Technical Manual

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SAFETY LABELS AND INSTRUCTIONS

This manual contains important information affecting the safety of personnel and the equipment being used.

The safety instructions and behavioural rules are intended to protect operators from potentially dangerous situations and assist in the safe operation of the trailer and associated equipment.

The following symbols are used with safety instructions and identify varying degrees of hazardous conditions.

The safety instructions associated with these symbols are to be considered the minimum requirements for effective hazard and operational control.

Points in the text marked with this symbol draw attention to immediately impending danger. Possible consequences are very serious or fatal injury.

These points contain information on potentially dangerous situations. Possible consequences are very serious or fatal injury.

This symbol draws attention to potentially dangerous situations. Possible consequences are light to moderately serious injury and machine damage.

Points in the text marked with this symbol draw attention to potentially harmful situations. Possible consequences are damage to machine or equipment in immediate vicinity

Text marked with this symbol contains useful information associated with the machine and its application.

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ENGINE OIL

The proper SAE viscosity grade oil is determined by the minimum outside temperature at cold engine start up, and the maximum out engine temperature during the engine operation. Use the minimum temperature column on the table to determine the oil viscosity to start a *cold soaked* engine. Use the maximum temperature column on the table to determine the oil viscosity for operation at the highest temperature anticipated. In general, use the highest viscosity oil to meet the start up temperature requirement.

TORQUE CONVERTER/TRANSMISSION FLUID

Transmission Fluid Shell Donax TC30 is suitable for use in the torque converter and transmission. Refer to the Fluid Specification Table for the oils which may be used under given conditions.

Do not use Dextron II in the torque converter/transmission.

HYDRAULIC OIL

Use high quality anti-wear hydraulic oil or engine oil for the hydraulic (steering, brakes and attachment actions) system. Referring to the Fluid Specification Table (page 16). ISO/VG 68 Oil and SAE 20W-20 Engine Oil both have a viscosity of 300 to 350 SUS at 38°C and therefore fit into these temperature ranges. For colder ambient temperatures, ISO/VG 32 Hydraulic Oil or SAE 10 W Engine Oil (150-200 SUS at 38°C) are better suited. The viscosities given are for use as guidelines only; however, do not use an oil which will exceed 4000 SUS at start up or be less than 80 SUS during operation. Also any oil used must have a viscosity index of no less than 90. Consult your oil dealer or manufacturer for oils that meet these requirements.

Engine oil being used as hydraulic oil must meet Mil-L-46152 or 2014C and API class CC or CD standards. No similar standards have been written for anti-wear hydraulic oil; it is therefore up to the machine owner to ensure that the oil is of a high quality.

GEAR OIL

Use Shell differential oil HP gear oil LS 90 or equivalent SAE90LS oil suitable for limited slip differentials.

MULTI-PURPOSE EP GREASE

Use multi-purpose EP grease, which contains both 1% to 5% molybdenum disulphide conforming to MIL-L-7866, and a suitable corrosion inhibitor. National Lubricating Grease Institute (NLGI) Grade No. 2 is suitable for most temperatures. NLGI No. 1 or No. 0 are suitable for extremely low temperatures.

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GENERAL SAFETY AND PRECAUTIONS

GENERAL

This section contains specific safety precautions that shall be followed whilst the machine is being operated or serviced. This list is *NOT* all inclusive and a measure of commonsense should always be applied together with established and ongoing site specific risk assessment and safety procedures.

ONLY TRAINED AND AUTHORISED OPERATORS SHALL OPERATE AND SERVICE THIS MACHINE.

DO NOT use the machine for any purpose other than its intended use.

DO NOT for any reason exceed the indicated capacity of the machine.

DO NOT operate the machine unless all operator checks and scheduled servicing have been performed. Report any damage or faulty operation immediately and do not operate the machine until the fault has been corrected.

DO NOT tie down or tow equipment such that the chains or slings are not rated for the capacity of the machine and equipment.

DO NOT operate the machine unless:

- There are no tags attached stating otherwise.
- All covers and guards are correctly installed.
- Personal protective equipment is worn.

DO NOT start the machine unless:

- There are no tags attached stating otherwise
- The area around the machine is clear.
- The park brake is applied.
- Transmission is in *neutral*.
- All water and oil levels are checked.
- All site specific checks are completed.

DO NOT leave the machine unless:

- The machine is parked in a safe place.
- The transmission is in *neutral*.
- The park brake is applied and brake head pressure is *zero*.
- The lift arms are lowered or any attachment is flat on the ground or supported.
- The engine is stopped.

DO NOT work on the machine in low ventilated areas while the engine is running.

ALWAYS sound the horn before starting the engine to alert anyone who may be around the machine.

ALWAYS: ensure that the operator’s compartment door is closed and made secure before operating the machine.

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Activity Required	Tick Box ✓ 1	2	3	Defects/Comment

6.1 FRAME RELATED - Guards and Covers

Inspect all guards and covers for security, damage and any missing covers/retainers. Repair or replace as required.				

6.2 FRAME RELATED - Fire Extinguisher

Inspect the fire extinguisher mounting/ holding bracket for security, damage and that the extinguisher is easy to remove and secure when clamped in.				
Check the charge pressure indicator, where fitted, is registering within the operable range and appears to be free and operating correctly.				

6.3 FRAME RELATED - Fire Suppression System – If Fitted

Inspect the security of all fittings and components of the fire suppression systems.				
Check the fire suppression bottle for the correct pre-charge. The indicator needle should be in the green zone.				

6.4 FRAME RELATED - Towing Equipment

Check the tow pin and securing chain for damage and replace as required.				

7. OPERATIONAL CHECKS - Safety System

Check the transmission neutral start valve for correct operation. Select a gear and check if the engine will attempt to start. Repair as required.				
Check the door interlock system for correct operation, moving in 1st gear slow.				
Perform DCS Low Engine Oil Shutdown with park brake off. When the engine shuts down ensure park brake applies.				
Note : Machine Not To Be Put In Operation If Safety Systems Are Not Working				

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Tick Box ✓

Activity Required	1	2	3	Defects/Comment
5. ELECTRICS, INSTRUMENTS and CONTROLS - Operator's Compartment				
Ensure compartment is clean of all loose materials, coal, dirt etc.				
Inspect the condition of the operator's gauges. Check for correct operation : Brake Head Pressure Brake Accumulator Pressure Steering Accumulator Pressure Engine Water Temperature Engine Exhaust Temperature Transmission Temperature Air Pressure Engine Oil Pressure Exhaust Filter Back Pressure				
Inspect the operator's seat for physical damage, including cushions and pads.				
Inspect all control devices (pedals, levers, handles, switches etc) for signs of wear, damage, missing parts and incorrect operation. Repair as required.				
Inspect tilt/lift and implement control valve boots for damage and replace if necessary.				
Check door hinges and latches for correct operation. Repair as required.				
5.1 ELECTRICS, INSTRUMENTS and CONTROLS - Electrical System				
Check lights for correct operation.				
Check cables, hoses and flameproof joints are secure.				
Check DCS installation for security.				
Check alignment, condition and mounting of alternator, drive coupling and motor.				
6. FRAME RELATED - Canopy				
Check for damage, security of fasteners				
6.1 FRAME RELATED - Guards and Covers				
Inspect all guards and covers for security, damage and any missing covers/retainers. Repair or replace as required.				

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Activity Required	Tick Box 1	2	3	Defects/Comment
3. HYDRAULICS				
Check the main hydraulic oil level and fill as required. Indicate litres used.				Ref: Spec 3
Ensure the hydraulic filler cap is secure and sealing.				
Check and record the following gauge pressures: • Steering Accumulator pressure (2500psi / 17250kPa) • Brake Accumulator pressure (2500psi / 17250kPa) • Brake Head Pressure (1750psi / 12100kPa)				
Note: Machine Not To Be Operated if Brake Head pressure is below 1750 PSI				
Check the steering circuit pressure filter indicator, replace filter if required.				CAT Part No. 501800
Check the hydraulic return filter indicator, replace if required.				CAT Part No. 502126
4. PNEUMATICS - Air Receiver				
Drain away all condensation from the air receiver vessel.				
Drain air circuit water trap.				
Inspect the circuit and relief valve for damage, leaks and correct operation.				
Replace air compressor filter.				CAT Part No. 503715
4.1 PNEUMATICS - Main Isolation Valve				
Inspect the 2-way valve for correct operation, leaks and locking mechanism. Replace/repair as required.				
4.2 PNEUMATICS - Horn				
Inspect the air horn and its operating valve for correct operation, abnormal noise (bypass), security and any leaks. Ensure the valve is clearly labelled. Repair as required.				

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Tick Box ✓

Activity Required	1	2	3	Defects/Comment
1.5 ENGINE - Exhaust System				
Inspect the exhaust heat exchanger for security and signs of leaks/damage.				
Clean heat exchanger assembly as per CATERPILLAR's recommended procedure.				CAT Part No. 508221 (Cleaning Solution)
Remove flametrap assembly and inspect for contamination and build up. Ensure flametrap assembly is cleaned prior to reinstallation.				
Measure flamepath gaps around the flametrap after assembly. Gap to be <0.2mm				
Change particulate filter using appropriate PPE, only if back pressure gauge indicates high.				CAT Part No. 500677
Ensure filter lid is securely sealed after refitting.				
1.6 ENGINE - Exhaust Cooling System				
Inspect the cooling system for signs of leakage, blockage, contamination and security.				
Check alignment and condition of heat exchanger cooling pump, drive coupling and motor.				
2. DRIVETRAIN - Transmission				
Inspect the transmission assembly and mounts for oil leaks, looseness, damage and any abnormal vibration, noise and heat (test drive).				
Check transmission breather.				
Replace transmission filter element.				2 x CAT Part No. 501471
Check transmission oil level and top up as required. Indicate litres used.				Ref: Spec 2
2.1 DRIVETRAIN - Drive Line				
Inspect all drive shaft, slip joints and CV joints for damage, looseness, wear and contamination build up. Clean/tighten as required.				

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SERIAL No.:	PLANT No.:	DATE:

Tick Box ✓

Activity Required	1	2	3	Defects/Comment
Record Hour Meter Reading _____ hrs				
Clean machine completely, pay particular attention to loose material, oil and coal dust.				

1. ENGINE - General

Inspect the complete engine assembly and mounts for damage, any signs of oil, coolant and fuel leaks, looseness and any abnormal vibration, noise and temperature (test drive).				
Drain and refill engine oil.				Ref: Spec 1
Replace engine oil filter.				CAT Part No. 503469
Inspect the engine for the correct oil level. Top up as required. Indicate litres used.				Ref: Spec 1
Check engine breather.				
If fitted with hydraulic throttle, inspect throttle fluid reservoir and fill as required. Indicate litres used.				Ref: Spec 3
If fitted with cable throttle, inspect condition of cable.				

1.2 ENGINE - Intake

Check the air filter restriction indicator for signs of filter contamination/blockage.				
Check condition of filter housing.				
Check the primary air filter element and replace if required.				CAT Part No. 505090
Check inner air filter element and replace if required.				CAT Part No. 505089
Check all fasteners, intake joints and brackets of the shutdown valve for security and tightness.				
Check all other intake joints for security and tightness.				
Check all air intake hoses, pipes and fittings for damage, leaks and looseness.				

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Comment:

Inspected By:		Date:	
Checked By:		Date:	

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Tick Box ✓

Activity Required	1	2	3	Defects/Comment

6.2 FRAME RELATED - Fire Extinguisher

Inspect the fire extinguisher mounting/ holding bracket for security, damage and that the extinguisher is easy to remove and secure when clamped in.				
Check the charge pressure indicator, where fitted, is registering within the operable range and appears to be free and operating correctly.				

6.3 FRAME RELATED - Fire Suppression System – If Fitted

Inspect the security of all fittings and components of the fire suppression systems.				
Check the fire suppression bottle for the correct pre-charge. The indicator needle should be in the green zone.				

6.4 FRAME RELATED - Lubrication

Lubricate the following grease point. Lubricate until grease is purged from the bushes. Articulation Pillow Block Drive line Cylinder Pins Zone Manifolds 3 x Lift cylinder top pivot points 2 x Tilt cylinder pins 6 x Steer cylinder pins 2 x RAS Cradle – Lift arm pivot pins 2 x Pedal pivot points 2 x Radiator pivot points 4 x Diff Pinion Oil Seals 4 x				Ref: Spec 7
Lubricate the engine drive coupling.				Ref: Spec 8

6.5 FRAME RELATED - Towing Equipment

Check the tow pin and securing chain for damage and replace as required.				

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Tick Box ✓

Activity Required	1	2	3	Defects/Comment
3. HYDRAULICS				
Check the main hydraulic oil level and fill as required. Indicate litres used.				Ref: Spec 3
Ensure the hydraulic filler cap is secure and sealing.				
Replace main relief pressure: Main relief pressure: 2988psi / 20.6MPa				
Re-seal accumulators and recharge accumulator pressures: Accumulator pressures: 900psi / 6.2MPa				
Replace brake/steer pump.				CAT Part No. 503935
Replace service brake valve.				CAT Part No. 500139
Check and record the following gauge pressures: • Steering Accumulator pressure (2500psi / 17250kPa) • Brake Accumulator pressure (2500psi / 17250kPa) • Brake Head Pressure (1750psi / 12100kPa)				
Note: Machine Not To Be Operated if Brake Head pressure is below 1750 PSI				
Replace brake head hoses and fittings.				
Replace steering circuit pressure filter.				CAT Part No. 501800
Replace hydraulic return filter.				CAT Part No. 502126
4. PNEUMATICS - Air Receiver				
Drain away all condensation from the air receiver vessel.				
Drain air circuit water trap.				
Check governor setting.				
Inspect the circuit and relief valve for damage, leaks and correct operation.				
Replace air compressor filter.				CAT Part No. 503715
4.1 PNEUMATICS - Main Isolation Valve				
Inspect the 2-way valve for correct operation, leaks and locking mechanism. Replace/repair as required.				

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SAFETY PRECAUTIONS

The following safety precautions are not intended to be exhaustive. Safe work practices should be used when servicing or operating heavy machinery.

When the temperature of diesel fuel is elevated, which occurs when fuel is circulated through an operating engine, the following hazards exist:

- Scalding or burns from contact with hot liquid.
- Presence of combustible vapour around the fuel source.

ALWAYS give the engine an opportunity to cool down before performing fuel system servicing.

ALWAYS wear personal protective equipment including safety glasses, gloves and suitable clothing.

ALWAYS perform fuel system servicing in a well ventilated area.

ALWAYS keep naked flames, sparks and other heat sources away from the machine.

ALWAYS clean up any spilled fuel immediately to remove the potential for ignition and slip or fall injuries.

ALWAYS be aware of, and isolate, other forms of energy and pinch points (fan, belts, pulleys) when accessing the engine compartment including pneumatic stored pressure, engine coolant pressure and other heat sources such as engine block and exhaust system components.

ALWAYS avoid oxy-cutting or welding near or onto any unshielded fuel system components.

I**MMEDIATELY** wash off spilled fuel when exposure to the skin has occurred.

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FLUSHING THE LUBRICATION SYSTEM

When the engine lubrication system is contaminated by coolant (ethylene glycol antifreeze solution or water soluble material) the following cleaning procedure is recommended.

Use “Cellosolve” or equivalent solution.

Use extreme care when handling these solvents to avoid serious injury to personnel or damage to finished surfaces. Always consult the Material Safety Data Sheet before use.

1. Drain all engine lubrication oil as described in this Section.
2. Remove and discard the oil filter element and replace as described in this Section.
3. Mix two parts Cellosolve (or equivalent) with one part SAE 10 engine oil and fill the engine crankcase to the correct operating level as indicated on the dipstick.
4. Start and run the engine at fast idle (1000 RPM to 1200 RPM) for 30 minutes to one hour, checking engine oil pressure regularly.
5. Stop the engine and immediately drain the crankcase and filters.
6. Replace the drain plug, fill the engine with SAE 10 oil and run the engine again at fast idle for 10-15 minutes then drain the oil.
7. Remove and replace the oil filter element.
8. Replace the drain plug and fill the engine with the specified grade of oil for normal operation (see Section 1).

Ensure that the source of contamination has been corrected before returning the engine to service.

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FAN ASSEMBLY

The hydraulically driven fan assembly provides the necessary air flow through the radiator to remove the heat absorbed by the coolant. (see Section 4 Hydraulic System - Fan Drive).

The fan assembly and blades should be inspected every 250 service hours.

Check fan tip speed with tachometer every 1000 hours (fan speed high idle 1758 RPM).

To inspect the fan assembly:

1. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
2. Check the fan blades for cracks and/or chips and replace or repair the fan if required.

Fan replacement is achieved by the following:

1. Removing the holddown bolts on the radiator.
2. Lift the hinged radiators up, and ensure that the gas struts that hold the radiators in position are in good working order.
3. Remove the four bolts from the transmission oil cooler and remove the cooler.
4. The fan hub mounting bolts are then removed detaching the fan and spacer from the hub, this is then able to be removed.
5. The fan should be replaced as a complete assembly only.
6. The replacement fan is to be bladed at with the same degree pitch as the fan that is removed.

The cooling fan is factory balanced, replacement of fan blades without correctly balancing the fan assembly may cause damage or personal injury through operational failure.

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6. Check the purifier element for any cracks or damage and replace if necessary.
7. Check the water jacket for free flow.
8. Hydrostatically pressure test the purifier water jacket and purifier housing as per the requirements of AS3584.
9. Using new gaskets reinstall purifier and exhaust downpipe ensuring that the flange gaskets provide an air tight seal.
10. Refill the engine with specified coolant, run the engine and check for any exhaust leaks.

Wear suitable eye protection, gloves and dust mask when performing work on the purifier as particulates may be harmful to the respiratory system. Immediately wash any particulate matter from skin with warm, soapy water.

To test purifier for Code D inspection:

1. Blank of both ends of purifier with blanking plates.
2. Hydrostatically test gas path to 1000 kPa using calibrated pressure gauges.
3. Hydrostatically test water jacket to 250 kPa using calibrated pressure gauges.
4. Check the fixed connections on both ends of the purifier to conform with surface an flatness tolerances nominated on the approval drawing.

Flatness and Surface Finish	
Size mm	**Accuracy for Grade H Tolerance mm**
< 10	**0.02**
≥ 10 < 30	**0.05**
≥ 30 < 100	**0.1**
≥ 100 < 300	**0.2**
≥ 300 < 1000	**0.3**
≥ 1000	**-----**

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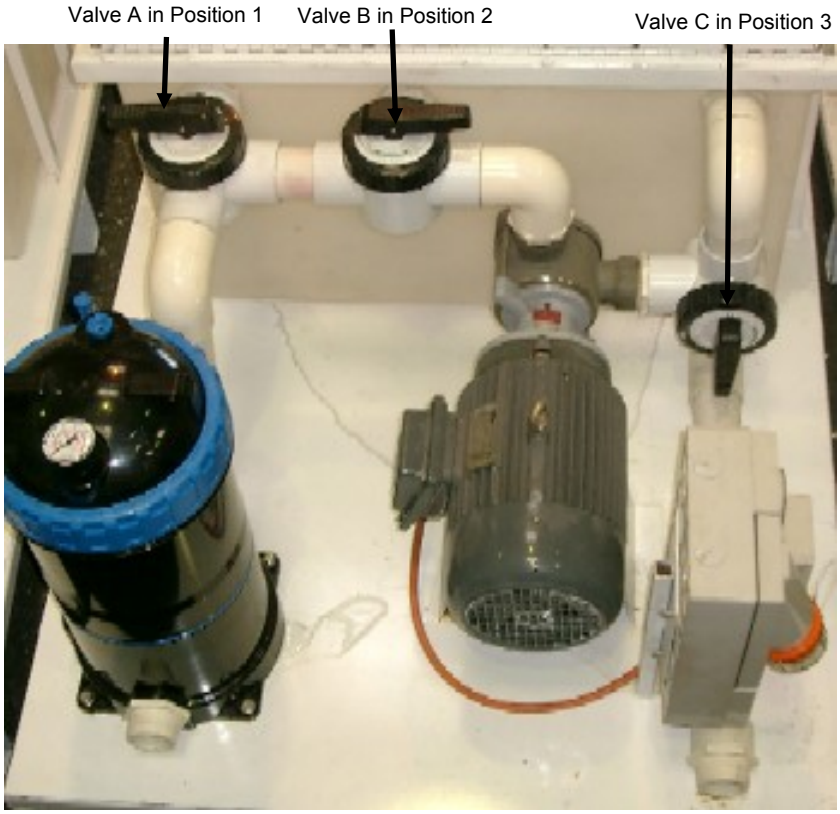

TURBO WASH VALVE POSITIONS—CLEANING

TURBO WASH VALVE POSITIONS—EMPTYING

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FLAME PATH JOINTS OR FIXED CONNECTIONS

As with other maintenance and examination schedules the flameproof exhaust system should be inspected, by a suitably appointed and qualified person, at intervals consistent with mine site and statutory maintenance schemes. The following is the suggested intervals for maintenance and inspection of the flameproof components.

Daily:

1. Visually check joint fasteners (nuts, bolts and studs) securing flameproof joints i.e. Flame exhaust manifold to engine block, exhaust manifold to turbo, turbo to exhaust downpipe, exhaust downpipe to exhaust conditioner.

Every 250 service hours:

1. Check tightness of all joint fasteners (nuts, bolts and studs) securing flameproof joints i.e. flame exhaust manifold to engine block, exhaust manifold to turbo, turbo to exhaust downpipe, exhaust downpipe to exhaust conditioner. Use soapy water around joints to check for any leaks.

Every 2000 service hours or 2 service years (Code D):

1. Disassemble all flameproof joint connections clean and inspect for surface finish, flatness, corrosion or damage. Repair as required.
2. Hydrostatically pressure test all exhaust system exhaust and water jacket chambers external to the engine block i.e. exhaust downpipe, purifier and heat exchanger.

Water jacket	Hydrostatic test	250 kPa (35 psi)
Gas Path	Hydrostatic test	1000 kPa (145 psi)

3. After testing and inspection are completed and passed, reassemble using new gaskets and correct torque settings.
4. When reassembly is complete check all flameproof joints for integrity using soapy water solution and 0.2 mm feeler gauge.

EXHAUST EMISSION TESTING PROCEDURE

Statutory requirements specify intervals for testing diesel engine exhaust emissions. For accurate testing the engine must be loaded as near as practical to maximum output power. The following procedure should be carried out for loading the engine to near maximum power.

Wear personal protection equipment when working in proximity to a running engine as long term hearing loss may result.

Position wheel chocks at both front wheels to eliminate sudden machine movement.

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Symptom	Probable cause	Caused by	Remedy
			Check, adjust and replace fan pulley belts as required. See Section 2.
		Improper circulation from flow restriction.	Remove test and replace thermostat as required. See Section 2.
			Descale cooling system internals to remove flow restrictions. See Section 2.
			Inspect hoses for undue bends, kinks or crushing.

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TROUBLESHOOTING GUIDE

The following information has been provided to aid in identifying the cause of a problem when examining a malfunctioning transmission. It is necessary to consider the torque converter charging pump, transmission, oil cooler and all connecting lines as a complete unit when determining the source of the problem since the condition and proper operation of all of these components effects the performance. By referring to how the unit operates together with this information service personnel should be able to correct any malfunction that may occur with the transmission.

The troubleshooting procedure consists of two classifications: Mechanical and Hydraulic.

Mechanical Checks

Before examining the transmission from a hydraulic point of view, the following mechanical checks should be made:

1. Check all control linkages are properly connected and adjusted at all connecting points.
2. Check all transmission control levers and cables for bindings and restrictions in travel that would prevent full engagement. Shift the transmission control levers by hand at the control valve, if full engagement cannot be obtained the cause may be in the control cover and valve assembly.
3. Check the input shaft is rotating when the engine is running.

Hydraulic Checks

Before checking the torque converter, transmission or associated hydraulic system for pressures and rate of oil flow, it is essential that the transmission oil level is *checked* first.

Cause		Remedy	
1.	Low oil level	1.	Fill to correct level
2.	Clutch pressure regulating valve stuck open	2.	Clean valve spool and housing or replace
3.	Faulty charging pump	3,	Replace pump
4.	Broken or worn clutch shaft or piston sealing rings	4.	Replace sealing rings
5.	Clutch piston bleed valve stuck open	5.	Remove piston and clean bleed valves

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DRIVE LINES

GENERAL DESCRIPTION

There are five drive shafts used on the machine.

Upper Drive Line

The upper drive line transmits power from the output of the engine drive coupling via a drive line to the input of the converter which is an integral part of the transmission.

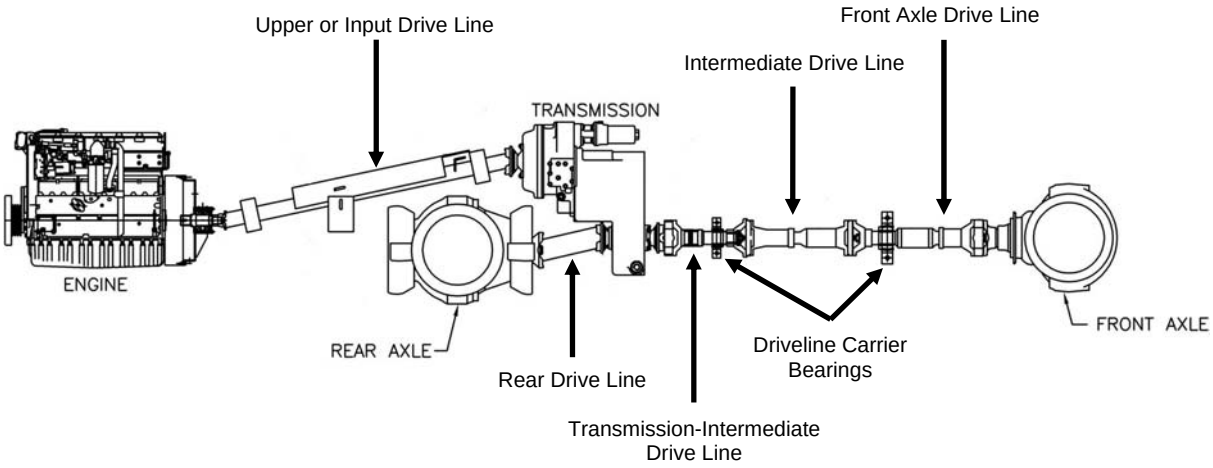
The upper drive line consists of a tube assembly, slip joint assembly and two universal joints. The drive line also has two safety brackets either side of the slip joint assembly to retain the assembly should a universal joint fail.

Rear Drive Line

The rear drive line transmits power from the transmission to the rear axle. It consist of a tube assembly, slip joint assembly and two universal joints.

Articulation and Front Drive Lines

The front drive line transmits power from the transmission to the front axle. The front drive line consists of three drive shafts that allow for the machine to articulate. The first drive shaft is attached to the output at the front of the transmission and consists of a tube assembly, slip joint assembly, bearing carrier assembly and two universal joints. The second drive shaft attaches between the first drive shaft and the third drive shaft and consists of a tube assembly, slip joint assembly and two universal joints. The third drive shaft attaches between the second drive shaft and bolts to the front axle and consists of a tube assembly, slip joint assembly, a carrier bearing and two universal joints.



NOTICE

Later model machine drive lines are fitted with grease for life Uni-joints.

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Each working section of the valve bank is fitted with 22.4 MPa (3250 psi) port reliefs. The working sections of the main hydraulic valve bank control; lift and tilt (lift arms) and attachments which are fitted to PTO. These are pilot activated via a four-way joystick control lever for the lift and tilt. The attachment functions are controlled by 2 two-way hydraulic control levers. Relief pressure is via separate inline port relief valves and the main relief valve all situated in the valve bank.

Auxiliary Circuits

The auxiliary circuits for the cooling fan are supplied by a separate pump driven from the transmission, pressure relief is by a separate inline relief valve set at 17.2 MPa (2500 psi). The fan motor receives a constant flow of 79 lpm at 2600 RPM. Hydraulic oil is supplied through the fan motor which then returns back to tank.

The auxiliary circuit for the heat exchanger motor and alternator motor are supplied by a gear pump piggybacked on the cooling fan pump. It has a primary relief valve set at 17.2 MPa (2500 psi) and a second relief set at 19.3 MPa (2800 psi). The alternator motor and heat exchanger water pump motor is set to a speed at 2400 RPM to 4000 RPM to allow full function at both motors.

SAFETY PRECAUTIONS

All personnel performing maintenance tasks on this machine should have been trained, assessed and be deemed competent. They should be appointed by the mine management.

The following safety precautions are not intended to be exhaustive. Safe work practices should be used when servicing or operating heavy machinery.

ALWAYS give the engine an opportunity to cool down before performing servicing around the rear frame as engine components around this location are hot and could cause burns or scalding.

ALWAYS be aware of, and isolate, other forms of energy and pinch points (fan, belts, pulleys and drive lines) when accessing the engine compartment including pneumatic stored pressure, engine coolant pressure, hydraulic oil pressure and other heat sources such as engine block and exhaust system components.

ALWAYS install the articulation lock when accessing the machine articulation area as machine articulation will result in crush injuries.

ALWAYS install the lift arm lock when access underneath the lift arm assembly is required. Remove any attachments before raising and locking the lift arm assembly.

NEVER assume that all forms of energy have been isolated unless you have confirmed for yourself.

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STEERING AND BRAKE HYDRAULIC MANIFOLD

The main hydraulic manifold interfaces the steering/brake pump to the steering and brake circuits and provides steering interlocking as well as accumulator automatic drain on loss of brake release pressure. The manifold also provides reduced pressure to the controls for the lift arm and attachment functions. Machine hosing is simplified with the manifold, providing only one tank return line and one pressure line connection.

The steering/brake system pressure is primarily governed by the compensated pressure setting of the steering/brake pump. The system normally is set to a compensated pressure of 17.2 MPa (2500 psi). The system is backed up by a system relief valve mounted in the main hydraulic manifold set to divert flow to tank at a relief pressure of 20.7 MPa (3000 psi). The relief valve would not factor into normal system operation however, should a system failure occur the relief valve will limit available pressure to 20.7 MPa (3000 psi).

The steering/brake system relief valve setting should be checked at 2000 service hours.

To check and adjust the relief valve setting:

1. Park the machine in a clear area, apply the park brake and install the articulation lock and chock the wheels.
2. With the engine running at idle access the steering/brake pump by removing the transmission cover and locate the pressure compensator adjustment on the side of the pump housing.
3. Release the park brake.
4. Loosen the adjusting screw lock nut and rotate the adjusting screw clockwise to increase the compensating pressure.
5. Have an observer watch the steering or brake accumulator pressure gauge while increasing the pump compensating pressure.
6. When the pressure approaches 20.7 MPa (3000 psiI) the relief valve will operate forcing the pump to remain on stroke. If this is the case then the relief valve is correctly set.
7. If the pump fails to come on stroke or comes on stroke too early it will be necessary to adjust the relief valve pressure setting.
8. Locate the relief valve on the main hydraulic manifold.
9. Loosen the lock nut and rotate the relief valve adjusting screw clockwise to increase the relief pressure and counter-clockwise to decrease the relief pressure.
10. When the correct main relief valve adjustment is achieved tighten the adjusting screw lock nut.
11. Adjust the compensator valve back and reduce the pressure in the system to below 2500 psi by working the steering or brakes.
12. Adjust the compensator on the steering/brake pump screw to bring the pressure back to 2500 psi when this is correct lock the compensator adjustment screw.
13. Refit the covers.

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Disassembly:

1. Depress pedal and remove pedal stop screw and jam nut from base. Also loosen jam nut for later removal of clevis.
2. Remove cap screws and lock washers from base.
3. Remove e-rings from ends of pins. Remove pins.
   NOTE: Some models use threaded studs, in place of pins and e-rings.
4. Remove set screw from pedal. Remove e-rings from both ends of pin.
   NOTE: Not all models use e-rings.
5. Separate pedal and base by removing pin through clearance hole in pedal. Remove pedal and base.
6. Temporarily insert pin into clevis and record distance from top of pin to mounting flange of housing. This measurement will be necessary for reassembly purposes.
   NOTE: Apply slight downward force on clevis while taking measurement to assure that rod is in contact with piston.
7. Remove clevis and jam nut from rod.
8. Separate housings by removing cap screws and lock washers.
9. Remove rod, piston, spring, spring and washer from housing. Remove boot (2) from housing.
   NOTE: Not all models use spring or washer.
10. Remove piston, shim(s) (6) and spring (7) from housing bore. Note number of shims being removed for reassembly purposes.
11. Remove o-ring (2) from housing bore.
    NOTE: Be careful not to scratch or mark the housing bore.
12. Remove retaining ring from housing bore
    NOTE: Be careful not to scratch or mark the housing bore.
13. Remove retainer from housing bore.
14. Remove retaining ring (2) from housing bore.
15. Remove piston and sleeve assembly (5) from housing bore. Separate piston (5) from sleeve.
16. Remove o-ring (2) and backup ring (2) from sleeve.
17. Remove spring from housing bore.
18. Remove cup (2) and backup ring (2) from piston (5).
    NOTE: A check ball is located inside piston (5). Make sure ball is clean and moves freely. Some models use an o-ring in place of cup (2) and backup ring (2).
19. Remove plug from housing.
20. Remove o-ring (2), cup (2), backup ring (2), washer, spring and guide (4) from plug.
    NOTE: Some models use an o-ring in place of cup (2).
21. Remove cage (2) from housing bore.
22. Remove valve assembly (3) from housing bore.
23. Remove o-ring (2) from valve assembly (3).
24. Remove plug and ball (2) from housing. Remove o-ring (2) from plug.

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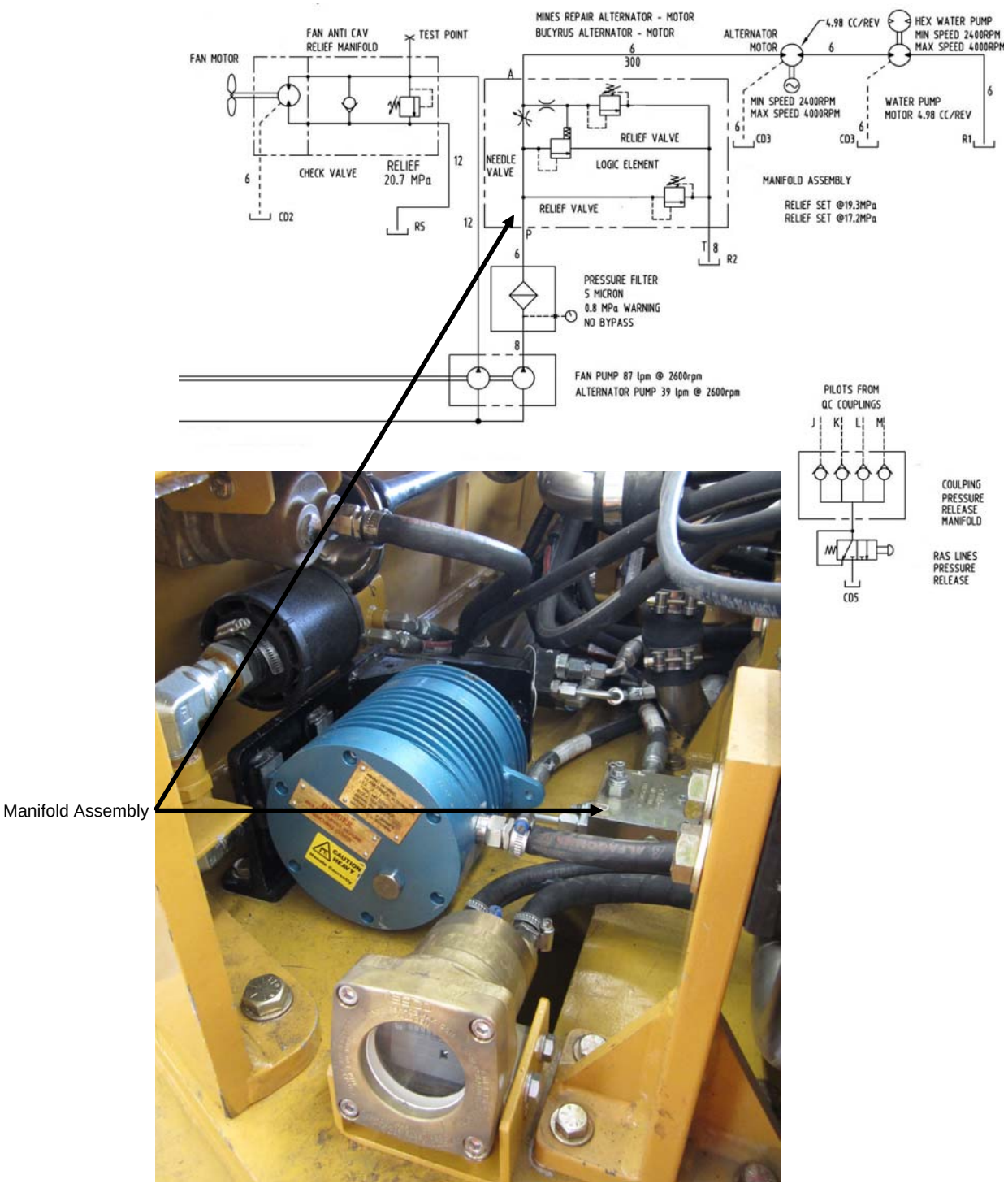
ALTERNATOR/HEAT EXCHANGER CIRCUIT

The auxiliary circuit for the heat exchanger water pump motor and alternator motor are supplied by a gear pump piggybacked on the cooling fan pump at 39 l/min at 2600 rpm. It has two inline relief valves R1 is set at 17.2 MPa (2500 psi) and R2 is set at 19.3 MPa a priority valve set at 20 l/min for the heat exchanger water pump motor (Port A).

Hydraulic oil is supplied through the heat exchanger water pump motor which then flows through the alternator motor and then back to tank.



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ENGINE SERVICE HOUR METER

This electric meter is mounted on the off driver's side at the rear of the machine. Use the hour meter to determine servicing intervals.

Care and Maintenance

Daily or every 10 service hours (Code A external examination):

1. Visually inspect the hour meter for correct operation.
2. Wipe lens clean and remove any built up debris around the housing.
3. Check lens for cracking or other damage, ensure that the retaining bolts are in place.

Servicing:

Servicing of flameproof electrical components should be conducted in accordance with the mine statutory maintenance schemes.

The following is recommended.

Three monthly or every 500 service hours (Code B external examination):

1. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
2. Carry out inspection as per 10 hour service.
3. Visually inspect cable gland/hose termination on the rear of the housing for any damage and security.
4. Verify security of the cover retaining bolts by hand tightening.
5. Record inspection in mine statutory log book.

Six monthly or every 1000 service hours (Code C semi internal examination):

1. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
2. Carry out inspection as per 500 hour service.
3. Remove the cover from the housing, inspect the electrical connections for signs of heating or fatigue.
4. Clean out interior as required, check the condition of the flame paths and reapply approved fluid film to the flame paths
5. Secure the cover retaining bolts by hand tightening.
6. Record inspection in mine statutory log book.

Twelve monthly or every 1500 service hours (Code C1 internal examination):

1. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
2. Carry out inspection as per 1000 hour service.
3. Remove the cover from each housing, dimensionally inspect the flame paths against the certification drawings.
4. Ensure the cable gland/hose connection is secure.
5. Verify approval/certification number against the mine log.
6. Record inspection in mine statutory log book.

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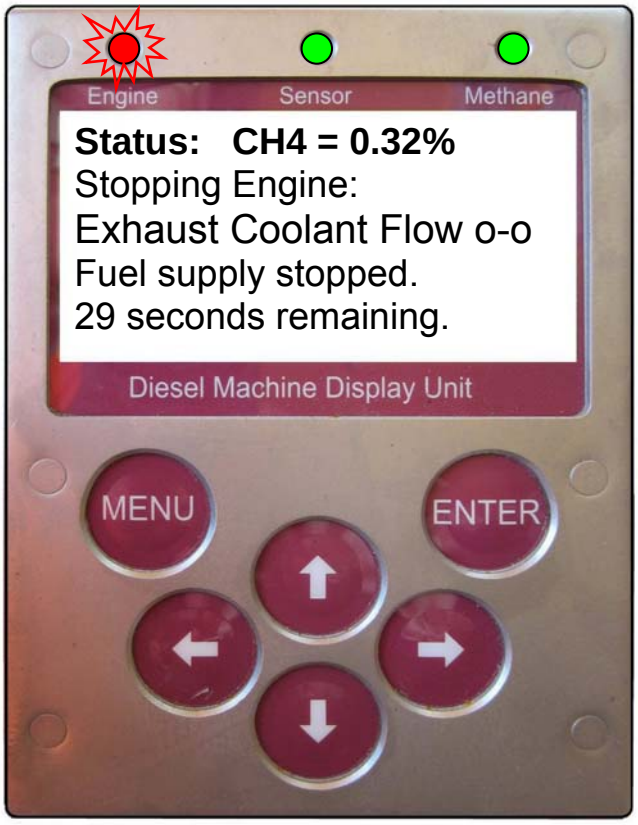
Fuel Cut Shutdown

The DCS is attempting to stop the engine by stopping the fuel supply to the engine. In this screenshot, the DCS is detecting the engine is still running, as *exhaust coolant flow* is still being indicated. If this does not cease within the time period shown, the operator will be requested to follow the emergency manual shutdown procedure.

If any of the following sensors give the relevant signal, then the engine will be considered still running.

Sensor Name	Value to Show Running
Alternator	On (supplying current)
Engine Oil Pressure	Greater than 0.7 Bar
Exhaust Coolant Flow	Closed – ‘o-o’



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Exhaust Gas Temperature Sensors

The exhaust gas temperature sensors are set to shut the engine down before the temperature reaches 150 °C. When the engine temperature rises to 150 °C the valve will open exhausting air pressure from the system thus the fuel shutdown cylinder will close the fuel rack. This closes off fuel to the engine and shuts the engine down. One sensor is located in the gas path in the heat exchanger under the filter, the other is before the outlet flame trap. The outlet sensor is located in the gas path on the outlet side of the exhaust flame trap. This is set to close the engine down before the outlet temperature reaches 105 °C.

EXHAUST GAS RTD TEMPERATURE SENSORS

Engine Oil Pressure Sensor Testing

The engine oil pressure sensor is located under the dash panel in the line to the engine oil pressure gauge. There is no need for routine calibration of the oil pressure sensor as long as the correct operation is verified at start up. A test valve is located in the operator's compartment to verify the oil pressure sensor is operating correctly. This will shut the machine down by stopping power to the solenoid valve. This valve will open exhausting air pressure from the system thus the fuel shutdown cylinder will close the fuel rack. This stops the fuel to the engine and shuts the engine down

ENGINE OIL PRESSURE SENSOR

SHUTDOWN SYSTEM TEST VALVE

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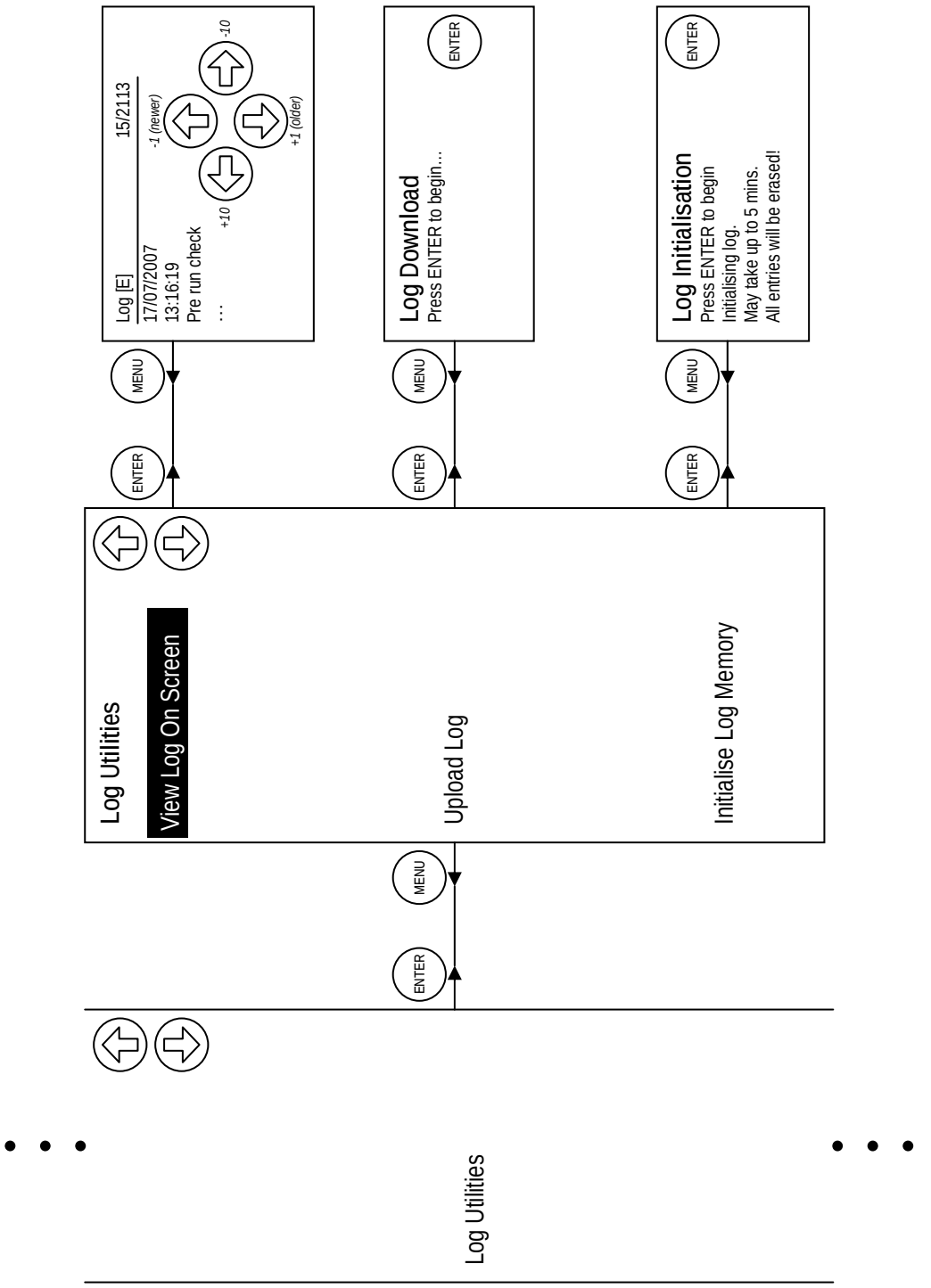
Log [E]
15/2113
17/07/2007
13:16:19
Pre run check
...
-1 (newer)
+1 (older)
-10
+10
MENU
ENTER
Log Download
Press ENTER to begin...
Log Initialisation
Press ENTER to begin
Initialising log.
May take up to 5 mins.
All entries will be erased!
Log Utilities
View Log On Screen
Upload Log
Initialise Log Memory
Log Utilities

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REAR FRAME

CHASSIS

The rear frame is a welded chassis coupled to the front frame via the articulation joint. The rear frame houses the engine system, transmission, hydraulic pumps, filters, fluid tanks and operator's compartment.

The rear frame also houses the cooling system radiators, rear axle, tow hitch and rearward facing headlights.

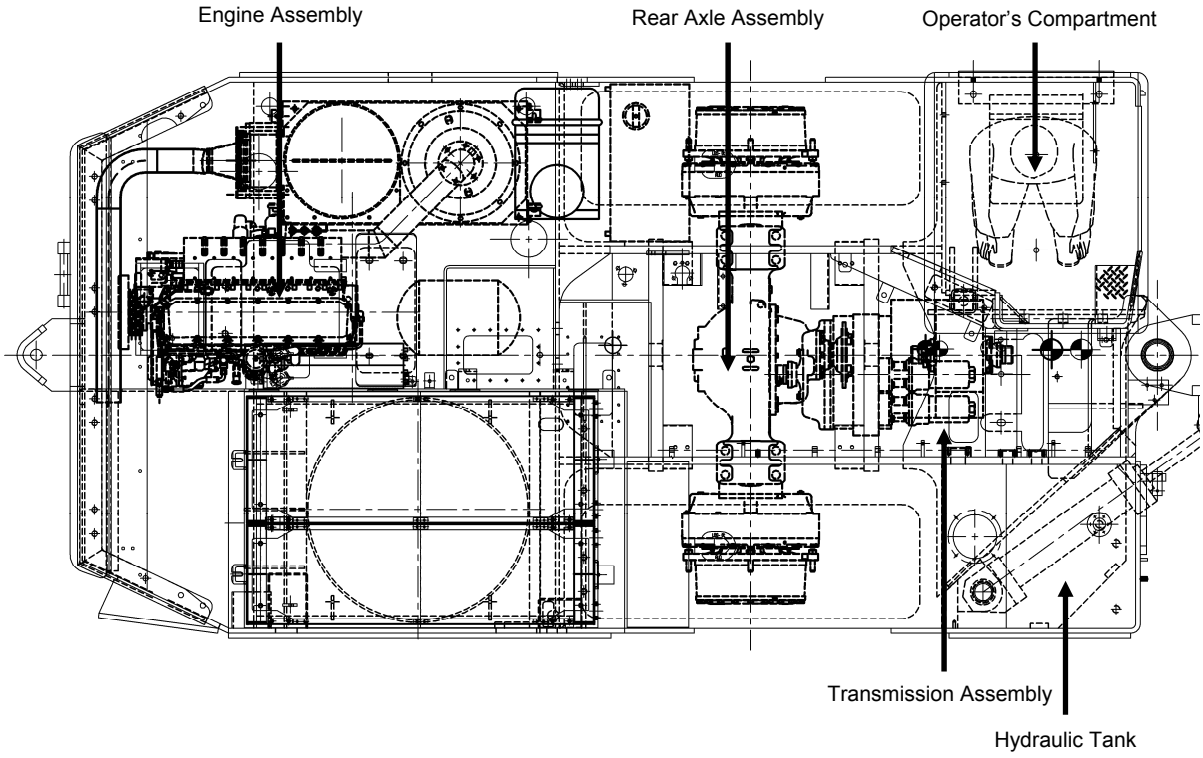
Care and Maintenance

Daily:

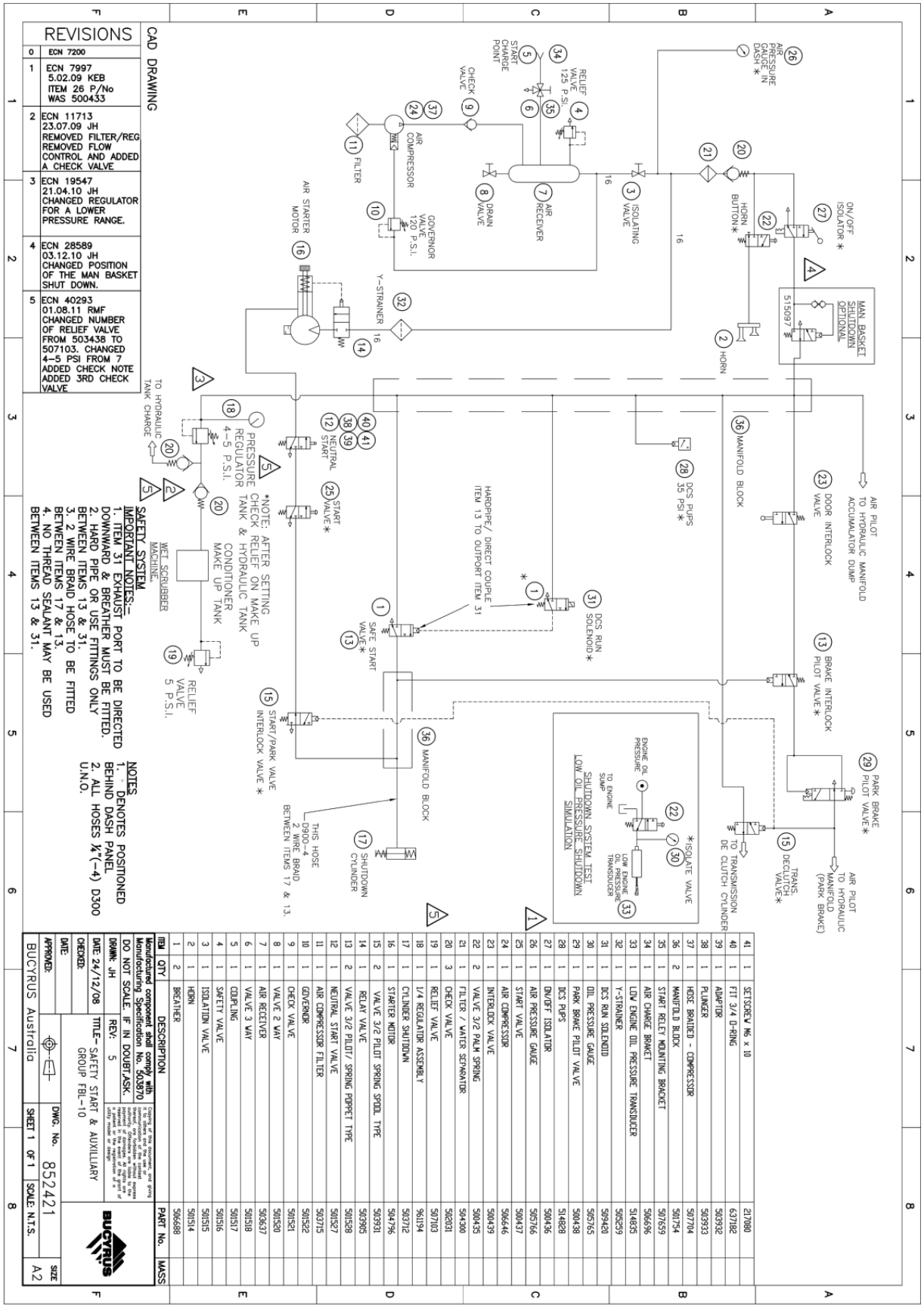
1. Visually inspect the rear frame and associated components including access covers for damage.
2. Visually inspect the tow clevis, coupling pin and retaining device for signs of structural damage.

Servicing

Refer to the Preventative Maintenance Schedule.



REAR FRAME ASSEMBLY


REVISIONS
CAD DRAWING
0 ECN 7200
1 ECN 7997 5.02.09 KEB ITEM 26 P/No WAS 500433
2 ECN 11713 23.07.09 JH REMOVED FILTER/REG REMOVED FLOW CONTROL AND ADDED A CHECK VALVE
3 ECN 19547 21.04.10 JH CHANGED REGULATOR FOR A LOWER PRESSURE RANGE.
4 ECN 28589 03.12.10 JH CHANGED POSITION OF THE MAN BASKET SHUT DOWN.
5 ECN 40293 01.08.11 RMF CHANGED NUMBER OF RELIEF VALVE FROM 503438 TO 507103. CHANGED 4-5 PSI FROM 7 ADDED CHECK NOTE ADDED 3RD CHECK VALVE
SAFETY SYSTEM
IMPORTANT NOTES:-
1. ITEM 31 EXHAUST PORT TO BE DIRECTED DOWNWARD & BREATHER MUST BE FITTED.
2. HARD PIPE OR USE FITTINGS ONLY BETWEEN ITEMS 13 & 31.
3. 2 WIRE BRAID HOSE TO BE FITTED BETWEEN ITEMS 17 & 13.
4. NO THREAD SEALANT MAY BE USED BETWEEN ITEMS 13 & 31.
NOTES
1. * DENOTES POSITIONED BEHIND DASH PANEL
2. ALL HOSES ¼"(-4) D300 U.N.O.
*NOTE: AFTER SETTING CHECK RELIEF ON MAKE UP TANK & HYDRAULIC TANK
THIS HOSE D900-4 BRAID 2 WIRE BETWEEN ITEMS 17 & 13.
AIR PILOT TO HYDRAULIC MANIFOLD ACCUMULATOR DUMP
TO HYDRAULIC TANK CHARGE
AIR PILOT TO HYDRAULIC MANIFOLD (PARK BRAKE)
TO TRANSMISSION DE CLUTCH CYLINDER
HARDPIPE/ DIRECT COUPLE ITEM 13 TO OUTPORT ITEM 31
SHUTDOWN SYSTEM TEST LOW OIL PRESSURE SHUTDOWN SIMULATION
TO ENGINE SUMP
ENGINE OIL PRESSURE
LOW ENGINE OIL PRESSURE TRANSDUCER
MAN BASKET SHUTDOWN OPTIONAL 515097
ON/OFF ISOLATOR *
HORN BUTTON*
HORN
ISOLATING VALVE
AIR RECEIVER
DRAIN VALVE
GOVERNOR VALVE 120 P.S.I.
AIR COMPRESSOR
FILTER
CHECK VALVE
START CHARGE POINT
RELIEF VALVE 125 P.S.I.
AIR PRESSURE CAUSE IN DASH *
AIR STARTER MOTOR
Y-STRAINER
PRESSURE REGULATOR 4-5 P.S.I.
CONDITIONER MAKE UP TANK
WET SCRUBBER MACHINE
RELIEF VALVE 5 P.S.I.
NEUTRAL START
START VALVE*
SAFE START VALVE*
START/PARK VALVE INTERLOCK VALVE *
DCS PUPS 35 PSI *
DCS RUN SOLENOID *
MANIFOLD BLOCK
DOOR INTERLOCK VALVE
BRAKE INTERLOCK PILOT VALVE*
PARK BRAKE PILOT VALVE*
TRANS DECLUTCH VALVE*
*ISOLATE VALVE
SHUTDOWN CYLINDER
ITEM QTY DESCRIPTION PART No. MASS
1 2 BREATHER 506688
2 1 HORN 50514
3 1 ISOLATION VALVE 501515
4 1 SAFETY VALVE 501516
5 1 COUPLING 501517
6 1 VALVE 3 WAY 501518
7 1 AIR RECEIVER 501637
8 1 VALVE 2 WAY 501520
9 1 CHECK VALVE 501521
10 1 GOVERNOR 501522
11 1 AIR COMPRESSOR FILTER 503715
12 1 NEUTRAL START VALVE 501527
13 2 VALVE 3/2 PILOT/ SPRING POPPET TYPE 501528
14 1 RELAY VALVE 503905
15 2 VALVE 3/2 PILOT SPRING SPOOL TYPE 503931
16 1 STARTER MOTOR 504796
17 1 CYLINDER SHUTDOWN 503712
18 1 1/4 REGULATOR ASSEMBLY 961194
19 1 RELIEF VALVE 507103
20 3 CHECK VALVE 502031
21 1 FILTER / WATER SEPARATOR 504300
22 2 VALVE 3/2 PALM SPRING 504435
23 1 INTERLOCK VALVE 504439
24 1 AIR COMPRESSOR 506646
25 1 START VALVE 506437
26 1 AIR PRESSURE GAUGE 505766
27 1 ON/OFF ISOLATOR 504436
28 1 DCS PUPS 514828
29 1 PARK BRAKE PILOT VALVE 504438
30 1 OIL PRESSURE GAUGE 505765
31 1 DCS RUN SOLENOID 509420
32 1 Y-STRAINER 505259
33 1 LOW ENGINE OIL PRESSURE TRANSDUCER 514835
34 1 AIR CHARGE BRACKET 506696
35 1 START RELEY MOUNTING BRACKET 507659
36 2 MANIFOLD BLOCK 501754
37 1 HOSE BRAIDED - COMPRESSOR 507704
38 1 PLUNGER 503933
39 1 ADAPTER 503932
40 1 FIT 3/4 D-RING 637182
41 1 SETSCREW M6 x 10 217080
DRAWN: JH REV: 5
DATE 24/12/08
CHECKED:
DATE:
APPROVED:
TITLE- SAFETY START & AUXILLARY GROUP FBL-10
DWG. No. 852421
SHEET 1 OF 1
SCALE: N.T.S.
SIZE A2
BUCYRUS Australia
Manufactured component shall comply with Manufacturing Specification No. 503970
DO NOT SCALE. IF IN DOUBT,ASK.
BUCYRUS

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PNEUMATIC SYSTEM TROUBLESHOOTING

The following pneumatic system troubleshooting guide is intended to provide basic guidance for analysing typical system faults and determining probable causes. This guide is not intended to be exhaustive but to provide personnel with a basic guide for fast rectification

Symptom	Probable cause	Caused by	Remedy
Engine will not crank at start up.	No air pressure to starter motor.	No air pressure in the air receiver.	Fill air receiver from an external supply.
		Main air isolation valve at the air receiver is closed.	Open main air isolation vale.
		On/off toggle switch in the operator's compartment is in the *off* position.	Toggle the on/off toggle switch to the *on* position.
		Transmission directional control lever is not set to the neutral position or is faulty.	Set transmission directional control lever to neutral. Replace valve if required.
		Exhaust temperature or exhaust gas temperature sensor activated. Engine temperature or coolant level activated.	Verify sensor status from indication panel. Allow sufficient time for the sensor to cool or replace sensor if suspected as faulty. Check engine coolant level.
		Neutral start interlock not functioning.	Check neutral start interlock function.
		Low hydraulic oil.	Fill hydraulic tank.
Poor engine cranking performance.	Insufficient air pressure to starter motor.	Pneumatic system bypass.	Check pneumatic system for leaks and rectify as required.
		Low system air pressure.	Check system air pressure. Reset governor pressure if required.
		Damaged or faulty relay valve.	Check and clean relay valve replace if required.
		Blocked starter motor silencer.	Check and clean starter motor silencer if required.
		Starter motor internal bypass.	Remove and overhaul or replace starter motor.
System pressure fails to charge to 120 psi when engine is running.	Insufficient air pressure received from compressor.	Governor setting out of adjustment. Bypass in compressor.	Test and adjust governor. Remove and overhaul or replace compressor.

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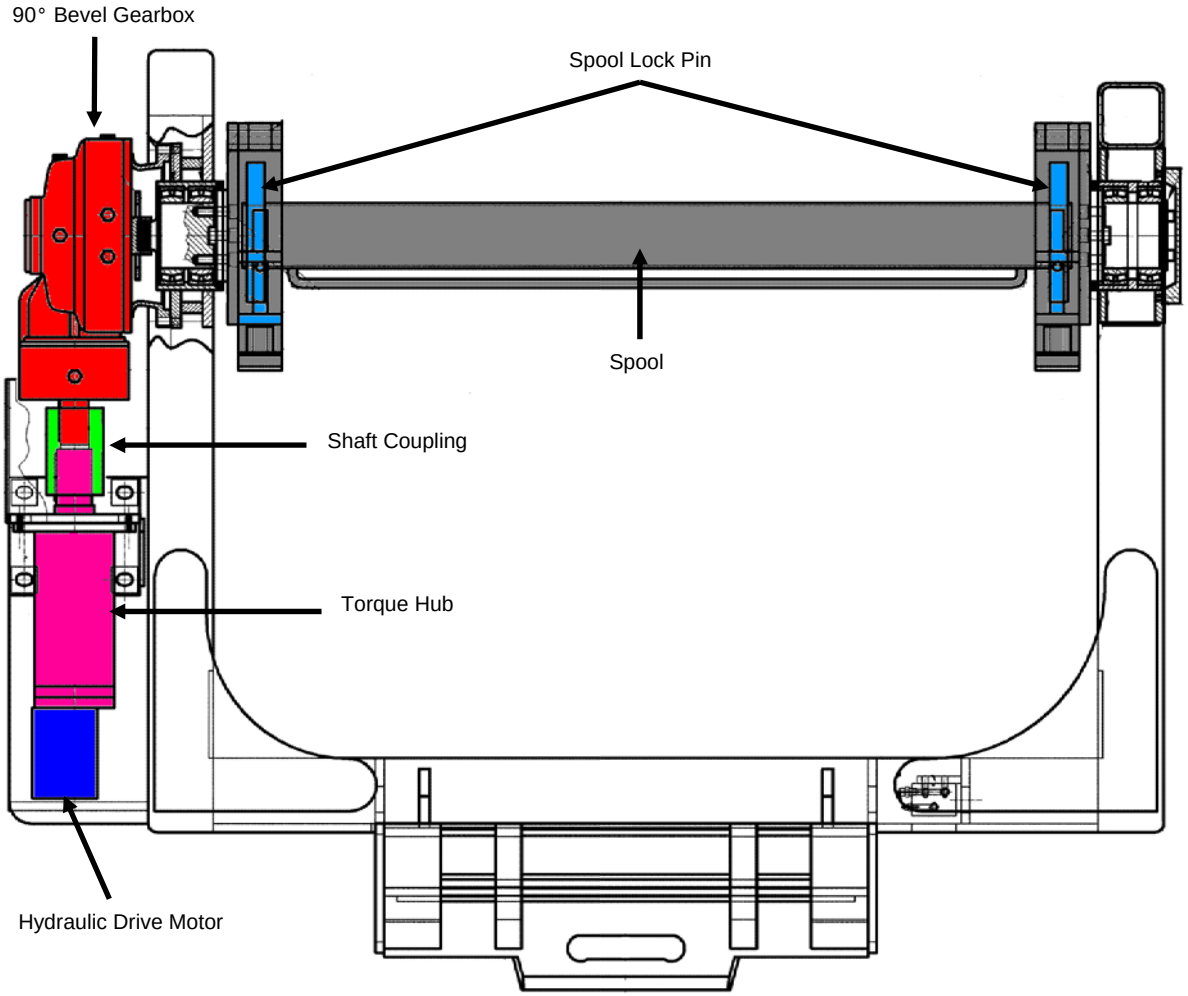
90° Bevel Gearbox
Spool Lock Pin
Spool
Shaft Coupling
Torque Hub
Hydraulic Drive Motor