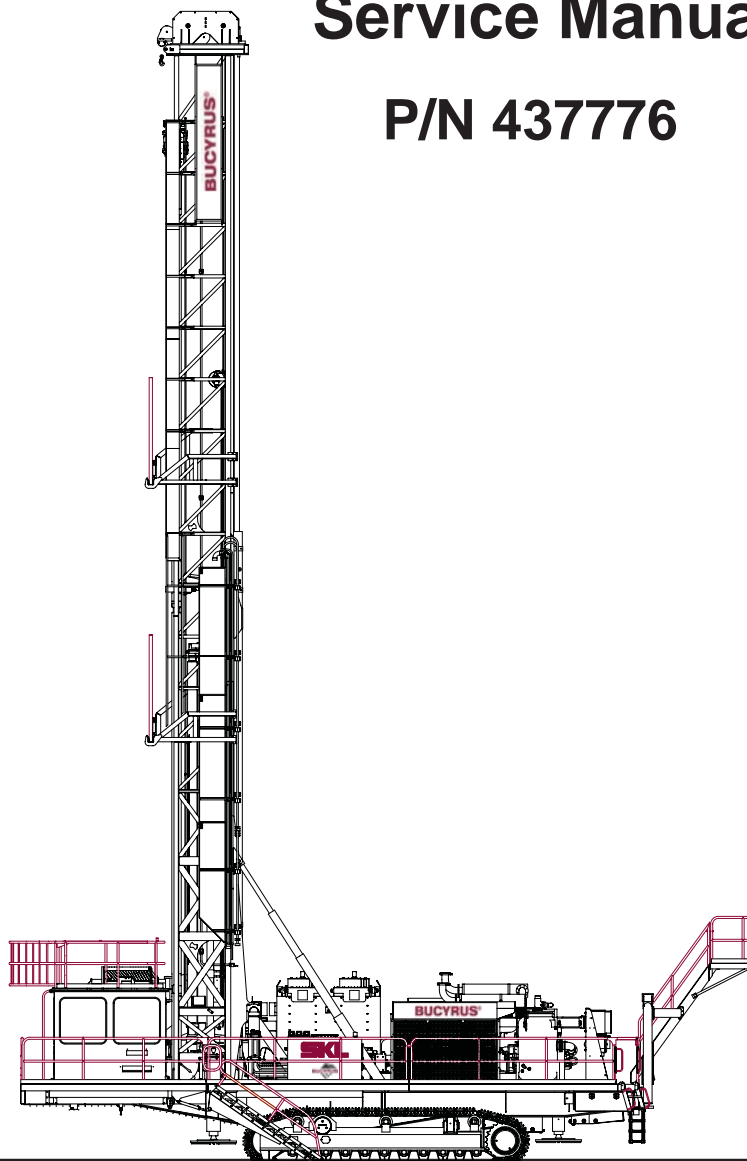




Model SKL Rotary Blasthole Drill

Service Manual

P/N 437776



Bucyrus Mining Equipment, Inc.

3501 S. FM Hwy 1417 • Denison, Texas 75020 • USA

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Safety

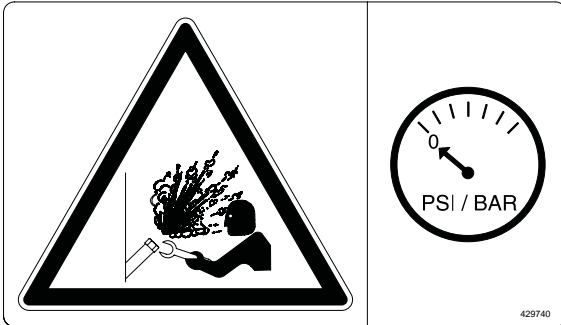
Before Operation

- **Do** study this manual and fully understand the controls and safety hazards.
- **Do** be sure all safety guards are securely in place.
- **Do** wear safety helmet, safety glasses, hearing protection and gloves, as appropriate, when working on machine.
- **Do** be sure all personnel are clear of the machine and work area before starting the engine or operating machine.
- **Do** be sure drill area is clear of all obstructions before operating machine.
- **Do** attach safety chain when using towbar.
- **Do Not** operate machine with:
 - A hydraulic leak
 - Broken or damaged electrical wiring
 - Damaged hydraulic hoses or fittings

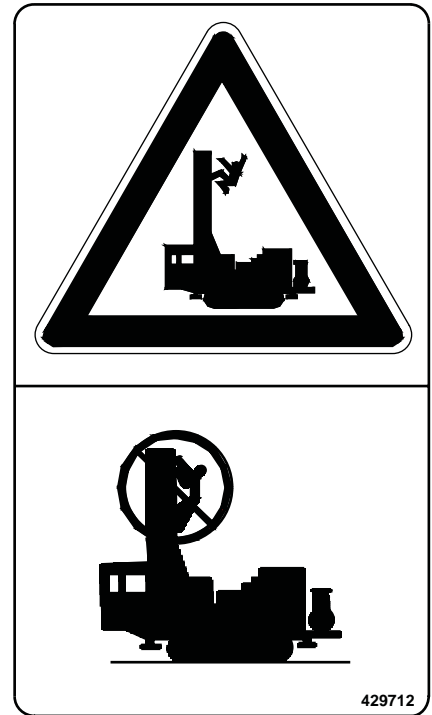
Operation

- **Do** provide sufficient ventilation when running the engine in an enclosed area. Exhaust gasses contain carbon monoxide, a deadly poison, which is colorless and odorless.
- **Do** make sure the drill pipe is secured in the loader before raising or lowering the mast, if your machine is equipped with a drill pipe loader.
- **Do** make sure the mast lock pins are engaged in the mast base before starting drilling operations.
- **Do** examine the surface before drilling to determine the possible presence of unfired explosives.
- **Do** use PPE (personal protection equipment) appropriate for the conditions you are working in; e.g. safety helmet, safety glasses, hearing protection, gloves, respirator.
- **Do Not** wear jewelry or loose fitting clothing when working on machinery. Keep clothing, hands and hair clear of moving parts.
- **Do Not** drill into or near a "bootleg" hole or any hole that may contain explosives.
- **Do Not** use the machine for any other purpose than what it was designed for. This machine is designed for rotary blasthole drilling operations only.
- **Do Not** travel on steep inclines, soft or unstable ground or close to unsupported excavations.
- **Do Not** move machine if drill is in a potentially unstable position.

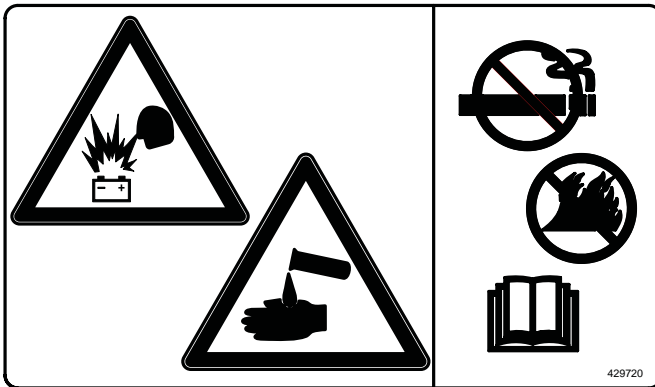
Safety Signs (International)



Flying Object & Spray Hazard (429740)



Fall Hazard-Mast (429712)



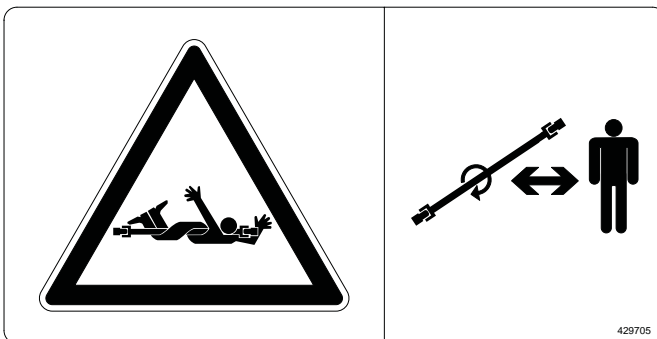
Explosion/Burn Hazard (429720)



Fall Hazard (T104915)



Explosion Hazard-Ether (429713)

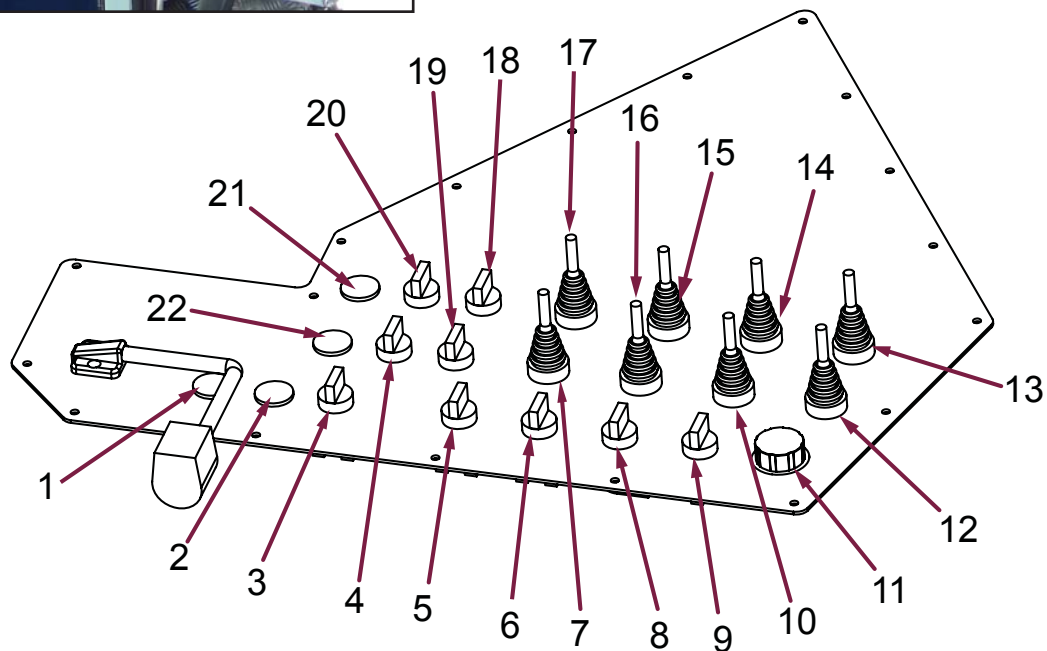


Entanglement Hazard (429705)

Operator Controls and Indicators



Fig. 2-3 L.H. Console



Left Hand Console

1. **Deck Wrench/Hydraulic Operated Bit Basket (HOBB) (optional)**
Switch LEFT for deck wrench function, RIGHT for HOBB function.
2. **Hydraulically Operated Deck Wrench (HOBO) Reverse (optional)**
Switch reverses function of HOBO. Switch LEFT for counterclockwise operation , RIGHT for clockwise operation.
3. **Mast Lock Switch**
Locks and unlocks the mast in the vertical or angle drilling positions. Turn and hold switch LEFT to unlock (retract) mast pins, RIGHT to lock (engage)



BE SURE to visually check to see that the mast lock pins are fully engaged in the locating holes before drilling or tramping and fully retracted before lowering the mast.

Drill Control System

Function Keys



Function and Number Keys

The yellow LED indicates the status of the <SHIFT>-Key. The <SHIFT>-Key enables to toggle between the function printed on the white half and the function printed on the grey half of the button. The numbers are not currently in use, but will be used in future to switch the screens of the Bucyrus® Drill Monitor.

The keys labelled with <F1> to <F12> are partly re-assigned to increase the ease of use of the Drill Monitor.

The following assignments are made:

- <F1> opens folder tools on desktop
- <F12> closes application

Drill Control System

Pressure and Rotation Panel

Pressure and Rotation Panel

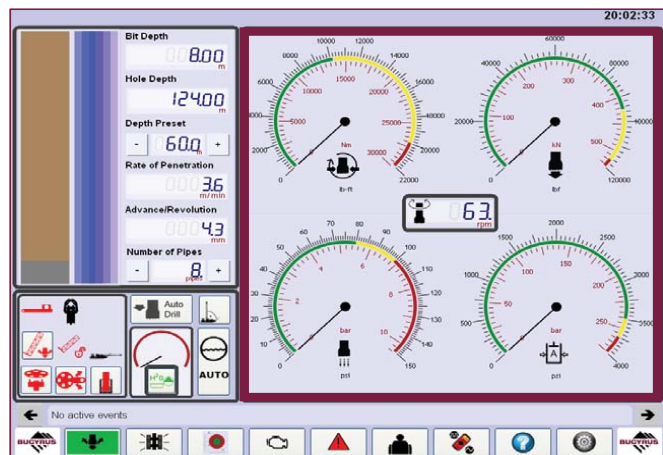
The pressure and rotation panel features four dual scale 3/4 gauges. The scaling of these gauges can be set customer specific.

The factory setting for the Pulldown Gauge is actual pull-down pressure in lb/f on the outer scale and Nm on the inner scale.

The rotation pressure gauge shows rotational torque in lb/f on the outer scale and Nm on the inner scale.

This kind of scaling has the advantage of relating comparable valves, which increases the ergonomic ease of use for the operator.

Further more the scales display the actual pressure setting for the pull-down and torque relief.



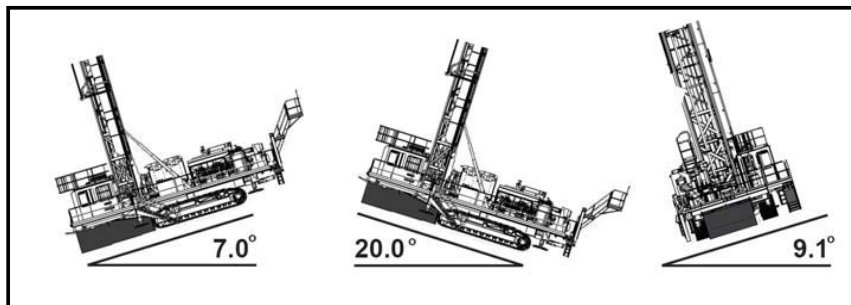
The Bit Air and Auxiliary Hydraulic pressure gauges read psi on the outer scale and Bar pressure on the inner scale. The Pressure and Rotation panel also displays the rotation speed as a digital value.

Drill Control System

Tram

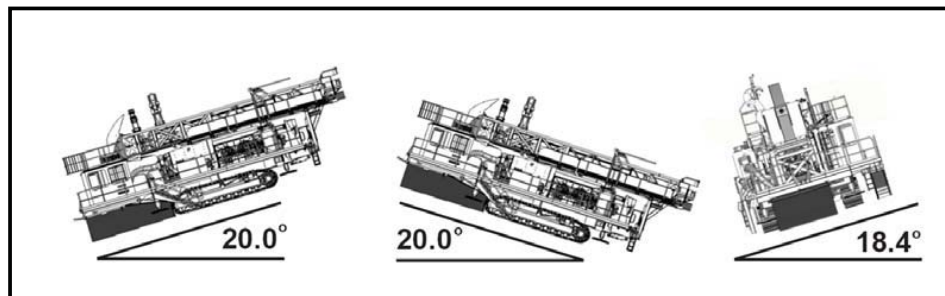
If the mast is up the park brake solenoid will energize when...

Tram mode is selected, all jacks are up, ladder is up, machine inclination fulfils the transient stability limits, dust curtain is up, pipe is out of hole and mast locks are engaged and pump solenoid is energized.



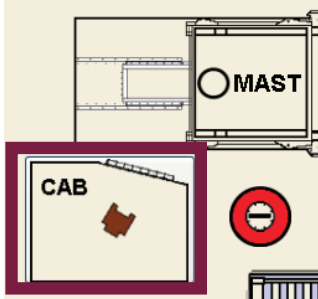
If the mast is on the mast rest the park brake solenoid will energize when...

Tram mode is selected, all jacks are up, ladder is up, machine inclination fulfils the transient stability limits, dust curtain is up, pipe is out of hole and pump solenoid is energized.

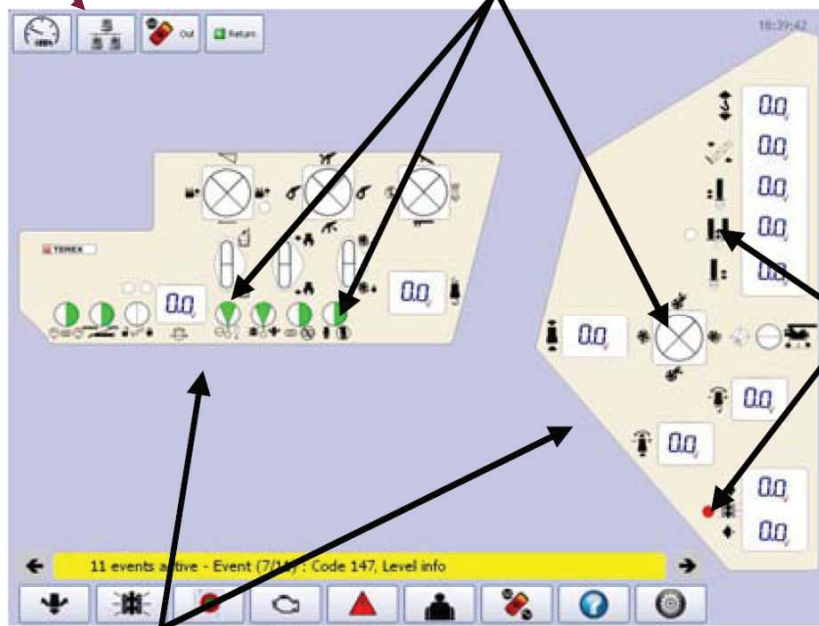


Drill Control System

Sub Screen – Cab Input



Status for equivalent physical switches, & buttons



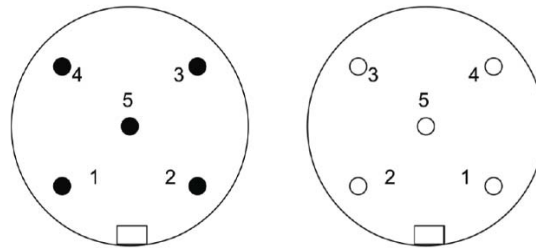
Status of real LEDs

Virtual representation of real cab dashboard

Drill Control System

D Can Bus

5-pin “micro” style connector (plug and socket)



The recommended pinning for the so-called 5-pin “micro” style connector (M12 thread) is shown in table

Pin	Signal	Description
1	(CAN_SHLD)	Optional CAN shield
2	(CAN_V+)	Optional CAN external positive supply (dedicated for supply of transceiver and optocouplers. If galvanic isolation of the bus node applies.
3	CAN_GND	Ground / 0V / V-
4	CAN_H	CAN_H bus line (dominant high)
5	CAN_L	CAN_L bus line (dominant low)

Pinning for 5-pin “micro” style connector

AC/Heater

Different models of AC/Heater units can be installed in these machines. Some models have the Sigma with manual controller while other models have the MI Air (roof mounted) with an electronic controller. See Operation Manual for programming of the electronic controller. Refer to the parts manuals for your machine to establish the correct model.

Refer to the following service information for repairs to your system.

AC/Heater (Sigma)

3.2.3 Thermostat

The electronic thermostat controls return air temperature and a separate De-ice thermostat controls the coil temperature.

Power Supply	:	11.25-30V DC
Selectable return air temperature	:	18-28°C
Dead Band	:	1.0°C (Either side of set point)
De-ice cut out temperature	:	-3.3 °C
De-ice cut in temperature	:	-1.1 °C
Maximum Control lead length	:	300mm of shielded cable

Note: *The cut off serial numbers for the new thermostat 681925 for different units are*

1. TFC6BX1 # 182 ONWARDS
2. TDR6BX1 # 455 ONWARDS
3. TDR7BX1 # 24 ONWARDS

3.3 PERFORMANCE SPECIFICATIONS

3.3.1 Cooling

Cooling capacity	:	7.0 kW
Evaporator air on temperature	:	29°C DB/19°C WB
Suction temperature	:	-2°C
Ambient temperature	:	46°C
Supply Airflow	:	250 l/s (nominal)
Refrigerant	:	R134a

3.3.2 Heating

Heating capacity	:	6.0 kW
Coil air on temperature	:	21°C
Water flow rate	:	9 l/min
Water temperature	:	90°C

3.3.3 Pressuriser

Airflow	:	50 l/s (nominal)
Pressure (in cabin)	:	62 Pa (nominal)

Note: *Pressure is dependant on filter cleanliness and degree of cabin sealing.*

3.4 UNIT MASS (KG)

Unit	TDR7	TFR7	TFC6	TCF7	FVV50	EB9P
Mass (kg)	110	80	36	35	10	8

AC/Heater (Sigma)

6.1.3 Three Monthly Inspection

COMPONENT/SYSTEM

Condenser coil.

Condenser fan motor.

Condenser fan.

Compressor.

Receiver drier.

High/Low pressure controls.

Fresh air and return air filters.

Evaporator coil.

Evaporator fan motor.

Evaporator fan.

Thermal expansion valve.

Thermostat.

Control switches.

Supply air louvres.

Condensate drip tray.

Main frame and panels.

INSPECTION REQUIRED

Check refrigeration connections against leakage. Check coil support bolts.

Check motor support clamps and screws. Check shaft bearings and brushes for wear. Check electrical connections.

Check for excessive noise during operation. Check for blade damage. Check securing screws.

Check refrigeration connections against leakage. Check securing bolts. Check mounting bracket. Check for excessive noise during operation.

Check refrigeration connections against leakage. Check securing bolts. Check for system charge in sight glass during operation.

Check electrical connections.

Check securing fasteners.

Check for refrigerant leakage.

Check coil securing screws.

Check motor support clamps and screws. Check shaft bearings and brushes for wear. Check electrical connections.

Check for excessive noise during operation. Check for blade damage. Check securing screws.

Check refrigerant connections against leakage.

Check electrical connections.

Check electrical connections. Check operation.

Check for damage and cleanliness.

Check for cleanliness. Check for drain pipe blockage.

Check securing screws and catches.

6.1.3 Three Monthly Inspection

COMPONENT/SYSTEM

Unit mounting.

Refrigeration lines.

INSPECTION REQUIRED

Check securing screws. Check plenum seal for leaks.

Check for leakage.

AC/Heater (Sigma)

7.2 FAULT ANALYSIS CHART NOTES

7.2.1 Clogged Strainer or Filter

Occasionally the strainer or filter in the liquid line may become clogged with foreign material left in the system during installation. When this happens, the liquid line leaving the strainer will feel cooler than the liquid entering. If it is badly clogged, some sweat or frost may appear at the strainer outlet.

7.2.2 Thermal Expansion Valve Leaks

A leaky expansion valve may allow the evaporator to fill with liquid which will be "slugged" into the suction line and into the compressor when the system starts. "Liquid slugging" within the compressor is detrimental to valves, gaskets, etc. and should be avoided. Slugging is occurring when the compressor 'chatters' intermittently as liquid enters the cylinders and causes hammering.

7.2.3 Thermal Expansion Valve Stuck in Open Position

If the expansion valve is stuck in an open position, there will be an excessive amount of sweating on the suction line and compressor crankcase due to the large amount of liquid being passed into the suction line. Expansion valve should be checked for loss of charge or faulty thermal bulb contact with the suction line.

7.2.4 Power Element

The power element of an expansion valve consists of the thermal bulb, capillary tube and the bellows or diaphragm which actuates the valve pin. If this power element is defective or has lost its charge, the valve will either maintain an almost closed position or may close completely. To test for a defective power element, the thermal bulb should be removed from the suction line and warmed by holding it tightly in the hand. The valve will open if the power element is not defective. If the power element is defective, the valve will remain closed.

7.2.5 Thermal Expansion Valve Improperly Adjusted

If the expansion valve is adjusted for too low a superheat, too much liquid will be passed to the evaporator. The suction line will be abnormally cold and liquid may "slug" back to the compressor. If the expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat should always be adjusted carefully using thermometer and suction gauge.

7.2.6 Thermal Expansion Valve Too Large

If a replacement thermal expansion valve has been improperly selected, and its capacity is too great for the system, the valve will not maintain a consistently level suction pressure. The thermal bulb will attempt to control the flow of liquid at its superheat setting, but the oversized valve port will pass liquid too rapidly. The presence of liquid near the thermal bulb will close the valve and the pressure in the evaporator will drop until the valve opens to pass another "slug" of liquid. This "hunting" will cause a suction pressure variation noticeable on the suction pressure gauge.

AC/Heater (MI AIR)

Note: it is assumed that all previous services are performed at milestone points. For example, at the 3 monthly service-the Monthly service will also be performed.

Diagnostics

This manual is written on the assumption that the service technician is trained and qualified to work on high voltage and refrigeration.

There is a general description of how the system operates in each mode, and some common/likely situations.

Operation- Cooling

With fan running and cool selected, the thermostat senses the cab return air condition and if it is above the set point, relay K2 closes and this powers the pump down relay, PDR.

This PDR supplies power to the liquid line solenoid valve, which allows refrigerant to flow to the evaporator coil through the expansion valve. The suction pressure will rise and once it reaches approximately 30 psig, the low pressure switch closes and this supplies power through to the compressor motor contactor and condenser fan.

This is providing the protection devices on the circuit breakers are closed.

Once the cooling load is satisfied, power to the PDR is removed and this shuts the liquid line solenoid valve. As the flow of refrigerant has been cut, the compressor evacuates the low side and "pumps down", cutting out on low pressure.

The purpose of this is to prevent liquid migration during the off cycle, and the potential of liquid refrigerant getting back to the compressor.

The pressurizer fan operates continuously in all modes.

Operation- Heating

With fan running and the temperature probe below the set point, heating will be required.

The amount of heat will depend on how far apart the set point and the probe temperature are.

First stage will come on provided the auto reset over temperature device is closed (above the heaters, accessible from the fan plenum), the digital over temperature device is closed and the evaporator fan contactor has closed.

Leveling Jacks

Leveling Jack Cylinders

Removal

1. Lower jack pad to ground, but do not have weight of machine on jacks.
2. Shutdown machine.



Relieve pressure on hydraulic and pneumatic systems before loosening connections or parts.

3. Remove retaining ring that holds retainer cap/jack pad to cylinder.
4. With hydraulic pressure relieved, disconnect upper fittings to cylinder and clamps.
5. Remove cap screws and cap from top of cylinder outer casing.
6. Hydraulic cylinder may have a lifting eye installed or it will have tapped holes to install a lifting eye. Using a suitable crane or heavy lifting device lift cylinder out of casing.

Repair

Refer to parts manual for specific cylinder and repair parts. Refer to cylinder repair information in Section 7 for type of cylinder on machine.

Replacement

1. Replacement is reverse of removal procedure.
2. Rotate jack pad to align bolt hole with cylinder.
3. Cycle cylinder several times to remove trapped air before putting machine into service.

Welding

If any welding is to be performed on the leveling jack casings, the welding ground must be attached to the jack pad to prevent an internal flash (arching) in the hydraulic cylinder.

Crawler Repair Manual

Index

1. Safety and danger instructions
 - 1.1. To be observed
 - 1.2. Safety instructions
2. Operating and Service Instructions
 - 2.1. General Maintenance Instructions
 - 2.2. Inspection intervals
 - 2.3. Tightening torque tables
 - 2.4. General instructions
3. Drive
 - 3.1. Drive – Function and operation
 - 3.2. Drive – Fitting and removal
4. Front idler unit
 - 4.1. Front idler unit – Function and description
 - 4.2. Front idler unit – Fitting and removal
5. Carrier rollers/support rails
 - 5.1. Carrier rollers/support rails – Function and operation
 - 5.2. Carrier rollers/support rails – Fitting and removal
6. Track rollers
 - 6.1. Track rollers – Function and operation
 - 6.2. Track rollers – Fitting and removal
7. Crawler track and grouser shoe
 - 7.1. Crawler track and grouser shoe - Function and description
 - 7.2. Crawler track and grouser shoes – Fitting and removal
8. Other/Special components
 - 8.1. Track guide – Function and operation
 - 8.2. Track guide – Fitting and removal
 - 8.3. Covers

Crawler Repair Manual

3. Drive

3.1. Drive – Function and operation

3.1.1 General danger instructions

Danger can occur in particular under the following circumstances:

- Product is handled by insufficiently trained personnel
- Incorrect installation, operation and maintenance/repair
- The product is not being used for its designated purpose

Alterations to the product are not permitted unless approved beforehand.

The transmission is designed exclusively for use as drive transmission for an undercarriage.

3.1.2 Instructions on transport and storage

- Please ensure that the crane or hoisting equipment has a sufficient load capacity when lifting/transporting the transmission
- Only use approved transport elements
- Fasten the transmission carefully onto the crane hook and use suspension devices according to the size of the transmission
- Make sure that no parts attached to the transmission can be damaged by transport elements when lifting the transmission
- The transmission may only be stored in dry, heated rooms
- Make sure that the position of the transmission cannot change (tumble over, slip, fall etc.) at point of storage

Crawler Repair Manual

Draining off transmission oil:

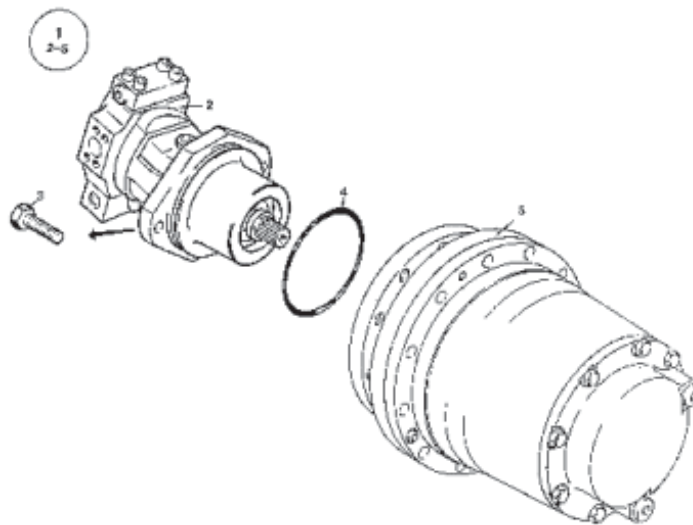


Danger of scalds and burns from hot transmission oil. The transmission housing may also be hot after running for longer periods. Always wear protective gloves and allow the transmission to cool down first. Collect draining oil in appropriate containers and dispose of in an environmentally safe manner.

Place oil collection container underneath the transmission. Undo and remove oil filler plug (1) and oil drain plug (2). Drain oil completely. Insert drain plug with new washer and tighten.

3.2.6 Motor

The motor is maintenance free and only has to be checked visually for leaks during inspection.



3.2.7 Multi-disc parking brake

The multi-disc parking brake is integrated into the transmission on the motor side and is lubricated by the transmission oil. Because of this design, the brake is maintenance free and consequently only has to be checked for damage when carrying out a general overhaul of the complete transmission.



The brake circuit must be vented (bled) after working on the brake or the hydraulic connections.

3.2.8 Disengaging mechanism

The disengaging clutch is located on the rotor gear side (opposite the motor) and is not subject to any special maintenance regulations.

Crawler Repair Manual

Filling instructions for spring elements with elastomer as medium

De-tension track and loosen (see Crawler Track chapter)

Remove cover from appropriate side section.

Fill up tank with elastomer using hand pump.

Bleed hose by pumping slowly.
Connect pump to adapter and pump spring unit up to prescribed filling pressure.

Disconnect pump from adapter upon completion of the filling process.

Important!

Hand pump and special bolt are not included with delivery

De-tensioning the spring element with elastomer as medium

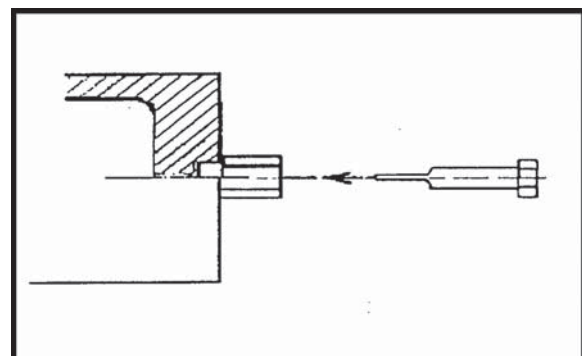
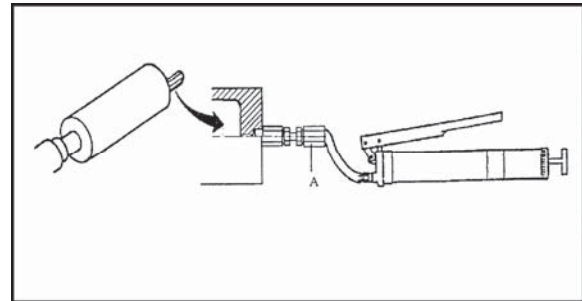
De-tension track and loosen (see Crawler Track chapter).

Remove cover from appropriate side section.

Using the special bolt, screw into the valve seat of the filling valve until about ¼ litres of elastomer emerge from the cross groove on the nut.

The volume can be read off on the pressure gauge.

Remove the special bolt slowly. The valve closes automatically.

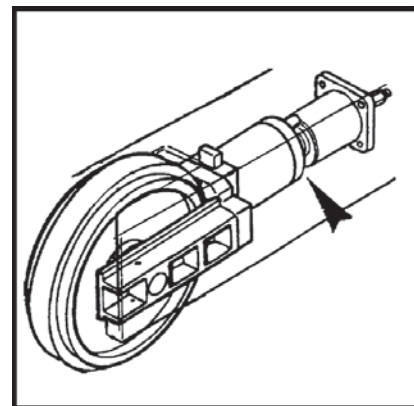
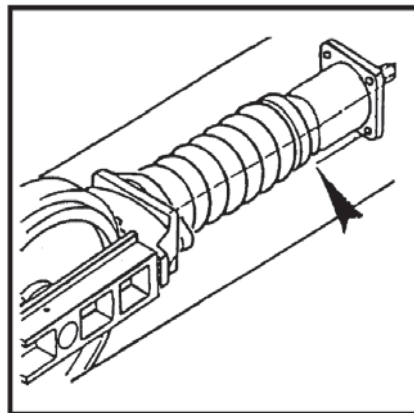
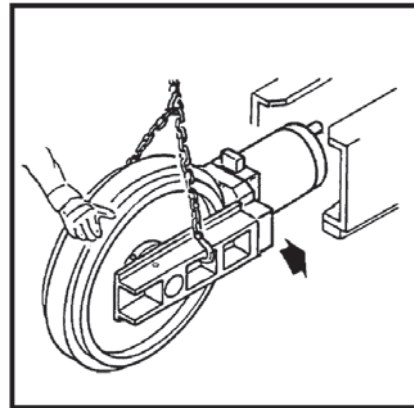


Crawler Repair Manual

Installation as described above though with a fluid spring element.

Make sure that the front idler unit is pushed in far enough without any collision until the spring unit knocks against the piston of the track tensioner.

Shown with a fluid spring element.



Crawler Repair Manual

6.2. Track rollers – Fitting and removal

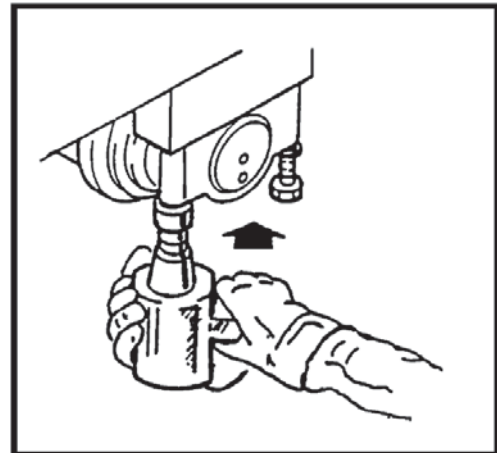
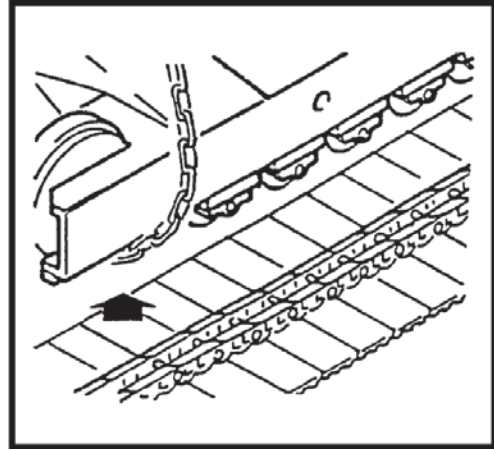
If necessary, slacken off track and undo track fastener (see "Track" chapter).

Raise the track undercarriage using a lifting device and clean dirt off of all parts.

Undo the bolts of the faulty track roller, remove and dispose.

If track guide is fitted, it will have to be removed first at the appropriate points before dismantling.

Fit new roller using new bolts and fasten in place. Re-join track again as described in the following chapter.



Crawler Repair Manual

Tightening torque for master track bolts [Nm]

The bolts mentioned here can be used for closing various master links.

The KLOC master links are an exception that can be closed with standard bolts according to specification. Although split master links initially appear the same, there are differences with regard to rigidity, expansion lengths and stress in the bolt connection.

Because the turning angle method depends to a decisive amount on the above-mentioned parameters, different pre-set torque levels would have to be named for every combination of bolt and master link.

For this reason, only the torque levels for the torque procedure have been specified in the table. The specification can be independent of the differing rigidity because of the strength of the bolt.

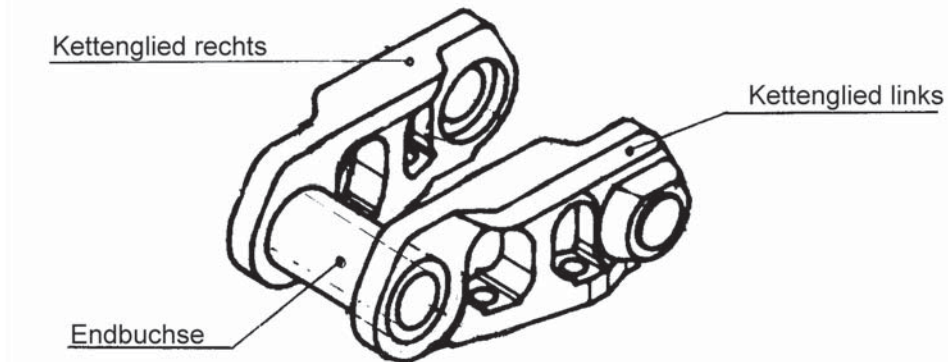
Metric thread (ISO Std.)				
Bolt (mm)	Torque procedure [Nm]		Torque procedure [ft lb]	
	Strength class 12.9	Strength class 13.9	Strength class 12.9	Strength class 13.9
M10 x 1	83 ±5	89 ±6	61 ±3	65 ±4
M12 x 1	133 ±15	144 ±16	98 ±10	106 ±12
M14 x 1.5	196 ±20	212 ±22	144 ±15	156 ±16
M16 x 1.5	304 ±30	329 ±33	224 ±20	242 ±24
M18 x 1.5	515 ±35	557±38	379 ±25	410 ±28
M20 x 1.5	710 ±50	769 ±54	523 ±35	567 ±39
M30 x 2	1750 ±190	1895 ±205	1290 ±140	1397 ±151
M33 x 2	2100 ±200	2274 ±216	1548 ±147	1677 ±159
Bolt (inch)	Torque procedure [Nm]		Torque procedure [ft lb]	
	Strength class 12.9	Strength class 13.9	Strength class 12.9	Strength class 13.9
7/16 – 20 UNF	108 ±10	117 ±11	79 ±7	86 ±8
1/2- 20 UNF	152 ±15	165 ±16	112 ±10	121 ±11
9/16 – 18 UNF	206 ±20	223 ±22	151 ±15	164 ±16
5/8 – 18 UNF	304 ±30	329 ±33	224 ±20	242 ±24
3/4 – 16 UNF	535 ±35	579 ±38	394 ±25	427 ±28
7/8 – 14 UNF	970 ±40	1050 ±43	715 ±29	774 ±31
1 – 14 UNS	1175 ±75	1272 ±81	866 ±55	938 ±59
1 1/8 – 12 UNF	1555 ±185	1684 ±200	1146 ±136	1242 ±147
1 1/4 – 12 UNF	1932 ±167	2094 ±181	1425 ±123	1544 ±133
1 3/8 – 12 UNF	2280 ±220	2469 ±238	1681 ±162	1821 ±175

Crawler Repair Manual

7.2.3 Removal and repair (crawler track / grouser shoe)

The repair segment differs from the element that is already fitted in the existing track.

Repair segment

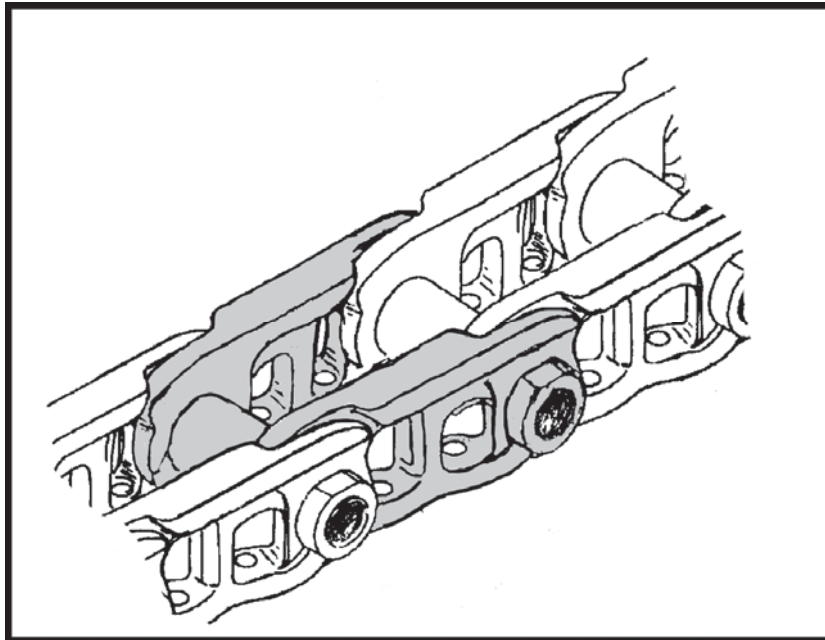


Kettenglied rechts = track link right

Kettenglied links = track link left

Endbuchse = master bushing

Existing track



Necessary spare parts:

- Repair segment as shown above
- Master pins
- Spacers (poss. seal washers)

Final Drive Repair Manual

Mod. F220



INHALTSVERZEICHNIS
INDEX

Notes:

Final Drive Repair Manual

Mod. F220

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B

SICHERHEITSINFORMATIONEN

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B

SAFETY INSTRUCTIONS

Final Drive Repair Manual

Mod. F220


 ALLGEMEINE EIGENSCHAFTEN
 GENERAL SPECIFICATIONS

Technische Eigenschaften
Technical features

Code	2494500	Code
Modell	F220/248V/160-MB-A	Model

BESCHREIBUNG	WERTE VALUES	DESCRIPTION
Untersetzung total	248.2	Total reduction
Leergewicht	854 kg	Dry weight
Motor	A6VE160	Motor
Differenzdruck Hydraulikmotor max		Max hydraulic motor differential pressure
Ausgangsdrehmoment	220 KNm	Output torque
Ölspezifikation BEI DIFFERENTIAL VOM TYP LIMITED SLIP, SIND DIE ANGEGBENEN, MIT ZUSATZSTOFFEN VERSETZTEN ÖLTYPEN ZU VERWENDEN Anmerkung: KEINE SYNTETISCHEN ÖLE, OHNE DIE ZUSTIMMUNG DES HERSTELLERS VERWENDEN		Oil Specification IN PRESENCE OF DIFFERENTIAL LIMITED SLIP, USE RECOMMENDED OIL ENRICHED IN ADDITIVES Note: DO NOT USE SYNTHETIC OIL WITHOUT CONSENT OF THE MANUFACTURER
Ölmenge		Oil capacity
Schmierfett		Grease
Anziehdrehmoment Wellenmutter		Nut torque
Bremse	2244113-2	Brake
Max. Bremsdrehmoment	1200 Nm	Braking torque max.
Anzahl der Kupplungsscheiben (pro Seite)		Number of clutch discs (each side)
Anzahl der Gegenkupplungsscheiben (pro Seite)		Number of clutch counterdiscs (each side)
Stärke der Bremscheibe Nennwert		Nominal brake disc thickness
Stärke der Gegenbremscheibe Nennwert		Nominal brake counterdisc thickness
Maximale Abnutzung der Bremscheibe (pro Seite)		Maximum brake disc wearing (each side)
Hub Bremskolben Verschleissgrenze		Maximum piston stroke (wearing)
Hub Bremskolben Nennwert		Nominal brake piston stroke new
Spezifizierung Öl für Kupplunger		Oil specification for clutches activation
Ölvolumen für Aktivierung der Kupplungen		Oil displacement for clutches actuation
Minimaler/Maximaler Betriebsdruck	15/320 bar	Minimum/Maximum operating pressure

Final Drive Repair Manual

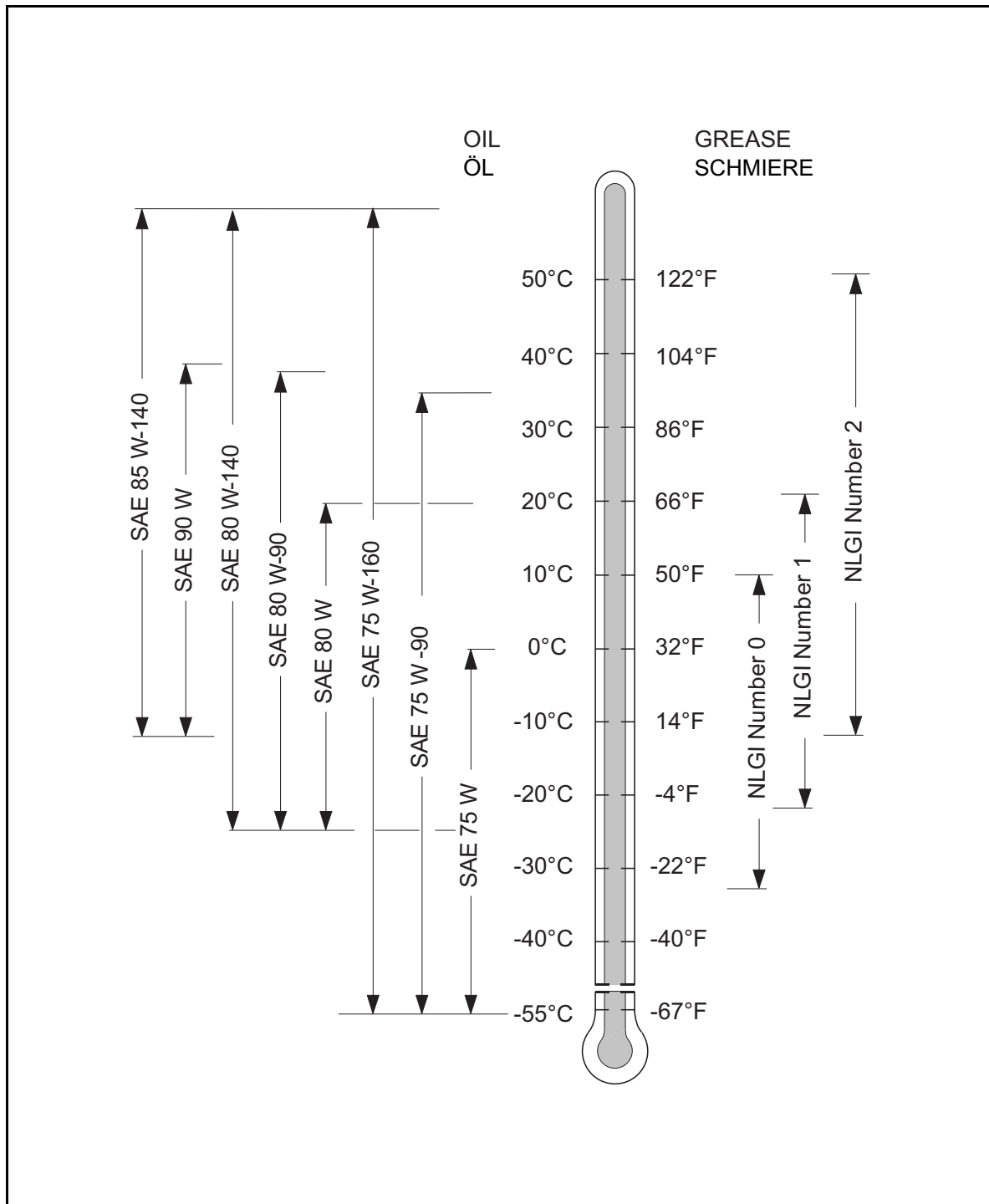
Mod. F220



ALLGEMEINE EIGENSCHAFTEN
GENERAL SPECIFICATIONS

C.7 Schmierung/Fettung: Temperaturbereich und relative Anwendungsbereiche

C.7 Lubrication / greasing: grades and application range



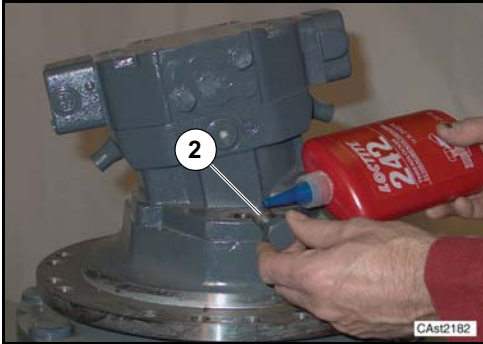
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Mod. F220


O&K
Antriebstechnik

 MOTOR
 MOTOR

4



An den Hydraulikmotorsschrauben (2) Loctite®242 auftragen.

Apply Loctite®242 on the hydraulic motor screws (2).

5



Die Schrauben (2) montieren.
 Mit dem vorgeschriebenen Anzugsmoment befestigen (Abschnitt C.8).

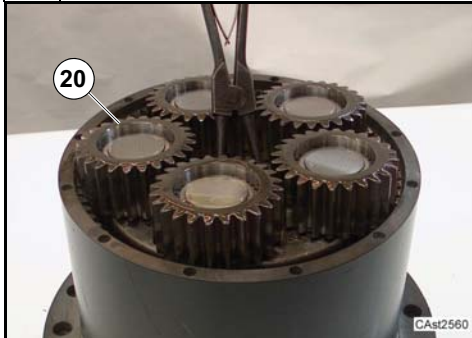
Screw the screws (2).
 Tighten at the prescribed torque wrench (Sec. C.8).

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 PLANETENZAHNRAD UND SCHUTZ
 COVER AND PLANETARY GEARS

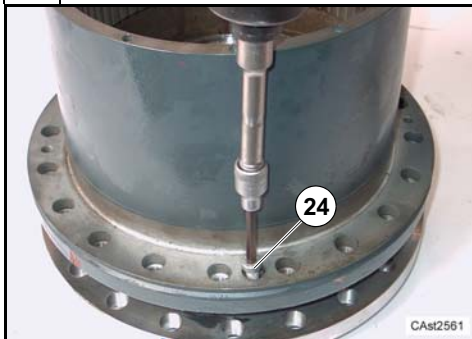
20



Den ganzen Planetenträger (20) entfernen.

Remove side gear carrier assembly (20).

21



Die Schrauben (24) lösen und entfernen.

Unscrew and remove screws (24).

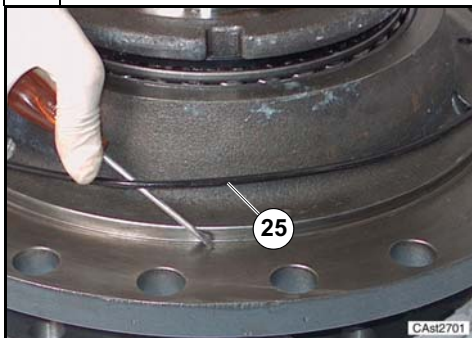
22



Das Hohlrad (23) entfernen.

Remove hollow wheel (23).

23



Den O-Ring (25) entfernen.

Remove O-Ring (25).

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**O&K**
AntriebstechnikPLANETENZAHNRAD UND SCHUTZ
COVER AND PLANETARY GEARS

32



Loctite®242 auf die Schrauben (1) auftragen.
Die Schrauben (1) einschrauben und mit dem vorgeschriebenen
Anzugsmoment befestigen (Abschnitt C.8).

*Apply some Loctite®242 on screws (1).
Screw in screws (1) and tighten at the prescribed torque wrench (Sec.
C.8).*

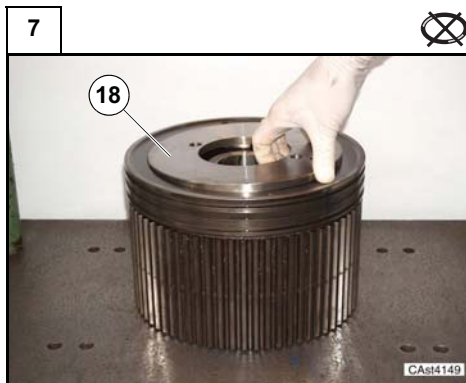
Final Drive Repair Manual

Mod. F220


O&K
Antriebstechnik

 BREMSE
 BRAKE

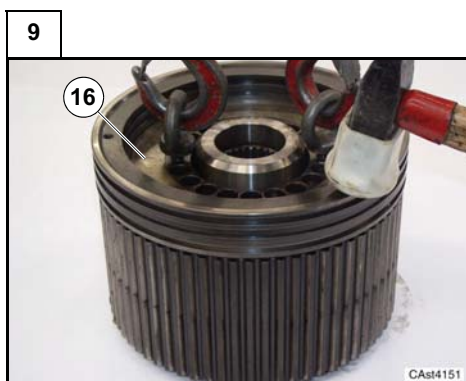

Die zwei Schrauben entfernen.

Remove the two screws.

Die Scheibe (18) entfernen.

Remove the disk (18).

Die Feder (17) entfernen.

Remove spring (17).

Den Kolben (16) entfernen.

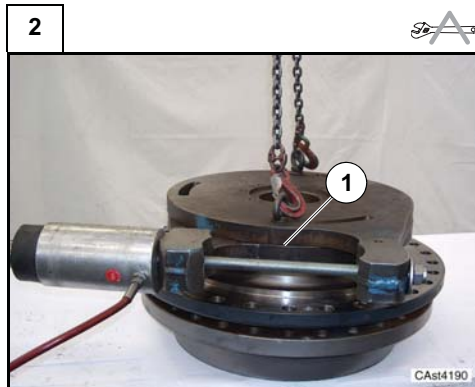
Remove piston (16).

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NABE UND LAGER
HUB AND BEARINGS



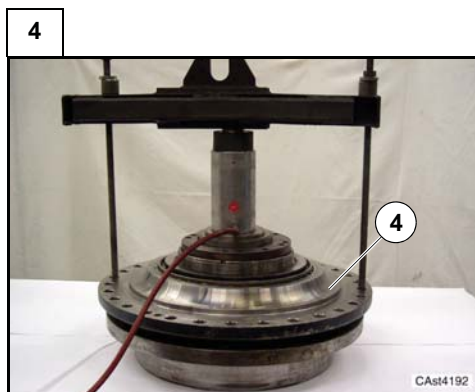
Den Ring (1) entblocken und entfernen.
Das Werkzeug 2897080 verwenden.

*Unlock and remove ring nut (1).
Use tool 2897080.*



Die Zwischenringe (2) entfernen.

Remove shims (2).



Die komplette Nabe (4) entfernen.

Remove hub (4) assembly.



Den Dichtung (8) aus der Nabe (4) entfernen.

Remove gasket (8) from hub (4).

Final Drive Repair Manual

Mod. F220

FEHLERSUCHE
TROUBLESHOOTING

PROBLEM	MÖGLICHE URSACHEN								
	1	2	3	4	5	6	7	8	9
- Zu starke Reifenabnutzung.	•	•	•	•	•	•	•		
- Bremsengeräusche.	•			•	•	•		•	•
- Beim Vorwärtsfahren werden Vibrationen und Lärmabgabe vernommen.	•	•	•		•	•			

PROBLEMS	POSSIBLE CAUSES								
	1	2	3	4	5	6	7	8	9
- Uneven wear of tyre.	•	•	•	•	•	•	•		
- Brake noise.	•			•	•	•		•	•
- Vibration during forward drive, intermittent noise.	•	•	•		•	•			

1 Falscher Einbau/Defektes Getriebe

Den Einbau kontrollieren oder Getriebe, wenn dieses die Testverfahren nicht besteht, reparieren/ersetzen.

2 Überladung und/oder schlechte Verteilung der Last

Übergewicht ablegen und die Last, den Fahrzeugbestimmungen entsprechend neu verteilen.

3 Radius der Reifen verschieden

Ein kleinerer Radius verursacht ein teilweises Durchrutschen des Rades bei Krafteinwirkung. Der andere Reifen mit grösserem Radius muss daher die gesamte Arbeit leisten. Reifen ersetzen oder den Druck beider Reifen kontrollieren und anpassen, bis ein gleicher Radius für beide Reifen erzielt wird.

4 Bruch des Getriebes

Es wird davon abgeraten ein Fahrzeug mit einem gebrochenen Getriebe zu verwenden.

Ein Verschieben der nicht beladenen Maschine um einige Meter ist jedoch möglich. (Mit blockiertem Getriebe.)

5 Getriebe verbogen

Getriebe ersetzen.

6 Falscher Gebrauch des Produktes

Die Gebrauchsanweisungen des Herstellers der Maschine beachten.

1 Incorrect installation / defective transmission.

Correct installation or repair or replace the transmission in case it does not survive any one of the test phases.

2 Overloading/ incorrect weight distribution

Remove excessive weight and redistribute load, following instructions related to the vehicle.

3 Different rotation radius of the tyres

If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyre.

4 Broken transmission

It is not advisable to operate the vehicle with a broken final drive. It is acceptable to move the vehicle (transmission off unloaded) a few meters away only.

5 Bent transmission

Replace transmission.

6 Incorrect use of the product

See the vehicle producer's instructions once again.

Radiator

Unauthorized service will void the warranty. Read the service information at the end of this section carefully before performing any repair work. Refer to parts manual for correct parts ordering.

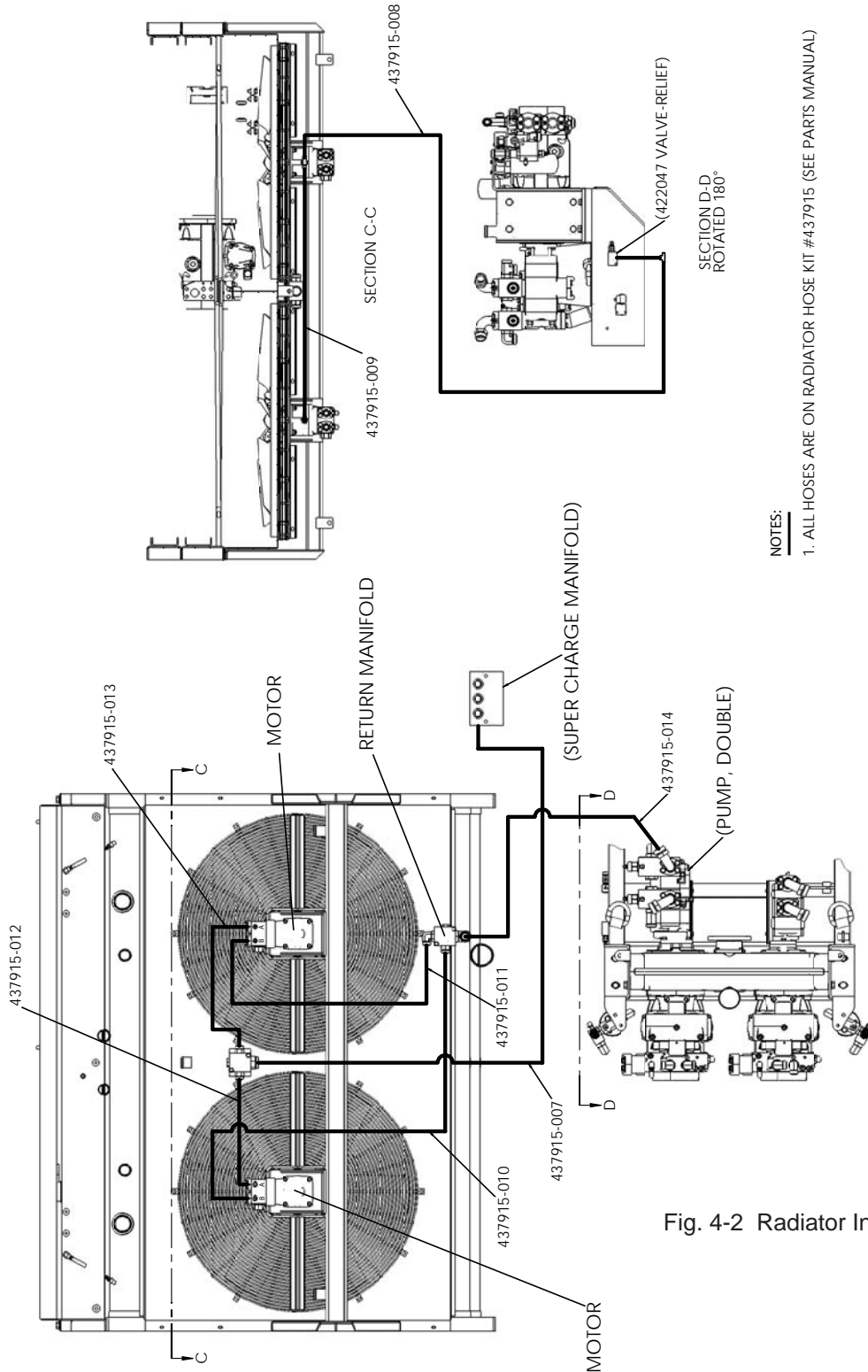


Fig. 4-2 Radiator Installation with Piping

Compressor Installation

Before Installation

1. Drain all lubricant from receiver tank and system.
2. Replace compressor oil filter elements.
3. Remove separator and check receiver tank for foreign material, metal cuttings, varnish and sludge. The system must be completely cleaned out.
4. Flush out compressor oil cooler.
5. Check all valves for foreign material and proper operation.
6. Install new filter elements and separator element. Install compressor unit.

Compressor Unit–Installation

1. Move compressor unit back into place with a suitable lifting device. Keep weight of compressor suspended with lifting device until all bolts and shims are installed.
(Shimming and alignment of the compressor to the engine can be carried out in a variety of methods, but the basic requirement is to achieve the following. There needs to be correct shimming underneath the compressor so as to when (1) with the compressor bolted down tight, (2) the top of both the compressor and engine housings are touching, and (3) there is an equal gap on both sides of the two housings and there is a gap between the two housings at the bottom of 0.001 to 0.002 in. With this process complete, the compressor and engine housing bolts can be installed and tightened symmetrically all around.
2. Tighten mounting bolts to engine flywheel housing. Tighten all bolts according to torque specifications listed in Section 9 of this manual.
3. Reconnect any hoses or fittings that were removed.

Before Start-Up of New or Rebuilt Compressor

1. Reconnect all hoses and valves that were removed.
2. Check all hose whips checks are in place and secure.
3. Fill system with new, clean lubricant (see Section 9 for specifications) and pour 2 quarts (1.9 liters) of lubricant down the inlet.
4. Start engine, check that receiver pressure is not over 120 PSI, warm up machine and set to high idle.
5. Set the controls at the rated pressure and RPM.
6. Check engine and compressor operating temperature. The engine water temperature should not be above 200°F (93.3°C) in radiator/top tank. Compressor discharge temperature should not be above 210°F (98.0°C).
7. Check all shutdown devices for proper operation and temperature range.

Control Cylinder

Reassembly

1. Clean all parts thoroughly. Inspect all components and replace any items that show excessive wear or damage of any kind.
2. Some seal kits are universal kits and may contain more seals than are required for your particular cylinder. Carefully match the new seals with the old and discard any extras.
3. Using Aurora Lube packet or lubricant suitable for your application, re-lubricate all metal wear surfaces and new seals prior to installation. Rub grease into the tube and rod surfaces thoroughly. Also lubricate the tube and end cap threads.
4. Slide the piston rod assembly into the tube. If your piston has cup type seals lubricate the enclosed shim paper and wrap it around the piston seals forming a funnel to pass the piston seals over the tube threads without damage. Wiggle the rod as you push it through the shim paper funnel. Once piston is past the threads remove and discard the shim paper.
5. On double acting cylinders either end cap may be re-installed first. On single acting cylinders install the end cap on the end opposite the spring first, and then screw in the end cap on the end containing the spring. Hold the cylinder firmly in a vise and use both hands to overcome the spring pressure.
6. Before putting the cylinder back into service thoroughly test it to be sure it functions properly and that there is no leakage past any of the seals.

System Blowdown Valve

System Blowdown Valve

This is a 2-way normally opened (N.O.) valve that is piloted closed from the same pilot line that opens the oil stop valve. When the compressor first starts up the system blowdown is piloted closed which allows the receiver to build up pressure. When the compressor is shut down the valve opens and vents any remaining receiver pressure. The system blowdown valve will stay open until the compressor starts up again.

When necessary to make repairs on the system blowdown valve use repair kit and follow the instructions provided below.

1. Remove the pilot cap and push the piston out of the pilot cap.
2. Remove the U-cup from the piston and replace it with the new one provided in the kit. Lubricate the U-cup with Parker Super "O" lube or an equivalent quality silicone grease.
3. Thoroughly clean the cap. Place the piston (with the U-cup in position) in the cap so the recessed center is showing at the valve body end of the cap.
4. Pull the retainer, poppet and spring out of the valve body. Discard the spring and separate the poppet from the retainer.
5. Remove the O-rings from the inside and outside diameters of the retainer.
6. Unscrew the stem portion of the poppet to allow removal of the disc. DO NOT mar the machined finish of the poppet when screwing the stem.
7. Remove the disc and replace it with the new one provided.
8. Replace the stem portion and tighten securely.
9. Clean the poppet and retainer thoroughly.
10. Replace the O-rings in the retainer and lubricate thoroughly with the silicone lubricant used above.
11. Place the poppet in the retainer as it was prior to separating it.
12. Clean the valve body and place the new spring in the valve body.
13. Place the poppet and retainer back in the valve body and replace the pilot cap.
14. Tighten the pilot cap securely with a wrench and the shutdown blowdown valve is ready for operation.

NOTE: * Indicates item is in repair kit



Fig. 4-24 System Blowdown Valve

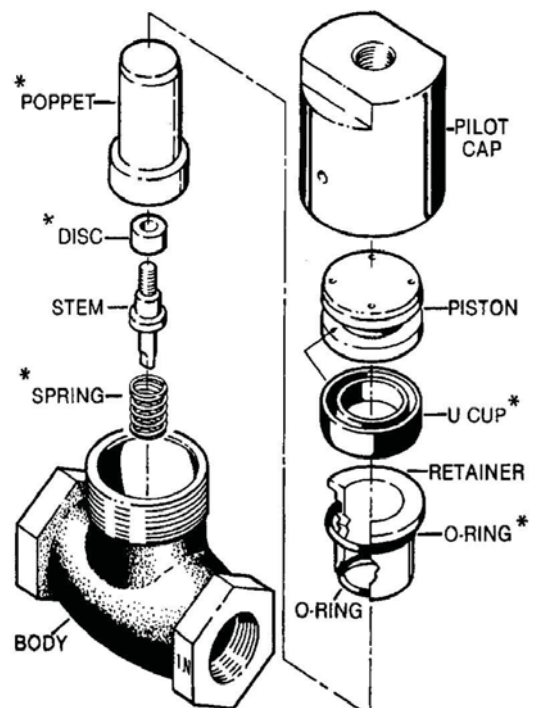


Fig. 4-25 Blowdown Valve Repair Parts

Compressor Maintenance

Maintenance Every 250 Hours

1. Remove the vacuator cups (3 used) clean and refit.
2. Grease control linkage.
3. Drain off water from the receiver if required.

Maintenance Every 500 Hours

See Lubricant Recommendation Guide in Section 9.

1. Run the compressor for 5 to 10 minutes to warm the fluid and drain the fluid receiver/sump by connecting the waste oil pump to the Wiggins Evac point (compressor drain). Open the isolator valve to enable evacuation.
2. Replace compressor fluid filter element.
3. Fill the receiver/sump with fluid.
5. Remove any accumulated dirt from the fluid filler cap prior to filling the sump.
6. Clean the return line orifice and strainer.

Maintenance Every 1000 Hours

Perform the following after every 1000 hours of operation:

1. Clean the return line orifice and strainer.
2. Service the minimum pressure valve.

Receiver Troubleshooting

The information contained in the troubleshooting chart has been compiled from field report data and factory experience. It contains symptoms and usual causes for the described problems. However DO NOT assume that these are the only problems that may occur. All available data concerning the trouble should be systematically analyzed before undertaking any repairs or component replacement procedures.

A detailed visual inspection is work performing for almost all problems. Doing so may prevent damage to the compressor. Always remember to:

1. Check for loose wiring.
2. Check for damaged piping.
3. Check for parts damaged by heat or an electrical short circuit, usually noticeable by discoloration or a burnt odor.

Should your problem persist after making the recommended check, consult the manufacturer.

Symptom	Probable Cause	Remedy
Engine shuts down with air demand present	Compressor discharge temperature switch is open	Cooling air flow is insufficient; clean cooler and check for proper fan speed. Low fluid sump level; add fluid. Temperature regulating valve is not functioning properly; change the thermostat element. Defective discharge temperature switch; check for a short or open circuit. Should this check out normal, it could be possible that the temperature switch itself is defective.
Compressor will not build-up full discharge pressure	Air demand is too great Dirty air filter Pressure regulator out of adjustment Defective pressure regulator Defective minimum pressure valve Shutdown blowdown and/or running blowdown valves are jammed open	Check service lines for leaks or open valves. Check the filter indicator and change or clean element if required. Adjust regulator according to control adjustment instruction in the Maintenance Section. Check diaphragm and replace if necessary (kit available). Check that piston is moving freely. Check at silencers.

Radiator and Core Service

6

Tube Installation

CAUTION! If a tube seems difficult to install into a seal, STOP and figure out WHY! One of the following reasons could be the answer.

1. A tube or seal with inadequate location.
2. Improperly installed seal that could be pushed too far into the header plate hole.
3. Damaged tube end.
4. Trying to insert the tube into the seal at too steep of an angle.
5. Tube is not centered in seal.

NOTE: If, for any of the above reasons, a tube is difficult to install, the seal should be removed and inspected for any scuffing marks, tears, cuts. If there is any doubt, replace the seal.

HELPFUL HINTS:

- If you are working with a center tank, the bottom core must be assembled before the top core.
- Minimize the angle of the tube as being installed into the top seal.
- Make sure the tube is centered in the bottom seal before any force is applied to pull or push in place.
- For ease of tube installation, install tubes behind the side member gussets in each row. Install the tubes behind the left side gussets, working towards the core center. Then go to the far right hole, in the same row, install the tube working towards the core center.
- Individual rubber tube stays and, some cases, tube stay ends are necessary to interlock the tubes. For part numbers see page 3. If more detailed information is required for proper assembly of cores using tube stays at tube stay ends, contact your nearest L&M manufacturing facility listed on page 8.

STEP 1.

Always work from the front side (opposite the fan side).

Start with the row furthest from you (fan side row) and at the left end of the row. Use a minimum of angle and a slight twisting, pushing motion to push the bottom end of the tube into the top seal. Push far enough in so the bottom of the tube clears the top of the bottom seal.

If you are working with the ITS system you need to push it in far enough to allow clearance for the ITS tabs at the center of the tube and at the bottom seal (see Fig. 4 and 6).

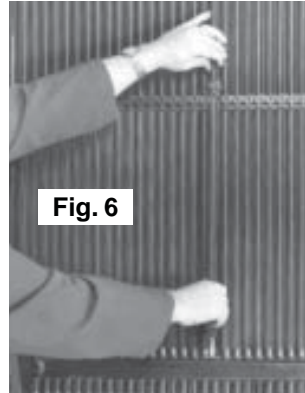


Fig. 6

NOTE: The front tab of the ITS tube support should face the front of the radiator and the side tab should be to your right (see Fig. 9).

STEP 2.

Center bottom end of tube into respective seal in the bottom header plate. Then, push tube

down and into seal until the formed bead is seated into the locking groove of the bottom seal

This may be done by grasping tubes by hand and pulling the tube downward unseated, or by using

Installation Tool, L&M PN 48350. This tool has a semicircular form on the end of the handle. Place this end on the formed bead of the tube and push downward until seated, as shown in Fig. 7.

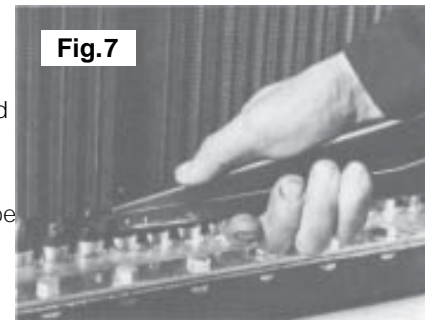


Fig. 7

Now, complete the row of tubes. Precaution should be taken to make sure the bead is seated into bottom seal, and that the tubes are straight and aligned to assure maximum air flow.

If you are working with an ITS system, use tube installation tool P/N 77050. (See Fig. 8.) Hook the slotted end of the tool behind the front tab on the ITS tube support. Using the tool and your other hand, center the bottom end of the tube into the bottom seal. At the same time guide the dovetail tabs into the tabs on the ITS tube support. Once in place with the tool

P/N 77050 still hooked onto the ITS tube support, pull the tube into the bottom seal until the formed bead is seated into the locking groove of the bottom seal.



Fig. 8

SERVICE MANUAL

MESABI®

HIGH EFFICIENCY COPPER TUBE AIR TO OIL COOLERS

Please read and flow instructions carefully before proceeding with any service work and/or repairs. Consult factory before proceeding with any possible warranty claims.

Manufactured by  **IMI RADIATOR, Inc.**

CSC High Pressure Service

Models CSC 350 and CSC 500

Repair Instructions: External Cleaning and Tube Removal

HELPFUL HINTS:

- Read this manual thoroughly
- Work in a clean environment
- Good Lighting is a must
- Use the proper tools and lube
- Call L&M customer service with questions

EXTERNAL CLEANING —

MESABI Aluminum Tube Air to Oil Cooler

To maintain efficiency and assure maximum life of a MESABI Aluminum Tube Oil Cooler, reasonable care must be taken when cleaning.

In some cases it may be best to blow out any dry dirt with shop air prior to washing core with the high pressure hot water washer. If there is any doubt about the cleaning method to be used, try the method on a portion of a single tube first, or contact an L&M manufacturing facility.

For general external cleaning, a high pressure hot water washer up to 1500 PSI can be used. Unlike conventional cores, you can and should get right up next to the core with the wand. Starting from the air exit side, place the high pressure washer nozzle next to the fin, concentrating on a small area, slowly working from the top down. Make sure you spray straight into the core, not at an angle. Continue washing until the exit water is free of dirt. Repeat from the opposite side.

Many radiator shops use a hot alkaline soap or caustic soda in their boil-out tanks with chemical additives. Soaking in high pH solutions may damage the aluminum alloy, depending on the exact characteristics of the solution. Solutions that are either too alkaline (pH>9.0) or too acid (pH<5.0) are not recommended.

Tube Stabilizer Bar Removal —

If your system was provided with tube stabilizer bars, remove them at this time.

Removing MESABI Tubes —

After a thorough cleaning as described above, blow dry the core section, then remove tube retainer from top portion of tube as shown in Fig. 1.

NOTE: Remember the proper orientation of the retainers and three cupped washers for reinstallation later.

With Installation Tool No. 42146, grasp center portion of tube as shown in Fig. 2. Rotate the tool so as to break the tube free from the seal, then raise the tube only enough to clear the lower header plate and swing tube out just far enough to allow tube to be pulled down and out of the upper header plate, as shown in Fig. 3

Remove all tubes in the row, repeating the above procedure.



Fig. 1

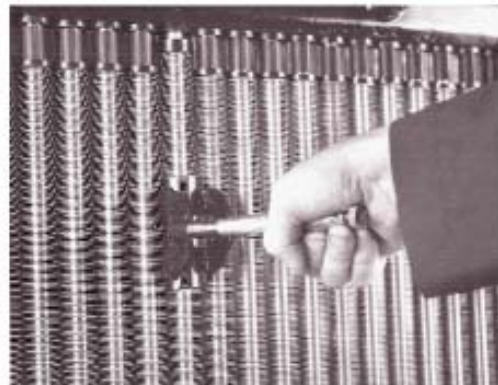


Fig. 2



Fig. 3

Level Wind Gearbox

Maintenance Instructions

General Note — These instructions contain information common to more than one model of Bevel Gear Drive. To simplify reading, similar models have been grouped as follows:
 GROUP 1 — Models 11, 150, 165, 175, 66 (illustrated), 65, 88, 600, 800, 810, 850, 1000, 1010 and 1200.
 GROUP 2 — Models 790, 920 (illustrated), 950, 1050 and 1250.
 GROUP 3 — Models M2 and M3.
 GROUP 4 — Models AD1, AD2, AD3, AD4 & AD5.
 NOTE: For PINION SHAFT disassembly instructions for Models 1010 and 1200, follow the Group 2 instructions. For PINION SHAFT disassembly instructions for the Model 790, follow the Group 1 instructions.

It is advisable to periodically inspect your Bevel Gear Drive for any signs of impending service. Spare or replacement parts can often be ordered and obtained before disassembly is necessary, thus minimizing machine down-time. The following symptoms can be inspected visually without disassembly and may, in some cases, indicate extensive maintenance procedures.

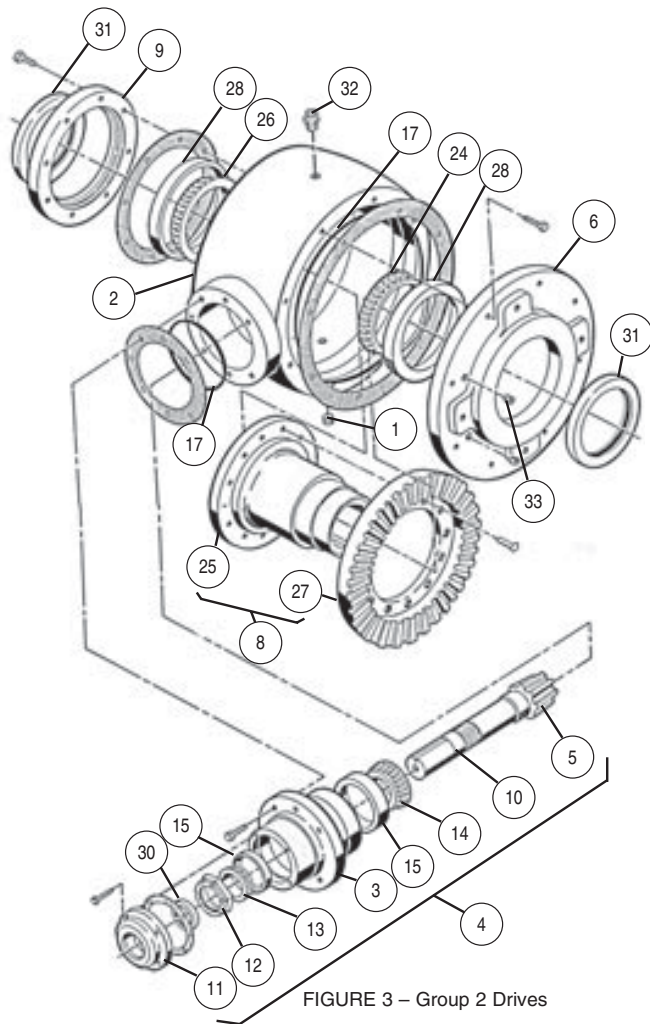


FIGURE 3 – Group 2 Drives

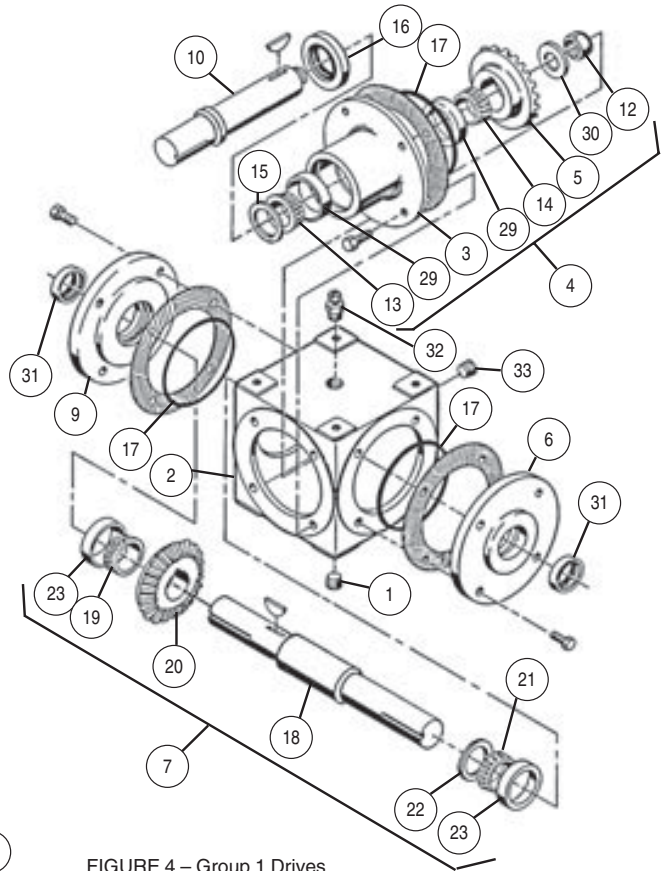


FIGURE 4 – Group 1 Drives

Oil leaking from pinion housing, caps, cap screws or pipe plugs—might be corrected by retightening or removal and recoating with pipe sealant before tightening. If this does not correct the leaking condition, disassembly will be necessary to replace O-rings.

High internal operating temperature (above 200° F.)—could indicate that unit was being overloaded and should be replaced entirely with a larger capacity unit. Damaged bearings or inadequate oil level can also cause heat build-up.

Oil leaking from seals—indicates that shaft and/or seals are worn and need replacing. Keep dirt and foreign particles off shafts in the area of the seals to minimize wear. Note: On initial run of new unit or after a new replacement of seals, some lubricant leakage is normal for the first few hours of running time until seals seat against the shafts. If condition persists, seal replacement will be necessary.

Excessive end play of shafts—if there is a noticeable (.005" or more measurable) shaft movement when couplings are removed and shaft is moved back and forth, it is an indication of bearing wear. Removing shims between caps and gear case can usually correct the condition and avoid bearing replacement.

Excessive backlash—might indicate worn gears which often may be readjusted, instead of replacing.

IMPORTANT

In the initial factory assembly, Loctite® was used on the threads of all cap screws. If any screws are removed, a new application of Loctite® is necessary or lock washers must be installed. Note—Screw threads and threaded hole must be degreased before the application of Loctite®.

Dust Collector

Initial Startup

If the dust system was installed on the drill at the factory, the unit should be set up ready to run. However, to become familiar with the operation of the unit, it is advisable to go through the following setup procedures.

The dust system is divided functionally into two separate subsystems:

- A. The blower assembly which provides the vacuum source.
- B. The compressed air supply which cleans the filter elements.

Blower Assembly—The blower assembly consists of an aluminum blower wheel, an aluminum blower housing, and a hydraulic motor. For the unit to operate as it was designed, the blower wheel must turn at both the right speed and the right direction to produce the level of vacuum required.

Fan Speed Adjustment

The preferred method is to set the speed to give the desired vacuum (16 inches of water) as measured with a water manometer. A water manometer is a very simple device consisting of a clear plastic tube bent into a "U" shape. The tube is partially filled with water so that two columns appear side by side and extend approximately half way up the length of the manometer. If both ends of the tube are open to the atmosphere, then the water level in each leg of the manometer will be equal. However, if one leg is connected to a vacuum source, the air pressure in the other leg will be greater and will push the water column down on the side connected to atmosphere. At the same time, the column connected to the vacuum will rise. The distance in inches between the two water columns is the measurement of the vacuum in inches of water. There are two places on the dust collector to measure the vacuum produced by the blower system.

1. The upper tap is connected to the clean air side of the filter element.
2. The lower tap is connected to the dirty air side of the filter element.

Figure 5-5 shows the different manometer readings when connected to either the upper, lower or across both taps at the same time. This measurement would reflect the pressure drop across the filter element. To measure the clean air vacuum, connect one side of the manometer to the upper tap and the other side to atmosphere. Likewise, to measure the dirty air side of the filter, connect one hose to the lower tap and the other hose to atmosphere. Normal readings (in inches of water) for the various configurations are shown at the top of fig. 5-5. Using clean filters, adjust the fan speed by using the flow control valve (fig. 5-6) to achieve these readings.

Direction of Fan Rotation

The blower wheel rotates in a clockwise direction when viewing the unit from the top. It is imperative that the blower turn in the right direction. It will not always be immediately obvious when the blower is turning backwards because the unit will still pull a vacuum of 2–3 inches of water. There are two methods to ensure that the fan is turning clockwise. The first is to make the measurements above. However, the easiest method is to physically view the fan as it is either starting or stopping and note the direction it is turning. Always stand to one side of the blower housing exhaust and wear safety glasses, as small particles could fly out at high speed causing personal injury.

Water Pump Service

5, 7, 15PFR PLUNGER PUMP SERVICE MANUAL



5 FRAME: 310, 340, 350, 311, 341, 351, 317, 347, 357
5 FRAME OEM: 30, 31, 34, 35, 42HS, 43HS, 45

7 FRAME: 530, 550
7 FRAME OEM: 51, 53, 55, 56, 57, 58, 59, 60, 70
15 FRAME: 650, 651, 660, 661, 1050, 1051, 1057

INSTALLATION AND START-UP INFORMATION

Optimum performance of the pump is dependent upon the entire liquid system and will be obtained only with the proper selection, installation of plumbing and operation of the pump and accessories.

SPECIFICATIONS: Maximum specifications refer to individual attributes. It is not implied that all maximums can be performed simultaneously. If more than one maximum is considered, check with your CAT PUMPS supplier to confirm the proper performance and pump selection. Refer to individual pump Data Sheets for complete specifications, parts list and exploded view.

LUBRICATION: Fill crankcase with special CAT PUMP oil per pump specifications [5PFR-18 oz., 7PFR-25 oz., 15PFR-42oz.]. DO NOT RUN PUMP WITHOUT OIL IN CRANKCASE. Change initial fill after 50 hours running period. Thereafter, change oil every 3 months or 500 hour intervals, whichever comes first.

PUMP ROTATION: Pump was designed for forward rotation to allow optimum lubrication of the crosshead area. Reverse rotation is acceptable if the crankcase oil level is increased slightly above center dot to assure adequate lubrication.

PULLEY SELECTION: Select size of motor pulley required to deliver the desired flow from Horsepower Requirement and Pulley Selection Chart (refer to Tech Bulletin 003 or individual Data Sheet).

DRIVE SELECTION: The motor or engine driving the pump must be of adequate horsepower to maintain full RPM when the pump is under load. Select the electric motor from the Horsepower Requirement Chart according to required pump discharge flow, maximum pressure at the pump and drive losses of approximately 3-5%. Consult the manufacturer of gas or diesel engine for selection of the proper engine size.

MOUNTING: Mount the pump on a rigid, horizontal surface in a manner to permit drainage of crankcase oil. An uneven mounting surface will cause extensive damage to the pump base. To minimize piping stress, use appropriate flexible hose to inlet and discharge ports. Use the correct belt; make sure pulleys are aligned. Excessive belt tension may be harmful to the bearings. Hand rotate pump before starting to be certain shaft and bearings are free moving.

LOCATION: If the pump is used in extremely dirty or humid conditions, it is recommended pump be enclosed. Do not store or operate in excessively high temperature areas or without proper ventilation.

INLET CONDITIONS: Refer to complete Inlet Condition Check-List in this manual before starting system. DO NOT STARVE THE PUMP OR RUN DRY. Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.

C.A.T.: Installation of a C.A.T. (Captive Acceleration Tube) is recommended in applications with stressful inlet conditions such as high temperatures, booster pump feed, long inlet lines or quick closing valves.

DISCHARGE CONDITIONS: OPEN ALL VALVES BEFORE STARTING SYSTEM to avoid deadhead overpressure condition and severe damage to the pump or system. Install a Pulsation Dampening device on the discharge head or in the discharge line as close to the head as possible. Be certain the pulsation dampener (Prrrr-o-lator) is properly precharged for the system pressure (see individual Data Sheet).

A reliable Pressure Gauge should be installed near the discharge outlet of the high pressure manifold. This is extremely important for adjusting pressure regulating devices and also for proper sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the pressure that is read at the discharge manifold of the pump, NOT AT THE GUN OR NOZZLE.

Use PTFE thread tape or pipe thread sealant (sparingly) connect accessories or plumbing. Exercise caution not to wrap tape beyond the last thread to avoid tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

PRESSURE REGULATION: All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). The primary pressure device must be installed on the discharge side of the pump. The function of the primary pressure regulating device is to protect the pump from over pressurization, which can be caused by a plugged or closed off discharge line. Over pressurization can severely damage the pump, other system components and can cause bodily harm. The secondary safety relief device must be installed between the primary device and pump. This will ensure pressure relief of the system if the primary regulating device fails. Failure to install such a safety device will void the warranty on the pump.

When the high pressure system is left running with the trigger gun off, the by-pass liquid can be routed to drain or to the pump inlet. If routed to the pump inlet, the by-pass liquid can quickly develop excessive heat and result in damage to the pump. A THERMO VALVE installed in the by-pass line is recommended to protect the pump. An AUTO SHUT-OFF ASSEMBLY may also be used.

NOZZLES: A worn nozzle will result in loss of pressure. Do not adjust pressure regulating device to compensate. Replace nozzle and reset regulating device to system pressure.

PUMPED LIQUIDS: Some Liquids may require a flush between operations or before storing. For pumping liquids other than water, contact your CAT PUMPS supplier.

STORING: For extended storing or between use in cold climates, drain all pumped liquids from pump and flush with antifreeze solution to prevent freezing and damage to the pump. DO NOT RUN PUMP WITH FROZEN LIQUID (refer to Tech Bulletin 083).

WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

Products described herein are covered by one or more of the following U.S. patents 3558244, 3652188, 3809508, 3920356, 3930756 and 5035580

PN 30002 Rev K 7311

Pump Drive Motor Service

Disassembly

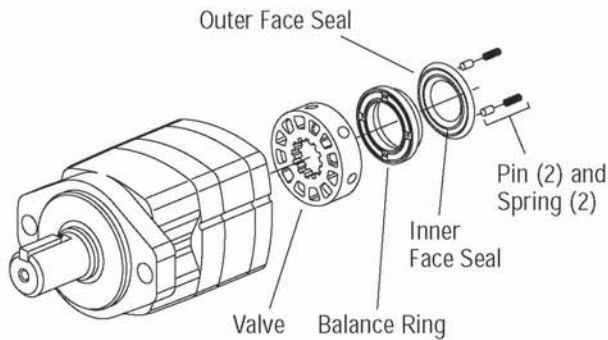


Figure 5

- 7 Remove balance ring assembly.
- 8 Remove inner and outer face seals from balance ring.
- 9 Remove the valve.

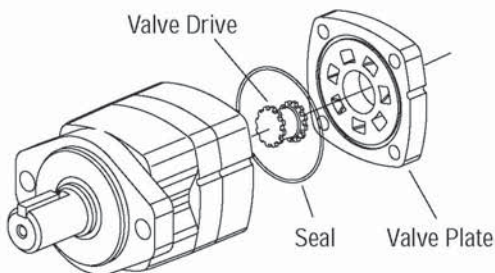


Figure 6

- 10 Remove the valve plate.
- 11 Remove the 76,0 [3.00] diameter seal from valve plate.
- 12 Remove the valve drive.

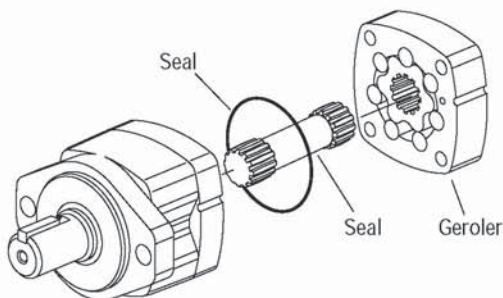


Figure 7

- 13 Remove the Geroler. Be sure to retain the rollers in the outer ring if they are loose.
- 14 Remove the drive.

- 15 Remove the 76,0 [3.00] diameter seal from wear plate, see Figure 7.

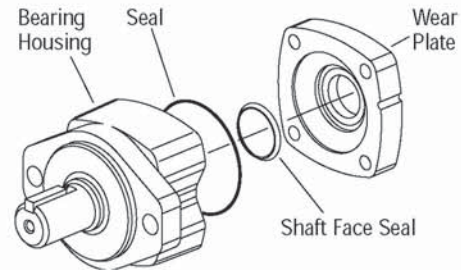


Figure 8

- 16 Remove the wear plate.
- 17 Remove the shaft face seal from the wear plate.
- 18 Remove the 76,0 [3.00] diameter seal from bearing housing.

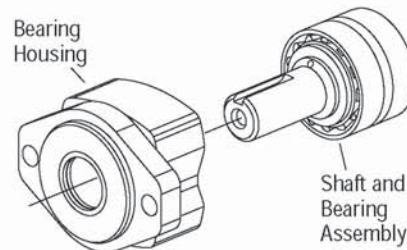


Figure 9

- 19 You may need a press to remove shaft and bearing assembly from bearing housing. (Key must be removed before removing shaft.)

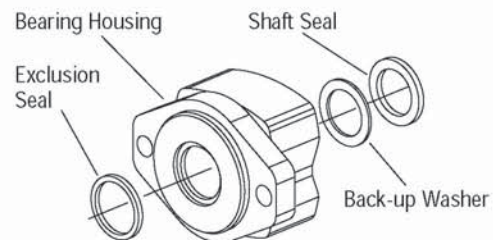


Figure 10

- 20 Use a small screwdriver to remove shaft seal, back-up washer and exclusion seal from bearing housing, see Figure 10. Do not damage bore of housing.

Note: Individual parts of shaft and bearing assembly are not sold separately. Replace as a unit.

Hoist/Pulldown Cylinder

Repair

Refer to parts manual for specific cylinder and repair part numbers. Refer to cylinder repair information in Section 7 of this manual for type of cylinder on machine. Follow the instructions on the "General Information" page, then follow the detailed instructions for the type of head and type of piston that matches what is in the cylinder. For this particular cylinder, follow the procedures for "N" Type Head and "Z" Type Piston. This cylinder is somewhat different, due to the double ended rod. Pay particular attention to the notes and differences on the drawing (fig. 6-2).

Installation

1. Protect the chrome surface of the exposed cylinder rods by wrapping with cloth or several layers of paper. Wrap the threaded ends of the cylinder rods with tape to protect threads from damage. With cylinder rods centered (equal length of rod exposed on both ends of cylinder body), lift cylinder barrel (do not lift by the cylinder rods) and position under mast with the lower cylinder guide mounts toward bottom of mast.
2. Position lower rod end through hole in mast base, then position upper rod end through hole in crown block. Install spacers and thread nut on rod ends so same length of rod extends beyond nut as before removal.
3. Install lower nut and tighten with chain wrench or special made wrench and a "cheater" pipe.
4. Remove cap plugs from rod ends and install fittings and hydraulic hoses.
5. Adjust the RDFA relief on the tensioner manifold to maximum.
6. Start engine and using pulldown control lever, move cylinder to align bolt holes with sheave mounting brackets. Install bolts using loctite on threads.
7. Remove chain from rotary head and mast crown.
8. Raise mast and run rotary head up and down mast ten to twelve times to work air out of the cylinder.
9. Place hardwood block and steel plate used previously on auto tool wrench jaw. Bring rotary head sub down against steel plate and block. Switch drill/propel switch to **Drill** mode and pulldown switch to **Engage** pulldown. Set pulldown pressure to 4000 PSI (275 bar) using pulldown system pressure control.
10. Lower mast with pulldown pressure still at 4000 PSI (275 bar), tighten lower hoist/pulldown cylinder nut using chain wrench or special wrench and cheater pipe. Tighten nut as much as possible. Decrease pulldown pressure and switch pulldown switch to **Disengage** pulldown.
11. Weld and bolt chock bars back in place against hoist/pulldown cylinder nut on top and bottom of mast.
12. Raise mast and install bit sub, table bushing and bit. Install drill pipe.
13. Re-install any grating that was removed.
14. Shut machine down and check the fluid level in the hydraulic reservoir and add as required.

Rotary Drive Gearbox

Repair

(Refer to Figure 6-13.)

1. Repair of the gearbox is limited to the replacement of damaged or worn parts.
2. Inspect gear teeth for galling or heat discoloration and replace as necessary.
3. Inspect gear teeth for uneven wear patterns.
4. Inspect bearings and replace as necessary.
5. Replace seals and gaskets.

If further disassembly and repair are necessary, refer to the following Cotta TM2116-7 Repair Manual. Refer to parts manual for part numbers.

Main Shaft Bearing Preload Checking

1. Place a dial indicator base on the rotary head housing and the needle on the seal plate (fig. 6-15).
2. Engage the deck wrench on the pipe or sub flats and apply 2500 PSI pulldown.
3. Any movement is too much. The main shaft bearings must have 0.002-0.004 in. preload.
4. Adjust preload as per the following instructions if required.



Fig. 6-15 Main Shaft Bearing Preload checking

Main Shaft Bearing Preload Setting

If for any of the following reasons (1) Rotary Head repairs, (2) scheduled service maintenance, or (3) movement detected in bull shaft, the preload of 0.002-0.004 in. must be set on the bull shaft bearings. This requires loosening or adjusting of the preload locknut. A special tool, P/N 431759, is available to facilitate the locknut servicing.

1. With the rotary head installed on the mast, place an 8 x 8 in. block of hardwood on top of the deck wrench and lower the main shaft of the rotary head so it is against the block. Remove top cover of gearbox.
2. Apply 2500 PSI (172 bar) pulldown pressure. This serves to load up the bearings to achieve the desired pre-load.
3. Cover the exposed bearing with a sheet metal disc or cloth to avoid contamination of the rotary gearcase. The locknut has four kidney shaped slots machined into the face of the nut. Setscrews pass through these slots and when tightened, "clamp" the nut onto the main shaft. These setscrews MUST be loosened off completely, then using a hammer and steel dolly firmly strike the outside of the locknut in the four areas that are between the slots (fig. 6-15). This will return the locknut to its original shape and allow the nut to turn freely on the thread.

NOTE

If the locknut is not freed up, it may catch on the thread and bind up. A steel dolly MUST be used, copper dollies might chip and put metal into the gearbox and bearings.

Rotary Drive Service

Cotta Service	Repair Manual	Cotta Service
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PREFACE

This documentation has been developed for the skilled service person, trained by Cotta Transmission Company for the repair and maintenance operations on Cotta units.

Covered are the serial numbers according to the design and manufacturing stage relative to this edition.

However, due to further technical developments of the product, the repair of the unit at your disposal could require different steps as well as other adjustments and testing specifications.

Therefore, we recommend that your Cotta product be repaired by service people whose practical and theoretical training is constantly updated by Cotta factory representatives.

The Cotta factory trained personnel can offer you:

1.Constantly trained Service people

2.Prescribed installations

3.Genuine Cotta spare parts according to the latest phase of development

Here, all operations are carried out for you with the utmost care and reliability.

Repair operations carried out by Cotta Transmission Company, are covered additionally within the terms of the actual contractual conditions, by Cotta warranty.

Damages caused by inappropriate or inexpert work, and or carried out by personnel unauthorized by Cotta Transmission, and any expenditures eventually arising from it, are excluded from contractual obligation.

This also applies if genuine Cotta Transmission parts are not used.

Rotary Drive Service

Cotta Service

Repair Manual

Cotta Service



Fig.5

Remove inner half of seal set from the Gearbox case.



Fig.6

Loosen hex head screws and remove seal housing using jack screws.



It is required to have the Gearbox level and secure from falling while disassembling!



Seal housing must be brought up evenly!



Fig.7

Remove shims and seal from seal housing.

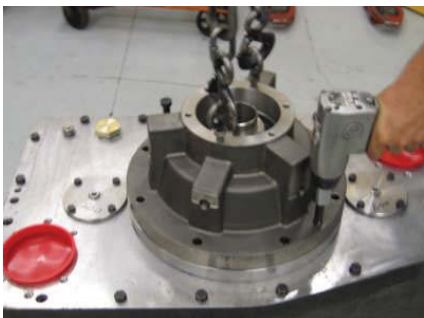


Fig.8

Loosen hex head screws and remove main seal housing using using jack screws.



Seal housing must be brought up evenly!

1.2

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Rotary Drive Service

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Fig. 17

Position Output shaft as shown.



Fig. 18

Lower case and output gear over shaft until contact is obtained between the bearing cup and cone.

Note: Take care to align the spines of the gear and shaft.



Fig. 19



Use caution when lowering the case onto the output shaft. Case will need to be stabilized by blocking in order to prevent the gearbox from falling!



Fig.20

Install snap ring.

Rotary Drive Service

Cotta Service

Repair Manual

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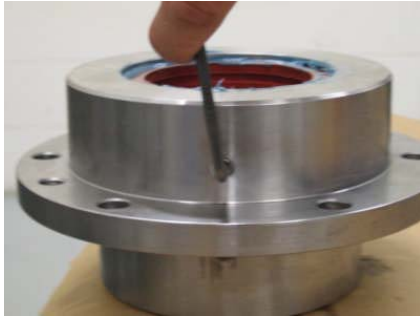


Fig. 58

Wet threads of plug with sealing compound.
(Loctite no. 545)
Install plug in seal housing and tighten firmly.

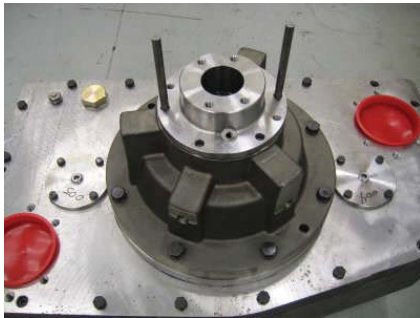


Fig. 59

Cover mounting surface of seal housing with sealing compound.
(Loctite no. 17430)
Assemble seal housing and shims to large seal housing.

Note: Pay attention to align the oil passage of the seal housing and bearing carrier!



Fig. 60

Wet hex head bolts with sealing compound.
(Loctite no. 242)
Screw in hex head bolts and lock washers and tighten firmly.

Torque limit (1/2 X 13).....48 ft. lbs.



Fig. 61

Install grease fitting into small seal housing and tighten firmly.

Pipe Rack

Carousel Indexing

To position the drill pipe the carousel must be rotated or "indexed." This is achieved by main carousel shaft rotating within bushings by means of the indexing cylinder. The indexing cylinder will move (rotate) the carousel exactly one pipe position for each full extension of the cylinder provided the indexing pin is engaged. This pin is attached to a hydraulic cylinder which engages the pin in to a hole, between each of the carousel holding pots. The carousel is then locked into position by the carousel lock pin which operates off the same switch as the indexing pin but in the opposite direction. The indexing pin is disengaged when the carousel lock pin is engaged.



Fig. 6-34 Carousel Indexing Assembly

The upper pipe rack of the carousel consists of the retaining and top retaining drum. The top retaining plate in conjunction with the design of the drill pipe allows the carousel to swing over the drill pipe and as the pipe is lowered, secure it within the retaining plate.

The top retaining plate does not play a part in "breaking out," it only retains the drill pipe. The retaining drum prevents the drill pipe from moving upwards and potentially falling out from within the carousel (this could occur when the mast is folded horizontal and the drill is being trammed backwards up sloping ground).

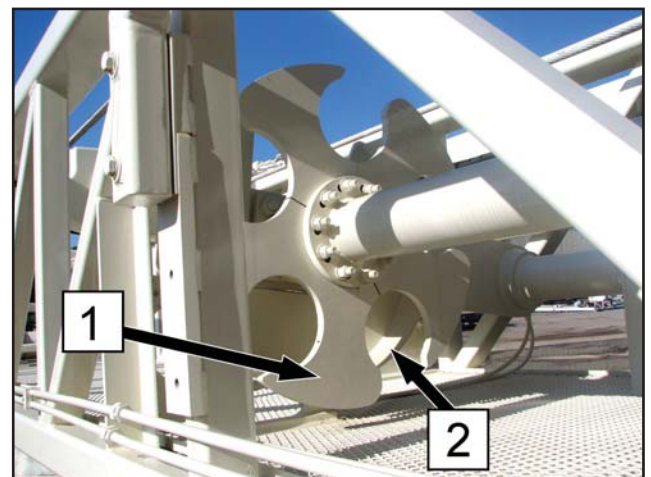


Fig. 6-35 Top Retaining Plate
1. Top Retaining Plate
2. Top Retaining Drum

Winch Assembly



When running out the wire rope, exercise care that the drum stops at the end of the rope run-out and does not begin rewinding in the reverse direction. Stop run-out before reaching the dead lays on the drum.

Wire Rope (cont.)

In addition, the following more detailed inspection should be performed monthly or at more frequent intervals dependent upon operating conditions and usage:

1. Run out wire rope completely and note conditions such as the number of broken wires in one lay, the reduction in rope diameter, corrosion, shortening of the lay and lubrication.
2. Run a soft cloth (preferably cotton) over the entire length of wire rope and examine rope lays which pick up threads of cloth. Determine the extent of damage due to broken wires or nicks.
3. Examine sheaves and drums for abnormal wear, breakage or deterioration. Replace any sheave or drum contributing to rope wear.
4. Examine the wire rope closely at the equalizer sheave location. Where wear is noted, the rope can be shortened from the dead end to change the point of wear. (However, two dead wraps must be maintained on the drum and required lift or operating range not reduced.)
5. Examine socketed fittings; if one broken wire is noted adjacent to the socket, resocket the wire rope.

The length and type of service and the severity of operation must be taken into consideration before determining the disposition of a wire rope which shows signs of damage. Where failure might endanger life of equipment, the rope must be condemned and replaced if any of the following conditions are discovered:

1. Six wires broken in one rope lay.
2. Three wires broken in one strand in one rope lay.
3. Wear of 1/3 the original diameter of outside individual wires.
4. Rope severely kinked, crushed, cut, or unstranded, or any other damage resulting in distortion of rope structure.
5. Considerable corrosion in the valleys between strands.
6. Reduction from nominal rope diameter of more than 1/64 in. (0.3 mm) for diameters up to and including 5/16 in. (3.1 mm); 1/32 in. (0.7 mm) for diameters of 3/8–1/2 in. (9.5–12.7 mm); 3/64 in. (1.2 mm) for diameters of 9/16–3/4 in. (14.2–19.1 mm); 1/16 in. (1.6 mm) for diameters of 7/8–1 1/8 in. (22.2–28.6 mm); and 3/32 in. (2.4 mm) for diameters of 1 1/4–1 1/2 in. (31.8–38.1 mm).

When any of the above conditions exist, the wire rope must be condemned and replaced.

Winch Service

DUAL BRAKE SYSTEM – OPERATION

When hoisting or pulling a load, the brake clutch allows free rotation of the inner brake race and input shaft. The sprag cams lay over and permit the inner race to turn free of the outer brake hub. Figure 2. The friction brake remains fully engaged. The winch, in raising a load, is not affected by any braking action during haul-in.

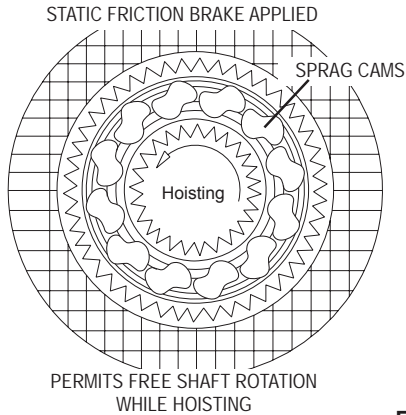
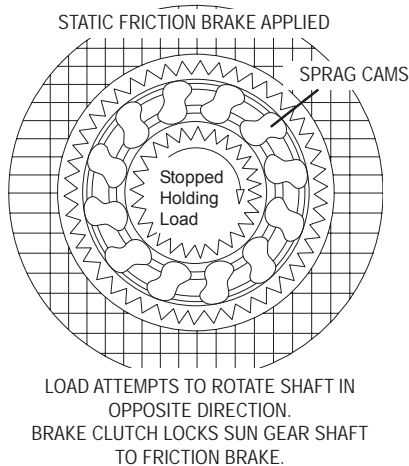


Figure 2

When the haul-in operation is stopped, the load attempts to turn the input shaft in the opposite direction. This reversed input causes the sprag cams to instantly engage and firmly lock the inner brake race to the outer brake hub. Figure 3.

Figure 3



When the winch is powered in reverse, to pay-out cable, the motor and gear train will not rotate until sufficient pilot pressure is supplied to open the brake valve. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower and the opening in the brake valve to decrease thus slowing the descent of the load.

When the control valve is returned to neutral or “hold”, the pilot pressure will drop and the brake valve will close, stopping the load. The friction brake will engage and hold the load after the brake valve has closed.

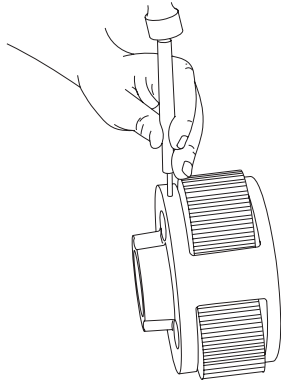
When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the friction brake will release sufficiently to allow the load to rotate the motor through its own internal leakage. This feature results in a very slow speed and extremely accurate positioning.

The friction brake receives very little wear in the lowering operation. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated.

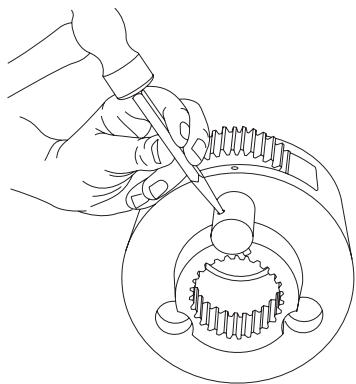
Winch Service

PLANETARY CARRIER SERVICE

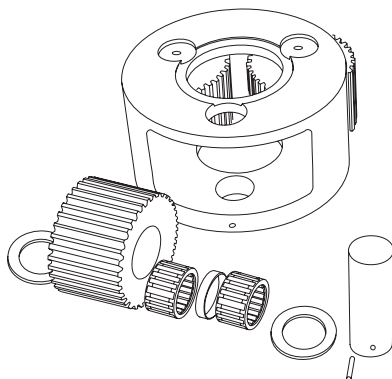
OUTPUT PLANET CARRIER DISASSEMBLY



1. Remove the planet gears by driving the roll pins into the center of the planet shafts.



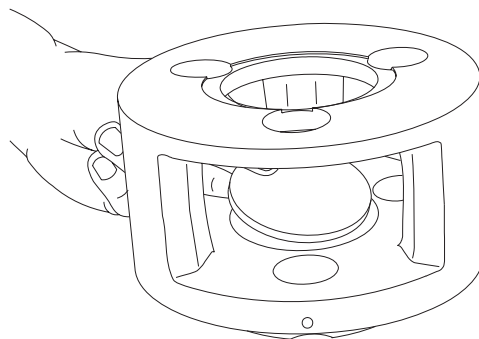
2. Use a punch to drive the roll pins from the planet shafts. Do not reuse the roll pins.



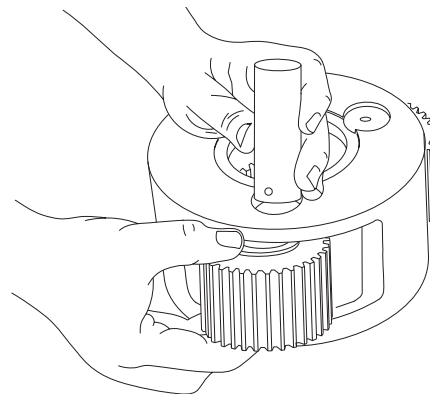
3. Now you can remove the planet shafts, bearings, spacer, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion,

discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the cage should be inspected for unusual wear or deformation, particularly the cage bars. If there is any damage that will impair the cage's ability to separate, retain and guide the rollers properly, the bearing should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shafts should be inspected for abnormal wear or pitting. Replace if necessary.

ASSEMBLY

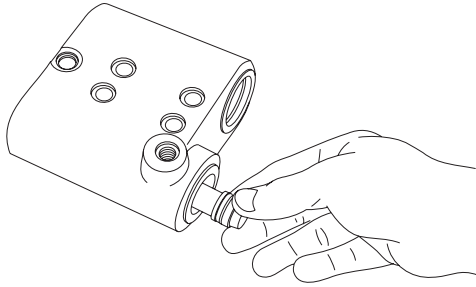


1. Place the output planet carrier on workbench with splined coupling side down. Install output thrust plate in center of carrier.

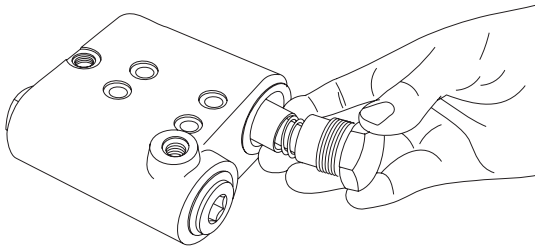


2. Insert two (2) bearings and a bearing spacer into a gear with the spacer between the bearings. Place a thrust washer on each side of the gear and position in a carrier opening. Slide the shaft through the carrier, thrust washer, bearing-gear sub-assembly and remaining thrust washer.

Winch Service



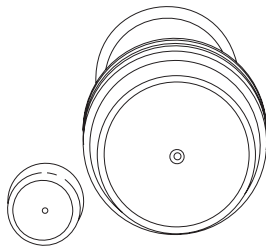
4. Remove spool plug and carefully remove spool assembly.
5. Remove the damper piston from the spool. The piston will come out slowly, because of a partial vacuum formed as it is removed. Use extreme care to avoid damaging the polished surfaces of the piston or spool.



6. Remove the check valve spring retainer, spring and check valve poppet. Check spring free length. Replace spring if less than 1-1/2 in. (38.1 mm) long.

CLEAN AND INSPECT

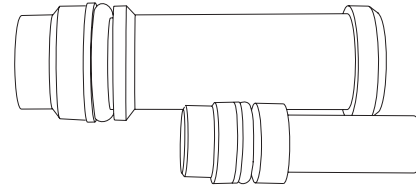
1. Discard all O-rings and back-up rings. Clean all parts in solvent and blow dry. Inspect polished surfaces of spool and damper piston for damage that may cause binding or leakage. Inspect spool bore in valve housing for damage or scoring. Inspect check valve seat in valve housing and check valve poppet. If the spools, bores or valves are damaged, the entire valve must be replaced as these parts are not serviced separately.



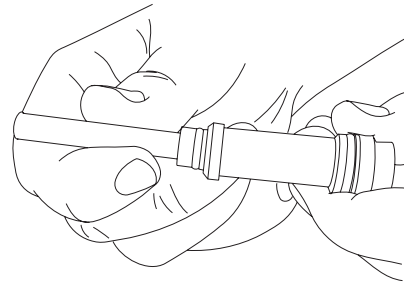
2. Inspect the .020 inch orifice in the end of the spool and the pilot orifice to be certain they are open.

ASSEMBLY

1. Install new O-rings on the plug and spring retainers.



2. Install new O-rings and back-up rings on the spool and damper piston as shown. It is important that each back-up ring is on the correct side of its O-ring. Take care not to cut the O-rings during assembly. Let the spool and damper piston set for ten minutes before installing them in their respective bores. This will allow the O-rings to return to their original size after being stretched.
3. Lubricate the spool and damper piston O-rings with hydraulic oil. Carefully install the damper piston into the spool.



4. Lubricate the spool bore and spool O-rings with hydraulic oil. Carefully install the spool into the valve housing. Always install the spool from the plug end as shown to minimize the possibility of damaging the O-ring. Install the plug, spool spring and spring retainer.
5. Install the check valve poppet, spring and check valve spring retainer.
6. Install the motor drain check ball, spring and elbow fitting.
7. Install the pilot orifice into the valve housing.
8. The brake valve is complete and ready to be installed on the winch motor.

Main Hydraulic Pump Circuit

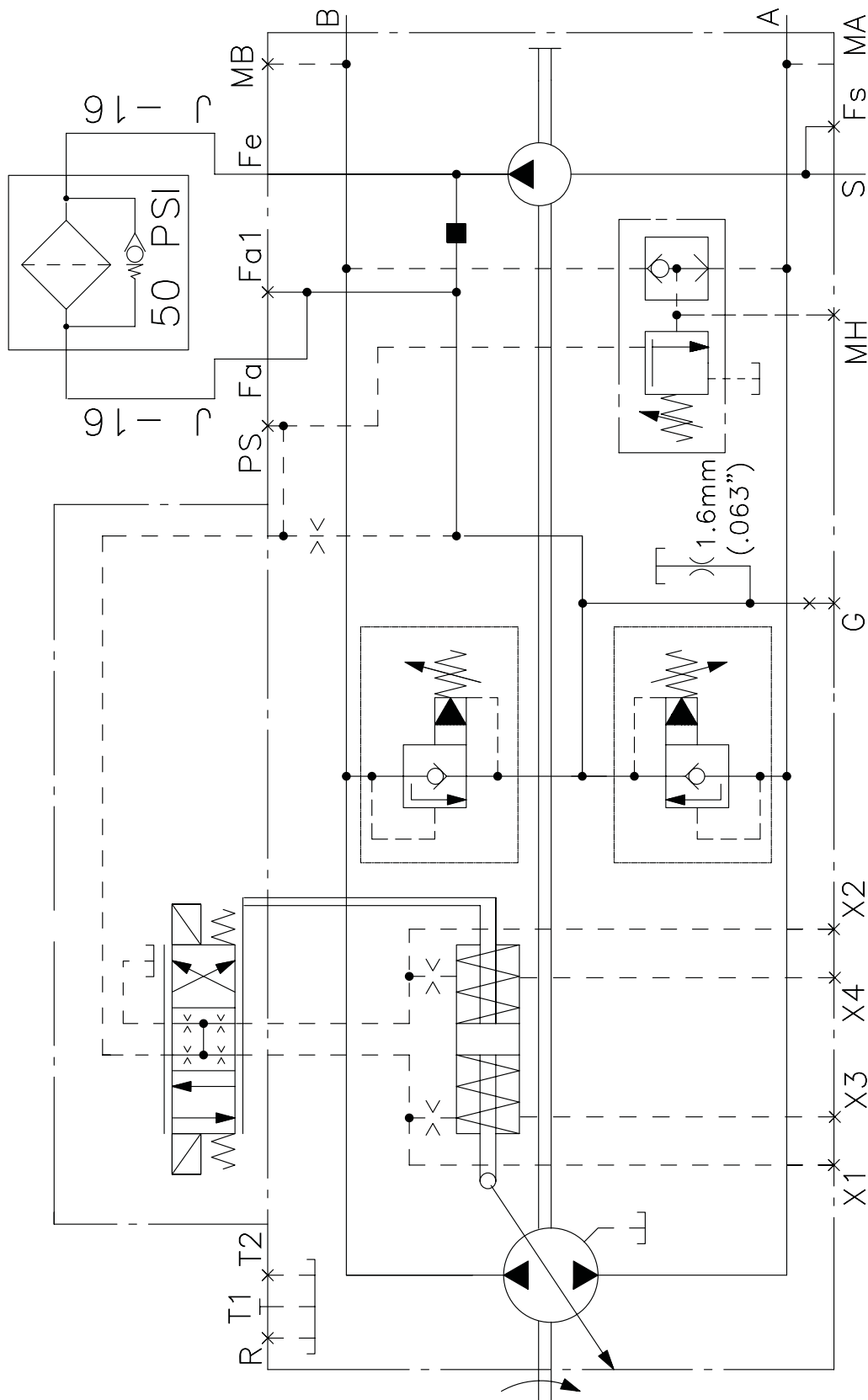


Fig. 7-3 AA4VG Pump Circuit with electric controls (EP)

Main Hydraulic Pumps Adjustments

Stroking Orifices

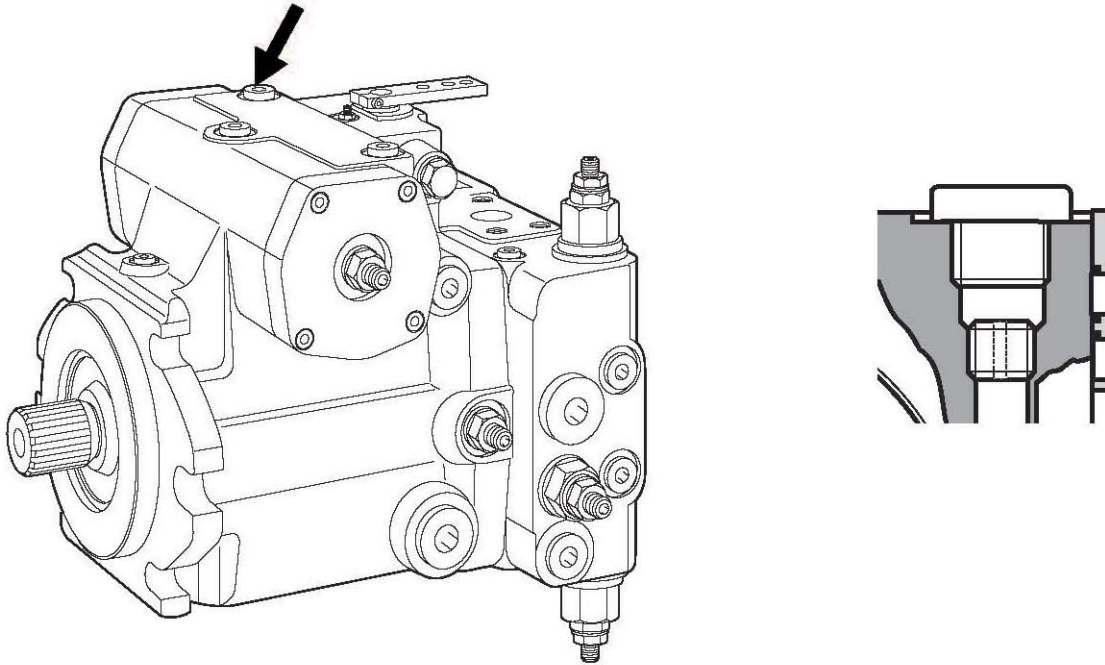


Fig. 7-14 AA4VG180 Hydraulic Pump Stroking Orifices (0.050 in. max)

NOTE

The size of these orifices is important because they control the amount of flow allowed through the control piston when the pump strokes on and off.

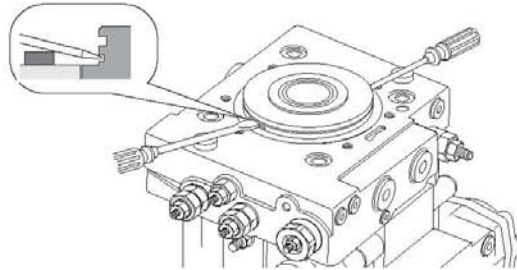
Main Pump Service

Repair

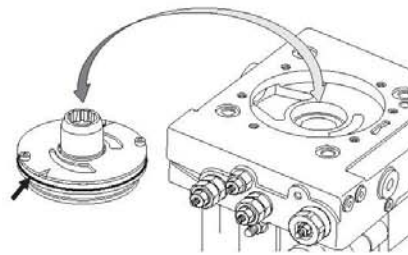
Overhaul of hydraulic pumps in the field is not recommended. Special tools, expert knowledge and absolute cleanliness are essential. It is usually best to exchange the pump for a new or factory rebuilt unit. However, if you choose to do the work yourself, the following manual will be of help. Refer to the parts manual for items specific to your machine.

Main Pumps	Model AA4VG250EP2 (EP Control)
Fan Pumps	Model P365
Auxiliary/Dust Collector Pumps	Model P330

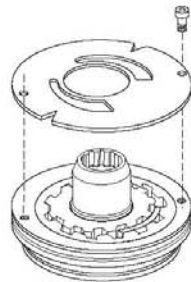
Main Pump Service



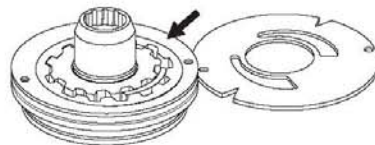
- ⚠️ Hilfspumpe abdrücken.
Abdruckschlitz und Unterlage benutzen!
- ⚠️ Pry off the boost pump.
Use protective support pads and the pry-off slots!



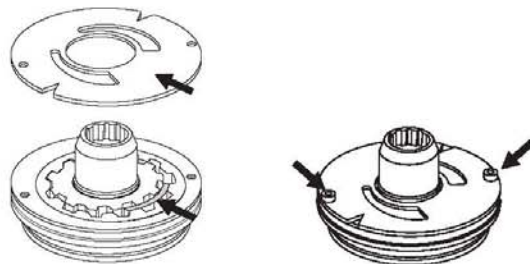
- O-Ring ausbauen.
- Remove O-ring.



- Verschleißplatte demontieren.
- Remove the wear plate.

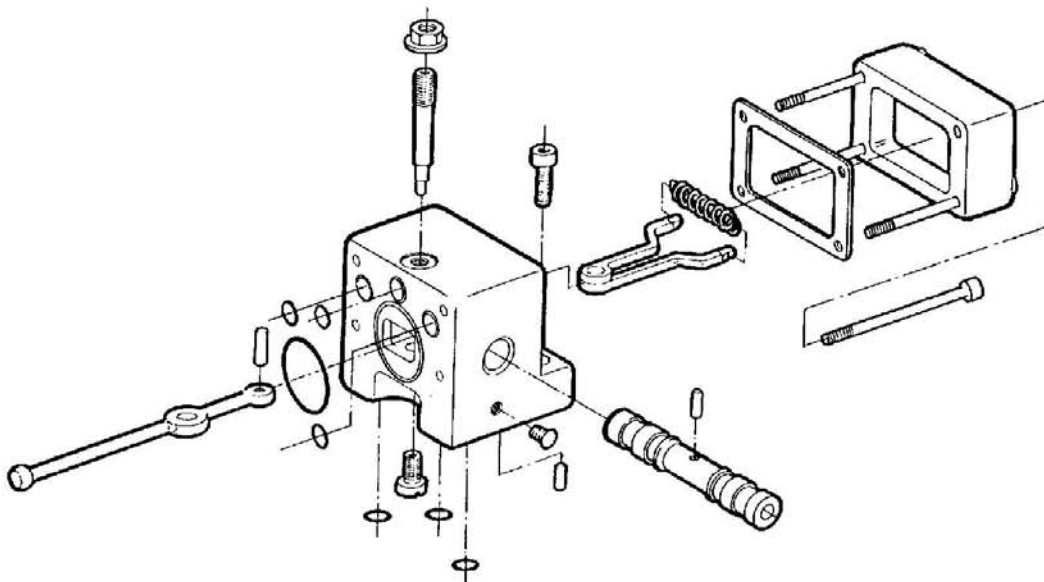
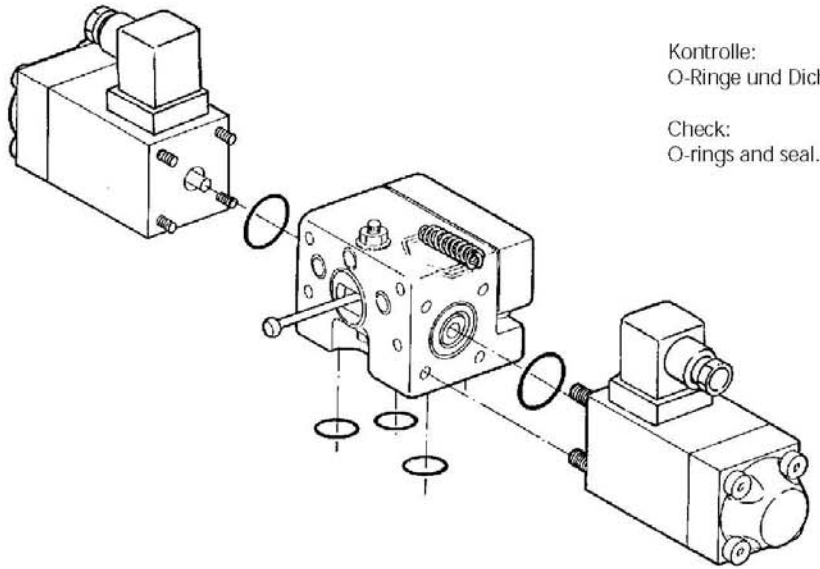


- Hilfspumpe auf Verschleiß kontrollieren.
- Check the boost pump for wear.

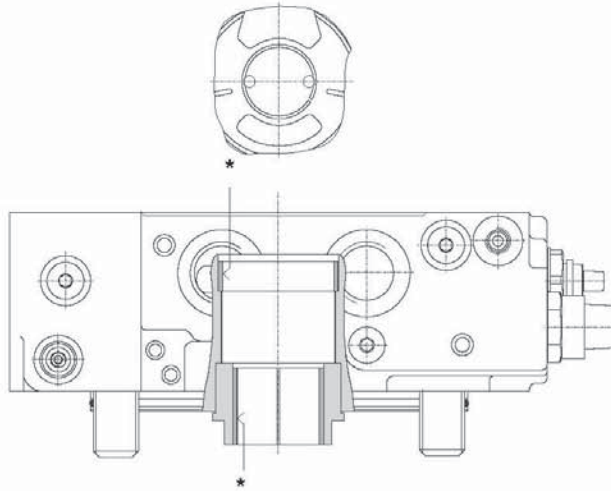


- Verschleißplatte aufsetzen und verschrauben.
- ⚠️ Breite Seite auf Steg.
- Fit wear plate.
- ⚠️ Wide side to the web.

Main Pump Service



Main Pump Service



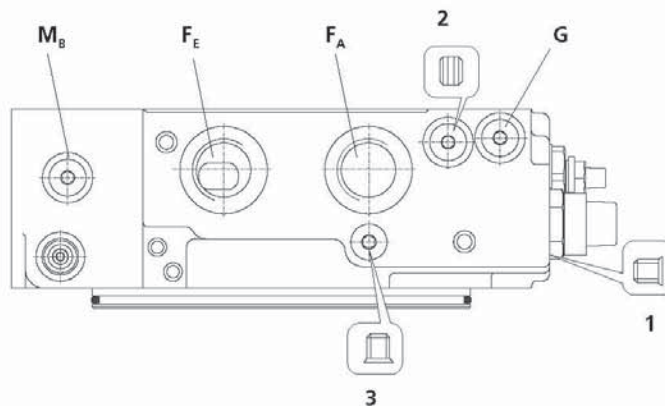
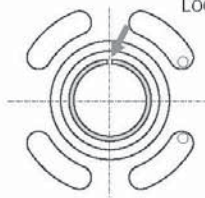
* Lagerbuchse kontrollieren.

Bei Austausch der Lagerbuchsen Einbaulage beachten!

* Check bearing bush.

Take the installation attitude into account when changing the bearing bushes.

Lage der Trennfuge /
Location of the dividing groove



G: Meßstelle Speisedruck / Boost pressure test point

F_A: Filterausgang / Filter outlet

F_E: Filtereingang / Filter inlet

M_A: Meßstelle / Test point

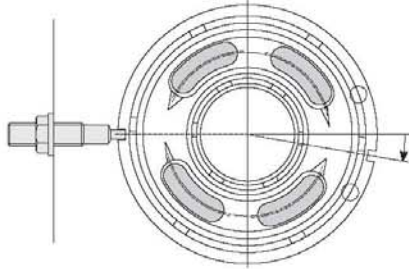
M_A: Meßstelle HD / Test point HD

1 Verschlußstopfen bei Druckfiltration / Plug with pressure filtration

2 Düse für Vorsteuerung / Orifice for pilot control

3 Bei DA-Steuerung kein Verschlußstopfen / With DA control, plug is not fitted.

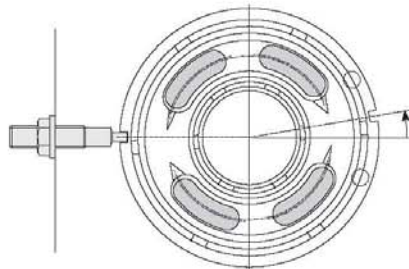
Main Pump Service



Steuerplatte Rechtslauf - in Drehrichtung verdreht.
Achtung!
Gerauschkerben sind drehrichtungsbezogen eingeschliffen.

Control plate clockwise rotation - indexed in the direction of rotation.

Note!
Noise grooves are machined - based on direction of rotation.

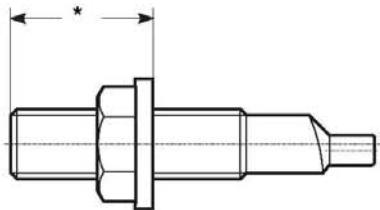


Steuerplatte Linkslauf - in Drehrichtung verdreht.
Achtung!

Gerauschkerben sind drehrichtungsbezogen eingeschliffen.

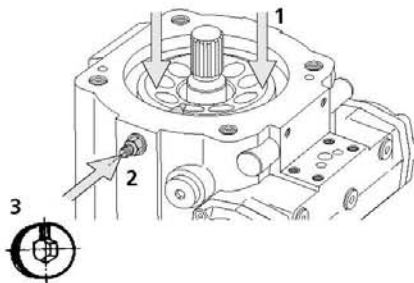
Control plate counter clockwise rotation - indexed in the direction of rotation.

Note!
Noise grooves are machined - based on direction of rotation.



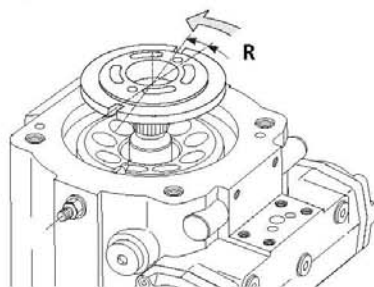
Grundeinstellung - Verdrillschraube
A4VG...250 * = $25 \pm 0,75$ mm

Basic setting - indexing screw
A4VG...250 * = $25 \pm 0,75$ mm



Zylinder nach unten drücken (1).
Verdrillschraube einbauen (2).
Kerbe in Montageposition.

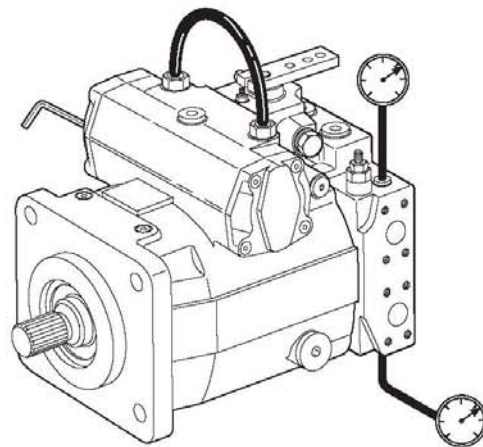
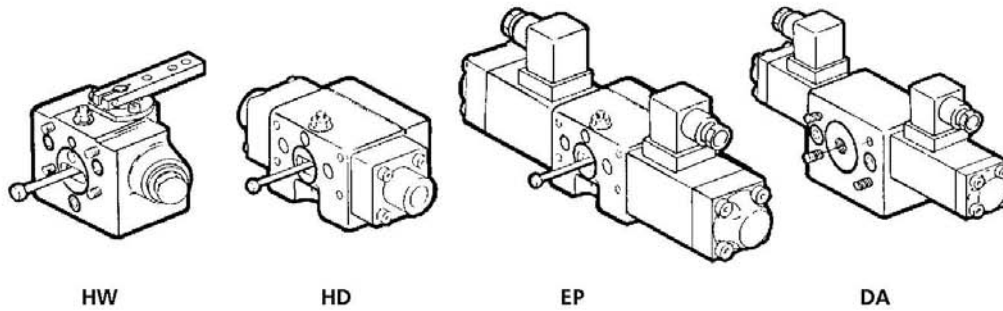
Press the cylinder downwards (1).
Screw in the indexing screw (2).
Groove in assembly position.



Steuerplatte einsetzen - Rechtslauf.

Insert the control plate - clockwise rotation.

Main Pump Service



Achtung!
 Sicherheitsbestimmungen beachten!
 Mit Schlauch NW6 beide Stellkammern verbinden. Vermeidung von Restsignal aus hydraulischer Nulllage.
 Manometer an M_A und M_B anschließen.
 Nulllage so einstellen, daß bei blockiertem Antrieb beide Manometer auf gleichem Druckwert stehen.
 Hinweis:
 Totband der Nulllage - vermitteln.

Attention!
 Observe safety regulations!
 Connect both control chambers with hose NW6. Avoidance of residual signals from hydraulic zero position.
 Connect manometer to M_A and M_B . Adjust zero position so that with a blocked drive both manometers indicate the same pressure value.
 Note:
 Determine the dead band for the zero position.

Gearbox Motor Service

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Gearbox Motor Service

ASSEMBLY PROCEDURES

SHUTTLE VALVE ASSEMBLY INTERNAL DRAIN

- Place valve assembly (10 Fig. 4) in a horizontal position with the O-ring groove up.
- Press seat (11) into the 1/2", 12.7mm diameter bore until it is flush with the body surface.
- Install spring centering washer (4) over each end of spool.
- Install springs (3) over ends of spool and into sockets of centering washers.
- Lubricate O-rings (2) and install over plugs (1). Install the plugs over springs and into body.
- Install spool (10) in bore against seat (11).
- Install spring (9) in spool (10).
- Lubricate O-rings (8) and install on groove of plug (7) on internally drained shuttle.
- Install plug (7) over spring (9) and tighten.
- Install seal (9 Fig. 4) in counter-bore in center of shuttle valve assembly. Hold in place with a coating of grease.
- Install the two seals in remaining counter-bores.
- Install the shuttle valve assembly on port block pad and secure with screws (11 Fig. 4). Torque screws to 20 ft.-lb. , 27 Nm.
- Install orifices (15) if required.

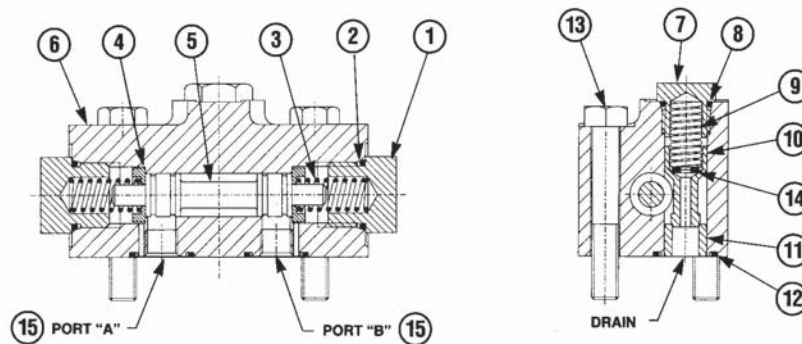


FIGURE 3
S13-48273 assembly, shuttle valve without orifices
S13-48776 assembly, shuttle valve with orifices

PARTS LIST FOR FIGURE 3 Shuttle Valve Assembly

ITEM	DESCRIPTION	S13-48273 Qty.	S13-48776 Qty.
1	Plug	2	2
2	O-ring	2	2
3	Spring	2	2
4	Washer, spring centering	2	2
5	Spool	1	1
6	Body	1	1
7	Plug	1	1
8	O-ring	1	1
9	Spring, relief valve	1	1
10	Spool, relief valve	1	1
11	Seat	1	1
12	Tetraseal	1	1
13	Screw, HHC, 5/16-18 x 2-3/4	3	3
14	Shim washer	*	*
15	Orifice	-	2

*as required

Mast Mounted Control Valve (SD8)

Adjustment Procedure

NOTE

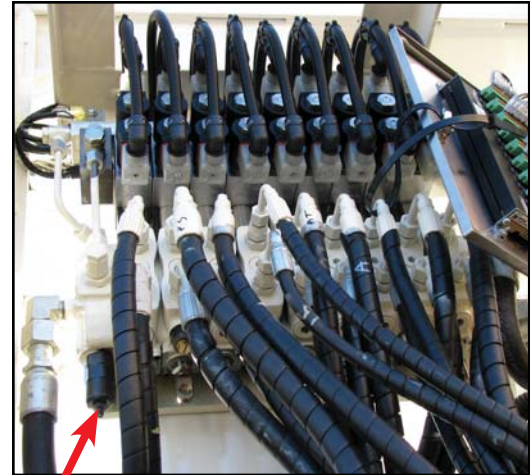
When checking and setting relief valves, the engine should be operated at full governed RPM.

Open service valve on top of hydraulic tank to relieve any residual pressure in system. Open valve for about 30 seconds to let all air escape from tank, then close valve. Install a 3000 PSI (207 bar) test gauge in the inlet port or a work port of the valve.

Start machine and engage one of the valve functions on the mast valve to deadhead the pressure.

Correct relief valve pressure is 2750 PSI (190 bar). This indicates that the relief valve is set properly and that the pump will build pressure. To adjust the relief valve, loosen the jam nut using a 13 mm wrench. Use a 4 mm allen wrench to adjust relief valve adjusting screw.

With the pressure deadheaded, turn the adjusting screw clockwise to increase relief pressure, or counter-clockwise to decrease the pressure. Tighten the jam nut while holding the adjusting screw. Recheck the pressure setting after the jam nut is tightened, to be sure 2750 PSI (190 bar) is showing on the gauge.



Relief Valve Setting Fig. 7-28 SD8 Mast Valve Bank Left Side (dust collector) of Mast

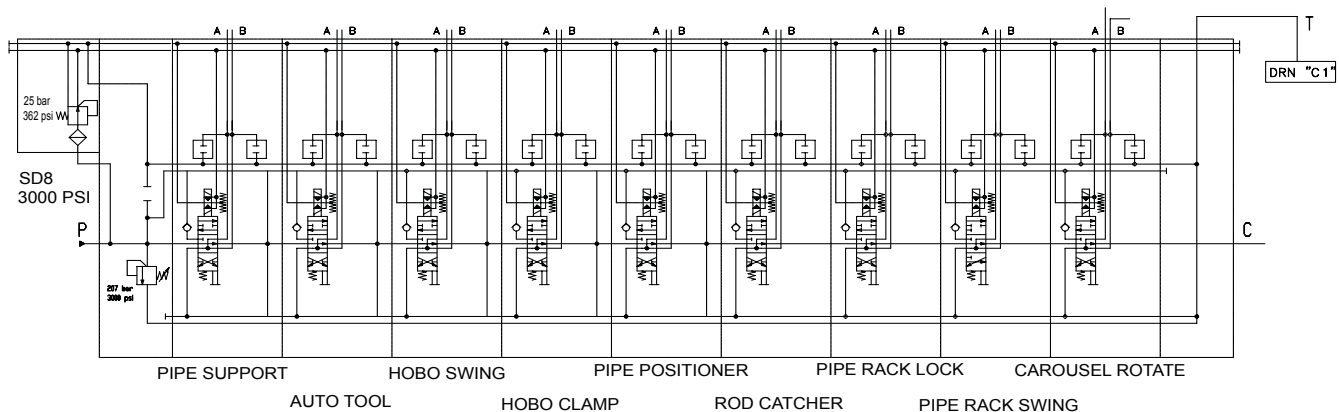


Fig. 7-29 SD8 Mast Valve Circuit

Main Control Valves (SD16 & K170)

Control Valves (SD16 & K170)

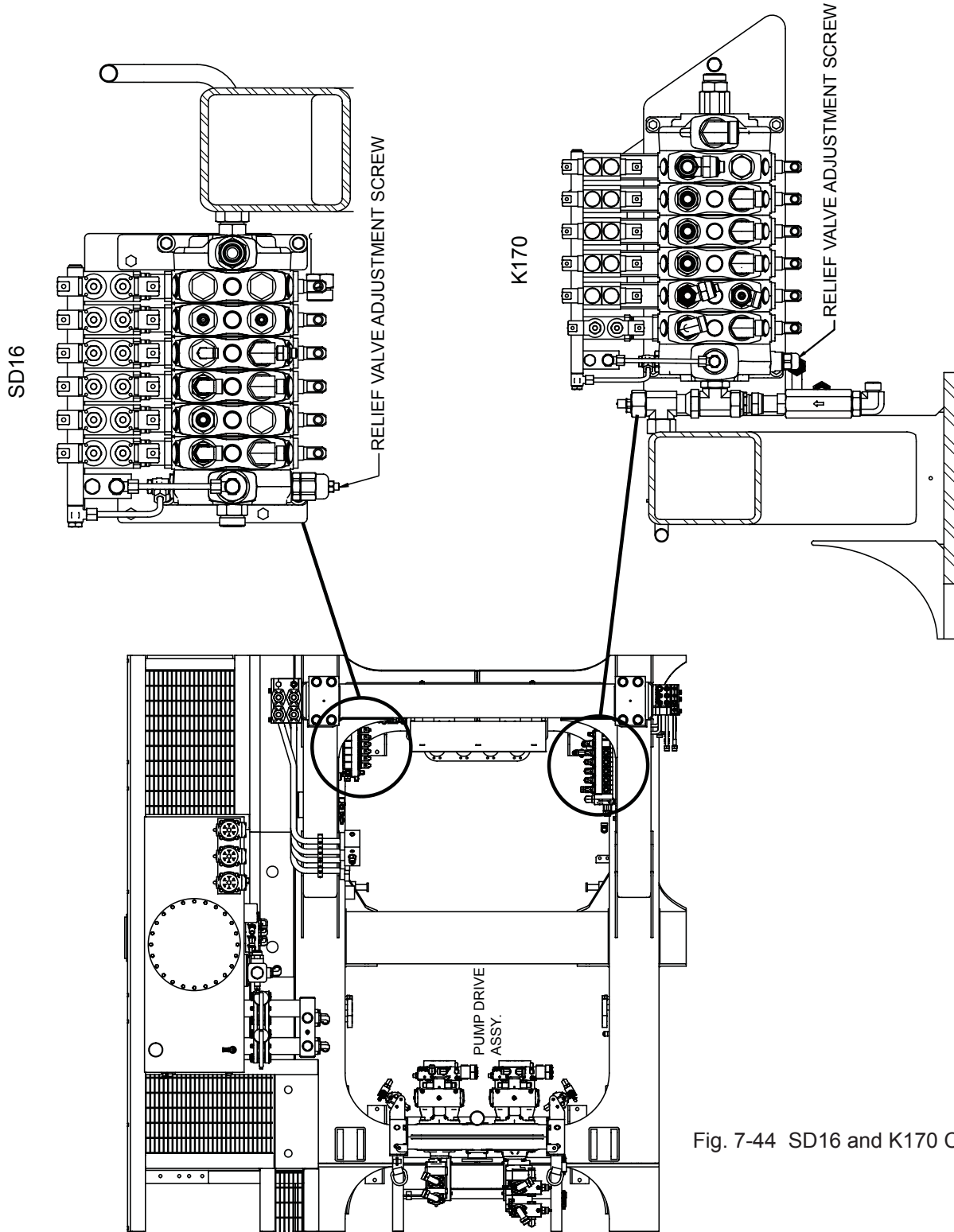
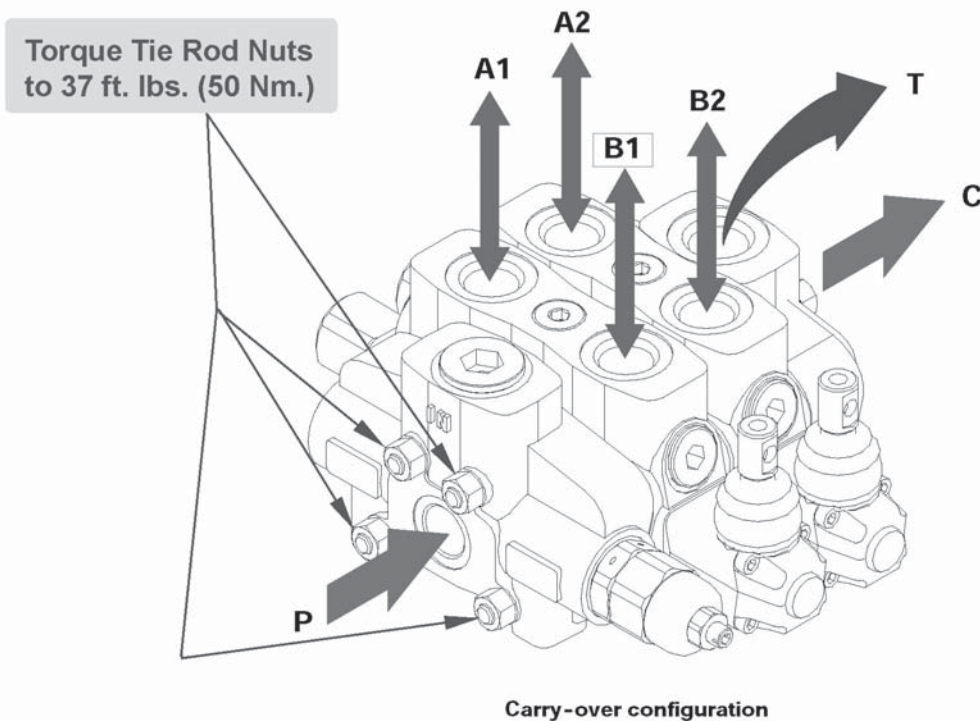


Fig. 7-44 SD16 and K170 Control Valves

6 Section Valve (SD16)

Torque Specifications



Fitting tightening torque - Nm / lbft

THREAD TYPE	P port	A and B ports	T and C ports
BSP (ISO 228/1)	G 3/4	G 3/4	G 1
With O-Ring seal	70 / 51.6	70 / 51.6	100 / 73.7
With copper washer	70 / 51.6	70 / 51.6	90 / 66.3
With steel and rubber washer	70 / 51.6	70 / 51.6	100 / 73.7
UN-UNF (ISO 11926-1)	1 5/16-12 UN-2B (SAE 16)	1 1/16-12 UN-2B (SAE 12)	1 5/16-12 UN-2B (SAE 16)
With O-Ring seal	150 / 110.6	95 / 70	150 / 110.6

Fig. 7-59 5/6 Section Valve (SD16) Torque Specifications

Assembly

1. Plug all openings to keep dirt out. Be sure all o-rings are in place between each section before assembly. There are five round o-rings and one square o-ring between each section. Place a small amount of grease on the o-rings to hold them in place while assembling.
2. Be sure to assemble valve sections on a flat surface. Install the four tie rods, and be sure the valve assembly is perfectly flat. Install the four nuts on each end. Tighten nuts gradually in sequence to 37 ft. lbs. (50 Nm.).
3. DO NOT over-tighten tie rod nuts, as this can cause leakage and valve spool binding or sticking.

Cooler Fan Motor

General Information

F12 is bent axis, fixed displacement heavy-duty motor/pump series. They can be used in numerous applications in both open and closed loop circuits.

Series F12 conforms to current ISO and SAE mounting flange and shaft end configurations. A very compact cartridge version is also available.

Frame sizes: F12-30, -40, -60, -80 and -110.

Thanks to the unique spherical piston design, F12 motors can be used at unusually high shaft speeds. Operating pressures to 480 bar provides for the high output power capability.

The 40° angle between shaft and cylinder barrel allows for a very compact, lightweight motor/pump.

The laminated piston ring offers important advantages such as low internal leakage and thermal shock resistance.

The pump version has highly engineered valve plates for increased selfpriming speed and low noise, available with left and right hand rotation.

The F12 motors produce very high torque at start-up as well as at low speeds.

Our unique timing gear design synchronizes shaft and cylinder barrel, making the F12 very tolerant to high 'G' forces and torsional vibrations.

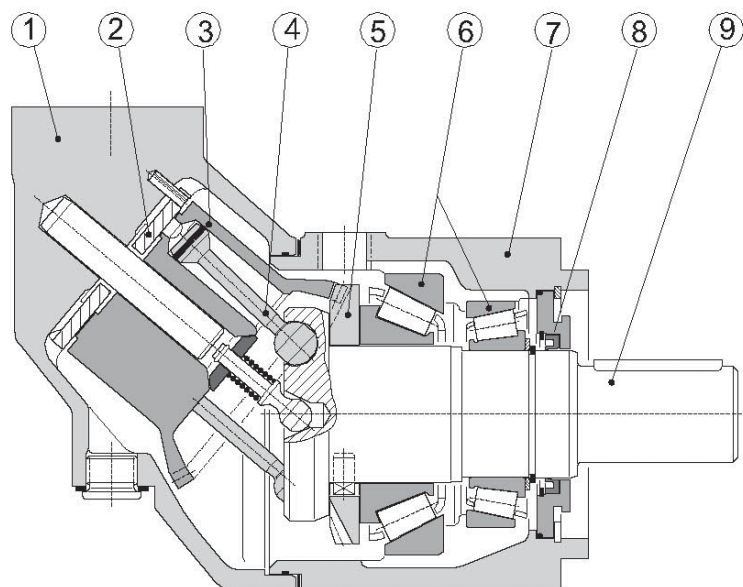
Heavy duty roller bearings permit substantial external axial and radial shaft loads.

The F12's have a simple and straightforward design with very few moving parts, making them very reliable motors/pumps.

The unique piston locking, timing gear and bearing set-up as well as the limited number of parts add up to a very robust design with long service life and, above all, proven reliability.

F12 cross section

1. Barrel housing
2. Valve plate
3. Cylinder barrel
4. Piston with piston ring
5. Timing gear
6. Tapered roller bearing
7. Bearing housing
8. Shaft seal
9. Output/input shaft



Hydraulic Cylinder Repair



RELIEVE all pressure before attempting service or maintenance procedures to this machine.

RELIEVE pressure in both hydraulic and pneumatic systems before loosening any connections or parts.

The following Texas Hydraulics Maintenance Manual provides information on hydraulic cylinder repair for most cylinders on the SKL rotary blasthole drill. Following this is more detailed service information on the jack cylinders.

Refer to the parts manual for the specific machine to identify and order replacement parts for the cylinder under repair. Identify the specific type of head and piston in the cylinder and then follow the steps as outlined below:

1. Follow the **General Information** steps on the following pages.
2. Follow the **Teardown** steps.
3. Follow the **Inspection** steps.
4. Follow the specific **Rebuild** steps for head and piston type under repair.

Hydraulic Cylinder Repair

Z Piston (Threaded)

General

The Z series piston uses ductile iron material, glass-filled nylon wearings (bearing rings), and a specially designed teflon seal called the AQ seal as the primary sealing element. The teflon sealing ring has a small groove on its outside diameter that houses a quad ring seal. The entire ring is energized by a square section rubber loader. A small static o-ring seal is fitted to a groove in the piston and is held in place by the shoulder of the rod. General procedures for teardown, inspection, and rebuild are contained in the General Procedures Maintenance Manual. See your Texas Hydraulics Sales Engineer if you have any questions.

Teardown

Remove the piston as follows: locate and remove the set-screw (it may be underneath one of the wearings). Insert a spanner wrench into the holes provided and turn the piston counter-clockwise (it is a right-handed thread) to remove it. After removing the piston, remove and discard the PRS static o-ring from the rod shoulder. Remove the AQ seal by means of blunt instruments of bronze or aluminum. Be sure there are no sharp edges on these tools. Be particularly careful of scratching the groove surface finish.

Rebuild

Separate the three components of the seal assembly. For easiest installation, warm the teflon outer ring in 120 to 150 °F hydraulic fluid or water. Lubricate the piston and all components with hydraulic fluid. Stretch the inner rubber expander into the seal groove. Do not use sharp edged tools and verify that it has not twisted. Likewise, stretch the teflon outer ring into the groove. Be extremely careful to avoid damaging the seal grooves during installation. Scratching the groove may cause by-pass leakage. The teflon ring will have a memory and may take as long as 24 hours to return to the correct size. This can be accelerated by pushing the piston/seal assembly through a honed or polished tube with an ID equal to the nominal cylinder bore to plus .010 inches. Clean the groove in the teflon ring and install the rubber quad ring. Verify that it has not twisted. If possible, allow the piston/seal assembly to sit at least one hour to allow the seals to elastically restore.

Place the rod on a clean table. Slide the piston onto the rod noting the proper orientation. Turn the piston clockwise until it is hand tight or fully seated (it is a right-handed thread). Insert a spanner wrench into the holes provided, torque the piston and install set-screws as indicated on the print. Install the wearings into the wearing grooves.

Hydraulic Cylinder Repair

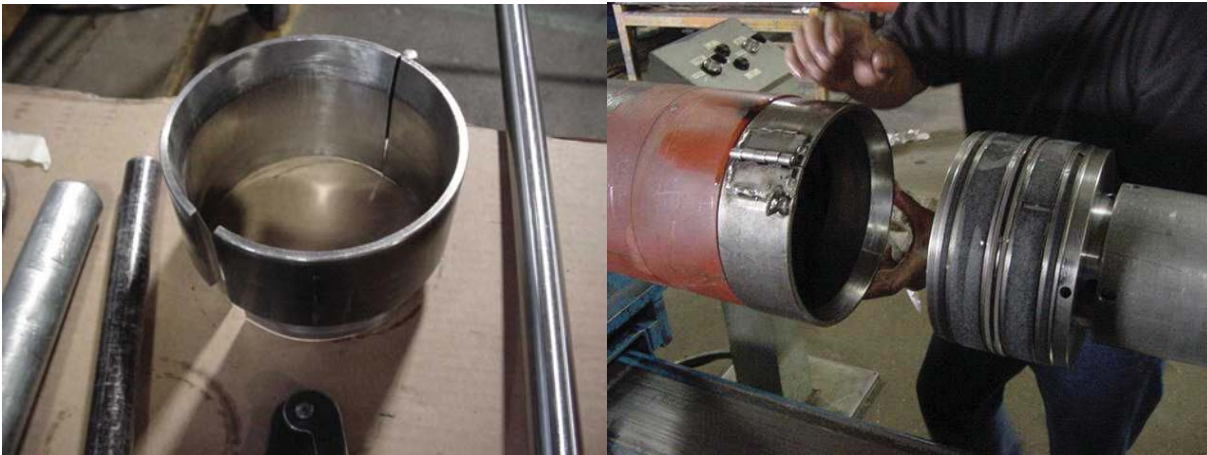
2. GENERAL -- TOOLS, CYL IDENTIFICATION

Tools: The following is a short list of items that should be useful in this service procedure.

- **Spanner Wrench** – This is an adjustable tool that will engage the spanner holes oriented in the face of the threaded components—the headcap and piston. Both use a 0.38” spanner hole. A larger, longer wrench as pictured is essential for the initial breakaway and final tightening. A shorter wrench is useful when the parts are free spinning.



- **Installation Sleeve** – This is a sleeve that is fitted into the tube ID to cover the internal threads and allow the piston to be inserted into the tube bore without trouble (see Appendix A for specific details.) The large and smooth chamfer on the entrance carefully squeezes the piston seal and guides the piston into place. The tool is split so that it can be removed once the piston and rod-tube has entered the tube bore.



Hydraulic Cylinder Repair

6. TESTING—CHECKING REBUILT CYLINDER

After final assembly of cylinder into the machine, slowly operate the cylinder back and forth to fill oil into the cylinder. Do not deadhead the cylinder and allow pressure to build (in the fully extended or retracted condition while purging). This is recommended to aid removal of air internal to the cylinder and reduce the chances of compressing an air pocket which might cause combustion inside the cylinder which could damage sealing components.

While cycling, note that the movement is smooth and without chatter or abnormal noise.

Check the retracted length between the tube mount and the rod mount and the stroke.

Hold pressure at the stroke ends and check for any leakage or loosening.

Check for excessive leakage at the rod.

Perform a bypass test to check internal leakage at the piston seal.

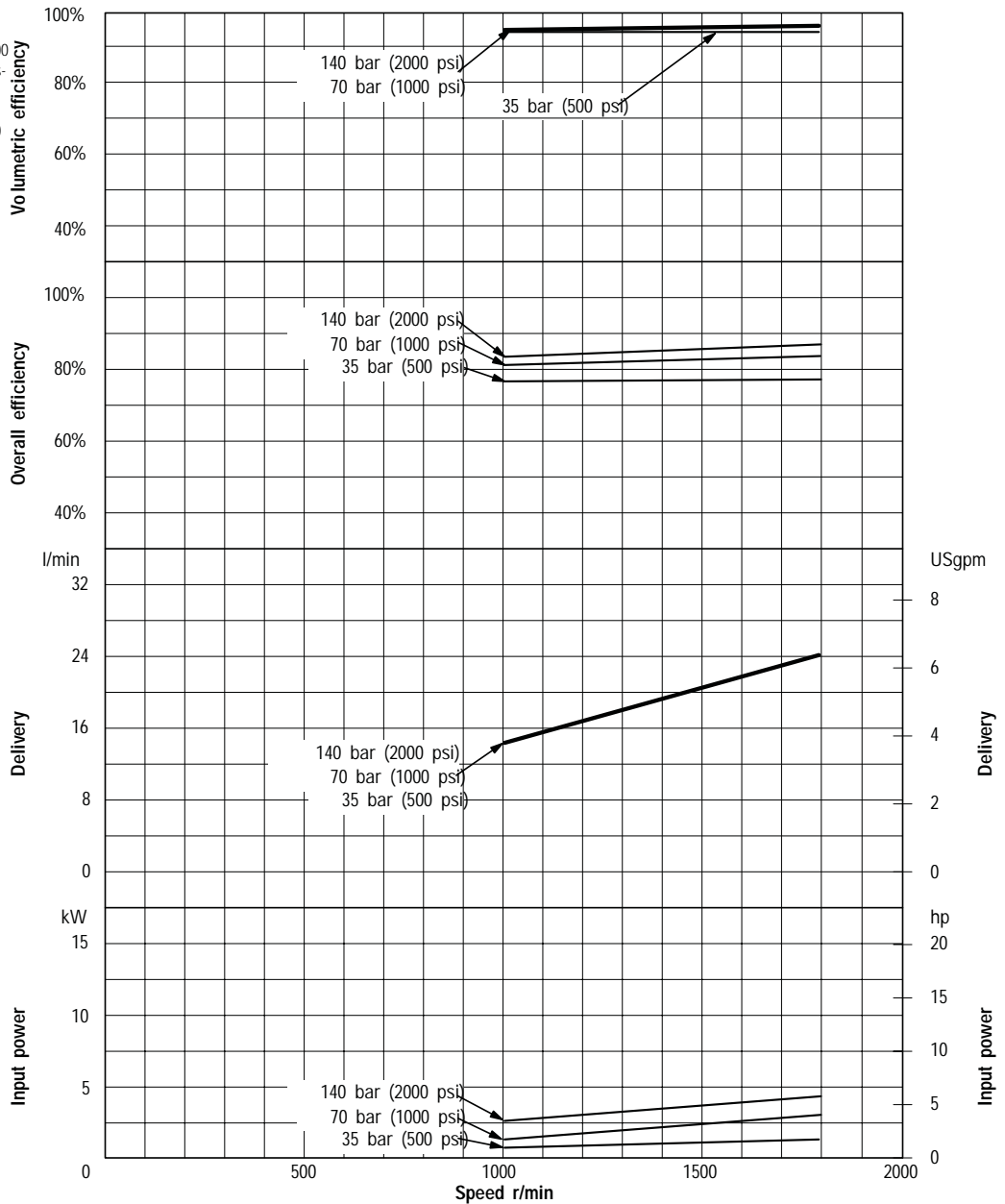
If cylinder is not put into service, seal ports with plugs to prevent contamination.

Cable Reel Hydraulic Pump Service

Performance Curves PVQ13

Oil type: SAE 1W
 Oil temperature: 49°C (20°F)
 Inlet: 0.2 bar (5 in. Hg)

Note: To obtain full flow operation of pump, pressure compensator setting must be 14 bar (200 psi) above desired operating pressure. Full flow curves were obtained with compensator settings 14 bar (200 psi) above 210 bar (3000 psi) max. rated pressure.

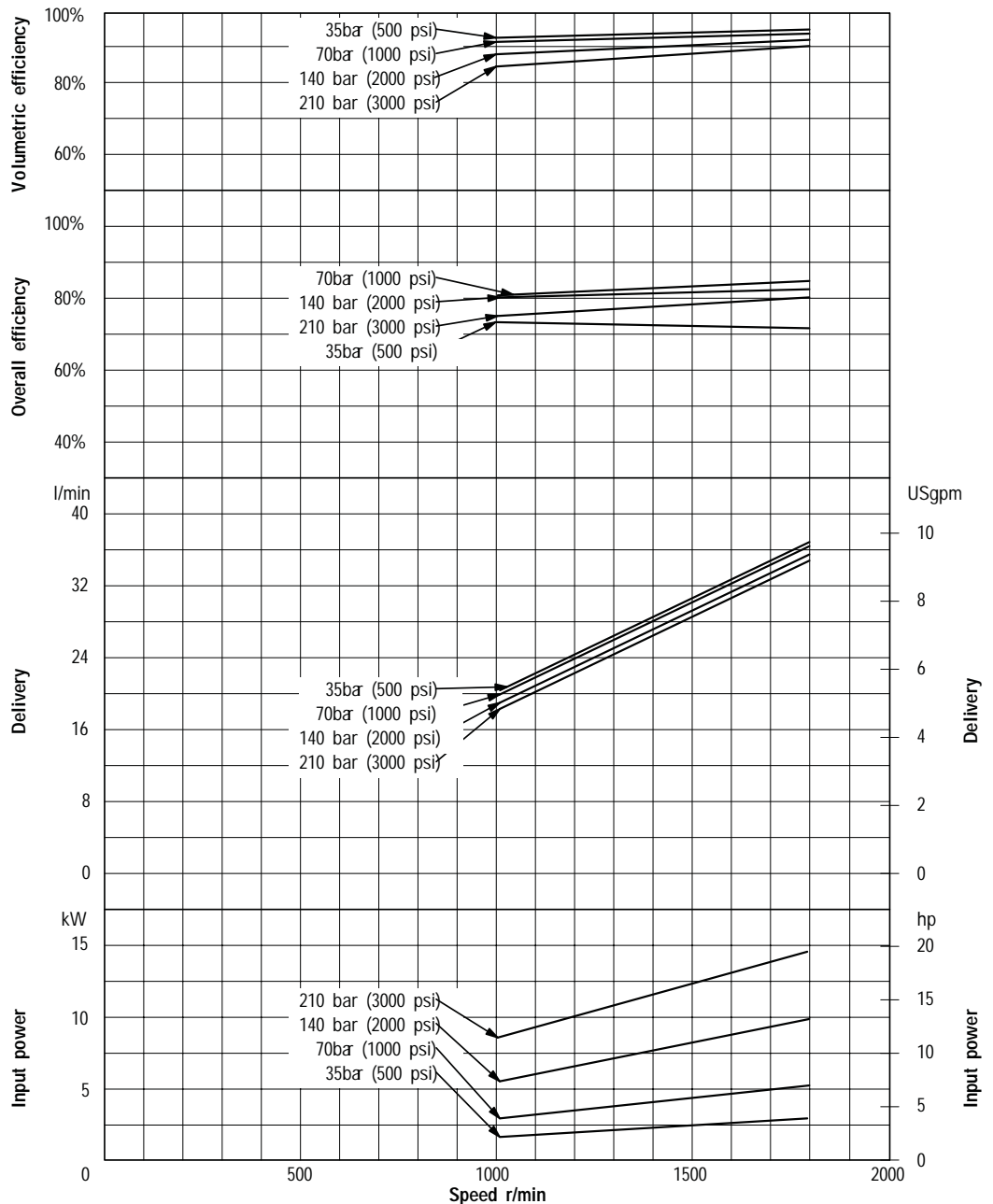


Cable Reel Hydraulic Pump Service

Performance Curves PVQ20

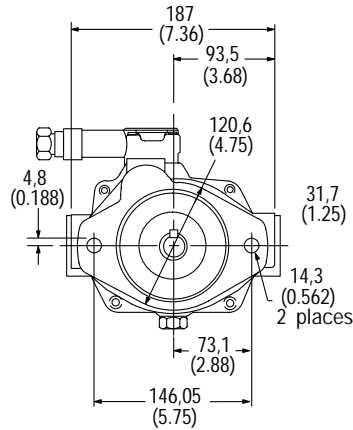
Oil type: SAE 10W
 Oil temperature: 49°C (20°F)
 Inlet: 0.2 bar (5 in. Hg)

Note: To obtain full flow operation of pump, pressure compensator setting must be 14 bar (200 psi) above desired operating pressure. Full flow curves were obtained with compensator settings 14 bar (200 psi) above 210 bar (3000 psi) max. rated pressure.

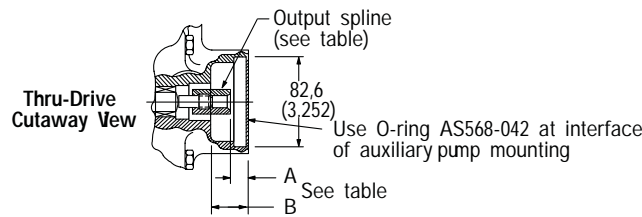


Cable Reel Hydraulic Pump Service

Thru-drives
 PVQ20/32
 "A9" and "A11"
 SAE "A"



Note: Ports are reversed for L.H. rotation
 Control location same for both L.H. and R.H. rotation.



PVQ20/32 "A9" AND "A11" SAE "A"

Model Number System	Spline Data	Max. Torque Nm (in. lb.)	Installation Dimensions mm (in)		Coupling Kit
			A	B	
"A9"	ASA B5.15-1960 9 teeth 16/32 DP Flat root side fit	58 (517)	16,7 (0.66)	33,0 (1.30)	02-136810
"A11"	ANS B92.1-1970 11 teeth 16/32 DP Flat root side fit	123 (1100)	18,5 (0.73)	39,1 (1.54)	02-306041

Note: O-ring included with pump. Coupling kit, cap screws, and washers must be ordered separately to mount rear pump.

Typical
 Rear Pumps
 (with shaf codes)
 for PVQ20/32
 Thru-drives

TYPICAL REAR PUMPS (WITH SHAF CODES) FOR PVQ20/32 THRU-DRIVES

Model Series	Typical Rear Pump	Rear Pump Shaft Code	Thru-drive Coupling Kit
"A9"	PVQ10/13	3	02-136810
	PVB5/6	S124 suffix	
	V10	11	
	V20	62	

Note: "A11" (not listed above) is intended for special application only

Cable Reel Hydraulic Pump Service

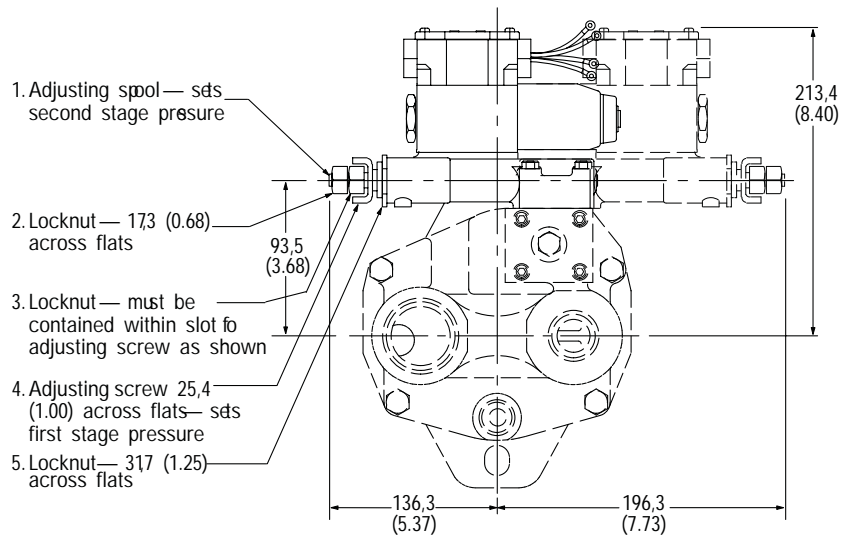
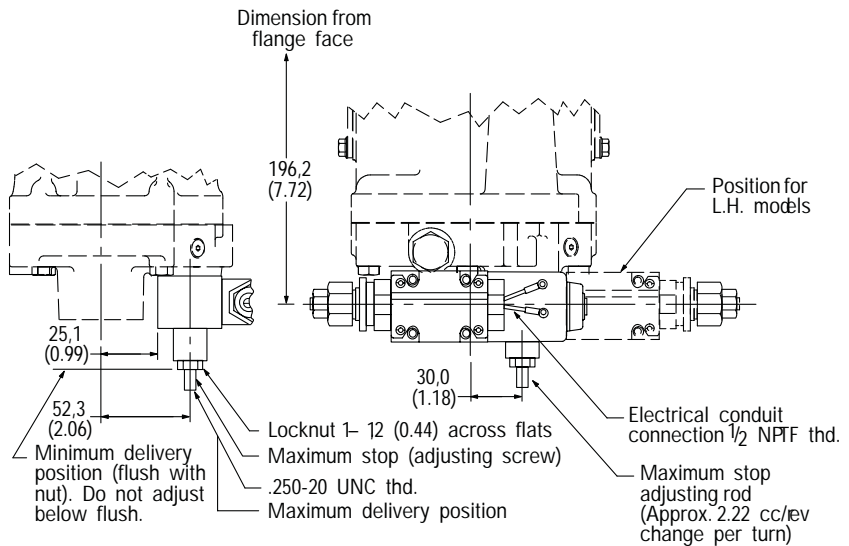
Controls
 Electric Dual
 Range Pressure
 Compensator
 with Maximum
 Displacement
 Stop

Maximum Flow Adjustment

With the system pressure below both compensator settings, loosen maximum stop adjusting screw locknut and adjust screw to desired flow position (turning screw clockwise decreases flow and turning screw counterclockwise increases flow). To lock screw in position, tighten lock nut. To assist initial priming adjust control setting to at least 40% of maximum flow position.

Compensator Control

1. With the directional valve de-energized, loosen locknut "5" and turn the adjusting screw "4" to the desired first stage pressure setting, then tighten locknut "5".
2. With directional valve de-energized, turn adjusting spool "1" counterclockwise until nut "3" is bottomed in adjusting screw slot. (Second stage setting is now equal to first stage pressure setting.) Turn adjusting spool clockwise to desired second stage pressure requirements. One complete turn of adjusting spool equals approximately 41 bar (60 psi). Energize solenoid and check pressure setting. De-energize solenoid and re-adjust if necessary. Secure this setting by tightening locknut "2".



Cable Reel Hydraulic Pump Service

Controls

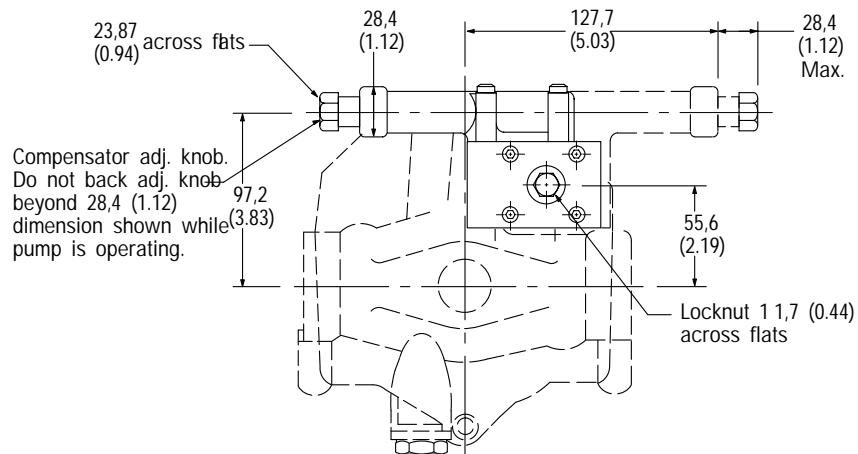
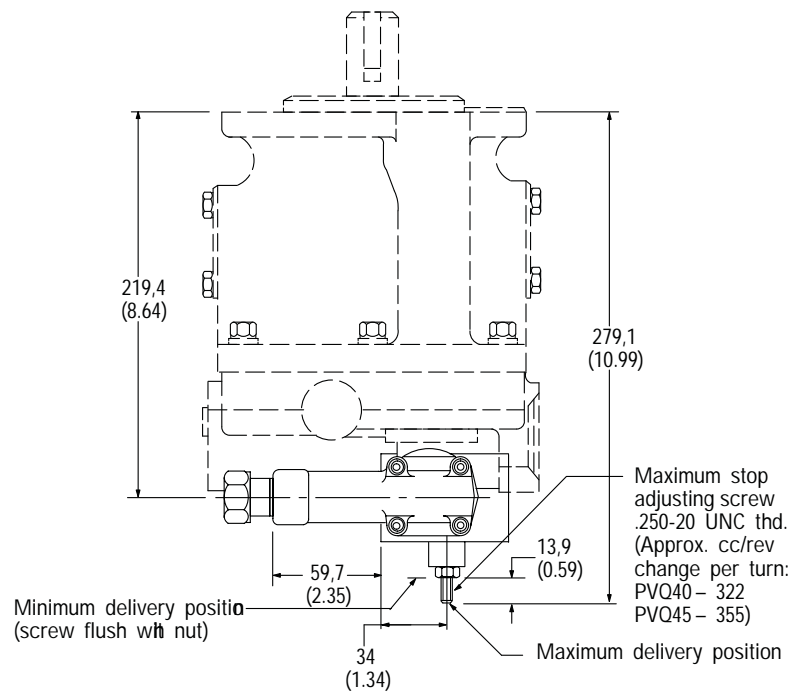
Pressure
Compensator
Control with
Adjustable
Maximum
Displacement
Stop

Adjustment

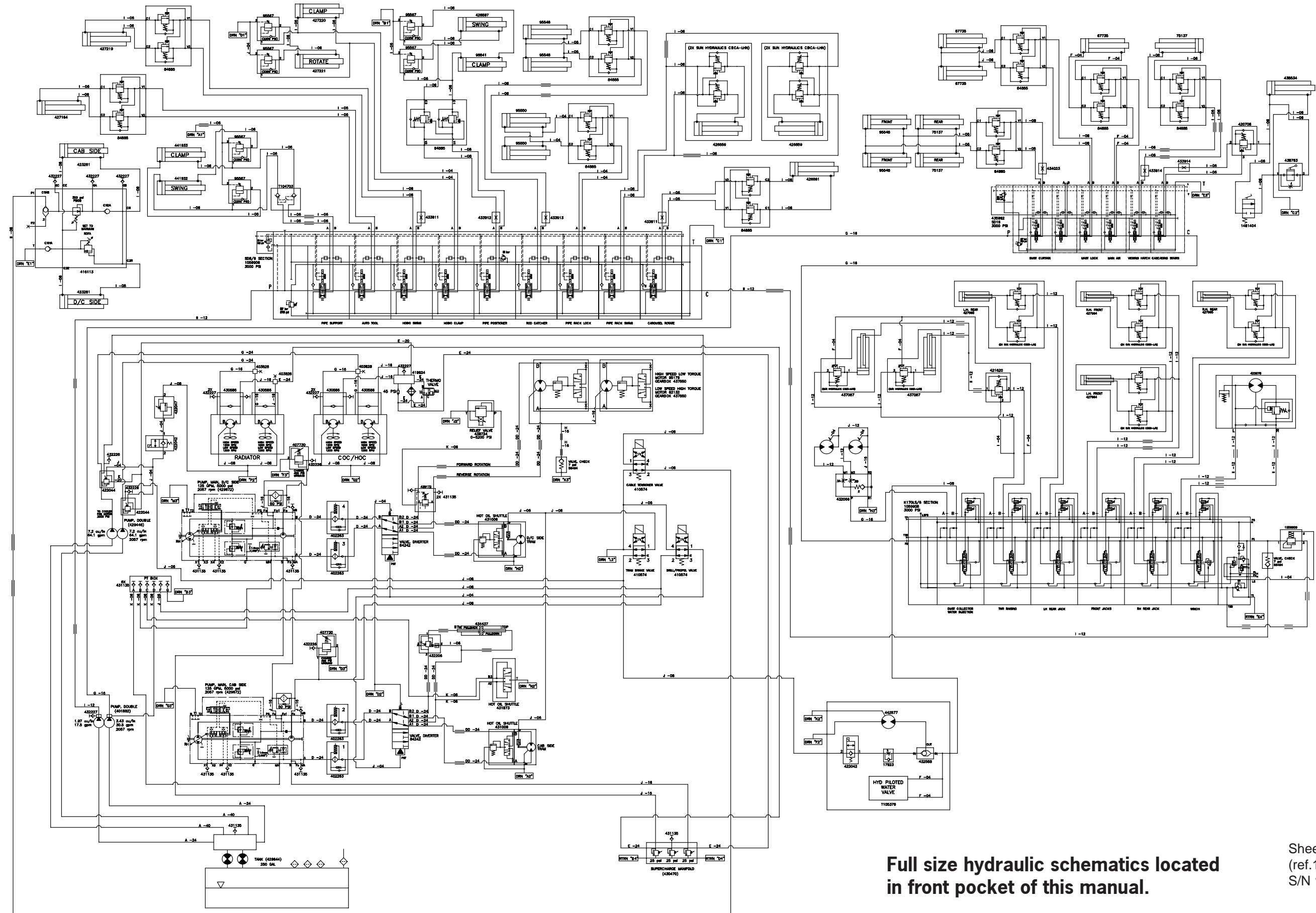
Loosen locknut on adjusting rod. Turn adjusting rod clockwise (CW) to decrease maximum pump delivery or counter clockwise (CCW) to increase maximum pump delivery until desired setting is obtained. Secure this setting by tightening locknut. To assist initial priming manual adjustment control setting must be at least 40% of maximum flow position.

This control enables the maximum pump delivery to be externally adjusted from 25% to 100% while maintaining all of the standard features of a pressure compensated pump.

Note: Not available with thru-drive models.



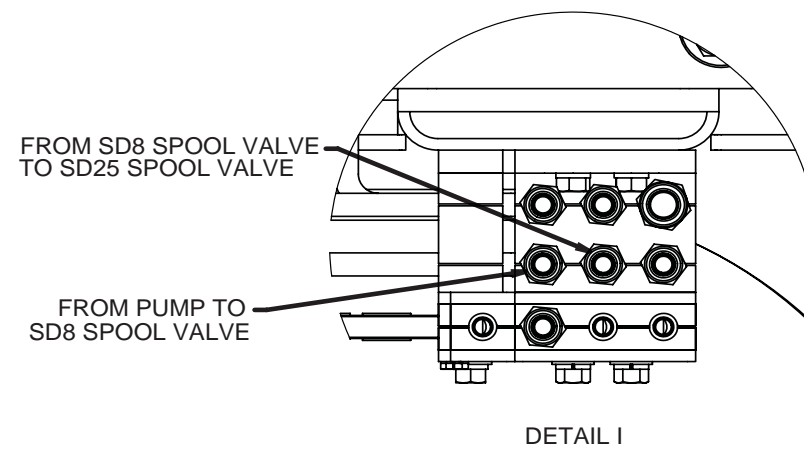
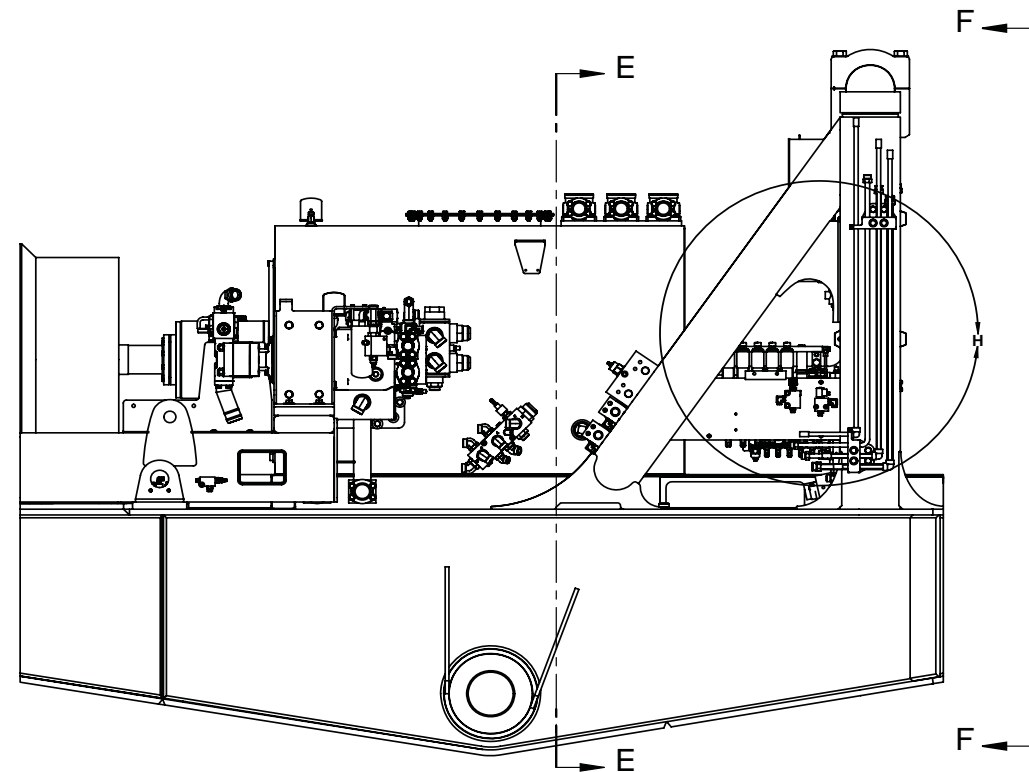
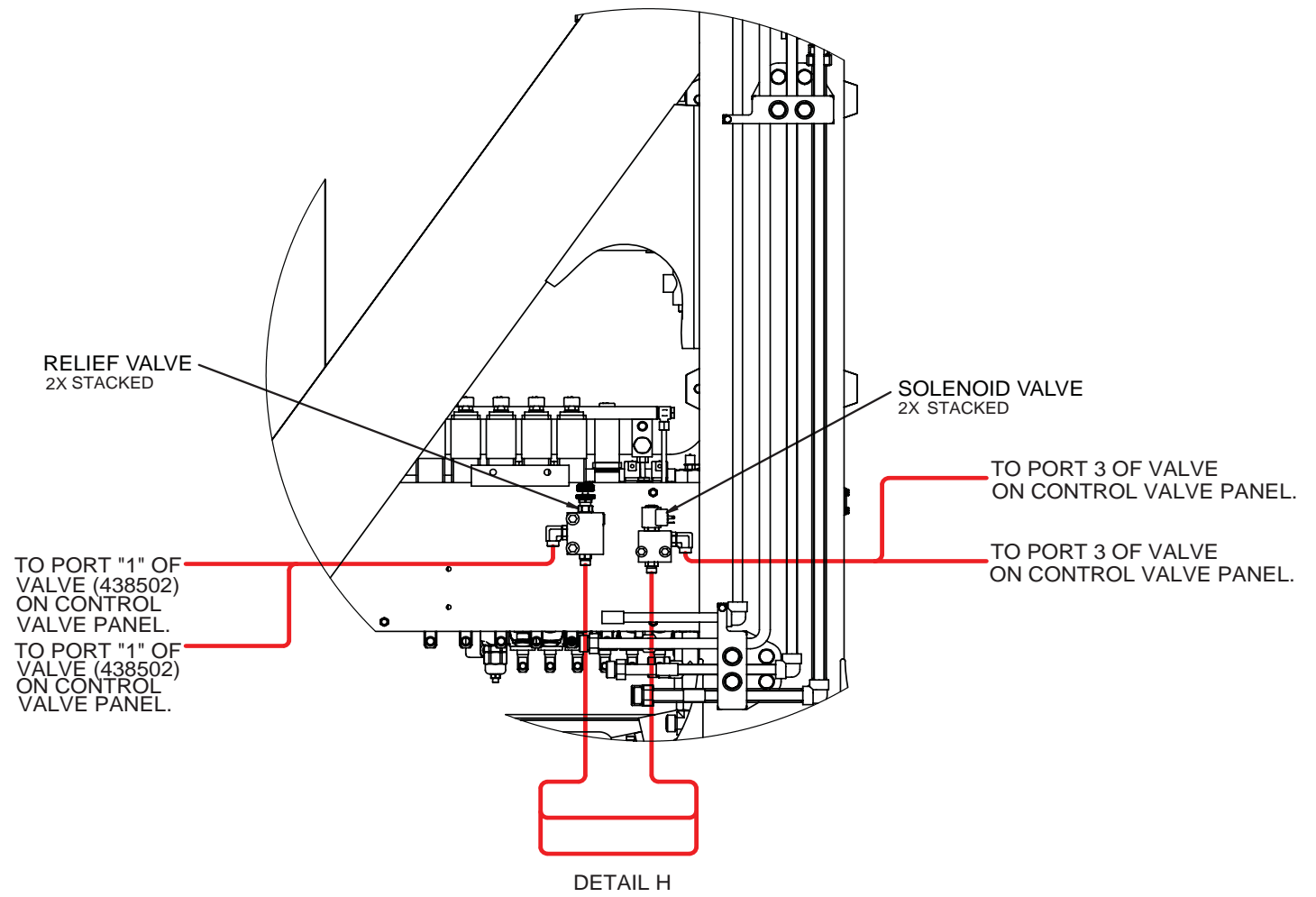
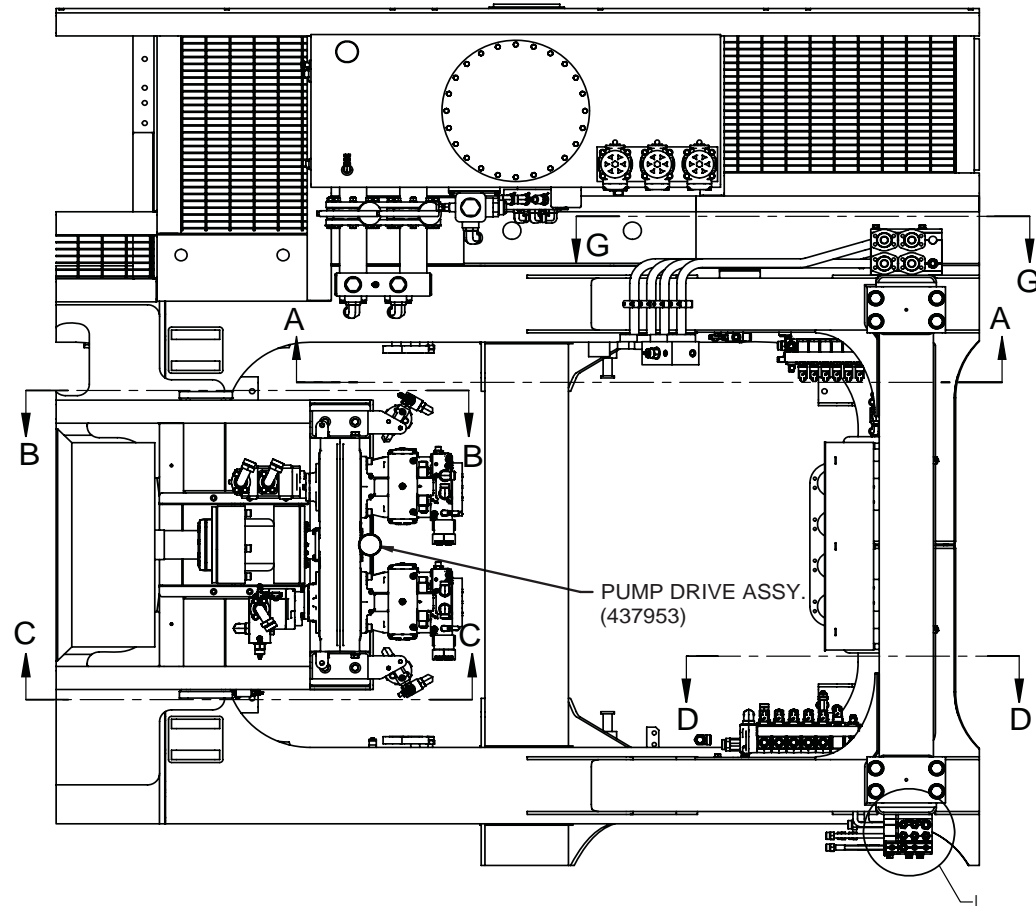
Hydraulic Schematic (Diesel 20M)



Full size hydraulic schematics located in front pocket of this manual.

Sheet 1 of 2
(ref.1054888 rev. 01)
S/N 1M69M49

Hydraulic Piping (Electric)



Batteries



Wear protective clothing, gloves, an acid-resistant apron and a face shield when servicing batteries. Keep sparks and open flames away from batteries. Do not smoke when working around batteries.

Batteries

1. Acid burn, fire and explosion hazards exist when working around drill and vehicle batteries. Sulfuric acid in batteries will cause severe burns. Batteries emit hydrogen gas, which will burn or explode if sparks or flame are present.
2. Always add battery water before starting up, not after shutting down. Keep batteries filled and charged. A discharged battery will freeze at much higher temperatures than a fully charged battery.
3. Always loosen vent caps from the weak batteries and cover with a cloth before charging.
4. DO NOT short across battery terminals. The spark can ignite gases.
5. Be sure battery fluid is at the proper level.
6. When charging batteries, always disconnect battery charger from its power source or turn it off before connecting or disconnecting charger leads to battery terminals.
7. When removing a battery, disconnect ground (-) terminal FIRST.
8. When installing a battery, connect ground (-) terminal LAST.

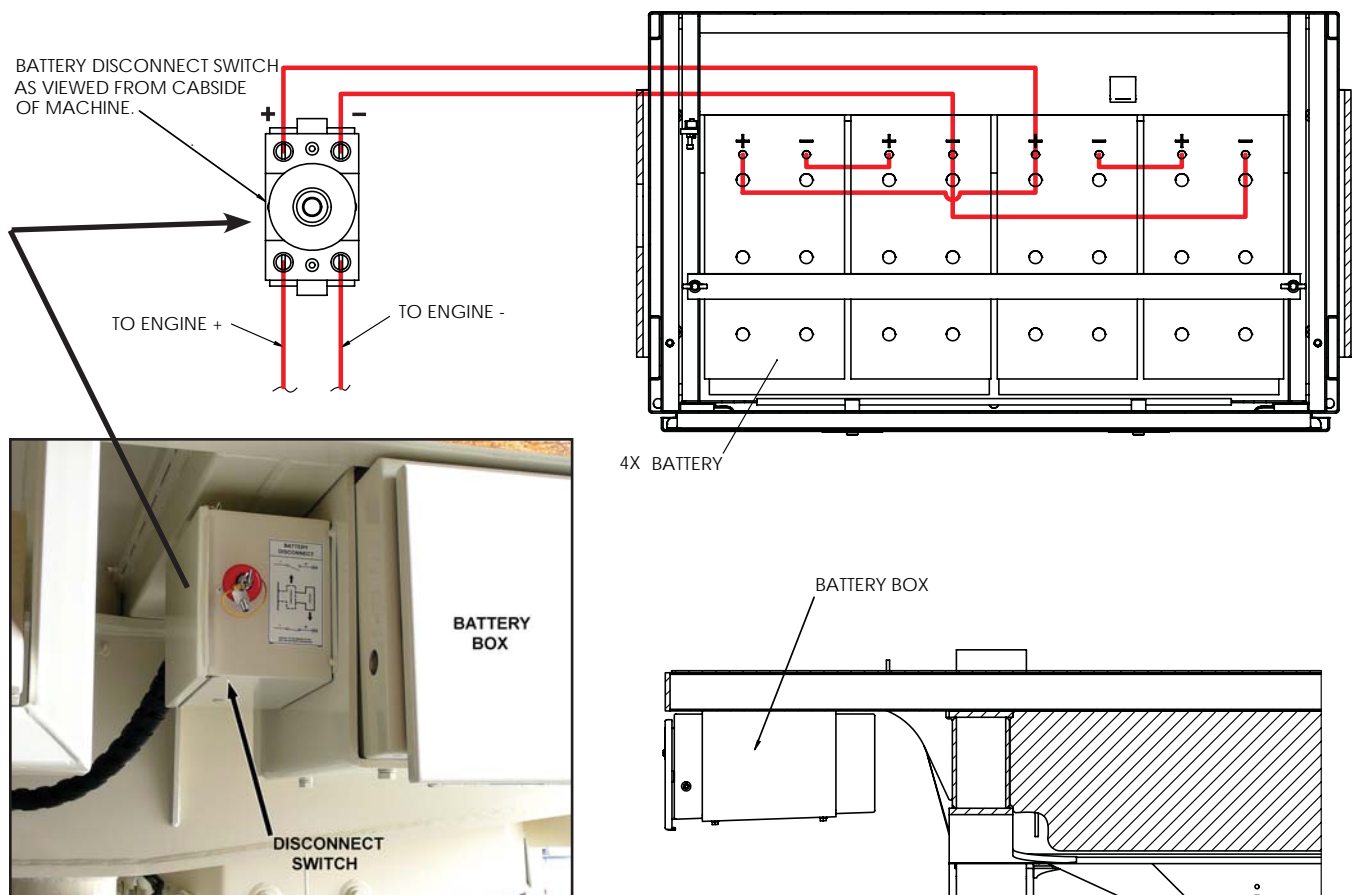


Fig. 8-3 Battery Installation (Diesel)

Electric Drive Motor

4.1.2 Measurement of insulation resistance



During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.

- (a) For rated voltage below 1000V, measured with a 500VDC megger.
For rated voltage above 1000V, measured with a 1000VDC megger.
- (b) In accordance with IEEE 43-2000, there are three recommendation minimum insulation resistance values. These values corrected to 40°C are :
 - (1) $kV+1$ in Megohms for most windings made before 1970, all field windings and windings not otherwise described.
 - (2) 100 Megohms for most DC armatures and AC windings built after about 1970 with form wound coils.
 - (3) 5 Megohms for machines with random wound stator coils and for form wound coils rated below 1kV.

ATTENTION !

After measurement the winding must be grounded for discharging the winding.

- (c) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to a winding :
 - (1) If the motor is equipped with space heaters, they can be energized to heat the winding.
 - (2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 20% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the full applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phase should be connected into one series circuit.



Ensure there is adequate guarding so live parts cannot be touched.

- (3) Heated air can be either blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

Electric Drive Motor

Table 3 oil viscosity for vertical motors**

Bearing Type	Oil viscosity	Range of pole
Angular contact ball (72XX , 73XX)	ISO VG32 (150 SSU/100°F)	2 pole
	ISO VG68 (300 SSU/100°F)	4 pole and above
Spherical roller (293XX , 294XX)	ISO VG68 (300 SSU/100°F)	4 pole
	ISO VG150 (700 SSU/100°F)	6 pole and above
RENK Vertical Bearing Inserts Type EV or Kingsbury Type	ISO VG68 (300 SSU/100°F)	4 pole and above

Table 4 oil viscosity for horizontal motors**

Bearing Type	Oil viscosity	Range of pole
Sleeve bearing	ISO VG32 (150 SSU/100°F)	2 pole
	ISO VG46 (200 SSU/100°F)	4 pole
	ISO VG68 (300 SSU/100°F)	6 pole and above

**Remark: When a lubrication nameplate attached to the motor, use lubrication oil it stipulates.

5.5.6 Cleaning and installation of bearings

- (a) Apply the proper amount of grease to disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.
- (b) Bearing installation

ATTENTION !

Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.

Since the bearing is a high precision component, it is important to avoid ingress of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and ensure clean conditions during installation and assembly.

ATTENTION !

The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be avoided absolutely.

The bearing should be heated in a bath of clean oil at temperature of approx. 80°C. After warming, slide the bearings in place quickly and nimbly so that it has not shrunk before being fully in position.

Grease the bearing after the temperature returns to normal, and then reassemble the motor.

Power Distribution Breaker Box

Power Distribution

The distribution breaker box (fig. 8-11) allows personnel to connect or disconnect power from different systems on the drill. Of particular importance is the ability to disconnect power from heating elements connected to systems that for some reason, heat should not be applied.

The distribution breaker box is located adjacent to the motor starter cabinet, mounted on the compressor air cleaner housing.

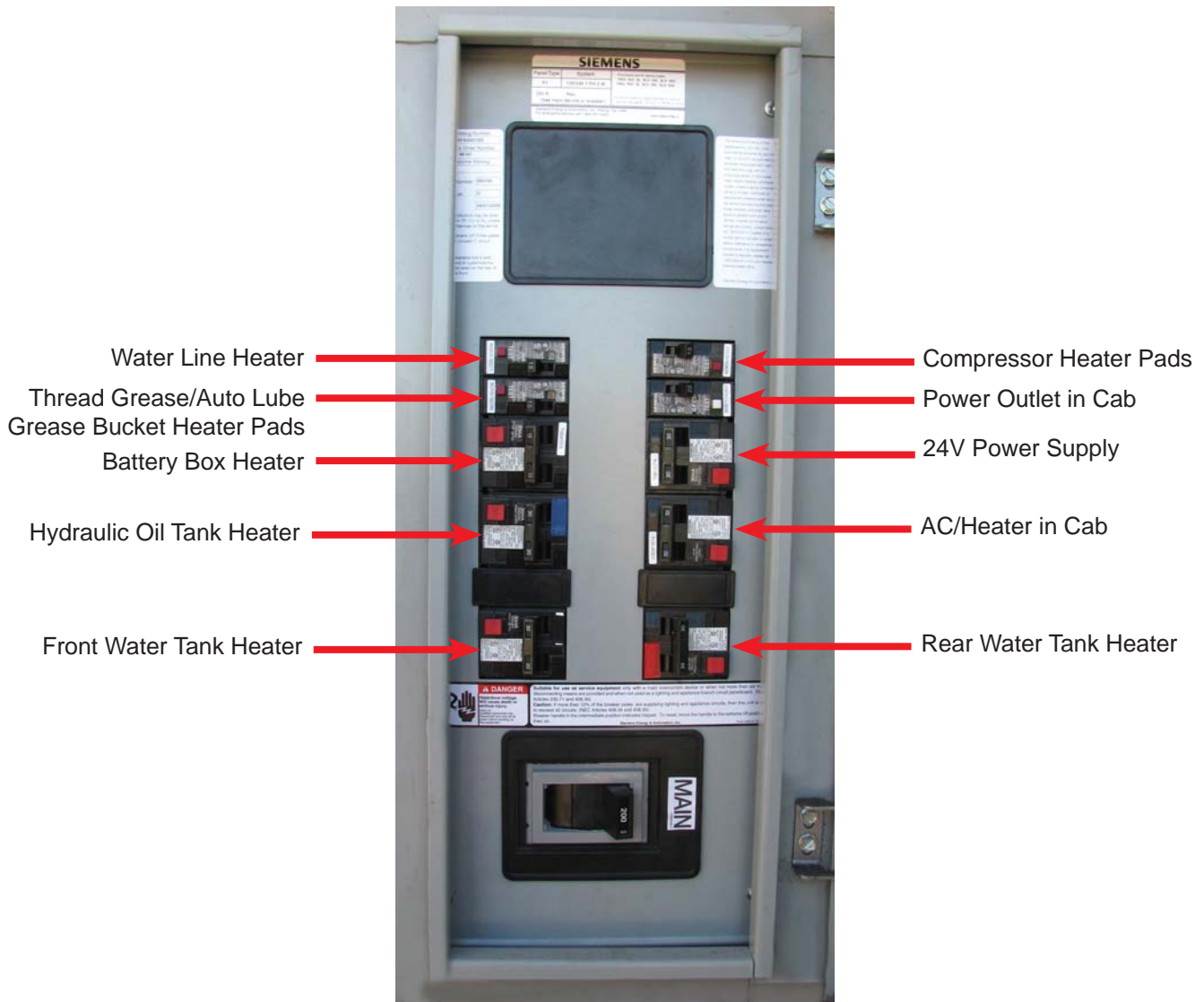
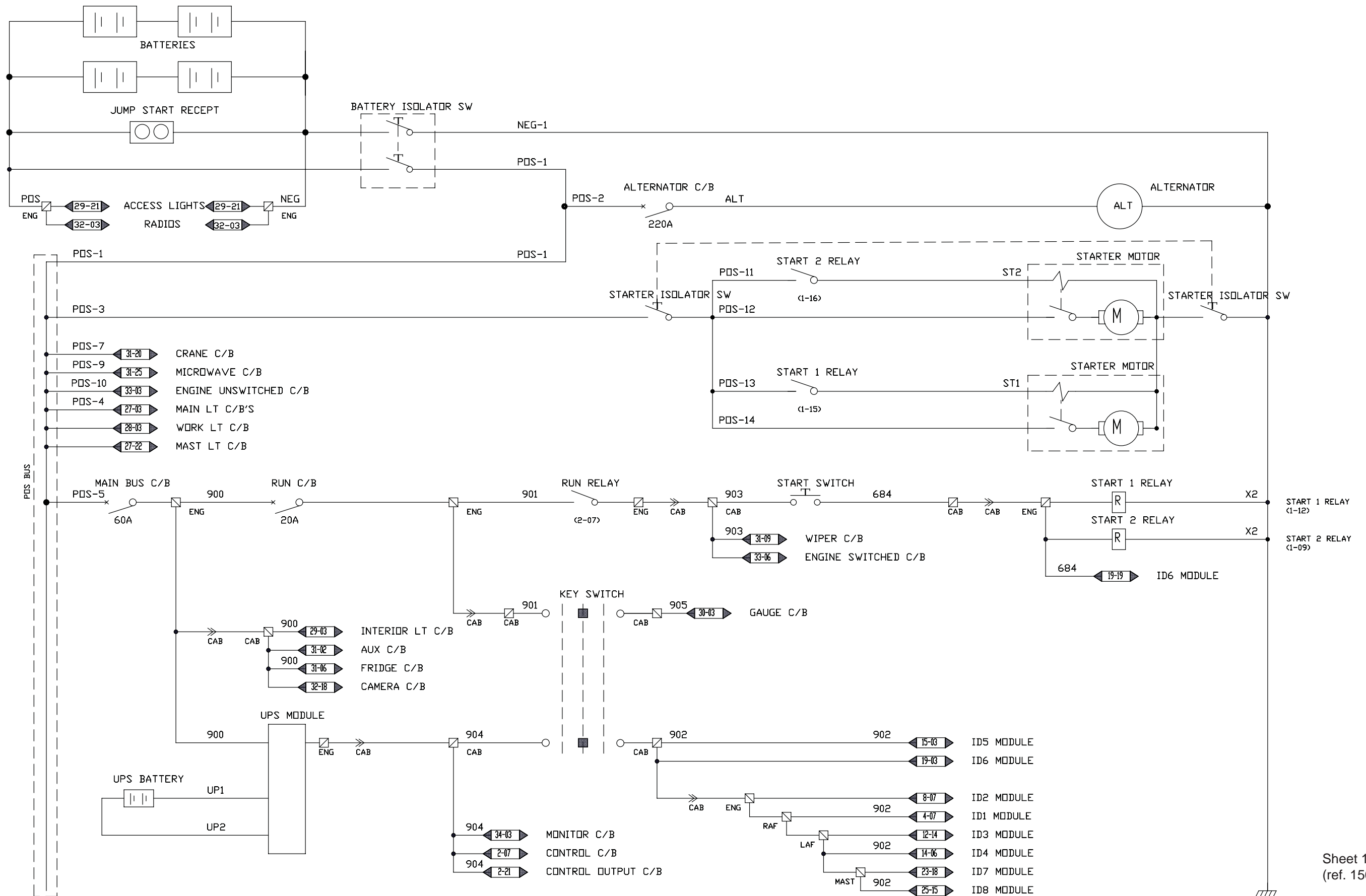
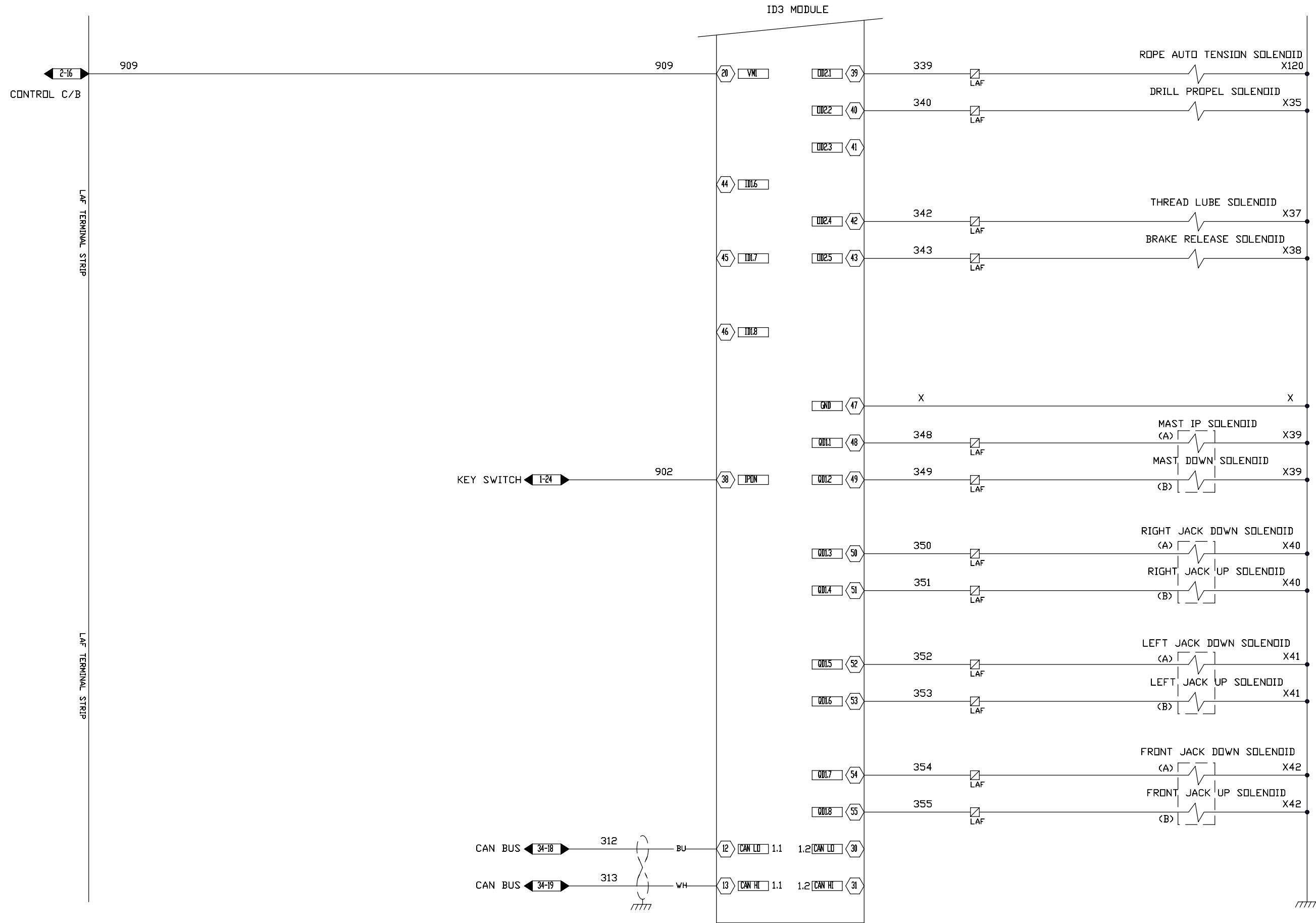


Fig. 8-11 Power Distribution Breaker Box
(Electric Drill with Cold Weather Package)

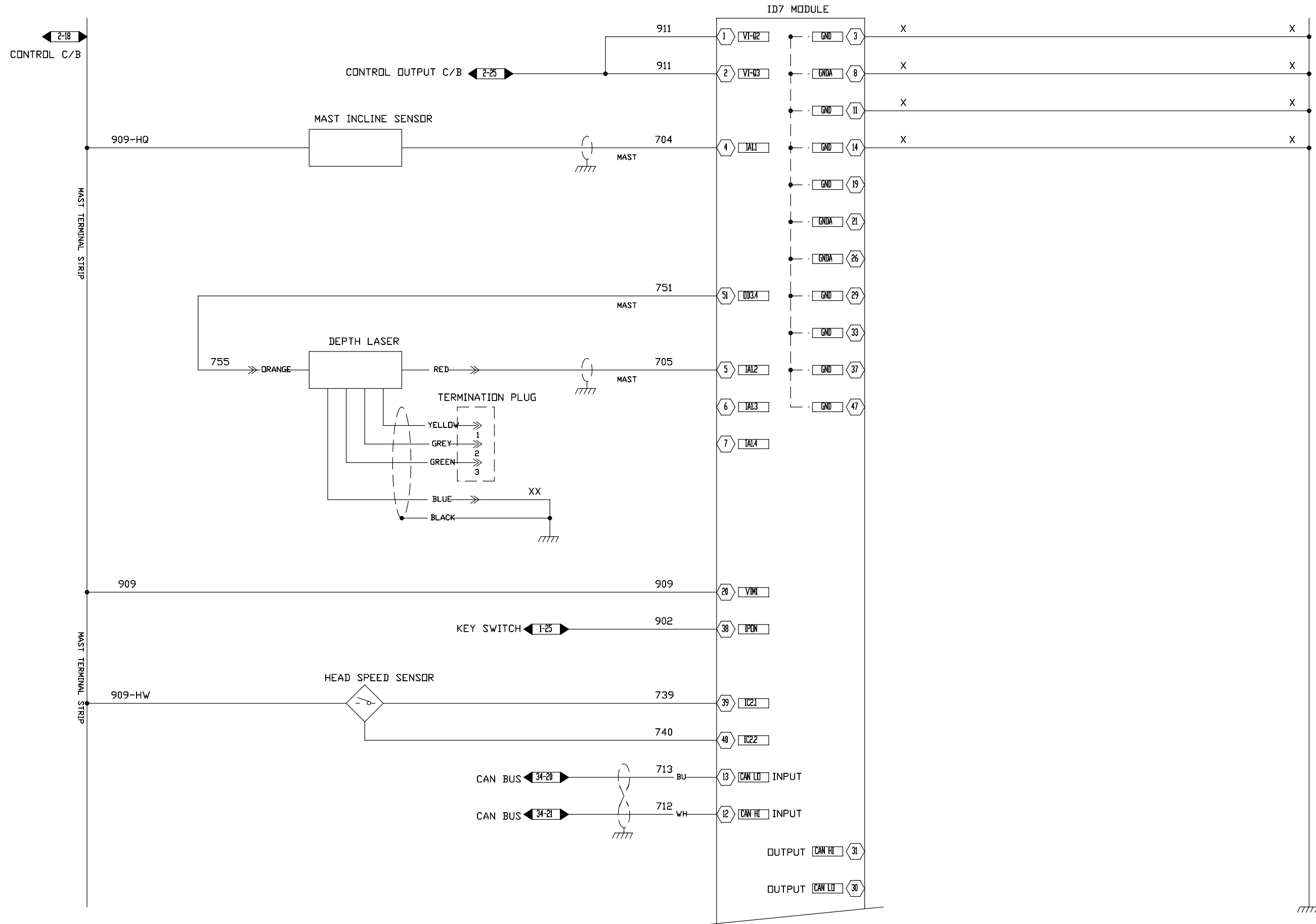
Electrical Schematic (Diesel)



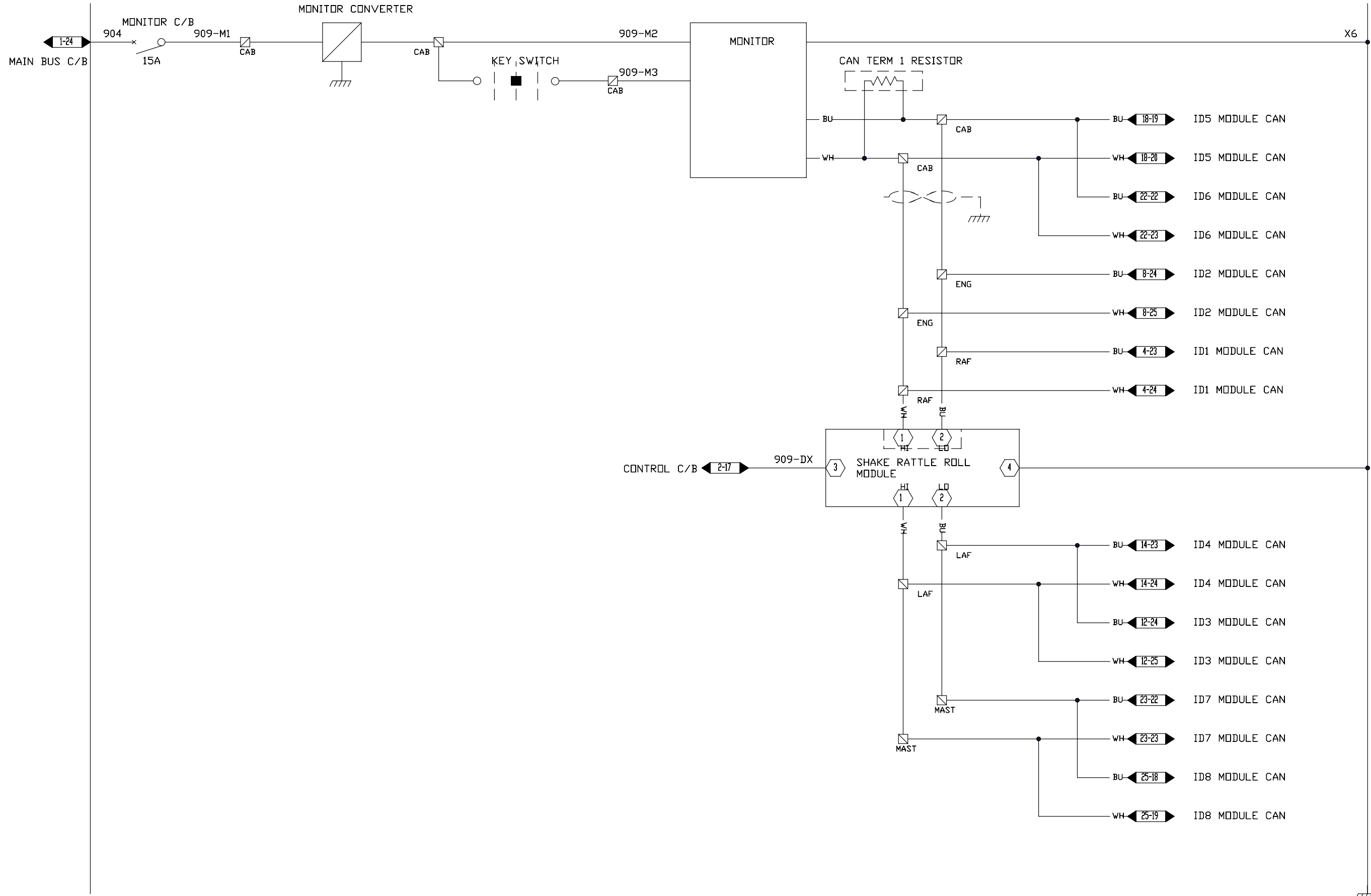
Electrical Schematic (Diesel)



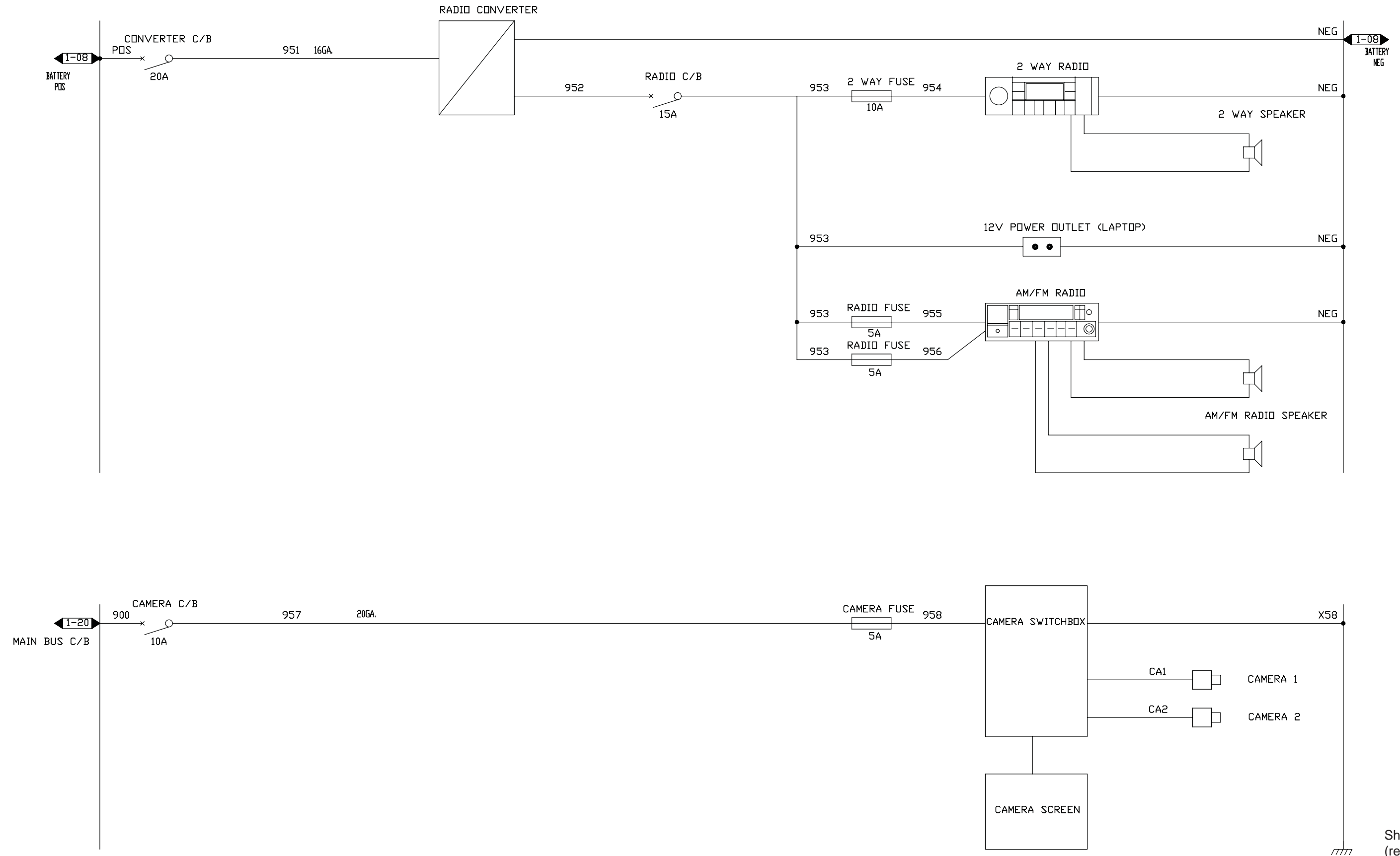
Electrical Schematic (Diesel)



Electrical Schematic (Diesel)

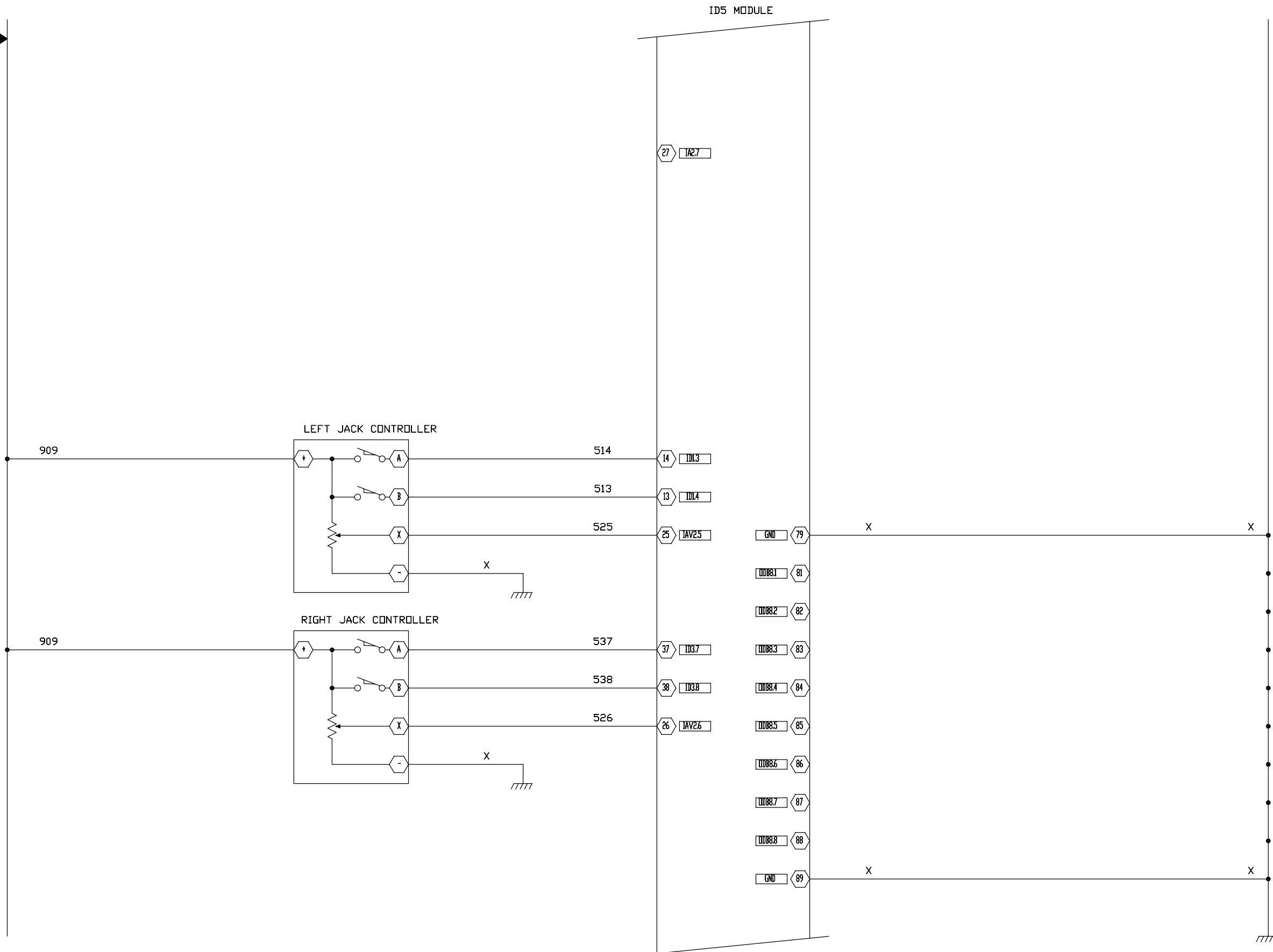


Electrical Schematic (Electric)

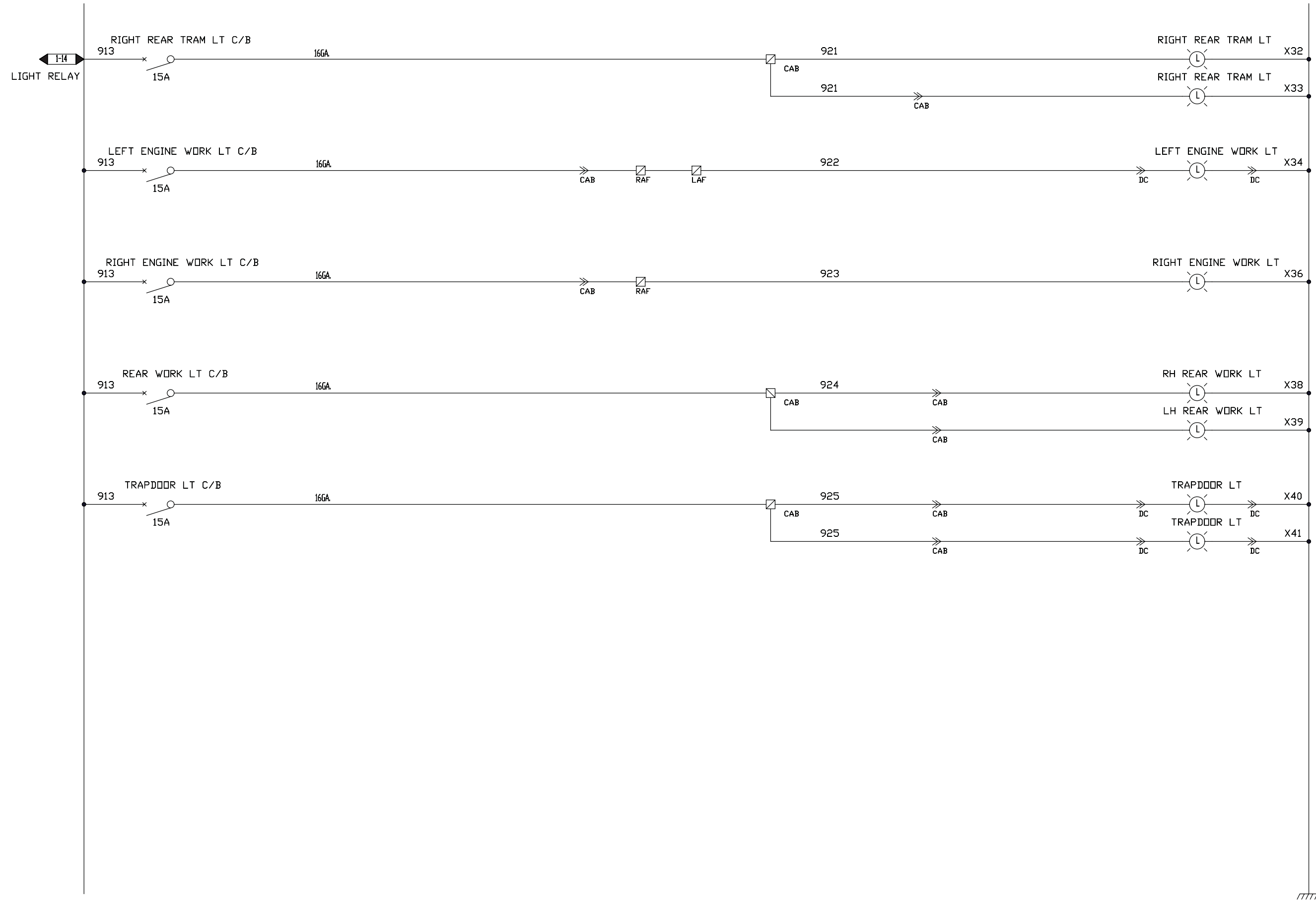


Electrical Schematic (Electric)

2-16
CONTROL C/B



Electrical Schematic (Electric)



Notes

Lubricant Specifications

Winch Lubrication

- Check oil level every 3 months or 500 operating hours whichever occurs first. Remove the large plug located in the center of the drum support. Oil level should be at the bottom of this opening.
- Gear housing should be drained and filled with new oil after the first 100 hours of operation. Then oil should be changed every 500 hours or every six (6) months, whichever occurs first.
- Remove and clean vent plug in solvent every time oil is changed. Vent plug must be kept clean and free from obstructions.
- The standard factory fill from Braden for the BG8 winch is Texaco Meropa150. Other oils may be used if they meet the following specifications:

AGMA 4EP or API GL-2 with ISO viscosity grade 150.

Do not mix different kinds of oil.

The following are recommended oils:

Texaco	Exxon	Mobil	Shell	Chevron
Meropa 150	Spartan EP 150	Mobilgear 629	Omala 150	American Industrial Oils 150
Meropa 220	Spartan EP 220	Mobilgear 630	Omala 220	American Industrial Oils 220

Water Pump (Cat Pump)

The Cat Pump is filled from the factory with Mobil SHC 626. This is suitable for temperatures below 0°F (-17.8°C). Special oil is available from Cat Pump dealers. If another type of oil is used, it must meet the specifications on the Crankcase Oil sheet shown in Fig. 9-8.

- Fill with oil to red dot in sight window on back of pump (Fig. 9-6).
- Lubricate the wicks monthly with 2–3 drops of oil in each hole on top of the crankcase (Fig. 9-7). DO NOT lubricate the wicks at initial start-up. Operate pump for 10–15 minutes, then lubricate the wicks. Use crankcase oil as lubricant.

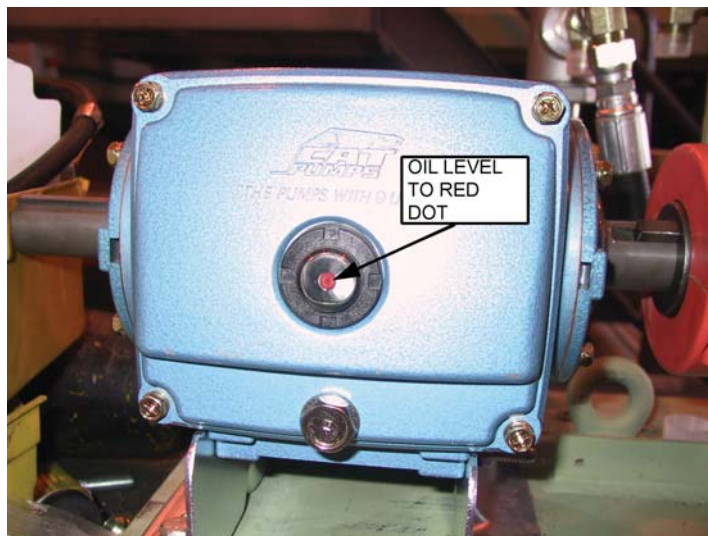


Fig. 9-6 Cat Pump Oil Level Sight Window (back of pump)

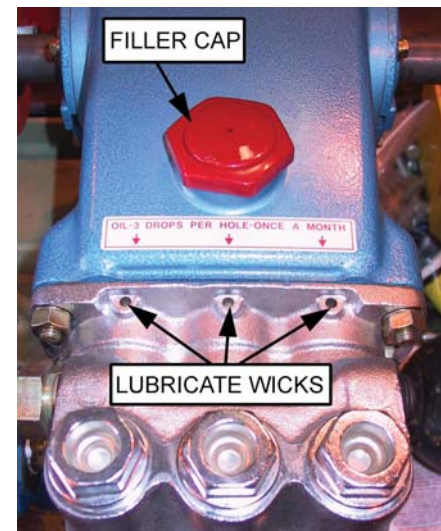


Fig. 9-7 Cat Pump Oil Filler Cap and Wick Lubrication Points

Auto Lube System

Lube Pump Air Motor

WARNING

ALWAYS check equipment for proper operation before each use, making sure safety devices are in place and operating properly. DO NOT alter or modify any part of the equipment as this may cause a malfunction and result in serious bodily injury.

BEFORE CONNECTING AIR MOTOR TO AIR LINE

LINCOLN SERIES III AIRMOTORS are fully pneumatic and require a minimum specified size of air supply hose for proper operation. Check specification for minimum ID. of the air supply hose and select corresponding sizes of air controls and accessories for non-restrictive air flow. Lincoln filter, regulator with gauge and lubricators are available as combination units (FRL).

For 3/8" air line - Model 85387-6
 For 1/2" air line - Model 85387-8
 For 3/4" air line - Model 85387-12

If quick disconnect coupling should be used, install supplied coupler to insure proper airmotor operation.

NOTE: Whenever flammable materials are pumped, ground Airmotor according to Local Codes.

OPERATING PRECAUTIONS

Use Lincoln replacement parts to assure compatible pressure rating.

Heed ALL warnings.

SERVICE AND DISASSEMBLY PROCEDURE

WARNING

Always disconnect air supply to Airmotor and relieve pressure before checking, servicing, or repairing any part of Airmotor

TOOLS REQUIRED

- 7/64 (.109) Hex Wrench
- 5/32 (.156) Hex Wrench
- 3/16 (.189) Hex Wrench
- 3/4 (.750) Open End Wrench (for 6" Airmotor)
- 15/16" (.937) Open End Wrench (for 8" Airmotor)
- 1/2" (.500) Open End Wrench (for 4-1/4" and 3" Airmotor)
- 1-1/8" (1.125) Open End Wrench (for 10" Airmotor)
- Pliers

The modular design of the Airmotor and accessibility of vital operation parts make service available without taking Airmotor out of line or without complete disassembly.

Power Valve

- Remove four screws (Items 27 & 34) with 3/16" hex wrench (2 on each side).
- Remove End Caps (Items 10 & 14).
- Push out Valve Spool (Item 13).
- Remove Spool Bumpers (Item 9) (One from each end).
- Remove "O" Ring (Item 11) (One from each end of valve body).
- Remove four Screws (Item 37) with 3/16" hex wrench and lift valve body (Item 12).
- Remove Gasket (Item 15) to complete valve disassembly.
- To REASSEMBLE, REVERSE procedure.

DO NOT OPERATE Airmotor in excess of recommended pressure range.

Disconnect air line and relieve (vent) pressure when Airmotor sits idle for long periods of time and before servicing.

WARNING

ALWAYS read and follow the fluid and solvent manufacturer's recommendations regarding the use of protective clothing and equipment.

WARNING

To reduce the risk of serious bodily injury or property damage. NEVER exceed the maximum air or fluid working pressure of the lowest rated system component.

ATTACHING AIRMOTOR TO PUMPTUBE

- Tightly attach the tie rods (Item 41) to the Airmotor lower casting. Use short threaded end of tie rods.
- Mount Airmotor on top of pump tube outlet and tightly connect pump tube coupling nut to Airmotor Piston Rod (Item 5).
- Hand tighten tie rods to the pump tube with four nuts (Item 42) supplied with Airmotor.
- Connect air supply and slowly cycle pump several times using only enough air pressure to operate pump without stalling.
- STOP pump on "UP" stroke and tighten four nuts to securely fasten Airmotor to pump tube.

Pilot Bar Subassembly

- Remove four Screws (Item 23)(two on each end) with 3/16" hex wrench and pull out Pilot Bar Subassembly.
- Remove two Screws (Item 39), with 7/64" hex wrench and lift out Valve Body (Item 17).
- Remove four Screws (Item 40)(two on each side of Pilot Bar) and lift off Upper Bracket (Item 31) and Lower Bracket (Item 32).
- Remove Air Signal Valves (Item 20).
- To REASSEMBLE, REVERSE procedure.

Cylinder Tube and Muffler

- Remove Air Brakes Subassembly (See previous instructions).
- Remove two Screws (Item 30) with 3/16" hex wrench and pull off Muffler (item 29).
- Remove Gasket (Items 28).
- Remove four Nuts (Item 26) with open end wrench.
- Lift upward and remove Upper Casting (Item 8).
- Remove four Tie Rods (Item 25).
- Remove Air Tube (Item 7).
- Lift upward and remove Cylinder Tube (Item 6).
- Remove Piston and Piston Rod (Item 5).
- Remove four Connecting Rods (Item 41) with open end wrench.
- To REASSEMBLE, REVERSE procedure.

NOTE: Align two holes on the the Cylinder Tube (Item 6) with two holes on the Pilot Bar (Item 24) before tightening Tie Rods (Item 25) so that proper seal with "O"-rings is achieved.

Auto Lube System

Lube Pump Tube

ATTACHING AIRMOTOR TO PUMPTUBE

1. Tightly attach tie rods to the airmotor (use short threaded end of the tie rods).
2. Mount airmotor on top of the pump-tube outlet and tightly connect Coupling Nut (Item 2) to airmotor piston rod.
3. Hand tighten tie rods to the pumptube with four nuts supplied with airmotor.
4. Slowly cycle the pump several times, using just enough air pressure to operate the pump without stalling.
5. Stop the pump on an "up" stroke and tighten the four nuts to securely fasten the airmotor to the pumptube.

OPERATING PRECAUTIONS

- Use Lincoln replacement parts to assure compatible pressure rating.
- HEED ALL WARNINGS.
- Be sure material hoses and other components are able to withstand fluid pressures developed by this pump.
- Do not operate pump continuously at speeds in excess of 75 cycles per minute.
- Disconnect air line from pump airmotor when system sits idle for long periods of time.
- **SERVICING.** Before servicing or cleaning pump, or removing fluid hose or gun from a unit that has been used, be sure to disconnect air lines and carefully bleed pressure off of the system.

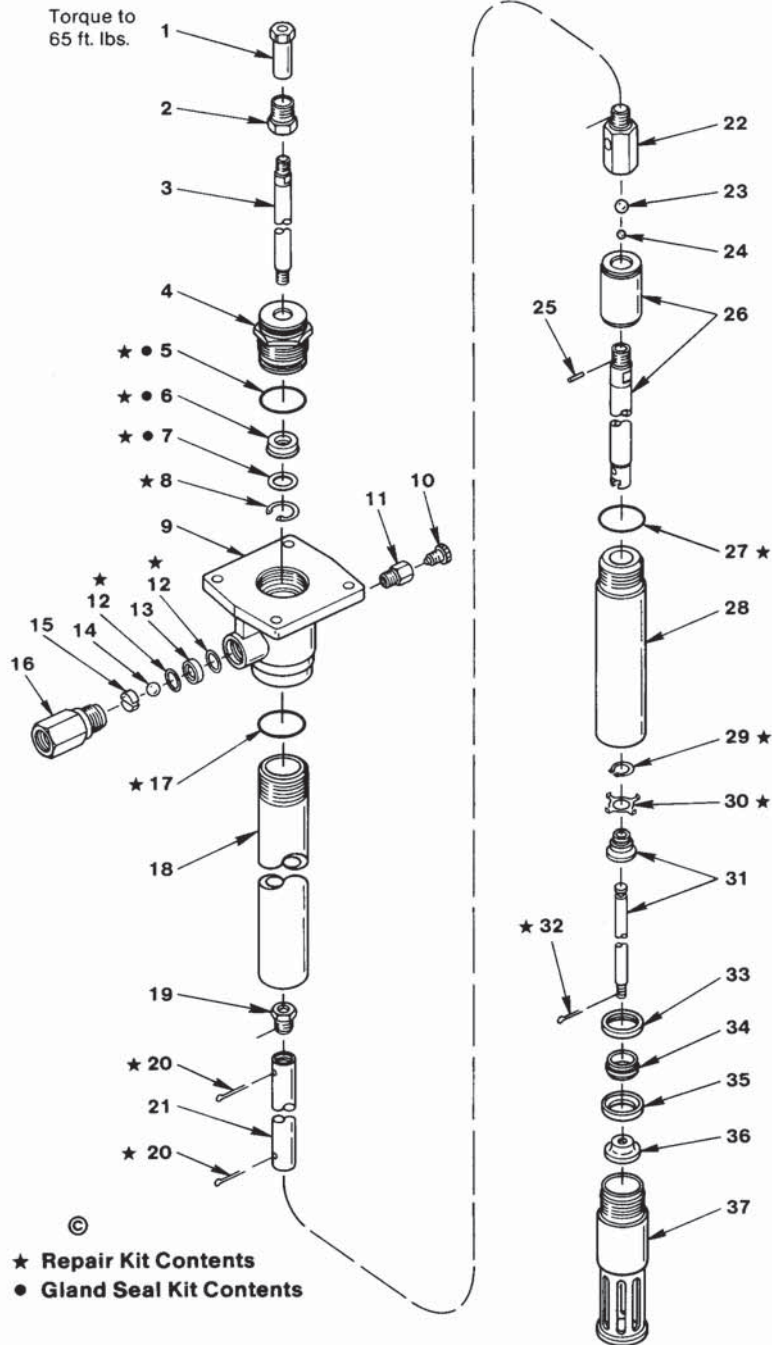
! WARNING

PREVENT STATIC SPARKING. If static sparking occurs, fire or explosion could result. Pump, dispensing valve, and containers must be grounded when handling flammable fluids such as petroleum products, paints, lacquers, etc. and wherever discharge of static electricity is hazard.

- Check continuity (a good static wire connection) with an ohmmeter. Place one probe on one hose fitting and the other probe on other hose fitting, continuity or proper grounding through hose is good when a reading is obtained on the ohmmeter.
- **PREVENT FIRES.** When pumping, flushing or recirculating volatile solvents, the area must be adequately ventilated.
- Keep solvents away from heat, sparks and open flames. Keep containers closed when not in use.

! CAUTION

DO NOT allow pump to operate when out of material.



PUMP PRIMING

To begin operation, the pump has to be primed with the pumped material. The Power-Master III pump is a double acting (pumps material on "up" & "down" stroke) positive displacement reciprocating pump and as such intakes material only on the "up" stroke.

To prime pump, open output line (material valve) and slowly open air supply valve until pump starts. Allow pump to cycle very slowly until all air is

pushed out of lines and material fills up pump and lines. Close output line (material shut-off valve) - pump should stall against pressure.

Note: Pumps are factory tested with light oil and some of it is left in to protect pump parts during storage and transportation. To prevent contamination of material to be pumped, flush pump before using.

Lubrication & Maintenance Schedule

Interval	Service Point	Service Required	Lubricant Required	Capacity
Daily or Each Shift	Engine Oil	Check/Add if required	SAE 10W-30	137.4 qt (130 L)
	Fuel Tank	Check/Fill if required ¹	---	876 gal (3316 L)
	Fuel/Water Separator	Drain water	---	---
	Engine Coolant	Check/Fill if required ²	50/50 Water/Anti-freeze	
	Hydraulic Oil Tank	Check/Add if required ^{3 4}	AW ISO 32	250 gal (946 L)
	Air/Oil Separator Tank	Check/Add if required	Synthetic ATF	
	Water Tank	Check/Add if required	Water/Anti/freeze	422 gal. (1597 L)
	Pump Drive Gearcase	Check/Add if required	Mobilube SHC (SYN) 75W-90 Gear Oil	9 qt. (8.5 L)
	Air Cleaners	Check Gauge Reading	---	---
	Oil Filters	Check Service Indicators	Note: Indicators may show change or by-pass when fluid is cold.	
	Radiator & Coolers	Check/Clean	---	---
	Shock Sub & Air Swivel	Lubricate	NLGI 2 Grease	---
	Tracks, Rollers, Sprockets	Check/Clean	---	---
	Track Frames, Axles, Mounts	Inspect Integrity/Damage	---	---
	Mast & A-Frame	Inspect Integrity/Damage	---	---
	Cab Mountings	Inspect Integrity/Damage	---	---
	Deck & Surrounds	Inspect Integrity/Damage	---	---
	Rotary Head & Motor(s)	Check	---	---
	Pulldown/Hoist Ropes	Inspect	---	---
	Pulldown Sheaves	Check that they are getting grease	---	---
	Grease Pump Lubricator	Top Up	NLGI 1 Grease	---
	Pipe Thread Lubricator	Top Up	NLGI 2 Grease ⁶	---
	Fire Suppression System	Charged	---	---
Fire Extinguishers	Charged/Secure	---	---	
Operating Controls	Check that all function correctly	---	---	
Cable Reel Hyd. Reservoir	Check/Add if required	AW MV ISO 32	10 gal. (37.8 L) (plus pump case)	
Walk Around Inspection	Report any leaks, damage, etc.	---	---	
Weekly or 50 Hours	Cooler Fan	Check/Torque mounting bolts	---	---
	Hydraulic Filters	Initial Change, then every 500 hrs	---	---
	Coolant Filter (if equipped)	Initial Change, then every 500 hrs	---	---
	Air/Oil Separator Tank	Initial Change, then every 300 hrs	Dexron III ATF	
	Compressor Oil Filters	Initial Change, then every 250 hrs	---	---
	Rotary Head	Check/Add if required	Mobilube SHC (SYN) 75W-90 Gear Oil	13 gal. (49.2 L)
	Water Pump	Initial Change, then every 300 hrs	ISO 68 Hydraulic Oil	42 oz. (1.26 L)
	PLUS ALL ITEMS LISTED IN DAILY SERVICE			

Preventive Maintenance—Bolted Joints

- **Vibratory Overload**

Abusive, unusual or unforeseen loads can cause bolted joint separation. This can result in the loosening of bolts, which in turn can cause bolt fatigue failure. Bolt fatigue will generally result in a fracture surface and ultimately failure at the first engaged thread of the bolt or sometimes in the fillet under the bolt head. Loose bolts can also fail quickly in fatigue. As an example, tests conducted by a bolt manufacturer indicated that a bolt tightened to 1420 lb tension and stressed cyclically to 9215 lb failed after 5960 load cycles. Identical bolts tightened to 8420 lb and stressed to the same 9215 lb survived 4.65 million cycles before failure. If the bolts had been tightened beyond 9215 lb, it would have been impractical to cycle them to failure.

- **Thermal Relaxation**

Bolted joints exposed to high temperatures or thermal cycling have a tendency relax or lose bolt tension over time, due to stress creep. Since pre-loading stretches bolts, and only stretches them a few thousandths of an inch. It is easy to imagine that a bolt heated to the operating temperature limits of an air compressor could increase the plasticity of the bolt material, allowing it to lose some of its initial loading. Bolted joints of a new machine that are subjected to high heat should be checked and re-torqued to specification after the first 500 hours of operation.

Critical Bolted Joint Maintenance

Critical bolted joints are those joints which hold major structures together or hold overhead loads. Failure of these joints could endanger personnel or seriously damage equipment. As stated earlier, these are identified in the drawing “Critical Fastener ID & Inspection Schedule. We recommend that critical bolted joints of drills should be **checked for proper torque every 120 days or 2000 operating hours** for machines that have **less than 10,000 operating hours**, and every **90 days or 1500 operating hours** for machines that have **greater than 10,000 operating hours**.

If a bolt is found to be loose (less than 90% of specified torque value), it should be removed and replaced. If the joint contains more than one bolt, all bolts in the joint should be replaced. The joint mating surfaces and bolts should be inspected for signs of corrosion, surface degradation, and the presence of hardened washers or Nordlock washers. Joints with Nordlock washers require the replacement of the washers as well. Hardened washers can generally be reused as long as the washer is undamaged. The new bolts should be lubricated with NLGI2 molycoat grease and torqued to the proper specification. Bolts should be replaced with the same grade bolt that was originally in the assembly. These drills primarily use SAE Grade 5 and Grade 8 bolts. These are identified by the markings on the head of the bolt. Chart #1 of the drawing for each machine titled “Critical Fastener Torque Values” graphically depicts the standard indentifying bolt markings.

Bolts in critical joints should also be removed and **visually inspected for corrosion and re-lubricate every 2.5 years or 15,000 hours of operation**. If bolts are not damaged, they may be re-installed and returned to service. Any damaged or corroded bolts should be discarded and replaced. In addition, bolts in critical joint should be **replaced every 5 years or 30,000 hours of operation**, regardless of apparent condition.

Other Bolt Maintenance

All bolts contained in these drills are subject to the same topics described above, but generally do not have the same degree of risk involved should a bolt failure occur. Every machine should have a “walk-around” inspection performed at the beginning of each operating shift, which includes looking for loose hardware. Other significant bolted joints include all pressurized fittings, flange connections and all bolted pin retainer/keeper plate bolts. All machine bolts should be inspected for proper torque specification annually at a minimum.

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