

FLIGHT LINE TOW TRACTOR

OPERATION, MAINTENANCE AND PARTS MANUAL

Part # - 400MB2C1 Class I

Part # - 400MB2C2 Class II

CONTRACT NO. (2013 EFF B) FA8533-12-D-0007
CONTRACT NO. (PRIOR TO 2013) FA8533-08-D-0002
NSN: 1740-00-143-8464 YW (Class 1)
NSN: 1740-01-552-9854 YW (Class 2)

TO: 36A10-3-60-1

This Manual Is Used With Cummins Engine Manual 38G1-151-1

NMC-WOLLARD, Inc.

2021 Truax Blvd.

Eau Claire, WI 54702

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INTRODUCTION

Congratulations on the purchase of your new Flight Line Tow Tractor from NMC-Wollard, Inc. With its optional equipment this is the simplest, most flexible system on the market today. With proper operation and preventative maintenance it will last for years.



This SAFETY ALERT SYMBOL indicates important safety messages in the manual. When you see this symbol, be alert to the possibility of PERSONAL INJURY and carefully read the message that follows.

⚠ WARNING

Never operate without all covers, shields and guards in place. Body, hair or clothing can become entangled in exposed, moving parts and can cause serious injury or death.

Some covers and guards have been removed for illustrative/photographic purposes only in this manual.

The Warranty appears in the front of this book. The order number and serial number are recorded on the cover. These numbers should be recorded on the Registration and Inspection Certificate for your reference and for proper identification of your machine by NMC-Wollard, Inc.

For information on ordering repair parts, refer to the Repair Parts chapter at the back of this book.

For convenience, it is recommended to copy the serial number and other important information from the data plate affixed to this unit onto Figure 1, page 4. This data is used to properly identify this unit by the manufacturer when ordering repair parts or obtaining technical support.

You are urged to study this manual and follow the instructions carefully. Your efforts will be repaid in better operation and service as well as a savings in time and repair expense. Failure to read and understand the machine or the system could lead to serious injury. If you do not understand the instructions in this manual contact the manufacturer.

This supersedes all previous published instructions.

When reading this manual, if a figure or paragraph *outside* the current section is referred to, it will be identified by Chapter-Section-Figure Number or Chapter-Section-Paragraph.

Example:

Figure 2-2-4.....Chapter 2-Section 2-Figure 4

2-2-1.4.....Chapter 2-Section 2-Paragraph 1.4

If figures or paragraphs from the *current* section are referred, the chapter and section may not be referenced.

This manual is available in pdf format on CD-ROM, P/N 47003CD.

Keep a copy of your NMC-Wollard, Inc. manuals on your computer or CD-ROM! You will be able to view and print pages and search for words or numbers. CD-ROM manuals include a linked table of contents. Mouse click on a table of contents entry to display the page containing that item.

For availability and pricing, contact NMC-Wollard, Inc. customer service at:

Phone (715) 835-3151

Fax (715) 835-6625

Email custserv@nmc-wollard.com

PURPOSE OF THIS MANUAL

This manual is meant to provide the information necessary to operate, maintain, and repair the towing tractor, model number 400MB2, manufactured by **NMC-Wollard, Inc., Eau Claire, WI 54702, phone 715-835-3151.**

ARRANGEMENT OF THIS MANUAL

This manual is divided into five Chapters. The introduction contains general information for familiarization with the manual. Chapter 1, General Information & Operating Instructions, contains general safety information, descriptions of the tow tractor and its components or systems, operating instructions and specifications. Chapter 2, Maintenance, contains a periodic/preventive maintenance schedule and routine maintenance procedures. Chapter 3 contains information for major repair or overhaul. Chapter 4 is the Illustrated Parts Breakdown (IPB). The IPB shows all parts and part numbers necessary for support of the tractor. The IPB can be used for requisitioning and identifying parts. Chapter 5 contains OEM manuals or data for major assemblies used on the tractor.

USAF UNIT DATA PLATE

CLASS I MB-2 AIRCRAFT TOW TRACTOR 27,000 DRAWBAR PULL	
NMC-WOLLARD	
2021 TRUAX BLVD, EAU CLAIRE, WI 54703 USA (715) 835-3151 WWW.NMC-WOLLARD.COM CAGE NO. 44185	
MODEL NO.	400MB2
SERIAL NO.	<input type="text"/>
DATE OF MFR.	<input type="text"/>
DATE OF DEL.	<input type="text"/>
REG. NO.	<input type="text"/>
CONTRACT NO.	FA8533-12-D-0007
NSN NO.	1740-01-559-3504 YW
TECHNICAL MANUAL NO.	47003
WARRANTY:	12 MO./1000 HRS
U.S. PROPERTY	

51591

Figure 1. Class I Unit Data Plate

CLASS II MB-2 AIRCRAFT TOW TRACTOR 27,000 DRAWBAR PULL	
NMC-WOLLARD	
2021 TRUAX BLVD, EAU CLAIRE, WI 54703 USA (715) 835-3151 WWW.NMC-WOLLARD.COM CAGE NO. 44185	
MODEL NO.	400MB2
SERIAL NO.	<input type="text"/>
DATE OF MFR.	<input type="text"/>
DATE OF DEL.	<input type="text"/>
REG. NO.	<input type="text"/>
CONTRACT NO.	FA8533-12-D-0007
NSN NO.	1740-01-559-7047 YW
TECHNICAL MANUAL NO.	47003
WARRANTY:	12 MO./1000 HRS
U.S. PROPERTY	

51592

Figure 2. Class II Unit Data Plate

1 YEAR WARRANTY

NMC-Wollard, Inc

NMC-Wollard, Inc. warrants to the original owner that all components of the equipment are free from defects in material and workmanship under normal use and service for 12 months or 1,000 hours, whichever comes first, from the date of shipment.

This warranty provides for NMC-Wollard, Inc. equipment components that fail because of defects in material or workmanship during the warranty period, without charge to the owner for parts or labor. The owner must provide prompt notice of the defect and allow a reasonable time for replacement or repair.

This warranty applies only to parts manufactured by NMC-Wollard, Inc. Components installed on NMC-Wollard, Inc. equipment but not manufactured by NMC-Wollard, Inc. shall be covered under the original manufacturer's warranty. NMC-Wollard, Inc. will assist in administering all such warranties, with the exception of tires, battery, and other expendable parts, for which the owner will be required to deal directly with the original manufacturer for warranty service. Neither tune-ups, normal maintenance and repair or replacement of expendable parts (such as oil, lubricants, belts, filters, tires, battery, etc.) are covered by this warranty.

This warranty does not cover damage resulting from carelessness or neglect; accidents, fire, or other casualties; improper repair, operation, transportation, or storage; or failure to provide necessary or appropriate maintenance. This warranty does not cover deterioration or failure caused by chemicals, falling objects, dirt and sand, or excessive heat or moisture. The NMC-Wollard, Inc. equipment must be maintained according to the instructions provided with it or this warranty may be considered void. Warranted components must be replaced with parts manufactured or approved by NMC-Wollard, Inc. Warranty determination will be made after NMC-Wollard, Inc. inspects the failed part.

NMC-Wollard, Inc. is not liable for damage or injury resulting from improper installation, use, abuse, inability to use or misapplication of NMC-Wollard, Inc. equipment, nor is NMC-Wollard, Inc. liable for damage resulting from equipment repaired or modified by persons not authorized by NMC-Wollard, Inc. NMC-Wollard, Inc. does not warrant any part or product to meet local, municipal, state, provincial, or national laws or regulations.

This Limited Warranty is in lieu of all other warranties, whether express, implied, or statutory. No other express warranty is given or authorized by NMC-Wollard, Inc. NMC-Wollard, Inc. expressly disclaims any implied warranty of merchantability or fitness for a particular purpose or otherwise. NMC-Wollard, Inc. shall not be liable for loss of use of equipment, loss of time, loss of business, or for any other incidental, or consequential damages. No authorized NMC-Wollard, Inc. representative has the right to change or modify this warranty in any respect

This warranty is non-transferable

TO OBTAIN WARRANTY SERVICE

Warranty can be obtained by contacting NMC-Wollard, Inc., 2021 Truax Blvd., Eau Claire, WI. 54703, (Phone 715 835-3151) (Fax 715 835-6625).

What should you do when you receive a new unit?

Check that you have received all the equipment ordered. Check inside the product manual for engine warranties. Some OEM manufacturers supply a registration card that must be filled out and returned immediately to initiate the warranty. If a survey card or delivery checklist is enclosed from NMC-Wollard, Inc. please return it.

What should you do when you discover a possible warranty problem?

Call NMC-Wollard, Inc. (715-835-3151). We will require the serial number, number of hours on the unit, and a description of the problem. You will be given a warranty authorization number and assistance in troubleshooting.

IMPORTANT! Clear and immediate communication with the factory is the key to obtaining a satisfactory and timely resolution of your warranty problem.

Every warranty situation is different and so there are no hard rules. We will work with your maintenance personnel and service managers to equitably resolve all claims.

What should you do after warranty problem has been resolved?

Complete and return the warranty claim form within 10 days. Place the assigned warranty authorization number we gave you when you first called us with the problem on your claim.

Return defective parts immediately. Your claim cannot be processed until all defective parts have been returned to NMC-Wollard, Inc. Identify returned parts with the assigned warranty authorization number.

What should you use for labor rate and labor time?

Labor rate are reviewed annually, if you do not have an established rate, call NMC-Wollard, Inc. We do not publish a rate book; instead, we have accumulated average times for repairs. We will authorize repair time once we have approved the repair. If unforeseen circumstances cause a significantly greater repair time than originally approved, please contact us before submitting your claim.

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NAF Axle Service & Repair Manual

Transmission, Funk, 2000 Series Service Manual

UEA Shift Quadrant Service Manual

IssPro Programmable Speedometer

Lubrication Pump, Beka-Max, Operator's/Service Manual

Cummins QCB5-9-44 and QSB6.7 Engine Diagnostic Code Definitions

Engine, Cummins, QSB6.7, Operation and Maintenance Manual

REVISION HIGHLIGHTS

TO: HOLDERS OF NMC-Wollard, Inc. OPERATION AND MAINTENANCE MANUAL number 47003, 400MB2 Tow Tractor.

Pages that have been revised are outlined below, together with highlights of the revision. Please delete the affected pages and enter Revision No. and date to the Revision Record page.

Rev. No.	Date	Chap/Sec/Pg. No.	Description of Changes	Eff.
1	07-31-09	Intro/1 Cover	This manual used with Cummins...added	All
		Intro/15	Ref to Cummins engine manual deleted	
		Intro/16,18	Rev 1	
		1/4/1	15 mph was 25+/-1.5	
		1/5/1,3-6	Trans plates updated. Internal ATR Letter added	
		2/1/13,15	Axle tube service updated	
		2/2/5-8	Updated elec.schem for EMI suppression, add files #	
		4/TOC	TOC updated	
		4/4/2-3	Updated 47852, add 48443	
		4/4/5-6	Add 47958	
		4/4/30-31	Update 47880	
		4/4/32-33	Add 44898, chng 47953 to 48817	
		4/4/46-122	Update harnesses, pages renumbered	
		4/4/54-55	Add EMI suppression components	
		4/4/56-57	Add III, Add 48853,48743,48744	
4/4/66-67	Add 48851, renumber III.			

Rev. No.	Date	Chap/Sec/Pg. No.	Description of Changes	Eff.
2	03-31-11	Intro/8-11,13-14	Update Chap 1, 2 & 4 TOC	All
		Intro/16, 18-19	Rev 2 added	
		Intro/20	Add Eff A	
		1/TOC	Update TOC	
		1/3/15-22	Updated drop pin operation, text flow changed	
		2/TOC	Updated TOC	
		2/1/7-8	Add Drop Pin Hitch to Daily Periodic Main.	
		2/1/18-27	Update Couplers, Jaw and Drop Pin Types. Text flow changed	
		2/2/3,5-10	Figure #'s adjusted. Update 47006	
		4/TOC	Update TOC	
		4/3/1-8	Update Parts Index	
		4/4/4-5	Add 47787, NW036670, NW035688, 48794. Delete 47186,47185,47787	
		4/4/6-7	New Page for 47186,47185 & 50481	
		4/4/6-126	Pages renumbered	
		4/4/9	Add 303228,206108,206109,45025,48595	
		4/4/29	Add NW035682 & 48811	
		4/4/33	Delete 46772	
		4/4/34-35	Update item #'s, Add 1.0106 & 48506	
		4/4/38	Add 48517 & 48518	
		4/4/42-43	Add 90424 & 3.2143	
		4/4/48-49	Add 1012632 & 2.3695	
		4/4/56-61	Reconcile and update 47195,47196,47832 & 47191. Add 2 pages	
		4/4/62-65	Reconcile and update Hyd diagram	
4/4/66-67	Add 1.4435, 3.0828, 202010, NW035604, 3.1576, 48419			
4/4/71	Add 203109, Chng 45062 to 50562			
4/4/75	Add 48099			
4/4/76-77	Replace 436300 w/ F101588, Update Ftgs			
4/4/80-81	Add 48539 & 48546			
4/4/86-87	Update 47327			

Rev. No.	Date	Chap/Sec/Pg. No.	Description of Changes	Eff.
3	01-29-13	Intro/1 (cover)	Contract number FA8533-12-D-0007. This is the beginning of 2013 contract production.	B
		Intro/4	Unit data plate illustrations updated	B
		Intro/7	Introduction Table of Contents updated	all
		Intro/16	Revision Record updated	all
		Intro/20	Revision 3 added, page flow affected	B
		Intro/21	Eff B added	B

Rev. No.	Date	Chap/Sec/Pg. No.	Description of Changes	Eff.
4	03-29-13	Cover	Updated	
		Intro/7-11,13-15	Introduction, Chapter 1, Chapter 2, Chapter4 and Chapter 5 Table of Contents updated	
		Intro/16	Revision Record updated, removed extra page	
		Intro/17-22	Page flow affected	
		Intro/19-20	Revision Highlights updated	
		Intro/21	Effectivity Code updated	
		1/TOC	Updated	
		1/2/2	Central Lubrication System added	B
		1/2/3	Battery information updated	
		1/2/2-4	Page flow affected	
		1/3/13	Central Lubrication System added	B
		1/3/13-19	Page flow affected	
		1/4/1	4.1 Tow Tractor specifications updated	
		1/4/2	Battery information updated	
		1/4/3	Optional Equipment updated	B
		1/4/5	2013 Michelin approval letter	
		1/4/6-10	Page flow affected	
		2/TOC	Updated	
		2/1/4-5	1.3.1 Beka-Max Lubrication specifications added	
		2/1/7-9	Periodic Maintenance table updated	
		2/1/10-17	Page flow updated	
		2/1/10	Lubrication plate updated	B
		2/2/5-6	Updated Cummins BT6.7QSB Electrical schematics	B/C/E
		2/2/10	Harness, Instrument panel added	B/C
		2/4/1	Updated Calibrating the Speedometer	all
		4/TOC	Table of Contents updated	all
4/3/1-10	Parts Index updated	all		
4/4/2-3	Update decal and lube plate information (USAF)	B		

4	03-29-13	4/4/2-3	Added Serial No. Plate information (Commercial)	
		4/4/5	Changed qty to 2 (key 17, part 47458)	all
		4/4/5,39	Added LED information - 45817, 51227, 51604, 309477 and 51603 (USAF)	B
		4/4/7	Added 51219, 51221	
		4/4/8-9	Updated illustration to add 47626 & 48350	
		4/4/28-29	Updated Wheel/Tire information	
		4/4/35	Added 51605 (USAF)	B
		4/4/36	Added cutouts to 47891 & 47892	all
		4/4/39	Added LED information	B
		4/4/44,46	Updated illustration, #35	
		4/4/48-49	Updated graphic and parts table to reflect changes made to Instrument Panel Harness	B,C
		4/4/54-55	Added schematic	B,C
		4/4/56+	Pages renumbered	
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		4/4/72-73	Added 51595 - Anti-Skid, Top, Sprayed Grit, Option	B
		4/4/74-75	Added 51103 - Anti-Skid, Top, Safetywalk, Option	D
		4/4/76-77	Added 51104 - Chock Box, Option	D
		4/4/-78-79	Added 51588 - Hot-Wired Hazard Lights, Option	B
		4/4-80-81	Added 51589 - Lube System, Axle Automatic, Option	B
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		4/4/85	Added engine part numbers to table (Commercial)	all
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		4/4/93	Change qty for 200129	
		4/4-138-139	Added Brake, Park Assembly - Hydraulic illustration and parts list	
5/TOC	TOC updated, updated IssPro Programmable Speedometer and added Lubrication Pump, Beka-Max, Operator's/Service Manual			

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5	03-14-14	Intro/2	Flight Line was Arircraft/Industrial	all
		Intro/16	Rev. 5 added	B
		Intro/11	Added 2.3 to Troubleshooting section	all
		Intro/21	Eff. E, 13944-14 was 13919-12	all
		Intro/10,11	Chapter2 TOC updated	all
		2/2/4	Add Steering troubleshooting	all

CHAPTER 1 GENERAL INFORMATION & OPERATING INSTRUCTIONS

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1 PRODUCT SAFETY

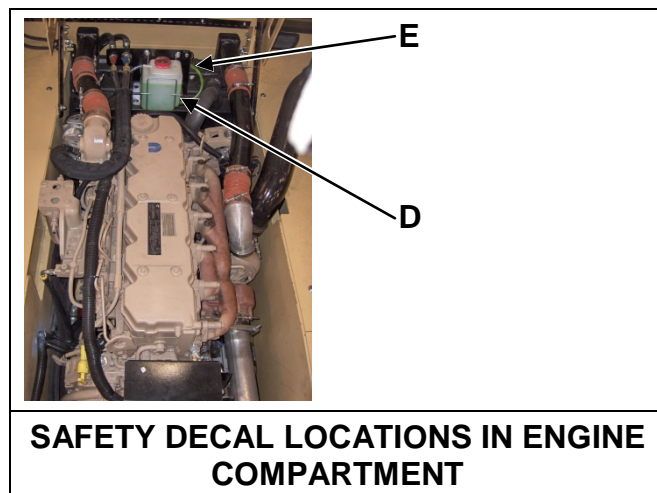
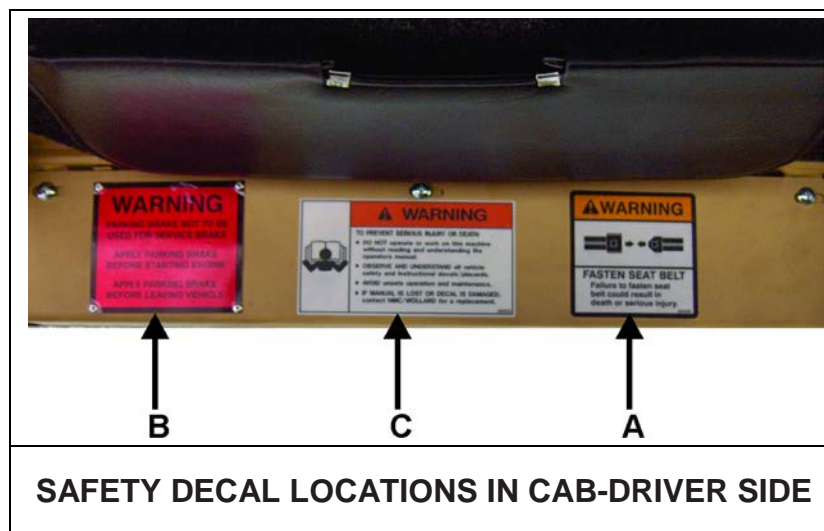
A brief description of signal words that may be used in this manual:

⚠ DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

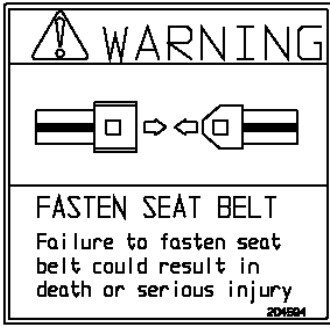
NOTICE! Used to address practices not related to personal injury.



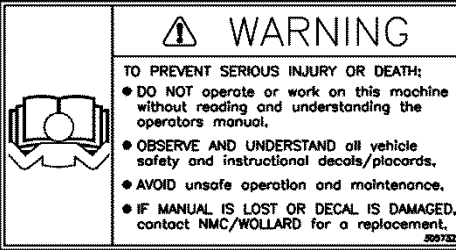
Tie down points are for tie down only, not for lifting.

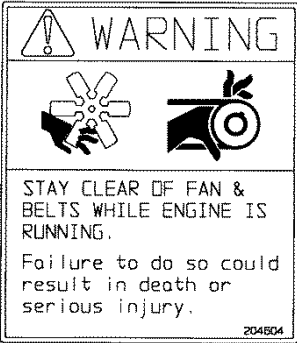
⚠ CAUTION For your protection, read all safety sign on the machine and in this manual. Replace any missing or illegible signs by ordering the part numbers shown on the safety sign page.

1.1. SAFETY DECALS


<p>SIGN A PART NO. 204594</p>


<p>SIGN B PART NO. MW17237</p>


<p>SIGN C PART NO. 305732</p>


<p>SIGN D PART NO. 204604</p>


<p>SIGN E PART NO. 204604</p>

1.1.1. Safety Sign Care

- Keep Safety Signs Clean And Legible At All Times
- Replace Safety Signs That Are Missing Or Have Become Illegible.
- Replaced Parts That Displayed A Safety Sign Should Also Display The Current Sign.
- Safety Signs Are Available From Your Dealer.

1.1.2. How to Install Safety Signs

- Be Sure That The Installation Area Is Clean And Dry.
- Remove The Smallest Portion Of The Split Backing Paper.
- Align The Decal Over The Specified Area And Carefully Press The Small Portion With The Exposed Adhesive Backing In Place.
- Remove Second Backing And Press Remaining Decal In Place.

1.2. GENERAL SAFETY PRECAUTIONS

All personnel who will handle, install, use or service this machine are required to read and understand the recommended practices and safety precautions in this manual. If there is a question that cannot be answered satisfactorily by a supervisor, contact the Customer Service Department at NMC-Wollard, Inc.

There are inherent hazards associated with the operation and servicing of this machine. For your protection please read and understand the following precautions before operating or servicing this machine.

DANGER

- Never approach overhead power lines or cables with any part of your machine. Contact with or getting close to any power lines or cables can result in electrocution.
- Fuel vapors create fire and explosion hazards. Do not allow any open flame, smoking materials or other potential ignition sources near fuel or the fuel system.

WARNING

- DO NOT place any part of body between wheels and wheel well opening to perform any service. Remove the wheel first to prevent serious injury from unexpected wheel movement.
- Never operate without all covers, shields and guards in place. Body, hair or clothing can become entangled in exposed, moving parts and can cause serious injury or death.
- Keep hands, loose clothing, long hair and loose jewelry away from moving parts. You may become entangled in moving parts that can cause serious injury or death.
- Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.
- Use seat belts, approved headgear, eye protection and other protective equipment as required by federal, state, local or employer regulations. Do not operate or service this machine while under the influence of any drugs or alcohol.
- Do not indulge in stunt driving or other reckless operation.
- Limit travel speed. Ground conditions, congestion, slope, location of personnel and other factors increase risk of collision or injury to personnel.
- Operator must be present while this machine is in use.

- California Proposition 65 Warning: Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- To minimize risk of serious injury or death, follow these hydraulic servicing precautions:
 - Follow all necessary lockout/tagout procedures.
 - Hydraulic systems have residual, stored pressure. Relieve all pressure from the hydraulic system before servicing.
 - Allow fluid to cool before working on system.
 - Hydraulic fluid escaping under pressure can have sufficient force to enter eyes and penetrate skin. If fluid gets in eyes or skin, flush with large quantities of water and seek medical attention.
 - Wear eye protection when servicing hydraulic components or systems.
 - Keep all hoses and connections in good serviceable condition. Check before start-up and periodically during operation.
 - Do not investigate for leaks with hands. Use a large piece of cardboard.
- To minimize risk of fire or explosion, follow these battery servicing safety precautions:
 - Sulfuric battery acid is poisonous. Avoid breathing battery fumes.
 - Battery acid is strong enough to burn skin and cause blindness if splashed into the eyes. Protect eyes and skin from contact. In the event of contact with battery acid, immediately rinse in large amounts of water. Obtain medical care if the eyes are burned.
 - Battery gas can explode. Keep sparks and flame away from battery.
 - Never check battery charge by placing a metal object across the battery posts. A spark will occur and cause possible explosion. Use a voltmeter or hydrometer.
- To avoid falls and injury, stand only on areas constructed with “gripstrut” or another skid resistant surface. Keep these surfaces in serviceable condition.
- Never make any alterations or modifications to this equipment including disabling safety devices or interlocks.

⚠ CAUTION

- Before starting repairs which do not require battery power, always turn off the key switch, then disconnect the battery connector from the battery to prevent accidental short circuit.
- Be certain area is clear of people and other equipment before starting operation.
- Keep machine clear of foreign objects and clean of grease/oil and other lubricants.

Failure to heed could result in serious personal injury or death.

In addition to these general safety precautions you will find specific safety messages embedded in the Operating and Maintenance Chapters of this manual. Please review them for your protection.

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2 EQUIPMENT DESCRIPTION

2.1. INTENDED USE

The tow tractor is designed for towing military aircraft up to 500,000 lbs. on dry, level concrete. Towing couplers are on the front and rear of the tractor with high and low mounting provision.

2.2. DESCRIPTION OF THE TRACTOR

The four-wheel-drive tractor operates like most automotive vehicles powered by an internal combustion engine. The major difference between this tractor and an automobile having a similar size engine is the higher gear ratio in the rear axle. The higher gear ratio allows great pulling (towing) ability.

2.3. FRAME

Heavy duty precision aligned, 1-piece welded structure. Main frame plates and side panels are heavy duty steel with structural rear bumper.

All frame and body surfaces are shot blasted, primed and painted with weather resistant paint. Standard bolts are SAE grade 5, zinc-phosphate coated to resist corrosion.

2.4. ENGINE

Engine, BT6.7QSB, Tier III

Cummins QSB6.7, 6 Cylinder, 6.7 Liter, 190 BHP (142kW) @ 2400 RPM. Torque @1500 RPM, 686 ft. Lbs. (930 N-m).

2.5. COOLING SYSTEM, ENGINE AND TURBO

An engine-radiator system is provided for cooling. Radiator is insulated from vibration. The incoming turbo air is cooled to increase the performance and ensure long turbo life.

2.6. TRANSMISSION

Funk Model 2000 Power Shift automatic with 6 speed forward and 3 reverse, full time four wheel drive (4x4), canister type oil filter, separate transmission fluid cooler, gear-driven pump for power steering and brakes. Integral no-spin differential allows front and rear axles to rotate independently- prevents drive line windup and stress. No spin feature joins axles together for maximum tractive effort if wheel slippage occurs.

Forward and reverse speed ranges are obtained through the use of electrically controlled solenoids and hydraulically actuated multiple disc clutches. These clutches are power absorbing members that can be engaged at full engine power. Shifting under full engine power makes this model a full power shift for the forward and reverse motion in all four speeds.

The clutches in this unit are hydraulically applied and spring released, which eliminates the need for adjustment. Each clutch uses eleven semi metallic friction

plates, and eleven polished steel reaction plates, except for the high gear clutch that uses eight of each plate.

The power from the engine is transmitted to the Shift-O-Matic through a torque converter. The use of the torque converter has two distinct advantages, one is the converter is essentially a fluid drive, there being no direct mechanical connection through it. This feature creates smooth and shock free drive eliminating engine stalling and lugging. A second advantage is that the converter transmits the engine power directly at almost engine speed, and there is no torque multiplication. The net result is an action like a transmission, with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced. During shifting it is not uncommon to hear and feel the clutches engage.

2.7. LUBRICATION SYSTEM

An oil pump draws oil through a strainer in the oil pan and circulates the oil through the engine. Before entering the engine, all the oil from the pump passes through the oil filter. Surplus oil drains back into the pan. Engine oil pressure is maintained by a spring-loaded pressure-relief valve in the oil pump.

The screw-on oil filter has an internal relief valve to bypass the filter if the element becomes clogged.

Engine oil flows through the oil cooler cavity to be cooled by coolant which flows through plates inside the oil cooler.

2.7.1. Central Lubrication System (Optional)

An electrically operated piston pump, with up to three pump elements, supplies lubricant to the main progressive distributor from where it is directed, in the correct ratio, to secondary progressive distributors. These secondary distributors supply lubricant to individual lubrication points. The electronic control unit controls the interval time and also the pump "run" time.

2.8. FUEL SYSTEM

The lift pump draws fuel from the fuel tank and delivers it to the fuel/water separator and secondly through a lubricity filter. The lubricity filter provides lubricant making the engine compatible with J8 jet fuels. Finally the fuel is delivered to an engine mounted fuel filter from which the fuel exits and flows to the injectors.

2.9. AIR CLEANER

The air cleaner is a dry element type and is located on the right front fender. It prevents dirt and other foreign materials from entering the engine.

2.10. EXHAUST SYTEM

The exhaust system consists of an exhaust manifold, exhaust pipe, muffler and tail pipe. The exhaust manifold has large radius curves which permit exhaust gases to leave the cylinders with a minimum of back pressure and power loss. All parts of the exhaust system are well supported with clamps and hangers.

2.11. ELECTRICAL SYSTEM

2.11.1. Battery

The battery is a conventional 12-volt type 4D with a positive cable and a negative ground cable. The cables have protective boots at the battery end.

2.11.2. Alternator

Electrical power is supplied by a belt-driven 95 amp alternator mounted on the front of the engine. It produces three-phase alternating current and voltage, rectified to DC by a full-wave rectifier bridge using six diodes. The alternator does not require a cutout relay.

The current regulator is part of the alternator assembly. It determines output current according to load, such as headlights, rear lights, etc.

2.11.3. Starter

A starter lock out switch prevents starter and ring gear damage when engine is running. Tractor starts only in neutral. All circuits are protected with circuit breakers.

The starter motor is a gear-reduction type and is used to turn the engine fast enough to start the engine.

2.11.4. Lights and Accessories

Two head lights are on the front of the tractor. The stop/tail lights and rear backup lights are in the rear body. The backup lights can also be used as work lights (there is a separate switch for this purpose).

2.12. INSTRUMENT PANEL

2.13. AXLES

Front and rear axles are steerable.

Axles are planetary, double reduction, heavy-duty bearing mounted differential assembly. The second reduction planetary gears set in wheel hubs multiply torque and reduce drive line stress. Rear axle is center pivot mounted and allows tractor to negotiate obstructions-axle has 4" oscillation. Front axle is solid mounted to the tractor frame.

2.14. BRAKE SYSTEM

2.14.1. Service Brake

The brake pedal is located on the floor, to the right of the steering column. The service brakes, both front and rear, are "wet" disk type, fully enclosed and oil cooled. They will withstand repetitive use without excessive fading, provide short stopping distances, and are spark free.

Dual brake system serves front and rear wheels independently. In the event of an engine failure, hydraulic accumulators store enough energy for several applications of the brake.

2.14.2. Parking Brake

The parking brake is located on the transmission. It is spring applied and activates when hydraulic pressure falls below 1200psi. When the hydraulic pressure is restored when the engine is started, the “automatic” brake function will be released.

The park brake is manually applied and released with a toggle switch on the console behind the shift lever.

If necessary, additional emergency braking can be obtained by application of the park brake.

An indicator light on the dash will come on when the parking brake is applied. See Figure 1-1. Release the parking brake before shifting from neutral. If the shift selector is moved from neutral while the parking brake is applied, the accelerator will not respond.

2.15. STEERING SYSTEM

The system is hydraulically assisted and uses a hydraulic cylinder built into the axles to move the tie rods which in turn pivot the wheel hubs.

Steering is driver selectable 4-wheel coordinated, 4-wheel crab, or front 2-wheel steer. In case of engine failure, emergency steering is manual only, and will only be possible if the tractor is rolling.

3 OPERATION

⚠ WARNING Read and understand the Owner's Manual before operating this machine. Failure to follow the safety instructions could result in serious injury or death.

3.1. PREOPERATION

3.1.1. Understand the Controls and Instruments

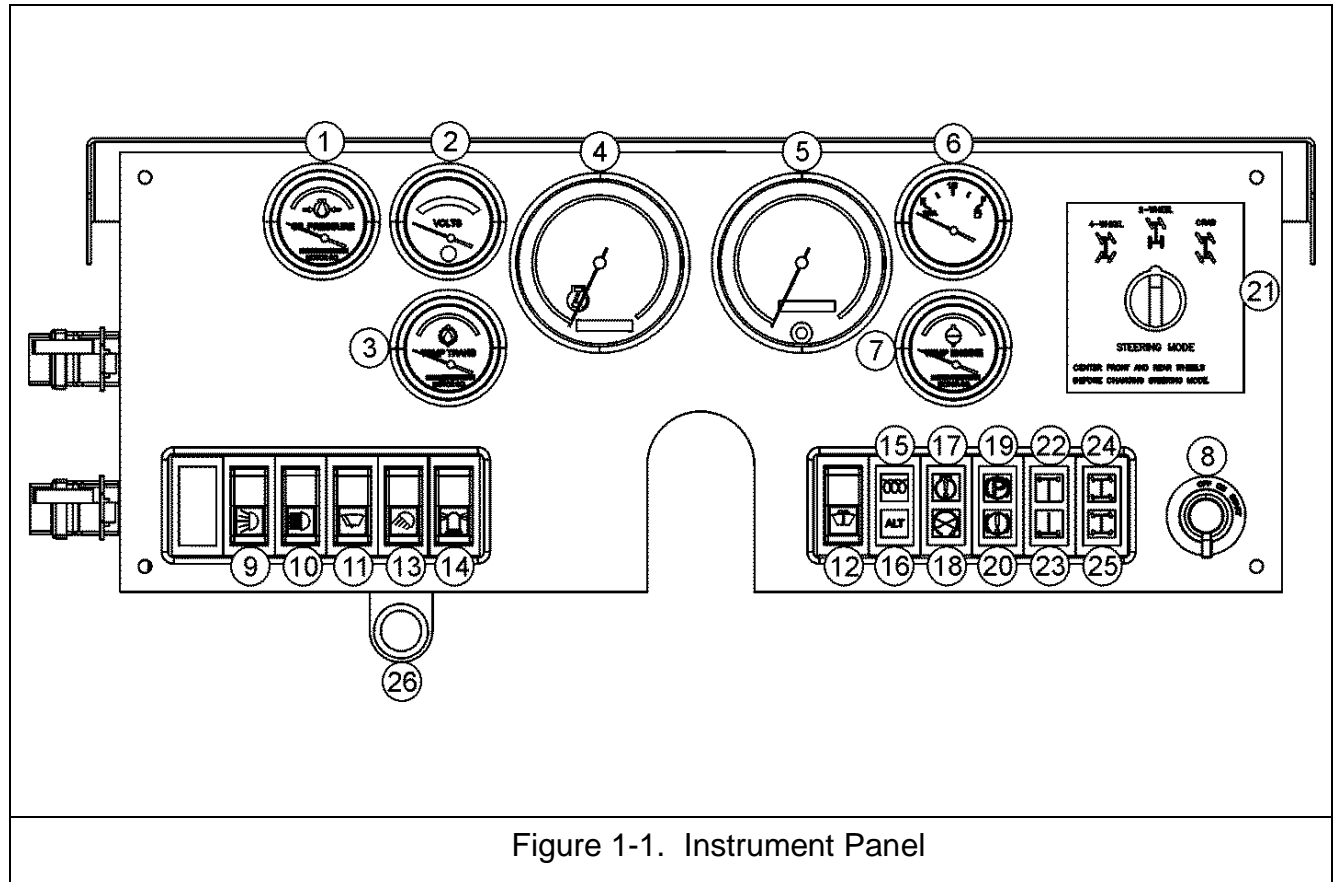


Figure 1-1. Instrument Panel

Instrument Panel

All driver instruments are conveniently located on the instrument panel (see Figure 1-1):

1. Oil Pressure Gauge - indicates oil pressure only (not oil level). It is marked 6 to 100 with intermediate index marks. If the gauge registers in the red area, stop the engine and troubleshoot the cause.
2. Voltmeter - registers voltage across the battery terminals. The needle should be in the green area while the tractor is operating. If the needle registers in the red while the tractor is operating, this indicates that the battery is not being charged by the alternator. Stop the tractor and inspect the battery, cables, and alternator connections.
3. Transmission Temperature Gauge - shows the temperature of the transmission fluid. Normal operating temperature is in the 160°F to

- 200°F range. If the needle goes into the red (250°F+), stop the engine and troubleshoot the cause.
4. Tachometer/Hour Meter - registers engine rpm and how many hours the engine has operated. It is sealed and can record 99999.9 hours before it returns to zero.
 5. Speedometer-mpg/kph.
 6. Fuel Gauge - shows the amount of fuel in the fuel tank. A sending unit in the tank is connected to the gauge. The gauge is marked E and F to indicate the relative quantity of fuel in the tank. Be sure you have sufficient fuel to complete your planned operation.
 7. Engine Coolant Temperature Gauge - shows the coolant temperature in the engine's water jacket. The gauge needle should rise when the engine is started, then level out at between 160 and 200 as the engine warms up. If the needle goes into the red, stop the engine and check for a cooling system problem.
 8. Ignition Switch - a rotary type with OFF, RUN and START positions.
 9. Headlight/tail light Switch - rocker switch controls the two sealed beam headlights and the tail lights.
 10. High Beam Switch (toggle On/Off) - "high-beam" indicator light is activated when the high-beams are on. This switch toggles "high-beam" on/off.
 11. Windshield Wiper Switch
 12. Windshield Washer Switch
 13. Work Light Switch - rocker switch controls the rear work lights.
 14. Beacon Switch
 15. Engine Pre-Heater (manifold grid heater) Indicator
 16. Alternator Indicator
 17. Engine Warning (malfunction) Indicator
 18. Engine Shutdown Indicator
 19. Parking Brake Applied Indicator
 20. Brake System Failure Indicator - "brake failure" light operates if either the front or rear brake systems lose pressure.
 21. Switch, Steering Mode Selector
 22. Front Wheels Straight Forward
 23. 2 Wheel Steering Mode Indicator
 24. Steering Crab Mode Indicator
 25. 4 Wheel Coordinated Steering Mode
 26. Power outlet, 12VDC

Operator Controls

1. The gear shift lever is on the driver's right. It permits selection of six forward or three reverse gears and a neutral position.

NOTICE ! If the shift lever is moved from the neutral position with the parking brake applied, the accelerator will not respond.

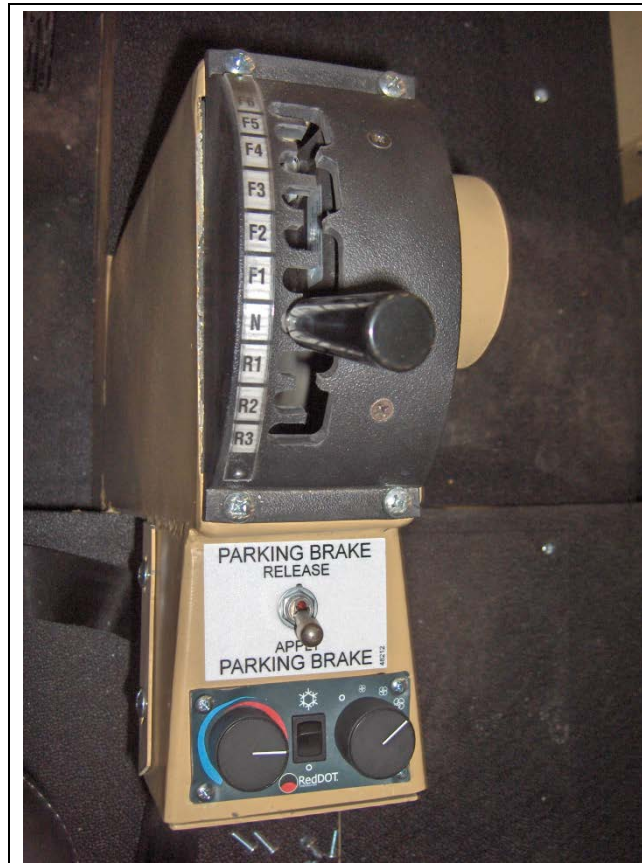


Figure 1-2. Console Controls

2. The accelerator pedal is to the right of the brake pedal and is an electronic sending unit type.
3. The service brake pedal is to the left of the accelerator pedal. See Figure 1-4 for hydraulic brakes. In the event of an engine failure, braking is still by application of the service brake pedal. Hydraulic brakes are power boosted so will be harder to apply with loss of power. If necessary, additional emergency braking can be obtained by application of the park brake.
4. The park brake is applied by pulling up on the parking brake switch and moving downward. Pull up and push switch forward to release. See Figure 1-2.



Figure 1-3. Foot Controls

Seats

The Operator and Passenger Seats are adjustable for fore and aft, vertical (by adjusting front and rear of seat together), backrest inclination (by adjusting front and rear of seat independently) and for body weight.

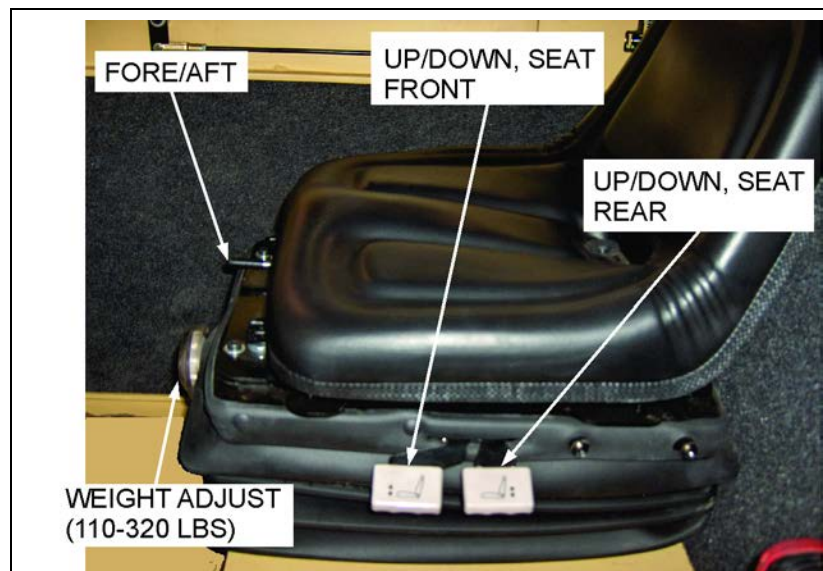


Figure 1-4. Seat

Heater and Air Conditioner Operation

1. For heater operation, the AC rocker switch must be off, Figure 1-5.
2. For AC operation, the AC rocker switch must be on, Figure 1-5.

3. Direct air onto the windshield by adjusting the air Louvers along the top side of the dash.
4. Direct heat or air conditioning with the louvers on the dash right side and ahead of the passenger.
5. Use the temperature knob to control temperature and the blower speed knob to control the blower.

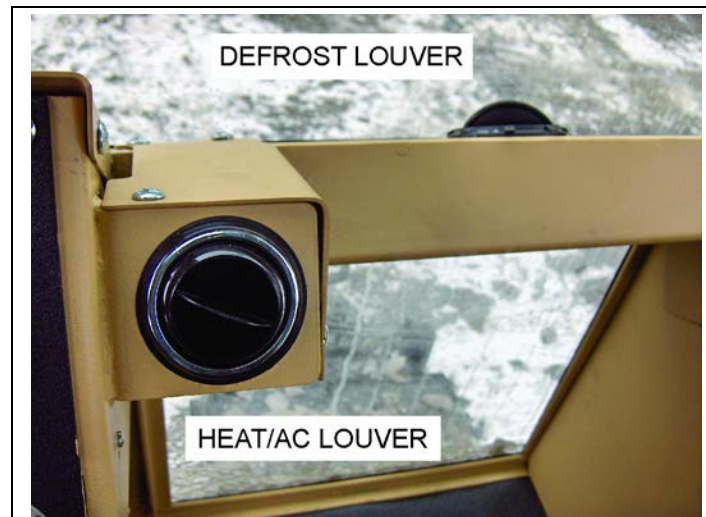


Figure 1-5. Heat/AC/Defrost Vents

Air Conditioner Operation

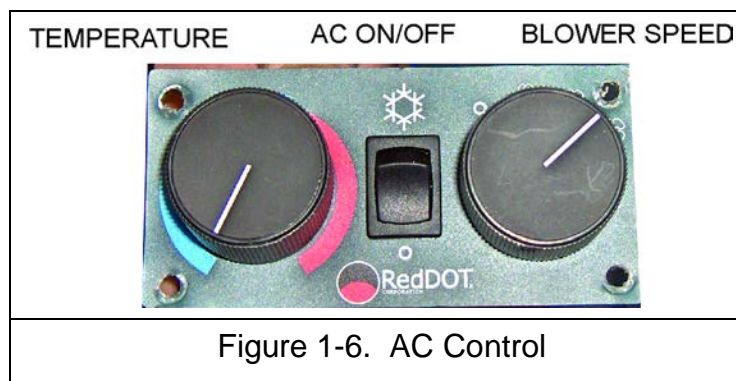


Figure 1-6. AC Control

3.1.2. Pre Operation Checklist



1. If the unit has just been received after shipment, commission the unit (put into service) as described in 5.1.
2. Always perform a thorough visual examination for any damage or missing items that may have occurred since the last operation that could cause the tractor not to be ground worthy or safe to operate. Report damage to the proper authorities so that repairs can be made.
3. Check for signs of fluid leakage under the parked machine. If found, identify the fluid and report to the proper authorities so that repairs can be made.
4. Check engine and transmission oil levels. This requires boarding the tow tractor deck at the rear. Use the fold down step near the hitch and grab handles to board the deck. Walk toward the front of the tractor, unlatch and raise the engine cover. Remove the yellow engine dipstick and wipe it clean and reinsert it. Then remove it again and check that

the level is within the normal operating range. Check the transmission with the transmission dipstick using the same procedure.

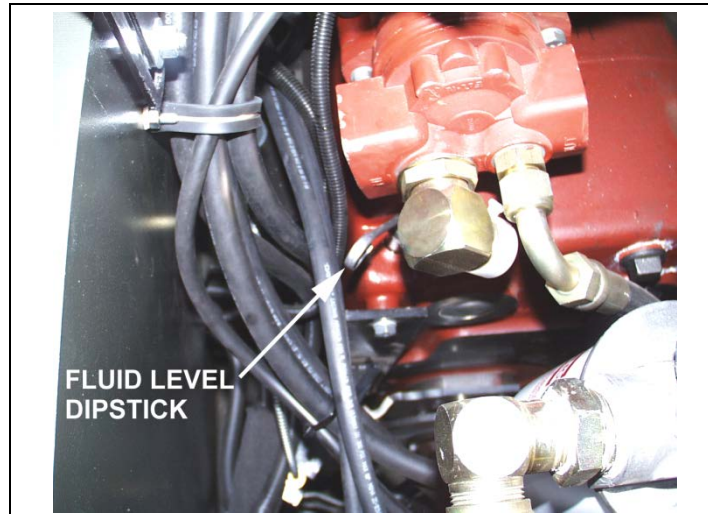


Figure 1-8. Transmission Fluid Level

5. Check coolant level in the coolant recovery reservoir.
6. Check the brake fluid level.
7. Check the fuel level and ensure you have an adequate supply for the anticipated operation.
8. Check wheels and tires for damage and proper inflation pressure (130 Psi). See tire application approval letter in 4.14.1.
9. Check that the fire extinguisher is securely attached and the charge gauge indicates in the green range.
10. Check for adequate windshield washer fluid in the bottle located at the left side of the operator's seat.



Figure 1-9. Windshield Washer Bottle

11. With the ignition on, check operation of lights, horn and wipers.

12. With the park brake applied, start the engine and check for adequate oil pressure. Check for any malfunction indicators. If the engine warning light comes on without any error code, it likely is indicating that there is water in the fuel/water separator. Shut down the tractor and drain the water until fuel appears from the fuel/water separator.
13. Position all mirrors as required for the operator.

3.2. OPERATING THE ENGINE

3.2.1. Starting The Engine (normal starting)

1. The transmission must be in the neutral position before starting the engine, and when the vehicle is parked and the engine is running.
2. A Cummins Operation And Maintenance Manual is included in Chapter 5 of this manual. This manual gives detailed procedures in Section 1 for:
 - a. Normal Starting
 - b. Cold Weather Starting
 - c. Jump Starting
 - d. Operating the Engine
 - e. Engine Shut Down
3. To start the engine:
 - a. Begin by ensuring the parking brake is applied.
 - b. Be sure the transmission is in the "Neutral" or the "N" position. This is assured by the lever being in the neutral detent. *If the transmission is not in the neutral position, the engine will not start. You will have to put the tractor in "Neutral" - rotate the Start switch to the "Off" position, and then start the engine.*
 - c. Turn ignition start switch to "Run" position, insure Preheat (manifold grid heater) indicator illuminates then extinguishes.
NOTE: In extremely cold weather, preheat indicator may come on, momentarily turn off, and then come on again. You must wait for it to go off the second time. See Figure 1-10.
 - d. Turn switch to "Start" position. Engine will start quickly.
 - e. If the engine does not start within 20 seconds, you must release the start switch and wait for one minute before re-engaging the starter motor. This allows the start motor to cool down. Note also, once start switch is moved to "Start" position it cannot be returned to the "Start" position without first turning it to the "Off" position.
 - f. Before you position the Start Switch to "Run", the tachometer may read a random value. However, after the engine starts it will read the appropriate values.

- g. After the engine starts, allow it to idle until the oil pressure gauge indicates normal oil pressure. Oil pressure should rise within three seconds after engine start.
4. If the engine does not develop adequate oil pressure within the three second time frame, you must immediately shut down the engine and have this problem addressed and corrected.
5. After a cold start, the manifold grid heater will cycle on and off until the engine warms up. At idle this will result in a noticeable voltage fluctuation and can cause dimming of lights and instruments. This is normal. This will be less noticeable after increasing engine speed.
6. The warning light panel houses all indicator lights monitoring tractor operation, Figure 1-10. It includes: a preheat (manifold grid heater) indicator; alternator indicator; parking brake indicator; brake failure indicator; and wheel position indicators for steering modes selected. In a normal engine start sequence, all warning lights will turn off assuring the tractor is ready to operate.

3.2.2. Starting The Engine (hard or cold weather starting)

⚠ WARNING DO NOT use ether as a starting aid. The engine is equipped with a manifold grid heater. Highly flammable ether and similar starting aids exposed to these devices can cause a fire or an explosion.

NOTICE! The tractor cannot be started by towing or pushing.

Battery

⚠WARNING To minimize risk of fire or explosion when charging a battery:

- Keep sparks and flame away from battery to avoid battery gas ex
- If charging the battery while installed in the vehicle, disconnect the negative (black) battery cable and then the positive (red) cable before connecting the charger.
- With the charger unplugged and the switch OFF, connect the positive (red) charger cable to the positive (+) battery terminal and then the negative (black) charger cable to the negative (-) battery terminal.
- Set the charger for the correct voltage and charging rate. Then plug the charger in and turn the switch ON.
- When charging is completed, turn the charger OFF, unplug it and then disconnect negative and then positive cables. Reconnect the positive and then the negative battery cables.

⚠WARNING To minimize risk of fire or explosion when jump starting a vehicle:

- Keep sparks and flame away from battery to avoid battery gas explosion.
- Do not allow the booster and dead vehicles to touch. Set park brakes and turn both vehicle ignitions OFF.
- Connect one end of the positive (red) booster cable to the positive (+) terminal on the dead battery and then the other end of this red cable to the positive (+) terminal of the booster vehicle battery.
- Connect the end of the negative (black) booster cable to the negative (-) terminal of the booster vehicle battery and the other end of this black cable to a unpainted bolt or bracket on the dead vehicle (good ground) located as far as possible from the dead battery to minimize the possibility of igniting any hydrogen gas.
- Start the booster vehicle and let it idle for several minutes, then start the dead vehicle. If the vehicle fails to start in a normal manner, discontinue jump starting and service the vehicle for other problems.
- Once the dead vehicle is running, disconnect the booster cables in the reverse order they were installed.
- Never allow booster cable ends to touch while connected to a battery.
- A worn out or badly sulfated battery will produce numerous problems that cannot be corrected until the battery is replaced.
- Always check battery condition and connections before investigating other tractor systems.
- A worn out or badly sulfated battery will produce numerous problems that cannot be corrected until the battery is replaced.
- Always check battery condition and connections before investigating other tractor systems.

Winterization Kit Types A And C UsageType C (Standard; engine starts down to –20° F)

- 50% Anti-Freeze in Engine Coolant (freeze protection down to –34° F)
- 12V/3.2 KW Engine Starter
- 12V/95A Alternator
- 120V/750W Engine Block Heater
- Dual 12V (190A total) Engine Intake Air Pre-Heaters controlled by engine ECU
- 12V/200W Fuel Heater in Fuel Filter
- Type ATF (C4) Hydraulic & Brake System Fluid
- Type ATF (C4) Transmission Fluid
- 1350 CCA Type 4D Battery, Reserve Capacity 360, 185 A.Hr.
- Size 1/0 Battery Cables

Note– fuel blends and engine oils appropriate for these temperatures must be used for satisfactory results. See Fluids And Capacities And Ambient Temperature Ranges section in Chapter 2.

Type A (Heavy-Duty; engine starts down to –40°F, vehicle storage down to –65° F)

Components as described above, with the following changes and additions:

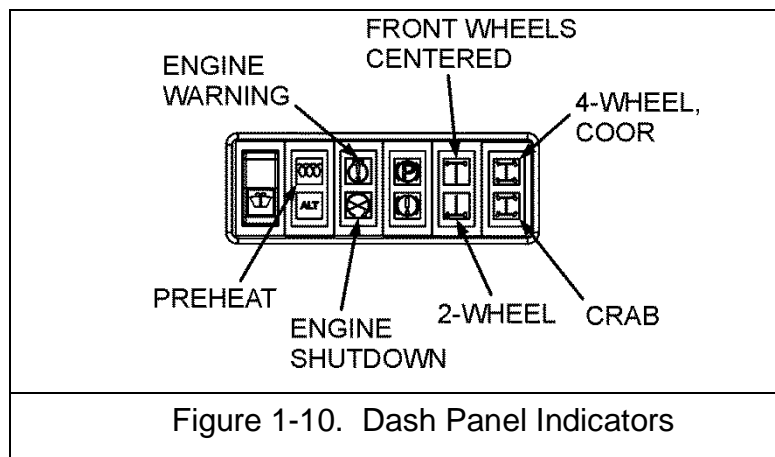
- 62% Anti-Freeze in engine coolant (freeze protection down to –67° F)
- 120V Battery Heater

Note– fuel blends and engine oils appropriate for these temperatures must be used for satisfactory results. See Fluids And Capacities And Ambient Temperature Ranges section in Chapter 2.

3.2.3. Engine Performance

Engine Protection System

1. The engine is equipped with an engine protection system. The system monitors critical engine temperatures and pressures and will log diagnostic faults when an over or under normal operation condition occurs.
2. If an out-of-range condition exists, the operator will be alerted by the in-cab yellow WARNING lamp. See Figure 1-10. It is not necessary to stop operation if the warning comes on, but it is a warning to change operation, such as reducing the load to correct the situation or to get the tractor to the shop for maintenance if the cause of the warning is not determinable. Check the instrument panel gauges for a possible indication of the problem.



3. If the fault continues to worsen, the warning lamp will begin to blink. If the fault becomes critical, the red STOP lamp is illuminated, see Figure 1-10, and the driver must pull to the side of the work area when it is safe to do so, and shut down to reduce the possibility of engine damage. If not shut down by the driver, the engine will automatically shut down in 30 seconds. **NOTE:** Engine power and speed will be gradually reduced depending on the level of severity of the observed condition.
4. Engine Protection Shutdown Override: In the event of an engine protection shutdown, the driver can over ride it by turning the ignition off, shifting to neutral and applying the parking brake. Then the engine can be restarted for an additional 30 seconds of operation.
5. Electronic Control Module (ECM) features and engine protection devices are also described in Section 1 of the Cummins manual.
6. If you encounter engine operation problems or malfunctions, see Section TS-Trouble Shooting of that manual.

Engine Diagnostic Code Retrieval And Explanations

Turn the ignition switch to the ON position but do not start the engine. At any time, cycle to accelerator pedal to full throttle and back to the idle position, three times within 5 seconds.

If no active fault codes are recorded, both Engine WARNING (yellow) and Engine STOP (red) lights will come on and stay on.

If active fault codes are recorded, the fault code will flash in the following sequence:

1. The WARNING (yellow) lamp will come on for 2 seconds then go off.
2. There will be a 2 second pause, then each digit of the 3 or 4-digit recorded fault code will flash in the STOP (red) lamp. There will be a 2 second pause between each digit and also at the end of the STOP (red) lamp sequence. Count the number of flashes in each digit to determine the number of the fault code.
3. The WARNING (yellow) lamp will come on again for 2 seconds and then go off.
4. The 3 or 4-digit fault code will repeat on the STOP (red) lamp.
5. The lights flash each fault code out two times before advancing to the next fault code. If only one active fault code is recorded, the control system will continuously display the same fault code. To advance to the next fault code, you can also cycle the accelerator pedal instead of waiting.
6. The explanation and correction of the fault codes can be found in "Cummins Diagnostic Codes," Chapter 5.

3.3. CENTRAL LUBRICATION SYSTEM (OPTIONAL)

The system operates on a progressive basis, and is capable of using grease up to NLGI Class 2. "Progressive" signifies that the lubrication points are lubricated in a progressive sequence, i.e. one after the other. This design principle permits easy monitoring of the system by means of an in-built pressure relief valve in the pump element. If any lubrication point cannot be lubricated from the distributor, a back pressure of up to 280 bar will be built up in the system and at that point, a controlled discharge of lubricant will be released via the pressure relief tee, thus allowing normal operation of the rest of the system.

The agitator rotates in the reservoir, forcing lubricant from the reservoir via the perforated base plate into the pump housing. The combination of agitator and the base plate serves to reduce air bubbles to insignificant dimensions. A red plastic wiper blade on the agitator permits visual inspection of pump operation and grease level. The pressure relief valve provides protection to the system in the event of an overpressure.

A Beka-Lube Operator's/Service is included in Chapter 5 of this manual. This manual gives detailed procedures for Pump Technical Data, Pump Elements and

Adjustment Instructions, Electronic Controller Overview and Adjustment Instructions, Wiring, Distribution Blocks, Hose Assembly, Pump Options, Troubleshooting, Block, Pressure and Initial System Testing, Pump Refilling and Grease System Layout.

3.4. DRIVING THE TRACTOR

⚠ WARNING To prevent serious injury, all riders must ride in a passenger seat with the safety belt fastened.

⚠ CAUTION Always check local ordinances before driving a vehicle on public roads or streets. Comply with all regulations and obey all traffic signs to prevent an accident.

⚠ CAUTION Be extremely alert during hazardous operating conditions. Operating conditions can change as work progresses and as weather changes.

⚠ CAUTION Always approach turns slowly and carefully. When approaching blind corners or steering around obstructions, reduce speed and proceed cautiously.

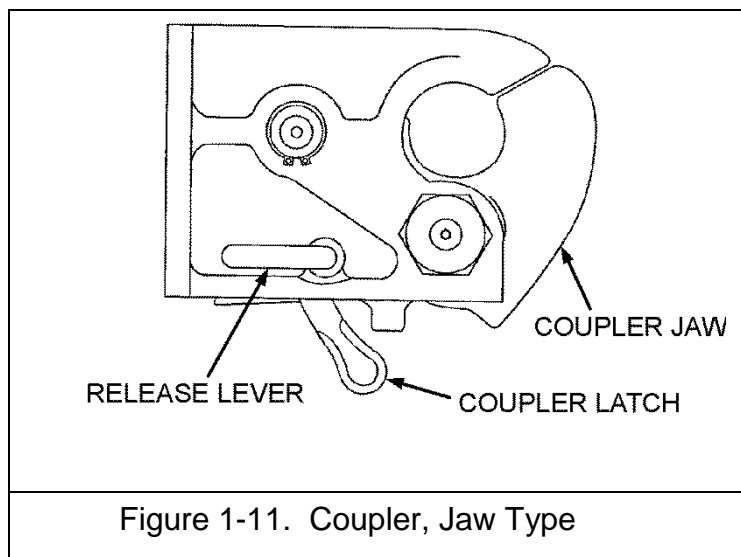
1. Turn on the lights required for your operation and the windshield wipers if needed.
2. Before operating the tractor, be sure to have your seat belt fastened. Passenger is also required to fasten seat belt.
3. When the engine is warmed up, the tractor is ready for work.
4. With the engine at idle speed, press on the brake pedal, release the parking brake (and trailer brake if in tow).
5. Position the shift lever in the direction of desired travel. You can start out in any gear depending on the load pulled and speed desired. If you pick a gear that is too high the engine may lug or stall.
6. Safety issues should be considered when selecting travel speed. Some trial and error may be advised. Each operator will get used to this transmission and learn to pick the appropriate gear and when to shift.
7. Position selector valve switch, located to the right of the instrument panel to select the desired steering mode. See Figure 1-13. **NOTE:** Position wheels straight ahead before selecting steering mode.
8. Release the foot brake and depress the accelerator pedal slowly and evenly. As the tractor starts to move and increase speed, move the transmission lever up through the gears as engine rpm's increase. Do not over-rev or lug down the engine.
9. When towing, allow tractor to decelerate by releasing accelerator pedal before applying foot brake.
10. When driving or towing, avoid the tendency to oversteer and turn too sharply. Allow enough clearance for the towed load.
11. To stop the vehicle, remove your foot from the accelerator and smoothly

- place moderate pressure on the brake to bring the vehicle to a stop.
12. With the tractor completely stopped, place the shift lever in the neutral detent and pull the parking brake switch to apply the parking brake.
 13. **NOTE:** The parking brake is designed to hold the tractor after it has come to a complete stop. It is not to be used to stop the vehicle except for emergency stopping described in 3.9.

⚠WARNING Be sure that the shift control lever is secure in the neutral detent and the parking brake is applied to prevent unintended movement that could result in serious injury or death.

3.5. COUPLERS, JAW AND DROP PIN TYPES

3.5.1. Jaw Coupler



⚠CAUTION Before operating, inspect for worn parts, freely moving pivots points and secure mounting. Correct as required before use.

Jaw type coupling operation. See Figure 1-11.

⚠WARNING Failure to keep body parts from between tow tractor and the tow bar could result in injury or death to personnel.

1. Open coupler jaw by moving release lever up and holding it while coupler latch is pushed back towards the mounting base and latched behind it. Coupler jaw can then be rotated down to open.
2. To couple, drive near the trailer with the trailer drawbar centered on the coupler. Stop and adjust the drawbar height so it will enter the coupler mouth. Move in slowly to automatically lock the coupler to the drawbar.

3. Check that the coupler jaw is closed and locked (coupler latch is fully toward trailer and release lever is down and engaged).

⚠ CAUTION Check that the coupler jaw is closed and locked (coupler latch is fully toward trailer and release lever is down and engaged), to prevent accidental unhooking, which can result in a runaway load causing endangerment to you and others.

Jaw type un-coupling operation. See Figure 1-11.

⚠ WARNING Failure to keep body parts from between tow tractor and the tow bar could result in injury or death to personnel.

1. Open coupler jaw by moving release lever up and holding it while behind it. Coupler jaw can then be rotated down to open.
2. Carefully drive tow tractor forward while supporting tow bar. Lower tow bar once adequate clearance is achieved.
3. Close the coupler jaw and make sure it is locked (coupler latch is fully toward couple jaw and release lever is down and engaged).

3.5.2. Drop Pin Coupler

⚠ CAUTION Before operating, inspect for worn pin, safety latch freely pivots and secure mounting. Correct as required before use.

Drop-pin hitch/lunette ring coupling operation. See Figure 1-12.

⚠ WARNING Failure to keep body parts from between tow tractor and the tow bar could result in injury or death to personnel.

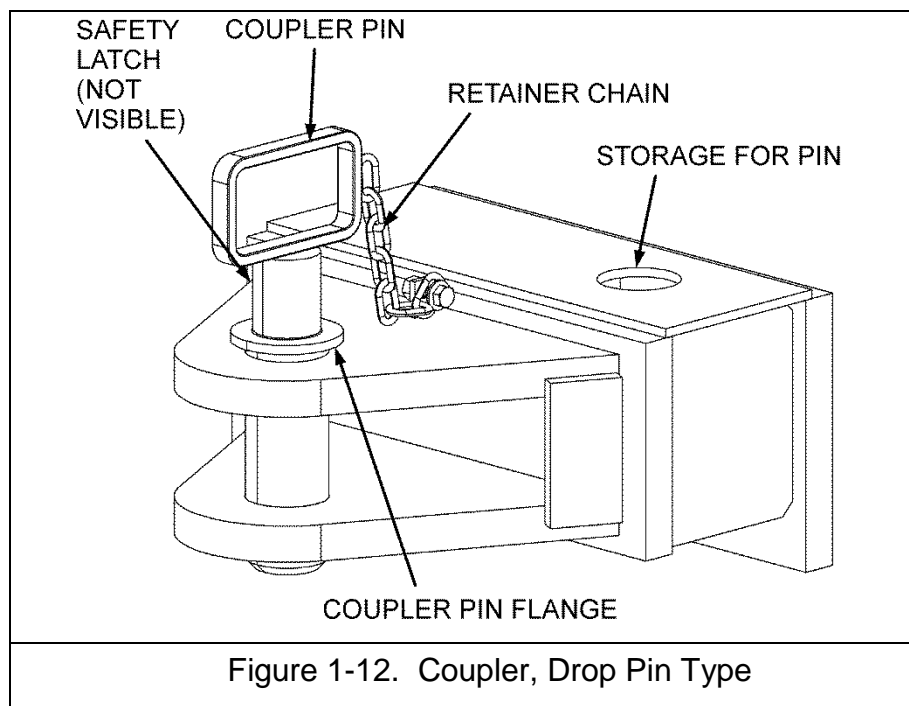
1. Crew member shall actuate the safety latch lever on drop-pin hitch assembly to allow pin removal from drop-pin hitch assembly, and place pin into storage for pin on drop-pin hitch assembly.
2. Carefully back tow tractor and align the tow bar lunette ring between the upper and lower plates of the drop-pin hitch assembly.
3. Install pin into hitch assembly, capturing tow bar lunette ring and ensuring safety latch lever is fully engaged.

⚠ CAUTION Be sure the safety latch properly engages over the top of the coupler pin flange to prevent accidental unhooking, which can result in a runaway load causing endangerment to you and others.

Drop-pin hitch/lunette ring disconnect operation. See Figure 1-12

⚠WARNING Failure to keep body parts from between tow tractor and the tow bar could result in injury or death to personnel.

1. Crew member shall actuate safety latch lever on drop pin hitch assembly to allow pin removal from drop pin hitch assembly, and place pin into pin holder on drop pin hitch assembly.
2. Carefully drive tow tractor forward while supporting tow bar. Lower tow bar once adequate clearance is achieved.
3. Stow pin in drop pin hitch assembly (not pin holder) on completion of towing operation.

**3.6. STEERING MODE SELECTION & OPERATION**

See Figure 1-10 and Figure 1-13.

1. The operator has a choice of operating in any of three steering modes by positioning the selector switch located on the dash panel.
2. The operator may select to operate the tractor in two wheel (2W) or front steering mode. When this mode is selected, the 2-wheel indicator will light.
3. The operator may select the coordinating mode 4-wheel (COOR) which will automatically steer the rear wheels as he operates the steering wheel. The 4-wheel (COOR) indicator will not light until steering progresses so all 4 wheels are synchronized. The action of the rear wheels is proportional and opposite to the action of the front wheels to give the shortest turning radius.

4. **NOTICE!** If changing from 4-wheel (COOR) mode directly to crab, or vice versa, you must switch to 2 wheel first and turn the steering wheel until the "front wheels centered" indicator lights. Then switch to the desired mode.
5. The third position of the steering selector switch allows the driver to steer the rear wheels in the same direction as the front wheels (CRAB). This steering mode is used for accurate positioning for trailer hook-up or for crab steering around or away from obstacles. The "crab" indicator will not light until steering progresses so all 4 wheels are synchronized.
6. When switched to 2 wheel, the system will remain in its original state until the rear axle is centered by the driver.
7. The relays are magnetically latched to remain in their "set" or "reset" state when power is off.
8. **NOTICE!** If the rear wheels were not centered when the tractor was shutdown, the system will restart in the last active steering mode even if a new mode is selected before engine start.

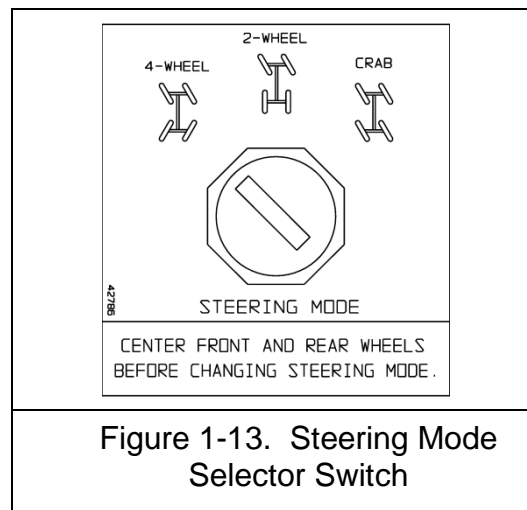


Figure 1-13. Steering Mode Selector Switch

3.7. TRANSMISSION OPERATION

1. If the oil temperature gauge, which is the converter oil out temperature, rises above 250° or the warning light comes on, stop the vehicle immediately. Shift to neutral and run the engine at 1000-1200 RPM. The temperature should drop rapidly to the engine water temperature. If the temperature does not drop, trouble is indicated. The trouble should be determined before the vehicle is operated again. Overheating generally occurs due to working in too high of a gear ratio. Shifting to a lower gear will help eliminate overheating.
2. Do not shut off engine when unit is overheating.

3.8. SHUTTING DOWN THE TRACTOR

1. Bring tractor to a complete stop. Place gear shift lever in neutral (N).
2. Apply the parking brake.

3. Turn off all lights.
4. If engine is used at full load, allow it to cool for 3-5 minutes at idle.
5. Turn off ignition switch.

⚠WARNING Always set the parking brake when parking the machine. The transmission does not have an internal parking lock and failure to apply the parking brake could allow unexpected movement resulting in crushing injury or death.

3.9. EMERGENCY STOPPING

If the service brakes fail, follow this procedure:

1. Downshift to next lower gear, unless already in "F1" or "R1".
2. If the tractor cannot be stopped safely by down shifting alone, then apply the parking brake by pulling up on the parking brake switch located behind the shift lever.
3. The parking brake should only be used for emergency stopping in the event of service brake failure. Whenever the park brake is used for an emergency stop, it must be inspected to determine if damage occurred. If the brake (pads, linkage, mounting) is damaged, repair before returning tractor to service.

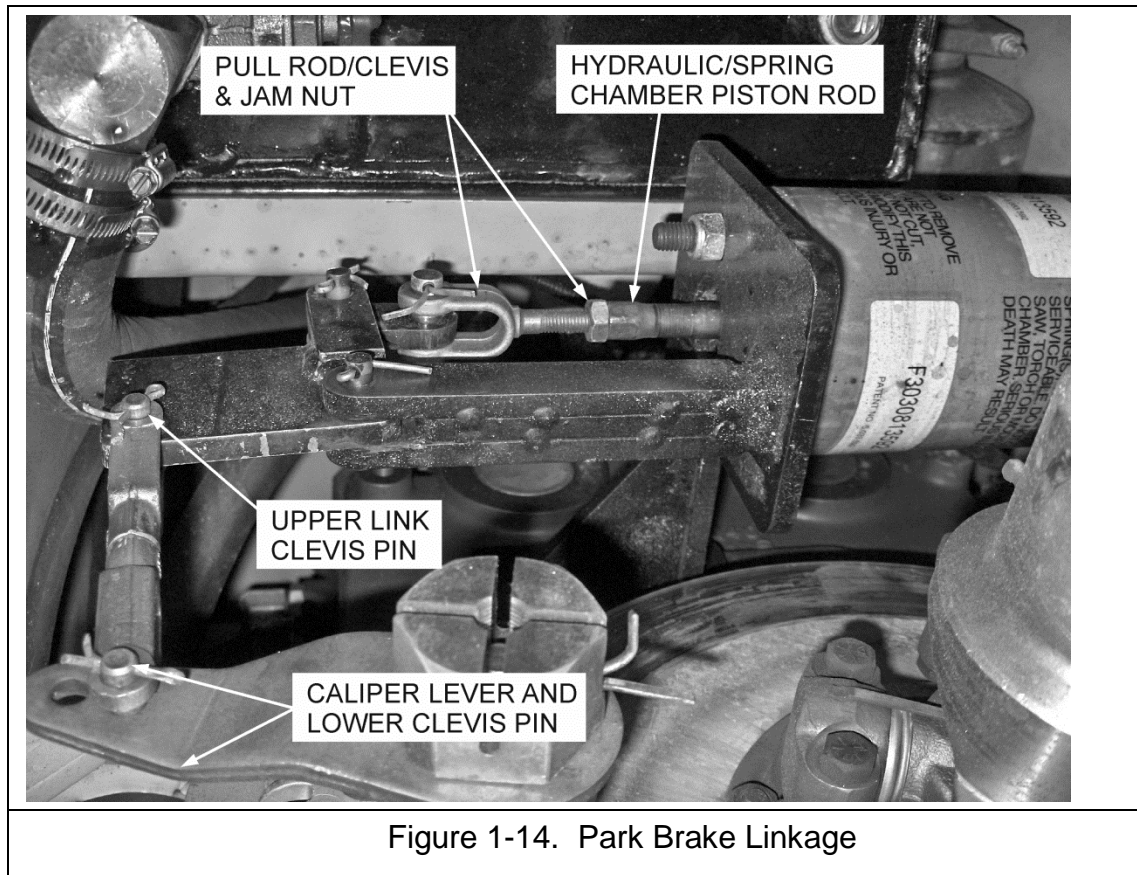
3.10. TOWING THE TRACTOR

1. If the vehicle is to be towed, it will be necessary to run the engine at idle speed to lubricate the transmission clutches.
2. If the engine cannot be run, disconnect the drive shafts from the front and rear of the transmission or it will be damaged.
3. If the drive shafts cannot be disconnected, the tow tractor can be towed for 1 mile [2km] maximum at no more than 3 MPH [5kph]. Towing longer will result in transmission damage

NOTICE! Failure to follow these instructions will void the transmission warranty

4. Because of the design of the hydraulic system, the engine cannot be started by pushing or towing.
5. Hydraulic pressure is required to release the park brake, so if the tractor is disabled, it will be necessary to mechanically release the park brake as described in 3.11.
6. Do not tow the tractor with flexible towing devices such as tow straps, chains or cables. Tow with a suitable tow bar and with a towing vehicle having adequate braking power to control both vehicles.

3.11. RELEASE PARK BRAKE ON DISABLED TRACTOR



1. Hydraulic pressure is required to release the park brake. If the tractor is disabled without engine power or hydraulic system failure, it may be necessary to mechanically release the park brake before moving the tractor.
2. Check if there is hydraulic reserve available to release the park brake with the park brake switch on the console. If not, proceed with the following procedure.
3. Tag Out the tractor, "DO NOT OPERATE, park brake not functioning"

⚠ WARNING Block ahead and behind, all four wheels while performing this procedure and while the tractor is parked with a non-functioning park brake to prevent movement and possible injury or death.

4. Loosen the jam nut on the pull rod/clevis and observe how much thread is exposed on the pull rod/clevis. This will aid in reconnecting the brake linkage later. See Figure 1-14. Turn CW on the hex end of the chamber piston rod to lengthen the linkage.
5. Turn until the caliper clevis pins are loose at the lower caliper lever and upper link connections. At this position, the brake is released. Remove the upper link clevis pin and swing the clevises away from the link. This will

prevent damage to the linkage in case the chamber is pressurized with the linkage unhooked.

⚠WARNING The park brake linkage (see Figure 1-14) is in tension when the park brake is applied and could spring apart causing personal injury if unhooked before releasing the brake.

6. To put back into service after the tractor is repaired, shut down the tractor.
7. Reconnect the upper clevis to the linkage with clevis pin and cotter pin.
8. Turn CCW on the hex end of the chamber piston rod to shorten the linkage effect, you are applying the park brake with spring pressure inside the chamber.
9. The park brake setting should be the same as before unhooking it, but before tightening the jam nut, check the adjustment as explained in Chapter 2.

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4 SPECIFICATIONS AND CAPABILITIES

4.1. TOW TRACTOR

Type of Vehicle:

..... Four Wheel Drive, Four Wheel Steer, Model 400MB2 Towing Tractor

Gross Weight Class 1 43,000 lbs.
Class 2 54,000 lbs.

Drawbar Pull Class 1 21,500 lbs.
Class 2 27,000 lbs.

USAF Class 1 rated for 30,000 lbs in USAF service.
Class 2 rated for 40,000 lbs in USAF service.

DBP/GVW may vary ±5%. DBP measured level to drawbar height.

Maximum Towable Aircraft Weight..... rated for 500,000 lbs in USAF service.

Speed, Forward..... 15 mph

Speed, Reverse..... 4.5mph

Fuel Tank

Capacity 45 Gals. (170 L)

Cooling System

Pressure Cap..... 14 psi.

4.2. ENGINE, BT6.7QSB, TIER III

Mode..... Cummins QSB6.7

Displacement 409ci [6.7L]

HP @2400 RPM 190 BHP (142kW)

Torque @1500 RPM 686 ft. Lbs. (930 N-m)

Number of Cylinders 6

Firing Order 1.5.3.6.2.4

Aspiration Turbo Charged

Thermostat Range 180°-203°F

OEM application approval letter Section 4.14.2

4.3. TRANSMISSION

Transmission

Make Funk

Type Power Shift W/Torque

Model 2000

Filter Cartridge

Part Number NW32664

Suction Screen Assembly

Part number 37075

Gear Ratios:

Forward

F1 5.5:1

F2 3.53:1

F3 2.94:1
F4 2.00:1
F5 1.41:1
F6 80:1
Reverse
R1 5.2:1
R2 3.53:1
R3 1.41:1
OEM application approval letter Section 4.14.4

4.4. AXLES

Manufacturer NAF Neunkirchener
Rear axle technical spec LAP5503.142
Front axle technical spec LAP5503.141
Total ratio 1:22.65
Brakes Hydraulic operated, oil immersed service brake (multiple discs)
Steering Integrated steering cylinder system, operating pressure 160 bar
Steering Angle-inner/outer hub 33.5°/26°
Wheel hub 10 Bolt, 22mm Wheel Studs
Maximum Load 30350 lbs [135000N]
Maximum Input 2582 ft-lbs [3500N-m]
Track Width..... 85" [2159mm]
Weight, Dry 1775 lbs [805Kg]
OEM application approval letter Section 4.14.3

4.5. BRAKES

Torque 14600 ft-lbs [19800N-m]
Operating Pressure, Max 100 bar

4.6. ELECTRICAL

Battery 12V, type 4D
Lighting Hi-Low Beam Headlights; Rotating Beacon (Amber);
..... Turn Signals, Backup Lights

4.7. INSTRUMENTATION & CONTROLS

Automotive type instrumentation Complete monitoring

4.8. COUPLERS

Following Types Available:
Jaw Type Coupler, Front and Rear
Drop Pin Coupler, Front and Rear

4.9. WHEELS

Rim Offset 1.0" (29.5mm)

4.10. TIRES

Tire Size 385/65R22.5

Tire Inflation Pressure 130 Psi

OEM application approval letter 4.14.1

4.11. STANDARD EQUIPMENT

- Four Wheel Drive
- Four Wheel Steering, Coordinated/Crab/2 Wheel
- Power Shift Transmission
- 12V/2.7KW Engine Starter
- 12V/95A Alternator
- 110V/750W Engine Block Heater
- Dual 12V Engine Manifold Grid Heaters
- 12V Fuel Heater in Fuel Filter
- 1150CCA Type 4D Battery, Reserve Capacity 325, 155 A.Hr.
- Turbo Air Cooling
- Engine Shutdown System
- Cab Assembly: 2 Man, 2 Speed Wipers, Heater/Defroster And Standard Offerings
- Two Sun Visors
- Windshield Washers
- Seat Belts
- Mirror Kit
- License Plate Holder
- Gauges, Full Instrumentation
- Backup Alarm
- Horn
- Fire Extinguisher, 17 Lb. Min. Dry
- Air Transportable Per MIL-STD-1791
- Corrosion Protection
- Paint: Dark Green Or Desert Sand

4.12. OPTIONAL EQUIPMENT

- Spotlight
- Coupler Jaw Type, Holland
- Coupler Drop Pin Type
- Air Conditioning
- Central Lubrication Pump

4.13. DIMENSIONAL DATA

See Section 5 for unit dimensions.

4.14. OEM APPLICATION APPROVAL LETTERS

4.14.1. Tire Application Approval



20 Jan 2009

John Ford
NMC-WOLLARD, Inc.

Dear Mr. Ford:

This is approval to use the Michelin

385/65R22.5 XZY3 LRJ, or
385/65R22.5 XFE LRJ

in an Airport Tow Tractor under the following conditions:

30,000# per axle fitted with two tires, at 130 psi
on NMC-WOLLARD, Inc. model 400MB2,

according to the following speed utilization schedule:

15 mph max speed	5% of time
7 mph	25% of time
3 mph	25% of time
Stationary (0 mph)	45% of time

The pressure listed on the sidewall of a tire is merely the “recommended” pressure for the maximum load listed on the sidewall, and not the “maximum” rated pressure for the tire. 130 psi is required for operation according to the conditions listed above, and is approved by Michelin for both tires. Certainly, you will have to ensure that the wheel pressure rating is adequate for these conditions.

If there are further questions, contact me by e-mail at ellis.johnson@us.michelin.com or by phone at (864) 458-4291.

Cordially,

Ellis Johnson, PE
Manager of Truck Tire Product Engineering



P.O. Box 19001
Greenville, SC 29602-9001

January 18, 2013

John Ford
NMC-Wollard, Inc.
2021 Truax Blvd.
Eau Claire, WI 54703

Subject: Michelin 385/65R22.5 XZY3 LRJ or 385/65R22.5 XFE LRL

Mr. Ford:

Michelin has approved the 385/65R22.5 XZY3 LRJ and 385/65R22.5 XFE LRJ for service on NMC model numbers M400 and MB-2 aircraft tow-tractors (Contract FA8533-12-D-00007) under the following conditions:

- 30,000 pounds per axle fitted with two tires (15,000 pounds per tire)
- Cold tire pressure: 130 psi
- Following the speed utilization schedule:

15 mph max speed	5% of time
7 mph	25% of time
3 mph	25% of time
Stationary (0 mph)	45% of time
- This approval is for the life of these two SKU's
 - 385/65R22.5 XZY3 LRJ Michelin Part Number MSPN 53779; CAI 974186 LPC B
 - 385/65R22.5 XFE LRL Michelin Part Number MSPN 36991; CAI952153 LPC B

Best Regards,

Phil Arpold
O.E Product Engineer
Michelin North America, Inc.
P.O. Box 19001
Greenville, SC 29602

4.14.2. Engine Application Approval

Cummins NPower, LLC
875 Lawrence Drive, Box 5070
De Pere, Wisconsin
54115-5070
Phone 920-337-1991
Fax 920-338-6990



To: NMC-WOLLARD, Inc.

Date: January, 26, 2009

Attn: Carl Langgaard

Enclosed is a letter of recommendation made after conducting a partial Installation Quality Assurance (IQA) review for the QSB powered chassis, machine model 400MB2, engine serial number 46876551, machine serial number 13781-08. This review must follow Cummins AEB 20.12 procedures prior to completion of the installation. Cummins control number 2583.

The IQA review of this unit by Cummins NPower is to assist in the identification of any installation designs, components, materials used, or techniques of installation which are known to have affected the durability or performance of the engine in the past on comparable installations. The review is not intended to be a substitute for prototype performance and durability testing by the manufacturer of the equipment and shall in no way constitute a warranty or other legal obligation of Cummins, Inc. or Cummins NPower, LLC.

Upon completion of the partial IQA review of the first 400MB2 Tow Tractor on January 26, Cummins NPower LLC recommends a more comprehensive review be conducted when test equipment availability and weather conditions permit. Shipment of the first machine is acceptable given that complete IQA testing be completed on a subsequent machine.

If deficiencies are identified during the complete review NMC-WOLLARD accepts full responsibility to institute the improvements or corrections to existing and future production units. NMC-WOLLARD may take exception to our conclusions and based on your experience and application knowledge choose to write a letter explaining why you do not need to concur with a particular Cummins Installation Recommendation.

Regards,


Chad Caelwaerts
Application Engineer

cc: Jim Vanden Boogard – Cummins NPower, LLC. - Mgr Application Engineering
Mark Hapka - Cummins NPower, LLC – Account Manager

OEM is to sign and return this document to Npower application engineer after reviewing and makes changes as required.

OEM Engineering Manager Signature  Date 1-26-09

Npower Account Manager Signature  Date 1/26/09

4.14.3. Axles Application Approval



Neunkirchener Achsenfabrik AG

Weyhausenstr. 2
D-91077 Neunkirchen a.b.
Germany

To: NWC WOLLARD, Inc.
From: NAF AG
Date: January 22 / 2009
Regarding: Axle Type Approval for the 400MB2 Aircraft Tow Tractor

Axle type(s):

NMC 01-Drawing Number: LAP5503.141 (E)
NMC 02-Drawing Number: LAP5503.142 (E)

Based on the Application Data, and Specifications supplied by NWC WOLLARD, Inc, NAF AG has reviewed and approves the above stated axle drawings to be in compliance with the required specifications and ratings of the 400MB2 Aircraft Tow Tractor.

These products are to be operated within the criteria stated on the products' drawings for use within the NMC WOLLARD, Inc. built 400MB2 Aircraft Tow Tractor.

Ken Hardman
Representative
NAF DSI Inc.

4.14.4. Transmission Application Approval

 JOHN DEERE	APPLICATION DATA SHEET (English)	ADS Number	2549
		Supersedes	

POWERSHIFT TRANSMISSION

CUSTOMER DATA											
Company Name		NMC-Wollard		Address		2021 Truax Blvd, Eau Claire, WI 54703					
Information Furnished By		Peter Driver		Title		Project engineer		Date	14 Jan 2009		
Est. Yearly Vehicle Production:		25	Production Date		May 2009	Prototype Req'd	N	Date			
VEHICLE DETAILS, (Please provide a sketch of the vehicle)											
Model No.		400MB-2		Type of Machine		Aircraft / Industrial Tow Tractor					
Duty Cycle		Intermittent									
Max Gross Weight		553,500		LBS, Front Axle		26,750		LBS, Rear Axle		26,750	LBS
Empty Weight		53,500		LBS, Front Axle		26,750		LBS, Rear Axle		26,750	LBS
Normal Direction of Operation:		Forward		Percentage of Time:		90		% Forward	10	% Reverse	
Driven axles: All wheel drive		X		Front axle only				Rear axle only			
Total Axle Reduction		22.65									
Tire Size	385/65R22.5	RR	19.44	IN	Opt. Tire Size	N/A	RR	N/A	IN		

VEHICLE PERFORMANCE REQUIREMENTS											
Typical Ground Material		Wet or Dry Concrete and Asphalt						Est. Tractive Coefficient		0.8	
Min. Desired top speed		15.0	MPH,	Max. Desired top speed		18	MPH,	Normal Rolling Resistance		2	%
Max Tractive Effort Required		27,000				LB.	@	0	MPH,	Gear Ratio	Any
Tractive Effort @ Working Speed						LB.	@		MPH,	Gear Ratio	
EWW Gradeability Req'd @ Working Speed		12				%	@	Any	MPH,	Gear Ratio	Any
GWW Gradeability Req'd @ Working Speed		1				%	@	2.5	MPH,	Gear Ratio	Any

STANDARD ENGINE				
Make & Model		Cummins QSB 6.7		
Gross Rated Power @ Gov. RPM		190 @ 2400		HP
Gov. Speed Full Load		2400	RPM, High Idle	+13%
Gross Peak Torque		686	LB FT @	1500
Torque Curve No.		FR91428		
Deductions From Gross Power:				
Engine Power for Fan @ Gov. RPM		19		HP
Engine Accessories Power @ Gov. RPM		12.7 LB FT		HP
List Accessories		Alternator etc.		

OPTIONAL ENGINE				
Make & Model		N/A		
Gross Rated Power @ Gov. RPM				HP
Gov. Speed Full Load			RPM, High Idle	RPM
Gross Peak Torque			LB FT @	RPM
Torque Curve No.				
Deductions From Gross Power:				
Engine Power for Fan @ Gov. RPM				HP
Engine Accessories Power @ Gov. RPM				HP
List Accessories				

TRANSMISSION						
Current Transmission		2263E13NB/YZ17606		Gear Ratios		F:5.2/3.53/2.94/2/1.41/0.8 R:5.20/3.53/1.41
Funk Model Suggested		Same		Gear Ratios		No. Ratios Req'd
Input Drive Type :		Direct Drive	Torque Converter	X	Lock-up Torque Converter	
Transmission Output Park Brake		None	External Disc	X	Wet Internal Disc	
Gross Weight & % Grade for Parking		1,786 LB FT Rated Brake			"No-Spin" Inter-axle Differential	
Current Torque Converter Model		1275 BAA Free Stator		Converter Stall Torque Ratio		2.070
		Yes	X	No		

TRANSMISSION OR CONVERTER PTO MOUNTED HYDRAULIC PUMPS							
L H Pump Drive:	Engine to Pump Gear Ratio	1.000:1	SAE Pad Size	B	Spline Size	13 Tooth	
Pump Make & Model	Eaton 25000		Pump Function	Steering and Brakes			
Pump Torque @ Stand-by Press.	5.42	LB FT,	Run Performance @ this condition	Yes	X	No	
Pump Torque @ Operating Cond.		LB FT,	Run Performance @ this condition	Yes		No	X
Pump Torque @ Relief Press.	68	LB FT,	Relief Press.	2,500	PSI, Flow @ Relief Press.	21.3	GPM
RH Pump Drive:	Engine to Pump Gear Ratio	N/A	SAE Pad Size		Spline Size		
Pump Make & Model			Pump Function				
Pump Torque @ Stand-by Press.		LB FT,	Run Performance @ this condition	Yes		No	
Pump Torque @ Operating Cond.		LB FT,	Run Performance @ this condition	Yes		No	
Pump Torque @ Relief Press.		LB FT,	Relief Press.		PSI, Flow @ Relief Press.		GPM
Center Pump or PTO (1:1 Ratio):							
PTO Function & Duty Cycle	N/A						
PTO Torque @ Stand-by Cond.		LB FT,	Run Performance @ this condition	Yes		No	
PTO Torque @ Operating Cond.		LB FT,	Run Performance @ this condition	Yes		No	
PTO Torque @ Maximum		LB FT,	Run Performance @ this condition	Yes		No	
AUXILIARY TRANSMISSION OR TRANSFER CASE							
Make & Model Used	N/A		Gear Ratio or Ratios				
Between Engine & Torque Conv.		Between Torque Conv. & Transmission		Between Transmission & Axle			
ADDITIONAL APPLICATION COMMENTS							
Speedometer pickup required							
Flywheel Housing: SAE #3							
Transmission Outputs: Mechanics 6C both sides							

TO BE COMPLETED BY JOHN DEERE COFFEYVILLE WORKS	
Funk Units Suggested for Application	Funk 2263 6/3 Powershift transmission with 5.2 low and 0.8 high gear ratios.
And 12.75" BAA free stator torque converter	
Reference Engine Conv. Performance Analysis No.	PEC 2549
Reference Vehicle Performance Analysis No.	PVC 2549
Limitations, special test programs, or other conditions applicable to this application	
APPLICATION ENGINEER:	W. E. Reeves <i>W. E. Reeves</i> DATE: 21 Jan 2009

CUSTOMER ACCEPTANCE

I agree that the stated specification accurately and fully describes the vehicle for which a Funk product is being considered and it is understood that the JOHN DEERE COFFEYVILLE WORKS, INC., LIMITED PRODUCT WARRANTY is applicable and is EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING BUT NOT BY WAY OF LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

ENTER NAME Peter Driver DATE 14 January 2009

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5 SHIPPING

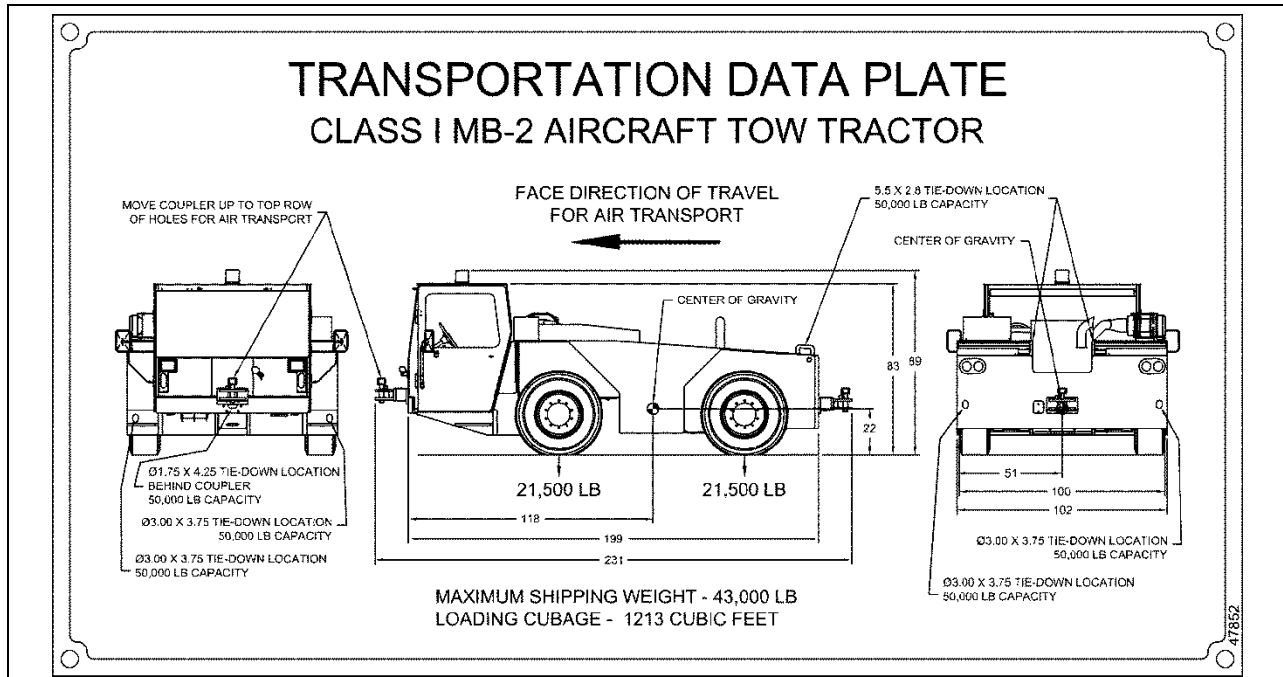


Figure 1-15. Transportation Data Plate, Class I Tractor

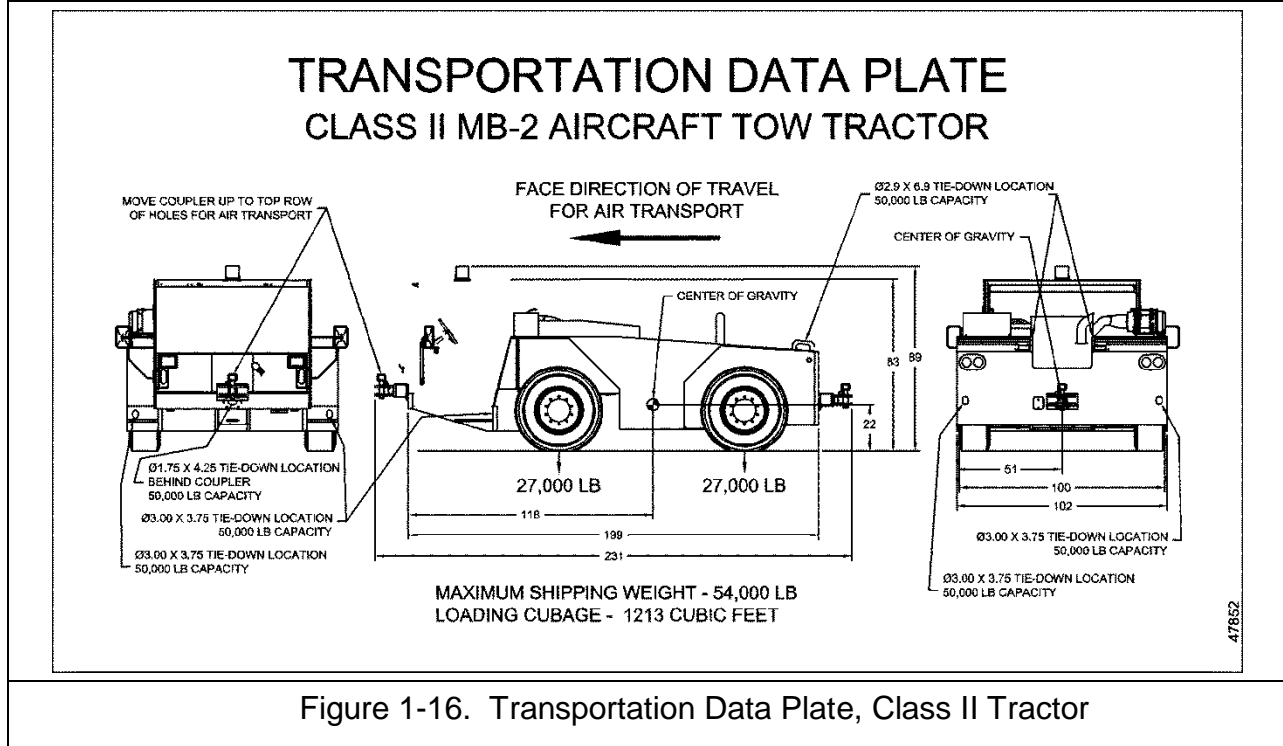


Figure 1-16. Transportation Data Plate, Class II Tractor




NOTICE! Tie down points are for tie down only, not for lifting.

1. Review transportation plate for pertinent shipping data.
2. Fold outside operator and hitch mirrors “in” so they do not protrude outward.
3. Remove the fire extinguisher from its operating location on the rear deck and store it inside the cab.
4. Securely tie the tractor down using the tie down eyes provided.

5.1. COMMISSION UNIT (PUT INTO SERVICE)

1. The tractor is shipped with all fluids except fuel. As a precaution, however, check all fluid levels, brakes, electrical system, engine, steering, axles, and transmission as described in Section 3 and perform the prescribed lubrication.
2. For shipping, the fire extinguisher is stored inside the cab. Before operating, move the extinguisher to its operating location on the rear corner of the deck. Be sure it is securely clamped in the storage bracket for operation.
3. Inspect the unit for shipping damage, glass, mirrors, lights, etc.

5.2 INTERNAL AIR TRANSPORT CERTIFICATE

	<h3>Internal Air Transport Certification</h3> <p>ASC/ENFC (ATTLA) 2530 Loop Road West WPAFB, OH 45433-7101 https://afkm.wpafb.af.mil/ATTLA (direct) https://wwwd.my.af.mil/afknprod/ATTLA (AF Portal)</p>	
<p>Date: 29 June 2009 Item Nomenclature: NMC-Wollard 400MB2 Tow Tractor Class I and II File Number: 2009.03.14 Requestor: 642 CBSG/GBEC (Robert Woodruff)</p>		
<p>Item Description: The NMC-Wollard 400MB2 Tow Tractor Class I and II is identified to be two axle aircraft tow tractors (Class I: NSN 1740-01-559-3504YW and Class II: NSN 1740-01-559-7047YW). Refer to data plate to determine Class as the vehicles are nearly identical. Approximate dimensions are 231" L x 102" W x 89" H. Gross weight of 40,000 lbs (Class I) and 53,000 lbs (Class II) with a gross vehicle weight rating (GVWR) of 43,000 lbs and 54,000 lbs respectively. The tractor has axle weights of 22,000 lbs (Class I) and 27,000 lbs (Class II) with an axle rating of 30,000 lbs each.</p>		
		
<p>Certified Aircraft: USAF C-17 and C-5</p>		
<p>Conditions of Certification:</p>		
<p>1. Maximum Weight for Air Transport:</p> <ul style="list-style-type: none">a. Gross Vehicle Weight:<ul style="list-style-type: none">(1) Class I – 43,000 lbs (Vehicle limit)(2) Class II – 54,000 lbs (Vehicle limit)b. Axle Limits:<ul style="list-style-type: none">(1) Class I – 22,000 lbs (Sleeper shoring limit)(2) Class II - 27,000 lbs (Rolling and sleeper shoring limit)		
<p>2. Item Preparation:</p>		

File Number 2009.03.14

- a. Front coupler/hitch must be removed or repositioned higher on the vehicle to achieve an adequate approach angle.
- b. Tire inflation pressure shall not exceed 130 psi. This is the manufacturer allowed limit and can support required weight.
- c. All hazardous materials (to include fuel level, batteries, etc.) must be prepared and certified for airlift in accordance with TM 38-250/AFMAN 24-204(I). Do not consider this air transport certification as approval for hazardous materials. Authorization for airlifting hazardous material is the responsibility of 401 SCMS/GUMAA (DSN 787-4503 or COM (937) 257-4503).

3. Loading Instructions:

- a. Item may be driven or backed into the aircraft.
- b. C-5 will be configured in the forward or aft kneeled position. The vehicle shall be loaded through kneeled end.
- c. C-17: Two rows of rolling shoring shall be placed on the ramp toes, cargo ramp and cargo floor when loading the Class II tow tractor.
- d. Four stacks of sleeper shoring are required. Two stacks shall be placed under or adjacent to each axle/vehicle end (one stack per side). See paragraph 5.a for required dimensions.

4. Restraint Requirements: The NMC-Wollard 400MB2 Tow Tractor Class I and II and all accompanying cargo must be restrained to meet MIL-HDBK-1791 requirements of 3G forward, 1.5G aft and lateral, and 2G up. In addition, stored or installed equipment must meet these requirements and be capable of withstanding a 4.5G down load. There are two tiedown provisions on the front and four tiedown provisions on the vehicle's aft end. All provisions are rated at 50,000 lbs. See data plate on vehicle or photos 1 and 2 below for specific provision locations.

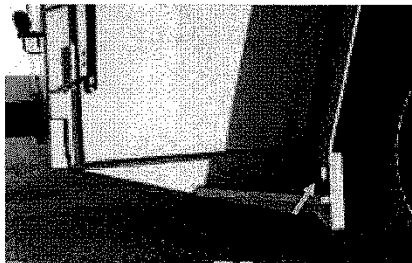


Photo 1. Front End Left Side Provision

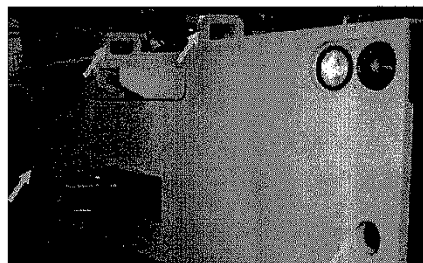


Photo 2. Aft End Provisions

5. Required Shoring Dimensions & Diagrams:

a. Sleeper Shoring: The sleeper shoring must be stacked snug with axle/s or frame structure/s and will be secured with cargo straps.

(1) Class I – 10" L x 22" W

(2) Class II – 12" L x 25" W

b. Rolling Shoring:

File Number 2009.03.14

(1) Class I – None Needed

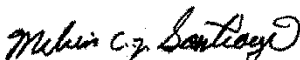
(2) C-17: Class II – 20" W x 1" H. Length dimension for each row shall be sufficient for timely load/off-load operation.

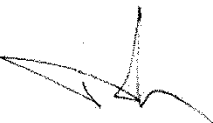
Note that rolling shoring is not required on C-5 aircraft.

Required Distribution:

1. Shipper shall give a copy of this certification to the ATOC representative when the item is presented for airlift. This memo shall be part of the official cargo manifest documentation package and shall be briefed to the aircraft loadmaster prior to loading this item.
2. AMC/A3V.
3. SDDC TEA.

Point of Contact: Michael Schneider, at Michael.Schneider2@wpafb.af.mil, DSN 674-5459 or Commercial (937) 904-5459. Refer to file number 2009.03.14 to reference this item.

Reviewed by: 
MELVIN C.J. SANTIAGO
Aerial Delivery Technical Expert
Crew Systems Branch

Approved by: 
TIMOTHY W. BUSH
Acting Technical Advisor
Crew Systems Branch

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6 STORAGE

If you need to keep your machine idle for more than 30 days, or you are putting it into indefinite storage, first prepare it according to the following procedures:

NOTICE! The following steps will help minimize corrosion and deterioration while your machine is in storage.

6.1. 30-90 DAY STORAGE

1. Perform any necessary repairs.
2. Clean machine carefully. Wash off mud and dirt. Wipe off excess oil and grease. Remove debris from radiator cooling fins.
3. Select a dry and protected storage location. Position machine so as to permit access to all components.
4. Start engine and run it until it reaches operating temperature. Shut off engine. Drain crankcase, change oil filter, and refill crankcase with recommended oil.
5. Disconnect battery. Put battery into safe storage in a fully charged condition. Protect battery terminals against corrosion using a spray on external engine preservative or petroleum jelly.
6. Seal all engine openings.
7. Apply a thin coat of grease to exposed metal surfaces.
8. Refinish any scratched or scuffed paint surfaces.
9. If the machine must be stored outdoors, cover with a heavy canvas or waterproof material. Secure cover with a strong waterproof tape so it will not blow away.

6.2. STORAGE FOR 90 DAYS OR LONGER

The recommendations below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Perform in addition to 30-90 day procedure.

1. Clean engine breather pipe and seal end of pipe.
2. Drain fuel system and fill with clean fuel. The fuel must be drained and filters discarded at end of storage period. If you add a fuel preservative to the fuel, the fuel and filters may not need to be discarded at the end of the storage period.
3. Operate engine until warm. Stop engine and fix any fuel, oil, or air leaks.
4. Drain the cooling system. In order to protect the cooling system against corrosion, fill with a coolant that has a corrosion inhibitor. If protection against frost is necessary, use an antifreeze mixture.
5. Operate engine for a short period in order to circulate lubricating oil and coolant in engine.
6. Remove injectors and spray an internal engine preservative into each cylinder bore. If this is not available, clean engine oil will offer some protection. Two to three ounces of oil should be placed in each cylinder.
7. Slowly turn crankshaft one revolution and then fit injectors with new seat washers and new dust seals.

8. Remove pipes installed between air filter and intake manifold. Spray preservative into intake manifold. Seal manifold with waterproof tape.
9. Remove exhaust pipe. Spray preservative into exhaust manifold. Seal manifold with waterproof tape.
10. Remove oil filler cap. Spray preservative into oil filler hole to protect rocker shaft assembly. Install filler cap.
11. Seal vent pipe of fuel tank or filler cap with waterproof tape.
12. Remove drive belts and put into storage.
13. Spray engine with external engine preservative to prevent corrosion. Do not spray area inside alternator cooling fan.

If engine protection is done correctly, corrosion damage normally will not occur. NMC-WOLLARD, Inc. is not responsible for corrosion damage which may occur when a vehicle is in storage after a period in service.

Follow instructions in your engine manual.

6.3. REMOVING MACHINE FROM STORAGE

1. Remove protective cover and unseal engine openings.
2. Install battery and connect cables. (Negative terminal grounded.)
3. Wipe excess grease from machine surfaces.
4. Inspect hydraulic seals at cylinders for leaks.

NOTICE! If the unit has been stored for more than 120 days, you can expect some deterioration of the hydraulic seals. Replace defective seals before operating machine.

5. Install all parts that were removed when vehicle was being prepared for storage.
6. Perform "Daily" checks as described in Maintenance, Chapter 2.

After the hydraulic system has warmed up to operating temperature, remove hydraulic tank fill cap and check appearance of hydraulic fluid. A milky appearance indicates that there is water in the system and that the system should be drained and re-filled with fresh oil.

CHAPTER 2 MAINTENANCE

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1 SERVICING

⚠WARNING Shut off and tag out the machine before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could result in injury or death.

⚠WARNING Follow the recommended maintenance program to prevent unsafe operation or accidents.

⚠WARNING DO NOT place any part of body between wheels and wheel well opening to perform any service. Remove the wheel first to prevent serious injury from unexpected wheel movement.

⚠CAUTION Keep maintenance area clean and dry. Oily and wet spots are slippery, greasy rags are a fire hazard, and wet spots are dangerous around electrical equipment.

⚠CAUTION Using non-original replacement parts is not recommended. Their use may cause unit failure and/or affect vehicle safety.

1.1. CHAPTER CONTENTS

This chapter provides a preventive maintenance schedule with the necessary procedures. Tools required are those normally available in any organizational tool shop.

NOTE: Consult the Manufacturers Information in Chapter 5 in this manual.

Also, guidelines for repairing the tractor are located in Chapter 3.

Before attempting to repair the tractor, be familiar with the information on these pages.

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1.2. BOLT TIGHTENING DATA

The following data is excerpted from SAE Report J1701, March, 1999. The complete report is available from SAE at www.sae.org. It contains detailed information about variables for torque management to achieve correct fastener joint tightening. This is an advisory guide and responsibility for its application lies with the user. Individual application discretion is recommended.

INCH SERIES TIGHTENING TORQUE, FT-LB						
Bolt Size	Grade 2 Dry	Grade 2 Lubed	Grade 5 Dry	Grade 5 Lubed	Grade 8 Dry	Grade 8 Lubed
0.250-28	7	5	10	8	14	11
0.250-20	6	5	9	7	12	9
0.3125-24	13	10	20	15	28	21
0.3125-18	12	9	18	14	25	19
0.375-24	23	17	35	27	50	38
0.375-16	20	15	31	24	44	33
0.4375-20	36	27	56	42	78	59
0.4375-14	32	24	50	38	70	53
0.500-20	55	42	85	64	120	90
0.500-13	49	37	76	32	107	80
0.5625-18	78	59	121	91	171	128
0.5625-12	70	53	109	82	154	152
0.625-18	110	82	170	127	240	180
0.625-11	97	73	150	113	212	159
0.750-16	192	144	297	223	420	315
1.750-10	172	129	269	201	276	282
1.000-12	-	-	704	528	995	746
1.000-8	-	-	644	483	909	681

METRIC TIGHTENING TORQUE, N-M						
Bolt Size	Class 8.8 Dry	Class 8.8 Lubed	Class 9.8 Dry	Class 9.8 Lubed	Class 10.9 Dry	Class 10.9 Lubed
8.0 x 1.25	26.40	19.80	28.50	21.40	36.50	27.30
10.0 x 1.5	52.20	39.20	56.60	52.40	72.20	54.20
12.0 x 1.75	91.00	68.00	99.00	74.00	126.00	94.00
14.0 x 2.00	145.00	109.00	157.00	118.00	200.00	150.00
16.0 x 2.00	226.00	170.00	245.00	184.00	313.00	235.00
20.0 x 2.50	441.00	331.00	478.00	258.00	610.00	458.00
24.0 x 3.00	762.00	572.00	826.00	620.00	1055.00	791.00
30.0 x 3.50	1515.00	1136.00	1641.00	1231.00	2095.00	1572.00
36.0 x 4.00	2647.00	1985.00	2868.00	2151.00	3662.00	2746.00

37° TUBE FITTINGS & PIPE FITTINGS						
Dase #	37° Swivel Nut Ft-Lbs	37° JIC Flats from Finger Tight	O-Ring Lock Nut Ft.-Lbs.	Pipe Dia. (inch)	NPT Ft-Lbs	NPT Turns from finger Tight
-04	10	2	8	¼	25	2-1/2
-06	20	1-1/4	13	3/8	40	2-1/2
-08	40	1	21	½	54	2-1/2
-10	60	1	48	¾	78	2-1/2
-12	80	1	63	1	112	2-1/2
-16	110	1	63	1	112	2-1/2
-20	130	1	-	1-1/4	154	2-1/2
-24	160	1	-	1-1/2	211	2-1/2
-32	250	1	-	2	300	2-1/2

Torque Conversion: Ft-Lbs = 0.7376xN-m N-m = 1.356xFt-Lbs

NOTE: Do not use these values if a different torque value is given for a specific procedure.

If the fastened part is aluminum, reduce torque 25%.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, they should be tightened to the strength of the original fastener.

Locknuts: Tighten plastic-insert or crimped-steel-type lock nuts to approx. 50% of the dry torque shown (applied to the nut, not the screw head).

1.3. FLUIDS AND CAPACITIES AND AMBIENT TEMPERATURE RANGES

The tow tractor can be operated over a wide range of ambient temperatures if the fluid recommendations and use of special equipment procedures described in the following sections are used.

Also see Starting The Engine (hard or cold weather starting), Winterization Kit Types A And C Usage in Chapter 1.

1.3.1. Fluid Requirements:

Engine, Transmission, Axle, Brake, Lubrication and Hydraulic System

ENGINE FLUID REQUIREMENTS FOR AMBIENT TEMPERATURE RANGES			
Item	Ambient Temp.	Specification	Capacity
Engine Coolant	-25°F and above -32°C and above	50/50 ethylene glycol antifreeze/water mixture ASTM4985 GM 6038M specification	18 qt. + 10.4 qt. in eng. [17L + 10L in eng.]
	-26°F to -65°F -33°C to -54°C	62/38 ethylene glycol antifreeze/water mixture ASTM4985 GM 6038M specification	
Engine Fuel	32°F and above 0°C and above	ASTM number 2D (Diesel)	49 gal [185 L]
	32°F and below 0°C and below	Winter blended fuel such as found at commercial fuel-dispensing outlets which are combinations of 1D and 2D diesel fuels.	
	All	Jet-A1 (meeting Nato Code F35) JP-8 (meeting Nato Code F34) (A significant reduction in power will be experienced with jet fuels)	
	23°F and above -5°C and above	Biodiesel B5 and up to B20 (See biodiesel considerations on following page)	
Engine Oil	24°F and above -5°C and above	15W-40 API CH-4/SJ classification	Pan only: 15qt [14.2 L] Total sys: 17 qt [16.4L]
	23°F to -10°F -5°C to -24°C	10W-30 API CH-4/SJ classification	
	-9°F and below -23°C and below	Synthetic 5W-30 with API CH/SF or higher classification	

TRANSMISSION FLUID REQUIREMENTS FOR AMBIENT TEMPERATURE RANGES			
Item	Ambient Temp.	Specification	Capacity
Transmission Fluid	32°F and above 0°C and above	Hydraulic transmission fluid Type C-4 or C-4 grade 30 NOTE: ATF Type A, Dexron III meets C-4 specification	4 gal. 15.1 L
	32°F to -10°F 0°C to -24 °C	Hydraulic transmission fluid Type C-4 (except grade 30)	
	-10°F and below -24°C and below	Hydraulic transmission fluid Type C-4 (except grade 30). Preheat required to raise temperature of sump to -10F. Alternate warm-up procedure: Operate transmission in Neutral for 20 minutes or until oil is warmed to the MINIMUM temperature	

AXLE FLUID REQUIREMENTS FOR AMBIENT TEMPERATURE RANGES			
Item	Ambient Temp.	Specification	Capacity
Differential Axle	All	SAE90 (Hypoid Oil) LS, API-GL5 or MIL-L-2105-B/LS	3.7 Gals [14L]
Axle Planetary	All	Same as differential or SAE80, API-GL4, or MIL-L-2105	1 Gal Each [4L Each]

BEKA-MAX EP-1 SERIES LUBRICATION PUMP			
Item	Ambient Temp.	Specification	Capacity
EP-1 Pump	-35°C up to +80°C	Normal chassis grease NLGI Class 2	

HYDRAULIC FLUID REQUIREMENTS FOR AMBIENT TEMPERATURE RANGES			
Item	Ambient Temp.	Specification	Capacity
Hydraulic Fluid	All	Mineral oil only. ATF Dextron III	20 Gals [76 L]

1.3.2. Biodiesel Considerations:

There are no special requirements for B5 (5% biofuel) and below blends meeting ASTM D975 specification and blended with B100 biofuel meeting either ASTM D6751 or EN14214 specifications. If biodiesel blended fuel above B5 and up to B20 (20% biofuel) are to be used, the following requirements must be met in addition to the preceding specifications:

- Depending on the particular biodiesel being used, there may be some compatibility issues with some of the wetted components of the fuel system, requiring increased maintenance.
- All fuel filters must be OEM replacement (Fleetguard) as originally supplied on the engine and available in the NMC-Wollard parts manual.
- The water separator filter maintenance schedule must be strictly adhered to.
- In addition to the OEM equipped filtration, it is recommended to install auxiliary water/fuel separation using Cummins filtration product FH232.
- Fuel must be used within 6 months of manufacture.
- All biodiesel storage and handling equipment must be properly cleaned and maintained on a regular schedule.
- A fuel heater is recommended for operations below -5 deg C (23 deg F).
- Do not use biodiesel on machines that are not operated on a daily basis, ie, avoid low duty cycle, intermittent operation or emergency standby applications.
- Expect a significant power reduction when using biodiesel fuel.
- If the tractor is to be stored, the engine must be operated on petroleum diesel fuel for a minimum of 30 minutes prior to shutdown.

1.4. INITIAL STARTUP AND FIRST TIME MAINTENANCE

COMPONENT	HOURS	SERVICE REQUIRED	REF.
Engine	25	Change Oil	1.7
Transmission	20	Change lubricant and filter	1.11
Axle	10	Re-torque lug nuts	1.13
Coupler (Hitch)	100	Re-torque coupler mounting bolts	1.14
Axle, Planetary	250	Change oil, planetary drives only	1.12

1.5. PERIODIC MAINTENANCE

COMPONENT	SERVICE REQUIRED	REF
DAILY OR REFUELING (PRE-START-UP)		
Engine	Inspect air intake, air system, cooling system, check oil level. Inspect for engine oil leakage	1.8, 1.9 Cummins Section 3
Engine	Drain fuel water separator	1.10 Cummins Section 3
Cooling System	Check for leaks and check coolant level	1.8
Transmission	Check oil level and check for leaks	1.11
Electrical System	Check lights, horn, wipers	1.17
Fuel System	Check for fuel leaks	1.10
Brakes	Check hydraulic brake pedal free play	1.15
Wheels and Tires	Inspect condition and check pressure	1.13
Lubrication Pump	During the first few weeks after installation, the system should be monitored: <ul style="list-style-type: none"> -- To ensure grease collar is adequate at all lubrication points, and -- To check all points and hoses for breakage and proper attachment 	
Axles	Check for leaks	1.12
Fire Extinguishers	Check for adequate charge	
Coupler: Jaw Type Drop Pin Type	Inspect	1.14.1 1.14.2
EVERY 50 OPERATING HOURS OR MONTHLY		
Engine	Fuel water separator and crankcase breather	1.10, Cummins Section 3
Hydraulic Reservoir	Check fluid level	1.18.2

COMPONENT	SERVICE REQUIRED	REF
EVERY 200 OPERATING HOURS		
Transmission	Change filter	1.11.2
EVERY 250 OPERATING HOURS OR 3 MONTHS		
Perform 50 hour service		
Wheel Lug Nuts	Check Torque	1.13
Engine	Inspect air cleaner, air cooler, fuel injection pump, radiator hoses	1.9 Cummins Section 4
Air Cleaner Restriction	Check	1.9
Grease Fittings	Lubricate	1.6
Exhaust System	Inspect	
Brakes-All	Inspect brake lines	1.15
Park Brake	Apply park brake on incline to determine if it holds tractor. If not, adjust.	1.16
Battery	Clean corrosion, check for water level, specific gravity	1.17
EVERY 500 OPERATING HOURS OR 6 MONTHS		
Perform 250 hour service		
Engine	Engine coolant, engine fuel filter, engine oil and filter	1.8, 1.10 Cummins Section 5
Engine Coolant	Check concentration	1.8 Cummins Section 5
Fuel System	Replace lubricity filter	1.10
Axles, Differential & Planetary	Check oil level	1.12
Axles, Grease	Grease tie bars and steering knuckle joints	1.12
Brakes	Inspect	1.15
Electrical System	Clean and inspect wiring, battery, and cables.	1.17
Transmission (Funk)	Check oil level/Change filter	1.11, 1.3.1
Hydraulic System	Change return & fill filters, clean suction screen	1.18.2

COMPONENT	SERVICE REQUIRED	REF
Coupler: Jaw Type Drop Pin Type	Inspect & Lubricate.	1.14.1 1.14.2
EVERY 600 OPERATING HOURS OR 6 MONTHS		
Transmission	Change oil and filter	1.11
EVERY 1000 OPERATING HOURS OR 1 YEAR		
Perform 500 hour service		
Transmission	Change oil	1.11
Hydraulic Reservoir	Change fluid fill filter and return filters	1.18.2
Axle Planetaries	Change oil	1.12
Brake Disc	Check for wear	1.12
Engine	Cooling fan, drive belt. (NOTICE! See Chapter 3 for special Engine handling instructions of fan clutch.)	Cummins Section 6
EVERY 2000 OPERATING HOURS OR 2 YEAR		
Perform 1000 hour service		
Engine	Viscous vibration damper, cooling system, radiator hoses	Cummins Section 7
EVERY 5000 OPERATING HOURS OR 4YEAR		
Engine	Engine overhead set, adjust	Cummins Section 8

1.6. LUBRICATION LOCATIONS

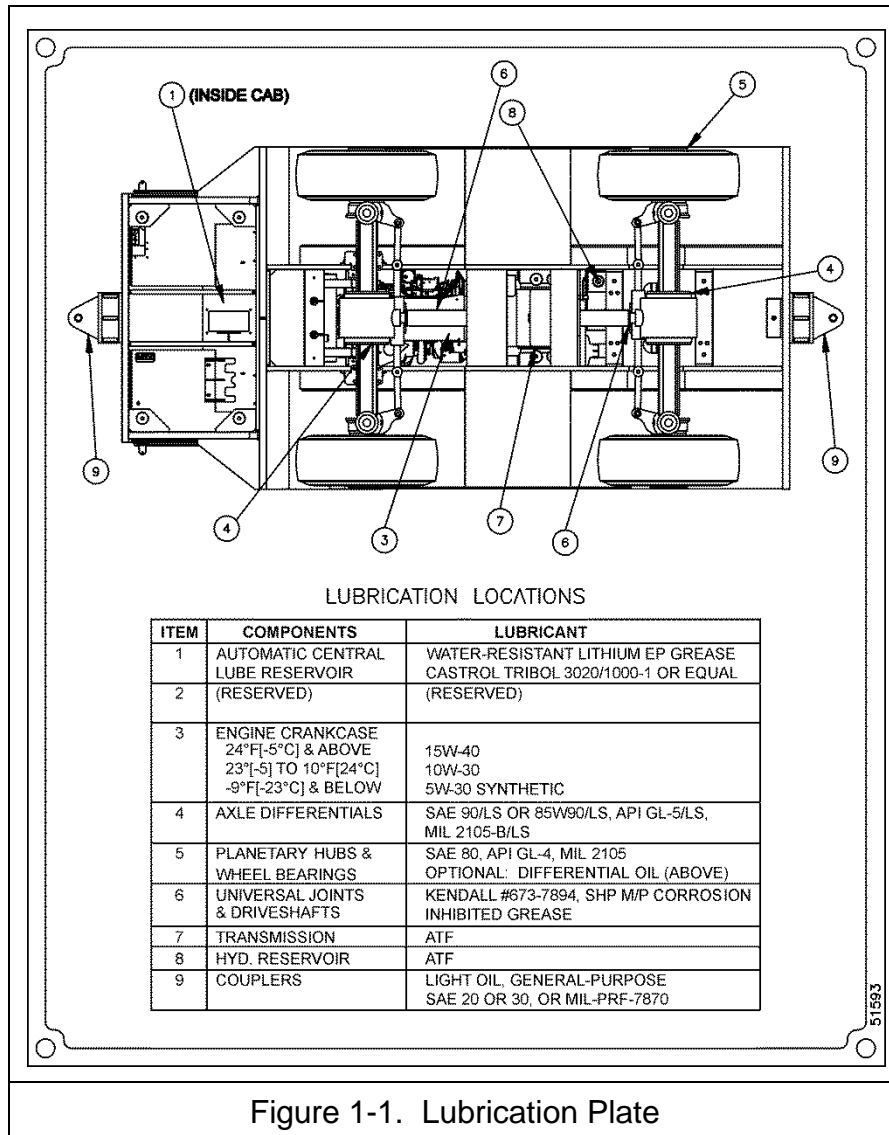


Figure 1-1. Lubrication Plate

1.7. ENGINE

Do not operate the new engine at more than 3/4 throttle for the first 8 to 10 hours. This will permit the bearings to seat properly. Change engine oil after the first 25 hours of operation.

1.8. COOLANT SYSTEM

After tractor has been parked overnight, check ground under engine for leaked coolant (green colored). If found, try to locate exact source of the leak. If source is a loose hose, tighten hose clamp or replace hose if necessary. If radiator or water pump is leaking, report condition to a supervisor.

Check that an adequate coolant level is visible in the overflow recovery tank which is located near the radiator.

1.9. AIR SYSTEM

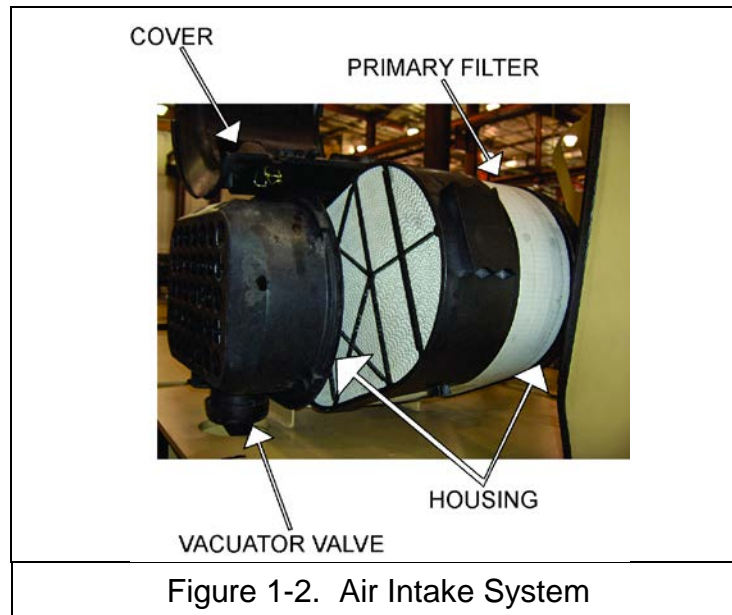


Figure 1-2. Air Intake System

1. Shut off the engine and remove the housing service cover. See Figure 1-2.
2. Remove the primary filter by pulling the filter out of the housing.
3. Using the plastic handle on the face of the safety filter, pull the filter toward the center of the housing and remove.
4. Visually check the new filter for cuts, tears or indentations on the sealing surfaces before installation. If any damage is visible, do not install.
5. If replacing safety filter, using the plastic handle on the safety filter, slide the filter at an angle into the outlet side and push in place until the filter seats firmly and evenly within the housing.
6. Slide primary filter down at approximately a 5° angle until it hits the end of the housing. Rotate the filter toward outlet section to complete the seal.
7. Place the service cover in position and fasten the latches. If the cover doesn't seat, remove and re-check the filter position. The cover will be difficult to install if the filter isn't installed correctly. Also, there is a service handle at the top of the filter which must match the indentation in the cover.
8. Inspect the vacuumator valve. Replace if any signs of wear or damage are visible.

1.10. FUEL SYSTEM

⚠ DANGER Fuel vapors create fire and explosion hazards which will result in severe personal injury or death. Do not allow any open flame, smoking materials or other potential igniter near fuel or the fuel system.

Raise engine cover and inspect fuel line connections for leaks. Be sure fuel lines are

securely fastened by retaining clips.

1.10.1. Drain Water Separator

1. Drain the water separator daily. If excessive amounts of water appear in the filter/separator, the tank may be contaminated and will require removal and cleaning or replacement. The water separator is located under the forward, left side of the engine.
2. The water separator is heated and is a Racor brand.

1.10.2. Engine Fuel Filter

1. The engine fuel filter is a spin on type. Use a filter wrench to remove it. It is located under on the left side of the engine. Replace this filter when required.
2. A manual lift pump is incorporated into the filter head.

1.10.3. Slow Release Lubricity Additive Fuel Filter

1. The fuel filter must be changed every 500 hours of operation. The filter needs to be changed to insure a continuous supply of lubricating additive to the fuel pump.
2. The filter head itself has a special threaded spud to insure that the correct filter with lubricity additive is used. Failure to change the fuel filter every 500 hours will result in damage to the fuel pump.
3. When changing filter make sure to plug fuel filter harness back into engine harness.
4. Seasonal applications should consider storing the filter off engine, insuring that ALL fuel is drained from the filter.

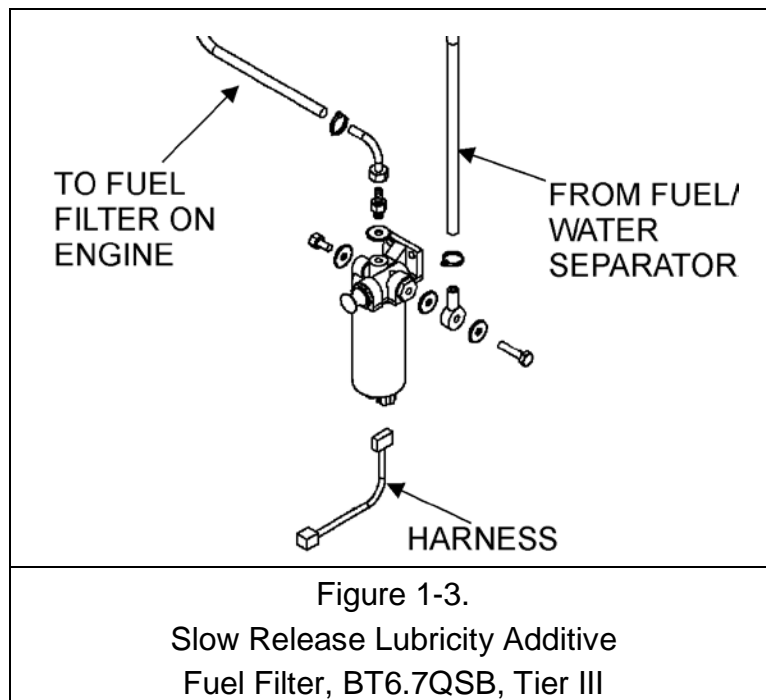
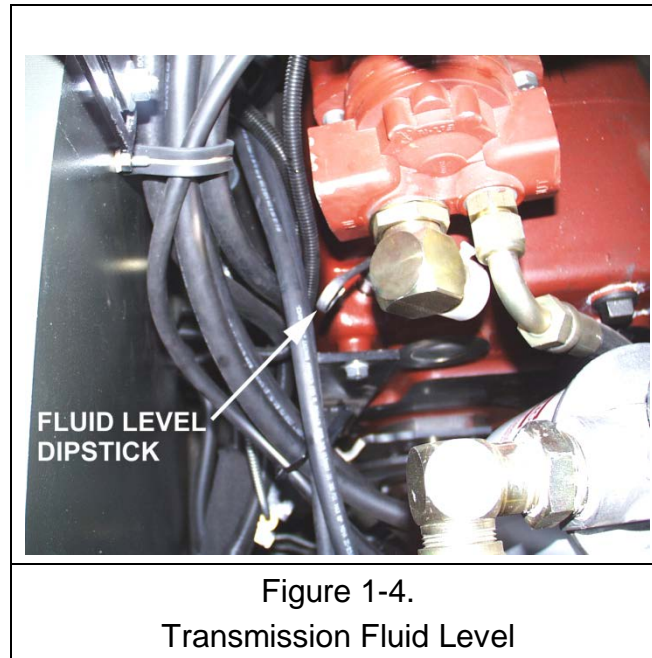


Figure 1-3.

Slow Release Lubricity Additive
Fuel Filter, BT6.7QSB, Tier III

1.11. TRANSMISSION



1.11.1. Check For Leaks

1. After tractor has been parked overnight, check the ground under the parked tractor for evidence of oil leakage (red-colored fluid). Try to find exact source of any leak and report condition to your supervisor.

1.11.2. Checking Fluid Level And Condition

1. Bring transmission to normal operating temperature (about 160-200°F). Five minutes of driving, including frequent stops and starts, will usually produce normal fluid temperature.
2. Put gear selector in neutral (N), set parking brake. Make sure area around dipstick is clean before removing.
3. With engine running at idle speed, withdraw transmission dipstick (see Figure 1-4) to check oil level.

NOTICE! If oil is discolored and has a foul (burned) smell, it may be caused from high operating temperatures. Oil and filter should be changed immediately. If oil has a milky look, water has entered transmission. Air bubbles mean there is a leak in the suction lines. Report any of these conditions to your supervisor.

NOTICE! Do not overfill transmission. Overfilling can result in transmission damage. It is easy to overfill the transmission. To avoid overfilling, add oil in small amounts and recheck level frequently.

4. Check level indicated on dipstick. Add fluid as needed to maintain level between “FULL” and “ADD” marks on dipstick.

1.11.3. Changing Transmission Fluid

1. Change lubricant and filter after first 20 hours of operation of the new transmission. Thereafter, change filter every 200 hours and lubricant every 600 hours. See 1.3.1 for specifications.
2. The transmission filter is located behind the front, left wheel well; under the tractor. It is red and midway between the two fuel filters.
3. When changing oil, dirty oil should be drained while unit is warm. Examine for contamination and dispose of properly.
4. Clean suction screen thoroughly before reinstalling.
5. Fill unit with 4 gallons of recommended lubricant in 1.3.1.
6. Start engine and run at idle to let converter and oil lines fill.
7. Check fluid level.

1.12. AXLES

Figure 1-5

1. After tractor has been parked overnight, check ground under axles for spots of oil. Try to find the exact source of any leak and report condition to your supervisor.
2. See 1.3.1 for lubrication specifications.

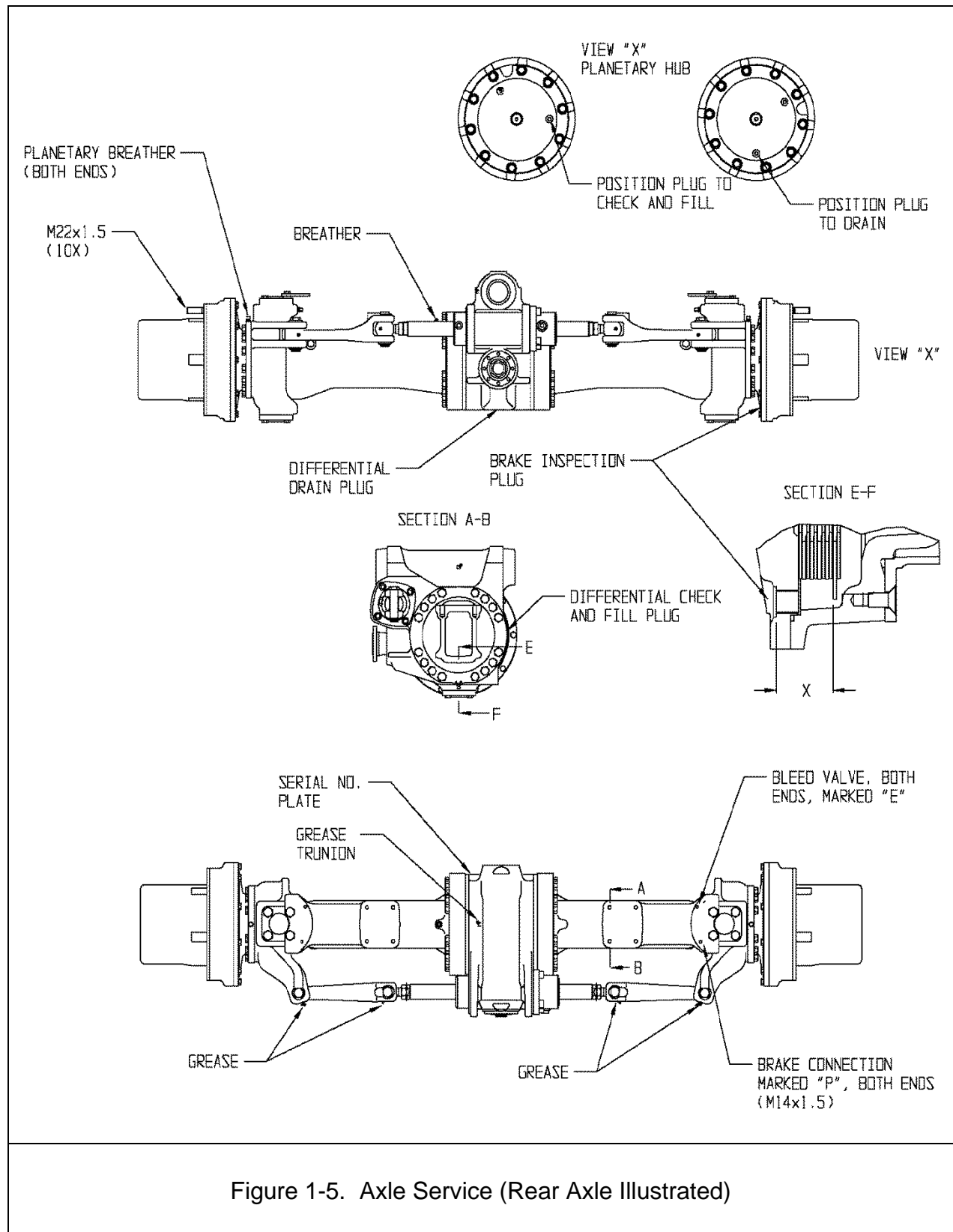
1.12.1. Check Axle Oil Level (Front and Rear)

1. Park tractor on a level surface. Shut off engine and set parking brake.
2. Using a rag and wire brush, thoroughly clean dirt and rust from around fill and check plugs.
3. Check differential oil level at the differential check/fill plug. Oil must seep from the plug opening. If it does not, add oil through the plug opening and replace plug. Wait for 5 minutes for oil to distribute and then recheck level. Once the oil level is satisfactory, tighten check/fill plug to 59 ft-lbs [80 Nm].
4. Rotate the wheels until the check/fill plug for the planetaries is at the horizontal position. Oil must seep from the plug opening. If it does not, add oil through the fill plug opening located above horizontal and replace the check/fill plug. Wait for 5 minutes for oil to distribute and then recheck level. Once the oil level is satisfactory, tighten the check/fill plugs to 37 ft-lbs [50 Nm].

1.12.2. Change Axle Oil (Front and Rear)

Differential

1. Using a rag and wire brush, thoroughly clean dirt and rust from around fill/check plug.
2. Drain old oil when oil is warm.
3. Remove the differential check/fill plug and then remove the differential drain plug allowing the old oil to drain into a container.
4. Clean magnetic drain plug and replace it. Tighten drain plug to 37 ft-lbs [50 Nm].
5. Refill differential with oil, the same as explained in checking oil above.



Planetary Drive, Both Ends

1. Using a rag and wire brush, thoroughly clean dirt and rust from around all plugs before removing them.
2. Drain old oil when oil is warm.
3. Rotate the wheels until the planetary drain plug and brake disk inspection plug located on the opposite side (back side of wheel hub) is at the bottom position.
4. Remove the planetary drain plug and brake disk inspection plug and allow the old oil to drain into containers on both sides of the wheel hub.
5. Clean the brake disk inspection magnetic plug and replace it. Tighten the plug to 37 ft-lbs [50 Nm].
6. Rotate the wheels back so the check/fill plug is at the horizontal position and the drain plug is above horizontal.
7. Remove the check/fill plug and refill with oil until it seeps from the plug opening. Clean the magnetic check/fill plug and replace it. Wait for 5 minutes for oil to distribute and then recheck level. Once the oil level is satisfactory, tighten the check/fill and drain plugs to 37 ft-lbs [50 Nm].

1.12.3. Axle Lubrication Greasing

1. Use high quality EP multi-purpose, lithium base, water resistant grease (DIN 51825). Wipe off any excess grease.
2. Grease both ends of both tie bars until clean grease purges from the joints.
3. Grease top and bottom sides of both steering knuckles until clean grease purges from joints.
4. Grease the trunnion mounting on the rear axle.

1.12.4. Adjusting Steering Stop

The steering limit is adjusted so there is 0.5-1.5mm between the stop screw and the stop surface in both the extended and contracted steering cylinder positions.

1.13. WHEELS AND TIRES

1. Inspect tire for cuts, nails, stones in the tread or deterioration. Remove stones and other foreign material imbedded in the tires. If damaged, report condition to supervisor. Check tire pressure. Correct pressure is 130 Psi. See tire application approval letter in 1-4.10.

⚠WARNING Regularly check tires and wheels for proper tire inflation or loose wheel studs/nuts. Dual wheel sets must have equal inflation in both tires to prevent tire overloading. Wheel or tire failure could result in loss of vehicle control.

⚠WARNING To minimize the risk of tire/wheel failure and loss of vehicle control, when servicing tire/wheels:

- Do not use cleaning solvent on tires. Solvents cause deterioration of the rubber.
- Never inflate tires with air from systems using alcohol evaporators.

- Never mix rim parts of different manufacturers or different sizes.
- Do not use damaged parts.

⚠ CAUTION Failure to follow proper wheel installation procedures could result in wheel mounting failure and loss of vehicle control.

Wheel Installation Procedure:

- Clean and dry wheel nuts, studs, and mating surfaces before assembly.
- Start wheel nuts by hand to avoid cross threading. Recheck wheel nut torque monthly or every 250 hours.
- Tighten wheel nuts, studs using a crisscross sequence.

1.13.1. Check Lug Nut Torque

⚠ CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control.

Tighten lug nuts to 406 ft-lbs [550 Nm].



Figure 1-6. Wheel & Lug Nuts

1.14. COUPLERS, JAW AND DROP PIN TYPES

1.14.1. Jaw Coupler

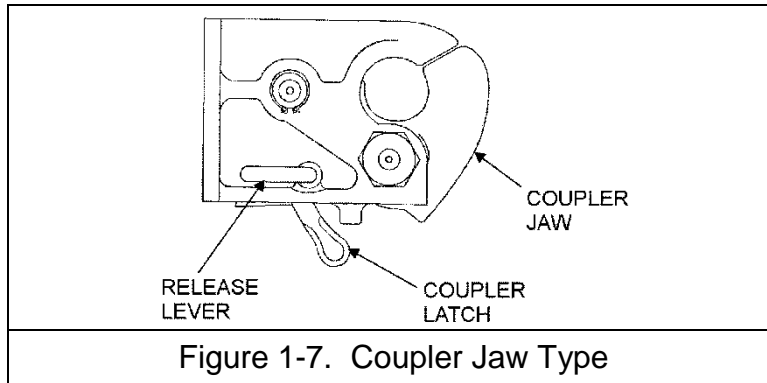


Figure 1-7. Coupler Jaw Type

Operator Inspection (Daily)

1. Inspect jaw coupler hitch during daily operator vehicle inspection for signs of physical damage, secure mounting, chain lanyard integrity and actuation of safety latch lever. Any discrepancies noted in the areas above shall be reported to vehicle maintenance for repair.

Maintainer Inspection (Every 500 Operating Hours or 18 Months)

2. Clean and check for proper operation. Inspect for worn, damaged or missing parts. Replace as required using only NMC-Wollard or Holland coupler parts.
3. Inspect in particular, the coupling contact area. Replace when wear exceeds 1/8" (.125") from the original surface profile.
4. Regularly lubricate all coupler pivot points with a light oil lubricant, SAE20 or 30 or MIL-PRF-7870.
5. Check (6) 3/4-10x4.00 Grade 8 mounting fasteners for proper torque, 376 ft-lbs. Dry. See Figure 1-8.

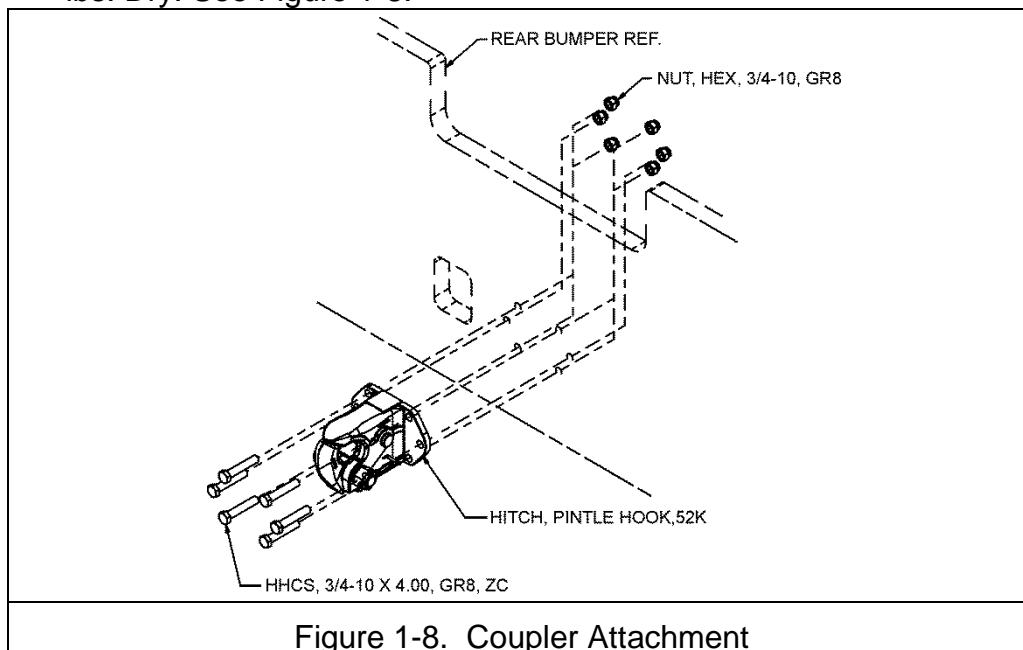


Figure 1-8. Coupler Attachment

1.14.2. Drop Pin Coupler

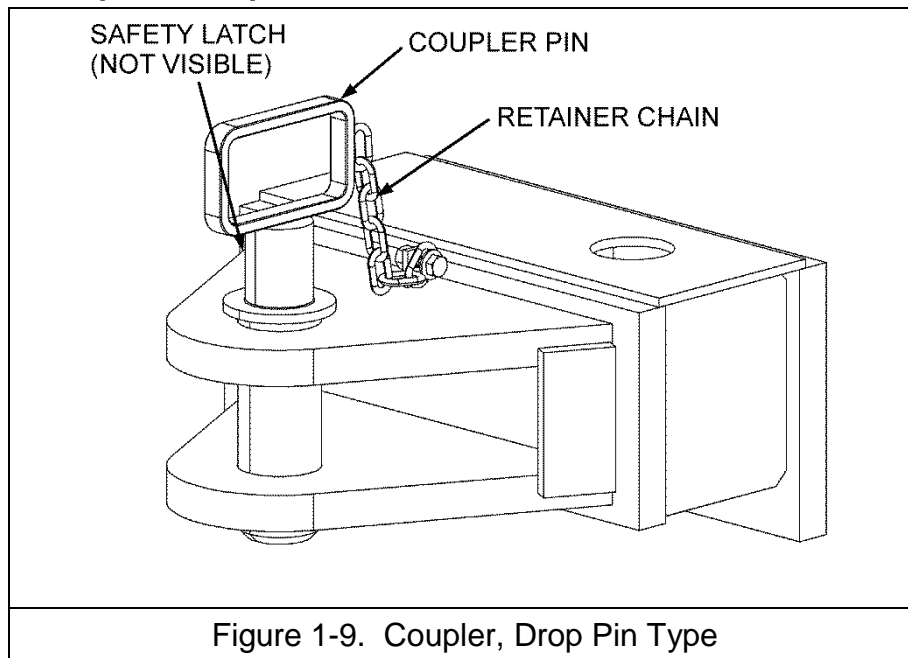


Figure 1-9. Coupler, Drop Pin Type

Operator Inspection (Daily)

1. Inspect drop-pin hitch during daily operator vehicle inspection for signs of physical damage, secure mounting, chain lanyard integrity and actuation of safety latch lever. Any discrepancies noted in the areas above shall be reported to vehicle maintenance for repair.

Maintainer Inspection (Every 500 Operating Hours or 18 Months)

1. Clean and check the safety latch for proper operation. Inspect for worn coupler pin holes, damaged or missing parts. Replace components when:
 - a. Worst-case latch engagement is less than shown in Figure 1-10, OR
 - b. Load-bearing surface of Pin is indented by more than 1/8" at any point, OR
 - c. Pin hole in upper or lower plate measures more than 2.38" across at any point.

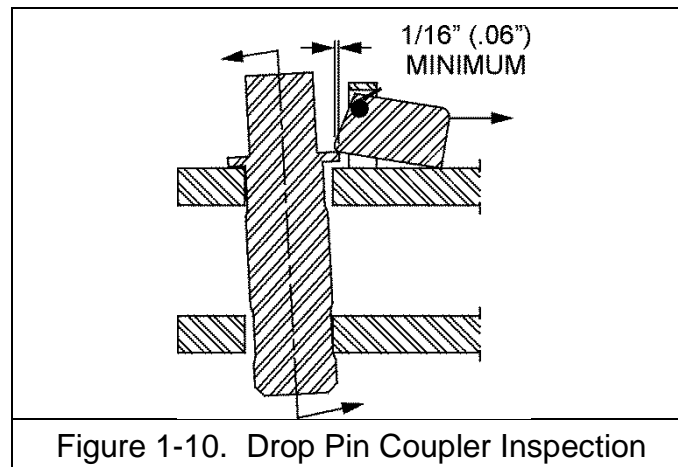


Figure 1-10. Drop Pin Coupler Inspection

2. Replace as required using only NMC-Wollard coupler parts.
3. Inspect that the safety latch pivots freely to engage over the top of the coupler pin flange.
4. Regularly lubricate the safety latch pivot with a light oil lubricant, SAE20 or 30 or MIL-PRF-7870.
5. Check (6) 3/4-10x4.00 Grade 8 mounting fasteners for proper torque, 376 ft-lbs. Dry.

1.15. BRAKES, SERVICE

⚠ WARNING Any brake service, other than periodic inspection or bleeding, should be performed only by personnel specially trained in brake service. Improper and poor quality service procedures can result in brake system failure, loss of vehicle control and personal injury.

1.15.1. Bleeding the Brakes

1. Bleeder valves are provided at each end of axle as shown on Figure 1-5.
2. Use standard automotive procedures to bleed the brakes beginning with the brake furthest from the hydraulic reservoir and progressing to the one nearest.

1.15.2. Brake Inspection, Disc

1. Inspect the disc wear with the brakes actuated.
2. Rotate the wheels so the brake inspection plug is above horizontal so oil does not drain out.
3. Remove the inspection plug and apply the brakes. Use a depth gauge and measure the distance "X" illustrated on Figure 1-5 and Figure 1-11 (from inspection plug seat surface to test nib of the 5th disk).
4. For reference only, new discs measure approximately 50.5mm.
5. If dimension "X" measures 47.5mm or less, the disks must be replaced.

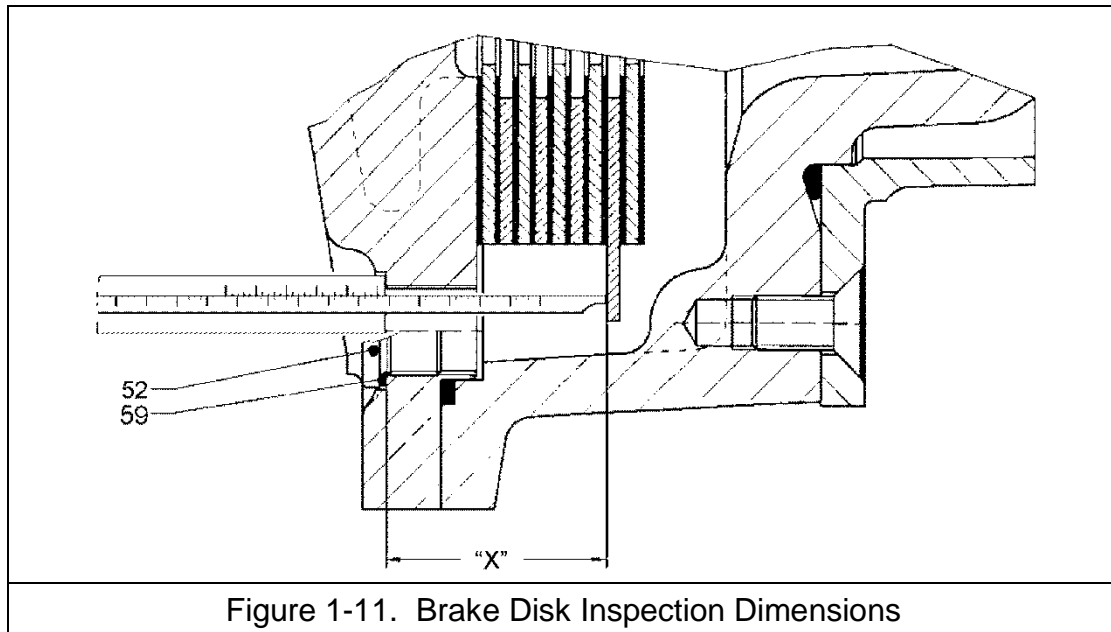


Figure 1-11. Brake Disk Inspection Dimensions

1.16. PARKING BRAKE AND CALIPER SERVICE

See Figure 1-13 and Figure 1-12.

The park brake is spring applied and hydraulic released. It is automatically applied when the ignition is turned off.

1.16.1. Disconnecting the Linkage

1. Shift to neutral and turn tractor off and chock the wheels to prevent rolling while servicing the parking brake.

⚠WARNING Block ahead and behind, all four wheels while performing this procedure and while the tractor is parked with a non-functioning park brake to prevent movement and possible injury or death.

⚠WARNING The park brake linkage (see Figure 1-13) is in tension when the park brake is applied and could spring apart causing personal injury if unhooked before releasing the brake.

2. Loosen the jam nut on the pull rod/clevis and observe how much thread is exposed on the pull rod/clevis. This will aid in reconnecting the brake linkage later. See Figure 1-13. Turn CW on the hex end of the chamber piston rod to lengthen the linkage.
3. Turn until the caliper clevis pins are loose at the lower caliper lever and upper link connections. At this position, the brake is released. Remove the upper link and caliper lever clevis pins and the two clevis link.

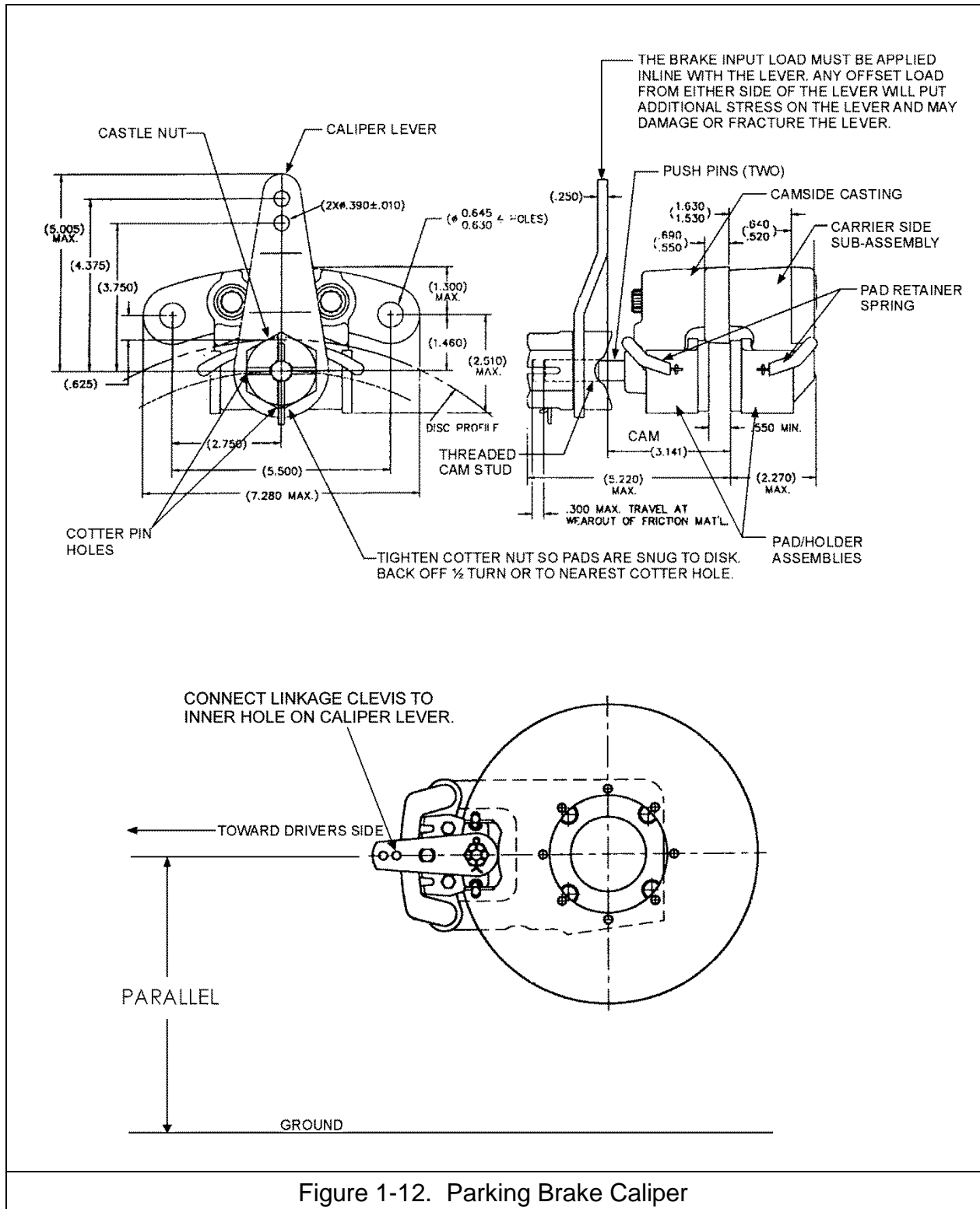


Figure 1-12. Parking Brake Caliper

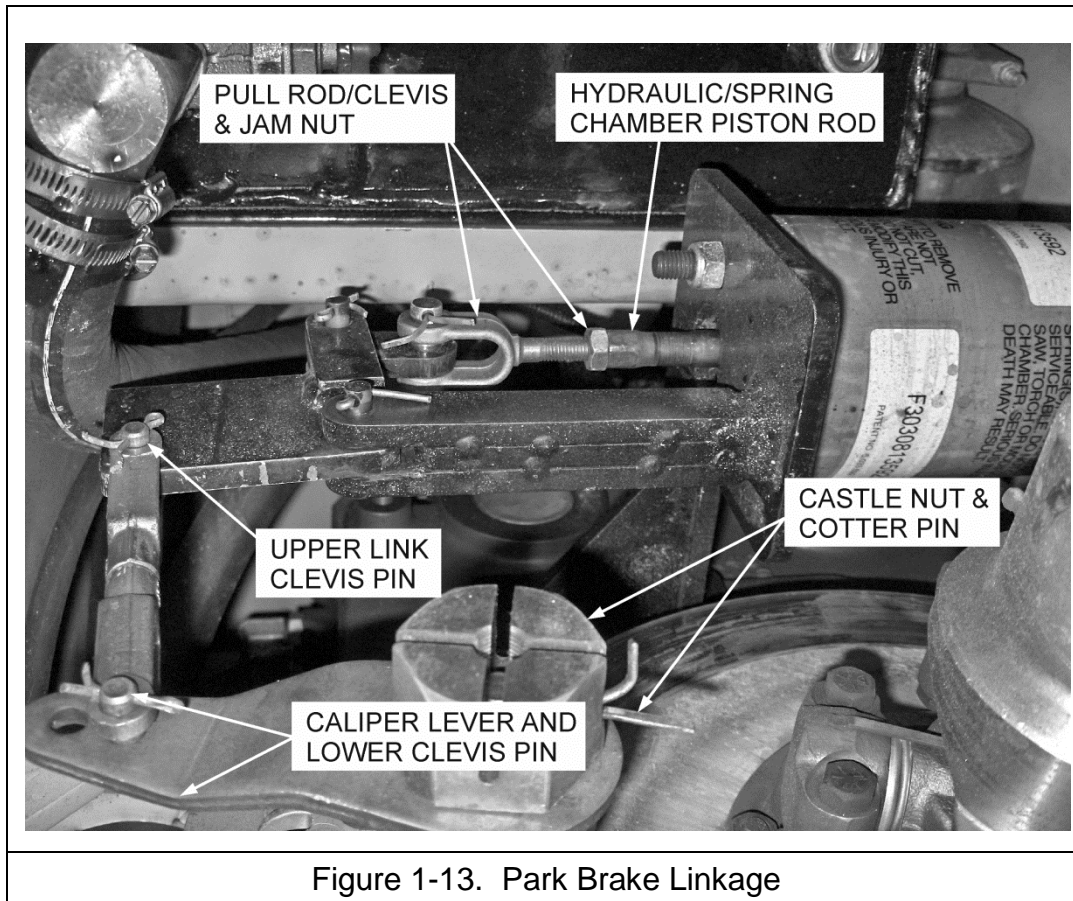


Figure 1-13. Park Brake Linkage

1.16.2. Adjust Caliper

1. Disconnect the linkage per 1.16.1.
2. Remove the cotter pin and tighten the castle nut to remove all clearance between the pads and the disk but not tight enough to force the pads and disc together, i.e., finger tight and no pressure on the cam lever.
3. Next, back off the castle nut 1/2 turn (180 degrees) and then line up the closest cotter pin hole with a slot in the castle nut. Install the cotter pin and secure it.
4. Reconnect and adjust the linkage per 1.16.5.

1.16.3. Friction Pad Inspection and Service

1. Replace the friction pads when the required adjustment of the castle nut (instructions above) goes beyond the cotter pin hole center line and there is not full contact of the cotter pin in the castle nut slots. Friction pads that wear down to .060" minimum thick are no longer useable.
2. Disconnect the linkage per 1.16.1.
3. Remove the cotter pin and castle nut from the cam stud. Remove the two push pins. Clean and lubricate all surfaces of the push pins, cam face where it contacts the push pins and the threaded cam stud. Use lube specification

20-003

4. Pad/holder assemblies are secured to the cam side casting and the carrier side subassembly with pad retainer springs. Remove the springs to remove pads. Slide new pad/holder assemblies in place and secure by reinstalling the pad retainer springs over the cam side casting and carrier side subassembly as illustrated.
5. Install the caliper lever on the cam spline so it points to the 9:00 position or toward the driver and thread the castle nut onto the threaded cam stud.
6. Reconnect and adjust the linkage per 1.16.5.

1.16.4. Installing A New Caliper

1. Disconnect the linkage per 1.16.1.
2. The caliper is assembled to the caliper support bracket so it is located on the disc at the 9:00 position when viewed facing forward (on the side toward the driver).
3. The caliper lever must also point to the 9:00 position or toward the driver. New calipers may be shipped with this lever located differently. If so, remove the cotter pin from the castle nut and remove the nut. Remove the lever from the cam spline and reassemble it so it points to 9:00. See Figure 1-12.
4. Reconnect and adjust the linkage per 1.16.5.

1.16.5. Connect and Adjust the Linkage

1. Adjust the caliper per 1.16.2 before connecting the linkage.
2. Thread the hydraulic/spring chamber piston rod onto the pull rod/clevis to the approximate same distance it was at the time of disconnecting. Do not tighten the jam nut at this time.
3. Start the engine and release the parking brake with the park brake switch.

⚠WARNING Pull rod/clevis moves very quickly with a very large force. Keep clear of linkage and caliper lever while pressurizing and de-pressurizing. Do not attempt to uncouple from caliper lever while under tension.

⚠WARNING Improperly adjusted park brake may not apply enough force, or may apply too much force and break caliper. In either situation, park brake will be non-functional with no obvious signs to operator.

4. Install the two clevis link to the upper link and caliper lever with clevis pins and cotter pins. Adjust the hydraulic/spring chamber piston rod on the pull rod/clevis until the two clevis link can be installed without any tension on the clevis pins. At this position, the brake is released.

NOTICE! Each clevis must be threaded a minimum of .37" onto the threaded rod and the pin to pin dimension of the 2 clevis link must be 2.0".

5. The linkage must attach to the cam lever without applying any force to the lever with the brake released. The lower clevis must be connected to the

inner hole on the caliper lever as illustrated on Figure 1-13.

6. Tighten the jam nut on the pull rod/clevis while holding the piston rod and the clevis from turning.

1.17. ELECTRICAL SYSTEM

1.17.1. Lights, Horn and Wipers

1. You must turn the ignition switch to RUN to power the electrical system during checking.
2. Check operation of all tractor lights including the amber beacon. Replace any burned-out lights. Check that wipers operate. Sound the horn.

1.17.2. Battery

Battery Care, Inspection and Maintenance

⚠WARNING To minimize risk of fire or explosion, follow these battery servicing safety precautions:

- Sulfuric battery acid is poisonous. Avoid breathing battery fumes.
- Battery acid is strong enough to burn skin and cause blindness if splashed into the eyes. Protect eyes and skin from contact. In the event of contact with battery acid, immediately rinse in large amounts of water.
- Obtain medical care if the eyes are burned.
- Battery gas can explode. Keep sparks and flame away from battery.
- Never check battery charge by placing a metal object across the battery posts. A spark will occur and cause possible explosion. Use a voltmeter or hydrometer.

Clean Battery

1. Check battery cables for corrosion, damage, or loose connections to the battery terminals.
2. Use a baking soda and water solution to clean the battery top and terminals. Never let solution enter battery. Use battery terminal post cleaner to clean up battery. After cleaning the battery, rinse and dry top of battery, apply a thin coat of grease to cable ends.
3. When tractor is going to sit for an extended period of time, the battery should be disconnected.

Checking Battery Charge

1. Checking the specific gravity of the electrolyte in the battery is a good method for determining approximate state of charge and condition.
2. To test specific gravity, use a good-quality hydrometer.
3. If the electrolyte level is too low to draw a sufficient amount into the hydrometer, add water and either charge battery or run engine for 30 minutes to thoroughly mix electrolyte.
4. If the battery was just charged, crank the engine for several seconds to reduce the "surface charge."

5. Draw electrolyte into hydrometer, then squirt it back several times to bring float to electrolyte temperature.
6. Draw in enough to suspend float, and allow bubbles to rise to surface before taking your reading. Hold hydrometer at eye level and take reading.
7. Correct reading by subtracting .004 for each 10 F BELOW 80 F
.004 for each 10 F ABOVE 80 F
8. A typical fully-charged battery should have a specific gravity (SG) of 1.280-1.260. A 50% charge is indicated by a SG of 1.180-1.170. A typical discharged battery will have a SG of 1.080-1.070.
9. A difference of more than .025 between cells means the battery is starting to fail due to internal shorts, or normal deterioration.
10. If charging does not bring SG to a satisfactory level, replace the battery.
11. If a good battery repeatedly becomes discharged during normal operation, there may be a problem with the regulator or alternator.

Clean and Inspect Wiring, Battery, and Cables

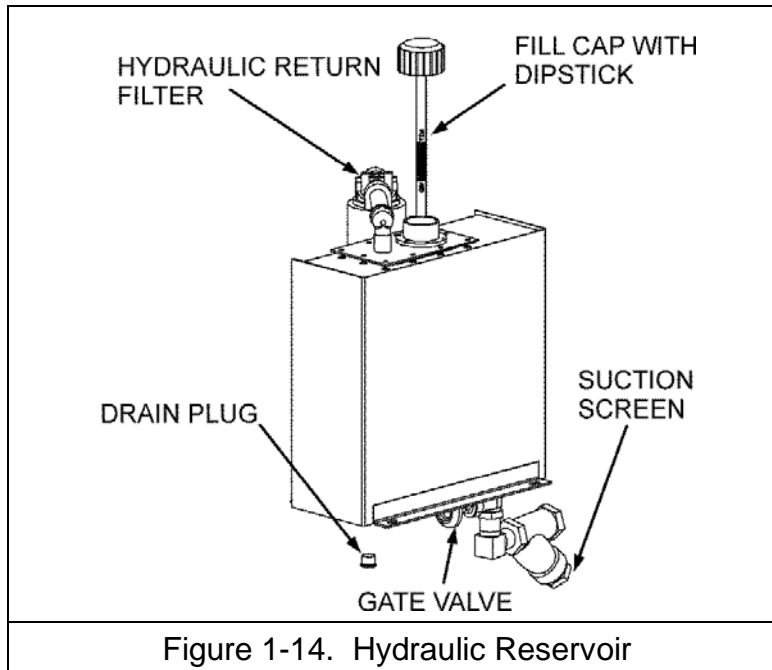
1. Inspect all wiring and cable harnesses for loose connections, evidence of shorting (burned insulation or terminals) and frayed wires.
2. Check that retaining clips are secure.
3. Remove exterior dirt and grease by wiping with a cloth dampened with solvent P-D-680.
4. Allow parts to air dry after cleaning.
5. When disconnecting the battery, first disconnect the negative cable, then disconnect the positive cable.
6. Remove cables from battery posts.
7. Inspect battery for evidence of electrolyte loss. Inspect case for cracks and leaks.
8. Check that posts are secure. If loose, replace battery. (Send battery to overhaul personnel for salvage.)
9. If corrosion or dirt is present, clean top of battery with a solution of clean warm water and baking soda. Scrub areas with a stiff bristle brush being careful not to scatter corrosion residue. Wipe clean with a cloth moistened with baking soda in water.
10. Using a common wire-brush type battery tool, brush battery posts and inside of cable ends.

1.18. HYDRAULIC SYSTEM

⚠WARNING To minimize risk of serious injury or death, follow these hydraulic servicing precautions:

- Follow all necessary lockout/tag out procedures.
- Hydraulic systems have residual, stored pressure. Relieve all pressure from the hydraulic system before servicing.
- Allow fluid to cool before working on system.
- Hydraulic fluid escaping under pressure can have sufficient force to enter eyes and penetrate skin. If fluid gets in eyes or skin, flush with large quantities of water and seek medical attention.

- Wear eye protection when servicing hydraulic components or systems.
- Keep all hoses and connections in good serviceable condition. Check before start-up and periodically during operation.
- Do not investigate for leaks with hands. Use a large piece of cardboard.



1.18.1. Service Hydraulic Filter and Suction Screen

1. Shut the gate valve on the reservoir. See Figure 1-14.
2. Change the hydraulic return filter cartridge.
3. Remove the suction screen clean with pressure air directed inside the screen.
4. Replace the screen and open the gate valve.

1.18.2. Change Hydraulic Fluid and Fill and Return Filter

1. See 1.3.1 for fluid specification.
2. Drain the hydraulic reservoir. See Figure 1-14.
3. Replace the return filter.
4. Refill with fluid to the full mark on the dipstick attached to the fill cap.
5. Catch all fluid spillage.

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2 TROUBLE SHOOTING

⚠ WARNING Perform lockout/tag out procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

⚠ CAUTION Before repairing the electrical system, disconnect the positive cable from the battery to prevent possible injury due to electrical shock.

2.1. TRANSMISSION

Transmission malfunctions may be caused by poor engine performance or dirty or contaminated oil.

Always begin by checking engine performance, then fluid level and condition. If oil temperature gauge rises to 250°F, stop the tractor immediately. Shift to neutral and run engine at 1000-1200 RPM. Transmission temperature should drop rapidly to ambient air temperature across heat exchanger. If temperature does not drop, trouble is indicated. The cause should be determined before tractor is operated again. Overheating generally occurs due to working in too high a gear ratio.

Do not shut off engine when transmission is overheating (as long as cooling system is in working order).

If problem continues, remove tractor from service and refer transmission to a transmission repair facility.

NOTICE! If you ever notice unusual noises such as gear noise or grinding, a buzz or whine, knocks, scraping, clicking, etc., remove tractor from service and refer it to a transmission repair facility.

2.2. ELECTRICAL, FUSES AND CIRCUIT BREAKERS

2.2.1. Instrument Panel Fuses

CIRCUIT	FUSE
21FU START CIRCUIT	5 AMP
22FU RUN CIRCUIT	5 AMP
23FU GAUGES	5 AMP
24FU ENGINE INDICATOR	5 AMP
25FU SHIFTER 7 STEERING	10 AMP
26FU FUEL HEATER	25 AMP
27FU NOT USED	
28FU NOT USED	
31FU HORN PWR OUT	5 AMP
32FU HEADLIGHT	20 AMP
33FU STOP, TAIL, TURN LITE	20 AMP
34FU WIPER, FAN, DOME LITE	20 AMP
35FU BEACON, HTR, BACKUP	25 AMP
36FU TRAILER CLRNCE	5 AMP
37FU TRAILER HYD PUMP	10 AMP
38FU W/SHIELD WASHER	5 AMP

NOTE: Panel fuse block is located on the left end of the instrument panel.

2.2.2. Engine Panel Fuses and Circuit Breakers

Circuit	Fuse or Circuit Breaker
Main Access(ory)	60A Circuit Breaker, Auto Reset (inside enclosure)
11FU Main Run	30A Fuse
16FU ECM Power	30A Fuse
17FU HVAC	40A Fuse

Illustration Not Available At Time Of Publication.

Figure 1-15. Hydraulic Schematic

2.3. STEERING TROUBLESHOOTING

If the rear wheels are moving out of alignment while driving in 2-wheel steering mode, use the procedure below to troubleshoot the problem.

1. First check for hydraulic leakage at the rear axle steering cylinder rods:
 - a. If there is leakage at either rod, replace the rod seal and check for damage/scoring. Operate 4-wheel steering until the rear wheels are centered. Switch to 2-wheel steering and test drive the tractor in 2-wheel steering.
 - b. If there is no leakage, proceed to step 2.
2. If problem still exists, make sure that the hydraulic oil tank is full. Operate 4-wheel steering until the rear wheels are centered.. Switch to 2-wheel steering and center the front wheels. Switch back to 4-wheel steering and turn the rear wheels full stroke both directions for 4 complete cycles. This will purge any air from the steering cylinders. Check oil level again and re-test.
3. If problem still exists, operate 4-wheel steering until the rear wheels are centered. Switch to 2-wheel steering, then disconnect the electrical plugs from both steering control valve coils, or remove the coils from the valve stems and re-test. If problem no longer exists, there is an electrical malfunction that is applying power to one or both valve coils when in 2-wheel mode.
4. If problem still exists, operate 4-wheel steering until the rear wheels are centered. Switch to 2-wheel steering. Disconnect both hydraulic hoses from the rear steering cylinder. Plug both hoses with a #6 (3/8) JIC 37° plug. Cap both axle fittings with #6 (3/8) JIC 37° cap and re-test. If the problem no longer exists, the fault is either the steering control valve or the manifold that the valve bolts onto.
5. If the problem still exists, replace the piston seals in the rear axle steering cylinder and check that the piston is not cracked and the cylinder bore is not damaged/scored. Re-test in case there are also faults in one of the areas above.

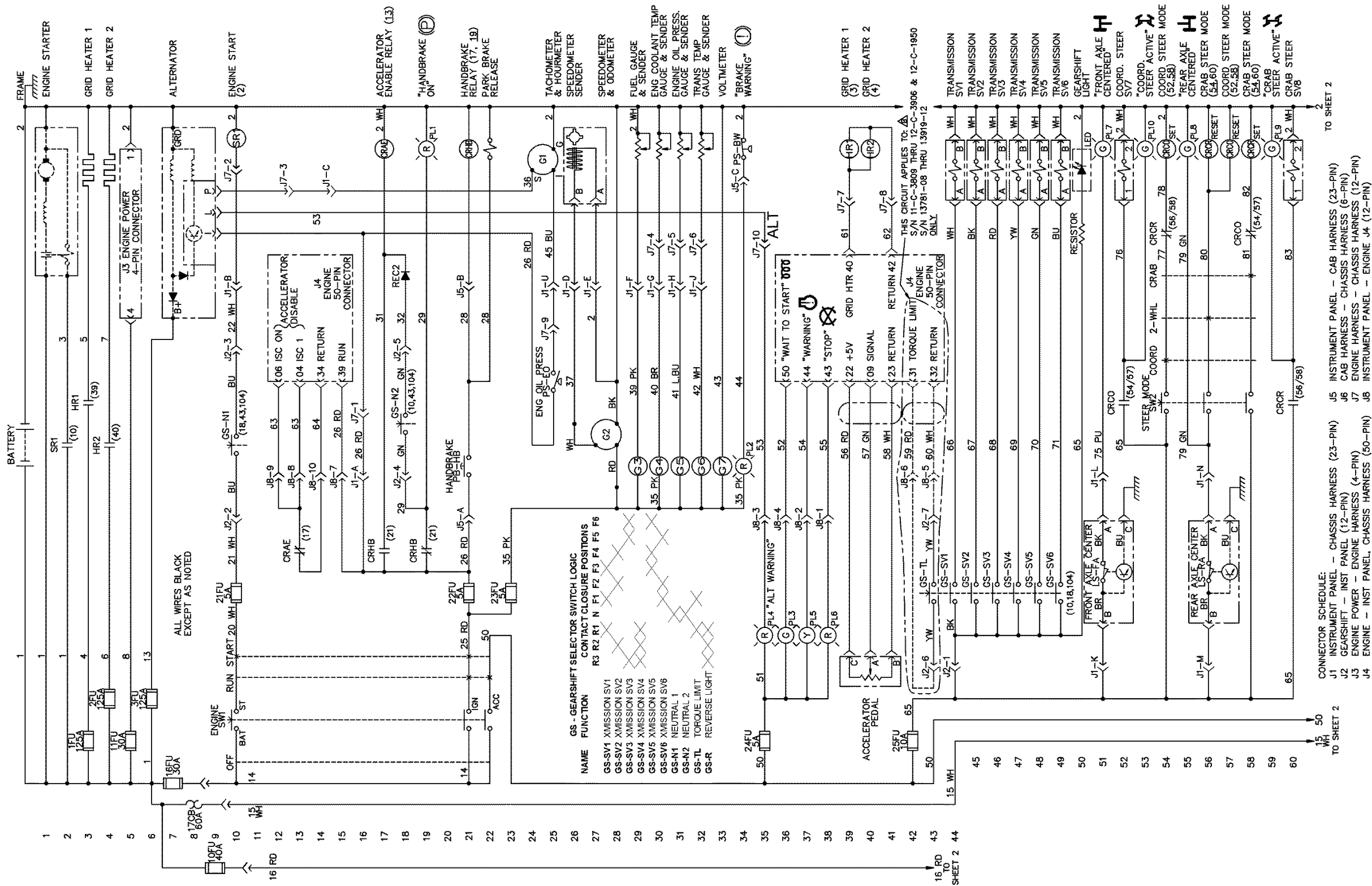


Figure 1-16. Schematic, Electrical, Cummins BT6.7 QSB (1 of 2)

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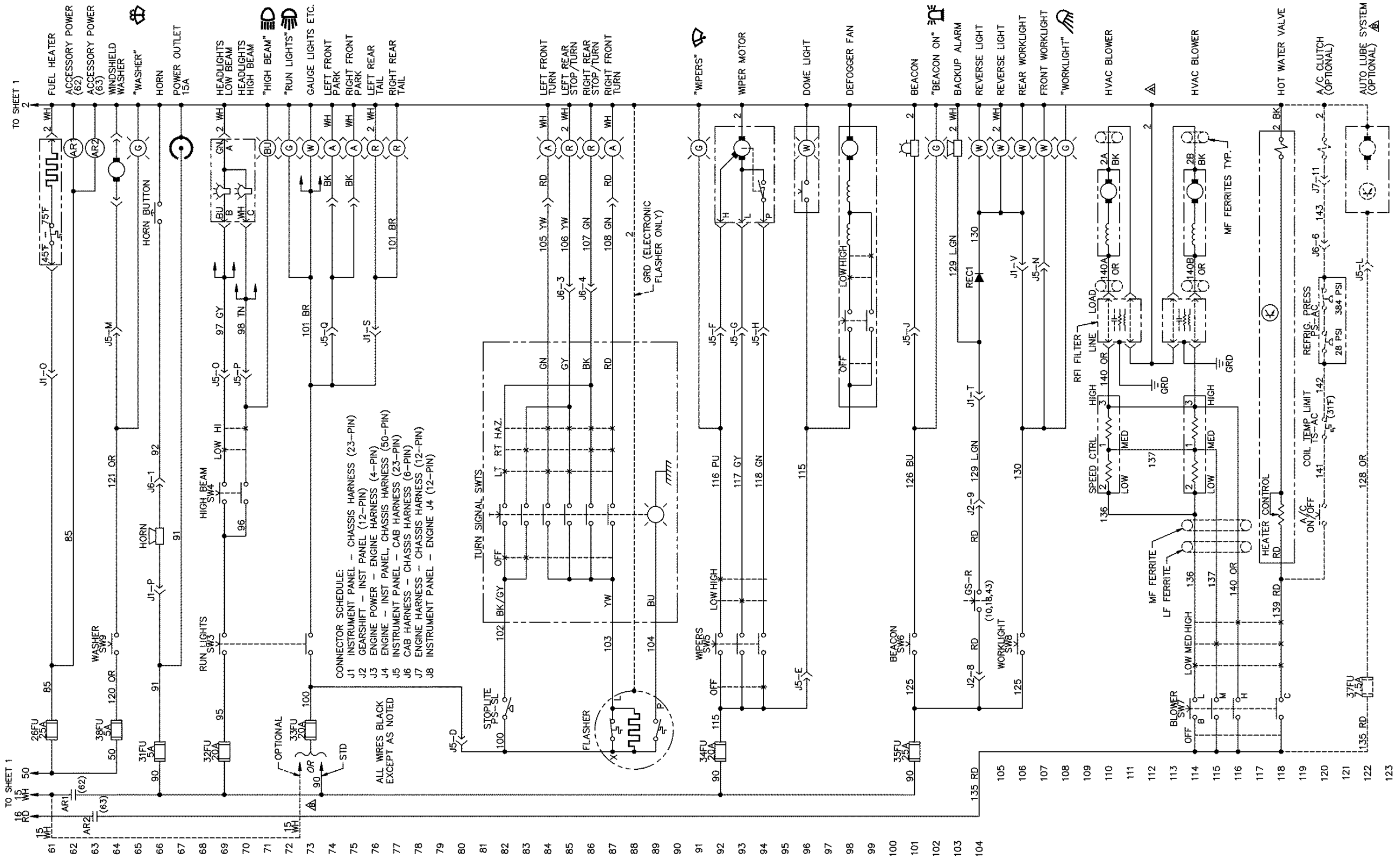


Figure 1-17. Schematic, Electrical, Cummins BT6.7QSB, (2 of 2)

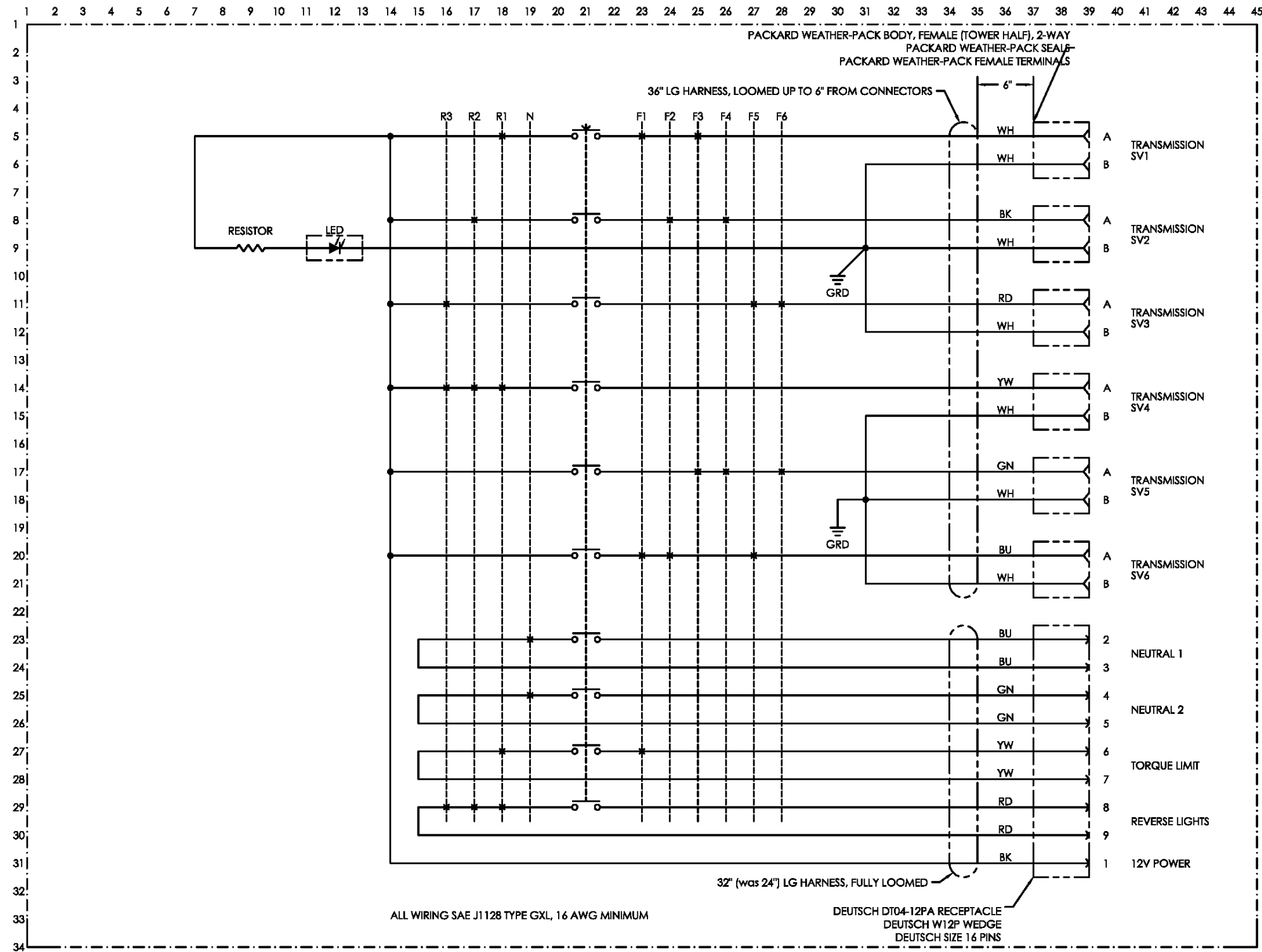
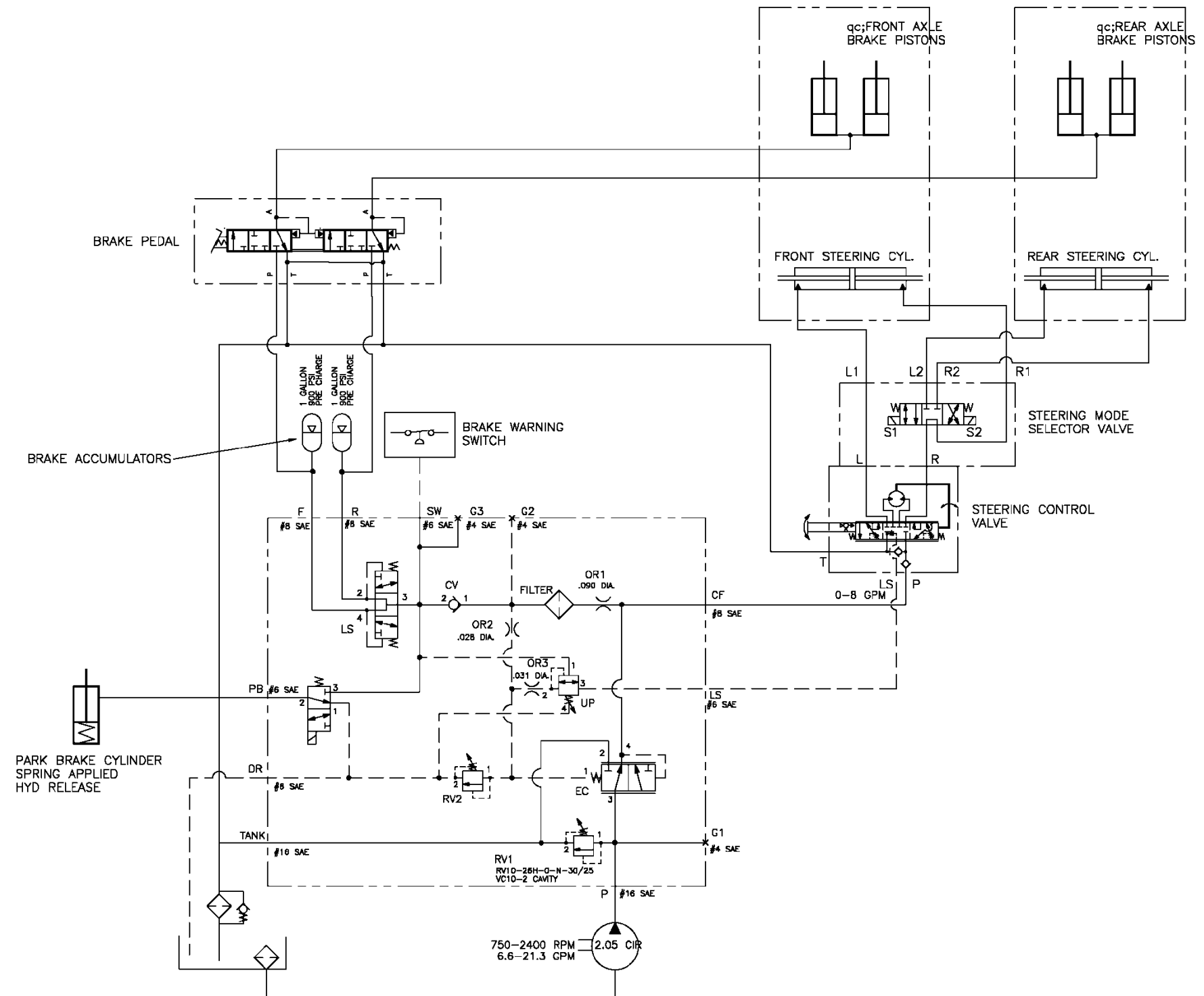


Figure 1-18. Electrical Schematic, Shift Control, Funk



47005

Figure 1-19. Hydraulic Schematic, Brakes/Steering, 400MB2

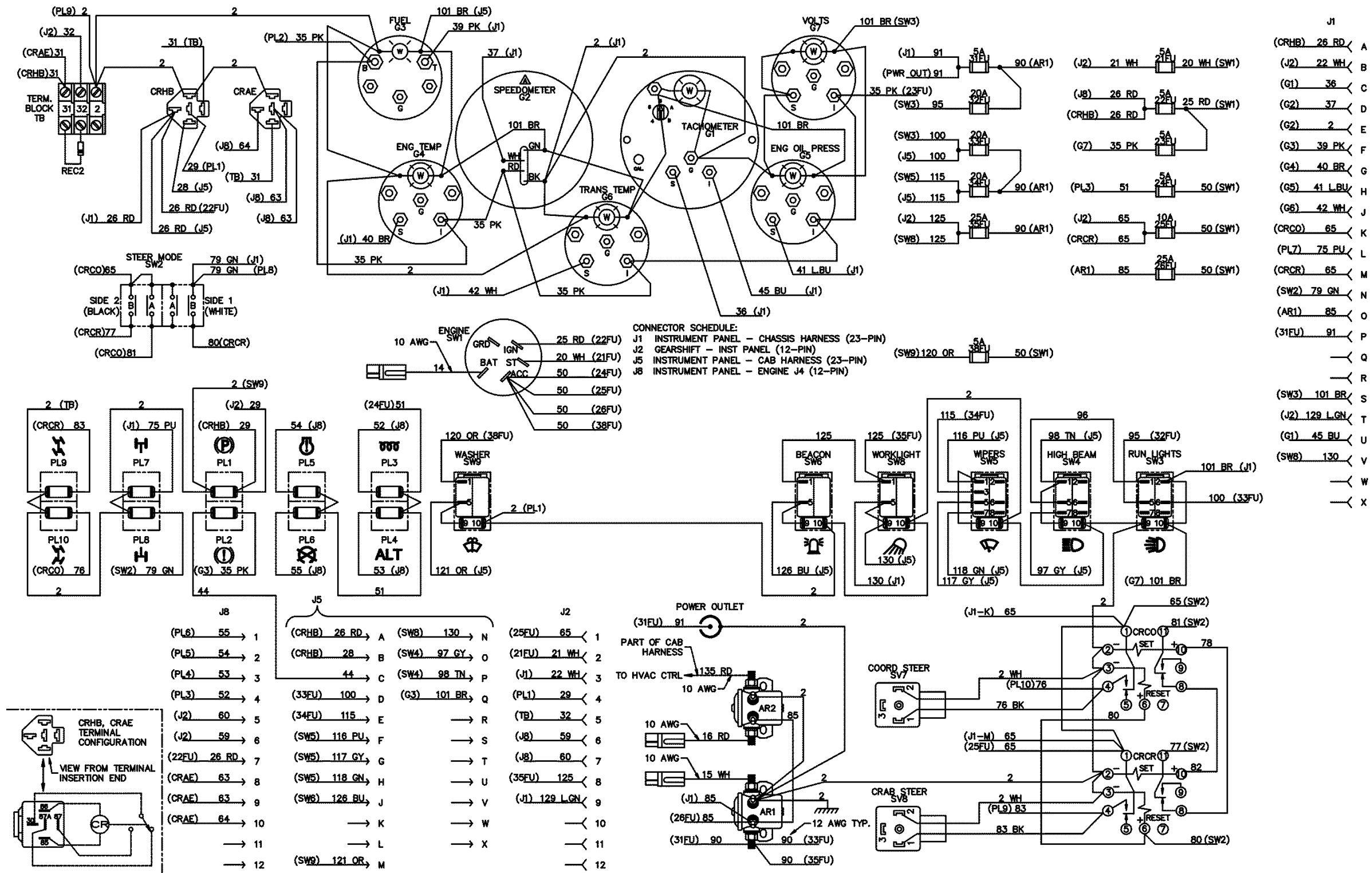


Figure 1-20. Harness, Instrument Panel

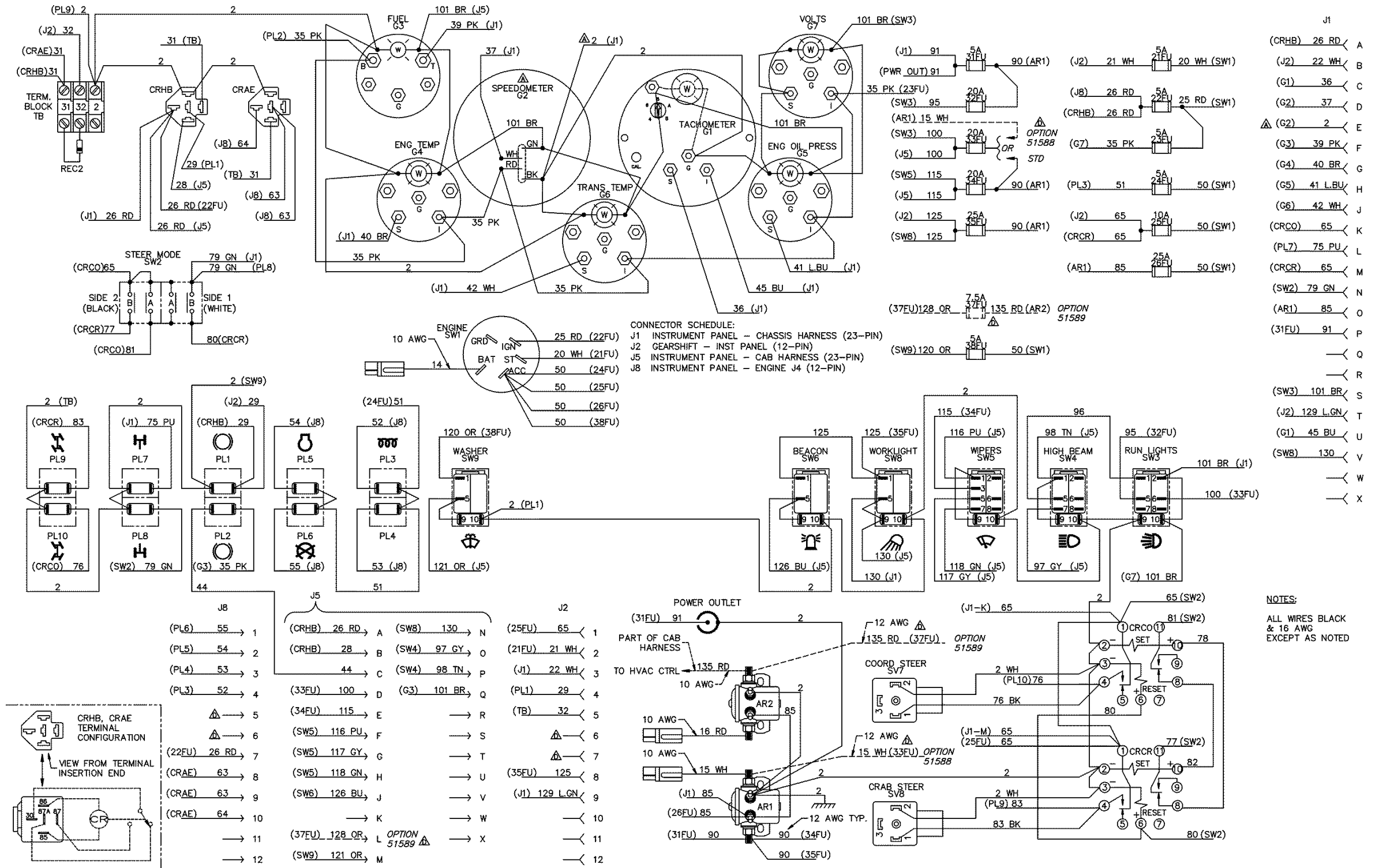


Figure 1-21. Harness, Instrument Panel SN 13928-13+, 12-C-3906, & 12-C-1950

1 REMOVAL AND INSTALLATION

⚠WARNING Perform lockout/tag out procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

1.1. GLASS REMOVAL AND INSTALLATION

⚠CAUTION Wear heavy protective gloves when handling glass to avoid being cut on sharp edges or broken glass.

Before beginning, read the following procedures and inspect the old installation to be sure you understand the instructions.

1.1.1. Recommended Procedure to Remove Glass

1. Following are instructions using a typical Windshield Removal Kit. Typical Kits include:
2. Braided Windshield Cut-Out Wire to “saw” around old glass and free it from old adhesive.
3. A starter tool which looks like a long knife with a slot to hook a piece of the cut out wire and force it between the glass and the adhesive seal.
4. Handles for Windshield Cut-Out Wire (Set of 2), used inside and outside glass to pull cut out wire back and forth and “saw” out old glass.
5. To use starting Tool, insert the end of the cut out wire into the slot and push between the window and adhesive seal. If removing door glass or rear slider window with the frames, this tool is also used to push the cut out wire between the frame and adhesive seal.
6. To use the Handles, cut wire to desired length that is convenient to “saw” with. Anchor each end of wire to each handle as kit instructions show.
7. Then, two people, one outside and one inside the window, “saw” back and forth around the glass to remove it.

⚠WARNING Adhesive Sealants and Primers used for glass installation are very flammable and toxic. Do not breath fumes, do not smoke or expose to flame and use only in a well-ventilated area. Read and heed all labels and information on manufacturer’s package.

1.1.2. To Replace Windshield or Front Tear Shaped Quarter Panel Glass

NOTICE! Windows originally installed with silicone adhesive must be repaired with silicone adhesive. Windows originally installed with urethane adhesive must be repaired with urethane. There are three ways to identify which you have. Units with serial number 13133 and lower are silicone. If you can see a distinct band of black glass primer around the window and extending slightly beyond the adhesive bead, it is urethane. Urethane adhesive is very hard even when probed with a sharp tool. Silicone adhesive is softer and pliable.

1. When replacing a windshield, measure actual distance between the top of

tractor frame and lower edge of old windshield glass (approximately 13"). Cut two 2x4 wood blocks to that length. They will be used to support the new windshield in place while the adhesive sets up.

1.1.3. Urethane Installation

1. Remove the damaged glass.
2. Use a putty knife, utility knife or similar tool to remove as much of the old adhesive as possible from the window opening. Do not leave any ragged lumps or high projections of old adhesive that will interfere with sealing and positioning of the new glass.
3. Any exposed metal (bare or painted) must be coated with pinch weld primer, PN 45483. Use the swab supplied with the primer to coat bare and painted metal. Metal still covered with urethane adhesive does not require pinch weld primer, but no harm will result if it is coated. Allow 2 minutes for the primer to dry before proceeding.
4. Use a clean shop rag to wipe the perimeter of the new glass clean. Use the foam applicator on the tube of glass primer, PN 45482, to apply a 3/4" (width of applicator) wide band of primer around the perimeter of the new glass. Allow the primer to dry for 2 minutes before proceeding.
5. Apply a bead of urethane adhesive sealant, PN 45481, around the glass perimeter and centered on the band of glass primer. Apply the bead approximately 1/8" deep and move the tube back and forth to obtain approximately 1/2" wide bead.
6. Immediately position the glass onto the window opening. Firmly press the glass against the cab surface all around the perimeter.
7. For windshields, use two wood blocks wedged between the top of the tractor frame and lower glass edge to support the glass in position. Tape the blocks in position with duct tape to the front of the cab. With the aid of the wood blocks, the glass will adhere strong enough to hold its own position after about 3 minutes. Duct tape can be used to tape and secure quarter panel glass in position while it cures.
8. You will have up to 15 minutes to make positioning corrections. The adhesive will completely cure after one hour.
9. Once a windshield is secured in final position, apply a bead of urethane adhesive caulk to each end of the windshield to fill the gap (fillet) between the windshield end and the vertical edge of the quarter panel glass. Also apply a bead to the top edge of the windshield to fill the gap at the top edge of the cab roof. Likewise, on new quarter panel glass, apply adhesive caulk to the front vertical edge and to the top edge. The rear and bottom edges do not require this fillet. Use a putty knife to neatly smooth the fillet beads out.

1.1.4. Silicone Installation

1. Remove the damaged glass.
2. Use a putty knife, utility knife or similar tool to remove as much of the old adhesive as possible from the window opening. Do not leave any ragged lumps or high projections of old adhesive that will interfere with seating and positioning of the new glass.
3. Use a clean shop rag to wipe the perimeter of the new glass clean.

4. Apply a bead of silicone adhesive sealant, PN 44949, around the glass perimeter. Apply the bead approximately 1/8" deep and move the tube back and forth to obtain approximately 1/2" wide bead.
5. Position the glass onto the window opening. Firmly press the glass against the cab surface all around the perimeter.
6. For windshields, use two wood blocks wedged between the top of the tractor frame and lower glass edge to support the glass in position. Tape the blocks in position with duct tape to the front of the cab. With the aid of the wood blocks, the glass will adhere strong enough to hold its own position after about one hour. Duct tape can be used to tape and secure quarter panel glass in position while it cures.
7. You will have up to one hour to make positioning corrections. The adhesive will require a minimum of 8 hours to completely cure.
8. Once a windshield is secured in final position, apply a bead of silicone adhesive caulk to each end of the windshield to fill the gap (fillet) between the windshield end and the vertical edge of the quarter panel glass. Also apply a bead to the top edge of the windshield to fill the gap at the top edge of the cab roof. Likewise, on new quarter panel glass, apply adhesive caulk to the front vertical edge and to the top edge. The rear and bottom edges do not require this fillet. Use a putty knife to neatly smooth the fillet beads out.

1.1.5. To Replace Door Window or Rear Slider Window

1. To replace these windows, remove the entire window with frame by the RECOMMENDED PROCEDURE TO REMOVE GLASS described previously.
2. All units use silicone adhesive, PN 44949, to seal the window frame to the cab opening. Apply a bead of silicone adhesive sealant around the new window frame perimeter where it fits into the door window opening. Apply the bead approximately 1/8" deep and move the tube back and forth to obtain approximately 1/2" wide bead.
3. Firmly position the window assembly into the window opening. The adhesive will require a minimum of 8 hours to completely cure.

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2 REPAIRS

⚠WARNING Perform lockout/tag out procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

2.1. TRANSMISSION

If internal repairs are required, the transmission must be sent to a specialized repair facility. In this event, use the removal and installation procedures included in this section.

Routine checks will help prevent down time. Report weak or borderline malfunctions at once. It is especially important in this transmission to keep the oil clean.

2.1.1. Transmission Adjustments

The clutches in this transmission are hydraulically applied and spring released. This gives automatic compensation for normal wear, eliminating the need for adjustment.

2.1.2. Shift Linkage

The shift linkage is electronically and hydraulically controlled and does not require adjustment.

To assure smooth operation, periodically inspect all shifter components and replace any that are worn or damaged. Clean any grease, dirt, or rust from shifter components.

2.1.3. Neutral Start Switch

The neutral start switch is a safety device which prevents engine from starting with transmission in any shift position other than NEUTRAL.

The neutral start switch is integrated in the shifter control and does not require testing.

2.2. CALIBRATING THE SPEEDOMETER

For detailed speedometer calibration, see OEM instruction for IssPro Programmable Speedometer in Chapter 5.

The ISSPRO Programmable Speedometer is calibrated by setting a combination of eight switches found in the rear of the instrument.

Calibration Settings:

Calibration Number	SWITCHES SET "ON"							
	1	2	3	4	5	6	7	8
559335-570394		x	x		x	x	x	x

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CHAPTER 3 OVERHAUL

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1 GENERAL REPAIR

⚠WARNING Shut off and tag out the machine before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could result in injury or death.

1.1. GUIDELINES FOR REPAIRING THE TRACTOR

The following are general instructions for the removal, disassembly, cleaning, inspection, reassembly, and installation of tractor components within the capabilities of the using organization. Common shop practices are not described. Use the exploded views in parts manual, chapter 4 for reference.

1.1.1. Special Tools

There are no special tools required for this tractor. Common automotive shop tools are all that is required to service the tractor.

1.1.2. Removal and Disassembly

Special instructions are noted in the appropriate text. Disassemble components only to the extent necessary to do repairs.

1.1.3. Cleaning

When cleaning, keep related parts together so reassembly is easier. Valves, pistons, sleeves and other internal parts that have close tolerance fits in mating bores should be cleaned individually to prevent surface scoring and marking. Special cleaning instructions are given where required.

1.1.4. Using Compressed Air

Use low-pressure compressed air to remove debris and dirt as necessary.

1.1.5. Frame, Engine, and Transmission

NOTICE! Be sure all openings are closed or covered adequately before cleaning to prevent the entry of water into internal parts.

Structural parts are best cleaned using soap and water and suitable brushes. Steam cleaning may also be done before disassembly to remove heavy accumulations of grease, oil, and dirt from exterior of engine, transmission and rear axle assembly.

1.1.6. Metal Parts

Wash metal parts in an appropriate cleaning solvent. Allow to air dry. Do not use compressed air to dry parts. The moisture generally present in air systems may cause corrosion. Lubricate metal parts as soon as possible after cleaning.

1.1.7. Bearings

Wash bearings in a bearing washer or immerse in solvent and scrub clean with a soft brush. Remove all grease and oil from bearing recesses. Allow to air dry.

Apply a thin film of lubricating oil to bearings and check for free movement between inner and outer race. Worn bearings must be replaced.

1.1.8. Gears

Clean gears using a soft bristle brush and cleaning solvent. Remove foreign matter from the gears.

1.1.9. Inspecting Parts

Inspect all parts visually for cracks, breaks, scratches, dents, bends, punctures, galling, wear, scoring, stripped threads, distortion and deformation. Give special attention to bearing surfaces, mating surfaces, gaskets and seals. Specific dimensional checks and tests are given where required.

1.2. REPAIR AND REPLACEMENT

1.2.1. Structural Parts

Structural parts, enclosing, and supporting members may be repaired by welding, brazing and refinishing. Major repairs should be performed by overhaul facilities. Where repainting is required, the surface should first be suitably prepared and primed.

1.2.2. Wiring

Wiring should be repaired in accordance with standard automotive practices.

1.2.3. Gaskets And Seals

Gaskets, oil seals, preformed packing, and seals should be replaced instead of being cleaned and reused, unless otherwise specified by local directives. Replace any seals and packings that show any deterioration or damage.

Use repair kits when available.

1.2.4. Reassembly And Installation

Unless otherwise specified, reassembly and installation are the reverse of removal and disassembly. Use the illustrations in parts manual chapter for reference.

1.3. ENGINE

1.3.1. Major Repairs

If you intend to perform your own engine repairs, you may wish to obtain additional service literature from your local Cummins industrial engine distributor. See the Cummins Operation and Maintenance Manual included with this manual.

1.3.2. Engine Belt Routing

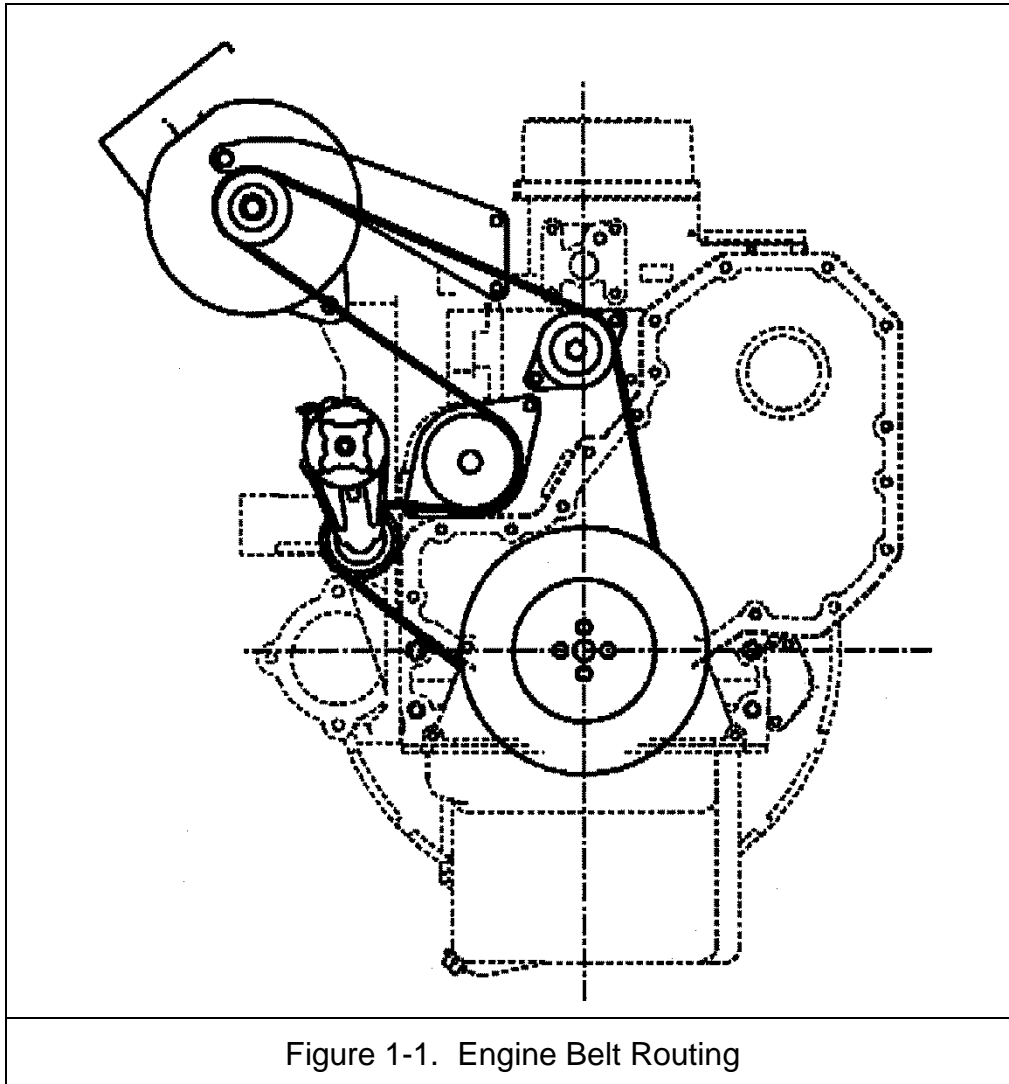


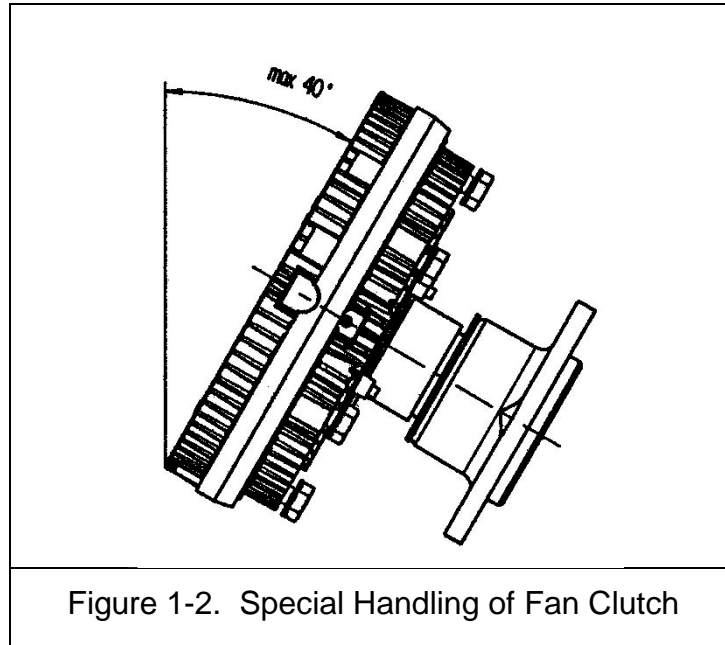
Figure 1-1. Engine Belt Routing

1.3.3. Engine Fan Clutch Assembly

Special Handling

1. The fan clutch assembly must be handled carefully or damage will result. The clutch is packed in individual cartons marked "this side up", and arrows on each side of the carton pointing up. The carton must be handled and stored accordingly.
2. When storing or handling the fan, do not tip it more than 40° as shown on the following figure.
3. If the fan clutch has been improperly stored or handled, silicone fluid will leak out. If there is evidence of fluid leakage, the drive must be rejected and sent back to the manufacturer for repair.

4. If the part falls to the ground at any time, it should be considered scrap and marked for disposal.



Test Clutch For Correct Speed

5. Apply a piece of reflective tape on the fan and use a tach to measure the fan speed to be sure it is within specification.
6. Proper RPM speed is 2375 RPM output with the input engine speed at 2500 RPM $\pm 5\%$. If the test fails, replace the clutch.

1.3.4. Engine Removal

1. Block rear wheels in both directions to prevent tractor from rolling when drive shaft is disconnected. Do not apply parking brake. Shift transmission into neutral.
2. Remove engine hood, side panels, and access plates.
3. Remove air cleaner and hose assemblies.
4. Disconnect battery cables.
5. Raise front of tractor with suitable stands.
6. Drain engine crankcase, cooling system and transmission.
7. Remove radiator hoses and radiator.
8. Remove fan blade.
9. Tag and disconnect all wire harnesses to engine and transmission components.
10. Disconnect air lines.

11. Remove ground strap.
12. Disconnect and cap fuel lines at required engine locations.
13. Disconnect accelerator linkage.
14. Disconnect exhaust pipe at the exhaust manifold. Tape over opening to prevent debris from entering engine.
15. If needed, remove screws from hood support and slide back to allow clearance for removing engine assembly.

⚠ WARNING The engine and transmission assembly is large and heavy. Use proper slings and hoists for removal and installation. If it falls on you, it could cause serious injury or death.

16. Attach a suitable hoisting bracket to engine and transmission assembly for support and lifting. Attach hoisting bracket to a hoist.
17. Remove converter drain plug access cover from lower end of converter housing. Matchmark torque converter with drive plate (for easier installation).
18. Remove converter-to-flywheel attaching nuts.
19. Remove converter housing-to-engine attaching bolts.
20. Lower tractor for easier engine removal, if necessary.
21. Remove engine mount capscrews.
22. Move engine away from transmission.

NOTICE! The drive plate (flywheel) will not support a load. None of the weight of the transmission must be allowed to rest on the drive plate during removal or installation. Before removing transmission support, support the transmission with a jack.

23. Lift engine assembly upward slowly from tractor frame.
24. Lower engine assembly onto a suitable support or repair stand.
25. To install engine assembly, reverse this procedure. Make sure plugs are secure and hoses are tight. Refill engine crankcase, cooling system, and transmission with recommended fluids and check for leaks.

1.3.5. Engine Diagnostic Code Retrieval And Explanations

See Chapter 5 for Cummins Engine Diagnostic code definitions.

1.4. TRANSMISSION

1.4.1. Transmission Removal

The engine must be removed first or the engine and transmission must be removed as a unit. The transmission is a very large unit and most hoists, jacks, etc. will not allow enough room to drop the transmission from the bottom of the tractor.

1. Block rear wheels in both directions to prevent vehicle from rolling when drive shafts are disconnected. Shift transmission into neutral. Do not apply parking brake.
2. Drain cooling system coolant, engine oil, and transmission oil and dispose of properly. Remove pump from rear of transmission.
3. Disconnect battery cables and remove battery.
4. Disable fuel system, disconnect and plug ends of fuel tubes.
5. Disconnect coolant lines from engine, transmission and radiator. Plug hose ends.
6. Unplug engine harness from under dash. Disconnect all wiring leading to transmission and engine.
7. Remove capscrews and washers securing rear drive shaft flange to park brake disk. Force drive shaft back until flange clears, swing drive shaft down and away from transmission.
8. Unhook the hydraulic hose from the parking brake actuator.
9. Remove capscrews and washers securing front drive shaft flange to transmission. Force drive shaft flange toward front of tractor until flange clears, swing drive shaft down and away from transmission.
10. Remove belts and fan from engine.
11. Remove radiator and shroud.
12. Remove fasteners from rear hood support and deck plate and slide back far enough to enable you to remove the engine/transmission unit.
13. Remove fasteners securing engine and transmission to their respective mounts. Pull engine/ transmission unit up and out of tractor. Be careful of protruding parts.

NOTICE! The drive plate (flywheel) will not support a load. None of the weight of the transmission must be allowed to rest on the drive plate during removal or installation.

14. Secure engine/transmission unit to prevent tipping or falling.
15. Match-mark torque converter with drive plate to provide easier installation.

NOTICE! Do not attempt to rotate the drive plate or torque converter by prying or using force or you will damage the drive plate.

16. Remove capscrews securing drive plate to torque converter.
17. Install a small "C" clamp on transmission housing to keep torque converter from falling out when transmission is removed from engine.
18. Remove capscrews and washers securing transmission bell housing to engine.
19. Carefully move transmission straight back to disconnect it from the engine.
20. Remove "C" clamp from torque converter.

NOTICE! The torque converter should not be disassembled.

1.4.2. Installing Engine And Transmission As A Unit

Installation is the opposite of removal.

1. When unit is installed in tractor, secure engine and transmission to their respective mounts with fasteners.
2. Connect rear drive shaft to parking brake disk. Connect front drive shaft to front of transmission.
3. Unplug and connect coolant lines to transmission and engine. Remount pump to rear of transmission.
4. Connect all transmission and engine wiring.
5. Unplug and connect fuel lines to engine.
6. Slide rear hood support and deck plate into place and secure.
7. Plug harnesses into receptacles in hood support.
8. Put radiator and shroud into place and secure. Reconnect coolant hoses to radiator.
9. Put fan and belts back on engine.
10. Return battery to battery holder and reconnect cables to engine and battery.
11. Replace drain plugs if you haven't, replace filters and fill engine, transmission and radiator with proper fluids.
12. Place gear shift lever in neutral position. Install gear shift cable.
13. Reconnect the hydraulic hose to the parking brake actuator.
14. If unit has not been refilled, fill unit with 4 gallons of recommended lubricant
15. Check for leaks.
16. Start engine and run at idle to let converter and oil lines fill. Check for leaks.
17. With engine at idle, finish filling according to .

1.4.3. Disassembly/Assembly Of Engine To Transmission

Consult the supplied Funk Service Manual for this procedure.

1.4.4. Steering System

Before servicing the steering system, inspect and clean steering system components.

Steering Column Removal

1. Disconnect external horn wire from under dash panel.
2. Remove rubber horn button from steering wheel by peeling it from plastic horn base.
3. Remove plastic horn base by turning and pulling it. There is a spring and spring seat assembly under the base. Take care not to lose them when removing the horn base.
4. Remove nut and flat washer from top of steering column shaft. Hold your hand under steering wheel while removing wheel. There are two carbon brushes and a spring which will fall out. Remove steering wheel assembly. Wheel is keyed to serrations on steering shaft.
5. Place nut and washer on steering column shaft to prevent loss.
6. Remove bolts at top of dash panel and tip panel toward driver's seat.
7. Remove bolts holding orbitrol (steering gear) to steering column and push orbitrol toward front of tractor to clear steering column.
8. Remove bolts holding steering column in bracket and push steering column out through back of dash panel.

Steering Column Installation

1. Push steering column through back of dash panel and attach column to bracket with fasteners. Push orbitrol up and onto steering column, check engagement, and reattach with screws.
2. Tip dash panel back and fasten into place with screws.
3. Remove nut and washer from steering shaft and install steering wheel assembly. Tap into place on shaft serrations with a soft-faced hammer. Install nut and washer to secure steering wheel to column.
4. Insert plunger into counterbored hole in steering wheel. Install horn parts.
5. Connect external horn wire. Test operation of horn.

Orbitrol Steering Gear Removal

1. Remove screws from top of dash panel and tip panel toward driver's seat.
2. Remove screws holding steering column to orbitrol and push orbitrol away from column.

3. Relieve pressure on hydraulic system.
4. Mark and remove hoses from orbitrol. Plug ends to eliminate system contamination.

Orbitrol Steering Gear Installation

1. Unplug and reattach hoses at proper ports.
2. Push orbitrol onto steering column and check engagement.
3. Tip dash panel back and fasten with screws.

1.5. FUEL TANK

⚠ DANGER Fuel vapors create fire and explosion hazards. Do not allow any open flame, smoking materials or other potential ignition sources near fuel or the fuel system.

⚠ DANGER To minimize risk of serious injury or death from fire or explosion, before servicing a fuel tank:

Clean the tank thoroughly before soldering or brazing. Fill tank with an inert gas such as carbon dioxide or nitrogen, or completely fill with water.

1.5.1. Removal and Disassembly

⚠ WARNING Disconnect the negative battery cable before servicing the fuel tank or fuel system. An electrical arc at the fuel tank sending unit can act as an igniter creating a fire and explosion hazard.

1. Disconnect cables from battery and remove battery from tractor (to prevent a possible spark when removing tank and related components).
2. Remove the rear deck plate from over the tank. It is secured by four 5/16 x 1" HHCS and nylock nuts.
3. Place a suitable container beneath drain opening at bottom rear of tank, accessible through hole in frame.
4. Remove drain plug from fuel tank and drain tank. Clean up any spillage.
5. Remove filler cap and cover filler hole to keep out debris. Remove tank straps from tank attached at top rear of tank and at lower front of tank.
6. Disconnect fuel sending wire and fuel hoses. Tank can now be lifted from tractor for cleaning and inspection.

NOTICE! Use care when handling the sending unit to prevent damaging it.

1.5.2. Cleaning and Inspection

1. Install drain plug on bottom of tank.
2. Pour a detergent and water solution into tank.

3. Agitate mixture by rotating tank. Make sure solution contacts entire interior surfaces of tank.
4. Drain cleaning solution from tank. Rinse and repeat steps 2-4.
5. Flush interior of tank with clean water and allow to air dry.
6. Inspect filler cap and sending unit for corrosion and damage.
7. Inspect tank protector strips for deterioration.
8. Inspect fuel tank for damage. Repair or replace tank as needed.
9. Check tank mounting straps for rust and corrosion.
10. Inspect elbows for damage.

1.5.3. Repair or Replacement

1. Repair tank by soldering or brazing if needed. Re-prime and paint any repaired areas of tank.
2. Test any repair with wet soap lather. Place an air hose in tank and admit air. By holding a rag around hose where it enters, a mild pressure will be built up. If the repair is sound, no bubbles will appear.
3. Replace corroded or damaged cap or sending unit.
4. Replace protector strips if they are damaged or deteriorated.
5. Replace straps if weakened by either of these conditions.
6. Replace damaged parts.
7. If there is any doubt as to the integrity of the tank, replace the tank.

1.5.4. Reassembly

1. Install new gasket on sending unit opening on tank, then carefully lower sending unit into tank. Do not use gasket cement.
2. Secure sending unit with its hardware.
3. Temporarily tape or cover tank filler opening to prevent entry of dirt when installing tank.
4. Apply thread sealer to drain plug threads and install drain plug.

1.5.5. Installation

1. When ready to install tank, place a quart of fuel in the tank, slosh round, and pour out.
2. Install hoses and sending unit wire.
3. Install tank straps with protector strips. Tighten mounting hardware to proper torque.
4. Install battery and connect battery cables.
5. Fill tank with fuel and check for leaks.

CHAPTER 4 REPAIR PARTS

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1 HOW TO USE THE REPAIR PARTS CHAPTER

TO ORDER REPAIR PARTS, call NMC-WOLLARD, Inc. Customer Service at 1-715-835-3151. Be prepared to supply the model number and serial number of your machine. Inform the Customer Service Representative what page and figure number the part you require is on, along with the date that appears in the footer of the parts page. Then order the part number that is listed for the item you require. For your convenience, Visa and MasterCard are accepted for payment.

VENDOR PART NUMBER column lists the original manufacturers' part numbers of items purchased by NMC-WOLLARD, Inc. Although these parts may be purchased from NMC-WOLLARD, Inc. by using the NMC-WOLLARD, Inc. part number, you may wish to purchase directly from the original manufacturer.

A/R	As Required	OA	Over-All
COMM	Commercial Item Readily Available From Local Sources	OD	Outside Diameter
DP	Double-Pole Single-Throw	RH	Right-Hand
HHCS	Hexhead Capscrew	RHMS	Roundhead Machine Screw
ID	Inside Diameter	SHCS	Socket Head Capscrew
LH	Left-Hand	SPDT	Single-Pole Double-Throw
NS	Not Shown		

ABBREVIATIONS may be used in this manual as follows:

NOMENCLATURE column contains the part description required for identification or procurement. If the part is an item purchased by NMC-WOLLARD, Inc. and has not been modified by NMC-WOLLARD, Inc., then following the description will be the vendor's federal supply (CAGE) code. If a vendor does not have a CAGE code, a number will be assigned by NMC-WOLLARD, Inc. with the prefix letter "V". Example: V00123. Where there is no vendor or CAGE code, NMC-WOLLARD, Inc. is the manufacturer.

EFF (Effectivity) column identifies by code the model or serial number/s on which a particular part is used. Absence of the code in the "EFF" column indicates that the part or assembly is used on all models with Ser #001 and on.

See the Introduction for Effectivity Code and Serial Numbers

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2 LIST OF VENDORS

Cage Code Vendor

NVC Sam's Auto Supply (purchase locally)
NVC White City Glass (purchase locally) NVC Breed Safety Restraint Systems
V00501 Metalastic/Canada, 11 Curity Avenue, Toronto, Canada, M4B 1X5
V00506 D&D Instruments, PO Box 64097. St. Paul, MN 55164-0097
V00507 Advanced Laser Machining LLC, 600 Cashman Drive, Chippewa Falls, WI 54729
V00511 Unlimited Services, Dept. No. 59431, Milwaukee, WI 53259-0431
V00512 Tech Products Corp., Dept. 0166, Columbus, OH 43265-0166
V00513 Certified Power Inc. Co., 95 West Deere Rd., Elkhorn, WI 53121
V00514 Northwest Filter, 7844 12th Avenue South, Minneapolis, MN 55420
V00517 Power Great Lakes, Inc., Dept 77-5626, Chicago, IL 60678-5626
V00523 Genuine Service & Machine, Inc., 2424 Pleasant Street, Eau Claire, WI 54701
V00524 Bearing Headquarters, 1814 Truax Blvd., Eau Claire, WI 54703
V00529 AA Electric, PO Box 325, Cedarburg, WI 53012-0325
V00531 Electronic Components, Dept. #149701, Detroit, MI 48267-1497
V00532 Batteries Plus, 3115 E. Hamilton Avenue, Eau Claire, WI 54701
V00539 Courtney Industrial Battery, 6522 N 40th St., Milwaukee, WI 53209
V00540 Ken Vance Motors, Inc., 5252 Hwy 93, Eau Claire, WI 54701
V00541 Markquart Chevrolet, PO Box 1528, Eau Claire, WI 54702
V00542 Maxima Technologies, Inc., PO Box 11579, Boston, MA 02211
V00543 Motion Industries, PO Box 1503, Eau Claire, WI 54702
V00544 Fiamm Technologies, Inc., 1550 Leeson Ave., Cadillac, MI 49601
V00545 Transtar Industries, 34 Official Rd., Addison, IL 60101
V00546 Catco, 2785 Long Lake Rd., St. Paul, MN 55113
V00547 Engineered Cooling Systems, 201 W Carmel Dr., Carmel, IN 46032
V00548 OE Sales, 239 Old New Brunswick Rd., Piscataway, NJ 08854
V00549 Wells Mfg. Corp., PO Box 88832, Milwaukee, WI 53288
V00550 JW Speaker Corp., MB Unit #68-6171, Milwaukee, WI 53268-0489
V00551 Grey Products, N6673 State Hwy 25, Durand, WI 54736-4206
V00552 Acme Alternate Fuel Systems, PO Box 2168, Mankato, MN 56002
V00553 Springs, Inc., 522 SW 19th St., Forrest Lake, MN 55025
V00554 Safety Systems & Controls, 2400 Campell Rd., Houston, TX 77080
V00555 Frank W. Murphy Mfg., PO Box 470248, Tulsa, OK 74147-0248
V00556 Contiental Engineering, PO Box 68, Chaska, MN 55318
V00570 Motormite
00779 Tyco Electronics Corp., M/S 38-77, 2800 Fulling Mill Road, PO Box 3608, Harrisburg, PA 17105-3608, Middletown, PA 17057

01276 Aeroquip Corporation, 1225 West Main Street, Van Wert, OH 45891
03718 Cummins Great Lakes, 5555 S Kilpatrick, Chicago, IL 60629-5348
05WC5 Bosch Automotive Motor Systems, 101 1st Ave, Waltham, MA 02154
0AT39 Brierton Engineering, PO Box 217, Abilene, KS 67410
0BFU2 Tewco Inc., 9701 South 58 Street, Franklin, WI 53132
0GE52 Drive Line, Inc., 5290 Hiatus Rd., Fort Lauderdale, FL 33351
0J567 Indiana Heat Transfer, 500 W. Harrison St., Plymouth, IN 46563
0NYT6 Interdynamics Inc., 80 39th St., Brooklyn, NY 11232
0NZJ1 Engineered Components, Inc., PO Box 360, 546 Old York Rd., Three Bridges, NJ 08887
0X0P8 Superior Unlimited, PO Box 3888, Bristol, TN 37625
12204 Daimler Chrysler, 26311 Lawrence Ave., Center Line, MI 48015
12662 Peterson Mfg. – Grndvw, PO Box 410032, Kansas City, MO 64141-0032
13445 Cole-Hersee Co., 20 Old Colony Ave., Boston, MA 02127
14894 Allied Automotive, 1094 Bendix Dr., Jackson TN 38301
16476 Datcon Instruments Co., PO Box 128, East Petersburg, PA 17520-0128
1CW22 Hella Inc., 210 Kelley Dr., Peach Tree, GA 30269
1DF85 Genuine Parts Co., DBA Napa Auto Parts, 1317 S 700 W, PO Box 26068, Salt Lake City, UT 84126
1FDW0 Force America, 501 East Cliff Rd. 100, Burnsville, MN 55337
1FQX3 Newark Electronics, 1611 West County Road B, Roseville, MN 55112
1HS72 Chicago Power Systems, Inc., 1533 Lathem St., Batavia, IL 60510
1W654 Terminal Supply Co., PO Box 1253, Troy, MI 48099
20984 Arrow Safety Device Company, Route 113, Georgetown, DE 19947-9524
24161 Gates Rubber Co., 999 South Broadway, Denver, CO 80217
24617 General Motors Corp., 3044 W Grand Blvd., Detroit, MI 48202-3091
26377 Ford Motor Company, General Parts Div., PO Box 412, Ypsilanti, MI 48197-0412
2Y580 Dominion Automotive Ind., 19308 70th Ave S., Kent, WA 98032
39569 Northern Power Products, PO Box 21348, Eagan, MN 55121-0348
3E157 Rockwell Standard Axle Co., 500 Commerce Rd, Richmond VA 23224-5414
3E525 Wilton Corp., RRI PO Box K, Winchester, TN 37398-9801
3U016 Diesel Service Co., PO Box E-1414, Minneapolis, MN 55480
41625 Incom Intl. Inc., Morse Controls Div., 21 Clinton St., Hudson OH 44236-2802
44185 NMC-WOLLARD, Inc., 2021 Truax Blvd., Eau Claire, WI 54703
49234 Protectoseal Co., 225 West Foster Avenue, Bensenville, IL 60106
52793 Saginaw Products Corp., 68 Williamson St., Saginaw MI 48601-3246

- 53867 Robert Bosch Corporation, 2800 South 25th Avenue, Broadview, IL
60153-4532
- 56118 Sparton Corp., 2400 W Ganson, Jackson, MI 49202-3772
- 56289 Sprague Electric Co., World Hqs., 678 Main St., Sanford ME 04073
- 57013 Preco Inc., 415 North Maple Grove, Boise, ID 83704
- 58051 Quadrastat Controls Corp., 3860 S Capital Avenue, City of Industry, CA
91748
- 58961 Waytek Inc., PO Box 690, Chanhassen, MN 55317
- 62465 Electronic Controls Co., 11080 Executive Dr., PO Box 7246, Boise, ID
83707
- 63477 Cooper Industries, Inc., Wagner Brake Div., 3700 Forrest Park Blvd., St.,
Louis, MO 63018
- 64386 Buckhorn Rubber Co., 5151 Industrial Dr., Hannibal, MO 63401-0998
- 65439 Advanced Technology Corp., 101 N. Eagle St., Geneva, OH 44041
- 68505 Prestolite Electric, Inc., 2100 Commonwealth Blvd. Suite 300, Ann Arbor,
MI 48105
- 69633 Meritor HVS LLC, ASP Div., 7975 Dixie Hwy, Florence, KY 41042
- 6H839 Zenith Spring Co., 3116 W Michigan St., Duluth MN 55806-1744
- 6K866 Keystone Cable Corp., 7600 Chrysler Dr., Detroit, MI 48211-1974
- 6N512 Inland Diesel Inc., PO Box 68-9633, Milwaukee WI 53268-9633
- 6Z742 Pokorny Sales, 20 Tierney Rd., Lake Hopatcong, NJ 07849
- 72447 Dana Corporation, Universal Joint Division, 6201 Trust Drive, Holland, OH
43528
- 73342 Allison Transmission Division, General Motors Corp., 4700 West 10th St.,
Indianapolis, IN 46222-3277
- 75175 Concord Instruments Corp., KD Lamp Company, 1910 Elm St., Cincinnati,
OH 45210-2451
- 75958 Borg-Warner Automotive Transmission & Engine Components Corp., 6700
18-1/2 Mile Rd., Sterling Heights, MI 48314-3206 (OBSOLETE)
- 77060 General Motors, Packard Electric Div., 408 Dana St. NE, P.O. Box 431,
Warren, OH 44486
- 77326 Pollak Joseph Corp., 195 Freeport St., Dorchester, MA 02122-2827
- 78505 Electronic Industries Inc., PO Box 266, 19 E Irving Ave., Oshkosh, WI
54902-0266
- 79470 Weatherhead Div., Dana Corp., 6615 Brotherhood Way, Ft. Wayne, IN
46825
- 7J132 Machine Service, Inc., 1000 Ashwaubenon St., PO Box 10265, Green
Bay, WI 54307-0265
- 7J925 Endries Fastners & Supply Inc., PO Box 69, Hwy 10W, Brillion, WI 54110
- 8S377 Fuel Systems, 12730 Robin Lane, Brookfield, WI 53005

- 92867 Orschlein Brake Lever Mfg. Co., 1177 North Morley, Moberly, MO 65270-2736
- 94222 Southco Inc., 210 N Brinton Lake Rd., Concordville, PA 19331
- 96151 (Char-Lynn) Eaton Corp., Fluid Power Operations, 15151 Hwy. 5 Eden Prairie, MI 55344

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44734-47	129	45034	45	45460	71
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44939R	41	45150	45	46542-12	95
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46602	33	47195-21	59	47226-12	31
46615	39	47195-22	59	47226-13	31
46994	87	47195-23	59	47226-14	31
46995	87	47195-24	59	47226-15	31
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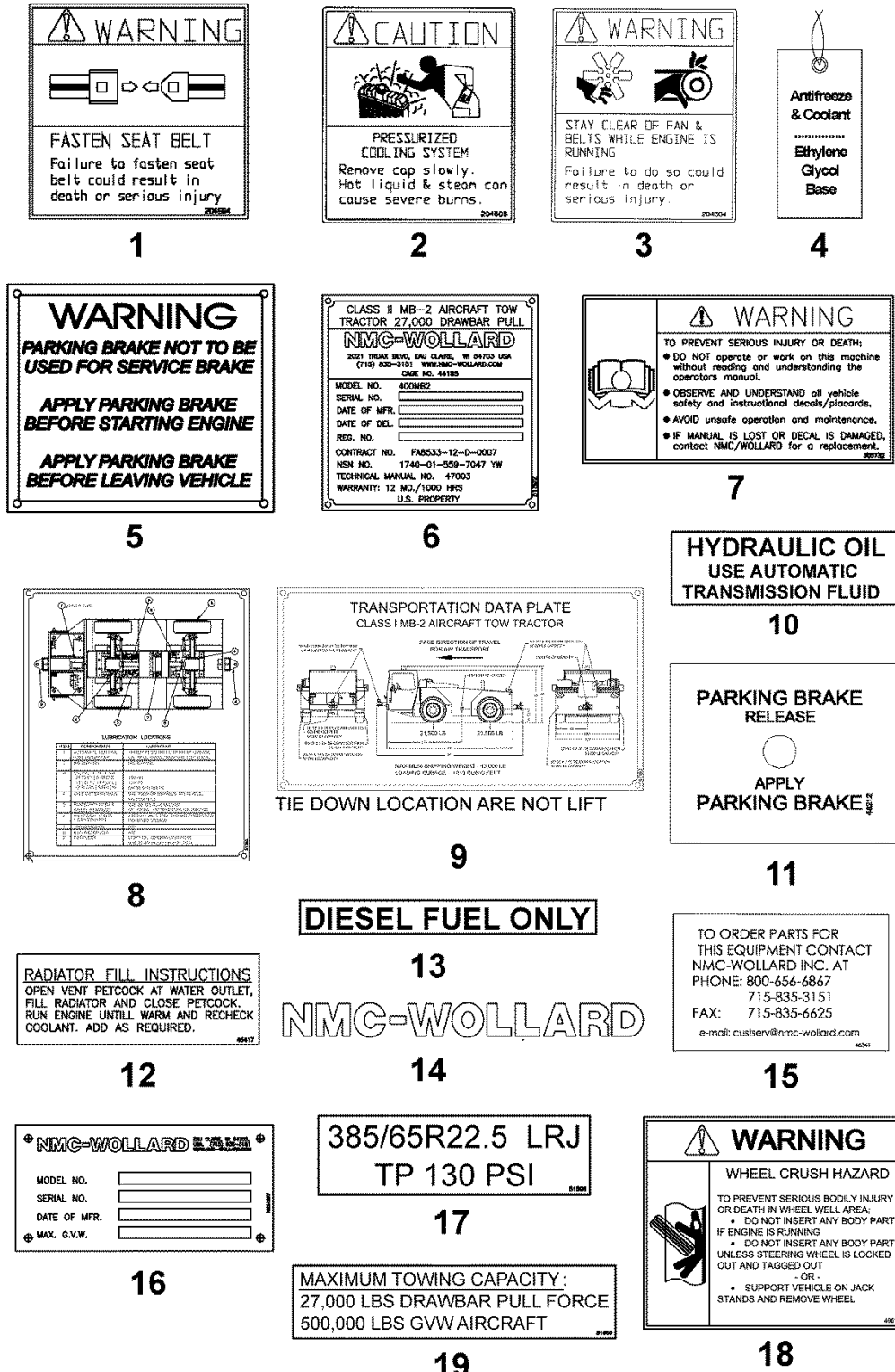
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NW032445	39	NW035388	45	NW036354	69
NW033103	95	NW035604	69	NW036355	69
NW033129	67	NW035606	97	NW036428	5
NW033318	35	NW035615	51	NW036491	43
NW033945	67	NW035616	51	NW036552	45
NW034176	45	NW035628	95	NW036560	43, 67
NW034428	5	NW035654	97	NW036670	5
NW035273	47	NW035682	29	NW036671	45
NW035374	45	NW035688	5	RF090896	65, 99
NW035376	45	NW035766	47	SW10H2688.....	3

4 ILLUSTRATED PARTS LIST



**FIGURE 1.
DECALS**

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
1-	47840	Cab Decal Assembly		REF
	48442	Grp, USAF Decals		1
	48441	Grp, USAF Decals		1
1	204594	Decal, Warning, Seatbelt		1
2	204606	Decal, Caution, Cooling System		1
3	204604	Decal, Warning, Fan/Belts		2
4	45277	Tag, Cooling System Content		1
5	NW017237	Plate, Warning		1
6	48443	Plate, Data, 400MB2 (48442)		1
	51592	Plate, Data, 400MB2 (48442)	B	1
	47851	Plate, Data, 400MB2 (48441)		1
	51591	Plate, Data, 400MB2 (48441)	B	1
7	305732	Decal, Warning, Read Manual		1
8	47853	Plate, Lube, 400MB2		1
	51593	Plate, Lube, 400MB2	B	1
9	47852	Plate, Transp Data 400MB2 Class I (48441)		1
	48229	Plate, Transp Data, 400MB2 Class II (48442)		1
10	SW10H2688	Decal, Hyd Oil		1
11	48212	Decal, Park Brake		1
12	45417	Decal, Rad Fill Instruct.		1
13	153768	Decal, Diesel, Fuel Only		1
14	48444	Grp, Decals N-W, 2 Lg Blk/2 Sml Blk		1
	42536	Decal, NMC-Wollard, Blk, 1.75 X 18		2
	306521	Decal, NMC-Wollard, Blk, 2.75 X 18		2
	48445	Grp, Decals N-W, 2 Lg Wht/2 Sml Wht		1
	42537	Decal, NMC-Wollard, Wht, 1.75 X 18		2
	306522	Decal, NMC-Wollard, Wht, 2.75 X 18		2
15	46341	Decal, Contact Info, Cus. Ser		1
16	NW024357	Plate, Serial No. NMC-W		1
17	51596	Decal, Tire Specs/Press, 400MB2	B	4
18	49519	Decal, Warning, Wheel Pinch, MB4	B	4
19	51600	Decal, Tow Capacity, 400MB2	B	2

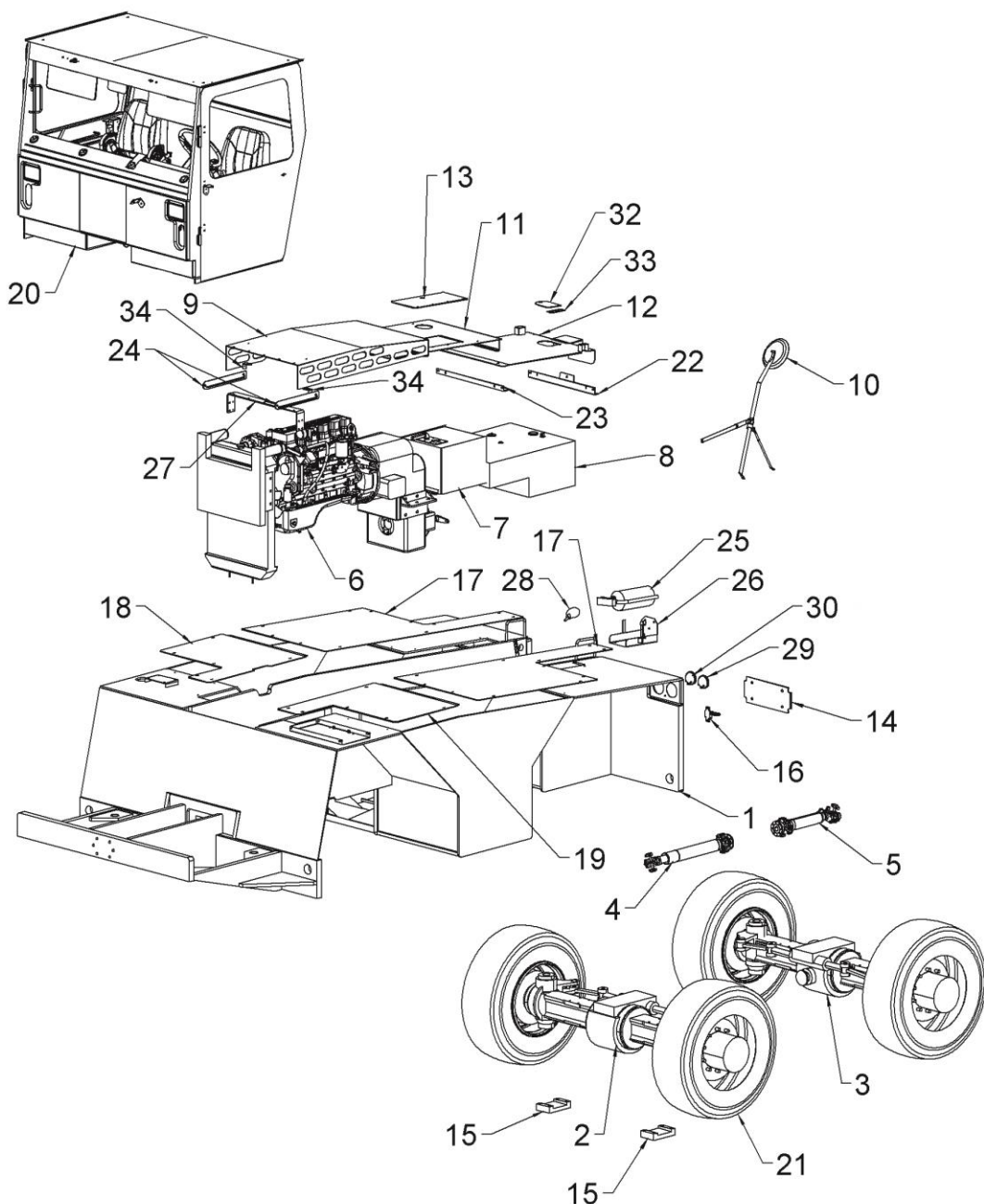


FIGURE 2.
CHASSIS ASSEMBLY
AXLES AND SENSOR
MIRROR
HITCH
FIRE EXTINGUISHER

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
2-	47002	Chassis Assy, Hyd Brakes		1
	47838	Chassis Electrical Assy, 400MB2		1
1	47413	Chassis Wld, 400MB2, 18K DBP Base(47185)		1
	47786	Chassis Wld, 400MB2, 25K DBP Base(47186)		1
2	47324	Axle, Drive/Steer, NAF, Front (See Figure 4)		1
3	47325	Axle, Drive/Steer, NAF, Rear (See Figure 4)		1
4	47781	Driveshaft, NAF/Funk, Frnt (See Figure 11)		1
5	47782	Driveshaft, NAF/Funk, Rear (See Figure 11)		1
6	47017	Eng/Ttrans Assy, 400MB2,Cumns/Funk (See Figure 32)		1
7	47812	Chassis Hydraulic Assy, 400MB2		1
	47209	Tank Assy, Hydraulic, 400MB2		1
8	47815	Fuel System, 400MB2		1
9	47962	Engine Cover Assy, 400MB2		1
	48174	Hinge, Cover, Eng		1
10	F101920	Kit, Mirror, Head & Brkt, 6" Convex		1
	40181	Mirror, Head, 8.5 Dia		1
	40216	Brkt, Mirror, Tripod		1
	F100378	Bolt, 5/16-18 x 1		3
	F014476	Nut, Nylock, 5/16-18		3
	F017264	HHCS, 1/4-20 x 1		2
	F013588	Nut, Nylock 1/4-20		2
11	47967	Wldmnt, Cover, Trans, 400MB2		1
12	48543	Wldmnt, Cover, Tank, Fuel, 400MB2		1
13	48213	Cover, Access Hyd/Trans, 400MB2		1
	48175	Hinge, Cover, Trans		1
14	45174	Holder, License Plate, 68148		1
	F001800	RHMS, 5/16-18 x 1		2
	F014476	Nut, 5/16-18, Nylock		2
	48794	Hardware Kit, License		1
15	47420	Plate, Bottom, Axle, Frnt, NAF		2
16	47470	Step, Folding, 400MB2		1
17	47458	Cover, Bin, Rear, 400MB2		2
18	47453	Wld, Cover, Bin, Frnt, Right, M4		1
19	47428	Wld, Cover, Bin, Frnt, Left, M40		1
20	47188	Cab Assembly (See Figure 15)		1
21	47193	Wheels & Tires, Desert Sand (See Figure 12)		1
	47192	Wheels & Tires, Green (See Figure 12)		1
22	47958	Bar, Fuel Tank Strap Mnt		1
23	47968	Angle, Latch, Cover, Trans, 400MB2		1
24	47974	Arm, Link, Cover, Eng, 400MB2		2
25	NW034428	Fire Extinguisher, 20 Lb. ABC		1
26	NW036428	Brkt, Fire Ext Mounting		1
27	47959	Mount, Engine Cover		1
28	2.3607	Light, White, Single Face, 4"		2
29	NW035844	Light, Stop/Tail, Red, Sealed		2
	45817	Light, Stop/Tail, Red, LED, Sealed	B	2
30	NW035842	Light, Back-Up, Clear, Sealed, 12V		2
	51227	Light, Back-Up, 4" Round LED	B	
31	NW035843	Grommet, Light, Tail & Back-Up		4
	51604	Grommet, Light, Oval 6"	B	2
32	NW036670	Plate, Access, Door, Fuel		1
33	NW035688	Hinge, Access Door		1
34	203227	Angle, Mnt, Rod, Hood		2
NS	NW024637	Alarm, Back-up		1

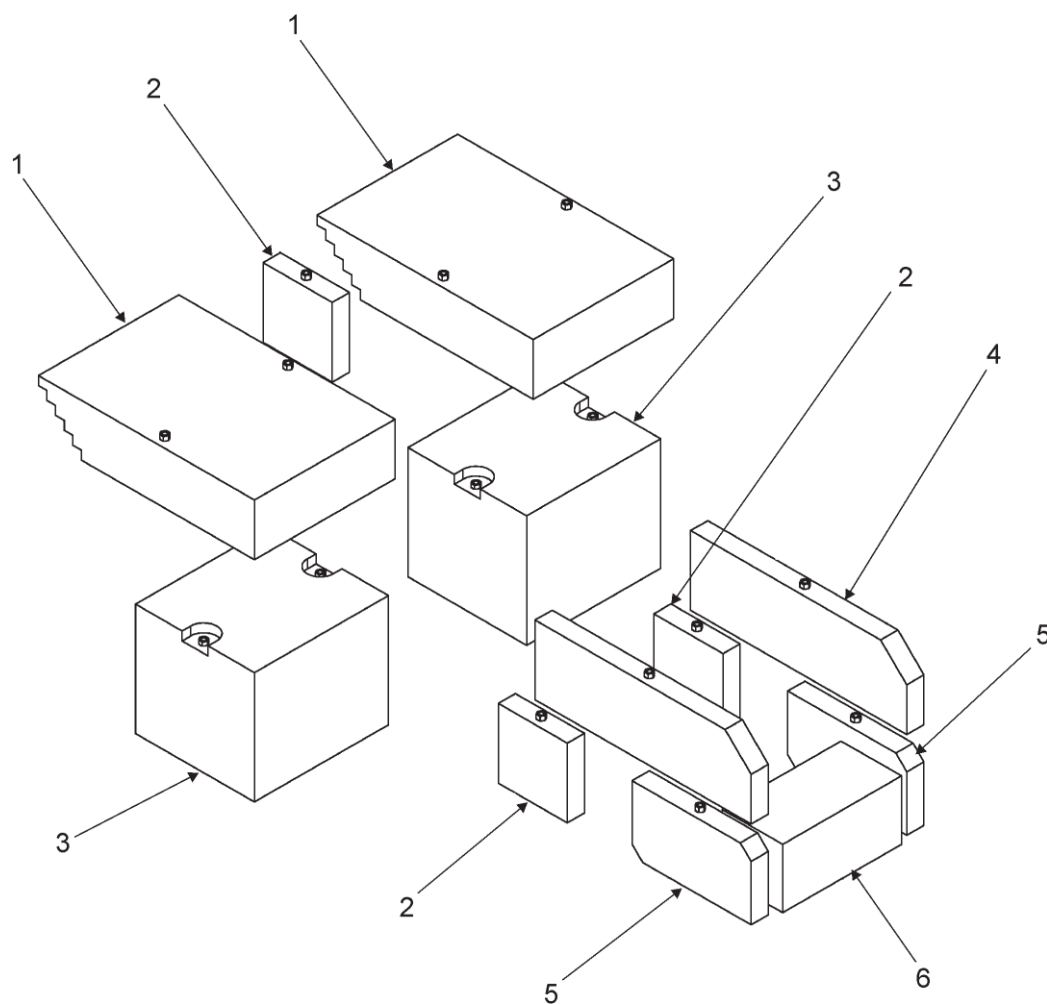
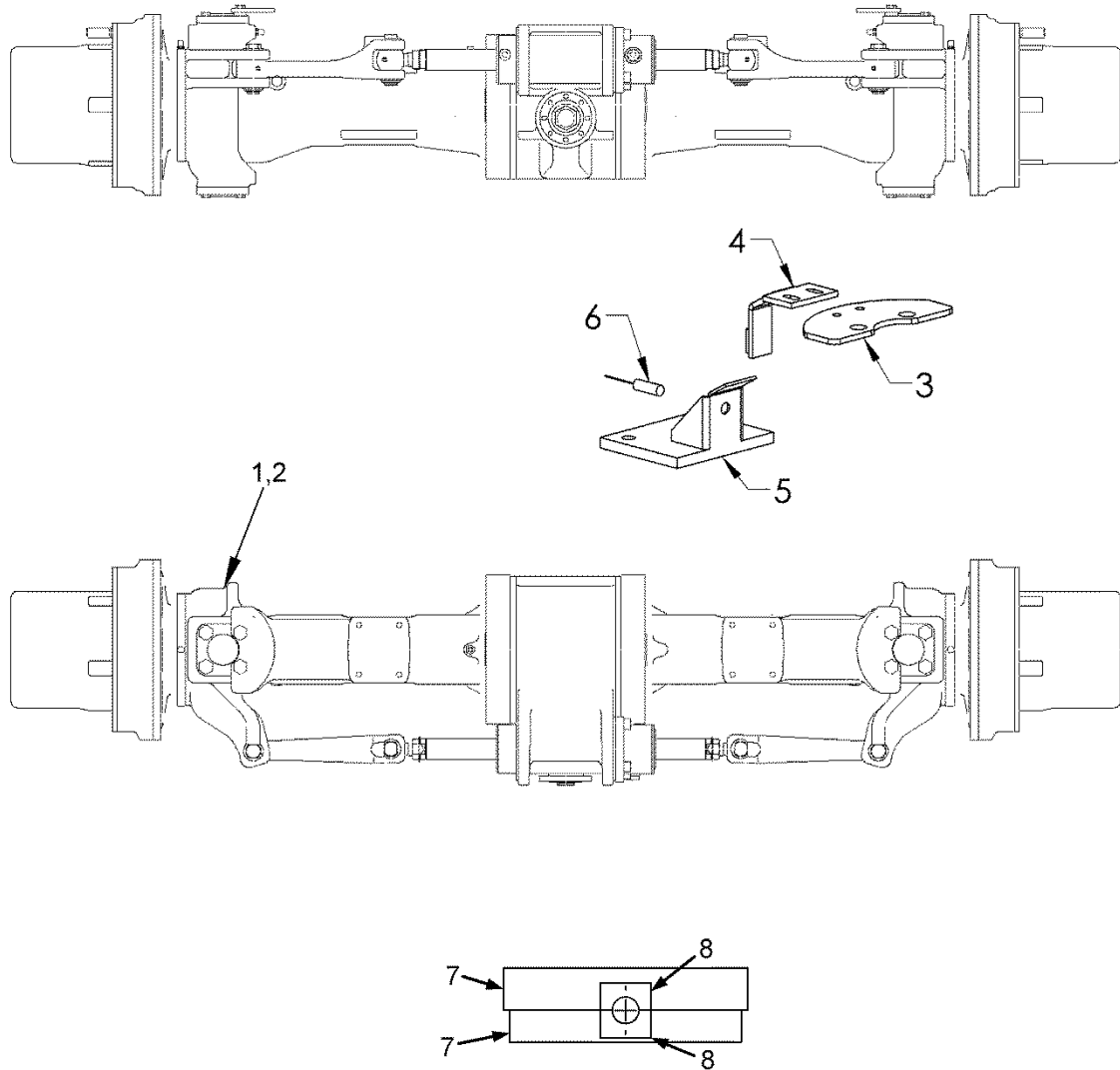


FIGURE 3.
COUNTERWEIGHT KIT, MB2, #29000
WEIGHT, CONCRETE COUNTER (NOT SHOWN)

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
3-	48935	Counterweight Kit, MB2, #29000		1
	47186	Grp, 53K, GVW		1
	51219	Grp, 40K GVW, M400, Steel & Slag		1
	47786	Chassis Wld, 400MB2, 25K DBP Base (See Figure 2)		1
1	48937	CWT, 12.0 X 32.5 X 50.0		2
2	48936	CWT, 4.0 X 16.0 X 16.0		3
3	48933	CWT, 26.0 X 27.5 X 31.0,		2
4	48831	CWT, 4.0 X 16.0 X 50.0		2
5	48832	CWT, 4.0 X 15.25 X 27.5		2
6	48934	CWT. 13.75 X 14.0 X 27.5 (Part Of Frame Weldment)		REF
NS	51221	CWT, 6.0 x 27.5 x 31.0, STL, #1445		2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
3-	47185	Grp, 40K, GVW (Not Shown)		REF
	47413	Chassis Wld, 400MB2, 18K DBP Base (See Figure 2)		1
	47787	Concrete, Hematite, 7000#/Cu. Yd.		2.5
	436300	Foam, .25 x 48" x 50' Fanfold		AR
	50481	Grp, 25K GVW (Not Shown)		REF
	47413	Chassis Wld, 400MB2, 18K DBP Base (See Figure 2)		1
	47787	Concrete, Hematite, 7000#/Cu. Yd.		1.5
	436300	Foam, .25 x 48" x 50' Fanfold		AR



M400-Axles.cdr

FIGURE 4.
AXLES

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
4-		Axle Assembly		Ref
1	47324	Axle, Front, Drive, Steer, 5503.141		1
2	47325	Axle, Rear, Drive, Steer, 5503.142		1
	47448	Pin, Rear Axle, NAF, 400MB2		1
3	48074	Plate, Modified, King Pin, 400MB2		2
4	48072	Wldmt, Arm, Swing, Sensor, 400MB2		2
5	48069	Wldmt, Sensor, Axle, Rear, 400MB2		1
6	47817	Sensor Assy		2
	303228	Switch, Prox, SPNO		1
	206108	Conn, El, Deutsch, Recp		1
	206109	Conn, El, Deutsch, Wedge		1
	45025	Conn, El, Deutsch, Pin		3
7	47626	Rear NAF Axle Mnt, M400		2
8	48350	Assy, Spacer, Trunnion, M400		1
NS	48595	Spacer, Trunion, 1/16		2

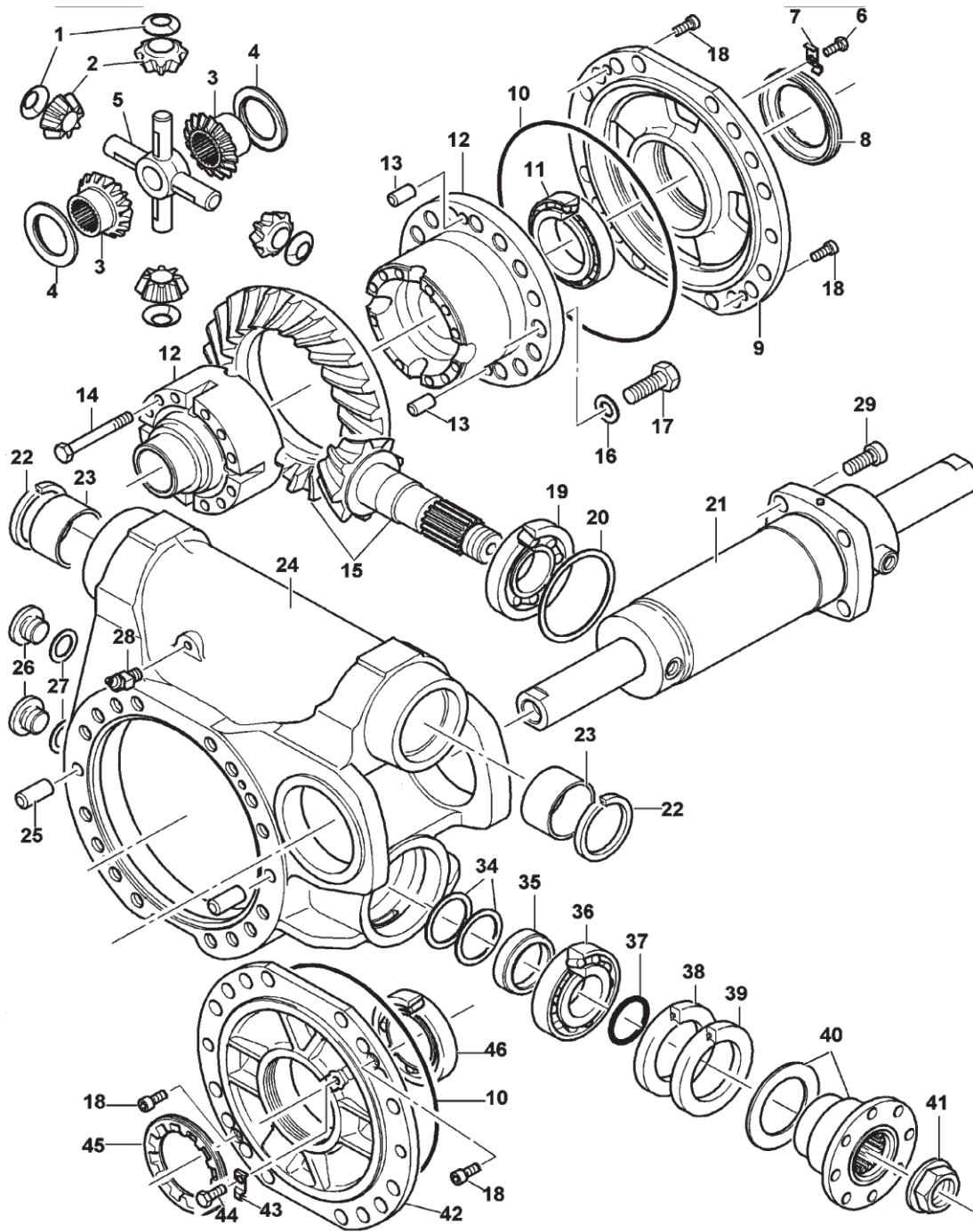


FIGURE 5.
AXLES, DIFFERENTIAL
1 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
5-	47324-10	Differential Complete, 2401.318 (Front)		1
	47325-10	Differential Complete, 2401.317 (Rear)		1
	47324-215	Differential Housing, 2219.038		1
1	47324-203	Thrust Washer, 7518.021		4
2	47324-196	Planetary Gear, 7514.029		4
3	47324-195	Differential Gear, 7513.044		2
4	47324-198	Adjusting Kit, 7517.015		2
	47324-199	Check Disk, 7517.021		AR
	47324-200	Check Disk, 7517.022		AR
	47324-201	Check Disk, 7517.023		AR
	47324-202	Check Disk, 7517.024		AR
5	47324-197	Cross Bolt, 7515.021		1
6	47324-10	Hexagon Screw M8x16, 1010.129		1
7	47324-214	Locking Plate, 9566.010		1
8	47324-188	Groove Nut M115x1.5, 7329.115		1
9	47324-183	Flange, 7527.183		1
10	47324-44	O-ring, 1170.716		2
11	47324-29	Tapered-Roller Bearing, 1110.032		1
12	47324-94	Differential Cage, 2102.175		1
13	47324-56	Straight Pin 12m6x32, 1200.229		2
14	47324-11	Hexagon Screw M12x100, 1010.323		12
15	47324-93	Crown Wheel / Pinion, 2101.242		1
16	47324-140	Washer 16.1x30x4, 7316.045		16
17	47324-14	Hexagon Screw M16x40, 1010.501		16
18	47324-19	Allen Screw M10x16, 1020.203		4
19	47324-30	Tapered-Roller Bearing, 1110.073		1
20	47324-151	Adjusting Kit, 7317.011		1
	47324-156	Adjusting Washer, 7317.105		AR
	47324-155	Adjusting Washer, 7317.104		AR
	47324-154	Adjusting Washer, 7317.103		AR
21	47324-104	Steering Cylinder, 5220.016		1
22	47325-11	Scraper Ring (Rear Only)		2
23	47325-12	Bushing (Rear Only)		2
24	47324-194	Differential Housing, 7506.265		1
25	47324-57	Straight Pin 16m6x60, 1200.231		4
26	47324-21	Screw Plug M30x1.5, 1040.103		2
27	47324-50	Seal Ring, 1180.507		2
28	47325-13	Tapered Lube Nipple (Rear Only)		1
29	47324-20	Allen Screw M16x45, 1020.521		4

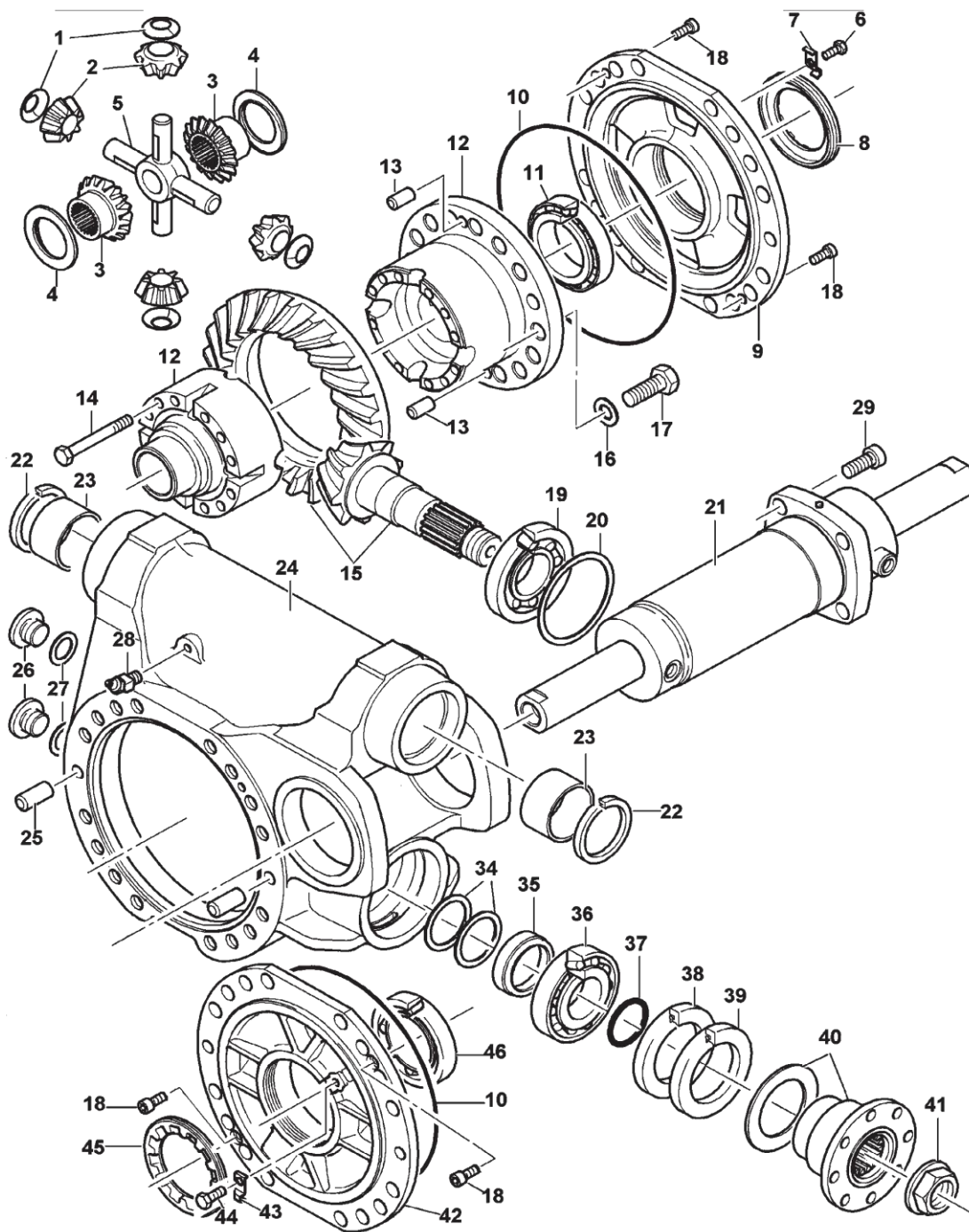


FIGURE 5.
AXLES, DIFFERENTIAL
2 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
5-	47324-10	Differential Complete, 2401.318 (Front)		1
	47325-10	Differential Complete, 2401.317 (Rear)		1
	47324-215	Differential Housing, 2219.038		1
34	47324-153	Adjusting Kit, 7317.037		1
	47324-179	Adjusting Washer, 7317.185		AR
	47324-178	Adjusting Washer, 7317.184		AR
	47324-177	Adjusting Washer, 7317.183		AR
	47324-176	Adjusting Washer, 7317.182		AR
	47324-175	Adjusting Washer, 7317.181		AR
	47324-174	Adjusting Washer, 7317.180		AR
	47324-173	Adjusting Washer, 7317.179		AR
	47324-172	Adjusting Washer, 7317.178		AR
	47324-171	Adjusting Washer, 7317.177		AR
	47324-170	Adjusting Washer, 7317.176		AR
	47324-169	Adjusting Washer, 7317.175		AR
	47324-168	Adjusting Washer, 7317.174		AR
47324-167	Adjusting Washer, 7317.173		AR	
35	47324-126	Spacer Bushing 70x11x25.9, 7311.061		1
36	47324-28	Tapered-Roller Bearing, 1110.030		1
37	47324-41	O-ring 42x4.5, 1170.013		1
38	47324-34	Seal Ring 80x115x10, 1160.208		1
39	47324-39	Seal Ring 80x115x10, 1160.261		1
40	47324-95	Drive Shaft Flange, 2107.098		1
41	47324-186	Nut M40x1.5, 7329.057		1
42	47324-216	Flange, 7527.103		1
43	47324-214	Locking Plate, 9566.010		1
44	47324-10	Hexagon Screw M8x16, 1010.129		1
45	47324-188	Groove Nut M115x1.5, 7329.115		1
46	47324-31	Tapered-Roller Bearing, 1110.087		1
NS	47324-191	Type Plate, 7340.018		1
NS	47324-55	Pin 3.0x5,1200.110		2

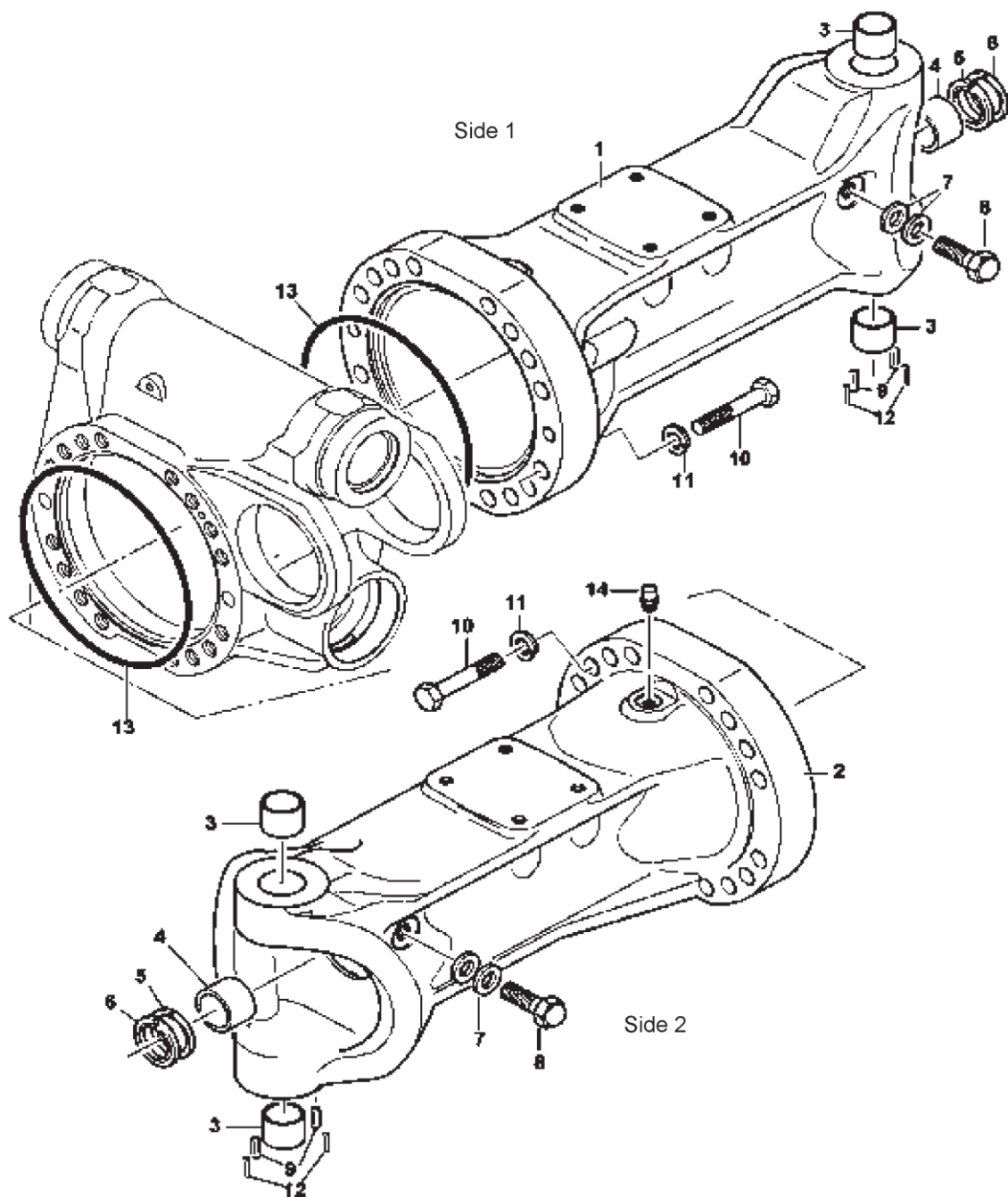


FIGURE 6.
AXLE, HOUSING

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
6-		Axle Housing Complete		1
1	47325-14	Axle Housing, 7273.091 (Rear)		1
	47324-119	Axle Housing, 7273.127(Front)		1
	47324-120	Axle Housing, 7273.128 (Front)		1
	47325-15	Axle Housing, 7273.092 (Rear)		1
3	47324-111	Bush, 7112.026		2
4	47324-112	Bush, 7112.035		1
5	47324-35	Oil Seal, 1160.211		1
6	47324-36	Oil Seal, 1160.218		1
7	47324-97	Adjusting Set, 2108.038		1
	47324-62	High Tensile Washer, 1210.022		NS
	47324-68	Seeger Adjusting Washer, 1210.407		NS
	47324-67	Seeger Adjusting Washer, 1210.406		NS
8	47324-204	Hexagon Screw, 7522.016		1
9	47324-60	Heavy Type Dowel Pin, 1200.485		2
10	47324-16	Hexagon Screw, 1010.665		16
11	47324-54	Locking Clip, 1190.020		16
12	47324-61	Heavy Type Dowel Pin, 1200.486		2
13	47324-45	O-ring, 1170.717		1
14	47324-73	Breather, 1250.002 (used on Axle housing, 7273.128 & 7273.092)		1

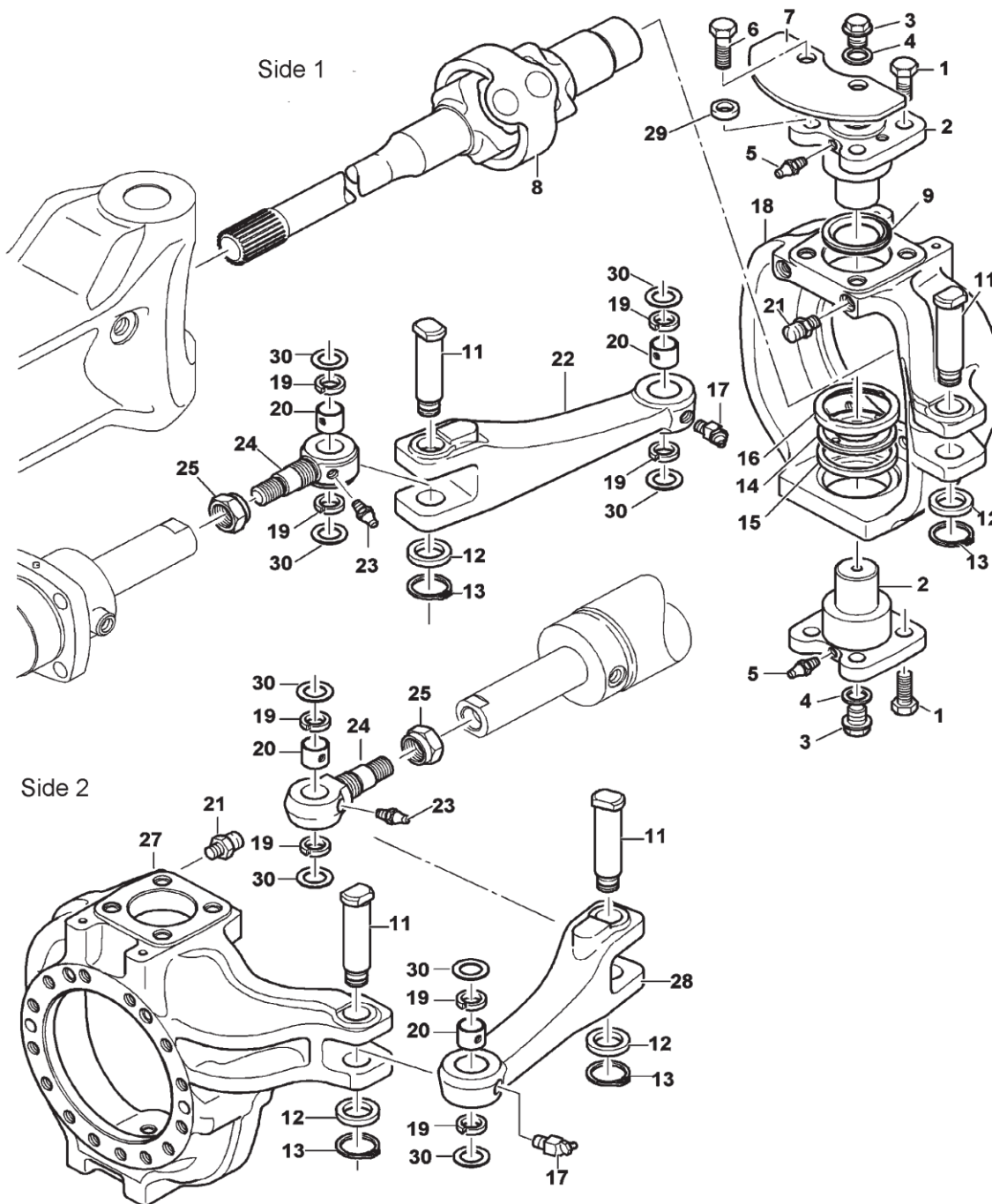


FIGURE 7.
AXLE, KNUCKLE

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
7-		Axle Knuckle		1
1	47324-15	Hexagon Screw, M18x2x50, 1010.660		6
2	47324-113	Steering Knuckle Stud, 7115.059		2
3	47324-24	Screw Plug, AM22x1.5, 1040.132		2
4	47324-51	Seal Ring, A22x27x1.5, 1180.527		2
5	47324-75	Taper Grease Nipple, AM 8x1, 1250.104		2
6	47324-17	Hexagon Screw, M18x2x70, 1010.666		2
7	47324-117	Guard Plate, Fl.8x100x200, 7148.047		1
8	47324-118	Double Jointed Shaft, 7210.038		1
9	47324-99	Adjusting Kit, 2108.063		1
	47324-143	Adjusting Washer, 7316.147		AR
	47324-145	Adjusting Washer, 7316.148		AR
	47324-146	Adjusting Washer, 7316.149		AR
	47324-147	Adjusting Washer, 7316.150		AR
	47324-148	Adjusting Washer, 7316.151		AR
	47324-149	Adjusting Washer,7316.152		AR
11	47324-180	High Tensile Washer, 7320.024		2
12	47324-63	Seeger Circlip Ring, 1210.026		2
13	47324-69	Washer, 1220.028		2
14	47324-142	Washer, 7316.146		1
15	47324-135	Washer, 7315.165		1
16	47324-185	Protective Cap, 7326.010		1
17	47324-74	Taper Grease Nipple, BM 8x1, 1250.101		1
18	47324-101	Axle Knuckle, 2421.070		1
19	47324-33	Seal Ring, G30x37x4, 1160.065		4
20	47324-130	Bush, 7312.068		2
21	47324-76	Breather Valve, M14x1.5, 1250.598		1
22	47324-115	Connecting Rod, 7123.070		1
23	47324-75	Tapered Lube Nipple, AM 8x1, 5.8, 1250.104		1
24	47324-183	Eye Bolt, 7322.155		1
25	47324-189	Hexagon Nut, M33x1.5, 7329.125		1
27	47324-100	Axle Knuckle, 2421.069		1
28	47324-114	Connecting Rod, 7123.069		1
29	47324-139	Washer, D30x4, 7316.044		2
30	47324-98	Adjusting Set, 2108.048		1
	47324-136	Adjusting Washer, 50x30x1, 7315.167		AR
	47324-137	Adjusting Washer, 50x30x2, 7315.238		AR

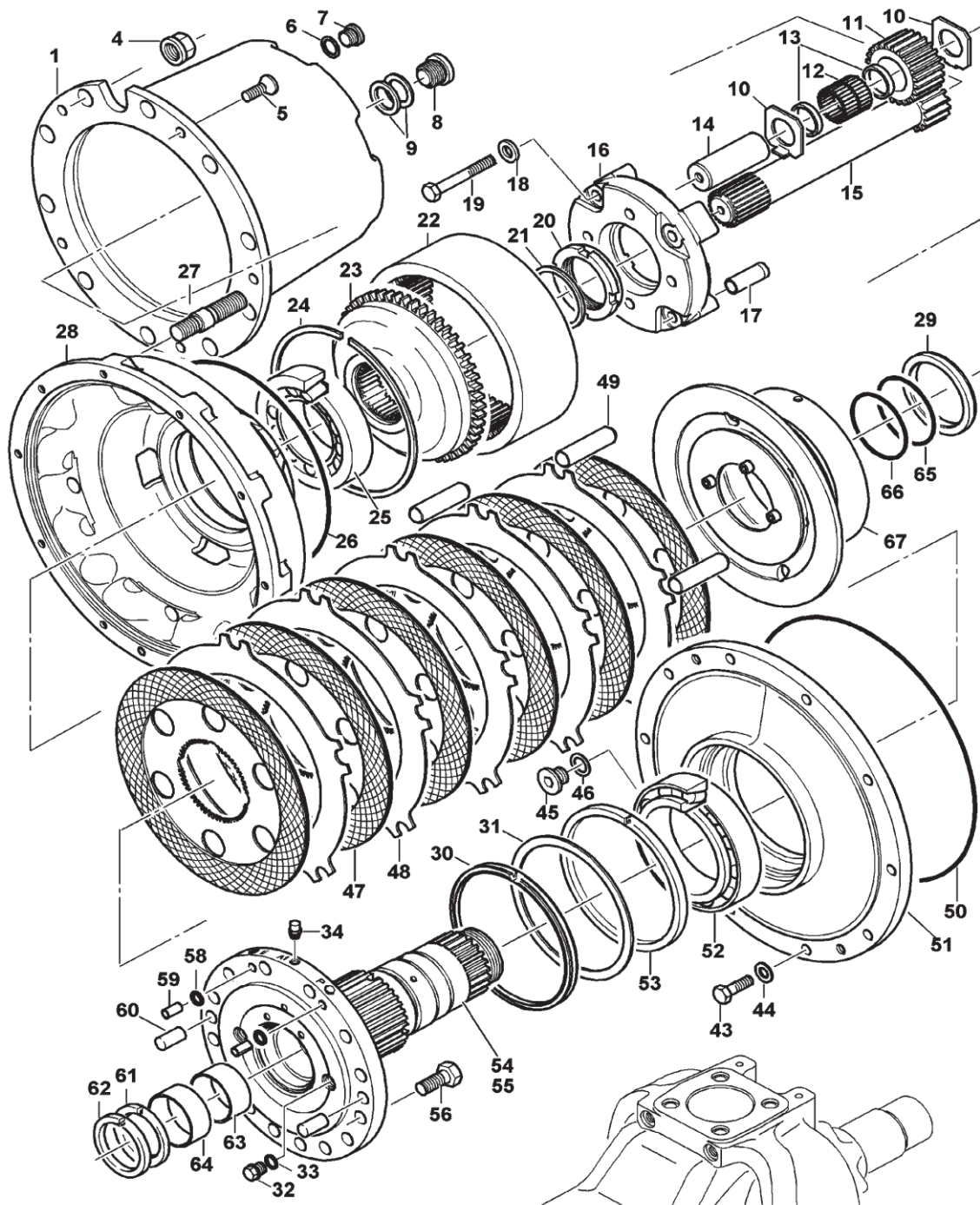


FIGURE 8.
AXLE, OUTER COMPONENT
1 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
8-		Outer Component Compl.		1
1	47324-211	Planetary Cage, 7821.243		1
4	47324-26	Wheel Nut with Rotating Washer, Kit (inc 10)		1
5	47324-25	Hexagon Screw , M12x25, 1040.201		5
6	47324-22	Screw Plug, M20x1.5, 1040.104		2
7	47324-48	Seal Ring, A20x24x1.5, 1180.502		2
8	47324-184	Screw Plug, M30x1.5, 7323.016		1
9	47324-96	Adjusting Set, 2108.017		1
	47324-64	Adjusting Washer, 30x42x2, 1210.113		AR
	47324-65	Adjusting Washer, 30x42x1, 1210.295		AR
	47324-66	Adjusting Washer, 1210.296		AR
10	47324-138	Check Disk, 7316.010		8
11	47324-207	Planetary Gear, 7806.085		4
12	47324-121	Needle Roller Cages, 35x45x40, 7305.043		4
13	47324-123	Intermediate Ring, 7307.134		8
14	47324-208	Planetary Stud, D35x94.5, 7807.061		4
15	47324-209	Sun Gear Shaft, 7818.123		1
16	47324-210	Planetary Cage, 7821.242		1
17	47324-132	Shear Bushing, 7313.020		4
18	47324-141	Washer, 12.1x24x3, 7316.047		4
19	47324-13	Hexagon Screw, M12x90, 1010.370		4
20	47324-187	Nut, M70x1.5, 7329.085		1
21	47324-152	Adjusting Set, 7317.028		1
	47324-166	Adjusting Washer, 7317.140		AR
	47324-165	Adjusting Washer, 7317.139		AR
	47324-164	Adjusting Washer, 7317.138		AR
	47324-163	Adjusting Washer, 7317.137		AR
	47324-162	Adjusting Washer, 7317.136		AR
	47324-161	Adjusting Washer, 7317.135		AR
	47324-160	Adjusting Washer, 7317.134		AR
	47324-159	Adjusting Washer, 7317.133		AR
	47324-158	Adjusting Washer, 7317.132		AR
47324-157	Adjusting Washer, 7317.131		AR	
22	47324-110	Gear Rim, 6801.028		1
23	47324-206	Ring Gear Carrier, 7804.052		1
24	47324-70	Spring Ring, SB 225x3, 1220.906		1
25	47324-27	Tapered-Roller Bearing, 1110.020		1
26	47324-47	O-ring, 260x5, 1170.754		1
27	47324-116	Wheel Bolt, M22x1.5, 7133.064		10
28	47324-212	Wheel Hub, 7828.110		1
29	47324-134	Washer, Ro108x12.5, 7315.135		1

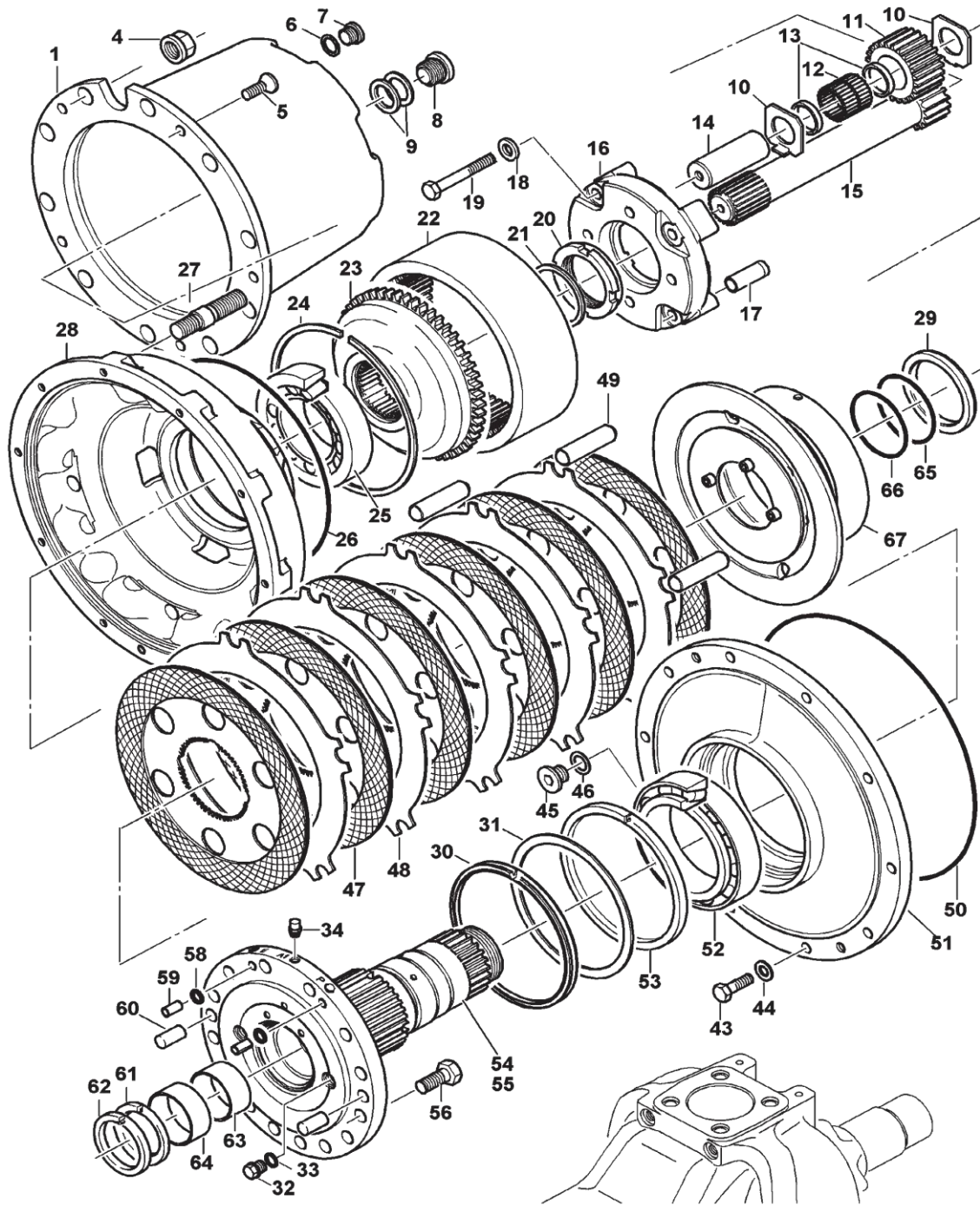


FIGURE 8.
AXLE, OUTER COMPONENT
2 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
8-		Outer Component Compl.		1
30	47324-125	V-ring, 170x190x10, 7308.073		1
31	47324-150	Thrust Washer, 7316.161		1
32	47324-23	Screw Plug, M14x1,5, 1040.110		2
33	47324-49	Seal Ring, 1180.503		2
34	47324-72	Breather, 1250.001		1
43	47324-12	Hexagon Screw, M12x40, 1010.328		10
44	47324-141	Washer, 12.1x24x3, 7316.047		10
45	47324-22	Screw Plug, M20x1.5, 1040.104		1
46	47324-48	Seal Ring, A20x24x1.5, 1180.502		1
47	47324-193	Inner Disk, 7345.061		6
48	47324-192	Steel Disk, 7344.034		5
49	47324-181	Stud, 7321.059		5
50	47324-46	O-ring, OR 350x4, 1170.728		1
51	47324-213	Wheel Hub, 7828.126		1
52	47324-32	Tapered-roller Bearing, 1110.220		1
53	47324-124	Oil Seal, 7308.072		1
54	47324-102	Stub Axle Compl., 2421.092		1
55	47324-103	Stub Axle Compl, 2421.093		1
56	47324-182	Hexagon Screw, M16x40, 7322.069		14
58	47324-40	O-ring, OR 12x3, 1170.006		2
59	47324-131	Bush, 7312.079		2
60	47324-58	Straight Pin, 16m6x36, 1200.234		2
61	47324-37	Oil Seal, 65x80x8, 1160.221		1
62	47324-38	Oil Seal, 65x80x8, 1160.222		1
63	47324-128	Bush, D65xD60x30, 7312.012		1
64	47324-129	Bush, D70xD65x28, 7312.028		1
65	47324-42	O-ring, OR 88x4, 1170.290		1
66	47324-43	O-ring, OR 85x4, 1170.295		1
67	47324-109	Ring Piston Brake Cylinder, 5360.050		1

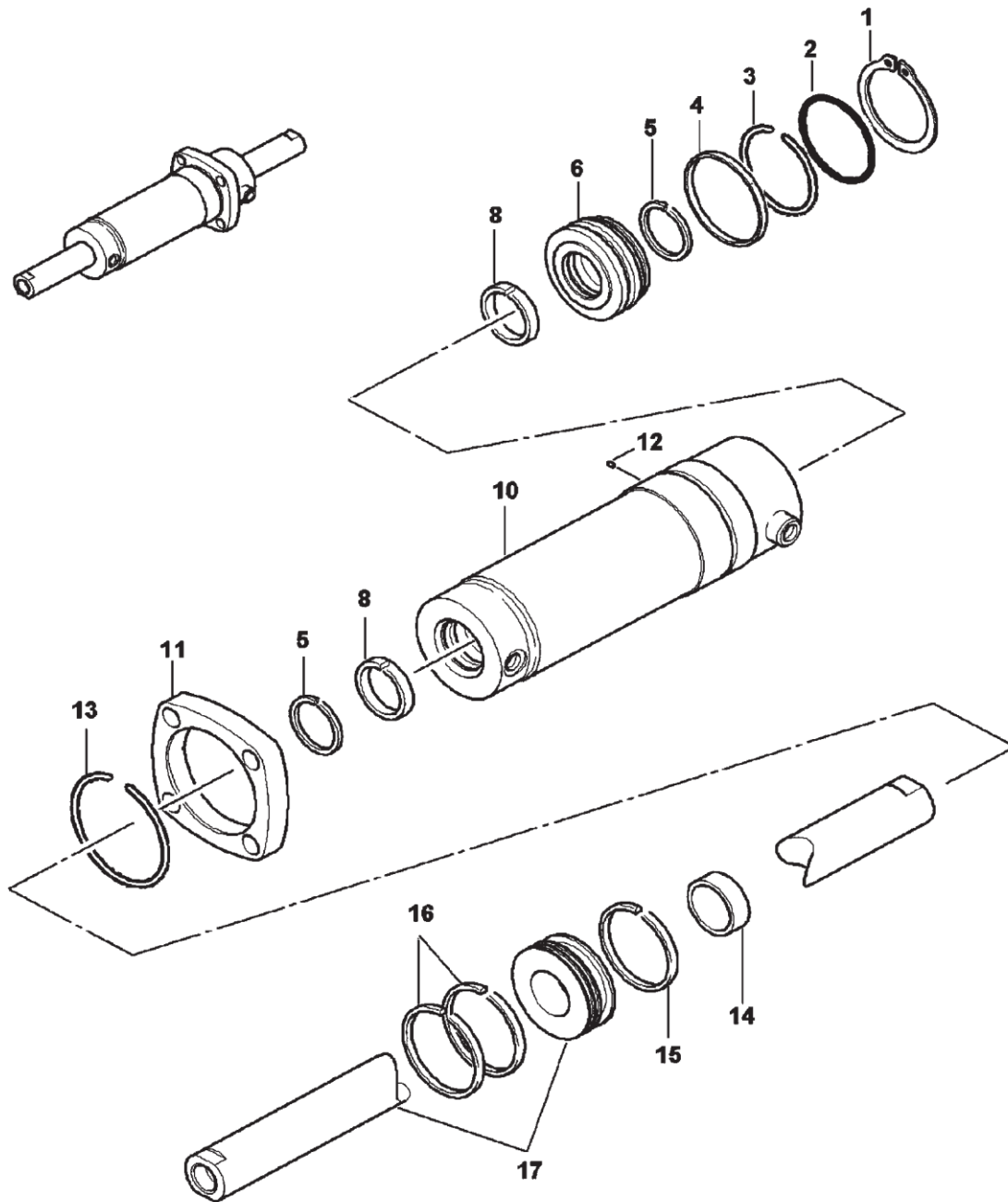


FIGURE 9.
AXLE, STEERING CYLINDER

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
9-	47324-104	Steering Cylinder, 5220.016		1
	47324-88	Seal Kit, 1360.047		1
1	47324-77	Seeger Circlip Ring, 1360.021		1
2	47324-92	Pre Seal Ring, 1360.054		1
3	47324-78	Round Wire Snap Ring, 1360.022		1
4	47324-81	Ring, 1360.028		1
5	47324-79	Scraper Ring, 1360.025		2
6	47324-89	Cylinder Socket, 1360.048		1
8	47324-80	Shaft Packing, 1360.027		2
10	47324-90	Tube, 1360.049		1
11	47324-84	Flange, 1360.032		1
12	47324-91	Clamping Spring Pin, 1360.050		1
13	47324-85	Round Wire Snap Ring, 1360.034		1
14	47324-86	Spacer Tube, 1360.038		1
15	47324-83	Piston Packing, 1360.030		1
16	47324-82	Guide Ring, 1360.029		2
17	47324-87	Piston Rod, 1360.039		1

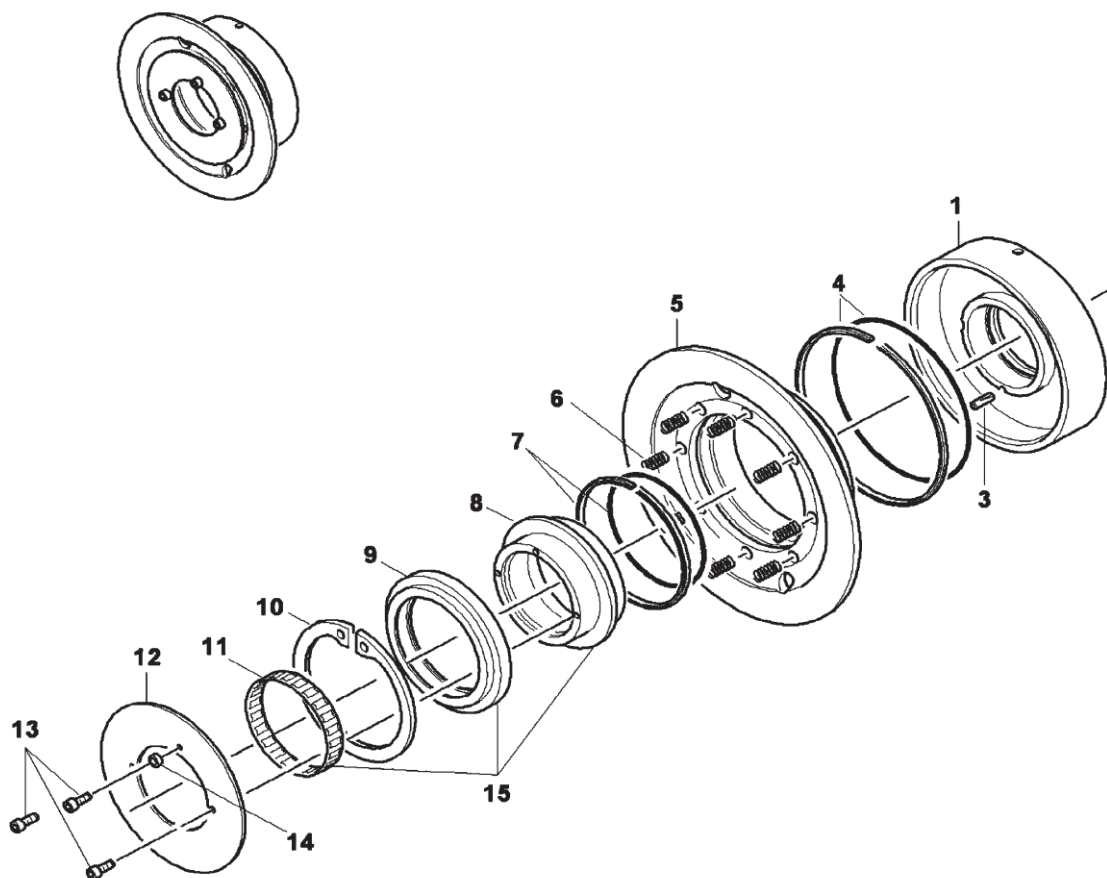


FIGURE 10.
AXLE, RING PISTON BRAKE CYLINDER

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
10-	47324-109	Ring Piston Brake Cylinder Complete, 5360.050		1
1	47324-106	Cylinder, 5263.057		1
3	47324-59	Grooved Dowel Pin, 1200.327		1
4	47324-52	Piston Seal, 1180.934		1
5	47324-105	Piston, 5252.192		1
6	47324-190	Compression Spring, 7331.048		8
7	47324-53	Piston Seal, 1180.935		1
8	47324-107	Cylinder, 5263.157		1
9	47324-122	Ring, 7307.066		1
10	47324-71	Seeger Snap Ring, 1220.929		1
11	47324-92	Tolerance Ring, 1750.725		1
12	47324-133	Washer, 7315.134		1
13	47324-18	Allen Screw, 1020.033		3
14	47324-127	Spacer Bushing, 7311.121		1
15	47324-108	Cylinder Compl., 5263.158		1

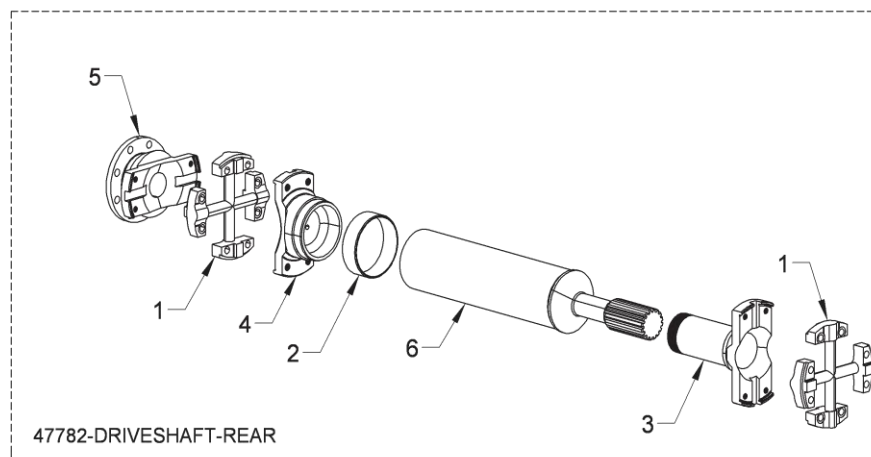
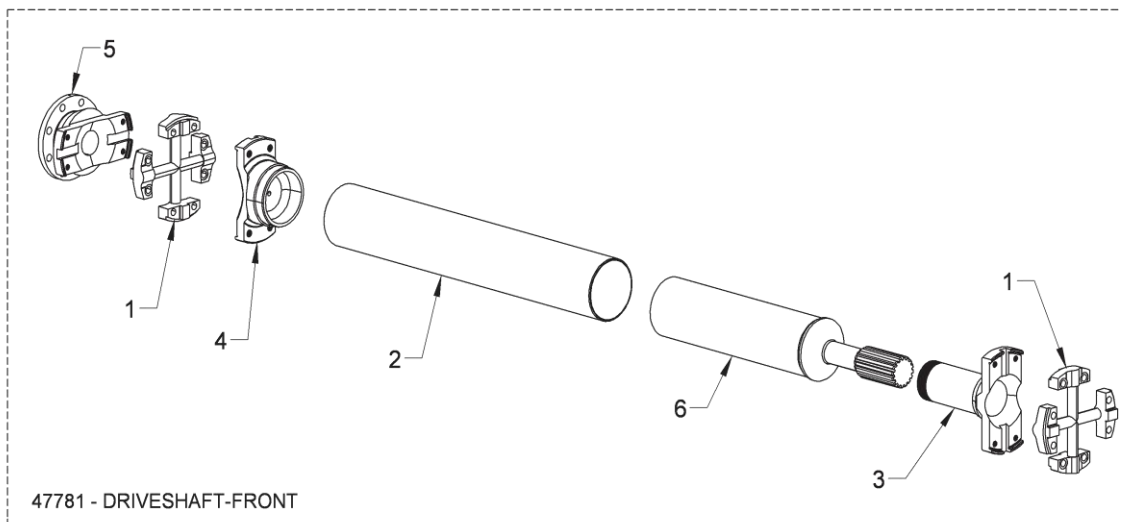
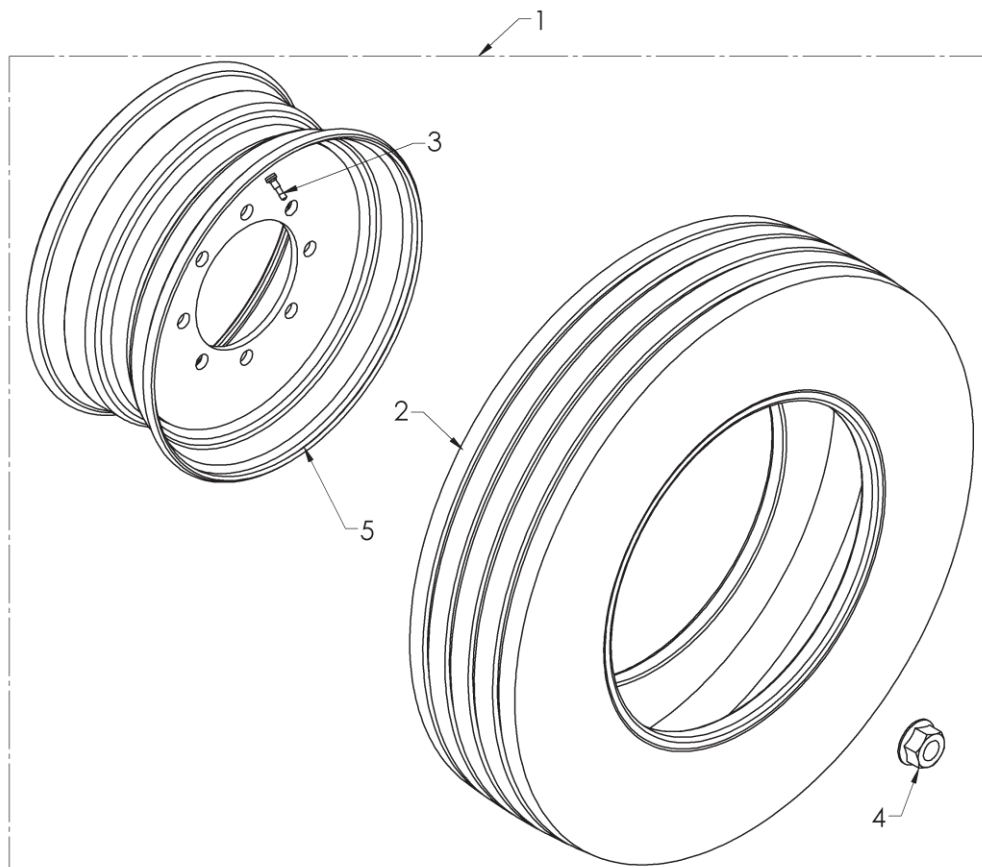


FIGURE 11.
DRIVESHAFT ASSEMBLIES

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
11-	47781	Driveshaft, NAF/Funk, Front, 126890		1
	47782	Driveshaft, NAF/Funk, Rear		1
1	47781-10	Bearing, 6C Hwd, 5-6106		2
2	47781-11	Tube-3.50" D.O.M. Steel Tubing (Used on 47781), 3.50-.095X21.615		1
	47782-11	Tube-3.50" D.O.M. Steel Tubing (Used on 47782), 3.50-.095x1.105		1
3	47781-12	Slip Yoke Wing, 6C Series, 1.75-16 Spline, 6.12F2E, 3-67776		1
4	47781-13	Weld Yoke Wing, 6C Series, 3.32 Hub, 1.880 F2W, 6C-22274J		1
5	47781-14	Weld Yoke Wing, 126889		1
	47782-14	Weld Yoke Wing, 6C Series, 2.82 Hub, 1.88 F TO E, 9668J		1
	47781-15	Flange Plate, 126888		1
6	47781-16	Slip Stub, 4-40-761		1



47414 and 47208 - Inflate to 130 PSI

50989 - Inflate to 120 PSI

FIGURE 12.
WHEELS/TIRE ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
12-		Wheels/Tire Assembly		1
1	47193	Wheels & Tires, Desert Sand		1
	47414	Wheel/Tire Assy, Sand		4
	47192	Wheels & Tires, Green		1
	47208	Wheel/Tire Assembly, Green		4
	50990	Wheel/Tire M400, 31.5k GVW		1
	50989	Wheel/Tire Assy M400, 31.5k GVW		1
2	47012	Tire, 385/65R22.5		1
3	NW035682	Stem, Valve, .453/.625, 1.25, 130# (V00551)		1
4	47324-26	Lugnut Kit (Qty 10)		1
5	47411	Wheel Weldment, 12.25 x 22.5		1
NS	48811	Out Svce, Mount Tire		1

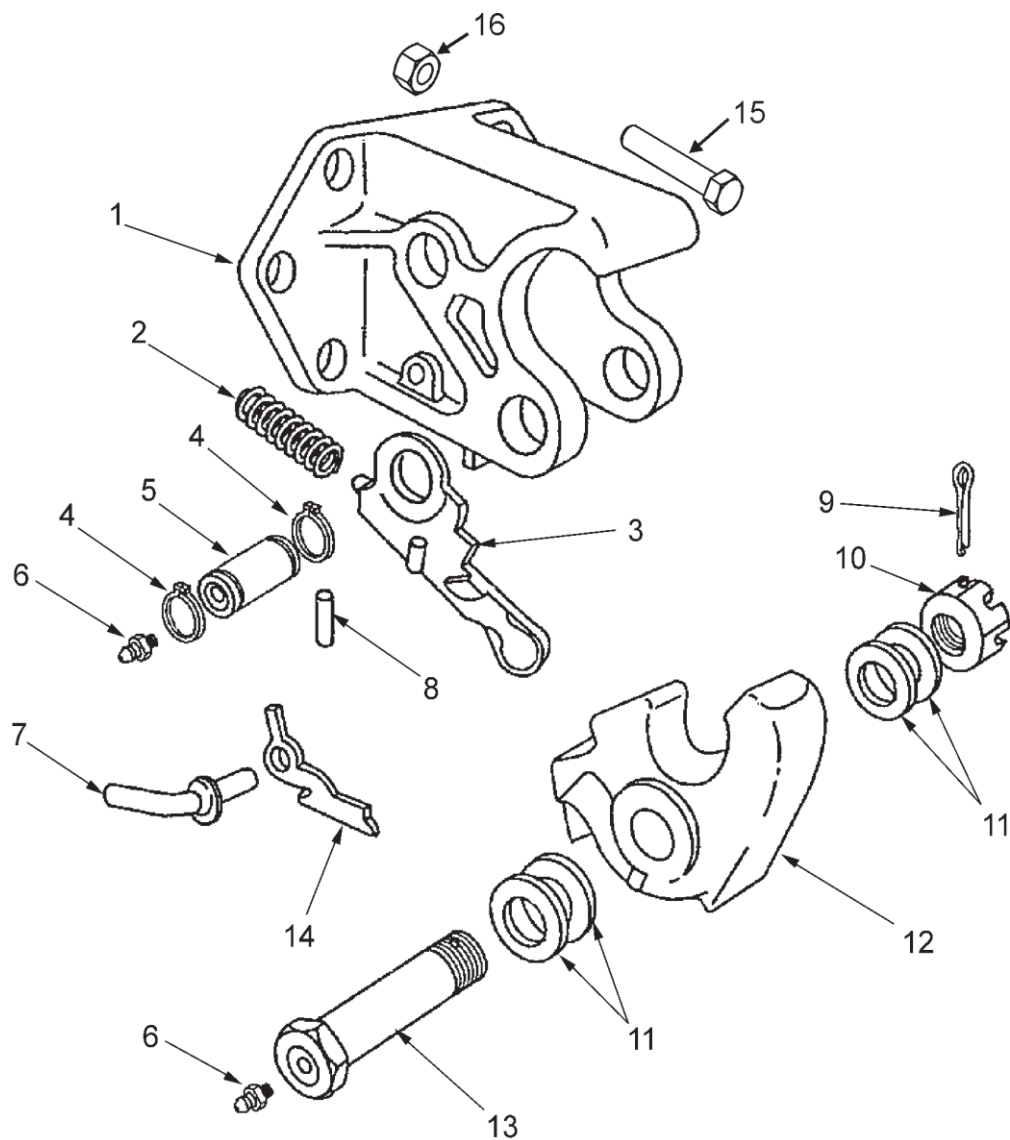


FIGURE 13.
COUPLER, JAW TYPE

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
13-	47226	Grp, Jaw Type Coupler, CP360, Option		REF
	47216	Coupler, Jaw Type, MB2		1
1	47226-10	Frame, XA361		1
2	47226-11	Spring, XB-T-33A		1
3	47226-12	Latch, Coupler, XA-393		1
4	47226-13	Clip, XB-T-377		2
5	47226-14	Tube, XA-01154		1
6	47226-15	Zerk, XB-767		2
7	47226-16	Lever, Release, XA-07760		1
8	47226-17	Pin, XB-3094		1
9	47226-18	Pin, Cotter, XB-5		1
10	47226-19	Nut, XB-T-20-2		1
11	47226-20	Washer, XA-T-88		2
12	47226-21	Coupler Jaw, XA-392		1
13	47226-22	Bolt, XA-06101		1
14	47226-23	Lever Plate, XA-394		1
15	F101519	HHCS, 3/4-10x4.00 Gr 8		6
16	48469	Nylock Nut, 3/4-10 Gr 8		6

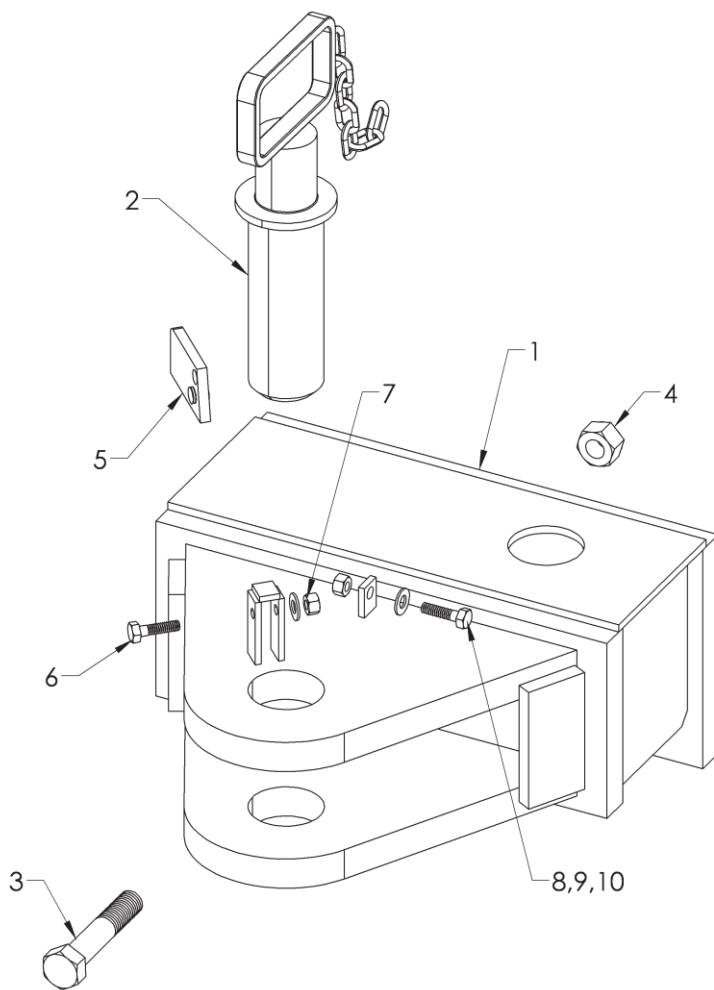


FIGURE 14.
HITCH ASSEMBLY, PIN

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
14-	47227	Grp, Pin Hitch		1
	47880	Hitch Assy, 2.25 Pin, 400MB2		2
1	47881	Hitch Wldmnt, 400MB2		1
2	46602	Pin Wldmnt, Hitch, 2.25 Dia		1
3	F101519	HHCS, 3/4-10x4.00 Gr 8		6
4	48469	Nylock Nut, 3/4-10 Gr 8		6
5	48537	Bar, Safety Latch		1
6	F018975	HHCS, 1/4-20 x 1.25, GR5, ZC		1
7	F013588	Nut, Hex, 1/4-20, Nylock, ZC		1
	F009704	FW, 1/4 STD, ZC		1
8	F100378	HHCS, 5/16-18 X 1.00, GR5, ZC		1
9	F100061	FW, 5/16 SAE, ZC		1
10	F014476	Nut, Hex, 5/16-18, Nylock, ZC		1

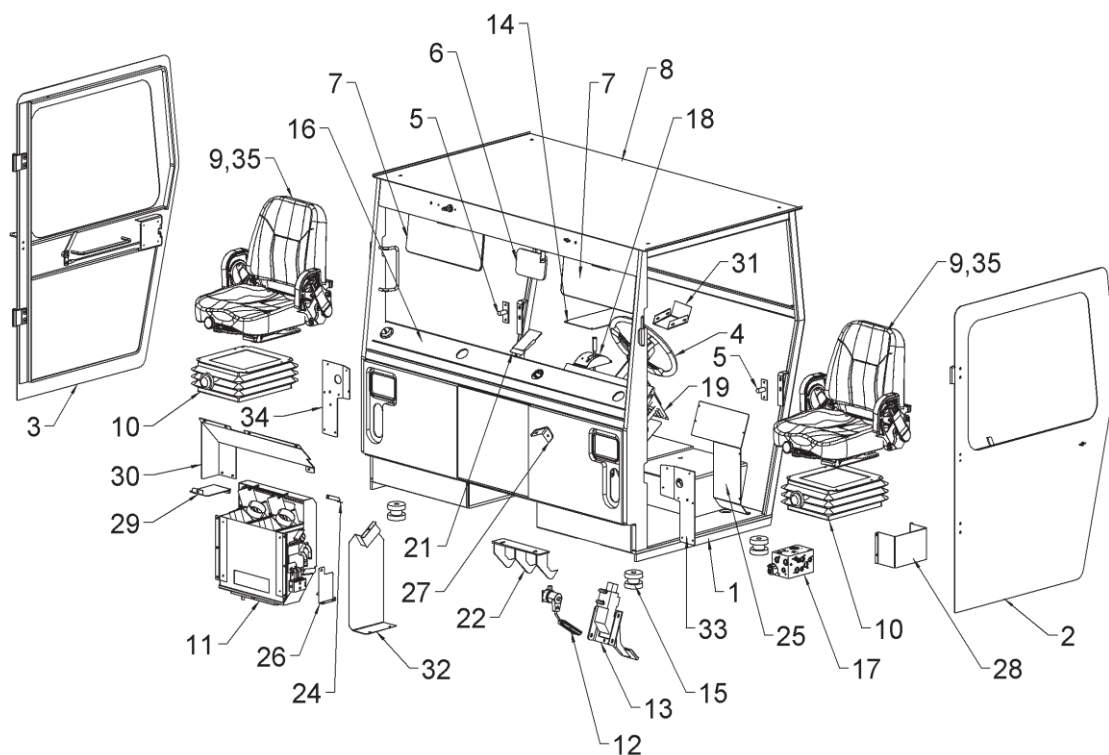
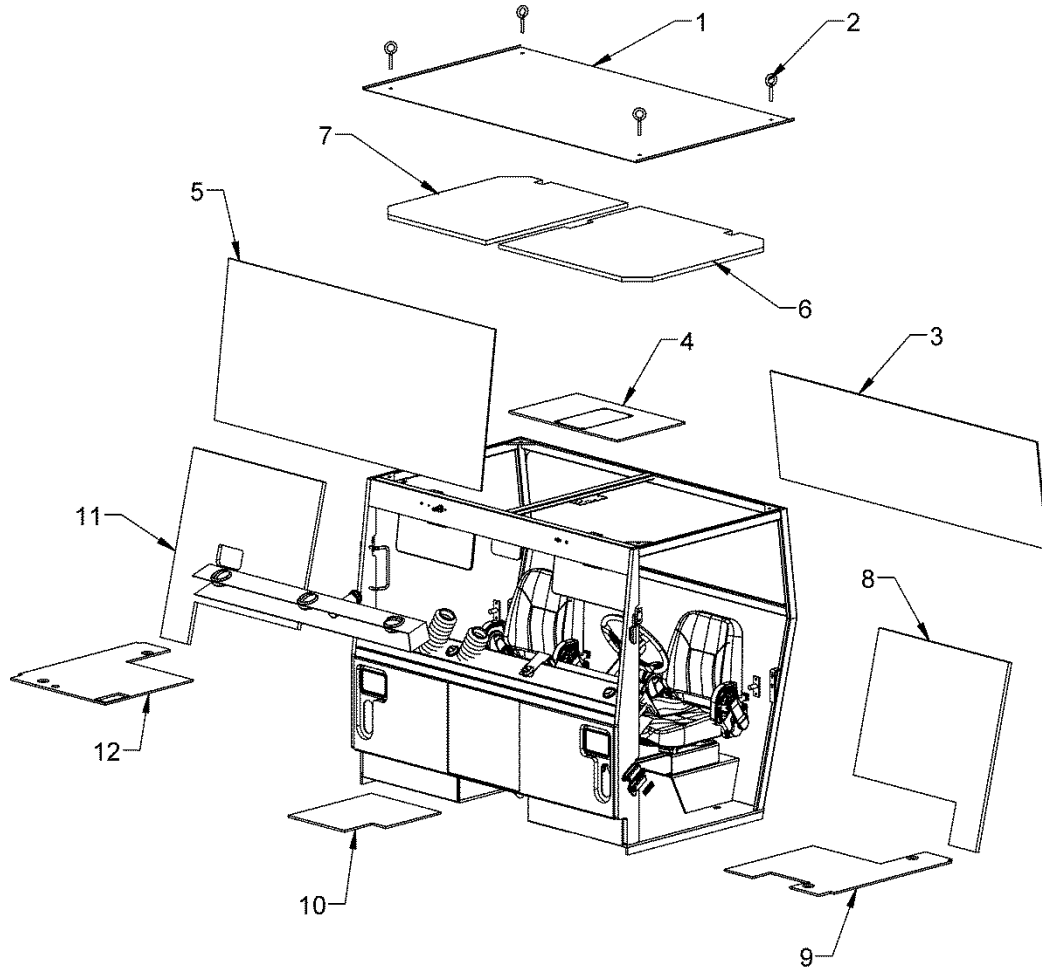


FIGURE 15.
CAB ASSEMBLY
SEAT ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
15-	47188	Grp, Enclosed Cab, 400MB2		1
	47833	Seat Assy, 400MB2 (Inc 9 & 10)		1
1	47088	Cab Wldmnt, 400MB2		1
2	47116	Assy, Door, Left, 400MB2 (See Figure 18)		1
3	47118	Assy, Door, Right, 400MB2 (See Figure 18)		1
4	47212	Steering Assy, Cab, 400MB2 (See Figure 19)		1
5	45098	Striker Plate, Door, 200MB4, 459S ZN		2
6	NW033318	Mirror, Convex Rect 4 X 8 (75175), 63-2308		1
7	304779	Visor, Sun, 19.5" Ctr Mnt, 1600719		2
8	47839	Cab Roof Assy, 400MB2 (See Figure 16)		1
9	47808	Seat, 400MB2		1
10	47809	Suspension, Seat, 400MB2		1
11	47195	Heater/AC Assy (See Figure 25)		1
	47196	Heater, Cab, Backwall w/o AC (See Figure 25)		1
12	44840	Pedal, Accel, Blkhd, Cummins Elec, WM540-131		1
13	47826	Brake Pedal Assy, 400MB2 (See Figure 28)		1
14		Access Cover		1
15	44898	Isolator, Rubber, Trans		4
16	47832	Air Ducting/Heat Plumbing, 400MB2 (See Figure 27)		1
17	47825	Hyd Manifold Assy, 400MB2 (See Figure 28)		1
18	47834	Shifter Assy, UEA, 400MB2		1
	45035	Control, Shift, Funk		1
19	47827	Instrument Panel Assy, 400MB2 (See Figure 20)		1
20	45986	Vent, Cab, 3C3Z54280		1
21	47806	Guard, Hose, Dash, 400MB2		1
22	47203	Accumulator Assy, Brakes, 400MB2 (See Figure 28)		1
	47199	Accumulator, 1 Gal (Not Shown)		2
	47365	Mtg Wldmnt, Accumulator		1
23	207069	Kit, Washer Bottle, 12V/2.2L, 160200-523		1
	48506	Hose, 0.188 Washer, Black		54"
24	47863	Stop, Lever, Heater/AC, 400MB2	A	1
25	48817	Cover, Front, Hyd Hose, Cab, 400MB2		1
26	48135	Cover, Bottom, LH, Heater, 400MB2		1
27	47997	Mount, Work Light, Front, 400MB2		1
	51605	Light, Flood, Rubber Mount LED	B	2
28	48103	Guard, Bottle, Washer, 400MB2		1
29	48134	Cover, Bottom, RH, Heater, 400MB2		1
30	48124	Wldmnt, Top, Heater, Cab, 400MB2		1
31	47980	Cover, Heater/Park Brk Mnt, 400MB2		1
32	48125	Wldmnt, Side, LH, Heat, Cab, 400MB2		1
33	47767	Cover, Encl, Light, LH, 400MB2		1
34	47764	Cover, Encl, Light, RH, 400MB2		1
35	1.0106	Belt, Seat, 60"		2
NS	47954	Cover, Side, Hose, Hyd, Cab, 400MB2		1
NS	47836	Cab Hydraulic Assy, 400MB2 (See Figure 28)		1



47835-Acoustics-M400.cdr

FIGURE 16.
INTERIOR ACOUSTICS, CAB, 400MB2
ROOF ASSEMBLY, CAB, 400MB2
GLAZING, CAB, 400MB2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
16-	47835	Interior Acoustics, Cab, 400MB2		1
	47839	Cab Roof Assy, 400MB2		1
	47831	Glazing, Cab, 400MB2		1
	45481	Sealant, Glass, Urethane, 10.5 oz, U400HV		4
	45482	Primer, Glass, Single Application, 5500SA		1
	45483	Primer, Pinchweld, 1 00 ML, 5404A		.5
1	47101	Roof, Cab, 400MB2		1
	44949	Sealant, Struct. Silicone, Black, DCC995		1
2	44952	Bolt, Eye, 1/2 X 1.5, Mach, Shldr, 0LP8		4
	F013500	Nut, Hex, 1/2-13, Nylock, ZC		4
3	47127	Window, Rear, 400MB2		1
4	47996	Matt, Center, Cab		1
5	47126	Pane, Glass, Frt, Windshield, 400MB2		1
6	47891	Panel, Acoustic, LH Cab Roof		1
7	47892	Panel, Acoustic, RH Cab Roof		1
8	47890	Panel, Acoustic, LH Rear Cab		1
9	47893	Matt, Floor, LH Cab		1
10	47995	Matt, Floor, Mid Cab		1
11	47896	Panel, Acoustic, RH Rear Cab		1
12	47894	Matt, Floor, RH Cab		1

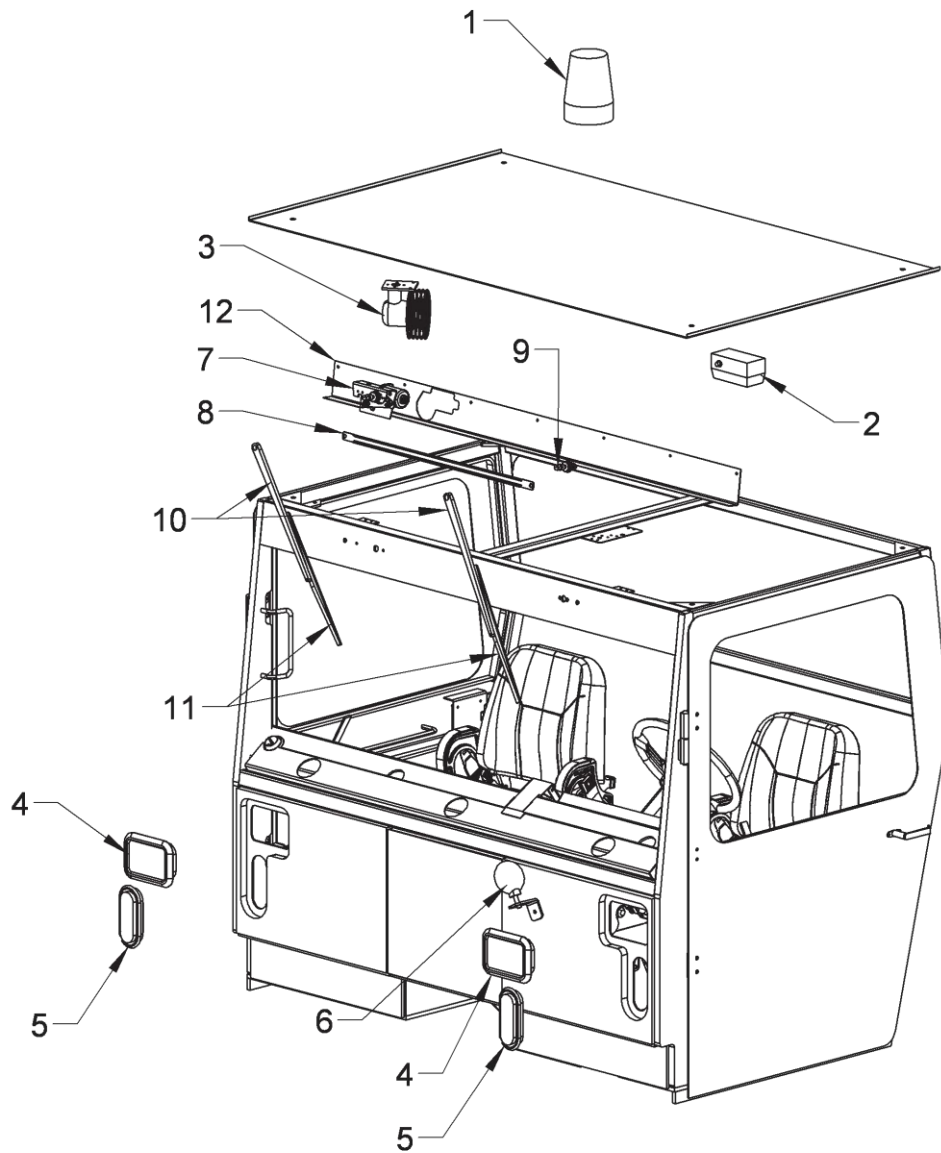


FIGURE 17.
ELECTRIC ASSEMBLY, CAB
WIPER ASSEMBLY
ROOF ASSEMBLY, CAB

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
17-	47837	Cab Electrical Assy, 400MB2 (Inc 1-7)		1
	47830	Wiper Assy, Cab, 400MB2 (Inc 9-14)		1
	47839	Cab Roof Assy, 400MB2 (Inc 8)		1
1	2.3911	Light, Beacon, Rot, Amber, Small, 76163		1
	45118	Gasket, Beacon (2.3911)		1
	309477	Light, Beacon, Strb, Amber, LED	B	1
2	40559	Light, Dome, w/Switch, 61491-5		1
3	NW032445	Fan, Defogger, Cab, 12V, 2-Speed, 3000-12V		1
4	47651	Headlight, Flush, 4X6, 400MB2		2
5	47215	Turn Signal w/Grmmt, 400MB2, M421KA		2
	2.3614	Flasher, 12 Volt, 3-Terminal, Ideal550		1
	51603	Turn/Park Signal, Oval, Amber, LED	B	2
	51347	Flasher, 12 Volt, 3-Terminal, LED	B	1
6	2.3607	Work Light		1
7	46615	Motor, Wiper, 2-Spd, Heavy-Duty, EKT 72215		1
8	44986	Link, Wiper Motor, 32.25", 307-1077 B		1
9	44987	Shaft, Pivot, Wiper, 5/8" Lg, 300796		1
10	48120	Arm, Wiper		2
11	48121	Blade, Wiper, 20"		2
12	47855	Guard, Windshield Wiper, 400MB2		1
NS	44963	Clip, Spring, Wiper, 300928		1

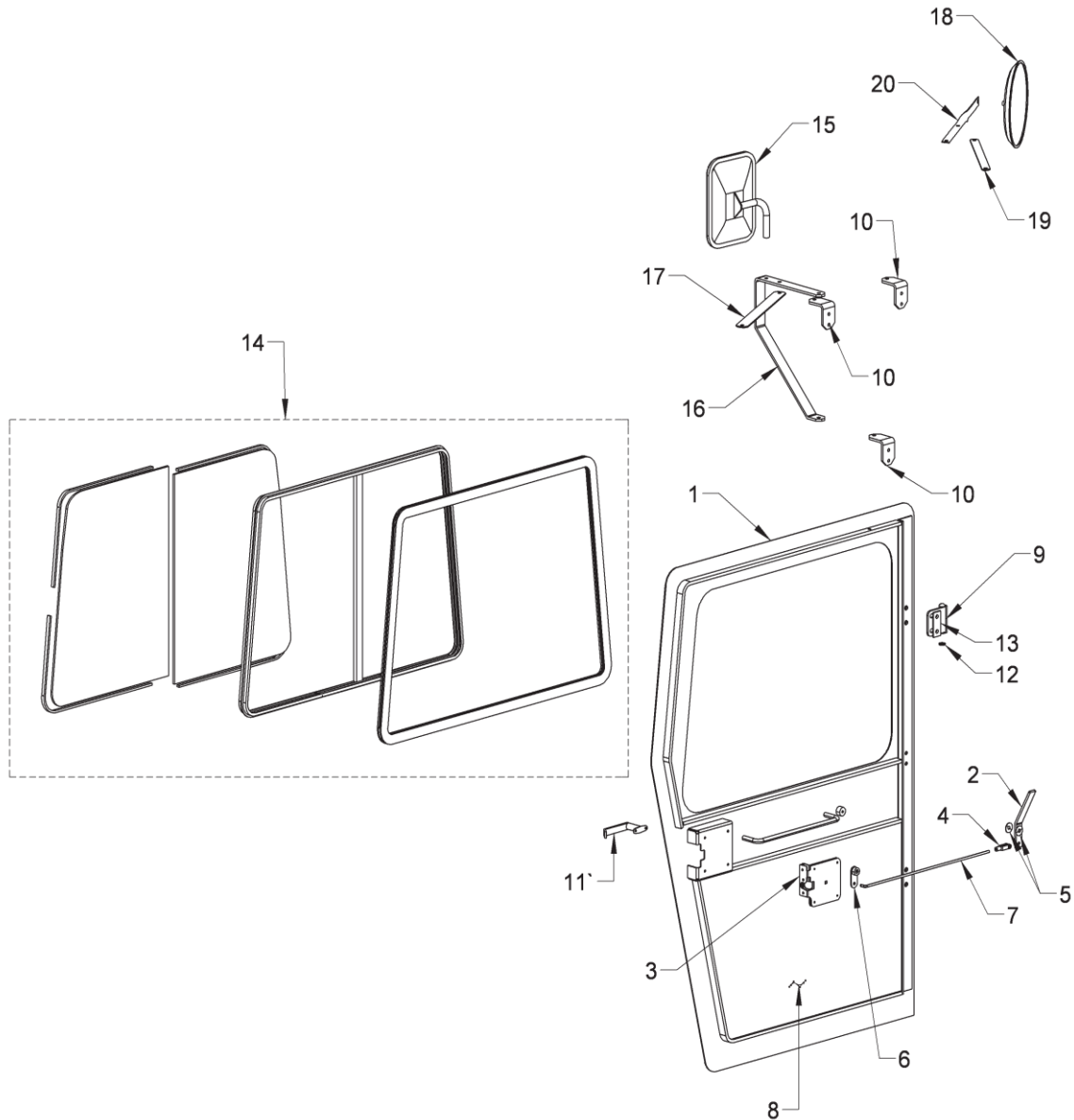


FIGURE 18.
DOOR ASSEMBLY, CAB
MIRROR, DOOR

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
18-	47116	Assy, Door, Left, 400MB2 (Shown)		1
	47118	Assy, Door, Right, 400MB2 (Not Shown)		1
1	47117	Wldmnt, Door, LH, 400MB2		1
	47119	Door Wldmnt, RH, 400MB2		1
2	44936	Handle, Door, Inside, MB4V2		1
	203185	Cover, Handle, Plastic		1
3	206744	Latch, Rotary, 459ZN		1
4	1.5437	Clevis, 1/4-28 X 5/16 Pin (06970), 175-601-210		1
5		Washer		2
6	44939L	Link Wldmnt, LH, Door Latch, MB4		1
	44939R	Link Wldmnt, RH, Door Latch, MB4		1
7	47129	Rod, Door Latch, 1/4-20, 400MB2		1
8	47130	Panel, Acstc, Cab Door, LH, 400MB2		1
	47133	Panel, Acstc, Cab Door, RH 400MB2		1
9	44913L	Hinge Wldmnt, LH, Door, 200MB4V2		2
	44913R	Hinge Wldmnt, RH, Door, 200MB4V2		2
10	42056	Brkt, Mirror, .25 X 3 X 3		1
11	45111	Handle, Door, Non-Locking, MB4, 10776-07		1
12	203129	Washer, Thrust		2
13	45251	Nutplate Wldmnt, Door, MB4V2		2
	206777	Nutsert, #10-24,.020-.130, Open, AKS4-1024-1		2
14	44954	Window, Door, Slider, LH, 200MB4V2, 64-0113-1R2		1
	44955	Window, Door, Slider, RH, 200MB4V2, 64-0113-1R2		1
15	NW020686	Mirror, Single, 7.5 X 10 (12662), 821		1
16	48077	Arm, Mirror, Door, 400MB2		1
17	48078	Brace, Mirror, Door, 400MB2		1
18	40181	Mirror, Head, 8.5 Dia (47118 Only)		1
19	48517	Brace, Mirror (47118 Only)		1
20	48518	Brkt, Mirror (47118 Only)		1
NS	206746	Gasket, Handle, 80974		1
NS	44961	Trim, w/Seal, .13X.75,90 DEG 20, 7100 B3X1/8		5
NS	45481	Sealant, Glass, Urethane,10.5OZ, U400HV		0.5
NS	45483	Primer, Pinchweld, 100 ML, 5404A		0.2
NS	45113	Bolt, Shldr, 3/8 X .38, 5/16-18		1
	424402	Chain, 14 Links		1

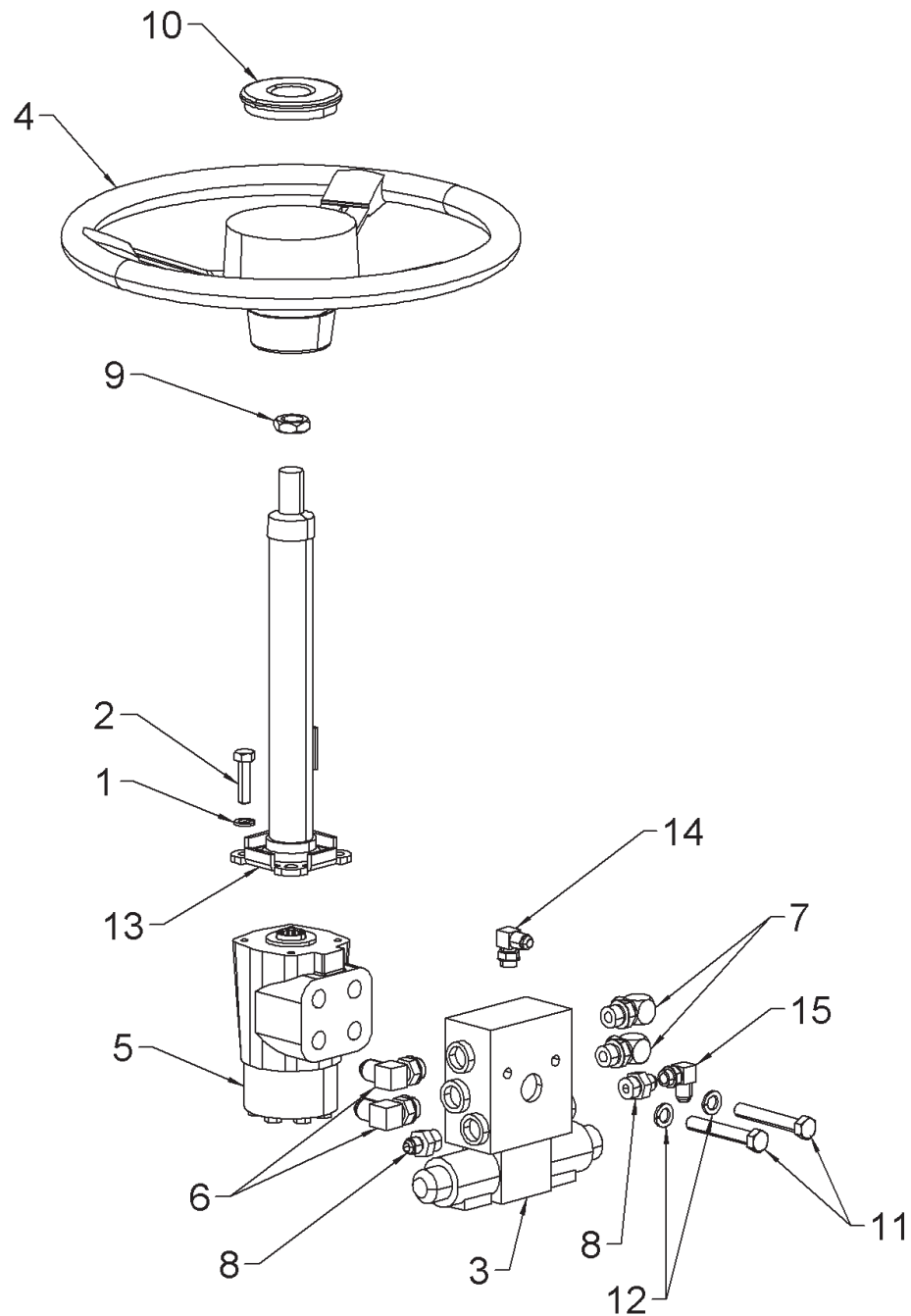


FIGURE 19.
STEERING ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
19-	47212	Steering Assembly		Ref
1		Washer, M10		4
2	NW031820	HHCS, M10 X 1.50 X 40MM, Gr8.8		4
3	44928	Valve, Steering Mode, Series 10, MCD8101		1
4	NW036491	Wheel, Steer, 16", Eaton Column, 16353BP		1
5	47329	Steer Unit, 22.6 CI, LS, 200-0695-002		1
6	91930	Ftg, Hyd, 08MJ-08MB90		2
7	NW036560	Ftg, Hyd, 08MB-06MJ90		2
8	3.2519	Ftg, Hyd, 06MJ-08MB		2
9	150526	Nut, Hex, 13/16-20, Steering, 1741		1
10	202736	Button, Horn, for VIP Wheel		1
11	45314	HHCS		2
12	44707	Washer		2
13	45082	Column, Steering, 12", w/Horn, 204-1042		1
14	90424	Ftg, Hyd, 04MJ-04MB90		1
15	3.2143	Ftg, Hyd, 06MJ-06FJX90		1

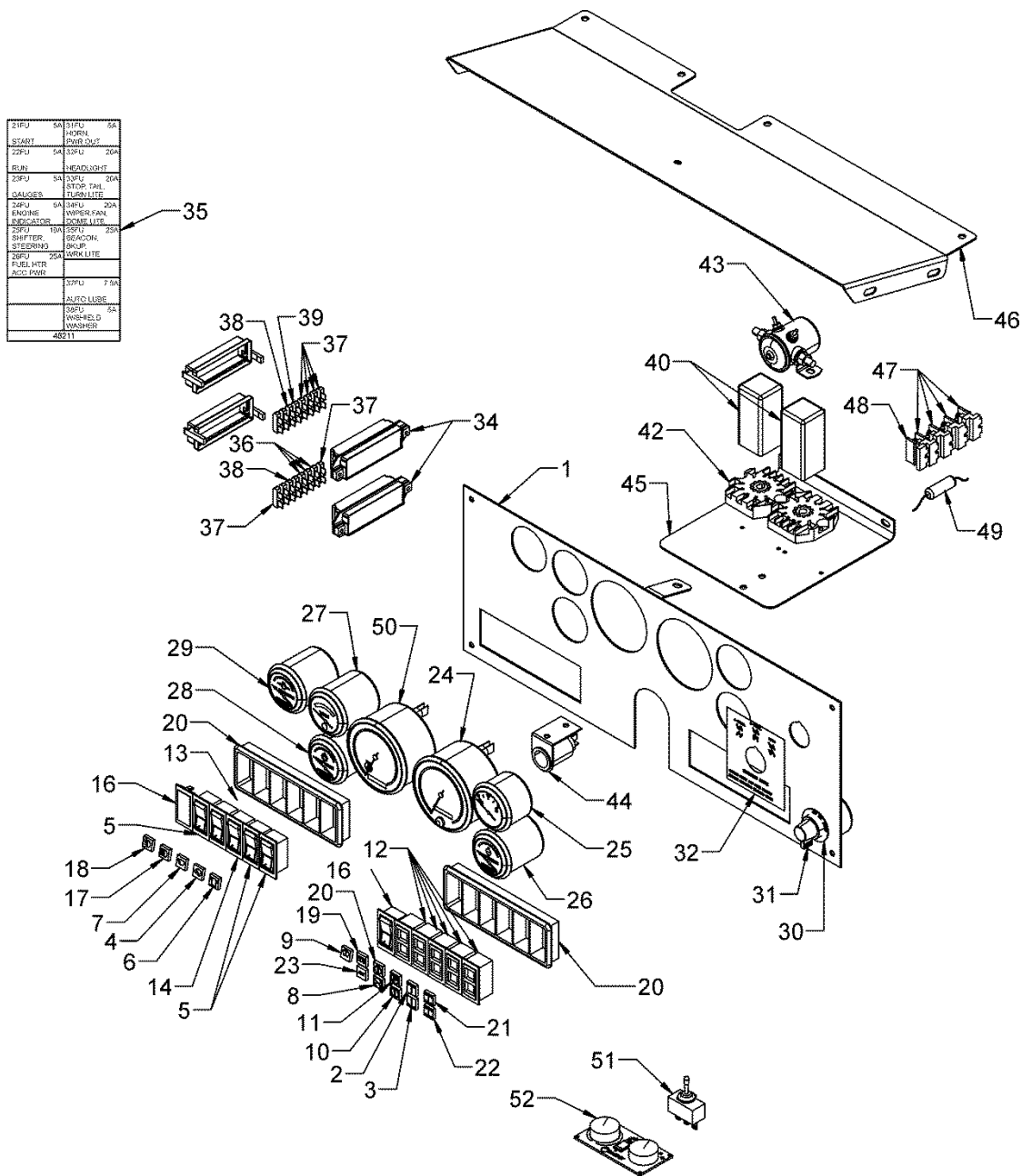


FIGURE 20.
INSTRUMENT PANEL ASSEMBLY
1 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
20-	47827	Instrument Panel Assy, 400MB2		1
1	47358	Panel Weldment, Inst, 400MB2		1
2	45150	Insert, Switch, Front Axle, Grn, DD900.224		1
3	45149	Insert, Switch, Rear Axle, Grn, DD900.225		1
4	NW035383	Insert, Switch, Worklight, Green (56289), SPR130-0033-00		1
5	NW034176	Switch, Rocker, Off-On, SPST (65439), 511005		2
6	NW035384	Insert, Switch, Beacon, Green (65439), 596628		1
7	NW036552	Insert, Switch, Wipers, Grn, SPR130-0060-00		1
8	45143	Insert, Switch, Engine Stop, Red, SPR 595 429		1
9	37602	Insert, Switch, w/Shld Washer, Grn, SPR130-0035-00		1
10	NW035388	Insert, Switch, Brake Fault, Red, SPR130-0094-00		1
11	37247	Insert, Switch, Park Brk, Red (92484), SPR130-0099-00		1
12	NW035378	Housing, Light Indicator, 2-Lamp (Advance), SPR 511 502		5
13	NW035376	Switch, Rocker, On-On, DPST (65439), 511106		2
14	43296	Switch, Rocker, On-On-On, DP3T, SPR511227		1
15	45164	Insert, Switch, Eng Warning, YLW 00900.166		1
16	NW035374	Switch, Rocker, Off-Mom.On, SPST (65439) 511008		1
17	NW035387	Insert, Switch, High Beam, Blue (Advance) SPR 596.169		1
18	NW035386	Insert, Switch, Headlight, Green (65439),		1
19	NW035385	Insert, Switch,Glo Plug, Green (65439),		1
20	NW035381	Frame, 6 Switch, SPR 595.902		2
21	45148	Insert, Switch, Crab Steer, Grn, 900.226		1
22	45147	Insert, Switch, Coord Steer, Grn, DD900.222		1
23	NW036671	Insert, Switch, "Alt", Red, DD900.227		1
24	48402	Speedometer, w/Odo, 0-45, Prgm, 437-950-OE		1
25	45034	Gauge Fuel, Time Delay, Black, MSE 234012-018		1
26	NW024700	Gauge, Eng Temp, 140-220+F (8S377), 06348-10		1
27	NW036129	Gauge, Voltmeter, 8V DC-18V DC (8S377), 06863-38		1
28	NW024701	Gauge, Trans Temp, 120-300F (8S377), 06118-12		1
29	NW024699	Gauge Oil Press, 0-100 PSI (8S377), 06103-12		1
30	NW030247	Decal, Ign Switch, Alum, Adhesive		1
31	F104281	Switch, Ign, Anti-Restart, Keyless (13445), 956-3124		1
32	42786	Decal, Strg Mode, 200, Coor, 2W, CR (P)		1
33	45145	Switch, Selector, 3-Position, 800T-J2KC1B		1
34	45099	Block, Fuse, ATC, 8-Gang, 62939B		2
35	48211	Decal, Inst Panel Fuses		1
36	200084	Fuse, 20A/32V, ATC, 46220		3
37	M257005	Fuse, 5A/32V, ATC, 46205		6
38	47158	Fuse, 25A/32V, ATC, 46225		2
39	304682	Fuse, 10A/32V, ATC, 46210 Red		1
40	304151	Relay, Latch, Magnetic, 12V DPDT, RR2KPUDC12V		2

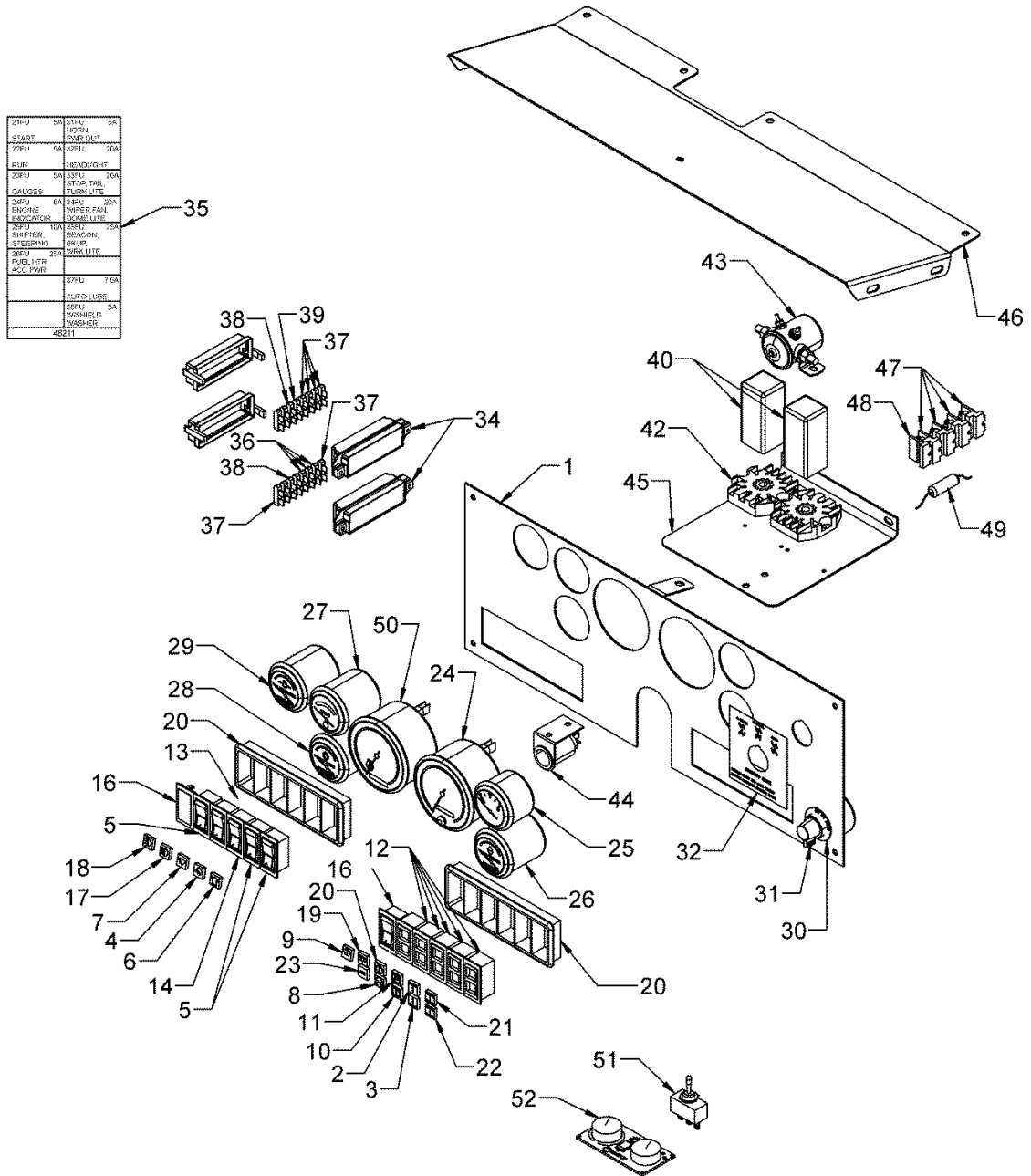


FIGURE 20.
INSTRUMENT PANEL ASSEMBLY
2 OF 2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
20-	47827	Instrument Panel Assy, 400MB2		1
41	NW035766	Relay, 12VDC, SPDT, 40A (78505), 2626		2
42	2.2983	Socket, Relay, 11-Pin (54173), RB11-PC		2
43	2.1401	Relay, Power, SPNO, 12VDC/80A, 35M2084 /70-90		1
44	305522	Outler, Power, 12V, 7821635		1
45	47356	Plate, Relay Mnt, 400MB2		1
46	47359	Cover, Instrument Panel, 400MB2		1
47	2.0021	Block, Terminal (5N603), 924		3
48	2.0022	End, Terminal (5N603), 930		1
49	2.3093	Diode, 3A, 200V, Axial Lead Nte 5805		1
50	NW035273	Tachometer/Hourmeter, 0-4000 Rpm, 71725-00		1
	NW035879	Light, Hour/Tak Gauge, 60DGV, 03123-00		1
51	47842	Toggle Switch, Locking, Park Brake		1
52	48257	Kit, Control Valve, Heat/AC		1
NS	424801	Cut, 4248, 0.56		4

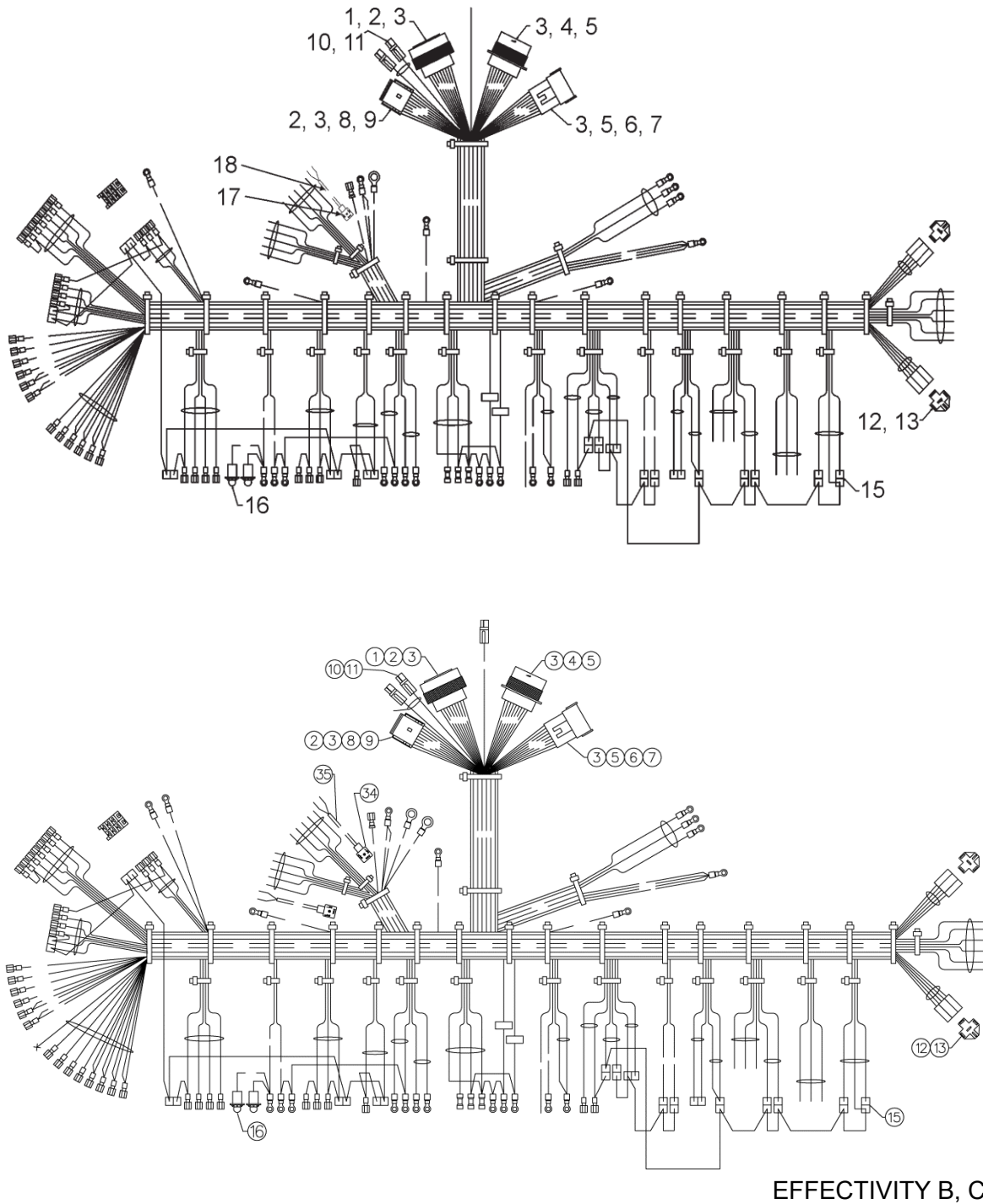


FIGURE 21.
HARNES, INSTRUMENT PANEL

EFFECTIVITY B, C

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
21-	47828	Harness, Instrument Panel		Ref
1	206114	Connector, Deutsch, 24-Pos		1
2	206117	Pin, Deutsch, 14-16 Awg		20
3	206101	Seal, Deutsch		37
4	206115	Connector, Deutsch, 24-Pos		1
5	206116	Pin, Deutsch, 14-16 Awg		15
6	45018	Connector, Deutsch, 12-Pos		1
7	45019	Wedge, Deutsch		1
8	45016	Connector, Deutsch, 12-Pos		1
9	45017	Wedge, Deutsch		1
10	2.3378	Connector, 60A		2
11	2.3379	Bushing, Reducing		2
12	37048	Connector, Replay, 5-Pos		2
13	37049	Terminal, 1/4" Fem Bld, 14-18 Awg		57
NS	37408	Connector, Switch		5
15	37409	Connector, Light		16
16	F101597	Light, Gauge, Non-Shutdown		4
17	1012632	Conn, EI, Din, 43650		2
	37410	Terminal, 1/4" REM, BLD, 12 GA	B,C	1
18	2.3695	Wire 16/2 SO 600V		62
	F002958	Wire, 16 Ga, Bk, Gxl	B,C	1585
34	1012632	Conn, EI, Din, 43650	B,C	2
35	2.3695	Wire 16/2 SO 600V	B,C	62
NS	37410	Terminal, 1/4" Fem Bld, 12 Ga		1
NS	F002958	Wire, 16 Ga, Bk, Gxl		1585
NS	F009794	Wire, 16 Ga, Rd, Gxl		174
NS	F009797	Wire, 16 Ga, Wh, Gxl		125
NS	F101647	Wire, 16 Ga, Pk, Gxl		108
NS	F101531	Wire, 16 Ga, Br, Gxl		87
NS	F101787	Wire, 16 Ga, Lt Bl, Gxl		61
NS	F101783	Wire, 16 Ga, Pu, Gxl		70
NS	F100933	Wire, 16 Ga, Gn, Gxl		68
NS	F101895	Wire, 16 Ga, Gy, Gxl		67
NS	37968	Wire, 16 Ga, Tn, Gxl		40
NS	F009791	Wire, 16 Ga, Lt Gn, Gxl		37
NS	F009793	Wire, 16 Ga, Bl, Gxl		30
NS	F101642	Wire, 16 Ga, Or, Gxl		52
NS	2.0865	Wire, 10 Ga, Bk, Gxl		37
NS	F100518	Wire, 10 Ga, Wh, Gxl		45
NS	2.1514	Wire, 12 Ga, Bk, Gxl		45

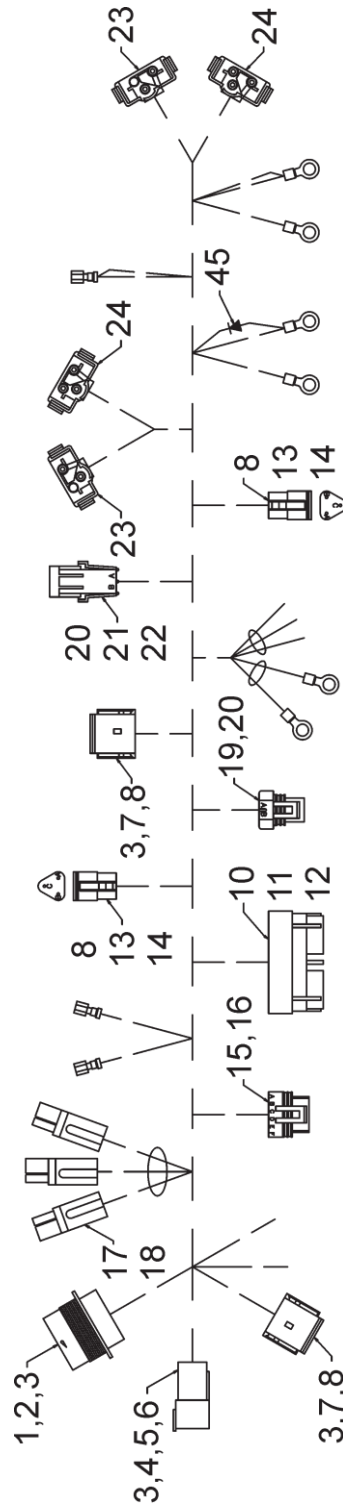


FIGURE 22.
HARNES, CHASSIS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
22-	47813	Harness, Chassis		
1	206115	Connector, Deutsch, 23-Pos		1
2	206116	Pin, Deutsch, 14-16 Awg		19
3	206101	Seal, Deutsch		9
4	206112	Connector, Deutsch, 6-Pos		1
5	206116	Pin, Deutsch, 14-16 Awg		4
6	206113	Wedge, Deutsch		1
7	45016	Connector, Deutsch, 12-Pos		2
8	206117	Pin, Deutsch, 14-16 Awg		27
NS	45017	Wedge, Deutsch		2
10	46300	Connector, Deutsch, 50-Pos		1
11	45010	Pin, Deutsch, 20-24 Awg		14
12	45011	Seal, Deutsch		36
13	206106	Connector, Deutsch, 3-Pos		2
14	206107	Wedge, Deutsch		2
15	45027	Connector, Deutsch, 6-Pos		1
16	45044	Pin, Deutsch, 20-22 Awg		3
17	2.3378	Connector, 60A		3
18	2.3379	Bushing		3
19	203157	Pin, 12-14 Awg		2
20	37309	Seal, 16-18 Awg		4
21	37639	Connector, Deutsch, 2-Pos		1
22	37307	Pin, Deutsch, 14-16 Awg		2
23	NW035615	Pig Tail, Light, 2-Wire		2
24	NW035616	Pig Tail, Light, 3-Wire		2
NS	F009794	Wire 16 Ga Rd Gxl		160
NS	F009797	Wire 16 Ga Wh Gxl		916
NS	F002958	Wire 16 Ga Bk Gxl		1681
NS	F101647	Wire 16 Ga Pk Gxl		306
NS	F101531	Wire 16 Ga Br Gxl		597
NS	F101787	Wire 16 Ga Lt Bl Gxl		160
NS	F101783	Wire 16 Ga Pu Gxl		142
NS	F100933	Wire 16 Ga Gn Gxl		562
NS	F009791	Wire 16 Ga Lt Gn Gxl		313
NS	F009792	Wire 16 Ga Yw Gxl		316
NS	F009793	Wire 16 Ga Bl Gxl		160
NS	F006612	Wire 14 Ga Bk Gxl		160
NS	2.0865	Wire 10 Ga Bk Gxl		174
NS	F100518	Wire 10 Ga Wh Gxl		174
NS	F009803	Wire 10 Ga Rd Gxl		174
NS	306657	Wire 20 Ga Bk Gxl		75
NS	304094	Wire 22/4, Shielded, Stranded		280
NS	2.3820	Loom, Flexguard, 1" ID		286
NS	2.3366	Loom, Flexguard, 1/2" ID		171
NS	F101793	Loom, Flexguard, 3/8" ID		336
45	45537	Diode, 6A, 200V, Molded, Pigtail		1

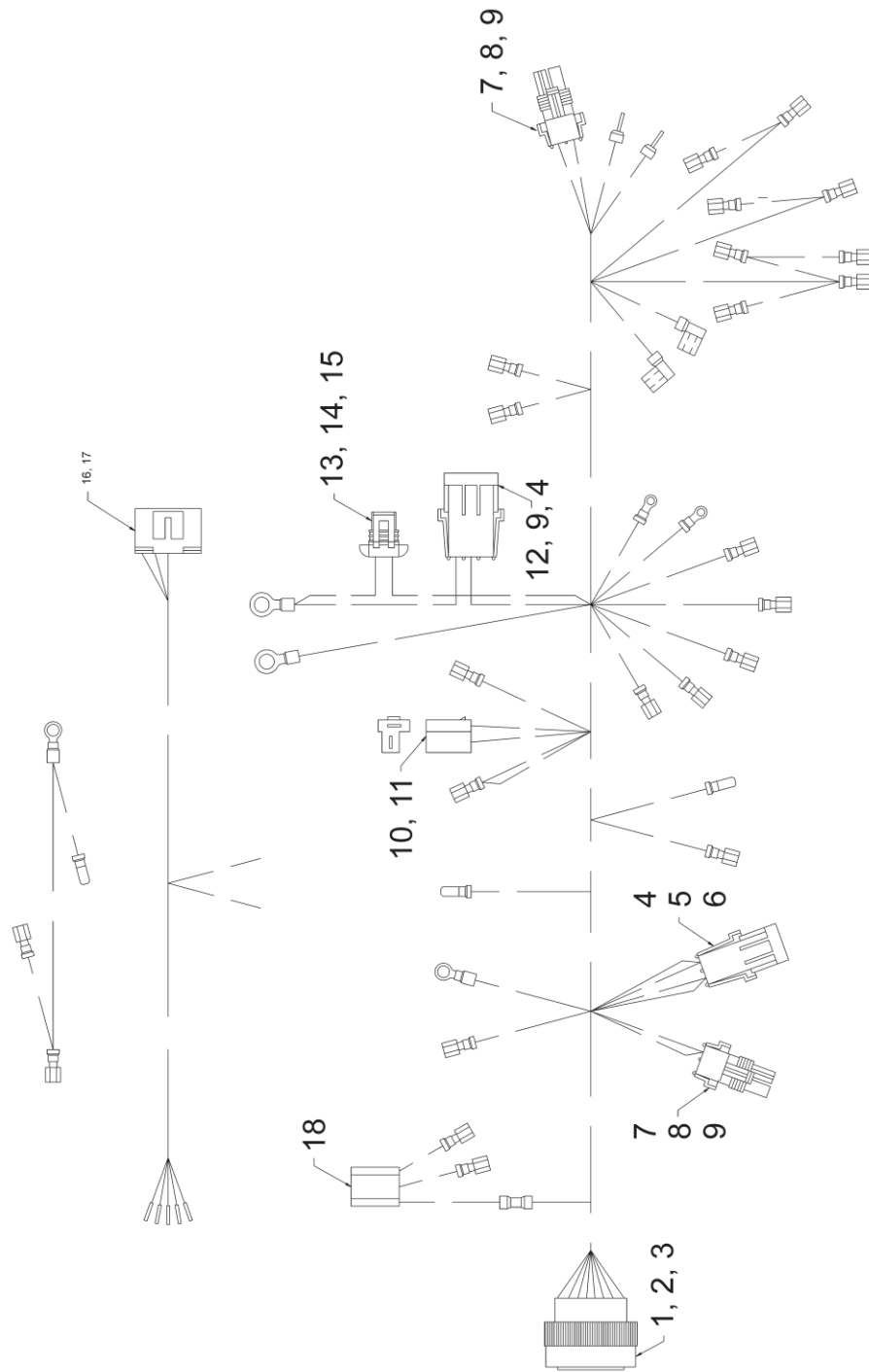
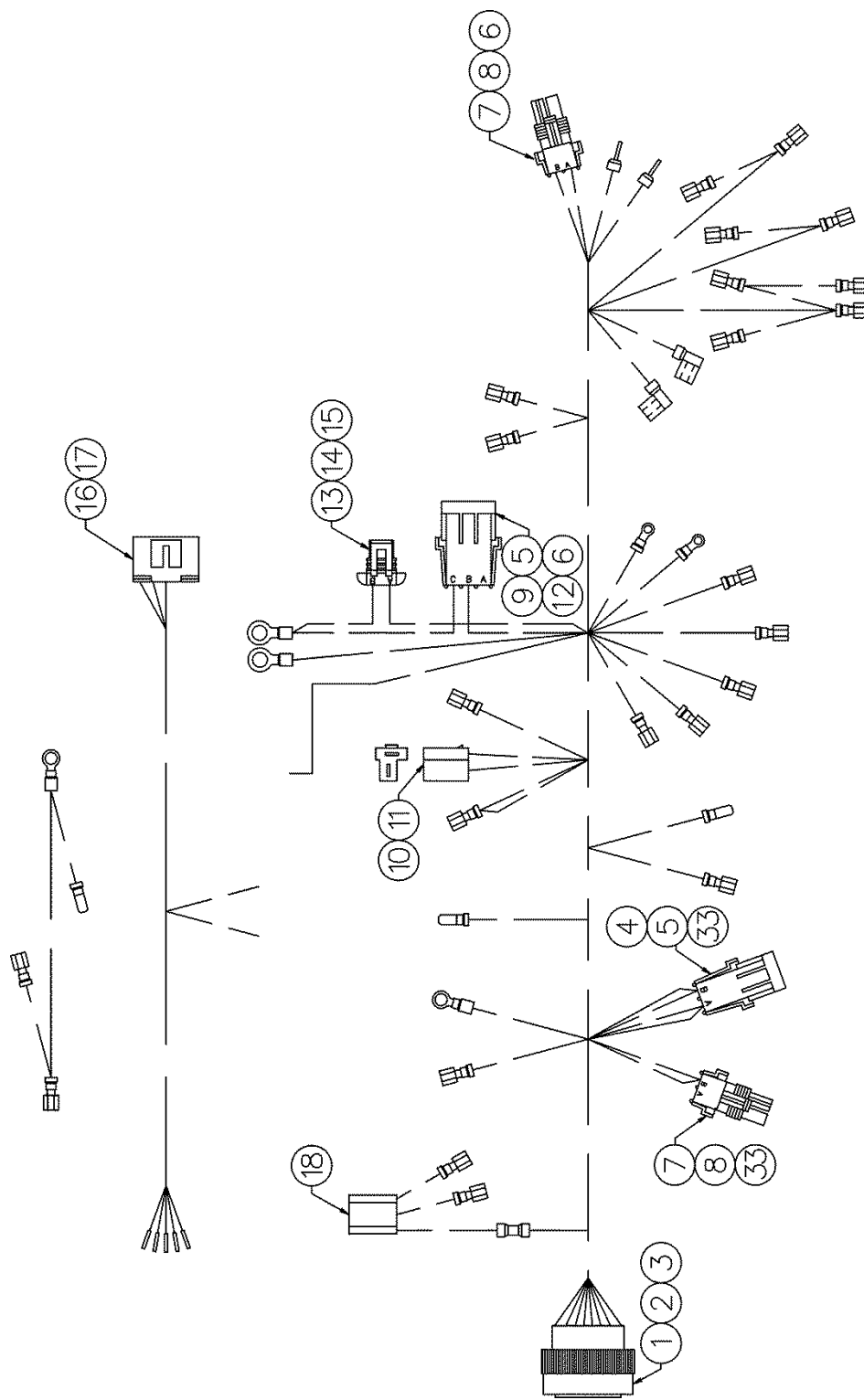


FIGURE 23.
HARNES, CAB, 400MB2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
23-	47829	Harness, Cab, 400MB2		Ref
1	206114	Connector, El, Deutsch, Plg, HDP26-2423		1
2	206117	Connector, El, Deutsch, Skt, 14-16 Awg		14
3	206101	Connector, El, Deutsch, Seal Plg, 12-16		9
4	37639	Connector, El, W-Pak, Body Shroud, 2Way		1
5	37307	Connector, El, W-Pak, Pin, 14-16 Awg		4
6	37309	Connector, El, W-Pak & 280, Seal, 16-18 Ga		2
7	37640	Connector, El, W-Pak, Body Tower, 2-Way		2
8	37308	Connector, El, W-Pak, Skt, 14-16 Awg		3
9	37311	Connector, El, W-Pak & 280, Cavity Plug		5
10	F101551	Connector, 2 Pos, Male Half		1
11	F101553	Terminal, Female (16-14 Ga)		2
12	37305	Connector, El, W-Pak, Body, Shroud, 3Way		1
13	206096	Connector, El, M-Pak 150, Body, F, 2Way		1
14	206098	Connector, El, M-Pak 150, Skt, 16-20 Awg		2
15	206099	Connector, El, M-Pak 150, Seal, 16-18 Ga		2
16	207199	Connector, Male, WJ Wiper Motor		1
17	37049	Terminal, 1/4 Fem Bld, 14-18 Ga		2
18	NW031880	Connector, Flasher, 3-Way		1
NS	F002958	Wire 16 Ga Blk Gxl		1196"
NS	F101642	Wire 16 Ga Org Gxl		238"
NS	F101895	Wire 16 Ga Gry Gxl		290"
NS	F100933	Wire 16 Ga Grn Gxl		311"
NS	F101531	Wire 16 Ga Brn Gxl		212"
NS	F009797	Wire 16 Ga Wht Gxl		26"
NS	37968	Wire 16 Ga Tan Gxl		174"
NS	F101783	Wire 16 Ga Purple Gxl		117"
NS	F101796	Loom 0.62 ID Flexguard		61"
NS	2.3366	Loom 0.50 ID Flexguard		67"
NS	F101793	Loom 0.35 ID Flexguard		14"
NS	2.3478	Loom 0.25 ID Flexguard		76"
NS	F100516	Wire, 12 Ga, Rd, Gxl		106"
NS	204681	Wire, 12 Ga, Or, Gxl		166"



EFFECTIVITY B, C

**FIGURE 24.
HARNES, CAB, 400MB2**

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
24-	47829	Harness, Cab, 400MB2	B,C	Ref
1	206114	Connector, El, Deutsch, Plg, HDP26-2423		1
2	206117	Connector, El, Deutsch, Skt, 14-16 Awg		14
3	206101	Connector, El, Deutsch, Seal Plg, 12-16		9
4	37639	Connector, El, W-Pak, Body Shroud, 2Way		1
5	37307	Connector, El, W-Pak, Pin, 14-16 Awg		4
6	37309	Connector, El, W-Pak & 280, Seal, 16-18 Ga		2
7	37640	Connector, El, W-Pak, Body Tower, 2-Way		2
8	37308	Connector, El, W-Pak, Skt, 14-16 Awg		3
9	37311	Connector, El, W-Pak & 280, Cavity Plug		5
10	F101551	Connector, 2 Pos, Male Half		1
11	F101553	Terminal, Female (16-14 Ga)		2
12	37305	Connector, El, W-Pak, Body, Shroud, 3Way		1
13	206096	Connector, El, M-Pak 150, Body, F, 2Way		1
14	206098	Connector, El, M-Pak 150, Skt, 16-20 Awg		2
15	206099	Connector, El, M-Pak 150, Seal, 16-18 Ga		2
16	207199	Connector, Male, WJ Wiper Motor		1
17	37049	Terminal, 1/4 Fem Bld, 14-18 Ga		2
18	NW031880	Connector, Flasher, 3-Way		1
33	43893	Seal, 12GA, W-Pak & M-Pak280		4
NS	F002958	Wire 16 Ga Blk Gxl		1196"
NS	F101642	Wire 16 Ga Org Gxl		238"
NS	F101895	Wire 16 Ga Gry Gxl		290"
NS	F100933	Wire 16 Ga Grn Gxl		311"
NS	F101531	Wire 16 Ga Brn Gxl		212"
NS	F009797	Wire 16 Ga Wht Gxl		26"
NS	37968	Wire 16 Ga Tan Gxl		174"
NS	F101783	Wire 16 Ga Purple Gxl		117"
NS	F101796	Loom 0.62 ID Flexguard		61"
NS	2.3366	Loom 0.50 ID Flexguard		67"
NS	F101793	Loom 0.35 ID Flexguard		14"
NS	2.3478	Loom 0.25 ID Flexguard		76"
NS	F100516	Wire, 12 Ga, Rd, Gxl		106"
NS	204681	Wire, 12 Ga, Or, Gxl		166"

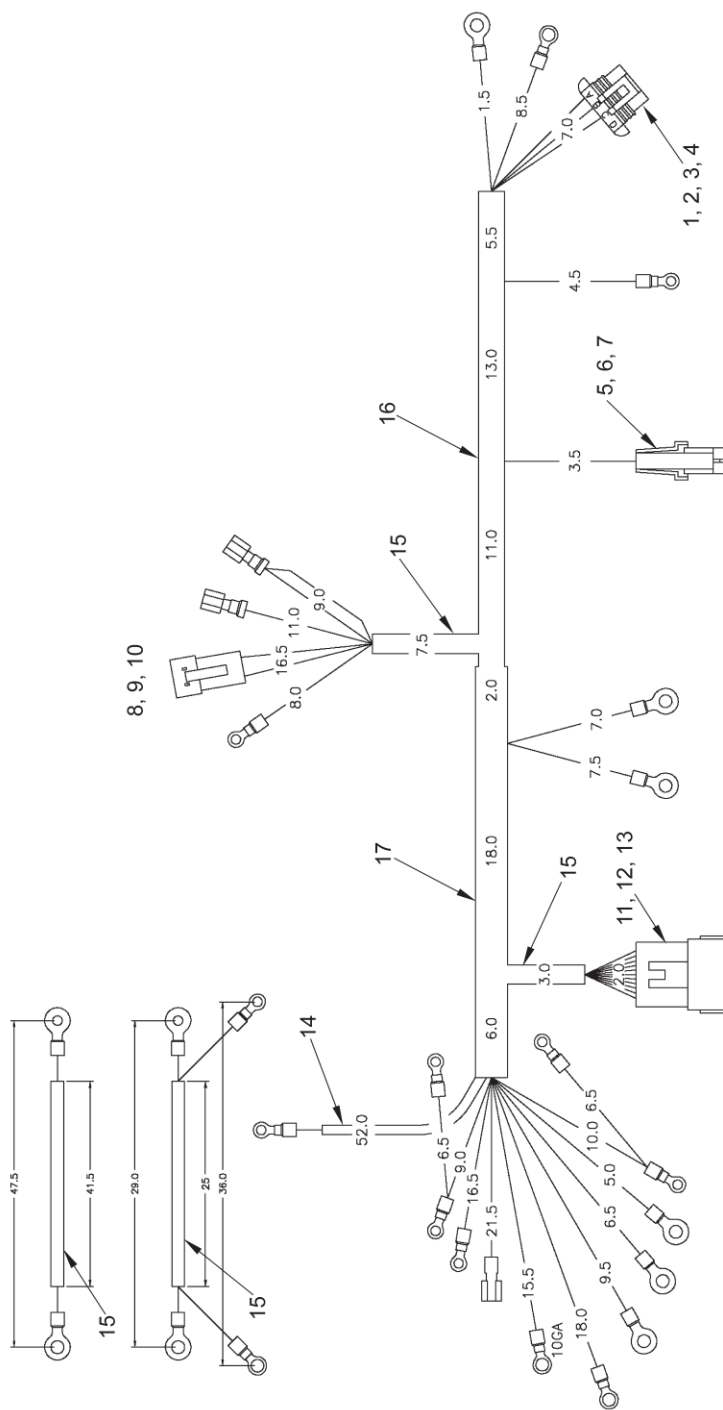


FIGURE 25.
HARNISS, ENG, QSB6.7

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
25-	47820	Harness, Eng, QSB6.7		Ref
1	45051	Connector, El, M-Pak 150, Body, F, 4Way		1
2	45028	Connector, El, M-Pak 150, Cavity Plug		1
3	206098	Connector, El, M-Pak 150, Skt, 16-20 Awg		3
4	206099	Connector, El, M-Pak 150, Seal, 16-18 Ga		4
5	45666	Connector, El, W-Pak, Body Shroud, 1Way		1
6	37309	Connector, El, W-Pak & 280, Seal, 16-18 Ga		1
7	37307	Connector, El, W-Pak, Pin, 14-16 Awg		1
8	46261	Connector, El, Deutsch, P, DTP06-4S		1
9	206101	Connector, El, Deutsch, Seal Plg, 12-16		2
10	308070	Connector, El, Deutsch, Skt, 12-14		2
11	45018	Connector, El, Deutsch, Recp, DT04-12PA		1
12	206116	Connector, El, Deutsch, Pin, 14-16 Awg		11
13	206101	Connector, El, Deutsch, Seal Plg, 12-16		1
14	2.3478	Loom 0.25 ID Flexguard		52"
15	2.3366	Loom 0.50 ID Flexguard		78"
16	2.3364	Loom 0.75 ID Flexguard		16"
17	2.3820	Loom 1.00 ID Flexguard		26"
NS	2.1034	Wire 4 Ga Blk Sgx, J1127		139"
NS	2.1033	Wire 6 Ga Blk Sgx, J1127		77"
NS	2.0865	Wire 10 Ga Blk Gxl		80"
NS	2.1514	Wire 12 Ga Blk Gxl		176"
NS	F002958	Wire 16 Ga Blk Gxl		217"
NS	F009793	Wire 16 Ga Blu Gxl		44"
NS	F101787	Wire 16 Ga Lt Blu Gxl		41"
NS	F009794	Wire 16 Ga Red Gxl		95"
NS	F101531	Wire 16 Ga Brn Gxl		54"
NS	F009797	Wire 16 Ga Wht Gxl		91"

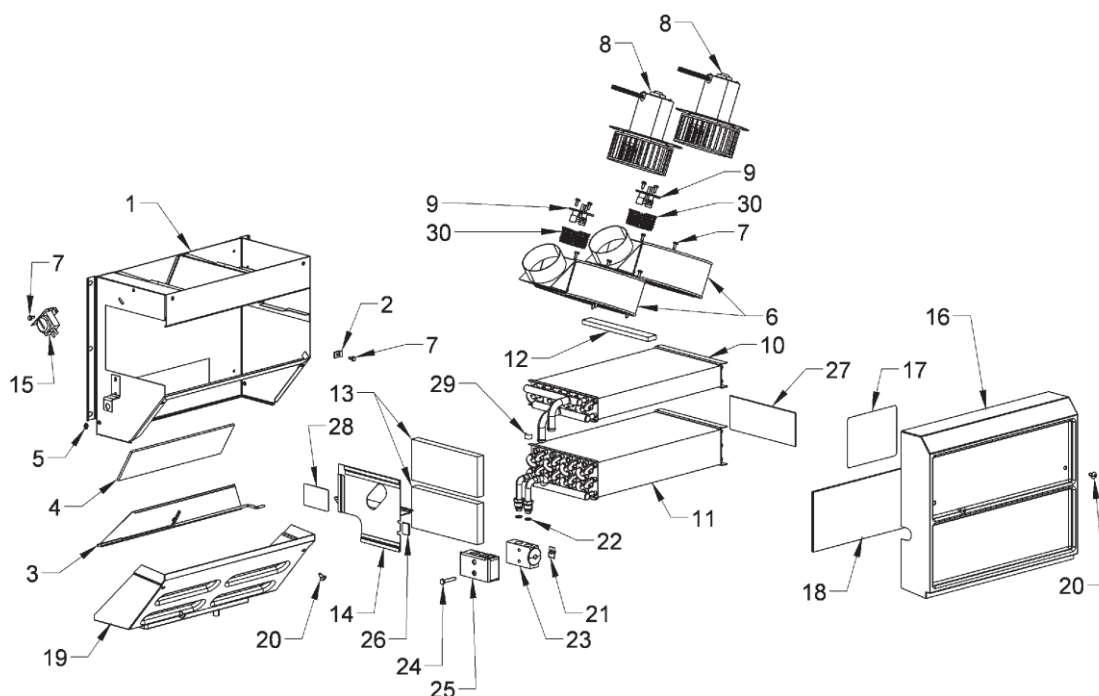
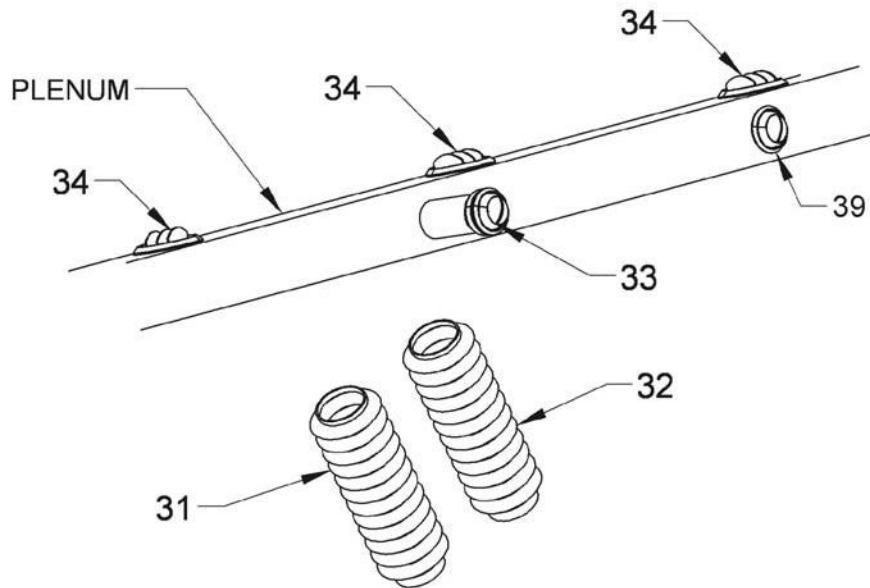


FIGURE 26.
HEATER/AC ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
26-	47195	Heater/AC, R-5040, RD-3-2650		1
	47196	Heater, Cab, Backwall		1
1	47195-10	Housing Assy, RD-3-2649-0		1
2	47195-11	Clip - Conduit, RD-4222-0		1
3	47195-12	Fresh Air Door Assy, RD-3-3184-0		1
4	47195-13	Gasket, Door, Fresh Air, RD-3-3183-0		1
5	47195-14	Retainer, Control Cable, RD-4221-0		1
6	47195-15	Blower Assy, RD-3-2220-0		2
7	47195-16	Screw, 10-32 Hew Wshr Hd, RD-5-4062-1-.5		22
8	47195-17	Motor Blower Assy, RD-3-3731-0		2
9	47195-18	Resistor, Speed Control, Single Fan, RD-5-3647-0		2
10	47195-19	Core - Heater, RD-1-0325-0		1
11	47195-20	Evaporator Assy, RD-2-1370-0 (47195 Only)		1
12	47195-21	Gasket, Cover Seal, RD-3-5658-0		1
13	47195-22	Gasket, Evap & Core, RD-5-4253-0		2
14	47195-23	Cover Assy - Core, RD-3-2652-0		1
15	47195-24	Thermostat, Side & Bot Mntd, RD-5-4531-24		1
16	47195-25	Core Cover - Plastic, RD-3-2415-2		1
17	47195-26	Label, Parts List, RD-3-2703-0		1
18	47195-27	Gasket, Cover & Housing, RD-3-2426-0		1
19	47195-28	Air Intake Cover Assy, RD-3205-29		1
20	47195-29	Screw, 1/4-20 Unc Truss Hd Torx Dog Pt, RD-5-4095-1-.5		4
21	47195-30	Nut, 1/4-20 Spring, Floating, RD-5-4305-0		1
22	47195-31	O-Ring, No 8, Green Hnbr, RD-5-4017-013		2
23	47195-32	Valve, Expansion R134A, RD-5-6868-0		1
24	47195-33	Screw, 1/4-20 Unc-2A HHC, RD-5-4061-0-1.5		1
25	47195-34	Cover - Expansion Valve, RD-5-8410-0		1
26	47195-35	Weatherstripping, 1/8 X 3/4, RD-5-6848-1		1
27	47195-36	Gasket, Evaporator & Core, RD-3-2177-0		1
28	47195-37	Label, Quality Audited, RD-5-4606-0		1
29	47195-38	Label, Inlet, .28 Lttrs, .75 Tape, RD-5-3880-0		1
30	47195-39	Guard, Resistor, RD-3-8113-0		2
NS	47195-40	Hose. Drain, 7/16 X 9/16, RD-5-3550-12		1
NS	47195-41	Tape, Refrigeration, RD-5-4058-10		1
NS	47195-42	Tube, 1/8 ID, RD-5-3816-18		1
NS	47195-43	Sealant, Tamper Proof, RD-5-6327-0		A/R



1 EMI SUPPRESSION COMPONENTS ON CAB BLOWER ASSEMBLY

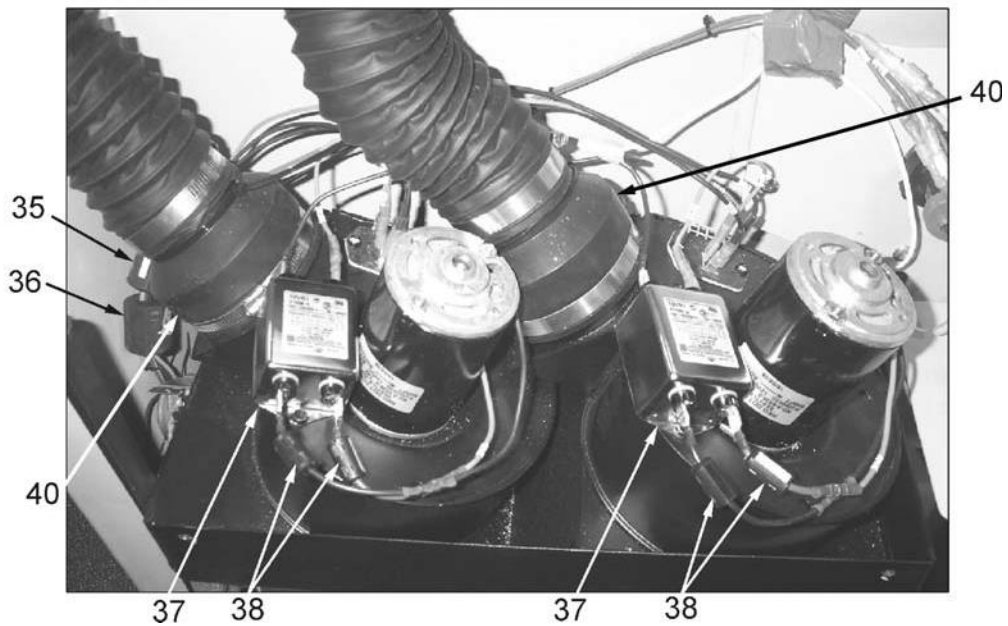


FIGURE 27.
AIR DUCTING/HEAT PLUMBING
SUPPRESSION, EMI, RED DOT 5040

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
27-	47832	Air Ducting/Heat Plumbing		1
1	49439	Suppression, EMI, Red Dot 5040 Blowers (inc 35-38)		1
31	F101685	Hose, 2.00 ID, Flex, Defrost		8"
32	45070	Hose, 3.00 ID, Flex, Defrost		16"
33	37206	Louver, Ball, 2" Hose		1
34	47843	Diffuser, 3" Dash		3
35	48597	Ferrite, MF, Rnd, .51 ID, Snap-On		1
36	48598	Ferrite, LF, Rnd, .51 ID, Snap-On		1
37	48596	Filter, RFI, Power Line, 10A		2
38	48599	Ferrite, MF, Rnd, .20 ID, Snap-On		4
39	37205	Louver, Ball		1
40	48418	Ftg, P, 48F-32F, Rubber		2
NS	9.0027	Hose 0.62 Heater		240"
NS	46582	Ftg, Hyd, 08MP-06FP90		1
NS	3.0241	Ftg, Hyd, 12MP-08FP		1
NS	F100941	Clamp, Hose, #10, .50-1		6
NS	48257	Kit, Cntrl, Valve, Heater		1
NS	F103726	Ftg, P, 10H-06MP, BRS		1
NS	45006	Ftg, Duct, 3.0M		2
NS	F103142	Ftg, P, 10H-08MP90, BRS		1

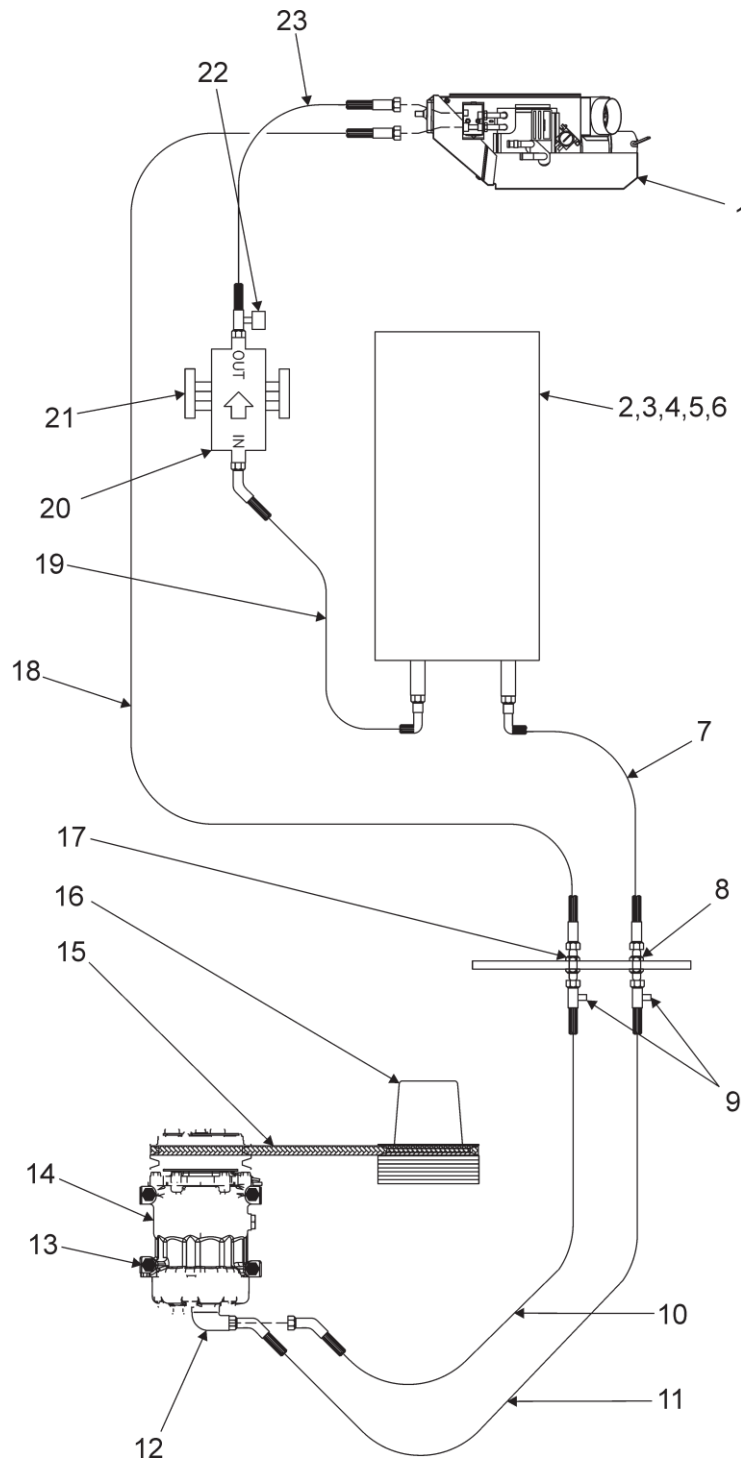


FIGURE 28.
CAB HEAT & AIR CONDITIONER ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
28-	47191	Grp, Cab Heat and A/C (Inc 1-23)		1
1	47195	Heater, Cab, Backwall (See Figure 25)		4
2	47202	Condensor, A/C, Multiflo		1
3	47990	Condenser Mnt Wldmnt		1
4	47991	Condenser Mnt Wldmnt		1
5	48743	Spacer, Cond Fan Gaurd		8
6	48744	Nut, Cage		8
7	48300	Hose Assy, AC, #8, 13"		1
8	48302	Ftg, Bulkhead, #8M		1
9	48853	Out Svce, Charge Air Cond, MB2		1
10	48299	Hose Assy, AC, #10, 37"4		1
11	48298	Hose Assy, AS, #8, 36", 4		1
12	48760	Manifold		1
13	47207	HHCS, M8x1.25 x 100M		1
14	47194	Compressor, A/C		1
15	47228	Belt V, A/C 7420 13/32 x 42-5/8		1
16	47200	Engine, Cummins QSB6.7-1		1
17	48303	Ftg, Bulkhead, #10M		1
18	48301	Hose Assy, AC, #10, 121"		1
19	48297	Hose Assy, AC, #6, 67", 4		1
20	48256	Dryer, A/C		1
21	48304	Brkt Dryer, AC		1
22	48305	Switch, Binary, AC		1
23	48296	Hose Assy, #6, 13 STM/S		1

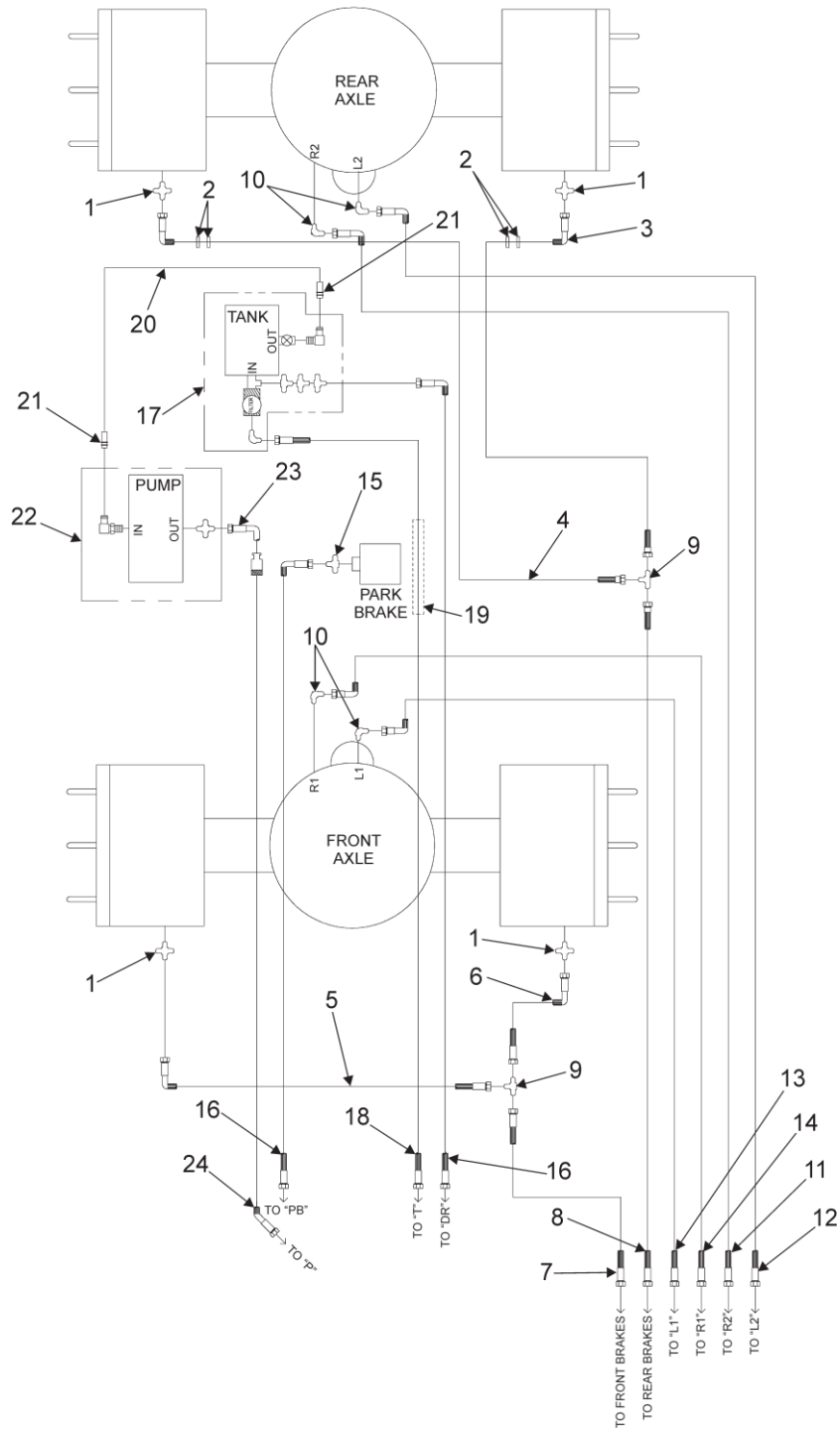


FIGURE 29.
HYDRAULIC DIAGRAM

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
29-	47812	Chassis Hydraulic Assy, 400MB2		1
1	45112	Ftg, Hyd, 14MM-04MJF45JT, 94350		4
2	3.1075	Clamp, Loop Type, 1/2"		6
3	14762.32	Hose Assy, #4M, 76.00", ST/90, 36911		1
4	14762.54	Hose Assy, #4M, 82", ST/90		1
5	14762.19	Hose Assy, #4M, 52.00", ST/90, D13ZI36629		1
6	14762.50	Hose Assy, #4M, 24.50", ST/90, 36220		1
7	14762.52	Hose Assy, #4M, 32" ST/ST		1
8	14762.53	Hose Assy, #4M, 92", ST/ST		1
9	301224	Ftg, Hyd, Tee, 04MJ-04MJ-04MJ		2
10	47878	Ftg, Hyd, Elbow, 06MJ-16MMAORB90, T55JS67485		4
11	8796.105	Hose Assy, #6M, 147.50", ST/90, D13ZI36569		1
12	8796.130	Hose Assy, #6M, 142", ST/90		1
13	8796.107	Hose Assy, #6M, 56.00", ST/90, D13ZI36571		1
14	8796.131	Hose Assy, #6M, 67", ST/90		1
15	48111	Ftg, Hyd, 06FFSS-06MJ, A40NS15011		1
16	8796.132	Hose Assy, #6M, 138", ST/90		2
17	47209	Tank Assy, Hydraulic, 400MB2 (Also See Figure 30)		1
18	48422.2	Hose Assy's, #16M, 131" ST/ST		1
19	RF090896	Sleeve Alum Fbrglas 2.50		24
20	48420	Hose, Hyd, #24L 24.0"L, 100R4		1
21	F101122	Clamp, Hose, #24, 1.06-2.00, IDEAL 5724		4
22	47823	Hyd Pump Assy, M400, Funk		1
23	91906	Ftg, Hyd, 12MJ-12FJX90		1
24	48422.1	Hose Assy's, #16M, 129" 12ST/45		1

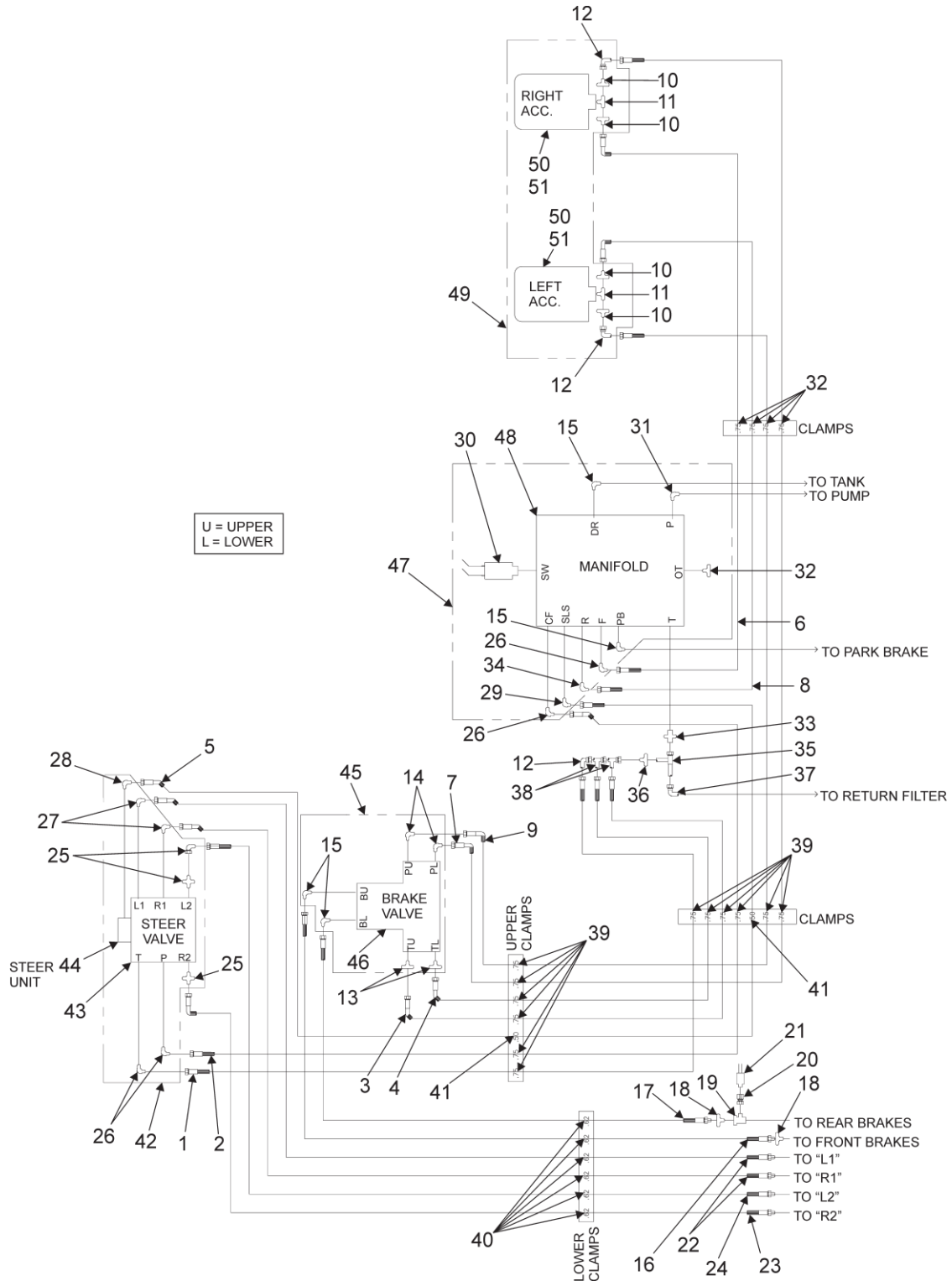


FIGURE 30.
CAB HYDRAULIC ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
30-	47836	Cab Hydraulic Assy, 400MB2		1
	47826	Brake Pedal Assy, 400MB2		1
1	8797.112	Hose Assy, #8M, 82.00"ST/45		1
2	8946.36	Hose Assy, #8M, 82.72",ST/ST		1
3	8797.113	Hose Assy, #8M, 84.00", ST/45		1
4	8797.12	Hose Assy, #8M, 93.32", ST/45		1
5	14762.55	Hose Assy, #4M, 101", ST/45		1
6	8797.3	Hose Assy, #8M, 46.58",ST/90, D13ZI36040		1
7	8797.114	Hose Assy, #8M, 120" ST/90		1
8	8797.1	Hose Assy, #8M, 46.08", ST/90, D13ZI36041		1
9	8797.115	Hose Assy, #8M, 116" ST/90		1
10	NW033945	Ftg, Hyd, 12FJ-08MJ, 221501-12-8S		4
11	1008303	Ftg, Hyd, Tee, 12MJ-12MJ-12MB		2
12	3.2241	Ftg, Hyd, 08MJ-08FJX90		3
13	201048	Ftg, Hyd, 08MJ-06MB, A40JT45935		2
14	NW033129	Ftg, Hyd, 06MB-08MJ90, 6MB-8MJ90		2
15	3.2878	Ftg, Hyd, 06MB-06MJ90 (V00565), A40JT53990		4
16	48417.1	Hose Assy, #66M, 56.00 ST/ST		1
17	48417.2	Hose Assy, #6M, 58.00 ST/ST		1
18	3.2941	Ftg, Hyd, 06FJ-04MJ		2
19	3.2966	Ftg, Hyd, Tee, 04MJ-04FJX-04MJ, A40JT52880		1
20	42794	Ftg, Hyd, 02FP-04FJX		1
21	37838	Switch, Press, 60# SPNO, XM2A-60R-QC-32		1
22	48417.3	Hose Assy, #6M, 66.00 ST/45		2
23	48417.4	Hose Assy, #6M, 58.00 ST/90		1
24	48417.5	Hose Assy, #6M, 62.00 ST/90		1
25	3.2519	Ftg, Hyd, 06MJ-08MB (V00565), A40ZI36001		2
26	91930	Ftg, Hyd, 08MJ-08MB90, T55JS18570		2
27	NW036560	Ftg, Hyd, 08MB-06MJ90 (V00565), P80JT07200		2
28	90424	Ftg, Hyd, 04MJ-04MB90 (V00565), A40JT53690		1
29	NW036184	Ftg, Hyd, 04MJ-06MB90, 849-FS0-6-4		1
30	47210	Switch, Press, 1250# SPDT, XM-11C-1250F/M		1
31	NW030992	Ftg, Hyd, 16MJ-16MB90, P80JT07230		1
32	207820	Ftg, Hyd, Plug, 10MB, 6408-10-0		1
33	NW030842	Ftg, Hyd, 16MB-16MJ, A40JT45185		1
34	90375	Ftg, Hyd, 08MJLL-08MB90, A40JT54620		1
35	203857	Ftg, Hyd, Tee, 16MJ-16FJX-16MJ		1
36	203846	Ftg, Hyd, 16FJ-08MJ		1
37	203855	Ftg, Hyd, 16MJ-16FJX90		1
38	3.2679	Ftg, Hyd, Tee, 08MJ-08FJX-08MJ (V00565), A40JT52970		2
39	205916	Clamp, Strut, Hyd Tube, .75", 100075		16
40	205917	Clamp, Strut, Hyd Tube, .62", 100062		6
41	207193	Clamp, Strut, Hyd Tube, .50", 100050		2
42	47212	Steering Assy, Cab, M400		Ref
43	44928	Valve, Steering Mode, Series 10		1
44	47329	Steer Unit, 22.6 CI, LS		1
45	47826	Brake Pedal Assy, M400		Ref
46	47184	Pedal, Brake, Hydraulic, 06-466-233		1
	47103	Brkt, Brake Pedal Mnt,400MB2		1
	48509	Pedal, Brake, Hydraulic		1
47	47825	Hyd Manifold Assy, M400		Ref
48	47198	Manifold, Hyd, Brake, Steer, Charg, VA1549-08-REVX		1
	47854	Cover, Manifold Access, 400MB2		1
49	47203	Accumulator Assy, Brakes, M400		Ref
50	47199	Accumulator, 1Gal, 900# Precha, SB350250-3.5E1		2
51	1.7304	Band, Mnt, Air Filter		2
52	3.2143	Ftg, Hyd, 06MJ-06FJX90		1

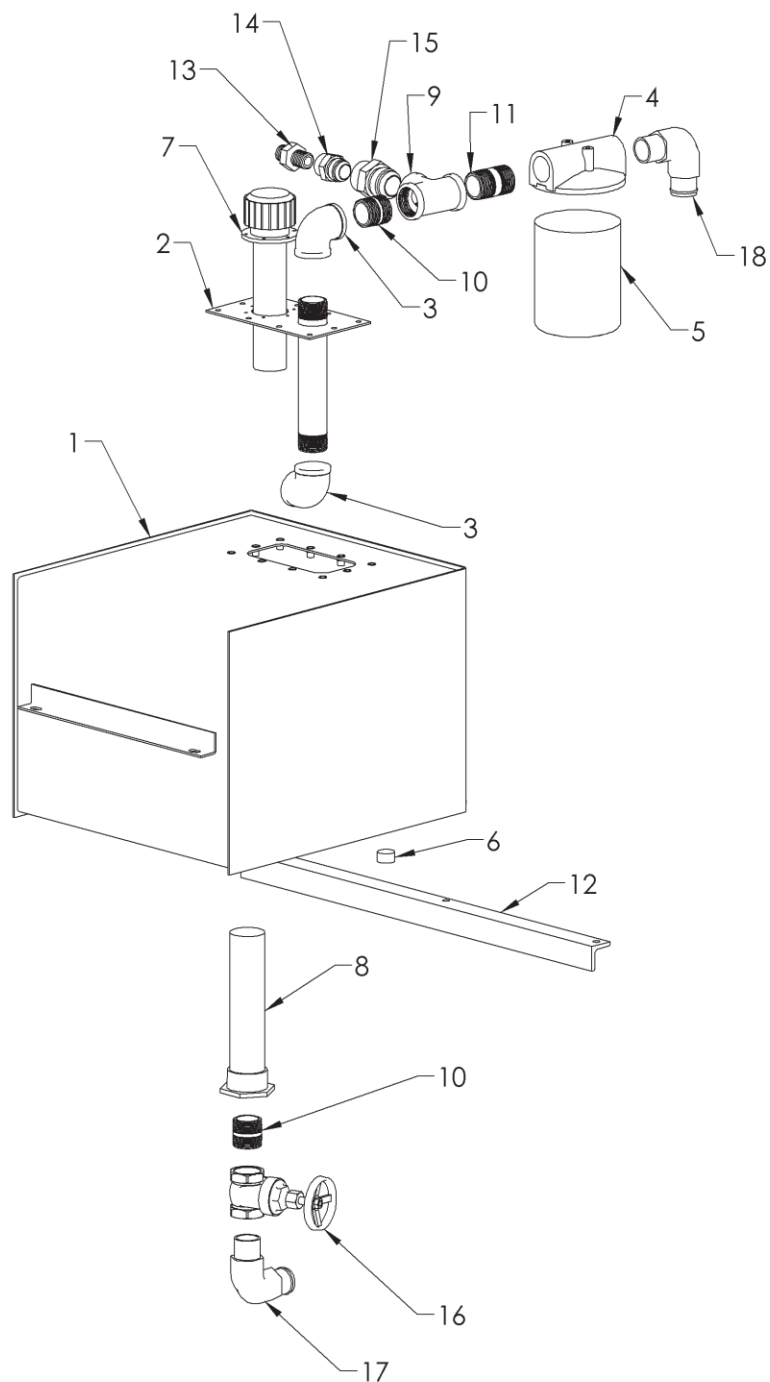


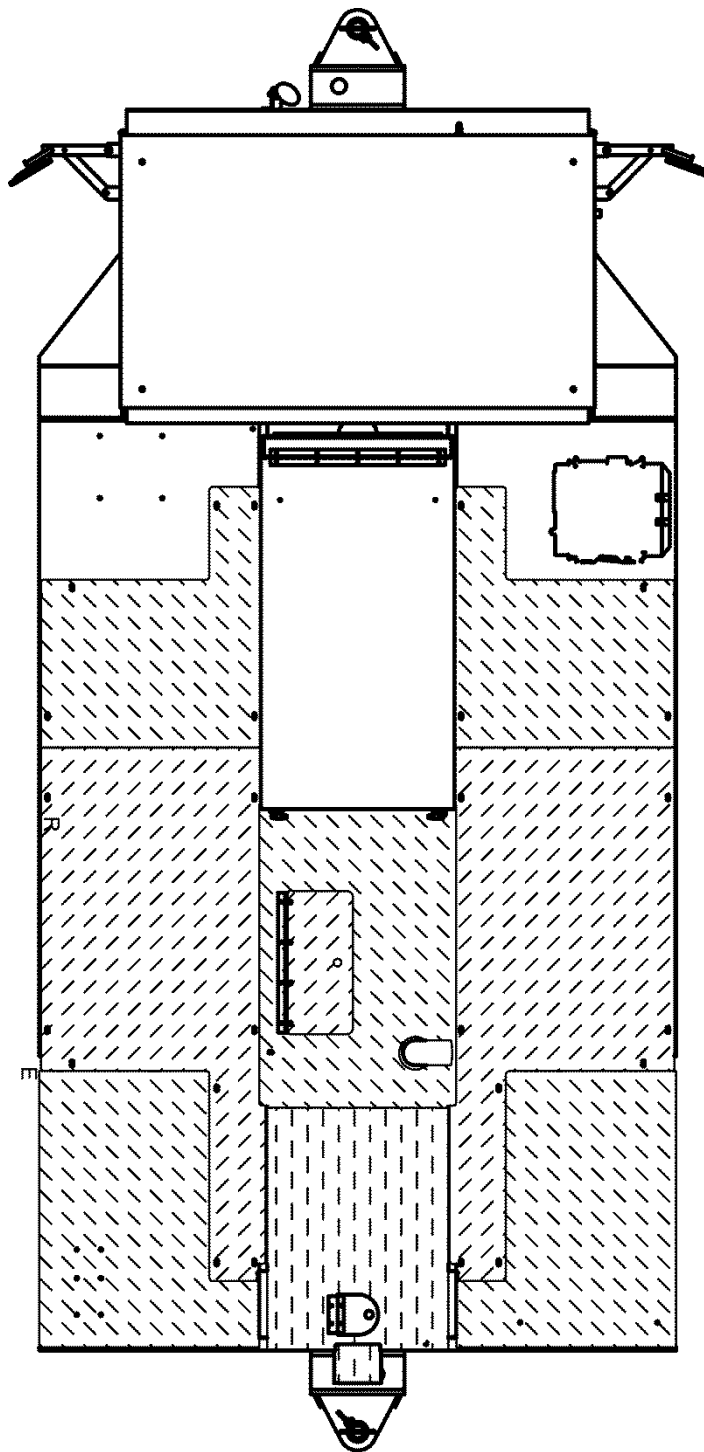
FIGURE 31.
HYDRAULIC TANK ASSEMBLY

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
31-	47209	Tank Assy, Hydraulic, 400MB2 (Also See Figure 29)		1
1	47460	Tank Wldmnt, Hyd, 20 Gal, 400MB2		1
2	47665	Cover Wldmnt, Hyd Tank, 400MB2		1
2	45116	Gasket, Cover, Hyd Tank, 200MB4V2		1
3	48424	Ftg, Pell, 20FP-20FP, BIP		1
4	NW036355	Head, Oil Filter, SF-120-25-0		1
5	NW036354	Filter, Oil, F5068-10C		1
6	39185	Plug, Magnetic, 3/4 NPT, Sq Dr (69633), 090-101		1
7	43414	Fill Unit, w/8" Basket/7.5" Dipst, FBA-2-8S-D		1
8	200049	Strainer, Tank Mntd, 2x1.125NPT		1
9	48423	Ftg, P, Tee, 20FP-20FP		1
10	48421	Nipple, 1.25, NPT, Cls, Sch40, BIP		2
11	1008558	Ftg, P, N, 20MP-3" L, BIP		1
12	48696	Angle, Hyd Tank Mnt		1
13	3.1576	Ftg, Hyd, 06MJ-08MP		1
14	NW035604	Ftg, P, N, 12MP-08FP, BIP		1
15	3.0828	Ftg, P, 20MP-12FP, BIP		1
16	1.4435	Valve, Gate, Brass		1
17	48419	Ftg, Hyd, 24HB-20MP90		1
18	202010	Ftg, Hyd, 16MJ-20MP90		1

Illustration Not Available At Time Of Publication.

**FIGURE 32.
WINTERIZATION OPTION**

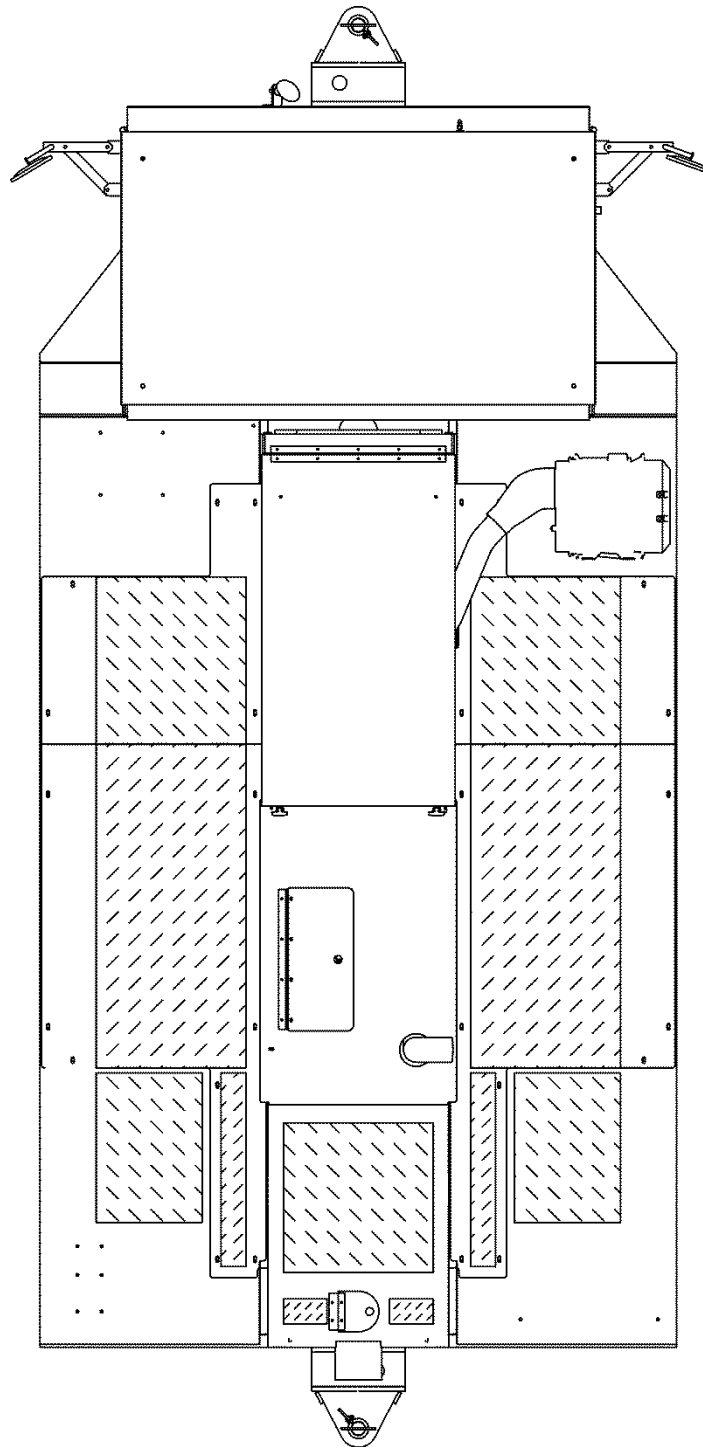
Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
32-	47187	Opt,Hd. Winterization,400MB2		1
	45370	Heater,Battery,Blanket,28"		2
	562A54	Placard,110v,AC-Only		1
	2.0176	Connector,1/2"Hub		2
	2.0177	Connector,Cord		1
	45459	Cord,Power,14/3,125v/15a,6 Ft		1
	45460	Box,W/Proof,1/2,5-Out,4",Round		1
	45461	Cover,Box,W/Proof,Blank,4",Rnd		1
	41856	Cord,Block Htr,16/3,120v,6 Ft		1
	45465	Terminal,Butt, 8 Ga,Insulated		3
	F101125	Clip,Insul,.62 Id, .34 Hole		2



47003-51595-Anti-Skid-SprayedGrit.cdr

FIGURE 33.
ANTI-SKID, TOP, SPRAYED GRIT, OPTION

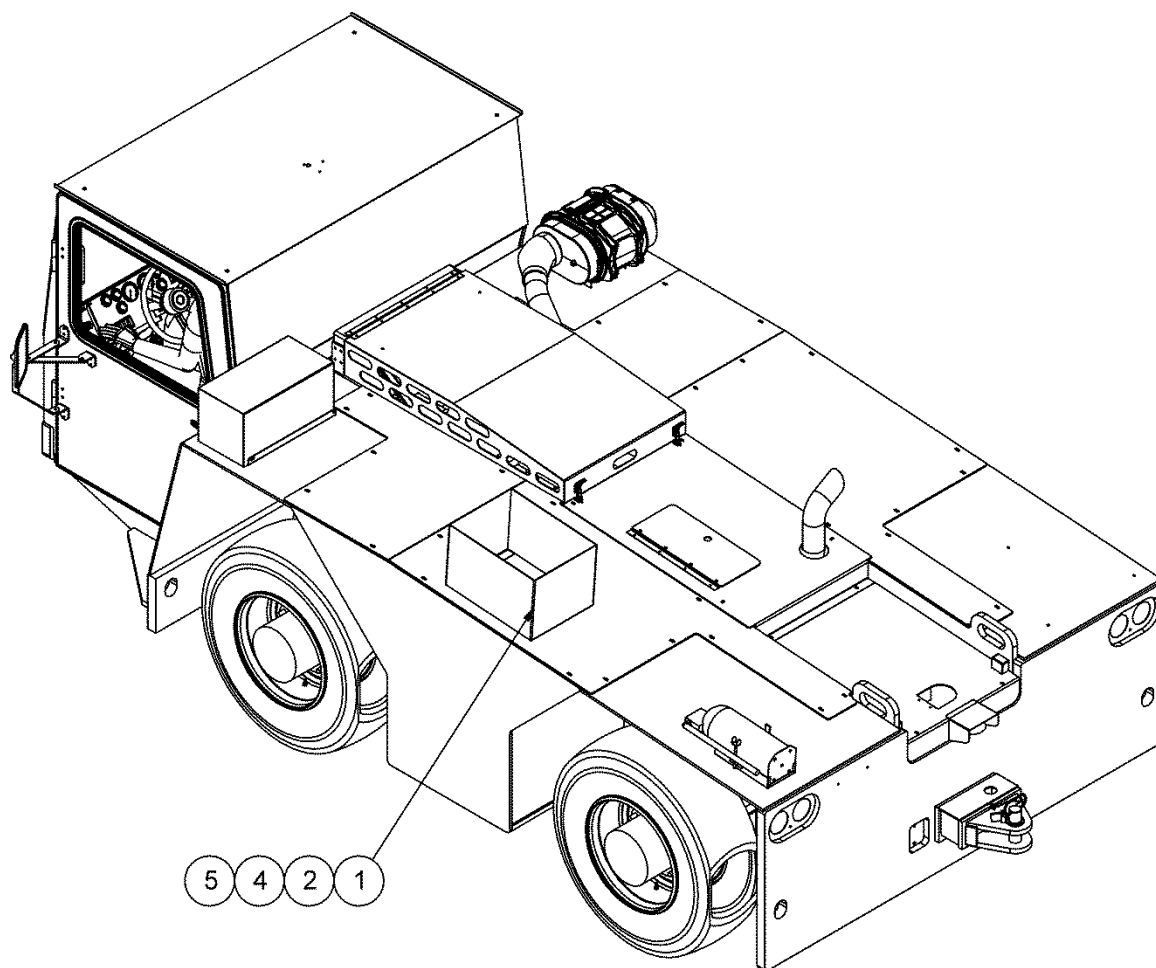
Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
33-	51595	Anti-Skid, Top, Sprayed Grit, Option	B	Ref



47003-51103-ANTI-SKID.CDR

FIGURE 34.
ANTI-SKID, TOP, SAFETYWALK, OPTION

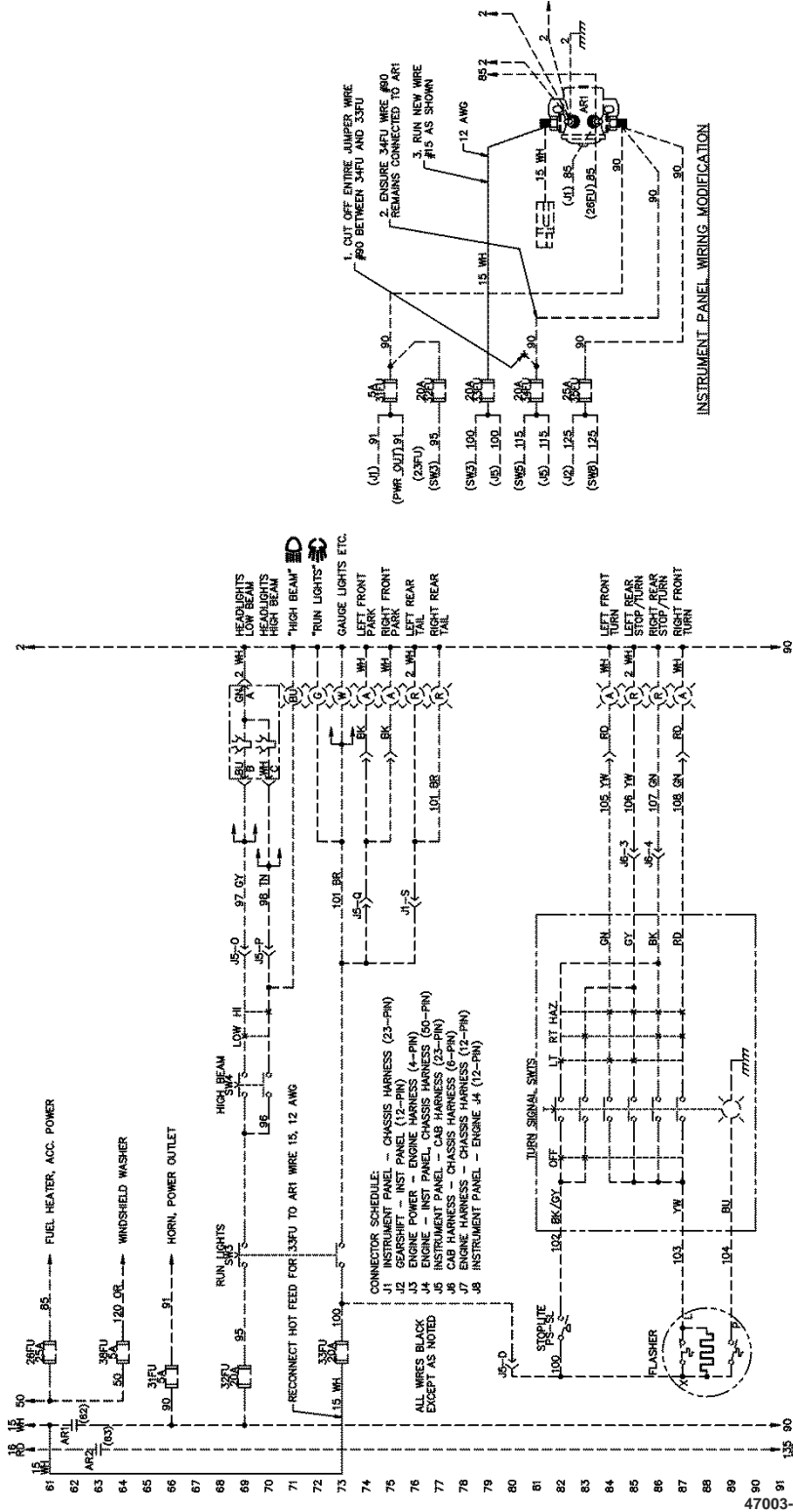
Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
34-	51103	Anti-Skid, Top, Safetywalk, Option	D	Ref
	9.0598	Safetywalk GP Black 6		214"
	9.2078	Safetywalk GP Black		109"



47003-51104-ChockBox.cdr

FIGURE 35.
CHOCK BOX, OPTION

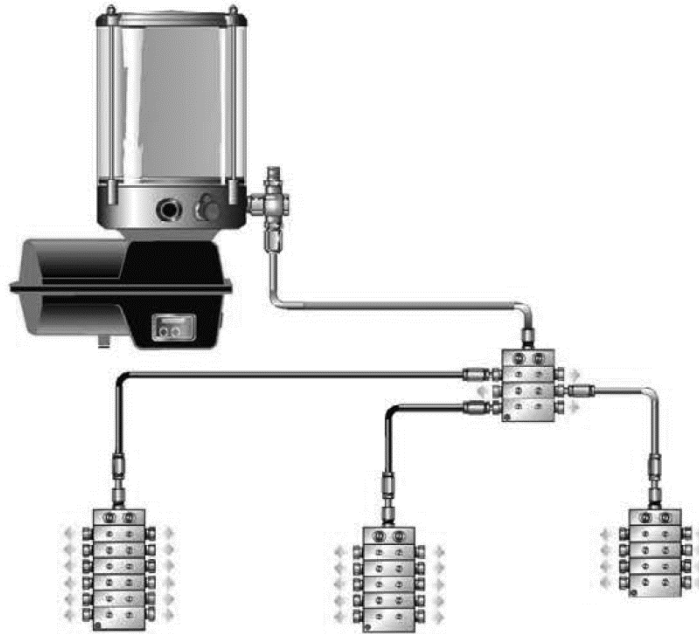
Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
35-	51104	Chock Box, Option	D	1
1	51105	Tray Weldment, Chocks		1
2	208474	Nutsert, 3/8-16,0.150-0.312 Grip, Open		4
3	51169	Cover Mod, Bin, Rear,w/Chock Box		1
4	F100311	HHCS,3/8-16 X 1.00		4
5	F1009669	FW,3/8 Std,ZC		4



SCHEMATIC MODIFICATIONS REF.

FIGURE 36.
HOT-WIRED HAZARD LIGHTS, OPTION

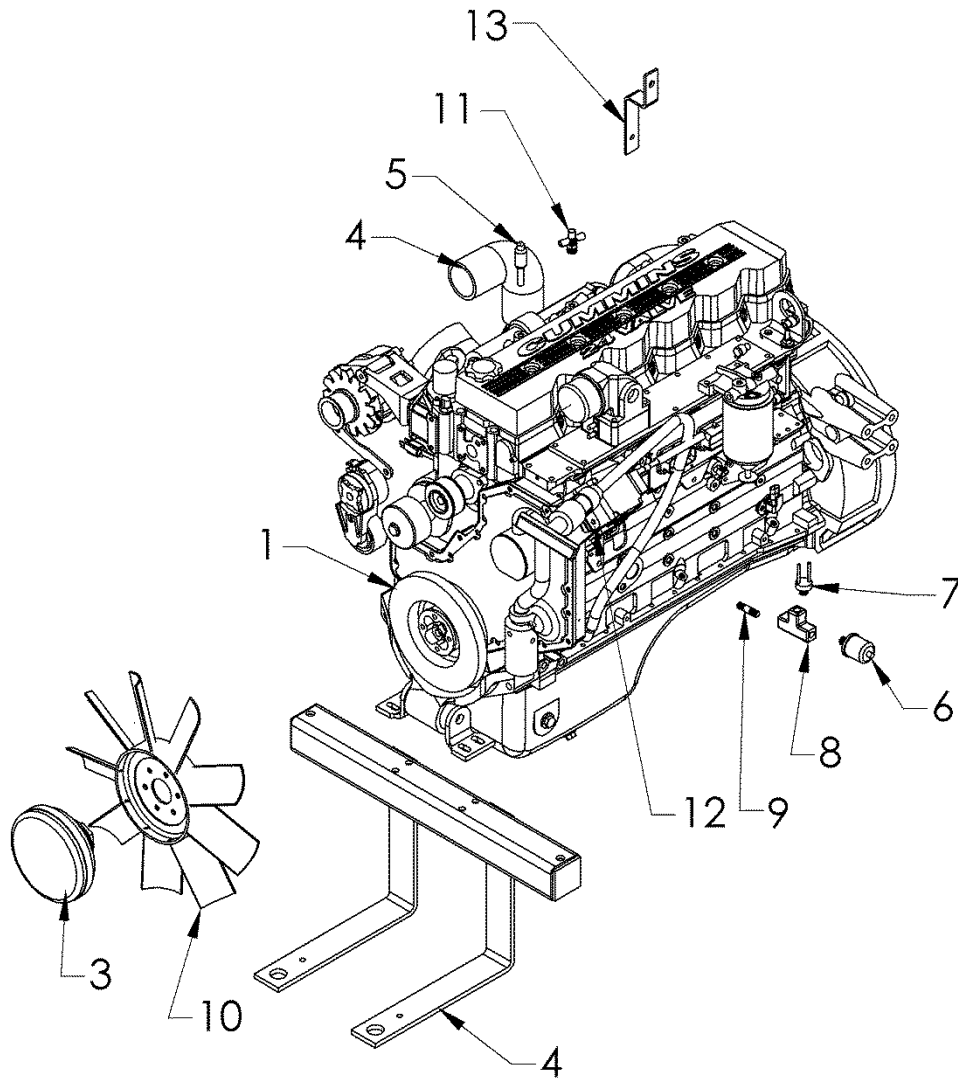
Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
36-	51588	Hot-Wired Hazard Lights, Option	B	1



47003-51589-LubeSystem.cdr

FIGURE 37.
LUBE SYSTEM, AXLE AUTOMATIC, OPTION

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
37-	51589	Lube System, Axle Automatic, Option	B	Ref
	51590	Kit, Autolube, Beka-Max		1



Special Handling

1. The fan clutch assembly must be handled carefully or damage will result. The clutch is packed in individual cartons marked “this side up”, and arrows on each side of the carton pointing up. The carton must be handled and stored accordingly.
2. When storing or handling the fan, do not tip it more than 40° as shown on the following figure.

If the fan clutch has been improperly stored or handled, silicone fluid will leak out. If there is evidence of fluid leakage, the drive must be rejected and sent back to the manufacturer for repair.

FIGURE 38.
ENG/TRANS ASSY, CUMMINS, TIER III

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
38-	47017	Eng/Trans Assy, Hyd Brakes		Ref
1	47200	Engine, Cummins, QSB6.7-190, w/ AC, (03718) (USAF)		1
	47201	Engine, Cummins, QSB6.7-190, w/o AC, (USAF)		1
	50170	Engine, Cummins, QSB6.7-190, w/AC, TPEM (Commercial)		1
	50171	Engine, Cummins, QSB6.7-190, w/AC, Export (Commercial)		1
	50175	Engine, Cummins, QSB6.7-190, No AC, TPEM Commercial)		1
	50176	Engine, Cummins, QSB6.7-190, No AC, Export Commercial)		1
2	47057	Mount Wldmnt, Eng Front		1
3	50562	Drive Assy, Fan, Viscous (Horton), 9802019	1	1
4	46574	Ell, Turbo		1
5	NW030236	Sender,Temp, Hi-Range, 1/4NPTF (16476), 02023-000		2
6	F101527	Sender, Oil PSI, 0-80, 1/8NPT(V00523)		1
7	NW021649	Switch, Oil Pressure, Hourmeter (13445), 8647		1
8	3.1820	Ftg, Hyd, Tee, 02MP-02FP-02FP (V00565), 5602-02-02-02		1
9	41528	Ftg, Hyd, M10B-02 NPT (48849), 9235-10-01		1
	41529	O-Ring, M10 (48849), 90\500-10MM		1
10	44911	Fan, Suction, 23.6", 9 Blade (Horton), 985600503		1
11	F100669	Valve,Drain Cock,1/4"		1
	3.0235	Ftg,Hyd,08MP-04FP		1
12	F101115	Clip, Insulated, .44 ID		1
13	48851	Brkt, Hose Mnt		1
NS	44900-1	Fan Drive Mounting (Inc. 4 Screws Below), FA9718-04		Ref
		Screw, Hex Flange Head Cap, M10 x 1.50 x 20, 3903990		4
NS	203109	Spacer, Brake Lever		1
NS	46410	Sender/Switch Assy, Oil, Cummins		1

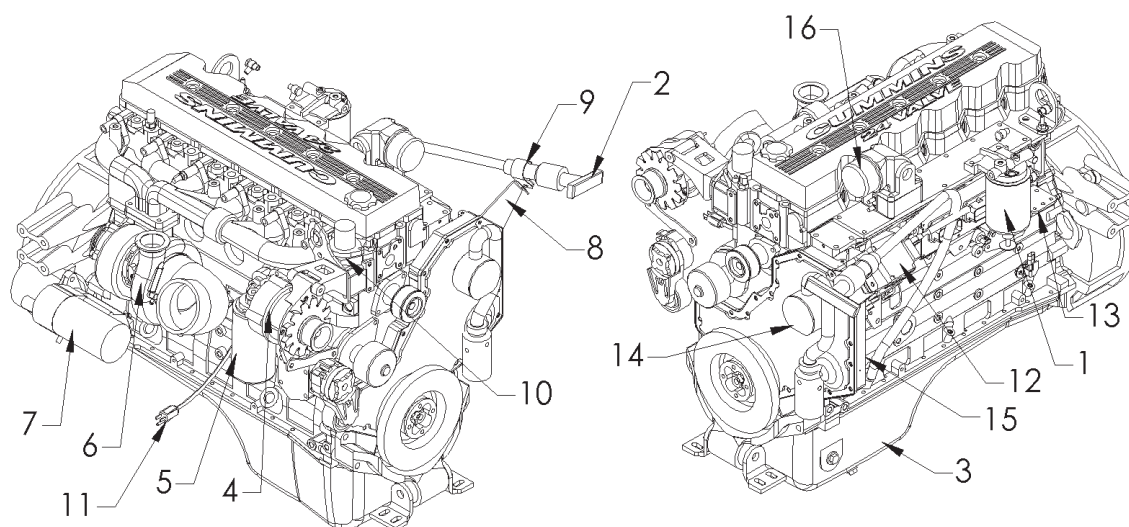
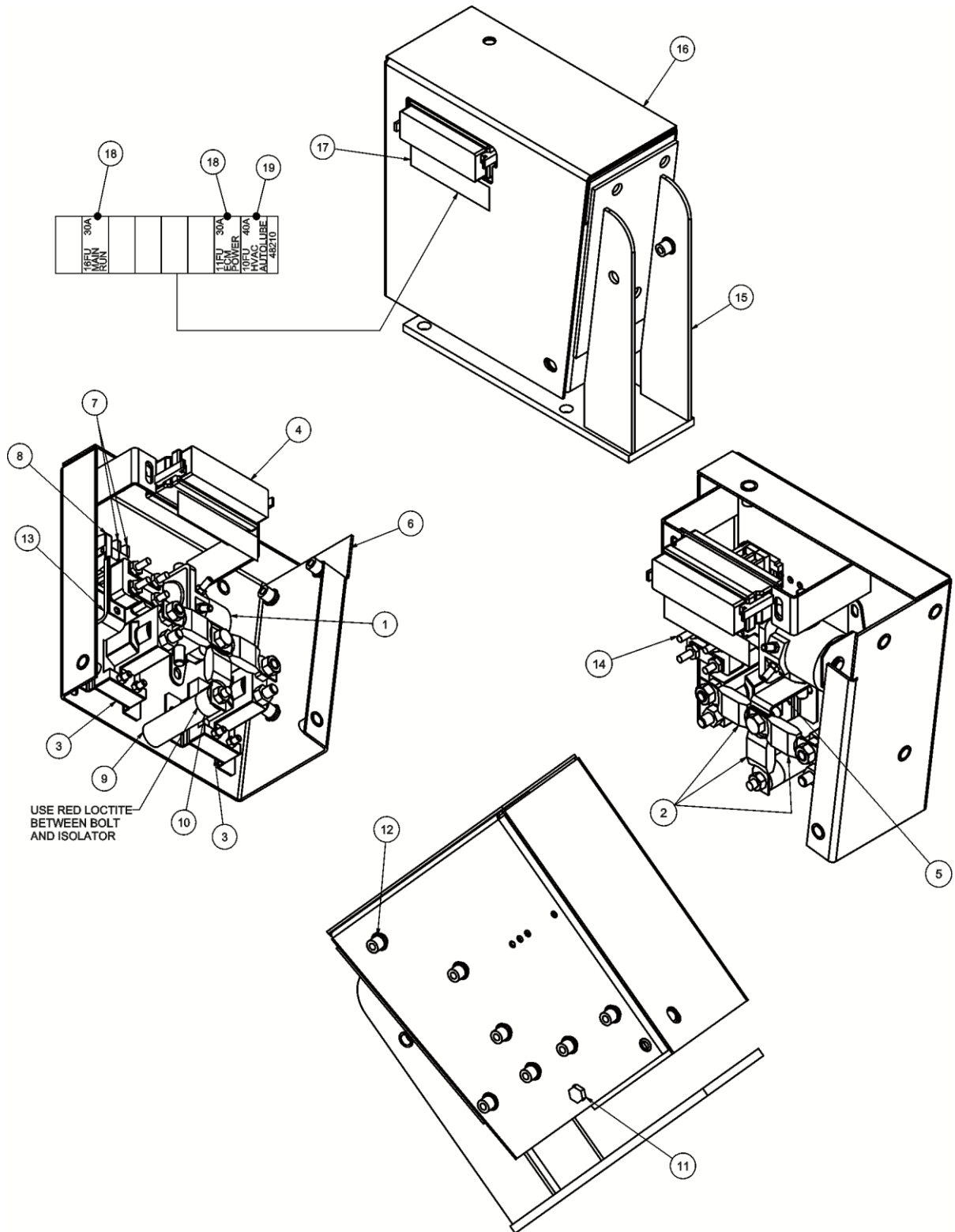


FIGURE 39.
ENGINE REPAIR PARTS, CUMMINS QSB6.7

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
39-	47200	Engine, Cummins, QSB6.7-190, w/ AC, Tier III (03718) (USAF)		Ref
	47201	Engine, Cummins, QSB6.7-190, w/o AC, Tier III (USAF)		Ref
	50170	Engine, Cummins, QSB6.7-190, w/AC, TPEM (Commercial)		Ref
	50171	Engine, Cummins, QSB6.7-190, w/AC, Export (Commercial)		Ref
	50175	Engine, Cummins, QSB6.7-190, No AC, TPEM Commercial)		Ref
	50176	Engine, Cummins, QSB6.7-190, No AC, Export Commercial)		Ref
1		Fuel Filter		1
2	44679-3	Dipstick, Cummins		1
3	46393	Oil Pan Kit, Inc Gasket		1
4	44679-4	Alternator, 12V/95 Amp		1
	44679-6	Alternator Belt		1
	44679-7	Pulley, Alternator		1
5	44679-8	Element, Oil Filter		1
6	44679-9	Turbo		1
	44679-113	Gasket, Turbocharger		1
7	44679-10	Starter		1
8	45193	Dipstick Mount		1
9	F101134	Clip, Loom		1
10	44679-237	Thermostat w/ Seal		1
	44679-238	Seal, Thermostat		1
11	44679-239	Coolant Heater w/Cable		1
	44679-141	Cable, Eng Heater		1
12	44679-240	Fuel Injection Pump		1
13	44679-245	Pump, Fuel Transfer		1
	44679-204	Gasket, Cover Plate		1
	44679-236	Washer, Sealing, 4 Coupling		1
	44679-219	Coupling, Hose		1
14	44679-241	Oil Filler Arrangement		1
	44679-112	Plug, Expansion		1
	44679-242	Breather, Crankcase		1
	44679-124	Seal		1
15	44679-243	Accessories Cover w/ Gasket		1
	44679-179	Gasket		1
16		Air Intake Connection		1
		Screw, Hex Flange Head Cap, M8 x 1.25 x 80		4
		Intake		1
		Tag, Instruction		1
		Heater, Intake Air		1
		Gasket, Connection		2
		Plug, Pipe, 3/4NPT		2
NS		Oil Pump		1



**FIGURE 40.
PANEL ASSEMBLY, ELECTRIC, CUMMINS B6.7QSB**

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
40-	47821	Panel Assy, Engine, 400MB2, QSB6.7		1
1	F102160	Relay, Starter, CC (V00549), F498		1
2	305006	Fuse, 125A/48V, Mega/AMG (1DF85), 7821137		3
3	43145	Relay, Power, SPNO, 12VDC/100A (035033), 120-901		2
4	45099	Block, Fuse, ATC, 8-Gang, Bottom (1CW22), 62939		1
5	45276	Bar, Buss, Angle, 2-Hole		1
6	45173	Panel Weldment, Eng Elec		1
7	2.0021	Block, Terminal (2E738), 924		2
8	2.0022	End, Terminal (2E738), 930		1
9	421503	Cut, 4215, 2.19		1
10	46601	Isolator		1
11	121966	HHCS, 1/4-20x2.5 Gr.5		1
12	306345	Nutsert, 1/4-20, .027-.165, Open		14
13	46995	Brkt, Circuit Breaker Mount		1
14	46994	Breaker, Circuit, 60A Auto Reset		1
15	48099	Brkt Wldmnt, Elec Panel		1
16	45167	Cover, Eng Elec Panel		1
17	48210	Decal, Eng Panel Fuses, 400MB2, QSB6.7		1
18	200085	Fuse, 30A/32V, attached (58961), 46230		2
19	45138	Fuse, 40A/32V, ATC		1
	50665	Kit, Wiring, Eng Elec, Panel		1

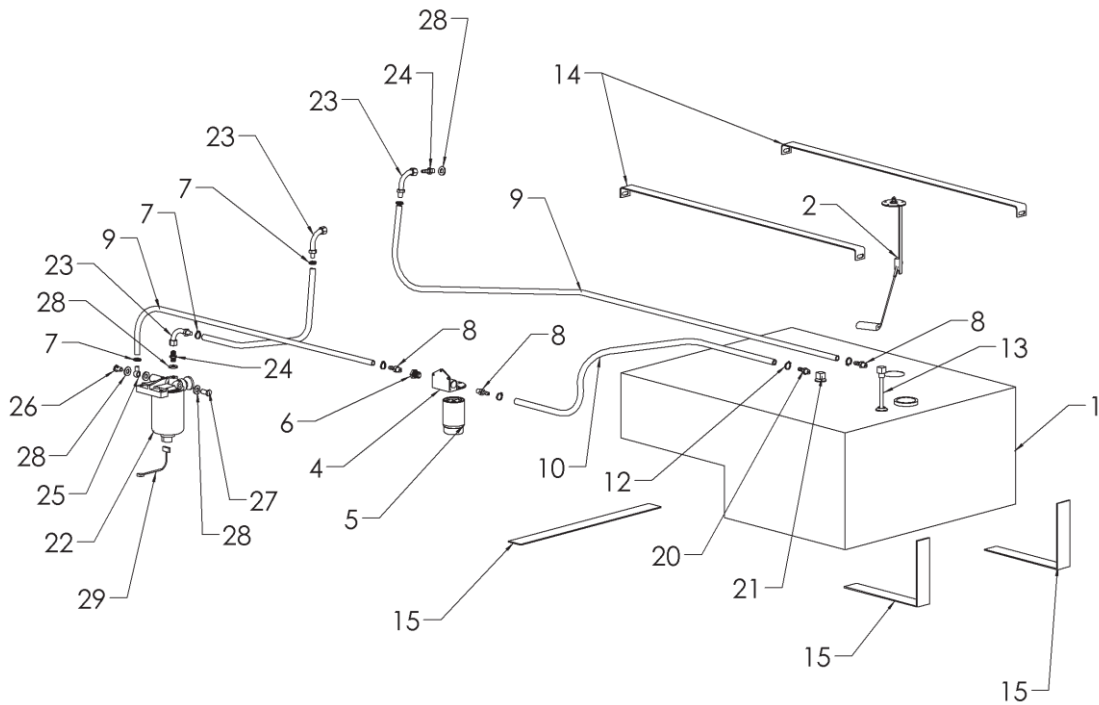


FIGURE 41.
FUEL SYSTEM, 400MB2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
41-	47815	Fuel System, 400MB2		Ref
	47461	Fuel Tank Assy, 400MB2		1
1	47462	Fuel Tank, 400MB2, 49 Gal		1
2	40958	Sending Unit, Fuel Level (includes gasket)		1
3	46508	Tube, Fuel, Suction, 1/2" Withdraw		1
4	37287	Filter, Fuel, W/Water Sep.		1
5	37287-1	Element, Filter, Fuel / Water Sep.		1
6	3.1920	Ftg, Hyd, 06MP-04FP		1
7	F100979	Hose Clamp, .44-.78		8
8	42051	Fitting, Hydraulic, 06H-04MP		2
9	9.2066	Hose, .37ID - .66OD		AR
10	46517	Hose, .50 ID Low Press		108"
11	F104402	Ftg, Hyd, 06H-06FJX90		1
12	200129	Sleeve, Protective		78"
13	NW036196	Tube, Fuel Return 9.50		1
14	47886	Fuel Tank Strap		2
15	F101588	Strip, Chafing, 1/8 x 2		112"
20	46520	Ftg, Hyd, 08H-06MP, BRS		1
21	46306	Ftg, Hyd, 06MJ-M12MB, B.S.		1
22		Adapter, Fuel Lubricity		1
		Head, Fuel Lubricity Filter		1
	48470	Filter, Fuel Lubricity Element, Cummins FS20022		1
23	47279	Ftg, By Cummins, 205146.000		3
24	47277	Ftg, By Cummins, 3964337		2
25		Ftg, By Cummins, 4929149		1
26		Ftg, By Cummins, 3957770		1
27		Plug Seal, By Cummins 4929619		4
28	47278	Washer, By Cummins 3963990		2
29		Water-In-Fuel Sensor Harness, By Cummins, 3954786		1
30	44948	Cap, Fill 2" NPSM, Green, W/Screen		1
NS	153768	Decal, Diesel Fuel Only (See Figure 1)		1

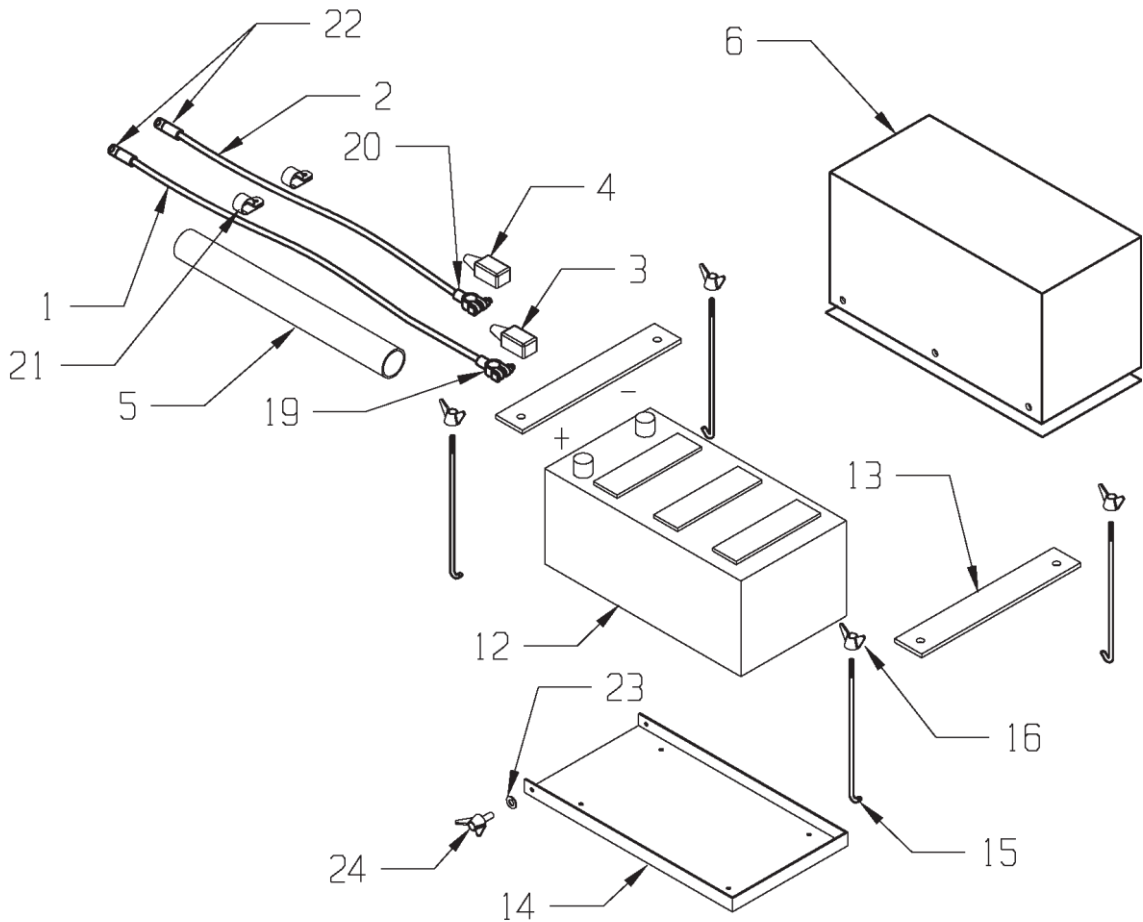


FIGURE 42.
BATTERY SYSTEM, 400MB2

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
42-	47824	Battery System		1
1	2.3267	Cable, Neoprene 1/0 AWG, Starter Pos		AR
2	2.3267	Cable, Neoprene 1/0 AWG, Starter Neg		AR
3	F100930	Boot, Battery Terminal, Red		1
4	F100931	Boot, Battery Term, Blk		1
5	200129	Sleeving, Protective		80"
6	45249	Box Wlmt, Battery		1
12	45146	Battery, 12V, 1300 CCA Min, 4DV (V00532), BAT4DA		1
	49437	Battery, 12V, 1350 CCA, Maint Free	B	1
13	45185	Holddown, Battery, 200MB4V2		2
14	45250	Pan, Battery Box, 200MB4V2		1
15	NW022821	J-Bolt, 5/16-18, Battery Hold-On		4
16	NW021810	Wingnut, 5/16-18		4
19	2.3360	Terminal, Pos 9/16 Wire Battery		1
20	2.3359	Terminal, Neg 9/16 Wire Battery		1
21	F101134	Clamp, Insulated, 0.75ID, 0.41 Hole		2
22	2.3274	Terminal, Ring		2
23	F009549	Washer, 5/16 Flat		2
24	205011	Screw, Wing, 5/16-18 x .75, 29W516S075		2

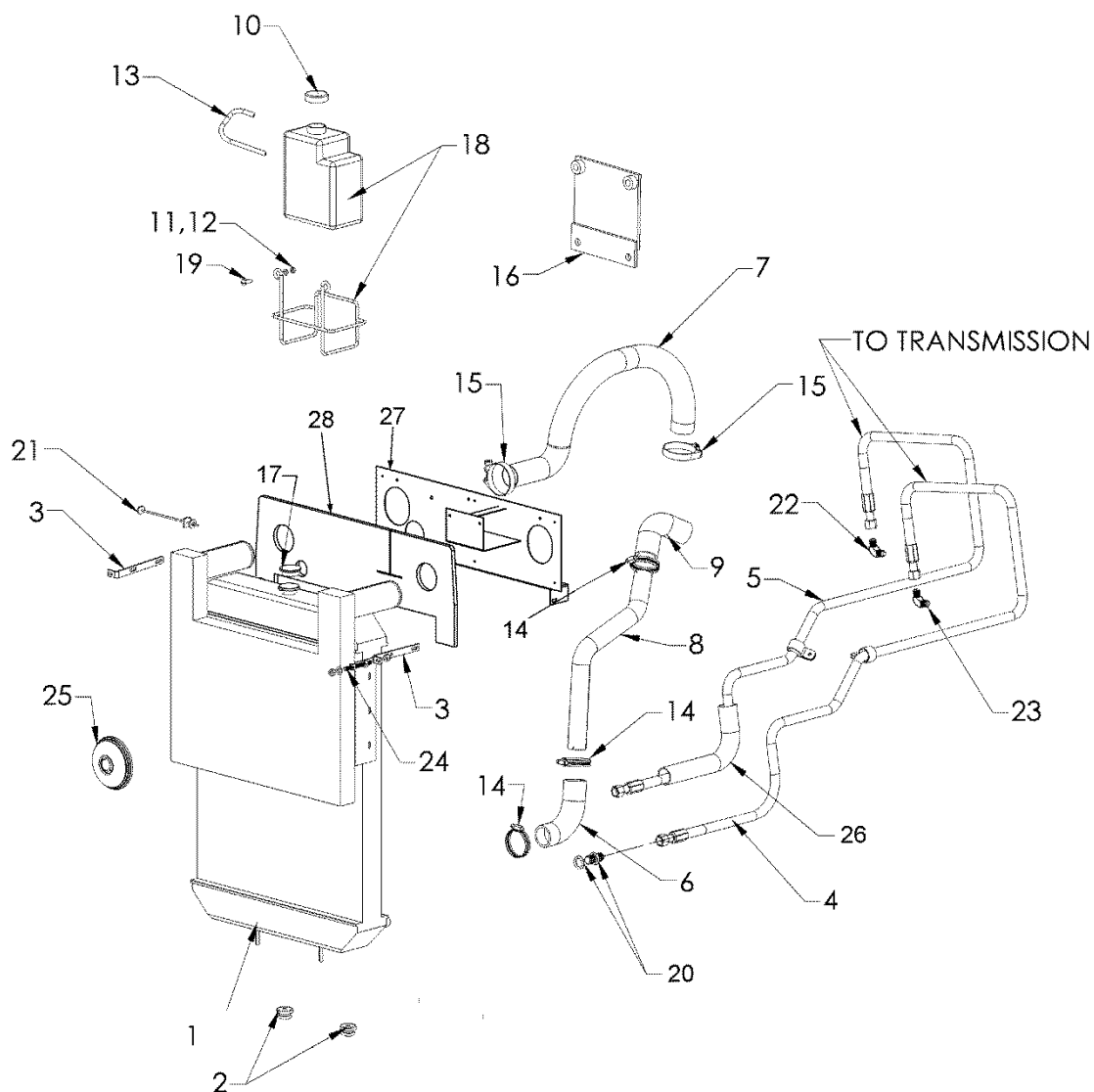


FIGURE 43.
COOLING SYSTEM, CUMMINS B6.7QSB

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
43-	47818	Cooling System, 400MB2, QSB6.7		1
1	49651	Rad./Oil/Charge Air Cooler (OJ567), SSY 12672		1
2	203566	Isolator, Rubber (V00512), 60230		2
3	48194	Strip, Radiator Mnt		2
4	10384.57	Hose Assy, #16L, 65", ST/ST		1
5	10384.58	Hose Assy, #16L, ST/45		1
6	47271	Hose, Modified, Rad, Lower		1
7	45227	Hose, Rad, Upper		1
8	48112	Pipe Weldment, Radiator Lower		1
9	45036	Hose, Rad, Lower (24161), 21473		1
10	40164	Cap, Reservoir (34669), 68		1
11	F014476	Nut, 5/16-18 Nylock		2
12	F009549	Washer, 5/16		2
13	NW031849K	Hose, Recovery		1
14	F101140	Clamp, Hose, #32, 1.56-2.50		4
15	F100937	Clamp, Hose, #28, 1.31-2.25		2
16	48191	Mount Weldment		1
17	44877-1	Cap, Radiator, 200-797712		1
18	44544	Reservoir, Coolant Overflow (ONYT6), BVR-4		1
19	38615	THMS, 5/16-18 x 1		2
20	NW030842	O-Ring Hyd Fitting, 16MB-16MJ (See item 30A)		2
21	206946	Kit, Oil Cooler Quick Mount (4 Pieces/Kit)		1
22	202634	Ftg. Hyd. 16MJLL-16MB90		3
23	37199	Ftg, Hyd, Mod (NW30992)		1
24	425201	Rod, Threaded, 3 1/2		2
	9413534	Nut, Hex, 3/8-16		8
	F100062	Washer, 3/8		2
25	2.3000	Horn, 12V, 2-Wire (V00544)		1
	400905	Spacer, Horn		1
26	200129	Sleeve, Protective		60"
27	48539	Air Dam Weldment		1
28	48546	Panel, Acstc, Rad Baffle		1
NS	45417	Decal, Radiator Fill Instructions (See Figure 1)		1
NS	45342	Clip, Insul, 1.5 ID		2
NS	90415	Ftg, Hyd, 12MJ-12MB		1

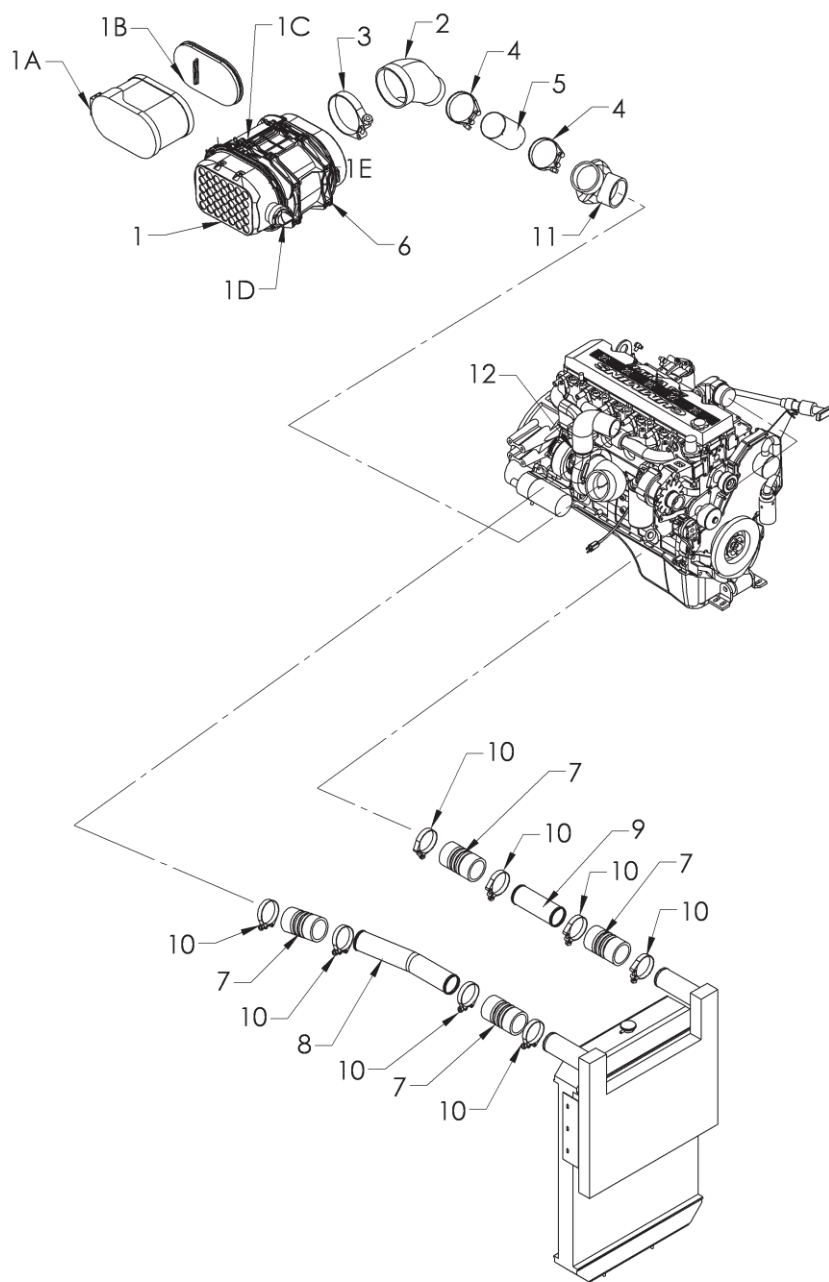


FIGURE 44.
AIR INTAKE SYSTEM, CUMMINS B6.7QSB

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
44-	47822	Air Intake System, 400MB2, QSB6.7		1
1	47053	Air Cleaner, Oblong, 6" Outlet		1
1A	46542-11	Filter, Primary, P608667		1
1B	46542-12	Filter, Safety, P607557		1
1C	46542-13	Cover, P608171		1
1D	46542-14	Vacuator Valve, P112803		1
1E	46542-15	Latch, P777366		4
NS	46542-16	U-Clip, P784517		4
2	46543	Eil, 6 x 4, Rubber, 45°, 45HL60R		1
3	46548	Clamp, T-Bolt, 6", P148347		1
4	NW035628	Clamp, T-Bolt, 4"		2
5	47230	Tube Wldmnt, Air Intake, 4 OD		1
6	NW032281	HHCS, M8 x 1.25 x 30mm, Gr8.8		4
7	45201	Hose, 3" Flex, Charge Air (24161), 26200		4
9	45334	Tube, Charge Air, Inlet		1
8	45333	Tube, Charge Air, Outlet		1
10	NW033103	Clamp, T Bolt, 3", 3923060		8
11	46574	Eil, 4.0 I.D., Rubber, 90° Low		1
12		Connection, Air Transfer		Ref
		Plug, Pipe, 1/8NPT		1
		Seal, O-Ring		1
		Eil, Air Transfer		1

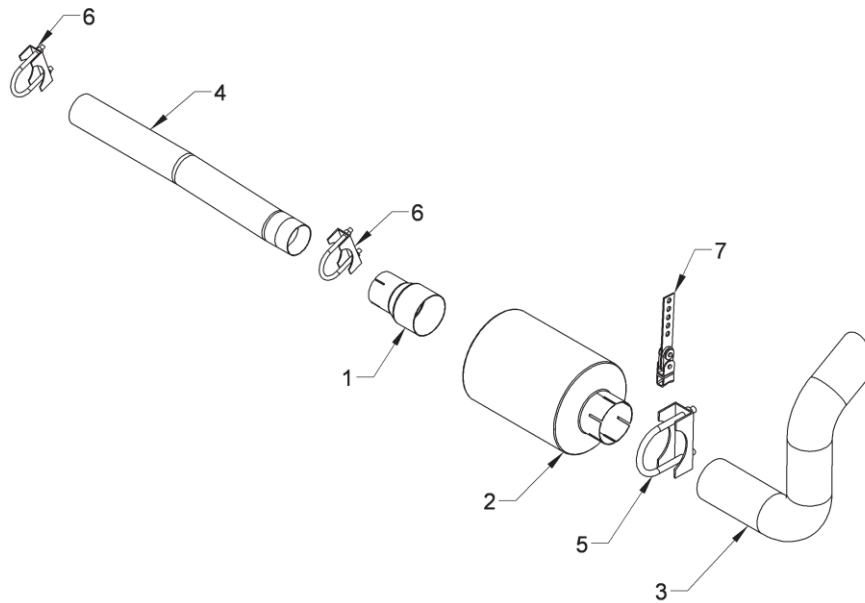


FIGURE 45.
EXHAUST SYSTEM, CUMMINS B6.7QSB

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
45-	47204	Exhaust System, Cummins		Ref
1	46504	Reducer, Exhaust, 4 OD x 3 ID		1
2	46505	Muffler, 4", 200MB4V2(4K227), 86114M		1
3	47206	Pipe, Exhaust, Tail, 4"		1
4	47205	Pipe Wldmnt, Exhaust, Front		1
5	NW035654	Clamp, Muffler, 4" ID		1
6	NW035606	Clamp, Muffler, 3.00		2
7	48414	Hanger, Tail Pipe (NVC), 75		1

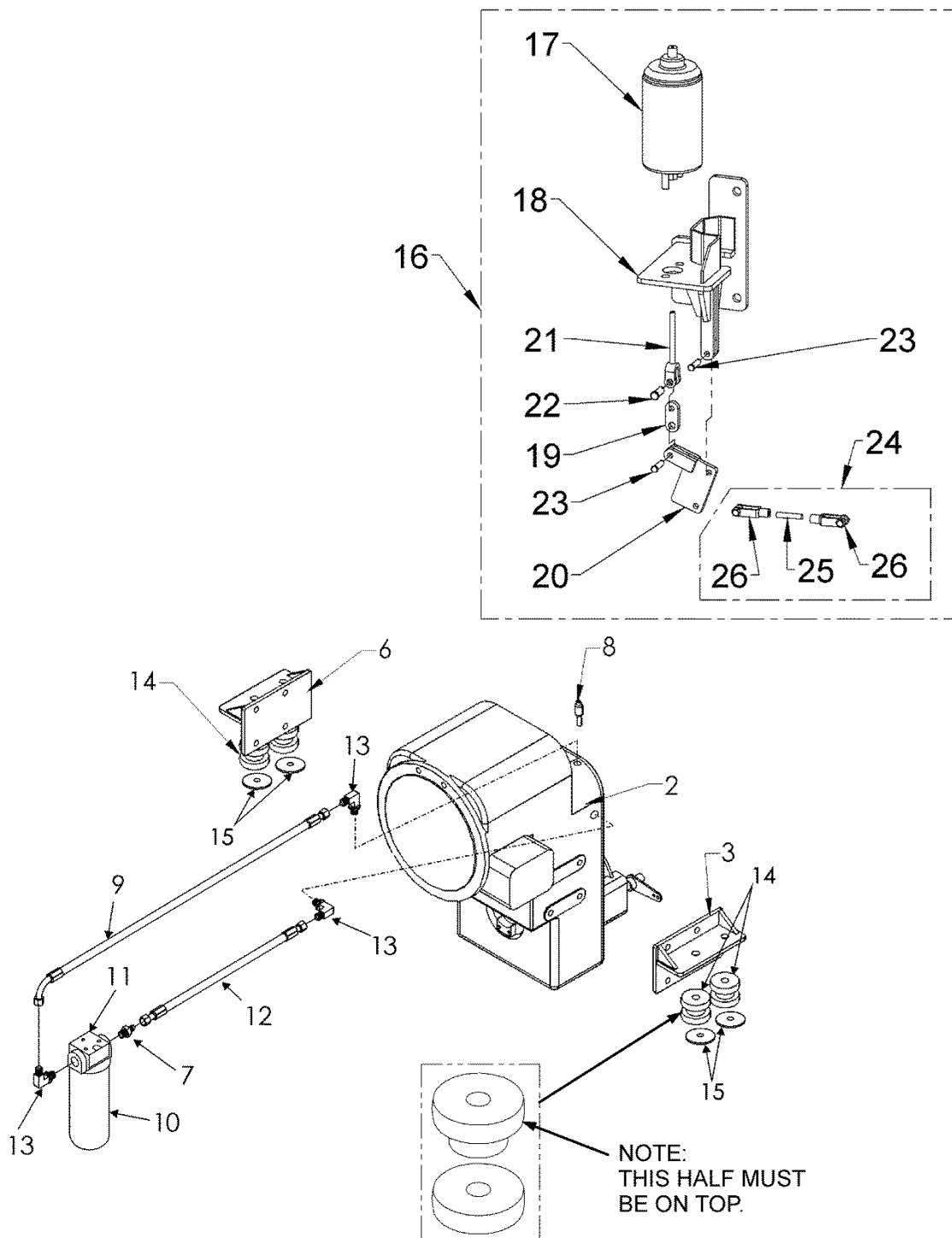


FIGURE 46.
TRANSMISSION, FUNK 2263

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
46-		Transmission Assembly		1
2	42503	Trans, Funk 2000, MB4		1
3	44917	Mount Wldmnt, Trans, LH		1
6	45054	Mount Wldmnt, Trans, RH		1
7	NW030842	Fitting, Hydraulic, 16MB-16MJ		2
8	NW030236	Sender,Temp, Hi-Range, 1/4NPTF (16476), 02023-000		1
9	43043.8	Hose Assembly, #16, 40.00, ST/90		1
10	37315	Filter Element, Transmission (03718), 4003483		1
11	43106	Filter Head, Transmission (03718), 4003489		1
12	43043.7	Hose Assembly, #16, 33.00, ST/ST		1
13	NW030992	Fitting, Hydraulic, Ell, 16MJ-16MB90		3
14	44898	Isolators, Rubber, Trans, Funk		4
	NW031820	HHCS, 10mm 1.5 x 40mm		4
	3.3326	Washer, Lock, 10mm		4
15	206015	Washer, Snubber		8
16	47327	Park Brake Assy,SAHR,M400 (Also See Figure 28)		1
17	47844	Actuator,Park Brake,M400		1
18	48081	Brkt Wld,Act,Park Brk,M400		1
19	48087	Pivot Link,Park Brake,M400		1
20	48091	Pivot Wld,Park Brk,M400		1
21	48585	Thread Clevis Rod		1
	48586	Nut, Hex, M10		1
22	48583	Pin, Clevis		1
	48584	Pin, Cotter		1
23	302240	Pin, Clevis		2
24	48403	Rod Assy,Park Brake,End,M400		1
25	416501	Cut,4165, 2.00		1
	48404	Nut,Jam,3/8-24,GR5		1
26	90562	Clevis,3/8-24 X 3/8 Pin,W/Pin (29404)		2
NS	RF090896	Sleeve, Alum Fbrgls 2.5		17

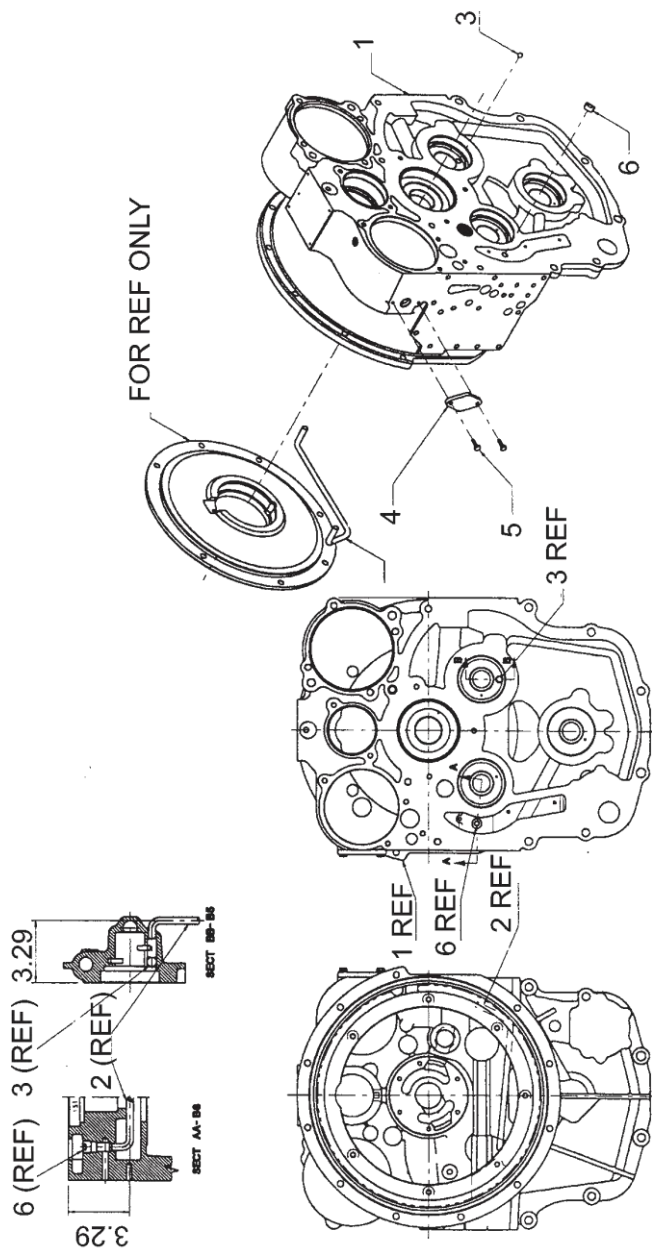


FIGURE 47.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
47-	43902	Group Front Cover (96105), 40A2357		1
1	43902-1	Cover, Front Assembly, 40A2221		1
2	43902-27	Tube, Front Cover, 4002855		1
3	43902-40	Ball, F7400016D		2
4	43902-41	Plate, Cover, YZ101113		1
5	43902-42	Capscrew, F100108		2
6	43902-6	Plug, Pipe, F190036		1

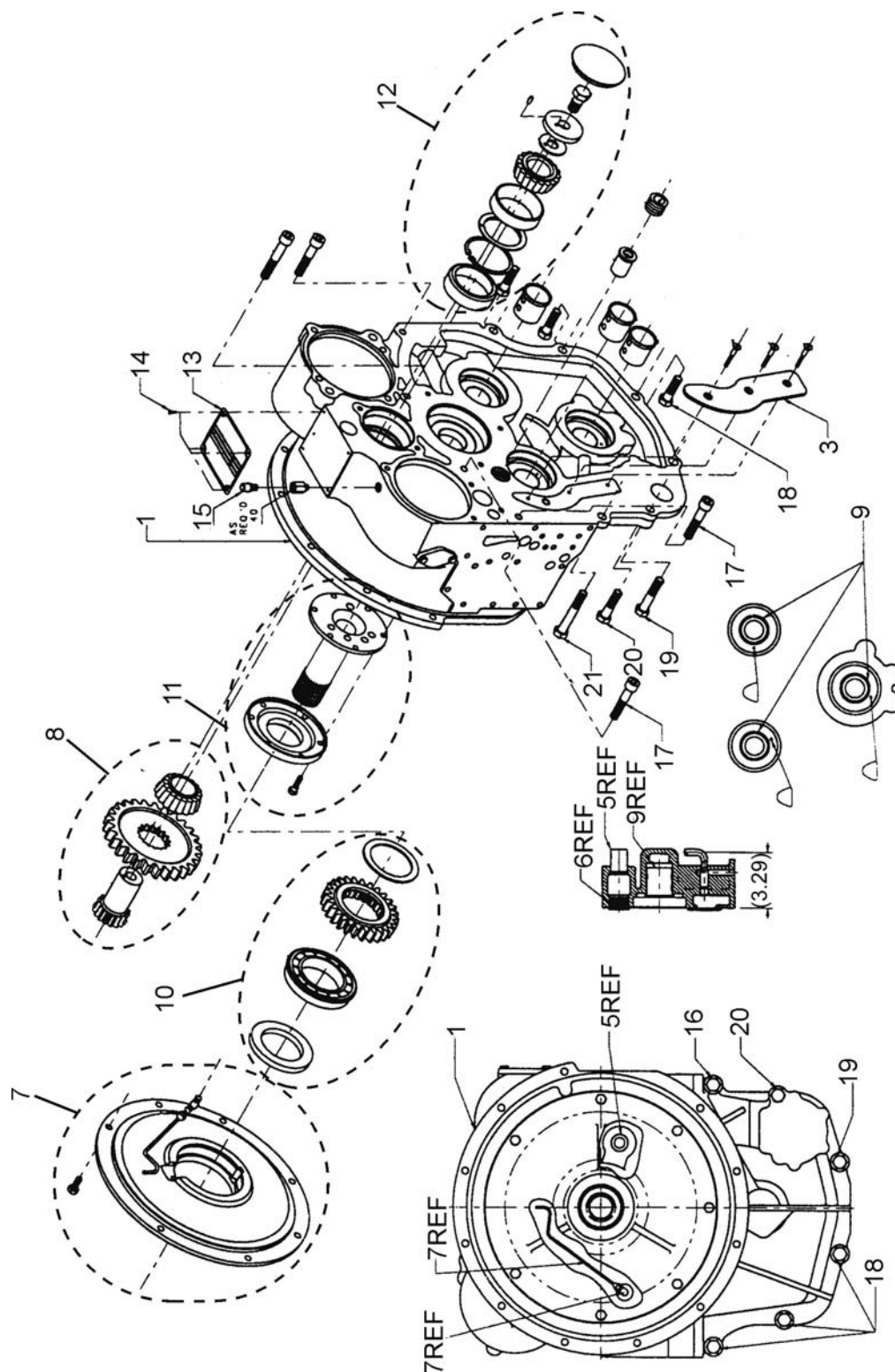
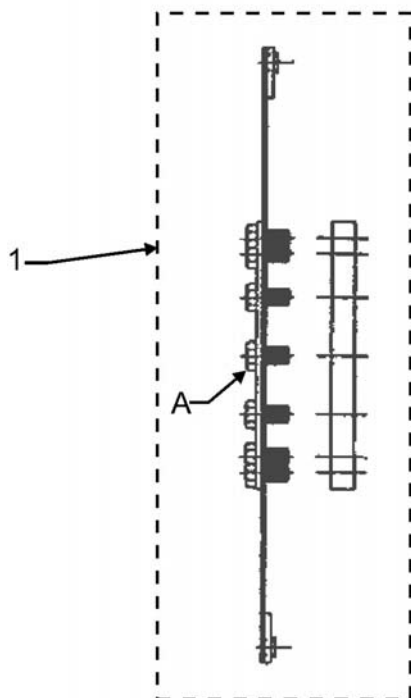


FIGURE 48.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
48-	43902	Group Front Cover (96105), 40A2357		1
1	43902-1	Cover, Front Assembly, 40A2221		1
3	43902-3	Cover, Oil Passage, 4102021		1
4	43902-4	Capscrew, F11211824		3
5	44734-2	Valve, Relief, YZ250263		1
6	43902-6	Plug, Pipe, F1900316		1
7	43902-45	Lubrication Assembly Tube Kit		1
8	43902-46	Idler Gear Kit		1
9	43902-9	Sleeve, Bore Front,4005295		3
10	43902-47	Impeller Hub Gear Kit		1
11	43902-43	Stator Support Tube Kit		1
12	43902-44	Bearing Kit		1
13	43902-29	Plate, Identification, 4001660		1
14	43902-30	Screw, Drive, F310063		4
15	43902-31	Breather, 0 PSI, F68105		1
16	43902-38	Capscrew, F1005052		1
17	43902-34	Capscrew, F1100940		3
18	43902-35	Capscrew, F1005024		3
19	43902-36	Capscrew, F1005032		1
20	43902-37	Capscrew, F1005040		1
NS	43902-33	Capscrew, F1100948		1
NS	43902-24	Retainer, Bearing, 4001041		1

ASM. NOTES:

REF #A
APPLY LOCKTITE #262. TORQUE
34LBS. FT. \pm 3LBS. FT. PER
S.I.M. 765. (TYP. 12 PLACES)



NOTE:

WHEN THESE DRIVE PLATES ARE USED
WITH 11.75 CONVERTERS THEY MUST
BE ASSEMBLED TO CONVERTER PER
DWG. #404345 TO AVOID POSSIBLE
INTERFACE PROBLEMS.

**FIGURE 49.
TRANSMISSION REPAIR PARTS**

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
49-	43903	Group, Plate Drive (96105), 4046763		1

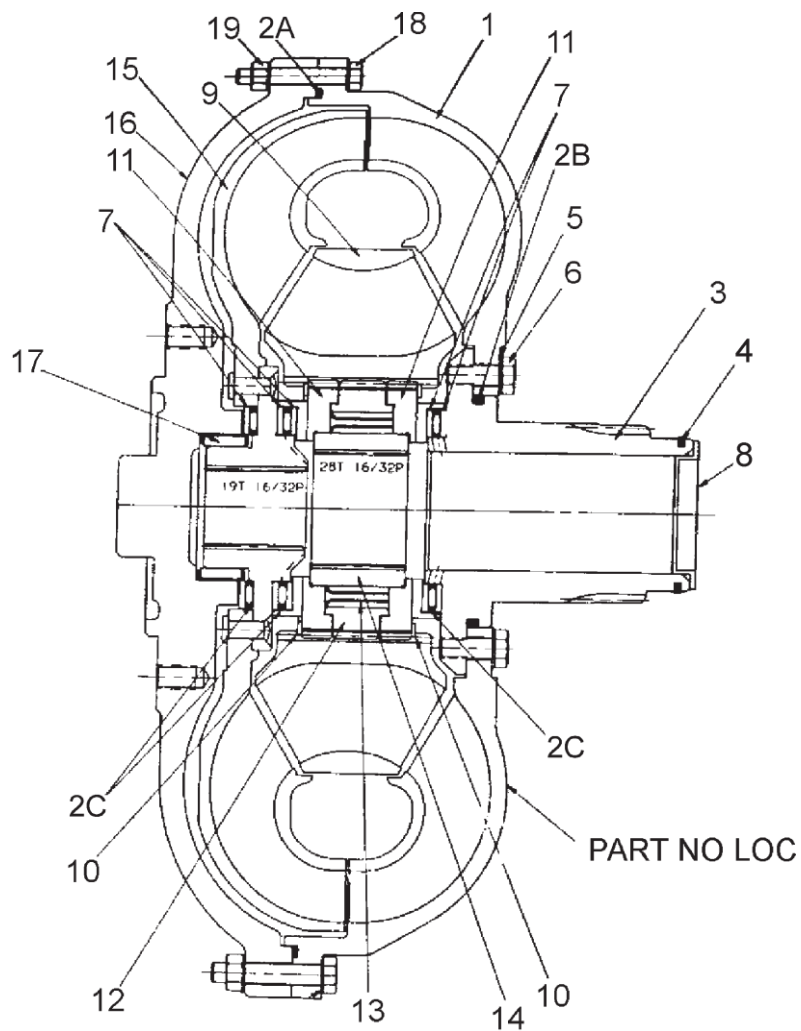


FIGURE 50.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
50-	44734-5	Converter, 1275BAA, Assembly (96105), 4145131		
1	44734-6	Impeller, 1275B, 4045872		1
2	44734-11	Bearing Needle & O-Ring Kit (Includes 2A, 2B & 2C)		1
2A		O-Ring		1
2B		O-Ring		1
2C		Bearing, Needle Thrust		3
3	44734-10	Impeller, Hub, 4145029		1
4		Seal, Ring, 4000497		1
5	43904-24	Washer, Flat, 4003680		60
6		Capscrew, F1002014		12
7	43904-26	Washer, Thrust, 4045901		5
8		Plug, Shipping, F2310042		1
9	44734-8	Stat. Conv 1275A, 4145012		1
10	43904-12	Ring, Retaining, 4003456		2
11	44734-27	Retainer, Clutch, 4145011		2
12	44734-29	Race, Clutch Outer, 4045723		1
13	43904-16	Sprag, Clutch Assembly, 4045081		1
14	44734-28	Race, Inner Clutch, 4045076		1
15	44734-9	Turb Assembly 1275A, 4145013		1
16	44734-7	Turbine, A, 4045195		1
17	44734-26	Turbine, Hub, 4145014		1
18	44734-30	Capscrew, F1002528H8NP		24
19	44734-31	Nut, Hex, F1300400U		24

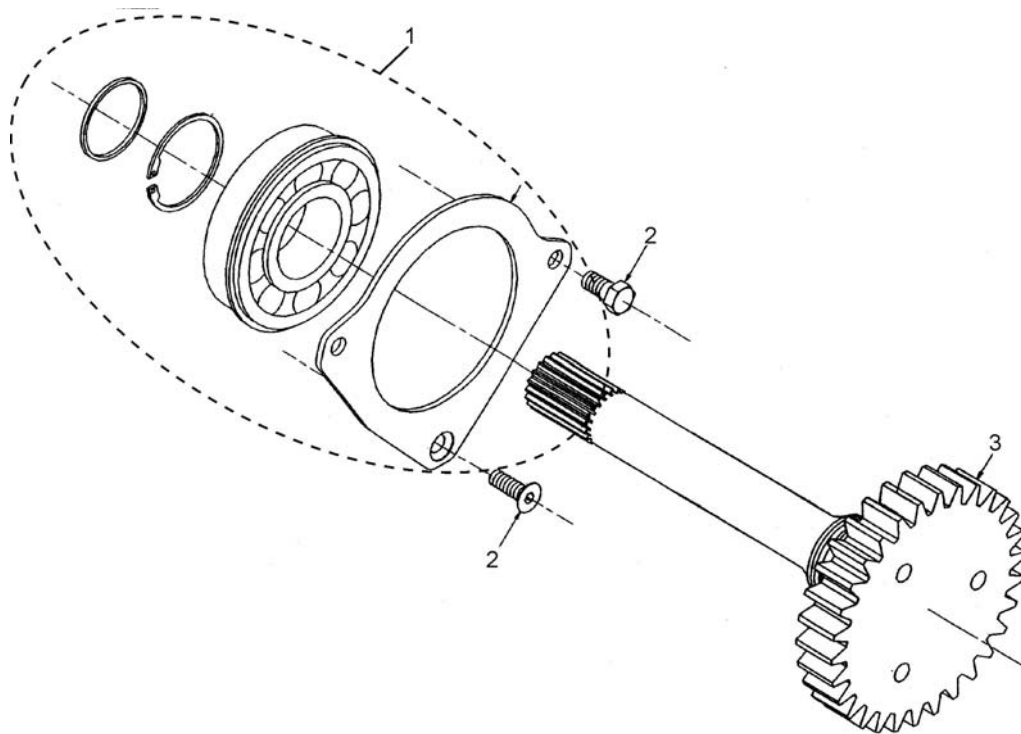


FIGURE 51.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
51-	43905	Group, Shaft Input (96105), 40A2222		
1	43905-7	Ball Bearing Kit		1
2	43905-4	Capscrew, F1003012		3
3	43905-1	Shaft, Input 30 Tooth, 40A2019		1

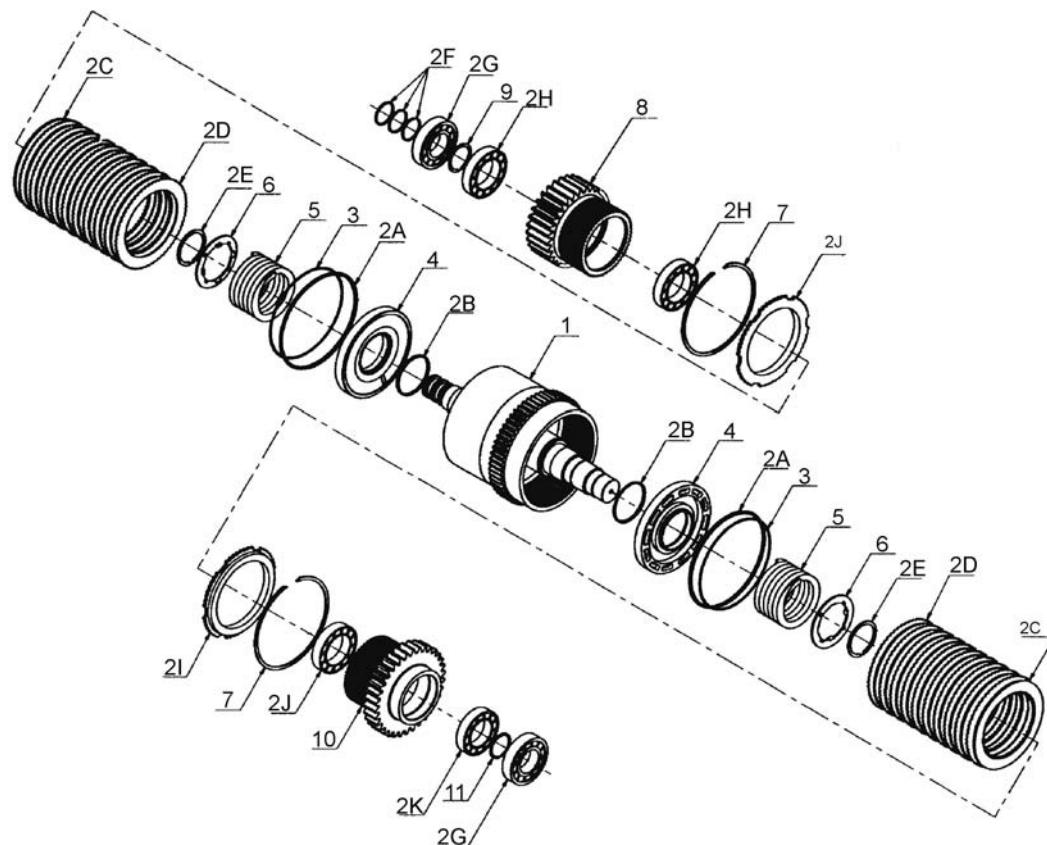


FIGURE 52.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
52-	43906	Clutch, 1st Gear Assembly (96105), YZ102403		
1	43906-1	Shift Clutch, 1st Assembly, 40A2216		1
2	43906-24	Bearing & Ring Kit(Includes 2A-K)		1
2A	43906-2	Seal, Lip		2
2B	43906-4	O-Ring, Arp144		2
2C	43906-8	Plate, Clutch		20
2D	43906-9	Plate, Clutch Separator		22
2E	43906-23	Ring, Retaining		2
2F	43906-22	Ring, Seal		3
2G	43906-21	Bearing		2
2H	43906-13	Bearing		2
2I	43906-10	Retainer, Clutch		2
2J	43906-17	Bearing, Ball		1
2K	43906-19	Bearing, Ball		1
3	43906-3	Ring, Back-Up, 4102398		2
4	43906-5	Clutch, Piston, 40A2034		2
5	43906-6	Spring, Clutch Return, 40A6261		2
6	43906-7	Spring, Retainer, 40A2038		2
7	43906-11	Ring, Snap, YZ103040		2
8	44734-36	Gear & Hub, YZ4102496		1
9	43906-15	Ring, Retaining, F81696		1
10	43906-16	Gear & Hub, YZ4102506		1
11	43906-20	Ring, Retaining, F81675		1

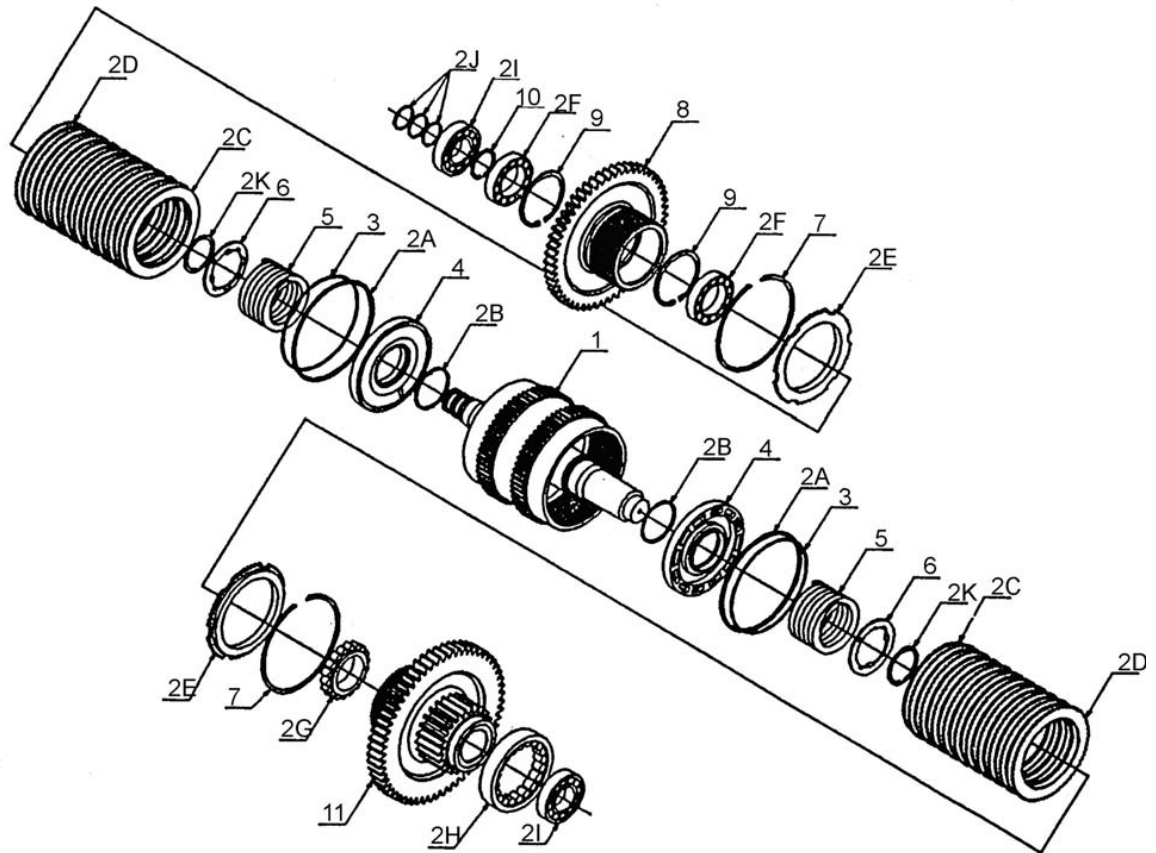


FIGURE 53.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
53-	43907	Clutch 2nd, Assembly (96105), YZ102404		
1	43907-1	Shift Clutch, 2nd Gear Assembly, 40A2218		1
2	43906-25	Bearing & Ring Kit (Includes 2A-K)		1
2A	43906-2	Seal, Lip		2
2B	43906-4	O-Ring		2
2C		Plate, Clutch		20
2D		Plate, Clutch Separator		22
2E		Retainer, Clutch Plates		2
2F		Bearing		2
2G		Bearing		1
2H		Bearing		1
2I		Bearing		2
2J		Ring, Seal		3
2K		Ring, Retaining		2
3	43906-3	Ring, Back-Up, 4102398		2
4	43906-5	Clutch, Piston, 40A2034		2
5	43906-6	Spring, Clutch Return, 40A6261		2
6	43906-7	Spring, Return, 40A2038		2
7	44734-38	Ring, Snap, YZ103040		2
8	44734-17	Gear & Hub, YZ4102504		1
9	43907-14	Ring, Snap, F39000315		2
10	43906-15	Ring, Retaining, F81696		1
11	44734-18	Gear & Hub, YZ4102503		1

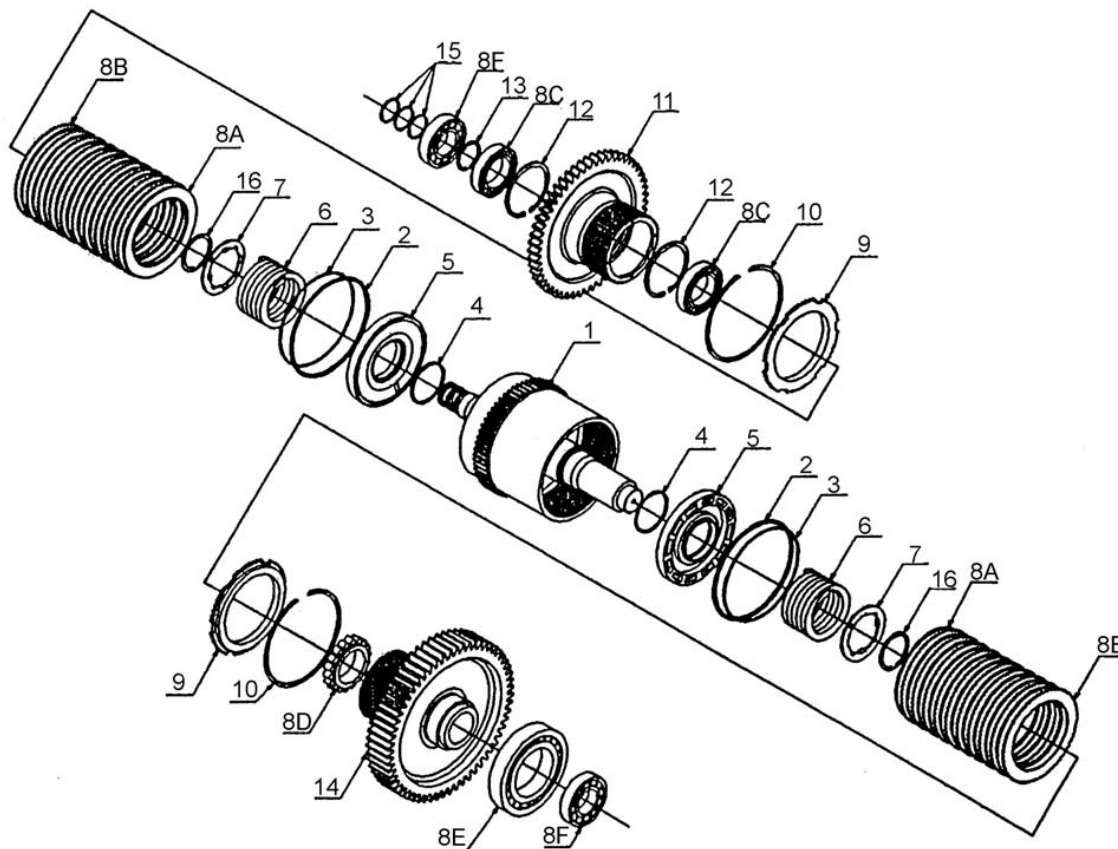


FIGURE 54.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
54-	43908	Clutch 3rd, Assembly (96105),YZ102415		
1	43908-1	Shift Clutch, 3nd Gear Assembly, 40A2219		1
2	43906-2	Seal, Lip, 40A2565		2
3	43906-3	Ring, Back-Up, 4102398		2
4	43907-4	O-Ring, F37020144		2
5	43906-5	Clutch, Piston, 40A2034		2
6	43906-6	Spring, Clutch Return, 40A6261		2
7	43906-7	Spring, Return, 40A2038		2
8	43908-2	Bearing Kit (Includes 8A-F)		1
8A		Plate, Clutch		20
8B		Plate, Clutch Separator		22
8C		Bearing		2
8D		Bearing		1
8E		Bearing		1
8F		Bearing		2
9		Retainer, Clutch		2
10	44734-38	Ring, Snap, YZ103040		2
11	44734-23	Gear & Hub, YZ4102497		1
12	43907-14	Ring, Snap, F39000315		2
13	43906-15	Ring, Retaining, F81696		1
14	44734-24	Gear & Hub, YZ4102495		1
15	44734-12	Ring, Seal, YZ250161		3
16	43906-23	Ring, Retaining, F81750		2

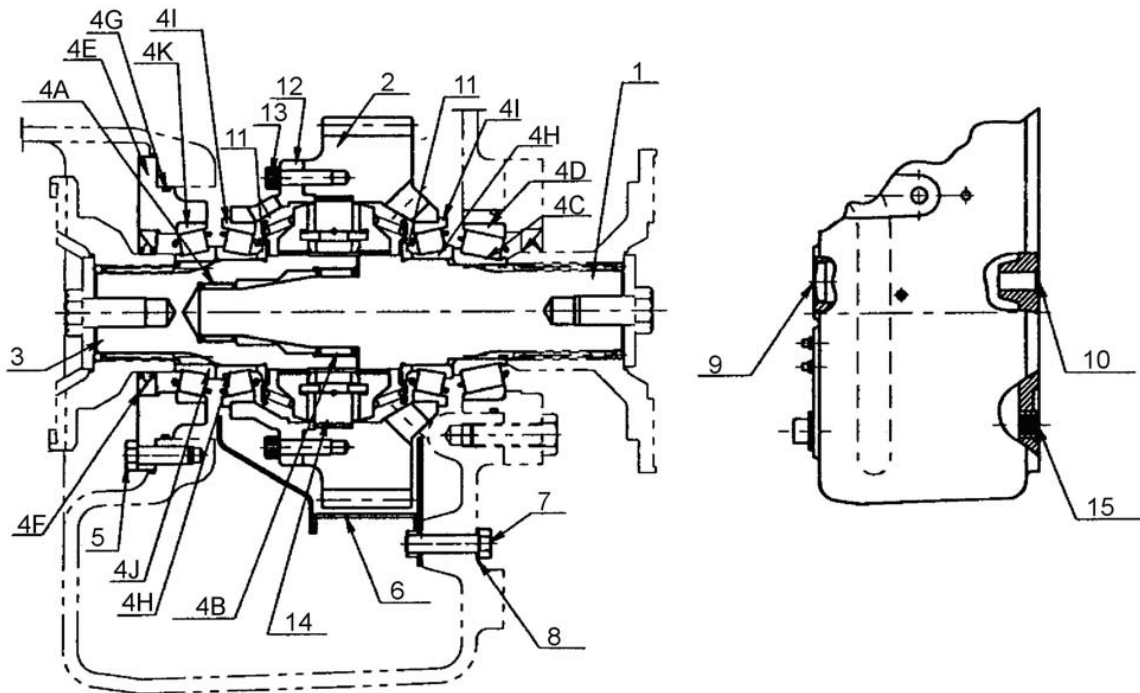


FIGURE 55.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
55-	43909	Group, No Spin Assembly (96105), YZ101590		
1	43909-1	Shaft, Output, YZ101458		1
2	43909-2	Hub, Drive, 40A2281		1
3	43909-3	Shaft, Output Assembly (Includes 4A & 4B), YZ101549		1
	43909-3a	Shaft, Output, YZ101457		1
4	43909-23	Bearing Kit (Includes 4A-K)		1
4A		Bearing		1
4B		Bearing, Needle		1
4C		Bearing		1
4D		Cup		1
4E		Bearing, Retainer		1
4F		Seal, Oil		1
4G		O-Ring		1
4H		Bearing, Cone		2
4I		Bearing, Cup		2
4J		Cone, Bearing		1
4K		Cup, Bearing		1
5	43902-28	Capscrew, F1003014		6
6	43909-10	Bfl, Assembly, 40A2286		1
	43902-30	Cyl, Bfl, 40A2284		1
	43902-31	Clinch Nut, 4003800		1
7	43909-11	Capscrew, F1002532		2
8	43909-12	Washer, F18002		2
9	43909-13	Plug, Expansion, F21026		1
10	43909-14	Plug, Expansion, F22012		1
11	43909-15	Spacer, Spring Retainer, YZ101461		2
12	43909-16	Housing, No-Spin, 40A2280		1
13	43909-17	Capscrew, F1100416		4
14	43909-20	No-Spin Assembly, 4006927		1
15	43902-6	Plug, Pipe, F1900316		1

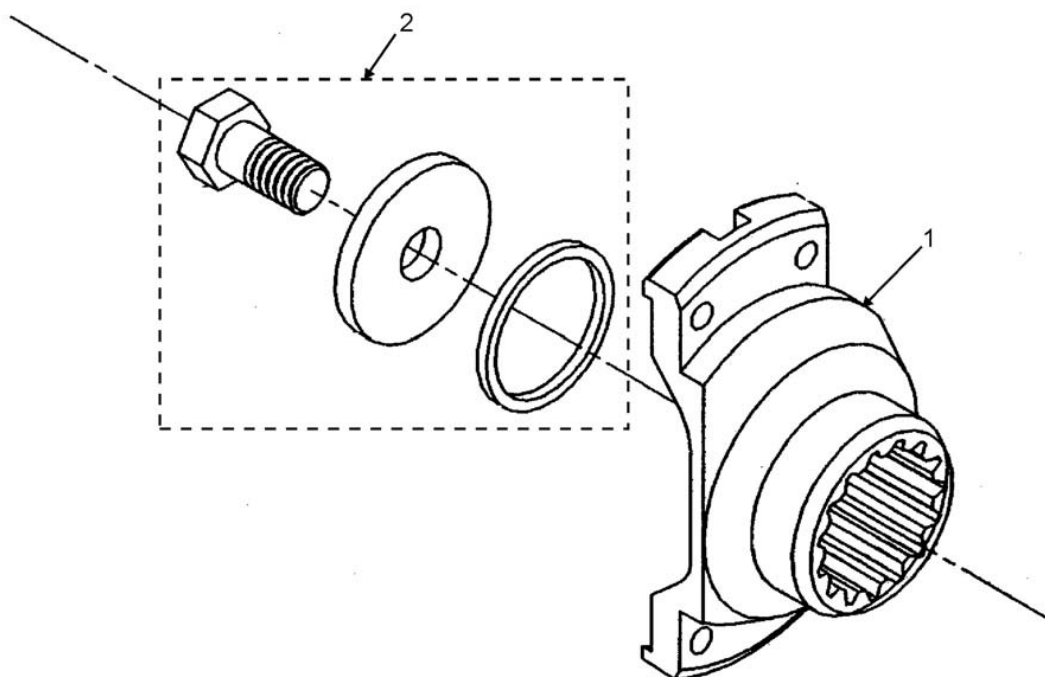


FIGURE 56.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
56-	43910	Group, Yoke Fitting 6C (96105), 40A2230		
1	43910-1	Yoke, 6C, YZ4102789		1
2	43910-22	O-Ring Kit		1

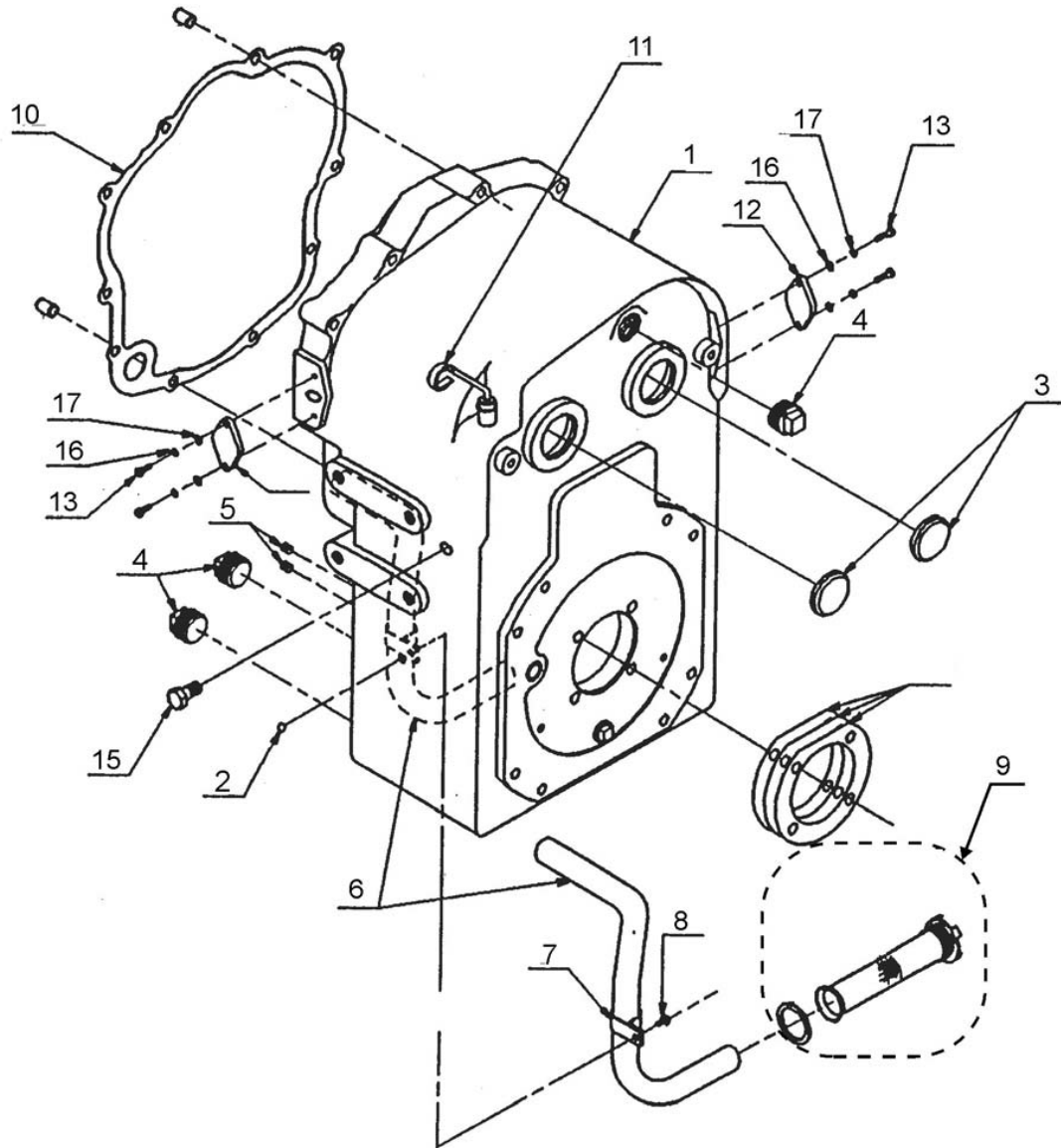


FIGURE 57.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
57-	44734-40	Group, Case Main (96105), YZ101397		Ref
1	44734-41	Case, Main, YZ101241		1
2	43911-2	Ball, Steel, F7400012D		1
3	43911-3	Plug, Expansion, F21043SC		2
4	43911-4	Plug, Pipe, F1900120GVS		3
5	43911-5	Plug, Pipe, F190034		2
6	43911-7	Tube, Suction, 40A2035		1
7	43911-8	Clamp, Tube, 4003307		1
8	43911-9	Capscrew, F100108		3
9	43911-11	Suction Screen Kit, 40A6020		1
10	43911-28	Gasket Kit, Main Housing, 4101088		1
11	43911-27	Dipstick Kit, 4102007		1
12	43911-15	Plate, Cover, YZ101113		2
13	43911-16	Capscrew, F1001010		4
14	43911-18	Kit, Shim, 40A2040		1
15	43911-19	Capscrew, F1007516		1
16	43911-25	Washer, Flat, F17001N		4
17	43911-26	Washer, Lock, F16200		4

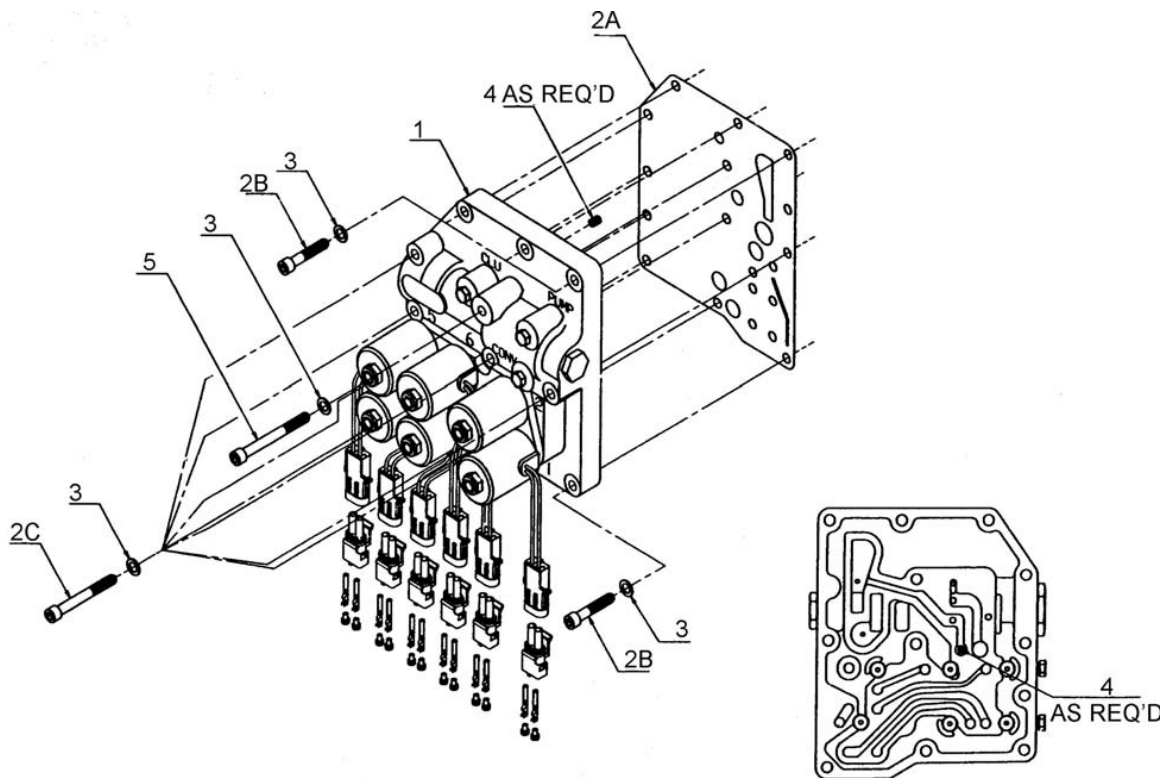
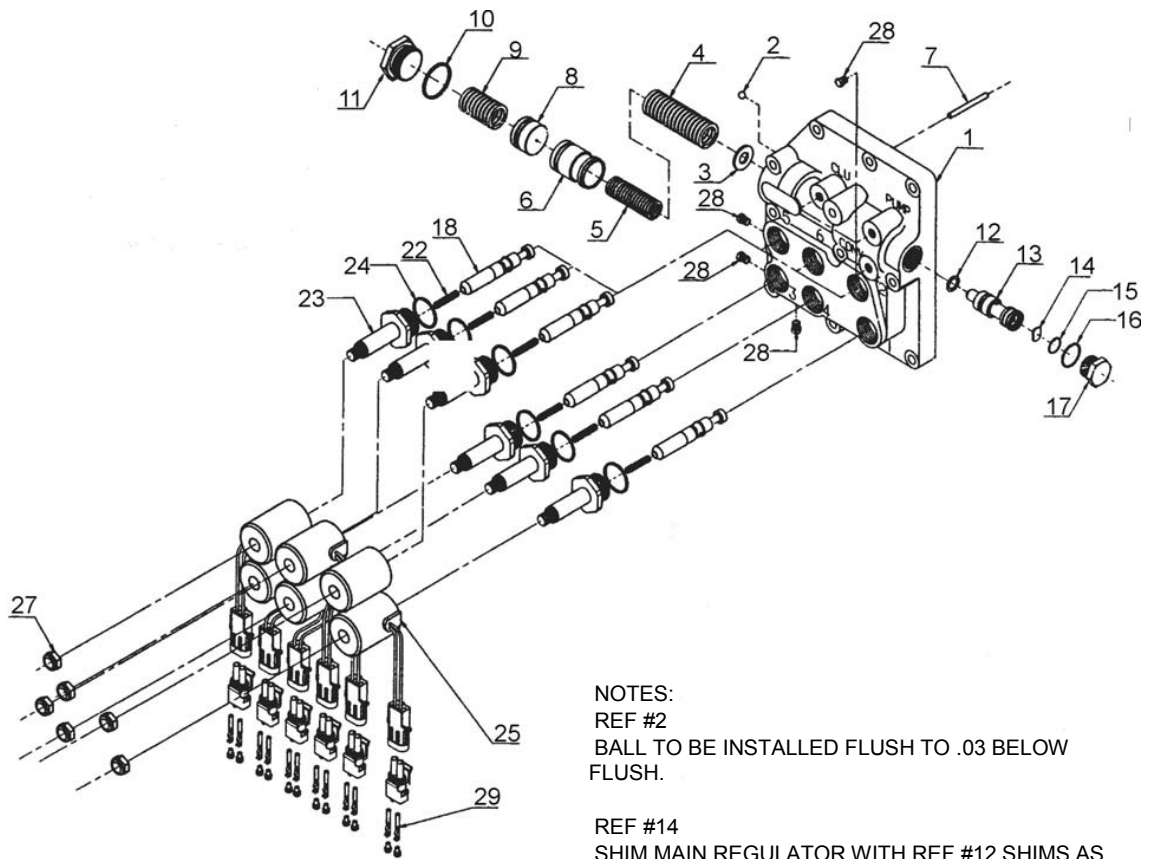


FIGURE 58.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
58-	43912	Group, Valve Electric (96105), YZ100597		
1	43912-1	Valve, Electric Assembly, YZ100594		1
2	43912-8	Gasket Kit, Valve Body (Includes 2A-C)		1
2A		Gasket, Valve Body		1
2B		Capscrew, Socket Head		4
2C		Capscrew, Socket Head		7
3	43912-4	Washer, Flat, 4003680		12
4	43912-5	Plug, Orifice,4004247E		1
5	43912-7	Capscrew, Socket Head, F1100344		1



- NOTES:
- REF #2
BALL TO BE INSTALLED FLUSH TO .03 BELOW FLUSH.

 - REF #14
SHIM MAIN REGULATOR WITH REF #12 SHIMS AS REQ'D PER APPLICABLE TEST SPEC AND MODEL.

 - REF #27
TORQUE STOP NUT TO 115-125 LBS. IN.

 - REF #28
APPLY SLICTITE THREAD COMPOUND TO THREADS OF PLUGS AT ASM.

 - REF #29
TO INSTALL SOCKET INTO CONNECTOR, PUSH PIN INTO CONNECTOR FROM THE REAR UNTIL LOCKED IN PLACE. FIRMLY SEAT SEALS. USING PACKARD CABLE SEAL, INSERT TOOL P/N 12033495. CLOSE FIRMLY SEAT SEALS, USING PACKARD CABLE.

 - TO REMOVE SOCKET FROM CONNECTOR: INSERT REMOVAL TOOL P/N 12014012 INTO CONNECTOR ON THE SIDE OPPOSITE THE WIRE. THE TOOL MUST REMAIN IN PLACE WHILE THE WIRE IS PULLED GENTLY FROM THE REAR OF THE

FIGURE 59.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
59-	44734-42	Group, Valve Assembly (96105), YZ100597		
1	43913-1	Body, Valve, 40A2520		1
2	43913-2	Ball, F740007D		1
3	43913-3	Washer, 40A2510		1
4	43913-4	Spring, Outer, 40A2563		1
5	43913-5	Spring, Inner, 40A2564		1
6	43913-6	Piston, Accumulator, 40B1065		1
7	43913-7	Pin, Dowel, F2710132		1
8	43913-8	Valve, Dump, 4001081		1
9	43913-9	Spring, Dump Valve, 4001074		1
10	43913-10	O-Ring, F37060916		1
11	43913-11	Plug, Dump Valve, 4001080		1
12	43913-12	Shim, Spring, 40A2511		3
13	43913-13	Spool, Regulating, 40A2512		1
14	43913-14	Plate, Orifice, 40A1335		1
15	43913-15	Ring, Snap, F3900056		1
16	43913-16	O-Ring, F37060910		1
17	43913-17	Plug, 4001290		1
18	43913-18	Plunger & Spool Assembly, 4102315		6
22	43913-22	Spring, Solenoid, 40A2269		6
23	43913-23	Core, Assembly, 4005293		6
24	43913-24	O-Ring, Arp912, F37060912		6
25	43913-25	Pin & Coil Assembly, YZ100593		6
	43913-21	Coil, Solenoid 12 VDC, 4005299		6
27	43913-27	Stop Nut, Thin, F7824320511		6
28	43913-28	Plug, Pipe, F190042		6
29	43913-29	Kit, Connector, YZ100837		6
	43913-30	Sleeve Contact, R78060		2
	43913-31	Seal Cable, R78059		1

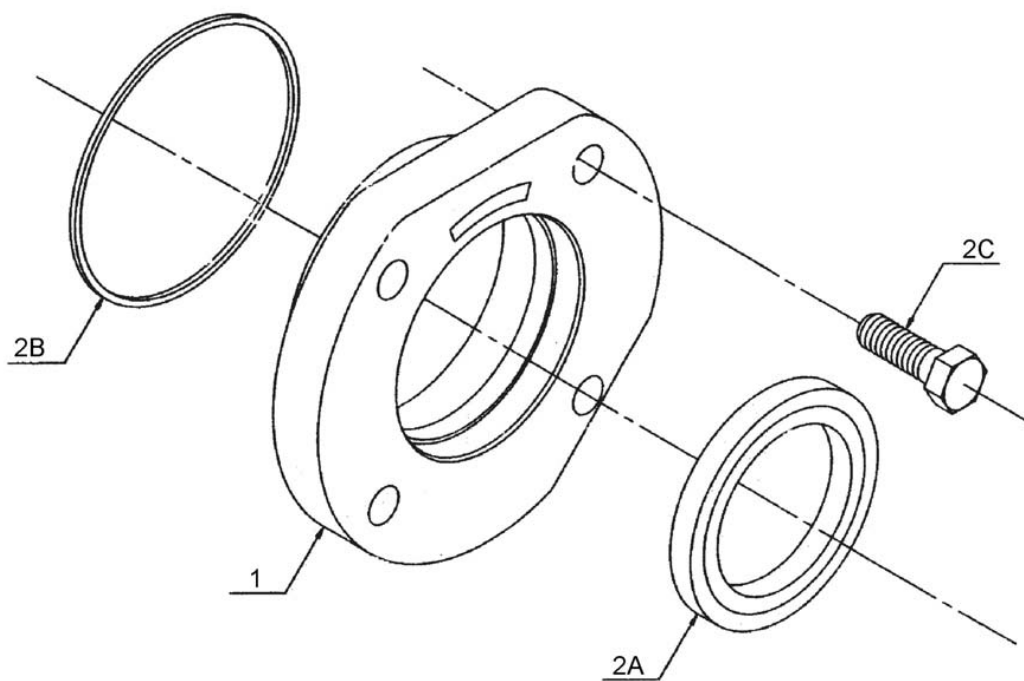


FIGURE 60.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
60-	44734-43	Group, Retainer Bracket (96105), 40A2061		
1	43914-1	Retainer, Bearing, 40A2275		1
2	43914-2	Seal Kit (Includes 2A-C)		1
2A		Seal, Oil		1
2B		O-Ring, Arp155		1
2C		Capscrew		4

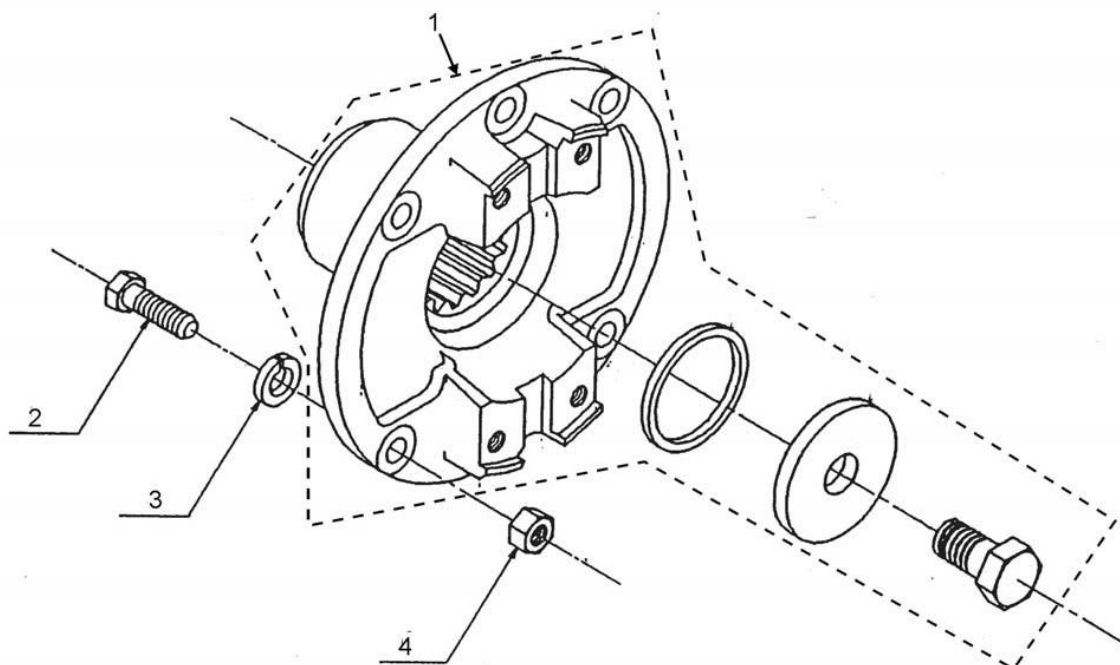


FIGURE 61.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
61-	44734-44	Group, Bracket Flange 6c (96105), 40A2238		
1	44734-47	Flange Kit		1
2	43915-5	Capscrew, 3/8-24x1.25 Gr8, F1003520H8		6
3	43915-7	Washer, Lock		
4	43915-6	Nut, Hex, 3/8-24 Gr8, F1300600U		6

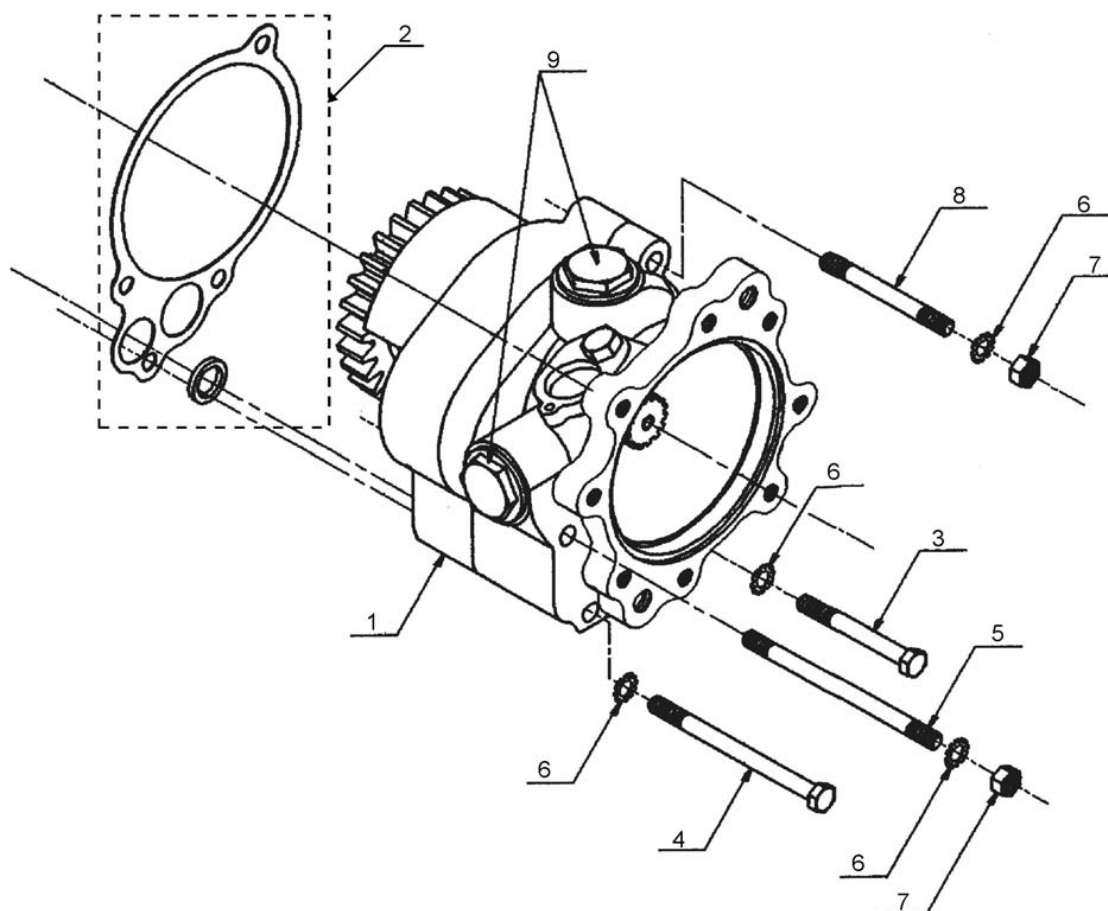


FIGURE 62.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
62-	44734-45	Group, Charge Pump (96105), 40A2059		
1	43916-1	Pump, Charge Assembly (See Figure 63), 4102062		1
2	43916-11	Gasket Kit, Pump		1
3	43916-3	Capscrew, F1003052		1
4	43916-4	Capscrew, F1003080		1
5	43916-5	Stud, 40A2273		1
6	44734-46	Washer, Lock, F16202		4
7	43916-7	Nut, Hex, F1300500T		2
8	43916-8	Stud, 40A2274		1
9	43916-10	Plug, Shipping, R66408		2

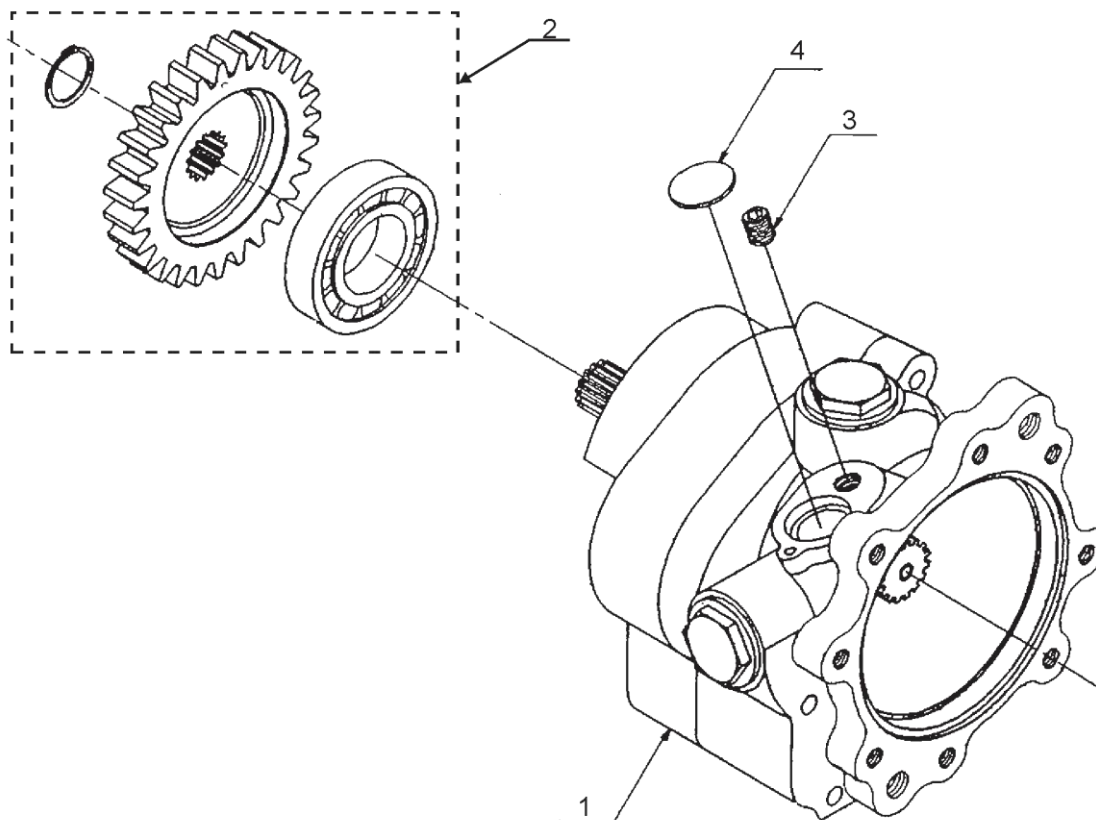


FIGURE 63.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
63-	43916-1	Pump, Charge Assembly (96105), 4102062		
1	43917-1	Pump, Charge Complete, YZ4102523		1
2	43917-7	Bearing & Gear Kit		1
3	43917-5	Screw, Set, F300848V		1
4	43917-6	Plug, Cup, F21018SC		1

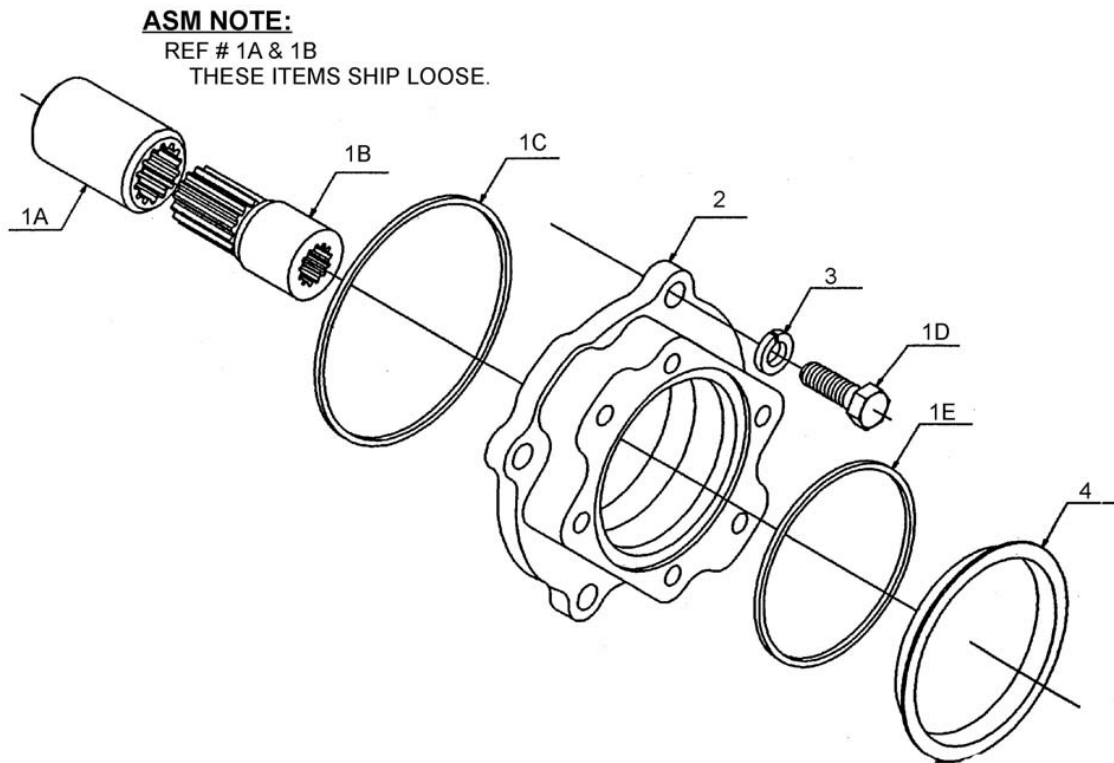


FIGURE 64.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
64-	43918	Pump, Hardware (96105), 40A2158		1
1	43918-9	O-Ring & Adapter Kit (Includes 1A-E)		1
1A		Spacer, Sleeve		1
1B		Adapter, Sleeve Assembly		1
1C		O-Ring, ARP250		1
1D		Capscrew		4
1E		O-Ring, ARP242		1
2	43918-4	Plate, Adapter, YZ102370		1
3	43918-8	Washer, Lock, F16204		4
4	43918-3	Plug, Shipping, F23378		1

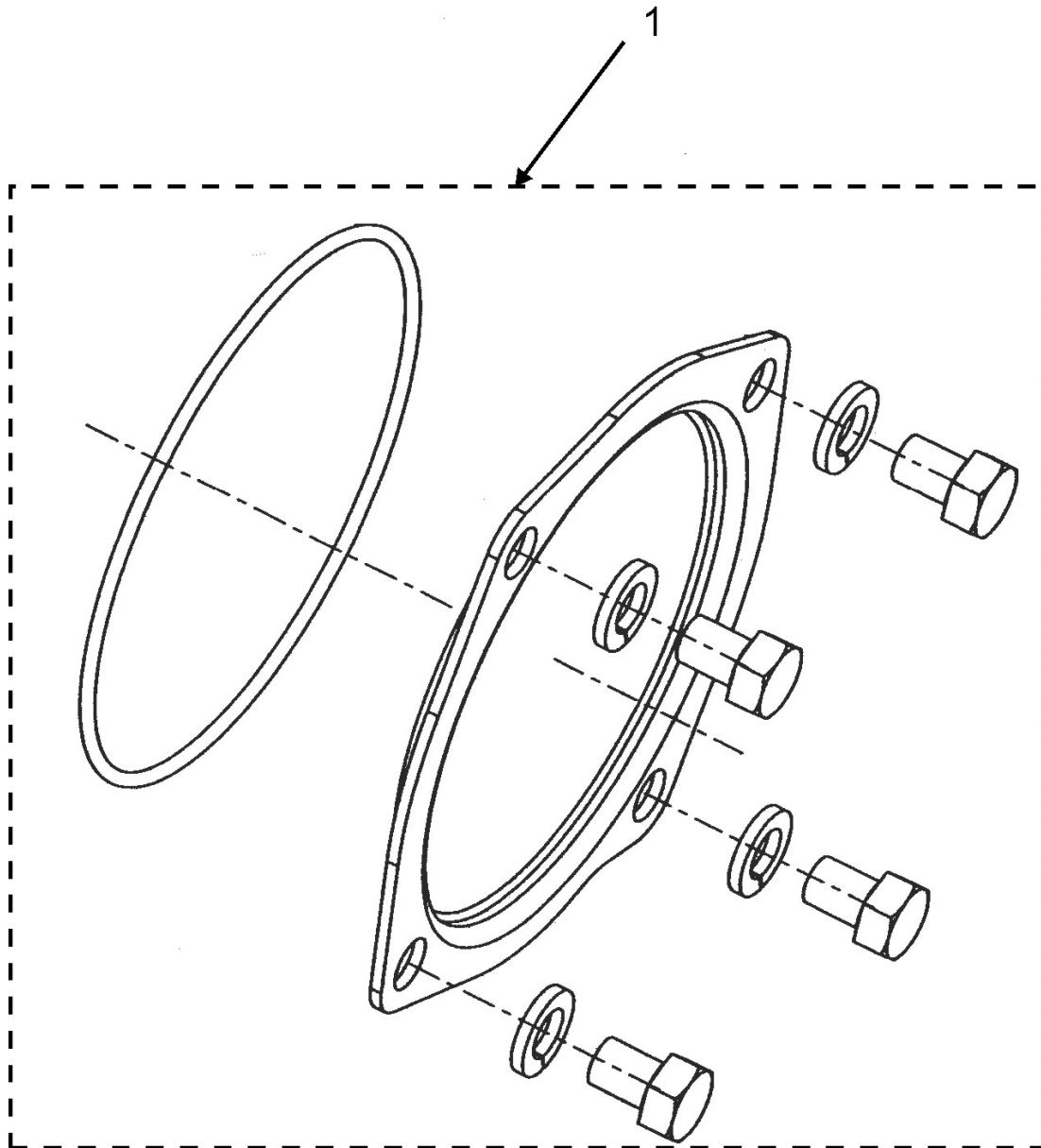


FIGURE 65.
TRANSMISSION REPAIR PARTS

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
65-	43919	Group, Plate Cover (96105), 4001842		1

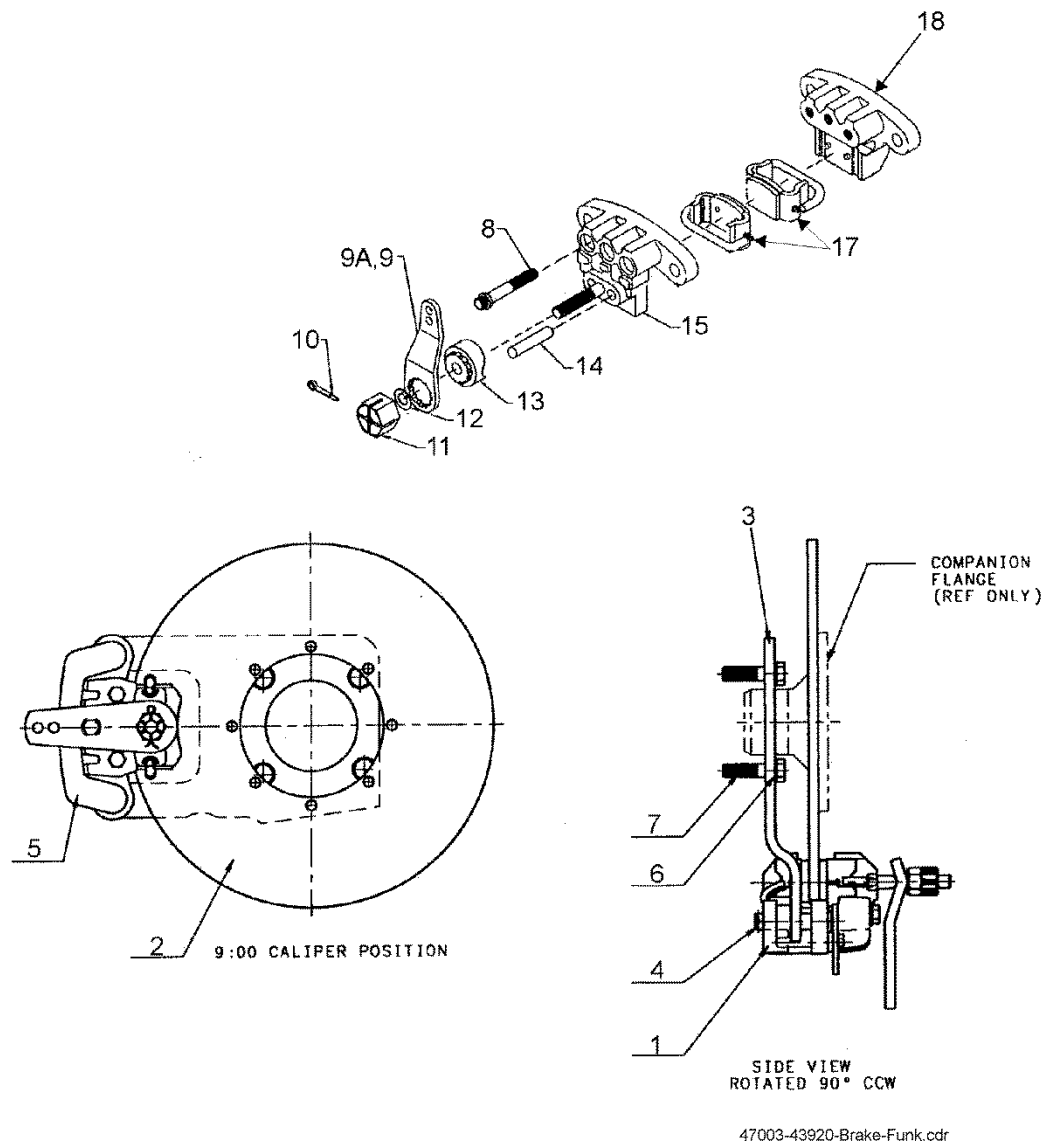


FIGURE 66.
BRAKE, PARK ASSEMBLY - HYDRAULIC

Fig. Item	NMC-Wollard Part No.	Nomenclature	Eff	Units Per Assy
66-		Brake, Park Assembly - Hydraulic		1
0	43920	Group, Brake Disk Assembly		Ref
0	44960	Park Brake System, Hyd Brakes		Ref
1	43920-1	Caliper, Assembly (22075)		1
2	43920-2	Disk, Brake Funk		1
3	43920-3	Bracket, Support Assembly		1
4	43920-4	Pin, Clevis		2
5	43920-5	Retainer, Pin		1
6	43918-8	Washer, Lock		4
7	43902-36	Capscrew		4
8	43920-7	Bolt (22075)		3
9	44734-50	Lever (22075)		1
9A	44819	Lever, Reworked, Air Brake Units Only		1
10	43920-9	Cotter Pin (22075)		1
11	43920-10	Castle Nut (22075)		1
12	43920-11	Washer (22075)		1
13	44734-51	Cam (22075)		1
14	44734-49	Push Pin (22075)		2
15	44734-52	Camside Casting (22075)		1
17	43920-6	Pads, Parking Brake, Set		1
18	43920-16	Carrierside Sub-Assembly (22075)		1

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CHAPTER 5 MANUFACTURES INFORMATION

This chapter contains the following OEM publications

NAF Axle Service & Repair Manual

Transmission, Funk, 2000 Series Service Manual

UEA Shift Quadrant Service Manual

IssPro Programmable Speedometer

Lubrication Pump, Beka-Max, Operator's/Service Manual

Cummins QCB5-9-44 and QSB6.7 Engine Diagnostic Code Definitions

Engine, Cummins, QSB6.7, Operation and Maintenance Manual

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Type / Description:	NMC 01 Planetary-steering axle in NMC-Wollard Aircraft Towing machine M-400
Drawing no. :	LAP 5503.141
Valid as of Serial no. :	01
Date :	18.09.2008
Author	Rauh

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1 General and Service Work

1.1 Introduction

The series production of NMC 01 began in September 2008. This model contains a permanent differential compensation. Both outer planetary drives are driven by double joint cardan shafts. The axle is steerable and is constructed for fix installing. The main drive is achieved via cardanflange size $\varnothing 120$. Two hydraulically operated multi-disk brakes used as operating brake and as parking brake are sufficient for the installation.

1.2 Ordering Spare Parts

Spare parts for these NAF Axles should best be bought direct from an official NMC-Wollard / supplier whereby many of the important parts are conveniently stored and available. Even when parts are not immediately available, it is recommended to order from the supplier and not from the factory. The supplier can usually describe the necessary part more accurately and give the part number more precisely and therefore avoid errors and mistaken shipments.

For every spare part delivery, it is important to give the full exact type name with factory number and year of fabrication. The type sign is located on the diff. Housing near the oil fill plug (refer to Fig. 1).

Use only original NAF spare parts. Use of parts from other manufacturers voids every warranty and may lead to impaired function such as service life.

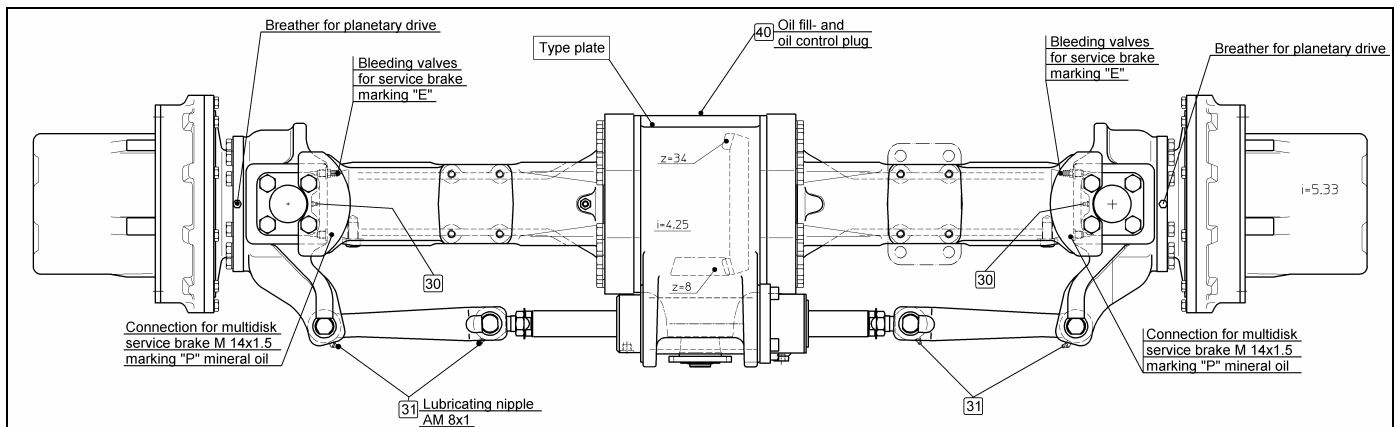


Fig. 1

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1.3 Parts Liability and Guarantees for safety related components

We strongly recommend changing complete components in the case of safety related components such as (control cylinders, steering cylinders, brake cylinders, spring housing cylinders, etc.).

Once a safety related component has been disassembled or opened, all guarantees and liabilities will be void and therefore NAF will not assume product liability for the drive unit. This also applies, even if the complete drive unit is still under guarantee.

1.4 Working Conditions and Tools

A clean and well-lit work environment is necessary for an orderly proper repair. There should also be enough room available to lay out the various parts and sub-assemblies and to put them in order.

Furthermore, a complete as possible quality tool set of all important tools and basic hardware is needed. Additionally, certain special tools are also necessary, which usually prove to be of invaluable help, especially, when one must perform certain repairs frequently. One spares oneself a lot of time and frustration. The speciality tools will be described in the subsequent sections, i.e. marked (e.g. with WZ. No.).

Furthermore, a certain expertise, and for some repairs, even specific training is necessary.

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1.5 Service Work

1.5.1 Lubrication Table

Lubrication Table for NMC 01			
Lubricating Location	No.	Fill Quantity	Lubricant
Differential	40/42	approx. 14.0 Litre	SAE 90 (Hypoidoil) LS
Planetary Drive	50/51	each approx. 4.0 Litre	SAE 90 / SAE 80 / GL 4
Steering leg bearing	30	as needed	Brand EP Grease
Tie bar	31	as needed	Brand EP Grease

Description of the Lubricating Location Numbers:

No.: 30 ⇒ Grease nipple on steering knuckle stud

No.: 31 ⇒ Grease nipple on the tie bar

No.: 40 ⇒ Oil fill plug for Differential and brakes

No.: 42 ⇒ Oil drain plug with magnet for Differential

No.: 50 ⇒ Oil drain plug with magnet for Planetary drive

No.: 51 ⇒ Oil fill plug with magnet for Planetary drive

No.: 52 ⇒ Rest oil drain plug for Planetary drive and control opening for brakes

(refer to Fig. 1/2/3)

Examples for Brand-EP-Transmission oil SAE 90 specification: API-GL 5 or MIL-L-2105 B / LS

Fuchs	(Renogear LS 90), (Renogear HLS 90)
DEA	(Deagear LS SAE 85 W-90), (Dearon BHS SAE 90)
Aral	(Degol 3216)
Mobil	(Mobilube SHC-LS)
Esso	(Gear oil LSA 85 W-90)
Shell	(Gear oil 90 LS)

Examples for Brand-EP-Transmission oil SAE 80 specification: API-GL 4 or MIL-L-2105

BP	(Gear Oil EP SAE 80W)
ELF	(Tranself EP SAE 80W)
Mobil	(Mobilube GX 80-A)
Shell	(HSG 80-90)
Texaco	(Geartex EP SAE 80W)

Examples for Brand -EP-Multipurpose grease, lithium saponified, water-resistance (DIN 51825)

Klüber	(Microlube GL 261) (Klüberplex BE 31-502)
Tripol	(Tribol 3020 / 1000 -1)

Please refer to the legend of the Lubrication Plan concerning the fill quantity.

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1.5.2 Service Interval

NAF axles are designed and built from long term experience and knowledge of work machines. Proper functioning and constant work readiness is only achieved if the axle is well cared for, properly handled and regularly serviced. This includes compliance to the service interval, the use of appropriate lubricants corresponding to the Lubrication Table and checking various service points. Special tools for maintenance work are not necessary.

Service Table for NMC 01					
Operating Hours	0 / Initiation	After 1 day	within the first 250 (one time)	500 (every)	2000 (every) or 1x year
Service Location (No.)					
Differential (40/42)	1	-			
Planetary drive (50/51/52)	1	-	3	4	3
Steering leg bearing (30)	2	-	-	2	-
Tie bar joints (31)	2	-	-	2	-
Wheel nuts	5	5	5	5	-
Multi-Disk operating brake (52)					5
Various visible nuts and bolts	-	-	5	-	5

- | | |
|------------------------|-----------------------|
| 1 = First filling | (see section 1.5.2.1) |
| 2 = Greasing | (see section 1.5.2.2) |
| 3 = Oil change | (see section 1.5.2.3) |
| 4 = Checking oil level | (see section 1.5.2.4) |
| 5 = Inspection | (see section 1.5.2.5) |

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1.5.2.1 First Filling

Caution! The axle is delivered from NAF without oil.

Explanation: The differential gearbox and axle beam have a common oil chamber, as well as the wheel hub and planetary drive have a common oil chamber. Only Attached gear box has a separate oil chamber. These four oil chambers are separated from each other, therefore the oil must fill into each provided openings, respectively scheduled or be refilled.

- **Differential**
Remove oil fill plug (No.40) and fill oil corresponding to the Lubrication Table until the oil reaches the bottom edge of the thread opening. Check the level approx. 5 minutes and if need, refill. Tightening moment for the fill plug (No.40) 50^{+5} Nm. (Fig. 1)
- **Planetary-Drive**
First of all, turns the wheel hub until the oil fill plug (No.50) is perpendicular to the horizontal of the hub. Remove oil fill plugs (No.50/51) and fill oil corresponding to the Lubrication Table until the bottom edge of the thread (No.50). Check the level approx. 5 minutes and if need, refill. Tightening moment for oil fill plugs (No.50/51) is 50^{+5} Nm. (see Fig. 4 / Position 2)

1.5.2.2 Greasing

- **Steering knuckle bearing**
Apply grease to 4 lubricating points (No.30) with a grease gun corresponding to the Lubrication Table until clean grease exits. Wiping off surplus grease. (see Fig. 2)
- **Tie bar joints**
Apply grease to both lubricating points (No.31) with a grease gun corresponding to the Lubrication Table until clean grease exits. Wiping off surplus grease. (see Fig. 2)

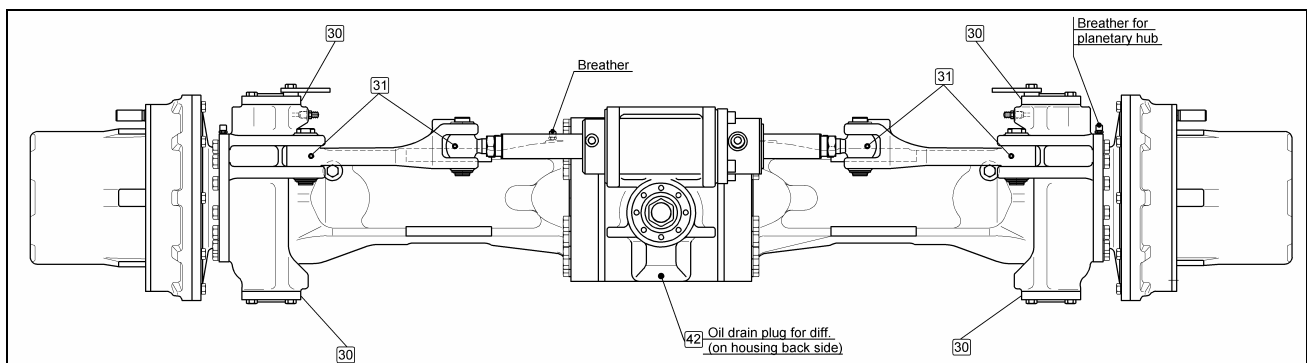


Fig 2

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1.5.2.3 Oil change

Note: Clean the area around the plugs beforehand.

- Differential

Perform oil change when oil is warm. Remove oil fill plug (No.40) then open oil drain plug (No.42) and drain oil. Clean off the magnet of the oil drain plug (No.42) of any grime and of any existing filings, before threading in. Tightening moment for drain plug (No.42) 50^{+5} Nm. Fill new oil corresponding to the Lubrication Table, until the oil level reaches the bottom edge of the thread opening (No.40). Check the level approx. 5 minutes and if need, refill. Tightening moment for the oil fill plug (No.40) is 80^{+10} 5 Nm. (Fig. 1 and 2)

- Planetary-Drive

Perform oil change when oil is warm, simultaneously with Differential. Therefore turn the wheel hubs such that the oil drain plugs (No.50/52*) are down. (Fig. 3 / Position 1). Clean the oil fill plugs (No.51) and oil drain plugs (No.50/52*) and the area around them of dirt. Remove oil drain plugs (No.50/52*) and drain oil. Clean off the magnet of the oil drain plugs (No.50) of any grime and of any existing filings before threading in. Then turn the wheel hubs 90° back until the drain plugs (No.50/52*) are positioned horizontally (Fig. 4 / Position 2). Remove oil fill plugs (No.51) and fill oil corresponding to the Lubrication Table until the bottom edge of the thread (No.50). Check the level approx. 5 minutes and if need, refill. Tightening moment for oil plugs (No.50/51/52*) is 50^{+5} Nm. (see Fig. 3 and 4) (*) on the back side of the wheel hub.

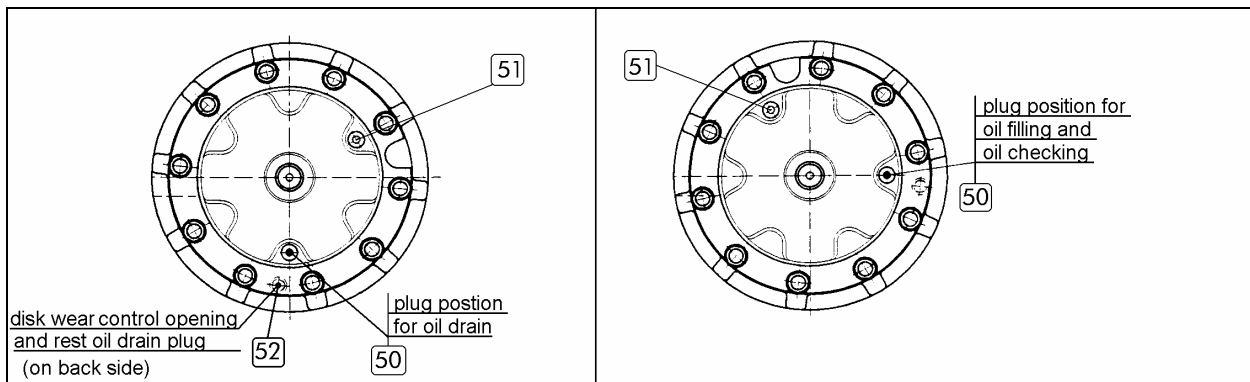


Fig 3

Fig 4

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1.5.2.4 Checking oil level

Note: Clean the area around the screw plugs of dirt beforehand.

- Differential
Remove oil fill plug (No.40), the oil level must reach to the bottom edge of the thread opening (No.40), if need refill oil corresponding to the Lubrication Table. Check the level approx. 5 minutes. Tightening moment for the oil fill plug (No.40) is 80^{+10} Nm. (Fig. 1).
- Planetary-Drive
First of all, turn the wheel hub until the oil control plug (No.50) is perpendicular to the horizontal position of the hub (Fig. 4 / Position 2). Remove oil control plug (No.50) the oil level must reach to the bottom edge of the thread opening (No.50), if need refill oil corresponding to the Lubrication Table. Check the level approx. 5 minutes. Tightening moment for the oil control plug (No.50) is 50^{+5} Nm. (see Fig. 4 / Position 2)

1.5.2.5 Inspection

- Various visible bolts and nuts
Due to stresses and vibrations exerted, it is possible for various bolts and nuts to set or give way. Timely tightening of these will prevent any leaks or other greater damages.
 - Wheel Nuts
Due to stresses of vehicle motion, the wheel nuts may set or loosen. Timely tightening will prevent a deflection of the centre to the rim.
Tightening moment for wheel nuts is 550 Nm.
 - Wearing test for Multi-Disk Operating Brake
(see Fig. 13 / Page 25)
Check disk set, if need replace disk set, then see Repair Manual
- Therefore turn the wheel hubs until the rest oil drain plugs (No.52*) are positioned on top. (Above the oil level).
- Apply the brake and remove rest oil drain plugs (No.52)
- Measured in applied position.
- Measure with a feeler gauge from the surface for plug (No.52) to the test nib of the 5th disk.
(nominal size for new disks $50.5^{+0.9/-0.4}$ mm)
(wearing size for wear out disks $47.5^{-0.8}$ mm)

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2 Repair Manual

2.1 Exchange of the Complete Differential

(see Fig. 5; Page 12)

Note! For large damages to the differential it may be more advantageous to exchange the complete differential instead of repairing it. Therefore it would be advantageous to remove the whole axle from the undercarriage.

- Remove Steering cylinder.(See Chapter 2.8)
- Drain oil from the differential and remove hydro-motor.
- Dismantle axle from the vehicle.
- Screw out hex. bolts (No.24) on both sides of the differential and take off axle beam (No.40) with complete side parts that is pull out.

Note! Original NAF spare and repaired differentials are properly set and adjusted from the factory. Differentials not from NAF should be inspected for proper bearing and contact pattern adjustment before installation.

- Remove rust protective coating from locating surfaces.
- Replace o-rings (No.28).
- Reinstall complete side parts, with this lead the external spline of the axle shaft into the compensating gears by light turn at the cardan flange.
- Then push together axle beam up to flange location, paying attention to the straight pins.
- Insert hex. bolts (No.24). Tightening moment is 400^{+20} Nm.
- Reinstall Steering cylinder with new hex.-bolts. Check the gap between flange and diff. housing with an thickness gauge (tolerance range 0.2 – 1.0 mm)
- Install axle into vehicle, (connect brakes and Hydro motor).
- Fill oil into differential.
- Move steering cylinder several times in both final positions on stationary point a check all connection again.
- Do not forget to vent brakes!
- Test-drive and apply several brake tests then retighten axle-mounting bolts.
- Check track wide, if necessary readjust it. (Track = 0)
- After the check, fix eye screw (No.68) by lock nut (No.81).

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2.2 Repairs on the Differential

2.2.1 Exchange of Crown Gear / Pinion

(see Fig. 5/ Page 12)

Note!

The crown gear and pinion (No.13) can only be exchanged as a matched set and not separately, since the gears have been mated to one another. The same numbers marked on the crown gear and pinion identifies the matched sets. (Engraved with etching pen). It is advisable to replace various bearings with this sort of repair.

- Remove differential. (section 2.1).
- Loosen allen bolts (No.4) and remove flange (No.5).on the crown gear side
- Remove differential cage (No.11) with crown gear (No.13).
- Pull off sleeve (No.51) and remove pinion (No.13) inward.
- Inspect tapered roller bearing (No.10/16) for differential cage and (No.35/42) for pinion and replace if need be.
- Loosen hex. bolts (No.9) and press crown gear (No.13) from the differential cage (No.11).
- Slide new crown gear onto differential cage (No.11) and during which insert both straight pins (No.12). Tighten new hex. bolts (No.7) (coating on thread) cross wise with a torque wrench. Tightening moment is 290^{+10} Nm.
- Determine thickness of the adjusting washer (No.45) (see section 2.2.1.2).
- If replacing, press selected adjusting washer (No.45) and bearing outer ring from (No.42; No.43; No 10 and No.16) into differential housing (No.23) i.g. on flange (No.5;10).
- Install bearing inner ring from (No.10 and 16) onto differential cage (No.11).
Assembly temperature for bearing inner ring from (No.10/16 and 24) max. 80°.
- Install bearing inner ring (from No.42) with roller cage, onto pinion (No.13).
Assembly temperature for bearing inner ring (No.42) max. 80°.
- Determine thickness of the adjusting washer (No.44) (see section 2.2.1.1).
- Feed in pinion (No.13) from the inside of the housing (No.23) and support.
- Select a combination of adjusting washer(s) (No.44) (see chapter 2.2.11.2) and slide it onto the pinion shaft (No.13).
- Press bearing inner ring (from No.35) with roller cage, onto pinion (No.13).
Assembly temperature for bearing inner ring (No.35) max. 80°.
- Install sleeve (No.51) and thread pinion nut (No.50) onto pinion (No.13) and tighten with 800 Nm.
- Check pinion bearing preload with a torque wrench and if need be, change adjusting washer (No.44). (Preload: 0.5 – 2.0 Nm).
- Loosen nut (No.50) again.
- Clean pinion (No.13) and pinion nut (No.50), of dirt, oil and inhibitors.
- Coat entire diameter and length of thread of pinion (No.13) and nut (No.50), with Loctite 262.
- Apply wear and seizing inhibiting paste to the contact surface of the nut (No.50). (i.e. Wolfracote SSP from Klüber)
- Renew O-ring (Nr.38).

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- Install sleeve (No.51) and thread pinion nut (No.50) onto pinion (No.13) and tighten with 800 Nm. The final position must be achieved within 3 to 5 minutes in order for the Loctite to achieve its full potential.
- Check pinion bearing preload with a torque wrench and if need be, change adjusting washer (No.44). (Preload: 0.5 – 2.0 Nm).
Document measured pinion bearing preload (see section 2.2.1.3).
- Thread on nut (No.17) approx. 1 turn, thread out nut (No.3) approx. 2 turns.
- Insert differential cage (No.11) complete, hold flange (No.5/14) and new o-ring (No.6) with allen bolts (No.4).
Fasten both flanges (No.5/14) additionally with for temporary assembly bolts M 18x2x40.
- Adjust backlash and crown gear bearing (0.15 – 0.25 play) (see section 2.2.2).
- Loosen temporary assembly bolts M 18 x30 and install differential (see section 2.1).

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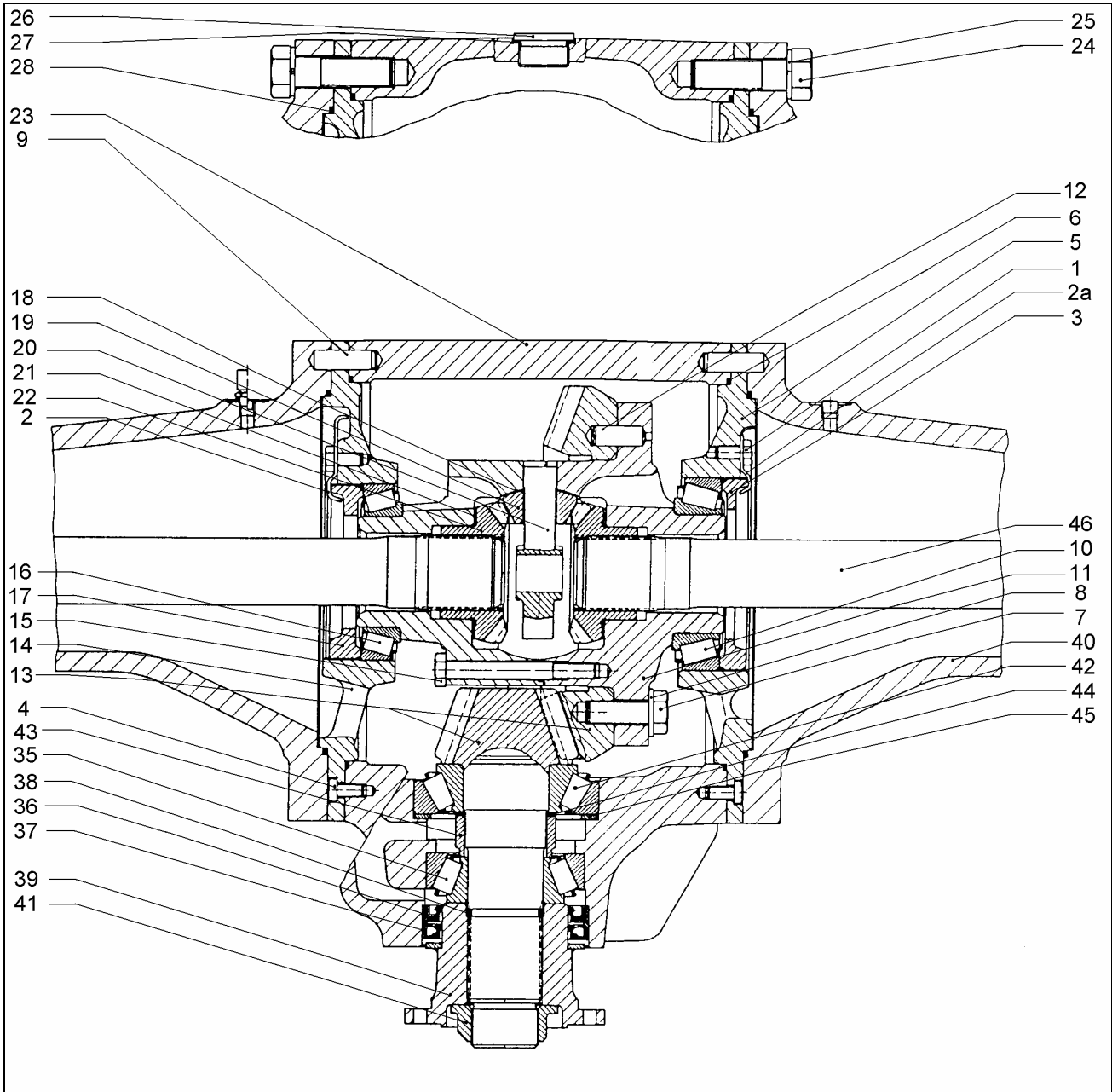


Fig. 5

- | | | | | |
|-------------------------|-------------------------|-----------------------|----------------------------|----------------------------|
| 1. hex. screw | 11. diff.-cage | 21. butting ring | 35. tapered-roller bearing | 41. nut |
| 2. locking plate | 12. dowel pin | 22. compensating gear | 36. seal ring | 42. tapered-roller brg. |
| 2a. locking plate | 13. crown wheel/pinion | 23. diff.-housing | 37. seal ring | 43. spacer sleeve |
| 3. nut | 14. flange | 24. hex. screw | 38. o-ring | 44. adjusting washer |
| 4. allen screw | 15. hex. screw | 25. locking ring | 39. drive shaft flange | 45. adjusting washer |
| 5. flange | 16. tapered-roller brg. | 26. screw plug. | 40. axle beam | 46. double j. cardan shaft |
| 6. o-ring | 17. nut | 27. seal ring | | 47. breather |
| 7. hex. screw | 18. thrust washer | 28. o-ring | | |
| 8. washer | 19. differential gear | 29. - | | |
| 9. dowel pin | 20. cross bolt | | | |
| 10. tapered-roller brg. | | | | |

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2.2.1.1 Determining Thickness of the Adjusting Washer (45)

Note! By selecting the adjusting washer (No.45) the contact pattern adjustment is carried-out.

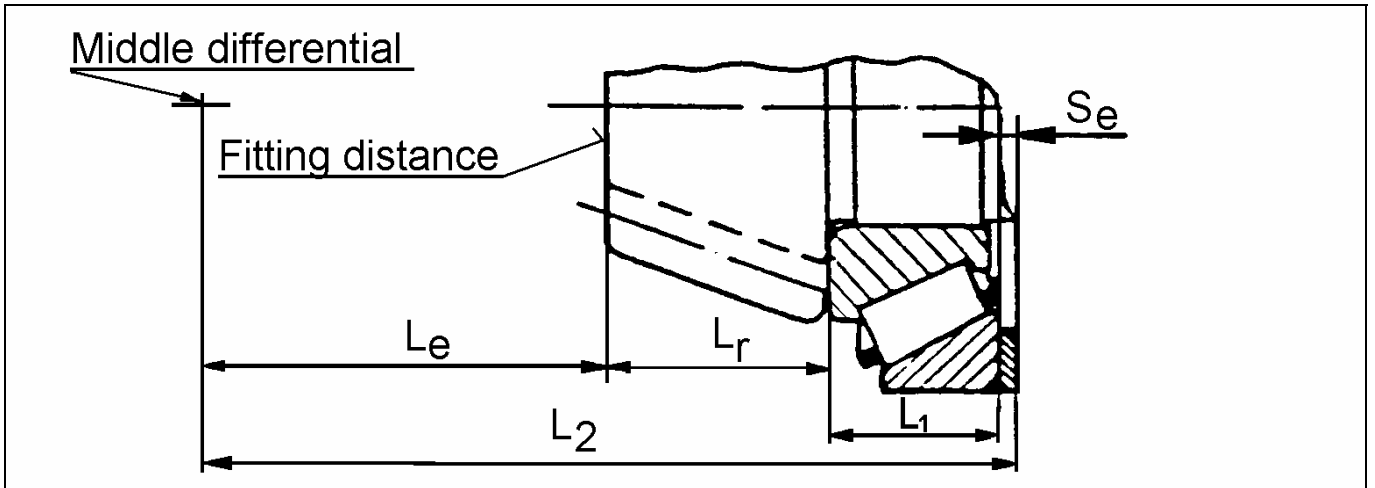


Fig. 7

- Calculating thickness (S_e) of the adjusting washer (No.45)

$$S_e = L_2 - L_e - L_r - L_1$$

A washer thickness between 2.4 and 3.65 mm must be achieved.

Select the nearest available washer thickness. Maximum allowable deviation of the washer thickness from the calculated thickness S_e is 0.1 mm.

„ L_2 “ = distance between bearing seat (No.43) and middle of the differential ($174,3^{+0,1}$).

„ L_e “ = mounting distance (engraved on pinion face approx. 83.02 mm).

„ L_r “ = measure and document pinion gear head height. (ca. $54,98^{+/-0,03}$)

„ L_1 “ = measure actual thickness of new bearing (No.42). The measurement „ L_1 “ can vary between 33.36 and 33.40. (Vernier caliper with at least 120 mm jaw length).

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2.2.1.2 Determining Thickness of the Adjusting Washer (44)

(see Fig. 5)

- Press in new bearing outer ring from (No.42) and (No.35) into differential housing (No.23) until stop.
- Install bearing inner ring (from No.42) with roller cage onto pinion (No.13).
Assembly temperature for bearing inner ring (No.43) max. 80°.
- Select a combination of spacer sleeve (No.43) and two or three adjusting washers (No.44).
Assemble with a combine measure in the range of 26.84 mm to 28.26 mm.

Note: First check working selected combination if usable.
Adjusting washer thickness: 0.96 to 1.44 (with 0.04 increments)
Spacer sleeve (No.43): 25.9 ± 0.02 mm

- Feed in pinion (No.13) from the inside of housing (No.23) and hold up.
- Start to insert with selected spacer sleeve (No.43), then adjusting washer(s) (No.44) onto the pinion (No.13). (see Fig. 5).

Tip: Start the select combination with a total width approximately of 26,6 (it is a empirical value)

- Press bearing inner ring (from No.42) with roller cage, onto pinion (No.13).
Assembly temperature for bearing inner ring (No.42) max. 80°.
- Apply wear and seizing inhibiting paste to the contact surface of the nut (No.41).
(i.e. Wolfracote SSP from Klüber)
- Install sleeve (No.51) and thread nut (No.41) onto pinion (No.13) and tighten with 800 Nm.
- Check pinion bearing preload with a torque wrench and if necessary change adjusting washer (No.44).

The pinion bearing may not have any axial play but should let itself turn with 0.5 to 2.0 Nm. For used bearings, an adjustment value of 0 to 1.0 Nm may apply.

For new bearings the pinion preload should be: 0.5 – 2.0 Nm.

Document measured pinion bearing preload (see section 2.2.1.4).

- Upon correct bearing preload, secure pinion bearing (No.41) with Loctite.
(see section 2.2.1)

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2.2.1.3 Pinion Bearing Adjustment

- Clean pinion (No.13) and pinion nut (No.41), of dirt, oil, and inhibitors.
- Coat entire diameter and length of thread of pinion (No.13) and nut (No.41), with Loctite 639.
- Apply wear and seizing inhibiting paste to the contact surface of the nut (No.41). (i.e. Wolfracote SSP from Klüber)
- Thread nut (No.41) onto pinion (No.13) and tighten with 800 Nm, there while arrest sleeve (No.39) with a special tool. The final location must be achieved within 3 to 5 minutes in order for the Loctite to achieve its full potential.
- Check pinion bearing preload with a torque wrench and if need be, correct the adjustment. The pinion bearing may not have any axial play but should let itself turn with 0.5 to 6.0 Nm. For used bearings an adjustment value of 0 to 5.0 Nm may apply.
- Document adjusted bearing preload for later crown gear bearing adjustment.

2.2.1.4 Backlash and Crown Gear Bearing Adjustment

- Loosen bolts (No.1) and remove both locking plates (No.2).
- Thread in nut (No.17) approx. 1 turn, thread out nut (No.3) approx. 2 turns.
- Insert differential cage (No.11) complete.
- Use new o-ring (No.6) and fix flange (No.5) with allen bolts (No.4). Fasten flange (No.6) additionally with four temporary assembly bolts M 18x2x40.
- Turn both nuts (No.17) and (No.3) until a backlash of 0.15 to 0.25 mm is achieved.
- Is the correct backlash reached then lock the nut (No.3) with locking plate (No.2) and hex. bolt (No.1).
- Adjust bearing preload of the crown gear bearing (No.10) and (No.16). For this, turn nut (No.17) until the necessary bearing preload of 1.0 – 3.0 Nm is achieved.
- This value is determined on the pinion nut (No.41) with a torque meter, in that to the pinion bearing preload (documented value from section 2.2.1.3) a moment of 0.2 to 0.7 is added.
- Is the correct bearing preload is achieved, secure also nut (No.17) with locking plate (No.2) and hex. bolt (No.1).
- Document adjusted bearing friction moment.

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2.2.1.5 Checking Contact Pattern

- Loosen temporary assembly bolts and allen bolts (No.4) at the flange (No.5) and remove flange.
- Take out differential cage (No.11) and coat flanks from 2 teeth (= 4 tooth flanks) of the crown gear (No.13) with thin yellow oil based paint and reinstall differential cage (No.11), flange (No.5) with temporary assembly bolts.
- Turn pinion, so that the contact pattern is marked by the paint.
- Remove flange (No.5), take out differential cage (No.11) with crown gear and assess contact pattern. With proper adjusting washer thickness a contact pattern as per Fig. 9 should be achieved (see section 2.2.1.2).

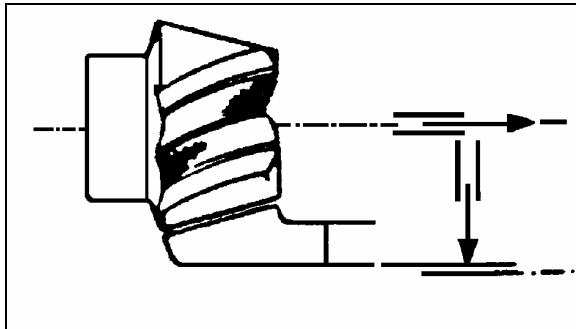


Fig. 7

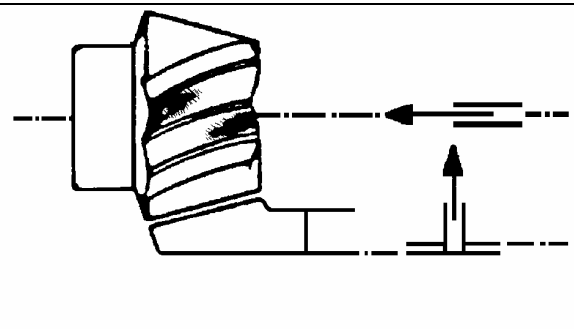


Fig. 8

If there is a contact pattern as in Fig. 7 or 8 showed, aim for contact pattern as per Fig. 9. This is with displacing of the pinion through change of thickness for the adjusting washer to do. By turning the nuts (3) and (17) is the crown gear position similar to Fig. 7 or 8 either to displacing.

Caution: During the adjustment process, always pay attention to the proper preload for the bearings (8) and (24). Likewise, when turning the nuts (3) and (25) pay attention to the correct backlash. Wash off oil paint from previous adjustment attempts.

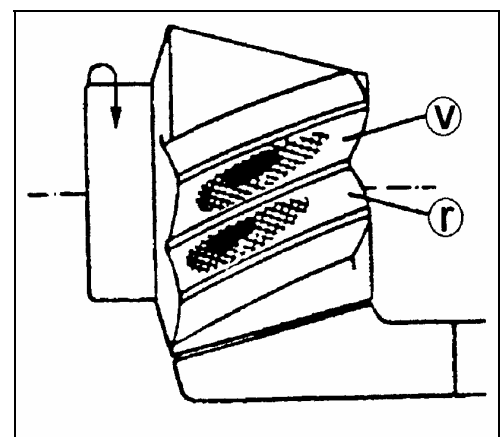


Fig. 9

Once the backlash and bearing preload has been adjusted, secure both nuts (No.3) and (No.17) with locking plate (No.2) and new hex. bolts (No.1).

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2.2.2 Exchange of Differential Cage (Compensating Gearbox)

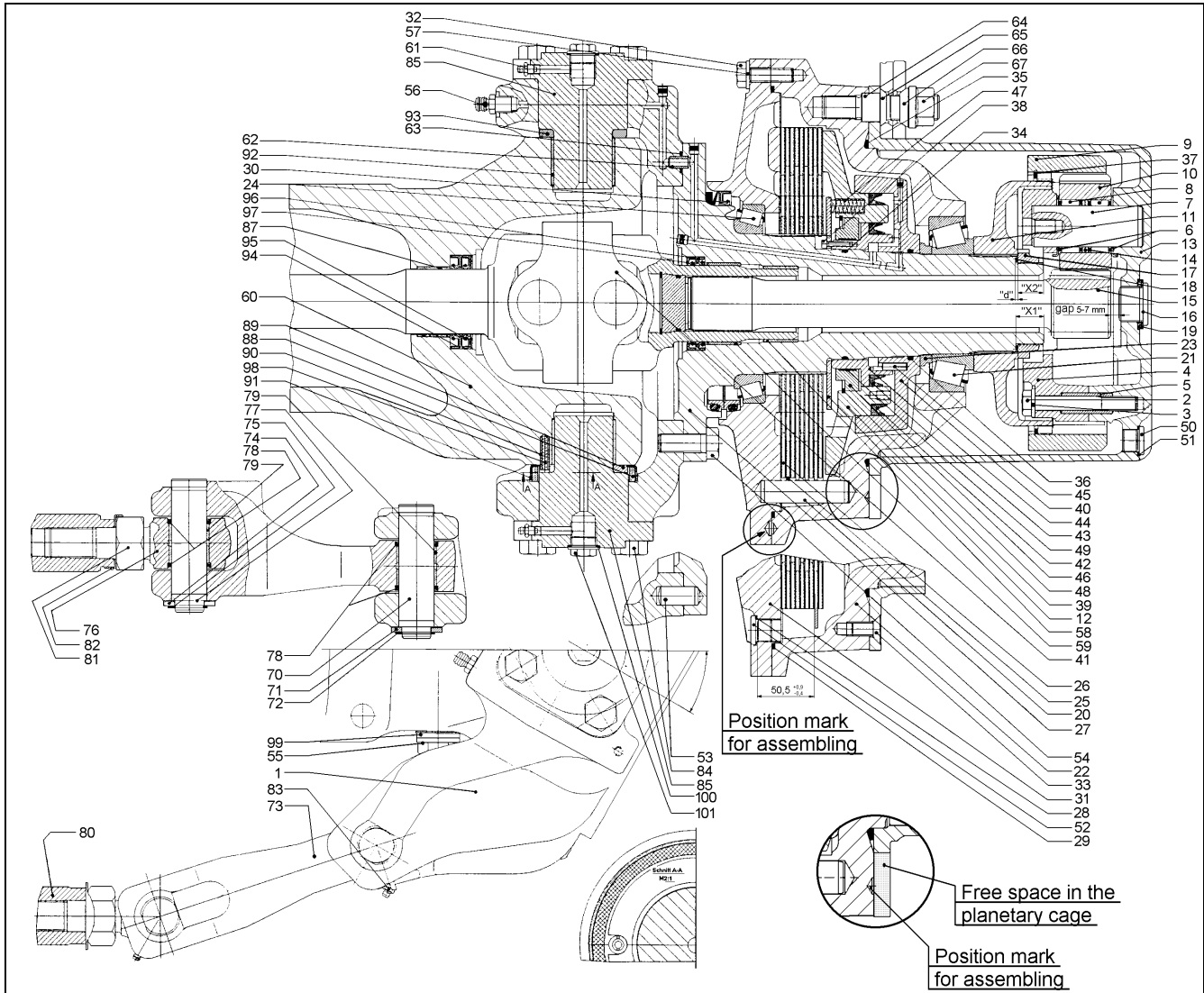
(see Fig. 5)

Note!

The both halves of the differential cage (No.11) are manufactured as a unit and therefore it can only be exchanged together, note orientation markings and identification.

- Remove differential. (see section 2.1)
- Detach flange (No.5).
- Take out differential cage (No.11) with crown gear (No.13).
- Pull off bearing inner rings from (No.10 / No.16) and check both tapered roller bearing (No.10 / No.16) and replace it if necessary.
- Loosen hex. bolts (No.7) and pull crown gear (No.13) from differential cage (No.11).
- Remove allen bolts (No.15) and open differential cage (No.11).
- Take out cross bolt (No.20) with differential gear (No.19) and thrust washer (No.18) as one unit. Check components and replace if be exigency.
- Remove compensating gears (No.22) with butting washers (No.21). Check components and replace if need be.
- Perform adjustment of the differential cage by selecting thickness „s“ of the butting washers (No.21).
 Thickness „s“ of the butting washers (No.21) to select from is 1.5; 1,7; 2,0; to 2.2 mm.
 1. For testing purposes, screw together both differential cage halves with the selected parts with four uncoated temporary assembly bolts M 10 x 90.
 2. With the use of a profiled shaft end, turn the compensating transmission through. There can be no noticeable resistance or no ascertainable jerking. The axial play at the compensating gear (No.22) must be less than 0.2 mm.
 3. For a wrong thrust washer adjustment, appropriately change and repeat test method.
- At the correct adjustment, remove the four uncoated temporary assembly bolts and finally fix together with twelve new coated hex. bolts (No.15).
 Tightening moment for hex. bolts (No.15) is 67^{+5} Nm.
- Press on both tapered roller bearings (No.10 / No.16) and during replacement also press bearing shells in both flanges (No.5 / 14).
- Insert differential cage (No.11) and flange (No.5).
- For test purposes, fasten flange side with four temporary assembly bolts M 18x2x40.
- Adjust backlash and crown gear bearing (refer to section 2.2.1.4).
- Check contact pattern 0.15 – 0.25 backlash (refer to section 2.2.1.5).
- Remove temporary assembly bolts M 18x2 x40.
- Install differential (see section 2.1).

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1. axle knuckle	36. o-ring	71. washer
2. hex. screw	37. circlip	72. Sg. Ring
3. washer	38. allen screw	73. connecting rod drop arm
4. planetary cage	39. piston	74. washer
5. Shear sleeve	40. cylinder	75. circlip
6. butting ring	41. double jointed cardan shaft	76. eye screw
7. planetary stud	42. Piston seal	77. collar stud
8. needle cage	43. Piston seal	78. seal ring
9. gear rim	44. cylinder	79. bushing
10. Planetenrad	45. taper-grooved dowel pin	80. steering cylinder
11. Ring gear carrier	46. ring	81. hex nut
12. washer	47. compression spring	82. washer
13. planetary cage	48. circlip	83. tapered grease nipple
14. Seeger ring	49. tolerance ring	84. hex bolt
15. sun gear	50. screw plug.	85. steering knuckle stud
16. screw plug.	51. seal ring	86. steering knuckle stud
17. groove nut	52. screw plug.	87. bushing
18. adjusting washers	53. dowel pin	88. bearing washer
19. washer package	54. hex. screw	89. bearing washer
20. stud	55. hex. screw	90. spring cotter
21. tapered-roller bearing	56. breather valve	91. cover
22. wheel hub	57. washer	92. bushing
23. washer	58. inner ring	93. washer
24. tapered-roller bearing	59. bushing	94. oil seal
25. driven disc	60. axle beam	95. oil seal
26. drive disc	61. tapered grease nipple	96. oil seal
27. spindle	62. split spring pin	97. oil seal
28. seal ring	63. o-ring	98. spring cotter
29. o-ring	64. wheel bolt	99. washer package
30. oil seal	65. centre ring	100. seal ring
31. wheel hub	66. liemes ring	101. plug
32. hex. screw	67. collar nut	
33. flat head bolt	68.	
34. o-ring	69.	
35. o-ring	70. collar stud	

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2.3 Planetary Drive

Note!

To work on the planetary drive it is not required to remove the axle from the vehicle. It is sufficient when the side of the vehicle that is being worked on is jacked up and the wheel removed.

2.3.1 Complete Exchange of Planetary Cage

(see Fig. 10)

- Lift up and secure vehicle.
- Remove wheel.
- Drain oil (section 1.5.2.2).
- Loosen off flat head bolt (No.33).
- Pull off the complete planetary cage (No.13).
- Replace o-ring (No.35) and insert into the recess of the wheel hub (No.22).
- Assemble new complete planetary cage (No.13).

For this, bring recess of the new planetary cage to the position mark of the wheel hub.

Then bring teeth of the sun gear (No.15) and the three planetary gears (No.10) in meshing location. Afterwards, slide on whole the planetary cage (No.13).

- Insert flat head bolt (No.33). Tightening moment is 70 Nm.
- Fill in oil (section 1.5.2.3 Planetary drive).
- Install wheel.
- Lift down vehicle.

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2.3.1.1 Checking and Adjusting Thrust Stud Adjustment.

Note: Thrust stud = Screw plug (No.28)

(see Fig. 11)

- For this measure distance (l_4) from the wheel hub flange surface (No.55) to the face of the axle shaft (No. 45) and distance (l_5) from the flange surface of the planetary cage (No.47) to the stopping face of the thrust stud (No.28) with a depth gauge.
- Axial play $l_5 - l_4$ must be at least 0.5 mm. (Max. allowable 2.0 mm)
- If the measured or calculated axial play is outside of these values, the thrust stub (No.28) is to be adjusted with appropriate new washer packet (No.19).
- For this, the assembled thrust stud (No.28) should be completely threaded out. To ease assembly, heat to approx. 80° .
- Then assemble the planetary cage (No.47) to the wheel hub (No.34) as per section 2.3.1. Insert sun gear shaft (No.40) inward through the threaded hole M 30 x 1.5 with an approx. $\varnothing 20$ mm mandrel and light tap hammering until stop.
- Selection of the washer packet „ S “ (No.29)
 - „ S “_{min} = 22 - „ A “ measured
 - „ S “_{max} = 23 - „ A “ measured
 - „ A “ = distance from spot face of planetary cage to the face of the axle shaft.
- Clean thread M 30 x 1.5 in planetary cage (No.47) of dirt, oil and inhibitors.
- Thread in thrust stud (No.28) with selected washer packet „ S “ (No.29) into planetary cage and tighten with 200 to 240 Nm.
- Fill oil (section 1.5.2.3 –Planetary drive).

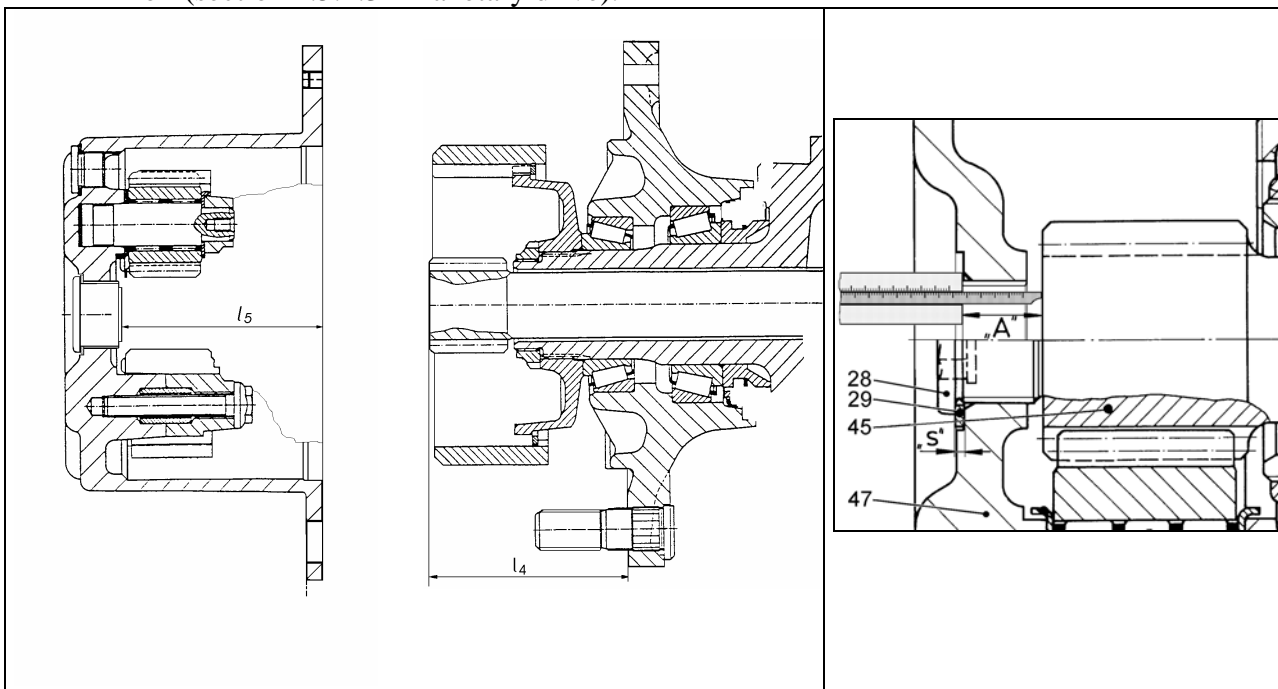


Fig. 11

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2.3.2 Exchange of Sun Gears

(see Fig. 20)

- Remove planetary cage (No.13) see section 2.3.1.
- Pull of sun gear shaft (No.15) from the double jointed cardan shaft (No.41).
- Slide on new sun gear shaft (No.15).
- Assemble new complete planetary cage (No.13) see section 2.3.1.

2.3.3 Exchange of Planetary Studs and Gears

(see Fig. 10)

- Remove planetary cage (No.13) see section 2.3.1.
- Place planetary cage (No.13) with the opening upward.
- Loosen three hex. bolts (No.2).
- Snap out both snap rings (No.4 and 5) then take out washer (No.3).
- Pull out the planetary studs (No.7) with an impact extractor M 12.
- Take out the unit planetary gear (No.10) with needle cage (Nor.8) and butting ring (No.6) to the major centre in the planetary cage (No.13).
- Insert new unit (planetary gear + needle cage + butting ring) then push up the planetary stud (No.7) to 8,7 mm depth min.
Tip: The butting ring nip must showed to the major centre in the planetary cage (No.13).
- Lay in the washer (No.3) then snap in both snap rings (No.4 and 5) again.
- Insert three new coated hex. bolts (No.2) and tighten it with 70 Nm.
- Check the free floating of the planetary gears (No.10).
The axial gap must have (min. 0.3 mm).
- Reassemble planetary cage (No.47) complete. (see section 2.3.1).

2.3.4 Exchange of Crown Gear Carrier

(see Fig. 10)

- Remove planetary cage (No.13) see section 2.3.1.
- Remove snap ring (No.37).
- Replace crown gear (No.9).
- Reinsert snap ring (No.37).
Note: The ring gear should have a radial play of approx. ± 0.4 mm on the ring gear carrier (No.9).
- Assemble planetary cage (No.13). See section 2.3.1.

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2.4 Wheel Bearings

To repair the wheel bearing on an installed axle are two device holders necessary (WZ 041). Otherwise is the complete half-axle (axle beam from differential housing) to detach. (Because later assembly). Must during a repair the face seal be opened is the installation of a new face seal set required even if the wear range still isn't reached.

(see Fig. 10)

2.4.1 Gear Bearing Exchange

- Remove planetary cage (No.13) complete (section 2.3.1).
- Disassemble sun gear (No.15) (section 2.3.2).
- Loosen 10 hex. screws (Nr.32) and attach in both detaching thread (M 12) of wheel hub (Nr.31) every one a device holder WZ 041 with one auxiliary screw M 12 x 20.
- Screw off groove nut (No.17) with a special groove socket wrench WZ 465.
For this, heat groove nut M70x1.5 (No.39) to approx. 150°C, (i.e. with soldering torch) and loosen with the special groove socket wrench WZ 465. The loosening moment can reach up to 1600 Nm.
- Remove adjusting washer (No.18) and crown gear carrier (No.11) with crown gear (No.9).
- Pull off wheel hub (No.22) and outer gear bearing (No.21), simultaneously from the spindle (No.27), with an appropriate extractor.
- Detach washer (No.23) and complete ring piston cylinder of the disk brake.
- Remove success the inner disks (No.26 / 25) and outer disks (No.28).
- Detach device holder WZ 041 and lift carefully wheel hub (No. 31).
- Pull bearing inner ring (No.24) with an extractor from the spindle (No.27)
- Remove V-ring and seal ring (No.30) from the spindle (No.27).
- Renew bearing outer rings (No.21 and. No.24) in the wheel hub (No.31).
- Press a new bearing inner ring (No.24) onto the spindle (No.27) again.
Assembly temperature for the bearing inner ring (No.24) max. 80°.
- Press new seal ring (No.30) into wheel hub (No.31) with an special insert punch (WZ 587);
- Slide the new V-ring onto spindle (No.27).
- Place carefully wheel hub (No.31) centrally and hold with device WZ 041 in position
- Place the five cylinder bolts (No.20).
- Insert incipient with inner disk with ecess lying above sparing in spindle (No.27), and mark one of the major oiler boring on the wheel hub with an pencil
- Start to insert the disk package with an inner disk (No.26) in alternate with outer disks.
While doing this twist the first both outer disks about one spacing (72°).
(That means, the nib of the first both outer disks shall not positioned on opposite to the control opening (No.52). Pay attention to set the disks with oil borings superimposed. The third outer disk has to be positioned on opposite to the control opening (No.52). At least insert a coated disk (No.26).
- Mark the recess of spindle (No.27) for further assembly of ring piston cylinder.
- Check both o-rings (No.34) and (No.36) if necessary renew it and coat it with paste „Klüber-Paste Wolfracote SSP“.
- Mark the position of the allen screw heads (No.38) on the ring piston cylinder.

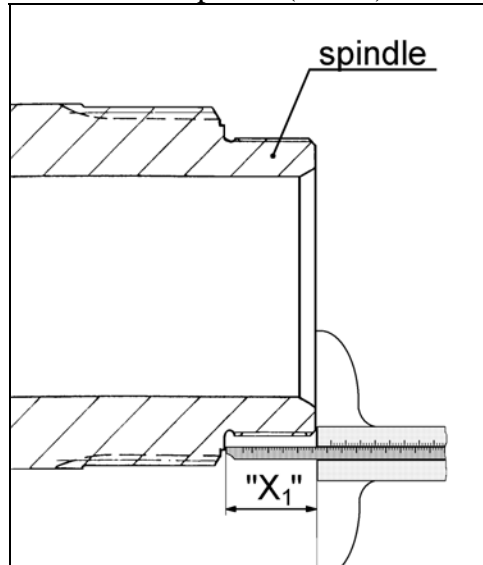
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- Insert piston (No.39) into the cylinder (No.40) till stop, positioning above recess of spindle (No.27). Be carefully by assembling to the o-rings. Check after assembly the plain contact from the piston to the disk package. (The allen screw heads (No.38) shows into the recess of spindle (No.27))
- Clean thread M 70 x 1.5 of the spindle (No.27) and nut (No.17) of dirt, oil, adhesive residue, and inhibitors.
- Insert washer (No.23) with the bezel to the ring piston cylinder site.
- Put on new o-ring (No.29) and mount the outer part from the wheel hub (No.22) centrally and pay attention to mesh the marks in the wheel hubs. Tip: Paint additional sign on both wheel hubs. (Original sign are spot drills in surfaces)
- Assemble heated bearing inner ring from (No.21) onto the spindle (No.27) completely, use assembly sleeve when needed.
Assembly temperature for the bearing inner ring (No.21) max. 80°.
- Tighten hex. bolts with 115 Nm.
- Coat end faces of the crown gear carrier (No.11) with paste “Klüber-Paste Wolfracote SSP” and slide it on.
- Adjust wheel bearing (see section 2.4.2) and tighten groove nut (No.17) with the special groove socket wrench WZ 465.
- Insert sun gear (No.15).
- Reassemble planetary cage (No.13). (see section 2.3.1).

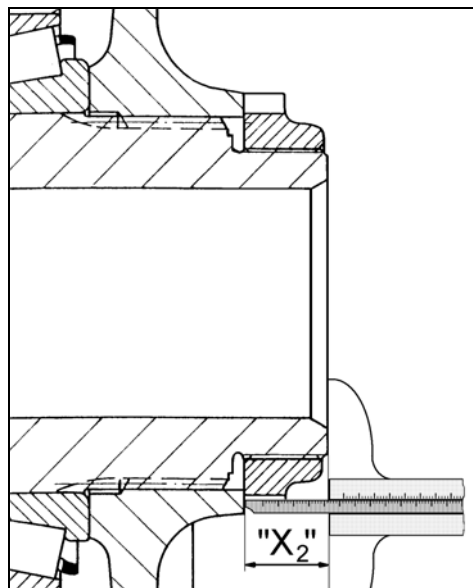
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2.4.2 Gear Bearing Adjustment

- Measure distance „X1“ on spindle (No.27). (theoretical = 24 ± 0.2)
 „X1“ = Distance between end face on spindle (No.27) and shoulder for adjusting washers.

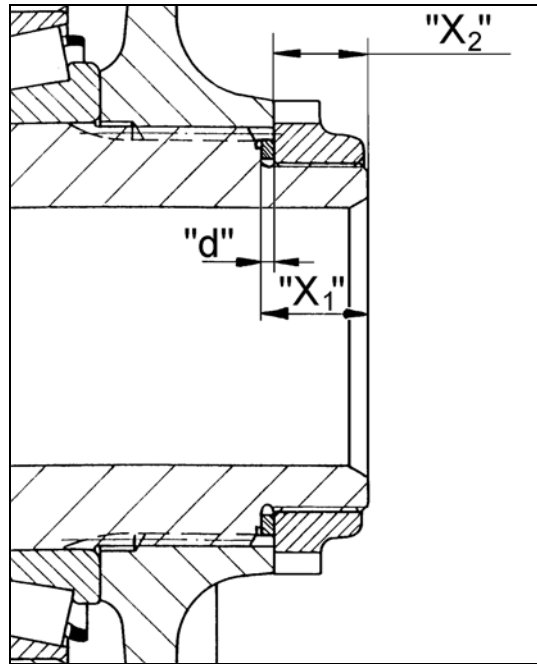


- Coat end face of the crown gear carrier (No.38) with Klüber-Paste Wolfracote SSP.
- Screw on nut (No.17) and tighten until a bearing preload of approx. 45 to 47 Nm (with seals) is achieved at the gear bearings. Align roller cage and gear bearing, during this turn wheel hub 1-2 times in both directions and continuously tap hammer on the outside of the wheel hub (No.22) and crown gear carrier (No.11).
- Measure distance „X2“. (theoretical „X2“ = $22^{+0.4/-1.0}$)
 „X2“ = Distance between end face on spindle (No.27) and end face of crown gear carrier (No.11).



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- Select washer thickness „d“ (No.18) of the adjusting washers.
 „d“ max = „X₁“ - „X₂“
 „d“ min = („X₁“ - „X₂“) - 0.12 (see Fig. lower)



- Loosen nut (No.17) again and remove it.
- Clean thread M 70 x 1.5 of spindle (No.27) and groove nut (No.17) of oil, dirt, inhibitors, and adhesive residue.
- Insert adjusting washer with calculate thickness „d“.
- Again coat end face of crown gear carrier with Klüber-Paste Wolfracote SSP (do not coat groove nut No.17).
- Coat entire diameter and length of thread M 70 x 1.5 of spindle (No.27) and groove nut (No.17) with Loctite 639.
- Thread on groove nut (No.17) with the special groove socket wrench WZ 465 and tighten with 1600 Nm. With the use of the torque amplifier Sk 3.91-1007 with 5:1 ratio, tighten with 320 Nm. The final bearing preload adjustment must be between 45 to 55 Nm.
- The final location of the groove nut (No.17) must be achieved within 2 -5 minutes, in order for the Loctite to achieve its full potential.

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2.5 Brake

2.5.1 Check Disks' Wear

(see Fig. 13)

- Therefore turn the wheel hubs until the rest oil drain plugs (No.52*) are positioned on top. (above the oil level).
- Apply the brake and remove rest oil drain plugs (No.52)
- Measured in applied position.
- Measure with a feeler gauge from the surface for plug (No.52) to the control nib of the 5th disk.
(nominal size for new disks $50.5^{+0.9 / -0.4}$ mm)
(wearing size for worn out disks $47.5^{-0.8}$ mm)

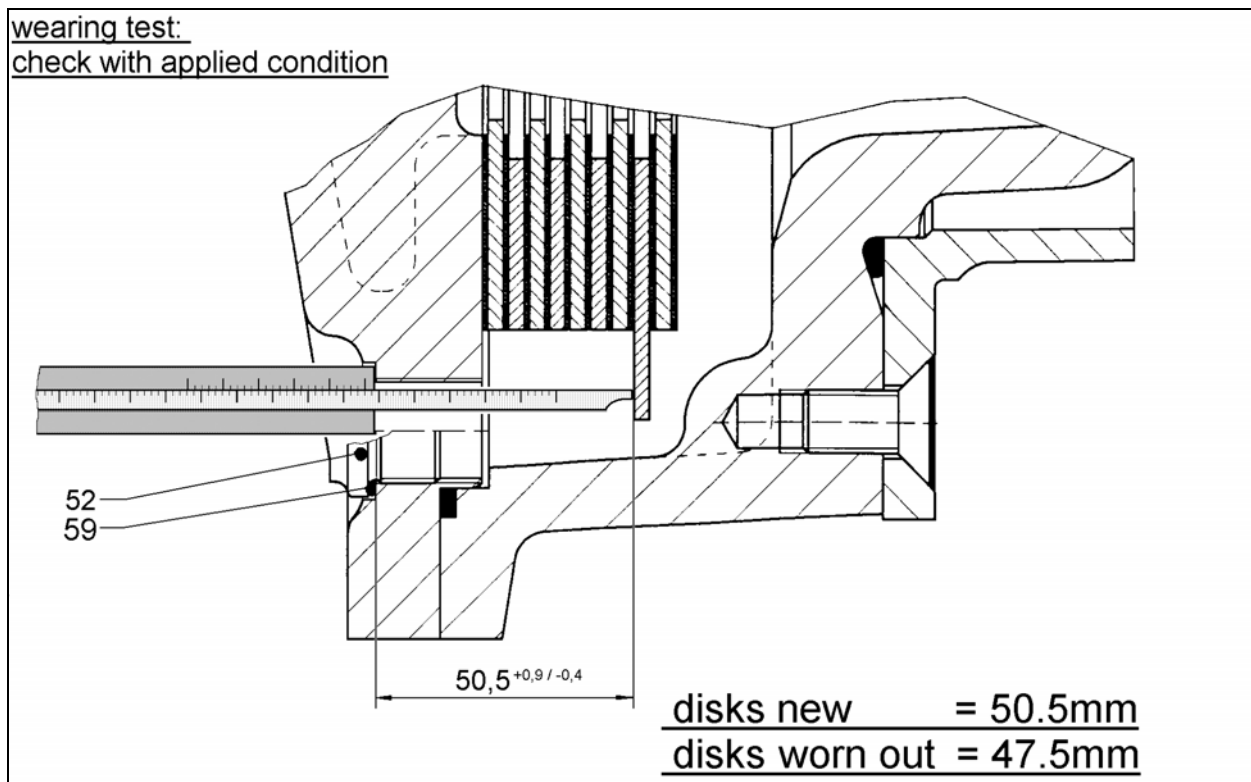


Fig 13

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2.5.2 Exchange of the Piston seals for the Operating brake

To exchange the piston seals on an installed axle are two device holder necessary (WZ 041). Otherwise is the complete half-axle (axle beam from differential housing) to detach. (because of later assembly). Must during a repair the face seal be opened is the installation of a new face seal set required even if the wear range still isn't reached.

(see Fig. 10)

- Remove planetary cage (No.13) complete (section 2.3.1).
- Disassemble sun gear (No.15) (section 2.3.2).
- Loosen 10 hex. screws (Nr.32) and attach in both detaching thread (M 12) of wheel hub (Nr.31) every one a device holder WZ 041 with one auxiliary screw M 12 x 20.
- Screw off groove nut (No.17) with a special groove socket wrench WZ 465.
For this, heat groove nut M 70 x 1.5 (No.39) to approx. 150°C, (i.e. with soldering torch) and loosen with the special groove socket wrench WZ 465. The loosening moment can reach up to 1600 Nm.
- Remove adjusting washer (No.18) and crown gear carrier (No.11) with crown gear (No.9).
- Pull off wheel hub (No.22) and outer gear bearing (No.21), simultaneously from the spindle (No.4), with an appropriate extractor.
- Detach washer (No.23) and complete ring piston cylinder of the disk brake.
For strong sit use both pulling threads (M 8) in piston (No.39) after removed cylinder (No.40) to fix an extruder.
- Look the inner disks (No.26 / 25) and outer disks (No.28) against to trop out.
- Detach piston (No.39) from the cylinder (No.40).
- Remove piston seals (No.42) and (No.43) with a suitable tool (scriber or proper plastic tool) from its seats. Be careful not to damage the seal surface in piston (No.39).
- Insert new piston seals (No.42/43) and oil it slight.
- Mark visible the groove in the cylinder (No.44) and (No.45) with a colour pencil for the dowel pin (No.45).
- Superimposed the mark from piston (No.39) and cylinder and push it on careful till it stops on the contact face.
Watch by the assembly not to damage or to turn up the seal lips from the piston seal (No.42). Also watch to mesh the dowel pin (No.45) in to the groove of the cylinder (No.46)
- Mark visible the groove in the spindle (No.27) for assembly the ring piston cylinder.
- Mark visible allen screw heads (No.38) on the ring piston cylinder.
- Renew both o-rings (No.34 and 36) and coat it with paste „Klüber-Paste Wolfracote SSP“.
- Place above marked recess of spindle (No.27) and push piston (No.39) into the cylinder (No.40) until it stop. Be carefully by assembling to the o-rings (No.34/36). Check after assembly the plain contact from the piston to the disk package. (The allen screw heads (No.38) shows into the recess of spindle (No.27))
- Clean thread M 70 x 1.5 of the spindle (No.27) and nut (No.17) of dirt, oil, adhesive residue, and inhibitors.
- Insert washer (No.23) with the bezel to the ring piston cylinder site.

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- Put on new o-ring (No.29) and mount the outer part from the wheel hub (No.22) centrally and pay attention to mesh the marks in the wheel hubs. Tip: Paint additional sign on both wheel hubs. (Original sign are spot drills in surfaces)
- Assemble heated bearing inner ring from (No.21) onto the spindle (No.27) completely, use assembly sleeve when needed.
Assembly temperature for the bearing inner ring (No.21) max. 80°.
- Tighten hex. bolts with 115 Nm.
- Coat end faces of the crown gear carrier (No.11) with paste “Klüber-Paste Wolfracote SSP” and slide it on.
- Adjust wheel bearing (see section 2.4.2) and tighten groove nut (No.17) with the special groove socket wrench WZ 465.
- Insert sun gear (No.15) and lock it with the snap ring (No.14).
- Reassemble planetary cage (No.13). (see section 2.3.1).

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2.5.3 Exchange of brake disks and pressure springs for the Operating brake

To exchange the brake disks or pressure springs on an installed axle are two device holders necessary (WZ 041). Otherwise is the complete half-axle (axle beam from differential housing) to detach. (because of later assembly). Must during a repair the face seal be opened is the installation of a new face seal set required even if the wear range still isn't reached. Accessory is press jig with min. 0.5 t pressure force necessary.

(see Fig. 10)

- Remove planetary cage (No.13) complete (section 2.3.1).
- Disassemble sun gear (No.15) (section 2.3.2).
- Loosen 10 hex. screws (Nr.32) and attach in both detaching thread (M 12) of wheel hub (Nr.31) every one a device holder WZ 041 with one auxiliary screw M 12 x 20.
- Screw off groove nut (No.17) with the special groove socket wrench WZ 465.
For this, heat groove nut M 70 x 1.5 (No.39) to approx. 150°C, (i.e. with soldering torch) and loosen with the special groove socket wrench WZ 465. The loosening moment can reach up to 1600 Nm.
- Remove adjusting washer (No.18) and crown gear carrier (No.11) with crown gear (No.9).
- Pull off wheel hub (No.22) and outer gear bearing (No.21), simultaneously from the spindle (No.27), with an appropriate extractor.
- Detach washer (No.23) and complete ring piston cylinder of the disk brake.
For strong sit use both pulling threads (M 8) in piston (No.39) after removed cylinder (No.40) to fix an extruder.
- Remove the inner disks (No.26/25) and outer disks (No.28) successive.
- Check or place the five existing numbers for cylinder bolts (No.20).
- Insert incipient with inner disk with ecess lying above sparing in spindle (No.27), and mark one of the major oiler boring on the wheel hub (No.31) with a pencil.
- Start to insert the disk package with an inner disk (No.26) in alternate with outer disks.
While doing this twist the first both outer disks about one spacing (72°).
(That means, the nib of the first both outer disks shall not positioned on opposite to the control opening (No.52). Pay attention to set the disks with oil borings superimposed. But the third outer disk has to be positioned with nib on opposite to the control opening (No.52). At least insert a coated disk (No.26).
- Loosen allen screws (No.38), take off washer (No.12) and pick out the 8 pressure springs (No.47).
- Insert the new pressure springs (No.47) and fix the washer (No.12) with allen screws (No.38). Tightening moment is 4.1 Nm.
- Mark visible the groove in the cylinder (No.44) and (No.45) with a colour pencil for the dowel pin (No.45).
- Superimposed the mark from piston (No.39) and cylinder and push it on careful till it stops on the contact face.
Watch by the assembly not to damage or to turn up the seal lips from the piston seal (No.42). Also watch to mesh the dowel pin (No.45) in to the groove of the cylinder (No.46)

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- Mark visible the groove in the spindle (No.27) for assembly the ring piston cylinder.
- Mark visible the position of the allen screw heads (No.38) on the ring piston cylinder.
- Replace the adjusting device:
Press the ring piston cylinder in the press jig, by a ring support (inner \varnothing 220 mm, outer \varnothing 300 mm) lying above the piston (No.39) and press down the cylinder (No.40). That way retained the ring (No.46).
- Mark the recess of spindle (No.27) for further assembly of ring piston cylinder.
- Check both o-rings (No.34) and (No.36) if necessary renew it and coat it with paste „Klüber-Paste Wolfracote SSP“.
- Mark the position of the allen screw heads (No.38) on the ring piston cylinder.
- Insert piston (No.39) into the cylinder (No.40) till stop, positioning above recess of spindle (No.27). Be carefully by assembling to the o-rings. Check after assembly the plain contact from the piston to the disk package. (The allen screw heads (No.38) shows into the recess of spindle (No.27))
- Clean thread M 70 x 1.5 of the spindle (No.27) and nut (No.17) of dirt, oil, adhesive residue, and inhibitors.
- Insert washer (No.23) with the bezel to the ring piston cylinder side.
- Put on new o-ring (No.29) and mount the outer part from the wheel hub (No.22) centrally and pay attention to mesh the marks in the wheel hubs. Tip: Paint additional sign on both wheel hubs. (Original sign are spot drills in surfaces)
- Assemble heated bearing inner ring from (No.21) onto the spindle (No.27) completely, use assembly sleeve when needed.
Assembly temperature for the bearing inner ring (No.21) max. 80°.
- Tighten hex. bolts with 115 Nm.
- Adjust wheel bearing (see section 2.4.2) and tighten groove nut (No.17) with a special groove socket wrench WZ 465.
- Insert sun gear (No.15) and look it with Seeger ring (No.14).
- Reassemble planetary cage (No.13). (see section 2.3.1).

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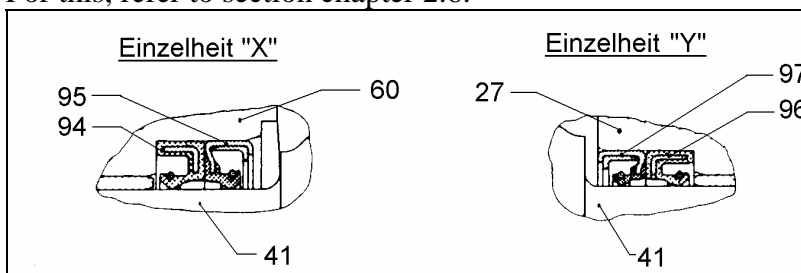
2.6 Exchange of Double Jointed Cardan Shaft

(see Fig. 13)

- Drain the oil from differential and planetary hubs completely.
- Remove planetary cage (No.13) complete (section 2.3.1).
- Disassemble sun gear shaft (No.15) (section 2.3.2).
- Snap out Seeger- ring (No.72), detach Seeger -washer (No.71) and pull out bolt (No70) from the axle knuckle (No.1) and connecting rod (Nr.73).
- Fix the complete planetary drive with a suitable device to pivot it.
- Loosen and remove hex. bolts M14 (No.84) at steering knuckle studs (No.85/86).
- Pull out steering knuckle studs (No.85) and (No.86) complete.
Try to express partial the studs with a grease gun.
Or use an impact extractor and expel it.
- Remove axle knuckle (No.1) with complete mounted spindle.
- Slide out double-jointed cardan shaft (No.41)
Tipp: If a part from the double-jointed cardan shaft was stuck in the differential gear it was possible to push it out from other side through a hole in the cross bolt. (Ø20mm round rod)
- Inspect the condition for guide bearing seal rings and if necessary renew it.
If new guide bearing was inserting, rub slight the slot area.
Fill the area between seal rings to 50% with grease.
- Slide double-jointed cardan shaft (No.41) into the axle beam and mesh into the profile of the inner disks and the diff.-compensating gear.
During this, be careful that the sealing lips of the seals in the axle beam are not damaged.
For soft meshing of the double-jointed cardan shaft into the profile of the inner disks and compensating gear, turn shortly the shaft.
- Slip on the complete planetary drive with axle knuckle.
During this, observe that the sealing lips of the seals in the spindle are not damaged.
- Mount steering knuckle studs with original washers.
(If readjustment is necessary see chapter 2.7.4)
- Slide on the sun gear shaft (No.15) (see chapter 2.3.2)
- Reassemble planetary cage (No.47). (see section 2.3.1).
- Fill in oil and test brake.

2.6.1 Exchange of Seal ring

- For this, refer to section chapter 2.6.



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2.7 Steering Knuckle Bearing

2.7.1 Remove steering knuckle stud

(see Fig. 10)

- Snap out Seeger- ring (No.72), detach Seeger -washer (No.71) and pull out bolt (No70) from the axle knuckle (No.1) and connecting rod (Nr.73).
- Fix the complete planetary drive with a suitable device to pivot it.
- Loosen and remove hex. bolts M14 (No.84) at steering knuckle studs (No.85/86).
- Pull out steering knuckle studs (No.85) and (No.86) complete.
Try to express partial the studs with a grease gun.
Or use an impact extractor and expel it.
- Remove bearing washer (No.93); butting ring (No.89); washer (No.91) and cover (No.101).
- Remove axle knuckle (No.1) with mounted double-jointed cardan shaft complete.

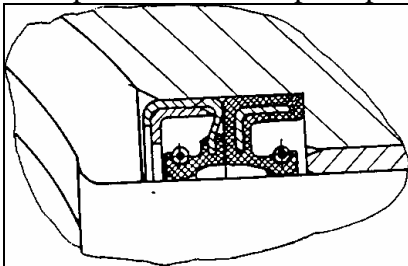
2.7.2 Exchange of Bearing Bush

(see Fig. 20)

Tip: Bearing bush (No.92) is slotted.

- By tapping with a small slotted screwdriver and bending the bearing bush out it is possible to use a pair of pliers to pull them out.
- Press in new Bearing bush with a suitable insert punch.
- Ream in the area of the press slot.
- Install new seals and fill the volume between seal rings to 50% with grease.

Note position of seal lips as per sketch below.



- Slide double-jointed cardan shaft (No.41) into the axle beam and mesh into the profile of the inner disks and the diff.-compensating gear.
During this, observe that the sealing lips of the seals in the axle beam are not damaged. For soft meshing of the double-jointed cardan shaft into the profile of the inner disks and compensating gear, turn shortly the shaft.
- Slip on the complete planetary drive with axle knuckle.
During this, observe that the sealing lips of the seals in the spindle are not damaged.
- Mount steering knuckle studs with original washers.
(If readjustment is necessary see chapter 2.7.4)
- Fill in oil and test brake.

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2.7.3 Install steering knuckle stud

(see Fig. 10)

- Inspect the condition for bearing washer (No.93); butting ring (No.89); washer (No.91) and cover (No.101) and if necessary renew it.
- Fix the butting ring (No.89) onto the axle beam with spring cotter (No.90).
- Turn up washer (No.91) and cover (No.101) to the butting ring (No.89) and fix it with grease.
- Push on the complete unit steering knuckle together with planetary hub. During introduce the double-jointed cardan shaft into the profile of sun gear shaft keep on that the lip of seal rings (No.95) are not damaged or turned up.
- Put in under steering knuckle stud (No.85) and jack it firmly in a closed position to the axle beam and hold this position.
- Put in upper steering knuckle stud (No.86) with new determined washer (No93). The grease groove of the washer must show to the sliding face of the steering knuckle stud.
(for determining see chapter 2.7.4)
- Tighten new adhesive coated bolts (No.84 a. 87) with 400^{+10} Nm.

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2.7.4 Recalculate bearing washer

- Push on the complete unit steering knuckle together with planetary hub. During introduce the double-jointed cardan shaft into the profile of sun gear shaft keep on that the lip of seal rings are not damaged or turned up.
- Put in under steering knuckle stud (No.86) and jack it firmly in a closed position to the axle beam and hold this position.
- Determine bearing washer:
 - Measure distance from top of steering knuckle to the plane surface of the axle beam. (Measurement A / Fig.14)
 - Measure flange step of steering knuckle stud (No.3) (Measurement B / Fig.14)
 - Calculate bearing washer: (Measurement C / Fig.14)
 $C = A - B + 0,2\text{mm}$
 Available thickness series for bearing washer (10) are 6.6; 6.8; 7.0; 7.2; 7.4; 7.6 mm.

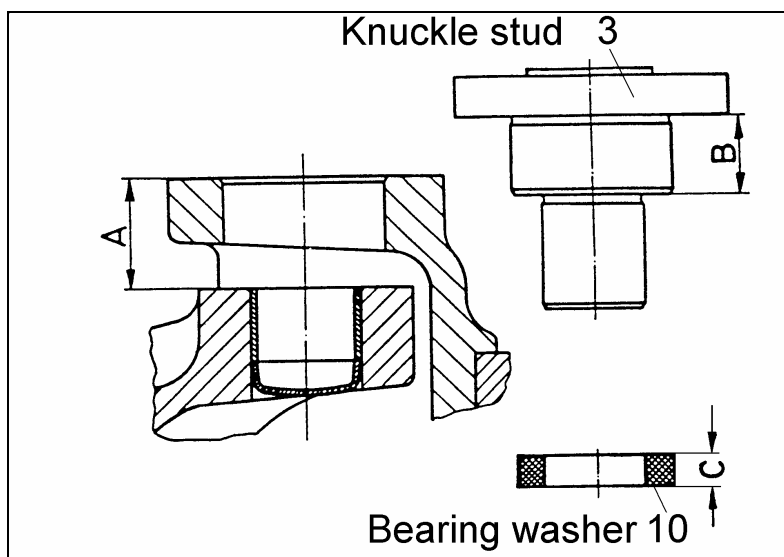


Fig. 14

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2.8 Exchange of Steering Cylinder

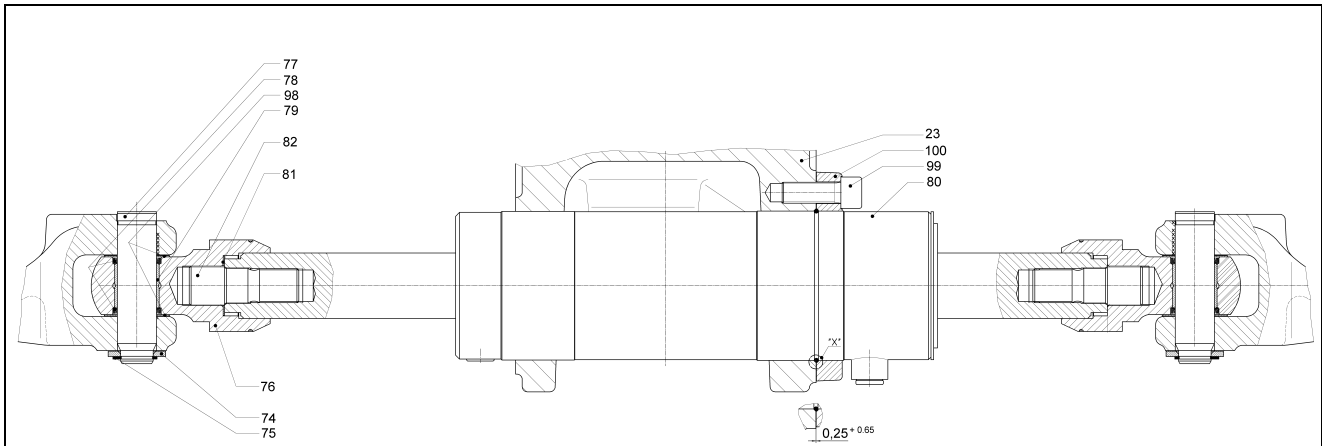


fig.15

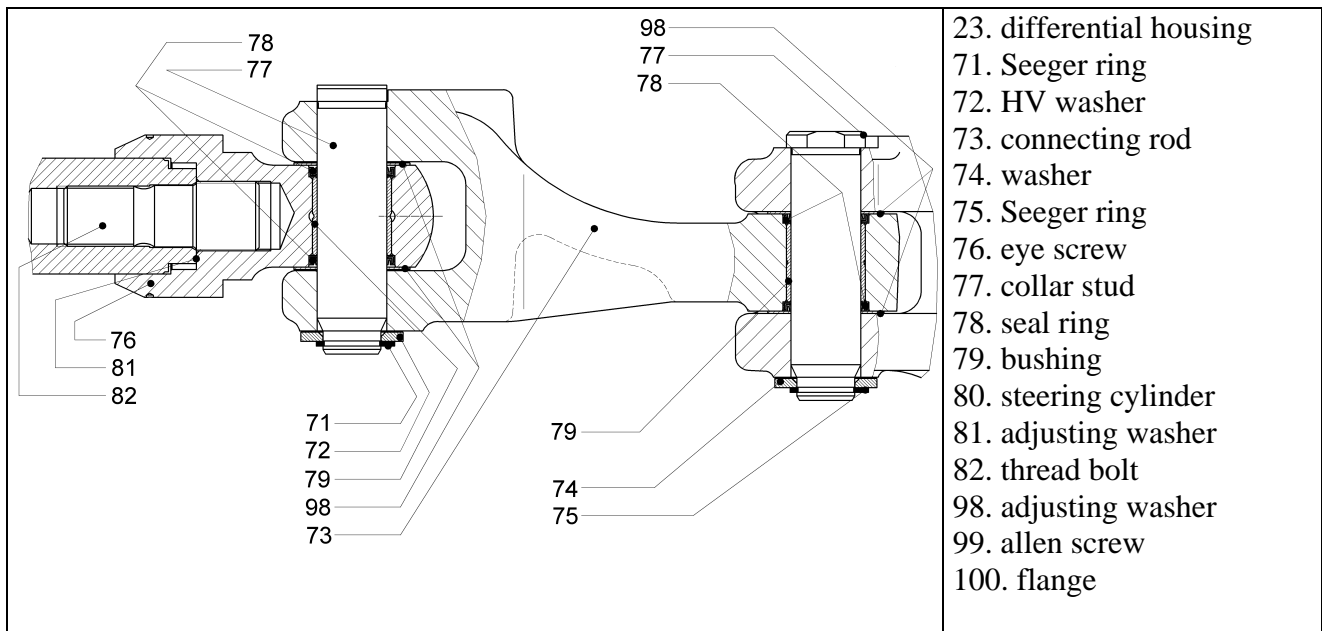


Fig. 16

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- Loosen both connectors of steering cylinder



- Snap out Snap ring (No.71), detach washer (No.72) and pull out collar stud (No.77) from connecting rod only at one side (No.73).
- Hammer out steering collar stud (No.77) with a fitting stud puncher. (e.g. brass mandrel)
Attention: collar studs are hardened, splintering danger

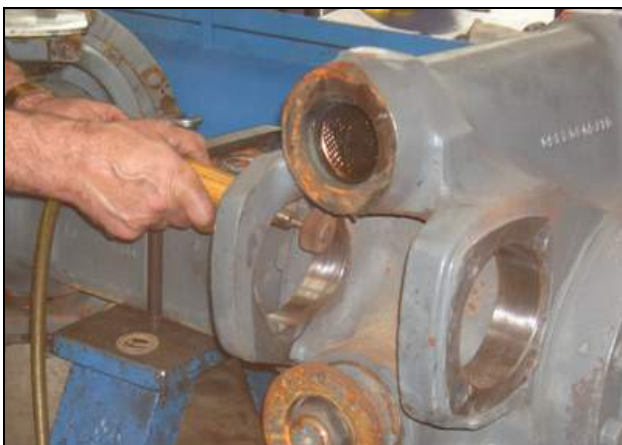


- First loosen eye screw at free side with special socket wrench WZ 806
- Then pull out collar stud at opposite side
- hold piston rod with wrench WS 41 at machined wrench finish and loosen second eye screw with special socket wrench WZ 806

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- Loosen four allen screws (No.99) and pull out the steering cylinder (No.80) to the flange side (No.100), from the differential housing (No.23), or push it out with a bushing.



- Clean differential housing and spray it with assembly paste

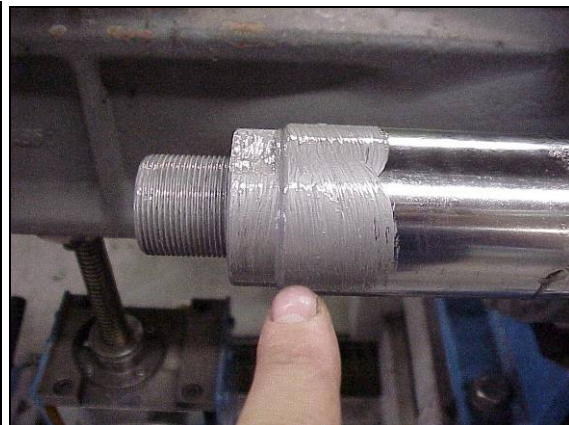


- Spray steering cylinder (No.80) with assembly paste and mount the connectors in horizontal position.

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- Tighten the new coated hex screws (No.99) with 300 Nm.
- ***Important:*** Between flange (No.100) and diff. housing (No.23) must be gab about min. 0.20 mm till max. 0.9 mm measurable with a feeler gauge. (see fig 15)



- Coat new thread bolts with assembly paste and tighten them with an insert chuck or two locknuts with 50 Nm.
- Screw on both eye screws and tighten one side with 100 Nm

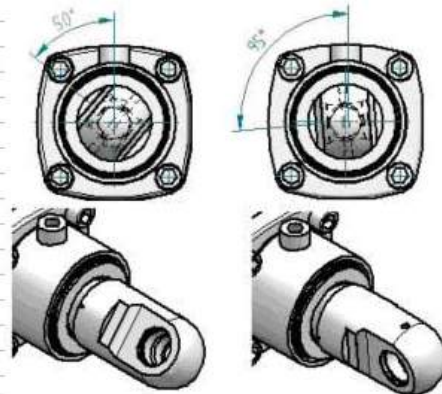


- Mount special angle measuring system WZ 811 onto the head of the allen screws. Determine the thickness of the adjusting washer. (see following table)

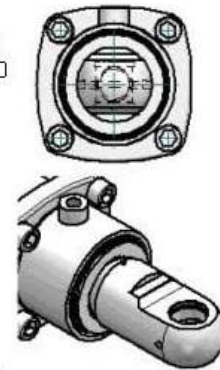
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minimum angle at a torque of 100 Nm maximum angle at a torque of 100 Nm



position at a torque of 400 to 1000 Nm



angle at 100 Nm on the right scale	washer thickness min.	washer thickness max.	selected washer thickness	torque +/- 100Nm
0	0,19	0,40	0,50	1013
10	0,23	0,44	0,50	937
20	0,27	0,48	0,50	861
30	0,31	0,52	0,50	785
40	0,35	0,56	0,50	710
50	0,40	0,60	0,50	634
60	0,44	0,65	0,50	558
70	0,48	0,69	0,50	483
80	0,52	0,73	0,50	407
90	-0,19	0,02	0,00	785

angle at 100 Nm on the left scale	washer thickness min.	washer thickness max.	selected washer thickness	torque +/- 100 Nm
10	0,90	1,10	1,00	634
20	0,85	1,06	1,00	710
30	0,81	1,02	1,00	785
40	0,77	0,98	1,00	861
50	0,73	0,94	1,00	937
60	-0,06	0,19	0,00	558
70	-0,10	0,19	0,00	634
80	-0,15	0,19	0,00	710
90	-0,19	0,19	0,00	785

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- Remove eye screw again and install selected adjusting washer.

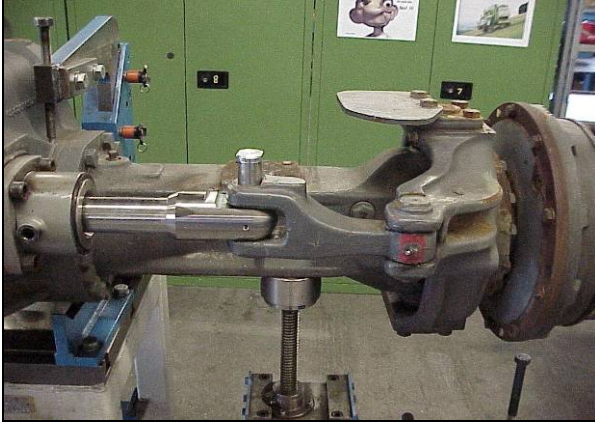


- Mount eye screw. Use a torque wrench with special socket wrench WZ 806 and tighten it with min. 350 Nm.



- Tighten eye screw further into horizontal position but do not exceed 1000 Nm. Then remove angle measuring system.

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- Install collar stud (No.77) and determine the adjusting washer on lower and upper gap. Then install washer (No.72) and lock it with Snap ring (Nr.71).
- Reconnect steering cylinder connectors and move the steering cylinder two times to the end positions and check the seat.

Revisions reserved

Neunkirchen on 19.09.2008

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 Author : Rauh

NAF Tool table for NMC 01 axle

Description:	WZ number:
<p>Insert punch to insert the seal rings 1160.208 and 1160.261 by drive shaft flange (without ring for short distance for outer seal ring 1160.261) (with ring for long distance for inner seal ring 1160.208)</p>	WZ 213
<p>Insert punch to insert the seal rings 1160.218 and 1160.211 into the axle housing</p>	WZ 649
<p>Insert punch to insert the seal rings 1160.221 and 1160.222 into the axle stub</p>	WZ 428
<p>Device holder + M 12 x 20 to detach the wheel hub on MIN 03</p>	WZ 041
<p>Extractor plate to pull off the inner part from the planetary cage in planetary drive system</p>	WZ 190
<p>Groove socket wrench for groove nut 7329.085 in wheel hub</p>	WZ 465
<p>Insert punch to insert the seal ring 7308.072 in wheel hub</p>	WZ 587
<p>Special socket wrench to insert the eye screw</p>	WZ 806
<p>Special angle measuring system to determine the adjusting washer</p>	WZ 811

**2000 Series
Service Manual**



For complete service information also see:
2000 Series Transmission Manual..... 4003558

FunkManufacturingCompany
CTM195 (28JUN99)
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ENGLISH


4003557

Introduction

FOREWORD

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

 This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, specifications, wear tolerances, and torque values.

Component Technical Manuals (CTM) are concise guides for specific machines. They are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

DX,TMIFC -19-22MAY92-1/1

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2000 Series Transmission

- Group 05—Safety
- Group 10—General Information
- Group 15—Oil Recommendation
- Group 100—Test and Troubleshooting

INDX

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INDX

2000 Series Transmission

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RECOGNIZE SAFETY INFORMATION

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.



DX,ALERT -19-07DEC88-1/1

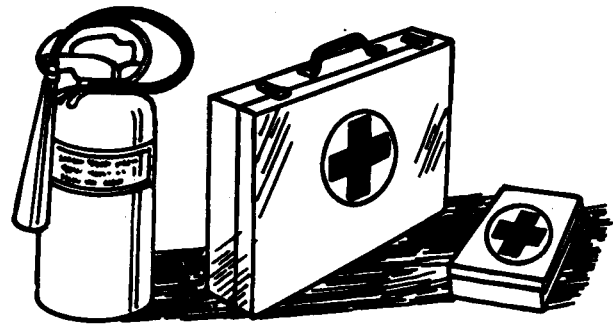
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PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



DX,FIRE2 -19-03MAR93-1/1

TS291 -JUN-23AUG88

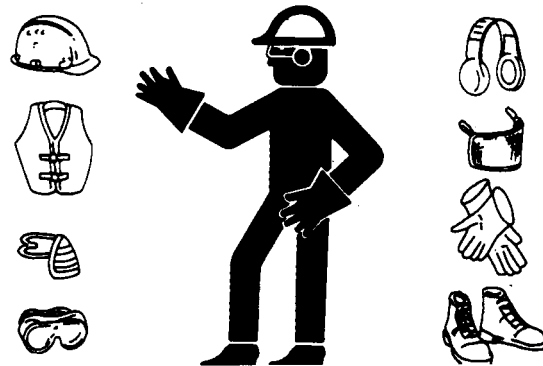
WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



DX,WEAR -19-10SEP90-1/1

TS206 -JUN-23AUG88

WORK IN VENTILATED AREA

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.



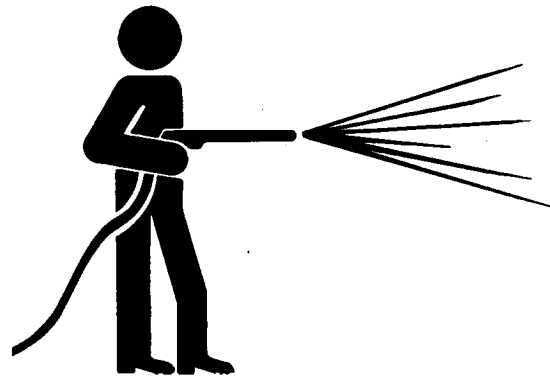
TS220 -UN-23AUG88

DX,AIR -19-23AUG88-1/1

WORK IN CLEAN AREA

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.

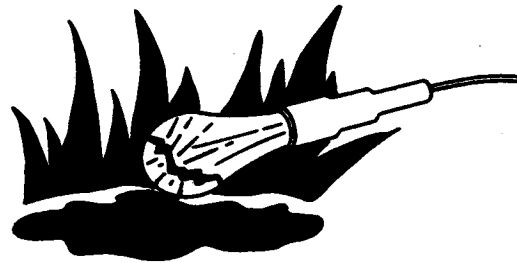


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DX,CLEAN -19-04JUN90-1/1

ILLUMINATE WORK AREA SAFELY

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

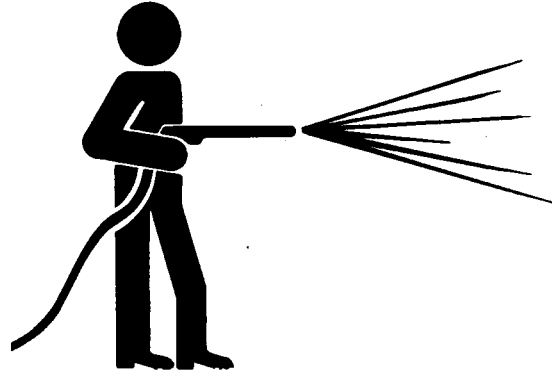


TS223 -UN-23AUG88

DX,LIGHT -19-04JUN90-1/1

USING HIGH-PRESSURE WASHERS

IMPORTANT: Directing pressurized water at electronic/electrical components or connectors, bearings and hydraulic seals, fuel injection pumps or other sensitive parts and components may cause product malfunctions. Reduce pressure, and spray at a 45 or 90 degree angle.



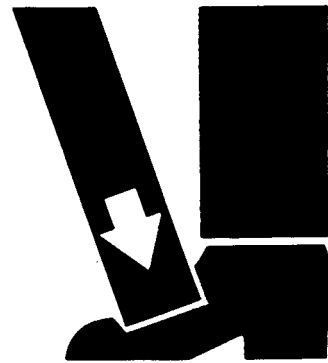
T6642EJ -UN-18OCT88

DPSG,YZ07927,186 -19-04MAR99-1/1

USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



TS226 -UN-23AUG88

DX,LIFT -19-04JUN90-1/1

USE PROPER TOOLS

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. **DO NOT** use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



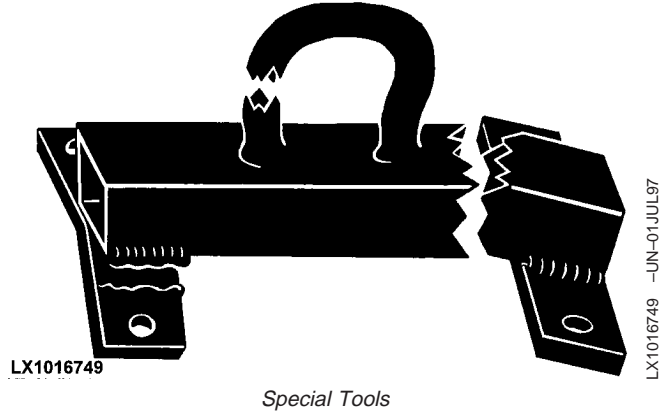
TS779 -UN-08NOV89

DX,REPAIR -19-04JUN90-1/1

USING SPECIAL TOOLS

Faulty or broken tools can result in serious injury. When constructing tools, use proper, quality materials and good workmanship.

Do not weld tools unless you have the proper equipment and experience to perform the job.

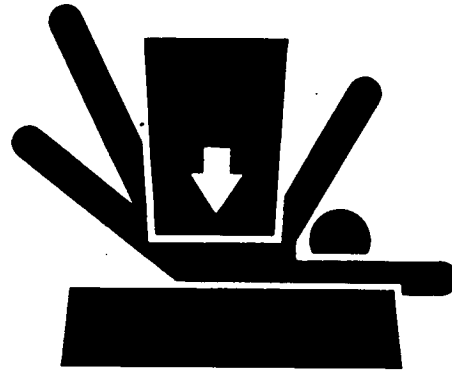


DPSG,YZ07927,122 -19-06JUL99-1/1

SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



TS229 -UN-23AUG88

DX,LOWER -19-04JUN90-1/1

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.



TS227 -UN-23AUG88

DX,FLAME -19-04JUN90-1/1

PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



TS204 -UN-23AUG88

DX,SPARKS -19-03MAR93-1/1

PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

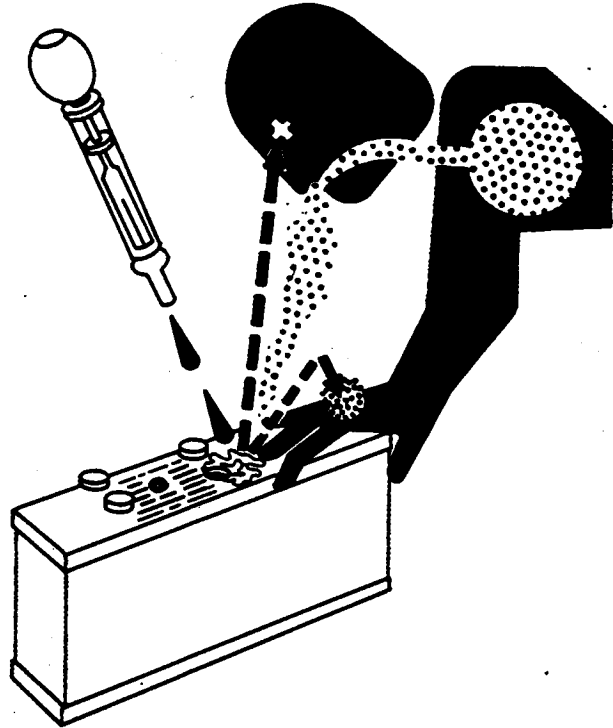
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



TS203 -UN-23AUG88

DX,POISON -19-21APR93-1/1

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.



TS953 -UN-15MAY90

DX,TORCH -19-03MAR93-1/1

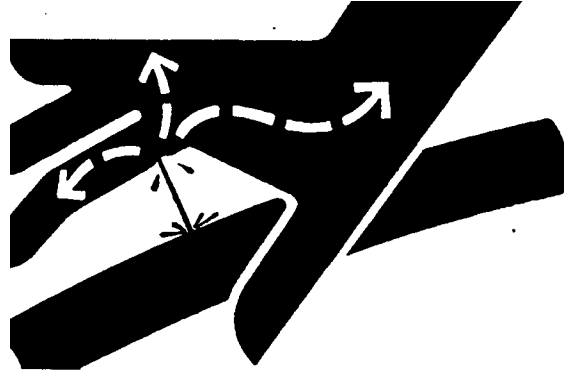
AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



X9811 -UN-23AUG88

DX,FLUID -19-03MAR93-1/1

LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.



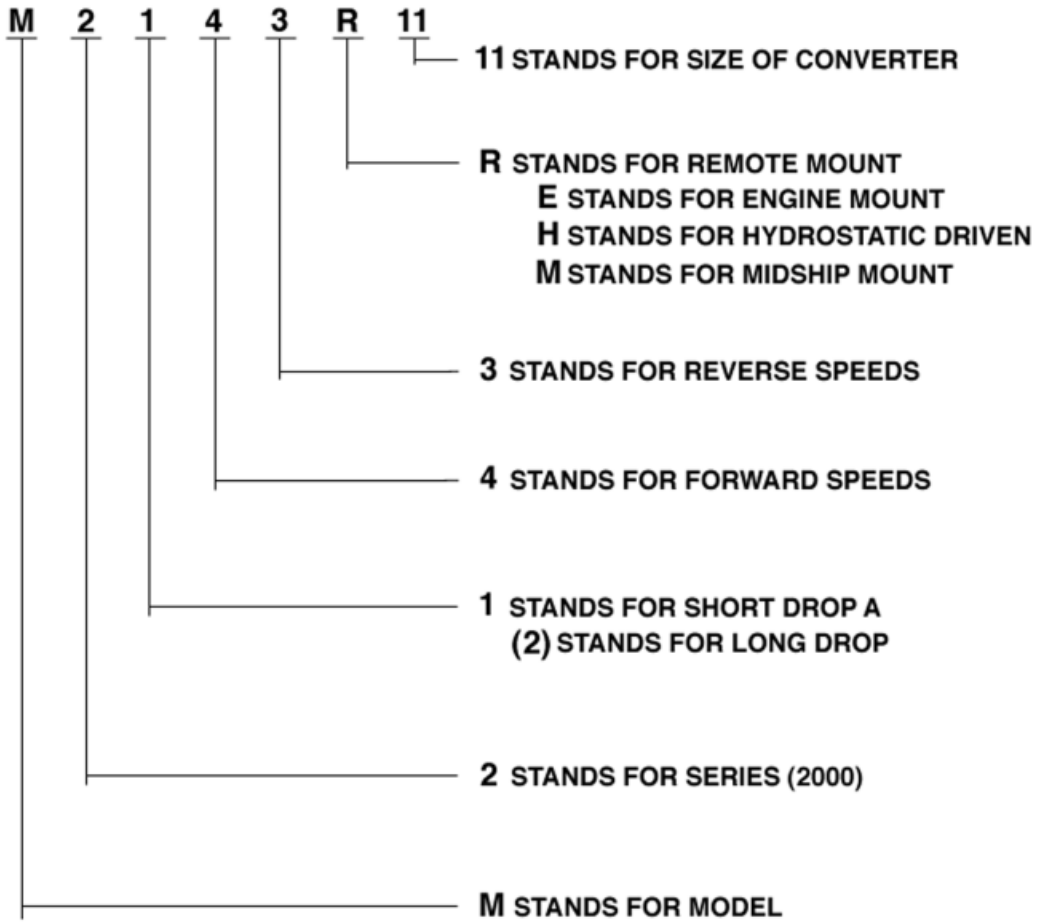
TS231 -19-07OCT88

DX,LIVE -19-25SEP92-1/1

SPECIFICATIONS

Item	Measurement	Specification	
2000 Series Transmission	Oil	Hydraulic transmission fluid.	
	Filter	Remote mounted spin-on type filter.	
	Transmission Operating Conditions		Maximum input speed (3000 rpm)
			Test input speed (2000 rpm) at a converter out temperature of 40.6—51.7°C (105—125°F).
			Maximum continuous operating temperature 93°C (200°F)
			Maximum intermittent temperature 110°C (230°F)
			Maximum temperature 121°C (250°F)
			Normal operating temperature 71—93°C (160—200°F)
			Check oil level temperature 71—93°C (160—200°F)
			Port # 2 (Refer to Setting The Clutch Pressure in group 100) Pump pressure is higher than clutch pressure, not to exceed clutch pressure by 105 kPa (15 psi)
Pressures and Flows at Control Valve. All pressure and flow tests must be accomplished at 2000 rpm at a converter out temperature of 40.6—51.7°C (105—125°F).		Pump out flow at 2000 rpm, 40.6—51.7°C (105—125°F) is 74.5 Lpm (19.6 gpm) (Refer to "PRESSURE AND FLOW CHECKS AT OTHER LOCATIONS" group 100).	
		Converter out flow at 2000 rpm, 40.6—51.7°C (105—125°F) is 64.6 Lpm (17 gpm) (Refer to "PRESSURE AND FLOW CHECKS AT OTHER LOCATIONS" group 100).	
		Converter out pressure at full throttle stall is not to be less than 241 kPa (35 psi) at 82.2—93.3°C (180—200°F) (Refer to "PRESSURE AND FLOW CHECKS AT OTHER LOCATIONS" group 100).	
		Port #1 (Refer to Setting The Clutch Pressure in group 100) Clutch pressure 1655—1790 kPa (240—260 psi)	
		Port #3 (Refer to "SETTING THE CLUTCH PRESSURE" and "PRESSURE AND FLOW CHECKS AT THE VALVE" in group 100) Converter in pressure 585 kPa (85 psi)	
		Lube, in pressure at 2000 rpm, 40.6—51.7°C (105—125°F) is not to exceed 170 kPa (25 psi) or be less than 70 kPa (10 psi) (Refer to "PRESSURE AND FLOW CHECKS AT OTHER LOCATIONS" group 100).	
	Towing	Do not exceed 5 km/h (3 mph)—Tow no further than 2 km (1 mile)	
	Voltage Requirements	See group 100 "CLUTCH SOLENOID VOLTAGE REQUIREMENTS"	

MODEL IDENTIFICATION



2000 Model Identification

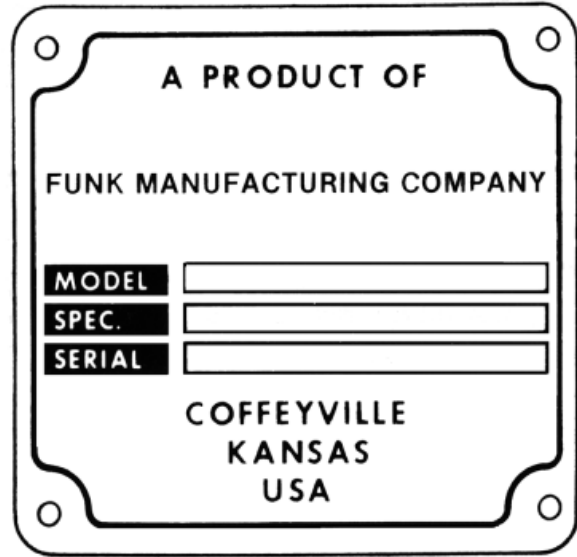
YZ1883 -UN-20JUL99

PARTS ORDERING

Should repair parts be required, please specify the model, specification, serial numbers and equipment numbers of your unit. The identification plate is located on the top of the front cover (refer to "2000 SERIES TRANSMISSION COMPONENT IDENTIFICATION" this group for location). All information on identification plate is needed when contacting FUNK.

Contact:

Funk Manufacturing Company
Attn.: Parts Department
Industrial Park, Highway 169 North
P.O. Box 577
Coffeyville, Kansas 67337-0577
Phone: 316-252-3400 or 800-844-1337
Fax: 316-252-3252



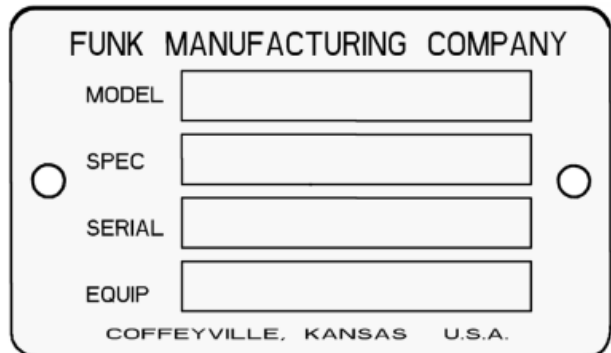
2000 Series Tag

YZ1873 -UN-24JUN99

DPSG,YZ07927,131 -19-19JUL99-1/1

SERVICE INFORMATION

When contacting our Service Department include equipment number.



Current 2000 Series ID Tag

YZ1881 -UN-22JUL99

DPSG,YZ07927,75 -19-21JUN99-1/1

2000 SERIES POWERSHIFT TRANSMISSION THEORY OF OPERATION

The Series 2000 Shift-O-Matic is a six speed forward, three speed reverse transmission. However, several different ranges can be achieved such as: 4-1, 5-1, 3-3 etc.

Forward motion, reverse motion, and the speeds are obtained through the use of electrically controlled solenoids and hydraulically actuated multiple disc clutches. These clutches are power absorbing members that can be engaged at full engine power. Shifting under full engine power makes this a full powershift for the forward and reverse motion in all speeds.

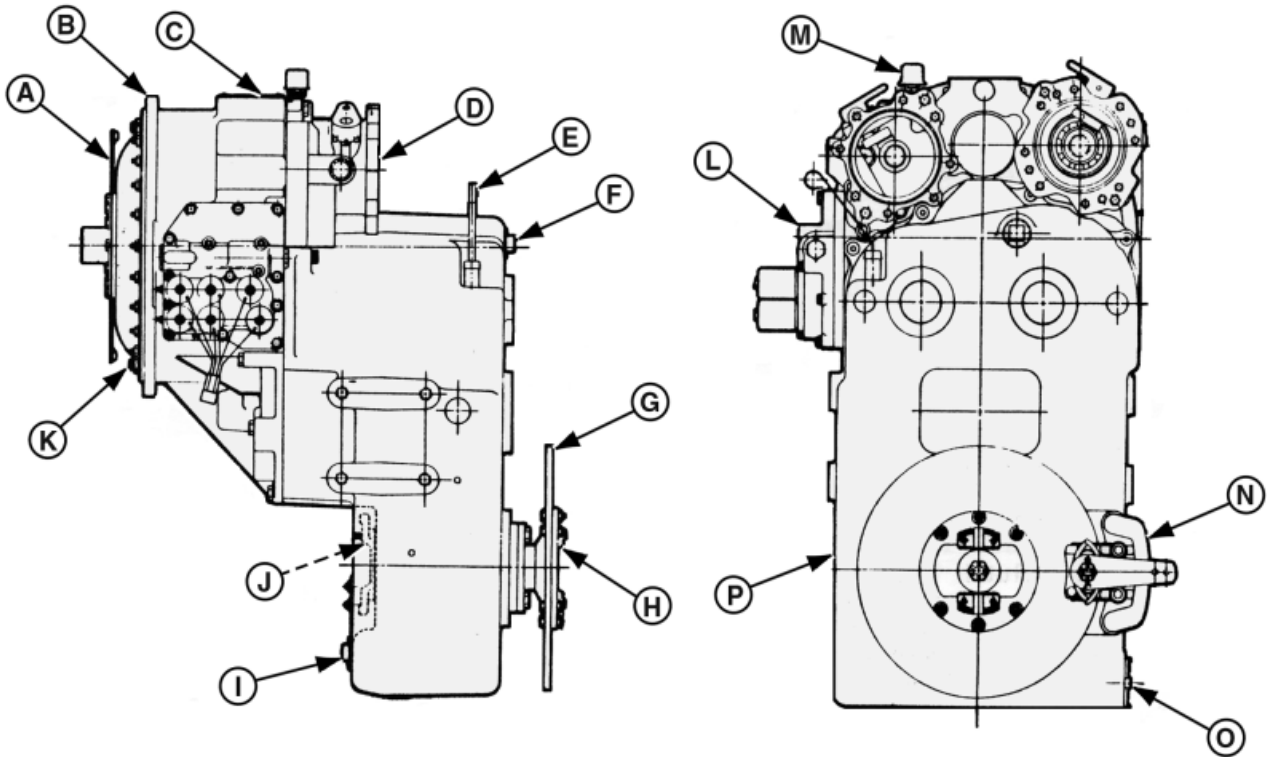
The clutches in these units are hydraulically applied and spring released. Because the clutches are hydraulically controlled, there is automatic compensation for normal wear, which eliminates the

need for adjustment. Each clutch uses a composition friction plate and a polished steel reaction plate.

The power from the engine is transmitted to the Shift-O-Matic through a torque converter. The use of the torque converter has two distinct advantages: (1) The converter is essentially a fluid drive, there being no direct mechanical connection between the engine and transmission assembly. This feature creates a very smooth and shock-free drive eliminating engine stalling. (2) The converter multiplies torque during heavy pull-down loads. When loads are light, the converter transmits the engine power directly at almost engine speed, and there is no torque multiplication. The net result is an action like a transmission, with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced.

DPSG,YZ07927,76 -19-21JUN99-1/1

2000 SERIES TRANSMISSION COMPONENT IDENTIFICATION



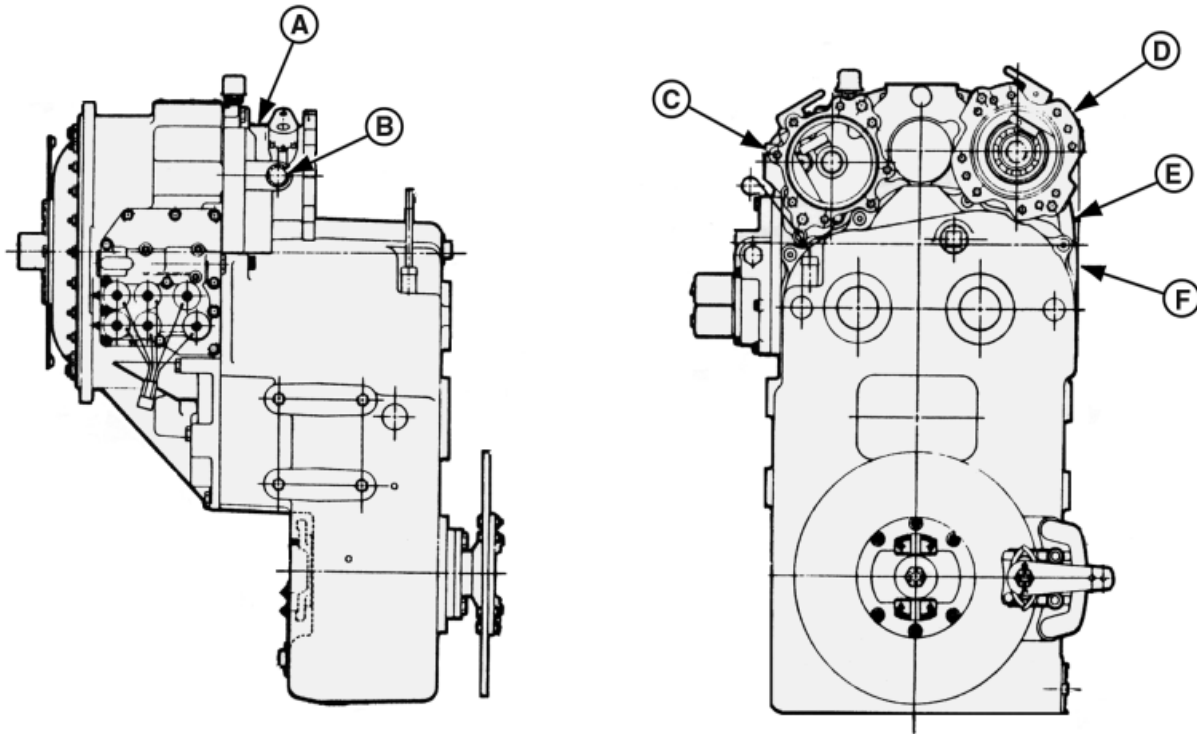
2000 Series Identification

- | | |
|----------------------------------|---|
| A — Laminated Drive Plate | I — Location for Customer Supplied Dip Stick |
| B — Front Cover | J — Output Yoke |
| C — Serial Tag Location | K — Converter |
| D — Charge Pump | L — Control Valve |
| E — Dip Stick | M — Breather |
| F — Oil Fill Plug | N — Parking Brake |
| G — Parking Brake Disk | O — Suction Tube Screen |
| H — Output Yoke | |

YZ1875 -JUN-28JUN99

DPSG,YZ07927,114 -19-28JUN99-1/1

2000 SERIES TRANSMISSION PORT IDENTIFICATION



2000 Series Port Identification

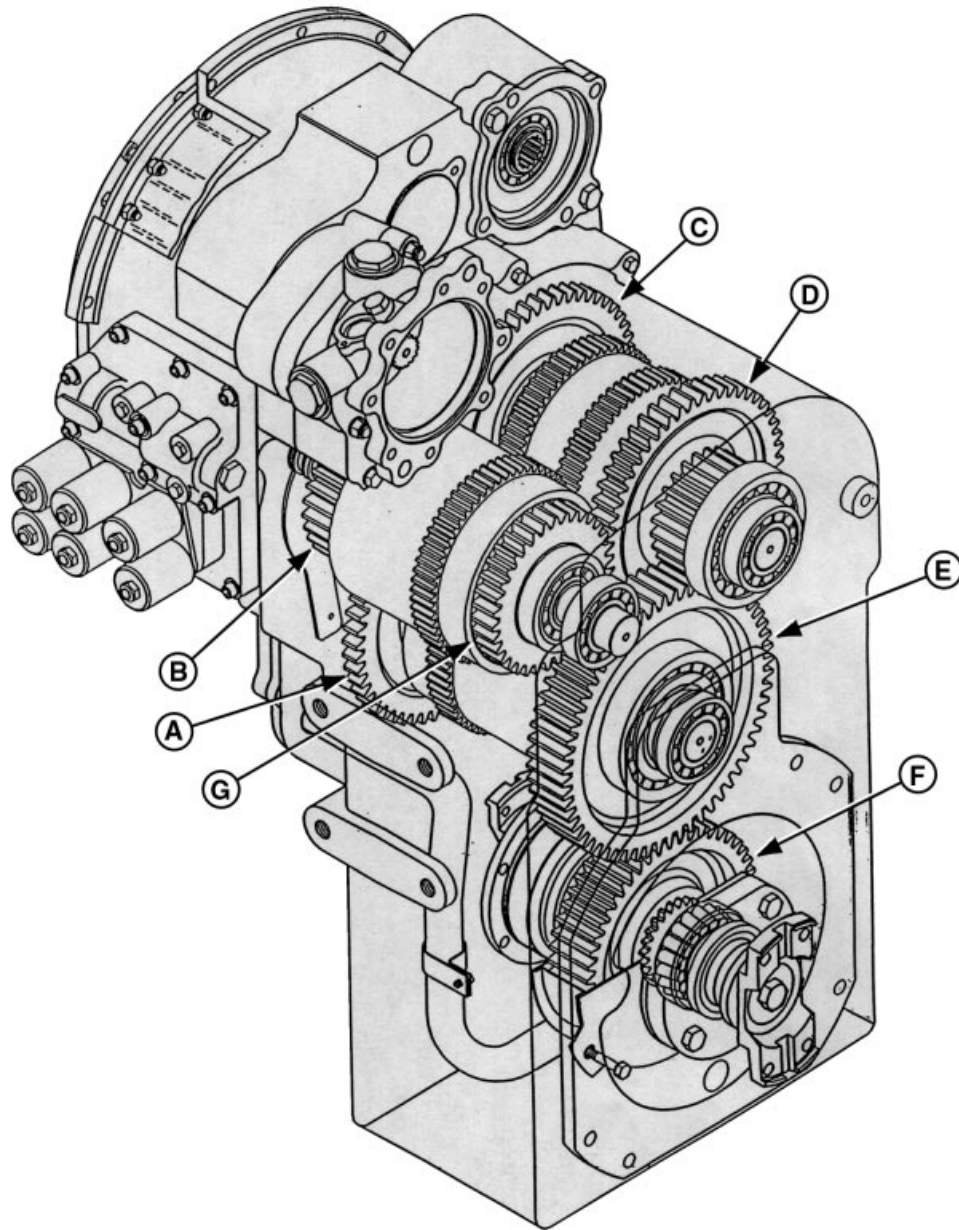
- A** — Pump Out to Filter
- B** — To Control Valve from Filter
- C** — Charge Pump with Auxiliary Disconnect

- D** — Auxiliary Pump Drive
- E** — Converter to Heat Exchanger
- F** — Lube in from Heat Exchanger

YZ1876 -UN-28JUN99

DPSG, YZ07927, 115 -19-28JUN99-1/1

2000 SERIES CLUTCH GEAR IDENTIFICATION



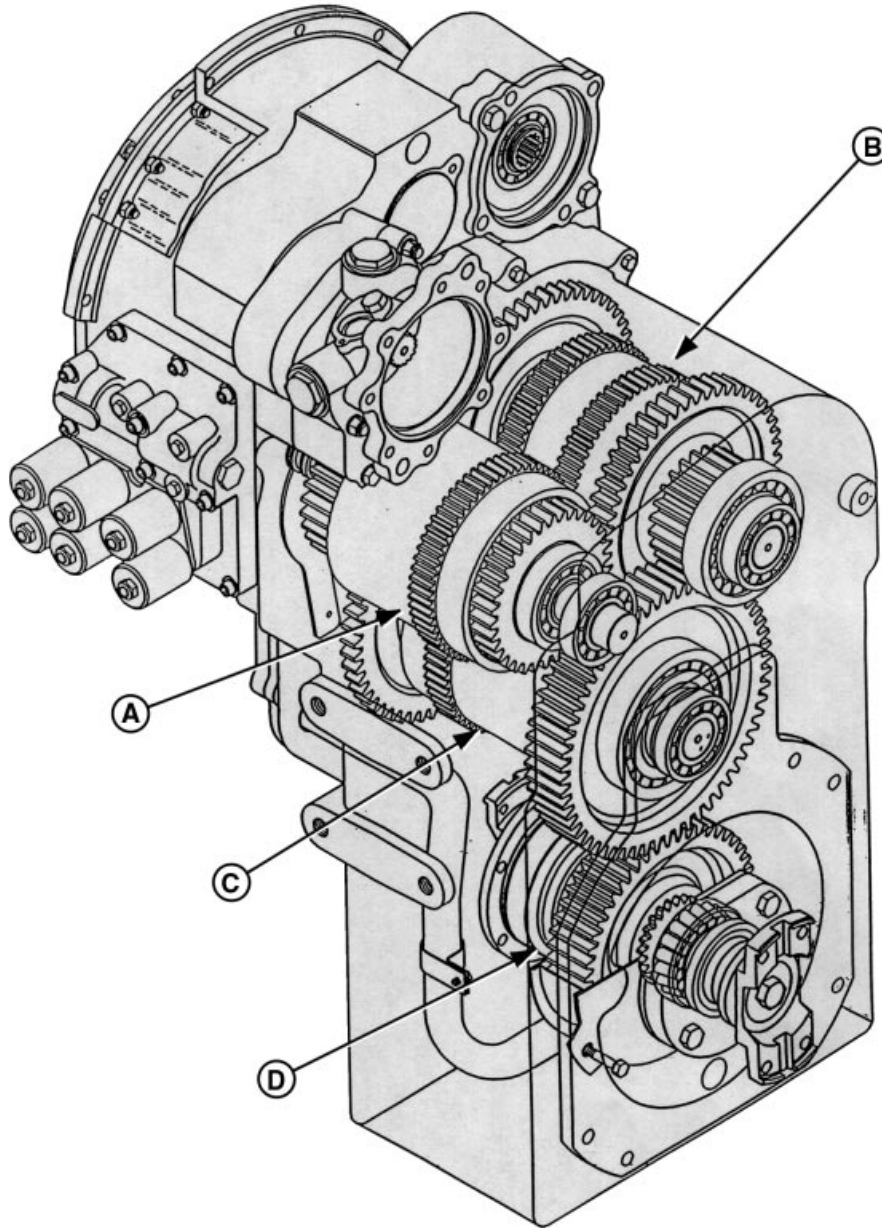
2000 Clutch Gears

- A — Reverse Gear
- B — Forward Hi Range
- C — Forward Lo Range
- D — Second Gear

- E — Third Gear
- F — Output
- G — First Gear

YZ1878 -JUN-30JUN99

2000 SERIES CLUTCH LOCATION LONG DROP



Clutch Location - Long Drop

- A — First Stage Clutch Assembly
- B — Second Stage Clutch Assembly

- C — Third Stage Clutch Assembly
- D — Output Assembly

YZ1879 -UN-30JUN99

OPERATION

Like all mechanical equipment, the Shift-O-Matic Drive will need attention and servicing. Routine checks will help prevent down time. The operator can aid in preventative maintenance by reporting weak or borderline malfunctions.

Because the unit operates "in" oil and "by" oil, most of the maintenance is concerned with oil replenishment

and oil cleanliness. The type of service and operating conditions shall determine the maintenance interval. However, as previously stated, it is especially important that the oil be kept clean.

DPSG,YZ07927,77 -19-21JUN99-1/1

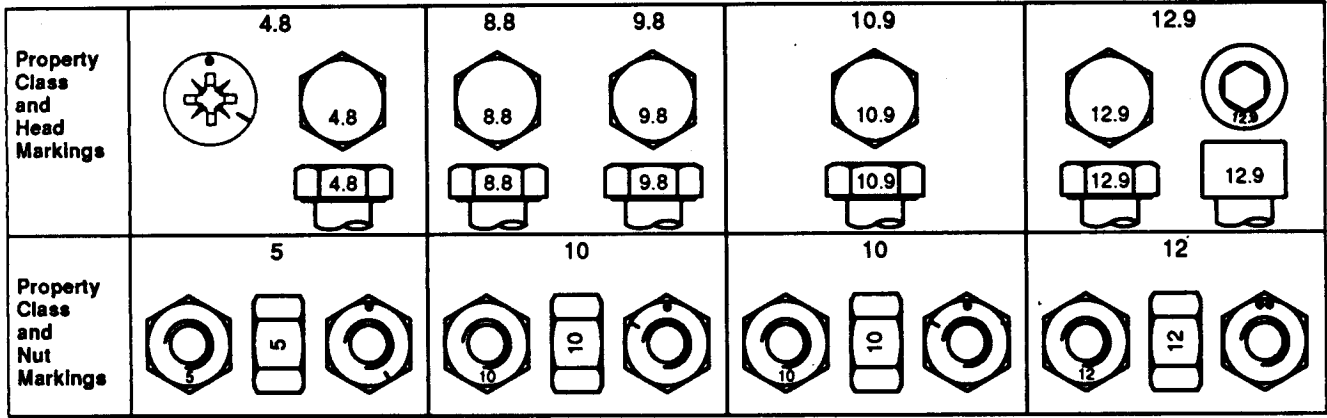
RULES OF OPERATION

NOTE: Clean area around the dip stick before removing.

1. Check the oil level daily, with the engine at idle speed, the Shift-O-Matic in neutral, and the transmission oil temperature 160—200°F (71—93.5°C).
2. The Shift-O-Matic must always be in neutral position before starting the engine, or when the vehicle is parked and the engine is running.
3. If the vehicle is to be towed, it will be necessary to run the engine at idle speed to lubricate the clutches.
4. If the engine cannot be run, towing must be limited to 4.82 km/h (3 mph) Maximum distance towing 2 km (one mile). If these conditions are to be exceeded, then the drive lines must be disconnected, and towing then, is permissible at speeds not to exceed the vehicle manufacturer recommended speeds.
5. If the oil temperature gauge, which is the converter oil out temperature, rises to 250°F (121.1°C) or the warning light comes on, stop the vehicle immediately. Shift to neutral and run the engine at 1000—2000 rpm. The temperature should drop rapidly to the engine water temperature, or if an air to oil exchanger is used, the temperature should drop rapidly to ambient air temperature across the heat exchanger. If the temperature does not drop, trouble is indicated, The trouble should be determined before the vehicle is operated again. Overheating generally occurs due to working in too high of a gear ratio.
6. Do not shut off the engine when unit is overheating, if the cooling system is known to be in working order.

DPSG,YZ07927,78 -19-21JUN99-1/1

METRIC BOLT AND CAP SCREW TORQUE VALUES



Metric

Applies to non-lubricated plain or zinc plated fasteners.

Size	-	Class 8.8		Class 10.9	
		N •m	lb-ft	N•m	lb-ft
M5	-	6.1	4.5	9.0	6.6
M6	-	10.4	7.7	15.3	11.3
M8	-	25	19	37	27
M10	-	50	37	73	54
M12	-	87	64	128	94
M14	-	139	102	204	150
M16	-	216	160	318	234
M20	-	435	321	620	457
M24	-	730	555	1072	790
M30	-	1450	1103	2129	1570
M36	-	2533	1927	3721	2744

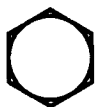









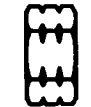
NOTE: Torque tolerance is $\pm 20\%$

Do not use these values if a different torque value or tightening procedure is given for a specific application.

METRIC BOLT AND CAP SCREW TORQUE VALUES chart meets Funk Engineering Procedures Manual Torque Specifications FEP 14.1.

TS1163 -19-04MAR91

UNIFIED INCH AND CAP SCREW TORQUE VALUES

SAE Grade and Head Markings	NO MARK	1 or 2 ^b 	5 	5.1 	5.2 	8 	8.2 
	NO MARK	2 	5  		8  		

TS1162 -19-04MAR91

Size	Grade 5		Grade 8	
	N•m	lb-ft	N•m	lb-ft
-	-	-	-	-
1/4-20	11.1	8.2	16	11.6
1/4-28	12.8	9.4	18	13.3
5/16-18	23	16.9	32	23.9
5/16-24	25	18.7	36	26.4
-	-	-	-	-
3/8-16	41	30	57	42
3/8-24	46	34	65	48
7/16-14	65	48	92	68
7/16-20	73	54	103	76
-	-	-	-	-
1/2-13	99	73	140	103
1/2-20	111	82	159	117
9/16-12	144	106	202	149
9/16-18	160	118	225	166
5/8-11	198	146	280	206
5/8-18	224	165	316	233
3/4-10	350	258	495	365
3/4-16	392	289	554	408
-	-	-	-	-
7/8-9	566	417	799	589
7/8-14	624	460	881	649
1-8	848	625	1199	884
1-12	928	684	1312	967

Applies to non-lubricated plain or zinc plated fasteners.

Continued on next page

DPSG,YZ07927,20 -19-11MAY99-1/2

General Information

10
12

NOTE: Torque tolerance is $\pm 20\%$

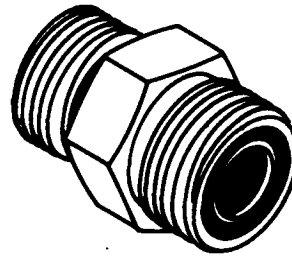
DO NOT use these values if a different torque value or tightening procedure is given for a specific application.

Torque values listed are for general use only. UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES chart meet Funk Engineering Procedures Manual Torque Specifications FEP 14.2

DPSG,YZ07927,20 -19-11MAY99-2/2

SERVICE RECOMMENDATIONS FOR FLAT FACE O-RING SEAL FITTINGS

1. Inspect the fitting sealing surfaces. They must be free or dirt or defects.
2. Inspect the O-ring. It must be free of damage or defects.
3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.



T6243AD -UN-18OCT88

FLAT FACE O-RING SEAL FITTING TORQUE

Nominal Tube		Dash	Thread Size	Swivel Nut		Bulkhead Nut	
O.D.	in.	Size	in.	N• m	lb-ft	N• m	lb-ft
6.35	0.250	-4	9/16-18	16	12	5.0	3.5
9.52	0.375	-6	11/16-16	24	18	9.0	6.5
12.70	0.500	-8	13/16-16	50	37	17.0	12.5
15.88	0.625	-10	1-14	69	51	17.0	12.5
19.05	0.750	-12	1 3/16-12	102	75	17.0	12.5
22.22	0.875	-14	1 3/16-12	102	75	17.0	12.5
25.40	1.000	-16	1 7/16-12	142	105	17.0	12.5
31.75	1.250	-20	1 11/16-12	190	140	17.0	12.5
38.10	1.500	-24	2-12	217	160	17.0	12.5

NOTE: Torque tolerance is + 15% -20%

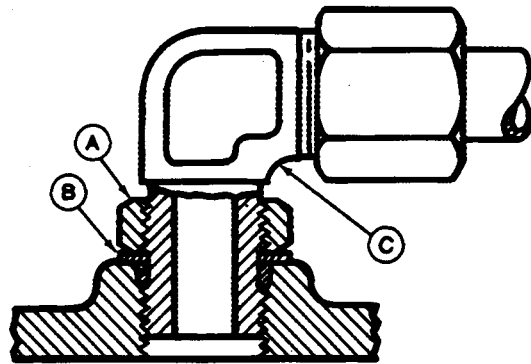
DPSG,YZ07927,12 -19-30APR99-1/1

SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS¹

ANGLE FITTING

1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.
2. Turn fitting into threaded boss until back-up washer contacts face of boss.

NOTE: Do not allow hoses to twist when tightening fittings.



Angle Fitting

T6520AB -JUN-18OCT88

3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).
4. Hold fitting head-end with a wrench and tighten lock nut and back-up washer to proper torque value.

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART

Thread Size	N•m	lb-ft
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

NOTE: Torque tolerance is + 15% -20%.

¹SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS charts meet Funk Engineering Procedures Manual Torque Specifications FEP 14.3.

**SUGGESTED WRENCHING TORQUE FOR
TAPERED PIPE THREAD¹**

TAPERED PIPE THREAD WITH SEALANT CHART		
Thread Size	N• m	lb-ft
1/16-27 UNF	15	10
1/8-27 UNF	20	15
1/4-18 UNF	25	20
3/8-18 UNF	35	25
1/2-14 UNF	45	35
3/4-14 UNF	60	45
1-11 1/2 UN	75	55
1-1/4-11 1/2 UN	95	70
1-1/2-11 1/2 UN	110	80
2-11 1/2 UN	130	95

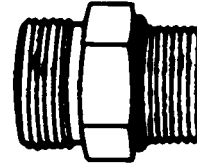
TAPERED PIPE THREAD WITHOUT SEALANT CHART		
Thread Size	N•m	lb-ft
1/16-27 UNF	20	15
1/8-27 UNF	25	20
1/4-18 UNF	35	25
3/8-18 UNF	45	35
1/2-14 UNF	60	45
3/4-14 UNF	75	55
1-11 1/2 UN	90	65
1-1/4-11 1/2 UN	110	80
1-1/2-11 1/2 UN	130	95
2-11 1/2 UN	160	120

¹ SUGGESTED WRENCHING TORQUE FOR TAPERED PIPE THREAD charts meet Funk Engineering Procedures Manual Torque Specifications FEP 14.4.

SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS¹

STRAIGHT FITTING

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



Straight Fitting With O-ring

T6243AE -JUN-18OCT88

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART

Thread Size	N•m	lb-ft
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

NOTE: Torque tolerance is + 15% - 20%.

¹*SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS charts meet Funk Engineering Procedures Manual Torque Specifications FEP 14.3.*

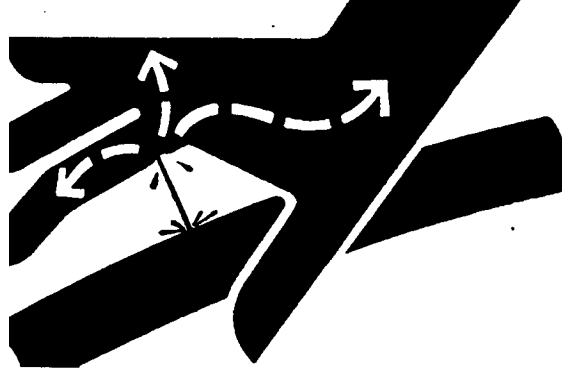
DPSG,YZ07927,10 -19-30APR99-1/1

CHECK OIL LINES AND FITTINGS



CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.



X9811 -UN-23AUG88

Check all oil lines, hoses, and fittings regularly for leaks or damage. Make sure all clamps are in position and tight. Make sure hoses are not twisted or touching moving machine parts. If abrasion or wear occurs, replace immediately.

Tubing with dents may cause the oil to overheat. If you find tubing with dents, install new tubing immediately.

IMPORTANT: Tighten fittings as specified in torque chart.

When you tighten connections, use two wrenches to prevent bending or breaking tubing and fittings.

DPSG,YZ07927,13 -19-30APR99-1/1

COLD WEATHER OPERATION

IMPORTANT: Viscosity grade selection is critical for cold weather operation of the transmission. Preheat procedures are required when operating transmission below the oil's **MINIMUM** critical temperature which is viscosity grade dependent.

NOTE: Refer to AIR TEMPERATURE RANGE chart for the MINIMUM transmission operating temperature viscosity grades.

PREHEAT TRANSMISSION FLUID WITH AUXILIARY SOURCE

- Preheat the transmission fluid to the **MINIMUM** temperature before operating.

ALTERNATE WARM-UP PROCEDURE:

- Operate transmission in neutral for approximately 20 minutes or until oil is warmed to the **MINIMUM** temperature.

HOT WEATHER OPERATION

Use higher viscosity grades (Refer to AIR TEMPERATURE RANGE chart) for:

- Ambient temperatures consistently above 30°C (86°F).
- Frequent stop-and-go driving in hot weather.
- High grade climbing in hot weather.

TOWING THE VEHICLE

AVOID DAMAGE TO TRANSMISSION:

- Run engine at idle speed to lubricate the clutches.
 - Do not exceed normal vehicle speeds while towing.
- If the engine cannot be run:
 - Disconnect drive line from transmission.
- If drive line can not be disconnected:
 - Do not exceed 5 km/h (3 mph)
 - Tow no further than 2 km (1 mile)

DPSG,YZ07927,29 -19-12MAY99-1/1

PUT TRANSMISSION IN STORAGE

This procedure applies to those transmissions and components that have been tested according to Funk Manufacturing test specifications and have had the oil drained from them prior to shipment.

The following actions will help protect the unit and component items from internal rust and corrosion damage for approximately one year, provided the transmissions are stored in a dry area:

- Seal all openings with moisture-proof covers or tape.
- Spray 113 ml (4 oz.) of atomized NOX RUST^{®1} VCI No. 10 oil or an equivalent into oil drain hole. This fluid is covered and approved per (MIL-P-46002 and MIL-I-23310).
- Dip, spray, or brush all exposed unpainted surfaces with NOX RUST X-110 or equivalent:

¹ NOX RUST is a trademark of Daubert Chemical Company.

DPSG,YZ07927,30 -19-12MAY99-1/1

REMOVE TRANSMISSION FROM STORAGE

- Wash off all external grease with a safety solvent.
- Remove covers or tape from all openings.
- Drain transmission completely.
- Tag transmission to indicate it needs to be filled with oil after installing in vehicle.
- Fill the unit with Funk approved transmission fluid.

RECOMMENDED OIL

Ambient Temperature/Oil Specifications	
Above -23°C (-10°F)	Hydraulic Transmission Fluid Type C-4 (except grade 30)
Below -23°C (-10°F)	Hydraulic Transmission Fluid Type C-4 (except grade 30) auxiliary preheat required to raise temperature in the sump to above -23°C (-10° F).
Above 0°C (32°F)	Hydraulic transmission fluid type C-4 or C-4 grade 30.

NOTE: The words “oil”, “fluid” and “transmission fluid” are used in this manual to mean, HYDRAULIC TRANSMISSION FLUID, the operating and lubricating oil for this transmission.

IMPORTANT: Funk Manufacturing Company does not recommend the use of any hydraulic transmission fluid that uses an “EP” (extreme Pressure) additive.

Funk Manufacturing Company does not recommend the use of any multi-viscosity oil. Use of multi-viscosity oil will damage the transmission.

DPSG.YZ07927.81 -19-21JUN99-1/1

FILL THE 2000 SERIES TRANSMISSION WITH OIL

AFTER INSTALLING TRANSMISSION IN VEHICLE:

IMPORTANT: The oil level is always checked with the engine running at idle speed, the Shift-O-Matic in neutral, and transmission oil temperature 71—93.5°C (160—200°F). Do not overfill transmission. This will cause overheating. Damage to the transmission will result.

In some applications that use an air to oil heat exchanger, the transmission temperature will be below the temperature recommended for checking oil level. Due to the expansion of oil as it heats up it is important that the oil level be checked at the recommended temperature.

- Park machine on level surface.

- Engage parking brake, block wheels.
- Put transmission in neutral.
- Remove oil fill plug (refer to “2000 SERIES TRANSMISSION COMPONENT IDENTIFICATION” group 10).
- Begin filling operation by adding 15.1 liters (4 gal) of recommended oil.
- Start the engine, run at idle speed to fill oil lines.
- Check oil level on dip stick with engine running at idle speed.
- Check oil level when the transmission is above the temperature of 71—93.5°C (160—200°F).

NOTE: For checking oil levels, the recommended oil temperature is 71—93.5°C (160—200°F).

Fill transmission to the full mark on dipstick with engine running at idle speed.

DPSG,YZ07927,87 -19-22JUN99-1/1

CHECK AND SERVICE THE 2000 SERIES TRANSMISSION REGULARLY

Routine checks will help prevent down time. The operator can aid in preventative maintenance by reporting signs of leaks or malfunctions.

The transmission operates in and by oil, most of the maintenance is concerned with oil replenishment and oil cleanliness. The type of service and operating conditions shall determine the maintenance interval.

NOTE: Engage park brake before checking oil level.

OIL LEVEL

IMPORTANT: The transmission should always be in the neutral position before starting the engine, or when the

vehicle is parked and the engine is running.

CHECK THE OIL LEVEL DAILY

- Set parking brake.
- Put the gear selector lever in neutral position.
- Operate the engine at idle speed.
- Heat oil temperature to 71—93.5°C (160—200°F).

NOTE: For checking oil levels, the recommended oil temperature is 71—93.5°C (160—200°F).

- Clean area around dipstick before removing.
- Keep oil level at the “FULL” mark on the dipstick.

DPSG,YZ07927,86 -19-22JUN99-1/1

INTERVALS FOR CHANGING TRANSMISSION OIL AND FILTERS

IMPORTANT: Change oil and filter after the first 20 hours of transmission operation. The oil and filter change intervals given here are for normal service conditions. If the transmission is to be operated in severe conditions contact the Funk Service Department for additional recommendations.

RECOMMENDED LUBRICANT AND FILTER CHANGE INTERVALS:

Recommendations utilizing the Funk filter with the bypass indicator inoperative or not connected:

- Change oil and filter after first 20 hours of transmission operation. Change filter every 200 hours of operations and the lubricant be changed every 600 hours of operation.

Some vehicles are equipped with devices to alert the operator when oil is bypassing the filter. Change the oil filter if a "filter Bypass Signal" is indicated and the transmission is at normal operating temperature. In cold weather operation and/or initial start-up the transmission oil is cold and will have a higher viscosity which allows the filter to bypass intermittently. The filter bypass indicator will be activated. Check the converter out oil temperature. If the temperature is in the normal working range, change the filter.

IMPORTANT: When stalling the converter make sure the transmission is in high gear, the vehicle brakes set, and the immediate area is clear of personnel and obstructions. Do not exceed 30 seconds or 121°C (250°F) converter out oil temperature at full governed engine rpm stall speed.

If the converter out oil temperature is below the normal working range, stop the machine and warm the oil up to the normal working range by stalling the converter, and observing the bypass indicator to be deactivated as the oil warms up. If this disarms the system, work the transmission in a higher gear to keep the converter out oil temperature in the normal working range. If this does not disarm the system, change the filter.

ROUTINE OIL AND FILTER MAINTENANCE:

- Change oil filter anytime the transmission is at normal operating temperature and a Filter Bypass Signal" is indicated.
- Change oil and filter anytime there are signs of contamination in the oil or the oil has a burnt odor.
- Change filter at every 200 hours, change filter and oil every 600 hours of transmission operation.

DPSG,YZ07927,82 -19-21JUN99-1/1

OIL TEMPERATURE WARNING SIGNAL

- If the oil temperature gauge, indicating the converter oil-out temperature, rises to 115°C (230°F) or the transmission oil temperature warning light comes on, stop the vehicle immediately. Shift to neutral and run the engine at 1000—1200 rpm.

IMPORTANT: Do not stop the engine when the transmission is overheating if the cooling system is known to be in working order.

- The transmission oil temperature should soon lower to the engine water temperature, or if an air-to-oil exchanger is used, the temperature should soon lower to ambient air temperature across the heat exchanger. If the temperature does not lower, trouble is indicated.
- Correct overheating problem before the vehicle is operated again.

DPSG,YZ07927,28 -19-12MAY99-1/1

OIL ANALYSIS

Oil analysis is best used by sampling at regular intervals to establish a base line analysis for the oil and operation conditions present. Changes from this base line may indicate unusual wear.

IMPORTANT: Change the oil and filter if an analysis of the used transmission oil indicates any of the following limits are exceeded.

- Glycol (Antifreeze), must not exceed 0% by volume.
- Water, must not exceed 0.05% by volume.
- Viscosity increase at 38°C (100°F), not more than 40% over new oil value.
- Total Acid Number (TAN) per ASTM D664, limit of 3.0 over new lubricant value.

DPSG,YZ07927,27 -19-12MAY99-1/1

SUCTION LEAK TEST

Some indications of a suction leak includes:

- Erratic oil pressure, Look for rapid fluctuation of gauges.
- Pump and filter hoses jumping.
- Excessive air entrapment in the transmission oil.
- A long prime time (time elapsed from engine start to an indication of pump pressure).

TEST FOR SUCTION LEAK:

1. Fill to normal level with transmission fluid.
2. Install a 21 bar 2068 kPa (300 psi) pressure gauge

in the pump port.

3. Start the engine.
4. See if there is an indication of erratic oil pressure.

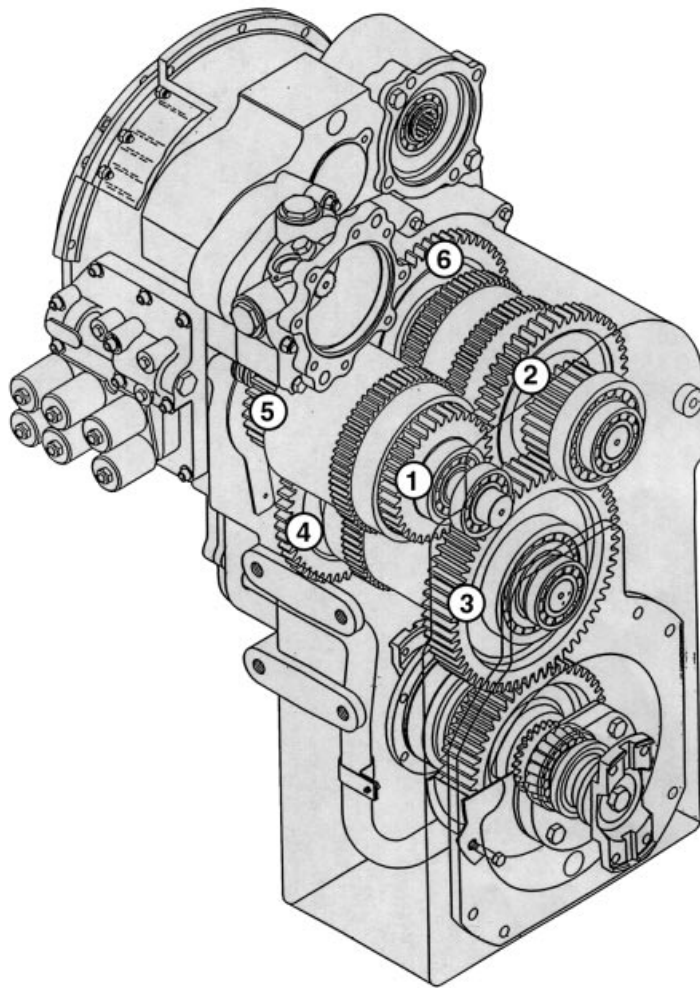
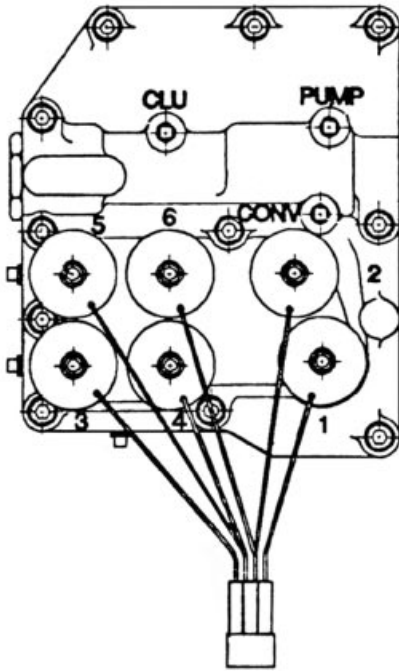
IMPORTANT: Check suction tube fitting for tightness.

5. Check the transmission oil level.

IMPORTANT: Check transmission oil level; failure to do so will result in poor performance and over heating.

DPSG,YZ07927,83 -19-21JUN99-1/1

SOLENOID CHARGED AND GEAR ENGAGED_{LONG DROP}



2000 Series Solenoid/Gear Selection

The numbers on the valve shows what solenoid is charged and what clutch gear is activated.

YZ1880 -UN-30JUN99

SOLENOID VALVE OPERATION FOR 6 FORWARD 3 REVERSE

Before troubleshooting the electric circuit of the valve, the table shows what solenoids are charged when that gear is selected.

2000 Series 6 Speeds Forward 3 Speeds Reverse 5.2 Gear Set							
Input Rotation E (CCW) * Clutch 5 & 6 Forward and Clutch 4 Reverse							
Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
F1	1 and 6	6.50	OE	CW	5.20	E	CCW
F2	2 and 6	4.42	OE	CW	3.53	E	CCW
F3	1 and 5	3.68	OE	CW	2.94	E	CCW
F4	2 and 5	2.50	OE	CW	2.00	E	CCW
F5	3 and 6	1.77	OE	CW	1.41	E	CCW
F6	3 and 5	1.00	OE	CW	0.80	E	CCW
Neutral	-	-	-	-	-	-	-
R1	1 and 4	6.50	E	CCW	5.20	OE	CW
R2	2 and 4	4.42	E	CCW	3.53	OE	CW
R3	3 and 4	1.77	E	CCW	1.41	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
* Looking at the rear of transmission toward the rear of the engine.

2000 Series 6 Speeds Forward 3 Speeds Reverse 8.2 Gear Set							
Input Rotation E (CCW) * Clutch 5 & 6 Forward and Clutch 4 Reverse							
Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
F1	1 and 6	10.25	OE	CW	8.20	E	CCW
F2	1 and 5	4.42	OE	CW	3.53	E	CCW
F3	2 and 6	4.42	OE	CW	3.53	E	CCW
F4	2 and 5	2.50	OE	CW	2.00	E	CCW
F5	3 and 6	1.77	OE	CW	1.41	E	CCW
F6	3 and 5	1.00	OE	CW	0.80	E	CCW
Neutral	-	-	-	-	-	-	-
R1	1 and 4	10.25	E	CCW	8.20	OE	CW
R2	2 and 4	4.42	E	CCW	3.53	OE	CW
R3	3 and 4	1.77	E	CCW	1.41	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
* Looking at the rear of transmission toward the rear of the engine.

SOLENOID VALVE OPERATION FOR 3 FORWARD 3 REVERSE

2000 Series 3 Speeds Forward 3 Speeds Reverse 5.2 Gear Set

Input Rotation E (CCW) * Clutch 5 & 6 Forward and Clutch 4 Reverse

Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
F1	1 and 6	6.50	OE	CW	5.20	E	CCW
F2	2 and 6	4.42	OE	CW	3.53	E	CCW
F3	3 and 6	1.77	OE	CW	1..41	E	CCW
Neutral	-	-	-	-	-	-	-
R1	1 and 4	6..50	E	CCW	5.20	OE	CW
R2	2 and 4	4.42	E	CCW	3.53	OE	CW
R3	3 and 4	1.77	E	CCW	1.41	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
* Looking at the rear of transmission toward the rear of the engine.

2000 Series 3 Speeds Forward 3 Speeds Reverse 8.2 Gear Set

Input Rotation E (CCW) * Clutch 5 & 6 Forward and Clutch 4 Reverse

Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
F1	1 and 6	10.25	OE	CW	8.20	E	CCW
F2	2 and 6	4.42	OE	CW	3.53	E	CCW
F3	3 and 6	1.77	OE	CW	1.41	E	CCW
Neutral	-	-	-	-	-	-	-
R1	1 and 4	10.25	E	CCW	8.20	OE	CW
R2	2 and 4	4.42	E	CCW	3.53	OE	CW
R3	3 and 4	1.77	E	CCW	1.41	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
* Looking at the rear of transmission toward the rear of the engine.

SOLENOID VALVE OPERATION FOR 3 FORWARD 3 REVERSE

The model 2000 with 3 forward and 3 reverse speeds, utilizes directional headset gears on 1st and 2nd stage shafts. Solenoid number five is for forward clutch in long drop which gives the transmission output shaft engine-wise rotation.

NOTE: In some vehicles, forward and reverse solenoids may be reversed depending on transmission location, direction and/or axle rotation.

2000 Series 3 Speeds Forward 3 Speeds Reverse 5.2 Gear Set							
Input Rotation E (CCW) * Clutch 5 & 6 Forward or Reverse							
Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
**F1 or R1	1 and 5	3.68	OE	CW	2.94	E	CCW
**F2 or R2	2 and 5	2.50	OE	CW	2.00	E	CCW
**F3 or R3	3 and 5	1.00	OE	CW	0.80	E	CCW
Neutral	-	-	-	-	-	-	-
**R1 or F1	1 and 6	3.68	E	CCW	2.94	OE	CW
**R2 or F2	2 and 6	2.50	E	CCW	2.00	OE	CW
**R3 or F3	3 and 6	1.00	E	CCW	0.80	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
 * Looking at the rear of transmission toward the rear of the engine.
 ** Application dependent on location and direction of transmission in vehicle.

2000 Series 3 Speeds Forward 3 Speeds Reverse 8.2 Gear Set							
Input Rotation E (CCW) * Clutch 5 & 6 Forward or Reverse							
Direction Designation	Solenoids Charged	Short Drop (9 5/8 in. Drop)			Long Drop (18 5/8 in. Drop)		
		Ratio	Output Rotation		Ratio	Output Rotation	
-	-						
**F1 or R1	1 and 5	5.80	OE	CW	4.64	E	CCW
**F2 or R2	2 and 5	2.50	OE	CW	2.00	E	CCW
**F3 or R3	3 and 5	1.00	OE	CW	0.80	E	CCW
Neutral	-	-	-	-	-	-	-
**R1 or F1	1 and 6	5.80	E	CCW	4.64	OE	CW
**R2 or F2	2 and 6	2.50	E	CCW	2.00	OE	CW
**R3 or F3	3 and 6	1.00	E	CCW	0.80	OE	CW

*E= Engine Rotation (CCW) *OE= Opposite Engine Rotation (CW)
 * Looking at the rear of transmission toward the rear of the engine.
 ** Application dependent on location and direction of transmission in vehicle.

CLUTCH SOLENOID VOLTAGE REQUIREMENTS

Checks must be at the valve.

Clutch Solenoid Voltage Requirements			
Nominal Voltage	6V*	12V	24V
Allowable Voltage	4.8—7.2 V	9—14V	23—26V
Current Draw	-	2 amps	1 amp
Current Draw Max.	3.2 amps	2.29 amps	1.4 amps
Resistance	1.72 ohm ± 4%	6.3 ohm ± 3%	24 ohm ± 3%

* This coil must be used with a Funk approved electronic control module.

DPSG,YZ07927,88 -19-22JUN99-1/1

PRESSURE AND FLOW CHECKS AT THE VALVE

All pressure and flow tests must be accomplished at 2000 rpm at a converter out temperature of 40.6—51.7°C (105—125°F).

Port #1 — is for clutch pressure, which must be 1655—1790 kPa (240—260 psi).

Port #2 — is for pump pressure which will be higher than clutch pressure but, is not to exceed clutch pressure by more than 105 kPa (15 psi).

Port #3 — is for converter in pressure which is not to exceed 585 kPa (85 psi) at operating temperature.

NOTE: In cold weather operation until the transmission is warmed up, pressures above 585 kPa (85 psi) can be expected.

DPSG,YZ07927,89 -19-22JUN99-1/1

PRESSURE AND FLOW CHECKS AT OTHER LOCATIONS

Pump out flow at 2000 rpm, 40.6—51.7°C (105—125°F) is 74.5 Lpm (19.6 gpm).

Converter out flow at 2000 rpm, 40.6—51.7°C (105—125°F) is 64.6 Lpm (17 gpm).



CAUTION: When stalling the converter set the vehicle brakes and clear the immediate area of personnel and obstructions.

IMPORTANT: When stalling the converter make sure the transmission is in high gear, do not exceed 30 seconds or 121°C (250°F) converter out oil temperature.

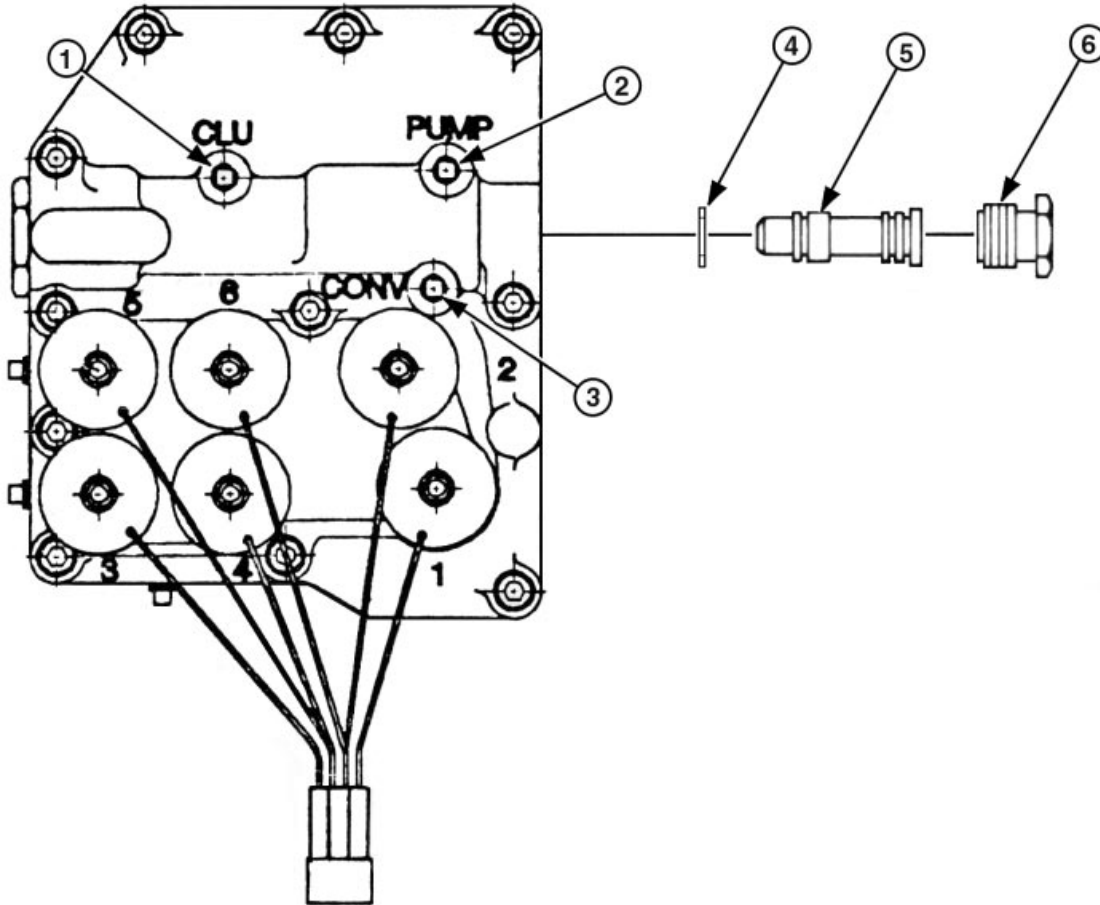
NOTE: Full throttle stall speeds will vary depending on the engine and torque converter being used. Check with the vehicle manufacturer for stall speed.

Converter out pressure at full throttle stall is not to be less than 241 kPa (35 psi) at 82.2—93.3°C (180—200°F).

Lube in pressure at 2000 rpm, 40.6—51.7°C (105—125°F) is not to exceed 170 kPa (25 psi) or be less than 70 kPa (10 psi).

DPSG,YZ07927,90 -19-22JUN99-1/1

SETTING THE CLUTCH PRESSURE



Clutch Pressure

On initial assembly of the pressure regulator, install two 7.62 mm (.030 in) shims.

NOTE: A maximum of five shims may be used.

To adjust the clutch pressure, remove the regulator cap #6, and the pressure regulator #5. The shims #4 will be installed onto the regulator valve.

With the transmission in neutral, the engine speed at idle 750 rpm minimum, and the converter out oil temperature at 40.6—51.7°C (105—125°F), the clutch pressure must be 1380 kPa (200 psi) minimum. If the

clutch pressure is below 1380 kPa (200 psi) add one 7.62mm (.030 in) shim.

Advance the engine speed to 2000 rpm, with the same temperatures and check the clutch pressure to be 1655—1790 kPa (240—260 psi).

If the clutch pressure is below 1655 kPa (240 psi) add one 7.62 mm (.030 in) shims, to achieve the 1655 kPa (240 psi) minimum pressure.

If the clutch is above 1790 kPa (260 psi) remove one 7.62 mm (.030 in) shim.

YZ1874 -UN-08JUL99

ERRATIC OIL PRESSURE

Symptom	Problem	Solution
Erratic oil pressure.	Low oil level.	Add oil to proper level.
	*Pump gasket not sealing.	Replace gasket.
	*Oil passage cover plate leaking in front cover.	Replace seal, apply sealant per instructions in assembly manual.
	*Foreign object in suction port.	Remove object and check for other contamination.

* Some indications of a suction leak are:

- Erratic oil pressure (rapid fluctuation of gauges)
- Pump and filter hoses jumping.
- Excessive air entrainment in the transmission oil.
- A long prime time (time elapsed from engine start to an indication of pump pressure).

*NOTE: * To determine if a suction leak exists, fill the transmission completely full of transmission fluid. Then start the engine to see if there is an indication of erratic oil pressure, If none, a suction leak probably exists.*

IMPORTANT: Do not neglect to drain the transmission back to the correct level after the test. Failure to do so will result in poor performance and overheating.

DPSG,YZ07927,92 -19-22JUN99-1/1

EXCESSIVE OIL PRESSURE

Symptom	Problem	Solution
Excessive oil pressure.	Excessive amount of regulator valve shims	Install correct amount of shims
	Sticking main regulator valve.	Check main regulator for contamination and clean orifice.
	Faulty spring.	Change spring.

DPSG,YZ07927,93 -19-22JUN99-1/1

LOW OIL PRESSURE_{IN ALL GEARS}

Symptom	Problem	Solution
Low oil pressure in all gears.	Sticking main regulator valve.	Clean main regulator valve.
	Oil pressure set too low.	Add shims (5 maximum).
	“O”ring on charge pump mount defective.	Replace “O”ring.
	Charge pump defective.	Replace pump.
	Internal disconnect seal damaged or installed incorrectly.	Replace seal and install correctly.
	Faulty regulator spring.	Replace regulator spring.

DPSG,YZ07927,94 -19-22JUN99-1/1

LOW OIL PRESSURE_{IN ONE GEAR}

Symptom	Problem	Solution
Low pressure on one gear but all right in other gears.	Contaminated solenoid valve spool.	Disassemble and clean entire control valve. Replace filter and transmission fluid.
	Broken wire to one solenoid, or dirty connection.	Repair wire (see solenoid chart for electrical valves and locations).
	Outer or inner piston seal leaking.	Replace seals.
	Shaft seal ring leaking.	Replace seal ring.

IMPORTANT: If a solenoid is removed from the valve it has to be reinstalled in the same location.

To determine the defective clutch is simply a matter of elimination. For example, if the gear selected used solenoids 6 and 3, and low pressure is indicated, select another clutch that uses one of those solenoids. If pressure is good, then the solenoid or clutch not selected is the one that is bad. To confirm that this is the faulty circuit, select another clutch that uses this solenoid, to assure that the discrepancy is actually in this solenoid or clutch.

Example: Clutch Selected	Indiation	Action
Uses solenoids 6 & 3	Low pressure	Solenoid or clutch 6 or 3 is defective.
Uses solenoids 5 & 3	Pressure O.K.	Solenoid or clutch 6 is defective.
Uses solenoids 6 & 2	Low pressure	Confirms solenoid or clutch 6 is defective.

DPSG.YZ07927.95 -19-22JUN99-1/1

VEHICLE WILL NOT MOVE

Symptom	Problem	Solution
Vehicle will not move but all pressures are normal.	Voltage to wrong solenoids on control valve.	Check wiring and connectors.
	No voltage to all solenoids.	Check wiring, controller and connectors.
	Voltage to all solenoids.	Check wiring and controller.
	Solenoid valve spool stuck	Inspect, clean and replace if necessary. Replace oil and Filter.
	Park brake not released.	Release park brake.

DPSG,YZ07927,96 -19-22JUN99-1/1

NO CONVERTER PRESSURE

Symptom	Problem	Solution
Low or no converter pressure.	Converter bypass valve defective.	Replace converter bypass valve.
	Converter hub seal ring not sealing.	Replace seal ring.
	Converter bypass valve pipe plug left out.	Install plug (see assembly manual).

DPSG,YZ07927,97 -19-22JUN99-1/1

FILTER OR FILTER LINES

Symptom	Problem	Solution
Filter or filter oil lines blow out.	Hose bends too sharp.	Reroute hoses.
	Defective hose	Replace hose.
	Main regulator valve stuck.	Clean valve, change filter and oil.
	Filter base plumbed wrong.	Double check that the oil flow is going in the direction indicated by the arrow on top of oil filter base.

DPSG,YZ07927,98 -19-22JUN99-1/1

CLUTCH PRESSURE DOES NOT RETURN_{IN ONE CLUTCH}

Symptom	Problem	Solution
Clutch selected pressure does not return to normal.	Contaminated solenoid valve spool.	Clean valve and replace oil and filter.
	Excessive internal leakage to clutch.	Inspect seal ring, piston seals, and all sealing surfaces (See assembly manual).

DPSG,YZ07927,123 -19-08JUL99-1/1

CLUTCH PRESSURE DOES NOT RETURN_{IN ALL CLUTCHES}

Symptom	Problem	Solution
Clutch selected pressure does not return to normal.	Contaminated solenoid valve spool.	Clean valve and replace oil and filter.
	Accumulator spring defective.	Replace spring.
	Primary pump defective.	Replace primary pump.

DPSG,YZ07927,99 -19-22JUN99-1/1

EXCESSIVE NOISE

Symptom	Problem	Solution
Excessive Noise	Charge pump defective	Replace pump.
	Excessive backlash in gear train.	Replace bearings and inspect for defective gears.
	Auxiliary driven pump bad.	Remove pump and check for noise.
	Internal problem	Check for contamination in the oil.

DPSG,YZ07927,100 -19-22JUN99-1/1

OIL BLOWS OUT

Symptom	Problem	Solution
Blows oil out of breather or dip stick tube.	Transmission over filled with oil.	Establish proper oil level (check front seal on auxiliary driven hydraulic pump if installed).
	Converter seal ring broken.	Remove transmission and install new seal ring on converter hub.

DPSG,YZ07927,101 -19-22JUN99-1/1

TRANSMISSION OVERHEATING

Symptom	Problem	Solution
Transmission overheating.	Converter stalling.	Shift to lower gear.
	Oil level too high.	Establish proper oil level (check front seal on auxiliary driven hydraulic pump, if installed).
	Engine overheating.	Check engine coolant.
	Water lines defective on heat exchanger.	Clean heat exchanger.
	Clutch slipping.	Check clutch pressure.

DPSG,YZ07927,102 -19-22JUN99-1/1

NO POWER

Symptom	Problem	Solution
Transmission pressure checks okay, but has no power and possibly overheating.	Converter sprag clutch damaged or installed wrong.	Disassemble converter and inspect (see assembly manual for correct installation.)
	Converter relief valve broken.	Replace relief valve.

DPSG,YZ07927,103 -19-22JUN99-1/1

OIL LEAKING FROM ENGINE FLYWHEEL

Symptom	Problem	Solution
Oil leaking from engine flywheel and /or weep hole in transmission bell housing.	Converter front cover seal leaking.	Replace seal.
	Converter hub seal or "O"ring damaged.	Replace seal.
	Bearing retainer plate gasket leaking.	Replace gasket.
	Converter not properly positioned within bell housing, causing converter and seal to leak.	Check engine flywheel offset dimensions and converter pilot bushing length against vehicle manufacture standards.

DPSG,YZ07927,104 -19-22JUN99-1/1

FOUR WHEEL DRIVE WILL NOT ENGAGEINTERNAL DISCONNECT ONLY

Symptom	Problem	Solution
Four wheel drive will not engage.	Solenoid stuck open.	Repair or replace solenoid. Check wiring diagram and connectors.
	Damaged or missing spring.	Replace or install spring.
	Bleed port blocked.	Check for proper installation of gasket and solenoid cap or contamination.
	The transmission is programmed to default to "two wheel drive" if electrical power is lost to the transmission.	Contact vehicle manufacture.

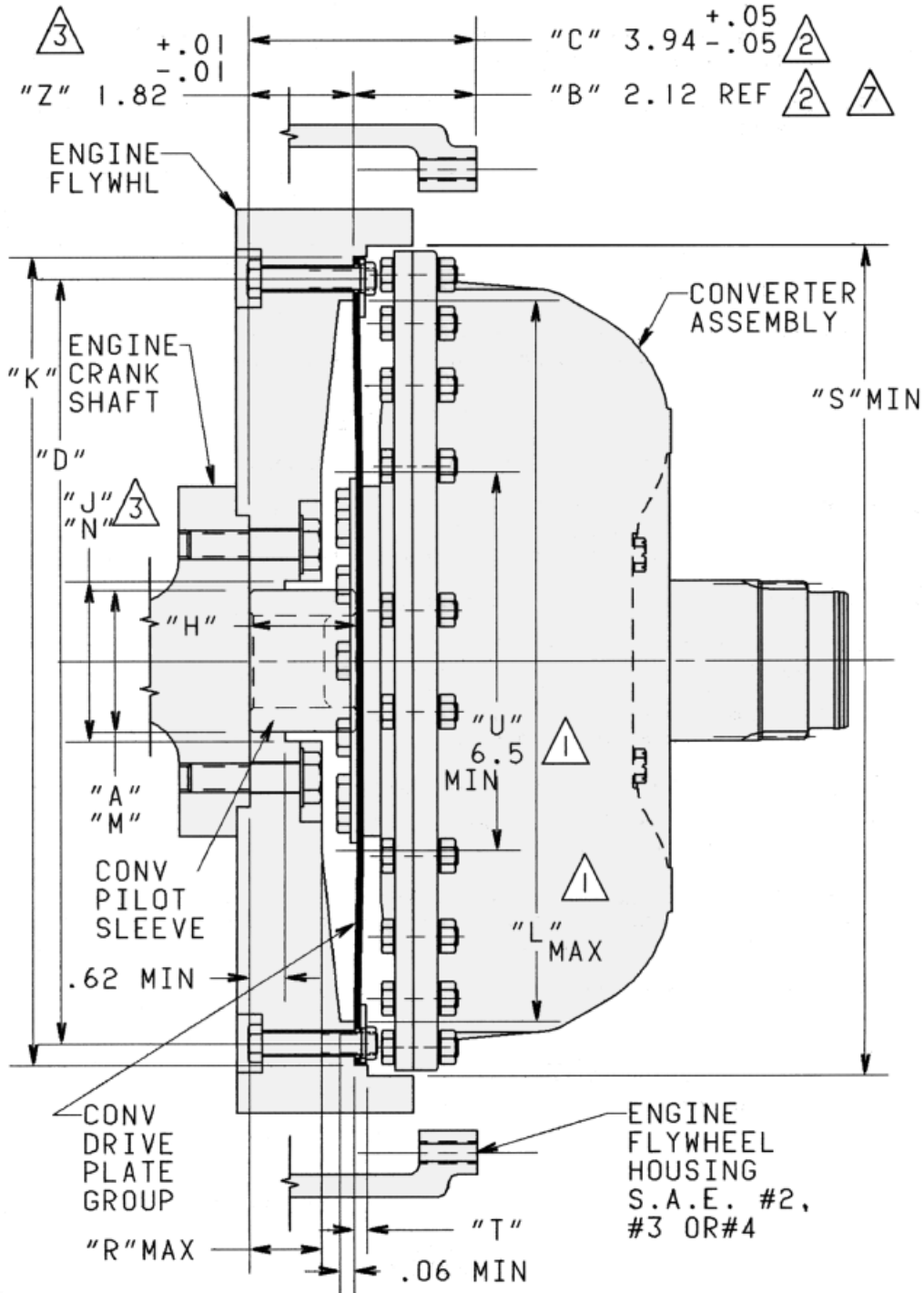
DPSG,YZ07927,105 -19-22JUN99-1/1

FOUR WHEEL DRIVE WILL NOT DISENGAGEINTERNAL DISCONNECT ONLY

Symptom	Problem	Solution
Four wheel drive will not disengage.	No power to solenoid, solenoid inoperative.	Check for electric power to solenoid, check wiring and connectors, replace solenoid.
	Check valve gasket installed backwards.	Install check valve properly.
	Piston seal damaged or installed backwards.	Replace seal or install properly.
	The transmission is programmed to default to "four wheel drive" if electrical power is lost to the transmission.	Contact vehicle manufacture.

DPSG,YZ07927,106 -19-22JUN99-1/1

CONVERTER-TO-ENGINE DIMENSIONS



Converter to Engine

YZ1877 -UN-28JUN99

DIMENSIONAL CHECK

When the following conditions occur dimensional checks must be done.

- An oil leak at the weep hole in the transmission bell housing.
- An oil leak at the drain hole (if any) in the engine flywheel housing.
- If the drive plate and /or converter has been changed.
- If the engine flywheel, or flywheel housing has been changed.
- If the engine has been changed.

NOTE: Refer to "Oil leaking from engine flywheel".

DPSG,YZ07927,107 -19-23JUN99-1/1

DIMENSIONAL CHECK_{REF 1}

Flywheels with dimension "K" must comply with dimensions "S" and "T" (as listed for each Funk converter size), and dimensions "L" , "R", and "U" will have to clear the drive plate and converter assemblies.

DPSG,YZ07927,108 -19-23JUN99-1/1

DIMENSIONAL CHECK_{REF 2}

Check the flywheel for the following dimensions:

1. "C" dimension 100 ± 1.27 mm ($3.94 \pm .05$ in.) from the flywheel housing mounting face to the pilot bore positive stop.
2. "Z" dimension $46.23 \pm .25$ mm ($1.82 \pm .01$ in) from the flywheel mounting face to the pilot bore positive stop.
3. "B" dimension 53.85 mm (2.12 in Ref) the flywheel offset.
4. Engines with dimensions "C" 100 ± 1.27 mm ($3.94 \pm .05$ in) "Z" $71.88 \pm .25$ mm ($2.83 \pm .01$ in) and "B" 39.62 mm (1.56 in Ref) requires a 14.22 mm (.56) thick housing adapter.

DPSG,YZ07927,109 -19-23JUN99-1/1

DIMENSIONAL CHECK_{REF 3}

Standard length pilot sleeves — dimension “H”, are set up for dimension “Z” $46.23 \pm .25$ mm ($1.82 \pm .01$ in) from the flywheel mounting face to the pilot bore positive stop.

1. Engine with dimension “Z” $71.88 \pm .25$ mm ($2.83 \pm$

.01 in) requires a 14.22 mm (.56 in) longer standard sleeve.

2. The use of a flywheel that has a shoulder as a positive stop will have to comply with dimension “N” (minimum) to clear the shoulder on the sleeve, dimension “J”.

DPSG,YZ07927,110 -19-23JUN99-1/1

CHECKING FOR THE CORRECT PILOT SLEEVE LENGTH

1. Take dimension “Z” which is from the flywheel mounting face to the pilot bore positive stop, or to the positive stop shoulder in the flywheel.
2. Place the pilot sleeve on the converter front cover pilot knob and push back to the front cover. Measure from the drive plate face (that will be mounted up to the flywheel), out to the end of the sleeve, or to the positive stop shoulder.

NOTE: This step ties to Dimensional check_{ref 3}.

3. The sleeve length (2) should be equal to or 2.54 mm (.10 in) longer than the pilot depth (1) ref “Z” in the flywheel.

The shoulder length (2) should be equal to or 2.54 mm (.10 in) longer than the shoulder depth (1) in the flywheel to properly locate the converter.

4. Check the diameter of the flywheel pilot bore dimension “M” and converter pilot sleeve dimension “A” for a proper fit. There should be .123—.076 mm (.0005—.003 in) diametric clearance. Flywheels that do not fit within this tolerance will require a special sleeve to accurately pilot the converter assembly. If the above dimensions check out, the assembly can continue.
5. Check the engine crankshaft endplay. It should comply with the engine manufacturer’s tolerance.

DPSG,YZ07927,111 -19-23JUN99-1/1

CONVERTER ASSEMBLY INSTALLATION

Converter assembly installation into transmission if separated from transmission.

1. Place a light coat of grease on the converter impeller hub gear, and the converter hub seal ring. Also apply a light coat of grease on the transmission input shaft splines, stator support tube splines, and the converter hub oil seal.

NOTE: Reference 7 applies to this step.

2. Support the converter assembly so that it can be positioned directly in line with the transmission input shaft centerline. Carefully insert the converter into the transmission keeping the input shaft centered in the hub bore. Push the converter assembly in slowly to feel when the splines and/or gear teeth begin to engage. If the converter assembly stops at

this point, rock it back and forth and turn the converter slightly to allow the splines and/or gears to line up.

IMPORTANT: Do not at any time force the converter in, damage will result.

When all splines and teeth are lined up, the converter assembly will slide easily into place, to the "B" dimension.

3. Place a light coat of grease on the converter assembly pilot sleeve I.D. and O.D., install the pilot sleeve on the converter pilot knob.
4. A 3/8 in-24 thread stud with a screwdriver slot in one end, threaded into the drive plate, from the engine side, will help in aligning the drive plate to the flywheel.

DPSG,YZ07927,112 -19-23JUN99-1/1

TRANSMISSION TO ENGINE

Installing the transmission to the engine

1. Rotate the engine flywheel until one of the through drilled holes is aligned with the flywheel housing access hole.
2. Support the transmission assembly so that it can be positioned directly in line with the engine crankshaft. Align the pilot sleeve with the flywheel pilot bore, and align the stud (protuding from drive plate face) with one of the through holes in the flywheel.

IMPORTANT: If the transmission does not close up to the flywheel, do not proceed. Forcing the transmission up to the engine with the assembly bolts could preload the engine crankshaft and cause engine and/or transmission problems later. Remove the transmission and check previous assembly steps as listed to determine where the problem is and take corrective action before proceeding.

3. Push the transmission up to the engine.
4. Bolt up the transmission to the engine flywheel housing.
5. Attach the drive plate to the flywheel, using 3/8 in-24 UNF grade 5 or grade 8 cap screws (provided by customer) length to be 12.7 mm (.5 in) longer that dimension through flywheel.
6. One by one, install the cap screws and hand tighten through the engine flywheel housing access hole, removing the alignment stud when it is encountered. After all the cap screws have been installed, tighten the cap crews to final torque of 47 N•m (35 lb-ft). for grade 5 or 68 N•m (50 lb-ft), for grade 8.
7. Recheck the engine crankshaft endplay and compare it with the endplay from assembly step 5. No endplay could mean that the crankshaft has been preloaded at assembly with the transmission. The engine and transmission should not be run until a reason for the preload is determined.
8. Reinstall the access hole cover.

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2000 Series Service Manual

CTM195 (28JUL99)

U.E.A. Shift Quadrant Service Instructions

Under normal conditions failure in the UEA shift quadrant is unlikely. However, should trouble occur within the assembly, repair parts are available and are more economical than replacing the entire unit. Refer to the following prints for the specific quadrant:

- (1) Shift Quadrant Connections and Harness.
- (2) Parts List.

A solid stainless steel control handle is normally supplied as a replacement unit even though the original handle may be of aluminum. The stainless type handle is less subject to wear and is standard equipment on extensive use applications. On high cycle applications the torsion spring type lever assembly is supplied on new assemblies and can be retrofitted to all existing UEA shift quadrants.

If a replacement switch is not the environmentally sealed pre-wired type, a heat shrinkable tubing package will be included with the switch. This must be installed after the necessary wire connections are made (Ref. Step #11 in shift switch replacement procedure). An external heat source must be used to heat the tubing to 350° F, in order to shrink it to conform to the switch. It is extremely important that a seal such as this tubing be used when replacing a switch, to keep the contacts free of dirt and grease.

If there is a problem of dust or contaminants getting into the switch on a non-environmentally sealed assembly, notify the factory and a sealed replacement switch can be supplied. This must be supplied with the harness pre-wired to it as the end cap seal is not readily field replaceable.

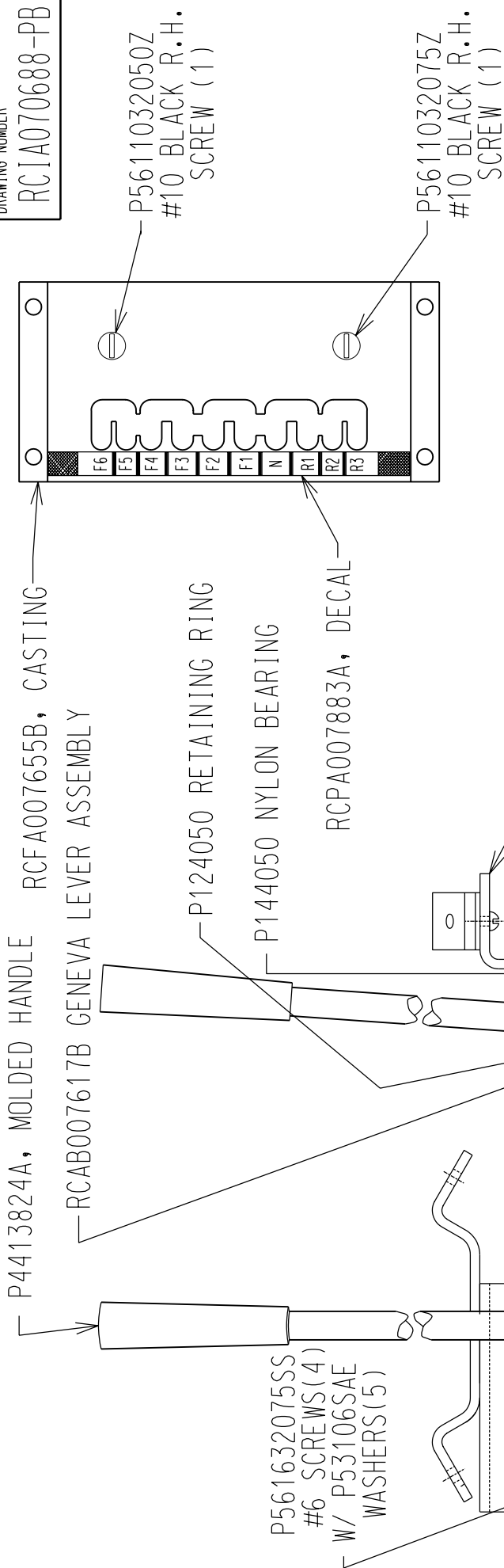
Shift Switch Replacement Procedures for Flat Spring Lever Assemblies:

1. Verify which switch is not functioning by checking against the truth or logic table on the Shift Quadrant Connections and Harness print. Intermittent malfunctioning is most easily detected by moving the control slowly and smoothly through the full range of positions. It is possible that a switch that has not been in use for some time, or a new switch, to 'hang-up' and not make proper contact. If this happens, tap the switch lightly and move the handle back and forth. This should restore the switch to working order. If it does not, replacement may be necessary.
2. Remove the two screws holding the flat spring handle to the switch drive unit. Save the spacers and screws for reuse.
3. Remove the four switch mounting screws from the corners of the switch drive unit and save the screws.
4. Turn the new replacement switch to the maximally counter-clockwise position.
5. Mate the splined coupler on the switch to the drive unit so that the handle would fit in the maximum counter-clockwise position. (The coupler has 12 splines so that coupling errors will occur in 30 degree increments).
6. Replace the four screws from Step 3, but do not fully tighten.
7. Replace the two screws and spacers to reattach the handle removed in Step 2, and fully tighten them. (20 in.-lbs. or 2.25 Newton-meters torque).
8. Hold the switch and move the handle to near the middle of the shift range.
9. With the handle centered in a middle detent slot, tighten the four mounting screws in the switch drive unit. (15 in.-lbs. or 1.7 Newton-meters torque).
10. Check to insure that the handle is centered in all detent slot positions. Readjust per Step 9 if necessary.
11. Reconnect the wiring and check as in Step 1.
12. Install heat shrink tubing as described above.

Shift Switch Replacement Procedures for Reduction Drive Unit Assembly Quadrants:

1. Move the shift lever to either end of the gate pattern in the casting.
2. Loosen and remove the (4) #6-32 x 3/4" round head screws attaching the switch to the mounting bracket. Save the screws and the spacers supporting the switch off the bracket. NOTE: One of the four screws is reversed from the other three and retained with a nut. This nut must also be reused.
3. Slide the defective switch assembly from the square shaft used to rotate it.
4. If replacing with an environmentally sealed switch with integrated harness, go on to Step 7. If harness is to be reused, carefully remove the heat shrink covering the defective switch.
5. Remove the wiring harness and attach to the replacement switch using the same contacts as used on the defective switch. (Refer to Connection and Harness print for correct color or number to contact sequence).
6. Replace heat shrink cover, furnished with new switch, per the third paragraph of page 1 of Shift Quadrant Service Instructions.
7. Rotate the center section of the new replacement switch to the end position (there is a built-in stop in the switch) that matches the position of the lever through the casting.
8. Carefully slide the new switch onto the square drive shaft. The wire harness should exit the assembly in the same direction as before disassembly was begun. If not, rotate the switch 90° or 180°, and again slide onto the drive shaft.
9. Replace the (3) #6-32 screws, that are easily accessible, through the mounting bracket, through the spacers and into the captive nuts on the switch itself. Do not tighten at this point.
10. The fourth #6-32 screw goes through the switch, through a spacer, through the mounting bracket and into the nut saved in Step 2. This nut is located behind the Reduction Drive Unit Assembly and must be held in position with a small wrench or pliers until the screw is partially tightened.
11. Hold the switch and rotate the lever or handle to a position near the middle of the shift range.
12. With the handle centered in a middle detent gate, tighten the four mounting screws until the switch will not move as the handle is moved.
13. Check to insure that the lever is basically centered in each gate position throughout the complete range of the shift pattern. If not, loosen the mounting screws and adjust the switch until the best positioning is achieved. NOTE: There should be an audible click in the switch itself between each shift position.
14. Securely tighten all mounting screws.
15. After reattachment of the shift quadrant assembly to the machine, verify that the switch is functioning correctly by checking against the truth or logic table on the Shift Quadrant Connections and Harness Print. It is possible for a new switch to 'hang-up' and not make proper contact even though it checked out properly at the factory. If this happens, tap the switch lightly and move the handle back and forth slowly and then faster. This will restore the switch to proper working order in most cases.

DRAWING NUMBER
RC1A070688-PB



<p>UNITED EQUIPMENT ACCESSORIES INC. 2103 EAST BREMER AVENUE WAVERLY, IA 50677 USA</p>	<p>PHONE#: (319) 352-3946 FAX#: (319) 352-2175 SCALE: N.T.S.</p>
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<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. THE TOLERANCES BELOW ARE APPLICABLE UNLESS OTHERWISE SPECIFIED.</p> <p>ANGULAR +/- 1° .X +/- .03 .XX +/- .015 .XXX +/- .005</p>	<p>NO. DATE BY REVISIONS</p>
<p>DRAWING TITLE: PARTS LIST FOR RC0100NMC3 SHIFT CONTROL</p>	
<p>DRAWING NUMBER RC1A070688-PB</p>	

RCAB007617B, REDUCTION DRIVE UNIT
RCAA007600 SWITCH DRIVE ASSY.



ISSPRO, INC. 2515 N.E. Riverside Way, Portland OR 97211
 Telephone: (503) 288-4488 • Toll Free: (800) 888-8065
 FAX: (503) 249-2999

ISSPRO 3 3/8" Dia. Programmable Speedometer Aircore Version

General Information:

Operating Voltage: 11-30 VDC: NOTE – Instrument comes equipped with a 12V lamp. Replace lamp with one of proper voltage when installing instrument on 24V systems.
 Input: Magnetic sensor or AC generator
 Transient Protection: +100 V, -400 V
 Reverse Voltage Protected

Calibration:

The ISSPRO Programmable Speedometer is calibrated (programmed) by setting a combination of eight switches found in the rear of the instrument. The odometer and pointer are electronically linked together and both are calibrated when the switches are properly set. Program before installing. Models are available with and without odometers.

Calibration Procedure:

Calculate the "calibration number" from the appropriate formula below. (A minimum calibration number of 9531 is required to be within calibration range). Refer to the "CALIBRATION SWITCH SETTING" table with this number. Locate the row in which the calibration number is between the limits, then set the switches marked with an "X" to the "on" position (up).

EXAMPLE: Calibration number = 43620: From the table 43620 lies between 43250 and 43900, therefore, switches 1,2,3,6,7 and 8 will be set to "on".

- (1) Front wheel mounted tone wheel: **CALIBRATION NUMBER = # SLOTS IN TONE WHEEL X TIRE REVS PER MILE**
- (2) Tail Shaft mounted magnetic sensor: **CALIBRATION NUMBER = TIRE REVS PER MILE X DIFFERENTIAL RATION X 16**
- (3) Sender driven from transmission cable drive:
CALIBRATION NUMBER = CABLE TURNS PER MILE (Usually 1000) X PULSES PER SENDER TURN

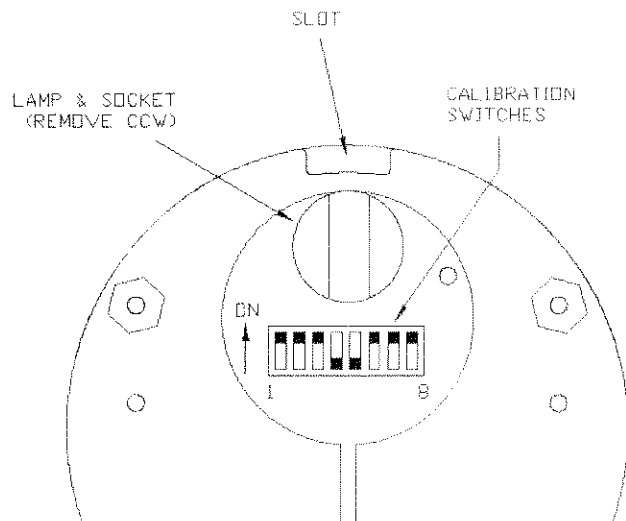
If the # of cable turns per mile is not known, follow this procedure: Obtain a ratio tester and a correct drive tang for your transmission. With a steel tap measure, mark off 1/10th mile (528 ft.) in as straight of a line as possible. Mark start and stop lines with chalk or paint. Position the vehicle so that one of the wheels aligns with the start mark. Disconnect the speedometer cable at the transmission and install the ratio tester in its place. Secure the cables and reset the ratio tester. Drive the vehicle to the stop point positioning the selected wheel on the stop mark. The reading displayed on the ratio tester is the number of cable turns per mile if using and Engler "SAC-10". If using an SS White ratio tester (P/N 312-12175Y), multiply the reading by 10 to obtain the cable turns per mile.

FREQUENTLY USED SENDERS

#PULSES PER TURN

DATCON 4-D-C 71267	8*
DIXSON SG201A, SG201A1, SG202	2*
ENGLER 870-0588	15
ISSPRO R8970, R8940	30
KIENZLE-ARGO 8-161-237008	8*
MOTOROLA 4-100 (7SG100), 4-111 (7SG100B)	30
ROCKWELL 240R02-001	30
SUN Model CP7643	6*
SYNCHRO-START Minigen	30
TELEFLEX 9604276	8*
VDO (Old Style Engler) ISSPRO 300092	4*
ZEMCO 4710	8*
ZEMCO 6314	5*

*NOTE: These senders do not produce the minimum required # of pulses to be in calibration range when driven at 1000 turns per mile. It may be necessary to change your sender to one that generates more pulses per rev such as an ISSPRO R8970.



REAR VIEW OF SPEEDOMETER

INSTALLATION: Mount the speedo in the dash panel and connect the wires as described below:

Make all of your connections to the black plug supplied and then plug it into the speedometer's white connector.

- RED – Connect to ignition switched power source.
- BLACK – Connect to ground along with one of the sensor wires.
- GREEN – Connect to dash lamp power.
- WHITE – Connect to other sensor wire.

INSTALLATION:

- 1.) Bring both sensor wires back to the speedo connector. Don't connect the sensor ground wire to a point which is physically different than the speedometer ground.
- 2.) **WHEN POWER IS APPLIED, THE NEEDLE SHOULD GO TO THE ZERO POSITION. IF IT DOESN'T, THERE MAY BE A BAD CONNECTION IN THE "HOT" (RED WIRE) OR GROUND WIRE CIRCUIT. CHECK POWER TO THE METER BY MEASURING WITH A VOLTMETER AT THE PLUG (METER LEADS ON THE PINS THAT ATTACH TO THE RED AND BLACK WIRES). IF THERE IS POWER AT THE PLUG, THE PROBLEM IS IN THE GAUGE.**
- 3.) Low voltage (below 10.5 volts) will cause inaccurate reading. If inaccuracy is suspected, measure voltage with vehicle operating and meter connected. This can be done by connecting a voltmeter to power source (i.e. fuse block, etc.) and/or piercing the red and black wire insulation with the meter leads.
- 4.) If speedo reads zero, then "jumps" to normal reading after a certain speed adjust the sensor in closer to gear (generators cannot be adjusted).
- 5.) A bad ground will make the needle erratic.

HINTS:

Finding tire revs per mile:

The best source of finding tire revolutions per mile is by contacting your tire dealer. However, if the information is impossible to get, use the following procedure:

- 1.) Check the tire revs per mile:
 - a. Mark the tire and floor directly below the center of the hub.
 - b. Move the vehicle one revolution of the tire and mark the floor corresponding to the mark on the tire.
 - c. Measure the distance between the two marks in inches. Use this distance in the formula below to find the tire revs per mile:

$$63,360 \text{ Divided By Measured Distance} = \text{Tire Revs Per Mile}$$

- 2.) After calibration the meter per instructions, if you will find the meter still runs too fast or slow try the calculations below to fine tune calibration:

Drive at a known speed and note the speed indicated on the speedometer. A good way of doing this is by following a vehicle with a calibrated speedometer. Next, with the following formula, use the numbers obtained and the original calibration number to calculate the correct calibration number.

$$\frac{(\text{Old calibration number}) \times (\text{MPH shown on meter})}{(\text{Actual MPH})} = \text{New Calibration number}$$

EXAMPLE:

The vehicle was actually going 55 MPH while the speedometer shows 60 MPH. The meter switches are set for calibration number of 39,847.

$$\frac{39,847 \times 60}{55} = 43,469$$

The new calibration number for this meter is 43,469. Refer to calibration chart (pages 3 and 4) and find that switches 1,2,3,6,7 and 8 will be in the "on" position.

The following calibration chart is for use with units that apply to direction sheet #IS073 (3 3/8" Programmable Speedometer Air Core Version.) If you have another application call ISSPRO for the appropriate calibration chart.

AIRCORE SPEEDOMETERS - MPH
CALIBRATION SWITCH SETTING

SWITCHES SET "ON"

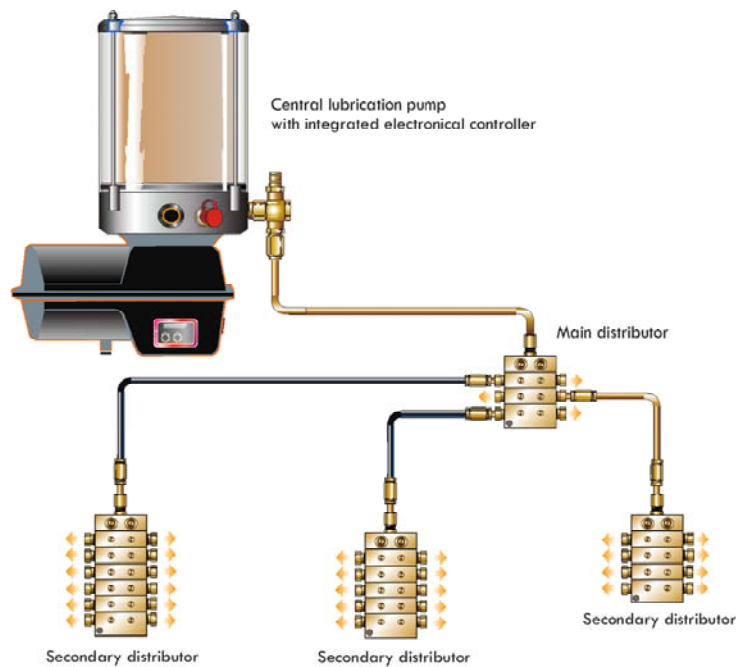
SWITCHES SET "ON"

CALIBRATION NUMBER	1	2	3	4	5	6	7	8	CALIBRATION NUMBER	1	2	3	4	5	6	7	8
677835 - 693784	x	x	x	x	x	x	x	x	268265 - 271464	x	x	x	x	x	x		x
662255 - 677834		x	x	x	x	x	x	x	265795 - 268264		x	x	x	x	x		x
647385 - 662254	x		x	x	x	x	x	x	263365 - 265794	x		x	x	x	x		x
633135 - 647384			x	x	x	x	x	x	260975 - 263364			x	x	x	x		x
619495 - 633134	x	x		x	x	x	x	x	258625 - 260974	x	x		x	x	x		x
606455 - 619494		x		x	x	x	x	x	256325 - 258624		x		x	x	x		x
593965 - 606454	x			x	x	x	x	x	254075 - 256324	x			x	x	x		x
581945 - 593964				x	x	x	x	x	251845 - 254074				x	x	x		x
570395 - 581944	x	x	x		x	x	x	x	249655 - 251844	x	x	x		x	x		x
559335 - 570394		x	x		x	x	x	x	247515 - 249654		x	x		x	x		x
548685 - 559334	x		x		x	x	x	x	245405 - 247514	x		x		x	x		x
538415 - 548684			x		x	x	x	x	243335 - 245404			x		x	x		x
528515 - 538414	x	x			x	x	x	x	241295 - 243334	x	x			x	x		x
519005 - 528514		x			x	x	x	x	239285 - 241294		x			x	x		x
509825 - 519004	x				x	x	x	x	237315 - 239284	x				x	x		x
500535 - 509824					x	x	x	x	235285 - 237314					x	x		x
491565 - 500534	x	x	x	x		x	x	x	233285 - 235284	x	x	x	x		x		x
483325 - 491564		x	x	x		x	x	x	231415 - 233284		x	x	x		x		x
475355 - 483324	x		x	x		x	x	x	229575 - 231414	x		x	x		x		x
467625 - 475354			x	x		x	x	x	227755 - 229574			x	x		x		x
460145 - 467624	x	x		x		x	x	x	225965 - 227754	x	x		x		x		x
452915 - 460144		x		x		x	x	x	224205 - 225964		x		x		x		x
445905 - 452914	x			x		x	x	x	222475 - 224204	x			x		x		x
439105 - 445904				x		x	x	x	220765 - 222474				x		x		x
432495 - 439104	x	x	x			x	x	x	219085 - 220764	x	x	x			x		x
426105 - 432494		x	x			x	x	x	217435 - 219084		x	x			x		x
419895 - 426104	x		x			x	x	x	215805 - 217434	x		x			x		x
413855 - 419894			x			x	x	x	214205 - 215804			x			x		x
407985 - 413854	x	x				x	x	x	212615 - 214204	x	x				x		x
402295 - 407984		x				x	x	x	211065 - 212614		x				x		x
396755 - 402294	x					x	x	x	209525 - 211064	x					x		x
390985 - 396754						x	x	x	207905 - 209524						x		x
385365 - 390984	x	x	x	x	x		x	x	206305 - 207904	x	x	x	x	x			x
380285 - 385364		x	x	x	x		x	x	204845 - 206304		x	x	x	x			x
375335 - 380284	x		x	x	x		x	x	203395 - 204844	x		x	x	x			x
370495 - 375334			x	x	x		x	x	201965 - 203394			x	x	x			x
365785 - 370494	x	x		x	x		x	x	200555 - 201964	x	x		x	x			x
361205 - 365784		x		x	x		x	x	199175 - 200554		x		x	x			x
356735 - 361204	x			x	x		x	x	197805 - 199174	x			x	x			x
352365 - 356734				x	x		x	x	196455 - 197804				x	x			x
348095 - 352364	x	x	x		x		x	x	195125 - 196454	x	x	x		x			x
343945 - 348094		x	x		x		x	x	193815 - 195124		x	x		x			x
339885 - 343944	x		x		x		x	x	192515 - 193814	x		x		x			x
335915 - 339884			x		x		x	x	191235 - 192514			x		x			x
332045 - 335914	x	x			x		x	x	189975 - 191234	x	x			x			x
328265 - 332044		x			x		x	x	188735 - 189974		x			x			x
324565 - 328264	x				x		x	x	187505 - 188734	x				x			x
320775 - 324564					x		x	x	186235 - 187504					x			x
317065 - 320774	x	x	x	x			x	x	184975 - 186234	x	x	x	x				x
313625 - 317064		x	x	x			x	x	183795 - 184974		x	x	x				x
310245 - 313624	x		x	x			x	x	182635 - 183794	x		x	x				x
306935 - 310244			x	x			x	x	181485 - 182634			x	x				x
303695 - 306934	x	x					x	x	180345 - 181484	x	x		x				x
300525 - 303694		x					x	x	179225 - 180344		x		x				x
297425 - 300524	x						x	x	178115 - 179224	x			x				x
294385 - 297424							x	x	177015 - 178114				x				x
291395 - 294384	x	x	x				x	x	175935 - 177014	x	x	x					x
288485 - 291394		x	x				x	x	174865 - 175934		x	x					x
285625 - 288484	x		x				x	x	173815 - 174864	x		x					x
282815 - 285624			x				x	x	172775 - 173814			x					x
280065 - 282814	x	x					x	x	171735 - 172774	x	x						x
277365 - 280064		x					x	x	170725 - 171734		x						x
274725 - 277364	x						x	x	169715 - 170724	x							x
271465 - 274724							x	x	168465 - 169714								x

MBS Z



OPERATOR'S/SERVICE MANUAL
For
BEKA-MAX
EP-1 SERIES LUBRICATION PUMP
And
MX-F DISTRIBUTION BLOCKS



For
NMC-WOLLARD M400 PUSHBACK/TOW TRACTOR





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INSTALLATION GUIDELINES

- Make sure that the equipment is in a safe and secure location.
- Make sure that main power disconnect is in the off position
- Lockout the equipment to prevent unauthorized use while work is underway
- Visualize where the distribution block(s), hose(s), pump(s) and clamp(s) will be located on the machine.
- Determine if any drilling or welding is required and permitted.
 - No drilling on lifting arms or on the axle
 - If welding is required and there are computers onboard, disconnect them
 - After the welding/drilling is complete, touch up with correct paint color
- Ensure that no contamination can penetrate into the components of the central lubrication system and the lubricated area during assembly.
- Work with clean tools all the time.

OTHER SAFETY POINTS

- If working from height, use proper safety equipment and fall arrest gear.
- Exercise extreme caution when working on wet or icy equipment.
- Wear proper safety gear when working such as safety boots, safety glasses and high-visibility vests.
- Turn off power whenever you are working on the electrical systems.
- If the system is going into overpressure, be careful around the pressure relief valve, as lubricant can be ejected with some force causing injury.

SYSTEM MAINTENANCE AND SERVICE

During the first few weeks after installation the system should be checked for the following:

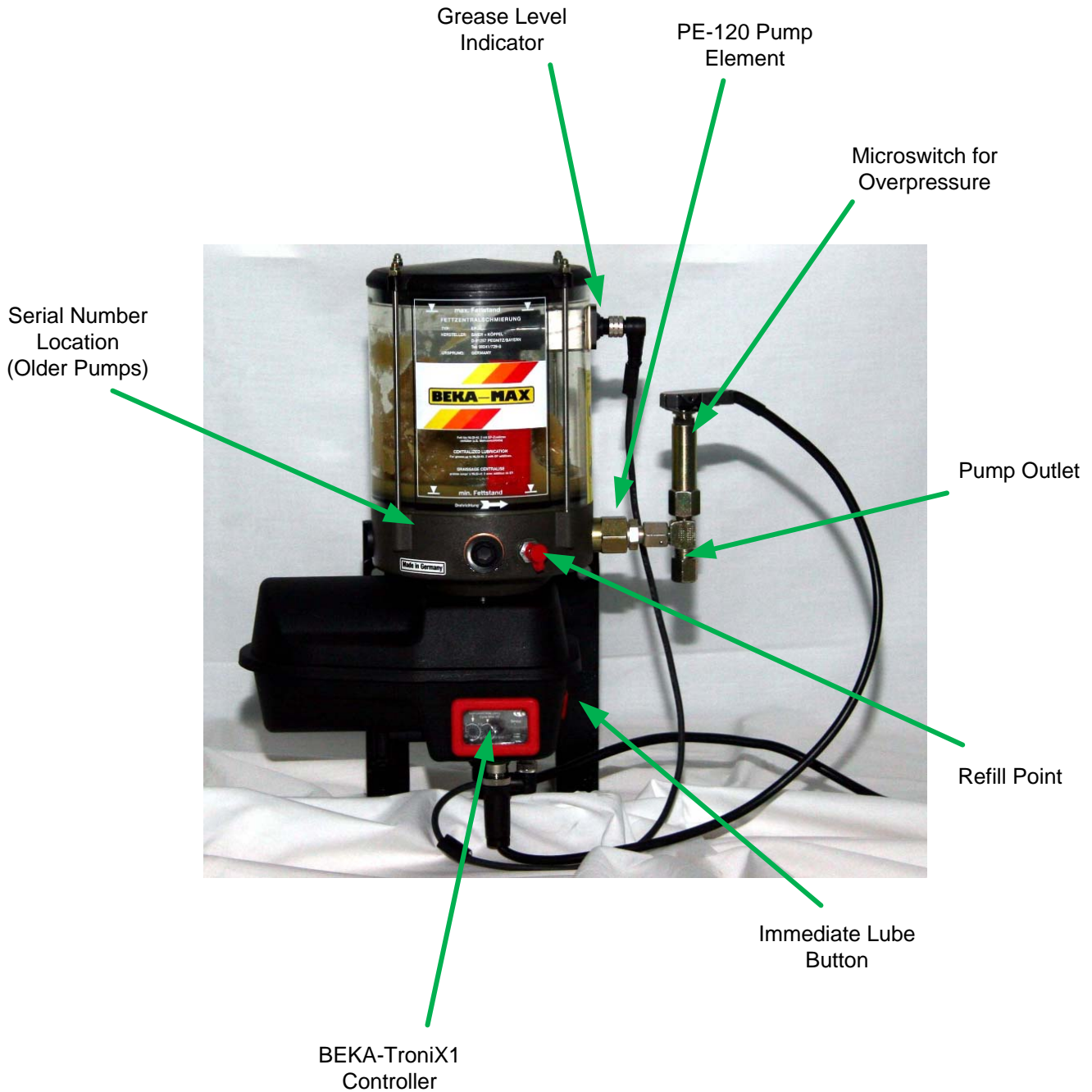
- ensure grease collar is adequate at all lubrication points
- check all points and hoses for breakage and proper attachment

The Beka-Max system does not require any routine maintenance, other than keeping the reservoir filled with lubricant, and visual inspections of the lines.

The system is weather tight and use of car washes and jet steam machines is acceptable.

Take care when using pressure washers. A direct stream of high pressure water could force it's way into the system or the controller.

The Beka-Max system comes with a 1 year warranty.



The serial number location on newer pumps is on the right side mounting tab. In the above picture, it would be located behind the pump element

The above picture also shows the older style Grease Level Indicator. The new style is mounted through the pump lid.



Design of the BEKA-MAX Central Lubrication System:

An electrically operated piston pump, with up to three pump elements, supplies lubricant to the main progressive distributor from where it is directed, in the correct ratio, to secondary progressive distributors. These secondary distributors supply lubricant to individual lubrication points. The electronic control unit controls the interval time and also the pump “run” time.

Operation of the System:

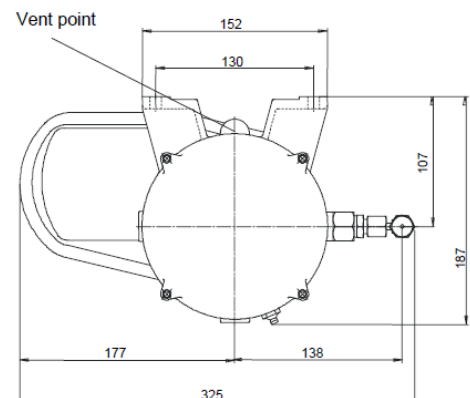
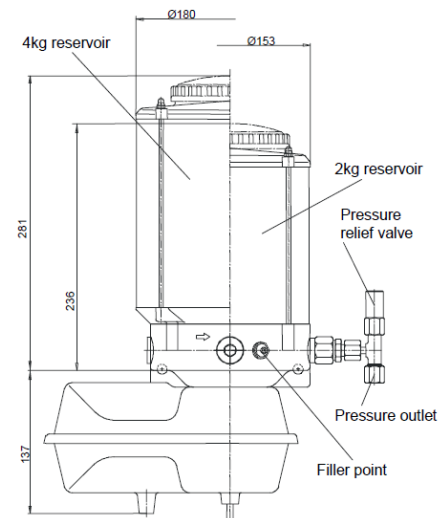
The system operates on a progressive basis, and is capable of using grease up to NLGI Class 2. “Progressive” signifies that the lubrication points are lubricated in a progressive sequence, i.e. one after the other. This design principle permits easy monitoring of the system by means of an in-built pressure relief valve in the pump element. If any lubrication point cannot be lubricated from the distributor, a back pressure of up to 280 bar will be built up in the system and at that point, a controlled discharge of lubricant will be released via the pressure relief tee, thus allowing normal operation of the rest of the system.

In addition to standard chassis greases, this progressive system is capable of operation with oil and fluid greases of any grade.

The agitator rotates in the reservoir, forcing lubricant from the reservoir via the perforated base plate into the pump housing. The combination of agitator and the base plate serves to reduce air bubbles to insignificant dimensions. A red plastic wiper blade on the agitator permits visual inspection of pump operation and grease level. The pressure relief valve provides protection to the system in the event of an overpressure.

EP-1 Pump Technical Data:

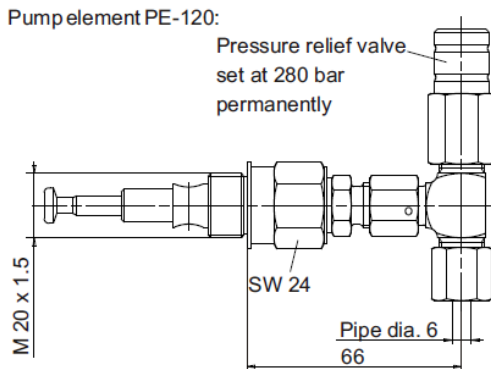
Operating temp:	-35°C up to +80°C
Recommended lubricant:	Normal chassis grease NLGI Class 2
Number of outlets:	Max. 3
Delivery per element:	Max 0.12 cc per stroke (PE-120) (1.8 cc per min)
Direction of rotation:	As per indicating arrow on label Counter-clockwise
Normal mounting position:	Reservoir in the vertical plane
Enclosure:	IP 65
Motor:	12VDC or 24VDC geared motor (operating speed 15 rpm)
Power consumption at Max back pressure of 300 bar:	Max 1 amp





PE-60/PE-120/PE-170 Pump Elements:

Pump elements are mounted into the pump base in the three provided positions. Any combination of pump elements can be utilized for the system. There are three fixed output elements and one variable. Pump elements include a pressure relief tee for system protection in case of over pressure, rated at 280 bar. The pressure relief hole must not be covered or closed off for any reason. Also the pressure relief valve is torqued on to provide the correct pressure, and must not be turned or disassembled. An external check valve may also be located between the pumping element body and the pressure relief tee.



Technical data:

	Delivery rate (cm ³ / stroke or revolution)	Order-no (with pressure relief valve)	Order-no Pressure relief valve
PE-60	0.06	2152 99067 0000	2152 0062
PE-120	0.12	2152 99061 0000	
PE-170	0.17	2152 99069 0000	

Installation of Pump Elements:

Fig. A

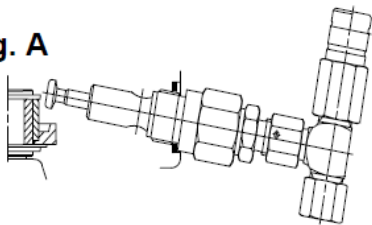
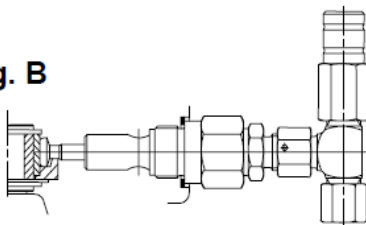


Fig. B



- 1) Create a path from the opening to the eccentric by using your finger and clear the grease away.
- 2) Extend the plunger out as much as it will go.
- 3) On a slight angle upwards, push the element into the base. When the element is close, slowly lower the element into the eccentric and tighten the element.

Once the element is seated into the eccentric, turn on the pump. If the agitator moves a sort distance and then stops, this means that the piston is not seated properly into the eccentric.

Remember to keep the copper washer with the element at all times.

To ease installation of the element, the agitator should be 180° opposite from the installation hole.

When removing the pump element, ensure that the piston is not left inside the pump.



PE-120V Adjustable Pump Element:

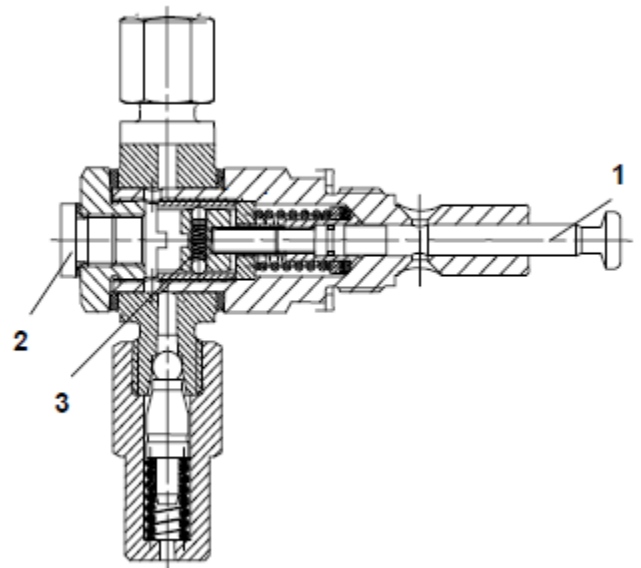
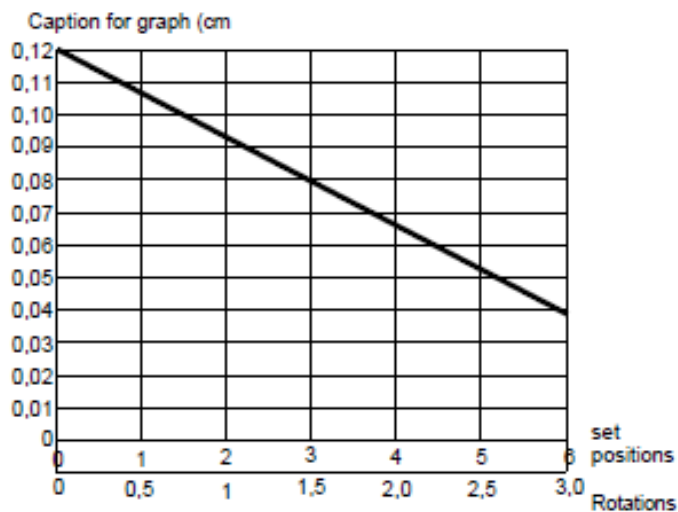
The pump element, PE-120V, has an adjustable output. This permits one pump unit to feed lubrication systems of different sizes by virtue of its adjustability.

Specifications:

- All pump elements are pre-set in the factory to maximum stroke capacity
- Maximum output 0.12 cm³ with full stroke.
- Reduction in output is 0.013 cc per set position (180°).

Adjustment Instructions:

- Remove plug (2) using an 5mm allen key.
- Use a screwdriver to adjust the set screw (3).
- Clockwise will reduce the output. Counter clockwise will increase the output. The maximum travel of the set screw is 6 positions. One full rotation of the set screw is two set positions.
- Replace and tighten blanking plug (2) including the washer.





Controller Overview:

The BEKA-TroniX1 controller is an electronic device used to control the operation of the pump. It is fitted with a database that monitors and records different variables, such as adjustment ranges, method of operation, manufacture date and serial number.

It can control the pump in one of two methods:

- 1) Time control
- 2) Pump revolution control

Controller Operation:

When the ignition has been switched on, the green and red LED will illuminate for 1.5 second and shows that the controller is operational. The BEKA-TroniX1 has memory. This serves to keep record of time elapsed. Should the ignition be switched off during lubrication or dwell time, then the time is stopped and recorded. Once the ignition is switched on again, the pump will continue from where it was left off.

At any time when the ignition is on, an immediate lubrication cycle can be started with the red button on the side of the controller, or an optional in-cab control. The pump will immediately start its lubrication cycle and the lubrication or dwell duration up to that point is reset and starts recording again.

The immediate lubrication button also clear any error codes currently monitored by the controller, such as an empty grease reservoir, or an overpressure in the system. Error codes will be flashed to the operator via the green and red LED lights. See the troubleshooting section for more information.

There is also options of grease level indication and of over pressure sensing. See the section on pump options for more details.

Controller Adjustment:

The controller can be easily adjusted to control the amount of lubrication provided to the machine by adjusting the graduated dials in the controller's sight glass. Remove the red frame by popping it off, and then remove the 4 Phillips screws holding the glass. The dials can then be turned by a small flat screwdriver. Make sure that the glass is properly installed to avoid water ingress. The ranges of each dial can also be adjusted, but only by Beka-Max technicians using the Beka Di-Sys software.

**** Before adjusting the controller, turn off power to the pump! ****

BEKA-troniX1 integrated electronic controller:

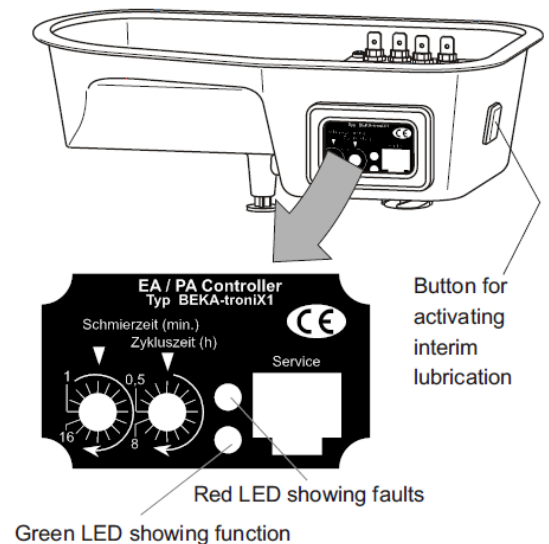
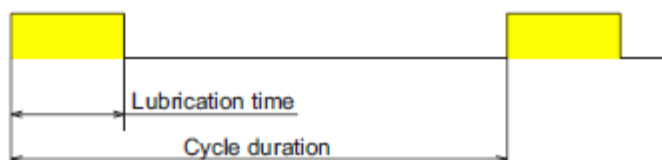


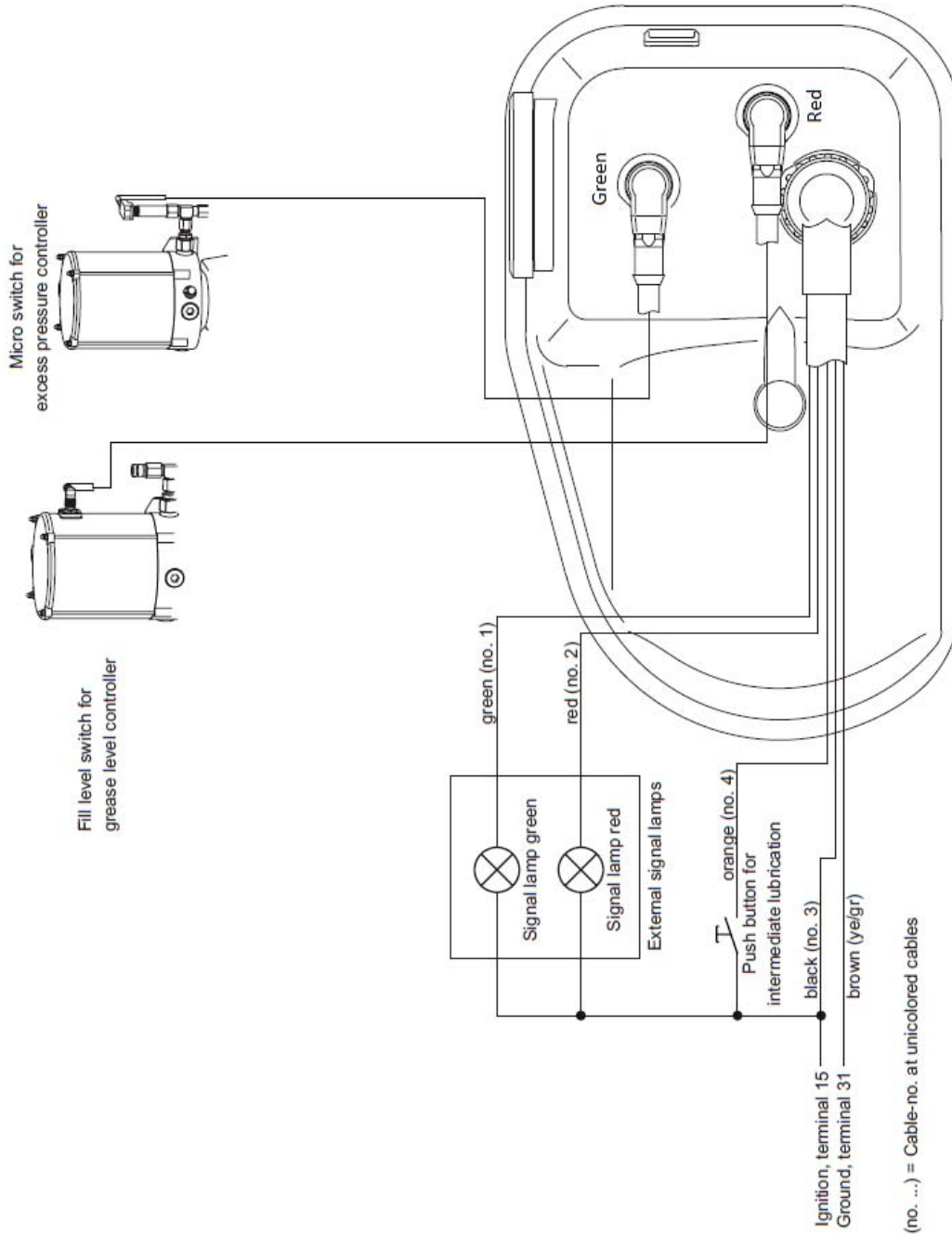
Diagram of cycle sequence:





Wiring for the BEKA-TroniX1 controller:

Controller will have a 5 wire main wire harness connected to the controller with a bayonet connector. The Green plug for a microswitch, and the red plug for the grease level indicator are optional, and will not be found on the controller unless one or both are equipped. (see section on Pump Options)

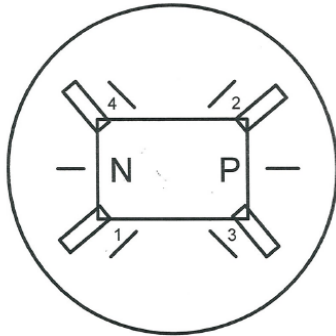


Wiring con't →



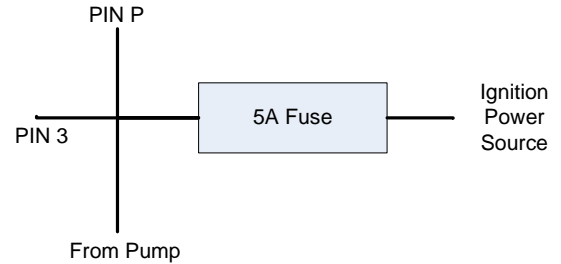
Green Push Button Switch with Light:

This switch will duplicate the green LED on the pump controller inside the operator's cab. It will also act as an immediate lubrication button. This button may also have a single red light mounted next to it, but only if the pump has options such as the grease level or overpressure detection. The red light will notify the operator of any problems with the system. The red light will wire up the same as the red light on the rectangular light holder below.



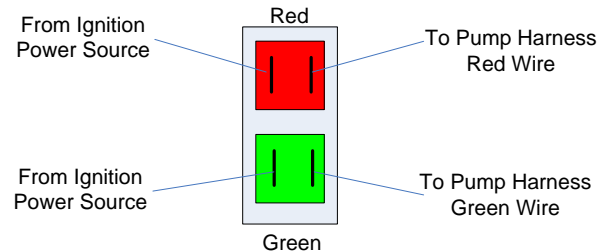
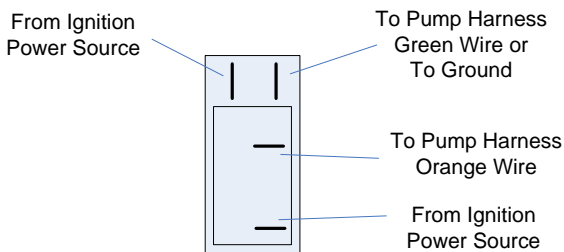
Pin **BEKA-TronX1 Wire**

Pin N	Green
Pin 4	Orange
Ground	Brown
Pins P / 3	Black



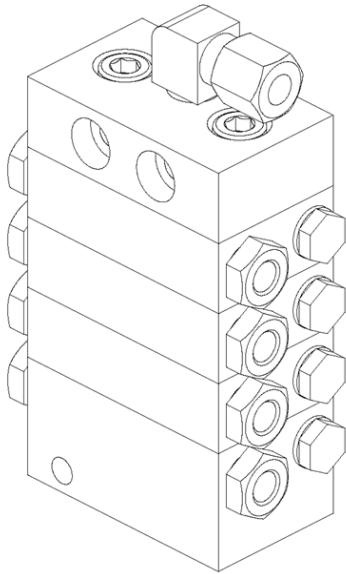
Rocker Style Switch with Lights:

The in-cab controls on different models may be a rectangular rocker style switch with another panel holding red and green lights to duplicate the controller LED lights.



Other Electrical Notes:

- Lubrication system should be wired to an ignition power source.
- A 5 amp fuse should be used on the power source for the system.
- All connections outside should be sealed with heat shrink or tape to protect from the elements. Dielectric grease is also recommended on plug connections.



The MX-F blocks are distributor devices with a hydraulic sequence controls, the pistons of which are regulated by the supplied lubricant in a way that the lubricant inevitably and successively escapes at the individual outlets. In the case of malfunctions during the flow of lubricant, the distributors will block up. This blockage is used for the monitoring of the distribution system. At this point, lubricant from the blockage will escape from the pressure relief valve at the pump.

The progressive distributors are assembled in a variable segment construction, which offers the advantage that the distributor can be extended or shortened to accommodate the number of lubrication points. This also allows the segments to be changed to modify the amount of lubricant a point will get. The difference in output is achieved by a difference in the diameter of the pistons in each segment.

A minimum of three segments (not including the starter segment) are required per block, with a maximum of 12 segments. Each segment can do one or two points depending on configuration.

Element denomination	Output		Piston \varnothing
	per outlet	per element	
MX-F 25	25 mm ³	50 mm ³	3 mm
MX-F 45	45 mm ³	90 mm ³	4 mm
MX-F 75	75 mm ³	150 mm ³	5 mm
MX-F 105	105 mm ³	210 mm ³	6 mm

The MX-F distribution block when installed should be in a vertical plane. Mounted in a horizontal plane will cause the pistons to fall to the side with gravity and lock up the block.

Other components of the MX-F distribution system:

A MX-F distributor can be made up of other components as well. Such as bridges to connect multiple segments together to increase flow to a single point. An explanation of building the copper bridge is included. There are also two other styles of bridge known as Solid Bridges, both with and without an outlet. More information on those can be received from your Beka dealer.

Port plugs are used to seal off one outlet on each segment.

NOTE: The internal port pin MUST be removed if a port plug is used on one outlet, as failure to remove the pin will result in a blockage.

Non-Return valves can also be placed on the outlets to prevent back flow.

A detailed MX-F manual and parts guide is available from your Beka-Max dealer.



Note: When creating or modifying the Distribution Block KEEP EVERYTHING CLEAN and make sure that all O-Rings are accounted for.

Modifying a Distribution Block

- 1) Have the Block supported in a vise.
- 2) Remove the screws on the top and keep blocks together.
- 3) Remove the starter block and always watch for o-rings that might come off.
- 4) Remove the unwanted Block and replace with new one.
- 5) When the blocks are back together and screws a hand tight, REMOVE block from vise.
- 6) On a flat surface, bang the block to ensure all blocks are flush with each other and no twisting.
- 7) Secure block into vise and finish tightening.



Note: If there is a Port Plug on either side of the individual Blocks, the distribution plug inside the block will be removed using an allan key.

Creating a Distribution Block

- 1) Have the needed End Block in a vise.
- 2) Place next block on top of the end block and the same time make sure all the O-Rings are still in proper position.
- 3) Do the same process for the other need individual blocks.
- 4) Place the starter block on the top and tighten down hand tight with the proper distribution screws.
- 5) Bang the entire blocks against a flat surface so all blocks are flush and tighten more.



Starter Block



Middle Block



End Block



Copper Bridge Building:



Cap Screw
0802000312

- 1) Have the Distribution block sitting tightly in a vise.
Remove the distribution plug inside both blocks that are getting the bridge.
- 2) Push the Reducer ring in the port of the block first.
- 3) Have the Cap Screw and the Double Sided Cone onto the Copper Bridge.
- 4) Tighten the Cap Screw into the distribution block.
- 5) Once secured remove the Complete Bridge to check if everything was tighten down properly on to the Copper Bridge and reattach.

Things to remember are:

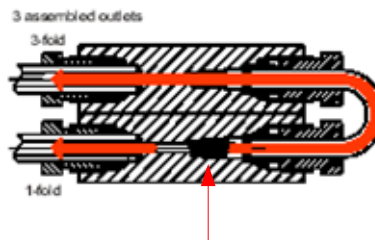


Pipe Bridge
F0409/14-00 001

- Make sure that the ends Copper Bridge are parallel as possible before lining all the pieces.
- Keep the Copper Bridge in good condition all the time.
- When checking the bridge and the reducer does not stay attached to the copper bridge, that's okay.



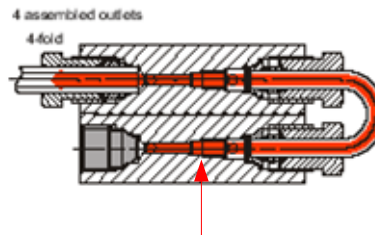
Reducer Ring
0802000310



Internal view of the Distribution Block without Port Plug.
Notice that there is a distribution plug.



Double Sided Cone
09038620013



Internal view of the Distribution Block with a Port Plug.
Notice there is no distribution plug.



Complete Bridge
4010 9600 10011



The most common hose used in the systems is HP (High Pressure) hose. This hose has an internal diameter of 6mm and a burst rating of 840 bar.

AFG hose is the next size up with an internal diameter of 8mm and a burst pressure of 680 bar.

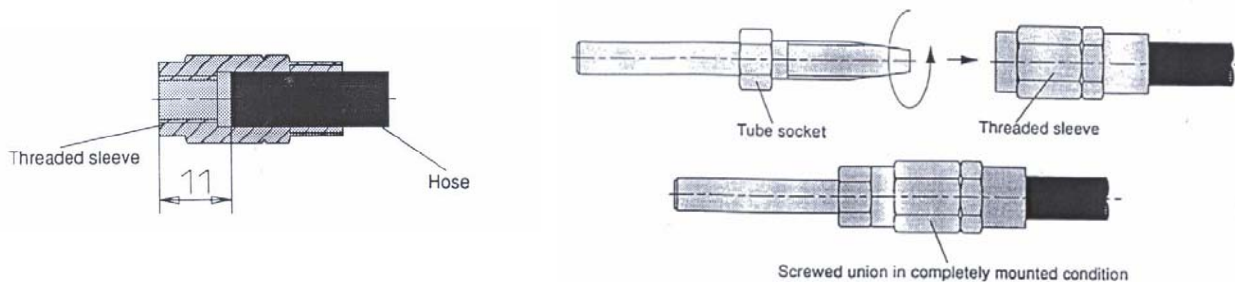
Polyimide line will be used where the runs are short and also where there's not much movement.

Steel line will be used where more protection is required for the run.

HP and AFG line require tubular sockets and threaded sleeves to be used to facilitate the connection with the distribution blocks and the fittings in the lubrication points. Poly and steel line do not require those pieces.

ASSEMBLY OF HOSE FITTINGS:

- 1) Make sure the end of the hose is clean.
- 2) The threaded sleeve should have a light coating of grease or oil applied, and then the sleeve will be threaded onto the hose end counter-clockwise to the stop position. Stop position is approximately 11 mm in.
- 3) Lubricant the selected tubular socket and thread it into the threaded sleeve and tighten.

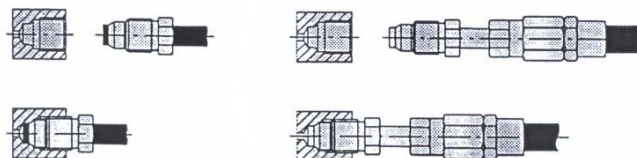


Note: From time to time, the outside diameter of the hose can vary slightly because of manufacturing tolerances. When required, a successful joint can be made by flattening the threaded sleeve, at the point where the hose enters, by 1 or 2 mm into an oval shape.

HOSE INSTALLATION NOTES:

- Use loom on the hoses as protection.
- Avoid points where chafing can occur against other parts of the vehicle
- Install hoses and lines with adequate clearance from heat sources
- When running lines to moving components, such as axles, cranes, hoists etc, particular care must be taken to avoid damage or chafing. Make sure there's enough line to compensate for the movement.
- When installing the lines into a fitting or into the distribution block, make sure that the line is properly seated into the compression cone before tightening.

Polyimide with cap screw, and double compression cone



HP hose with straight tubular socket, cap screw, and double compression cone



The EP-1 series lubrication pump can come with a variety of physical options:

- Different size reservoirs (1.9kg, 2.5kg, 4kg, 8kg 2-piece, 8kg-1 piece, 16kg)
- 12 or 24 volt motors.
- Up to three pumping elements, each element capable of feeding up to 100 lubrication points. Multiple pump elements can also be combined together with one outlet.
- External Check Valve on the pump element.
- Electronic options as shown below.

The EP-1 series lubrication pump with the BEKA-TroniX1 controller can be fitted with two electronic options.

- 1) Grease Level Indication
- 2) Microswitch to detect system overpressure

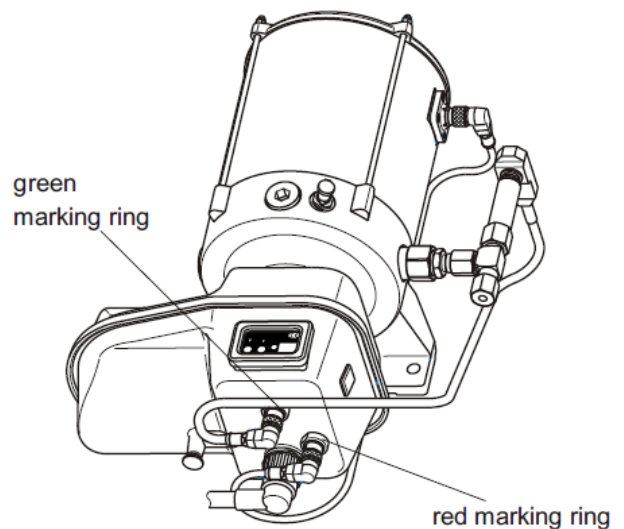
To utilize these two options, the pump must have the BEKA-TroniX1 controller with the two additional plugs on the bottom. The red ring plug is for the grease level, and the green ring plug is for the microswitch.

Microswitch:

The microswitch is attached to the pressure relief tee on the exit of the pump element. Should a fault occur in the system, causing an overpressure of more than 250 bar, the microswitch will activate. Once activated, it will illuminate the green LED light, and flash the red LED light. *The immediate lubrication button must be pressed to reset the controller and restart the pump.*

Grease Level Indicator:

This uses a capacitive proximity switch inside the reservoir of the pump, either through the side of the reservoir, or through the lid. As long as there is enough grease in the pump, the switch sends a signal to the controller. If the grease level sinks below minimum, the proximity switch will turn off the signal. This will shut off the pump, and the red LED will illuminate. *Once the reservoir is refilled, the controller will restart itself.*



All of these options can be retrofitted to any EP-1 series pump. Contact your Beka-Max dealer for the information and parts required to do so.

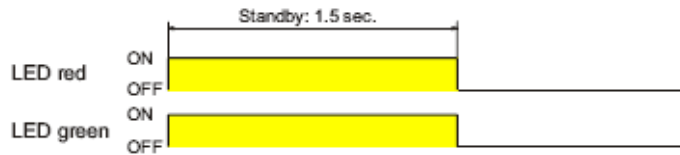


PROBLEM	REASON	CORRECTION
Agitator not rotating	<ul style="list-style-type: none"> -Incorrect wiring -Incorrect Voltage -Pump element incorrectly seated -Foreign object in pump 	<ul style="list-style-type: none"> -Check wiring and voltage -Remove and inspect pump element -Check pump and reservoir for foreign object and remove
Pump is working, but does not supply grease	<ul style="list-style-type: none"> -Air in feed piston -Pump element incorrectly seated -Worn pump element 	<ul style="list-style-type: none"> -Bleed the pump -Reseat pump element -Replace pump element
No grease collar at all points of lubrication	<ul style="list-style-type: none"> -Pump does not work -Period between cycles is too long -Lubrication times are too short 	<ul style="list-style-type: none"> -Check wiring -Check pump element output -Adjust controller timer
No grease collar at one lubrication point	<ul style="list-style-type: none"> -Broken hose in system -Blockage at distribution block 	<ul style="list-style-type: none"> -Replace hose -Check with pressure gauge, then clean block
Reduced pump speed	<ul style="list-style-type: none"> -Not enough voltage -High pressure, due to low ambient temperature 	<ul style="list-style-type: none"> -Check voltage -Use an arctic grease or an NLGI-1 grease
Leakage of grease at the pressure relief valve (PRV)	<ul style="list-style-type: none"> -Excessive pressure in the system -Distribution blocks are blocked -System is blocked -Defective valve spring 	<ul style="list-style-type: none"> -Check the system -Find and clean block -Clogged or seized bearing -Replace PRV
Everything working, but grease not flowing out of end of hose	<ul style="list-style-type: none"> -Hose not filled with grease at factory -Pump element not functioning 	<ul style="list-style-type: none"> -Connect a grease gun to the end of the hose and force grease through it -Inspect and test pump element
Not enough grease coming out of the pump element	<ul style="list-style-type: none"> -Overfilled reservoir blocking the vent tube causing a vacuum -Pump element worn 	<ul style="list-style-type: none"> -Remove lid and vent tube, and clean grease out of breather. -Only fill reservoir to Max mark -Test pump element pressure
Points are getting too much grease	<ul style="list-style-type: none"> -Wasting too much grease 	<ul style="list-style-type: none"> -Reduce the duration of the lubrication time

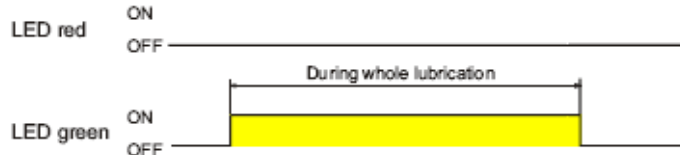


BEKA-TroniX1 Error Codes:

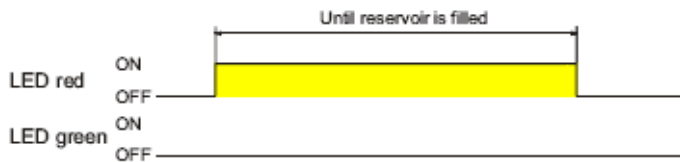
Standby indicator:



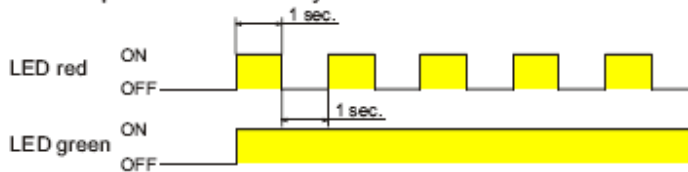
Lubrication sequence:



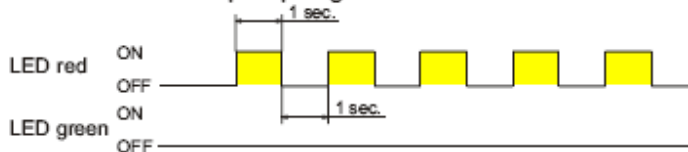
Grease level too low:



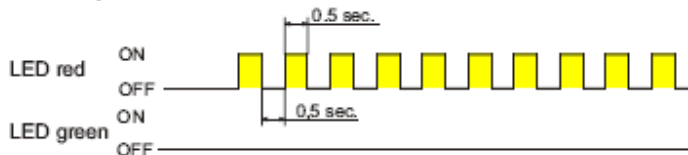
Excess pressure in main system:



Revolution error in pump engine:



Memory error:



Test lubrication:



Test Lubrication: To adjust the time controlling to continual lubrication for servicing purposes, the lubrication time must be set to a higher value than the cycle duration.



Guide to Troubleshooting Overpressure:

High pressure in the system can be caused by a blockage at the lubrication point, damage to the lines, incompatible lubricant, or contamination/wear inside the distributor blocks.

Progressive blocks rely on the lubricant moving the pistons within the distribution segments. A blockage in the system will cause hydraulic back pressure and prevent the pistons from moving and distributing lubricant. System pressure relief is around 280 bar (4500-5000 psi). If the system is equipped with the optional pressure gauge, this can be checked for proper system operation. If it is not equipped with the gauge, then a pressure gauge can be installed inline downstream of the pressure relief valve, or connected directly to the outlet of the pressure relief tee.

Locating Blockage and Blockage Causes/Rectification:

To locate the blockage, loosen the inlet fitting at the distribution block located **farthest** from the main distribution block. The main block is the one connected to the pump, and will feed the secondary blocks. When you loosen the inlet fittings, you are looking for a release of grease under high pressure. If no grease is released, there is no issue with that block, and move to the next block, working closer to the main.

End of a distribution line:

A blockage located at the end of the distribution line are usually caused by a broken line being capped after it's broken in some manner. This is done because of the thought that the entire reservoir of grease may be pumped out of the broken line. This will not happen with a progressive system, as only the dosage being fed to that lubrication point will be released, and the other points will continue to get their lubrication. If a line is broken, and cannot be repaired right away, a bag should be tie strapped over the end of the hose to collect the lubricant. Another cause of this type of blockage could be a crushed steel line, or a rotated bushing which will block the grease access hole.

To locate this type of blockage, first determine which distribution block is the problem using the method above. Retighten the line and press the immediate lubrication button to bring the system back to relief pressure, or attach a manual grease gun to the block inlet to achieve the same. Then loosen all of the outlet lines from the block, looking for high pressure grease leakage. The line that has the leakage will lead to the lubrication point with the issue. If no grease leakage is seen, then the problem is internal to that block and see internal blockages below. Repair the blockage and make sure all your lines are retightened. Test to make sure your blockage is clear.

Internal Blockages in a Distribution Block:

These blockages are mainly caused by contamination in the grease. Great care should be taken with your lubrication system to prevent dirt and other contaminants from entering the system. Another cause is incompatible grease, or a long time of the machine not being used. This could cause the grease to turn solid as it may separate.

Once you have isolated which block has a blockage, and you have checked it using the previous method to confirm that the issue is not downstream of the block, then you can go ahead with removing the block off the machine. Before removing, mark/tag all the lines so that they can be reconnected in the correct outlets. Remove the 9mm caps on both sides of the block to gain access to the pistons. Push the pistons back and forth until you locate the one that is stuck. You may be able to loosen it by heavy pushing, but that distribution segment should be replaced, as it could very well be damaged by the contamination, such as scoring of the surface, and could seize again. If you remove the pistons, make sure that they return to the segment they were removed from. To replace that segment, see the section on block modification. Once the block is reassembled, test, and reinstall onto the machine.

Once all block and lines are reassembled. Test block and system using methods on the next page.

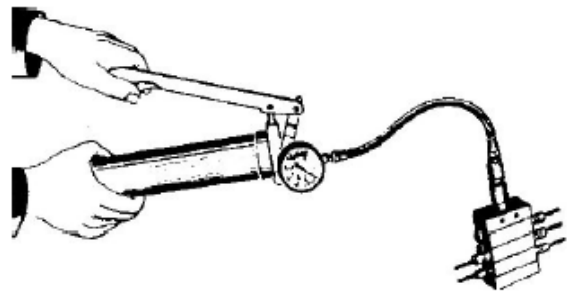
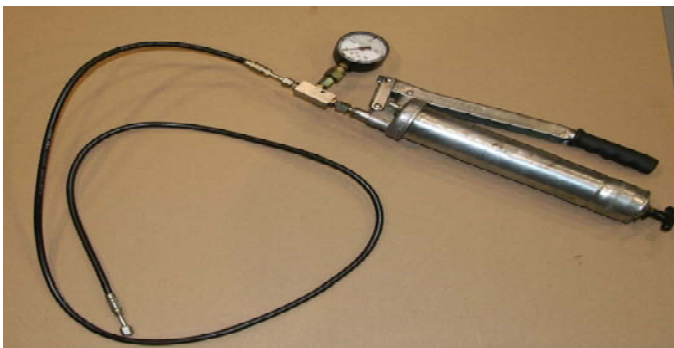


TESTING BLOCKS FOR OVERPRESSURE:

System installs and repairs will require the distribution block to be checked for blockages. Remove the inlet hose into the distribution block, and attach the grease gun to the inlet fitting. If your grease gun is not setup for this connection, then a grease nipple can be installed in the inlet of the block and a normal grease gun can be utilized.

Pump lubricant through the block from the grease gun. Grease flow and block movement should be smooth, and pressure should drop off once pumping has stopped. If pressure remains high and doesn't drop off, or you cannot pump grease due to extreme high pressure, then there is an issue with the block and troubleshooting will have to continue using the methods on the previous page.

There should also be no leaks along the hoses or at any fitting. After about 30 pumps, you should start seeing fresh grease at the lubrication points.



Deposits of hardened grease detected at the pistons and bores of the distribution segments must be eliminated by cleaning with a suitable parts cleaner and blowing with compressed air. The bores in the segments must be free of residues of grease. This should be checked by use of some thin wire.

CAUTION!

Hardening of grease indicates that the lubricant being used is not suitable for central lubrication systems. Ask for advice by the supplier of your lubricant or by the system installer.

After having checked all segments, re-assemble the distribution complying with the sequence noted previously. In order to preclude jamming of pistons, tighten the tie rods holding the segments together to a torque of 12 Nm (For MX-F blocks).



IMPORTANT!

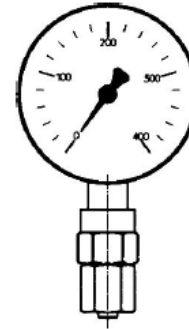
All repair work must be done with the upmost attention to cleanliness.



PRESSURE TESTING THE PUMP ELEMENT:

The pumping element and pressure relief valve (PRV) can be tested as required with the use of a pressure gauge. The gauge must range from 0-400 bar (0-5500/6000 psi).

The feed hose from the pumping element is removed at the outlet of the PRV tee. The pressure gauge will be attached to the outlet of the PRV tee. The necessary parts to achieve this can be purchased from a Beka-Max dealer or a local hydraulic supply store.



pressure gauge with thread to be assembled with the pump element
plug Ø6 M14x1.5

Once the gauge is attached to the pump, the pump can be powered up and a cycle activated. Within the first few revolutions of the pump, the gauge will start to indicate pressure. The pressure should easily build up to approximately 280 bar (4000 psi), at which point the pressure relief valve will release and grease will exit from it.

No pressure buildup, or a weak buildup, will indicate that the pumping element is worn and requires replacement. Pressure dropping in between revolutions indicates that a check valve has failed, and that an external check valve will have to be installed or replaced.

The pressure relief valve releasing at too low of a pressure (below 250 bar) or too high (above 300 bar) indicates failure of the PRV.

Do not run the pump with the PRV disabled or removed from the system, as the pump element will easily pump up to 700 bar (10000 psi) causing system damage or possible injury.

INITIAL SYSTEM INSTALLATION TESTING:



Notice: Before Testing the blocks make sure that the hoses are filled with grease.

When install is complete,

- 1) Attach a Grease Gun to the top of each block and force enough grease that reaches all the points.
- 2) Ensure all fitting at the point and the block are not leaking.
- 3) Ensure that the pump is working (agitator is rotating in a counterclockwise manner)
- 4) Don't forget to adjust the timer to the proper levels on the base of the pump.
- 5) While cleaning up, let the pump run and go through a few cycles.



Notice: When using the GREASE GUN and the pressure is rising and not descending then there might be a blockage in system.



PUMP REFILLING/GREASE TYPES

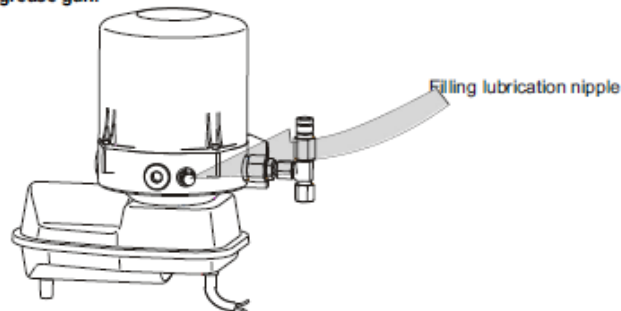
The EP-1 Series Lubrication Pump can handle lubricants ranging from oil up to NLGI class 2 greases. The grease needs to be a lithium based grease. Greases with particles and high solids need to be avoided as they will cause wear and damage to the system components. The grease should also have high pressure EP additives. A grease with moly additive is acceptable as long as it does not exceed 3%.

When refilling the system through one of the methods below, great care needs to be taken to avoid system contamination. Ensure cleanliness of connections and the grease used.

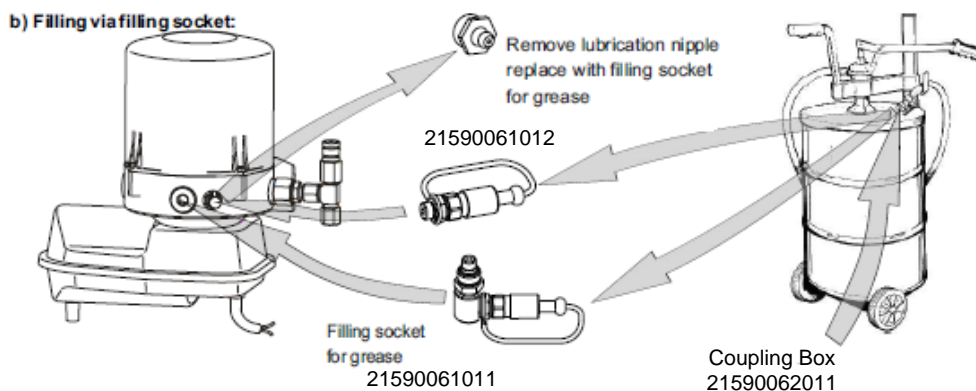
Another option for refilling the pump, is a fill top lid, which has a 3 inch opening and cap. While available, it is not recommended as it could easily allow foreign objects into the system through the large opening.

If the reservoir is emptied of grease, it may be necessary to bleed the system. To accomplish this, remove the main hose from the pump element. Then initiate an immediate lubrication until a solid stream of grease comes out. Reconnect the line and initiate another immediate lubrication cycle.

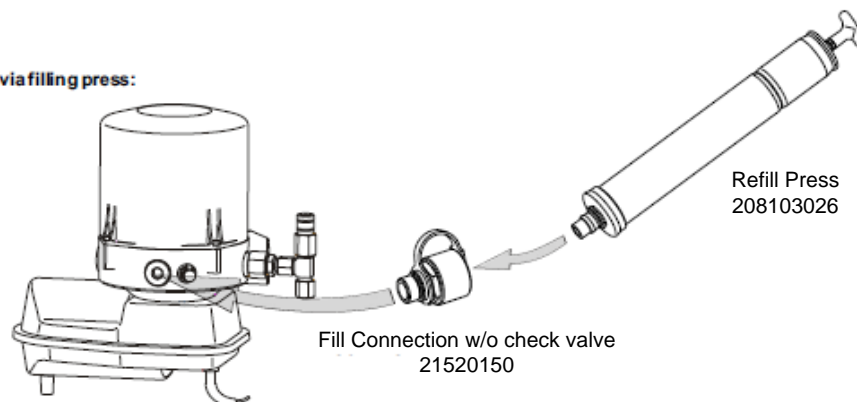
a) Standard filling via lubrication nipple with manual or pneumatic grease gun:



b) Filling via filling socket:



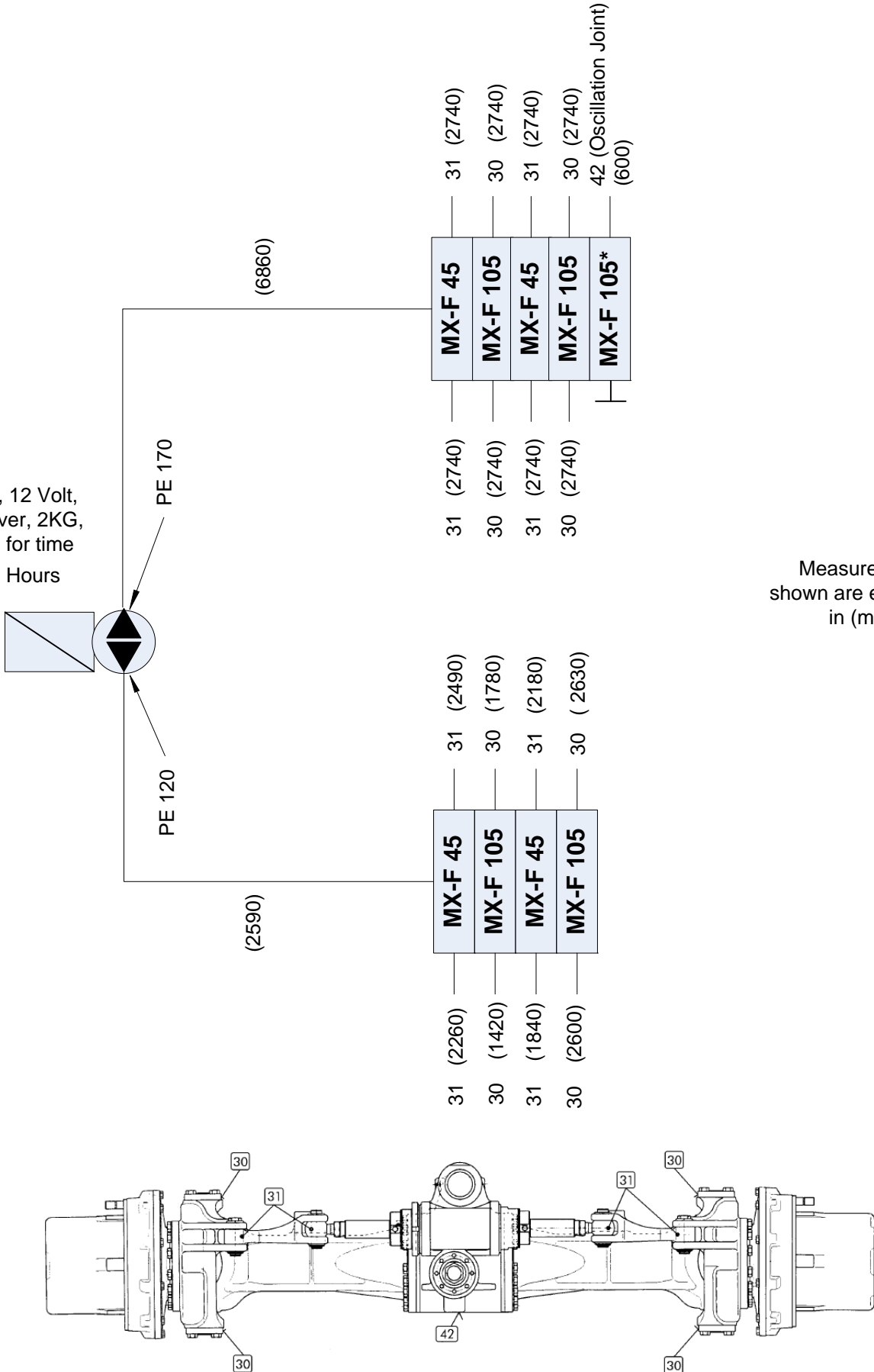
c) Filling via filling press:



GREASE SYSTEM LAYOUT



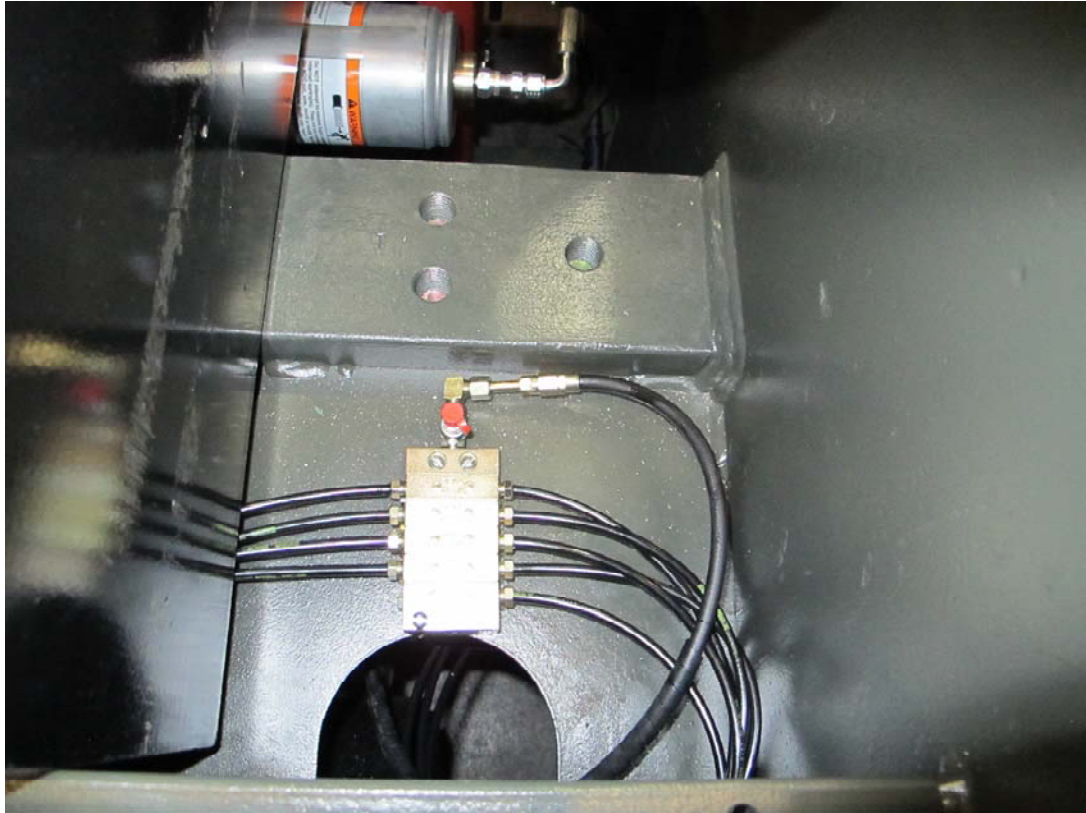
EP1 Pump, 12 Volt,
Regular Cover, 2KG,
X1 Control for time
6mins./ 4 Hours



Measurements
shown are expressed
in (mm).



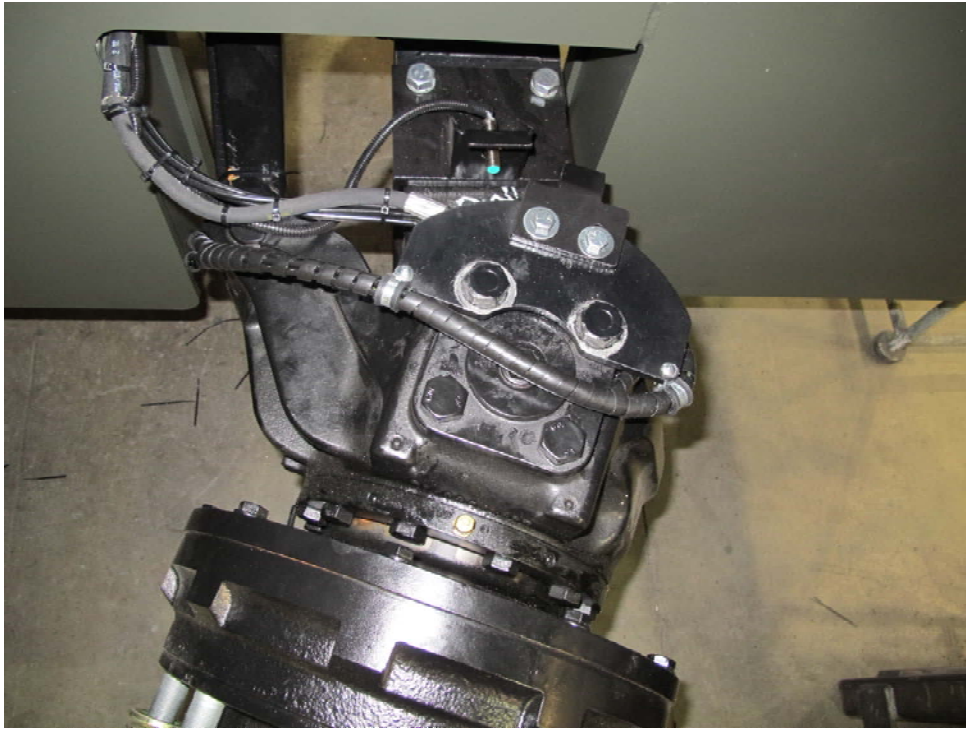
Pump mounted inside of the operator's cab.

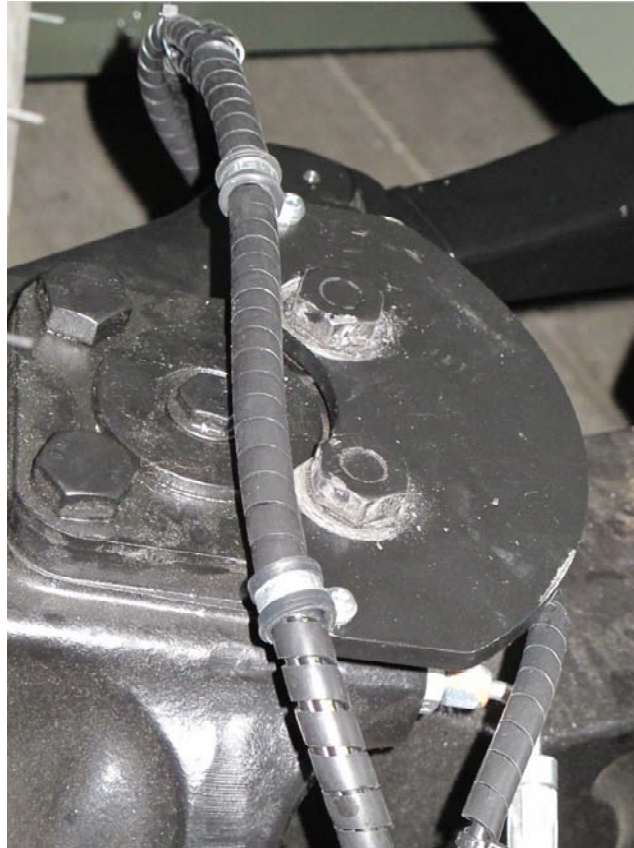


Rear Axle Distribution Block



Front Axle Distribution Block





Note: Clamps mounted to plate and not to axle.







Additional information, system layout diagrams, and more detailed manuals on individual components are available upon request.

For technical support, sales and parts, and other products, please contact your local Beka-Max dealer.

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Appendix B. SAE Diagnostic Trouble Codes and Cummins Fault Codes

Fault Code	J1939 SPN	J1939 FMI	Lamp Color	J1939 SPN Description	Cummins Description
111	629	12	Red	Controller #1	Engine Control Module Critical internal failure - Bad intelligent Device or Component
115	612	2	Red	System Diagnostic Code # 2	Engine Speed/Position Sensor Circuit lost both of two signals from the magnetic pickup sensor - Data Erratic, Intermittent, or incorrect
122	102	3	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit – Voltage Above Normal, or Shorted to High Source
123	102	4	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
124	102	16	Amber	Boost Pressure	Intake Manifold 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
131	91	3	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
132	91	4	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
133	974	3	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit – Voltage Above Normal, or Shorted to High Source
134	974	4	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
135	100	3	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
141	100	4	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
143	100	18	Amber	Engine Oil Pressure	Oil Pressure Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
144	110	3	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Voltage Above Normal, or Shorted to High Source
145	110	4	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
146	110	16	Amber	Engine Coolant Temperature	Coolant Temperature High - Data Valid but Above Normal Operational Range - Moderately Severe Level
147	91	1	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit – Abnormal Frequency, Pulse Width, or Period
148	91	0	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit – Abnormal Frequency, Pulse Width, or Period
151	110	0	Red	Engine Coolant Temperature	Coolant Temperature Low - Data Valid but Above Normal Operational Range - Most Severe Level
153	105	3	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
154	105	4	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
155	105	0	Red	Intake Manifold #1 Temp	Intake Manifold Air Temperature High – Data Valid but Above Normal Operational Range - Most Severe Level
187	3510	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit – Voltage Below Normal, or Shorted to Low Source

193	520199	3	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Above Normal, or Shorted to High Source
194	520199	4	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Below Normal, or Shorted to Low Source
195	111	3	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Above Normal, or Shorted to High Source
196	111	4	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
197	111	18	Amber	Coolant Level	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level
199	1661	4	Amber	Engine Automatic Start Lamp	Engine Automatic Start Lamp Driver Circuit - Voltage Above Normal, or Shorted to High Source
211	1484	31	None	J1939 Error	Additional Auxiliary Diagnostic Codes logged - Condition Exists
212	175	3	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
213	175	4	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
214	175	0	Red	Oil Temperature	Engine Oil Temperature - Data Valid but Above Normal Operational Range - Most Severe Level
221	108	3	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
222	108	4	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
227	3510	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit - Voltage Above Normal, or Shorted to High Source
231	109	3	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
232	109	4	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
233	109	18	Amber	Coolant Pressure	Coolant Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
234	190	0	Red	Engine Speed	Engine Speed High - Data Valid but Above Normal Operational Range - Most Severe Level
235	111	1	Red	Coolant Level	Coolant Level Low - Data Valid but Below Normal Operational Range - Most Severe Level
237	644	2	Amber	External Speed Input	External Speed Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect
238	3511	4	Amber	System Diagnostic code # 1	Sensor Supply Voltage #3 Circuit - Voltage Below Normal, or Shorted to Low Source
239	3511	3	Amber	System Diagnostic code #2	Sensor Supply Voltage #3 Circuit - Voltage Above Normal, or Shorted to High Source
241	84	2	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit - Data Erratic, Intermittent, or Incorrect
242	84	10	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit tampering has been detected - Abnormal Rate of Change
244	623	4	Amber	Red Stop Lamp	Red Stop Lamp Driver Circuit - Voltage Below Normal, or Shorted to Low Source
245	647	4	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Below Normal, or Shorted to Low Source
249	171	3	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
256	171	4	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
261	174	16	Amber	Fuel Temperature	Engine Fuel Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

263	174	3	Amber	Fuel Temperature	Engine Fuel Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
265	174	4	Amber	Fuel Temperature	Engine Fuel Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
268	94	2	Amber	Fuel Delivery Pressure	Fuel Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
271	1347	4	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit – Voltage Below Normal, or Shorted to Low Source
272	1347	3	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit – Voltage Above Normal, or Shorted to High Source
281	1347	7	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve #1 – Mechanical System Not Responding Properly or Out of Adjustment
284	1043	4	Amber	Internal Sensor Voltage Supply	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal, or Shorted to Low Source
285	639	9	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate
286	639	13	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing Configuration Error – Out of Calibration
287	91	19	Red	Accelerator Pedal Position	SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error - Received Network Data In Error
288	974	19	Red	Remote Accelerator	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data Error - Received Network Data In Error
292	441	14	Red	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 - Special Instructions
293	441	3	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit - Voltage Above Normal, or Shorted to High Source
294	441	4	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit - Voltage Below Normal, or Shorted to Low Source
295	108	2	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
296	1388	14	Red	Auxiliary Pressure	Auxiliary Pressure Sensor Input 1 - Special Instructions
297	1388	3	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input # 2 Circuit - Voltage Above Normal, or Shorted to High Source
298	1388	4	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input # 2 Circuit - Voltage Below Normal, or Shorted to Low Source
319	251	2	Maint	Real Time Clock Power	Real Time Clock Power Interrupt - Data Erratic, Intermittent, or Incorrect
322	651	5	Amber	Injector Cylinder #01	Injector Solenoid Cylinder #1 Circuit – Current Below Normal, or Open Circuit
323	655	5	Amber	Injector Cylinder #05	Injector Solenoid Cylinder #5 Circuit – Current Below Normal, or Open Circuit
324	653	5	Amber	Injector Cylinder #03	Injector Solenoid Cylinder #3 Circuit – Current Below Normal, or Open Circuit
325	656	5	Amber	Injector Cylinder #06	Injector Solenoid Cylinder #6 Circuit – Current Below Normal, or Open Circuit
331	652	5	Amber	Injector Cylinder #02	Injector Solenoid Cylinder #2 Circuit – Current Below Normal, or Open Circuit
332	654	5	Amber	Injector Cylinder #04	Injector Solenoid Cylinder #4 Circuit – Current Below Normal, or Open Circuit
334	110	2	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Data Erratic, Intermittent, or Incorrect

338	1267	3	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Above Normal, or Shorted to High Source
339	1267	4	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Below Normal, or Shorted to Low Source
341	630	2	Amber	Calibration Memory	Engine Control Module data lost - Data Erratic, Intermittent, or Incorrect
342	630	13	Red	Calibration Memory	Electronic Calibration Code Incompatibility - Out of Calibration
343	629	12	Amber	Controller #1	Engine Control Module Warning internal hardware failure - Bad Intelligent Device or Component
349	191	16	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Above Normal Operational Range - Moderately Severe Level
351	627	12	Amber	Controller #1	Injector Power Supply - Bad Intelligent Device or Component
352	3509	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Below Normal, or Shorted to Low Source
386	3509	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Above Normal, or Shorted to High Source
415	100	1	Red	Engine Oil Pressure	Oil Pressure Low - Data Valid but Below Normal Operational Range - Most Severe Level
418	97	15	Maint.	Water in Fuel Indicator	Water in Fuel Indicator High - Data Valid but Above Normal Operational Range - Least Severe Level
422	111	2	Amber	Coolant Level	Coolant Level - Data Erratic, Intermittent, or Incorrect
425	175	2	Amber	Oil Temperature	Engine Oil Temperature - Data Erratic, Intermittent, or Incorrect
428	97	3	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Above Normal, or Shorted to High Source
429	97	4	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
431	558	2	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect
432	558	13	Red	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration
435	100	2	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
441	168	18	Amber	Electrical Potential (Voltage)	Battery #1 Voltage Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
442	168	16	Amber	Electrical Potential (Voltage)	Battery #1 Voltage High - Data Valid but Above Normal Operational Range - Moderately Severe Level
449	157	0	Red	Injector Metering Rail 1 Pressure	Fuel Pressure High - Data Valid but Above Normal Operational Range - Moderately Severe Level
451	157	3	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
452	157	4	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
488	105	16	Amber	Intake Manifold	Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
489	191	18	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Below Normal Operational Range - Moderately Severe Level

497	1377	2	Amber	Switch Circuit	Multiple Unit Synchronization Switch Circuit - Data Erratic, Intermittent, or Incorrect
523	611	2	Amber	System Diagnostic code # 1	OEM Intermediate (PTO) Speed switch Validation - Data Erratic, Intermittent, or Incorrect
527	702	3	Amber	Circuit - Voltage	Auxiliary Input/Output 2 Circuit - Voltage Above Normal, or Shorted to High Source
528	93	2	Amber	Switch - Data	Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect
529	703	3	Amber	Circuit - Voltage	Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source
546	94	3	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
547	94	4	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
551	558	4	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal, or Shorted to Low Source
553	157	16	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure High – Data Valid but Above Normal Operational Range - Moderately Severe Level
554	157	2	Amber	Injector Metering Rail 1 Pressure	Fuel Pressure Sensor Error - Data Erratic, Intermittent, or Incorrect
559	157	18	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
584	677	3	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Above Normal, or Shorted to High Source
585	677	4	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Below Normal, or Shorted to Low Source
595	103	16	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed High - Data Valid but Above Normal Operational Range – Moderately Severe Level
596	167	16	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage High – Data Valid but Above Normal Operational Range - Moderately Severe Level
597	167	18	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
598	167	1	Red	Alternate Potential (voltage)	Electrical Charging System Voltage Low – Data Valid but Below Normal Operational Range - Most Severe Level
599	640	14	Red	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown - Special Instructions
649	1378	31	Maint	Engine Oil Change Interval	Change Lubricating Oil and Filter – Condition Exists
687	103	18	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed Low - Data Valid but Below Normal Operational Range – Moderately Severe Level
689	190	2	Amber	Engine Speed	Primary Engine Speed Sensor Error – Data Erratic, Intermittent, or Incorrect
691	1172	3	Amber	Turbocharger #1 Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit – Voltage Above Normal, or Shorted to High Source
692	1172	4	Amber	Turbocharger #1 Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
697	1136	3	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
698	1136	4	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

719	22	3	Amber	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Above Normal, or Shorted to High Source
729	22	4	Amber	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Below Normal, or Shorted to Low Source
731	723	7	Amber	Engine Speed Sensor #2	Engine Speed/Position #2 mechanical misalignment between camshaft and crankshaft sensors - Mechanical System Not Responding Properly or Out of Adjustment
753	723	2	Amber	Engine Speed Sensor #2	Engine Speed/Position #2 Camshaft sync error - Data Erratic, Intermittent, or Incorrect
757	2802	31	Amber	Electronic Control Module	Electronic Control Module data lost - Condition Exists
778	723	2	Amber	Engine Speed Sensor #2	Engine Speed Sensor (Camshaft) Error – Data Erratic, Intermittent, or Incorrect
779	703	11	Amber	Auxiliary Equipment Sensor Input	Warning Auxiliary Equipment Sensor Input # 3 (OEM Switch) - Root Cause Not Known
951	166	2	None	Cylinder Power	Cylinder Power Imbalance Between Cylinders - Data Erratic, Intermittent, or Incorrect
1117	627	2	None	Power Supply	Power Lost With Ignition On - Data Erratic, Intermittent, or Incorrect
1139	651	7	Amber	Injector Cylinder # 01	Injector Cylinder #1 - Mechanical System Not Responding Properly or Out of Adjustment
1141	652	7	Amber	Injector Cylinder # 02	Injector Cylinder #2 - Mechanical System Not Responding Properly or Out of Adjustment
1142	653	7	Amber	Injector Cylinder # 03	Injector Cylinder #3 - Mechanical System Not Responding Properly or Out of Adjustment
1143	654	7	Amber	Injector Cylinder # 04	Injector Cylinder #4 - Mechanical System Not Responding Properly or Out of Adjustment
1144	655	7	Amber	Injector Cylinder # 05	Injector Cylinder #5 - Mechanical System Not Responding Properly or Out of Adjustment
1145	656	7	Amber	Injector Cylinder # 06	Injector Cylinder #6 - Mechanical System Not Responding Properly or Out of Adjustment
1239	2623	3	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal, or Shorted to High Source
1241	2623	4	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal, or Shorted to Low Source
1242	91	2	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 1 and 2 - Data Erratic, Intermittent, or Incorrect
1256	1563	2	Amber	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1257	1563	2	Red	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1852	97	16	Amber	Water in Fuel Indicator	Water in Fuel Indicator - Data Valid but Above Normal Operational Range - Moderately Severe Level
1911	157	0	Amber	Injector Metering Rail	Injector Metering Rail 1 Pressure - Data Valid but Above Normal Operational Range - Most Severe Level
2111	52	3	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2112	52	4	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2113	52	16	Amber	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Moderately Severe Level
2114	52	0	Red	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Most Severe Level

2115	2981	3	Amber	Coolant Pressure	Coolant Pressure 2 Circuit - Voltage Above Normal, or Shorted to High Source
2116	2981	4	Amber	Coolant Pressure	Coolant Pressure 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2117	2981	18	Amber	Coolant Pressure	Coolant Pressure 2 - Data Valid but Below Normal Operational Range - Moderately Severe Level
2182	1072	3	Amber	Engine Brake Output # 1	Engine Brake Actuator Driver 1 Circuit - Voltage Above Normal, or Shorted to High Source
2183	1072	4	Amber	Engine Brake Output # 1	Engine Brake Actuator Driver 1 Circuit - Voltage Below Normal, or Shorted to Low Source
2185	3512	3	Amber	System Diagnostic code # 1	Sensor Supply Voltage #4 Circuit – Voltage Above Normal, or Shorted to High Source
2186	3512	4	Amber	System Diagnostic code # 1	Sensor Supply Voltage #4 Circuit – Voltage Below Normal, or Shorted to Low Source
2195	703	14	Red	Auxiliary Equipment Sensor	Auxiliary Equipment Sensor Input 3 Engine Protection Critical - Special Instructions
2215	94	18	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
2216	94	1	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range – Moderately Severe Level
2217	630	31	Amber	Calibration Memory	ECM Program Memory (RAM) Corruption - Condition Exists
2249	157	1	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid but Below Normal Operational Range - Most Severe Level
2261	94	15	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Least Severe Level
2262	94	17	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Least Severe Level
2263	1800	16	Amber	Battery Temperature	Battery Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
2264	1800	18	Amber	Battery Temperature	Battery Temperature - Data Valid but Below Normal Operational Range - Moderately Severe Level
2265	1075	3	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit – Voltage Above Normal, or Shorted to High Source
2266	1075	4	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit – Voltage Below Normal, or Shorted to Low Source
2292	611	16	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device - Data Valid but Above Normal Operational Range - Moderately Severe Level
2293	611	18	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device flow demand lower than expected - Data Valid but Below Normal Operational Range - Moderately Severe Level
2311	633	31	Amber	Fuel Control Valve #1	Fueling Actuator #1 Circuit Error – Condition Exists
2321	190	2	None	Engine Speed	Engine Speed / Position Sensor #1 - Data Erratic, Intermittent, or Incorrect
2322	723	2	None	Engine Speed Sensor #2	Engine Speed / Position Sensor #2 - Data Erratic, Intermittent, or Incorrect
2345	103	10	Amber	Turbocharger 1 Speed	Turbocharger speed invalid rate of change detected - Abnormal Rate of Change
2346	2789	15	None	System Diagnostic Code #1	Turbocharger Turbine Inlet Temperature (Calculated) - Data Valid but Above Normal Operational Range – Least Severe Level

2347	2790	15	None	System Diagnostic Code #1	Turbocharger Compressor Outlet Temperature (Calculated) - Data Valid but Above Normal Operational Range – Least Severe Level
2363	1073	4	Amber	Engine Compression Brake Output # 2	Engine Brake Actuator Circuit #2 – Voltage Below Normal, or Shorted to Low Source
2365	1112	4	Amber	Engine Brake Output # 3	Engine Brake Actuator Driver Output 3 Circuit - Voltage Below Normal, or Shorted to Low Source
2367	1073	3	Amber	Engine Compression Brake Output # 2	Engine Brake Actuator Circuit #2 – Voltage Above Normal, or Shorted to High Source
2368	1112	3	Amber	Engine Brake Output # 3	Engine Brake Actuator Driver 3 Circuit - Voltage Above Normal, or Shorted to High Source
2372	95	16	Amber	Engine Fuel Filter Differential Pressure	Fuel Filter Differential Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2373	1209	3	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2374	1209	4	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2375	412	3	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2376	412	4	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2377	647	3	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Above Normal, or Shorted to High Source
2425	730	4		Intake Air Heater # 2	Intake Air Heater 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2426	730	3		Intake Air Heater # 2	Intake Air Heater 2 Circuit - Voltage Above Normal, or Shorted to High Source
2555	729	3	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Above Normal, or Shorted to High Source
2556	729	4	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Below Normal, or Shorted to Low Source
2557	697	3	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Above Normal, or Shorted to High Source
2558	697	4	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Below Normal, or Shorted to Low Source
2963	110	15	None	Engine Coolant Temperature	Engine Coolant Temperature High - Data Valid but Above Normal Operational Range - Least Severe Level
2973	102	2	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect