or serious injury.

6.2 TRANSMISSION DESCRIPTION

Instructions in this section pertain mainly to general specifications, towing, maintenance information, and transmission removal and installation procedures. Internal transmission service instructions and detailed specifications are provided in the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002).

The ZF 4 WG-98 TC Transmission used in this vehicle is a four-speed configuration. The “intermediate drop” designation refers to the relative top-to-bottom length of the transmission case, chosen for its compatibility with vehicle chassis and operating requirements. Intermediate drop does not refer to an operational rpm shift or drop.

6.3 TRANSMISSION OPERATION

The transmission is mounted to the frame by front and rear mounting brackets and rubber isolator pads. Power from the engine is transmitted to the transmission by means of a drive shaft, bolted to the engine flywheel and a torque converter at the transmission input. The transmission in turn transmits power to the drive shafts, driving the front and rear axles.

The torque converter consists of three main components: the impeller (driver), stator and turbine (driven) in an oil-filled, enclosed housing. As the torque converter is driven by the engine flywheel, the impeller (pump) wheel rotates, forcing oil through the stator, which is held stationary by the stator shaft bolted to the transmission housing. This directs the moving oil onto the vanes of the turbine (driven) wheel, causing the turbine wheel to rotate. The turbine wheel is connected to the transmission input shaft, and transfers power to the transmission. Oil from the turbine wheel is then returned to the impeller wheel to repeat the process. This process results in an increase in the torque available at the transmission input shaft.

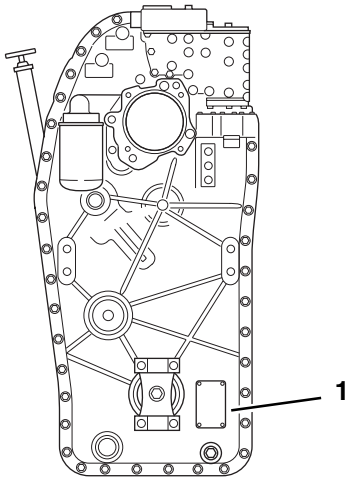
The transmission and torque converter are powered by their own internal hydraulic (“transmission fluid”) system, separate from the vehicle hydraulic system. Pressurized oil for the valve control circuits and torque converter is supplied by a pump located at the rear of the transmission. The pump is driven by the central shaft, which in turn is connected to the impeller of the torque converter. The vehicle is equipped with an external oil cooler to cool the transmission oil.

The transmission gear (“speed”) select lever, an electric shift control, is located on the left side of the steering column in the operator’s cab. Movement of the gear select lever energizes the selected transmission shift solenoid valves, which, in turn, direct the transmission fluid under pressure to the selected forward or reverse valve and to the designated range (gear or “speed”) clutch. Several factors, including terrain, loading, engine rpm, axle/wheel-end gearing and the selected transmission gear, determine actual vehicle speed.

To engage the clutch, the gear select lever is placed in the desired direction (forward or reverse) and range (gear or “speed”) position. The gear select lever movement energizes the selected direction and range (gear) solenoids, allowing transmission fluid under pressure to flow through tubes and passages to the selected clutch shafts. Oil sealing rings are located on the clutch shaft; these rings direct oil under pressure through a drilled passageway in the shaft to a desired clutch. Hydraulic pressure forces the piston and discs against the back-up plate. Discs, with edge tangs, clamp against toothed discs on the inner diameter, enabling the hub and the clutch shaft to lock together and drive as a unit, providing output power.

6.4 TRANSMISSION SERIAL NUMBER

The transmission serial number plate (**1**) is located on the pump side (front) of the transmission at the bottom right, toward the vehicle frame. Information specified on the serial number plate includes the transmission model number, the transmission serial number and other data. Information on the serial number plate is required in correspondence regarding the transmission.



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6.5 TRANSMISSION SPECIFICATIONS

6.5.1 Transmission General Specifications

General transmission specifications are found in Section 2, "General Information and Specifications." Transmission fluid information is found in Section 2.6.3, "Transmission."

6.5.2 Transmission Performance Specifications

Performance criteria is based on full throttle engine speed unless otherwise specified or not applicable.

Travel Speed (standard tires, no load)

First gear ..... 3.5 mph (5,6 km/hr)

Second gear ..... 6 mph (9,7 km/hr)

Third gear ..... 14 mph (23 km/hr)

Fourth gear ..... 20 mph (32 km/hr)

6.5.3 Transmission Lubrication

a. Transmission Fluid

Complete transmission fluid information is found in Section 2.6.3, "Transmission."

b. Transmission Fluid (Oil) Capacity

Capacity w/ filter change ..... 3 gal (11,4 liters)

Filter..... 1.5 qt (1,4 liters)

6.5.4 Transmission-Related Fuse/Relay Ratings

Instrument Cluster ..... 10 amp

Neutral Start Relay 12V

Transmission ..... 7.5 amp

6.6 TRANSMISSION MAINTENANCE

6.6.1 Maintenance Introduction

WARNING: To help avoid severe burns, **DO NOT** attempt this procedure when the engine, cooling, and hydraulic systems are hot. Wait until they have cooled before proceeding.

- Follow the manufacturer's instructions to avoid health hazards when using solvents and caustic cleaners.
- Exercise extreme care when using a steam cleaner to help avoid burns.

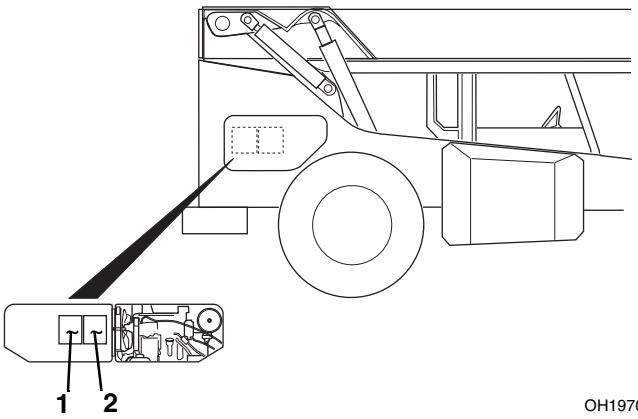
IMPORTANT: *These instructions cover only the routine maintenance of the transmission. Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002), for information on transmission internal component replacement.*

Refer to the ZF 4 WG-98 TC Transmission Technical Data and Maintenance Manual, P/N 8990449 (ZF P/N 5872 134 002), for information on transmission diagnosis and internal schematics.

Cleanliness is of extreme importance. Before attempting any repairs, thoroughly clean the exterior of the transmission to help prevent dirt from entering while performing maintenance checks and procedures.

Section 6.6.2, "Transmission Maintenance Schedule," provides a suggested maintenance schedule with references to pertinent procedures and instructions in this manual. To help prevent transmission problems before they occur, follow the maintenance schedule.

Note: *Lubrication (**1**) and Maintenance chart (**2**) decals are located inside the engine compartment access door. These decals contain a general maintenance schedule that should be followed to maintain the vehicle in good operating condition. Refer to Section 2, "General Information and Specifications." The same schedule information is presented in the appropriate owners/ operators manual, with a detailed account of how to perform the procedures.*



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6.6.2 Transmission Maintenance Schedule

Complete transmission maintenance information is located in the appropriate owners/operators manual.

- At ten hour intervals, check the transmission oil level. Refer to the appropriate owners/operators manual.
- When the vehicle completes its first 50 hours of use, change the transmission filter. Change the filter only; **DO NOT** change the transmission oil at the first 50 hour maintenance level. Refer to the appropriate owners/operators manual.
- At 1,000 hour intervals, change the transmission oil and filter. Refer to the appropriate owners/operators manual.

Periodically, depending on operating conditions and other factors, back flush the transmission oil cooler (**3**), which is located in or behind the radiator. ALWAYS back flush the transmission oil cooler after removing the transmission for repair or replacement.

The transmission oil cooler outlet hose (**4**), routed to the lower oil cooler fitting, is located on the top of the transmission. The transmission oil cooler inlet hose (**5**), routed to the upper oil cooler fitting, is located on the top of the transmission. (Refer to Section 7A.6.3, “Radiator/ Oil Cooler and Coolant Heater Replacement,” and Section 7B.6.4, “Radiator/Hydraulic and Transmission Cooler Replacement.”

CAUTION: **DO NOT** exceed 165 psi (39.6 bar) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

Disconnect and back flush the oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. If necessary, remove the radiator or oil cooler from the vehicle, and clean the oil cooler circuit using oil, compressed air and steam.

***IMPORTANT: DO NOT** use flushing compounds for cleaning purposes.*

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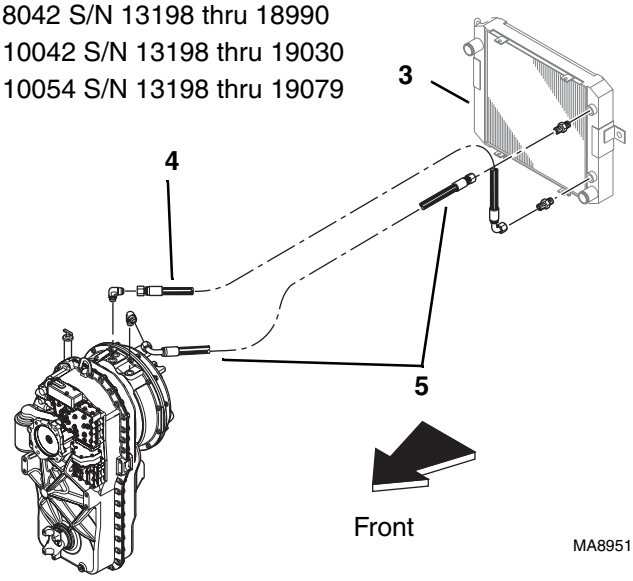
10042 S/N 13198 thru 19030
10054 S/N 13198 thru 19079



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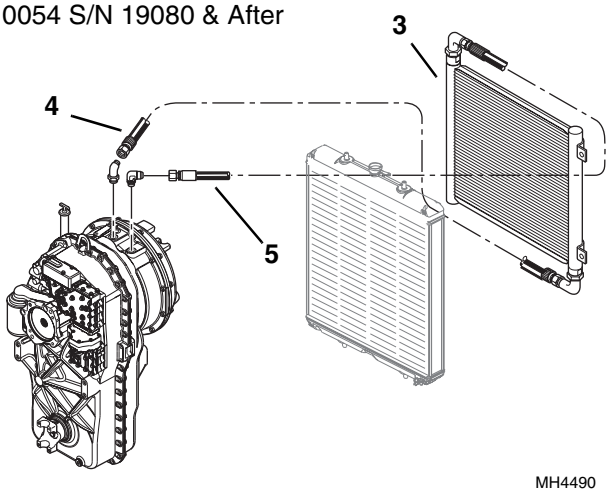
8042 S/N 18991 & After
10042 S/N 19031 & After
10054 S/N 19080 & After



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6.7 TRANSMISSION REPLACEMENT

Note: *Contact the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if internal transmission repair is required during the warranty period.*

IMPORTANT: *To help ensure safety and optimum performance, replace the transmission if it is damaged. Refer to the appropriate parts manual for ordering information.*

Cleanliness is of extreme importance. Before attempting to remove the transmission, thoroughly clean the exterior of the transmission to help prevent dirt from entering during the replacement process. Avoid spraying water or cleaning solution onto or near the transmission shift solenoids and other electrical components.

6.7.1 Transmission Removal

WARNING: Risk of severe personal injury. **NEVER** lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

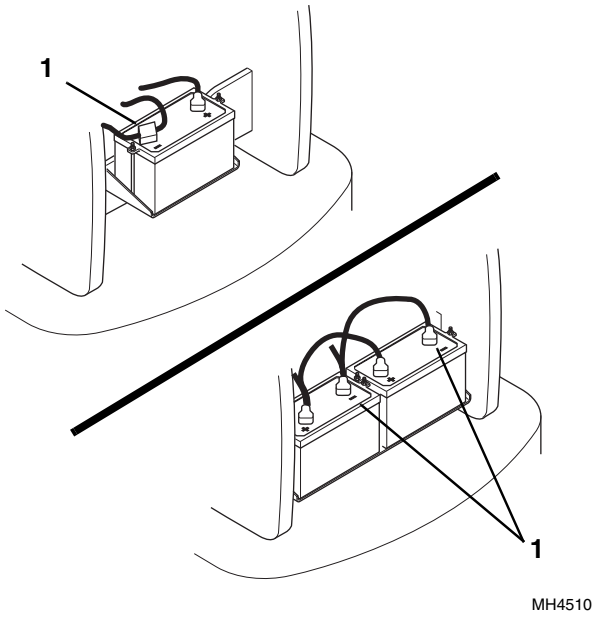
1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: **DO NOT** get under a raised boom unless the boom is blocked up. ALWAYS block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

3. Temporarily block up or support the boom.

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the engine, transmission and hydraulic fluid to cool.
5. Drain the hydraulic oil reservoir. (Refer to the appropriate owners/operators manual for information concerning the hydraulic oil and filter change.)
6. Disconnect the battery negative (-) cable or cables (**1**) at the battery negative (-) terminal, to prevent the engine from starting accidentally.



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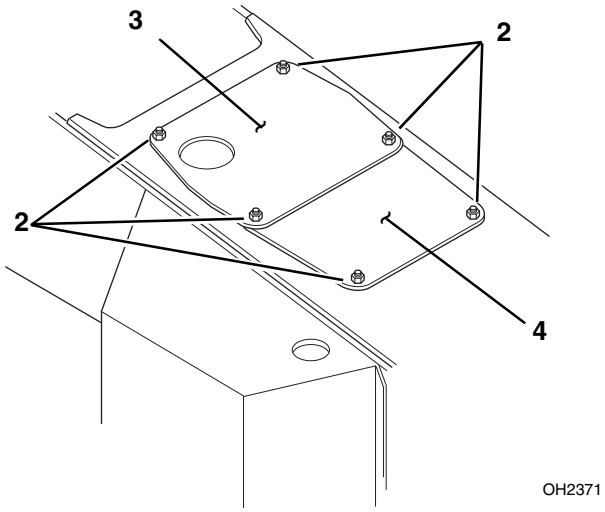
7. Remove six hex nuts, six lockwashers and six flat washers (**2**) securing the upper (**3**) and lower (**4**) transmission covers to the frame. Remove the covers.



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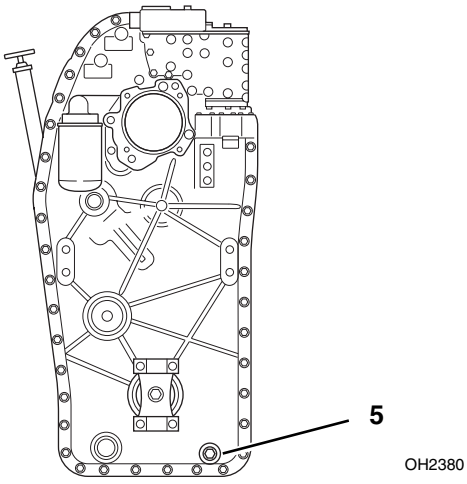
8. Thoroughly clean the transmission and surrounding area, including all hoses and fittings, before proceeding.

9. Place a suitable receptacle under the transmission drain plug (**5**). Remove the transmission drain plug, and allow the transmission oil to drain into the receptacle.
10. Transfer the used transmission oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.



11. Remove the engine-to-transmission drive shaft. Refer to Section 5.4.3, b. “Engine-to-Transmission Drive Shaft.”
12. Remove the transmission-to-axle drive shafts. Refer to Section 5.4.3, a. “Transmission-to-Axle Drive Shafts.”
13. Remove the hydraulic pump. Refer to Section 8.11.2, a. “Pump Removal.”
14. Label and disconnect the transmission temperature switch connector (**6**) and shift solenoid wiring harness connectors (**7** and **8**).
15. Remove the capscrew (**9**) securing the black wire (**10**) to the transmission housing, and disconnect the wire. **DO NOT** reinstall the capscrew at this time.
16. Remove the capscrew (**11**) securing the clamp (**12**) and wiring harness to the transmission housing, and move the wiring harness safely out of the way. **DO NOT** reinstall the capscrew at this time.

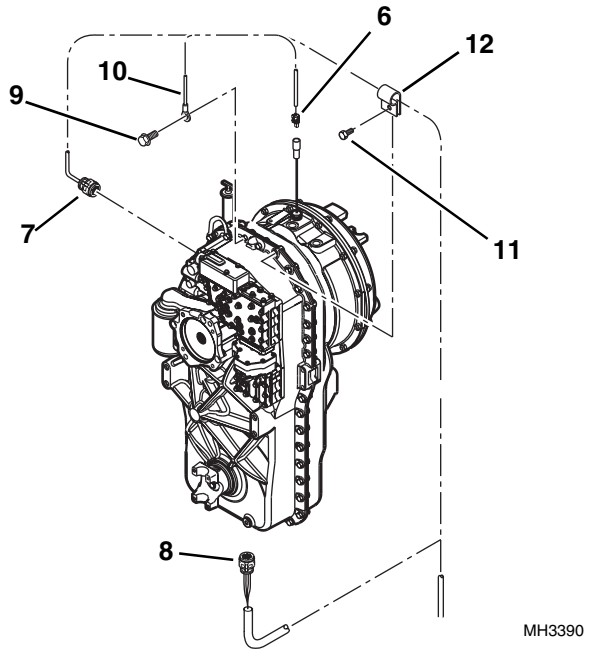
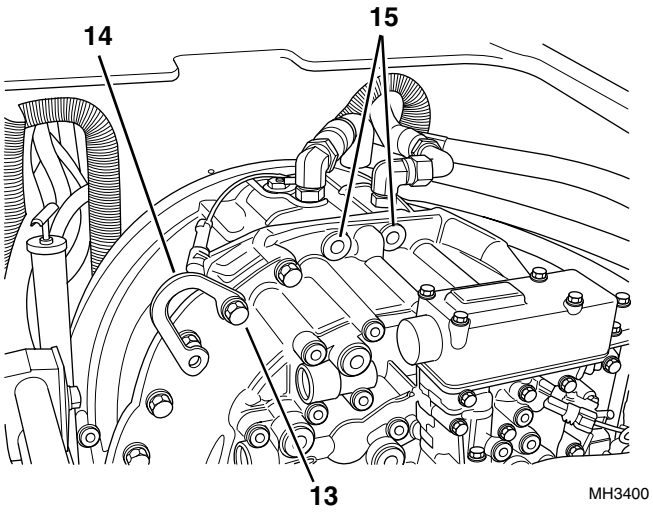


Figure 6-1 Transmission Wiring Harness Connector Location

17. Remove the capscrew (**13**) securing the lifting ring (**14**) to the transmission housing. Once the lifting ring has been removed, reinstall the capscrew into the hole.
18. Move the lifting ring (**14**) to the holes (**15**) used to secure the black wire (**10**) and clamp (**12**). Secure the lifting ring using the capscrews (**9** and **11**), and tighten securely.



19. Label, disconnect and cap the transmission oil cooler inlet (**1**) and outlet (**2**) hoses at the transmission. The transmission oil cooler outlet hose, routed to the lower radiator fitting, is located on the top of the transmission. The transmission oil cooler inlet hose, routed to the upper radiator fitting, is located on top of the transmission.
20. Wipe up any spilled hydraulic and transmission oil.

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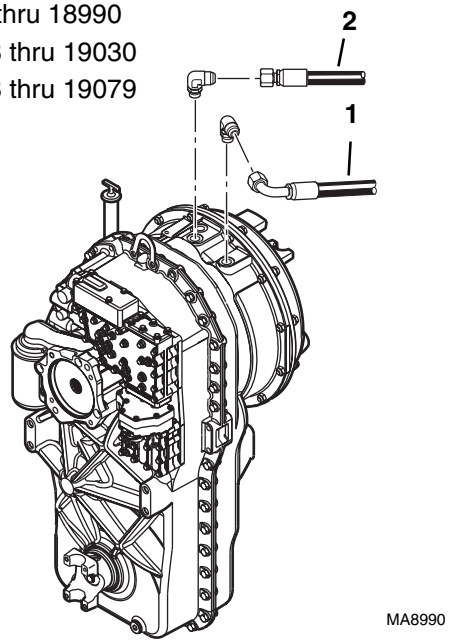
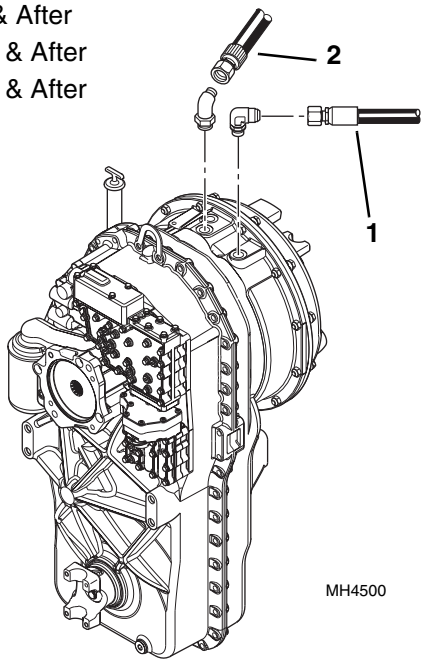
10042 S/N 13198 thru 19030
10054 S/N 13198 thru 19079



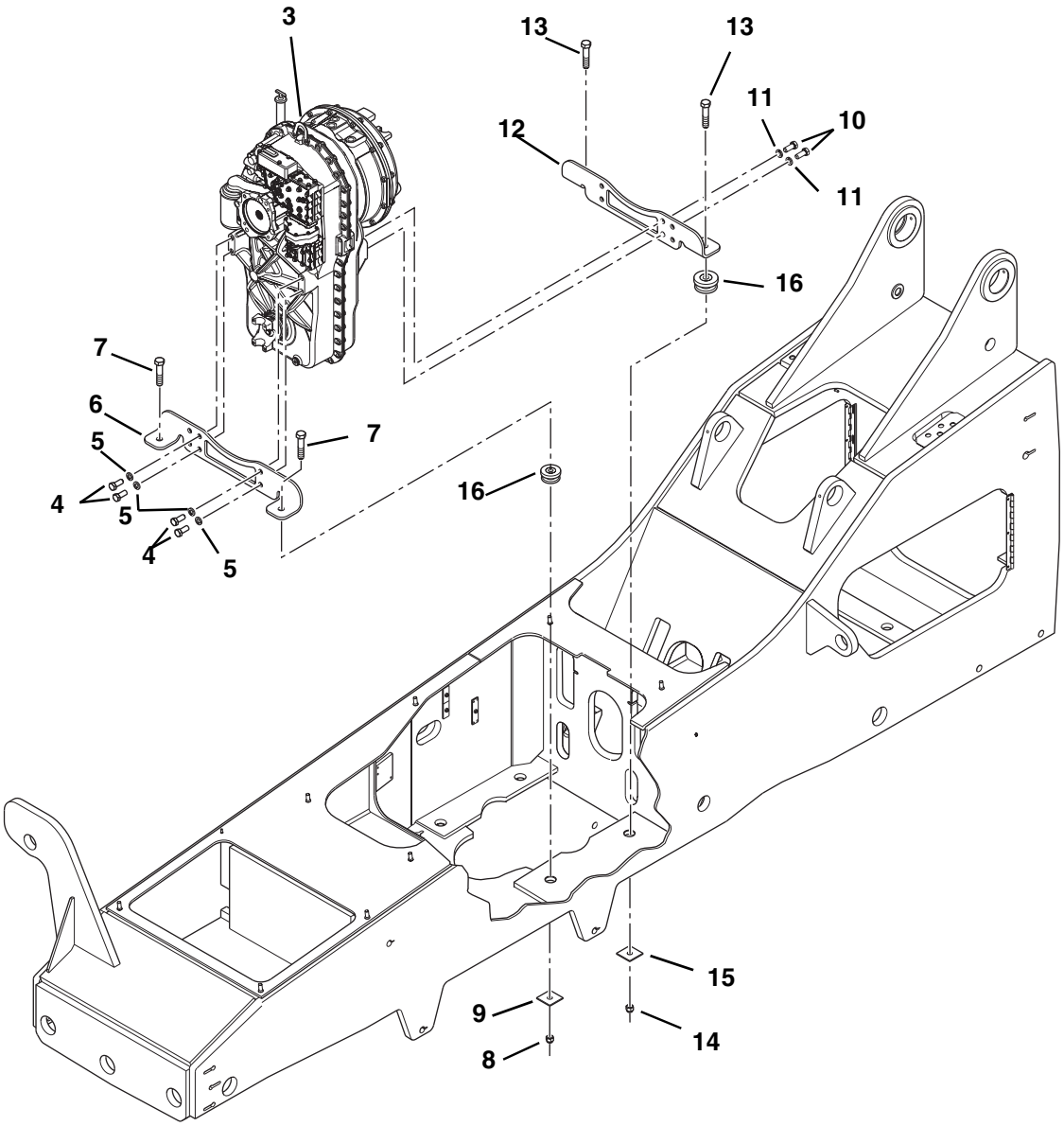
8042 S/N 18991 & After
10042 S/N 19031 & After
10054 S/N 19080 & After



21. Connect a lifting strap or chain to the lifting eye (**3**) at the top of the transmission, and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the transmission at this time.
22. Place blocks under the transmission to help support it during removal.
23. Remove the four capscrews (**4**) and four lockwashers (**5**) securing the front transmission mount (**6**) to the transmission.
24. Remove the two capscrews (**7**), two hex locknuts (**8**) and two rebound washers (**9**). Remove the front transmission mount (**6**) from the vehicle.
25. Remove the four capscrews (**10**) and four lockwashers (**11**) securing the rear transmission mount (**12**) to the transmission.
26. Remove the two capscrews (**13**), two hex locknuts (**14**) and two rebound washers (**15**). Remove the rear transmission mount (**12**) from the vehicle.
27. Inspect the rubber mounts (**16**). Replace the mounts if damaged.

WARNING: Risk of personal injury. The transmission may move while hoisting it out of the chassis. Carefully move the transmission and adjust the sling as needed. Keep fingers, hands, legs and other body parts clear of the transmission.

28. Carefully remove the transmission from the vehicle. Avoid causing damage to the transmission or surrounding parts.
29. Lift the transmission clear of the vehicle, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.



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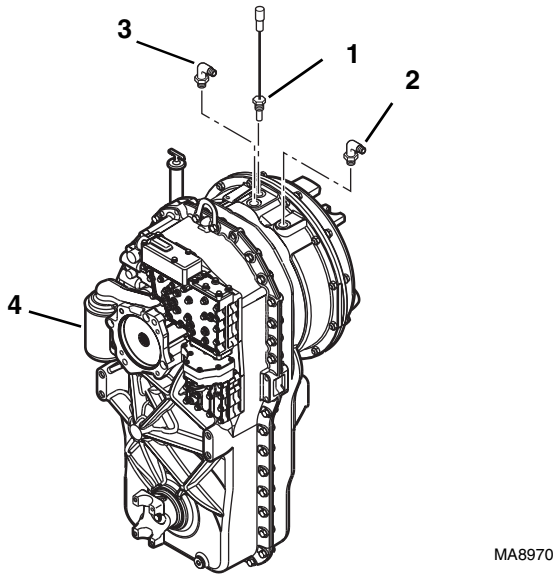
30. Remove any external transmission components as required, including the transmission temperature switch (**1**), and inlet (**2**) and outlet (**3**) cooler hose fittings. Cover all transmission openings.
31. Remove the transmission oil filter (**4**) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.



The transmission is now ready for inspection and/or further service. Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on transmission diagnosis, and internal component repair or replacement.

6.7.2 Transmission Inspection and Internal Repair

Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on internal component repair or replacement. Refer to the ZF 4 WG-98 TC Transmission Technical Data Manual and Maintenance Manual, P/N 8990449 (ZF part number 5872 134 002) for information on transmission diagnosis and internal schematics.

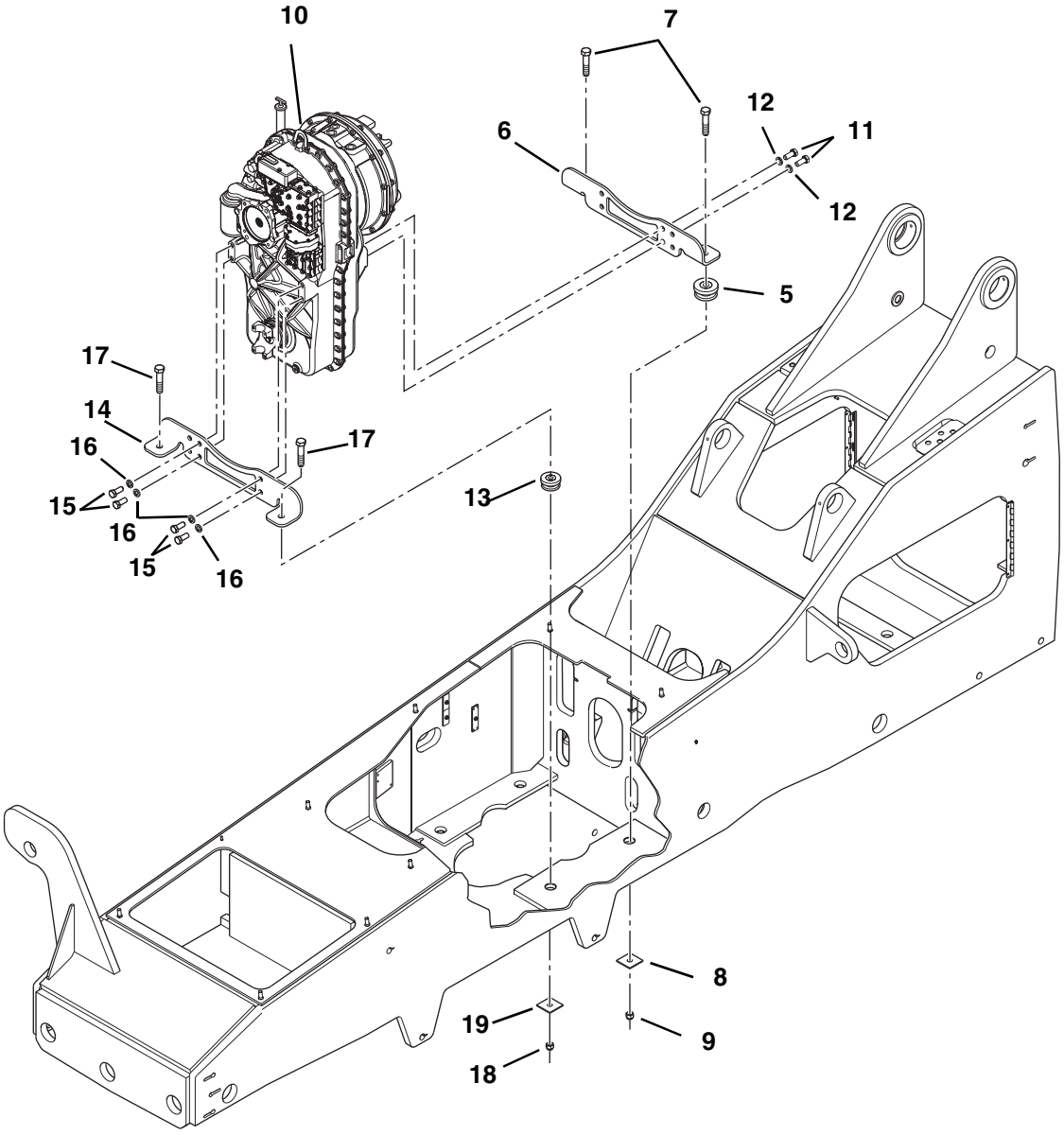
If replacing the entire transmission, transfer the transmission temperature switch to the replacement transmission. The gear shift solenoids are included with a new transmission.

6.7.3 Transmission Installation

WARNING: Risk of severe personal injury. **NEVER** lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

WARNING: The transmission must be properly installed using fasteners of the correct size and grade, and torqued to their specified values.

1. Install two rubber mounts (**5**) and the rear transmission mount (**6**) in the vehicle frame. Secure the mount with two capscrews (**7**), two rebound washers (**8**) and two locknuts (**9**).
2. Use a hoist or overhead crane and sling attached to the lifting eye (**10**) at the top of the transmission. Raise and position the transmission within the chassis.
3. Attach the transmission to the rear mounting bracket (**6**) with four capscrews (**11**) and four lockwashers (**12**). Torque the capscrews to 148 lb-ft (200 Nm).
4. Install the two front rubber mounts (**13**) and the front transmission mounting bracket (**14**) on the transmission with four capscrews (**15**) and four lockwashers (**16**). Torque the capscrews to 148 lb-ft (200 Nm).
5. Attach the front mounting bracket (**14**) to the frame with two capscrews (**17**), two hex locknuts (**18**) and two rebound washers (**19**).
6. Remove the hoist or overhead crane and sling.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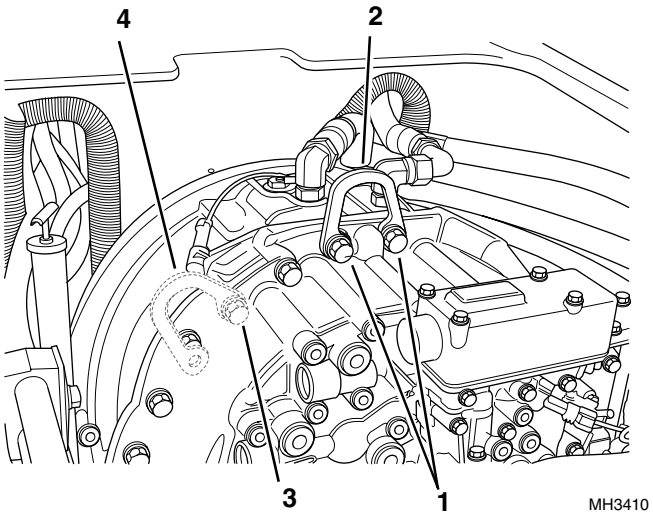
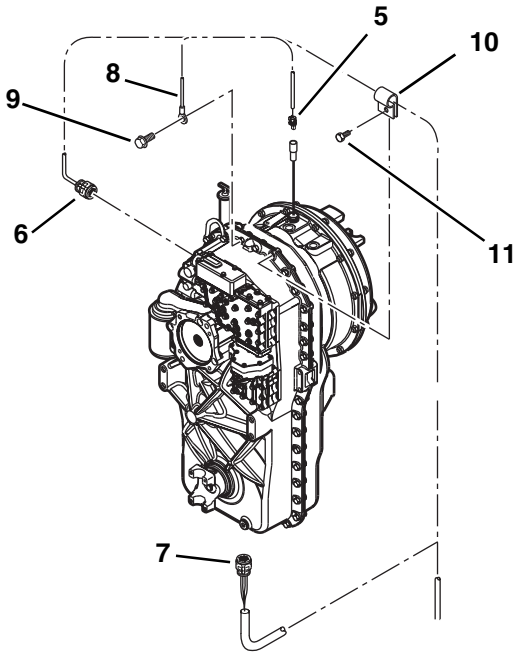
Note: *The lifting ring must be repositioned, to allow the covers to be installed.*

7. Remove the two capscrews (**1**) securing the lifting ring (**2**) to the transmission housing. Save the capscrews for later use.
8. Remove the capscrew (**3**), and secure the lifting ring (**2**) in the storage position (**4**) on the transmission housing as shown.

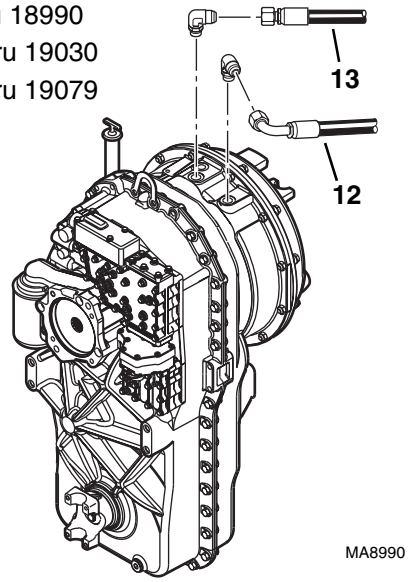


9. Connect the transmission temperature switch connector (**5**) and shift solenoid wiring harness connectors (**6** and **7**).

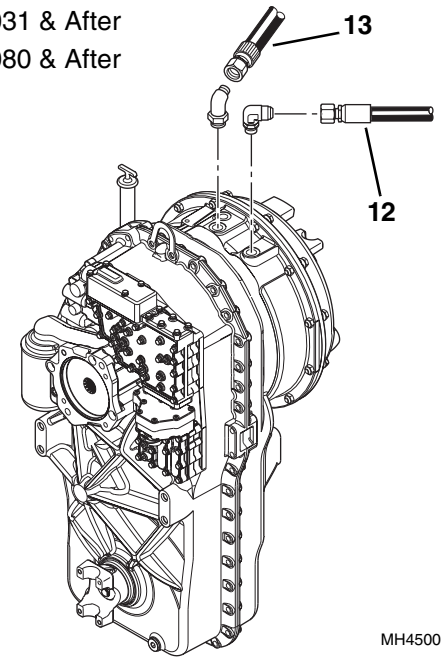


10. Attach the black wire (**8**) to the transmission housing with a capscrew (**9**) removed in Step 7.
11. Secure the wiring harness to the transmission housing using the clip (**10**) and capscrew (**11**) removed in Step 7.
12. Connect the transmission oil cooler inlet (**12**) and outlet (**13**) hoses at the transmission.

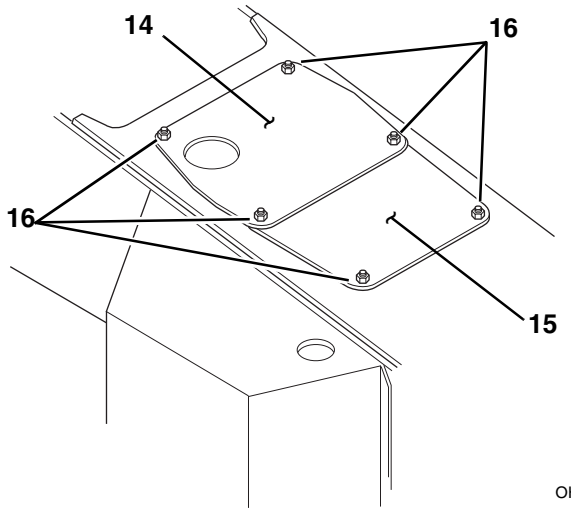
8042 S/N 13198 thru 18990
10042 S/N 13198 thru 19030
10054 S/N 13198 thru 19079



8042 S/N 18991 & After
10042 S/N 19031 & After
10054 S/N 19080 & After



13. Install the hydraulic pump. Refer to Section 8.11.2, h. “Pump Installation.”
14. Install the engine-to-transmission drive shaft. (Refer to Section 5.4.7, b. “Engine-to-Transmission Drive Shaft.”
15. Install the transmission-to-axle drive shafts. Refer to Section 5.4.7, a. “Transmission-to-Axle Drive Shafts.”
16. Clean the transmission oil filter mounting surface.
17. Apply a thin film of clean Universal Tractor Fluid to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).
18. Transmission oil may be added through the dipstick tube. Remove the dipstick and add approximately 3 gallons (11,4 liters) of Universal Tractor Fluid. Check the oil level by taking intermittent dipstick readings as outlined in the appropriate owners/ operators manual. **DO NOT** overfill. Reinstall the dipstick when finished.
19. Install the upper (**14**) and lower (**15**) transmission covers, and secure to the frame with six flat washers, six lockwashers and six hex nuts (**16**).



20. Connect the battery negative (-) cable at the battery.

6.7.4 After Transmission Service or Replacement

Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on servicing the transmission after overhaul or repair. In general:

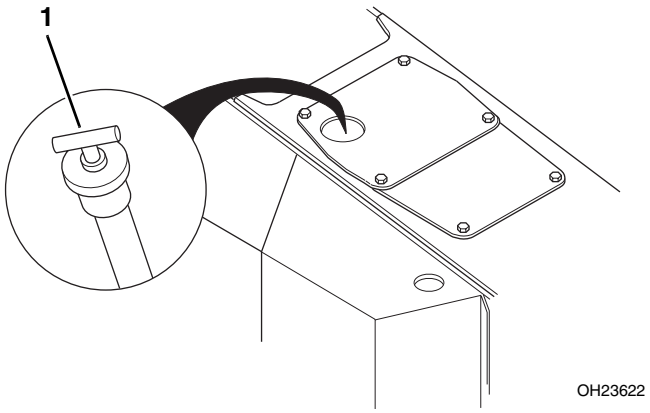
1. Check the transmission oil level and add oil as required.
2. Install a new transmission filter.
3. Check the torque on the drive shaft yoke capscrews.
4. Wear suitable eye protection. When an overhauled or repaired transmission is installed, thoroughly clean the oil cooler lines to and from the transmission.
5. Drain and flush the entire system.
6. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the vehicle for cleaning.
7. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.

	CAUTION: **DO NOT** exceed 165 psi (11,4 bar) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

8. Back flush the transmission oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. Flushing in the direction of normal oil flow does not adequately clean the cooler. If needed, remove the radiator or oil cooler from the vehicle.

***IMPORTANT: DO NOT** use flushing compounds for cleaning purposes.*

9. Reassemble all components and fill the transmission with clean, fresh Universal Tractor Fluid through the dipstick tube opening (**1**). Remove the dipstick and fill with approximately 3 gallons (11,4 liters) of Universal Tractor Fluid. Check the level by taking intermittent dipstick readings as outlined in the appropriate owners/operators manual. **DO NOT** overfill. Reinstall the dipstick when finished.



10. Run the engine for two minutes at idle to help prime the torque converter and the transmission oil lines.
11. Recheck the level of the fluid in the transmission with the engine running at idle.
12. Add Universal Tractor Fluid as necessary to bring the fluid level up until it reaches the FULL mark on the dipstick. Recheck the oil level when it reaches operating temperature (180-200° F or 83-94° C).
13. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

6.8 TOWING A DISABLED VEHICLE

Towing a disabled vehicle should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the vehicle, and move it under its own power, before using the emergency towing procedures outlined in the appropriate owners/operators manual.

IMPORTANT: *After the vehicle has been towed to a secure location, reactivate the parking brake. Carefully follow the procedures from start to finish. Consult your local* ***Sky Trak*** *distributor or the* ***JLG*** *Service Department at 1-877-554-5438 or 1-717-485-6657, if you are unsure about any part of the procedure, or for specific instructions concerning your particular situation.*

6.9 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

Note: *Contact the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if internal transmission repair is required during the warranty period.*

Detailed transmission service instructions (covering repair, disassembly, reassembly and adjustment information) are provided in the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002).

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

6.9.1 Transmission Troubleshooting

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	2. Travel select lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.14.7, a. “Travel Select Lever and Wiring Harness Testing.”
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.14.7, b. “Upper and Lower Transmission Valve Body Solenoid Testing.”
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to Section 6.9.1, “Transmission Troubleshooting,” **Problem 2.** “Low or no pump flow or pressure.”
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.
2. Low or no pump flow or pressure.	1. Low oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	2. Transmission filled with incorrect oil, or oil contaminated.	2. Drain transmission and fill to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	3. Pump suction pipe screen clogged.	3. Clean, repair and/or replace suction pipe.
	4. Central shaft damaged.	4. Replace central shaft.
	5. Pump worn or damaged.	5. Repair or replace pump assembly.

6.9.1 Transmission Troubleshooting (Continued)

Problem	Cause	Remedy
3. Low clutch pressure.	1. Incorrect oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. Refer to the appropriate owners/ operators manual.
	2. Main pressure valve stuck open.	2. Clean the valve spool and housing.
	3. Broken or worn coupling shaft or piston o-rings.	3. Replace coupling and/or o-rings.
	4. Pressure reducing valve stuck open.	4. Clean the valve spool and housing.
4. Lack of power.	1. Park or service brake dragging.	1. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	2. Low engine rpm causes converter stall.	2. Adjust the engine rpm to specifications. Refer to Cummins Service Manual.
	3. Pump output pressure is low.	3. Refer to Section 6.9.1, “Transmission Troubleshooting,” **Problem 2.** “Low or no pump flow or pressure.”
	4. Clutch discs worn or damaged.	4. Replace clutch discs.
	5. Transmission overheating.	5. Refer to Section 6.9.1, “Transmission Troubleshooting,” **Problem 5.** “Transmission overheating (oil above 248° F [120° C]).”
5. Transmission overheating (oil above 248° F [120° C]).	1. Low oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. Refer to the appropriate owners/ operators manual.
	2. Clogged radiator.	2. Remove debris from the radiator.
	3. Transmission filled with incorrect oil, or oil contaminated.	3. Drain transmission and fill to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	4. Excessive “roading.”	4. Stop and idle the engine.
	5. Restriction in oil cooler hoses.	5. Replace cooler hoses.
	6. Pump worn or damaged.	6. Repair or replace pump assembly.
	7. Engine thermostat stuck.	7. Replace engine thermostat. Refer to Section 7B.6.2, b. “Thermostat Installation.”

6.9.1 Transmission Troubleshooting (Continued)

Problem	Cause	Remedy
6. Grinding or "clunking" noise from transmission.	1. Oil level too low.	1. Fill oil to correct level. Refer to appropriate owners/operators manual.
	2. Transmission filled with incorrect oil.	2. Drain transmission and fill to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	3. Incorrect clutch engagement.	3. Refer to Section 9.14.7, "Transmission Solenoid Valves."
	4. Internal damage.	4. Repair or replace parts as needed.
	5. Broken diaphragm (flex plate).	5. Replace diaphragm (flex plate). Refer to Section 6.7.1, "Transmission Removal."
	6. Loose diaphragm (flex plate) mounting capscrews.	6. Tighten capscrews.
7. Oil leaking from transmission.	1. Oil leaking from vent (high oil level).	1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to the appropriate owners/operators manual). Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Drain plug loose and/or o-rings damaged or missing.	2. Replace o-rings as needed and tighten plug to 26 lb-ft (35 Nm).
	3. Hose fittings loose.	3. Tighten fittings.
	4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight).	4. Replace gaskets and/or tighten capscrews to 7 lb-ft (9,5 Nm).
	5. Housing capscrews loose.	5. Tighten capscrews to 34 lb-ft (46 Nm).
	6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight).	6. Replace o-rings and/or tighten capscrews to 85 lb-ft (115 Nm).
	7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage).	7. Replace converter and/or input shaft seal.
	8. Oil leaking at output shaft (output shaft seal damaged).	8. Replace output shaft seal.
	9. Housing damaged.	9. Replace housing as needed.

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Section 7A
Engine: Cummins 4BT3.9 and 4BTA3.9

Contents

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7A.1 INTRODUCTION

7A.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

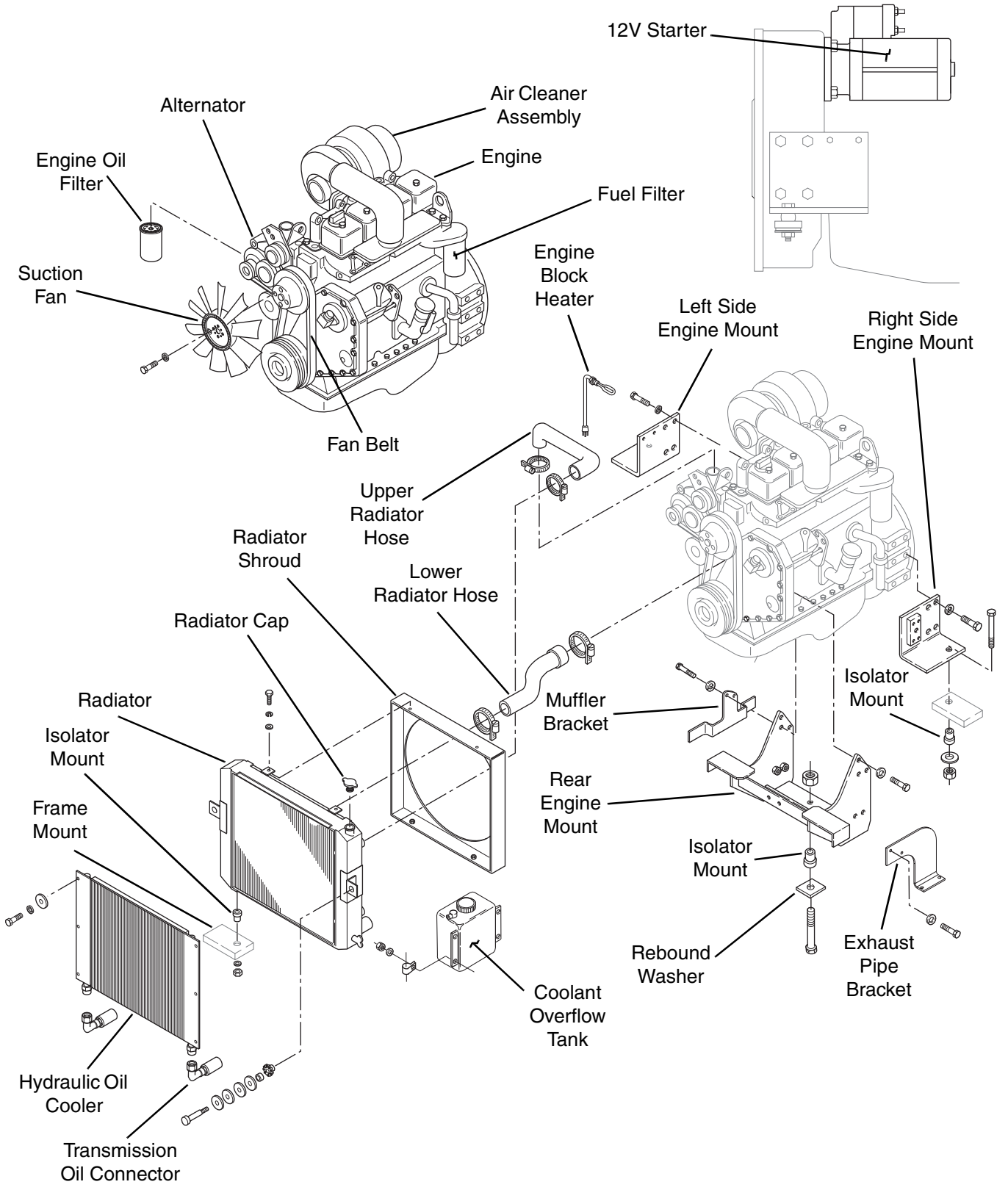
IMPORTANT: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Cummins Engine Distributor and the applicable Cummins engine service manual for assistance with comprehensive engine diagnosis, repair and component replacement.*

Note: *The 8042 model unit has the 4BT3.9 Cummins engine installed. The 10042 and 10054 models have the 4BTA3.9 engine installed. The "A" designation represents the After Cooler found on the 10042 and 10054 models. For additional information on the After Cooler, refer to the appropriate Cummins engine manual.*

A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended. **DO NOT** run the engine at high, no-load speeds. **DO NOT** apply an overload to the engine.

7A.1.2 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.


12V Starter
Alternator
Air Cleaner Assembly
Engine Oil Filter
Engine
Fuel Filter
Suction Fan
Engine Block Heater
Left Side Engine Mount
Right Side Engine Mount
Fan Belt
Upper Radiator Hose
Radiator Shroud
Lower Radiator Hose
Radiator Cap
Isolator Mount
Muffler Bracket
Radiator
Isolator Mount
Rear Engine Mount
Frame Mount
Isolator Mount
Rebound Washer
Exhaust Pipe Bracket
Coolant Overflow Tank
Hydraulic Oil Cooler
Transmission Oil Connector

MH4000

7A.2 SAFETY INFORMATION

General Vehicle Operation

WARNING: Before attempting to start the engine and/or operate the vehicle, read the owners/operators manual.

- Before operating the engine and/or the vehicle, install any engine guards that were removed, and clear all personnel from the immediate area.
- Check that the brakes are fully functional.
- **DO NOT** exceed the stability limits of the vehicle.
- Allow only ONE person to have control of the engine and the vehicle.

Preparation

WARNING: Wear protective glasses and protective shoes.

- **Verify that the work area** is capable of supporting the weight of the vehicle and the torque created by any suspended load.
- **DO NOT** work on an engine or a vehicle that is supported ONLY by a hoist or lift jacks. Use blocks or suitable stands.

Engine Operation

WARNING: Operate the engine in a well-ventilated area only. Assure that engine operation will not produce a concentration of toxic emissions.

- **DO NOT** operate the engine in the presence of a fuel spill or gas leak. Such combustible vapors, when drawn into the engine, can cause engine over-acceleration, explosion, fire and extensive personal injury and property damage. Before operating in any hazardous environment, consult a recognized authority (such as the engine distributor) on engine operation in hazardous environments.
- **DO NOT** smoke or operate the engine during refueling.

Cleaning

WARNING: When using steam cleaners and pressure washers, wear protective glasses, gloves and clothing to help prevent personal injury.

WARNING: **NEVER** use gasoline or other flammable materials for cleaning parts. Use only approved cleaning solvents.

Engine Coolant (anti-freeze/anti-boil over)

WARNING: **DO NOT** remove the radiator cap while the engine and coolant are hot. Hot coolant under pressure is dangerous and can injure the eyes and cause severe burns.

- Cooling system corrosion inhibitors contain alkali (chemicals that break down organic substances such as skin and eye tissue), **DO NOT** swallow. Avoid prolonged or repeated contact with corrosion inhibitors. In case of skin contact, immediately wash affected area with soap and water. In case of contact with eyes, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Obtain medical assistance immediately. Keep corrosion inhibitors out of the reach of children.
- **DO NOT** use salt water or other corrosive liquid in the cooling system.

Rotating Parts and Fan Blades

WARNING: Keep away from parts which rotate; the fan blades can appear invisible when the fan is rotating.

DO NOT pull or pry on the fan blades. This practice will cause fan failure. Use only approved methods and tools for manually rotating the engine.

Battery

WARNING: Keep sparks and fires away from batteries. Batteries produce hydrogen gas, which can explode and cause severe personal injury and property damage.

Battery fluid can burn the skin and injure the eyes. If you come in contact with battery acid, flush the affected area with large amounts of water and obtain medical assistance immediately.

Engine Oil

WARNING: Engine oil can cause skin disorders and other personal injury. Avoid prolonged or repeated contact with both new and used engine oil.

Diesel Fuel

WARNING: Diesel fuel can cause skin irritation. Use gloves or protective hand lotion when working on the fuel system.

Engine Repair

WARNING: Before beginning any adjustments or repairs, place accident prevention tags in the operator's compartment and on the controls, and disconnect the battery negative cable.

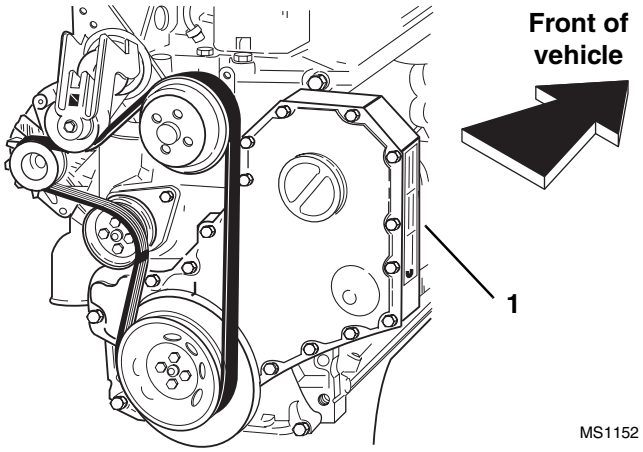
- **DO NOT** operate, clean, lubricate or adjust the engine without proper training.
- **NEVER** attempt to perform an adjustment or repair that is not understood.
- Before servicing, relieve pressure in fuel, oil, coolant and hydraulic lines. Obtain medical assistance immediately if a high-pressure jet of fuel, oil, coolant or hydraulic fluid strikes the skin.
- **DO NOT** permit loose clothing, hair, etc., near moving parts.
- Keep away from parts which rotate; fan blades can appear invisible when the fan is rotating.
- To help prevent burns, avoid contact with components that remain hot after power is turned off or disconnected.
- Some of the gaskets on the engine contain asbestos. Breathing asbestos dust is dangerous to health and may cause severe bodily harm. Avoid creating dust and follow local directives for handling and disposing of materials that contain asbestos.

Parts

WARNING: When replacement is necessary, **ALWAYS** use factory-approved fasteners and parts.

7A.3 ENGINE SERIAL NUMBER

The Cummins 4BT3.9 or 4BTA3.9 serial number (**1**) Is stamped on the front of the engine block, near the fan pulley. Information contained in the serial number is required in correspondence with the engine manufacturer.



Supply the engine serial number and/or data tag information when communicating about an engine or engine components.

7A.4 SPECIFICATIONS AND MAINTENANCE INFORMATION

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

Note: *Detailed Cummins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate Cummins engine service manual.*

7A.5 STANDARD PRACTICES

7.5.1 Cleanliness

Cleanliness is very important during engine repair. Contamination of the engine during repair will reduce the life of an engine. Thoroughly clean the engine and engine compartment area before attempting to service or repair the engine.

DO NOT steam clean the following parts:

- Electrical Components
- Wiring
- Injectors
- Fuel Pump
- Belts and Hoses
- Bearings

During reassembly and inspection, thoroughly clean all parts, and, where present, remove burrs and scales.

7A.5.2 Gaskets and O-rings

NEVER reuse a gasket or o-ring. Use new gaskets and o-rings. Thoroughly clean sealing surfaces before installing a new gasket or o-ring. ALWAYS install new flat-faced o-rings when servicing hydraulic fittings.

Cover any open ports of high-precision components (such as fuel system equipment) exposed by removal or disassembly to help prevent the entry of foreign material.

7A.5.3 Capscrews, Nuts and Metric Parts

When replacing capscrews, ALWAYS use a capscrew of the same size and strength (Grade) as the capscrew being replaced. Incorrect capscrews can result in engine damage. Return capscrews removed from the engine to their original locations.

Always replace used elastic locknuts with new elastic locknuts.

The Cummins 4BT3.9 and 4BTA3.9 engines use parts that are of metric dimensions. Metric capscrews are described, in millimeters, in terms of major thread diameter, distance between threads and overall length.

Metric capscrew dimensions:

M8 x 1,25 - 25

- 25 — Length, in millimeters
- 1,25 — Distance between threads, in millimeters
- M8 — Major thread diameter, in millimeters

Verify that the correct type of part is used at all times.

7A.6 ENGINE COOLING SYSTEM

The engine cooling system is a closed, pressurized system that consists of coolant passages in the engine, plus the oil cooler, thermostat, water pump, coolant heater, hoses, radiator and radiator overflow bottle. The engine is cooled by the circulation of coolant through passages in the cylinder block, engine head and radiator. Circulation is by thermo-siphon action, assisted by an impeller-type water pump, driven by a fan belt from the crankshaft pulley.

The water pump bearings are prepacked with a special grease and **DO NOT** require service. Replace a faulty water pump. General engine cooling specifications and maintenance procedures are listed in Section 2, “General Information and Specifications.”

7A.6.1 Radiator Pressure Cap

The cooling system is designed to use a radiator pressure cap to help prevent the coolant from boiling. In addition, the pressure helps to eliminate the formation of steam pockets within the engine and ensures coolant circulation throughout all coolant passageways of the engine. For a 210° F (99° C) system, use a 13 psi (90 kPa) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

7A.6.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

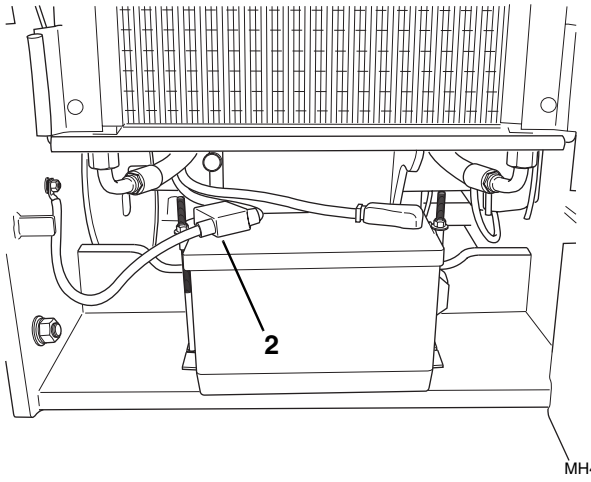
- If the engine seems to take a long time to warm up, the thermostat may be stuck in the open position and requires replacement.
- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, “Accident Prevention Tags.”

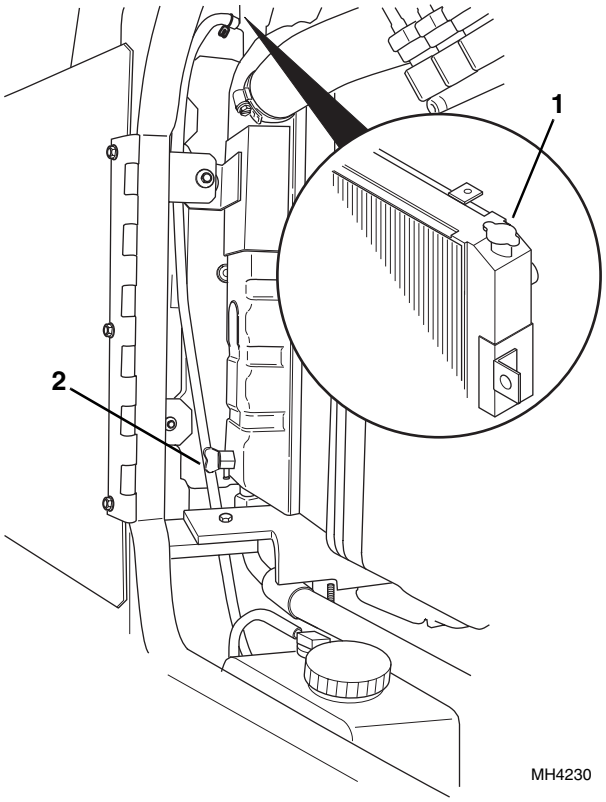
> **WARNING:** **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

3. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.
4. Disconnect the negative (-) battery cable (**2**).

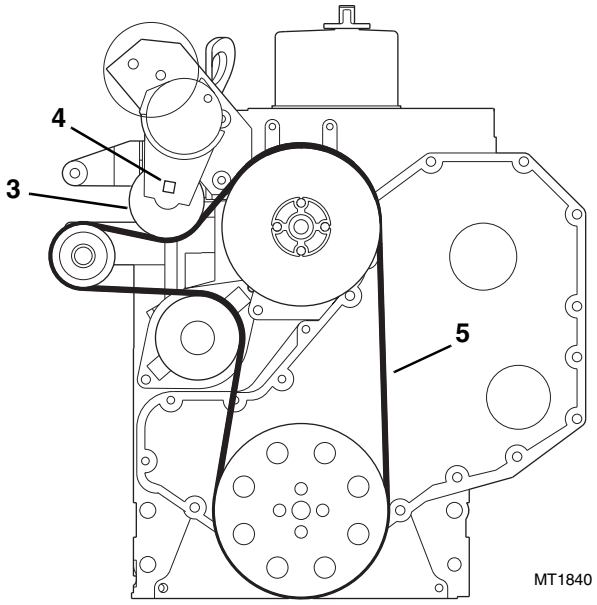


Note: *Drain approximately two quarts (2 liters) of coolant.*

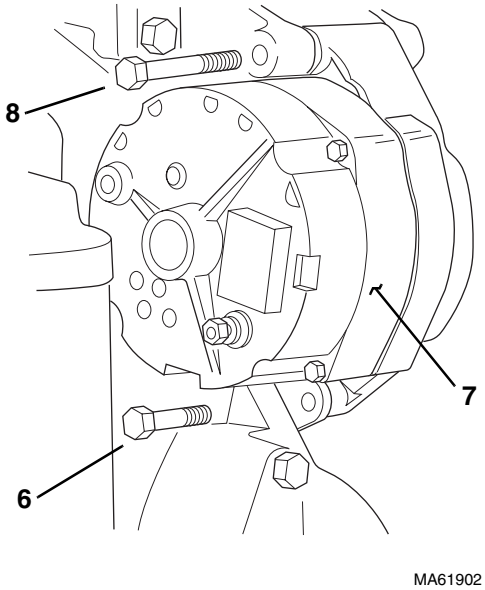
5. Slowly turn the radiator cap (**1**) to the first stop and allow any pressure to escape. Remove the radiator cap. Place a funnel at the base of the radiator to channel the drained coolant into a container. Open the radiator petcock (**2**), and allow the coolant to drain into the funnel. Transfer the coolant into a properly labeled container. Dispose of properly. Close the radiator petcock.



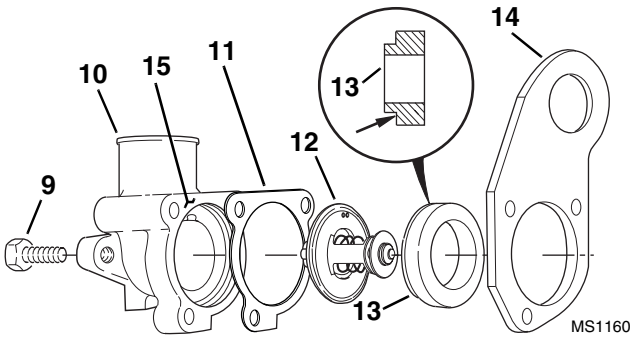
6. This engine is equipped with an automatic belt tensioner pulley (**3**). Insert a 1/2" drive ratchet into the square hole (**4**) in the tensioner housing, and remove the tension from fan belt (**5**).
7. While lifting the automatic belt tensioner pulley (**3**) away from the belt, remove the fan drive belt (**5**).



8. Loosen the lower alternator bracket capscrew (**6**) on the bottom of the alternator (**7**). Remove the upper alternator mounting capscrew (**8**), and lower the alternator.



9. Remove the three capscrews (**9**) securing the thermostat housing (**10**) to the engine.



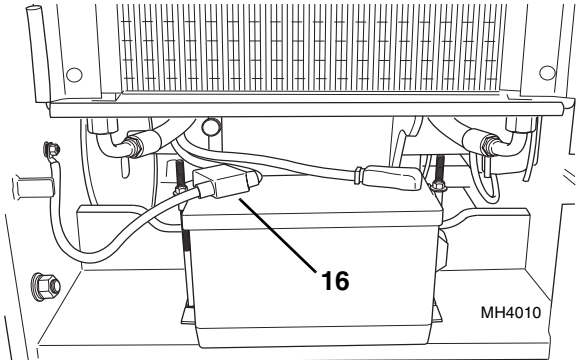
10. Remove the thermostat housing (**10**), old gasket (**11**), thermostat (**12**), thermostat seal (**13**) and engine lift bracket (**14**). Clean all gasket surfaces (**15**). **DO NOT** let any debris into the thermostat opening.

IMPORTANT: *ALWAYS use the correct thermostat and install a new gasket.* ***NEVER*** *operate the engine without a thermostat, or engine damage will result.*

b. Thermostat Installation

Note: *Ensure that notched edge (arrow) of thermostat seal (**13**) is facing thermostat.*

1. Install the engine lift bracket (**14**), thermostat seal (**13**), thermostat (**12**) gasket (**11**) and thermostat housing (**10**). Secure with the three capscrews (**9**) removed earlier. Torque to 18 lb-ft (24 Nm).
2. Raise the alternator (**7**), and install the upper alternator mounting capscrew (**8**) and alternator lower capscrew **6**). Torque to 32 lb-ft (43 Nm).
3. Insert a 1/2" drive ratchet or breaker bar into the into the square hole (**4**) in the automatic belt tensioner housing and lift the automatic tensioner pulley (**3**). With the automatic tensioner pulley lifted out of the way, install the fan drive belt (**5**).
4. Connect the negative (-) battery cable (**16**).
5. Open the radiator cap (**1**), and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
6. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.



7A.6.3 Radiator/Oil Cooler and Coolant Heater Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Oil Cooler and Radiator Removal

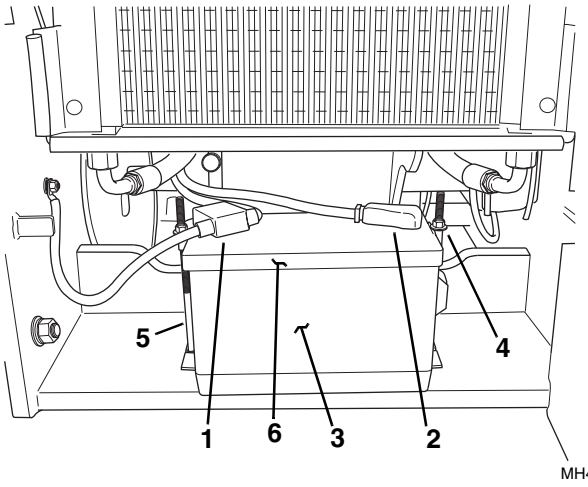
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler, and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

3. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.

4. Disconnect the negative (-) battery cable (**1**) and positive (+) battery cable (**2**) from the battery (**3**).
5. Remove the battery hold-down nuts (**4**) threaded hold-down rods (**5**) and hold-down bracket (**6**). Remove battery from vehicle. Store battery in a cool, dry area.



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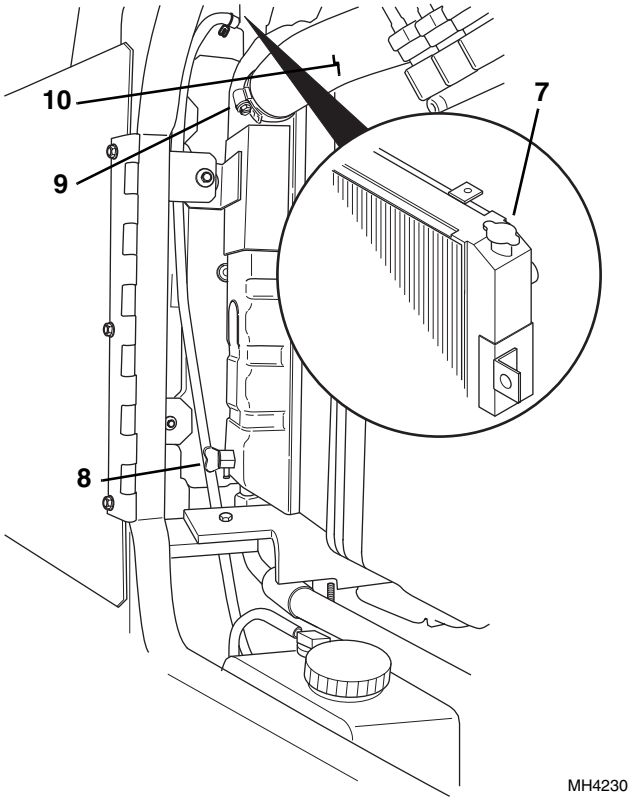
WARNING: Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

6. Slowly turn the radiator cap (**7**) to the first stop and allow any pressure to escape. Remove the radiator cap.
7. Place a suitable container beneath the radiator petcock (**8**).



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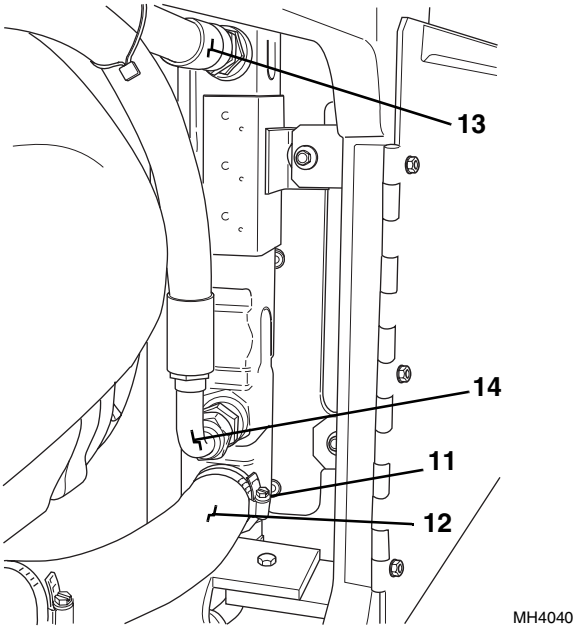
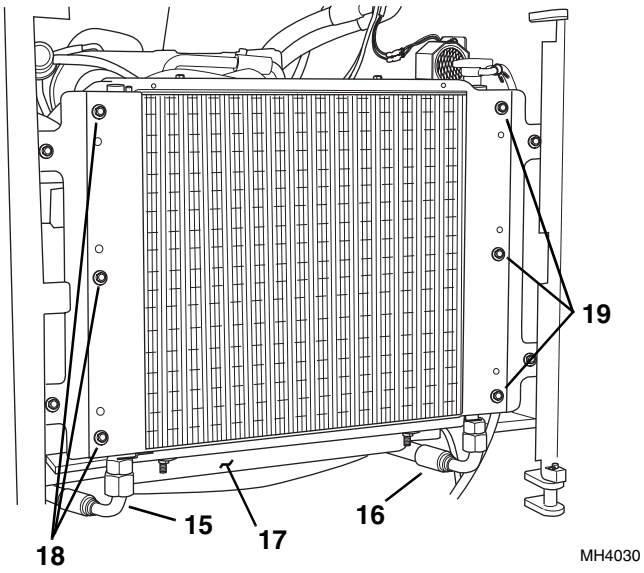
8. Place a funnel at the base of the radiator to channel the drained coolant into the container. Open the radiator petcock (**8**) and allow the coolant to drain into the funnel. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Close the radiator petcock.
9. Loosen the radiator side clamp (**9**) on the radiator input (upper) hose (**10**). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary.

10. Loosen clamp (**11**) on the radiator return (lower) hose (**12**). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary.



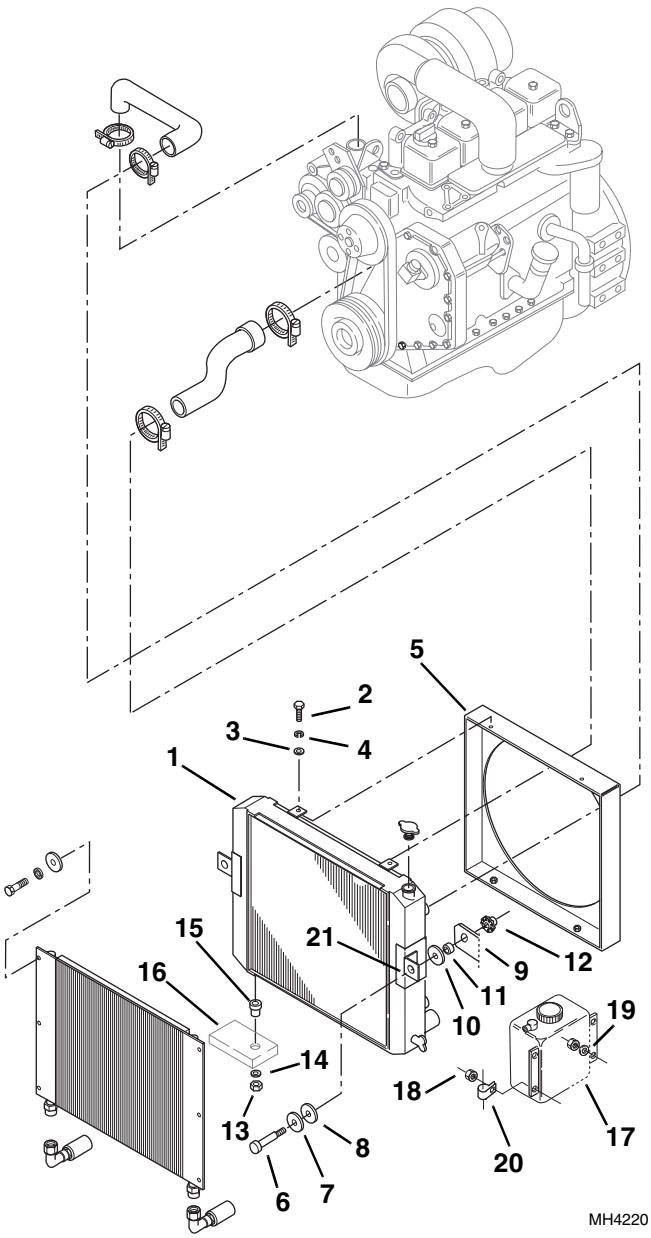
11. Disconnect and cap the transmission inlet (**13**) and outlet (**14**) hoses. Place a suitable container below the fittings to catch any oil that may drain from the radiator.

12. Disconnect and cap the inlet (**15**) and outlet (**16**) fittings from the oil cooler (**17**).



13. At the rear of the oil cooler, remove the six capscrews (**18** and **19**), lockwashers and flat washers. Remove oil cooler.

14. Working above the radiator (**1**), remove capscrews (**2**), plain washers (**3**) and lockwashers (**4**) securing the radiator at the upper mounting tabs to the radiator shroud (**5**). The radiator shroud contains weld nuts that retain the capscrews.



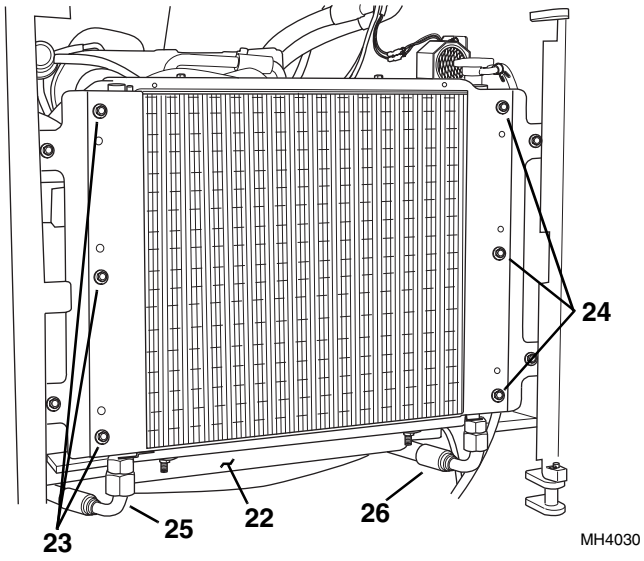
15. At the sides of the radiator, remove the capscrews (**6**), radiator mount bushings (**7**), flat washers (**8** and **10**), spacers (**11**) and elastic locknuts (**12**) securing the radiator side mounting tabs to the radiator mount weldments.
16. Working below the radiator, remove the elastic locknuts (**13**) and rebound washers (**14**). Lift the radiator and remove the isolator mounts (**15**) from between the radiator (**1**) and frame mounts (**16**). Carefully remove the radiator from the vehicle.
17. At the radiator overflow tank (**17**), remove the elastic locknuts (**18**), flat washers (**19**) and hose support (**20**). Remove the radiator overflow tank.

b. Oil Cooler and Radiator Installation

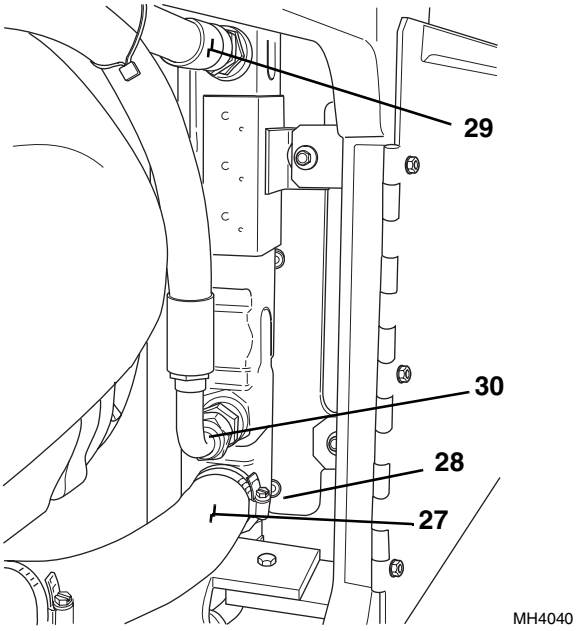
Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

1. Install the radiator overflow tank (**17**), hose support (**20**), flat washer (**19**) and new elastic locknuts (**18**).
2. Install the isolator mounts (**15**) to the bottom of the radiator (**1**). Insert radiator through the vehicle frame mounts (**16**) and install the rebound washers (**14**) and new elastic locknuts (**13**).
3. At the sides of the radiator, install capscrews (**6**) with radiator mount bushings (**7**) and flat washers (**8**) through the radiator mount tab (**21**). Install flat washers (**10**) and spacers (**11**) between radiator mount tabs (**21**) and mount weldments (**9**) Install new elastic locknuts (**12**) on the back side of the weldments (**9**).
4. Working above the radiator (**1**), install capscrews (**2**), plain washers (**3**) and lockwashers (**4**) to secure the radiator at the upper mounting tabs to the radiator shroud (**5**). The radiator shroud contains weldnuts that retain the capscrews.

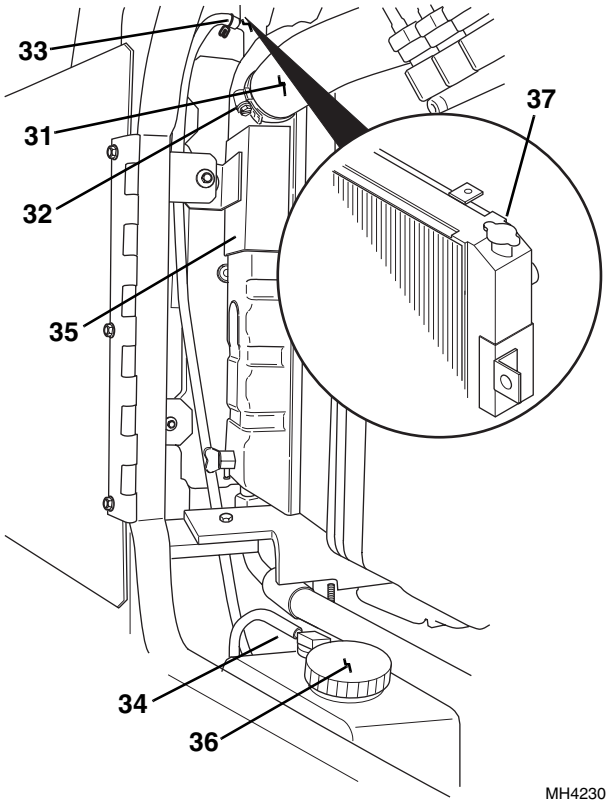
5. Place the oil cooler (**22**) into the vehicle, and install the capscrews (**23** and **24**), lockwashers and flat washers.



6. Uncap and connect inlet (**25**) and outlet (**26**) fittings to the oil cooler (**22**).
7. At the lower radiator return hose (**27**), and with the clamp (**28**) installed over the hose, work the hose onto the radiator, and tighten the clamp.

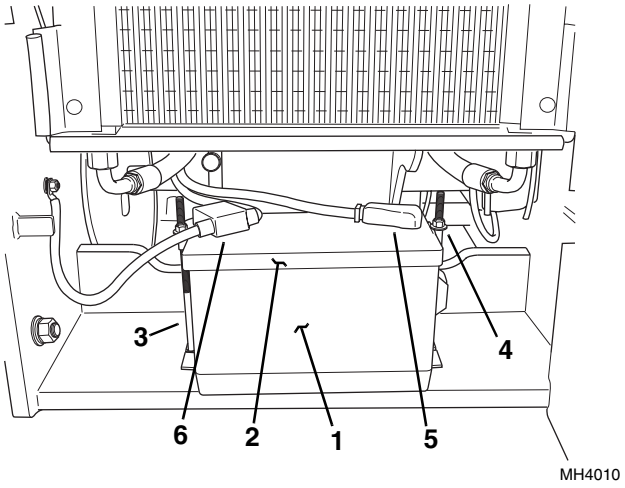


8. Uncap and connect transmission inlet (**29**) and outlet (**30**) hoses to the radiator.
9. At the upper radiator hose (**31**), and with the clamp (**32**) installed over the hose, work the hose onto the radiator, and tighten the clamp.



10. Install the radiator overflow tube at the radiator cap connection (**33**) and at the overflow bottle (**36**) tube connection (**34**).
11. Open the radiator cap (**37**) and fill the radiator (**35**) completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle (**36**) until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.

12. Install the battery (**1**), hold-down bracket (**2**), threaded hold-down rods (**3**) and hold-down nuts (**4**).
13. Connect the positive (+) battery cable (**5**) and negative (-) battery cable (**6**) to the battery (**1**).



14. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.

7A.6.4 Engine Block Heater Replacement

a. Engine Block Heater Removal

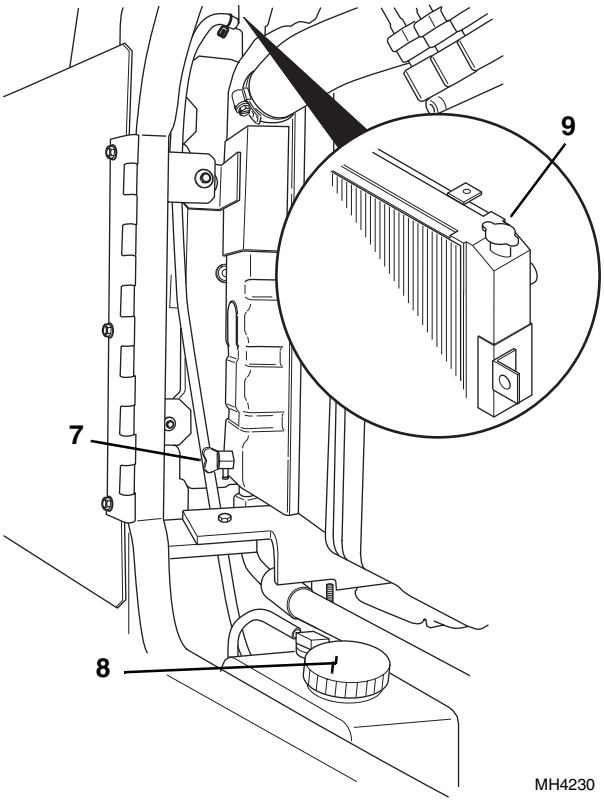
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N) and engage the neutral lock lever; engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

3. Unlock, unlatch and open the engine cover. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.
4. Disconnect the negative (-) battery cable (**8**) from the battery (**1**).

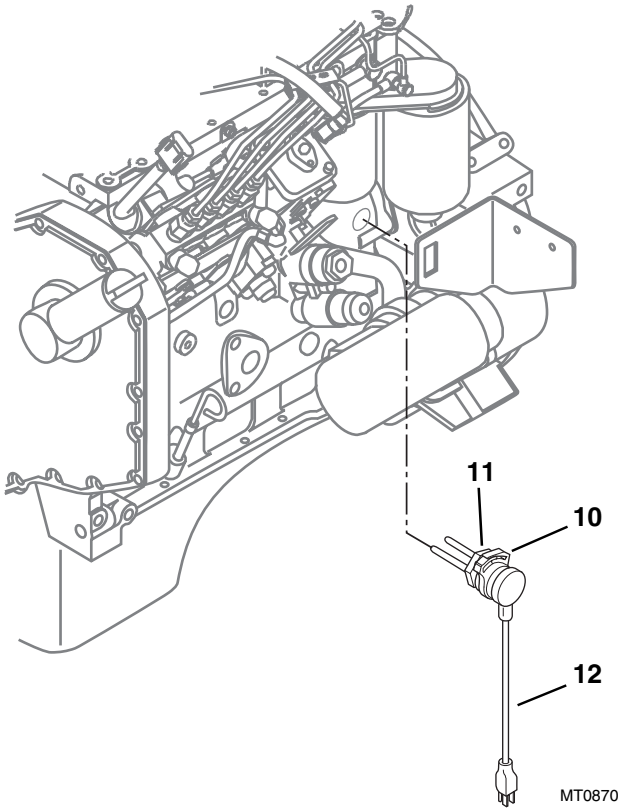
WARNING: Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

5. Place a suitable container beneath the radiator petcock (**7**). Slowly turn the radiator cap (**9**) to the first stop, and allow any pressure to escape. Remove the radiator cap (**9**).



6. Open the radiator petcock (**7**), and allow the coolant to drain into the funnel. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Close the radiator petcock.

7. Remove plastic retainer (**10**) from around coolant heater element (**11**) and 110 volt cord (**12**). Using a 29-mm socket, remove heating element from engine block.



b. Engine Block Heater Installation

1. Apply Teflon tape to coolant heater element threads (**11**), and install element using a 29-mm socket. **DO NOT** overtighten. Plug-in the 110-volt cord (**12**) into heater element, and install plastic retainer (**10**) around coolant heater element and 110-volt cord (**12**).
2. Connect the negative (-) battery cable (**6**) to the battery (**1**).
3. Fill the cooling system. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle (**8**) and fill, or drain, as necessary.

7A.7 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9, “Electrical System.”

7A.8 FUEL SYSTEM

The fuel system includes a fuel tank (**1**), fuel level sender with gasket (**2**), instrument cluster gauge (not shown), fuel strainer (**3**), fuel lift pump (**4**), fuel filter (**5**), fuel supply hose (**6**) and fuel return line (**7**).

The threaded fuel filler (**8**) has a fuel cap (**9**) and permits entry of diesel fuel into the tank.

The fuel level sender (**2**) and instrument cluster gauge are described in Section 9.14.15, “Fuel Level Indicator and Fuel Level Sender.”

A fuel supply hose (**6**) carries fuel from the tank (**1**) to the fuel lift pump (**4**) and then under pressure to the fuel filter (**5**). Filtered fuel is directed to the fuel injection pump and to the individual fuel injectors. Surplus fuel at the fuel injector pump is returned to the tank via the fuel return line (**7**).

7A.8.1 Diesel Fuel

Fuel represents a major portion of vehicle operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: *Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.*

IMPORTANT: *Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.*

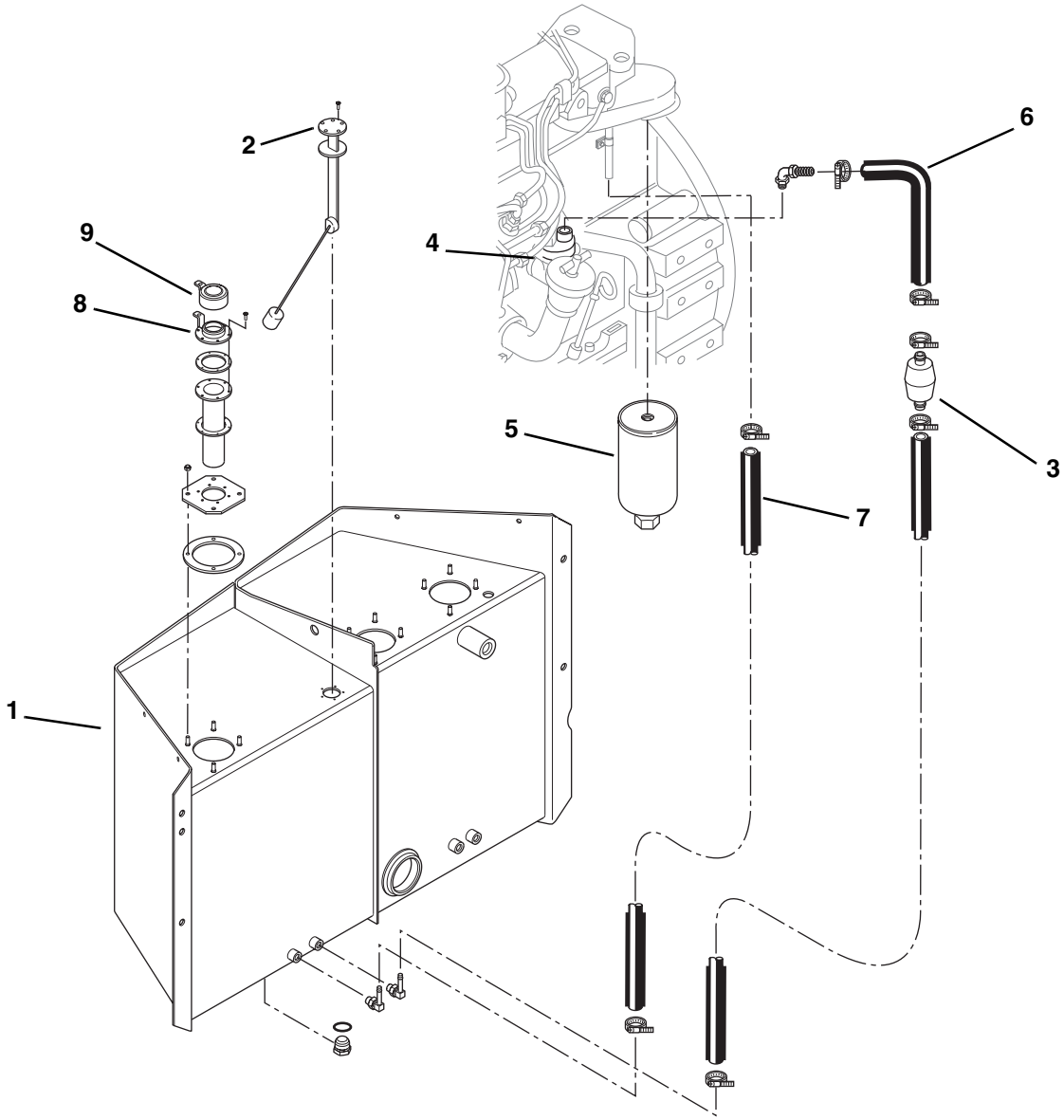
Inform the owner/operator of the vehicle to use #2 diesel fuel, unless ambient temperatures are below 32° F (0° C). When temperatures are below 32° F (0° C), a blend of #1 diesel and #2 diesel fuels (known as “winterized” #2 diesel) may be used.

Note: *#1 diesel fuel may be used, however, fuel economy will be reduced.*

WARNING: **DO NOT** mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

Use a low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

Note: *When using diesel fuel with a sulfur content below 1.3 percent, the filter change interval must be reduced by 75 hours. The use of fuel with a sulfur content above 1.3 percent is not recommended.*



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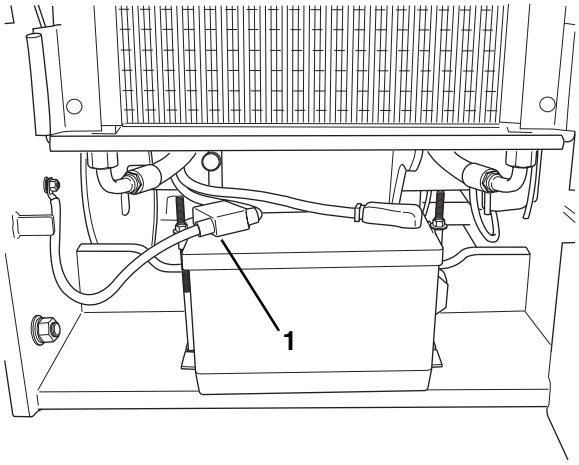
7A.8.2 Fuel/Hydraulic Oil Tank

Note: *The fuel/hydraulic oil tank is part of a one piece unit divided into a two compartment (tank) unit. It is located on the right side of the vehicle, across from the operator's cab. If it is determined that either the fuel or hydraulic oil tank must be removed, both the fuel and hydraulic oil must be drained before tank removal. Always dispose of hydraulic oil or fuel properly.*

WARNING: Explosion and fire hazard. Cap or safely cover the fuel/hydraulic oil tank fittings before removing tank.

a. Fuel/Hydraulic Oil Tank Removal

1. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.
2. Disconnect the negative (-) battery cable (**1**).



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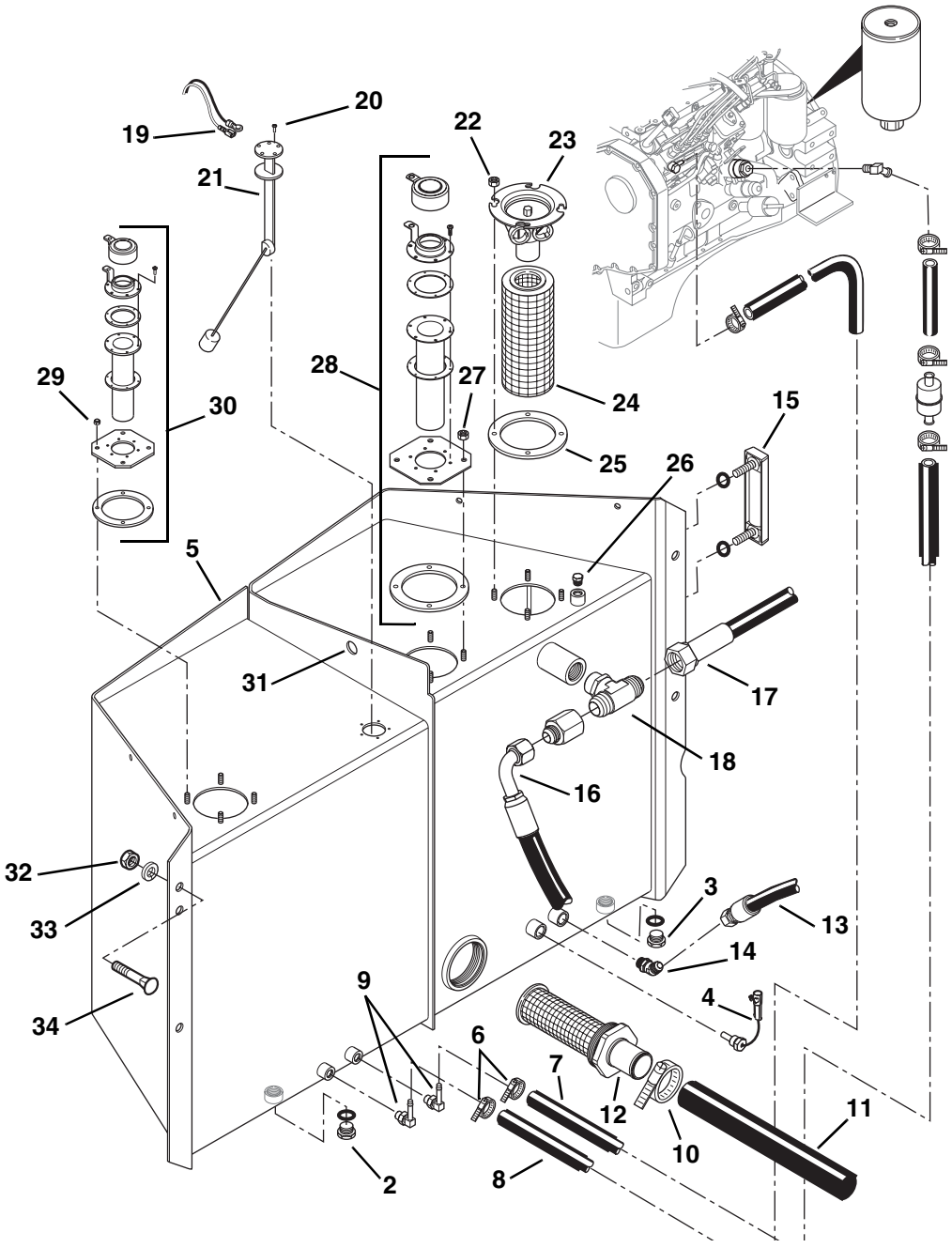
3. Remove the fuel/hydraulic oil tank top cover from tank. Refer to Section 4.7, "Access Panels and Covers."
4. Remove the two frame top covers from above the frame. Refer to Section 4.7, "Access Panels and Covers."

Note: *If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.*

Note: *Have a dry chemical (Class B) fire extinguisher near the work area.*

5. Remove fuel tank drain plug (**2**), and drain fuel into an approved and suitable container. Dispose of fuel properly.
6. Remove hydraulic oil tank drain plug (**3**), and drain hydraulic oil into an approved and suitable container. Dispose of oil properly.
7. Disconnect the hydraulic oil temperature sensor connector (**4**), from the engine harness connector, and remove from tank (**5**).
8. Loosen the clamps (**6**) and disconnect the fuel supply hose (**7**) and return line hose (**8**) from tank.
9. Remove the fuel line fittings (**9**) from tank.
10. Loosen clamp (**10**) and disconnect the lower hydraulic oil strainer hose (**11**) from hydraulic fuel strainer (**12**). Cap hose.
11. Remove the hydraulic fuel strainer (**12**) from tank (**5**).
12. Disconnect and cap the hydraulic return hose (**13**) and remove lower tank fitting (**14**).
13. Remove capscrews securing the hydraulic fluid level sight-glass (**15**) from tank.
14. Disconnect upper hydraulic hoses (**16** and **17**) from the tee fittng (**18**) and cap hoses.
15. Remove the tee fittng (**18**) from tank.
16. Disconnect fuel level sender electrical connectors (**19**) from the fuel level sender (**21**).
17. Remove screws (**20**) securing fuel sender (**21**) to the tank. Remove fuel sender from tank.
18. Remove nuts (**22**) securing the hydraulic oil filter head (**23**) to the tank. Remove filter (**24**) and gasket (**25**) from tank.
19. Remove plug (**26**) from top of tank.
20. Remove nuts (**27**) securing hydraulic oil filler neck components (**28**) and remove filler neck components.
21. Remove nuts (**29**) securing fuel filler neck components (**30**) and remove filler neck components.
22. Position and connect a suitable chain support to tank lifting point (**31**) and take up slack in the chain.
23. While supporting the tank, remove nuts (**32**) and lockwashers (**33** securing the tank to vehicle frame. Pull tank away from the tank carriage bolts (**34**), and remove tank. Retain hardware for reuse.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b. Disassembly

DANGER: **NEVER** weld in, on, near or around the fuel/hydraulic oil reservoir. Fuel and hydraulic fluid and fumes can cause the reservoir to explode. This can result in death or serious personal injury.

The fuel/hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated fuel, hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

d. *If a leak is suspected between the fuel and hydraulic oil tank, contact **JLG** Service Department at:*
*Domestic: **1-877-554-5438***
*International: **1-717-485-6657***

To clean the fuel/hydraulic oil tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.

WARNING: **NEVER** drain or store fuel in an open container due to the possibility of explosion or fire. Discard the fuel in an approved manner.

2. Depending on which side of the tank is contaminated (fuel or hydraulic oil), remove the fuel or oil tank drain plug, and safely drain any fuel or hydraulic oil into a suitable container. Dispose of fuel or hydraulic oil properly.
3. Clean the fuel/hydraulic oil tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. For the fuel tank side, add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

e. Inspection

Note: *If a leak is suspected between the fuel and hydraulic oil tank, contact **JLG** Service Department at:*
*Domestic: **1-877-554-5438***
*International: **1-717-485-6657***

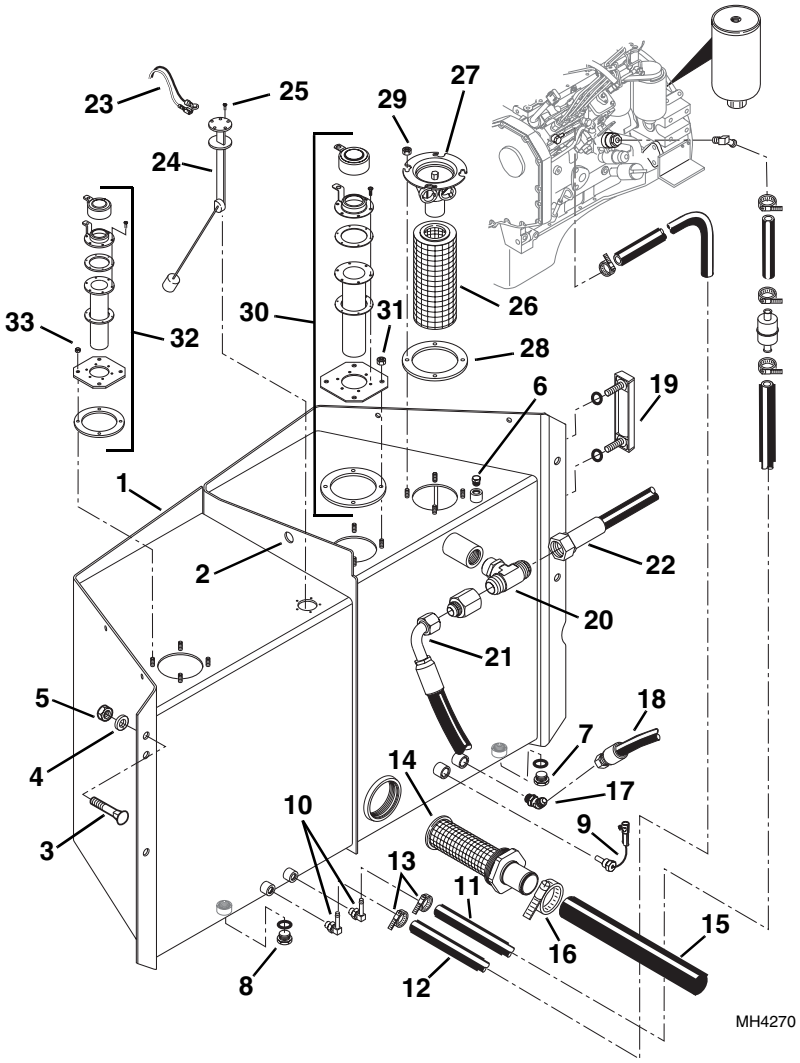
1. Inspect the fuel/hydraulic oil tank thoroughly for any cracks, slices, leaks or other damage.
2. With the fuel/hydraulic oil tank removed from the vehicle, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the tank for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

f. Assembly

The fuel/hydraulic oil reservoir is a one piece-unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal regulations.

g. Fuel/Hydraulic Oil Tank Installation

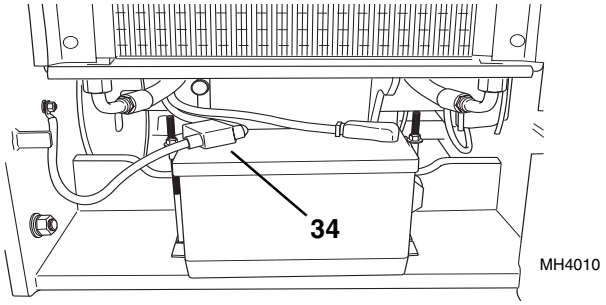
1. Attach the tank (**1**) to a suitable lifting device at the lift point (**2**).
2. Place the tank carriage bolts (**3**) into the slotted holes in frame.
3. Position the tank (**1**) and insert carriage bolts (**3**) through tank attachment holes. Install lock-washers (**4**) and finger tighten nuts (**5**) onto carriage bolts. Slide tank and carriage bolts toward the front of vehicle, until carriage bolts are bottomed out into the slotted frame holes.
4. Install plugs (**6**, **7** and **8**) using new o-ring seals.
5. Install the hydraulic oil temperature sensor (**9**) in the tank and connect to the engine harness connector.
6. Install the fuel line fittings (**10**) to the tank.
7. Install the fuel supply (**11**) and return line (**12**) hoses to the fuel tank. Secure with clamps (**13**).
8. Install the hydraulic fuel strainer (**14**) in the tank.
9. Connect the lower hydraulic oil strainer hose (**15**) to the strainer (**14**) and secure using clamp (**16**).
10. Install lower tank fitting (**17**) and connect hydraulic return hose fitting (**18**).
11. Install the hydraulic fluid level sight-glass (**19**) using special designed and drilled capscrews and gaskets.
12. Connect the tee fitting (**20**) to the tank.



13. Connect upper hydraulic hoses (**21** and **22**) to the tee fitting.
14. Attach fuel level sender harness connectors (**23**) to the sending unit (**24**).
15. Install the fuel sender with new gasket (**24**) into the fuel tank and secure with screws (**25**). **DO NOT** overtighten.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

16. Install hydraulic oil filter (**26**) onto the hydraulic oil filter head (**27**). Replace gasket (**28**) onto tank and install filter head (with filter attached), and secure using new elastic locknuts (**29**).
17. Install hydraulic filler neck components (**30**) and secure using new elastic locknuts (**31**).
18. Install fuel filler neck components (**32**) and secure using new elastic locknuts (**33**).
19. Fill fuel tank and hydraulic tank according to specifications. Refer to Section 2.6, “Fluids, Lubricants and Capacities.”
20. Check fuel and hydraulic oil tanks for leaks.
21. Connect the negative (-) battery cable (**34**).

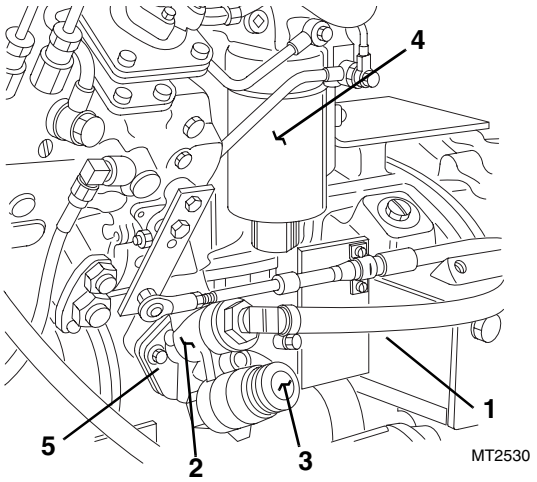


7A.8.3 Fuel Level Sender and Gauge

The fuel level sender and gauge assembly is described in Section 7A.8.3, “Fuel Level Sender and Gauge.”

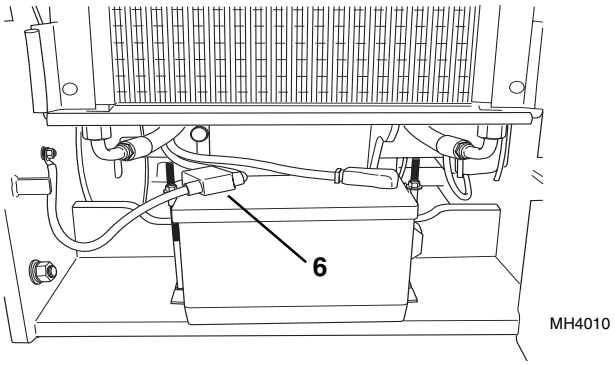
7A.8.4 Fuel Lift Pump Inspection and Testing

1. Inspect the camshaft lever and return spring for excessive wear.
2. To test the diaphragm, remove the fuel inlet line (**1**) from the fuel lift pump (**2**). Block the fuel inlet with a finger and operate the hand plunger (**3**). A properly operating pump will provide suction that will remain until the finger is removed from the inlet.



a. Fuel Lift Pump Removal

1. Disconnect the negative (-) battery cable (**6**) from the battery.



2. Clean debris from around the fuel lift pump (**2**).
3. Disconnect the fuel inlet line (**1**).
4. Remove the capscrews (**5**), gasket and fuel lift pump (**2**).

b. Cleaning and Drying

Clean the exterior of the pump with mineral spirits, and blow dry with compressed air.

Note: *Parts replacement is not practical. The fuel lift pump is serviced as an entire assembly.*

c. Fuel Lift Pump Installation

1. Clean the mounting surface on the cylinder block.
2. Install the fuel lift pump (**2**) with a new gasket. Install and torque the capscrews (**5**) to 18 lb-ft (24 Nm).
3. Connect the fuel line (**1**). Vent air from fuel system. Refer to appropriate Owners/Operators Manual.
4. Connect the negative (-) battery cable (**6**).

7A.8.5 Fuel Filter

Refer to the appropriate Owners/Operators Manual for your vehicle for the correct fuel filter (**4**) removal procedure.

7A.8.6 Venting Air from the Fuel System

Refer to the appropriate Owners/Operators Manual for your vehicle for the correct fuel system venting procedure.

7A.8.7 Fuel Injectors

The engine uses Bosch 17-mm, closed nozzle, hole-type injectors. The injectors have different part numbers for different engine ratings. The last four digits of the Cummins part number (stamped on the bottom portion of the injector) identify the injector.

IMPORTANT: *Use only the specified injector for the engine. Damage to the engine can occur if incorrect injectors are used.*

During the injection cycle, high pressure from the injection pump rises to the operating (or “pop”) pressure, which causes the needle valve in the injector to lift. Fuel is then injected into the cylinder. A shimmed spring is used to force the needle valve closed as the injection pressure drops below the pop pressure to seal off the nozzle after injection.

Failure of the needle valve to lift and to close at the correct time, or a needle valve that is stuck open, can cause the engine to misfire and produce low power. Fuel leaking from the open nozzle can cause a fuel knock, poor performance, smoke, poor fuel economy and rough running.

a. Locating Faulty Fuel Injectors

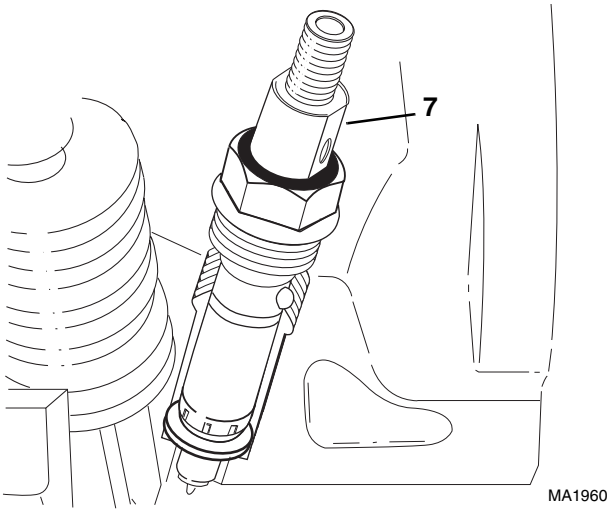
A faulty fuel injector can cause:

- Misfiring
- Knocking
- Overheating
- Loss of power
- Smoky (black) exhaust
- Increased fuel consumption

The particular faulty fuel injector(s) may be determined by releasing the pipe union nut on each fuel injector in turn, with the engine running at a fast “tick-over.” If, after slackening a pipe union nut, the engine revolutions remain constant, a faulty fuel injector has been identified.

To test a fuel injector:

1. Remove the fuel injector (**7**) from the cylinder head. Refer to Section 7A.8.7, b. “Injector Replacement.”



2. Invert the fuel injector, with the nozzle facing out, then retighten the unions.
3. Loosen the unions of the other fuel injector pipes (to help avoid the possibility of the engine starting).

> **WARNING:** Diesel fuel under pressure can penetrate the skin and cause serious personal injury. Slowly loosen fittings, and allow release of residual pressure before removing.

4. Operate the starter to turn the engine over until fuel sprays from the nozzle. Examine the shape of the spray. If the spray is unduly “wet” or “streaky”, or obviously sprays to one side, or if the nozzle “dribbles” fuel, it may only be necessary to probe the nozzle holes to remove blockage.

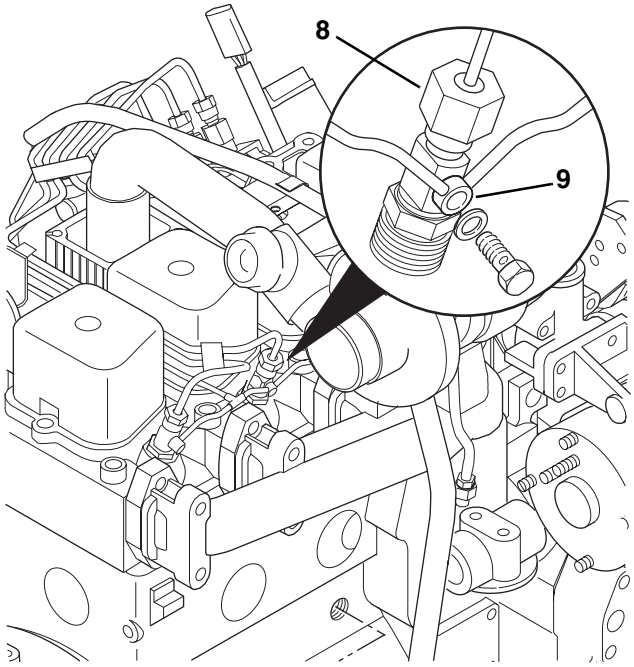
***IMPORTANT: DO NOT** attempt to adjust injection pressure without a testing pump and pressure gauge. It is not possible to accurately adjust the setting of fuel injectors without the proper equipment.*

A perfect fuel injector, when tested by pumping fuel through it in the open air, gives a short “pinging” sound as the fuel emerges from the holes. After the fuel injector has been in service for some time, the pinging changes to a crackling sound. It is not until the fuel injector sounds “dead” that its condition is likely to affect the running of the engine.

b. Injector Replacement

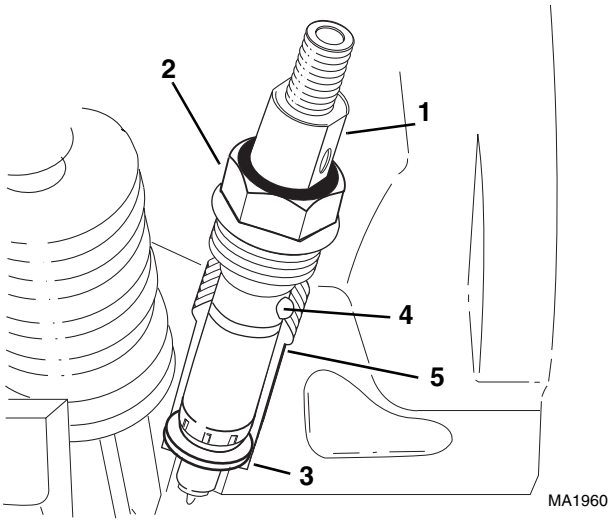
Preparatory steps:

1. Thoroughly clean around the injector(s).
2. Disconnect the high-pressure fuel lines (**8**).
3. Disconnect the fuel drain manifold (**9**).

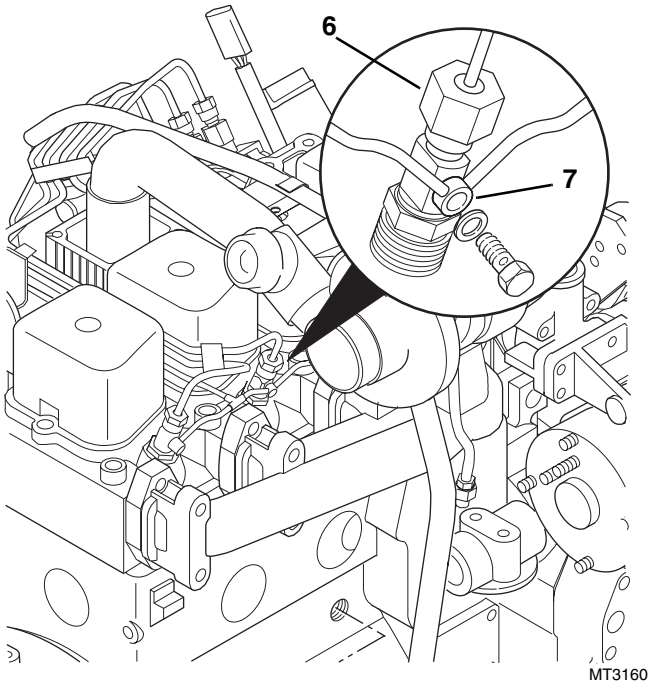


IMPORTANT: *The injector must not rotate in the bore of the cylinder head, or damage to the cylinder head will occur. If rust has formed on the hold-down nut, soak the nut with rust-penetrating solvent for a minimum of three minutes. Then, tap the injector body with a drift pin to help loosen any rust.*

4. Use a 16-mm wrench to prevent the injector body (**1**) from turning. Loosen the hold-down nut (**2**) with a 24-mm box wrench.



5. Clean the injector nozzle bore.
6. Remove the injector hold-down nut from the injector body.
7. Apply a light coat of anti-seize compound to the new injector surface. Avoid getting anti-seize compound into the fuel drain hole.
8. Install the hold-down nut on the injector body.
9. Install a new o-ring into the recessed groove in the top of the hold-down nut. Make sure the o-ring is not cut or twisted during installation.
10. Apply a light coat of anti-seize compound to the threads of the injector hold-down nut.
11. Assemble the injector and new copper washer (**3**). Use only **ONE** copper washer. A light coat of clean 15W40 engine oil placed between the washer and the injector will help keep the washer from falling during installation.
12. Install the injector with the protrusion (**4**) on the side of the nozzle fitting into the notch (**5**) in the head.
13. Tighten the hold-down nut (**2**) and torque to 44 lb-ft (60 Nm).
14. Install the fuel drain manifold (**7**) and torque to 6 lb-ft (8 Nm).



15. Install the high-pressure fuel lines (**6**) and torque to 18 lb-ft (24 Nm).
16. Run the engine and check for fuel and air leakage.
17. Bleed the fuel system in accordance with the instructions found in the appropriate owners/ operators manual.

7A.8.8 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate owners/ operators manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7A.9 ENGINE EXHAUST SYSTEM

> **WARNING:** Exhaust fumes contain carbon monoxide, a colorless, odorless gas which is fatal when inhaled in a confined area. Avoid breathing exhaust fumes, and prevent engine operation from becoming a cause of toxic emissions. Exhaust system components reach high temperatures and can cause severe burns. **DO NOT** come into contact with hot exhaust system components.

The exhaust system is supported by the engine and the vehicle frame, and helps minimize the transfer of noise

and vibration into the operator's cab. The tail pipe directs exhaust fumes to the right side of the vehicle, away from the cab.

Annoying rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all capscrews and nuts slightly loose until all parts are properly aligned, then tighten all fasteners working from the front of the system to the rear.

When replacing the muffler, also replace the tail pipe.

Before assembling components, use exhaust system sealer at all slip joint connections.

When installing exhaust system components, allow sufficient clearance between the components and other vehicle pipes, hoses and wiring that could be adversely affected by excessive heat.

When installing an exhaust system, provide for parts expansion when the system is hot.

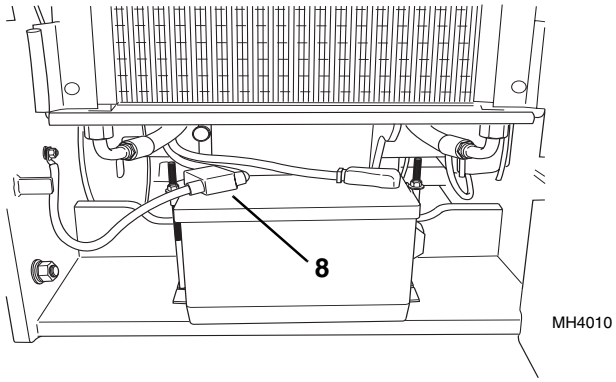
Whenever performing service on the vehicle, check the condition of the exhaust system. Check the entire exhaust system for broken, damaged, missing or improperly aligned parts, open seams, holes, loose connections and other deterioration which could permit exhaust fumes to seep into the operator's cab. Correct any damaged areas immediately.

7A.9.1 Exhaust System Removal

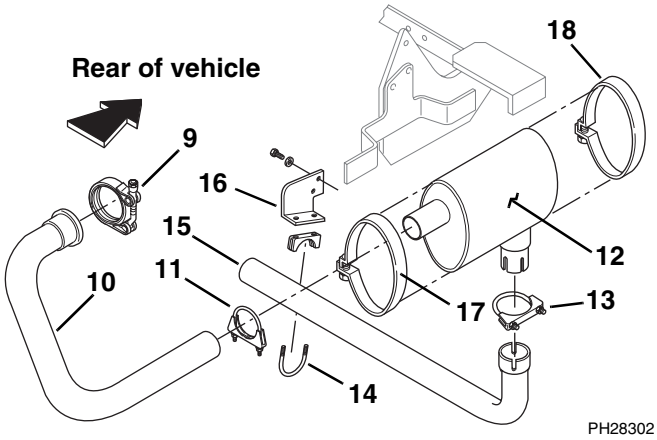
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N) and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, "Accident Prevention Tags."

> **WARNING:** To avoid severe burns, **DO NOT** attempt to remove the engine when the engine, cooling system and hydraulic system are hot. Wait until all parts and systems are cool before proceeding.

3. Unlock, unlatch and open the engine doors. Allow the engine to cool before proceeding.
4. Disconnect the negative (-) battery cable (**8**).

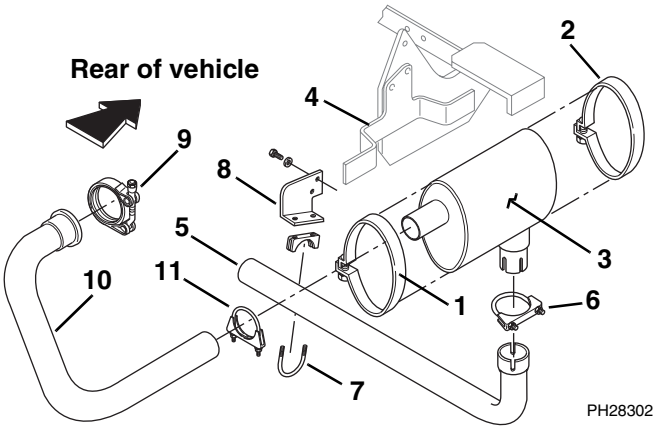


5. Disconnect and remove the V-band clamp (**9**) from the exhaust pipe (**10**).
6. Disconnect and remove the clamp (**11**) attaching the muffler (**12**) to the exhaust pipe (**10**) and remove the exhaust pipe.
7. Disconnect and remove the clamp (**14**) supporting the tail pipe (**15**), from the tail pipe support bracket (**16**).
8. Disconnect and remove the clamp (**13**) attaching the tail pipe (**15**) to the muffler (**12**) and remove the tail pipe.
9. Disconnect and remove the front and rear band clamps (**17** and **18**), and remove the muffler (**12**).

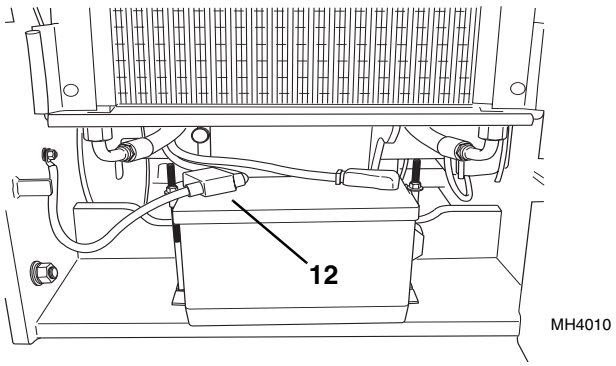


7A.9.2 Exhaust System Installation

Note: *Keep all clamps loosened until entire exhaust system is in place.*



1. Install the front and rear band clamps (**1** and **2**) around the muffler (**3**) and install the muffler to the muffler support bracket (**4**).
2. Install the tail pipe (**5**) to the muffler (**3**) and secure with a clamp (**6**).
3. Secure the tail pipe (**5**) with the clamp (**7**) to the tail pipe support bracket (**8**).
4. Install the V-band clamp (**9**) to the exhaust pipe (**10**).
5. Install the clamp (**11**) securing the muffler (**3**) to the exhaust pipe (**5**).
6. Tighten all clamps.
7. Connect the negative (-) battery cable (**12**).



8. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.

7A.10 AIR CLEANER ASSEMBLY

If a replacement engine is being installed into the vehicle, the air cleaner assembly must be transferred to the new engine.

The air cleaner assembly should be transferred to the replacement engine after the used engine is removed from the vehicle.

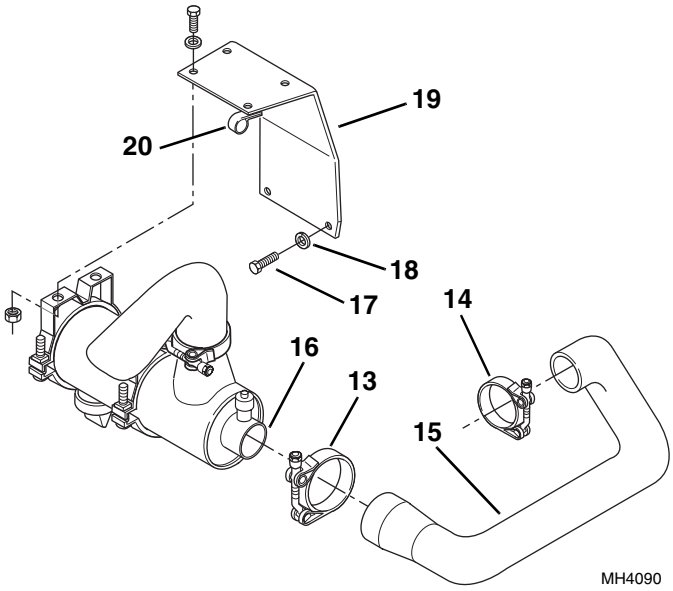
CAUTION: **NEVER** run the engine with only the inner safety element installed.

IMPORTANT: *Before transferring the air cleaner assembly to the new engine, remove the elements and clean the inside and outside of the air cleaner canister. Replace the outer primary and inner safety elements. Refer to the appropriate Owners/Operators Manual for your vehicle for the correct element change procedure.*

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

7A.10.1 Air Cleaner Assembly Removal

1. Remove the T-bolt band clamps (**13** and **14**) securing the air intake hose (**15**) to the air cleaner assembly (**16**) and engine intake.



2. Remove the engine harness clamp (**20**), and move harness away from air cleaner assembly (**16**).
3. Remove the two capscrews (**17**) and lockwashers (**18**) securing the air cleaner mounting bracket (**19**) to the engine. Remove the air cleaner assembly.

7A.10.2 Air Cleaner Assembly Installation

Note: *Apply Loctite® 242 threadlock to the capscrew threads before installation.*

1. With the air cleaner assembly attached, install the air cleaner mounting bracket (**19**) using capscrews (**17**) and lockwashers (**18**).
2. Place the loosened T-bolt clamps (**13** and **14**) over the air intake hose (**15**), and install hose on the air cleaner assembly (**16**) and engine intake. Tighten T-bolt clamps.
3. Install the engine harness clamp (**20**) and harness to the air cleaner mounting bracket (**19**).

7A.11 ENGINE REPLACEMENT

7A.11.1 Engine Removal

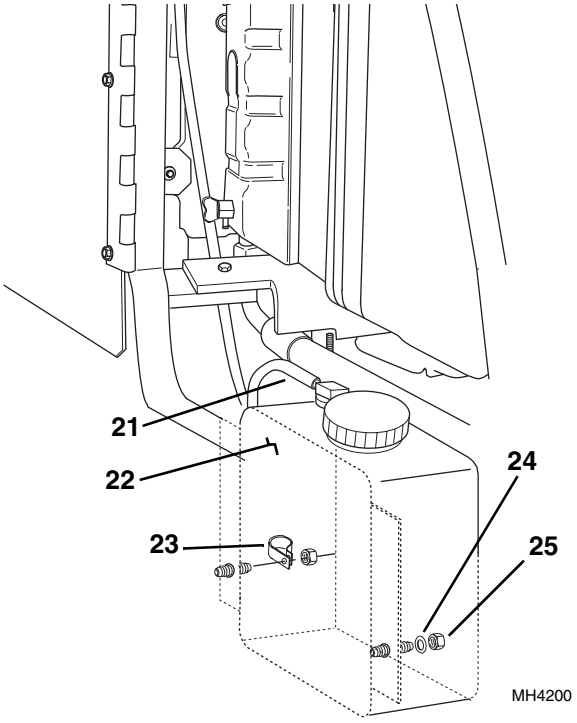
> **WARNING:** To avoid severe burns, **DO NOT** attempt to remove the engine when the engine, cooling system and hydraulic system are hot. Wait until all parts and systems are cool before proceeding.

Note: *The radiator and oil cooler must be removed from the vehicle before engine removal. Refer to Section 7A.6.3, a. "Oil Cooler and Radiator Removal." Several additional components must be removed before engine removal. They will be addressed in the following procedures.*

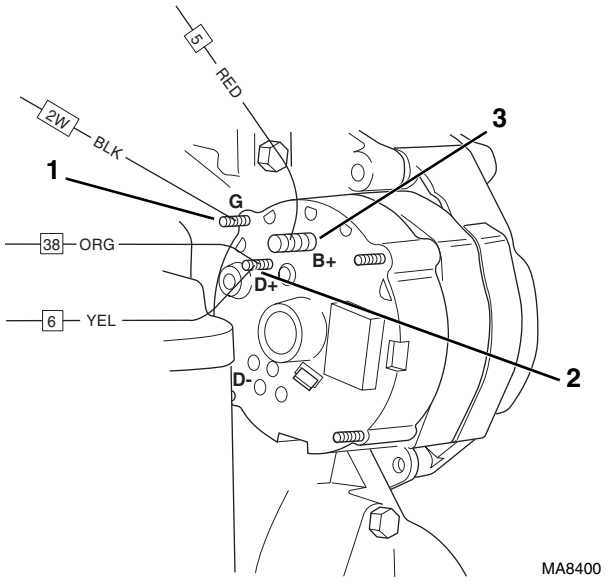
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, "Accident Prevention Tags."
3. Open the side and rear access doors, and allow the engine, cooling system and hydraulic system to cool.
4. Remove the engine exhaust. Refer to Section 7A.9.1, "Exhaust System Removal."

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

5. Remove the radiator overflow tube (**21**), overflow tank (**22**), hose support (**23**), flat washer (**24**) and elastic locknuts (**25**).

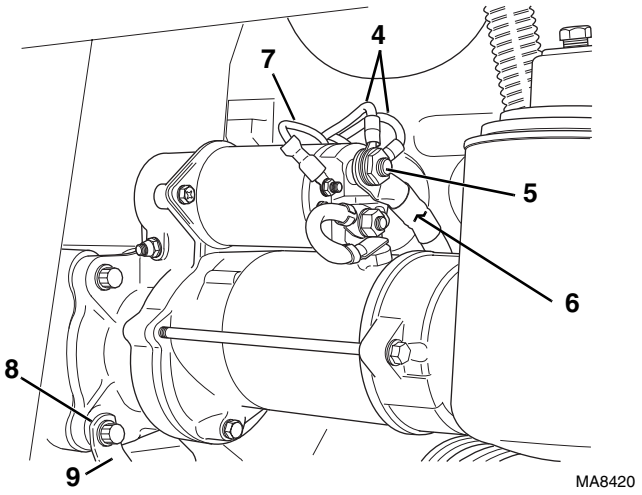


6. Label and disconnect the alternator ground wire (**1**), D+ (**2**) and B+ (**3**) harness wire leads.

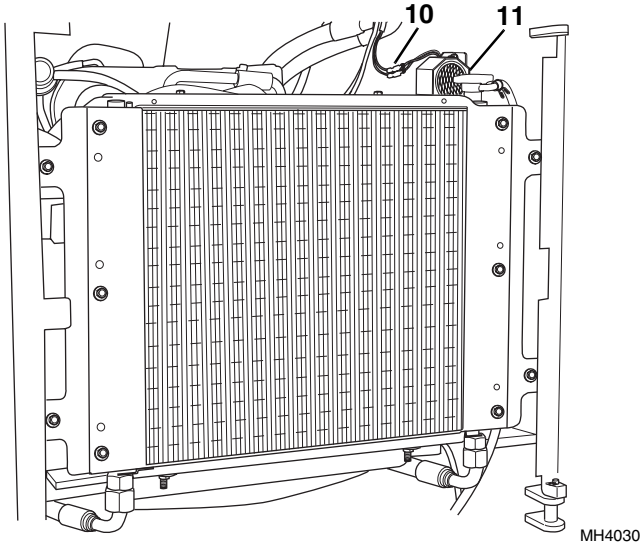


Note: *Record how the starter wires are installed to ensure correct installation later.*

7. At the starter, remove the two red wires (**4**) from the upper solenoid stud (**5**).
8. Remove the red, positive (+) battery cable (**6**) from the upper solenoid stud.
9. Label and disconnect the blue/orange wire (**7**) from the starter solenoid housing stud.
10. Remove, the lower 12-point starter bolt (**8**) securing the starter to the flywheel housing. Remove the negative (-) ground cable (**9**) from the 12-point starter mounting bolt. Reinstall the 12-point starter bolt into the lower starter bolt position.



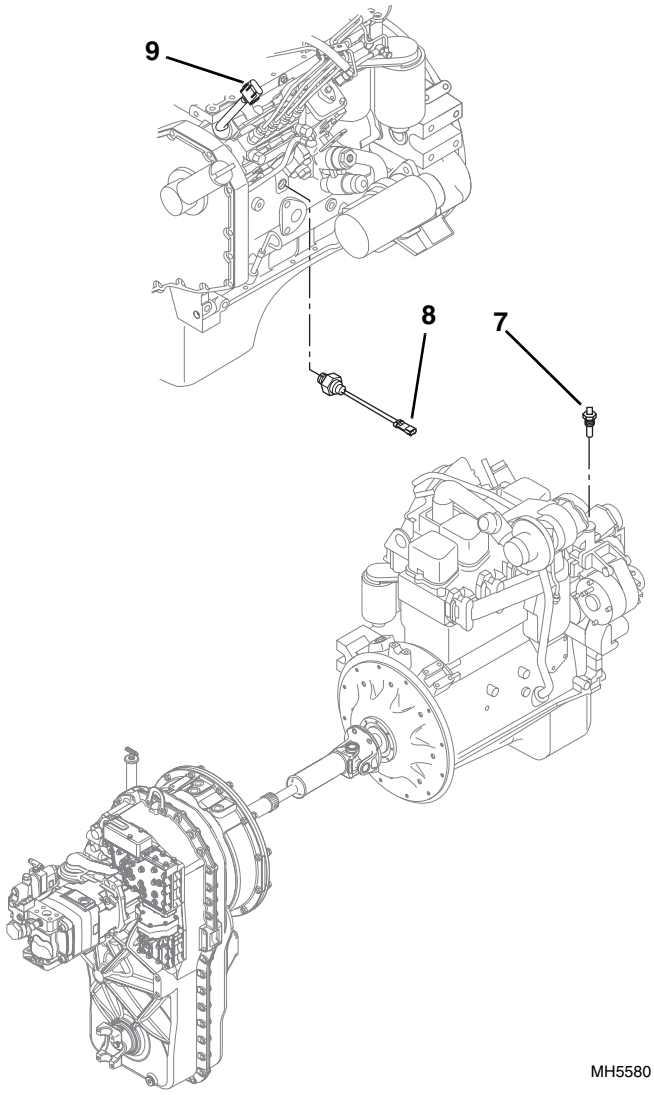
11. Label and disconnect the back-up alarm harness connector (**10**) from the back-up alarm (**11**).



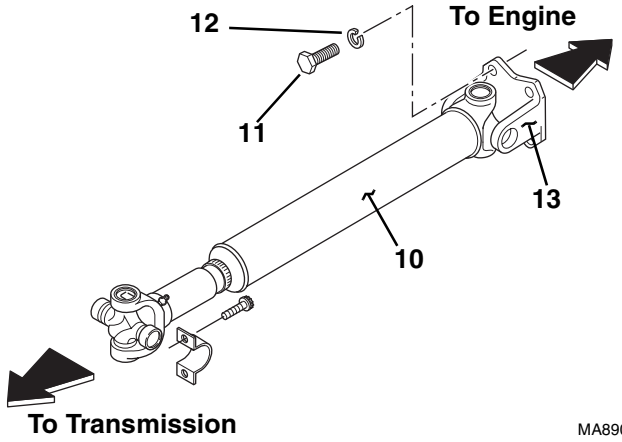
12. Remove fasteners and back-up alarm.

Note: *The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that engine clears the harness during removal.*

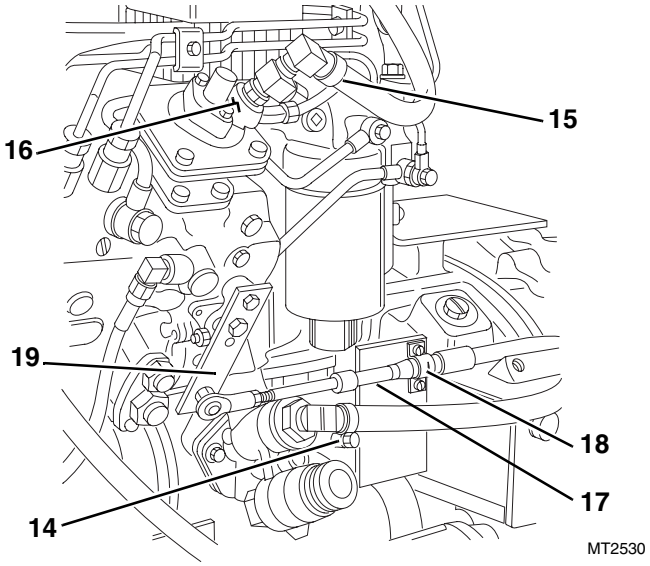
13. Label and disconnect the engine coolant temperature switch lead (**7**) and oil pressure switch lead (**8**). Refer to Section 9.14.12, "Engine Coolant High Temperature Sender," and Section 9.14.11, "Engine Low Oil Pressure Sender."
14. Disconnect the fuel shut-off solenoid harness connector (**9**).



15. Remove the capscrews (**11**) and lockwashers (**12**) securing the flange yoke (**13**) to the engine.
16. Remove the drive shaft assembly (**10**) from engine.



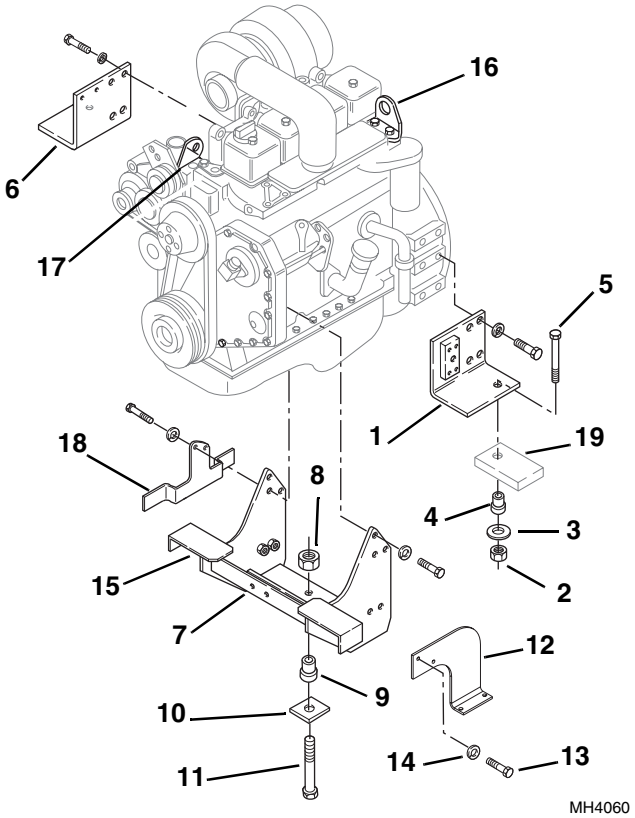
17. Disconnect the fuel inlet line (**14**) at the fuel lift pump. Install a plug in the end of fuel inlet line.



18. Disconnect the fuel return line (**15**) from the injector pump (**16**).
19. Mark the location of the throttle cable (**17**) at the throttle cable mount clamp (**18**). Remove clamp.
20. Disconnect the throttle cable (**17**) at the engine throttle lever (**19**).

Note: *Always discard used elastic locknuts and install new elastic locknuts.*

21. At the front right engine mount (**1**) remove the elastic locknut (**2**), rebound washer (**3**), engine isolator (**4**) and capscrew (**5**). Repeat for the front left engine mount (**6**).



22. At the rear engine mount (**7**), remove the elastic locknut (**8**), engine isolator (**9**), rebound washer (**10**) and capscrew (**11**).
23. At the exhaust pipe bracket (**12**), remove the capscrews (**13**) and lockwashers (**14**). Remove exhaust pipe bracket.
24. Position a fork truck behind the vehicle, and drive forward, placing the forks underneath the rear engine mount (**15**) and front engine mount brackets (**1** and **6**). Slightly lift the engine, and slowly back engine out of the vehicle. Have an assistant ensure that the engine clears all frame components during removal.
25. Place engine on a flat, level surface.
26. If replacing the engine, attach a lifting chain to the front (**16**) and rear (**17**) engine lift brackets, and lift engine clear of the ground.
27. Remove the right (**1**), and left (**6**) front engine mounting brackets, and muffler bracket (**18**).
28. Remove the rear engine mount bracket (**15**) from the engine.

7A.11.2 Engine Disassembly, Inspection and Service

Engine disassembly, internal inspection, service, repair and assembly procedures are covered in the Cummins 4BT3.9 or 4BTA3.9 service manual. Several special engine service tools are required to properly service the Cummins engine. Contact the local Cummins parts distributor for further information.

Note: *If the engine is being replaced, there may be external components that will be required to be transferred from the original engine to the replacement engine depending upon who you purchase the new engine from and the configuration of your replacement engine. Refer to the appropriate Cummins user manual for detailed procedures that cover the transfer of original engine components to the replacement engine.*

7A.11.3 Engine Installation

Note: *Always replace used elastic locknuts with new elastic locknuts.*

Note: *Refer to Section 2.3, "Torques," for specific fastener torque specifications.*

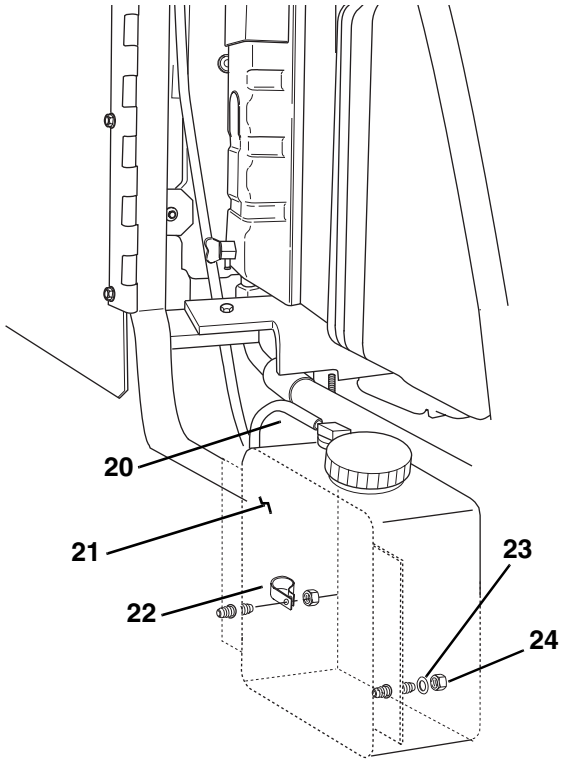
1. If replacing the engine, attach a lifting chain to the front (**16**) and rear (**17**) engine lift brackets, and lift engine clear of the ground.

Note: *Apply Loctite® 242 threadlock to the engine mount bracket capscrew threads before installation.*

1. Inspect the rear engine mounting bracket isolator (**9**). Replace isolator if cracked or worn.
2. If previously removed, install the rear (**15**) engine mount bracket to the engine.
3. Install the muffler bracket (**18**), right (**1**), and left (**6**) front engine mounting brackets to the engine.
4. Place engine on a flat, level surface.
5. Position a fork truck behind the engine, and drive forward, placing the forks underneath the rear engine mount (**15**) and front right (**1**) and left (**6**) engine mount brackets. Lift the engine and slowly drive it into the back of the vehicle. Have an assistant ensure that the engine clears all frame, hose and harness components during engine installation. Position engine brackets over rear and front frame mounts (**19**).
6. At the rear engine mount (**7**), install the capscrew (**11**), rebound washer (**10**), engine isolator (**9**) and new elastic locknut (**8**).
7. Install the right side exhaust pipe mount bracket (**12**), capscrews (**13**) and lockwashers (**14**) to the rear engine mount (**7**).

Note: *Always replace used elastic locknuts with new elastic locknuts.*

8. Install the radiator overflow tube (**20**), and overflow tank(**21**), hose support (**22**), flat washer (**23**) and new elastic locknuts (**24**).



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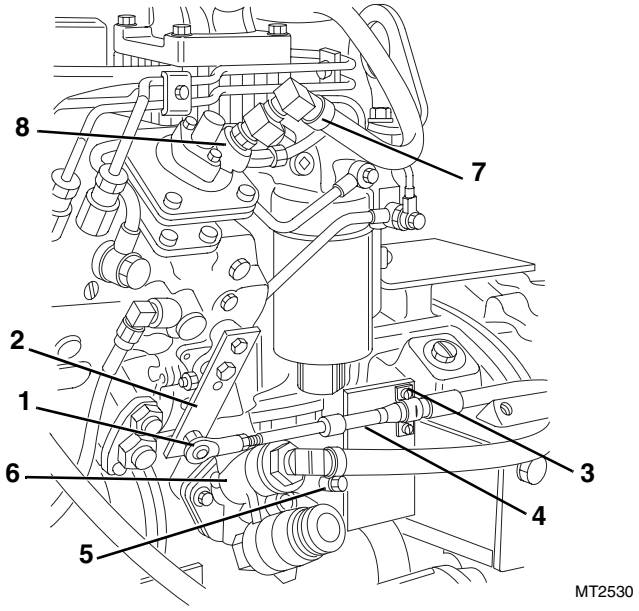
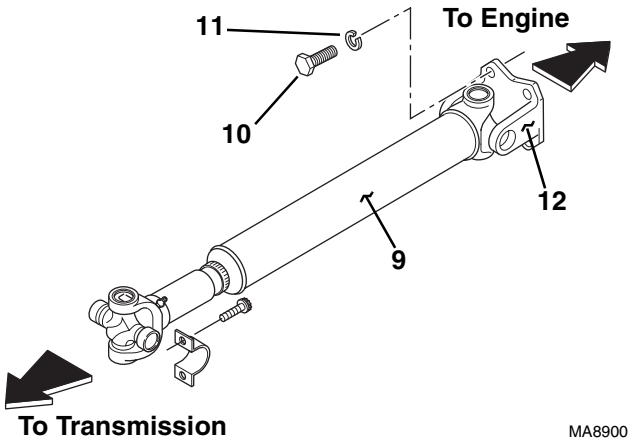
9. Secure the throttle cable clevis (**1**) to the engine throttle lever (**2**), located just above the starter.
10. Install the throttle cable mount clamp (**3**) over the throttle cable (**4**).
11. Connect the fuel inlet line (**5**) to the fuel lift pump (**6**).



12. Connect the fuel return line (**7**) to the fuel injector pump (**8**).
13. Raise the drive shaft assembly (**9**) into position. The slip-yoke end of the drive shaft mounts toward the engine. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.



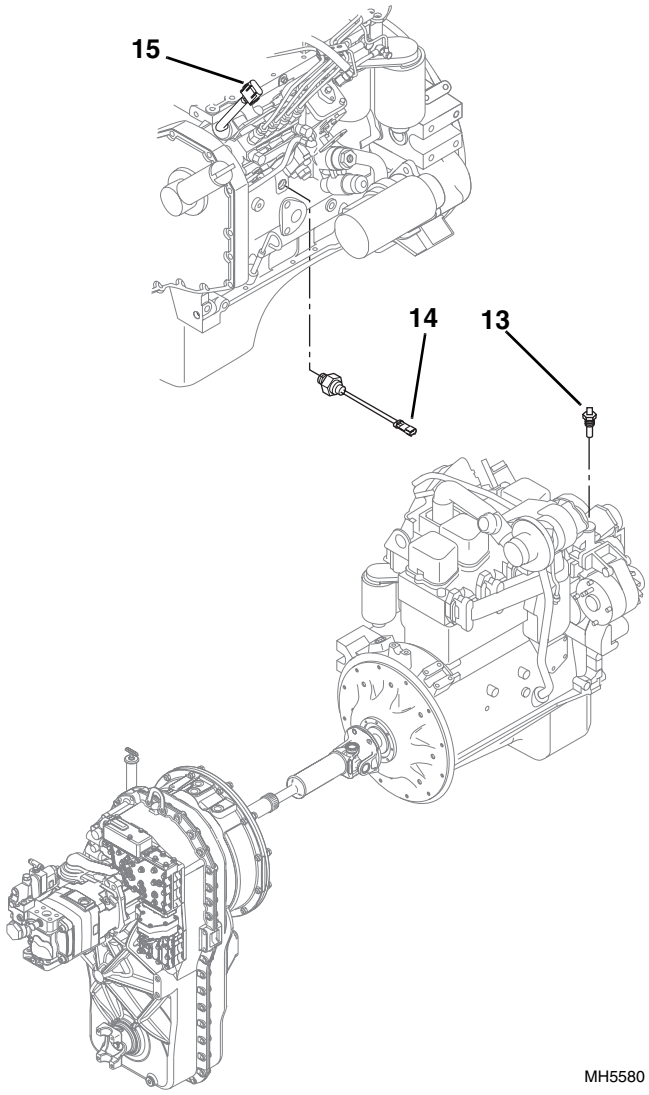
IMPORTANT: *Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

Note: *If installing a new drive shaft unit, special attention need not be applied to installation. New drive shaft units are balanced at the factory.*

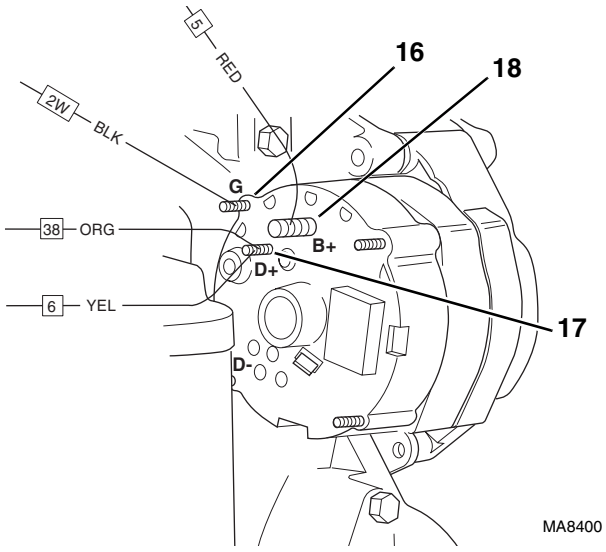
14. At the drive shaft (**9**), install the capscrews (**10**) and lockwashers (**11**), securing the flange yoke (**12**) to the engine. Torque to 105 ±10 lb-ft (142 ±14 Nm).

Note: *The engine harness is routed and attached at various places on the engine using hold-down clamps and plastic wire ties. Before installing engine and with the help of an observer, ensure that engine clears the harness during installation.*

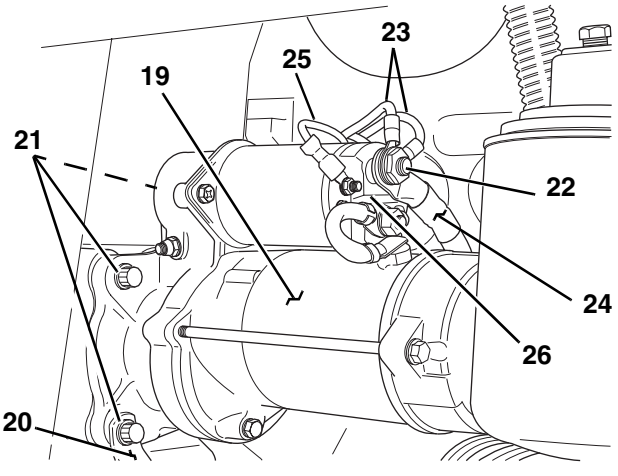
15. Connect the engine coolant temperature switch lead (**13**) and oil pressure switch lead (**14**). Refer to Section 9.14.12, “Engine Coolant High Temperature Sender,” and Section 9.14.11, “Engine Low Oil Pressure Sender.”
16. Connect the fuel shut-off solenoid harness connector (**15**) to the fuel shut-off solenoid.



17. Connect the alternator ground wire (**16**), D+ (**17**) and B+ (**18**) harness wire leads.

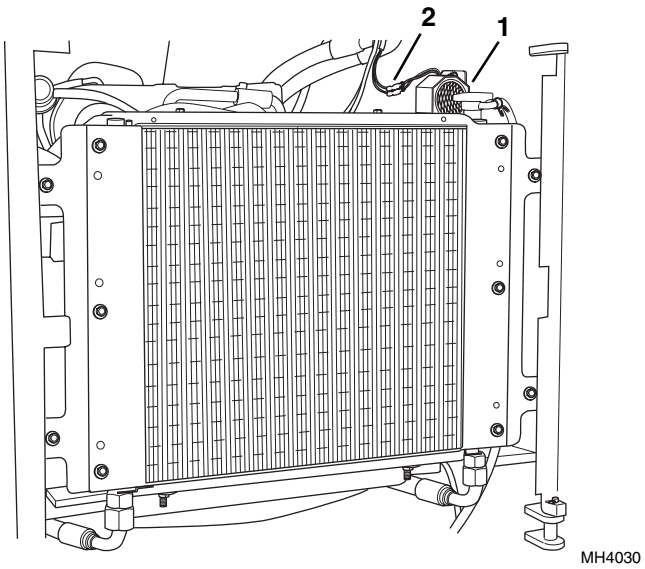


18. Position the starter (**19**) in its mounting opening on the flywheel housing. Position the ground cable (**20**) over the lower starter bolt. Secure the starter with 12-point fasteners (**21**). Torque fasteners to 32 lb-ft (43 Nm).
19. Install the red, positive (+) battery cable (**22**) and two red wires (**23**) to the upper solenoid stud (**24**). Install a lockwasher and nut on stud, and finger tighten. **DO NOT** connect the negative (-) lead at this time.
20. Install the blue/orange wire (**25**) to the solenoid mounting stud (**26**). Install a lockwasher and nut to the stud. Torque to 3.4 lb-ft (4,6 Nm).

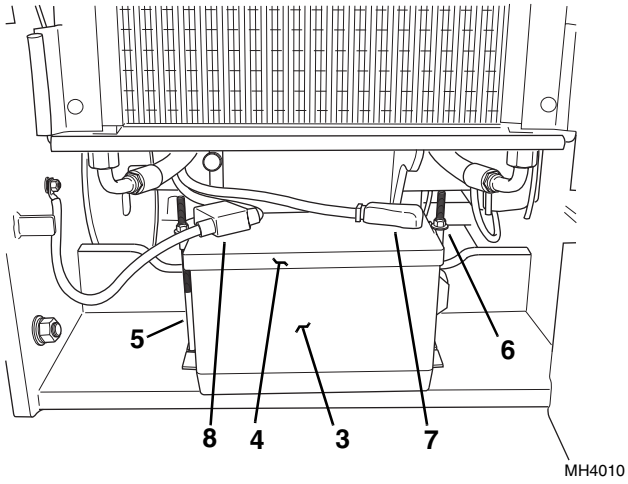


21. Install Starter and Connect Wires to the Starter.

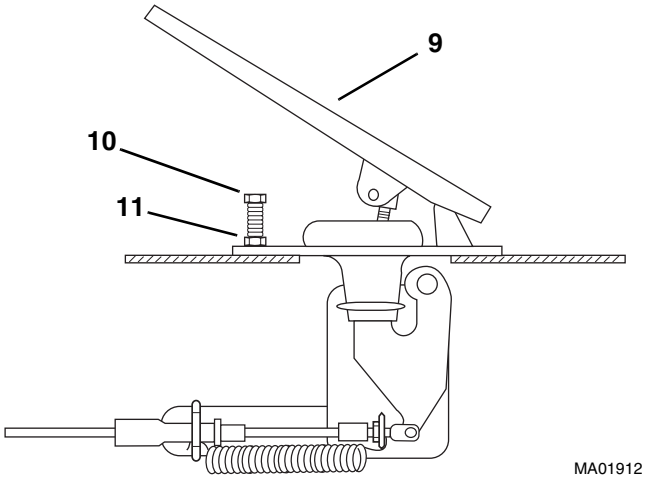
22. Install the exhaust system to the engine. Refer to Section 7A.9.2, “Exhaust System Installation.”
23. Install the radiator and oil cooler. Refer to Section 7A.6.3, “Radiator/Oil Cooler and Coolant Heater Replacement.”
24. Install the back-up alarm (**1**) and fasteners onto frame studs.
25. Connect the back-up alarm harness connector (**2**) to the back-up alarm (**1**).



26. Install the engine exhaust. Refer to Section 7A.9.2, “Exhaust System Installation.”
27. Install the rear engine access door with the help of at least one assistant. Refer to Section 4.4.6, “Door and Latches.”
28. Install the battery (**3**), hold-down bracket (**4**), two threaded hold-down rods (**5**) and hold-down nuts (**6**).
29. Connect the positive (+) and negative (-) battery cables (**7** and **8**).

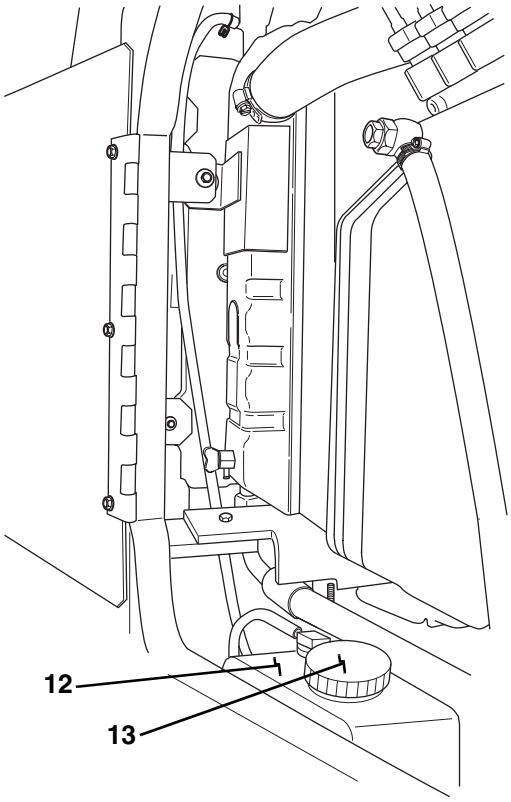


30. Check that all hydraulic system, electrical system, cooling system, fuel system, and exhaust system connections are correct and connected tightly.
31. From within the cab, lightly depress the throttle pedal (**9**) to full-throttle position. As needed, adjust the limit-stop screw (**10**) until it touches the pedal. Tighten the locknut (**11**) to 120-125 lb-in (13,6-14,1 Nm).



Note: *Have an assistant stand by with a Class B fire extinguisher. Start and idle the engine.*

32. Fill the overflow tank (**12**), 1/4 to 1/2 full with a 50/50 mixture of ethylene glycol and water. Replace and tighten overflow tank cap (**13**).
33. Run engine to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.



34. Allow the engine to cool. Check the radiator coolant level, and top off with a 50/50 mixture of ethylene glycol and water. Replace the radiator cap.
35. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.

IMPORTANT: *During the full throttle check:*

- ***DO NOT*** *operate any hydraulic function.*
- ***DO NOT*** *steer or apply any pressure to the steering wheel.*
- *Keep the transmission in NEUTRAL (N).*

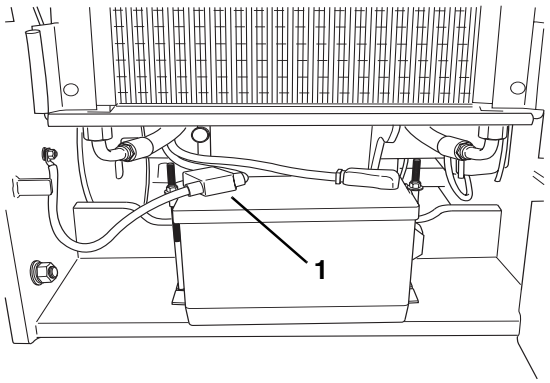
36. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle. If the rpm is not 2600-2800 rpm, readjust the throttle limit-stop screw at the throttle pedal within the cab.
37. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
38. Check for proper operation of all components.
39. Turn the engine OFF.

7A.12 ENGINE COUPLER

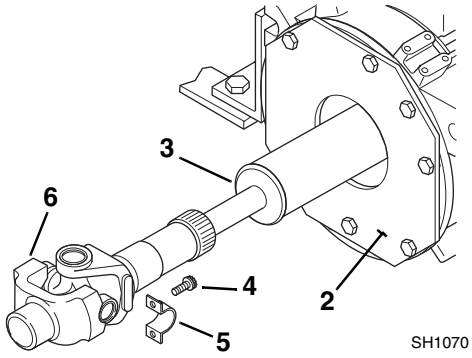
Note: *Before beginning, verify your current coupler type. If you have a hexagonal access cover plate (**2**), use the "Split Taper Bushing instructions for removal. Installation instructions remain the same for all applications.*

7A.12.1 Split Taper Bushing Coupler and Drive Shaft Removal

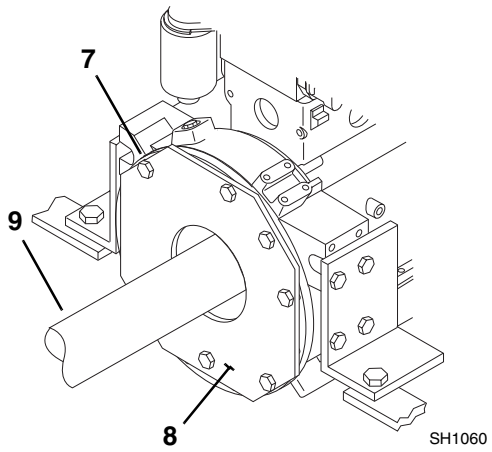
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N) and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, "Accident Prevention Tags."
3. Disconnect the negative (-) battery cable (**1**).



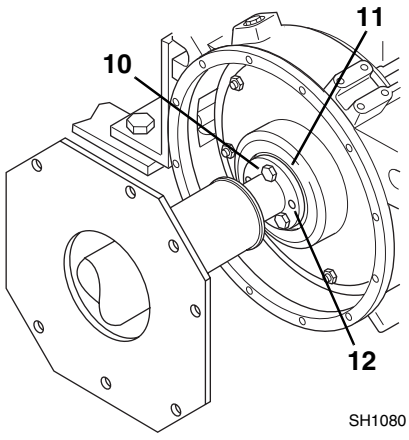
4. Remove the drive shaft (**3**) from between the engine and the transmission. At the transmission end of the drive shaft, remove the capscrews (**4**) and straps (**5**) holding the drive shaft to the transmission yoke (**6**). Discard both straps and capscrews.



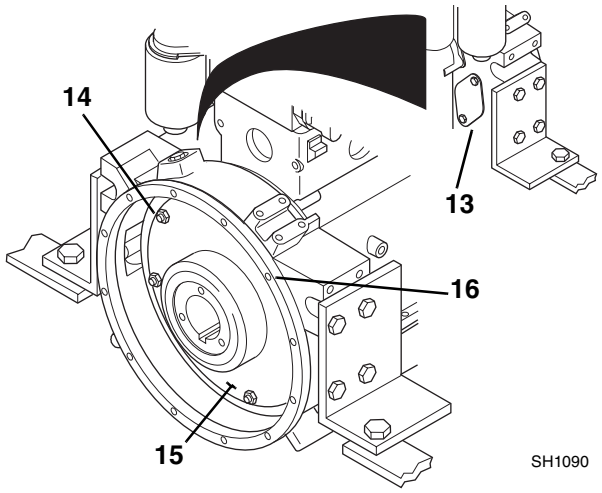
5. Remove the capscrews and lockwashers (**7**) holding the access cover plate (**8**) to the bell housing of engine. Discard the capscrews and lockwashers. Let the cover plate rest on the tube of the drive shaft (**9**).



6. Remove the capscrews (**10**) holding the split taper bushing (**11**) to the coupler. After the capscrews are removed, thread two of the capscrews into the two threaded holes (**12**) in the flange of the bushing. Turn these two capscrews evenly into the bushing flange to force the bushing out of the coupler. Remove the bushing with the drive shaft attached from the vehicle and discard. Discard the cover plate.



7. Remove the access hole cover (**13**) from the back of the bell housing on the right side of the engine. This is to access the capscrews (**14**) holding the coupler (**15**) to the flywheel. Save the cover and hardware for reassembly.



8. Remove the capscrews and nuts (**14**) holding the coupler (**15**) to the flywheel. Turn the engine by hand, using the fan belt, until the capscrews line up with the access hole (**13**). Discard the capscrews and nuts. After all the capscrews are removed, remove the coupler from the flywheel and discard the coupler.

Note: *It will be easier to remove the coupler from the left side of the engine.*

9. At this time use a suitable cleaner/solvent and thoroughly clean the mounting lip of the flywheel. Wipe any debris from the inside of the bell housing. Use the cleaner to clean the threaded holes (**16**) around the flange of the bell housing.

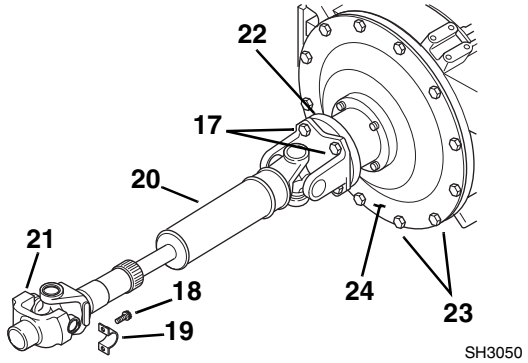
7A.12.2 Coupler and Drive Shaft Removal

1. Shut off the engine, shift the transmission into NEUTRAL, apply the parking brake and remove the ignition key.

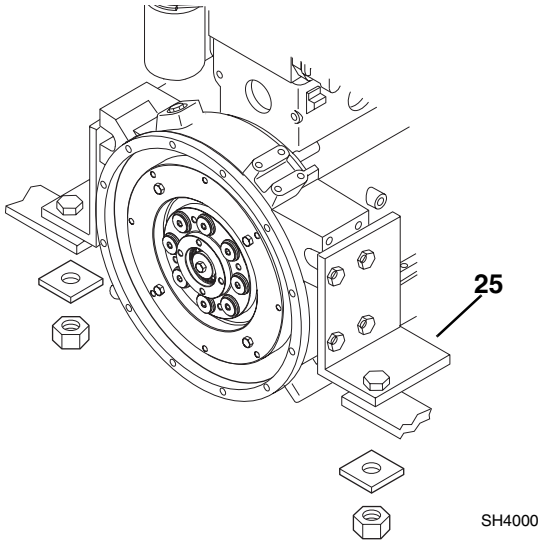
Note: *Rotating the fan belt by hand, gives greater access to removing the drive shaft mounting capscrews (**17**).*

1. Remove the capscrews (**18**) and straps (**19**) that secure the drive shaft (**20**) to the transmission yoke (**21**). Discard both straps and capscrews.
2. Remove the capscrews and lockwashers (**17**) securing the drive shaft (**20**) to the coupling flange (**22**).

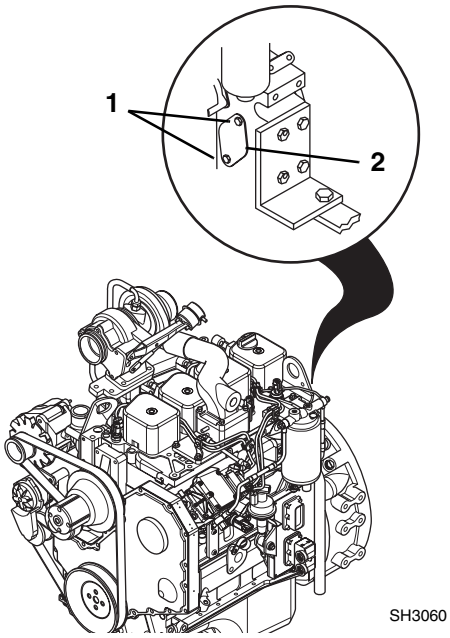
Note: *It may be necessary to loosen/remove the motor mounts (**25**) on either side of the engine to gain access to the bottom capscrews (**23**) on the outer half of the coupler (**24**). Place a jack under the bell housing (use a wood block to support engine) and carefully lift the engine until the bottom edge of the bell housing is at the top edge of the frame member that mounts the rear axle to the frame. Watch the fan-to-radiator clearance as you are lifting the engine. If necessary, turn the fan slightly, by hand, to gain additional clearance.*



3. Remove the capscrews and lockwashers (**23**) securing the outer half of the coupler (**24**).



4. Remove the capscrews (**1**) securing the small access cover (**2**).



5. Remove the capscrews and locknuts (**3**) securing the coupler (**4**) to the flywheel. Turn the engine by hand, using the fan belt, until the capscrews line up with the access hole (**2**).

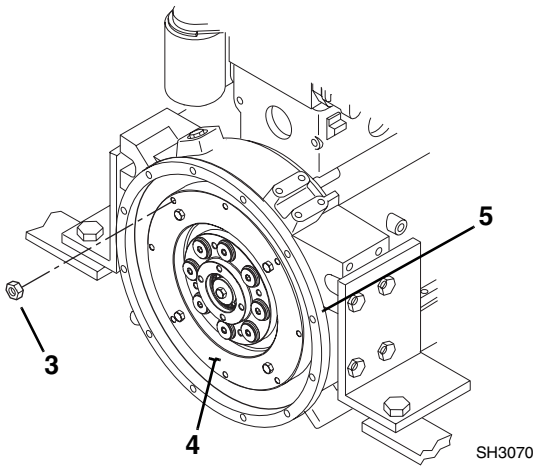
6. At this time, use a suitable cleaner/solvent and thoroughly clean the mounting lip of the flywheel. Wipe any debris from the inside of the bell housing. Use the cleaner to clean the threaded holes (**5**) around the flange of the bell housing.

7A.12.3 Coupler and Drive Shaft Installation

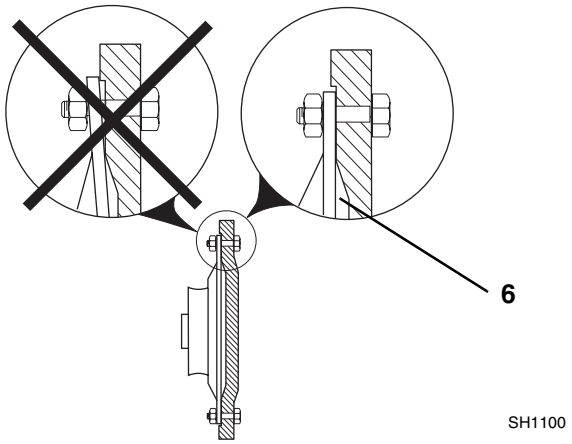
1. Use cleaner to clean the backside of the coupler, where it comes in contact with the flywheel.

Note: *The new coupler weighs approximately 56 lbs (25,4 kg) and requires two people, one on each side, to install.*

Note: ALWAYS *replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*



2. Place the new coupler (**4**) into the indentation of the flywheel and use new Grade 8 capscrews and locknuts (**3**) to secure the coupler to the flywheel.
3. Insert one capscrew into the access hole (**2**) on the rear right side of the bell housing and through the flywheel and coupler. Assemble a new elastic locknut onto the capscrew. DO NOT fully tighten at this time.
4. Turn the flywheel 180° and insert another capscrew and assemble with another new elastic locknut. DO NOT fully tighten until all of the capscrews and locknuts are in place.
5. After all the capscrews are in place, check to be sure the coupler is resting squarely in the indentation of the flywheel (**6**). Torque all the capscrews to 37 lb-ft (48 Nm).

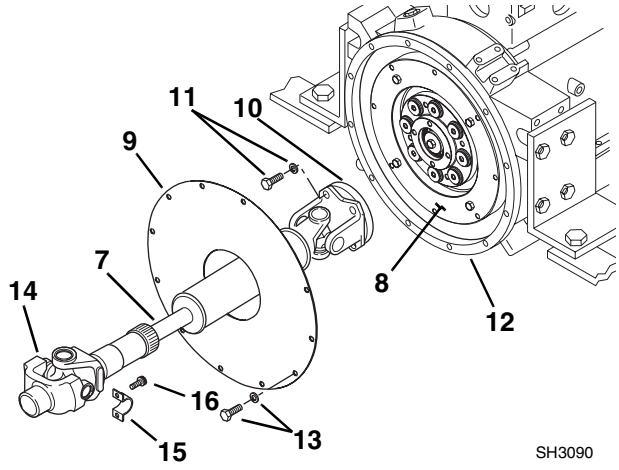


6. Install the small access cover plate (**2**), to the right side of the engine and tighten the hardware securely.

Note: *Before assembling the drive shaft (**7**) to the coupling (**8**); be sure the access cover plate (**9**) is placed on the engine-side of the frame member that mounts the rear axle to the frame.*

Note: *Apply Loctite® threadlock 242 (Red) compound to all of the capscrews used during assembly.*

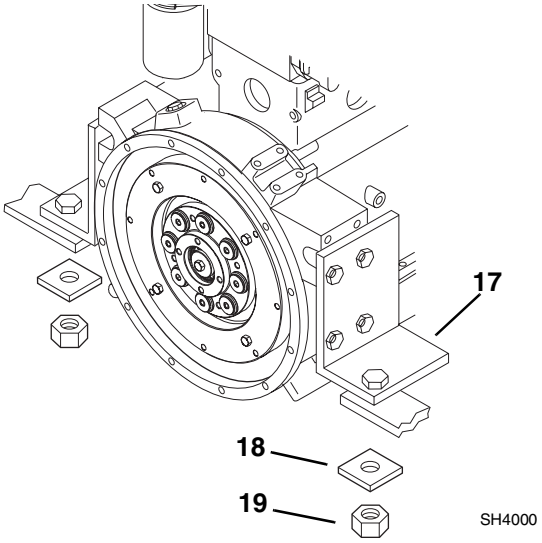
7. Install the access cover plate (**9**) over the drive shaft (**7**) (both supplied in the kit) and assemble the drive shaft flange (**10**) to the coupler (**8**) using new Grade 8 capscrews and lockwashers (**11**). Torque to 48 lb-ft (65 Nm).



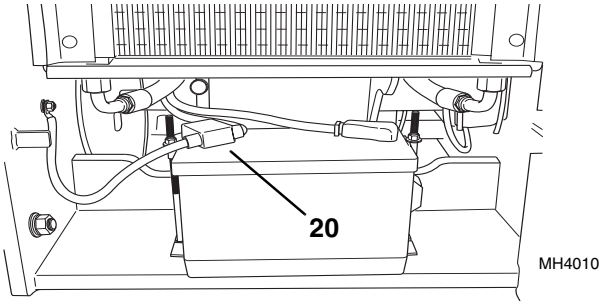
8. Install the access cover plate (**9**) to the engine bell housing (**12**) with capscrews and lockwashers (**13**) Torque to 37 lb-ft (48 Nm).

Note: ***ALWAYS*** *replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

9. If engine mounts (**17**) were previously removed or loosened, carefully lower the engine down onto the front engine mounts. Reassemble the rebound washer (**18**) and secure in place with a new elastic locknut (**19**). Torque to 60 lb-ft (81 Nm). Repeat this procedure for the engine mount on the other side.



10. Thoroughly clean the transmission yoke (**14**) and secure in place with new straps (**15**) and capscrews (**16**). Torque to 55-60 lb-ft (75-81 Nm).
11. After the drive shaft is in place, grease both u-joints and the slip joint using multi-purpose grease (MPG).
12. Connect the negative (-) battery cable (**20**).



7A.13 ENGINE STORAGE

If the engine is properly protected and stored according to the following recommendations, no corrosion damage will normally occur. Cummins Engine Company, Inc. and **JLG** are not responsible for any damage that occurs in relation to a service storage period.

Use the following procedures immediately upon removing engine from service if it is being stored for an extended period of time.

1. Clean the outside of the engine.
2. When using a preservative fuel, drain the fuel system and fill with the preservative fuel. When not using preservative fuel, keep the fuel system charged with regular fuel, which, along with the fuel filter, will have to be drained and discarded at the end of the storage period.
3. Run the engine to operating temperature. Correct any fuel, fluid, oil or air leaks. Stop the engine, and drain the oil.
4. Replace the oil filter.
5. Fill the crankcase (sump) to the FULL mark on the dipstick with new, clean oil or with an approved preservative fluid. If a preservative fluid is used, it must be drained and replaced with regular lubricating oil before the engine is returned to service.
6. Drain the cooling system. To provide protection against corrosion, fill the cooling system with a coolant containing a corrosion inhibitor. If frost protection is needed, use the appropriate mixture of anti-freeze and water. If frost protection is not required, use an appropriate mixture of water with an approved corrosion mixture.
7. Run the engine for a short period to distribute lubricating oil and coolant throughout the engine.
8. Clean out the engine breather pipe (where fitted) and seal the end of the pipe.
9. Remove the fuel injectors and spray clean engine lubricating oil into cylinder bores. Divide four ounces (118,3 ml) of lubricating oil evenly between the four cylinders.
10. Remove the air filter and any pipe installed between the air filter and the induction manifold. Seal the manifold with waterproof tape.
11. Remove the exhaust pipe. Seal the manifold with waterproof tape.
12. Disconnect the battery and store it safely, in a fully charged condition. Before the battery is put into storage, give the battery terminals a protection against corrosion with a light coating of dielectric grease or petroleum jelly.
13. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
14. Remove and store the fan drive belt.

Note: *Before starting the engine after storage, operate the starter motor with one of the fuel shut-off solenoid wires disconnected for 15 seconds or until the dash panel low oil pressure warning indicator goes out. This will allow oil to be circulated throughout the engine to prevent damage to internal components.*

7A.14 TROUBLESHOOTING

Trouble	Possible Causes (see key, below)
Low Cranking Power	1, 2, 3, 4
Will Not Start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 61, 63
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 63
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 63
Blue/White Exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Erratic Running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High Oil Pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive Crankcase Pressure	25, 31, 33, 34, 45, 55, 60
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and Stops	10, 11, 12

Key to Possible Causes

1. Battery charge low
2. Bad electrical connection
3. Faulty starter motor
4. Incorrect grade of lubricating oil
5. Low cranking speed
6. Fuel tank empty
7. Faulty stop control operation
8. Fuel inlet restricted
9. Faulty fuel lift pump
10. Clogged fuel filter
11. Restricted air cleaner
12. Air in fuel system
13. Faulty fuel injection pump
14. Faulty fuel injectors or incorrect type
15. Incorrect use of cold start equipment
16. Faulty cold start equipment
17. Broken fuel injection pump drive
18. Incorrect fuel pump timing
19. Incorrect valve timing
20. Poor compression
21. Blocked fuel tank vent
22. Incorrect grade of fuel
23. Sticking throttle or restricted movement
24. Exhaust pipe restriction
25. Leaking cylinder head gasket
26. Overheating
27. Cold running
28. Incorrect tappet adjustment
29. Sticking valves
30. Incorrect high pressure pipes
31. Worn cylinder bores
32. Pitted valves and seats
33. Broken, worn or sticking piston ring(s)
34. Worn valve stems and guides
35. Restricted air cleaner
36. Worn or damaged bearings
37. Insufficient oil in sump
38. Inaccurate gauge
39. Oil pump worn
40. Pressure relief valve sticking open
41. Pressure relief valve sticking closed
42. Broken relief valve spring
43. Faulty suction pipe
44. Restricted oil filter
45. Piston seizure/pick up
46. Incorrect piston height
47. Damaged fan
48. Faulty engine mounting
49. Incorrectly aligned flywheel housing or incorrectly aligned flywheel
50. Faulty thermostat
51. Restriction in water jacket
52. Loose fan belt
53. Restricted radiator
54. Faulty water pump
55. Restricted breather pipe
56. Damaged valve stem oil deflectors (if fitted)
57. Coolant level too low
58. Blocked sump strainer
59. Broken valve spring
60. Exhauster or vacuum pipe leak
61. Turbo impeller damaged or dirty
62. Turbo lubricating oil seal leak
63. Induction system leaks

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Section 7B
Engine: Cummins QSB4.5T

Contents

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7B.1 INTRODUCTION

7B.1.1 Disclaimer and Scope

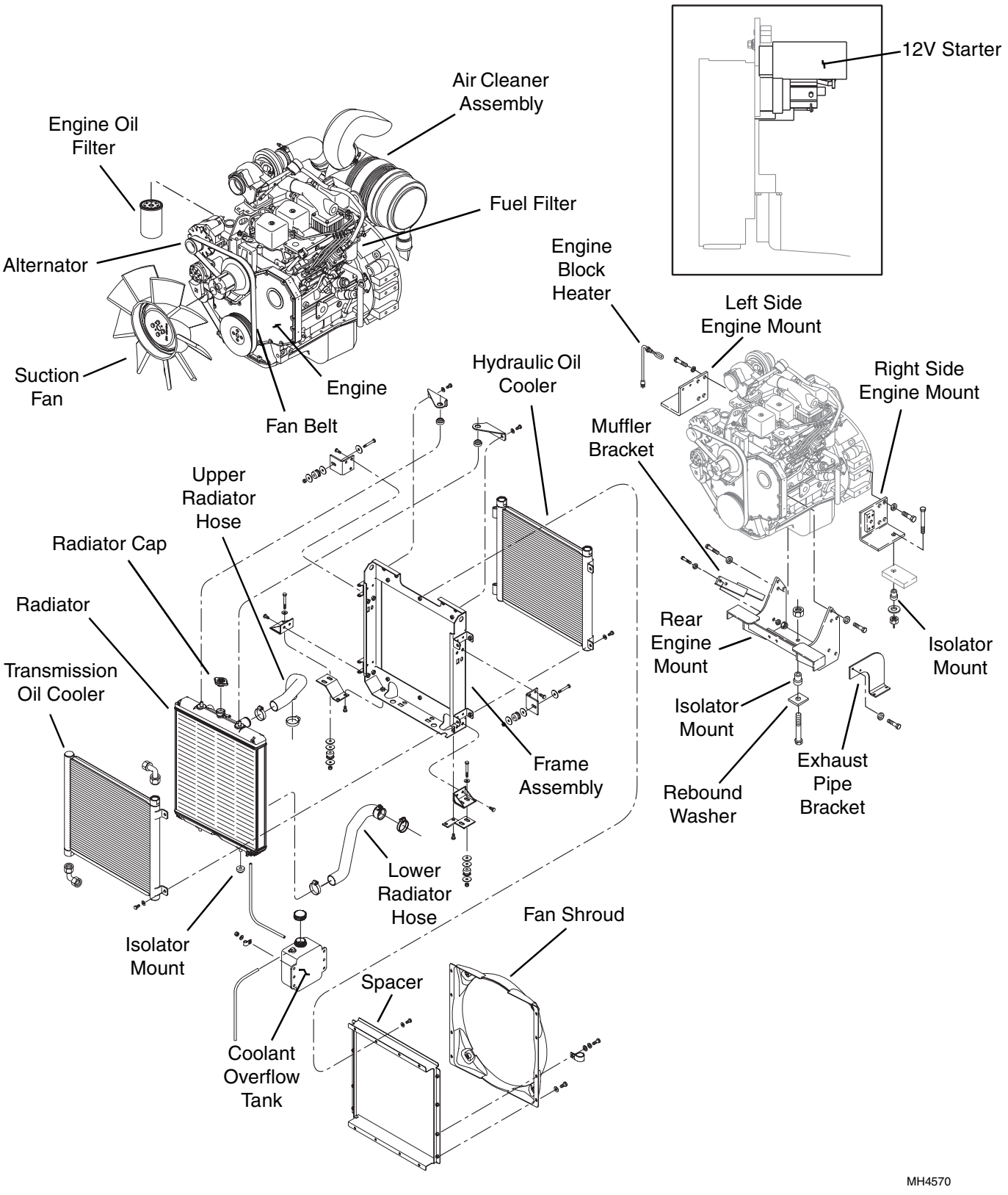
These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

IMPORTANT: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Cummins Engine Distributor and the applicable Cummins engine service manual for assistance with comprehensive engine diagnosis, repair and component replacement.*

A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended. **DO NOT** run the engine at high, no-load speeds. **DO NOT** apply an overload to the engine.

7B.1.2 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.


12V Starter
Air Cleaner Assembly
Engine Oil Filter
Fuel Filter
Alternator
Engine Block Heater
Left Side Engine Mount
Suction Fan
Engine
Hydraulic Oil Cooler
Right Side Engine Mount
Fan Belt
Muffler Bracket
Upper Radiator Hose
Radiator Cap
Radiator
Rear Engine Mount
Isolator Mount
Transmission Oil Cooler
Isolator Mount
Exhaust Pipe Bracket
Frame Assembly
Rebound Washer
Lower Radiator Hose
Fan Shroud
Isolator Mount
Spacer
Coolant Overflow Tank
MH4570

7B.2 SAFETY INFORMATION

General Vehicle Operation

WARNING: Before attempting to start the engine and/or operate the vehicle, read the Owners/Operators Manual.

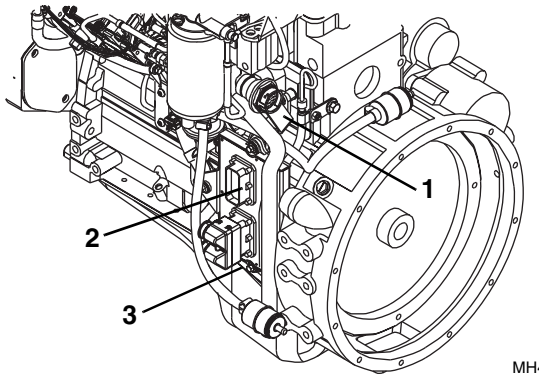
- Before operating the engine and/or the vehicle, install any engine guards that were removed and clear all personnel from the immediate area.
- Check that the brakes are fully functional.
- **DO NOT** exceed the stability limits of the vehicle.
- Allow only ONE person to have control of the engine and the vehicle.

Preparation

WARNING: Wear protective glasses and protective shoes.

- **Verify that the work area** is capable of supporting the weight of the vehicle and the torque created by any suspended load.
- **DO NOT** work on an engine or a vehicle that is supported ONLY by a hoist or lift jacks. Use blocks or suitable stands.

CAUTION: When doing welding anywhere on the vehicle, disconnect the wire harness (**1** and **2**) from the Engine Control Module (ECM) (**3**) on the engine.



MH4540

Engine Operation

WARNING: Never use Ether on Engines equipped with Cold Start Grid Heaters. Use of starting fluid, which contains Ether, can cause an explosion.

WARNING: Operate the engine in a well-ventilated area only. Assure that engine operation will not produce a concentration of toxic emissions.

- **DO NOT** operate the engine in the presence of a fuel spill or gas leak. Such combustible vapors, when drawn into the engine, can cause engine over-acceleration, explosion, fire and extensive personal injury and property damage. Before operating in any hazardous environment, consult a recognized authority (such as the engine distributor) on engine operation in hazardous environments.
- **DO NOT** smoke or operate the engine during refueling.

Cleaning

WARNING: When using steam cleaners and pressure washers, wear protective glasses, gloves and clothing to help prevent personal injury.

WARNING: **NEVER** use gasoline or other flammable materials for cleaning parts. Use only approved cleaning solvents.

Rotating Parts and Fan Blades

WARNING: Keep away from parts which rotate; the fan blades can appear invisible when the fan is rotating.

DO NOT pull or pry on the fan blades. This practice will cause fan failure. Use only approved methods and tools for manually rotating the engine.

Engine Coolant (anti-freeze/anti-boil over)

WARNING: **DO NOT** remove the radiator cap while the engine and coolant are hot. Hot coolant under pressure is dangerous and can injure the eyes and cause severe burns.

- Cooling system corrosion inhibitors contain alkali (chemicals that break down organic substances such as skin and eye tissue), **DO NOT** swallow. Avoid prolonged or repeated contact with corrosion inhibitors. In case of skin contact, immediately wash affected area with soap and water. In case of contact with eyes, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Obtain medical assistance immediately. Keep corrosion inhibitors out of the reach of children.
- **DO NOT** use salt water or other corrosive liquid in the cooling system.

Battery

WARNING: Keep sparks and fires away from batteries. Batteries produce hydrogen gas, which can explode and cause severe personal injury and property damage.

Battery fluid can burn the skin and injure the eyes. If you come in contact with battery acid, flush the affected area with large amounts of water and obtain medical assistance immediately.

Engine Oil

WARNING: Engine oil can cause skin disorders and other personal injury. Avoid prolonged or repeated contact with both new and used engine oil.

Diesel Fuel

WARNING: Diesel fuel can cause skin irritation. Use gloves or protective hand lotion when working on the fuel system.

Engine Repair

WARNING: Before beginning any adjustments or repairs, place accident prevention tags in the operator's compartment and on the controls, and disconnect the battery negative cable.

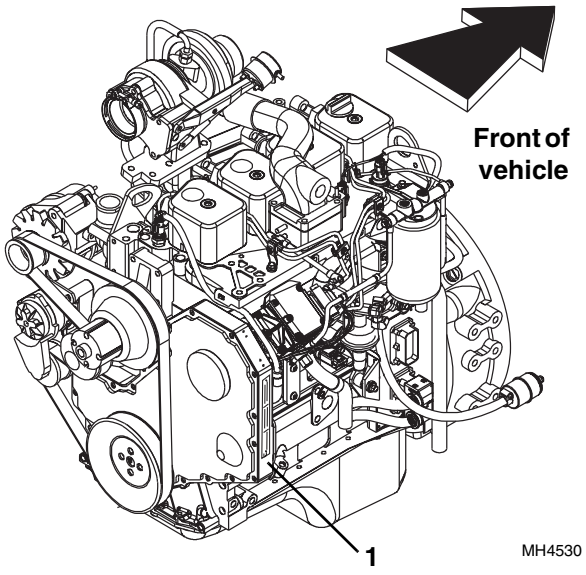
- **DO NOT** operate, clean, lubricate or adjust the engine without proper training.
- **NEVER** attempt to perform an adjustment or repair that is not understood.
- Before servicing, relieve pressure in fuel, oil, coolant and hydraulic lines. Obtain medical assistance immediately if a high-pressure jet of fuel, oil, coolant or hydraulic fluid strikes the skin.
- **DO NOT** permit loose clothing, hair, etc., near moving parts.
- Keep away from parts which rotate; fan blades can appear invisible when the fan is rotating.
- To help prevent burns, avoid contact with components that remain hot after power is turned off or disconnected.

Parts

WARNING: When replacement is necessary, **ALWAYS** use factory-approved fasteners and parts.

7B.3 ENGINE SERIAL NUMBER

The serial number (**1**) Is stamped on the front of the engine block, near the fan pulley. Information contained in the serial number is required in correspondence with the engine manufacturer.



Supply the engine serial number and/or data tag information when communicating about an engine or engine components.

7B.4 SPECIFICATIONS AND MAINTENANCE INFORMATION

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

Note: *Detailed Cummins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate Cummins engine service manual.*

7B.5 STANDARD PRACTICES

7B.5.1 Cleanliness

Cleanliness is very important during engine repair. Contamination of the engine during repair will reduce the life of an engine. Thoroughly clean the engine and engine compartment area before attempting to service or repair the engine.

DO NOT steam clean the following parts:

- Electrical Components
- Wiring
- Injectors
- Fuel Pump
- Belts and Hoses
- Bearings

During reassembly and inspection, thoroughly clean all parts, and, where present, remove burrs and scales.

7B.5.2 Gaskets and O-rings

NEVER reuse a gasket or o-ring. Use new gaskets and o-rings. Thoroughly clean sealing surfaces before installing a new gasket or o-ring. ALWAYS install new flat-faced o-rings when servicing hydraulic fittings.

Cover any open ports of high-precision components (such as fuel system equipment) exposed by removal or disassembly to help prevent the entry of foreign material.

7B.5.3 Capscrews, Nuts and Metric Parts

When replacing capscrews, ALWAYS use a capscrew of the same size and strength (Grade) as the capscrew being replaced. Incorrect capscrews can result in engine damage. Return capscrews removed from the engine to their original locations.

Always replace used elastic locknuts with new elastic locknuts.

The Cummins QSB4.5T engines use parts that are of metric dimensions. Metric capscrews are described, in millimeters, in terms of major thread diameter, distance between threads and overall length.

Metric capscrew dimensions:

M8 x 1,25 - 25

- 25 — Length, in millimeters
- 1,25 — Distance between threads, in millimeters
- M8 — Major thread diameter, in millimeters

Verify that the correct type of part is used at all times.

7B.6 ENGINE COOLING SYSTEM

The engine cooling system is a closed, pressurized system that consists of coolant passages in the engine, plus the oil cooler, thermostat, water pump, coolant heater, hoses, radiator and radiator overflow bottle. The engine is cooled by the circulation of coolant through passages in the cylinder block, engine head and radiator. Circulation is by thermo-siphon action, assisted by an impeller-type water pump, driven by a fan belt from the crankshaft pulley.

The water pump bearings are pre packed with a special grease and **DO NOT** require service. Replace a faulty water pump. General engine cooling specifications and maintenance procedures are listed in Section 2, “General Information and Specifications.”

7B.6.1 Radiator Pressure Cap

The cooling system is designed to use a radiator pressure cap to help prevent the coolant from boiling. In addition, the pressure helps to eliminate the formation of steam pockets within the engine and ensures coolant circulation throughout all coolant passageways of the engine. For a 210° F (99° C) system, use a 13 psi (90 kPa) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

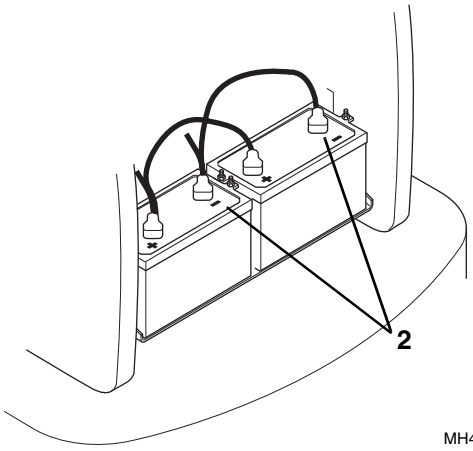
7B.6.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If the engine seems to take a long time to warm up, the thermostat may be stuck in the open position and requires replacement.
- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”
3. Disconnect the negative (-) battery cables (**2**) from the batteries.

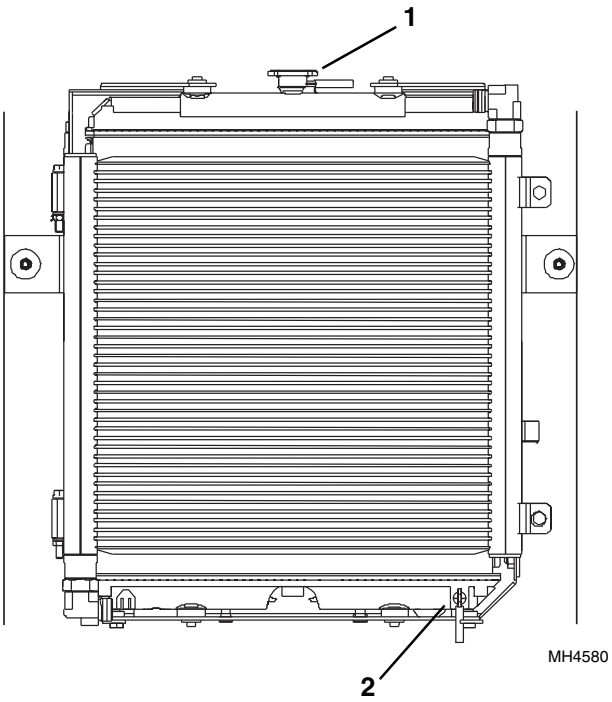


WARNING: **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

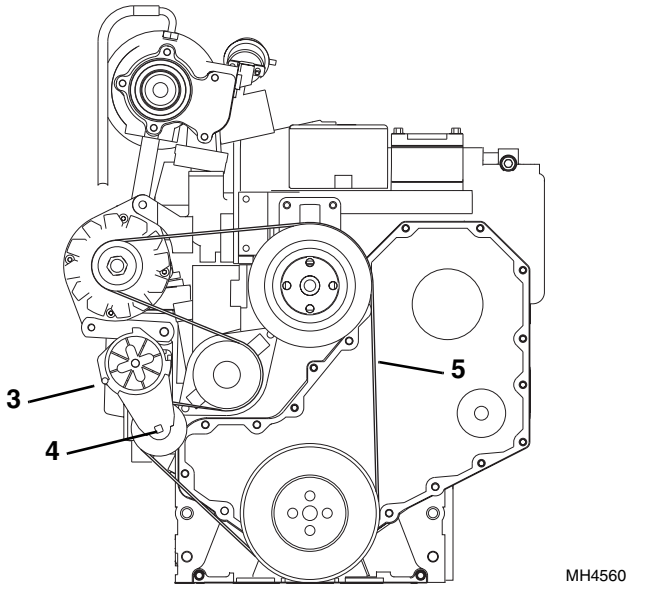
4. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.

Note: *Drain approximately two quarts (2 liters) of coolant.*

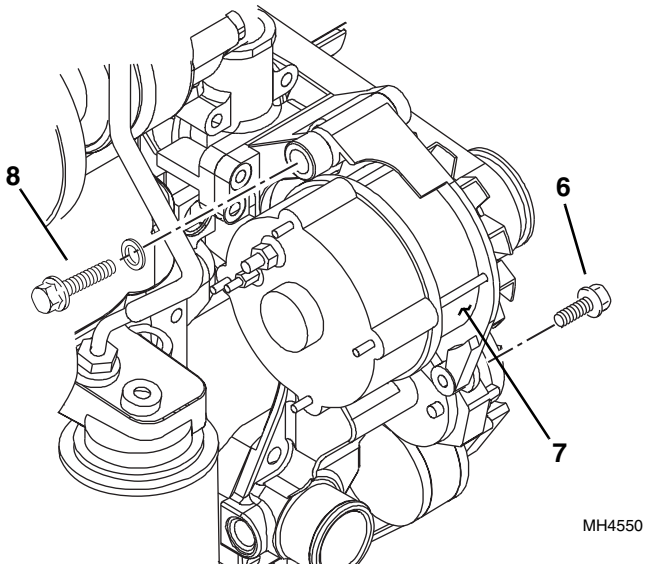
5. Slowly turn the radiator cap (**1**) to the first stop and allow any pressure to escape. Remove the radiator cap. Place a funnel at the base of the radiator to channel the drained coolant into a container. Open the radiator petcock (**2**), and allow the coolant to drain into the funnel. Transfer the coolant into a properly labeled container. Dispose of properly. Close the radiator petcock.



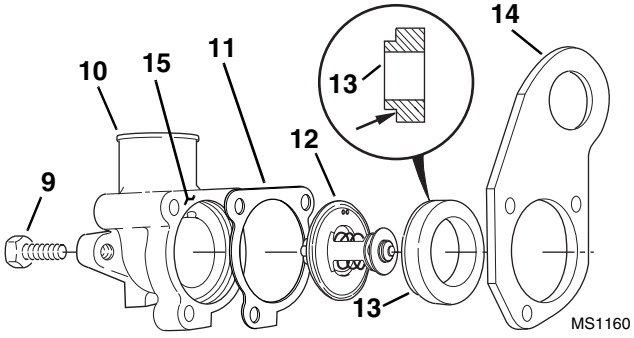
6. This engine is equipped with an automatic belt tensioner pulley (**3**). Insert a 1/2" drive ratchet into the square hole (**4**) in the tensioner housing, and remove the tension from fan belt (**5**).
7. While lifting the automatic belt tensioner pulley (**3**) away from the belt, remove the fan drive belt (**5**).



8. Loosen the lower alternator bracket capscrew (**6**) on the bottom of the alternator (**7**). Remove the upper alternator mounting capscrew (**8**), and lower the alternator.



9. Remove the capscrews (**9**) securing the thermostat housing (**10**) to the engine.



10. Remove the thermostat housing (**10**), old gasket (**11**), thermostat (**12**), thermostat seal (**13**) and engine lift bracket (**14**). Clean all gasket surfaces (**15**). **DO NOT** let any debris into the thermostat opening.

IMPORTANT: *ALWAYS use the correct thermostat and install a new gasket.* ***NEVER*** *operate the engine without a thermostat, or engine damage will result.*

b. Thermostat Installation

Note: *Ensure that notched edge (arrow) of thermostat seal (**13**) is facing thermostat.*

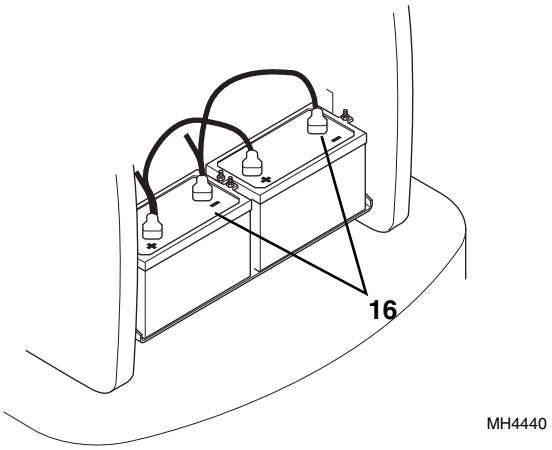
1. Install the engine lift bracket (**14**), thermostat seal (**13**), thermostat (**12**) gasket (**11**) and thermostat housing (**10**). Secure with the capscrews (**9**) removed earlier. Torque to 18 lb-ft (24 Nm).
2. Raise the alternator (**7**), and install the upper alternator mounting capscrew (**8**) and alternator lower capscrew (**6**). Torque to 32 lb-ft (43 Nm).
3. Insert a 1/2" drive ratchet or breaker bar into the into the square hole (**4**) in the automatic belt tensioner housing and lift the automatic tensioner pulley (**3**). With the automatic tensioner pulley lifted out of the way, install the fan drive belt (**5**).
4. Connect the negative (-) battery cables (**16**) to the batteries.
5. Refer to Section 7B.6.3, “Drain and Flush Radiator.”

7B.6.3 Drain and Flush Radiator

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)

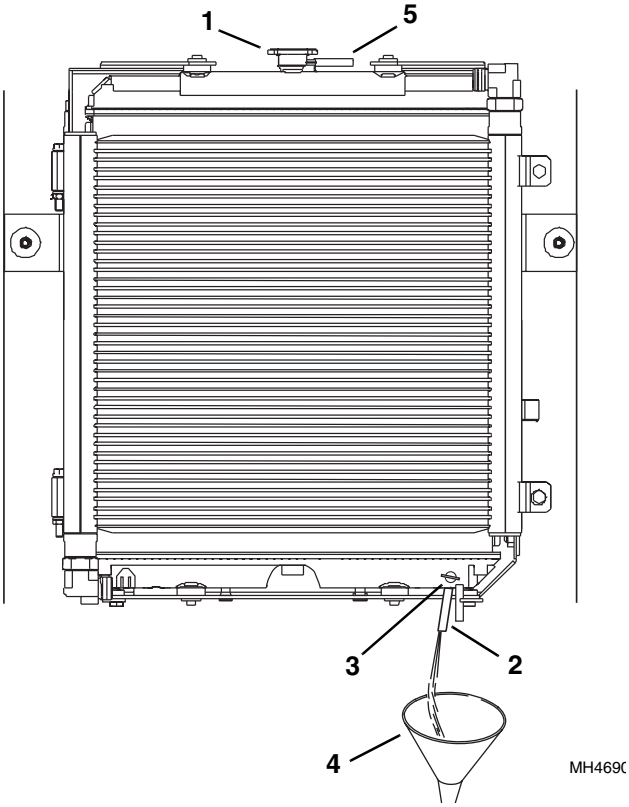
> **WARNING:** **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler, and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

3. Disconnect the battery negative (-) ground cables (**16**) at the battery negative (-) terminal.



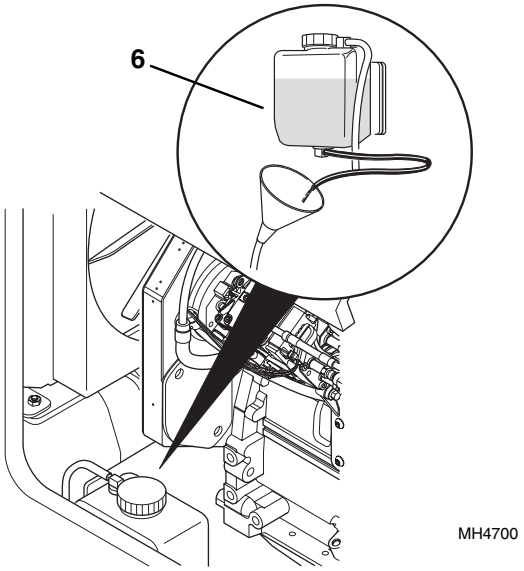
WARNING: **Never** remove the radiator cap while the engine is hot. The cooling system is under pressure. Hot coolant can cause severe burns or eye injury. Wear protective clothing and safety glasses.

4. Unlock and open rear engine door. Slowly turn the radiator cap (**1**) to the first stop, and allow any pressure to escape. Remove the radiator cap.
5. Locate the drain tube (**2**) and petcock (**3**) on the right side of the radiator. Place a funnel (**4**) under the drain tube (**2**) and loosen the drain petcock (**3**).
6. Drain the coolant into a suitable container.



7. Drain the contents of the overflow bottle (**6**) by removing the hose (**5**) from the radiator fill neck. Use the hose to drain the coolant into a suitable container.

Note: *On vehicles equipped with a cab heater option, a shut off valve is installed at the engine inlet. Disconnect hose from shut off valve to drain heater.*



8. Flush the system with clean water and allow to drain again. Upon completion, replace the hose onto the the radiator fill neck (**5**) and tighten the drain petcock (**3**).
9. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.
10. Connect the negative (-) battery cables (**7**) to the batteries.
11. Turn the ignition to RUN and turn the heat control knob to the HOT position to open the heat valve.
12. Fill the radiator completely with a 50/50 mixture of ethylene glycol and water.
13. Replace the radiator cap (**1**). Add coolant to the overflow bottle until the bottle is1/2 to 3/4 full. This “overfilling” will compensate for any air in the cooling system.
14. Clean any dirt or debris from the radiator fins and core.
15. Start the engine and allow to idle for 30 seconds. Bring engine speed up to 1500 rpm for about one minute; inspect for leaks.
16. Allow the engine to cool.
17. The overflow bottle should be 1/4 to 1/2 full. If not, fill to this level with a 50/50 mixture of ethylene glycol and water.
18. Close and latch the engine door.

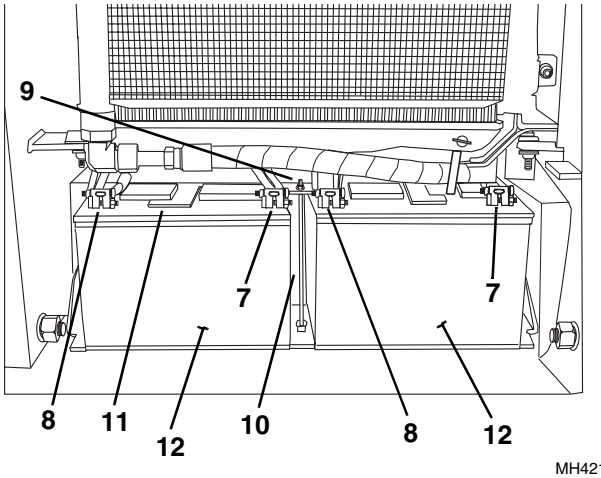
7B.6.4 Radiator/Hydraulic and Transmission Cooler Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Oil Coolers and Radiator Removal

1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Disconnect the battery negative (-) ground cables (**7**) and positive (+) cables (**8**) from the batteries (**12**).
4. Remove the battery hold-down nuts (**9**), threaded hold-down rods (**10**), and hold-down bracket (**11**). Remove batteries (**12**) from the vehicle. Store batteries in a cool dry area.



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WARNING: **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler, and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

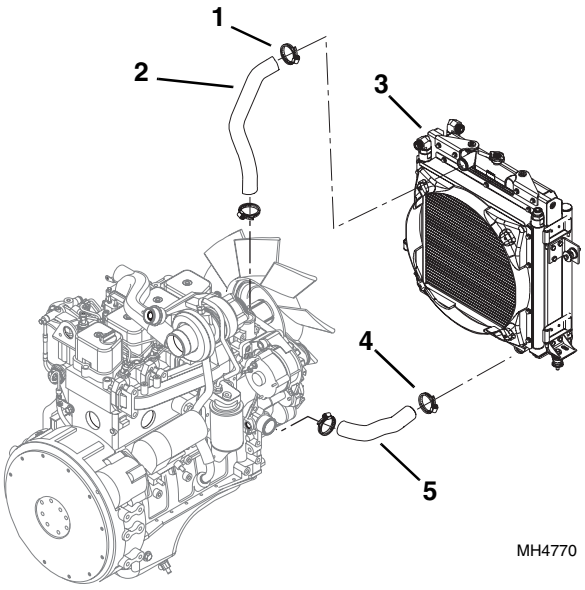
5. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding.
6. Draining the cooling system while the engine is hot can cause cracks in the engine block.

WARNING: Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

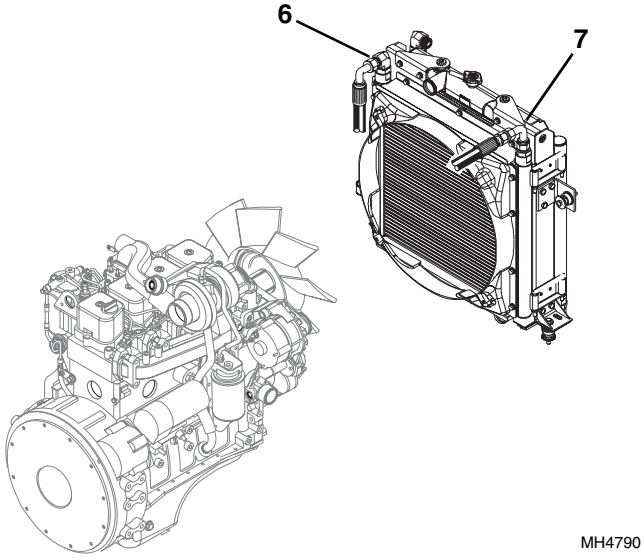
7. Slowly turn the radiator cap (**1**) to the first stop and allow any pressure to escape. Remove the radiator cap.
8. Locate the drain tube (**2**) and petcock (**3**) on the right side of the radiator. Place a funnel (**4**) under the drain tube (**2**) and loosen the drain petcock (**3**).

Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Close the radiator drain plug.

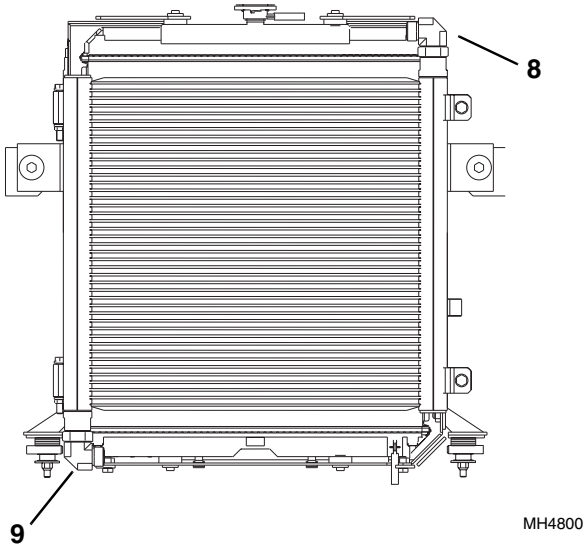
9. Loosen the radiator side clamp (**1**) on the radiator input (upper) hose (**2**). Work the hose off the radiator (**3**). Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary. Loosen clamp (**4**) on the radiator return (lower) hose (**5**). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary.



10. Disconnect and cap the hydraulic oil cooler inlet (**6**) and outlet (**7**) hoses. Place a suitable container below the fittings to catch any oil that may drain from the radiator.



11. Disconnect and cap the inlet (**8**) and outlet (**9**) fittings from the transmission oil cooler.



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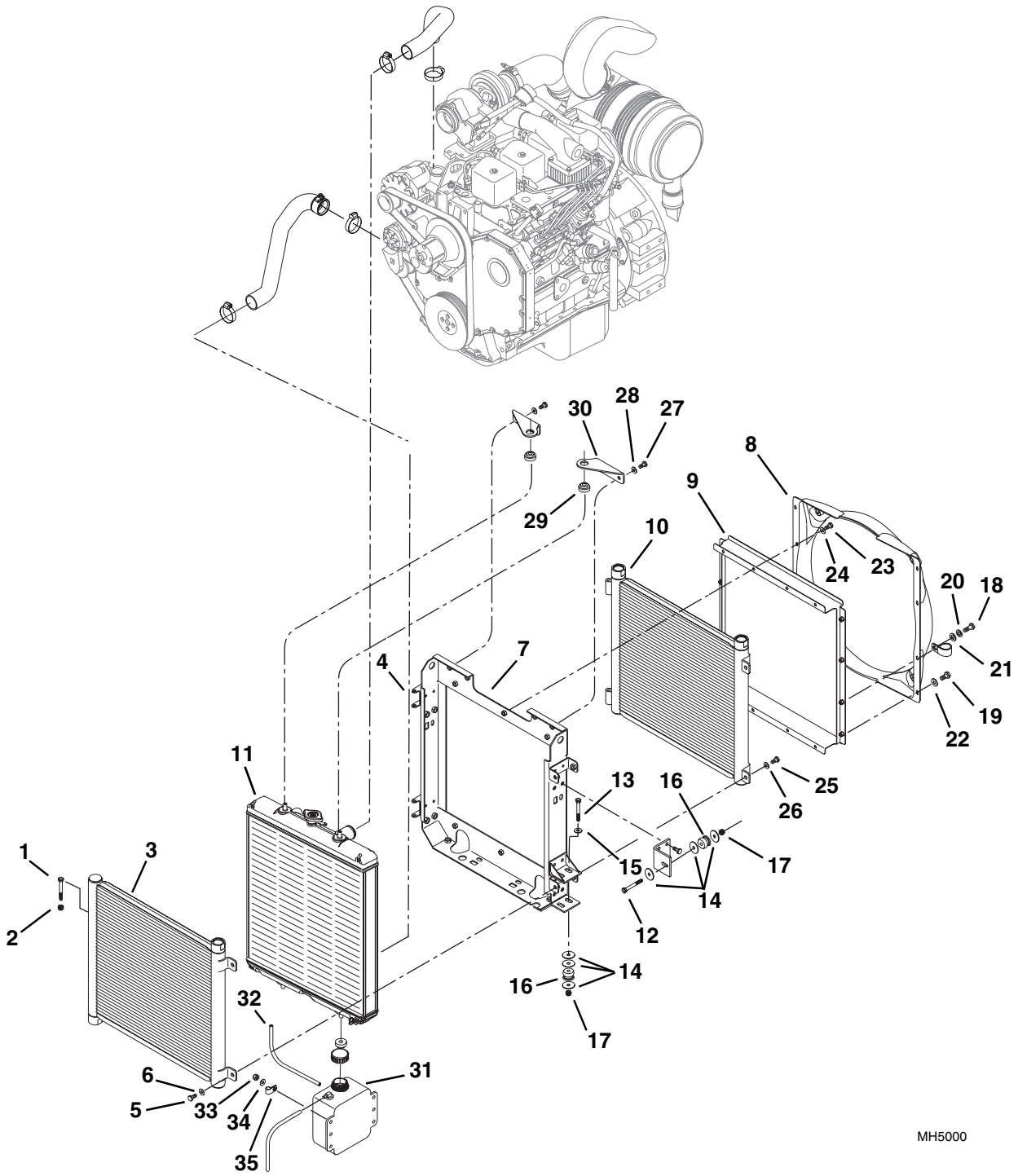
12. Working at the back of vehicle, remove the capscrews (**1**) and lockwashers (**2**) securing the transmission oil cooler (**3**) to the hinges (**4**), and the capscrews (**5**) and washers (**6**) securing the other side of the transmission oil cooler to the weldnuts on the frame assembly (**7**).
13. Remove the fan shroud (**8**), fan shroud spacer (**9**), hydraulic oil cooler (**10**), frame assembly (**7**) and radiator (**11**) as a unit, by removing capscrews (**12** and **13**), washers (**14** and **15**), isolators (**16**) and locknuts (**17**).
14. Disassemble the fan shroud (**8**) from the fan shroud spacer (**9**), by removing capscrews (**18** and **19**), lockwasher (**20**) and washers (**21** and **22**).
15. Disassemble the fan shroud spacer (**9**) from the frame assembly (**7**), by removing capscrews (**23**) and washers (**24**).
16. Disassemble the hydraulic oil cooler (**10**) from the frame assembly (**7**) by removing the capscrews (**25**) and washers (**26**).
17. Disassemble the radiator (**11**) from the frame assembly (**7**) by removing capscrews (**27**), washers (**28**), isolators (**29**) and frame brackets (**30**).
18. Remove the radiator overflow tank (**31**) by disconnecting the hose (**32**) from the radiator (**11**) filler neck, and removing the locknuts (**33**), washers (**34**) and hose clip (**35**).

b. Oil Coolers and Radiator Installation

Note: ALWAYS *replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

1. Install the radiator overflow tank (**31**) by connecting the hose (**32**) to the radiator (**11**) filler neck, and installing the locknuts (**33**), washers (**34**) and hose clip (**35**).
2. Assemble the radiator (**11**) to the frame assembly (**7**) by installing capscrews (**27**), washers (**28**), isolators (**29**) and frame brackets (**30**).
3. Assemble the hydraulic oil cooler (**10**) to the frame assembly (**7**) by installing capscrews (**25**) and washers (**26**).
4. Assemble the fan shroud spacer (**9**), to the frame assembly (**7**) by installing capscrews (**23**) and washers (**24**).
5. Assemble the fan shroud (**8**) to the fan shroud spacer (**9**), by installing capscrews (**18** and **19**), lockwasher (**20**) and washers (**21** and **22**).
6. Install the fan shroud (**8**), fan shroud spacer (**9**), hydraulic oil cooler (**10**), frame assembly (**7**) and radiator (**11**) as a unit, by installing capscrews (**12** and **13**), washers (**14** and **15**), isolators (**16**) and locknuts (**17**).
7. Working at the back of vehicle, install the capscrews (**1**) and lockwashers (**2**) that secure the transmission oil cooler (**3**) to the hinges (**4**), and the capscrews (**5**) and washers (**6**) securing the other side of the transmission oil cooler to the weldnuts on the frame assembly (**7**).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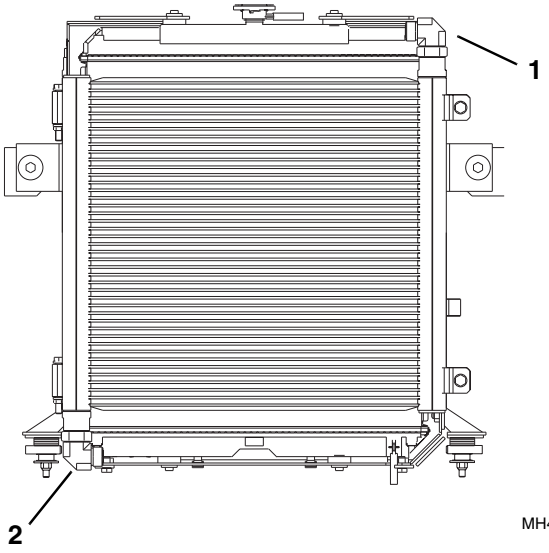
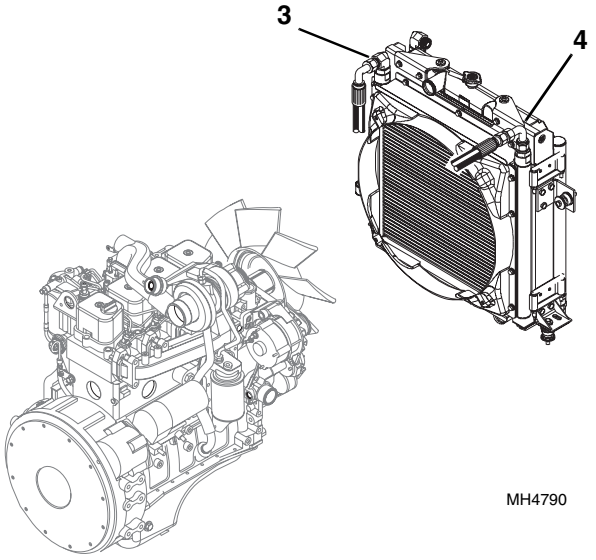
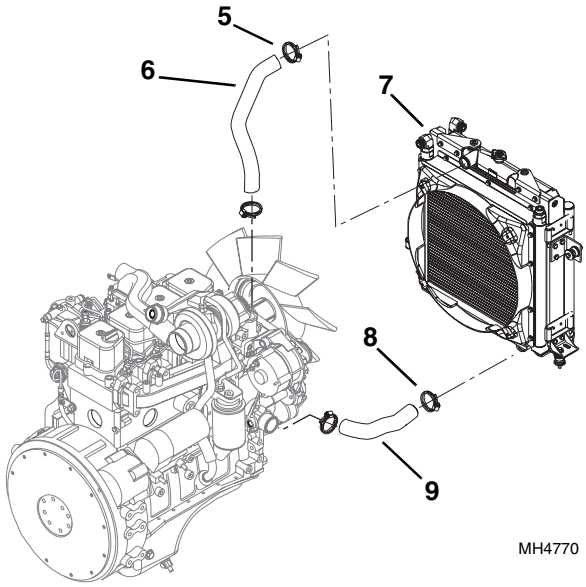
8. At the back of the vehicle, connect the transmission cooler inlet (**1**) and outlet (**2**) hoses.



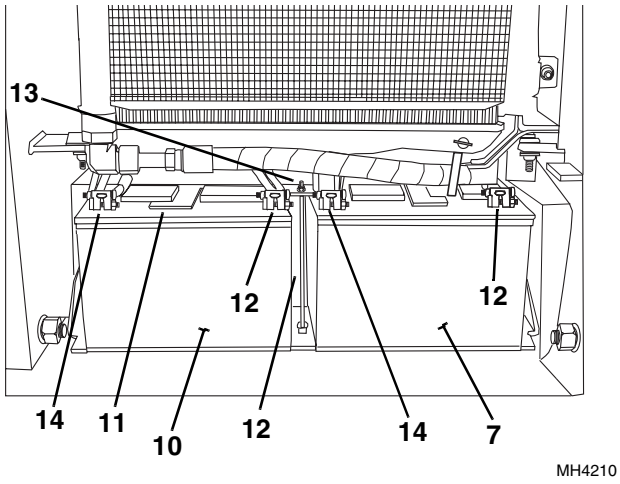
9. Connect the hydraulic oil cooler inlet (**3**) and outlet (**4**) hoses.



10. Install the radiator side clamp (**5**) on the radiator input (upper) hose (**6**) at the radiator (**7**). Install the clamp (**8**) on the radiator return (lower) hose (**9**) at the radiator.



11. Install the batteries (**10**), hold-down bracket (**11**), threaded hold-down rods (**12**) and hold-down nuts (**13**).
12. Connect the positive (+) battery cables (**14**) and negative (-) battery cables (**12**) to the batteries (**10**).



13. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.

7B.6.5 Block Heater Replacement

a. Engine Block Heater Removal

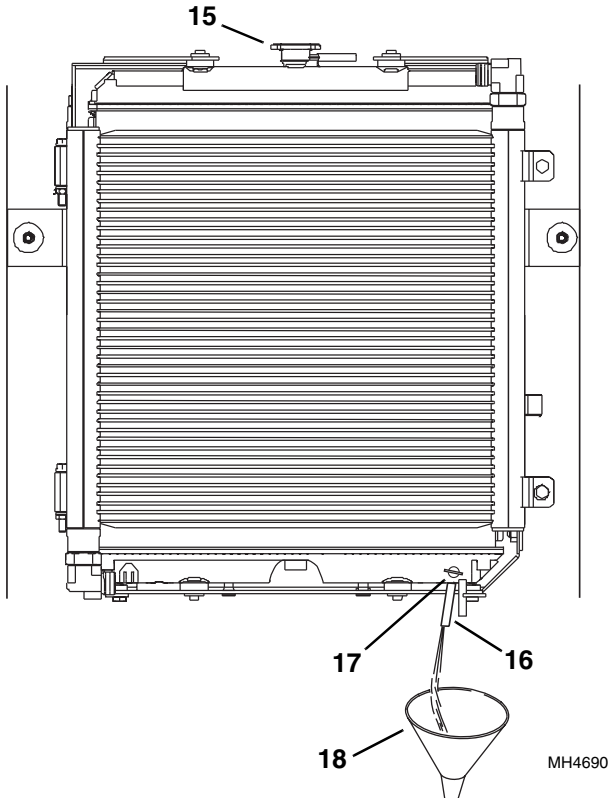
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N) and engage the neutral lock lever; engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. (Refer to Section 1.5, “Accident Prevention Tags.”)

> **WARNING:** **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

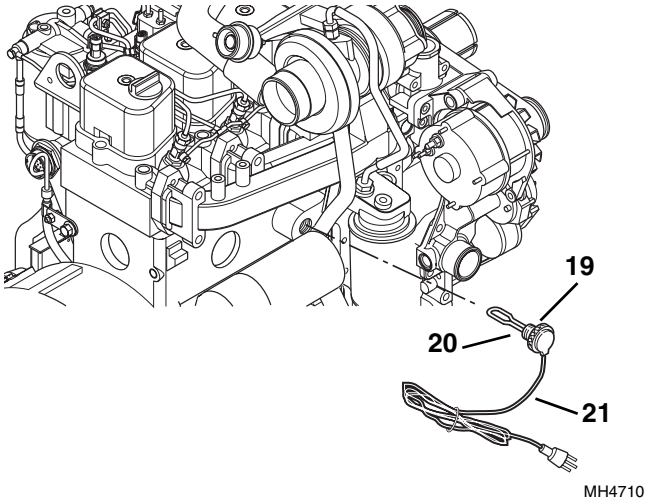
3. Unlock, unlatch and open the rear engine door. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.Disconnect the negative (-) battery cables (**14**) from the batteries (**10**).

> **WARNING:** Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

4. Slowly turn the radiator cap (**15**) to the first stop, and allow any pressure to escape. Remove the radiator cap.
5. Locate the drain tube (**16**) and petcock (**17**) on the right side of the radiator. Place a funnel (**18**) under the drain tube and loosen the drain petcock.
6. Drain the coolant into a suitable container.

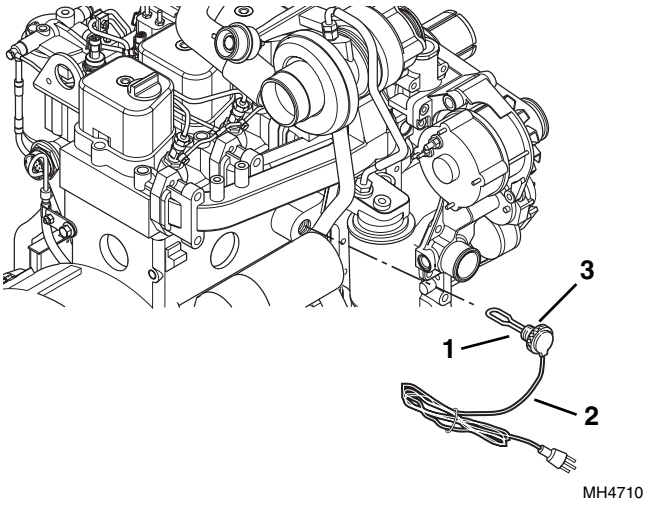


7. Remove plastic retainer (**19**) from around coolant heater element (**20**) and 110 volt cord (**21**). Remove heating element from engine block.



b. Engine Block Heater Installation

1. Apply Teflon tape to coolant heater element threads (**1**), and install element using a 29-mm socket. **DO NOT** overtighten. Plug-in the 110-volt cord (**2**) into heater element, and install plastic retainer (**3**) around coolant heater element and 110-volt cord.



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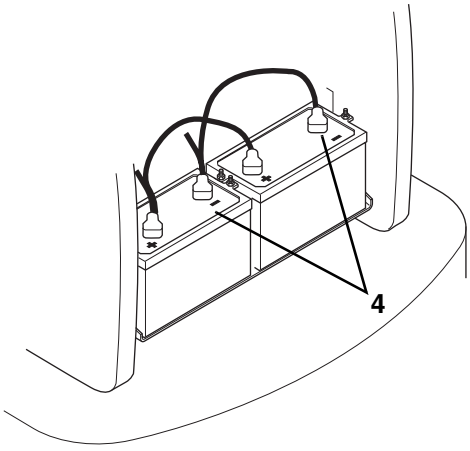
2. Connect the negative (-) battery cables (**4**) to the batteries.



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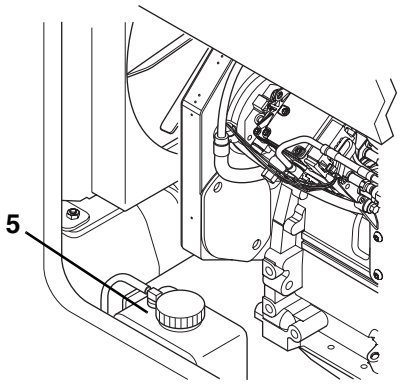
3. Fill the cooling system. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle (**5**) and fill, or drain, as necessary.



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7B.7 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9, “Electrical System.”

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7B.8 FUEL SYSTEM

The fuel system includes a fuel tank (**1**), fuel level sender with gasket (**2**), instrument cluster gauge (not shown), fuel strainer (**3**), fuel lift pump (**4**), fuel filter (**5**), fuel supply hose (**6**) and fuel return line (**7**).

The threaded fuel filler (**8**) has a fuel cap (**9**) and permits entry of diesel fuel into the tank.

The fuel level sender (**2**) and instrument cluster gauge are described in Section 9.14.15, “Fuel Level Indicator and Fuel Level Sender.”

A fuel supply hose (**6**) carries fuel from the tank (**1**) to the fuel lift pump (**4**) and then under pressure to the fuel filter (**5**). Filtered fuel is directed to the fuel injection pump and to the individual fuel injectors. Surplus fuel at the fuel injector pump is returned to the tank via the fuel return line (**7**).

7B.8.1 Diesel Fuel

WARNING: Engine fuel is **flammable** and can cause a fire or an explosion. Keep sparks and open flames away from the vehicle and **DO NOT** use smoking materials while refueling.

Fuel represents a major portion of vehicle operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: *Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.*

Due to the precise tolerances of diesel injection systems, keep the fuel clean and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. The preferred fuel is ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best fuel economy and performance under most operating conditions. Fuels with Cetane ratings higher than 40 may be needed in higher altitudes or extremely low ambient temperatures to prevent misfiring and excessive smoke.

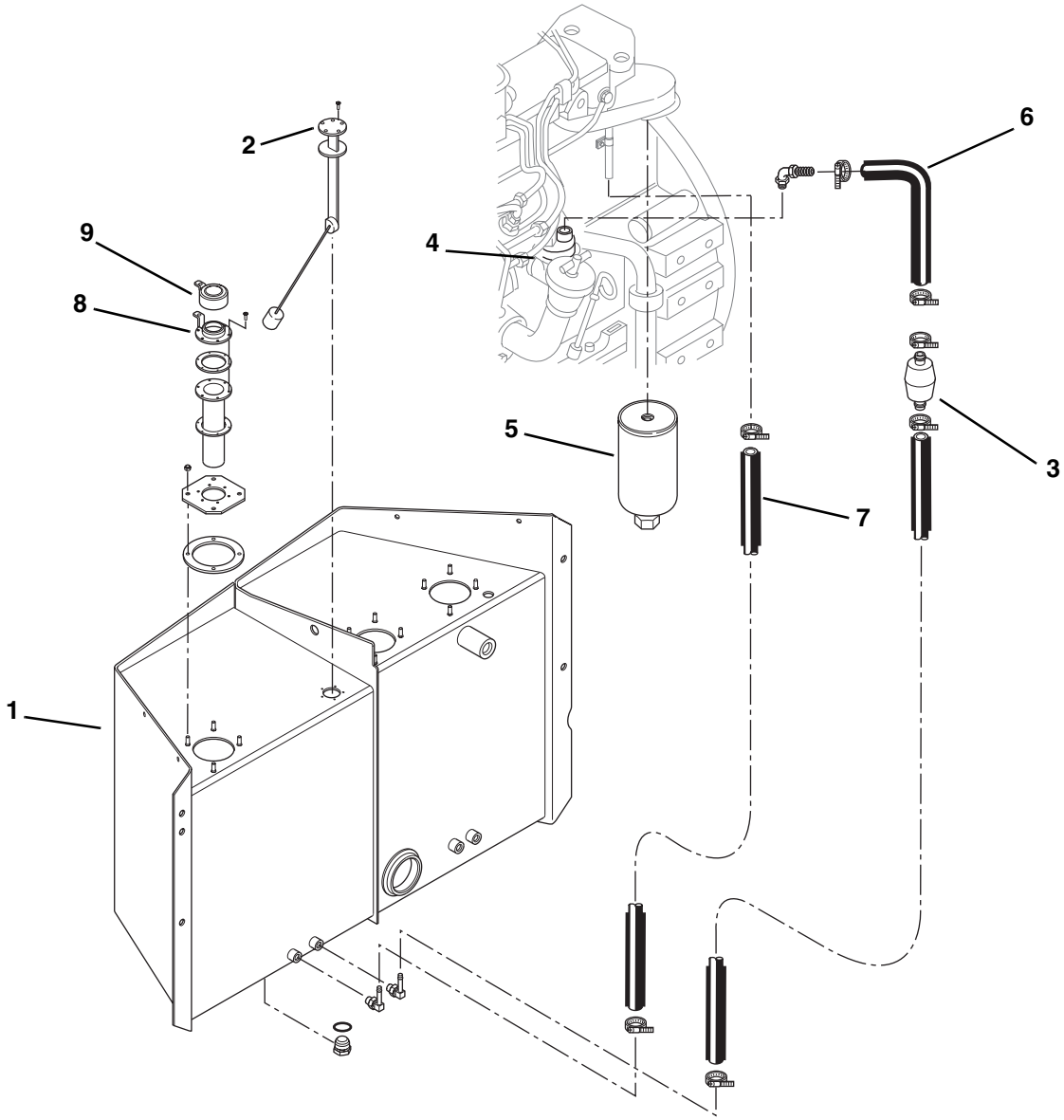
- *When operating at temperatures above 32° F (0° C), use standard #2 diesel fuel.*
- *When operating at temperatures below 32° F (0° C), use a blend of #1 & #2 diesel fuels, most commonly known as “winterized” #2 diesel.*

IMPORTANT: *#1 diesel fuel may be used, however, fuel economy will be reduced.*

WARNING: **DO NOT** mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

Use a low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

Note: *When using diesel fuel with a sulfur content below 1.3 percent, the filter change interval must be reduced by 75 hours. The use of fuel with a sulfur content above 1.3 percent is not recommended.*



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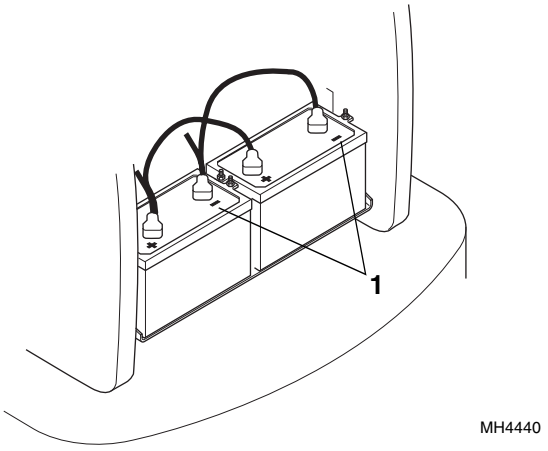
7B.8.2 Fuel/Hydraulic Oil Tank

Note: *The fuel/hydraulic oil tank is part of a one piece unit divided into a two compartment (tank) unit. It is located on the right side of the vehicle, across from the operator's cab. If it is determined that either the fuel or hydraulic oil tank must be removed, both the fuel and hydraulic oil must be drained before tank removal. Always dispose of hydraulic oil or fuel properly.*

WARNING: Explosion and fire hazard. Cap or safely cover the fuel/hydraulic oil tank fittings before removing tank.

a. Fuel/Hydraulic Oil Tank Removal

1. Unlock, unlatch and open the side and rear engine doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.
2. Disconnect the negative (-) battery cables (**1**) from the batteries.



3. Remove the fuel/hydraulic oil tank top cover from tank. Refer to Section 4.7, "Access Panels and Covers."
4. Remove the two frame top covers from above the frame. Refer to Section 4.7, "Access Panels and Covers."

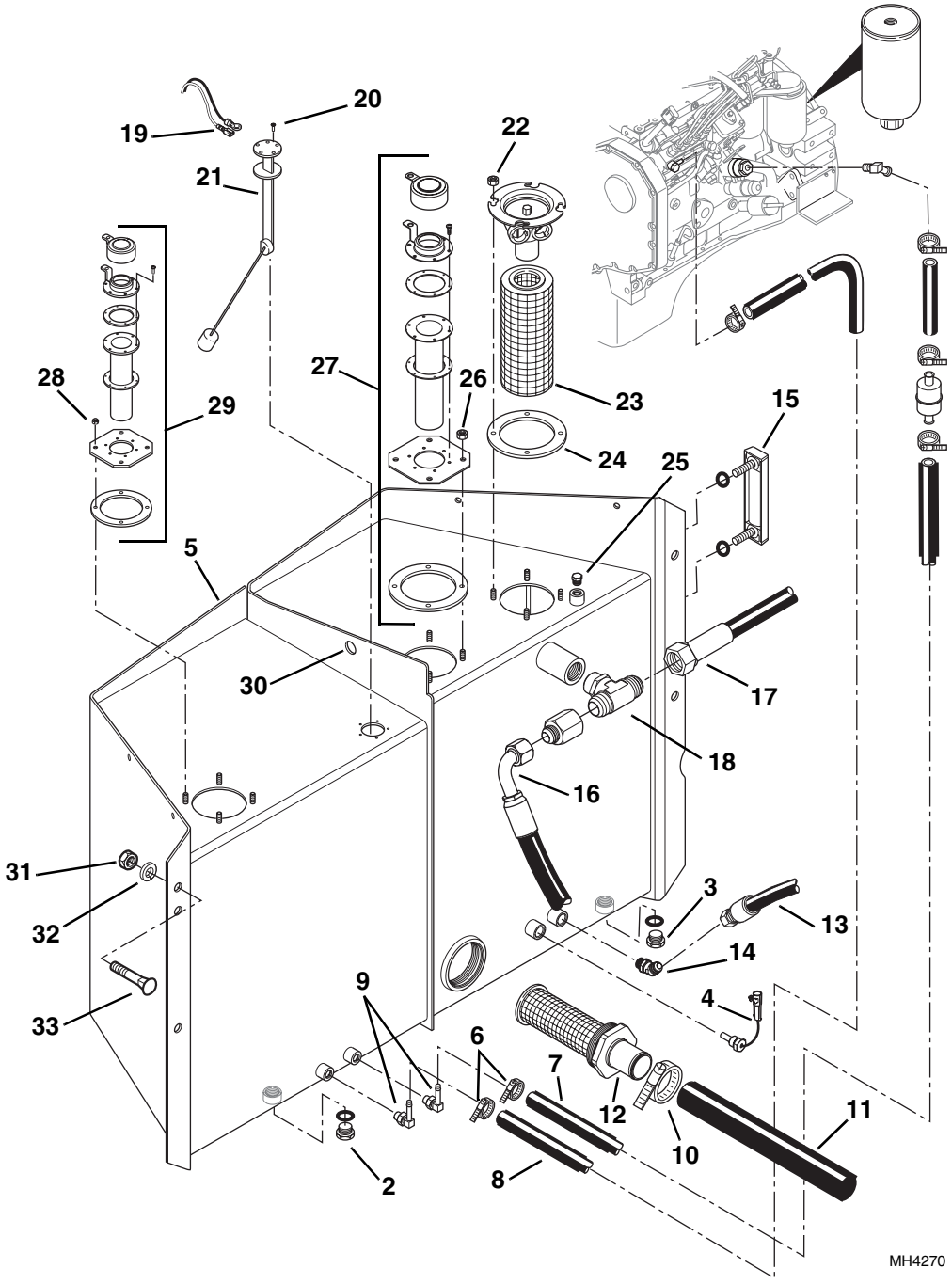
Note: *If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.*

Note: *Have a dry chemical (Class B) fire extinguisher near the work area.*

5. Remove fuel drain plug (**2**), and drain fuel into an approved and suitable container. Dispose of fuel properly.
6. Remove hydraulic oil drain plug (**3**), and drain hydraulic oil into an approved and suitable container. Dispose of oil properly.
7. Disconnect the hydraulic oil temperature sensor connector (**4**), from the engine harness connector, and remove from tank (**5**).
8. Loosen the clamps (**6**) and disconnect the fuel supply hose (**7**) and return line hose (**8**) from tank.
9. Remove the fuel line fittings (**9**) from tank.
10. Loosen clamp (**10**) and disconnect the lower hydraulic oil strainer hose (**11**) from hydraulic fuel strainer (**12**). Cap hose.
11. Remove the hydraulic fuel strainer (**12**) from tank (**5**).
12. Disconnect and cap the hydraulic return hose (**13**) and remove lower tank fitting (**14**).
13. Remove capscrews securing the hydraulic fluid level sight-glass (**15**) from tank.
14. Disconnect upper hydraulic hoses (**16** and **17**) from the t-fittng (**18**) and cap hoses.
15. Remove the t-fittng (**18**) from tank.
16. Disconnect fuel level sender electrical connectors (**19**) from the engine harness.
17. Remove screws (**20**) securing fuel sender (**21**) to the tank. Remove fuel sender from tank.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

18. Remove elastic nuts (**22**) securing the hydraulic oil filter (**23**) to the tank. Remove filter and gasket (**24**) from tank.
19. Remove plug (**25**) from top of tank.
20. Remove elastic nuts (**26**) securing hydraulic oiler filler neck components (**27**) and remove components.
21. Remove elastic nuts (**28**) securing fuel filler neck components (**29**) and remove components.
22. Position and connect a suitable chain support to tank lifting point (**30**) and take up slack in the chain.
23. While supporting the tank, remove hex nuts (**31**) and lockwashers (**32**) securing the tank to vehicle frame. Pull tank away from the tank carriage bolts (**33**), and remove tank. Retain hardware for reuse.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b. Disassembly

DANGER: **NEVER** weld in, on, near or around the fuel/hydraulic oil reservoir. Fuel and hydraulic fluid and fumes can cause the reservoir to explode. This can result in death or serious personal injury.

The fuel/hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated fuel, hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

Note: *If a leak is suspected between the fuel and hydraulic oil tank, contact* ***JLG*** *Service Department at:*
Domestic: ***1-877-554-5438***
International: ***1-717-485-6657***

To clean the fuel/hydraulic oil tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area

WARNING: **NEVER** drain or store fuel in an open container due to the possibility of explosion or fire. Discard the fuel in an approved manner.

2. Depending on which side of the tank is contaminated (fuel or hydraulic oil), remove the fuel or oil tank drain plug, and safely drain any fuel or hydraulic oil into a suitable container. Dispose of fuel or hydraulic oil properly.
3. Clean the fuel/hydraulic oil tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. For the fuel tank side, add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

d. Inspection

Note: *If a leak is suspected between the fuel and hydraulic oil tank, contact* ***JLG*** *Service Department at:*
Domestic: ***1-877-554-5438***
International: ***1-717-485-6657***

Note: *Inspect the fuel/hydraulic oil tank thoroughly for any cracks, slices, leaks or other damage.*

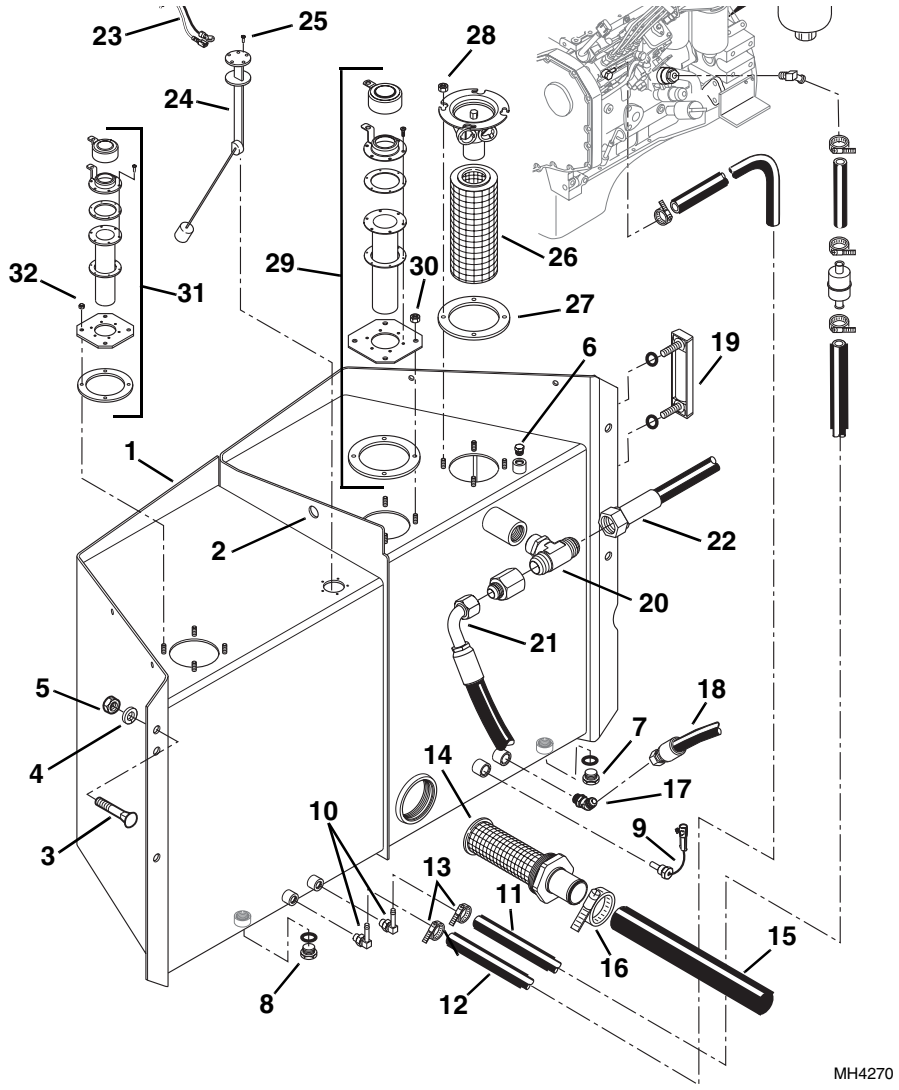
With the fuel/hydraulic oil tank removed from the vehicle, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the tank for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

e. Assembly

The fuel/hydraulic oil reservoir is a one piece-unit and cannot be disassembled. The fuel level indicator and hydraulic filters can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal regulations.

f. Fuel/Hydraulic Oil Tank Installation

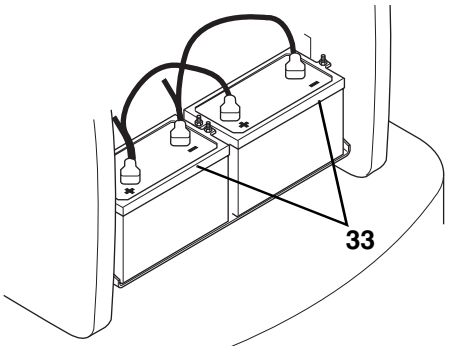
1. Attach the tank (**1**) to a suitable lifting device at the lift point (**2**).
2. Place the tank carriage bolts (**3**) into the slotted holes in frame.
3. Position the tank (**1**) and insert carriage bolts (**3**) through tank attachment holes. Install lockwashers (**4**) and finger tighten hex nuts (**5**) onto carriage bolts. Slide tank and carriage bolts toward the front of vehicle, until carriage bolts are bottomed out into the slotted frame holes.
4. Install plugs (**6**, **7** and **8**) using new gaskets.
5. Install the hydraulic oil temperature sensor (**9**) in the tank and connect to the engine harness connector.
6. Install the fuel line fittings (**10**) in the tank.
7. Install the fuel supply (**11**) and return line (**12**) hoses to the fuel tank. Secure with clamps (**13**).
8. Install the hydraulic fuel strainer (**14**) in the tank.
9. Connect the lower hydraulic oil strainer hose (**15**) to the strainer (**14**) and secure using clamp (**16**).
10. Install lower tank fitting (**17**) and connect hydraulic return hose fitting (**18**).
11. Install the hydraulic fluid level sight-glass (**19**) using special designed and drilled capscrews and gaskets.
12. Connect the t-fitting (**20**) to the tank.



13. Connect upper hydraulic hoses (**21** and **22**) to the t-fitting.
14. Attach fuel level sender harness connectors (**23**) to the sending unit (**24**).
15. Install the fuel sender with new gasket (**24**) into the fuel tank and secure with screws (**25**). **DO NOT** overtighten.

Note: *ALWAYS replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

16. Install hydraulic oil filter (**26**) and gasket (**27**) and secure using new elastic nuts (**28**).
17. Install hydraulic filler neck components (**29**) and secure using new elastic locknuts (**30**).
18. Install fuel filler neck components (**31**) and secure using new elastic locknuts (**32**).
19. Fill fuel tank with No. 2 D fuel. Fill the hydraulic tank with ISO-46 hydraulic oil.
20. Check fuel and hydraulic oil tanks for leaks.
21. Connect the negative (-) battery cables (**33**) to the batteries.

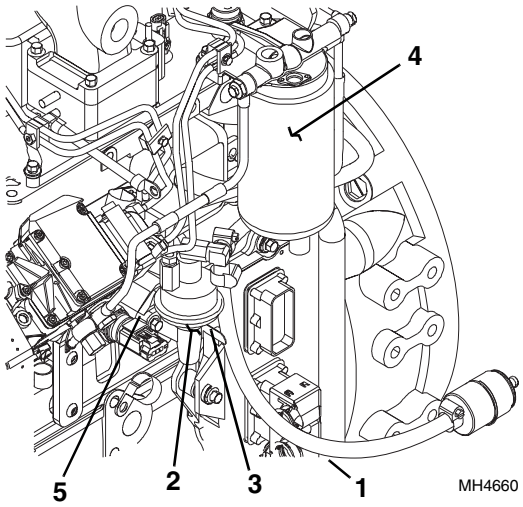


7B.8.3 Fuel Level Sender and Gauge

The fuel level sender and gauge assembly is described in Section 9.14.15, “Fuel Level Indicator and Fuel Level Sender.”

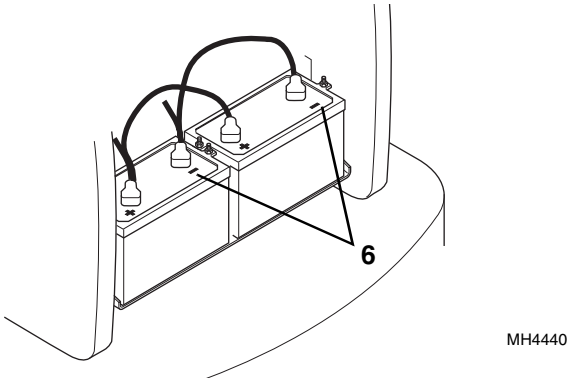
7B.8.4 Fuel Lift Pump Inspection and Testing

1. To test the diaphragm, remove the fuel inlet line (**1**) from the fuel lift pump (**2**). Block the fuel inlet with a finger and operate the hand plunger (**3**). A properly operating pump will provide suction that will remain until the finger is removed from the inlet.



a. Fuel Lift Pump Removal

1. Disconnect the negative (-) battery cables (**6**) from the batteries.



2. Clean debris from around the fuel lift pump (**2**).
3. Disconnect the fuel inlet line (**1**).
4. Remove the capscrews (**5**), gasket and fuel lift pump (**2**).

b. Cleaning and Drying

Clean the exterior of the pump with mineral spirits, and blow dry with compressed air.

Note: *Parts replacement is not practical. The fuel lift pump is serviced as an entire assembly.*

c. Fuel Lift Pump Installation

1. Clean the mounting surface on the cylinder block.
2. Install the fuel lift pump (**2**) with a new gasket. Install and torque the capscrews (**5**) to 18 lb-ft (24 Nm).
3. Connect the fuel line (**1**). Vent air from fuel system. Refer to appropriate Owners/Operators Manual.
4. Connect the negative (-) battery cables (**6**) to the batteries.

7B.8.5 Fuel Filter

Refer to the appropriate Owners/Operators Manual for your vehicle for the correct fuel filter (**4**) removal procedure.

7B.8.6 Venting Air from the Fuel System

Refer to the appropriate Owners/Operators Manual for your vehicle for the correct fuel system venting procedure.

7B.8.7 Fuel Injectors

The engine uses Bosch 17-mm, closed nozzle, hole-type injectors. The injectors have different part numbers for different engine ratings. The last four digits of the Cummins part number (stamped on the bottom portion of the injector) identify the injector.

IMPORTANT: *Use only the specified injector for the engine. Damage to the engine can occur if incorrect injectors are used.*

During the injection cycle, high pressure from the injection pump rises to the operating (or “pop”) pressure, which causes the needle valve in the injector to lift. Fuel is then injected into the cylinder. A shimmed spring is used to force the needle valve closed as the injection pressure drops below the pop pressure to seal off the nozzle after injection.

Failure of the needle valve to lift and to close at the correct time, or a needle valve that is stuck open, can cause the engine to misfire and produce low power. Fuel leaking from the open nozzle can cause a fuel knock, poor performance, smoke, poor fuel economy and rough running.

a. Locating Faulty Fuel Injectors

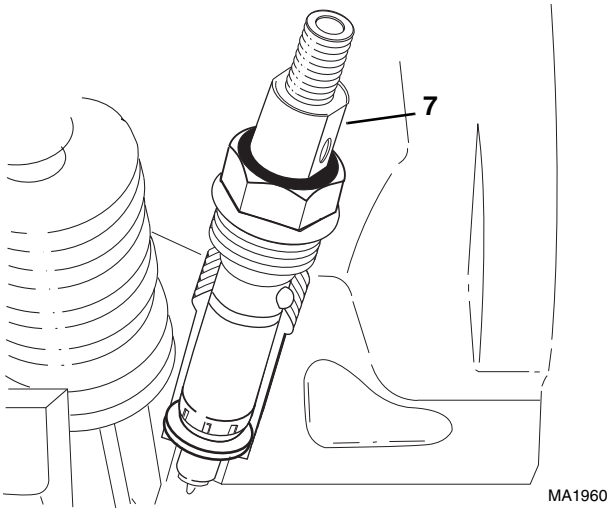
A faulty fuel injector can cause:

- Misfiring
- Knocking
- Overheating
- Loss of power
- Smoky (black) exhaust
- Increased fuel consumption

The particular faulty fuel injector(s) may be determined by releasing the pipe union nut on each fuel injector in turn, with the engine running at a fast "tick-over." If, after slackening a pipe union nut, the engine revolutions remain constant, a faulty fuel injector has been identified.

To test a fuel injector:

1. Remove the fuel injector (**7**) from the cylinder head.
2. Refer to Section 7B.8.7, b. "Injector Replacement."



3. Invert the fuel injector, with the nozzle facing out, then retighten the unions.
4. Loosen the unions of the other fuel injector pipes (to help avoid the possibility of the engine starting).

> **WARNING:** Diesel fuel under pressure can penetrate the skin and cause serious personal injury. Slowly loosen fittings, and allow release of residual pressure before removing.

5. Operate the starter to turn the engine over until fuel sprays from the nozzle. Examine the shape of the spray. If the spray is unduly "wet" or "streaky," or obviously sprays to one side, or if the nozzle "dribbles" fuel, it may only be necessary to probe the nozzle holes to remove blockage.

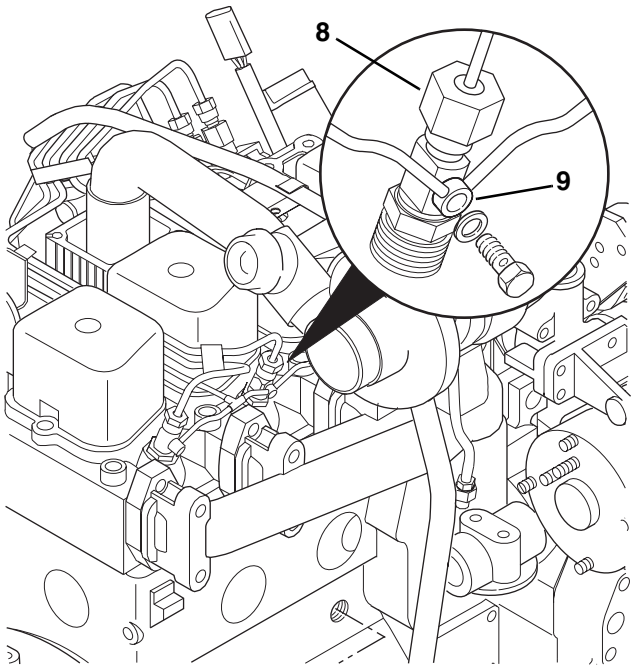
***IMPORTANT: DO NOT** attempt to adjust injection pressure without a testing pump and pressure gauge. It is not possible to accurately adjust the setting of fuel injectors without the proper equipment.*

A perfect fuel injector, when tested by pumping fuel through it in the open air, gives a short "pinging" sound as the fuel emerges from the holes. After the fuel injector has been in service for some time, the pinging changes to a crackling sound. It is not until the fuel injector sounds "dead" that its condition is likely to affect the running of the engine.

b. Injector Replacement

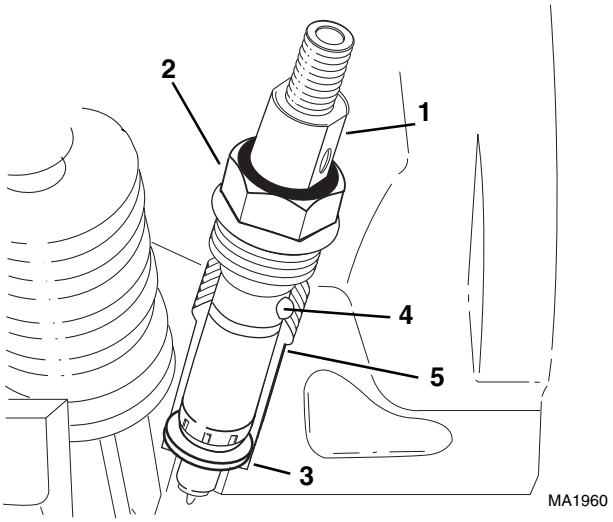
Preparatory steps:

1. Thoroughly clean around the injector(s).
2. Disconnect the high-pressure fuel lines (**8**).
3. Disconnect the fuel drain manifold (**9**).

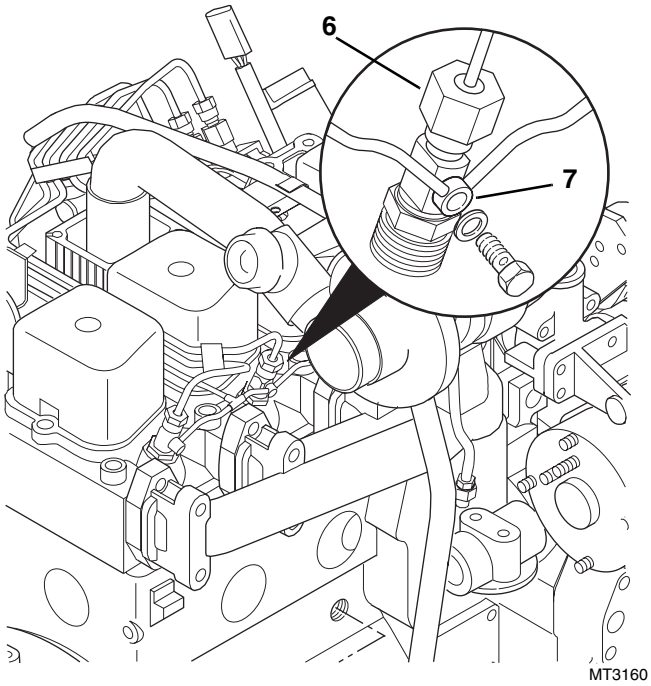


IMPORTANT: *The injector must not rotate in the bore of the cylinder head, or damage to the cylinder head will occur. If rust has formed on the hold-down nut, soak the nut with rust-penetrating solvent for a minimum of three minutes. Then, tap the injector body with a drift pin to help loosen any rust.*

4. Use a 16-mm wrench to prevent the injector body (**1**) from turning. Loosen the hold-down nut (**2**) with a 24-mm box wrench.



5. Clean the injector nozzle bore.
6. Remove the injector hold-down nut from the injector body.
7. Apply a light coat of anti-seize compound to the new injector surface. Avoid getting anti-seize compound into the fuel drain hole.
8. Install the hold-down nut on the injector body.
9. Install a new o-ring into the recessed groove in the top of the hold-down nut. Make sure the o-ring is not cut or twisted during installation.
10. Apply a light coat of anti-seize compound to the threads of the injector hold-down nut.
11. Assemble the injector and new copper washer (**3**). Use only **ONE** copper washer. A light coat of clean 15W40 engine oil placed between the washer and the injector will help keep the washer from falling during installation.
12. Install the injector with the protrusion (**4**) on the side of the nozzle fitting into the notch (**5**) in the head.
13. Tighten the hold-down nut (**2**) and torque to 44 lb-ft (60 Nm).
14. Install the fuel drain manifold (**7**) and torque to 6 lb-ft (8 Nm).



15. Install the high-pressure fuel lines (**6**) and torque to 18 lb-ft (24 Nm).
16. Run the engine and check for fuel and air leakage.
17. Bleed the fuel system in accordance with the instructions found in the appropriate owners/ operators manual.

7B.8.8 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate owners/ operators manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7B.9 ENGINE EXHAUST SYSTEM

> **WARNING:** Exhaust fumes contain carbon monoxide, a colorless, odorless gas which is fatal when inhaled in a confined area. Avoid breathing exhaust fumes, and prevent engine operation from becoming a cause of toxic emissions. Exhaust system components reach high temperatures and can cause severe burns. **DO NOT** come into contact with hot exhaust system components.

The exhaust system is supported by the engine and the vehicle frame, and helps minimize the transfer of noise and vibration into the operator's cab. The tail pipe directs exhaust fumes to the right side of the vehicle, away from the cab.

Annoying rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all capscrews and nuts slightly loose until all parts are properly aligned, then tighten all fasteners working from the front of the system to the rear.

When replacing the muffler, also replace the tail pipe.

Before assembling components, use exhaust system sealer at all slip joint connections.

When installing exhaust system components, allow sufficient clearance between the components and other vehicle pipes, hoses and wiring that could be adversely affected by excessive heat.

When installing an exhaust system, provide for parts expansion when the system is hot.

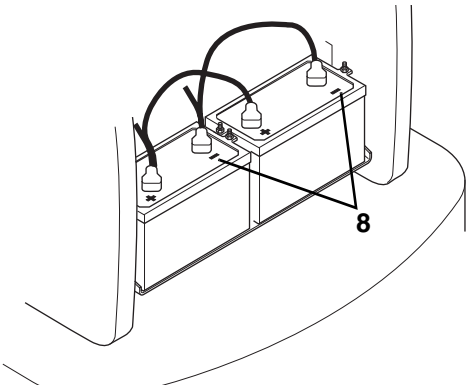
Whenever performing service on the vehicle, check the condition of the exhaust system. Check the entire exhaust system for broken, damaged, missing or improperly aligned parts, open seams, holes, loose connections and other deterioration which could permit exhaust fumes to seep into the operator's cab. Correct any damaged areas immediately.

7B.9.1 Exhaust System Removal

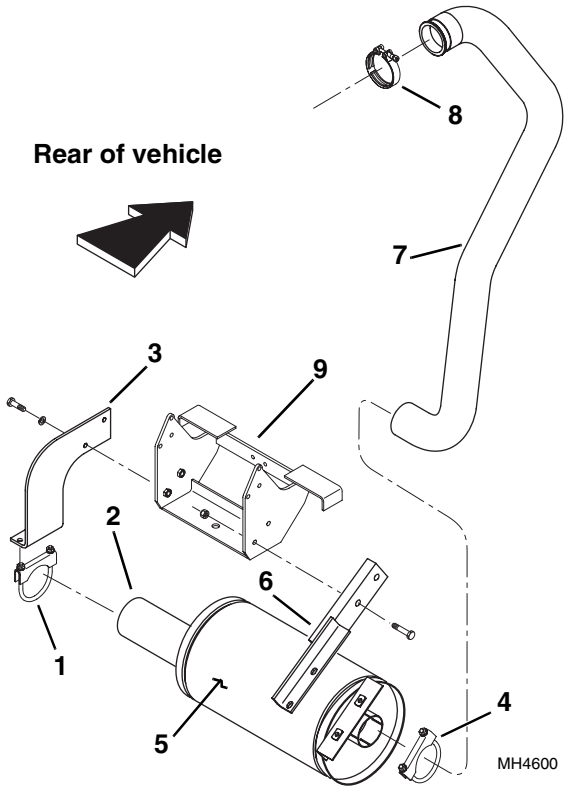
1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N) and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. (Refer to Section 1.5, "Accident Prevention Tags."

> **WARNING:** To avoid severe burns, **DO NOT** attempt to remove the engine when the engine, cooling system and hydraulic system are hot. Wait until all parts and systems are cool before proceeding.

3. Unlock, unlatch and open the engine doors. Allow the engine to cool before proceeding.
4. Disconnect the negative (-) battery cables (**8**) from the batteries.



5. Disconnect and remove the clamp (**1**) supporting the tail pipe (**2**), from the tail pipe support bracket (**3**).
6. Disconnect and remove the clamp (**4**) attaching the muffler (**5**) to the muffler mounting bracket (**6**) and exhaust pipe (**7**), and remove the muffler from the muffler mounting bracket.

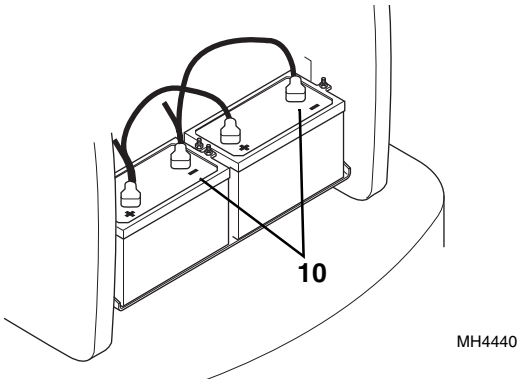


7. Disconnect and remove the V-band clamp (**8**) from the exhaust pipe (**7**) and remove the exhaust pipe.
8. Disconnect and remove the muffler mounting bracket (**6**) and tail pipe support bracket (**3**) from the rear engine mount (**9**).

7B.9.2 Exhaust System Installation

Note: *Keep all clamps loosened until entire exhaust system is in place.*

1. Install the muffler mounting bracket (**6**) and tail pipe support bracket (**3**) to the rear engine mount (**9**).
2. Install the V-band clamp (**8**) to the exhaust pipe (**7**)
3. Secure the tail pipe (**2**) with the clamp (**1**) to the tail pipe support bracket (**3**).
4. Attach the muffler (**5**) to the muffler mounting bracket (**6**) and exhaust pipe (**7**) with the clamp (**4**).
5. Tighten all clamps.
6. Connect the negative (-) battery cables (**10**) to the batteries.



7. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.

7B.10 AIR CLEANER ASSEMBLY

If a replacement engine is being installed into the vehicle, the air cleaner assembly must be transferred to the new engine.

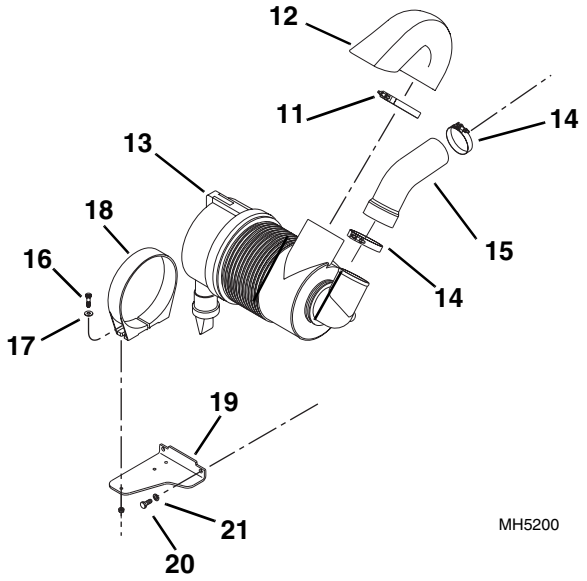
The air cleaner assembly should be transferred to the replacement engine after the used engine is removed from the vehicle.

CAUTION: **NEVER** run the engine with only the inner safety element installed.

IMPORTANT: *Before transferring the air cleaner assembly to the new engine, remove the elements and clean the inside and outside of the air cleaner canister. Replace the outer primary and inner safety elements. Refer to the appropriate Owners/Operators Manual for your vehicle for the correct element change procedure.*

7B.10.1 Air Cleaner Assembly Removal

1. Remove the T-bolt band clamp (**11**) securing the air scoop (**12**) to the air cleaner assembly (**13**).



2. Remove the T-bolt clamps (**14**) securing the hose (**15**) to the air cleaner assembly (**13**).
3. Remove capscrews (**16**) and lockwashers (**17**) securing the band (**18**) to the air cleaner bracket (**19**). Remove the air cleaner assembly (**13**).
4. Remove the capscrews (**20**) and lockwashers (**21**), securing the air cleaner mounting bracket (**19**) to the engine.

7B.10.2 Air Cleaner Assembly Installation

Note: *Apply Loctite® 242 threadlock (Red) compound to the capscrew threads before installation.*

5. Secure the air cleaner mounting bracket (**19**) to the engine using capscrews (**20**) and lockwashers (**21**).
6. Secure the band (**18**) to the air cleaner bracket (**19**). using capscrews (**16**) and lockwashers (**17**).
7. Install the air cleaner assembly (**13**).
8. Install the T-bolt clamps (**14**) to secure the hose (**15**) to the air cleaner assembly (**13**).
9. Install the T-bolt band clamp (**11**) to secure the air scoop (**12**) to the air cleaner assembly (**13**).
10. Tighten all clamps.

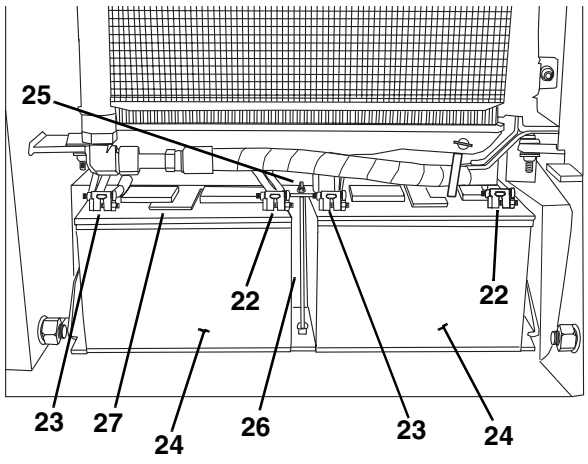
7B.11 ENGINE REPLACEMENT

7B.11.1 Engine Removal

WARNING: To avoid severe burns, **DO NOT** attempt to remove the engine when the engine, cooling system and hydraulic system are hot. Wait until all parts and systems are cool before proceeding.

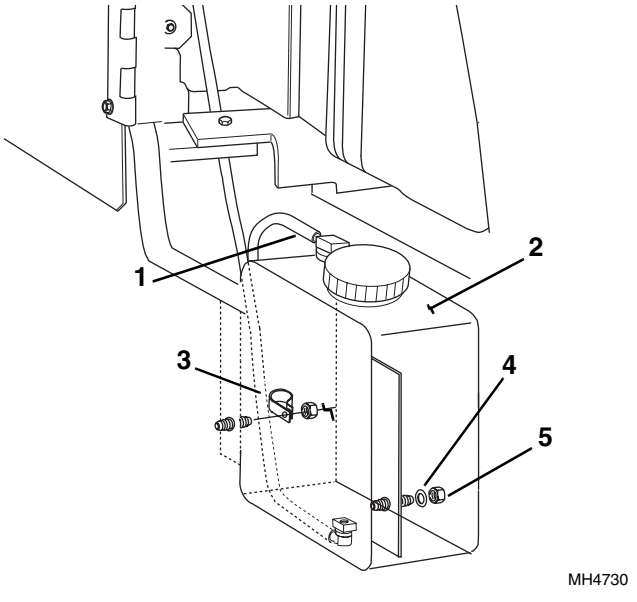
Note: *The radiator and oil cooler must be removed from the vehicle before engine removal. Refer to Section 7B.6.4, a. "Oil Coolers and Radiator Removal." Several additional components must be removed before engine removal. They will be addressed in the following procedures.*

1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, "Accident Prevention Tags."
3. Disconnect the battery negative (-) ground cables (**22**) and positive (+) battery cables (**23**) from the batteries (**24**).
4. Remove the battery hold-down nuts (**25**), threaded hold-down rods (**26**), and hold-down bracket (**27**). Remove batteries (**24**) from the vehicle. Store batteries in a cool dry area.



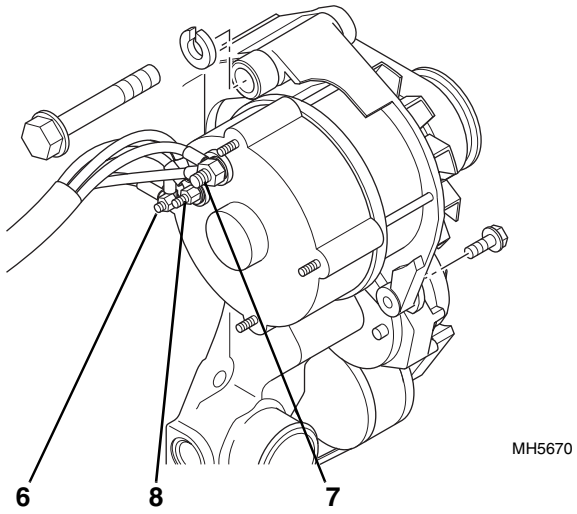
5. With the help of at least one assistant, remove the rear engine door. Refer to Section 4.7.1, "Access Panel and Cover Replacement."

6. Remove the radiator overflow tube (**1**), overflow tank (**2**), hose support (**3**), flat washer (**4**) and elastic locknuts (**5**).

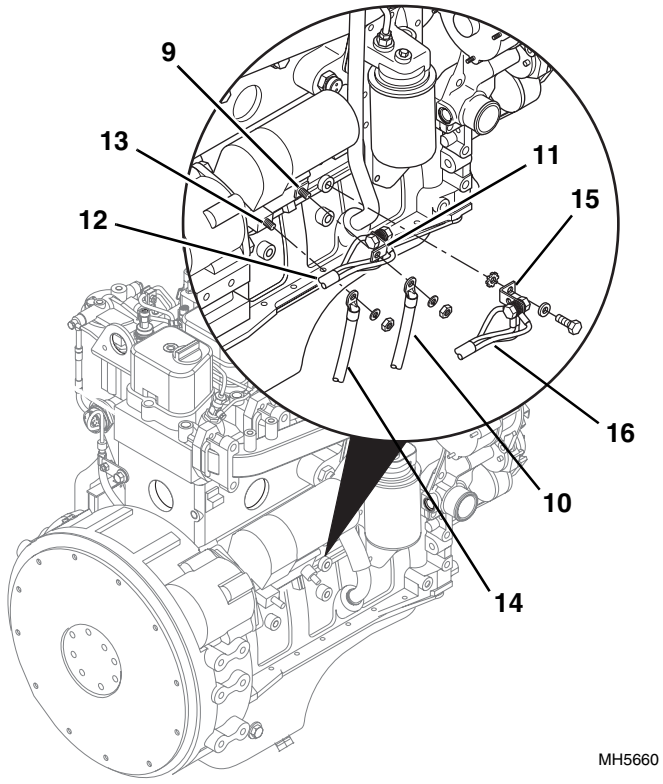


Note: *Record how the alternator and starter wires are installed to ensure correct installation later.*

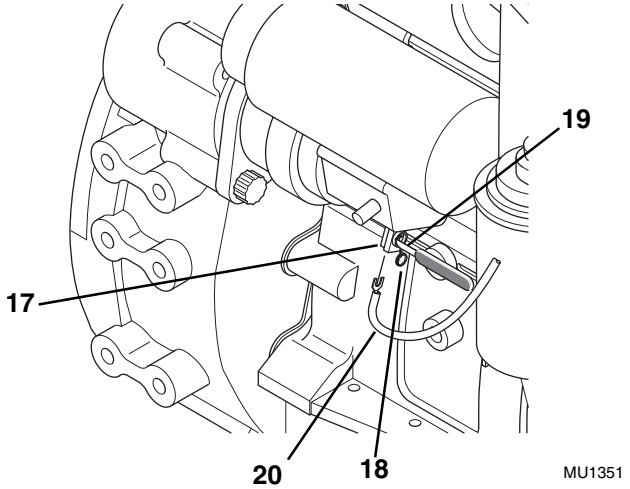
7. Label and disconnect the alternator wires:
   - AG1 and AG2 from G terminal (**6**)
   - AB1 and AB2 from B terminal (**7**)
   - 38 and 6 from D terminal (**8**)



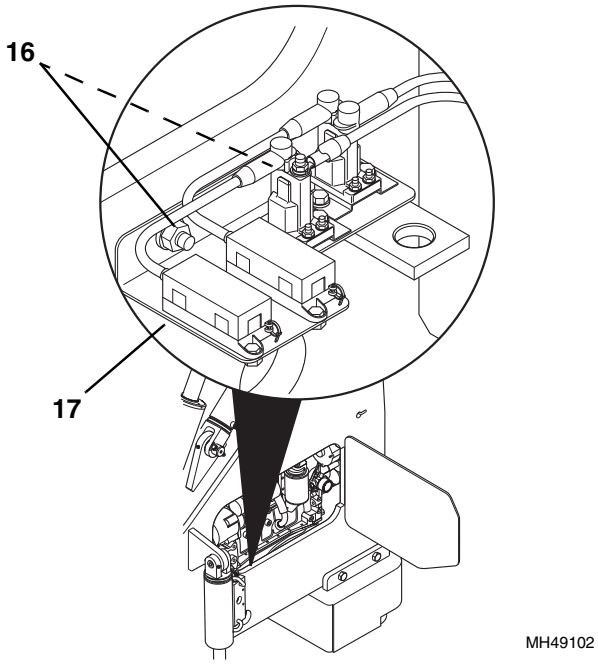
8. At the positive starter stud (**9**), label and disconnect the positive (+) battery cable (**10**) and starter positive buss bar (**11**). Leave the wires (**12**) connected to the starter positive buss bar.



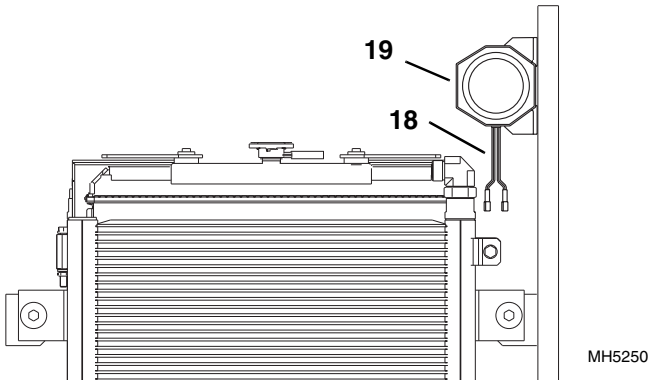
9. At the negative starter stud (**13**), label and disconnect the negative (-) battery cable (**14**).
10. Remove the engine ground buss bar (**15**) from the engine block. Leave the wires (**16**) connected to the engine ground buss bar.
11. For jump start protection, a protective plastic cover (**17**) is installed around the starter solenoid terminal and mounting screw. A removable, tethered cap (**18**) allows access to the terminal mounting screw.



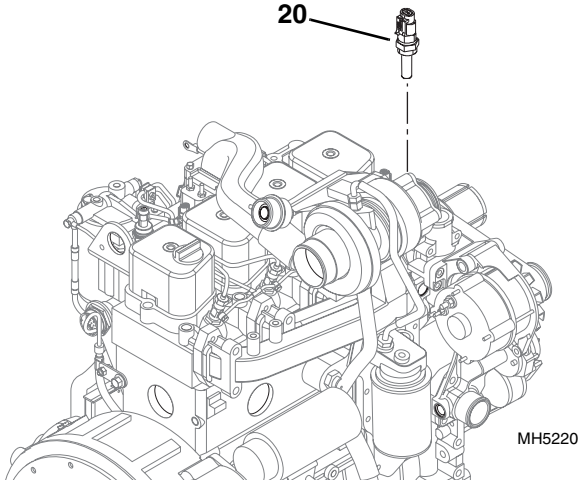
12. Use a small, flat knife blade (**19**), inserted next to the cap (**18**), so that the cap pops out of the protective cover.
13. Label the blue wire (**20**) from the starter solenoid terminal. Use a small phillips screwdriver to loosen the screw far enough to allow the blue wire to be removed from the terminal.
14. Remove the locknuts and washers (**16**) securing the coldstart grid heater (**17**) to the frame studs and place it, out of the way, on the engine.



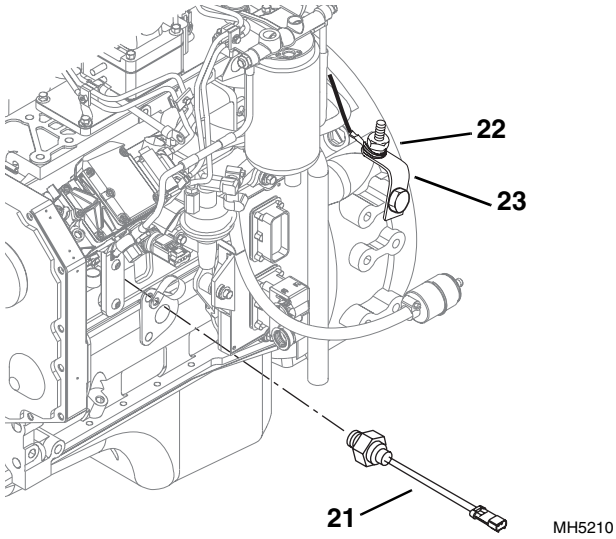
15. Label and disconnect the back-up alarm harness connector (**18**) from the back-up alarm (**19**). Refer to Section 9.11.2, “Back-up Alarm.”



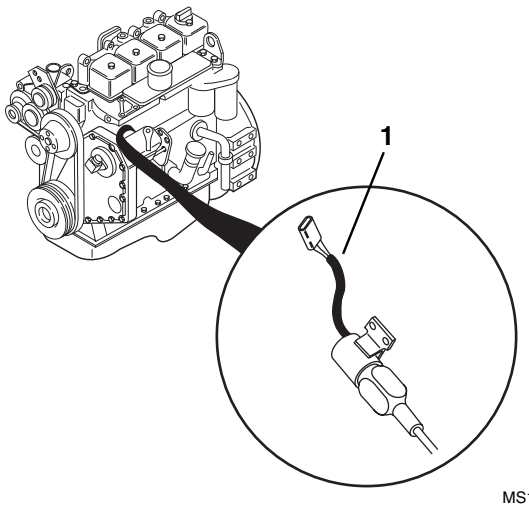
16. Label and disconnect the engine coolant temperature switch lead (**20**). Refer to Section 9.14.12, “Engine Coolant High Temperature Sender.”



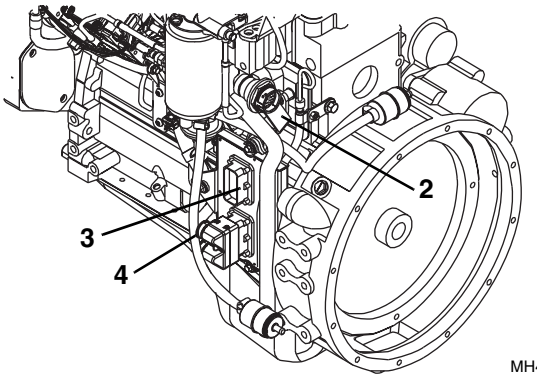
17. Label and remove oil pressure switch lead (**21**).
18. Label and remove the diagnostic system ground wire (**22**) at the buss bar (**23**).



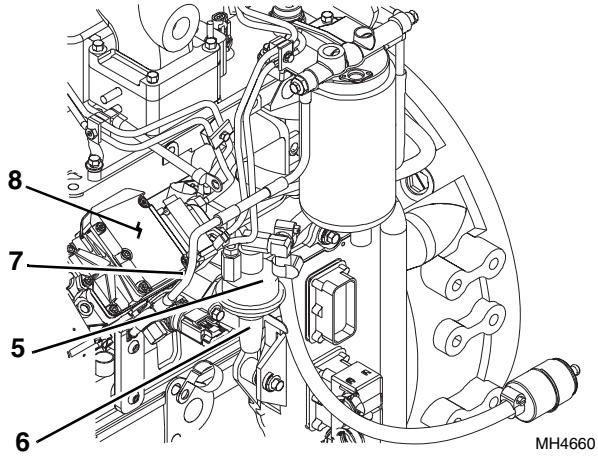
19. Disconnect the fuel shut-off solenoid harness connector (**1**). For more information, refer to Section 9.14.2, “Fuel Shut-off Solenoid (SN 8042, 13198 - 18990, 10042, 13198 - 19030, 10054, 13198 - 19079).”



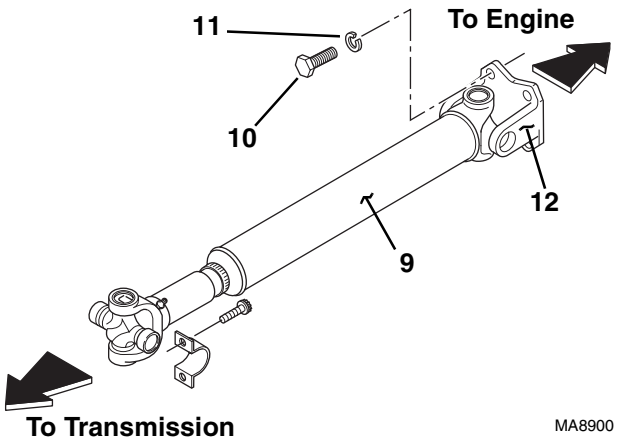
20. Disconnect the wire harness connectors (**2** and **3**) from the Engine Control Module (ECM) (**4**) at the engine.



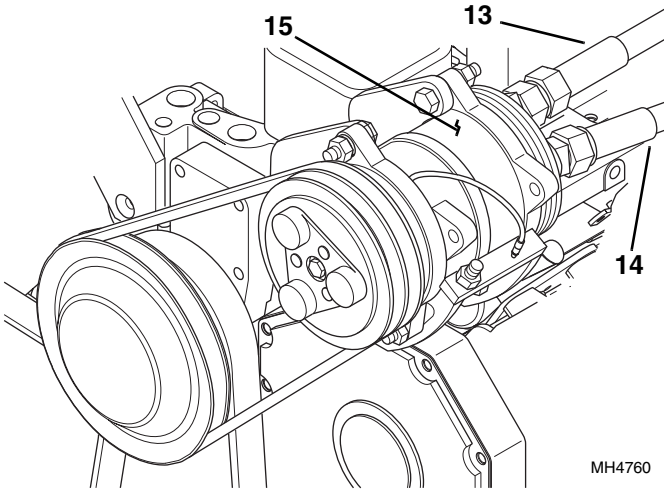
21. The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that engine clears the harness during removal.
22. Disconnect the fuel inlet line (**5**) at the fuel lift pump (**6**). Install a plug in the end of fuel inlet line and cap the fitting on the lift pump.



23. Disconnect the fuel return line (**7**) from the injector pump (**8**). Install a plug in the end of fuel inlet line and cap the fitting on the injector pump.
24. Remove the capscrews (**10**) and lockwashers (**11**) securing the flange yoke (**12**) to the engine.
25. Remove the drive shaft assembly (**9**) from engine.

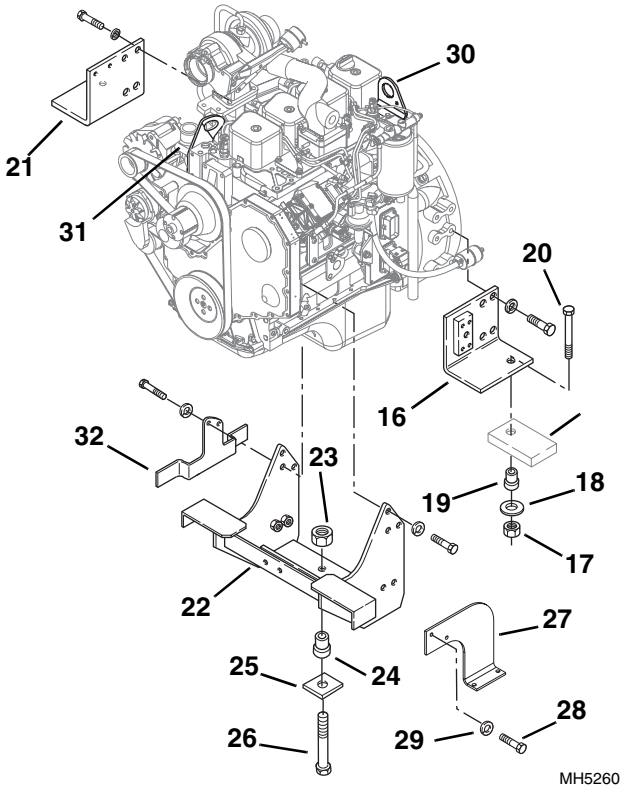


IMPORTANT: *Before the engine can be removed from the vehicle, the air conditioning hoses (**13** and **14**) need to be removed from the air conditioning compressor (**15**). This procedure must be completed by an authorized air conditioning service technician. This service technician will also need to be available when the new engine is installed to re-install the air conditioning hoses (**13** and **14**) to the air conditioning compressor (**15**).*



Note: *Always discard used elastic locknuts and install new elastic locknuts.*

26. At the front right engine mount (**16**) remove the elastic locknut (**17**), rebound washer (**18**), engine isolator (**19**) and capscrew (**20**). Repeat for the front left engine mount (**21**).
27. At the rear engine mount (**22**), remove the elastic locknut (**23**), engine isolator (**24**), rebound washer (**25**) and capscrew (**26**).
28. At the exhaust pipe bracket (**27**), remove the capscrews (**28**) and lockwashers (**29**). Remove exhaust pipe bracket.
29. Position a fork truck behind the vehicle, and drive forward, placing the forks underneath the rear engine mount (**22**) and front engine mount brackets (**16** and **21**). Slightly lift the engine, and slowly back engine out of the vehicle. Have an assistant ensure that the engine clears all frame components during removal.



30. Place engine on a flat, level surface.
31. If replacing the engine, attach a lifting chain to the front (**30**) and rear (**31**) engine lift brackets, and lift engine clear of the ground.
32. Remove the right (**16**), and left (**21**) front engine mounting brackets, and muffler bracket (**32**).

7B.11.2 Engine Disassembly, Inspection and Service

Engine disassembly, internal inspection, service, repair and assembly procedures are covered in the Cummins QSB4.5T service manual. Several special engine service tools are required to properly service the Cummins engine. Contact the local Cummins parts distributor for further information.

Note: *If the engine is being replaced, there may be external components that will be required to be transferred from the original engine to the replacement engine depending upon who you purchase the new engine from and the configuration of your replacement engine. Refer to the appropriate Cummins user manual for detailed procedures that cover the transfer of original engine components to the replacement engine.*

7B.11.3 Engine Installation

Note: *Always replace used elastic locknuts with new elastic locknuts.*

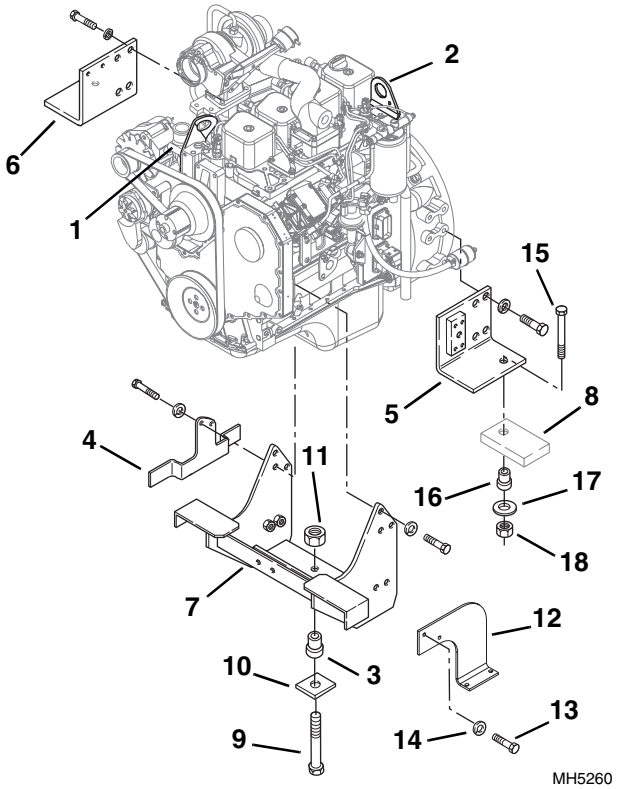
Note: *Refer to Section 2.3, "Torques," for specific fastener torque specifications.*

Note: *The engine harness is routed and attached at various places on the engine using hold-down clamps and plastic wire ties. Before installing engine and with the help of an observer, ensure that engine clears the harness during installation.*

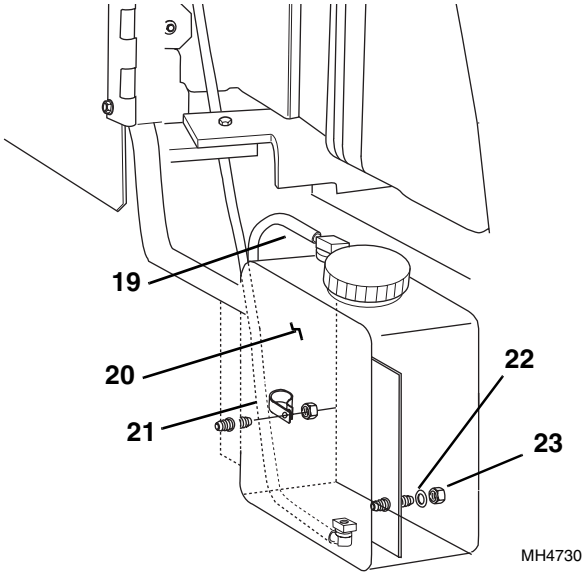
1. If replacing the engine, attach a lifting chain to the front (**1**) and rear (**2**) engine lift brackets, and lift engine clear of the ground.

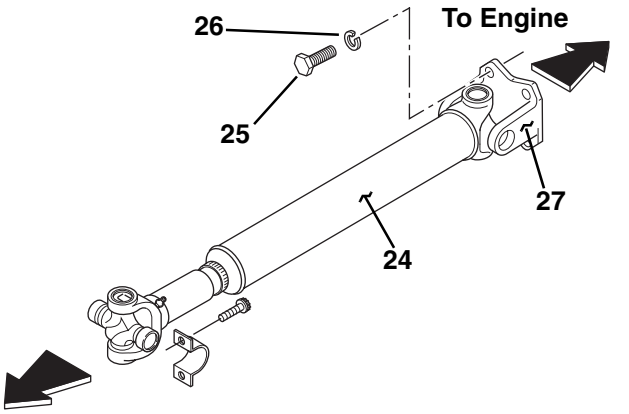
Note: *Apply Loctite® 242 threadlock (Red) compound to the engine mount bracket capscrew threads before installation.*

1. Inspect the rear engine mounting bracket isolator (**3**). Replace isolator if cracked or worn.
2. Install the muffler bracket (**4**), right (**5**) and left (**6**) front engine mounting brackets to the engine.
3. Place engine on a flat, level surface.
4. Position a fork truck behind the engine, and drive forward, placing the forks underneath the rear engine mount (**7**) and front right (**5**) and left (**6**) engine mount brackets. Lift the engine and slowly drive it into the back of the vehicle. Have an assistant ensure that the engine clears all frame, hose and harness components during engine installation. Position engine brackets over rear and front frame mounts (**8**).
5. At the rear engine mount (**7**), install the capscrew (**9**), rebound washer (**10**), engine isolator (**3**) and new elastic locknut (**11**).
6. Install the right side exhaust pipe mount bracket (**12**), capscrews (**13**) and lockwashers (**14**) to the rear engine mount (**7**).
7. Secure the front right engine mount (**5**) using capscrew (**15**), engine isolator (**16**), rebound washer (**17**), and new elastic locknut (**18**). Repeat for the front left engine mount (**6**).



8. Install the radiator overflow tube (**19**), and overflow tank (**20**), hose support (**21**), flat washer (**22**) and new elastic locknuts (**23**).



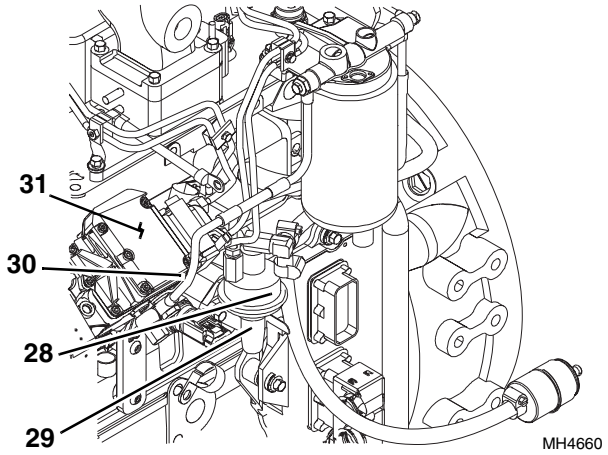


9. Raise the drive shaft assembly (**24**) into position. The slip-yoke end of the drive shaft mounts toward the engine. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.

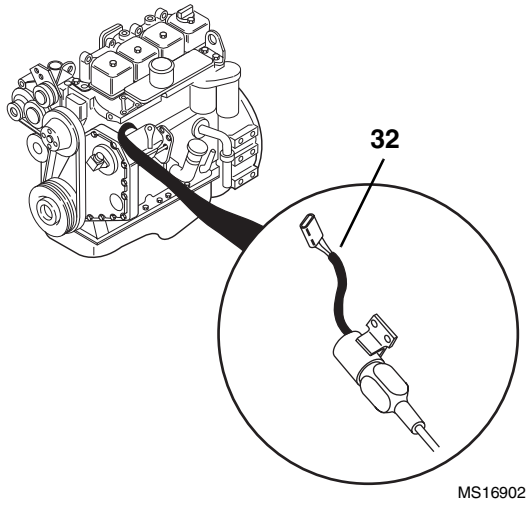
IMPORTANT: *Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

Note: *If installing a new drive shaft unit, special attention need not be applied to installation. New drive shaft units are balanced at the factory.*

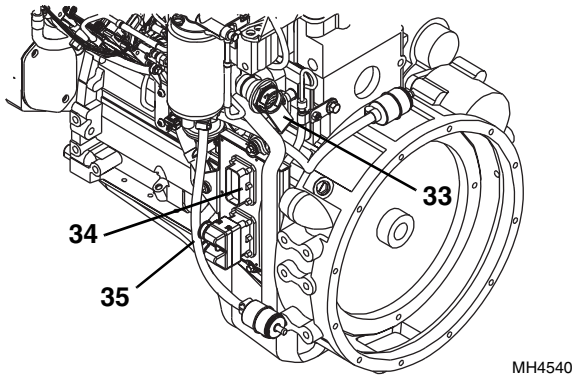
10. At the drive shaft (**24**), install the capscrews (**25**) and lockwashers (**26**), securing the flange yoke (**27**) to the engine. Torque to 105 ±10 lb-ft (142 ±14 Nm).
11. Connect the fuel inlet line (**28**) to the fuel lift pump (**29**).
12. Connect the fuel return line (**30**) at the injector pump (**31**).



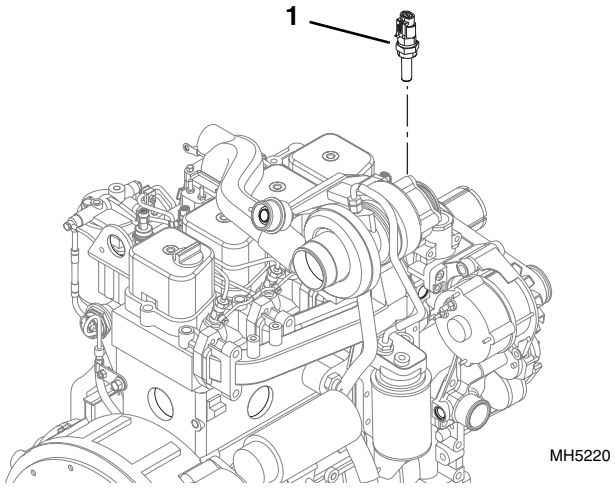
13. Connect the fuel shut-off solenoid harness connector (**32**) to the fuel shut-off solenoid. Refer to Section 9.14.2, “Fuel Shut-off Solenoid (SN 8042, 13198 - 18990, 10042, 13198 - 19030, 10054, 13198 - 19079).”



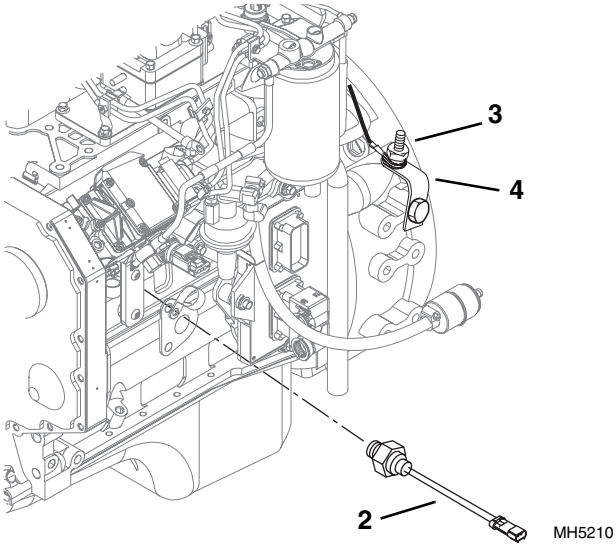
14. Connect the wiring harness connectors (**33** and **34**) to the Engine Control Module (ECM) (**35**) on the engine.



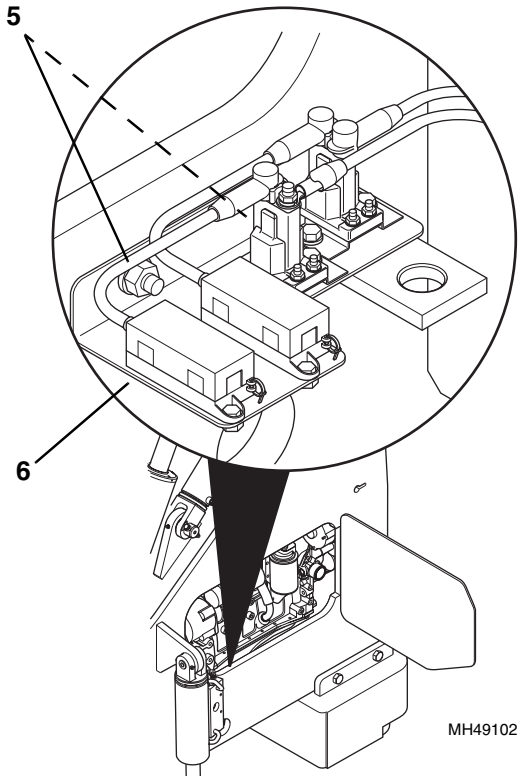
15. Connect the engine coolant temperature switch lead (**1**).



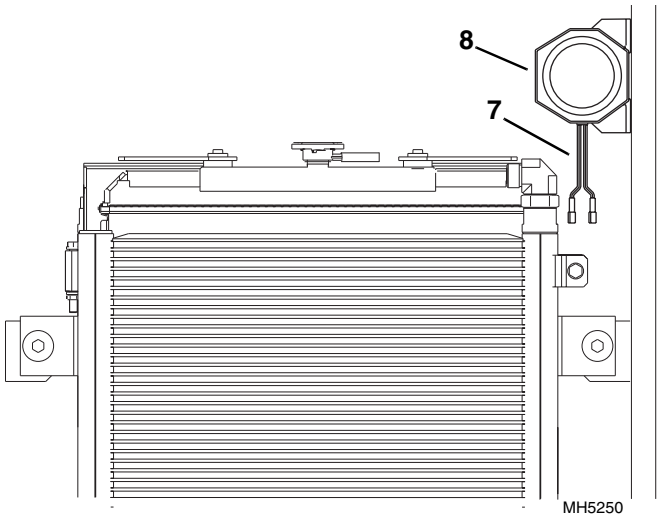
16. Connect the oil pressure switch lead (**2**).
17. Connect the diagnostic system ground wire (**3**) at the buss bar (**4**).



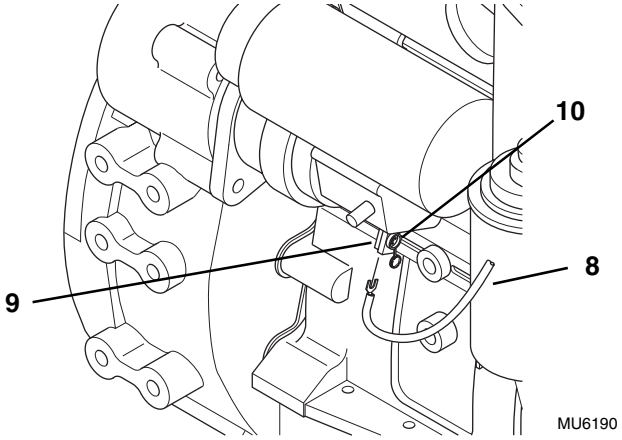
18. Install the locknuts and washers (**5**) that secure the coldstart grid heater (**6**) to the frame studs.



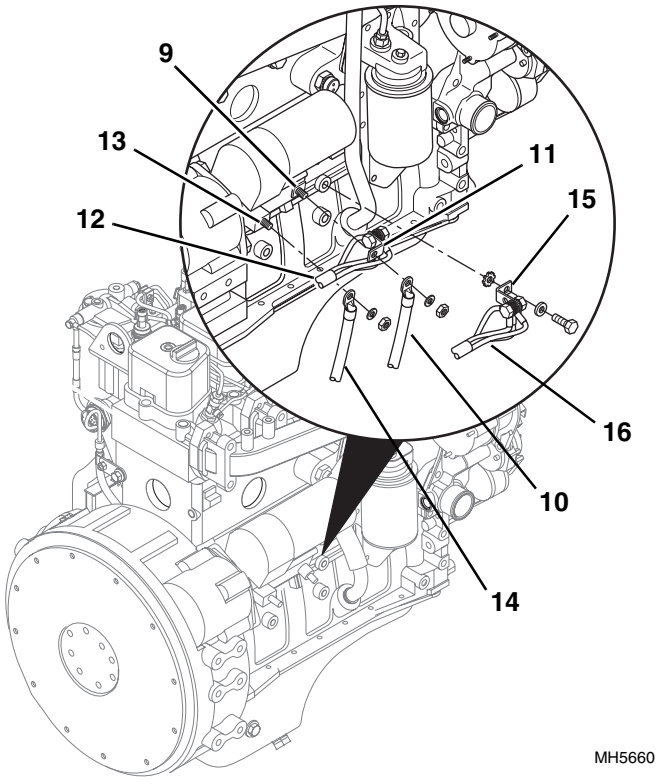
19. Connect the back-up alarm harness connector (**7**) from the back-up alarm (**8**).



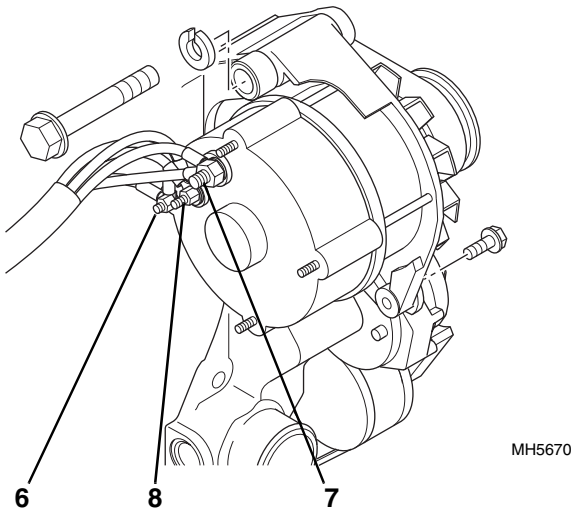
20. Insert the fork terminal of the blue wire (**8**) into the protective cover (**9**) on the starter solenoid terminal. Use a small phillips screwdriver to tighten the screw (**10**) securely.
21. Snap the tethered cap back in place over the screw in the protective cover.



22. On the engine block, connect the engine ground buss bar (**15**) with the wires (**16**) still attached to the bar.
23. At the negative starter stud (**13**), connect the negative (-) battery cable (**14**).

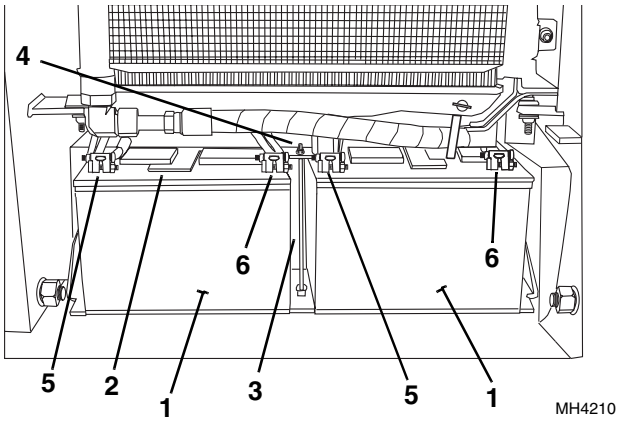


24. At the positive starter stud (**9**), connect the positive (+) battery cable (**10**) and starter positive buss bar (**11**) with the wires (**12**) still attached to the bar.
25. Label and disconnect the alternator wires:
    - AG1 and AG2 from G terminal (**6**)
    - AB1 and AB2 from B terminal (**7**)
    - 38 and 6 from D terminal (**8**)



26. Install the exhaust system to the engine. Refer to Section 7B.9.2, “Exhaust System Installation.”
27. Install the air cleaner assembly on the engine. Refer to Section 7B.10.2, “Air Cleaner Assembly Installation.”
28. Install the radiator and oil cooler. Refer to Section 7B.6.4, “Radiator/Hydraulic and Transmission Cooler Replacement.”
29. Install the rear engine access door with the help of at least one assistant. Refer to Section 4.7.1, “Access Panel and Cover Replacement.”

30. Install the batteries (**1**), hold-down bracket (**2**), threaded hold-down rods (**3**) and hold-down nuts (**4**).
31. Connect the positive (+) battery cables (**5**) and negative (-) battery cables (**6**) to the batteries (**1**).



32. Check that all hydraulic system, electrical system, cooling system, fuel system, and exhaust system connections are correct and connected tightly.
33. Have an assistant stand by with a Class B fire extinguisher. Start and idle the engine.
34. Run engine to normal operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill or drain as necessary.
35. Shut off the engine
36. Allow the engine to cool. Check the radiator coolant level and top off with a 50/50 mixture of ethylene glycol and water.Allow
37. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.

IMPORTANT: *During the full throttle check:*

- ***DO NOT*** *operate any hydraulic function.*
- ***DO NOT*** *steer or apply any pressure to the steering wheel.*
- *Keep the transmission in NEUTRAL (N).*

38. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle. If the rpm is not 2550-2650 rpm, readjust the throttle limit-stop screw at the throttle pedal within the cab. Refer to Section 4.3.5, c. “Throttle Adjustment.”
39. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
40. Check for proper operation of all components.
41. Turn the engine OFF.

7B.12 ENGINE COUPLER

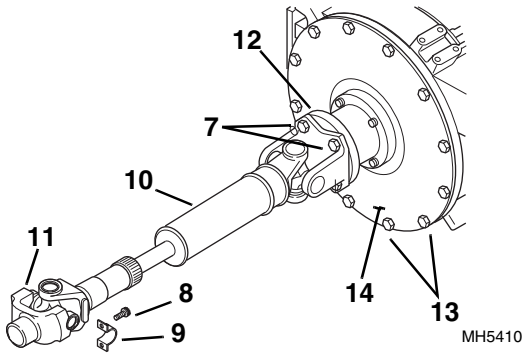
7B.12.1 Coupler and Drive Shaft Removal

1. Level the vehicle, ground the attachment, place the travel select lever in NEUTRAL (N), and engage the neutral lock lever, engage the parking brake switch and shut off the engine.
2. Remove the ignition key. Secure accident prevention tags to the steering wheel and ignition key switch. Refer to Section 1.5, “Accident Prevention Tags.”
3. Disconnect the negative (-) battery cables (**6**) from the batteries.

Note: *Rotating the fan belt by hand, gives greater access to removing the drive shaft mounting capscrews (**7**).*

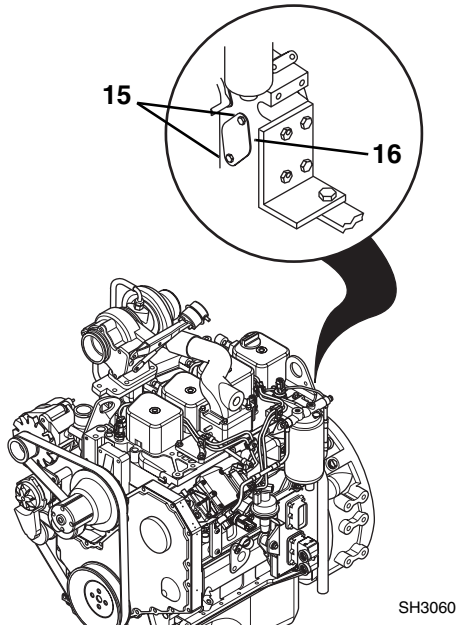
1. Remove the capscrews (**8**) and straps (**9**) that secure the drive shaft (**10**) to the transmission yoke (**11**). Discard both straps and capscrews.
2. Remove the capscrews and lockwashers (**7**) securing the drive shaft (**10**) to the coupling flange (**12**).

Note: *It may be necessary to loosen/remove the motor mounts (**20**) on either side of the engine to gain access to the bottom capscrews (**13**) on the outer half of the coupler (**14**). Place a jack under the bell housing (use a wood block to support engine) and carefully lift the engine until the bottom edge of the bell housing is at the top edge of the frame member that mounts the rear axle to the frame. Watch the fan-to-radiator clearance as you are lifting the engine. If necessary, turn the fan slightly, by hand, to gain additional clearance.*

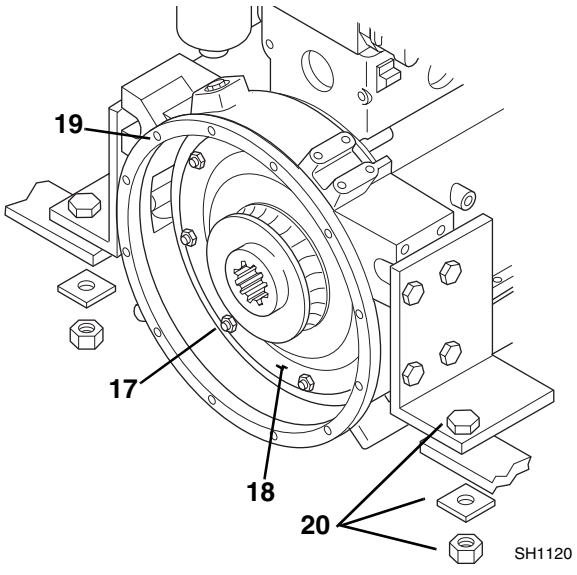


3. Remove the capscrews and lockwashers (**13**) securing the outer half of the coupler (**14**).

4. Remove the capscrews (**15**) securing the small access cover (**16**).



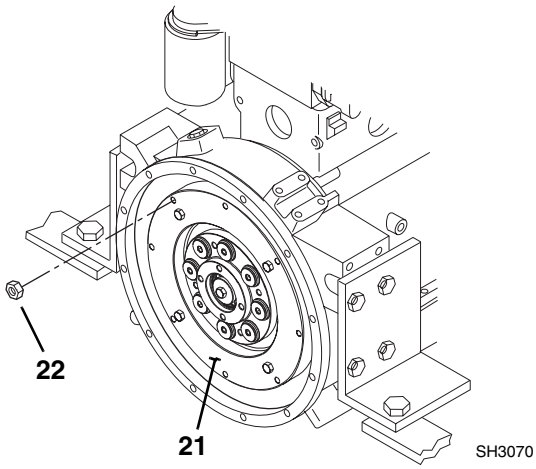
5. Remove the capscrews and locknuts (**17**) securing the coupler (**18**) to the flywheel. Turn the engine by hand, using the fan belt, until the capscrews line up with the access hole (**16**).



6. At this time, use a suitable cleaner/solvent and thoroughly clean the mounting lip of the flywheel. Wipe any debris from the inside of the bell housing. Use the cleaner to clean the threaded holes (**19**) around the flange of the bell housing.

7B.12.2 Coupler and Drive Shaft Installation

1. Use cleaner to clean the backside of the coupler, where it comes in contact with the flywheel.

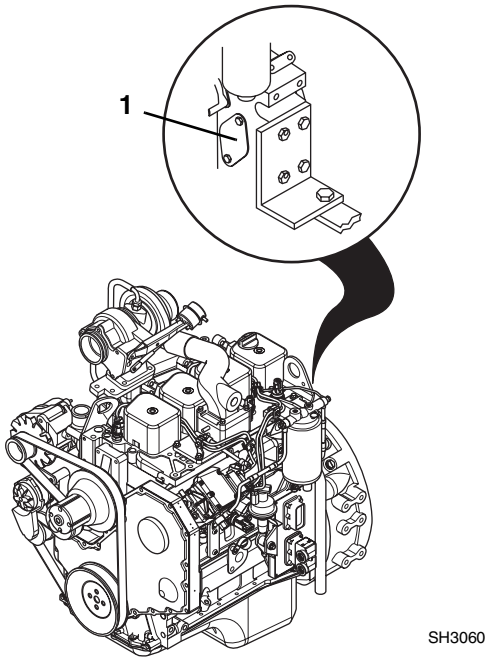


Note: *The new coupler weighs approximately 56 lbs (25,4 kg) and requires two people, one on each side, to install.*

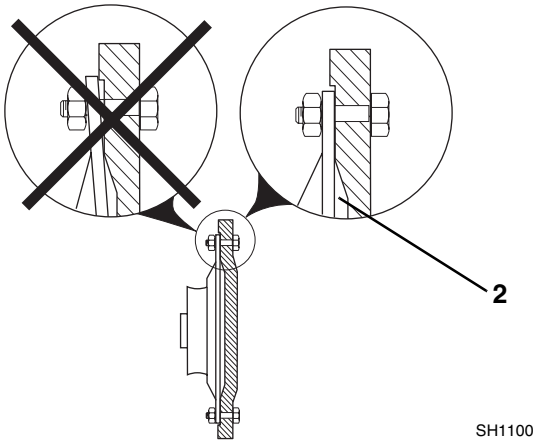
Note: ***ALWAYS*** *replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

2. Place the new coupler (**21**) into the indentation of the flywheel and use new Grade 8 capscrews and locknuts (**22**) to secure the coupler to the flywheel.

3. Insert one capscrew into the access hole (**1**) on the rear right side of the bell housing and through the flywheel and coupler. Assemble a new elastic locknut onto the capscrew. DO NOT fully tighten at this time.



4. Turn the flywheel 180° and insert another capscrew and assemble with another new elastic locknut. DO NOT fully tighten until all of the capscrews and locknuts are in place.
5. After all the capscrews are in place, check to be sure the coupler is resting squarely in the indentation of the flywheel (**2**). Torque all the capscrews to 37 lb-ft (48 Nm).

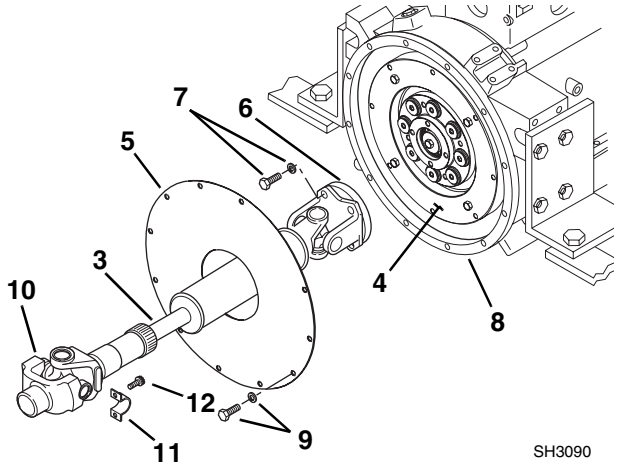


6. Install the small access cover plate (**1**), to the right side of the engine and tighten the hardware securely.

Note: *Before assembling the drive shaft (**3**) to the coupling (**4**); be sure the access cover plate (**6**) is placed on the engine-side of the frame member that mounts the rear axle to the frame.*

Note: *Apply Loctite® 242 threadlock (Red) compound to all of the capscrews used during assembly.*

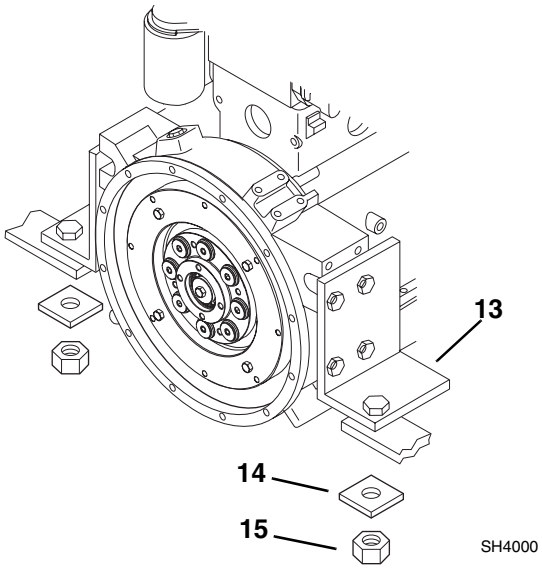
7. Install the access cover plate (**6**) over the drive shaft (**3**) and assemble the drive shaft flange (**7**) to the coupler (**4**) using new Grade 8 capscrews and lockwashers (**8**). Torque to 48 lb-ft (65 Nm).



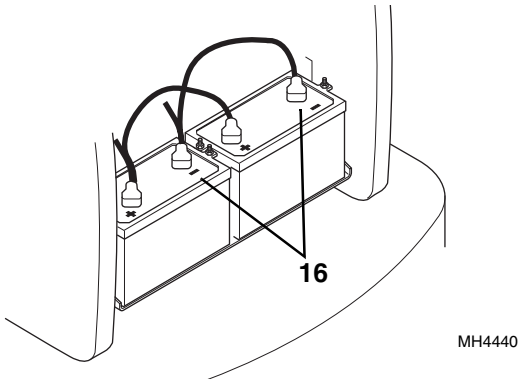
8. Install the access cover plate (**6**) to the engine bell housing (**9**) with capscrews and lockwashers (**10**) Torque to 37 lb-ft (48 Nm).

Note: ALWAYS *replace elastic locknuts with new elastic locknuts to help ensure proper fastening.*

9. If engine mounts (**13**) were previously removed or loosened, carefully lower the engine down onto the front engine mounts. Reassemble the rebound washer (**14**) and secure in place with a new elastic locknut (**15**). Torque to 60 lb-ft (81 Nm). Repeat this procedure for the engine mount on the other side.



10. Thoroughly clean the transmission yoke (**12**) and secure in place with new straps (**12**) and capscrews (**13**) from the kit. Torque to 55-60 lb-ft (75-81 Nm).
11. After the drive shaft is in place, grease both u-joints and the slip joint using multi-purpose grease (MPG).
12. Connect the negative (-) battery cables (**16**) to the batteries.



7B.13 ENGINE STORAGE

If the engine is properly protected and stored according to the following recommendations, no corrosion damage will normally occur. Cummins Engine Company, Inc. and **JLG** are not responsible for any damage that occurs in relation to a service storage period.

Use the following procedures immediately upon removing engine from service if it is being stored for an extended period of time.

1. Clean the outside of the engine.
2. When using a preservative fuel, drain the fuel system and fill with the preservative fuel. When not using preservative fuel, keep the fuel system charged with regular fuel, which, along with the fuel filter, will have to be drained and discarded at the end of the storage period.
3. Run the engine to operating temperature. Correct any fuel, fluid, oil or air leaks. Stop the engine, and drain the oil.
4. Replace the oil filter.
5. Fill the crankcase (sump) to the FULL mark on the dipstick with new, clean oil or with an approved preservative fluid. If a preservative fluid is used, it must be drained and replaced with regular lubricating oil before the engine is returned to service.
6. Drain the cooling system. To provide protection against corrosion, fill the cooling system with a coolant containing a corrosion inhibitor. If frost protection is needed, use the appropriate mixture of anti-freeze and water. If frost protection is not required, use an appropriate mixture of water with an approved corrosion mixture.

7. Run the engine for a short period to distribute lubricating oil and coolant throughout the engine.
8. Clean out the engine breather pipe (where fitted) and seal the end of the pipe.
9. Remove the fuel injectors and spray clean engine lubricating oil into cylinder bores. Divide four ounces (118,3 ml) of lubricating oil evenly between the four cylinders.
10. Remove the air filter and any pipe installed between the air filter and the induction manifold. Seal the manifold with waterproof tape.
11. Remove the exhaust pipe. Seal the manifold with waterproof tape.
12. Disconnect the battery and store it safely, in a fully charged condition. Before the battery is put into storage, give the battery terminals a protection against corrosion with a light coating of dielectric grease or petroleum jelly.
13. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
14. Remove and store the fan drive belt.

Note: *Before starting the engine after storage, operate the starter motor with one of the fuel shut-off solenoid wires disconnected for 15 seconds or until the dash panel low oil pressure warning indicator goes out. This will allow oil to be circulated throughout the engine to prevent damage to internal components.*

7B.14 TROUBLESHOOTING

Trouble	Possible Causes (see key)
Low Cranking Power	1, 2, 3, 4
Will Not Start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 61, 63
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 63
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 63
Blue/White Exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Erratic Running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High Oil Pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive Crankcase Pressure	25, 31, 33, 34, 45, 55, 60
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and Stops	10, 11, 12

IMPORTANT: *These instructions cover only routine troubleshooting guidelines for the engine. Refer to the Cummins Engine Distributor and applicable Cummins Engine Service Manual for assistance in comprehensive engine diagnosis, repair and component replacement.*

Key to Possible Causes

1. Battery charge low
2. Bad electrical connection
3. Faulty starter motor
4. Incorrect grade of lubricating oil
5. Low cranking speed
6. Fuel tank empty
7. Faulty stop control operation
8. Fuel inlet restricted
9. Faulty fuel lift pump
10. Clogged fuel filter
11. Restricted air cleaner
12. Air in fuel system
13. Faulty fuel injection pump
14. Faulty fuel injectors or incorrect type
15. Incorrect use of cold start equipment
16. Faulty cold start equipment
17. Broken fuel injection pump drive
18. Incorrect fuel pump timing
19. Incorrect valve timing
20. Poor compression
21. Blocked fuel tank vent
22. Incorrect grade of fuel
23. Sticking throttle or restricted movement
24. Exhaust pipe restriction
25. Leaking cylinder head gasket
26. Overheating
27. Cold running
28. Incorrect tappet adjustment
29. Sticking valves
30. Incorrect high pressure pipes
31. Worn cylinder bores
32. Pitted valves and seats
33. Broken, worn or sticking piston ring(s)
34. Worn valve stems and guides
35. Restricted air cleaner
36. Worn or damaged bearings
37. Insufficient oil in sump
38. Inaccurate gauge
39. Oil pump worn
40. Pressure relief valve sticking open
41. Pressure relief valve sticking closed
42. Broken relief valve spring
43. Faulty suction pipe
44. Restricted oil filter
45. Piston seizure/pick up
46. Incorrect piston height
47. Damaged fan
48. Faulty engine mounting
49. Incorrectly aligned flywheel housing or incorrectly aligned flywheel
50. Faulty thermostat
51. Restriction in water jacket
52. Loose fan belt
53. Restricted radiator
54. Faulty water pump
55. Restricted breather pipe
56. Damaged valve stem oil deflectors (if fitted)
57. Coolant level too low
58. Blocked sump strainer
59. Broken valve spring
60. Exhauster or vacuum pipe leak
61. Turbo impeller damaged or dirty
62. Turbo lubricating oil seal leak
63. Induction system leaks

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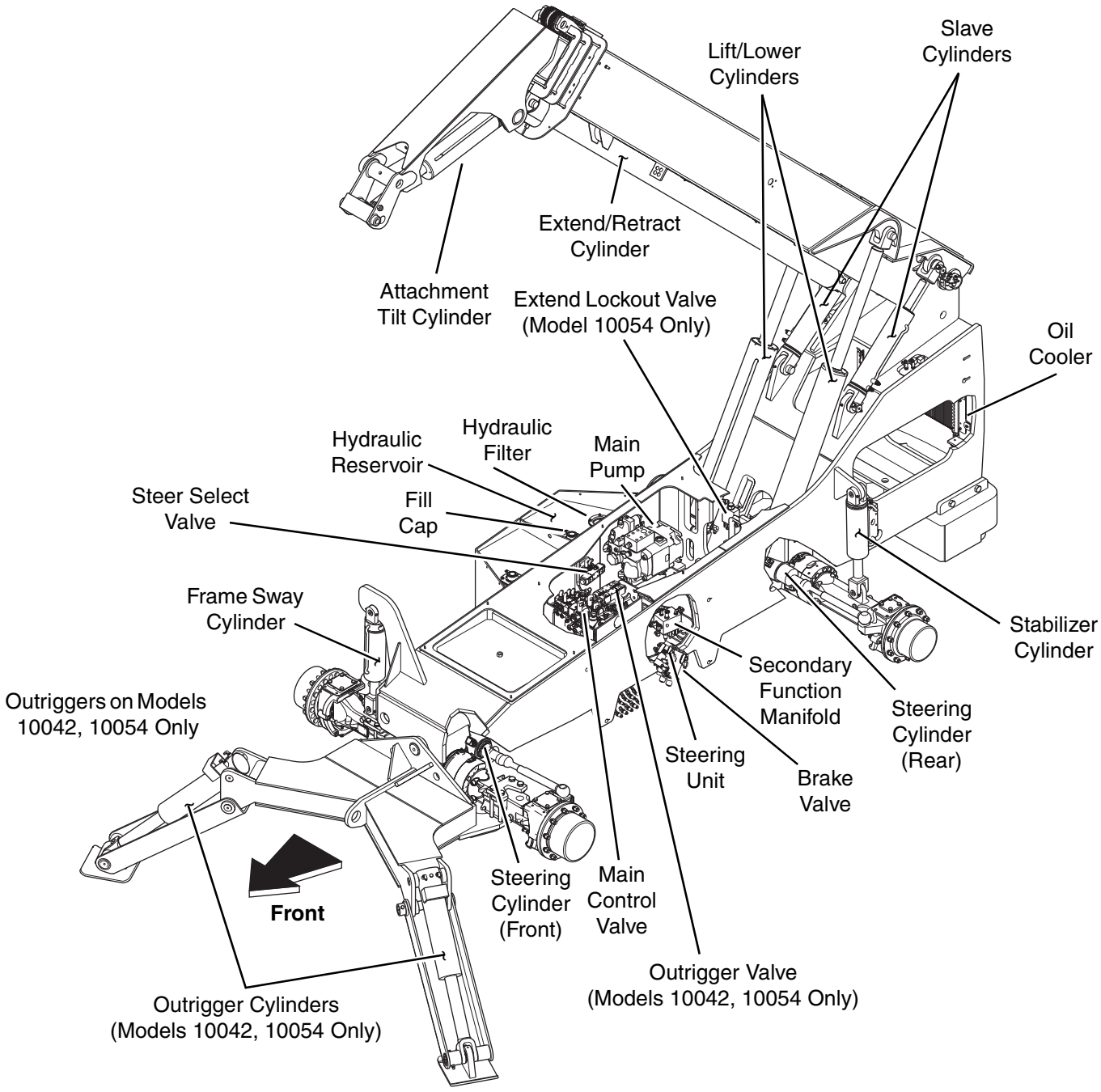
Section 8
Hydraulic System

Contents

8.1 HYDRAULIC COMPONENT TERMINOLOGY

To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the vehicle. The following illustration identifies the components that are referred to throughout this section.



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8.2 SAFETY INFORMATION

WARNING: **DO NOT** service the vehicle without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual. Failure to follow the safety practices may result in death or serious injury.

WARNING: Wait for hydraulic fluid to cool before servicing any hydraulic component. Hot hydraulic fluid can cause severe burns.

Petroleum-based hydraulic fluids are used in this vehicle. The temperature of hydraulic fluid increases during the operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present. Hydraulic fluid has a flash point that ranges from 300-600° F (150-318° C) and an auto-ignition temperature of 500-750° F (262-402° C).

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

WARNING: Relieve hydraulic pressure before servicing any hydraulic component. Escaping hydraulic fluid under pressure can penetrate the skin causing death or serious injury.

Operate the hydraulic controls after the engine has stopped to relieve trapped pressure.

Note: *Residual pressure may remain in hydraulic cylinders, hoses, valve bodies, components, etc. If the hydraulic lines going to or coming from a component are taut, slowly and cautiously relieve (“bleed off”) pressure.*

Whenever you disconnect a hydraulic line, coupler, fitting or other component, slowly and cautiously loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

WARNING: Before starting the engine, verify that all hydraulic connections are properly tightened. Escaping hydraulic fluid under pressure can penetrate the skin causing death or serious injury.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also. Refer to Section 9.7, “Electrical System Troubleshooting,” in this manual.

8.3 SPECIFICATIONS

Refer to Section 2.5, “Specifications,” for hydraulic system specifications.

8.4 HYDRAULIC FLUID

General information and specifications pertaining to hydraulic fluid are found in Section 2.5.8, “Fluid and Lubricant Capacities.”

Use only clean, filtered fluid in the hydraulic system.

After servicing or replacing a hydraulic system component, cycle all vehicle functions several times to remove (purge or “bleed”) air from the hydraulic system. **DO NOT** build maximum pressure at the end of stroke by continuing to hold the joystick function.

Inspect the hydraulic system and fluid frequently, and look for problems or conditions including the following:

Aeration

Aeration is the presence of air bubbles in hydraulic fluid. Sudden, violent inward collapse of the air (known as implosion) can occur when compressed air bubbles are subjected to system pressure. Aeration can thus lead to damage and overheating of components.

Pump aeration will produce a loud crackling sound, as though rocks or marbles were being forced through the pump. Excessive aeration will give the hydraulic fluid a cloudy or milky appearance, and cause erratic operation of hydraulic system components.

Aeration is caused by air being introduced into the system, possibly through a leaky seal or joint in the pump or elsewhere in the system. Check for leaky hydraulic cylinders and threaded fittings by introducing a special dye, visible under fluorescent light, which may be helpful in determining the source of the leak.

Cavitation

Cavitation occurs when hydraulic fluid fails to entirely fill an existing space. Cavitation, like aeration, can produce a loud crackling sound, as though rocks or marbles were being forced through the system. Cavitation can be due to a low hydraulic oil level in the reservoir, a restricted intake line or improperly high fluid viscosity.

Contamination

Contamination, or dirt, can be any material other than hydraulic fluid that causes harm or decreases the performance of the system. Contaminants include solids, liquids and gases. Most contaminants are abrasive in nature, causing rapid wear or damage to the system.

Excessive heat

Excessive heat is a relative thermal condition that affects fluid viscosity. Extreme operating conditions, such as excessive operation, outside air temperature and other factors including aeration, cavitation, contamination and over-pressurization can cause fluid and component temperatures to go beyond their specified limits. Excessive heat causes oxidation in hydraulic fluid to occur more rapidly, breaking down its viscosity. A chain reaction then results and can lead to component damage or failure. The true cause of an excessive heat condition must be diagnosed and cured, or the problem will recur.

Implosion

An implosion is a sudden, violent inward collapse, and can often cause a vacuum effect. Imploding air bubbles within a hydraulic system can cause component damage.

Over-pressurization

Over-pressurization is pressure greater than that for which a component was engineered to withstand or operate under. Over-pressurization can cause equipment damage. **DO NOT** attempt to adjust or tamper with pressure cartridges, settings, etc. unless otherwise specified.

Viscosity

Viscosity is the property of a fluid or semi-fluid that enables it to develop and maintain shearing stress dependent upon flow rate (velocity), and to offer continued resistance to flow. In other words, viscosity is a measurement of fluid resistance to flow (internal friction).

8.5 HOSES, TUBE LINES, FITTINGS, ETC.

There are numerous hydraulic hoses, tubes, fittings, etc. used on this vehicle. Periodically inspect all of these and carefully examine any signs of wear, abrasion and/or deterioration. Determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

8.5.1 Replacement Considerations

Conditions including, but not limited to, the following are sufficient for considering component replacement:

1. Any evidence of hydraulic fluid leakage at the surface of a flexible hose or its junction with the metal and couplings.
2. Any blistering or abnormal deformation to the outer covering of a hydraulic hose.
3. Hydraulic oil leakage at any threaded or clamped joint that cannot be eliminated by normal tightening or other recommended procedures.
4. Evidence of excessive abrasion or scrubbing on the outer surface of a hose, rigid tube, or hydraulic fitting. Modification must be made to eliminate the interference of the elements in contact with one another, or to otherwise protect the components from contact with one another. Slightly moving a hose or adjusting a plastic tie wrap may often be all that is necessary to eliminate interference; evaluate each situation and proceed as required by the individual circumstances.

8.5.2 Hose, Tube, Line and Fitting Replacement

Before removing a hydraulic hose or component, always mark or otherwise label the related parts and the exact location of the hose or component to aid in proper reinstallation. Hydraulic fluid is a good cleaner and can remove most liquid-ink type markings, so make sure the mark or label will remain intact. Alternative methods to using markers include color-coded tie wraps, number-tag sets, alpha-numeric stampings or markings, and suitably labeled pieces of tape. Select an appropriate marking method for the conditions and proceed accordingly.

NEVER replace a hydraulic hose or other component with a part not specifically designed for this vehicle. For example, replacing a hydraulic hose rated for use in a 3000 psi (207 bar) circuit with a common garden hose can result in an exploded garden hose, hydraulic fluid spray and other damage or personal injury. Use only factory approved parts for best performance and safety.

Removal and replacement of hoses, tube lines, fittings, etc. usually involves straightforward procedures. When removing a hydraulic hose or other component, be aware that o-rings are used throughout the hydraulic system. ALWAYS replace a used o-ring with a new part.

Check all routing of hoses, wiring and tubing for sharp bends or interference with any rotating members. Install appropriate protective devices such as tie wraps and conduit to help shield hoses from damage. All tube and hose clamps must be tight.

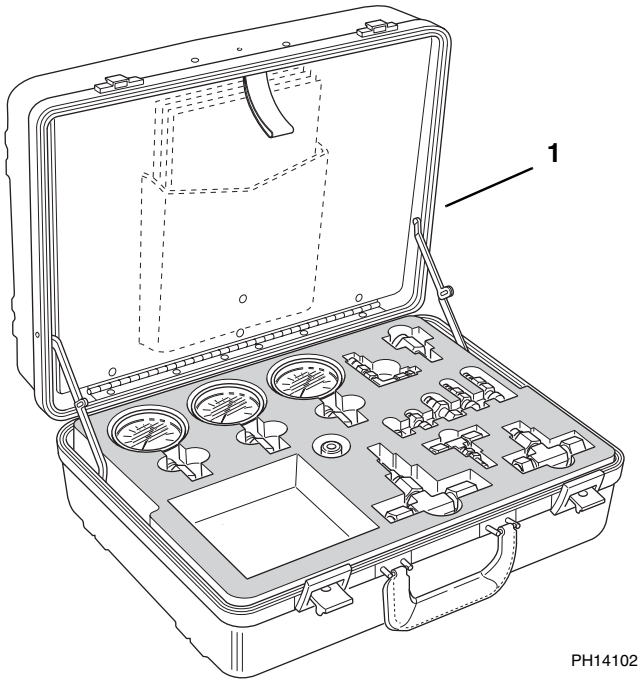
8.6 HYDRAULIC PRESSURE DIAGNOSIS

JLG Parts Department has two kits available to use for hydraulic system maintenance and troubleshooting: the Sky Trak Pressure Test Kit and the Sky Trak Flowmeter Kit. The kits are contained in a durable polyethylene carrying case for demanding field service conditions.

Pressure Test Kit

The hydraulic pressure test kit (**1**) is used to pressure test the various hydraulic components in the hydraulic system. The kit includes:

- Gauges for testing high and low pressure circuits
- Fittings, couplers and hoses
- Laminates of test diagrams and test procedures
- 13" x 18" x 7" durable carrying case



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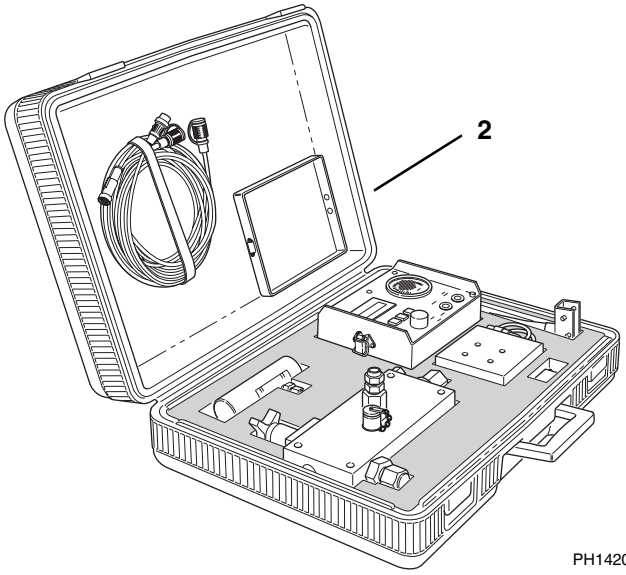
Flowmeter Kit

The flowmeter test kit (**2**) is used to pinpoint hydraulic system faults. It includes a flowmeter with load valve, magnetic base, photo tachometer head and flex arm. The kit features:

- Bi-directional for unrestricted connection and simplified testing
- Internal by-pass to protect system and tester from over-pressure
- Measures up to 60 GPM and 6000 psi
- 16" x 22" x 7" durable carrying case



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Contact JLG Parts Department at 717-485-6472 for ordering information.

Part Number	Description	Approximate Weight	Price and Availability
7133413	Hydraulic Pressure Test Kit	16 lbs.	Consult Factory
1321107	Hydraulic Flowmeter Kit	28 lbs.	Consult Factory

8.6.1 Pressure Checks and Adjustments

When diagnosing trouble in the hydraulic system, use the hydraulic testing information in Section 8.7, “Hydraulic System Testing.”

In general, follow the steps below whenever conducting pressure checks and performing adjustments:

1. Park the vehicle on a firm, level surface. Engage the park brake, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, level the boom and turn the engine OFF.
2. Pressure tee fittings are conveniently located in each hydraulic circuit. Install a pressure gauge capable of measuring at least 10% more pressure than that which the circuit being checked operates under.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

3. Start the engine. Operate vehicle functions several times to allow hydraulic oil to reach operating temperature. The hydraulic oil temperature should be between 100-120° F (38-49° C). If a temperature gauge or thermometer is unavailable, the hydraulic oil reservoir should be warm to the touch.
4. Refer to Section 8.7, “Hydraulic System Testing,” for testing procedures.
5. Fully depress the accelerator pedal as required. Place and hold the joystick in the position needed to operate the particular vehicle function being checked. Continue holding the joystick in position until pressure readings are taken.
6. Check the pressure gauge reading. It should read as specified in the Pressure Readings column of the charts found in Section 8.7, “Hydraulic System Testing.” If the reading is not as specified, turn the engine OFF and check other components in the system. Verify that all related hydraulic components and electrical switches, sensors, solenoids, etc. are operating correctly.
7. As a last resort, adjust the appropriate relief valve, if applicable. Turning the adjustment screw clockwise will increase the pressure; turning the screw counterclockwise will decrease the pressure.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

8. Start the engine and check the pressure again. Turn the engine OFF, operate the auxiliary hydraulic control lever (on units equipped with the optional auxiliary hydraulic system), then disconnect or remove the pressure gauge from the vehicle.

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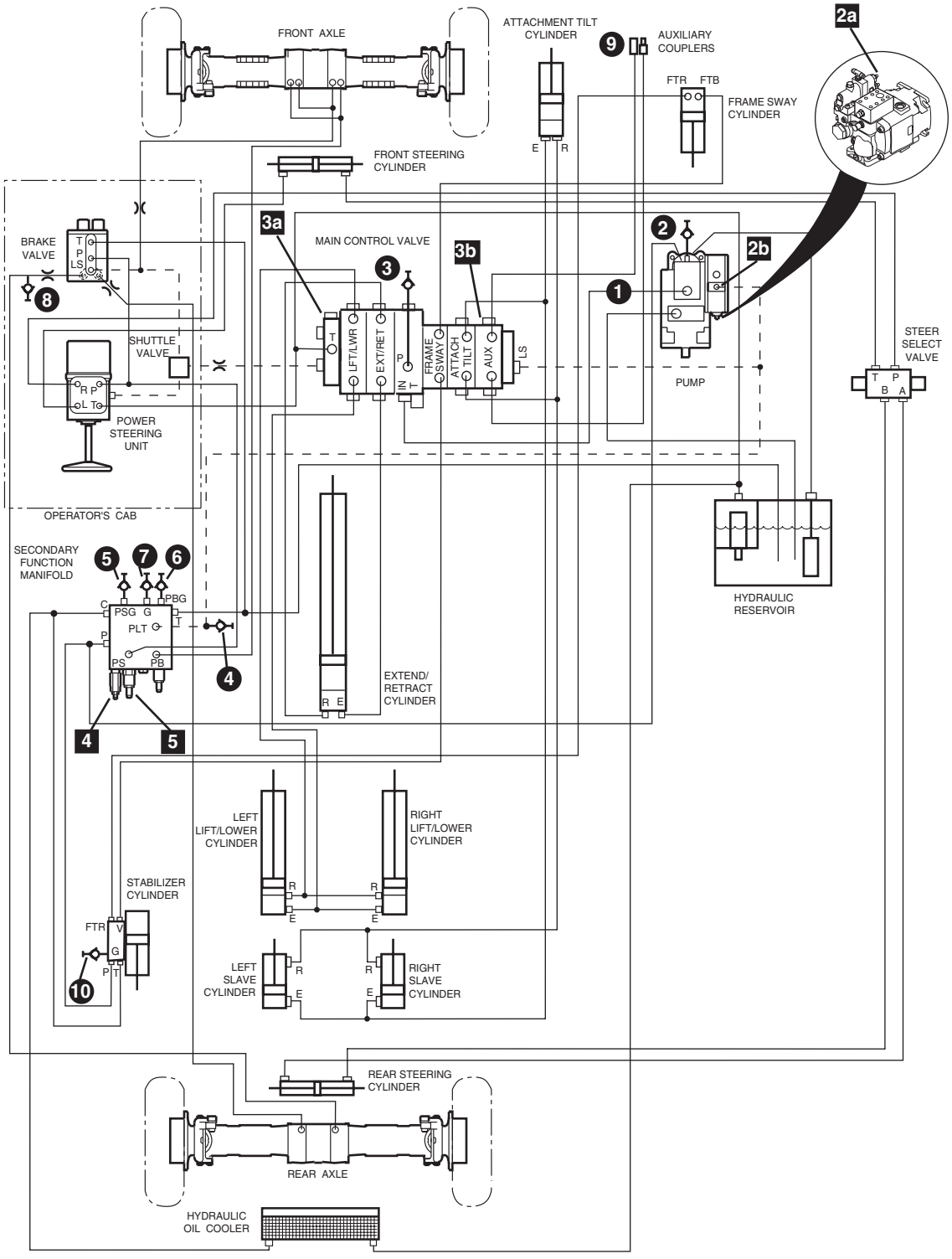
8.7 HYDRAULIC SYSTEM TESTING

8.7.1 8042 Hydraulic Testing



Engine Information

Idle . . . . . 1,050 ±50 rpm
Full Speed. . . . . 2,750 ±100 rpm

Hydraulic Oil Information

Oil Type - 10W, meet ISO Grade 46
Capacity - Reservoir . . . . . 32.2 gal. (127 liter)
Capacity - System. . . . . 57.5 gal. (218 liter)
Note: To adjust relief settings, pressure reducing settings or standby pressure, turn the adjustment screw clockwise to increase pressure or counterclockwise to decrease pressure.
The hydraulic oil temperature for the pump flow test should be between 100-120° F (38-49° C) (tank hot to the touch) during testing.

Equipment Needed to Perform Tests from Hydraulic Diagnostic Test Kit

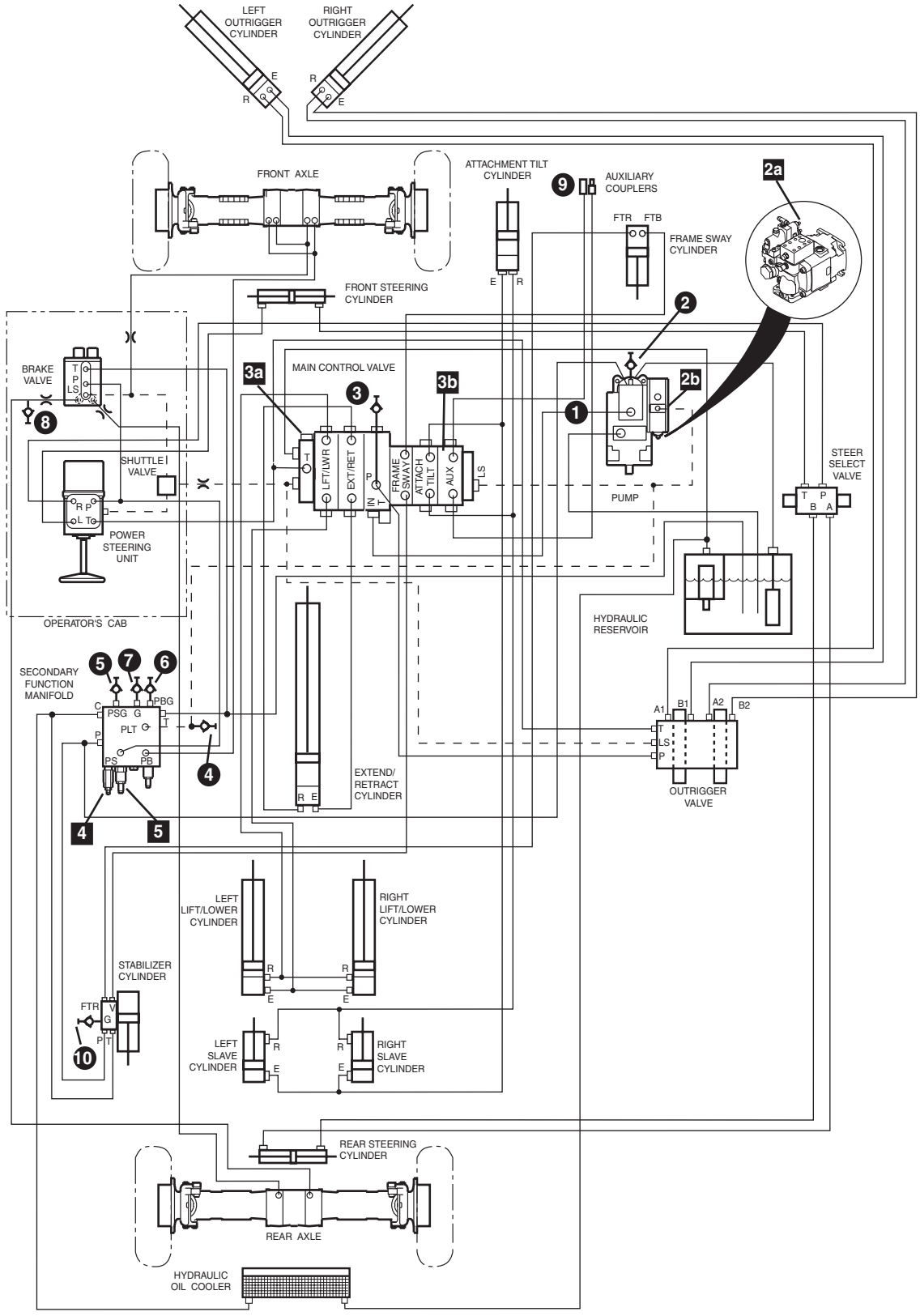
Test Location	Gauge	Fittings
2 3 4 5	4,000 psi gauge (280 bar gauge)	Unit equipped with fittings from factory.
6 7 8 10	1,000 psi gauge (70 bar gauge)	Unit equipped with fittings from factory.
9	4,000 psi gauge (280 bar gauge)	Requires a male or female quick disconnect coupler

CAUTION: GAUGE DAMAGE may occur. Malfunctioning hydraulic system circuits may have excessive pressure and can cause hydraulic pressure spikes. Test circuit with the highest reading pressure gauge first. If this gauge cannot record an accurate pressure reading, use the next lower pressure gauge.

TEST LOCATION	Hydraulic Pump Flow Test
1	**To check flow readings, a flow meter capable of measuring 60 gpm (3,8 liter/sec) and a load valve capable of 6,000 psi (413,4 bar) will be required (not included with Hydraulic Diagnostic Test Kit).** 2,000 psi (137,8 bar) load @ Engine Speed of 2,500 ±25 rpm — Flow rate should be 48.9 GPM (3 liter/sec).

TEST LOCATION	ADJUST. LOCATION	COMPONENT DESCRIPTION	PRESSURE READINGS	PRESSURE TEST PROCEDURES
2	2a	Pump Standby Pressure	550-600 psi (38-41 bar)	Loosen load sense line at location 2b to bleed off pressure, and then retighten line. With engine at idle and no hydraulic functions operated, check pump standby pressure. If pressure is incorrect, adjust top screw on compensator.
2	N/A	Pump Pressure Compensator	3,300 psi (228 bar)	With engine at idle, turn steering wheel all the way in one direction. Hold over relief and check maximum pump pressure. If pressure is incorrect, consult factory.
3	3a	Main Control Valve	System Relief 3,000 ±100 psi (207 ±7 bar)	With engine at FULL throttle, use the boom control lever to fully retract the boom. Hold over relief and check pressure. If pressure is incorrect, adjust or replace cartridge.
3	N/A	Attachment Tilt Relief/ FORWARD or REARWARD	3,000 ±100 psi (207 ±7 bar)	CONSULT FACTORY
4	N/A	Secondary Function Manifold	Load Sense 0-3000 psi (0-207 bar)	With engine at idle, load sense is 0 psi. With engine at idle, use the boom control lever to fully retract the boom. Hold over relief and check pressure. Pressure should be 3000 psi (207 bar).
5	4	Secondary Function Manifold	Steering Relief 2500 ±100 psi (172 ±7 bar)	With engine at idle, turn the steering wheel all the way in one direction. Hold over relief and check pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge.
6	N/A	Secondary Function Manifold	Park Brake Release 550 ±50 psi (38 ±3,4 bar)	With engine at idle and no hydraulic functions operated, disengage the park brake, check pressure. This is not an adjustment.
7	5	Secondary Function Manifold	Park Brake Pressure 550 ±50 psi (38 ±3,4 bar)	With engine at idle and park brake released, turn the steering wheel all the way in one direction. Hold over relief and check pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge in the secondary function manifold.
8	N/A	Brake Valve (Manual Brake Pressure)	400 psi minimum (28 bar)	With engine OFF, pump brake pedal twice. **DO NOT** overstroke the brake pedal. If pressure is incorrect, check for external leaks. If no leaks are found, refer to service manual brake system information.
8	N/A	Brake Valve (Service Brake Pressure)	550 psi minimum (38 bar)	With engine at idle, depress and hold brake pedal. **DO NOT** turn steering wheel. **DO NOT** overstroke the brake pedal. Check pressure. If pressure is incorrect, consult service manual.
9	3b	Auxiliary Hydraulics	3000 psi (207 bar)	With engine at low idle, move auxiliary control lever left or right. Hold auxiliary control lever over relief and check pressure. If pressure is incorrect, check main relief per 3.
10	N/A	Stabilizer Cylinder	75-150 psi (5,2-10,3 bar)	With the engine at idle, check the pressure on the cylinder.

8.7.2 10042 Hydraulic Testing



Engine Information

Idle . . . . . 1,050 ±50 rpm
Full Speed. . . . . 2,750 ±100 rpm

Hydraulic Oil Information

Oil Type - 10W, meet ISO Grade 46
Capacity - Reservoir . . . . . 32.2 gal. (127 liter)
Capacity - System. . . . . 64 gal. (242 liter)
Note: To adjust relief settings, pressure reducing settings or standby pressure, turn the adjustment screw clockwise to increase pressure or counterclockwise to decrease pressure.
The hydraulic oil temperature for the pump flow test should be between 100-120° F (38-49° C) (tank hot to the touch) during testing.

Equipment Needed to Perform Tests from Hydraulic Diagnostic Test Kit

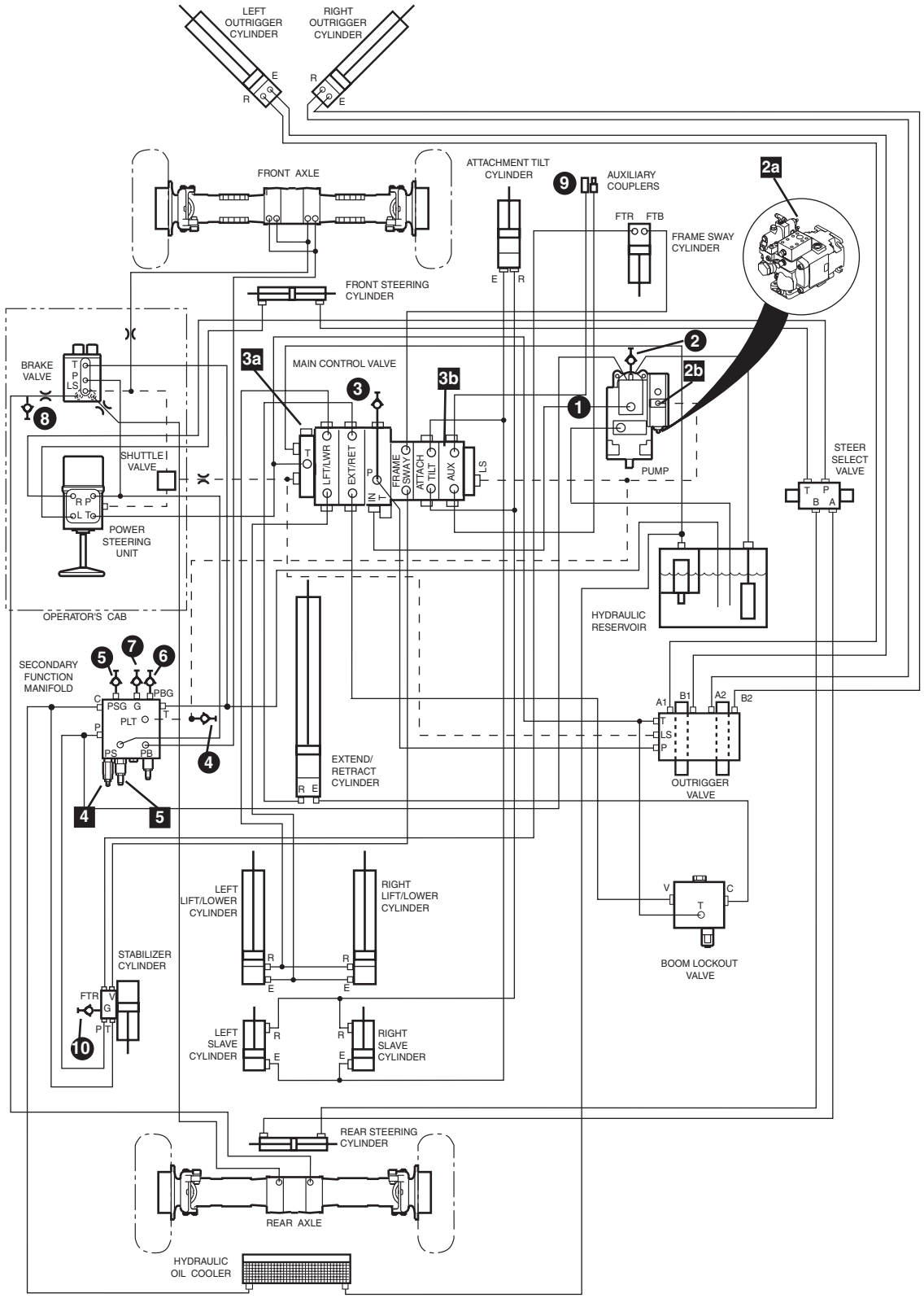
Test Location	Gauge	Fittings
2 3 4 5	4,000 psi gauge (280 bar gauge)	Unit equipped with fittings from factory.
6 7 8 10	1,000 psi gauge (70 bar gauge)	Unit equipped with fittings from factory.
9	4,000 psi gauge (280 bar gauge)	Requires a male or female quick disconnect coupler

CAUTION: GAUGE DAMAGE may occur. Malfunctioning hydraulic system circuits may have excessive pressure and can cause hydraulic pressure spikes. Test circuit with the highest reading pressure gauge first. If this gauge cannot record an accurate pressure reading, use the next lower pressure gauge.

TEST LOCATION	Hydraulic Pump Flow Test
1	**To check flow readings, a flow meter capable of measuring 60 gpm (3,8 liter/sec) and a load valve capable of 6,000 psi (413,4 bar) will be required (not included with Hydraulic Diagnostic Test Kit).** 2,000 psi (137,8 bar) load @ Engine Speed of 2,500 ±25 rpm — Flow rate should be 48.9 GPM (3 liter/sec).

TEST LOCATION	ADJUST. LOCATION	COMPONENT DESCRIPTION	PRESSURE READINGS	PRESSURE TEST PROCEDURES
2	2a	Pump Standby Pressure	550-600 psi (38-41 bar)	Loosen load sense line at location 2b to bleed off pressure, and then retighten line. With engine at idle and no hydraulic functions operated, check pump standby pressure. If pressure is incorrect, adjust top screw on compensator.
2	N/A	Pump Pressure Compensator	3,300 psi (228 bar)	With engine at idle, turn steering wheel all the way in one direction. Hold over relief and check maximum pump pressure. If pressure is incorrect, consult factory.
3	3a	Main Control Valve	System Relief 3,000 ±100 psi (207 ±7 bar)	With engine at FULL throttle, use the boom control lever to fully retract the boom. Hold over relief and check pressure. If pressure is incorrect, adjust or replace cartridge.
3	N/A	Attachment Tilt Relief/ FORWARD or REARWARD	3,000 ±100 psi (207 ±7 bar)	CONSULT FACTORY
4	N/A	Secondary Function Manifold	Load Sense 0-3,000 psi (0-207 bar)	With engine at idle, load sense is 0 psi. With engine at idle, use the boom control lever to fully retract the boom. Hold over relief and check pressure. Pressure should be 3000 psi (207 bar).
5	4	Secondary Function Manifold	Steering Relief 2,500 ±100 psi (172 ±7 bar)	With engine at idle, turn the steering wheel all the way in one direction and hold while checking pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge.
6	N/A	Secondary Function Manifold	Park Brake Release 550 ±50 psi (38 ±3,4 bar)	With engine at idle and no hydraulic functions operated, disengage the park brake, check pressure. This is not an adjustment.
7	5	Secondary Function Manifold	Park Brake Pressure 550 ±50 psi (38 ±3,4 bar)	With engine at idle and park brake released, turn the steering wheel all the way in one direction. Hold over relief and check pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge in the secondary function manifold.
8	N/A	Brake Valve (Manual Brake Pressure)	400 psi minimum (28 bar)	With engine OFF, pump brake pedal twice. **DO NOT** overstroke the brake pedal. If pressure is incorrect, check for external leaks. If no leaks are found, refer to service manual brake system information.
8	N/A	Brake Valve (Service Brake Pressure)	550 psi minimum (38 bar)	With engine at idle, depress and hold brake pedal. **DO NOT** turn steering wheel. **DO NOT** overstroke the brake pedal. Check pressure. If pressure is incorrect, consult service manual.
9	3b	Auxiliary Hydraulics	3,000 psi (207 bar)	With engine at low idle, move auxiliary control lever left or right. Hold auxiliary control lever over relief and check pressure. If pressure is incorrect, check main relief per 3.
10	N/A	Stabilizer Cylinder	75-150 psi (5,2-10,3 bar)	With the engine at idle, check the pressure on the cylinder.

8.7.3 10054 Hydraulic Testing



Engine Information

Idle . . . . . 1,050 ±50 rpm
Full Speed. . . . . 2,750 ±100 rpm

Hydraulic Oil Information

Oil Type - 10W, meet ISO Grade 46
Capacity - Reservoir . . . . . 32.2 gal. (127 liter)
Capacity - System. . . . . 64 gal. (242 liter)

Note: To adjust relief settings, pressure reducing settings or standby pressure, turn the adjustment screw clockwise to increase pressure or counterclockwise to decrease pressure.

The hydraulic oil temperature for the pump flow test should be between 100-120° F (38-49° C) (tank hot to the touch) during testing.

Equipment Needed to Perform Tests from Hydraulic Diagnostic Test Kit

Test Location	Gauge	Fittings
2 3 4 5	4,000 psi gauge (280 bar gauge)	Unit equipped with fittings from factory.
6 7 8 10	1,000 psi gauge (70 bar gauge)	Unit equipped with fittings from factory.
9	4,000 psi gauge (280 bar gauge)	Requires a male or female quick disconnect coupler

CAUTION: GAUGE DAMAGE may occur. Malfunctioning hydraulic system circuits may have excessive pressure and can cause hydraulic pressure spikes. Test circuit with the highest reading pressure gauge first. If this gauge cannot record an accurate pressure reading, use the next lower pressure gauge.

TEST LOCATION	Hydraulic Pump Flow Test
1	**To check flow readings, a flow meter capable of measuring 60 gpm (3,8 liter/sec) and a load valve capable of 6,000 psi (413,4 bar) will be required (not included with Hydraulic Diagnostic Test Kit).** 2,000 psi (137,8 bar) load @ Engine Speed of 2,500 ±25 rpm — Flow rate should be 48.9 GPM (3 liter/sec).

TEST LOCATION	ADJUST. LOCATION	COMPONENT DESCRIPTION	PRESSURE READINGS	PRESSURE TEST PROCEDURES
2	2a	Pump Standby Pressure	550-600 psi (38-41 bar)	Loosen load sense line at location 2b to bleed off pressure, and then retighten line. With engine at idle and no hydraulic functions operated, check pump standby pressure. If pressure is incorrect, adjust top screw on compensator.
2	N/A	Pump Pressure Compensator	3,300 psi (228 bar)	With engine at idle, turn steering wheel all the way in one direction. Hold over relief and check maximum pump pressure. If pressure is incorrect, consult factory.
3	3a	Main Control Valve	System Relief 3,000 ±100 psi (207 ±7 bar)	With engine at FULL throttle, use the boom control lever to fully retract the boom. Hold over relief and check pressure. If pressure is incorrect, adjust or replace cartridge.
3	N/A	Attachment Tilt Relief/ FORWARD or REARWARD	3,000 ±100 psi (207 ±7 bar)	CONSULT FACTORY
4	N/A	Secondary Function Manifold	Load Sense 0-3,000 psi (0-207 bar)	With engine at idle, load sense is 0 psi. With engine at idle, use the boom control lever to fully retract the boom. Hold over relief. Pressure should be 3000 psi (207 bar).
5	4	Secondary Function Manifold	Steering Relief 2,500 ±100 psi (172 ±7 bar)	With engine at idle, turn the steering wheel all the way in one direction. Hold over relief and check pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge.
6	N/A	Secondary Function Manifold	Park Brake Release 550 ±50 psi (38 ±3,4 bar)	With engine at idle and no hydraulic functions operated, disengage the park brake and check pressure. This is not an adjustment.
7	5	Secondary Function Manifold	Park Brake Pressure 550 ±50 psi (38 ±3,4 bar)	With engine at idle and park brake released, turn the steering wheel all the way in one direction. Hold over relief and check pressure. If pressure is incorrect, adjust or replace the pressure reducing cartridge in the secondary function manifold.
8	N/A	Brake Valve (Manual Brake Pressure)	400 psi minimum (28 bar)	With engine OFF, pump brake pedal twice. **DO NOT** overstroke the brake pedal. If pressure is incorrect, check for external leaks. If no leaks are found, refer to service manual brake system information.
8	N/A	Brake Valve (Service Brake Pressure)	550 psi minimum (38 bar)	With engine at idle, depress and hold brake pedal. **DO NOT** turn steering wheel. **DO NOT** overstroke the brake pedal. Check pressure. If pressure is incorrect, consult service manual.
9	3b	Auxiliary Hydraulics	3,000 psi (207 bar)	With engine at low idle, move auxiliary control lever left or right. Hold auxiliary control lever over relief and check pressure. If pressure is incorrect, check main relief per 3.
10	N/A	Stabilizer Cylinder	75-150 psi (5,2-10,3 bar)	With the engine at idle, check the pressure on the cylinder.

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8.8 HYDRAULIC CIRCUITS AND TROUBLESHOOTING

This section covers the hydraulic circuits and includes a circuit drawing, troubleshooting chart, and description of the circuit for each function.

Typically, the circuit drawings illustrate the flow of oil for the hydraulic function being shown.

The troubleshooting charts cover some common problems that can occur during the operation of the hydraulic system. Electrical and hydraulic functions are often related. Verify that the electrical components of the circuit are functioning properly whenever troubleshooting the hydraulic circuit.

Always check the following before beginning to troubleshoot a circuit that is not functioning correctly.

1. Check the hydraulic oil level in the reservoir. Oil level should be to the middle of the sight glass with all cylinders retracted.
2. Check hoses, tubes, fittings and other hydraulic components for leaks, bends, kinks, interference, etc.
3. Check for air in the hydraulic system. Erratic machine performance and/or spongy cylinder operation are signs of air in the hydraulic system.

WARNING: Wait for hydraulic fluid to cool before servicing any hydraulic component. Hot hydraulic fluid can cause severe burns.

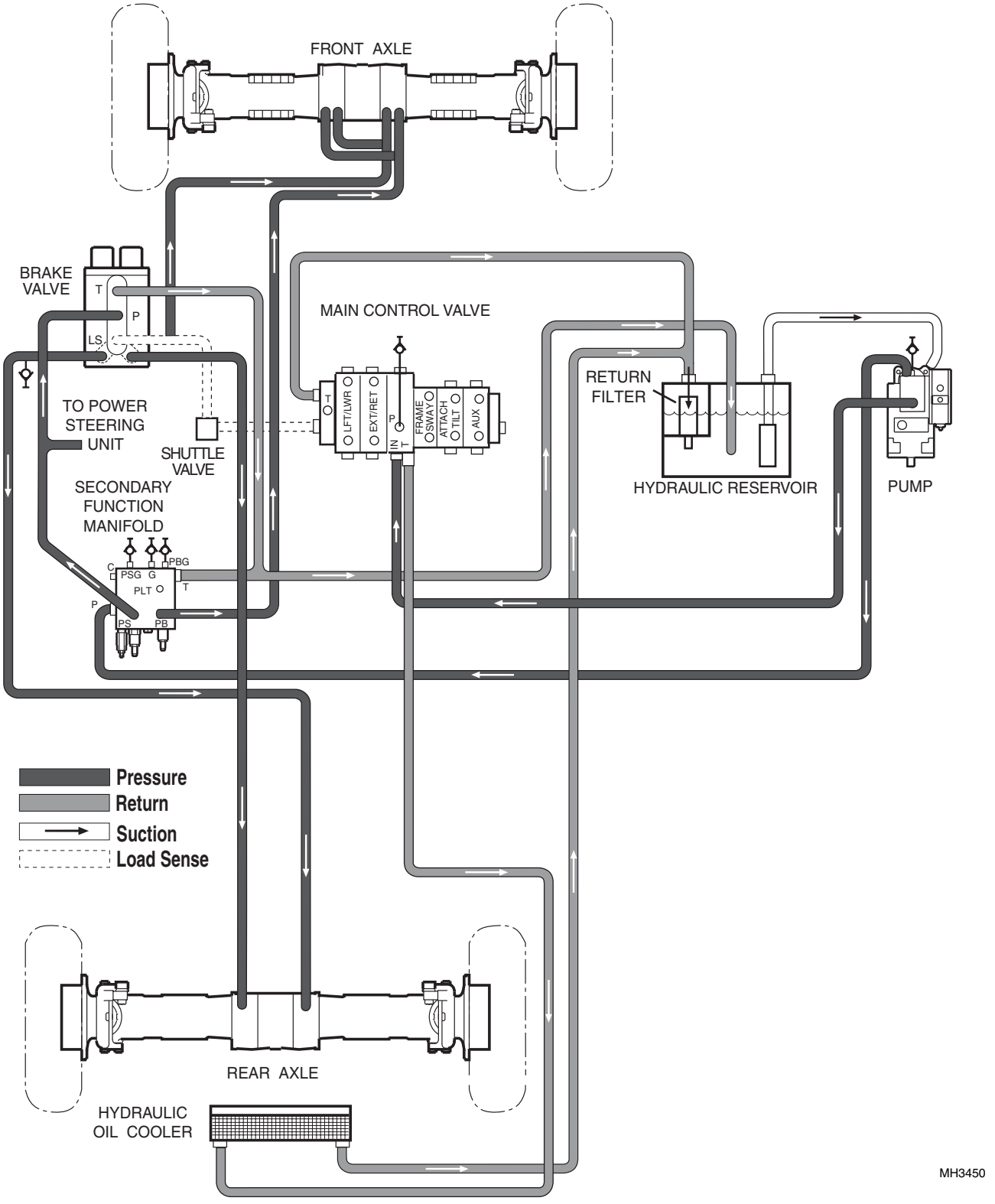
WARNING: Relieve hydraulic pressure before servicing any hydraulic component. Escaping hydraulic fluid under pressure can penetrate the skin causing death or serious injury. When checking for air in the hydraulic system, wear safety glasses and gloves to help provide protection from spraying hydraulic oil.

If air in the hydraulic system is suspected, you will hear air leakage when hydraulic fittings are loosened and see air bubbles in the hydraulic fluid.

Loose fittings, faulty o-rings or seals, trapped oil, leaks, system opened for service, etc., can cause air in the system. Determine what is causing air to enter the system and correct it. Bleed air from the system.

8.8.1 Brake Circuit and Troubleshooting

(Refer to Section 8.8.21, “Brake Circuit Description,” for a more detailed explanation of this circuit.)

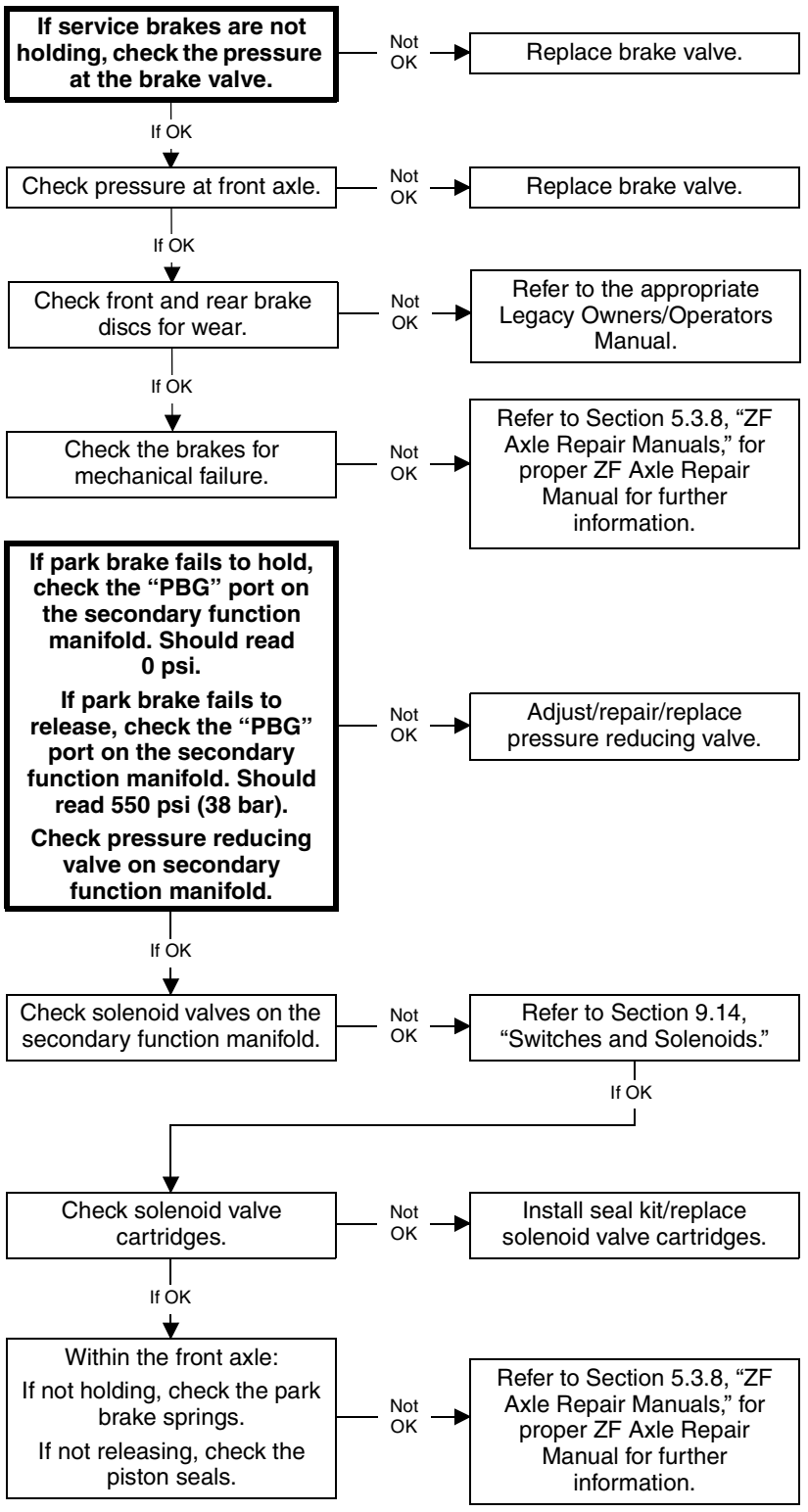


Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

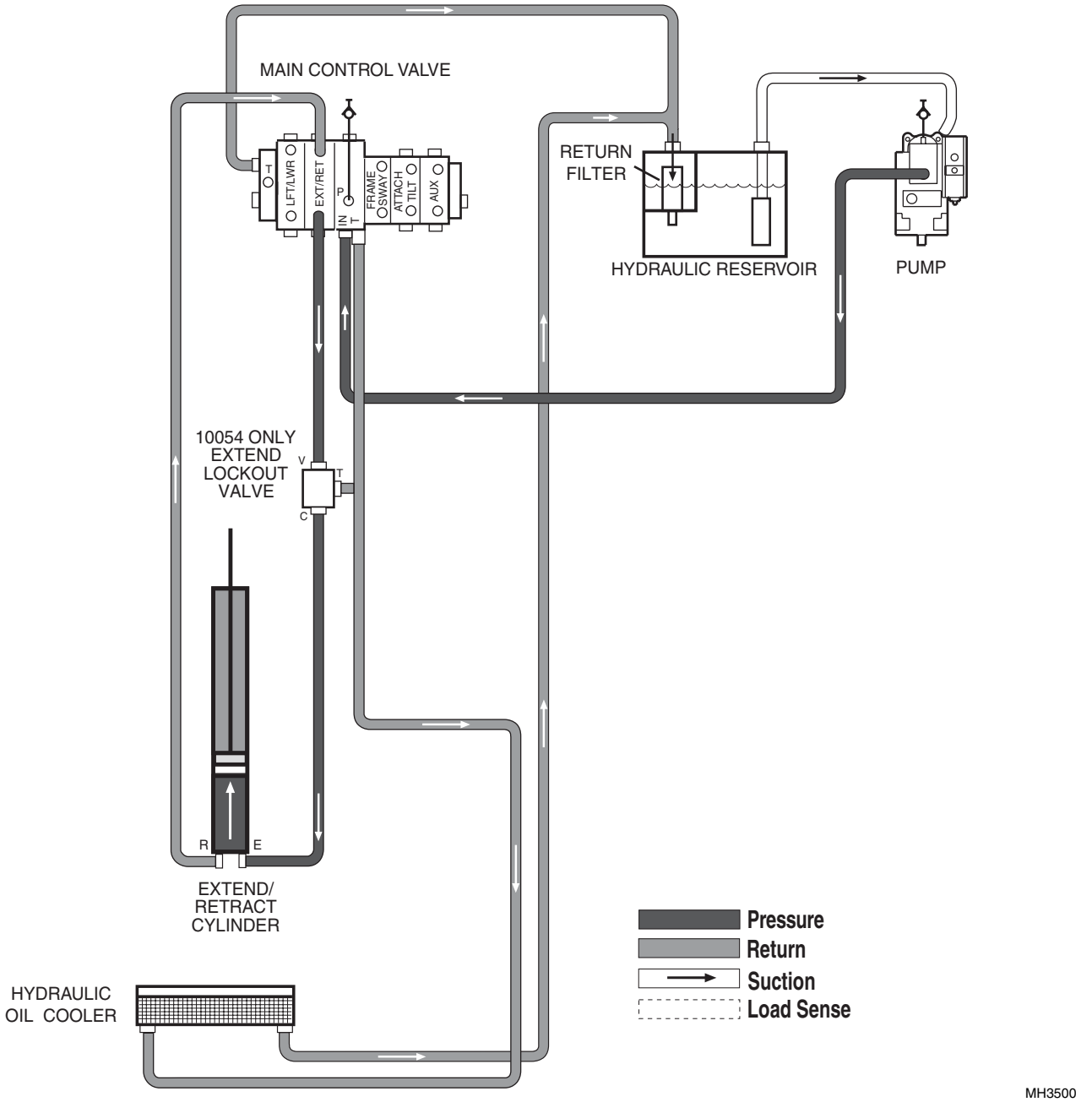
NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.



8.8.2 Boom Extend Circuit and Troubleshooting

(Refer to Section 8.8.22, “Boom Extend/Retract Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

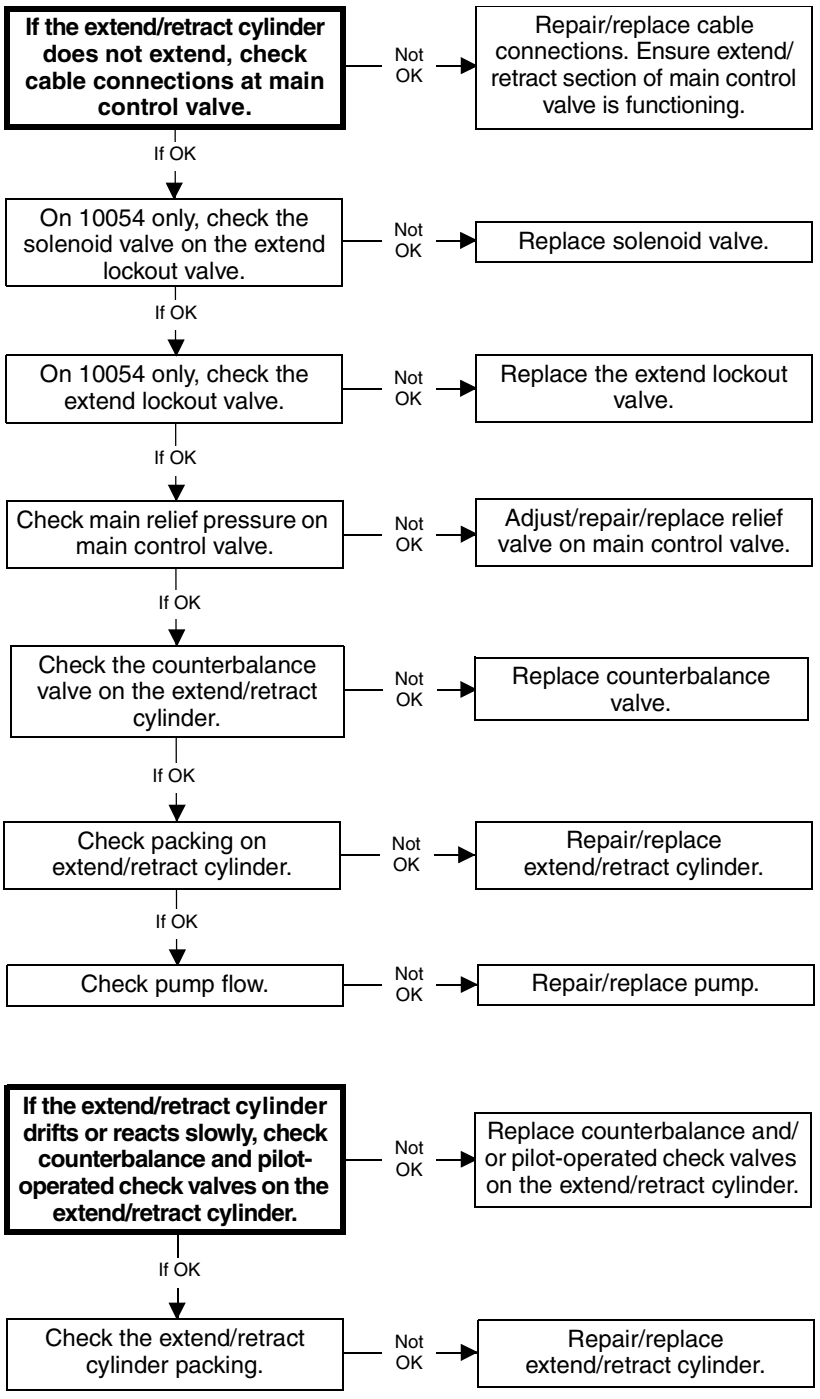
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

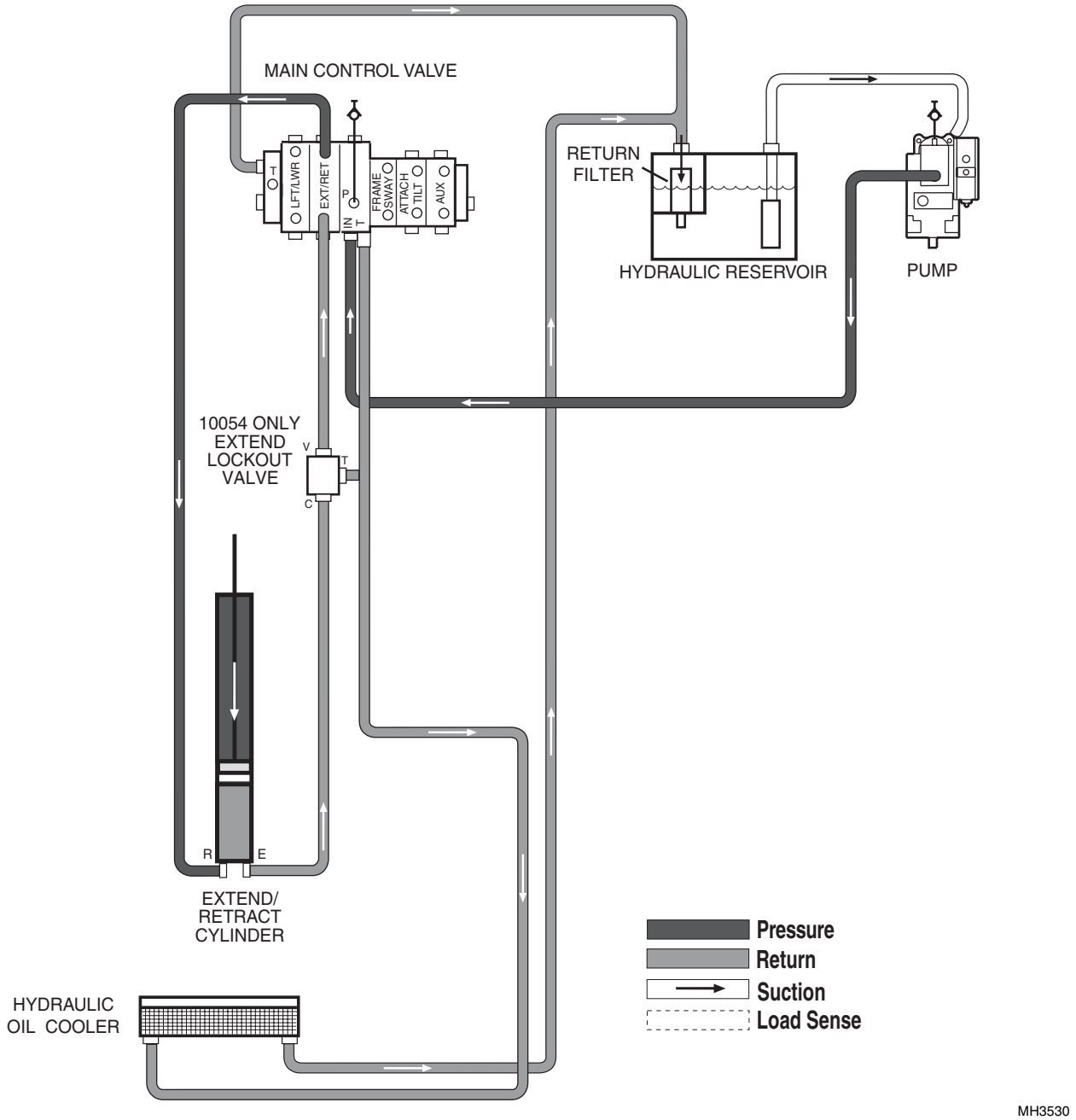
NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.



8.8.3 Boom Retract Circuit and Troubleshooting

(Refer to Section 8.8.22, “Boom Extend/Retract Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.

If the extend/retract cylinder does not retract, check cable connections at main control valve.
Not OK → Repair/replace cable connections. Ensure extend/retract section of main control valve is functioning.

If OK ↓

On 10054 only, check the solenoid valve on the extend lockout valve.
Not OK → Replace solenoid valve.

If OK ↓

On 10054 only, check the extend lockout valve.
Not OK → Replace the extend lockout valve.

If OK ↓

Check main relief pressure on main control valve.
Not OK → Adjust/repair/replace relief valve on main control valve.

If OK ↓

Check the pilot-operated check valve on the extend/retract cylinder.
Not OK → Replace the pilot-operated check valve.

If OK ↓

Check packing on extend/retract cylinder.
Not OK → Repair/replace extend/retract cylinder.

If OK ↓

Check pump flow.
Not OK → Repair/replace pump.

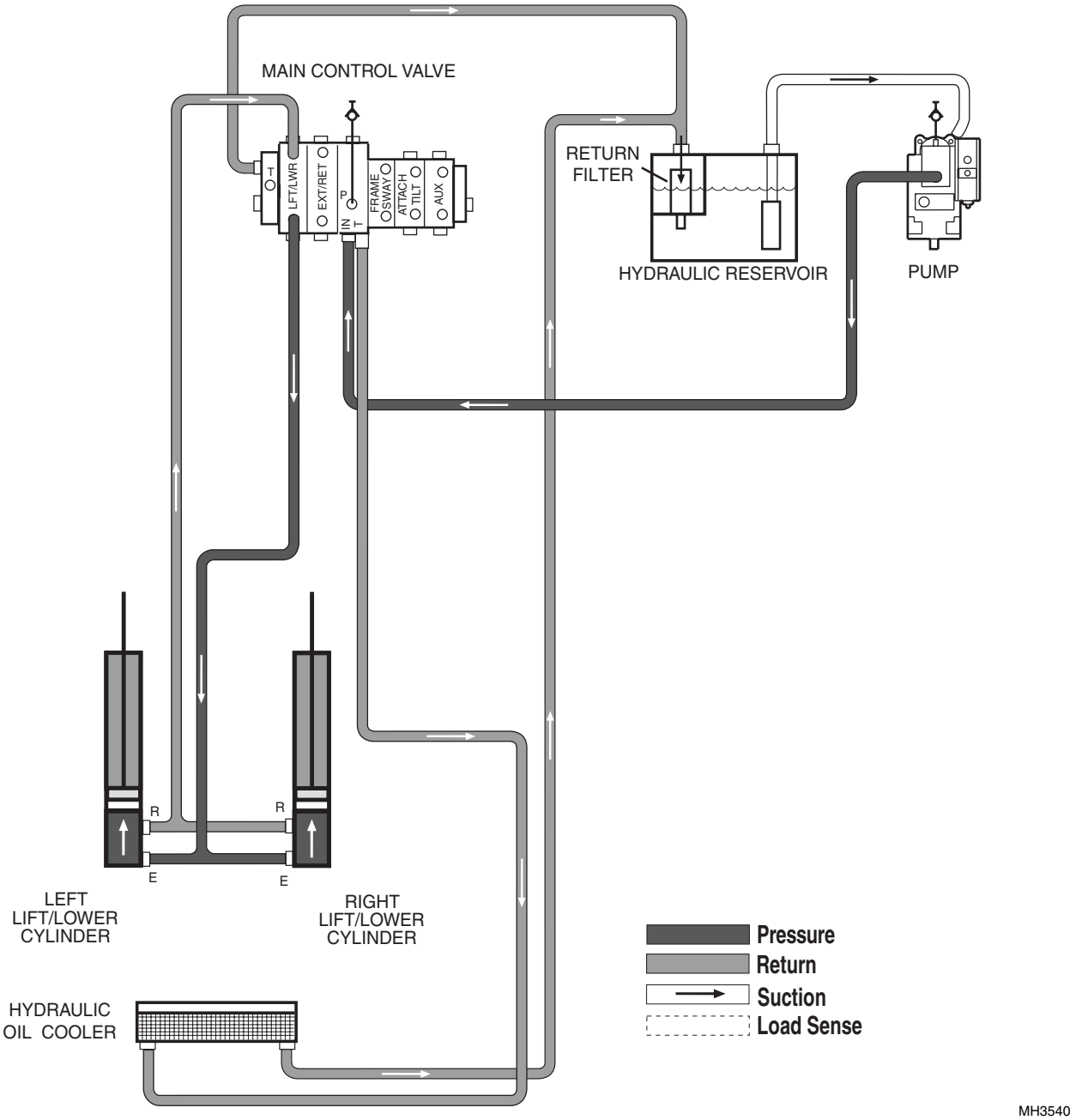
If the extend/retract cylinder drifts or reacts slowly, check counterbalance and pilot-operated check valves on the extend/retract cylinder.
Not OK → Replace counterbalance and/or pilot-operated check valves on the extend/retract cylinder.

If OK ↓

Check the extend/retract cylinder packing.
Not OK → Repair/replace extend/retract cylinder.

8.8.4 Boom Lift Circuit and Troubleshooting

(Refer to Section 8.8.23, “Boom Lift/Lower Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.

If the lift/lower cylinders do not raise, check the cable connections at the main control valve.

Not OK → Repair/replace cable connections. Ensure lift/lower section of main control valve is functioning.

If OK ↓

Check main relief pressure on main control valve.

Not OK → Adjust/repair/replace relief valve on main control valve.

If OK ↓

Check the counterbalance valve on the lift/lower cylinders.

Not OK → Replace counterbalance valve.

If OK ↓

Check packing on lift/lower cylinder(s).

Not OK → Repair/replace lift/lower cylinder(s).

If OK ↓

Check pump flow.

Not OK → Repair/replace pump.

If the lift/lower cylinders drift or react slowly, check counterbalance and pilot-operated check valves on the lift/lower cylinders.

Not OK → Replace counterbalance and/or pilot-operated check valves on the lift/lower cylinders.

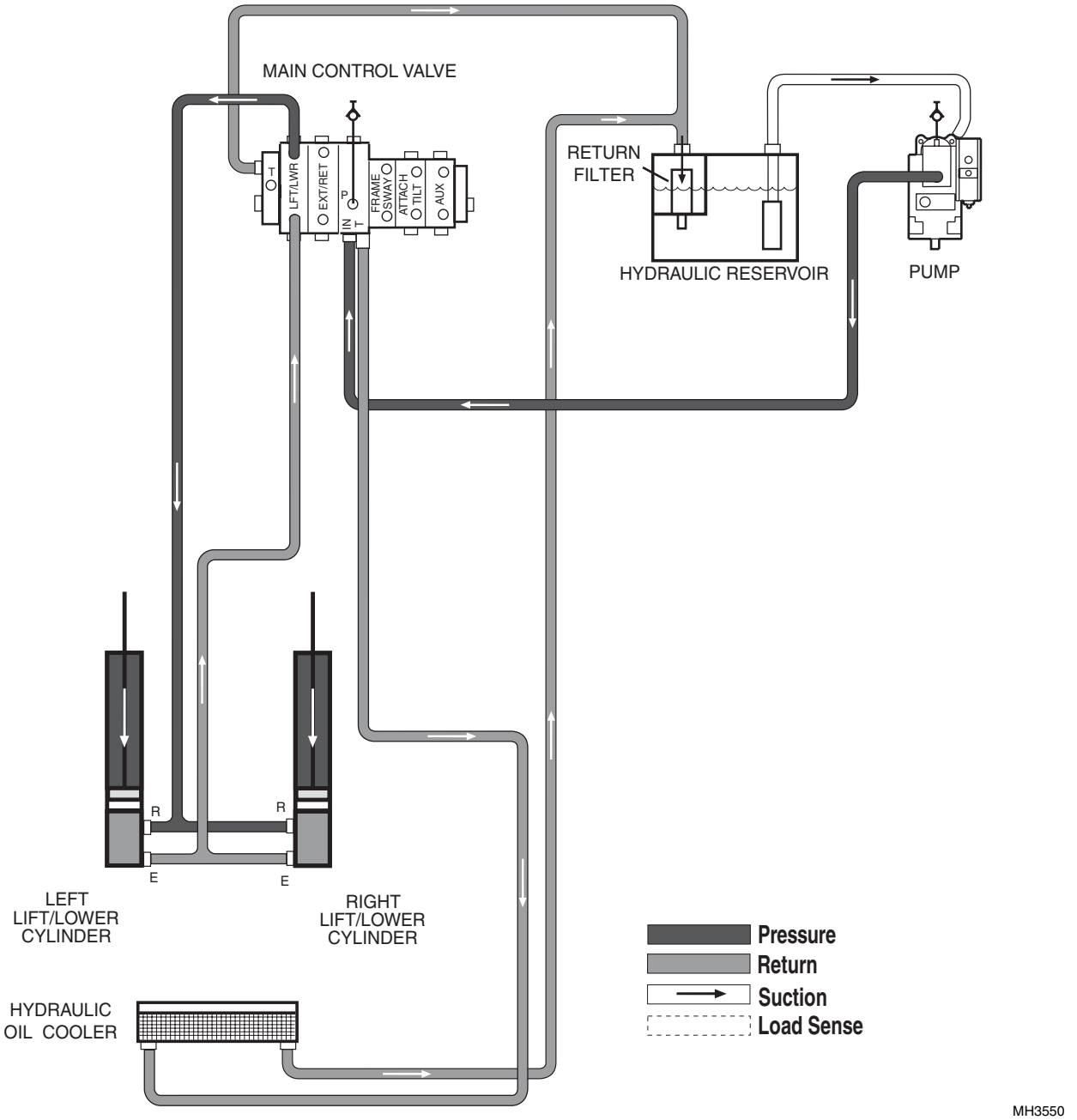
If OK ↓

Check the packing on the lift/lower cylinders.

Not OK → Repair/replace lift/lower cylinders.

8.8.5 Boom Lower Circuit and Troubleshooting

(Refer to Section 8.8.23, “Boom Lift/Lower Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.

If the lift/lower cylinders do not lower, check the cable connections at the main control valve.

Not OK → Repair/replace cable connections. Ensure lift/lower section of main control valve is functioning.

If OK ↓

Check main relief pressure on main control valve.

Not OK → Adjust/repair/replace relief valve on main control valve.

If OK ↓

Check the pilot-operated check valve on the lift/lower cylinder(s).

Not OK → Replace the pilot-operated check valve.

If OK ↓

Check packing on lift/lower cylinder(s).

Not OK → Repair/replace lift/lower cylinder(s).

If OK ↓

Check pump flow.

Not OK → Repair/replace pump.

If the lift/lower cylinder drifts or reacts slowly, check counterbalance and pilot-operated check valves on the lift/lower cylinders.

Not OK → Replace counterbalance and/or pilot-operated check valves on the lift/lower cylinders.

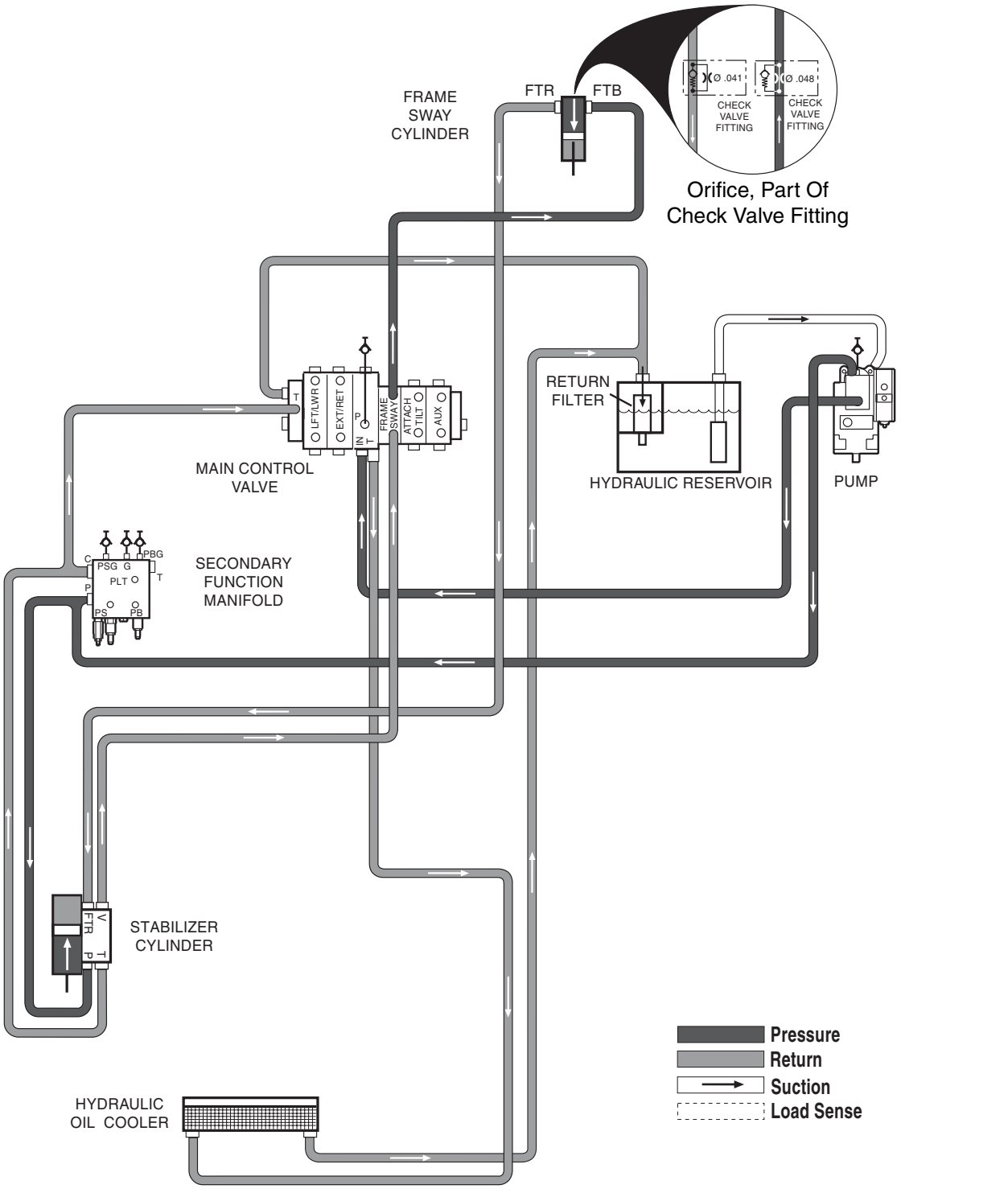
If OK ↓

Check the packing on the lift/lower cylinders.

Not OK → Repair/replace lift/lower cylinders.

8.8.6 Frame Sway (Left) and Stabilizer Circuit and Troubleshooting

(Refer to Section 8.8.24, “Frame Sway and Stabilizer Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

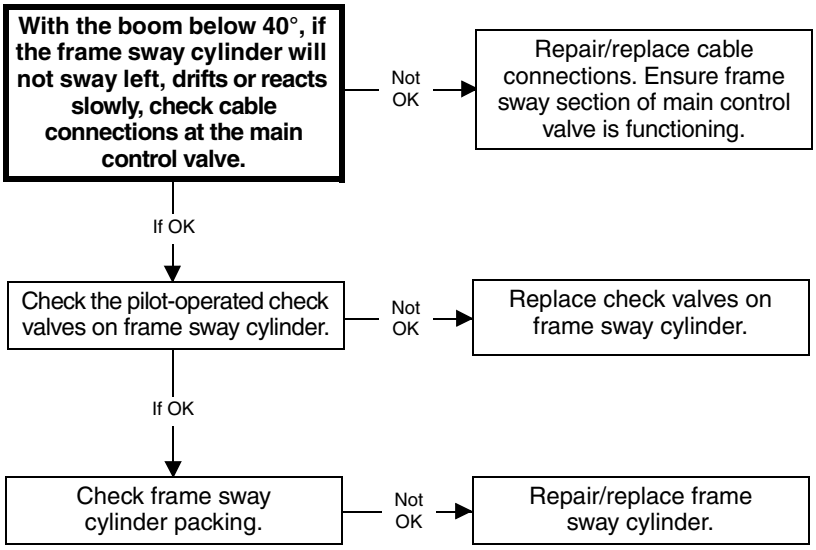
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

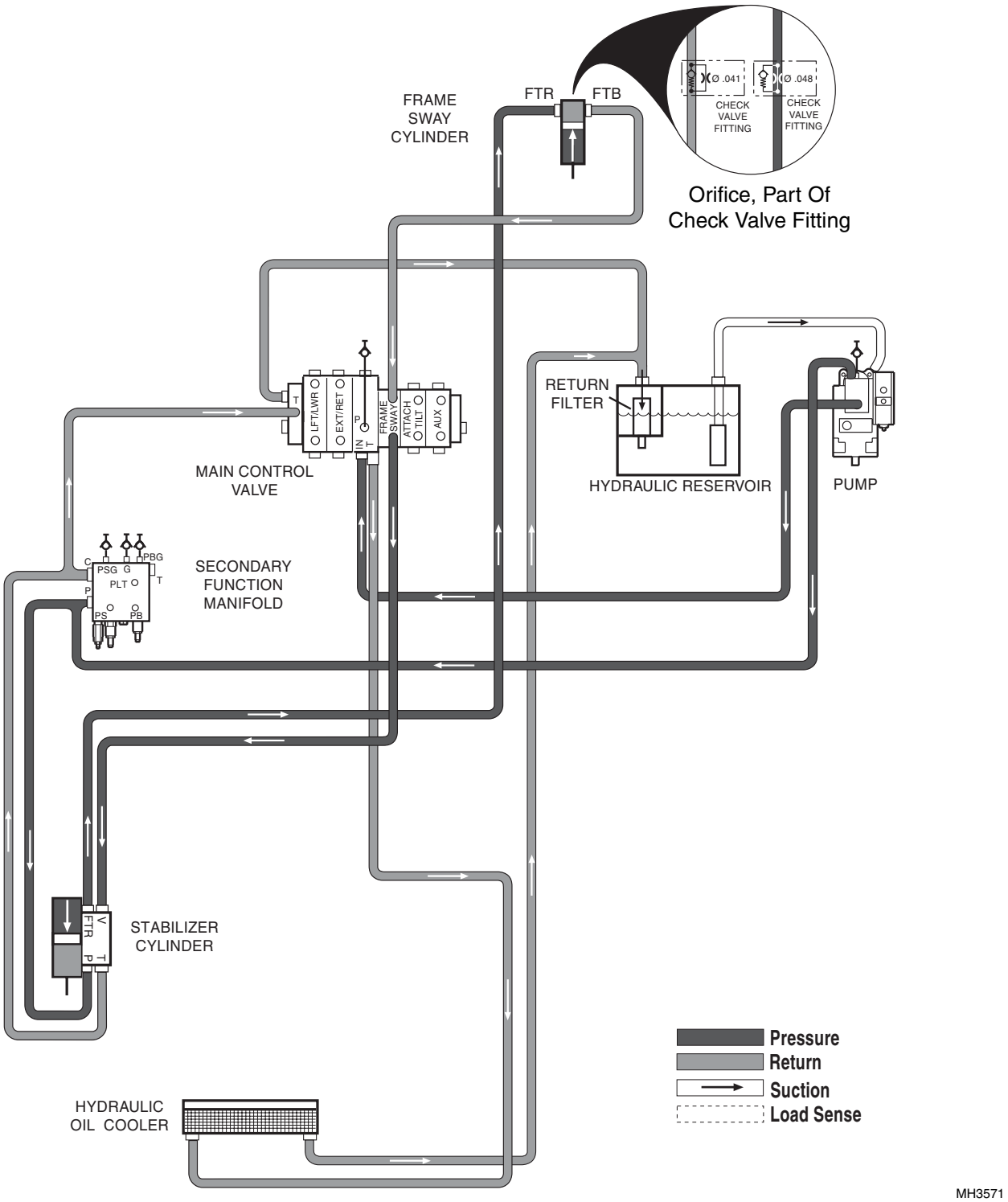
Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.



Refer to Section 10.12, "Stabil-TRAK™ Hydraulic Circuit Operation and Troubleshooting," for further information on troubleshooting the frame sway and stabilizer circuits.

8.8.7 Frame Sway (Right) and Stabilizer Circuit and Troubleshooting

(Refer to Section 8.8.24, “Frame Sway and Stabilizer Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

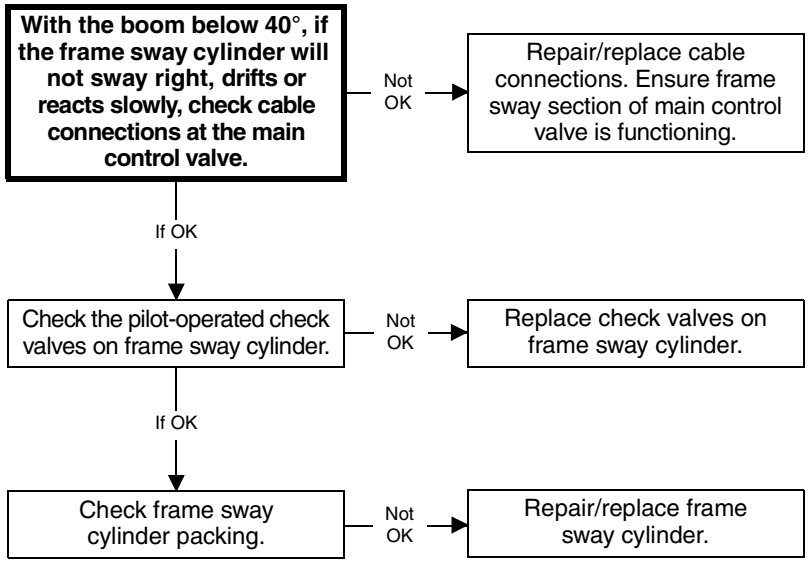
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

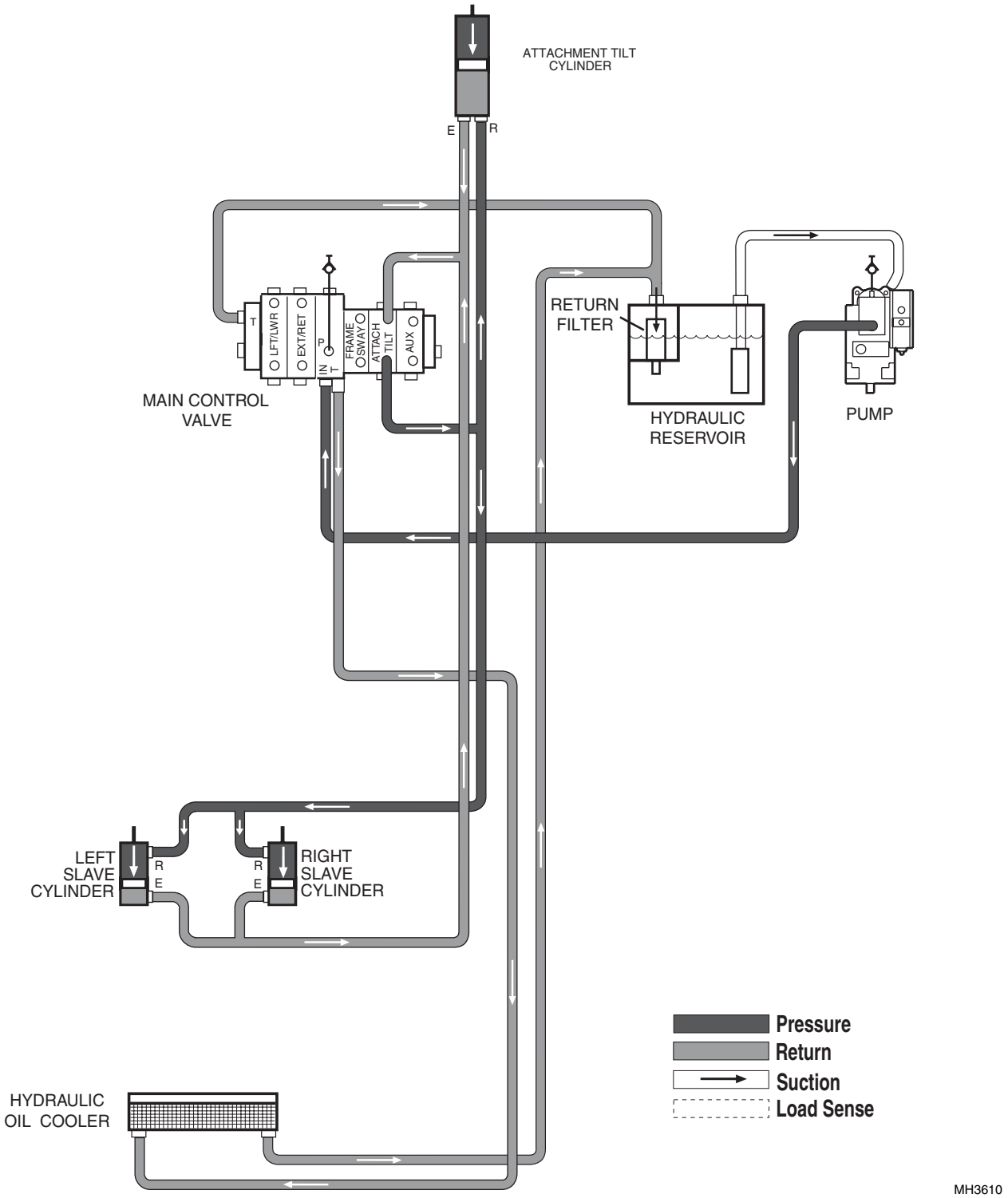
Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.



Refer to Section 10.12, "Stabil-TRAK™ Hydraulic Circuit Operation and Troubleshooting," for further information on troubleshooting the frame sway and stabilizer circuits.

8.8.8 Attachment Tilt (Down) and Slave Cylinder Circuit and Troubleshooting

(Refer to Section 8.8.25, “Attachment Tilt and Slave Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

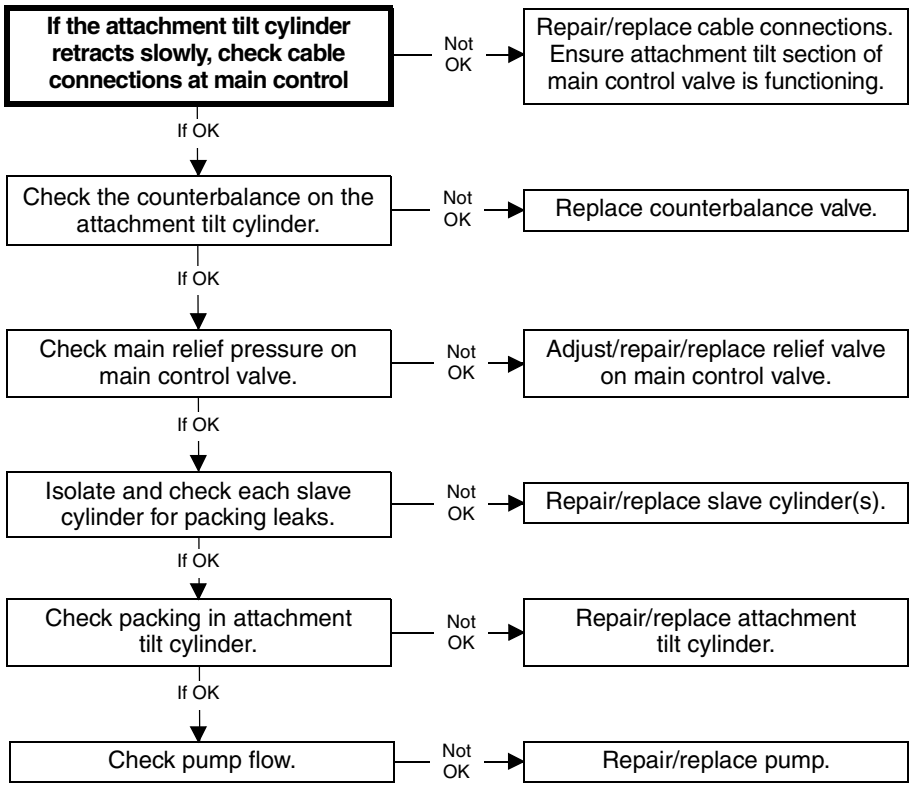
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

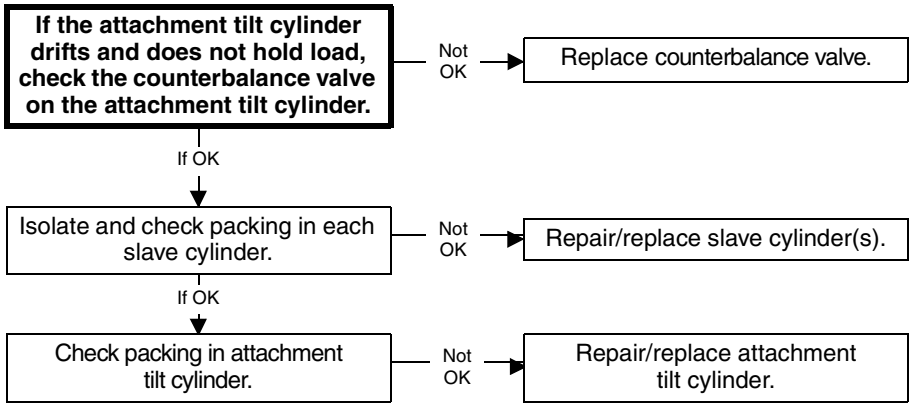
NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

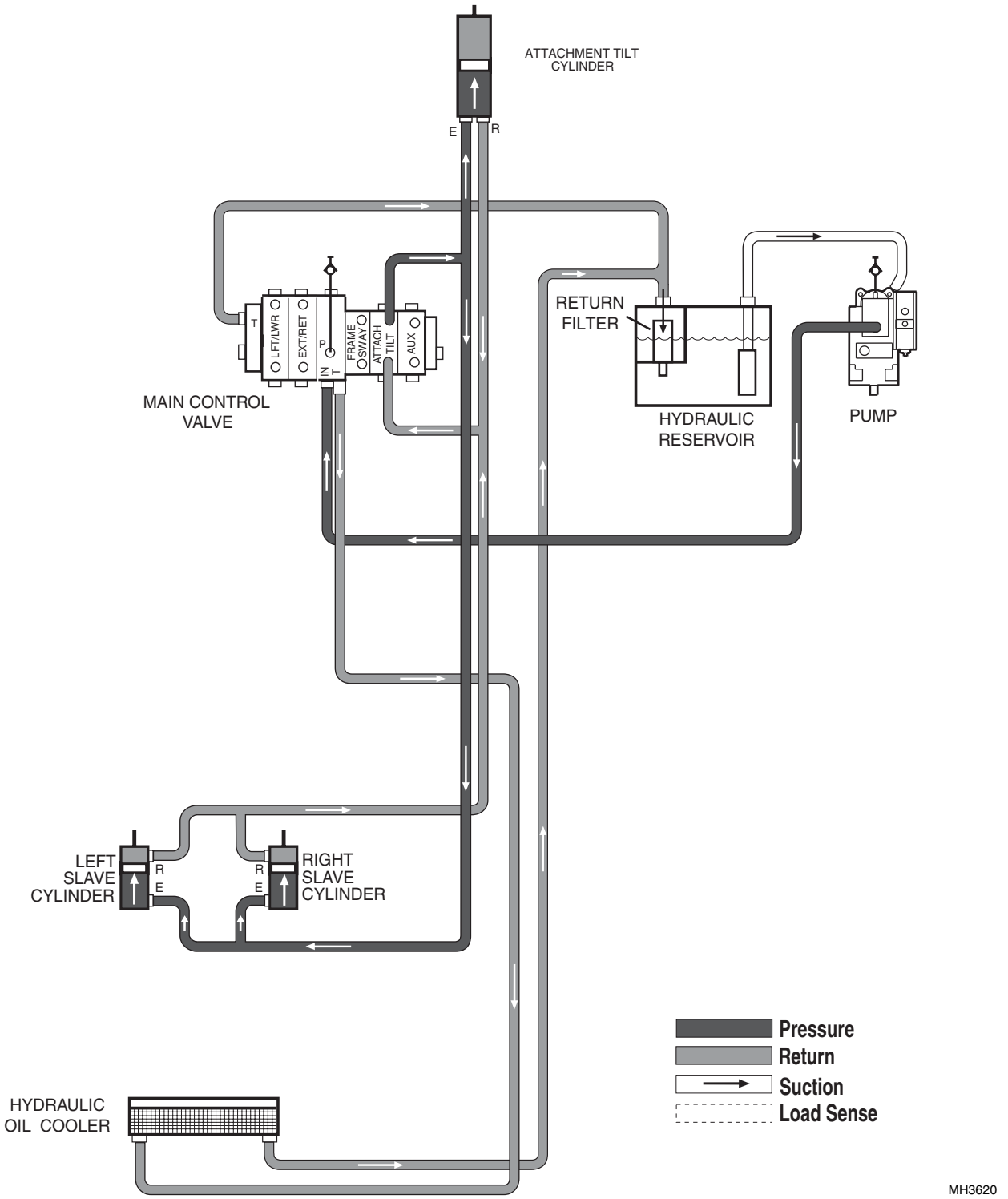
Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.





8.8.9 Attachment Tilt (Up) and Slave Cylinder Circuit and Troubleshooting

(Refer to Section 8.8.25, “Attachment Tilt and Slave Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

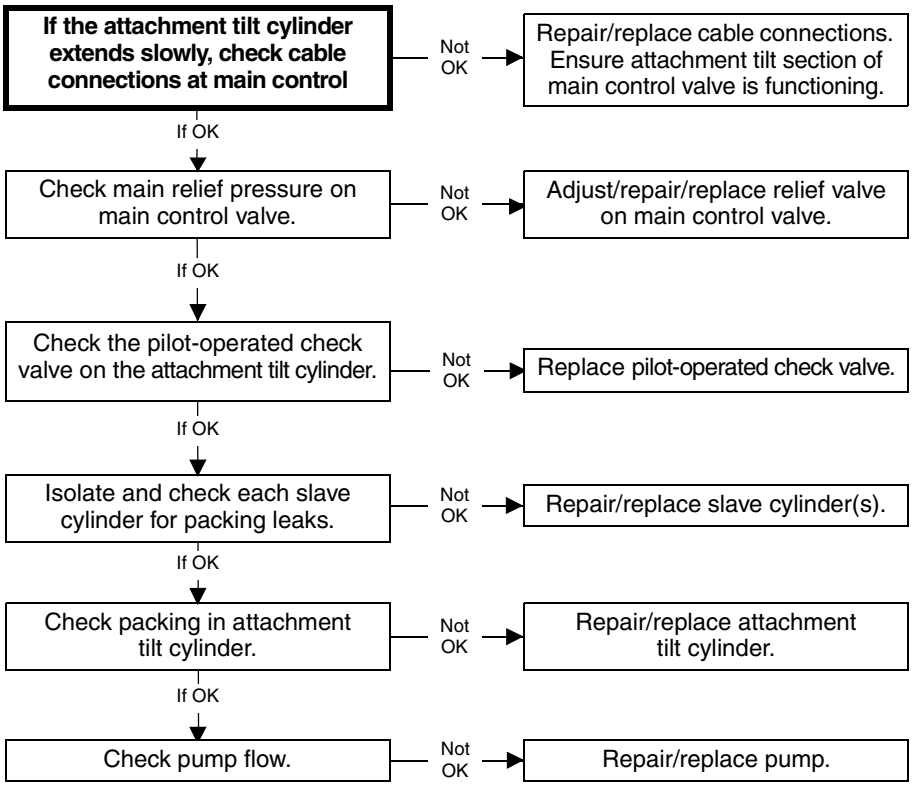
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

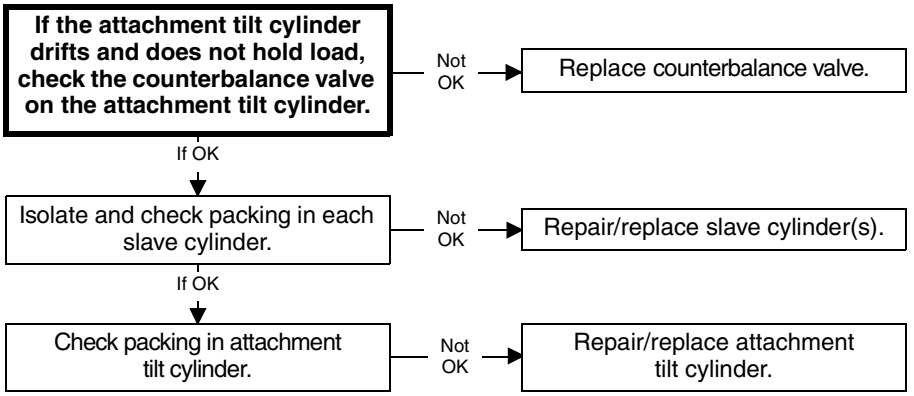
NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

NOTE:

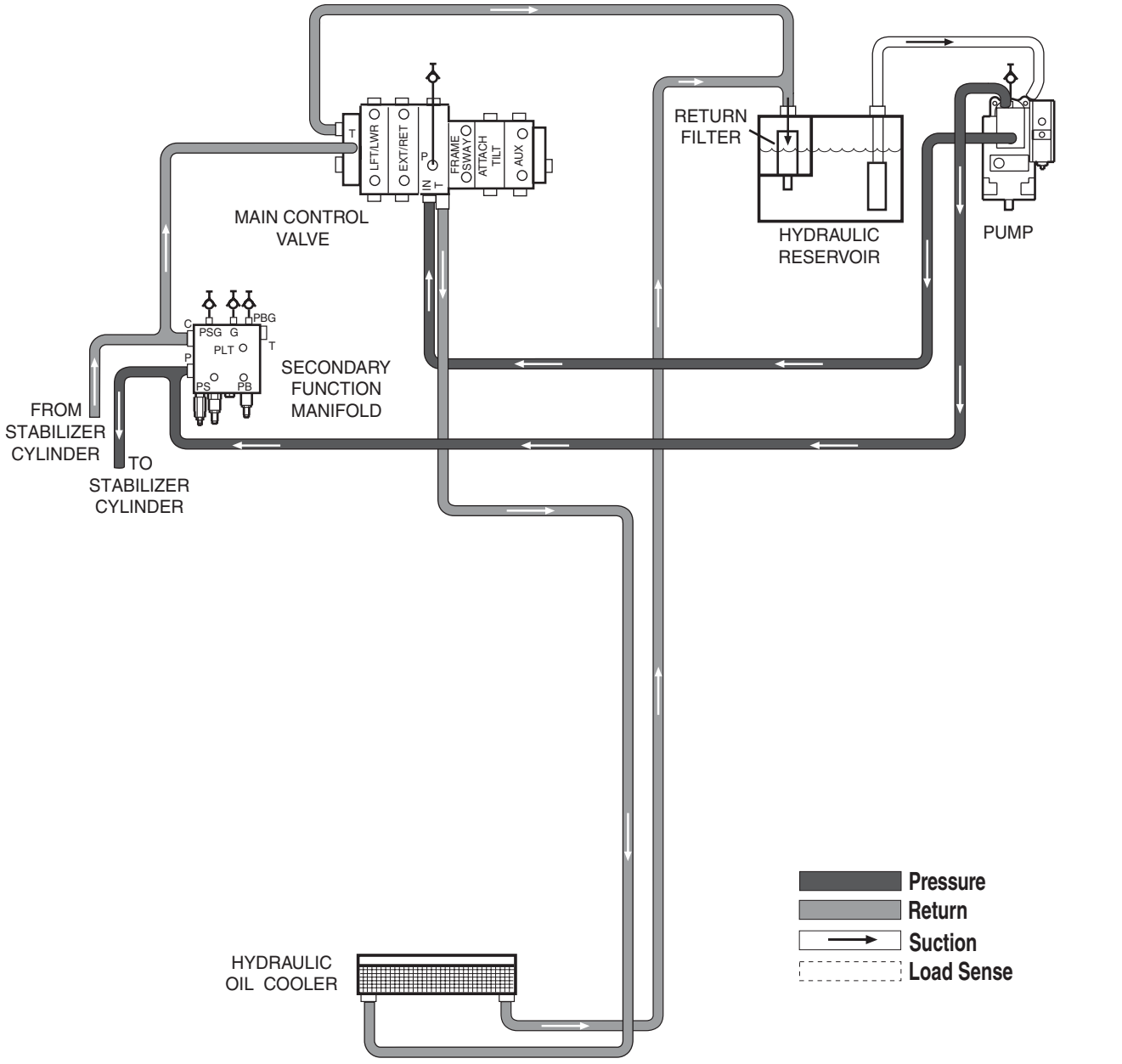
Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.





8.8.10 Pump and Cooling Circuit and Troubleshooting

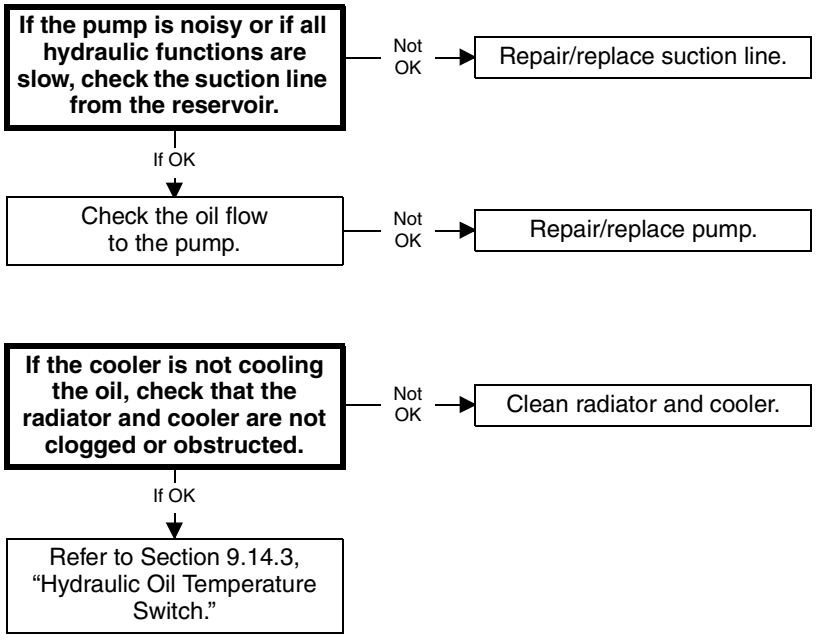
(Refer to Section 8.8.26, “Pump and Cooling Circuit Description,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

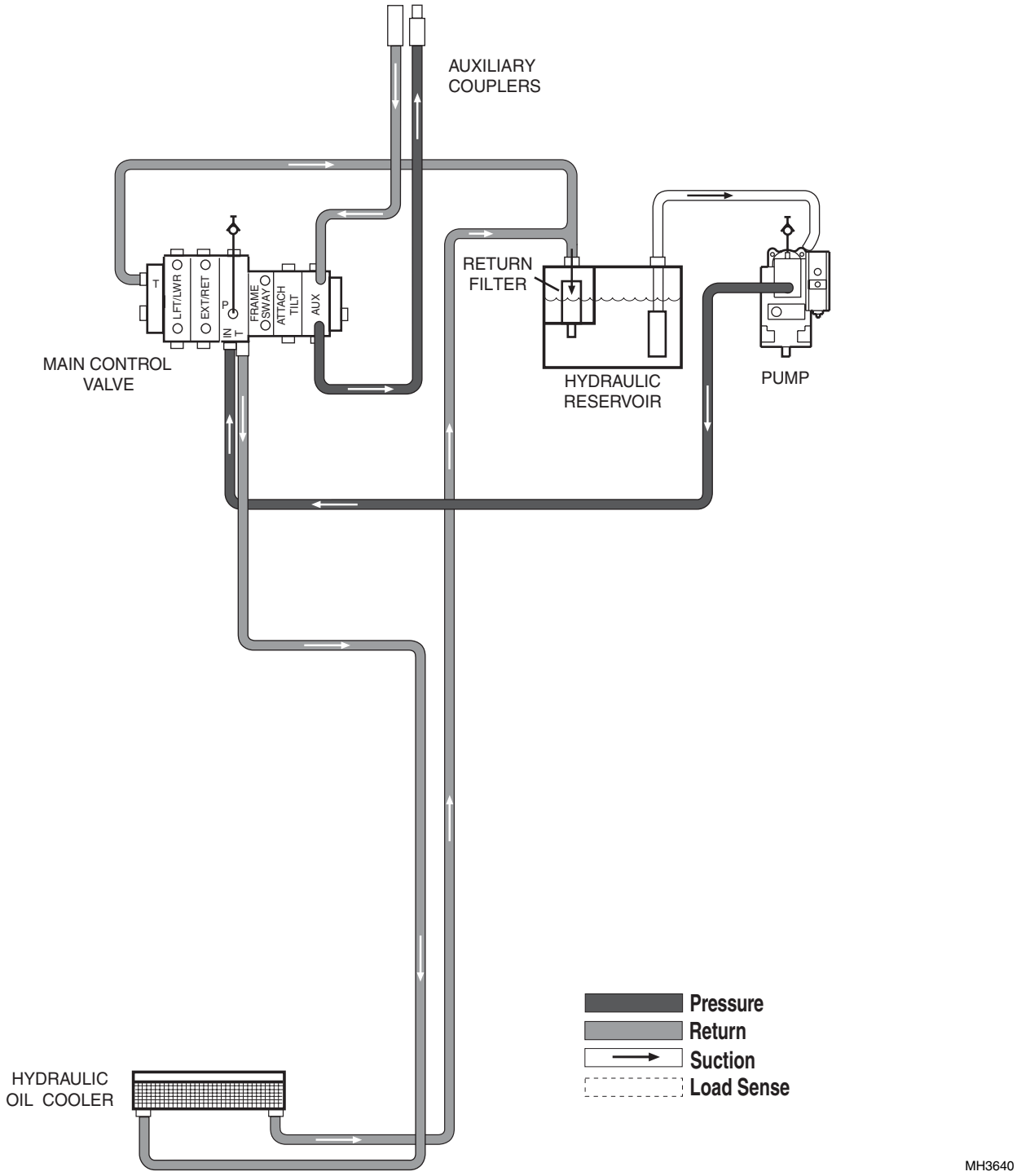
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:
When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.



8.8.11 Auxiliary Hydraulics Circuit and Troubleshooting (Male Coupler Pressurized)

(Refer to Section 8.8.27, “Auxiliary Hydraulics Circuit Description,” for a more detailed explanation of this circuit.)

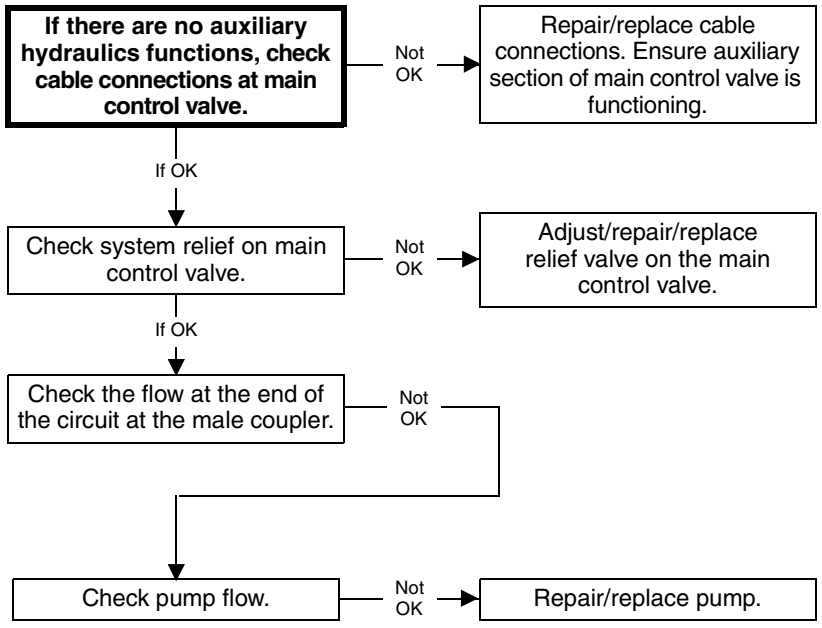


Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

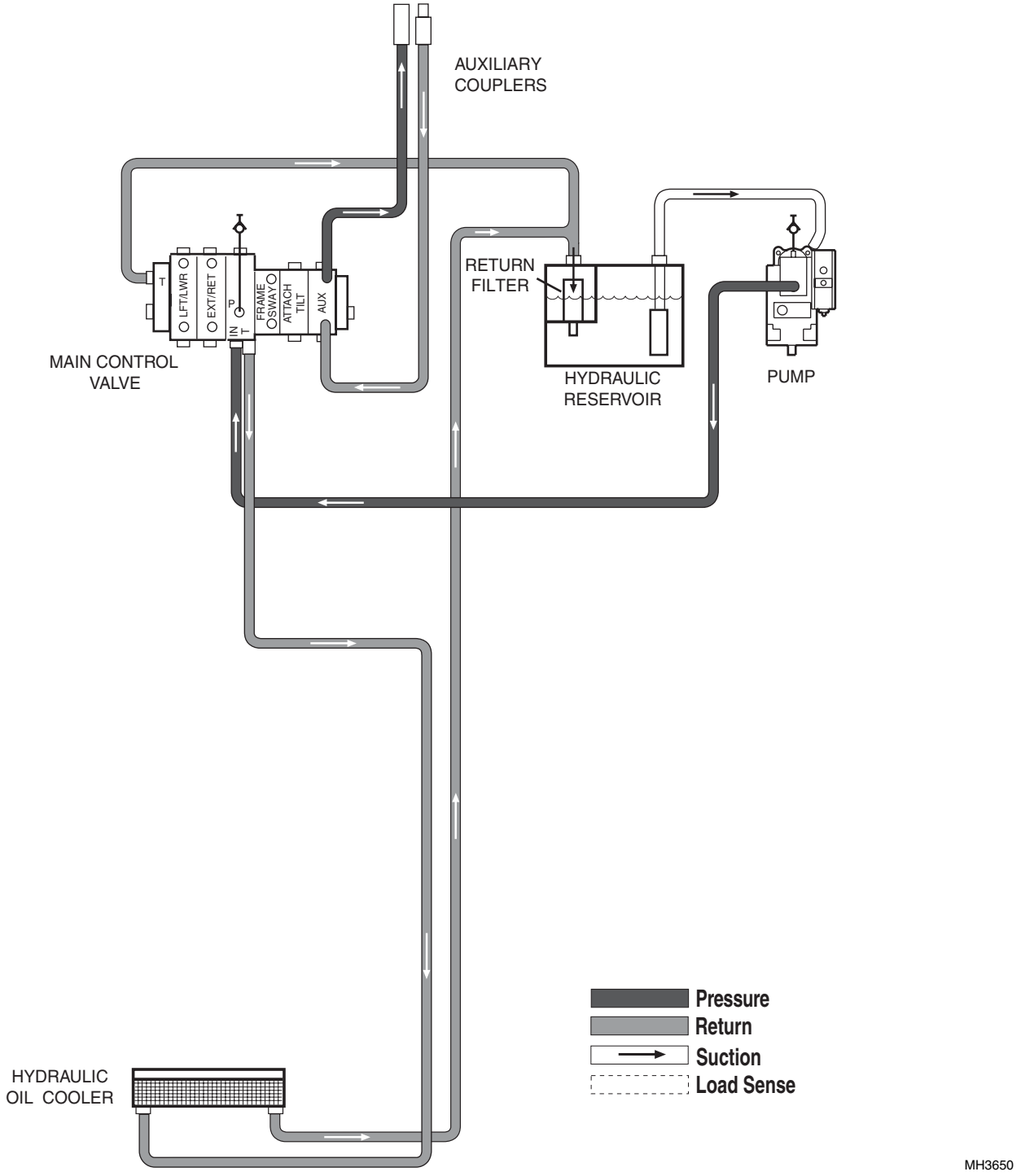
NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.



8.8.12 Auxiliary Hydraulics Circuit and Troubleshooting (Female Coupler Pressurized)

(Refer to Section 8.8.27, “Auxiliary Hydraulics Circuit Description,” for a more detailed explanation of this circuit.)

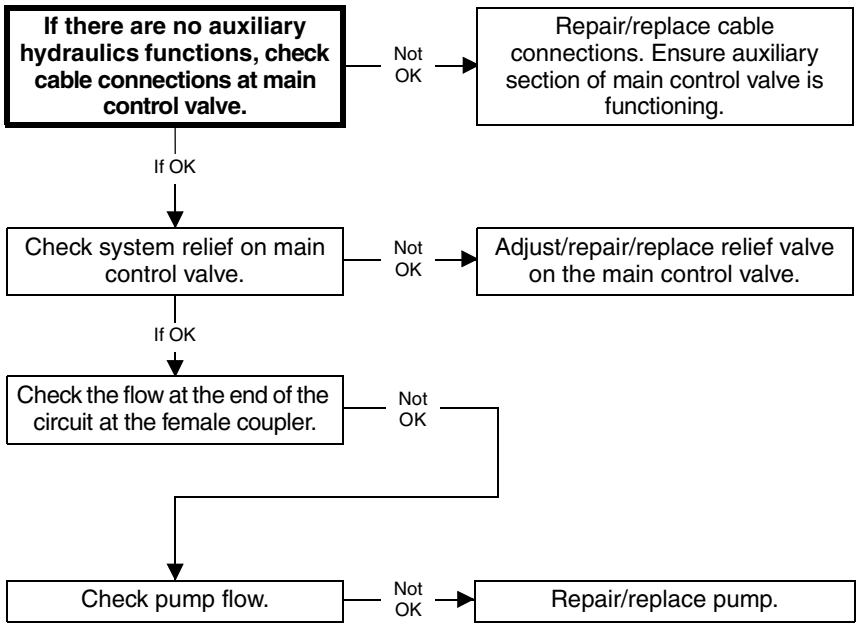


Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

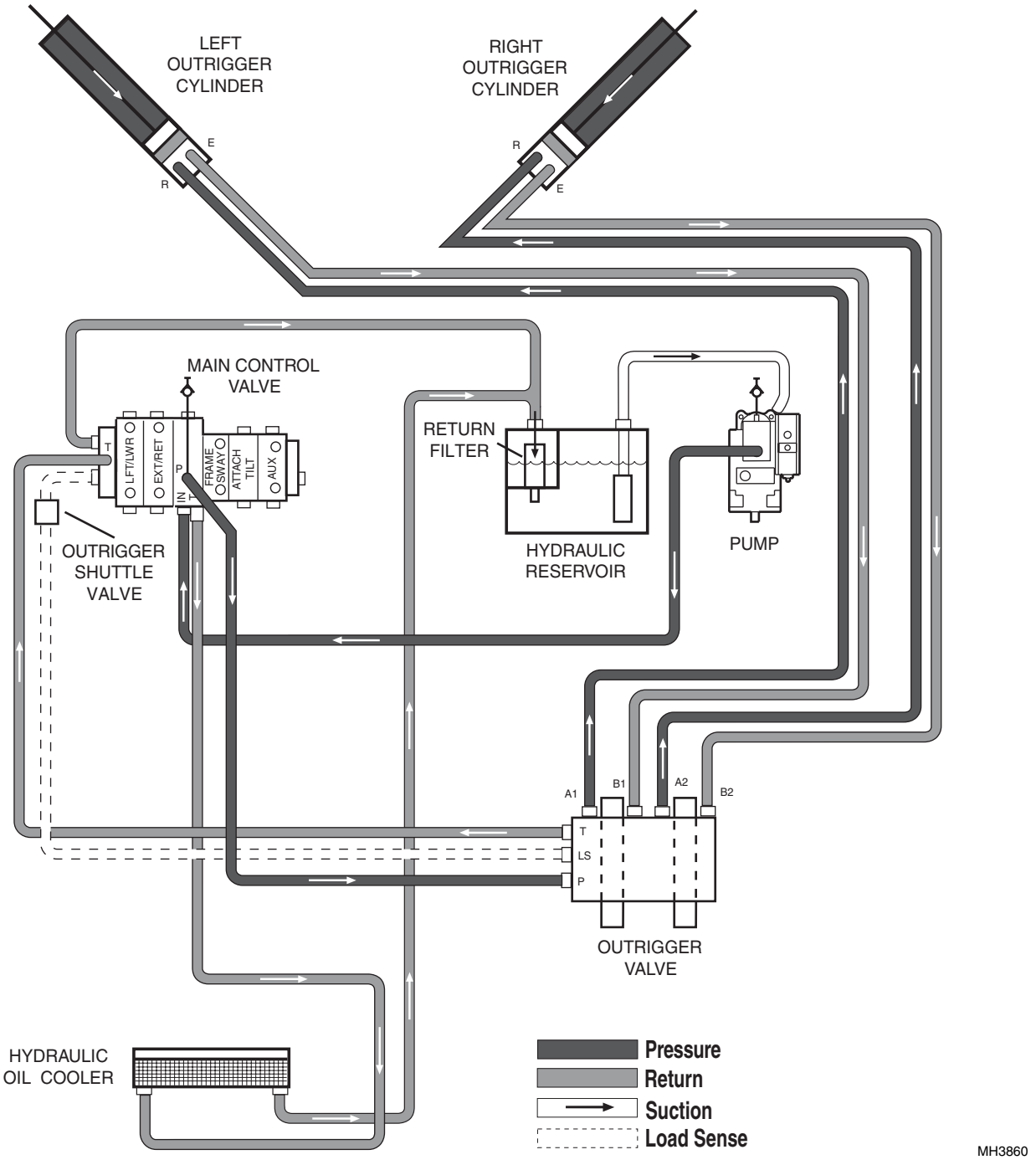
NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.



8.8.13 Outrigger Circuit (Up) and Troubleshooting (10042/10054)

(Refer to Section 8.8.28, “Outrigger Circuit Description (10042/10054),” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

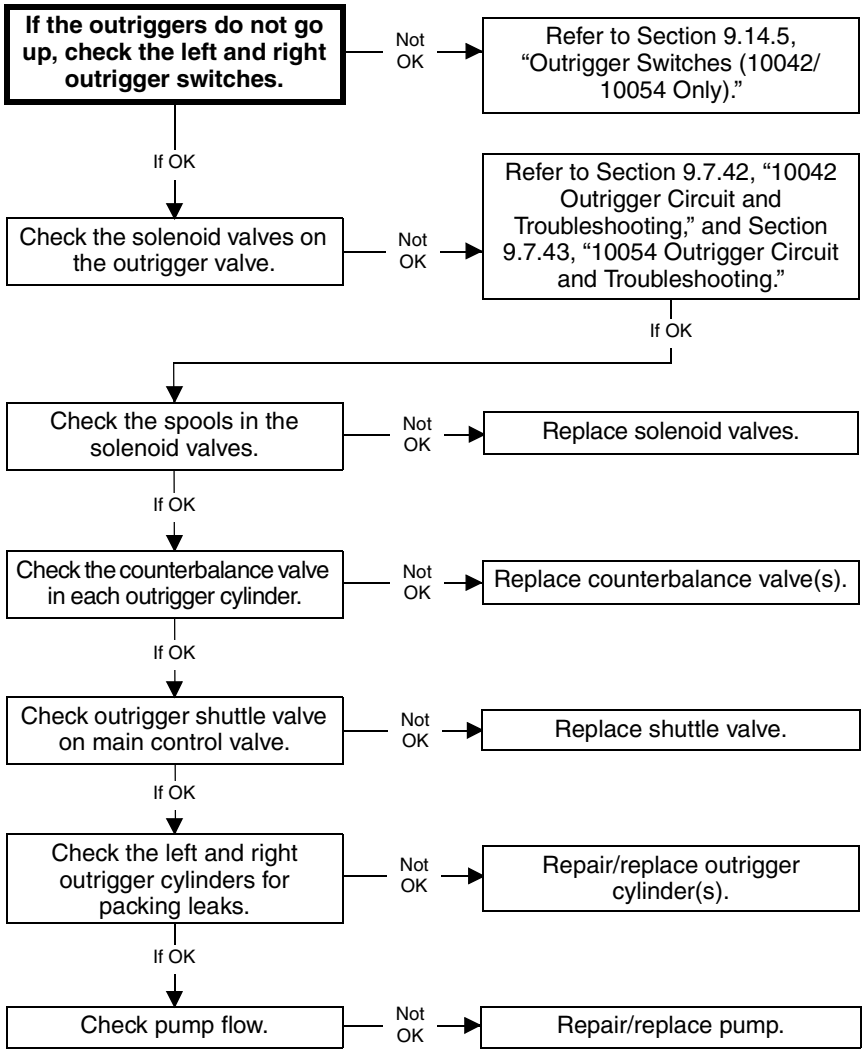
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

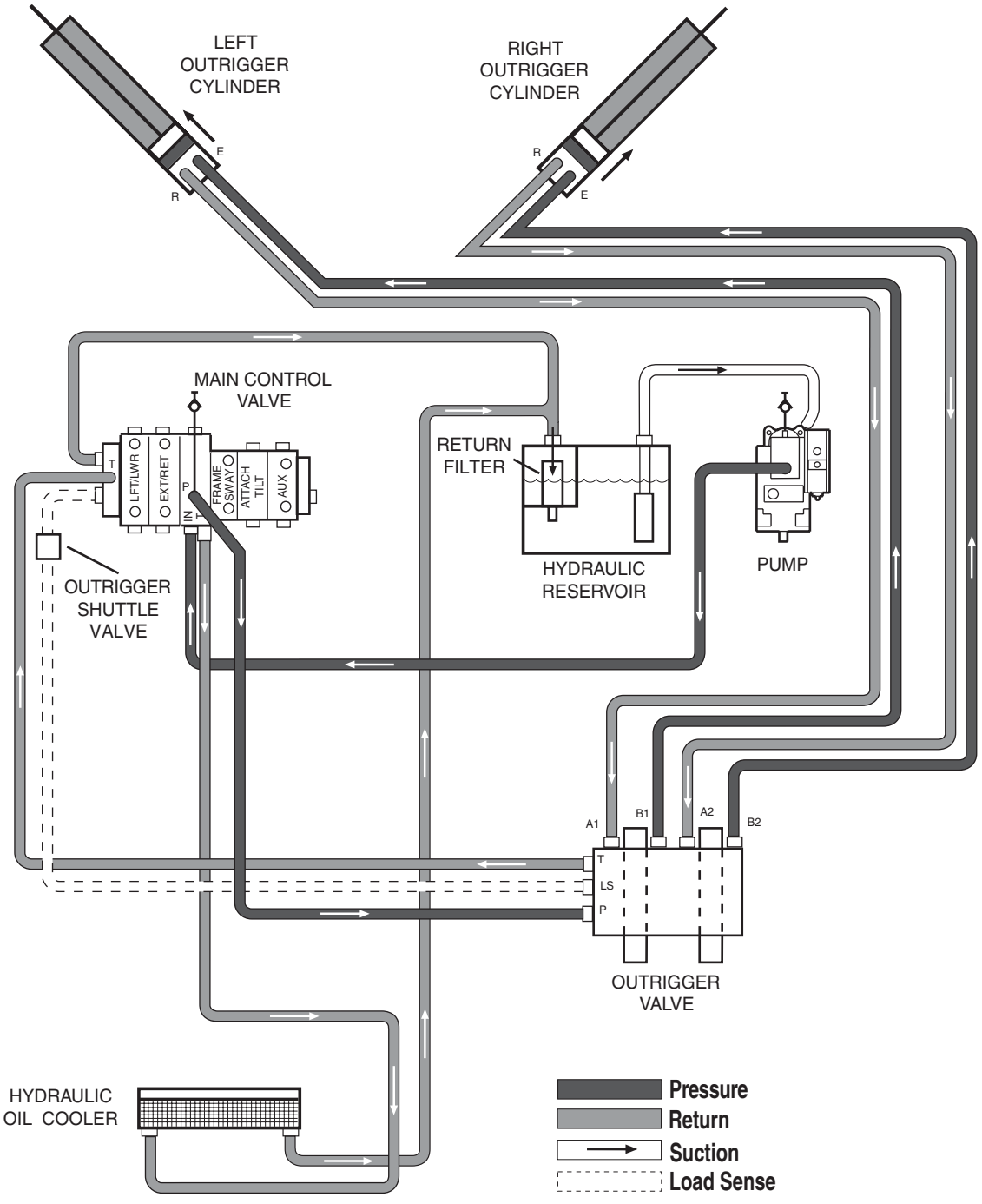
NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.



8.8.14 Outrigger Circuit (Down) and Troubleshooting (10042/10054)

(Refer to Section 8.8.28, “Outrigger Circuit Description (10042/10054),” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

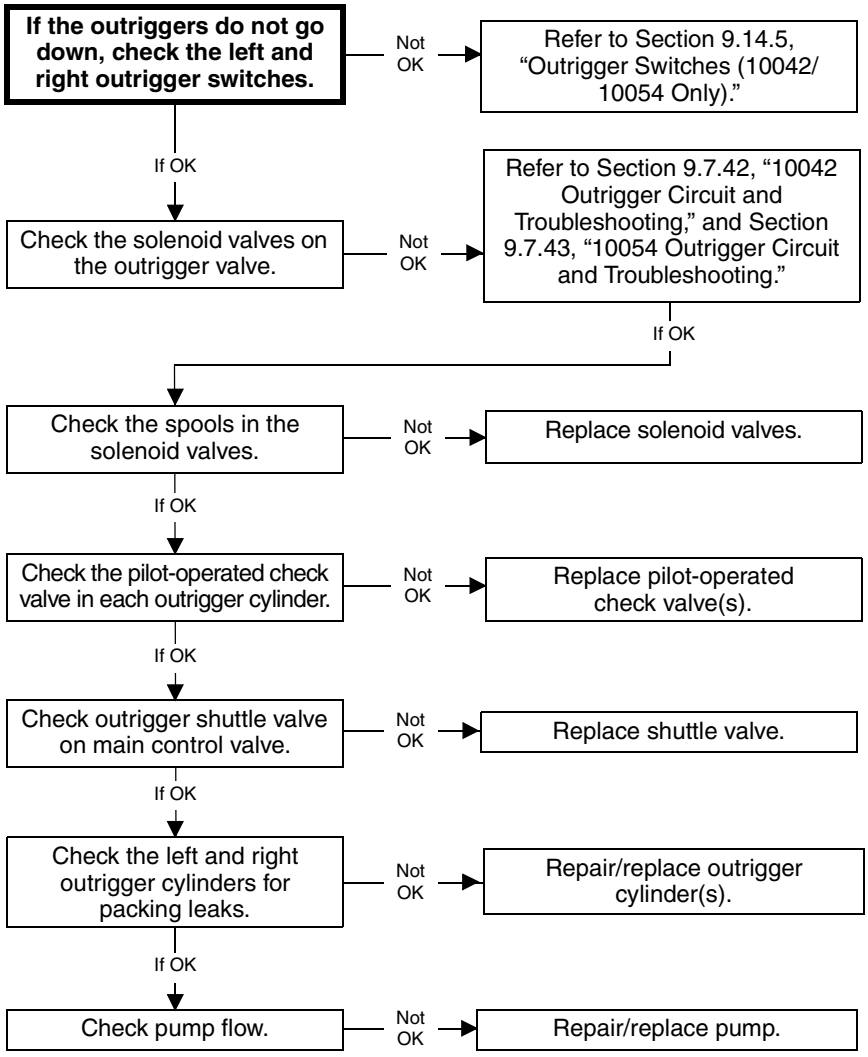
1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, "Hydraulic System Testing," for correct pressure readings.

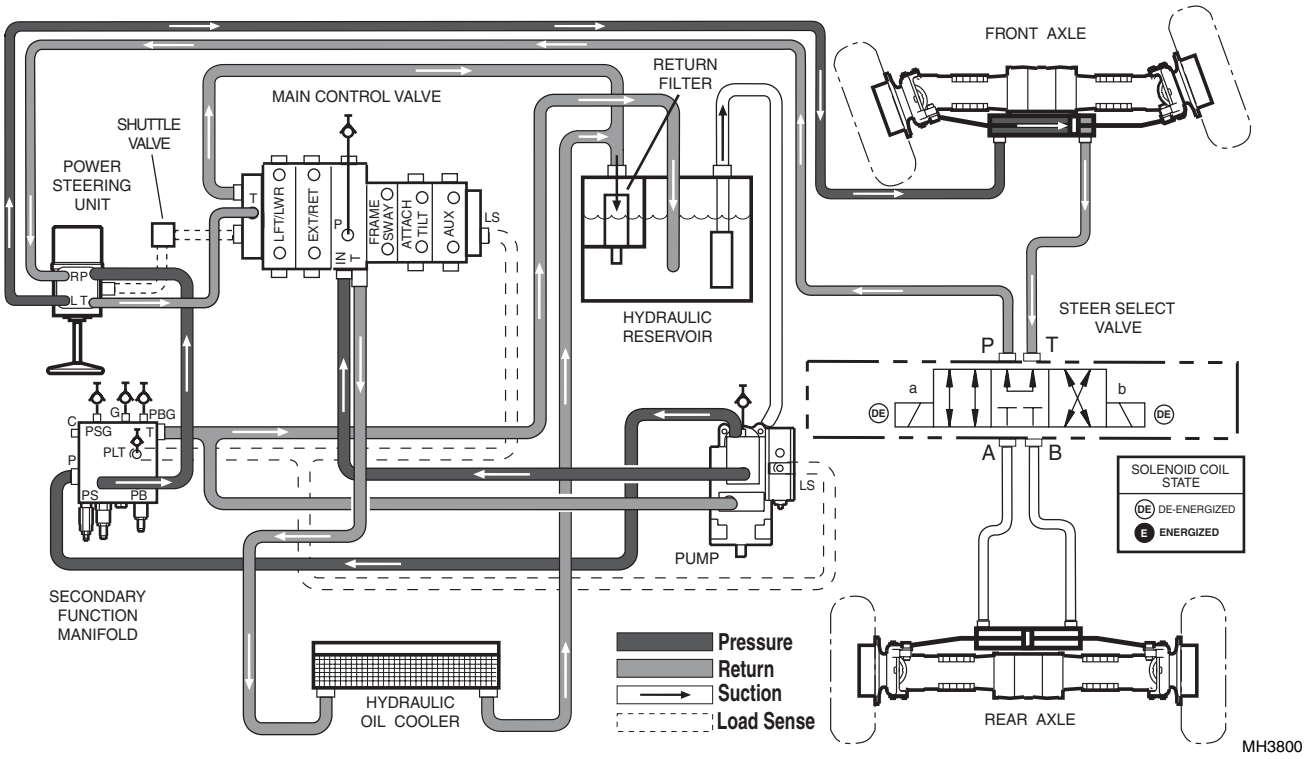
NOTE:

Refer to Section 2.5.4, "Performance Specifications," for approximate cylinder cycle times. The operation of the system function should approximate the times listed.



8.8.15 Front-Wheel Steering Circuit (Left Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:
When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.
Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK ↓

Check that the check valve fitting at the power steering unit is operating properly.
Not OK → Replace check valve fitting.

If OK ↓

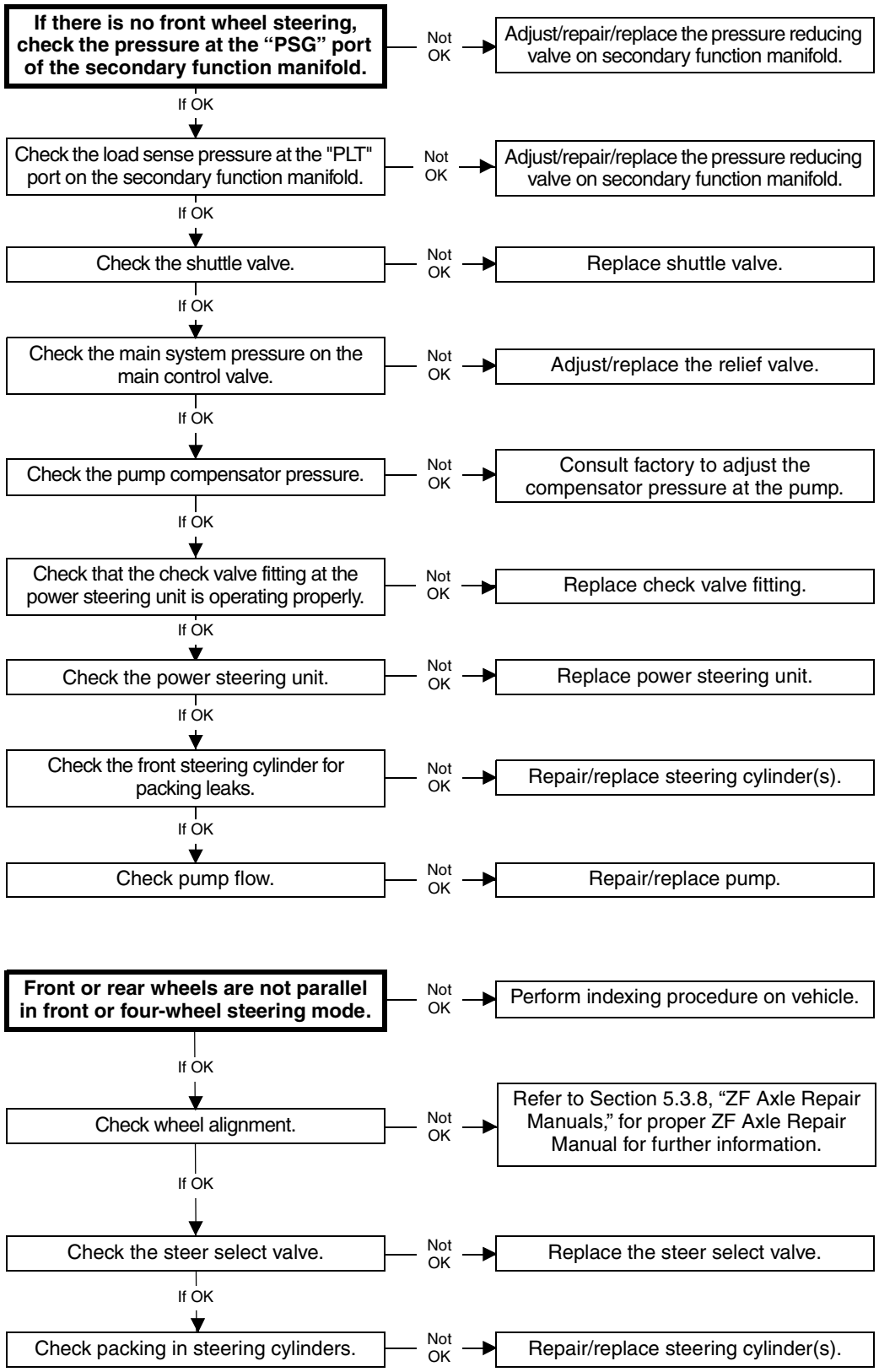
Check the shuttle valve.
Not OK → Replace shuttle valve.

If OK ↓

Check the power steering unit.
Not OK → Replace power steering unit.

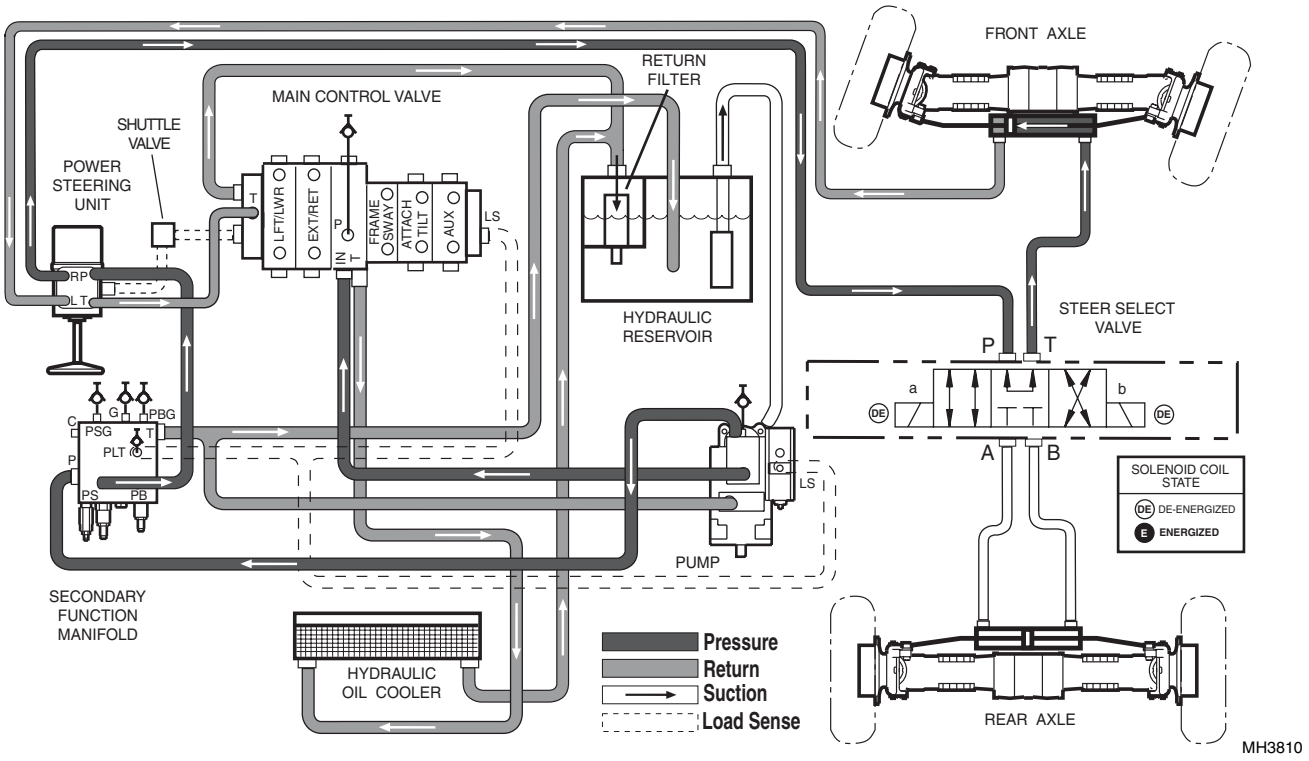
If OK ↓

Check packing in steering cylinders.
Not OK → Repair/replace steering cylinder(s).


If there is no front wheel steering, check the pressure at the "PSG" port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the "PLT" port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front steering cylinder for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, "ZF Axle Repair Manuals," for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder(s).

8.8.16 Front-Wheel Steering Circuit (Right Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:
When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.
Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK

Check that the check valve fitting at the power steering unit is operating properly.
Not OK → Replace check valve fitting.

If OK

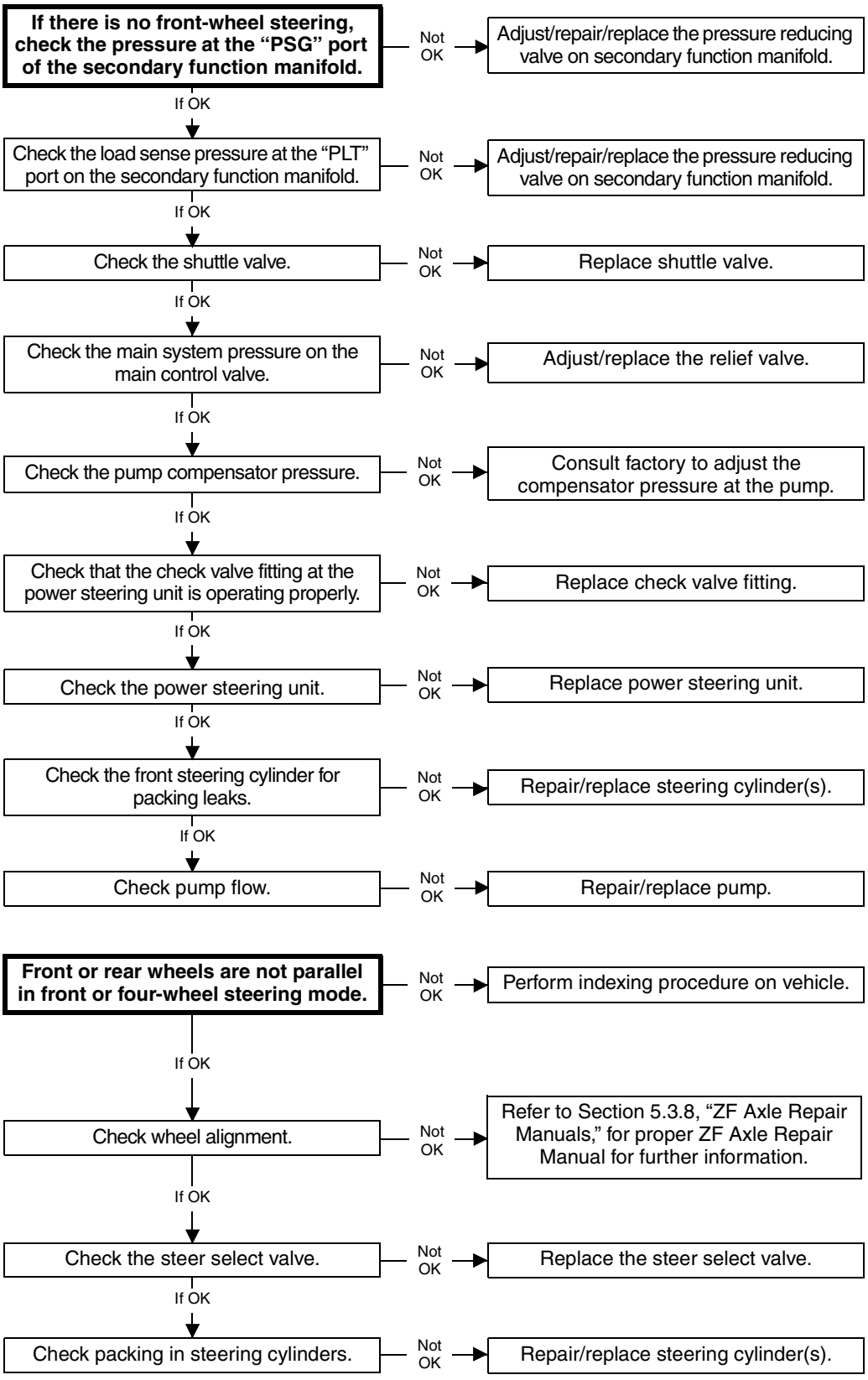
Check the shuttle valve.
Not OK → Replace shuttle valve.

If OK

Check the power steering unit.
Not OK → Replace power steering unit.

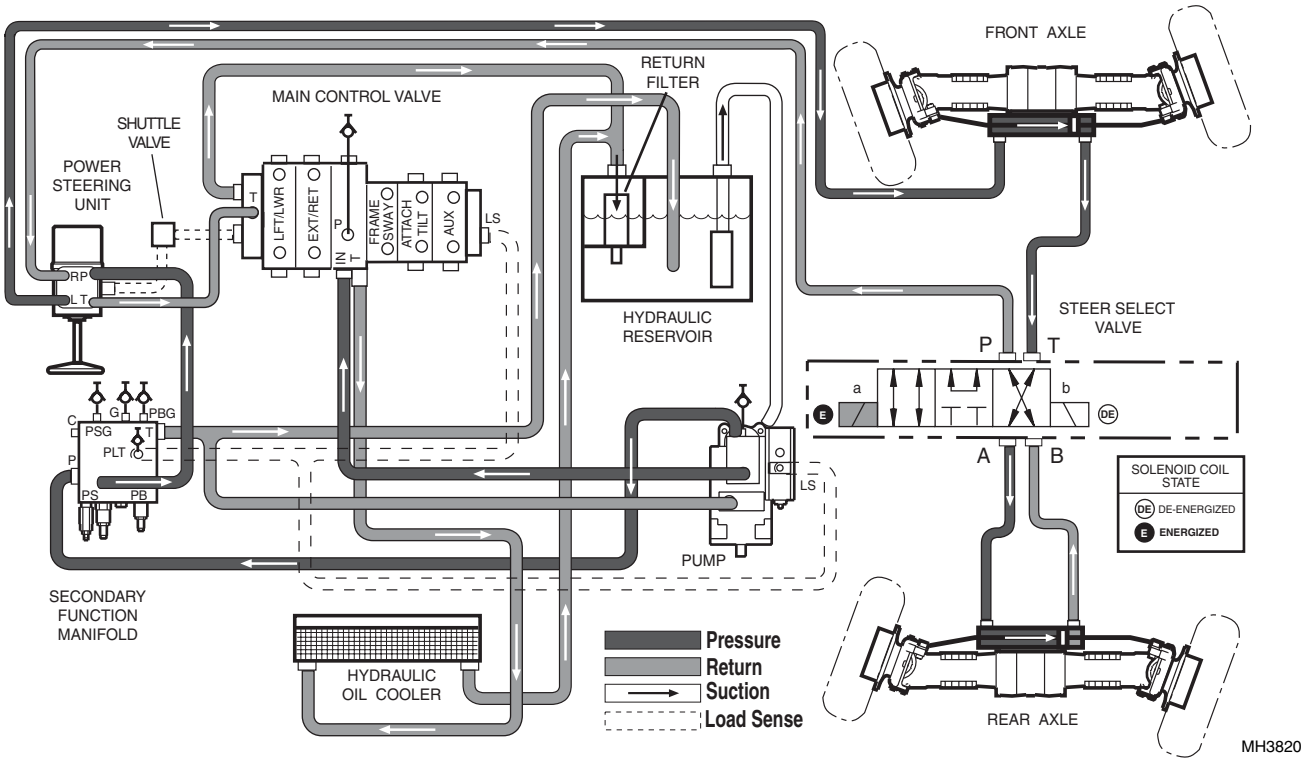
If OK

Check packing in steering cylinders.
Not OK → Repair/replace steering cylinder(s).


If there is no front-wheel steering, check the pressure at the "PSG" port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the "PLT" port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front steering cylinder for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, "ZF Axle Repair Manuals," for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder(s).

8.8.17 Four-Wheel Steering Circuit (Left Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:
When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.
Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK ↓

Verify that the check valve fitting at the power steering unit is operating properly.
Not OK → Replace check valve fitting.

If OK ↓

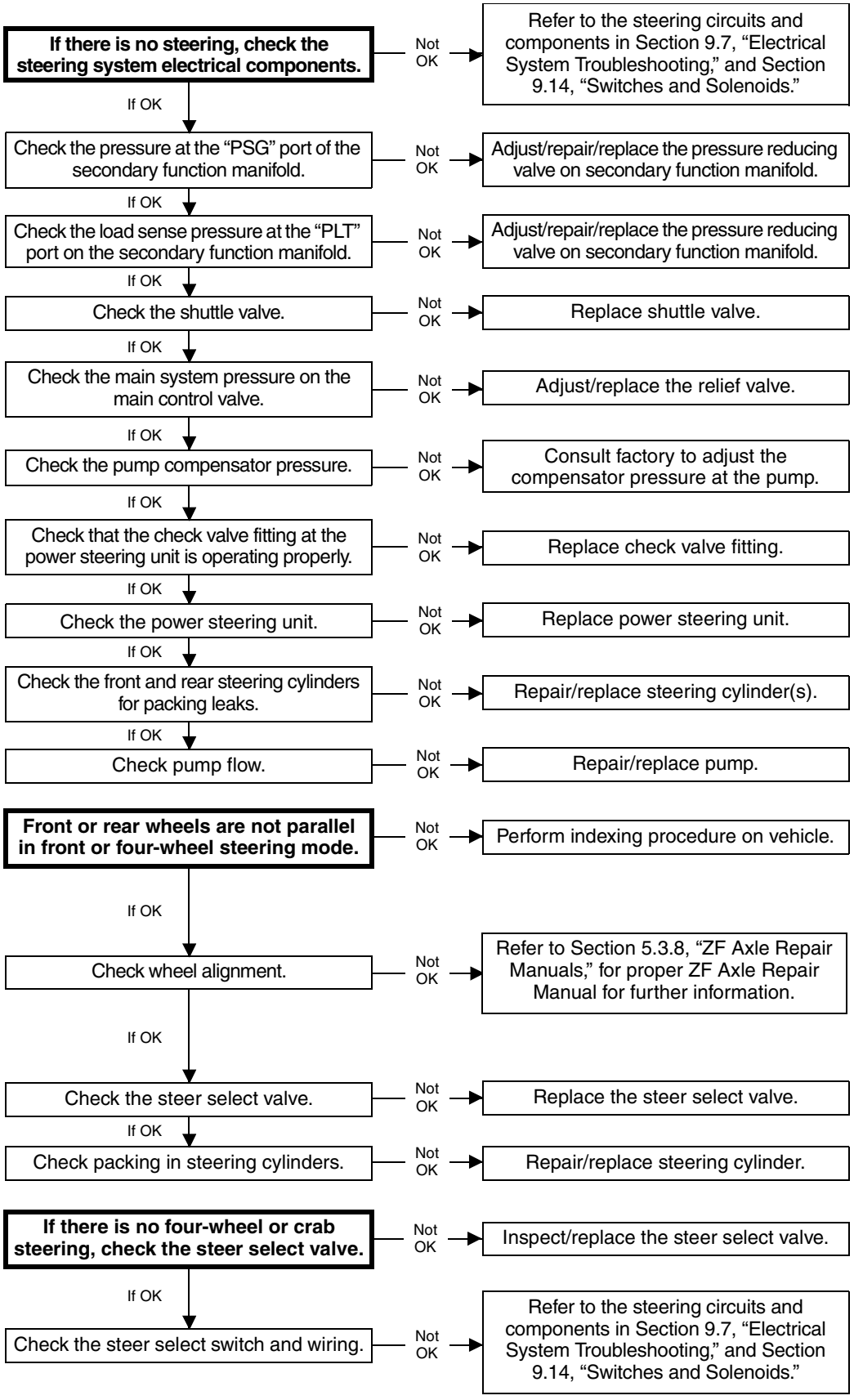
Check the shuttle valve.
Not OK → Replace shuttle valve.

If OK ↓

Check the power steering unit.
Not OK → Replace power steering unit.

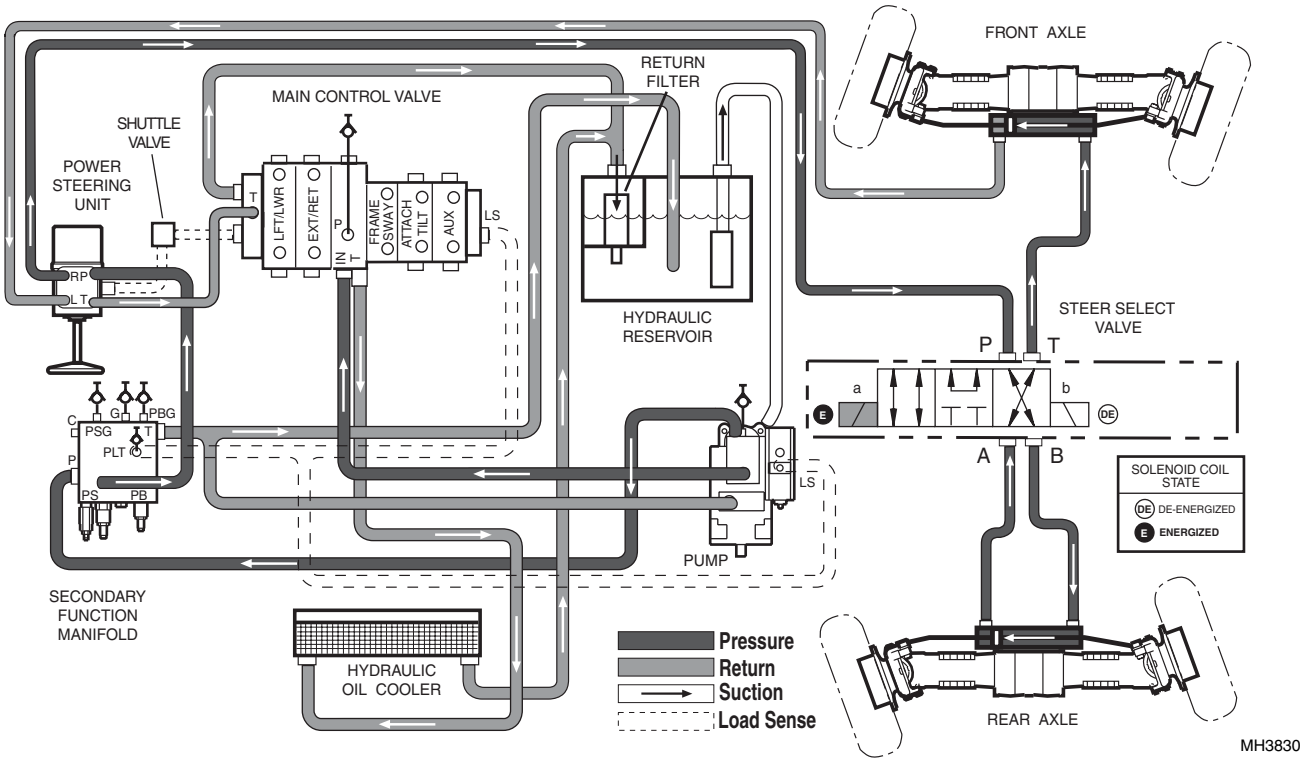
If OK ↓

Check packing in steering cylinders.
Not OK → Repair/replace steering cylinder(s).


If there is no steering, check the steering system electrical components.
Not OK
Refer to the steering circuits and components in Section 9.7, “Electrical System Troubleshooting,” and Section 9.14, “Switches and Solenoids.”
If OK
Check the pressure at the “PSG” port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the “PLT” port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front and rear steering cylinders for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, “ZF Axle Repair Manuals,” for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder.
If there is no four-wheel or crab steering, check the steer select valve.
Not OK
Inspect/replace the steer select valve.
If OK
Check the steer select switch and wiring.
Not OK
Refer to the steering circuits and components in Section 9.7, “Electrical System Troubleshooting,” and Section 9.14, “Switches and Solenoids.”

8.8.18 Four-Wheel Steering Circuit (Right Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:
When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.
Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK ↓

Verify that the check valve fitting at the power steering unit is operating properly.
Not OK → Replace check valve fitting.

If OK ↓

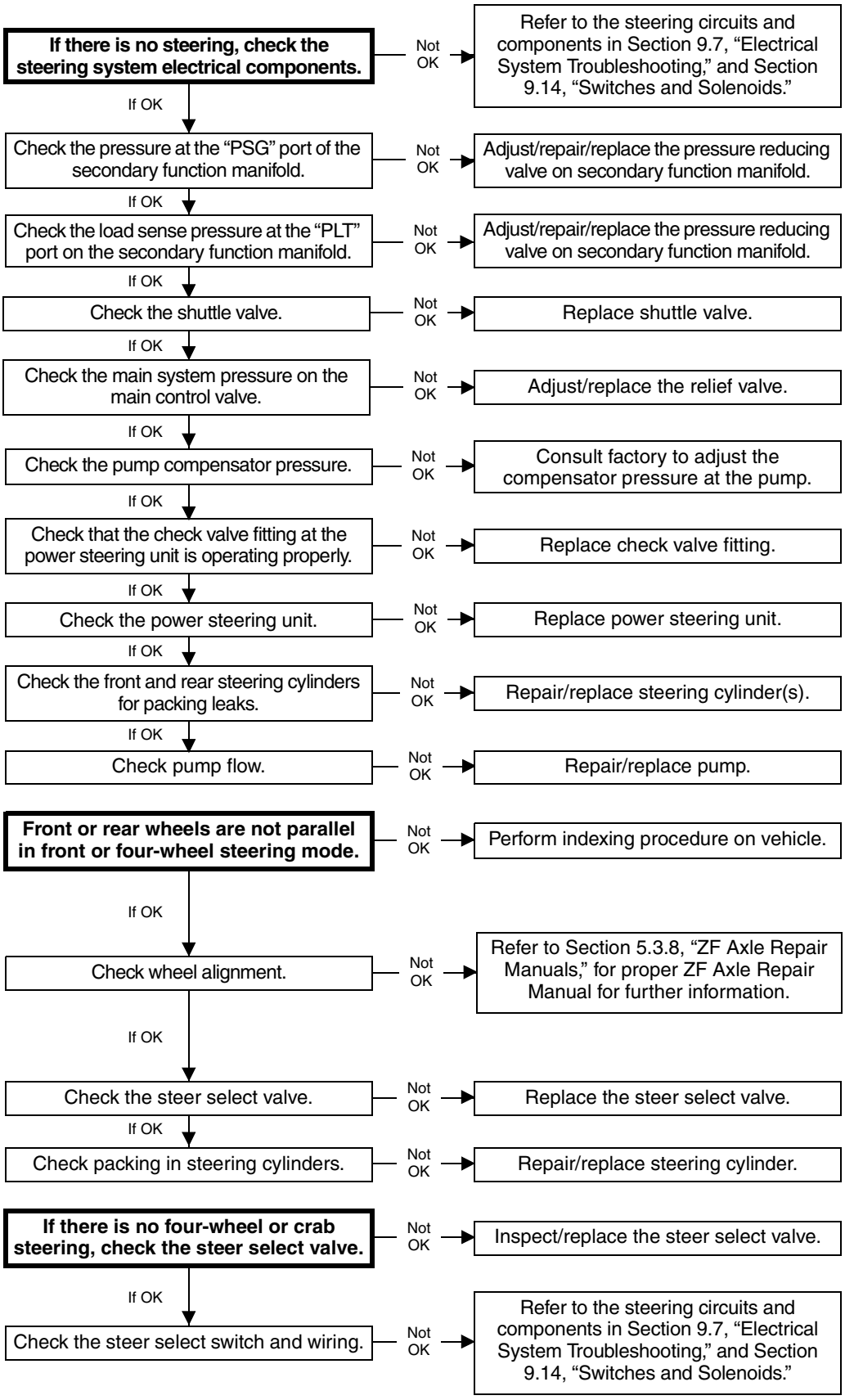
Check the shuttle valve.
Not OK → Replace shuttle valve.

If OK ↓

Check the power steering unit.
Not OK → Replace power steering unit.

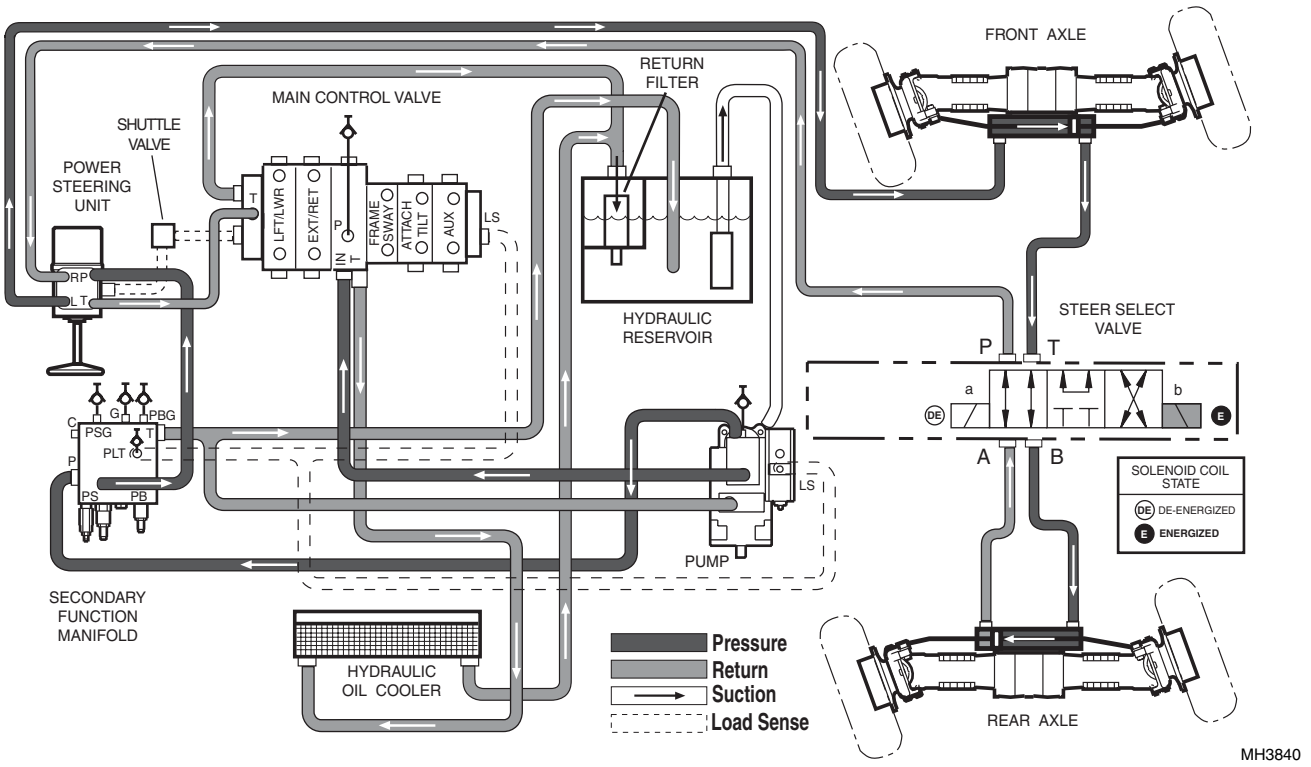
If OK ↓

Check packing in steering cylinders.
Not OK → Repair/replace cylinder(s).


If there is no steering, check the steering system electrical components.
Not OK
Refer to the steering circuits and components in Section 9.7, “Electrical System Troubleshooting,” and Section 9.14, “Switches and Solenoids.”
If OK
Check the pressure at the “PSG” port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the “PLT” port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front and rear steering cylinders for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, “ZF Axle Repair Manuals,” for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder.
If there is no four-wheel or crab steering, check the steer select valve.
Not OK
Inspect/replace the steer select valve.
If OK
Check the steer select switch and wiring.
Not OK
Refer to the steering circuits and components in Section 9.7, “Electrical System Troubleshooting,” and Section 9.14, “Switches and Solenoids.”

8.8.19 Crab Steering Circuit (Left Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**
3. **Air in the lines**

NOTE:

When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.

Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK

Verify that the check valve fitting at the power steering unit is operating properly.

Not OK → Replace check valve fitting.

If OK

Check the shuttle valve.

Not OK → Replace shuttle valve.

If OK

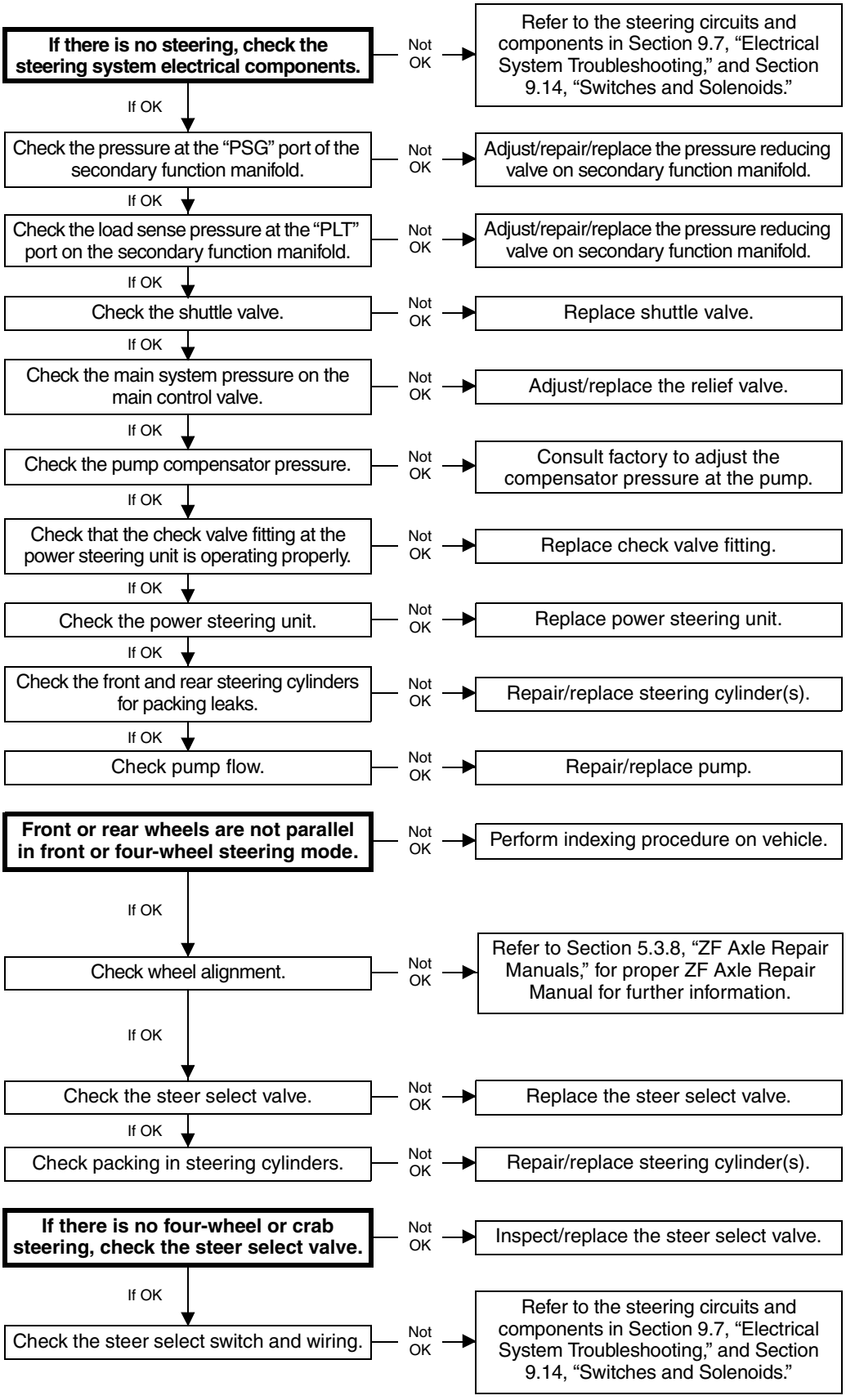
Check the power steering unit.

Not OK → Replace power steering unit.

If OK

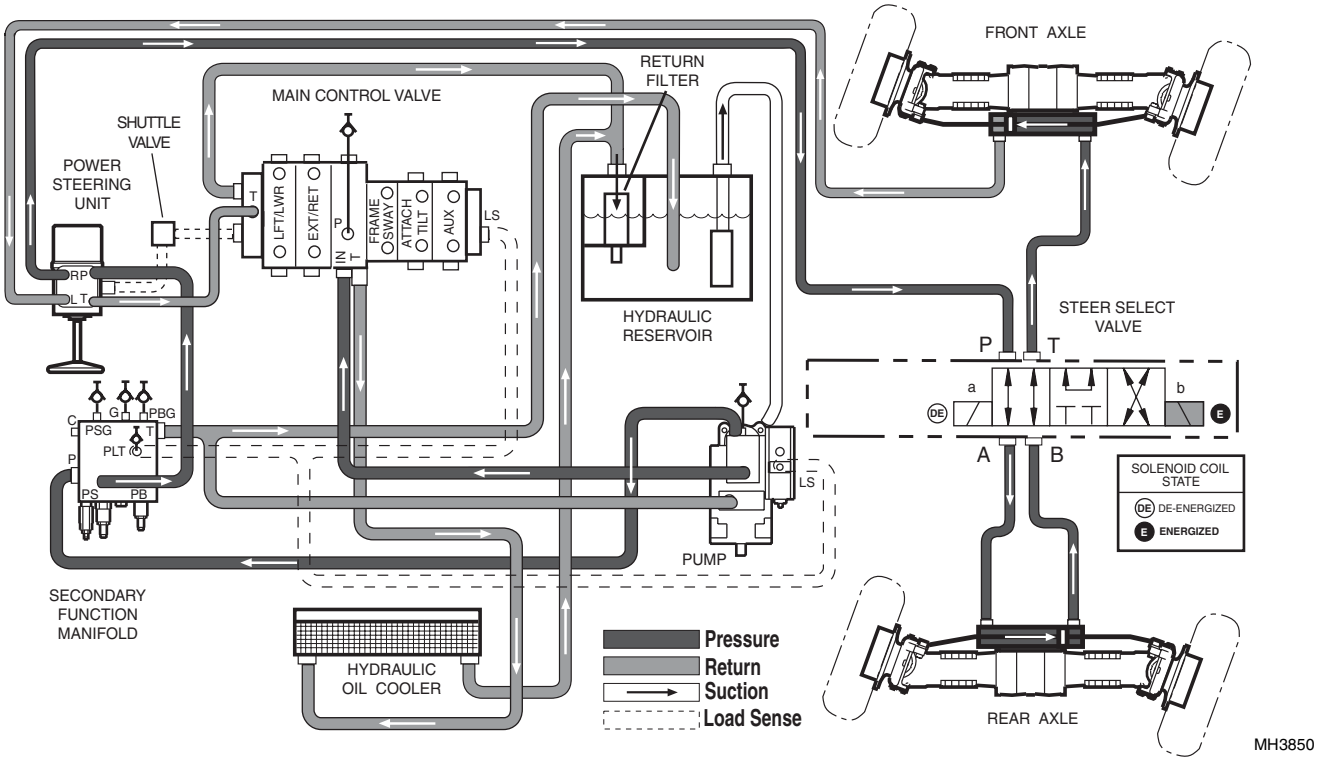
Check packing in steering cylinders.

Not OK → Repair/replace steering cylinder(s).


If there is no steering, check the steering system electrical components.
Not OK
Refer to the steering circuits and components in Section 9.7, "Electrical System Troubleshooting," and Section 9.14, "Switches and Solenoids."
If OK
Check the pressure at the "PSG" port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the "PLT" port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front and rear steering cylinders for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, "ZF Axle Repair Manuals," for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder(s).
If there is no four-wheel or crab steering, check the steer select valve.
Not OK
Inspect/replace the steer select valve.
If OK
Check the steer select switch and wiring.
Not OK
Refer to the steering circuits and components in Section 9.7, "Electrical System Troubleshooting," and Section 9.14, "Switches and Solenoids."

8.8.20 Crab Steering Circuit (Right Turn) and Troubleshooting

(Refer to Section 8.8.29, “Steering Circuit Descriptions,” for a more detailed explanation of this circuit.)



Before troubleshooting any hydraulic circuit, ALWAYS begin by checking the following:

1. **Hydraulic oil level in the reservoir**
2. **All hoses, tubes, fittings for leaks, kinks, interference, etc.**

NOTE:
When checking pressures in circuits, refer to Section 8.7, “Hydraulic System Testing,” for correct pressure readings.

If the steering is slow or difficult, check the pressure at the “PSG” port of the secondary function manifold.
Not OK → Adjust/repair/replace pressure reducing valve on secondary function manifold.

If OK

Verify that the check valve fitting at the power steering unit is operating properly.
Not OK → Replace check valve fitting.

If OK

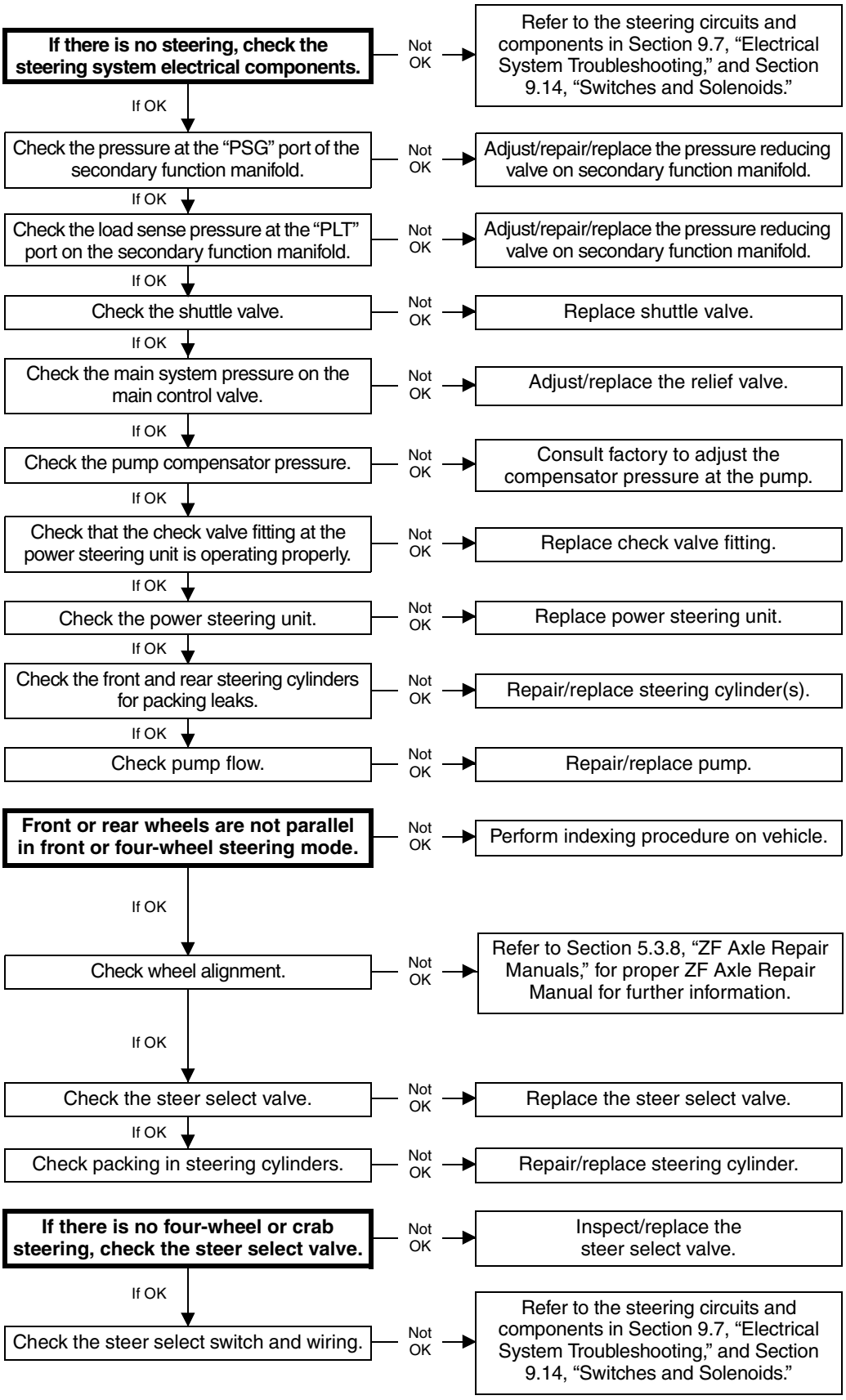
Check the shuttle valve.
Not OK → Replace shuttle valve.

If OK

Check the power steering unit.
Not OK → Replace power steering unit.

If OK

Check packing in steering cylinders.
Not OK → Repair/replace steering cylinder(s).


If there is no steering, check the steering system electrical components.
Not OK
Refer to the steering circuits and components in Section 9.7, "Electrical System Troubleshooting," and Section 9.14, "Switches and Solenoids."
If OK
Check the pressure at the "PSG" port of the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the load sense pressure at the "PLT" port on the secondary function manifold.
Not OK
Adjust/repair/replace the pressure reducing valve on secondary function manifold.
If OK
Check the shuttle valve.
Not OK
Replace shuttle valve.
If OK
Check the main system pressure on the main control valve.
Not OK
Adjust/replace the relief valve.
If OK
Check the pump compensator pressure.
Not OK
Consult factory to adjust the compensator pressure at the pump.
If OK
Check that the check valve fitting at the power steering unit is operating properly.
Not OK
Replace check valve fitting.
If OK
Check the power steering unit.
Not OK
Replace power steering unit.
If OK
Check the front and rear steering cylinders for packing leaks.
Not OK
Repair/replace steering cylinder(s).
If OK
Check pump flow.
Not OK
Repair/replace pump.
Front or rear wheels are not parallel in front or four-wheel steering mode.
Not OK
Perform indexing procedure on vehicle.
If OK
Check wheel alignment.
Not OK
Refer to Section 5.3.8, "ZF Axle Repair Manuals," for proper ZF Axle Repair Manual for further information.
If OK
Check the steer select valve.
Not OK
Replace the steer select valve.
If OK
Check packing in steering cylinders.
Not OK
Repair/replace steering cylinder.
If there is no four-wheel or crab steering, check the steer select valve.
Not OK
Inspect/replace the steer select valve.
If OK
Check the steer select switch and wiring.
Not OK
Refer to the steering circuits and components in Section 9.7, "Electrical System Troubleshooting," and Section 9.14, "Switches and Solenoids."

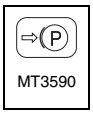
8.8.21 Brake Circuit Description

The brake system circuit, Section 8.8.1, “Brake Circuit and Troubleshooting,” includes the park brake and the service brake, along with the secondary function manifold, main control valve and various hoses, fittings and other components.

When the engine is OFF and the ignition key switch is in the OFF position, the park brake is ON. The park brake is part of the front axle ONLY.

The vehicle is designed so that the service brake can be used to stop the vehicle with the engine OFF. The service brakes are contained within both the front and rear axles. Refer to Section 5, “Axles, Drive Shafts, Wheels and Tires,” for further information.

a. Park Brake Circuit (refer to page 8.18)



Only the front axle is equipped with a spring-applied, pressure-released park brake. The park brake operates via two solenoids at the secondary function manifold. With the engine running and the park brake switch ON, one of the solenoids is normally open and the other is normally closed. This prevents fluid flow in one direction but allows it in another. Spring pressure within the front axle engages the park brake. Oil is prevented from flowing to the front axle and releasing the park brake.

With the engine running and the park brake switch OFF, fluid flows from the hydraulic pump, to the secondary function valve, through the park brake solenoid valve, out the park brake “PB” port and to the park brake section of the front axle. Oil pressure overcomes the spring pressure within the front axle, and the park brake is released. Oil is prevented from flowing back to the reservoir because of the closed solenoid valve at the secondary function manifold.

With the engine OFF and the park brake switch OFF, spring pressure at the front axle engages the park brake.

b. Service Brake Circuit (refer to page 8.18)

A hydraulic line from secondary function manifold “PS” port provides fluid flow to the service brake valve when the engine is running. A line returns oil back to the reservoir from “T” port on the service brake valve. There are also two lines for the rear wheel brakes and a load sense line on the service brake valve. Pressure can be checked at the secondary function manifold “PSG” port and at the pressure tap fitting installed in the rear brake line.

The service brake valve itself is a severe-duty type valve used in a variety of agricultural and commercial applications. The valve actually consists of two identical brake valves mounted next to each other in the same casting. Each valve can operate independently of the other.

Fluid Flow When Brake Pedal is NOT Pressed

System pressure from the pump flows to the main control valve and then to the secondary function manifold. From there, the oil is routed out to the brake valve “P” port. The brake valve is located above the brake pedal and beneath the dash. With the pedal NOT depressed, the spool valves are closed and no oil is allowed to flow to the axles.

Fluid Flow When Brake Pedal is Pressed

System pressure from the pump flows to the main control valve, to the secondary function manifold and to the brake valve. With the pedal depressed, spool valves open and oil is allowed to flow through the brake valve and out to the axles. Valve operation occurs in two modes: the power mode and the manual mode.

In the power mode of operation (engine ON), the service brake valve operates much the same as a pressure reducing valve. As force is applied to the brake pedal, the valve sends oil to the vehicle brakes at pressure that is proportional to the force that is applied to the pedal.

In the manual mode of operation (engine OFF), the brake valve operates as a two-stage pump. The first stage pumps a high volume of oil up to a low amount of pressure. The second stage then pumps a low volume of oil for higher braking pressure.

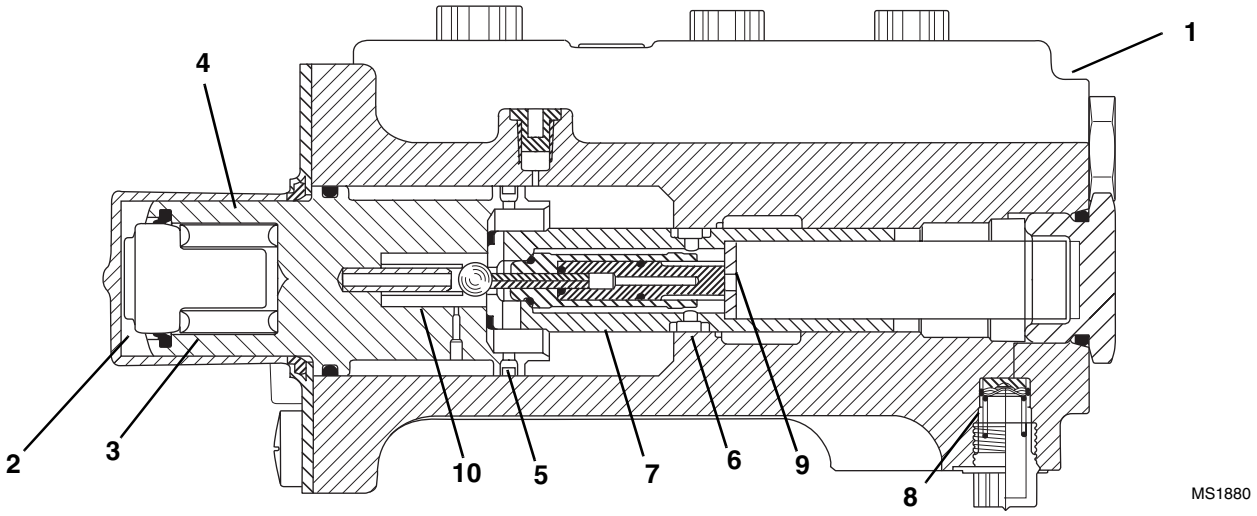
At rest (or standby), system pressure exists at the service brake valve, ready for pedal application.

The steps that follow describe service brake valve function in both of the modes.

Power Mode

When the engine is ON, the brakes operate in the power mode.

1. Displacement of the brake pedal is transmitted to the service brake valve (**1**) at the plunger (**2**).
2. The series spring (**3**) transmits plunger displacement to the piston (**4**). The series spring also absorbs slight pedal pressure variations and helps to provide smoother braking.
3. At rest or standby, system pressure exists at the service brake valve (**1**), and the lines are vented to the reservoir. The reservoir venting is restricted as pedal pressure is applied, causing the piston to contact the piston sealing ring (**5**). The piston (**4**) is blocked when the fluid return metering notches (**6**) on the spool are covered by the spool bore.



4. Pressure in both the front and rear axle brake lines is equal. A groove in each of the two spools opens to a cross-hole between the two spool bores, preventing uneven brake pressure. This feature is called the “equalizer” function.
5. Power-mode braking begins when the metering notches (**6**) in the spool (**7**) meter oil from the inlet port to the spool chamber. Fluid flows from the spool chamber, through the one-way orifice (**8**) and into the brake lines. Brake pressure is controlled by a force balance between the force applied at the pedal and the resulting force from pressure in the spool area.
6. The load sense bleed orifice helps provide stability and aids in purging air from the system.

Manual Mode

In the event that hydraulic pressure at the inlet port is too low to provide the braking force required, the service brake valve automatically transitions to the manual mode to provide braking power.

Flow paths out of the valve that would rob efficiency are automatically blocked in the manual mode. The inlet port check valve seals off the inlet port, and the load sense shutoff valve closes. The service brake valve then acts as a two-stage pump.

1. Brake pedal displacement is transmitted to the service brake valve (**1**) at the plunger (**2**).
2. The series spring (**3**) transmits plunger displacement to the piston (**4**).
3. The piston (**4**) and spool (**7**), functioning as pumps, send oil to the brake lines. Initially, the brake lines are vented to the reservoir by an annular gap between a stepped-down piston diameter and the piston bore. Flow to the reservoir is restricted when the piston contacts the piston sealing ring (**5**).
4. Volume generated by piston displacement causes the spool make-up check device (**9**) to unseat. Fluid flows into the spool chamber and out to the brake lines.
5. Pressure in both the front and rear axle brake lines is equal. A groove in each of the two spools opens to a cross-hole between the two spool bores, preventing uneven brake pressure. This feature is called the “equalizer” function.
6. At a set piston chamber pressure, a relief valve (**10**) begins to meter oil and limits the pressure within the piston chamber. The pressure in the piston chamber becomes isolated from the pressure in the spool chamber when the make-up check device (**9**) reseats itself.
7. Further displacement of the service brake pedal causes higher pressure in the spool chamber. The load sense pin in the make-up check device (**9**) is sensitive to the increased pressure and transmits a force to the relief ball. The increasing force on the relief ball effectively lowers the relief setting within the piston chamber. Eventually, piston chamber pressure reaches zero, and the valve has moved completely from the first stage to the second stage. The smaller area of the second stage permits the brake valve to develop higher braking pressure.

8. Controlling the force applied to the service brake pedal controls the amount of braking power.
9. If the first application of force applied to the service brake pedal was not enough to deliver the braking required, the one way orifices at the work ports help give the brake valve “pump up” ability. The one-way orifices allow unrestricted flow to the brake lines but also restrict the rate of decompression.

8.8.22 Boom Extend/Retract Circuit Description

Hydraulic flow is applied in the boom extend/retract circuit by the hydraulic piston pump through the main control valve. System pressure is directed to either side of the extend/retract cylinder by the shifting of the spool valve in the main control valve. The spool valve is shifted by the operator joystick and its associated control cable.

a. Boom Extend Position (refer to page 8.20)


MA7220

When the joystick is in the boom EXTEND position, the spool valve is shifted by the cable, so flow is directed through extend/retract spool valve ports, through the counterbalance valve to the base end of the extend/retract cylinder. On the 10054 model, the extend lockout valve will prevent boom extension beyond 42 feet unless the outriggers are down. Refer to Section 9.7.43, “10054 Outrigger Circuit and Troubleshooting.” Return oil from the rod end of the cylinder exits through the check valve. The oil will pass from the cylinder to the spool valve, to the oil cooler, to the return filter and then to the reservoir.

If system pressure exceeds 3250 psi (224 bar), the extend/retract port relief will open and allow hydraulic oil to return to the reservoir. If the return filter is plugged, the oil returning to the reservoir bypasses the filter when the internal pressure of the filter reaches 25 psi (1,7 bar).

b. Boom Retract Position (refer to page 8.22)


MA7230

When the joystick is in the boom RETRACT position, the extend/retract spool valve is shifted by the cable so that system pressure is directed through the spool valve, to the rod end of the extend/retract cylinder. The counterbalance valve is piloted open by high pressure, allowing return oil from the base end of the cylinder to flow through the spool valve, to the oil cooler, to the return filter and then to the reservoir.

If system pressure reaches 3250 psi (224 bar), the main relief valve opens, allowing hydraulic oil to return to the reservoir. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 25 psi (1,7 bar) and return to the reservoir unfiltered.

The extend/retract cylinder includes a counterbalance valve and a pilot-operated check valve. The valves serve two main functions. One of the functions is to help prevent component damage. The other valve function can be described as follows:

- If the vehicle is traveling and the boom runs into a solid object, pressure will build up on the base end of the cylinder. Without a counterbalance valve, the cylinder rod would bend, damaging the cylinder. With the counterbalance valve installed, the pressure will build up until it reaches 3250 psi (224 bar) and then the counterbalance valve will be internally piloted open, allowing the pressure to return to the reservoir. This condition will only exist if the cylinder has been extended. If the cylinder is already fully retracted, the counterbalance valve will have no effect and damage can result.
- Should any of the hydraulic lines going to the extend/retract cylinder fail, there will be a loss of hydraulic system pressure to the cylinder. For example, if there was a hydraulic line failure in the pressurized retract line during retracting, the counterbalance valve would lose pilot pressure, closing off flow returning to the reservoir. The oil in the base end of the cylinder would then be trapped, which would immediately stop boom retraction, preventing an elevated load from uncontrolled retraction. The load can be lowered safely to the ground by following the procedures in the appropriate Legacy Owners/Operators Manual.

IMPORTANT: DO NOT *attempt to reset a counterbalance valve cartridge. In the event that a counterbalance valve cartridge was disabled for emergency boom lowering or any unauthorized adjustments are ever made to this cartridge, remove and replace the cartridge with a new part. Failure to replace this cartridge with a new part may alter the holding characteristics of the counterbalance valve, creating an unsafe condition for vehicle operation.*

8.8.23 Boom Lift/Lower Circuit Description

Hydraulic flow is applied in the lift/lower circuit by the hydraulic piston pump through the main control valve. System pressure is directed to either side of the left and right lift/lower cylinders by the shifting of the spool valve in the main control valve. The spool valve is shifted by the operator joystick and its associated control cable.

a. Boom Lift Circuit (refer to page 8.24)

With the joystick in the boom lift position, pressure shifts the lift/lower spool valve in the main control valve to direct system pressure through the counterbalance valve to the base end of both the left and right lift/lower cylinders.

Return oil from the rod end of the cylinders flows through the pilot-operated check valve to the spool valve, to the oil cooler, to the return filter and then to the reservoir.

If system pressure exceeds 3250 psi (224 bar), the main relief will open, allowing oil to return to the reservoir. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 25 psi (1,7 bar) and return to the reservoir unfiltered.

b. Boom Lower Circuit (refer to page 8.26)

When the joystick is in the boom lowering position, pressure shifts the lift/lower spool valve in the main control valve. Oil is then directed to the pilot-operated check valve to the rod end of the left and right lift/lower cylinders. System pressure also pilots open the counterbalance valve in the base end of the lift/lower cylinders.

The open counterbalance valve allows oil from the base of the cylinders to flow to the main control valve, to the oil cooler, to the return filter and then to the reservoir.

If system pressure exceeds 3250 psi (224 bar), the main relief will open, allowing oil to return to the reservoir. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 25 psi (1,7 bar) and return to the reservoir unfiltered.

The counterbalance and pilot-operated check valves serve another main function for safety purposes. This function can be described as follows:

- Should any of the hydraulic lines routed to the lift/lower cylinders fail, there will be a loss of hydraulic system pressure to the cylinder. For example, if a hydraulic line failure occurred in the pressurized lowering line during lowering, the counterbalance valve would lose pilot pressure, closing off flow returning to the reservoir. The oil in the base end of the cylinder would then be trapped, which would immediately stop boom lowering and prevent an elevated load from falling to the ground uncontrolled. The load can be lowered safely to the ground by following the procedures in the appropriate Legacy Owners/Operators Manual.

***IMPORTANT: DO NOT** attempt to reset the counterbalance valve cartridge. In the event that the counterbalance valve cartridge was disabled for emergency boom lowering, or if any unauthorized adjustments are ever made to the cartridge, remove and replace the cartridge with a new part. Failure to replace the cartridge with a new part may alter the holding characteristics of the counterbalance valve, creating an unsafe condition for vehicle operation.*

8.8.24 Frame Sway and Stabilizer Circuit Description

Hydraulic flow is applied in the frame sway circuit by the hydraulic piston pump through the main control valve. System pressure is directed to either side of the frame sway cylinder by the shifting of the spool valve in the main control valve. The spool valve is shifted by the operator joystick and its associated control cable. The stabilizer circuit is connected to the frame sway circuit. For a description of the stabilizer circuit, refer to Section 10.13, “Boom Extend System Hydraulic Circuit Operation and Troubleshooting.”

a. Frame Sway LEFT (refer to page 8.28)

With the joystick moved to the left, the spool valve in the frame sway section of the main control valve assembly is shifted.

System pressure is directed to the spool valve in the main control valve, and from there to the base end of the frame sway cylinder. Oil from the rod end of the frame sway cylinder flows through a check valve, unseated by system pressure, to the stabilizer cylinder, back to the main control valve, to the oil cooler, to the return filter and then to the reservoir.

b. Frame Sway RIGHT (refer to page 8.30)

With the joystick moved to the right, the spool valve in the frame sway section of the main control valve assembly is shifted.

System pressure is directed to the spool valve, back to the frame sway cylinder, where it flows to the rod end of the cylinder. Oil from the base end of the cylinder flows through the check valve, which was unseated by system pressure, then to the spool valve, to the stabilizer cylinder, back to the main control valve, to the oil cooler, to the return filter and then to the reservoir.

8.8.25 Attachment Tilt and Slave Circuit Description

System pressure is applied in the attachment tilt and slave cylinder circuit from the attachment tilt section of the main control valve.

Fluid flow is directed to either side of the attachment tilt and slave cylinder pistons by shifting of the spool valve in the attachment tilt section of the main control valve assembly. The spool valve is shifted by the operator joystick and its associated control cable.

Moving the joystick BACKWARD controls attachment tilt UP. Moving the joystick FORWARD controls attachment tilt DOWN.

a. DOWN Position (refer to page 8.32)

With the joystick moved FORWARD, the attachment tilts DOWN. The spool valve in the main control valve is shifted so system pressure is directed to the rod end of the attachment tilt cylinder and the slave cylinders.

The extension of the slave cylinders is fixed by the position of the boom, so that only the attachment tilt cylinder is retracted to tilt the attachment downward. The pilot pressure opens the counterbalance valve. The open counterbalance valve allows return oil from the base of the attachment tilt cylinder to flow to ports of the attachment tilt section of the main control valve, to the oil cooler, to the return filter and then to the reservoir.

If system pressure reaches 3250 ±100 psi (224 ±7 bar) the main relief will open and allow hydraulic oil to return to the return filter and to the reservoir. In any case, if the return filter becomes restricted, hydraulic oil will bypass the filter when the pressure reaches 25 psi (1,7 bar).

b. UP Position (refer to page 8.34)

With the joystick moved BACKWARD, the attachment tilts UP. The spool valve in the main control valve is shifted so system pressure is directed to the base end of the attachment tilt cylinder and the slave cylinders.

If system pressure reaches 3250 ±100 psi (224 ±7 bar) the main relief will open, allowing hydraulic oil to flow to the return filter and to the reservoir. If the return filter becomes restricted, hydraulic oil will bypass the filter when the pressure reaches 25 psi (1,7 bar).

Return oil from the rod side of the attachment tilt cylinder is directed back to the attachment tilt section of the main control valve through the spool valve, to the oil cooler, to the return filter and then to the reservoir.

If the return filter becomes restricted, hydraulic oil will bypass the filter when the pressure reaches 25 psi (1,7 bar).

8.8.26 Pump and Cooling Circuit Description

In the pump and cooling circuit, the pump draws fluid from the hydraulic reservoir, and sends pressurized fluid to the main control valve.

The main control valve regulates maximum system operating pressure for various vehicle functions. The piston pump sends fluid to the main control valve and to the secondary function manifold. When fluid from the main control valve is returned to the reservoir, it is sent through the hydraulic oil cooler first. There is a return line from the main control valve to the tank that will bypass the cooler when pressure reaches the 65 psi (4.5 bar).

8.8.27 Auxiliary Hydraulics Circuit Description

The auxiliary hydraulics circuit functions can be achieved by moving the auxiliary attachment control lever. Moving the control lever to the left controls auxiliary function in one direction, usually forward, if the auxiliary device is so designed. Moving the control lever to the right controls auxiliary functions in reverse, or the opposite direction.

a. Male Coupler Pressurized (refer to page 8.38)

With the auxiliary attachment control lever moved to the right, pressure will shift the auxiliary spool valve, allowing system pressure to flow from the auxiliary spool valve to the male connection of the auxiliary hydraulics coupler. From the coupler, fluid flows to the attachment, back to the female auxiliary coupler, to the auxiliary spool valve, to the oil cooler, to the return filter and then to the reservoir.

b. Female Coupler Pressurized (refer to page 8.40)

With the auxiliary attachment control lever moved to the left, pressure will shift the auxiliary spool valve, allowing oil to flow from the auxiliary spool valve to the female connection of the auxiliary hydraulic coupler. From the coupler, fluid flows to the attachment, back to the male auxiliary coupler, to the auxiliary spool valve, to the oil cooler, to the return filter and then to the reservoir.

8.8.28 Outrigger Circuit Description (10042/10054)

System pressure is applied to the outrigger circuit through the main control valve to the outrigger valve. Fluid flow is directed to either side of the outrigger cylinders by the outrigger valve. The valve is controlled by the position of the left and right outrigger switches located on the side console.

a. UP Position (refer to page 8.42)

Pressing the top of the left and right outrigger switches will raise the outriggers. Two of the solenoids on the outrigger valve are energized. The spools are shifted allowing flow to the rod end of the outrigger cylinders.

Pilot pressure opens the counterbalance valve. The open counterbalance valve allows return oil from the base end of the outrigger cylinders to flow back to the outrigger valve, to the main control valve, to the oil cooler, to the return filter and then to the reservoir.

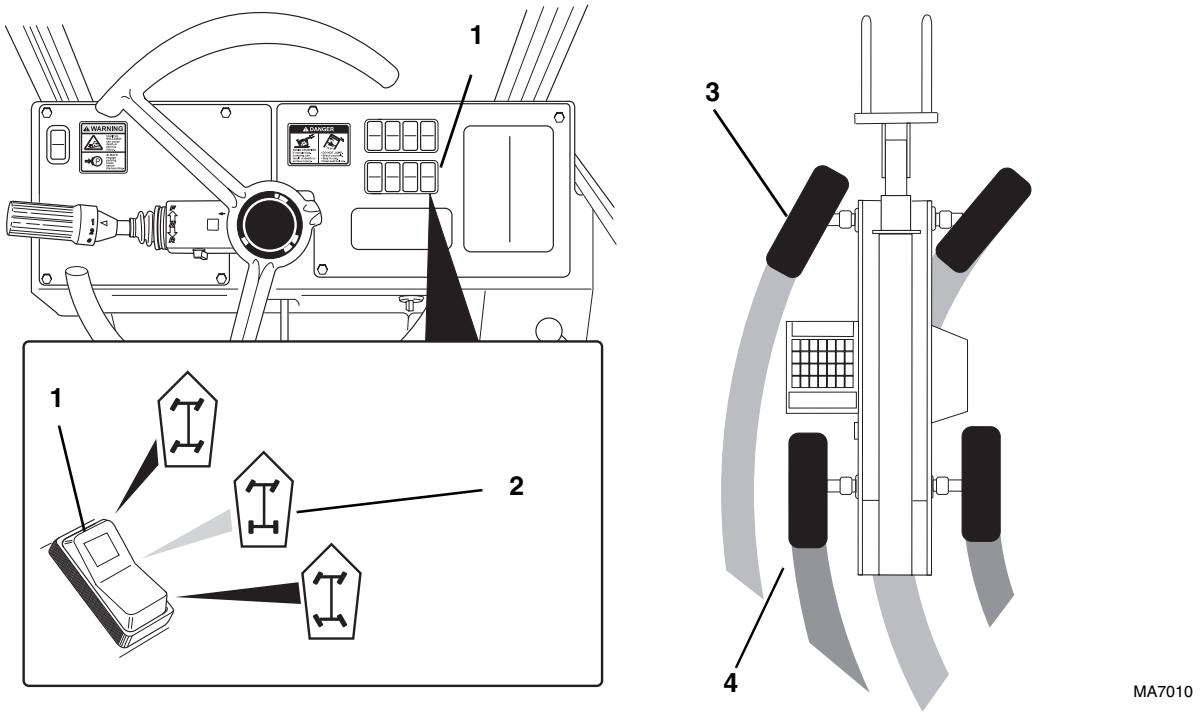
If the return filter becomes restricted, hydraulic oil will bypass the filter when the pressure reaches 25 psi (1,7 bar).

b. DOWN Position (refer to page 8.44)

Pressing the bottom of the left and right outrigger switches will lower the outriggers. The other solenoids on the outrigger valve are energized. The spools are shifted allowing flow to the base end of the outrigger cylinders.

Return oil from the rod side of the outrigger cylinders is directed back through the outrigger valve, to the main control valve, to the oil cooler, to the return filter and then to the reservoir.

If the return filter becomes restricted, hydraulic oil will bypass the filter when the pressure reaches 25 psi (1,7 bar).



8.8.29 Steering Circuit Descriptions

Vehicle steering includes front-wheel steering, four-wheel steering and crab steering.

a. Front-Wheel Steering

When the steer select switch (**1**) is in the front-wheel steer (center) position (**2**), the front wheels (**3**) will steer in the direction the steering wheel is turned and the rear wheels (**4**) will remain fixed.

1. Front-Wheel Steering Left Turn (refer to page 8.46)

In the front-wheel steering mode, when a left turn is made, system pressure from the secondary function manifold is applied through the intake side of the metering section of the power steering unit.

A specific amount of hydraulic oil is exhausted from the metering section and routed to the power steering control valve, internal to the power steering unit, where it is channeled to the left rod end of the front steering cylinder.

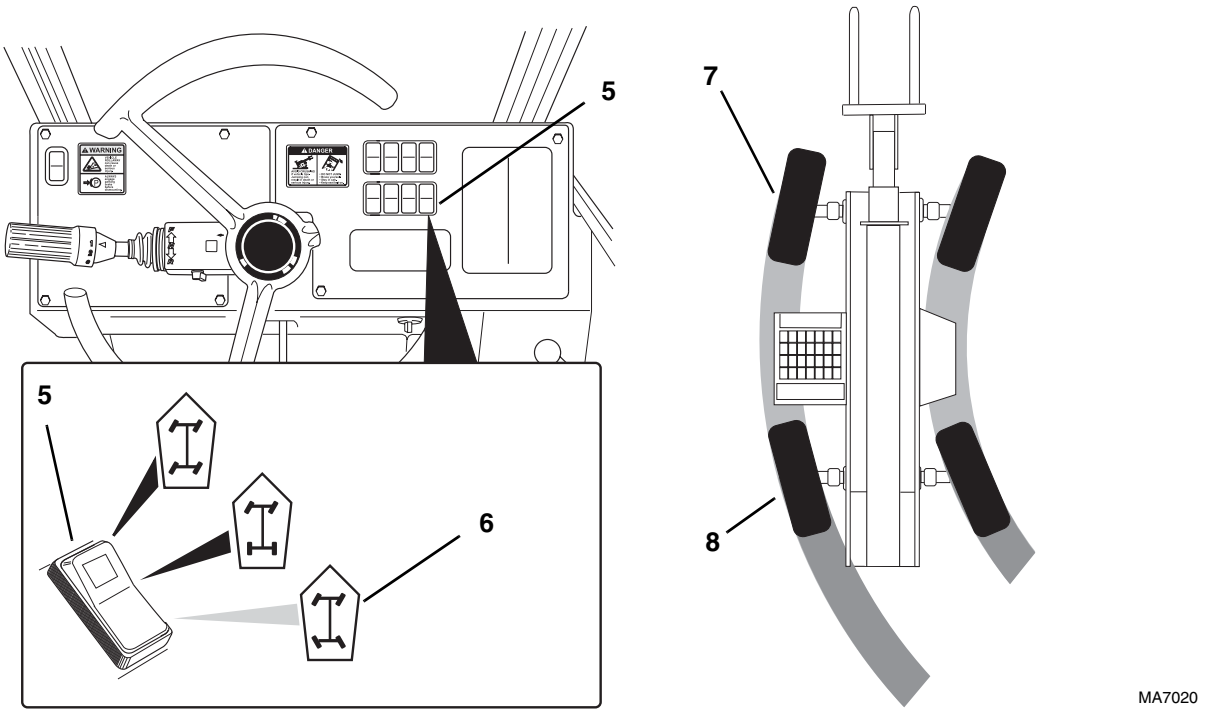
Oil from the right rod end of the front steering cylinder flows through the steer select valve to the power steering unit, then to the oil cooler and to the return filter in the reservoir. Both solenoids in the steer select valve are deenergized.

2. Front-Wheel Steering Right Turn (refer to page 8.48)

When a right turn is made, the steering unit spool is shifted so that system pressure from the secondary function manifold is applied to the intake side of the metering section of the power steering unit.

A specific amount of hydraulic oil is exhausted from the metering section and routed to the power steering control valve, internal to the power steering unit, where it is channeled through the steer select valve to the right rod end of the front steering cylinder. Both solenoids in the steer select valve are de-energized.

Oil from the left rod end of the front steering cylinder flows to the power steering control valve, then to the oil cooler and to the return filter in the reservoir.



b. Four-Wheel Steering

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When the steer select switch (**5**) is in the four-wheel steer (rear) position (**6**), the front wheels (**7**) will steer in the direction the steering wheel is turned and the rear wheels (**8**) will steer in the opposite direction.

1. Four-Wheel Steering Left Turn (refer to page 8.50)

With the steer select switch (**5**) in the four-wheel steer (rear) position (**6**), one of the steer select valve solenoids is energized. The power steering unit control valve spool is shifted so that the system pressure from the secondary function valve is applied to the intake side of the power steering unit metering section.

A specific amount of hydraulic oil is exhausted from the metering section and routed back to the power steering control valve section, internal to the power steering unit, where it is channeled to the left rod end of the front steering cylinder.

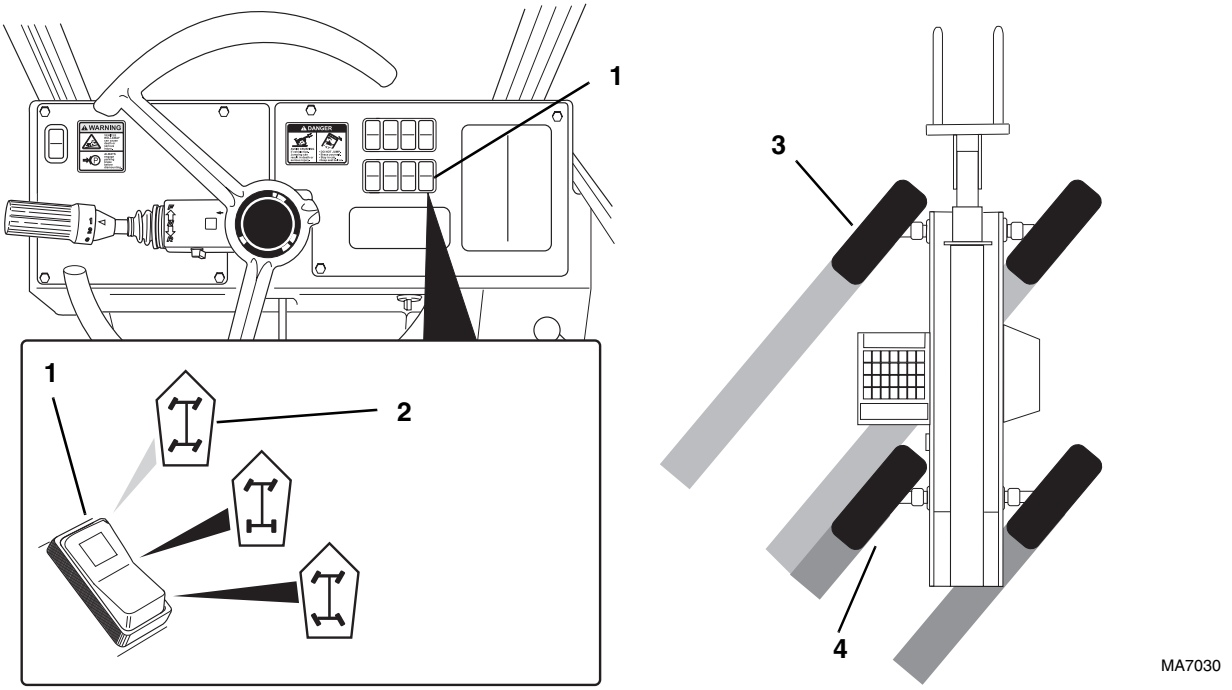
Oil from the right rod end of the front steering cylinder flows through the steer select valve to the left rod end of the rear steering cylinder. Oil from the right rod end of the rear steering cylinder flows through the steer select valve and back to the power steering control valve, then to the return filter in the reservoir.

2. Four-Wheel Steering Right Turn (refer to page 8.52)

With the steer select switch (**5**) in the four-wheel steer (rear) position (**6**), one of the steer select valve solenoids is energized. The power steering unit control valve spool is shifted so that the system pressure from the secondary function manifold is applied to the intake side of the power steering unit metering section.

A specific amount of hydraulic oil is exhausted from the metering section and routed back to the power steering control valve, internal to the power steering unit, where it is channeled through the steer select valve to the right rod end of the rear steering cylinder.

Oil from the left rod end of the rear steering cylinder flows through the steer select valve to the right rod end of the front steering cylinder. Oil from the left rod end of the front steering cylinder flows back to the power steering control valve, then to the return filter in the reservoir.



c. Crab Steering

When the steer select switch (**1**) is in the crab steer (forward) position (**2**), the front wheels (**3**) will steer in the direction the steering wheel is turned and the rear wheels (**4**) will steer in the same direction.

1. Crab Steering Left Turn (refer to page 8.54)

With the steer select switch (**1**) in the crab steer (forward) position (**2**), one of the steer select valve solenoids is energized. The power steering control valve is shifted so that system pressure from the secondary function manifold is applied through the intake side of the power steering unit metering section.

A specific amount of hydraulic oil is exhausted from the metering section and routed back to the power steering control valve, internal to the power steering unit, where it is channeled to the left rod end of the front steering cylinder.

Oil from the right rod end of the front steering cylinder flows through the steer select valve to the right rod end of the rear steering cylinder. Oil from the left rod end of the rear steering cylinder flows through the steer select valve and back to the power steering control valve, then to the return filter in the reservoir.

2. Crab Steering Right Turn (refer to page 8.56)

With the steer select switch (**1**) in the crab steer (forward) position (**2**), one of the steer select valve solenoids is energized. The power steering control valve is shifted so that system pressure from the secondary function manifold is applied through the intake side of the power steering unit metering section.

A specific amount of hydraulic oil is exhausted from the metering section and routed back to the power steering control valve, internal to the power steering unit, where it is channeled through the steer select valve to the left rod end of the rear steering cylinder.

Oil from the right rod end of the rear steering cylinder flows through the steer select valve to the right rod end of the front steering cylinder. Oil from the left rod end of the front steering cylinder flows to the power steering control valve, then to the return filter in the reservoir.

8.9 FOUR-WHEEL STEER INDEXING PROCEDURE

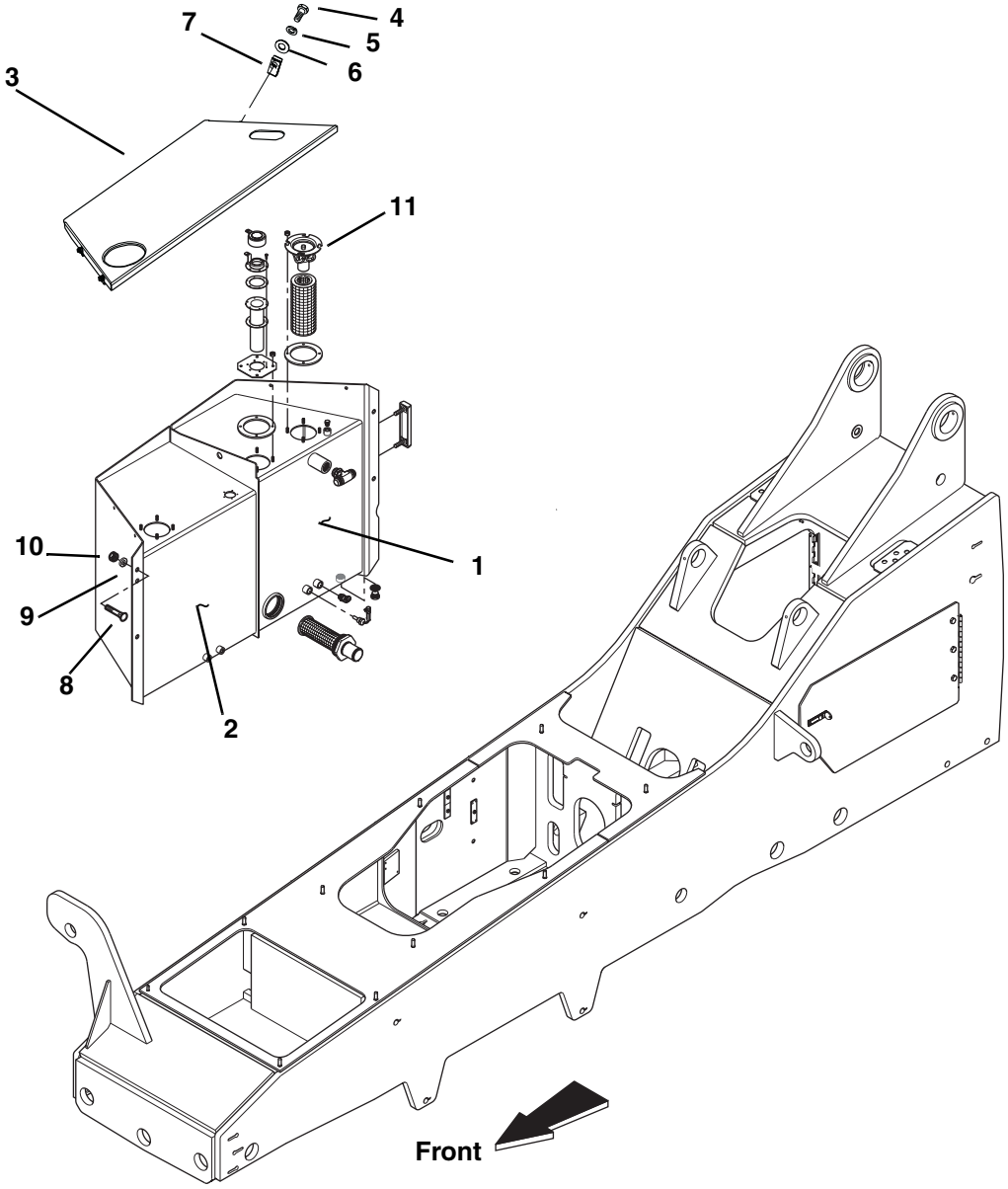
If the vehicle does not drive “straight,” the steering could be out-of-phase. Perform the following indexing procedures to synchronize the front and rear steering.

1. With the steer select switch in the four-wheel steer position, turn the steering wheel full left.
2. While holding the steering wheel full left, toggle the steer select switch to the front-wheel steer position, and steer the front wheels back to center.
3. Toggle the steer select switch back to the four-wheel steer position and turn the steering wheel full left.
4. Toggle the steer select switch back to the front-wheel steer position, and steer the front wheels full left.
5. Toggle the switch to the four-wheel steer position, and return to center.

The vehicle should now be properly indexed in four-wheel steering. If the wheels are still out-of-phase, repeat the above procedure. If, after repeating the above procedure, the wheels are still out-of-phase, refer to Section 8.8.17, “Four-Wheel Steering Circuit (Left Turn) and Troubleshooting,” and Section 8.8.18, “Four-Wheel Steering Circuit (Right Turn) and Troubleshooting.”

8.10 HYDRAULIC RESERVOIR

The hydraulic reservoir (**1**) and the fuel tank (**2**) are one unit. They are located on the right side of the vehicle under a cover (**3**). To remove the fuel tank/hydraulic reservoir cover, remove the capscrews (**4**), lockwashers (**5**) and flat washers (**6**) from the clips (**7**) on the cover. The fuel tank/ hydraulic reservoir is secured to the right side of the vehicle frame with four carriage bolts (**8**), lockwashers (**9**) and hex nuts (**10**).



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Occasionally, fluid may seep, leak or be more forcefully expelled from the filter head (**11**) when system pressure exceeds the rating of the filter head or breather. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 25 psi (1,7 bar) and return to the reservoir unfiltered.

Carefully examine fluid seepage or leaks from the hydraulic reservoir to determine the exact cause. Clean the reservoir and note where any seepage occurs.

DANGER: **NEVER** weld in, on, near or around the hydraulic reservoir. Hydraulic fluid and fumes can cause the reservoir to explode. This can result in death or serious personal injury.

Leaks from a cracked or damaged reservoir require that the reservoir be removed from the vehicle, flushed completely with water and repaired by a certified welder using approved techniques. If these conditions cannot be met, the reservoir must be replaced in its entirety. Contact **Sky Trak** distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, should reservoir welding or replacement be required.

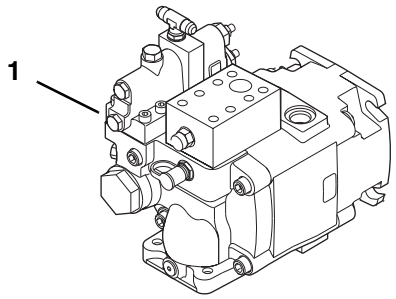
8.10.1 Hydraulic Reservoir Replacement

The fuel tank/hydraulic reservoir (**1** and **2**) are one unit and are removed together. Refer to Section 7A.8.2, “Fuel/Hydraulic Oil Tank,” or Section 7B.8.2, “Fuel/Hydraulic Oil Tank,” for information on the fuel tank/hydraulic reservoir removal. Support the fuel tank/hydraulic reservoir with a suitable device. Loosen, but do not remove, the hex nuts (**10**) on the carriage assemblies. Slide the unit to the right to allow the carriage bolt heads to come through the slots in the frame.

Install the replacement fuel tank/hydraulic reservoir (**1**, **2**), sliding the carriage bolt assemblies into the slots in the frame. Slide the unit to the left and secure it to the vehicle by tightening the hex nuts (**10**).

8.11 HYDRAULIC SYSTEM PUMP

The piston pump (**1**) is attached to the transmission. The rotation of the pump shaft causes the cylinder block, shoe plate and pistons to rotate. The angle of the yoke face creates a reciprocating motion to each piston within the cylinder block. As the pistons move out of the cylinder block, a vacuum is created and fluid is forced into the void through a 2" inside diameter hose by atmospheric pressure. The motion of the piston reverses, and fluid is pushed out of the cylinder block into the outlet port through a 3/4" inside diameter hose to the secondary function manifold.



MH3310

Hydraulic system pressure begins at the pump. Various factors are involved in creating the relatively high pressure used in the hydraulic system. Pump rpm, controlled via a transmission input shaft (and dependent on engine rpm), the internal pump passageways and the differential between pump inlet (2" I.D.) and outlet (3/4" I.D.) openings, all contribute to pressure supplied.

8.11.1 Pump Failure Analysis

The pump is the “heart” of the hydraulic system, and whenever there is a problem in the system, the pump often is blamed. However, pump failure is seldom due to failure of pump components. Pump failure usually indicates another problem in the hydraulic system.

According to pump manufacturer statistics, 90-95 percent of pump failures are due to one or more of the following causes:

- Aeration
- Cavitation
- Contamination
- Excessive Heat
- Over-Pressurization
- Improper Fluid

In the event of pump failure, investigate further to determine the cause of the problem.

8.11.2 Pump Replacement

a. Pump Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

3. Temporarily block up or support the raised boom.

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.

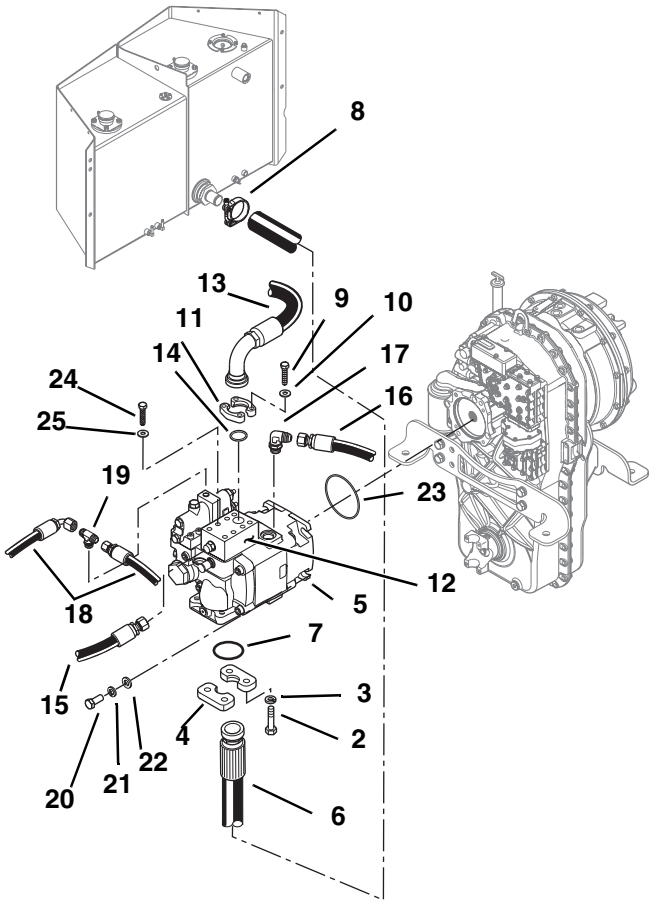
> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

5. Drain the hydraulic oil reservoir. Refer to the appropriate Legacy Owners/Operators Manual, Hydraulic Oil and Filter Change.
6. Remove the transmission covers.
7. Thoroughly clean the pump and surrounding area, including all hoses and fittings before proceeding.

Note: *Cap all hoses as you remove them to prevent unnecessary fluid spillage.*

8. Remove the four capscrews (**2**) and four lockwashers (**3**) securing the flange halves (**4**) to the pump (**5**). Remove the inlet hose (**6**) and o-ring (**7**).

Note: *It is not necessary to remove the T-bolt band clamp (**8**) and inlet hose (**6**) from the hydraulic reservoir outlet connection.*



MH3230

Note: *Before removing any fittings from the pump, note their orientation to ensure correct installation.*

9. Remove the four capscrews (**9**) and four lockwashers (**10**) securing the flange halves (**11**) to the check valve manifold (**12**). Remove the outlet hose (**13**) and o-ring (**14**). Remove the tank hose (**15**) from the check valve manifold.
10. Disconnect the case drain hose (**16**) from the fitting (**17**).
11. Disconnect the load sense lines (**18**) and "T" connection (**19**).
12. Remove the four capscrews (**24**) and four lockwashers (**25**) securing the check valve manifold (**12**) to the pump (**5**). Remove the check valve manifold from the pump.

Note: *On early production units, the check valve is a remote mounted inline type; installed between the pump and the main control valve. For these units, remove the outlet hose from the pump; the check valve can remain in place for pump removal. For these early production units, an update kit is available to update your unit to current production. Contact the JLG Parts Department at 717-485-6472 to order the kit.*

13. Remove the four capscrews (**20**), four lockwashers (**21**) and four plain washers (**22**) securing the pump (**5**) to the transmission. Remove the o-ring (**23**) located between the transmission and the pump. Wipe up any hydraulic oil spillage.

b. Tools Required for Pump Repair

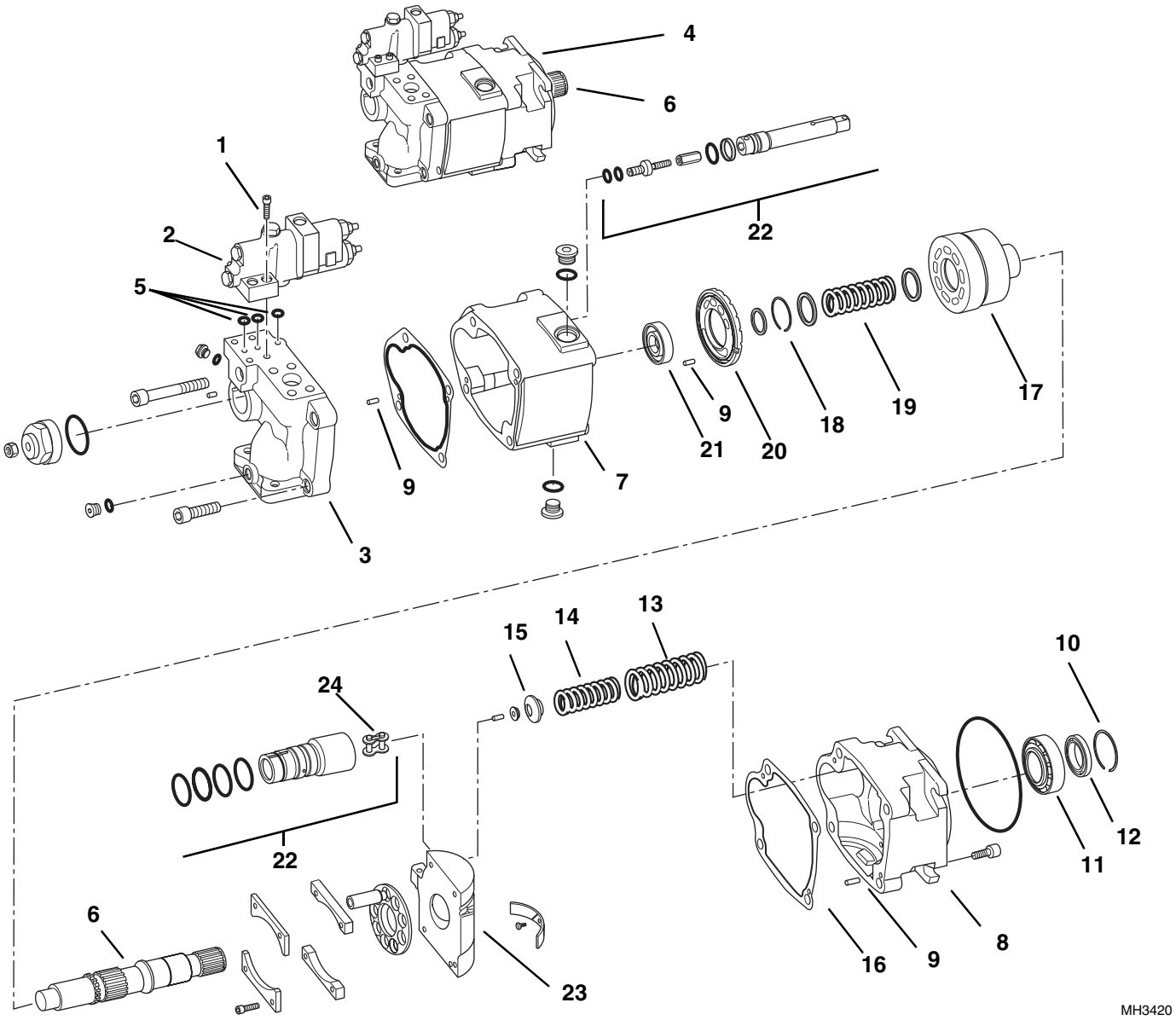
The following tools are used for servicing the pump:

- Ball Peen Hammer
- Plastic Tip Hammer
- Hex (Allen) Wrenches (Metric)
- Wrenches (Metric)
- Flat Tip Screwdriver
- Lock Ring Pliers
- Torque Wrench
- Copper Hammer
- Brass Punch

c. General Repair Precautions

1. To facilitate repair of the pump, and before any work is done, read and understand all of the steps used in the disassembly and assembly procedures.
2. Perform procedures in a clean area. It is important to service hydraulic equipment in an environment as clean as possible.
3. If it becomes necessary to pry sections apart, be extremely careful to avoid damaging the machined surfaces. Excessive force used while prying can result in misalignment and serious damage to parts.
4. Match-mark the exterior surfaces of any housings before separating the components. Use the marks to return components to their original positions during assembly.
5. To help prevent damage, **DO NOT** grip machined surfaces in a vise.

Note: *If parts are difficult to fit together during assembly, tap gently with a soft hammer.* ***NEVER*** *use an iron or steel hammer to tap parts.*



d. Pump Disassembly

1. Remove the four screws (**1**) securing the pressure compensator subassembly (**2**) from the valve housing section (**3**) of the pump (**4**). Remove the three o-rings (**5**).
2. Secure the pump (**4**) with the pump shaft (**6**) pointing up in a suitable holding device or bench vise (if possible).
3. Scribe or otherwise make a mark across the valve housing (**3**), the housing (**7**) and the flange section (**8**), perpendicular to the parting lines for easy identification and proper alignment during assembly later.

Note: *Typically, it will only be necessary to separate the flange section (**8**) from the housing (**7**) and valve block (**3**) sections when disassembling the pump (**4**).*

Note: *If it becomes necessary to pry the components apart when separating pump sections, proceed carefully and **DO NOT** damage the machined surfaces or internal components. Dowel pins (**9**) will remain installed in most cases; **DO NOT** remove dowel pins unless they are damaged.*

4. Remove the shaft seal retaining ring (**10**), using lock ring pliers.
5. Remove the bearing (**11**).

Note: *Check the condition of the shaft seal (**12**). Remove the shaft seal only if replacement is required.*

6. Remove springs (**13** and **14**) and spring seat (**15**).
7. Lift the flange section (**8**) off the housing section (**7**). Remove the gasket (**16**) from between the two sections.

Note: *In most cases, the parts inside the cylinder block (**17**) will not require removal.*

> **CAUTION:** Injury may result if the retaining ring for the cylinder block spring is removed without adequate protection.

8. Pull the shaft (**6**) and the piston rotating assembly (**17**) out of the pump (**4**). **DO NOT** remove the retaining ring (**18**) because the cylinder block spring (**19**) is under high compression.
9. Remove the valve plate (**20**) and bearing (**21**).
10. If necessary, remove the control piston assembly (**22**) from the yoke (**23**) by removing the retaining clip from the chain link (**24**).

e. Pump Cleaning

Clean all pump components with a suitable cleaner such as trichlorethylene.

f. Pump Inspection

1. Inspect internal pump components for wear, damage, etc. If inner surfaces of the pump **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal pump seals and damage to the polished surfaces within the pump and other hydraulic system components.
2. If a dowel pin (**9**) or dowel-mounting hole is damaged, replace the dowel or housing as required.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

3. Seal kits are available. Replace all flexible seals.

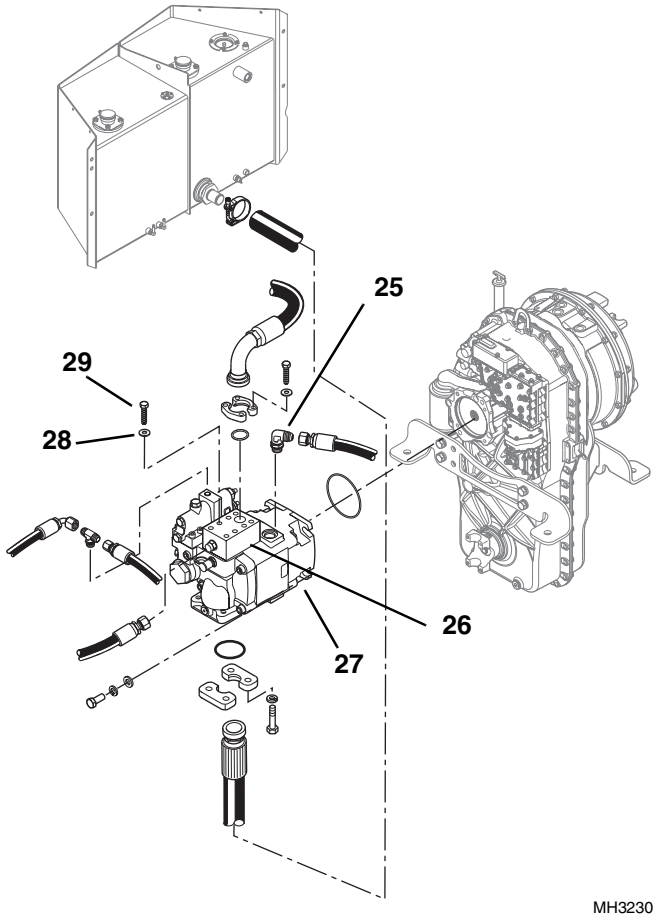
g. Pump Assembly

Assembly is generally performed in the reverse order of disassembly.

1. Rinse all parts in an approved solvent. Blow dry and wipe the parts with a clean, lintless cloth before beginning assembly.
2. If installing, coat the outer edge of a new shaft seal (**12**) with a non-hardening sealant (Permatex® Aviation Form-A-Gasket No. 3 or equivalent). **DO NOT** damage the shaft seal. Press the seal into the housing until seal is flush with the housing recess. Wipe off excess sealant.

h. Pump Installation

1. While the pump is still on the bench, install all fittings, except the outlet hose fitting (**25**), orientating them as noted during removal.
2. Secure the check valve manifold (**26**) onto the pump (**27**) using the four lockwashers (**28**) and four capscrews (**29**).



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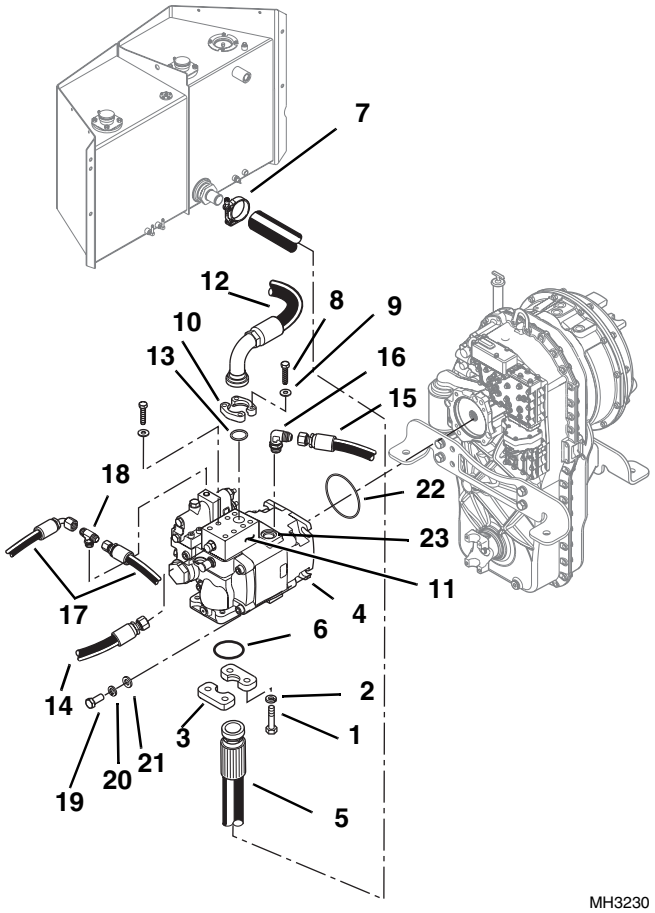
3. Place the pump (**4**) and a new, oiled o-ring (**22**) into position on the transmission. Align the pump shaft with the internal transmission gear, so that the machined teeth mesh together.
4. Align the bolt holes with the pump mount holes. Secure the pump to the transmission with four plain washers (**21**), four lockwashers (**20**) and four capscrews (**19**).
5. If necessary, slide the T-bolt band clamp (**7**) onto the pump inlet hose (**5**). Secure the hose to the hydraulic reservoir outlet connection with the T-bolt band clamp.
6. Place a new oiled o-ring (**6**) into position over the pump opening. Secure the inlet hose (**5**) with two flange halves (**3**), four lockwashers (**2**) and four capscrews (**1**).



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7. Connect the load sense lines (**17**) to the Tee fitting (**18**).
8. Install the tank hose (**14**) onto the check valve manifold (**11**).
9. Place a new, oiled o-ring (**13**) into position over the opening on the check valve manifold (**11**). Secure the outlet hose (**12**) with two flange halves (**10**), four lockwashers (**9**) and four capscrews (**8**).
10. Fill the hydraulic reservoir with clean, filtered hydraulic oil.
11. Prime the pump by filling the case drain port (**23**) with fresh, filtered hydraulic oil from a clean container before installing the case drain connector (**16**) and hose (**15**).
12. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

13. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

WARNING: Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

14. Inspect for leaks and check all fluid levels. The hydraulic reservoir oil level must be to the middle of the sight gauge.

Note: *Check for leaks and repair as required before continuing.*

i. Pump Test

Refer to Section 8.7, “Hydraulic System Testing.”

1. Perform a flow meter test on the pump.
2. Check the load sense.
3. Check the system functions.

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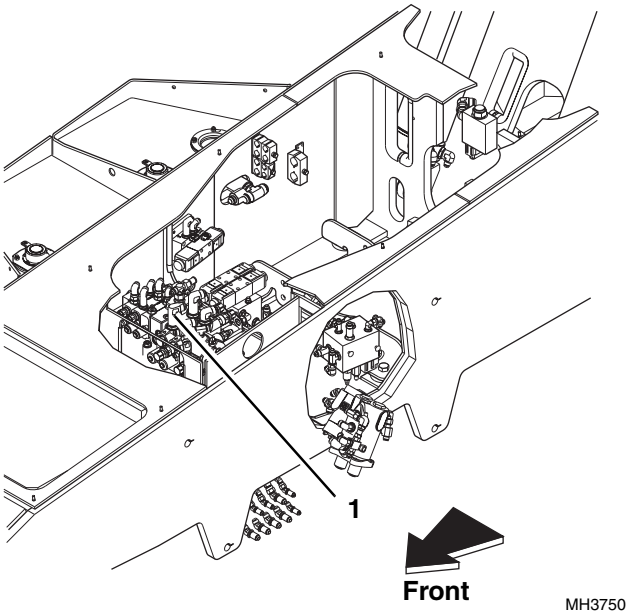
8.12 VALVES AND MANIFOLDS

Valves are devices that open or close passageways. Manifolds contain circuit passageways involved in the distribution of hydraulic fluid flowing under pressure. There are various valves and manifolds in use on this vehicle. As valves open and close, hydraulic fluid is directed to flow through various passageways to the prescribed circuit, causing vehicle functions to occur.

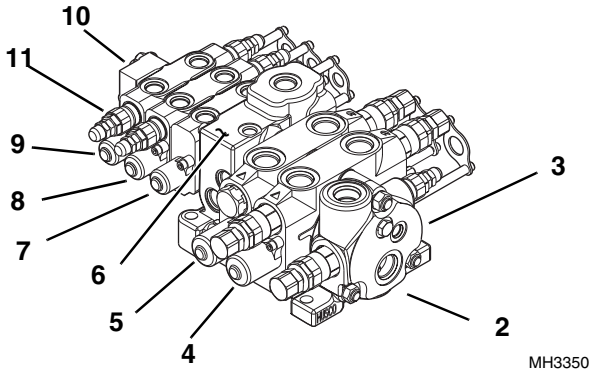
8.12.1 Main Control Valve

The main control valve (**1**) is mounted on the frame under the lower transmission cover.



The main control valve assembly (**2**) consists of various working sections with their own valve assemblies, each providing a specific hydraulic function. The section assemblies are the outlet (**3**), lift/lower (**4**), extend/retract (**5**), mid-inlet/outlet (**6**), frame sway (**7**), attachment tilt (**8**), auxiliary hydraulics (**9**) and load sense outlet (**10**) sections.

Note: *If the vehicle has auxiliary hydraulics installed, the auxiliary hydraulics section will have relief valves (**11**). If the vehicle does not have auxiliary hydraulics installed, the relief valve ports will be plugged.*



a. Main Control Valve Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

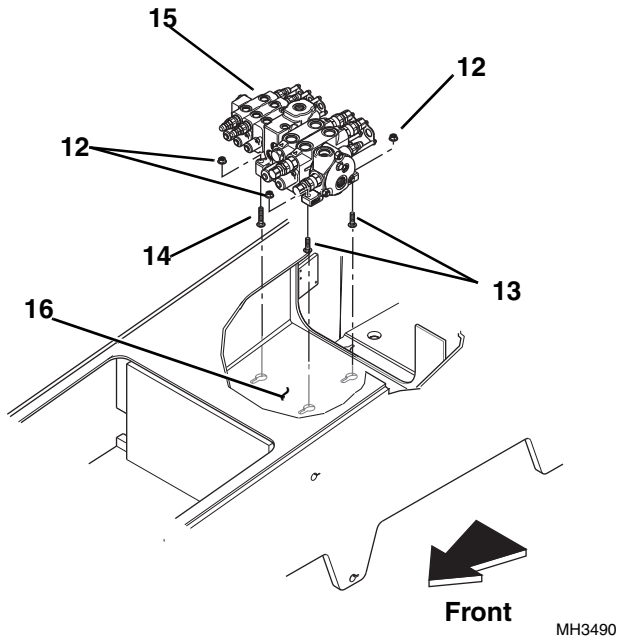
3. Temporarily block up or support the raised boom.

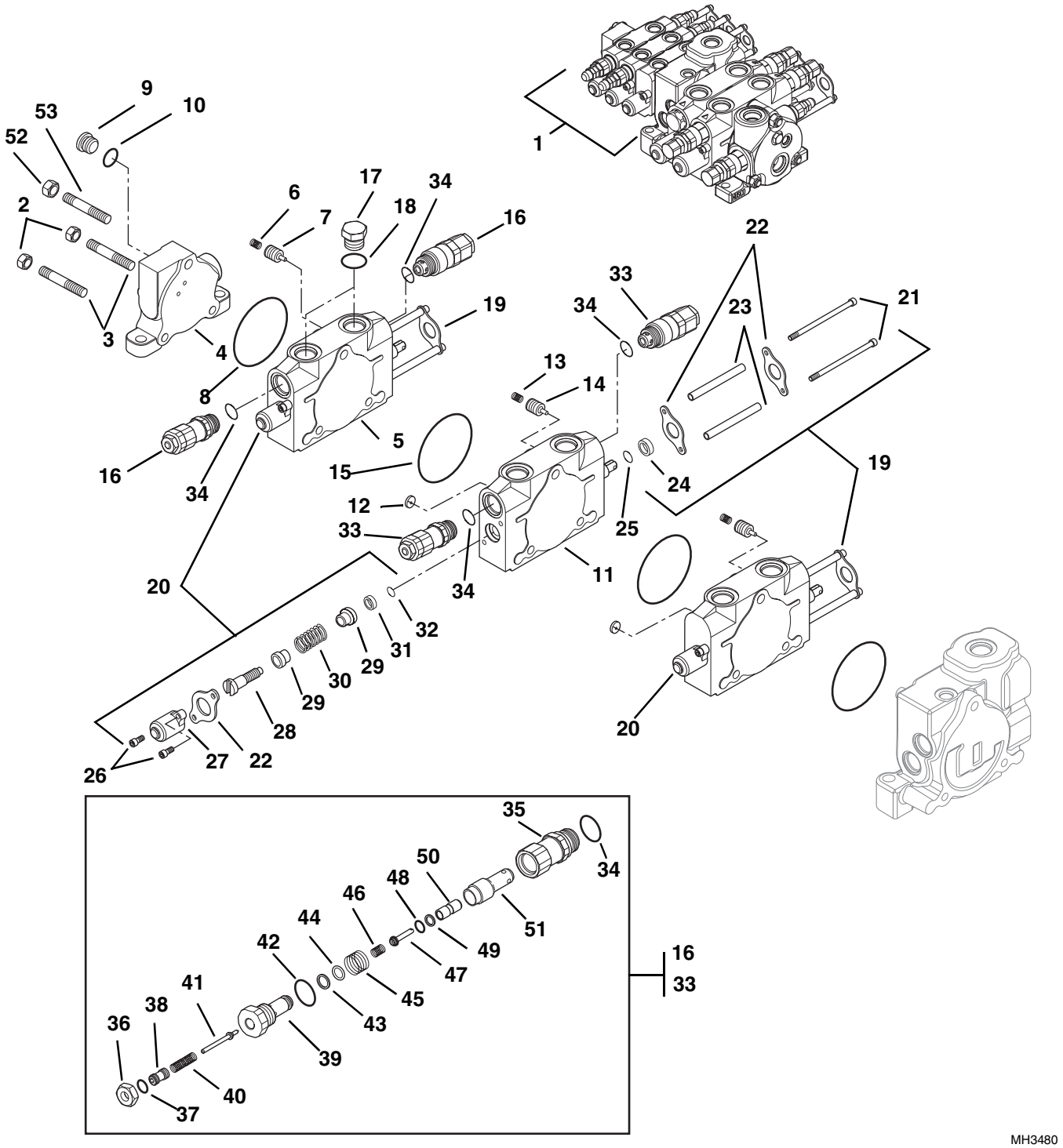
> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

5. With the engine OFF, operate all the hydraulic functions to relieve trapped pressure.
6. Remove the transmission covers. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
7. Place a suitable container to catch hydraulic fluid drainage beneath the frame.
8. Label or otherwise mark and disconnect all the hydraulic hoses, tubes and control cables at the main control valve. Refer to Step 5 in Section 4.3.6, “Joystick Assembly Replacement.”
9. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle and the work area.
10. Remove the three hex flange nuts (**12**) and the carriage bolts (**13** and **14**) securing the main control valve (**15**) to the frame (**16**).
11. Remove the main control valve (**15**) from the frame.

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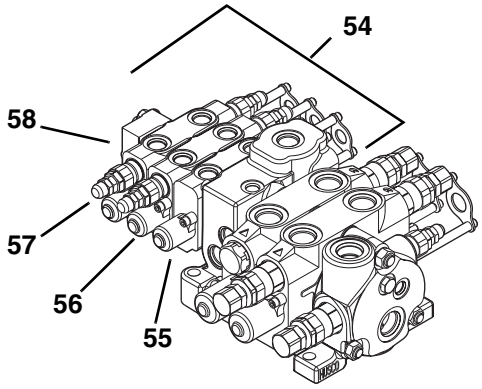
b. Main Control Valve Disassembly

This section covers disassembly of one half (**54**) of the main control valve, including the frame sway (**55**), attachment tilt (**56**), auxiliary hydraulics (**57**) and load sense outlet (**58**) sections of the main control valve.



1. To disassemble the frame sway, attachment tilt, auxiliary hydraulics and load sense outlet sections of the main control valve (**1**), remove the nuts (**2** and **52**) from the end of the tie rods (**3** and **53**). Pull the tie rods out through the sections.
2. Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

***IMPORTANT: DO NOT** adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring recalibration or a new relief valve.*

Disassemble the Load Sense Outlet Section

1. Carefully separate the load sense outlet section (**4**) from the auxiliary hydraulic section (**5**). Avoid dislodging or losing the spring (**6**) and poppet (**7**) in the auxiliary hydraulic section.
2. Remove the o-ring (**8**) from between the two sections.
3. Remove the shut-off plug (**9**) and o-ring (**10**) from the load sense outlet section (**4**).

Disassemble the Auxiliary Hydraulic Section

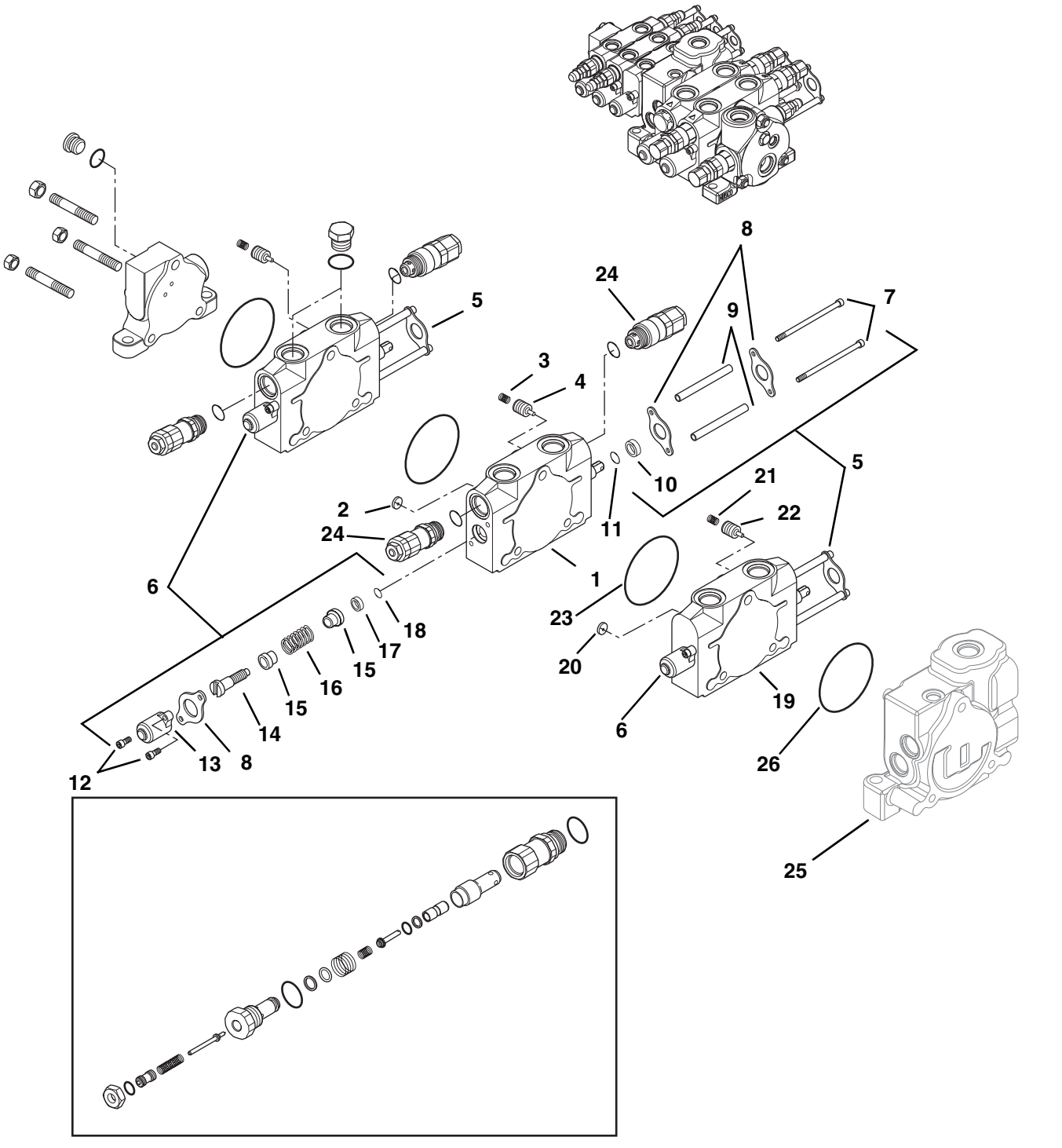
1. Carefully separate the auxiliary hydraulic section (**5**) from the attachment tilt section (**11**). Avoid dislodging or losing the shuttle (**12**), spring (**13**) and poppet (**14**) in the attachment tilt section.
2. Remove the o-ring (**15**) from between the two sections.
3. Remove the spring (**6**) and poppet (**7**) from the auxiliary hydraulic section (**5**).
4. Remove the two relief valves (**16**).
5. Remove the two plugs (**17**), if installed, and o-rings (**18**) from the top of the section.
6. Remove both socket head capscrews (**21**) securing the cable retainer assembly (**19**) to the auxiliary hydraulic section (**5**).
7. Remove the retainer (**22**), both sleeves (**23**), another retainer (**22**), wiper (**24**) and o-ring (**25**) from the cable retainer assembly (**19**).
8. Remove both socket head capscrews (**26**) securing the end mechanism (**20**) to the auxiliary hydraulic section (**5**).
9. Remove the spool cap (**27**), retainer (**22**), spool end (**28**), spring seat (**29**), spring (**30**), another spring seat (**29**), wiper (**31**) and o-ring (**32**) from the end mechanism (**20**).

Disassemble the Relief Valves

***Note:** If the vehicle includes auxiliary hydraulic, there will be relief valve assemblies (**16**) on the auxiliary hydraulic section. The other relief valve assemblies (**33**) are part of the attachment tilt section.*

The relief valves are preset at 3250 ±50 psi (224 ±3,5 bar).

1. Remove the relief valve (**16** or **33**) and o-ring (**34**) from the applicable section assembly.
2. Grip the relief valve body (**35**) with a suitable tool, and use another tool to remove the nut (**36**), revealing an o-ring (**37**) and the adjustment screw (**38**).
3. Carefully remove the plug (**39**), spring (**40**) and pilot poppet (**41**).
4. Remove the large o-ring (**42**), back-up ring (**43**), small o-ring (**44**), large spring (**45**), small spring (**46**), piston (**47**), o-ring (**48**), back-up ring (**49**) and relief valve poppets (**50** and **51**).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Disassemble the Attachment Tilt Section

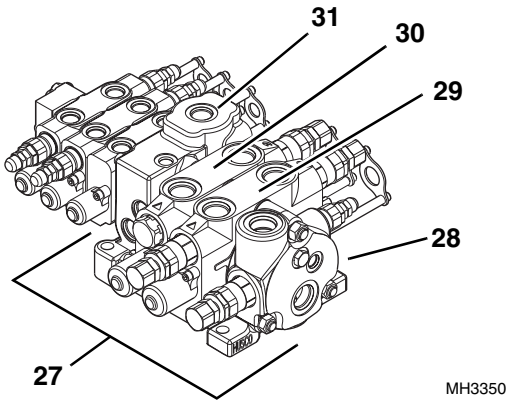
1. Carefully separate the attachment tilt section (**1**) from the frame sway section (**19**). Avoid dislodging or losing the shuttle (**20**), spring (**21**) and poppet (**22**) in the frame sway section.
2. Remove the o-ring (**23**) from between the two sections.
3. Remove the shuttle (**2**), spring (**3**) and poppet (**4**) from the attachment tilt section (**1**).
4. Remove the two relief valves (**24**). Refer to "Disassemble the Relief Valves" on page 8.79.
5. Remove both socket head capscrews (**7**) securing the cable retainer assembly (**5**) to the attachment tilt section (**1**).
6. Remove the retainer (**8**), both sleeves (**9**), another retainer (**8**), spacer (**10**) and o-ring (**11**) from the cable retainer assembly (**5**).
7. Remove both socket head capscrews (**12**) securing the end mechanism (**6**) to the attachment tilt section (**1**).
8. Remove the spool cap (**13**), retainer (**8**), spool end (**14**), spring seat (**15**), spring (**16**), another spring seat (**15**), wiper (**17**) and o-ring (**18**) from the end mechanism (**6**).

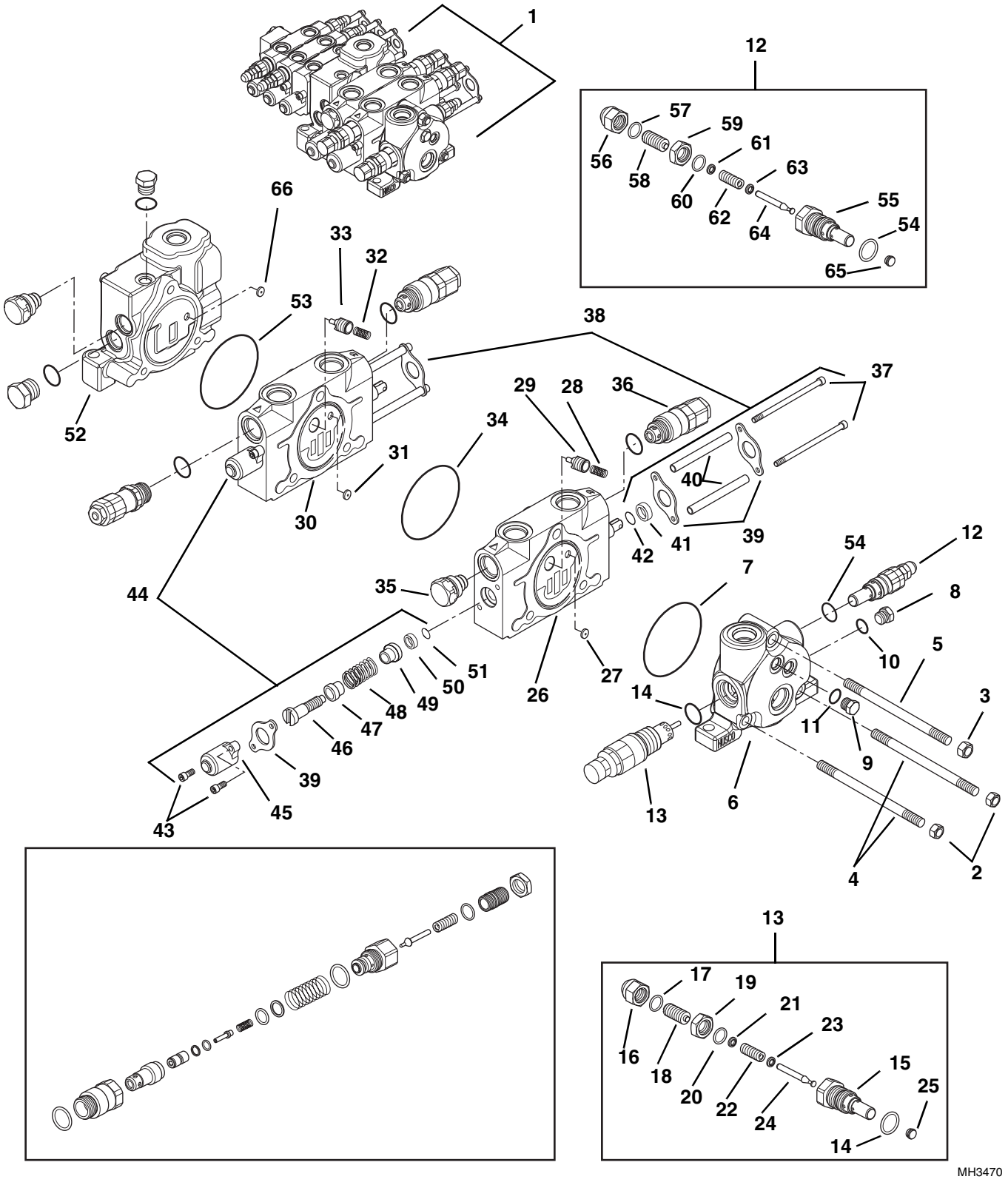
Disassemble the Frame Sway Section

1. Carefully separate the frame sway section (**19**) from the mid-inlet/outlet section (**25**).
2. Remove the o-ring (**26**) from between the two sections.
3. Remove the shuttle (**20**), spring (**21**) and poppet (**22**) from the frame sway section (**19**).
4. Remove the two socket head capscrews (**7**) securing the cable retainer assembly (**5**) to the frame sway section (**19**).
5. Remove the retainer (**8**), both sleeves (**9**), another retainer (**8**), wiper (**10**) and o-ring (**11**) from the cable retainer assembly (**5**).
6. Remove both socket head capscrews (**12**) securing the end mechanism (**6**) to the frame sway section (**19**).
7. Remove the spool cap (**13**), retainer (**8**), spool end (**14**), spring seat (**15**), spring (**16**), another spring seat (**15**), wiper (**17**) and o-ring (**18**) from the end mechanism (**6**).

c. Main Control Valve Disassembly

This section covers the disassembly of the other half (**27**) of the main control valve, including the outlet (**28**), lift/lower (**29**), extend/retract (**30**) and mid-inlet/outlet (**31**) sections of the main control valve.

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1. To disassemble the outlet, lift/lower, extend/retract and mid-inlet/outlet sections of the main control valve (**1**), remove the three nuts (**2** and **3**) from the end of the three tie rods (**4** and **5**). Pull the tie rods out through the section assemblies.
2. Disassemble each section as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

IMPORTANT: DO NOT *adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring recalibration or a new relief valve assembly.*

Disassemble the Outlet Section

1. Carefully separate the outlet section (**6**) from the lift/lower section (**26**). Avoid dislodging or losing the shuttle (**27**), spring (**28**) and poppet (**29**) in the lift/lower section.
2. Remove the o-ring (**7**) from between the two sections.
3. Remove the plugs (**8** and **9**) and o-rings (**10** and **11**) from the outlet section (**6**).

Disassemble the Relief Valves (Outlet Section)

The load sense relief valve (**12**) and the main relief valve (**13**) are part of the outlet section (**6**). The load sense relief valve is preset at 2600 psi (179 bar). The main relief valve is preset at 3500 psi (241 bar).

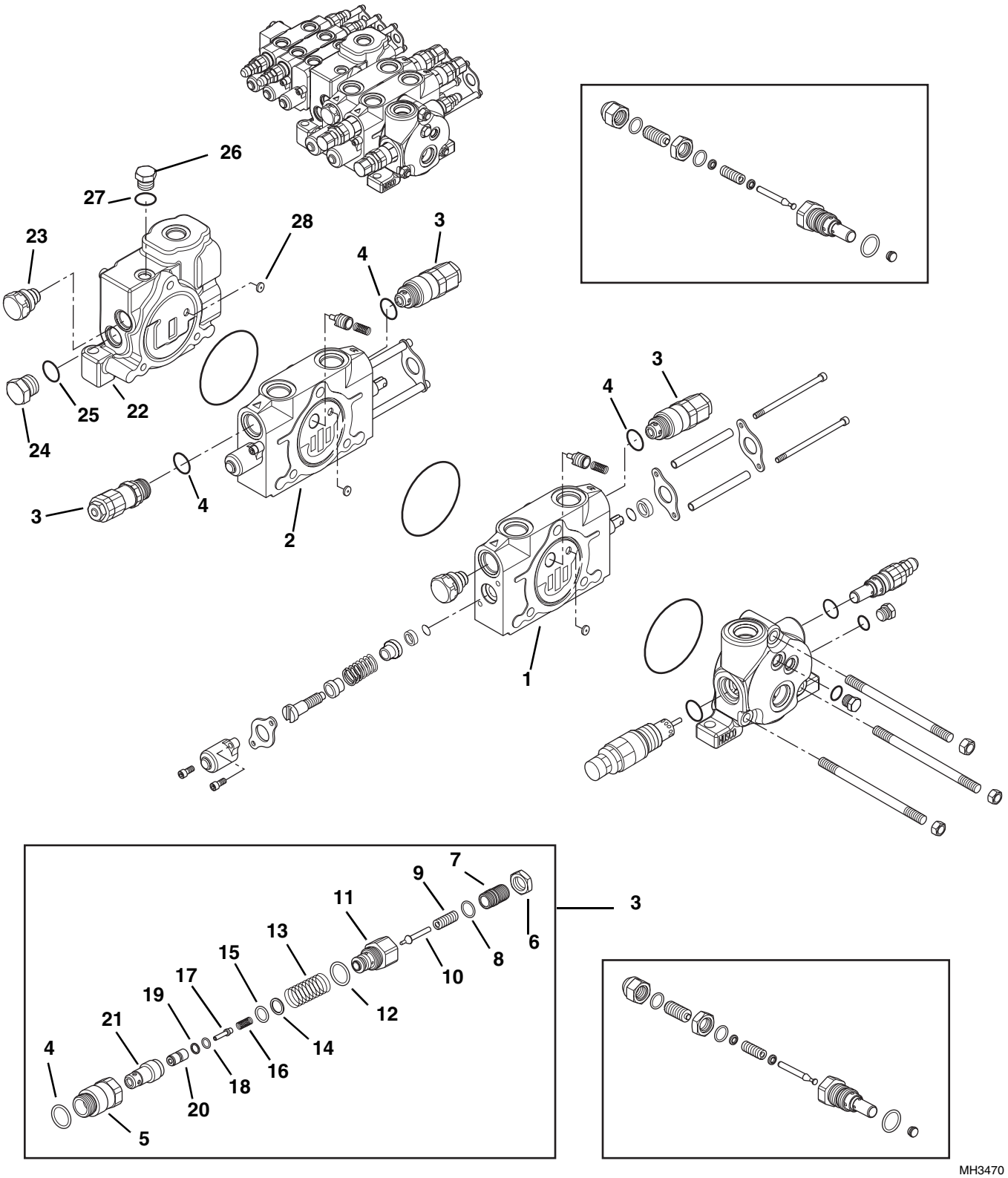
1. Remove the load sense relief valve (**12**) from the outlet section (**6**).
2. Remove the o-ring (**54**) from the relief valve.
3. Grip the relief valve body (**55**) with a suitable tool, and use another tool to remove the nut (**56**), revealing an o-ring (**57**) and the adjustment screw (**58**).
4. Remove the nut (**59**), o-ring (**60**), shim (**61**), spring (**62**), spring retainer (**63**) and poppet (**64**).
5. Remove the plug (**65**) from the body (**55**).
6. Remove the main relief valve (**13**) from the outlet section (**6**).
7. Remove the o-ring (**14**) from the relief valve.
8. Grip the relief valve body (**15**) with a suitable tool, and use another tool to remove the nut (**16**), revealing an o-ring (**17**) and the adjustment screw (**18**).
9. Remove the nut (**19**), o-ring (**20**), shim (**21**), spring (**22**), spring retainer (**23**), and poppet (**24**).
10. Remove the plug (**25**) from the body (**15**).

Disassemble the Lift/Lower Section

1. Carefully separate the lift/lower section (**26**) from the extend/retract section (**30**). Avoid dislodging or losing the shuttle (**31**), spring (**32**) and poppet (**33**) in the extend/retract section.
2. Remove the o-ring (**34**) from between the two sections. Remove the shuttle (**27**), spring (**28**) and poppet (**29**) from the lift/lower section (**26**).
3. Remove the anti-void assembly (**35**) from the lift/lower section (**26**).
4. Remove the relief valve (**36**). Refer to “Disassemble the Relief Valve (Lift/Lower and Extend/Retract Sections)” on page 8.85.
5. Remove both socket head capscrews (**37**) securing the cable retainer assembly (**38**) to the lift/lower section (**26**).
6. Remove the retainer (**39**), both sleeves (**40**), another retainer (**39**), wiper (**41**) and o-ring (**42**) from the cable retainer assembly (**38**).
7. Remove both socket head capscrews (**43**) securing the end mechanism (**44**) to the lift/lower section (**26**).
8. Remove the spool cap (**45**), retainer (**39**), spool end (**46**), spring seat (**47**), spring (**48**), another spring seat (**49**), wiper (**50**) and o-ring (**51**) from the end mechanism (**44**).

Disassemble the Extend/Retract Section

1. Carefully separate the extend/retract section (**30**) from the mid-inlet/outlet section (**52**). Avoid dislodging or losing the shuttle (**66**) from the mid-inlet/outlet section.
2. Remove the o-ring (**53**) from between the two sections.
3. Remove the shuttle (**31**), spring (**32**) and poppet (**33**) from the extend/retract section (**30**).
4. Remove the two socket head capscrews (**37**) securing the cable retainer assembly (**38**) to the extend/retract section (**30**).
5. Remove the retainer (**39**), both sleeves (**40**), another retainer (**39**), wiper (**41**) and o-ring (**42**) from the cable retainer assembly (**38**).
6. Remove both socket head capscrews (**43**) securing the end mechanism (**44**) to the extend/retract section (**30**).
7. Remove the spool cap (**45**), retainer (**39**), spool end (**46**), spring seat (**47**), spring (**48**), another spring seat (**49**), wiper (**50**) and o-ring (**51**) from the end mechanism (**44**).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MH3470

Disassemble the Relief Valve (Lift/Lower and Extend/ Retract Sections)

The relief valves (**3**) on the lift/lower section (**1**) and the extend/retract section (**2**) are preset at 3250 ±50 psi (224 ±3,5 bar).

1. Remove the relief valve (**3**) from the appropriate section.
2. Remove the o-ring (**4**) from the relief valve.
3. Grip the relief valve body (**5**) with a suitable tool and use another tool to remove the nut (**6**), revealing an adjustment screw (**7**) and an o-ring (**8**).
4. Remove the spring (**9**) and poppet (**10**) from the plug (**11**).
5. Remove the o-ring (**12**), large spring (**13**), back-up ring (**14**), o-ring (**15**), small spring (**16**), poppet (**17**), o-ring (**18**), back-up ring (**19**), small poppet (**20**) and large poppet (**21**) from the body (**5**).

Disassemble the Mid-Inlet/Outlet Section

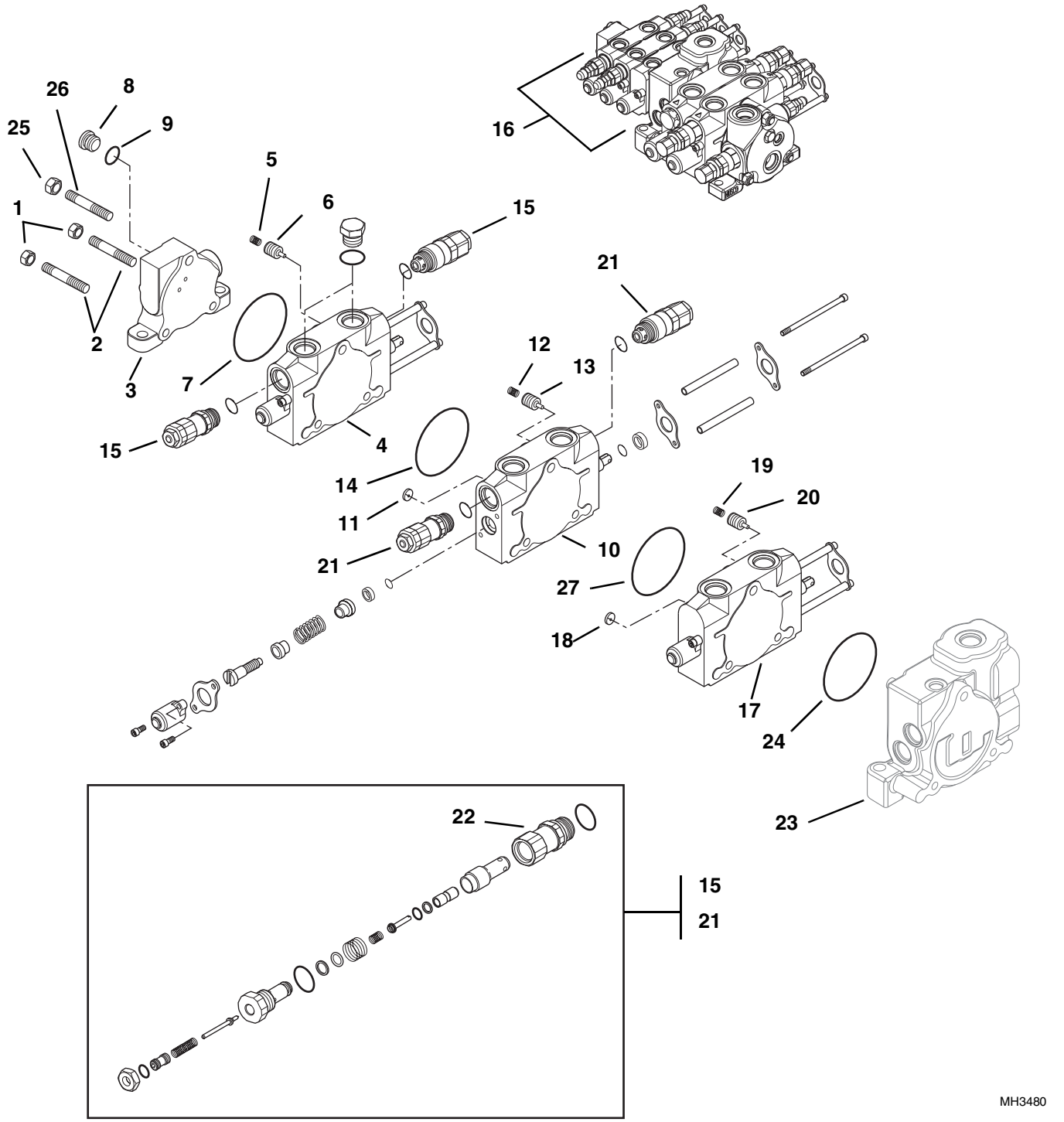
1. Remove the shuttle (**28**) from the mid-inlet/outlet section (**22**).
2. Remove the shut-off plug (**23**).
3. Remove the remaining plugs (**24** and **26**) and o-rings (**25** and **27**).

d. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as triclorethylene, before continuing. Blow dry.

e. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.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MH3480

f. Main Control Valve Assembly

This section covers the assembly of the load sense outlet, auxiliary hydraulics, attachment tilt and frame sway sections of the main control valve (**16**).

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

Assemble the Load Sense Outlet Section

1. Install a new oiled o-ring (**9**) and the plug (**8**) into the load sense section (**3**).
2. Loosely install three tie rod nuts (**1** and **25**) onto tie rods (**2** and **26**) and insert into the load sense section (**3**). At the end of the assembly procedure when all main control valve sections are in place, the two tie rod nuts (**1**) will be torqued 13-15 lb-ft (18-20 Nm) and the third tie rod nut (**25**) to 30-36 lb-ft (41-49 Nm).

Assemble the Auxiliary Hydraulics Section

1. Assemble the auxiliary hydraulics section (**4**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Auxiliary Hydraulic Section” on page 8.79.
2. Insert the spring (**5**) and poppet (**6**) into the auxiliary hydraulics section (**4**).
3. Place a new oiled o-ring (**7**) between the auxiliary hydraulics section (**4**) and the load sense outlet section (**3**), and slide the auxiliary hydraulics section onto the tie rods.

*Assemble the Relief Valves for the Auxiliary Hydraulics Section (**4**) and Attachment Tilt Section (**10**), if installed.*

Note: *There is a seal and spring kit package for assembling the relief valves.*

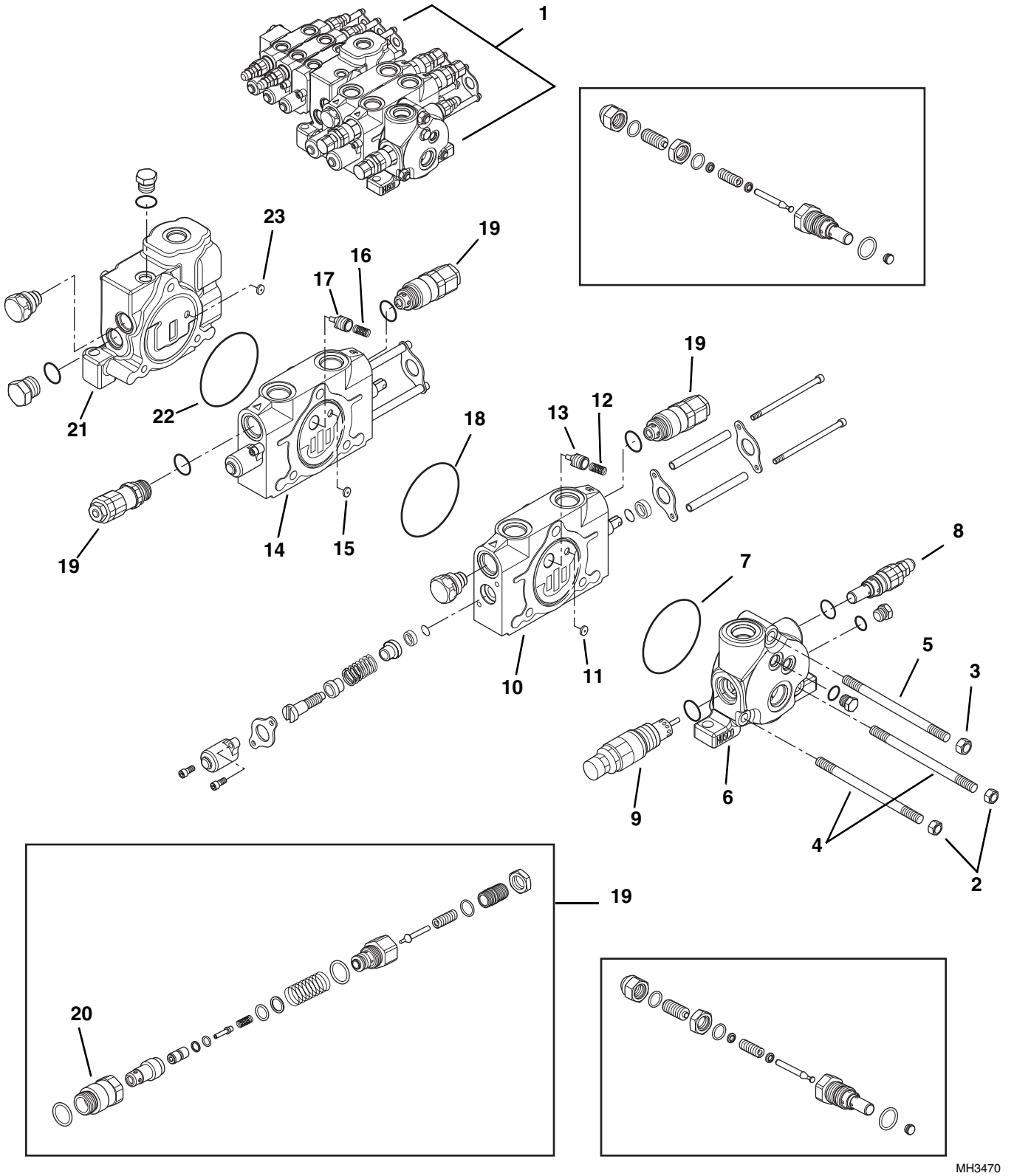
1. Assemble the relief valves (**15** and **21**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Relief Valves” on page 8.79.
2. Using a wrench on the body (**22**), install the relief valve onto the section.

Assemble the Attachment Tilt Section

1. Assemble the attachment tilt section (**10**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Attachment Tilt Section” on page 8.81.
2. Insert the shuttle (**11**), spring (**12**) and poppet (**13**) into the attachment tilt (**10**) section.
3. Place a new oiled o-ring (**14**) between the attachment tilt section (**10**) and the auxiliary hydraulics section (**4**), and slide the attachment tilt section onto the tie rods.

Assemble the Frame Sway Section

1. Assemble the frame sway section (**17**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Frame Sway Section” on page 8.81.
2. Insert the spring (**19**), poppet (**20**) and shuttle (**18**) into the frame sway section.
3. Place a new oiled o-ring (**27**) between the frame sway section (**17**) and the attachment tilt section (**10**) and slide the frame sway section onto the tie rods.
4. Place a new oiled o-ring (**24**) on the frame sway section (**17**), and set entire assembly aside. It will be attached to the mid-inlet/outlet section (**23**) via the tie rods at the end of the assembly procedure.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g. Main Control Valve Assembly

This section covers assembly of the outlet, lift/lower, extend/retract and mid-inlet/outlet sections of the main control valve (**1**).

Note: *ALWAYS replace o-rings with new o-rings lubricated with clean hydraulic oil to help ensure a leak-proof seal and proper vehicle performance.*

Assemble the Outlet Section

1. Assemble the outlet section (**6**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Outlet Section” on page 8.83.
2. Screw three nuts (**2** and **3**) onto three tie rods (**4** and **5**) and insert into the outlet section (**6**).

Assemble the Relief Valves (Outlet Section)

Note: *There is a seal and spring kit for assembling the relief valve.*

1. Assemble the load sense (**8**) and main relief valves (**9**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Relief Valves (Outlet Section)” on page 8.83.
2. Install the load sense (**8**) and the main relief valve (**9**) onto the outlet section (**6**).

Assemble the Lift/Lower Section

1. Assemble the lift/lower section (**10**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Lift/Lower Section” on page 8.83.
2. Insert the shuttle (**11**), spring (**12**) and poppet (**13**) into the section.
3. Place a new oiled o-ring (**7**) between the outlet section (**6**) and the lift/lower section (**10**), and slide the lift/lower section onto the tie rods.

Assemble Relief Valves (Extend/Retract and Lift/Lower Sections)

There are two relief valves (**19**) on the extend/retract section (**14**). On the lift/lower section (**10**), the relief valve (**19**) is on the “A” side. The relief valves are preset at 3250 ±50 psi (224 ±3,5 bar).

Note: *There is a seal and spring kit* for assembling the relief valves.

For each relief valve (**19**):

1. Assemble the relief valve (**19**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Relief Valve (Lift/Lower and Extend/Retract Sections)” on page 8.85.
2. Using a wrench on the body (**20**), install the relief valve (**19**) into the appropriate section assembly.

Assemble the Extend/Retract Section

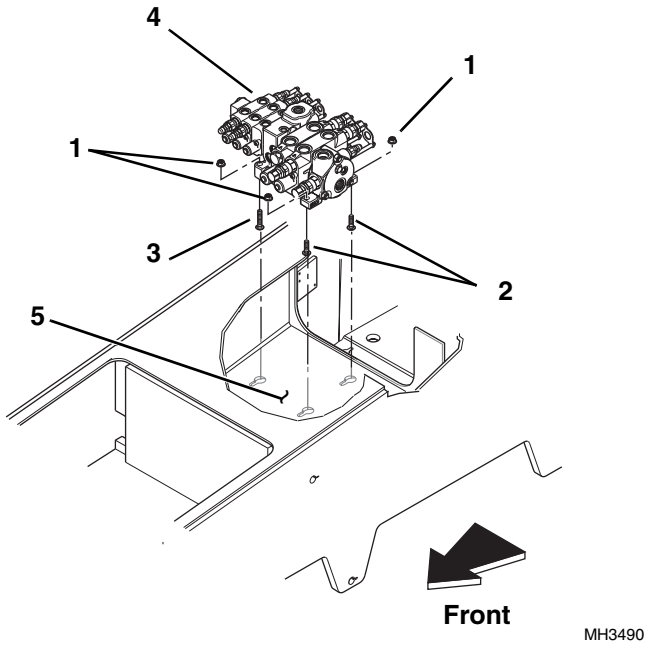
1. Assemble the extend/retract section (**14**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Extend/Retract Section” on page 8.83.
2. Insert the shuttle (**15**), spring (**16**) and poppet (**17**) into the extend/retract section (**14**).
3. Place a new oiled o-ring (**18**) between the extend/retract section (**14**) and the lift/lower section (**10**) and slide the extend/retract section onto the tie rods.

Assemble the Mid-Inlet/Outlet Section

1. Assemble the Mid-Inlet/Outlet section (**21**) in the reverse order of the disassembly procedure. Refer to “Disassemble the Mid-Inlet/Outlet Section” on page 8.85.
2. Insert the shuttle (**23**) into the mid-inlet/outlet section (**21**).
3. Place a new oiled o-ring (**22**) between the extend/retract section (**14**) and the mid-inlet/outlet section (**21**).
4. Torque the two tie rod nuts (**2**) to 43-53 lb-ft (58-72 Nm) and the third tie rod nut (**3**) to 66-82 lb-ft (89-111 Nm), holding all sections together.
5. Retrieve the attachment tilt, frame sway and auxiliary assembly. Tighten the three tie rod nuts from this assembly into the mid-inlet/outlet section. Refer to “Assemble the Load Sense Outlet Section” on page 8.87, Step 2 for the torque values.
6. Ensure that the large o-ring in the frame sway section is properly seated between the frame sway section and the mid-inlet/outlet section. Refer to “Assemble the Frame Sway Section” on page 8.87, Step 4.

h. Main Control Valve Installation

1. Insert the carriage bolts (**2** and **3**) from the bottom into the main valve (**4**).



2. Loosely install the hex flange nuts (**1**) onto the carriage bolts (**2** and **3**).
3. Install the main control valve (**4**) into the vehicle, aligning the carriage bolt heads (**2** and **3**) with the slots (**5**) in the frame. Slide the main valve into position, and tighten the nuts (**1**).
4. Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.
5. Use new oiled o-rings as required. Reattach and secure all hoses, clamps, etc. to the main control valve.
6. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

WARNING: Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

9. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.
10. Install the transmission covers.

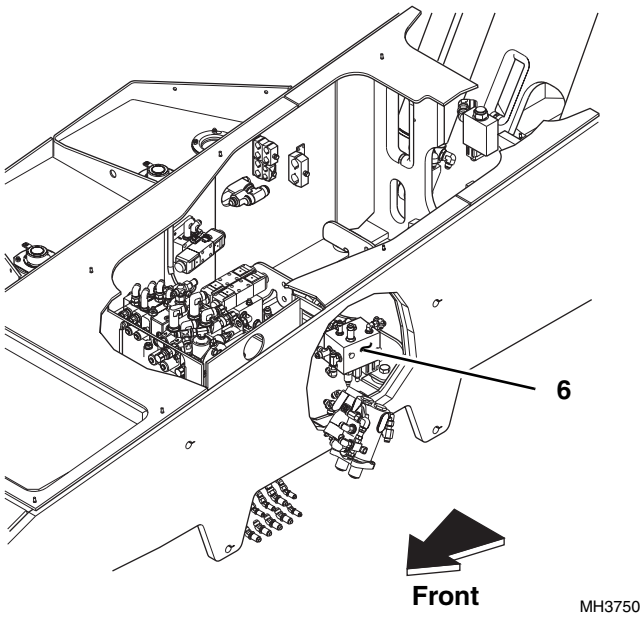
i. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.7, “Hydraulic System Testing.”

8.12.2 Secondary Function Manifold

The secondary function manifold (**6**) is a directional control valve. Hydraulic oil from the pump flows into the secondary function manifold where the pressure is reduced before the oil is directed to the power steering unit or the park brake.

The secondary function manifold is a machined block with ports for two pressure reducing valves, a pressure relief valve, two park brake solenoid valves (one normally open and one normally closed), a check valve and diagnostic test nipples. The secondary function manifold is secured on the left side of the frame with two carriage bolts and two hex flange nuts.



Verify the correct operation of the solenoids before considering replacement of the secondary function manifold. Refer to Section 9, “Electrical System.” The manifold itself is not serviceable and must be replaced if defective.

***Note: DO NOT** loosen, disassemble or attempt to adjust any of the pressure valves unless specifically instructed by JLG to do so! Tampering with a pressure valve will irrevocably alter pressure in the affected circuits.*

a. Secondary Function Manifold Replacement

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

3. Temporarily block up or support the raised boom.

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

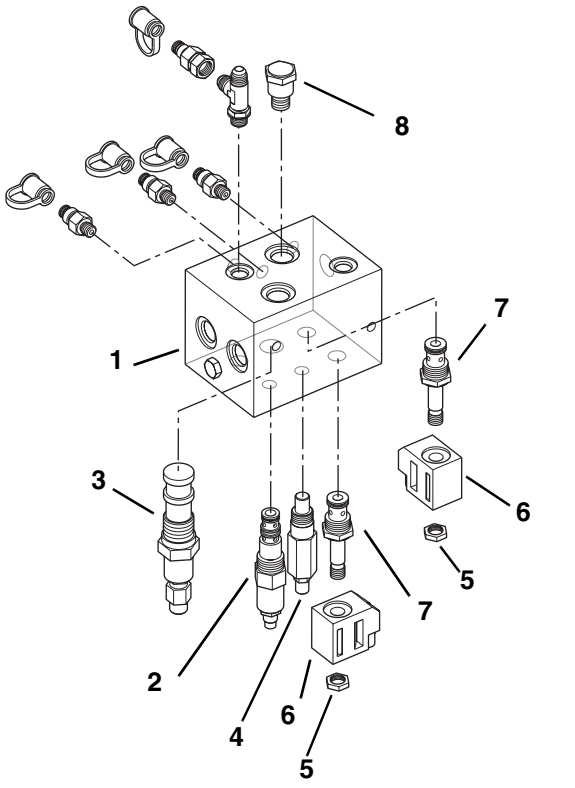
4. Unlock and open the rear door. Allow the hydraulic fluid to cool.
5. Remove the transmission covers.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

6. Label or otherwise mark the hydraulic hoses in relation to the secondary function manifold. Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.
7. Remove the two hex flange nuts from the carriage bolts securing the secondary function manifold to the frame. Remove the secondary function manifold from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.

b. Secondary Function Manifold Disassembly, Cleaning, Inspection and Assembly

1. Secure the secondary function manifold (**1**) in a suitable bench vise, if possible.



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2. Remove the 550 psi (38 bar) pressure reducing valve (**2**).
3. Remove the 2500 psi (172 bar) pressure reducing valve (**3**).
4. Remove the 650 psi (45 bar) pressure relief valve (**4**).
5. Remove the solenoid nuts (**5**), coils (**6**) and cartridges (**7**).
6. Remove the check valve (**8**).
7. Clean all components with a suitable cleaner before inspection.
8. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
9. Inspect internal passageways of the secondary function manifold and its component parts for wear, damage, etc. If inner surfaces of the secondary function manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the secondary function manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

10. Secure the secondary function manifold (**1**) in a bench vise or by other suitable means.
11. Install the pressure reducing valve assembly (**2**) and torque to 60-70 lb-ft (81-95 Nm).
12. Install the pressure reducing valve assembly (**3**) and torque to 35-40 lb-ft (47-54 Nm).
13. Install the relief valve assembly (**4**) and torque to 25-30 lb-ft (34-41 Nm).
14. Install the check valve (**8**) and torque to 25-30 lb-ft (34-41 Nm).
15. Install the solenoid cartridges (**7**) and torque to 25-30 lb-ft (34-41 Nm). Install the solenoid coils (**6**) and nuts (**5**). Torque the nuts to 4-6 lb-ft (5-8 Nm).

c. Secondary Function Manifold Installation

1. Align the secondary function manifold with its mounting holes on the frame.
2. Secure the secondary function manifold with two carriage bolts and hex flange nuts. Torque fasteners to specification. Refer to the fastener torque chart in Section 2.3, “Torques.”
3. Before attaching the hoses, prime the secondary function manifold by filling the hydraulic hose ports with fresh, filtered hydraulic fluid from a clean container.
4. Use new oiled o-rings as required. Reattach and secure all diagnostic test nipples, hoses, clamps, wiring, etc.
5. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

6. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

7. Inspect the secondary function manifold for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

8. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

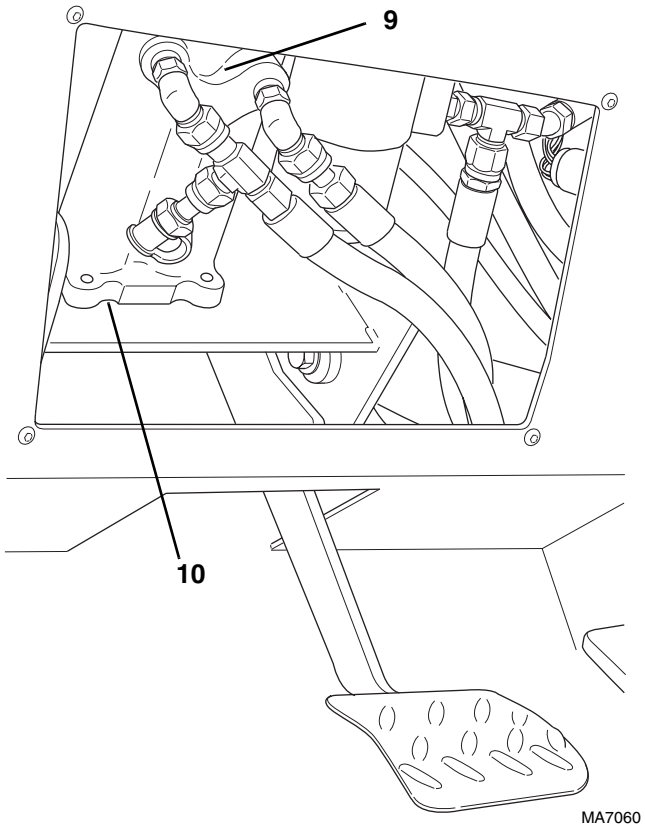
d. Secondary Function Manifold Test

Conduct a pressure check of the park brake and steering hydraulic circuits. Refer to Section 8.7, “Hydraulic System Testing.”

8.12.3 Service Brake Valve

The service brake valve (**9**) is secured with four capscrews and lockwashers at the base of the steering column support (**10**), concealed by the lower dash cover.

The service brakes themselves are part of the axles (the park brake is part of the front axle only). Refer to Section 5, “Axles, Drive Shafts, Wheels and Tires,” for further information.



a. Service Brake Valve Removal

1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

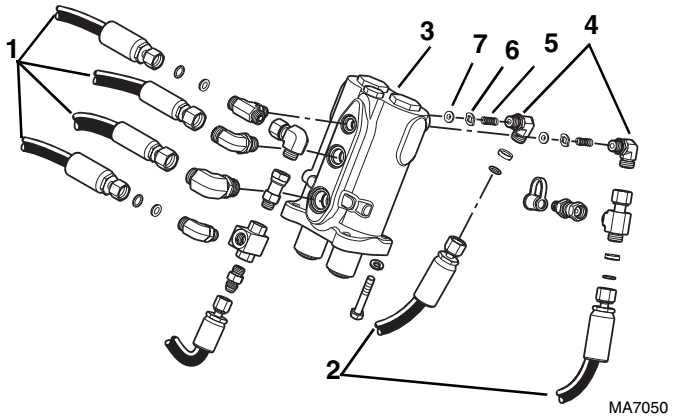
WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. To remove the service brake valve, both the lower dash panel and the front dash panel must be removed. Refer to Section 4.5, “Cab Removal.”
5. Label or otherwise mark the hydraulic hoses on the top (**1**) and bottom (**2**) of the service brake valve (**3**). Disconnect and cap all hoses, fittings, etc.

Note: *When the outlet fittings (**4**) on the brake valve (**3**) are removed, a conical spring (**5**), a wave plate (**6**) and an orifice (**7**) may fall out. If replacement parts are required, contact the factory.*



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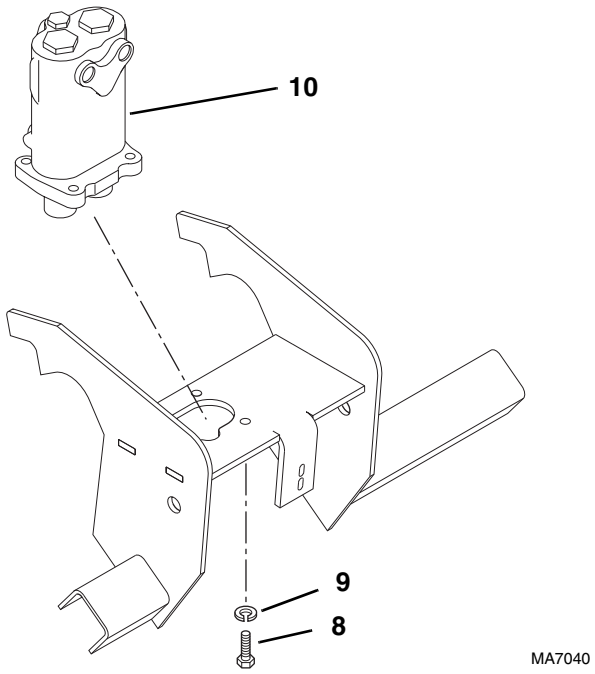
6. Remove the four capscrews (**8**) and four lockwashers (**9**) mounting the service brake valve (**10**) to the steering column support.

Note: ***DO NOT*** *disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.*



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b. Service Brake Valve Installation

1. Install the service brake valve (**10**) with the four lockwashers (**9**) and four capscrews (**8**) to mount the brake valve to the steering column support.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

2. Use new oiled o-rings as required. Reattach and secure all valves, hoses, clamps, etc.
3. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

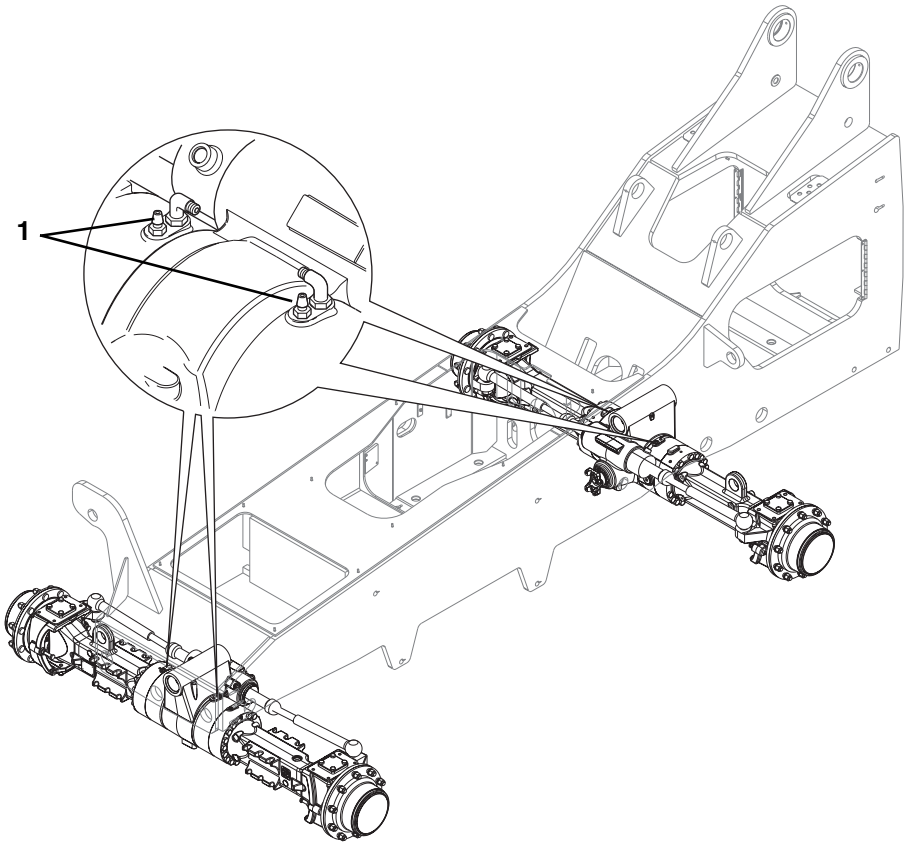
4. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

5. Inspect the service brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.



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c. Brake Test

Carefully bleed the brake lines as soon as the brake valve is installed in the vehicle. Air in the system will not allow the brakes to apply properly. There are four brake bleeder locations (**1**) on the axles. Work with an assistant to perform this procedure.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

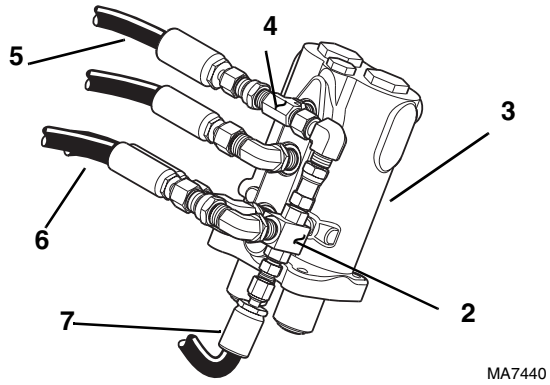
1. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch, and start the engine.
2. Have the assistant frame sway the vehicle full left to expose the brake bleeders on the right front and right rear axles.
3. Remove the plastic cap from the front brake bleeder (**1**). Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

4. **DO NOT** open the brake bleeder without holding the tubing firmly on the bleeder. There is pressure at the brakes. Carefully open the bleeder with a 12 mm wrench. Have the assistant depress the brake pedal. Close the brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the brake bleeder.
5. Repeat Steps 3 and 4 for the right rear brake.
6. Frame sway the vehicle full right, exposing the brake bleeders on the left front and rear axles.
7. Repeat Steps 3 and 4 for the left front and left rear brakes.
8. Conduct a pressure and function check of the service brake. Refer to Section 8.7, “Hydraulic System Testing.”

8.12.4 Shuttle Valve

The shuttle valve (**2**) is attached to the brake valve (**3**) with a tee fitting (**4**). The shuttle valve joins the brake valve load sense line (**5**), the shuttle IN line (**6**) from the main control valve and the steering valve shuttle IN line (**7**). The shuttle valve contains a pressure dependent, two-way check and is a non-serviceable item. It must be replaced in its entirety if defective.



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a. Shuttle Valve Removal

1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.
4. To remove the shuttle valve (**2**), remove the right front console panel on the front dash. Refer to Section 4.5, “Cab Removal,” for information on removing the dash panel.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

5. Disconnect, label and cap all hydraulic fittings and hoses during removal from the shuttle valve (**2**). Disconnect the brake valve load sense line (**5**) and pull the shuttle valve assembly forward. Disconnect the shuttle IN line (**6**) and the steering valve shuttle IN line (**7**). Wipe up any hydraulic fluid spillage.

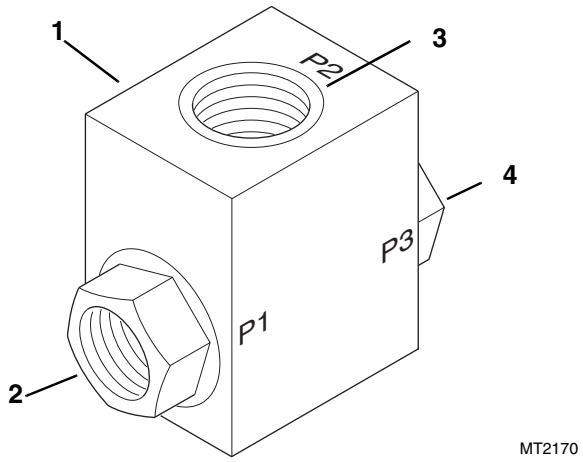
b. Shuttle Valve Cleaning, Inspection and Reassembly

1. Clean the shuttle valve with a suitable cleaner before inspection.
2. Inspect internal passageways and the shuttle valve overall for wear, damage, etc. If inner surfaces of the component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the shuttle valve. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the shuttle valve.
3. Replace a defective shuttle valve with a new part.

c. Shuttle Valve Installation

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

1. Reattach and secure hoses, fittings, etc. Attach the shuttle IN steering valve line at port P1 (**2**) and the shuttle-in main control valve line at port P2 (**3**), and the load sense brake valve line at port P3 (**4**) of the shuttle valve (**1**).



MT2170

2. Check the routing of all hoses, wiring, etc., for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all fittings.
3. Reinstall the display panel. Refer to Section 4.5, “Cab Removal,” for information on installing the dash panel.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

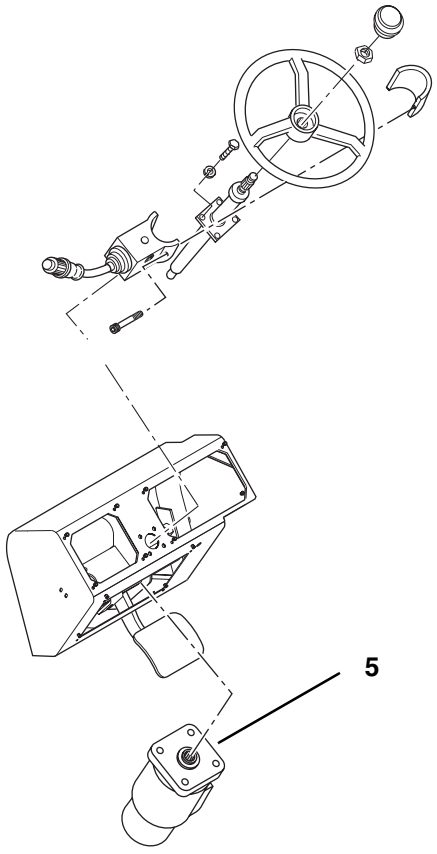
6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

d. Shuttle Valve Test

Conduct a pressure check of the service brake and steering hydraulic circuits. Refer to Section 8.7, “Hydraulic System Testing.”

8.12.5 Power Steering Valve

The power steering valve (**5**) is located at the base of the steering wheel shaft, concealed by the lower dash cover. The valve is not serviceable and must be replaced in its entirety if defective.



MA7360

a. Power Steering Valve Removal

1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

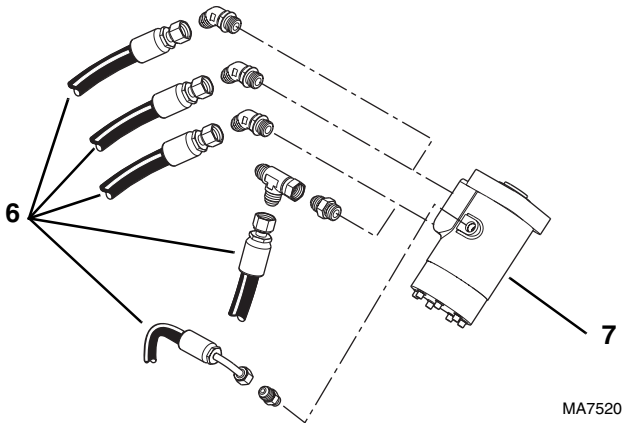
> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. To remove the power steering valve, remove the right console panel from the front dash. Refer to Section 4.5, “Cab Removal.”
5. Label or otherwise mark the hydraulic hoses (**6**) connected to the power steering valve (**7**). Disconnect the hoses and cap all hoses, fittings, etc. Wipe up any hydraulic fluid spillage.
6. Refer to Section 4.3.2, “Steering Wheel, Column and Shifter,” for information on removing the steering column. The steering column and power steering valve are mounted together. DO NOT attempt to disassemble the steering valve.

b. Power Steering Valve Installation

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

1. Install the steering column, connecting it to the power steering valve.
2. Connect all the hydraulic hoses (**6**) to the power steering valve (**7**).
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.



> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

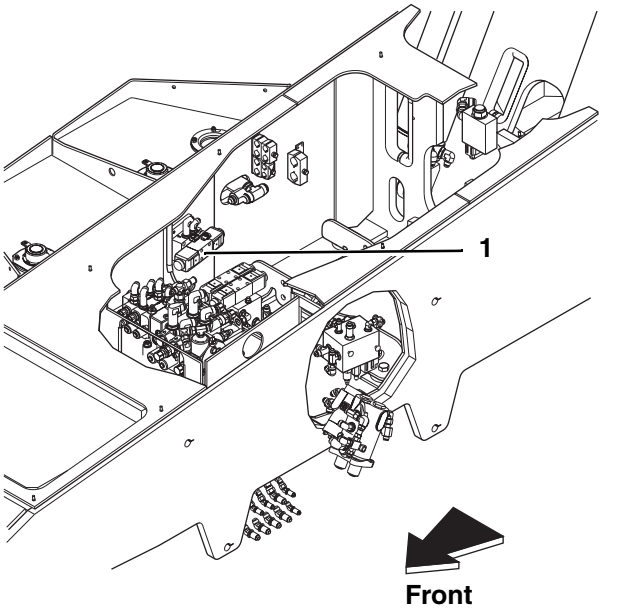
6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

c. Power Steering Test

Conduct a pressure check of the steering hydraulic circuits at the secondary function manifold. Refer to Section 8.7, “Hydraulic System Testing.”

8.12.6 Steer Select Valve

The vehicle can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve (**1**) controls the direction of hydraulic fluid flow to the steering cylinders mounted on each axle. The steer select valve (**1**) is attached to a manifold mounted on a mounting plate inside the frame near the fuel tank.



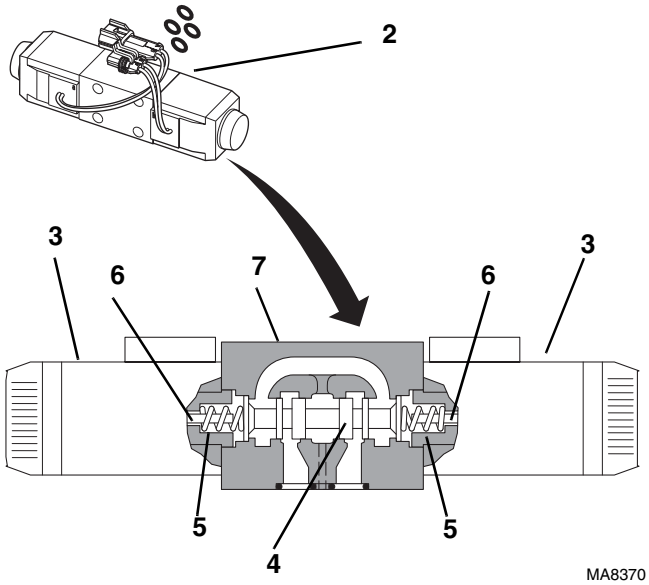
MH3750

The steer select valve (**2**) contains two solenoids (**3**) that direct the flow of hydraulic fluid according to steering input. The valve is a direct, dual solenoid operated, spool-type main control valve.

The valve consists of a housing (**7**), two solenoids (**3**), a control spool (**4**) and two return springs (**5**). In the de-energized state, the spool (**4**) is held by the return springs (**5**) in the center position.

The spool is shifted via the action of the two wet-pin type solenoids (**3**). The force of an acting solenoid pushes against the push pin (**6**) on the end of the spool (**4**). The spool is shifted from its normal position to the end position for selected flow.

When the solenoid is de-energized, the control spool (**4**) is returned to its normal condition by the centering springs (**5**).



MA8370

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. Refer to Section 9.7, “Electrical System Troubleshooting,” and Section 9.14.9, “Steer Select Switches.” The housing (**7**) of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Manifold and Valve Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

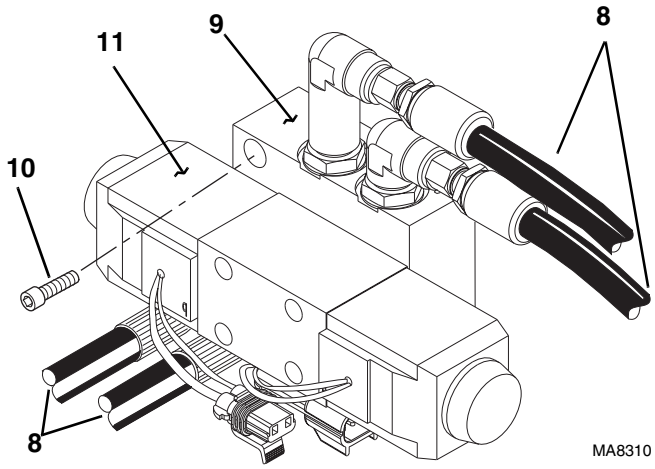
3. Temporarily block up or support the raised boom.

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

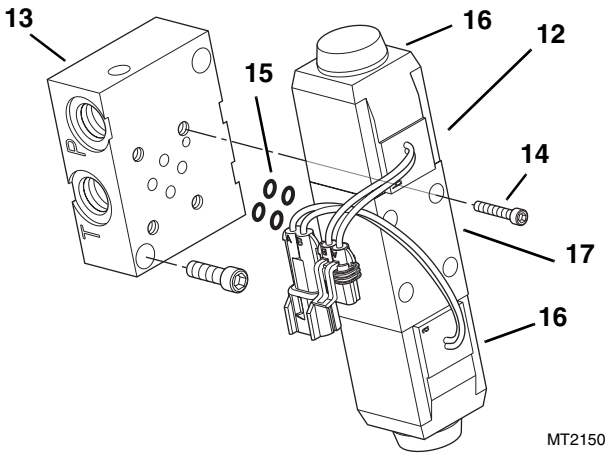
5. Label or otherwise mark the hydraulic hoses (**8**) in relation to the steer select manifold (**9**). Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.



6. Remove the two socket head capscrews (**10**) securing the steer select manifold (**9**) to the mounting plate on the frame.
7. Remove the steer select manifold (**9**) with attached steer select valve (**11**) from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.

b. Steer Select Valve and Manifold Disassembly, Cleaning, Inspection and Assembly

1. Place the steer select assembly on a suitable work surface.
2. Separate the steer select valve (**12**) from the manifold (**13**) by removing the four socket head capscrews (**14**). Discard the four o-rings (**15**).



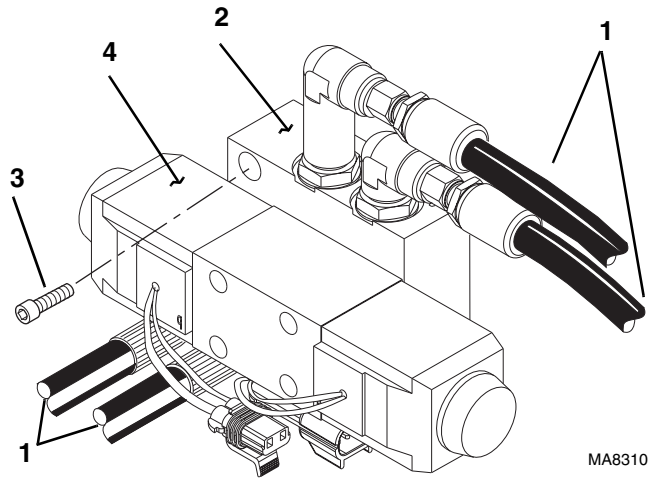
3. Remove the solenoid valves and cartridges (**16**) from the steer select housing (**17**).
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

7. Install the solenoid valves and cartridges (**16**) in the steer select housing (**17**).
8. Attach the steer select valve (**12**) to the manifold (**13**) using four new, oiled o-rings (**15**) and the four socket head capscrews (**14**).

c. Steer Select Manifold and Valve Installation

1. Attach the steer select manifold (**2**) and valve (**4**) to the mounting plate on the frame using the two socket head capscrews (**3**).



2. Connect the hydraulic hoses (**1**), fittings, solenoid wire terminal leads, etc., to the steer select valve (**4**) and manifold (**2**).
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

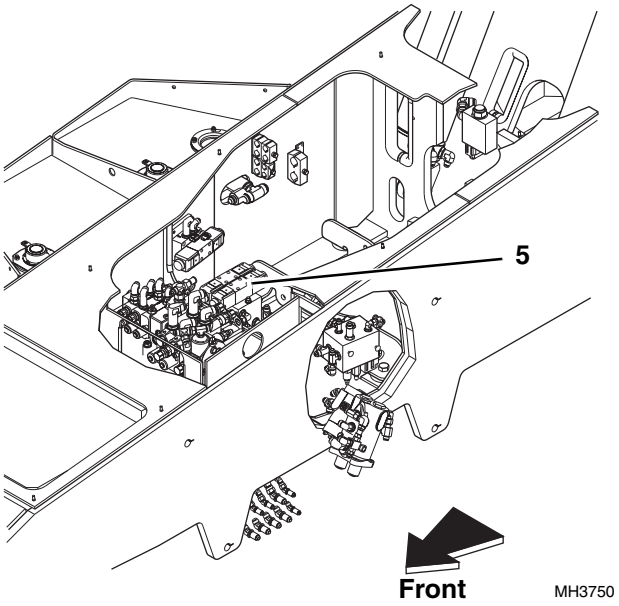
d. Steering Test

Refer to Section 8.7, “Hydraulic System Testing.”

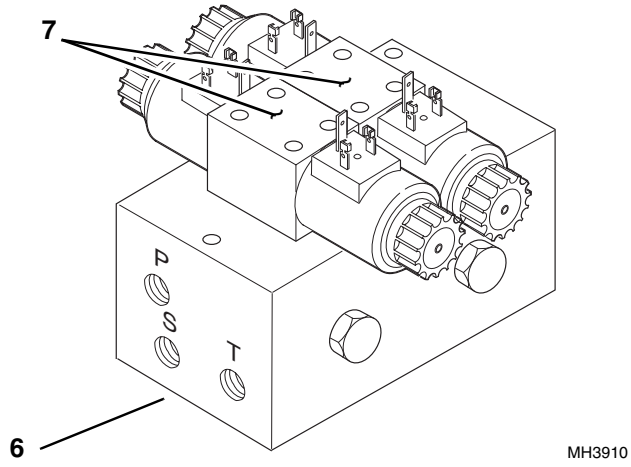
1. Conduct a pressure check of the steering hydraulic circuit at the secondary function manifold.
2. Check each steering mode for proper function.

8.12.7 Outrigger Valve (10042/10054)

The outrigger valve (**5**) allows the left and right outriggers to be raised or lowered depending on the position of the outrigger switches located on the side console in the cab.



The outrigger valve (**6**) contains two solenoid valve assemblies (**7**) that direct the flow of hydraulic fluid according to position of the outrigger switches.



Verify the correct operation of the outrigger valve solenoids before considering replacement of the valve. Refer to Section 9.7, “Electrical System Troubleshooting.”

a. Outrigger Valve Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

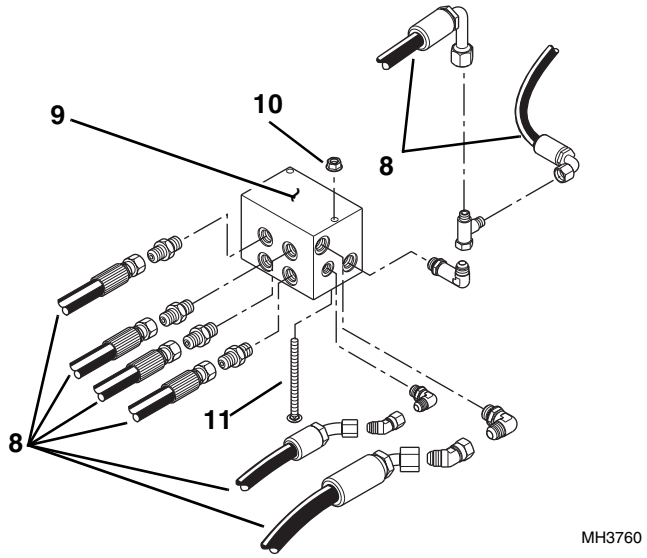
3. Temporarily block up or support the raised boom.

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

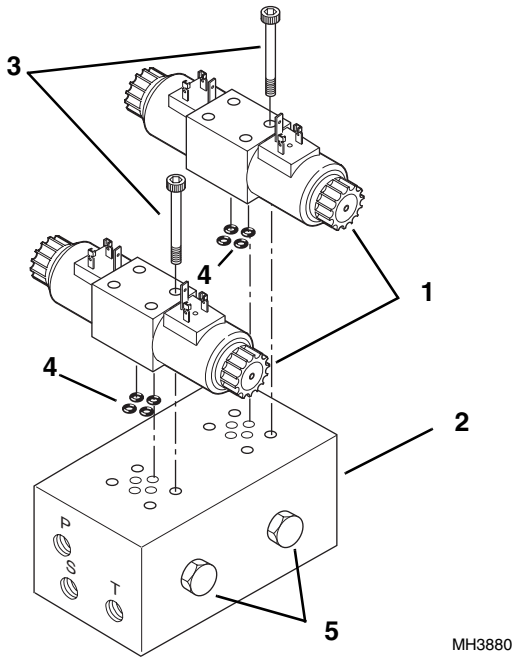
5. Remove the transmission covers.
6. Label or otherwise mark the hydraulic hoses (**8**) in relation to the outrigger valve (**9**). Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.



7. Remove the two hex flange nuts (**10**) and two carriage bolts (**11**) securing the outrigger valve (**9**) to the frame.
8. Remove the outrigger valve (**9**) from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.

b. Outrigger Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the outrigger valve assembly on a suitable work surface.
2. Remove the solenoid valve assemblies (**1**) from the outrigger valve (**2**) by removing the four socket head capscrews (**3**). Discard the four o-rings (**4**).



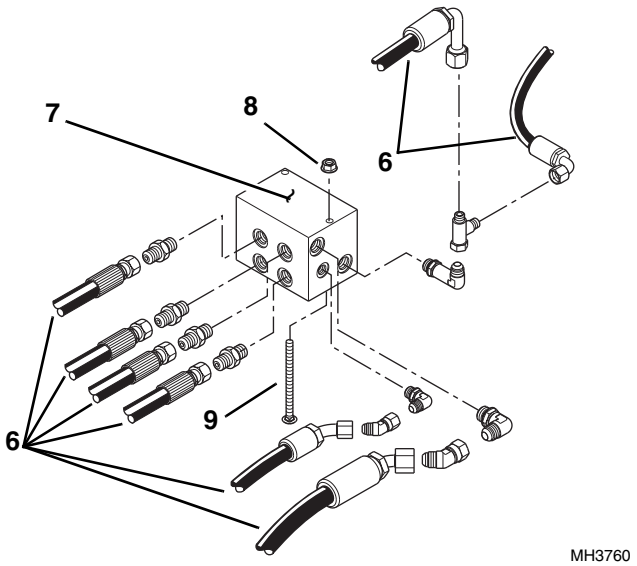
3. Remove the shuttle cartridges (**5**) from the outrigger valve (**2**).
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the outrigger valve for wear, damage, etc. If inner surfaces of the valve **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the valve or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

7. Install the shuttle cartridges (**5**) into the outrigger valve (**2**). Torque to 35 lb-ft (48 Nm).
8. Attach the solenoid assemblies (**1**) to the outrigger valve (**2**) using four new, oiled o-rings (**4**) and the four socket head capscrews (**3**).

c. Outrigger Valve Installation

1. Insert the two carriage bolts (**9**) through the bottom of the outrigger valve (**7**) and loosely attach the hex flange nuts (**8**) to the carriage bolts.
2. Position the outrigger valve (**7**) so that the heads of the carriage bolts go through the slots in the frame. Tighten the hex flange nuts.



3. Connect the hydraulic hoses (**6**), fittings, solenoid wire terminal leads, etc., to the outrigger valve.
4. Check the routing of all hoses and wiring for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

WARNING: Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

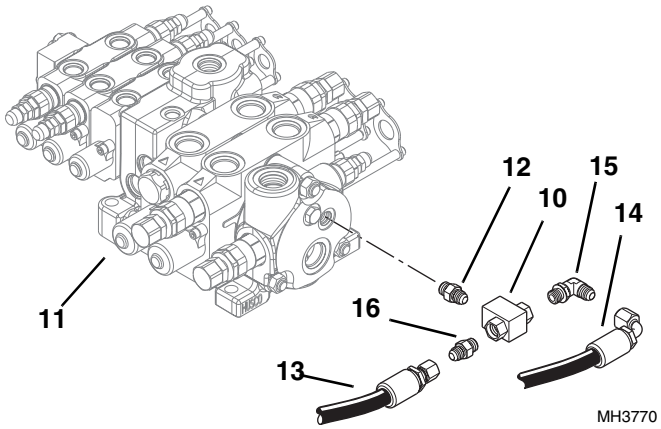
7. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

d. Outrigger Valve Test

Raise and lower the outriggers to check the outrigger hydraulic circuit for proper function.

8.12.8 Outrigger Shuttle Valve (10042/10054)

The outrigger shuttle valve (**10**) is attached to the main control valve (**11**) with a straight fitting (**12**). The shuttle valve joins the outrigger load sense line (**13**) and the steer/brake load sense line (**14**) and selects the higher signal to feed to the main control valve shuttle line. The shuttle valve contains a pressure-dependent, two-way check valve and is a nonserviceable item. It must be replaced in its entirety if defective.



a. Outrigger Shuttle Valve Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

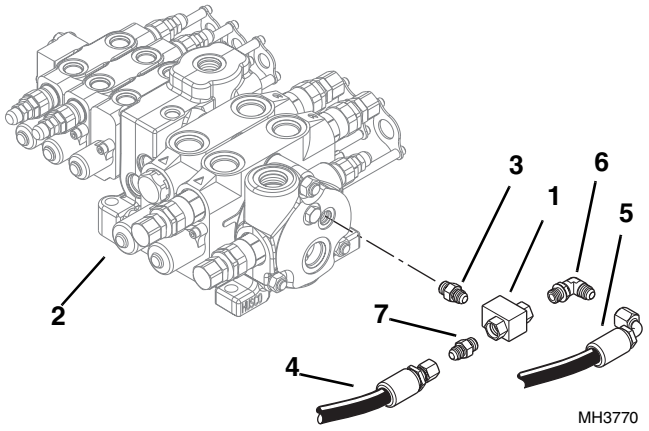
3. Temporarily block up or support the raised boom.

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.
5. Remove the transmission covers.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

6. Disconnect, label and cap all hydraulic fittings and hoses during removal from the shuttle valve (**1**). Disconnect the outrigger load sense line (**4**). Disconnect the brake load sense line (**5**). Disconnect the outrigger shuttle valve from the main control valve (**2**). Remove the fittings (**3**, **6** and **7**). Wipe up any hydraulic fluid spillage.



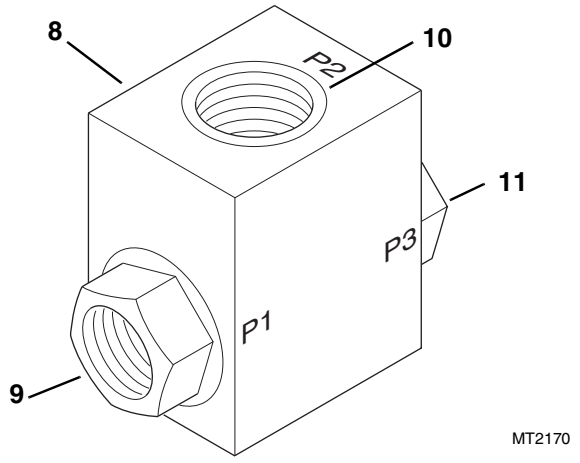
b. Shuttle Valve Cleaning, Inspection and Reassembly

1. Clean the shuttle valve with a suitable cleaner before inspection.
2. Inspect internal passageways and the shuttle valve overall for wear, damage, etc. If inner surfaces of the component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the shuttle valve. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the shuttle valve.
3. Replace a defective shuttle valve with a new part.

c. Outrigger Shuttle Valve Installation

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

1. Reattach and secure hoses, fittings, etc. Attach the shuttle valve to the main control valve at port P2 (**10**), the load sense outrigger line at port P1 (**9**), and the load sense brake valve line at port P3 (**11**) of the shuttle valve (**8**).
2. Check the routing of all hoses, wiring, etc., for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all fittings.



3. Install the lower transmission cover.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

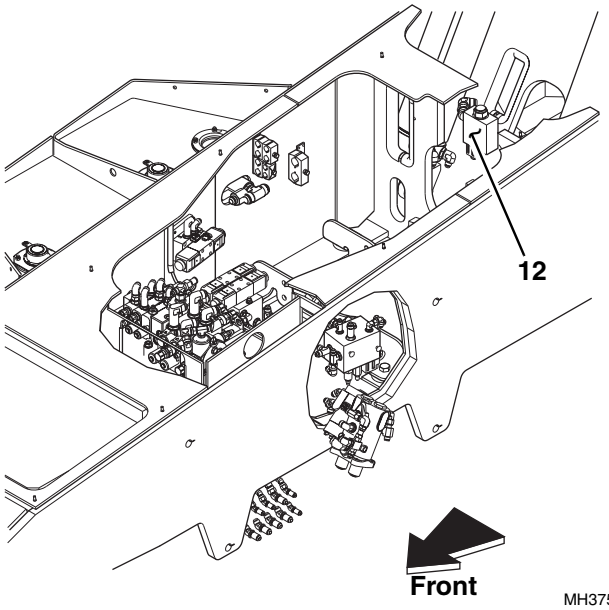
6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

d. Outrigger Shuttle Valve Test

Raise and lower the outriggers to check the outrigger hydraulic circuit for proper function.

8.12.9 Extend Lockout Valve (10054)

Model 10054 has an extend lockout valve (**12**) which prevents the boom from being extended beyond 42 feet unless the outriggers are lowered onto firm terrain. Once the outriggers are lowered, pressure switches located on each outrigger cylinder close and energize the solenoid on the boom extend lockout valve. The boom can then be fully extended.



a. Extend Lockout Valve Removal

1. Park the vehicle on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

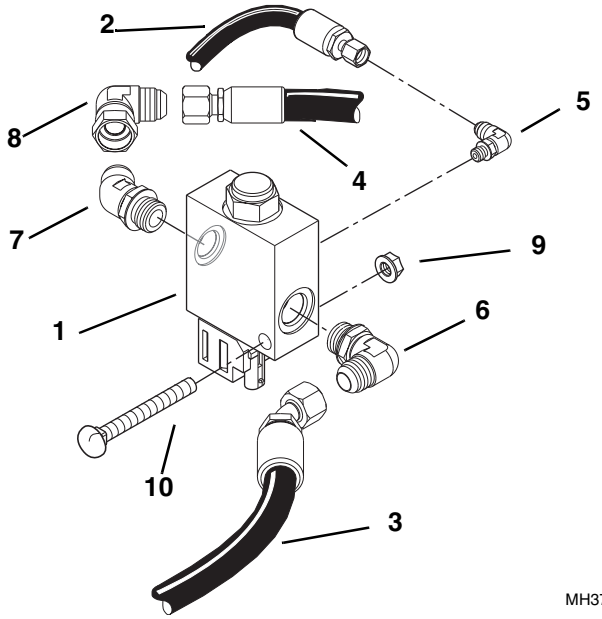
3. Temporarily block up or support the raised boom.

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Unlock and open the rear door. Allow the hydraulic fluid to cool.
5. Remove the transmission covers.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

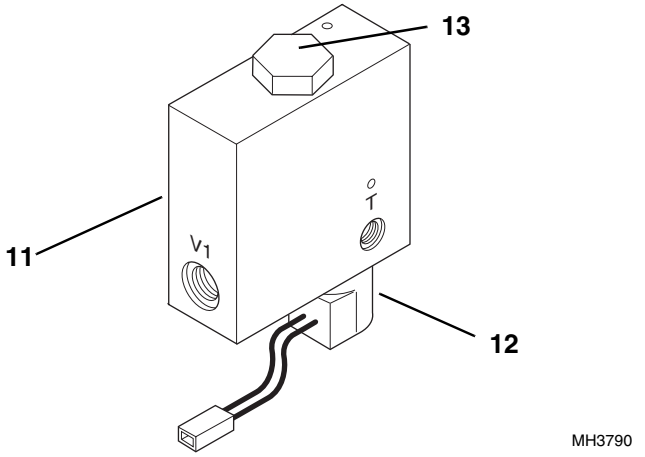
6. Disconnect the wiring connection to the solenoid valve on the extend lockout valve (**1**).
7. Disconnect, label and cap all hydraulic fittings and hoses during removal from the extend lockout valve (**1**). Disconnect the tank line (**2**). Disconnect the main control line (**3**) and the extend/retract cylinder line (**4**). Remove the fittings (**5**, **6**, **7** and **8**).



8. Remove the hex flange nut (**9**) and the carriage bolt (**10**) securing the extend lockout valve (**1**) to the frame.
9. Remove the extend lockout valve (**1**) from the vehicle. Wipe up any hydraulic fluid spillage.

b. Extend Lockout Valve Disassembly, Cleaning, Inspection and Reassembly

1. Secure the extend lockout valve (**11**) in a suitable bench vise if possible. Remove the solenoid nut, coil and cartridge (**12**) from the valve. Remove the pressure sense valve (**13**) from the valve.



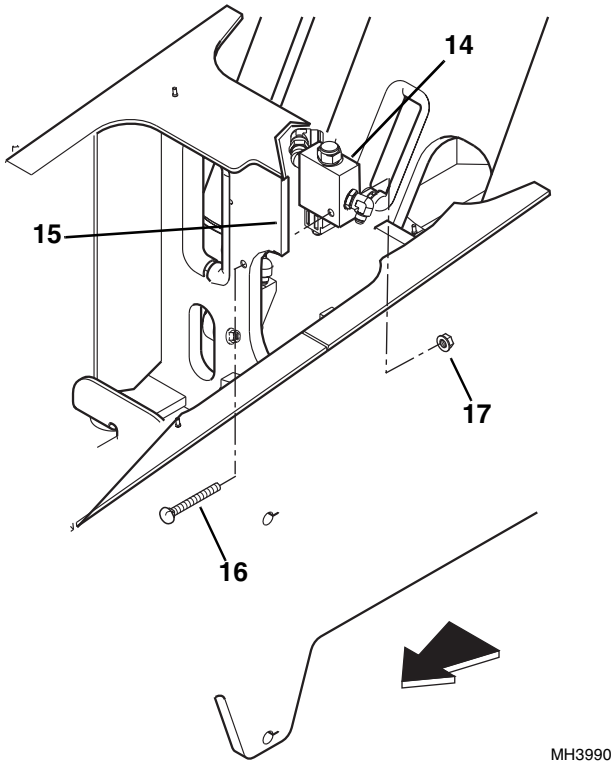
2. Clean all components with a suitable cleaner before inspection.
3. Inspect the solenoid cartridge for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
4. Inspect internal passageways and the extend lockout valve overall for wear, damage, etc. If inner surfaces of the component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the extend lockout valve. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the valve.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

5. Install the solenoid valve (**12**).
6. Install the pressure sensing valve (**13**). Torque to 65 lb-ft (88 Nm).

c. Extend Lockout Valve Installation

1. Place the extend lockout valve (**14**) into position on the mounting plate on the vehicle frame (**15**).



2. Install the carriage bolt (**16**) and the hex flange nut (**17**) securing the extend lockout valve (**14**) to the frame (**15**).
3. Use new oiled o-rings. Reattach and secure hoses, fittings and wiring terminal.
4. Check the routing of all hoses, wiring, etc., for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all fittings.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

WARNING: Hydraulic oil leaking under pressure can penetrate the skin and cause severe personal injury. **DO NOT** use your hand or any part of your body to check for hydraulic leaks. When checking for hydraulic leaks, wear safety glasses and gloves to help provide protection from spraying hydraulic oil. Use a piece of cardboard or paper to search for leaks.

6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

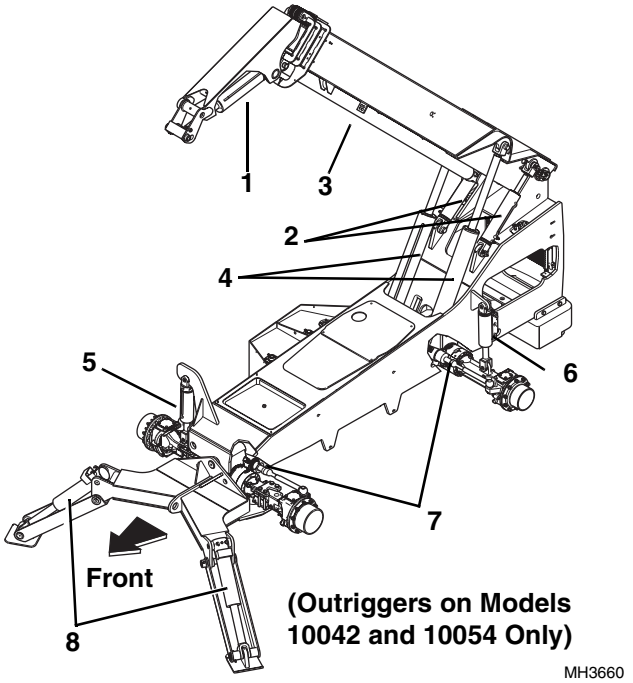
d. Extend Lockout Valve Test

Conduct a test of the extend lockout valve.

1. Park the vehicle on a firm, level surface.
2. With the boom fully retracted and lowered, lower the outriggers.
3. Extend the boom to 54 feet. The boom should extend fully and should not stop at 42 feet.

8.13 HYDRAULIC CYLINDERS

This section covers servicing the attachment tilt (**1**), slave (**2**), extend/retract (**3**), lift/lower (**4**), frame sway (**5**), stabilizer (**6**), steering (**7**), outrigger (**8**) and optional (swing carriage and side tilt) hydraulic cylinders on the vehicle.



There are many factors involved with the proper disassembly, cleaning, inspection, repair and reassembly of hydraulic cylinders; therefore, only qualified professionals with proper training, supervision, tools and equipment should rebuild the cylinders used on this vehicle.

For example, special pin spanner wrenches of the correct size are needed to disassemble the cylinders. Also, the lift/lower cylinder rod locknut must be torqued to 1750-2000 lb-ft (2373-2712 Nm); this requires a special torque wrench and/or torque multiplier. If the proper knowledge and equipment are not available, the cylinders must be sent out for rebuilding by a competent professional at a company that specializes in rebuilding agricultural and commercial heavy-equipment hydraulic cylinders.

Rebuild cylinders only in a clean, well-lighted area where all components can be carefully and thoroughly inspected. If leaving a cylinder dismantled for any length of time longer than the immediate rebuilding period, and especially in high-humidity environments, coat the metal parts with a suitable preservative and place them in protective storage.

Refer to the specific instructions for removal, rebuilding and installation of each cylinder.

8.13.1 General Cylinder Disassembly Instructions

WARNING: To help prevent severe burns, proceed with caution when applying heat to parts.

IMPORTANT: *Avoid the use of excessive heat, which will damage parts and make them unusable.*

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts catalog for ordering information.

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

8.13.2 General Cylinder Cleaning Instructions

Clean all reusable metal parts thoroughly after disassembly and prior to inspection. Use an approved solvent such as trichlorethylene.

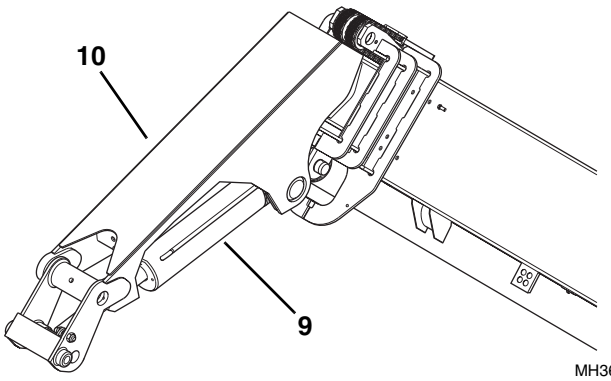
8.13.3 General Cylinder Assembly Instructions

1. Before reassembly, ensure that parts are clean and free from foreign matter. Use an approved solvent for cleaning, such as trichlorethylene.
2. Use the proper tools for specific installation tasks. Clean tools are required for installation.
3. Protect the finish on the rod at all times. Damage to the rod can cause premature seal failure.

4. ALWAYS use new oiled o-rings, seals, gaskets, etc. **DO NOT** overstretch seals, wipers and o-rings. After installing such parts, verify that they are not twisted in their grooves.
5. To aid in installation, lubricate piston seals and the seal installation path with clean, filtered hydraulic oil.
6. Lubricate the outer surfaces of the seals and o-rings and the inside of the tube, piston and head gland with clean, filtered hydraulic oil. Use a suitable installation or compression tool when installing the piston and head gland into the cylinder to help prevent twisting or damaging the seals and o-rings. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.
7. Follow the manufacturer's instructions when applying primer, locking or retaining compounds that are specified in the cylinder assembly procedures. The use of primer is recommended in some cases to decrease cure time. Allow sealant to cure fully before proceeding with the assembly procedure. The curing process may be hastened by the use of a heat gun to blow warm, dry air on the parts.
8. After assembling a cylinder, test the cylinder at low operating pressures. Verify that the piston and rod move freely in both directions.
9. Increase the operating pressure to the maximum pressure recommended for the cylinder. Check for external leakage and for free movement in both directions.
10. Retract the piston fully. Cap the hydraulic fittings.

8.13.4 Attachment Tilt Cylinder

The attachment tilt cylinder (**9**) is attached at the front of the inner boom inside the gooseneck (**10**).



a. Attachment Tilt Cylinder Removal

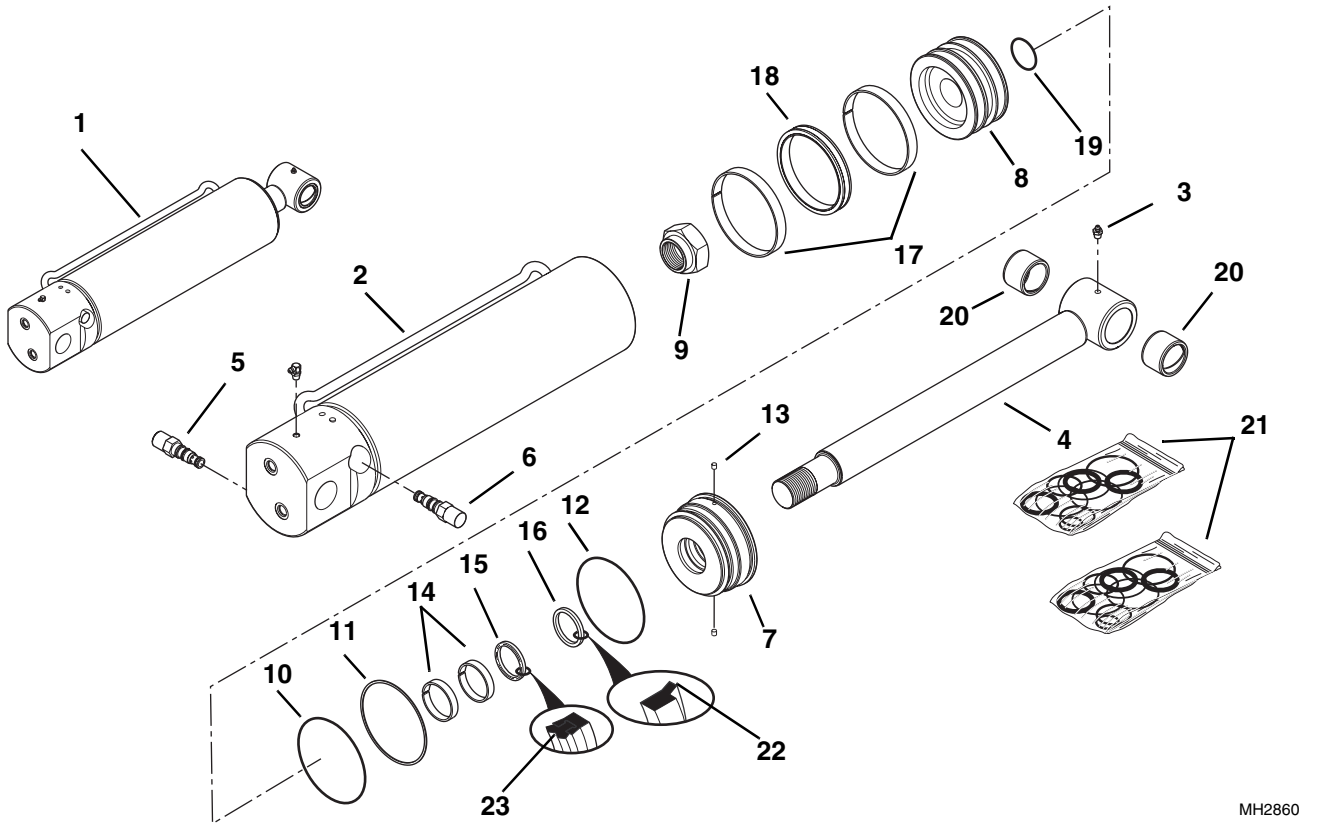
1. Remove any attachment from the vehicle. Park the vehicle on a firm, level surface, fully retract the boom. Allow sufficient work space at the front of the boom. Raise the boom enough to allow the quick attach or the bottom of the gooseneck to clear the ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, "Accident Prevention Tags.")

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the hydraulic hoses in relation to the attachment tilt cylinder. Disconnect and cap both hoses and attachment tilt cylinder fittings. Refer to Section 3, "Boom."
5. Remove the retaining bolt at the rod end of the attachment tilt cylinder. Remove the lower pivot pin.
6. Attach a suitable sling to an appropriate lifting device and to the attachment tilt cylinder. Make sure the device used can actually support the cylinder.
7. Remove the two 2" external retaining rings securing the attachment tilt cylinder base pin to the boom.
8. Remove the lower attachment tilt cylinder pin by tapping it out through the bottom of the quick attach (if installed).
9. Remove the attachment tilt cylinder base pin by tapping it out through the top of the gooseneck.
10. Remove the attachment tilt cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near or around the vehicle.



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b. Attachment Tilt Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the attachment tilt cylinder (**1**) with a suitable cleaner before inspection. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. If necessary, remove the grease fitting (**3**) from the end of the rod (**4**).
3. Clamp the trunnion end of the attachment tilt cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

4. Slowly remove the 4000 psi (276 bar) counterbalance valve (**5**) and the pilot-operated check valve (**6**) from the attachment tilt cylinder.
5. Extend the rod (**4**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

6. Using a pin spanner wrench, unscrew the head gland (**7**) from the tube (**2**). The head gland was originally torqued to 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube.

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**8**). Keep the rod centered within the tube to help prevent binding.*

7. Carefully pull the rod (**4**) along with the head gland (**7**) and all attachments straight out of the tube (**2**).
8. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
9. Remove the locknut (**9**) from the rod (**4**). The locknut is a deformed-thread type nut torqued at 1850-2000 lb-ft (2508-2712 Nm).

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**9**) and the rod (**4**) before the piston (**8**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

10. Remove the piston (**8**) and head gland (**7**) from the rod (**4**).
11. Remove the o-ring (**10**), back-up ring (**11**), and o-ring (**12**) from the head gland (**7**).
12. Remove the locking insert (**13**) from its hole in the head gland threads. Pry or drill out the insert as required. **DO NOT** damage the head gland threads. A new locking insert will be required for reassembly.
13. Remove the precision wearbands (**14**), the deep Z-seal with rod back-up (**15**) and the sealed outside diameter heavy-duty rod wiper (**16**) from the head gland (**7**).
14. Remove both precision wearbands (**17**) and the capped T-seal (**18**) from the piston (**8**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself and two supportive split caps that mount on either side of the "T" itself.*

15. Remove the small o-ring (**19**) from within the piston (**8**).
16. If the bushings (**20**) need replacement, support the rod (**4**) in a soft-jawed vise or other suitable holding device. Carefully press the bushings from the rod.

c. Attachment Tilt Cylinder Cleaning

1. Thoroughly clean the inner surface of the attachment tilt cylinder with trichlorethylene or another approved cleaner.
2. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits (**21**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

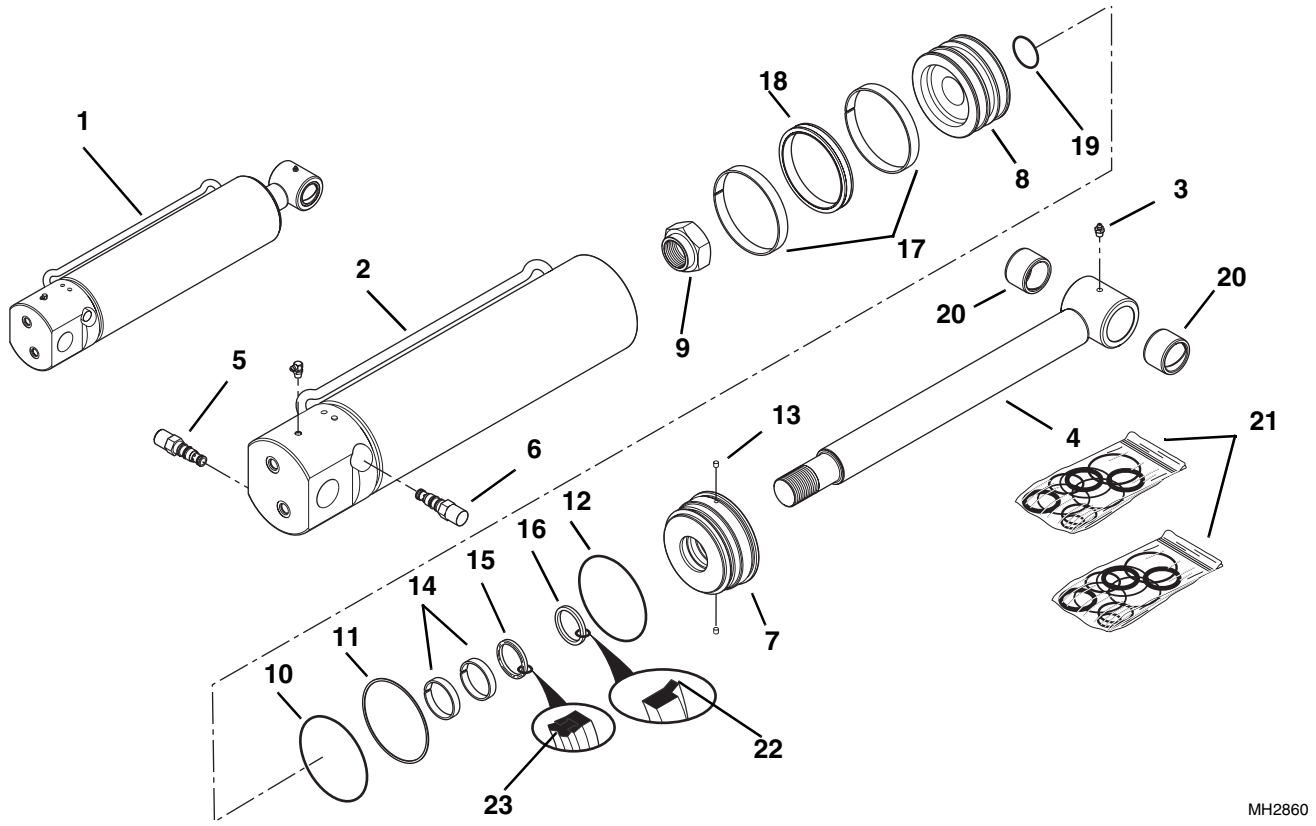
d. Attachment Tilt Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**2**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Inspect all other components for wear, damage, etc. Clean parts with trichlorethylene.
4. Check that the rod (**4**) is straight. If it is bent, a new rod must be installed.

e. Attachment Tilt Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the sealed outside diameter heavy-duty rod wiper (**16**) into the outer end of the head gland (**7**). The wiper lip (**22**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
2. Install new oiled o-ring (**10**), back-up ring (**11**), oiled o-ring (**12**), precision wearbands (**14**) and deep Z-seal with rod back-up (**15**) onto the head gland (**7**) orienting the edge (**23**).
3. Install the small new oiled o-ring (**19**) into the rod-end of the piston (**8**).



4. Install both precision wearbands (**17**) and the capped T-seal (**18**) onto the piston (**8**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

5. Install the head gland (**7**) and piston (**8**) onto the rod (**4**).

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

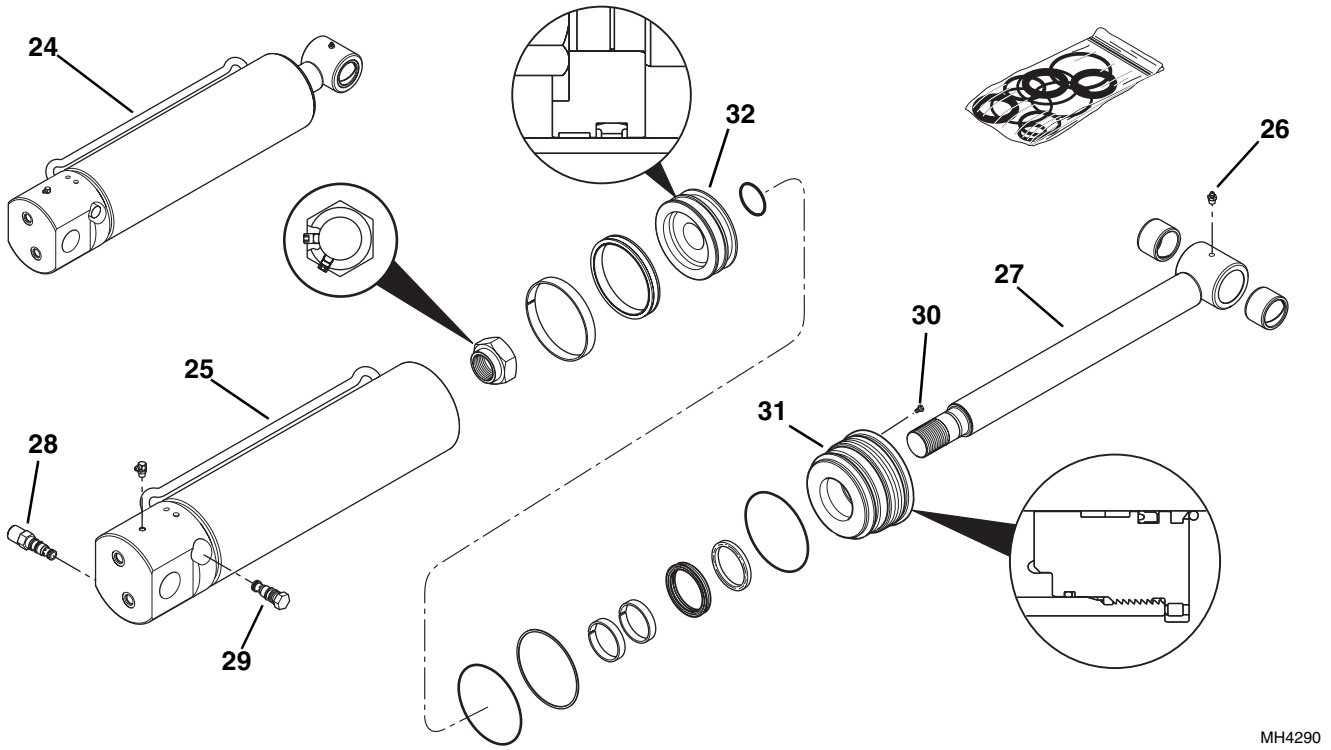
6. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod. Apply Loctite #271 (red) and install the locknut (**9**) onto the rod (**4**). Torque the nut to 1850-2000 lb-ft (2508-2712 Nm). The threads will deform upon tightening, locking the nut in place.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely.Excessive force can damage the cylinder.*

7. Place the attachment tilt cylinder tube (**2**) in a soft-jawed vise or other acceptable holding equipment if possible.

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**8**). Keep the rod centered within the tube to help prevent binding.*

8. Carefully insert the rod (**4**) with all attachments straight into the tube (**2**).
9. Using a pin spanner wrench, thread the head gland (**7**) almost completely into the tube (**2**), leaving just enough room to install a new locking insert (**13**) into its hole in the head gland threads.
10. Install a new locking insert (**13**). Thread the head gland (**7**) tightly into the tube and torque to 500-600 lb-ft (678-813 Nm).
11. Using new oiled o-rings, thread the 4000 psi (276 bar) counterbalance valve (**5**) and the pilot-operated check valve (**6**) into the attachment tilt cylinder. Torque to 30-35 lb-ft (41-47 Nm).
12. If necessary, install a grease fitting (**3**) into the tapped hole in the end of the rod (**4**). Lubricate the bushings (**20**) in the rod end through the grease fitting with multi-purpose grease before the vehicle is operated.



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b. Attachment Tilt Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the attachment tilt cylinder (**24**) with a suitable cleaner before inspection. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**25**).*

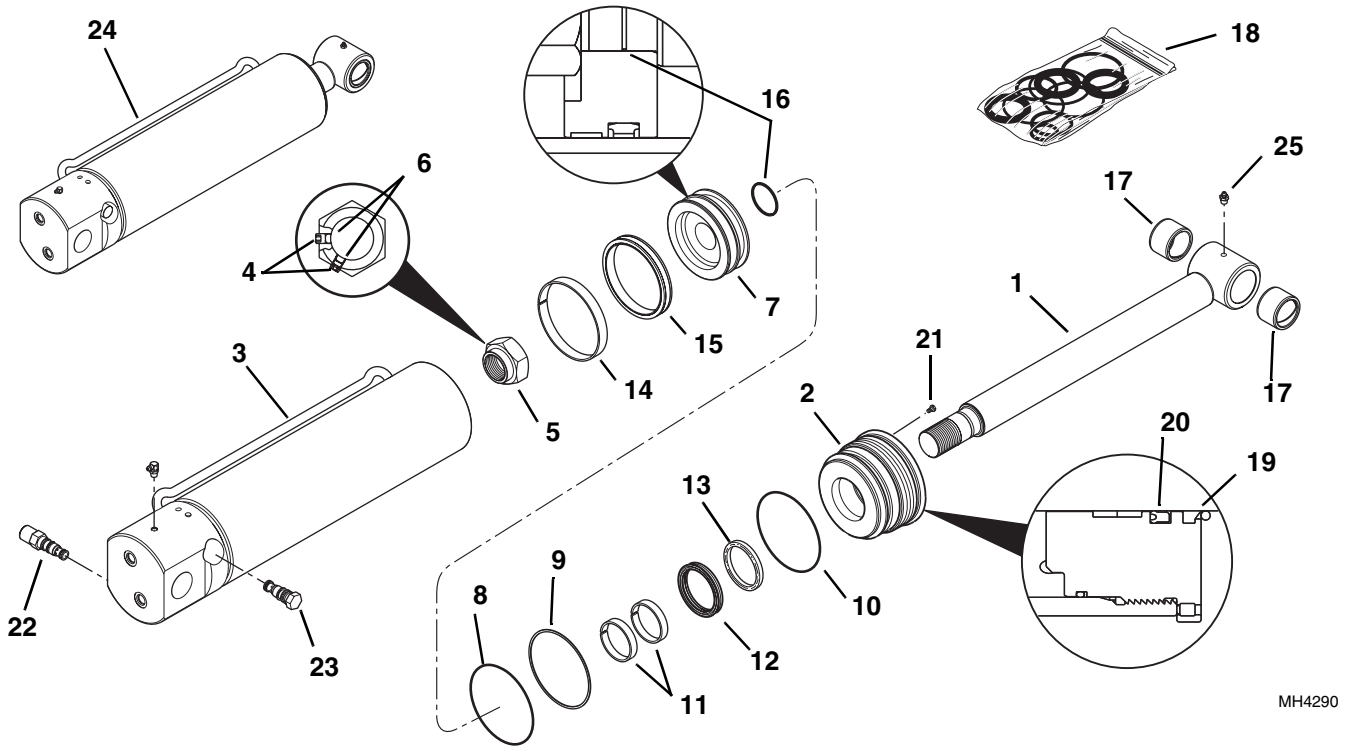
2. If necessary, remove the grease fitting (**26**) from the end of the rod (**27**).
3. Clamp the trunnion end of the attachment tilt cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

4. Slowly remove the 4000 psi (276 bar) counterbalance valve (**28**) and the pilot-operated check valve (**29**) from the attachment tilt cylinder.
5. Extend the rod (**27**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

6. Remove the lock screw (**30**) from the flange of the head gland (**31**).
7. Using a pin spanner wrench, unscrew the head gland (**31**) from the tube (**25**). The head gland was originally torqued to 300 ±50 lb-ft (407 ±68 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube.
8. When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**32**). Keep the rod centered within the tube to help prevent binding.



9. Carefully pull the rod (**1**) along with the head gland (**2**) and all attachments straight out of the tube (**3**).
10. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
11. Remove the two setscrews (**4**) from the locknut (**5**). Under each setscrew is a nylon ball (**6**). Be sure to remove the nylon balls from the locknut. Discard the nylon balls.
12. Remove the locknut (**5**) from the rod (**1**). The locknut is torqued at 1735-1885 lb-ft (2352-2556 Nm).

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**5**) and the rod (**1**) before the piston (**7**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

13. Remove the piston (**7**) and head gland (**2**) from the rod (**1**).
14. Remove the o-ring (**8**), back-up ring (**9**), and o-ring (**10**) from the head gland (**2**).
15. Remove the precision wearbands (**11**), the deep Z-seal with rod back-up (**12**) and the sealed outside diameter heavy-duty rod wiper (**13**) from the head gland (**2**).
16. Remove the precision wearband (**14**) and the capped T-seal (**15**) from the piston (**7**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself and two supportive split caps that mount on either side of the "T" itself.*

17. Remove the small o-ring (**16**) from the groove in the end of the rod (**1**).
18. If the bushings (**17**) need replacement, support the rod (**1**) in a soft-jawed vise or other suitable holding device. Carefully press the bushings from the rod.

c. Attachment Tilt Cylinder Cleaning

1. Thoroughly clean the inner surface of the attachment tilt cylinder with trichlorethylene or another approved cleaner.
2. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits (**18**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Attachment Tilt Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**3**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Inspect all other components for wear, damage, etc. Clean parts with trichlorethylene.
4. Check that the rod (**1**) is straight. If it is bent, a new rod must be installed.

e. Attachment Tilt Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the sealed outside diameter heavy-duty rod wiper (**13**) into the outer end of the head gland (**2**). The wiper lip (**19**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
2. Install new oiled o-ring (**10**), back-up ring (**9**), oiled o-ring (**8**), precision wearbands (**11**) and deep Z-seal with rod back-up (**12**) onto the head gland (**2**) orienting the edge (**20**).
3. Install the small new oiled o-ring (**16**) into the groove in the end of the rod (**1**).
4. Install the precision wearband (**14**) and the capped T-seal (**15**) onto the piston (**7**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

5. Install the head gland (**2**) and piston (**7**) onto the rod (**1**).

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

6. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod. Apply Loctite #271 (red) and install the locknut (**5**) onto the rod (**1**). Torque the nut to 1735-1885 lb-ft (2352-2556 Nm).
7. Place new nylon balls (**6**) into the threaded holes of the locknut (**5**). Insert the setscrews (**4**) into the holes and tighten until the nylon balls are deformed into the threads of the rod.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely.Excessive force can damage the cylinder.*

8. Place the attachment tilt cylinder tube (**3**) in a soft-jawed vise or other acceptable holding equipment if possible.

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**7**). Keep the rod centered within the tube to help prevent binding.*

9. Carefully insert the rod (**1**) with all attachments straight into the tube (**3**).
10. Using a pin spanner wrench, thread the head gland (**2**) completely into the tube (**3**). Torque to 300 ±50 lb-ft (407 ±68 Nm).
11. Apply Loctite #242 (blue) to the threads of the lock screw (**21**) and thread into the flange of the head gland (**2**). Torque to 3-4 lb-ft (4-5 Nm).
12. Using new oiled o-rings, thread the 4000 psi (276 bar) counterbalance valve (**22**) and the pilot-operated check valve (**23**) into the attachment tilt cylinder (**24**). Torque to 30-35 lb-ft (41-47 Nm).
13. If necessary, install a grease fitting (**25**) into the tapped hole in the end of the rod (**1**). Lubricate the bushings (**17**) in the rod end through the grease fitting with multi-purpose grease before the vehicle is operated.

f. Attachment Tilt Cylinder Installation

1. Attach a suitable sling to an overhead crane or other suitable device and to the attachment tilt cylinder. Make sure the device used can actually support the cylinder. Place the attachment tilt cylinder in position within the gooseneck. Refer to Section 3, “Boom.”
2. Install the lower attachment tilt cylinder pin by tapping it through the bottom of the quick attach (if installed). Install the retaining bolt.
3. Coat the attachment tilt cylinder base pin with anti-seize compound, and install the pin by tapping it in through the top of the gooseneck.
4. Secure the attachment tilt cylinder base pin to the boom with two 2" external retaining rings.
5. Install the lower pivot pin and quick attach as required.
6. Connect the attachment tilt cylinder hydraulic hoses in relation to the labels or markings made during removal.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

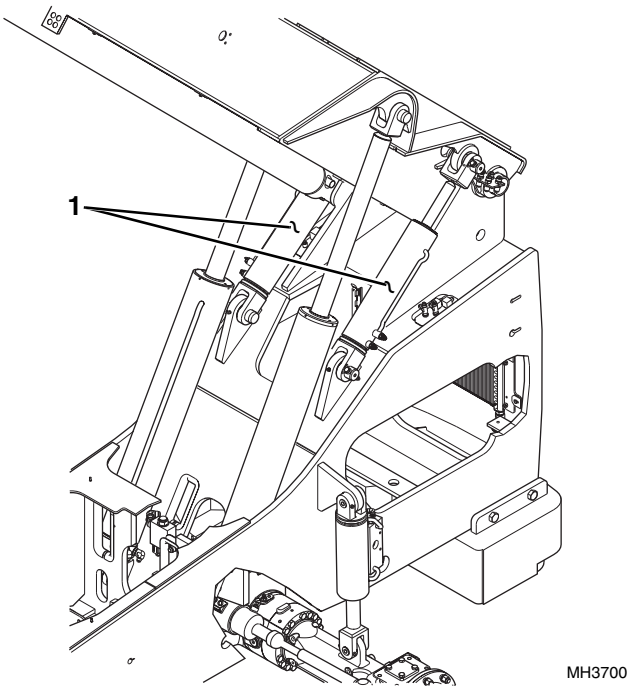
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Add hydraulic fluid to the reservoir as needed. Shut the engine OFF.
9. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.
10. Conduct a pressure check of the attachment tilt cylinder hydraulic circuit and bleed the circuit as outlined in the procedure that follows.

g. Attachment Tilt Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check the cylinder pressure, consult the factory.
2. With no accessory installed on the quick attach, start with the lift/lower and attachment tilt cylinders fully retracted.
3. Fully extend the attachment tilt cylinder. Hold the attachment tilt joystick at full extend while fully raising the lift/lower cylinder.
4. Fully retract the attachment tilt cylinder. Hold the attachment tilt joystick at full retract while fully retracting the lift/lower cylinder.
5. Repeat Steps 3 and 4 five times.

8.13.5 Slave Cylinders

Each slave cylinder (**1**) is secured to the vehicle frame and outer boom with cylinder mount pins, capscrews and nuts.



a. Slave Cylinder Removal

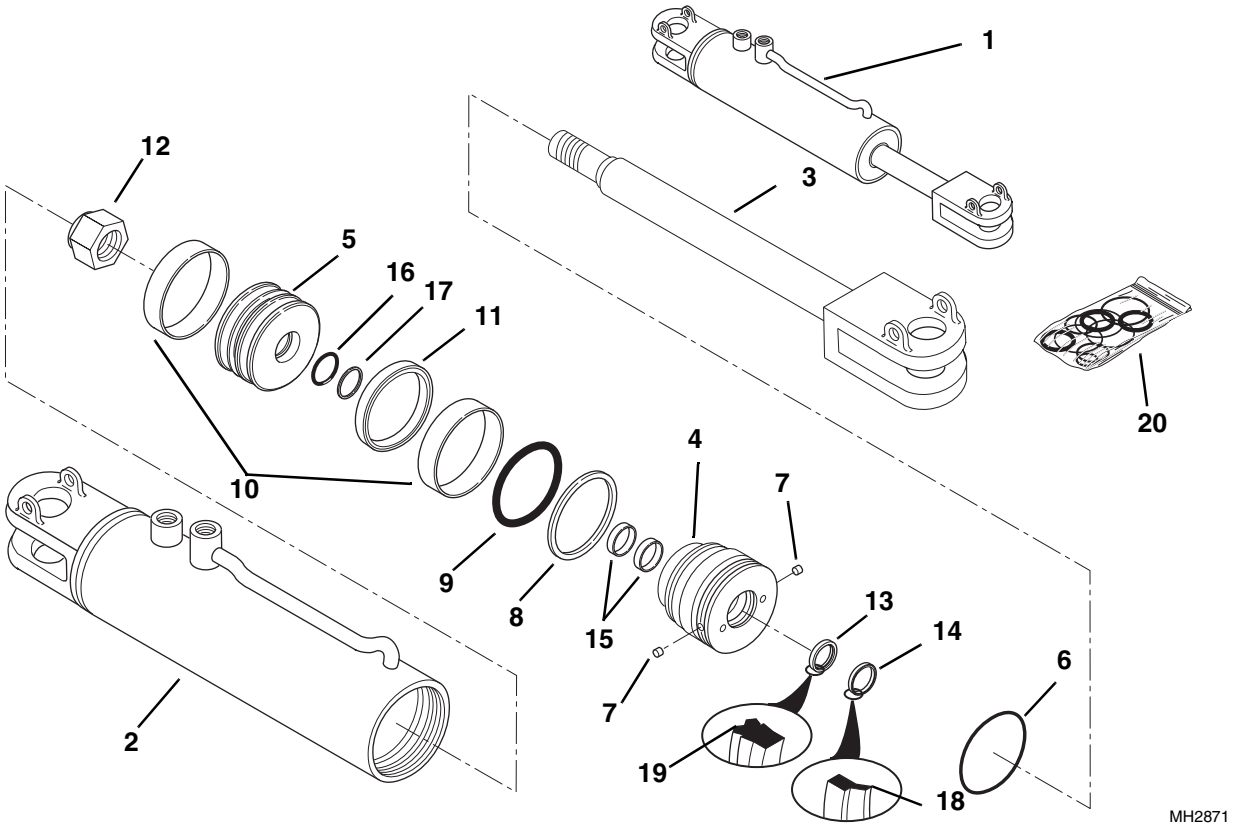
1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, then raise the boom to approximately a 30-degree angle. Support the boom. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the hydraulic hoses in relation to the slave cylinder being removed. Disconnect and cap the hydraulic hoses and slave cylinder fittings.
5. Securely support the slave cylinder. Remove the nuts, capscrews and cylinder pins securing the slave cylinder to the vehicle frame and outer boom.
6. With the help of at least one assistant, remove the slave cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.



b. Slave Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the slave cylinder (**1**) with a suitable cleaner before inspection. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. Place the slave cylinder (**1**) in a soft-jawed vise or other acceptable holding equipment if possible.
3. Extend the rod (**3**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

4. Using a pin spanner wrench, unscrew the head gland (**4**) from the tube (**2**). The head gland was originally torqued at 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube (**2**).

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**5**). Keep the rod centered within the tube to help prevent binding.*

5. Carefully pull the rod (**3**) with all attachments straight out of the tube (**2**).
6. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
7. Remove the o-ring (**6**), back-up ring (**8**) and o-ring (**9**) from the head gland.
8. Remove the locking insert (**7**) from its hole in the head gland threads. Pry or drill out the insert as required. **DO NOT** damage the head gland threads. A new locking insert will be required for reassembly.

9. Remove the precision wearbands (**10**) and the capped T-seal (**11**) from the piston (**5**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

10. Remove the locknut (**12**) from the rod (**3**). The deforming-thread type nut was coated with Loctite #271 (red) and torqued to 900-1050 lb-ft (1220-1424 Nm). Discard the nut.

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**12**) and the rod (**3**) before the piston (**5**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

11. Remove the piston (**5**) and head gland (**4**) from the rod (**3**).
12. From the head gland (**4**), remove the deep Z-seal with rod back-up (**13**), the sealed outside diameter heavy-duty rod wiper (**14**) and the precision wearbands (**15**).
13. From the piston (**5**), remove the small o-ring (**16**) and the back-up ring (**17**).

c. Slave Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from a complete seal kit (**20**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Slave Cylinder Inspection

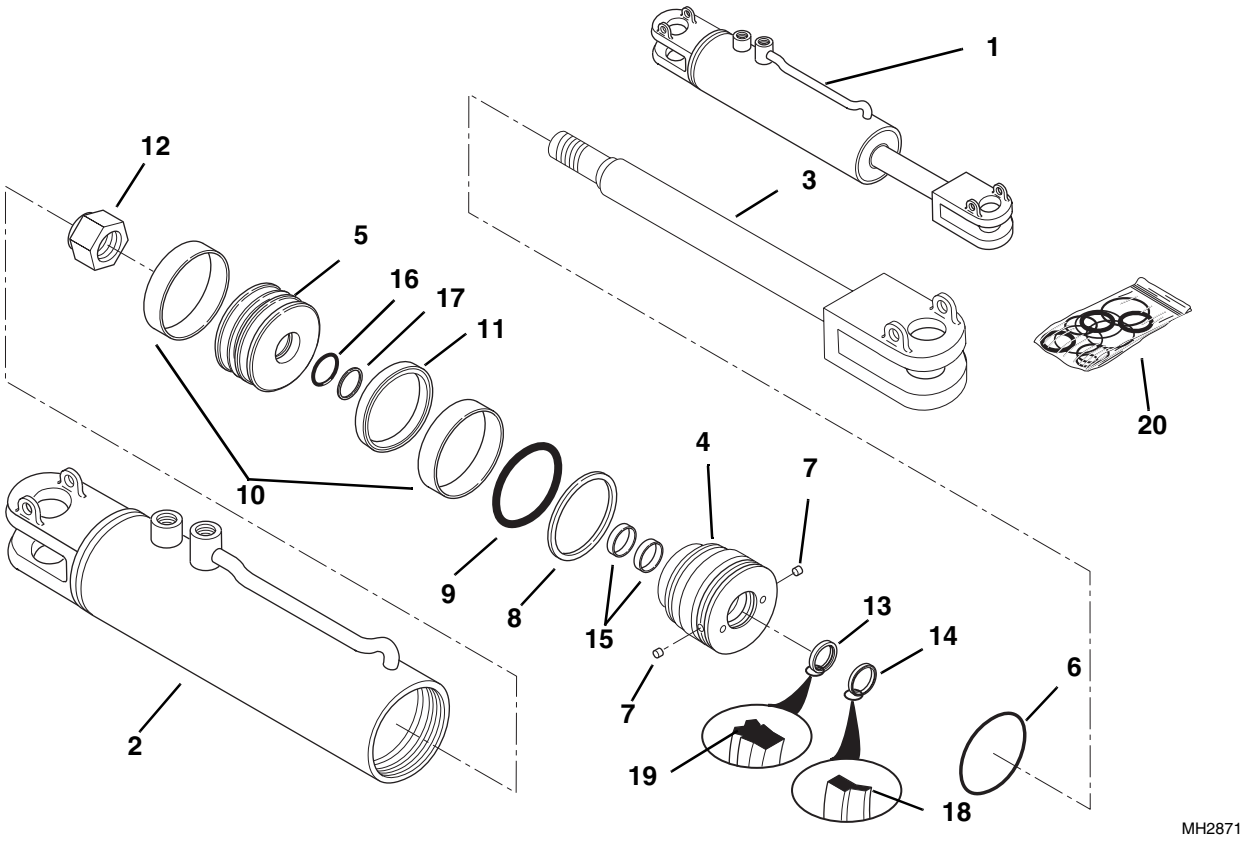
1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**2**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod, or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**3**) is straight. If it is bent, install a new rod.

e. Slave Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings, when installing the piston and head gland into the cylinder. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

1. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
2. Install the back-up ring (**17**) and the small o-ring (**16**) in the piston (**5**).
3. Install the sealed outside diameter heavy-duty rod wiper (**14**). The wiper lip (**18**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.



4. Install the deep Z-seal with rod back-up (**13**) in the head gland (**4**) orienting the edge (**19**).
5. Carefully install the head gland (**4**) onto the rod (**3**).
6. Carefully install the piston (**5**) onto the rod (**3**).

Note: *If a white, powdery residue remains on the threads and parts, clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before proceeding.*

7. Apply Loctite Threadlocker #271 (red) to the locknut (**12**). Thread the locknut onto the rod (**3**) and torque to 900-1050 lb-ft (1220-1424 Nm). The threads will deform upon tightening, locking the nut in place.
8. Install the capped T-seal (**11**) and precision wearbands (**10**) onto the piston (**5**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

9. Install new oiled o-ring (**9**), back-up ring (**8**) and oiled o-ring (**6**) onto the head gland (**4**).
10. Install new locking inserts (**7**) into the head gland.

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**5**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

11. Carefully insert the rod (**3**) with all attachments straight into the tube (**2**).
12. Using a pin spanner wrench, thread the head gland (**4**) into the tube (**2**). Torque the head gland to 300-400 lb-ft (407-542 Nm).

f. Slave Cylinder Installation

1. Align the slave cylinder with its mounting bosses within the rear frame uprights.
2. Align the mount pin bolt holes with the slave cylinder mount holes. Align the self-aligning bearing. Secure the slave cylinder with the cylinder pins, capscrews and nuts. Torque the capscrews and nuts to specification. Refer to the fastener torque chart in Section 2.3, "Torques."

3. Use new oiled o-rings, and reattach and secure the hydraulic hoses to the slave cylinder fittings.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

4. Start and run the engine at approximately one-third to one-half throttle for about one minute, without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

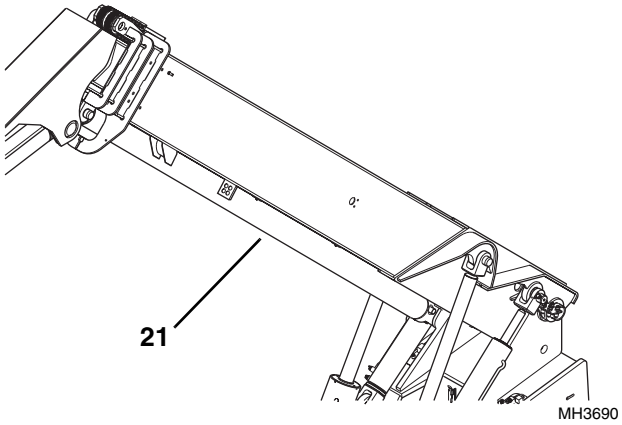
5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF. Add hydraulic fluid if required.
6. Conduct a pressure check of the attachment tilt/ slave cylinder hydraulic circuit, and bleed the circuit as outlined in the procedure that follows.
7. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

g. Slave Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check each cylinder pressure, consult the factory.
2. With no accessory installed on the quick attach, start with the lift/lower and attachment tilt cylinders fully retracted.
3. Fully extend the attachment tilt cylinder. Monitor pressure while fully raising the lift/lower cylinder.
4. Fully retract the attachment tilt cylinder. Monitor pressure while fully retracting the lift/lower cylinder.
5. Repeat Steps 3 and 4 five times.

8.13.6 Extend/Retract Cylinder

The extend/retract cylinder (**21**) is located under the boom, attached to the rear of the outer boom and the front of the intermediate boom.



a. Extend/Retract Cylinder Removal

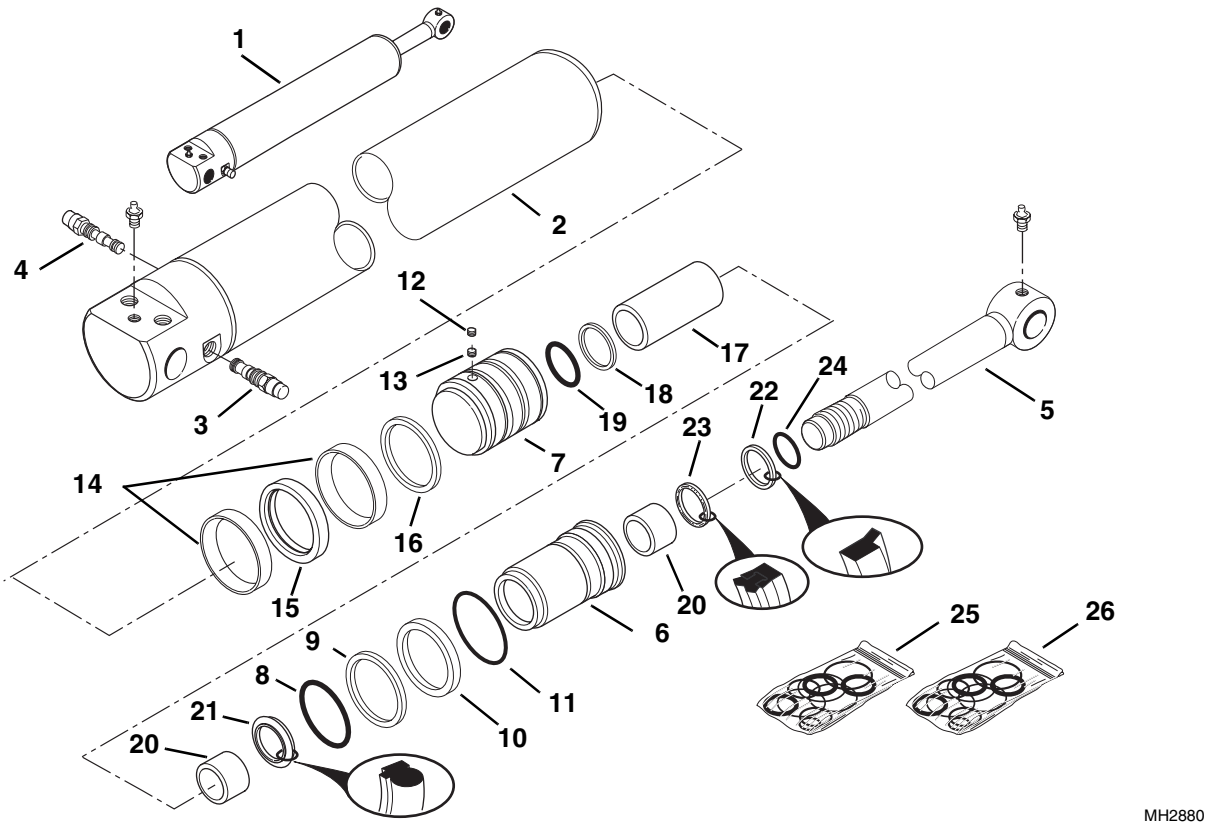
1. Park the vehicle on a firm, level surface, and fully retract all hydraulic cylinders. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF. Support the boom in a horizontal and level position with blocking.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Operate the hydraulic controls after the engine has stopped, to relieve any trapped pressure.
5. Label or otherwise mark the hydraulic hoses in relation to the extend/retract cylinder. Disconnect and cap both hoses and the cylinder fittings.



6. Attach a suitable sling to an overhead crane or other suitable device and to the extend/retract cylinder. Make sure the device used can actually support the cylinder.
7. Remove the two 2" external retaining rings securing the extend/retract cylinder rod pin to the intermediate boom section. Remove the pin.
8. Remove the two 2" external retaining rings securing the extend/retract cylinder base pin to the outer boom. Remove the pin.
9. Remove the extend/retract cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near or around the vehicle.

b. Extend/Retract Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the extend/retract cylinder (**1**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. Secure the extend/retract cylinder in a soft-jawed vise, or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the counterbalance valve (**3**) and the pilot-operated check valve (**4**).

IMPORTANT: ***DO NOT*** *tamper with or attempt to reset the counterbalance valve cartridge. If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

4. Extend the rod (**5**) as required to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Using a pin spanner wrench, unscrew the head gland (**6**) from the tube (**2**). The head gland was originally torqued to 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube (**2**).

IMPORTANT: *When sliding the rod and piston assembly out of the tube, prevent the threaded end of the tube from damaging the piston (**7**). Keep the rod centered within the tube to help prevent binding.*

6. Carefully pull the rod (**5**) with all attachments straight out of the tube (**2**).
7. Fasten the rear of the rod in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
8. Remove the setscrews (**12** and **13**) from the piston (**7**). The setscrews are used to provide a secondary lock on the piston. Pry or drill out the setscrews as required. **DO NOT** damage the piston threads. New setscrews will be required for reassembly.
9. Remove the precision wearbands (**14**), the piston seal (**15**) and the square ring (**16**) from the piston.
10. Remove the piston (**7**) from the rod (**5**). The piston was installed with Loctite #271 and torqued to 1800-2000 lb-ft (2441-2712 Nm).

Note: *It may be necessary to apply heat to break the bond of the sealant between piston (**7**) and the rod (5) before the piston can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

11. Remove the rod spacer (**17**).
12. From within the piston (**7**), remove the back-up ring (**18**) the o-ring (**19**).
13. Remove the o-ring (**8**), back-up ring (**9**), locking insert (**10**) and o-ring (**11**) from the head gland (**6**). Remove them from the rod (**5**).
14. Remove the head gland (**6**) from the rod (**5**).
15. From within the head gland (**6**), remove the precision wearbands (**20**) and, if installed, the buffer seal (**21**). Remove the sealed outside diameter heavy-duty rod wiper (**22**), the U-cup seal (**23**) and the o-ring (**24**).

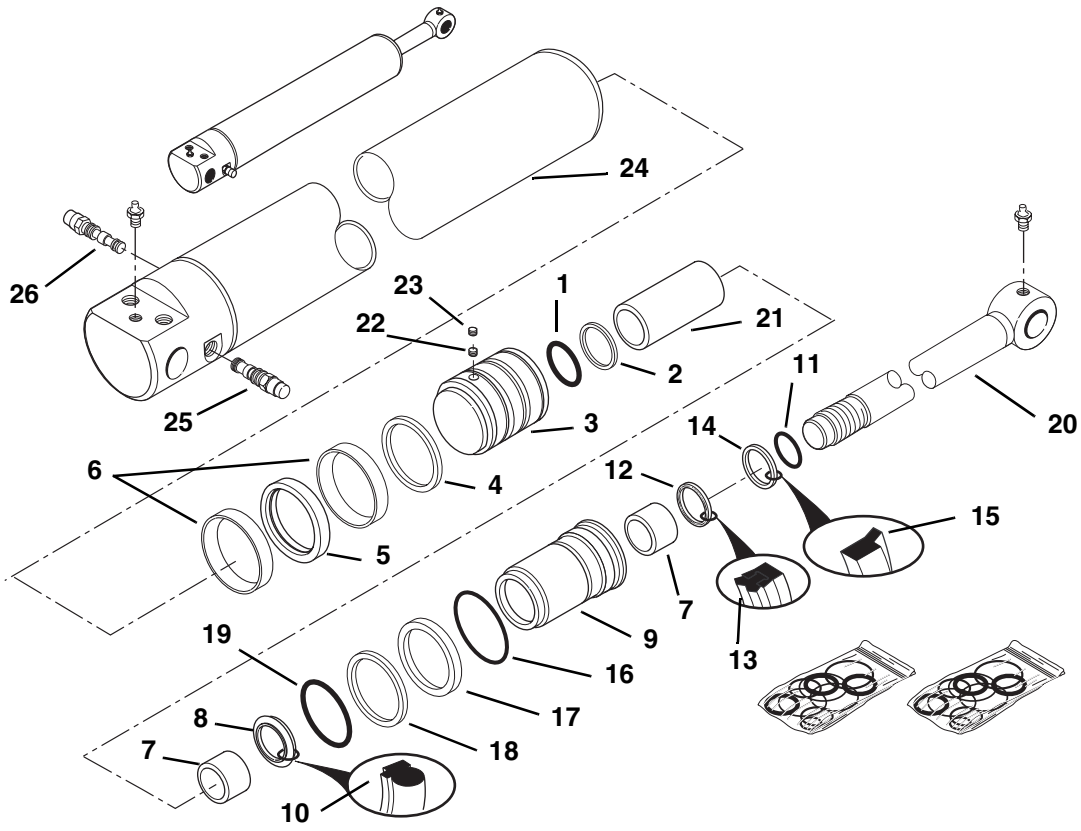
c. Extend/Retract Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder tube (**2**).
2. Discard all seals, back-up rings, o-rings, etc. Replace with new items from complete seal kits (**25** and **26**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Extend/Retract Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**2**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**5**) is straight. If it is bent, install a new rod.



e. Extend/Retract Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install a new small oiled o-ring (**1**) and new back-up ring (**2**) into the piston (**3**).
2. Install the square ring (**4**), the piston seal (**5**) and both precision wearbands (**6**) onto the piston (**3**).
3. Install the precision wearbands (**7**) and the buffer seal (**8**), if used, into the front end of the head gland (**9**). Orient the buffer seal as shown (**10**).
4. Install the o-ring (**11**) and the U-cup seal (**12**) orienting the edge (**13**).
5. Install the sealed outside diameter heavy-duty rod wiper (**14**). The wiper lip (**15**) should be toward the outer end of the head gland (**9**) and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
6. Install a new oiled o-ring (**16**), locking insert (**17**), back-up ring (**18**) and oiled o-ring (**19**) onto the head gland (**9**).
7. Secure the rod (**20**) in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
8. Carefully slide the head gland (**9**), then the rod spacer (**21**) onto the rod (**20**).
9. Carefully slide the piston (**3**) onto the rod (**20**). Apply Loctite Threadlocker #271 to the piston and torque the piston to 1800-2000 lb-ft (2440-2712 Nm).
10. Apply Loctite Threadlocker #243 to the setscrew threads. Thread the first setscrew (**22**) and then the second (**23**) into the piston (**3**). Torque the setscrews to 155-165 lb-in (18-19 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder.*

11. Secure the extend/retract cylinder tube (**24**) in a soft-jawed vise or other acceptable holding equipment if possible.
12. Lubricate the inside of the tube (**24**) and outside of the piston (**3**) and head gland (**9**) with clean, filtered hydraulic oil.
13. Apply a compression sleeve or other suitable tool to the head gland (**9**) and piston (**3**) in order to compress the o-rings, back-up rings and seals, while inserting the assembled piston, rod and head gland into the tube (**24**).

IMPORTANT: *When sliding the rod (**20**) and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**3**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

14. Carefully insert the rod (**20**) with all attachments straight into the tube (**24**).
15. Using a pin spanner wrench, thread the head gland (**9**) into the tube (**24**). Torque the head gland to 300-400 lb-ft (407-542 Nm).
16. Lubricate the counterbalance valve (**25**) and the pilot-operated check valve (**26**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the counterbalance valve and the pilot-operated check valve into the cylinder. Torque the valves to 150-160 lb-ft (203-217 Nm).

IMPORTANT: DO NOT *tamper with or attempt to reset the counterbalance valve cartridge. If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

17. Test the cylinder at low operating pressure (100 psi or 7 bar). Verify that the piston and the rod move freely in both directions.
18. Increase the operating pressure to the maximum amount for the cylinder 3000 psi (207 bar), and again check for free movement in both directions.
19. Retract the rod fully into the tube, and cap and plug the hydraulic hose ports.

f. Extend/Retract Cylinder Installation

1. Attach a suitable sling to an overhead crane or other suitable device and to the extend/retract cylinder. Make sure the device used can actually support the cylinder. Place the extend/retract cylinder in position guiding the rod end through the retainer on the outer boom.

Note: *Check the condition of the rubber bumper located on the retainer. Replace if damaged. Refer to Section 3.3.3, "Outer Boom Removal."*

2. Coat the extend/retract cylinder base pin with anti-seize compound and install the pin by tapping it in.
3. Secure the extend/retract cylinder base pin to the boom with two 2" external retaining rings.
4. Guide the rod end into position aligning the eye with the intermediate boom mounting holes. Coat the extend/retract cylinder rod pin with anti-seize compound and install the pin by tapping it in.
5. Secure the extend/retract cylinder rod pin to the boom with two 2" external retaining rings.
6. Connect the extend/retract cylinder hydraulic hoses in relation to the labels or markings made during removal.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

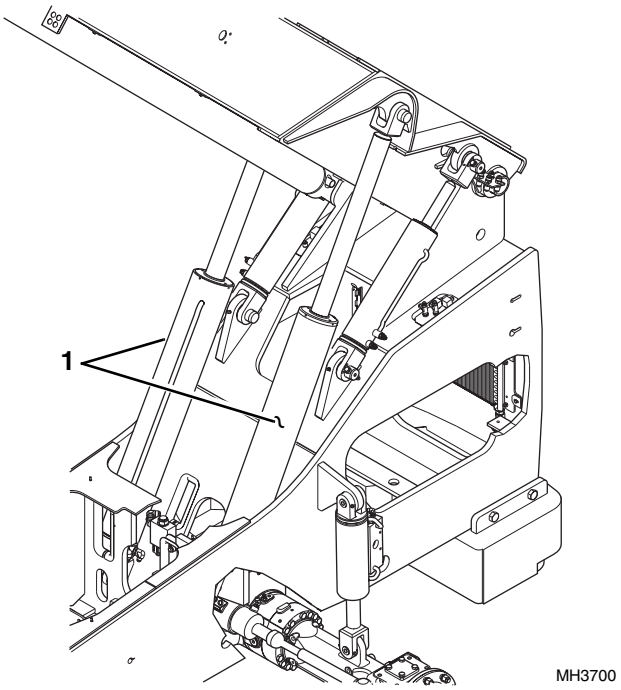
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Add hydraulic fluid to the reservoir as needed. Shut the engine OFF.
9. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.
10. Conduct a pressure check of the attachment tilt cylinder hydraulic circuit and bleed the circuit as outlined in the procedure that follows.

g. Extend/Retract Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, "Hydraulic System Testing." To check the cylinder pressure, consult the factory.
2. With no accessory installed on the quick attach, start with the lift/lower and attachment tilt cylinders fully retracted.
3. Fully extend the extend/retract cylinder. Hold the joystick at full extend while fully raising the lift/lower cylinder.
4. Fully retract the attachment tilt cylinder. Hold the attachment tilt joystick at full retract while fully retracting the lift/lower cylinder.
5. Repeat Steps 3 and 4 five times.

8.13.7 Lift/Lower Cylinder

The lift/lower cylinders (**1**) are anchored to the underside of the outer boom and to the vehicle frame.



a. Lift/Lower Cylinder Removal

> **WARNING:** **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch, raise and support the boom to allow removal of the lift/lower cylinder and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the lift/lower cylinder hydraulic hoses. Disconnect and cap all hoses and fittings.
5. Attach a sling to the lift/lower cylinder and to a suitable hoist or overhead crane. Support the lift/lower cylinder in the sling.
6. Remove the locknut, capscrew and rod end mount pin from the cylinder. Allow the cylinder to retract so that it can clear the mounting bracket on the outer boom.
7. Remove the locknut, capscrew and base end mount pin from the cylinder.
8. Safely and carefully, remove the lift/lower cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.

For S/N 13198 thru 19234

b. Lift/Lower Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the lift/lower cylinder (**2**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

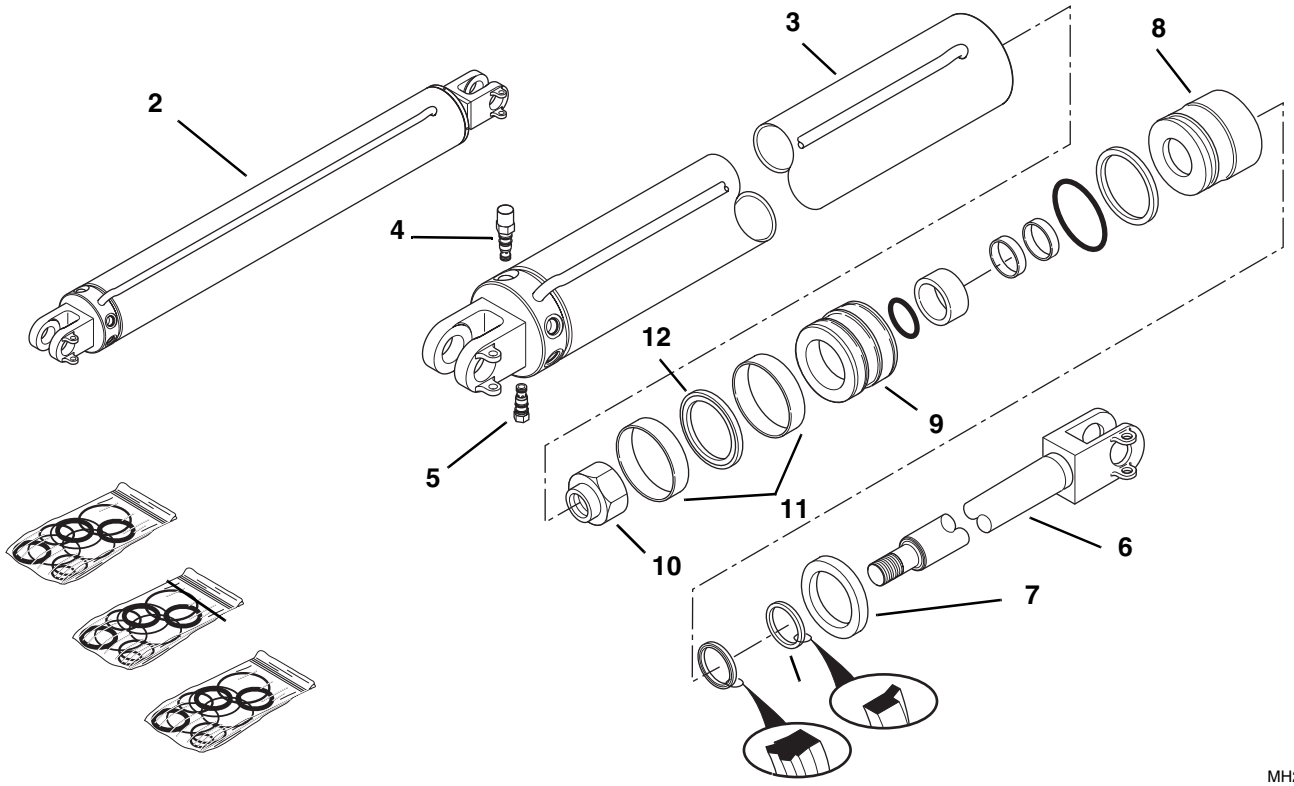
IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**3**).*

2. Secure the lift/lower cylinder in a soft-jawed vise or other acceptable holding equipment if possible.
3. Slowly remove the counterbalance valve (**4**) and pilot-operated check valve (**5**) from the tube (**3**).

IMPORTANT: ***DO NOT*** *tamper with or attempt to reset the counterbalance valve cartridge. If adjustment or replacement is necessary, replace the counterbalance valve with a new part.*

4. Extend the rod (**6**) as required to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*



5. Using a pin spanner wrench, unscrew the locking collar (**7**) from the tube (**3**). The locking collar was originally torqued to 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required.
6. Carefully slide the locking collar (**7**) and the head gland (**8**) down along the rod toward the eyelet end, away from the cylinder tube (**3**).

IMPORTANT: *When sliding the rod and piston assembly out of the tube, prevent the threaded end of the tube from damaging the piston (**9**). Keep the rod centered within the tube to help prevent binding.*

7. Carefully pull the rod (**6**) with all attachments straight out of the tube (**3**).
8. Fasten the rod in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
9. Remove the locknut (**10**) from the rod (**6**). The nut was installed with Loctite #271 (red) and torqued to 1750-2000 lb-ft (2373-2712 Nm).

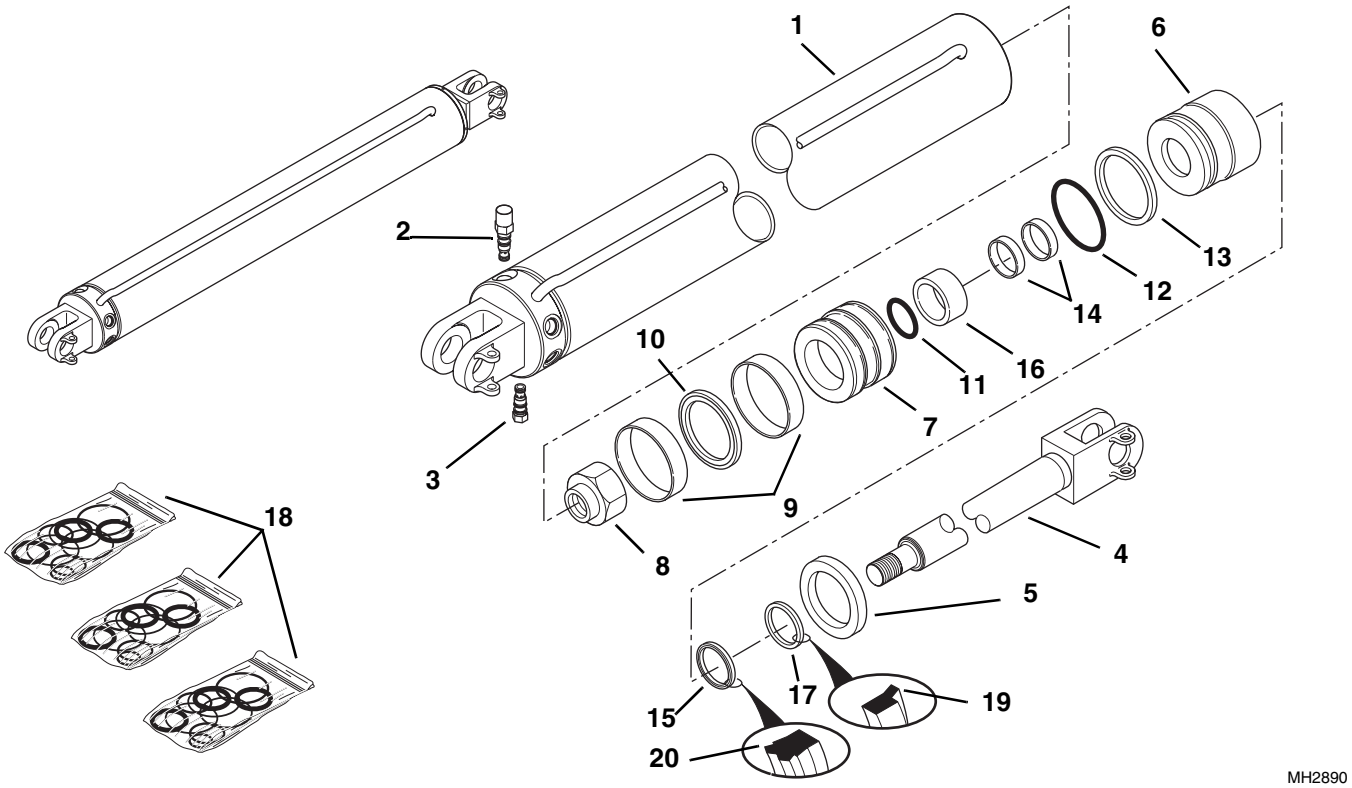
Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**10**) and the rod (**6**) before the piston (**9**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

10. Remove the piston (**9**) from the rod (**6**).
11. Remove both precision wearbands (**11**) and the capped T-seal (**12**) from the piston (**9**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*



12. Remove the small o-ring (**11**) from within the piston (**7**).
13. Remove the o-ring (**12**) and back-up ring (**13**) from the head gland (**6**). Slide the rings off the rod (**4**) to remove them from the rod.
14. Remove the precision wearbands (**14**) from within the head gland (**6**). Remove the sealed, outside diameter heavy-duty rod wiper (**17**) and the deep Z-seal with back-up (**15**) from the other end of the head gland. Remove the rod spacer (**16**).

c. Lift/Lower Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder tube (**1**).
2. Discard all seals, back-up rings, o-rings, etc. Replace with new items from complete seal kits (**18**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Lift/Lower Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If inner surface of the tube (**1**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**4**) is straight. If it is bent, install a new rod.

e. Lift/Lower Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install a new small oiled o-ring (**11**) into the piston (**7**).
2. Install the capped T-seal (**10**) and both precision wearbands (**9**) onto the piston (**7**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

3. Install the precision wearbands (**14**) into the forward end of the head gland (**6**). Install the deep Z-seal with back-up (**15**) orienting the edge (**20**). Install the sealed, outside diameter heavy-duty rod wiper (**17**). The wiper lip (**19**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
4. Install a new oiled o-ring (**12**) and back-up ring (**13**) onto the head gland (**6**).
5. Fasten the rear of the rod in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
6. Carefully slide the head gland (**6**) onto the rod (**4**). Slide the rod spacer (**16**) onto the rod.
7. Carefully slide the piston (**7**) onto the rod (**4**).
8. Apply Loctite Threadlocker #271 (red) to the threads of the locknut (**8**). Thread the locknut onto the rod (**4**). Torque to 1750-2000 lb-ft (2373-2712 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**1**).*

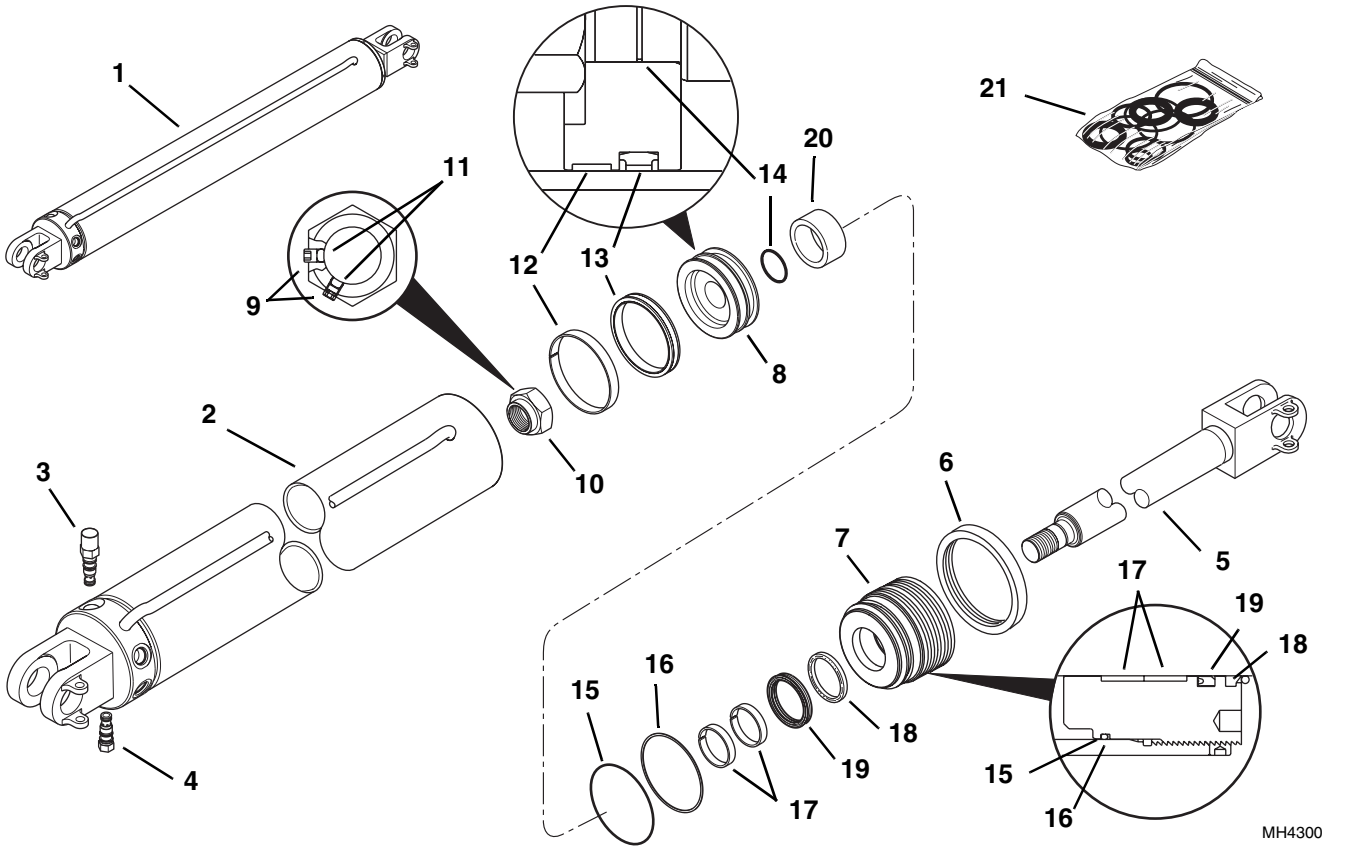
9. Secure the lift/lower cylinder in a soft-jawed vise or other acceptable holding equipment if possible.
10. Lubricate the inside of the tube (**1**) and outside of the piston (**7**) and head gland (**6**) with clean, filtered hydraulic oil.
11. Apply a compression sleeve or other suitable tool to the head gland (**6**) and piston (**7**) in order to compress the o-rings, back-up rings and seals, while inserting the assembled piston, rod and head gland into the tube (**1**).

IMPORTANT: *When sliding the rod (**4**) and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**7**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

12. Carefully insert the rod (**4**) with all attachments straight into the tube (**1**).
13. Using a pin spanner wrench, thread the locking collar (**5**) into the tube (**1**). Torque the locking collar to 300-400 lb-ft (407-542 Nm).

IMPORTANT: ***DO NOT*** *tamper with or attempt to reset the counterbalance valve cartridge (**2**). If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

14. Lubricate the counterbalance valve (**2**) and the pilot-operated check valve (**3**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the valves into tube (**1**). Torque to 30-35 lb-ft (41-47 Nm).
15. Test the cylinder at low operating pressure (100 psi or 7 bar). Verify that the piston and the rod move freely in both directions.
16. Increase the operating pressure to the maximum amount for the cylinder 3000 psi (207 bar), and again check for free movement in both directions.
17. Retract the rod fully into the tube, and cap and plug the hydraulic hose ports.



For S/N 19235 & After

b. Lift/Lower Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the lift/lower cylinder (**1**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. Secure the lift/lower cylinder in a soft-jawed vise or other acceptable holding equipment if possible.
3. Slowly remove the counterbalance valve (**3**) and pilot-operated check valve (**4**) from the tube (**2**).

IMPORTANT: ***DO NOT*** *tamper with or attempt to reset the counterbalance valve cartridge. If adjustment or replacement is necessary, replace the counterbalance valve with a new part.*

4. Extend the rod (**5**) as required to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Using a pin spanner wrench, unscrew the locking collar (**6**) from the tube (**2**). The locking collar was originally torqued to 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required.
6. Carefully slide the locking collar (**6**) and the head gland (**7**) down along the rod toward the eyelet end, away from the cylinder tube (**2**).

IMPORTANT: *When sliding the rod and piston assembly out of the tube, prevent the threaded end of the tube from damaging the piston (**8**). Keep the rod centered within the tube to help prevent binding.*

7. Carefully pull the rod (**5**) with all attachments straight out of the tube (**2**).
8. Fasten the rod in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.

9. Remove the two setscrews (**9**) from the locknut (**10**). Under each setscrew is a nylon ball (**11**). Be sure to remove the nylon balls from the locknut. Discard the nylon balls.
10. Remove the locknut (**10**) from the rod (**5**). The locknut is torqued at 1735-1885 lb-ft (2352-2556 Nm).

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**10**) and the rod (**5**) before the piston (**8**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

11. Remove the piston (**8**) from the rod (**5**).
12. Remove the precision wearband (**12**) and the capped T-seal (**13**) from the piston (**8**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

13. Remove the small o-ring (**14**) from the end of the rod (**5**).
14. Remove the o-ring (**15**) and back-up ring (**16**) from the head gland (**7**).
15. Remove the precision wearbands (**17**) from within the head gland (**7**). Remove the sealed, outside diameter heavy-duty rod wiper (**18**) and the deep Z-seal with back-up (**19**) from the other end of the head gland. Remove the rod spacer (**20**).

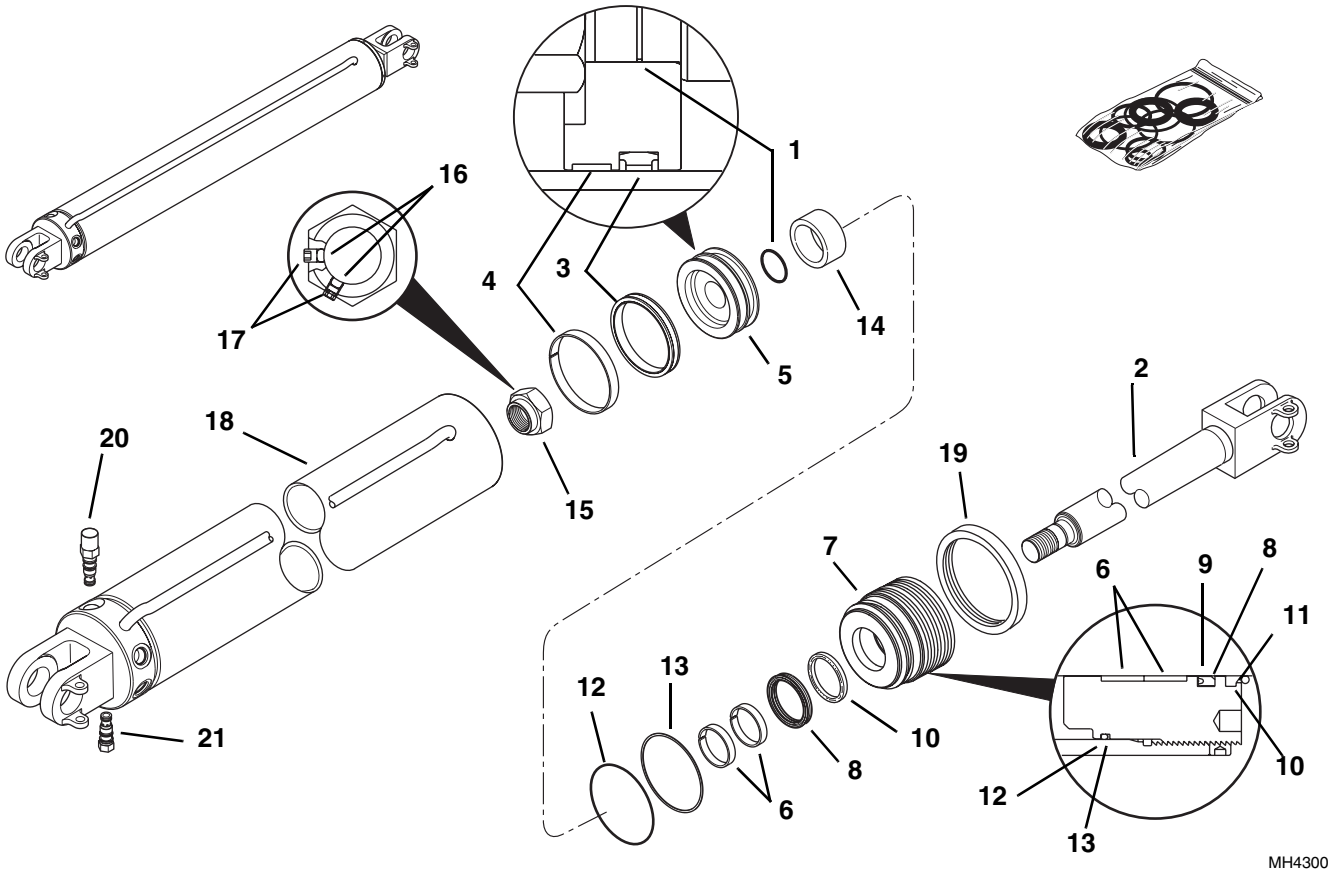
c. Lift/Lower Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder tube (**2**).
2. Discard all seals, back-up rings, o-rings, etc. Replace with new items from a complete seal kit (**21**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Lift/Lower Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If inner surface of the tube (**2**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**5**) is straight. If it is bent, install a new rod.



e. Lift/Lower Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install a new small oiled o-ring (**1**) into the groove in the end of the rod (**2**).
2. Install the capped T-seal (**3**) and the precision wearband (**4**) onto the piston (**5**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

3. Install the precision wearbands (**6**) into the forward end of the head gland (**7**). Install the deep Z-seal with back-up (**8**) orienting the edge (**9**). Install the sealed, outside diameter heavy-duty rod wiper (**10**). The wiper lip (**11**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
4. Install a new oiled o-ring (**12**) and back-up ring (**13**) onto the head gland (**7**).
5. Fasten the rear of the rod in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
6. Carefully slide the head gland (**7**) onto the rod (**2**). Slide the rod spacer (**14**) onto the rod.
7. Carefully slide the piston (**5**) onto the rod (**2**).
8. Apply Loctite Threadlocker #271 (red) to the threads of the locknut (**15**). Thread the locknut onto the rod (**2**). Torque the nut to 1735-1885 lb-ft (2352-2556 Nm).
9. Place new nylon balls (**16**) into the threaded holes of the locknut (**15**). Insert the setscrews (**17**) into the holes and tighten until the nylon balls are deformed into the threads of the rod.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**18**).*

10. Secure the lift/lower cylinder in a soft-jawed vise or other acceptable holding equipment if possible.
11. Lubricate the inside of the tube (**18**) and outside of the piston (**5**) and head gland (**7**) with clean, filtered hydraulic oil.
12. Apply a compression sleeve or other suitable tool to the head gland (**7**) and piston (**5**) in order to compress the o-rings, back-up rings and seals, while inserting the assembled piston, rod and head gland into the tube (**18**).

IMPORTANT: *When sliding the rod (**2**) and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**5**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

13. Carefully insert the rod (**2**) with all attachments straight into the tube (**18**).
14. Using a pin spanner wrench, thread the locking collar (**19**) onto the tube (**18**). Torque the locking collar to 300-400 lb-ft (407-542 Nm).

IMPORTANT: DO NOT *tamper with or attempt to reset the counterbalance valve cartridge (**20**). If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

15. Lubricate the counterbalance valve (**20**) and the pilot-operated check valve (**21**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the valves into tube (**18**). Torque to 30-35 lb-ft (41-47 Nm).
16. Test the cylinder at low operating pressure 100 psi (7 bar). Verify that the piston and the rod move freely in both directions.
17. Increase the operating pressure to the maximum amount for the cylinder 3000 psi (207 bar), and again check for free movement in both directions.
18. Retract the rod fully into the tube, and cap and plug the hydraulic hose ports.

f. Lift/Lower Cylinder Installation

WARNING: **DO NOT** get under a raised boom unless the boom is blocked up. Always block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

1. Raise and support the boom to allow installation of the lift/lower cylinder.
2. Attach a sling to the lift/lower cylinder and to a hoist or an overhead crane. Safely and carefully, position the lift/lower cylinder inside the frame aligning the rod and base eyelets with mounting bosses of the boom and frame.
3. Secure the cylinder with cylinder mount pins, capscrews and nuts.
4. Connect all hoses according to the labels or other marks used to identify their locations during removal.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

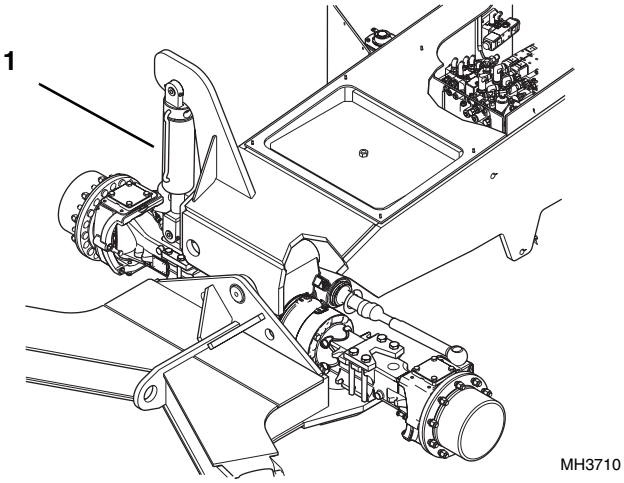
5. Operate the vehicle in order to check all boom functions and check for hydraulic system leaks.
6. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle. Perform the pressure check and circuit bleeding procedure below.

g. Lift/Lower Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check each cylinder pressure, consult the factory.
2. With no accessory installed on the quick attach, start with the lift/lower and attachment tilt cylinders fully retracted.
3. Fully raise and fully extend the boom. Hold the joystick at full extend, while fully raising the lift/lower cylinder.
4. Fully retract the attachment tilt cylinder. Hold the joystick at full retract, while fully lowering the boom.
5. Repeat Steps 3 and 4 five times.

8.13.8 Frame Sway Cylinder

The frame sway cylinder (**1**) is attached to the right side of the frame at the front axle and to the cast loop on the axle.



a. Frame Sway Cylinder Removal

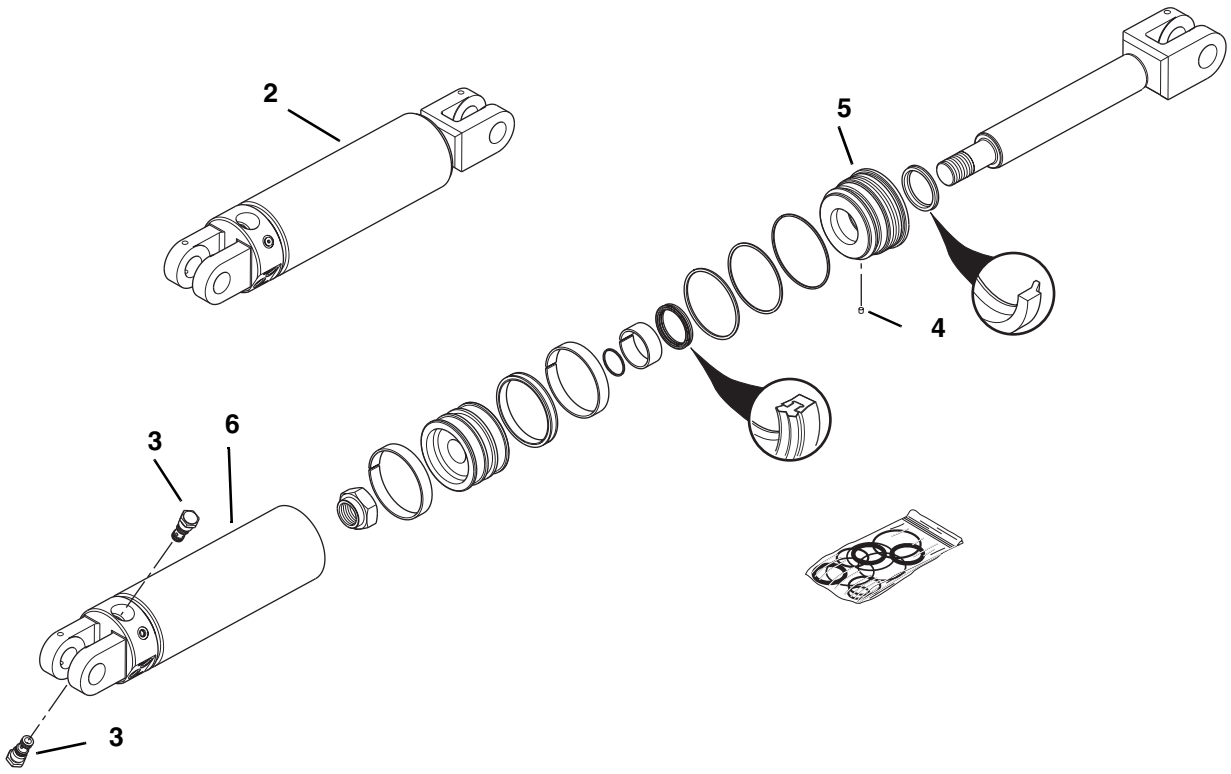
1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the hydraulic hoses in relation to the cylinder being removed. Safely position suitable supports between the frame and axle to prevent the frame from leaning to one side.
5. Disconnect and cap all hoses and fittings, etc.
6. Use a sling and hoist or other suitable lifting device to support the cylinder. Remove the nuts, capscrews, and cylinder mount pins securing the cylinder to the frame and anchor plate.
7. Remove the cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.



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b. Frame Sway Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the frame sway cylinder (**2**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder.*

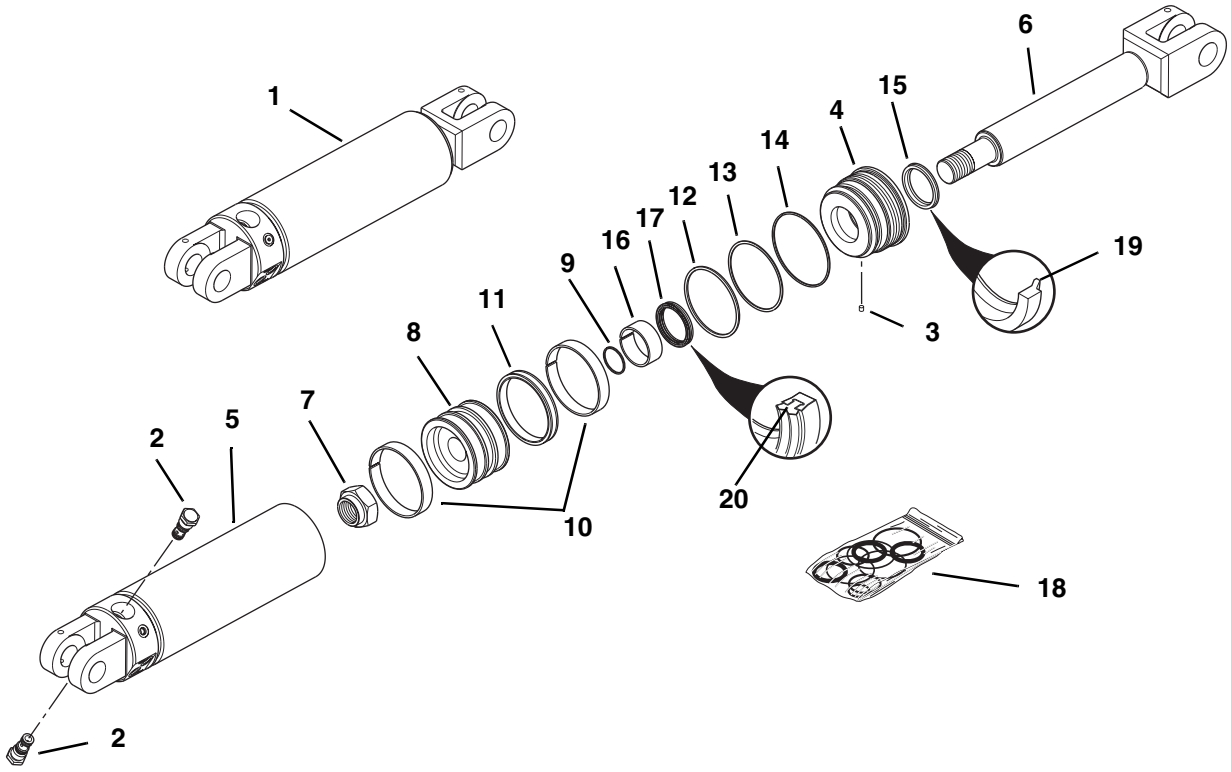
2. Secure the frame sway cylinder (**2**) in a soft-jawed vise or other holding device, and place a suitable container beneath the cylinder to catch hydraulic fluid run-off.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the pilot-operated check valves (**3**) from the frame sway cylinder.
4. Remove the locking insert (**4**) from its hole in the head gland threads. Pry or drill out the insert as required. **DO NOT** damage the head gland threads. A new locking insert will be required for reassembly.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the rod can cause premature seal failure.*

5. Use a pin spanner wrench to unthread the head gland (**5**) from the tube (**6**). The head gland is installed at a torque of 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube.



IMPORTANT: *When sliding the rod and piston assembly out of the tube,* ***DO NOT*** *damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

6. Carefully withdraw the rod (**6**) straight out of the tube (**5**). Keep the rod straight during withdrawal to help avoid scratching, nicking or damaging the tube.
7. Secure the rod eyelet and remove the locknut (**7**) from the threaded end of the rod. Discard the nut; a new nut will be required for reassembly.

Note: *Heating the nut (**7**) to approximately 300° F (150° C) may also be required to break the seal formed by the Loctite Threadlocker #271 (red) applied to the nut when installed. The application of significant force is required to overcome the 1100-1250 lb-ft (1492-1695 Nm) of torque the nut was tightened to when originally installed.*

8. Remove the piston (**8**) from the rod (**6**).
9. Remove the small o-ring (**9**) from the piston (**8**).
10. Remove the head gland (**4**) from the rod (**6**).
11. Remove both precision wearbands (**10**) from the piston (**8**).
12. Remove the capped T-seal (**11**) from the piston (**8**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

13. Remove the o-ring (**12**), the back-up ring (**13**) and the o-ring (**14**) from the head gland (**4**).
14. Remove the heavy-duty rod wiper (**15**) from the head gland (**4**).
15. Remove the precision wearband (**16**) and deep Z-seal with rod back-up (**17**) from inside the head gland (**4**).

c. Frame Sway Cylinder Internal Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from a complete seal kit (**18**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

d. Frame Sway Cylinder Inspection and Repair

1. Inspect all parts for wear, damage, etc. If inner surfaces of the cylinder (**1**) do not display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the component.
2. Inspect the inside of the tube (**5**) for scoring and other damage. If the tube is damaged, replace it with a new tube.
3. Remove small scratches on the rod or inside of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend scratch(es) into the surrounding surface.
4. Clean the parts with trichlorethylene after repair.
5. Check that the rod (**6**) is straight. If the rod is bent, install a new rod.

e. Frame Sway Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the deep Z-seal with rod back-up (**17**) into the head gland, orienting the edge (**20**).
2. Install the precision wearband (**16**) into the head gland.
3. Install the heavy-duty rod wiper (**15**) with the raised portion of the wiper lip seal (**19**) oriented toward the rod eyelet. The wiper lip should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
4. Install a new oiled o-ring (**14**), back-up ring (**13**) and oiled o-ring (**12**) onto the head gland (**4**). If the back-up ring is not flat on both sides, the side with the arc must be toward the o-ring.
5. Install the head gland (**4**) onto the rod (**6**). If necessary, use a soft hammer to drive the head gland onto the rod.
6. Install the new small oiled o-ring (**9**) into the piston (**8**).
7. Install the capped T-seal (**11**) onto the piston (**8**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

8. Install the two precision wearbands (**10**) onto the piston (**8**).
9. Install the piston (**8**) onto the rod (**6**).
10. Secure the rod eyelet in a soft-jawed vise or other suitable holding device. Place a padded support below the threaded end of the rod to help prevent damaging the rod.
11. Apply Loctite Primer "T" and Threadlocker #271 (red), to a new locknut (**7**) in accordance with Loctite instructions. Install the nut onto the threaded end of the rod (**6**). Torque the nut to 1100-1250 lb-ft (1492-1695 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**5**).*

12. Fasten the tube (**5**) in a soft-jawed vise or other suitable holding device.
13. To aid in installation, lubricate the o-rings and the inside of the tube, piston and head gland with clean, filtered hydraulic oil.

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings when installing the piston (**8**) and head gland (**4**) into the cylinder. When sliding the rod and piston assembly into the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

14. Keep the rod (**6**) straight, and carefully insert the rod into the tube (**5**). Avoid scratching, nicking or damaging the tube while installing the rod.
15. Begin threading the head gland (**4**) into the tube (**5**). Place the locking insert (**3**) in its hole in the head gland threads, just before the hole is threaded into the tube. Use a suitable pin spanner wrench to thread the head gland (**4**) completely into the tube (**5**). Torque the head gland to 300-400 lb-ft (407-542 Nm).
16. Lubricate the pilot-operated check valves (**2**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the pilot-operated check valves into tube (**5**). Torque valves to 35-40 lb-ft (47-54 Nm).
17. Test the cylinder at low operating pressure 100 psi (6,9 bar) to verify that the piston and rod move freely in both directions.
18. Increase the operating pressure to the maximum for the cylinder 3250 psi (224 bar), and check for external leakage and for free movement in both directions.
19. Retract the piston fully.

f. Frame Sway Cylinder Installation

1. Lubricate the cylinder pins with multi-purpose, lithium-based grease.
2. Use a sling and hoist or other suitable lifting device to help install the cylinder. Orient the cylinder with the cylinder eyelet on top and the rod eyelet on the bottom.
3. Install the upper cylinder pin. Drive the lubricated cylinder pin through the cylinder eyelet, frame mount and self-aligning bearing. Secure the pin with a capscrew and hex-locknut. Torque to 18 lb-ft (24 Nm).
4. Use new flat-faced, oiled o-rings when installing the upper and lower hydraulic hoses. Install and tighten the hoses onto the appropriate fittings.

WARNING: Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

5. With the help of an assistant, start the engine. Carefully and slowly, operate the joystick frame sway function to properly align the rod with the anchor plate as required. Turn the engine OFF.
6. Install the lower cylinder pin. Drive the lubricated cylinder pin through the rod eyelet, anchor plate and self-aligning bearing. Secure the pin with a capscrew and hex-locknut. Torque nut to 18 lb-ft (24 Nm).
7. Remove all tools, etc. from the vehicle. Carefully remove the blocking supporting the vehicle frame at the front and rear axles.
8. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions. Operate the joystick to fully sway the frame left and right at least five times each.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

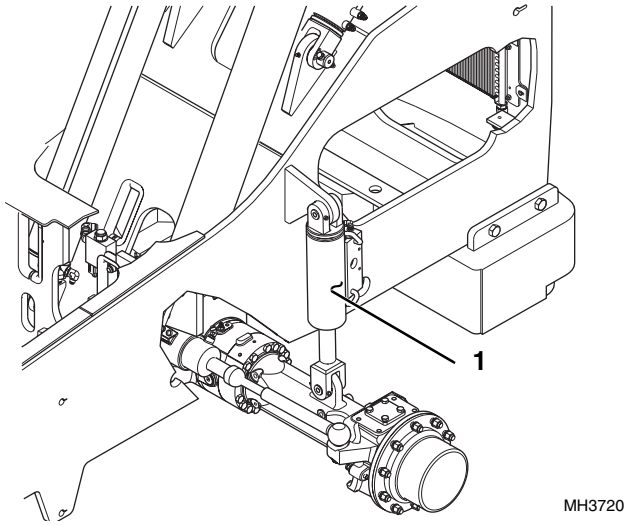
9. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF. Add hydraulic fluid if required.
10. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

g. Frame Sway Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check the cylinder pressure, consult the factory.
2. Start with the frame sway and stabilizer cylinders balanced, that is, with the frame level.
3. Sway the vehicle fully left. Hold the joystick at full sway left for several seconds, then sway the vehicle fully right and hold the joystick at full sway right for several seconds. Observe the readings on the gauge during the frame sway operations.
4. Level the frame. While leveling the frame, check the pressure reading on the gauge.
5. Repeat Steps 3 and 4 five times.

8.13.9 Stabil-TRAK Cylinder

The stabilizer cylinder (**1**) is attached to the left side of the frame at the rear axle and to the cast loop on the axle.



The Stabil-TRAK™ manifold attached to the stabilizer cylinder at the left rear of the vehicle provides the operating characteristics for the patented Stabil-TRAK™ system.

a. Stabilizer Cylinder Removal

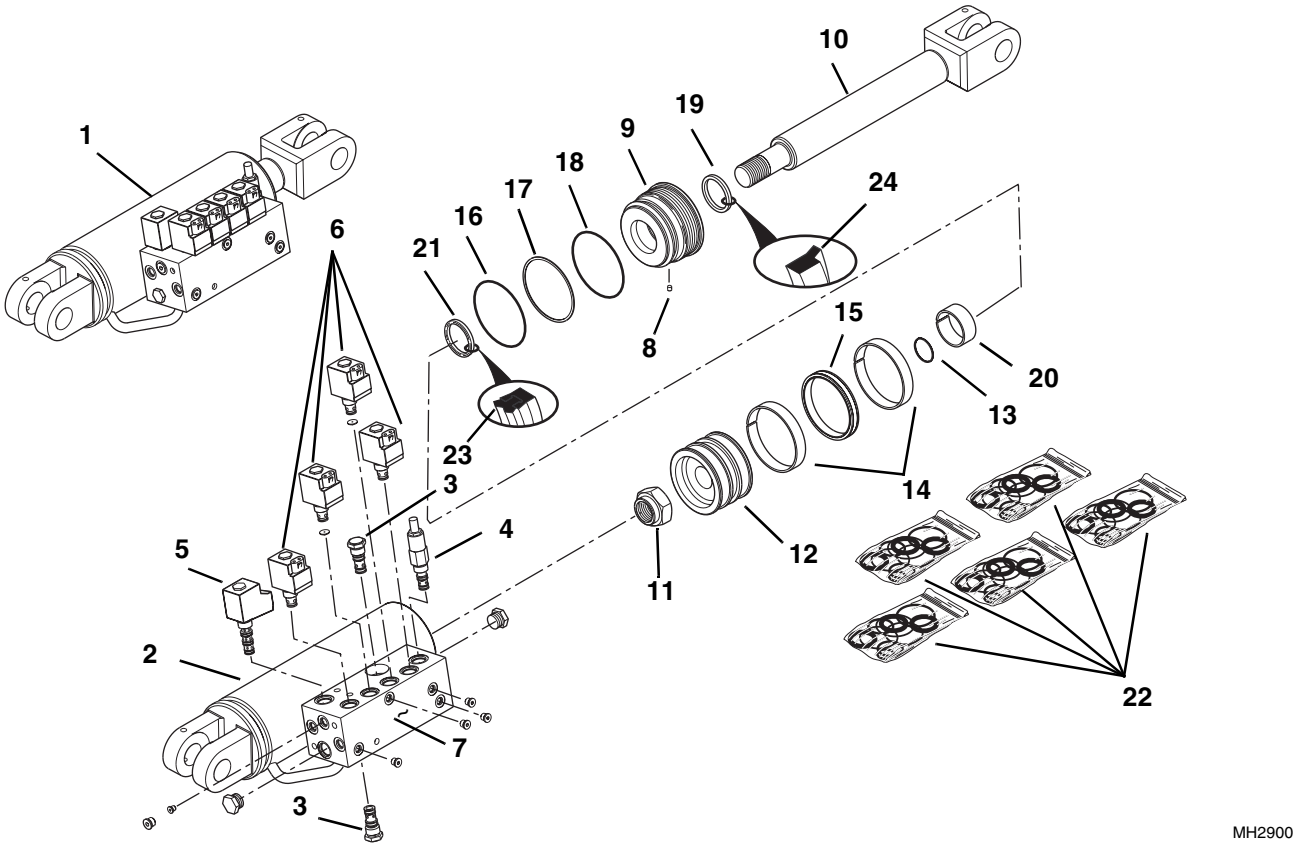
1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders, ground the attachment (if any), place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the hydraulic hoses in relation to the cylinder being removed. Safely position suitable supports between the frame and axle to prevent the frame from leaning to one side.
5. Disconnect and cap all hoses and fittings, etc.
6. Use a sling and hoist or other suitable lifting device to support the cylinder. Remove the nuts, capscrews, and cylinder mount pins securing the cylinder to the frame and anchor plate.
7. Remove the cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.



For S/N 13198 thru 19356

b. Stabilizer Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the stabilizer cylinder (**1**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. Secure the stabilizer cylinder (**1**) in a soft-jawed vise or other holding device, and place a suitable container beneath the cylinder to catch hydraulic fluid run-off.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the two pilot-operated check valves (**3**), the pressure reducing valve (**4**) and the five solenoid valves (**5** and **6**) on the manifold block (**7**) if replacement of any of these components is required. Label the solenoid valves with the locations stamped on the manifold. Remove the solenoid cartridges from the manifold.
4. Remove the locking insert (**8**) from its hole in the head gland threads. Pry or drill out the insert as required. **DO NOT** damage the head gland threads. A new locking insert will be required for reassembly.

Note: *The head gland (**9**) is installed at a torque of 300-400 lb-ft (407-542 Nm). Use suitable tools to remove the head gland.*

5. Use a pin spanner wrench to unthread the head gland (**9**) from the tube (**2**). The head gland is installed at a torque of 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the rod can cause premature seal failure.*

6. Carefully withdraw the rod (**10**) straight out of the tube (**2**). Keep the rod straight during withdrawal to help avoid scratching, nicking or damaging the tube.

IMPORTANT: *When sliding the rod and piston assembly out of the tube,* ***DO NOT*** *damage the piston (**12**) by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

7. Secure the rod eyelet and remove the locknut (**11**) from the threaded end of the rod. Discard the nut; a new nut will be required for reassembly.

Note: *Heating the nut to approximately 300° F (150° C) may also be required to break the seal formed by the Loctite Threadlocker #271 (red) applied to the nut when installed. The application of significant force is required to overcome the 1100-1250 lb-ft (1492-1695 Nm) of torque the nut was tightened to when originally installed.*

8. Remove the piston (**12**) from the rod (**10**).
9. Remove the small o-ring (**13**) from the piston. Remove both precision wearbands (**14**) and the capped T-seal (**15**) from the piston (**12**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

10. Remove the head gland (**9**) from the rod (**10**).
11. Remove the o-ring (**16**), the back-up ring (**17**) and the o-ring (**18**) from the head gland (**9**).
12. Remove the heavy-duty rod wiper (**19**). Remove the precision wearband (**20**) and deep Z-seal with rod back-up (**21**) from inside the head gland (**9**).

Note: *Discard all seals and o-rings. ALWAYS replace seals, o-rings, gaskets, etc. with new parts to help ensure proper sealing and operation.*

c. Stabilizer Cylinder Internal Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from the complete seal kits (**22**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

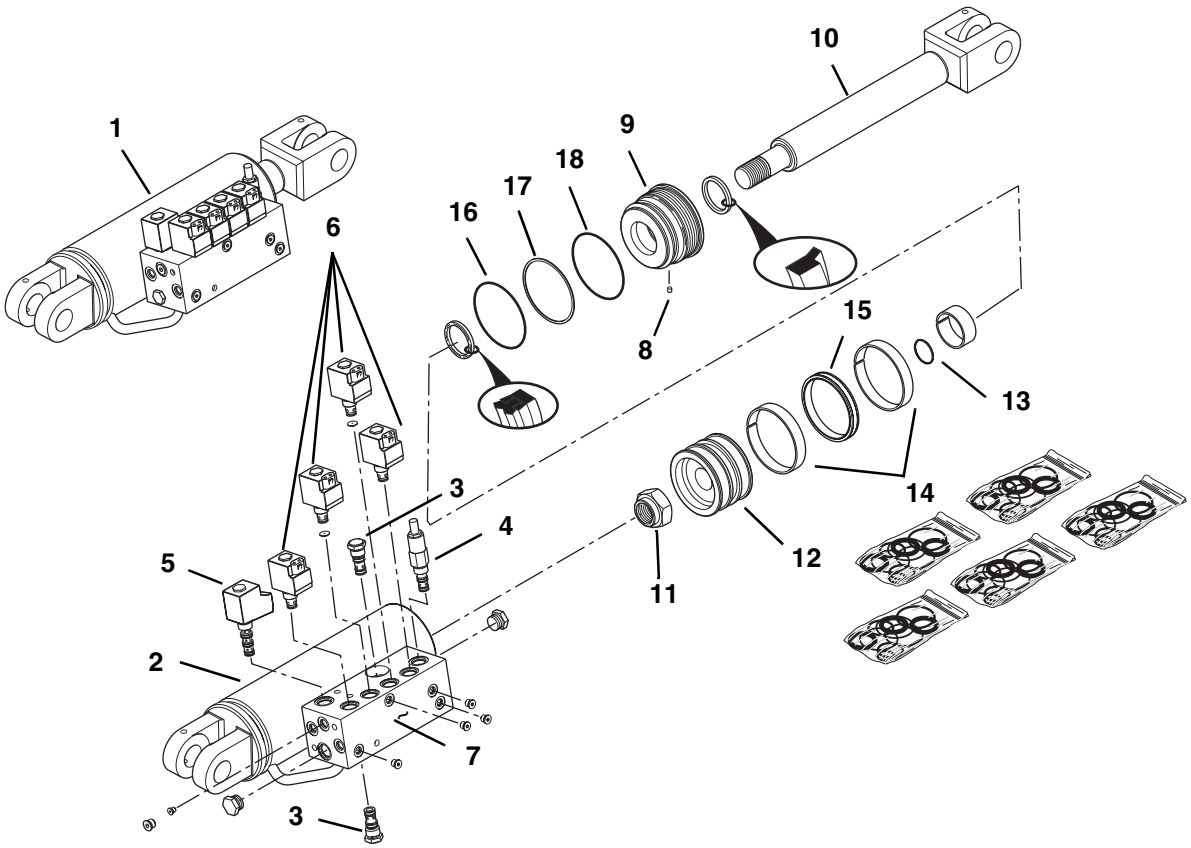
d. Stabilizer Cylinder Inspection and Repair

1. Inspect all parts for wear and damage. If inner surfaces of the cylinder (**1**) **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the component.
2. Inspect the inside of the tube (**2**) for scoring and other damage. If the tube is damaged, replace it with a new tube.
3. Remove small scratches on the rod or inside of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out small imperfections in the metal and blend scratch(es) into the surrounding surface.
4. Clean the parts with trichlorethylene after repair.
5. Check that the rod (**10**) is straight. If the rod is bent, install a new rod.

e. Stabilizer Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the deep Z-seal with rod back-up (**21**) into the head gland (**9**), orienting the edge (**23**).
2. Install the precision wearband (**20**) into the head gland (**9**).
3. Install the heavy-duty rod wiper (**19**) with the raised portion of the wiper lip seal (**24**) oriented toward the rod eyelet. The wiper lip should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.



4. Install new oiled o-ring (**18**), back-up ring (**17**) and oiled o-ring (**16**) onto the head gland (**9**). If the back-up ring is not flat on both sides, the side with the arc must be toward the o-ring.
5. Install the head gland (**9**) onto the rod (**10**). If necessary, use a soft hammer to drive the head gland onto the rod.
6. Install the new small oiled o-ring (**13**) into the piston (**12**).
7. Install the capped T-seal (**15**) onto the piston (**12**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

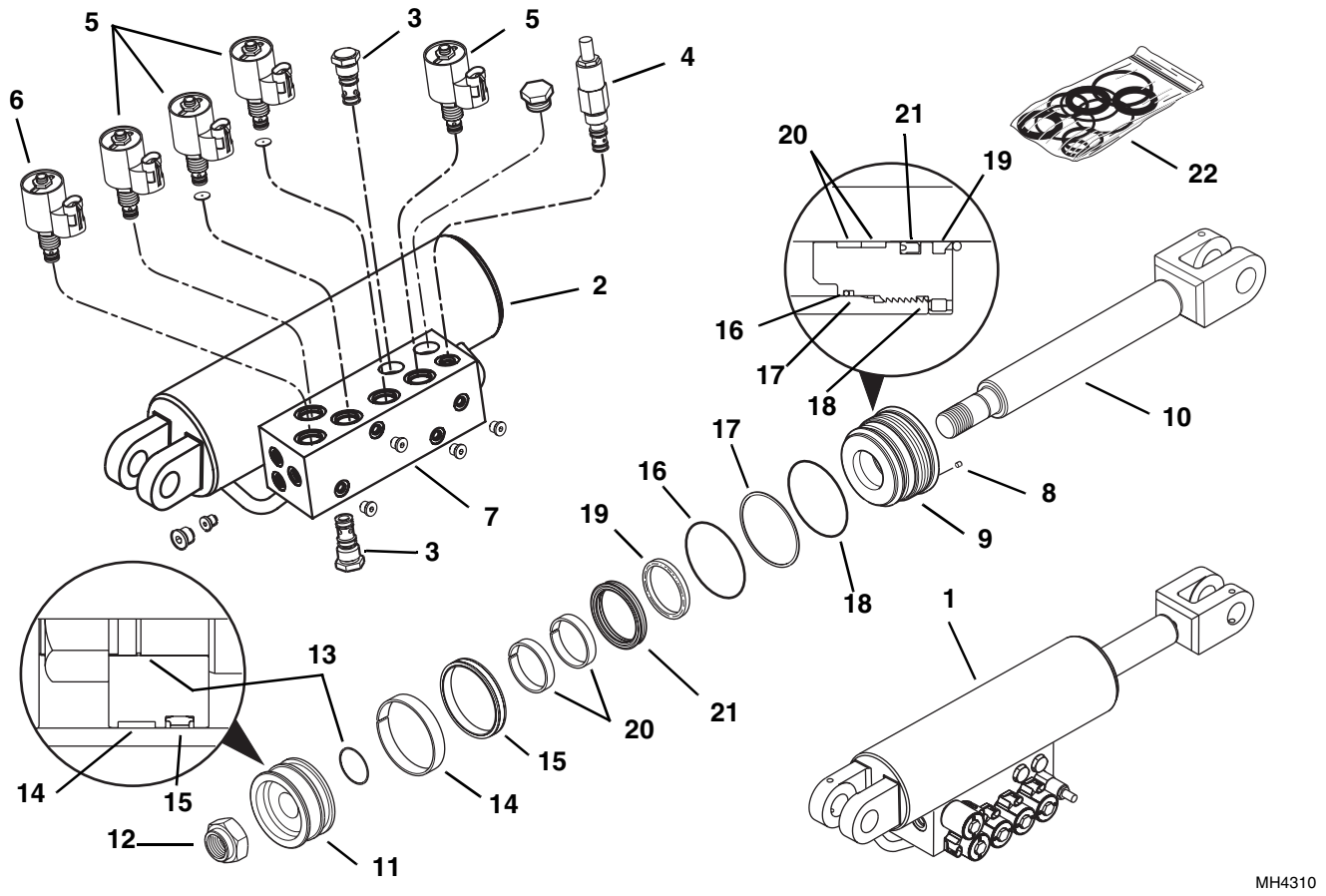
8. Install the two precision wearbands (**14**) onto the piston (**12**).
9. Install the piston (**12**) onto the rod (**10**).
10. Secure the rod eyelet in a soft-jawed vise or other suitable holding device. Place a padded support below the threaded end of the rod to help prevent damaging the rod.
11. Apply Loctite Primer "T" and Threadlocker #271 (red) to a new locknut (**11**) in accordance with Loctite instructions. Install the nut onto the threaded end of the rod. Torque the nut to 1100-1250 lb-ft (1492-1695 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

12. Fasten the cylinder tube (**2**) in a soft-jawed vise or other suitable holding device.
13. Lubricate the o-rings and the inside of the tube, piston and head gland with clean, filtered hydraulic oil. This will aid in installation.

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings when installing the piston (**12**) and head gland (**9**) into the cylinder. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

14. Keep the rod (**10**) straight and carefully insert the rod into the tube (**2**). Avoid scratching, nicking or damaging the tube while installing the rod.
15. Begin threading the head gland (**9**) into the tube (**2**). Place the locking insert (**8**) in its hole in the head gland threads just before the hole is threaded into the tube. Use a suitable pin spanner wrench to thread the head gland (**9**) completely into the tube (**2**). Torque the head gland to 300-400 lb-ft (407-542 Nm).
16. Using new oiled o-rings, thread the two pilot-operated check valves (**3**), the pressure reducing valve (**4**) and the five solenoid valves (**5** and **6**) into the manifold block (**7**). Torque the five solenoid cartridges (**5** and **6**) to 25-30 lb-ft (34-41 Nm). Torque the check valves (**3**) and the pressure reducing valve (**4**) to 35-40 lb-ft (47-54 Nm). Place the solenoid coils on the cartridges and torque the solenoid nuts to 4-6 lb-ft (5-8 Nm).
17. Test the cylinder (**1**) at low operating pressure 100 psi (7 bar) to verify that the piston and rod move freely in both directions.
18. Increase the operating pressure to the maximum for the cylinder 4000 psi (275 bar) and check for external leakage and for free movement in both directions.
19. Retract the piston fully.



For S/N 19357 & After

b. Stabilizer Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the stabilizer cylinder (**1**) with a suitable cleaner. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**2**).*

2. Secure the stabilizer cylinder (**1**) in a soft-jawed vise or other holding device, and place a suitable container beneath the cylinder to catch hydraulic fluid run-off.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the two pilot-operated check valves (**3**), the pressure reducing valve (**4**) and the five solenoid valves (**5** and **6**) on the manifold block (**7**) if replacement of any of these components is required. Label the solenoid valves with the locations stamped on the manifold. Remove the solenoid cartridges from the manifold.
4. Remove the lock screw (**8**) from the head gland flange (**9**).

Note: *The head gland (**9**) is installed at a torque of 300 ±50 lb-ft (407 ±68 Nm). Use suitable tools to remove the head gland.*

5. Use a pin spanner wrench to unthread the head gland (**9**) from the tube (**2**). The head gland is installed at a torque of 300 ±50 lb-ft (407 ±68 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the rod can cause premature seal failure.*

6. Carefully withdraw the rod (**10**) straight out of the tube (**2**). Keep the rod straight during withdrawal to help avoid scratching, nicking or damaging the tube.

IMPORTANT: *When sliding the rod and piston assembly out of the tube,* ***DO NOT*** *damage the piston (**11**) by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

7. Secure the rod eyelet and remove the locknut (**12**) from the threaded end of the rod.

Note: *Heating the nut to approximately 300° F (150° C) may also be required to break the seal formed by the Loctite Threadlocker #271 (red) applied to the nut when installed. The application of significant force is required to overcome the 1175-1400 lb-ft (1593-1898 Nm) of torque the nut was tightened to when originally installed.*

8. Remove the piston (**11**) from the rod (**10**).
9. Remove the small o-ring (**13**) from the groove in the end of the rod (**10**). Remove the precision wearband (**14**) and the capped T-seal (**15**) from the piston (**11**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

10. Remove the head gland (**9**) from the rod (**10**).
11. Remove the o-ring (**16**), the back-up ring (**17**) and the o-ring (**18**) from the head gland (**9**).
12. Remove the heavy-duty rod wiper (**19**). Remove the precision wearbands (**20**) and deep Z-seal with rod back-up (**21**) from inside the head gland (**9**).

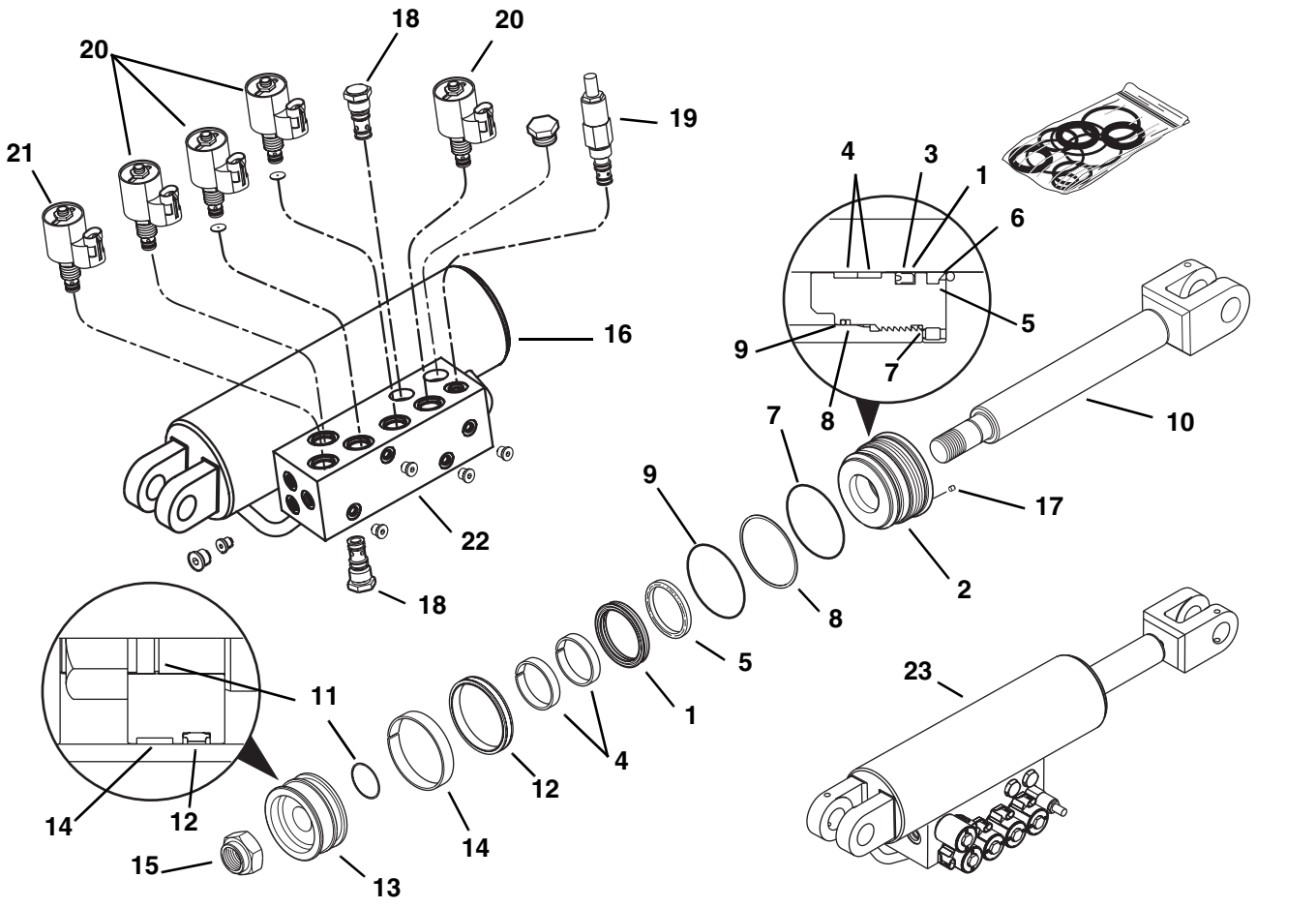
Note: *Discard all seals and o-rings. ALWAYS replace seals, o-rings, gaskets, etc. with new parts to help ensure proper sealing and operation.*

c. Stabilizer Cylinder Internal Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from the complete seal kits (**22**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

d. Stabilizer Cylinder Inspection and Repair

1. Inspect all parts for wear and damage. If inner surfaces of the cylinder (**1**) **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the component.
2. Inspect the inside of the tube (**2**) for scoring and other damage. If the tube is damaged, replace it with a new tube.
3. Remove small scratches on the rod or inside of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out small imperfections in the metal and blend scratch(es) into the surrounding surface.
4. Clean the parts with trichlorethylene after repair.
5. Check that the rod (**10**) is straight. If the rod is bent, install a new rod.



MH4310

e. Stabilizer Cylinder Assembly

Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the deep Z-seal with rod back-up (**1**) into the head gland (**2**), orienting the edge (**3**).
2. Install the precision wearbands (**4**) into the head gland (**2**).
3. Install the heavy-duty rod wiper (**5**) with the raised portion of the wiper lip seal (**6**) oriented toward the rod eyelet. The wiper lip should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
4. Install new oiled o-ring (**7**), back-up ring (**8**) and oiled o-ring (**9**) onto the head gland (**2**). If the back-up ring is not flat on both sides, the side with the arc must be toward the o-ring.
5. Install the head gland (**2**) onto the rod (**10**). If necessary, use a soft hammer to drive the head gland onto the rod.
6. Install the new small oiled o-ring (**11**) into on the end of the rod (**10**).
7. Install the capped T-seal (**12**) onto the piston (**13**).

Note: *The T-seal actually consists of four components; a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" seal band.*

8. Install the precision wearband (**14**) onto the piston (**13**).
9. Install the piston (**13**) onto the rod (**10**).

10. Secure the rod eyelet in a soft-jawed vise or other suitable holding device. Place a padded support below the threaded end of the rod to help prevent damaging the rod.
11. Apply Loctite Threadlocker #271 (red) to the locknut (**15**) in accordance with Loctite instructions. Install the nut onto the threaded end of the rod. Torque the nut to 1175-1400 lb-ft (1593-1898 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**16**).*

12. Fasten the cylinder tube (**16**) in a soft-jawed vise or other suitable holding device.
13. Lubricate the o-rings and the inside of the tube, piston and head gland with clean, filtered hydraulic oil. This will aid in installation.

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings when installing the piston (**13**) and head gland (**2**) into the cylinder. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

14. Keep the rod (**10**) straight and carefully insert the rod into the tube (**16**). Avoid scratching, nicking or damaging the tube while installing the rod.
15. Apply Loctite #242 (blue) to the threads of the head gland (**2**) and thread into the tube (**16**). Use a suitable pin spanner wrench to thread the head gland (**2**) completely into the tube (**16**). Torque the head gland to 300 ±50 lb-ft (407 ±68 Nm).
16. Apply Loctite #242 (blue) to the threads of the lock screw (**17**) and thread into the flange of the head gland (**2**). Torque to 3-4 lb-ft (4-5 Nm).
17. Using new oiled o-rings, thread the two pilot-operated check valves (**18**), the pressure reducing valve (**19**) and the five solenoid valves (**20** and **21**) into the manifold block (**22**). Torque the five solenoid cartridges (**20** and **21**) to 20-25 lb-ft (27-34 Nm). Torque the check valves (**18**) and the pressure reducing valve (**19**) to 35-40 lb-ft (47-54 Nm). Place the solenoid coils on the cartridges and torque the solenoid nuts to 4-6 lb-ft (5-8 Nm).
18. Test the cylinder (**23**) at low operating pressure [100 psi (7 bar)] to verify that the piston and rod move freely in both directions.
19. Increase the operating pressure to the maximum for the cylinder [4000 psi (275 bar)] and check for external leakage and for free movement in both directions.
20. Retract the piston fully

f. Stabilizer Cylinder Installation

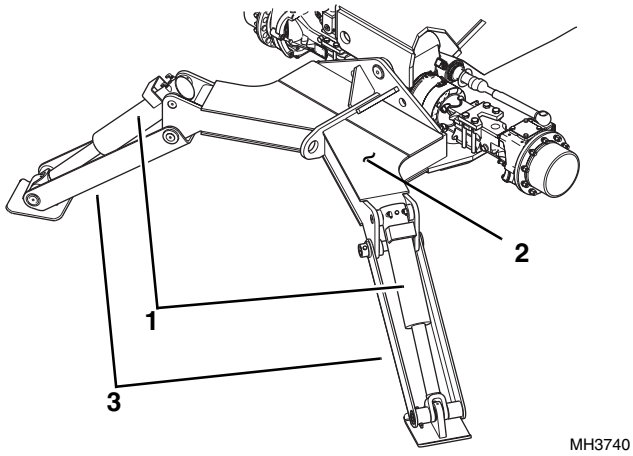
1. Lubricate the cylinder pins with multi-purpose, lithium-based grease.
2. Use a sling and hoist or other suitable lifting device to help install the cylinder. Orient the cylinder with the cylinder eyelet on top and the rod eyelet on the bottom.
3. Install the upper cylinder pin. Drive the lubricated cylinder pin through the cylinder eyelet, frame mount and self-aligning bearing. Secure the pin with a capscrew and hex locknut. Torque to 18 lb-ft (24 Nm).
4. Use new flat-faced oiled o-rings when installing the upper and lower hydraulic hoses. Install and tighten the hoses onto the appropriate fittings on the manifold.

g. Stabilizer Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check the cylinder pressure, consult the factory.
2. Start the vehicle. Level the frame.
3. Sway the vehicle fully left. Hold the joystick at full sway left for several seconds, then sway the vehicle fully right and hold the joystick at full sway right for several seconds. Observe the readings on the gauge during the frame sway operations.
4. Level the frame. While leveling the frame, check the pressure reading on the gauge.
5. Repeat Steps 3 and 4 five times.

8.13.10 Outrigger Cylinders (10042/10054)

Each outrigger cylinder (**1**) is secured to the outrigger frame (**2**) with a capscrew, elastic hex locknut and pivot pin at the top and at the bottom of the outrigger leg (**3**).



MH3740

a. Outrigger Cylinder Removal

1. Park the vehicle on a firm, level surface, fully retract all hydraulic cylinders except the outrigger cylinders. Lower the outriggers, but **DO NOT** allow the outriggers to touch the ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

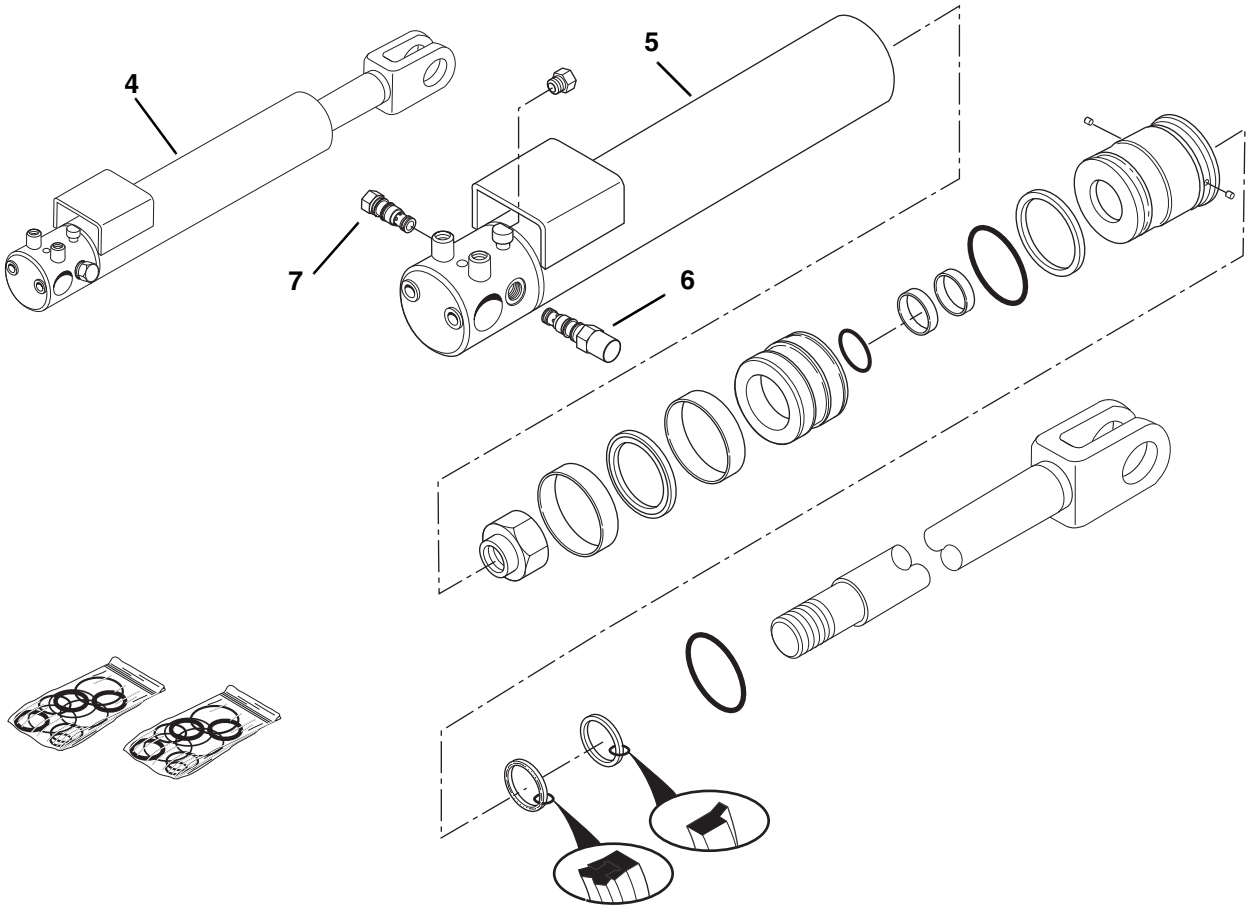
3. Unlock and open the rear door. Allow the hydraulic fluid to cool.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

4. Label or otherwise mark the hydraulic hoses in relation to the outrigger cylinder being removed. Disconnect and cap the hydraulic hoses and outrigger cylinder fittings.

   On Model 10054, disconnect the wiring connector to each outrigger cylinder pressure switch.
5. Securely support the outrigger cylinder. Remove the elastic hex locknut, capscrew and cylinder pin securing the outrigger cylinder to the outrigger leg on the outrigger frame. Discard the locknut.

With the help of at least one assistant, remove the outrigger cylinder from the vehicle. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.



For Early Production

b. Outrigger Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

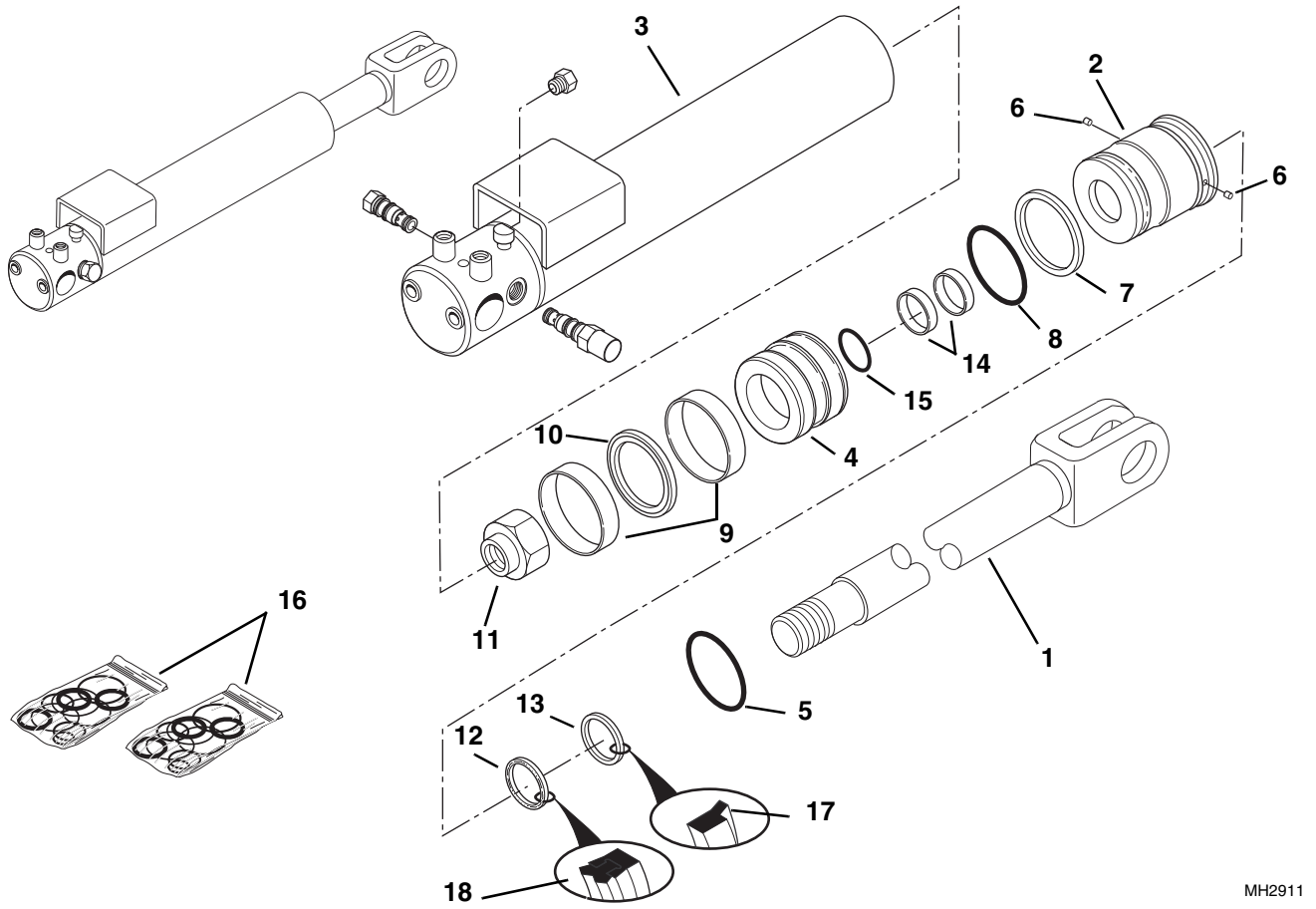
1. Clean the outrigger cylinder (**4**) with a suitable cleaner before inspection. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**5**).*

2. Place the outrigger cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the counterbalance valve (**6**) and the pilot-operated check valve (**7**) from the outrigger cylinder.



4. Extend the rod (**1**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Using a pin spanner wrench, unscrew the head gland (**2**) from the tube (**3**). The head gland was originally torqued at 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube (**3**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**4**). Keep the rod centered within the tube to help prevent binding.*

6. Carefully pull the rod (**1**) with all attachments straight out of the tube (**3**).
7. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
8. Remove the o-ring (**5**), back-up ring (**7**) and o-ring (**8**) from the head gland (**2**).
9. Remove the locking inserts (**6**) from their installation holes in the head gland threads. Pry or drill out the inserts as required. **DO NOT** damage the head gland threads. New locking inserts will be required for reassembly.
10. Remove the precision wearbands (**9**) and the capped T-seal (**10**) from the piston (**4**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

11. Remove the locknut (**11**) from the rod (**1**). The deforming-thread type nut was coated with Loctite #271 (red) and torqued to 1300-1500 lb-ft (1763-2034 Nm). Discard the nut.

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**11**) and the rod (**1**) before the piston (**4**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

12. Remove the piston (**4**) and head gland (**2**) from the rod (**1**).
13. From the head gland (**2**), remove the deep Z-seal with rod back-up (**12**), the sealed outside diameter heavy-duty rod wiper (**13**) and the precision wearbands (**14**).
14. From the piston (**4**), remove the small o-ring (**15**).

c. Outrigger Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from a complete seal kits (**16**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Outrigger Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**3**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod, or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**1**) is straight. If it is bent, install a new rod.

e. Outrigger Cylinder Assembly

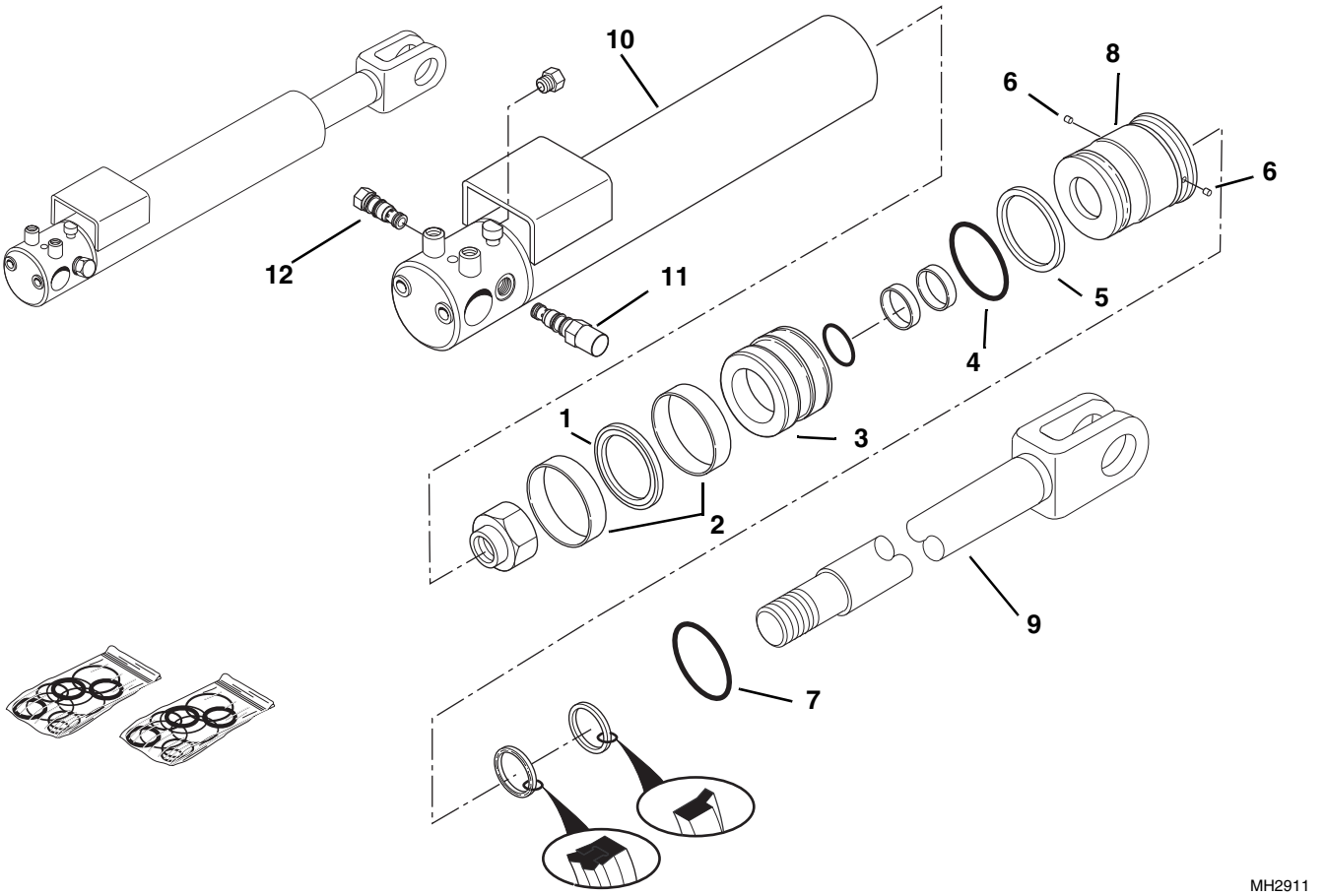
Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings when installing the piston and head gland into the cylinder. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

1. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod. Install the small o-ring (**15**) in the piston (**4**).
2. Install the sealed outside diameter heavy-duty rod wiper (**13**). The wiper lip (**17**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
3. Install the deep Z-seal with rod back-up (**12**) in the head gland (**2**) orienting the edge (**18**).
4. Install the precision wearbands (**14**) into the head gland (**2**).
5. Carefully install the head gland (**2**) onto the rod (**1**).
6. Carefully install the piston (**4**) onto the rod (**1**).

Note: *If a white, powdery residue remains on the threads and parts, clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before proceeding.*

7. Apply Loctite Threadlocker #271 (red) to a new locknut (**11**). Thread the locknut onto the rod (**1**) and torque to 1300-1500 lb-ft (1763-2034 Nm). The threads will deform upon tightening, locking the nut in place.



8. Install the capped T-seal (**1**) and precision wearbands (**2**) onto the piston (**3**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

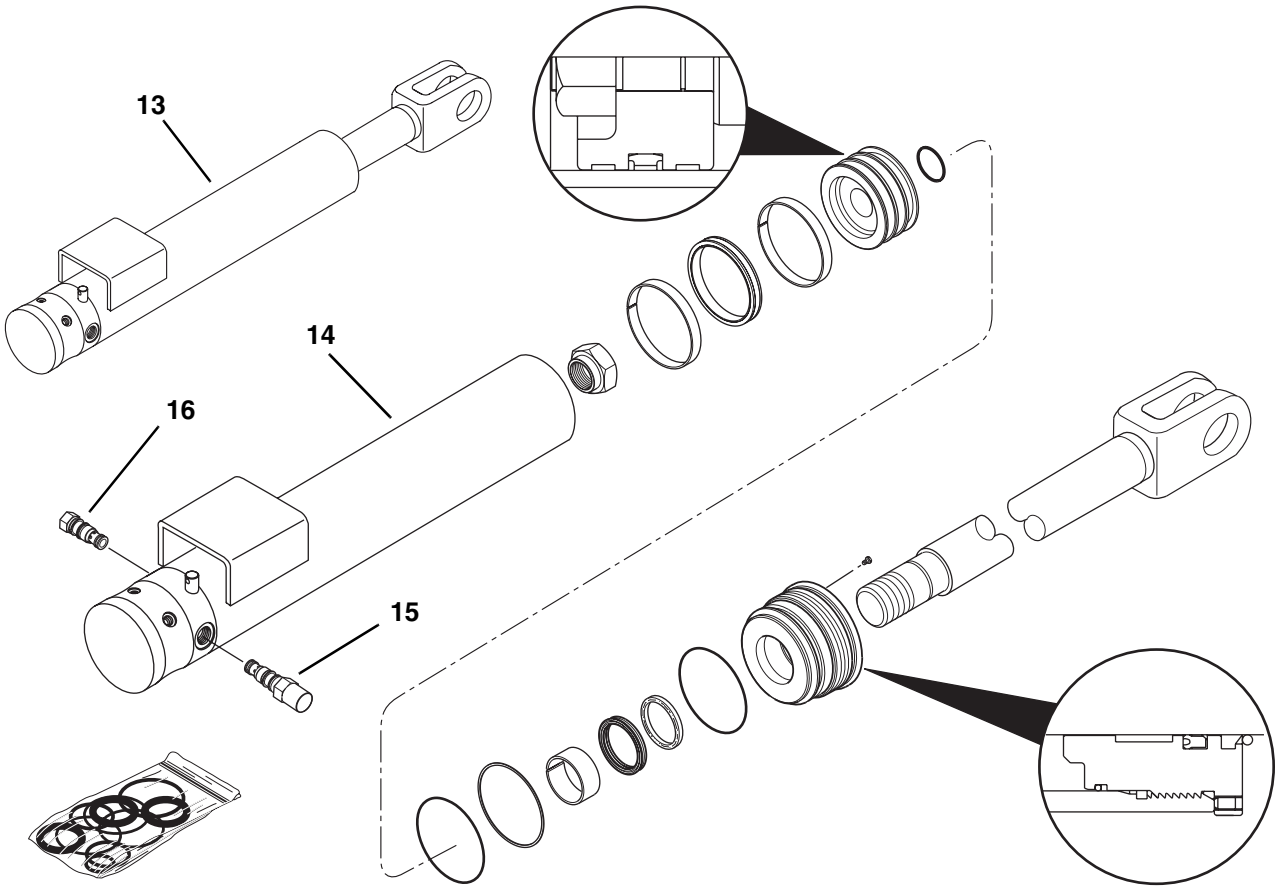
9. Install new oiled o-ring (**4**), back-up ring (**5**) and oiled o-ring (**7**) onto the head gland (**8**).
10. Install two new locking inserts (**6**) into their holes in the head gland (**8**) threads.

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**3**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

11. Carefully insert the rod (**9**) with all attachments straight into the tube (**10**).
12. Using a pin spanner wrench, thread the head gland (**8**) into the tube (**10**). Torque the head gland to 300-400 lb-ft (407-542 Nm).

IMPORTANT: *DO NOT tamper with or attempt to reset the counterbalance valve (**11**). If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

13. Lubricate the counterbalance valve (**11**) and the pilot-operated check valve (**12**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the valves into the tube (**10**). Torque to 30-35 lb-ft (41-47 Nm).



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b. Outrigger Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

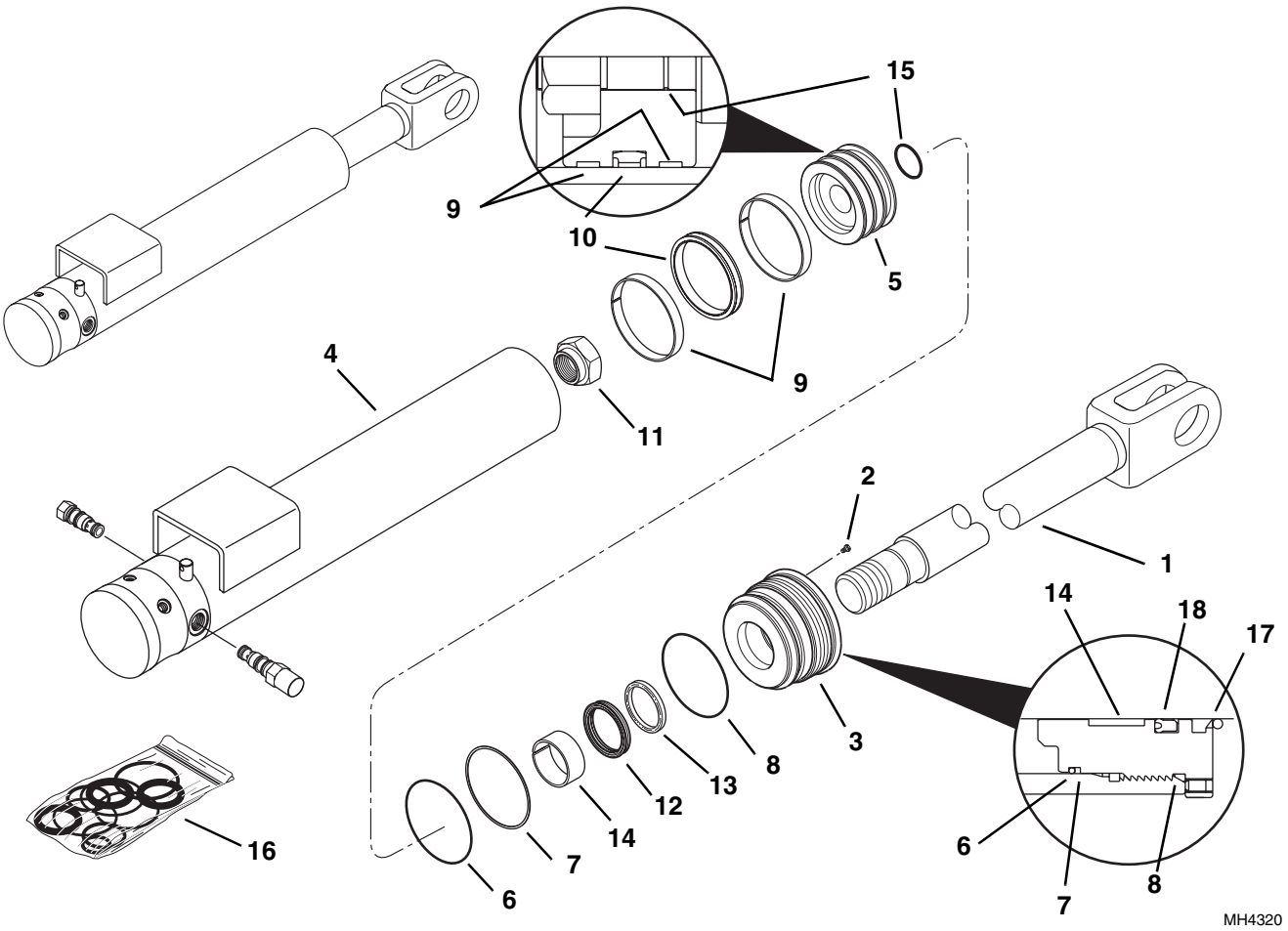
1. Clean the outrigger cylinder (**13**) with a suitable cleaner before inspection. Remove all dirt, debris and grease from the cylinder.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**14**).*

2. Place the outrigger cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the counterbalance valve (**15**) and the pilot-operated check valve (**16**) from the outrigger cylinder.



4. Extend the rod (**1**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Remove the lock screw (**2**) from the flange of the head gland (**3**).
6. Using a pin spanner wrench, unscrew the head gland (**3**) from the tube (**4**). The head gland was originally torqued at 300 ±50 lb-ft (407 ±68 Nm), so a considerable amount of force is required to remove it. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube (**4**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**5**). Keep the rod centered within the tube to help prevent binding.*

7. Carefully pull the rod (**1**) with all attachments straight out of the tube (**4**).
8. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
9. Remove the o-ring (**6**), back-up ring (**7**) and o-ring (**8**) from the head gland (**3**).
10. Remove the precision wearbands (**9**) and the capped T-seal (**10**) from the piston (**5**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

11. Remove the locknut (**11**) from the rod (**1**). The locknut was coated with Loctite #271 (red) and torqued to 1650-1800 lb-ft (2237-2440 Nm).

Note: *It may be necessary to apply heat to break the bond of the sealant between the locknut (**11**) and the rod (**1**) before the piston (**5**) can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

12. Remove the piston (**5**) and head gland (**3**) from the rod (**1**).
13. From the head gland (**3**), remove the deep Z-seal with rod back-up (**12**), the sealed outside diameter heavy-duty rod wiper (**13**) and the precision wearband (**14**).
14. From the groove in the end of the rod (**1**), remove the small o-ring (**15**).

c. Outrigger Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder.
2. Discard all seals, back-up rings and o-rings. Replace with new items from a complete seal kits (**16**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.*

d. Outrigger Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**4**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod, or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**1**) is straight. If it is bent, install a new rod.

e. Outrigger Cylinder Assembly

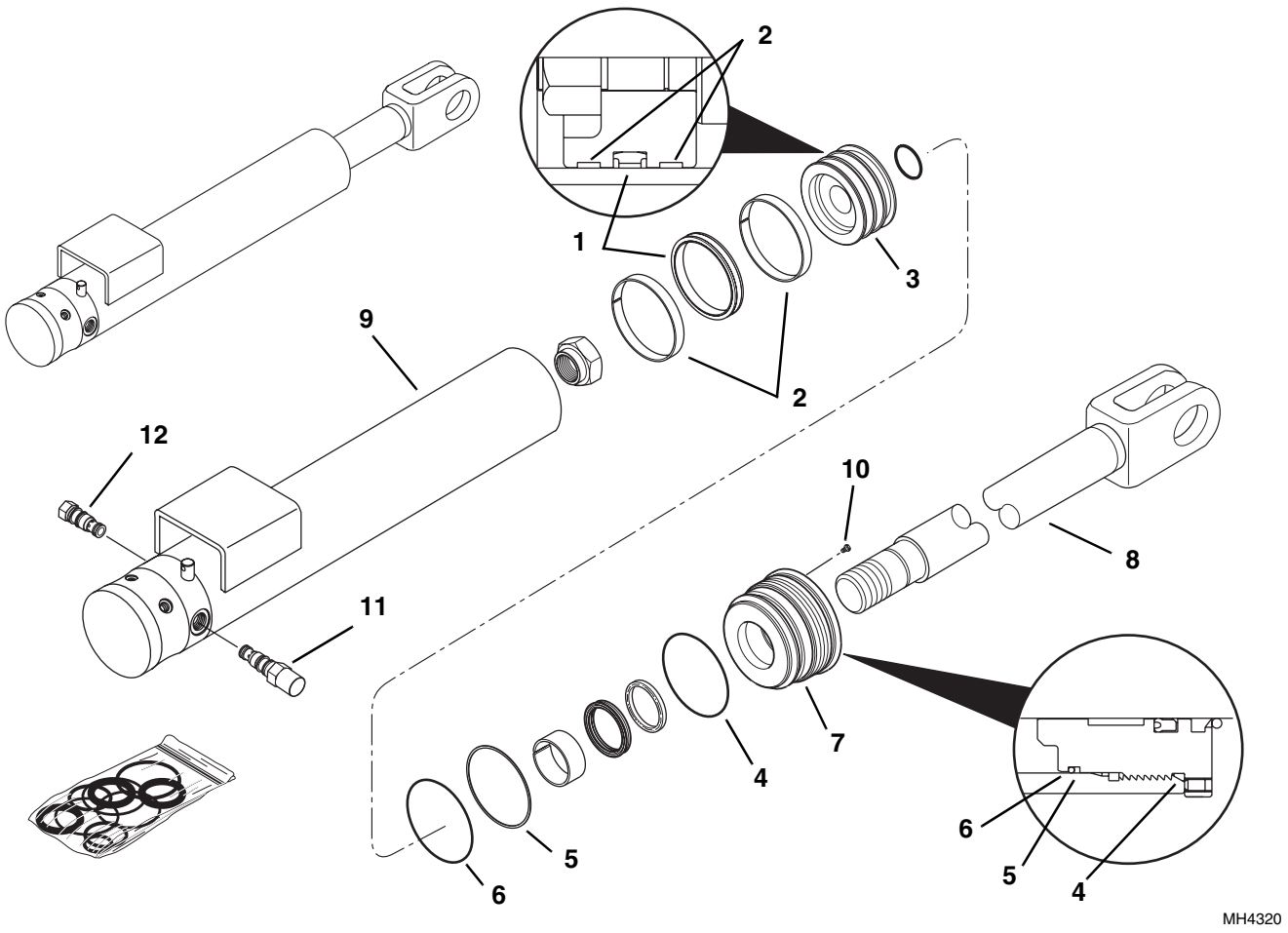
Note: *Follow Section 8.13.3, "General Cylinder Assembly Instructions."*

IMPORTANT: *Use a suitable installation tool or compression sleeve to help prevent twisting or damaging the seals and o-rings when installing the piston and head gland into the cylinder. When sliding the rod and piston assembly in the tube, **DO NOT** damage the piston by scraping it against the threads in the tube. Keep the rod in line with the tube to prevent binding.*

1. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod. Install the small o-ring (**15**) in the groove in the end of the rod (**1**).
2. Install the sealed outside diameter heavy-duty rod wiper (**13**). The wiper lip (**17**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
3. Install the deep Z-seal with rod back-up (**12**) in the head gland (**3**) orienting the edge (**18**).
4. Install the precision wearband (**14**) into the head gland (**3**).
5. Carefully install the head gland (**3**) onto the rod (**1**).
6. Carefully install the piston (**5**) onto the rod (**1**).

Note: *If a white, powdery residue remains on the threads and parts, clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before proceeding.*

7. Apply Loctite Threadlocker #271 (red) to the locknut (**11**). Thread the locknut onto the rod (**1**) and torque to 1650-1800 lb-ft (2237-2440 Nm).



8. Install the capped T-seal (**1**) and precision wearbands (**2**) onto the piston (**3**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

9. Install new oiled o-ring (**4**), back-up ring (**5**) and oiled o-ring (**6**) onto the head gland (**7**).

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**3**). Keep the rod centered within the tube to help prevent binding. Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

10. Carefully insert the rod (**8**) with all attachments straight into the tube (**9**).
11. Apply Loctite #242 (blue) to the threads of the head gland (**7**). Using a pin spanner wrench, thread the head gland (**7**) into the tube (**9**). Torque the head gland to 300 ±50 lb-ft (407 ±68 Nm).
12. Apply Loctite #242 (blue) to the threads of the lock screw (**10**) and thread into the flange of the head gland (**7**). Torque to 3-4 lb-ft (4-5 Nm).

IMPORTANT: *DO NOT tamper with or attempt to reset the counterbalance valve (**11**). If adjustment or replacement is necessary, replace a counterbalance valve with a new part.*

13. Lubricate the counterbalance valve (**11**) and the pilot-operated check valve (**12**) with clean, filtered hydraulic oil. Using new oiled o-rings, thread the valves into the tube (**9**). Torque to 30-35 lb-ft (41-47 Nm).

f. Outrigger Cylinder Installation

1. Lubricate the outrigger cylinder pins with multi-purpose lithium-based grease.
2. Use a sling and hoist or other suitable lifting device to help install the cylinder. Orient the cylinder with the cylinder eyelet on top and the rod eyelet on the bottom.
3. Install the upper cylinder pin. Drive the lubricated cylinder pin through the outrigger frame mount and the cylinder eyelet, aligning the mount pin bolt holes with the outrigger cylinder mount holes. Secure the outrigger cylinder with the capscrews and nuts. Torque the capscrews and nuts to specification. Refer to the fastener torque chart in Section 2.3, “Torques.” Repeat with the lower cylinder pin.
4. Use new flat-faced oiled o-rings when installing the upper and lower hydraulic hoses. Install and tighten the hoses onto the appropriate fittings.

   On Model 10054, connect the pressure switches.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

5. Start and run the engine at approximately one-third to one-half throttle for about one minute without moving the vehicle or operating any hydraulic functions.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

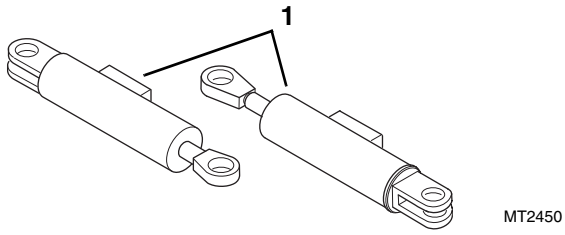
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF. Add hydraulic fluid if required.
7. Conduct an outrigger cylinder hydraulic circuit test following the procedure that follows.
8. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle, work area and tools.

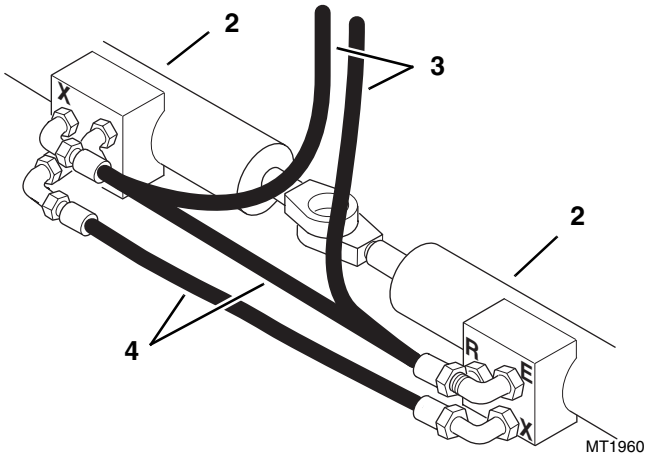
g. Outrigger Cylinder Circuit Test

1. Lower the outrigger cylinder to the ground.
2. Apply full down pressure until the front wheels lift off the ground.
3. Watch for any drifting.
4. If drifting occurs, raise and lower the outriggers several times and repeat Steps 1 and 4 until no drifting occurs.

8.13.11 Swing Carriage (Optional)

The optional swing carriage provides a way to swing the carriage attachment from side-to-side. The swing carriage includes two cylinders (**1**) that operate together to provide the side-to-side motion.





a. Swing Carriage Cylinder Removal

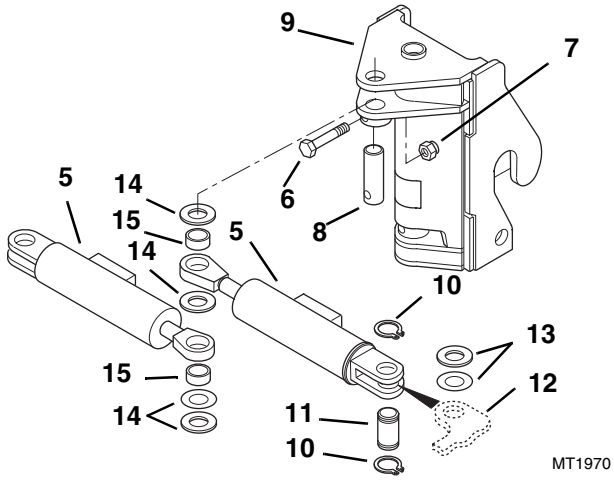
1. Level the boom (place the boom in a horizontal position).
2. Swing the carriage to the centered position.
3. Lower the boom until the carriage is resting firmly on the ground.
4. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the park brake switch and shut the engine OFF.
5. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

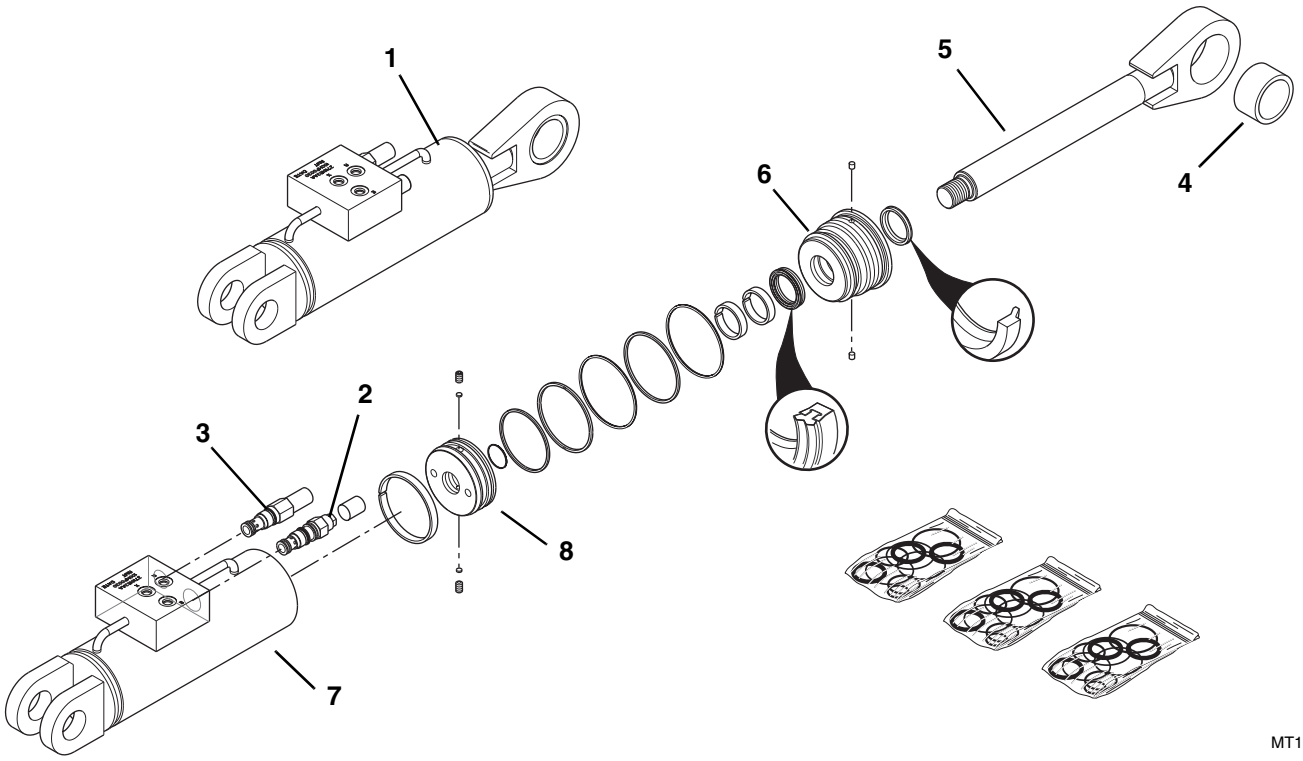
> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

6. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

7. Remove all dirt and grease from the swing carriage cylinders (**2**) and their hydraulic lines (**3** and **4**).
8. Label or otherwise mark the hydraulic lines (**3** and **4**).
9. Disconnect and cap all hoses and fittings, etc.
10. Use a sling and hoist or other suitable lifting device to support the cylinders (**5**). Remove the bolt (**6**) and nut (**7**) holding the center mounting pin (**8**) to the pivot mount (**9**). Remove the pin.
11. Remove snap rings (**10**) and cylinder base end pins (**11**) from the mounting plates on carriage (**12**).
12. Identify and mark the location of the 1-1/2" I.D. shims (**13**) at the base end of the cylinder.
13. Remove the cylinders (**5**) from the pivot mount (**9**) and the mounting plates (**12**) using a strap sling and hoist or other suitable lifting equipment. While removing the cylinder(s), identify the locations of the 2" I.D. shims (**14**) at the rod end(s) of the cylinder(s). **DO NOT** lose the bearing(s) (**15**), which may be loose, in the cylinder rod end(s).
14. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle. Disconnect and cap all hoses and fittings, etc.





For Early Production

b. Swing Carriage Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the swing carriage cylinder (**1**) with a suitable cleaner to remove dirt, debris, grease, etc.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder.*

2. Secure the swing carriage cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the 3000 psi (207 bar) counterbalance cartridge (**2**) and the 2000 psi (138 bar) direct-acting relief valve (**3**) from the swing carriage cylinder.
4. If the self-aligning bearing (**4**) requires replacement, support the rod (**5**) in a soft-jawed vise or other suitable holding device. Carefully press the bearing out of the rod eyelet.
5. Extend the rod (**5**) to access the cylinder base.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

6. Using a pin spanner wrench, unscrew the head gland (**6**) from the cylinder tube (**7**). The head gland was originally torqued to 250-300 lb-ft (339-407 Nm), so a considerable amount of force is required. Carefully slide the head gland down along the rod toward the eyelet, away from the cylinder tube (**7**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**8**). Keep the rod centered within the tube to help prevent binding.*

7. Carefully pull the rod (**5**) with all attachments straight out of the tube (**7**).
8. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.

9. Remove the two setscrews (**8**), with locking inserts (**9**), from the piston (**7**). Pry or drill out the setscrews as required. **DO NOT** damage the piston threads. New setscrews with locking inserts will be required for reassembly.
10. Remove the piston (**7**) from the rod (**4**).

Note: *Loctite Threadlocker #271 (red) and 440-500 lb-ft (597-678 Nm) were applied to the piston (**7**) when it was installed. It may be necessary to apply heat to break the bond of the sealant between the piston (**7**) and the rod (**4**) before the piston can be unthreaded and removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

11. Remove the piston square seal (**10**), square ring (**11**) and precision wearband (**12**) from the piston (**7**).
12. From within the piston, remove the small o-ring (**13**).
13. Remove the locking inserts (**14**) from their installation holes in the head gland threads. Pry or drill out the inserts as required. **DO NOT** damage the head gland threads. New locking inserts will be required for reassembly.
14. Remove the head gland (**5**) from the rod (**4**).
15. Remove the o-ring (**15**), back-up ring (**16**) and o-ring (**17**) from the head gland (**5**).
16. From within the head gland (**5**), remove the precision wearbands (**18**) and the deep Z-seal (**19**). From the other end, remove the rod wiper (**20**).

c. Swing Carriage Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the swing carriage cylinder (**1**).
2. Discard all seals, back-up rings and o-rings. Replace with new items from the complete seal kits (**21**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.
4. If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

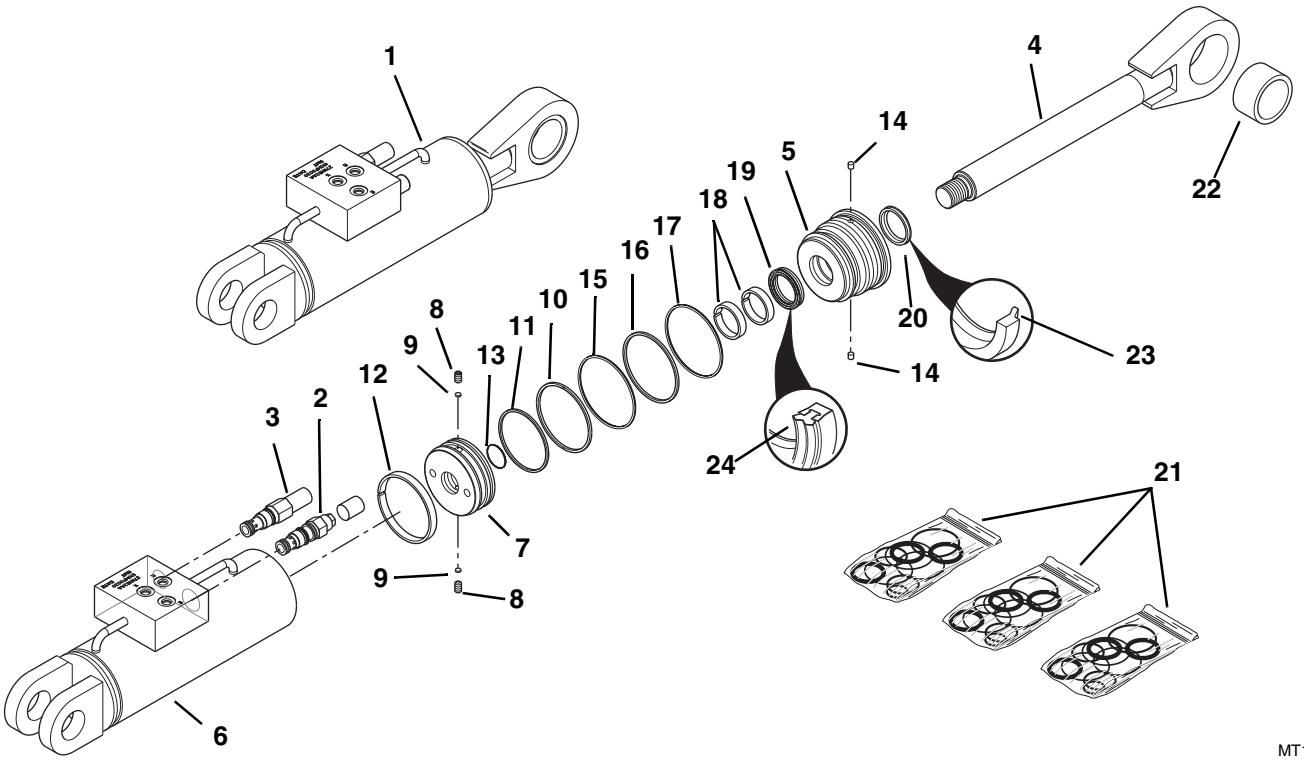
d. Swing Carriage Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**6**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene after repair.
4. Check that the rod (**4**) is straight. If it is bent, install a new rod.

e. Swing Carriage Cylinder Assembly

Note: *Follow the information in Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the deep Z-seal (**19**), orienting the edge (**24**). Install the precision wearbands (**18**) into the forward end of the head gland (**5**), and at the rear end, install the rod wiper (**20**). The wiper lip (**23**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
2. Install a new oiled o-ring (**17**), back-up ring (**16**) and oiled o-ring (**15**) onto the head gland (**5**).
3. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
4. Push the head gland (**5**) onto the rod (**4**). If necessary, use a soft hammer to drive the head gland onto the rod.
5. Install two new locking inserts (**14**) into their holes in the head gland threads.
6. Install a new small oiled o-ring (**13**) into the piston (**7**).



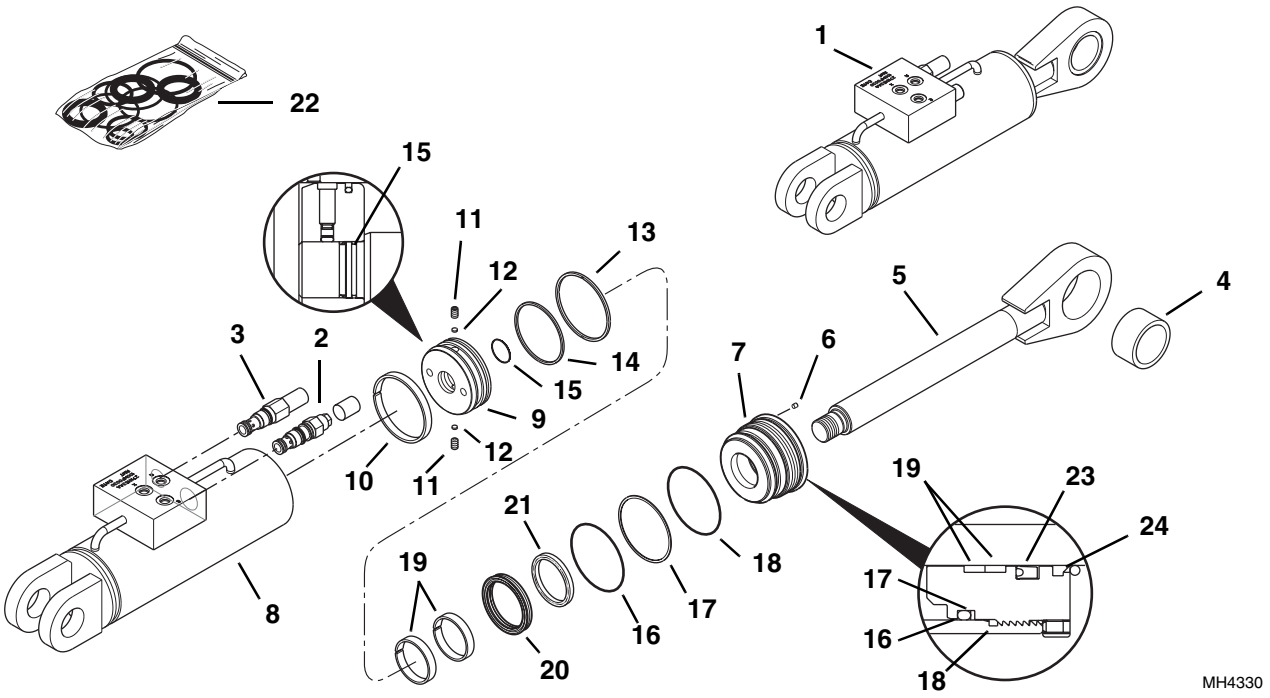
7. Install a new piston square seal (**10**), square ring (**11**) and precision wearband (**12**) onto the piston (**7**).
8. Apply Loctite Primer "T" and Threadlocker #271 (red) to the threads of the piston (**7**) in accordance with Loctite instructions. Thread the piston (**7**) onto the rod (**4**) and torque to 440-500 ft-lb (597-678 Nm).
9. Install two new setscrews (**8**) with locking inserts (**9**) into their holes in the piston (**7**). Torque to 85-95 lb-ft (115-124 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**6**).*

10. Place the cylinder tube (**6**) in a soft-jawed vise or other acceptable holding equipment if possible.
11. Lubricate the piston (**7**), head gland (**5**) and the inside of the tube (**6**) with clean, filtered hydraulic oil.
12. Apply a compression sleeve or other suitable tool to the head gland (**5**) in order to compress the o-rings (**15** and **17**).

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston (**7**). Keep the rod centered within the tube to help prevent binding.*

13. Carefully insert the rod (**4**) with all attachments straight into the tube (**6**). Use a pin spanner wrench to thread the head gland into the tube. Torque the head gland to 250-300 lb-ft (339-407 Nm). Remove the compression tool.
14. Using new oiled o-rings, install the counterbalance valve (**2**) and direct-acting relief valve (**3**). Lubricate the cartridge and valve with clean, filtered hydraulic oil. Torque the valves to 35-40 lb-ft (47-54 Nm).
15. Test the cylinder at low operating pressure (100 psi or 7 bar). Verify that the piston and rod move freely in both directions.
16. Increase the operating pressure to the maximum for the cylinder (3000 psi or 207 bar). Verify that the piston and rod move freely in both directions.
17. Retract the piston fully and cap the hydraulic hose ports. Install the cylinder on the carriage.
18. If the bearing (**22**) requires replacement, support the rod (**4**) in a soft-jawed vise or other suitable holding device. Carefully press a new bearing into the rod eyelet.



For Current Production

b. Swing Carriage Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the swing carriage cylinder (**1**) with a suitable cleaner to remove dirt, debris, grease, etc.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder.*

2. Secure the swing carriage cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

> **WARNING:** Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Slowly remove the 3000 psi (207 bar) counterbalance cartridge (**2**) and the 2000 psi (138 bar) direct-acting relief valve (**3**) from the swing carriage cylinder.
4. If the self-aligning bearing (**4**) requires replacement, support the rod (**5**) in a soft-jawed vise or other suitable holding device. Carefully press the bearing out of the rod eyelet.
5. Extend the rod (**5**) to access the cylinder base.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

6. Remove the lock screw (**6**) from the flange of the head gland (**7**).
7. Using a pin spanner wrench, unscrew the head gland (**7**) from the cylinder tube (**8**). The head gland was originally torqued to 300 ±50 lb-ft (407 ±68 Nm), so a considerable amount of force is required. Carefully slide the head gland down along the rod toward the eyelet, away from the cylinder tube (**8**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**9**). Keep the rod centered within the tube to help prevent binding.*

8. Carefully pull the rod (**5**) with all attachments straight out of the tube (**8**).

9. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
10. Remove the precision wear band (**10**) from the piston (**9**).
11. Remove the two setscrews (**11**), and nylon balls (**12**), from the piston (**9**). Pry or drill out the nylon balls as required. **DO NOT** damage the piston threads. New nylon balls will be required for reassembly.
12. Remove the piston (**9**) from the rod (**5**). The piston was originally torqued to 425-500 ft-lb (576-678 Nm) so a considerable amount of force will be required to remove the piston.
13. Remove the piston square seal (**13**) and square ring (**14**) from the piston (**9**).
14. Remove the small o-ring (**15**) from the groove in the end of the rod (**5**).
15. Remove the head gland (**7**) from the rod (**5**).
16. Remove the o-ring (**16**), back-up ring (**17**) and o-ring (**18**) from the head gland (**7**).
17. From within the head gland (**7**), remove the precision wearbands (**19**) and the deep Z-seal (**20**). From the other end, remove the rod wiper (**21**).

c. Swing Carriage Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the swing carriage cylinder (**1**).
2. Discard all seals, back-up rings and o-rings. Replace with new items from the complete seal kits (**22**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

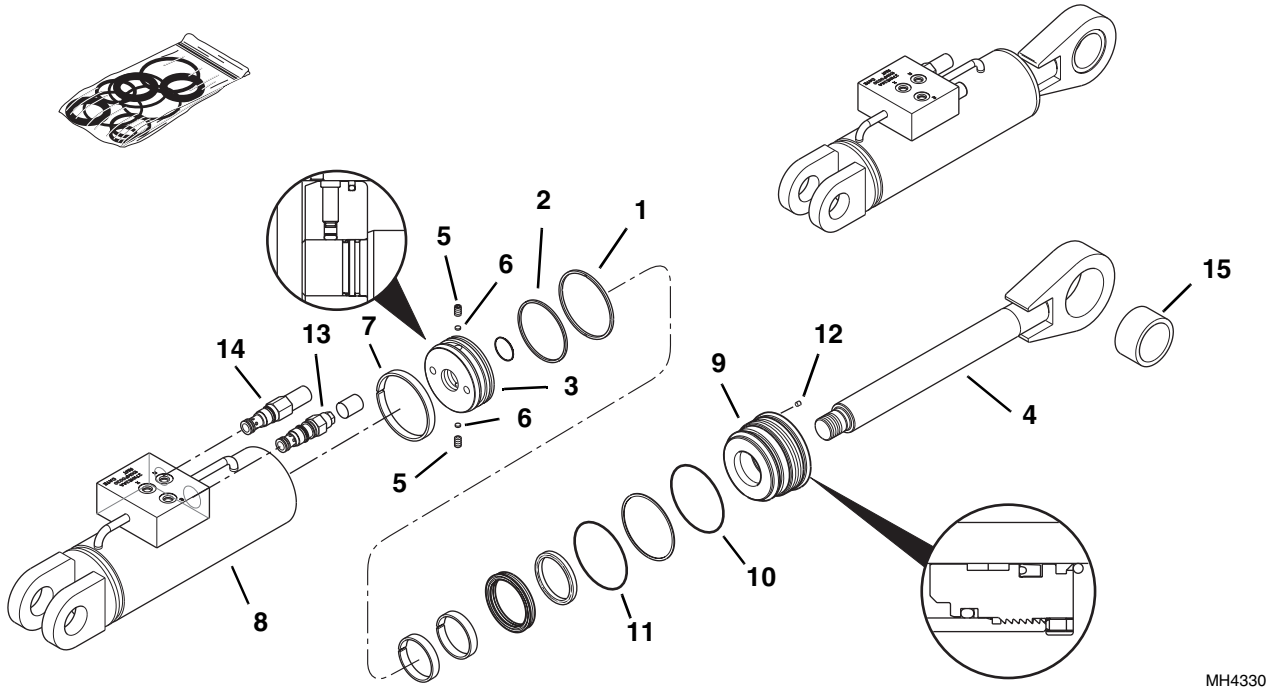
d. Swing Carriage Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**8**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene after repair.
4. Check that the rod (**5**) is straight. If it is bent, install a new rod.

e. Swing Carriage Cylinder Assembly

Note: *Follow the information in Section 8.13.3, "General Cylinder Assembly Instructions."*

1. Install the deep Z-seal (**20**), orienting the edge (**23**). Install the precision wearbands (**19**) into the forward end of the head gland (**7**), and at the rear end, install the rod wiper (**21**). The wiper lip (**24**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
2. Install a new oiled o-ring (**18**), back-up ring (**17**) and oiled o-ring (**16**) onto the head gland (**7**).
3. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
4. Push the head gland (**7**) onto the rod (**5**). If necessary, use a soft hammer to drive the head gland onto the rod.
5. Install a new small oiled o-ring (**15**) into the groove in the end of the rod (**5**).



6. Install a new piston square seal (**1**), square ring (**2**).
7. Apply Loctite #242 (blue) to the threads of the piston (**3**). Thread the piston (**3**) onto the rod (**4**) and torque to 425-500 ft-lb (576-678 Nm).
8. Apply Loctite #242 (blue) to the threads of the two setscrews (**5**). Install two setscrews (**5**) with nylon balls (**6**) into their holes in the piston (**3**). Tighten until the nylon balls are deformed into the threads of the rod.
9. Install the precision wearband (**7**) onto the piston (**3**).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**8**).*

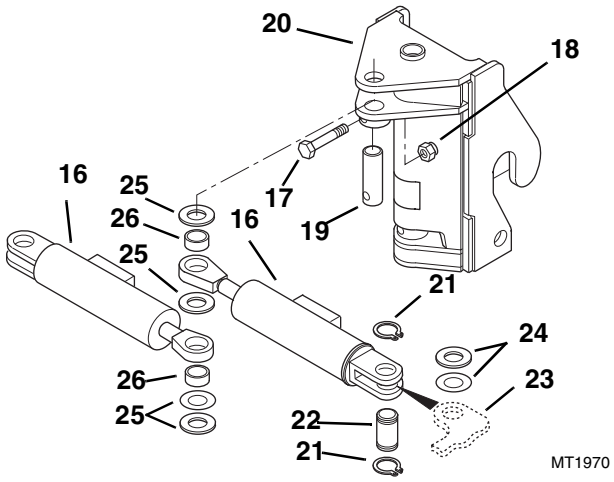
10. Place the cylinder tube (**8**) in a soft-jawed vise or other acceptable holding equipment if possible.
11. Lubricate the piston (**3**), head gland (**9**) and the inside of the tube (**8**) with clean, filtered hydraulic oil.
12. Apply a compression sleeve or other suitable tool to the head gland (**9**) in order to compress the o-rings (**10** and **11**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**3**). Keep the rod centered within the tube to help prevent binding.*

13. Carefully insert the rod (**4**) with all attachments straight into the tube (**8**). Apply Loctite #242 (blue) to the threads of the head gland (**9**). Use a pin spanner wrench to thread the head gland into the tube. Torque the head gland to 300 ±50 lb-ft (407 ±68 Nm).
14. Apply Loctite #242 (blue) to the threads of the lock screw (**12**). Thread the lock screw into the flange of the head gland (**9**) and torque to 3-4 lb-ft (4-5 Nm).
15. Using new oiled o-rings, install the counterbalance valve (**13**) and direct-acting relief valve (**14**). Lubricate the cartridge and valve with clean, filtered hydraulic oil. Torque the valves to 30-35 lb-ft (41-47 Nm).
16. Test the cylinder at low operating pressure (100 psi or 7 bar). Verify that the piston and rod move freely in both directions.
17. Increase the operating pressure to the maximum for the cylinder (3000 psi or 207 bar). Verify that the piston and rod move freely in both directions.
18. Retract the piston fully and cap the hydraulic hose ports. Install the cylinder on the carriage.
19. If the bearing (**15**) requires replacement, support the rod (**4**) in a soft-jawed vise or other suitable holding device. Carefully press a new bearing into the rod eyelet.

f. Swing Carriage Cylinder Installation

1. Install the swing carriage cylinder(s) (**16**) on the pivot mount (**20**). Secure the rod ends to the pivot mount using the shims (**25**) and bearings (**26**). Insert the pin (**19**) and secure with the bolt (**17**) and nut (**18**).



2. Secure the tube end to the mount plates (**23**) using the shims (**24**) and pins (**22**). Secure with snap rings (**21**).
3. Lubricate the tube ends with multi-purpose, lithium-based grease.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

4. Remove all plugs and caps from the hydraulic lines, and securely tighten the lines to the cylinder(s).

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

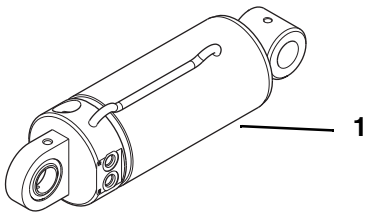
5. Start the engine.
6. Swing the carriage five times through its full range or until the operation of the swing carriage is normal (no jerks or spongy feel).
7. Shut the engine OFF. Check the hydraulic level and fill as required.

g. Swing Carriage Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check the cylinder pressure, consult the factory.
2. Center the swing carriage cylinders.
3. Swing the carriage fully left. Hold the joystick at full swing left for several seconds, then swing the carriage fully right and hold the joystick at full swing right for several seconds. Observe the readings on the gauge during the carriage swinging operations.
4. Center the carriage. While centering the carriage, check the pressure reading on the gauge.
5. Repeat Steps 3 and 4 five times.

8.13.12 Side Tilt Carriage Cylinder (Optional)

The optional side tilt carriage cylinder (**1**) provides a way to tilt the carriage attachment from side-to-side. The side tilt carriage includes a cylinder that operates to provide the side tilt motion.



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a. Side Tilt Carriage (Optional) Removal

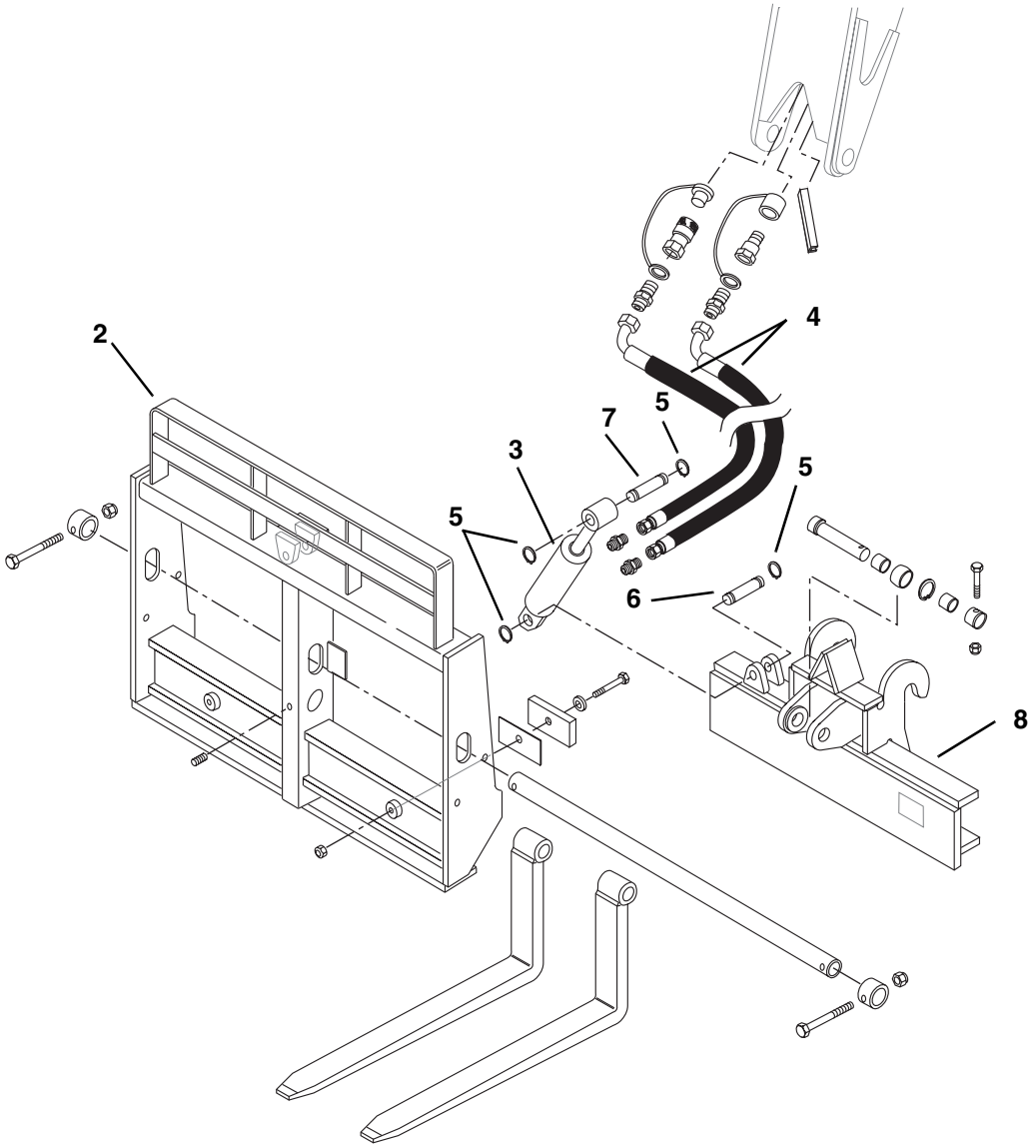
1. Level the boom (place the boom in a horizontal position).
2. Tilt the carriage (**2**) to fully retract the side tilt carriage cylinder (**3**).
3. Use suitable blocks to support the side tilt carriage (**2**) in this position.
4. Engage the park brake switch, place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position and shut the engine OFF.
5. Place an Accident Prevention Tag on both the ignition key switch and the steering wheel, stating that the vehicle should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

6. Unlock and open the rear door. Allow the hydraulic fluid to cool.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

7. Remove all dirt and grease from the side tilt carriage cylinder (**3**) and the auxiliary hydraulics lines (**4**).
8. Label or otherwise mark the auxiliary hydraulics assemblies (**4**).
9. Disconnect and cap all hoses and fittings, etc.
10. Remove the snap rings (**5**) and cylinder base pin (**6**) and rod pin (**7**) from the mounting plates on the carriage (**2**) and pivot base (**8**).
11. Remove the cylinder (**3**) using a sling and hoist or other suitable lifting equipment.
12. Wipe up any hydraulic fluid spillage in, on, near and around the vehicle.



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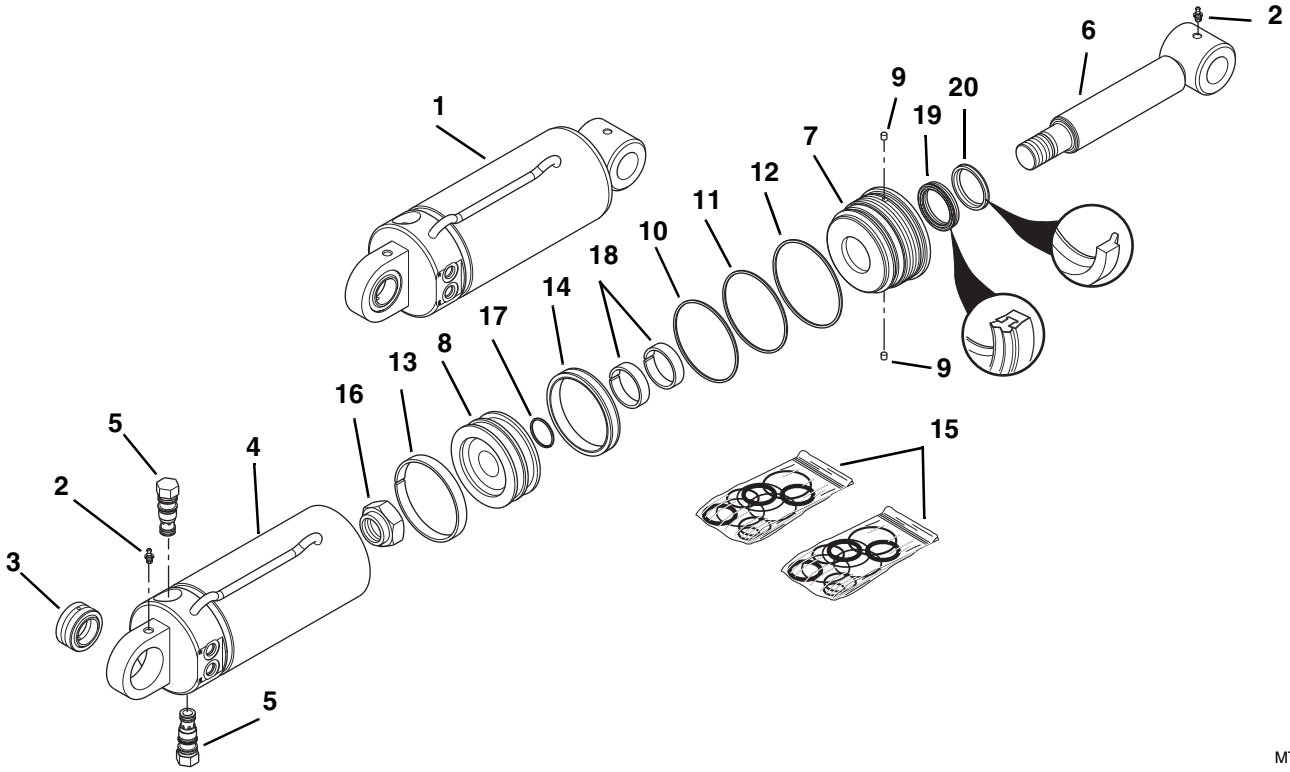


b. Side Tilt Carriage Cylinder Disassembly

Note: *An additional o-ring may be included at the base of the cylinder rod. This additional o-ring may be discarded, as it served only in a temporarily protective role.*

1. Clean the side tilt carriage cylinder (**1**) with a suitable cleaner to remove dirt, debris, grease, etc.
2. If necessary, remove both grease fittings (**2**) from the cylinder tube end and the rod end.
3. If necessary, press the self-aligning bearings (**3**) from the cylinder tube and rod ends.

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**4**).*

4. Place the side tilt carriage cylinder (**1**) in a soft-jawed vise or other acceptable holding equipment if possible.

WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

5. Slowly remove both pilot check valves (**5**) from the side tilt carriage cylinder.
6. Extend the rod (**6**) to allow access to the base of the cylinder.

IMPORTANT: *Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.*

7. Using a pin spanner wrench, unscrew the head gland (**7**) from the tube (**4**). The head gland was originally torqued to 300-400 lb-ft (407-542 Nm), so a considerable amount of force is required.
8. Carefully slide the head gland down along the rod toward the eyelet end, away from the cylinder tube (**4**).

IMPORTANT: *When sliding the rod and piston assembly into the tube, prevent the threaded end of the tube from damaging the piston (**8**). Keep the rod centered within the tube to help prevent binding.*

9. Carefully pull the rod (**6**) with all attachments straight out of the tube (**4**).
10. Fasten the rod end in a soft-jawed vise, and put a padded support below and near the threaded end of the rod, to help prevent damage to the rod.
11. Remove the locking inserts (**9**) from their holes in the head gland threads. Pry or drill out the insert as required. **DO NOT** damage the head gland threads. New locking inserts will be required for reassembly.
12. Remove the o-ring (**10**), back-up ring (**11**) and o-ring (**12**) from the head gland (**7**).
13. Remove the precision wearband (**13**) and capped T-seal (**14**) from the piston (**8**).

Note: *The T-seal actually consists of four components: a wide, flexible inner band, the flexible T-seal band itself, and two supportive split caps that mount on either side of the "T" itself.*

c. Side Tilt Carriage Cylinder Cleaning

1. Remove all hydraulic fluid, dirt and debris from the inner surface of the cylinder tube (**4**).
2. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits (**15**) to help ensure proper cylinder function.
3. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white, powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite T cleaner before reinstallation.*

4. Remove the locknut (**16**) from the rod (**6**).

Note: *Loctite Threadlocker #271 (red) and 550-650 lb-ft (746-881 Nm) of torque were applied to the locknut when it was installed. It may be necessary to apply heat to break the bond of the sealant between the locknut (**16**) and the rod (**6**) before the parts can be removed. Some parts of cylinders are sealed with a special organic sealant and locking compound.*

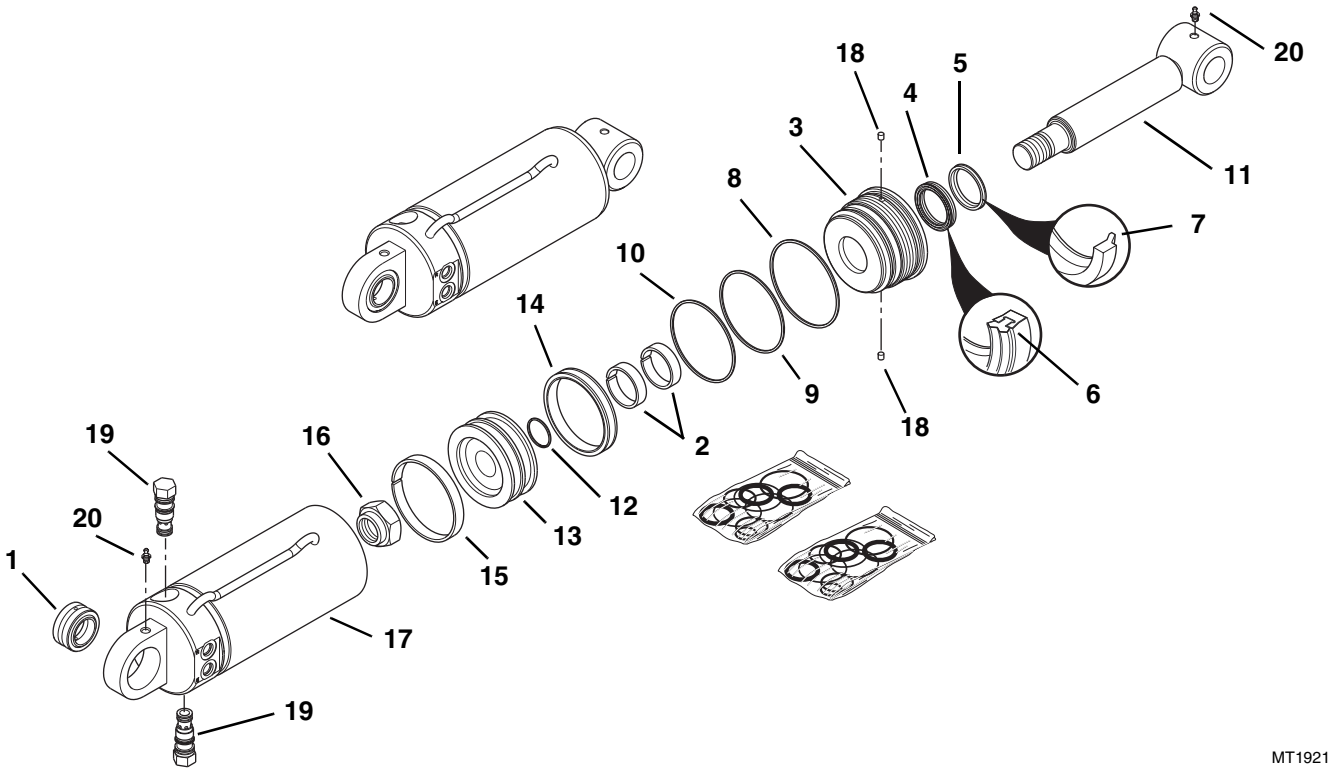
Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded joint. Wipe off any hydraulic oil and heat the joint uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating or the parts may become distorted or damaged. Apply sufficient torque or pressure for removal while the parts are still hot.

Breakdown of sealant will leave a white, powdery residue on threads and parts. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with Loctite "T" cleaner before reinstallation.

5. Remove the piston (**8**) and head gland (**7**) from the rod (**6**).
6. Remove the small o-ring (**17**) from inside the piston (**8**).
7. Remove the precision wearbands (**18**), deep Z-seal (**19**) and rod wiper (**20**) from the head gland (**7**).

d. Side Tilt Carriage Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube (**4**) does not display a smooth finish, or is scored or damaged in any way, replace the tube. Often, dirty hydraulic fluid causes failure of internal seals and damage to the smooth surface within the tube.
2. Remove slight scratches on the piston, rod or inner surface of the tube with very fine grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Clean parts with trichlorethylene.
4. Check that the rod (**6**) is straight. If it is bent, install a new rod.



e. Side Tilt Carriage Cylinder Assembly

Note: *Follow the general assembly instructions in Section 8.13.3, "General Cylinder Assembly Instructions."*

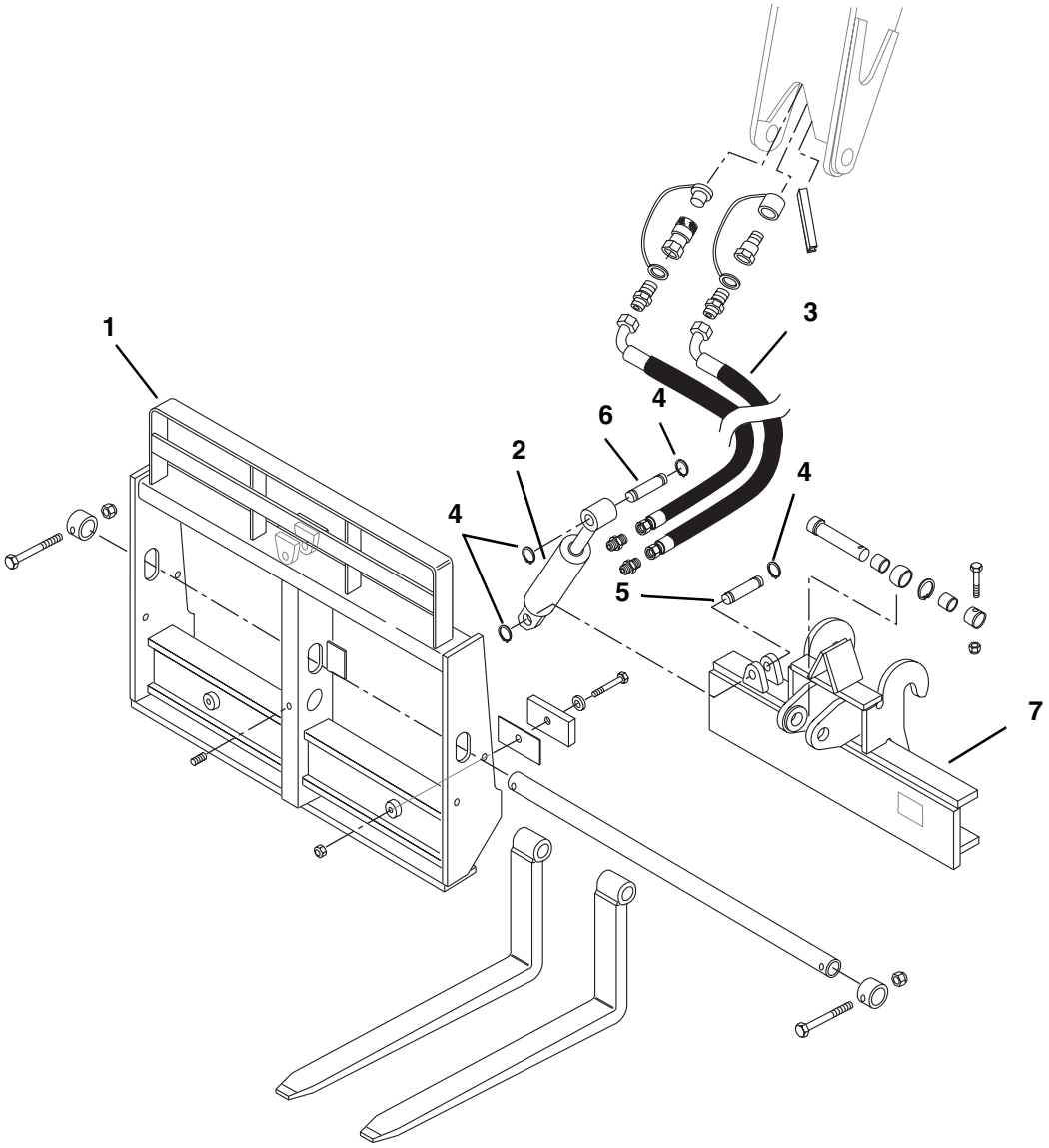
1. If necessary, press the self-aligning bearings (**1**) into the cylinder tube and rod ends. The bearings should protrude equally from each side of the eyelet.
2. Install the precision wearbands (**2**) into the rear of the head gland (**3**), and the deep Z-seal (**4**) and rod wiper (**5**) into the front of the head gland (**3**). Orient the Z-seal edge (**6**). The rod wiper lip (**7**) should be toward the outer end of the head gland and the seal lips toward the inner end of the head gland. Use tools that will not damage the seals.
3. Install new oiled o-ring (**8**), back-up ring (**9**) and oiled o-ring (**10**) on the head gland (**3**).
4. Fasten the rod end in a soft-jawed vise and put a padded support below and near the threaded end of the rod to help prevent damage to the rod.
5. Carefully slide the head gland (**3**) onto the rod (**11**). If necessary, use a soft hammer to drive the head gland onto the rod.
6. Install a new small oiled o-ring (**12**) inside the rod end of the piston (**13**).
7. Install the capped T-seal (**14**) and the precision wearband (**15**) on the piston (**13**).
8. Carefully slide the piston (**13**) onto the rod (**11**).
9. Apply Loctite Primer "T" and Threadlocker #271 (red) to the threads of the locknut (**16**) in accordance with Loctite instructions. Thread the locknut onto the rod (**11**) and torque to 550-650 lb-ft (746-881 Nm).

IMPORTANT: *Avoid using excess force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube (**17**).*

10. Fasten the cylinder tube (**17**) in a soft-jawed vise or other acceptable holding equipment.
11. Lubricate the piston (**13**), head gland (**3**) and the inside of the tube (**17**) with clean, filtered hydraulic oil.
12. Apply a compression sleeve or other suitable tool to the head gland (**3**) in order to compress the o-ring (**10**), back-up ring (**9**) and o-ring (**8**).

IMPORTANT: *When sliding the rod and piston assembly in the tube, prevent the threaded end of the tube from damaging the piston seal (**14**). Keep the rod centered within the tube to help prevent binding.*

13. Carefully insert the rod (**11**) with all attachments straight into the tube (**17**). Using a pin spanner wrench, begin to thread the head gland into the tube. Install new locking inserts (**18**) into the head gland. Continue to thread the head gland into the tube and torque to 300-400 lb-ft (407-542 Nm). Remove the compression tool.
14. Install new oiled o-rings and back-up rings on the pilot check valves (**19**). Lubricate the valve and rings with clean, filtered hydraulic oil. Install and torque to 30-35 lb-ft (41-47 Nm).
15. If necessary, install both grease fittings (**20**) into their threaded holes in the cylinder tube eyelet.
16. Test the side tilt cylinder at low operating pressure (100 psi or 6,9 bar). Verify that the piston and rod move freely in both directions.
17. Increase the operating pressure to the maximum for the cylinder (1750 psi or 120 bar). Verify that the piston and rod move freely in both directions.
18. Retract the piston fully and cap the hydraulic hose ports. Install the cylinder on the carriage. Lubricate the self-aligning bearing (**1**) via the grease fittings (**20**) with multi-purpose grease before operating the side tilt carriage on the vehicle.



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f. Side Tilt Carriage Cylinder Installation

1. Install the side tilt carriage cylinder (**2**) onto the side tilt carriage (**1**). Secure the rod end to the side tilt carriage with the cylinder rod pin (**6**) and snap rings (**4**). Secure the tube end to the pivot base (**7**) with the cylinder base pin (**5**) and snap rings (**4**).
2. Lubricate the pivot pins (**5** and **6**) with multi-purpose grease.

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

3. Remove all plugs and caps from the hydraulic lines (**3**) and securely tighten the lines to the cylinder.

> **WARNING:** Avoid prolonged engine operation in closed areas with inadequate ventilation. Failure to properly ventilate exhaust fumes can result in death or serious injury.

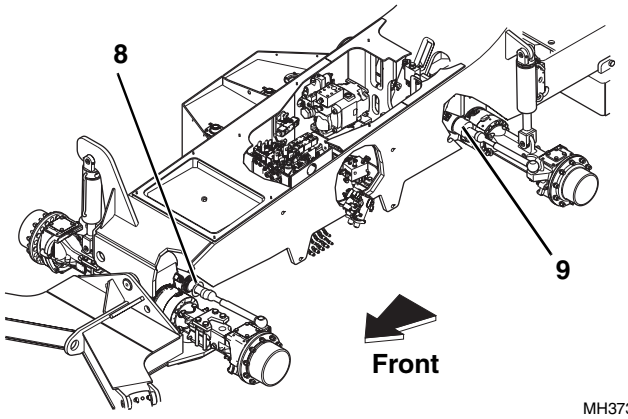
4. Start the engine and remove any blocking from the carriage.
5. Tilt the side carriage five times through its full range or until operation of the side tilt carriage is normal (no jerks or spongy feel).
6. Shut the engine OFF. Check the hydraulic level and fill as required.

g. Side Tilt Carriage Cylinder Pressure Checking and Circuit Bleeding

1. Attach a 4000 psi (276 bar) gauge to the test fitting on the main control valve to test the system pressure. Pressure readings should be 3000 ±100 psi (207 ±7 bar). Refer to Section 8.7, “Hydraulic System Testing.” To check the cylinder pressure, consult the factory.
2. Start with the side tilt carriage cylinder balanced, that is, with the carriage level and centered, not tilted.
3. Tilt the carriage fully left. Hold the joystick at full tilt left for several seconds, then tilt the carriage fully right and hold the joystick at full tilt right for several seconds. Observe the readings on the gauge during the carriage tilting operations.
4. Center and level the carriage. While levelling the carriage, check the pressure reading on the gauge.
5. Repeat Steps 3 and 4 five times.

8.13.13 Steering Cylinders

The steering cylinders (**8** and **9**) are secured to the axle assemblies. Steer cylinders are covered in the appropriate manufacturer’s axle literature. For the front steering cylinder (**8**), refer to the ZF Axle Repair Manual, Model MS-T 3060 P/N 8990419 (ZF P/N 5871 560 002). For the rear steering cylinder (**9**), refer to the ZF Axle Repair Manual, Model MS-T 3045 P/N 8990430 (ZF P/N 5871 550 002).



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Section 9
Electrical System

Contents

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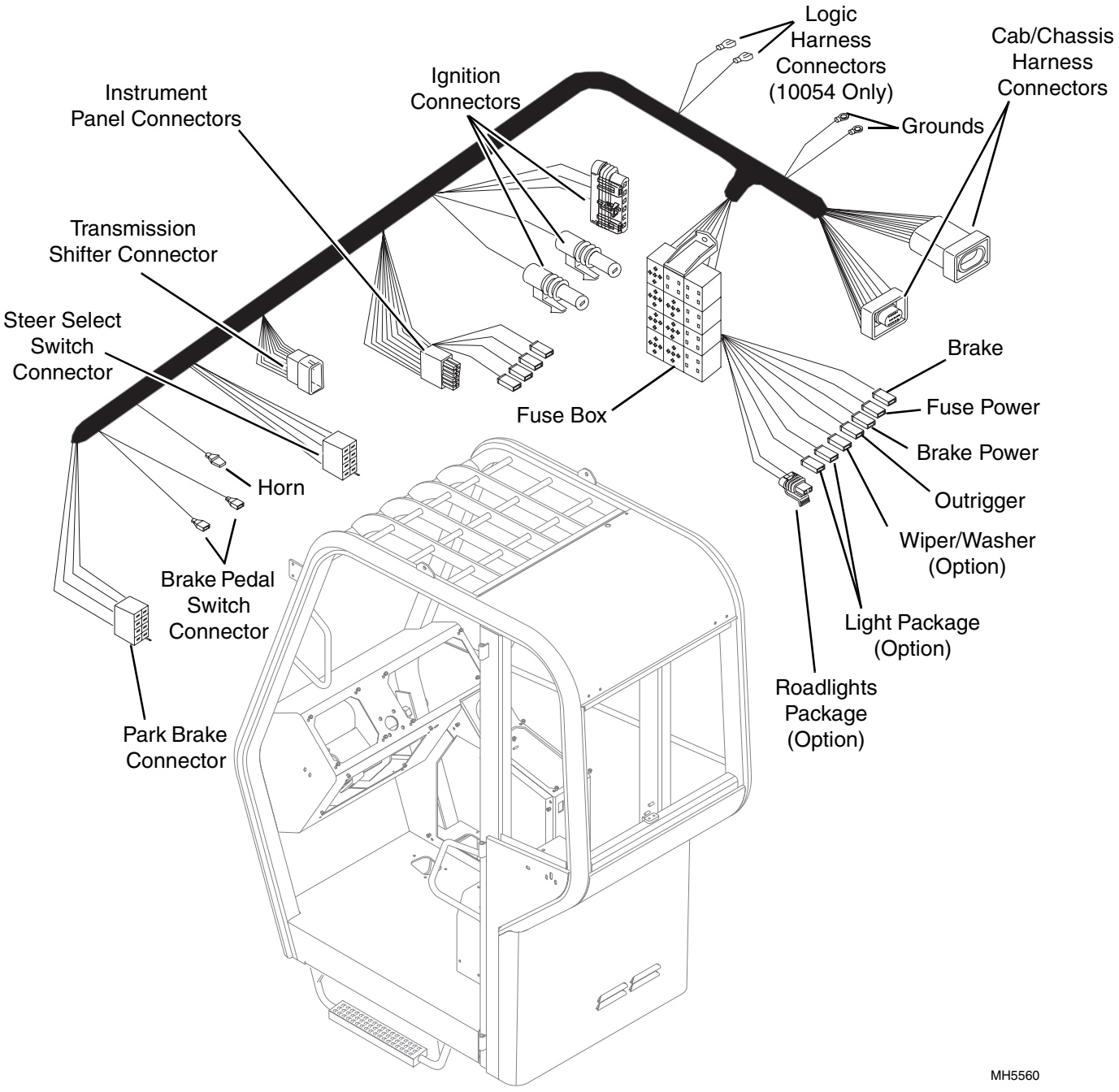
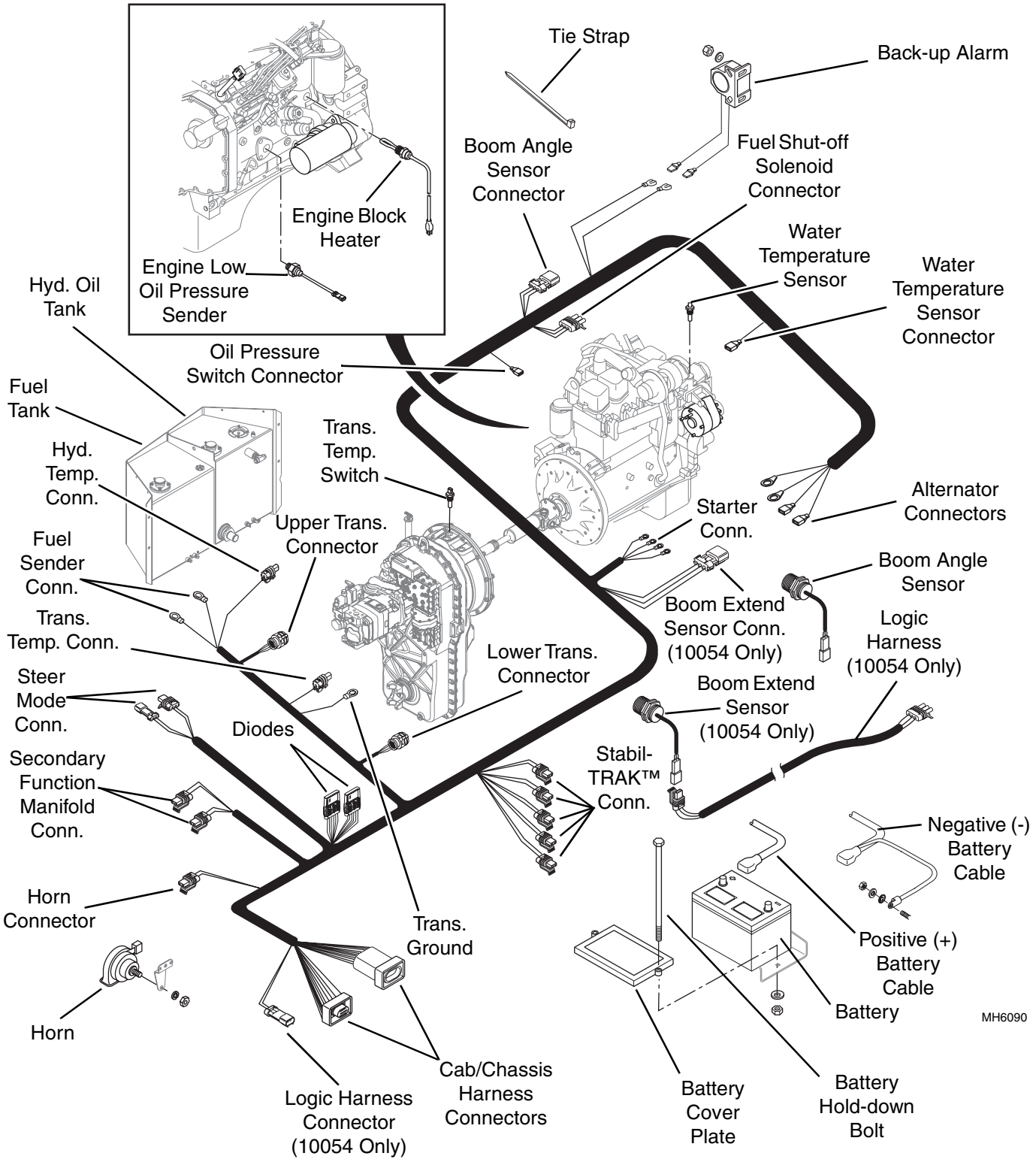
9.1 ELECTRICAL COMPONENT TERMINOLOGY

To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the vehicle. The following illustration identifies the components that are referred to throughout this section.

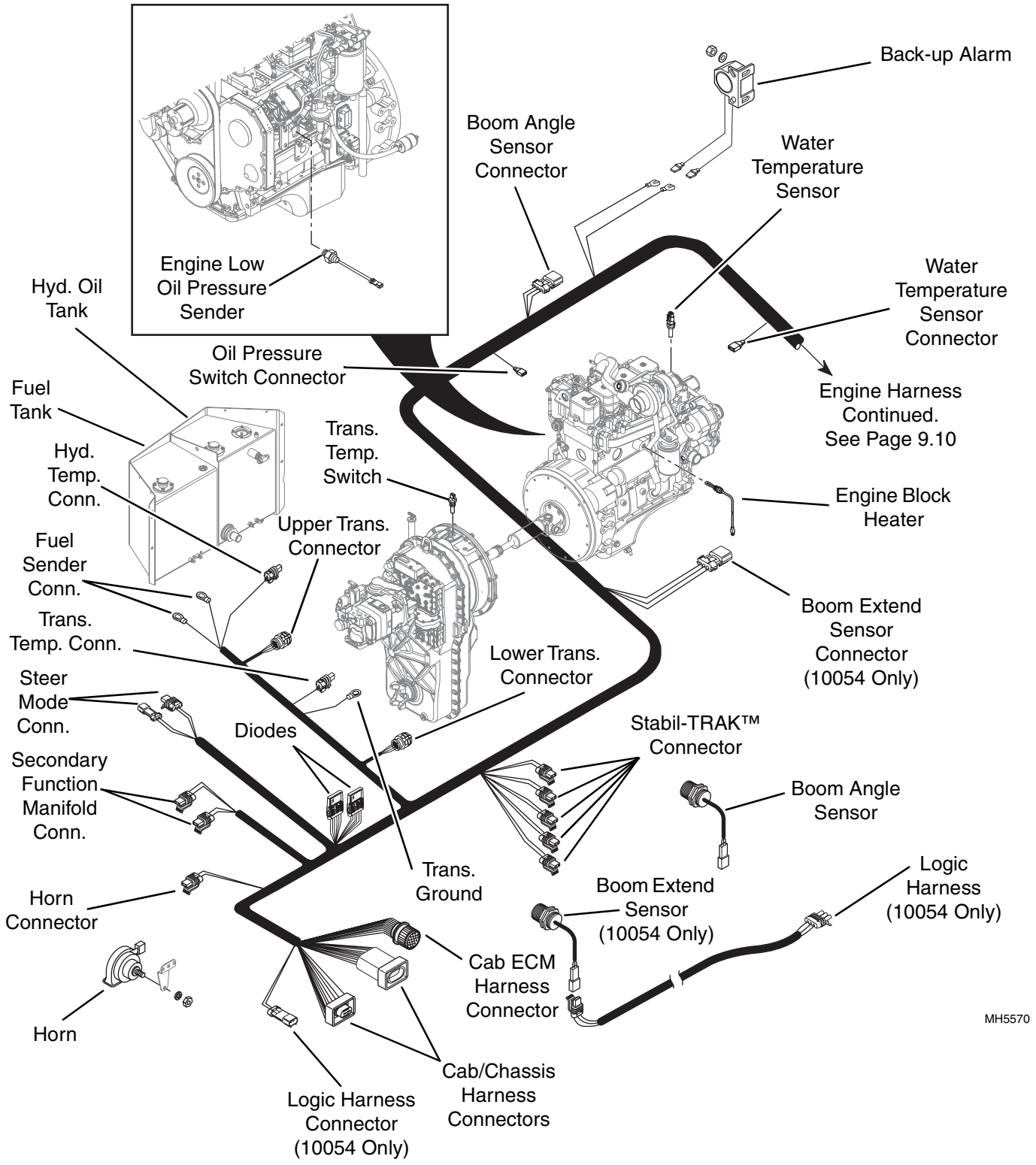
9.1.1 General Overview (Cab Harness)



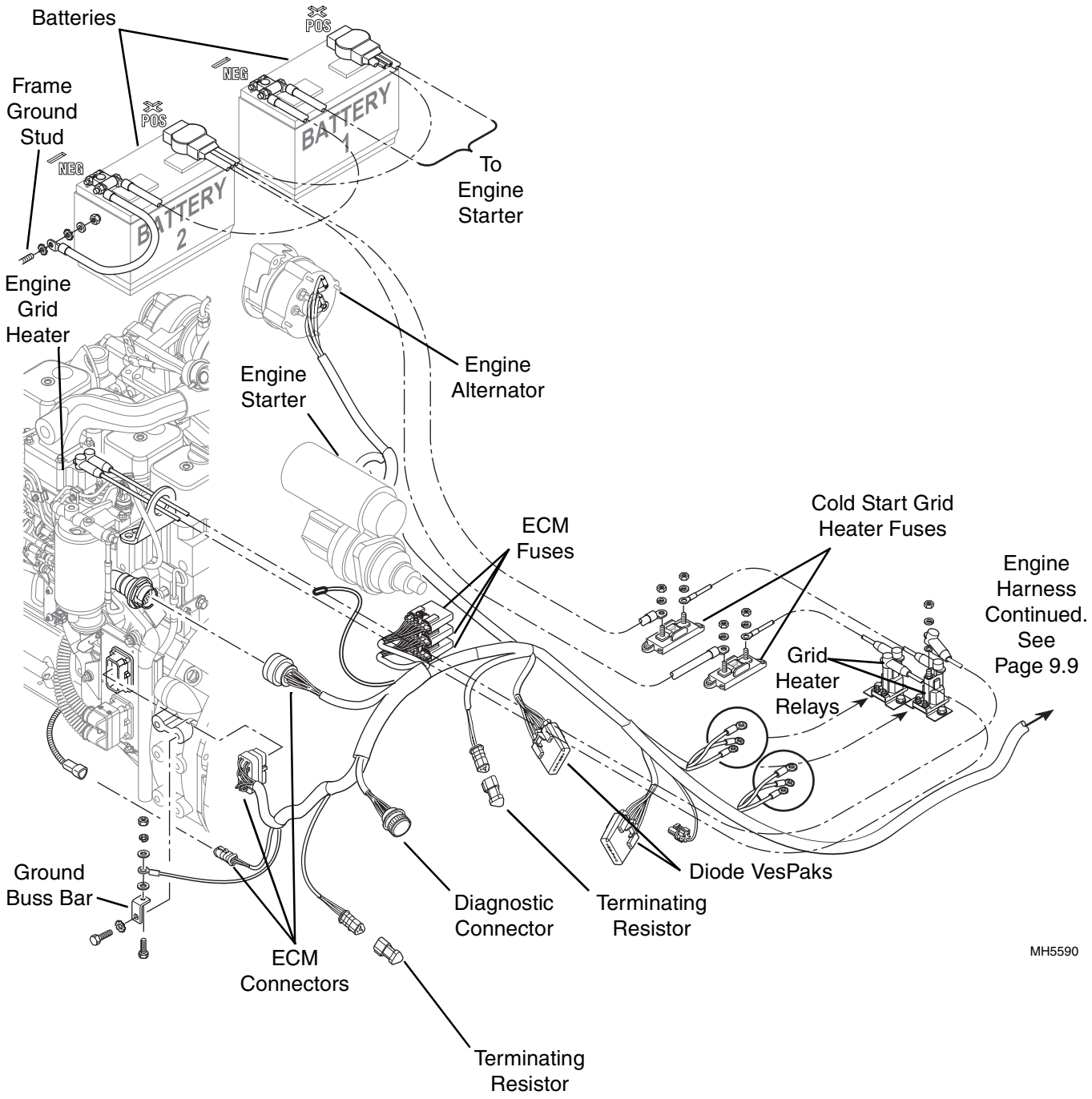
9.1.2 General Overview (Engine Harness) (SN 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079)



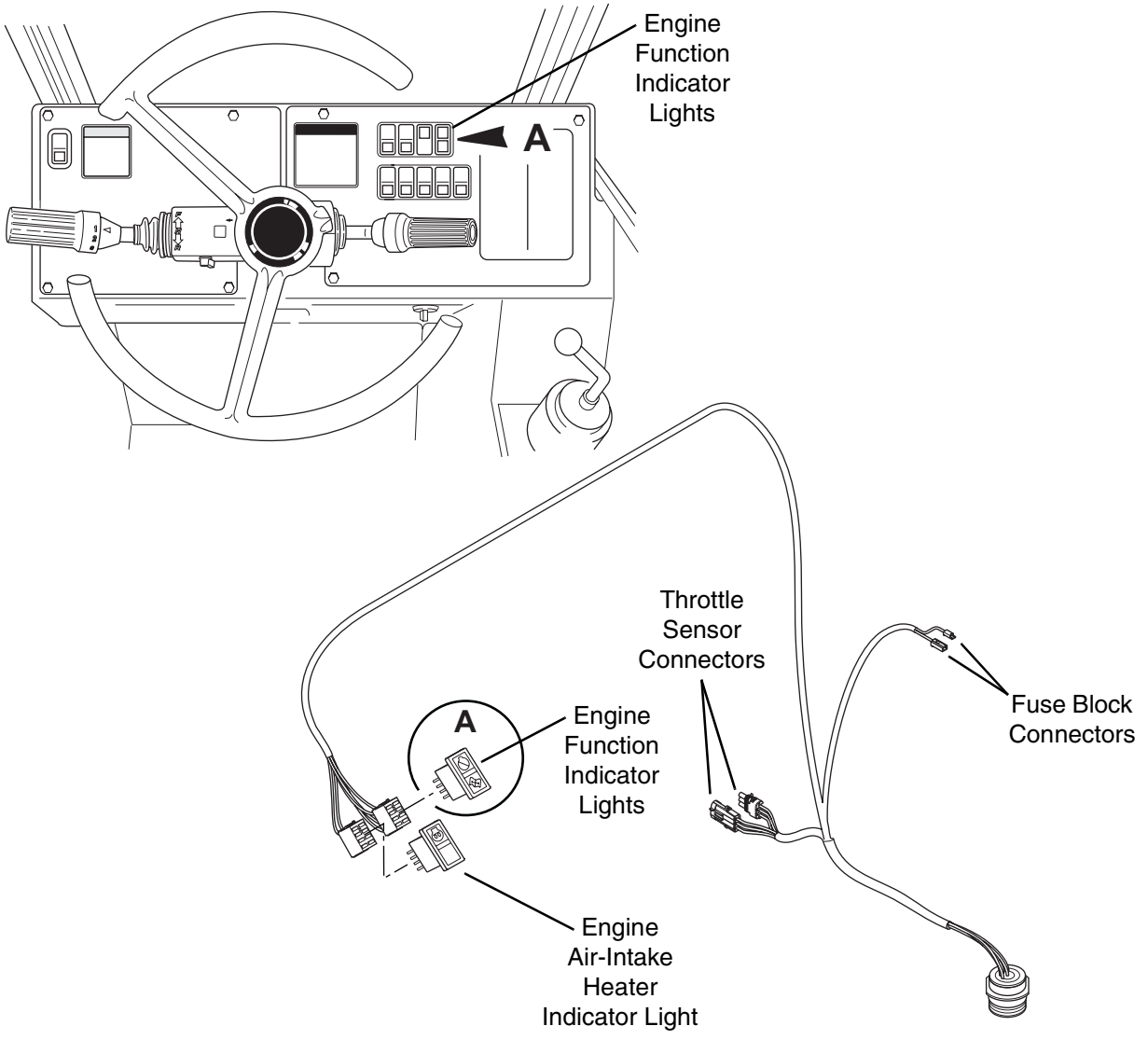
9.1.3 General Overview (Engine Harness) (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)



9.1.3 General Overview (Engine Harness) (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After) (Continued)



9.1.4 General Overview (ECM Cab Harness) (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)



9.2 SERVICE WARNINGS

9.2.1 General

CAUTION: **DO NOT** disconnect any wiring without first stopping the engine, turning all electrical switches to the OFF position an disconnecting the battery ground (-) cable from the battery. Failure to remove the negative (-) battery cable will result in damage to vehicle electronic systems.

CAUTION: **DO NOT** cause a short circuit by connecting leads to incorrect terminals. Always identify a lead and its correct terminal. A short circuit or wrong connection creating reverse polarity will immediately and permanently ruin internal components within the electrical system.

CAUTION: **DO NOT** momentarily or "flash" connect a terminal to check for current flow. No matter how brief the contact, the transistors may be ruined.

9.2.2 Battery

WARNING: All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery and possible severe personal injuries, particularly to the eyes. Wear safety glasses when working near the battery.

WARNING: Avoid battery acid. Battery acid can cause chemical burns or other serious injury. In case of contact with battery acid, flush area immediately with water.

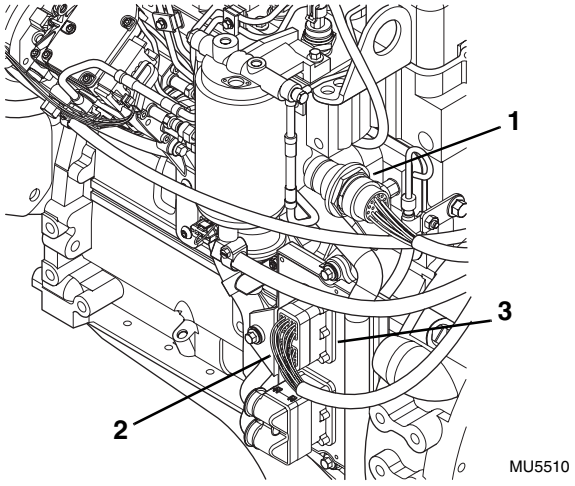
WARNING: Charge the battery in a well-ventilated area only. Always turn battery chargers OFF before connecting to or disconnecting from a battery.

CAUTION: **DO NOT** disconnect the battery while the engine is running. This will cause a voltage surge in the alternator charging system that will immediately ruin internal components.

CAUTION: **DO NOT** connect a battery into the system without checking for correct polarity and voltage.

Applies To Serial Numbers:
8042, 18991 - 19987, 10042 19031 - 19987,
10054, 19080 - 19987 And
8042/10042/10054, 0160002332 & After

CAUTION: When doing welding anywhere on the vehicle disconnect the wire harness (**1** and **2**) from the Engine Control Module (ECM) (**3**) on the engine.

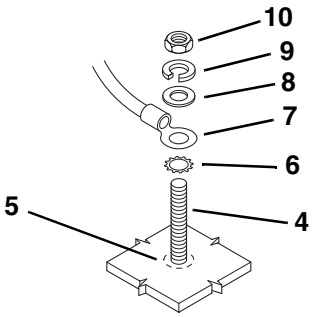


9.3 SPECIFICATIONS

Electrical system specifications are listed in Section 2, "General Information and Specifications."

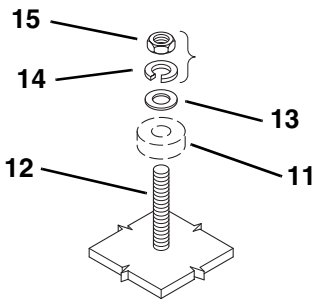
9.4 EFFECTIVE GROUND CONNECTIONS

1. Effective ground connections are essential to the efficient operation of electrical components. If an inadequate ground is suspected or determined, establishing another ground may be desired. Also, in the event a factory-authorized accessory is being installed, it is necessary to follow the proper sequence for providing an electrical ground. The sequence for installing or attaching a component to an electrical ground to a stud, bolt or capscrew (**4**) is to provide a clean surface by eliminating paint and rust from the area around the base of the stud (**5**). Install a tooth type lockwasher (**6**), electrical wire connector (**7**), flat washer (**8**), tooth or slot-type lockwasher (**9**) and hex nut or locknut (**10**).



MA0871

2. When an electrical component (**11**) is to be grounded, eliminate paint and rust from around the stud, bolt or capscrew (**12**), install a flat washer (**13**), tooth type or slot-type lockwasher, or locking nut with slotted type lockwasher (**14**) and hex nut or locknut (**15**).



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9.5 WIRING HARNESSES

For Serial Numbers 8042, 13198-18990, 10042, 13198-19030 & 10054 13189-19079; wiring on the vehicle is contained within two separate wiring harnesses, an engine harness and a cab harness.

For Serial Numbers 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After; wiring on the vehicle is contained within three separate wiring harnesses, an engine harness, ECM cab harness and a cab harness.

A harness consists of black-nylon woven braiding, providing a protective cover to bundle numerous wiring groups, splices, terminals, connectors and (where applicable) diodes. Each harness is identified with a part number when the vehicle leaves the factory.

Each wire is identified by a wire number on each end of the individual wire and by the color and gauge size of the wire. The wire numbers are also identified on the appropriate electrical schematic. All circuits have been electrically tested for continuity, and all diodes have been tested for correct biasing. Where several individual connectors appear, the wiring leading to a particular connector can help identify the specific circuit. For some circuits, a colored band (tie wrap) is present, and is affixed to the connector wiring and used as a color-code indicator. If wiring needs to be replaced, use the correct gauge size wiring. **NEVER** replace a wire with a smaller gauge wire.

9.5.1 Removal and Replacement

Remove a wiring harness only if damaged or unusable. Install a new harness one terminal at a time, as the old harness is removed. Label or tag the terminal locations of all wires, harness clips, tie wraps and conduit, as the old harness is removed, to allow correct installation of the new harness.

9.5.2 Disassembly

Disassembly of the wiring harness is not recommended due to the precise arrangement of wires and splice requirements. If it becomes necessary to replace wires, use the correct gauge size wiring, and **NEVER** replace a wire with a smaller gauge wire.

9.5.3 Cleaning and Drying

Clean a wire harness with a natural bristle brush and the same detergent used to clean the vehicle. Allow the harness to air dry. **DO NOT** allow surface temperatures to exceed 300° F (149° C).

9.5.4 Inspection and Repair

Replace a harness only if it is damaged or unusable. If a splice or repair must be made to a wire, always use rosin core solder to bond wires together. Use heat-shrink tubing or insulating electrical tape to cover all splices or bare wires.

9.5.5 Installation

The wiring harnesses are held securely in place by wire tie wraps, clips or other devices that help prevent chafing or wearing of the insulation and entanglement with moving parts. Sections of ribbed plastic conduit have been installed where wiring or harnesses pass through openings in the vehicle frame. Always install tie wraps, clips, conduit, etc., in their original locations to help prevent damage to the wiring or harnesses.

9.5.6 Wire Code and Color

The chart below indicates the wire code abbreviation and color as used on the electrical schematics.

Wire Code	Color
BLK	Black
BLU	Blue
BRN	Brown
DK BLU	Dark Blue
DK GRN	Dark Green
GRN	Green
GRY	Gray
LT BLU	Light Blue
LT GRN	Light Green
ORG	Orange
PNK	Pink
PUR	Purple
RED	Red
TAN	Tan
YEL	Yellow
VIO	Violet
WHT	White

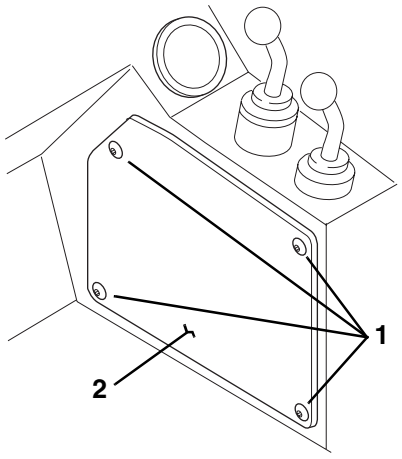
9.6 FUSES AND RELAYS

Fuses and relays help to protect the electrical system. In general, a blown fuse is a symptom of another electrical problem. Address the true problem, not just the symptom. Simply replacing the fuse often will not solve the problem. Blown fuses are usually due to simple causes, including loose or corroded connections, or a defective relay.

There are two main causes of blown fuses: a shorted or grounded wire in the applicable circuit, or a defective electrical component. Visually check the condition of the fuse, wires, connections and components in the involved circuit before replacing a fuse. Check the circuit for shorts, grounding or defective electrical components.

Keep in mind that many parts in the electrical system work with components of the hydraulic system; a careful inspection of the related hydraulic components may help in solving problems.

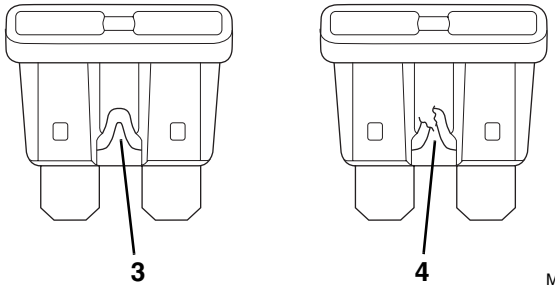
For access to the fuse and relay panel, remove the four screws (**1**) securing the right side console access panel (**2**) to the cab. The fuses and sealed 12-volt relays are mounted under the right side console access panel. The fuse and relay panels are part of the cab harness.



OH2430

9.6.1 Circuit Protection - Fuses

The fuse is the most common method used for protecting wiring circuits. A good fuse (**3**) will have the center element connected to both sides of the fuse. Whenever there is an excessive amount of current flowing through a circuit, the fusible element will melt (**4**) and create an open or incomplete circuit.



MT0420

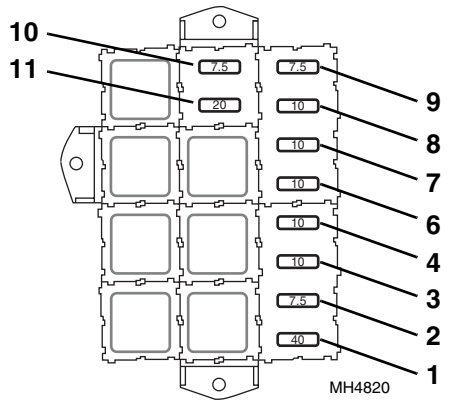
Fuses are a one time protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is open (**4**), remove the suspected fuse and examine the element in the fuse for an open (break). If not broken, also check for continuity using a DMM or a continuity tester. If the element is open or continuity is suspect, replace the fuse with one of an equal current rating.

Fuse Types	
Current Rating Amperes	**Color**
Auto Fuses, Mini Fuses	
1	Black
2	Gray
3	Violet
5	Tan
7.5	Brown
10	Red
15	Blue
20	Yellow
25	White
30	Green
Maxi Fuses	
20	Yellow
30	Light Green
40	Orange or Amber
50	Red
60	Blue

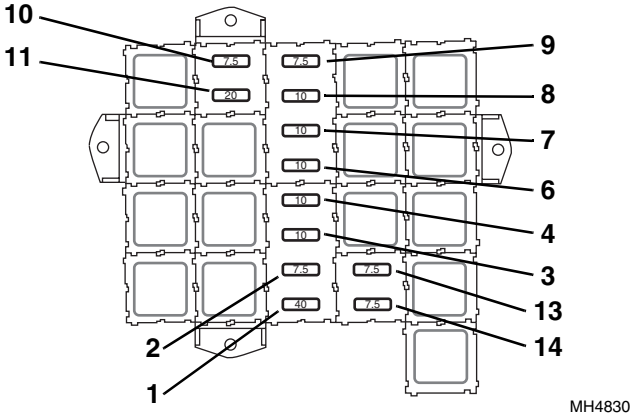
9.6.2 Fuse and Relay Locations

a. Fuse Block Fuse Locations

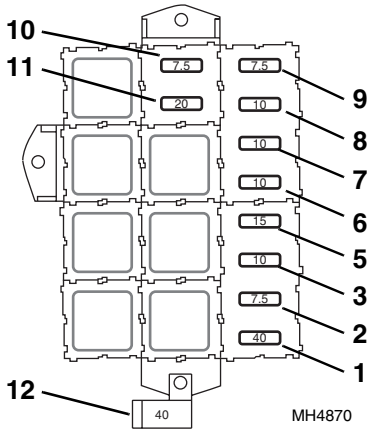
SN 8042/10042, 13198 - 16782 Without Lighting Package



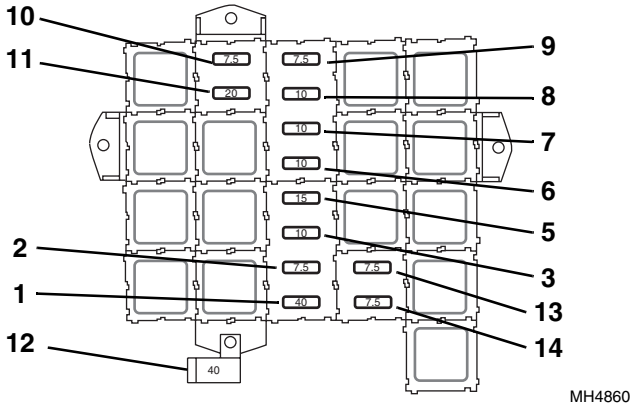
SN 10054, 13198 - 16782 Without Lighting Package



SN 8042/10042, 13198 - 16782 With Lighting Package, 16783 - 19987 And 0160002332 & After



SN 10054, 13198 - 16782 With Lighting Package, 16783 - 19987 And 0160002332 & After

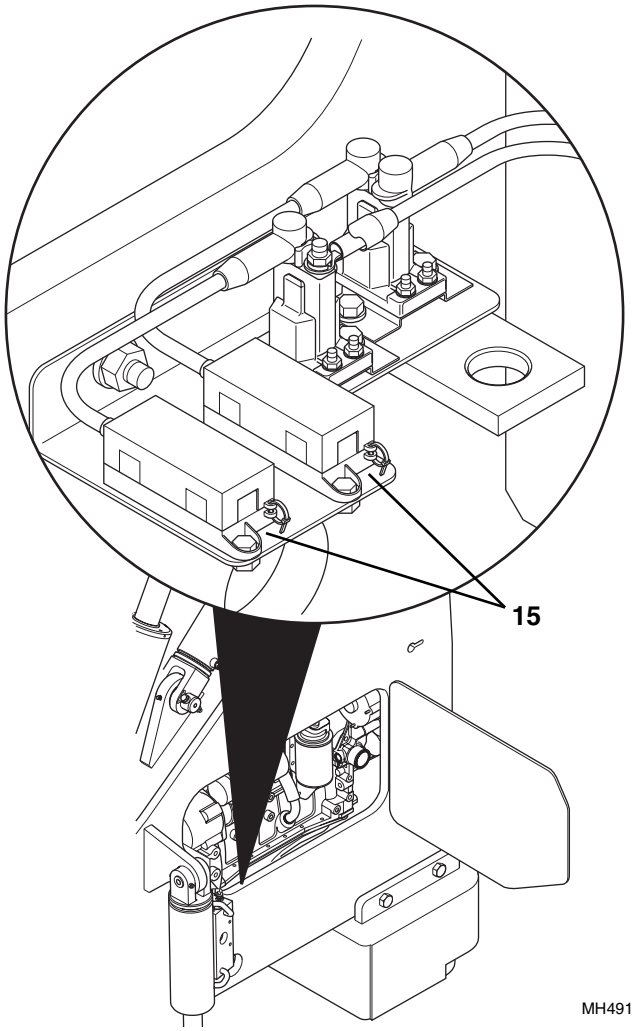


No.	Amp	Circuit Protected
1	40 Amp	Main
2	7.5 Amp	Light Switch Relay
3	10 Amp	Instrument Cluster
4	10 Amp	Horn/Heater (SN 13198 through 16782)
5	15 Amp	Horn/Heater (SN 16783 through 19987 and 0160002332 & After)
6	10 Amp	Steer Select Switch
7	10 Amp	Stabilizer
8	10 Amp	Optional Washer/Wiper
9	7.5 Amp	Outriggers & ECM Indicator Light
10	7.5 Amp	Transmission
11	20 Amp	Optional Lights
12	40 Amp	Optional Road/Work Lights (SN 16783 through 19987 and 0160002332 & After)
13	7.5 Amp	Boom/Outrigger Interlock **(10054 Only)**
14	7.5 Amp	Boom/Outrigger Interlock **(10054 Only)**

b. Engine Compartment Fuse Locations (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

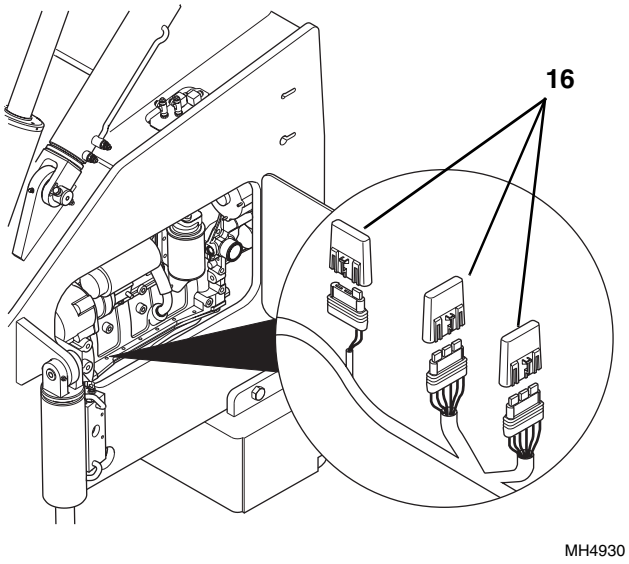
Cold Start Grid Heater Fuses

The two 125 amp fuses (**15**) that protect the cold start grid heater are located inside the engine compartment and are mounted on a bracket mounted on the left side of the frame rail.



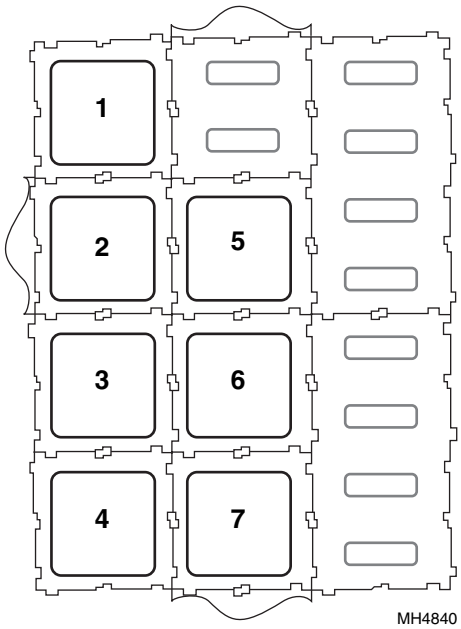
ECM Fuses

The three fuse holders (**16**) that protect the ECM and diagnostic system are located inside the engine compartment and are tie wrapped to the wire harness on the top of the engine bell housing. One holder contains one 7.5 amp fuse, one holder contains three 7.5 amp fuses and the other holder contains three 10 amp fuses.

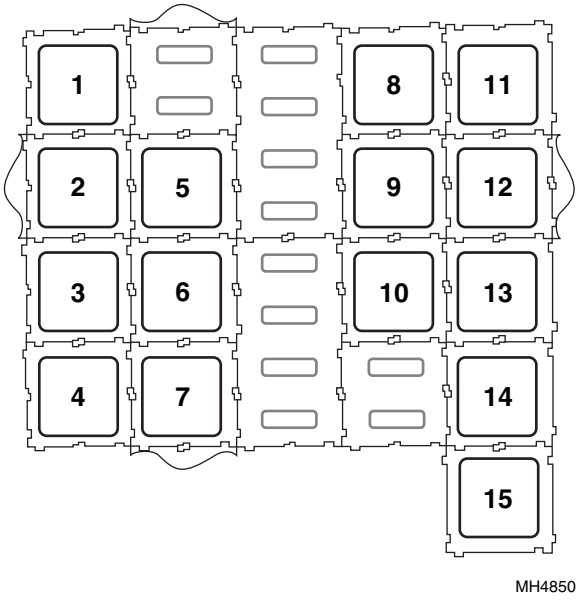


c. Fuse Block Relay Locations

8042/10042



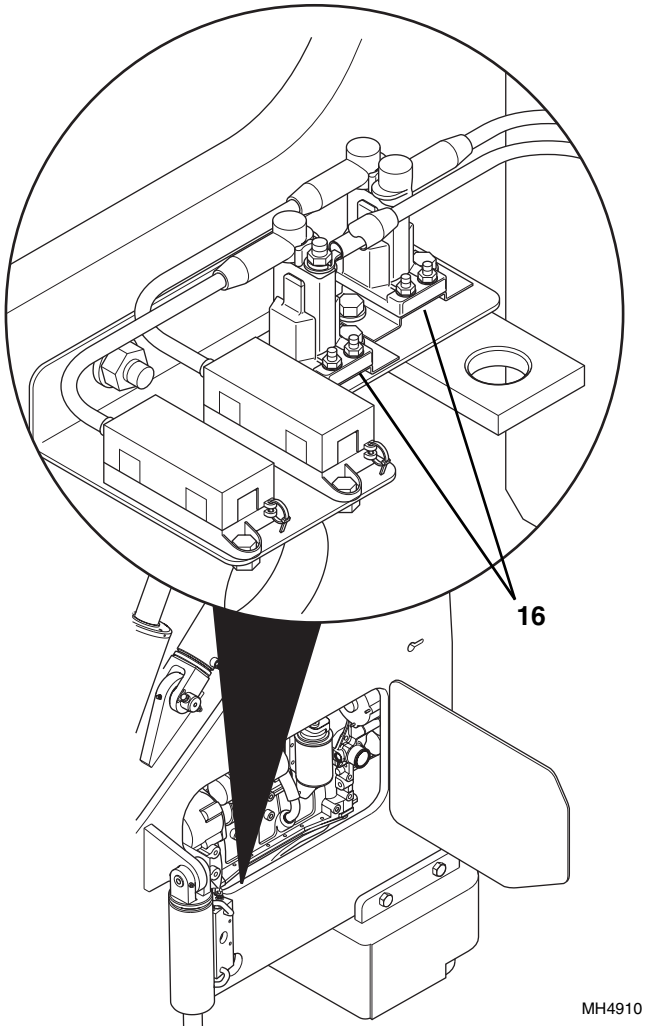
10054



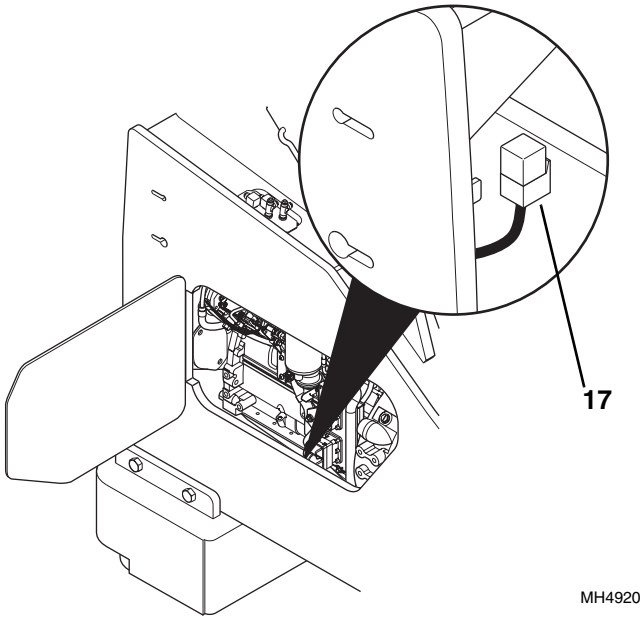
No.	Volt	Circuit Protected
1	12 Volt	Optional Headlight Switch Relay
2	12 Volt	Light Switch Relay
3	12 Volt	Stabilizer Lock Relay
4	12 Volt	Boom Switch Relay
5	12 Volt	Park Brake Disengage Relay
6	12 Volt	Neutral Start Relay
7	12 Volt	Back Up Relay
8	12 Volt	Park Brake Interlock Relay **(10054 Only)**
9	12 Volt	Boom Extend Relay **(10054 Only)**
10	12 Volt	Outrigger Lockout Relay (SN 13198 through 17984) Blank (SN 17985 & After) **(10054 Only)**
11	12 Volt	Stabil-TRAK Interlock Relay **(10054 Only)**
12	12 Volt	Stabil-TRAK Lock Up Relay **(10054 Only)**
13	12 Volt	Boom Extend Interlock Relay **(10054 Only)**
14	12 Volt	Right Outrigger Lock Relay **(10054 Only)**
15	12 Volt	Left Outrigger Lock Relay **(10054 Only)**

d. Engine Compartment Relay Locations (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

There are two relays located inside the engine compartment, mounted on a bracket mounted to the left frame rail. The relays (**16**) control the engine grid heater.



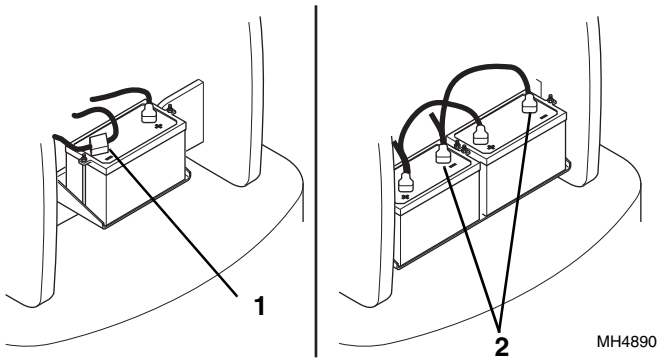
There is an engine fuel relay (**17**), mounted on the right frame rail next to the engine.This relay is part of the Cummins engine harness and also part of the ECM Diagnostic System. If there is a problem with the relay it will trigger a diagnostic code through that system. Refer to Section 9.7.2, “ECM Diagnostic System (8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/ 10054, 0160002332 & After).”



9.6.3 Fuse and Relay Replacement

WARNING: **DO NOT** perform service or maintenance on the vehicle with the engine running, with the exception of the transmission level check. Contact with moving parts can cause death or serious personal injury.

Shut off the engine and disconnect the negative (-) battery cable(s) at the negative (-) battery terminal(s) before checking the electrical system fuses or relays.

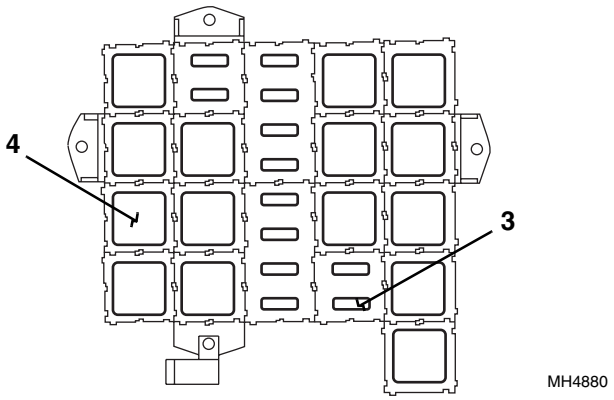


1. Unlock and open the rear engine door.
2. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).

a. Fuse Block Fuse or Relay Replacement

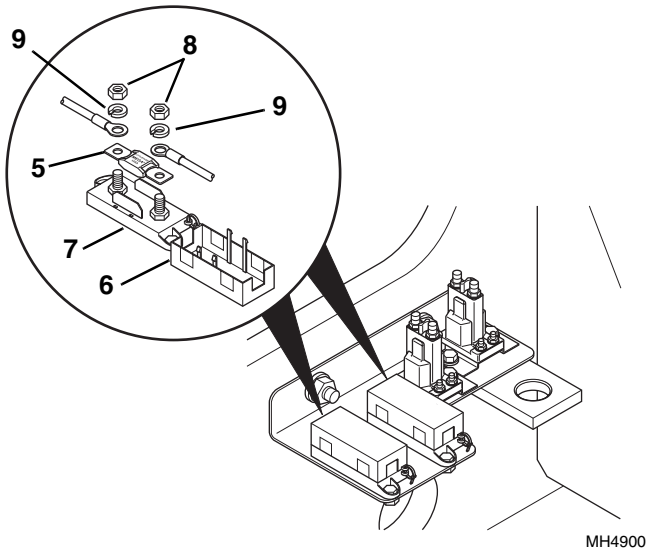
Remove a suspect fuse (**3**) or relay (**4**) (Refer to Section 9.6.2, “Fuse and Relay Locations,” for locations of fuses and relays) from the fuse and relay panel by pulling the fuse or relay straight out and away. ALWAYS install the correct amp rated fuse or relay.



b. Engine Compartment Fuse Replacement (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

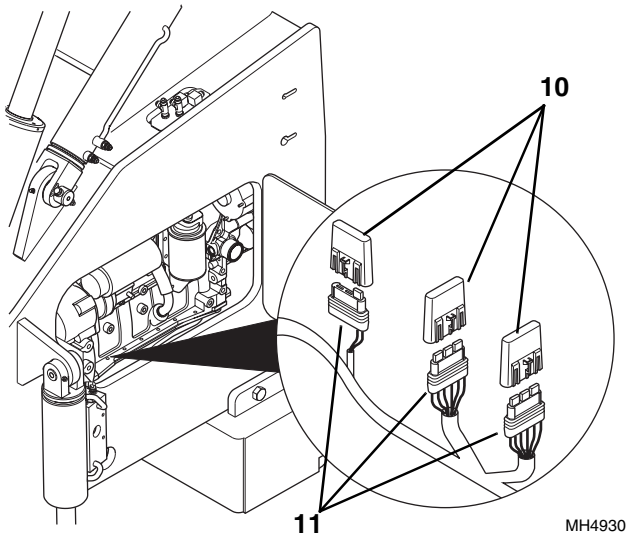
Cold Start Grid Heater Fuses

1. To access the fuses (**5**) open the protective covers (**6**) from the engine panel side. Allow the covers to rotate on the tethers on the engine side of the holder (**7**).
2. Remove the two hex nuts (**8**) and lockwashers (**9**) securing the fuse (**5**) and wires to the fuse holder (**7**). Remove the fuse and replace with a new fuse.
3. Place the new fuse and then the wires onto the studs of the holder. Secure the fuse and wires in place with the lockwashers (**9**) and hex nuts (**8**). Torque the hex nuts to 7-9 lb-ft (10-12 Nm).
4. Snap the protective cover (**6**) back in place. Be sure the cover snaps securely in place on the holder.



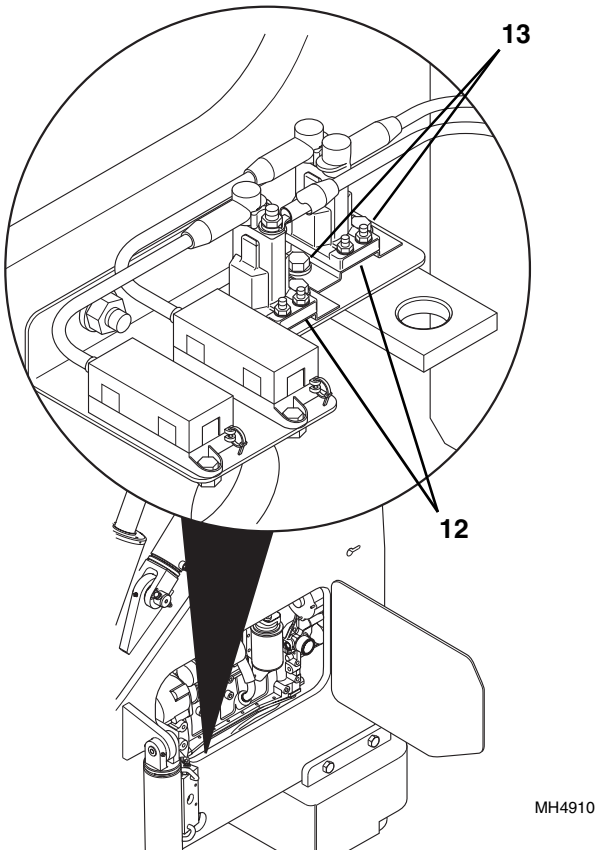
ECM Fuses

1. Locate the three fuse holders. Remove the clear plastic protective cover (**10**) from the holder (**11**).
2. Remove the failed fuse from the holder and replace with a new fuse.
3. Reassemble the plastic cover onto the fuse holder and securely snap the cover in place. Replace any tie wraps that were removed, securing the fuse holders to the wire harness.



c. Engine Compartment Relay Replacement (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

To remove the relays (**12**) from inside the engine compartment, remove the mounting screws and washers (**13**). When re-installing the relays torque the mounting hardware to 5 - 9 lb-ft (7 - 12,5 Nm).



d. After Fuse or Relay Service

If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).

9.7 ELECTRICAL SYSTEM TROUBLESHOOTING

9.7.1 Introduction

The electrical system produces, stores and distributes electricity in the operation of the vehicle.

An engine-driven, 12-volt, 65-amp alternator, equipped with an internal, solid-state voltage regulator, produces electricity. Current from the alternator charges the battery and powers electrical system components.

The battery provides power for starting the engine and supplements the output of the alternator during periods of peak demand.

For Serial Numbers 8042, 13198-18990, 10042, 13198-19030 & 10054 13189-19079; wiring on the vehicle is contained within two separate wiring harnesses, an engine harness and a cab harness. Several multiple or “bulkhead” connectors at the end of each harness joins the two together.

For Serial Numbers 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 and 8042/10042/10054, 0160002332 & After; wiring on the vehicle is contained within three separate wiring harnesses, an engine harness ECM cab harness and a cab harness. Several multiple or “bulkhead” connector at the end of each harness joins the harnesses together.

Each wire within a harness has color-coded insulation which is marked with a number to aid in identifying and tracing each circuit and in making proper connections. Fuses and relays are included with the cab harness to help protect the electrical system and its components.

The main wiring diagrams in this section indicate electrical circuits and components respective of their approximate locations on the vehicle.

The information in this section has been developed from the perspective that all wires are connected and routed as they were when the vehicle left the factory. Take into account any disconnected or rerouted wires before beginning to diagnose a circuit. Refer to the wiring diagrams to test circuits for continuity or for shorts using a digital multimeter, analog multimeter, test light, ohmmeter or low-reading voltmeter.

The text discusses each circuit and component, as well as component function and replacement. Many of the circuits have a separate diagram specific to that circuit’s function which can be used for troubleshooting purposes. Those same circuits also have their own troubleshooting flow charts. Keep in mind that the various systems on the vehicle include both electrical and hydraulic components. What at first may appear to be an electrical problem, may turn out to be a hydraulic problem.

Note: *All of the main electrical schematics in this section are shown in the OFF position. The individual circuit diagrams are shown in the ON position.*

9.7.2 ECM Diagnostic System (8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

Advanced diagnostics are included to make this Cummins engine straightforward to repair and service. Diagnostic examination of a fault or maintenance condition can occur through onboard or offboard systems.

Onboard Diagnostics

- Extensive fault detection fault capability within the ECM
- Flash-out of fault codes
- Engine function indicator light located on the left side of the dash to indicate warning/stop
- Maintenance lamp

Offboard Diagnostics

- INSITE™, a Windows®-based reporting program used as a service tool for this engine. It is used to help troubleshoot and repair the engine. This tool is capable of doing diagnostics and programming. This tool is available from your local Cummins Distributor. Call the Cummins Customer Assistance Center at 1-800-343-7357.

Onboard Diagnostics

a. Fault Detection

Faults are detected while the key switch is in the RUN position, during the operation of the vehicle itself. If a fault becomes active (currently detected) at this time, a fault is logged in memory and a snapshot of engine parameters is logged. In addition, certain faults may illuminate the warning lamp (amber) or the stop lamp (red) depending upon the severity of the active fault.

b. Flash-Out of Fault Codes

Fault flash-out mode can be entered through the use of a diagnostic switch or the accelerator pedal. To enter the fault flash-out mode, the key switch must be in the RUN position with the engine not running.

When a diagnostic switch is used to enter the fault flash-out mode, the ECM will automatically flash the first fault code after the switch is turned to the RUN position.

The diagnostic increment/decrement is used to sequence forward or backwards through the active faults.

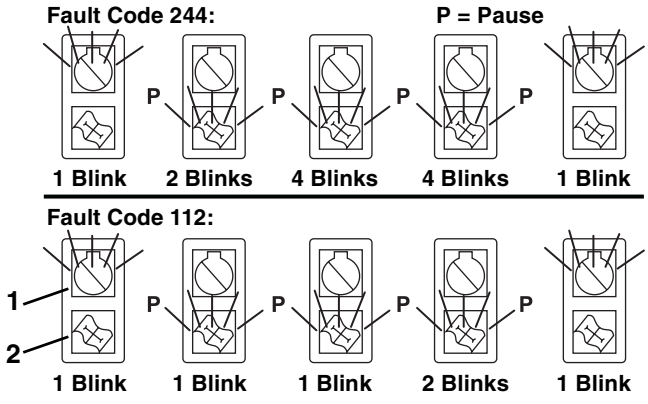
To enter fault flash-out mode using the accelerator pedal, fully depress and release the pedal 3 times. Once in diagnostic mode, cycling the accelerator pedal will sequence forward through the active faults. The following graphic depicts the pattern of the fault code flash-out scheme as indicated by the stop lamp.

Stop Lamp (1) - The stop lamp provides critical operator messages. These messages require immediate and decisive operator response. The stop lamp is also used to diagnose flash-out fault codes.

Warning Lamp (2) - The warning lamp provides important operator messages. These messages require timely operator attention. The warning lamp is also used to delineate diagnostic fault codes.

There is a laminated Wiring Diagram and Fault Code Information Chart available from your local Cummins Distributor. Call the Cummins Customer Assistance Center at 1-800-343-7357.

Example Fault Code Sequences



Offboard Diagnostics

INSITE™, is the Windows®-based PC service/ programming/diagnostic tool for 944E-42 engine. It is used to help troubleshoot and repair the engine with extended fault diagnostics and processing power. INSITE™ allows the user to view active and inactive faults and clear the inactive faults. It provides a monitor function that allows the service technician to monitor measured parameters, actuator status and some calculated values. It also provides the technician with the capability to turn on certain drivers such as the grid heaters and lift pump as well as running diagnostic tests such as single cylinder cutout.

9.7.3 Troubleshooting with a Digital Multimeter (DMM)

IMPORTANT: *Circuits which include any solid-state control modules should only be tested with a ten megohm or higher impedance digital multimeter or damage could occur to the module.*

A DMM should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present, a DMM indicates how much voltage is present.

The ohmmeter function on a DMM shows how much resistance exists between two points along a circuit. Low resistance in a circuit means good continuity.

IMPORTANT: *Disconnect the power feed from the suspect circuit when measuring resistance with a DMM; this prevents incorrect readings. DMM's apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.*

Diodes and solid-state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement, take a reading once, then reverse the leads and take a second reading. If the readings differ, the solid-state component is affecting the measurement.

The following are examples of the various methods of connecting the DMM to the circuit to be tested:

- Backprobe both ends of the connector, and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test-driving.
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.

9.7.4 Probing Electrical Connectors

a. Front Probe

Disconnect the connector and probe the terminals from the mating side (front) of the connector.

***Note: DO NOT** insert test equipment probes into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal can cause a poor connection, which can result in system failures. Always use a connector test adapter kit or a flat wire probe adapter kit (usually supplied with a DMM) when front probing terminals. **DO NOT** use paper clips or other substitutes as they can damage terminals and cause incorrect measurements.*

b. Back Probe

DO NOT disconnect the connector and probe the terminals from the harness side (back) of the connector.

- Back probe connector terminals only when specifically required in diagnostic procedures.
- **DO NOT** back probe a sealed connector or a flat wire connector.
- Back probing can be a source of damage to connector terminals. Use care in order to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large of a test probe.
- After back probing any connector, inspect for terminal damage. If terminal damage is suspected, test for proper terminal contact.

c. Measuring and Testing Voltage

Testing for Voltage Drop

This test checks for voltage being lost along a wire, or through a connection or switch.

1. Connect the positive lead of a DMM to the end of the wire (or to one side of the connection or switch) which ever is closer to the battery.
2. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
3. Operate the circuit.
4. Voltage through the wire should be displayed.

Measuring Voltage Drop

The following test determines the difference in voltage potential between two points.

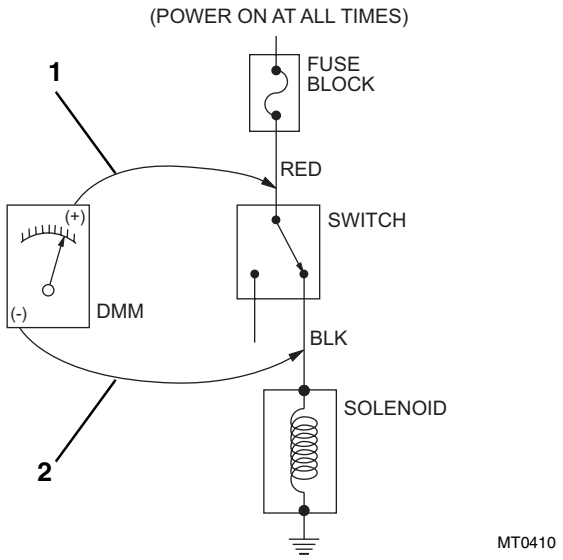


Figure 9-1 Measuring Voltage Drop

1. Set the rotary dial of the DMM to the V (DC) position.
2. Connect the (+) positive lead (**1**) of the DMM to one point of the circuit to be tested.
3. Connect the (-) negative lead (**2**) of the DMM to the other point of the circuit.
4. Operate the circuit.
5. The DMM displays the difference in voltage between the two points.

Testing for Continuity

The following procedures verify good continuity in a circuit.

With a DMM

1. Set the rotary dial of the DMM to the Ohm position.
2. Disconnect the power feed (i.e. fuse, control module) from the suspect circuit.
3. Disconnect the load.
4. Press the MIN MAX button on the DMM.
5. Connect one lead of the DMM to one end of the circuit to be tested.
6. Connect the other lead of the DMM to the other end of the circuit.
7. If the DMM displays low or no resistance and a tone is heard, the circuit has good continuity.

With a Test Lamp

IMPORTANT: *Only use the test lamp procedure on low impedance power and ground circuits.*

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.
6. If the test lamp illuminates (full intensity), then the circuit has good continuity.

Testing for Short to Ground

The following procedures test for a short to ground in a circuit.

With a DMM

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the DMM to the Ohm position.
4. Connect one lead of the DMM to one end of the circuit to be tested.
5. Connect the other lead of the DMM to a good ground.
6. If the DMM does NOT display infinite resistance (OL), there is a short to ground in the circuit.

With a Test Lamp

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.
6. If the lamp illuminates (full intensity), then the circuit has good continuity.

Testing a Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
   - When the DMM displays voltage, the short is in the wiring leading to the first connector or switch.
   - If the DMM does not display voltage, refer to the next step.
4. Close each connector or switch until the DMM or analog tester displays voltage, in order to find which circuit is shorted.

Testing for Electrical Intermittence

Perform the following procedure while wiggling the harness from side to side. If possible, continue this at 6-inch intervals while watching the test equipment.

- Testing for Short to Ground
- Testing for Continuity

Testing Relays from the Fuse Block

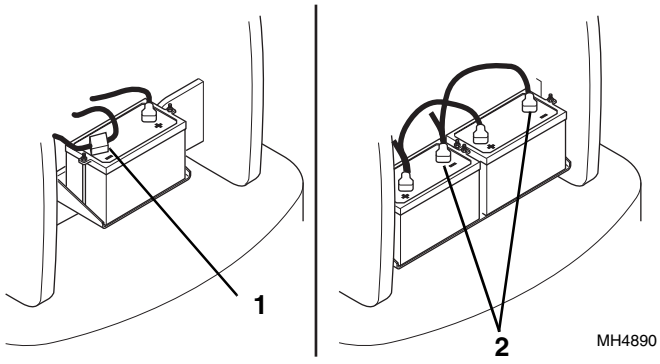
Relays are used to control a large amount of current by using a small amount of control current flowing through the relay coil.

WARNING: **DO NOT** perform service or maintenance on the vehicle with the engine running, with the exception of the transmission level check. Contact with moving parts can cause death or serious personal injury.

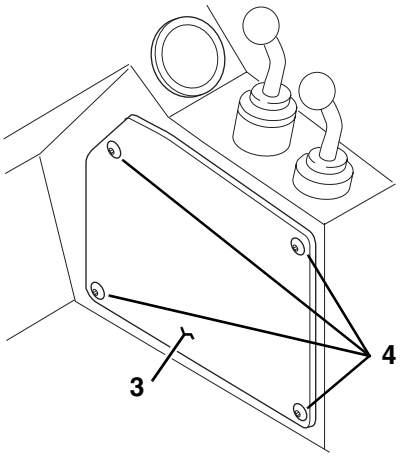
1. Be sure that the vehicle is on a level surface, the implement grounded, park brake engaged, ignition switch is in the OFF position.
2. Unlock and open the rear engine door.

3. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

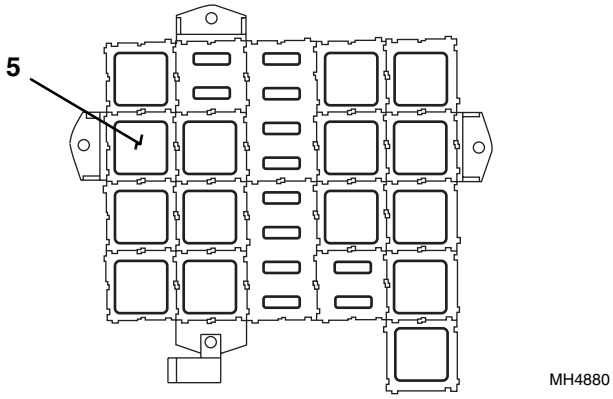
   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



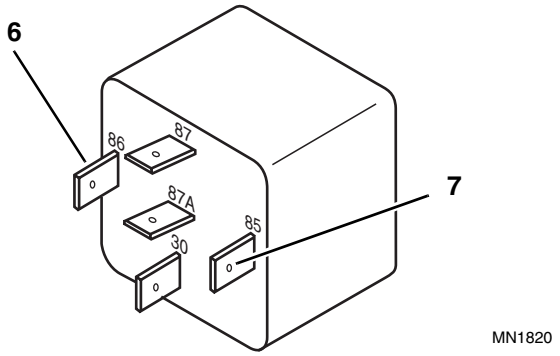
4. The fuse block relays (**5**) are located in the fuse block and is mounted behind the right side console access panel (**3**). To gain access, remove the screws (**4**) that secure the right side panel in place.

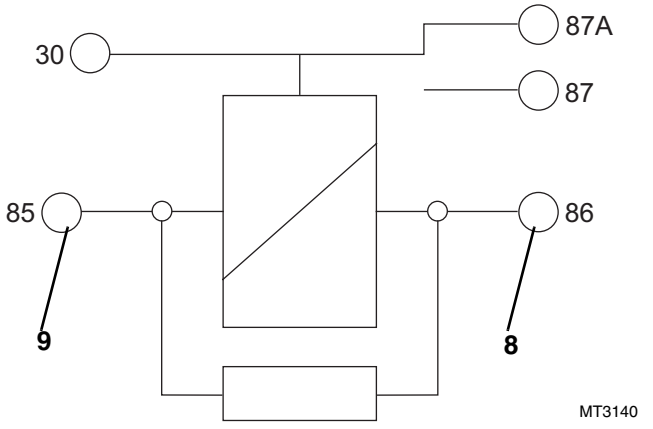


5. Remove the suspect relay (**5**) from the fuse block.



6. Apply the proper voltage to the relay coil at terminal 86 (**6** and **8**) and attach the ground (-) probe to terminal 85 (**7** and **9**), ground. An audible click should be heard indicating that the relay is functioning properly.





7. When reassembling the right side console access panel (**3**), torque the screws (**4**) to 3 - 5 lb-ft (13 - 22 Nm).
8. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).

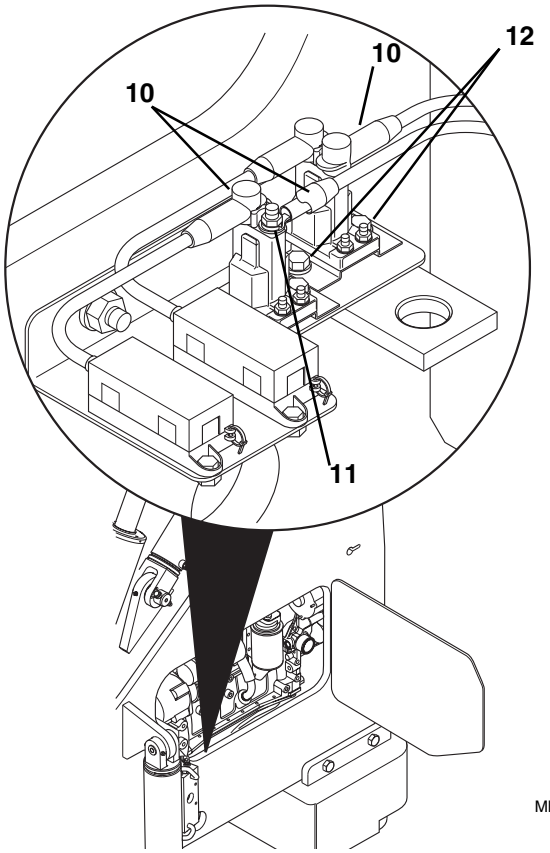
Testing Relays located in the Engine Compartment

1. Be sure the vehicle is on a level surface, the implement grounded, parking brake engaged, ignition switch is in the OFF position
2. Unlock and open the rear engine door.
3. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
4. To remove the relays from inside the engine compartment, label and remove all the wires connected to the suspect relay.

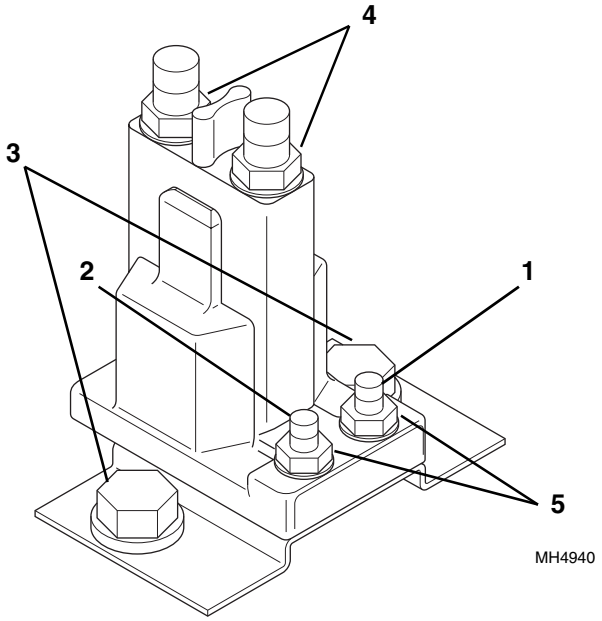
   To access the terminal nuts and washers on the grid heater relays, lift the protective cover (**10**) and slide it along the wire, away from the mounting hardware.

   Save the terminal nuts and washers (**11**) for later reassembly.
5. Remove the mounting hardware (**12**) from the mounting bracket on the relay. Remove the relay from the engine compartment.
6. Inspect the general condition of the relay casing and terminals. Replace the relay if it is cracked or damaged in any way.



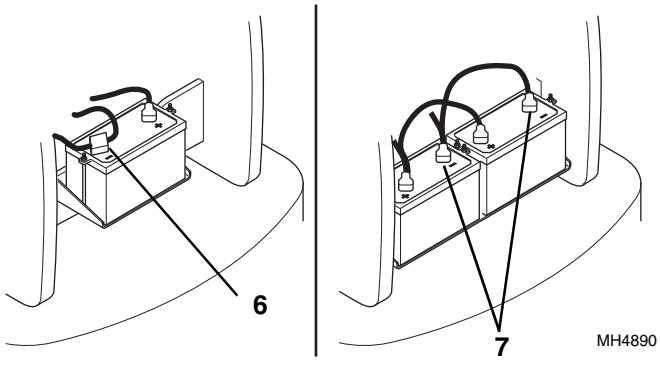
MH4910

7. To test the operation of the relays, connect a 12-volt DC positive lead to the positive terminal (**1**). Connect the negative lead to the mounting bracket or negative post (**2**), listening for a “click” sound as the contacts close. Replace the relay if the contacts do not close.



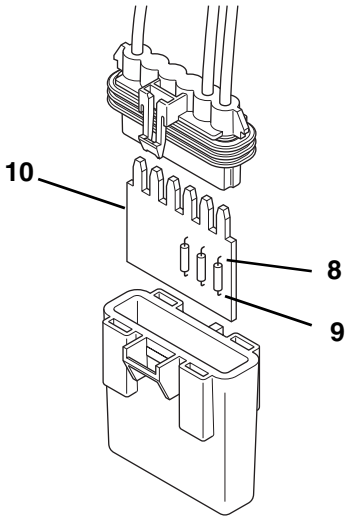
8. When reassembling the relays to the mounting bracket, torque the relay mounting hardware (**3**) to 5 - 9 lb-ft (7 - 12,5 Nm).
9. When reassembling the wires to the relay, torque the terminal nuts (**4**) to a maximum of 95 lb-in (11 Nm). Torque the other terminal nuts (**5**), to a maximum of 40 lb-in (4,5 Nm).
10. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**6**).

    If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**7**).



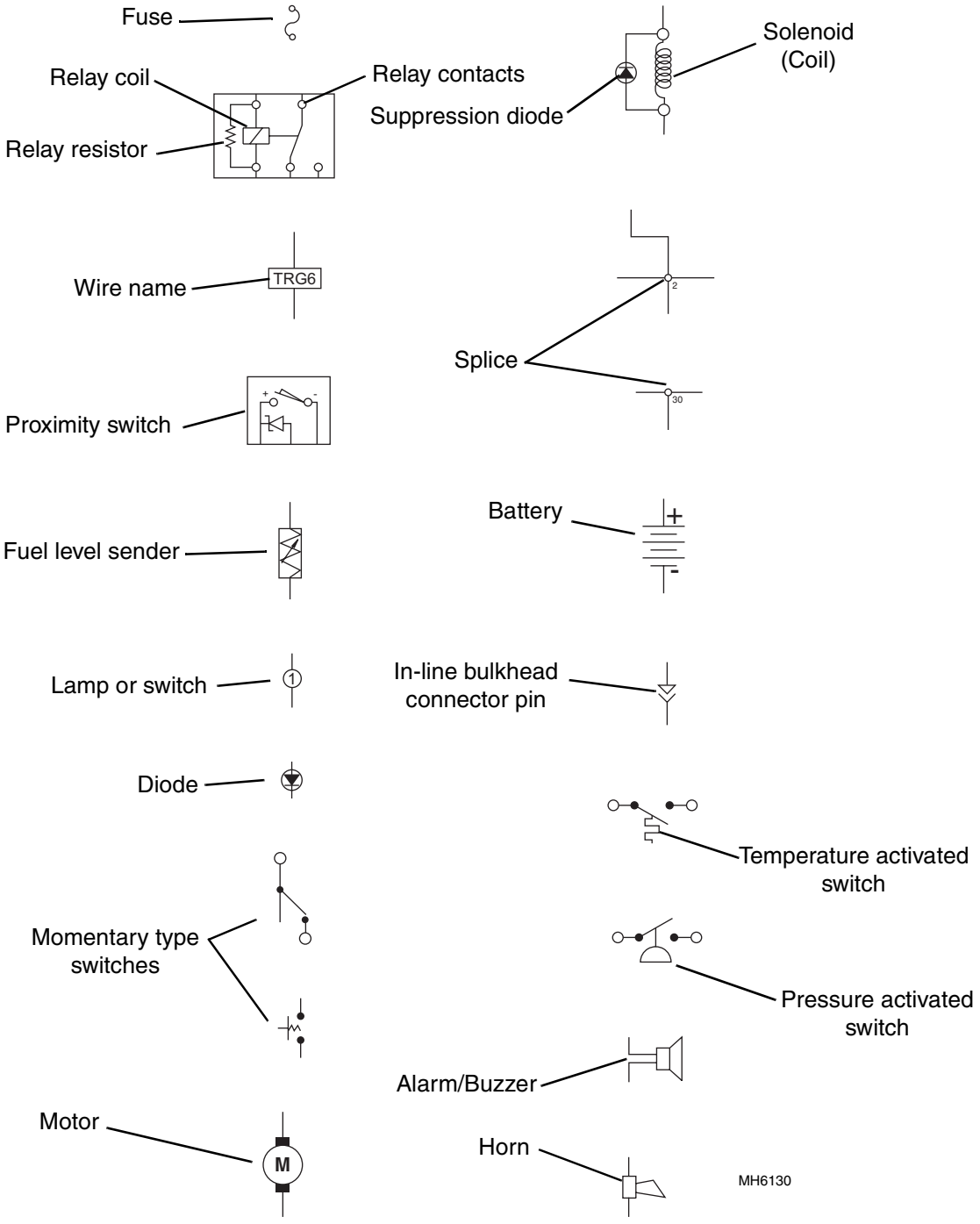
Testing Diodes

To test diodes in the electrical system, set the DMM dial on R x1 setting and connect one lead to each side (**9**) of the diode. Note the reading on the DMM. Reverse the leads and note reading. The DMM should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected to the other. If both readings are high or infinite, the diode is open. If both readings are low, the diode is shorted. Repeat test on remaining diodes. If any diodes are shorted or open, replace the diode board (**10**). Note the orientation of the board when removing it for replacement. Replace diode board in the same orientation as it was when it was removed.



9.7.5 Electrical Symbols Directory

The following directory shows the most common electrical symbols used in the electrical schematics and circuit diagrams in this section.



9.7.6 8042 Electrical Schematic Legend (SN 13198 Through 18990)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.38 or 9.40	12	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.39 or 9.41	18	BLK	Splice 20 (Ground) to Fuel Level Sender
2AA	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (4-Wheel) (–)
2BB	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (Crab) (–)
2CC	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F)
2DD	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F) (Engine Harness)
2E	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B)
2EE	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B)
2FF	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Transmission Ground
2GG	9.38 or 9.40	16	BLK	Splice 20 (Ground) to Instrument Panel Connector (Pin J5)
2H	9.39 or 9.41	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)
2HH	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.39 or 9.41	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Steer Select Switch (Pin 7)
2K	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (–)
2KK	9.38 or 9.40	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (–)
2M	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (–)
2N	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (–)
2P	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (–)
2R	9.39 or 9.41	18	BLK	Not Used
2S	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Fuel Shut-off Solenoid Connector (Pin C)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
2T	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Boom Sensor Connector (Pin C)
2W	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Alternator (GND)
2X	9.39 or 9.41	16	BLK	Splice 20 (Ground) to Back-up Alarm (–)
3	9.38	10	PUR	† Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
3A	9.38	10	PUR	† Fuse Buss Bar to Transmission Fuse to Option Connector
	9.40			§ Fuse Buss Bar to Transmission Fuse
3B	9.40	10	PUR	§ Open Fuse to Option Connector
3C	9.40	10	PUR	§ Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
5	9.39 or 9.41	10	RED	Starter (Pin 30) to Alternator (B+)
6	9.38 or 9.40	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.39 or 9.41	18	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.38 or 9.40	16	BRN	Stabilizer Fuse to Jumper Wire 157
8	9.38 or 9.40	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.39 or 9.41	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (+) (Engine Harness)
9	9.38 or 9.40	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.39 or 9.41	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (+) (Engine Harness)
10	9.38 or 9.40	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.39 or 9.41	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)
11	9.38	16	LT GRN/BLU	† Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
				† Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
11A	9.40	16	LT GRN/BLU	§ Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
11B	9.40	16	LT GRN/BLU	§ Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
12	9.38 or 9.40	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.38	12	DK BLU	† Light Switch Relay (Pin 87) to Splice 12A to Road/Worklights Connector (Option)
	9.40			§ Light Switch Relay (Pin 87) to Splice 12A
12AA	9.40	12	DK BLU	§ Splice 12A to Road/Worklights Connector (Option)
12B	9.38	12	DK BLU	† Splice 12A to Headlight Switch Relay (Pin 30)
	9.40			§ Splice 12A to Option Connector
12C	9.38	16	DK BLU	† Splice 27 to Roadlights Connector (Option) (Hazards)
	9.40			§ Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.38 or 9.40	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.39 or 9.41	18	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.38 or 9.40	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.39 or 9.41	18	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)
17	9.38 or 9.40	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.39 or 9.41	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
18	9.38 or 9.40	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.39 or 9.41	18	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.38 or 9.40	14	BLK	Splice 20 (Ground) to Cab Ground Stud (Cab Harness)
	9.38 or 9.40	12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (Pin A3) (Cab Harness)
	9.39 or 9.41	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
21C	9.38 or 9.40	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Connector (Option) (Main Beam)
22	9.38 or 9.40	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.38 or 9.40	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Connector (Option) (Main Beam) (Cab Harness)
	9.39 or 9.41	16	ORG/GRN	Not Used (Engine Harness)
24	9.38 or 9.40	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.38 or 9.40	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.39 or 9.41	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (+) (Engine Harness)
26	9.38	10	RED	† Main Fuse to Ignition Switch 3-Way Connector (Pin A)
	9.40			§ Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.38	10	RED	† Main Fuse to Ignition Switch 5-Way Connector (Pin A)
	9.40			§ Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.40	10	RED	§ Splice 26 to Main Fuse
27	9.38 or 9.40	10	RED	Main Fuse to Splice 100 (Cab Harness)
	9.39 or 9.41	10	RED	Splice 27 to Starter (Pin 30) (Engine Harness)
27A	9.38	12	RED	† Optional Lights Fuse to Splice 27 to Light Switch Relay (Pin 30)
	9.40			§ Optional Lights Fuse (Lights 1) to Headlight Switch Relay (Pin 30)
27B	9.38	12	RED	† Optional Lights Fuse to Main Fuse
	9.40			§ Optional Lights Fuse (Lights 1) to Splice 100
27C	9.38 or 9.40	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.39 or 9.41	12	RED	Cab/Chassis Female Connector (Pin A4) to Splice 27 (Engine Harness)
27D	9.38 or 9.40	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.39 or 9.41	12	RED	Cab/Chassis Female Connector (Pin B5) to Splice 27 (Engine Harness)
27F	9.40	12	RED	§ Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.38 or 9.40	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.39 or 9.41	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.39 or 9.41	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (+)
28B	9.39 or 9.41	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (+)
29	9.40	12	RED	§ Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
31	9.38 or 9.40	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.39 or 9.41	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)
32	9.38 or 9.40	14	GRY/WHT	Option Fuse to Wiper/Washer Connector (Option)
34	9.38 or 9.40	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.39 or 9.41	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to Fuel Shut-off Solenoid Connector (Pin A) (Engine Harness)
35	9.38 or 9.40	16	BRN/WHT	Jumper Wire 157 to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.39 or 9.41	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.38 or 9.40	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.39 or 9.41	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.38 or 9.40	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.38 or 9.40	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.39 or 9.41	16	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (+) (Engine Harness)
40A	9.38 or 9.40	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.38 or 9.40	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)
41	9.38	16	DK BLU/WHT	† Park Brake Switch Connector (Pin 1) to Splice 41 to Male Connector (Cab Harness)
				Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.39 or 9.41		BLU/WHT	Cab/Chassis Male Connector (Pin A2) to Splice 41 (Engine Harness)
41A	9.40	16	DK BLU/WHT	§ Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.39 or 9.41		BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A) (Engine Harness)
41B	9.40	16	DK BLU/WHT	§ Park Brake Switch Connector (Pin 1) to Splice 41 (Cab Harness)
	9.39 or 9.41		BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A) (Engine Harness)
41C	9.40	16	DK BLU/WHT	§ Splice 41 to Male Connector
42	9.38	18	TAN	† Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
				Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
42A	9.40	18	TAN	§ Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.40	18	TAN	§ Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.38 or 9.40	16	DK BLU/ORG	Splice 45 to Splice 114
45A	9.38	16	DK BLU/ORG	† Splice 45 to Inline Diode to Splice 152
45A2	9.40	16	DK BLU/ORG	§ Splice 45 to Inline Diode to Splice 152B
45B	9.38 or 9.40	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.38 or 9.40	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)
47	9.38 or 9.40	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.39 or 9.41	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
47A	9.39 or 9.41	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (+)
47B	9.39 or 9.41	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (+)
48	9.38 or 9.40	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.39 or 9.41	16	RED/BLU	Not Used
50	9.38 or 9.40	16	WHT/YEL	Option Fuse to Option Connector
51	9.38 or 9.40	16	WHT/RED	Option Fuse to Option Connector
52	9.38 or 9.40	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
101	9.38 or 9.40	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.39 or 9.41	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.39 or 9.41	16	BRN	Splice 101 to Diode VESPAK (Pin B)
101B	9.39 or 9.41	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.38 or 9.40	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.39 or 9.41	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.38 or 9.40	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.39 or 9.41	16	PNK	Splice 102 to Diode VESPAK (Pin E) (Engine Harness)
102B	9.38 or 9.40	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.39 or 9.41	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)
103	9.38 or 9.40	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.39 or 9.41	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.39 or 9.41	16	BLU	Splice 103 to Diode VESPAK (Pin A)
103B	9.39 or 9.41	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)
104	9.38 or 9.40	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.39 or 9.41	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.39 or 9.41	16	YEL	Splice 104 to Diode VESPAK (Pin E)
104B	9.39 or 9.41	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)
105	9.38 or 9.40	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.39 or 9.41	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.39 or 9.41	16	GRN	Splice 105 to Diode VESPAK (Pin B)

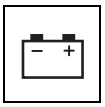
† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
105B	9.39 or 9.41	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)
106	9.38 or 9.40	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.39 or 9.41	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter (Pin 50) (Engine Harness)
107	9.38	18	BLU	† Splice 41 to Female Connector
				† Male Connector to Park Brake Disconnect Relay (Pin 86)
107A	9.40	18	BLU	§ Splice 41 to Female Connector
107B	9.40	18	BLU	§ Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.38 or 9.40	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.38 or 9.40	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.38 or 9.40	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.38 or 9.40	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.38 or 9.40	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.38 or 9.40	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.38 or 9.40	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.38 or 9.40	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.38 or 9.40	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.38 or 9.40	16	VIO	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.39 or 9.41	16	VIO	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.39 or 9.41	16	VIO	Splice 150 to Diode VESPAK (Pin A)
150B	9.39 or 9.41	18	VIO	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)
151	9.38 or 9.40	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.39 or 9.41	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152	9.38	16	BLK/WHT	† Park Brake Switch Connector (Pin 3) to Splice 152 to Male (Cab Harness)
				† Female Connector to Inline Diode to Instrument Panel Connector (Pin J7) (Cab Harness)
	9.39 or 9.41	10	RED	Starter (Pin M) to Fuel Shut-off Solenoid Connector (Pin B) (Engine Harness)
152A	9.38	16	BLK/WHT	† Not Used
152A1	9.40	16	BLK/WHT	§ Female Connector to Inline Diode to Splice 152A
152A2	9.40	16	BLK/WHT	§ Not Used
152A3	9.40	16	BLK/WHT	§ Splice 152A to Instrument Panel Connector (Pin J7)
152B1	9.40	16	BLK/WHT	§ Male Connector to Splice 152B
152B2	9.40	16	BLK/WHT	§ Splice 152B to Park Brake Switch Connector (Pin 3)
153	9.38 or 9.40	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.38 or 9.40	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.38 or 9.40	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990

Wire No.	Page	Gauge	Color	From - Function - To
155	9.38 or 9.40	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.38 or 9.40	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
157	9.38 or 9.40	16	BRN	Jumper Wire (Wire 7 to Wire 35)
158	9.38 or 9.40	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5) (Cab Harness)
	9.39 or 9.41	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (–) (Engine Harness)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990



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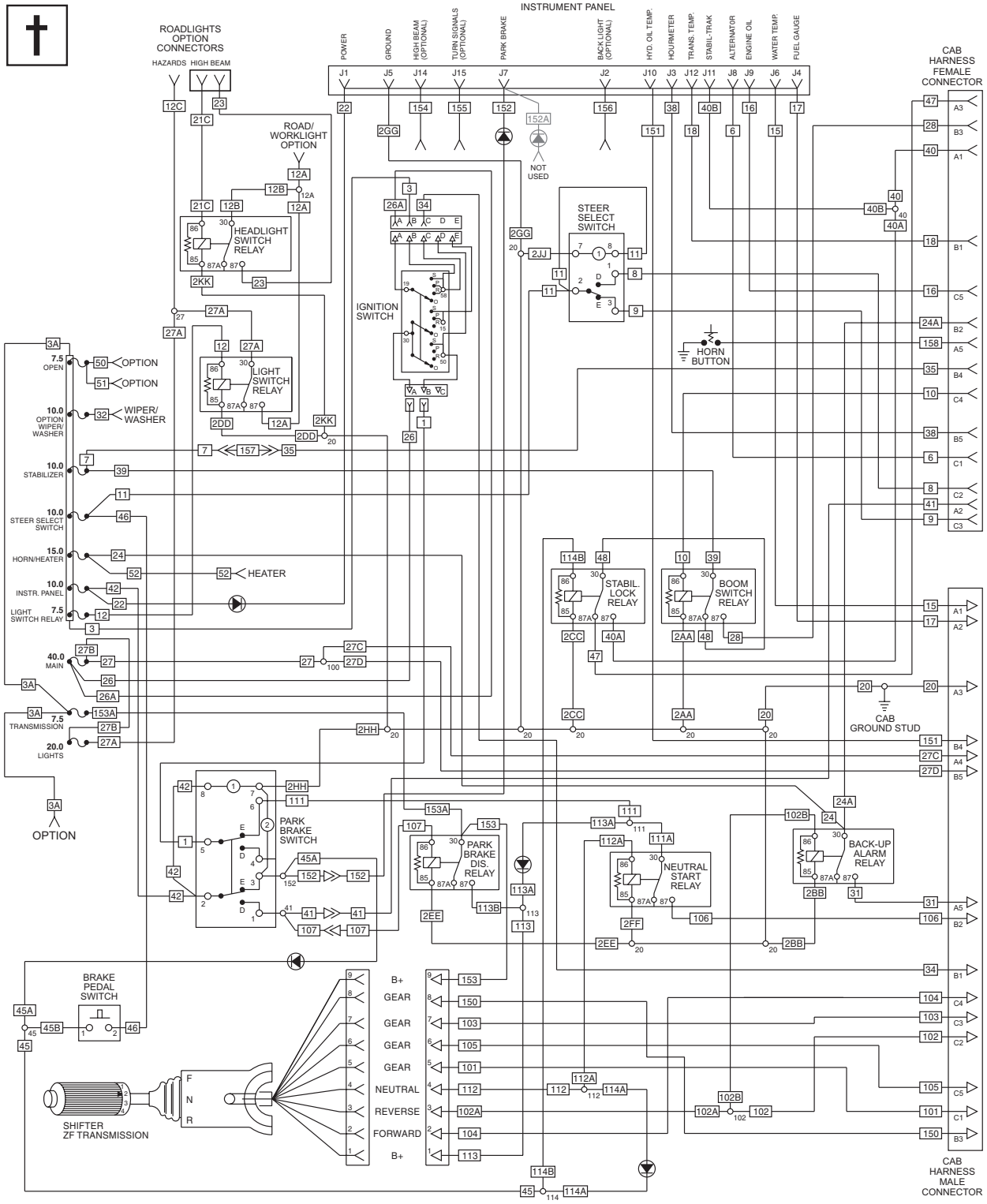
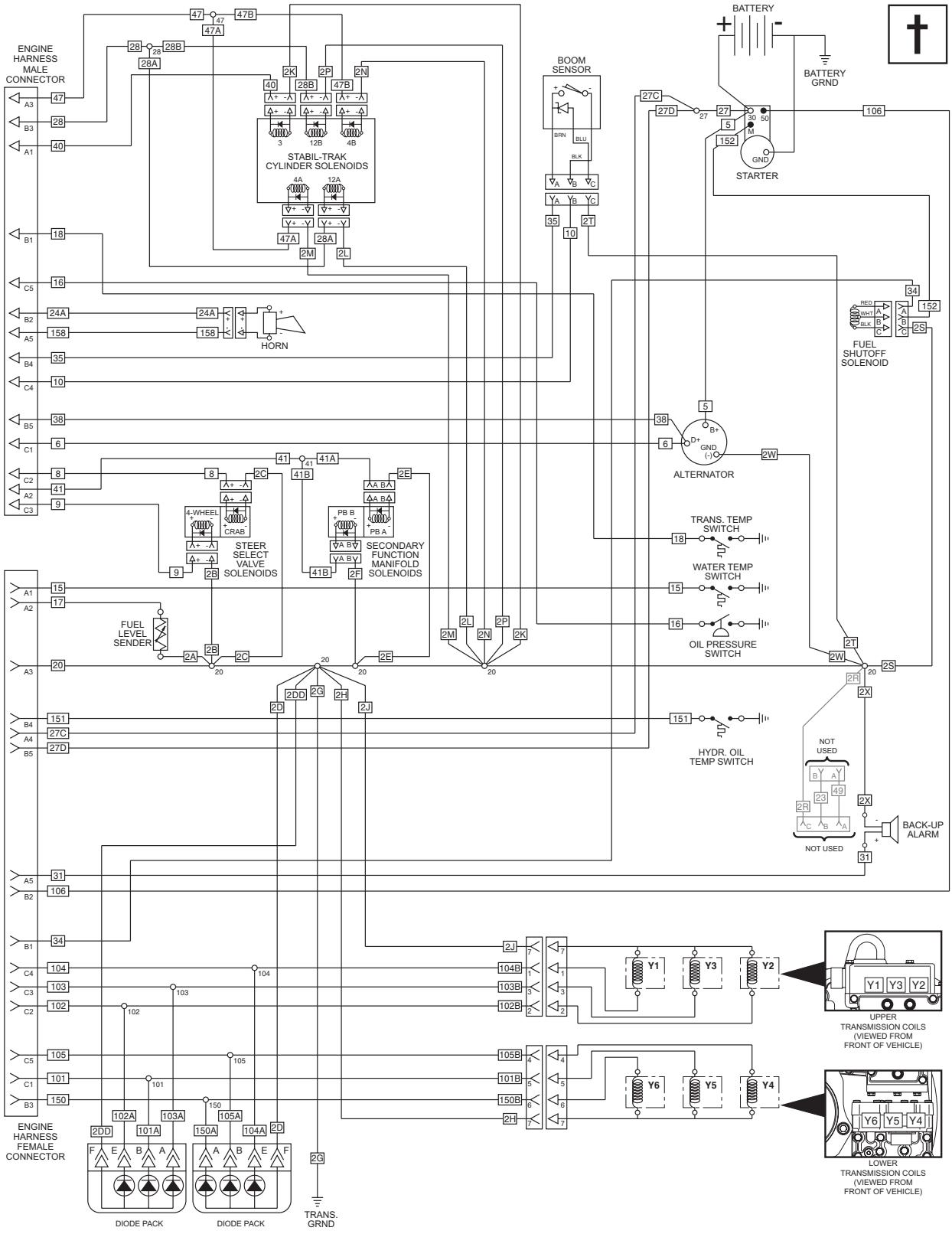
9.7.7 8042 Electrical Schematic (SN 13198 Through 16782, Without Lighting Package)

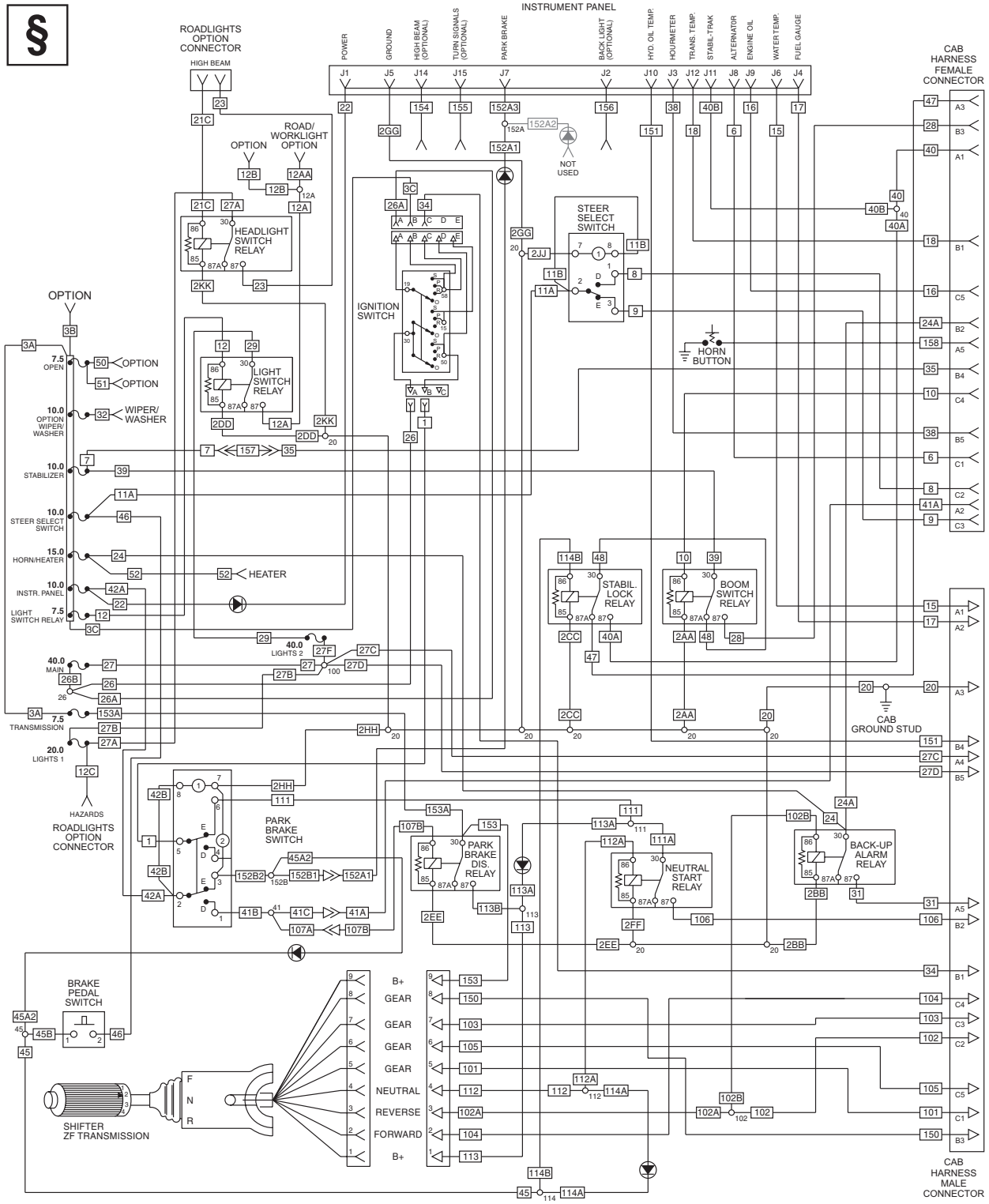


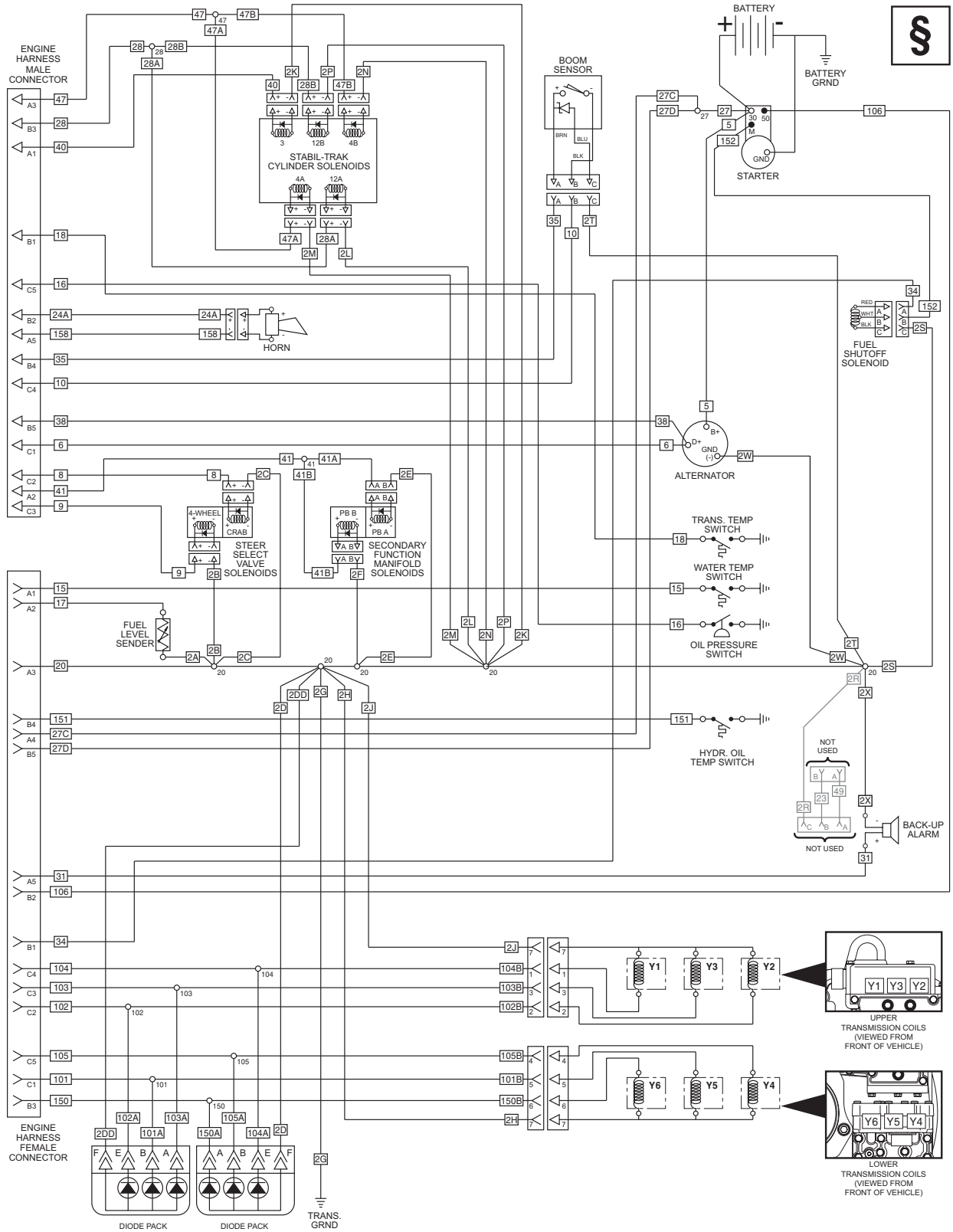
MH42401


BATTERY
BATTERY GRND
ENGINE HARNESS MALE CONNECTOR
BOOM SENSOR
STABIL-TRAK CYLINDER SOLENOIDS
STARTER
HORN
FUEL SHUTOFF SOLENOID
ALTERNATOR
TRANS. TEMP SWITCH
WATER TEMP SWITCH
OIL PRESSURE SWITCH
HYDR. OIL TEMP SWITCH
STEER SELECT VALVE SOLENOIDS
SECONDARY FUNCTION MANIFOLD SOLENOIDS
FUEL LEVEL SENDER
NOT USED
BACK-UP ALARM
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
ENGINE HARNESS FEMALE CONNECTOR
DIODE PACK
DIODE PACK
TRANS. GRND

MH42402

9.7.8 8042 Electrical Schematic (SN 13198 Through 16782, With Lighting Package and SN 16783 Through 18990)




BATTERY
BATTERY GRND
§
ENGINE HARNESS MALE CONNECTOR
BOOM SENSOR
STABIL-TRAK CYLINDER SOLENOIDS
STARTER
HORN
FUEL SHUTOFF SOLENOID
ALTERNATOR
TRANS. TEMP SWITCH
WATER TEMP SWITCH
OIL PRESSURE SWITCH
HYDR. OIL TEMP SWITCH
STEER SELECT VALVE SOLENOIDS
SECONDARY FUNCTION MANIFOLD SOLENOIDS
FUEL LEVEL SENDER
NOT USED
BACK-UP ALARM
ENGINE HARNESS FEMALE CONNECTOR
DIODE PACK
DIODE PACK
TRANS. GRND
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)

MA78622

9.7.9 8042 Cab Harness, Engine Harness & ECM Cab Harness Electrical Schematic Legend (SN 18991 - 19987 And 0160002332 & After)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.50	10	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.51	16	BLK	Splice 20 (Ground) to Fuel Level Sender
2AA	9.50	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.51	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (4-Wheel) (Pin B)
2BB	9.50	18	BLK	Splice 20A (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.51	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (Crab) (Pin B)
2CC	9.50	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.51	16	BLK	Splice 20 (Ground) to Diode VESPAK VP2 (Pin F) (Engine Harness)
2DD	9.50	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.51	16	BLK	Splice 20 (Ground) to Diode VESPAK VP1 (Pin F) (Engine Harness)
2E	9.51	18	BLK	Splice 20A (Ground) to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B)
2EE	9.50	18	BLK	Splice 20A (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.51	18	BLK	Splice 20A (Ground) to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B)
2FF	9.50	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.51	16	BLK	Splice 20 (Ground) to Transmission Ground (Engine Harness)
2GG	9.50	16	BLK	Splice 20A (Ground) to Instrument Panel Connector (Pin J5)
2H	9.51	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)
2HH	9.50	18	BLK	Splice 20A (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.51	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.50	18	BLK	Splice 20A (Ground) to Steer Select Switch (Pin 7)
2K	9.51	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (Pin B)
2KK	9.50	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.51	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (Pin B)
2LL	9.50	12	BLK	Splice 20 (Ground) to Cab Ground Stud
2M	9.51	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (Pin B)
2MM	9.50	12	BLK	Splice 20A (Ground) to Cab Ground Stud
2N	9.51	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (Pin B)
2P	9.51	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (Pin B)
2R	9.51	16	BLK	Not Used
2T	9.51	16	BLK	Splice 20B (Ground) to Boom Sensor Connector (Pin C)
2X	9.51	16	BLK	Splice 20B (Ground) to Back-up Alarm (–)
3A	9.50	10	PUR	Fuse Buss Bar to Transmission Fuse
3B	9.50	10	PUR	Open Fuse to Female Option Connector
3C	9.50	10	PUR	Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
6	9.50	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.51 & 9.52	16	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.50	16	BRN	Stabilizer Fuse to Female Connector
8	9.50	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.51	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (A) (Engine Harness)
9	9.50	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.51	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (A) (Engine Harness)
10	9.50	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.51	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)

These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.

Wire No.	Page	Gauge	Color	From - Function - To
11A	9.50	16	LT GRN/BLU	Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
11B	9.50	16	LT GRN/BLU	Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
12	9.50	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.50	12	DK BLU	Light Switch Relay (Pin 87) to Splice 12A
12AA	9.50	12	DK BLU	Splice 12A to Road/Worklights Connector (Option)
12B	9.50	12	DK BLU	Splice 12A to Female Option Connector
12C	9.50	16	DK BLU	Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.50	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.51	16	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.50	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.51	16	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)
17	9.50	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.51	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)
18	9.50	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.51	16	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.50	12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (Pin A3) (Cab Harness)
	9.51	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
20A	9.50	12	BLK	Splice 20A (Ground) to Cab/Chassis Female Connector (Pin A4) (Cab Harness)
	9.51	12	BLK	Cab/Chassis Male Connector (Pin A4) to Splice 20A (Ground) (Engine Harness)
20B	9.51	12	BLK	Splice 20A (Ground) to 20B (Ground)
20C	9.51	12	BLK	Splice 20B (Ground) to Engine Ground Buss Bar
20D	9.51	12	BLK	Splice 20 (Ground) to 20D (Ground)
20E	9.51	12	BLK	Splice 20D (Ground) to Engine Ground Buss Bar
21C	9.50	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Female Connector (Option) (Main Beam)
22	9.50	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.50	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Female Connector (Option) (Main Beam) (Cab Harness)
	9.51	16	ORG/GRN	Not Used (Engine Harness)
24	9.50	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.50	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.51	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (B) (Engine Harness)
26	9.50	10	RED	Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.50	10	RED	Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.50	10	RED	Splice 26 to Main Fuse
27	9.50	10	RED	Main Fuse to Splice 100
27A	9.50	12	RED	Optional Lights Fuse (Lights 1) to Headlight Switch Relay (Pin 30)
27B	9.50	12	RED	Optional Lights Fuse (Lights 1) to Splice 100
27C	9.50	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.51	12	RED	Cab/Chassis Female Connector (Pin A4) to 12V Buss Bar (Engine Harness)
27D	9.50	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.51	12	RED	Cab/Chassis Female Connector (Pin B5) to 12V Buss Bar (Engine Harness)
27F	9.50	12	RED	Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.50	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.51	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.51	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (A)
28B	9.51	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (A)
29	9.50	12	RED	Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
31	9.50	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.51	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)
32	9.50	14	GRY/WHT	Option Fuse to Wiper/Washer Female Connector (Option)
34	9.50	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.51	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to 7.5 amp Mini Fuse VESPAK Connector P9 (Pin E) (Engine Harness)
34A	9.51 & 9.52	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P9 (Pin F) to Engine Control Module Connector P1 (Pin A)
35	9.50	16	BRN/WHT	Female Connector to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.51	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.50	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.51 & 9.52	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.50	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.50	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.51	18	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (A) (Engine Harness)
40A	9.50	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.50	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)
41	9.51	16	BLU/WHT	Cab/Chassis Male Connector (Pin A2) to Splice 41
41A	9.50	16	DK BLU/WHT	Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.51	18	BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A) (Engine Harness)
41B	9.50	16	DK BLU/WHT	Park Brake Switch Connector (Pin 1) to Male Connector (Cab Harness)
	9.51	18	BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A) (Engine Harness)
42A	9.50	18	TAN	Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.50	18	TAN	Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.50	16	DK BLU/ORG	Splice 45 to Splice 114
45A2	9.50	16	DK BLU/ORG	Splice 45 to Inline Diode to Park Brake Switch Connector (Pin 3)
45B	9.50	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.50	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)
47	9.50	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.51	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)
47A	9.51	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (A)
47B	9.51	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (A)
48	9.50	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.51	16	RED/BLU	Not Used
50	9.50	16	WHT/YEL	Option Fuse to Female Option Connector
51	9.50	16	WHT/RED	Option Fuse to Female Option Connector
52	9.50	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
101	9.50	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.51	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.51	16	BRN	Splice 101 to Diode VESPAK VP1 (Pin B)
101B	9.51	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.50	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.51	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.50	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.51	16	PNK	Splice 102 to Diode VESPAK VP1 (Pin C) (Engine Harness)
102B	9.50	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.51	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
103	9.50	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.51	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.51	16	BLU	Splice 103 to Diode VESPAK VP1 (Pin A)
103B	9.51	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)
104	9.50	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.51	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.51	16	YEL	Splice 104 to Diode VESPAK VP2 (Pin C)
104B	9.51	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)
105	9.50	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.51	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.51	16	GRN	Splice 105 to Diode VESPAK VP2 (Pin B)
105B	9.51	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)
106	9.50	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.51 & 9.52	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter Solenoid (Engine Harness)
107A	9.50	18	BLU	Park Brake Switch Connector (Pin 1) to Female Connector
107B	9.50	18	BLU	Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.50	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.50	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.50	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.50	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.50	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.50	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.50	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.50	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.50	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.50	16	PUR	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.51	16	PUR	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.51	16	PUR	Splice 150 to Diode VESPAK VP2 (Pin A)
150B	9.51	18	PUR	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)
151	9.50	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.51	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152A1	9.50	16	BLK/WHT	Female Connector to Inline Diode to Splice 152A
152A2	9.50	16	BLK/WHT	Not Used
152A3	9.50	16	BLK/WHT	Splice 152A to Instrument Panel Connector (Pin J7)
152B	9.50	16	BLK/WHT	Park Brake Switch Connector (Pin 3) to Male Connector
153	9.50	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.50	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.50	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)
155	9.50	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.50	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
157	9.50	16	BRN	Jumper Wire (Wire 7 to Wire 35)
158	9.50	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5)
	9.51	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (Pin A) (Engine Harness)
⬢ A	9.52	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
AB1	9.52	10	RED	Alternator (Pin B+) to 12V Buss Bar
AB2	9.52	10	RED	Alternator (Pin B+) to 12V Buss Bar
AG1	9.52	10	BLK	Alternator (Pin GND) to Ground Buss Bar
AG2	9.52	10	BLK	Alternator (Pin GND) to Ground Buss Bar
⬢ B	9.52	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
BN	9.52	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Male Diagnostic Connector, P7 (Pin A)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
BNE	9.52	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin E)
BNF	9.52	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin F)
BNH	9.52	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin H)
BNP	9.52	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin P)
BNW	9.52	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin W)
BP	9.52	16	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin F) to Engine Control Module, Male Diagnostic Connector, P7 (Pin B)
BP1	9.52	16	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin E)
BPB	9.52	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin B)
BPB1	9.52	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin A)
BPC	9.52	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin C)
BPC1	9.52	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin C)
BPD	9.52	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin F) to Engine Control Module, Female Engine Connector, P1 (Pin D)
BPD1	9.52	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin E)
BPM	9.52	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin M)
BPM1	9.52	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin A)
BPS	9.52	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin S)
BPS1	9.52	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin C)
⬢C	9.52	6	RED	125 Amp Fuse to Grid Heater Relay 2 (Pin 2)
CG1	9.52	16	BLK	Preheat Indicator Light, Female Connector, P15 (Pin 1B-) to Cab Ground Stud
CNH	9.52	18	YEL	Splice 1 to Engine, Female Connector, P3 (Pin A)
CNH1	9.52	18	YEL	Splice 1 to Resistor, Female Connector, P4 (Pin A)
CNH2	9.52	18	YEL	Splice 4 to Engine Control Module, Male Diagnostic Connector, P7 (Pin C)
CNH3	9.52	18	YEL	Splice 4 to Resistor, Female Connector, P8 (Pin A)
CNH4	9.52	18	YEL	Splice 1 to Splice 4
CNL	9.52	18	GRN	Splice 2 to Engine, Female Connector, P3 (Pin B)
CNL1	9.52	18	GRN	Splice 2 to Resistor, Female Connector, P4 (Pin B)
CNL2	9.52	18	GRN	Splice 5 to Engine Control Module, Male Diagnostic Connector, P7 (Pin D)
CNL3	9.52	18	GRN	Splice 5 to Resistor, Female Connector, P8 (Pin B)
CNL4	9.52	18	GRN	Splice 2 to Splice 5
CNS	9.52	18	DRAIN	Splice 3 to Engine, Female Connector, P3 (Pin C)
CNS1	9.52	18	DRAIN	Splice 3 to Resistor, Female Connector, P4 (Pin C)
CNS2	9.52	18	DRAIN	Splice 6 to Engine Control Module, Male Diagnostic Connector, P7 (Pin E)
CNS3	9.52	18	DRAIN	Splice 6 to Resistor, Female Connector, P8 (Pin C)
CNS4	9.52	18	DRAIN	Splice 3 to Splice 6
CNS5	9.52	18	BLK	Splice 3 to Engine Block
⬢D	9.52	6	RED	125 Amp Fuse to Grid Heater Relay 1 (Pin 2)
DD	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin N) to Engine Control Module, Female Engine Connector, P2 (Pin 36)
DI	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin M) to Engine Control Module, Female Engine Connector, P2 (Pin 35)
DLP	9.52	16	WHT/RED	Splice 6 to Male Connector
DLP1	9.52	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 1A+) to Splice 6
DLP2	9.52	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 2A+) to Splice 6
DLP3	9.52	16	WHT/RED	Splice 6 to Female Connector
DS	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin L) to Engine Control Module, Female Engine Connector, P2 (Pin 37)
⬢E	9.52	6	RED	Grid Heater Relay 1 (Pin 1) to Engine Grid Heater (Pin 1)

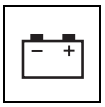
⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
⬢F	9.52	6	RED	Grid Heater Relay 2 (Pin 1) to Engine Grid Heater (Pin 2)
⬢G	9.52	1/0	RED	Battery 1, Positive (+) Terminal to Starter 12V Buss Bar
GH1	9.52	18	BLK	Splice 8 to Engine Control Module, Female Engine Connector, P2 (Pin 41)
GH1A	9.52	16	BLK	Splice 8 to Diode VESPAK Connector P10 (Pin A)
GH1B	9.52	16	BLK	Splice 8 to Grid Heater Relay 1 (Pin 3)
GH2	9.52	18	BLK	Splice 9 to Engine Control Module, Female Engine Connector, P2 (Pin 31)
GH2A	9.52	16	BLK	Splice 9 to Diode VESPAK Connector P10 (Pin B)
GH2B	9.52	16	BLK	Splice 9 to Grid Heater Relay 2 (Pin 3)
GH3	9.52	16	BLK	Grid Heater Relay 1 (Pin 1) to Diode VESPAK Connector P11 (Pin A)
GH4	9.52	16	BLK	Grid Heater Relay 2 (Pin 1) to Diode VESPAK Connector P11 (Pin F)
GHG	9.52	16	BLK	Splice 7 to Diode VESPAK Connector P10 (Pin F)
GHG1	9.52	16	BLK	Splice 7 to Grid Heater Relay 1 (Pin 4)
GHG2	9.52	16	BLK	Splice 7 to Grid Heater Relay 2 (Pin 4)
GHG3	9.52	16	BLK	Battery 2, Negative (-) Terminal to Splice 7
⬢H	9.52	1/0	RED	Battery 1, Positive (+) Terminal to Battery 2, Positive (+) Terminal
⬢J	9.52	1	BLK	Battery 2, Negative (-) Terminal to Frame Ground
J87H	9.52	18	RED	Engine Control Module, Female Engine Connector, P2 (Pin 49) to Engine Control Module, Male Diagnostic Connector, P7 (Pin F)
J87L	9.52	18	BLK	Engine Control Module, Female Engine Connector, P2 (Pin 50) to Engine Control Module, Male Diagnostic Connector, P7 (Pin G)
⬢K	9.52	1/0	BLK	Battery 1, Negative (-) Terminal to Battery 2, Negative (-) Terminal
⬢L	9.52	1/0	BLK	Battery 1, Negative (-) Terminal to Starter Ground Stud
ML	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin F) to Engine Control Module, Female Engine Connector, P2 (Pin 4)
OFF1	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin H) to Engine Control Module, Female Engine Connector, P2 (Pin 25) (Engine Harness)
	9.52	18	ORG	Engine Control Module Bulkhead, Male Connector (Pin H) to Idle Validation Switch, Male Connector, P16 (Pin C) (ECM Cab Harness)
ON1	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin J) to Engine Control Module, Female Engine Connector, P2 (Pin 26) (Engine Harness)
	9.52	18	VIO	Engine Control Module Bulkhead, Male Connector (Pin J) to Idle Validation Switch, Male Connector, P16 (Pin B) (ECM Cab Harness)
PH1	9.52	18	BLU	Engine Control Module Bulkhead, Male Connector (Pin P) to Preheat Indicator Light, Female Connector, P19 (Pin 1A+)
PH1A	9.52	16	PNK/BLU	Engine Control Module Bulkhead, Female Connector (Pin P) to Diode VESPAK Connector P11 (Pin B)
RTS	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin O) to Engine Control Module, Female Engine Connector, P2 (Pin 45)
SL	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin D) to Engine Control Module, Female Engine Connector, P2 (Pin 1)
SL1	9.52	18	GRN	Engine Control Module Bulkhead, Male Connector (Pin D) to Engine Function Indicator Light, Female Connector, P15 (Pin 1B-)
SWR	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin K) to Engine Control Module, Female Engine Connector, P2 (Pin 20) (Engine Harness)
	9.52	18	YEL	Engine Control Module Bulkhead, Male Connector (Pin K) to Idle Validation Switch, Male Connector, P16 (Pin A) (ECM Cab Harness)
THG	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin A) to Engine Control Module, Female Engine Connector, P2 (Pin 19)
THG1	9.52	18	BLK	Engine Control Module Bulkhead, Male Connector (Pin A) to Throttle Sensor, Female Connector, P14 (Pin A)
THP	9.52	18	RED	Engine Control Module Bulkhead, Female Connector (Pin B) to Engine Control Module, Female Engine Connector, P2 (Pin 29)
THP1	9.52	18	RED	Engine Control Module Bulkhead, Male Connector (Pin B) to Throttle Sensor, Female Connector, P14 (Pin C)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
THS	9.52	18	WHT	Engine Control Module Bulkhead, Female Connector (Pin C) to Engine Control Module, Female Engine Connector, P2 (Pin 30)
THS1	9.52	18	WHT	Engine Control Module Bulkhead, Male Connector (Pin C) to Throttle Sensor, Female Connector, P14 (Pin B)
WL	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin E) to Engine Control Module, Female Engine Connector, P2 (Pin 3)
WL1	9.52	18	BRN	Engine Control Module Bulkhead, Male Connector (Pin E) to Engine Function Indicator Light, Female Connector, P15 (Pin 2B-)
WSL	9.52	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin G) to Engine Control Module, Female Engine Connector, P2 (Pin 11)

These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.



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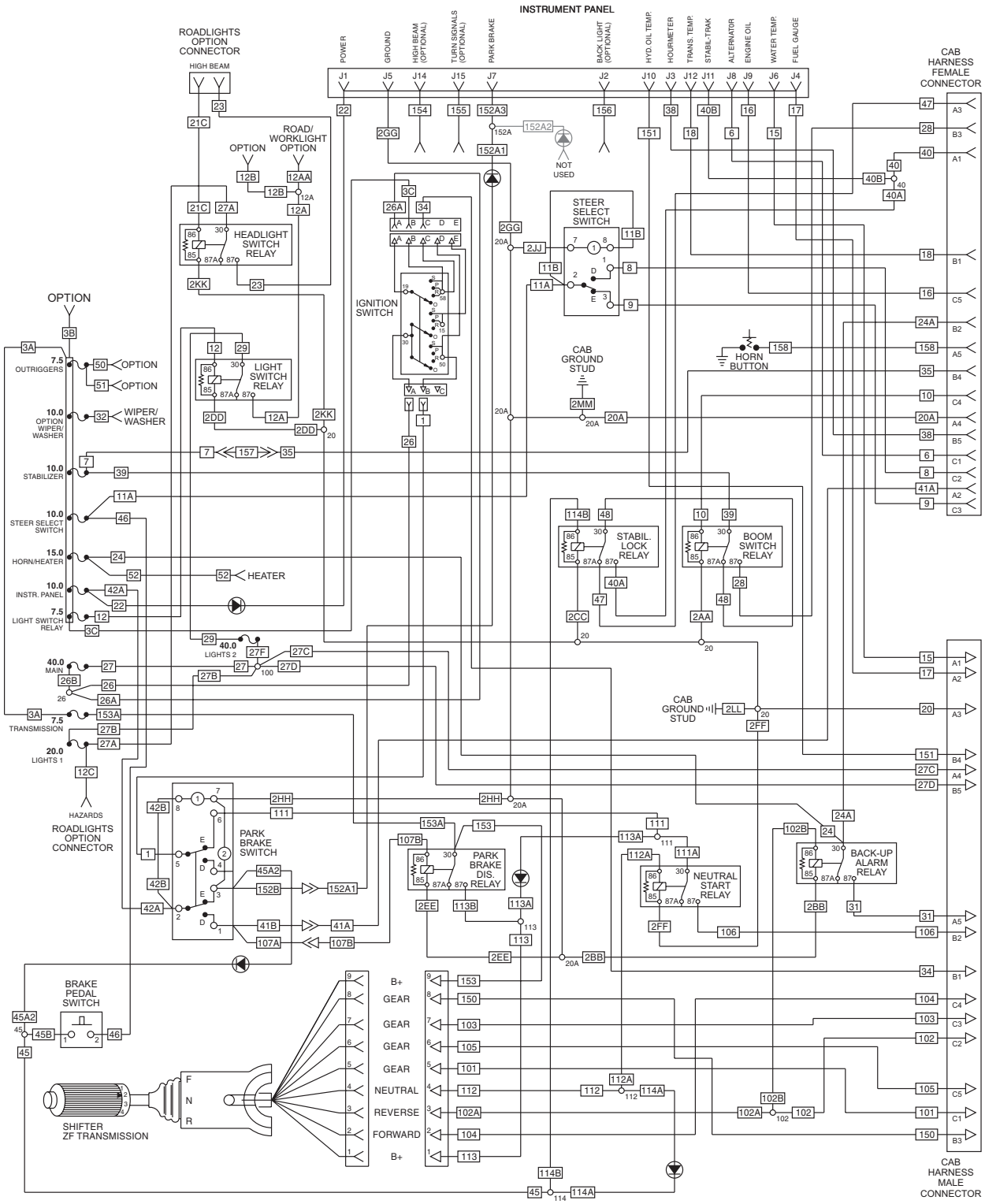
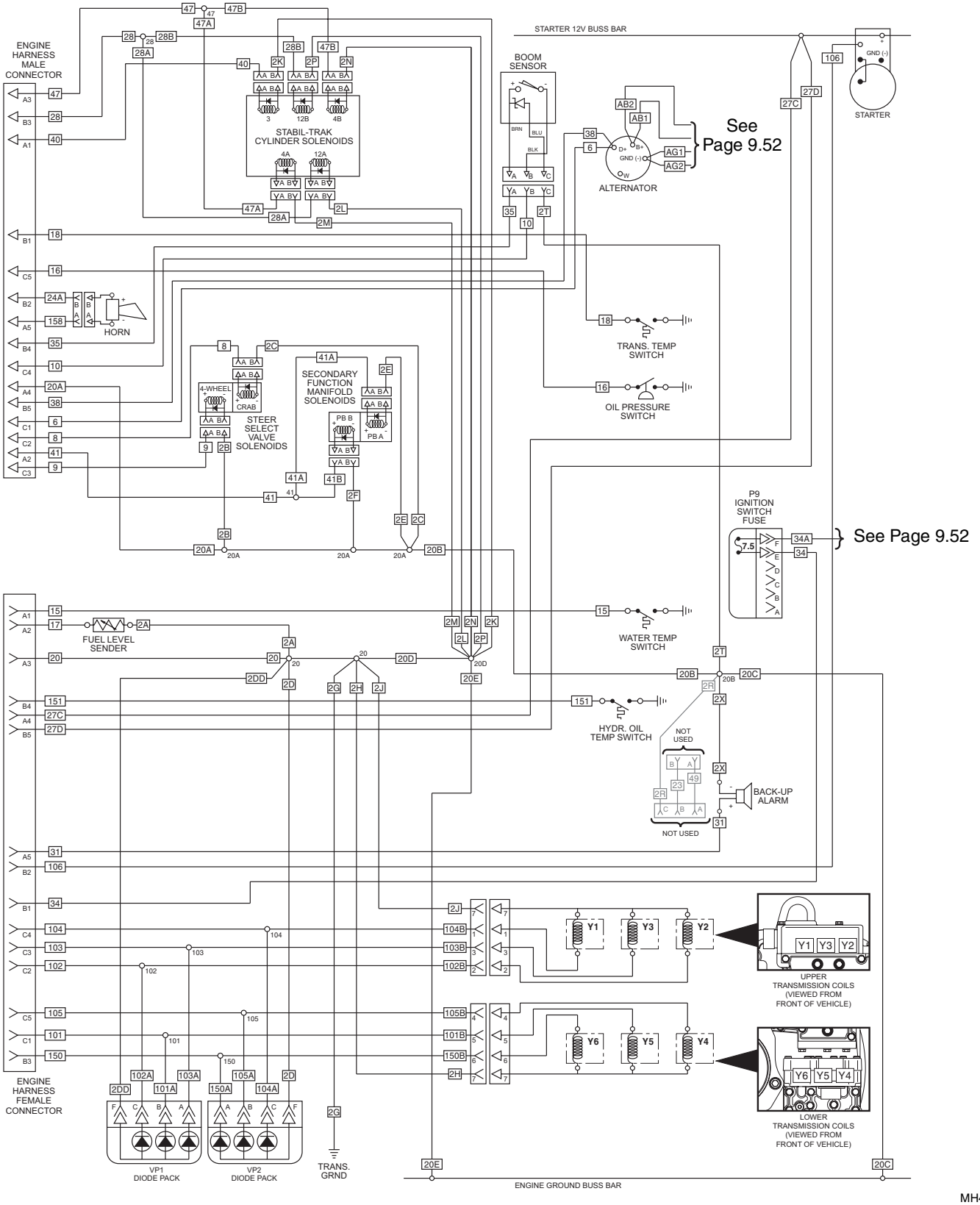
9.7.10 8042 Cab Harness & Engine Harness Electrical Schematic (SN 18991 - 19987 And 0160002332 & After)

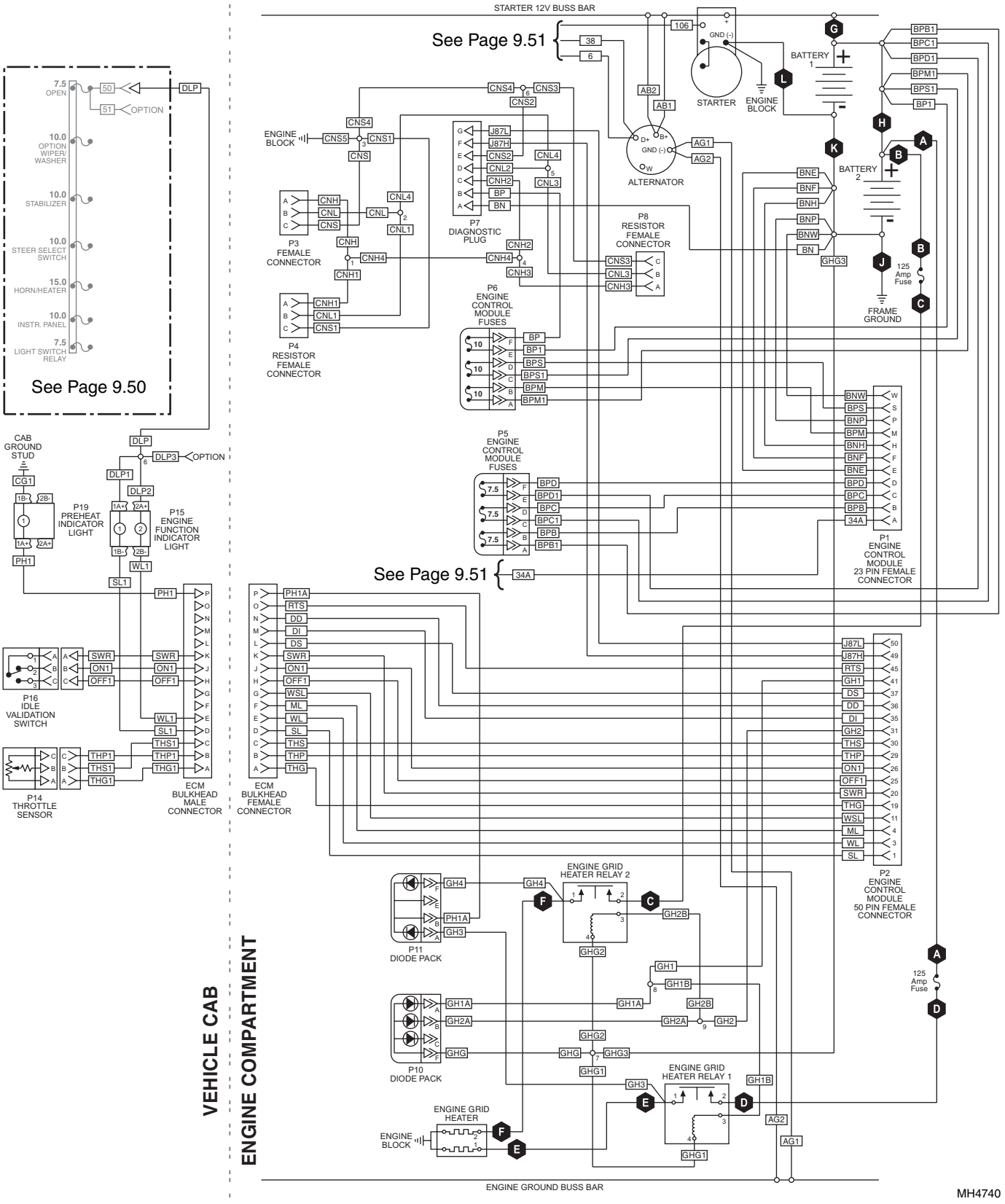


MH48101


ENGINE HARNESS MALE CONNECTOR
ENGINE HARNESS FEMALE CONNECTOR
STARTER 12V BUSS BAR
BOOM SENSOR
STABIL-TRAK CYLINDER SOLENOIDS
ALTERNATOR
STARTER
HORN
TRANS. TEMP SWITCH
OIL PRESSURE SWITCH
SECONDARY FUNCTION MANIFOLD SOLENOIDS
STEER SELECT VALVE SOLENOIDS
4-WHEEL CRAB
P9 IGNITION SWITCH FUSE
WATER TEMP SWITCH
FUEL LEVEL SENDER
HYDR. OIL TEMP SWITCH
NOT USED
BACK-UP ALARM
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
VP1 DIODE PACK
VP2 DIODE PACK
TRANS. GRND
ENGINE GROUND BUSS BAR
See Page 9.52
See Page 9.52

MH48102

9.7.11 8042 ECM Cab Harness & Engine Harness (SN 18991 - 19987 And 0160002332 & After)



9.7.12 10042 Electrical Schematic Legend (SN 13198 Through 19030)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.62 or 9.64	12	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.63 or 9.65	18	BLK	Splice 20 (Ground) to Fuel Level Sender (Engine Harness)
	9.62 or 9.64	16	BLK	Splice 2 to Left Outrigger Switch Connector (Pin 7) (Outrigger Harness)
2AA	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (4-Wheel) (–) (Engine Harness)
	9.62 or 9.64	16	BLK	Splice 2 to Right Outrigger Switch Connector (Pin 7) (Outrigger Harness)
2BB	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (Crab) (–)
2CC	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F) (Engine Harness)
	9.62, 9.63, 9.64 or 9.65	16	BLK	Splice 2 to Outrigger Valve Solenoid (Left Down) (–) (Outrigger Harness)
2DD	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F) (Engine Harness)
2E	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B) (Engine Harness)
	9.62, 9.63, 9.64 or 9.65	16	BLK	Splice 2 to Outrigger Valve Solenoid (Left Up) (–) (Outrigger Harness)
2EE	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B) (Engine Harness)
	9.62, 9.63, 9.64 or 9.65	16	BLK	Splice 2 to Outrigger Valve Solenoid (Right Down) (–) (Outrigger Harness)
2FF	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Transmission Ground (Engine Harness)
	9.62, 9.63, 9.64 or 9.65	16	BLK	Splice 2 to Outrigger Valve Solenoid (Right Up) (–) (Outrigger Harness)
2GG	9.62 or 9.64	16	BLK	Splice 20 (Ground) to Instrument Panel Connector (Pin J5)
2H	9.63 or 9.65	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
2HH	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.63 or 9.65	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Steer Select Switch (Pin 7)
2K	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (–)
2KK	9.62 or 9.64	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (–)
2M	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (–)
2N	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (–)
2P	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (–)
2R	9.63 or 9.65	18	BLK	Not Used
2S	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Fuel Shut-off Solenoid Connector (Pin C)
2T	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Boom Sensor Connector (Pin C)
2W	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Alternator (GND)
2X	9.63 or 9.65	16	BLK	Splice 20 (Ground) to Back-up Alarm (–)
3	9.62	10	PUR	† Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
3A	9.62	10	PUR	† Fuse Buss Bar to Transmission Fuse to Option Connector
	9.64			§ Fuse Buss Bar to Transmission Fuse
3B	9.64	10	PUR	§ Outrigger Fuse to Option Connector
3C	9.64	10	PUR	§ Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
5	9.63 or 9.65	10	RED	Starter (Pin 30) to Alternator (B+)
6	9.62 or 9.64	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.63 or 9.65	18	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.62 or 9.64	16	BRN	Stabilizer Fuse to Jumper Wire 157
8	9.62 or 9.64	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.63 or 9.65	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (+) (Engine Harness)
9	9.62 or 9.64	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.63 or 9.65	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (+) (Engine Harness)
10	9.62 or 9.64	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.63 or 9.65	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)
11	9.62	16	LT GRN/BLU	† Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
				† Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
11A	9.64	16	LT GRN/BLU	§ Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
11B	9.64	16	LT GRN/BLU	§ Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
12	9.62 or 9.64	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.62	12	DK BLU	† Light Switch Relay (Pin 87) to Splice 12A to Road/Worklights Connector (Option)
	9.64			§ Light Switch Relay (Pin 87) to Splice 12A
12AA	9.64	12	DK BLU	§ Splice 12A to Road/Worklights Connector (Option)
12B	9.62	12	DK BLU	† Splice 12A to Headlight Switch Relay (Pin 30)
	9.64			§ Splice 12A to Option Connector
12C	9.62	16	DK BLU	† Splice 27 to Roadlights Connector (Option) (Hazards)
	9.64			§ Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.62 or 9.64	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.63 or 9.65	18	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.62 or 9.64	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.63 or 9.65	18	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)
17	9.62 or 9.64	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.63 or 9.65	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)
18	9.62 or 9.64	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.63 or 9.65	18	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.62 or 9.64	14	BLK	Splice 20 (Ground) to Cab Ground Stud (Cab Harness)
	9.62 or 9.64	12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (PinA3) (Cab Harness)
	9.63 or 9.65	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
	9.62 or 9.64	14	BLK	Splice 2 to Cab Ground Stud (Outrigger Harness)
21C	9.62 or 9.64	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Connector (Option) (Main Beam)
22	9.62 or 9.64	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.62 or 9.64	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Connector (Option) (Main Beam) (Cab Harness)
	9.63 or 9.65	16	ORG/GRN	Not Used (Engine Harness)
24	9.62 or 9.64	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.62 or 9.64	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.63 or 9.65	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (+) (Engine Harness)
26	9.62	10	RED	† Main Fuse to Ignition Switch 3-Way Connector (Pin A)
	9.64			§ Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.62	10	RED	† Main Fuse to Ignition Switch 5-Way Connector (Pin A)
	9.64			§ Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.64	10	RED	§ Splice 26 to Main Fuse

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
27	9.62 or 9.64	10	RED	Main Fuse to Splice 100 (Cab Harness)
	9.63 or 9.65	10	RED	Splice 27 to Starter (Pin 30) (Engine Harness)
27A	9.62	12	RED	† Optional Lights Fuse to Splice 27 to Light Switch Relay (Pin 30)
	9.64			§ Optional Lights Fuse (Lights 1) to Splice 27 to Headlight Switch Relay (Pin 30)
27B	9.62	12	RED	† Optional Lights Fuse to Main Fuse
	9.64			§ Optional Lights Fuse (Lights 1) to Splice 100
27C	9.62 or 9.64	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.63 or 9.65	12	RED	Cab/Chassis Female Connector (Pin A4) to Splice 27 (Engine Harness)
27D	9.62 or 9.64	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.63 or 9.65	12	RED	Cab/Chassis Female Connector (Pin B5) to Splice 27 (Engine Harness)
27F	9.64	12	RED	§ Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.62 or 9.64	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.63 or 9.65	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.63 or 9.65	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (+)
28B	9.63 or 9.65	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (+)
29	9.64	12	RED	§ Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)
31	9.62 or 9.64	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.63 or 9.65	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)
32	9.62 or 9.64	14	GRY/WHT	Option Fuse to Wiper/Washer Connector (Option)
34	9.62 or 9.64	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.63 or 9.65	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to Fuel Shut-off Solenoid Connector (Pin A) (Engine Harness)
35	9.62 or 9.64	16	BRN/WHT	Jumper Wire 157 to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.63 or 9.65	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.62 or 9.64	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.63 or 9.65	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.62 or 9.64	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.62 or 9.64	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.63 or 9.65	16	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (+) (Engine Harness)
40A	9.62 or 9.64	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.62 or 9.64	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
41	9.62	16	DK BLU/WHT	† Park Brake Switch Connector (Pin 1) to Splice 41 to Male Connector (Cab Harness)
				Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.63 or 9.65		BLU/WHT	Cab/Chassis Male Connector (Pin A2) to Splice 41 (Engine Harness)
41A	9.64	16	DK BLU/WHT	§ Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.63 or 9.65		BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A) (Engine Harness)
41B	9.64	16	DK BLU/WHT	§ Park Brake Switch Connector (Pin 1) to Splice 41 (Cab Harness)
	9.63 or 9.65		BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A) (Engine Harness)
41C	9.64	16	DK BLU/WHT	§ Splice 41 to Male Connector
42	9.62	18	TAN	† Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
				Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
42A	9.64	18	TAN	§ Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.64	18	TAN	§ Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.62 or 9.64	16	DK BLU/ORG	Splice 45 to Splice 114
45A	9.62	16	DK BLU/ORG	† Splice 45 to Inline Diode to Splice 152
45A2	9.64	16	DK BLU/ORG	§ Splice 45 to Inline Diode to Splice 152B
45B	9.62 or 9.64	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.62 or 9.64	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)
47	9.62 or 9.64	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.63 or 9.65	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)
47A	9.63 or 9.65	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (+)
47B	9.63 or 9.65	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (+)
48	9.62 or 9.64	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.63 or 9.65	16	RED/BLU	Not Used
50	9.62 or 9.64	16	WHT/YEL	Outrigger Fuse to Female Option Connector to Wire 60E
51	9.62 or 9.64	16	WHT/RED	Option Fuse to Option Connector
52	9.62 or 9.64	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
60A	9.62 or 9.64	16	YEL	Splice 60 to Right Outrigger Switch Connector (Pin 2)
60B	9.62 or 9.64	16	YEL	Splice 60 to Right Outrigger Switch Connector (Pin 8)
60C	9.62 or 9.64	16	YEL	Splice 60 to Left Outrigger Switch Connector (Pin 2)
60D	9.62 or 9.64	16	YEL	Splice 60 to Left Outrigger Switch Connector (Pin 8)
60E	9.62 or 9.64	16	YEL	Splice 60 to Male Connector
61	9.62, 9.63, 9.64 or 9.65	16	RED/GRY	Right Outrigger Switch Connector (Pin 1) to Outrigger Valve Solenoid (Right Up) (+)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
62	9.62, 9.63, 9.64 or 9.65	16	PUR/WHT	Right Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Right Down) (Pin 1)
63	9.62, 9.63, 9.64 or 9.65	16	BRN/YEL	Left Outrigger Switch Connector (Pin 1) to Outrigger Valve Solenoid (Left Up) (Pin 1)
64	9.62, 9.63, 9.64 or 9.65	16	GRY/PUR	Left Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Left Down) (Pin 1)
101	9.62 or 9.64	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.63 or 9.65	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.63 or 9.65	16	BRN	Splice 101 to Diode VESPAK (Pin B)
101B	9.63 or 9.65	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.62 or 9.64	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.63 or 9.65	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.62 or 9.64	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.63 or 9.65	16	PNK	Splice 102 to Diode VESPAK (Pin E) (Engine Harness)
102B	9.62 or 9.64	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.63 or 9.65	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)
103	9.62 or 9.64	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.63 or 9.65	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.63 or 9.65	16	BLU	Splice 103 to Diode VESPAK (Pin A)
103B	9.63 or 9.65	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)
104	9.62 or 9.64	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.63 or 9.65	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.63 or 9.65	16	YEL	Splice 104 to Diode VESPAK (Pin E)
104B	9.63 or 9.65	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)
105	9.62 or 9.64	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.63 or 9.65	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.63 or 9.65	16	GRN	Splice 105 to Diode VESPAK (Pin B)
105B	9.63 or 9.65	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)

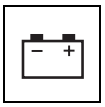
† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
106	9.62 or 9.64	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.63 or 9.65	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter (Pin 50) (Engine Harness)
107	9.62	18	BLU	† Splice 41 to Female Connector
				† Male Connector to Park Brake Disconnect Relay (Pin 86)
107A	9.64	18	BLU	§ Splice 41 to Female Connector
107B	9.64	18	BLU	§ Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.62 or 9.64	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.62 or 9.64	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.62 or 9.64	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.62 or 9.64	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.62 or 9.64	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.62 or 9.64	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.62 or 9.64	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.62 or 9.64	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.62 or 9.64	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.62 or 9.64	16	VIO	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.63 or 9.65	16	VIO	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.63 or 9.65	16	VIO	Splice 150 to Diode VESPAK (Pin A)
150B	9.63 or 9.65	18	VIO	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)
151	9.62 or 9.64	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.63 or 9.65	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152	9.62	16	BLK/WHT	† Park Brake Switch Connector (Pin 3) to Splice 152 to Male (Cab Harness)
				† Female Connector to Inline Diode to Instrument Panel Connector (Pin J7) (Cab Harness)
	9.63 or 9.65	10	RED	Starter (Pin M) to Fuel Shut-off Solenoid Connector (Pin B) (Engine Harness)
152A	9.62	16	BLK/WHT	† Not Used
152A1	9.64	16	BLK/WHT	§ Female Connector to Inline Diode to Splice 152A
152A2	9.64	16	BLK/WHT	§ Not Used
152A3	9.64	16	BLK/WHT	§ Splice 152A to Instrument Panel Connector (Pin J7)
152B1	9.64	16	BLK/WHT	§ Male Connector to Splice 152B
152B2	9.64	16	BLK/WHT	§ Splice 152B to Park Brake Switch Connector (Pin 3)
153	9.62 or 9.64	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.62 or 9.64	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.62 or 9.64	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030

Wire No.	Page	Gauge	Color	From - Function - To
155	9.62 or 9.64	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.62 or 9.64	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
157	9.62 or 9.64	16	BRN	Jumper Wire (Wire 7 to Wire 35)
158	9.62 or 9.64	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5) (Cab Harness)
	9.63 or 9.65	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (–) (Engine Harness)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19030



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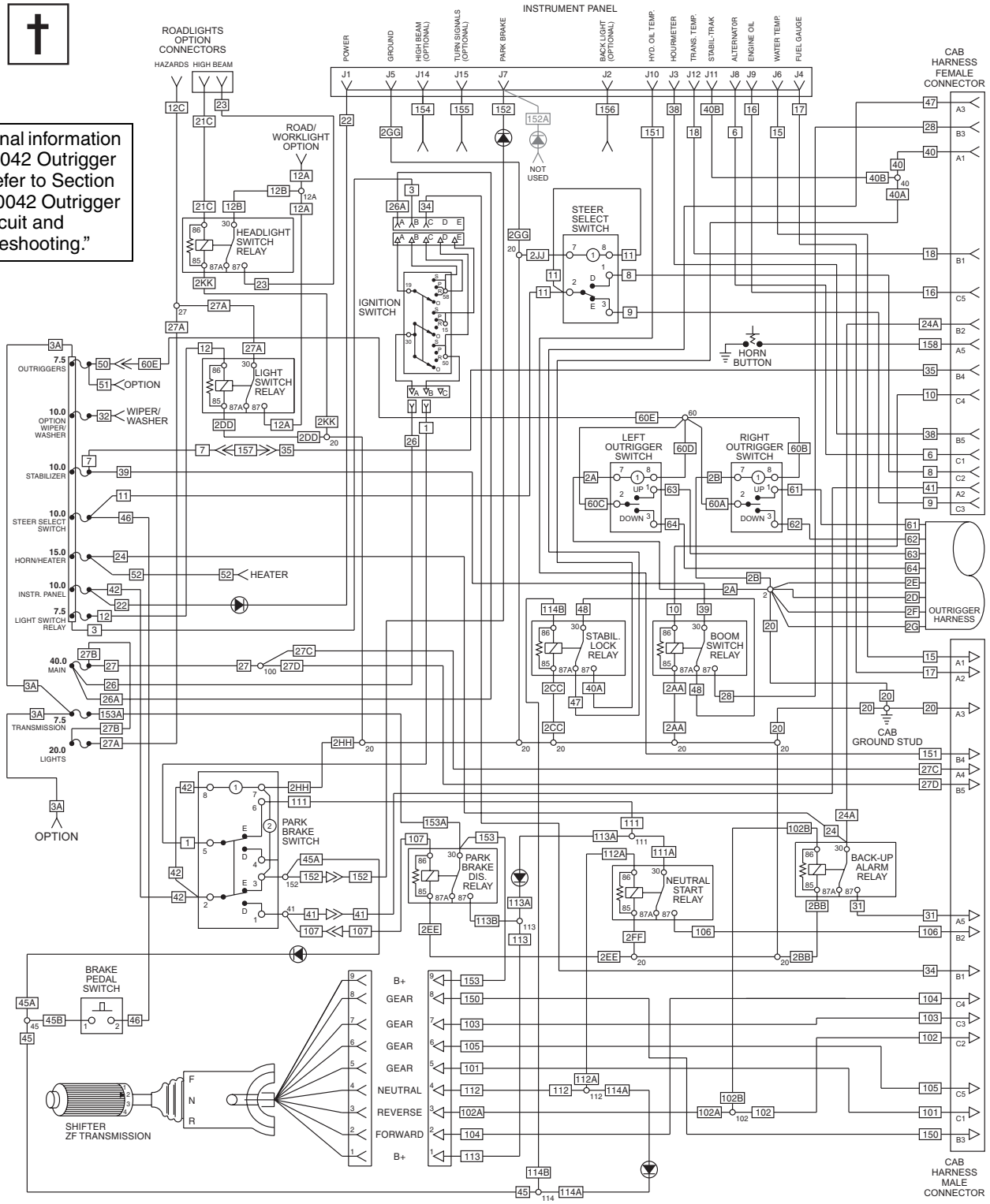
9.7.13 10042 Electrical Schematic (SN 13198 Through 16782, Without Lighting Package)

For additional information on the 10042 Outrigger Circuit, refer to Section 9.7.42, “10042 Outrigger Circuit and Troubleshooting.”



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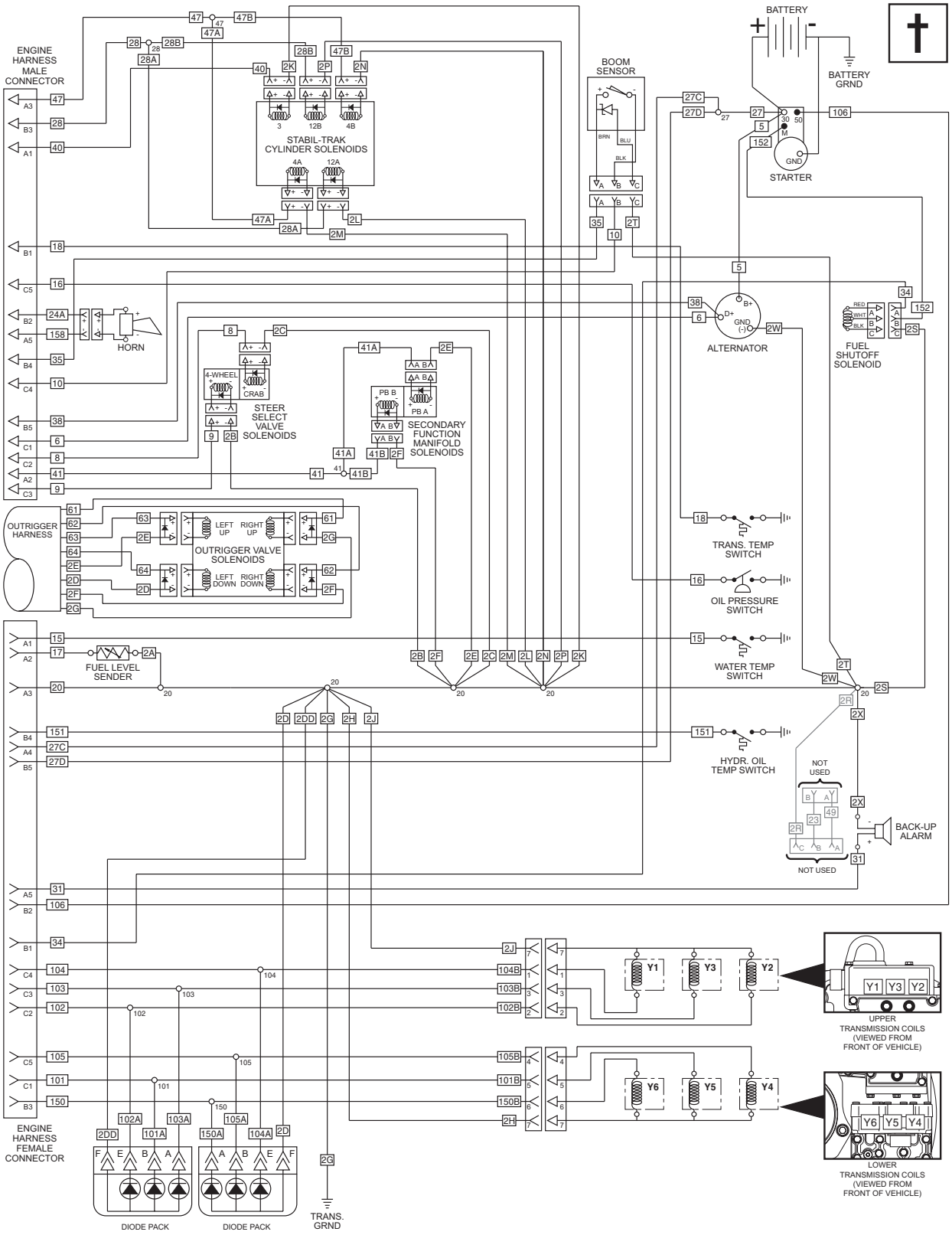
ENGINE HARNESS MALE CONNECTOR
ENGINE HARNESS FEMALE CONNECTOR
BATTERY
BATTERY GRND
STARTER
BOOM SENSOR
STABIL-TRAK CYLINDER SOLENOIDS
HORN
STEER SELECT VALVE SOLENOIDS
4-WHEEL
CRAB
SECONDARY FUNCTION MANIFOLD SOLENOIDS
OUTRIGGER HARNESS
OUTRIGGER VALVE SOLENOIDS
LEFT UP
RIGHT UP
LEFT DOWN
RIGHT DOWN
ALTERNATOR
FUEL SHUTOFF SOLENOID
TRANS. TEMP SWITCH
OIL PRESSURE SWITCH
WATER TEMP SWITCH
HYDR. OIL TEMP SWITCH
FUEL LEVEL SENDER
BACK-UP ALARM
NOT USED
DIODE PACK
DIODE PACK
TRANS. GRND
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)

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9.7.14 10042 Electrical Schematic (SN 13198 Through 16782, With Lighting Package and SN 16783 Through 19030)

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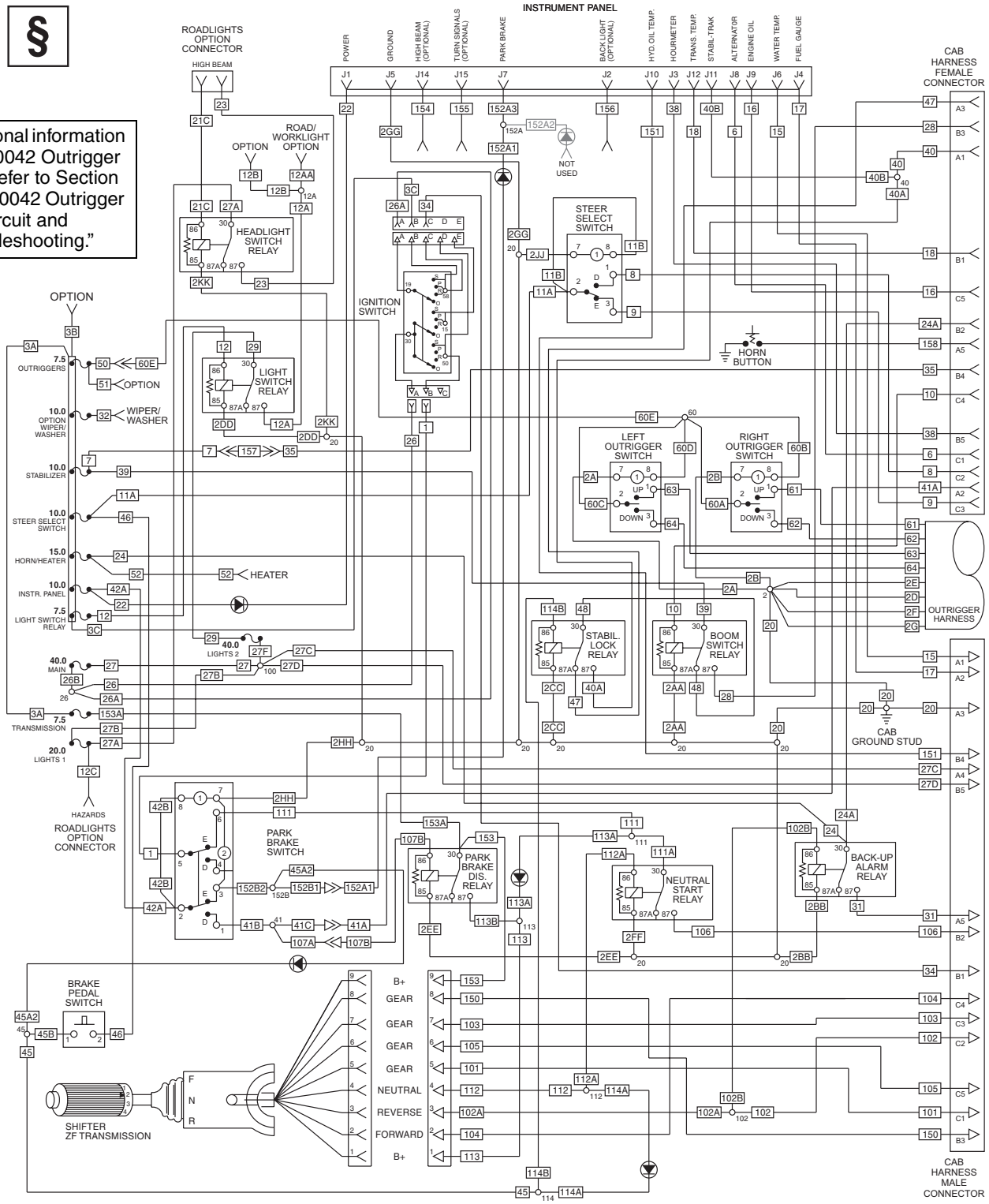
For additional information on the 10042 Outrigger Circuit, refer to Section 9.7.42, "10042 Outrigger Circuit and Troubleshooting."



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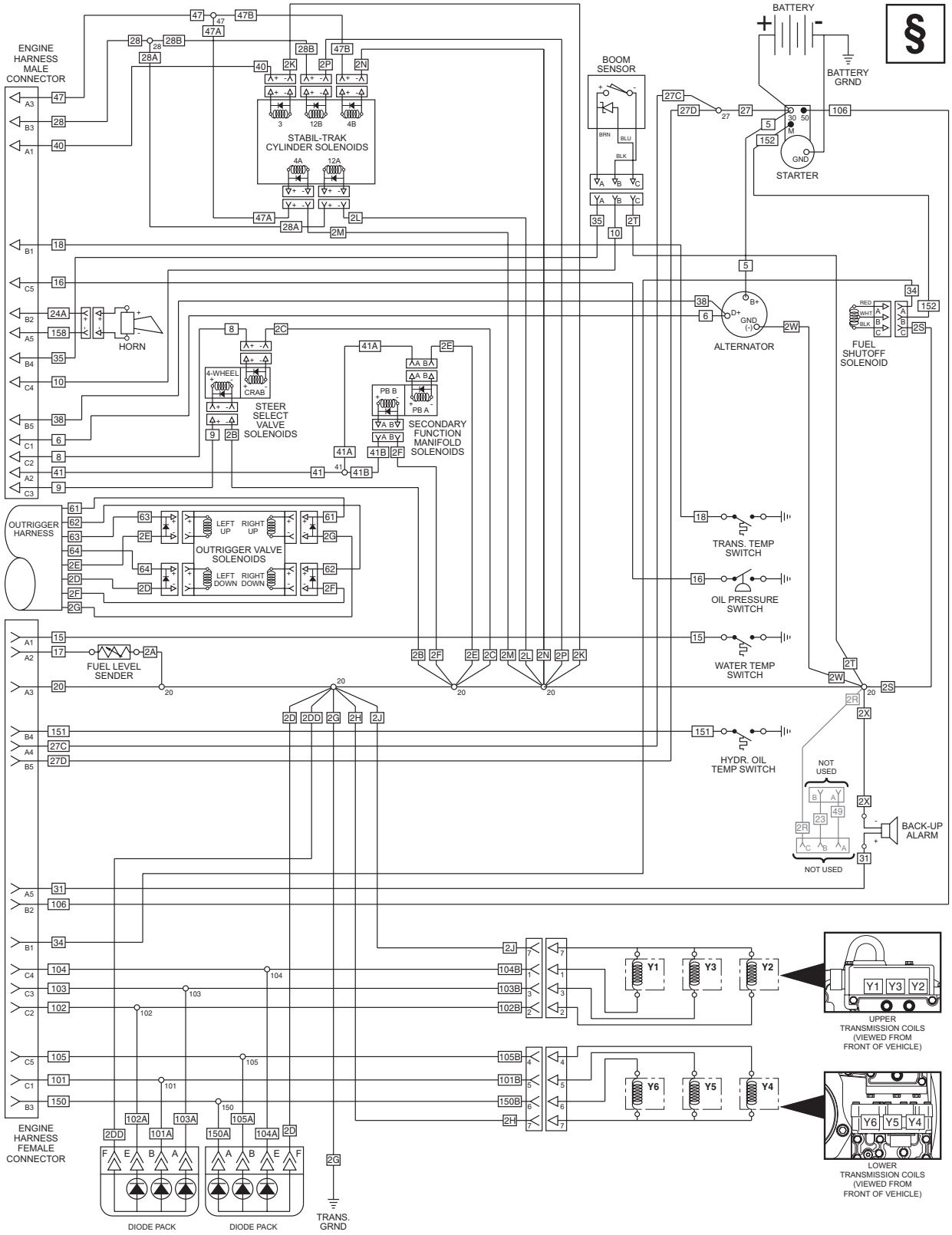

ENGINE HARNESS MALE CONNECTOR
STABIL-TRAK CYLINDER SOLENOIDS
BOOM SENSOR
BATTERY
BATTERY GRND
STARTER
HORN
STEER SELECT VALVE SOLENOIDS
SECONDARY FUNCTION MANIFOLD SOLENOIDS
ALTERNATOR
FUEL SHUTOFF SOLENOID
OUTRIGGER HARNESS
OUTRIGGER VALVE SOLENOIDS
TRANS. TEMP SWITCH
OIL PRESSURE SWITCH
WATER TEMP SWITCH
FUEL LEVEL SENDER
HYDR. OIL TEMP SWITCH
BACK-UP ALARM
NOT USED
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
ENGINE HARNESS FEMALE CONNECTOR
DIODE PACK
DIODE PACK
TRANS. GRND

MH42502

9.7.15 10042 Cab Harness, Engine Harness & ECM Cab Harness Electrical Schematic Legend (SN 19031 - 19987 And 0160002332 & After)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.74	10	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.75	16	BLK	Splice 20 (Ground) to Fuel Level Sender (Engine Harness)
	9.74	16	BLK	Splice 2 to Left Outrigger Switch Connector (Pin 7) (Outrigger Harness)
2AA	9.74	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.75	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (4-Wheel) (Pin B) (Engine Harness)
	9.74	16	BLK	Splice 2 to Right Outrigger Switch Connector (Pin 7) (Outrigger Harness)
2BB	9.74	18	BLK	Splice 20A (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.75	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (Crab) (Pin B)
2CC	9.74	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.75	16	BLK	Splice 20 (Ground) to Diode VESPAK VP2 (Pin F) (Engine Harness)
	9.74 & 9.75	16	BLK	Splice 2 to Outrigger Valve Solenoid (Left Down) (Pin 2) (Outrigger Harness)
2DD	9.74	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.75	16	BLK	Splice 20 (Ground) to Diode VESPAK VP1 (Pin F) (Engine Harness)
2E	9.75	18	BLK	Splice 20A (Ground) to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B) (Engine Harness)
	9.74 & 9.75	16	BLK	Splice 2 to Outrigger Valve Solenoid (Left Up) (Pin 2) (Outrigger Harness)
2EE	9.74	18	BLK	Splice 20A (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.75	18	BLK	Splice 20A (Ground) to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B) (Engine Harness)
	9.74 & 9.75	16	BLK	Splice 2 to Outrigger Valve Solenoid (Right Down) (Pin 2) (Outrigger Harness)
2FF	9.74	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.75	16	BLK	Splice 20 (Ground) to Transmission Ground (Engine Harness)
	9.74 & 9.75	16	BLK	Splice 2 to Outrigger Valve Solenoid (Right Up) (Pin 2) (Outrigger Harness)
2GG	9.74	16	BLK	Splice 20A (Ground) to Instrument Panel Connector (Pin J5)
2H	9.75	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)
2HH	9.74	18	BLK	Splice 20A (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.75	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.74	18	BLK	Splice 20A (Ground) to Steer Select Switch (Pin 7)
2K	9.75	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (Pin B)
2KK	9.74	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.75	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (Pin B)
2LL	9.74	12	BLK	Splice 20 (Ground) to Cab Ground Stud
2M	9.75	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (Pin B)
2MM	9.74	12	BLK	Splice 20A (Ground) to Cab Ground Stud
2N	9.75	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (Pin B)
2P	9.75	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (Pin B)
2R	9.75	16	BLK	Not Used
2T	9.75	16	BLK	Splice 20B (Ground) to Boom Sensor Connector (Pin C)
2X	9.75	16	BLK	Splice 20B (Ground) to Back-up Alarm (–)
3A	9.74	10	PUR	Fuse Buss Bar to Transmission Fuse
3B	9.74	10	PUR	Open Fuse to Female Option Connector
3C	9.74	10	PUR	Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
6	9.74	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.75 & 9.76	16	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.74	16	BRN	Stabilizer Fuse to Female Connector

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
8	9.74	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.75	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (A) (Engine Harness)
9	9.74	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.75	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (A) (Engine Harness)
10	9.74	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.75	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)
11A	9.74	16	LT GRN/BLU	Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
11B	9.74	16	LT GRN/BLU	Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
12	9.74	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.74	12	DK BLU	Light Switch Relay (Pin 87) to Splice 12A
12AA	9.74	12	DK BLU	Splice 12A to Road/Worklights Connector (Option)
12B	9.74	12	DK BLU	Splice 12A to Female Option Connector
12C	9.74	16	DK BLU	Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.74	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.75	16	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.74	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.75	16	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)
17	9.74	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.75	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)
18	9.74	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.75	16	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.74	12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (Pin A3) (Cab Harness)
	9.75	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
	9.74	14	BLK	Splice 2 to Cab Ground Stud (Outrigger Harness)
20A	9.74	12	BLK	Splice 20A (Ground) to Cab/Chassis Female Connector (Pin A4) (Cab Harness)
	9.75	12	BLK	Cab/Chassis Male Connector (Pin A4) to Splice 20A (Ground) (Engine Harness)
20B	9.75	12	BLK	Splice 20A (Ground) to 20B (Ground)
20C	9.75	12	BLK	Splice 20B (Ground) to Engine Ground Buss Bar
20D	9.75	12	BLK	Splice 20 (Ground) to 20D (Ground)
20E	9.75	12	BLK	Splice 20D (Ground) to Engine Ground Buss Bar
21C	9.74	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Female Connector (Option) (Main Beam)
22	9.74	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.74	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Female Connector (Option) (Main Beam) (Cab Harness)
	9.75	16	ORG/GRN	Not Used (Engine Harness)
24	9.74	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.74	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.75	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (B) (Engine Harness)
26	9.74	10	RED	Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.74	10	RED	Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.74	10	RED	Splice 26 to Main Fuse
27	9.74	10	RED	Main Fuse to Splice 100
27A	9.74	12	RED	Optional Lights Fuse (Lights 1) to Headlight Switch Relay (Pin 30)
27B	9.74	12	RED	Optional Lights Fuse (Lights 1) to Splice 100

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
27C	9.74	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.75	12	RED	Cab/Chassis Female Connector (Pin A4) to 12V Buss Bar (Engine Harness)
27D	9.74	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.75	12	RED	Cab/Chassis Female Connector (Pin B5) to 12V Buss Bar (Engine Harness)
27F	9.74	12	RED	Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.74	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.75	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.75	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (A)
28B	9.75	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (A)
29	9.74	12	RED	Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)
31	9.74	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.75	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)
32	9.74	14	GRY/WHT	Option Fuse to Wiper/Washer Female Connector (Option)
34	9.74	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.75	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to 7.5 amp Mini Fuse VESPAK Connector P9 (Pin E) (Engine Harness)
34A	9.75 & 9.76	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P9 (Pin F) to Engine Control Module Connector P1 (Pin A)
35	9.74	16	BRN/WHT	Female Connector to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.75	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.74	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.75 & 9.76	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.74	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.74	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.75	18	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (A) (Engine Harness)
40A	9.74	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.74	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)
41	9.75	16	BLU/WHT	Cab/Chassis Male Connector (Pin A2) to Splice 41
41A	9.74	16	DK BLU/WHT	Female Connector to Cab/Chassis Female Connector (Pin A2) (Cab Harness)
	9.75	18	BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A) (Engine Harness)
41B	9.74	16	DK BLU/WHT	Park Brake Switch Connector (Pin 1) to Male Connector (Cab Harness)
	9.75	18	BLU/WHT	Splice 41 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A) (Engine Harness)
42A	9.74	18	TAN	Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.74	18	TAN	Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.74	16	DK BLU/ORG	Splice 45 to Splice 114
45A2	9.74	16	DK BLU/ORG	Splice 45 to Inline Diode to Park Brake Switch Connector (Pin 3)
45B	9.74	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.74	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)
47	9.74	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.75	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)
47A	9.75	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (A)
47B	9.75	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (A)
48	9.74	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.75	16	RED/BLU	Not Used
50	9.74	16	WHT/YEL	Option Fuse to Female Option Connector
51	9.74	16	WHT/RED	Option Fuse to Female Option Connector
52	9.74	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
60A	9.74	16	YEL	Splice 60 to Right Outrigger Switch Connector (Pin 2)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
60B	9.74	16	YEL	Splice 60 to Right Outrigger Switch Connector (Pin 8)
60C	9.74	16	YEL	Splice 60 to Left Outrigger Switch Connector (Pin 2)
60D	9.74	16	YEL	Splice 60 to Left Outrigger Switch Connector (Pin 8)
60E	9.74	16	YEL	Splice 60 to Male Connector
61	9.74 & 9.75	16	RED/GRY	Right Outrigger Switch Connector (Pin 1) to Outrigger Valve Solenoid (Right Up) (Pin 1)
62	9.74 & 9.75	16	PUR/WHT	Right Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Right Down) (Pin 1)
63	9.74 & 9.75	16	BRN/YEL	Left Outrigger Switch Connector (Pin 1) to Outrigger Valve Solenoid (Left Up) (Pin 1)
64	9.74 & 9.75	16	GRY/PUR	Left Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Left Down) (Pin 1)
101	9.74	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.75	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.75	16	BRN	Splice 101 to Diode VESPAK VP1 (Pin B)
101B	9.75	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.74	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.75	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.74	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.75	16	PNK	Splice 102 to Diode VESPAK VP1 (Pin C) (Engine Harness)
102B	9.74	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.75	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)
103	9.74	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.75	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.75	16	BLU	Splice 103 to Diode VESPAK VP1 (Pin A)
103B	9.75	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)
104	9.74	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.75	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.75	16	YEL	Splice 104 to Diode VESPAK VP2 (Pin C)
104B	9.75	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)
105	9.74	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.75	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.75	16	GRN	Splice 105 to Diode VESPAK VP2 (Pin B)
105B	9.75	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)
106	9.74	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.75 & 9.76	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter Solenoid (Engine Harness)
107A	9.74	18	BLU	Park Brake Switch Connector (Pin 1) to Female Connector
107B	9.74	18	BLU	Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.74	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.74	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.74	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.74	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.74	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.74	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.74	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.74	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.74	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.74	16	PUR	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.75	16	PUR	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.75	16	PUR	Splice 150 to Diode VESPAK VP2 (Pin A)
150B	9.75	18	PUR	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
151	9.74	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.75	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152A1	9.74	16	BLK/WHT	Female Connector to Inline Diode to Splice 152A
152A2	9.74	16	BLK/WHT	Not Used
152A3	9.74	16	BLK/WHT	Splice 152A to Instrument Panel Connector (Pin J7)
152B	9.74	16	BLK/WHT	Male Connector to Park Brake Switch Connector (Pin 3)
153	9.74	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.74	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.74	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)
155	9.74	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.74	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
157	9.74	16	BRN	Jumper Wire (Wire 7 to Wire 35)
158	9.74	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5)
	9.75	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (Pin A) (Engine Harness)
⬢A	9.76	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
AB1	9.76	10	RED	Alternator (Pin B+) to 12V Buss Bar
AB2	9.76	10	RED	Alternator (Pin B+) to 12V Buss Bar
AG1	9.76	10	BLK	Alternator (Pin GND) to Ground Buss Bar
AG2	9.76	10	BLK	Alternator (Pin GND) to Ground Buss Bar
⬢B	9.76	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
BN	9.76	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Male Diagnostic Connector, P7 (Pin A)
BNE	9.76	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin E)
BNF	9.76	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin F)
BNH	9.76	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin H)
BNP	9.76	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin P)
BNW	9.76	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin W)
BP	9.76	16	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin F) to Engine Control Module, Male Diagnostic Connector, P7 (Pin B)
BP1	9.76	16	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin E)
BPB	9.76	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin B)
BPB1	9.76	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin A)
BPC	9.76	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin C)
BPC1	9.76	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin C)
BPD	9.76	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin F) to Engine Control Module, Female Engine Connector, P1 (Pin D)
BPD1	9.76	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin E)
BPM	9.76	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin M)
BPM1	9.76	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin A)
BPS	9.76	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin S)
BPS1	9.76	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin C)
⬢C	9.76	6	RED	125 Amp Fuse to Grid Heater Relay 2 (Pin 2)
CG1	9.76	16	BLK	Preheat Indicator Light, Female Connector, P15 (Pin 1B-) to Cab Ground Stud
CNH	9.76	18	YEL	Splice 1 to Engine, Female Connector, P3 (Pin A)
CNH1	9.76	18	YEL	Splice 1 to Resistor, Female Connector, P4 (Pin A)
CNH2	9.76	18	YEL	Splice 4 to Engine Control Module, Male Diagnostic Connector, P7 (Pin C)
CNH3	9.76	18	YEL	Splice 4 to Resistor, Female Connector, P8 (Pin A)
CNH4	9.76	18	YEL	Splice 1 to Splice 4
CNL	9.76	18	GRN	Splice 2 to Engine, Female Connector, P3 (Pin B)

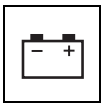
⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
CNL1	9.76	18	GRN	Splice 2 to Resistor, Female Connector, P4 (Pin B)
CNL2	9.76	18	GRN	Splice 5 to Engine Control Module, Male Diagnostic Connector, P7 (Pin D)
CNL3	9.76	18	GRN	Splice 5 to Resistor, Female Connector, P8 (Pin B)
CNL4	9.76	18	GRN	Splice 2 to Splice 5
CNS	9.76	18	DRAIN	Splice 3 to Engine, Female Connector, P3 (Pin C)
CNS1	9.76	18	DRAIN	Splice 3 to Resistor, Female Connector, P4 (Pin C)
CNS2	9.76	18	DRAIN	Splice 6 to Engine Control Module, Male Diagnostic Connector, P7 (Pin E)
CNS3	9.76	18	DRAIN	Splice 6 to Resistor, Female Connector, P8 (Pin C)
CNS4	9.76	18	DRAIN	Splice 3 to Splice 6
CNS5	9.76	18	BLK	Splice 3 to Engine Block
⬢ D	9.76	6	RED	125 Amp Fuse to Grid Heater Relay 1 (Pin 2)
DD	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin N) to Engine Control Module, Female Engine Connector, P2 (Pin 36)
DI	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin M) to Engine Control Module, Female Engine Connector, P2 (Pin 35)
DLP	9.76	16	WHT/RED	Splice 6 to Male Connector
DLP1	9.76	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 1A+) to Splice 6
DLP2	9.76	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 2A+) to Splice 6
DLP3	9.76	16	WHT/RED	Splice 6 to Female Connector
DS	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin L) to Engine Control Module, Female Engine Connector, P2 (Pin 37)
⬢ E	9.76	6	RED	Grid Heater Relay 1 (Pin 1) to Engine Grid Heater (Pin 1)
⬢ F	9.76	6	RED	Grid Heater Relay 2 (Pin 1) to Engine Grid Heater (Pin 2)
⬢ G	9.76	1/0	RED	Battery 1, Positive (+) Terminal to Starter 12V Buss Bar
GH1	9.76	18	BLK	Splice 8 to Engine Control Module, Female Engine Connector, P2 (Pin 41)
GH1A	9.76	16	BLK	Splice 8 to Diode VESPAK Connector P10 (Pin A)
GH1B	9.76	16	BLK	Splice 8 to Grid Heater Relay 1 (Pin 3)
GH2	9.76	18	BLK	Splice 9 to Engine Control Module, Female Engine Connector, P2 (Pin 31)
GH2A	9.76	16	BLK	Splice 9 to Diode VESPAK Connector P10 (Pin B)
GH2B	9.76	16	BLK	Splice 9 to Grid Heater Relay 2 (Pin 3)
GH3	9.76	16	BLK	Grid Heater Relay 1 (Pin 1) to Diode VESPAK Connector P11 (Pin A)
GH4	9.76	16	BLK	Grid Heater Relay 2 (Pin 1) to Diode VESPAK Connector P11 (Pin F)
GHG	9.76	16	BLK	Splice 7 to Diode VESPAK Connector P10 (Pin F)
GHG1	9.76	16	BLK	Splice 7 to Grid Heater Relay 1 (Pin 4)
GHG2	9.76	16	BLK	Splice 7 to Grid Heater Relay 2 (Pin 4)
GHG3	9.76	16	BLK	Battery 2, Negative (-) Terminal to Splice 7
⬢ H	9.76	1/0	RED	Battery 1, Positive (+) Terminal to Battery 2, Positive (+) Terminal
⬢ J	9.76	1	BLK	Battery 2, Negative (-) Terminal to Frame Ground
J87H	9.76	18	RED	Engine Control Module, Female Engine Connector, P2 (Pin 49) to Engine Control Module, Male Diagnostic Connector, P7 (Pin F)
J87L	9.76	18	BLK	Engine Control Module, Female Engine Connector, P2 (Pin 50) to Engine Control Module, Male Diagnostic Connector, P7 (Pin G)
⬢ K	9.76	1/0	BLK	Battery 1, Negative (-) Terminal to Battery 2, Negative (-) Terminal
⬢ L	9.76	1/0	BLK	Battery 1, Negative (-) Terminal to Starter Ground Stud
ML	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin F) to Engine Control Module, Female Engine Connector, P2 (Pin 4)
OFF1	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin H) to Engine Control Module, Female Engine Connector, P2 (Pin 25) (Engine Harness)
	9.76	18	ORG	Engine Control Module Bulkhead, Male Connector (Pin H) to Idle Validation Switch, Male Connector, P16 (Pin C) (ECM Cab Harness)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
ON1	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin J) to Engine Control Module, Female Engine Connector, P2 (Pin 26) (Engine Harness)
	9.76	18	VIO	Engine Control Module Bulkhead, Male Connector (Pin J) to Idle Validation Switch, Male Connector, P16 (Pin B) (ECM Cab Harness)
PH1	9.76	18	BLU	Engine Control Module Bulkhead, Male Connector (Pin P) to Preheat Indicator Light, Female Connector, P19 (Pin 1A+)
PH1A	9.76	16	PNK/BLU	Engine Control Module Bulkhead, Female Connector (Pin P) to Diode VESPAK Connector P11 (Pin B)
RTS	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin O) to Engine Control Module, Female Engine Connector, P2 (Pin 45)
SL	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin D) to Engine Control Module, Female Engine Connector, P2 (Pin 1)
SL1	9.76	18	GRN	Engine Control Module Bulkhead, Male Connector (Pin D) to Engine Function Indicator Light, Female Connector, P15 (Pin 1B-)
SWR	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin K) to Engine Control Module, Female Engine Connector, P2 (Pin 20) (Engine Harness)
	9.76	18	YEL	Engine Control Module Bulkhead, Male Connector (Pin K) to Idle Validation Switch, Male Connector, P16 (Pin A) (ECM Cab Harness)
THG	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin A) to Engine Control Module, Female Engine Connector, P2 (Pin 19)
THG1	9.76	18	BLK	Engine Control Module Bulkhead, Male Connector (Pin A) to Throttle Sensor, Female Connector, P14 (Pin A)
THP	9.76	18	RED	Engine Control Module Bulkhead, Female Connector (Pin B) to Engine Control Module, Female Engine Connector, P2 (Pin 29)
THP1	9.76	18	RED	Engine Control Module Bulkhead, Male Connector (Pin B) to Throttle Sensor, Female Connector, P14 (Pin C)
THS	9.76	18	WHT	Engine Control Module Bulkhead, Female Connector (Pin C) to Engine Control Module, Female Engine Connector, P2 (Pin 30)
THS1	9.76	18	WHT	Engine Control Module Bulkhead, Male Connector (Pin C) to Throttle Sensor, Female Connector, P14 (Pin B)
WL	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin E) to Engine Control Module, Female Engine Connector, P2 (Pin 3)
WL1	9.76	18	BRN	Engine Control Module Bulkhead, Male Connector (Pin E) to Engine Function Indicator Light, Female Connector, P15 (Pin 2B-)
WSL	9.76	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin G) to Engine Control Module, Female Engine Connector, P2 (Pin 11)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**



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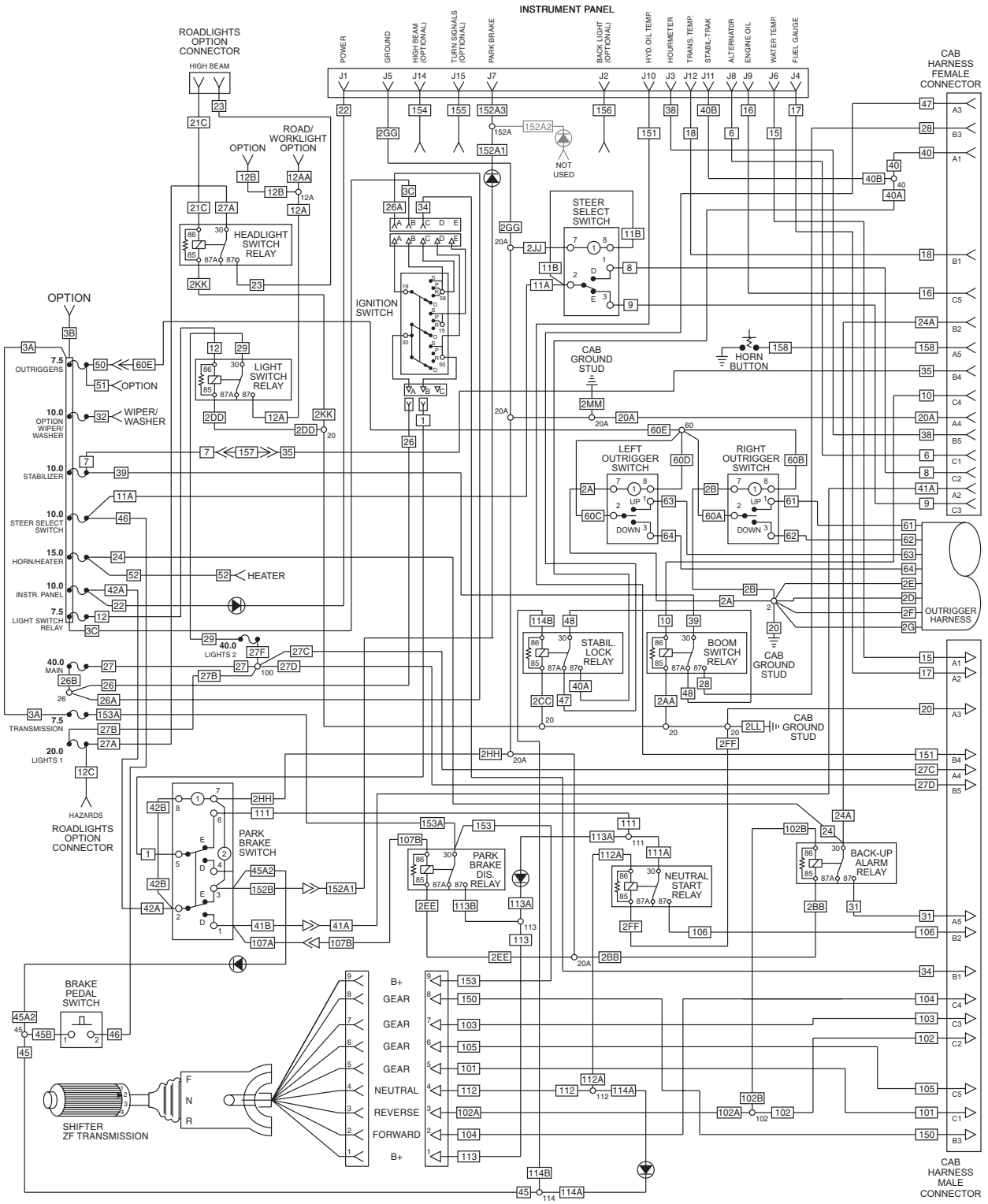
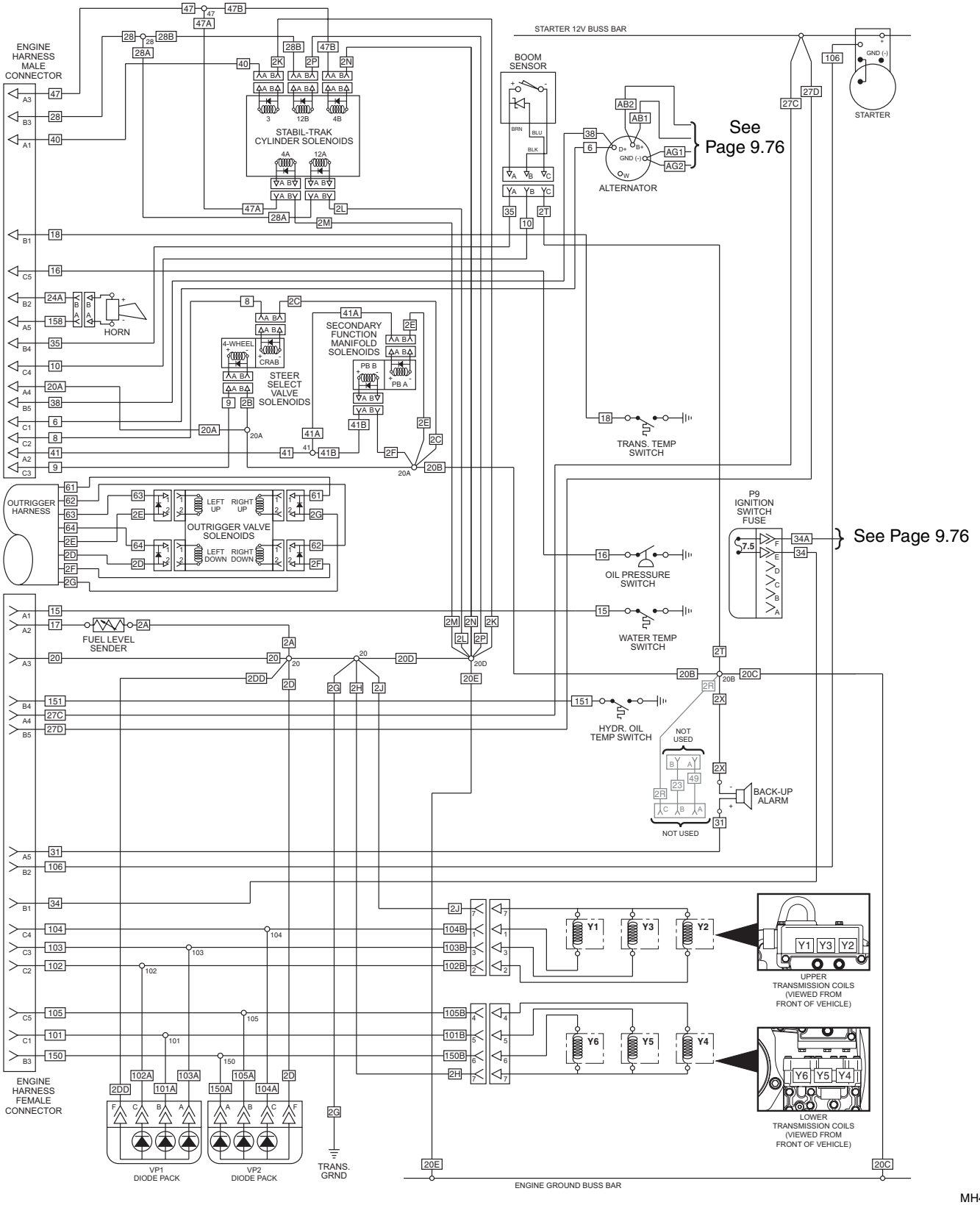
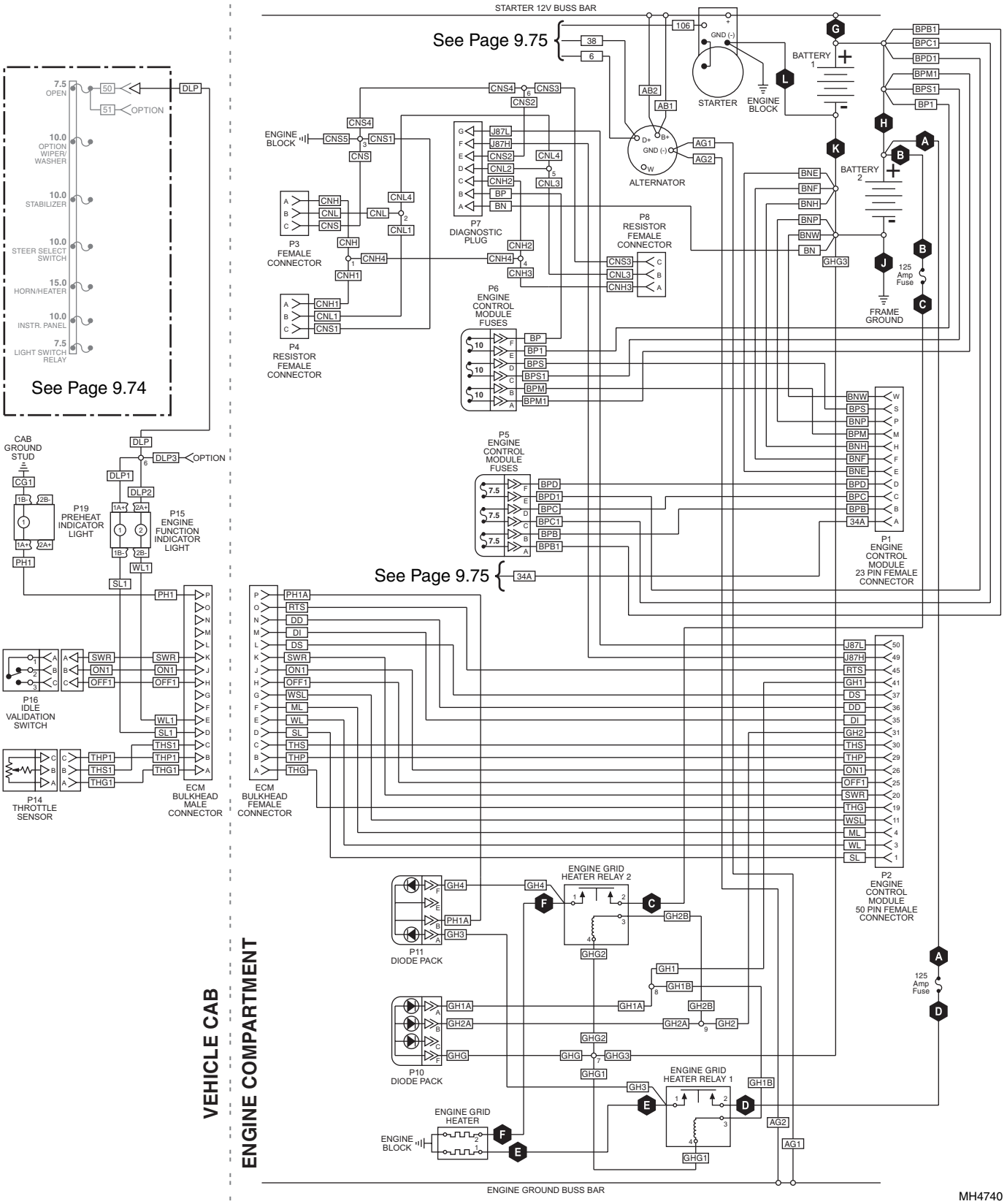
9.7.16 10042 Cab Harness & Engine Harness Electrical Schematic (SN 19031 - 19987 And 0160002332 & After)



MH47801


ENGINE HARNESS MALE CONNECTOR
STARTER 12V BUSS BAR
BOOM SENSOR
STABIL-TRAK CYLINDER SOLENOIDS
ALTERNATOR
STARTER
See Page 9.76
HORN
4-WHEEL CRAB
STEER SELECT VALVE SOLENOIDS
SECONDARY FUNCTION MANIFOLD SOLENOIDS
TRANS. TEMP SWITCH
OUTRIGGER HARNESS
OUTRIGGER VALVE SOLENOIDS
LEFT UP
RIGHT UP
LEFT DOWN
RIGHT DOWN
P9 IGNITION SWITCH FUSE
See Page 9.76
OIL PRESSURE SWITCH
WATER TEMP SWITCH
FUEL LEVEL SENDER
HYDR. OIL TEMP SWITCH
NOT USED
BACK-UP ALARM
NOT USED
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
ENGINE HARNESS FEMALE CONNECTOR
VP1 DIODE PACK
VP2 DIODE PACK
TRANS. GRND
ENGINE GROUND BUSS BAR
MH47802

9.7.17 10042 ECM Cab Harness & Engine Harness (SN 19031 - 19987 And 0160002332 & After)



9.7.18 10054 Cab Harness & Engine Harness Electrical Schematic Legend (SN 13198 Through 19079)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.84 or 9.86	12	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.85 or 9.87	18	BLK	Splice 20 (Ground) to Fuel Level Sender
2AA	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (4-Wheel) (–)
2BB	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Steer Select Valve Solenoid (Crab) (–)
2CC	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F)
2DD	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Diode VESPAK (Pin F) (Engine Harness)
2E	9.85 or 9.87	16	BLK	Not Used
2EE	9.85 or 9.87	18	BLK	Splice 20 (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.85 or 9.87	16	BLK	Not Used
2FF	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Transmission Ground
2GG	9.84 or 9.86	16	BLK	Splice 20 (Ground) to Instrument Panel Connector (Pin J5)
2H	9.85 or 9.87	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)
2HH	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.85 or 9.87	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Steer Select Switch (Pin 7)
2K	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (–)
2KK	9.84 or 9.86	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (–)
2M	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (–)
2N	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (–)
2P	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (–)
2R	9.85 or 9.87	18	BLK	Splice 20 (Ground) to Boom Extend Harness Male Connector (Pin C)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
2S	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Fuel Shut-off Solenoid Connector (Pin C)
2T	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Boom Sensor Connector (Pin C)
2W	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Alternator (GND)
2X	9.85 or 9.87	16	BLK	Splice 20 (Ground) to Back-up Alarm (–)
3	9.84	10	PUR	† Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
3A	9.84	10	PUR	† Fuse Buss Bar to Transmission Fuse to Option Connector
	9.86			§ Fuse Buss Bar to Transmission Fuse
3B	9.86	10	PUR	§ Open Fuse to Female Connector
3C	9.86	10	PUR	§ Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
5	9.85 or 9.87	10	RED	Starter (Pin 30) to Alternator (B+)
6	9.84 or 9.86	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.85 or 9.87	18	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.84 or 9.86	16	BRN	Stabilizer Fuse to Female Connector
8	9.84 or 9.86	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.85 or 9.87	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (+) (Engine Harness)
9	9.84 or 9.86	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.85 or 9.87	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (+) (Engine Harness)
10	9.84 or 9.86	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.85 or 9.87	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)
11	9.84	16	LT GRN/BLU	† Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
				† Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
11A	9.86	16	LT GRN/BLU	§ Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
11B	9.86	16	LT GRN/BLU	§ Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)
12	9.84 or 9.86	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.84	12	DK BLU	† Light Switch Relay (Pin 87) to Splice 12A to Road/Worklights Connector (Option)
	9.86			§ Light Switch Relay (Pin 87) to Splice 12A
12AA	9.86	12	DK BLU	§ Splice 12A to Road/Worklights Connector (Option)
12B	9.84	12	DK BLU	† Splice 12A to Headlight Switch Relay (Pin 30)
	9.86			§ Splice 12A to Option Connector
12C	9.84	16	DK BLU	† Splice 27 to Roadlights Connector (Option) (Hazards)
	9.86			§ Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.84 or 9.86	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.85 or 9.87	18	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.84 or 9.86	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.85 or 9.87	18	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
17	9.84 or 9.86	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.85 or 9.87	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)
18	9.84 or 9.86	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.85 or 9.87	18	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.84 or 9.86	14	BLK	Splice 20 (Ground) to Cab Ground Stud (Cab Harness)
		12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (Pin A3) (Cab Harness)
	9.85 or 9.87	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
21C	9.84 or 9.86	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Connector (Option) (Main Beam)
22	9.84 or 9.86	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.84 or 9.86	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Connector (Option) (Main Beam) (Cab Harness)
	9.85 or 9.87	16	ORG/GRN	Logic Harness Female Connector (Pin B) to Boom Extend Harness Male Connector (Pin B) (Engine Harness)
24	9.84 or 9.86	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.84 or 9.86	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.85 or 9.87	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (+) (Engine Harness)
26	9.84	10	RED	† Main Fuse to Ignition Switch 3-Way Connector (Pin A)
	9.86			§ Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.84	10	RED	† Main Fuse to Ignition Switch 5-Way Connector (Pin A)
	9.86			§ Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.86	10	RED	§ Splice 26 to Main Fuse
27	9.84 or 9.86	10	RED	Main Fuse to Splice 100 (Cab Harness)
	9.85 or 9.87	10	RED	Splice 27 to Starter (Pin 30) (Engine Harness)
27A	9.84	12	RED	† Optional Lights Fuse to Splice 27 to Light Switch Relay (Pin 30)
	9.86			§ Optional Lights Fuse (Lights 1) to Splice 27 to Headlight Switch Relay (Pin 30)
27B	9.84	12	RED	† Optional Lights Fuse to Main Fuse
	9.86			§ Optional Lights Fuse (Lights 1) to Splice 100
27C	9.84 or 9.86	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.85 or 9.87	12	RED	Cab/Chassis Female Connector (Pin A4) to Splice 27 (Engine Harness)
27D	9.84 or 9.86	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.85 or 9.87	12	RED	Cab/Chassis Female Connector (Pin B5) to Splice 27 (Engine Harness)
27F	9.86	12	RED	§ Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.84 or 9.86	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.85 or 9.87	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.85 or 9.87	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (+)
28B	9.85 or 9.87	16	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (+)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
29	9.86	12	RED	§ Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)
31	9.84 or 9.86	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.85 or 9.87	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)
32	9.84 or 9.86	14	GRY/WHT	Option Fuse to Wiper/Washer Connector (Option)
34	9.84 or 9.86	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.85 or 9.87	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to Fuel Shut-off Solenoid Connector (Pin A) (Engine Harness)
35	9.84 or 9.86	16	BRN/WHT	Female Connector to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.85 or 9.87	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.84 or 9.86	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.85 or 9.87	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.84 or 9.86	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.84 or 9.86	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.85 or 9.87	16	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (+) (Engine Harness)
40A	9.84 or 9.86	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.84 or 9.86	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)
41	9.84	16	DK BLU/WHT	† Park Brake Switch Connector (Pin 1) to Splice 41 to Male Connector (Cab Harness)
				Not Used (Cab Harness)
	9.85 or 9.87		BLU/WHT	Not Used (Engine Harness)
41A	9.86	16	DK BLU/WHT	§ Not Used (Cab Harness)
	9.85 or 9.87		BLU/WHT	Not Used (Engine Harness)
41B	9.86	16	DK BLU/WHT	§ Park Brake Switch Connector (Pin 1) to Splice 41 (Cab Harness)
	9.85 or 9.87		BLU/WHT	Not Used (Engine Harness)
41C	9.86	16	DK BLU/WHT	§ Splice 41 to Male Connector
42	9.84	18	TAN	† Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
				Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
42A	9.86	18	TAN	§ Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.86	18	TAN	§ Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.84 or 9.86	16	DK BLU/ORG	Splice 45 to Splice 114
45A	9.84	16	DK BLU/ORG	† Splice 45 to Inline Diode to Splice 152
45A2	9.86	16	DK BLU/ORG	§ Splice 45 to Inline Diode to Splice 152B
45B	9.84 or 9.86	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.84 or 9.86	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
47	9.84 or 9.86	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.85 or 9.87	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)
47A	9.85 or 9.87	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (+)
47B	9.85 or 9.87	16	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (+)
48	9.84 or 9.86	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.85 or 9.87	16	RED/BLU	Logic Harness Female Connector (Pin A) to Boom Extend Harness Male Connector (Pin A)
50	9.84 or 9.86	16	WHT/YEL	Option Fuse to Option Connector
51	9.84 or 9.86	16	WHT/RED	Option Fuse to Option Connector
52	9.84 or 9.86	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
101	9.84 or 9.86	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.85 or 9.87	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.85 or 9.87	16	BRN	Splice 101 to Diode VESPAK (Pin B)
101B	9.85 or 9.87	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.84 or 9.86	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.85 or 9.87	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.84 or 9.86	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.85 or 9.87	16	PNK	Splice 102 to Diode VESPAK (Pin E) (Engine Harness)
102B	9.84 or 9.86	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.85 or 9.87	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)
103	9.84 or 9.86	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.85 or 9.87	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.85 or 9.87	16	BLU	Splice 103 to Diode VESPAK (Pin A)
103B	9.85 or 9.87	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)
104	9.84 or 9.86	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.85 or 9.87	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.85 or 9.87	16	YEL	Splice 104 to Diode VESPAK (Pin E)
104B	9.85 or 9.87	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

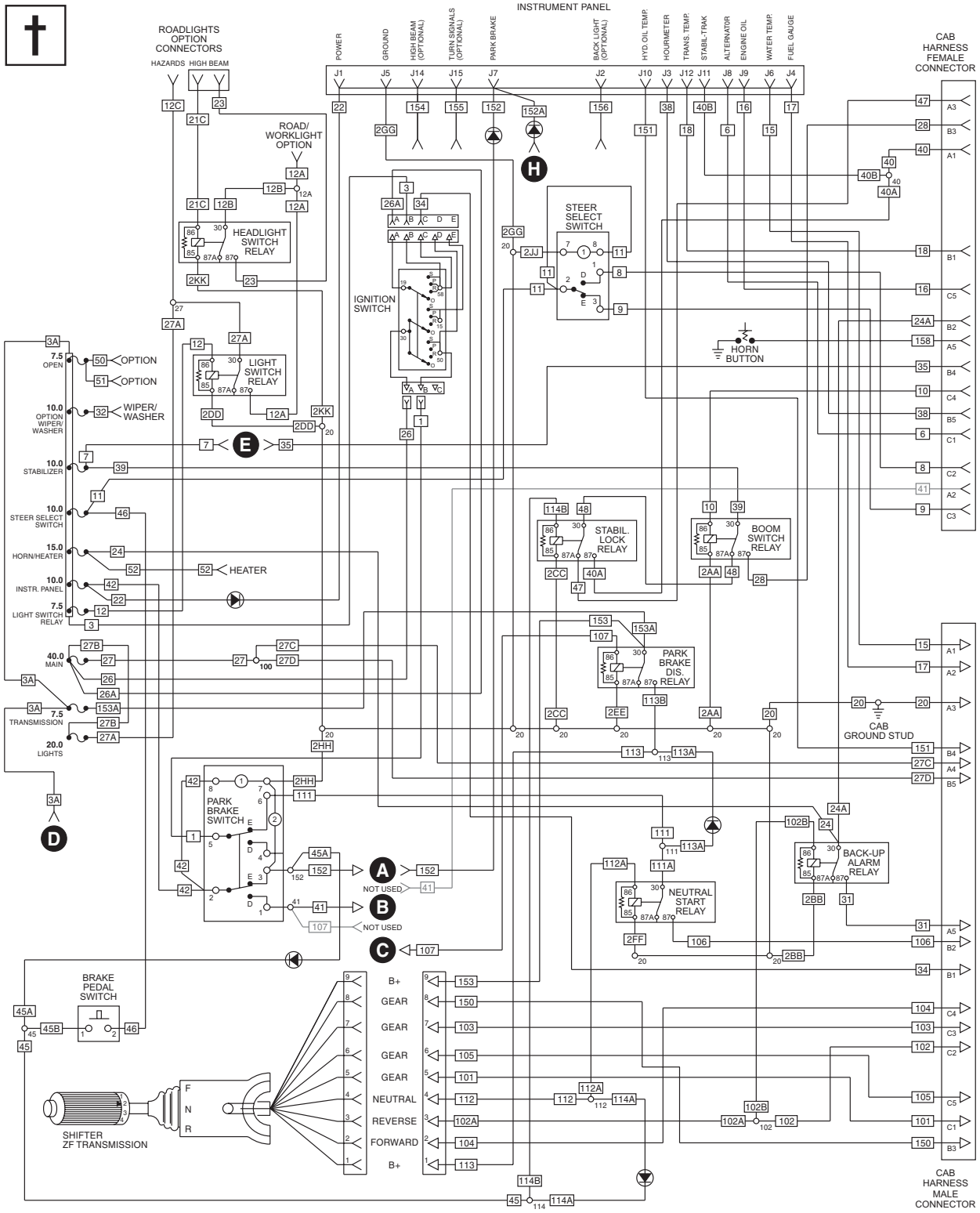
Wire No.	Page	Gauge	Color	From - Function - To
105	9.84 or 9.86	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.85 or 9.87	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.85 or 9.87	16	GRN	Splice 105 to Diode VESPAK (Pin B)
105B	9.85 or 9.87	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)
106	9.84 or 9.86	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.85 or 9.87	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter (Pin 50) (Engine Harness)
107	9.84	18	BLU	† Not Used
				† Male Connector to Park Brake Disconnect Relay (Pin 86)
107A	9.86	18	BLU	§ Not Used
107B	9.86	18	BLU	§ Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.84 or 9.86	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.84 or 9.86	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.84 or 9.86	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.84 or 9.86	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.84 or 9.86	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.84 or 9.86	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.84 or 9.86	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.84 or 9.86	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.84 or 9.86	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.84 or 9.86	16	VIO	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.85 or 9.87	16	VIO	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.85 or 9.87	16	VIO	Splice 150 to Diode VESPAK (Pin A)
150B	9.85 or 9.87	18	VIO	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)
151	9.84 or 9.86	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.85 or 9.87	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152	9.84 or 9.86	16	BLK/WHT	† Park Brake Switch Connector (Pin 3) to Splice 152 to Male Connector (Cab Harness)
				† Female Connector to Inline Diode to Instrument Panel Connector (Pin J7) (Cab Harness)
	9.85 or 9.87	10	RED	Starter (Pin M) to Fuel Shut-off Solenoid Connector (Pin B) (Engine Harness)
152A	9.84	16	BLK/WHT	† Instrument Panel Connector (Pin J7) to Inline Diode to Female Connector
152A1	9.86	16	BLK/WHT	§ Female Connector to Inline Diode to Splice 152A
152A2	9.86	16	BLK/WHT	§ Splice 152A to Inline Diode to Female Connector
152A3	9.86	16	BLK/WHT	§ Splice 152A to Instrument Panel Connector (Pin J7)

† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
152B1	9.86	16	BLK/WHT	§ Male Connector to Splice 152B
152B2	9.86	16	BLK/WHT	§ Splice 152B to Park Brake Switch Connector (Pin 3)
153	9.84 or 9.86	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.84 or 9.86	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.84 or 9.86	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)
155	9.84 or 9.86	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.84 or 9.86	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
158	9.84 or 9.86	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5) (Cab Harness)
	9.85 or 9.87	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (–) (Engine Harness)

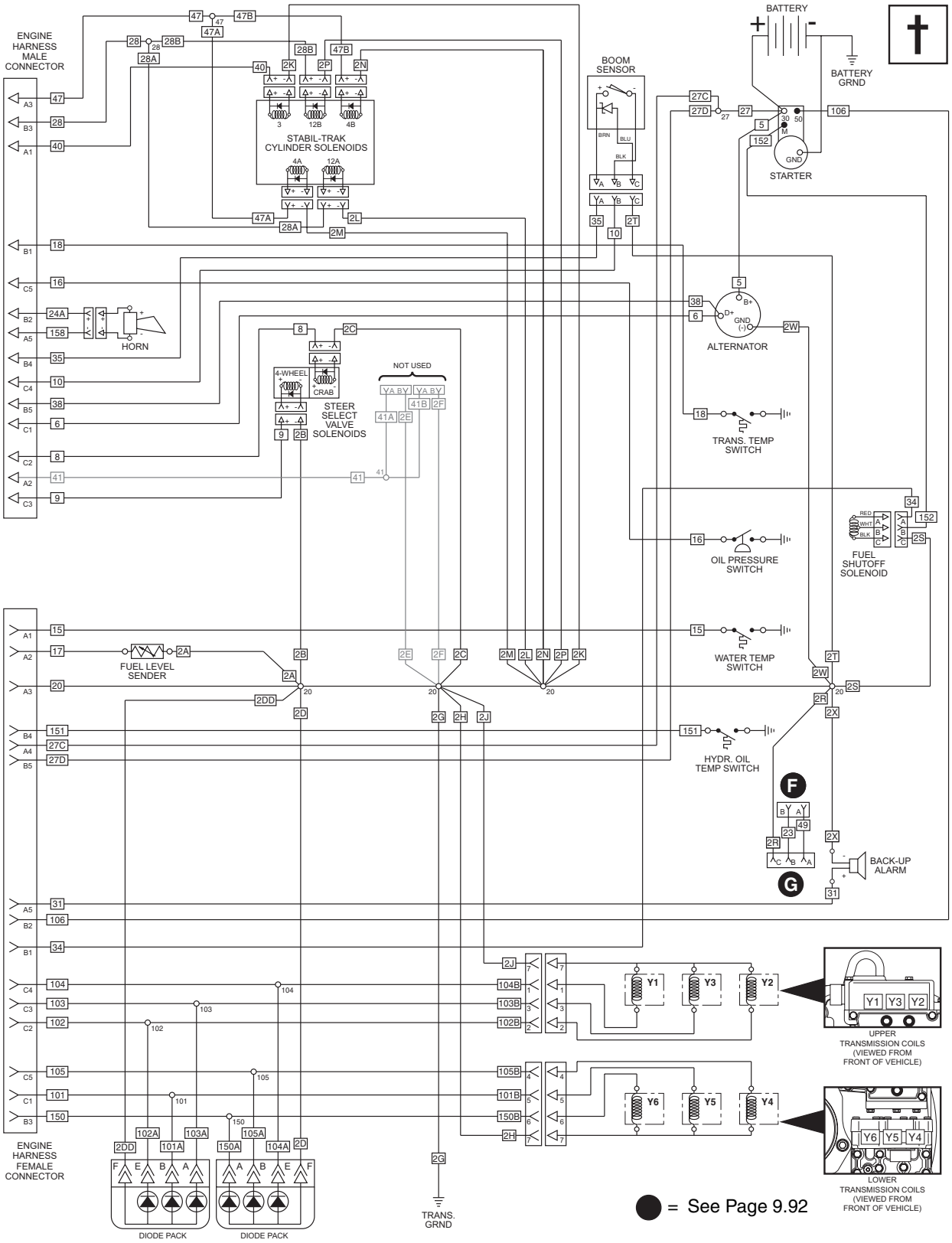
† SN 13198 through 16782 w/o Lighting Package
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 19079

9.7.19 10054 Cab Harness & Engine Harness Electrical Schematic (SN 13198 Through 16782, Without Lighting Package)



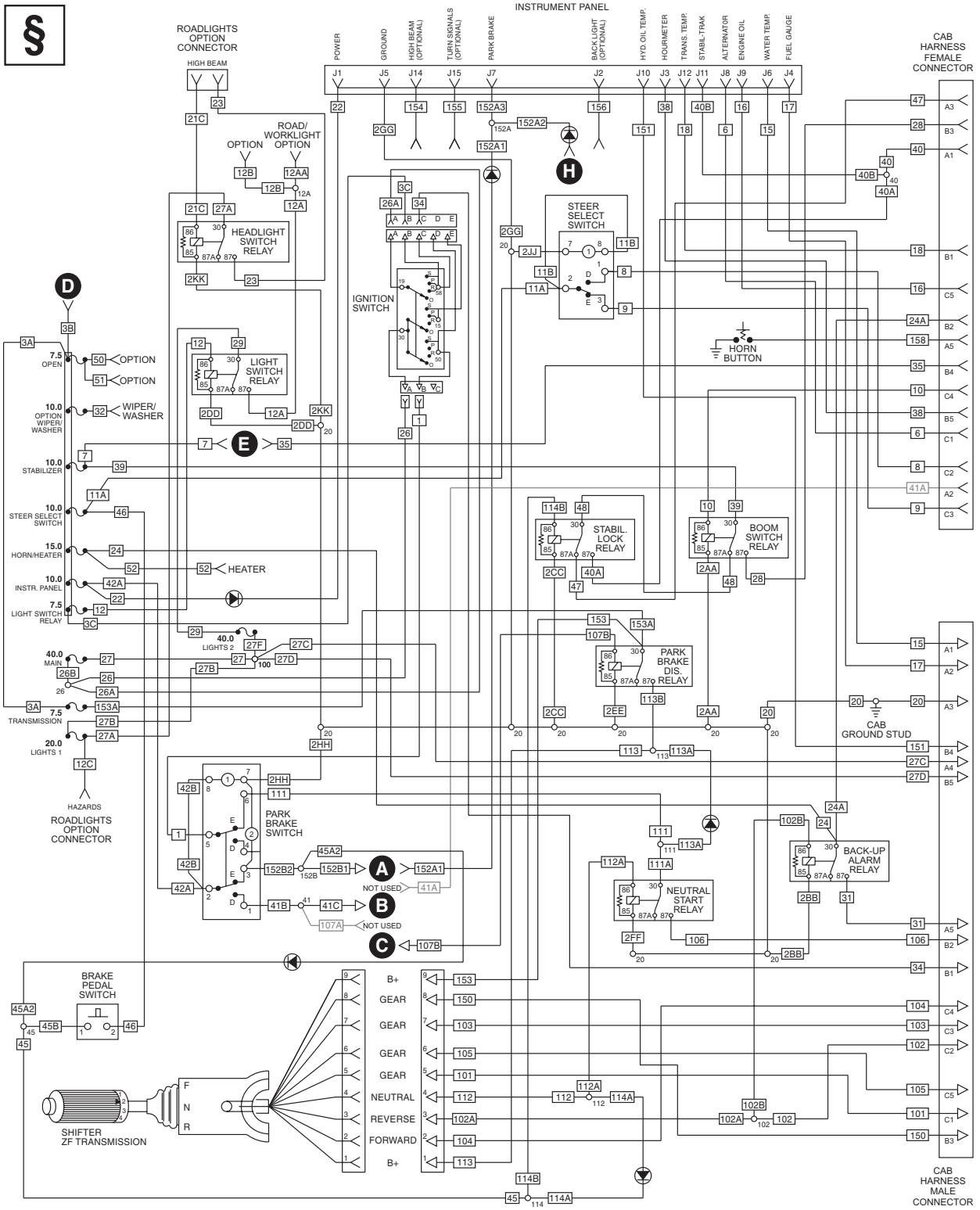
● = See Page 9.92

MA78211


ENGINE HARNESS MALE CONNECTOR
ENGINE HARNESS FEMALE CONNECTOR
STABIL-TRAK CYLINDER SOLENOIDS
BOOM SENSOR
BATTERY
BATTERY GRND
STARTER
ALTERNATOR
HORN
STEER SELECT VALVE SOLENOIDS
NOT USED
TRANS. TEMP SWITCH
OIL PRESSURE SWITCH
FUEL SHUTOFF SOLENOID
WATER TEMP SWITCH
FUEL LEVEL SENDER
HYDR. OIL TEMP SWITCH
BACK-UP ALARM
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
DIODE PACK
DIODE PACK
TRANS. GRND
= See Page 9.92

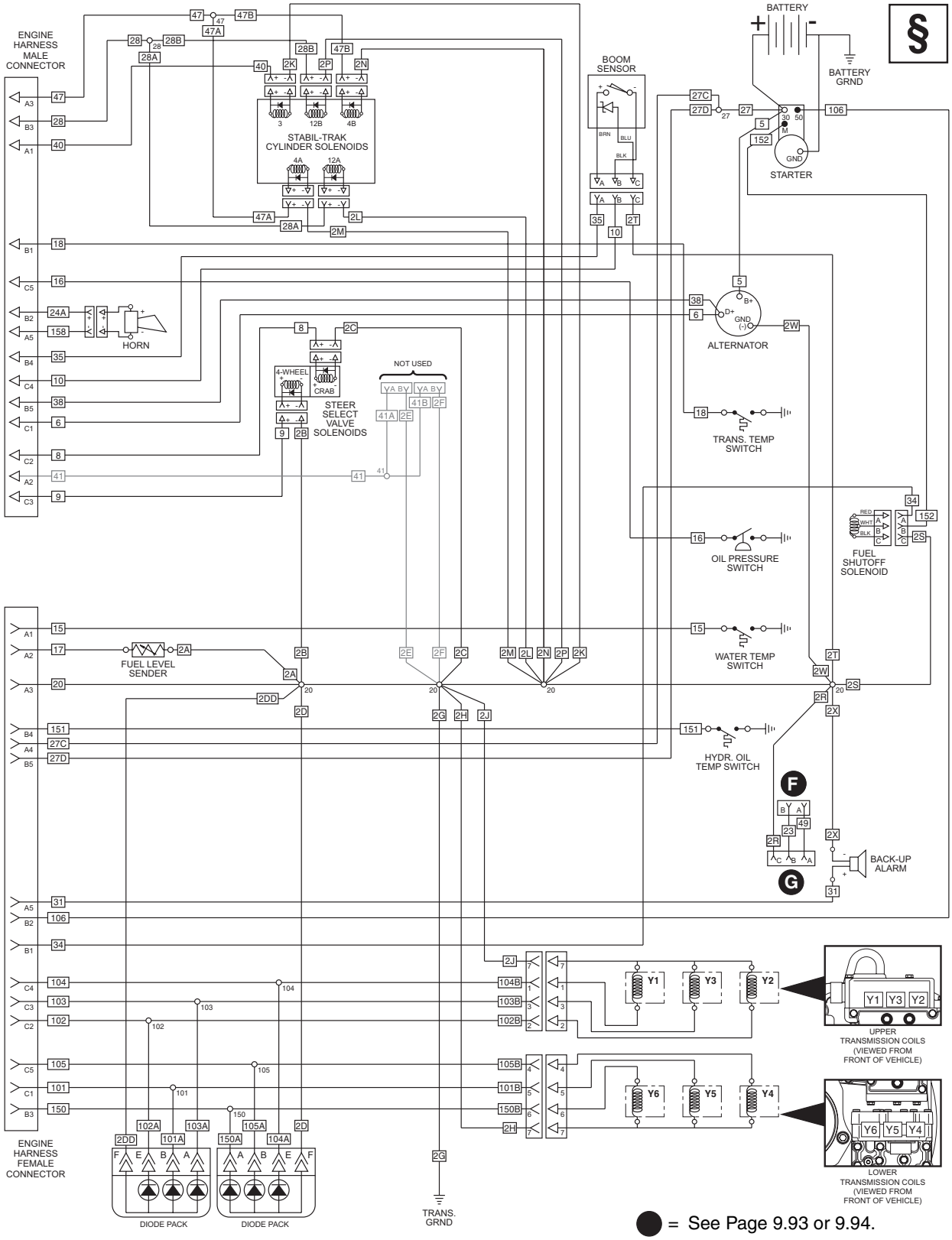
MA78212

9.7.20 10054 Cab Harness & Engine Harness Electrical Schematic (SN 13198 Through 16782, With Lighting Package and SN 16783 Through 19079)



● = See Page 9.93 or 9.94.

MH43601



● = See Page 9.93 or 9.94.

MH43602

9.7.21 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic Legend (SN 13198 Through 19079)

Wire No.	Page	Gauge	Color	From - Function - To
2	9.92, 9.93 or 9.94	14	BLK	Splice 2A to Cab Ground Stud
2A1	9.92, 9.93 or 9.94	16	BLK	Left Outrigger Lock Relay (Pin 85) to Right Outrigger Lock Relay (Pin 85)
2A2	9.92, 9.93 or 9.94	16	BLK	Right Outrigger Lock Relay (Pin 85) to Boom Extend Interlock Relay (Pin 85)
2A3	9.92, 9.93 or 9.94	16	BLK	Splice 2A to Left Outrigger Lock Relay (Pin 85)
2B1	9.92 or 9.93	16	BLK	‡ Outrigger Lockout Relay (Pin 85) to Boom Extend Lockout Relay (Pin 85)
2B2	9.92, 9.93 or 9.94	16	BLK	Boom Extend Lockout Relay (Pin 85) to Park Brake Interlock Relay (Pin 85)
2B3	9.92 or 9.93	16	BLK	‡ Splice 2A to Outrigger Lockout Relay (Pin 85)
	9.94	16	BLK	~ Splice 2A to Boom Extend Lockout Relay (Pin 85)
2C1	9.92, 9.93 or 9.94	16	BLK	Stabil-TRAK Interlock Relay (Pin 85) to Stabil-TRAK Lock Up Relay (Pin 85)
2C2	9.92, 9.93 or 9.94	16	BLK	Splice 2A to Stabil-TRAK Interlock Relay (Pin 85)
2D	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Outrigger Valve Solenoid (Left Down) (Pin 2)
2E	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Outrigger Valve Solenoid (Left Up) (Pin 2)
2F	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Outrigger Valve Solenoid (Right Down) (Pin 2)
2G	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Outrigger Valve Solenoid (Right Up) (Pin 2)
2H	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Boom Extend Solenoid Connector (Pin B)
2J	9.92, 9.93 or 9.94	14	BLK	Splice 2B to Cab Ground Stud
2K1	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B)
2K2	9.92, 9.93 or 9.94	16	BLK	Splice 2B to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B)
2L1	9.92, 9.93 or 9.94	16	BLK	Splice 2A to Right Outrigger Switch (Pin 7)

‡ SN 13198 through 17984
~ SN 17985 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
2L2	9.92, 9.93 or 9.94	16	BLK	Splice 2A to Left Outrigger Switch (Pin 7)
3	9.92, 9.93 or 9.94	14	RED	Male Connector at Open Fuse (Cab Harness, Wire 3B) to Splice 3
3A	9.92, 9.93 or 9.94	14	RED	Splice 3 to Outrigger Switches/Boom Sensor Fuse
3B	9.92, 9.93 or 9.94	14	RED	Splice 3 to Outrigger Cylinders Fuse
3C	9.92, 9.93 or 9.94	14	RED	Splice 3 to Female Connector (Option)
7	9.92, 9.93 or 9.94	16	TAN	Stabil-TRAK Lock Up Relay (Pin 30) to Male Connector at Stabilizer Fuse
23	9.92, 9.93 or 9.94	16	ORG/GRN	Boom Extend Interlock Relay (Pin 86) to Engine Harness Male Connector (Pin B)
35	9.92, 9.93 or 9.94	16	BRN/GRN	Stabil-TRAK Lock Up Relay (Pin 87A) to Male Connector at Stabilizer Fuse (Cab Harness, Wire 35)
45A	9.92, 9.93 or 9.94	16	DK BLU/ORG	Stabil-TRAK Lock Up Relay (Pin 87) to Male Connector at Park Brake Switch (Cab Harness, Wire 152A1)
45B	9.92, 9.93 or 9.94	16	DK BLU/ORG	Female Connector at Park Brake Switch (Cab Harness, Wire 152B1) to Male Connector at Park Brake Switch (Cab Harness, Wire 152A1)
49	9.92, 9.93 or 9.94	16	RED/BLU	Outrigger Switches/Boom Sensor Fuse to Engine Harness Male Connector (Pin A)
50A	9.92 or 9.93	16	RED/WHT	‡ Boom Extend Lockout Relay (Pin 87A) to Outrigger Lockout Relay (Pin 30)
50B	9.92 or 9.93	16	RED/WHT	‡ Outrigger Lockout Relay (Pin 30) to Stabil-TRAK Interlock Relay (Pin 86)
	9.94	16	RED/WHT	~ Boom Extend Lockout Relay (Pin 87A) to Stabil-TRAK Interlock Relay (Pin 86)
50C	9.92, 9.93 or 9.94	16	RED/WHT	Right Outrigger Cylinder Pressure Switch Connector (Pin A) to Boom Extend Lockout Relay (Pin 87A)
51A	9.92, 9.93 or 9.94	16	BLU/WHITE	Park Brake Interlock Relay (Pin 87A) to Splice 51
51B	9.92, 9.93 or 9.94	16	BLU/WHITE	Splice 51 to Female Connector at Park Brake Switch (Cab Harness, Wire 107B)
51C	9.92, 9.93 or 9.94	16	BLU/WHITE	Splice 51 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A)
51D	9.92, 9.93 or 9.94	16	BLU/WHITE	Splice 51 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A)
52	9.92, 9.93 or 9.94	16	DK BLU/RED	Park Brake Interlock Relay (Pin 30) to Female Connector at Park Brake Switch (Cab Harness, Wire 41C)

‡ SN 13198 through 17984
~ SN 17985 through 19079

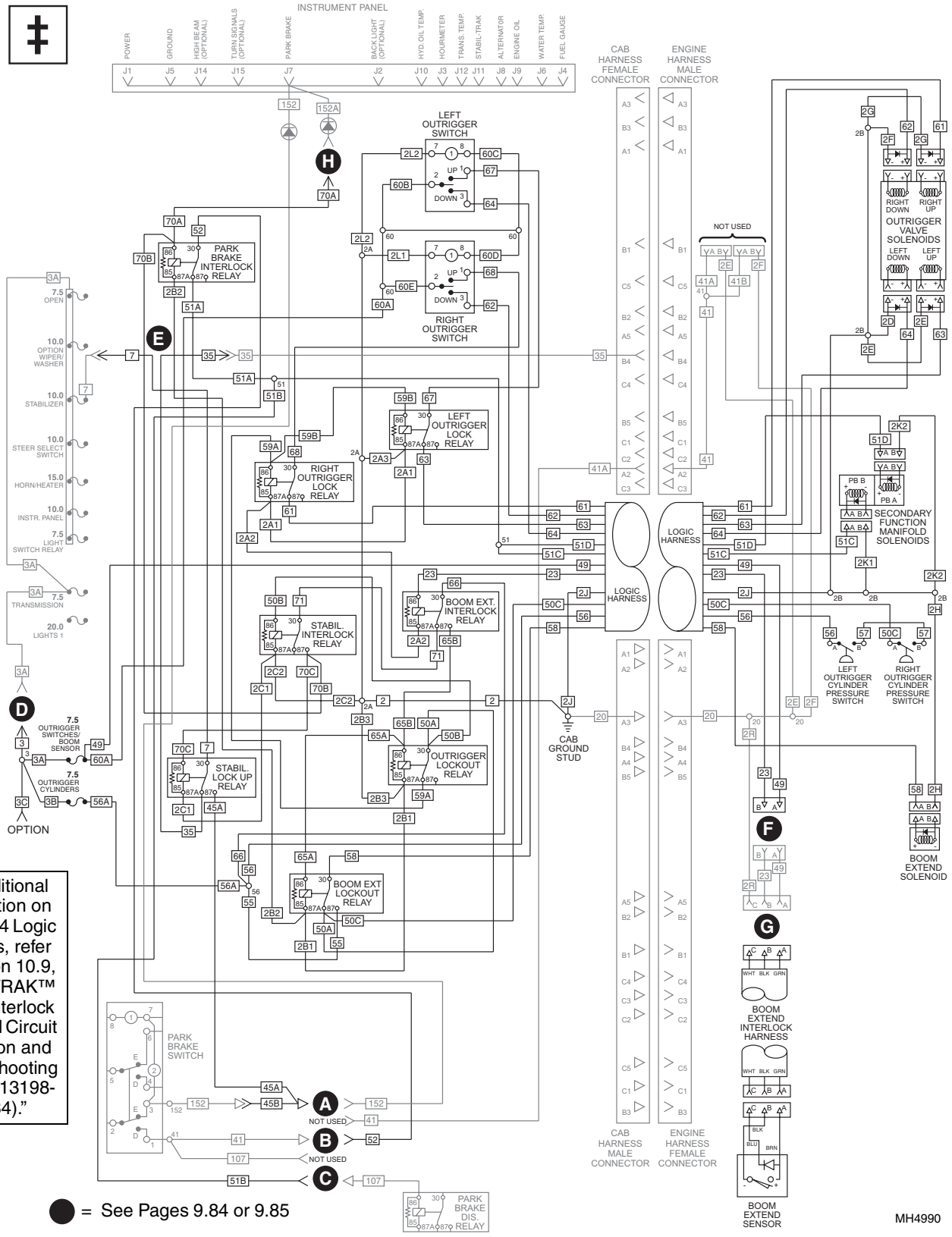
Wire No.	Page	Gauge	Color	From - Function - To
55	9.92, 9.93 or 9.94	16	ORG/RED	Boom Extend Lockout Relay (Pin 87) to Splice 56
56	9.92, 9.93 or 9.94	16	GRY/BLU	Splice 56 to Left Outrigger Cylinder Pressure Switch Connector (Pin A)
56A	9.92, 9.93 or 9.94	16	GRY/BLU	Splice 56 to Outrigger Cylinder Fuse
57	9.92, 9.93 or 9.94	16	GRY/ORG	Right Outrigger Cylinder Pressure Switch Connector (Pin B) to Left Outrigger Cylinder Pressure Switch Connector (Pin B)
58	9.92, 9.93 or 9.94	16	GRN	Boom Extend Lockout Relay (Pin 30) to Boom Extend Solenoid Connector (Pin A)
59A	9.92 or 9.93	16	BRN	‡ Outrigger Lockout Relay (Pin 87A) to Right Outrigger Lock Relay (Pin 86)
59B	9.92 or 9.93	16	BRN	‡ Right Outrigger Lock Relay (Pin 86) to Left Outrigger Lock Relay (Pin 86)
60A	9.92, 9.93 or 9.94	16	YEL/GRN	Outrigger Switches/Boom Sensor Fuse to Splice 60
60B	9.92, 9.93 or 9.94	16	YEL/GRN	Splice 60 to Left Outrigger Switch (Pin 2)
60C	9.92, 9.93 or 9.94	16	YEL/GRN	Splice 60 to Left Outrigger Switch (Pin 8)
60D	9.92, 9.93 or 9.94	16	YEL/GRN	Splice 60 to Right Outrigger Switch (Pin 8)
60E	9.92, 9.93 or 9.94	16	YEL/GRN	Splice 60 to Right Outrigger Switch (Pin 2)
61	9.92, 9.93 or 9.94	16	RED/GRY	Right Outrigger Lock Relay (Pin 87A) to Outrigger Valve Solenoid (Right Up) (Pin 1)
62	9.92, 9.93 or 9.94	16	PUR/WHT	Right Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Right Down) (Pin 1)
63	9.92, 9.93 or 9.94	16	BRN/YEL	Left Outrigger Lock Relay (Pin 87A) to Outrigger Valve Solenoid (Left Up) (Pin 1)
64	9.92, 9.93 or 9.94	16	GRY/PUR	Left Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Left Down) (Pin 1)
65A	9.92 or 9.93	16	DK BLU	‡ Boom Extend Lockout Relay (Pin 86) to Outrigger Lockout Relay (Pin 86)
	9.94	16	DK BLU	~ Boom Extend Lockout Relay (Pin 86) to Boom Extend Interlock Relay (Pin 87)
65B	9.92 or 9.93	16	DK BLU	‡ Outrigger Lockout Relay (Pin 86) to Boom Extend Interlock Relay (Pin 87)
66	9.92, 9.93 or 9.94	16	ORG/GRY	Splice 56 to Boom Extend Interlock Relay (Pin 30)
67	9.92, 9.93 or 9.94	16	BRN/BLK	Left Outrigger Switch (Pin 1) to Left Outrigger Lock Relay (Pin 30)

‡ SN 13198 through 17984
~ SN 17985 through 19079

Wire No.	Page	Gauge	Color	From - Function - To
68	9.92, 9.93 or 9.94	16	RED/BLK	Right Outrigger Switch (Pin 1) to Right Outrigger Lock Relay (Pin 30)
70A	9.92, 9.93 or 9.94	16	ORG/BLK	Park Brake Interlock Relay (Pin 86) to Male Connector at Dash Panel (Cab Harness, Wire 152A2)
70B	9.92, 9.93 or 9.94	16	ORG/BLK	Park Brake Interlock Relay (Pin 86) to Stabil-TRAK Interlock Relay (Pin 87)
70C	9.92, 9.93 or 9.94	16	ORG/BLK	Stabil-TRAK Lock Up Relay (Pin 86) to Stabil-TRAK Interlock Relay (Pin 87)
71	9.92, 9.93 or 9.94	16	ORG/WHT	Stabil-TRAK Interlock Relay (Pin 30) to Boom Extend Interlock Relay (Pin 87A)
71A	9.94	16	ORG/WHT	~ Boom Extend Interlock Relay (Pin 87A) to Right Outrigger Lock Relay (Pin 86)
71B	9.94	16	ORG/WHT	~ Right Outrigger Lock Relay (Pin 86) to Left Outrigger Lock Relay (Pin 86)

‡ SN 13198 through 17984
~ SN 17985 through 19079

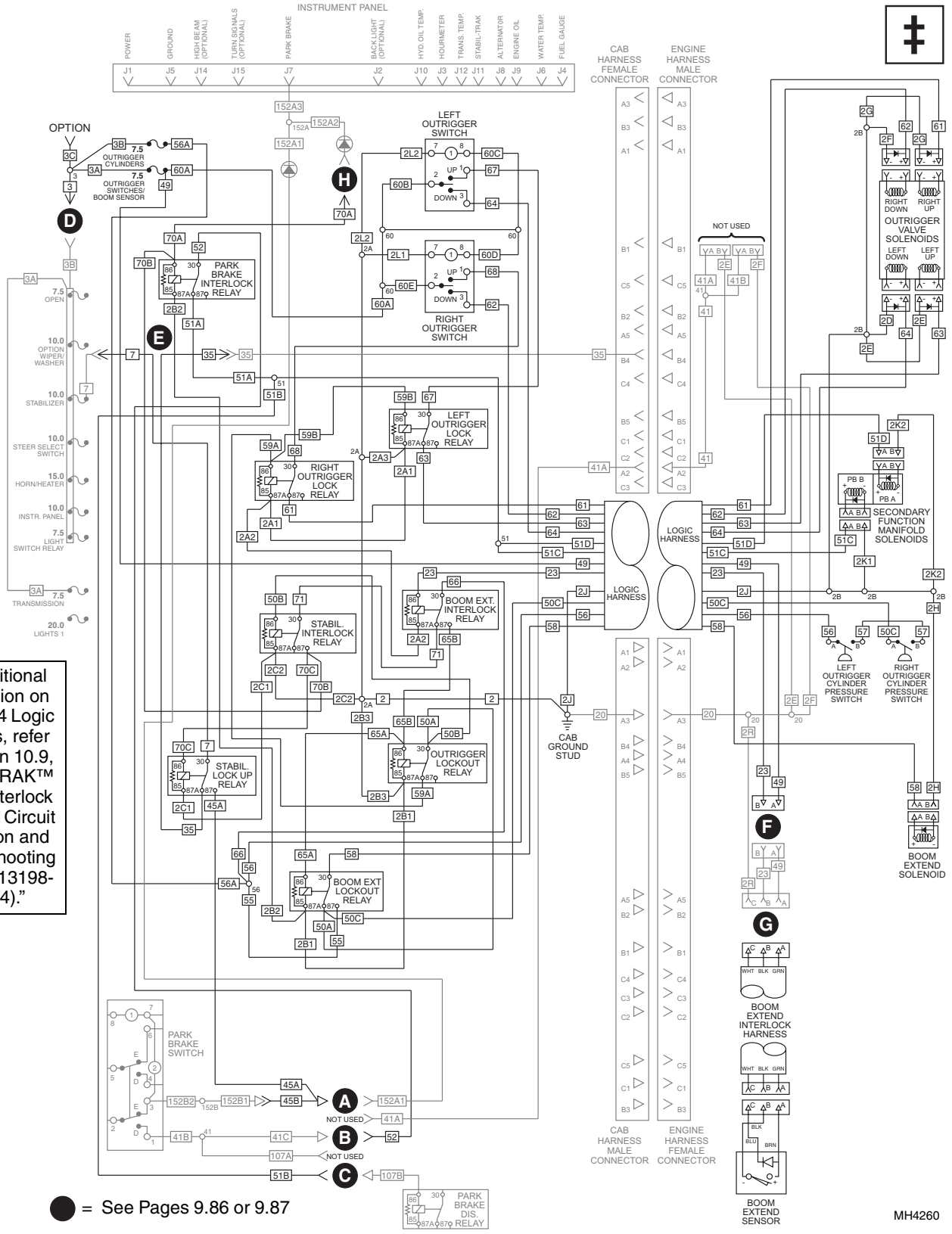
9.7.22 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic (SN 13198 Through 16782, Without Lighting Package)



For additional information on the 10054 Logic Harness, refer to Section 10.9, "Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984)."

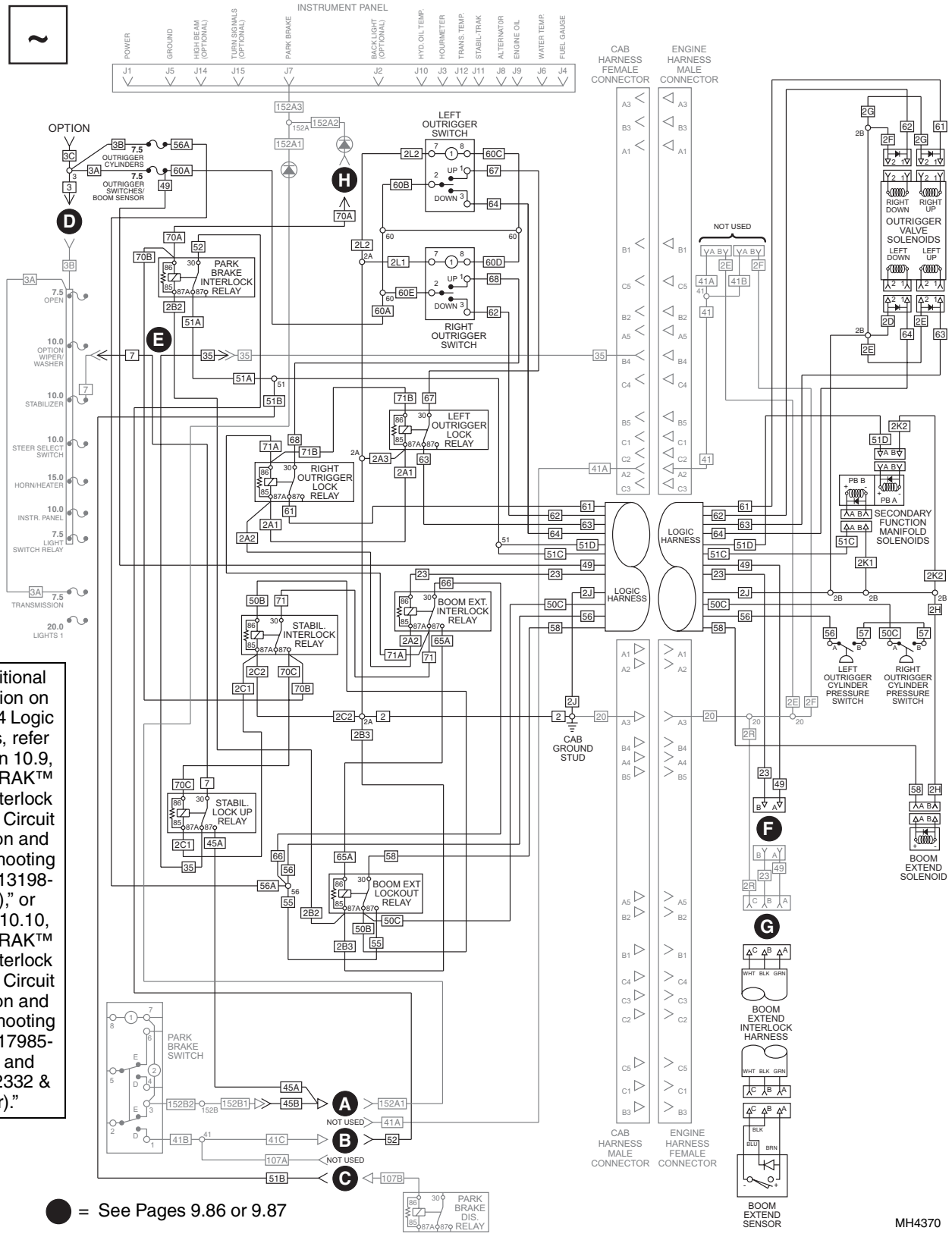
● = See Pages 9.84 or 9.85

9.7.23 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic (SN 13198 Through 16782, With Lighting Package and SN 16783 Through 17984)



For additional information on the 10054 Logic Harness, refer to Section 10.9, "Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984)."

9.7.24 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic (SN 13198 Through 16782, With Lighting Package and SN 17985 Through 19079)



For additional information on the 10054 Logic Harness, refer to Section 10.9, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984),” or Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After).”

9.7.25 10054 Cab Harness, Engine Harness & ECM Cab Harness Electrical Schematic Legend (SN 19080 - 19987 And 0160002332 & After)

Wire No.	Page	Gauge	Color	From - Function - To
1	9.102	10	WHT	Ignition Switch 3-Way Connector (Pin B) to Park Brake Switch Connector (Pin 5)
2A	9.103	16	BLK	Splice 20 (Ground) to Fuel Level Sender
2AA	9.102	18	BLK	Splice 20 (Ground) to Boom Switch Relay (Pin 85)
2B	9.103	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (4-Wheel) (Pin B)
2BB	9.102	18	BLK	Splice 20A (Ground) to Back-up Alarm Relay (Pin 85)
2C	9.103	16	BLK	Splice 20A (Ground) to Steer Select Valve Solenoid (Crab) (Pin B)
2CC	9.102	18	BLK	Splice 20 (Ground) to Stabilizer Lock Relay (Pin 85)
2D	9.103	16	BLK	Splice 20 (Ground) to Diode VESPAK VP2 (Pin F)
2DD	9.102	18	BLK	Splice 20 (Ground) to Light Switch Relay (Pin 85) (Cab Harness)
	9.103	16	BLK	Splice 20 (Ground) to Diode VESPAK VP1 (Pin F) (Engine Harness)
2E	9.103	18	BLK	Not Used
2EE	9.102	18	BLK	Splice 20A (Ground) to Park Brake Disconnect Relay (Pin 85)
2F	9.103	18	BLK	Not Used
2FF	9.102	18	BLK	Splice 20 (Ground) to Neutral Start Relay (Pin 85)
2G	9.103	16	BLK	Splice 20 (Ground) to Transmission Ground
2GG	9.102	16	BLK	Splice 20A (Ground) to Instrument Panel Connector (Pin J5)
2H	9.103	18	BLK	Splice 20 (Ground) to Lower Transmission Connector (Pin 7, Solenoid Y4, Y5 & Y6)
2HH	9.102	18	BLK	Splice 20A (Ground) to Park Brake Switch Connector (Pin 7)
2J	9.103	18	BLK	Splice 20 (Ground) to Upper Transmission Connector (Pin 7, Solenoid Y1, Y2 & Y3)
2JJ	9.102	18	BLK	Splice 20A (Ground) to Steer Select Switch (Pin 7)
2K	9.103	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 3) (Pin B)
2KK	9.102	18	BLK	Splice 20 (Ground) to Headlight Switch Relay (Pin 85)
2L	9.103	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12A) (Pin B)
2LL	9.102	12	BLK	Splice 20 (Ground) to Cab Ground Stud
2M	9.103	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4A) (Pin B)
2MM	9.102	12	BLK	Splice 20A (Ground) to Cab Ground Stud
2N	9.103	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 4B) (Pin B)
2P	9.103	18	BLK	Splice 20D (Ground) to Stabil-TRAK™ Cylinder Solenoid (SOL 12B) (Pin B)
2R	9.103	16	BLK	Splice 20B (Ground) to Boom Extend Harness Male Connector (Pin C)
2T	9.103	16	BLK	Splice 20B (Ground) to Boom Sensor Connector (Pin C)
2X	9.103	16	BLK	Splice 20B (Ground) to Back-up Alarm (–)
3A	9.102	10	PUR	Fuse Buss Bar to Transmission Fuse
3B	9.102	10	PUR	Open Fuse to Female Connector
3C	9.102	10	PUR	Ignition Switch 5-Way Connector (Pin B) to Fuse Buss Bar
6	9.102	18	YEL	Instrument Panel Connector (Pin J8) to Cab/Chassis Female Connector (Pin C1) (Cab Harness)
	9.103 & 9.104	16	YEL	Cab/Chassis Male Connector (Pin C1) to Alternator (D+) (Engine Harness)
7	9.102	16	BRN	Stabilizer Fuse to Female Connector
8	9.102	16	GRN/WHT	Steer Select Switch (Pin 1) to Cab/Chassis Female Connector (Pin C2) (Cab Harness)
	9.103	16	LT GRN/WHT	Cab/Chassis Male Connector (Pin C2) to Steer Select Valve Solenoid (Crab) (A) (Engine Harness)
9	9.102	16	GRN/BLK	Steer Select Switch (Pin 3) to Cab/Chassis Female Connector (Pin C3) (Cab Harness)
	9.103	16	LT GRN/BLK	Cab/Chassis Male Connector (Pin C3) to Steer Select Valve Solenoid (4-Wheel) (A) (Engine Harness)
10	9.102	16	TAN	Boom Switch Relay (Pin 86) to Cab/Chassis Female Connector (Pin C4) (Cab Harness)
	9.103	16	TAN	Cab/Chassis Male Connector (Pin C4) to Boom Sensor Connector (Pin B) (Engine Harness)
11A	9.102	16	LT GRN/BLU	Steer Select Switch Relay Fuse to Steer Select Switch Connector (Pin 2)
11B	9.102	16	LT GRN/BLU	Steer Select Switch Connector Jumper (Pin 2) to (Pin 8)

These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.

Wire No.	Page	Gauge	Color	From - Function - To
12	9.102	18	DK BLU	Light Switch Relay Fuse to Light Switch Relay (Pin 86)
12A	9.102	12	DK BLU	Light Switch Relay (Pin 87) to Splice 12A
12AA	9.102	12	DK BLU	Splice 12A to Road/Worklights Connector (Option)
12B	9.102	12	DK BLU	Splice 12A to Option Connector
12C	9.102	16	DK BLU	Optional Lights Fuse (Lights 1) to Roadlights Connector (Option) (Hazards)
15	9.102	18	LT BLU	Instrument Panel Connector (Pin J6) to Cab/Chassis Male Connector (Pin A1) (Cab Harness)
	9.103	16	LT BLU	Cab/Chassis Female Connector (Pin A1) to Water Temperature Switch (Engine Harness)
16	9.102	18	BRN	Instrument Panel Connector (Pin J9) to Cab/Chassis Female Connector (Pin C5) (Cab Harness)
	9.103	16	BRN	Cab/Chassis Male Connector (Pin C5) to Oil Pressure Switch (Engine Harness)
17	9.102	18	GRY	Instrument Panel Connector (Pin J4) to Cab/Chassis Male Connector (Pin A2) (Cab Harness)
	9.103	16	GRY	Cab/Chassis Female Connector (Pin A2) to Fuel Level Sender (Engine Harness)
18	9.102	18	GRN	Instrument Panel Connector (Pin J12) to Cab/Chassis Female Connector (Pin B1) (Cab Harness)
	9.103	16	GRN	Cab/Chassis Male Connector (Pin B1) to Transmission Temperature Switch (Engine Harness)
20	9.102	12	BLK	Cab Ground Stud to Cab/Chassis Male Connector (Pin A3) (Cab Harness)
	9.103	12	BLK	Cab/Chassis Female Connector (Pin A3) to Splice 20 (Ground) (Engine Harness)
20A	9.102	12	BLK	Splice 20A (Ground) to Cab/Chassis Female Connector (Pin A4) (Cab Harness)
	9.103	12	BLK	Cab/Chassis Male Connector (Pin A4) to Splice 20A (Ground) (Engine Harness)
20B	9.103	12	BLK	Splice 20A (Ground) to 20B (Ground)
20C	9.103	12	BLK	Splice 20B (Ground) to Engine Ground Buss Bar
20D	9.103	12	BLK	Splice 20 (Ground) to 20D (Ground)
20E	9.103	12	BLK	Splice 20D (Ground) to Engine Ground Buss Bar
21C	9.102	16	RED	Headlight Switch Relay (Pin 86) to Roadlights Female Connector (Option) (Main Beam)
22	9.102	16	WHT	Instrument Panel Fuse to Inline Diode to Instrument Panel Connector (Pin J1)
23	9.102	16	GRN	Headlight Switch Relay (Pin 87) to Roadlights Female Connector (Option) (Main Beam) (Cab Harness)
	9.103	16	ORG/GRN	Logic Harness Female Connector (Pin B) to Boom Extend Harness Male Connector (Pin B) (Engine Harness)
24	9.102	14	ORG/GRN	Horn/Heater Fuse to Back-Up Alarm Relay (Pin 30)
24A	9.102	14	ORG/GRN	Back-Up Alarm Relay (Pin 30) to Cab/Chassis Female Connector (Pin B2) (Cab Harness)
	9.103	16	ORG/BLK	Cab/Chassis Male Connector (Pin B2) to Horn Connector (B) (Engine Harness)
26	9.102	10	RED	Ignition Switch 3-Way Connector (Pin A) to Splice 26
26A	9.102	10	RED	Ignition Switch 5-Way Connector (Pin A) to Splice 26
26B	9.102	10	RED	Splice 26 to Main Fuse
27	9.102	10	RED	Main Fuse to Splice 100
27A	9.102	12	RED	Optional Lights Fuse (Lights 1) to Headlight Switch Relay (Pin 30)
27B	9.102	12	RED	Optional Lights Fuse (Lights 1) to Splice 100
27C	9.102	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin A4) (Cab Harness)
	9.103	12	RED	Cab/Chassis Female Connector (Pin A4) to 12V Buss Bar (Engine Harness)
27D	9.102	12	RED	Splice 100 to Cab/Chassis Male Connector (Pin B5) (Cab Harness)
	9.103	12	RED	Cab/Chassis Female Connector (Pin B5) to 12V Buss Bar (Engine Harness)
27F	9.102	12	RED	Splice 100 to Optional Road/Worklights Fuse (Lights 2)
28	9.102	16	PUR/WHT	Boom Switch Relay (Pin 87) to Cab/Chassis Female Connector (Pin B3) (Cab Harness)
	9.103	16	PUR/WHT	Cab/Chassis Male Connector (Pin B3) to Splice 28 (Engine Harness)
28A	9.103	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12A) (A)
28B	9.103	18	PUR/WHT	Splice 28 to Stabil-TRAK™ Cylinder (SOL 12B) (A)
29	9.102	12	RED	Optional Road/Worklights Fuse (Lights 2) to Light Switch Relay (Pin 30)
31	9.102	16	ORG/RED	Back-up Alarm Relay (Pin 87) to Cab/Chassis Male Connector (Pin A5) (Cab Harness)
	9.103	16	ORG/RED	Cab/Chassis Female Connector (Pin A5) to Back-up Alarm (+) (Engine Harness)

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Wire No.	Page	Gauge	Color	From - Function - To
32	9.102	14	GRY/WHT	Option Fuse to Wiper/Washer Female Connector (Option)
34	9.102	16	RED/BLK	Ignition Switch 5-Way Connector (Pin C) to Cab/Chassis Male Connector (Pin B1) (Cab Harness)
	9.103	16	RED/BLK	Cab/Chassis Female Connector (Pin B1) to 7.5 amp Mini Fuse VESPAK Connector P9 (Pin E) (Engine Harness)
34A	9.103 & 9.104	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P9 (Pin F) to Engine Control Module Connector P1 (Pin A)
35	9.102	16	BRN/WHT	Female Connector to Cab/Chassis Female Connector (Pin B4) (Cab Harness)
	9.103	16	BRN/WHT	Cab/Chassis Male Connector (Pin B4) to Boom Sensor Connector (Pin A) (Engine Harness)
38	9.102	16	ORG	Instrument Panel Connector (Pin J3) to Cab/Chassis Female Connector (Pin B5) (Cab Harness)
	9.103 & 9.104	16	ORG	Cab/Chassis Male Connector (Pin B5) to Alternator (D+) (Engine Harness)
39	9.102	16	RED/GRY	Stabilizer Fuse to Boom Switch Relay (Pin 30)
40	9.102	16	BRN/BLK	Splice 40 to Cab/Chassis Female Connector (Pin A1) (Cab Harness)
	9.103	18	BRN/BLK	Cab/Chassis Male Connector (Pin A1) to Stabil-TRAK™ Cylinder (SOL 3) (A) (Engine Harness)
40A	9.102	16	BRN/BLK	Splice 40 to Stabilizer Lock Relay (Pin 87)
40B	9.102	16	BRN/BLK	Splice 40 to Instrument Panel Connector (Pin J11)
41	9.103	16	BLU/WHT	Not Used
41A	9.102	16	DK BLU/WHT	Not Used (Cab Harness)
	9.103	18	BLU/WHT	Not Used (Engine Harness)
41B	9.102	16	DK BLU/WHT	Park Brake Switch Connector (Pin 1) to Male Connector (Cab Harness)
	9.103	18	BLU/WHT	Not Used (Engine Harness)
42A	9.102	18	TAN	Instrument Panel Fuse to Park Brake Switch Connector (Pin 2)
42B	9.102	18	TAN	Park Brake Switch Connector Jumper (Pin 2) to (Pin 8)
45	9.102	16	DK BLU/ORG	Splice 45 to Splice 114
45A2	9.102	16	DK BLU/ORG	Splice 45 to Inline Diode to Park Brake Switch Connector (Pin 3)
45B	9.102	16	DK BLU/ORG	Splice 45 to Brake Pedal Switch (Pin 1)
46	9.102	16	WHT/ORG	Steer Select Switch Relay Fuse to Brake Pedal Switch (Pin 2)
47	9.102	16	ORG/WHT	Stabilizer Lock Relay (Pin 87A) to Cab/Chassis Female Connector (Pin A3) (Cab Harness)
	9.103	16	ORG/WHT	Cab/Chassis Male Connector (Pin A3) to Splice 47 (Engine Harness)
47A	9.103	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4A) (A)
47B	9.103	18	ORG/WHT	Splice 47 to Stabil-TRAK™ Cylinder (SOL 4B) (A)
48	9.102	16	PUR/BLK	Stabilizer Lock Relay (Pin 30) to Boom Switch Relay (Pin 87A)
49	9.103	16	RED/BLU	Logic Harness Female Connector (Pin A) to Boom Extend Harness Male Connector (Pin A)
50	9.102	16	WHT/YEL	Option Fuse to Female Option Connector
51	9.102	16	WHT/RED	Option Fuse to Female Option Connector
52	9.102	12	ORG	Horn/Heater Fuse to Heater Connector (Option)
101	9.102	16	BRN	Shifter Connector (Pin 5) to Cab/Chassis Male Connector (Pin C1) (Cab Harness)
	9.103	16	BRN	Cab/Chassis Female Connector (Pin C1) to Splice 101 (Engine Harness)
101A	9.103	16	BRN	Splice 101 to Diode VESPAK VP1 (Pin B)
101B	9.103	18	BRN	Splice 101 to Lower Transmission Connector (Pin 5, Solenoid Y5)
102	9.102	16	PNK	Splice 102 to Cab/Chassis Male Connector (Pin C2) (Cab Harness)
	9.103	16	PNK	Cab/Chassis Female Connector (Pin C2) to Splice 102 (Engine Harness)
102A	9.102	16	PNK	Splice 102 to Shifter Connector (Pin 3) (Cab Harness)
	9.103	16	PNK	Splice 102 to Diode VESPAK VP1 (Pin C) (Engine Harness)
102B	9.102	16	PNK	Splice 102 to Back-Up Alarm Relay (Pin 86) (Cab Harness)
	9.103	18	PNK	Splice 102 to Upper Transmission Connector (Pin 2, Solenoid Y2) (Engine Harness)
103	9.102	16	BLU	Shifter Connector (Pin 7) to Cab/Chassis Male Connector (Pin C3) (Cab Harness)
	9.103	16	BLU	Cab/Chassis Female Connector (Pin C3) to Splice 103 (Engine Harness)
103A	9.103	16	BLU	Splice 103 to Diode VESPAK VP1 (Pin A)
103B	9.103	18	BLU	Splice 103 to Upper Transmission Connector (Pin 3, Solenoid Y3)

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Wire No.	Page	Gauge	Color	From - Function - To
104	9.102	16	YEL	Shifter Connector (Pin 2) to Cab/Chassis Male Connector (Pin C4) (Cab Harness)
	9.103	16	YEL	Cab/Chassis Female Connector (Pin C4) to Splice 104 (Engine Harness)
104A	9.103	16	YEL	Splice 104 to Diode VESPAK VP2 (Pin C)
104B	9.103	18	YEL	Splice 104 to Upper Transmission Connector (Pin 1, Solenoid Y1)
105	9.102	16	GRN	Shifter Connector (Pin 6) to Cab/Chassis Male Connector (Pin C5) (Cab Harness)
	9.103	16	GRN	Cab/Chassis Female Connector (Pin C5) to Splice 105 (Engine Harness)
105A	9.103	16	GRN	Splice 105 to Diode VESPAK VP2 (Pin B)
105B	9.103	18	GRN	Splice 105 to Lower Transmission Connector (Pin 4, Solenoid Y4)
106	9.102	12	BLU/ORG	Neutral Start Relay (Pin 87) to Cab/Chassis Male Connector (Pin B2) (Cab Harness)
	9.103 & 9.104	12	BLU/ORG	Cab/Chassis Female Connector (Pin B2) to Starter Solenoid (Engine Harness)
107A	9.102	18	BLU	Not Used
107B	9.102	18	BLU	Male Connector to Park Brake Disconnect Relay (Pin 86)
111	9.102	12	RED	Park Brake Switch (Pin 6) to Splice 111
111A	9.102	12	RED	Splice 111 to Neutral Start Relay (Pin 30)
112	9.102	16	GRY	Shifter Connector (Pin 4) to Splice 112
112A	9.102	16	GRY	Splice 112 to Neutral Start Relay (Pin 86)
113	9.102	16	RED	Shifter Connector (Pin 1) to Splice 113
113A	9.102	16	RED	Splice 113 to Inline Diode to Splice 111
113B	9.102	16	RED	Splice 113 to Park Brake Disconnect Relay (Pin 87)
114A	9.102	16	BLU/ORG	Splice 112 to Inline Diode to Splice 114
114B	9.102	16	BLU/ORG	Splice 114 to Stabilizer Lock Relay (Pin 86)
150	9.102	16	PUR	Shifter Connector (Pin 8) to Cab/Chassis Male Connector (Pin B3) (Cab Harness)
	9.103	16	PUR	Cab/Chassis Female Connector (Pin B3) to Splice 150 (Engine Harness)
150A	9.103	16	PUR	Splice 150 to Diode VESPAK VP2 (Pin A)
150B	9.103	18	PUR	Splice 150 to Lower Transmission Connector (Pin 6, Solenoid Y6)
151	9.102	16	YEL/GRN	Instrument Panel Connector (Pin J10) to Cab/Chassis Male Connector (Pin B4) (Cab Harness)
	9.103	16	YEL/GRN	Cab/Chassis Female Connector (Pin B4) to Hydraulic Temperature Switch (Engine Harness)
152A1	9.102	16	BLK/WHT	Female Connector to Inline Diode to Splice 152A
152A2	9.102	16	BLK/WHT	Splice 152A to Inline Diode to Female Connector
152A3	9.102	16	BLK/WHT	Splice 152A to Instrument Panel Connector (Pin J7)
152B	9.102	16	BLK/WHT	Park Brake Switch Connector (Pin 3) to Male Connector
153	9.102	16	GRY/WHT	Park Brake Disconnect Relay (Pin 30) to Shifter Connector (Pin 9)
153A	9.102	16	GRY/WHT	Transmission Fuse to Park Brake Disconnect Relay (Pin 30)
154	9.102	16	BLU/WHT	Instrument Panel Connector (Pin J14) to Roadlights Connector (Option) (Main Beam)
155	9.102	16	GRN/RED	Instrument Panel Connector (Pin J15) to Roadlights Connector (Option) (Turn Signals)
156	9.102	16	RED/WHT	Instrument Panel Connector (Pin J2) to Roadlights Connector (Option) (Instrument Panel Backlight)
158	9.102	16	BLK	Horn Button to Cab/Chassis Female Connector (Pin A5) (Cab Harness)
	9.103	16	WHT	Cab/Chassis Male Connector (Pin A5) to Horn Connector (Pin A) (Engine Harness)
⬢A	9.104	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
AB1	9.104	10	RED	Alternator (Pin B+) to 12V Buss Bar
AB2	9.104	10	RED	Alternator (Pin B+) to 12V Buss Bar
AG1	9.104	10	BLK	Alternator (Pin GND) to Ground Buss Bar
AG2	9.104	10	BLK	Alternator (Pin GND) to Ground Buss Bar
⬢B	9.104	6	RED	Battery 2, Positive (+) Terminal to 125 Amp Fuse
BN	9.104	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Male Diagnostic Connector, P7 (Pin A)
BNE	9.104	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin E)
BNF	9.104	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin F)
BNH	9.104	16	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin H)
BNP	9.104	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin P)
BNW	9.104	14	BLK	Battery 2, Negative (-) Terminal to Engine Control Module, Female Engine Connector, P1 (Pin W)

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Wire No.	Page	Gauge	Color	From - Function - To
BP	9.104	16	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin F) to Engine Control Module, Male Diagnostic Connector, P7 (Pin B)
BP1	9.104	16	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin E)
BPB	9.104	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin B)
BPB1	9.104	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin A)
BPC	9.104	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin C)
BPC1	9.104	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin C)
BPD	9.104	16	RED/WHT	7.5 amp Mini Fuse VESPAK Connector P5 (Pin F) to Engine Control Module, Female Engine Connector, P1 (Pin D)
BPD1	9.104	16	RED/WHT	Battery 2, Positive (+) Terminal to 7.5 amp Mini Fuse VESPAK Connector P5 (Pin E)
BPM	9.104	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin B) to Engine Control Module, Female Engine Connector, P1 (Pin M)
BPM1	9.104	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin A)
BPS	9.104	14	RED/GRN	10 amp Mini Fuse VESPAK Connector P6 (Pin D) to Engine Control Module, Female Engine Connector, P1 (Pin S)
BPS1	9.104	14	RED/GRN	Battery 2, Positive (+) Terminal to 10 amp Mini Fuse VESPAK Connector P6 (Pin C)
⬢C	9.104	6	RED	125 Amp Fuse to Grid Heater Relay 2 (Pin 2)
CG1	9.104	16	BLK	Preheat Indicator Light, Female Connector, P15 (Pin 1B-) to Cab Ground Stud
CNH	9.104	18	YEL	Splice 1 to Engine, Female Connector, P3 (Pin A)
CNH1	9.104	18	YEL	Splice 1 to Resistor, Female Connector, P4 (Pin A)
CNH2	9.104	18	YEL	Splice 4 to Engine Control Module, Male Diagnostic Connector, P7 (Pin C)
CNH3	9.104	18	YEL	Splice 4 to Resistor, Female Connector, P8 (Pin A)
CNH4	9.104	18	YEL	Splice 1 to Splice 4
CNL	9.104	18	GRN	Splice 2 to Engine, Female Connector, P3 (Pin B)
CNL1	9.104	18	GRN	Splice 2 to Resistor, Female Connector, P4 (Pin B)
CNL2	9.104	18	GRN	Splice 5 to Engine Control Module, Male Diagnostic Connector, P7 (Pin D)
CNL3	9.104	18	GRN	Splice 5 to Resistor, Female Connector, P8 (Pin B)
CNL4	9.104	18	GRN	Splice 2 to Splice 5
CNS	9.104	18	DRAIN	Splice 3 to Engine, Female Connector, P3 (Pin C)
CNS1	9.104	18	DRAIN	Splice 3 to Resistor, Female Connector, P4 (Pin C)
CNS2	9.104	18	DRAIN	Splice 6 to Engine Control Module, Male Diagnostic Connector, P7 (Pin E)
CNS3	9.104	18	DRAIN	Splice 6 to Resistor, Female Connector, P8 (Pin C)
CNS4	9.104	18	DRAIN	Splice 3 to Splice 6
CNS5	9.104	18	BLK	Splice 3 to Engine Block
⬢D	9.104	6	RED	125 Amp Fuse to Grid Heater Relay 1 (Pin 2)
DD	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin N) to Engine Control Module, Female Engine Connector, P2 (Pin 36)
DI	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin M) to Engine Control Module, Female Engine Connector, P2 (Pin 35)
DLP	9.104	16	WHT/RED	Splice 6 to Male Connector
DLP1	9.104	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 1A+) to Splice 6
DLP2	9.104	16	WHT/RED	Engine Function Indicator Light, Female Connector, P15 (Pin 2A+) to Splice 6
DLP3	9.104	16	WHT/RED	Splice 6 to Female Connector
DS	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin L) to Engine Control Module, Female Engine Connector, P2 (Pin 37)
⬢E	9.104	6	RED	Grid Heater Relay 1 (Pin 1) to Engine Grid Heater (Pin 1)
⬢F	9.104	6	RED	Grid Heater Relay 2 (Pin 1) to Engine Grid Heater (Pin 2)
⬢G	9.104	1/0	RED	Battery 1, Positive (+) Terminal to Starter 12V Buss Bar
GH1	9.104	18	BLK	Splice 8 to Engine Control Module, Female Engine Connector, P2 (Pin 41)
GH1A	9.104	16	BLK	Splice 8 to Diode VESPAK Connector P10 (Pin A)
GH1B	9.104	16	BLK	Splice 8 to Grid Heater Relay 1 (Pin 3)

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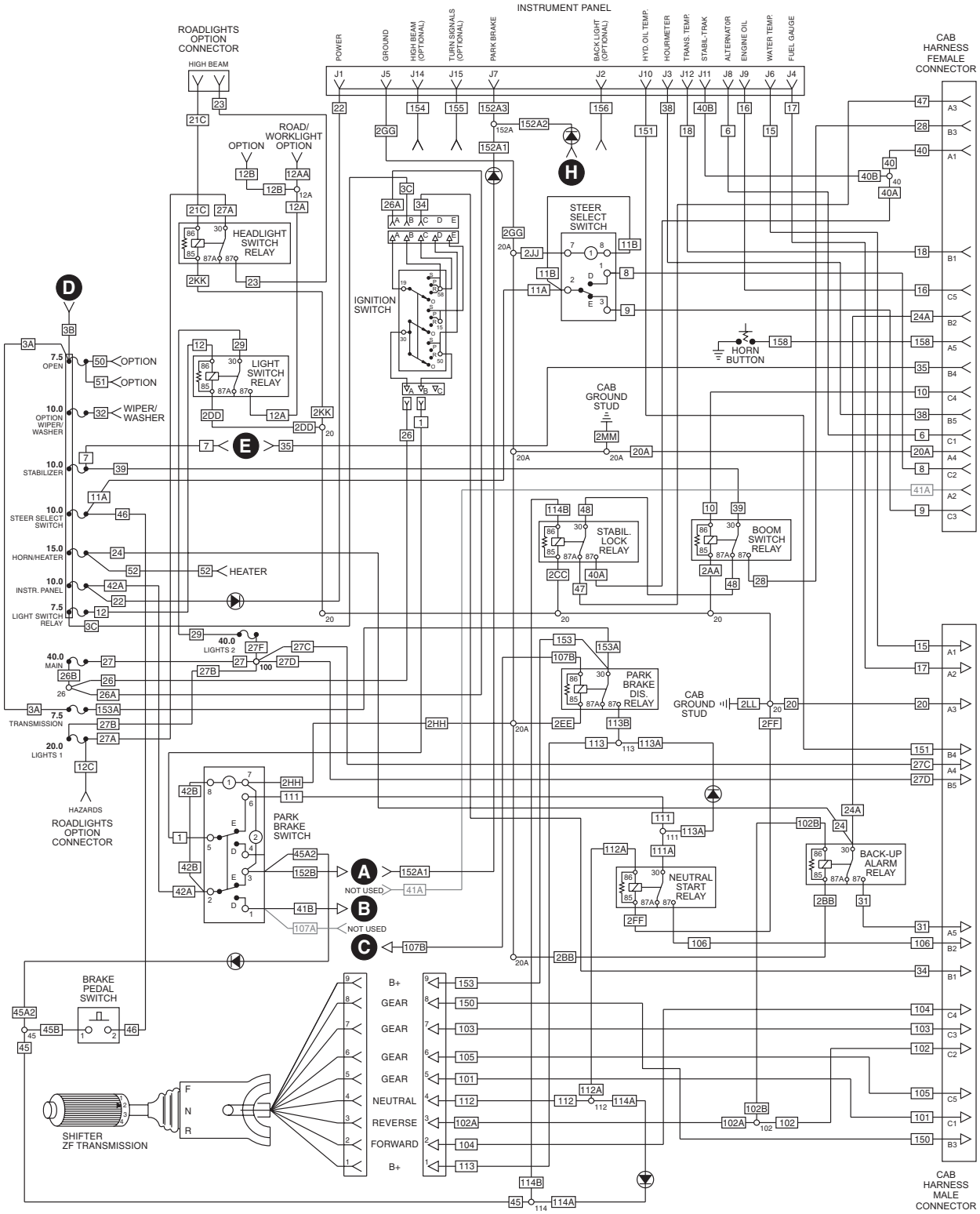
Wire No.	Page	Gauge	Color	From - Function - To
GH2	9.104	18	BLK	Splice 9 to Engine Control Module, Female Engine Connector, P2 (Pin 31)
GH2A	9.104	16	BLK	Splice 9 to Diode VESPAK Connector P10 (Pin B)
GH2B	9.104	16	BLK	Splice 9 to Grid Heater Relay 2 (Pin 3)
GH3	9.104	16	BLK	Grid Heater Relay 1 (Pin 1) to Diode VESPAK Connector P11 (Pin A)
GH4	9.104	16	BLK	Grid Heater Relay 2 (Pin 1) to Diode VESPAK Connector P11 (Pin F)
GHG	9.104	16	BLK	Splice 7 to Diode VESPAK Connector P10 (Pin F)
GHG1	9.104	16	BLK	Splice 7 to Grid Heater Relay 1 (Pin 4)
GHG2	9.104	16	BLK	Splice 7 to Grid Heater Relay 2 (Pin 4)
GHG3	9.104	16	BLK	Battery 2, Negative (-) Terminal to Splice 7
⬢ H	9.104	1/0	RED	Battery 1, Positive (+) Terminal to Battery 2, Positive (+) Terminal
⬢ J	9.104	1	BLK	Battery 2, Negative (-) Terminal to Frame Ground
J87H	9.104	18	RED	Engine Control Module, Female Engine Connector, P2 (Pin 49) to Engine Control Module, Male Diagnostic Connector, P7 (Pin F)
J87L	9.104	18	BLK	Engine Control Module, Female Engine Connector, P2 (Pin 50) to Engine Control Module, Male Diagnostic Connector, P7 (Pin G)
⬢ K	9.104	1/0	BLK	Battery 1, Negative (-) Terminal to Battery 2, Negative (-) Terminal
⬢ L	9.104	1/0	BLK	Battery 1, Negative (-) Terminal to Starter Ground Stud
ML	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin F) to Engine Control Module, Female Engine Connector, P2 (Pin 4)
OFF1	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin H) to Engine Control Module, Female Engine Connector, P2 (Pin 25) (Engine Harness)
	9.104	18	ORG	Engine Control Module Bulkhead, Male Connector (Pin H) to Idle Validation Switch, Male Connector, P16 (Pin C) (ECM Cab Harness)
ON1	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin J) to Engine Control Module, Female Engine Connector, P2 (Pin 26) (Engine Harness)
	9.104	18	VIO	Engine Control Module Bulkhead, Male Connector (Pin J) to Idle Validation Switch, Male Connector, P16 (Pin B) (ECM Cab Harness)
PH1	9.104	18	BLU	Engine Control Module Bulkhead, Male Connector (Pin P) to Preheat Indicator Light, Female Connector, P19 (Pin 1A+)
PH1A	9.104	16	PNK/BLU	Engine Control Module Bulkhead, Female Connector (Pin P) to Diode VESPAK Connector P11 (Pin B)
RTS	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin O) to Engine Control Module, Female Engine Connector, P2 (Pin 45)
SL	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin D) to Engine Control Module, Female Engine Connector, P2 (Pin 1)
SL1	9.104	18	GRN	Engine Control Module Bulkhead, Male Connector (Pin D) to Engine Function Indicator Light, Female Connector, P15 (Pin 1B-)
SWR	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin K) to Engine Control Module, Female Engine Connector, P2 (Pin 20) (Engine Harness)
	9.104	18	YEL	Engine Control Module Bulkhead, Male Connector (Pin K) to Idle Validation Switch, Male Connector, P16 (Pin A) (ECM Cab Harness)
THG	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin A) to Engine Control Module, Female Engine Connector, P2 (Pin 19)
THG1	9.104	18	BLK	Engine Control Module Bulkhead, Male Connector (Pin A) to Throttle Sensor, Female Connector, P14 (Pin A)
THP	9.104	18	RED	Engine Control Module Bulkhead, Female Connector (Pin B) to Engine Control Module, Female Engine Connector, P2 (Pin 29)
THP1	9.104	18	RED	Engine Control Module Bulkhead, Male Connector (Pin B) to Throttle Sensor, Female Connector, P14 (Pin C)
THS	9.104	18	WHT	Engine Control Module Bulkhead, Female Connector (Pin C) to Engine Control Module, Female Engine Connector, P2 (Pin 30)
THS1	9.104	18	WHT	Engine Control Module Bulkhead, Male Connector (Pin C) to Throttle Sensor, Female Connector, P14 (Pin B)
WL	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin E) to Engine Control Module, Female Engine Connector, P2 (Pin 3)

⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

Wire No.	Page	Gauge	Color	From - Function - To
WL1	9.104	18	BRN	Engine Control Module Bulkhead, Male Connector (Pin E) to Engine Function Indicator Light, Female Connector, P15 (Pin 2B-)
WSL	9.104	18	BLK	Engine Control Module Bulkhead, Female Connector (Pin G) to Engine Control Module, Female Engine Connector, P2 (Pin 11)

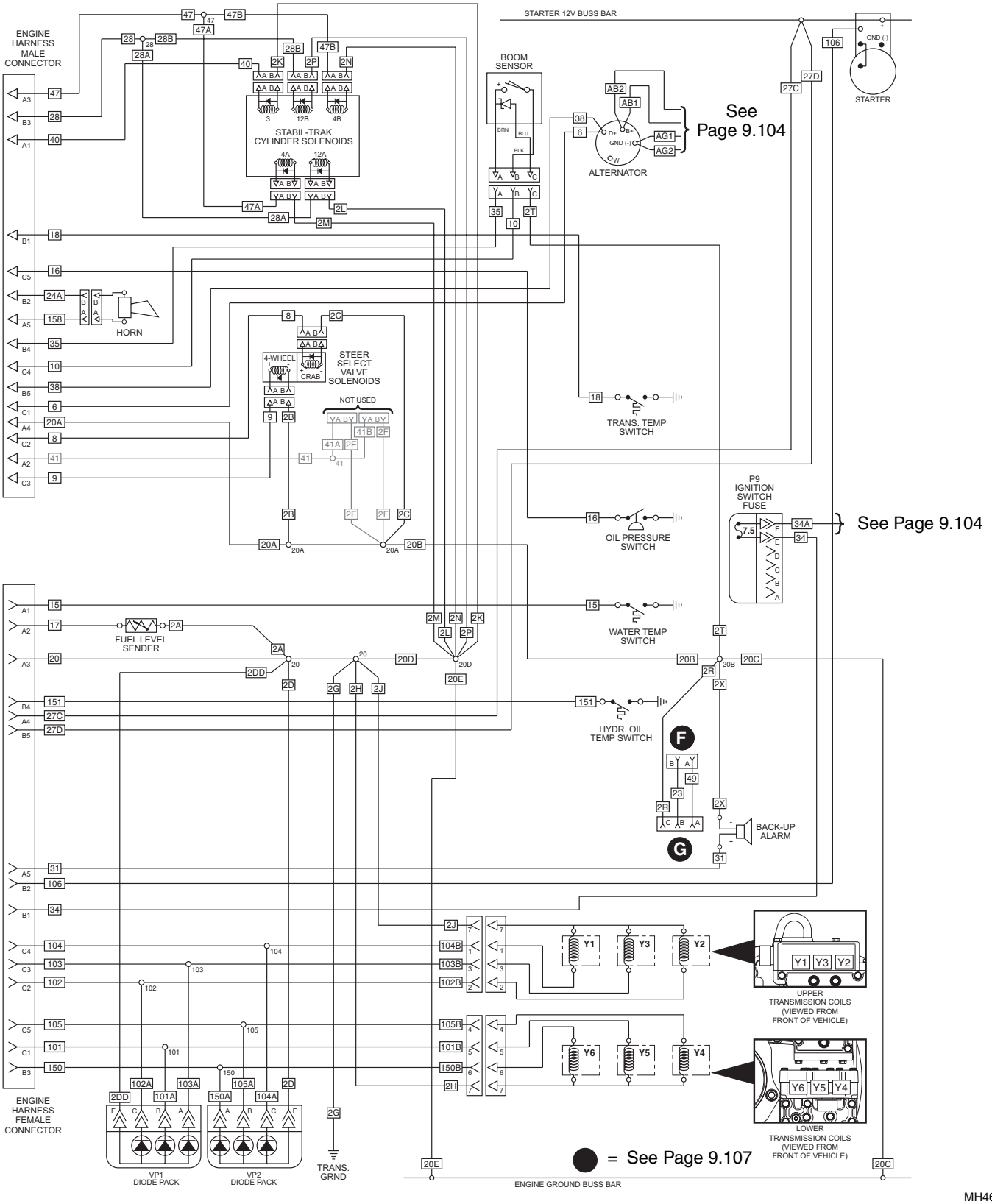
These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.

9.7.26 10054 Cab Harness & Engine Harness Electrical Schematic (SN 19080 - 19987 And 0160002332 & After)



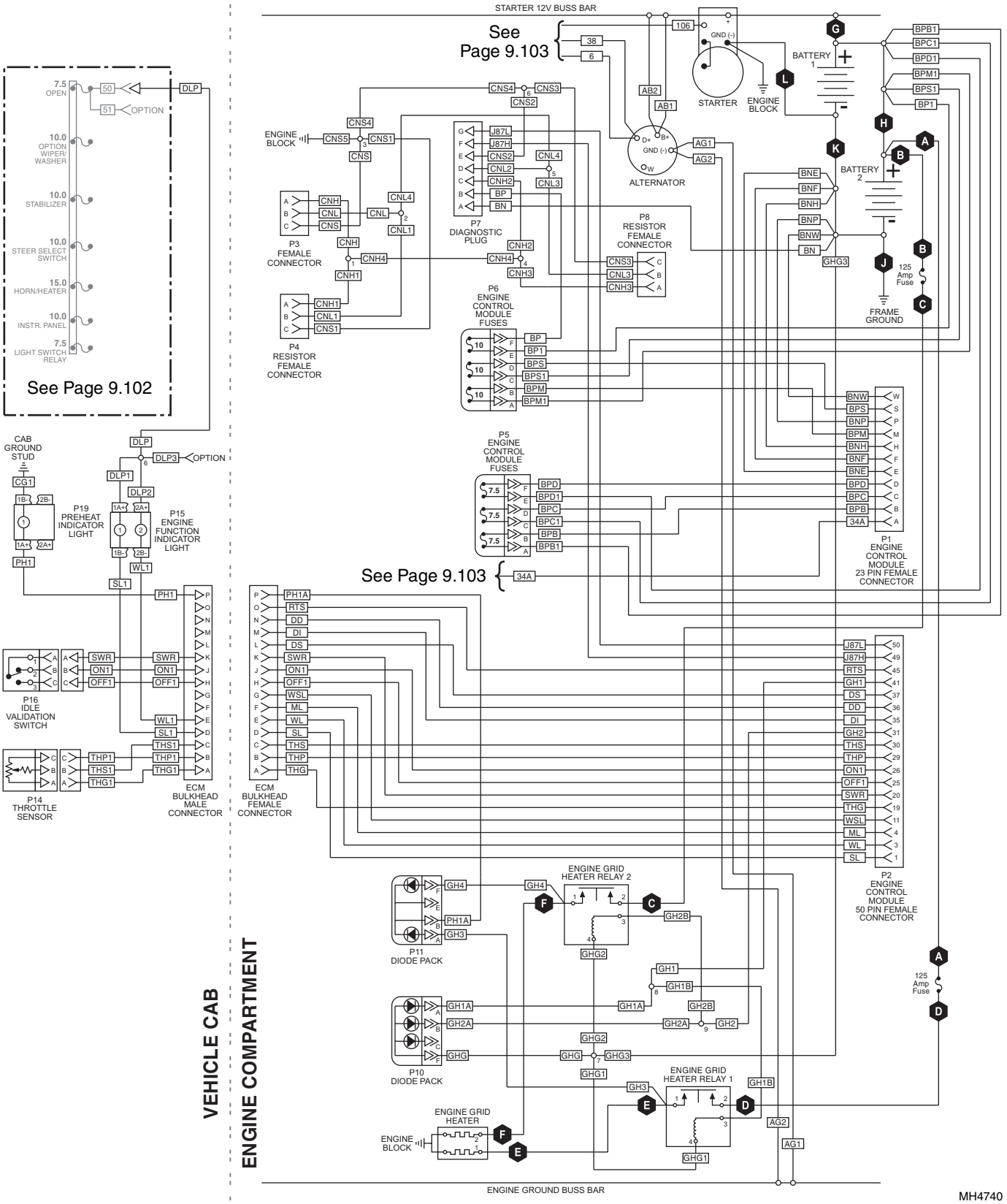
● = See Page 9.107

MH46701


ENGINE HARNESS MALE CONNECTOR
STARTER 12V BUSS BAR
BOOM SENSOR
STARTER
ALTERNATOR
See Page 9.104
STABIL-TRAK CYLINDER SOLENOIDS
HORN
STEER SELECT VALVE SOLENOIDS
NOT USED
TRANS. TEMP SWITCH
P9 IGNITION SWITCH FUSE
See Page 9.104
OIL PRESSURE SWITCH
WATER TEMP SWITCH
FUEL LEVEL SENDER
HYDR. OIL TEMP SWITCH
BACK-UP ALARM
UPPER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
LOWER TRANSMISSION COILS (VIEWED FROM FRONT OF VEHICLE)
ENGINE HARNESS FEMALE CONNECTOR
VP1 DIODE PACK
VP2 DIODE PACK
TRANS. GRND
= See Page 9.107
ENGINE GROUND BUSS BAR

MH46702

9.7.27 10054 ECM Cab Harness & Engine Harness (SN 19080 - 19987 And 0160002332 & After)

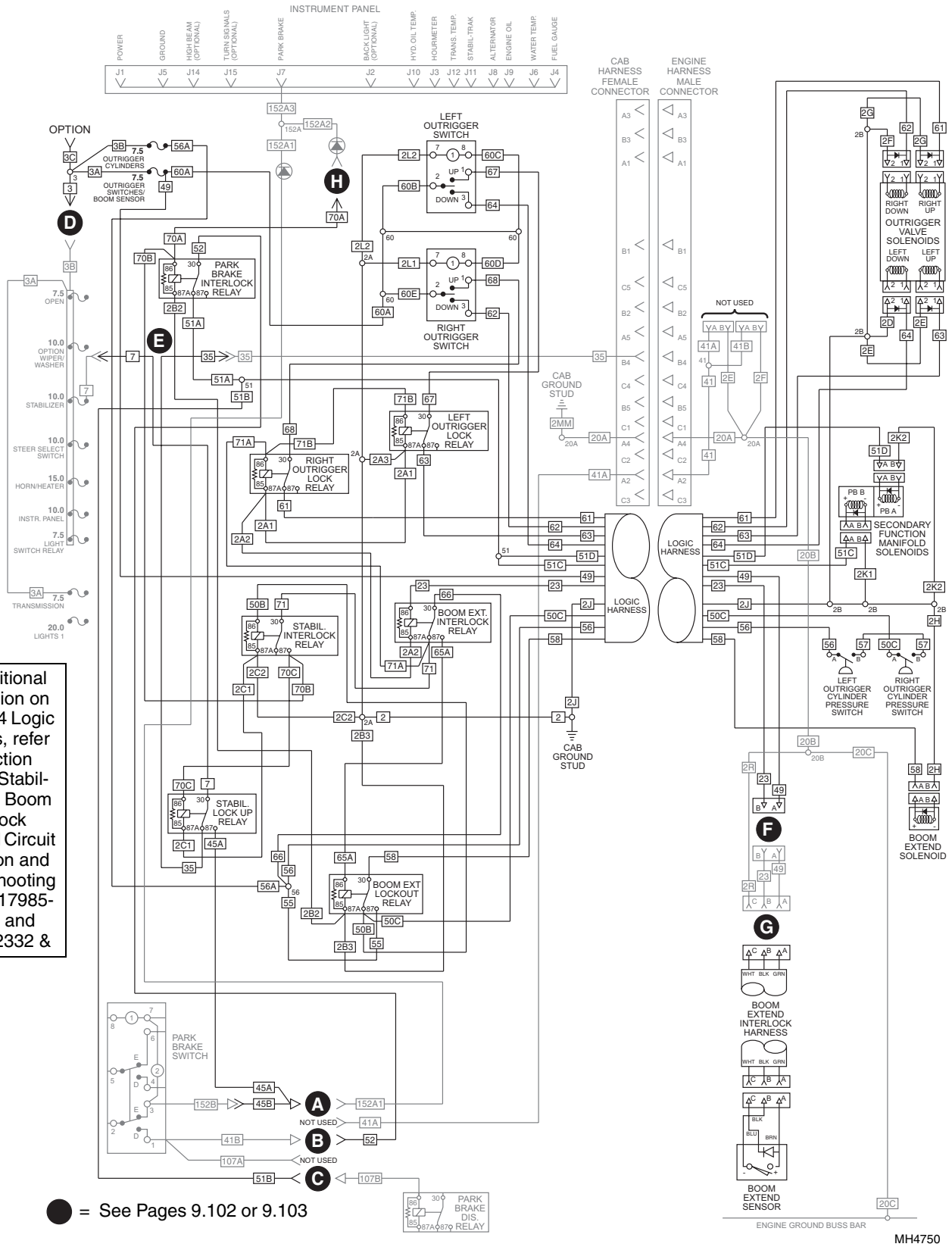


9.7.28 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic Legend (SN 19080 - 19987 And 0160002332 & After)

Wire No.	Page	Gauge	Color	From - Function - To
2	9.107	14	BLK	Splice 2A to Cab Ground Stud
2A1		16	BLK	Left Outrigger Lock Relay (Pin 85) to Right Outrigger Lock Relay (Pin 85)
2A2		16	BLK	Right Outrigger Lock Relay (Pin 85) to Boom Extend Interlock Relay (Pin 85)
2A3		16	BLK	Splice 2A to Left Outrigger Lock Relay (Pin 85)
2B2		16	BLK	Boom Extend Lockout Relay (Pin 85) to Park Brake Interlock Relay (Pin 85)
2B3		16	BLK	Splice 2A to Boom Extend Lockout Relay (Pin 85)
2C1		16	BLK	Stabil-TRAK Interlock Relay (Pin 85) to Stabil-TRAK Lock Up Relay (Pin 85)
2C2		16	BLK	Splice 2A to Stabil-TRAK Interlock Relay (Pin 85)
2D		16	BLK	Splice 2B to Outrigger Valve Solenoid (Left Down) (Pin 2)
2E		16	BLK	Splice 2B to Outrigger Valve Solenoid (Left Up) (Pin 2)
2F		16	BLK	Splice 2B to Outrigger Valve Solenoid (Right Down) (Pin 2)
2G		16	BLK	Splice 2B to Outrigger Valve Solenoid (Right Up) (Pin 2)
2H		16	BLK	Splice 2B to Boom Extend Solenoid Connector (Pin B)
2J		14	BLK	Splice 2B to Cab Ground Stud
2K1		16	BLK	Splice 2B to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin B)
2K2		16	BLK	Splice 2B to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin B)
2L1		16	BLK	Splice 2A to Right Outrigger Switch (Pin 7)
2L2		16	BLK	Splice 2A to Left Outrigger Switch (Pin 7)
3		14	RED	Male Connector at Open Fuse (Cab Harness, Wire 3B) to Splice 3
3A		14	RED	Splice 3 to Outrigger Switches/Boom Sensor Fuse
3B		14	RED	Splice 3 to Outrigger Cylinders Fuse
3C		14	RED	Splice 3 to Female Connector (Option)
7		16	TAN	Stabil-TRAK Lock Up Relay (Pin 30) to Male Connector at Stabilizer Fuse (Cab Harness, Wire 7)
23		16	ORG/GRN	Boom Extend Interlock Relay (Pin 86) to Engine Harness Male Connector (Pin B)
35		16	BRN/GRN	Stabil-TRAK Lock Up Relay (Pin 87A) to Male Connector at Stabilizer Fuse (Cab Harness, Wire 35)
45A		16	DK BLU/ORG	Stabil-TRAK Lock Up Relay (Pin 87) to Male Connector at Park Brake Switch (Cab Harness, Wire 152A1)
45B		16	DK BLU/ORG	Female Connector at Park Brake Switch (Cab Harness, Wire 152B1) to Male Connector at Park Brake Switch (Cab Harness, Wire 152A1)
49		16	RED/BLU	Outrigger Switches/Boom Sensor Fuse to Engine Harness Male Connector (Pin A)
50B		16	RED/WHT	Boom Extend Lockout Relay (Pin 87A) to Stabil-TRAK Interlock Relay (Pin 86)
50C		16	RED/WHT	Right Outrigger Cylinder Pressure Switch Connector (Pin A) to Boom Extend Lockout Relay (Pin 87A)
51A		16	BLU/WHITE	Park Brake Interlock Relay (Pin 87A) to Splice 51
51B		16	BLU/WHITE	Splice 51 to Female Connector at Park Brake Switch (Cab Harness, Wire 107B)
51C		16	BLU/WHITE	Splice 51 to Secondary Function Manifold Park Brake Solenoid (PB B) (Pin A)
51D		16	BLU/WHITE	Splice 51 to Secondary Function Manifold Park Brake Solenoid (PB A) (Pin A)
52		16	DK BLU/RED	Park Brake Interlock Relay (Pin 30) to Female Connector at Park Brake Switch (Cab Harness, Wire 41C)
55		16	ORG/RED	Boom Extend Lockout Relay (Pin 87) to Splice 56
56		16	GRY/BLU	Splice 56 to Left Outrigger Cylinder Pressure Switch Connector (Pin A)
56A		16	GRY/BLU	Splice 56 to Outrigger Cylinder Fuse
57		16	GRY/ORG	Right Outrigger Cylinder Pressure Switch Connector (Pin B) to Left Outrigger Cylinder Pressure Switch Connector (Pin B)
58		16	GRN	Boom Extend Lockout Relay (Pin 30) to Boom Extend Solenoid Connector (Pin A)
60A		16	YEL/GRN	Outrigger Switches/Boom Sensor Fuse to Splice 60
60B		16	YEL/GRN	Splice 60 to Left Outrigger Switch (Pin 2)
60C		16	YEL/GRN	Splice 60 to Left Outrigger Switch (Pin 8)
60D		16	YEL/GRN	Splice 60 to Right Outrigger Switch (Pin 8)
60E		16	YEL/GRN	Splice 60 to Right Outrigger Switch (Pin 2)
61		16	RED/GRY	Right Outrigger Lock Relay (Pin 87A) to Outrigger Valve Solenoid (Right Up) (Pin 1)

Wire No.	Page	Gauge	Color	From - Function - To
62	9.107	16	PUR/WHT	Right Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Right Down) (Pin 1)
63		16	BRN/YEL	Left Outrigger Lock Relay (Pin 87A) to Outrigger Valve Solenoid (Left Up) (Pin 1)
64		16	GRY/PUR	Left Outrigger Switch Connector (Pin 3) to Outrigger Valve Solenoid (Left Down) (Pin 1)
65A		16	DK BLU	Boom Extend Lockout Relay (Pin 86) to Boom Extend Interlock Relay (Pin 87)
66		16	ORG/GRY	Splice 56 to Boom Extend Interlock Relay (Pin 30)
67		16	BRN/BLK	Left Outrigger Switch (Pin 1) to Left Outrigger Lock Relay (Pin 30)
68		16	RED/BLK	Right Outrigger Switch (Pin 1) to Right Outrigger Lock Relay (Pin 30)
70A		16	ORG/BLK	Park Brake Interlock Relay (Pin 86) to Male Connector at Dash Panel (Cab Harness, Wire 152A2)
70B		16	ORG/BLK	Park Brake Interlock Relay (Pin 86) to Stabil-TRAK Interlock Relay (Pin 87)
70C		16	ORG/BLK	Stabil-TRAK Lock Up Relay (Pin 86) to Stabil-TRAK Interlock Relay (Pin 87)
71		16	ORG/WHT	Stabil-TRAK Interlock Relay (Pin 30) to Boom Extend Interlock Relay (Pin 87A)
71A		16	ORG/WHT	Boom Extend Interlock Relay (Pin 87A) to Right Outrigger Lock Relay (Pin 86)
71B		16	ORG/WHT	Right Outrigger Lock Relay (Pin 86) to Left Outrigger Lock Relay (Pin 86)

9.7.29 10054 Logic Harness & Boom Extend Interlock Harness Electrical Schematic (SN 19080 - 19987 And 0160002332 & After)

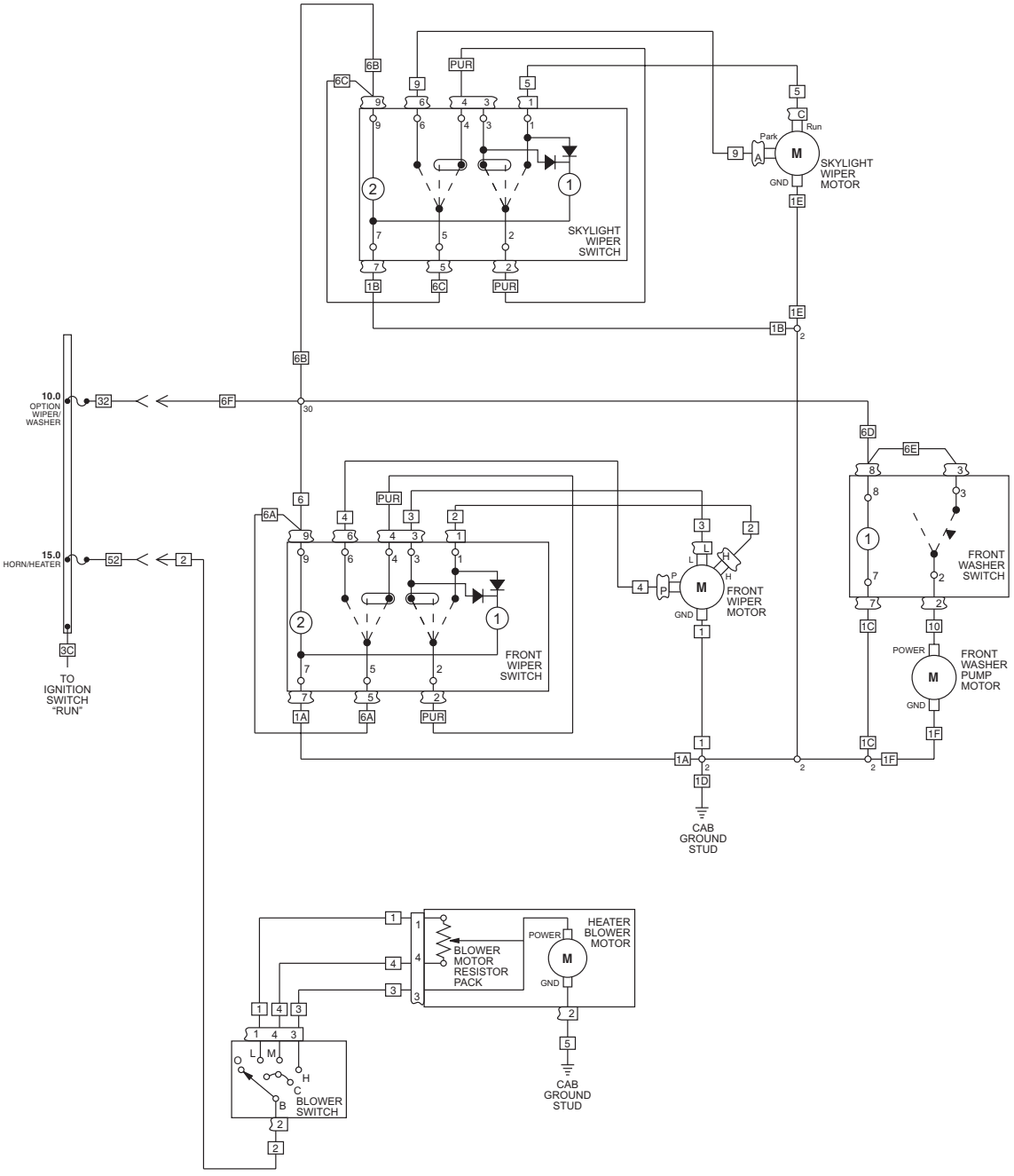


For additional information on the 10054 Logic Harness, refer to Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 &

9.7.30 Wiper/Washer & Heater Harness Electrical Schematic Legend

Wire No.	Page	Gauge	Color	Description
WIPER/WASHER HARNESS WIRES (OPTION)				
1	9.109	14	BLK	Splice 2 to Front Wiper Motor (Ground)
1A		14	BLK	Splice 2 to Front Wiper Switch (Pin 7)
1B		14	BLK	Splice 2 to Skylight Wiper Switch (Pin 7)
1C		14	BLK	Splice 2 to Front Washer Switch (Pin 7)
1D		14	BLK	Splice 2 to Cab Ground
1E		14	BLK	Splice 2 to Skylight Wiper Motor (Ground)
1F		14	BLK	Splice 2 to Front Washer Motor (Ground)
2		14	BLU	Front Wiper Switch (Pin 1) to Front Wiper Motor (HIGH)
3		14	WHT	Front Wiper Switch (Pin 3) to Front Wiper Motor (LOW)
4		14	GRN	Front Wiper Switch (Pin 6) to Front Wiper Motor (PARK)
5		14	YEL	Skylight Wiper Switch (Pin 1) to Skylight Wiper Motor (RUN)
6		14	RED/WHT	Splice 30 to Front Wiper Switch (Pin 9)
6A		14	RED/WHT	Front Wiper Switch (Pin 9) to Front Wiper Switch (Pin 5)
6B		14	RED/WHT	Splice 30 to Skylight Wiper Switch (Pin 9)
6C		14	RED/WHT	Skylight Wiper Switch (Pin 9) to Skylight Wiper Switch (Pin 5)
6D		14	RED/WHT	Splice 30 to Front Washer Switch (Pin 8)
6E		14	RED/WHT	Front Washer Switch (Pin 8) to Front Washer Switch (Pin 3)
6F		14	RED/WHT	Splice 30 to Cab Harness Connector (Wire 32)
9		14	GRN	Skylight Wiper Switch (Pin 6) to Skylight Wiper Motor (PARK)
10		14	GRN	Front Washer Switch (Pin 2) to Front Washer Motor (POWER)
PUR		14	PUR	Front Wiper Switch Connector Jumper from Pin 2 to Pin 4
PUR		14	PUR	Skylight Wiper Switch Connector Jumper from Pin 2 to Pin 4
HEATER HARNESS WIRES (OPTION)				
1		14	YEL	Heater Switch (Pin 1) to Heater Blower Motor (Pin 1)
2		14	RED/WHT	Heater Switch (Pin 2) to Cab Harness Connector (Wire 52)
3		14	ORG	Heater Switch (Pin 3) to Heater Blower Motor (Pin 3)
4		14	RED	Heater Switch (Pin 4) to Heater Blower Motor (Pin 4)
5		14	BLK	Heater Blower Motor (Pin 2) to Cab Ground Stud

9.7.31 Wiper/Washer & Heater Harness Electrical Schematic

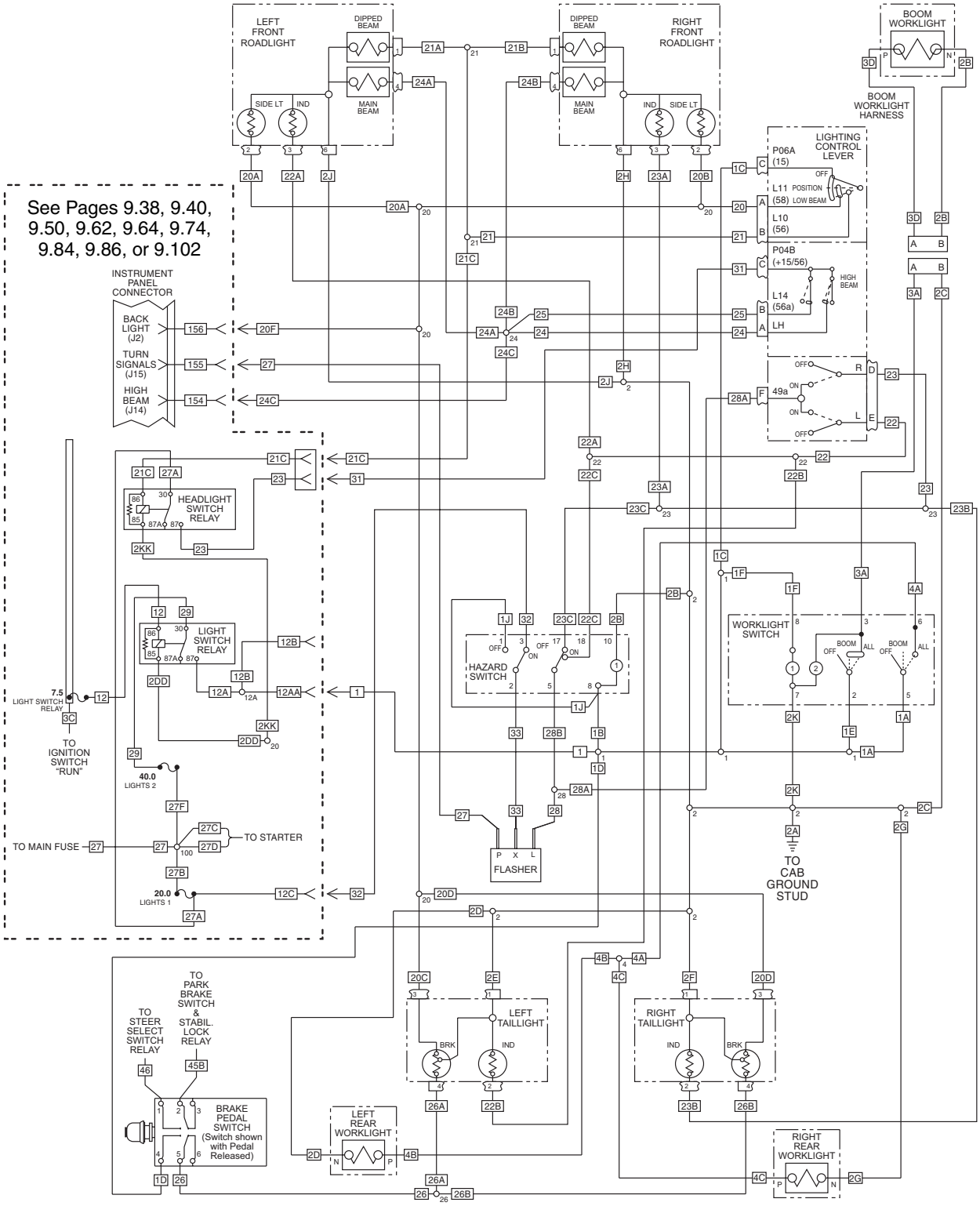


MH5160

9.7.32 Roadlight Harness Electrical Schematic Legend

Wire No.	Page	Gauge	Color	Description
1		12	RED	Splice 1 to Cab Harness Fuse Block Connector (Wire 12AA)
1A		14	RED	Splice 1 to Worklight Switch (Pin 5)
1B		14	RED	Splice 1 to Hazard Switch (Pin 8)
1C		14	RED	Splice 1 to Lighting Control Lever 3-Way Connector (Pin C)
1D		14	RED	Splice 1 to Brake Pedal Switch (Pin 4)
1E		14	RED	Splice 1 to Worklight Switch (Pin 2)
1F		14	RED	Splice 1 to Worklight Switch (Pin 8)
1J		14	RED	Jumper from Hazard Switch (Pin 8) to Hazard Switch (Pin 1)
2A		12	BLK	Splice 2 to Cab Ground Stud
2B		16	BLK	Splice 2 to Hazard Switch (Pin 10)
2C		16	BLK	Splice 2 to Boom Worklight Harness Connector (Pin B)
2D		16	BLK	Splice 2 to Left Rear Worklight (Pin N)
2E		16	BLK	Splice 2 to Left Taillight (Pin 1)
2F		16	BLK	Splice 2 to Right Taillight (Pin 1)
2G		16	BLK	Splice 2 to Right Rear Worklight (Pin N)
2H		16	BLK	Splice 2 to Right Front Roadlight (Pin 6)
2J		16	BLK	Splice 2 to Left Front Roadlight (Pin 6)
2K		16	BLK	Splice 2 to Worklight Switch (Pin 7)
3A		16	LT BLU	Worklight Switch (Pin 3) to Boom Worklight Harness Connector (Pin A)
4A		14	YEL	Splice 4 to Worklight Switch (Pin 6)
4B		14	YEL	Splice 4 to Left Rear Worklight (Pin P)
4C		14	YEL	Splice 4 to Right Rear Worklight (Pin P)
20		16	WHT	Splice 20 to Lighting Control Lever 3-Way Connector (Pin A)
20A		16	WHT	Splice 20 to Left Front Roadlight (Pin 2)
20B		16	WHT	Splice 20 to Right Front Roadlight (Pin 2)
20C		16	WHT	Splice 20 to Left Taillight (Pin 3)
20D		16	WHT	Splice 20 to Right Taillight (Pin 3)
20F	9.111	16	WHT	Splice 20 to Cab Harness Instrument Panel Connector (Wire 156)
21		16	RED	Splice 21 to Lighting Control Lever 3-Way Connector (Pin B)
21A		16	RED	Splice 21 to Left Front Roadlight (Pin 1)
21B		16	RED	Splice 21 to Right Front Roadlight (Pin 1)
21C		16	RED	Splice 21 to Cab Harness Fuse Block Connector (Wire 21C)
22		16	ORG	Splice 22 to Lighting Control Lever 6-Way Connector (Pin E)
22A		16	ORG	Splice 22 to Left Front Roadlight (Pin 3)
22B		16	ORG	Splice 22 to Left Taillight (Pin 2)
22C		16	ORG	Splice 22 to Hazard Switch (Pin 18)
23		16	GRN	Splice 23 to Lighting Control Lever 6-Way Connector (Pin D)
23A		16	GRN	Splice 23 to Right Front Roadlight (Pin 3)
23B		16	GRN	Splice 23 to Right Taillight (Pin 2)
23C		16	GRN	Splice 23 to Hazard Switch (Pin 17)
24		16	DK BLU	Splice 24 to Lighting Control Lever 6-Way Connector (Pin A)
24A		16	DK BLU	Splice 24 to Left Front Roadlight (Pin 4)
24B		16	DK BLU	Splice 24 to Right Front Roadlight (Pin 4)
24C		16	DK BLU	Splice 24 to Cab Harness Instrument Panel Connector (Wire 154)
25		16	PNK	Splice 24 to Lighting Control Lever 6-Way Connector (Pin B)
26		16	GRY	Splice 26 to Brake Pedal Switch (Pin 5)
26A		16	GRY	Splice 26 to Left Taillight (Pin 4)
26B		16	GRY	Splice 26 to Right Taillight (Pin 4)
27		16	PUR/WHT	Flasher (Pin P) to Cab Harness Instrument Panel Connector (Wire 155)
28		16	PUR	Splice 28 to Flasher (Pin L)
28A		16	PUR	Splice 28 to Lighting Control Lever 6-Way Connector (Pin F)
28B		16	PUR	Splice 28 to Hazard Switch (Pin 5)
31		16	YEL	Cab Harness Fuse Block Connector (Wire 23) to Lighting Control Lever 6-Way Connector (Pin C)
32		14	GRN	Cab Harness Fuse Block Connector (Wire 12C) to Hazard Switch (Pin 3)
33		16	PUR	Flasher (Pin X) to Hazard Switch (Pin 2)
BOOMLIGHT HARNESS WIRES				
2B	9.111	14	BLK	Boom Worklight Harness Connector (Pin B) to Boom Light (Pin N)
3D		14	LT BLU	Boom Worklight Harness Connector (Pin A) to Boom Light (Pin P)

9.7.33 Roadlight Harness Electrical Schematic

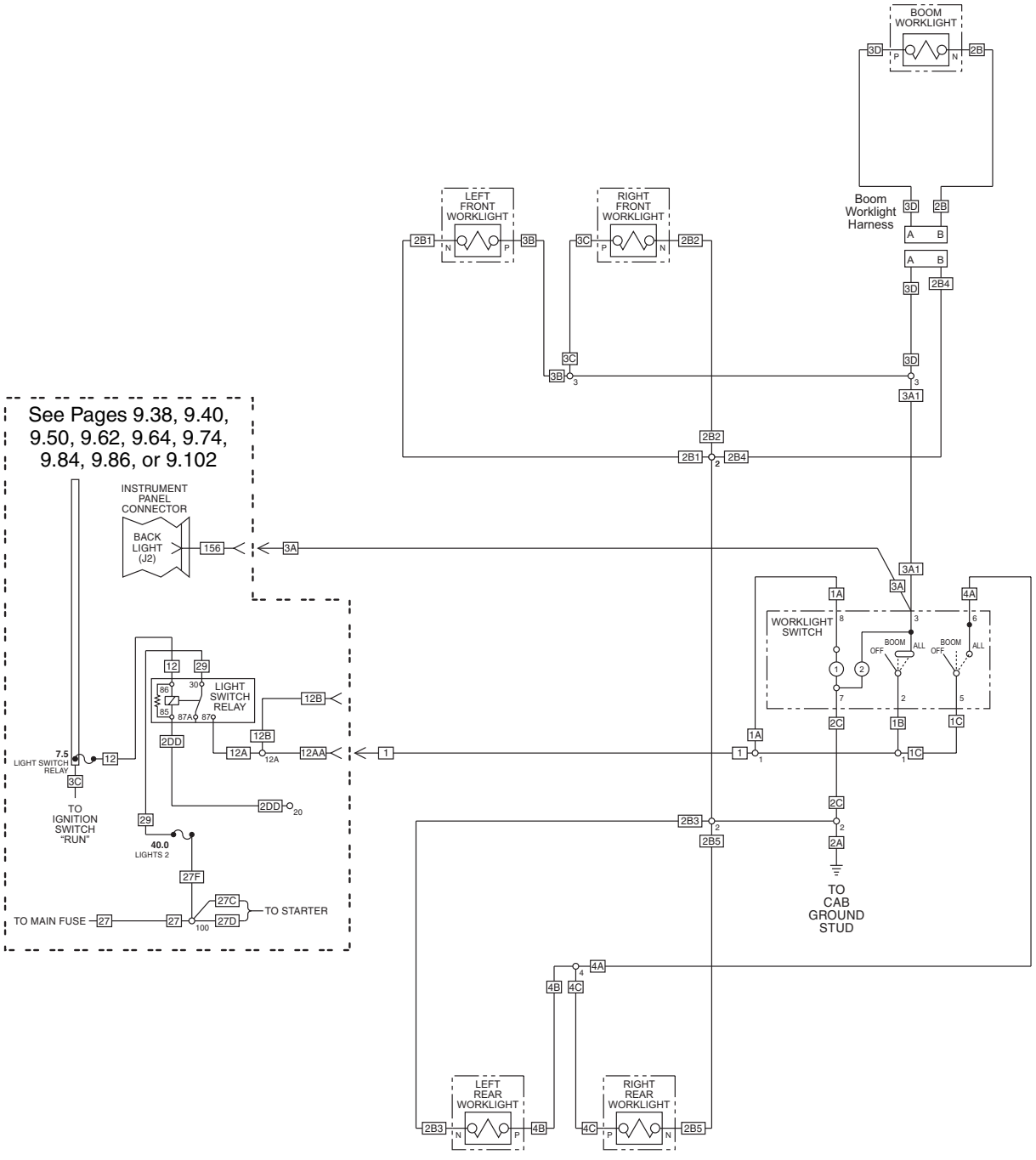


MH6080

9.7.34 Worklight Harness Electrical Schematic Legend

Wire No.	Page	Gauge	Color	Description
1	9.113	12	RED	Splice 1 to Cab Harness Fuse Block Connector (Wire 12AA)
1A		14	RED	Splice 1 to Worklight Switch (Pin 8)
1B		14	RED	Splice 1 to Worklight Switch (Pin 2)
1C		14	RED	Splice 1 to Worklight Switch (Pin 5)
2A		12	BLK	Splice 2 to Cab Ground
2B1		16	BLK	Splice 2 to Left Front Worklight (Pin N)
2B2		16	BLK	Splice 2 to Right Front Worklight (Pin N)
2B3		16	BLK	Splice 2 to Left Rear Worklight (Pin N)
2B4		16	BLK	Splice 2 to Worklight Harness Connector (Pin B)
2B5		16	BLK	Splice 2 to Right Rear Worklight (Pin N)
2C		14	BLK	Splice 2 to Worklight Switch (Pin 7)
3A		14	LT BLU	Worklight Switch (Pin 3) to Cab Harness Instrument Panel Connector (Wire 156)
3A1		14	LT BLU	Splice 3 to Worklight Switch (Pin 3)
3B		14	LT BLU	Splice 3 to Left Front Worklight (Pin P)
3C		14	LT BLU	Splice 3 to Right Front Worklight (Pin P)
3D		14	LT BLU	Splice 3 to Worklight Harness Connector (Pin A)
4A		14	YEL	Splice 4 to Worklight Switch (Pin 6)
4B		14	YEL	Splice 4 to Left Rear Worklight (Pin P)
4C		14	YEL	Splice 4 to Right Rear Worklight (Pin P)
BOOMLIGHT HARNESS WIRES				
2B	9.113	14	BLK	Boom Worklight Harness Connector (Pin B) to Boom Light (Pin N)
3D		14	LT BLU	Boom Worklight Harness Connector (Pin A) to Boom Light (Pin P)

9.7.35 Worklight Harness Electrical Schematic

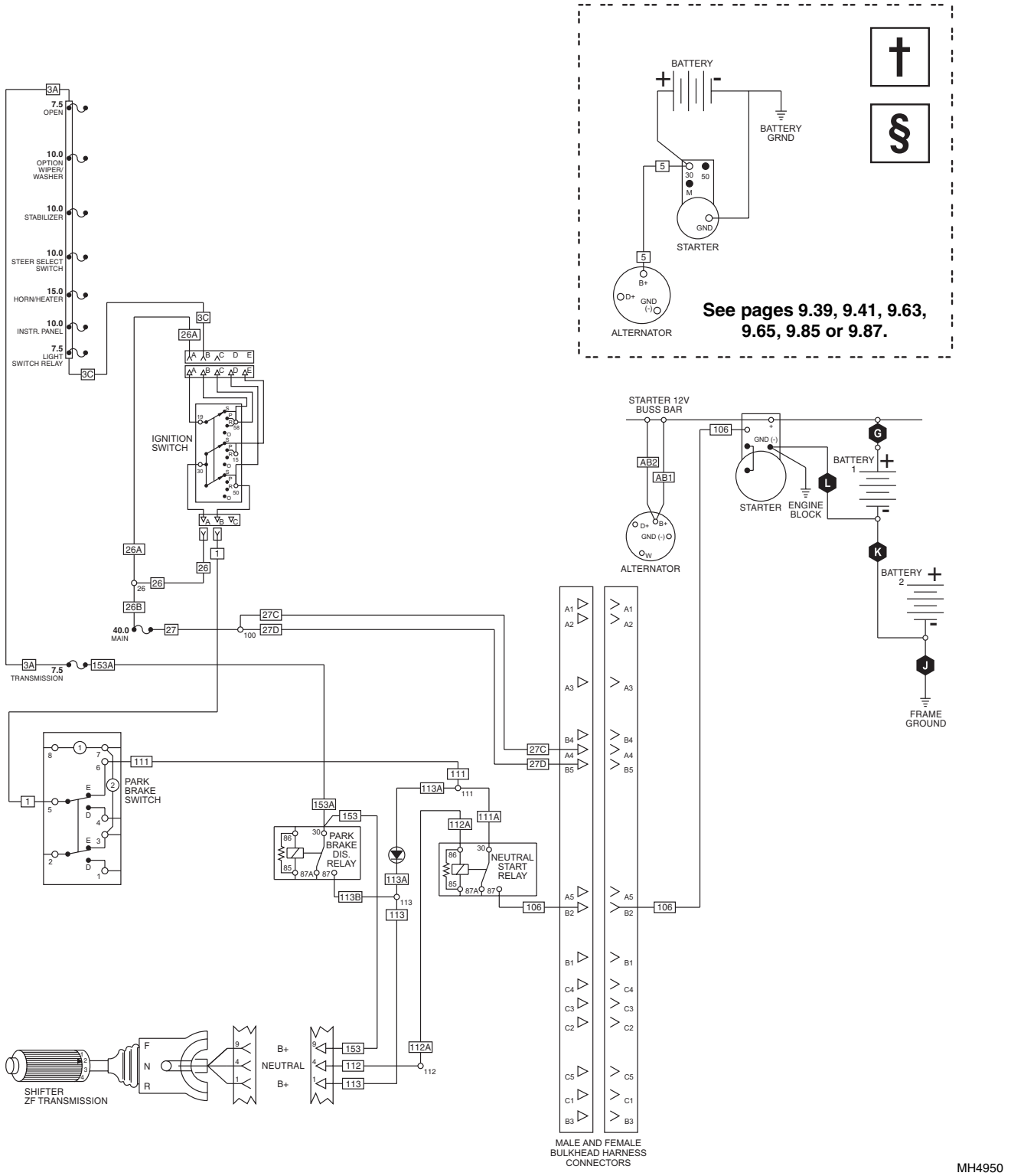


MH5180

9.7.36 Engine Start Circuit and Troubleshooting

Schematic is drawn with the ignition switch in the START position.

Except where noted, this schematic is taken from diagrams on pages 9.50, 9.52, 9.74, 9.76, 9.102 and 9.104.



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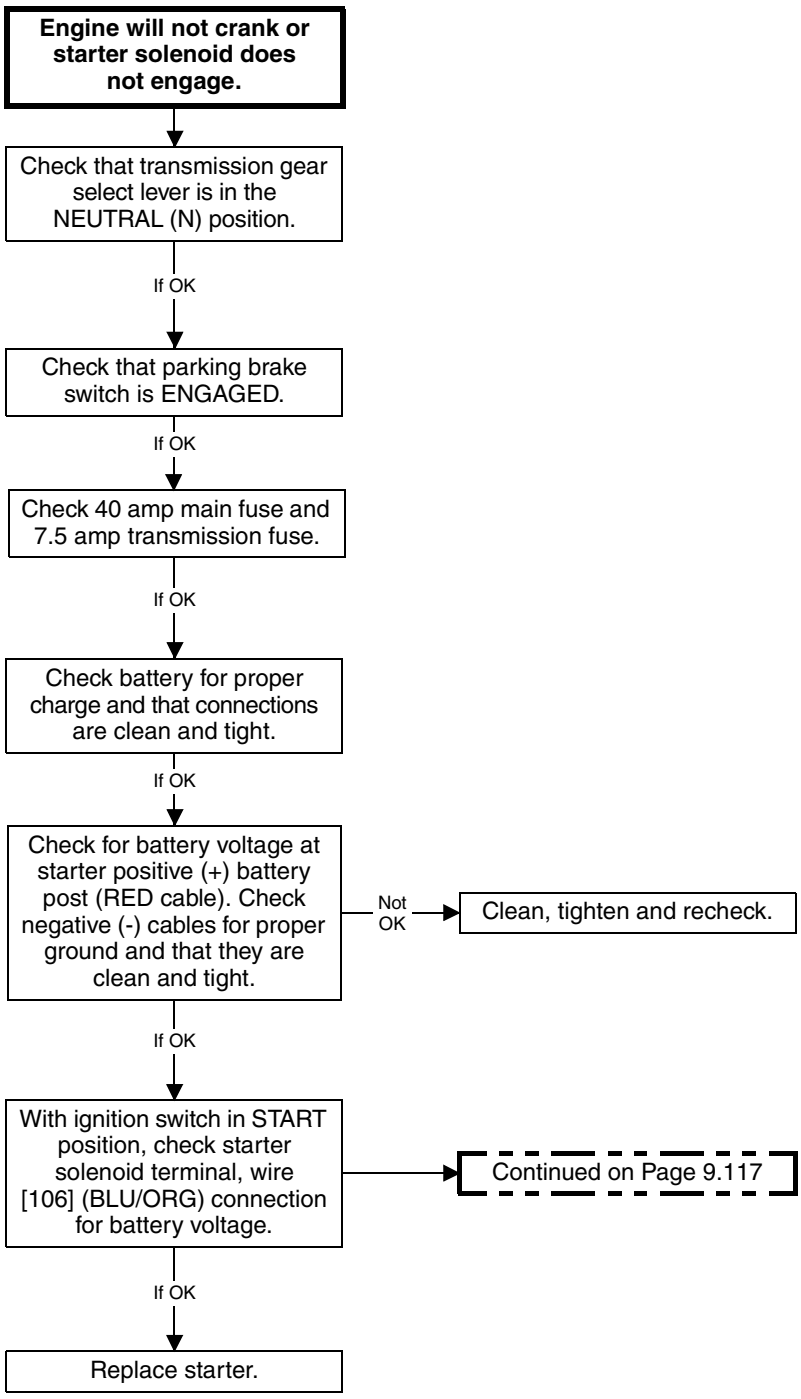
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**
2. **On 10042 or 10054, if the vehicle is starting hard, make sure that both outrigger switches are in the neutral (center) position.**



† **SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.**

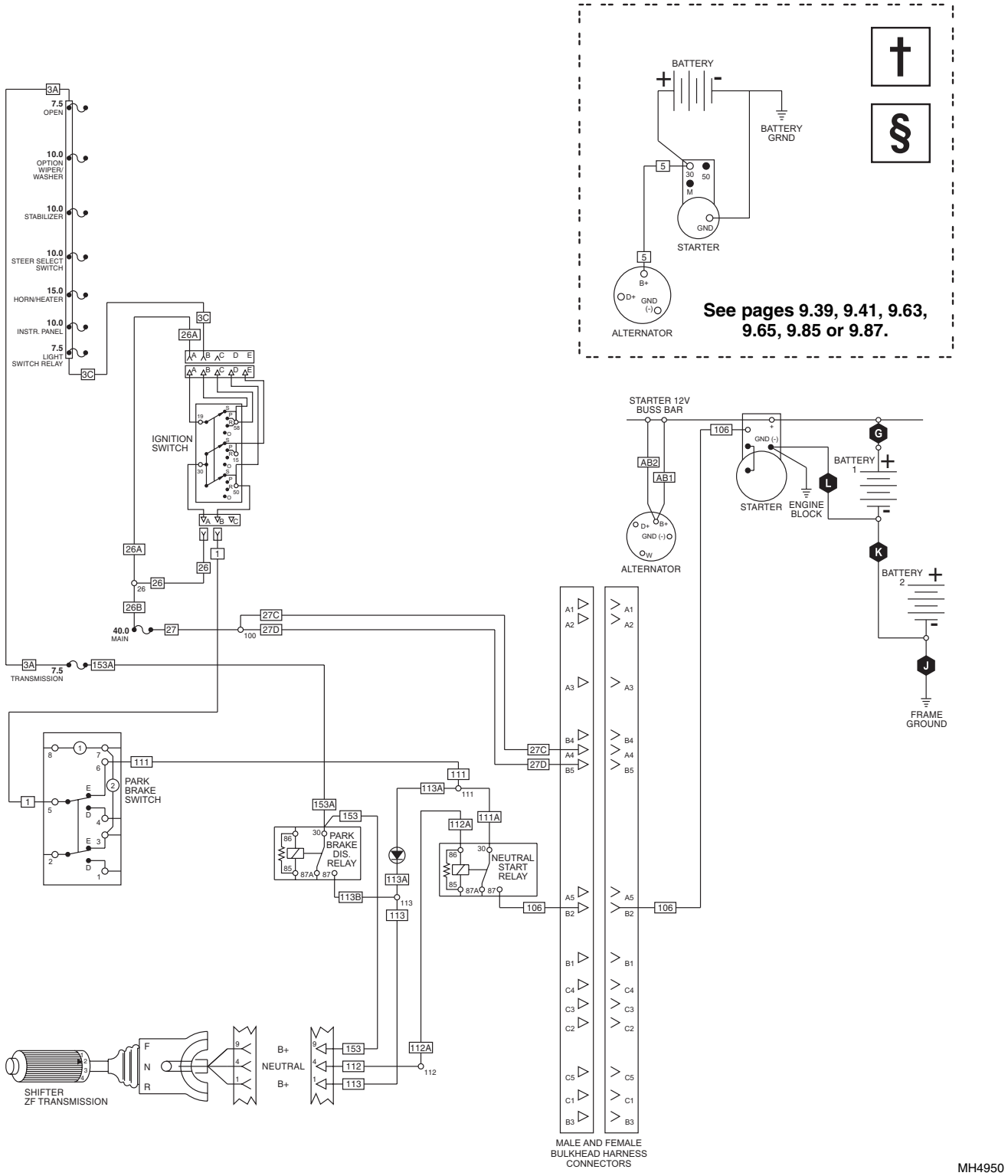
§ **SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.**

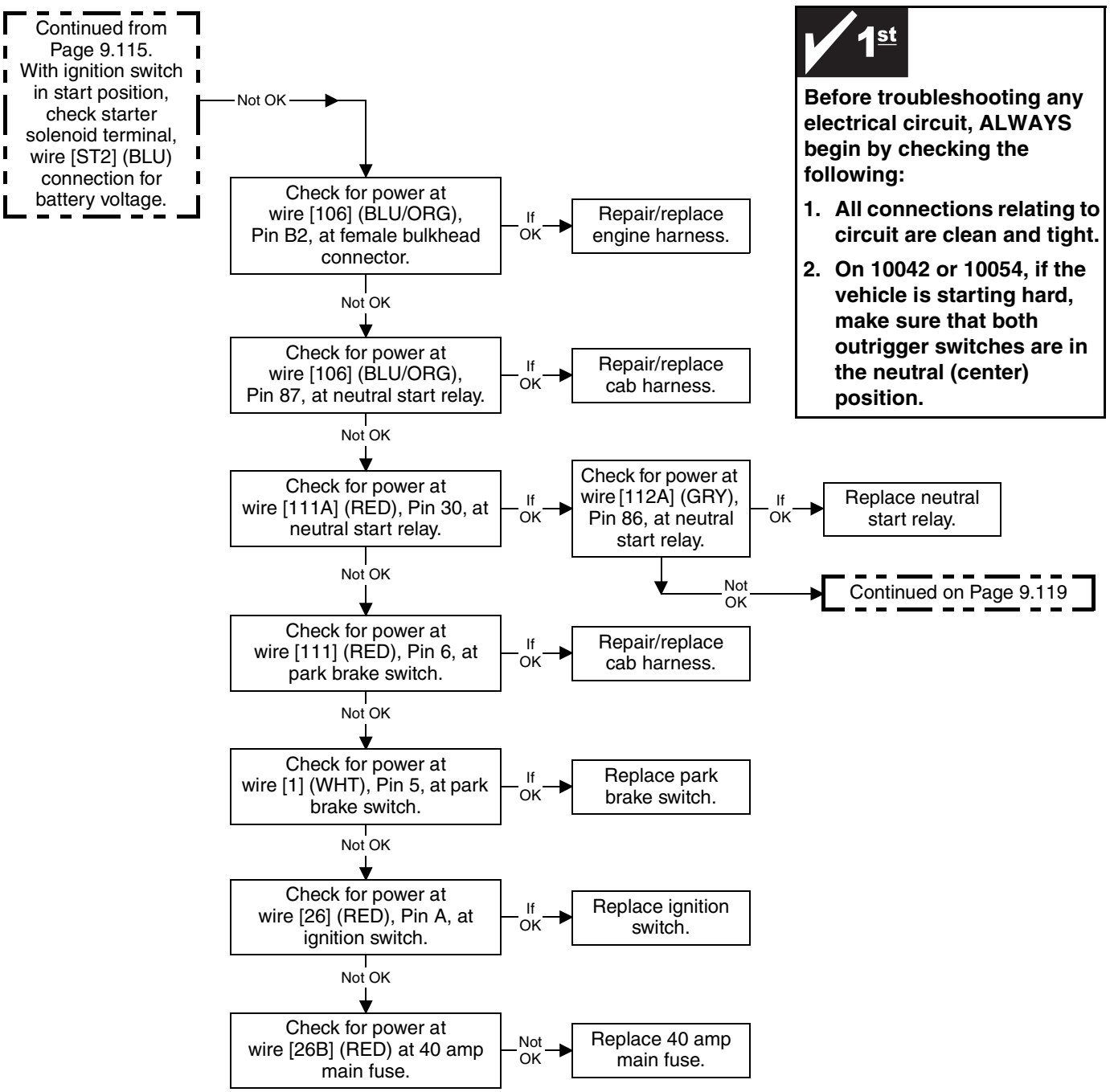
⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

9.7.36 Engine Start Circuit and Troubleshooting (Continued)

Schematic is drawn with the ignition switch in the START position.

Except where noted, this schematic is taken from diagrams on pages 9.50, 9.52, 9.74, 9.76, 9.102 and 9.104.





† **SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.**

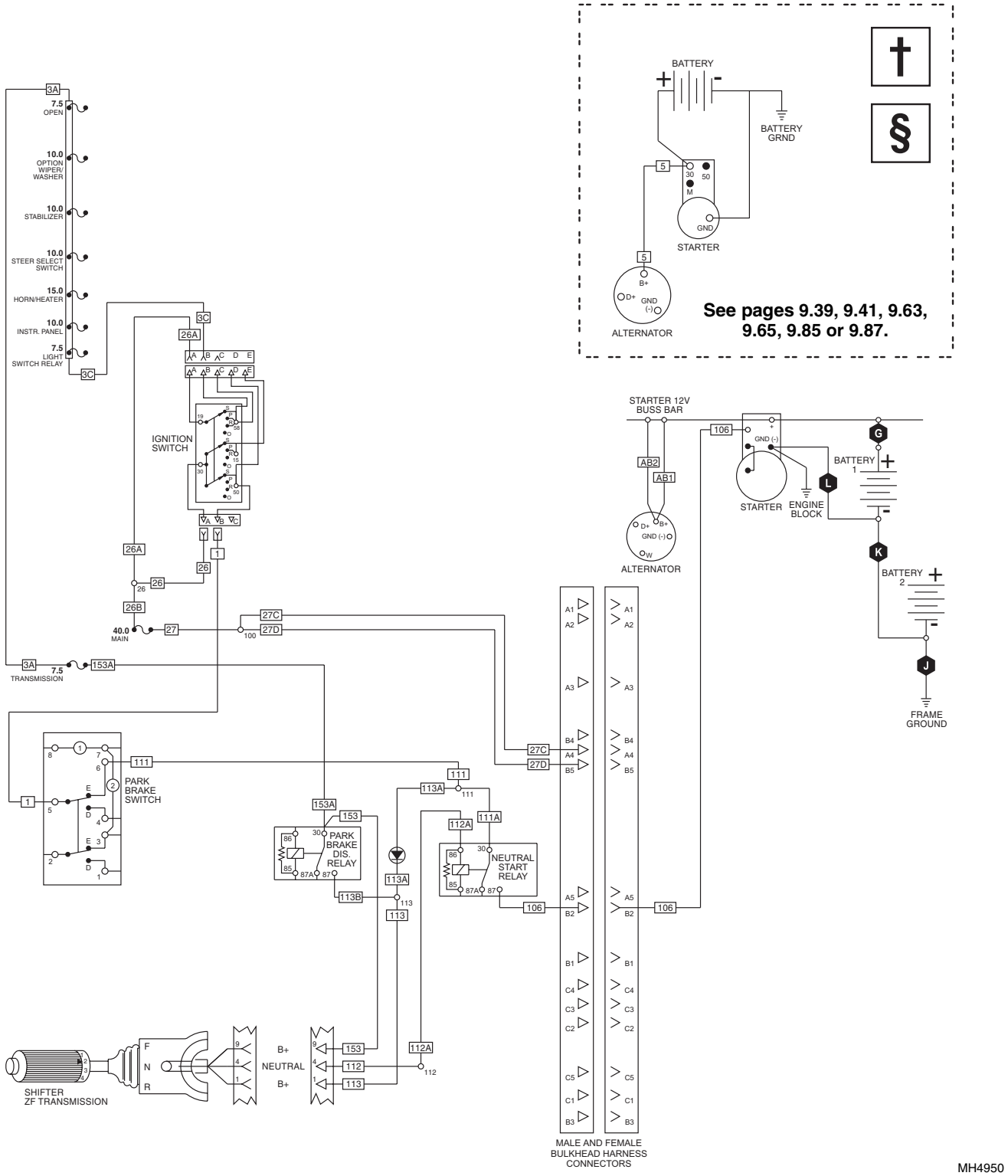
§ **SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.**

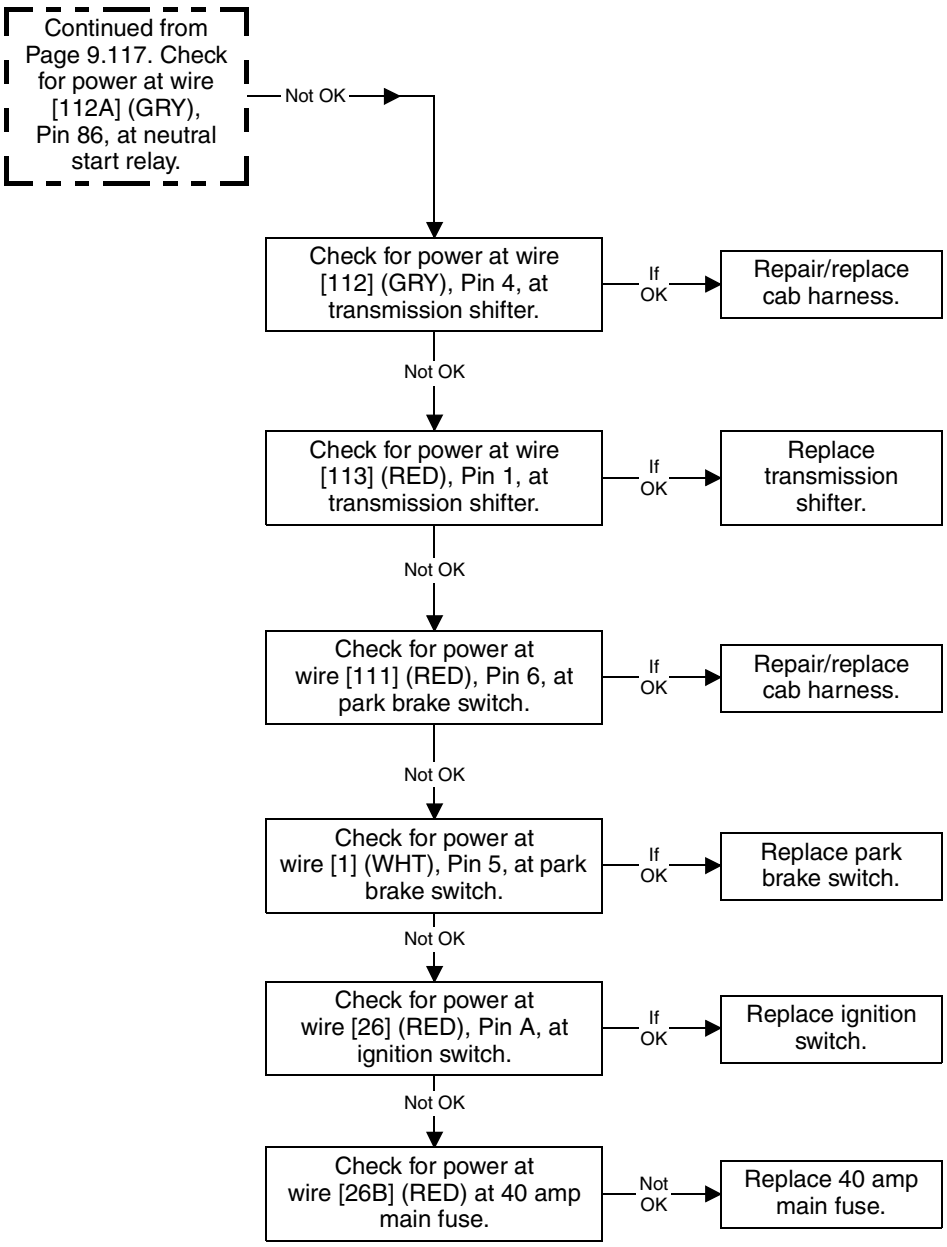
⬢ **These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.**

9.7.36 Engine Start Circuit and Troubleshooting (Continued)

Schematic is drawn with the ignition switch in the START position.

Except where noted, this schematic is taken from diagrams on pages 9.50, 9.52, 9.74, 9.76, 9.102 and 9.104.





1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**
2. **On 10042 or 10054, if the vehicle is starting hard, make sure that both outrigger switches are in the neutral (center) position.**

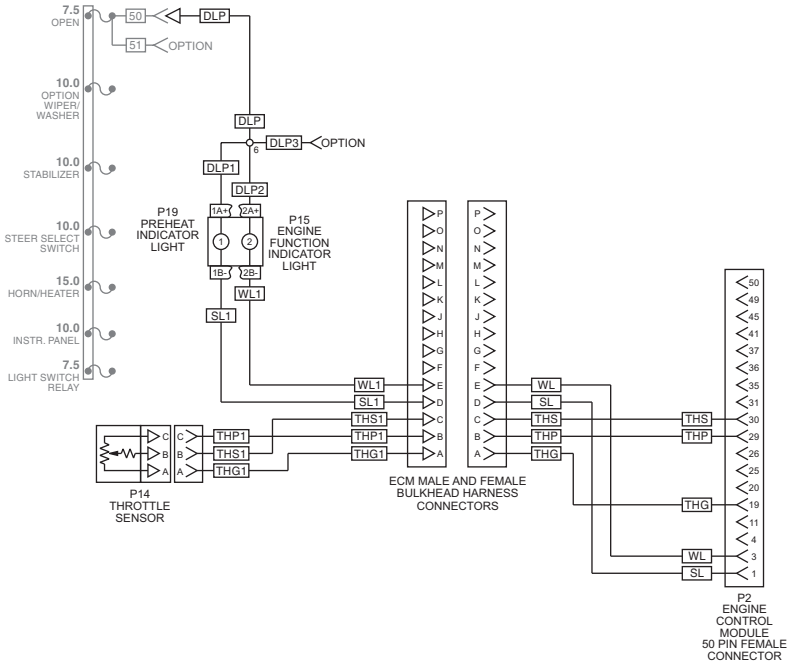
† SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.

§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.

⬢ These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.

9.7.37 Electronic Throttle Circuit and Troubleshooting (SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)

Schematic is drawn with the ignition switch in the RUN position.



MH5010

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**

Engine speed drops to low idle and there is no response when the throttle pedal is depressed.

At ECM power harness female bulkhead connector, at Pin B, wire [THP] (RED), check for 5 VDC.

Not OK → At P2, engine control module 50 pin female harness connector, at Pin 29, wire [THP] (RED), check for 5 VDC.

- If OK → Repair/replace engine harness.
- Not OK → ECM issue. Contact Cummins.

If OK →

Check for 5 VDC at throttle sensor female harness connector, at Pin C, wire [THP1] (RED).

Not OK → Repair/replace ECM cab harness.

If OK →

Check resistance across pins at throttle sensor male connector. Resistance across Pins A and C should be 2,000 - 3,000 ohms. Resistance across Pins A and B should vary from approximately 500±100 ohms, with throttle pedal at rest, to approximately 2,200±100 ohms, with pedal fully depressed.

Not OK → Replace throttle pedal assembly.

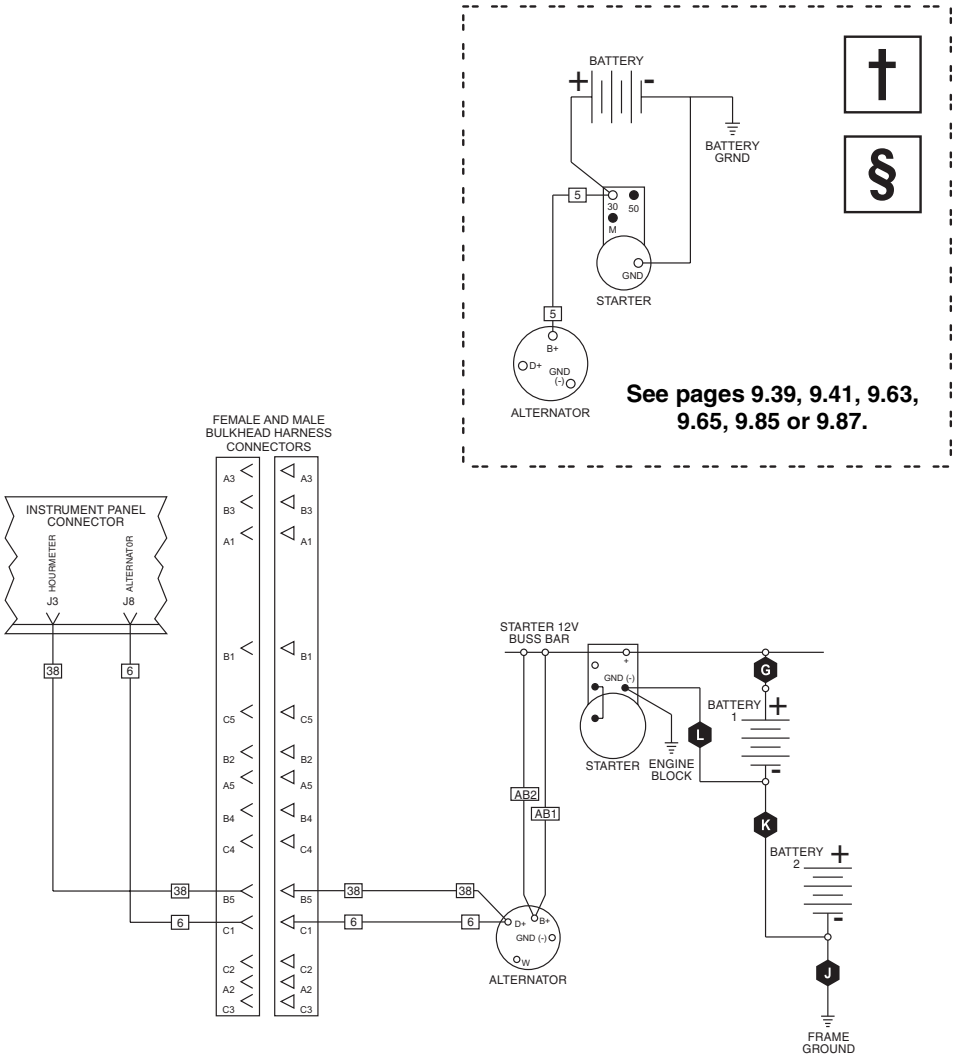
If OK →

Refer to Section 9.7.2, b. “Flash-Out of Fault Codes,” to retrieve fault codes.

9.7.38 Charging Circuit and Troubleshooting

Schematic is drawn with the ignition switch in the RUN position.

Except where noted, this schematic is taken from diagrams on pages 9.50, 9.52, 9.74, 9.76, 9.102 and 9.104.

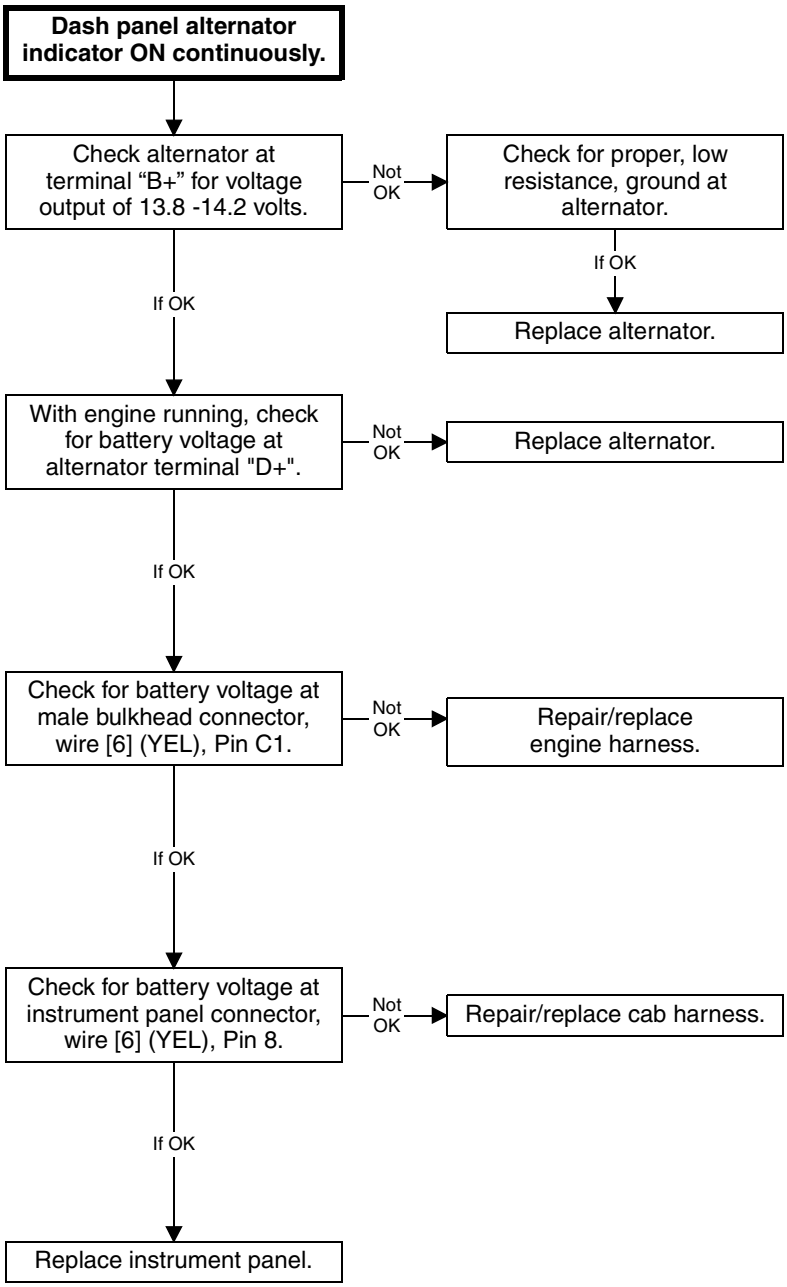


MH5020

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**
3. **Check that bulb is OK.**



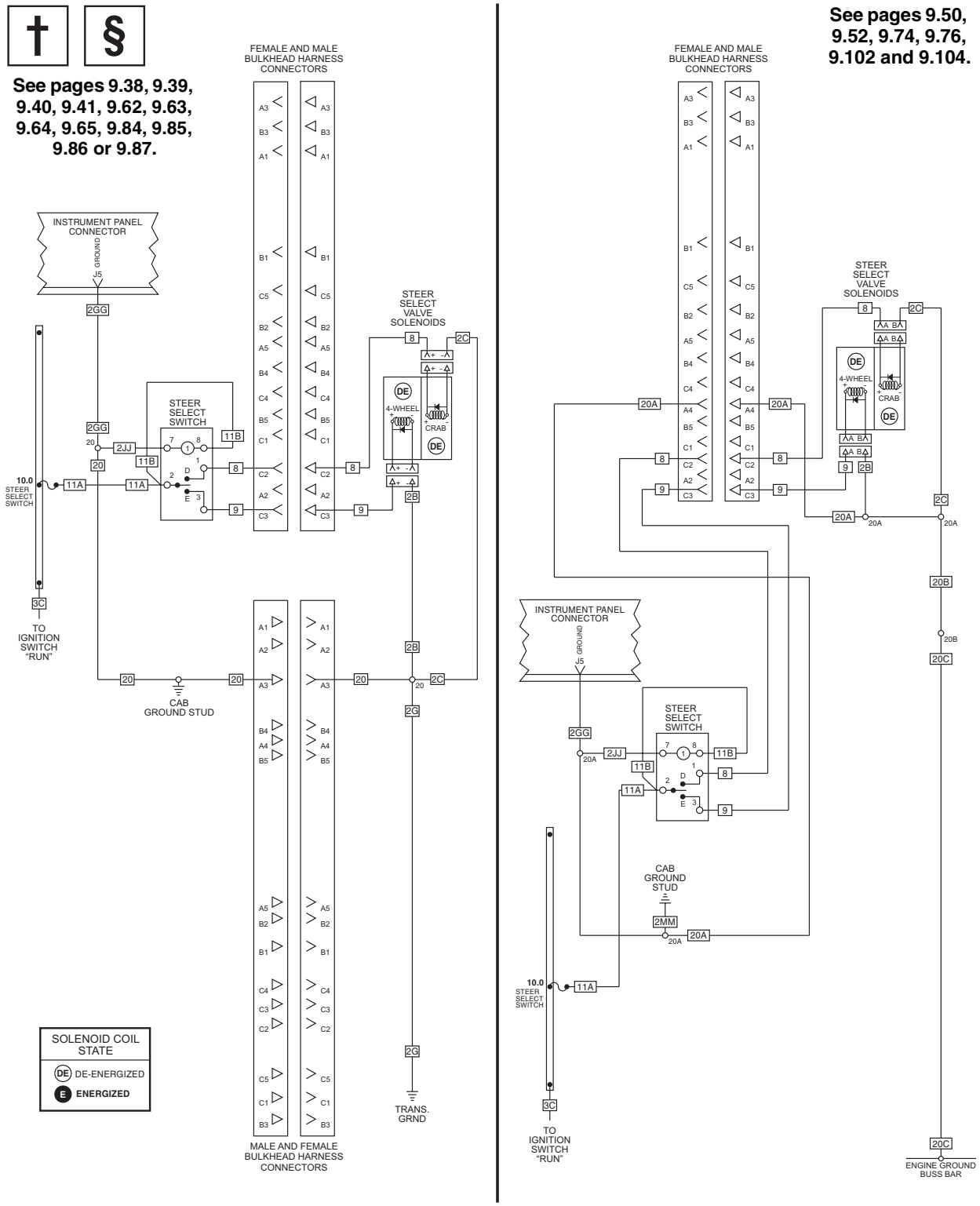
† SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.

§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.

⬢ These wires are not part of a wire harness. Refer to the appropriate Parts Manual for part number information.

9.7.39 Front Steer Circuit and Troubleshooting

Schematic is drawn with the ignition switch in the RUN position.

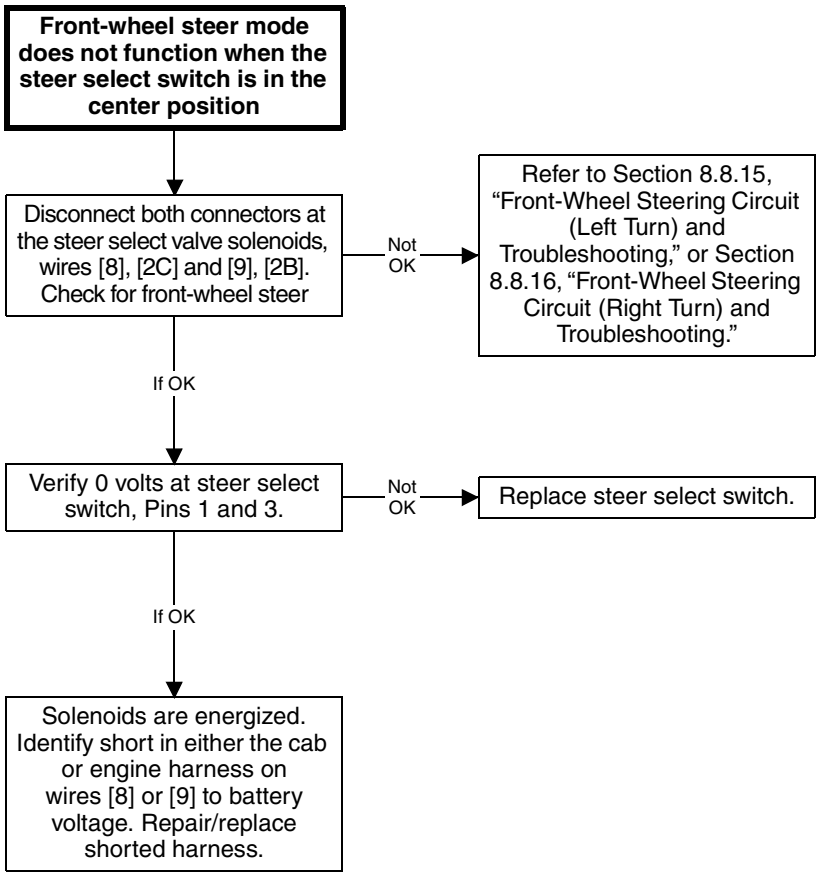


MH5050

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

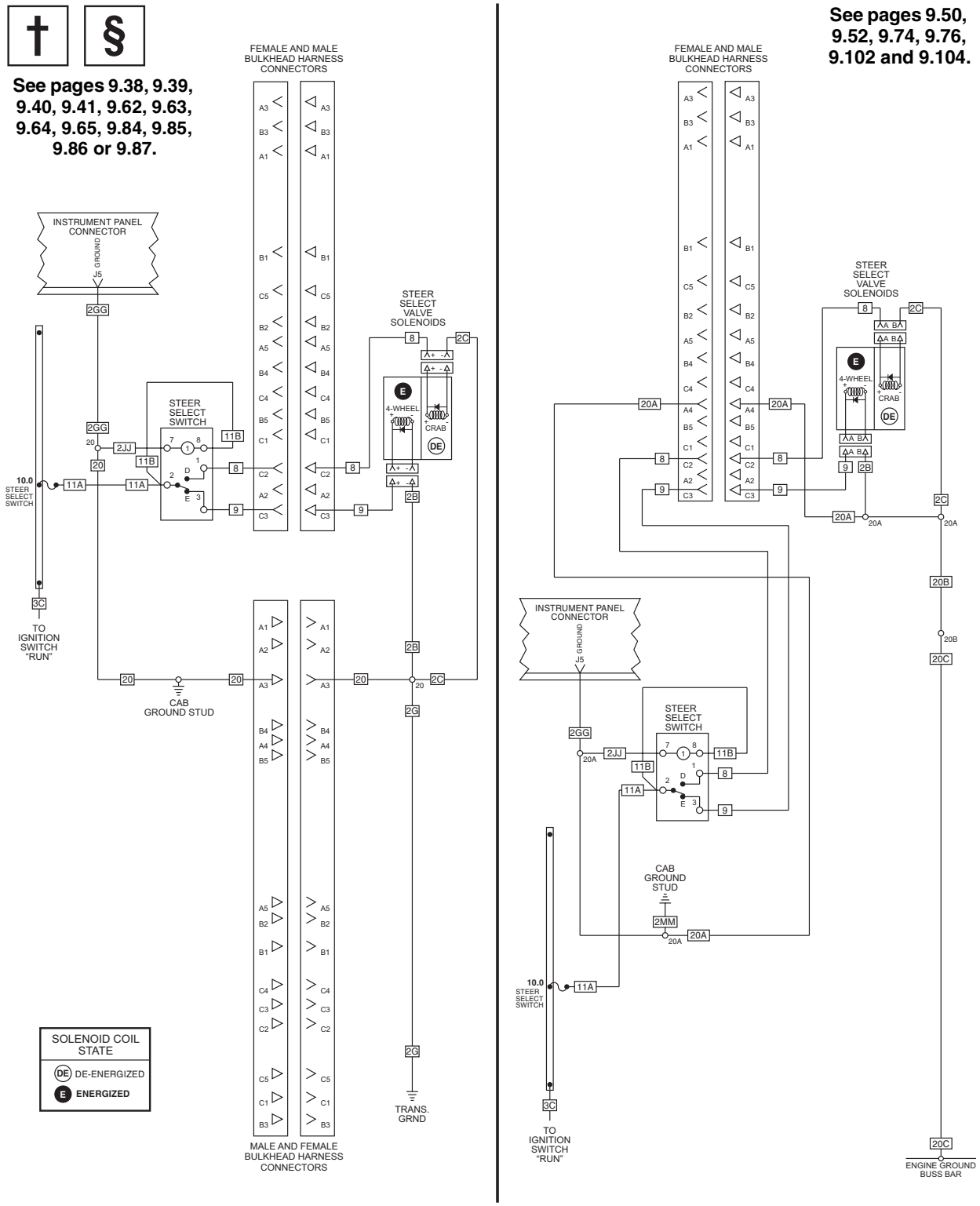
1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**



† SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.

9.7.40 Four-Wheel Steer Circuit and Troubleshooting

Schematic is drawn with the ignition switch in the RUN position.

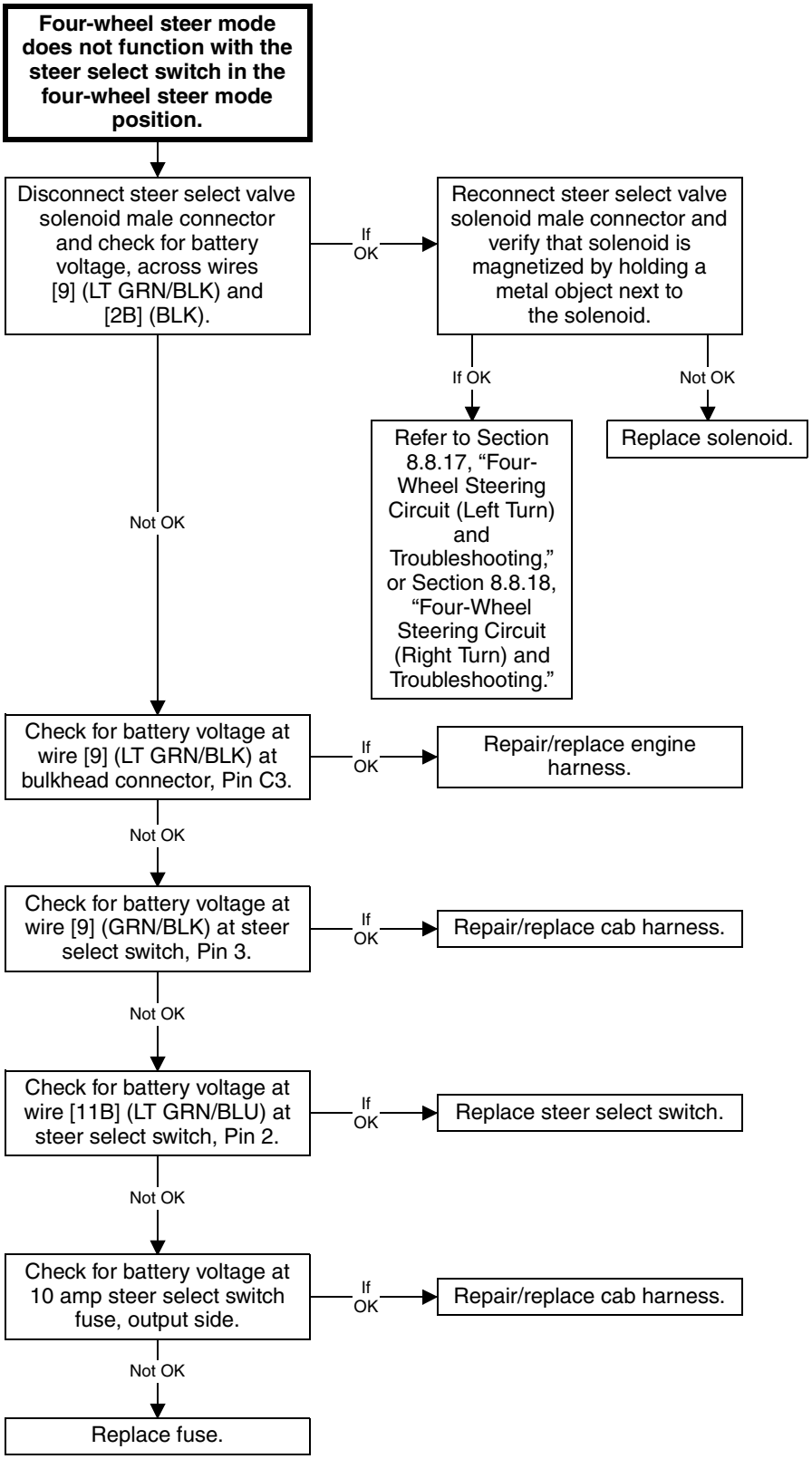


MH5070

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

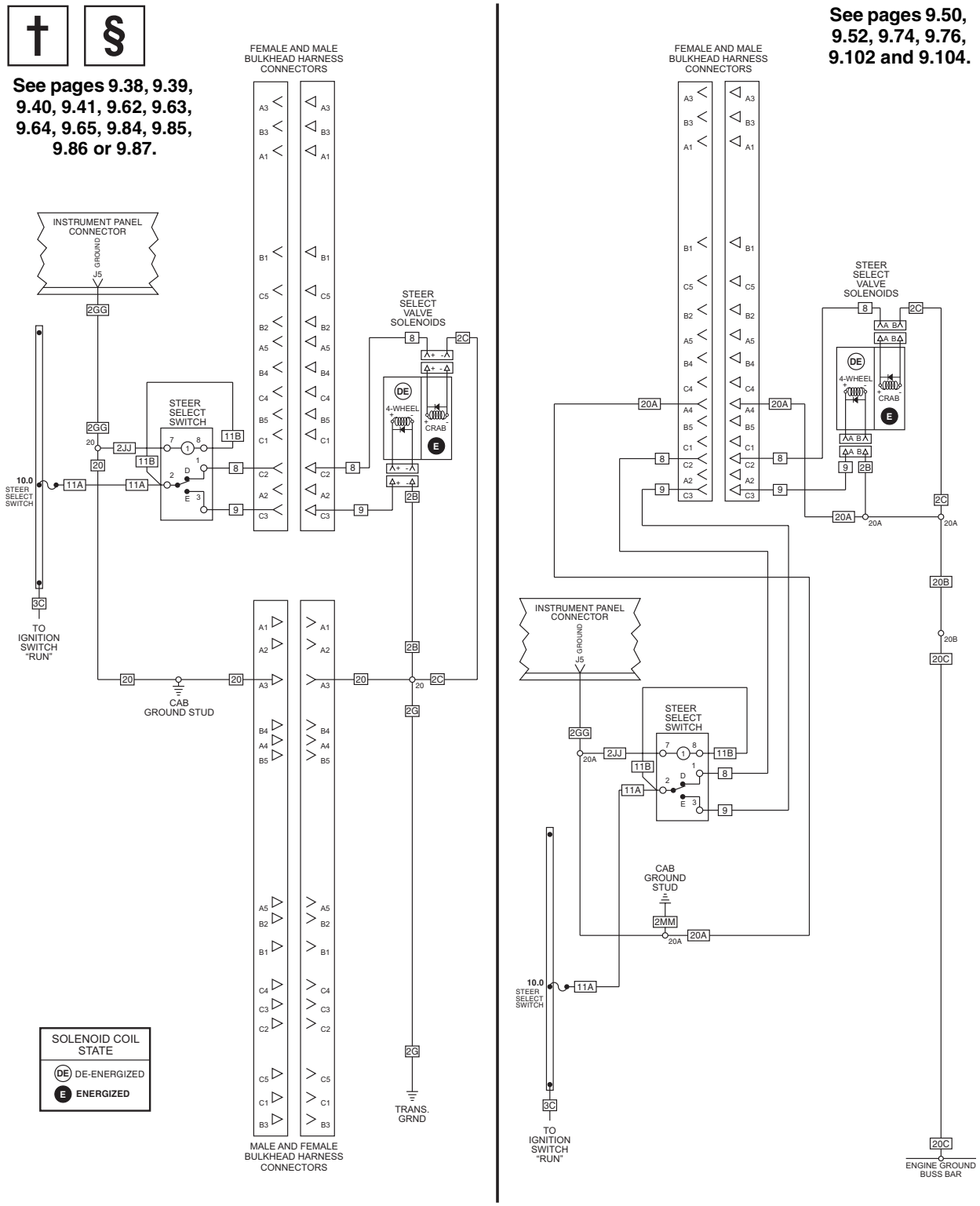
1. **All connections relating to circuit are clean and tight.**



† SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.

9.7.41 Crab Steer Circuit and Troubleshooting

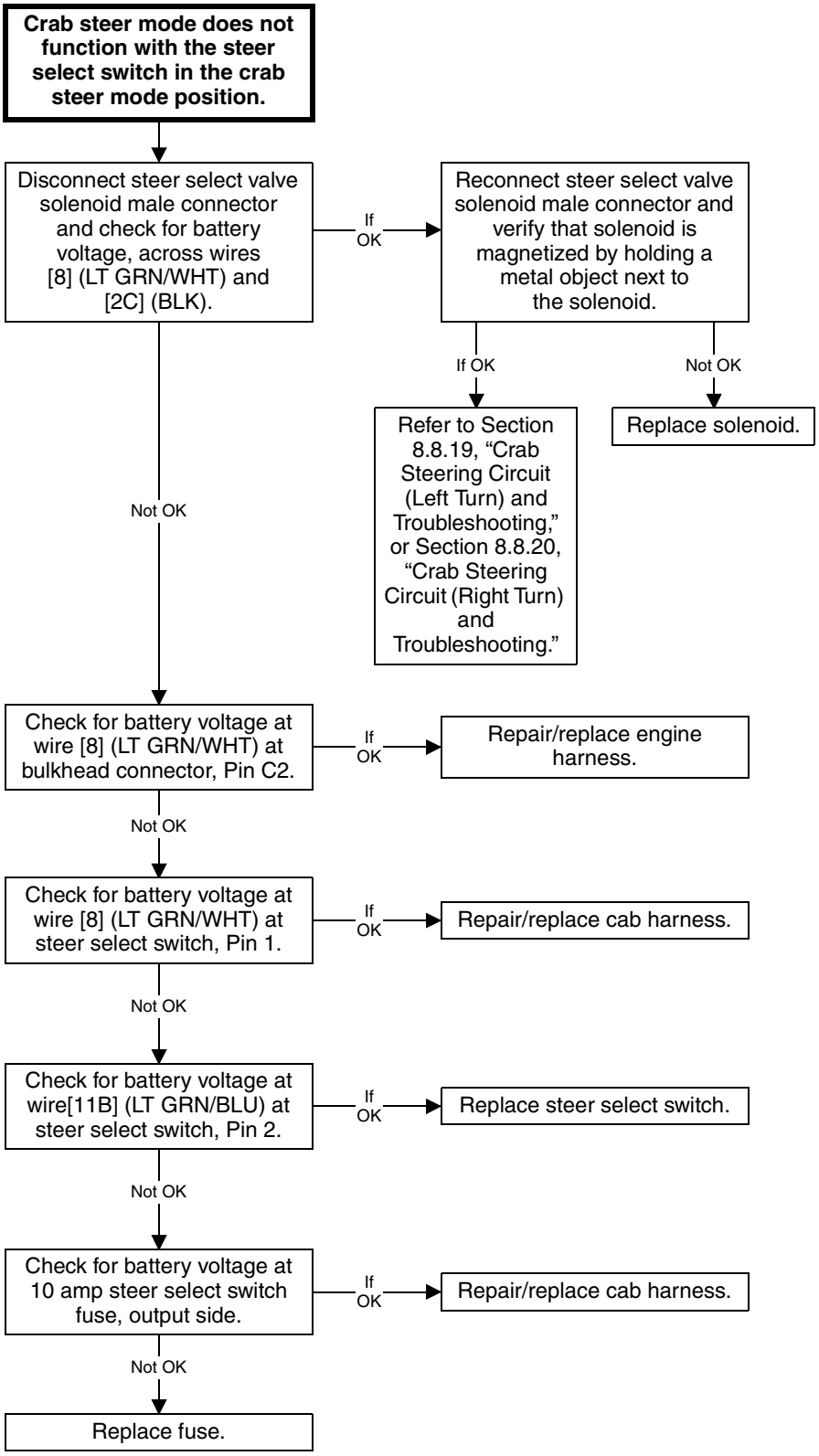
Schematic is drawn with the ignition switch in the RUN position.



1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

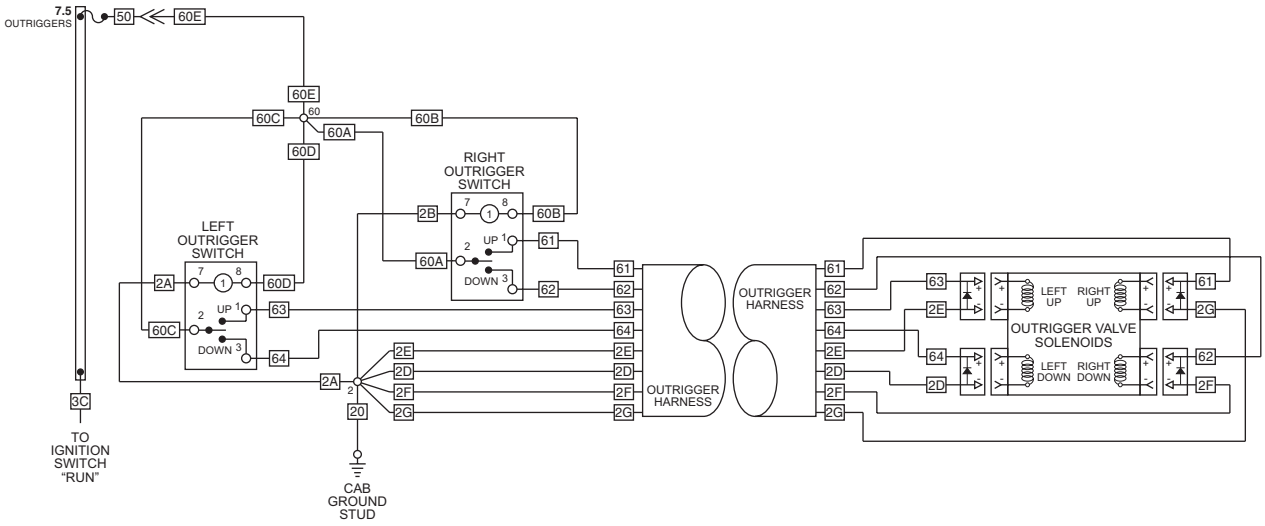
1. **All connections relating to circuit are clean and tight.**



† SN 13198 through 16782 w/o Lighting Package. See pages 9.38, 9.39, 9.62, 9.63, 9.84 or 9.85.
§ SN 13198 through 16782 w/Lighting Package and SN 16783 through 18990. See pages 9.40, 9.41, 9.64, 9.65, 9.86 or 9.87.

9.7.42 10042 Outrigger Circuit and Troubleshooting

Schematic is drawn with the ignition switch in the RUN position.



MH5110

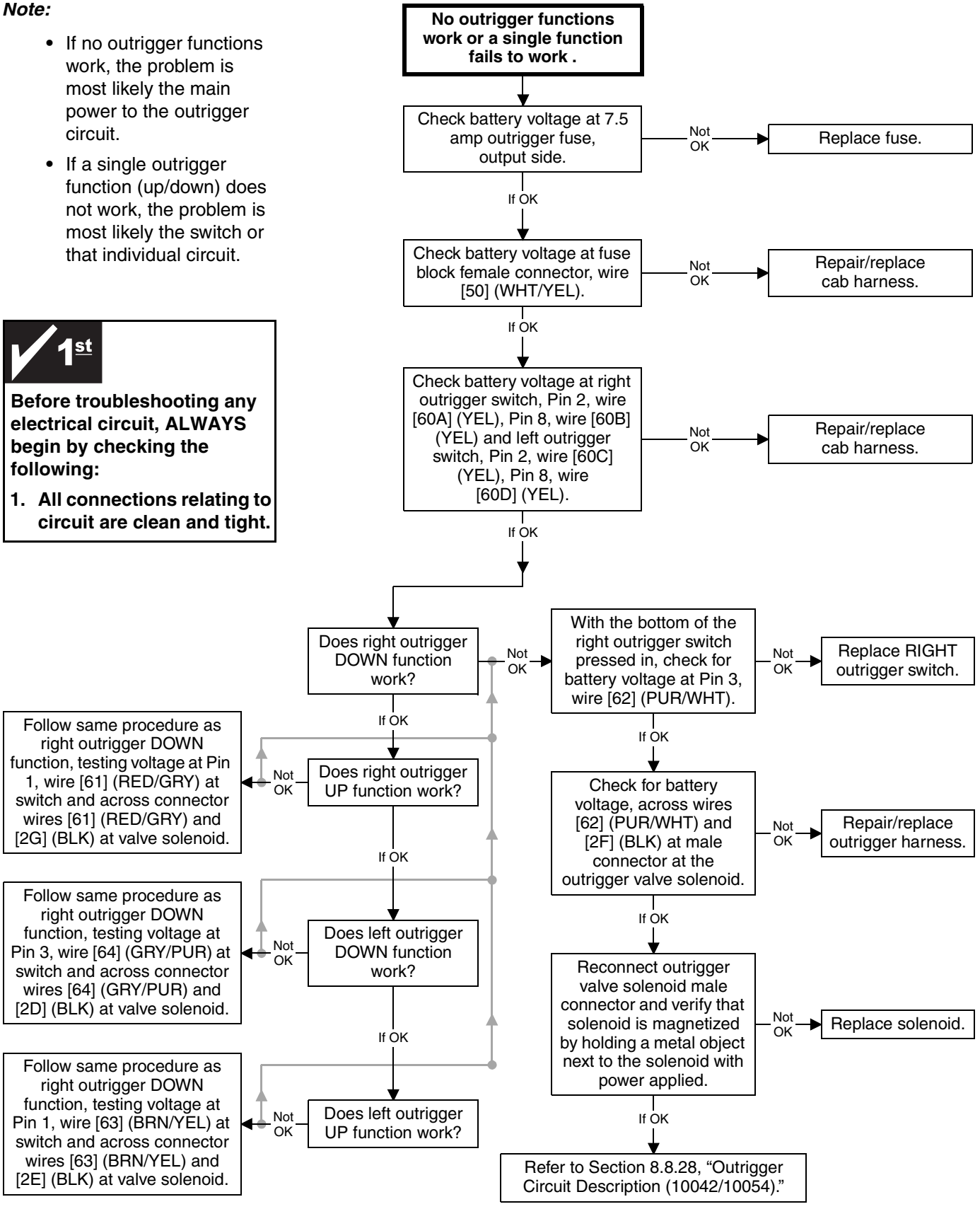
Note:

- If no outrigger functions work, the problem is most likely the main power to the outrigger circuit.
- If a single outrigger function (up/down) does not work, the problem is most likely the switch or that individual circuit.

1st

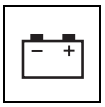
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**



9.7.43 10054 Outrigger Circuit and Troubleshooting

For additional information on the 10054 Outrigger Circuit, refer to Section 10.7, “Stabil-TRAK™ Electrical Circuit Operation and Troubleshooting (8042/10042),” Section 10.9, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984),” or Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After).”



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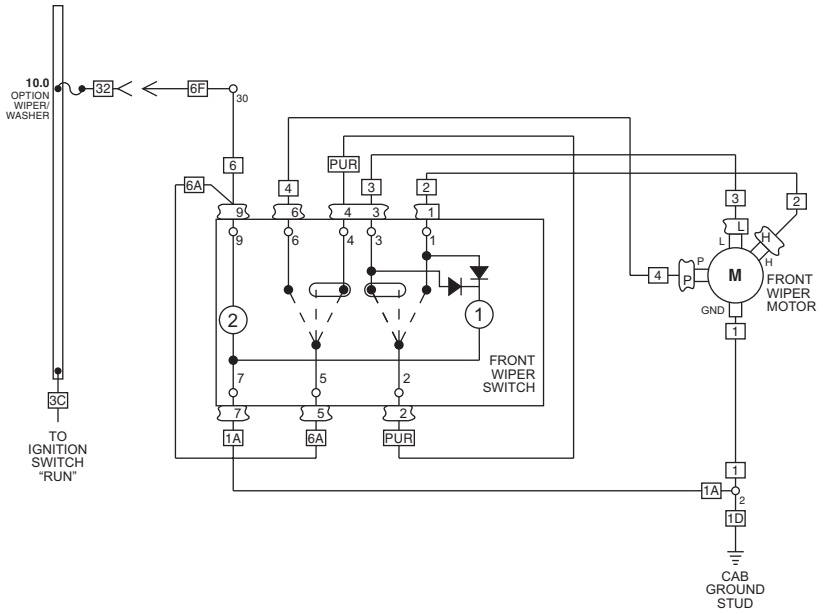
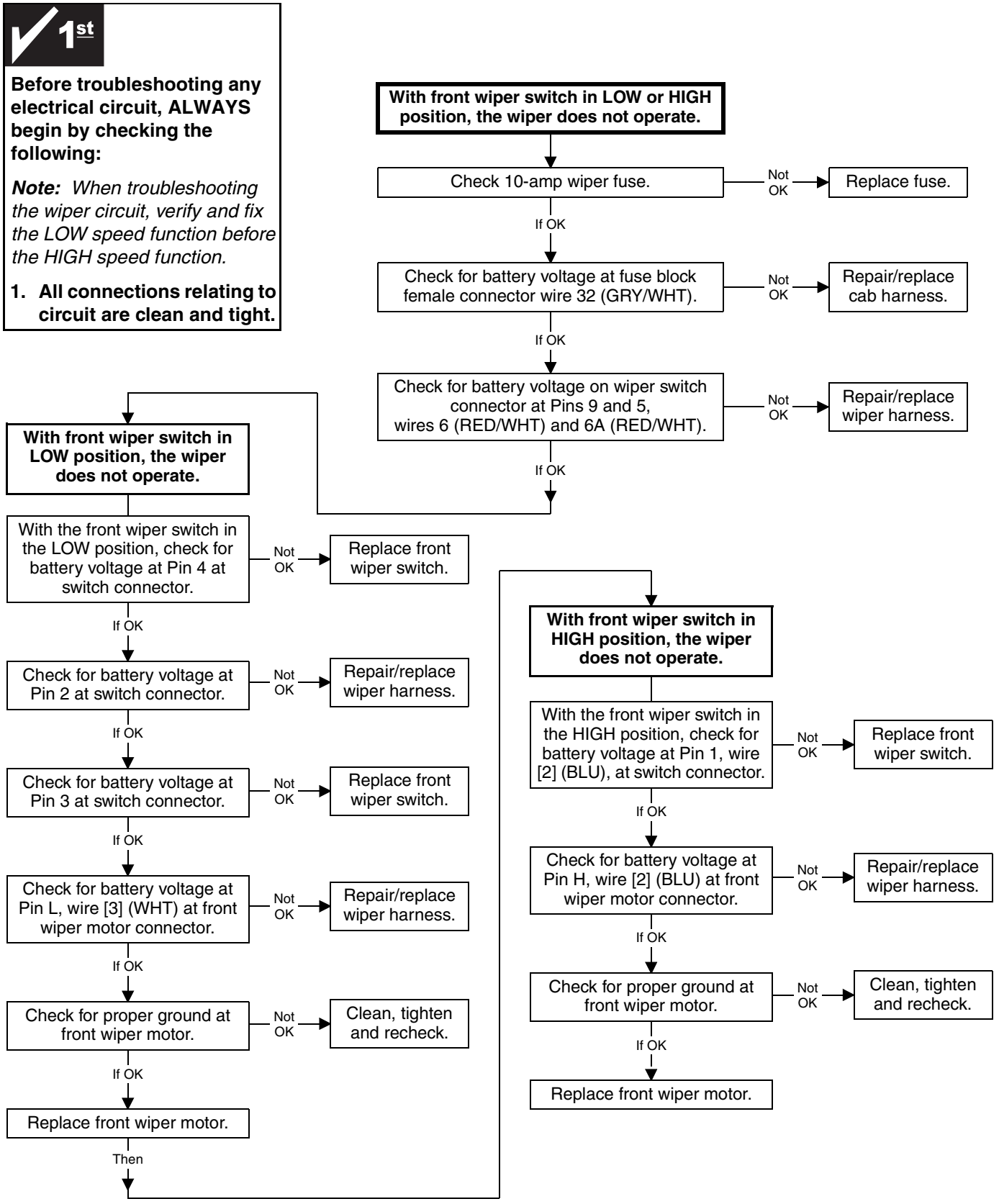
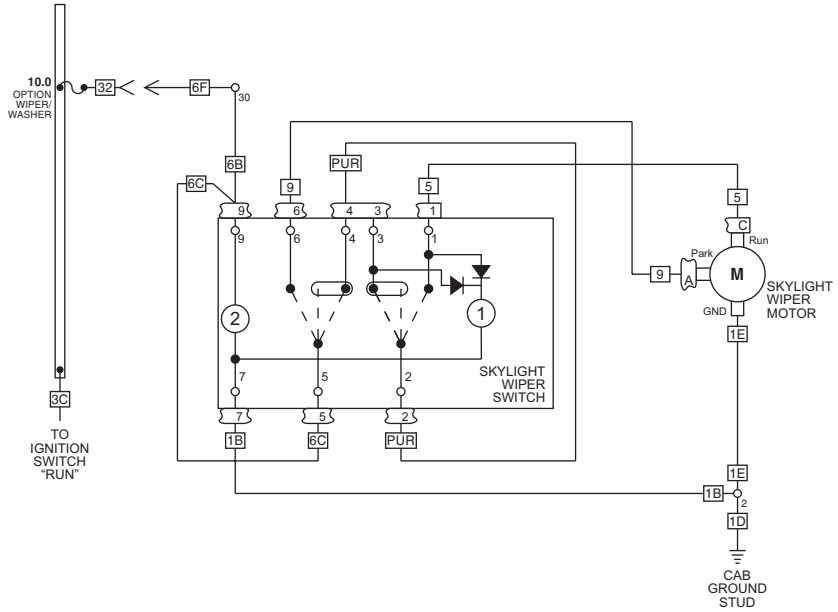
9.7.44 Front Windshield Wiper Circuit and Troubleshooting (Option)



MH5120


1st
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:
Note: When troubleshooting the wiper circuit, verify and fix the LOW speed function before the HIGH speed function.
1. All connections relating to circuit are clean and tight.
With front wiper switch in LOW or HIGH position, the wiper does not operate.
Check 10-amp wiper fuse.
Not OK
Replace fuse.
If OK
Check for battery voltage at fuse block female connector wire 32 (GRY/WHT).
Not OK
Repair/replace cab harness.
If OK
Check for battery voltage on wiper switch connector at Pins 9 and 5, wires 6 (RED/WHT) and 6A (RED/WHT).
Not OK
Repair/replace wiper harness.
If OK
With front wiper switch in LOW position, the wiper does not operate.
With the front wiper switch in the LOW position, check for battery voltage at Pin 4 at switch connector.
Not OK
Replace front wiper switch.
If OK
Check for battery voltage at Pin 2 at switch connector.
Not OK
Repair/replace wiper harness.
If OK
Check for battery voltage at Pin 3 at switch connector.
Not OK
Replace front wiper switch.
If OK
Check for battery voltage at Pin L, wire [3] (WHT) at front wiper motor connector.
Not OK
Repair/replace wiper harness.
If OK
Check for proper ground at front wiper motor.
Not OK
Clean, tighten and recheck.
If OK
Replace front wiper motor.
Then
With front wiper switch in HIGH position, the wiper does not operate.
With the front wiper switch in the HIGH position, check for battery voltage at Pin 1, wire [2] (BLU), at switch connector.
Not OK
Replace front wiper switch.
If OK
Check for battery voltage at Pin H, wire [2] (BLU) at front wiper motor connector.
Not OK
Repair/replace wiper harness.
If OK
Check for proper ground at front wiper motor.
Not OK
Clean, tighten and recheck.
If OK
Replace front wiper motor.

9.7.45 Skylight Wiper Circuit and Troubleshooting (Option)

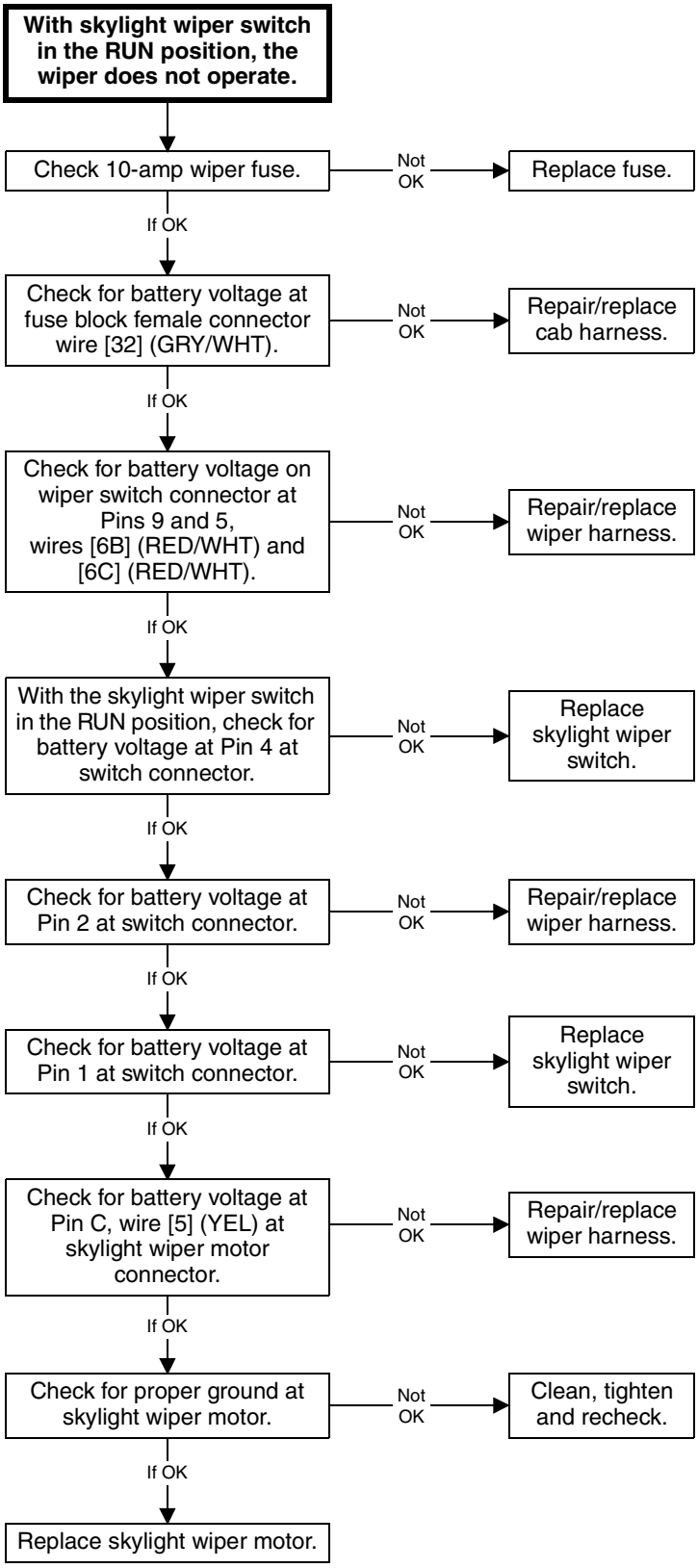


MH5130

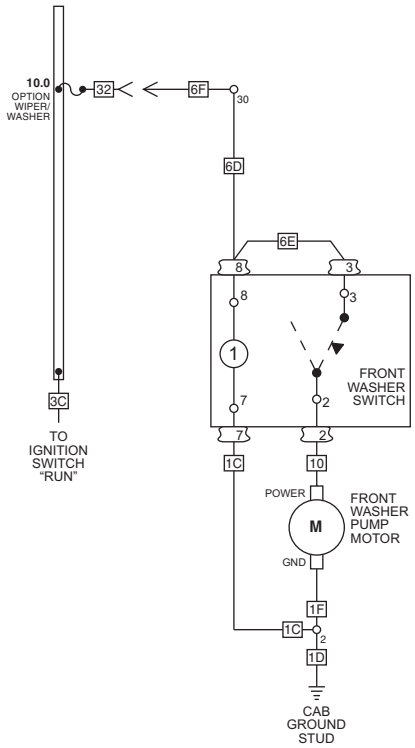
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**



9.7.46 Front Windshield & Skylight Washer Circuit and Troubleshooting (Option)

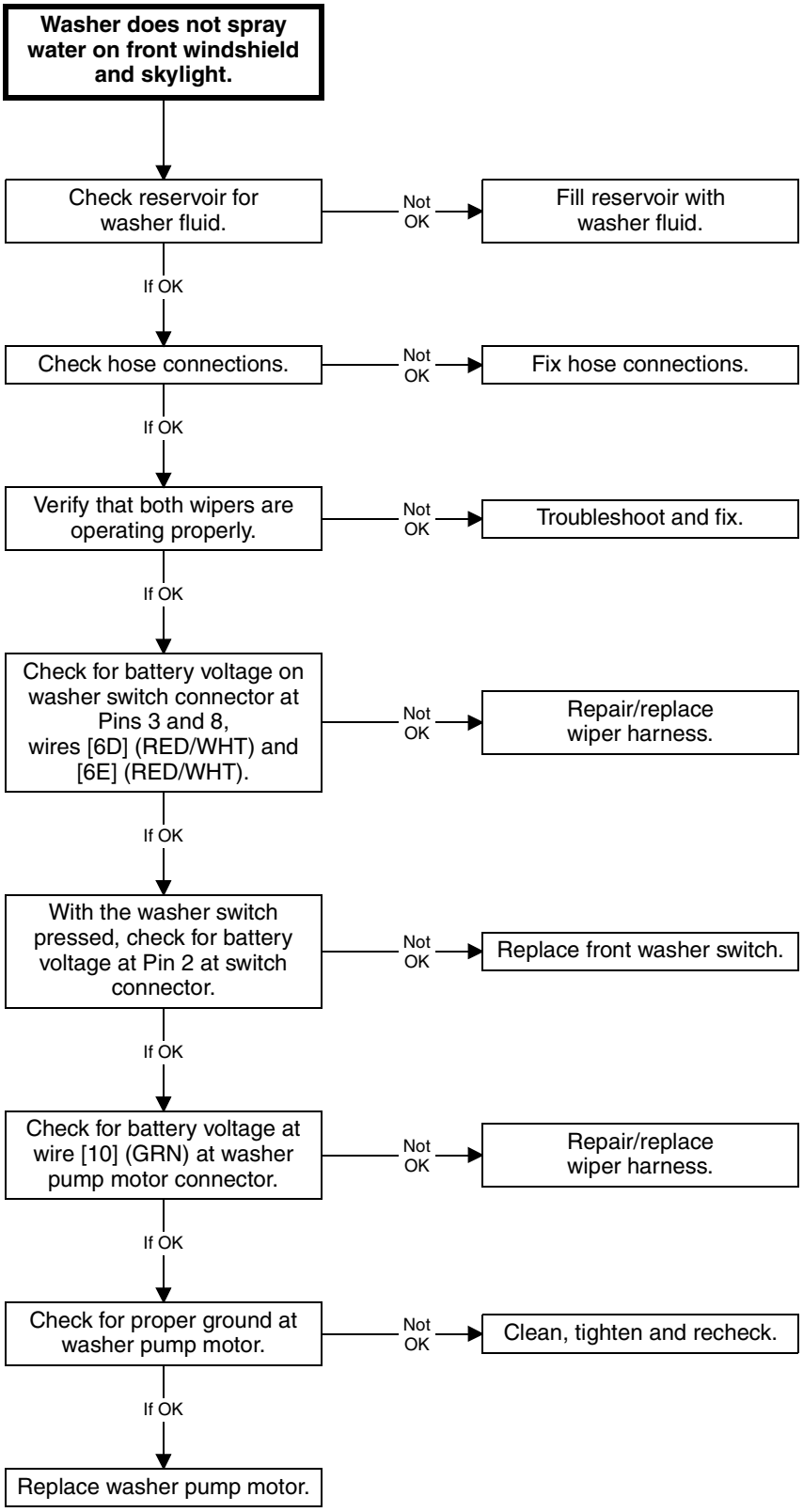


MH5140

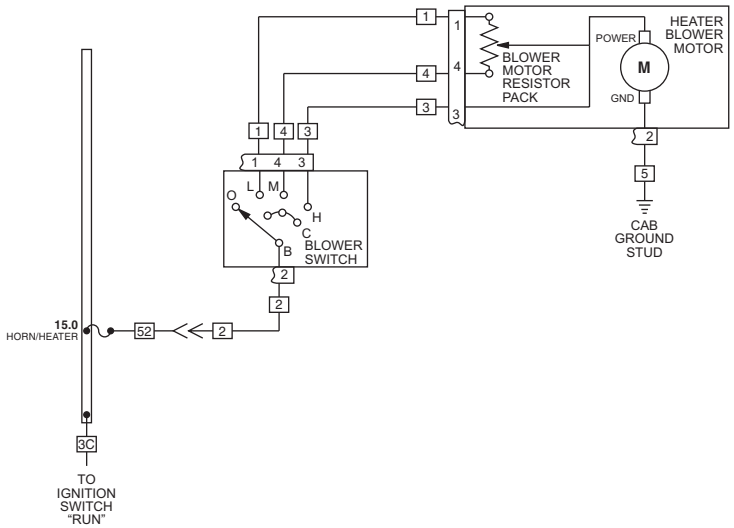
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**



9.7.47 Heater Circuit and Troubleshooting (Option)



MH5150

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **All connections relating to circuit are clean and tight.**

Heater fan does not operate.

Check 15-amp heater fuse. — Not OK → Replace fuse.

If OK

Check for battery voltage at fuse block female connector wire [52] (ORG). — Not OK → Repair/replace cab harness.

If OK

Check for battery voltage at blower switch connector, Pin 2, wire [2] (RED/WHT). — Not OK → Repair/replace heater harness.

If OK

Check for battery voltage at blower switch connector; Pin 1, wire [1] (YEL) with switch set to LOW speed; Pin 4, wire [4] (RED) with switch set to MEDIUM speed; and Pin 3, wire [3] (ORG) with switch set to HIGH speed. — Not OK → Replace blower switch.

If OK

Check for battery voltage at blower connector; Pin 1, wire [1] (YEL) with switch set to LOW speed; Pin 4, wire [4] (RED) with switch set to MEDIUM speed; and Pin 3, wire [3] (ORG) with switch set to HIGH speed. — Not OK → Repair/replace heater harness.

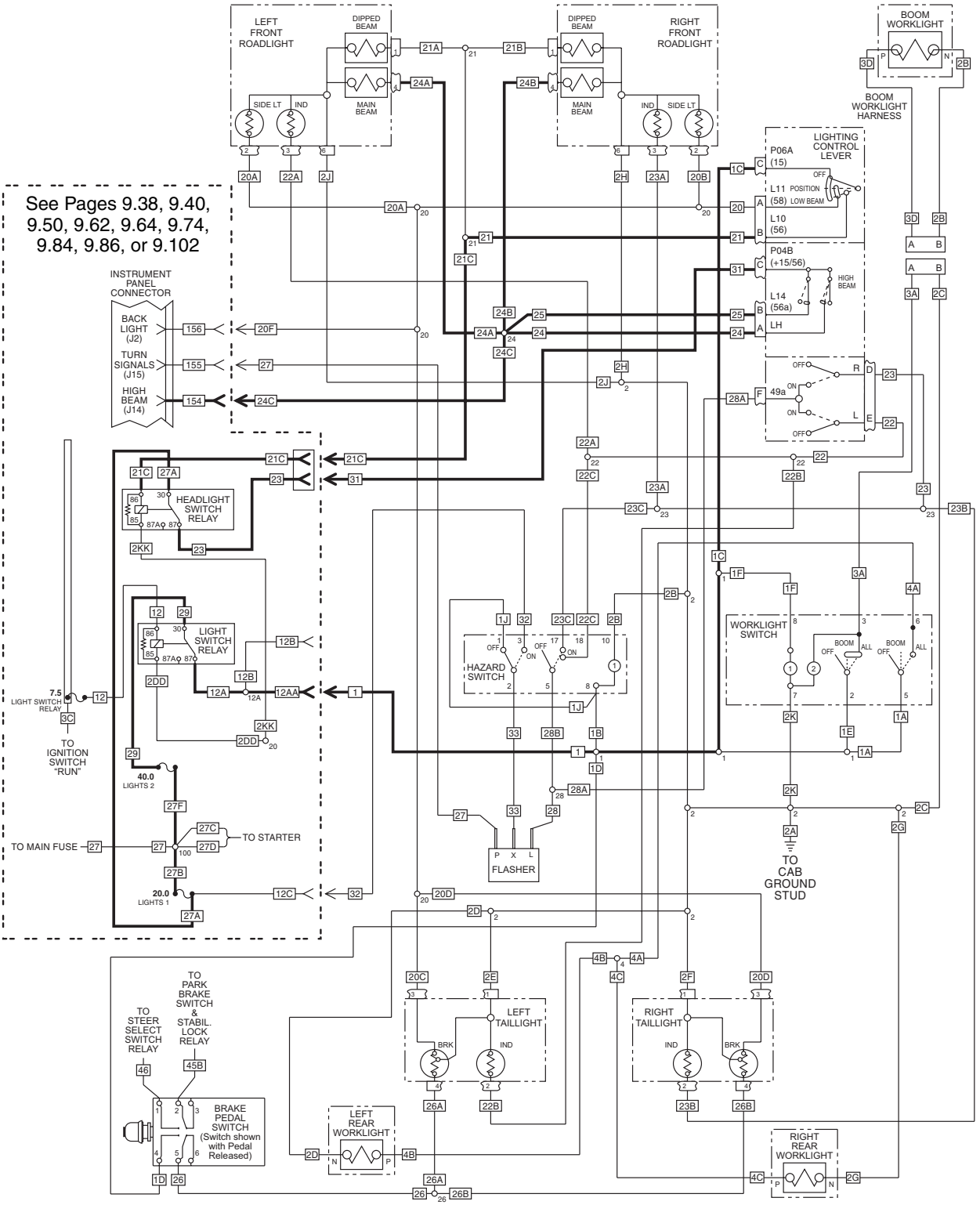
If OK

Check for proper ground at blower motor. — Not OK → Clean, tighten and recheck.

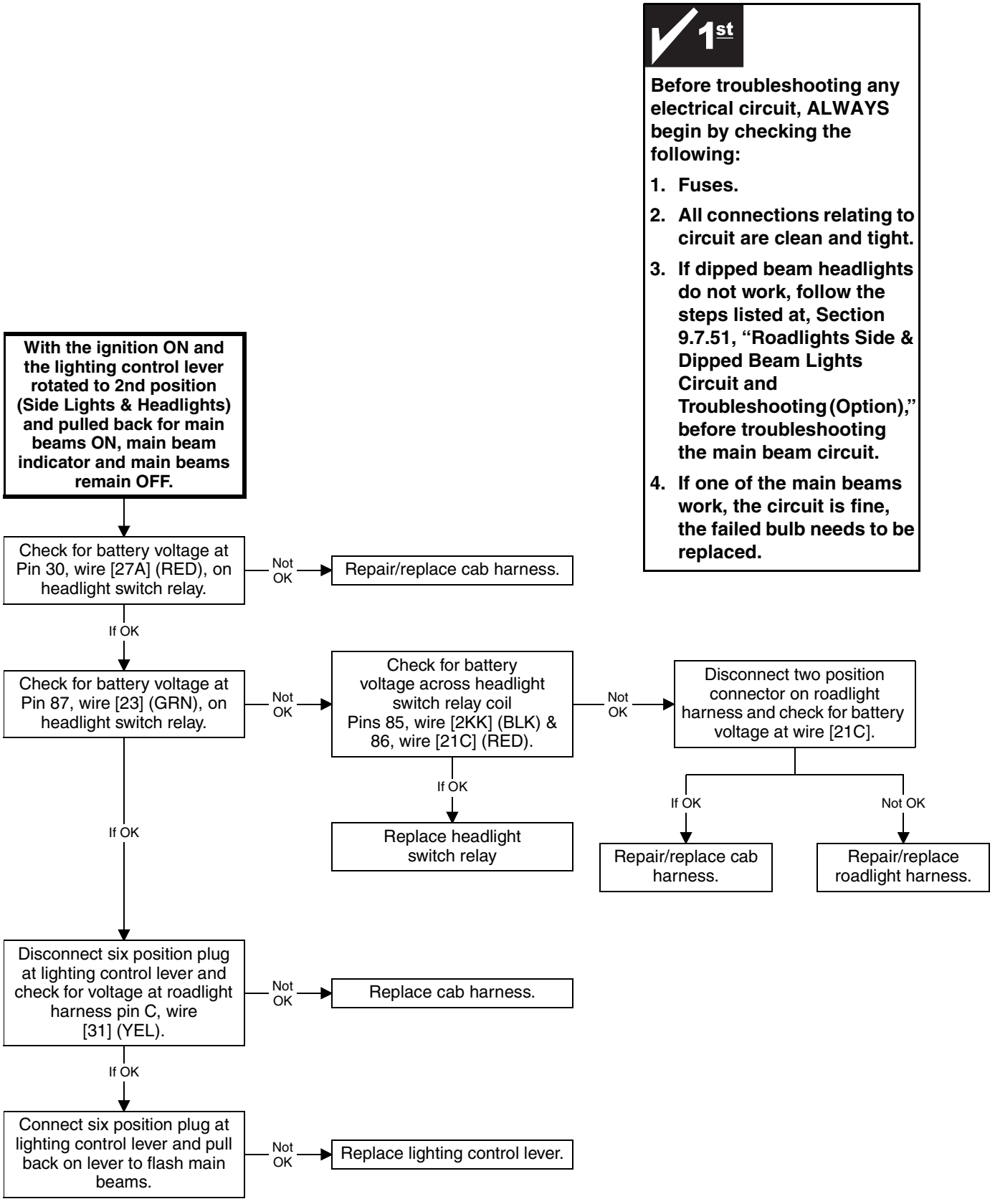
If OK

Replace blower motor.

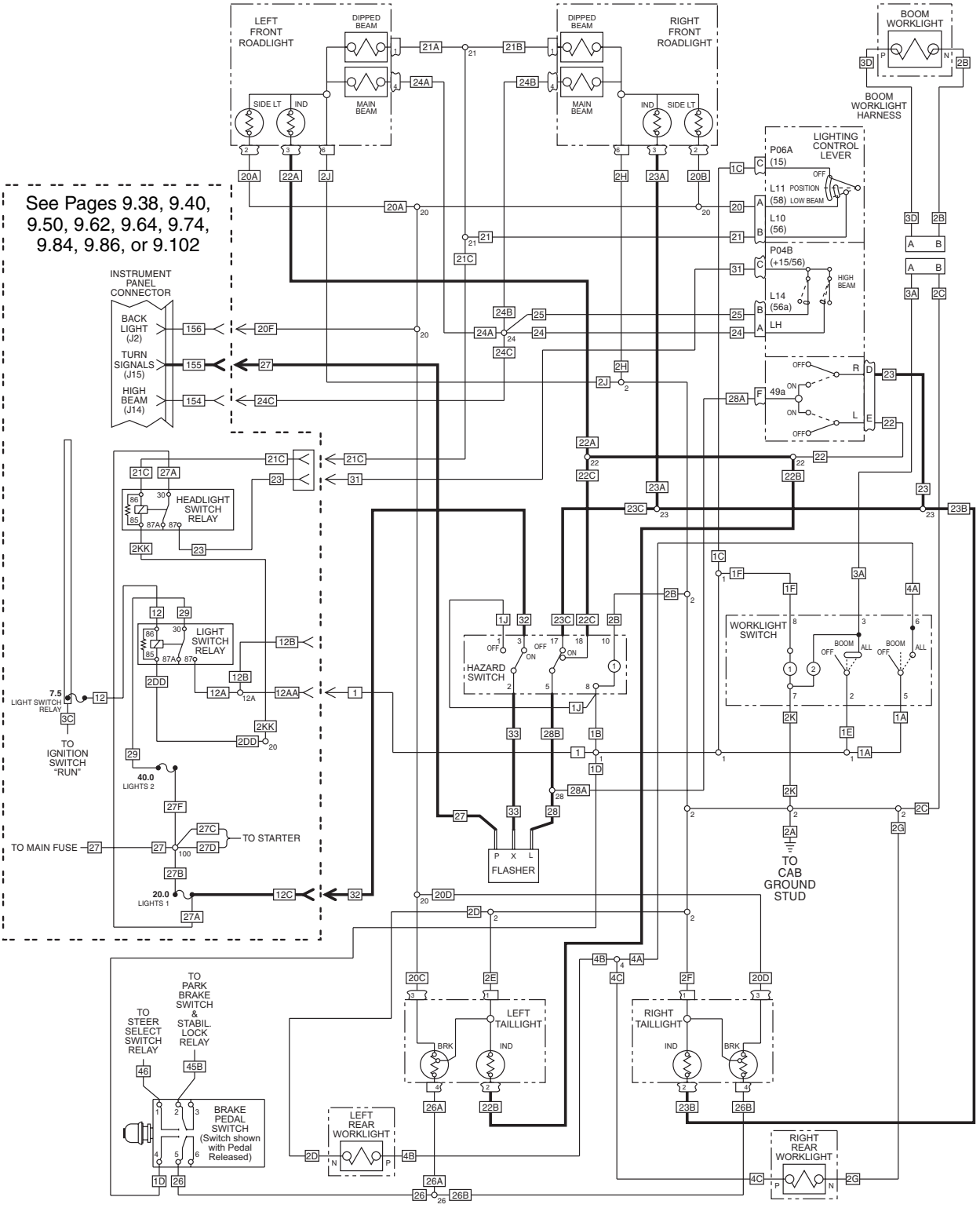
9.7.48 Roadlights Main Beam Circuit and Troubleshooting (Option)



MH5620


1st
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:
1. Fuses.
2. All connections relating to circuit are clean and tight.
3. If dipped beam headlights do not work, follow the steps listed at, Section 9.7.51, "Roadlights Side & Dipped Beam Lights Circuit and Troubleshooting (Option)," before troubleshooting the main beam circuit.
4. If one of the main beams work, the circuit is fine, the failed bulb needs to be replaced.
With the ignition ON and the lighting control lever rotated to 2nd position (Side Lights & Headlights) and pulled back for main beams ON, main beam indicator and main beams remain OFF.
Check for battery voltage at Pin 30, wire [27A] (RED), on headlight switch relay.
Not OK
Repair/replace cab harness.
If OK
Check for battery voltage at Pin 87, wire [23] (GRN), on headlight switch relay.
Not OK
Check for battery voltage across headlight switch relay coil Pins 85, wire [2KK] (BLK) & 86, wire [21C] (RED).
Not OK
Disconnect two position connector on roadlight harness and check for battery voltage at wire [21C].
If OK
Replace headlight switch relay
If OK
Repair/replace cab harness.
Not OK
Repair/replace roadlight harness.
If OK
Disconnect six position plug at lighting control lever and check for voltage at roadlight harness pin C, wire [31] (YEL).
Not OK
Replace cab harness.
If OK
Connect six position plug at lighting control lever and pull back on lever to flash main beams.
Not OK
Replace lighting control lever.

9.7.49 Roadlights Hazard Lights Circuit and Troubleshooting (Option)

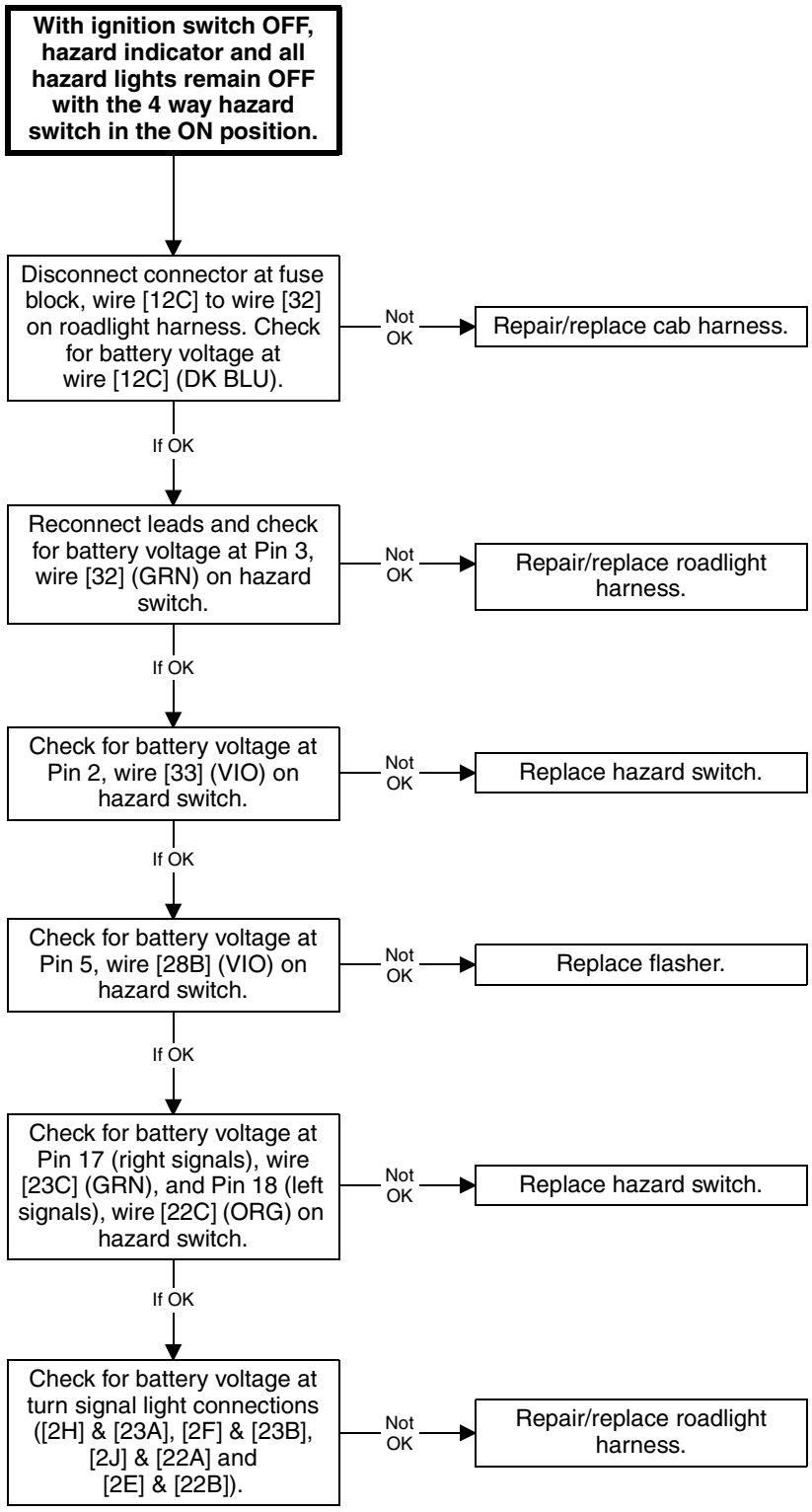


MH5170

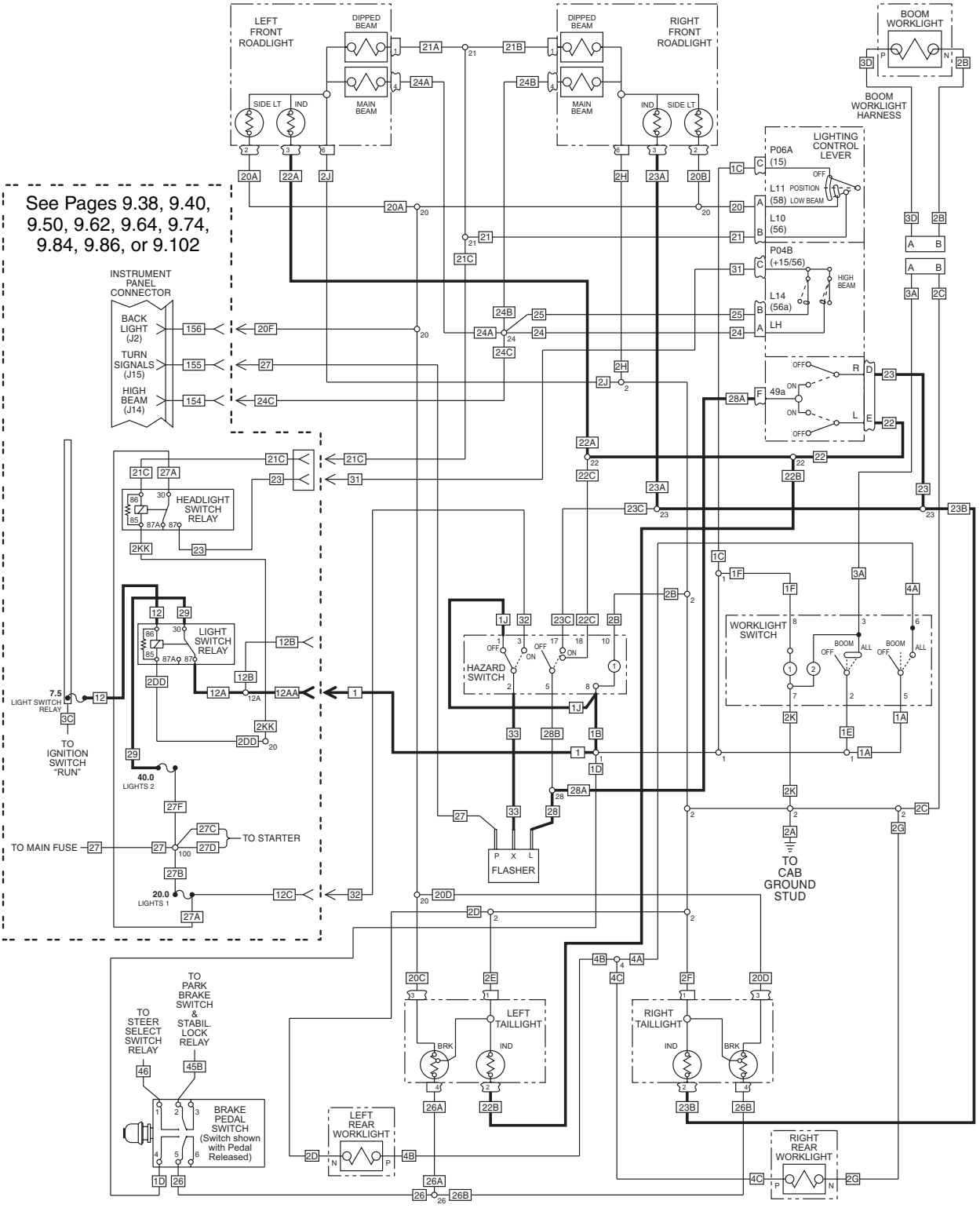
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**
3. **If one or more of the hazard lights work, the circuit is fine, the failed bulb(s) need to be replaced.**



9.7.50 Roadlights Turn Signals Circuit and Troubleshooting (Option)

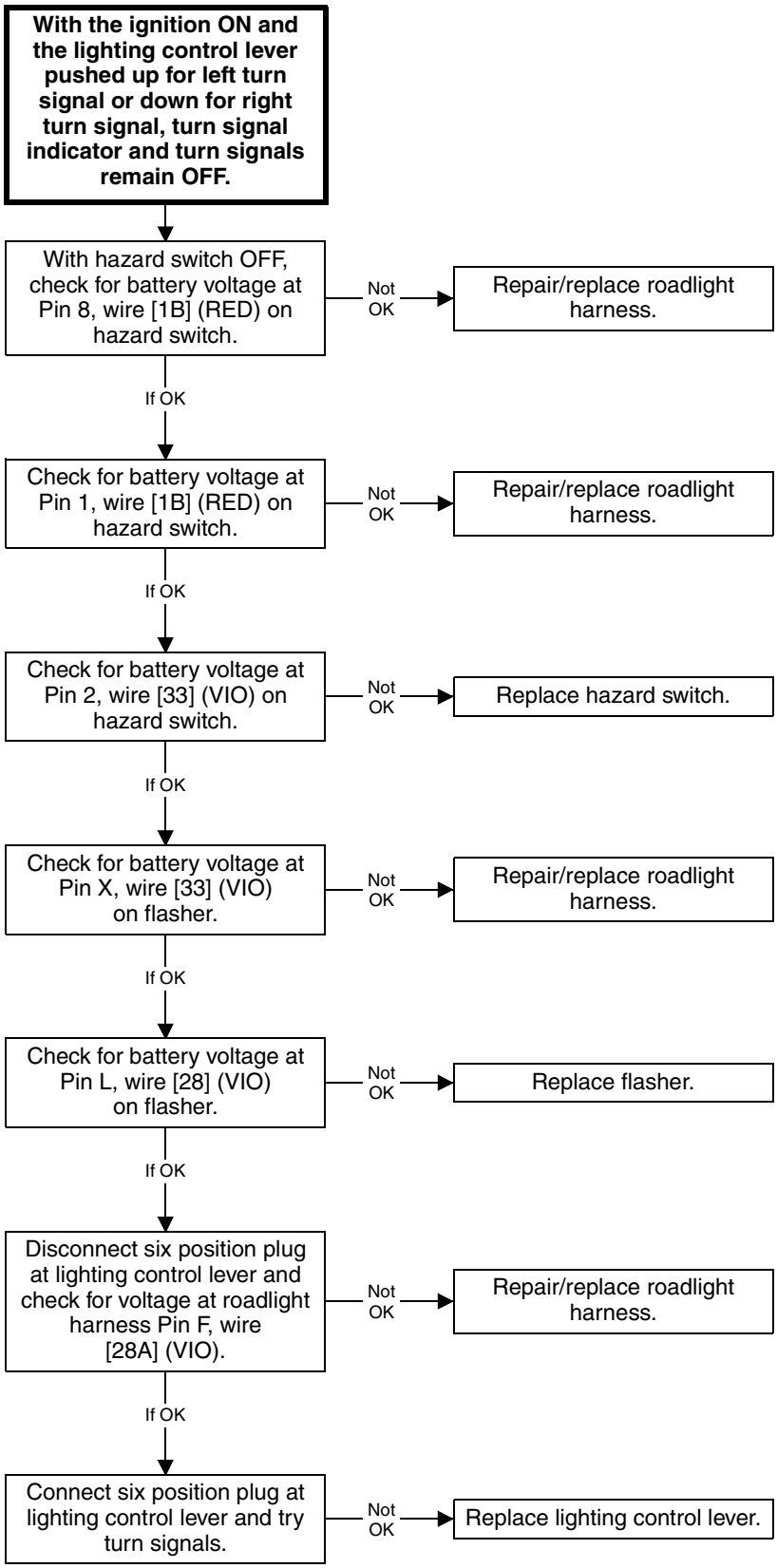


MH5630

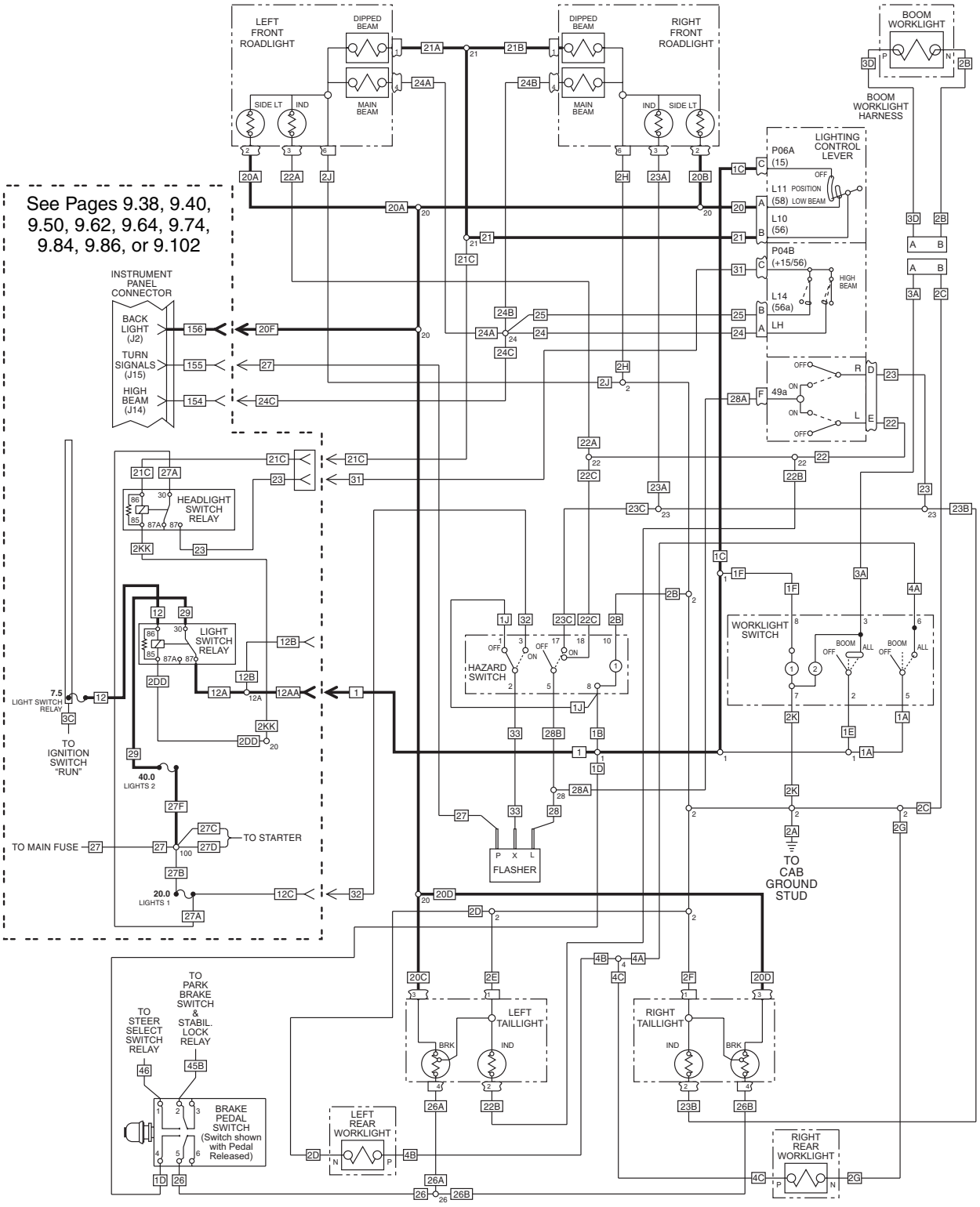
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**
3. **Before troubleshooting the turn signal circuit, verify that the hazard light circuit is operating. If not, follow the steps listed at, Section 9.7.49, "Roadlights Hazard Lights Circuit and Troubleshooting (Option)," before troubleshooting the turn signal circuit.**
4. **Before troubleshooting the turn signal circuit, verify that the worklight circuit is operating. If not, follow the steps listed at, Section 9.7.53, "Roadlights w/ Worklights Circuit and Troubleshooting (Option)," before troubleshooting the turn signal circuit.**
5. **If one of the turn signals work, the circuit is fine, the failed bulb needs to be replaced.**



9.7.51 Roadlights Side & Dipped Beam Lights Circuit and Troubleshooting (Option)

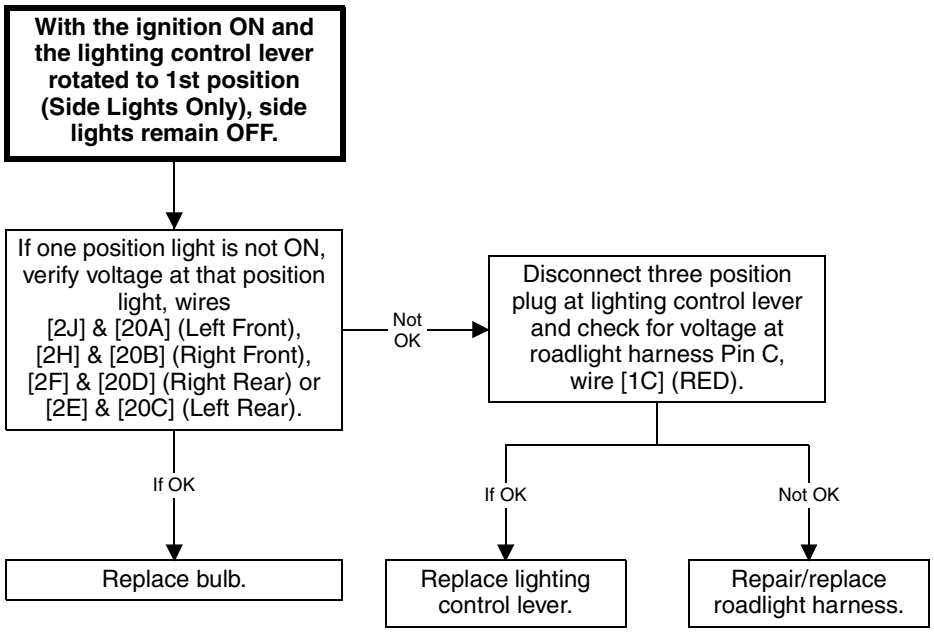


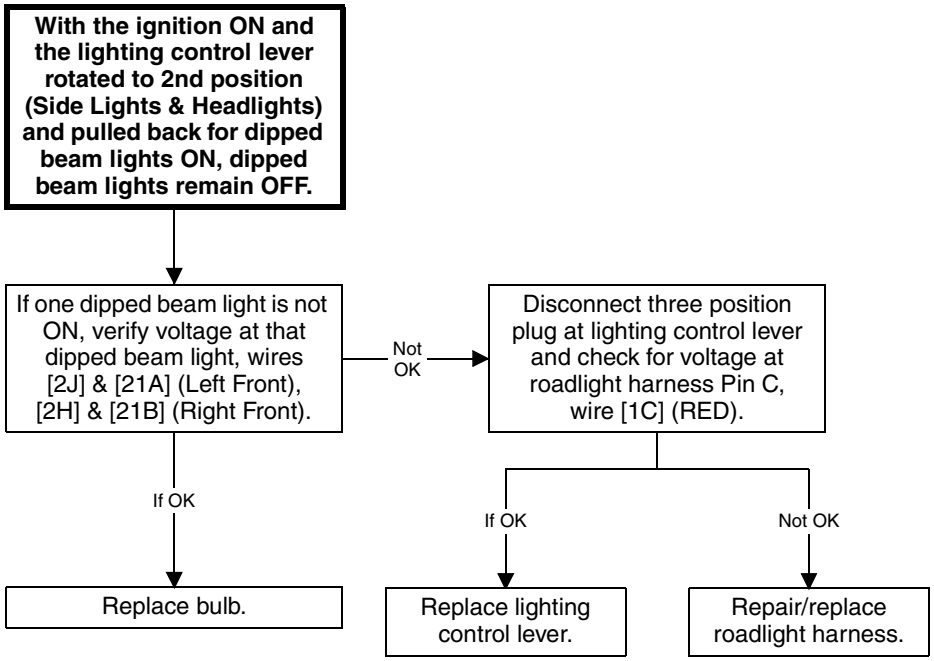
MH5640

1st

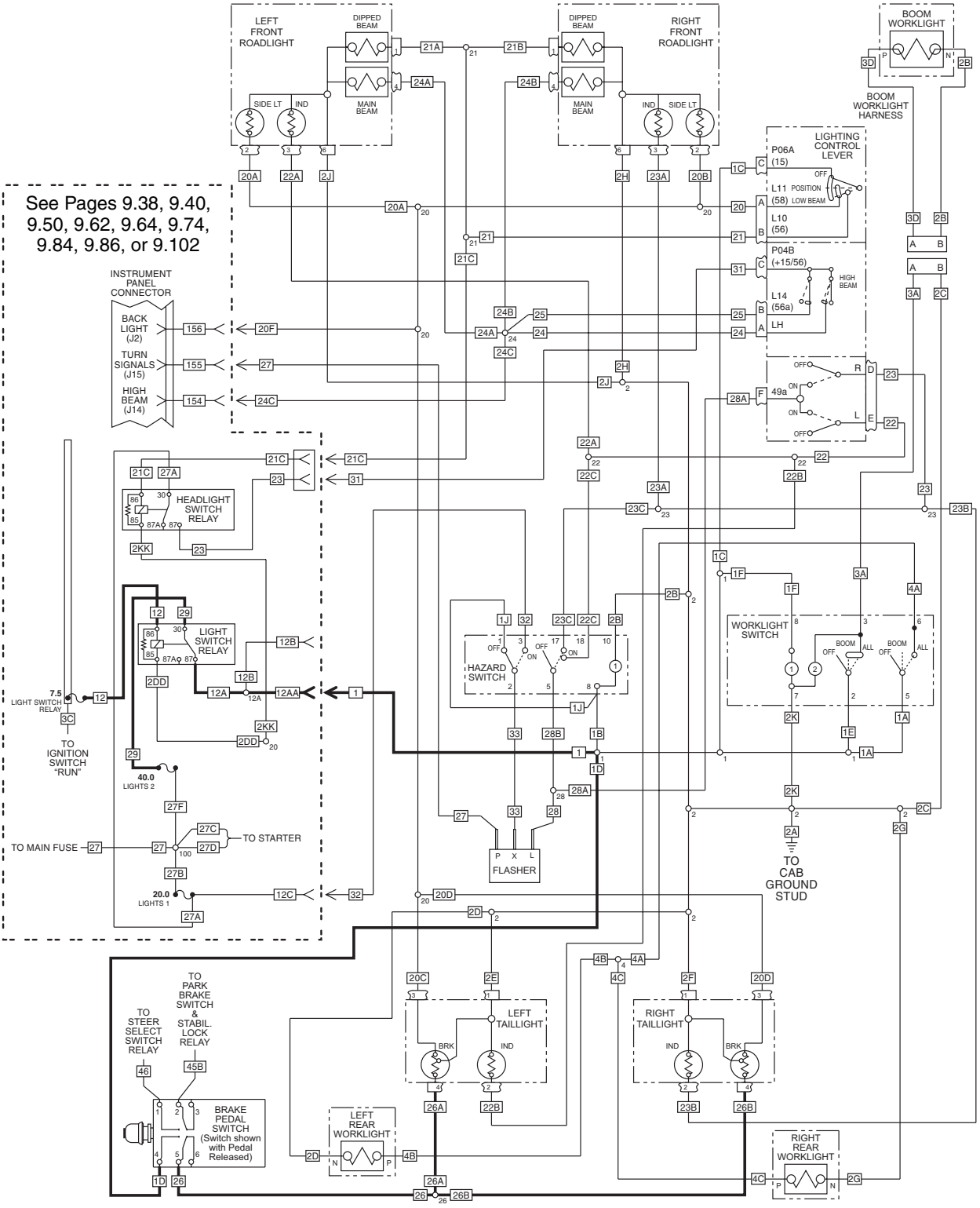
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**
3. **Before troubleshooting either the side lights circuit or the dipped beam lights circuit, verify that the worklight circuit is operating. If not, follow the steps listed at, Section 9.7.53, "Roadlights w/ Worklights Circuit and Troubleshooting (Option)," before troubleshooting either the side lights circuit or the dipped beam lights circuit.**





9.7.52 Roadlights Brake Lights Circuit and Troubleshooting (Option)

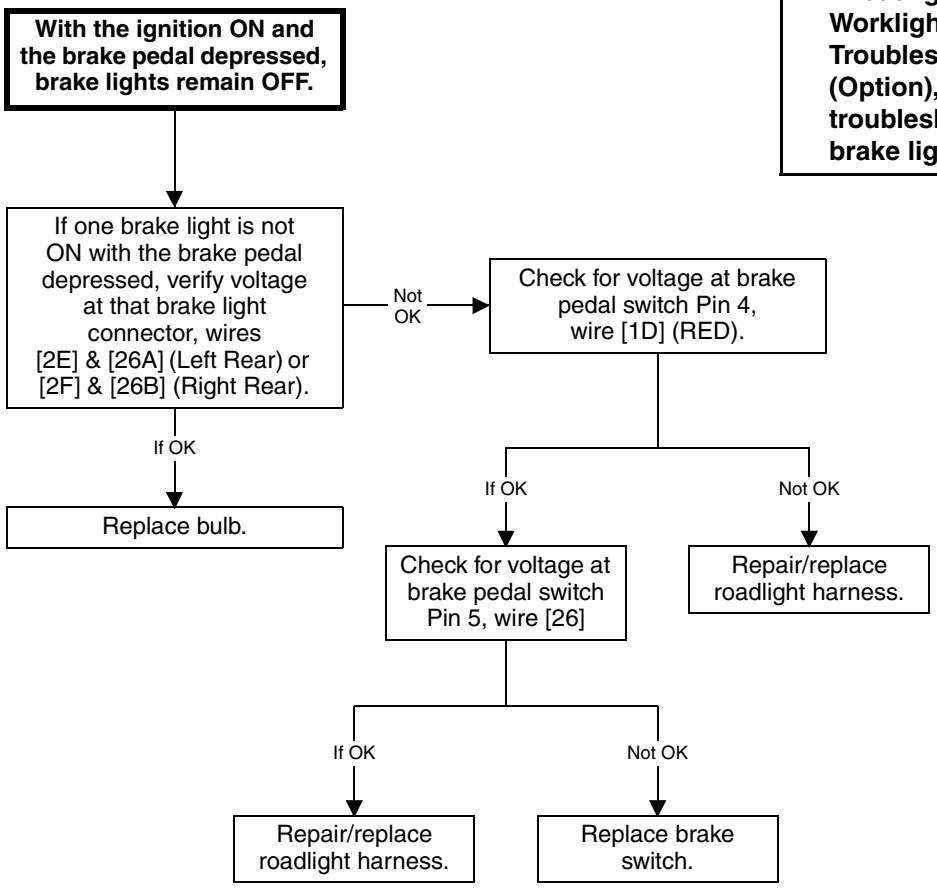


MH5650

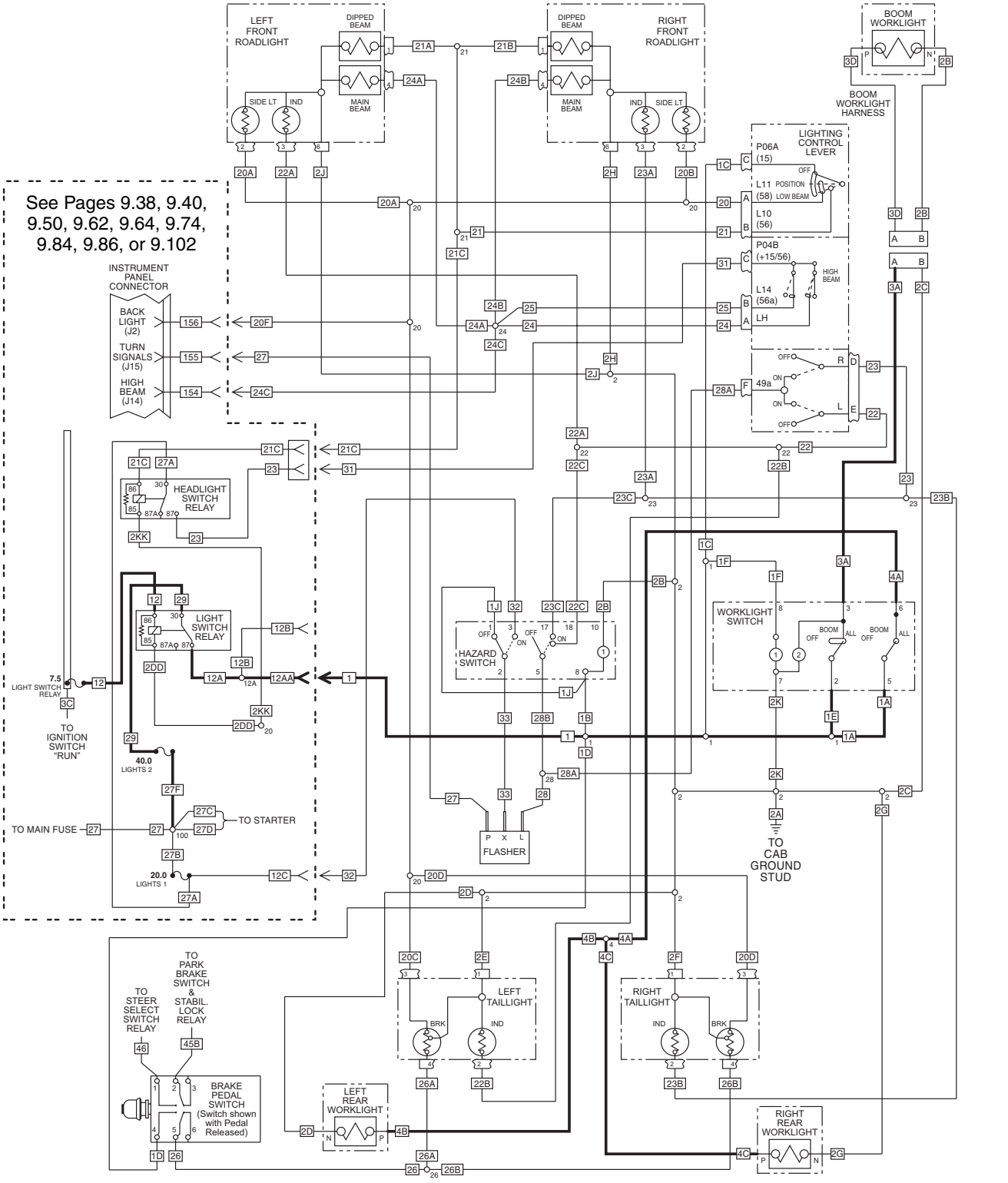
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

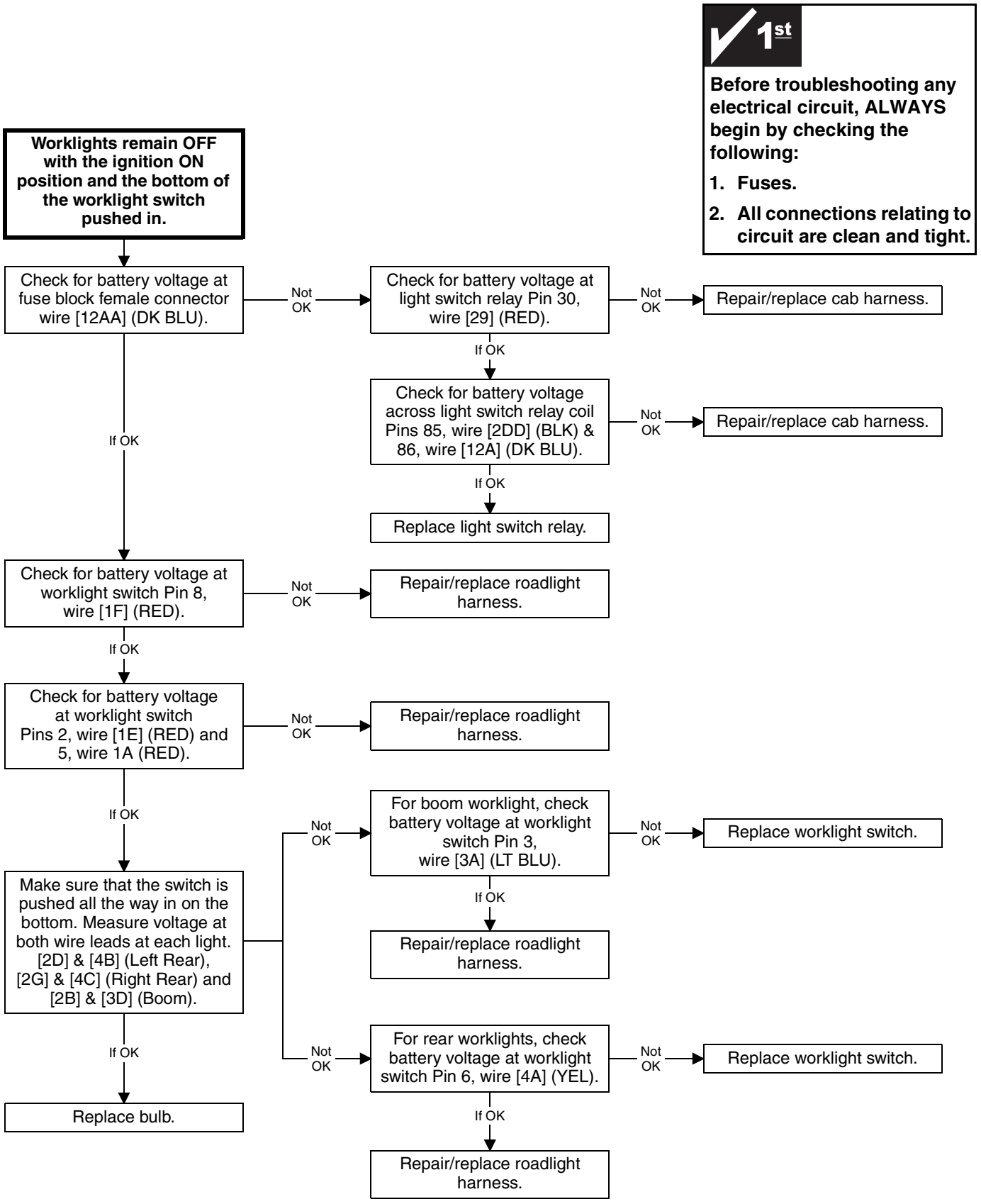
1. **Fuses.**
2. **All connections relating to circuit are clean and tight.**
3. **Before troubleshooting the brake lights circuit, verify that the worklight circuit is operating. If not, follow the steps listed at, Section 9.7.53, "Roadlights w/ Worklights Circuit and Troubleshooting (Option)," before troubleshooting the brake lights circuit.**



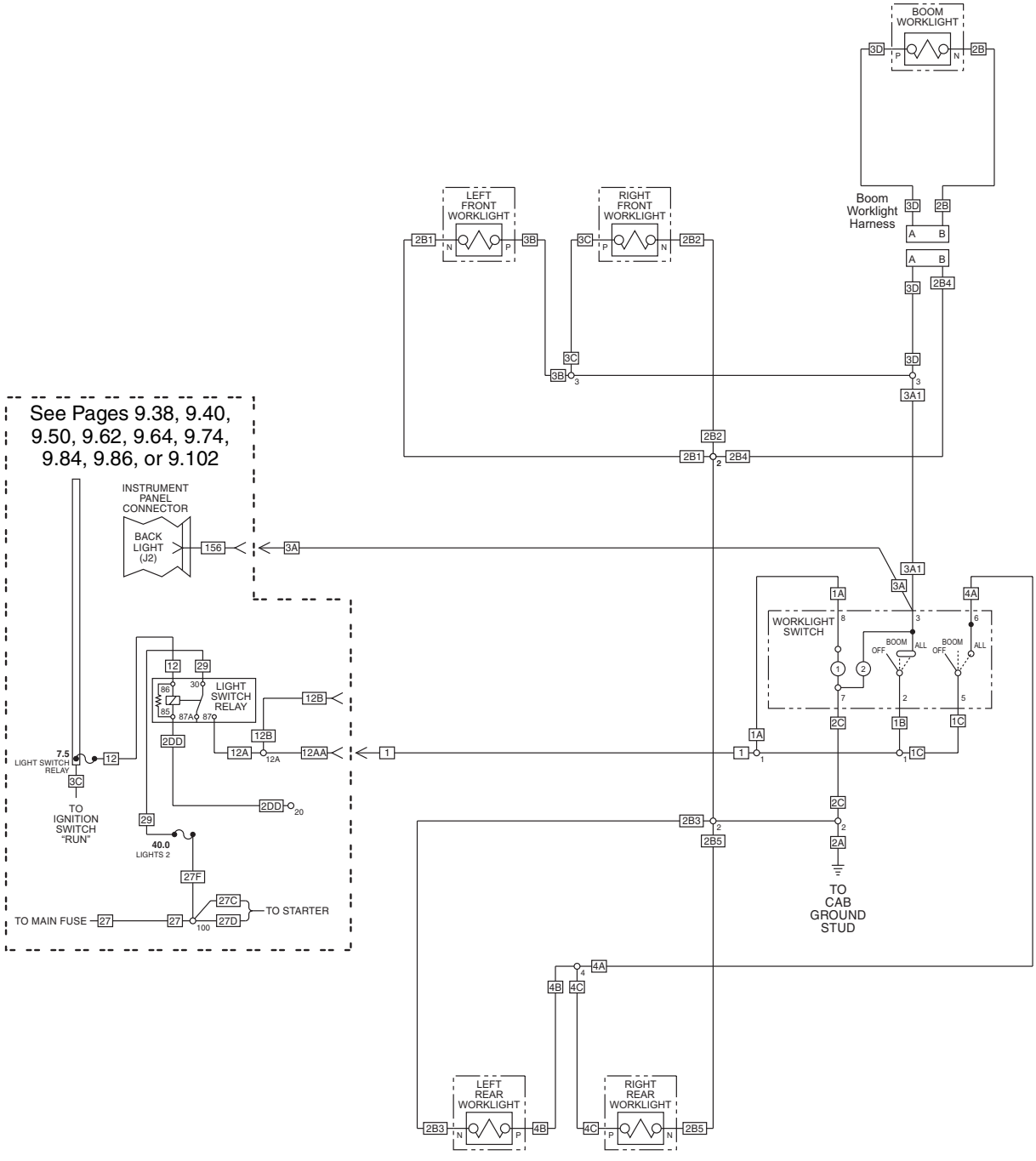
9.7.53 Roadlights w/Worklights Circuit and Troubleshooting (Option)



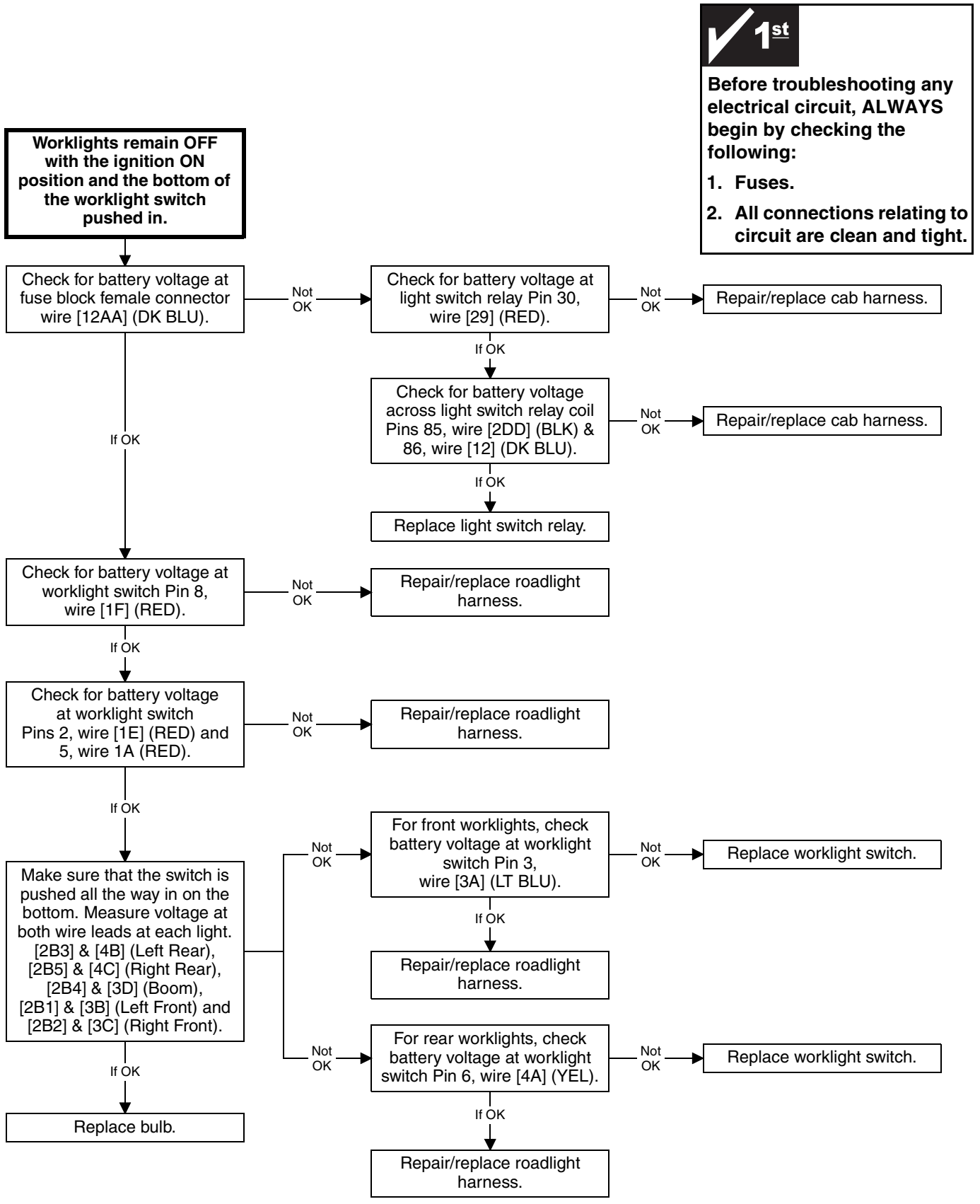
MH5610


1st
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:
1. Fuses.
2. All connections relating to circuit are clean and tight.
Worklights remain OFF with the ignition ON position and the bottom of the worklight switch pushed in.
Check for battery voltage at fuse block female connector wire [12AA] (DK BLU).
Not OK
Check for battery voltage at light switch relay Pin 30, wire [29] (RED).
Not OK
Repair/replace cab harness.
If OK
Check for battery voltage across light switch relay coil Pins 85, wire [2DD] (BLK) & 86, wire [12A] (DK BLU).
Not OK
Repair/replace cab harness.
If OK
Replace light switch relay.
If OK
Check for battery voltage at worklight switch Pin 8, wire [1F] (RED).
Not OK
Repair/replace roadlight harness.
If OK
Check for battery voltage at worklight switch Pins 2, wire [1E] (RED) and 5, wire 1A (RED).
Not OK
Repair/replace roadlight harness.
If OK
Make sure that the switch is pushed all the way in on the bottom. Measure voltage at both wire leads at each light. [2D] & [4B] (Left Rear), [2G] & [4C] (Right Rear) and [2B] & [3D] (Boom).
Not OK
For boom worklight, check battery voltage at worklight switch Pin 3, wire [3A] (LT BLU).
Not OK
Replace worklight switch.
If OK
Repair/replace roadlight harness.
Not OK
For rear worklights, check battery voltage at worklight switch Pin 6, wire [4A] (YEL).
Not OK
Replace worklight switch.
If OK
Repair/replace roadlight harness.
If OK
Replace bulb.

9.7.54 Worklight (Without Roadlights) Circuit and Troubleshooting (Option)



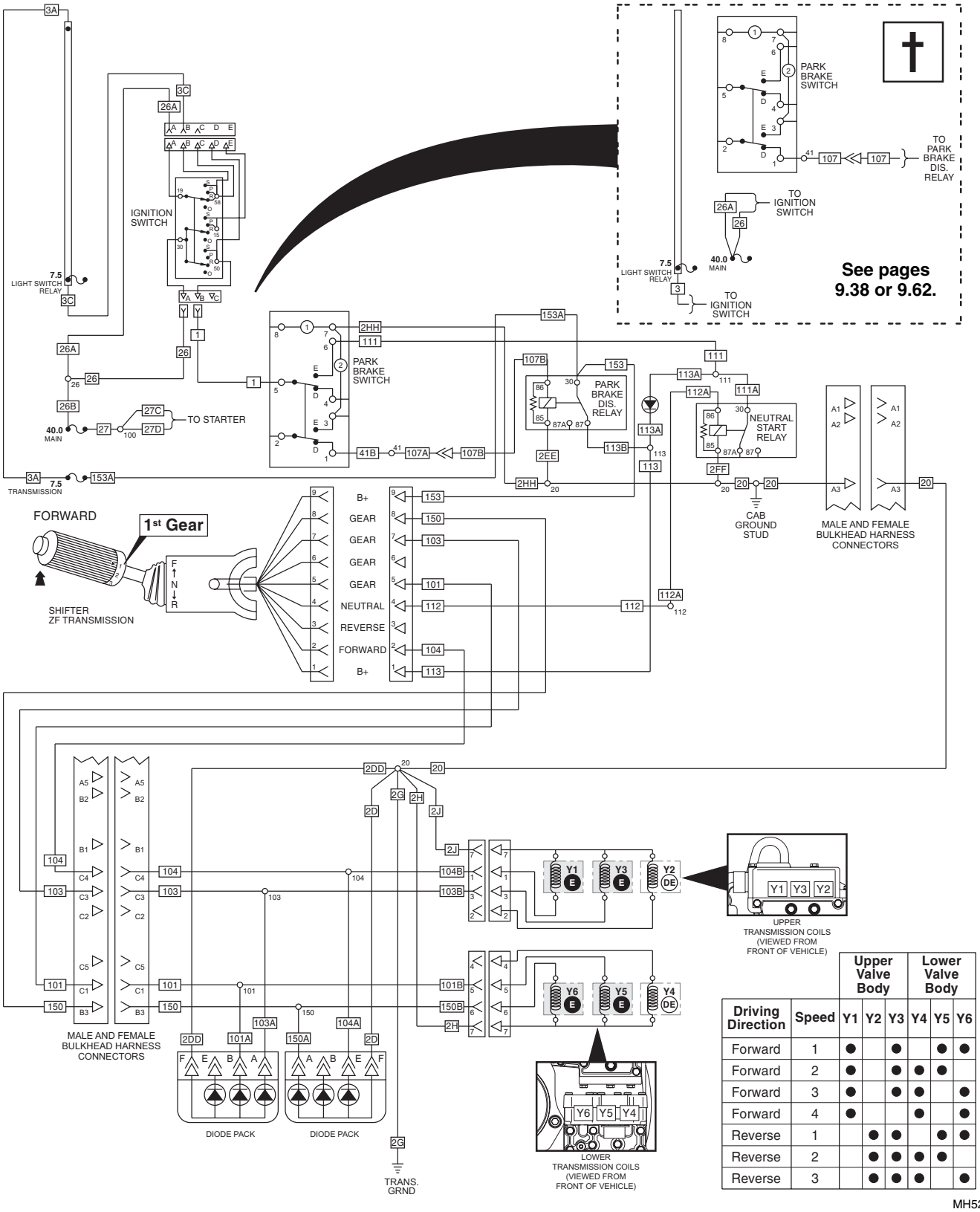
MH5180


1st
Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:
1. Fuses.
2. All connections relating to circuit are clean and tight.
Worklights remain OFF with the ignition ON position and the bottom of the worklight switch pushed in.
Check for battery voltage at fuse block female connector wire [12AA] (DK BLU).
Not OK
Check for battery voltage at light switch relay Pin 30, wire [29] (RED).
Not OK
Repair/replace cab harness.
If OK
Check for battery voltage across light switch relay coil Pins 85, wire [2DD] (BLK) & 86, wire [12] (DK BLU).
Not OK
Repair/replace cab harness.
If OK
Replace light switch relay.
If OK
Check for battery voltage at worklight switch Pin 8, wire [1F] (RED).
Not OK
Repair/replace roadlight harness.
If OK
Check for battery voltage at worklight switch Pins 2, wire [1E] (RED) and 5, wire 1A (RED).
Not OK
Repair/replace roadlight harness.
If OK
Make sure that the switch is pushed all the way in on the bottom. Measure voltage at both wire leads at each light. [2B3] & [4B] (Left Rear), [2B5] & [4C] (Right Rear), [2B4] & [3D] (Boom), [2B1] & [3B] (Left Front) and [2B2] & [3C] (Right Front).
Not OK
For front worklights, check battery voltage at worklight switch Pin 3, wire [3A] (LT BLU).
Not OK
Replace worklight switch.
If OK
Repair/replace roadlight harness.
Not OK
For rear worklights, check battery voltage at worklight switch Pin 6, wire [4A] (YEL).
Not OK
Replace worklight switch.
If OK
Repair/replace roadlight harness.
If OK
Replace bulb.

9.8 TRANSMISSION GEAR SELECTION TROUBLESHOOTING

The following seven electrical circuit schematics address each transmission position. For additional troubleshooting information, refer to Section 9.14.6, “Transmission Shift Control Switch.”

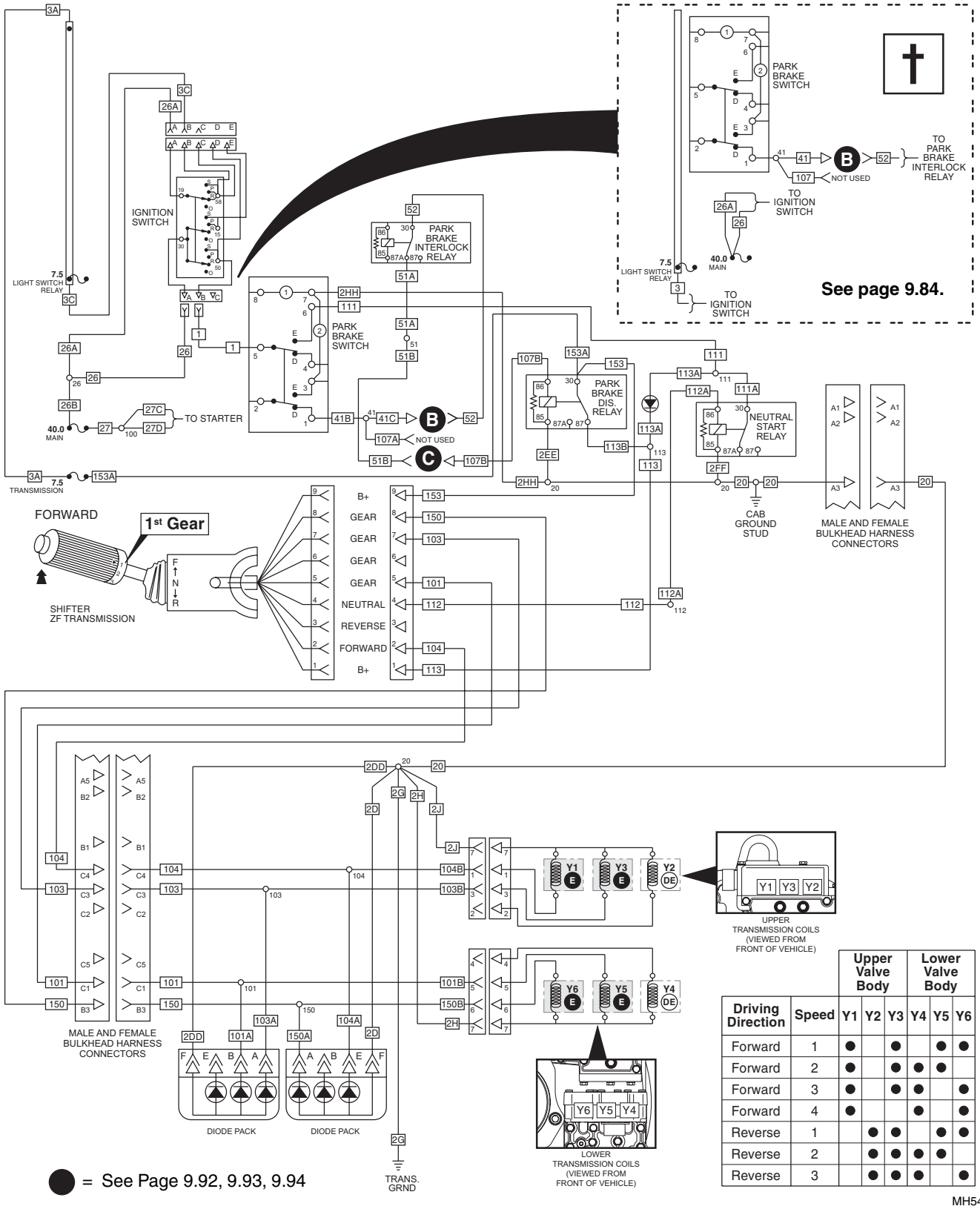
9.8.1 Transmission, Forward First Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5270

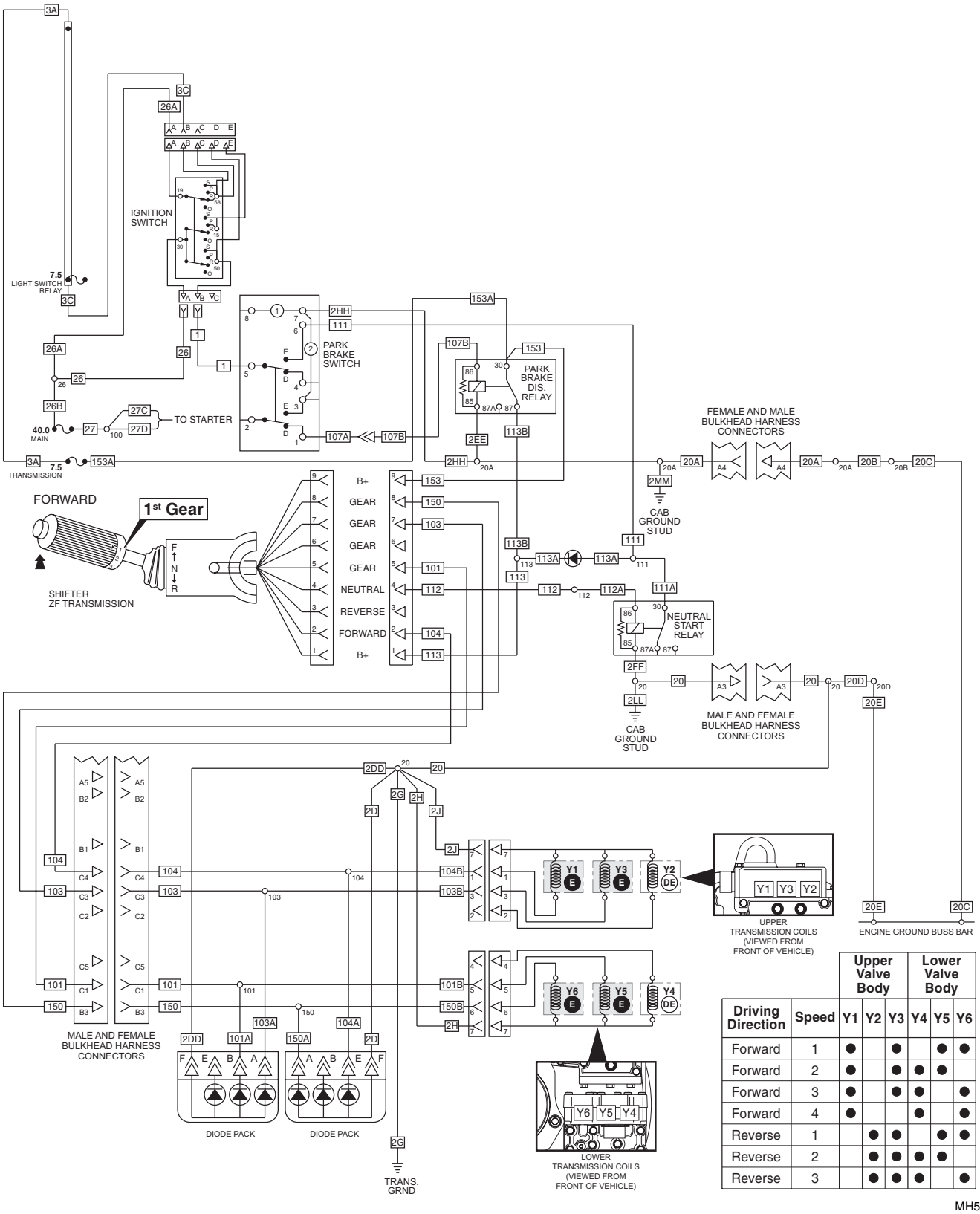
9.8.2 Transmission, Forward First Gear Circuit, (SN 10054, 13198 - 19079)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5420

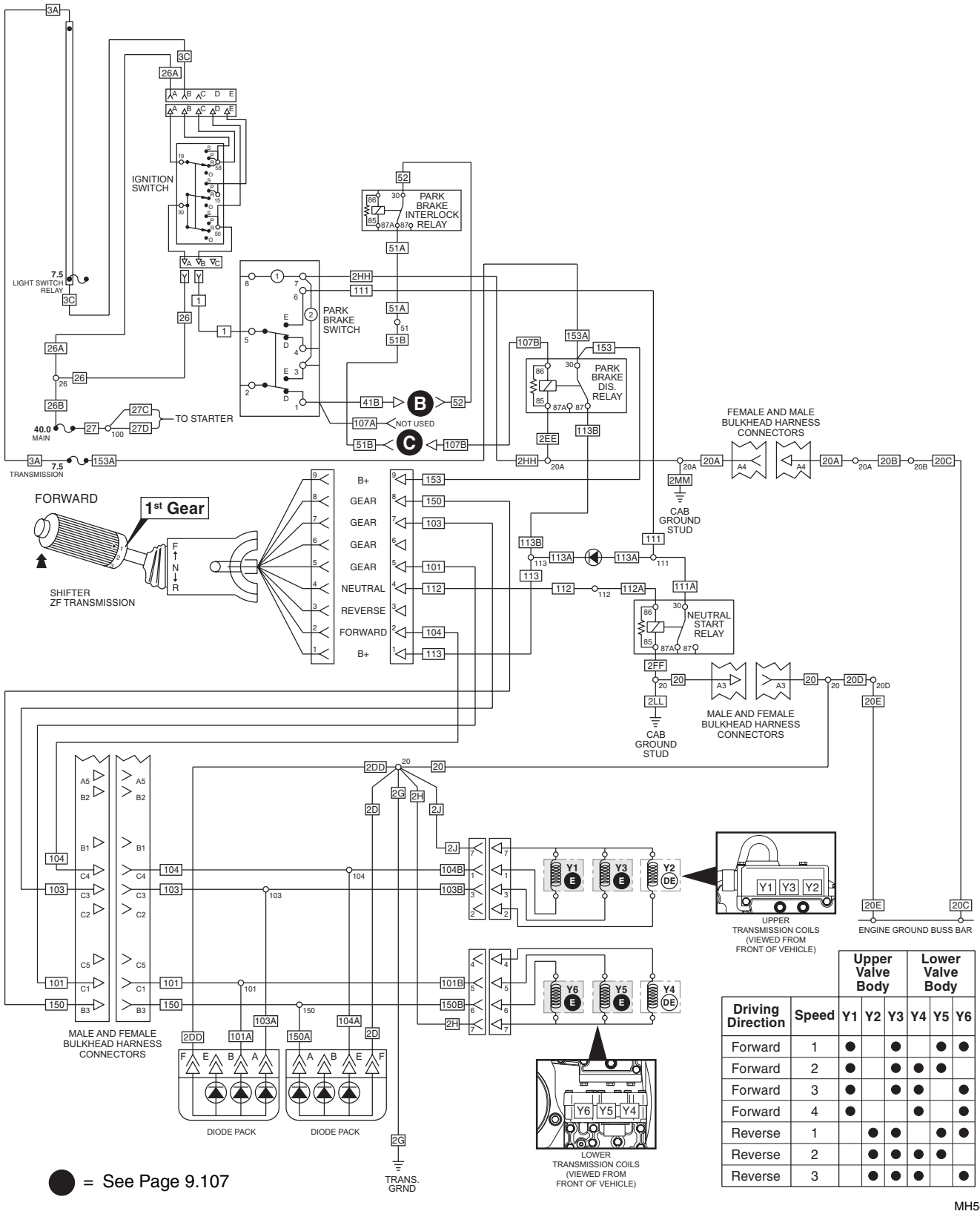
9.8.3 Transmission, Forward First Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5280

9.8.4 Transmission, Forward First Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

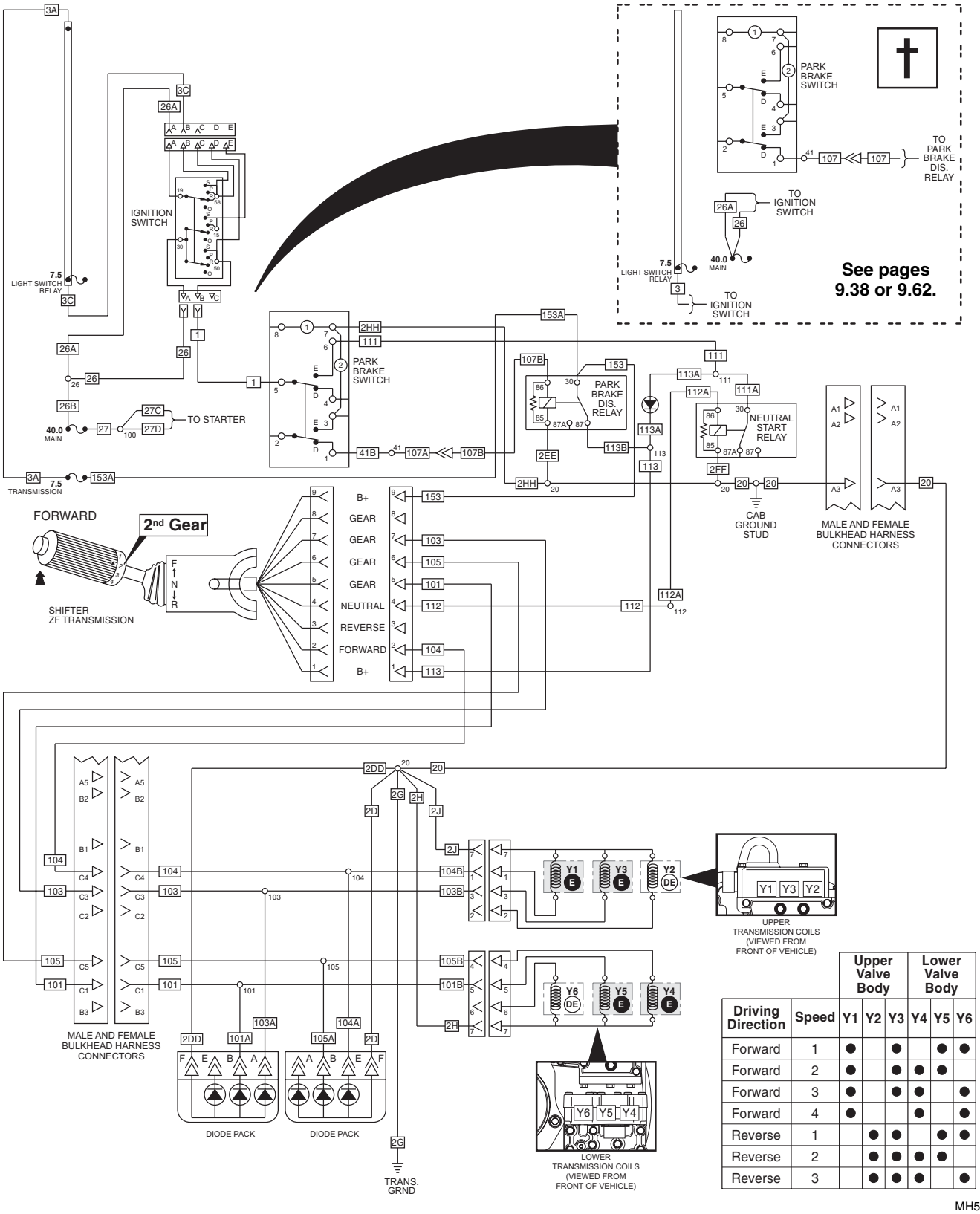


Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

● = See Page 9.107

MH5430

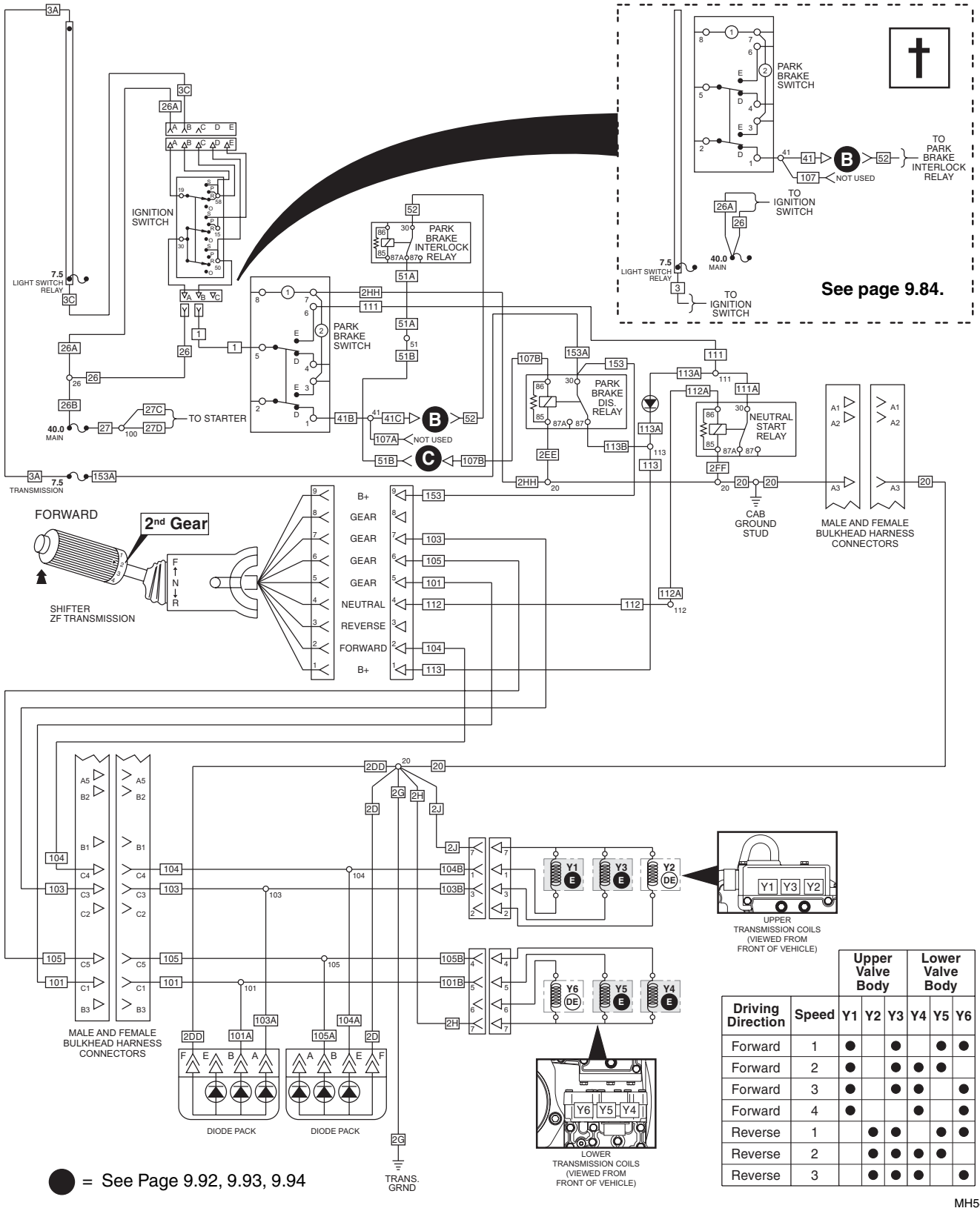
9.8.5 Transmission, Forward Second Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5290

9.8.6 Transmission, Forward Second Gear Circuit, (SN 10054, 13198 - 19079)

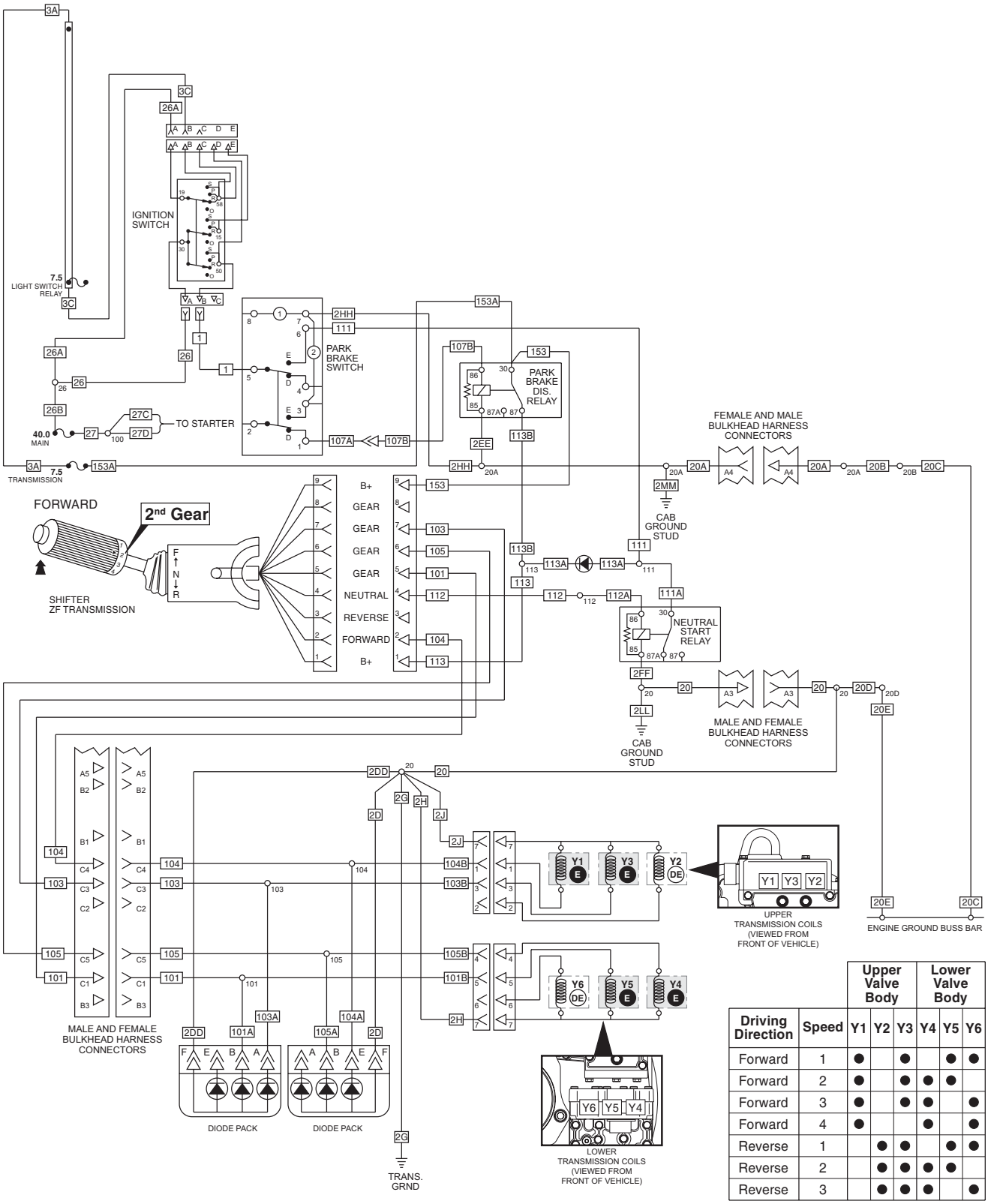


● = See Page 9.92, 9.93, 9.94

		Upper Valve Body			Lower Valve Body		
Driving Direction	Speed	Y1	Y2	Y3	Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5440

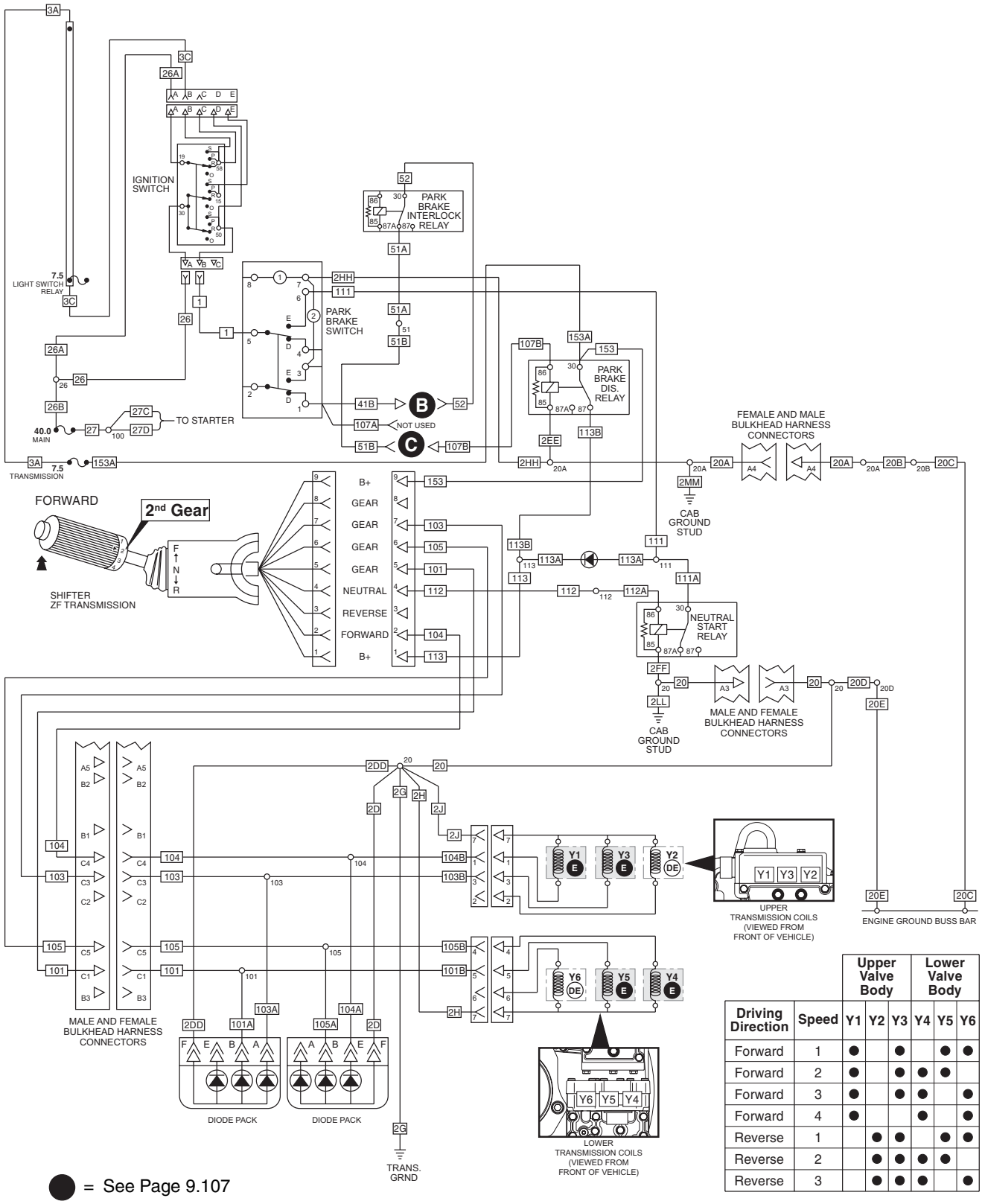
9.8.7 Transmission, Forward Second Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5300

9.8.8 Transmission, Forward Second Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

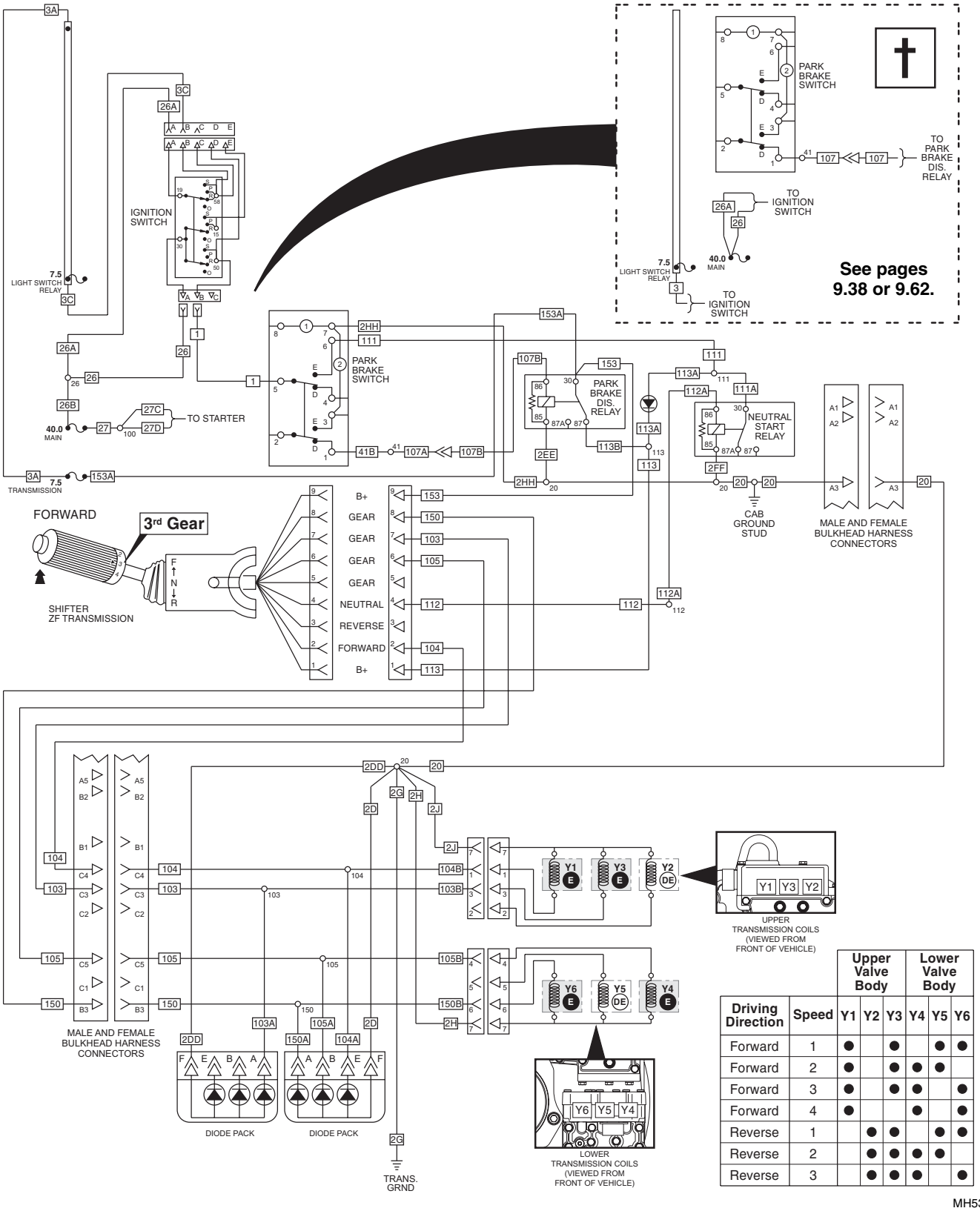


● = See Page 9.107

		Upper Valve Body			Lower Valve Body		
Driving Direction	Speed	Y1	Y2	Y3	Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5450

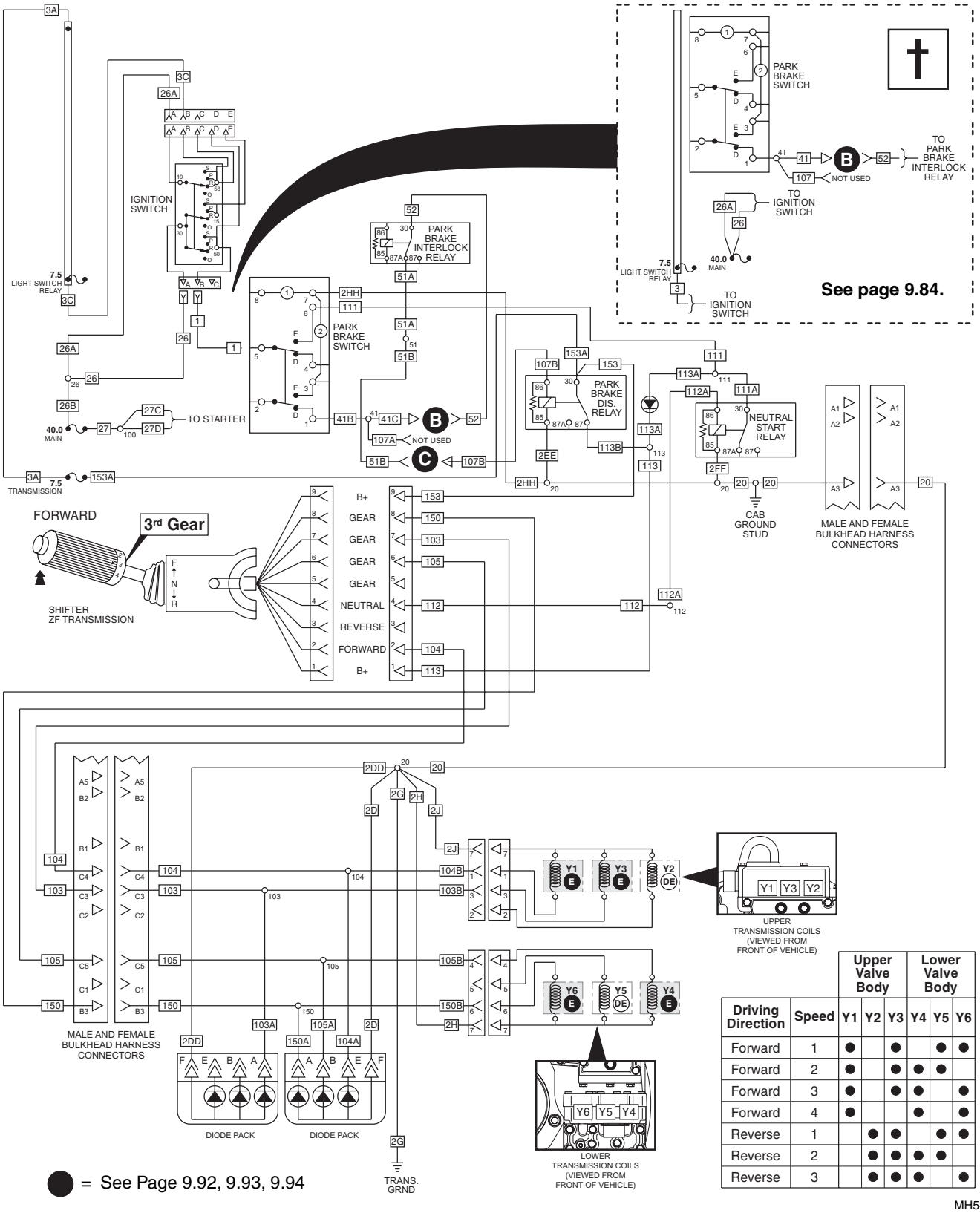
9.8.9 Transmission, Forward Third Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5310

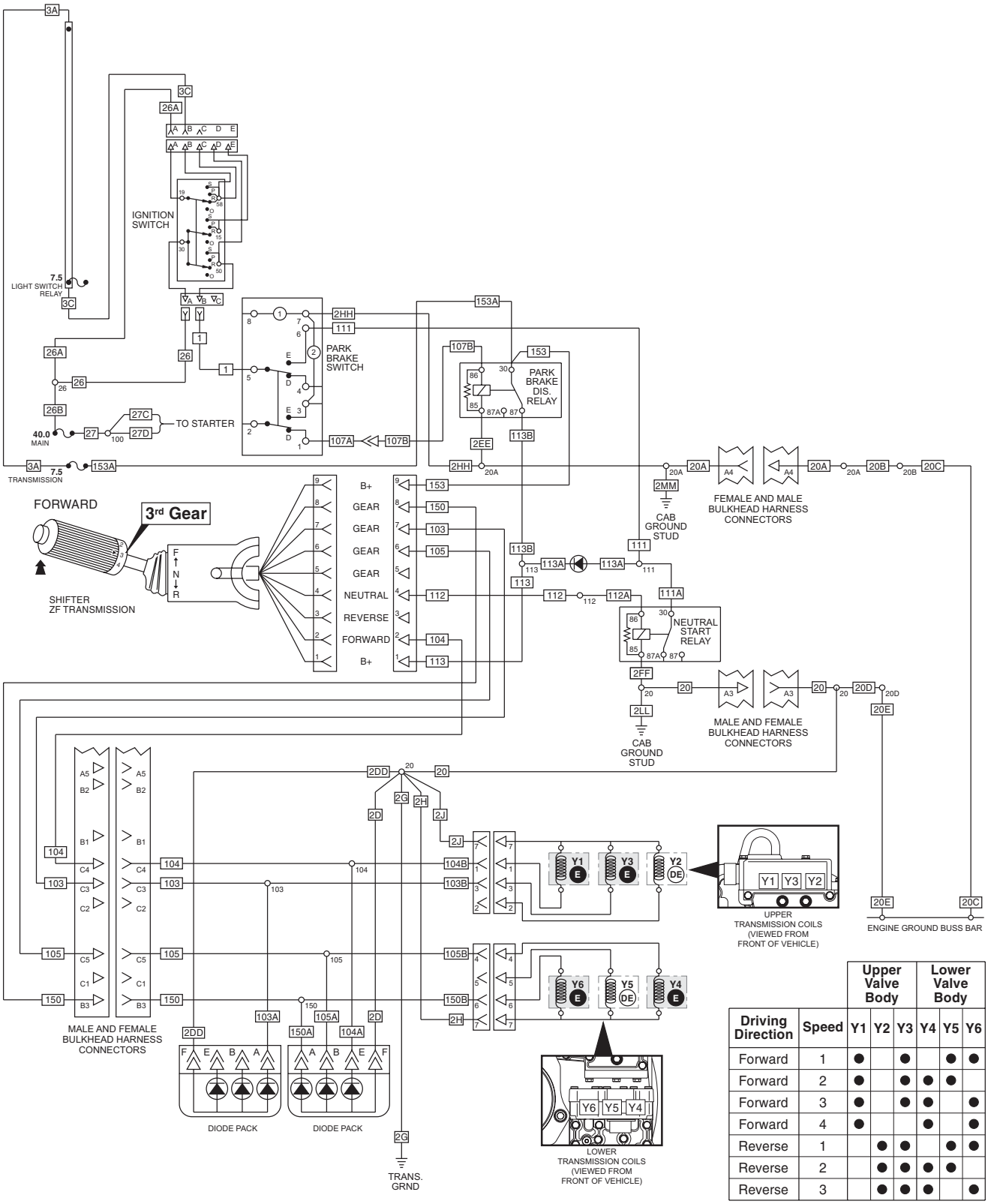
9.8.10 Transmission, Forward Third Gear Circuit, (SN 10054, 13198 - 19079)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5460

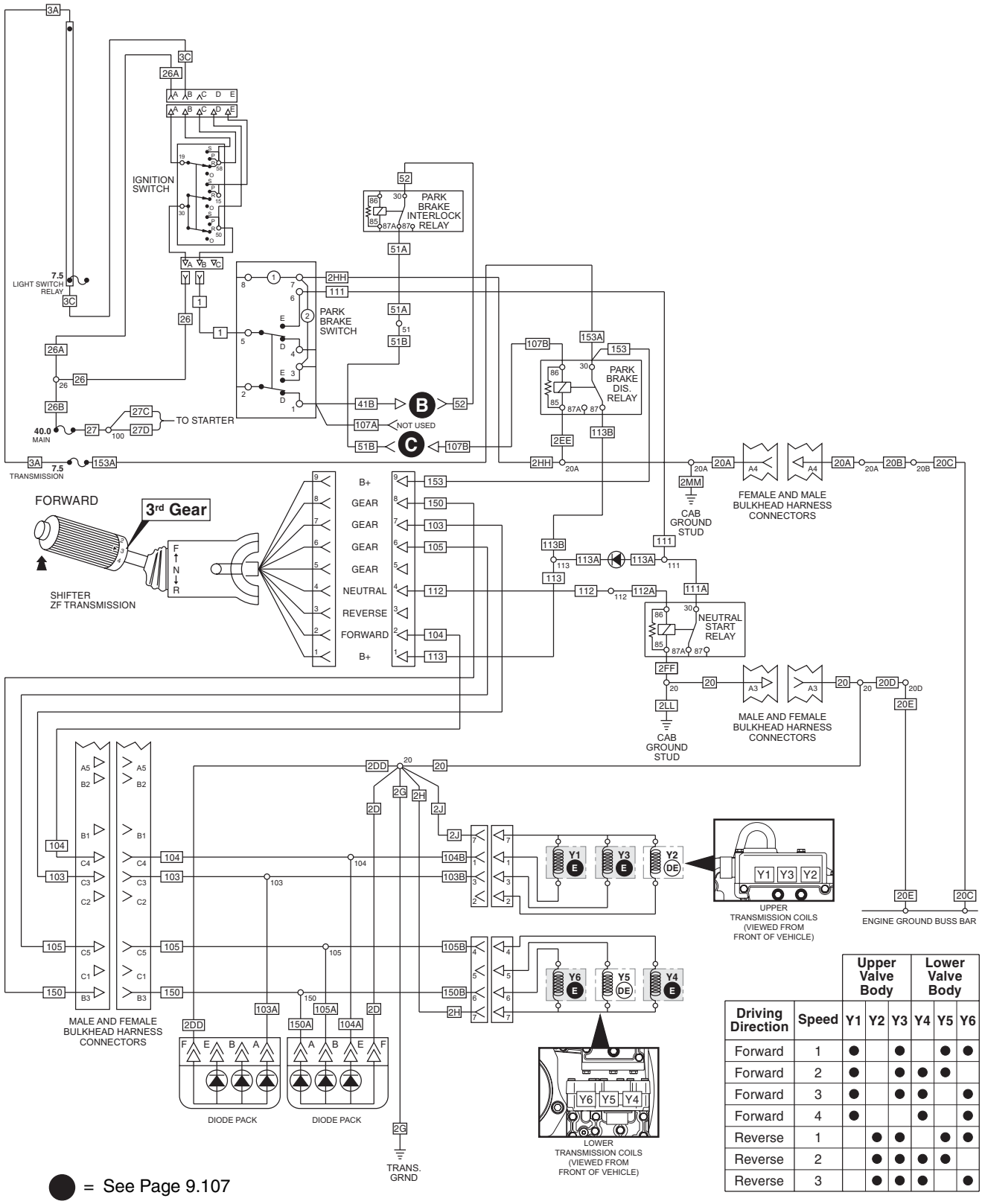
9.8.11 Transmission, Forward Third Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5320

9.8.12 Transmission, Forward Third Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

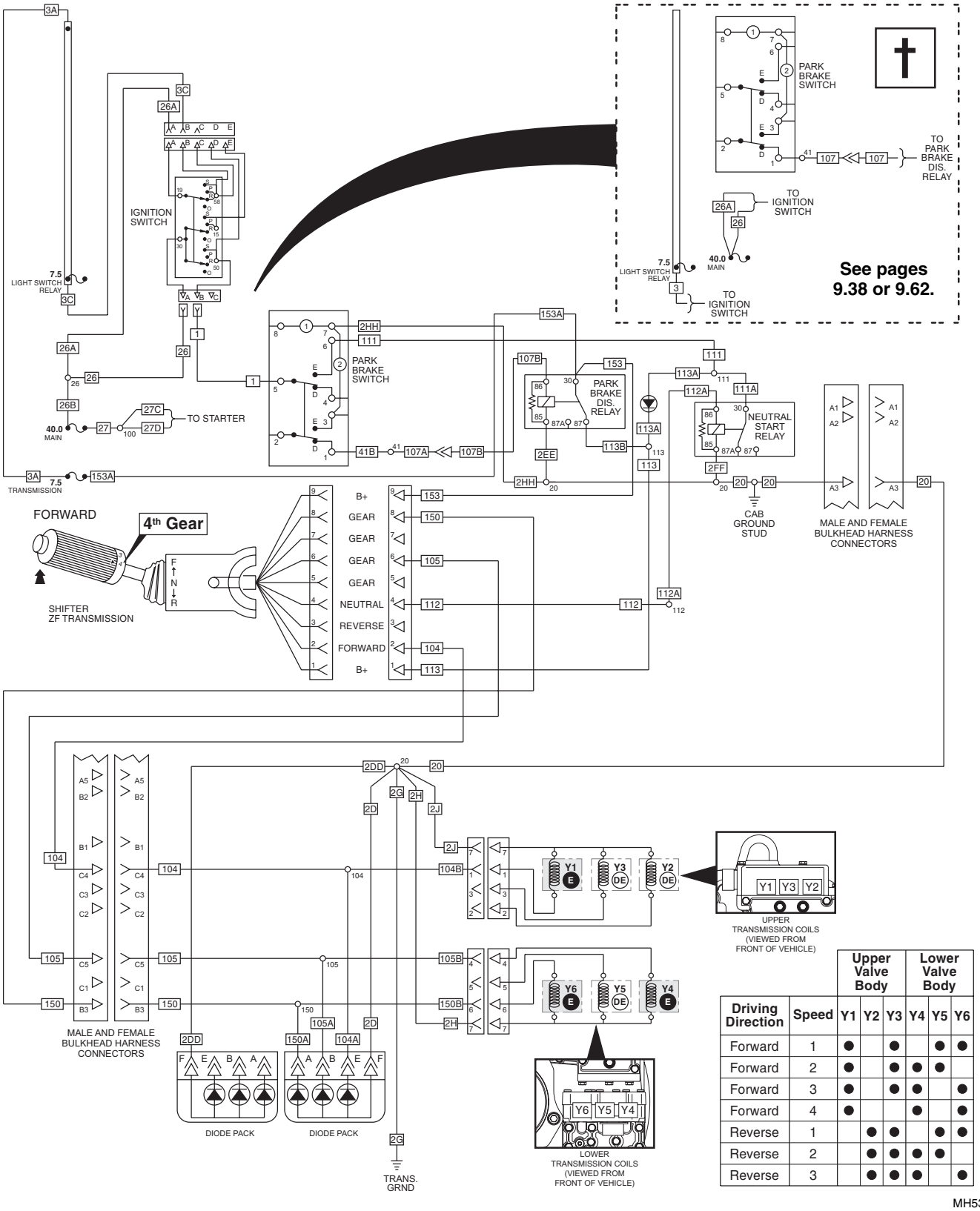


Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

● = See Page 9.107

MH5470

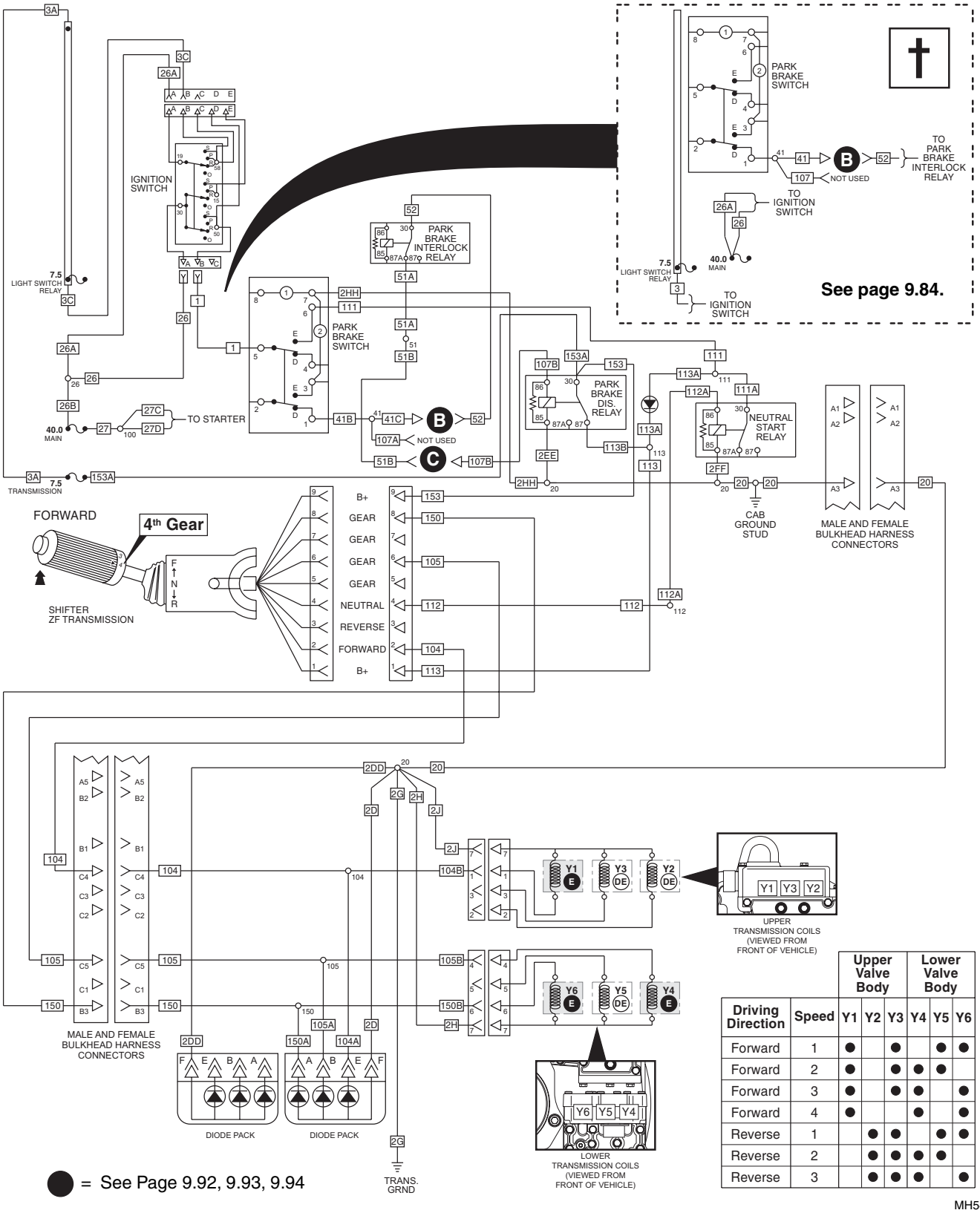
9.8.13 Transmission, Forward Fourth Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5330

9.8.14 Transmission, Forward Fourth Gear Circuit, (SN 10054, 13198 - 19079)

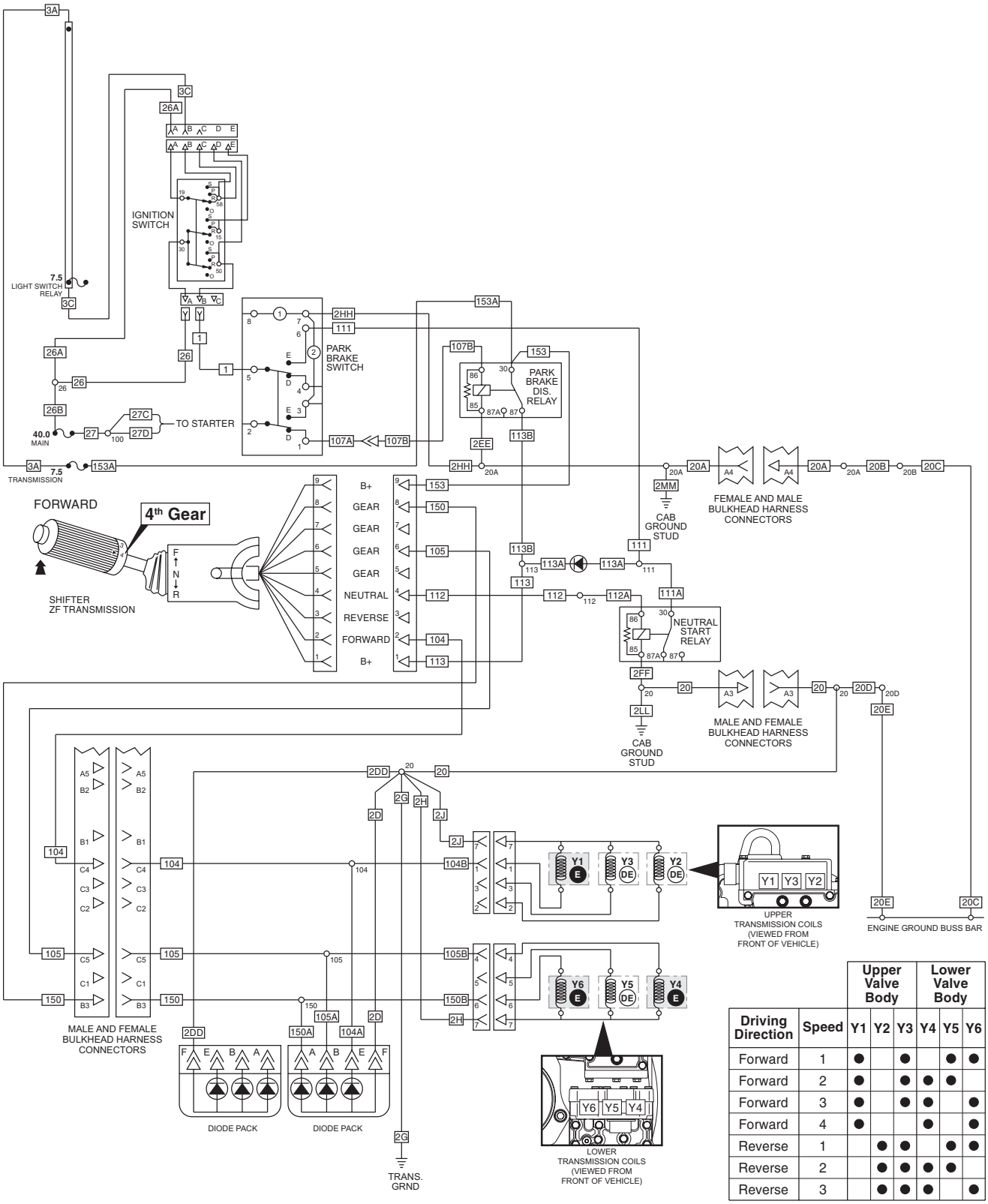


● = See Page 9.92, 9.93, 9.94

Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5480

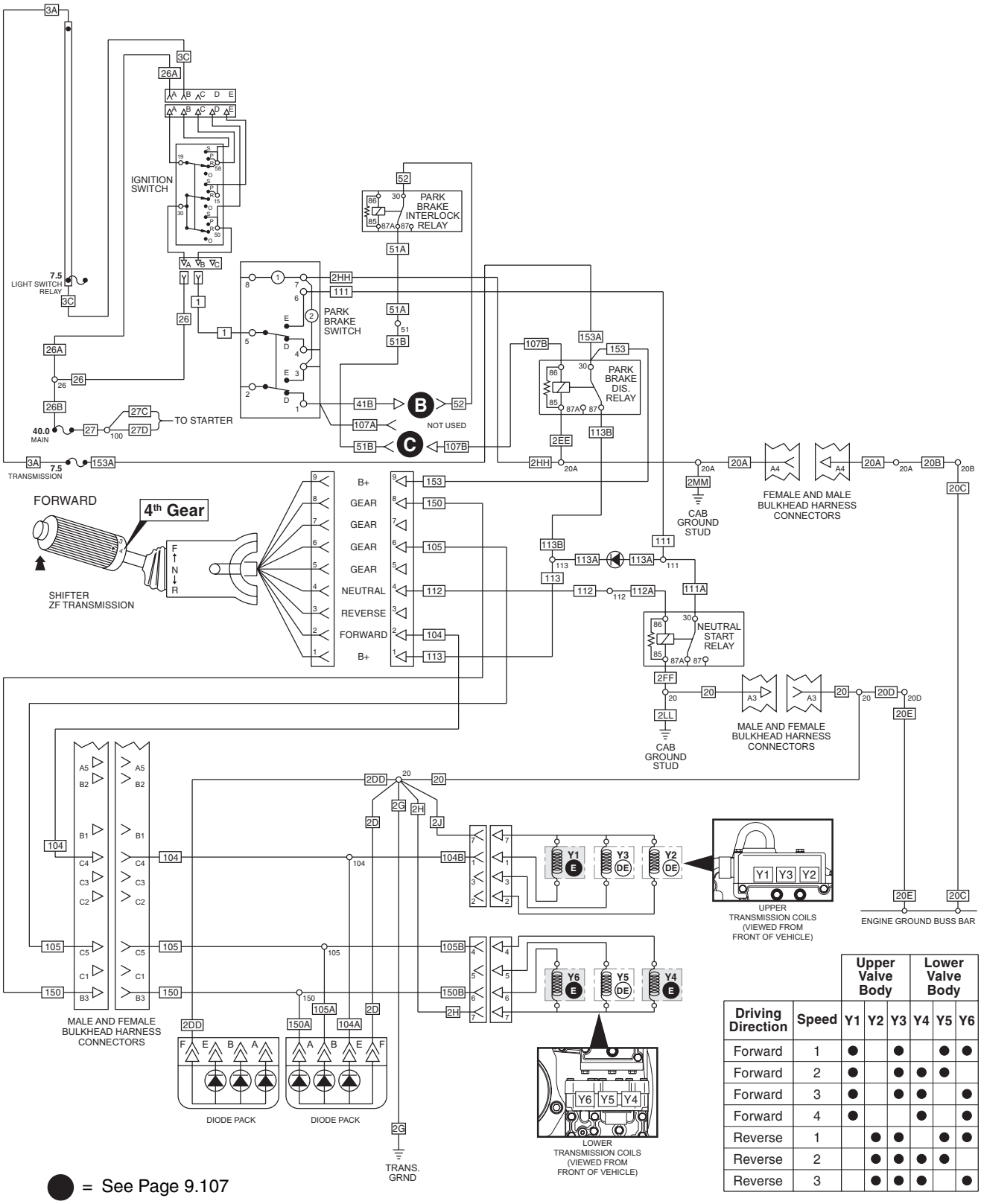
9.8.15 Transmission, Forward Fourth Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5340

9.8.16 Transmission, Forward Fourth Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

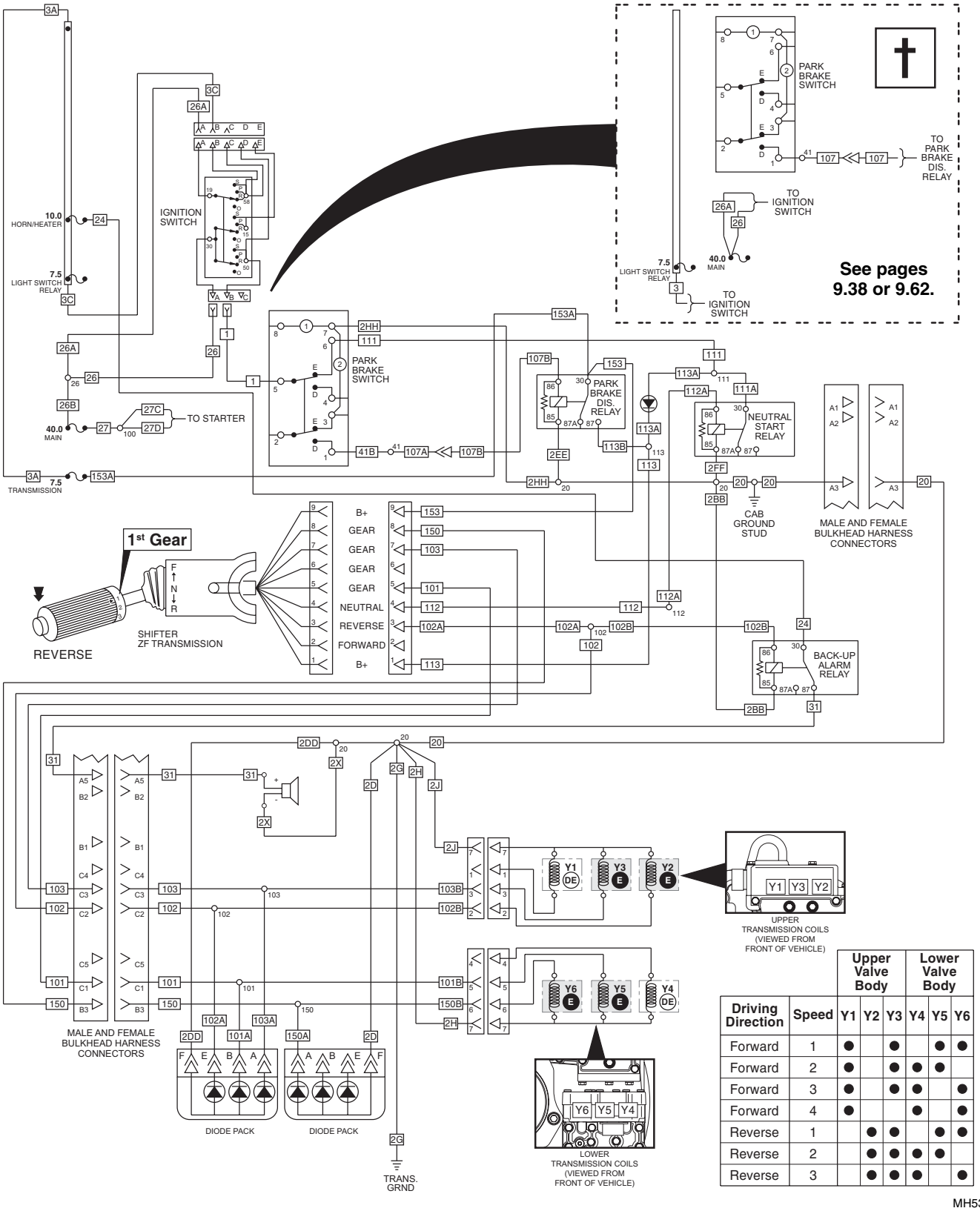


Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

● = See Page 9.107

MH5490

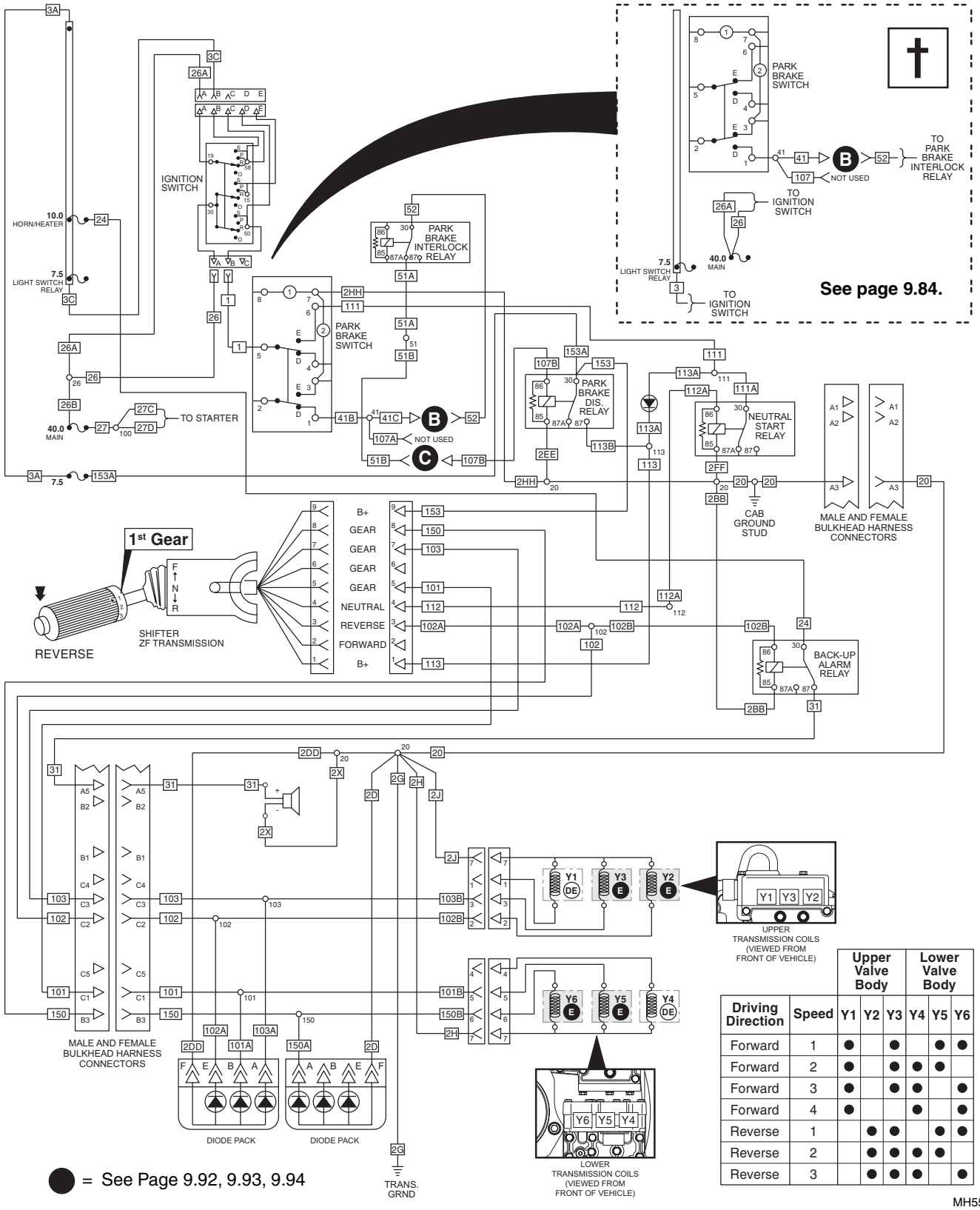
9.8.17 Transmission, Reverse First Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5350

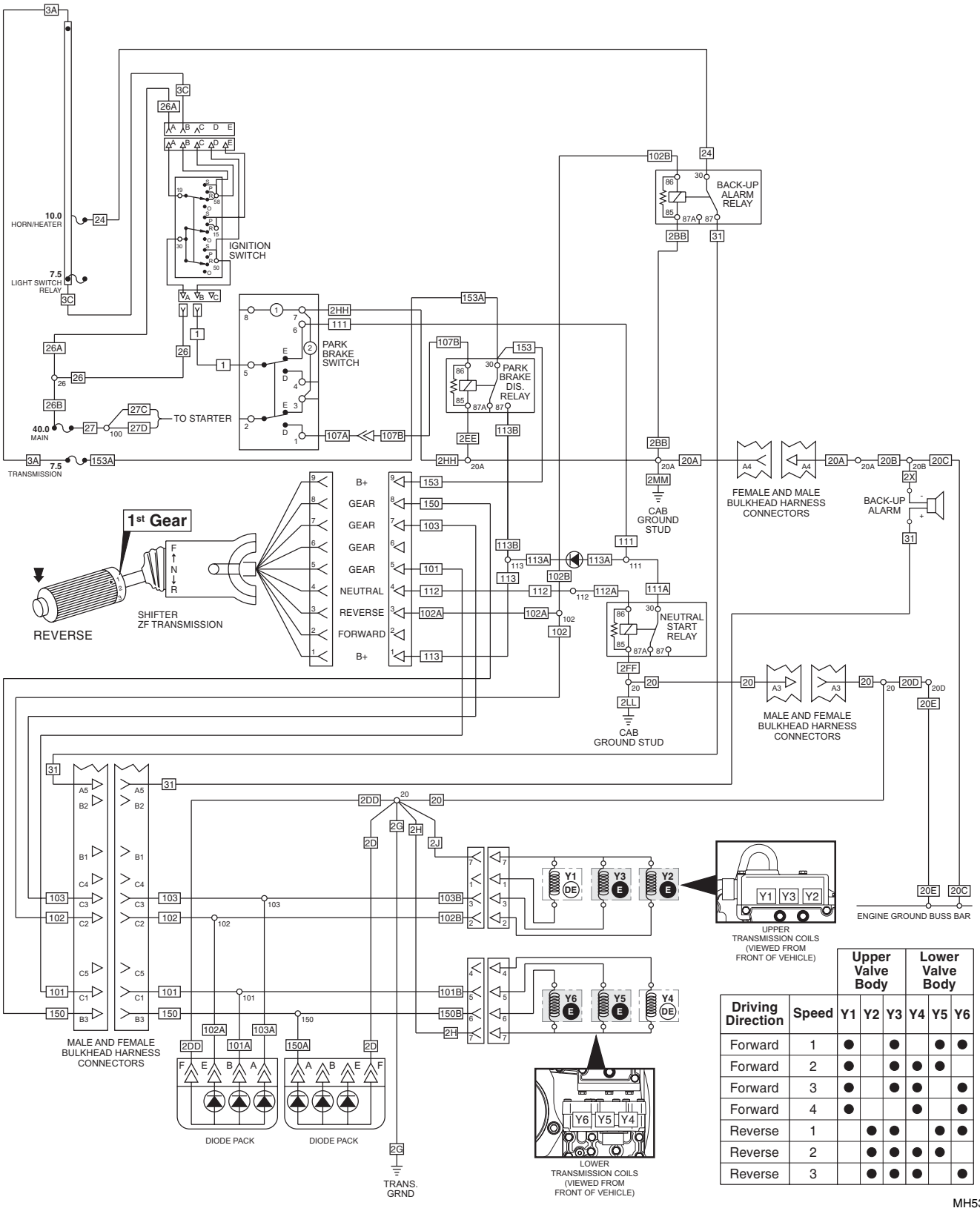
9.8.18 Transmission, Reverse First Gear Circuit, (SN 10054, 13198 - 19079)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5500

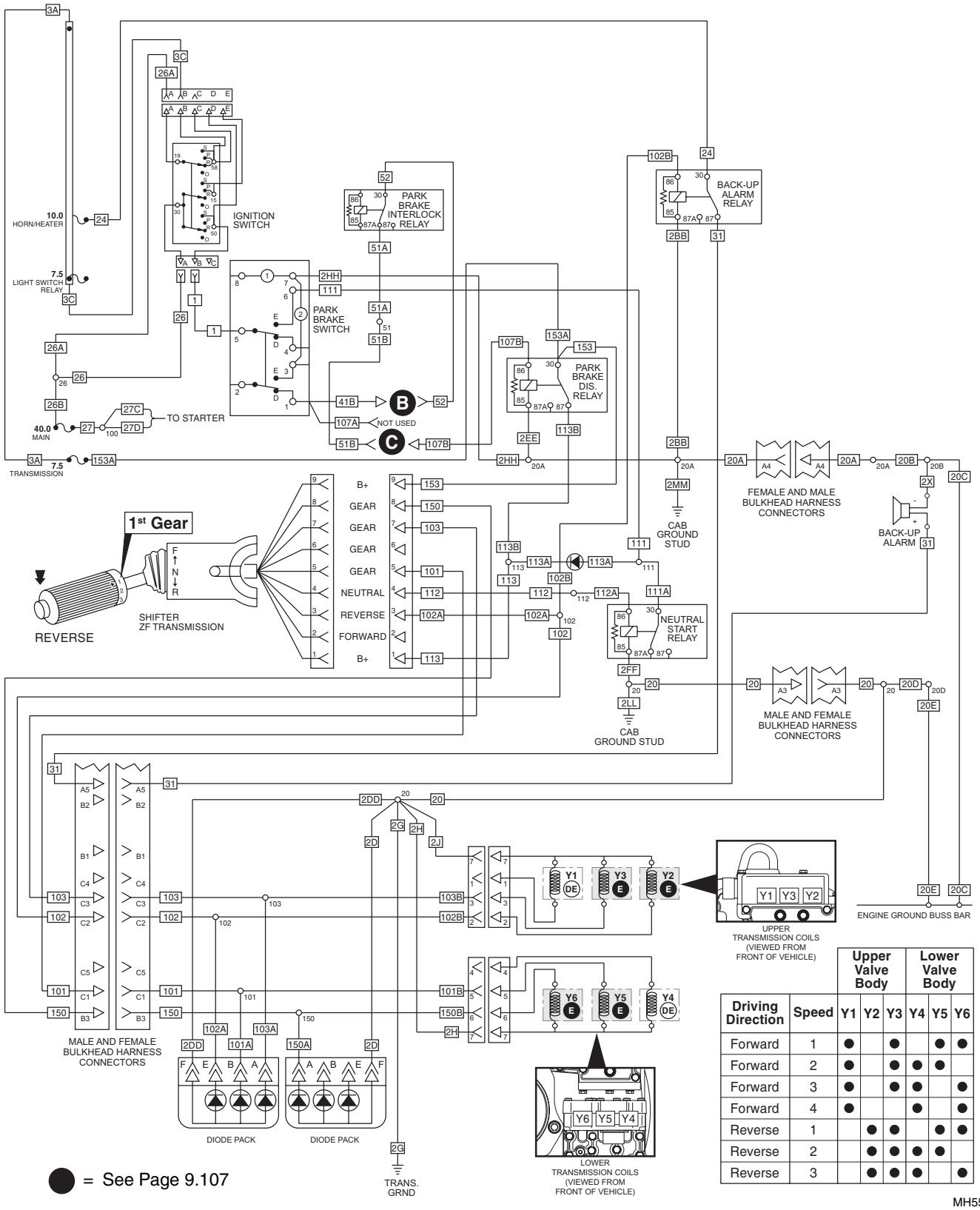
9.8.19 Transmission, Reverse First Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5360

9.8.20 Transmission, Reverse First Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

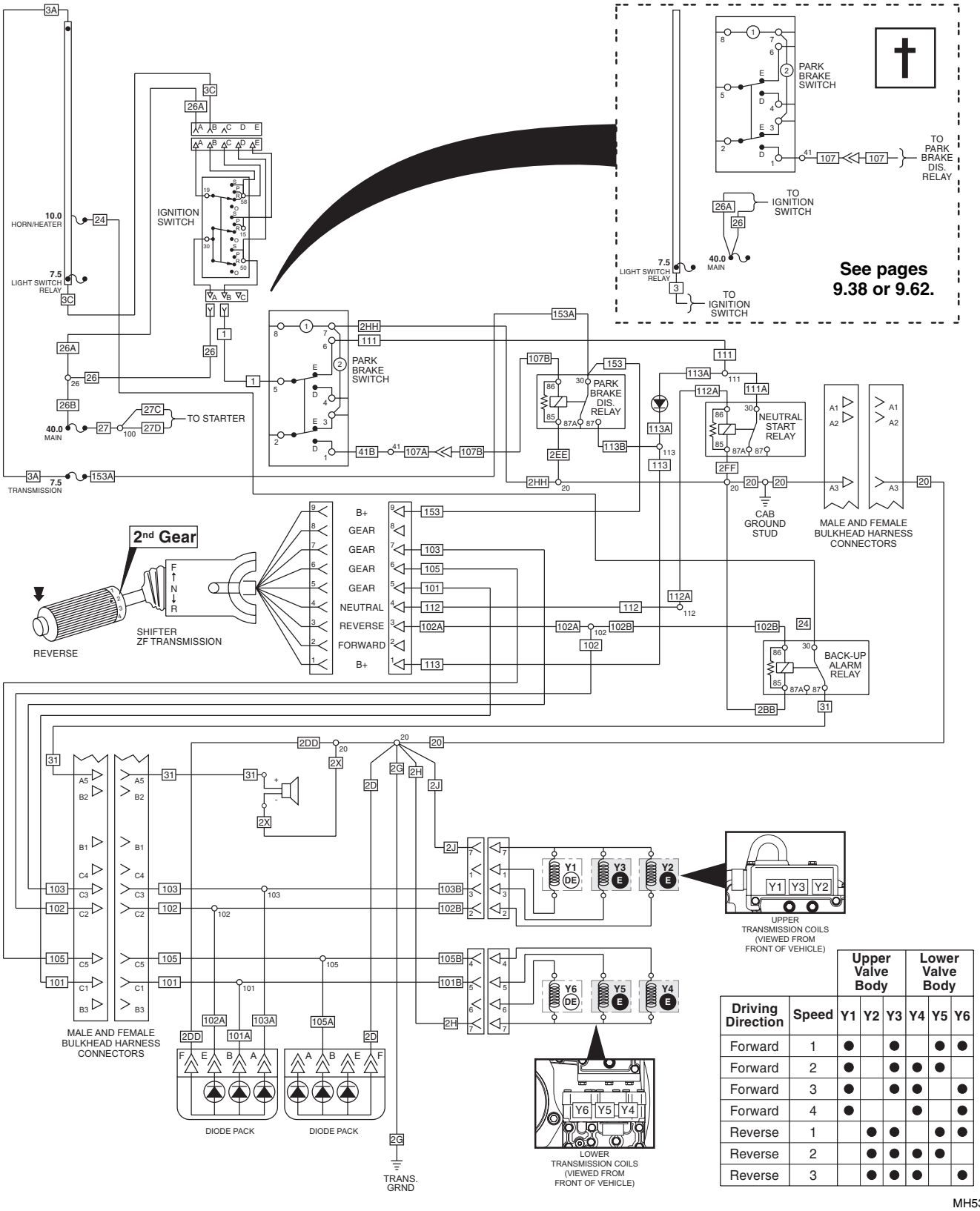


Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

● = See Page 9.107

MH5510

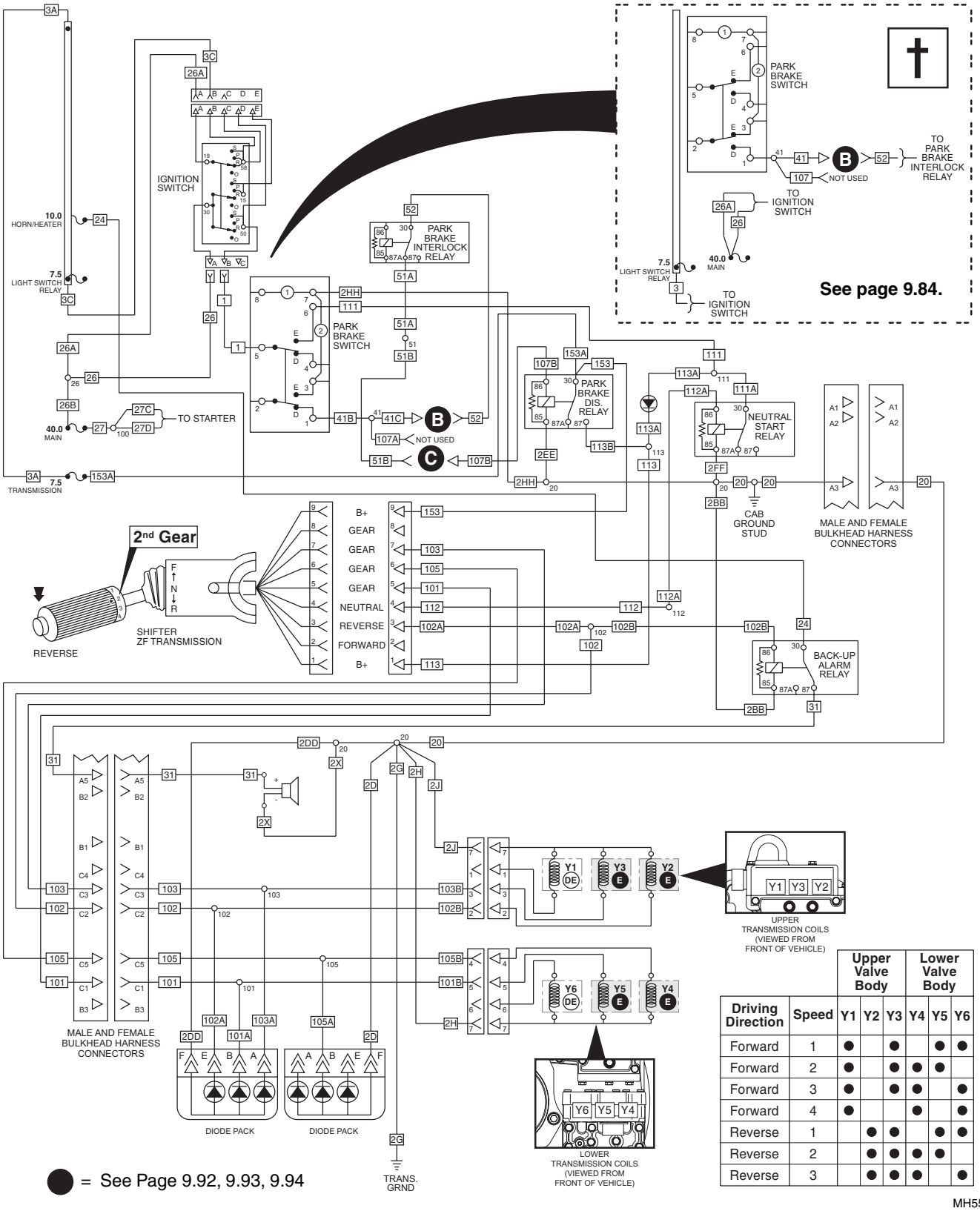
9.8.21 Transmission, Reverse Second Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5370

9.8.22 Transmission, Reverse Second Gear Circuit, (SN 10054, 13198 - 19079)

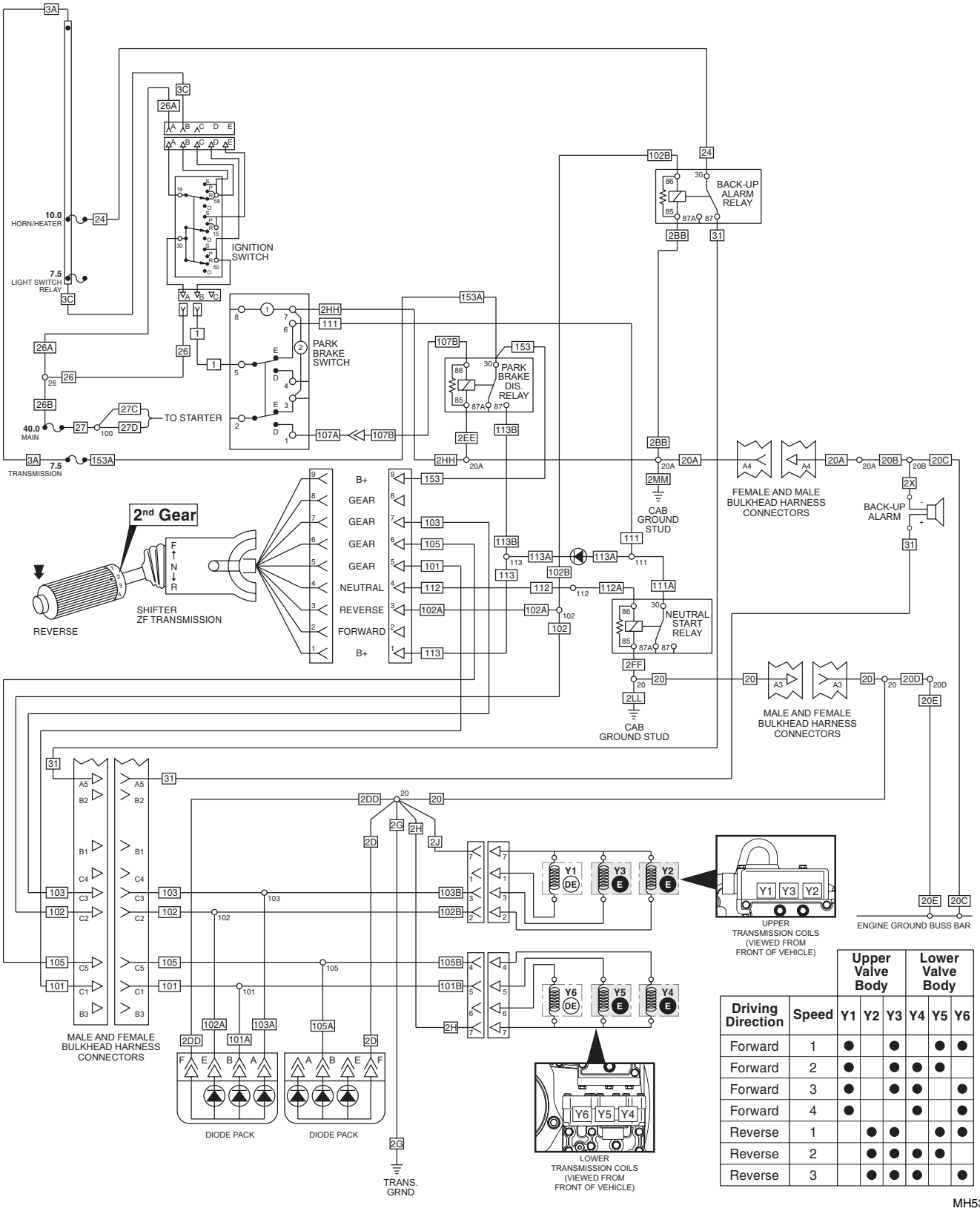


● = See Page 9.92, 9.93, 9.94

Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5520

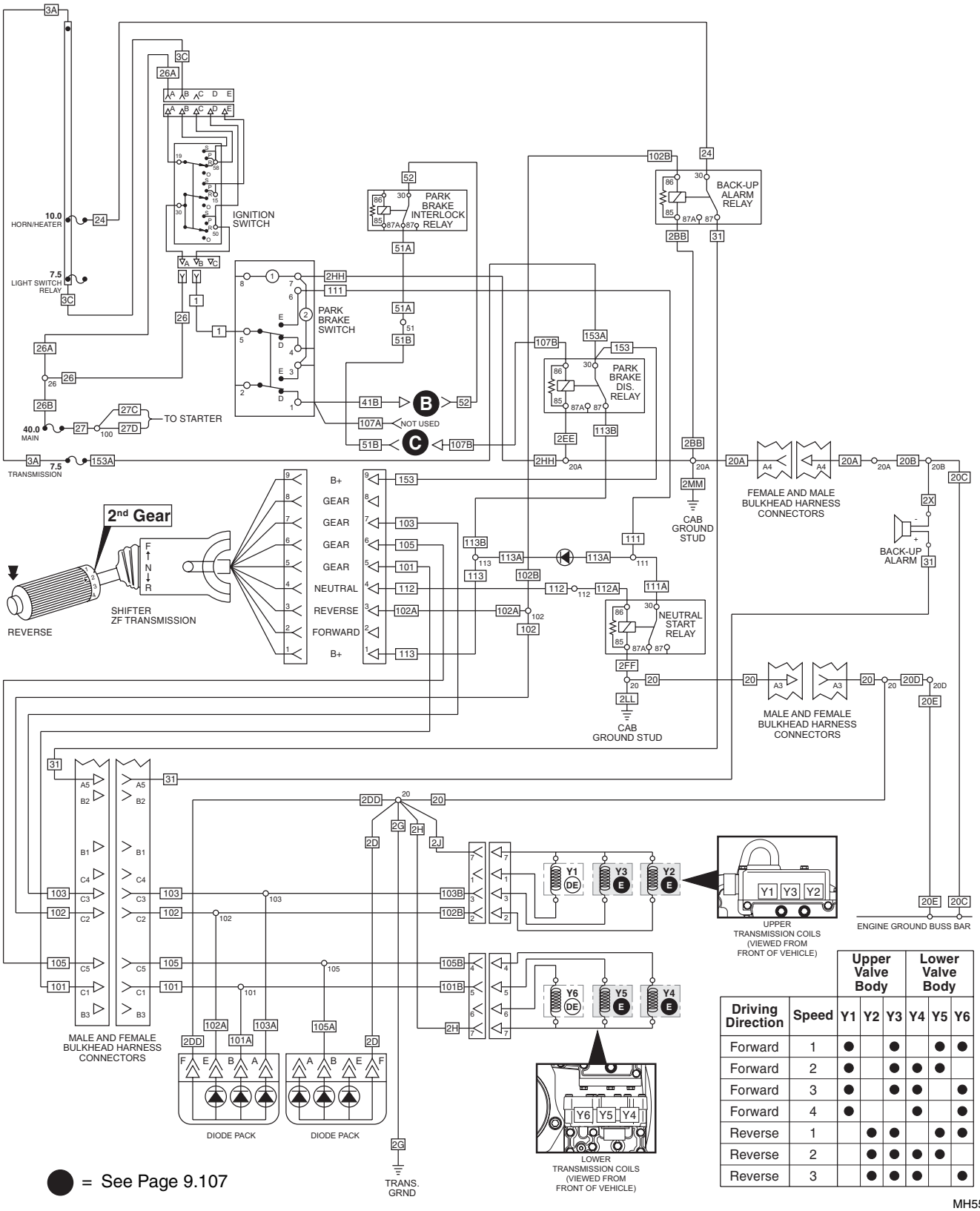
9.8.23 Transmission, Reverse Second Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5380

9.8.24 Transmission, Reverse Second Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)

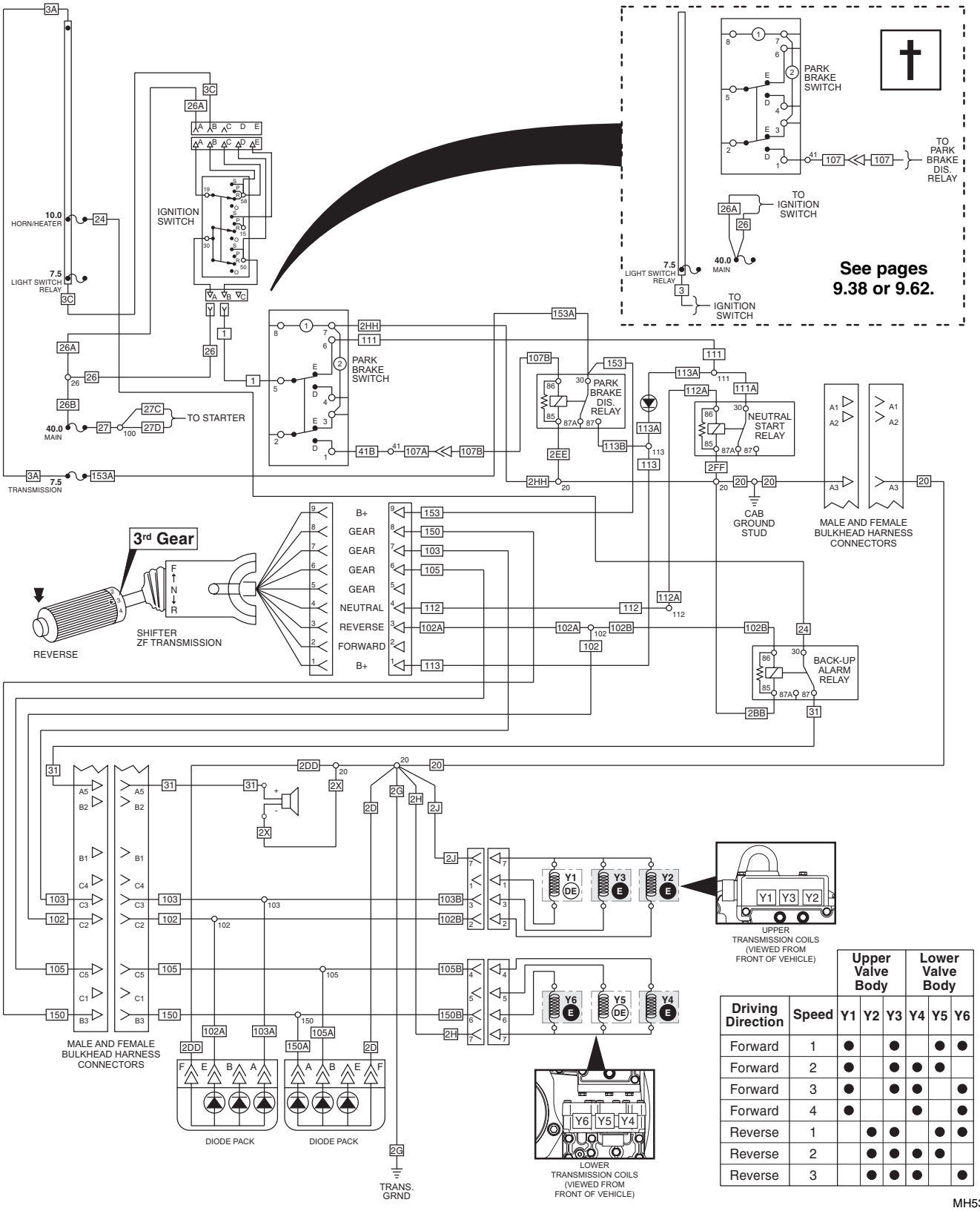


Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

● = See Page 9.107

MH5530

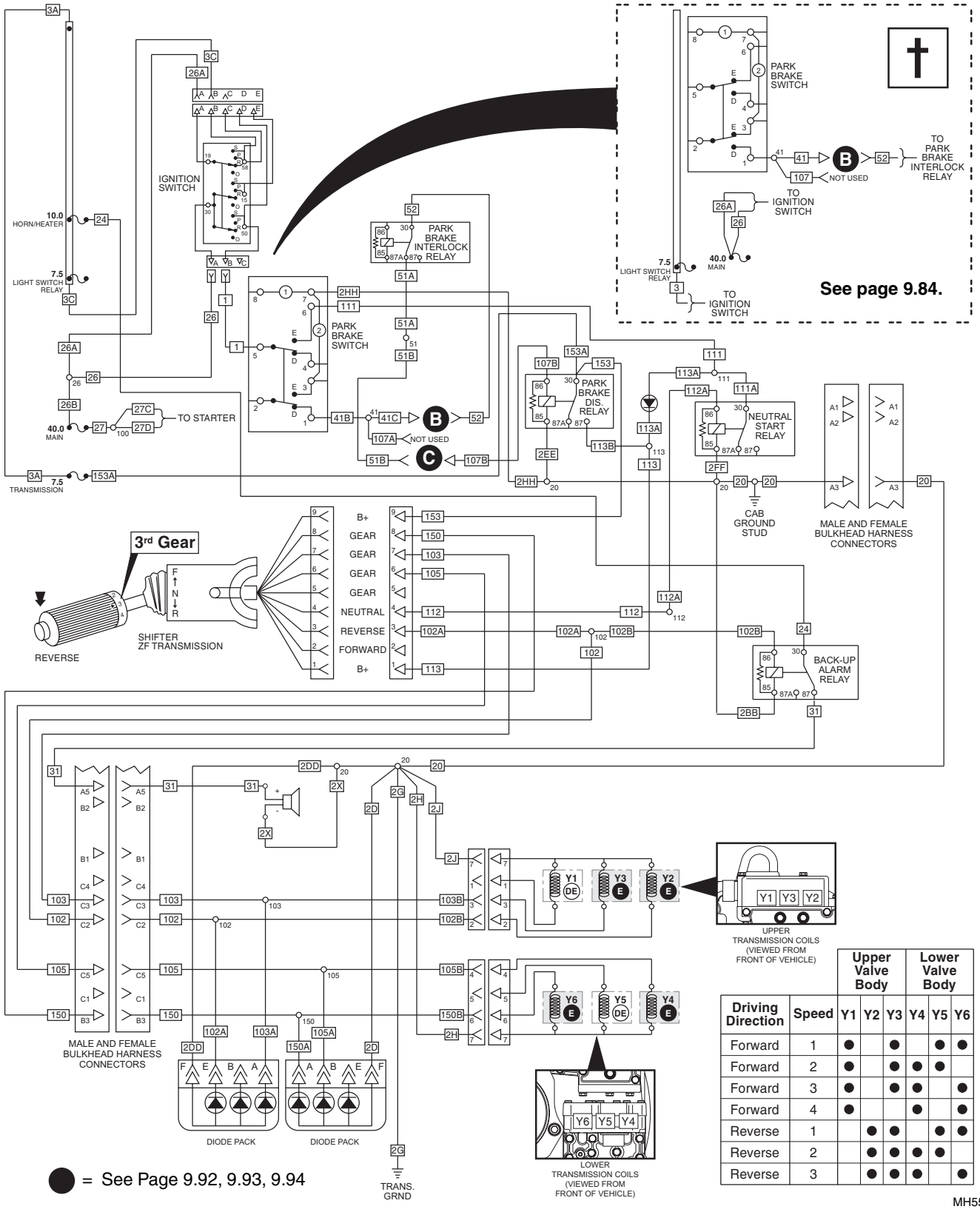
9.8.25 Transmission, Reverse Third Gear Circuit, (SN 8042, 13198 - 18990, 10042 13198 - 19030)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5390

9.8.26 Transmission, Reverse Third Gear Circuit, (SN 10054, 13198 - 19079)

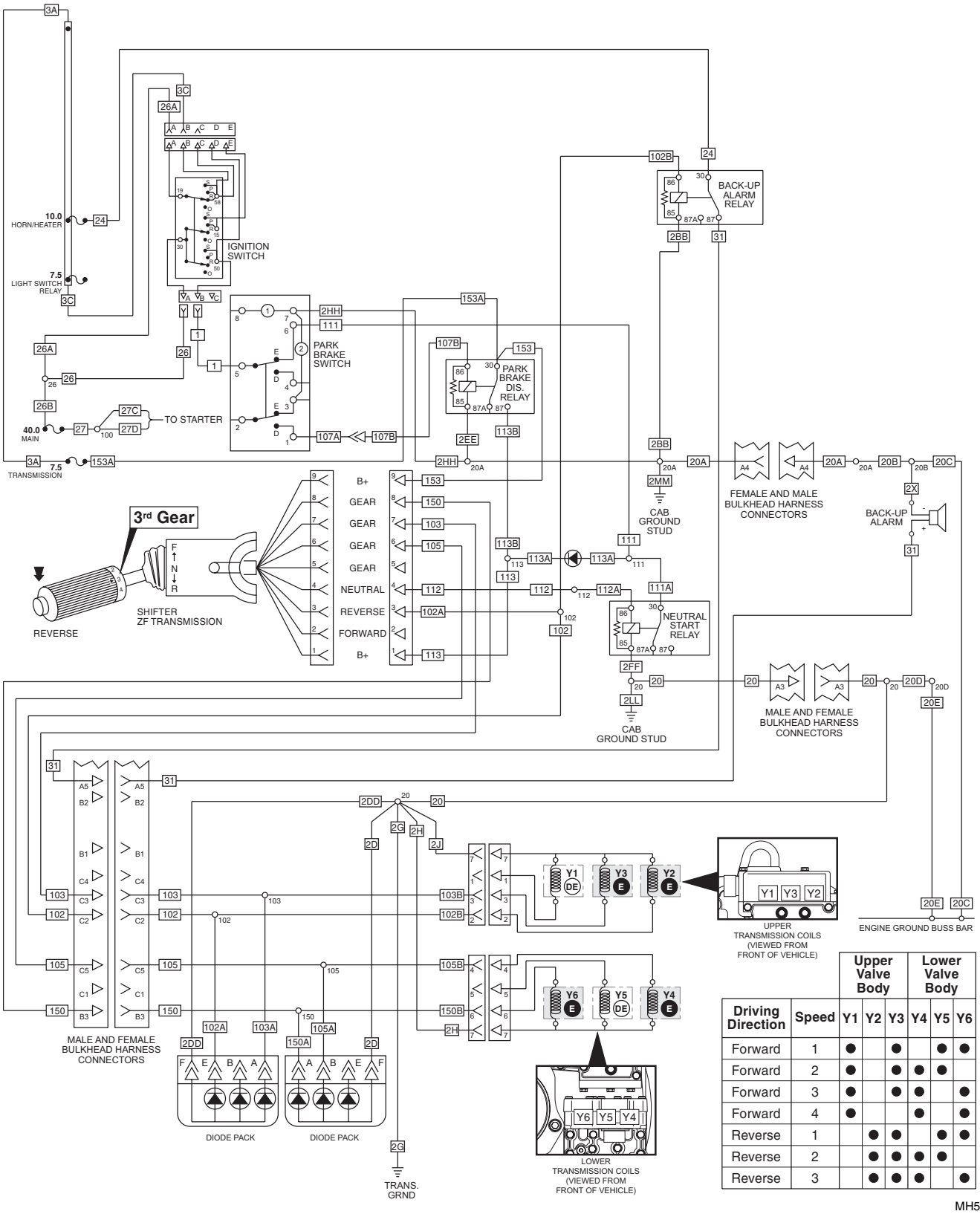


● = See Page 9.92, 9.93, 9.94

Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5540

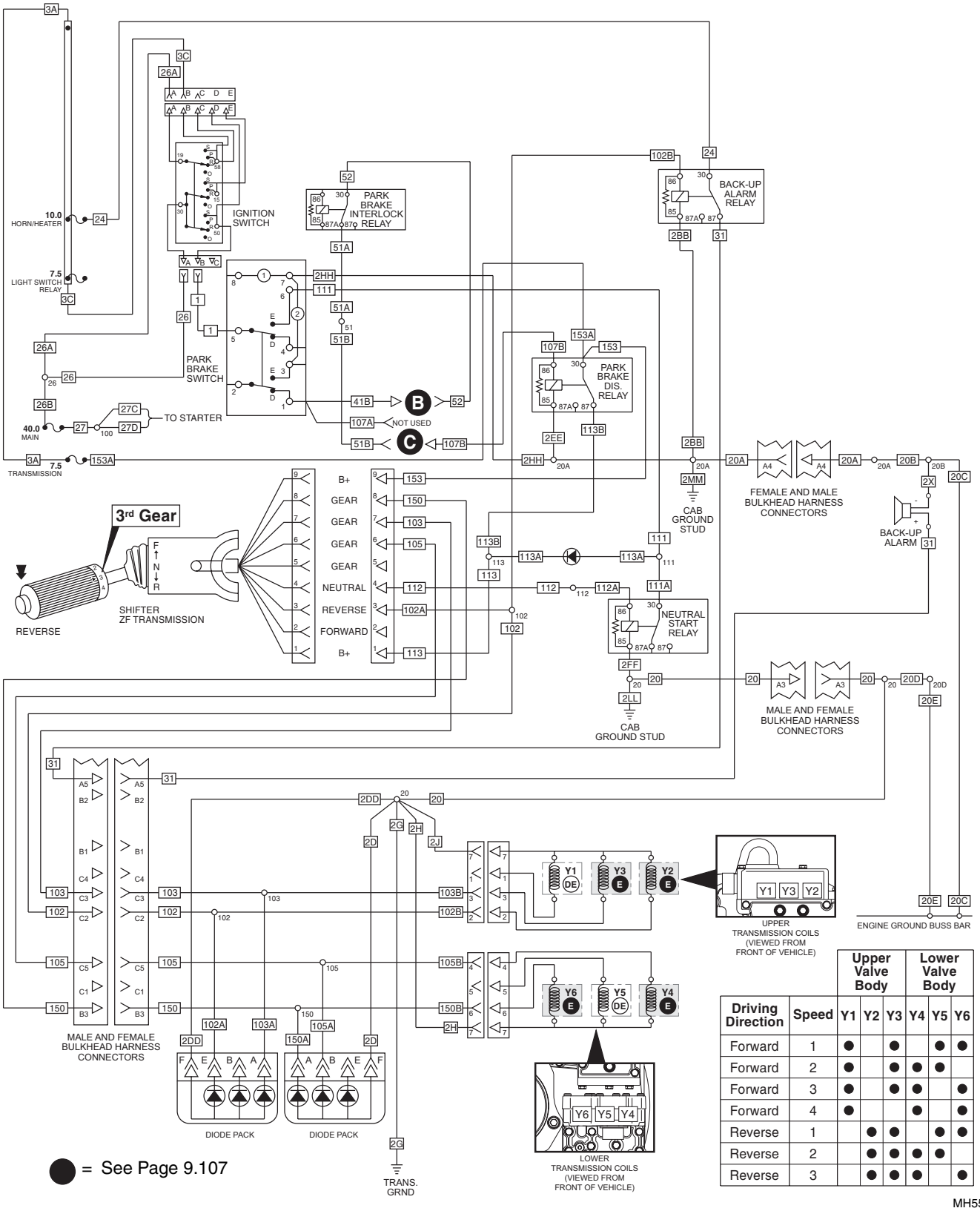
9.8.27 Transmission, Reverse Third Gear Circuit, (SN 8042, 18991 - 19987, 10042, 19031 - 19987 And 8042/10042, 0160002332 & After)



Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

MH5400

9.8.28 Transmission, Reverse Third Gear Circuit, (SN 10054, 19080 - 19987 And 0160002332 & After)



● = See Page 9.107

Driving Direction	Speed	Upper Valve Body Y1	Y2	Y3	Lower Valve Body Y4	Y5	Y6
Forward	1	●		●		●	●
Forward	2	●		●	●	●	
Forward	3	●		●	●		●
Forward	4	●			●		●
Reverse	1		●	●		●	●
Reverse	2		●	●	●	●	
Reverse	3		●	●	●		●

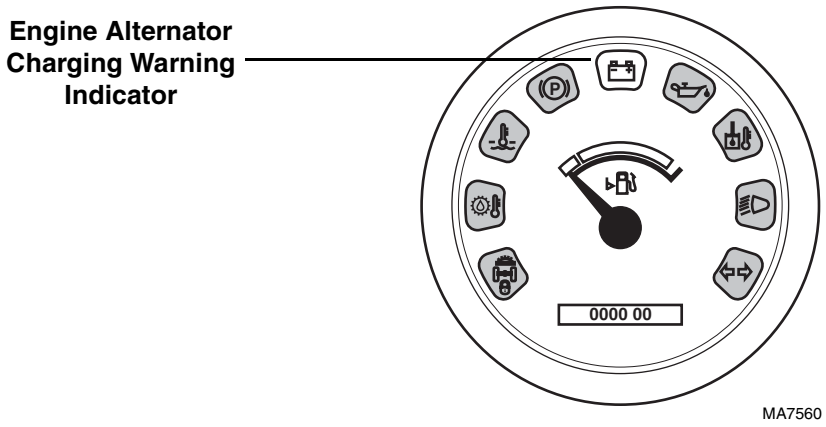
MH5550

9.8.29 Dash Panel Warning Indicator Troubleshooting

The following troubleshooting flow charts discuss each instrument cluster panel indicator separately. Additional information for each indicator can be found by referring to the correct electrical legends and schematics on pages 9.30 through 9.103.

The Instrument cluster light bulbs can be replaced. Bulb function should be checked before proceeding to each troubleshooting chart. Refer to Section 9.11.3, “Instrument Cluster.”

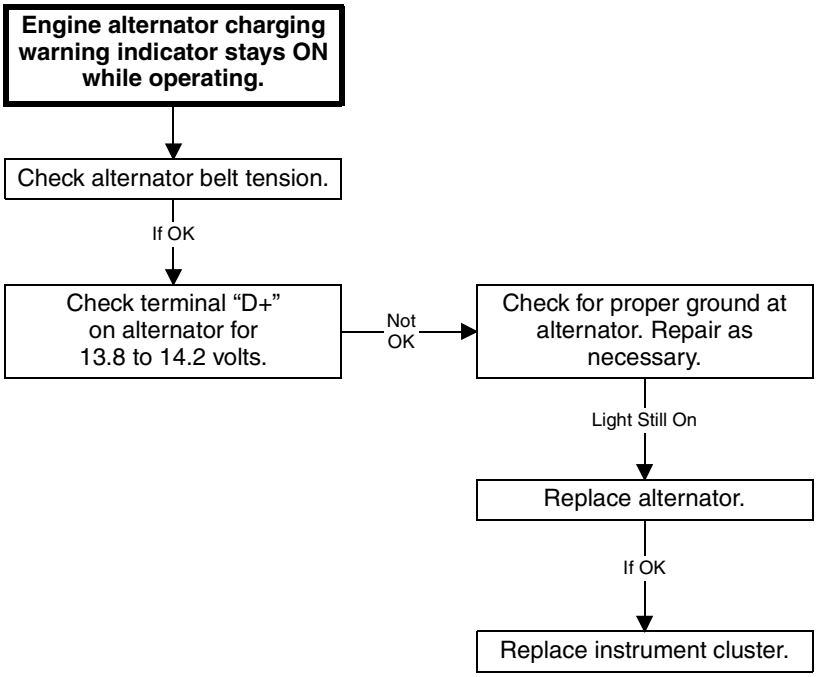
9.8.30 Engine Alternator Charging Warning Indicator Troubleshooting



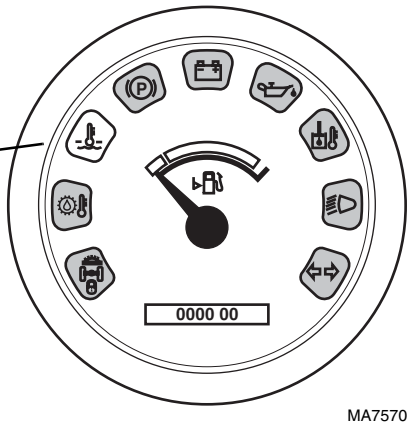
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**



9.8.31 Engine Coolant Temperature Warning Indicator Troubleshooting



1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**

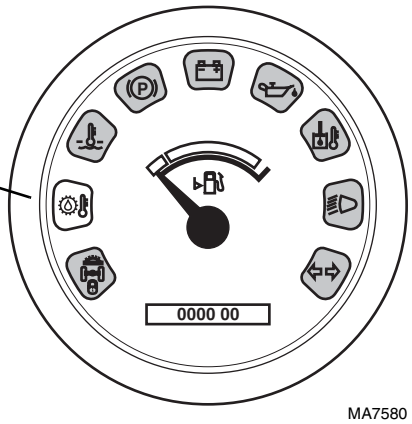
Engine coolant temperature warning indicator stays ON while operating.

Check radiator coolant level, fan belt tension, radiator cap, thermostat, and for plugged condition or debris on radiator.
- Not OK → Repair as needed.
- If OK →

Check connections at temperature switch and back of instrument cluster.
- Not OK → Repair as needed.
- If OK →

Disconnect harness at temperature switch. Indicator light should go out.
- Not OK → Check circuit for grounded wire 15 (LT BLU). If grounded, repair wire. Refer to pages 9.38, 9.39, 9.40, 9.41, 9.50, 9.51, 9.62, 9.63, 9.64, 9.65,9.74, 9.75, 9.84, 9.85, 9.86, 9.87, 9.102 or 9.103.
  - If circuit tests OK → Replace instrument cluster.
- If OK → Replace engine coolant temperature switch and retest system.

9.8.32 Transmission Temperature Warning Indicator Troubleshooting



1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**

Transmission temperature warning indicator stays ON while operating and alarm sounds.

Stop and idle vehicle for 1 minute to allow transmission oil to cool.

Not OK

Check transmission fluid level. Check radiator for plugged condition or debris.

Not OK → Repair as needed.

If OK

Check connections and circuit at switch on transmission.

Not OK → Repair as needed.

If OK

Disconnect harness at transmission temperature switch. Indicator light should go out.

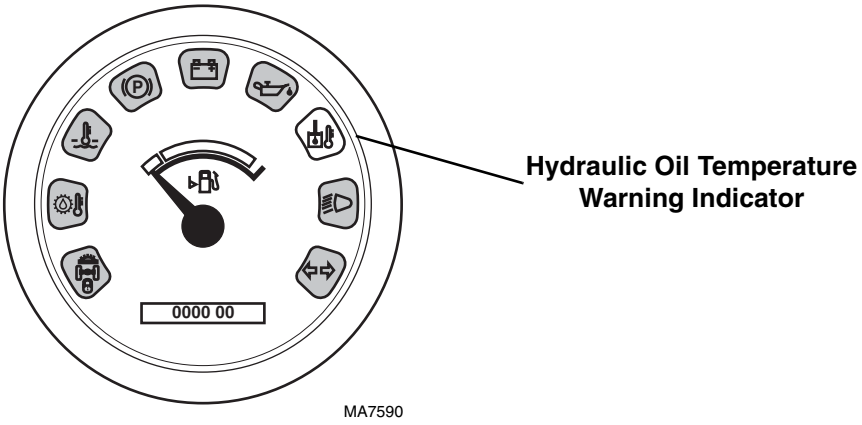
Not OK → Check circuit for grounded wire 18 (GRN). If grounded, repair wire. Refer to pages 9.38, 9.39, 9.40, 9.41, 9.50, 9.51, 9.62, 9.63, 9.64, 9.65,9.74, 9.75, 9.84, 9.85, 9.86, 9.87, 9.102 or 9.103.

If circuit tests OK → Replace instrument cluster.

If OK

Replace transmission temperature switch and retest system.

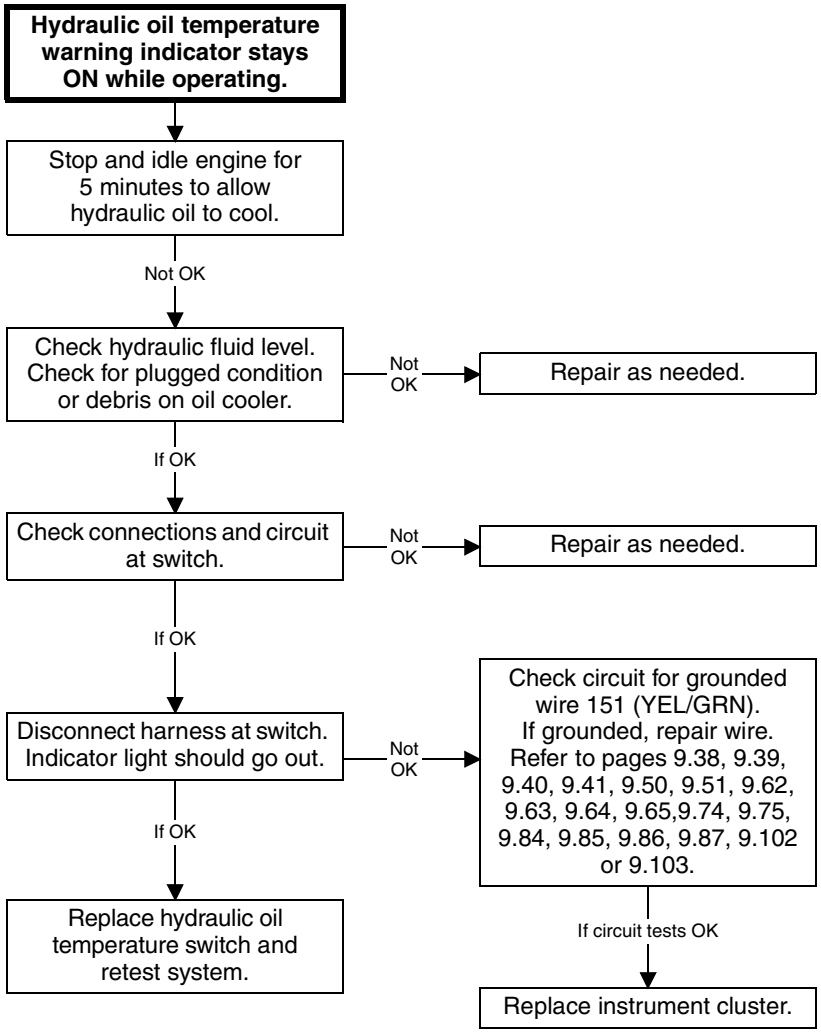
9.8.33 Hydraulic Oil Temperature Warning Indicator Troubleshooting



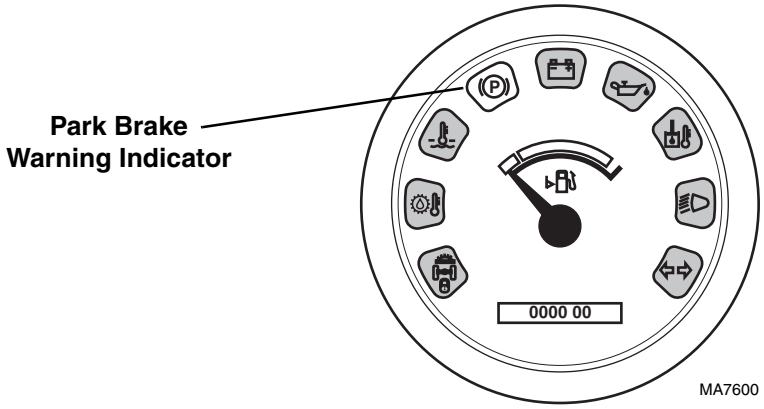
1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**



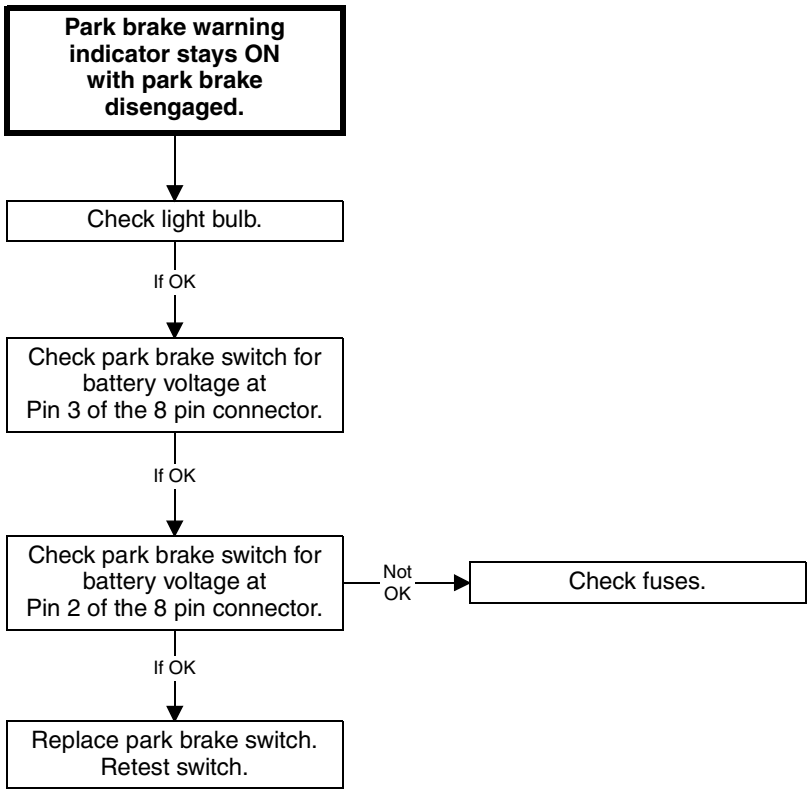
9.8.34 Park Brake Warning Indicator Troubleshooting



1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**

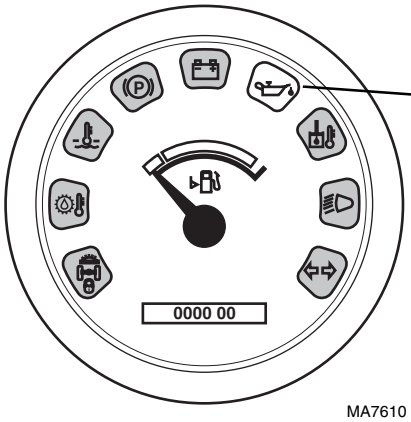


9.8.35 Engine Oil Pressure Warning Indicator Troubleshooting

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**



Engine Oil Pressure Warning Indicator

Engine oil pressure warning indicator stays ON while operating.

Check connections at oil pressure switch and instrument cluster.

If OK → Check engine for oil pressure.

- If OK → Disconnect wire 16 (BLU) from oil pressure switch and verify that switch contact is open.
  - Not OK → Replace oil pressure switch.
- Not OK → Repair engine component.

Not OK → Repair connections as needed.

Not OK → Disconnect oil pressure switch at harness. Turn ignition ON and check for grounded circuit. If Indicator light is still on, check wire 16 (BLU). Refer to pages 9.38, 9.39, 9.40, 9.41, 9.50, 9.51, 9.62, 9.63, 9.64, 9.65,9.74, 9.75, 9.84, 9.85, 9.86, 9.87, 9.102 or 9.103.

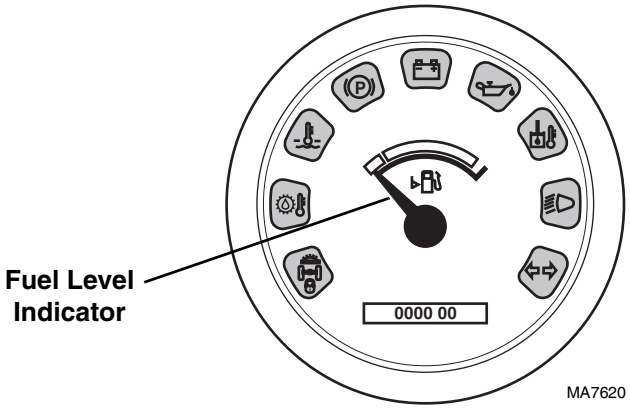
If OK → Replace instrument cluster.

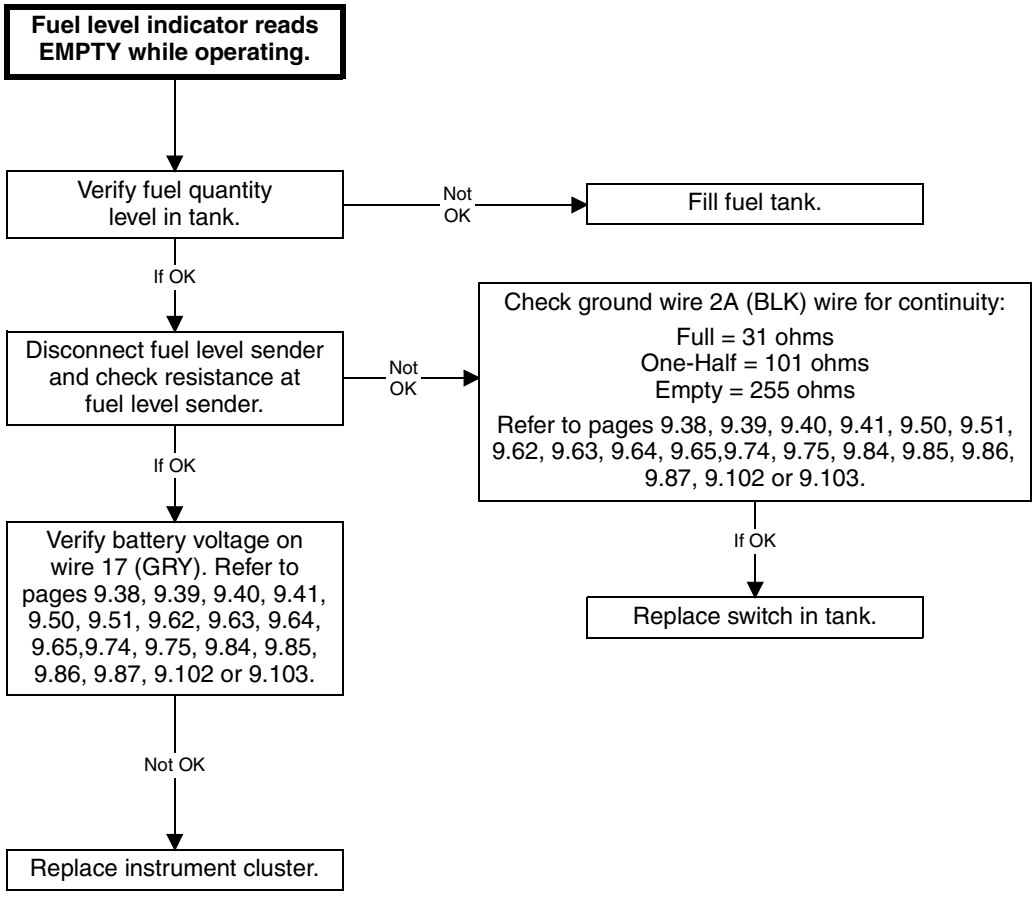
9.8.36 Fuel Level Indicator Troubleshooting

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**



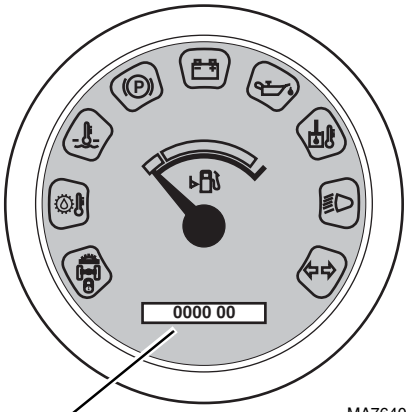


9.8.37 Hourmeter Indicator Troubleshooting

1st

Before troubleshooting any electrical circuit, ALWAYS begin by checking the following:

1. **Fuses.**
2. **Battery for proper charge.**
3. **All connections relating to circuit are clean and tight.**
4. **Check instrument cluster bulb for proper function.**



Hourmeter Indicator

Hourmeter indicator does not register operating hours.

Check wire 38 (ORG) for battery voltage to instrument panel connector.

Not OK

Check for proper ground at alternator. Refer to pages 9.38, 9.39, 9.40, 9.41, 9.50, 9.51, 9.62, 9.63, 9.64, 9.65,9.74, 9.75, 9.84, 9.85, 9.86, 9.87, 9.102 or 9.103.

If OK

Check alternator terminal “D+” for battery voltage.

Not OK

Replace alternator.

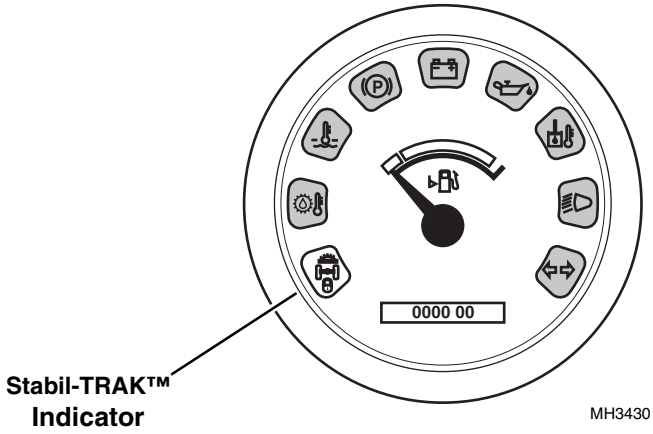
Not OK

Repair ground wires as necessary.

If OK

Replace instrument cluster.

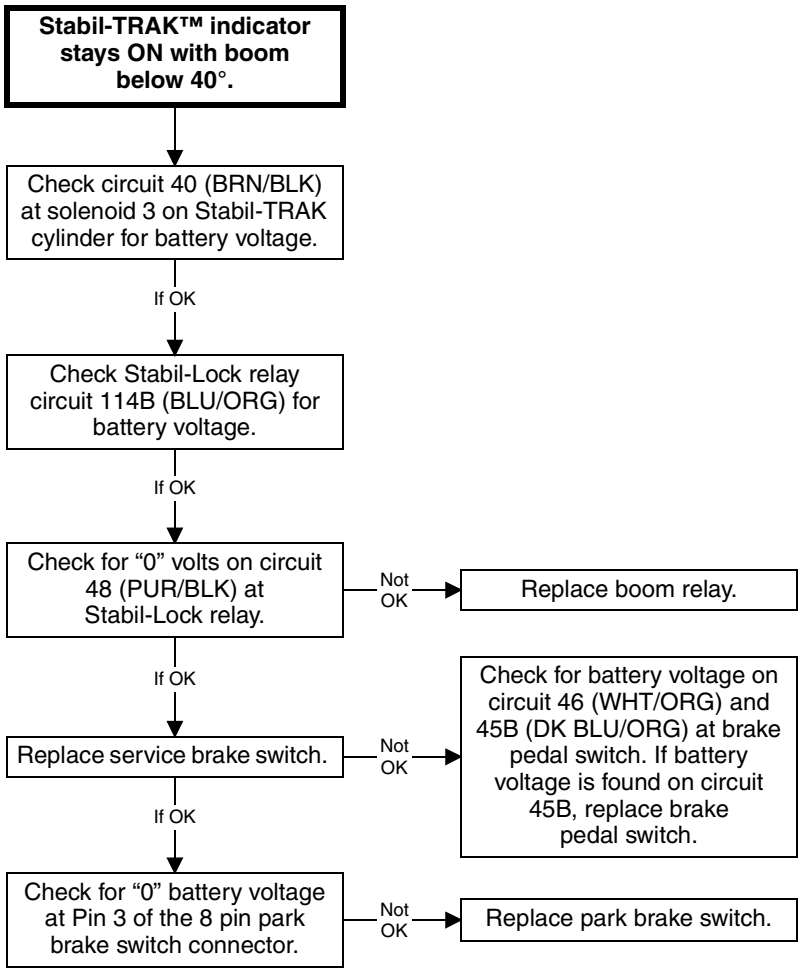
9.8.38 Stabil-TRAK™ Indicator Troubleshooting



1st

Before troubleshooting this electrical circuit, ALWAYS begin by checking the following:

1. **Boom below 40°.**
2. **Transmission shifter in NEUTRAL.**
3. **Park Brake OFF.**



9.9 ENGINE START CIRCUIT

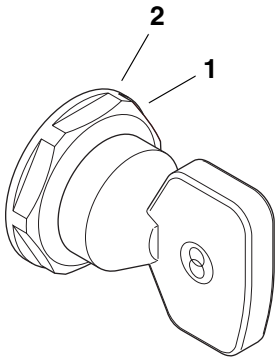
The purpose of the engine start circuit is to energize the starter solenoid and engage the starter motor to start the engine. To start the engine, the ignition key switch must be in the START (**1**) position, the park brake switch must be in the ON position and the transmission shift control switch (travel select lever) must be in the NEUTRAL (center) position.

When the ignition key switch is turned to the START (**1**) position, and with the transmission in (N) NEUTRAL, the starting circuit activates the starter relay, starter solenoid and fuel shut-off solenoid. The fuel shut-off solenoid opens a valve that supplies fuel to the injection pump.

9.9.1 Starting Circuit

The starting circuit functions as follows:

1. Current from the battery flows through the positive (+) battery cable to the starter solenoid.
2. Current then flows to the fuse box, through the main fuse and to the ignition key switch.
3. When the key switch is turned to the START (**1**) position, current flows through contacts in the ignition key switch to the park brake switch.



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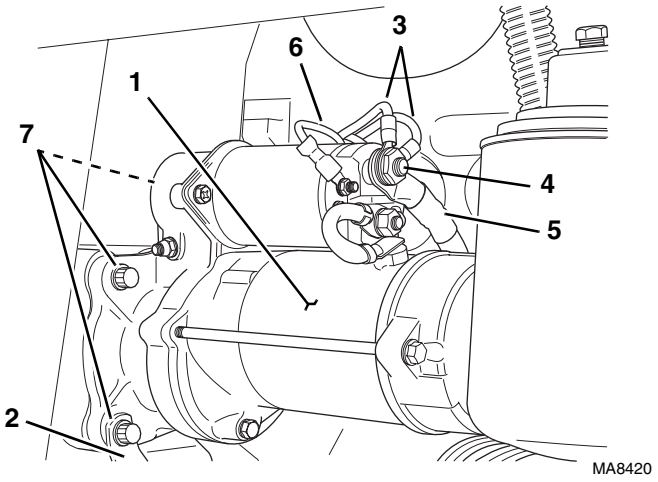
4. If the park brake is set, current flows through contacts in the brake switch to the neutral start circuit.
5. If the transmission select lever is in (N) NEUTRAL, current flows through the neutral start circuit to energize the coil of the starter relay. The relay closes internal contacts that allow current to flow to the starter solenoid and starter.
6. The starter solenoid engages a gear on the starter pinion shaft to mesh with the flywheel. The starter pinion and gear begin to spin, in turn, rotating the flywheel, crankshaft and related components within the engine.
7. When the ignition key switch is initially turned, the fuel shut-off solenoid opens a valve to supply power to the fuel injection pump. As the starter rotates the engine components, the fuel injection pump, and related lines and injectors supply fuel to the cylinders.
8. When the pistons compress the injected fuel, ignition occurs, the engine starts and the starter pinion retracts.
9. As the engine runs, it drives the alternator that recharges the battery used during the starting cycle.
10. When the ignition key switch is released, it returns to the RUN (**2**) position where it directs current to the fuse panel that, in turn, distributes electrical current for the operation of vehicle controls, gauges and other equipment.

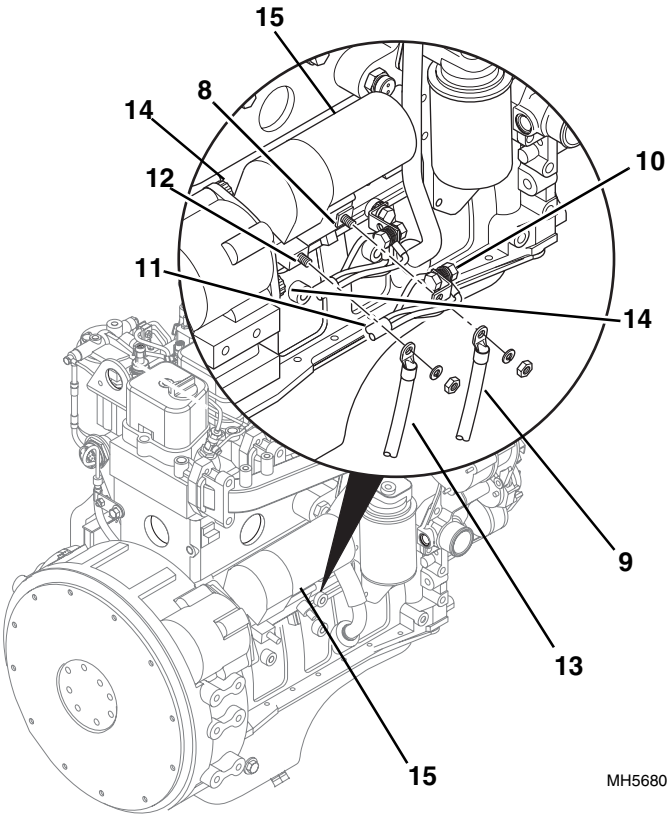
9.9.2 Starter

The starter (**1** or **15**) is located on the left side of the engine (the left side of the vehicle).

SN 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079



SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After



The starter operates when the attached starter solenoid engages a gear on the starter pinion shaft to mesh with the flywheel, and the starter pinion and gear begin to spin, in turn rotating the flywheel, crankshaft and related components within the engine.

The starter is grounded indirectly via the negative (-) battery cable. The cable (**2** or **13**) is routed from the battery to the starter housing where it attaches to the engine.

a. Testing the Starter on the Engine

If the starter does not engage when the ignition key switch is turned, check the following:

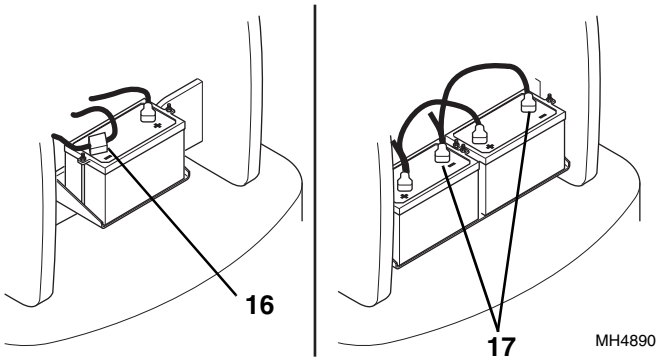
1. The main fuse may be blown, requiring replacement. Check for the cause of the blown fuse.
2. There may be a defect in the ignition key switch, ignition wiring or starter solenoid.
3. Check battery condition. Clean the battery posts and the connectors at each end of the battery cables.
4. Check for broken wiring and damaged insulation on the wiring. Replace all broken or damaged wiring.
5. Check all connections at the starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
6. If the starter still does not operate after these checks have been performed, check the starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a “whirring” noise is heard but the engine does not turn over, the starter is spinning but not engaging the flywheel. The starter drive or solenoid that pushes the drive forward to engage the flywheel may be defective. Missing or damaged teeth on the flywheel can also prevent the starter from cranking the engine.
3. If the starter only “clicks” it may indicate that the battery is discharged, or that there is a loose or corroded battery cable connection. Check the battery state of charge and battery condition first, then check the cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.7.36, “Engine Start Circuit and Troubleshooting.”

c. Starter Removal

Remove the starter only if it fails. To remove the starter:



1. Unlock and open the rear engine door.
2. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**16**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**17**).

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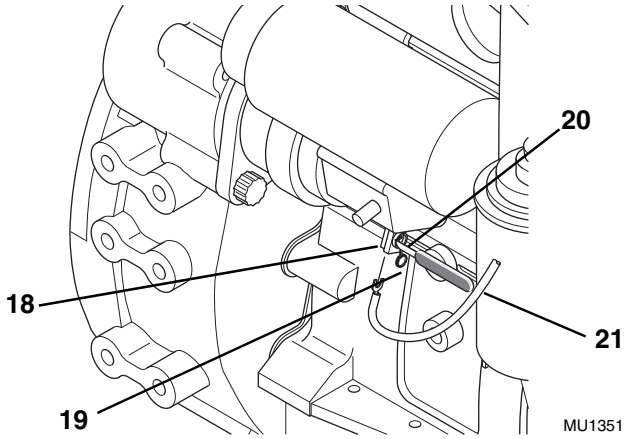
3. Remove the red wires (**3**) from the solenoid stud (**4**). Remove the red, positive (+) battery cable (**5**) from the starter. Label and disconnect the blue/orange wire (**6**) from the starter solenoid housing stud. Record how the wires are installed to ensure correct installation later.
4. Loosen, but **DO NOT** remove, the three fasteners (**7**) securing the starter to the flywheel housing. Support the starter securely, as it is relatively heavy and will fall if not supported.
5. Support the starter and remove the fasteners securing the starter to the engine. Remove the negative (-) ground cable from its starter mounting bolt (**7**).
6. Remove the starter (**1**) from the vehicle.

SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

1. At the positive starter stud (**8**), label and disconnect the positive (+) battery cable (**9**) and starter positive buss bar (**10**). Leave the wires (**11**) connected to the starter positive buss bar.
2. At the negative starter stud (**12**), label and disconnect the negative (-) battery cable (**13**).
3. For jump start protection, a protective plastic cover (**18**) is installed around the starter solenoid terminal and mounting screw. A removable, tethered cap (**19**) allows access to the terminal mounting screw.



4. Use a small, flat knife blade (**20**), inserted next to the cap (**19**), so that the cap pops out of the protective cover.
5. Label the blue/orange wire (**21**) from the starter solenoid terminal. Use a small phillips screwdriver to loosen the screw far enough to allow the blue wire to be removed from the terminal.
6. Loosen, but **DO NOT** remove, the two fasteners (**14**) securing the starter (**15**) to the flywheel housing. Support the starter securely, as it is relatively heavy and will fall if not supported.
7. Remove the fasteners (**14**) securing the starter to the engine.
8. Remove the starter (**15**) from the vehicle.

d. Starter Cleaning and Drying

1. While the starter is being removed, wipe away any grease or dirt that has accumulated around the starter mounting opening.
2. If reinstalling the starter, clean the exterior of the starter with an approved solvent. **DO NOT** submerse the starter or allow the solvent to contact the starter bushings.
3. Dry the starter with a clean, lint-free cloth.

e. Starter Periodic Maintenance

A starter requires no routine maintenance beyond the occasional inspection of the electrical connections, which must be clean and tight. The starter is not serviceable; replace a defective starter with a new unit.

f. Starter Installation

Applies To Serial Numbers: 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079

1. Position the starter (**1**) in its mounting opening on the flywheel housing. Position the ground cable (**2**) over the correct starter mounting bolt (**3**). Secure the starter with the three fasteners (**3**). Torque fasteners to 32 lb-ft (43 Nm).

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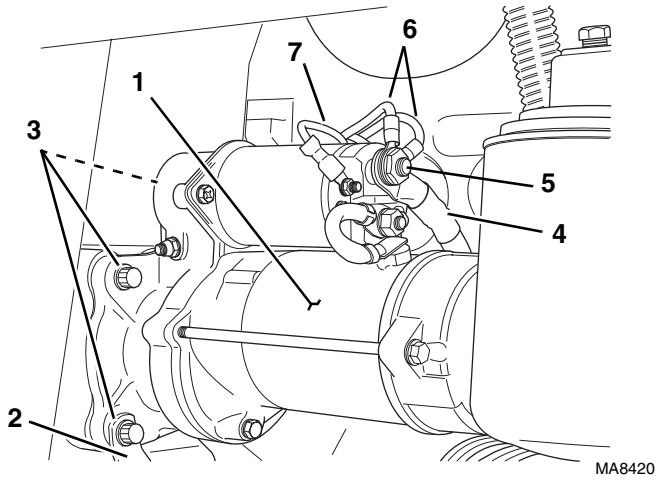
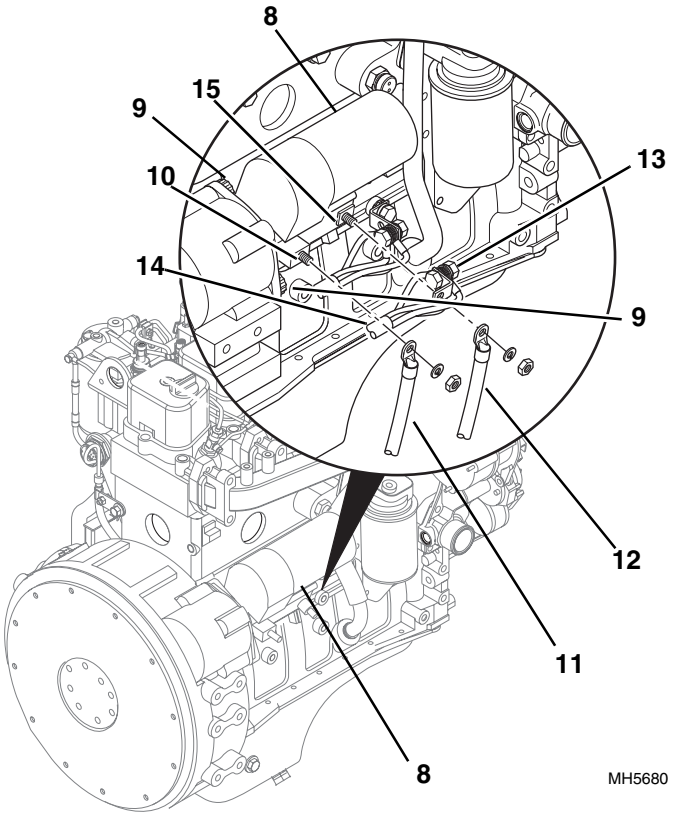


2. Connect the red, positive (+) battery cable (**4**) to the upper solenoid stud (**5**). Install the two red wires (**6**) to the upper solenoid stud, and secure with lockwasher and nut. Torque nuts to 3.4 lb-ft (4,6 Nm).
3. Connect the blue/orange wire (**7**) to the solenoid mounting stud.

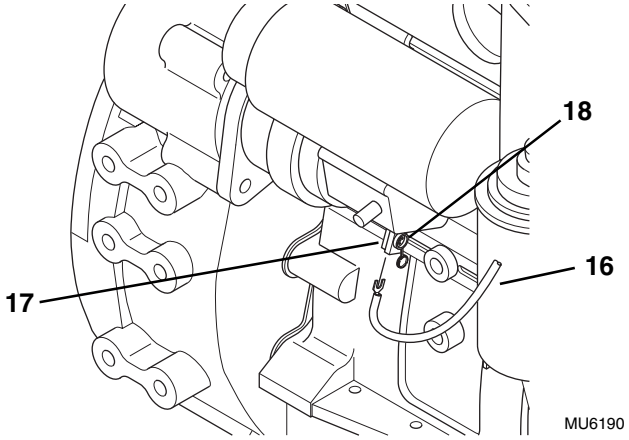
Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

1. Position the starter (**8**) in its mounting opening on the flywheel housing. Secure the starter with two fasteners (**9**). Torque fasteners to 32 lb-ft (43 Nm).
2. At the negative starter stud (**10**), connect the negative (-) battery cable (**11**). Torque mounting hardware to 3.7 lb-ft (5 Nm).
3. Connect the positive (+) battery cable (**12**) and starter positive buss bar (**13**), with the wires (**14**) still connected, at the positive starter stud (**15**). Torque mounting hardware to 3.7 lb-ft (5 Nm).

SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After



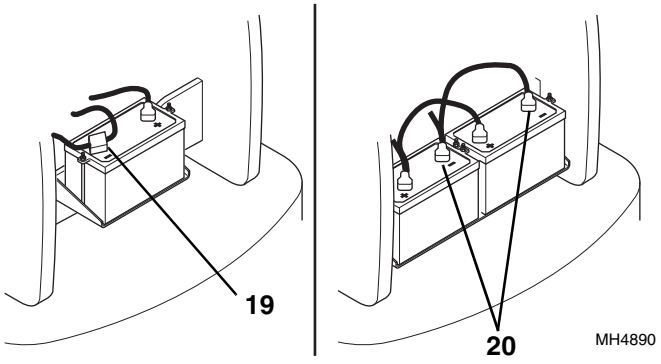
4. Insert the fork terminal of the blue/orange wire (**16**) into the protective cover (**17**) on the starter solenoid terminal. Use a small phillips screwdriver to tighten the screw (**18**) securely.
5. Snap the tethered cap back in place over the screw in the protective cover.



Applies To All Vehicles

6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**19**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**20**).



9.10 CHARGING CIRCUIT

The purpose of the charging circuit is to maintain battery voltage between 13.8 and 14.2 volts. The key switch must be in the RUN position with the engine running in order for the charging system to operate.

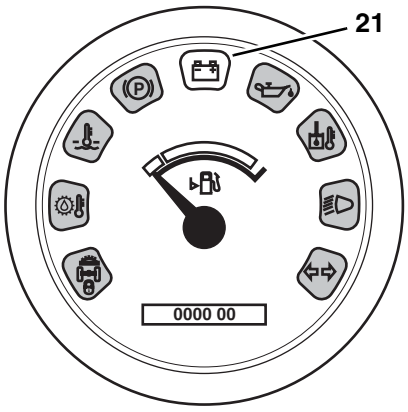
The charging circuit consists of the battery and a belt-driven alternator with an internal voltage regulator. These components work together to provide electrical power for the vehicle, including the starting system, operator's instrument cluster, horn, solenoids, back-up alarm and all accessories.

Current flows from the positive post of the battery to the battery terminal on the starter motor solenoid.

When the ignition key switch is in the RUN position, current flows from the instrument cluster to the alternator D+ terminal, and is used to excite the field windings; The alternator begins emitting a charge. Current flows from the alternator B+ terminal to the starter motor B terminal, then through the positive (+) battery cable to the battery.

The circuit in the instrument panel connects to the battery positive terminal through the fuse panel and detects field voltages in excess of 16 volts or system voltages that are less than 2-4 volts below battery voltage. Either of these conditions will cause the warning light on the operator's instrument cluster to illuminate.

The alternator charging warning indicator (**21**), a battery-shaped icon on the instrument cluster panel, illuminates for three seconds when the engine is started and will remain illuminated if the engine is not running. The alternator charging warning indicator illuminates when the battery is at a low state of charge, and when the alternator is no longer able to charge the battery.



The negative (-) post of the battery is connected to the starter ground, a stud located on the starter housing. Other ground leads routed directly from the main chassis ground are provided to the alternator and fuel shut-off switch, and are spliced within the wiring harness to other electrical system grounds.

The alternator includes an internal voltage regulator that limits alternator voltage to a preset value and helps prevent circuit overloads, power surges, etc. during peak-voltage output.

Beyond inspecting the fan belt every 1,000 hours of engine operation, there is no periodic maintenance required for the charging circuit. When inspecting the fan belt, also check the electrical wiring and connectors.

Under normal conditions the alternator will have no problem keeping the battery charged. The only condition in which the battery may cause a problem is when it has been completely discharged for an extended period of time. In this condition, the alternator may be unable to recharge the battery, and a battery charger will be required for recharging.

Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the vehicle. (Refer to the appropriate Owners/Operators Manual.) Allow the engine to run, which will enable the alternator to charge the battery.

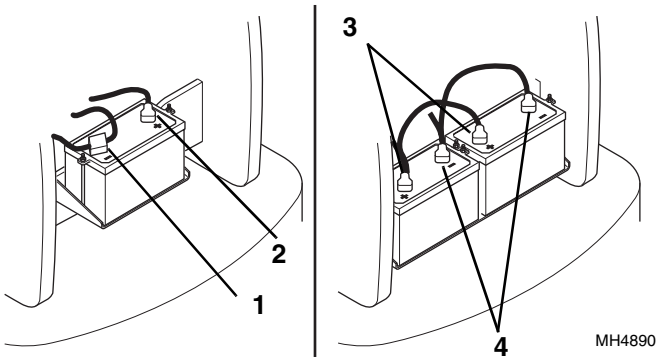
WARNING: **DO NOT** charge a frozen battery. A frozen battery may explode and cause serious personal injury. Allow the battery to thaw before “jump-starting” the vehicle or connecting a battery charger.

CAUTION: Before performing ANY welding on vehicle:

If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

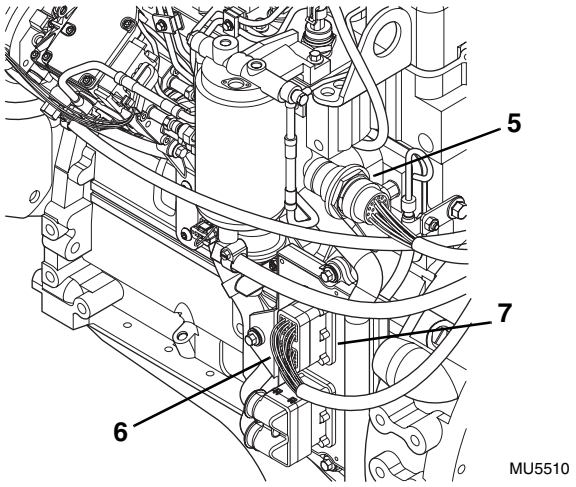
If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**4**).

Failure to disconnect the negative (-) battery cable will result in damage to vehicle electronic systems.



Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

CAUTION: When doing welding anywhere on the vehicle disconnect the wire harness (**5** and **6**) from the Engine Control Module (ECM) (**7**) on the engine.



Applies To All Vehicles

If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check the all battery cable connections at the battery (**1**, **2**, **3** and **4**), and verify that they are clean and tight.
2. Check the external alternator wiring and connections, and verify that they are in good condition.
3. Check the fan belt condition and tension. (Refer to the appropriate Legacy Owners/Operators Manual.)

4. Verify that the alternator mounting hardware is tight.
5. Run the engine and check the alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.
6. For additional information on the charging circuit refer to Section 9.7.38, “Charging Circuit and Troubleshooting.”

9.10.1 Alternator

a. Alternator Removal

1. Unlock and open the rear engine door.
2. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**4**).
3. Install a 1/2" square drive ratchet into the square hole (**8**) in the tensioner bracket (**9**).
4. While lifting the automatic belt tensioner (**9**) away from the belt, remove the fan drive belt (**10**).

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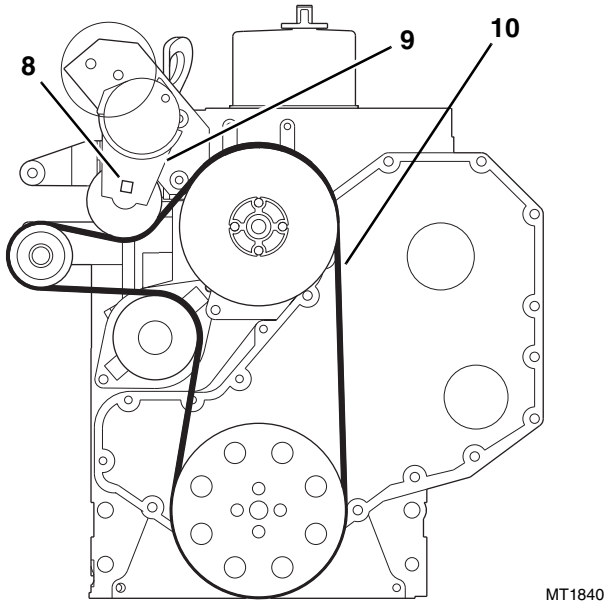
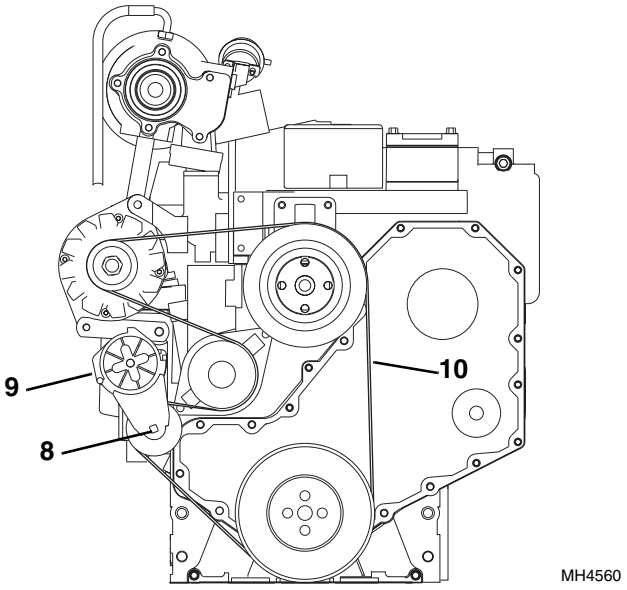


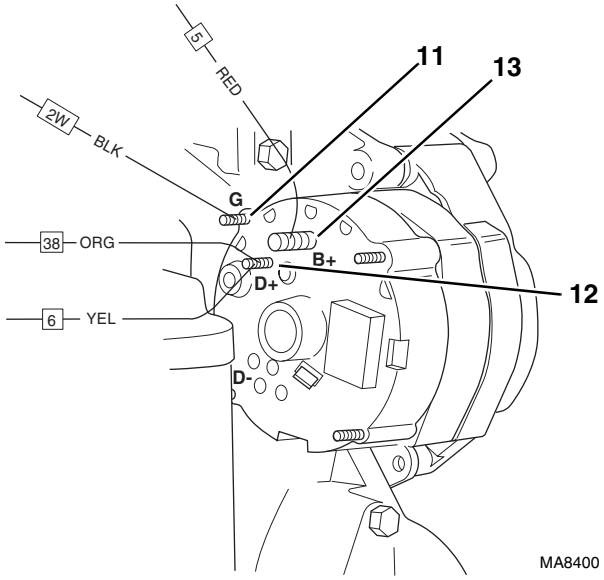
SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After



Note: *Record how the alternator are installed to ensure correct installation later.*

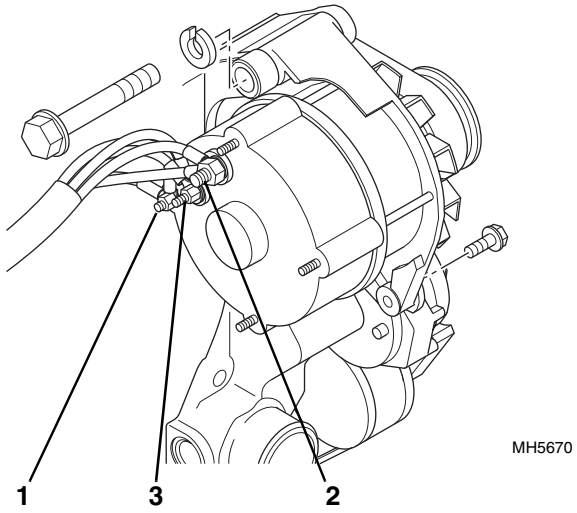
Applies To Serial Numbers: 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079

5. Label and disconnect the alternator ground wire (**11**), D+ (**12**) and B+ (**13**) wire leads.



Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

6. Label and disconnect the alternator wires:
   - AG1 and AG2 from G terminal (**1**)
   - AB1 and AB2 from B+ terminal (**2**)
   - 38 and 6 from D+ terminal (**3**)



Applies To All Vehicles

7. Remove the lower mounting capscrew (**4**) securing the alternator to the lower mounting hole (**5**) on the engine.
8. While supporting the alternator with one hand, remove the upper (longer) mounting hardware (**6**) from the upper alternator mount (**7**). Remove the alternator from the vehicle.

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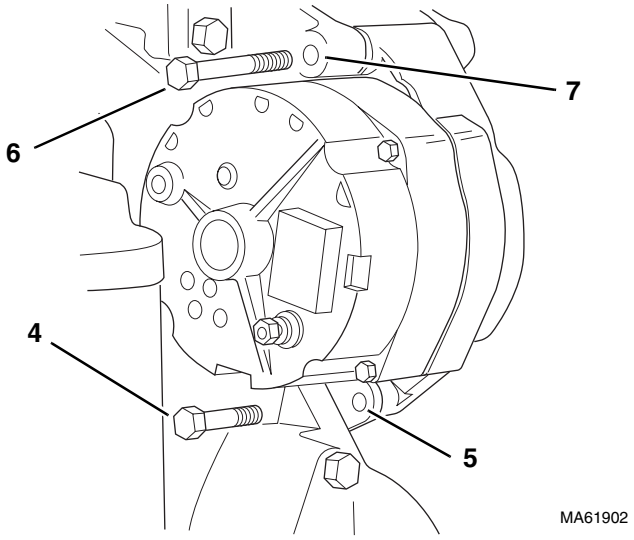
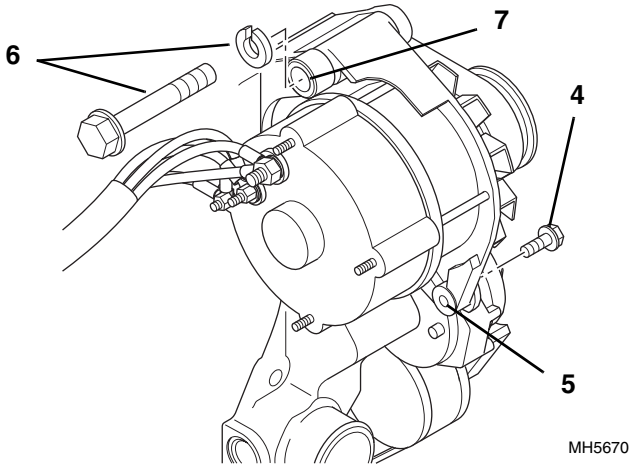


SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

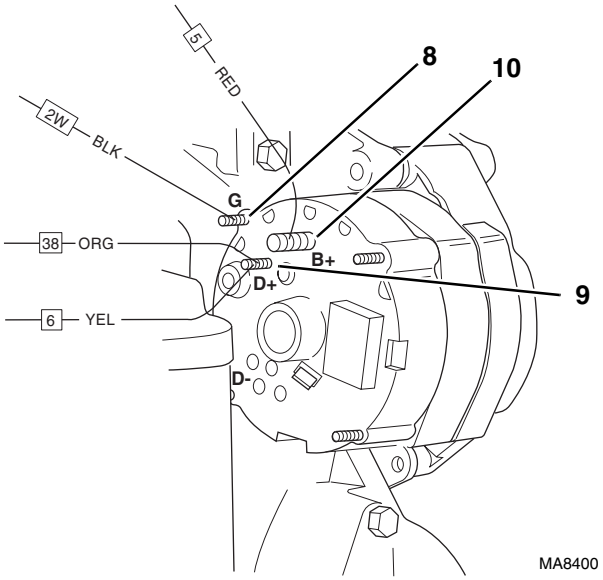


b. Alternator Installation

1. Position the alternator and align with the upper alternator mount (**7**) on the engine bracket. Insert the upper (longer) mounting hardware (**6**) through the alternator mount. Thread the longer capscrew into the alternator front mount. **DO NOT** tighten completely at this time.
2. Align the lower alternator mount hole (**5**) with the lower mounting bracket on the engine, and insert the lower mounting capscrew (**4**). Tighten the lower capscrew (**4**) and upper capscrew (**6**) securely.

Applies To Serial Numbers: 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079

3. At the rear of the alternator, connect the alternator ground wire (**8**), D+ (**9**) and B+ (**10**) wire leads.



MA8400

Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

4. At the rear of the alternator, connect the alternator wires:
   - AG1 and AG2 to G terminal (**1**)
   - AB1 and AB2 to B+ terminal (**2**)
   - 38 and 6 to D+ terminal (**2**)

Applies To All Vehicles

5. Place a 1/2" square drive ratchet into the square hole (**11**) on the tensioner bracket (**12**). Apply pressure against the tensioner bracket (**12**) and route the fan belt (**13**) onto the alternator and engine pulleys. Release and check the tensioner pulley to verify that it is pivoting freely in order to provide the proper tension on the belt. Check for proper fan belt deflection. (Refer to the appropriate Legacy Owners/ Operators Manual.)

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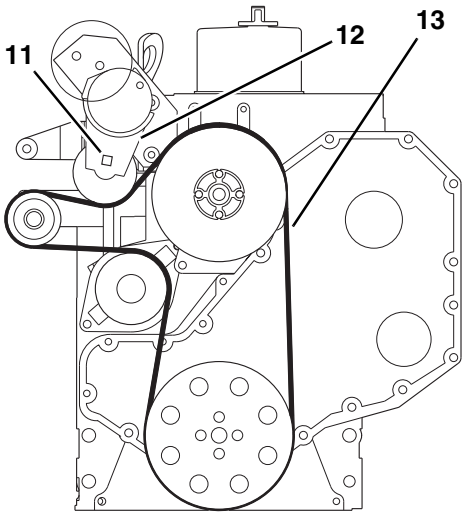
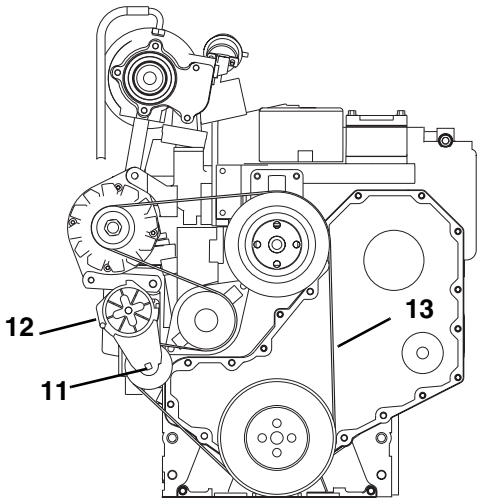


MT1840

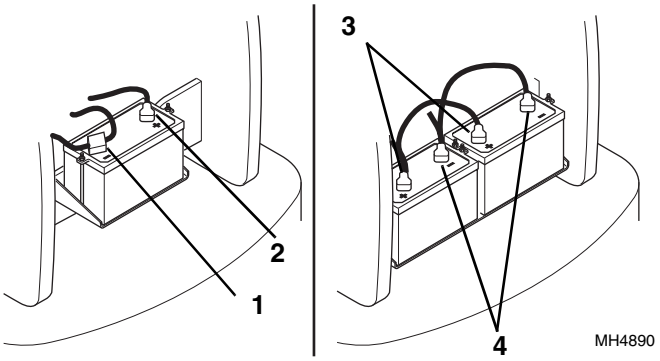
SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After



MH4560

6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**4**).



9.10.2 Battery

> **WARNING:** All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery, and cause possible severe personal injuries. Wear safety glasses when working near batteries. In case of contact with acid, flush area immediately with water.

Note: *For Serial Numbers 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079, a single, lead-acid type, 12-volt, negative (-) ground, maintenance-free battery rated at 1000 cold-cranking amps is used in this vehicle. For Serial Numbers 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After, two, lead-acid type, 12-volt, negative (-) ground, maintenance-free batteries rated at 850 cold-cranking amps each are used in this vehicle. (Refer to the appropriate Owners/ Operators Manual for general information.)*

a. Battery Description

The battery supplies power to the starter and ignition system to crank the engine, and it provides extra power when the electrical load requirements of the vehicle exceed the supply from the charging system in the event of an alternator or charging-system failure. The battery also acts as a voltage stabilizer in the electrical system, smoothing out or reducing temporarily high voltage.

With the correct battery cables properly attached and with the battery properly mounted, the battery does not require periodic maintenance.

When starting the engine, allow the starter to crank for a maximum of 15 seconds only, then wait a minimum of two minutes to help avoid burning out the starter. Also, **DO NOT** let the engine idle excessively, as low engine rpm can also lead to battery discharge.

Keep the battery from freezing by maintaining a full charge. A completely discharged battery will freeze at 18° F (8° C).

Due to the maintenance-free design, water **NEVER** has to be added to the battery, so there are no filler caps. Each battery is sealed, except for small vent holes in the cover. The vent holes allow gas and pressure produced in the battery during charging to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. The special chemistry also greatly reduces the possibility of overcharge damage.

The vents require that the battery be kept in an upright position, to help prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole.

DO NOT exceed this 45° angle when carrying or installing a battery.

The battery has top-post terminals. Keep the terminals clean, and securely tighten clean cable clamps onto the posts. Grease or special spray sealers may be applied over the connections.

b. Visual Inspection of the Battery

Inspect for damage such as a cracked or broken case, or cover, that could permit loss of electrolyte. If obvious physical damage is noticed, replace the battery. Handle the battery with care. Determine the cause of battery damage and correct as needed before installing the new battery.

c. Battery Load Test

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative (-) battery cables from both negative (-) battery terminals (**4**).
2. If the vehicle has one battery, disconnect the positive (+) battery cable at the positive (+) battery terminal (**2**).

   If the vehicle has dual batteries, disconnect both positive (+) battery cables from both positive (+) battery terminals (**3**).
3. Make sure that the negative and positive battery terminal posts are clean to help assure a good electrical connection.
4. Attach voltmeter and battery load tester clamps to the battery terminal posts.
5. Remove the surface charge from any battery that has just been charged (by a battery charger or by the vehicle alternator). **DO NOT** remove the surface charge from a battery that has been in storage. To remove the surface charge, apply a 300-ampere load across the terminals for 15 seconds. Then turn off the load and wait for 15 seconds to allow the battery to recover and normalize.
6. Battery temperature should be estimated by touch and also by the surrounding temperature it was exposed to during the preceding few hours before testing. Select the nearest estimated temperature from the following chart, and determine the minimum voltage that must be maintained while the battery supplies a specified electrical load.
7. Apply a 260-ampere load test to check the charge acceptance of the battery. Observe the voltage after 15 seconds with the load connected, and then remove the load.
8. If voltage is at or above the value determined in Step 6, the battery is good and may be returned to service.
9. If voltage is below the value determined in Step 6, check the charge acceptance of the battery one more time before discarding it. If the voltage continues to read below the value determined in Step 6, replace the battery.

Note: *The accuracy of this test procedure depends on closely following the load, time and temperature specifications.*

Relation of Battery Temperature to Minimum Voltage	
Temperature	**Minimum Voltage**
70° F (21° C) and above	9.6
50° F (10° C)	9.4
30° F (-1° C)	9.1
15° F (-10° C)	8.8
0° F (-18° C)	8.5

d. Battery Charging

Charge rates between three and 50 amperes are generally satisfactory as long as spewing of electrolyte does not occur, or that the battery does not feel excessively hot (over 125° F [52° C]). Battery temperature can be estimated by touching or feeling the battery case. If spewing of electrolyte occurs or temperature exceeds 125° F (52° C), commonly referred to as “boiling” the battery, the charging rate must be reduced or temporarily halted to permit cooling. Failure to do so will destroy the battery.

When charging a battery, keep this point in mind:

- Battery charging consists of a charge current in amperes for a period of time in hours. Thus, a 25-ampere charging rate for two hours would result in a 50-ampere, hour charge to the battery.

The time required for a charge will vary due to the following conditions:

- ***Size of battery:*** For example, a completely discharged, large, heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- ***Temperature:*** For example, more time will be required to charge a battery at 0° F than at 80° F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, then, in time, the battery will accept a higher rate as the battery warms.
- ***State of Charge:*** A completely discharged battery requires more than twice as much charge as a half-charged battery. Because the electrolyte is nearly pure water and therefore a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.
- ***Charger Capacity:*** A charger that can only supply 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.

e. Battery Troubleshooting

If a battery has tested satisfactorily but then fails to perform satisfactorily for no apparent reason, the following items are among the more common factors that may help understand the cause:

1. Vehicle accessories left on, causing battery discharge.
2. Charging system defect such as slipping fan belt, high wiring resistance or a faulty alternator.
3. A vehicle electrical load exceeds alternator output capacity (common with the addition of electrical accessories such as radio equipment, lights, air conditioning or window defogging/de-misting devices).
4. Electrical system defects, such as shorted wires.
5. Extended slow speed driving with many accessories on and excessive engine idling. (Both cases **DO NOT** allow engine rpm to reach a sufficient speed to enable alternator output to sufficiently charge the battery.)
6. Loose or poor battery cable-to-post connections, previous improper charging of a run-down battery or loose battery hold-down hardware.
7. High resistance connections or defects in the starting system.
8. Failure to disconnect the battery before long periods of vehicle storage. Small current drains of vehicle accessories that are connected all of the time can also discharge the battery in a six to eight-week period. A battery left in a discharged condition for a prolonged period of time is subject to freezing and can become difficult to recharge.

f. Jump-Starting with an Auxiliary (“Booster”) Battery

Note: *Use this information in addition to that found in the appropriate Legacy Owners/Operators Manual.*

Both the auxiliary or “booster” battery and the discharged battery should be treated carefully when using jumper cables. Follow the following procedure exactly, and **DO NOT** cause sparks to occur:

1. Engage the park brake of the booster vehicle and place its transmission in (N) NEUTRAL. **DO NOT** allow both vehicles to touch each other in any manner, as this could establish a ground connection and counteract the jump-starting process.

WARNING: Any other procedure other than that outlined in these instructions could result in:

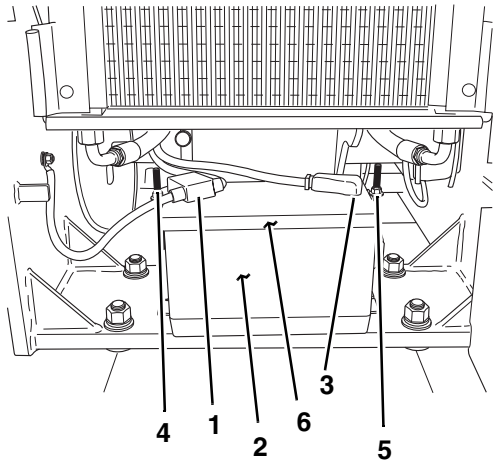
- Personal injury caused by electrolyte spewing out of the top vent holes on the battery.
- Personal injury or property damage due to battery explosion.
- Damage to the starting systems of both vehicles.

2. Continue with the jump-starting instructions found in the appropriate Legacy Owners/Operators Manual.

g. Battery Removal

Applies To Serial Numbers: 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079

1. Disconnect the negative (-) battery cable (**1**), from the battery (**2**). Disconnect the positive (+) battery cable (**3**) from the battery.
2. Remove the battery retaining (hold-down) strap hardware (**4** and **5**) and the retaining strap (**6**).
3. Carefully slide the battery (**2**) out of the battery tray, and remove the battery from the vehicle.



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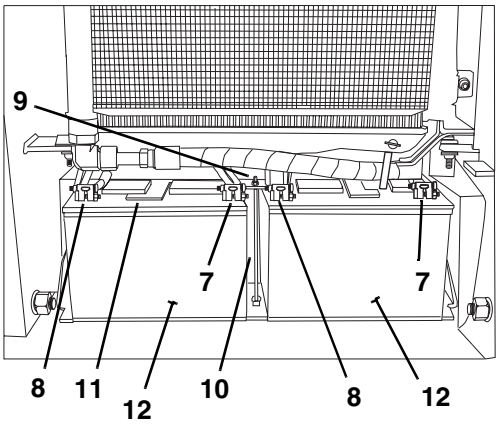
Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

1. Disconnect the battery negative (-) ground cables (**7**) and positive (+) cables (**8**) from the batteries (**12**).
2. Remove the battery hold-down nuts (**9**), threaded hold-down rods (**10**), and hold-down bracket (**11**). Remove batteries (**12**) from the vehicle. Store batteries in a cool dry area.



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h. Battery Inspection, Cleaning and Drying

Note: *The best time to clean the battery compartment is when the battery is removed from the vehicle.*

1. Periodically inspect the battery for accumulation of dirt or corrosion on the battery, terminals, cable ends and battery retaining hardware. Also, check that the battery case and cover are not cracked or leaking, and that the terminal posts are not broken or loose.
2. Prepare a mixture of baking soda and water, and obtain a non-metallic scrub brush. Dip the brush in the mixture, and scrub the battery and cable terminals. Also, clean the battery mounting area on the vehicle frame before replacing the battery.
3. Dry the battery with a clean, lint-free cloth.

i. Battery Installation

Applies To Serial Numbers: 8042, 13198 - 18990, 10042 13198 - 19030, 10054, 13198 - 19079

1. Carefully slide the battery (**2**) in the battery compartment.
2. Install the battery retaining (hold-down) strap (**6**) and the retaining strap hardware (**4** and **5**). Attach the strap properly to help prevent the battery from shifting, moving and vibrating. Vibration is harmful to a battery. **DO NOT** overtighten the fasteners.
3. Connect the positive (+) cable (**3**) to the positive battery terminal post.
4. Connect the negative (-) cable (**1**) to the negative battery terminal post.

Applies To Serial Numbers: 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After

1. Install the batteries (**12**), hold-down bracket (**11**), threaded hold-down rods (**10**) and hold-down nuts (**9**).
2. Connect the positive (+) battery cables (**8**) and negative (-) battery cables (**7**) to the batteries (**12**).

9.11 ELECTRICAL SYSTEM COMPONENTS

Electrical components include warning devices such as the indicators in the operator's instrument cluster, horn, back-up alarm, and other components such as the various solenoids and all accessories.

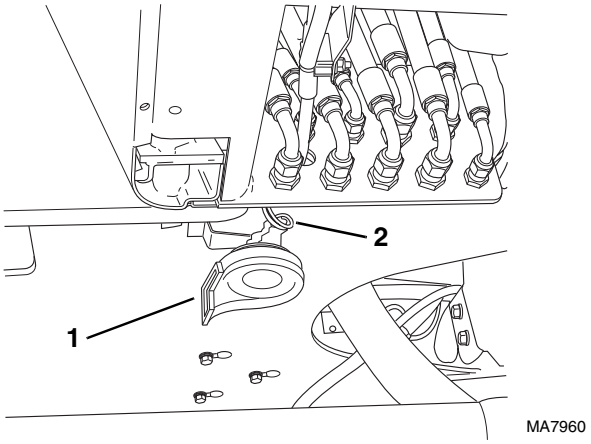
Examine the appropriate wiring diagrams and schematics earlier in this section, to help understand the wiring circuits involved.

9.11.1 Warning Devices

Vehicle warning devices include the horn, instrument cluster warning lights and the back-up alarm.

a. Horn

The horn (**1**) is mounted on the vehicle frame.



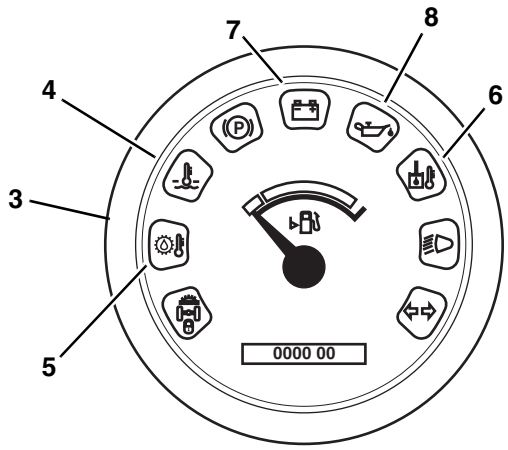
The horn sounds when the momentary-contact horn button on the center of the steering wheel is pressed. Removal of the horn button is discussed in Section 4.3.2, a. "Steering Wheel Removal" of this manual.

The horn sound is produced by a solenoid-actuated diaphragm in the horn that develops a resonating air column in the horn trumpet, which is shaped to project the sound. If the horn does not sound when the horn button is pressed, check that the fuse is not blown.

Check for corrosion on the horn mounting that may be preventing a solid ground, and check for a loose horn wire. Test the horn switch for continuity when the horn button is pressed.

If the problem is still not located, unplug the horn connector (**2**), remove the nut attaching the horn to frame (not shown) and test the horn using short, heavy-gauge wires connected to a fused or otherwise protected 6-amp minimum output, 12-volt DC power supply. If the horn does not sound, replace the horn.

b. Warning Indicator Lights (In Operator's Instrument Cluster)



There are five subdued or "hidden" warning indicator lights present in the instrument cluster (**3**). These warning indicators illuminate during critical circumstances.

IMPORTANT: *All five warning indicator lights demand immediate attention and vehicle service. In many cases, the vehicle should be shut down as soon as practical to help prevent serious mechanical failure. Appropriate service procedures for each circuit, as applicable, appear elsewhere in this section of the manual.*

c. Engine Coolant Temperature Warning Indicator

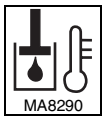
This indicator (**4**) is illuminated when the engine coolant temperature is above 210° F (99° C). An audible alarm will sound, and the engine must be shut down as soon as practical to help avoid engine damage. For additional information refer to Section 9.8.31, "Engine Coolant Temperature Warning Indicator Troubleshooting."

d. Transmission Temperature Warning Indicator

This indicator (**5**) illuminates when the transmission fluid temperature exceeds 250° F (121° C). An audible alarm will sound, and the vehicle should be stopped and the engine allowed to run at high idle for five minutes.

If the light and alarm **DO NOT** cease after five minutes, the engine must be shut down to help avoid transmission damage. For additional information refer to Section 9.8.32, "Transmission Temperature Warning Indicator Troubleshooting."

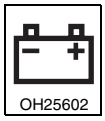
e. Hydraulic Oil Temperature Warning Indicator



This warning light (**6**) will activate when the hydraulic oil temperature is above 195° F (91° C). The vehicle should be stopped and the engine allowed to idle at high idle for five minutes.

If the light continues to illuminate after five minutes, the engine must be shut down to help avoid damage in the hydraulic system. For additional information refer to Section 9.8.33, “Hydraulic Oil Temperature Warning Indicator Troubleshooting.”

f. Alternator Charging Warning Indicator



This light (**7**) illuminates when the charging system is not working properly. Check and service the alternator and battery as required. For additional information refer to Section 9.7.38, “Charging Circuit and Troubleshooting.”

g. Engine Oil Pressure Warning Indicator

This indicator (**8**) illuminates and an audible alarm sounds after 15 seconds if the engine is not started; this is normal. When the ignition key switch is turned to the OFF position, the indicator is reset.

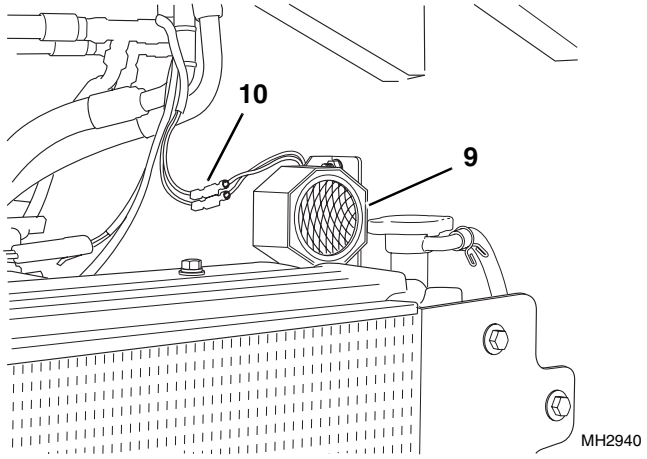
Should the light and alarm begin during engine operation, the engine oil pressure is too low. The engine must be shut down as soon as practical to help avoid engine damage. For additional information refer to Section 9.8.35, “Engine Oil Pressure Warning Indicator Troubleshooting.”

9.11.2 Back-up Alarm

The back-up alarm (**9**) is located at the rear of the vehicle.

When the transmission shift control switch (travel select lever) is shifted to the (R) REVERSE position, the back-up alarm will automatically sound.

Place the travel select lever in (R) REVERSE to test the back-up alarm. The back-up alarm must not sound when the travel select lever is in (N) NEUTRAL or (F) FORWARD. Also, with the ignition key switch in the RUN position, the back-up alarm will sound when the travel select lever is shifted into the (R) REVERSE position.

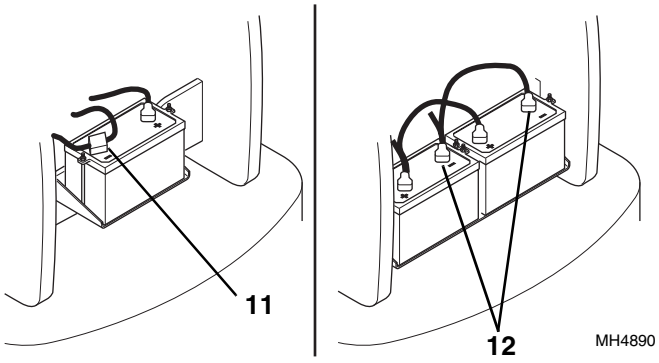


The back-up alarm is energized via current from the transmission shift control switch, part of the travel select lever, mounted within the steering column. See the appropriate wiring schematic and diagram in this section to help understand the back-up alarm circuit. Refer to Section 4.3.2, c. “Transmission Travel and Gear Select Lever Removal,” for information on removing and replacing the transmission shift control switch.

a. Back-Up Alarm Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**11**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**12**).



2. Label and disconnect the wiring from the back-up alarm (**10**).
3. Remove the two 1/4-20 nuts and lockwashers securing the back-up alarm to the vehicle frame. Remove the alarm from the vehicle.

b. Disassembly

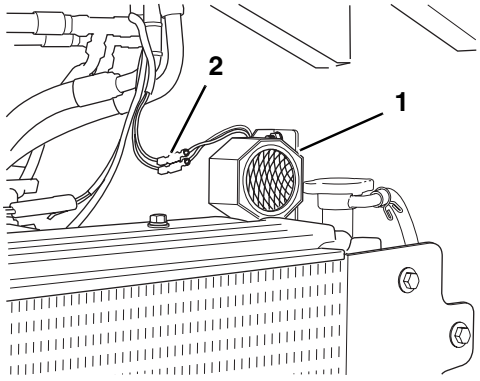
DO NOT disassemble the back-up alarm. Replace a defective or faulty alarm with a new part.

c. Inspection and Replacement

Inspect the wiring harness connector and alarm terminals for continuity and shorting. Replace a defective or faulty alarm with a new part.

d. Installation and Testing

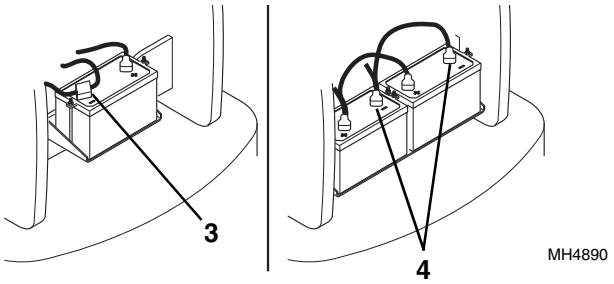
1. Position the back-up alarm (**1**) onto the 1/4-20 studs located on the inside frame wall at the rear of the vehicle. Secure with two lockwashers and 1/4-20 nuts.



MH29402

2. Connect the wiring harness connector lead (**2**) to the back-up alarm.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**3**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**4**).



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4. Test the alarm by turning the ignition key switch to the RUN position and shifting the travel select lever into the REVERSE position. The back-up alarm should sound.

9.11.3 Instrument Cluster

The information under this heading deals mainly with the description and function of each indicator in the operator's instrument cluster. Appropriate service procedures for each circuit, as applicable, appear elsewhere in this section of the manual.

The instrument cluster is of solid-state, printed circuit design, and contains one wiring terminal and a display panel that provides overall monitoring of vehicle functions and status.

> **CAUTION:** Before performing ANY welding on vehicle, disconnect the negative (-) battery cable at the negative (-) battery terminal. Failure to remove the negative (-) battery cable will result in damage to vehicle electronic systems.

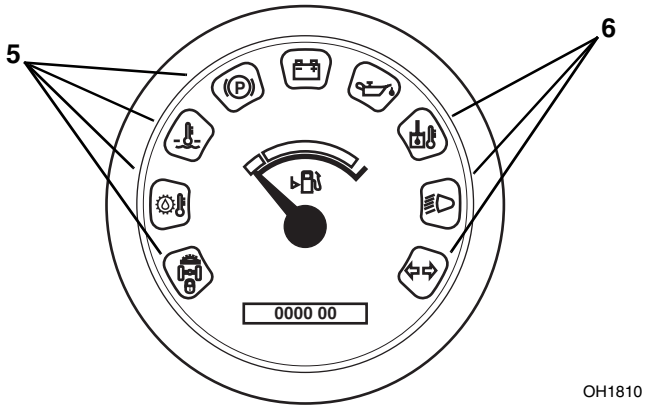
Prevent the instrument cluster from coming into contact with static or other electrical sources. When washing the vehicle, keep spray away from the operator's display panel. Replace a defective, malfunctioning or faulty panel with a new unit.

The operator's display panel provides important information in a "user friendly" design with easily recognizable graphic and alpha-numeric indicators. The panel provides information the operator needs to know about vehicle and engine functions.

When testing circuits connected to the instrument cluster, disconnect the harness connector and test the harness side only.

a. Power-Up Lights

When the ignition key switch is turned to power up the vehicle, all lights in the instrument cluster (**5** and **6**) will illuminate for three seconds as a test function.



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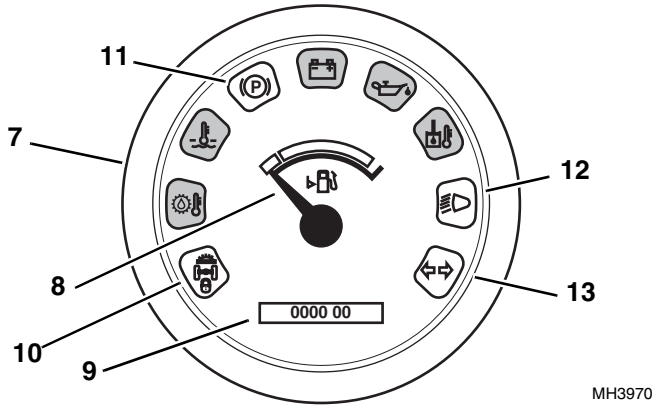
b. Normal Operating Lights

After the engine starts, the operator's instrument cluster (**7**) provides information via the following indicators:

Fuel Level Indicator

The fuel level indicator (**8**) represents the quantity of fuel remaining in the fuel tank. For additional information, refer to Section 9.8.36, "Fuel Level Indicator Troubleshooting."



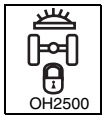
Hourmeter Indicator

The hourmeter indicator (**9**) displays the total number of running hours of the vehicle. The hourmeter only functions when the engine is running.

c. Function Indicator Lights

There are three subdued or "hidden" function indicator lights on the display panel that illuminate only when a specific function is activated. They are:

Stabil-Trak™ Indicator



The Stabil-Trak™ indicator (**10**) illuminates with the boom above 40° and the parking brake engaged, travel select lever in (N) Neutral or the service brake pedal depressed and held.

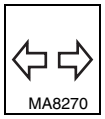
Park Brake Indicator

The park brake indicator (**11**) illuminates anytime the park brake switch is applied, and the ignition key switch is in the RUN position.

High-Beam Indicator (Optional)

The high-beam indicator (**12**) illuminates when the optional headlight switch is placed in the HIGH-BEAM position.

Directional Light Indicator (Optional)



The directional light (turn signal) indicator (**13**) illuminates when the optional directional light lever is moved either to the LEFT or RIGHT turn position.

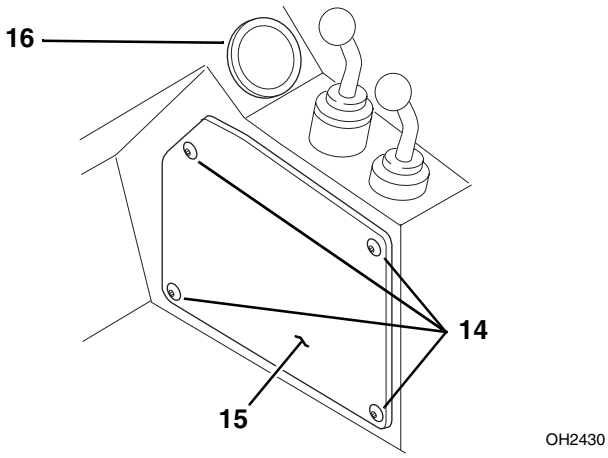
d. Operator's Instrument Cluster Removal

CAUTION: Static electricity can cause damage to the operator's instrument cluster. Avoid any manner of touching (hands, tools, etc.) the printed circuit boards and terminals. Disconnect the negative (-) battery cable at its battery terminal (**3** or **4**) before beginning this procedure. Failure to comply can result in damage to the operator's instrument cluster and malfunction of the instruments and indicator lights.

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**3**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**4**).

2. Remove the four fasteners (**14**) securing the right side access panel (**15**).

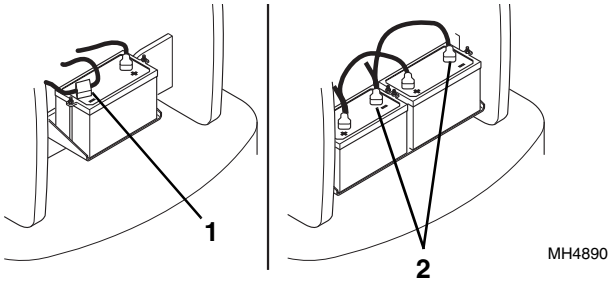


3. Unscrew the locking ring from below the instrument cluster (**16**). Pull the instrument cluster up and away from the cut-out, and unplug the harness connector.

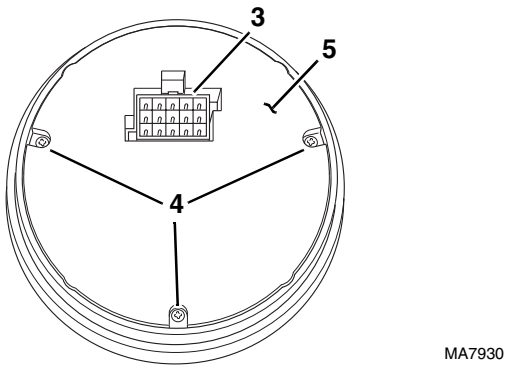
e. Operator's Instrument Cluster Bulb Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).

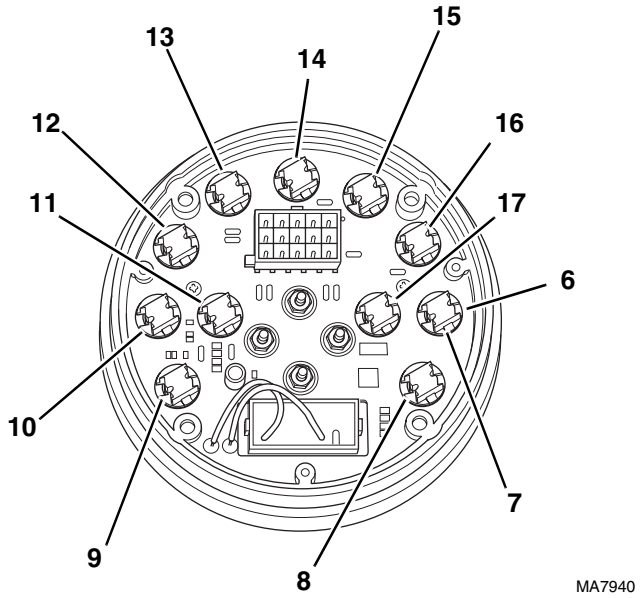


2. Unscrew the plastic ring retainer from the back of the instrument cluster. Disconnect the harness plug connector from the back of the instrument cluster (**3**). Remove three screws, (**4**) securing the instrument cluster rear access plate (**5**). Remove the cover plate.



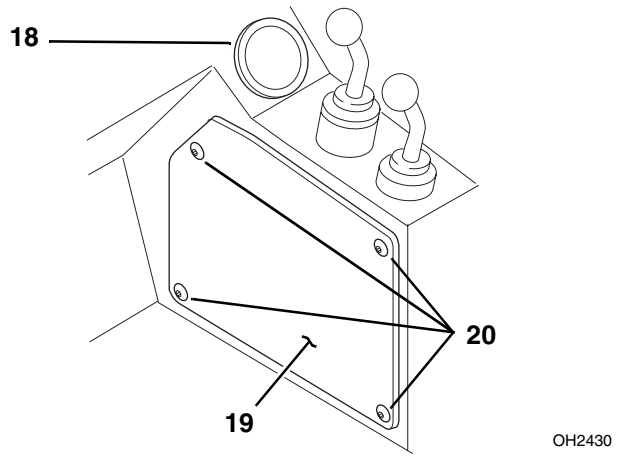
3. Rotate the suspect bulb assembly (**6**) 1/4- turn counterclockwise and remove bulb.

Item	Description
7	Transmission Temperature
8	Stabil-TRAK™
9	Turn Signal (Optional)
10	Main Beam (Optional)
11	Fuel Level
12	Hydraulic Oil Temperature
13	Engine Oil
14	Alternator
15	Park Brake
16	Engine Coolant Temperature
17	Fuel Level



f. Operator's Instrument Cluster Installation

1. Install the instrument cluster rear access plate (**5**) using three screws (**4**).
2. Connect the harness plug terminal into the instrument cluster terminal (**3**).
3. Place the instrument cluster (**18**) into the cut-out, and install the plastic retaining ring and secure.

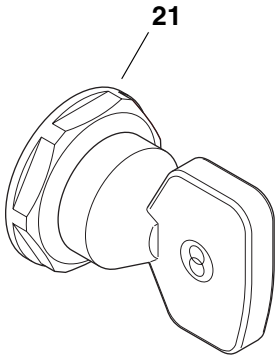


4. Install the right side access panel (**19**) using four screws (**20**).
5. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).

Operator's Display Panel Test

Check the following, as the key switch is placed in the RUN position (**21**):



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1. All lights must illuminate for a minimum of 3 seconds.

Note: *If the park brake switch is engaged, the park brake instrument cluster light will also stay illuminated.*

2. Alternator warning and engine oil pressure light must stay illuminated after three seconds.

9.12 WINDOW WIPER/WASHER (OPTION)

9.12.1 Windshield Wiper Switch

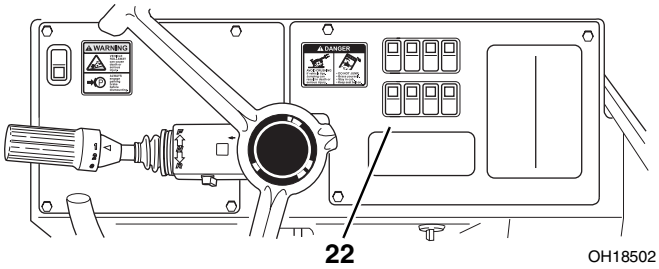

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Figure 9-2 Windshield Wiper Switch Location

OS19302

The windshield wiper switch (**22**) is supplied on enclosed cab models only. The front windshield wiper is located on the dash panel to the right of the steering column and is pressed or "snapped" into a rectangular switch bezel. It is a three-position switch providing OFF (upper position), center for LOW speed and lower position for HIGH speed operation.

a. Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Carefully pry the windshield wiper switch (**22**) and wire connector out of the mounting hole.
3. Disconnect the windshield wiper switch with bezel from the cab wiring harness connector.

b. Disassembly

DO NOT disassemble the switch. The switch is not serviceable. Replace the switch if found to be defective.

c. Cleaning and Drying

Without submerging the switch, clean the switch with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

1. Inspect the switch terminals for continuity with the switch in the OFF, LOW speed and HIGH speed positions. (Refer to Section 9.7.44, "Front Windshield Wiper Circuit and Troubleshooting (Option).")
2. Replace the switch if it fails any of the tests in Step 1.

e. Installation and Testing

1. Connect the windshield wiper switch to the cab harness connector.
2. Position the switch over the rectangular switch bezel, and snap into position.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
4. Turn the ignition key switch to the RUN position and test the windshield wiper LOW speed and HIGH speed functions.

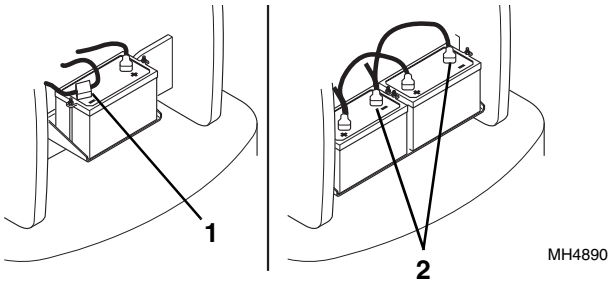
9.12.2 Windshield Wiper Motor

a. Removal

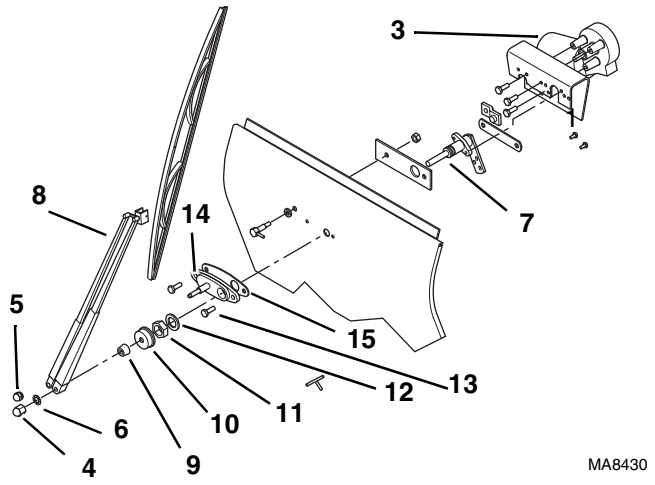
Note: *It may be necessary to remove several hydraulic hoses from under the dash in order to remove and install the wiper motor housing. (Refer to Section 4.3.3, "Steering Column/Valve Replacement.")*

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



2. Remove the right side instrument panel.
3. Remove the lower access panel below the instrument panel.
4. Disconnect the right side defroster hose from dash panel hose connector.
5. Disconnect the cab harness connectors from the wiper motor (**3**).



6. From the outside and front of the cab, remove the windshield wiper blade arm nuts (**4** and **5**) and washer (**6**) from the motor shaft (**7**).
7. Disconnect the washer hose (**19**) from hose connector (**20**).
8. Remove the wiper arms (**8**), knurled driver (**9**) and rubber cap (**10**) from the motor shaft (**7**).
9. Remove the metal hex jam nut (**11**) and metal washer (**12**) from the motor shaft.
10. Remove the motor mounting bolts (**13**), panto adapter (**14**) and gasket (**15**) from the motor shaft.

Note: *Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.*

11. Remove the motor (**3**) from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Cleaning and Drying

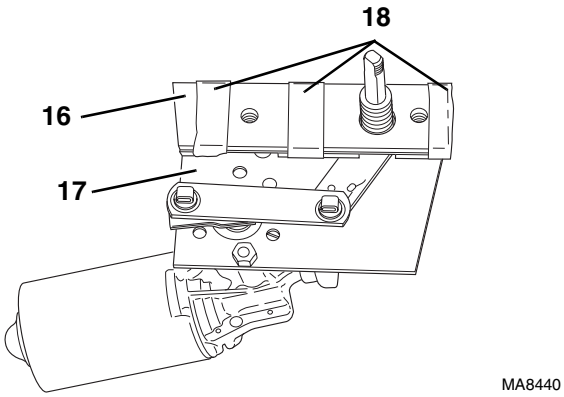
Without submerging the motor, clean the motor with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found. (Refer to Section 9.7.44, "Front Windshield Wiper Circuit and Troubleshooting (Option).")

e. Installation and Testing

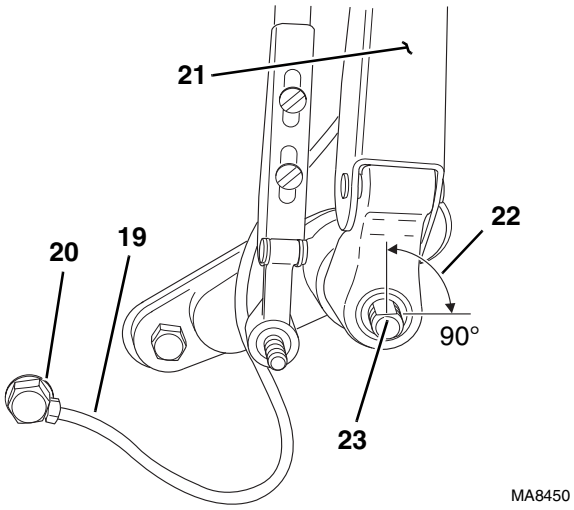
Note: *An assistant will be required for the installation of the windshield motor.*



1. Install all required hardware to the motor assembly. Align spacer (**16**) and wiper motor bracket, (**17**) and apply masking tape (**18**) in order to hold the two components together during installation.
2. Align motor (**3**) with cab mounting holes and insert motor through cab.

3. Have an assistant insert gasket (**15**), panto adapter (**14**) onto to the motor shaft (**7**). Insert bolts (**13**) through front cab holes and thread into motor housing. Tighten bolts.
4. Install metal washer (**12**) and metal hex jam nut (**11**). Tighten metal hex jam nut. Install rubber cap (**10**) and knurled driver (**9**) onto the motor shaft.

Note: *Align the wiper blade arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.*



5. Install wiper blade arm (**21**) at 90° (**22**) from the motor shaft flat (**23**).
6. Install internal-tooth lockwasher (**6**), 1/4" (**5**) and 3/8" (**4**) acorn nuts, and tighten.
7. Connect the cab harness connectors to windshield wiper motor connectors.
8. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
9. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
10. Install right side defroster hose to the dash panel hose connector.
11. If previously removed, install hydraulic hoses under the dash. (Refer to Section 4.3.3, “Steering Column/ Valve Replacement.”)
12. Install the top right dash panel and lower dash panel.

9.12.3 Skylight Wiper Switch

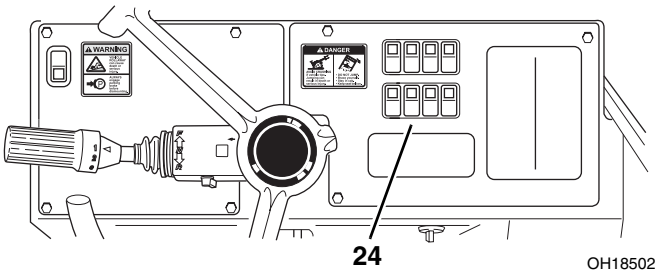
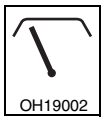


Figure 9-3 Skylight Wiper Switch Location



The skylight wiper switch (**24**) is supplied on enclosed cab models only. The skylight wiper switch is located on the dash to the right of the steering column and is pressed or “snapped” into a rectangular switch bezel. It is a three-position switch providing OFF (upper), center (not used) and lower (one speed) positions.

a. Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Carefully pry the skylight wiper switch (**24**), bezel and wiring out of the mounting hole.
3. Disconnect the skylight wiper switch from the cab harness connector.

b. Disassembly

DO NOT disassemble the switch. The switch is not serviceable. Replace switch if found to be defective.

c. Cleaning and Drying

Without submerging the switch, clean the switch with an approved solvent and dry with a clean, lint-free cloth.

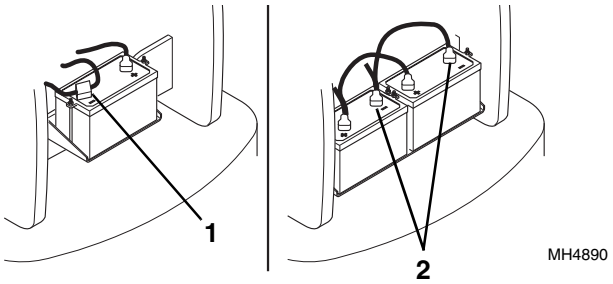
d. Inspection and Replacement

1. Inspect the switch terminals for continuity with the switch in the OFF and ON positions. (Refer to Section 9.7.45, “Skylight Wiper Circuit and Troubleshooting (Option).”)
2. Replace the switch if it fails any of the tests in Step 1.

e. Installation and Testing

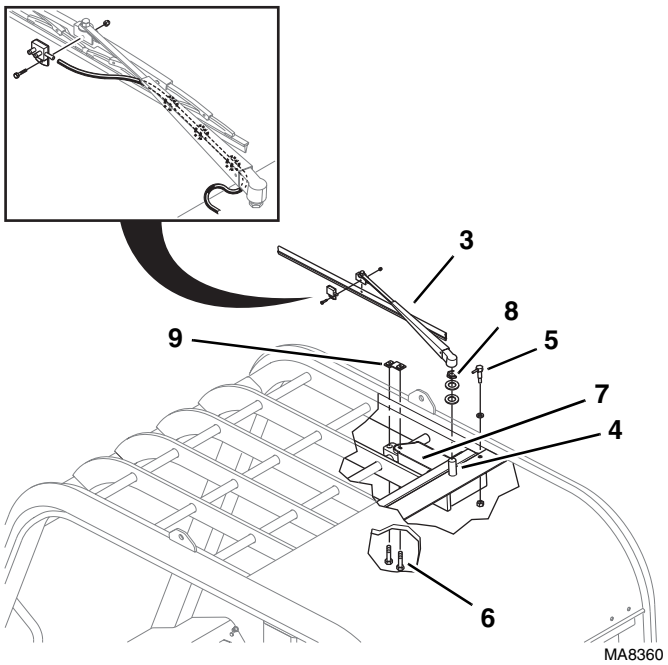
1. Connect the skylight wiper switch to the cab harness connector.
2. Position the switch over the rectangular switch bezel and snap into position.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).



4. Turn the ignition key switch to the RUN position and test the skylight wiper functions.

9.12.4 Skylight Wiper Motor



a. Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Remove the wiper arm (**3**) from the wiper motor shaft (**4**).
3. Disconnect the washer hose from the top hose fitting (**5**).
4. From inside the cab, remove screws (**6**) from top locknut plate (**9**).
5. Unclip the plastic motor cover (**7**) and remove.
6. From the top of the cab, remove the hex nut (**8**) from the wiper motor shaft (**4**).
7. From inside the cab, pull the wiper motor down and away from the roof.
8. Label and disconnect the cab harness connectors from the wiper motor.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Cleaning and Drying

Without submerging the motor, clean the motor with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

Refer to Section 9.7.45, “Skylight Wiper Circuit and Troubleshooting (Option).”

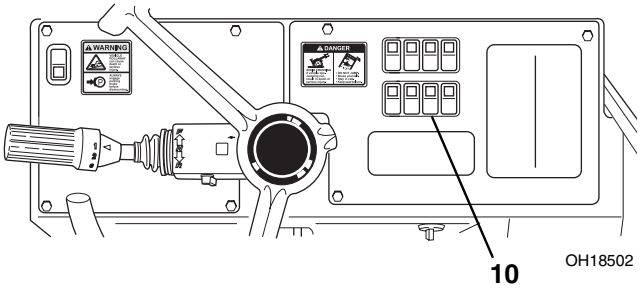
e. Installation and Testing

1. Hold wiper motor up toward cab top and install the cab harness connectors.
2. With the help of an assistant, insert the wiper motor through the roof hole and have the assistant thread the hex nut (**8**) onto the wiper motor shaft (**4**). Insure that the motor housing is facing the front of the cab.

3. Install the wiper arm (**3**) onto the wiper motor shaft (**4**).
4. Install the screws (**6**) through the plastic motor cover (**7**) and into the top locknut plate (**9**), and tighten.
5. Connect washer hose to top hose fitting (**5**).
6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
7. Turn ignition key switch to the RUN position and turn skylight wiper switch to the ON position. Ensure wiper stays on the window through a full stroke. Turn the skylight wiper switch to the OFF position.
8. Engage the washer switch and ensure washer fluid is sprayed on the skylight window. Turn the ignition key switch to the OFF position.

9.12.5 Windshield/Skylight Washer Switch



The windshield washer switch (**10**) is supplied on enclosed cab models only. The switch is located on the dash to the right of the steering column and is pressed or “snapped” into a rectangular switch bezel. It is a spring-loaded momentary, two-position switch providing OFF (upper) and ON (lower). The switch will return to the OFF position when released. When pressed, washer fluid is sprayed on both the front windshield and roof glass.

a. Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Carefully pry the windshield washer switch (**10**), bezel and wiring out of the mounting hole.
3. Disconnect the switch from the cab harness connector.

b. Disassembly

DO NOT disassemble the switch. The switch is not serviceable. Replace switch if found to be defective.

c. Cleaning and Drying

Without submerging the switch, clean the switch with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

1. Inspect the switch terminals for continuity with the switch in the OFF and ON positions. For additional information, refer to Section 9.7.46, “Front Windshield & Skylight Washer Circuit and Troubleshooting (Option).”
2. Replace the switch if it fails any of the tests in Step 1.

e. Installation and Testing

1. Connect the windshield washer switch to the cab harness connector.
2. Position the switch over the rectangular switch bezel and snap into position.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
4. Check the washer reservoir for fluid; fill if needed.
5. Turn the ignition key switch to the RUN position and test the windshield washer functions. Verify that fluid is being pumped to both the front and top windshields.

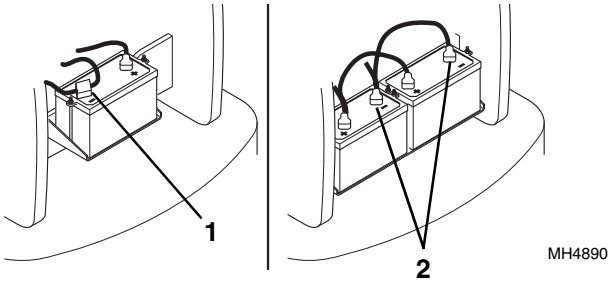
9.12.6 Windshield/Skylight Washer Reservoir and Pump

The windshield washer motor and reservoir is a unit and cannot be serviced separately.

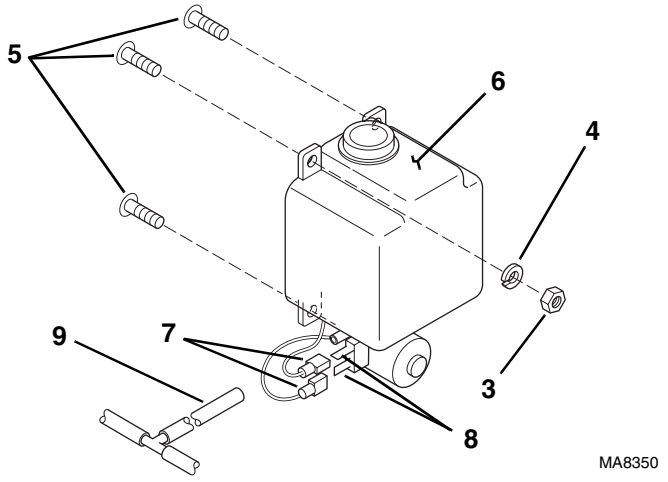
a. Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



2. Remove the nuts (**3**) and the lockwashers (**4**) from the washer mounting studs (**5**).



3. Pull the washer reservoir (**6**) out and away from the mounting studs.
4. Rotate the washer reservoir, label and remove the cab harness connectors (**7**) from the washer reservoir connectors (**8**).
5. Remove the windshield washer hose (**9**) from the reservoir.

b. Disassembly

DO NOT disassemble the pump. The pump is not serviceable. Replace pump if found to be defective.

c. Cleaning and Drying

Without submerging the pump, clean the pump and reservoir with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

Inspect the electrical terminals for continuity. For additional information, refer to Section 9.7.46, “Front Windshield & Skylight Washer Circuit and Troubleshooting (Option).”

e. Installation and Testing

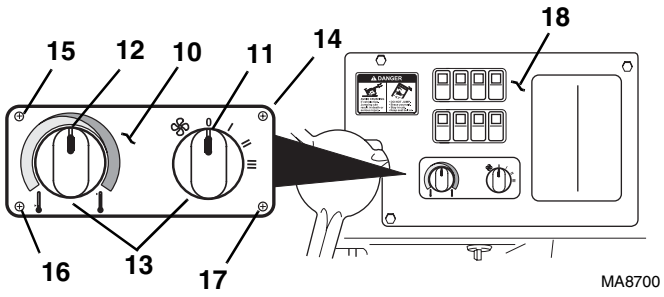
1. Connect the windshield washer hose (**9**) to the reservoir.
2. Connect the cab wiring harness connectors (**7**) to the reservoir connectors (**8**).
3. Install the reservoir tank (**6**) onto the welded studs (**5**).
4. Install the lockwashers (**4**) and nuts (**3**) and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on both the windshield and roof glass.

9.13 CAB HEATER AND FAN (OPTION)

9.13.1 Cab Heater Controls

Note: *If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced. For additional information on the removal and installation of the heater box, refer to Section 4.4.4, a. "Heater Assembly Removal."*



The cab heater controls are located directly below the switch banks on the right side dash panel. The control panel (**10**) consists of a variable speed fan control knob (**11**) and a temperature control knob (**12**).

a. Cab Heater Controls Removal

Note: *After determining which control knob is not functioning, remove only the suspect control knob. In order to remove either knob, the cab heater and fan control panel must be removed from the dash panel.*

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Remove the setscrew (**13**) from the variable speed fan control knob (**11**) or temperature control knob (**12**).
3. Remove the right side control panel (**18**) screws.
4. Remove the screws and backing locknuts (**14**, **15**, **16** and **17**) from the cab heater and fan control panel (**10**).
5. Pull the control panel out from the dash panel, and if removing variable speed fan control, remove the cab harness connector.
6. If removing the temperature control knob, disconnect the cable connector and remove control knob.
7. Remove the hex locknut from the suspect control shaft.
8. Remove the control from the panel.

b. Disassembly

DO NOT disassemble the cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

c. Cleaning and Drying

Without submerging the variable speed fan control, clean the control with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

For additional information refer to Section 9.7.47, "Heater Circuit and Troubleshooting (Option)."

e. Installation and Testing

1. Check that the variable speed fan control (**11**) is in the OFF position.
2. If installing the temperature control (**12**), attach the control cable (not shown) to the back of the control.
3. Insert the control shaft through the panel, ensuring that the knob is in the VERTICAL position.
4. Install the hex locknut on the shaft and tighten.
5. Connect the cab harness connector to the variable speed fan control.
6. Install the screws and backing locknuts (**14**, **15**, **16** and **17**), securing the control panel to the dash panel.
7. Install the setscrew (**13**), securing the knob to the control.
8. Install the right side control panel screws (**18**).
9. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

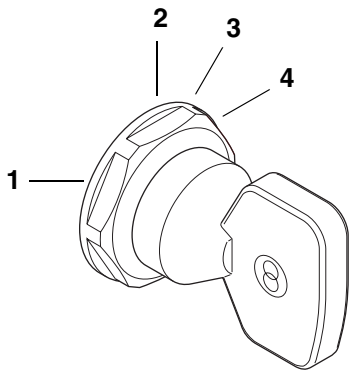
   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).

9.14 SWITCHES AND SOLENOIDS

Note: *For information on the front windshield wiper, skylight wiper and windshield washer systems, refer to Section 9.12, "Window Wiper/Washer (Option)."*

9.14.1 Ignition Key Switch

The ignition key switch (**1**) is located on the lower right side of the front dash. It is a key-operated switch used to start the engine and to run the vehicle.



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When the key is inserted into the ignition key switch, the switch can be turned clockwise from the OFF position (**2**) to the RUN (**3**) and START (**4**) positions. The START position is spring-loaded to return the switch to the RUN position. This position must be manually held in place for normal starting and for ether (cold start option) to be injected into the cylinders.

In the OFF position (**2**), the entire electrical system is shut down, with power at the ignition switch terminals and the starter solenoid only.

In the RUN position (**3**), all controls and indicators are operable.

When the park brake switch is ON and the transmission is in (N) NEUTRAL, turning the ignition switch to the START position (**4**) engages the starter to start the engine and injects fuel into the cylinders.

If the key binds in the switch, check the key for defects and the switch for foreign objects. Clean or remove foreign material from the key as required. Check that the key is not bent or excessively worn; replace a bent or worn key with a new key.

Apply powdered graphite to the key, and insert and withdraw the key from the switch several times to distribute the graphite into the switch-lock mechanism.

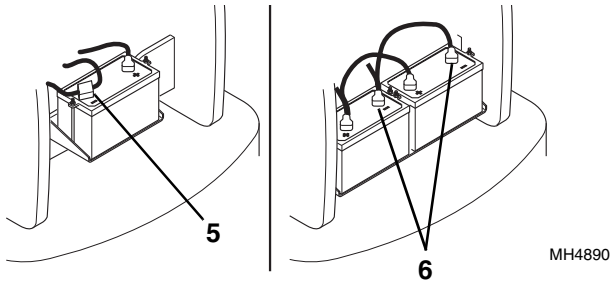
During freezing temperatures, if the ignition key switch fails to turn, or does not allow the key to be inserted, warm the switch with a heat gun (blow-dryer), or use liquid lock deicer to help evaporate frozen moisture from within the switch.

IMPORTANT: *Only use graphite or a liquid lock deicer within the switch. Replace a defective switch.*

a. Ignition Switch Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**5**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**6**).



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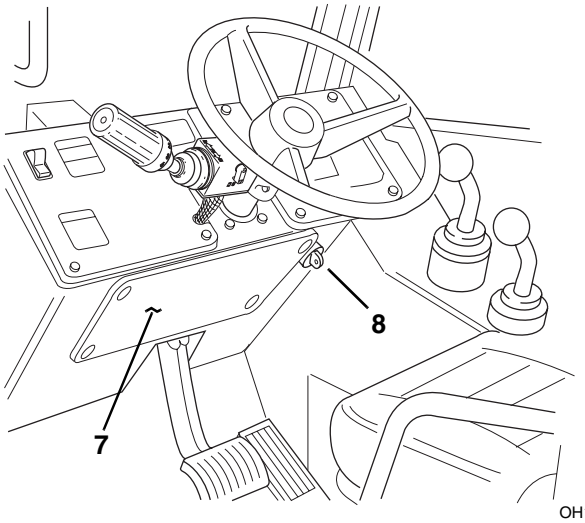
2. Remove lower access panel (**7**).
3. Remove the hex nut securing the ignition key switch (**8**) to the dash.



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4. Reach up and under the dash to work the ignition switch and wiring out of the mounting hole.
5. Disconnect the ignition switch connectors from the cab harness connectors, and remove the switch from the vehicle.

b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine the proper operation of the ignition key switch, using the following charts, test the wires on the back of the switch for continuity with an ohmmeter.

Test the ignition key switch for continuity, by checking from the ignition (BLUE) wire to each of the following wires in each switch position. Continuity (X) should be present as indicated in the following chart:

Switch Position			
Test from BLUE wire to:	**OFF**	**RUN**	**START**
WHT Wire (10 Gauge) Pin B on 3-Pin Connector			X

Test the ignition key switch for continuity, by checking from the ignition (RED) wire to each of the following wires in each switch position. Continuity (X) should be present as indicated in the following chart:

Switch Position			
Test from RED wire to:	**OFF**	**RUN**	**START**
PUR Wire (10 Gauge) Pin B on 5 Pin Connector		X	X
RED/BLK Wire (16 Gauge) Pin C on 5 Pin Connector		X	X

If all wires do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

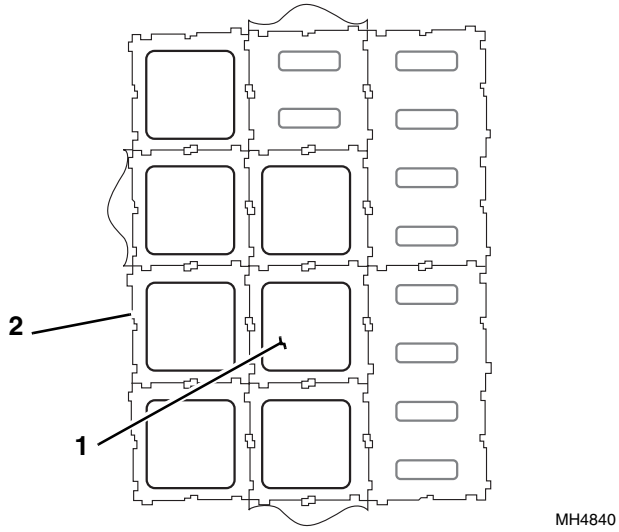
1. Connect the ignition key switch to the cab harness connectors.
2. Reach up and under the dash to work the ignition switch into the ignition switch-mounting hole on the lower right side of the dash (**8**).
3. Align the ignition switch so that when it is in the OFF position (**2**), the key slot is positioned vertically (straight up and down). Install the hex nut securing the ignition switch to the dash. **DO NOT** overtighten.
4. Install the lower access panel (**7**).
5. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**5**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**6**).

e. Transmission Neutral Start Feature

The transmission neutral start feature is a safety feature designed to prevent the engine from starting with the transmission in (F) FORWARD or (R) REVERSE.

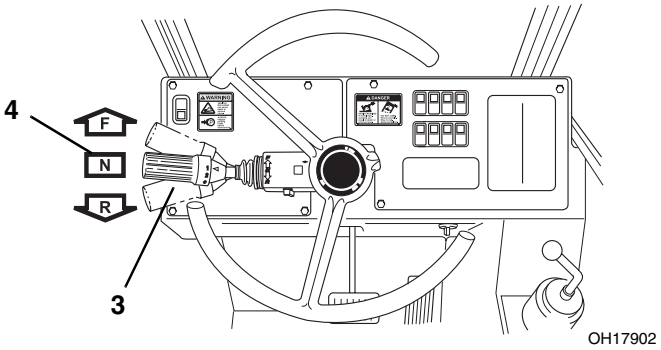
Shifting into (N) NEUTRAL activates the neutral start relay (**1**) located in the relay and fuse panel (**2**). When the travel select lever is in (N) NEUTRAL, electrical power flows to the starter relay, allowing the starter to engage and start the engine.



Test the transmission neutral start circuit as follows:

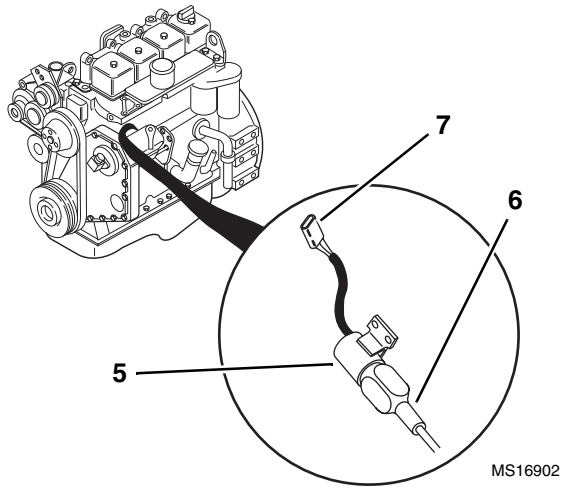
- The starter MUST NOT operate with the travel select lever in (F) FORWARD or (R) REVERSE.
- The starter MUST NOT operate when the park brake is OFF (disengaged).
- The starter MUST operate with the travel select lever in (N) NEUTRAL.

If the starter fails to turn the engine with the travel select lever (**3**) in (N) NEUTRAL (**4**) and the ignition key switch is in the START position, refer to Section 9.7.36, “Engine Start Circuit and Troubleshooting.” The NEUTRAL position contacts in the travel select lever (**3**) are non-repairable. Replace the travel select lever if defective.



9.14.2 Fuel Shut-off Solenoid (SN 8042, 13198 - 18990, 10042, 13198 - 19030, 10054, 13198 - 19079)

The fuel shut-off solenoid (**5**), located on the rear of the fuel injection pump, is a solenoid that lets fuel enter the injection pump when the ignition key switch is turned to the START or RUN positions. The fuel shut-off solenoid is connected to mechanical linkage (**6**).

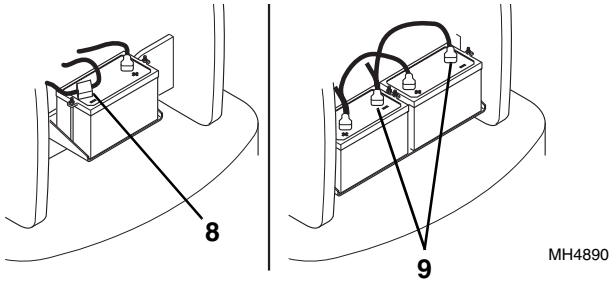


a. Fuel Shut-off Solenoid Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**8**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**9**).

2. Disconnect the wiring connector at the fuel shut-off solenoid lead (**7**), then remove the fuel shut-off solenoid (**5**) from the fuel injector pump.
3. Remove the two bolts securing the solenoid to the mounting plate. Remove the nut holding the linkage to the arm on the fuel injection pump. Save the hardware for later reuse.



b. Fuel Shut-off Solenoid Disassembly

DO NOT disassemble a fuel shut-off solenoid. Replace a defective fuel shut-off solenoid with a new part.

c. Fuel Shut-off Solenoid Inspection and Replacement

Use a 12-volt DC source and ground to test the solenoid. Energize the solenoid, and watch for the plunger to retract. If the plunger does not retract, replace the fuel shut-off solenoid with a new part.

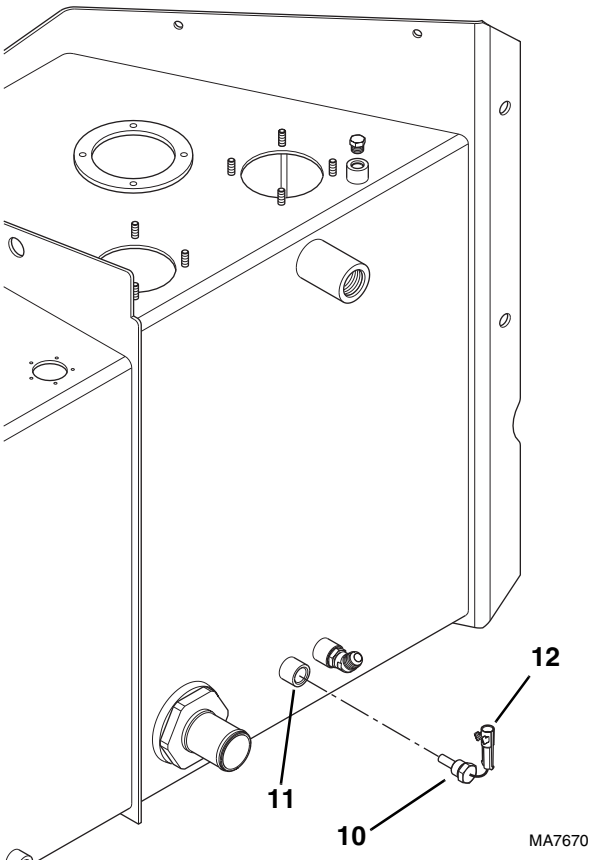
d. Fuel Shut-off Solenoid Installation

1. Clean the exterior of the fuel injector pump.
2. Using the hardware removed earlier, install the nut holding the linkage to the arm on the fuel injection pump. Install the two bolts to secure the solenoid to the mounting plate.
3. Connect the wiring connector at the fuel shut-off solenoid lead (**7**).
4. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**8**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**9**).
5. Clear personnel and any obstructions from the area around the vehicle.
6. Start the engine. If the engine starts, the fuel shut-off solenoid is functioning. If the engine fails to start, the fuel shut-off run solenoid may have a poor ground connection. Visually check the wiring at the fuel shut-off solenoid leads and/or check for continuity with a voltmeter as required.
7. Check for fuel and/or oil leakage around the solenoid.

9.14.3 Hydraulic Oil Temperature Switch

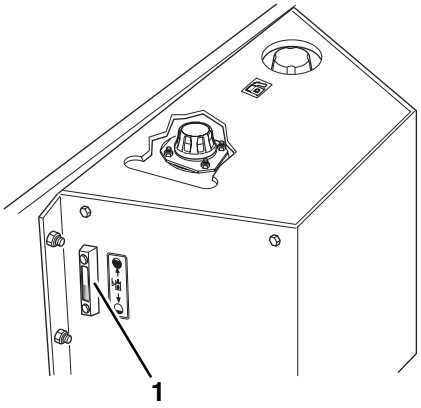
The hydraulic oil temperature switch (**10**) is threaded into a fitting (**11**) at the lower inside wall of the hydraulic oil tank.



The hydraulic tank oil temperature switch connector (**12**) attaches to the wiring harness and operator's instrument cluster. When the hydraulic oil temperature is above 195° F (91° C), the hydraulic oil temperature warning indicator on the operator's instrument cluster illuminates. The vehicle should be stopped and the engine allowed to run at high idle for five minutes.

If the warning indicator continues to illuminate after five minutes, the engine must be shut down to help avoid damage to the hydraulic system.

Examine the fluid in the hydraulic oil sight glass (**1**) to check whether there is a sufficient amount of fluid in the system (the oil level should be at the bottom of the sight glass with all hydraulic cylinders retracted) and whether the fluid is contaminated. Replace the hydraulic oil filter as required. Explore other causes for excessive temperature, such as high air temperature, plugged oil cooler or lines, loose fan belt, plugged radiator, etc. (Refer to Section 9.8.33, “Hydraulic Oil Temperature Warning Indicator Troubleshooting.”)



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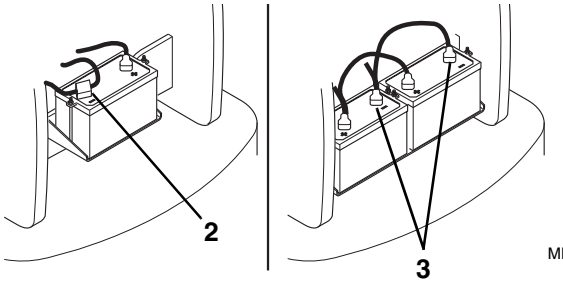
a. Hydraulic Tank Oil Temperature Switch Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**2**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**3**).



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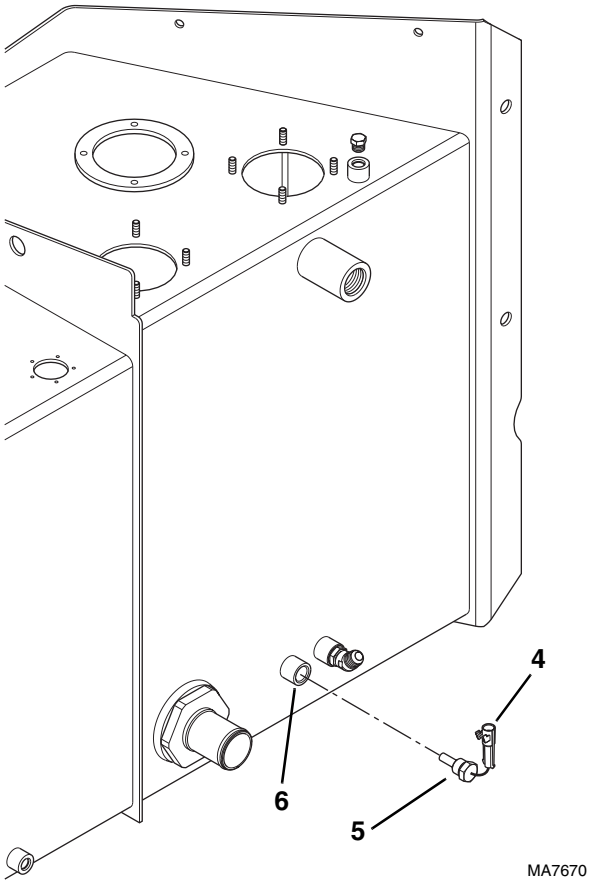
2. Drain oil from the hydraulic tank reservoir into a clean container for reuse.



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3. Label and disconnect the temperature switch wiring connector (**4**) from the harness connector.
4. Unthread the switch (**5**) from the hydraulic reservoir welded fitting (**6**).

b. Hydraulic Oil Temperature Switch Disassembly

DO NOT disassemble the hydraulic oil temperature switch. Replace a defective or faulty switch with a new switch.

c. Hydraulic Oil Temperature Switch Cleaning and Drying

DO NOT submerge the hydraulic oil temperature switch. Clean only with an approved solvent and dry with a clean, lint-free cloth.

d. Hydraulic Oil Temperature Switch Inspection and Replacement

Inspect switch wiring for continuity and shorting. Replace a defective or faulty switch with a new switch.

e. Installation and Testing

1. Thread the switch (**5**) into its fitting (**6**) on the hydraulic reservoir. Tighten securely.
2. Fill hydraulic oil reservoir with hydraulic oil.
3. Connect the switch wiring connector lead (**4**) to the harness connector.
4. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**2**).

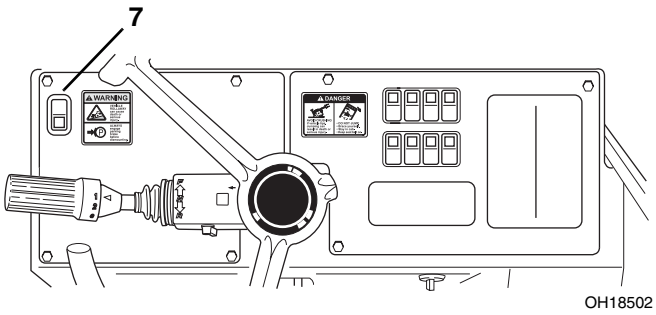
   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**3**).
5. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
6. Start the engine, check for hydraulic fluid leaking at the hydraulic oil temperature switch and allow the hydraulic fluid to reach operating temperature. Cycle the boom several times and check whether the hydraulic oil temperature warning indicator illuminates on the operator's display panel.

9.14.4 Park Brake Switch

The park brake switch (**7**) is located on the dash to the left of the steering column and is pressed or "snapped" into a rectangular switch bezel. The park brake switch must be ENGAGED to permit engine starting.

Note: *The park brake may be used to stop in an EMERGENCY situation; however, notify the operator to use caution as the stop will be abrupt and the operator and the load may be jolted forward unexpectedly.*

The park brake switch is a two-position toggle switch; the two positions are ENGAGED (**8**) and DISENGAGED (**9**). The switch is marked with an engaged (**10**) and disengaged (**11**) symbol. When engaged, the park brake switch completes the park brake circuit.



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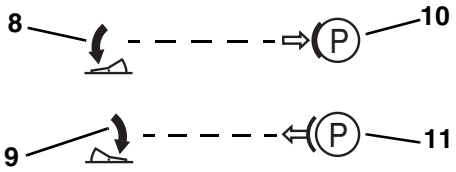

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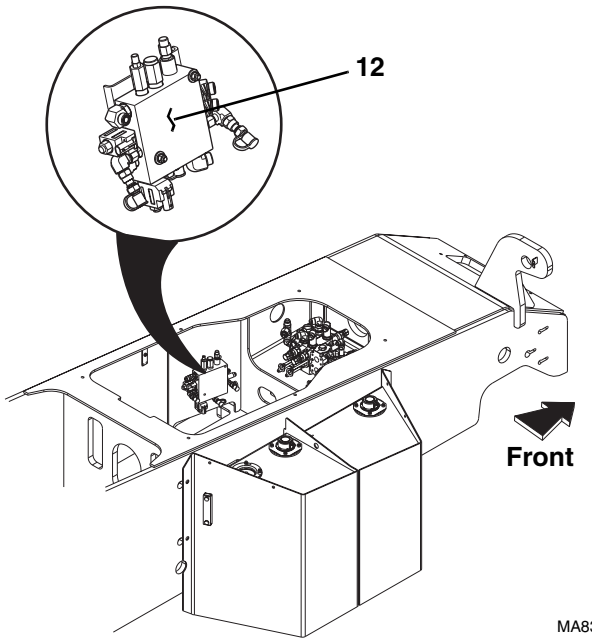
The park brake solenoids on the secondary function valve (**12**) are normally de-energized, allowing the park brake to engage. When the park brake solenoids are energized, the park brake is disengaged. The system is designed so that, when electrical power is OFF, the park brake is engaged. (Refer to Section 10.7, "Stabil-TRAK™ Electrical Circuit Operation and Troubleshooting (8042/10042)," or Section 10.9, "Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984)," or Section 10.10, "Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After).")



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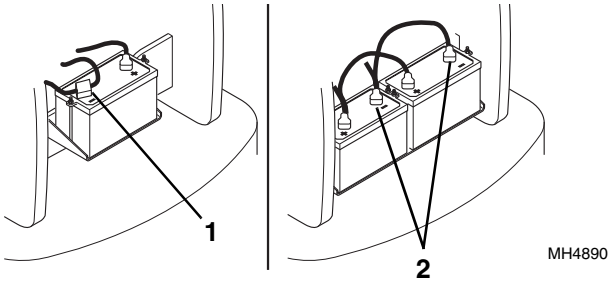
a. Park Brake Switch Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



2. Carefully pry the park brake switch (**3**) and wiring out of the mounting hole.
3. Label and disconnect the wiring from the park brake switch. Remove the switch from the vehicle.

b. Park Brake Switch Disassembly

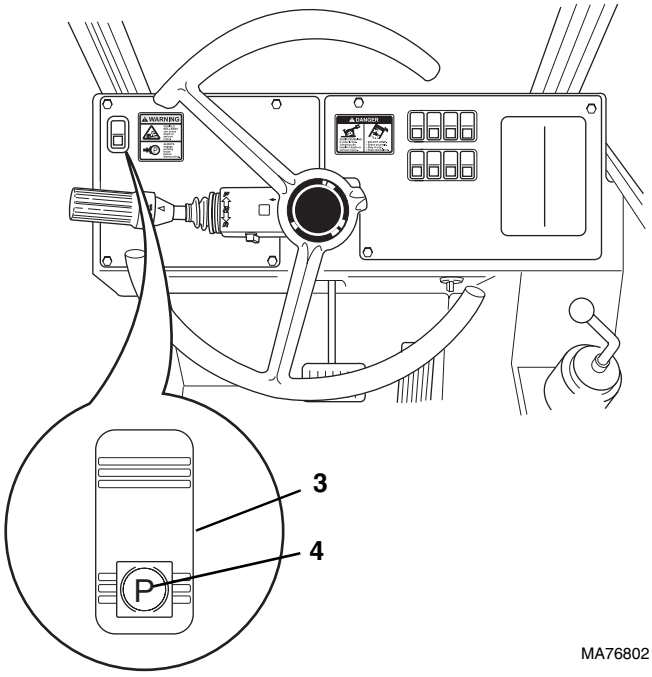
DO NOT disassemble the park brake switch. Replace a defective or faulty switch with a new switch.

c. Park Brake Switch Inspection and Replacement

Inspect the switch terminals for continuity and shorting in both the ENGAGED and DISENGAGED positions. Replace a defective or faulty switch with a new switch.

d. Park Brake Switch Installation and Testing

1. Route the wiring from the dash through the bezel, then connect the wiring to the park brake switch (**3**) as labeled during switch removal.



2. Properly position the “P” on the switch (**4**) to the bottom, then press or “snap” the switch into place in the bezel.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
4. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
5. Start the engine, engage the park brake switch, place the travel select lever in (F) FORWARD or (R) REVERSE and in second gear and apply full throttle. The vehicle should remain motionless in both (F) FORWARD and (R) REVERSE positions.
6. To test for proper park brake switch disengagement, firmly depress the service brake pedal, disengage the park brake switch, place the travel select lever in either (F) FORWARD or (R) REVERSE and in first gear, and slowly press the throttle pedal while releasing the service brake pedal. The park brake should release, and the vehicle should travel freely.

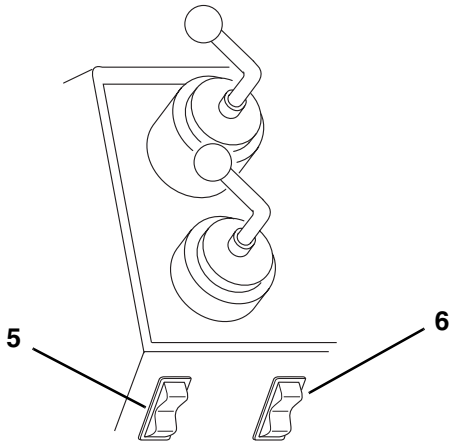
Note: *The park brake indicator on the operator’s instrument cluster must illuminate when the park brake switch is engaged, and not illuminate when the park brake switch is disengaged.*

9.14.5 Outrigger Switches (10042/10054 Only)

Inspect the switch terminals for continuity and shorting in both the non-depressed and depressed positions. Replace a defective or faulty switch with a new switch.

a. Left and Right Outrigger Switches

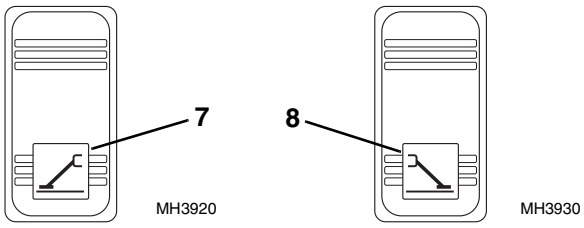
The left and right outrigger switches (**5** and **6**) control the RAISE and LOWER movements of both outriggers. The rocker switches are spring-loaded to return to the center (STOP) position when released.



Both outriggers are wired in series and have pressure switches (10054 only) that detect a pressure difference when one of the outriggers contacts the ground. Both outriggers must make contact with the earth (10054 only) before the boom will be allowed to fully extend.

b. Outrigger Switch Removal

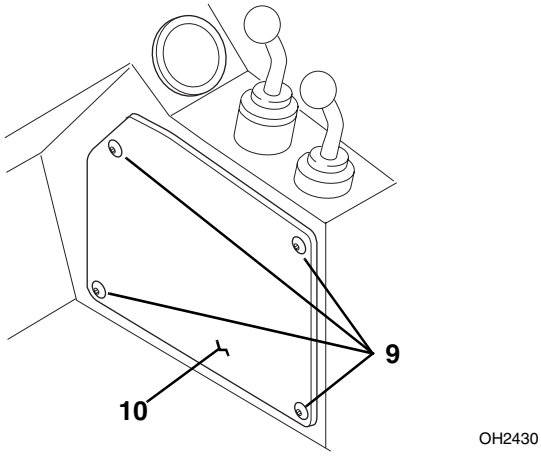
Note: *The LEFT and RIGHT outrigger switches function the same but have the LEFT* (**7**) *or RIGHT (**8**) icon on each switch. If removing both switches, ensure that you install each switch in the proper bezel location.*



1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).

2. Remove the four fasteners (**9**) securing the right side access panel (**10**), and remove the panel.



3. Carefully pry the outrigger switch (**5** or **6**) and wiring out of the mounting hole.
4. Label and disconnect the wiring from the outrigger switch. Remove the switch from the vehicle.

c. Outrigger Switch Disassembly

DO NOT disassemble the outrigger switch. Replace a defective or faulty switch with a new switch.

d. Outrigger Switch Inspection

Inspect the switch terminals for continuity and shorting in both the RAISE and LOWER positions. Replace a defective or faulty switch with a new switch.

e. Outrigger Switch Installation and Testing

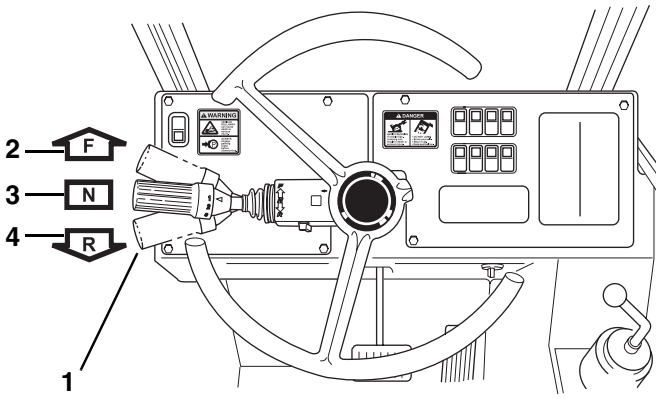
1. Route the wiring connectors through the bezel, then connect the wiring to the outrigger switch (**5** or **6**) as labeled during switch removal.
2. Properly position the symbol (**7** and **8**) on the switch to the bottom, then press or “snap” the switch into place in the bezel.
3. Install the right side access panel (**10**), four fasteners (**9**) and tighten.
4. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
5. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
6. Start the vehicle, and lower or raise effected outrigger through full travel.

9.14.6 Transmission Shift Control Switch

a. Travel Select Lever

The transmission shift control switch (travel select lever) (**1**) is located on the left side of the steering column. The switch has three positions: (F) FORWARD (**2**) (all the way up), (N) NEUTRAL (**3**) (center), and (R) REVERSE (**4**) (all the way down). The switch or lever must be in the (N) NEUTRAL (**3**) position to permit engine starting.



Moving the lever (**1**) opens and closes electrical contacts in the switch, allowing electricity to flow to the appropriate relays and onto the transmission shift solenoids.

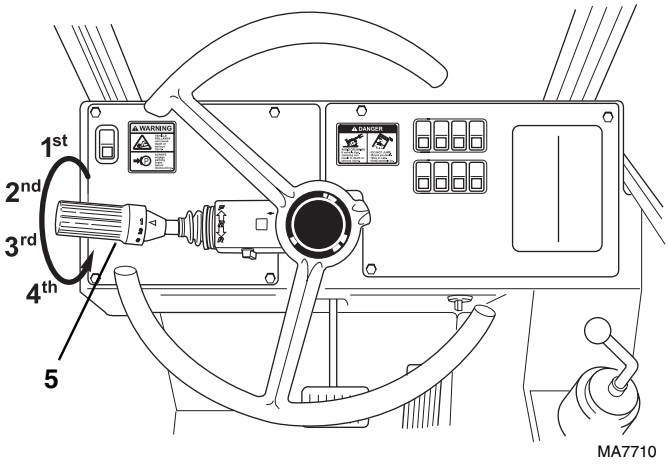
Travel selections are changed by grasping the lever, pulling it toward the steering wheel, then up or down to the desired selection, (F) FORWARD (**2**) or (R) REVERSE (**4**).

When the switch is shifted to the (R) REVERSE (**4**) position, the back-up alarm will automatically sound. (Refer to circuit diagrams in Section 9.8, “Transmission Gear Selection Troubleshooting,” and also, Section 9.14.7, a. “Travel Select Lever and Wiring Harness Testing.”)

Refer to Section 4.3.2, c. “Transmission Travel and Gear Select Lever Removal,” and Section 4.3.2, d. “Transmission Travel and Gear Select Lever Installation,” for removal and installation instructions.

b. Gear Select Lever

The gear select lever (**5**) is part of the transmission shift control switch (travel select lever). The lever has a twist-grip handle with four positions.



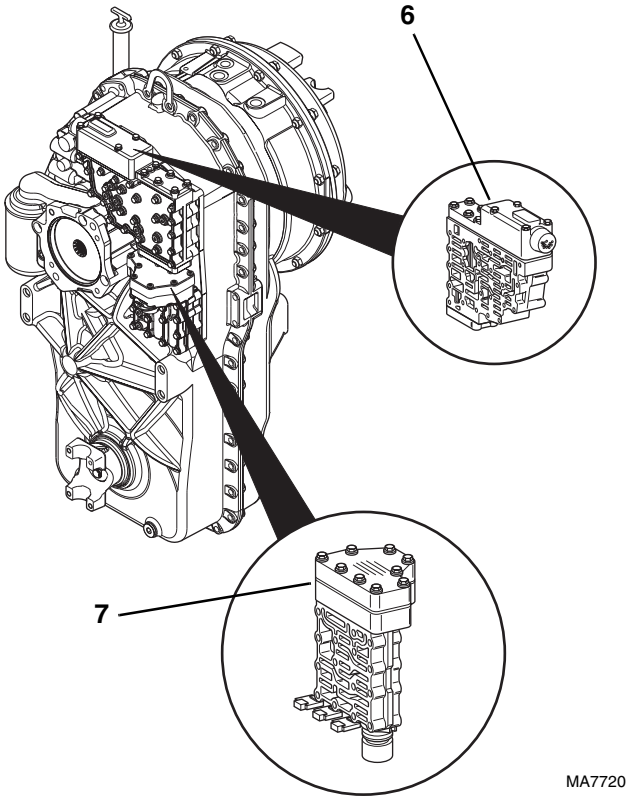
The vehicle has four forward gears and three reverse gears.

First gear is used for the highest torque and pulling power, and the higher-numbered gears are for increasing vehicle travel speed.

Refer to Section 4.3.2, c. “Transmission Travel and Gear Select Lever Removal,” and Section 4.3.2, d. “Transmission Travel and Gear Select Lever Installation,” for removal and installation instructions.

9.14.7 Transmission Solenoid Valves

The transmission is shifted via six solenoids. Three solenoid valves (Y1, Y2 and Y3) are contained in an UPPER spool-type solenoid cartridge assembly (valve body) (**6**).



The remaining three solenoid valves (Y4, Y5 and Y6) are contained in the LOWER spool-type solenoid cartridge assembly (valve body) (**7**). While each 12-volt solenoid coil at the transmission is the same, the internal wiring to the solenoids is different and connected so that the various transmission clutches can be actuated via input from the transmission shift control switch (travel select lever).

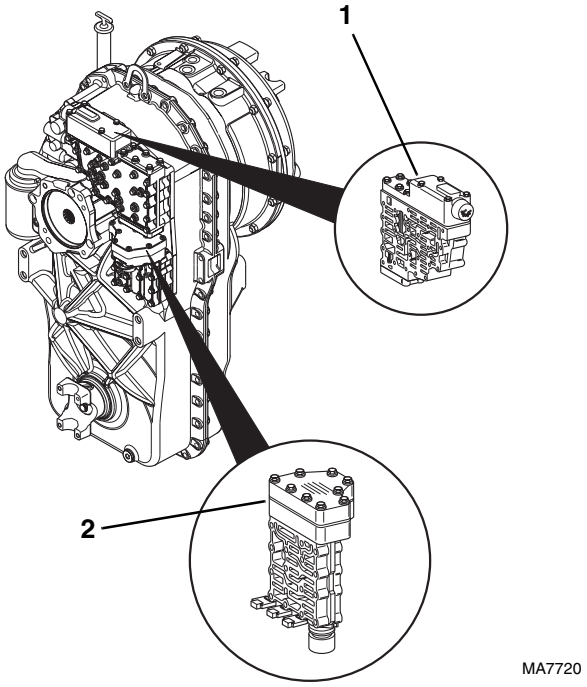
By placing the transmission shift control switch (travel select lever) in any given position, a combination of solenoids are activated, which, in turn, engage a combination of internal clutches. (Refer to Section 9.14.7, a. “Travel Select Lever and Wiring Harness Testing,” and Section 9.14.7, b. “Upper and Lower Transmission Valve Body Solenoid Testing.”)

If the transmission is not shifting properly, the transmission shift control switch (travel select lever), wiring harness or transmission shift solenoids should be checked in order to determine which component is defective. Specific information to determine which travel position and corresponding component is not responding can be found by referring to the circuit diagrams in Section 9.8, “Transmission Gear Selection Troubleshooting,”. Replace a defective component.

a. Travel Select Lever and Wiring Harness Testing

Note: *An assistant will be required to operate the travel select lever, in order to perform the following test.*

1. Remove the plug from the **UPPER** (**1** and **3**) and **LOWER** (**2** and **5**) transmission solenoid valve bodies. Turn the ignition key switch to the RUN position.



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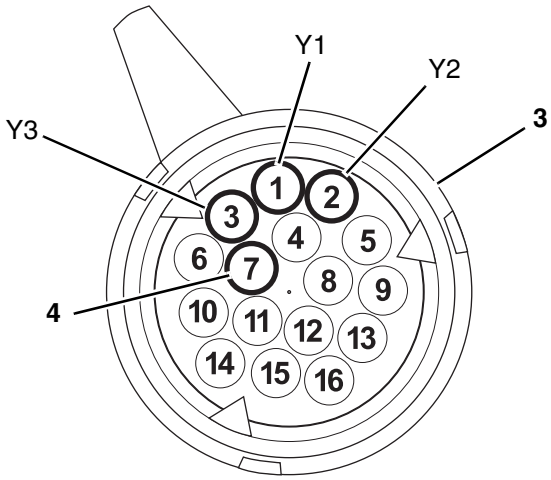
Note: *In order to perform the solenoid test, the park brake switch must be in the OFF position.*

2. Have an assistant place the travel select lever in the position that is not functioning correctly.

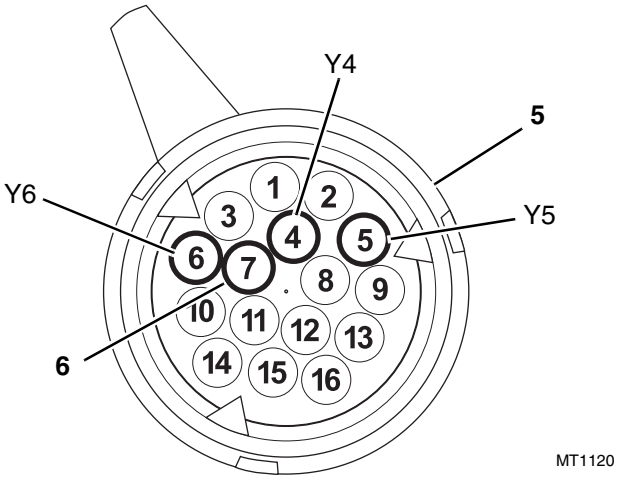


MT1110

3. Check the harness side pin connections with a DMM for battery voltage corresponding to the direction and gear that has been selected. Refer to the chart that follows. Place the negative (-) lead on pin 7 (ground) (**4** or **6**) and the positive (+) lead on the pin to be tested; test for battery voltage.

   If battery voltage is not present on any of the pins that have been tested, the wiring harness is suspect and should be replaced.

   If battery voltage is present, the harness is functioning properly.



MT1120

Note: *The following chart shows which solenoids are active with any given selection of the transmission shift control switch (travel select lever) and gear select position.*

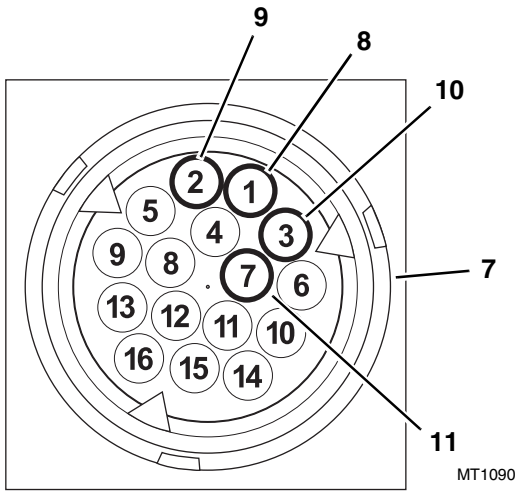
		Upper Valve Body			Lower Valve Body		
Driving Direction	**Speed**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Forward	1	•		•		•	•
Forward	2	•		•	•	•	
Forward	3	•		•	•		•
Forward	4	•			•		•
Reverse	1		•	•		•	•
Reverse	2		•	•	•	•	
Reverse	3		•	•	•		•

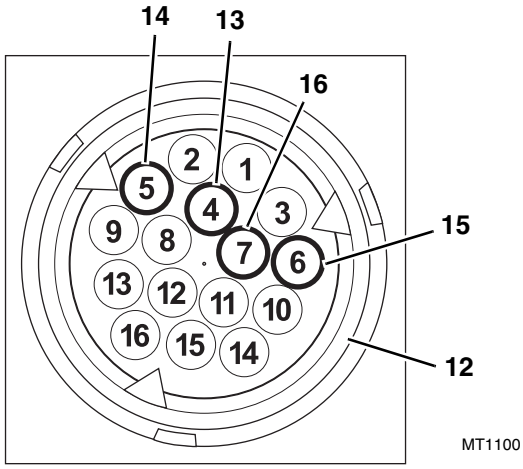
b. Upper and Lower Transmission Valve Body Solenoid Testing

Inspect the solenoid connector plugs (**7** and **12**). Following the chart below, test each pin connection on the upper transmission valve body connector for continuity and shorting. Each solenoid should have between 25.0 and 30.0 ohms of resistance when testing with an ohm/volt meter. Replace a defective solenoid valve. (Refer to Section 9.14.7, c. “Transmission Upper Valve Body Solenoid Removal.”

Solenoid Pin Position	Active Solenoid	Callout
1	Y1	**8**
2	Y2	**9**
3	Y3	**10**
7	Ground	**11**
4	Y4	**13**
5	Y5	**14**
6	Y6	**15**
7	Ground	**16**

Note: *All six solenoids within both upper and lower solenoid valve body housings are of the same design.*



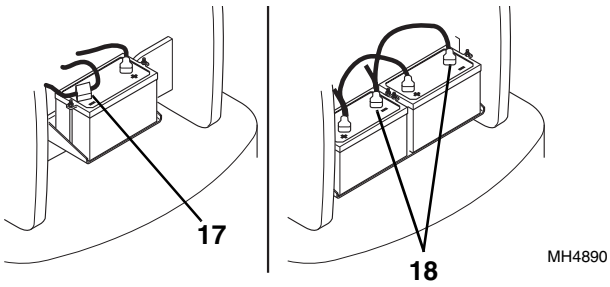


c. Transmission Upper Valve Body Solenoid Removal

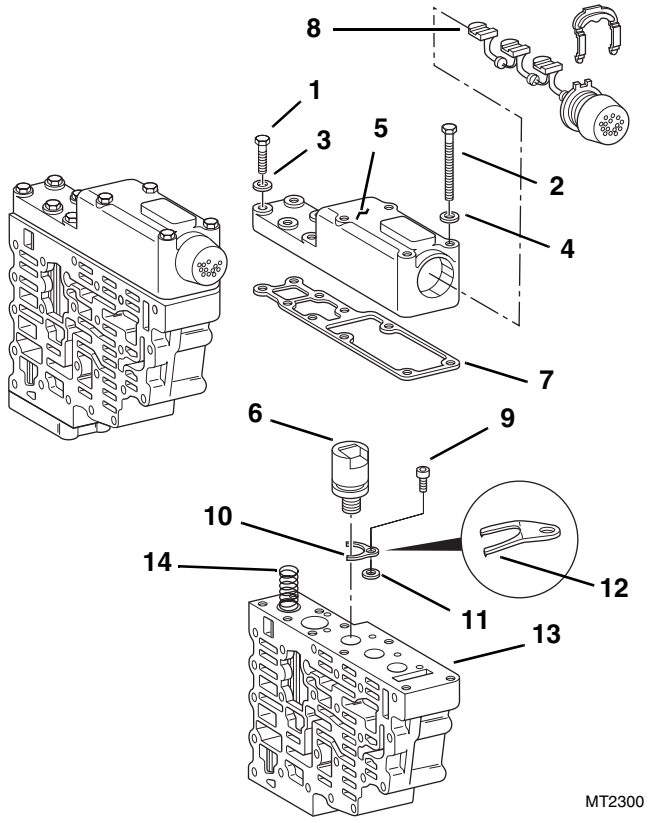
Note: *Before removing the valve body protective cover, clean the area around the housing to prevent contamination.*

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**17**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**18**).



2. Remove the six capscrews (**1**) four hex-head capscrews (**2**), ten lockwashers (**3** and **4**) and protective cover plate (**5**) secured over the transmission solenoid cartridge valve (**6**). Inspect the protective cover gasket (**7**); replace if torn or missing.



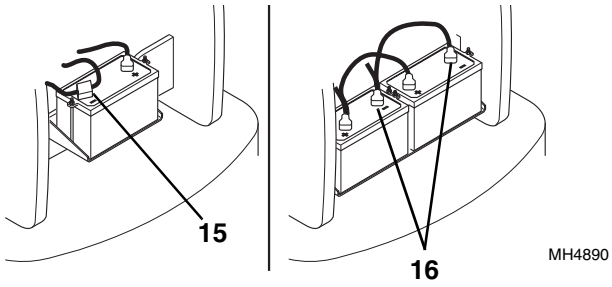
3. Disconnect the internal wire connector (**8**) from the solenoid valve that is being removed. Label the internal wire connections if removing more than one solenoid valve.
4. Remove the solenoid capscrew (**9**), retaining plate (**10**) and flat washer (**11**) securing the solenoid valve (**6**) to the transmission.
5. Remove the solenoid valve (**6**) and replace.

d. Transmission Upper Valve Body Solenoid Installation

Note: *When installing the solenoid valve into the valve body, position the solenoid valve wires so that they do not interfere with the protective cover plate.*

1. Install the flat washer (**11**) and solenoid valve (**6**) along with the retaining plate (**10**). Connect the internal wire connector to solenoid. Insure that the claw side (**12**) of the retaining plate is facing down toward the valve body surface (**13**).
2. Install the solenoid capscrew (**9**) and torque to 53 lb-in (6 Nm).
3. Install the protective cover gasket (**7**) on the valve body. Position the protective cover plate (**5**) over the gasket. Install six lockwashers (**3**) and capscrews (**1**), and tighten until the valve body spring (**14**) (upper valve body only) is compressed and the cover plate sits flush over the gasket.
4. Install the four lockwashers (**4**) and four capscrews (**2**). Torque to 84 lb-in (9,5 Nm).
5. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**15**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**16**).



6. Test the operation of the transmission. Put the transmission through its entire range of gears (speeds) in both (F) FORWARD and (R) REVERSE, and check that the transmission also shifts into (N) NEUTRAL.
7. Verify that each function works properly and that the transmission does not engage when in (N) NEUTRAL.

For further information, refer to the Transmission Service Manual, Model ZF 4 WG-98 TC P/N 8990455 (ZF P/N 5871 135 002).

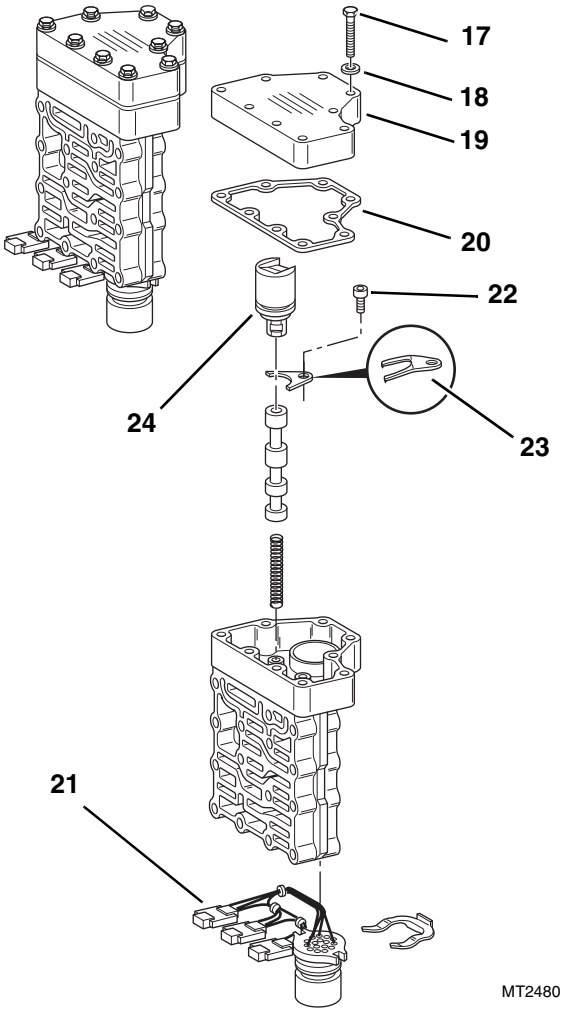
e. Transmission Lower Valve Body Solenoid Removal

Note: *In order to service the lower valve body housing, the upper valve body housing MUST be removed to allow access to the lower housing protective cover. The area around the upper and lower valve body housing must be thoroughly cleaned to avoid contamination of internal transmission components.*

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**15**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**16**).

2. Thoroughly clean the area around the upper and lower valve body housing.
3. Remove screws securing the upper valve housing to the transmission.
4. Remove upper valve body housing from transmission, and set aside in a clean area, free of dirt, grease and oil.
5. Remove the upper valve housing flat gasket.
6. Remove the nine lower valve body protective cover screws (**17**), lockwashers (**18**) protective cover (**19**) and gasket (**20**)



7. Disconnect the internal wire connector (**21**) from the solenoid valve that is being removed. Label the internal wire connections if removing more than one solenoid valve.
8. Remove the solenoid capscrew (**22**) and retaining plate (**23**), securing the solenoid valve (**24**) to the transmission.
9. Remove the solenoid valve (**24**) and replace.

f. Transmission Lower Valve Body Solenoid Installation

Note: *When installing the solenoid valve into the valve body, position the solenoid valve wires so they do not interfere with the protective cover plate.*

1. Install the solenoid valve (**24**) and retaining plate (**23**). Connect the internal wire connector (**21**) to the solenoid. Insure that the claw side of the retaining plate (**23**) is facing down toward the valve body surface.
2. Install the solenoid capscrew (**22**) and torque to 53 lb-in (6 Nm).
3. Install the protective cover gasket (**20** onto the valve body. Position the protective cover (**19**) over the gasket. Install lockwashers (**18**) and capscrews (**17**), and tighten until the cover plate is compressed and it sits flush over the gasket. Torque to 84 lb-in (9,5 Nm).
4. Install the upper transmission valve body gasket and upper valve body assembly to transmission.
5. Install the lockwashers and capscrews, and torque screws to 84 lb-in (9,5 Nm).
6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**15**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**16**).
7. Test the operation of the transmission. Put the transmission through its entire range of gears (speeds) in both (F) FORWARD and (R) REVERSE, and check that the transmission also shifts into (N) NEUTRAL.
8. Verify that each function works properly and that the transmission does not engage when in (N) NEUTRAL.

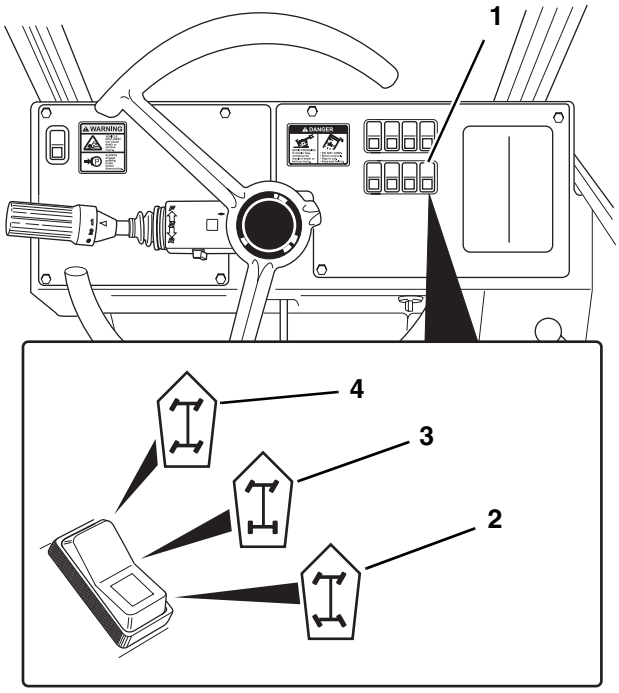
For further information, refer to the Transmission Service Manual, Model ZF 4 WG-98 TC, P/N 8990455 (ZF P/N 5871 135 002).

9.14.8 Steering

Certain steering functions are dependent upon electrical operations as described below. Consult the Owners/ Operators Manual for further information related to steering.

a. Steer Select Switch

The steer select switch (**1**) is located on the right side of the operator's control panel. It is a three-position switch that is pressed or "snapped" into a rectangular switch bezel.



OH19412

The three-position switch (**1**) is a single-pole, double throw toggle switch that has three positions. It has a multiple-connector plug on its underside that connects to the cab wiring harness. Wiring from the plug connects the switch with power from the fuse panel bus bar, and to the operator's instrument cluster and the steer select solenoids on the vehicle.

Steer select solenoids are energized or de-energized accordingly to provide the type of steering selected. The switch allows four-wheel steer (**2**) (the rear wheels turn opposite the front wheels), two-wheel steer (**3**) (the front wheels only) or crab steer (**4**) (the rear wheels turn in the same direction as the front wheels).

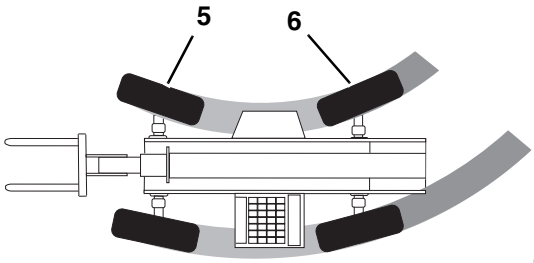
b. Steer Modes and Conditions

Four-Wheel Steer Mode

OH2611

With the steer select switch (**1**) in the lower position (**2**), the following conditions must be met:

1. Front wheels (**5**) must steer in the direction that the steering wheel is turned.



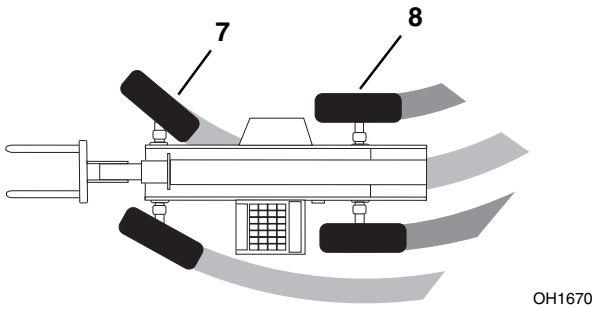
OH1660

2. Rear wheels (**6**) must steer in the opposite direction from which the steering wheel is turned. Refer to Section 9.7.40, "Four-Wheel Steer Circuit and Troubleshooting."

Front-Wheel Steer Mode

With the steer select switch (**1**) in the center position (**3**), the following condition must be met:

1. The front wheels (**7**) must steer in the direction that the steering wheel is turned.

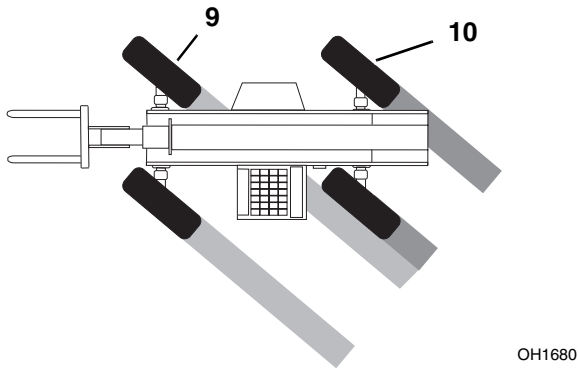


2. Rear wheels (**8**) must remain in a fixed FORWARD position and not move. (Refer to Section 9.7.39, “Front Steer Circuit and Troubleshooting.”)

Crab-Steer Mode

With the steer select switch (**1**) in the upper most position (**4**), the following conditions must be met:

1. Front wheels (**9**) must steer in the direction that the steering wheel is turned.



2. Rear wheels (**10**) must steer in the direction that the steering wheel is turned. (Refer to Section 9.7.41, “Crab Steer Circuit and Troubleshooting.”)

c. Four-Wheel Steer Indexing

If the vehicle does not drive “straight,” the steering may not be synchronized or is “out of phase.” Perform the four-wheel steer indexing procedure to synchronize the steering.

1. With the steer select switch (**1**) in the four- wheel steer position (**2**), turn the steering wheel fully left.
2. While holding the steering wheel fully left, toggle the steer select switch to the front-wheel steer position (**3**).
3. Steer the front wheels back to center.
4. Toggle the steer select switch back to four-wheel steer position (**2**).
5. Turn the steering wheel fully left.
6. Toggle the steer select switch back to the front-wheel steer position (**3**).
7. Steer the front wheels fully left.
8. Toggle the switch to the four-wheel steer position (**2**) and return to center.

The vehicle should now be properly indexed in four-wheel steer. If the steering is still not synchronized, repeat the procedure. (Refer to Section 9.7.39, “Front Steer Circuit and Troubleshooting” and subsequent circuits and troubleshooting charts.)

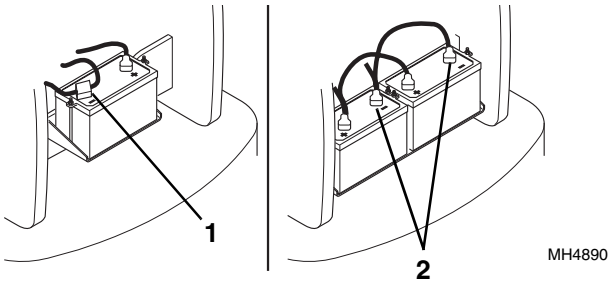
9.14.9 Steer Select Switches

For additional information, refer to Section 9.7.39, “Front Steer Circuit and Troubleshooting.”

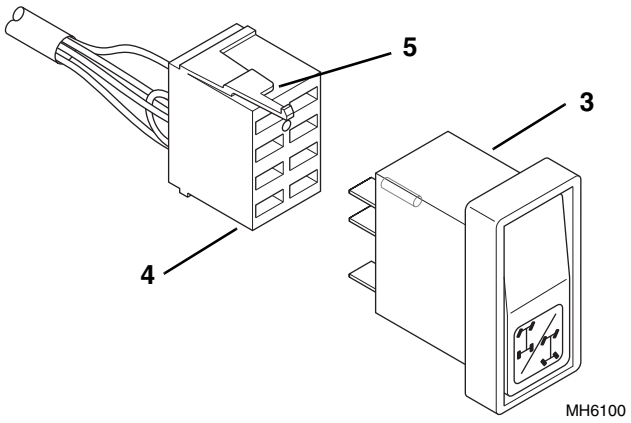
a. Steer Select Switch Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



2. Carefully pry the switch (**3**) and wiring out of the mounting hole in the switch bezel.



3. Note and mark the "front" or top of the switch as positioned in the dash.
4. Disconnect the wiring harness connector (**4**) from the steering select switch (**3**) by pressing down on the tab (**5**) on the harness connector. Remove the switch from the vehicle

b. Steer Select Switch Disassembly, Inspection and Replacement

DO NOT disassemble the switch. Replace a defective or faulty switch with a new part.

Inspect the switch and the wiring harness connector terminals for continuity and shorting in all three switch positions. Inspect the switch terminals for continuity in the “UP” and “DOWN” positions and for shorting in the “MIDDLE” position. Replace a defective or faulty switch with a new part.

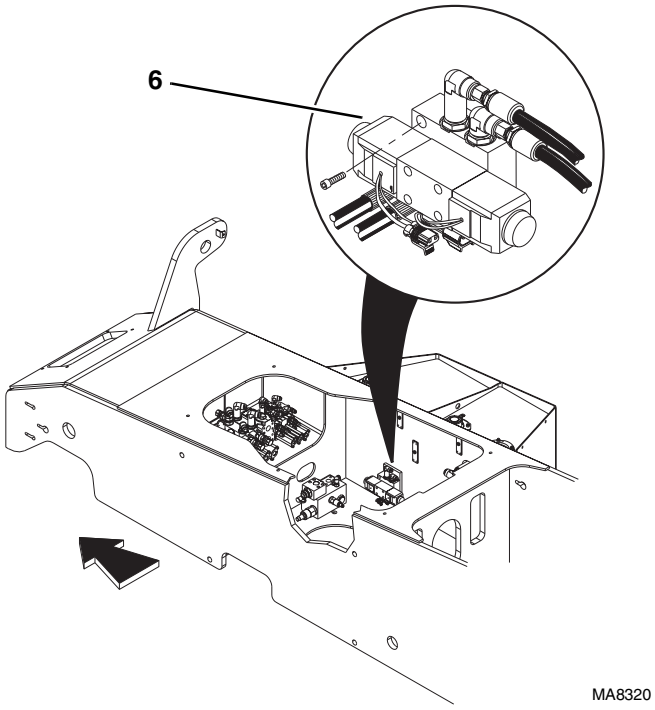
c. Steer Select Switch Installation and Testing

1. Route the wiring through the dash and switch bezel, then connect the wiring to the switch (**3**) (the pin connector only goes on one way).
2. Properly position the “front” and top of the switch as noted during removal, then press or “snap” the switch into place in the bezel.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
4. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
5. Start the engine and check the operation of the steer select switch functions with the switch in all three positions. If the vehicle has the rear steer option, also test the rear steer mode for proper operation.

9.14.10 Steer Select Valve

The steer select valve (**6**), is secured to the steer select manifold and frame with four capscrews and o-rings (**7**) on the inside wall of the vehicle frame.

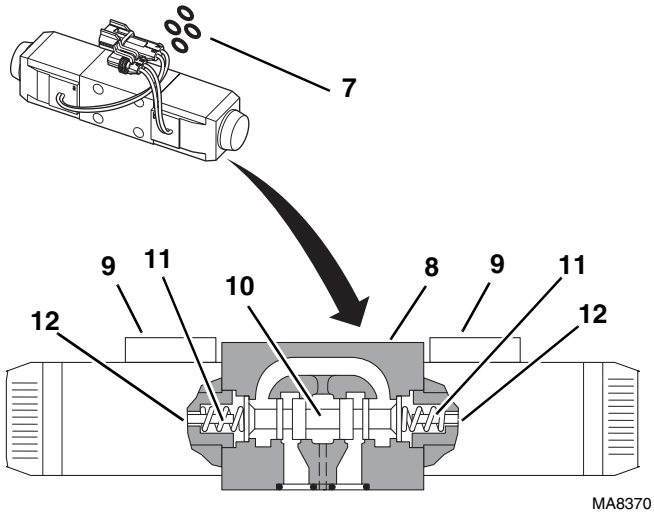


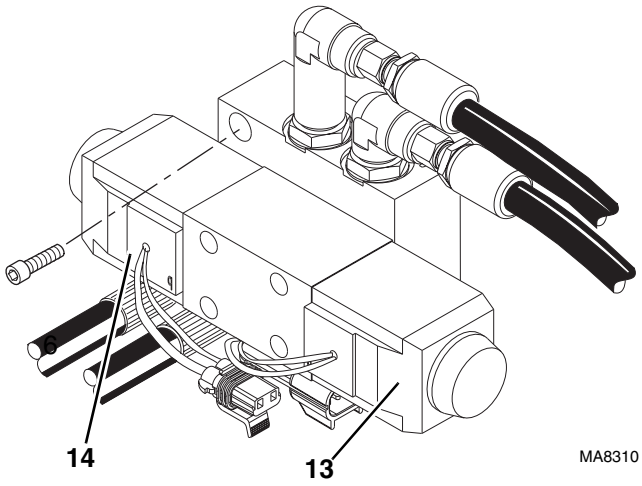
The steer select valve contains two solenoids that direct hydraulic fluid through hoses and ultimately help operate the steering. The valve is a direct dual-solenoid operated, spool-type directional control valve. The steer select valve controls the start, stop and direction of hydraulic fluid flow to the steering cylinders mounted on each axle. The valve consists of a housing (**8**), two solenoids (**9**), a control spool (**10**) and two return springs (**11**).

In the de-energized state, the spool (**10**) is held by the return springs (**11**) in the center position. The spool is shifted through the action of the two wet-pin type solenoids (**9**).

The force of an acting solenoid works against the push pin (**12**) on the end of the spool (**10**). The spool is shifted from its normal position to the end position for the selected flow. The selected flow pattern is covered in Section 8, “Hydraulic System.”

When the solenoid is de-energized, the control spool (**10**) is returned to its normal (centered) condition by the centering springs (**11**).



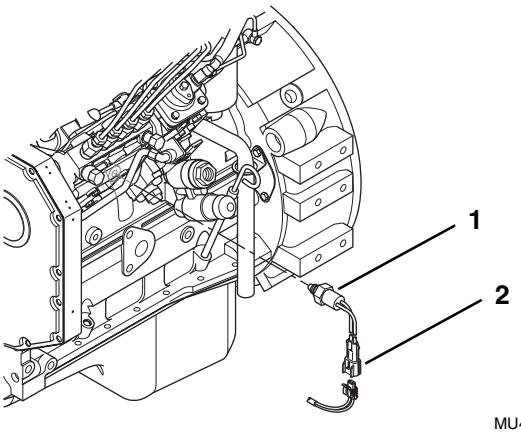


Check the steer select valve solenoids (**13** and **14**) for proper operation, and check the wiring for continuity or shorts. When energized/de-energized, the solenoid should move and/or an audible “click” should be heard; check for the presence of voltage with a voltmeter.

Replace a defective or faulty steer select valve with a new unit. (Refer to Section 9.7.39, “Front Steer Circuit and Troubleshooting.”)

9.14.11 Engine Low Oil Pressure Sender

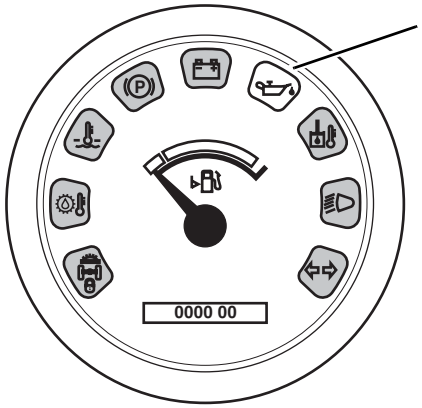
The engine oil pressure sender (**1**) is located on the engine and is connected via the engine wiring harness, bulkhead connector and cab wiring harness to the front dash panel.



MU4500

The engine oil pressure indicator is located in the operator's instrument cluster (**3**) and illuminates when engine oil pressure is too low to properly lubricate the engine. The warning indicator illuminates when oil pressure is below 8.7 psi (0,6 bar).

When the engine has attained normal oil pressure, the sender opens and the indicator on the operator's instrument cluster turns OFF. (Refer to Section 9.8.35, "Engine Oil Pressure Warning Indicator Troubleshooting.")

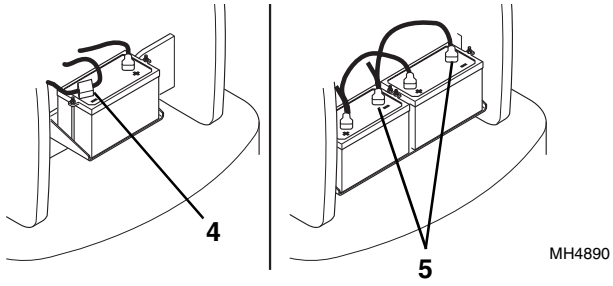


MA7610

a. Engine Oil Pressure Sender Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**5**).



MH4890

2. Unplug the engine low oil pressure sender connector (**2**) from the wiring harness connector.
3. The sender (**1**) is threaded into the engine block. Remove the sender.

b. Engine Oil Pressure Sender Disassembly

DO NOT disassemble the sender. Replace a defective or faulty sender.

c. Engine Oil Pressure Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

d. Engine Oil Pressure Sender Installation and Testing

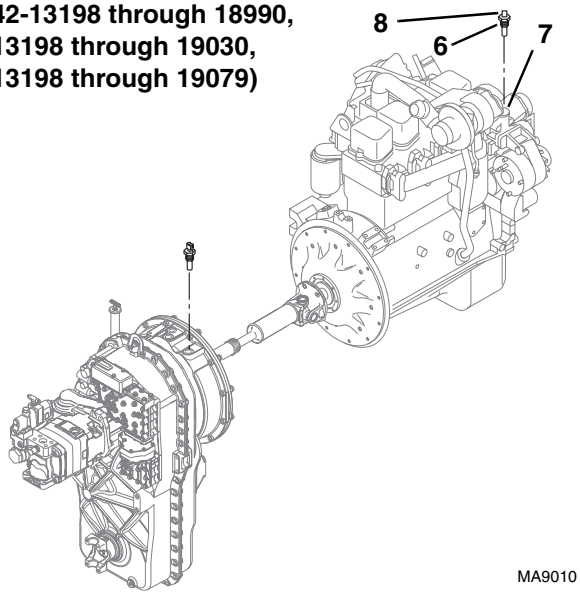
1. Thread the sender (**1**) into the engine block snugly.
2. Connect the wiring harness connector lead to the engine low oil pressure sender connector (**2**).
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**5**).
4. Check for proper oil level.
5. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
6. Start the engine, allow it to reach operating temperature, and observe the operator's instrument cluster for warning indication.

9.14.12 Engine Coolant High Temperature Sender

The engine coolant high temperature sender (**6**) is threaded into the engine block (**7**) and is connected to the operator's instrument cluster via the engine wiring harness, bulkhead connector and cab wiring harness.

(SN 8042-13198 through 18990, 10042-13198 through 19030, 10054-13198 through 19079)



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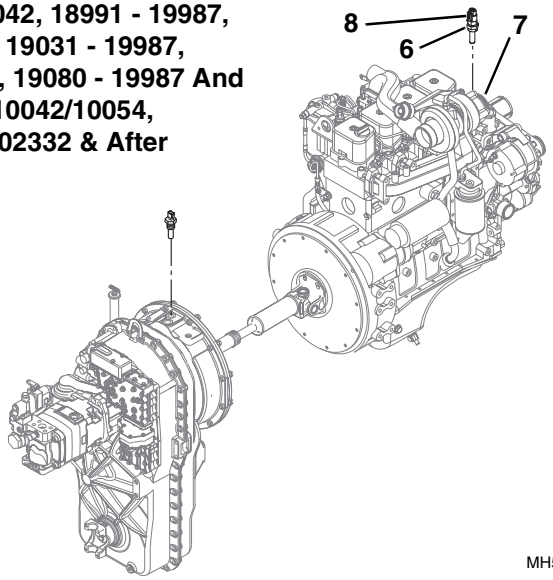
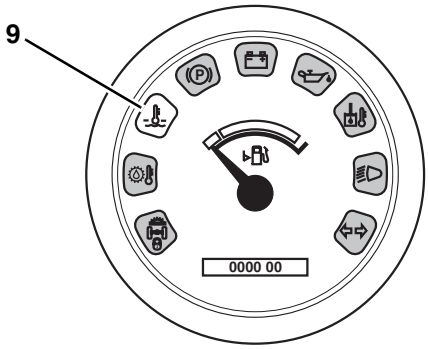


MH5240

When the engine coolant temperature exceeds normal operating limits and rises above 210° F (99° C), the contacts close within the sending unit. The operator's instrument cluster indicator (**9**) illuminates.

When the engine coolant temperature is below 210° F (99° C), the contacts within the sending unit open and the instrument cluster indicator turns OFF. (Refer to Section 9.8.31, "Engine Coolant Temperature Warning Indicator Troubleshooting.")



MA7570

a. Engine Coolant High Temperature Sender Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**5**).
2. Unplug the engine coolant high temperature sender connector (**8**) from the wiring harness connector.
3. The sender (**6**) is threaded into the engine block (**7**). Remove the sender.

b. Engine Coolant High Temperature Sender Disassembly

DO NOT disassemble the sender. Replace a defective or faulty sender.

c. Engine Coolant High Temperature Sender Inspection and Replacement

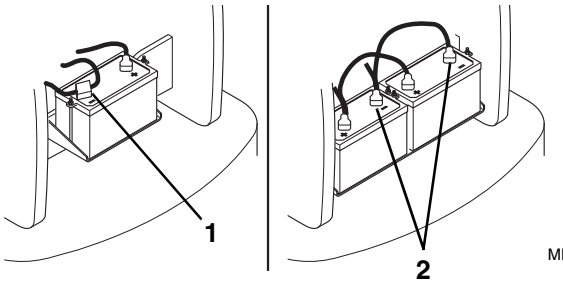
Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

d. Engine Coolant High Temperature Sender Installation and Testing

1. Thread the engine coolant high temperature sender (**6**) into the engine block (**7**) snugly, then connect the sender connector (**8**) to the wiring harness connector.

2. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
3. Check for proper coolant level.
4. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.



MH4890

5. Start the engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument cluster, etc.

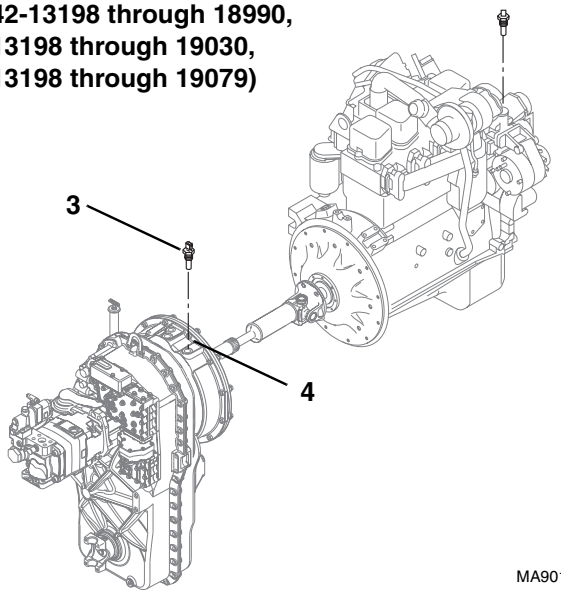
9.14.13 Transmission Temperature Sender

The transmission temperature sender (**3**) is threaded into the transmission housing (**4**) and is connected to the operator's instrument cluster via the engine wiring harness, bulkhead connector and cab wiring harness.

When the transmission fluid temperature rises above 250° F (121° C), the contacts close within the sending unit. The operator's instrument cluster indicator (**5**) illuminates.

When the transmission temperature is below 250° F (121° C), the contacts within the sending unit open and the operator's instrument cluster indicator turns off. (Refer to Section 9.8.32, "Transmission Temperature Warning Indicator Troubleshooting.")

(SN 8042-13198 through 18990, 10042-13198 through 19030, 10054-13198 through 19079)



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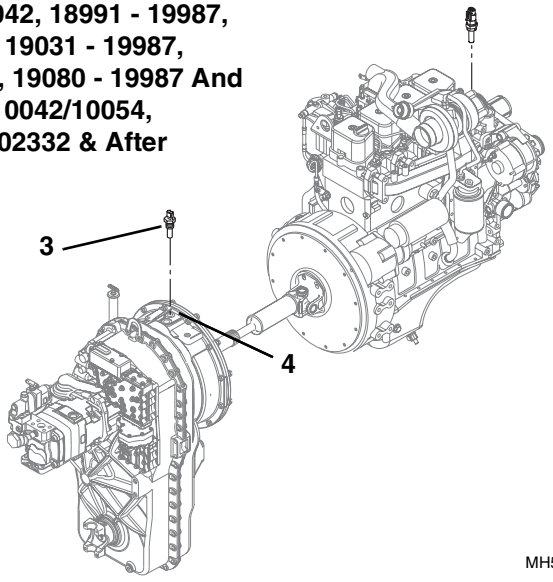
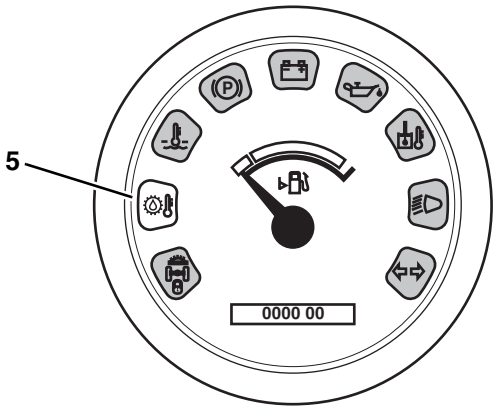


MH5240



MA7580

a. Transmission Temperature Sender Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).
2. Unplug the sender connector (**3**) from the cab harness connector.
3. The sender (**3**) is threaded into the transmission housing or case (**4**). Remove the sender.

b. Transmission Temperature Sender Disassembly

DO NOT disassemble the sender. Replace a defective or faulty sender with a new part.

c. Transmission Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender.

d. Transmission Temperature Sender Installation and Testing

1. Thread the sender (**3**) into the transmission housing (**4**) snugly.
2. Connect the sender connector (**3**) to the wiring harness connector.
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
4. Clear the area around the vehicle of personnel and any obstructions to vehicle travel.
5. Start the engine, allow all systems to reach operating temperature and observe the operator's instrument cluster for transmission temperature sender indication.
6. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, clogged or defective transmission cooler, defective display, etc.

9.14.14 Engine Block Heater

The engine is equipped with an engine block heater (**6**) that can be plugged into a standard 110/120V A.C. grounded outlet, to heat the engine coolant.

When temperatures are below 10° F (-12° C), the block heater should be used to aid in starting.

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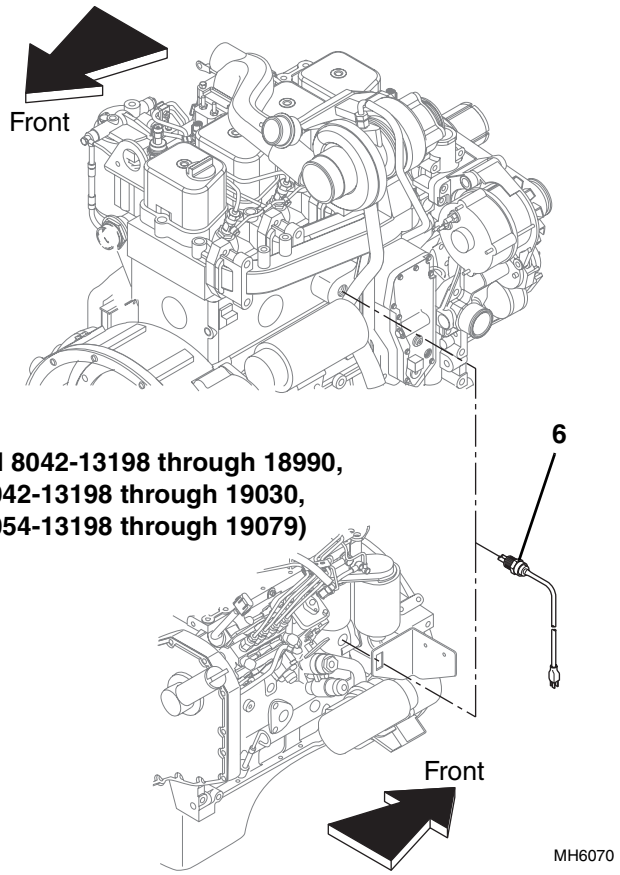


(SN 8042-13198 through 18990, 10042-13198 through 19030, 10054-13198 through 19079)

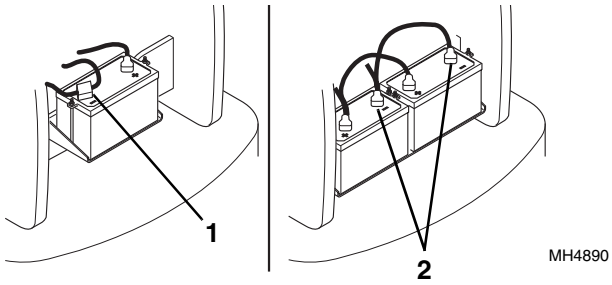
a. Engine Block Heater Removal

1. Level the vehicle, ground the attachment, place the travel select lever in (N) NEUTRAL, engage the park brake switch and shut the engine OFF. Remove the ignition key.
2. Secure accident prevention tags to the steering wheel and ignition switch. (Refer to Section 1.5, “Accident Prevention Tags.”)

WARNING: **DO NOT** attempt this procedure when the engine is hot. Wait for the engine, muffler and tailpipes to cool down before proceeding. Failure to do so could result in severe burns.

3. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

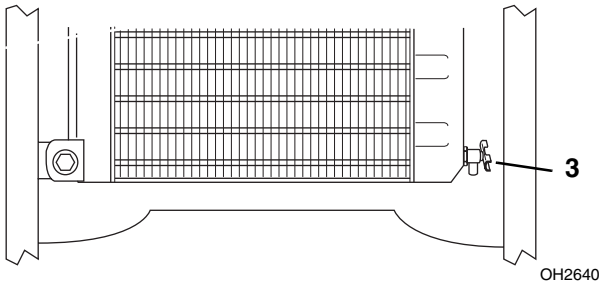
   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



4. Unlatch, unlock and open the engine right and left engine access doors. Allow the engine to cool before proceeding. Draining the cooling system while the engine is hot can cause cracks in the engine block.

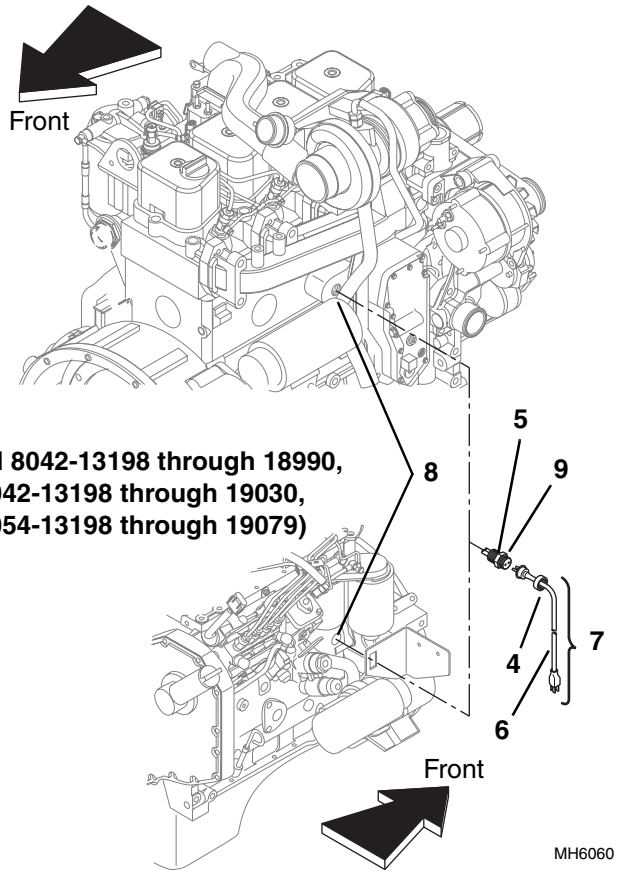
WARNING: Hot coolant can cause severe burns or eye injury. **NEVER** remove the radiator cap while the engine is hot. The cooling system is under pressure. Wear protective clothing and safety glasses.

5. Place a suitable container beneath the radiator drain plug or petcock (**3**) on the bottom, right side of the radiator. Slowly turn the radiator cap (not shown) to the first stop and allow any pressure to escape. Remove the radiator cap.



6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Open the radiator drain plug or petcock (**3**) and allow the coolant to drain into the funnel. Close the radiator drain plug or petcock.
7. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced.
8. Remove plastic retainer (**4**) from around engine block heater element (**5**) and 110-volt cord (**6**).
9. Using a 29 mm socket, remove heating element from engine block.

(SN 8042, 18991 - 19987, 10042 19031 - 19987, 10054, 19080 - 19987 And 8042/10042/10054, 0160002332 & After)



(SN 8042-13198 through 18990, 10042-13198 through 19030, 10054-13198 through 19079)

b. Engine Block Heater Disassembly

DO NOT disassemble the heater element. Replace a defective or faulty heater with a new part.

c. Engine Block Heater Inspection and Replacement

Inspect the block heater element and the 110-volt cord for cuts or exposed wires. Replace a defective or faulty block heater.

d. Engine Block Heater Testing

Note: *The following test should be performed with a cold engine.*

The coolant heater unit (**7**) can be tested on the machine by plugging the 110-volt cord (**6**) into a 110 volt outlet. After 20 to 30 minutes, place your hand on the engine block (**8**) next to the heater. If the heater element is functioning properly, you will feel the heat at that location. If the block is cold, the heater element is defective and should be replaced.

e. Engine Block Heater Installation

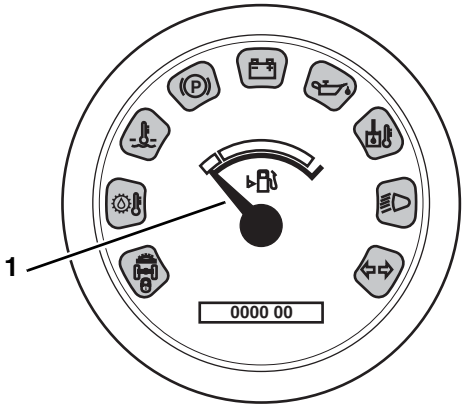
1. Apply Teflon tape to coolant heater element threads (**9**) and install element. **DO NOT** over**-**tighten.
2. Plug-in 110-volt cord (**6**) into heater element and install plastic retainer (**4**) around coolant heater element and 110-volt cord.
3. Fill radiator with coolant. Refer to the appropriate Legacy Owners/Operators Manual.
4. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).

Note: *When the coolant heater is not in use, secure the 110-volt cord with a wire tie to prevent damage to cord.*

9.14.15 Fuel Level Indicator and Fuel Level Sender

The fuel level indicator (**1**) can be found on the operator's instrument cluster.



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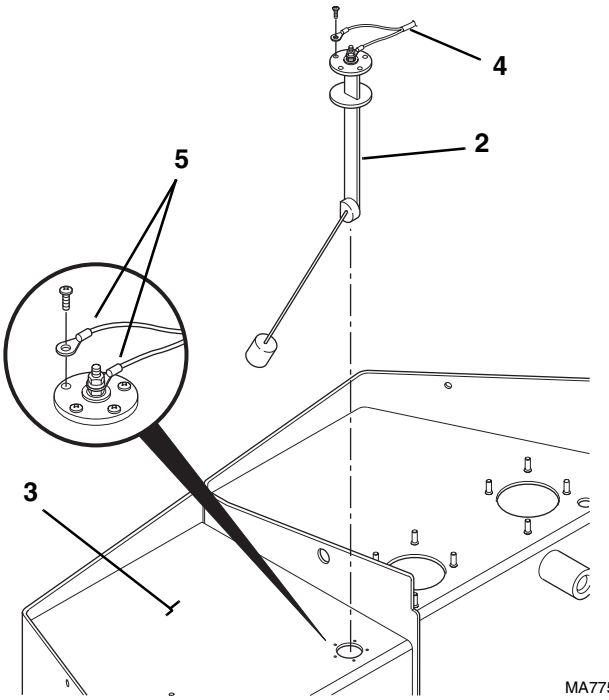
The fuel level indicator (**1**) works in conjunction with the fuel level sender (**2**). The submerged, coil-type fuel level sender is secured to the fuel tank (**3**) and is connected to the operator's instrument cluster via the engine wiring harness, bulkhead connector and cab wiring harness.



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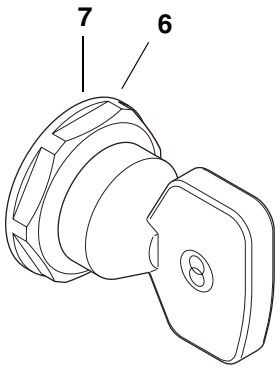
The operator's instrument cluster fuel level indicator (**1**) shows the level of fuel remaining in the fuel tank. The fuel level sender wiring harness connector can be accessed from the top of the fuel tank.

The fuel level sender (**2**) consists of a resistance, float-type fuel level sender mounted in the top of the fuel tank (**3**) and the wiring (**4**) connecting it with the fuel indicator in the operator's instrument cluster.

The resistance of the fuel level sender is 31 ohms for a full tank of fuel, 101 ohms for 1/2 tank and 255 ohms for an empty tank. The fuel level indicator gauge in the operator's instrument cluster receives a signal from the fuel level float sender corresponding to the remaining amount of fuel in the tank. Examine the fuel level sender circuit in Section 9.8.36, "Fuel Level Indicator Troubleshooting."

a. Fuel Level Indicator Testing

1. Remove fuel tank cover.
2. The fuel level sender wiring harness leads (**5**) can be accessed from the top of the fuel tank. Disconnect the fuel level sender wiring harness leads. With the help of an assistant, touch both harness leads together.
3. From the operator's cab, have the assistant turn the ignition key switch to the RUN (**6**) position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster. The reading must be at the FULL mark after the engine startup bulb test is completed.



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4. Turn the ignition key switch to the OFF (**7**) position. The fuel level indicator needle should return to the EMPTY position.

b. Fuel Level Circuit Tests

For additional information refer to Section 9.8.36, “Fuel Level Indicator Troubleshooting.”

If the fuel level indicator is suspected of giving a false reading, perform the following checks:

1. Check for loose or defective wiring, faulty ground connections, and corrosion on the fuel tank sender and wiring lead.
2. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN (**6**) position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level indicator wiring connector behind the operator’s instrument cluster. (The instrument cluster locking ring can be unfastened and raised slightly to do this.)

   If the fuel level indicator needle (**1**) does not move, check the fuel tank for fuel.

   If the fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out, and in addition, wiring and connectors have been checked and ruled out, the operator’s instrument cluster is defective and must be replaced.
3. Check that the ignition terminal has current and that the fuse in the fuse panel is not blown.
4. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the operator’s instrument cluster, fuse and relay panel, ignition key switch, and from the fuel level sender on the fuel tank through the wiring in the cab.
5. Check the fuel level sender. The resistance of the fuel level sender is 31 ohms for a full tank of fuel, 101 ohms for 1/2 tank and 255 ohms for an empty tank. A defective fuel level sender in the fuel tank may also prevent the fuel level indicator from moving.

Excessive fuel level indicator “fluctuation” may be caused by loose wire connections or a defective fuel level sender in the fuel tank.

A full tank reading at all times may occur if the wiring to the fuel level sender in the tank is broken, if the sender is not properly grounded or if the sender is defective.

If the fuel level indicator appears to be inaccurate, the fuel level sender in the tank may be defective, or there may be low voltage at the fuel level indicator connector to the operator’s instrument cluster.

If the fuel level indicator fluctuates when other electrical items are used, there may be a defective, corroded or improper ground. Check the cab harness ground stud under the dash, the engine to chassis ground, and the negative (-) battery cable and ground stud cable.

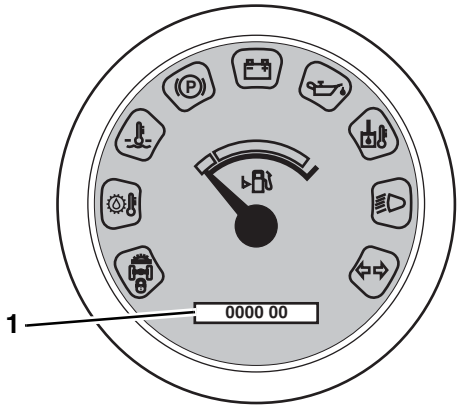
9.14.16 Hourmeter

The hourmeter (**1**) is a non-repairable instrument that records hours of vehicle engine operation in tenth of an hour increments and is located in the instrument cluster.

The hourmeter is an analog device, similar to an odometer, and will display 99,999.9 hours before resetting to zero.

If trouble is suspected, time the hourmeter for six minutes to verify that a tenth of an hour has been recorded.

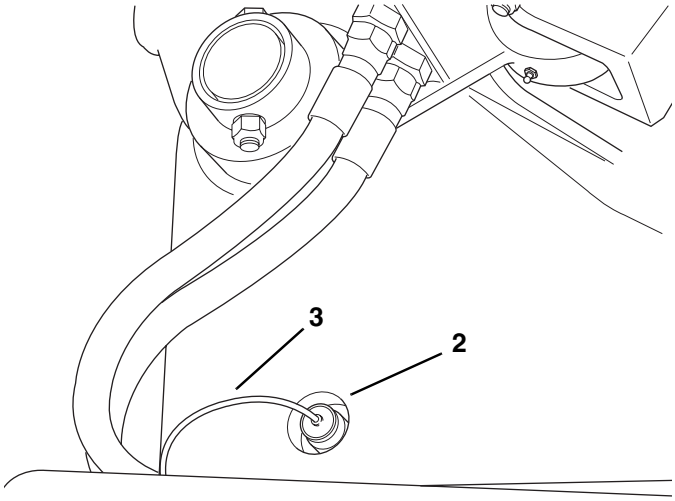
The hourmeter is built into the instrument cluster and cannot be repaired. If the hourmeter is suspect, replace the instrument cluster.



MA7640

9.14.17 Boom Angle Sensor Removal and Replacement

The boom angle sensor (**2**) is located at the rear of, and on the right side of the vehicle. When the boom is lifted above 40°, the boom sensor sends a signal to the Stabil-TRAK indicator on the instrument cluster.

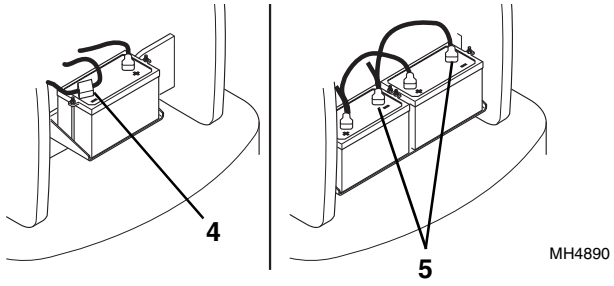


MH2930

a. Boom Angle Sensor Removal

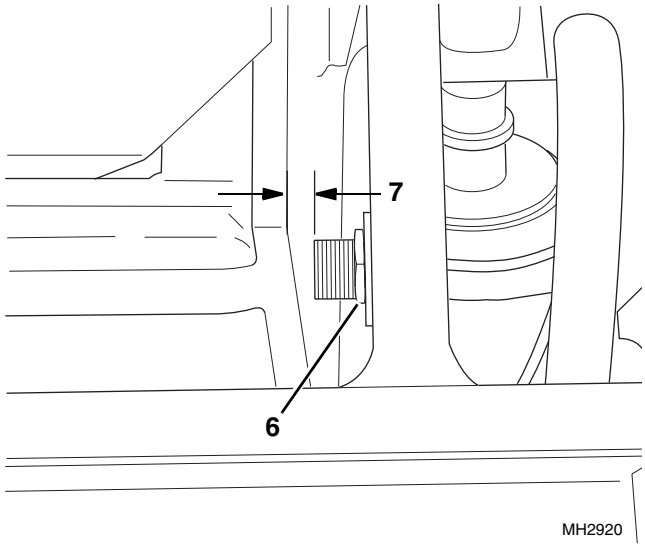
1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**5**).



MH4890

2. Disconnect the boom angle sensor electrical connector (**3**) from the engine harness connector.
3. Loosen and remove the sensor inside locknut (**6**)
4. Remove sensor from the outside of boom frame



MH2920

b. Boom Angle Sensor Installation

1. Install boom angle sensor (**2**) through outside of boom frame.
2. Install inside locknut (**6**) onto sensor.
3. Measure the clearance between the sensor and frame, and adjust sensor distance (**7**) to .120" (3,05 mm) and tighten locknut (**6**).
4. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**5**).

9.14.18 Boom Extend Interlock Sensor Removal/Replacement (10054 Only)

The boom extend interlock sensor (**8**) is located on the left side of the vehicle, on the outer boom frame (**9**) and just behind the cab. The boom extend interlock sensor prohibits the last boom section from extending unless both outriggers are down and pressure is applied to the ground surface.

a. Boom Extend Interlock Sensor Removal

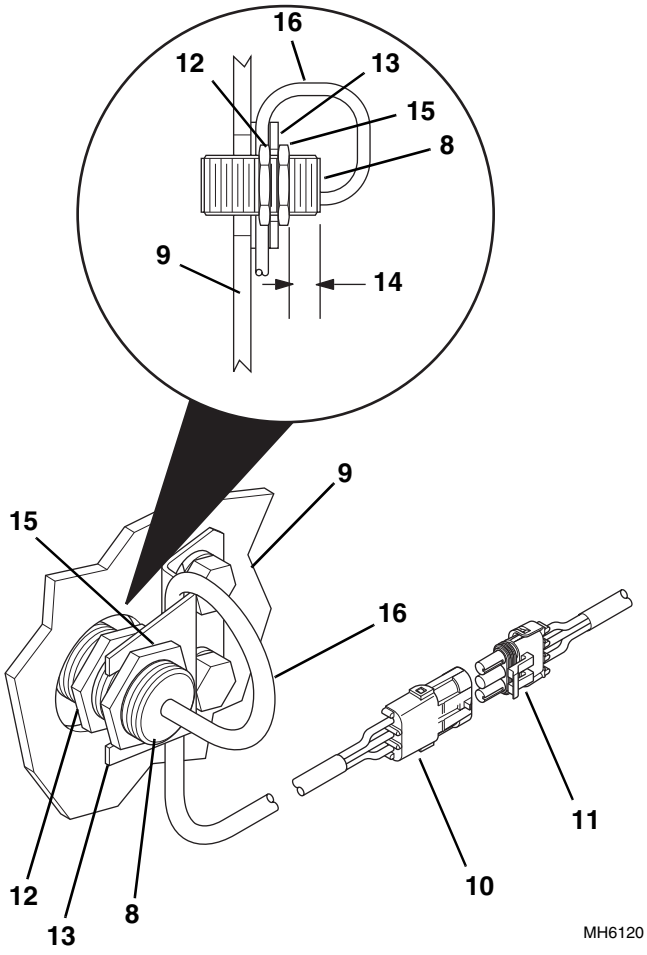
1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**5**).
2. Make note of wire tie locations and clip wire ties where necessary.
3. Disconnect boom extend interlock sensor (**8**) electrical connector (**10**) from the boom extend harness connector (**11**).
4. Loosen the inside locknut (**12**) on the sensor.
5. Slide the sensor out of the bracket (**13**) and remove from vehicle.

b. Boom Extend Interlock Sensor Installation

1. Partially install inside locknut (**12**) onto the sensor.
2. Make sure that there are four to six threads, approximately .75" and 1.00" (**14**), between the outside locknut (**15**) and the end of the sensor (**8**).
3. Make sure that the wire harness (**16**) is between the bracket (**13**) and the sensor (**8**), and slide the sensor into the bracket (**13**).
4. Connect the boom extend interlock sensor connector (**10**) to the boom extend harness connector (**11**).
5. Replace wire ties as necessary.
6. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**4**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**5**).



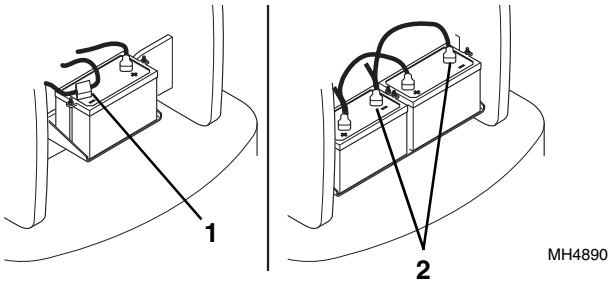
9.14.19 Service Brake Switch

The service brake switch works in conjunction with the Stabil-TRAK™ system. With the boom above 40°, the transmission shifter in either forward or reverse, and the service brake depressed, the Stabil-TRAK™ system engages. If the Service Brake Switch is suspect in the proper operation of the Stabil-TRAK™ system, refer to Section 10.8, “Stabil-TRAK™ System Test.”

a. Service Brake Switch Removal

1. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**2**).



2. Label and disconnect the cab harness electrical connectors (**3**) from the service brake switch (**4** or **7**).

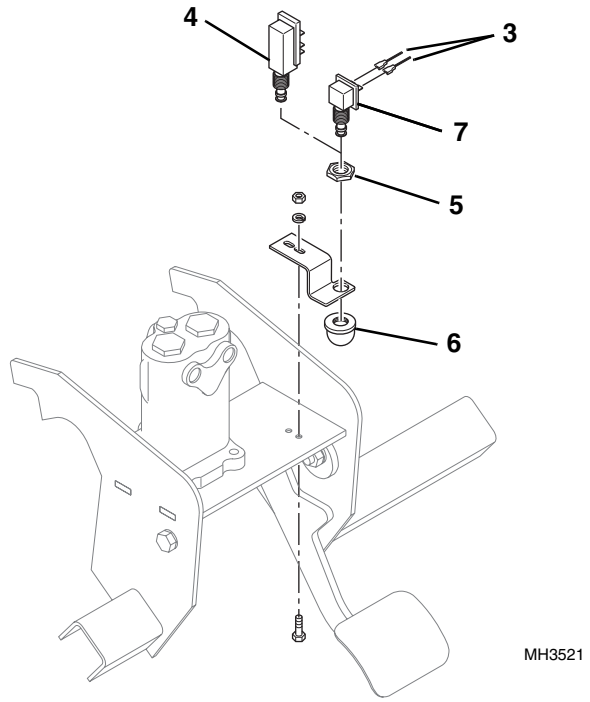
Note: *If roadlight option is installed the brake switch* (**4**) *will be longer and there will be more electrical connections made.*

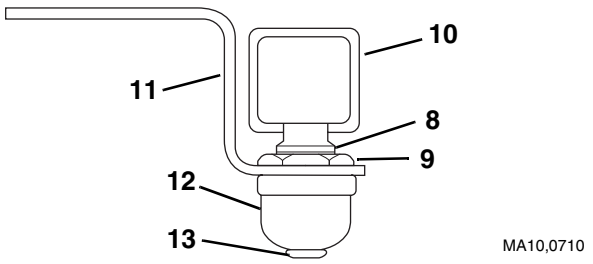
3. Loosen locknut (**5**) and remove switch dust cover (**6**). Remove switch body (**7**).

b. Service Brake Switch Installation

1. Ensure that there is only one thread (**8**) showing above the locknut (**9**) on the shaft of the switch body (**10**).
2. Insert switch body (**10**) through the top of the service brake switch bracket (**11**).
3. Thread the switch dust cover (**12**) onto the switch body (**10**) until finger tight against the service brake switch bracket (**11**).
4. Use a wrench and fully tighten the locknut (**9**) against the service brake switch bracket (**11**). There should now be approximately two or three threads showing above the locknut.
5. Thread the bottom lip (**13**) of the switch plunger through the hole in the bottom of the dust cover (**12**).
6. Connect the cab harness electrical connectors (**3**) to the service brake switch (**4** or **7**) connectors.
7. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**1**).

   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**2**).
8. Adjust the brake switch. (Refer to Section 9.14.19, c. “Service Brake Switch Adjustment.”)

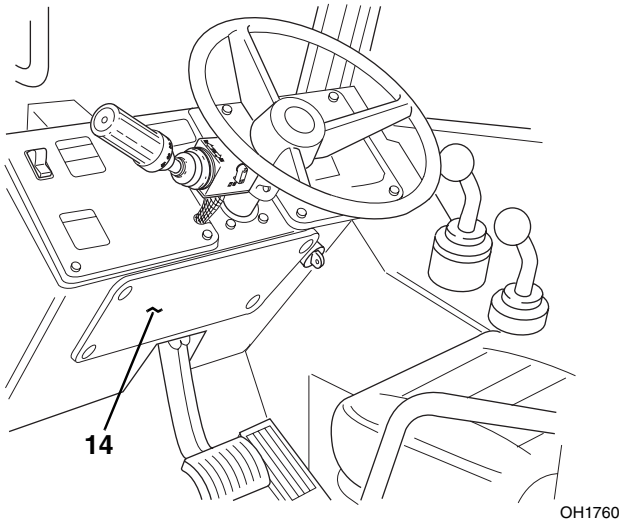




c. Service Brake Switch Adjustment

Note: *The service brake switch adjustment will require two people. Enlist the help of an assistant before attempting to follow the adjustment procedure.*

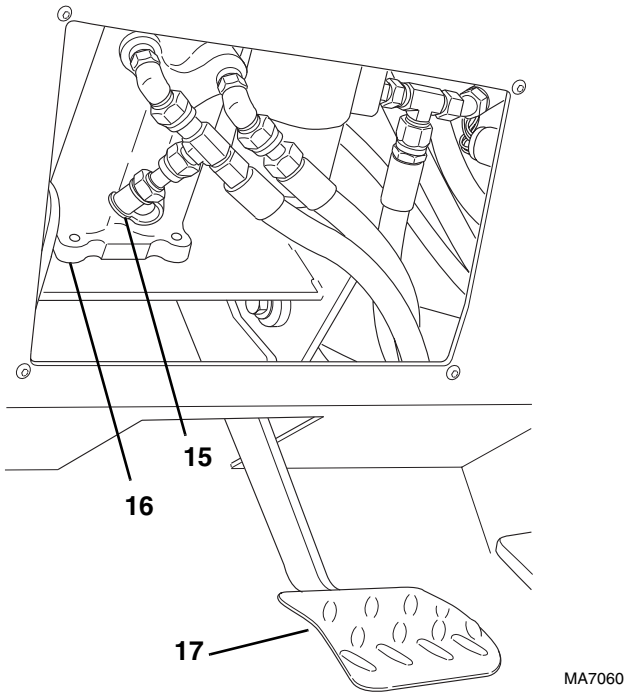
1. Remove lower access panel (**14**).



2. Loosen locknut (**9**) securing the switch body (**10**) to the service brake switch bracket (**11**).
3. Connect a 1000 psi (69 bar) pressure gauge to the test port (**15**) on the service brake valve (**16**).

> **WARNING:** **NEVER** attempt to adjust the service brake switch without an assistant. Anytime the engine is running and the parking brake is disengaged, there must be an operator located in the cab and the two front tires must be blocked. Death or serious personal injury could result from the vehicle lurching forward or backward and running over the person attempting to adjust the service brake switch.

4. Block both front tires.
5. Start the engine and run it at low idle.
6. Position the boom above 40°, have the engine running at idle, the transmission in forward 4th gear and the park brake released.
7. Slowly depress and hold the brake pedal (**17**) to maintain 150 ±50 psi (10,3 ±3,4 bar) brake pressure.



8. Using the switch dust cover (**12**) and the locknut (**9**) in combination, position the brake switch so the Stabil-TRAK dash light comes ON at the 150 ±50 psi (10,3 ±3,4 bar) brake pressure.
9. Repeat steps 6 through 8 until the Stabil-TRAK dash light comes ON at the 150 ±50 psi (10,3 ±3,4 bar) brake pressure.
10. After the required pressure is achieved, use a wrench and fully tighten the locknut (**9**) against the service brake switch bracket (**11**).

In order to test the switch for proper operation, the boom must be raised above the 40° position, the parking brake switch must be in the OFF position and the vehicle must be in a forward or reverse gear mode. Proper operation of the switch will activate the Stabil-TRAK dash panel indicator. If the Stabil-TRAK indicator does not activate when all conditions are met, the sensor must be adjusted. (Refer to Section 9.14.17, b. “Boom Angle Sensor Installation.”)

11. Shut off the engine.
12. Remove blocking from front tires.
13. Remove the pressure gauge.
14. Replace lower access panel (**14**).

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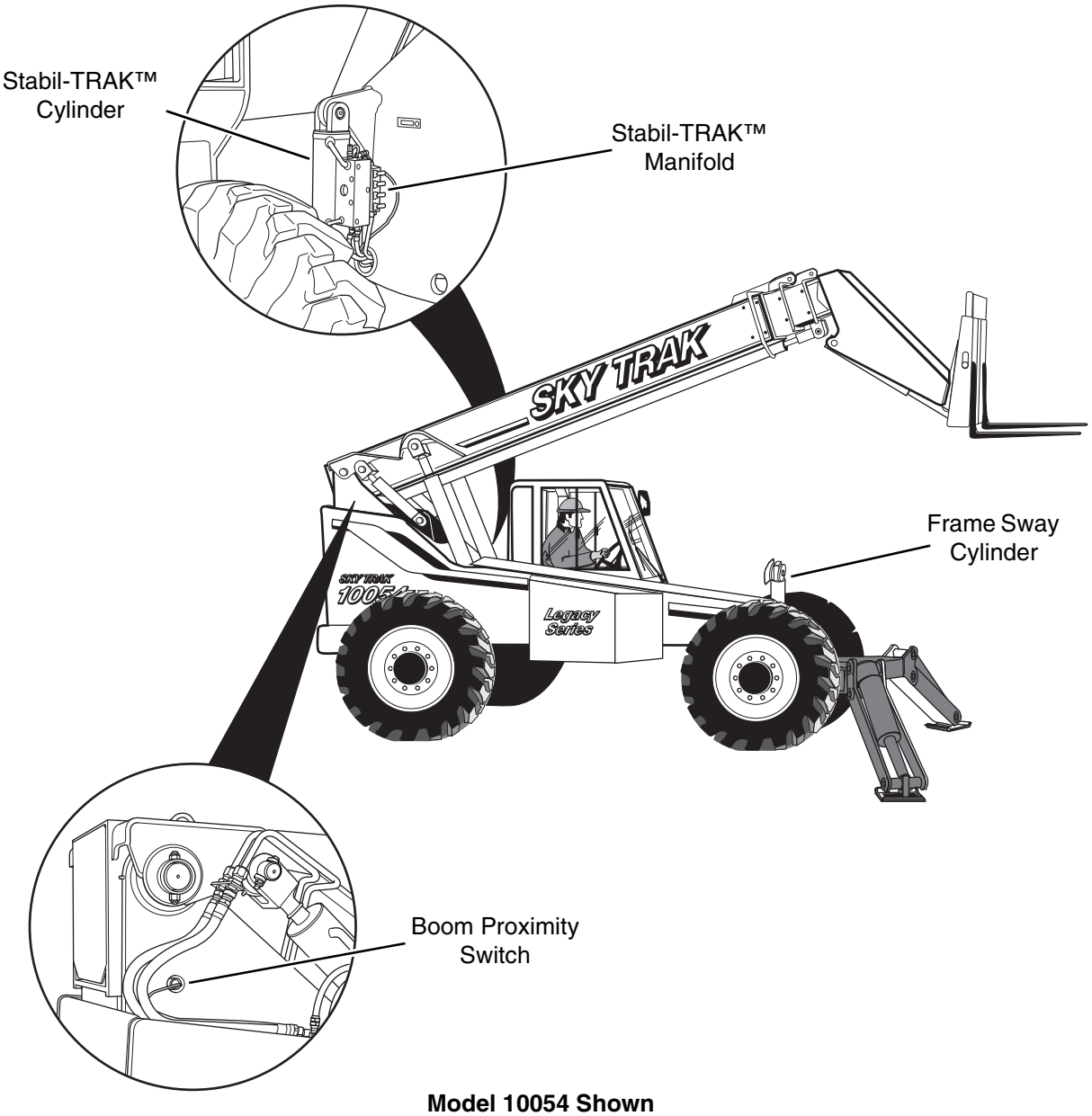
Section 10
Stabil-TRAK™ System and Boom Interlock System

Contents

10.1 STABIL-TRAK™ SYSTEM COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the Stabil-TRAK™ system. The following illustration identifies the components that are referred to throughout this section.

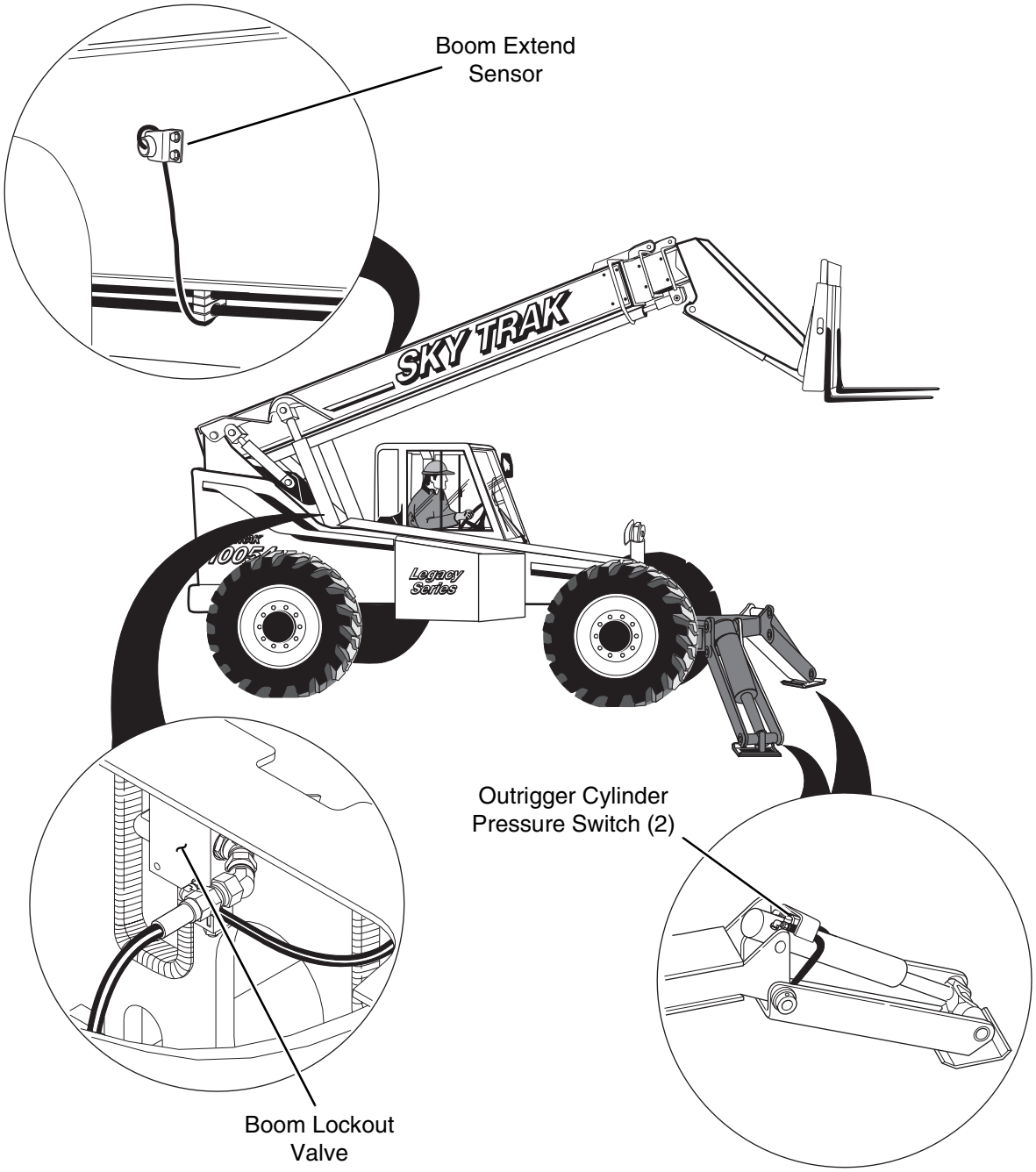


Model 10054 Shown

MH2961

10.2 BOOM EXTEND INTERLOCK SYSTEM COMPONENT TERMINOLOGY (10054 ONLY)

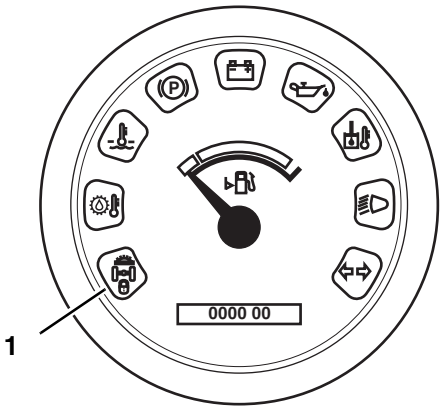
To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the boom extend interlock system. The following illustration identifies the components that are referred to throughout this section.



10.3 STABIL-TRAK™ DESCRIPTION

The patented rear axle lock or Stabil-TRAK™ system works to stabilize the vehicle under various conditions. The appropriate Owners/Operators manual contains basic Stabil-TRAK™ information; a copy of the owners/operators manual should always be available in the storage compartment located on the left inside wall of the cab, next to the seat support.

The operator's instrument cluster Stabil-TRAK™ light (**1**) goes ON when the Stabil-TRAK™ system is in the LOCKED mode.



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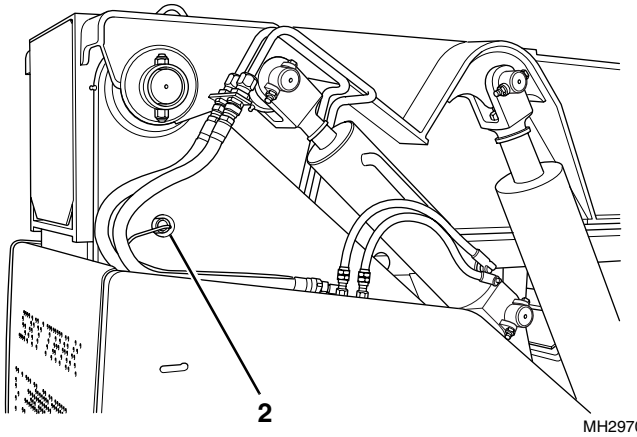
The stabilizing system operates via an interface between:

- boom proximity switch (**2**),
- park brake switch,
- service brake switch,
- gear selector in (N) NEUTRAL,
- hydraulic circuits,
- electrical circuits and
- five solenoid-operated valves on the Stabil-TRAK™ manifold (**3**)



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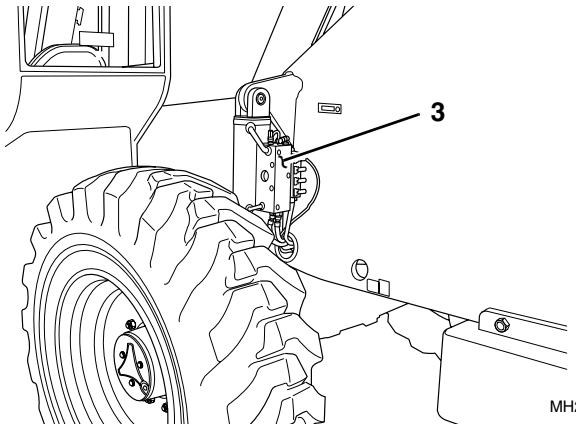

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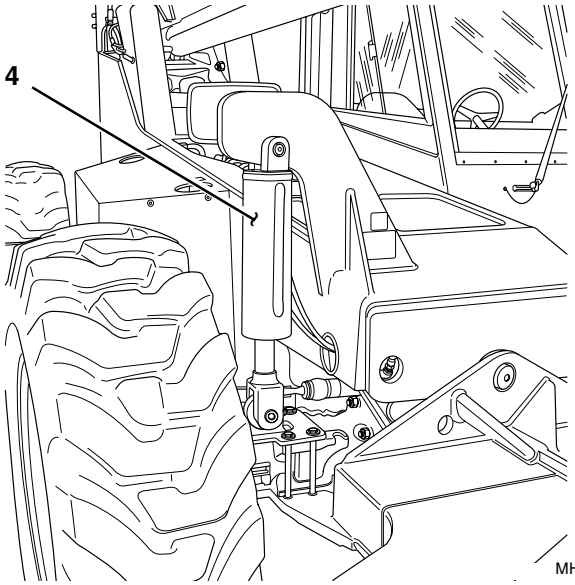
The frame sway cylinder (**4**) is also involved in the Stabil-TRAK™ system, but only passively, as hydraulic oil travels between the frame sway cylinder and the Stabil-TRAK™ manifold to accommodate Stabil-TRAK™ system operation.



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The Stabil-TRAK™ lock system will be activated when the boom angle is greater than 40° and one or more of the following functions are activated:

- Engaging the Parking Brake Switch
- Placing the Travel Select Lever in (N) NEUTRAL
- Depressing and holding the Service Brake
- Model 10054 Only: Lowering both outriggers onto solid terrain, and extending the boom beyond a point between the "E" and "F" boom extend letters (approximately 40' [12 m])

With the boom lowered to an angle of less than 40°, the rear axle lock system is not active and none of these functions will affect the Stabil-TRAK™ system.

10.4 STABIL-TRAK™ OPERATION

The rough terrain forklift rarely operates on ground that is a smooth, flat surface. As its name infers, the "Construction Rough Terrain Forklift" is typically found on worksites with numerous holes, trenches, rocks and slopes.

To negotiate this type of terrain, rough terrain forklifts are designed with a free oscillating rear axle. This design enables the operator to drive over changes in terrain with minimal concern for what the rear tires are going over.

With oscillation, the rear axle will rotate upward or downward when a tire meets with anything causing it to raise or lower. The rear of the vehicle moves up or down approximately one-half the distance of the tires movement, while giving the vehicle minimal lateral movement. The oscillation capability is necessary for traveling across rough terrain.

The rear axle is capable of oscillation; the front axle is normally locked to the vehicle frame by the frame sway cylinder. The frame sway cylinder does allow for adjustment of the frame and load to a level position when traveling on a rough terrain worksite, or for leveling a load.

The least stable condition for the rough terrain forklift is when the boom is raised and the carriage is empty. This is because the center of gravity is now high and closest to the rear apex of the stability triangle.

10.4.1 Understanding the Stabil-TRAK™ System

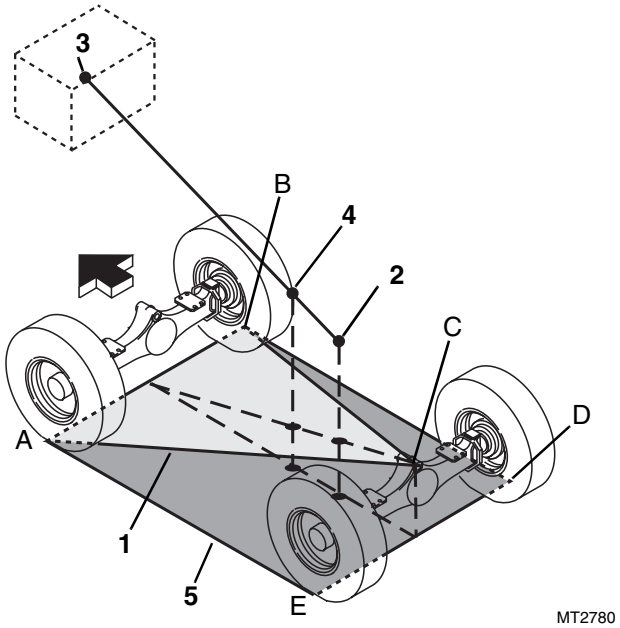
The following information explains the difference between a typical telescopic handler and the benefits that the Stabil-TRAK™ system provides.

Most telescopic handlers operate within a 3-point stability triangle (**1**) as defined by points A, B and C.

Point **2** in the illustration represents the center of gravity of an unloaded vehicle. The load has its own center of gravity represented by point **3**. When the vehicle is loaded, the vehicle and load become one mass with a combined center of gravity, represented by point **4**.

As the boom is lowered or extended, point **4** will move forward in the 3-point stability triangle, or backward in the 3-point stability triangle as the boom is raised. Point **4** can also move left or right toward the edges of the stability triangle if the frame is tilted. As long as point **4** remains in the boundaries of the 3-point stability triangle (**1**), the vehicle will remain stable. If point **4** ever goes beyond the boundaries of the stability triangle, the vehicle can tip over.

In the LOCKED MODE, the exclusive Stabil-TRAK™ System provides a 4-point stability rectangle (**5**) by positively locking the frame to the rear axle through the stabilizer cylinder. The vehicle is then supported at four points; A, B, D and E. While in the LOCKED MODE, it is clear that point **4** will remain within the entire boundary of the 4-point stability rectangle, giving the operator more flexibility in positioning the load.



The Model 10054 has an additional boom extend interlock system. This system prevents the boom from being extended beyond a point between the “E” and “F” boom extend letters (approximately 40' [12 m]), unless both outriggers have been lowered onto solid terrain.

Once this system has been activated, the vehicle will automatically place the Stabil-TRAK™ system in the LOCKED MODE and apply the park brake. The system will remain in the LOCKED MODE, until the boom has been retracted. (Refer to Section 10.6, “Boom Extend Interlock System Operation (10054 Only),” for more information.)

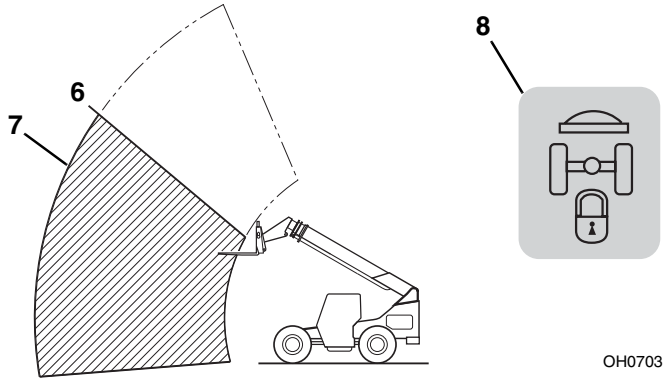
Note: *On Model 10042, the position of the outriggers will not effect the described operation of the frame sway in any of the following modes.*

The following describes the three basic modes of the patented Stabil-TRAK™ system. The vehicle may operate in any one of the following three modes.

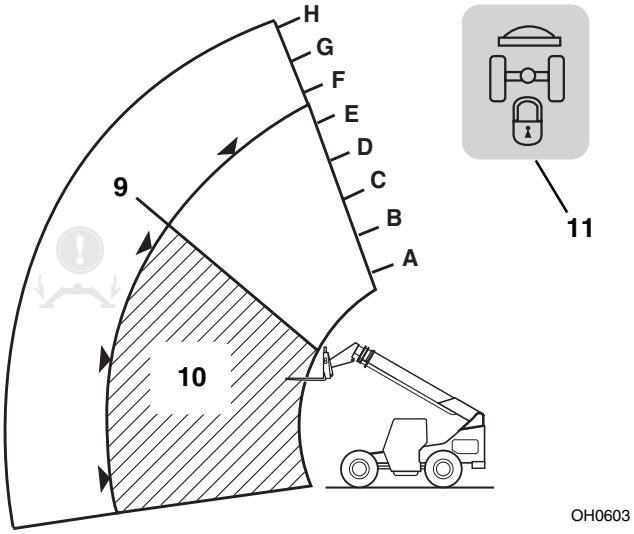
a. FREE PIVOT Mode

With the boom <u>below</u> 40° (**6** or **9**), the Stabil-TRAK™ system is in the FREE PIVOT MODE (**7** or **10**) and the rear axle is allowed to pivot freely. The frame sway control will function normally with or without the outriggers down. The Stabil-TRAK light will be OFF (**8** or **11**).

8042/10042



10054



b. LOCKED Mode

With the boom above 40° (**1** or **4**) and by activating one or more of the functions (as follows), the Stabil-TRAK™ system is in the LOCKED MODE (**2** or **5**) and the rear axle is locked so it is rigid with the frame. The Stabil-TRAK™ light (**3** or **6**) will be ON when:

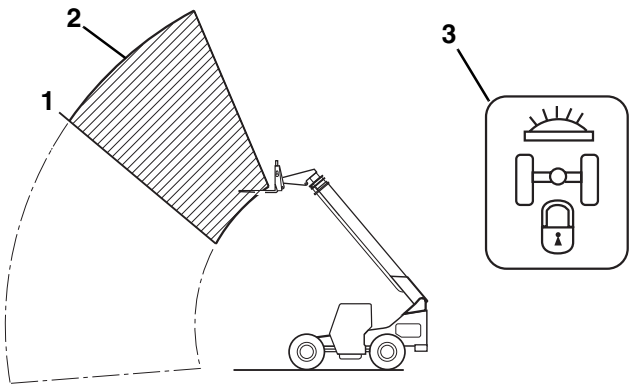
- Engaging the parking brake switch
- Placing the travel select lever in (N) NEUTRAL
- Depressing and holding the service brake pedal

The Model 10054 has an additional boom extend interlock system. This system prevents the boom from being extended beyond a point between the “E” and “F” boom extend letters (approximately 40' [12 m]), unless both outriggers have been lowered onto solid terrain.

Once this system has been activated, the vehicle will automatically place the Stabil-TRAK™ system in the LOCKED MODE. The system will remain in the LOCKED MODE, until the boom has been retracted. (Refer to Section 10.6, “Boom Extend Interlock System Operation (10054 Only),” for more information.)

The frame sway control will function slower than normal in this mode with or without the outriggers down.

8042/10042



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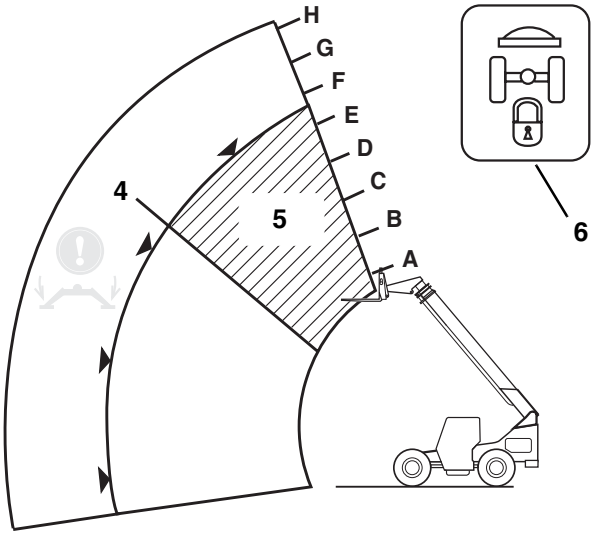
10054



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c. SLOW PIVOT Mode

With the boom above 40° (**7** or **10**), the Stabil-TRAK™ system is now in the SLOW PIVOT MODE (**8** or **11**). In this mode the rear axle is UNLOCKED and is allowed to pivot, but will respond SLOWLY to changes in terrain. The Stabil-TRAK™ light (**9** or **12**) will be OFF when:

- The parking brake switch is disengaged
- Placing the travel select lever in Forward or Reverse
- The service brake pedal is disengaged

The frame sway control function will function normally in this mode.

To check that the Stabil-TRAK™ System is functioning properly, refer to Section 10.8, “Stabil-TRAK™ System Test,” for the proper system function.

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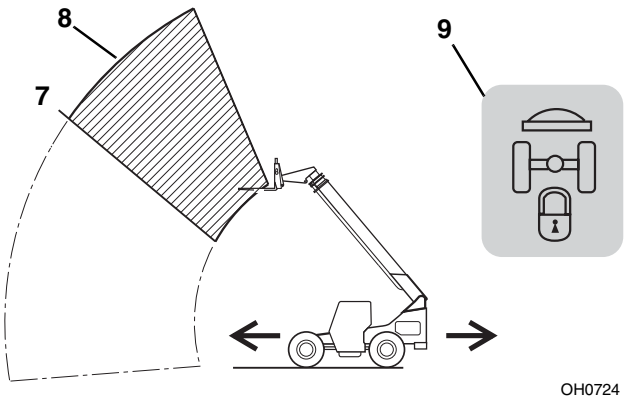

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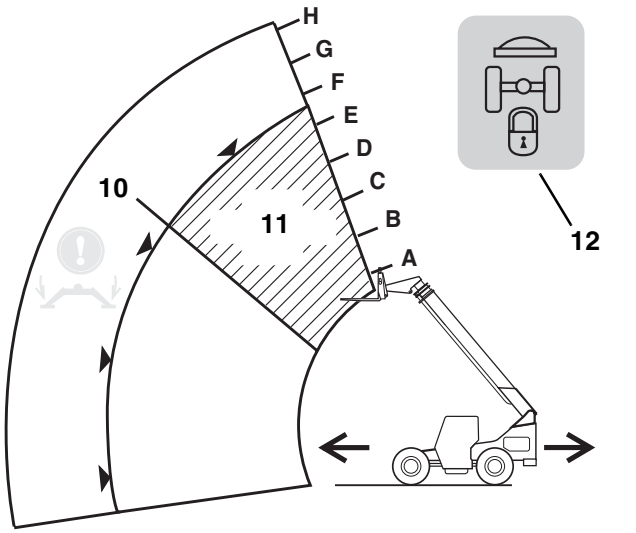


10.4.2 Stabil-TRAK™ Solenoid Valves

There are five Stabil-TRAK™ solenoid valves installed in the Stabil-TRAK™ manifold, attached to the stabilizer cylinder above the left side of the rear axle.

If a solenoid valve is suspected of malfunctioning, disconnect the coil wiring lead and test the coil for proper resistance (7-9 ohms) and for proper voltage from the harness (12 VDC). Replace the solenoid coil if open or shorted to ground.

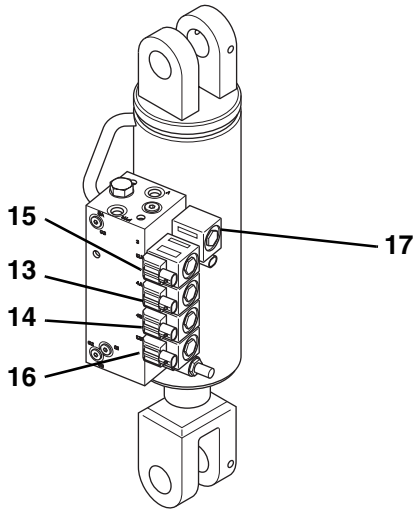
Also inspect the valve cartridge, o-rings, and the other hydraulic and electrical components in the circuit to accurately determine the cause of the problem.

All solenoid coils are identical and can be interchanged for diagnostic purposes.

***Note: DO NOT** interchange solenoid valves 4A (**13**), 4B (**14**), 12A (**15**) or 12B (**16**) with solenoid valve 3 (**17**). These valves will fit into the other locations, but are configured differently internally and will not operate properly if interchanged.*

Cartridge valves 4A (**13**), 4B (**14**), 12A (**15**) and 12B (**16**) are identical and can be interchanged for diagnostic proposes.

***IMPORTANT:** Make sure the .060 orifices are in place when installing solenoid valves 4A (**13**) and 4B (**14**).*



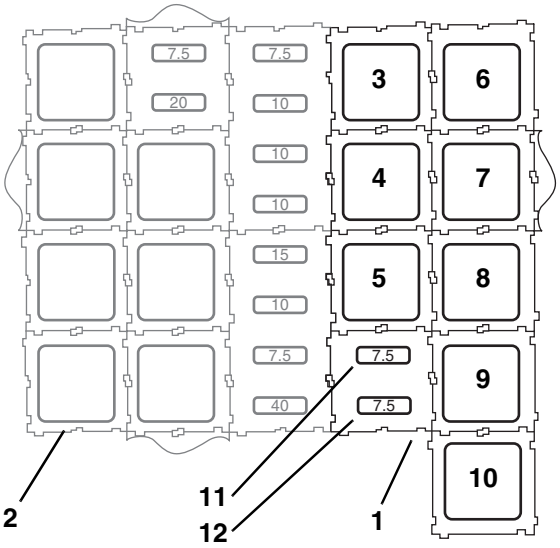
In general, if there is a problem with the Stabil-TRAK™ system beyond common electrical troubles, the involved electrical and hydraulic circuits should each be checked and the exact source of the problem diagnosed before any parts are replaced.

10.4.3 Logic Wiring Harness (10054 Only)

The Model 10054 uses an additional logic wiring harness, that includes all wiring, fuses and relays needed for the operation of the boom interlock, Stabil-TRAK™ and outrigger systems.

The logic harness has a fuse panel (**1**) that is attached to the fuse panel (**2**) from cab harness. The logic harness includes all the additional relays (**3** through **10**) and fuses (**11** and **12**) required for the operation of the boom interlock, Stabil-TRAK™ and outrigger systems.

Refer to Section 10.9, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984),” or Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After),” for electrical troubleshooting information.



MH4111

No.	Volt	Circuit Protected
3	12 Volt	Park Brake Interlock Relay
4	12 Volt	Boom Extend Relay
5	12 Volt	Outrigger Lockout Relay (SN 13198 through 17984) Blank (SN 17985 & After)
6	12 Volt	Stabil-TRAK Interlock Relay
7	12 Volt	Stabil-TRAK Lock Up Relay
8	12 Volt	Boom Extend Interlock Relay
9	12 Volt	Right Outrigger Lock Relay
10	12 Volt	Left Outrigger Lock Relay
11	7.5 Amp	Boom/Outrigger Interlock
12	7.5 Amp	Boom/Outrigger Interlock

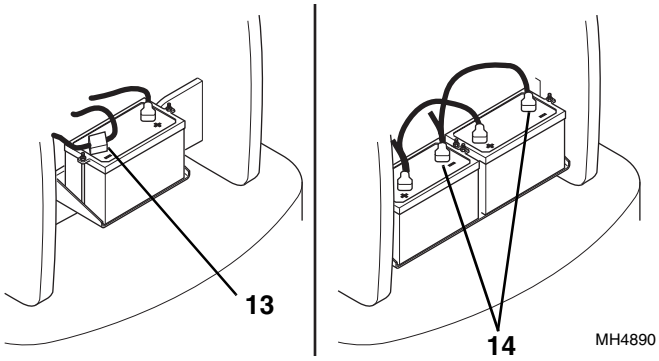
10.4.4 Relay Testing

If after checking the electrical system, a relay is suspect, test the relay as follows:

WARNING: **DO NOT** perform service or maintenance on the vehicle with the engine running, with the exception of the transmission level check. Contact with moving parts can cause death or serious personal injury.

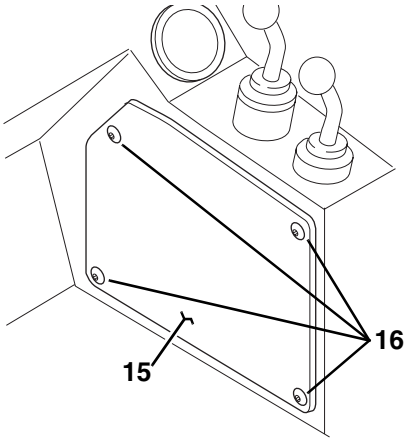
1. Be sure that the vehicle is on a level surface, the implement grounded, park brake engaged, ignition switch is in the OFF position.
2. Unlock and open the rear engine door.
3. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**13**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**14**).



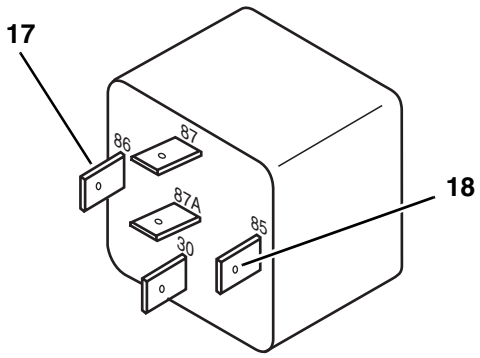
MH4890

4. The fuse block relays (**3** through **10**) are located in the fuse block and is mounted behind the right side console access panel (**15**). To gain access, remove the screws (**16**) that secure the right side panel in place.

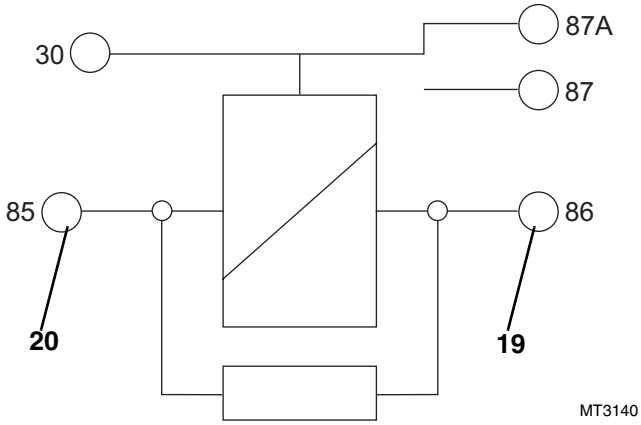


OH2430

5. Remove the suspect relay from the fuse panel.
6. Apply the proper voltage to the relay coil at terminal 86 (**17** and **19**) and attach the ground (-) probe to terminal 85 (**18** and **20**), ground. An audible click should be heard indicating that the relay is functioning properly.



MN1820



MT3140

7. When reassembling the right side console access panel (**15**), torque the screws (**16**) to 3 - 5 lb-ft (13 - 22 Nm).
8. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**13**).

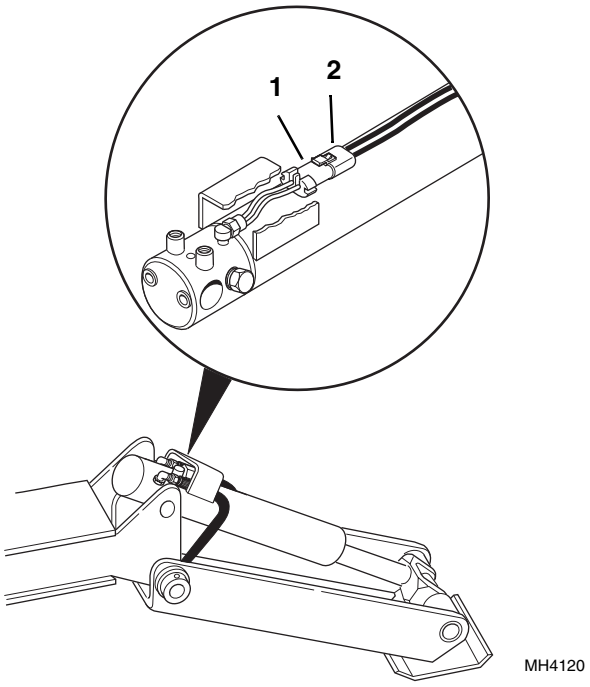
   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**14**).

10.4.5 Outrigger Pressure Switches (10054 Only)

a. Testing

If after checking the electrical system, a pressure switch is suspect, test the switch as follows:

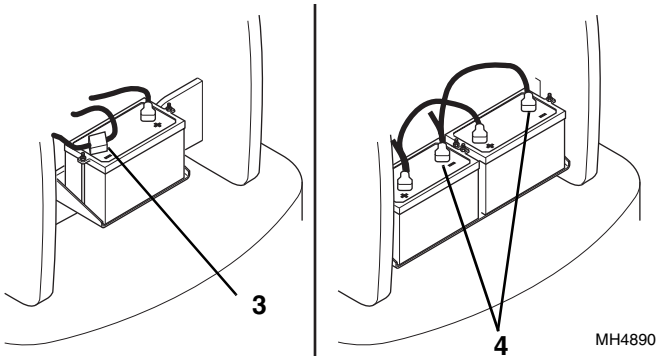
1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position and engage the parking brake switch.
2. Lower the outriggers onto firm terrain, and shut the engine OFF.
3. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
4. Disconnect the pressure switch wiring connector (**1**) from the harness connector (**2**).
5. Check for continuity across the red and black wires at the pressure switch wiring connector (**1**). If there is no continuity across the red and black wires, replace the switch.



b. Removal

1. Park the vehicle on a firm, level surface. Level the vehicle, ground the attachment, place the travel select lever in the (N) NEUTRAL position, place the neutral lock lever in the (N) NEUTRAL LOCK position and engage the parking brake switch.
2. Raise both outriggers fully, and shut the engine OFF.
3. If the vehicle has one battery, disconnect the negative (-) battery cable at the negative (-) battery terminal (**3**).

   If the vehicle has dual batteries, disconnect both negative battery cables from both negative (-) battery terminals (**4**).



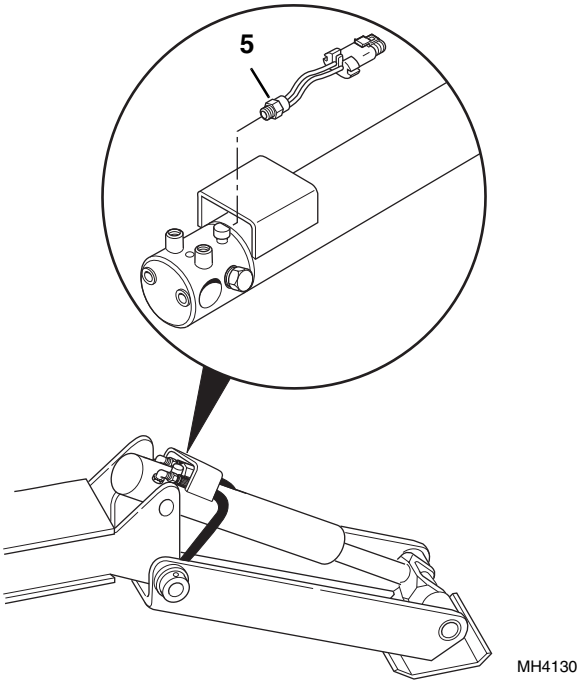
4. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the vehicle should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)

> **WARNING:** Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

5. Unlock and open the rear door. Allow the engine, transmission and hydraulic fluid to cool.
6. Disconnect the pressure switch wiring connector (**1**) from the harness connector (**2**).

> **WARNING:** Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Relieve hydraulic pressure before servicing any hydraulic component.

7. Remove the outrigger pressure switch (**5**) from the outrigger cylinder.
8. Wipe up any spilled hydraulic oil.



c. Installation

1. Install the pressure switch (**5**), and torque to 25-38 lb-ft (34-41 Nm).
2. Connect the pressure switch wiring connector (**1**) to the harness connector (**2**).
3. If the vehicle has one battery, connect the negative (-) battery cable to the negative (-) battery terminal (**3**).

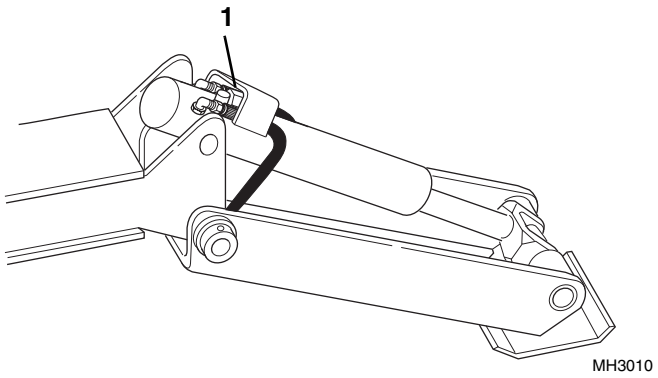
   If the vehicle has dual batteries, connect both negative battery cables to both negative (-) battery terminals (**4**).

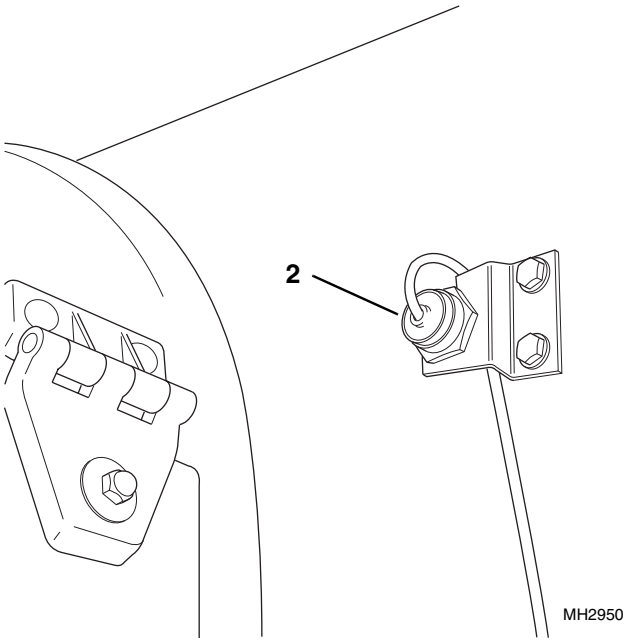
10.5 BOOM EXTEND INTERLOCK SYSTEM DESCRIPTION

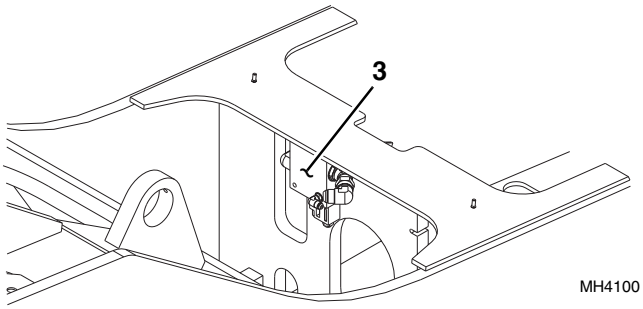
Note: *The boom interlock system is used only on the Model 10054.*

The boom extend interlock system is designed to provide additional stability, allowing the boom to be extended to its maximum limits. The appropriate owners/operators manual contains boom extend interlock basic information. A copy of the owners/operators manual should always be available in the storage compartment located on the cab frame, behind and to the left of the operator's seat.

The interlock system operates via an interface between the outrigger pressure switches (**1**), boom extend sensor (**2**), boom lockout valve (**3**) and the logic wiring harness.







The boom extend interlock system can only be activated when both outriggers are lowered onto firm terrain. Once the boom extend interlock system has been activated, the vehicle will automatically place the Stabil-TRAK™ system in the LOCKED MODE. The Stabil-TRAK™ system will remain in the LOCKED MODE, until the boom has been retracted. (Refer to Section 10.4, “Stabil-TRAK™ Operation,” for more information.)

10.6 BOOM EXTEND INTERLOCK SYSTEM OPERATION (10054 ONLY)

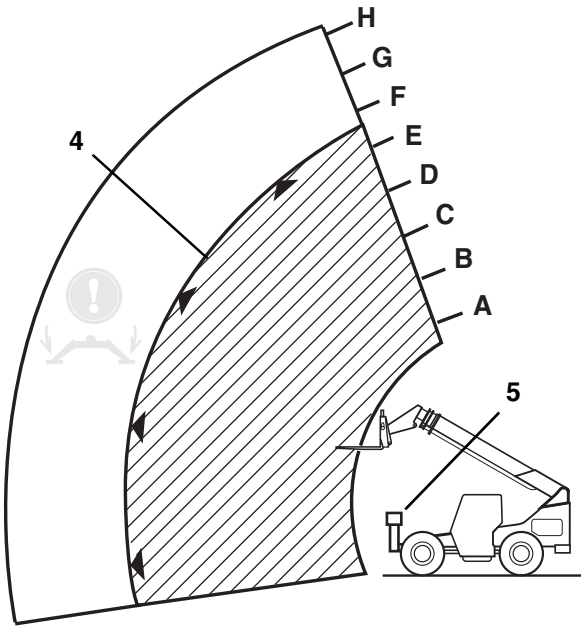
The ultimate purpose of this system is to add an extra measure of stability, allowing the boom to be extended to its maximum limits. The boom extend interlock system may operate in one of the two following modes:

10.6.1 Extend Interlock Mode

The EXTEND INTERLOCK MODE, limits boom extension (**4**) to a point after letter "E" has appeared on the side of the boom and before letter "F" appears. A sensor in the boom will automatically STOP the boom from extending past this point until the outriggers have been lowered onto firm terrain.

The retract function will still operate normally in this mode.

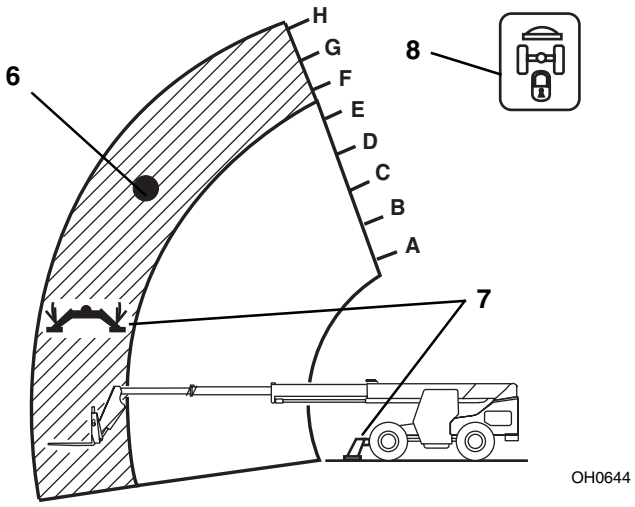
With the outriggers RAISED (**5**) and the boom inside of the extension limit (**4**) the vehicle will function normally. The Stabil-TRAK system will perform as designed.



10.6.2 Outrigger Interlock Mode

The OUTRIGGER INTERLOCK MODE, allows for full boom extension (**6**) only as long as both outriggers (**7**) have been lowered onto firm terrain (outriggers DOWN). Once this condition is met, the boom is allowed to extend to its full limits.

IMPORTANT: *As an added measure of safety, ALWAYS remember to shift the Travel Select Lever to the (N) NEUTRAL position, move the neutral lock lever to NEUTRAL LOCK position, and engage the park brake when lowering the outriggers.*



As the boom is extended past the “F” boom extend letter, the vehicle will automatically place the Stabil-TRAK™ system in the LOCKED MODE. It will remain in this mode until the boom has been retracted to a point where the boom extend sensor is activated.

With the outrigger interlock engaged additional systems are automatically activated which enhance the stability of the vehicle:

- Stabil-TRAK is in the LOCKED Mode.
- Transmission has been DECLUTCHED.
- Parking brake is ENGAGED.
- Outrigger RAISE function is inoperable.
- Stabil-TRAK light will be ON (**8**)

Other effects you will experience while the outrigger interlock is engaged:

- With Stabil-TRAK active, frame sway will be slower than normal.
- Outriggers are still allowed to lower to adjust for any changes in outrigger footing.

Not until the boom has been retracted past the extension limit will any of these conditions change.

It is important that you regularly check that this system is functioning properly. To check that the Stabil-TRAK™ System is functioning properly, refer to Section 10.8, “Stabil-TRAK™ System Test,” for the proper system function.

10.7 STABIL-TRAK™ ELECTRICAL CIRCUIT OPERATION AND TROUBLESHOOTING (8042/10042)

IMPORTANT: *Before using the 8042 and 10042 Stabil-TRAK System Troubleshooting chart and diagrams, complete the Section 10.8, "Stabil-TRAK™ System Test," on page 10.20, to determine what part of the system is not functioning properly.*

8042 and 10042 Stabil-TRAK™ System Troubleshooting			
	FREE PIVOT MODE	***SLOW PIVOT MODE***	***LOCKED MODE***
	Reference Page (10.17)	Reference Page (10.18)	Reference Page (10.19)
Machine Conditions / **Switch/ Relay Solenoid**	Ignition On Boom Below 40° Boom Retracted PB & SB Released Trans. in Forward or Reverse	Ignition On Boom Above 40° Boom Extended PB & SB Released Trans. in Forward or Reverse	Ignition On Boom Above 40° Boom Extended PB & SB Applied & Trans. in Neutral
Solenoid 12A	E	DE	DE
Solenoid 12B	E	DE	DE
Solenoid 3	DE	DE	E
Solenoid 4A	DE	E	DE
Solenoid 4B	DE	E	DE
Boom Angle Sensor	C	O	O
Boom Switch Relay	E	DE	DE
Stabilizer Lock Relay	DE	DE	E
Stabilizer Light	OFF (DE)	OFF (DE)	ON (E)
Ignition Switch	C	C	C
Park Brake Switch	O	O	C
Service Brake Switch	O	O	C
Secondary Function Manifold Park Brake Solenoids	E	E	DE
Park Brake Disengage Relay	E	E	DE
Neutral Start Relay	DE	DE	E

Definitions:

PB = Park Brake

SB = Service Brake

DE = De-energized

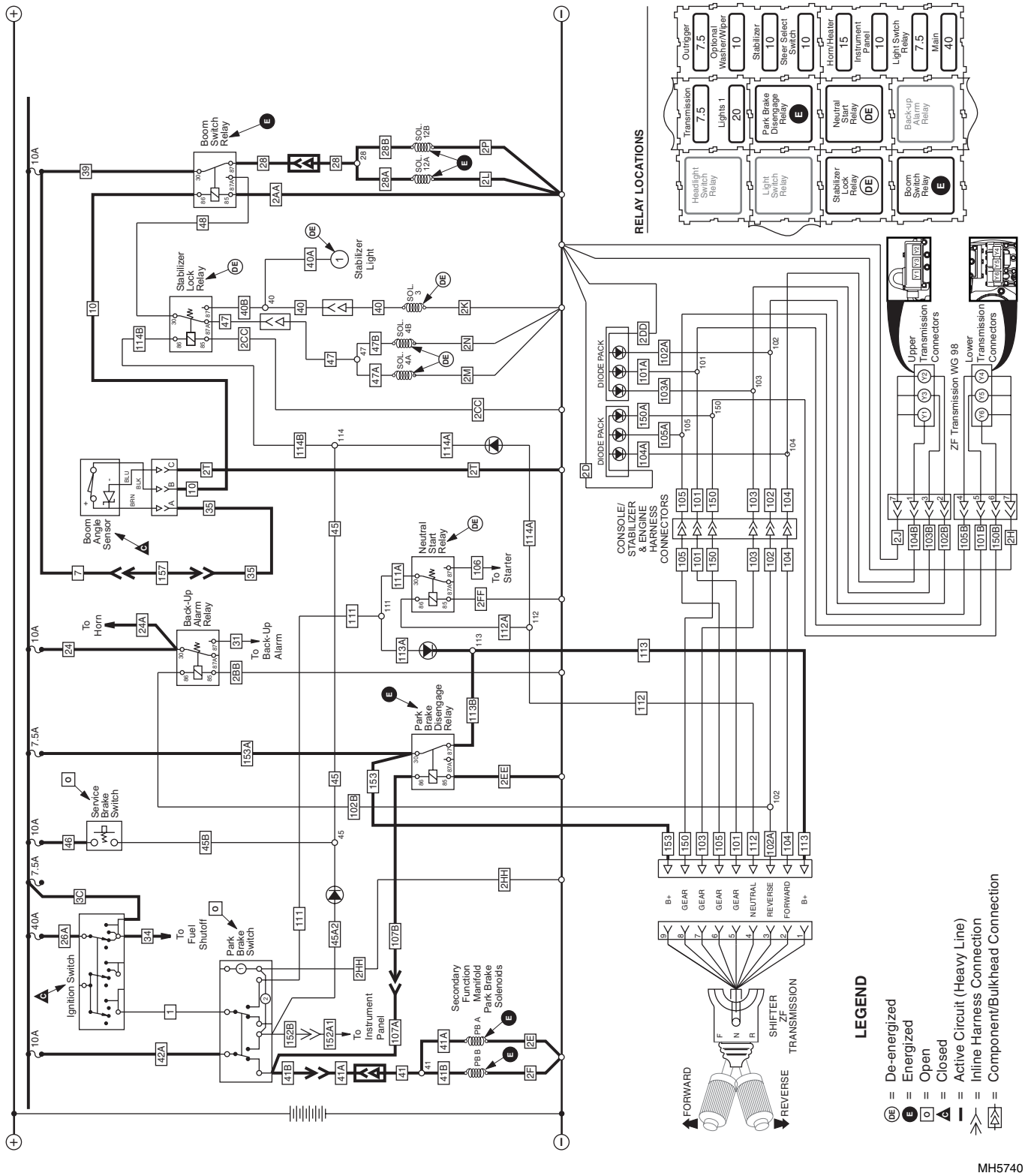
E = Energized

C = Closed

O = Open

8042 and 10042 Stabil-TRAK™ Electrical Circuit FREE PIVOT Mode

FREE PIVOT MODE				
Conditions	1.	Ignition "ON"	4.	PB & SB Released
	2.	Boom Below 40°	5.	Transmission in Fwd. or Rev.
	3.	Boom Retracted		



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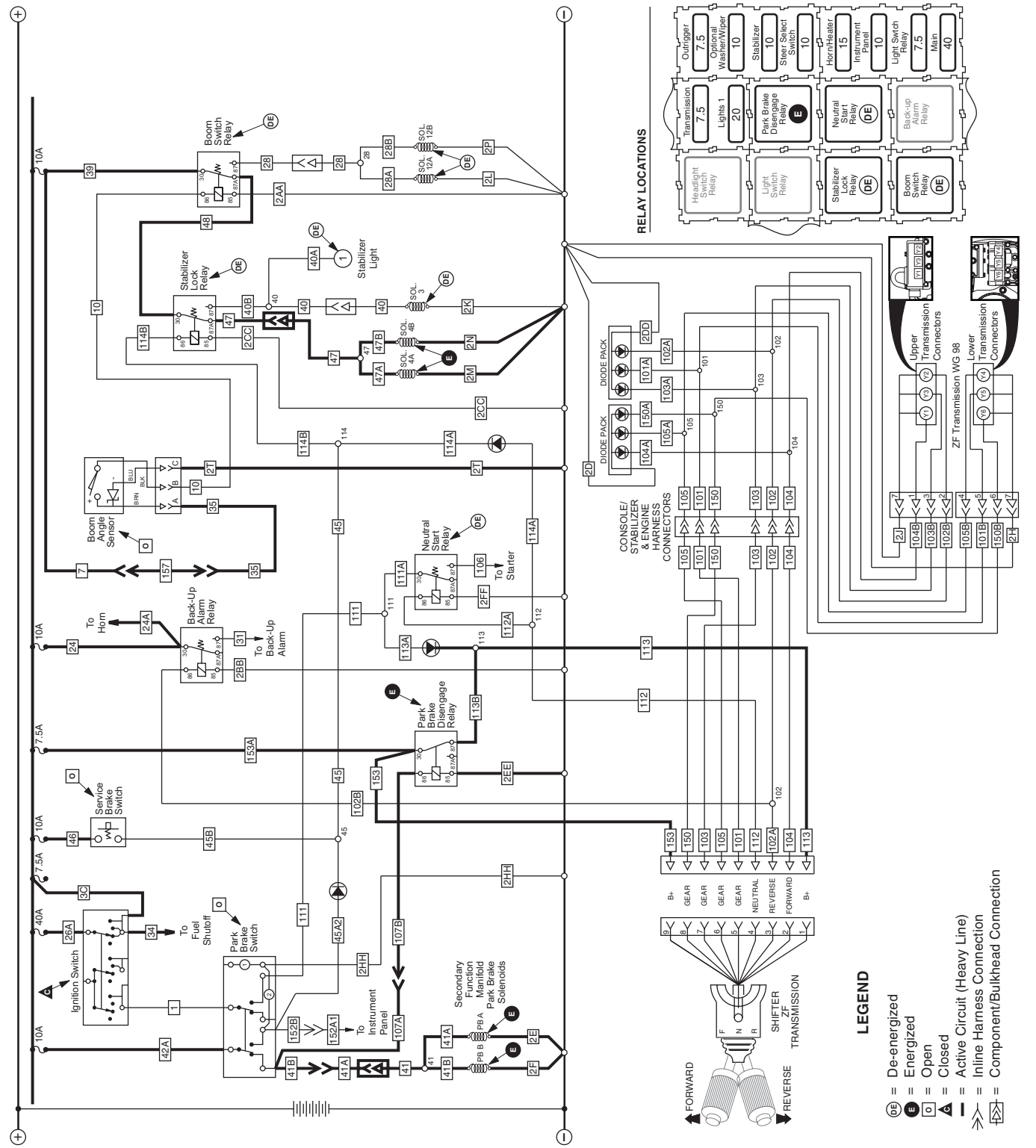
SLOW PIVOT MODE	1.	Ignition "ON"	4.	PB & SB Released
Conditions	2.	Boom Above 40°	5.	Transmission in Fwd. or Rev.
	3.	Boom Extended		

8042 and 10042 Stabil-TRAK™ Electrical Circuit SLOW PIVOT Mode



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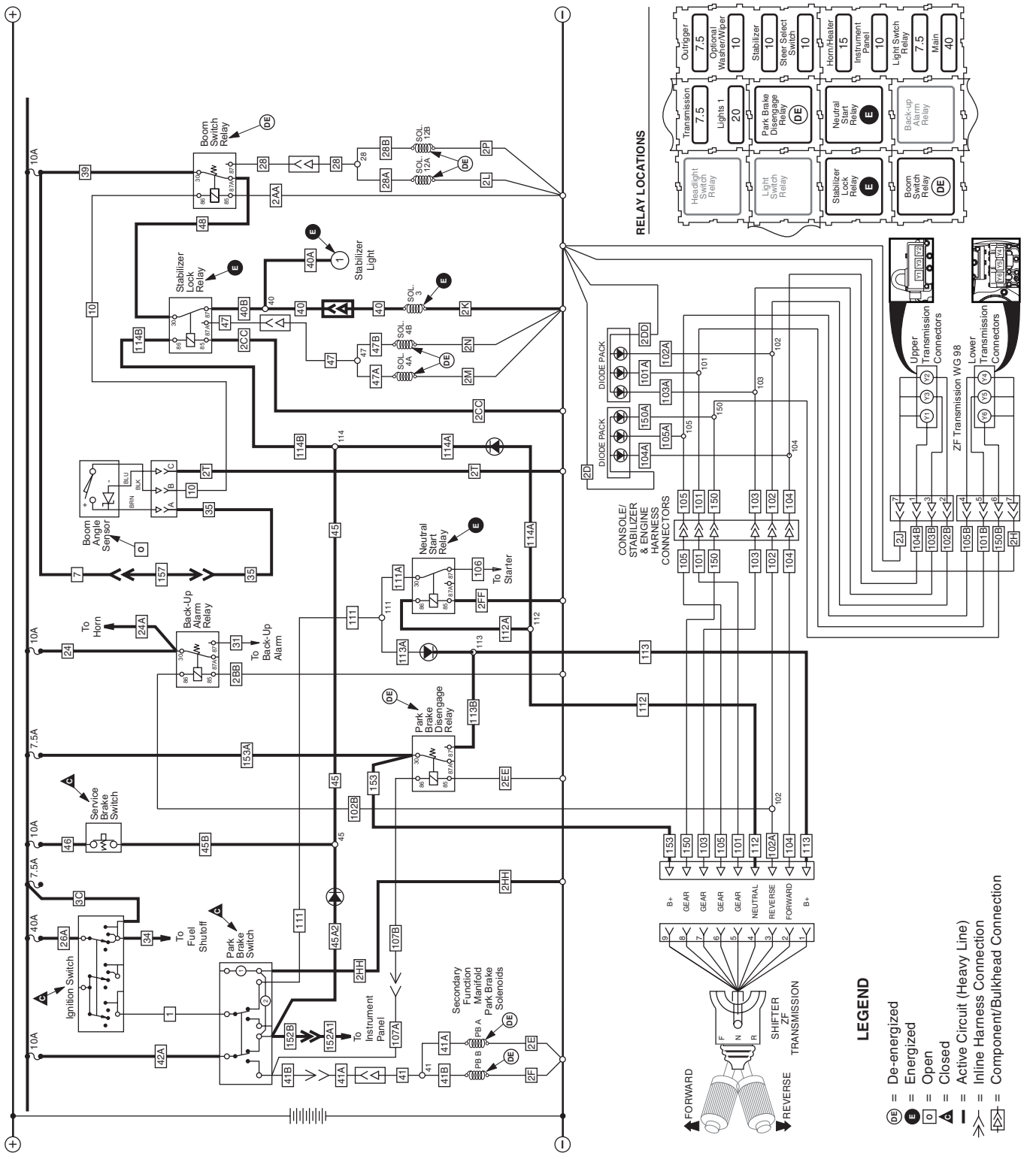
8042 and 10042 Stabil-TRAK™ Electrical Circuit LOCKED MODE

LOCKED MODE				
Conditions	1.	Ignition "ON"	4.	PB & SB Applied
	2.	Boom Above 40°	5.	Transmission in Neutral
	3.	Boom Extended		



10.8 STABIL-TRAK™ SYSTEM TEST

IMPORTANT: *The operator must know that the Stabil-TRAK™ system is active and functioning properly.*

To test the function of the Stabil-TRAK™ system, read the Stabil-TRAK™ System Test instructions and follow Steps 1 through 9 of Section 10.8.2, "Stabil-TRAK™ System Test Procedures."

10.8.1 Stabil-TRAK™ System Test Instructions

- Test the Stabil-TRAK™ system with the vehicle on a level surface.
- Remove any attachment from the quick attach before performing the test.
- **DO NOT** extend the boom at any time during the test. Perform the test with the boom fully retracted.
- **DO NOT** raise the boom above 60° for Steps 3-6.
- **DO NOT** raise the boom above 45° for Steps 7-9.
- Follow Steps 1 through 9 of the Stabil-TRAK™ system test procedure exactly as written.

IMPORTANT: *If the Stabil-TRAK™ light goes OFF and the front left tire lowers to the ground at any time during Steps 4* through *7, the test was not performed properly or the Stabil-TRAK™ system is not functioning properly. Carefully repeat the steps starting with Step 1.*

If the Stabil-TRAK™ light goes OFF and the front left tire lowers to the ground consistently during Steps 4 through 7, the Stabil-TRAK™ system is not functioning properly and the test should be stopped immediately. If the Stabil-TRAK™ system is not functioning properly, follow the procedures in Section 10.12, "Stabil-TRAK™ Hydraulic Circuit Operation and Troubleshooting," to repair the system.

> **WARNING:** **DO NOT** operate this vehicle unless you are in the seat with the seat belt fastened around you. Death or serious personal injury could result if the belt is not securely fastened.

10.8.2 Stabil-TRAK™ System Test Procedures

If Steps 1 through 9 prove positive, the Stabil-TRAK™ system is functioning properly, and the vehicle can be returned to service. If any of these steps indicate that the Stabil-TRAK™ system is not functioning properly, follow the procedures in Section 10.12, "Stabil-TRAK™ Hydraulic Circuit Operation and Troubleshooting," to repair the system.

Stabil-TRAK System Test Procedures	
FREE PIVOT MODE	**Step 1**
	a. Place the vehicle on a level surface with 0° sway.
	b. Have the boom fully retracted and horizontal.
	c. Place an 8" (203 mm) wood or cement block in front of the front left tire.
	d. Enter the vehicle.
	e. Fasten the seat belt.
	f. Turn the key to the RUN position.
	g. Check to be sure the Stabil-TRAK™ light is OFF.  OH2500
	Step 2
	a. Start the engine.
	b. Turn the parking brake switch OFF.
	c. Move the range select lever to (1) FIRST gear.
	d. Move the travel select lever to the (F) FORWARD position.
	e. Drive the vehicle up on the block.
	f. Use the frame sway control to level the vehicle back to 0°.
LOCKED MODE	**Step 3**
Service Brake Test ▶	a. Depress the service brake pedal.
	b. Move the travel select lever to the (N) NEUTRAL position.
	c. Raise the boom to <u>exactly 60°</u>. The Stabil-TRAK™ light should come ON when the boom angle is at about 40° and remain ON.
	Step 4
	a. Use your left foot to depress the service brake pedal.
	b. With the range select lever in (2) SECOND gear, move the travel select lever to the (R) REVERSE position.
	c. Ease your left foot partially off the service brake pedal, make sure that the Stabil-TRAK™ light remains ON.
	d. With your right foot, increase the engine rpm slightly, as necessary, just enough to back the vehicle off the block. While backing off the block, the front left tire should remain off the ground.
	IMPORTANT: *Perform Steps 5 thru 9 with the engine rpm at idle.*
	Step 5
Neutral Test ▶	a. Keep the <u>service brake pedal</u> depressed.
	b. Move the travel select lever to the (N) NEUTRAL position.
	c. Take your foot off the service brake pedal. The Stabil-TRAK™ light should remain ON and the front left tire should remain off the ground.
	Step 6
Park Brake Test ▶	a. With the <u>travel select lever</u> in the (N) NEUTRAL position, engage the parking brake switch.
	b. Move the travel select lever to the (F) FORWARD position. The Stabil-TRAK™ light should remain ON and the front left tire should remain off the ground.

Stabil-TRAK System Test Procedures	
LOCKED MODE	**Step 7**
	a. With the parking brake switch ON, move the travel select lever to the (N) NEUTRAL position.
	b. Lower the boom to exactly 45°.
	c. Frame sway the vehicle no more than 5° to the left.
	d. Frame sway the vehicle back to 0°.
	e. Frame sway the vehicle no more than 5° to the right. ***Note:*** *Observe that frame sway will be slower than normal during this test.*
	f. The Stabil-TRAK™ light should remain ON and the front left tire should remain off the ground. The front left tire should not raise or lower during frame sway.
	g. Frame sway back toward 0°, leaving the vehicle swayed to the right approximately 1° to 2°.
	Step 8
	a. Depress the service brake pedal.
	b. Disengage the parking brake switch.
	c. With the range select lever in (1) FIRST gear, move the travel select lever to the (R) REVERSE position.
	d. Release the service brake pedal to deactivate the Stabil-TRAK™ system.
SLOW PIVOT MODE	e. The Stabil-TRAK™ light should go OFF.
	f. The front left tire should return to the ground while the vehicle travels in reverse.
LOCKED MODE	g. Depress the service brake pedal to stop the vehicle.
	Step 9
	a. With the service brake pedal depressed and the boom angle at exactly 45°, move the range select lever to (3) THIRD gear.
	b. Move the travel select lever to (F) FORWARD.
	c. Release the service brake pedal to deactivate the Stabil-TRAK™ system. The Stabil-TRAK™ light should go OFF.
	d. Slowly drive the vehicle forward against the block to stop the vehicle from moving forward.
	e. With the front left tire against the block, frame sway the vehicle no more than 5° to the left.
SLOW PIVOT MODE	f. Check that the front left tire remains on the ground. It is normal for the front left tire to raise slightly when swaying to the left, but the tire should immediately lower when the frame sway function is stopped.
	g. Frame sway the vehicle back to 0° and pause briefly.
	h. Frame sway the vehicle no more than 5° to the right.
	i. Check that the front right tire remains on the ground. It is normal for the front right tire to raise slightly when swaying to the right, but the tire should immediately lower when the frame sway function is stopped.
	j. Frame sway the vehicle back to 0°.
	k. Depress the service brake pedal.
	l. Shift the travel select lever to (N) NEUTRAL.
	m. Lower the boom.

10.9 STABIL-TRAK™ BOOM INTERLOCK ELECTRICAL CIRCUIT OPERATION AND TROUBLESHOOTING (10054, 13198-17984)

IMPORTANT: *Before using the 10054 Stabil-TRAK System Troubleshooting chart and diagrams, complete Section 10.8, "Stabil-TRAK™ System Test," on page 10.20 and Section 10.11, "Boom/Outrigger Interlock System Test," on page 10.34, to determine what part of the system is not functioning properly.*

10054 Stabil-TRAK™ System Troubleshooting

		BOOM EXTEND MODE 1	***BOOM EXTEND MODE 2***	***BOOM EXTEND MODE 3***
		Reference Page (10.25)	Reference Page (10.26)	Reference Page (10.27)
Switch/ Relay Solenoid / **Machine Conditions**		Ignition On Boom Below 40° Boom Retracted PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended To 42 Series Extension Limit PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended Beyond 42 Series Extension Limit PB Applied By Interlock Sys. Trans. In Neutral By Interlock Sys. Outriggers Lowered
Solenoid 12A	**Stabil-TRAK Components Affected By Boom Interlock System**	E	E	DE
Solenoid 12B		E	E	DE
Solenoid 3		DE	DE	E
Solenoid 4A		DE	DE	DE
Solenoid 4B		DE	DE	DE
Boom Angle Sensor		C	C	O
Boom Switch Relay		E	E	DE
Stabilizer Lock Relay		DE	DE	E
Stabilizer Light		OFF (DE)	OFF (DE)	ON (E)
Ignition Switch		C	C	C
Park Brake Switch		O	O	O
Park Brake Light		OFF (DE)	OFF (DE)	ON (E)
BOOM EXTEND INTERLOCK SYSTEM TROUBLESHOOTING				
Boom Extend Interlock Sensor		C	O	O
Boom Extend Interlock Relay		E	DE	DE
Boom Extend Lockout Relay		E	DE	DE
Outrigger Lockout Relay		E	DE	DE
Outrigger Pressure Switches		O	O	C
Left Outrigger Lockout Relay		DE	DE	E
Right Outrigger Lockout Relay		DE	DE	E
Stabilizer Interlock Relay		DE	DE	E
Stabilizer Lock-Up Relay		DE	DE	E
Extend Circuit Solenoid Valve		E	DE	E
Secondary Function Manifold Park Brake Solenoids		E	E	DE
Park Brake Interlock Relay		DE	DE	E
Park Brake Disengage Relay		E	E	DE

Note: *If an outrigger is raised or a pressure switch is defective, boom on the 10054 will not extend beyond the 42 Series extension limit.*

Definitions:

Boom Retracted = Less than 42 Series extension limit

Boom Extended = Boom at 42 Series extension limit or greater (See Figure at Right).

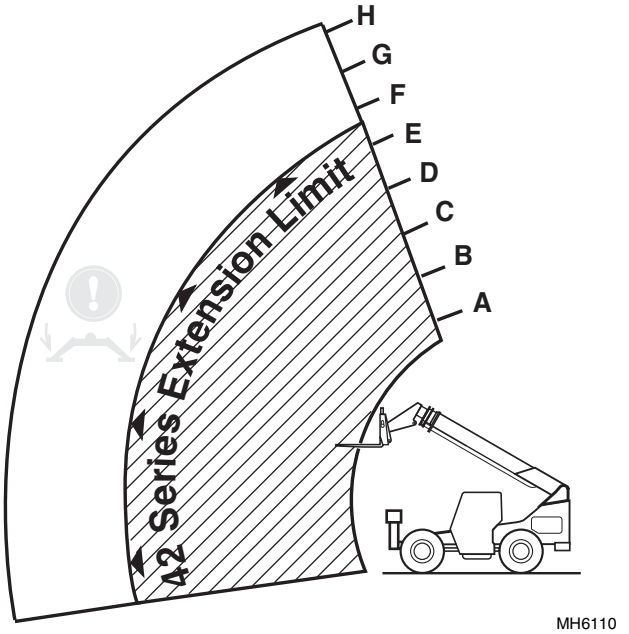
PB = Park Brake

DE = De-energized

E = Energized

C = Closed

O = Open



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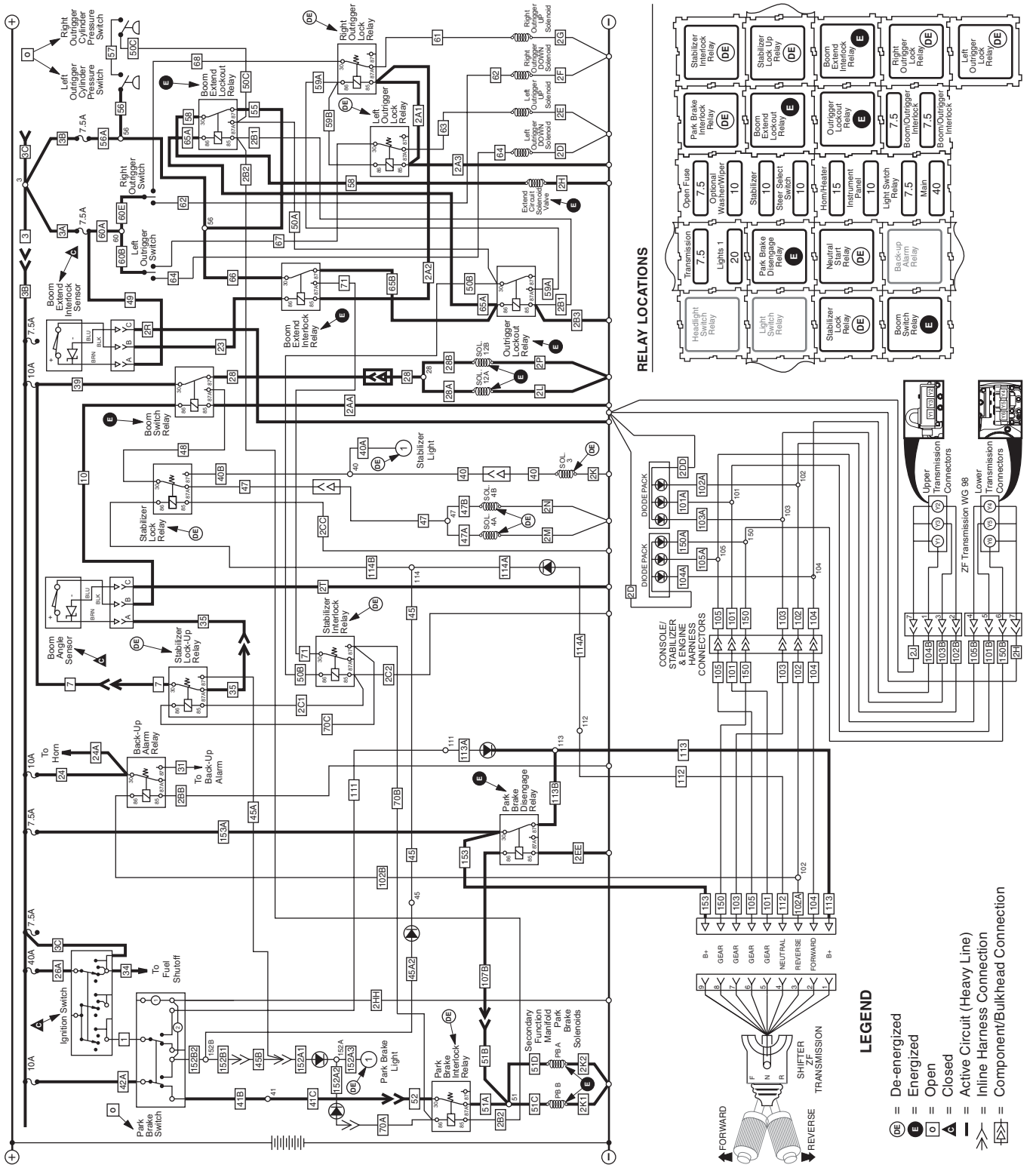
10054 Stabil-TRAK™ Electrical Circuit
SN 13198-17984
Boom Extend Mode 1

MODE 1	**1.**	Ignition "ON"	**4.**	PB Released
Conditions	**2.**	Boom Below 40°	**5.**	Transmission in Fwd. or Rev.
	3.	Boom Retracted	**6.**	Outriggers Raised



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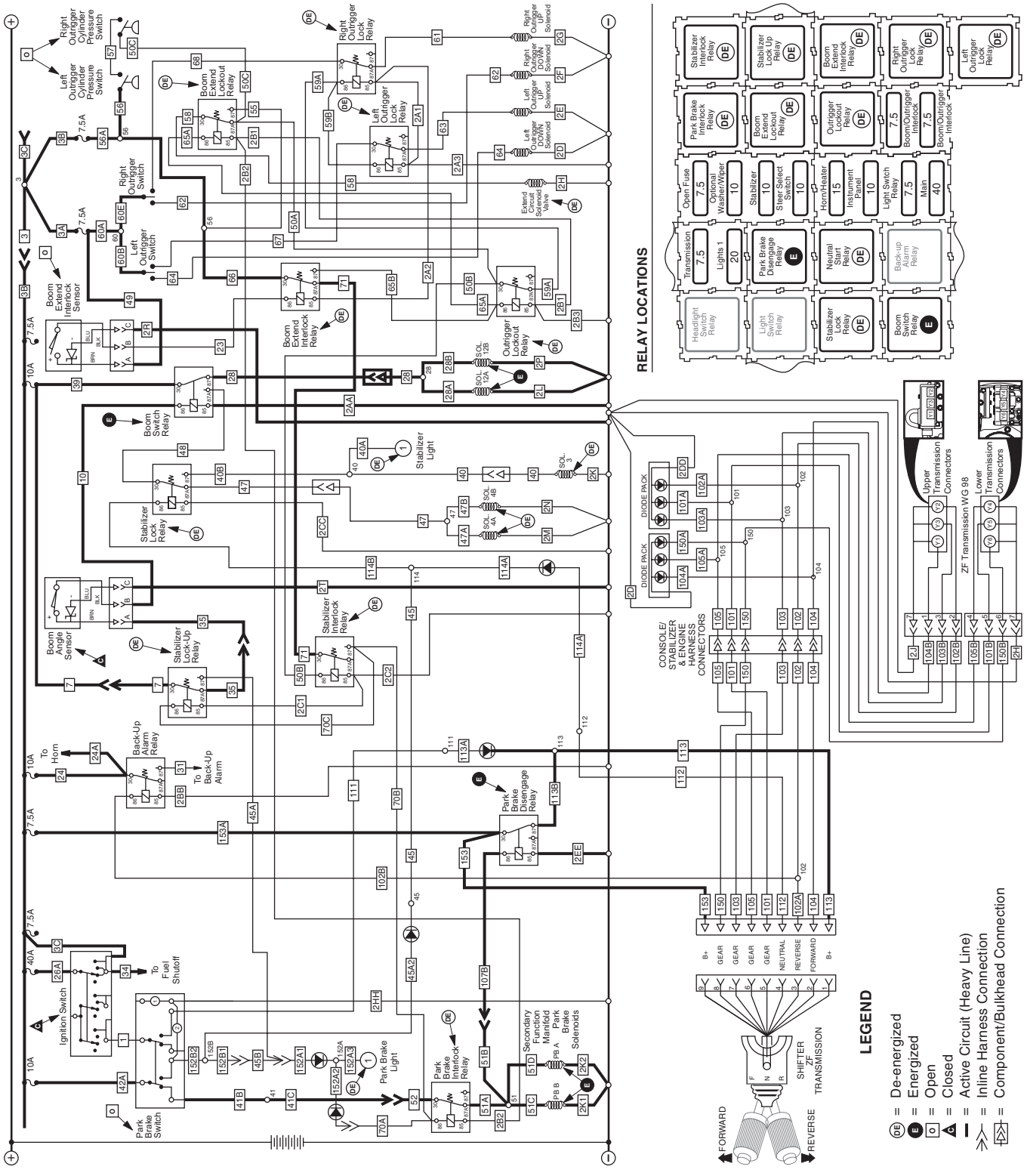
MODE 2	**1.**	Ignition "ON"	**4.**	PB Released
Conditions	**2.**	Boom Below 40°	**5.**	Transmission in Fwd. or Rev.
	3.	Boom Extended To 42 Foot Ext. Limit	**6.**	Outriggers Raised

10054 Stabil-TRAK™ Electrical Circuit
SN 13198-17984
Boom Extend Mode 2



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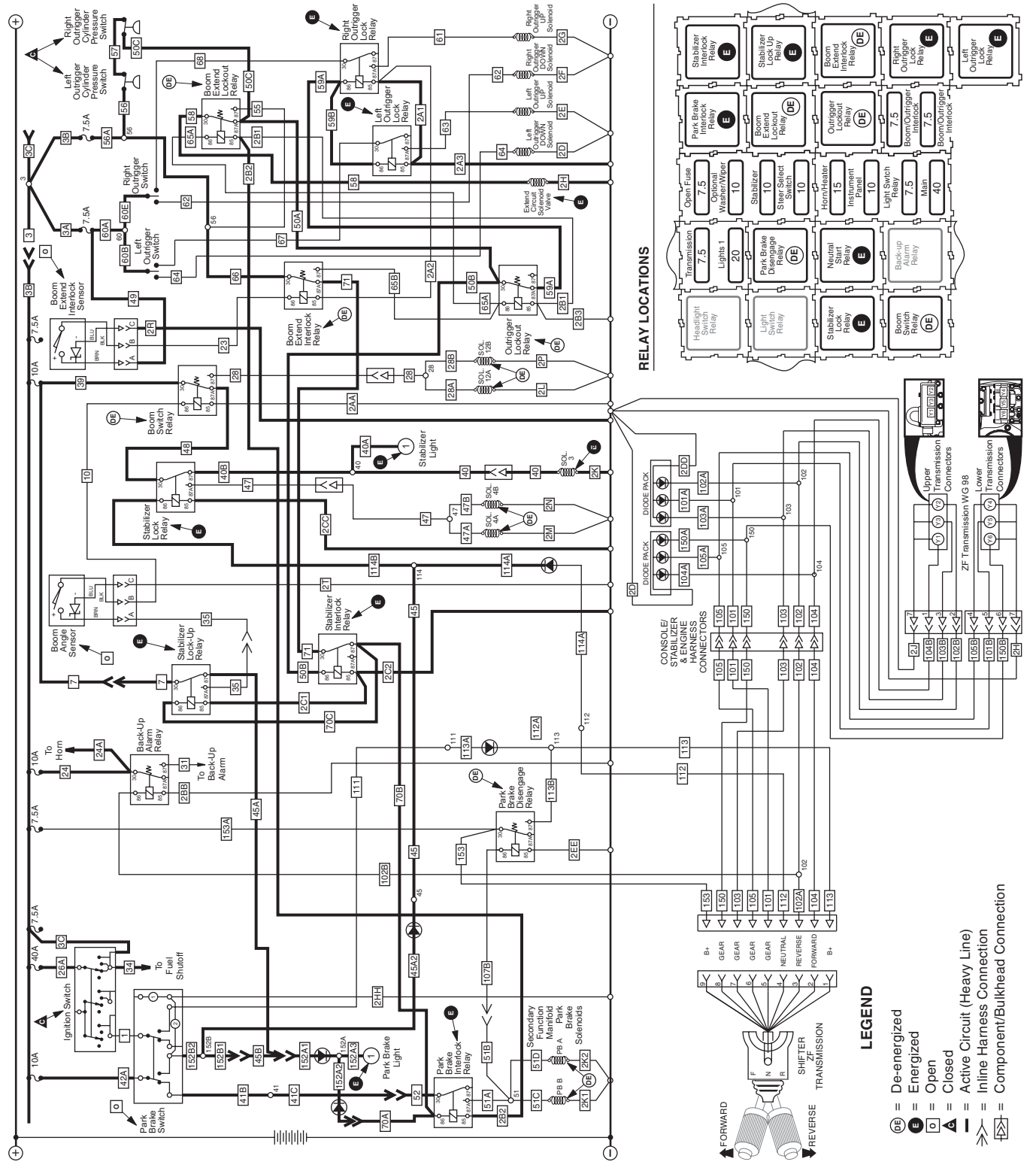
10054 Stabil-TRAK™ Electrical Circuit
SN 13198-17984
Boom Extend Mode 3

MODE 3	**1.**	Ignition "ON"	**4.**	PB Applied By Interlock Sys.
Conditions	**2.**	Boom Below 40°	**5.**	Trans. in Neutral By Interlock Sys.
	3.	Boom Extended Beyond 42 Foot Ext. Limit	**6.**	Outriggers Lowered



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10.10 STABIL-TRAK™ BOOM INTERLOCK ELECTRICAL CIRCUIT OPERATION AND TROUBLESHOOTING (10054, 17985-19987 AND 0160002332 & AFTER)

IMPORTANT: *Before using the 10054 Stabil-TRAK System Troubleshooting chart and diagrams, complete Section 10.8, "Stabil-TRAK™ System Test," on page 10.20 and Section 10.11, "Boom/Outrigger Interlock System Test," on page 10.34, to determine what part of the system is not functioning properly.*

10054 Stabil-TRAK™ System Troubleshooting				
		BOOM EXTEND MODE 1	***BOOM EXTEND MODE 2***	***BOOM EXTEND MODE 3***
		Reference Page (10.31)	Reference Page (10.32)	Reference Page (10.33)
Switch/ Relay Solenoid / **Machine Conditions**		Ignition On Boom Below 40° Boom Retracted PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended To 42 Series Extension Limit PB Released Trans. Fwd. or Rev. Outriggers Raised	Ignition On Boom Below 40° Boom Extended Beyond 42 Series Extension Limit PB Applied By Interlock Sys. Trans. In Neutral By Interlock Sys. Outriggers Lowered
Solenoid 12A	**Stabil-TRAK Components Affected By Boom Interlock System**	E	E	DE
Solenoid 12B		E	E	DE
Solenoid 3		DE	DE	E
Solenoid 4A		DE	DE	DE
Solenoid 4B		DE	DE	DE
Boom Angle Sensor		C	C	O
Boom Switch Relay		E	E	DE
Stabilizer Lock Relay		DE	DE	E
Stabilizer Light		OFF (DE)	OFF (DE)	ON (E)
Ignition Switch		C	C	C
Park Brake Switch		O	O	O
Park Brake Light		OFF (DE)	OFF (DE)	ON (E)
BOOM EXTEND INTERLOCK SYSTEM TROUBLESHOOTING				
Boom Extend Interlock Sensor		C	O	O
Boom Extend Interlock Relay		E	DE	DE
Boom Extend Lockout Relay		E	DE	DE
Outrigger Pressure Switches		O	O	C
Left Outrigger Lockout Relay		DE	E	E
Right Outrigger Lockout Relay		DE	E	E
Stabilizer Interlock Relay		DE	DE	E
Stabilizer Lock-Up Relay		DE	DE	E
Extend Circuit Solenoid Valve		E	E	E
Secondary Function Manifold Park Brake Solenoids		E	E	DE
Park Brake Interlock Relay		DE	DE	E
Park Brake Disengage Relay		E	E	DE

Note: *If an outrigger is raised or a pressure switch is defective, boom on the 10054 will not extend beyond the 42 Series extension limit.*

Definitions:

Boom Retracted = Less than 42 Series extension limit

Boom Extended = Boom at 42 Series extension limit or greater (See Figure at Right).

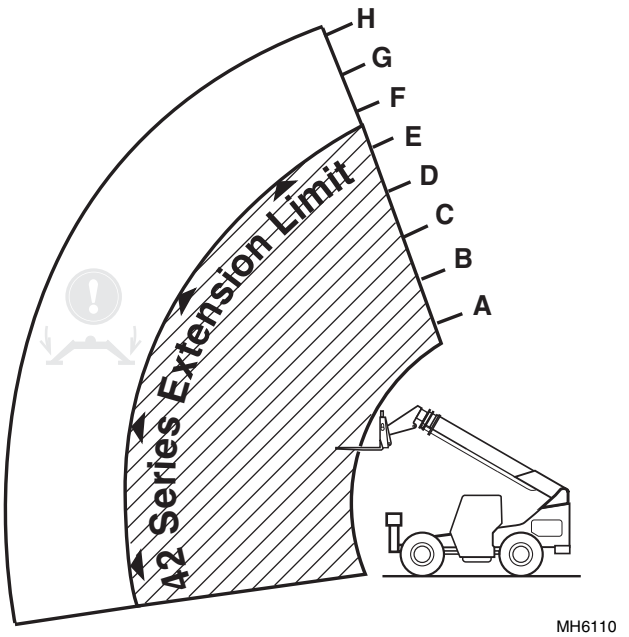
PB = Park Brake

DE = De-energized

E = Energized

C = Closed

O = Open



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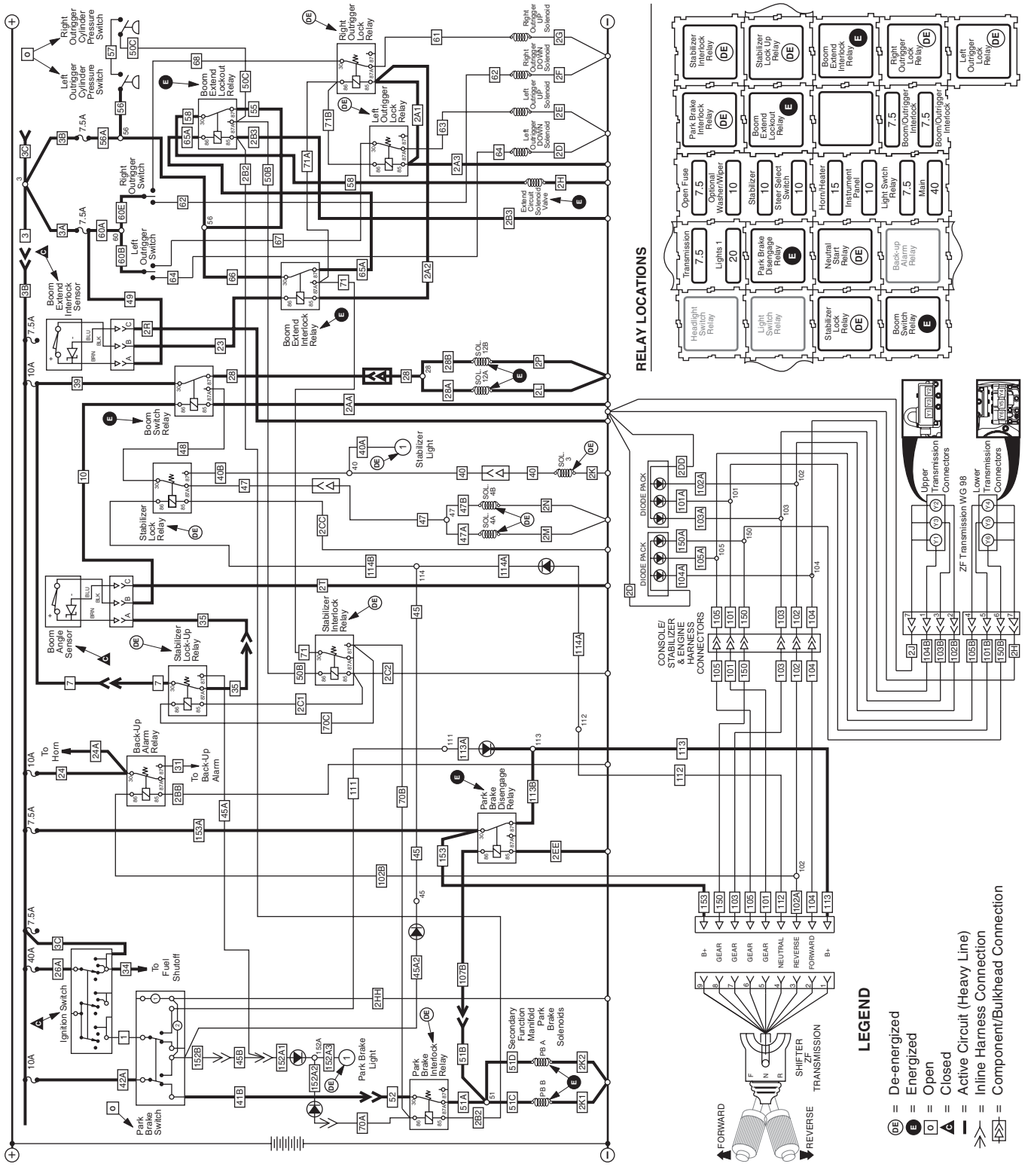
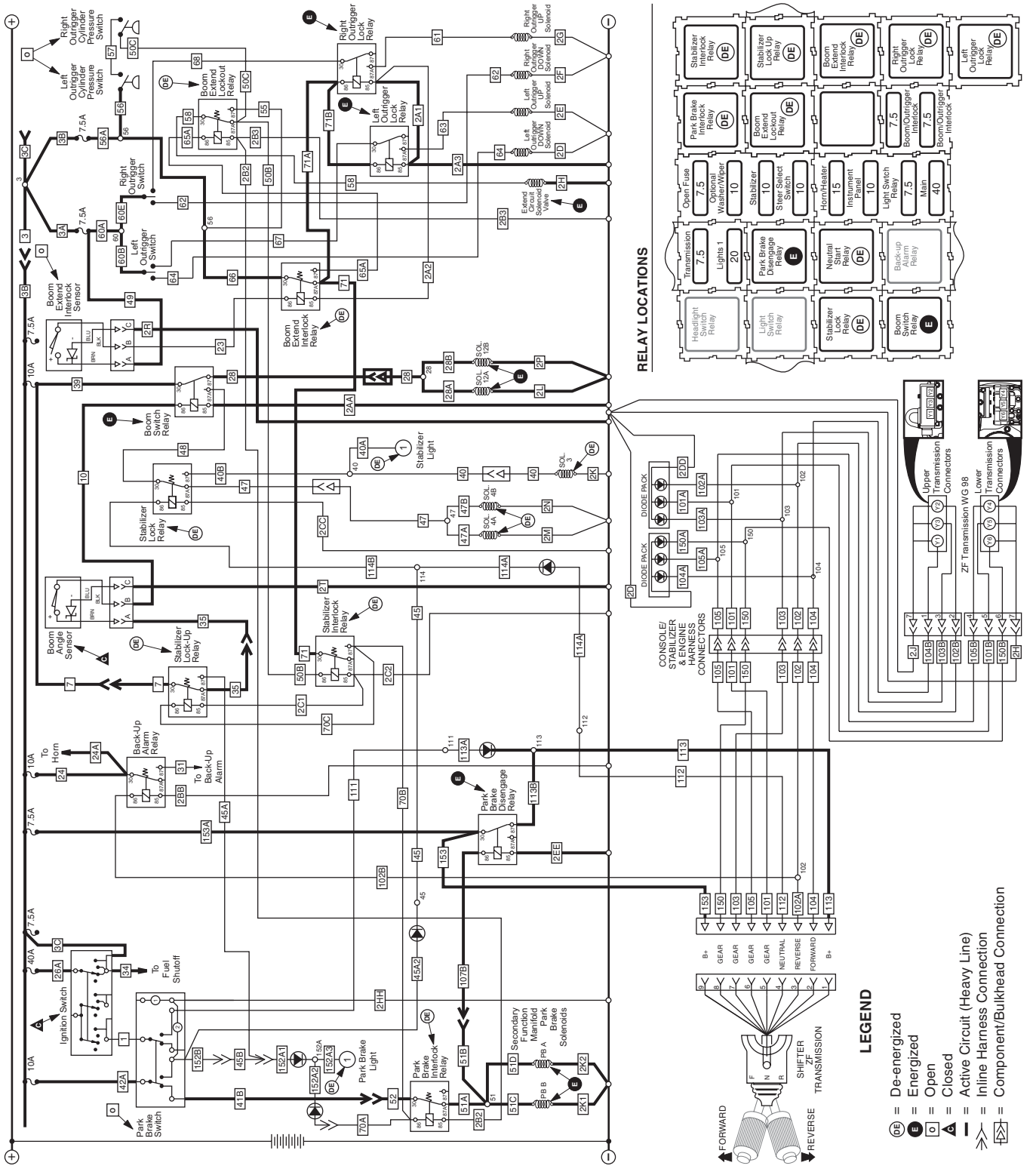
10054 Stabil-TRAK™ Electrical Circuit SN 17985-19987 And 0160002332 & After Boom Extend Mode 1

MODE 1	**1.**	Ignition “ON”	**4.**	PB Released
Conditions	**2.**	Boom Below 40°	**5.**	Transmission in Fwd. or Rev.
	3.	Boom Retracted	**6.**	Outriggers Raised



MODE 2	**1.**	Ignition "ON"	**4.**	PB Released
Conditions	**2.**	Boom Below 40°	**5.**	Transmission in Fwd. or Rev.
	3.	Boom Ext. To 42 Foot Ext. Limit	**6.**	Outriggers Raised

10054 Stabil-TRAK™ Electrical Circuit
SN 17985-19987 And 0160002332 & After
Boom Extend Mode 2



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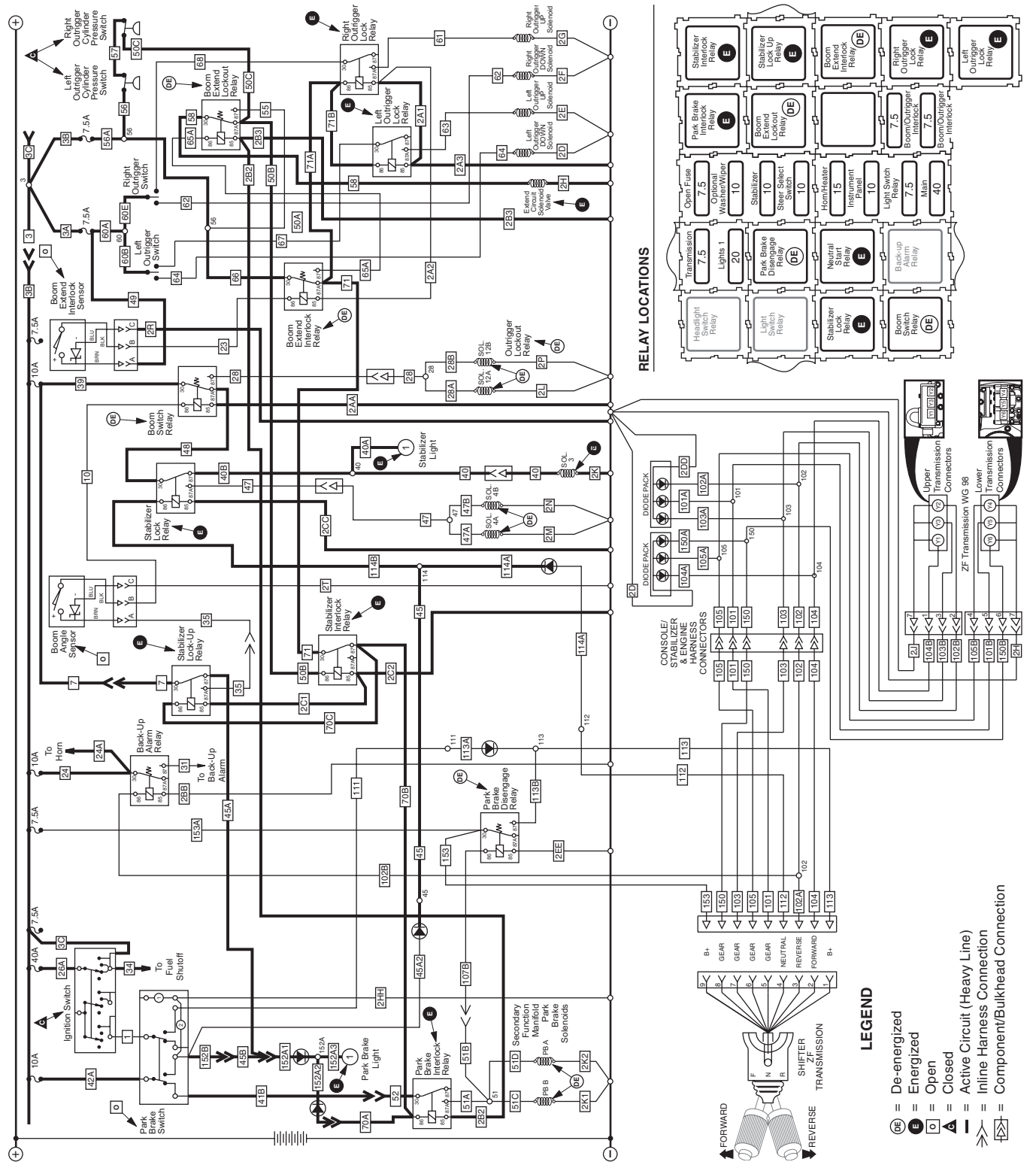
10054 Stabil-TRAK™ Electrical Circuit
SN 17985-19987 And 0160002332 & After
Boom Extend Mode 3

MODE 3	**1.**	Ignition "ON"	**4.**	PB Applied By Interlock Sys.
Conditions	**2.**	Boom Below 40°	**5.**	Trans. in Neutral By Interlock Sys.
	3.	Boom Ext. Beyond 42 Foot Ext. Limit	**6.**	Outriggers Lowered



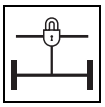
10.11 BOOM/OUTRIGGER INTERLOCK SYSTEM TEST

Before performing the following Boom/Outrigger Interlock System Test, perform Section 10.8, “Stabil-TRAK™ System Test,” to determine if the Stabil-TRAK™ system is working properly. If necessary, repair the Stabil-TRAK™ system before testing the boom/outrigger interlock system.

WARNING: **DO NOT** operate this vehicle unless you are in the seat with the seat belt fastened around you. Death or personal serious injury could result if the belt is not securely fastened.

10.11.1 System Test Procedures

If Steps 1 through 5 prove positive, the Boom/Outrigger Interlock System is functioning properly, and the vehicle can be returned to service. If any of these steps indicate that the Boom/Outrigger Interlock system is not functioning properly, follow the procedures in Section 10.13, “Boom Extend System Hydraulic Circuit Operation and Troubleshooting,” to repair the system.



Boom/Outrigger Interlock System Test Procedures	
BOOM EXTEND MODE 1	**Step 1**
	a. Place the vehicle with no load on a hard, level surface such as blacktop or concrete.
	b. Fasten your seat belt.
	Step 2
BOOM EXTEND MODE 2	a. With the outriggers in the raised position and the boom in a horizontal position, extend the boom. The boom should extend until the letter “E” appears and then should STOP. If the boom extends beyond the letter “F”, retract the boom fully and have the system repaired before using the vehicle again.
	b. Attempt to frame sway the vehicle to the right and left; it should frame sway normally.
	Step 3
BOOM EXTEND MODE 3	a. Lower both outriggers to the ground. **DO NOT** lift the front wheels of the vehicle off the ground at this time. The Stabil-TRAK™ light should come ON when the outriggers are lowered.
	b. With the boom still in a horizontal position, extend the boom.
	c. Attempt to raise both outriggers; they should not rise. If the outriggers rise, **STOP** and retract the boom and have the system repaired before using the vehicle again.
	d. If the outriggers cannot be raised, attempt to lower the outriggers fully until both front wheels are off the ground; the outriggers should lower.
	Step 4
	a. Place the travel select lever in the (F) FORWARD position and the gear select lever in the (1) FIRST gear position.
	b. Attempt to accelerate the vehicle; the vehicle should not move.
	c. If the vehicle attempts to move, **STOP** and have the system repaired before using the vehicle again.
	IMPORTANT: *Perform Steps 5 thru 9 with the engine rpm at idle.*
	Step 5
	a. Attempt to frame sway the vehicle to the right and left; it should frame sway, but at a slower speed than normal.
	b. The Stabil-TRAK™ light should remain ON.
	c. Return the vehicle to a level position.
	Step 6
	a. Place the travel select lever in the (N) NEUTRAL position, move the neutral lock lever to the NEUTRAL LOCK position.
	b. Fully retract the boom.
BOOM EXTEND MODE 1	c. Raise the outriggers.
	d. Engage the parking brake switch, shut the engine OFF and remove the key.
	e. Exit the vehicle using both handholds.

10.12 STABIL-TRAK™ HYDRAULIC CIRCUIT OPERATION AND TROUBLESHOOTING

The function of the Stabil-TRAK™ system varies under different operating conditions. The basic modes include the FREE PIVOT MODE, SLOW PIVOT MODE and LOCKED MODE.

The hydraulic operation and troubleshooting information for each of these modes will be described on the following pages.

10.12.1 Troubleshooting Symptom Chart

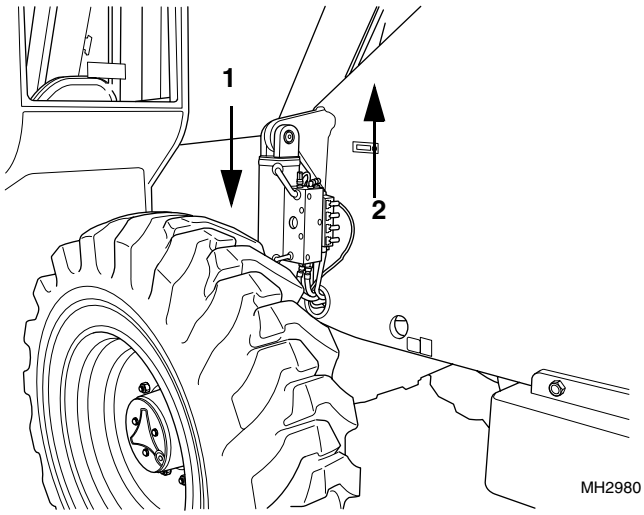
Symptom	Conditions	Reference
With the boom below 40°, when swaying the frame to the right, the left front tire comes off the ground.	Ignition ON, engine running Boom angle is below 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.12.3, “Hydraulic Circuit Operation - FREE PIVOT Mode, Rod Oil Out,” and Section 10.12.4, “Hydraulic Troubleshooting - FREE PIVOT Mode, Rod Oil Out.”
With the boom below 40°, when swaying the frame to the left, the right front tire comes off the ground.	Ignition ON, engine running Boom angle is below 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.12.5, “Hydraulic Circuit Operation - FREE PIVOT Mode, Base Oil Out,” and Section 10.12.6, “Hydraulic Troubleshooting - FREE PIVOT Mode, Base Oil Out.”
While traveling, ride feels spongy (riding on 3 wheels).	Ignition ON, engine running Boom angle is above 40° Travel select lever is in (F) FORWARD or (R) REVERSE Park brake OFF Service brake DISENGAGED	Refer to Section 10.12.7, “Hydraulic Circuit Operation - SLOW PIVOT Mode, Rod Oil Out,” and Section 10.12.8, “Hydraulic Troubleshooting - SLOW PIVOT Mode, Rod Oil Out.”
Stabil-TRAK™ light in instrument cluster is not ON.	Ignition ON, engine running Boom angle is above 40° Travel select lever is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.12.11, “Hydraulic Circuit Operation - LOCKED MODE,” and Section 10.12.13, “Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Right,” or Section 10.12.15, “Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Left.”
With the boom above 40°, when swaying the frame to the right, the left front tire comes off the ground.	Ignition ON, engine running Boom angle is above 40° Travel select lever is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.12.12, “Hydraulic Circuit Operation - LOCKED MODE, Frame Sway Right,” and Section 10.12.13, “Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Right.”
With the boom above 40°, when swaying the frame to the left, the right front tire comes off the ground.	Ignition ON, engine running Boom angle is above 40° Travel select lever is in (N) NEUTRAL, or Park brake ON or Service brake ENGAGED	Refer to Section 10.12.14, “Hydraulic Circuit Operation - LOCKED MODE, Frame Sway Left,” and Section 10.12.15, “Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Left.”

10.12.2 Stabil-TRAK™ Cylinder Oil Flow

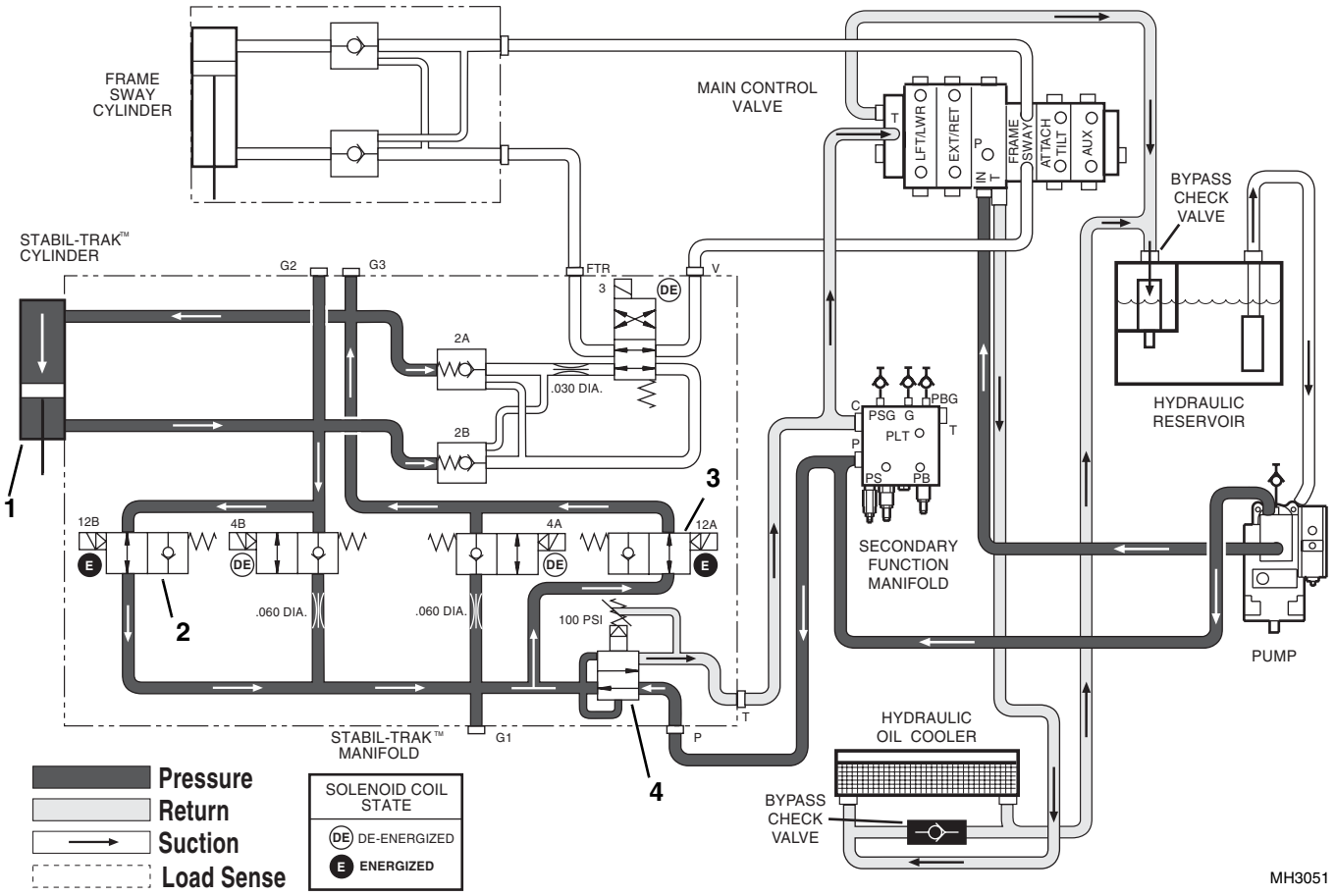
In the FREE PIVOT and SLOW PIVOT MODES, oil flow from the stabilizer cylinder will be in one of two directions; ROD OIL OUT or BASE OIL OUT.

ROD OIL OUT flow will occur when the left side of the rear axle is lower than the right side (left wheel in a pothole, or the right wheel passing over an obstruction), causing the cylinder to extend (**1**).

BASE OIL OUT flow will occur when the right side of the rear axle is lower than the left (right wheel in a pothole, or the left wheel passing over an obstruction), causing the cylinder to compress (**2**).



10.12.3 Hydraulic Circuit Operation - FREE PIVOT Mode, Rod Oil Out



Conditions:

- Boom angle is below 40°
- Rear axle pivots freely
- Travel select lever in (F) FORWARD or (R) REVERSE position
- Park brake OFF
- Service brake DISENGAGED

Operation:

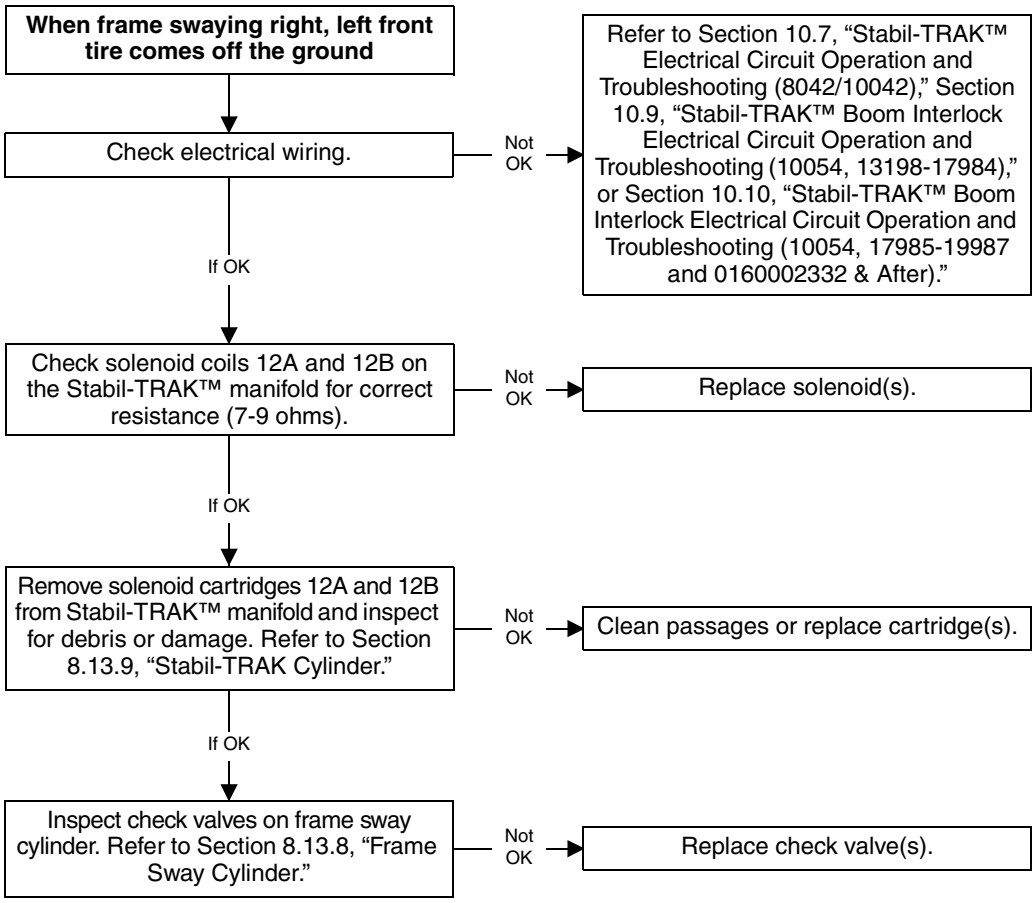
When the conditions are met, solenoids 12A and 12B are energized. As the left side of the rear axle moves down, the rod extends, forcing hydraulic oil out from the rod end of the Stabil-TRAK™ cylinder (**1**). The oil then flows through the solenoid-operated valves 12B (**2**) and 12A (**3**), to the base side of the Stabil-TRAK™ cylinder.

Because the volume of oil needed on the base side is greater than that needed on the rod side, the extra oil needed is supplied from the main hydraulic system through a 100 psi (7 bar) reducing cartridge (**4**) in the Stabil-TRAK™ manifold.

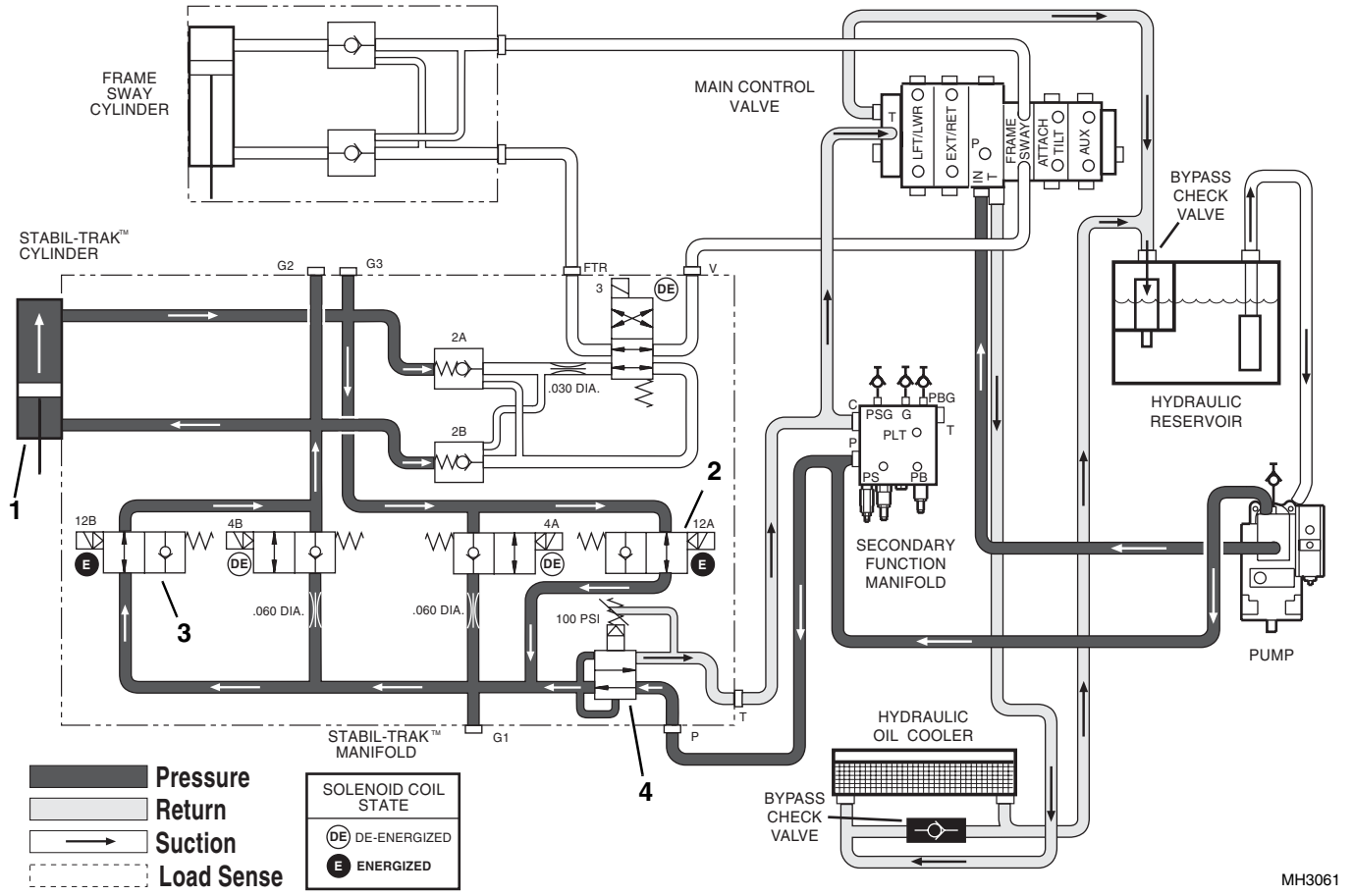
10.12.4 Hydraulic Troubleshooting - FREE PIVOT Mode, Rod Oil Out

Conditions:

- Ignition ON, engine running
  - Boom angle is below 40°
  - Travel select lever in (F) FORWARD or (R) REVERSE
  - Park brake OFF
  - Service brake DISENGAGED



10.12.5 Hydraulic Circuit Operation - FREE PIVOT Mode, Base Oil Out



Conditions:

- Boom angle is below 40°
- Rear axle pivots freely
- Travel select lever in (F) FORWARD or (R) REVERSE position
- Park brake OFF
- Service brake DISENGAGED

Operation:

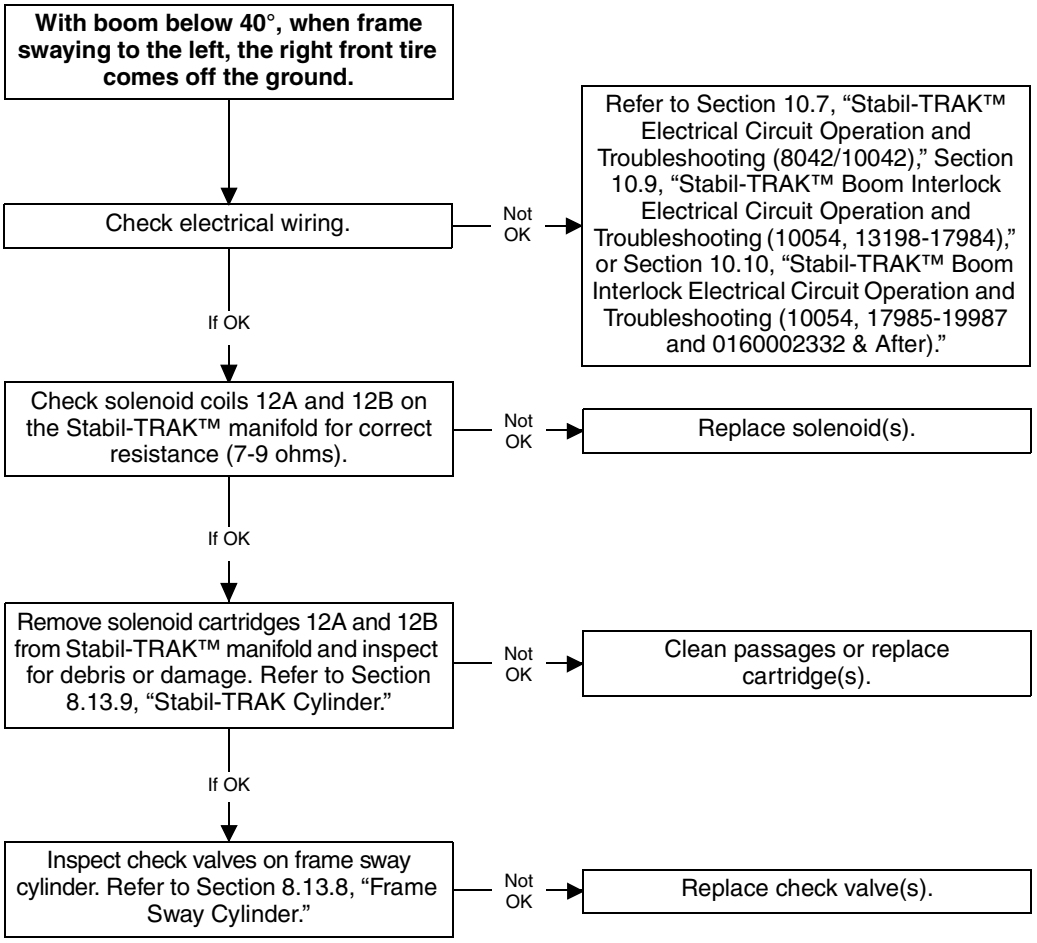
When the conditions are met, solenoids 12A and 12B are energized. As the left side of the rear axle moves down, the rod is forced up, forcing hydraulic oil out from the base end of the Stabil-TRAK™ cylinder (**1**). The oil then flows through the solenoid-operated valves 12A (**2**) and 12B (**3**), to the rod side of the Stabil-TRAK™ cylinder.

Because the volume of oil needed on the rod side is less than that needed on the base side, excess oil is returned to the tank through a 100 psi (7 bar) reducing cartridge (**4**) in the Stabil-TRAK™ manifold.

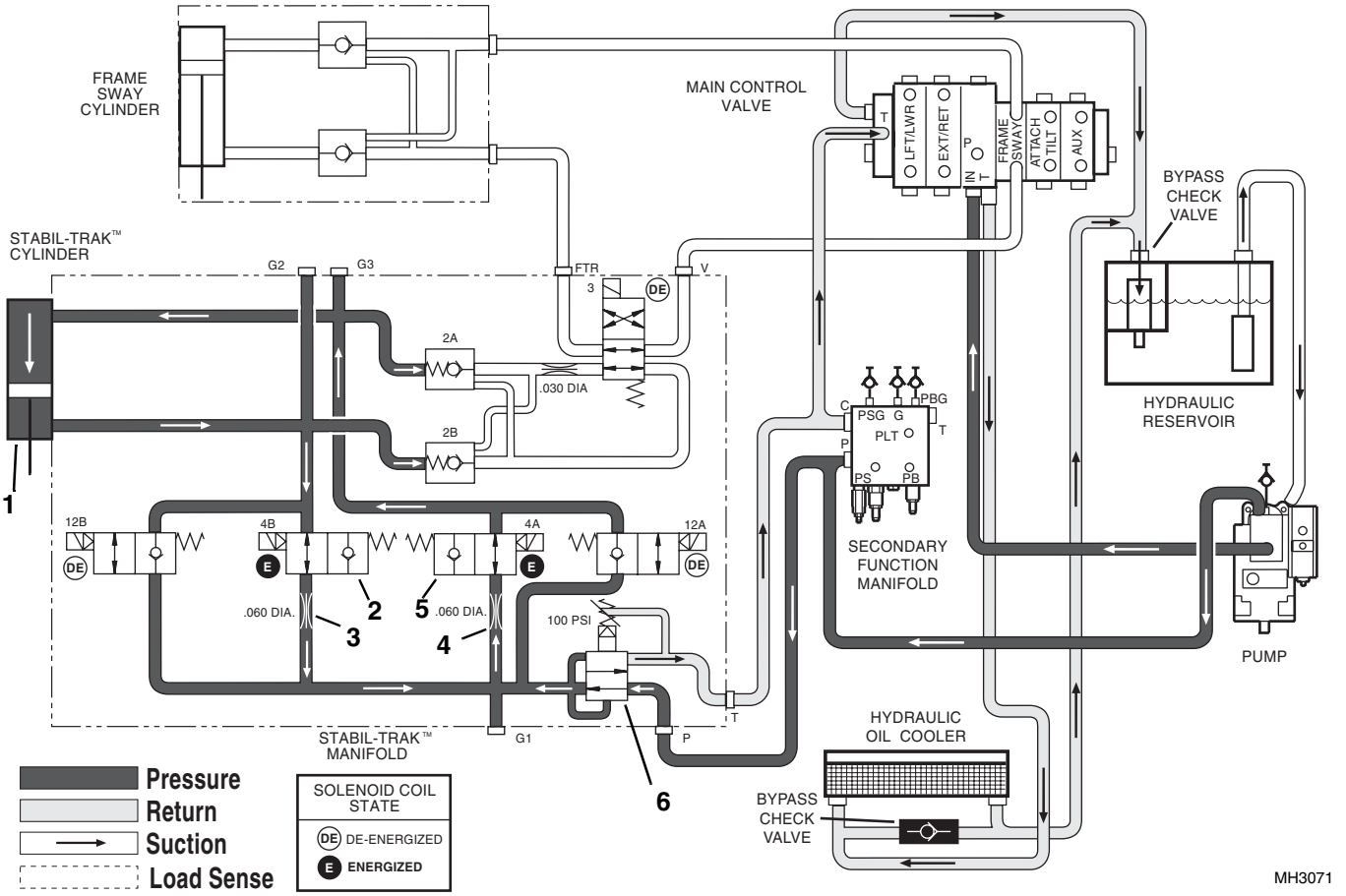
10.12.6 Hydraulic Troubleshooting - FREE PIVOT Mode, Base Oil Out

Conditions:

- Ignition ON, engine running
  - Boom angle is below 40°
  - Travel select lever in (F) FORWARD or (R) REVERSE
  - Park brake ON
  - Service brake DISENGAGED



10.12.7 Hydraulic Circuit Operation - SLOW PIVOT Mode, Rod Oil Out



Conditions:

- Boom angle is above 40°
- Park brake OFF
- Service brake DISENGAGED
- Travel select lever in (F) FORWARD or (R) REVERSE position

Operation:

As the boom is raised above 40°, the boom proximity switch is deactivated, causing solenoids 12A and 12B to de-energize and solenoids 4A and 4B to energize. This allows oil to flow from the rod end of the Stabil-TRAK™ cylinder (**1**), through solenoid-operated valve 4B (**2**), through a .060" orifice (**3**), through another .060" orifice (**4**), then through solenoid-operated valve 4A (**5**), then to the base end of the Stabil-TRAK™ cylinder.

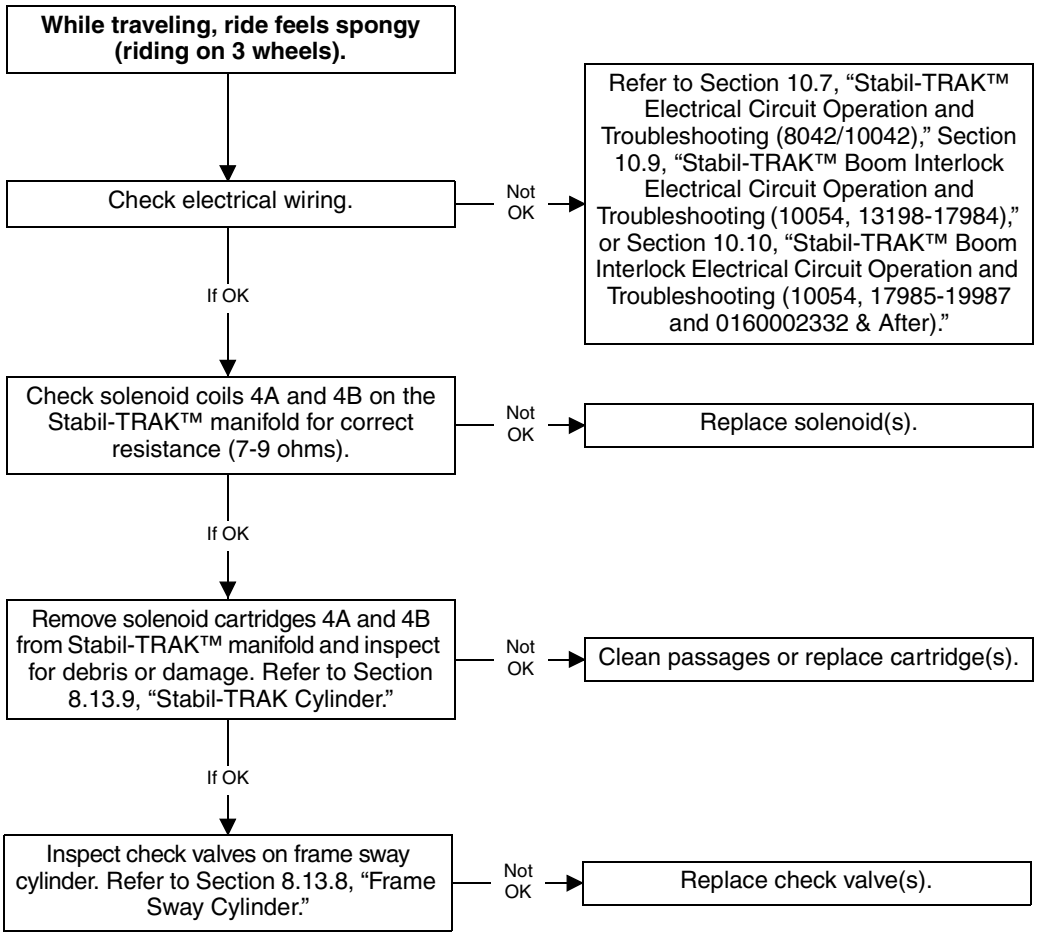
The .060" orifices (**3** and **4**) in solenoid-operated valves 4A (**5**) and 4B (**2**) will slow the movement of the rear axle in reaction to terrain changes. The frame sway will react normally in this mode.

Because of the greater volume of oil required, extra oil is required from the system through the 100 psi (7 bar) reducing cartridge (**6**) in the Stabil-TRAK™ manifold. The restrictions produce the slow movement, or SLOW PIVOT mode.

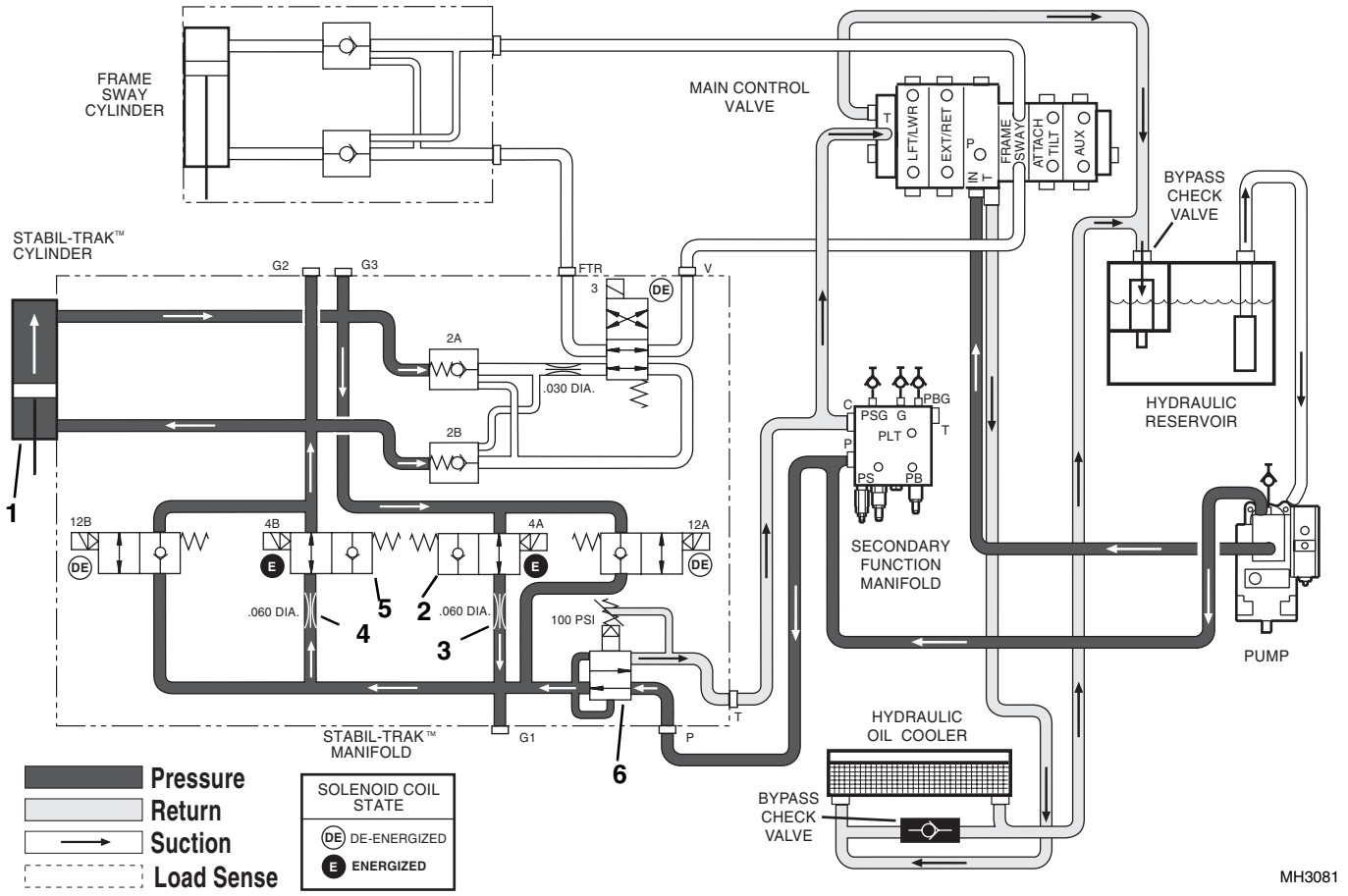
10.12.8 Hydraulic Troubleshooting - SLOW PIVOT Mode, Rod Oil Out

Conditions:

- Ignition ON, engine running
  - Boom angle is above 40°
  - Travel select lever in (F) FORWARD or (R) REVERSE
  - Park brake OFF
  - Service brake DISENGAGED



10.12.9 Hydraulic Circuit Operation - SLOW PIVOT Mode, Base Oil Out



Conditions:

- Boom angle is above 40°
- Park brake OFF
- Service brake DISENGAGED
- Travel select lever in (F) FORWARD or (R) REVERSE position

Operation:

As the boom is raised above 40°, the boom proximity switch is deactivated causing solenoids 12A and 12B to de-energize and solenoids 4A and 4B to energize. This allows oil to flow from the base end of the Stabil-TRAK™ cylinder (**1**), through solenoid-operated valve 4A (**2**), through a .060" orifice (**3**), through another .060" orifice (**4**), then through solenoid-operated valve 4B (**5**), to the rod end of the Stabil-TRAK™ cylinder.

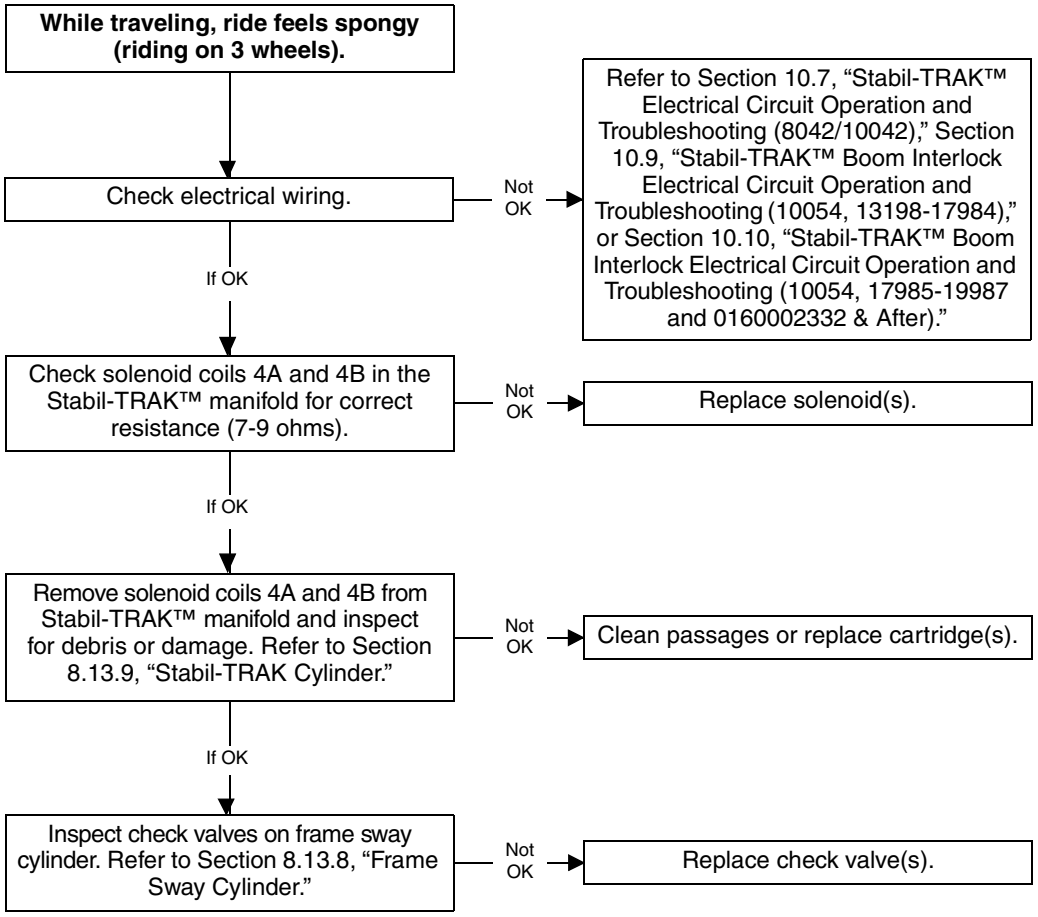
The .060" orifices (**3** and **4**) in solenoid-operated valves 4A and 4B will slow the movement of the rear axle in reaction to terrain changes. The frame sway will react normally in this mode.

Because of the greater volume of oil in the base end, extra oil is returned to the tank through the 100 psi (7 bar) reducing cartridge (**6**) in the Stabil-TRAK™ manifold. The restrictions produce the slow movement, or SLOW PIVOT mode.

10.12.10 Hydraulic Troubleshooting - SLOW PIVOT Mode, Base Oil Out

Conditions:

- Ignition ON, engine running
  - Boom angle is above 40°
  - Travel select lever in (F) FORWARD or (R) REVERSE
  - Park brake OFF
  - Service brake DISENGAGED



10.12.11 Hydraulic Circuit Operation - LOCKED MODE

a. Conditions:

- Boom angle is above 40°
- Park brake ON, or service brake ENGAGED, or travel select lever in (N) NEUTRAL

b. Operation:

When the conditions are met, solenoids 4A, 4B, 12A and 12B are de-energized and solenoid 3 is energized. In the LOCKED MODE, oil is prevented from flowing through the Stabil-TRAK™ manifold due to check valves in solenoid-operated valves 4A (**1**), 4B (**2**), 12A (**3**), and 12B (**4**).

10.12.12 Hydraulic Circuit Operation - LOCKED MODE, Frame Sway Right

When the joystick control is placed in the frame sway mode, cables activate the frame sway valve in the main control valve assembly. As the joystick is moved to the right, the frame sway spool valve is shifted, allowing oil to flow through the valve, to the Stabil-TRAK™ manifold, port V.

Oil entering the Stabil-TRAK™ manifold at port V flows through solenoid cartridge valve 3 (**5**), through a .030" orifice (**6**) and check valve 2A (**7**), to the base end of the Stabil-TRAK™ cylinder (**8**). The orifice slows the movement of the frame sway.

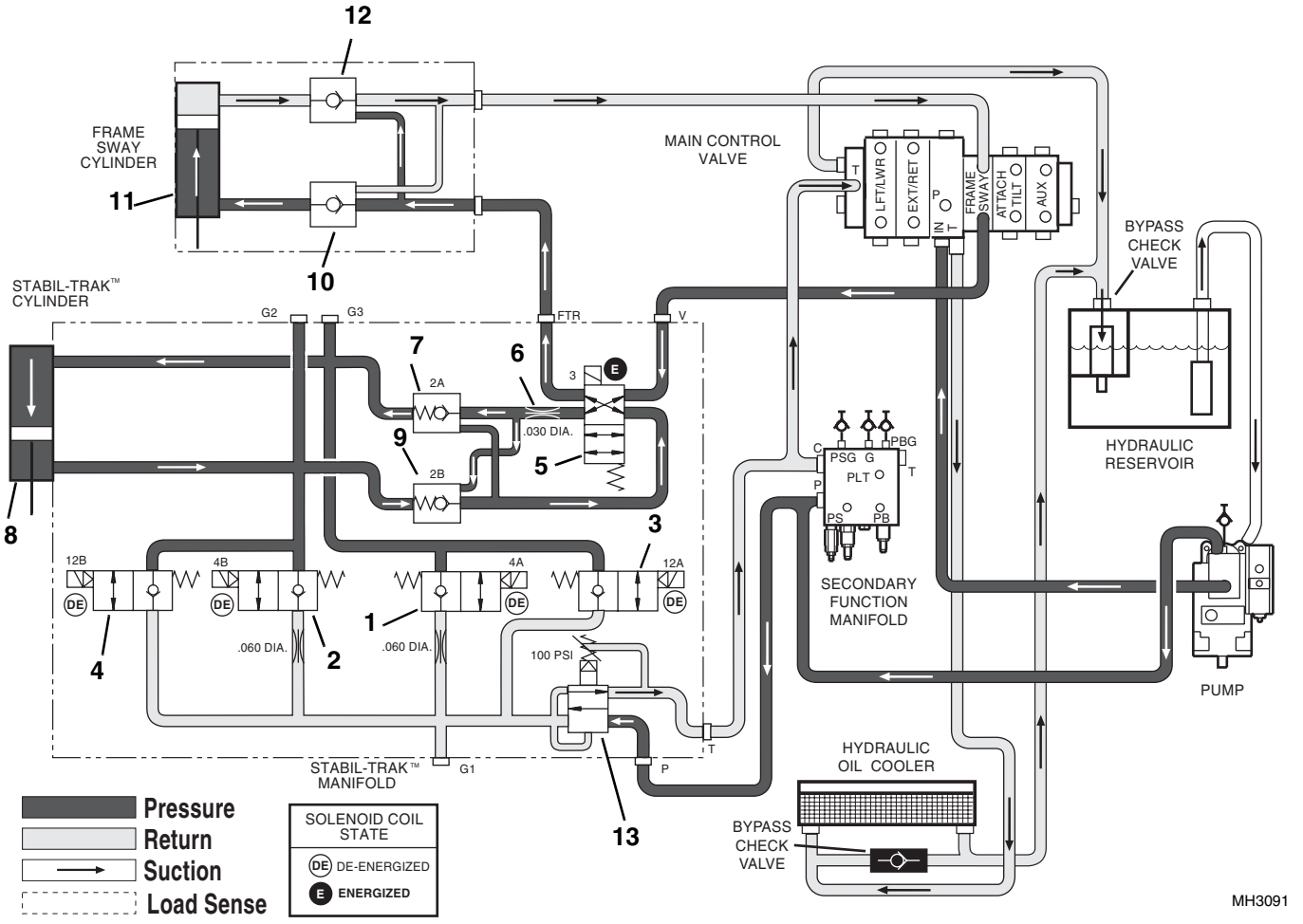
Some of this oil is diverted to the pilot line of check valve 2B (**9**), opening the valve.

Rod end oil from the Stabil-TRAK™ cylinder flows through check valve 2B (**9**), opened by pilot pressure in the Stabil-TRAK™ manifold. The oil then flows through cartridge valve 3 (**5**), out of the Stabil-TRAK™ manifold at port FTR, through a check valve (**10**), to the rod end of the frame sway cylinder (**11**).

Oil from the base end of the frame sway cylinder flows through a piloted-open check valve (**12**) and back through the frame sway spool valve in the frame sway section of the main control valve, dumping the returned oil to the reservoir.

Pressurized oil entering the Stabil-TRAK™ manifold at port P is stopped at the four closed solenoid-operated valves 4A (**1**), 4B (**2**), 12A (**3**) and 12B (**4**). At this time pilot pressure will cause the 100 psi relief valve (**13**) to change position, allowing the excess oil to vent to the reservoir.

10.12.13 Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Right



Conditions:

- Ignition ON, engine running
  - Boom angle is above 40°
  - Travel select lever in (N) NEUTRAL, or park brake ON or service brake ENGAGED

With boom above 40°, when frame swaying to the right, the left front tire comes off the ground.

Check electrical wiring.

Not OK → Refer to Section 10.7, “Stabil-TRAK™ Electrical Circuit Operation and Troubleshooting (8042/10042),” Section 10.9, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984),” or Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After).”

If OK

Check solenoid cartridge 3 in the Stabil-TRAK™ manifold. Refer to Section 8.13.9, “Stabil-TRAK Cylinder.”

Not OK → Replace cartridge.

If OK

Inspect check valves 2A and 2B on the Stabil-TRAK™ cylinder. Refer to Section 8.13.9, “Stabil-TRAK Cylinder.”

Not OK → Replace check valve(s).

10.12.14 Hydraulic Circuit Operation - LOCKED MODE, Frame Sway Left

a. Conditions

- Boom angle is above 40°
- Park brake ON, or service brake ENGAGED, or travel select lever in (N) NEUTRAL

b. Operation

When the joystick control is placed in the frame sway mode, cables activate the frame sway valve in the main control valve assembly. As the joystick is moved to the right, the frame sway spool valve is shifted, allowing oil to flow through the valve, through the check valve (**1**) to the base end of the frame sway cylinder (**2**).

Some of this oil is diverted to the pilot line of the check valve (**3**) on the return side of the frame sway cylinder, opening the valve.

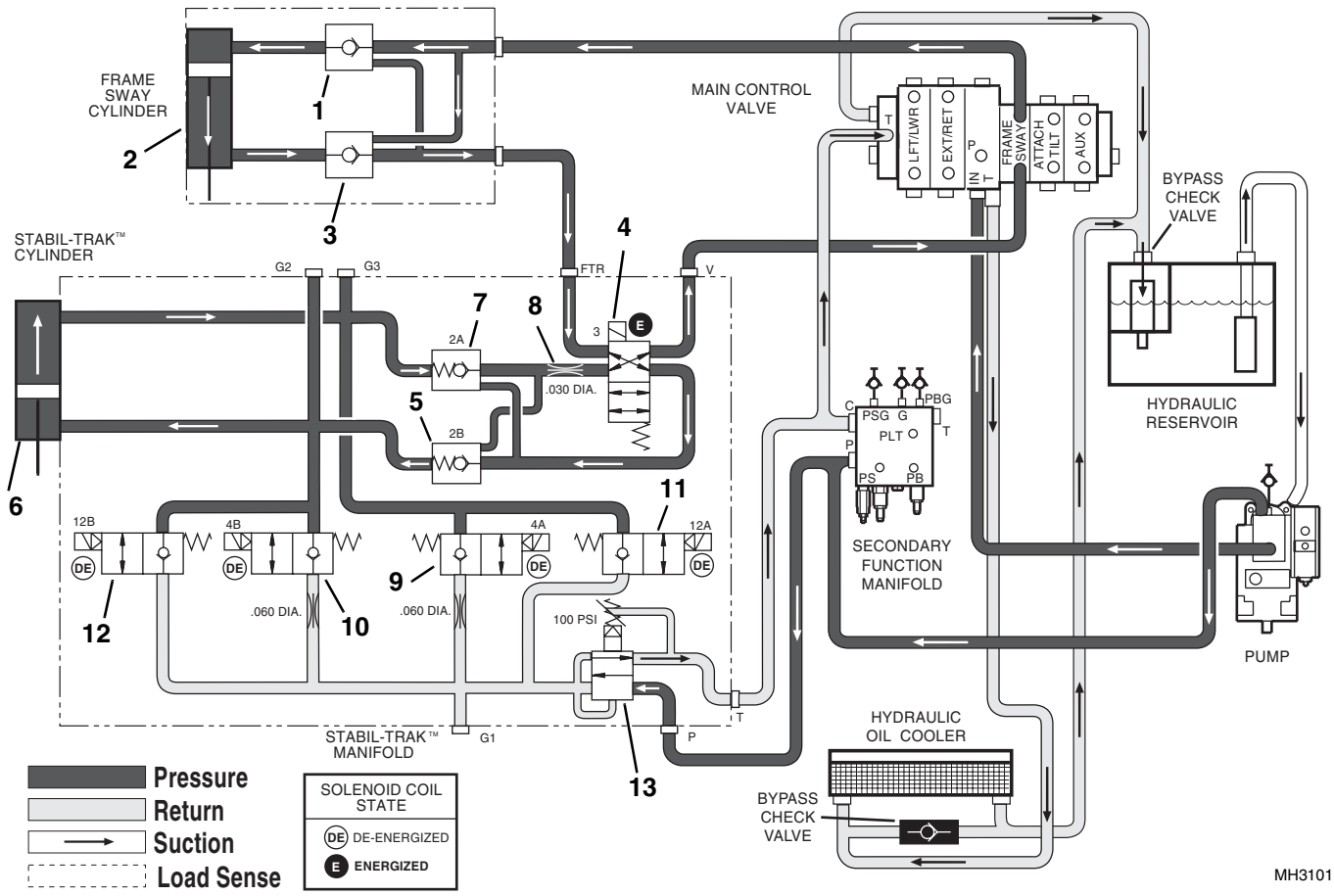
Oil from the rod end of the frame sway cylinder flows through the check valve (**3**) opened by incoming pilot pressure oil, to the FTR port of the Stabil-TRAK™ manifold.

Oil entering at port FTR flows through solenoid valve 3 (**4**) through check valve 2B (**5**), to the rod end of the Stabil-TRAK™ cylinder (**6**). Some of this oil is diverted to the pilot line of check valve 2A (**7**), opening the valve.

Oil from the base end of the Stabil-TRAK™ cylinder flows through check valve 2A (**7**) and through a .030" orifice (**8**). This orifice slows the movement of the frame sway. The oil then flows through solenoid-operated valve 3 (**4**), through port V, to the frame sway spool valve in the main control valve. Oil flows through the valve, dumping the returned oil to the reservoir.

Pressurized oil entering the Stabil-TRAK™ manifold at port P is stopped at the four closed solenoid-operated valves 4A (**9**), 4B (**10**), 12A (**11**), and 12B (**12**). At this time pilot pressure will cause the 100 psi relief valve (**13**) to change position, allowing the excess oil to vent to the reservoir.

10.12.15 Hydraulic Troubleshooting - LOCKED MODE, Will Not Frame Sway Left



Conditions:

- Ignition ON, engine running
  - Boom angle is above 40°
  - Travel select lever in (N) NEUTRAL, or park brake ON or service brake ENGAGED

With boom above 40°, when frame swaying to the left, the right front tire comes off the ground.

Check electrical wiring.

Not OK → Refer to Section 10.7, “Stabil-TRAK™ Electrical Circuit Operation and Troubleshooting (8042/10042),” Section 10.9, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 13198-17984),” or Section 10.10, “Stabil-TRAK™ Boom Interlock Electrical Circuit Operation and Troubleshooting (10054, 17985-19987 and 0160002332 & After),”

If OK

Check solenoid cartridge 3 in the Stabil-TRAK™ manifold. Refer to Section 8.13.9, “Stabil-TRAK Cylinder.”

Not OK → Replace cartridge.

If OK

Inspect check valves 2A and 2B on the Stabil-TRAK™ cylinder. Refer to Section 8.13.9, “Stabil-TRAK Cylinder.”

Not OK → Replace check valve(s).

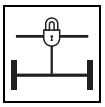
10.13 BOOM EXTEND SYSTEM HYDRAULIC CIRCUIT OPERATION AND TROUBLESHOOTING

The function of the boom extend interlock system varies under different operating conditions. The basic modes include the EXTEND INTERLOCK MODE and OUTRIGGER INTERLOCK MODE.

The hydraulic operation and troubleshooting information for each of these modes will be described on the following pages.

10.13.1 Troubleshooting Symptom Chart

Symptom	Conditions	Reference
With both outriggers RAISED, the boom will not extend.	Ignition ON, engine running Both outriggers RAISED	Refer to Section 10.13.2, “Hydraulic Circuit Operation - Extend Interlock Mode.”
With both outriggers lowered onto firm terrain, the boom will not extend to its full limits.	Ignition ON, engine running Both outriggers lowered onto firm terrain	Refer to Section 10.13.4, “Hydraulic Circuit Operation - Outrigger Interlock Mode,” and Section 10.13.5, “Hydraulic Troubleshooting - Outrigger Interlock Mode.”



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10.13.2 Hydraulic Circuit Operation - Extend Interlock Mode

Operation:

When the outriggers in the RAISED position, the outrigger pressure switches (**1** and **2**) are open.

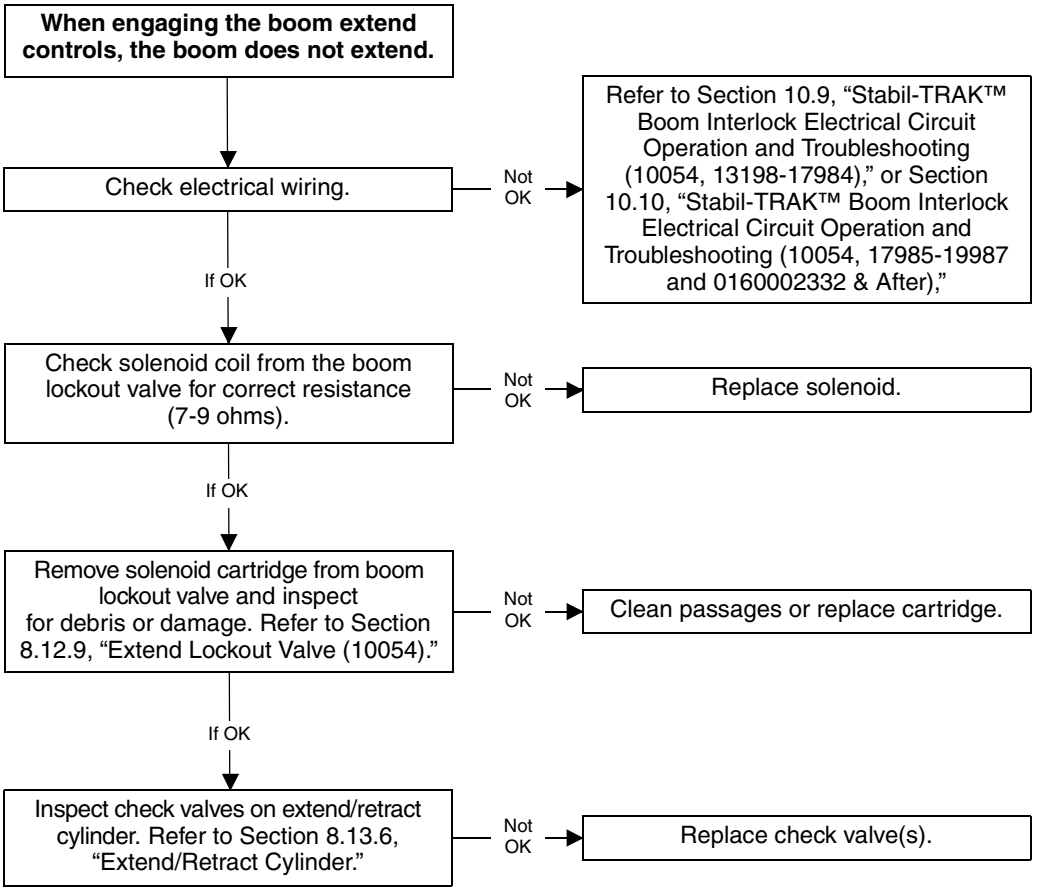
As the boom is extended past the boom extend switch, the switch opens, de-energizing the boom lockout solenoid (**3**). This allows pressurized oil to flow through the valve body (**4**) to the piston side of the pilot-operated valve (**5**), causing it to close. This prevents oil flow to the extend/retract cylinder (**6**), preventing the boom from being extended further.

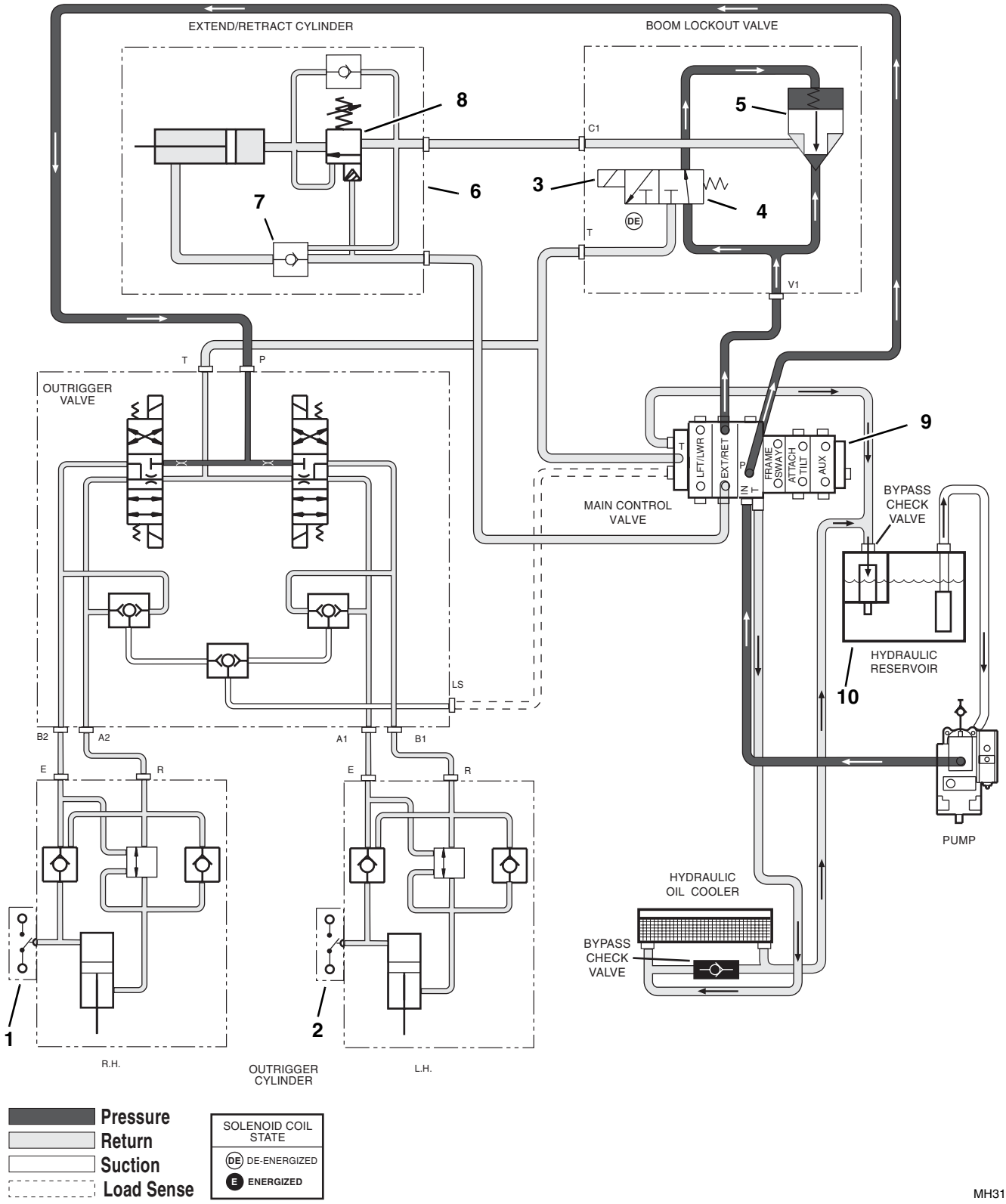
The retract function is still allowed, as oil flow through the boom lockout valve reversed, forcing the pilot-operated check valve (**7**) and counterbalance valve (**8**) to open.The oil flow will cause the pilot-operated valve (**5**) to open, returning oil to the main control valve (**9**) and reservoir (**10**).

10.13.3 Hydraulic Troubleshooting - Extend Interlock Mode

Conditions:

- Ignition ON, engine running
- Outriggers RAISED
- Travel select lever in (F) FORWARD or (R) REVERSE
- Park brake OFF
- Service brake DISENGAGED




EXTEND/RETRACT CYLINDER
BOOM LOCKOUT VALVE
8
5
C1
6
3
4
7
DE
T
V1
T
P
OUTRIGGER VALVE
LFT/LWR
EXT/RET
FRAME SWAY
ATTACH TILT
AUX
IN
9
MAIN CONTROL VALVE
BYPASS CHECK VALVE
HYDRAULIC RESERVOIR
10
LS
B2
A2
A1
B1
E
R
PUMP
HYDRAULIC OIL COOLER
BYPASS CHECK VALVE
1
2
R.H.
OUTRIGGER CYLINDER
L.H.
Pressure
Return
Suction
Load Sense
SOLENOID COIL STATE
DE DE-ENERGIZED
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10.13.4 Hydraulic Circuit Operation - Outrigger Interlock Mode

Operation:

When the outriggers are lowered onto firm terrain, pressure within the outrigger cylinders close the outrigger pressure switches (**1** and **2**), energizing the boom extend lockout solenoid valve (**3**).

As the boom extends past the boom extend switch, the switch opens. The boom extend lockout solenoid valve (**3**), remains energized by the circuit provided by the outrigger pressure switches.

Pressurized oil flows to the base of the pilot-operated valve (**4**), opening the valve and allowing oil to flow to the extend/retract cylinder (**5**).

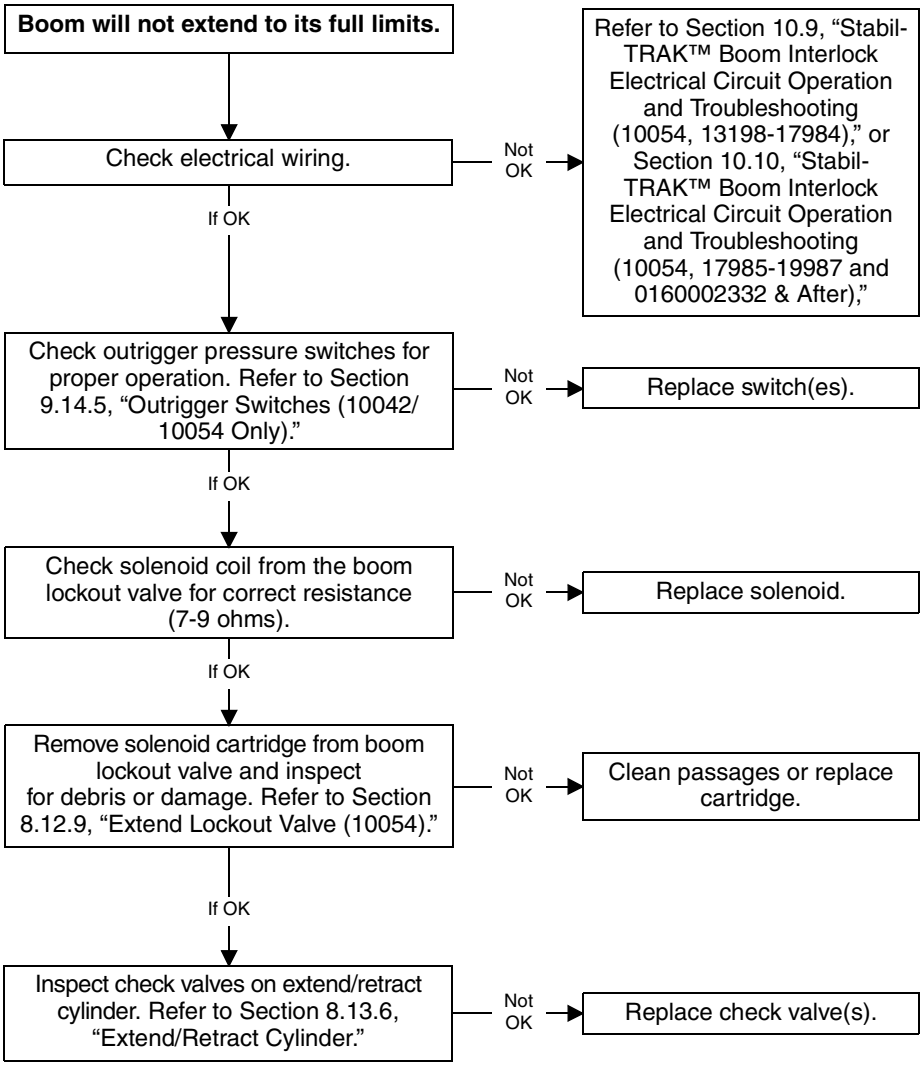
10.13.5 Hydraulic Troubleshooting - Outrigger Interlock Mode

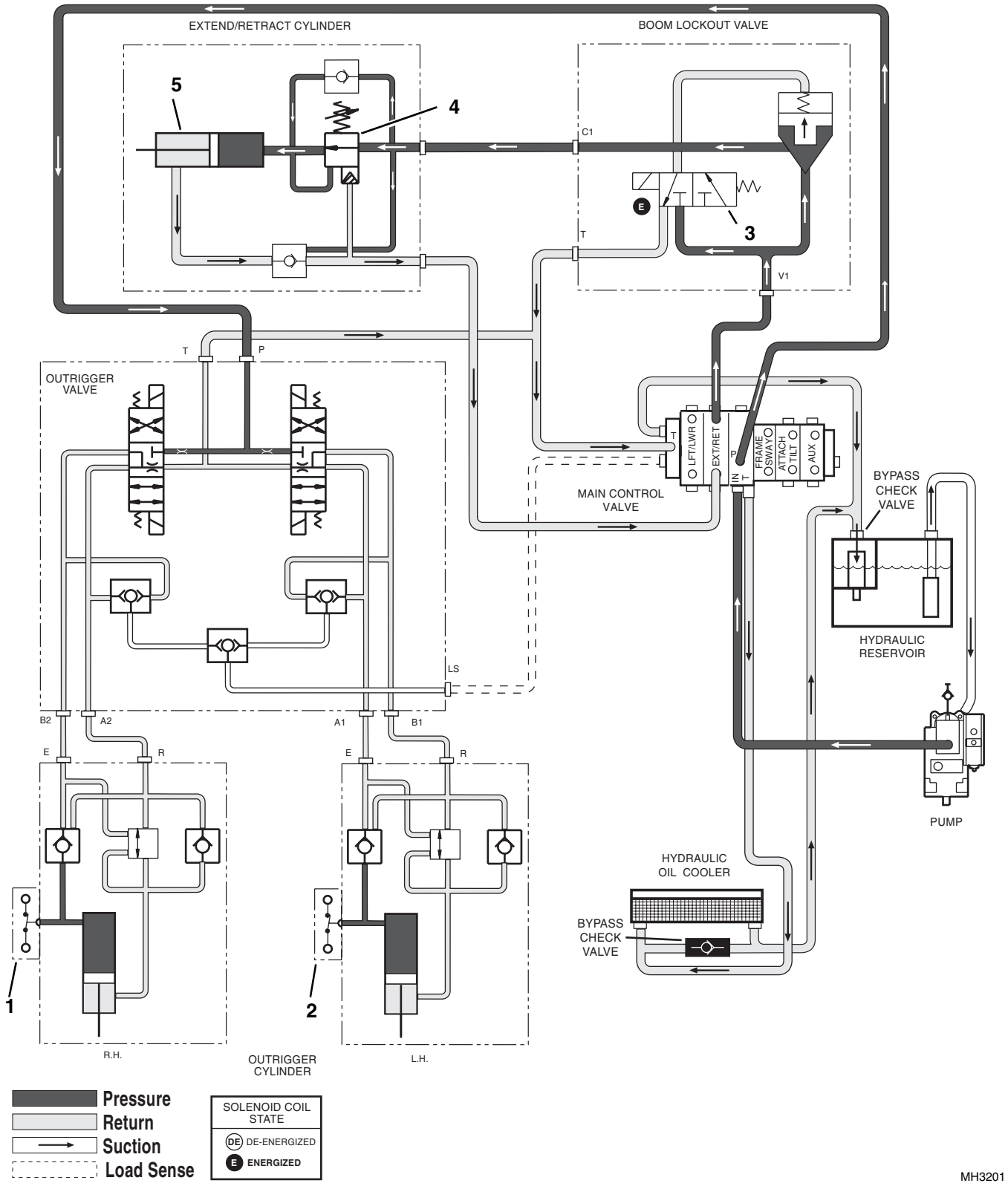
Conditions:

- Both outriggers lowered onto firm terrain.

Note: *When the outrigger interlock mode is engaged, the following systems are automatically activated:*

- Stabil-TRAK™ system is in the LOCKED MODE. (Refer to Section 10.4, "Stabil-TRAK™ Operation," for more information.)
- Transmission has been DECLUTCHED.
- Park brake ENGAGED.
- Outrigger RAISE function has been DISABLED. However, the LOWER function is still active, to allow for any changes in outrigger footing.




EXTEND/RETRACT CYLINDER
BOOM LOCKOUT VALVE
5
4
C1
E
3
T
V1
T
P
OUTRIGGER VALVE
LFT/LWR
EXT/RET
P
IN
T
FRAME SWAY
ATTACH TILT
AUX
MAIN CONTROL VALVE
BYPASS CHECK VALVE
HYDRAULIC RESERVOIR
LS
B2
A2
A1
B1
E
R
E
R
PUMP
HYDRAULIC OIL COOLER
BYPASS CHECK VALVE
1
2
R.H.
OUTRIGGER CYLINDER
L.H.
Pressure
Return
Suction
Load Sense
SOLENOID COIL STATE
DE DE-ENERGIZED
E ENERGIZED

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Section 11
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W


DANGER
DO
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Accident Prevention Tags

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