

REPAIR MANUAL



T225
T243 HDS
T245 HDS
T245 HDK
Protough 2200

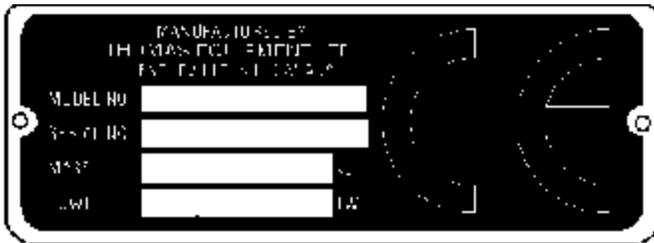
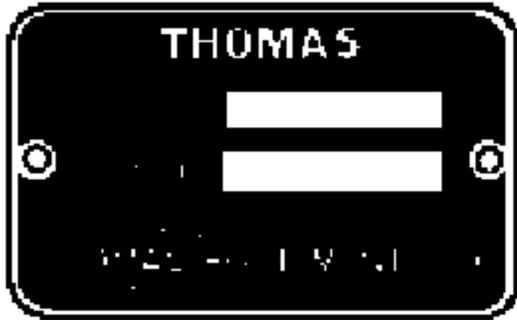
S / N LM000101 ONWARD

S / N LP000100 ONWARD

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FOREWORD

It is important when ordering replacement parts or making a service inquiry to provide both the model number and serial number of your Thomas loader. The serial number plate is located at the rear of the machine on the right hand side fuel tank. In the event that the serial number plate is missing, the model number and serial number are both stamped into the mainframe inside the rear door, next to the hydraulic control valve.



SAFETY PRECAUTIONS

Practically all Service work involves the need to drive the loader. The Operators Manual, supplied with each loader, contains safety precautions relating to driving, operating and servicing that loader. These precautions are as applicable to the service technicians as they are to the operator and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or re-assembly operations, whether within the shop facility or “out in the field”, may have an effect upon safety, not only upon the mechanic carrying out the work but also upon bystanders.

PERSONAL CONSIDERATIONS

* CLOTHING

The wrong clothing or carelessness in dress can cause accidents. Check to see that you are suitably clothed. Some jobs require special protective equipment.

* SKIN PROTECTION

Used motor oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and length of time used oil stays on your skin.

* EYE PROTECTION

The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiseling, grinding, welding, painting and any other task that involves foreign matter.

* BREATHING PROTECTION

Fumes, dust and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.

* HEARING PROTECTION

Loud noise may damage your hearing and the longer the exposure the greater the risks of hearing damage. Always wear hearing protection when working around loud machinery.

*

HAND PROTECTION

It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work, clean your hands with soap and water. Solvents such as white spirits, paraffin, etc. may harm the skin.

* FOOT PROTECTION

Substantial or protective footwear with reinforced toecaps will protect the feet from falling objects. Additional oil-resistant soles will help to avoid spilling.

* SPECIAL CLOTHING

For certain work it may be necessary to wear flame or acid resistant clothing.



EQUIPMENT CONSIDERATIONS

* MACHINE GUARDS

Before using any machine, check to ensure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing coming in contact with the moving parts of the machine but also ward off objects that might fly off the machine and cause injury.

* LIFTING APPLIANCES

Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes are thoroughly checked before use. If in doubt, select stronger equipment. Never stand under a suspended load or raised implement.

* COMPRESSED AIR

The pressure from a compressed air line is often as high as 100 PSI (6.9 Bar). any misuse may cause injury.

Never use compressed air to blow dust, filing dirt, etc. away from your work area unless the correct type of nozzle is fitted.

Compressed air is not a cleaning agent. It will only move dust etc. from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears and skin.

SAFETY PRECAUTIONS

* HAND TOOLS

Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job as this leads either to some injury or to a poor job done.

Never Use:

- A hammer with a loose or split handle.
- Spanners or wrenches with splayed or worn jaws.
- Wrenches or files as hammers; drills or clevis pins or bolts as punches.

For removing or replacing hardened pins use a copper or brass drift rather than a hammer.

For dismantling, overhaul and assembly of major and sub-components always use the Special Service Tools recommended. These will reduce the work effort, labor time and the repair cost.

Always keep tools clean and in good working order.

* ELECTRICITY

Electricity has become so familiar in day to day usage that it's potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.

Before using any electrical equipment, particularly portable appliances, make a visual check to ensure to make sure that the cable is not worn or frayed and that the plugs, sockets etc. are intact. Make sure you know where the nearest isolating switch for your equipment is located.

GENERAL CONSIDERATIONS

* SOLVENTS

Use only cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components such as seals, etc. and can cause skin irritation. Solvents should be checked that they are suitable not only for the cleaning of components and individual parts but also that they do not affect the personal safety of the user.

* HOUSEKEEPING

Many injuries result from tripping or slipping over, or on, objects or materials left lying around by a careless worker.

Prevent these accidents from occurring. If you notice a hazard, don't ignore it, remove it.

A clean hazard free place of work improves the surroundings and daily environment for everybody.

* FIRE

Fire has no respect for persons or property. The destruction that a fire can cause is not always fully realized. Everyone must be constantly on guard.

- Extinguish matches, cigars, cigarettes etc. before throwing them away.
- Work cleanly, disposing of waste material into proper containers.
- Locate all the fire extinguishers and ensure all personnel know how to operate them.
- Do not panic, warn those near and sound the alarm.
- Do not allow or use an open flame near the loader fuel tank, battery or component parts.

* FIRST AID

In the type of work that mechanics are engaged in, things such as dirt, grease, fine dust etc. all settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may be found that a septic condition has formed in a short time. What appears at first to be trivial could become painful and injurious. It only takes a few minutes to have a fresh cut dressed but it will take longer if you neglect it.

* CLEANLINESS

Cleanliness of the loader hydraulic system is essential for optimum performance. When carrying out service and repairs, plug all hose ends and components connections to prevent dirt entry.

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacement. Use of a high pressure washer or steam cleaner is recommended.

SAFETY PRECAUTIONS

OPERATIONAL CONSIDERATIONS

- * Stop the engine, if at all possible, before performing any service.
- * Place a warning sign on loaders which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.
- * Do not attempt to start the engine while standing beside the loader or attempt to bypass the safety starting system.
- * Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- * Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.
- * Never work beneath a loader which is on soft ground. Always take the unit to an area which has a hard working surface, preferably concrete.
- * If it is found necessary to raise the loader for ease of maintenance, make sure that safe and stable supports are installed beneath the main frame before commencing work.
- * Use footsteps or working platforms when servicing those areas of the loader that are not within easy reach.
- * Before loosening any hoses or tubes, switch off the engine, remove all pressure in the lines by operating the foot pedals several times. This will remove the danger of personal injury by oil pressure.
- * Prior to pressure testing, make sure all the hoses and connectors on both the loader and on the test machine are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibility of personal injury.
- * Always lower equipment to the ground when leaving the loader.
- * If high lift attachments are installed on a loader, beware of overhead power and telephone lines when travelling. Drop attachment near to ground level to increase stability and minimize risks.
- * Do not park or attempt to service a loader on an incline. If unavoidable, take extra care and block the wheels.
- * Escaping hydraulic / diesel fluid under pressure can penetrate the skin causing serious injury. Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Stop the engine and relieve pressure before connecting or disconnecting lines. Tighten all connections before starting the engine or pressurizing the lines. If any fluid is injected into the skin, obtain medical attention immediately.
- * Prior to removing wheels and tires from a loader, check to determine whether additional ballast (liquid or weight) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.
- * When inflating tires beware of over inflation.; constantly check the pressure. Over inflation can cause tires to burst and result in personal injury.
- * Safety precautions are very seldom the figment of someone's imagination. They are the result of sad experience where most likely someone has paid dearly through personal injury.
- * Heed these precautions and you will protect yourself accordingly. Disregard them and you will duplicate the sad experiences of others.

SERVICE TECHNIQUES

A. SERVICE SAFETY

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This shop manual provides general directions for accomplishing service and repair work with tested effective techniques. Following them will help assure reliability.

SAFETY PRECAUTIONS

There are numerous variations in procedures, techniques, tools and parts for servicing vehicles as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that he or she compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

B. SERVICE TECHNIQUES

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to O rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhaul components being more reliable and efficient in operation.

Replace O rings, seals or gaskets whenever they are disturbed. Never mix new and old seals and O rings, regardless of condition. Always lubricate new seals and O rings with hydraulic oil before installation.

When replacing component parts use the correct tool for the job.

C. HOSES AND TUBES

Always replace hoses and tubes if the end connections are damaged. Be sure any hose installed is not kinked or twisted.

When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

The hoses are the arteries of the unit; be sure they are in good condition when carrying out repairs or maintenance otherwise the machines output and productivity will be affected.

After hose replacement to a moving component, check that the hose does not foul by moving the component through the complete range of travel.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swaged position have failed and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which results in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

D. PRESSURE TESTING

Prior to pressure testing, be sure all hoses are in good condition and all connections tight. Pressure readings must be taken with gauges of specified pressure readings.

The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibility of personal injury.

E. BEARINGS

Bearings which are considered suitable for further service should be cleaned in a suitable solvent and immersed in clean lubricating oil until required.

Installation of a bearing can be classified into two (2) ways:

- press fit on rotating parts such as shafts and gears, or
- push fit into static locations such as reduction gear houses.

Where possible, always install the bearing onto the rotating components first.

SAFETY PRECAUTIONS

Use the correct tools or a press to install a bearing or bushing. In the absence of the correct tools or press, heat the bearing and / or casing in hot oil to assist the installation of the bearing.

When bearings or bushings are removed, always carefully check that the bearing is free from discoloration and signs of overheating. Also check for mechanical damage such as excessive clearance, nicks and scuffing. If in doubt, replace the bearings or bushings.

Bearings should never be removed unless absolutely necessary. Always use the recommended puller to reduce the risk of bearing or related component failure.

These bearings and bushings are subjected, in normal operation, to high working loads and adverse conditions.

Be sure during normal routine servicing, maintenance or repair that bearings are given the right attention and are installed with care.

F. BOOM SUPPORTS

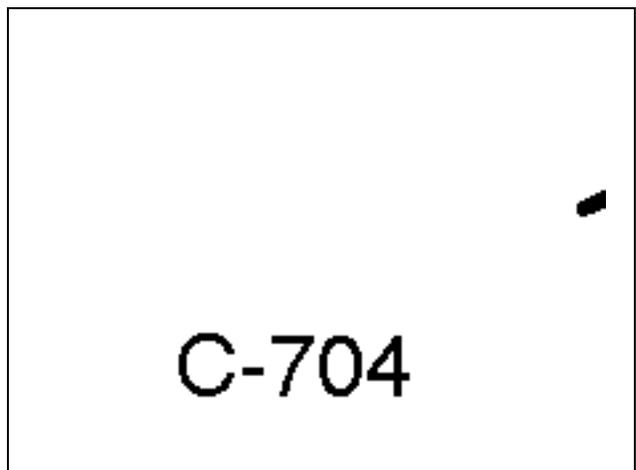
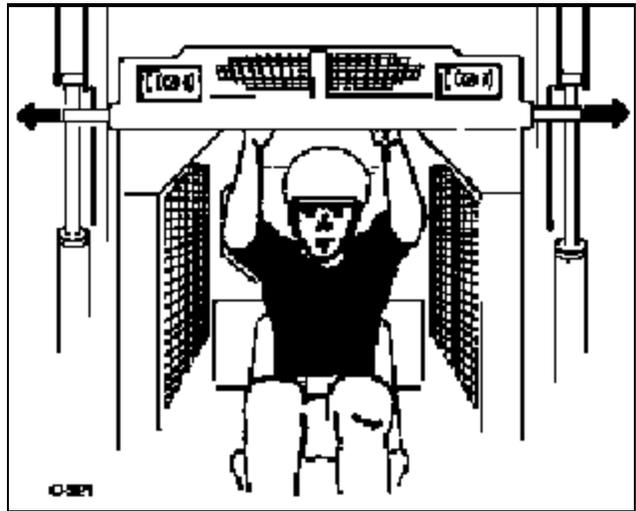
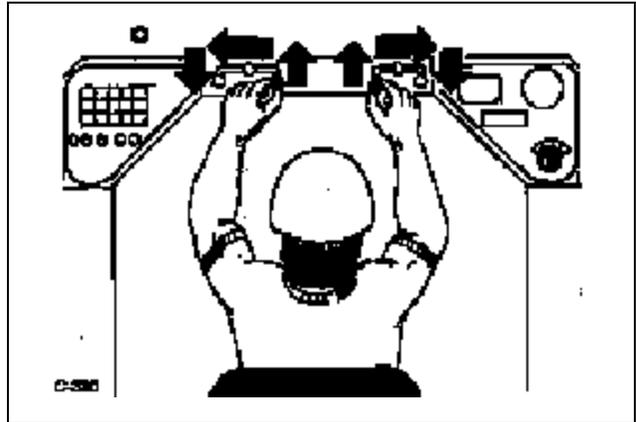
**WARNING**

To avoid personal injury, service the loader with the arms down and the bucket or attachment on the ground. If it is necessary to service the loader with the boom arms raised be sure to engage the boom supports. Never work under or around a loader with raised boom arms without boom supports engaged.

For safety while performing regular service or maintenance work, the loader is equipped with boom supports.

The boom supports, when extended, prevent the boom arms from dropping if hydraulic pressure is relieved or the foot control pedals are accidentally cycled.

To operate the boom supports, first remove any bucket or attachment from the quick - tach; raise the boom arms to full height and shut off the engine. Raise the boom handles up and push out toward the boom arms to extend the boom supports.



G. BOOM LOCKDOWNS

The boom lock down is intended to lock the loaders boom arms in the down position for safe entry and exit of the loader cab when using specific attachments. To operate the boom lock down, lower the boom arms fully down and shut off the engine. Engage the parking brake . Install the boom lock down bars. **NOTE: N/A on the ProTough 2200 model.**

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NOTES

SECTION 1 HYDRAULIC SYSTEM



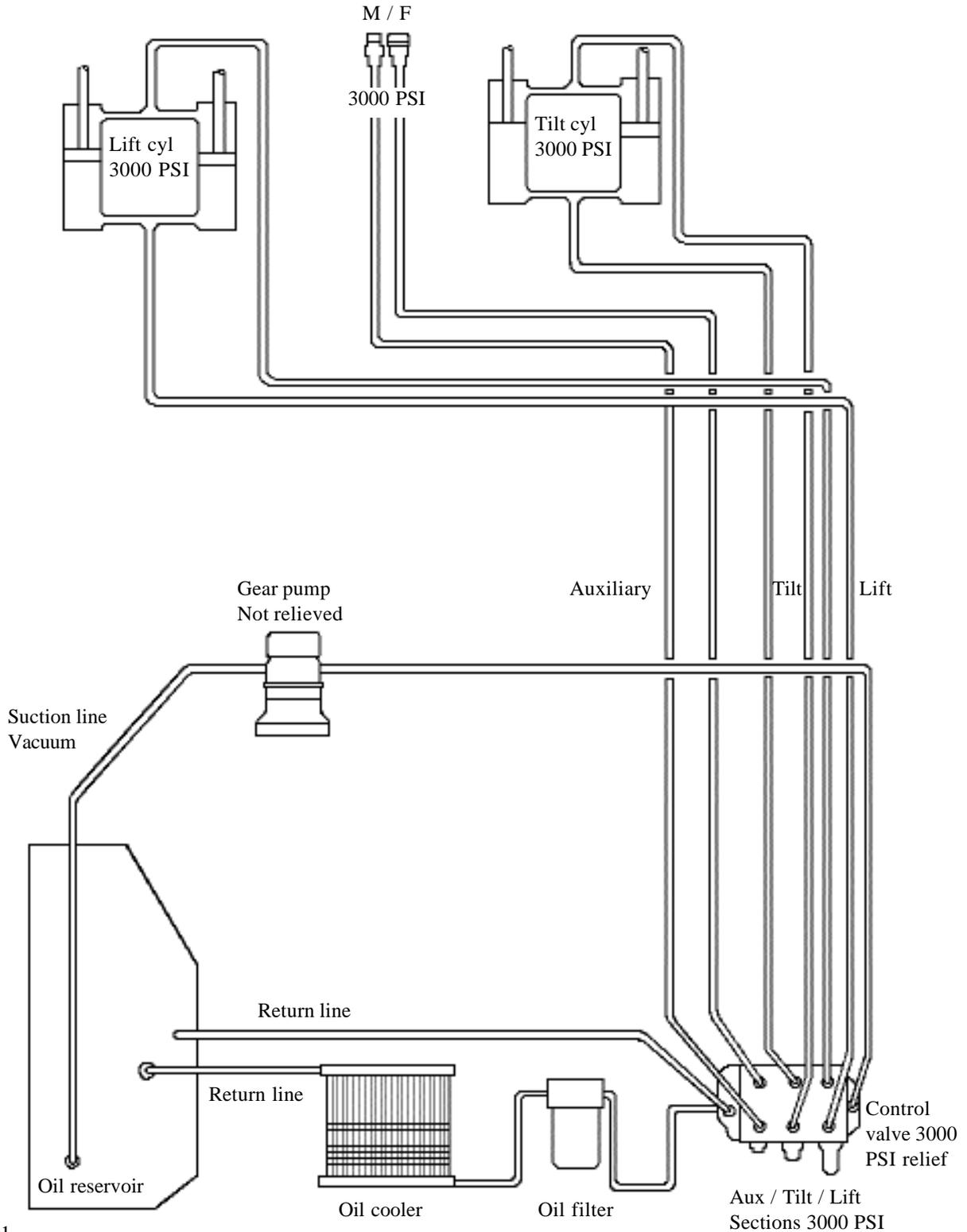
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HYDRAULIC SCHEMATIC 1.1

Hydraulic Circuit and System Pressure Schematic 245HDS

(S/NLM000101 onward)

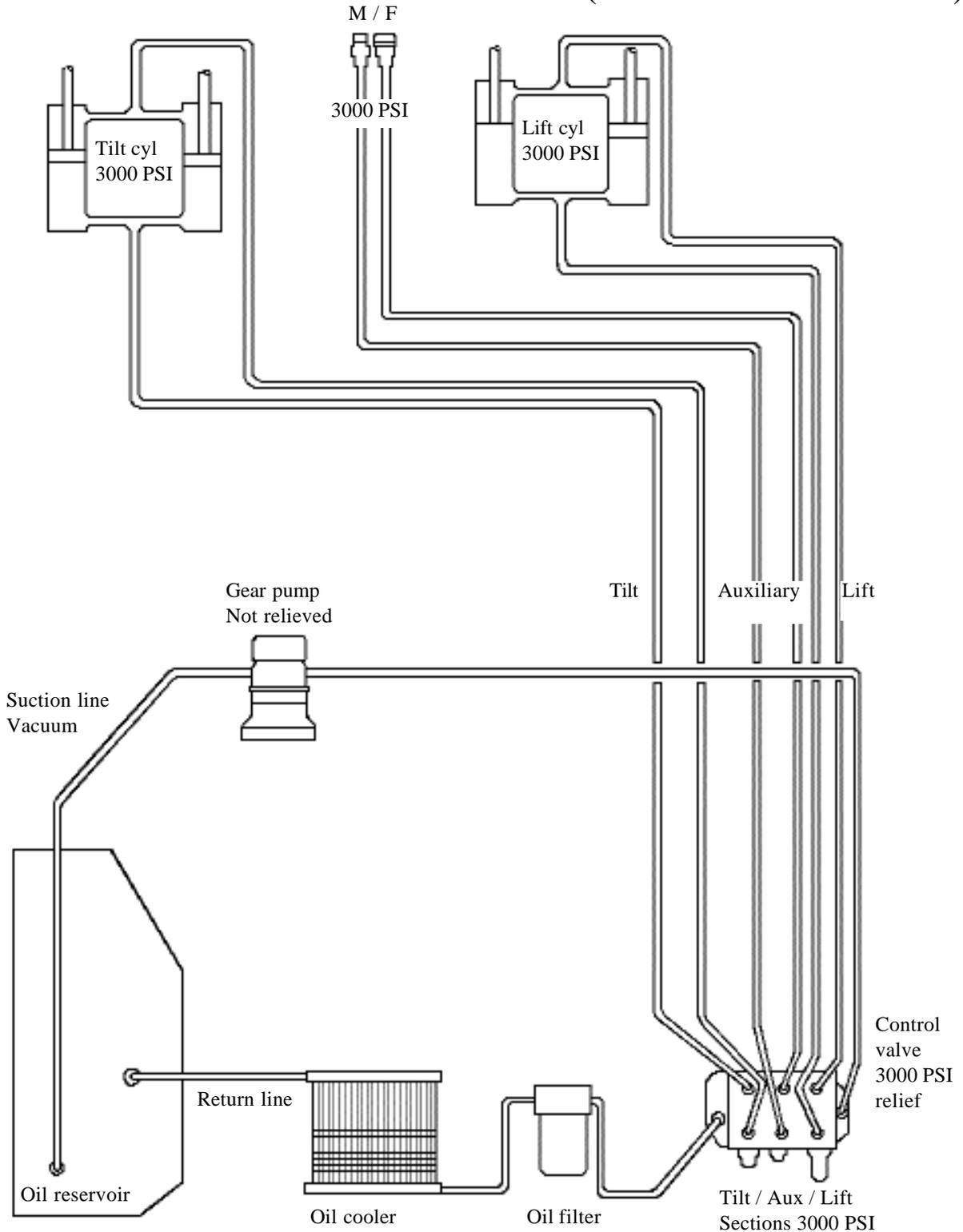


C1721

HYDRAULIC SCHEMATIC 1.1

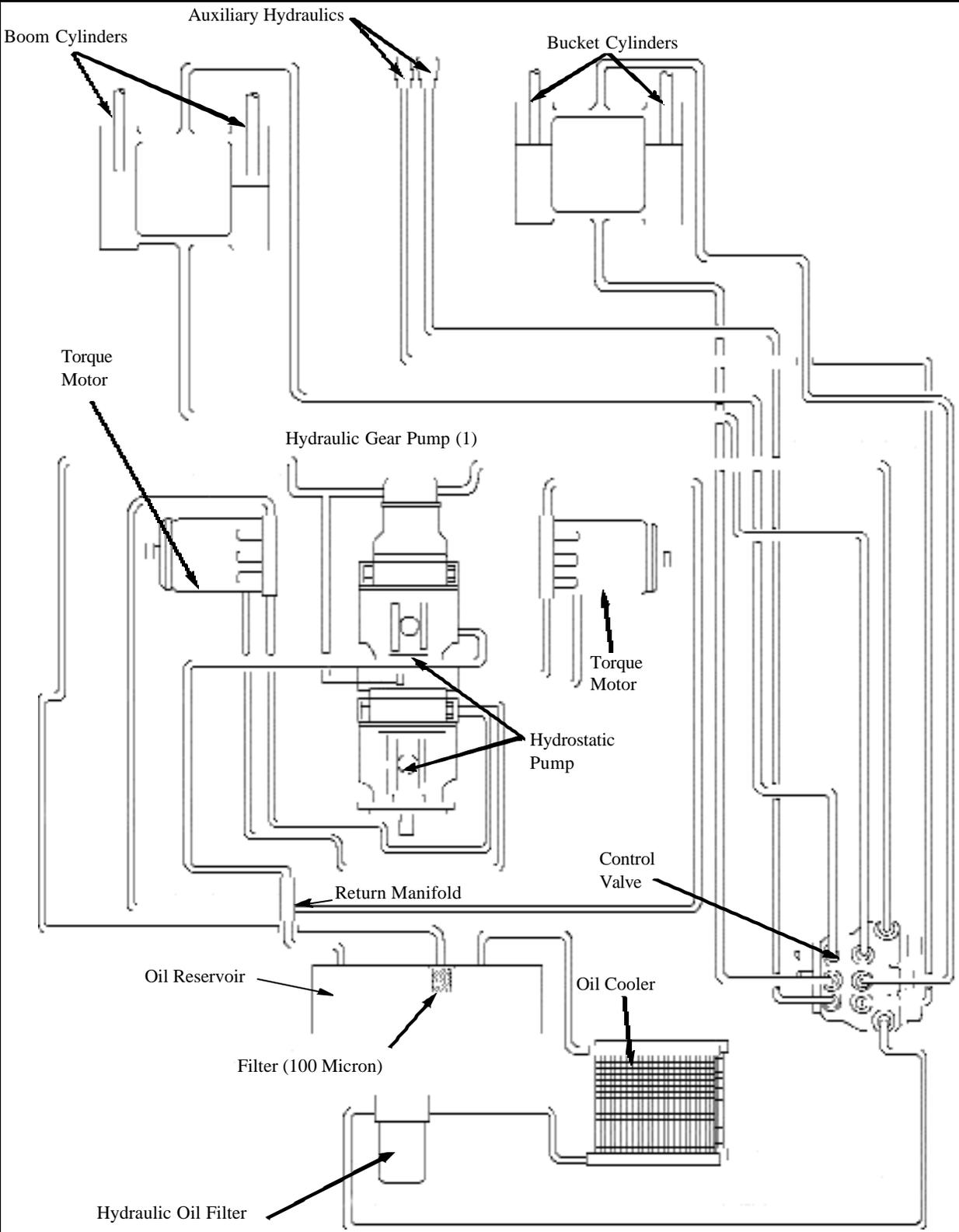
Hydraulic Circuit and System Pressure Schematic 243HDS

(S/NLM000101 onward)



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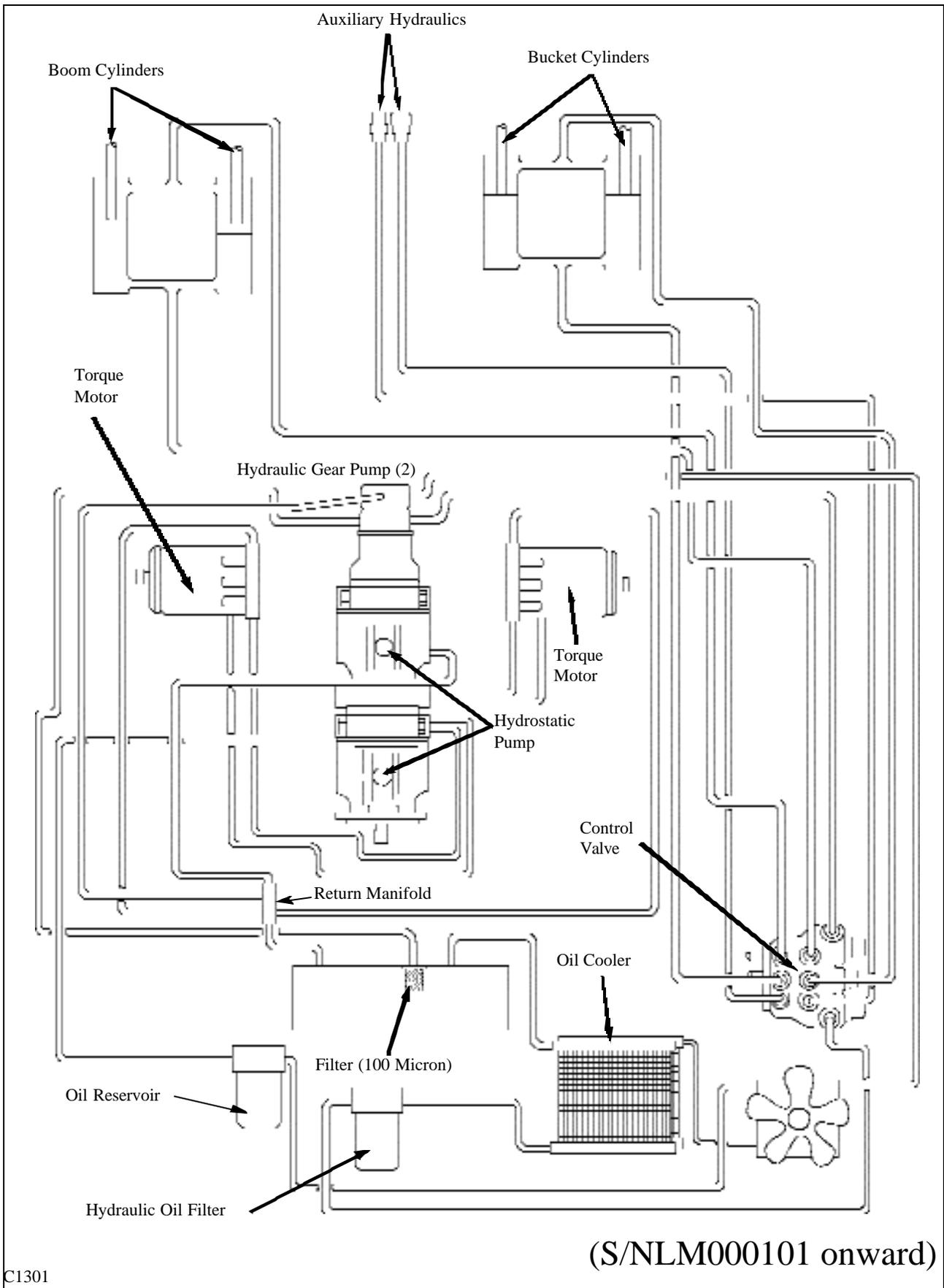
HYDRAULIC CIRCUIT (ProTough2200) 1.1



C2824

(S/NLP000100 onward)

HYDRAULIC CIRCUIT (T245HDK) 1.1



C1301

SPECIFICATIONS & MAINTENANCE 1.2

T243HDS & T245HDS MODELS



Pump Type	.....	Gear, 1.4 cu. in. (23cc)
Pump Brand	.....	Sauer Sundstrand
Pump Capacity	.....	20.5 GPM (77.6 LPM)
Rated Speed	.....	2800 RPM
Control Valve	.....	Series Type
Main Relief Pressure	.....	3000 PSI (207 Bar)
Port Relief Pressure	.....	Tilt Reliefs, lift downside: 3260 psi
	.....	lift upside: 2460 psi
Reservoir Capacity	.....	18 US Gallons (68 Litres)
Fluid Type	.....	10W30 API SE / CD Oil
Reservoir Filtration	.....	100 Micron
System Filtration	.....	10 Micron
Oil Cooler	.....	1000 BTU
Lift Cylinders	.....	( 2) 3” Bore Diameter
Lift Cylinder Rods	.....	.2” Diameter
Tilt Cylinders	.....	( 2) 3” Bore Diameter
Tilt Cylinder Rods	.....	1.5” Diameter

<u>Maintenance Schedule</u>	<u>.....First (HRS)</u>	<u>.....Every (HRS)</u>
Oil level check	.8	.8
Oil filter change	.50	.150
Oil cooler clean	.8	.8
General system check (leaks etc.)	.8	.8
Cylinders, lubricate	.8	.8
Reservoir filters change	1000	1000
Hydraulic oil change	1000	1000

SPECIFICATIONS & MAINTENANCE 1.2

T245HDK & ProTough 2200 MODELS

Pump Type	.....Gear, 1.4 cu. in. (23cc)	
Pump Brand	.....Sauer Sundstrand	
Pump Capacity	.....20.5 GPM (77.6 LPM)	
Rated Speed	.....2700 RPM	
Control Valve	.....Series Type	
Main Relief Pressure	.....3000 PSI (207 Bar)	
Port Relief Pressure	.....Tilt Reliefs, lift downside: 3260 psi.....lift upside: 2460 psi	
Reservoir Capacity	.....18 US Gallons (68 Litres)	
Fluid Type	.....10W30 API SE / CD Oil	
Reservoir Filtration	.....100 Micron	
System Filtration	.....10 Micron	
Oil Cooler	.....1000 BTU	
Lift Cylinders	.....ProTough 2200(2) 2.5'' Bore Diameter	
Lift Cylinder Rods	.....ProTough 2200 1.5'' Diameter	
Tilt CylindersProTough 2200 (2) 2.5'' Bore Diameter	
Tilt Cylinder RodsProTough 2200 1.5'' Diameter	
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Tilt Cylinder RodsT245HDK 2.0'' Diameter	
<u>Maintenance Schedule</u>	<u>.....First (HRS)</u>	<u>.....Every (HRS)</u>
Oil level check	.....8	.....8
Oil filter change	.....50	.....150
Oil cooler clean	.....8	.....8
General system check (leaks etc. )	.....8	.....8
Cylinders, lubricate	.....8	.....8
Reservoir filters change	.....1000	.....1000
Hydraulic oil change	.....1000	.....1000

GENERAL INFORMATION 1.3

General Operation

Refer to figures C1721 and C1722 on pages 2 and 3. Oil is drawn from the hydraulic oil reservoir through a 100 micron element. From there it travels to the main hydraulic pump.

The hydraulic pump is a gear type which is driven by a shaft and coupler through the hydrostatic drive pump at engine speed. The oil then flows from the gear pump to the hydraulic control valve.

The hydraulic control valve is equipped with an adjustable relief valve which is adjusted to 3000 PSI (207 Bar). The control valve is a sectional series type with 3 spools. (banks) The various spools activate the boom, bucket and auxiliary hydraulic functions.

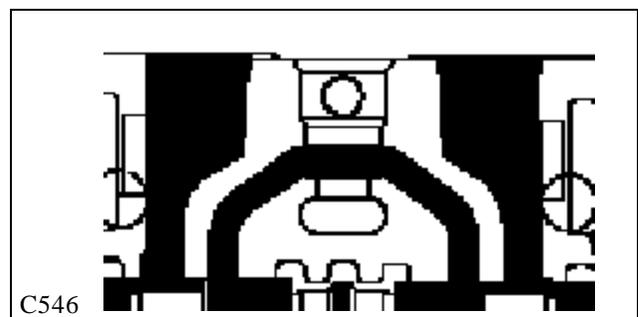
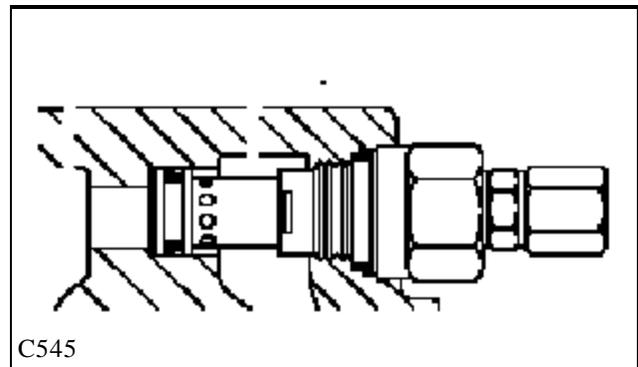
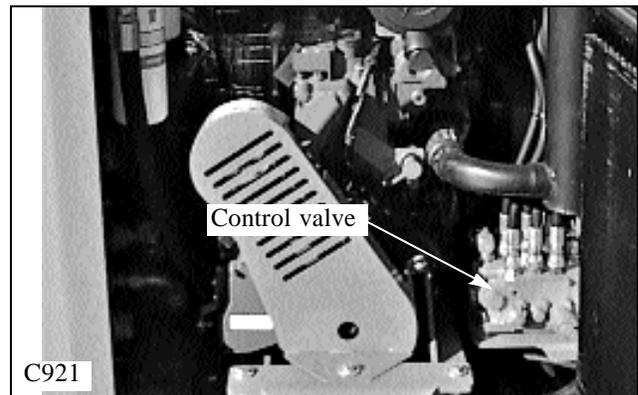
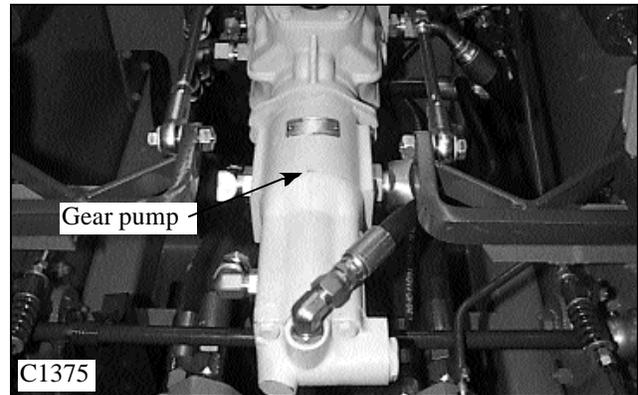
When the spools are in neutral, oil flows from the hydraulic gear pump, through the control valve and returns to the hydraulic filter, to the cooler and then back to the hydraulic reservoir. As a spool is moved, oil is directed to one of the valve ports and oil flows out to operate a function. The return oil coming back from this operation is ported to the next valve section which allows operation of more than one function at the same time. Each spool end contains a centering spring which returns the spool to neutral when the foot pedal, or control handle, is released.

The boom section, on foot control operated loaders, has a detent mechanism to hold the spool in the float position. The auxiliary section is operated by solenoid coils and may be engaged momentarily by the control lever mounted switch, forward or reverse, or by engaging the dash mounted toggle switch for constant power in the forward direction only.

The system relief valve operates when ever a hydraulic function has been restricted or over loaded. (fig. C545) To protect against excessive pressure build up, the relief valve opens and allows oil to return to the reservoir. The system relief valve is adjustable, and is preset at 3000 PSI. (207 Bar)

Load check valves are located between the ports of each spool circuit. The function of the load check valve is to hold the boom arms or bucket in position during spool movement.

In operation, the check valve, (fig C546), is retained on its seat by spring pressure. At initial spool movement, the natural tendency is for the oil, which is being pressurized by the closing of the open center oil passage to flow to an area of lower pressure. As the open center passage is being blocked, the oil would then attempt to flow past the open spool. This oil is held at the check valve until the



GENERAL INFORMATION 1.3

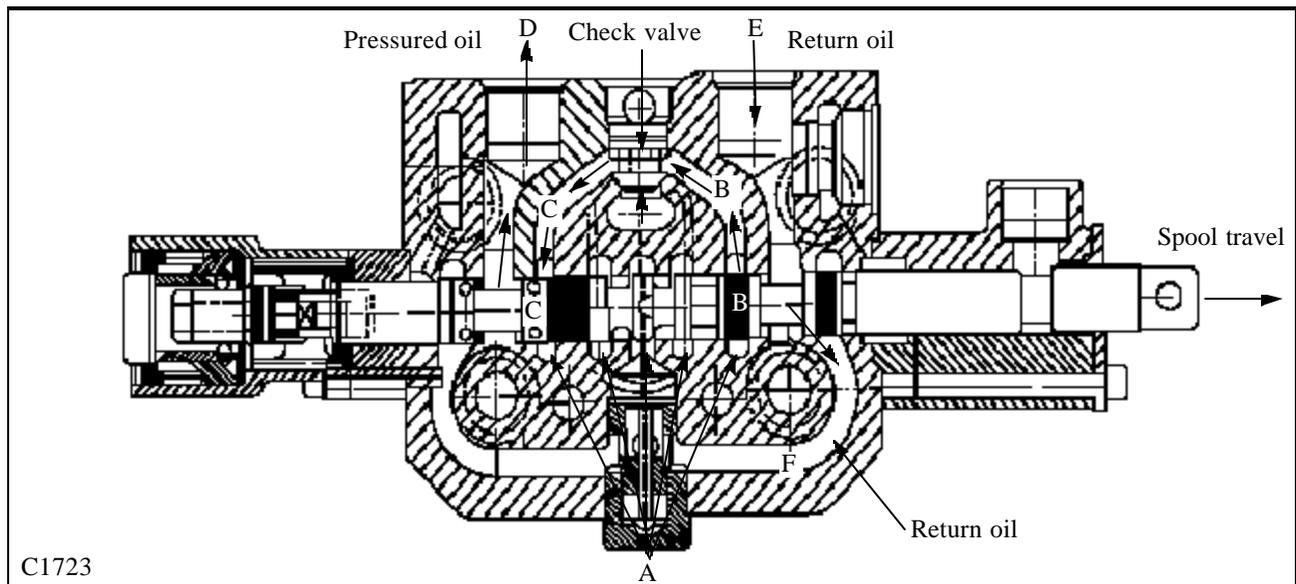
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pumped oil overcomes the force holding the check valve on its seat. As the pressure increases, the oil pressure unseats the check valve and pressurized oil flows out a circuit port.

Figure C1723 is a cut away view of a control valve section.

Pressurized oil flows through the center of the control valve at oil passage (A). As the spool is moved, in this case forward, oil moves from passage (A) to passage (B). The increased pressure at (B) raises the check valve. At the same time the spool is moving forward, port (D) is pressurized from passage (A), and passage (C) is opened up to port (D) also. Pressured oil from (D) operates a hydraulic function. Oil returned from the hydraulic function goes to port (E) and is directed to passage (F), which is connected to the oil return outlet section.

This sequence is reversed when the spool is moved in. Pushing the boom spool clear into the detent position allows the hydraulic circuit to pass oil freely between ports (D) and (E). This allows the boom to float or follow the ground terrain.



CONTROL VALVE 1.4

Testing and Adjusting the Relief Valve Pressure

Hoses and gauges required for this test must be capable of withstanding 5000 PSI (345 Bar) continuous pressure, and hydraulic flow meter capable of measuring 30 gallons per minute. (113 LPM) (fig. C1815)

1 Install the flow meter / pressure tester to the auxiliary hydraulic quick couplers. The female coupler attached to the loader provides the power out when the toggle switch is engaged on the dash panel. (fig. C641) Connect the flow meter and pressure gauge inlet side to match the power out of the female auxiliary coupler to prevent meter and gauge damage. Be sure to connect a return line to the male auxiliary hydraulic quick coupler. (fig. C1814)

2 Start the engine and engage the auxiliary hydraulic system. Increase the engine speed to full operating RPM. (See Section 7 for checking and adjusting engine speed to 2800 RPM plus or minus 25 RPM)

CAUTION

Serious damage may occur to the gear pump if the relief valve setting is adjusted too high.

3 Turn the flow control valve on the flow meter to restrict the oil flow down to 2 GPM. (7.5 LPM) As you are turning the flow control valve, watch the pressure gauge and make sure it does not go over 3000 PSI.(207 Bar) Stop further adjustment immediately if the reading goes over this setting. Shut off the auxiliary hydraulic system switch and shut off the engine. Move to step 6 to make initial setting.



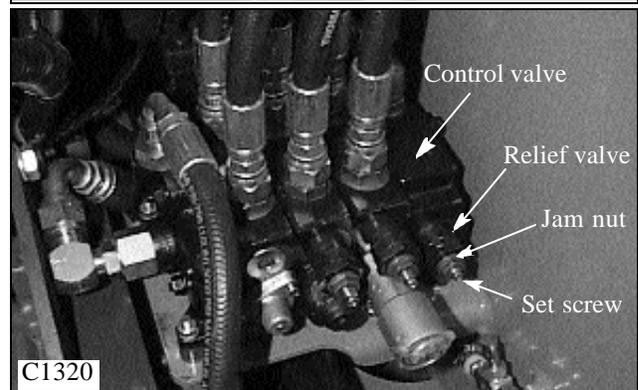
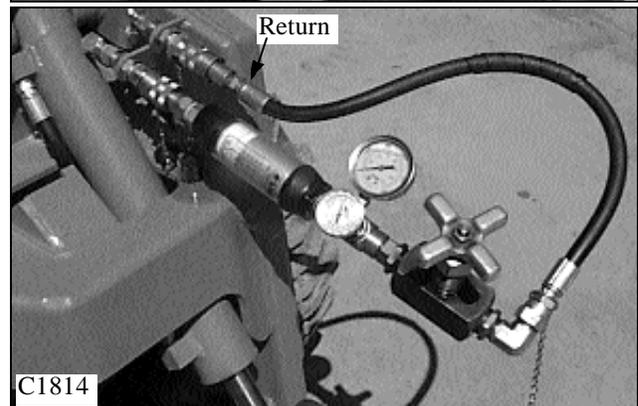
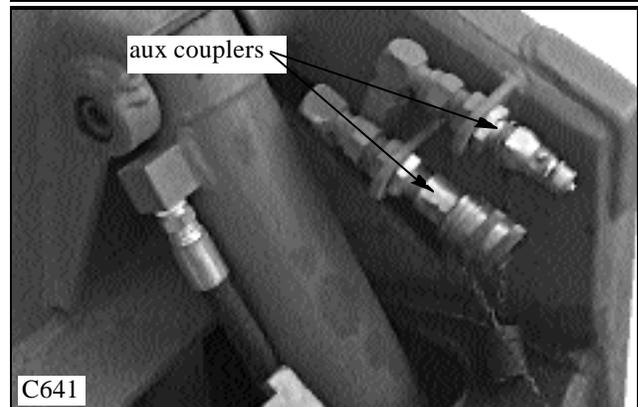
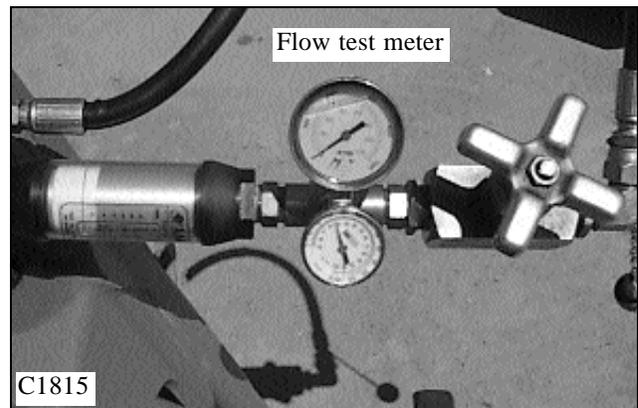
To prevent personal injury or damage to the loader, do not adjust the relief valve with the engine operating

4 Repeat steps 2 and 3 if necessary. Allow the loader to operate at this setting until the oil temperature has increased to 160° F(71°C), operating temperature.

5 Turn the flow control valve further to restrict the oil flow to no flow. Correct pressure setting is 3000 PSI +/- 100 PSI. (207 Bar, +/-6.9 Bar)

6 If adjustment is necessary, shut down the auxiliary hydraulic system switch, shut off the engine and return the flow control valve to the open position. Locate the control valve in the engine compartment.

7 Loosen the jam nut on the relief valve adjusting screw and turn the screw clockwise, counting the turns, until the screw bottoms out. (fig. C1320)

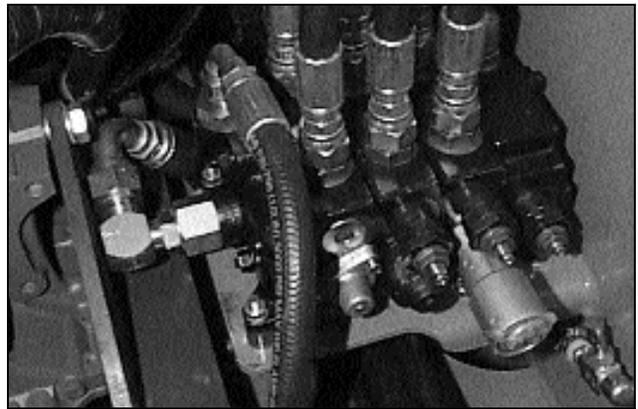
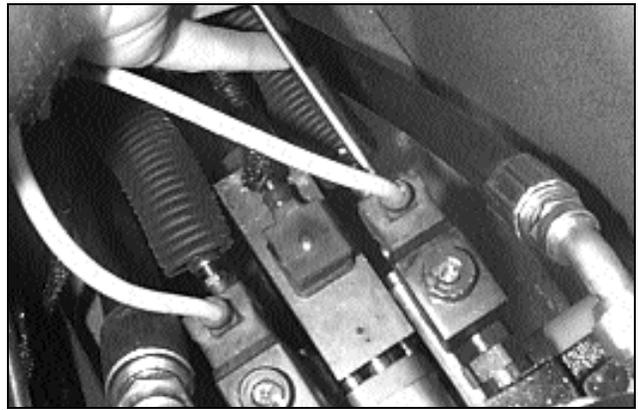
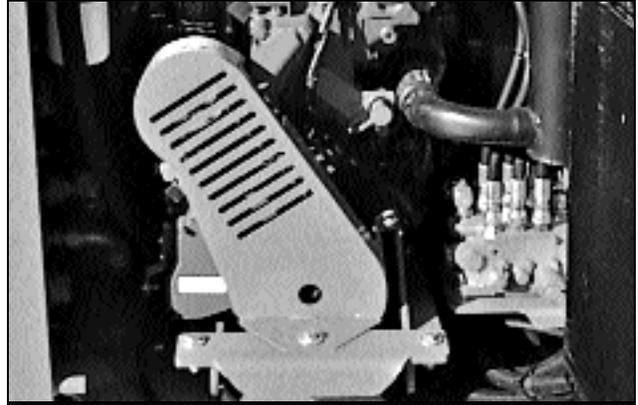


CONTROL VALVE 1.4

1

8 Turn the screw back out lesser turns than you turned in to increase pressure, or out more turns to increase pressure.

9 Retake the pressure readings by performing steps 2 through 5. If necessary make further adjustments by repeating steps 6 through 9.



From gear pump →

CONTROL VALVE 1.4

10 Torque the 7/8" ORB (o-ring) fittings to the control valve at 80 ft / lbs (109N.m.), the 7/8" JIC hose ends to the fittings at 45 to 50 ft / lbs (35N.m.), the 1 1/16 ORB fitting to the control valve at 80 to 85 ft / lbs(109 N.m.), and the 1 1/16 JIC hose end to the fitting at 75 to 80 ft / lbs (109 N.m.).

11 After all connections have been made, including the control valve electrical connections, check the oil level in the hydraulic reservoir and top off if necessary.

12 Start the engine and cycle the various hydraulic functions to check for leaks. Do not use your hands to check

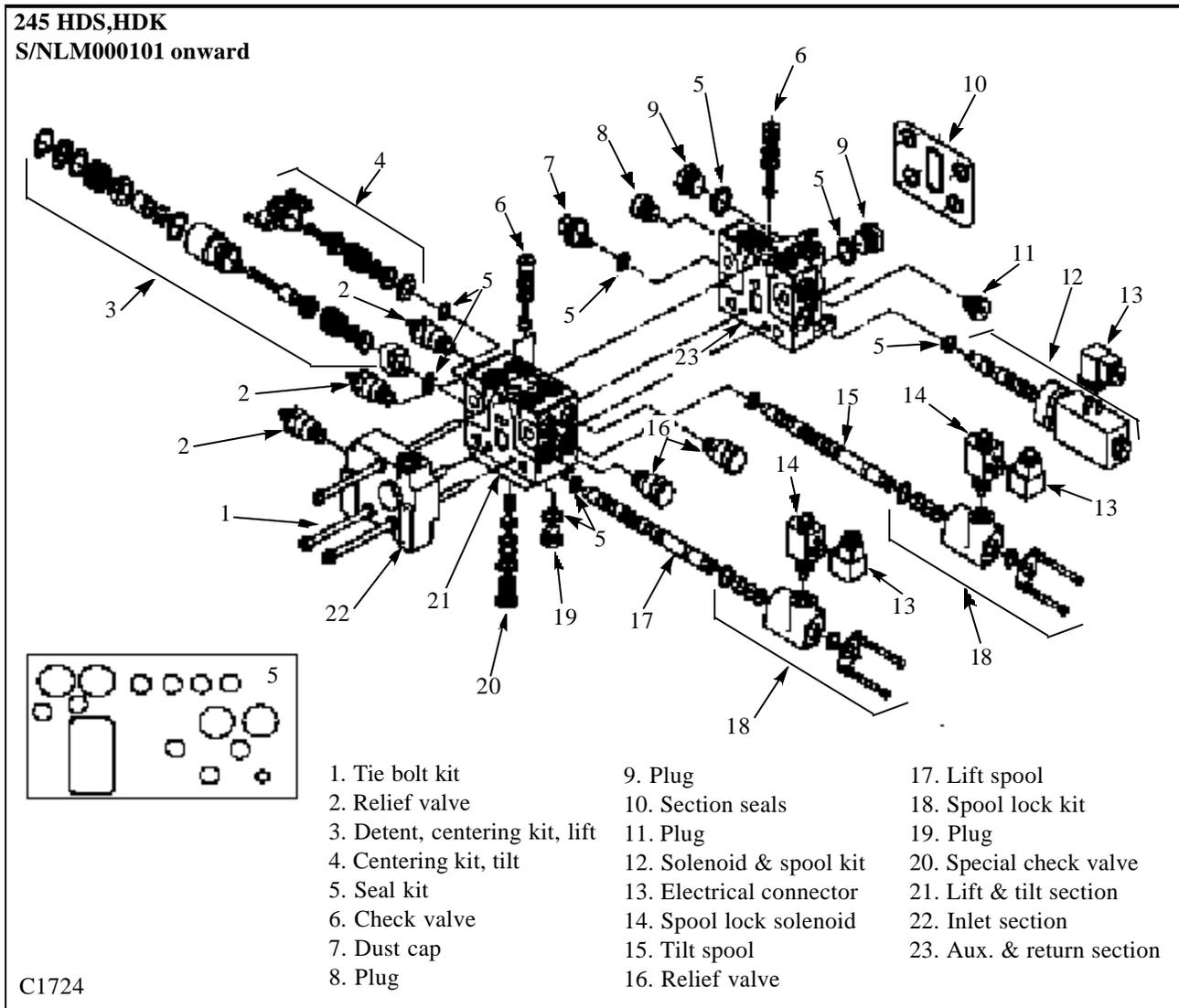
for leak locations, fluid under operating pressure can penetrate the skin and cause serious personal injury.



Use extreme caution when checking the hydraulic system for leaks. Fluid under pressure can penetrate the skin and cause serious injury.

13 After checking for leaks, you must retest the relief valve setting as outlined at the first part of the control valve section.

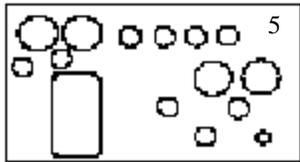
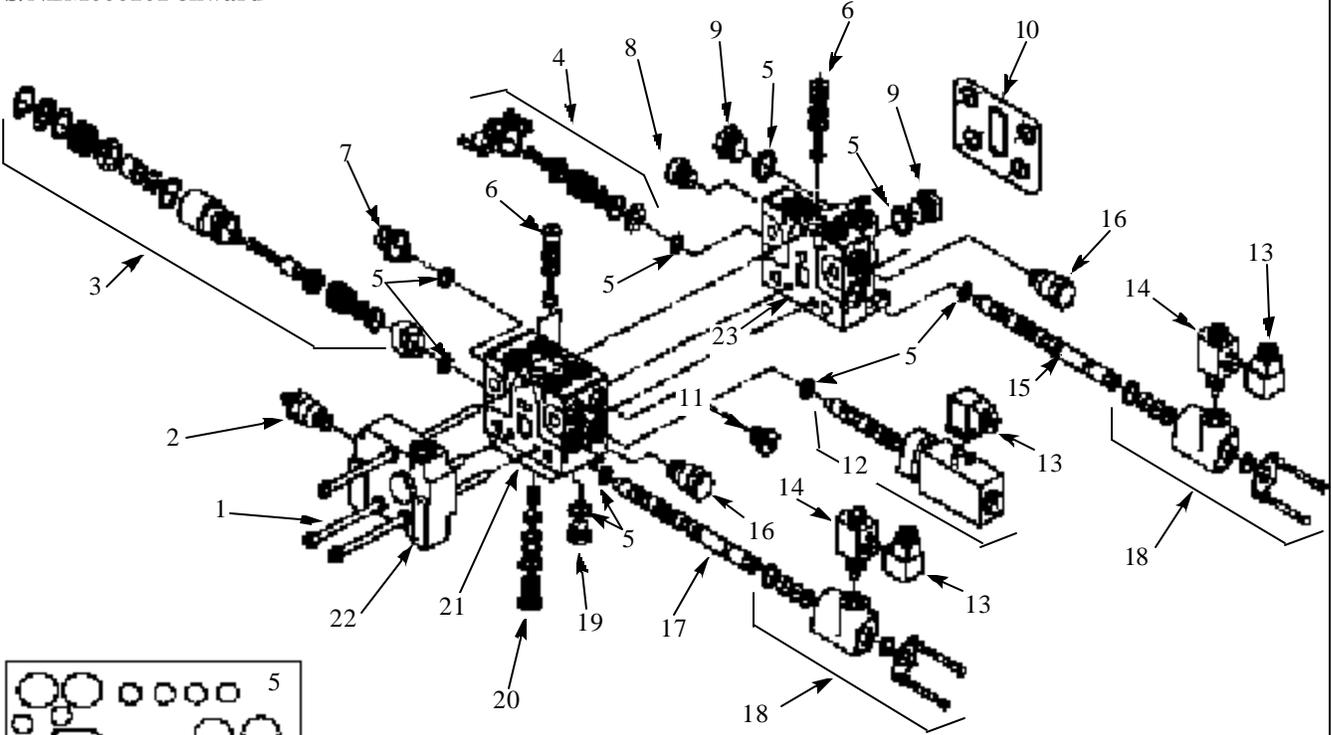
Control Valve Disassembly



CONTROL VALVE 1.4

1

243 CONTROL VALVE
S/NLM000101 onward



- | | | |
|--------------------------------|--------------------------|---------------------------|
| 1. Tie bolt kit | 9. Plug | 17. Lift spool |
| 2. Relief valve | 10. Section seals | 18. Spool lock kit |
| 3. Detent, centering kit, lift | 11. Plug | 19. Plug |
| 4. Centering kit, tilt | 12. Solenoid & spool kit | 20. Special check valve |
| 5. Seal kit | 13. Electrical connector | 21. Lift & aux section |
| 6. Check valve | 14. Spool lock solenoid | 22. Inlet section |
| 7. Dust cap | 15. Tilt spool | 23. Tilt & return section |
| 8. Plug | 16. Relief valve | |

C935

Before disassembling the hydraulic control valve, clean the body with a suitable solvent and dry with compressed air.



WARNING.
To avoid eye injury, use safety goggles when cleaning with compressed air.

Remove the hydraulic control valve as outlined in the removal section. Ensure all openings are plugged to prevent solvents and dirt from contaminating the control valve assembly. Refer to figures C1724 and C935 to assist in the disassembly of the control valve.

1 Remove the pressure relief valve(s). Discard the o-rings. Mark the locations of each relief valve as they may

have different pressure settings.

2 Remove the 3 tie bolts holding the valve sections together.

3 Remove the solenoid lock assemblies.

4 Remove the nut on the end of the auxiliary solenoid coil and remove the coil.

5 Remove the bolts retaining the auxiliary spool to the control valve section and remove the spool.

6 Remove the spool end caps from the lift and tilt sections.

7 Remove the lift and tilt spools from their section. Keep the spools marked and separated with their respective section. Use caution when removing and storing spools to prevent damage.

8 Remove the bolt retaining the spring spacers, spring and return washers from the ends of the lift and tilt spools.

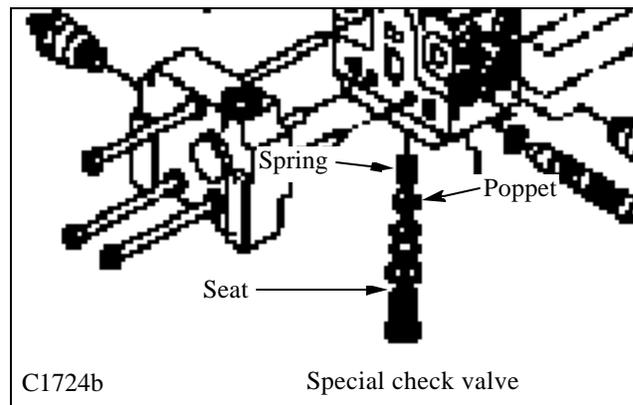
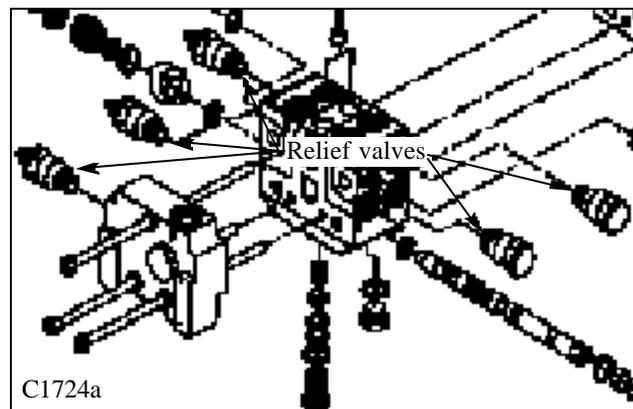
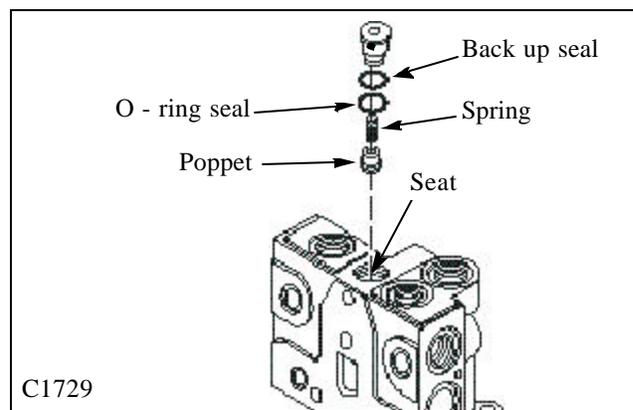
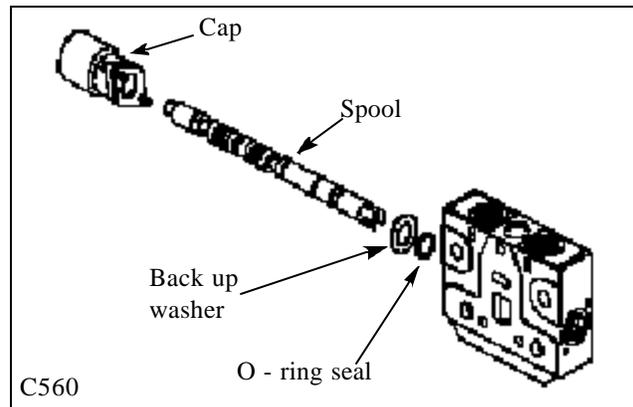
CONTROL VALVE 1.4

1

- 9 Remove the circlip retaining the detent springs, detent balls and spacer washers from the lift spool end cap.
- 10 Discard all the spool o-rings
- 11 Remove the 3 load check valves from the top of each control valve section.
- 12 Remove the special check valve from the bottom of the control valve lift section.

Inspection

- 1 Thoroughly clean and dry all parts.
- 2 Inspect the load check valve springs for broken or collapsed coils. Check the poppet valve seat area for scoring or wear. Replace the load check valve if worn or damaged.
- 3 Check the valve seats inside the control valve body for scoring or wear. If the seat is worn or damaged in the body, the whole section must be replaced. Scoring on the seat or the load check valve poppet will result in the boom arms, bucket tilt or auxiliary systems unable to hold a load stationary when the control valve spools are in the neutral position.
- 4 Examine each spool closely for scoring or wear. Replace the spool and valve section together if the spool is damaged.
- 5 Check the control valve body spool bores for scoring, wear or contaminant. Replace the control valve section and spool as a unit if the spool bores are damaged.
- 6 Inspect the return washers, return springs, spring spacers and detent spool for damage or wear. Replace the parts as a complete kit if necessary.
- 7 Inspect each relief valve and relief valve seat in the control valve body for scoring or wear. Replace the control valve section or relief valve as required.
- 8 Check the spring on the special check valve for collapsed or broken coils. Inspect the poppet and seat for scoring or wear. Replace the special check valve assembly if worn or damaged.



CONTROL VALVE 1.4

1

Assembly

Make sure all parts are clean and free of any solvent residue and lint.

1 Lightly coat the control valve section seals with petroleum jelly. Place the seals into position on one section.

IMPORTANT

Keep the work area, tools and hands clean while making repairs to the control valve.

2 Install the next section onto the section with the seals installed. Use the 2 lower tie bolts as a guide to help line up the section seal grooves. Double check to make sure the seals do not fall out of place.

3 Tighten the 2 lower tie bolts hand tight.

4 Install the 3 load check valves. Lubricate the check valve poppet and seat with hydraulic system oil. Install new seals and lubricate the seals with a light coating of petroleum jelly. Line up the hole in the check valve cap with the tie bolt holes in the control valve body. (fig. C1729)

5 Install the top tie bolt and torque all 3 tie bolts at 15 to 18 ft/ lbs (20 - 25 N.m.). Check to make sure the section seals are still in place. (fig. C935a)

6 Install the special check valve into the bottom of the boom lift section body. Lubricate the special check valve poppet and seat with hydraulic system oil. Install new seals and lightly lubricate the seal with petroleum jelly.

7 Lubricate each spool with system oil and carefully insert into the section body with a rotating motion. (fig. C560)

8 Install the washers, spring spacers, spring and bolt onto the lift and tilt spools.

9 Lubricate new spool seals with petroleum jelly and place them onto the spools.

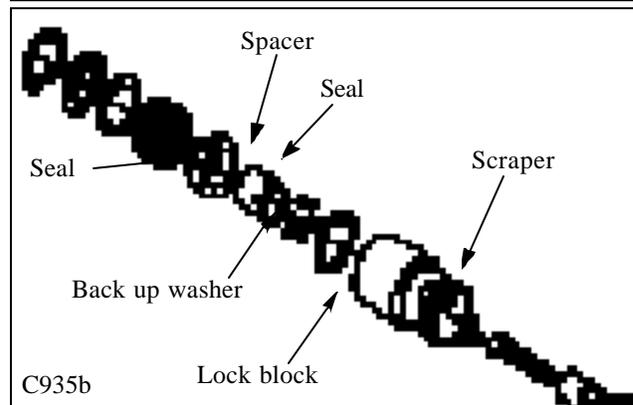
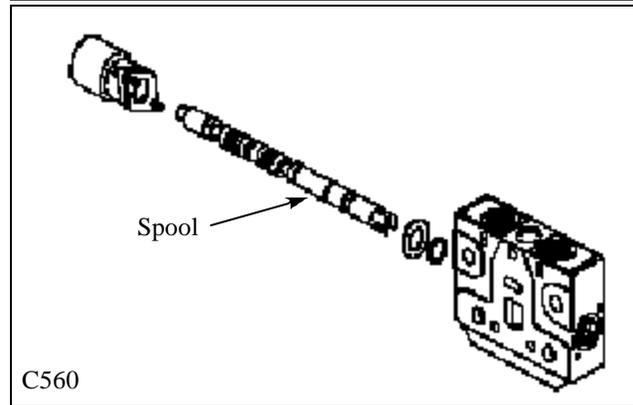
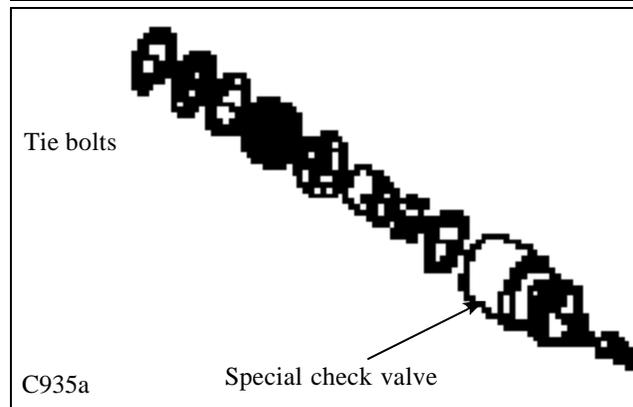
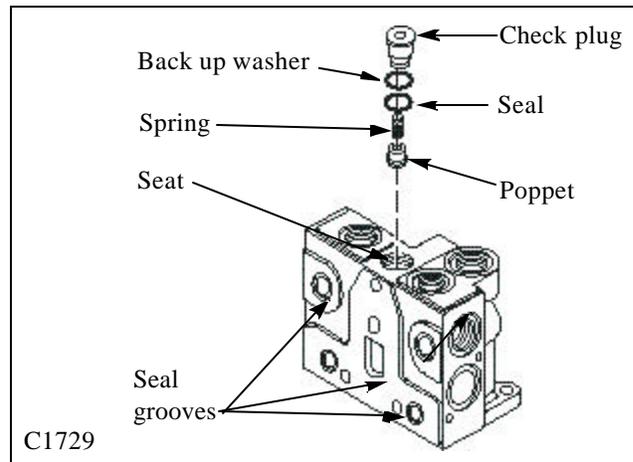
10 Install the back up washers over the spool seals.

11 Reassemble the lift spool detent and spring return cap. Liberally apply petroleum jelly to the detent ball bearings to retain them in place during assembly.

12 Install the lift cap, tilt cap and auxiliary cap onto the rear of the control valve assembly.

13 Install the valve lock block onto the lift and tilt spools. Lubricate the seal with petroleum jelly. See the exploded view for assembly assistance.

14 Install the spool scraper seals and cover plates onto the valve lock block. (fig. C935b)



CONTROL VALVE 1.4

1

15 Install new seals onto the various relief valves. Lubricate the seals, threads and relief valve seats with system oil and install the relief valves into their respective bores.

16 Install new seals onto the various port plugs. Lubricate with petroleum jelly and install the plugs in their respective bores.

17 Lubricate the control valve locks with system oil and install them into the lock blocks. (fig. C972)

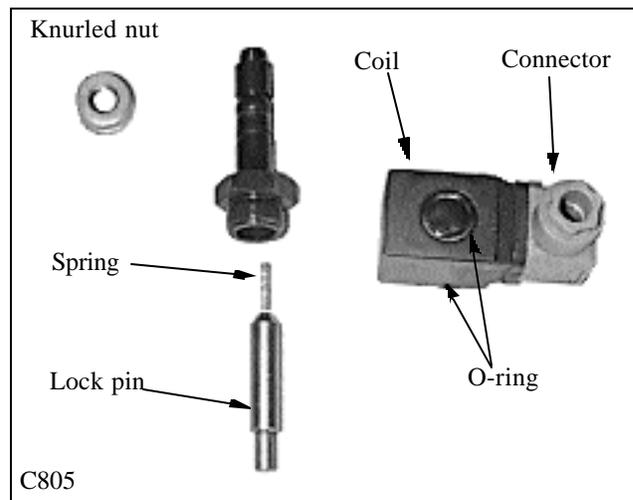
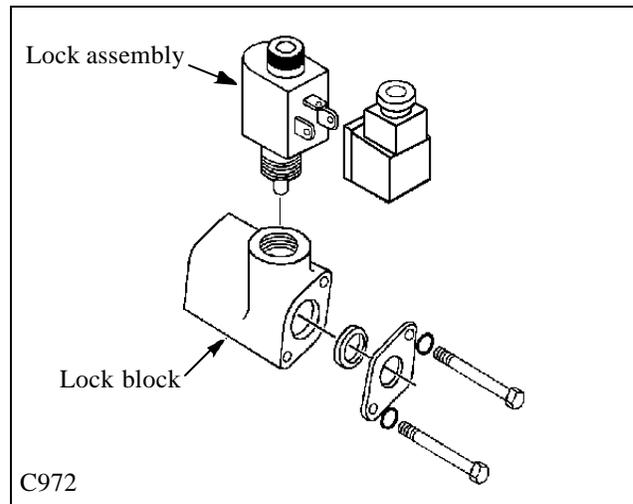
18 Install the auxiliary solenoid coil onto the auxiliary spool. Lubricate the seals with petroleum jelly and install the retaining nut to the end of the solenoid coil.

19 Assemble the control valve into the loader.



Use extreme caution when checking the hydraulic system for leaks. Fluid under pressure can penetrate the skin and cause serious injury.

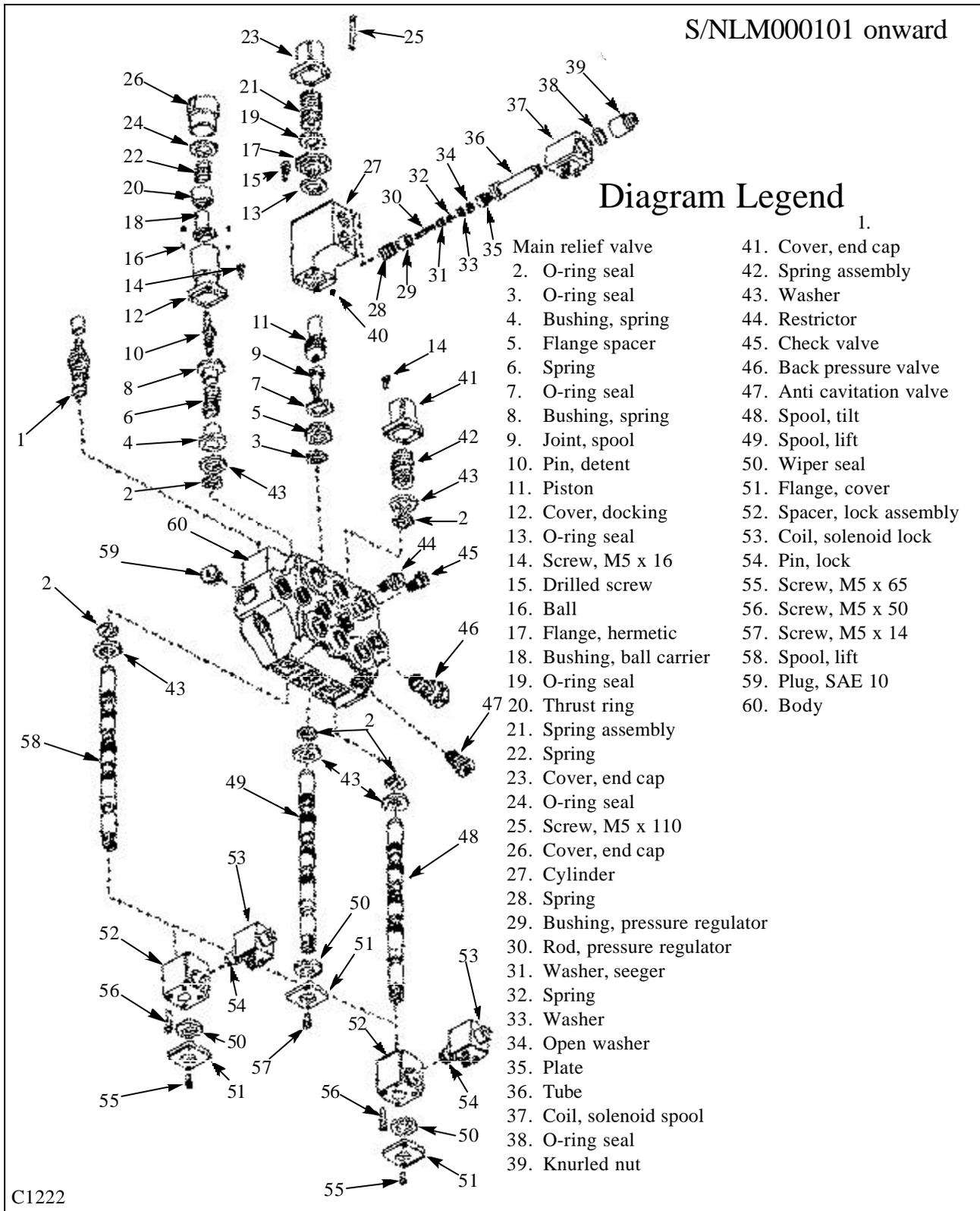
20 Upon start up, make sure the hydraulic oil reservoir is at the proper fill level. Start the engine and follow the relief valve testing procedure outlined at the beginning of the control valve section.



CONTROL VALVE 1.4

Control Valve Disassembly (245 HDK,T243,245 HDS MODELS)

1



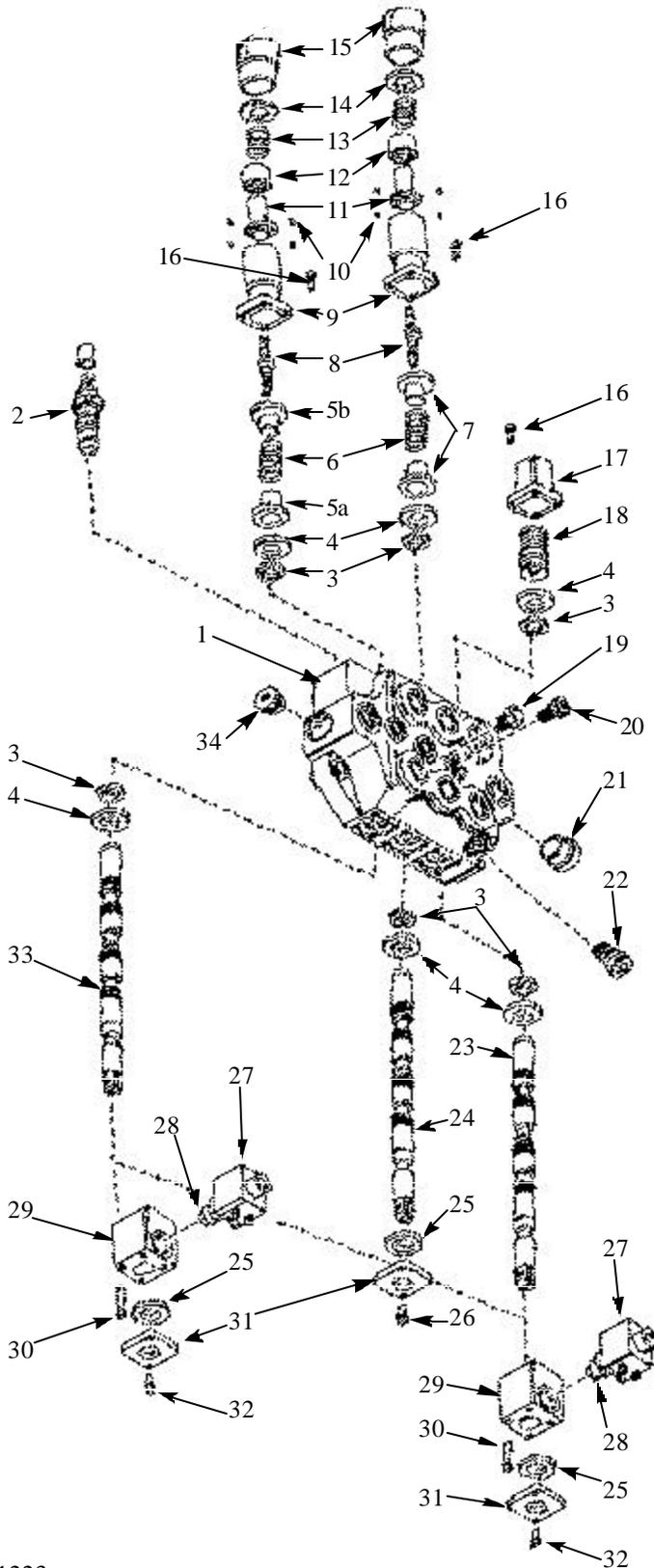
CONTROL VALVE 1.4

Control Valve Disassembly (T2200)

(LP000100 onward)

1

Diagram Legend



1. Control valve body
2. Main relief valve
3. O-ring seal
4. Washer
5. Bushing, spring
6. Spring
7. Bushing, spring
8. Detent pin
9. Cover, docking
10. Ball
11. Bushing, ball carrier
12. Thrust ring
13. Spring
14. O-ring seal
15. Cover, spring
16. Screw, M5 x 16
17. Endcap
18. Spring assembly
19. Restrictor (certain s / n)
20. Check valve
21. Plug, SAE 12
22. Anti cavitation valve
23. Spool, tilt
24. Spool, auxiliary
25. Wiper seal
26. Screw, M5 x 14
27. Coil, lock solenoid
28. Pin, lock assembly
29. Spacer, lock assembly
30. Screw, M5 x 50
31. Flange, cover
32. Screw, M5 x 65
33. Spool, lift
34. Plug, SAE 10

C1223

CONTROL VALVE 1.4

Disassembly / Repair

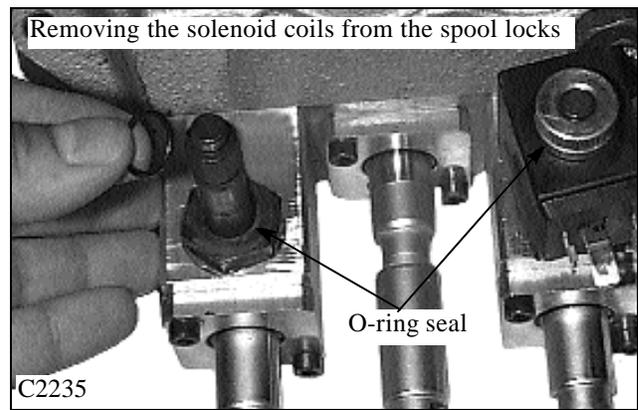
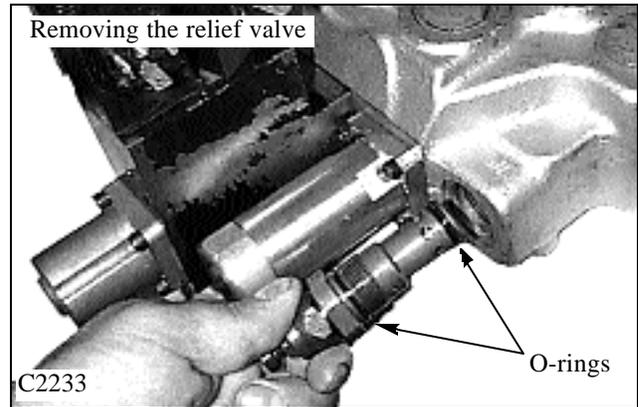
Before disassembling the hydraulic control valve, clean the body with a suitable solvent and dry with compressed air.

WARNING

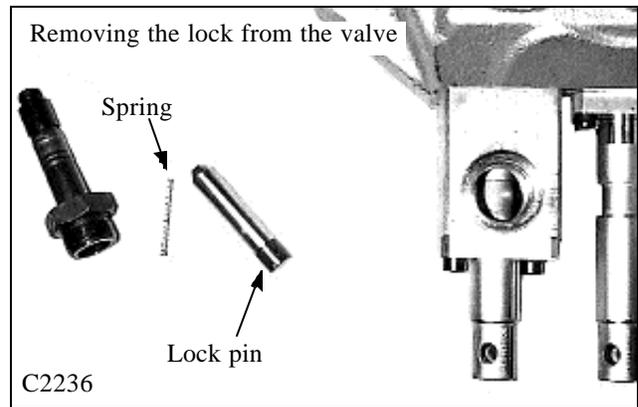
To avoid eye injury, use safety goggles when cleaning with compressed air.

Remove the hydraulic control valve as outlined in the removal section, page 1-7. Ensure all openings are plugged to prevent solvents and dirt from contaminating the control valve assembly. Refer to diagrams C1222 and C1223, pg. 1-17 ~ 18, to assist in the disassembly of the control valve.

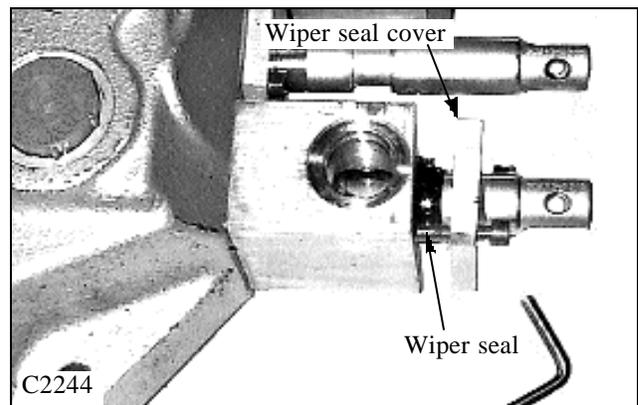
1 Remove the pressure relief valve. Discard the O-rings. (fig. C2233).



2 Remove the solenoid coils and locking pin from the valve lock block. (fig. C2235, C2236). There are 2 O-ring seals located on either side of the solenoid coils.



3 Remove the outer wiper seal cover from the lock block. (fig. C2244).

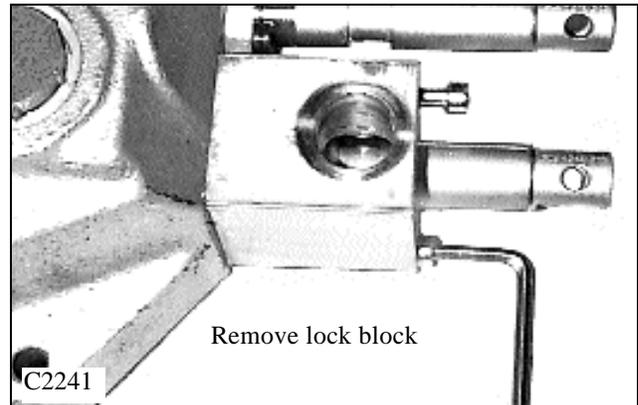


CONTROL VALVE 1.4

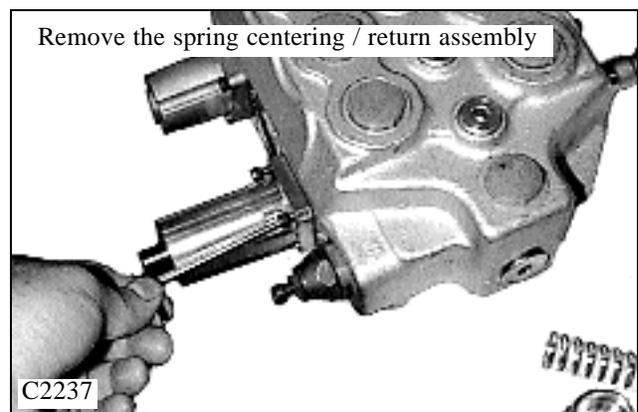
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Disassembly / Repair (cont'd)

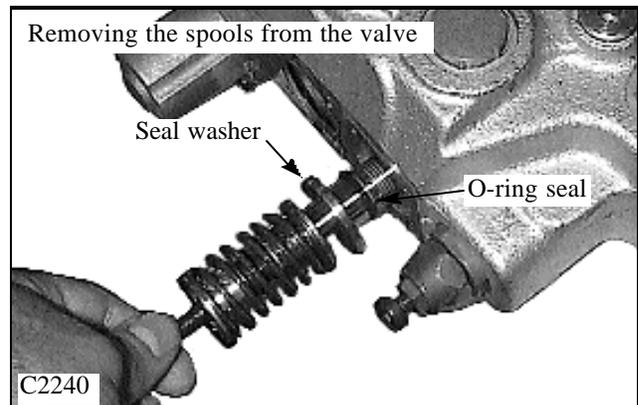
4 Remove the lock block from the valve. (fig. C2241).



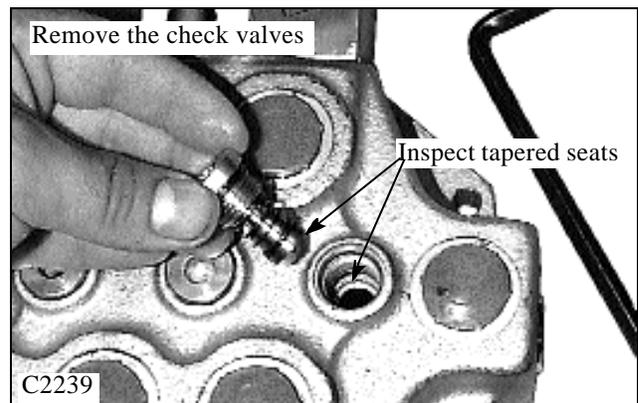
5 Remove the spring return / centering cap from the end of the spool. (fig. C2237).



6 Pull out the spool. (fig. C2240). As you pull out the spool, note it's smooth action as it comes out of the valve body. The spool should move freely and smoothly in the bore of the valve body. Check the control valve spool and bore for scuff marks or abnormal wear. Replace the spool and or control valve if signs of wear are present.



7 Remove the check valves from control valve body. (fig. C2239). They are located between the ports of each section. Check the seat and poppet of the valve body and check valve. Replace the check valve and or the control valve if any signs of wear are present.

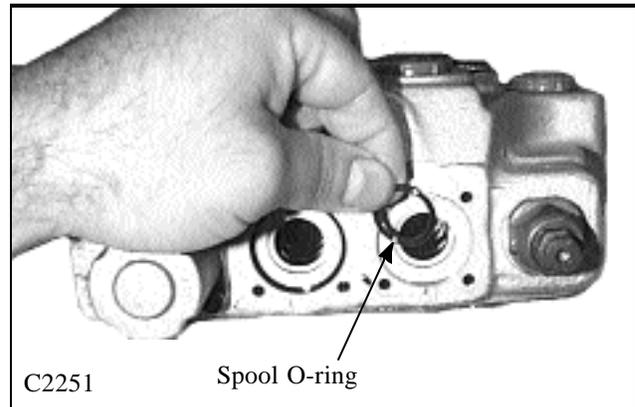


CONTROL VALVE 1.4

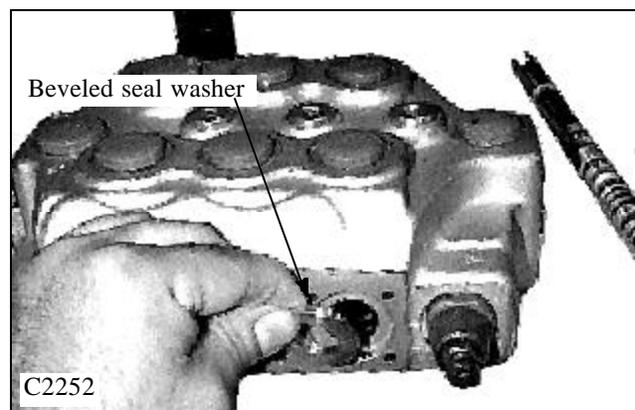
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Disassembly Repair (cont'd)

8 When replacing the spool to the control valve, use new O-ring seals and apply system oil to the O-rings and spools. (fig. C2251).



9 Fit the seal washer to the control valve with the beveled side of the washer facing the control valve. (fig. C2252). Fit the spool to the control valve now if repairs are not needed to the detent or spring return mechanism. Use system oil to lubricate the spool before inserting to the control valve.

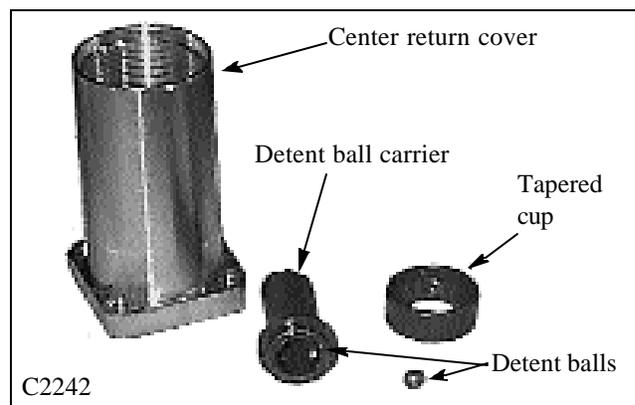
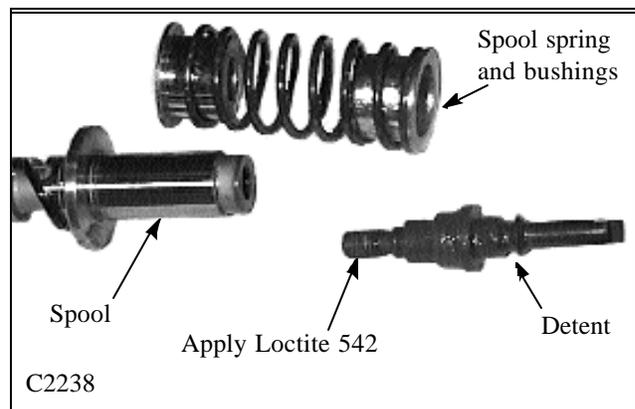


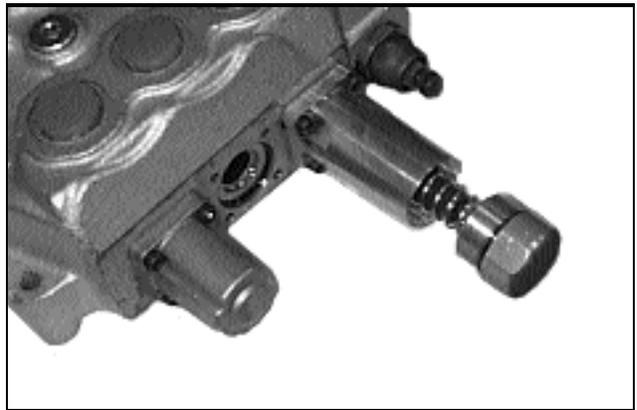
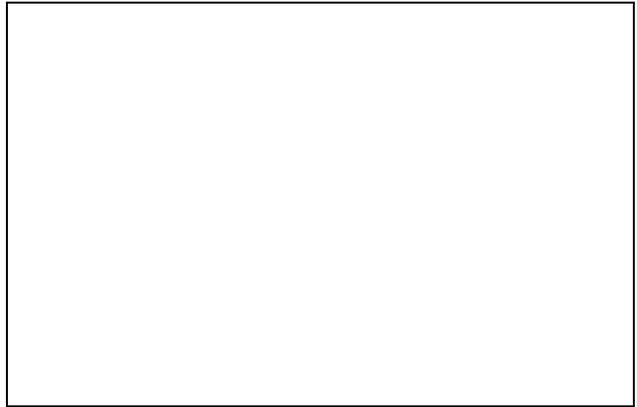
10 Photographs C2238, C2242 are exploded views of the lift spool detent mechanism. Place the cable end of the spool in a vice, or insert a screw driver through the clevis pin holes, to keep it from turning. The detent is threaded to the spool and can be removed for inspection or repairs.

Replace broken springs, worn detents and / or damaged detent balls with a new detent kit.

Apply Loctite 542 to the threads of the detent when installing to the spool.

Apply Castrol "Sphero"l" TN grease to the inside of the spring cover.



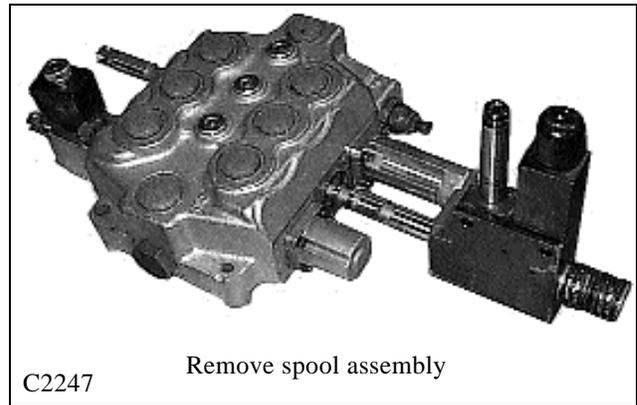


CONTROL VALVE 1.4

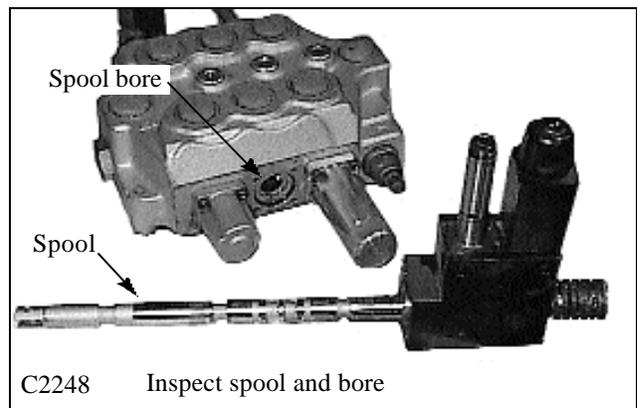
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Disassembly / Repair (cont'd)

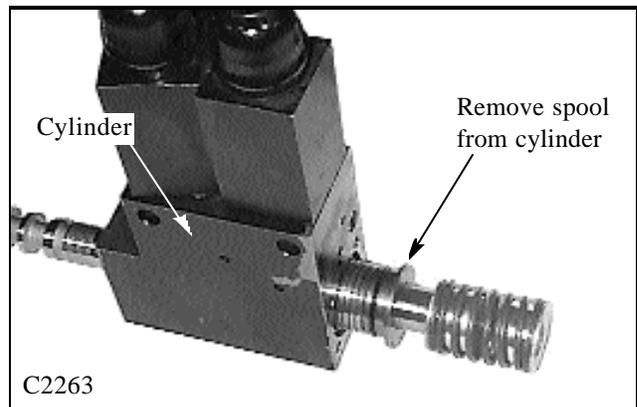
4 Remove the solenoid spool assembly from the control valve. (fig. C2247). Note the effort required to remove the spool from the spool bore. It should come out smoothly without binding or “snagging” throughout it’s travel.



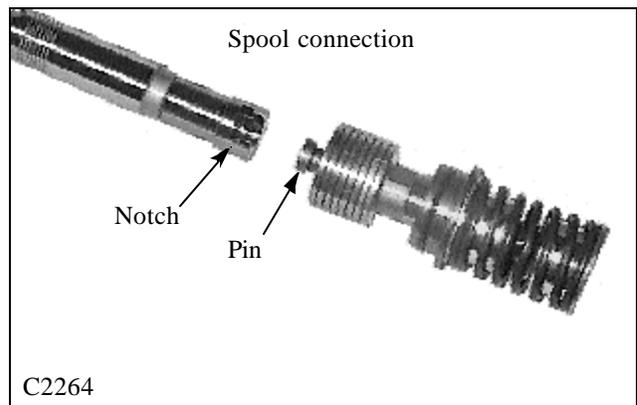
5 Inspect the spool and spool bore for abnormal wear. (fig. C2248). Replace the spool and / or the control valve if large scratches or indentations are present in the spool or spool bore. Minor scratches can be removed from the spool with extra fine emery cloth.

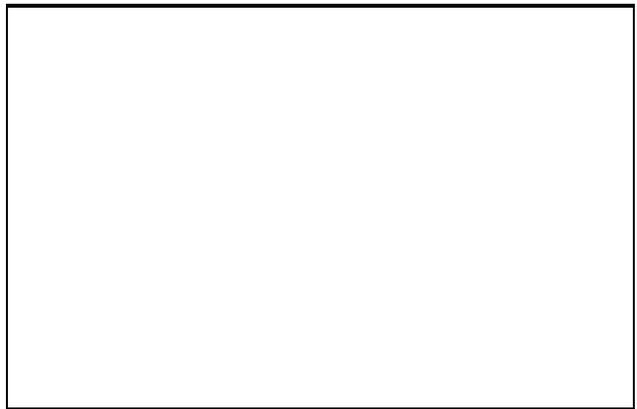
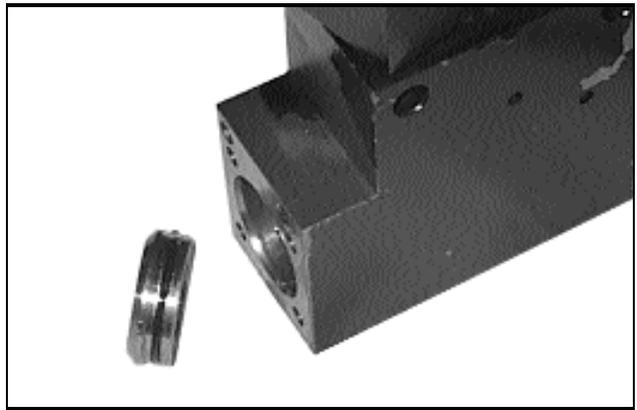
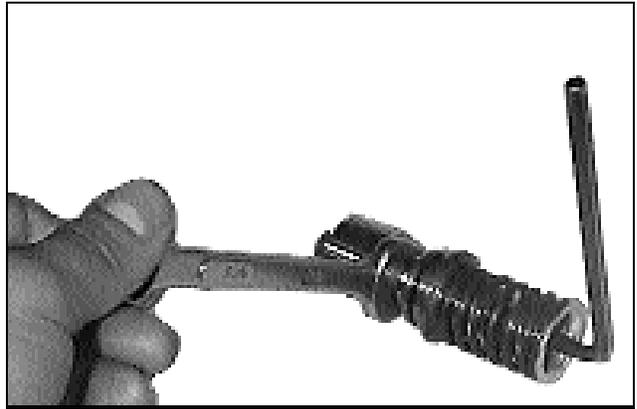


6 Remove the spool from the cylinder assembly by pushing the spool rearward through the cylinder. (fig. C2263). The spool will not pull through the front.



7 The piston part is machined with a nail head type pin that fits to a machined notch in the spool. (fig. C2264). Separate the spool from the piston and spring assembly.





O-Ring and seat

Two arrows originate from the text 'O-Ring and seat' and point downwards and to the right, towards the empty box above.

C2250

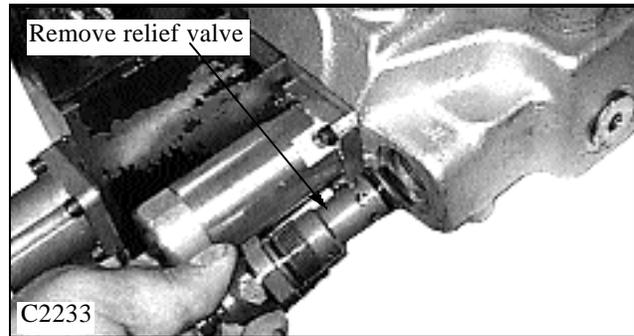
CONTROL VALVE 1.4

1

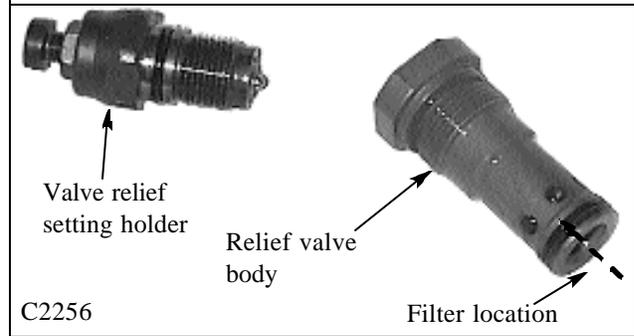
Relief Valve Filter

If hydraulic function and / or performance has deteriorated from normal, the screen filter in the control valve relief may be restricted. To service the relief filter:

- 1 Lower the boom arms, engage the parking brake and shut off the engine.
- 2 Remove the relief valve from the control valve body. (fig. C2233). Check the filter by running system oil back through the filter to check restriction or contamination. If oil does not flow through the relief filter it will require replacement.
- 3 Separate the valve setting holder from the relief valve body. (fig. C2256).
- 4 The relief filter is located in the relief valve body. (fig. C2340). Using an appropriate tool, push the piston and filter assembly out.
- 5 Replace the piston and filter assembly with new parts.
- 6 Torque the holder and valve body to the control valve body at 31 lbs / ft (42 Nm).

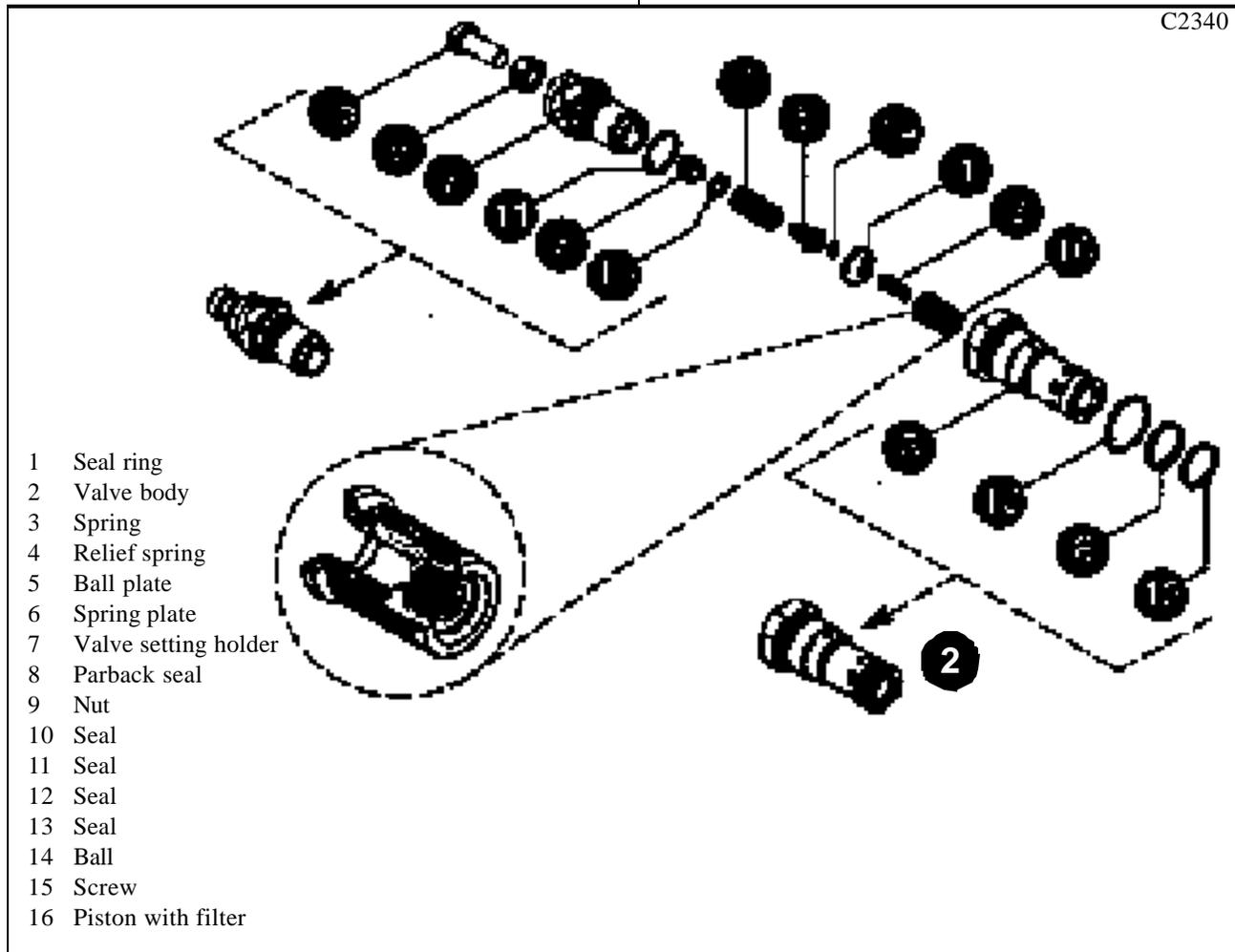


C2233



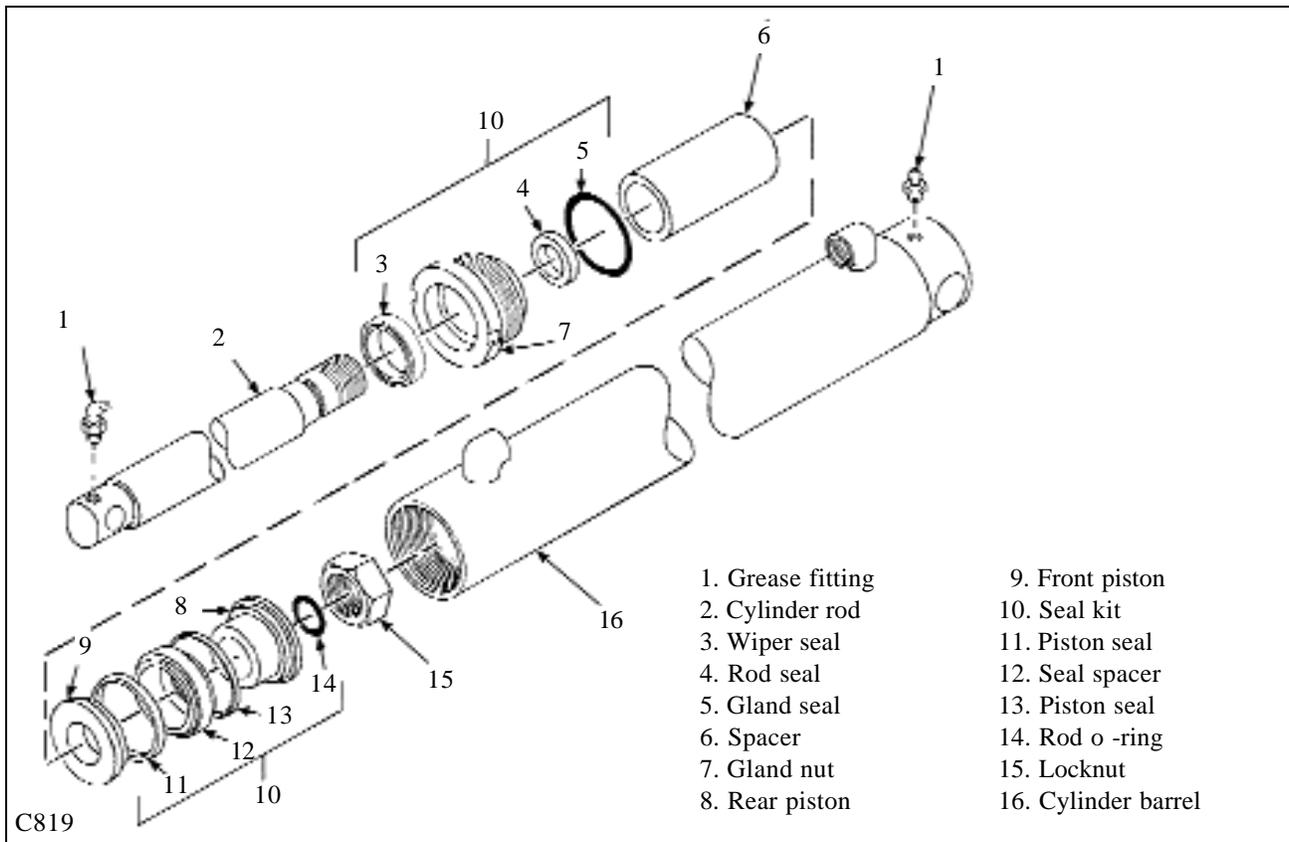
C2256

C2340



- 1 Seal ring
- 2 Valve body
- 3 Spring
- 4 Relief spring
- 5 Ball plate
- 6 Spring plate
- 7 Valve setting holder
- 8 Parback seal
- 9 Nut
- 10 Seal
- 11 Seal
- 12 Seal
- 13 Seal
- 14 Ball
- 15 Screw
- 16 Piston with filter

HYDRAULIC CYLINDERS 1.5



General Information

All cylinders are a double acting, designed to extend and retract under pressure.

The piston rods, which are made of high strength distortion free material, are precision ground and hard chrome plated. The cylinders barrels are micro honed to close tolerance, straightness and smooth finish for long piston packing seal life.

All cylinders have a 2 piece piston assembly made of ductile iron and a polypac seal arrangement consisting of a piston seal and 2 wear rings.

The rod seal is a "U" cup design, with the "U" facing the pressurized oil. The rod wiper keeps foreign matter from entering the cylinder by wiping the rod clean as the cylinder retracts.

The gland nut seal is of an "O" - ring design. This seal keeps the oil from leaking around the gland nut and cylinder barrel threads.

Certain cylinders have spacers in them. These spacers are used to limit the stroke of the rod.

Some cylinders also have replaceable hardened bushings in the pivot areas that can be serviced when worn out.

HYDRAULIC CYLINDERS 1.5

Testing the Seals

If the boom or bucket cylinders drift down with the control valve spools in the neutral position, and with no external leaks in the hydraulic system, the following test will indicate if oil is leaking by the cylinder piston seals. With the hydraulic oil at operating temperature and a fully loaded attachment, check that the cylinders do not drop more than 1.5 inches per minute. Before performing this test, ensure the control linkages are not binding and the hydraulic control valve spools are centering in the neutral position.

- 1 This test must be performed with the engine running. Remove any attachment and block the loader securely with all 4 wheels off the ground.
- 2 Retract the cylinder(s) to be tested. Shut off the engine and cycle the controls to release the hydraulic pressure.
- 3 Disconnect the hose from the fixed end of the cylinder to be tested. Cap the hose to prevent contamination. (fig. C1331, C1776)
- 4 Start the engine and cycle the control(s) as to retract the cylinder. Do not over activate the controls as to place in the detent position. Have a container can ready to catch any waste oil to prevent environmental contamination.



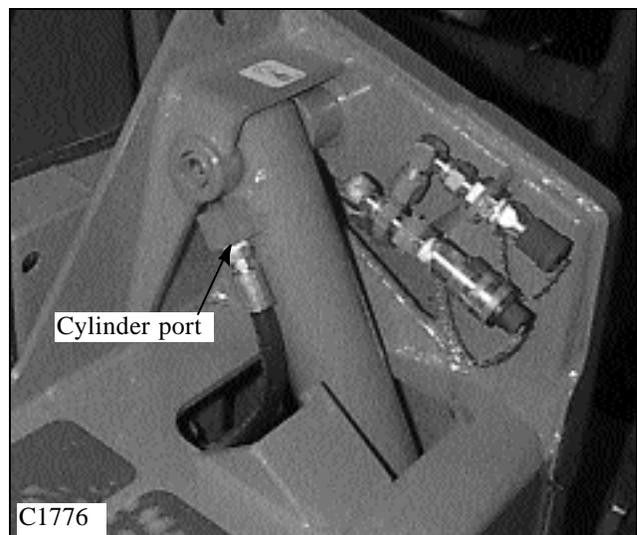
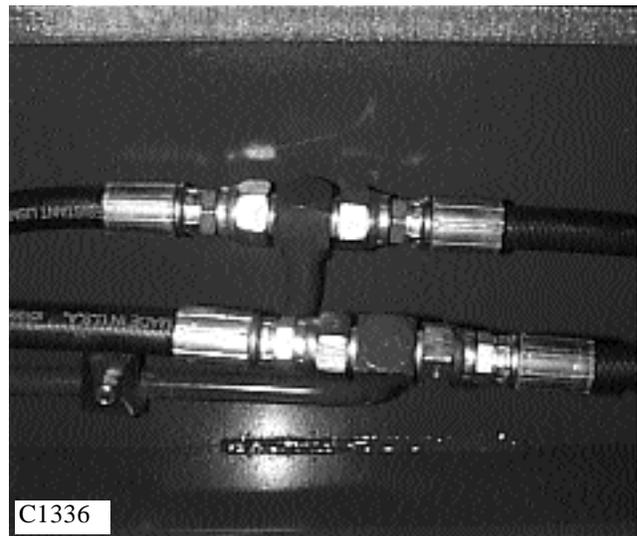
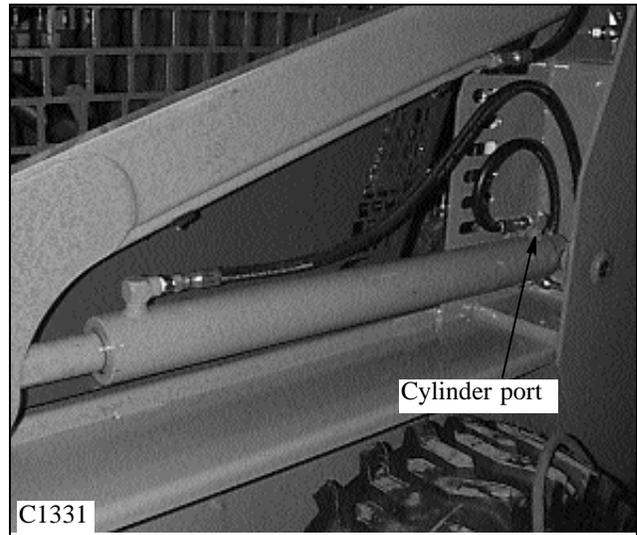
Use extreme caution when checking the hydraulic system for leaks. Fluid under pressure can penetrate the skin and cause serious injury.

- 5 Repeat for all both pairs of cylinders.
- 6 If oil leaks from the cylinder port the seals are bad and need replacement. If no oil leaks you may need to check the load check valves in the hydraulic control valve.
- 7 Connect the hydraulic hose to the cylinder ports if no further servicing is required.



To prevent personal injury, never repair or tighten hydraulic hoses or fittings while the engine is running or the system under pressure.

NOTE: To remove the hose from the tilt cylinder you must first loosen the opposite end connected to the hydraulic tubing under the step area of the boom arms. (fig. C1336)



HYDRAULIC CYLINDERS 1.5

Lift Cylinder Removal



To prevent personal injury, never repair or tighten hydraulic hoses or fittings while the engine is running or the system under pressure.

The following procedure will assist you in cylinder removal.

For removal of the boom cylinders:

1 Lower the boom arms, stop the engine and cycle the controls to relieve any hydraulic back pressure in the system. Lock the control in the float or detent position.



To prevent personal injury, never work under the boom arms unless the boom support pins are engaged.

2 Remove the hydraulic hoses from the cylinder. (fig. C1331) Cap all open ports and lines to prevent contamination.

IMPORTANT

Cap or plug all open ports and lines to prevent system contamination.

3 Place a floor jack under the boom forearm. (fig. C1809)

4 Raise the boom arms with the floor jack until the pivot pins in the end of the boom lift cylinder can be removed.

5 Remove the locknut and bolt from both mounting pins. (fig. C1775, C1331b)

6 Remove the pivot pins with an appropriate punch and hammer to prevent brooming of the pin. Brooming the pin makes it difficult to remove.

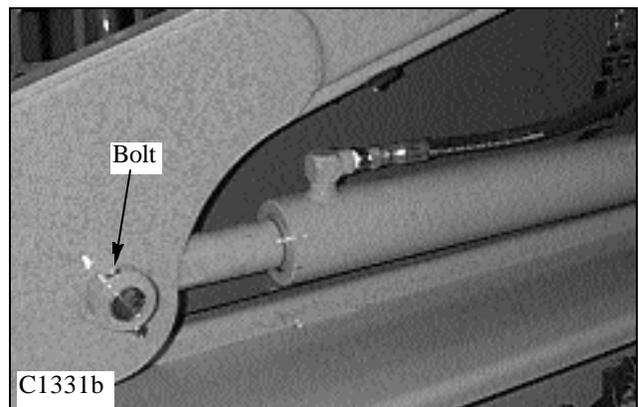
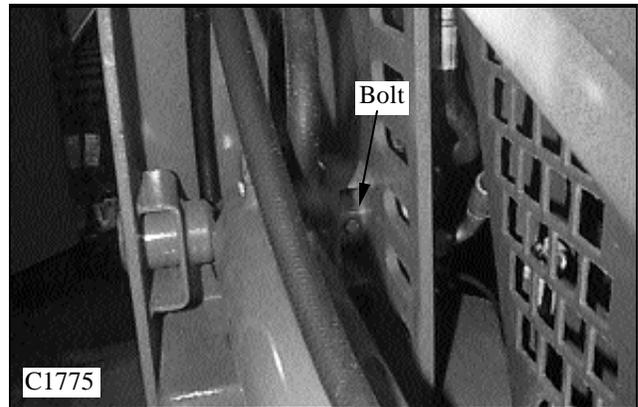
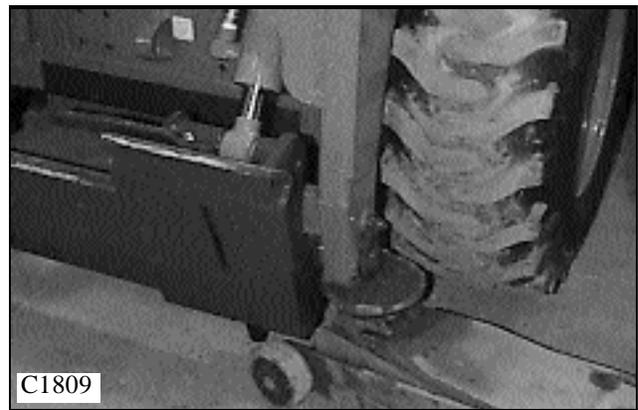
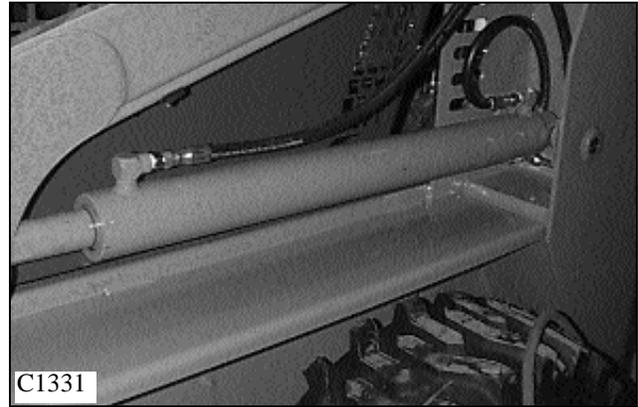
7 Remove the cylinder from the loader.

8 Upon replacement, inspect the pivot pins for any wear. Replace if necessary. Reverse order above for installation.

9 Upon start up, check for system leaks and replenish the hydraulic reservoir as required.



Use extreme caution when checking the hydraulic system for leaks. Fluid under pressure can penetrate the skin and cause serious injury.



HYDRAULIC CYLINDERS 1.5

Tilt Cylinder Removal

For tilt cylinder removal:

- 1 Lower the boom arms, remove any attachment and extend the tilt cylinders. Shut off the engine and cycle the controls to relieve excessive back pressure in the hydraulic system.
- 2 Loosen or remove the hydraulic hoses from hydraulic tubing under the boom arm step. (fig. C1336)
- 3 Remove the hydraulic hoses from the tilt cylinder.



To prevent personal injury, never repair or tighten hydraulic hoses or fittings while the engine is running or the system under pressure.

Plug and or cap all open ports or lines to prevent contamination. (fig. C641)

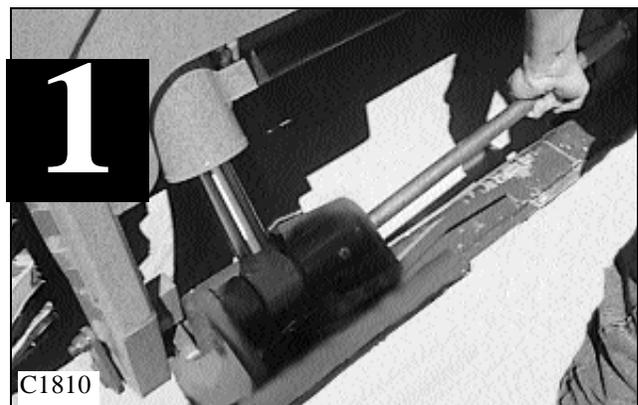
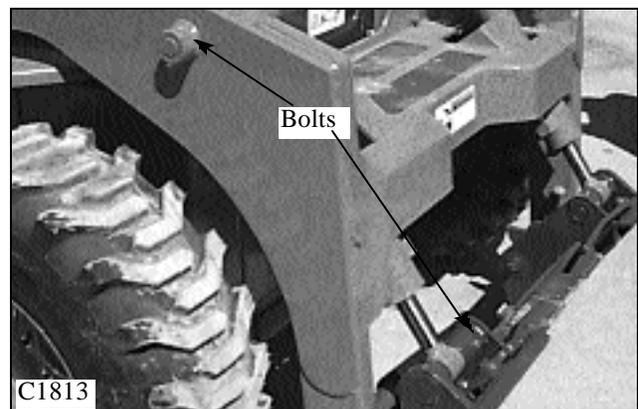
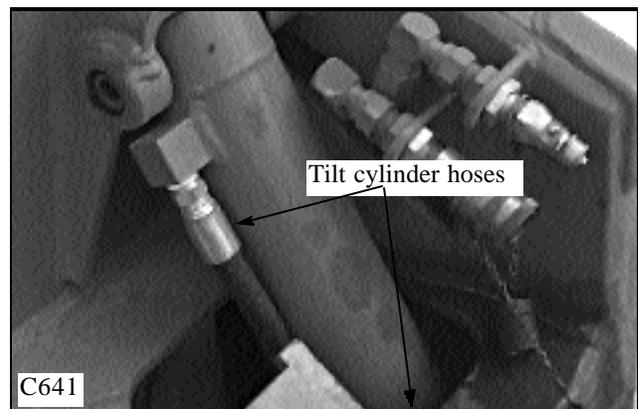
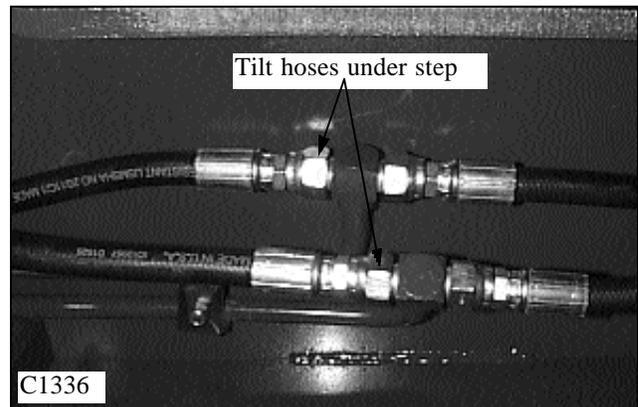
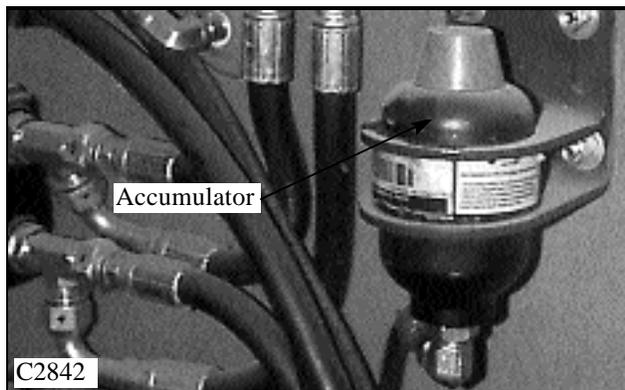
- 4 Remove the locknuts from the bolts retaining the pivot pins to the loader and remove the bolts. (fig. C1813)
- 5 Remove the pivot pins. (fig. C1810)
- 6 Remove the cylinder from the loader.
- 7 Upon reassembly, inspect the pivot pins and bushings for wear and replace as required. Reverse order for cylinder installation.
- 8 Upon start up, check for system leaks and replenish the hydraulic oil reservoir as required.

ACCUMULATOR

The accumulator stores system pressure until it is required. To activate the accumulator the key must be placed in the accessories position. This provides electrical power to operate the electrical auxiliary.

The electrical auxiliary and stored system pressure activates the spools, this decreases the hydraulic pressure from the male / female connectors located on the boom lift arms.

Once this pressure is decreased the operator can remove / replace the quick attach accessories easily. Refer to Figure C2842.



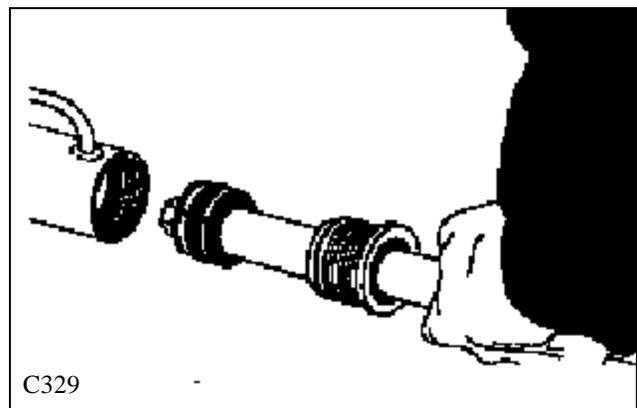
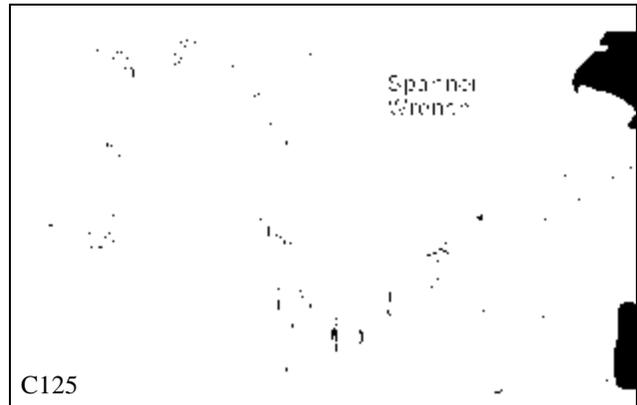
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HYDRAULIC CYLINDERS 1.5

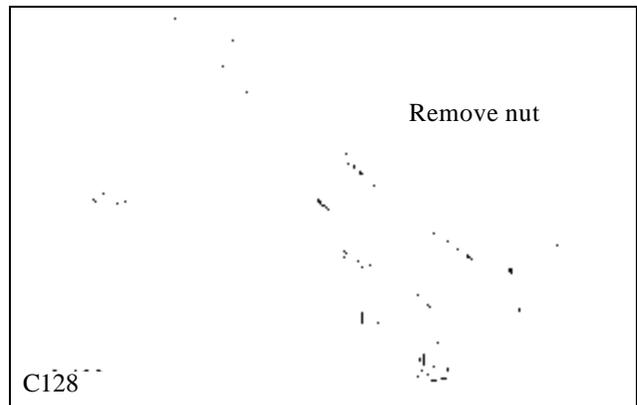
Cylinder Repair

Before Attempting repairs to the hydraulic cylinder, clean the body with a suitable solvent. Ensure all openings are plugged to prevent solvent from entering the cylinder.

- 1 Remove the cylinder as outlined previously.
- 2 Place the base end of the cylinder in a vise and support the front end of the body. Remove the plugs from the hose ports. (fig. C125)
- 3 Loosen the gland nut from the cylinder barrel using a spanner wrench. The gland nut threads are coated with loctite bonding agent at time of assembly. It may be necessary to apply heat to the gland nut and cylinder barrel threaded area, with a torch, to ease removal. (fig. C125)
- 4 Remove the gland nut, rod and piston seal assembly from the barrel. (fig. C329)



- 5 Place the cylinder rod bushing end in a vise and remove the locknut from the rod.



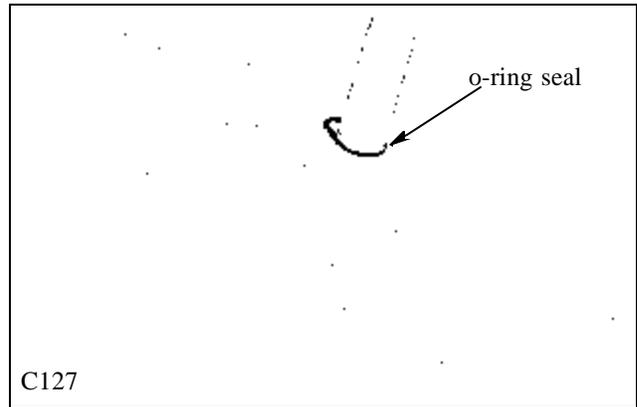
- 6 Remove the 2 piece piston assembly from the rod. (fig. C126)
- 7 NOTE: Some piston assemblies rear piston parts are threaded onto the rod. You will need to use a spanner wrench to remove this type of rear piston.



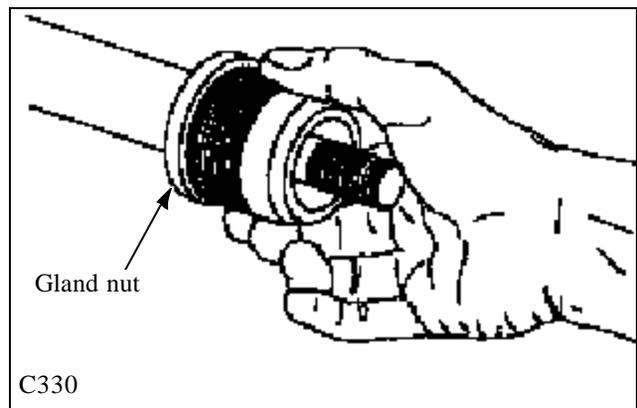
HYDRAULIC CYLINDERS 1.5

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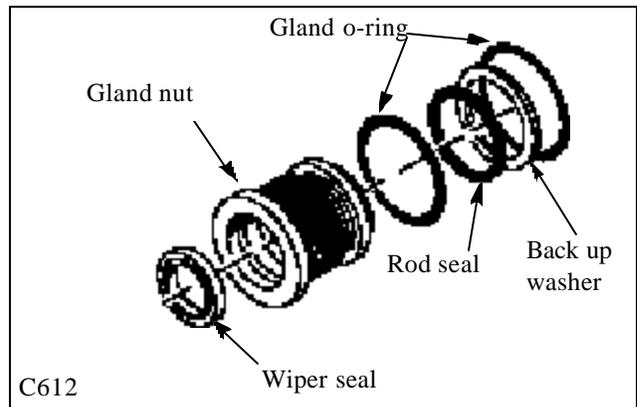
8 Depending on the design of the rear piston, non threaded type, remove and discard the o-ring seal from the end of the cylinder rod. (fig. C127)



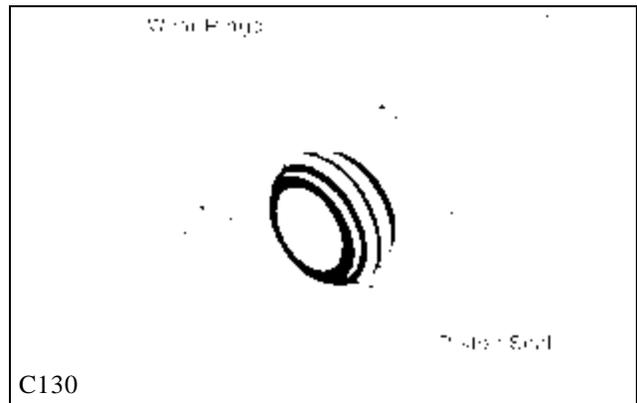
9 Remove the gland nut assembly from the cylinder rod. (fig. C330)



10 Remove and discard the wiper seal, rod seal and o-ring seals and teflon back up washer, (if used), from the gland nut assembly. (fig. C612) NOTE: Some seal designs may vary from illustration



11 Remove and discard the wear rings and piston seal from the piston assembly. (fig. C130)



HYDRAULIC CYLINDERS 1.5

Inspection

- 1 Inspect the cylinder rod for scratches, dents and other damage. Minor rod damage may be repaired using a fine abrasive. Major scratches or dents are not repairable and the rod must be replaced. The chrome surface must be intact to provide a rust resistant surface. Blemishes on the rod will damage the rod seal and wiper and will cause leaking after a short period of use.
- 2 Inspect the cylinder rod threads. The threads must be in good condition to withstand the high torque required to secure the piston assembly to the rod.
- 3 Inspect the gland nut for nicks, burrs or other damage. Minor damage may be repaired using a fine abrasive.

Smooth down edges that could damage seals and cause leakage.

- 4 Inspect the gland nut threads for damage.
- 5 Inspect the piston assembly for damage. Remove minor scratches or damage with a fine abrasive.
- 6 Using a suitable light, inspect the cylinder barrel bore for scratches, dents, burrs or any other damage. Replace the cylinder barrel if there is any evidence of damage.
- 7 Inspect the cylinder barrel threads for damage. The threads must be in good condition to withstand the high torque required to secure the gland nut assembly to the cylinder barrel.

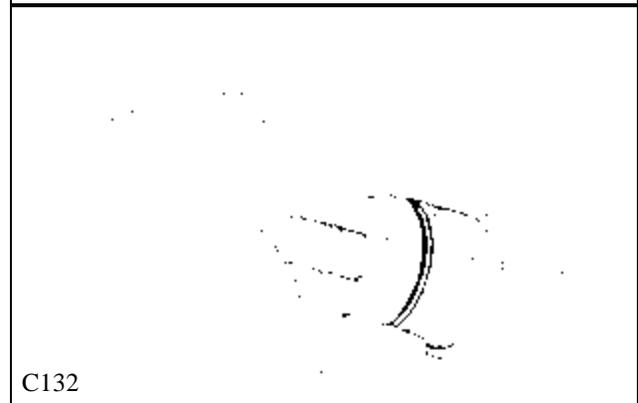
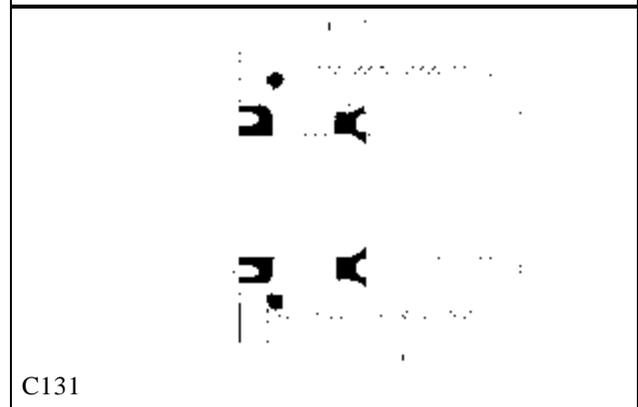
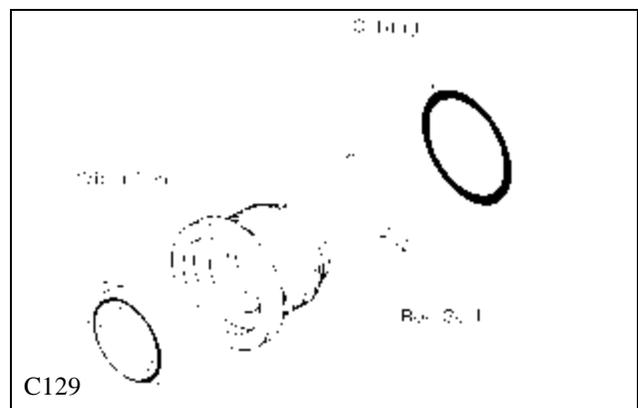
Assembly

1 Install a new gland nut rod seal. Form the seal into an oval shape and place it into the gland nut, with the “U” side of the seal facing the barrel end, and slip the seal into the groove. (fig. C129, C131)

2 Install a new wiper seal in the gland nut. (fig. C129, C131)

3 Install a new gland nut o-ring seal. (fig. C129, C131)

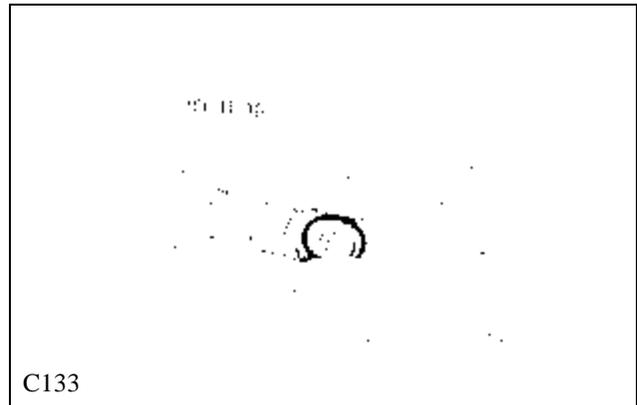
4 Apply system oil to the cylinder rod and assemble the gland nut assembly to the rod. (fig. C132)



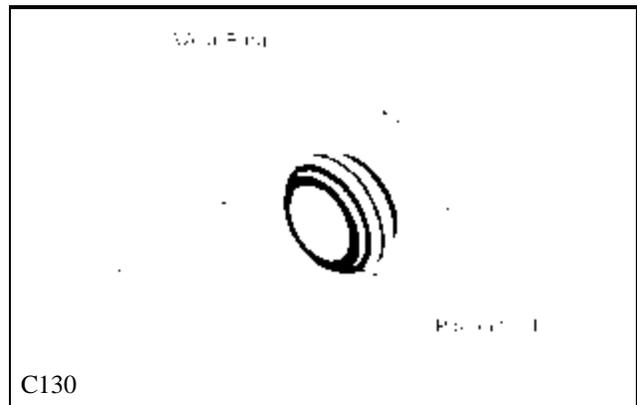
HYDRAULIC CYLINDERS 1.5

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5 Install a new o-ring seal on the cylinder rod if used. Some cylinder rod are fully threaded here to accommodate a threaded type rear piston part. (fig. C133)

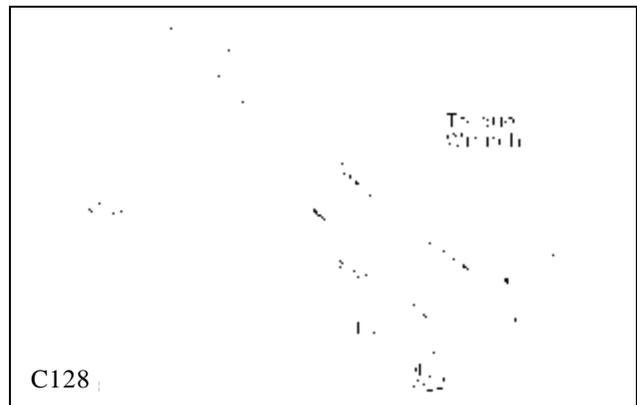


6 Install new wear rings and piston seal to the the 2 piece piston assembly. (fig. C130)



7 Install the piston assembly to the cylinder rod. Some rear piston assemblies are threaded onto the cylinder rod. Use a spanner wrench to install the rear piston part to the cylinder rod. Torque the locknut to the rod at 150 ft / lbs (204 N.m.). (fig. C128)

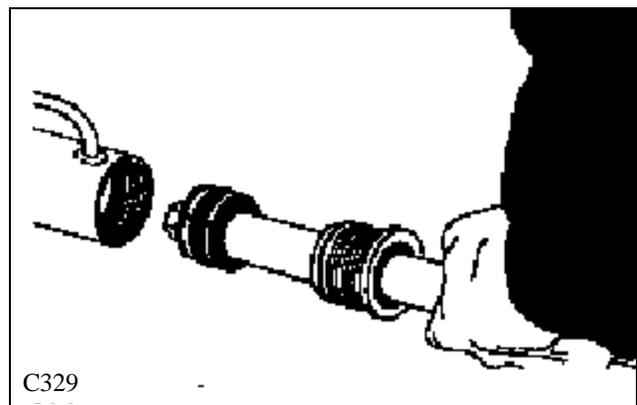
8 Make sure the inside bore of the cylinder barrel is clean. Lubricate the inside of the barrel with system oil. Do not get oil into the threaded area of the barrel.



9 Lubricate the piston seal assembly with system oil and install the cylinder rod and piston assembly to the cylinder barrel. (fig. C329)

10 Apply loctite 242 to the gland nut threads and tighten the gland nut using a spanner wrench. Tighten the gland nut as much as you can using the spanner wrench. Make sure the threaded area of the gland nut and cylinder barrel are free of oil before applying the loctite bonding adhesive.

11 Assemble the cylinder to the loader. Use teflon tape or equivalent on the threads of the hydraulic hose ends, if the hose ends are of the taper pipe thread type.



HYDRAULIC OIL FILTER 1.6

General Information

C637

HYDRAULIC OIL COOLER 1.7



General Information

The hydraulic oil cooler is mounted on the inside of the rear door. (fig. C1382) The front half of the cooler is designed to cool the engine. Swinging the cooler assembly open inside the door gains access to the rear side of the cooler which is dedicated to cooling the hydraulic oil. Oil returning from the hydraulic control valve is circulated through the oil cooler before being returned to the hydraulic oil reservoir.

Air drawn through the cooler fins by the hydraulic motor driven fan cools the oil. A combination of cooler size and air flow passing through the cooler fins gives the cooler a rating of 1000 BTU / Min..

The oil cooler should be checked daily for dirt build up on the cooling fins. If air flow is restricted through the cooling fins, overheating of the hydraulic system may occur. Clean any dirt build up on the cooling fins with compressed air. Flush with water if necessary.

Servicing the rear of the cooler is accessed by removing the two bolts located next to the inside door latch mechanism, (fig. C1367) and swinging open. (fig. C1356)

The set screw holding the cooling fan to the hydraulic driven fan motor needs to be checked for tightness every 150 hours. Torque the set screw at 5 ft / lbs. (6.8 N.m.)

If cooler replacement is necessary you will need to drain both the engine and hydraulic sections of the oil cooler assembly. The oils are not the same type so do not mix them if you plan to reuse. Be prepared to contain 4 litres (1 gal) of oil from each cooler section. Please dispose of all waste product in an environmentally friendly manner.

1 Tag all hose routing locations. Remove the hoses taking care to support the cooler fittings while loosening the hose to prevent cooler damage. Cap all hoses and fittings to prevent contamination.

2 The cooler assembly is very heavy and will need to be removed with some form of mechanical aid, such as an over head hoist. (fig. C1366)

HYDRAULIC OIL COOLER 1.7

- 3 Remove the mounting bolts holding the cooler assembly to the rear door. (fig. C1382, C1367)
- 4 Remove the cooler taking care not to damage the cooling fins and shroud.
- 5 Remove the mounting bracket from the cooler and transfer to the new cooler.
- 6 Replace the cooler assembly in reverse order.7 Torque the 1 1/16 hose end and fittings at 75 ft / lbs (100 N.m.). Use caution while tightening the fittings to prevent damaging the oil cooler.



To prevent personal injury, never repair or tighten hydraulic hoses or fittings while the engine is running or the system under pressure.

- 8 Upon engine restart do not add extra engine oil. Follow the same procedure as an oil change, Section 7.4. Warm engine to allow thermostat to open and replenish the oil coolers. Allow to cool 15 to 20 minutes before topping the crankcase.
- 9 Check for oil leaks. Do not use your hands to check for location of oil leakage.



Use extreme caution when checking the hydraulic system for leaks. Fluid under pressure can penetrate the skin and cause serious injury.

- 10 Check the oil level in the hydraulic oil reservoir and replenish as required.

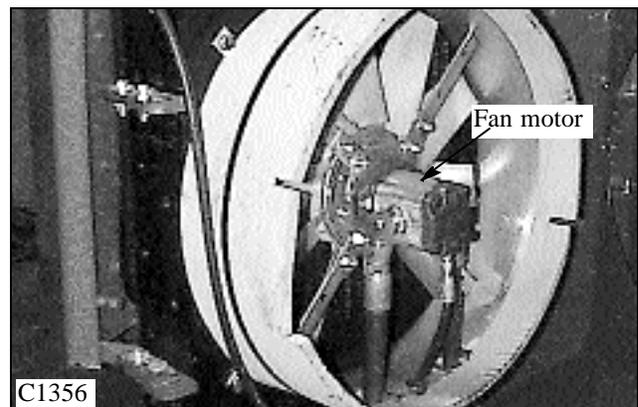
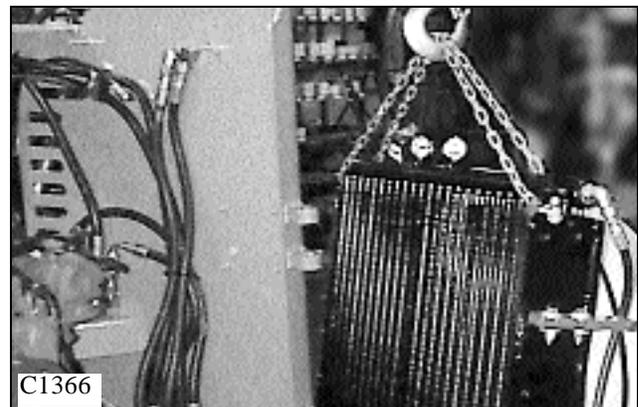
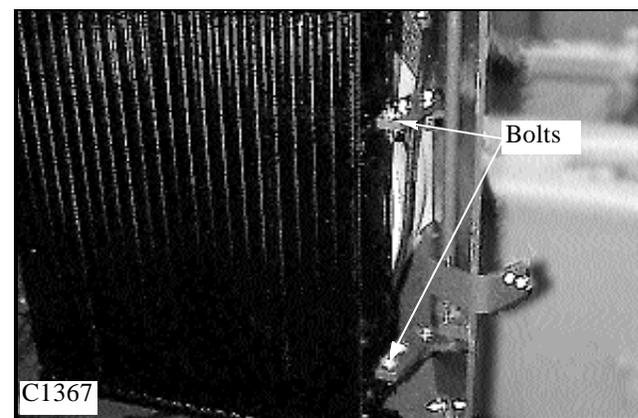
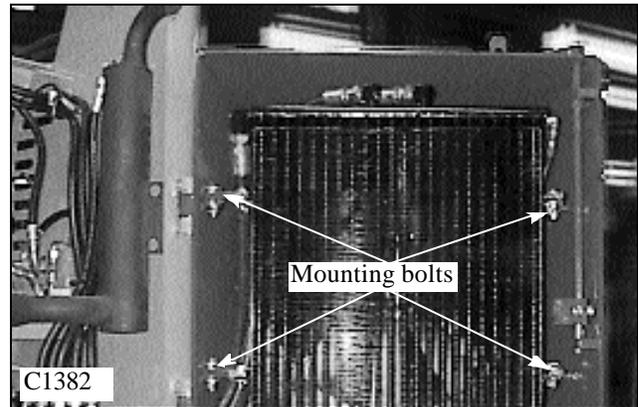
Cooling Motor

Cooling fan speed, RPM, is not adjustable but can be checked to help diagnose system problems.

- 1 Shut off the engine and engage the parking brake.
- 2 Open the rear door and swing the cooler assembly out by removing the two bolts on the cooler mounts. (fig. C1367)
- 3 Place a piece of photo light reflective tape on one of the cooling fan blades.
- 4 Start the engine and adjust the engine speed to 2800 RPM, standard high idle setting. Engine RPM check and setting in Section 7.11.



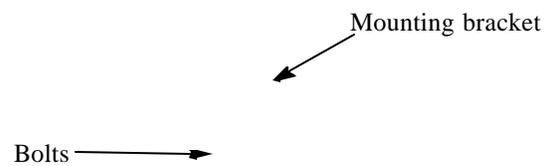
Use extreme care while servicing the cooling fan. The turning blade could cause dismemberment.



HYDRAULIC OIL COOLER 1.7

5 Using a photo sensor tachometer, check the fan speed RPM. The minimum fan speed reading should be no less than 2300 RPM.

6 Low fan speed could be caused by fan motor damage, low charge pressure or inadequate engine speed.



C1356b

HYDRAULIC OIL COOLER 1.7

General Information (Protough 2200)

The hydraulic oil cooler is mounted to the radiator. (fig. C2882) Oil returning from the control valve is circulated through the oil cooler before being sent on to other parts of the hydraulic system.

An engine driven cooling fan drives air through the radiator & oil cooler when the rear door is closed.

The oil cooler is rated at 1000 BTU / minute.

The oil cooler & radiator should be checked daily for dirt build up on their cooling fins. If air flow is restricted through the cooling fins, over heating of the system may occur. Clean any dirt build up with compressed air. Flush with water if necessary.

The outer edge of the oil cooler has a layer of sealing foam that presses against the rear door, when the door is closed. This directs the air, driven by the engine cooling fan, through the hydraulic oil cooler. The sealing foam and adjustment should be checked at every service interval.

Refer to Figure(C2882).

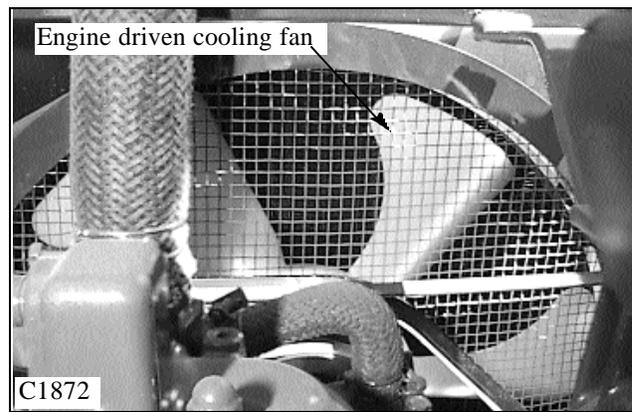
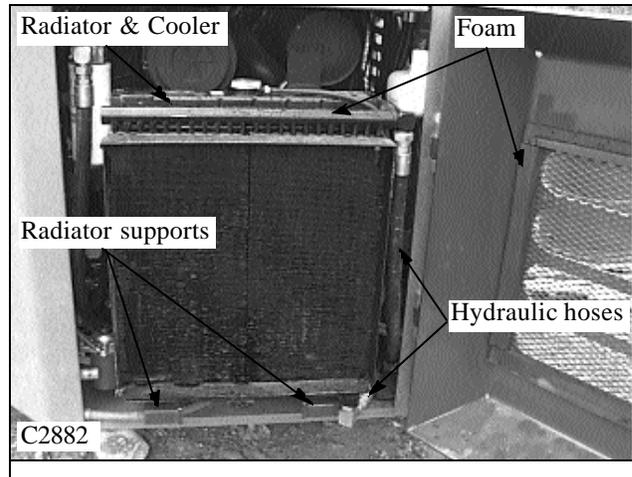
Cooler Replacement

- 1- Lower the boom arms, engage the parking brake and shut off the engine.
- 2- Open the rear door and remove the cooler shroud.
- 3- Remove the cooler hoses. Plug the open hoses and cooler ports to prevent contamination.
- 4- Remove the bolts which connect the radiator to the radiator support frame.
- 5- Remove the radiator support brace which connects the radiator to the engine.
- 6- Remove the radiator.
- 7- Inspect the fittings & clamps for damage and replace if necessary.
- 8- Replace the radiator / cooler, coolant & cooler shroud (If required).
- 9- Replenish the hydraulic fluid as required. Check for system leaks and check the fit of the shroud seal which surrounds the perimeter of the radiator. Adjust / replace if necessary.

Cooling Motor

Cooling fan speed, RPM, is not adjustable but can be checked to help diagnose system problems.

- 1 Shut off the engine and engage the parking brake.
- 2 Open the rear door,remove the hydraulic hoses,radiator brace and the bolts which secure the radiator to the mounting support,remove the radiator (fig. C2882).
- 3 Place a piece of photo light reflective tape on one of the cooling fan blades (Figure C1872).
- 4 Start the engine and adjust the engine speed to 2800 RPM, standard high idle setting. Engine RPM check and setting in Section 7.11.



DANGER

Use extreme care while servicing the cooling fan. The turning blade could cause dismemberment.

HYDRAULIC OIL RESERVOIR 1.8

1

General Information

The hydraulic oil reservoir is located at the rear of the loader on the left hand side. (fig. C916) The reservoir is completely separated from all chain and gear drives to eliminate contamination. A magnetic drain plug is installed in the bottom of the reservoir, and a magnet is attached to the 100 micron suction filter, to assist in removing metal particles from the oil.

Oil level is checked through a sight gauge located just inside the engine compartment, left hand side, on the oil reservoir. The proper fill level is marked by a line and should be checked daily. (fig. C1384)

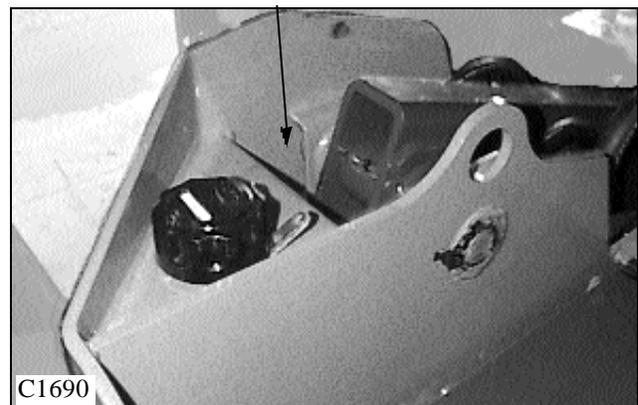
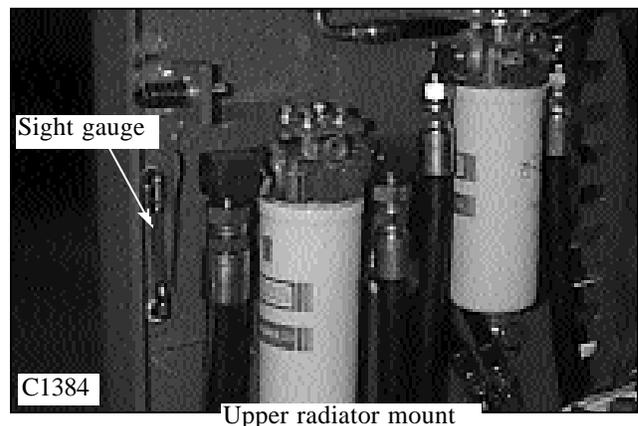
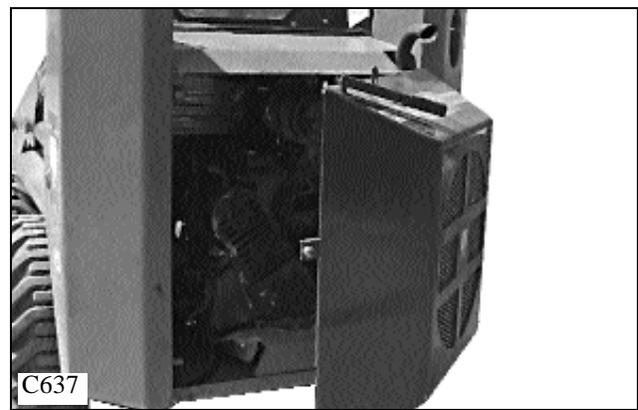
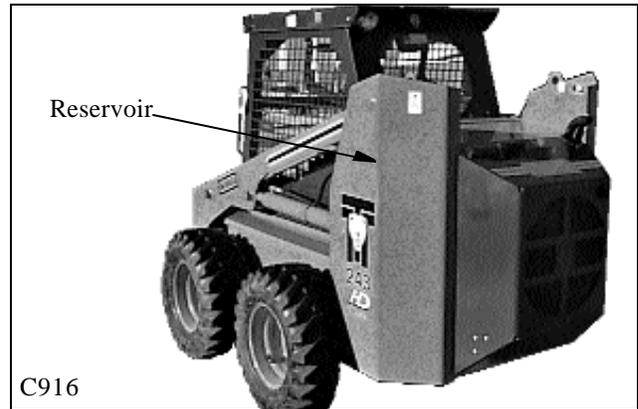
The oil reservoir fill cap is located at the top of the reservoir. (fig. C1690) The oil fill cap assembly has a 30 micron screen to catch larger particles of contaminant before entering the reservoir, but **always use oil filtered through a 10 micron min. filter for replenishing the hydraulic reservoir.** The oil fill cap is also a reservoir vent, or breather, and contains a 10 micron filter to remove air borne particles.

To Check the Oil Level:

- 1 Check the reservoir oil level with the loader on level ground.
- 2 Lower the boom arms, retract the cylinders and engage the parking brake. Shut off the engine.
- 3 Open the rear door. (fig. C637)
- 4 Check the oil level in the sight gauge. (fig. C1384)
- 5 If oil is visible approximately mid way in the sight gauge, the level is correct. The correct level is marked with a line from the factory.

To Add Oil:

- 1 Remove the bolt on the filler cap.
- 2 Open the filler cap. (fig. C1690)
- 3 Inspect the filler screen in the filler neck for damage. If the filler screen is damaged, replace it.
- 4 Using a clean container, add 10W30 API class SE / CD oil.
- 5 Replace the filler cap.



HYDRAULIC OIL RESERVOIR 1.8

Servicing the Oil Reservoir:

Change the hydraulic oil, change the suction screen element and clean the magnet in the tank after every 1000 operating hours or if the oil has become contaminated or after any major hydrostatic drive system repair.

1 Lower the boom arms, shut off the engine and engage the parking brake.

2 Remove the magnetic drain plug located at the bottom of the hydraulic oil reservoir. Clean any metal particles that may be attached to the magnet. (fig. C1695)

Have containers ready to hold approximately 18 gallons (68 l) of fluid.

C1695

Drain plug

3 Access the suction screen element in the hydraulic reservoir by removing the inspection cover on the reservoir, located in the engine compartment. (fig. C1384)

Clean the excess silicone from the cover and reservoir.

NOTE: You may need to remove the hydraulic oil filter to gain access to the inspection cover nuts.

4 Remove the suction screen element from the reservoir by turning counter clockwise. (fig. C1769, C1777)

5 Remove and clean the magnet attached to the suction element. (fig. C1769)

6 Install the magnet onto a new suction element and install the suction element.

7 Apply silicone around the inspection hole and install the inspection cover to the reservoir. Do not over tighten the mounting nuts. Maximum torque is 18 ft / lbs (24 N.m.).

8 Fill the reservoir to the proper level with 10W30 API classification SE / CD oil, approximately 18 gallons or 68 litres.

TROUBLESHOOTING 1.9

1

Problem	Cause	Corrective Action	Section
Loss of hydraulic power (no flow from the gear pump).	Reservoir low on oil.	Check for leaks. Fill the reservoir to the proper level.	1.8
	Universal joint between engine and tandem pump failure.	Inspect and replace the damaged parts as required. Check for proper alignment.	7.11
	Gear pump not functioning.	Inspect and replace damaged parts.	1.4 / 2.9
	Splined coupling failure in the hydrostatic pump	See the Sauer Sundstrand Repair Manual BLN 10056.	2.10
Loss of hydraulic power (full flow from gear pump).	Electrical failure.	Check fuse, switches and wiring.	8
	Auxiliary hydraulics engaged.	Disengage the switch.	4.9
	Relief valve failure or out of adjustment.	Check pressure. Adjust or repair as required.	1.4
	Control locks engaged	Check fuse, safety switches and valve lock parts.	1.4 / 8
Hydraulic action jerky.	Reservoir low on oil.	Check for leaks. Fill the reservoir to the proper level.	1.8
	Control linkages loose or worn.	Inspect, adjust or replace parts.	4
	Air in hydraulic system.	Check for leaks between the oil reservoir and pump.	
	Load check valve not functioning.	Inspect and replace damaged parts.	1.4
	Control valve spool spring return mechanism not functioning	Inspect and replace damaged parts.	1.4
Boom raises slowly at full RPM	Reservoir low on oil.	Check for leaks. Fill the reservoir to the proper level.	1.8
	Control linkages loose or worn.	Inspect, adjust or replace parts.	4
	Auxiliary engaged.	Disengage .	4.9
	Lifting more than rated capacity.	Reduce the load.	
	Engine RPM too low.	Check engine RPM and reset.	7.11
	Relief valve failure or out of adjustment.	Check pressure. Adjust or repair as required.	1.4
	Cylinder seal(s) failure.	Check seals.	1.5
	Internal leakage in the control valve.	Inspect the control valve and repair as required.	1.4
Hydraulic cylinders will not support a load. (leak down)	Control valve spools not centering.	Check control linkage and control valve spool spring centering devise.	1.4 / 4
	External leak between control valve and cylinders	Inspect and repair.	
	Cylinder seal(s) failure	Check seals.	1.5
	Load check valve not functioning.	Inspect and replace damaged parts.	1.4

TROUBLESHOOTING 1.9



Problem	Cause	Corrective Action	Section
Hydraulic oil overheating.	Reservoir low on oil.	Check for leaks and replenish as required.	1.8
	Oil cooler plugged or dirty.	Clean the cooling fins.	1.7
	Auxiliary engaged.	Disengage.	4.9
	Cooling fan speed low, hydraulic fan drive motor damage.	Check fan speed.	1.7
	Engine RPM too low.	Check engine RPM and reset.	7.11
	Temperature sender defective.	Replace.	8
	Relief valve failure or out of adjustment.	Check pressure, adjust or replace.	1.4
	Wrong type of hydraulic fluid.	Replace.	1.8

TORQUE CHART 1.10

Torque Chart NOTE: all torques are in ft / lbs. (Multiply by 1.36 = N.m.)

HOSE SIZE	37° JIC FITTINGS	HOSE SIZE	ORB FITTINGS
1/4	9 to 10	1/4	14 to 16
5/16	15 to 16	5/16	18 to 20
3/8	20 to 22	3/8	24 to 26
1/2	30 to 33	1/2	50 to 60
5/8	40 to 44	5/8	72 to 80
3/4	70 to 77	3/4	125 to 135
7/8	82 to 90	7/8	160 to 180
1	55 to 60	1	200 to 220
1 1/4	120 to 132	1 1/4	210 to 280
1 1/2	131 to 144	1 1/2	270 to 360
2	300 to 330		

The following torque specifications are for steel ORB fittings into aluminum.			
HOSE SIZE	ORB FITTINGS	HOSE SIZE	ORB FITTINGS
1/4	5 to 7	3/4	40 to 45
5/16	8 to 10	7/8	50 to 55
3/8	10 to 12	1	90 to 99
1/2	21 to 24	1 1/4	80to 90
5/8	27 to 30		

CONVERSION CHART 1.11

CONVERSION FACTORS Metric to U.S.			
	MULTIPLY	BY	TO OBTAIN
Area:	sq. meter hectare	10.763 91 2.471 05	square foot acre
Force:	newton newton	3.596 942 0.224 809	ounce force pound force
Length:	millimeter meter kilometer	0.039 370 3.280 840 0.621 371	inch foot mile
Mass:	kilogram	2.204 622	pound
Mass/Area:	kilogram/hectare	0.000 486	ton/acre
Mass/Energy:	g/kWhr.	0.001 844	lb/kWhr.
Mass/Volume:	kg/cubic meter	1.685 555	lb/cubic yd.
Power:	kilowatt	1.341 02	horsepower
Pressure:	kilopascal bar	0.145 038 14.50385	lb/sq. inch lb/sq. inch
Temperature:	degree C	$1.8 \times C + 32$	degree F
Torque:	newton meter newton meter	8.850 748 0.737 562	lb/ft lb/ft
Velocity:	kilometer/hr.	0.621 371	mile/hr.
Volume:	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre	0.061 024 35.314 66 1.307 950 0.033 814 1.056 614 0.879 877 0.264 172 0.219 989	cubic inch cubic foot cubic yd. ounce (US fluid) quart (US liquid) quart (Imperial) gallon (US liquid) gallon (Imperial)
Volume/Time:	litre/min. litre/min.	0.264 172 0.219 989	gallon/min. (US liquid) gallon/min. (Imperial)

CONVERSION CHART 1.11

U.S. to Metric			
	MULTIPLY	BY	TO OBTAIN:
Area:	square foot acre	0.092 903 0.404 686	square meter hectare
Force:	ounce force pound force	0.278 014 4.448 222	newton newton
Length:	inch foot mile	25.4 * 0.304 8 * 1.609 344 *	millimeter meter kilometer
Mass:	pound ounce	0.453 582 28.35	kilogram gram
Mass/Area:	ton/acre	2241 702	kilogram/hectare
Mass/Energy:	lb/hp/hr	501.277 4	g/kWhr
Mass/Volume:	lb/cubic yd.	0.593 276	kg/cubic meter
Power:	horsepower	0.745 700	kilowatt
Pressure:	lbf/sq. in. lbf/sq. in. lbf/sq. in.	6.894 757 0.089 0.070 306	kilopascal bar kg/sq. cm
Temperature:	degree F	1.8 F - 32	degree C
Torque:	pound/inch pound/foot	0.112 986 1.355 818	newton meter newton meter
Velocity:	miles/hr.	1.609 344 *	kilometer/hr.
Volume:	cubic inch cubic foot cubic yard ounce (US fluid) quart (US liquid) quart (imperial) gallon (US) gallons (imperial)	16.387 08 0.028 317 0.764 555 29.573 53 0.946 353 1.136 523 3.785 412 4.546 082	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre
Volume/Time:	gallon/min.	3.785 412	litre/min.

NOTES

SECTION 2

HYDROSTATIC DRIVE SYSTEM

Hydrostatic Drive Circuit	2.1
General Information	2.2
Trouble Shooting	2.3
Pressure Tests	2.4
Towing Procedure	2.5
Flushing The Hydraulic System	2.6
Start-up Procedure	2.7
Gear Pump Replacement	2.8
Tandem Pump Replacement	2.9
Drive Motor	2.10
Torque Chart	2.11
Conversion Chart	2.12

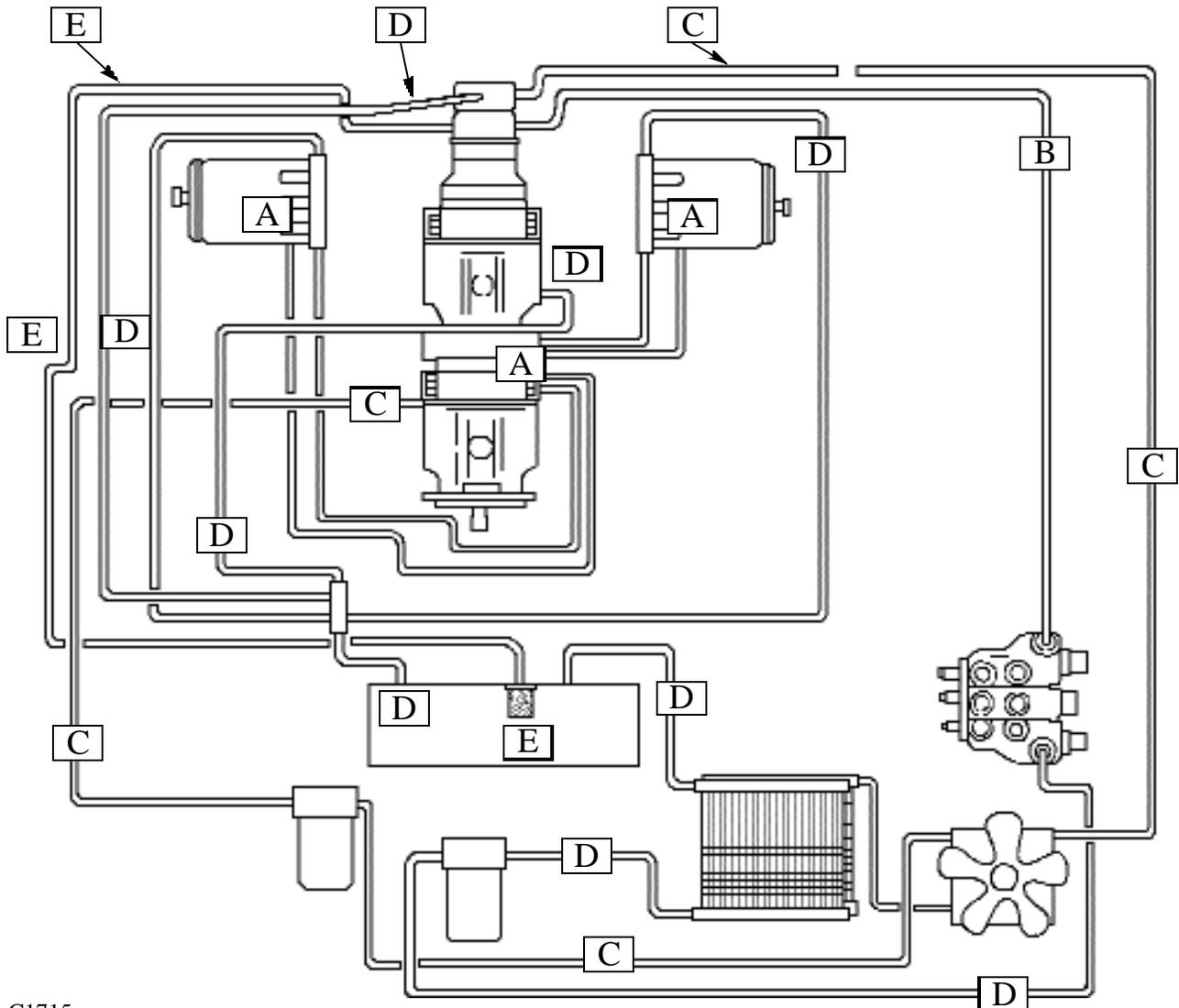


HYDROSTATIC CIRCUIT 2.1

Hydrostatic Circuit and System Pressure Schematic (T245,243HDS & T245HDK MODELS)

2

- A** High Pressure Relief at 325 Bar (4700PSI)
- B** Aux. Press. Relief Set at 3000 PSI (207 Bar)
- C** System Charge Pressure 75 to 160 PSI (5 to 11 Bar)
- D** Return Pressure
- E** Suction Line (Vacuum) 4 - 6 Hg @ 160°F (71°C)



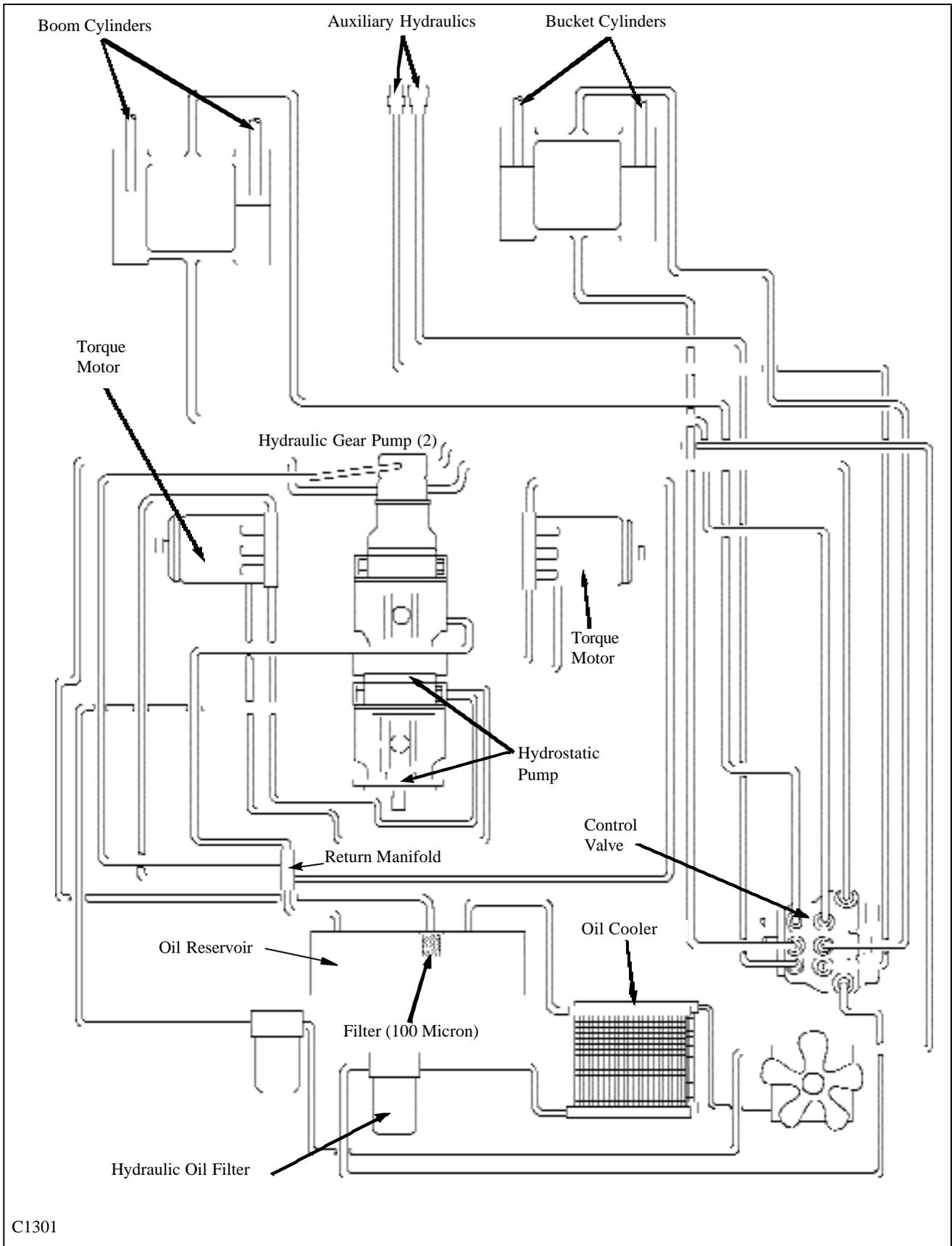
C1715

Hydrostatic Circuit and System Pressure Schematic (T245,243HDS & T245HDK MODELS)

Pump Type Variable Displacement, Reversible Piston
Brand Name Of Pump Sauer Sundstrand
Series Type 40 / M44
Series Type T245HDK 40/M46
No. Of Drive Pumps 2 (TWO)
Mounting Tandem
Rotation (viewed from shaft end) Clockwise
Operating Speed 2800 RPM (+ / - 50 RPM)
Pump Displacement 2.65 cu. in. (43.5cc)
No. Of Relief Valves 2 (TWO)
Relief Valve Setting 325 Bar (4700 PSI)
Max. Allowable Case Pressure 25 PSI (1.7 Bar)
Charge Pump Type External Gear
Charge Pressure 75 PSI Min. (5 Bar)
Drive Motor Type Geroler Torque Motor
Brand Name Eaton
Series Type 6000
Rotation Dual
No. Of Drive Motors 2 (TWO)
Drive Motor Displacement 15 cu. in. (246cc)
Max. Case Pressure 25 PSI (1.7 Bar)
Fluid Type 10w30 API Class SE, CD Oil
Reservoir Filtration One 100 Micron Screen Element
Charge Oil Filtration One 5 Micron Element
Hydraulic Oil Filtration One 5 Micron Element
Charge Element P / N 35243
Hydraulic Element (STD Only) P / N 35243
Hydraulic Element (HI-FLOW Only) P / N 43541
Hydrostatic Repair Manual (Sauer Sundstrand) BLN-9992
Battery 2 x 12v



2.1 HYDRAULIC / HYDROSTATIC CIRCUIT (T245HDK,T245,T243 HDS MODELS)

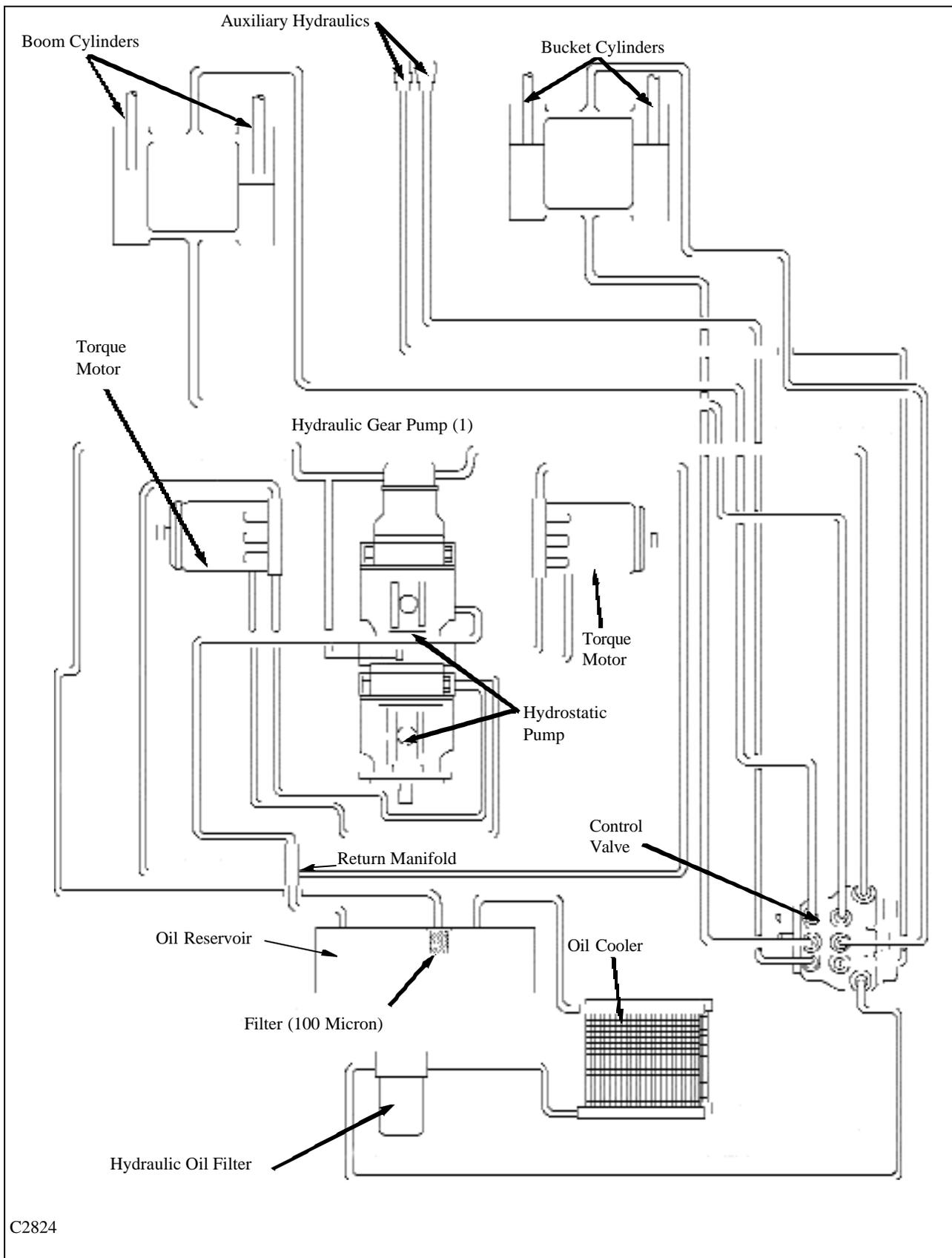


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2.1 HYDRAULIC / HYDROSTATIC CIRCUIT (T245HDK,T245,T243 HDS MODELS)

Pump Type Variable Displacement, Reversible Piston
Brand Name Of Pump Sauer Sundstrand
Series Type 40 / M44
Series Type T245HDK 40/M46
No. Of Drive Pumps 2 (TWO)
Mounting Tandem
Rotation (viewed from shaft end) Clockwise
Operating Speed 2800 RPM (+ / - 50 RPM)
Pump Displacement 2.65 cu. in. (43.5cc)
No. Of Relief Valves 2 (TWO)
Relief Valve Setting 325 Bar (4700 PSI)
Max. Allowable Case Pressure 25 PSI (1.7 Bar)
Charge Pump Type External Gear
Charge Pressure 75 PSI Min. (5 Bar)
Drive Motor Type Geroler Torque Motor
Brand Name Eaton
Series Type 6000
Rotation Dual
No. Of Drive Motors 2 (TWO)
Drive Motor Displacement 15 cu. in. (246cc)
Max. Case Pressure 25 PSI (1.7 Bar)
Fluid Type 10w30 API Class SE, CD Oil
Reservoir Filtration One 100 Micron Screen Element
Charge Oil Filtration One 5 Micron Element
Hydraulic Oil Filtration One 5 Micron Element
Charge Element P / N 35243
Hydraulic Element (STD Only) P / N 35243
Hydraulic Element (HI-FLOW Only) P / N 43541
Hydrostatic Repair Manual (Sauer Sundstrand) BLN-9992
Battery 2x12v

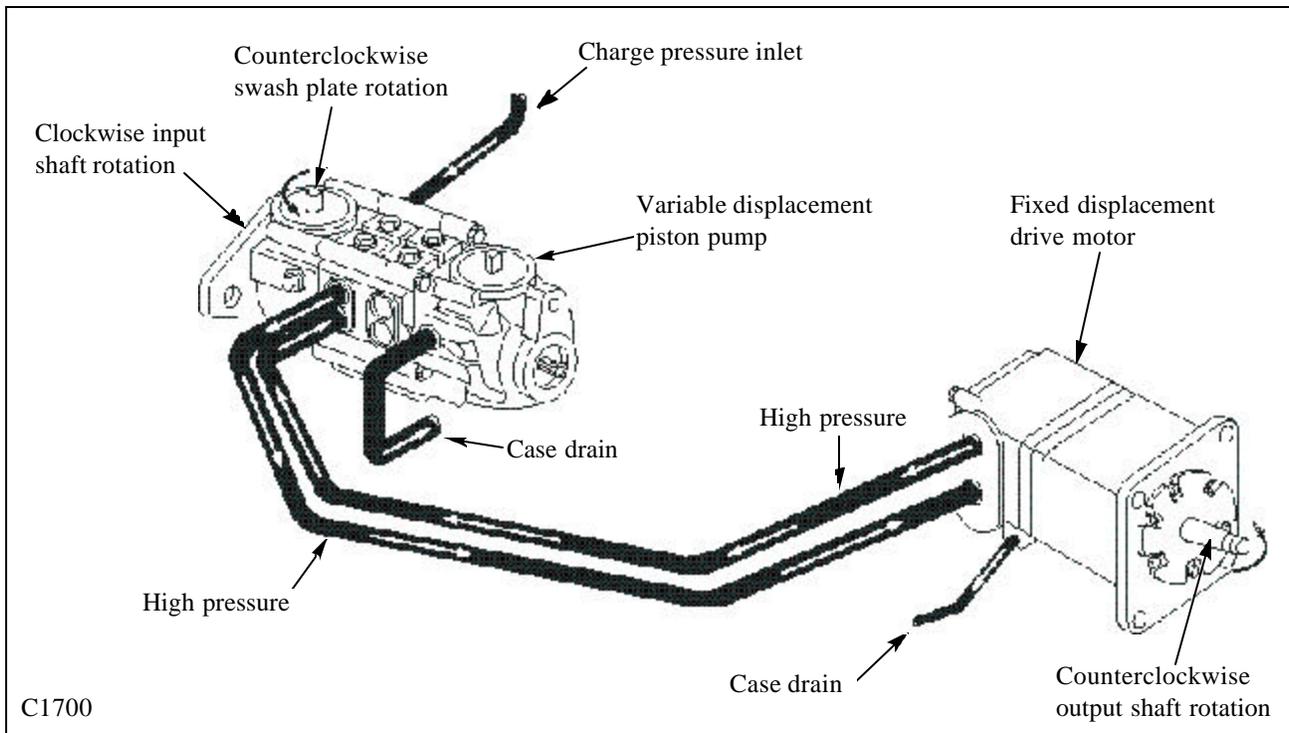
2.1 HYDRAULIC / HYDROSTATIC CIRCUIT (ProTough2200)



2.1 HYDRAULIC / HYDROSTATIC CIRCUIT (ProTough2200)

Pump Type	Variable Displacement, Reversible Piston
Brand Name Of Pump	Sauer Sundstrand
Series Type	40 / M44
No. Of Drive Pumps	2 (TWO)
Mounting	Tandem
Rotation (viewed from shaft end)	Clockwise
Operating Speed	2800 RPM (+ / - 50 RPM)
Pump Displacement	2.65 cu. in. (43.5cc)
No. Of Relief Valves	2 (TWO)
Relief Valve Setting	325 Bar (4700 PSI)
Max. Allowable Case Pressure	25 PSI (1.7 Bar)
Charge Pump Type	External Gear
Charge Pressure	75 PSI Min. (5 Bar)
Drive Motor Type	Geroler Torque Motor
Brand Name	Eaton
Series Type	6000
Rotation	Dual
No. Of Drive Motors	2 (TWO)
Drive Motor Displacement	15 cu. in. (246cc)
Max. Case Pressure	25 PSI (1.7 Bar)
Fluid Type	10w30 API Class SE, CD Oil
Reservoir Filtration	One 100 Micron Screen Element
Charge Oil Filtration	One 5 Micron Element
Hydraulic Oil Filtration	One 5 Micron Element
Charge Element	P / N 35243
Hydraulic Element (STD Only)	P / N 35243
Hydraulic Element (HI-FLOW Only)	P / N 43541
Hydrostatic Repair Manual (Sauer Sundstrand)	BLN-9992
Battery	1x12v

GENERAL INFORMATION 2.2



The driveshaft of the piston pump is rotated by the engine. The piston block which is splined to the driveshaft also turns. The piston block, rotating group, consists of 9 piston assemblies which have free swiveling shoes swagged on the ball end of each piston assembly. The shoe end of the piston rides against the smooth machined surface of the camplate. With the camplate in the neutral position, the piston assemblies do not reciprocate in the piston block, but are rotating. No oil is drawn into or discharged from the pump. The pump is in a zero displacement position and the loader remains stationary.

With the camplate in the neutral position the pressure of the charge oil, which ranges from 75 to 150 psi (5 - 11 Bar), is able to unseat both check valves and supply oil to both sides of the pump because of the balance in pressure. Very little charge oil volume is required in the neutral position so the excess oil is bypassed over the charge pressure relief valve and recirculated back to the reservoir. The oil that leaks internally in the pump and motor collects in their body housings and is returned to the reservoir by external case drain in the pump and motors. This leakage oil is the only oil the charge pump replenishes. This makes the design a closed loop system.

As the steering lever is moved forward, or reverse, the loader starts a directional movement. As the camplate begins to move, the piston assemblies start to reciprocate in the piston block. As the steering lever continues further movement the cam angle increases, the pistons reciprocate further, more oil is pumped and the speed of the loader is increased.

When the camplate begins to move the check valve on the discharge, or pressure, side seats because of the higher pressure differential. The other check valve remains open on the intake or low pressure side to continue supplying the closed loop system with charge oil.

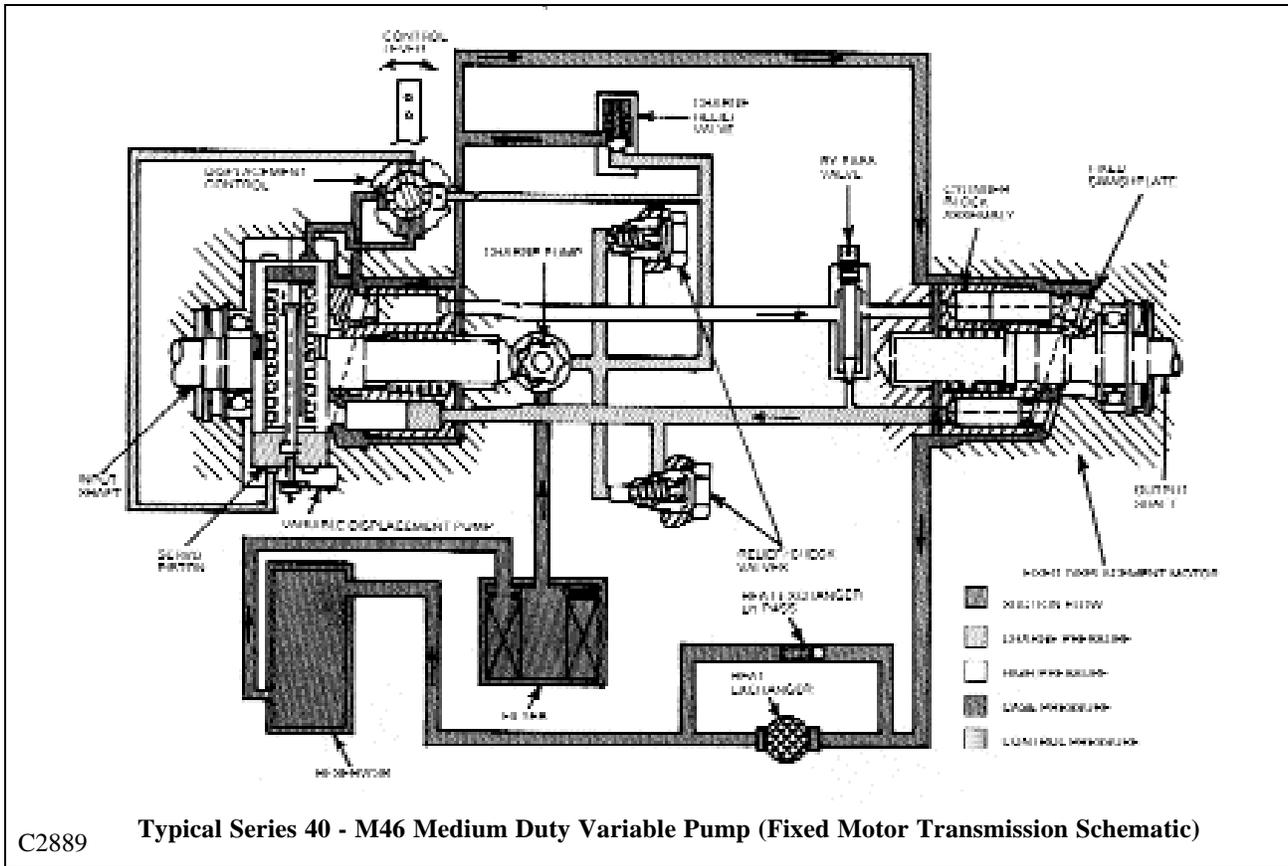
The drive motor, which is a fixed displacement type, delivers a constant output torque for a given pressure throughout the speed range of the motor.

The movement of the pump camplate, forward or reverse, controls the direction of the drive motor rotation.

The function of the pressure relief valve is to relieve the pressure side of the system of excessive high pressure when the loader encounters a heavy load or stalls out. When the relief valve senses an over load it unseats, allowing excess pressure and volume to flow into the low pressure side of the pump. A small volume of oil starts to flow across to the other relief valve. This relief valve is exposed to the low pressure on the intake side of the pump and is seated by the spring tension within the relief valve body.

The small volume of oil being bypassed is enough to unseat the relief valve and let it recirculate back into the inlet side of the pump. As the pressure continues to build on the pressure side, a larger volume of oil flows and at a greater speed through the drilled orifice in the relief valve cartridge, causing a pressure drop inside the relief valve. The surrounding pressure is now able to unseat the relief valve and bypass maximum volume of oil. The system reliefs function the same for both sides of the system.

GENERAL INFORMATION (SERVO PUMP) 2.2



C2889 Typical Series 40 - M46 Medium Duty Variable Pump (Fixed Motor Transmission Schematic)

The M46 Medium Displacement pumps /motors can be applied separately or combined in a system to transfer and control power. When combined in such a system, these units provide an infinitely variable speed range between zero and maximum, in both forward and reverse modes of operation.

The M46 variable displacement pumps use the parallel axial piston/slipper design in conjunction with a tiltable swashplate to vary the pump's displacement. Reversing the direction of tilt of the swashplate reverses the flow of oil from the pump and thus reverses the direction of the motor output rotation.

The M46 variable displacement pump and Tandem pump are controlled by a compact responsive hydro-mechanical, closed loop control system. A choice of manual, hydraulic or electrical displacement controls are available.

A charge relief valve and check valves are included in the pump end cap to control the makeup and cooling oil flow for the system. The charge check valves also incorporate the high pressure relief valve function into their design. The fixed and variable displacement motors also incorporate the parallel axial piston/slipper design. Fixed displacement motors utilize a fixed swashplate angle. The variable displacement motors use a variable angle swashplate with a hydraulic control system, designed to provide two positions of the swashplate: maximum and minimum

displacement. Refer to Figure: (C2889).

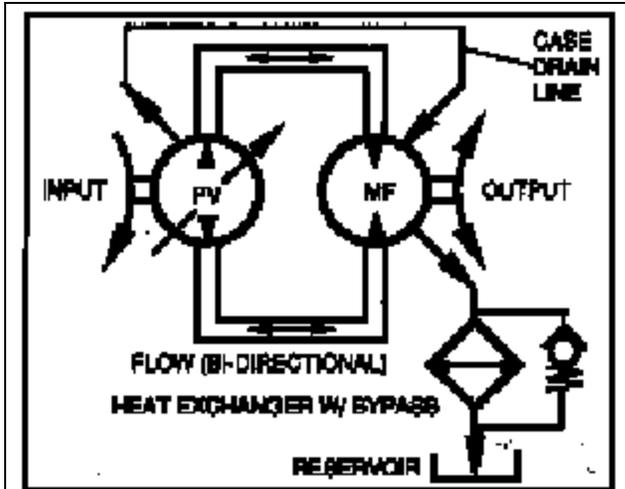
M46 pumps and motors have their own hydraulic support system which is:

Basic Closed Circuit:

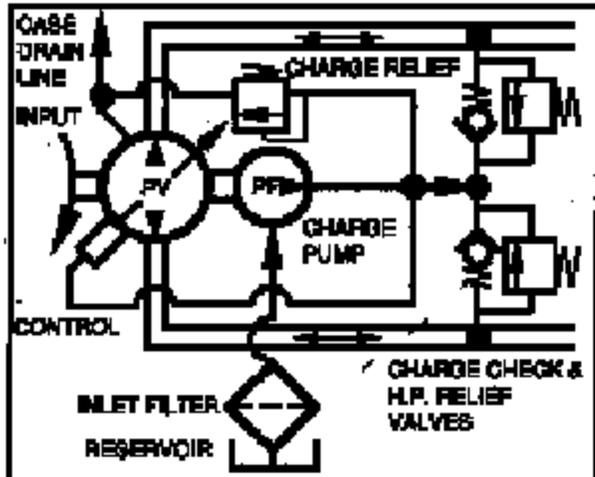
The main parts of the pump are connected by hydraulic lines to the main ports of the motor. Fluid flows in either direction, from the pump in this closed circuit. Either of the hydraulic lines can be under high pressure. The direction and speed of the fluid flow (and the motor output shaft rotation) depends on the position of the pump swashplate. The system pressure is determined by the machine load. Refer to: Figure (C2888).

Case Drain & Heat Exchange:

The pump and motor require drain lines to remove the hot fluid from the system. The pump case should be drained from its upper drain port to insure the case remains full of fluid. The pump case drain is then connected to the lower drain port on the motor housing. The upper motor housing drainport is connected to the reservoir. A heat exchanger, with a bypass valve, may be required to cool the case drain fluid before it returns to the reservoir. When operating the pump near rated speed, some case flow may have to be diverted around the motor to ensure



Basic Closed Circuit



Charge System

C2888

pump case pressure remains within recommended limits.

Charge System and Inlet Filter:

The charge pump supplies cool fluid to the system and keeps the closed loop charged to prevent cavitation. The charge pump draws its fluid from the system reservoir. Since either of the main hydraulic lines can be high pressure, two (2) charge check valves are used to direct the charge supply into the low pressure line. These check valves are incorporated into the high pressure relief valves in the pump end cap. Any charge flow not being used for the closed circuit is discharged over a direct operating charge relief valve, through the pump and motor housings and back to the system reservoir. Refer to: Figure(C2888).

High Pressure Relief Valves:

Two (2) optional combination check/high pressure relief valves may be provided in the pump end cap for operation overload protection. These cartridge type relief valves are factory set and are not field adjustable. Changing the maximum system pressure can be accomplished by installing different cartridges with the desired settings. Refer to: Figure (C2895).

CAUTION

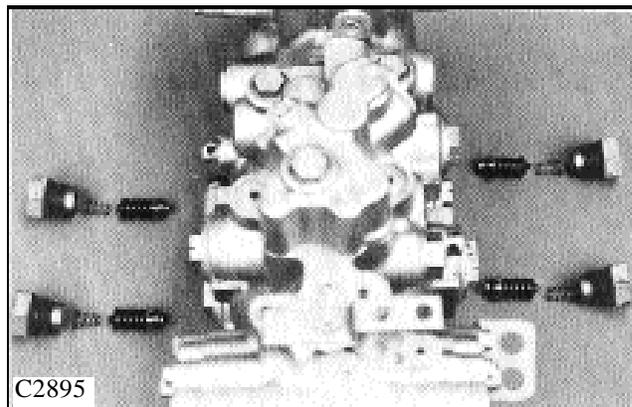
Continuous case pressure should not exceed 25 PSI (1.7 BAR).

CAUTION

The inlet vacuum, measured at the charge pump inlet should not exceed 5 in. Hg (.8 BAR abs.), except during cold starts.

CAUTION

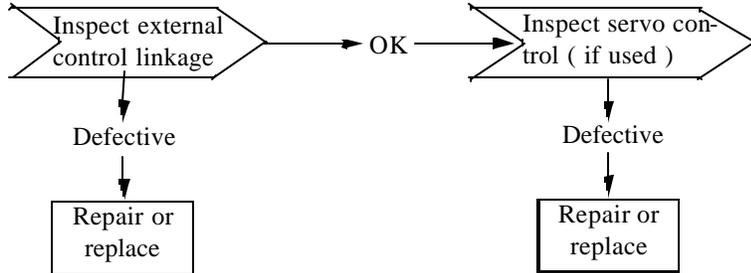
Charge Pressure must not be less than 220 PSI (15.2 BAR) for satisfactory operation. Pressure less than this may result in premature unit failure or loss of control.



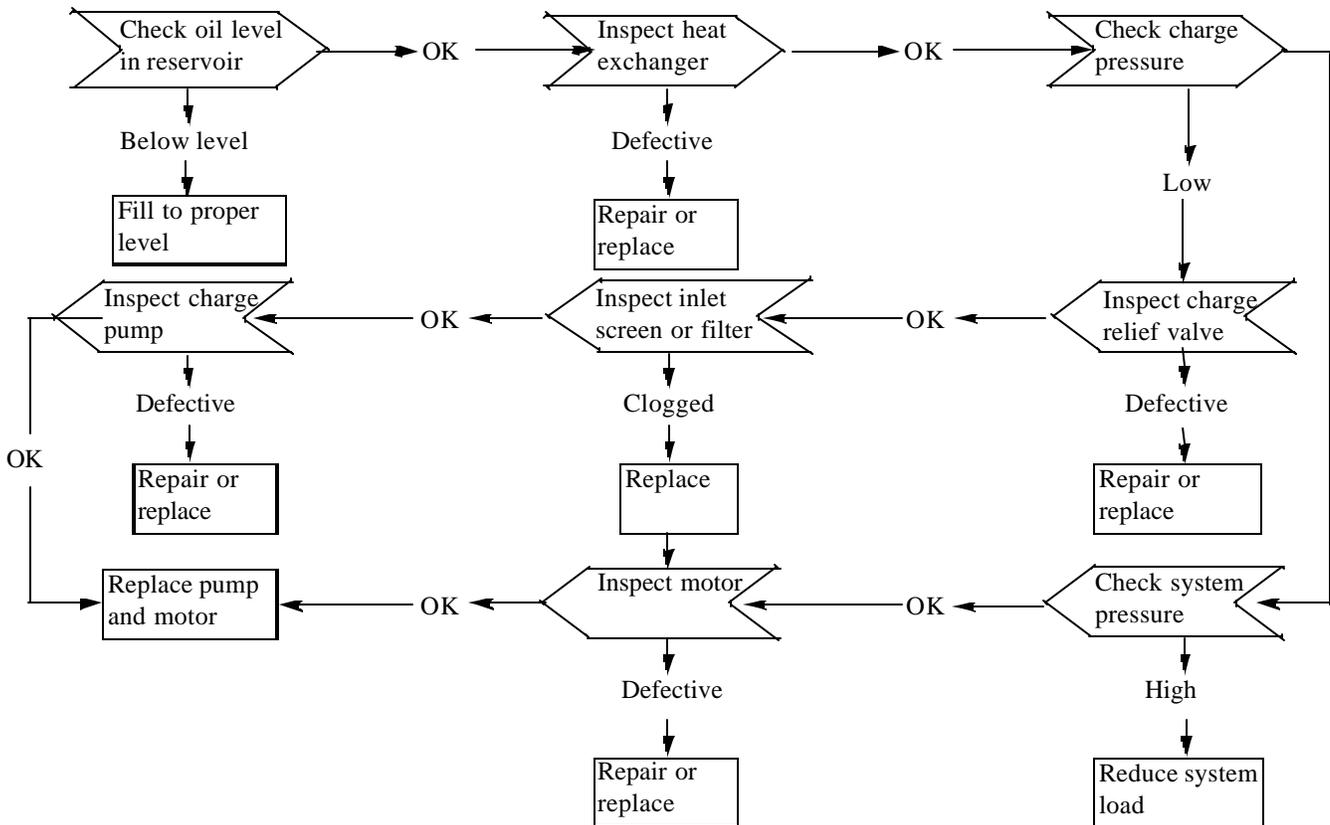
C2895

TROUBLE SHOOTING 2.3

Symptom: Neutral Difficult Or Impossible To Find

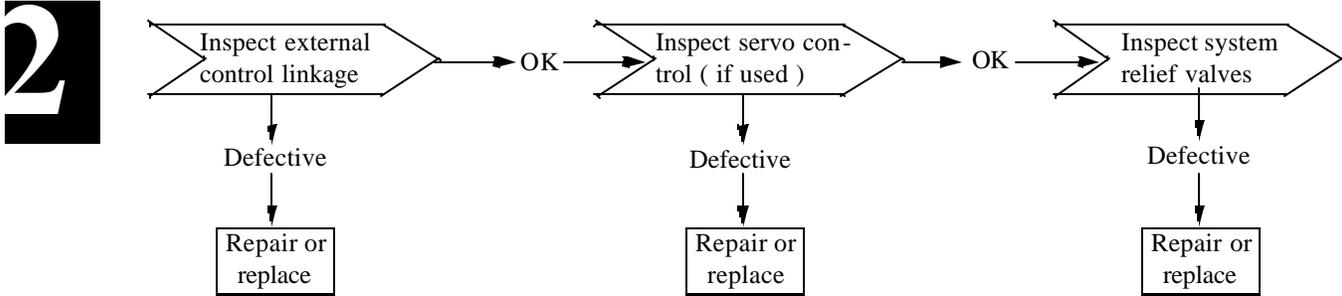


Symptom: System Operating Hot

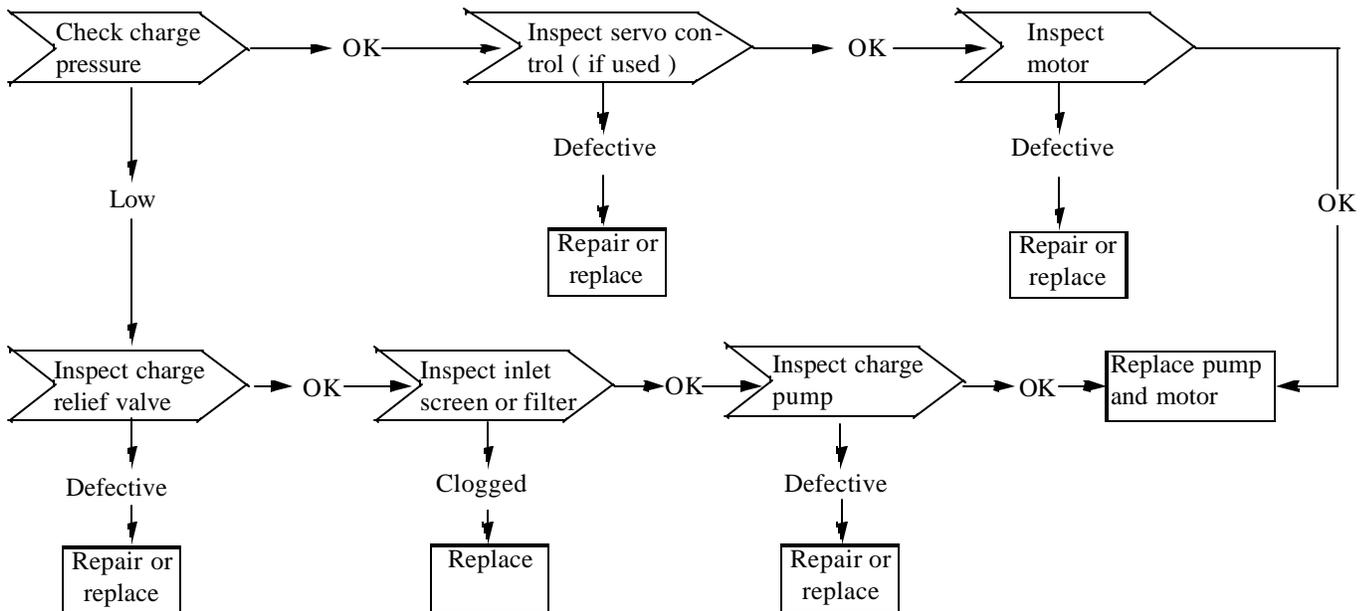


TROUBLE SHOOTING 2.3

Symptom: Operates In One Direction Only

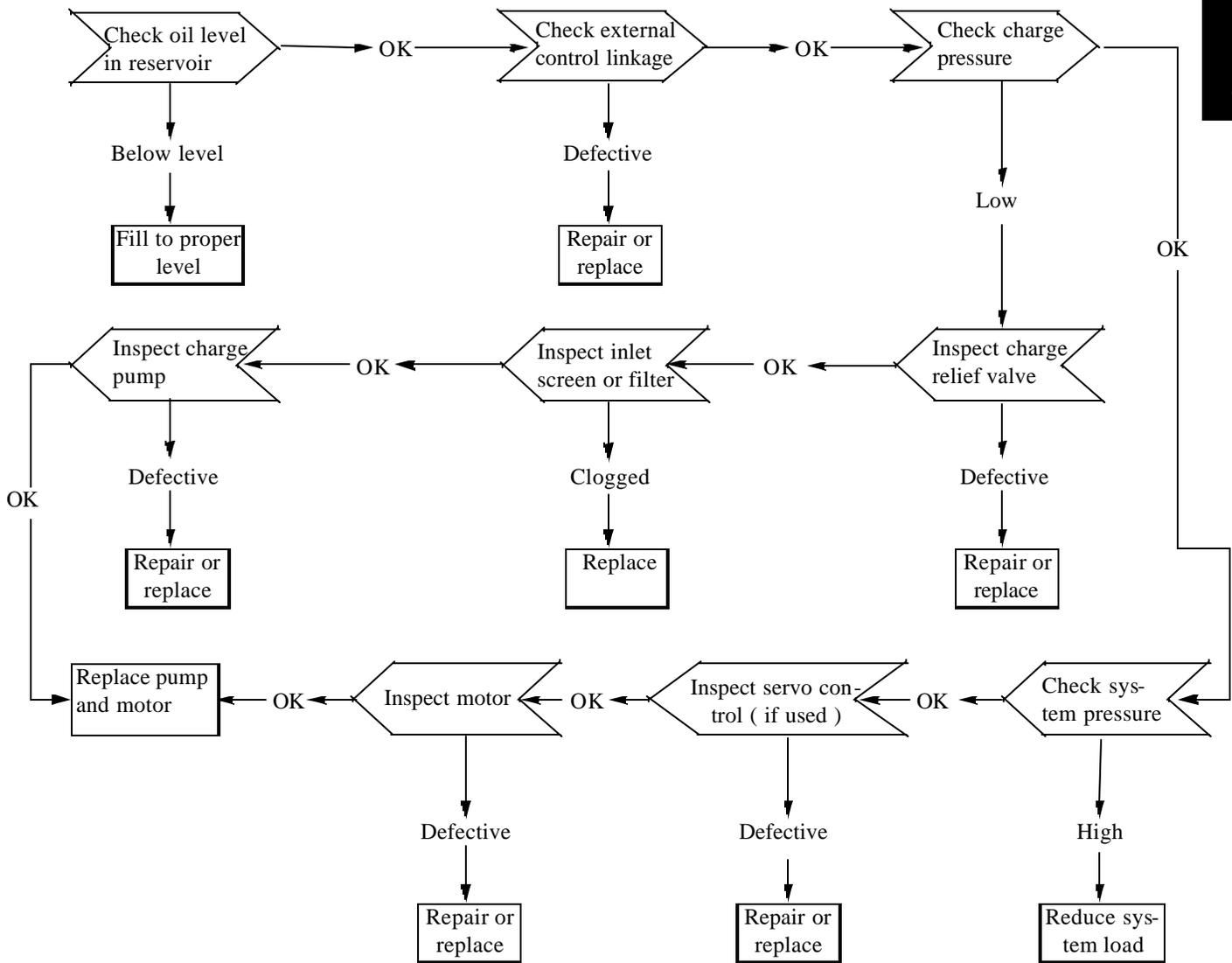


Symptom: System Response Sluggish



TROUBLE SHOOTING 2.3

Symptom: System Will Not Operate In Either Direction

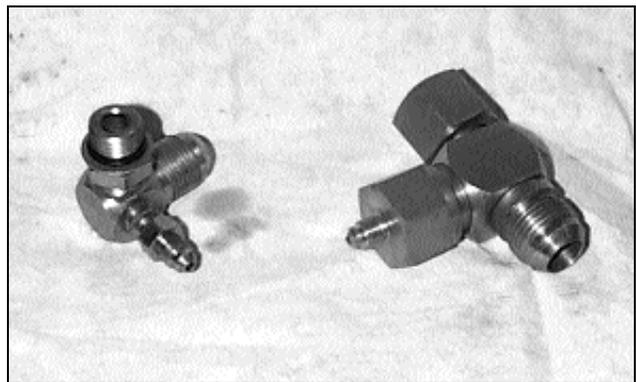
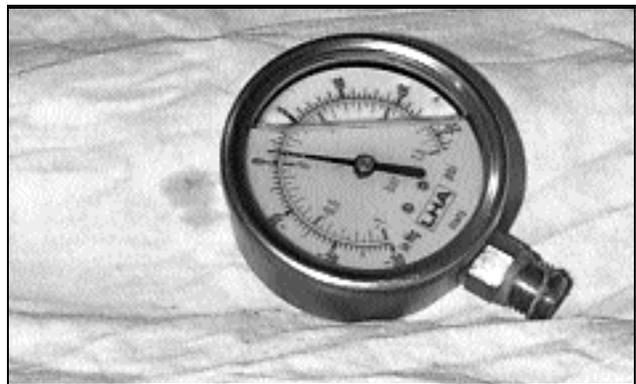
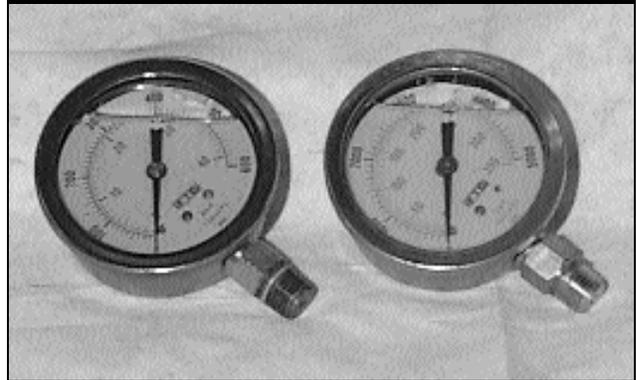


TROUBLE SHOOTING 2.3

System Diagnosing Steps And Special Tools

2

- 1 Check oil level in reservoir:**
 - a. fill to proper level as marked on site tube.
- 2 Inspect external control linkage for:**
 - a. misadjustment or disconnection
 - b. binding, bending or breakage
 - c. misadjusted, damaged or broken hydroback
- 3 Inspect servo control valve for: (if used)**
 - a. proper inlet pressure
 - b. misadjusted or damaged neutral return spring
 - c. galled or stuck control spool
 - d. galled or stuck servo piston
- 4 Inspect heat exchanger for:**
 - a. obstructed air flow
 - b. improper plumbing (inlet to outlet)
 - c. obstructed fluid flow
- 5 Inspect inlet filter or screen for:**
 - a. plugged or clogged screen or filter
 - b. obstructed inlet or outlet
 - c. open inlet to charge pump (open line)
- 6 Check charge pressure:**
 - a. follow test procedures section 2.5
- 7 Inspect charge relief valve for:**
 - a. poppet held of seat
 - b. damaged or broken spring
 - c. damaged valve seat
 - d. improper charge relief setting
- 8 Inspect charge pump for:**
 - a. broken or missing drive coupling
 - b. damaged or missing o-rings
 - c. galled or broken gerotor set
- 9 Inspect system relief valves for:**
 - a. damaged or broken springs
 - b. valve held of seat
 - c. damaged valve seat
 - d. improper pressure relief settings
- 10 Check system pressure:**
 - a. follow test procedures section 2.5
- 11 Inspect hydraulic motor for:**
 - a. disconnected coupling



Caps and plugs

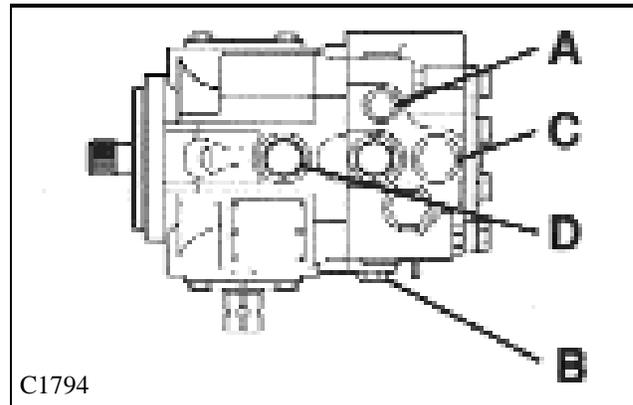
PRESSURE TESTS 2.4

The following photos show the various port locations available on the hydrostatic tandem pump for checking system pressure.

Completing these pressure test will diagnose any mechanical problem in the hydrostatic system.



Use caution when dealing with hydraulic fluid under pressure. Escaping fluid under pressure can penetrate the skin and cause serious injury.



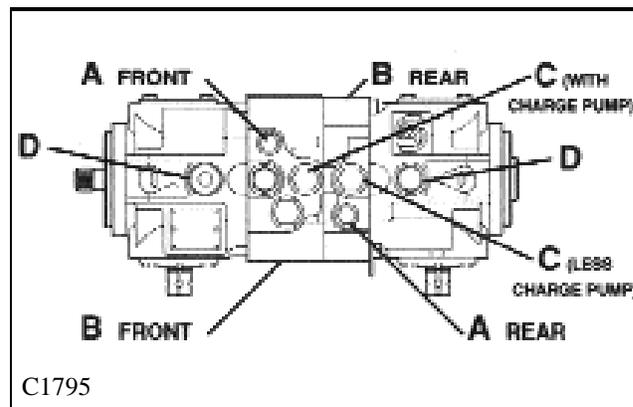
C1794

Installing a gauge into the high pressure port 'A' or 'B', will verify the status of the high pressure relief valves. Checking the pressure at port 'C' will give accurate charge pressure reading.

Checking the pressure at port 'D' will verify case drain pressure.

Measuring the vacuum at the charge pump inlet can help locate in in the inlet lines and filters. It would be necessary to tee into the charge pump line fitting.

Snubbers are recommended to protect the gauges from pressure spikes. Frequent gauge calibration is necessary to insure accuracy.

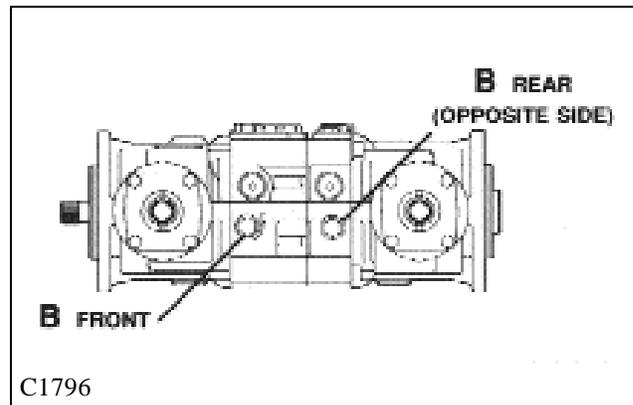


C1795

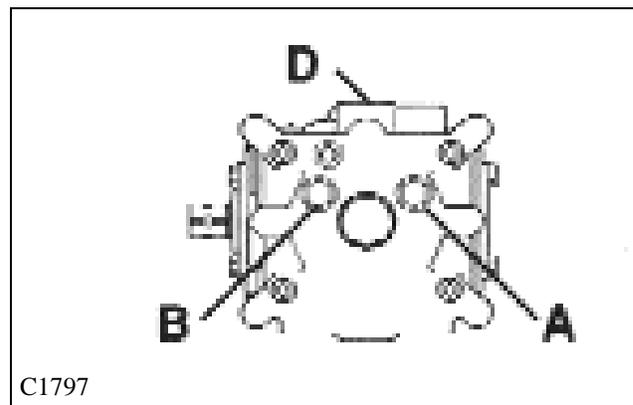
Gauge Information		
A	System Pressure Port 'A'	10,000 PSI Gauge (690 Bar) 9/16 - 18 O-Ring Fitting
B	System Pressure Port 'B'	10,000 PSI Gauge (690 Bar) 9/16 - O-Ring Fitting
C	Charge Pressure Port	500 PSI Gauge (34.5 Bar) Tee Into Charge Filter Outlet Line
D	Case Pressure Port	500 PSI Gauge (34.5 Bar) 1 - 1/16 - 12 O-Ring Fitting
E	Charge Pump Inlet Vacuum	Vacuum Gauge (30 in. Hg) Tee Into Charge Pump Inlet



Do not make connection or adjustments while the engine is operating.



C1796



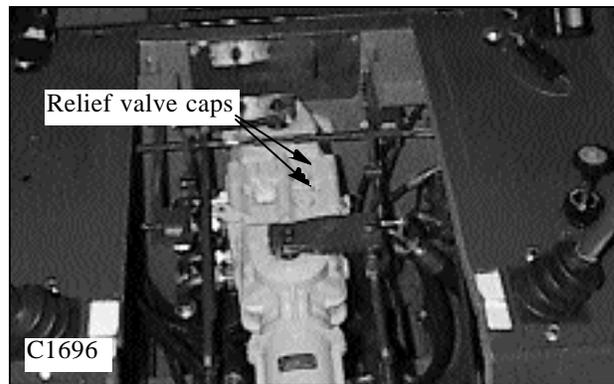
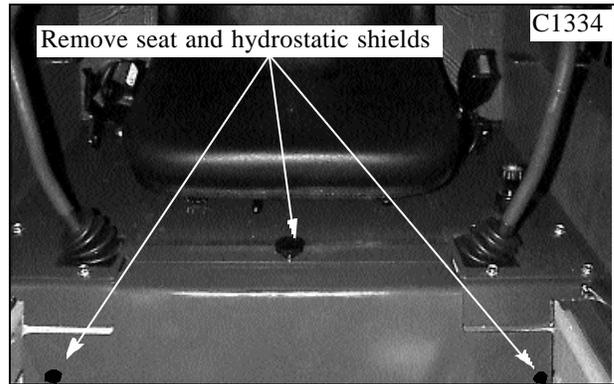
C1797

TOWING 2.5

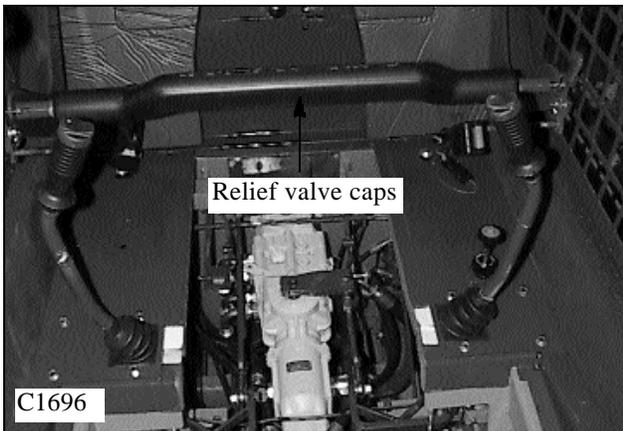
In an event the loader has malfunctioned or failed, the loader may be towed a short distance by following the procedure below.

- 1 Remove the seat and hydrostatic shield. (fig. C1334)
- 2 Loosen the high pressure relief valve caps four complete turns. There are four high pressure relief valves, two on top and two on the bottom. Be sure to loosen all four. (fig. C1696,C2884) Torque caps 30 to 50 ft / lbs (41 to 68 N.m.) upon reassembly.
- 3 Lower the restraint bar to release the parking brake. Refer to Figure (C1696).
- 4 Use the front frame mounted tie downs to attach pulling devise. (fig. C1703) Use the rear tie downs to pull the loader backwards. (fig. C1701)

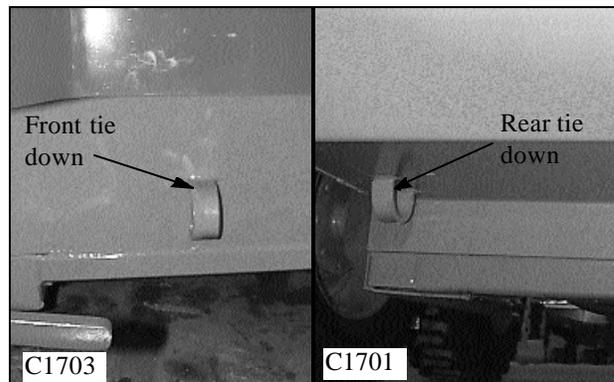
2



Use chains or cables rated a minimum of 1 and 1/2 times the gross vehicle weight.



Failure to follow the proper towing procedure may damage the hydrostatics and parking brake system.



FLUSHING THE HYDRAULIC SYSTEM 2.6

General Information

Contamination in the hydraulic system is a major cause of component failure. Contamination can enter the hydraulic system in any of the following ways.

- 1 When draining the hydraulic system.
- 2 When disassembling components.
- 3 Making auxiliary connections with dirty couplers.
- 4 Normal component wear.
- 5 Component failure

The best way to remove contaminants from the hydrostatic drive system is to disassemble each component and flush and clean thoroughly.

The hydraulic control circuits may be cleaned by attaching a suitable hydraulic filter to the auxiliary couplings and circulating the fluid through it.



Contamination Types

There are 2 types of contamination, microscopic, or non visible, and visible. Microscopic contamination is suspended in the fluid and moves freely through the hydraulic circuits. Examples of problems caused by microscopic contaminants include the following:

- 1 Cylinder rod seal leaks.
- 2 Control valve spools do not return to neutral.
- 3 Hydraulic system has a high operating temperature.
- 4 Components wear rapidly.

Visible contamination is foreign material that can be found by sight, touch or odor. Some examples of visible contamination include the following:

- 1 Particles of metal or dirt in the oil.
- 2 Air in the oil.
- 3 Odor of burned oil.
- 4 Water in the oil.

FLUSHING THE HYDRAULIC SYSTEM 2.6

Cleaning The System

2

The first step in cleaning the hydraulic system is to determine if you have visible or microscopic contamination.

If the contamination is visible, do the following steps:

1 Change the hydraulic oil by removing the drain plug in the bottom of the hydraulic oil reservoir. (fig. C1695)

Be prepared to contain approximately 80 litres of fluid.

2 Check the extent of the contamination by disassembling 1 each of the hydraulic cylinders. Check the cylinders for damage. Repair or replace the cylinders as required. If you determine the damage was caused by severe contamination and is not the result of normal wear, it will be necessary to remove, clean and repair all valves, pumps, lines, cylinders, etc.

3 Replace all hydraulic filters.

If the contamination is determined to be microscopic, perform the following steps:

1 Change the hydraulic oil by removing the plug in the bottom of the oil reservoir. (fig. C1695) Be prepared to contain approximately 80 litres of fluid.

2 Connect an external 10 micron filtering system, capable of sustaining minimum of 2000 PSI (138 Bar) and has a back pressure gauge, to the auxiliary couplings. (fig. C1687, C1688)

3 Start the engine and let it idle at approximately half throttle.



Be sure to use a filtering system capable of handling the pressure of the hydraulic system.

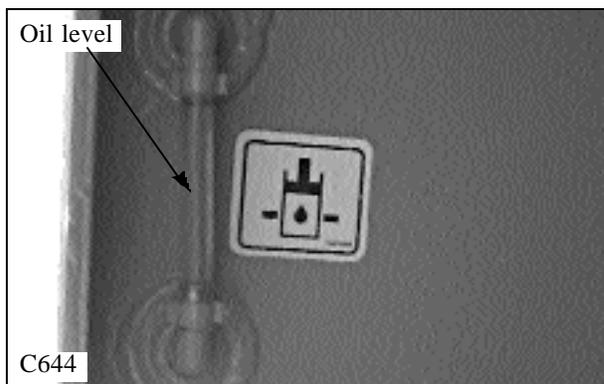
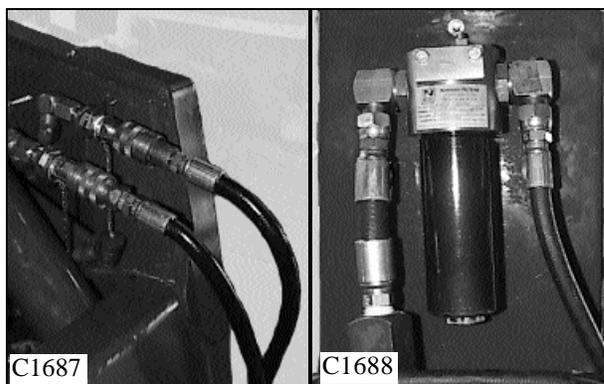
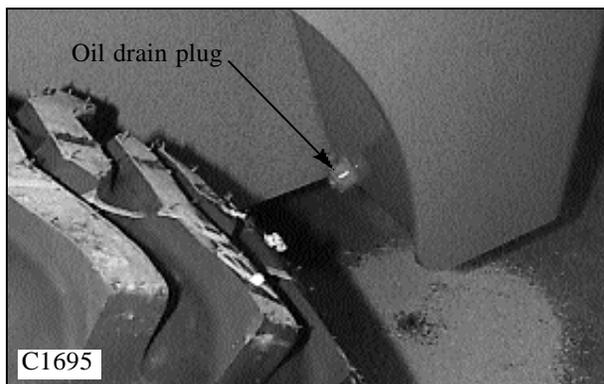
4 Engage the auxiliary circuit. Check to make sure the filtering system is not over taxed by the loaders hydraulic system pressure. Adjust engine idle accordingly to match the filtering systems capacity. This may vary as the filter becomes dirty, you may need to decrease engine RPM. Circulate the oil through filter for 30 minutes.

5 As the oil is being circulated through the auxiliary circuit, raise the liftarms up and down in full stroke cycles. Repeat this exercise for 15 minutes.

6 Cycle the bucket tilt cylinders in the same manner as above. Repeat the exercise, in full extension and retraction, for 15 minutes.

7 Install new hydraulic oil filters. (fig. C1617)

8 Start the engine and check for leaks. Replenish the hydraulic oil reservoir as required. (fig. C644)





C1695

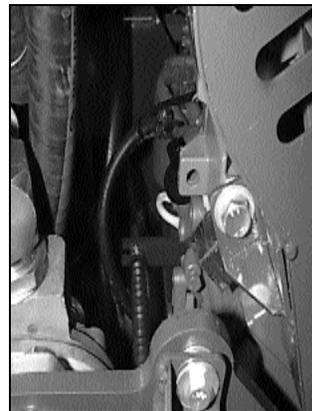
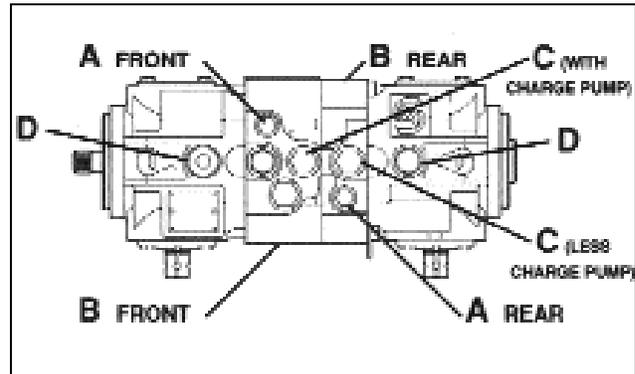
START-UP PROCEDURE 2.7

The following start-up procedure should always be adhered to when starting up a new installation or when restarting after pump repairs have been made.



This start-up procedure must be made with the loader securely raised off the ground.

- 1 Fill the hydraulic oil reservoir to the proper level. (fig. C644)
- 2 The inlet hose from the oil reservoir to the charge should be filled with oil prior to starting.
- 3 Check inlet and pressure hose fittings for proper tightness prior to starting.
- 4 The pump must be filled prior to start-up with filtered oil. Fill the pump by pouring oil into the side case drain port. (fig. C1795 location "D")
- 5 Disconnect the engine stop solenoid wiring, or remove the fuse connected to the red wire. (fig. C1691, C1692)
- 6 Turn the engine over by engaging the starter. Repeat this step, turning the engine over in 15 second interval, 5 or 6 times. This will fill the rest of the hydraulic hoses.
- 7 Reconnect the engine stop solenoid or replace the fuse.
- 8 Start the engine and let idle at lowest possible setting.
- 9 Check for leaks and make adjustments as required. Do not use your hands to check for leaks while the engine is operating.



C1690

- 10 Replenish the hydraulic oil reservoir as required.
- 11 Restart the engine and increase the RPM's to half throttle. Bring the hydraulic fluid up to operating temperature and make control adjustments as outline in section 4.

GEAR PUMP REPLACEMENT 2.8

Start the gear pump removal procedure by removing any attachment, raising the boom arms and engaging the boom support pins. Shut off the engine.



To prevent personal injury do not work under the boom arms without the boom supports engaged.

- 1 Remove the seat and hydrostatic shield.
- 2 Attach a vacuum system to the hydraulic oil reservoir filler location. (fig. C1689) Or drain the oil reservoir. Seal the threads on the drain plug, if removed, with teflon tape or a liquid form of pipe sealant before re - installing.
- 3 Disconnect the hydraulic hoses from the gear pump. (fig. C2884) Remove the pump fittings. Cap all open hoses to prevent contamination. After capping ends you may unhook vacuum system from oil reservoir.
- 4 Remove the two bolts holding the gear pump to the hydrostatic tandem section (fig. C1375,C2879). Remove the gear pump.

IMPORTANT

If gear pump replacement is being done because of failure, the hydraulic system and oil should be checked for contamination.

- 5 Replace gear pump in reverse order.
- 6 If the hydraulic system has been contaminated by pump or other failure you must follow the cleaning procedure outlined in section 2.7.
- 7 Start the engine and check for leaks. Do not use your hands to find leaks.

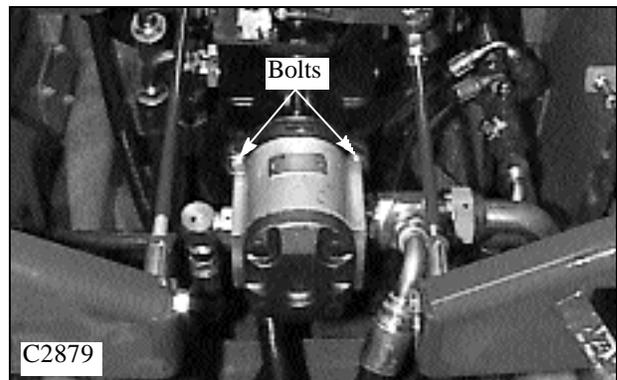
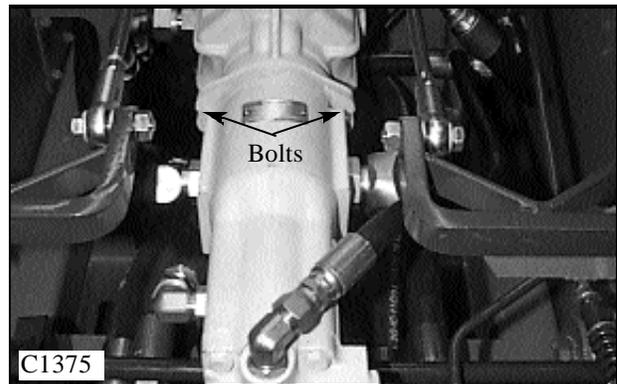
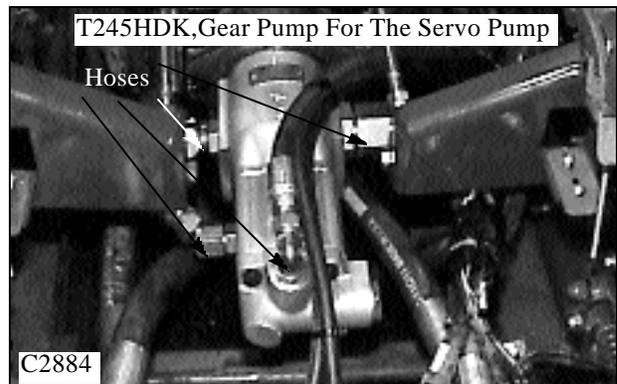
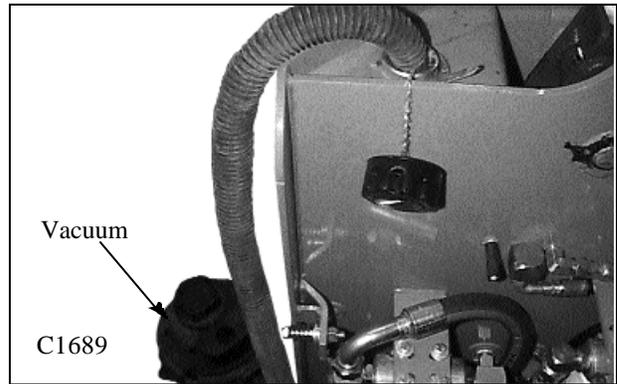


Use caution when dealing with hydraulic fluid under pressure. Escaping fluid under pressure can penetrate the skin and cause serious injury.

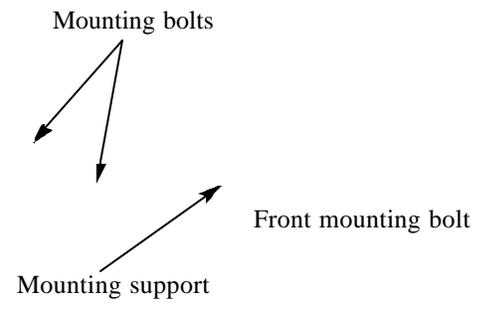
- 8 Check the fluid level in the hydraulic oil reservoir and replenish as required.

IMPORTANT

When making repairs to the hydraulic system, keep the work area and parts clean. Use caps and plugs on all open line and ports.



2



C2847

ProTough 2200 Model.

TANDEM PUMP REPLACEMENT 2.9

Upon reassembly, inspect the outside area of the tandem pump housing for damage that may have occurred in transit or handling.

- 1 Attach a lifting devise to the tandem pump.
- 2 Install the front lower mounting bracket and bolt. (fig. C2847,C1387).
- 3 Install the tandem pump to the loader.



To prevent personal injury, do not attempt to lift heavy objects without assistance.

- 4 Line up the u-joint to the tandem pump input splined shaft as you guide the pump into it's mounting location. (fig. C2847,C1355).
- 5 Install the two rear mounting bolts.
- 6 Line up the lower mounting bracket holes and install the bolt.
- 7 Torque the two rear mounting bolts to 60 ft/lbs. (82 N.m.) Torque the front pump bracket mounting bolt to 50 ft/lbs. (68 N.m.) Torque the front lower mounting bracket bolt at 20 to 25 ft/lbs. (32 N.m.) Remove the lifting devise.

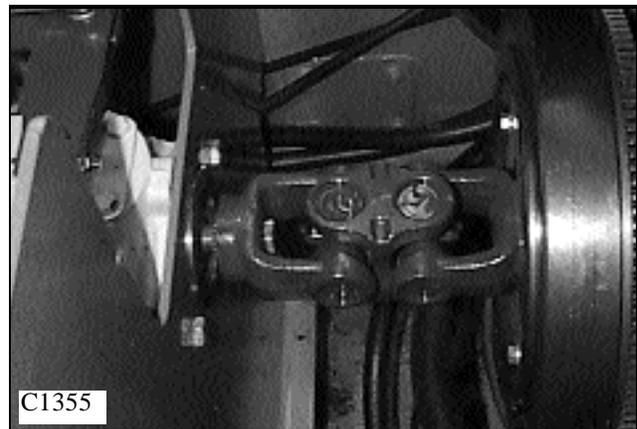
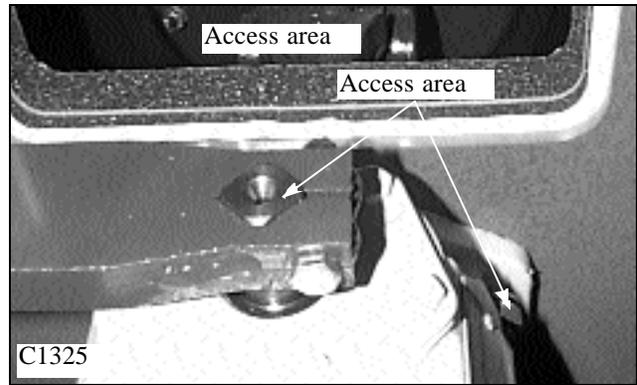
8 Connecting the four high pressure drive hoses and fittings to the tandem pump can only be accomplished in a certain sequence. (fig. C1317) Torque the fittings to the pump at 120 to 150 ft/lbs. (160 to 205 N.m.) Torque the hoses to the fittings at 80 to 85 ft/lbs. (115 N.m.) If you have removed the hoses completely use the following pattern to reconnect:

- A Hose no. 1 connects to the top port of the right hand drive motor.
- B Hose no. 2 connects to the bottom port of the right hand drive motor.
- C Hose no. 3 connects to the top port of the left hand drive motor.
- D Hose no. 4 connects to the bottom port of the left hand drive motor.

9 Connect the charge inlet fitting and hose to the tandem pump. (fig. C1342) Torque fitting to pump at 120 to 150 ft/lbs. (160 to 205 N.m.) Torque hose to fitting at 80 to 85 ft/lbs. (115 N.m.)

IMPORTANT

When making repairs to the hydraulic system, keep the work area and parts clean. Use caps and plugs on all open line and ports.



NOTE:

This configuration applies to 243 HDS / 245 HDS only

2

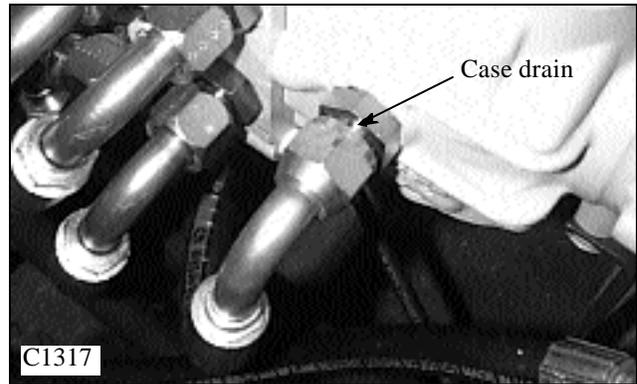
TANDEM PUMP REPLACEMENT 2.9

10 Connect the tandem pump case drain fitting and hose. (fig. C1317) Torque fitting to pump at 120 to 150 ft/lbs. (160 to 205 N.m.) Torque hose to fitting at 80 to 85 ft/lbs. (115 N.m.)

2

IMPORTANT

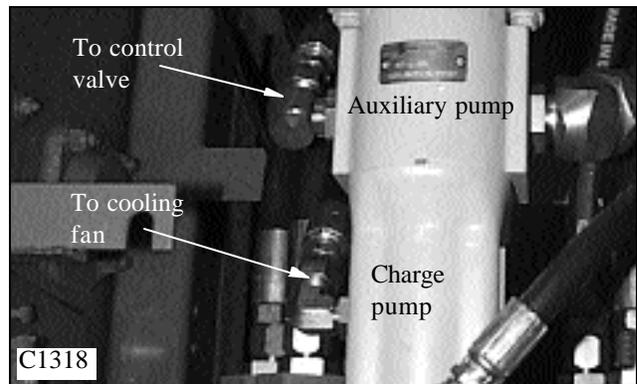
When making repairs to the hydraulic system, keep the work area and parts clean. Use caps and plugs on all open line and ports.



11 Connect the auxiliary gear and charge pump outlet fittings and hoses to the gear pump. (fig. C1318) Torque the fittings to the pump at 75 to 80 ft/lbs. (110 N.m.) Torque the hoses to the fittings at 60 to 65 ft/lbs. (88N.m.)

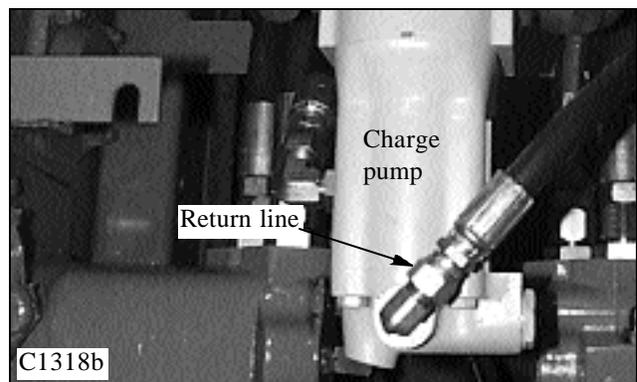
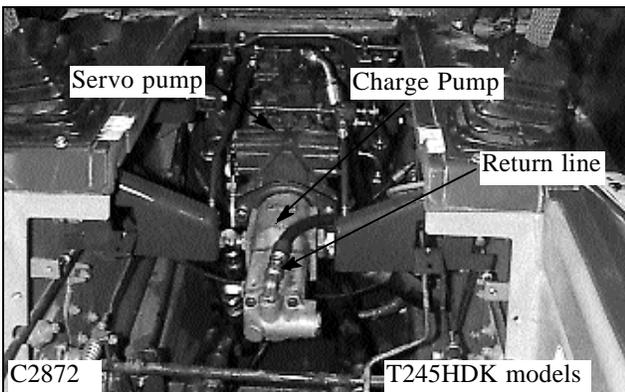
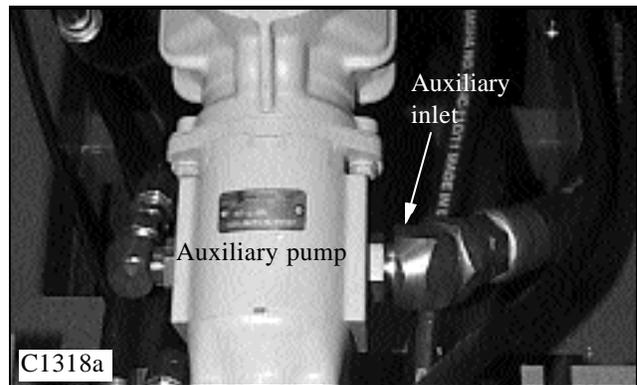
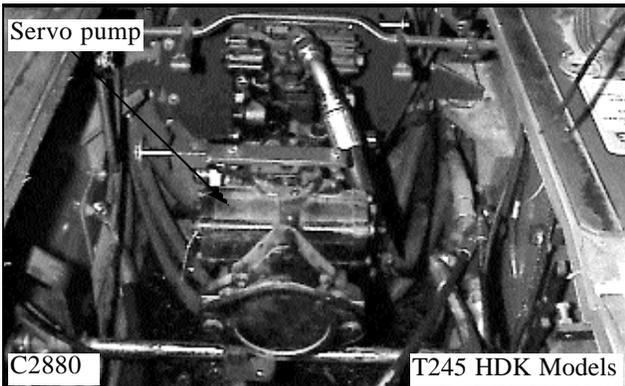
IMPORTANT

Inspect fitting o-rings and flares for marks or damage. Replace if necessary.



12 Connect the inlet fitting and hose to the auxiliary gear pump. Torque the fitting to the pump at 180 to 200 ft/lbs. (245 to 275 N.m.). (fig. C1318a)

13 Connect the fitting and hose to the charge pump return port. (fig. C1318b) Torque the fitting to the pump at 50 to 60 ft/lbs. (68 to 81.5 N.m.) Torque the hose to the fitting at 40 to 50 ft/lbs. (54 to 68 N.m.)



TANDEM PUMP REPLACEMENT 2.9

14 Reinstall the steering control linkages and locks as outlined in Section 4. (fig. C1693 , C2856 & C2872)

15 Fill the hydraulic oil reservoir to the proper level.

IMPORTANT

Follow the start up procedure outlined in section 2.8 upon restarting after pump repairs or replacement.

16 Follow the start up procedure outlined in section 2.8 before attempting to start the loader.



This start-up procedure must be made with the loader securely raised off the ground.

17 The start up must be made with the loader raised securely from the ground. Changing the pumps and the steering control linkages has affected the neutral adjustment. Failure to raise the loader clear of the ground may result in the loader engaging in motion and possibly causing serious injury.



To prevent personal injury never make repairs to the hydraulic system while the engine is operating.

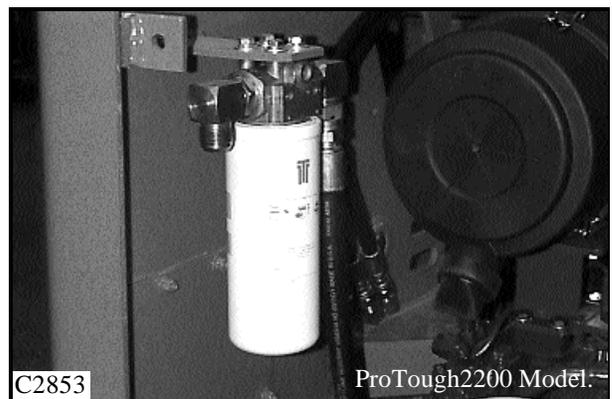
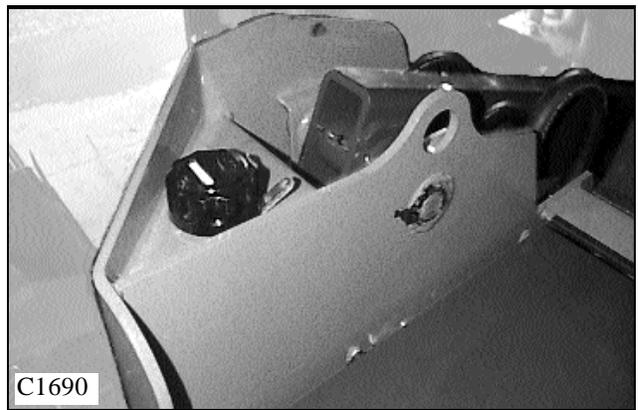
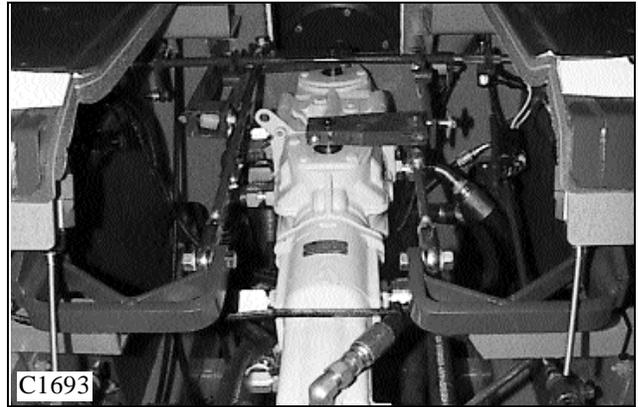
18 Start the loader and check for leaks. Make repairs as necessary and replenish the hydraulic oil reservoir. Never use your hands to check for hydraulic leaks.

19 Make adjustments to the steering controls, steering locks, and restraint bar cables as required. Follow the procedures for control adjustments in Section 4

Gear pump

C2856

T245HDKModel.



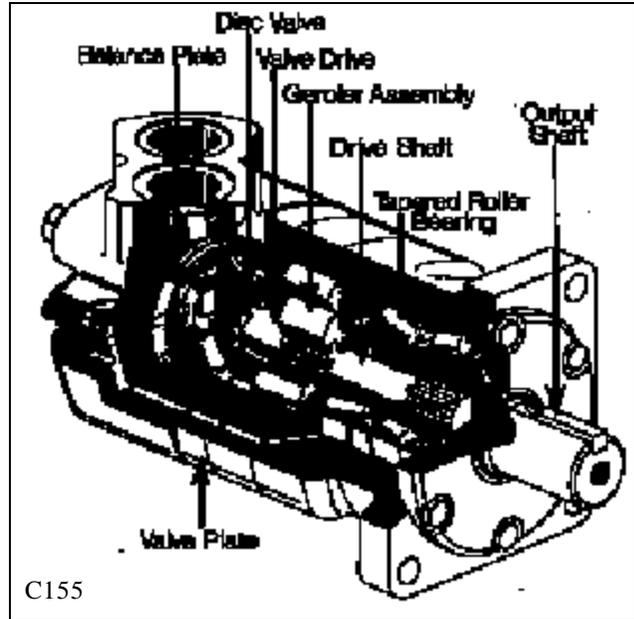
ProTough2200 Model:-

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DRIVE MOTOR 2.10

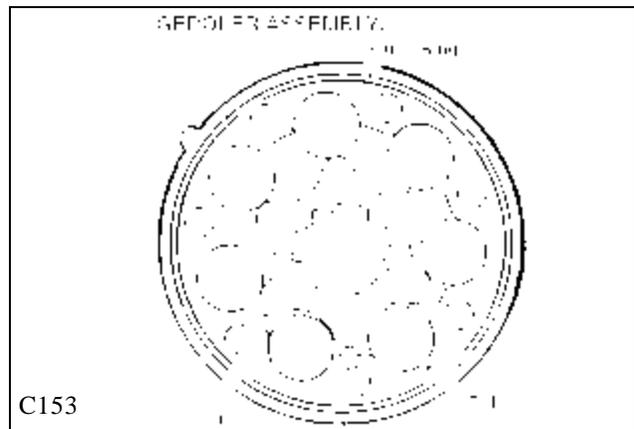
General Information

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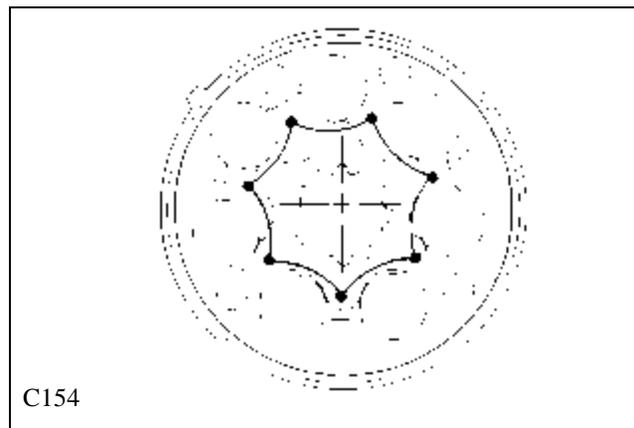


The basic gerotor design uses a combination of mechanical and hydraulic principles that are utilized in the high torque, low speed motors.

The outer ring (fig. C153) of the gerotor assembly is similar to an internal gear that is held in a fixed position by securing it to the motor housing. The rotating inner gear, called a star, orbits inside the secured outer ring.



Because of the different number of teeth on the star and outer ring, the star rotates in an eccentric circular orbiting motion from the housing center line. (fig. C154)

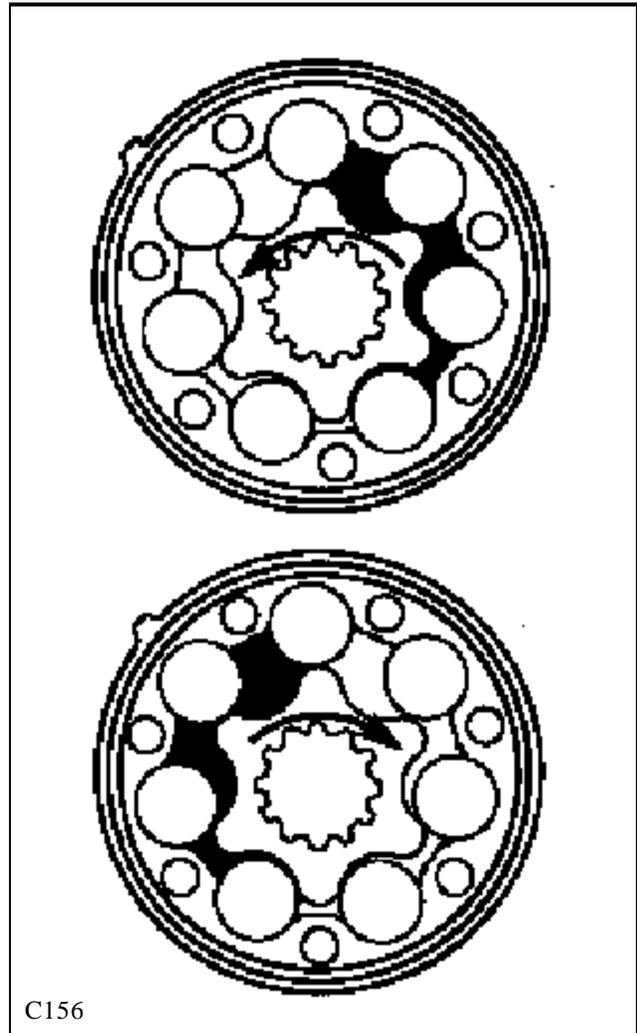


DRIVE MOTOR 2.10

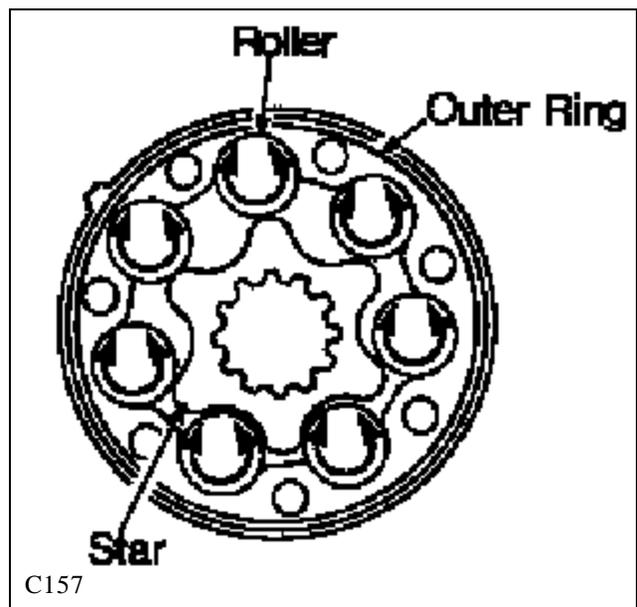
A drive shaft is used to transmit the rotation of the star to the output shaft. The drive shaft has crowned external splines to match the internal splines in the star and output shaft. This type of drive is used because the star center line continuously changes during rotation.

As the star orbits, it causes a continuous opening and closing of the outer ring fluid pockets. Half of these fluid pockets are subject to fluid pressure, causing star rotation, and the opposing half are connected to the return line.

When pressure is introduced into the fluid pockets on the right side of the star (fig. C156) the output rotation will be counterclockwise. When the fluid pockets on the left side of the star are pressurized the output shaft rotation will be clockwise.



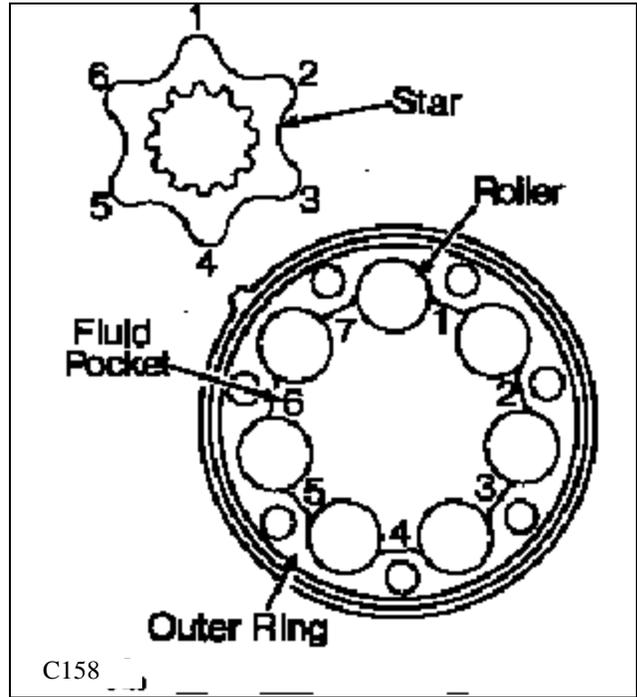
To seal the fluid pockets the torque motor incorporates a rotating roller type seal. (fig. C157) This type of a rolling seal reduces friction at the star points providing increased efficiency and reduced component wear.



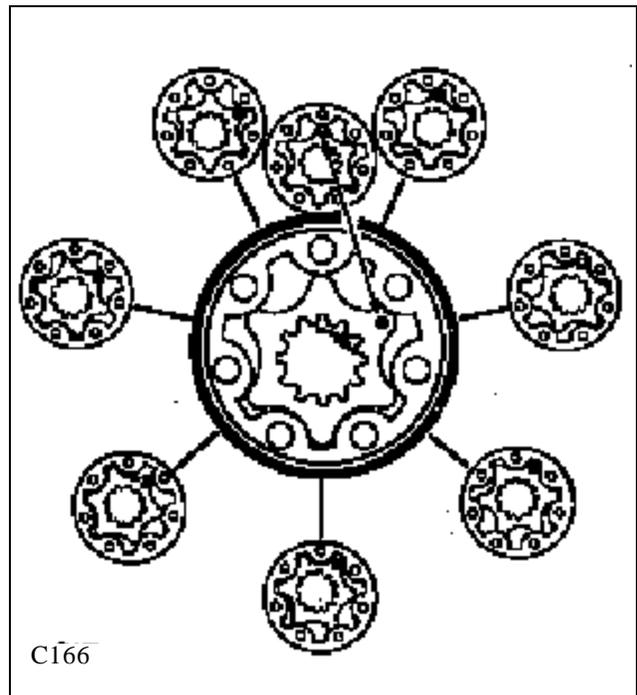
DRIVE MOTOR 2.10

2

The geroler (fig. C158), is both a fluid displacement motor and a gear reducer. It provides 6 times (the number of star points) greater power per revolution than a gear, vane or piston type motor. This means that 6 times the greater torque can be developed at one sixth the speed without further gear reduction.

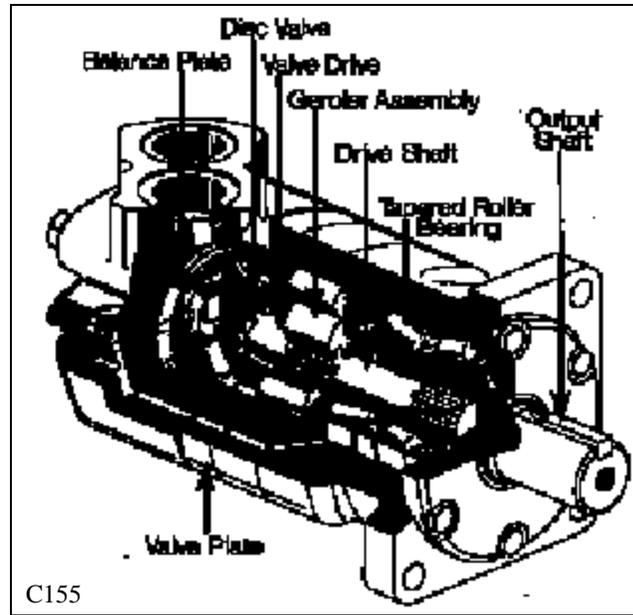


Shown in fig. C166 is one complete star orbit, or one sixth of the output shaft rotation. The star must travel through 6 complete orbits for each single rotation of the output shaft creating a speed reduction of 6 to 1. The use of 7 fluid power pockets with the 6 to 1 ratio provides 42 fluid power cycles per each complete shaft revolution.

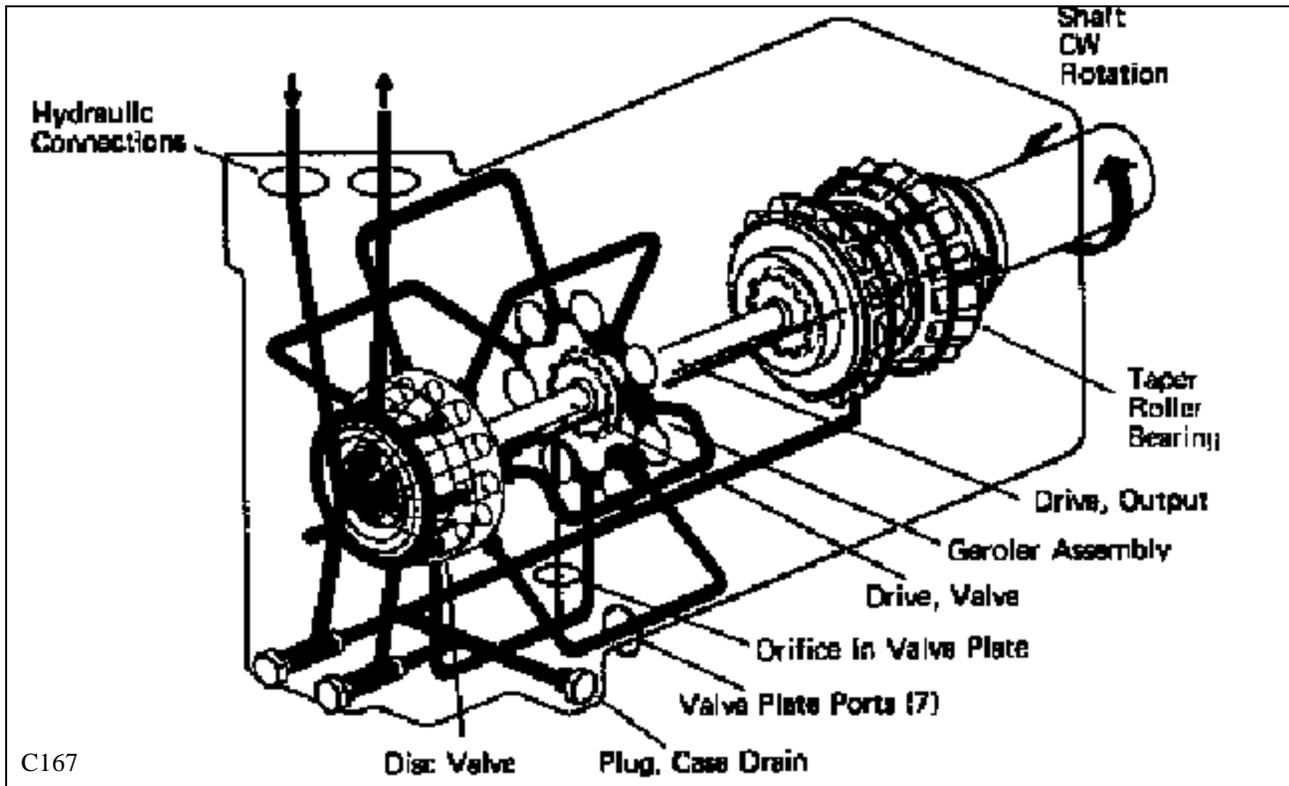


DRIVE MOTOR 2.10

For smooth and continuous motor output rotation, the torque motor utilizes a disc valve which operates in synchronization with the geroler star. The disc valve arrangement consist of a stationary balance plate, rotating disc valve and a stationary valve plate. (fig. C155) The disc valve contains an inlet fluid passage port for each star valley and a return fluid passage point. A separate crowned driveshaft is used to synchronize the disc valve and the geroler star so that they turn as one. To accept fluid from the disc valve, the valve plate also contains internal porting passages to each outer ring pocket area.



C155



C167

Figure C167 illustrates the fluid flow through the torque motor for a clockwise rotation. Fluid enters the housing through the inlet port and is directed to the balance plate. The balance ring contains an inner and outer seal to separate the high and low pressure fluid passages. Fluid passes through the stationary balance plate to the rotating disc valve. The rotating disc valve ports the fluid to the stationary valve plate and the proper side of the geroler pockets causing the rotor star to turn. As the rotor star rotates, and each fluid pocket reaches its

full open position, the return porting in the rotating disc valve opens to allow the fluid in the pocket are to pass back through the valve plate, disc valve, balance plate and out through the housing return port, as the pocket closes. The disc valve is timed to the geroler rotor star to govern the the inlet fluid flow to the output shaft rotation. If the timing of the disc valve to the geroler star is off one tooth, the relationship of input fluid flow to output motor shaft rotation will be reversed.

DRIVE MOTOR 2.10

Removal / Replacement

1 Remove any attachment, raise the boom arms and engage the boom support pins.

2



To prevent personal injury do not work under the boom arms without the boom supports engaged.

2 Raise the loader securely off the ground.

3 Remove the wheels on the side to be repaired.

4 Drain the oil from the final drive housing. Be prepared to contain approximately 23 litres (5 gal) of fluid. (fig. C829)

5 Remove the seat and hydrostatic shield.

6 Remove the brake linkage rod from the brake caliper lever. (fig. C830)

7 Remove the final drive inspection cover located between the axles of the final drive housing.(fig. C1655)

8 Remove the brake disc as outlined in Section 4.5. Follow the brake assembly procedure in Section 4.5 when reassembling.

9 Remove the primary chain as outlined in Section 3.

10 Remove the two high pressure hoses and the drain line from the drive motor. (fig. C1363) Cap the open hose ends to prevent contamination. Upon reassembly torque the high pressure hoses to the fittings at 80 to 85 ft/lbs. (115 N.m.) Torque the drain line to the fitting at 18 to 23 ft/lbs. (24 to 31 N.m.)

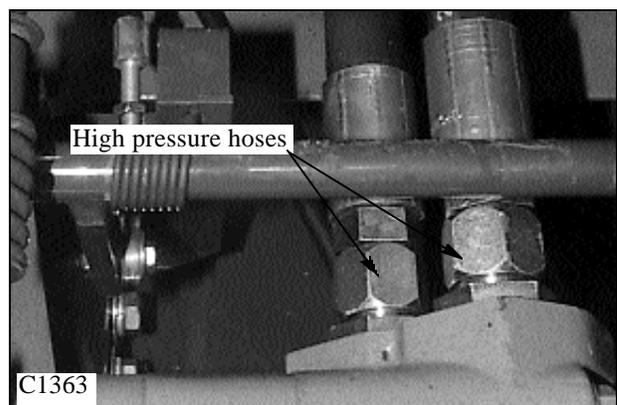
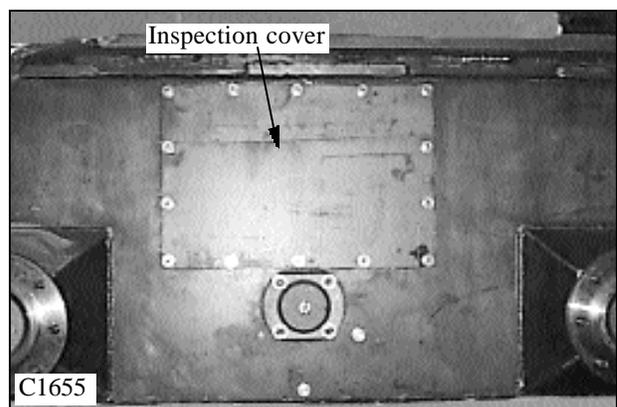
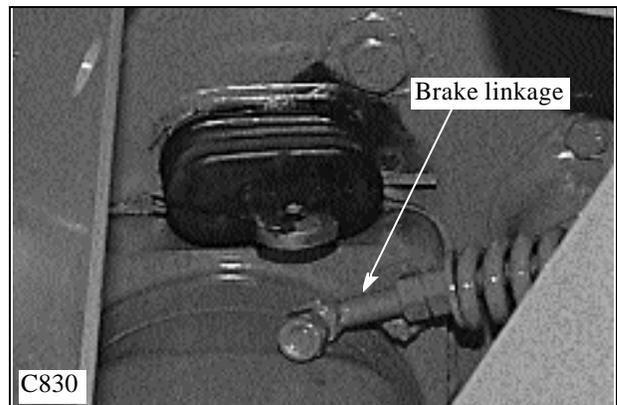
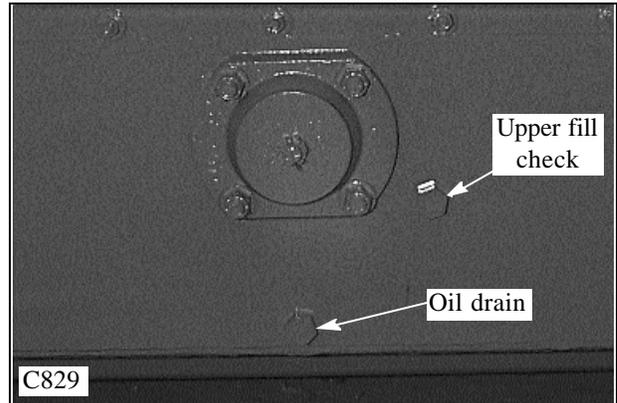
IMPORTANT

When making repairs to the hydraulic system, keep the work area and parts clean. Use caps and plugs on all open line and ports.

11 Remove the adapter fittings from the drive motor.

Plug the open ports in the drive motor to prevent contamination. Upon reassembly torque the two large fittings to the drive motor at 150 to 180 ft/lbs. (205 to 245 N.m.)

Torque the drain line fitting to the drive motor at 30 to 35 ft/ lbs. (41 to 48 N.m.)



DRIVE MOTOR 2.10

12 Remove the four nuts retaining the drive motor to the final drive housing. (fig. C1389) Use care when working around the brake boot to prevent damage.

13 Remove the drive motor. Seal the drive motor with silicone upon reassembly.

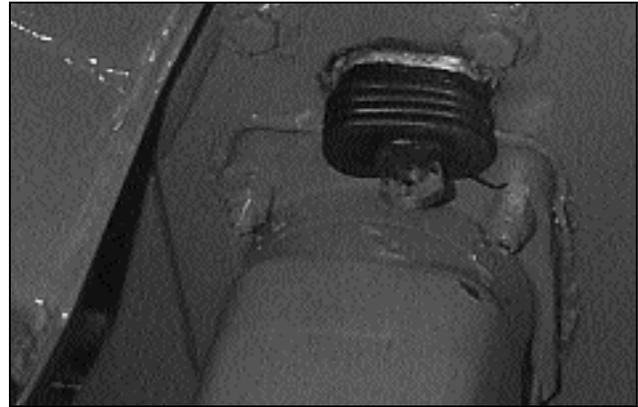
14 Upon reassembly torque the four mounting nuts to 80 ft/lbs.

15 If the drive motor replacement is being performed because of major parts failure, such as geroler damage, the hydraulic system must be checked for contamination and flushed if necessary as outlined in Section 2.7.

16 If you are installing a new drive motor, remove the drive motor sprocket and nut if you wish to reuse the sprocket.

17 Remove the drive motor sprocket with an appropriate puller. (Fig. C1838)

18 Install the sprocket and torque the nut to 350 ft/lbs minimum. (475 N.m.) Continue to tighten until the cotter pin ('Z' pin) hole lines up with the slots in the castle nut. (fig. C1821) The sprocket and nut must be torqued in place before reassembly to the final drive housing.



sprocket puller

C1838

1 Clean the mounting areas thoroughly that need to be sealed with silicone.

2 Apply a bead 1 / 4 of an inch thick around the drive motor bearing retainer and around each mounting hole. (fig. C1822)

3 Make sure the mounting studs are properly seated to the housing. If necessary, remove the stud, apply green loctite (# 609) and torque stud to housing at 40 ft/lbs. (54.5 N.m.)

4 Install the drive motor to the final drive housing. Make sure you have installed the sprocket and nut to the drive motor before installation.

5 Install the four nylok nuts and torque to 80 ft/lbs. (115 N.m.)

DRIVE MOTOR 2.10

2

6 Replace the master link in the primary dive chain. You may need to rotate an axle to get the ends of the chain to meet close enough to assemble the master link. Section 3. shows chain replacement procedure.

7 Replace the parking brake assembly as outlined in Section 4.5.

8 Install the adapter fittings to the drive motor. Torque the 2 large fittings to the drive motor at 150 to 180 ft/lbs. (205 to 245 N.m.) Torque the drain line fitting to the drive motor at 30 to 35 ft/lbs. (41 to 48 N.m.)

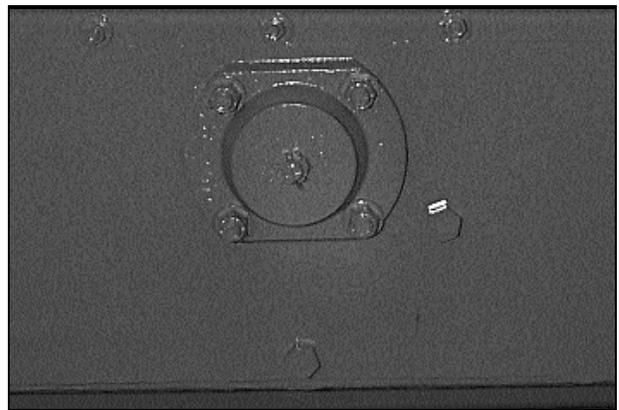
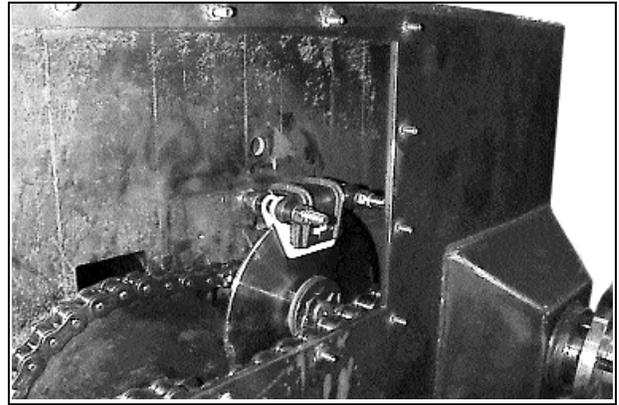
9 Install the drain line and torque the fitting at 18 to 23 ft/lbs. (24 to 31 N.m.) 10 Install the high pressure drive hoses. Torque the hoses to the fittings at 80 ft/lbs. (110 N.m.)



Use caution when dealing with hydraulic fluid under pressure. Escaping fluid under pressure can penetrate the skin and cause serious injury.



To prevent personal injury never make repairs to the hydraulic system while the engine is operating.



11 Clean the final drive housing and inspection cover thoroughly before applying silicone sealant. (fig. C1368)

12 Install the inspection cover. When installing the nuts, do not over tighten. The mounting torque should not exceed 11 ft/lbs. (15 N.m.)

13 Add oil to the final drive housing unit it trickles out the upper check plug hole. This will require approximately 23 litres (5 gal) of 10w30 API SE/ CD oil. (fig. C829)

14 Start the engine and check for hydraulic leaks. Do not use your hands to trace hydraulic leaks. Shut off the engine and inspect each fitting for proper torque.

15 Install the wheels and torque the nuts at 100 to 110 ft/lbs. (136 to 150 N.m.)

16 Install shields and seat, let loader down to ground and test drive to check performance.

C1717

DRIVE MOTOR 2.10

Disassembly

Fig. C021 shows an exploded view of the hydraulic torque motor. Before disassembling the torque motor, clean the outer surface of all loose dirt and grease and dry with compressed air. Be sure all openings are plugged to prevent solvent or soap entering the torque motor.

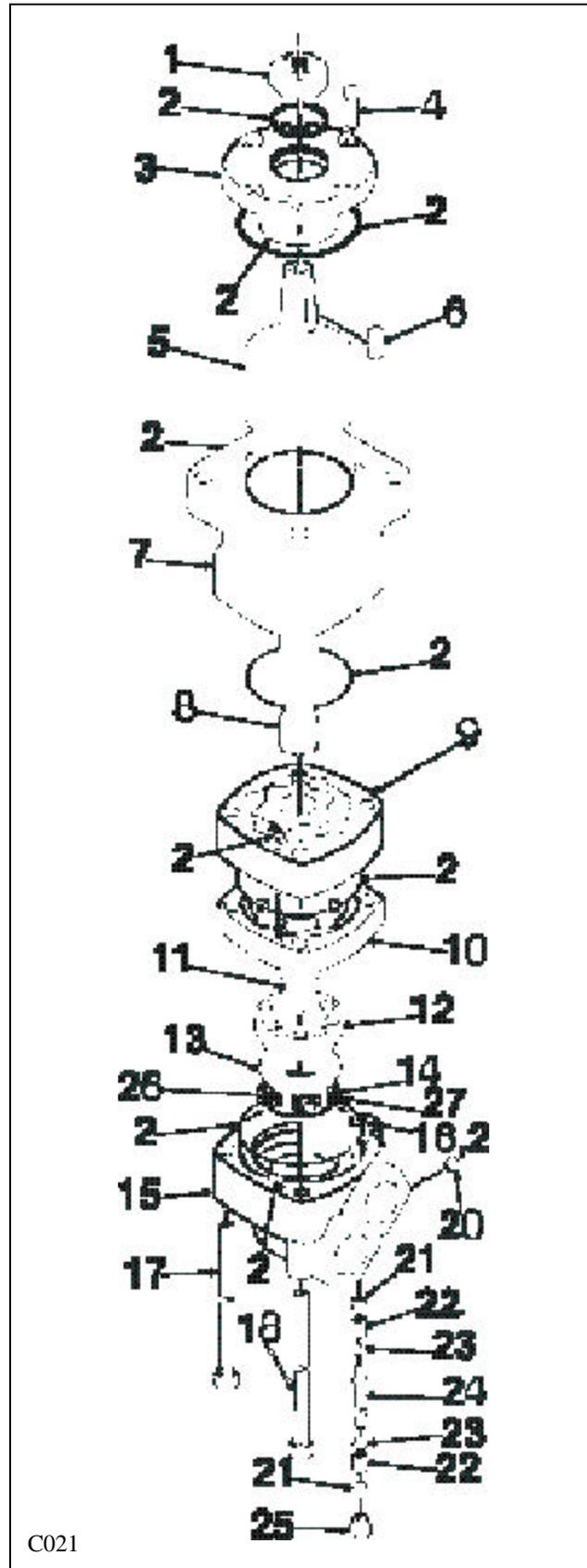


To avoid eye injury, use safety goggles when cleaning with compressed air.

- | | |
|------------------------|--------------------|
| 1 Nut | 14 Spring |
| 2 Seal Kit | 15 Housing |
| 3 Retainer | 16 Plug |
| 4 Bolt | 17 Bolt |
| 5 Shaft & Bearing Assy | 18 Bolt |
| 6 Key | 20 Plug |
| 7 Bearing Housing | 21 Sleeve |
| 8 Drive Shaft | 22 Spring |
| 9 Geroler | 23 Poppet |
| 10 Valve Plate | 24 Piston |
| 11 Valve Drive | 25 Plug |
| 12 Valve | 26 Inner Face Seal |
| 13 Balance Ring | 27 Outer Face Seal |

IMPORTANT

When making repairs to the hydraulic system, keep the work area and parts clean. Use caps and plugs on all open line and ports.

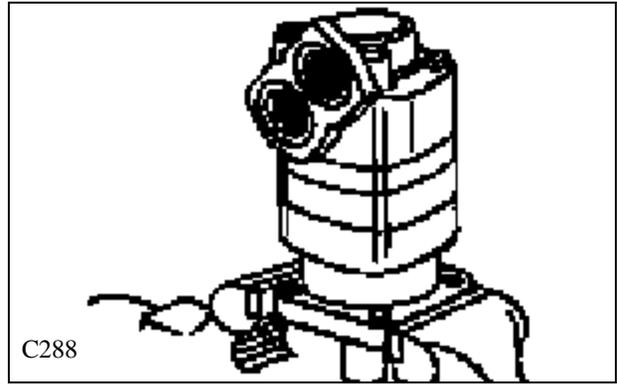


DRIVE MOTOR 2.10

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1 Place the drive motor in a vise with the output shaft facing down. (fig. C288) Clamp the motor to the vise, holding it by the mounting flange area. Do not clamp the motor on the housing as excessive pressure will cause distortion.

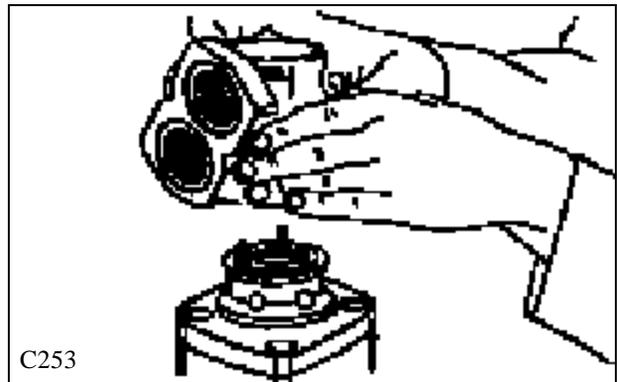
2 Mark a line across the various sections of the drive motor to assist in reassembly.



3 Remove the 4 bolts from the drive motor valve housing. (fig. C252) Upon reassembly, torque the bolts in a criss cross pattern at 62.5 ft/lbs. (85 N.m.)



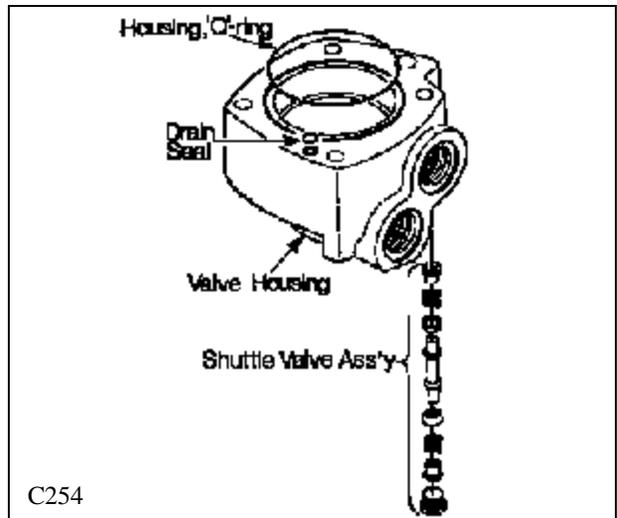
4 Carefully lift the valve housing straight up. (fig. C253) The balance ring subassembly and spring should remain on the valve.



5 Remove the following parts from the valve housing. (fig. C254)

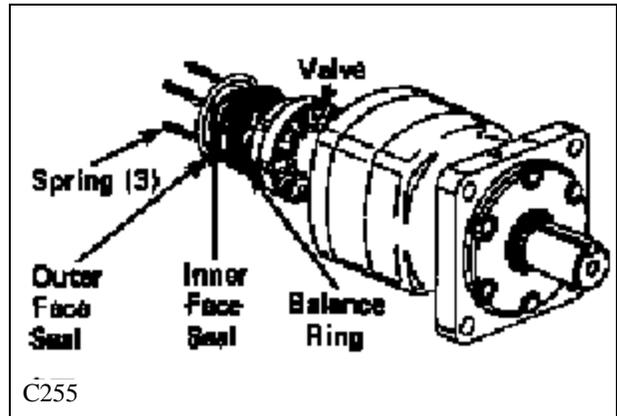
- a. Housing Seal
- b. Drain Seal
- c. Shuttle Valve Assy

Discard all old seals and replace with new ones at time of reassembly.

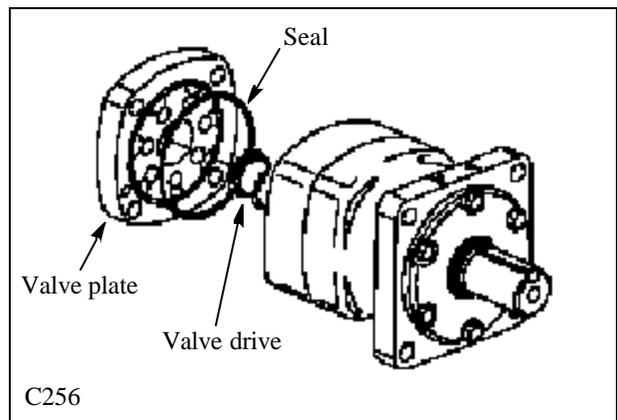


DRIVE MOTOR 2.10

6 Remove the three balance ring springs, balance ring and valve. (fig. C255)Remove both the inner and outer face seals from the balance ring and discard them.



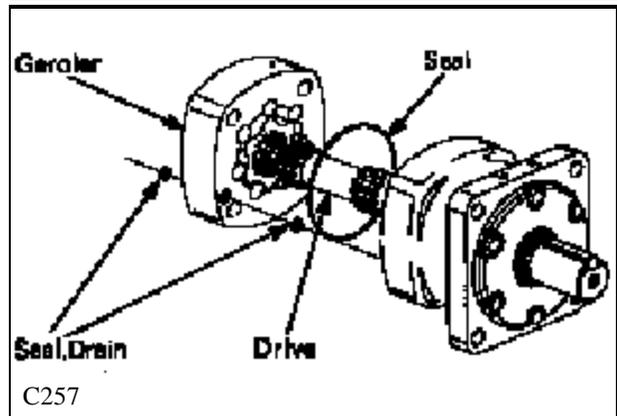
7 Remove the valve plate, seal and valve drive. (fig. C256) Discard the seal.



8 Remove the geroler assembly. (fig. C257) Keep the rollers and star together in the outer geroler ring.

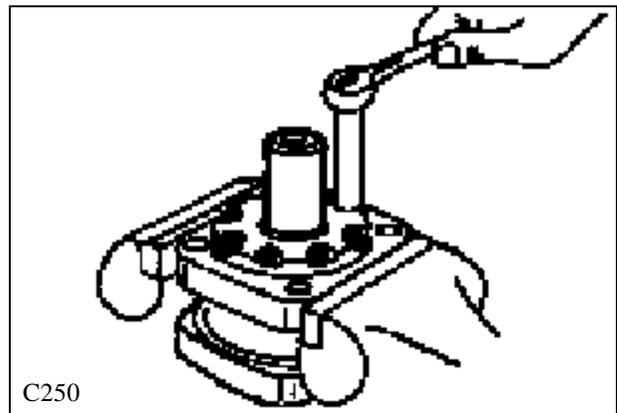
9 Remove the two drain seals from each side of the geroler ring. Discard the seals.

10 Remove the geroler drive and the seal from the bearing housing.



11 Turn the bearing housing over in the vise with the output shaft facing up. (fig. C250)

12 Remove the six bolts in the retainer plate. (fig. C250) Upon reassembly, torque the bolts in a criss cross pattern at 25 ft/lbs. (34 N.m.)

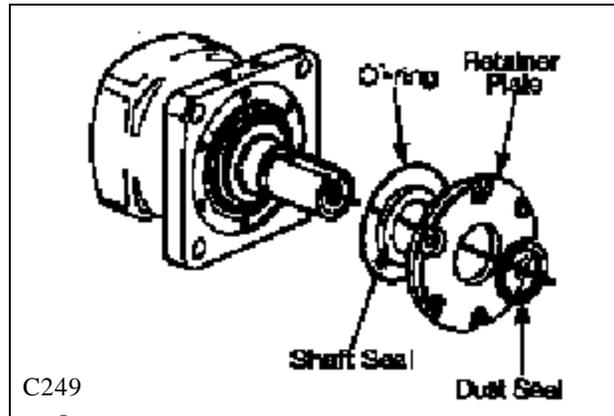


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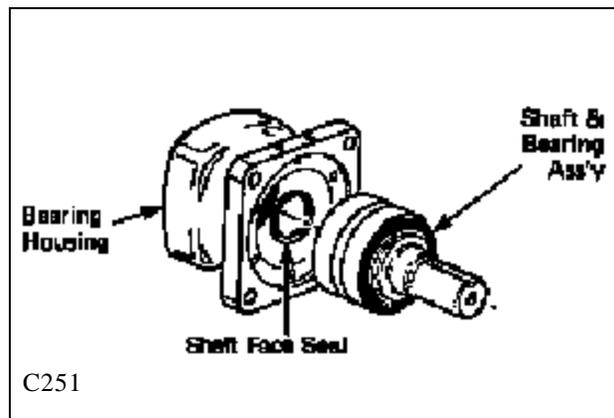
DRIVE MOTOR 2.10

2

- 13 Remove the retainer plate from the bearing housing. (fig. C249) The retainer plate may need to be pried slightly to remove. Be careful not to damage the bearing housing or the retainer plate.
- 14 Remove the dust seal, shaft seal and o - ring from the retainer plate. Discard the seals and o - rings.



- 15 Remove the shaft and bearing assembly from the bearing housing. (fig. C251) The shaft and bearing will need to be pressed out. Separate parts are not available for the shaft and bearing sub assembly, use care when handling the parts.
- 16 Remove the shaft face seal from the bore of the bearing housing. Be careful not to damage the bore of the bearing housing.



Inspection

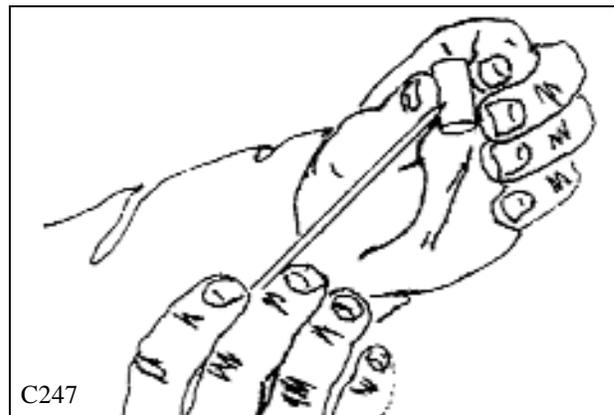
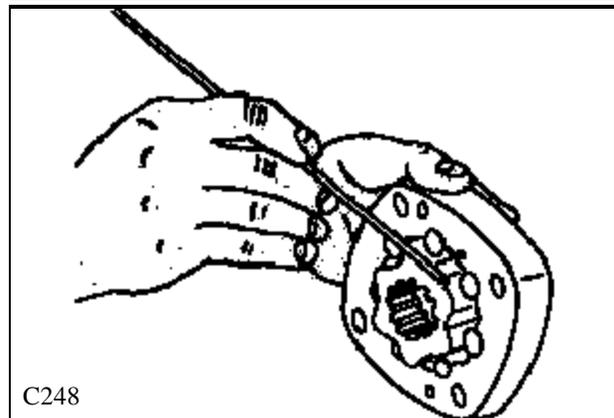
Clean all parts in a suitable solvent and dry using compressed air. Do not use cloth or paper towel to dry parts.



To avoid eye injury, use safety goggles when cleaning with compressed air.

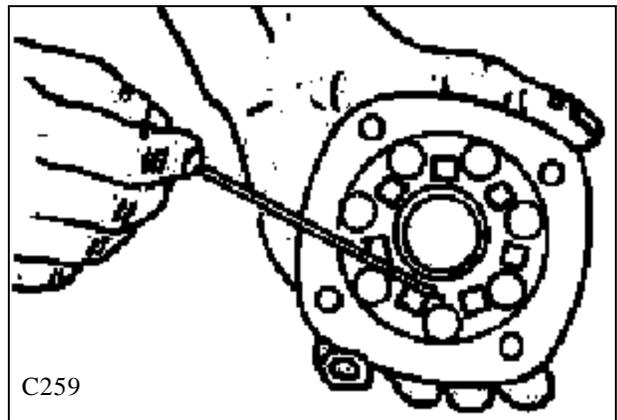
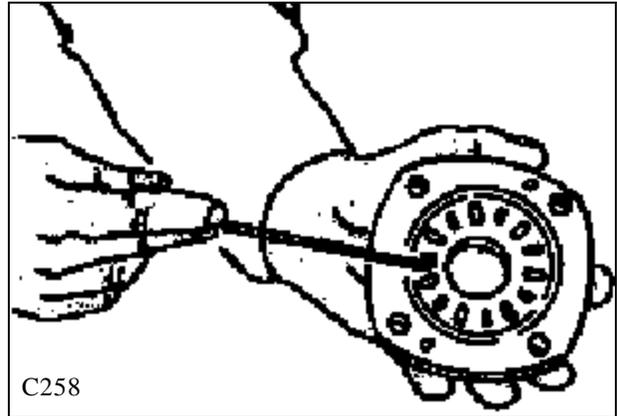
Do not use coarse grit, file or grind any motor parts. Replace any parts that are scratched or have burrs that could cause leakage.

- 1 Inspect the geroler star for wear or damage. (fig. C248)
- 2 Inspect the geroler rollers for wear or damage. (fig. C247)

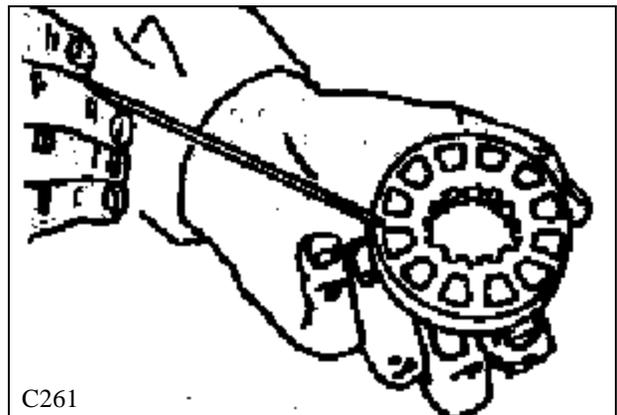
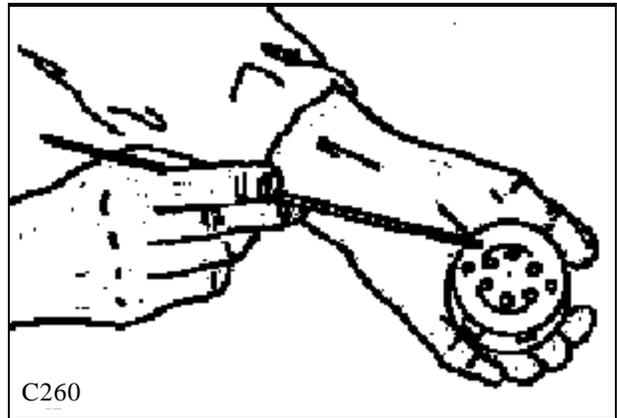


DRIVE MOTOR 2.10

3 Inspect both sides of the valve plate for scratches or wear. (fig. C258, C259)



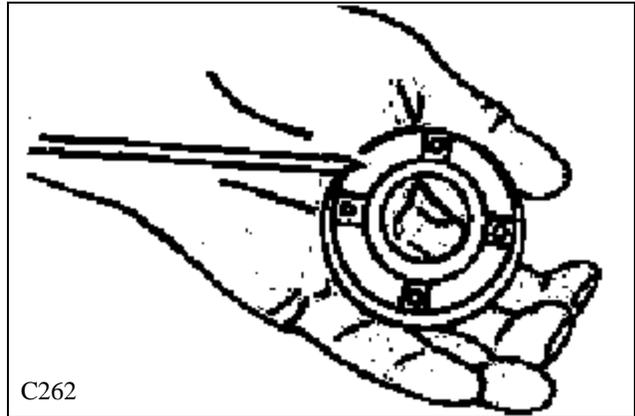
4 Inspect the valve for scratches or wear. (fig. C260, C261)



2

DRIVE MOTOR 2.10

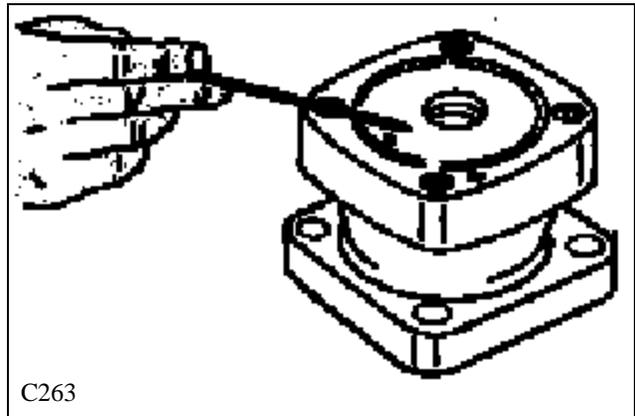
5 Inspect the balance ring for scratches or wear. (fig. C262)



C262

6 Inspect the face of the bearing housing for scratches or wear. (fig. C263)

7 Inspect the splines on both the valve drive shaft and the geroler drive shaft. Replace if ends are burred or splines are worn. (Not shown, see previous diagrams)



C263

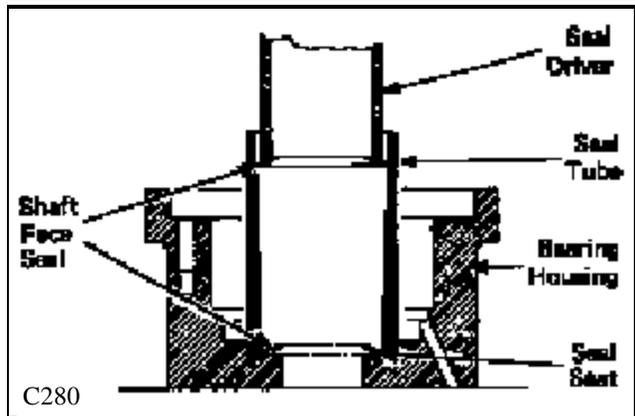
Assembly

When reassembling the drive motor, always use new seals and o - rings. Lubricate the seals and o - rings with petroleum jelly prior to assembly.

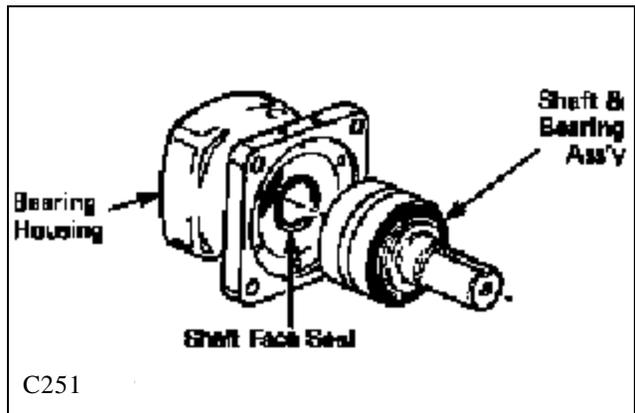
1 Install the shaft face seal in the bearing housing using a suitable tool to seat the seal. Place the bearing housing on a smooth flat surface with the largest open end of the housing facing upward. Align the small inside diameter end of the seal installation tube with the seal seat in the housing. (fig. C280) Apply petroleum jelly to the shaft seal. Install the seal into the bore of the installation tube as shown. (fig. C280)

Insert the seal driver in the tube and push the shaft face seal with a rotating action until it is seated. Check the seal closely for damage. An incorrectly installed seal will cause loss of internal lubrication and result in premature parts wear and failure.

2 Install the shaft and bearing sub assembly in the housing. (fig. C251) A press should be used for this procedure. Take care not to damage the shaft seal in the bore of the housing.



C280

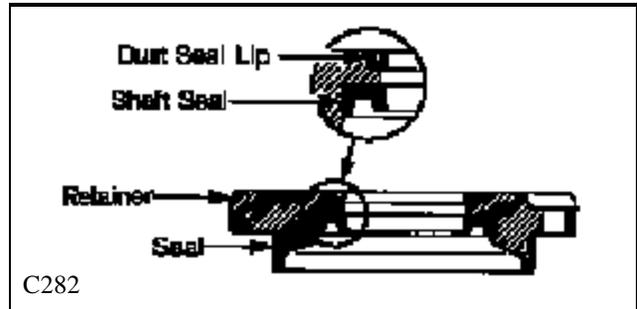
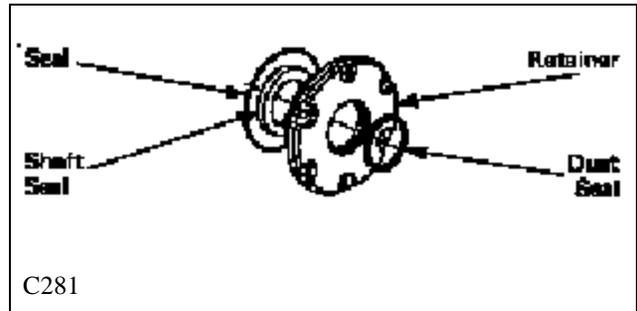


C251

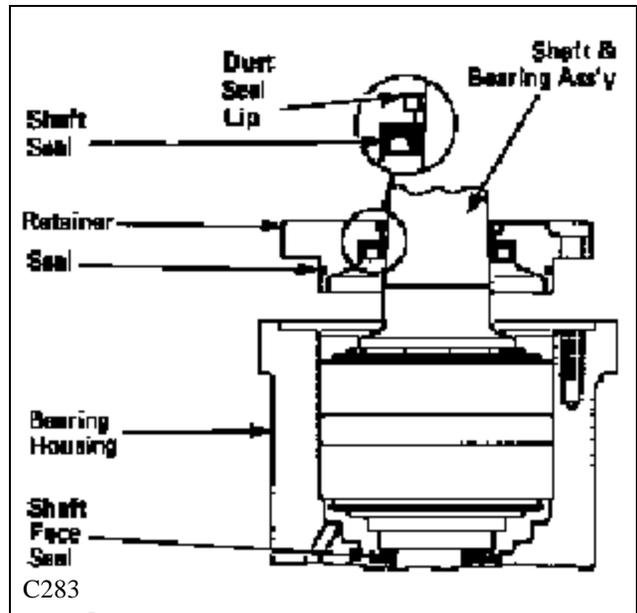
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DRIVE MOTOR 2.10

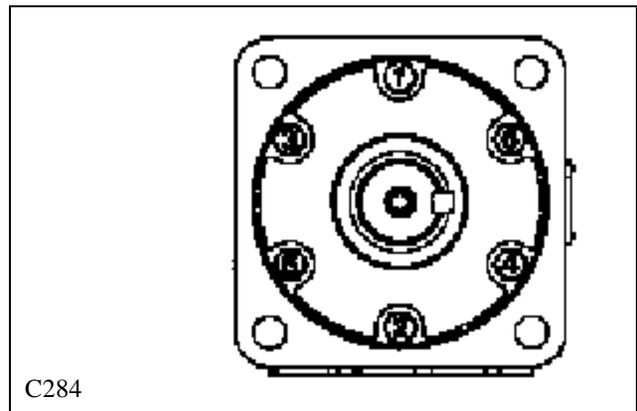
- 3 Install the dust seal in the retainer plate. (fig. C281)
The metal side of the dust seal must face upward.
- 4 Install the shaft seal into the rear of the retainer plate. (fig. C281)
The smooth or flat side of the shaft seal must face toward the retainer. (fig. C282)
- 5 Apply petroleum jelly to the inside diameter of both the dust seal and the shaft seal.



- 6 Install the retainer plate with seals over the output shaft sub assembly with a twisting motion. (fig. C283)
Be careful not to damage the the seals during assembly.
Damage to the seals will cause external leakage.



- 7 Lubricate the threads of the six retainer plate bolts and install them finger tight. Torque the bolts in sequence in 4 ft/lbs increments until the final measurement of 25 ft/lbs (34 N.m.) is reached. Fig. C284 shows bolt sequence pattern.



2

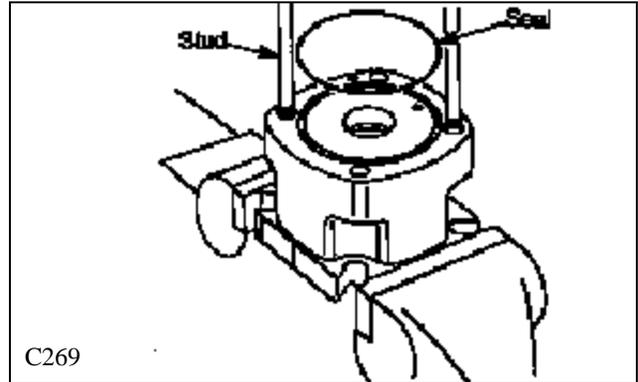
DRIVE MOTOR 2.10

2

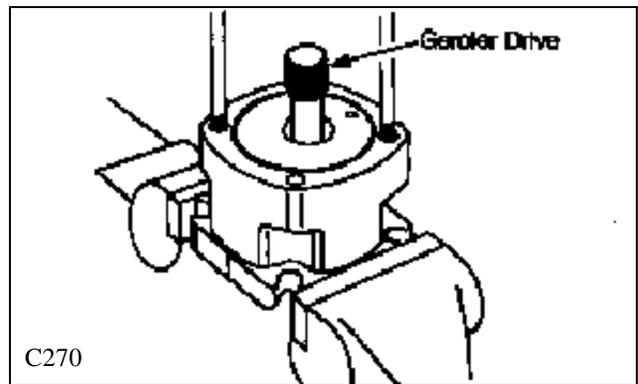
- 8 Position the bearing housing in a vise, clamping across the edge of the mounting flange. (fig. C269)
- 9 Pour a small amount of oil inside the output shaft.
- 10 If available, install two studs into the housing to assist in alignment of parts during assembly.
- 11 Apply a light film of petroleum jelly to the housing seal and install in the bearing housing.
- 12 Install the geroler drive shaft into the bearing housing. (fig. C270) Install the longer splined end of the shaft into the bearing housing.
- 13 Apply petroleum jelly to the two case drain seals and install them on both sides of the geroler assembly in the case drain hole grooves. (fig. C271)
- 14 Align the case drain and pressure relief holes in the geroler assembly with the case drain and pressure relief holes in the bearing housing. Install the geroler assembly to the bearing housing.

IMPORTANT	Follow the timing instructions closely to assure correct motor rotation.
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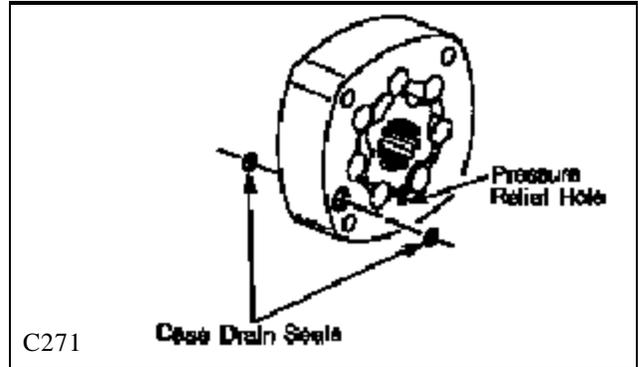
- 15 The next few steps will perform the timing procedure. Locate the largest open pocket in the geroler star. Mark the location of this pocket on the outside edge of the geroler case. (fig. C272)
- 16 Install the valve drive shaft into the geroler.
- 17 Apply a light film of petroleum jelly to the valve plate seal. Install the seal to the valve plate.
- 18 Align the case drain hole in the valve plate with the case drain hole in the geroler. Install the valve plate, with the seal side toward the geroler, to the geroler assembly.
- 19 Locate the slot opening in the valve plate which is in line with the largest open pocket in the geroler star. This is the reference slot for aligning the valve. (fig. C272)
- 20 Install the valve on the valve plate. Line up any of the open holes of the valve with the referenced slot on the valve plate. (largest open pocket of geroler star) Rotate the valve clockwise, 1/2 spline tooth, to engage the splined teeth of the valve drive. Do not rotate counter clockwise, this will reverse output shaft rotation.



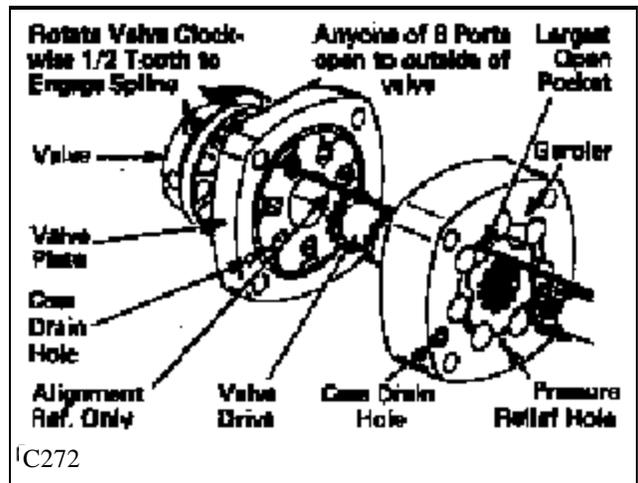
C269



C270



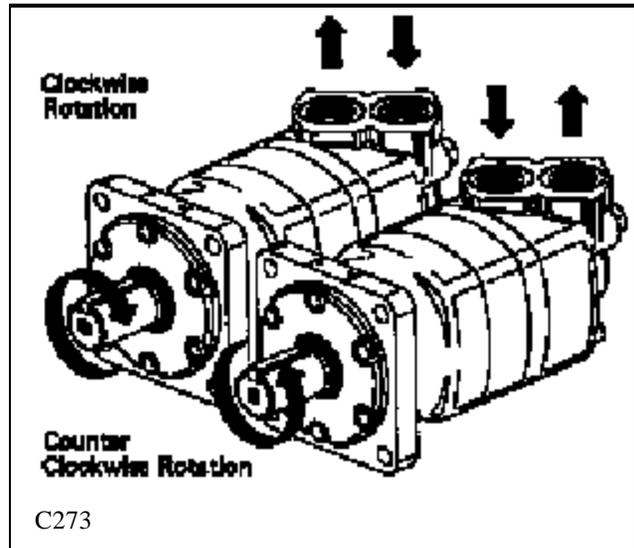
C271



C272

DRIVE MOTOR 2.10

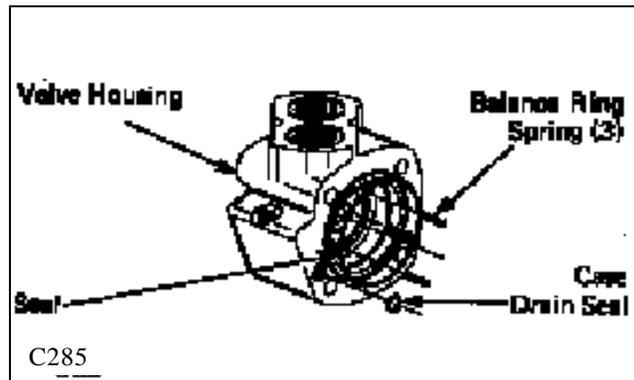
When timed correctly the motor will rotate when pressurized as shown in fig. C273.



21 Apply clean grease on the three balance ring springs. Install the three springs into the holes located inside the bore of the valve housing. (fig. C285)

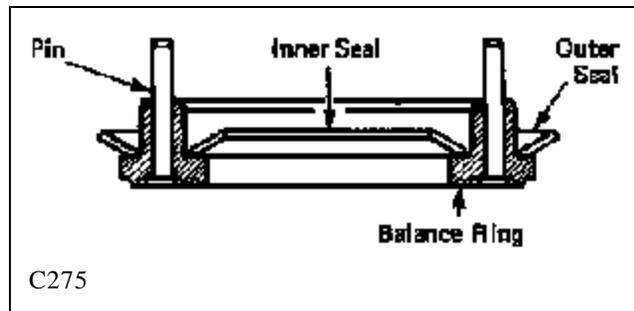
22 Apply a light film of petroleum jelly on the case drain seal. Install the seal in the case drain seal groove on the valve housing.

23 Apply a light film of petroleum jelly on the valve housing seal. Install the seal in the groove on the valve housing.



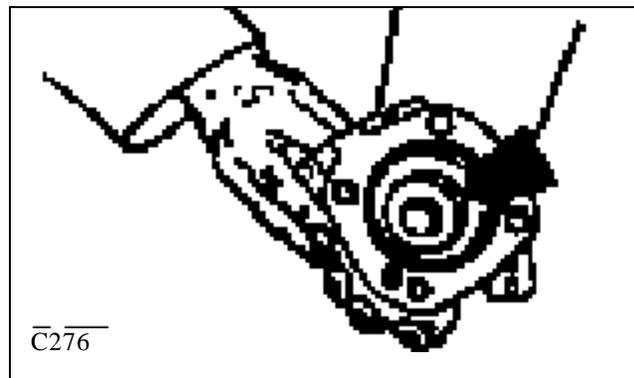
24 Apply petroleum jelly to both the inner and outer face seals. Install the face seals on the balance ring. (fig. C275)

IMPORTANT	The face seals must be installed as shown on fig. C275 or the motor will not operate.
------------------	---



25 Align the balance ring pins with the two holes in the valve housing. Install the balance ring into the valve housing.

26 Insert your finger through the port of the valve housing. (fig. C276) Apply pressure to the side of the balance ring assembly to hold it in place while the valve housing is being installed onto the valve plate.



2

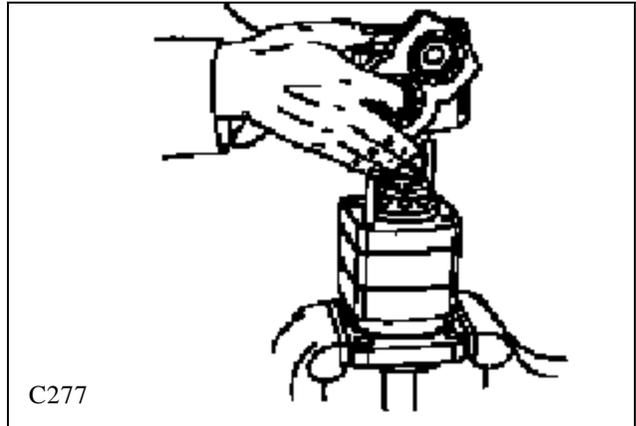
DRIVE MOTOR 2.10

27 Align the case drain hole in the valve housing with the case drain hole in the valve plate. (fig. C277) Install the valve housing on to the valve plate.

2

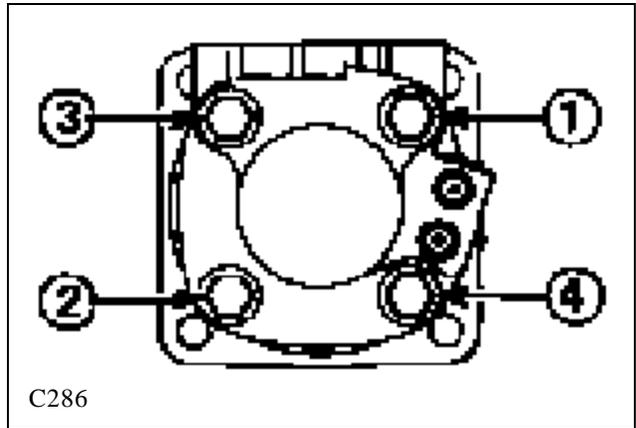
IMPORTANT

After installing the valve housing, check between the body parts for misplaced seals.



C277

28 Install the four bolts through the valve housing and turn in finger tight. Torque the bolts in sequence to 62.5 ft/lbs. (85 N.m.)

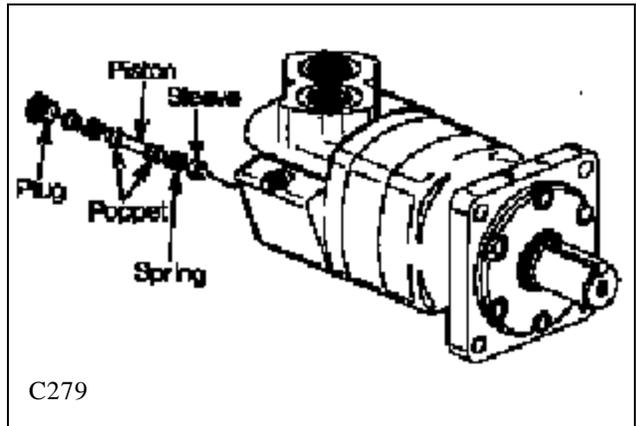


C286

29 Install the shuttle valve assembly into the valve housing. (fig. C279)

IMPORTANT

For correct motor operation the shuttle valve must be installed in the correct sequence.



C279

TORQUE CHART 2.11

Torque Chart NOTE: all torques are in ft / lbs. (Multiply by 1.36 = N.m.)

HOSE SIZE	37° JIC FITTINGS	HOSE SIZE	ORB FITTINGS
1/4	9 to 10	1/4	14 to 16
5/16	15 to 16	5/16	18 to 20
3/8	20 to 22	3/8	24 to 26
1/2	30 to 33	1/2	50 to 60
5/8	40 to 44	5/8	72 to 80
3/4	70 to 77	3/4	125 to 135
7/8	82 to 90	7/8	160 to 180
1	55 to 60	1	200 to 220
1 1/4	120 to 132	1 1/4	210 to 280
1 1/2	131 to 144	1 1/2	270 to 360
2	300 to 330		

The following torque specifications are for steel ORB fittings into aluminum.			
HOSE SIZE	ORB FITTINGS	HOSE SIZE	ORB FITTINGS
1/4	5 to 7	3/4	40 to 45
5/16	8 to 10	7/8	50 to 55
3/8	10 to 12	1	90 to 99
1/2	21 to 24	1 1/4	80to 90
5/8	27 to 30		

CONVERSION CHART 2.12

CONVERSION FACTORS			
Metric to U.S.			
	MULTIPLY	BY	TO OBTAIN
Area:	sq. meter hectare	10.763 91 2.471 05	square foot acre
Force:	newton newton	3.596 942 0.224 809	ounce force pound force
Length:	millimeter meter kilometer	0.039 370 3.280 840 0.621 371	inch foot mile
Mass:	kilogram	2.204 622	pound
Mass/Area:	kilogram/hectare	0.000 486	ton/acre
Mass/Energy:	g/kWh/hr.	0.001 044	lb/tp/hr.
Mass/Volume:	kg/cubic meter	1.685 555	lb/cubic yd.
Power:	kilowatt	1.341 02	horsepower
Pressure:	kilopascal bar	0.145 038 14.50385	lb/sq. inch lb/sq. inch
Temperature:	degree C	1.8 x C +32	degree F
Torque:	newton meter newton meter	8.850 748 0.737 562	lb/inch lb/foot
Velocity:	kilometer/hr.	0.621 371	miles/hr.
Volume:	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre	0.061 024 35.314 66 1.307 950 0.033 514 1.056 614 0.879 877 0.264 172 0.219 969	cubic inch cubic foot cubic yd. ounce (US fluid) quart (US liquid) quart (imperial) gallon (US liquid) gallon (imperial)
Volume/Time:	litre/min. litre/min.	0.264 172 0.219 969	gallon/min. (US liquid) gallon/min. (imperial)

CONVERSION CHART 2.12

U.S. to Metric			
	MULTIPLY	BY	TO OBTAIN
Area:	square foot acre	0.092 903 0.404 686	square meter hectare
Force:	ounce force pound force	0.278 014 4.448 222	newton newton
Length:	inch foot mile	25.4 * 0.304 8 * 1.609 344 *	millimeter meter kilometer
Mass:	pound ounce	0.453 592 28.35	kilogram gram
Mass/Area:	ton/acre	2241 702	kilogram/hectare
Mass/Energy:	lb/kwhr	502.277 4	g/kWhr
Mass/Volume:	lb/cubic yd.	0.593 276	kg/cubic meter
Power:	horsepower	0.745 700	kilowatt
Pressure:	lb/sq. in. lb/sq. in. lb/sq. in.	6.894 757 0.069 0.070 308	kilopascal bar kg/sq. cm
Temperature:	degree F	1.8 F - 32	degree C
Torque:	pound/inch pound/foot	0.112 986 1.355 818	newton meter newton meter
Velocity:	mile/hr.	1.609 344 *	kilometer/hr.
Volume:	cubic inch cubic foot cubic yard ounce (US fluid) quart (US liquid) quart (Imperial) gallon (US) gallons (Imperial)	16.387 08 0.028 317 0.764 556 29.573 53 0.946 353 1.136 523 3.785 412 4.546 082	cubic centimeter cubic meter cubic meter milliliter litre litre litre litre
Volume/Time:	gallon/min.	3.785 412	litre/min.

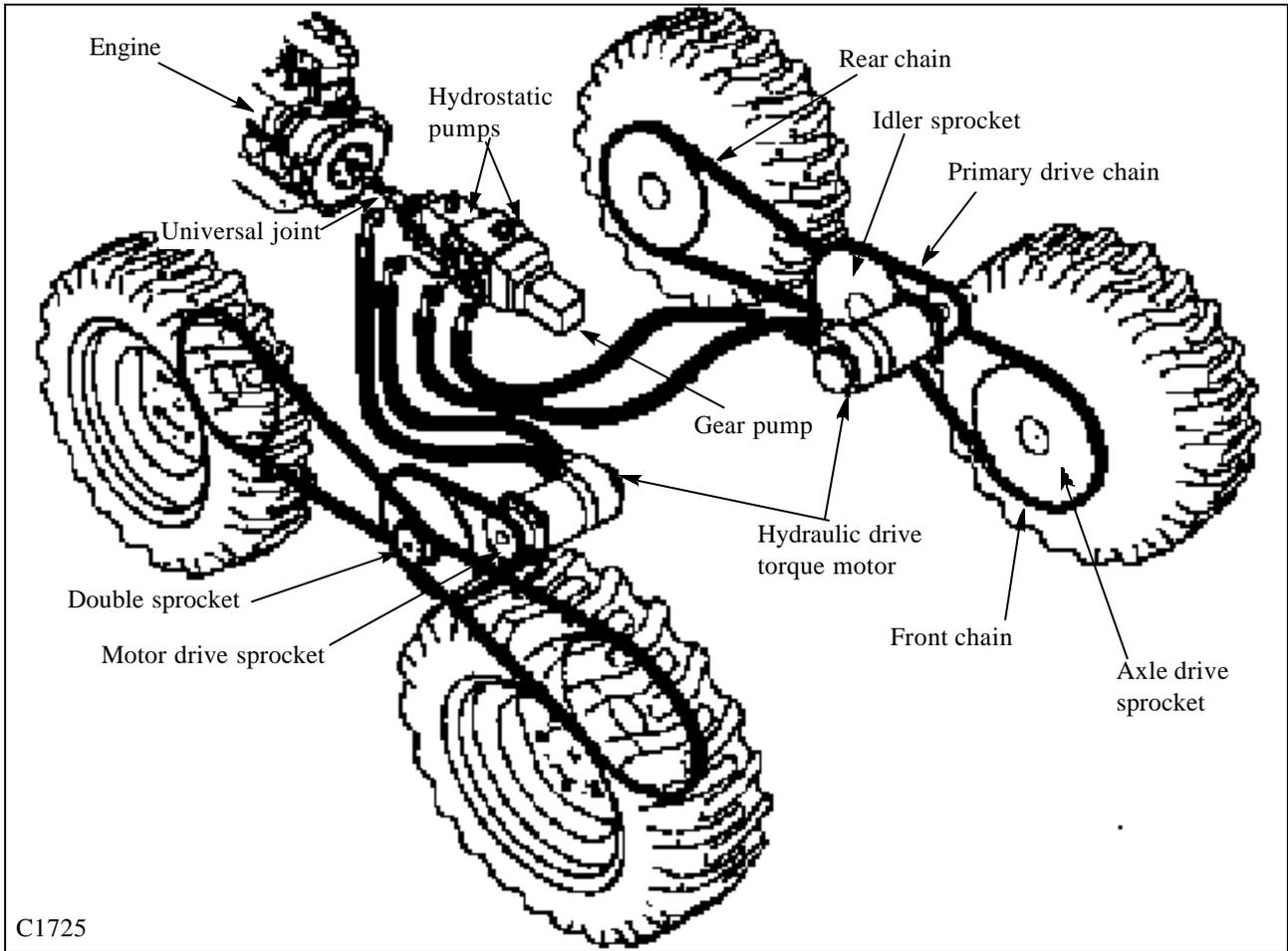
NOTE

SECTION 3 FINAL DRIVE

Specifications.....	3.1
Maintenance.....	3.2
Drive Chain	3.3
Idler Sprocket & Shaft.....	3.4
Axle Assembly.....	3.5
Trouble Shooting	3.6



SPECIFICATIONS 3.1



Specifications 3.1

Chain Size: PrimaryASA 80
 Front axle.....ASA 100
 Rear axleASA 100
 Rear axleASA 100H
 (ASA100H: S/N LM001005 onward)
 Approved Manufacture and Type: Tsubaki, solid roller
 Lubricating oil.....10W30 API SE / CD
 Capacity (per housing)5 gallons (23ℓ)

Torque Specifications:

Hydrostatic drive motor
 mounting nuts.....80 - 85 ft / lbs. (109 - 115 N.M.)
 Hydrostatic drive motor
 mounting studs40 ft / lbs. (54 N.M.)
 Idler flange nuts40 - 45 ft / lbs. (54 - 61 N.M.)
 Wheel nuts.....100 - 110 ft / lbs. (136 - 149 N.M.)

Tire Pressure:

12.00 X 16.550 PSI (345 KPa)

MAINTENANCE 3.2

Maintenance Schedule

CHECK	INITIAL HRS CHECK	EVERY HRS AFTER
Tire Pressure	8	8
Wheel Nut Torque	8	8
Lubricating Oil	50	150
Chain Tension	50	150
Axle Bearing Preload	50	150
Motor Mounting Nuts	50	150
Idler Flange Nuts	50	150

3

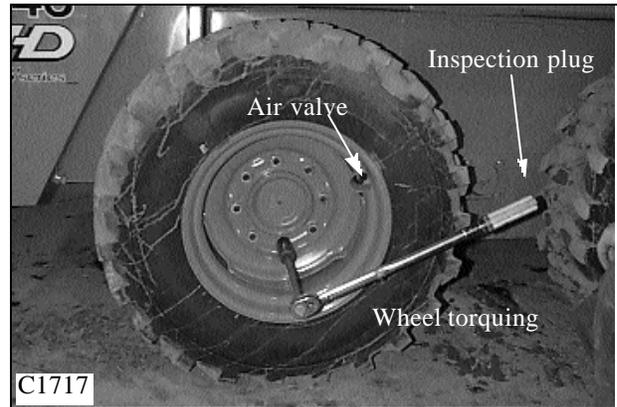
Oil Level Check and Fill

The loader has two independent final drive housings. Check the lubricating oil with the loader parked on a level surface.

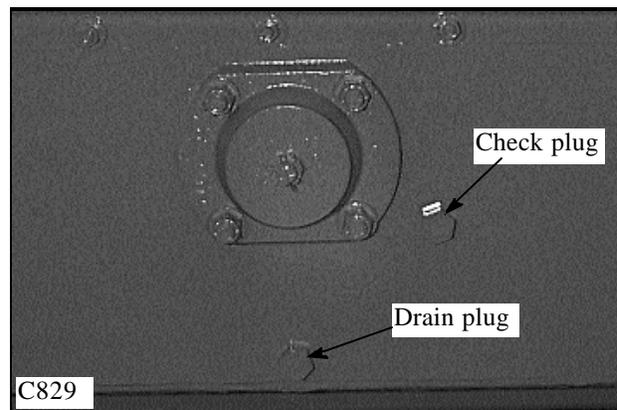
- 1 Clean the area around the oil check plugs located between the two drive wheels. (fig. C829)
- 2 Remove the upper check plug to verify oil level.
- 3 Oil should trickle out the hole when filled to the proper level.
- 4 If replenishment is required, remove the cap covering the oil fill port located underneath the seat and hydrostatic shield. (fig. C1389)
- 5 Add amount of oil necessary to trickle out the upper inspection hole.

If contaminants are present in the oil, drain the oil.

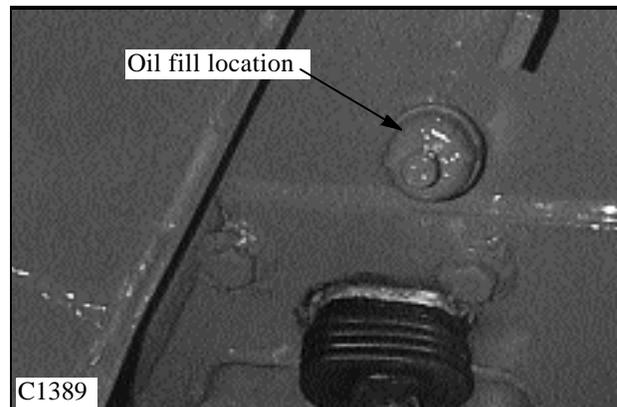
- 1 Remove the lower check plug. (fig. C829) Be prepared to contain five gallons (23£) oil.
- 2 Flush the final drive housing by removing the wheels and the inspection cover. (fig. C1655)
- 3 Clean the excess silicone from the housing and inspection cover. Flush the housing with clean oil and wipe out with an appropriate towel.
- 4 Inspect the housing for the contamination source.
- 5 Make repairs as required.
- 6 Replace the oil level drain and check plugs. Reseal the inspection cover to the final drive housing using silicone. Do not over tighten the inspection cover mounting nuts, 18 ft / lbs maximum.
- 7 Fill the housing to the proper level using 10W30 API classification SE / CD, five gallons (23£).



C1717



C829



C1389



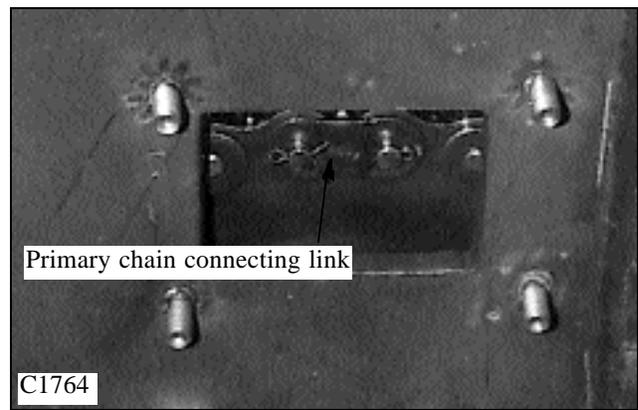
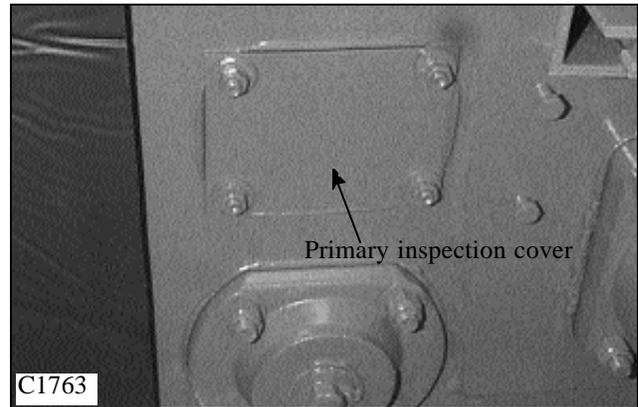
C1655

DRIVE CHAIN 3.3

Chain Inspection

The drive chains should be inspected for wear or damage after the first 50 hours of operation and every 150 hours thereafter, or any time the final drive inspection cover is removed. If the chain shows any signs of wear or damage, replace it. Inspect as follows:

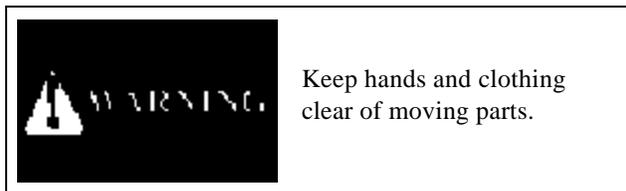
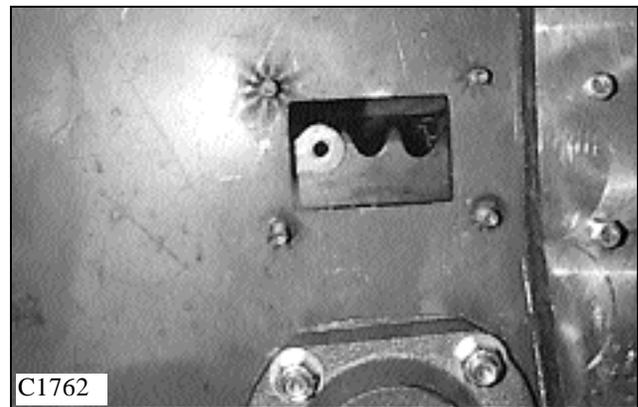
- 1 Remove any attachment, lower the boom arms, shut off the engine and engage the parking brake.
- 2 Secure the loader with the wheels off the ground.
- 3 Remove the wheels and inspection cover.
- 4 Inspect the chain rollers for wear. They should be smooth, no grooves or flat spots, and they should turn freely on the link pins with no gritty sound or feel.
- 5 Inspect the chain side plates for excess wear and looseness.
- 6 Inspect the connecting link cotter pins for damage.
- 7 Check the sprockets for excessive wear or damage, ie: broken teeth, sharp or rounded teeth, out of round center hole caused by loose or damaged bearings.
- 8 If the chain has been removed from the loader, check that when laid out flat it runs straight and not to the side indicating misalignment.



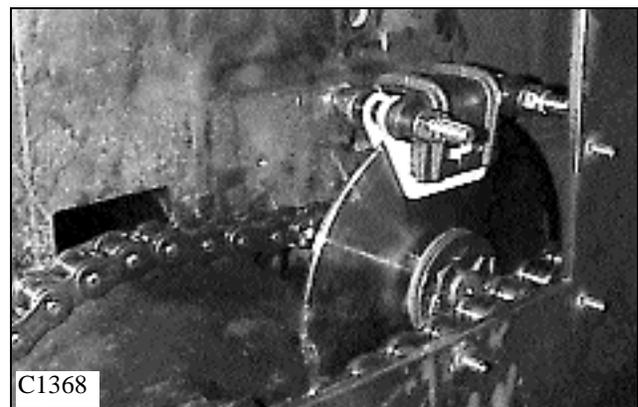
Primary Chain Replacement

REMOVAL:

- 1 Block the loader securely with the wheels clear of the ground.
- 2 Remove the wheels and inspection cover.
- 3 Remove the inner primary chain inspection cover. (fig. C1763)
- 3 Find the connector link in the chain. It may be necessary to rotate the chain drives to locate. Start the engine and slowly engage the control lever to rotate the chains until the connecting link is visible in the primary chain inspection cover hole. (fig. C1764)



- 4 Remove the brake disc as outlined in Section 4.5 (fig. C1368)
- 5 Disconnect the connecting link and remove the primary chain. Use a new connecting link at time of reassembly. (fig. C1762)

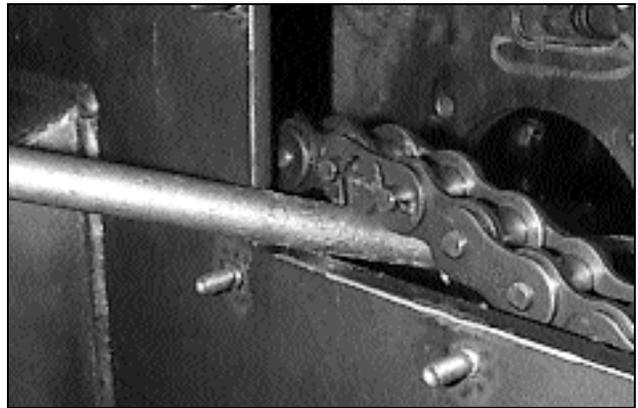
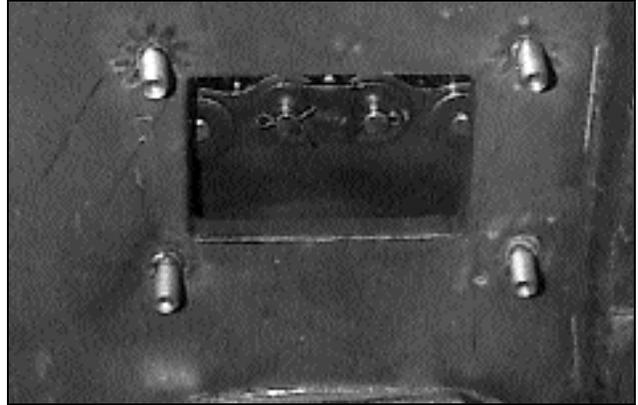


DRIVE CHAIN 3.3

REPLACEMENT:

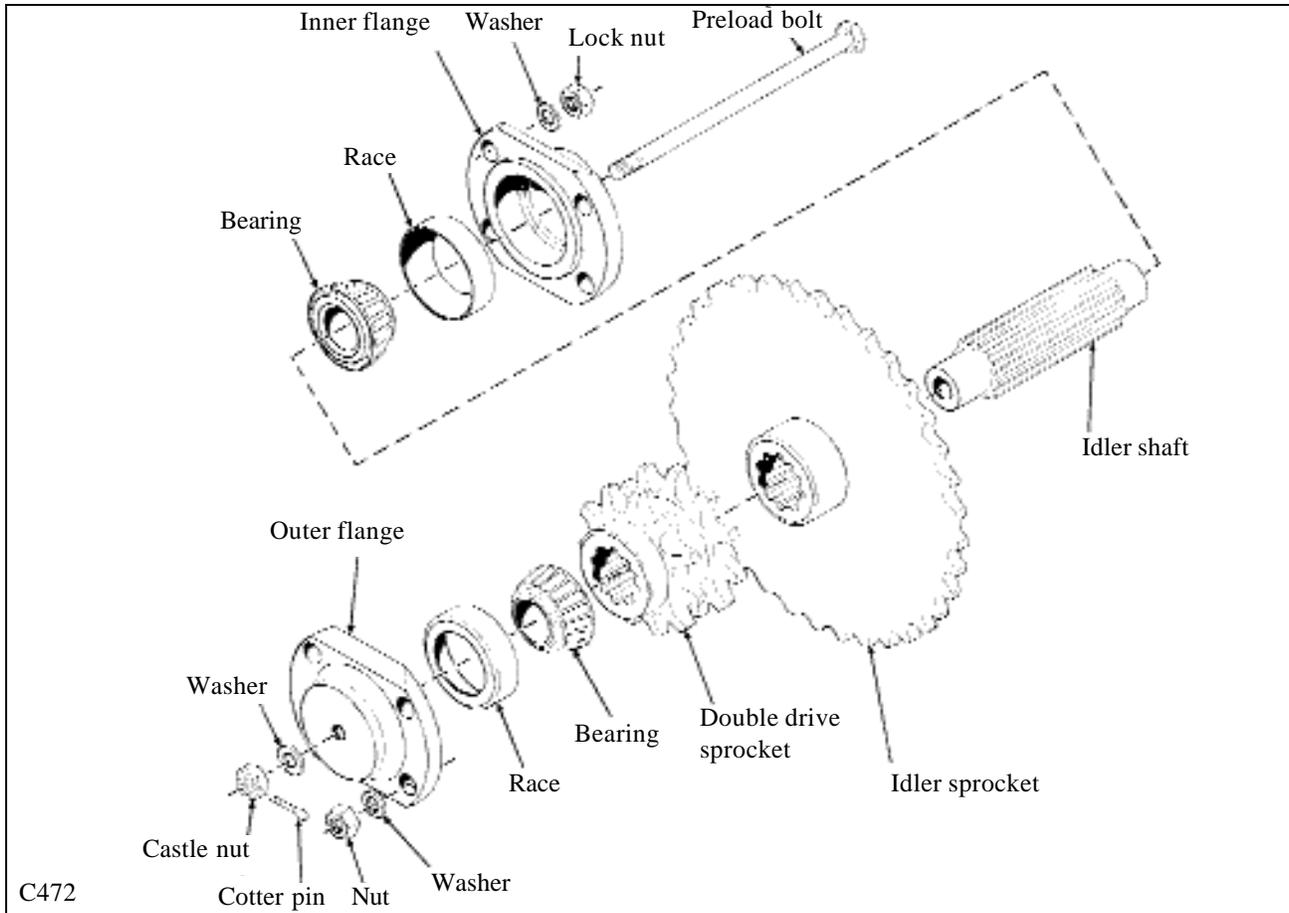
- 1 To replace chain, attach a piece of wire to one end of the chain to act as a guide. Install the chain around the primary sprocket.
- 2 Install the chain around the drive sprocket.
- 3 Install a new connecting link with the cotter pins facing the small primary chain inspection cover hole.
- 4 Replace the brake components in the reverse order as outlined in Section 4.5. Do not over tighten the inspection cover nuts. 18 ft / lbs maximum. (24 N.m)

3



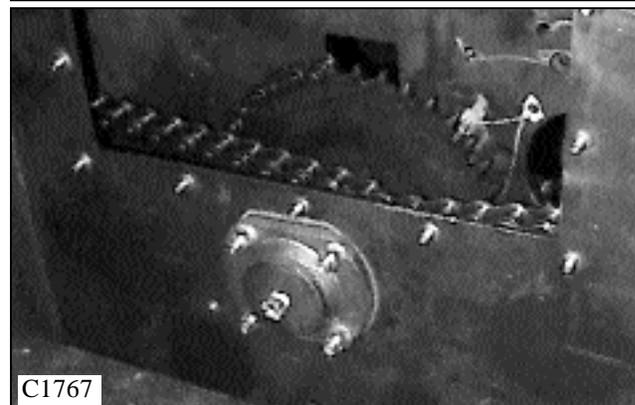
1 connecting link
↓

IDLER SPROCKET & SHAFT 3.4



Bearing Preload Adjustment

- 1 Block the loader securely with the wheels clear of the ground.
- 2 Remove the wheels. Torque the wheel nuts at 100 to 110 ft / lbs when reinstalling. (136 to 149 N.m.)
- 3 Remove the inspection cover located between the drive axles. Clean the excess silicone off the final drive housing and the inspection cover. Seal the cover with silicone at time of assembly. Torque the cover nuts to 18 ft / lbs maximum. (24 N.m.)
- 4 Rock the idler sprocket to determine if there is any play in the idler shaft bearings. (fig. C1753)
- 5 If play is found, remove the cotter pin from the castle nut on the end of the preload bolt. (fig. C1767)



IMPORTANT

The idler sprocket will slide back and forth on the shaft approximately. 1/16 and should not be confused with idler bearing play.

IDLER SPROCKET & SHAFT 3.4

- 6 Place a screwdriver in the slot on the end of the preload bolt and tighten the castle nut until there is no play in the idler sprocket shaft bearings. (fig. C1760)
- 7 Install a new cotter pin on the castle nut.
- 8 Replace the inspection cover and the wheels.

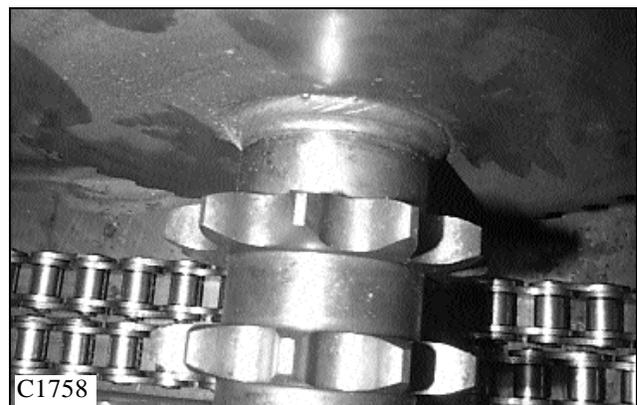
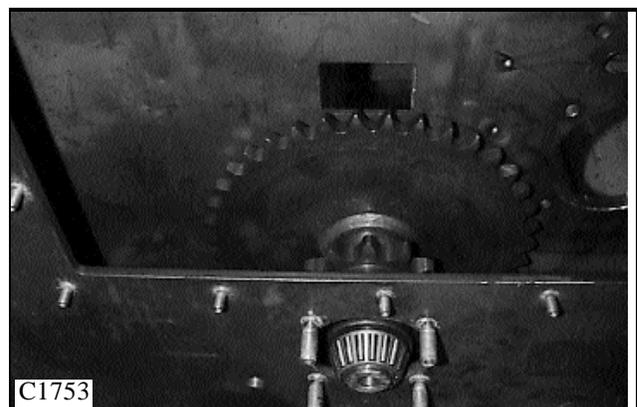
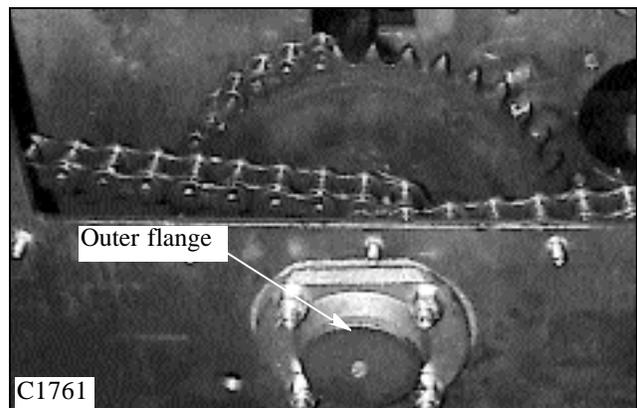
IMPORTANT

The idler sprocket will slide back and forth on the shaft approximately. 1/16 and should not be confused with idler bearing play.

3

Removal

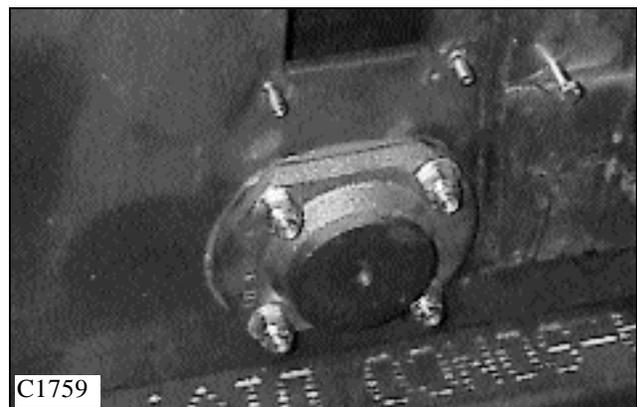
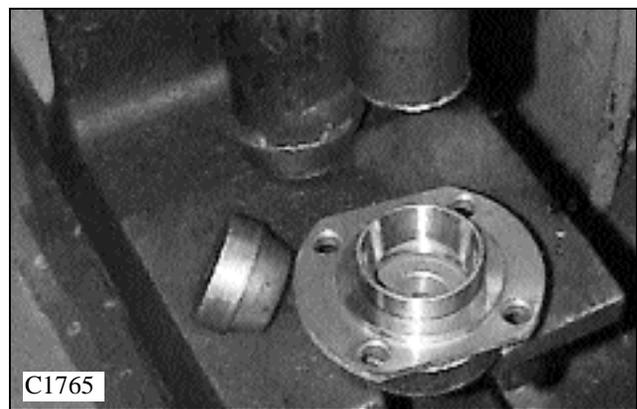
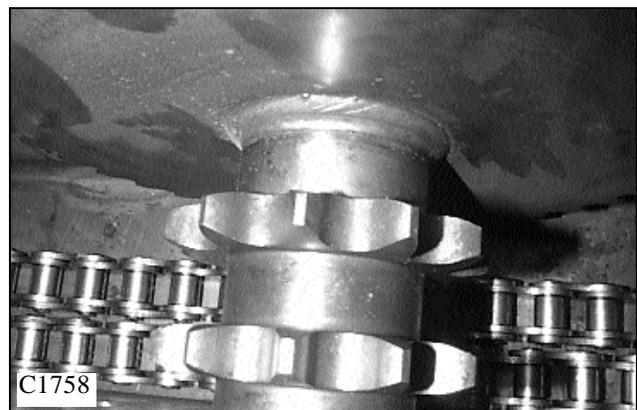
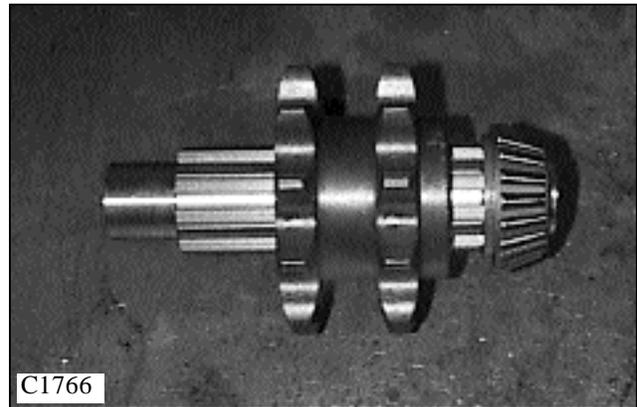
- 1 Block the loader securely with the wheels clear of the ground.
- 2 Remove the wheels.
- 3 Remove the final drive inspection cover located between the axles.
- 4 Drain the lubricating oil from the final drive housing as outlined in Section 3.2.
- 5 Remove the primary chain as outlined in Section 3.3.
- 6 Remove the preload bolt by removing the cotter pin from the castle nut, remove the castle nut and pulling out the bolt.
- 7 Disconnect the front and rear chains as outlined in Section 3.3.
- 8 Remove the inside and outside bearing flanges from the housing. (fig. C1761, C1753)
- 9 Using a brass drift punch drive the splined idler shaft through the idler sprocket and double output sprocket.
- 10 The idler shaft will come out the inside of the loader with the inside bearing still attached to the idler shaft.
- 11 Remove the double drive and idler sprocket from the final drive housing. (fig. C1758)
- 12 Remove the inside bearing from the idler shaft using an appropriate bearing puller.



IDLER SPROCKET & SHAFT 3.4

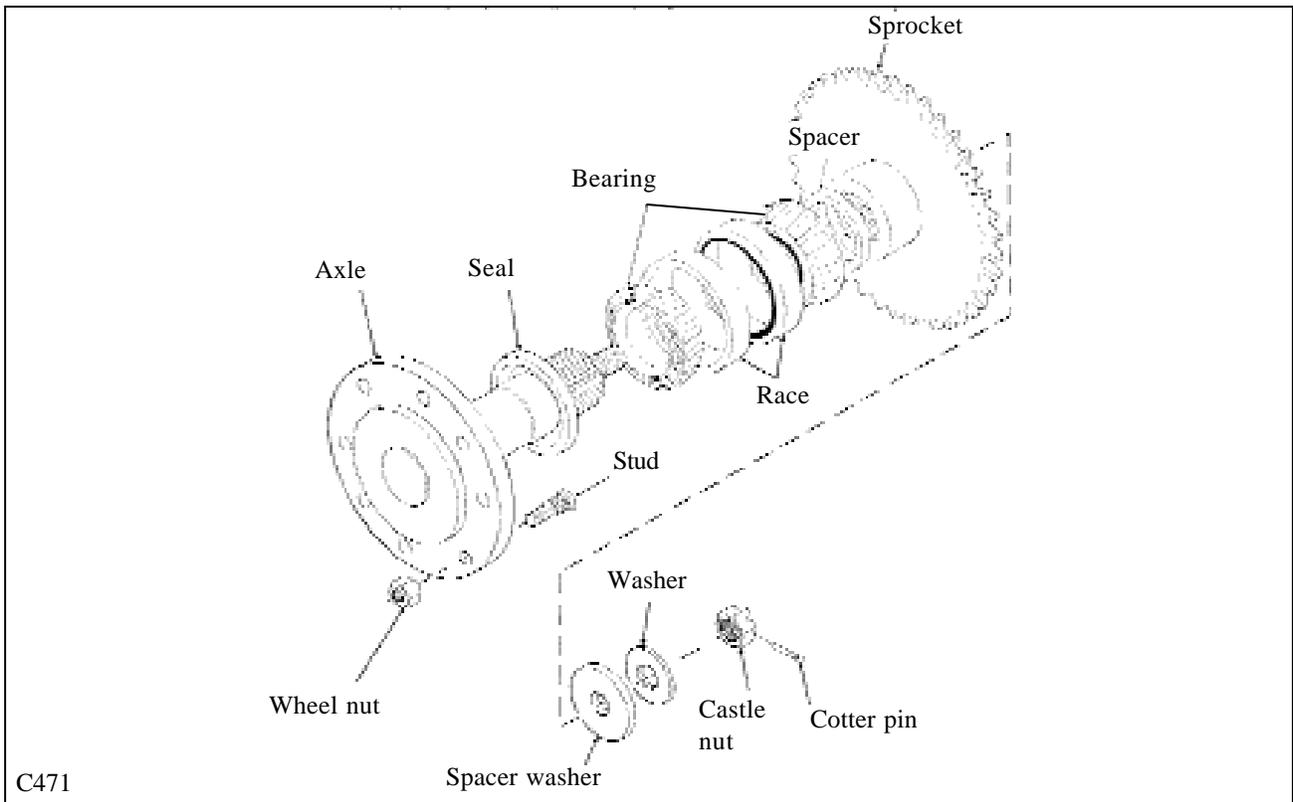
Installation

- 1 Install the inside bearing to the idler shaft. Use a press and appropriate pressing tools to push the bearing onto the shaft. (fig. C1766)
- 2 Install the idler sprocket and double drive sprocket in the final drive housing. Make sure the “lip” side of the double sprocket faces the outside bearing, toward the inspection cover. (fig. C1766, C1758)
- 3 Slide the idler shaft and bearing, from the inside, through the idler and double sprockets.
- 4 Pull the bearing races from the inside and outside bearing flanges if scared or pitted.
- 5 Lubricate new races with oil and press them into the bearing flange taking care to press the race into the flange straight. (fig. C1765)
- 6 Install the inside flange to the final drive housing. Use silicone to seal the surfaces. (fig. C1759)
- 7 Use washers under the flange lock nuts and torque the lock nuts at 45 to 55 ft / lbs. (61 to 75 N.m.) Tighten the lock nuts evenly so the flange is pulled straight into the housing without binding. Use new lock nut when assembling the flanges to the final drive housing.
- 8 Using a suitable driver, install the bearing onto the idler shaft. Make sure the bearing is completely bottomed against the shoulder of the idler shaft. Use a bearing heater to ease this procedure if available.
- 9 Apply silicone to the housing and loosely install the outside flange onto the final drive housing. Make sure to use washers under the new locking nuts. Do not tighten yet.
- 10 Connect the front and rear drive chains as outlined in Section 3.3.
- 11 Tighten the outside bearing flange nuts evenly so the flange is pulled into the housing straight. Torque the nuts at 45 to 55 ft / lbs. (61 to 75 N.m.)
- 12 Install the preload bolt through the final drive housing using silicone to seal the flange holes.
- 13 Set the preload on the idler bearings as outlines in Section 3.4.
- 14 Install the primary chain as outlined in section 3.3.
- 15 Assemble the brake components as outlined in Section 4.5.
- 16 Fill the final drive housing with 10W30 SE / CD oil to the upper check plug level. (Section 3.1)
- 17 Replace the inspection cover using silicone to seal the hole. Do not over tighten the cover mounting nuts beyond 18 ft / lbs maximum. (24 N.m.)
- 18 Install the wheels. Torque the wheel nut at 100 to 110 ft / lbs. (136 to 149 N.m.)



DRIVE AXLE 3.5

3



Removal

- 1 Remove any attachment and place the loader on a level surface.
- 2 Block the loader securely off the ground and remove the wheels on the side to be repaired.
- 3 Drain the lubricating oil from the final drive housing as outlined in Section 3.1.
- 4 Remove the final drive inspection cover located between the two drive axles. Clean the excess silicone from the final drive housing and inspection cover.
- 5 Remove the drive chain from the axle to be removed as outlined in Section 3.3.
- 6 Remove the axle cover plate from inside the final drive housing. (fig. C1765)
- 7 Remove the cotter pin from the castle nut on the end of the axle. (fig. C1370)
- 8 Remove the castle nut, washer and spacer.

Inner axle cover



C1765

DRIVE AXLE 3.5

9 Attach a puller, such as Thomas P / N 957372, to the axle to be removed. (fig. C1774)

10 Remove the axle. The inside bearing, spacer, and drive sprocket will fall into the final drive housing as the axle is being pulled out.

11 Check the bearing races still in the final drive housing. Pull them out and replace them with an appropriate driver if any scaring or pitting is present.

12 Remove the sprocket and bearing from the final drive housing if replacement is necessary. No need to remove the sprocket if replacement is not needed.

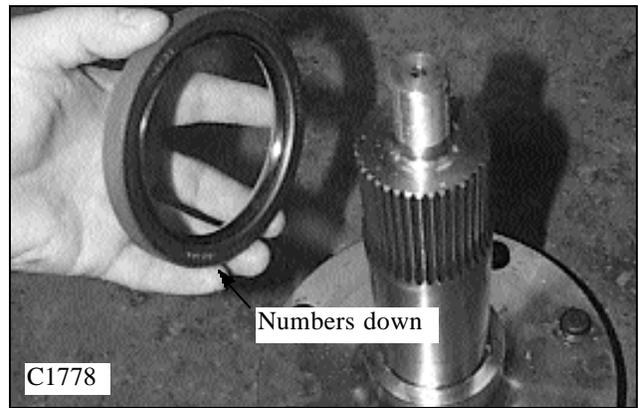
13 Use a bearing puller to remove the bearing from the axle.

14 Remove and discard the old axle seal.

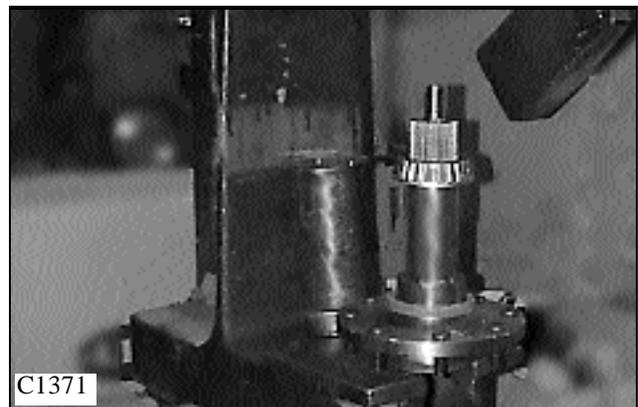


Installation

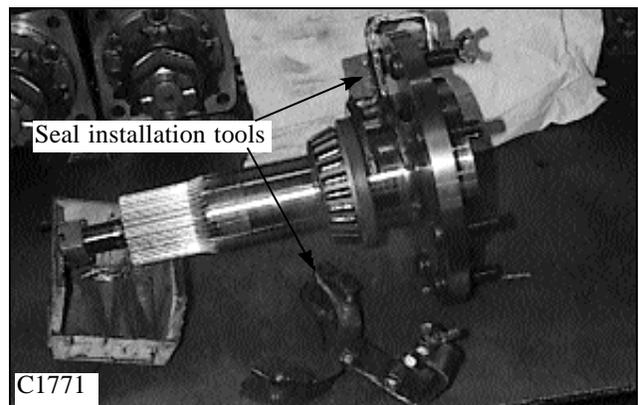
1 Lubricate the axle seal with grease and install it onto the axle with the seal part number directed to the outside of the loader or the flange side of the axle. (fig. C1778) Make sure the axle has not incurred damage the the seal surface. It must be smooth with no nicks or rust.



2 Press the bearing onto the axle taking care not to damage the wheel studs. (fig. C1371) Make sure the bearing is seated to the shoulder of the axle.



3 Place two seal installation tools, Thomas P / N 958674, between the seal and the axle flange. (fig. C1771) These tools will properly locate the seal into the final drive housing when pulling the axle bearings into place.

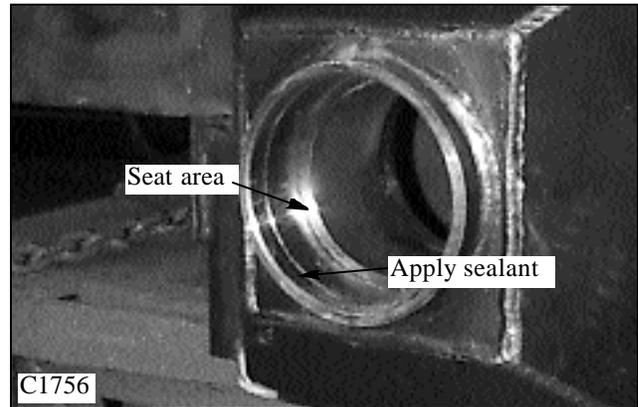


DRIVE AXLE 3.5

4 Lubricate the new races to ease assembly. Make sure they are fully seated into the housing. (fig. C1756)

5 Apply gasket sealant to the housing seal area. Do not get the sealant onto the bearing or race surfaces. (fig. C1756)

NOTE: When installing the drive axle sprockets, the front sprocket teeth run next to the inspection cover or outside of the loader. The rear axle sprocket teeth are away from the outside inspection cover, toward the inside of the loader.



C1756

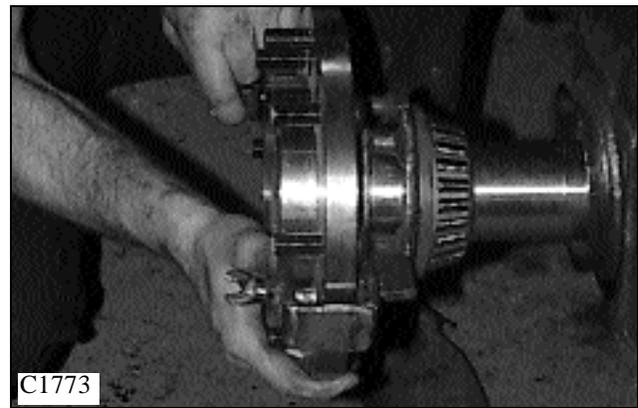
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6 Install the axle to the final drive housing. (fig. C1773)

7 As the axle is being guided into housing align the bearing, spacer and sprocket onto the axle. Use the exploded view diagram to assist in parts placement.

8 Install the small axle washer and castle nut to the axle.

9 Tighten the castle nut onto the axle until it pulls the bearing on far enough to install the larger axle washer.

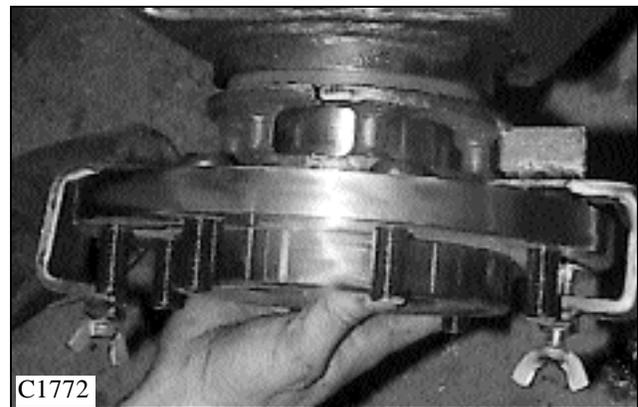


C1773

10 Install the large axle washer, small washer and castle nut. Tighten the castle nut until the seal installation tool bottoms out against the final drive housing. Tap the flanged area of the axle with a hammer to help seat the axle seal.

11 Loosen the castle nut slightly and remove the seal installation tools.

12 Tighten the castle nut until the bearings are fully seated. Continue tightening the castle nut to line up the next slot in the nut with the cotter pin hole in the axle.



C1772

13 Install a new cotter pin in the end of the axle. Tap it down lightly to seat it and bend the ends around the hex area of the castle nut. (fig. C1370)

14 Assemble the rest of the removed drive and brake parts and replace the inspection covers. Use silicone to seal the covers and do not over tighten the mounting nuts, 18 ft / lbs maximum. Replace the wheels and torque the wheel nuts at 100 to 110 ft / lbs. (136 to 149 N.M.)



C1370

TROUBLESHOOTING 3.6

Problem	Cause	Corrective Action	Section
Final drive noisy.	No lubricating oil.	Check the oil level. Check for leaks and cause. Add 10W30 API SE / CD oil to correct level.	3.2
	Chain loose.	Replace chain and check tension every 150 hours.	3.3
	Axles have too much end play.	Check the axle end play. Replace damaged parts if required and adjust end play.	3.5
	Parking brake engaged or out of adjustment.	Inspect and adjust or replace damaged parts.	4.5
No drive on one side.	Drive chain failure.	Inspect the chain. Replace damaged parts. Check the chain tension every 150 hours.	3.3
	Torque motor failure.	Do pressure checks. Replace parts as required.	2
	Hydrostatic drive failure.	Do pressure checks. Replace parts as required.	2
Lubricating oil leaking out the breather in the filler cap.	Lubricating oil level too high.	Check oil level and drain excess.	3.2
	Torque motor shaft seal leaking.	Repair the hydraulic torque motor.	2
Wheel studs shearing.	Wheel nuts loose.	Tighten nuts to 100 to 110 ft / lbs. (135 to 149 N.M.) Check wheel nuts every 8 hours.	3.2
Wheel stud threads shearing.	Wheel nuts over torqued.	Tighten nuts to 100 to 110 ft / lbs. (135 to 149 N.M.) Check wheel nuts every 8 hours.	3.2



NOTES

SECTION 4

CONTROLS

Trouble Shooting	4.1
Steering	4.2
Steering Locks	4.3
Restraint Bar	4.4
Parking Brake	4.5
Foot Pedals.....	4.6
Hand Controls	4.7
Throttle.....	4.8
Auxiliary Control.....	4.9
Hi - Flow Controls.....	4.9



TROUBLE SHOOTING 4.1

4

Symptom	Cause	Corrective Action	Section
Loader creeps, won't center	Neutral adjustment	Adjust linkage	4.2
	Worn, loose linkage	Replace, tighten parts	4.2
	Lock adjustment	Adjust lock linkage	4.3
	Binding, dragging parts	Clean or replace	4.2
Steering jerky	Worn, loose linkage	Replace	4.2
	Binding linkage	Repair, replace	4.2
	Linkage adjustment	Adjust	4.2
	Low charge pressure	Repair, replace	1
Loader doesn't track straight	Limiter stops	Adjust	4.2
	Binding linkage	Repair, replace	4.2
	Hydrostatic failure	Repair, replace	1
Steering locks don't work	Broken spring	Replace	4.3
	Missing parts	Replace	4.3
	Stuck linkage	Service pivot points	4.3
	Linkage adjustment	Adjust	4.3
	Damaged cable	Replace	4.4
Steering locks won't release	Damaged cable	Replace	4.4
	Missing, damaged hardware	Replace	4.3, 4.4
Boom controls inoperative	Damaged cables, linkage	Replace	4.6, 4.7
	Safety switch (s)	Adjust, replace	4.3
	Bad electrical ground	Repair	5
	Blown fuse	Replace	5.7
	Valve lock malfunction	Replace parts	1.4, 5
	Low hydraulic oil	Replenish	1.2
	No oil pressure	Make repairs	1
Boom operation slow	Cable linkage	Replace, adjust	4.6, 4.7
	Aux. hydraulics engaged	Disengage	4.8, 4.10
	Engine RPM low	Adjust	7.11
	Control valve relief	Adjust, replace	1.4
	Cylinder seal, damage	Repair, replace	1.5
Boom controls stiff	Cable wear	Replace	4.6, 4.7
	Pivot wear	Replace parts	4.6, 4.7
	Control valve wear	Repair, replace	1.4
Auxiliary hyd. inoperative	Blown fuse	Replace	5.7
	Switch (s) failure	Replace	5.3
	Aux. valve malfunction	Repair, replace	1.4
	Electrical short	Repair	5
	Bad electrical ground	Repair	5
Brake won't hold	Cable broken	Replace	4.4, 4.5
	Brake pads worn	Adjust, replace	4.5
	Brake linkage failure	Replace	4.5
	Brake caliper, disc damage	Replace	4.5

STEERING 4.2

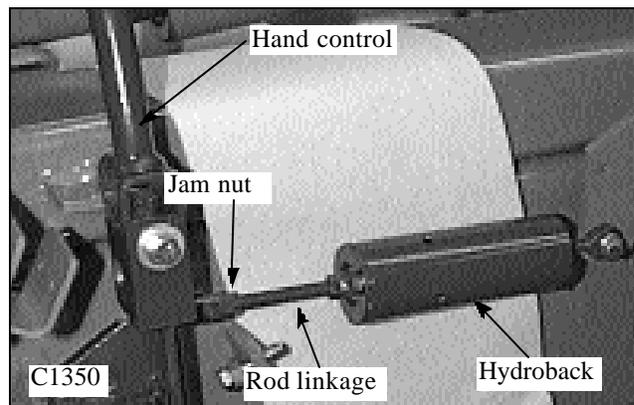
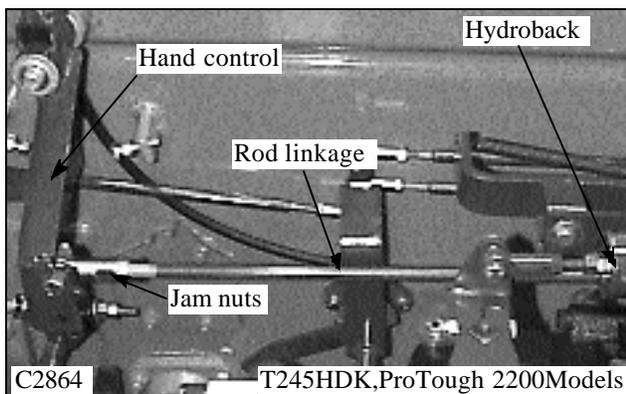
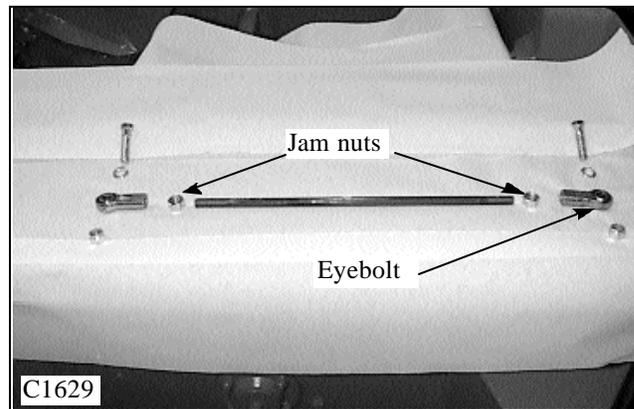
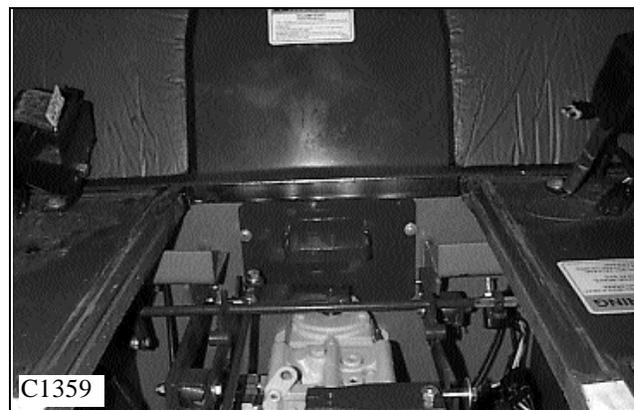
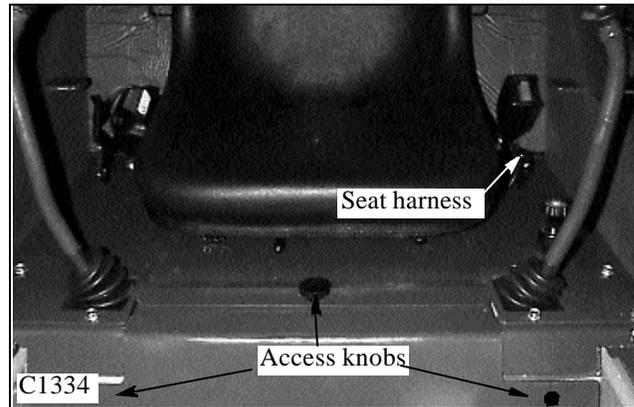
NOTE: If you are unfamiliar with the functions and operations of the control levers, pedals and switches of the loader please read the Owner / Operators manual before attempting any repairs or adjustments.

Steering and other adjustments or repairs can only be made with the operators seat and hydrostatic shield removed. (fig. C1334, C1359)

Proper steering functions, and control operations, depends heavily on the condition of the linkages. Always check linkage condition before making any adjustments. Replace any worn rod ends and bolts as required. No amount of adjustment will overcome worn, loose or damaged linkage. (fig. C1629) Replace the steering lever pivot bushings if it has excessive slack in it. Remove the four bolts around the steering lever boot. Remove the bolt holding the linkage to the steering lever. Remove the bolt holding the steering lever to the pivot shaft. Some steering levers are equipped with electrical switches in the lever handle. Unplug the electrical connection at the base of the steering lever before removing.

All linkage adjustments are started from the neutral position. In the neutral position, the steering levers should be in a straight up, vertical position. Both levers should be an equal distance from the operators location, to provide equal arm reach.

Control lever angle is set by adjusting the rod end linkage on the hydroback assembly. (fig. C1350,C2864). The restraint bar must be in the down position to allow the levers to move freely. The angle should be set, with the aid of an angle finder gauge, to a vertical measurement 90 degrees to the horizontal of loader frame. Be sure to take a base angle measurement of the loader frame, and add or subtract this measured angle from the steering lever angle. Make sure the rod end is not worn, and the mounting bolts are tight. Loosen the jam nut and turn the rod linkage in or out to attain correct angle. Maintain a minimum of .375 inches (10mm) of threads inside the female rod end to prevent stripping. Make sure the loader is supported securely off the ground after any adjustments, or parts replacement , has been made. Changing the angle also effects the neutral position.



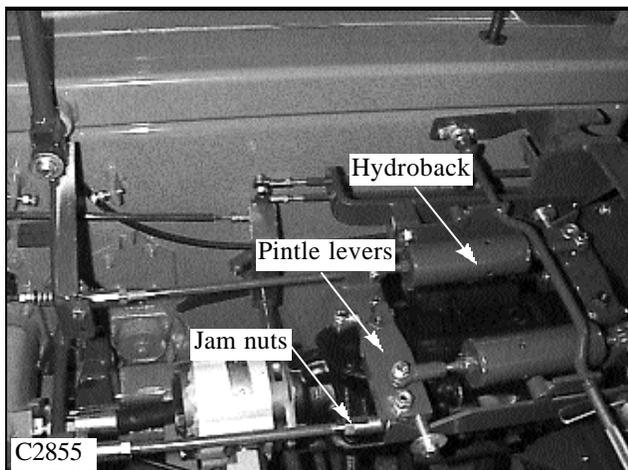
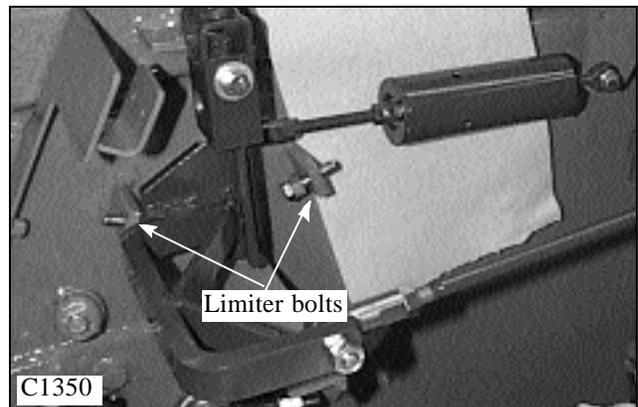
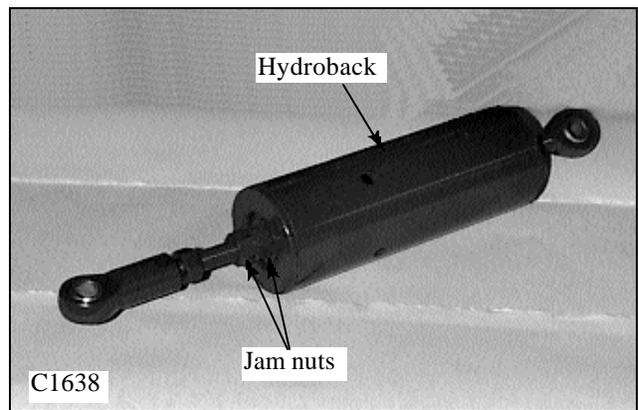
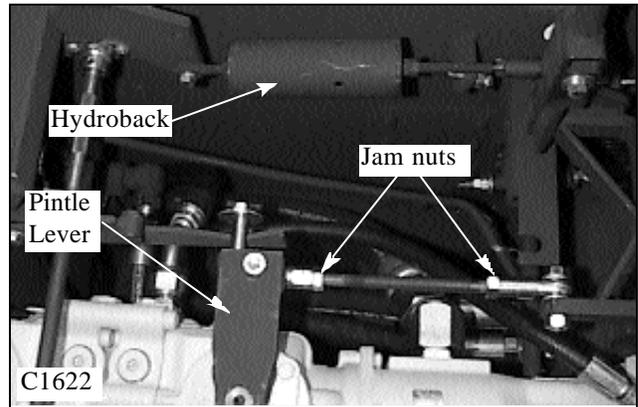
STEERING 4.2

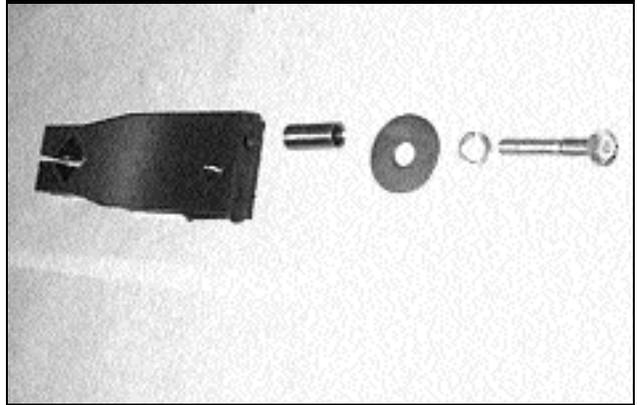
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Neutral is adjusted by loosening both rod end linkage jam nuts and turning the rod linkage in or out to move the pintle lever forward or back. (fig. C1622,C2855). Before making neutral adjustments you must be sure the linkages are not worn and mounting bolts are all tight.. Replace any worn parts. You cannot achieve a consistent neutral position with worn or binding parts. One end of the linkage rod is left hand thread, the other is right hand. The restraint bar must be down, and the engine running, to visually see when the drive wheels are stopped, or in neutral. Be sure the loader is securely supported off the ground before attempting this adjustment. Tighten the jam nuts and recheck the center, or neutral position. Apply slight pressure to the lever in either direction. You should have equal wheel movement, forward and back, for an equal amount the lever is pushed or pulled. Neutral position should have a positive feel to it. If it has a slight dead spot, or loose feel, just off center, you may need to adjust the spring inside the hydroback assembly. Loosen the 2 jam nuts, next to the hydroback body, (fig.C1638,C2855) and the turn nuts out to allow the spring to extend inside the housing. Finger turn the nuts in to take out any dead, or loose, spot. Jam the nuts back together.. Readjust the the neutral if necessary. For very fine, minor, neutral centering adjustments, you may turn the hydroback rod linkage. Make only minor changes here, as this adjustment also changes the steering lever angle.

After making neutral adjustments, you will need to check the control lever steering locks. Section 4.3

Wheel speed, or tracking, is set adjusting by limiter bolts, or stops. (Fig. C1350,) Turning the bolts in or out restricts the travel of the control lever. Raise the loader securely from the ground. Start the engine and verify the engine RPM's are at 2800 + / - 50 RPM. See section 7.11 Lower the restraint bar. Using a surface tachometer, measure the speed the drive wheels are turning. (fig. C1641) Adjust forward and reverse speed to 67 RPM, left and right sides, Tolerance of + / - 1 RPM.





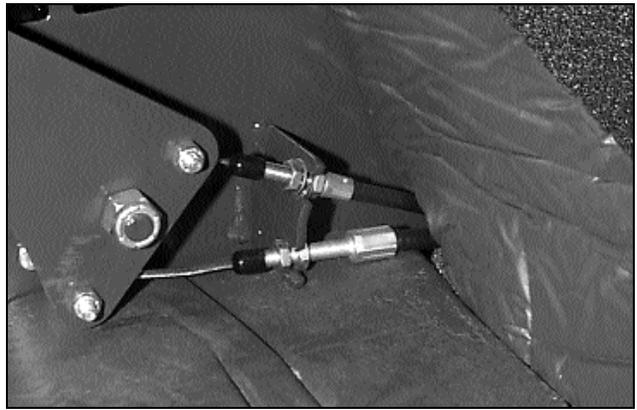
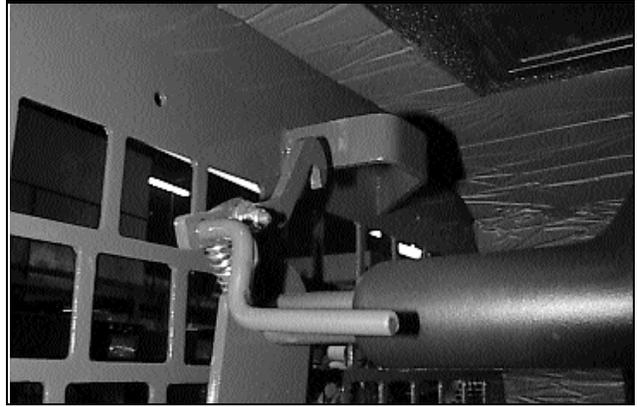
Lock arm

Notch

Pintle lever
lock assembly

C1346

RESTRAINT BAR 4.4



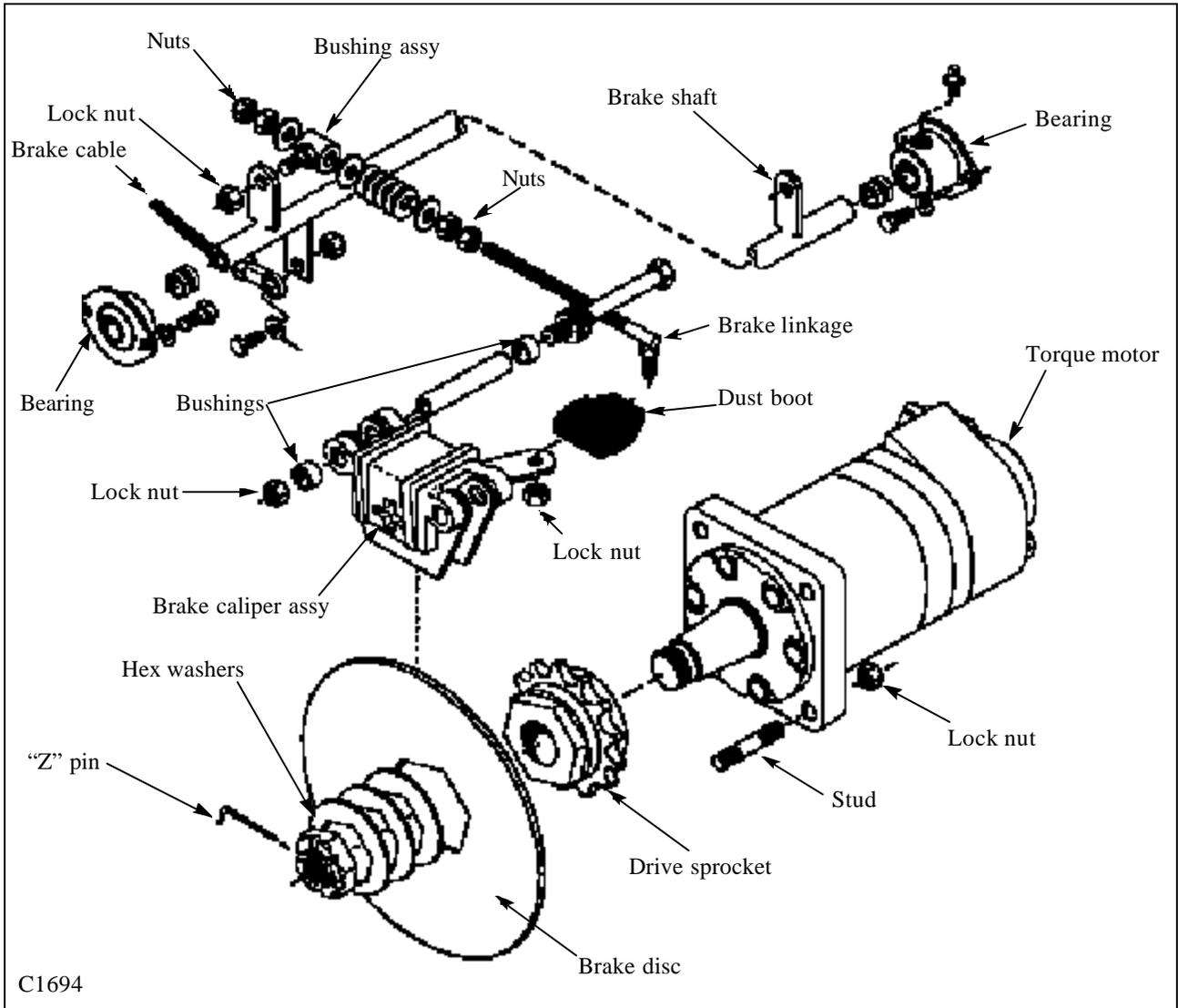
Steering lock cable

Lock activator

C1360

Clearance

PARKING BRAKE 4.5



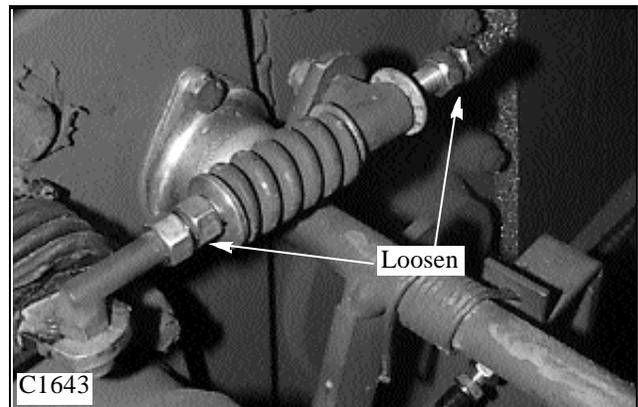
The parking brake is operated by, raising to engage or lowering to release, the restraint bar. It is connected to the brake linkage through a cable. Before attempting any adjustments, or repairs, make sure the restraint bar and cable are in proper working order. Section 4.4

PARKING BRAKE 4.5

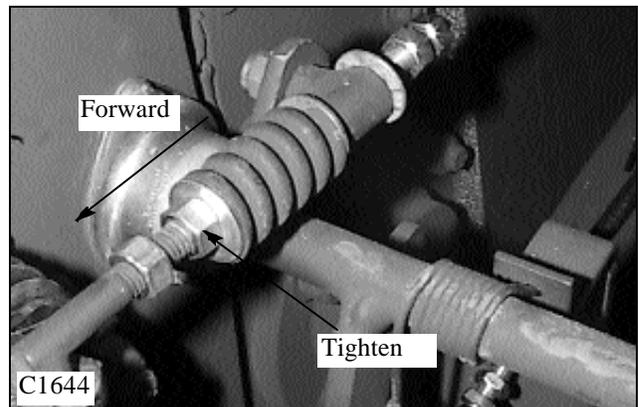
Correct parking brake adjustment is measured at the restraint bar with a push force measuring gauge. (fig. C1646) Slowly raise the restraint bar and take a reading just before the restraint latch touches the catch. A reading of 22 to 28 lbs. (30 to 38 Kg) push is optimum. Lower readings will result in poor brake performance. Higher readings will place excessive strain on the parking brake cable, which could result in premature wear or breakage.



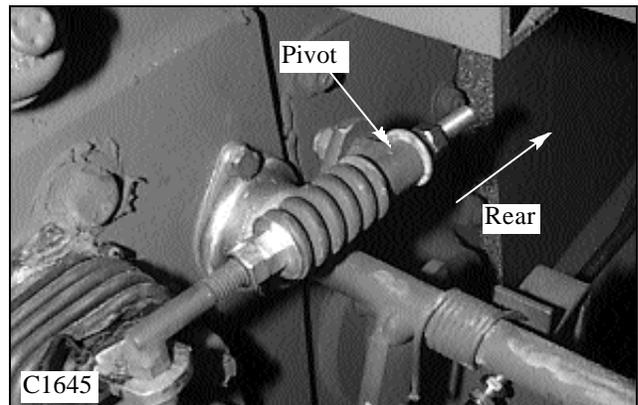
If adjustments are required, loosen the four jam nuts on the brake linkage rods, both left and right hand sides. (Fig.C 1643). Adjustments are made with the restraint bar down.



Pull the brake linkage rod forward, to tighten or increase pressure on the brakes, and finger turn the forward set of nuts to touch the spring on the brake rod. (fig. C1644) Do both left and right sides. Remeasure the restraint bar effort reading with the effort gauge. Move the nuts on the rods to get desired setting. Tighten the two forward jam nuts together when the right setting has been reached.



The rear set of nuts are to pull the brake off. They need to be adjusted with the restraint bar down. Push rearward on the brake linkage rod until it won't go any further. Allow the rod to come forward .25 inches. (6 mm) Tighten the two rear nuts against the pivot bushing. (fig. C1645) Be sure to leave the linkage rods some slack. The brakes will activate, drag, when the restraint bar is down if incorrectly adjusted. This will cause premature failure of brake pads and brake disc rotors.

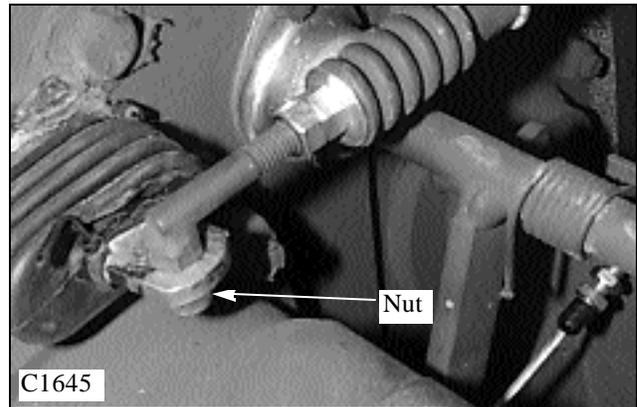


PARKING BRAKE 4.5

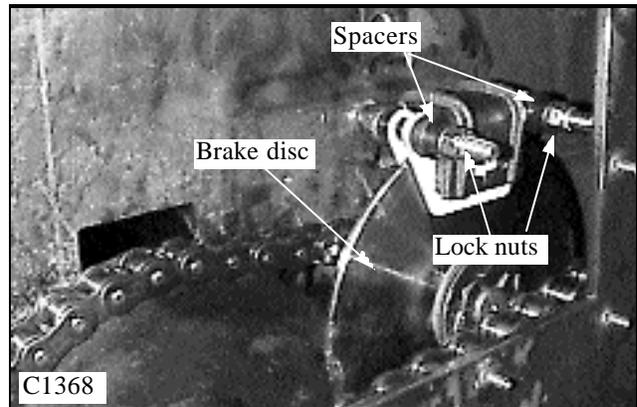
Brake Pad Replacement

Changing the brake pads and or brake caliper, will require the removal of the wheels and the transmission inspection cover. Raise and secure loader off the ground. Remove the wheels. Upon reassembly, torque the wheel nuts to 110 ft / lbs. (136 to 149 N.m.) Remove the inspection cover. Upon reassembly, do not tighten the inspection cover nuts beyond 18 ft / lbs. (24.5 N.m.)

Lower the restraint bar. Remove the lock nut holding the brake linkage rod to the brake caliper lever. (fig. C1645)

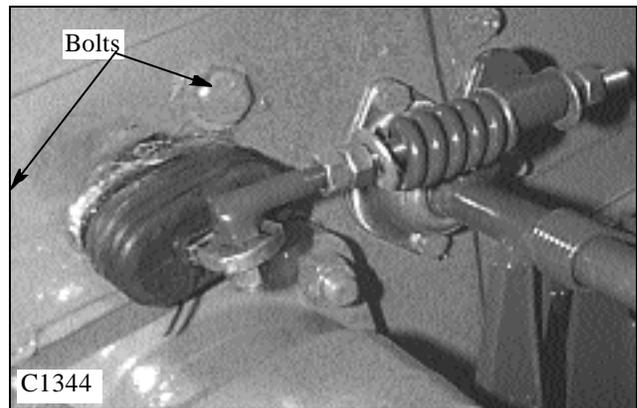


To change the brake pads, remove the two lock nuts and spacer bushings on the brake caliper. (fig. C1368) The head of the bolts are located on either side of the brake lever dust boot. Reseal these bolts with silicone when reassembling . (fig. C1344) Pull the bolts out far enough to allow the brake pads to drop out. Reverse the procedure for pad replacement. Torque the bolts to 50 to 60 ft / lbs. (68 to 88 N.m.)



Brake Disc

Brake disc replacement does not require pad or caliper removal. Loosen the two lock nuts, (fig. C1368) holding the caliper. Leave the nuts on the bolts by one or two threads. Straighten one end of the “ Z ” pin, located on the end of the drive motor shaft, and remove it. Remove the three hexagon washers. The brake disc will now come out. Inspect the drive motor sprocket. If the machined hexagon area has been stripped, or rounded off, the sprocket must be replaced. See section 1. Removing the brake disc may allow the brake caliper lever to move out of it’s pivot groove. When reinstalling the brake disc, be sure to hold the brake caliper lever in the forward groove. Install the brake disc, hexagon washers, and a new “ Z ” pin. Bend the pin to form a “ Z ” pattern.



Brake Caliper

Brake caliper replacement will require the removal of the brake disc assembly, described above. Remove the brake linkage, brake disc, and the brake dust boot. Remove the caliper assembly. Keep track of the spacers and washers. See fig. C069 on the previous page for an exploded view.

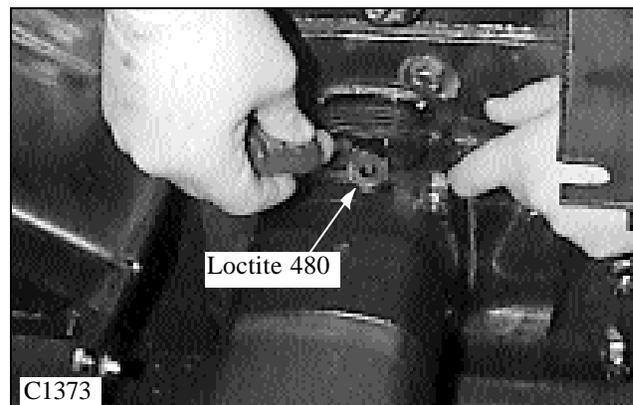
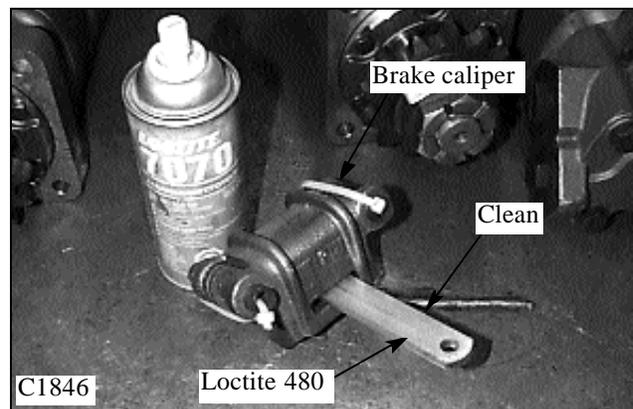
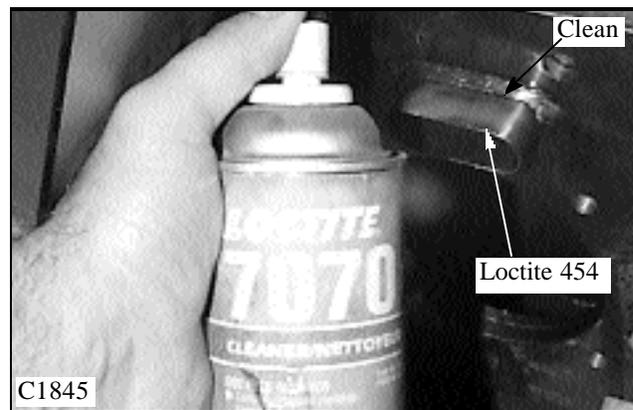


PARKING BRAKE 4.5

Clean the excess boot material and glue from the transmission housing. This area must be spotlessly clean. Prepare the area with Loctite 7070 or alcohol wipes and lint free swabs. Prepare the brake boot in the same manner. Use the Loctite 7070 or alcohol to clean all residues that may be on the gluing application area. Wearing protective gloves, Apply Loctite 454 to the transmission housing area where the brake boot will cover. Make sure to get full coverage top and bottom. Do not contaminate the gluing surfaces with finger prints. Slide the boot in place. Put a nylon zip tie around the outside of the boot and glued area. Allow the glue to cure.

The brake calipers come preset up for the left hand side. If you are installing a right hand caliper, you must drop the brake pads, remove the caliper lever, turn it over and reinstall. Replace the brake pads. Prepare the caliper lever surface with Loctite 7070 or alcohol and a lint free cloth or wipe. Install the brake caliper bolts into the transmission housing. Seal the heads of the bolts and washers with silicone. Place the inside washers over the bolts. Install the long spacer bushings onto the brake caliper. Slip the caliper onto the two bolts. Push the brake lever through the boot. Be sure to have allowed sufficient time for the boot glue to have cured. Install the two short out side bushings onto the brake caliper. Turn on the lock nuts one or two threads. Reinstall the brake disc assembly. Tighten the two brake bolts. Torque to 50 to 60 ft / lbs. (68 to 88 N.m.) Reinstall the three hexagon washers. Replace the “ Z ” pin. Make sure the brake caliper lever and dust boot gluing areas are clean. Raise the lip of the boot and apply Loctite Black Max (480). Make sure you get complete coverage, top and bottom. Do not tear the boot. Allow the glue to fully cure before using the brake. Reinstall the transmission inspection side cover. Reseal with silicone. Do not over tighten the inspection cover nuts, 18 ft / lbs maximum. (24.5 N.m.) Reinstall the wheel assemblies. Torque the wheel nuts to 110 ft / lbs. (136 to 149 N.m.).

Reinstall the removed brake linkages. Check and adjust the parking brake outlined at the start of this section.



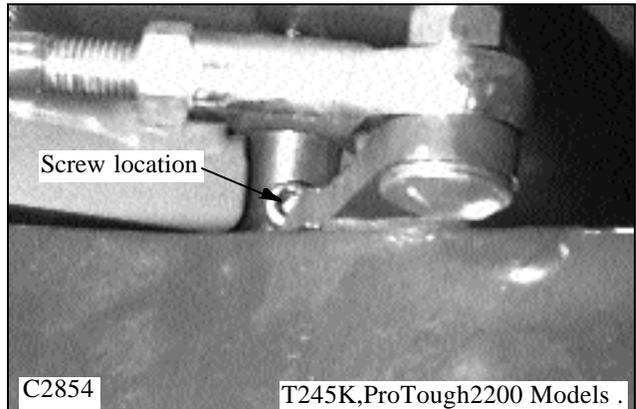
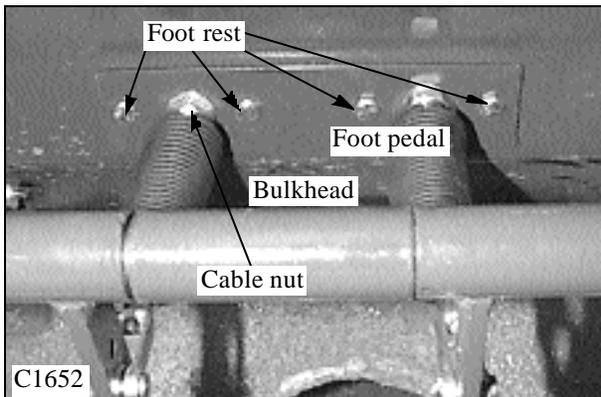
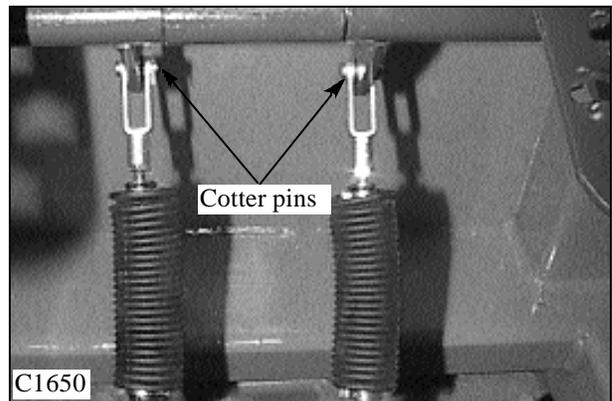
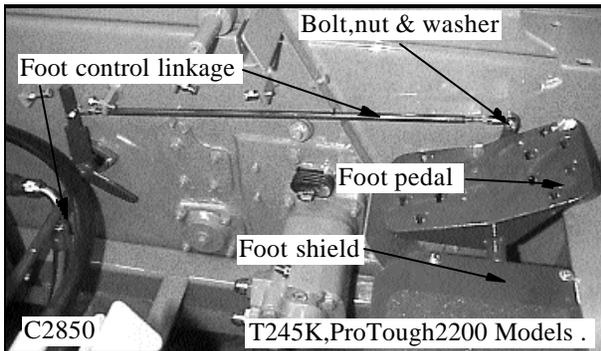
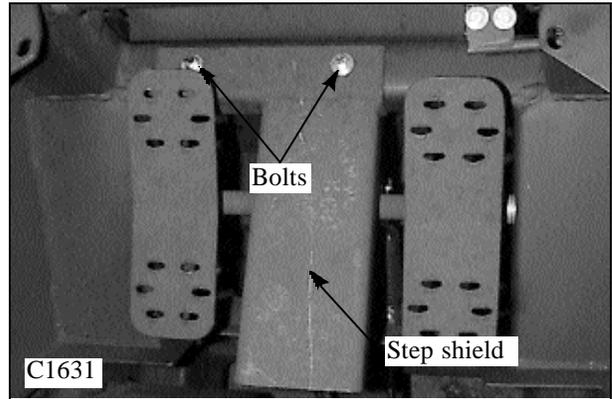
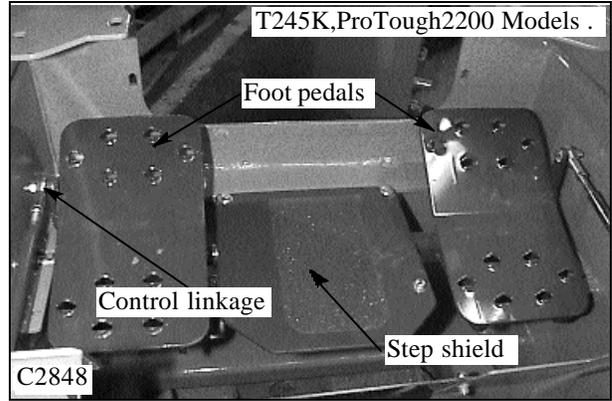
FOOT PEDALS 4.6

Replace the anti skid surface on the step shield if it is worn or peeling. Scrape or peel it off. The replacement anti skid material has a self adhesive tape surface for re-applying.

To remove the pedals, remove the bolts located to the left or right of the foot pedals. Reach underneath and push the foot pedal shaft to the right or left. Be prepared to catch or hold the spacer washers used between the frame and the foot pedals. These are used to set the foot pedal end play and will need to be reused when reassembling. Pull the pedals up and out. Inspect the pedal shaft and foot pedals for wear. Replace if necessary. Reassemble in reverse order.

It is not necessary to remove the foot pedals to change the control cables. Remove the cotter pins or bolts as outlined above. Loosen the cable bulkhead or control linkage rod nuts. Remove the four bolts holding the bulkhead plate to the frame plate. Refer to Figures (C1652,CC1631,C1650).

If the foot pedal or step shield needs replacing/repair, remove the bolts connecting the control linkages to the foot pedal (s). Then remove the bolts from the step shield along with the two screws which are directly below the area where the control linkage connects to the foot pedal Refer to Figure (C2854). The step shield / foot pedals can now be easily removed. This procedure applies to the T245HDK / ProTough 2200 models. Refer to Figures (C2848,C2850).



4

FOOT PEDALS 4.6

Cable
nuts

Cotter pins

C1385

HAND CONTROLS 4.7

The steering levers on hand control operated machines also pivot left to right, to control operation of the boom and bucket. Steering lever centering, neutral, wheel speeds and steering locks are adjusted the same as the foot pedal type operated loaders. See section 4.2 and 4.3.

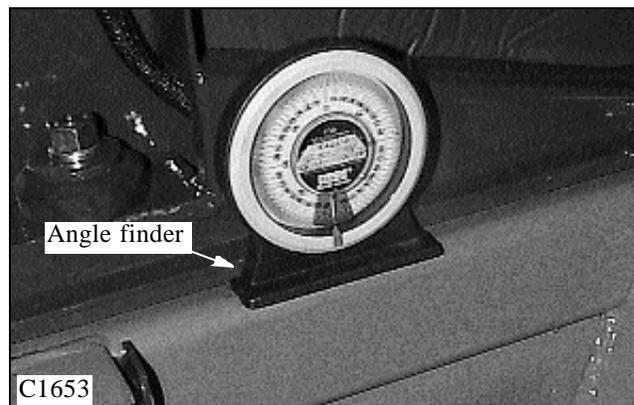
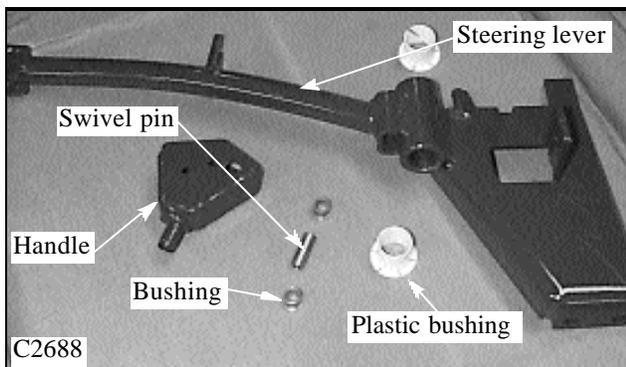
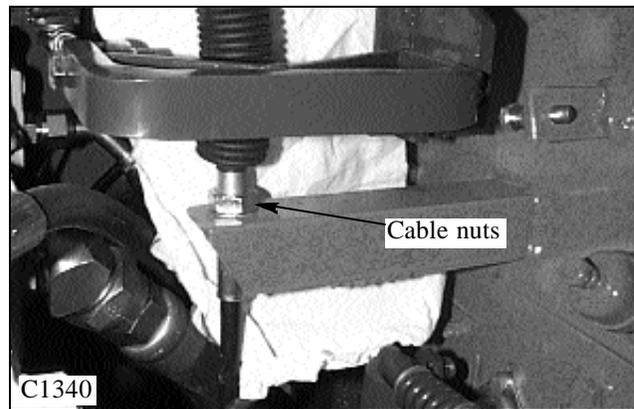
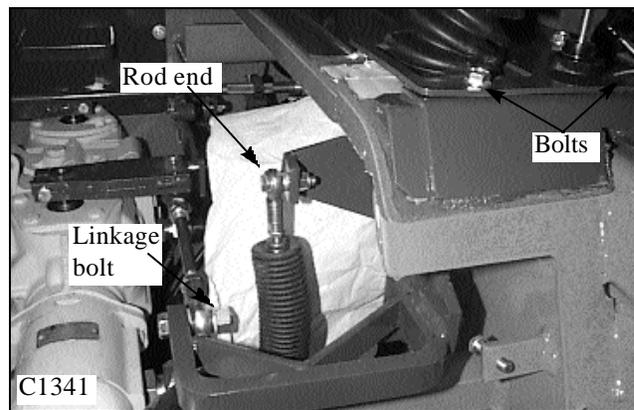
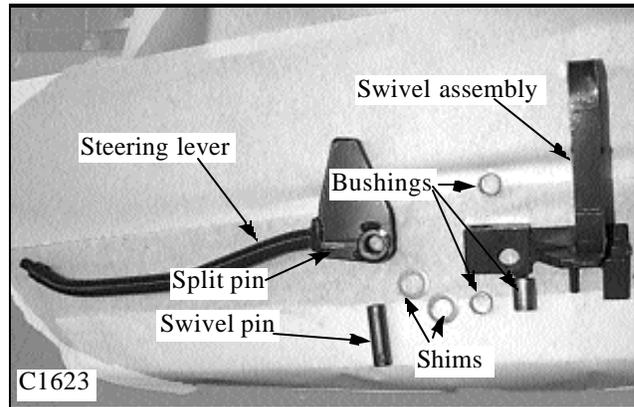
Making adjustments, or replacing parts may effect the neutral, or center, adjustment of the loader. Make sure loader wheel are raised securely from the ground before starting the engine.

Before making any adjustments to the control lever functions, make sure all pivot and swivel bushings are not worn allowing the steering lever to “flop” around. (fig. C1632) Check control cable rod ends and eyelets for excessive slack. (fig. C1341)

Replace the steering lever pivot assembly if needed, by removing the four bolts around the steering lever boot. Unhook the bolt holding the steering linkage to the steering lever. Remove the bolt holding the cable to the steering lever. Unhook the electrical plug at the base of the steering lever, going to the wires running up inside the steering lever, to the control handle. Remove the bolt holding the steering lever to the pivot. Remove the steering lever. (fig. C1341) Knock out the split pin, and remove the swivel pin. (fig. C1623,C2866) Upon reassembly you need to replace the shims that may have been used to limit before and after movement. Not all loaders have these shims. Replace the swivel assembly and reinstall removed parts in the reverse order. Be sure to replace the washers used as spacers between the rod ends and mounting surfaces. These keep the linkages from binding. Before starting the loader, make sure the wheels are raised securely off the ground. The adjustments or changes made may effect neutral centering, and cause the loader to move upon start up. Make neutral, wheel speed, and steering lever lock adjustments as outlined in sections 4.2 and 4.3.

Because the hand operated steering lever performs in two different directions, steering lever angles have to be set on two different vertical planes.

Take a base measurement of the loader frame, with an angle finder, first. This angle will need to be added or subtracted to the angles measured on the steering lever (fig. C1653).



4

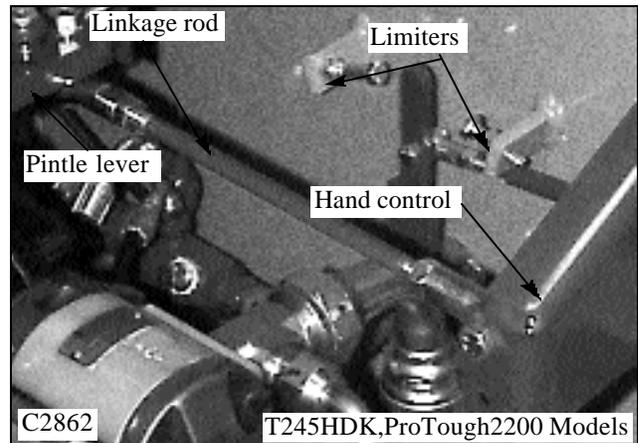
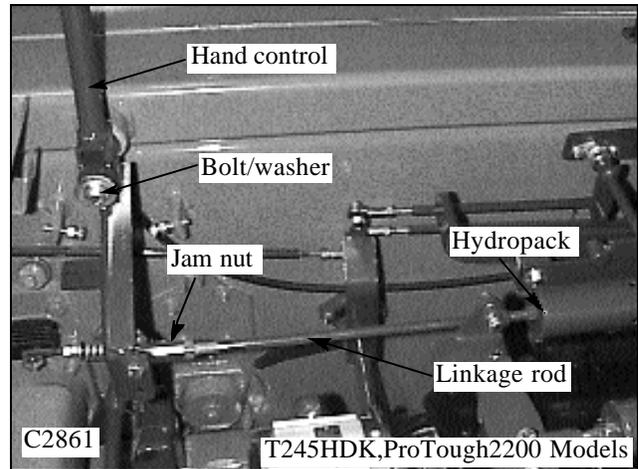
HAND CONTROLS 4.7

Linkage Rod Replacement

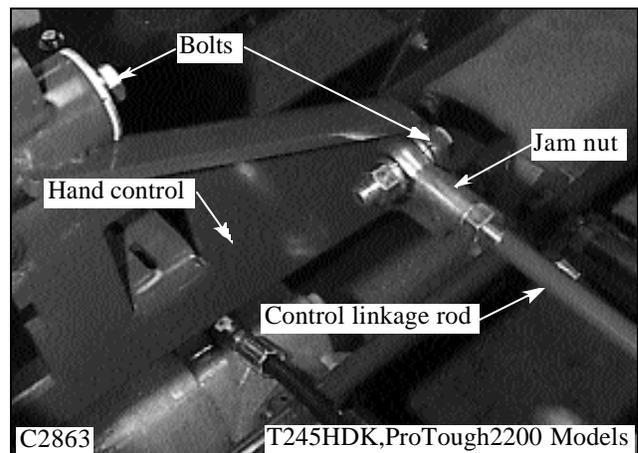
Check linkage rod ends, eyelets for wear before removing. Replace worn parts when replacing new linkage rods. Linkage rod ends should be inspected every 150 hours of operation.

- 1 Raise the boom arms, engage the boom supports and shut off the engine.
- 2 Remove the seat and hydrostatic shield.
- 3 Loosen the jam nuts on the linkage rod end and eyelet end. (fig. C2863).
- 4 Loosen the jam nuts. (fig. C2861,C2863).
- 5 Remove the bolts from control valve end of the linkage rod
- 6 Remove the linkage rod.
- 7 If the eyelet ends of the rod are worn replace them. If not reuse them.
- 8 Install the new linkage rods in the reverse order above. There must be a minimum of 7/16" (11 mm) of thread engagement into the linkage rod end and eyelet ends.

Note: After installation of a new cable, the control lever angle will need to be verified and adjusted if necessary. Refer to page 4-18.



IMPORTANT When setting control angles, always take a base measurement. Add or subtract this angle to give a true reading when measuring controls.



HAND CONTROLS 4.7

Control Lever Replacement

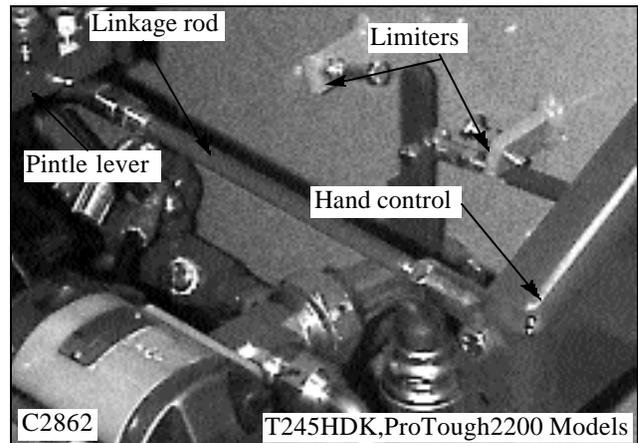
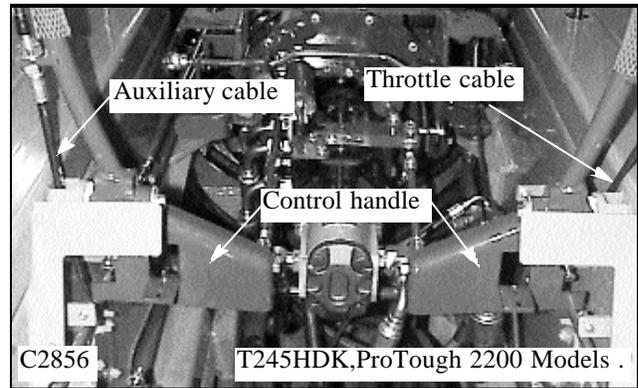
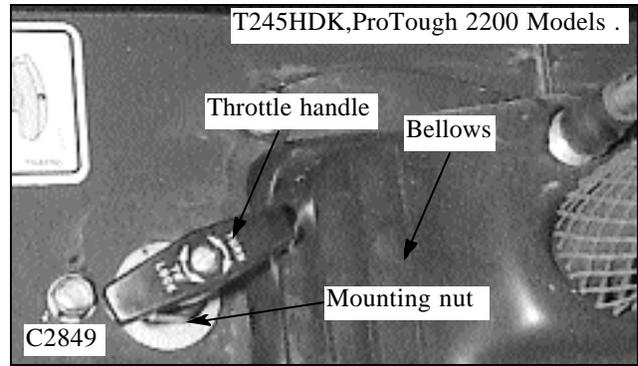
- 1 Raise the boom arms, engage the boom supports and shut off the engine.
- 2 Remove the seat and hydrostatic shield.
- 3 Remove the bellows cover screws (fig.C2849) and remove the bellows.
- 4 Remove the bolts from the control linkage rod where it is connected to the control arm.
- 5 Remove the bolt from the control rod and hydro back linkage Figure (C2861 previous page).
- 6 Remove the bolt which is connected to the main frame of the loader. Refer (Figure C2863).

Note: If the loader is equipped with optional electrical accessories operated by control handle mounted switches, the control handle switch wiring will need to be disconnected and transferred to the new steering lever. If the control lever functions are sloppy due to excessive wear should be replaced.

- 1 Remove the bolts from the ends of the linkage rod.
- 2 Remove the linkage rod.
- 3 Save any spacer washers that can be used again.
- 4 Replace the linkage rod assembly if required.

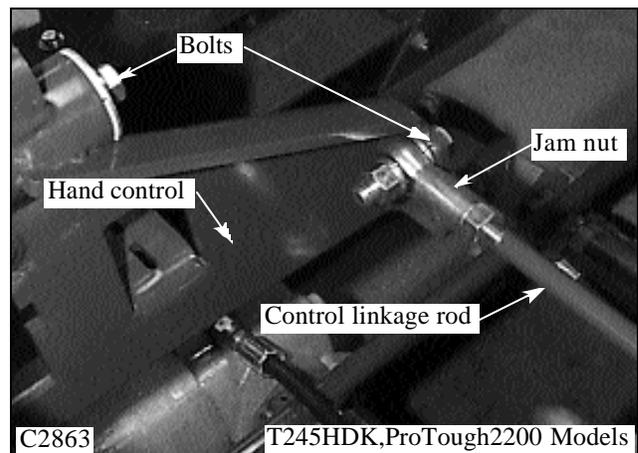
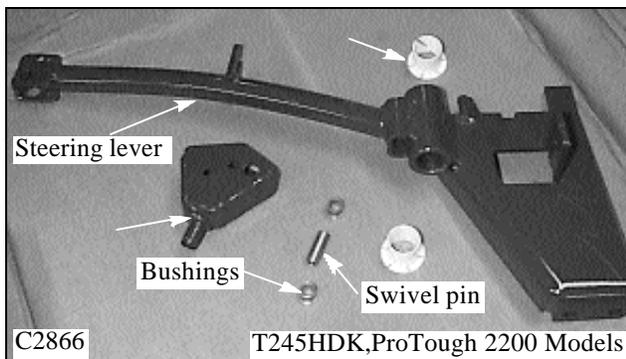
Install the control lever assembly to the loader in the reverse order of removal. Move the control lever after installation to check for binding and travel clearance. Check the control lever angles. Check the wheel speed, or tracking, to assure optimum performance.

Note: Refer to (Figure C2866). This figure shows a physical description of the control handle.



WARNING

Never work under the boom arms without the boom supports engaged.

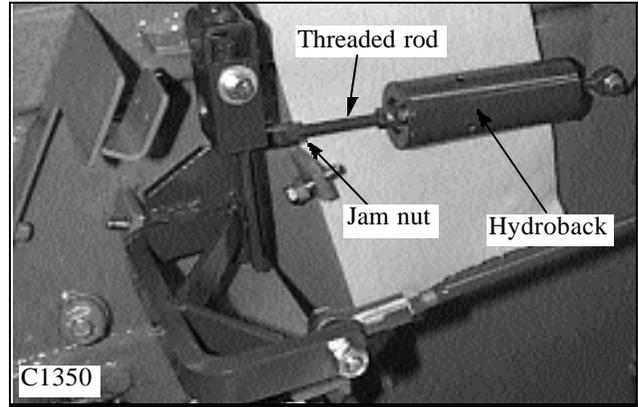


HAND CONTROLS 4.7

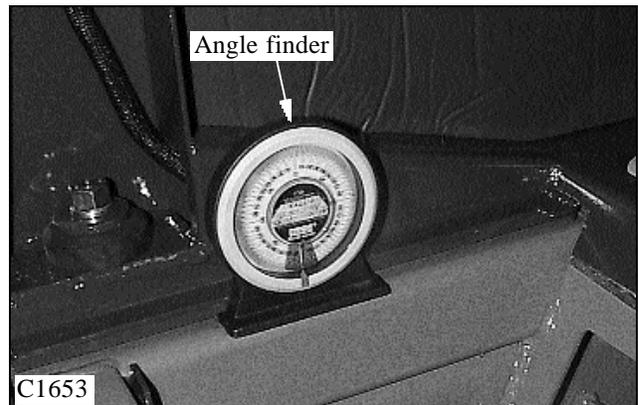
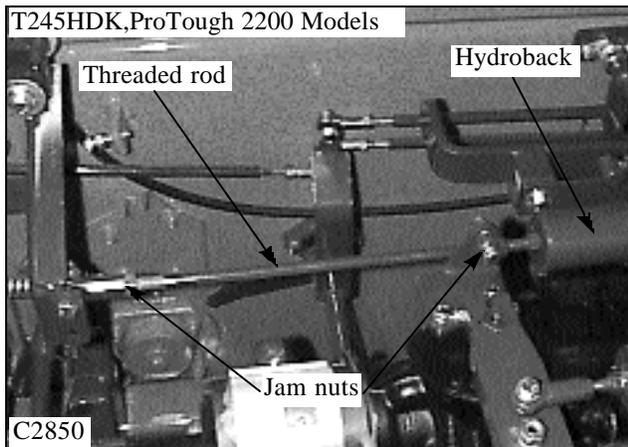
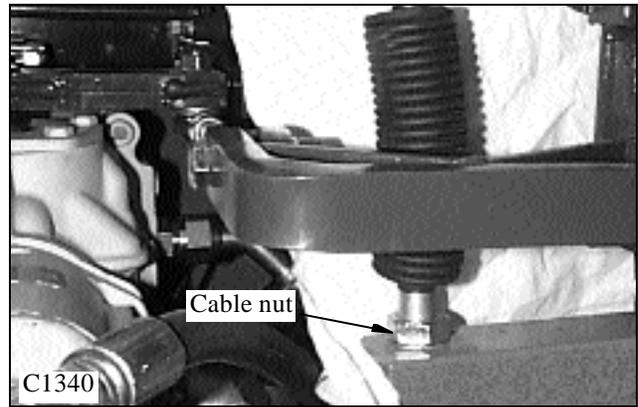
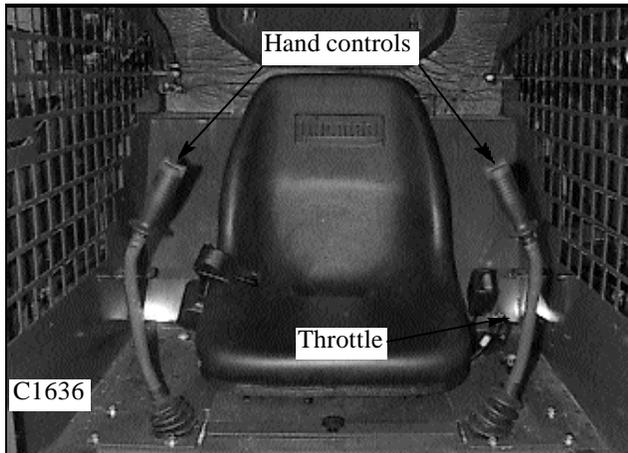
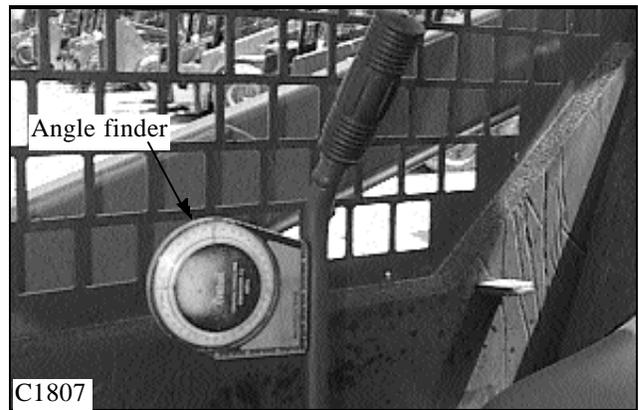
Adjust the distance away from the operator with the hydroback linkage. (fig. C1350)

Loosen the jam nut and turn the threaded rod in or out to reach the desired measurement. Set the angle 90 degrees to the horizontal measurement of the loader frame. (fig. C1807) Make sure there is a minimum of .375 inches (6mm) of threads holding the female rod end to the hydroback linkage.

Adjusting the in and out movement angle of the steering lever is accomplished by adjusting the nuts (jam nuts) on the cables or linkage rods. (Figures C1340 & C2850). Take a base angle measurement of the loader. (fig. C1653) This angle will need to be added or subtracted to the angle measured at the steering lever.



IMPORTANT When setting control angles, always take a base measurement. Add or subtract this angle to give a true reading when measuring controls.



Cable
nuts

Cotter pins

C1385

Throttle handle

Mounting nut

C1923

T245HDK,ProTough 2200 Models .

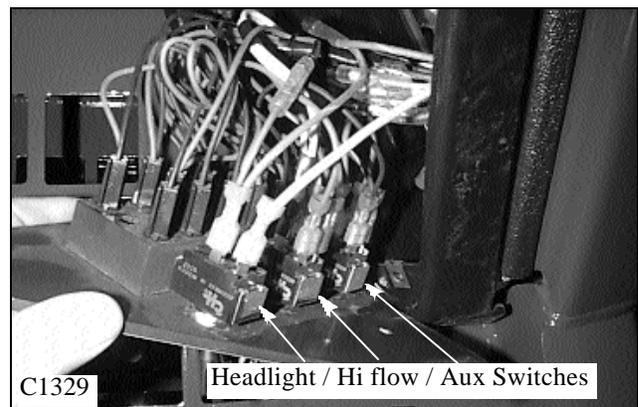
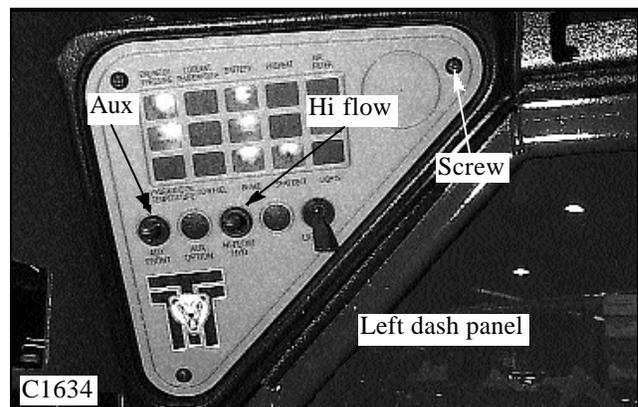
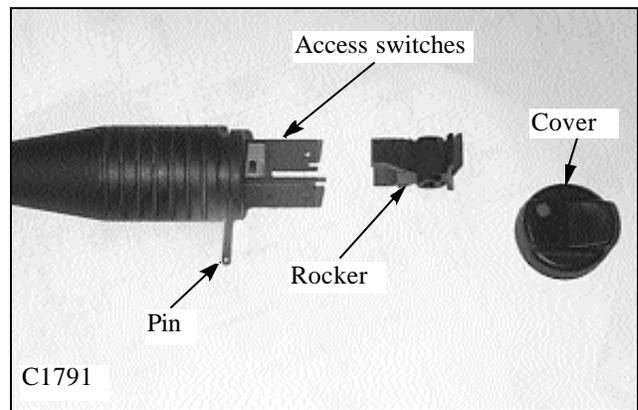
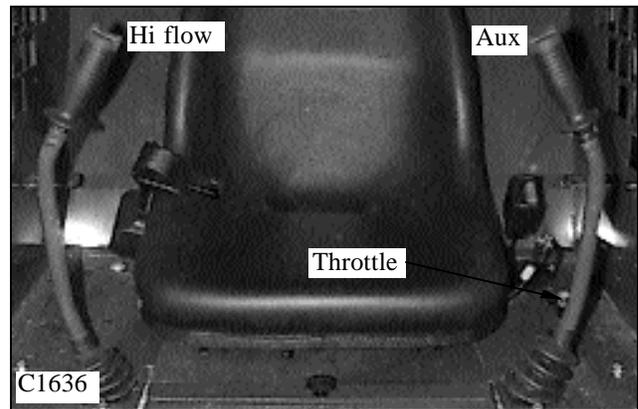
AUX AND HI FLOW 4.9

The auxiliary hydraulics, and optional Hi-flow hydraulics, are controlled by electrical switches located in the top of each steering lever handle. (fig. C1636) Each handle contains two separate switches for forward and reverse operation of hydraulic flow. These are momentary switches, you must hold the button down manually to maintain hydraulic flow. The left hand dash panel also holds a single pole switch for auxiliary and or hi flow hydraulic operation. (fig. C1634) These switches engage the hydraulics in one direction only, until manually turned off.

Remove the seat and access the battery compartment. Disconnect both battery ground cables. Disconnect the wiring plug at the base of each steering lever before changing the switches in the handles. Remove the rubber cap on top off the control handle. Remove the pin holding the rocker in place. Pull the switches out making sure to feed the wire up the steering lever if more slack is needed. Take note of which color wire hooks to each terminal. There are three wires on each switch. Replace the switch, or switches, and replace in reverse order.

Access the dash panel switches by removing the three screws on the front panel. (fig. C1634)

The switches are held in by a single nut, turned on hand tight. Note the wiring locations on the switch and replace the switch. Do not over tighten the dash panel screws when reinstalling.



AUX AND HI FLOW 4.9

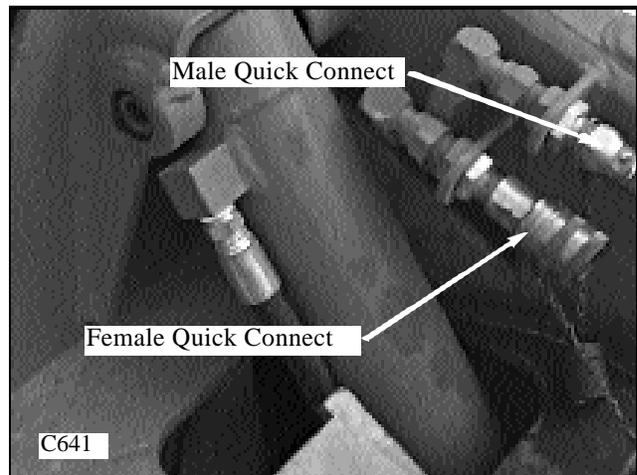
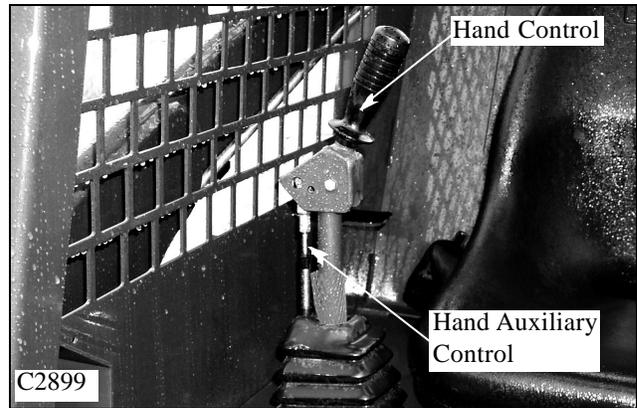
ProTough 2200 Model

The Auxiliary Hand Control. Is located on the R.H. steering control lever (Fig. C2899) it is used to engage the loaders auxiliary hydraulic circuit to power attachments such as post hole augers, sweepers etc.

By pressing and holding the hand auxiliary control handle towards the left this provides hydraulic flow to the female quick connect coupling located at the front of the boom arms (Fig. C641). Releasing the hand auxiliary control handle returns the auxiliary hydraulic circuit to neutral, stopping hydraulic flow.

By pressing and holding the hand auxiliary control handle towards the right this provides hydraulic flow to the male quick connect coupling located at the front of the boom arms (Fig. C641). Releasing the hand auxiliary control handle returns the auxiliary hydraulic circuit to neutral, stopping hydraulic flow.

For continuous flow to the auxiliary hydraulic circuit, position the hand auxiliary control handle towards the left this provides continuous hydraulic flow to the female quick connect coupling located at the front of the boom arms (Fig. C641). To stop hydraulic flow to the auxiliary hydraulic circuit, return the hand auxiliary control handle to the neutral position.



AUX AND HI FLOW 4.9

T245HDK Model

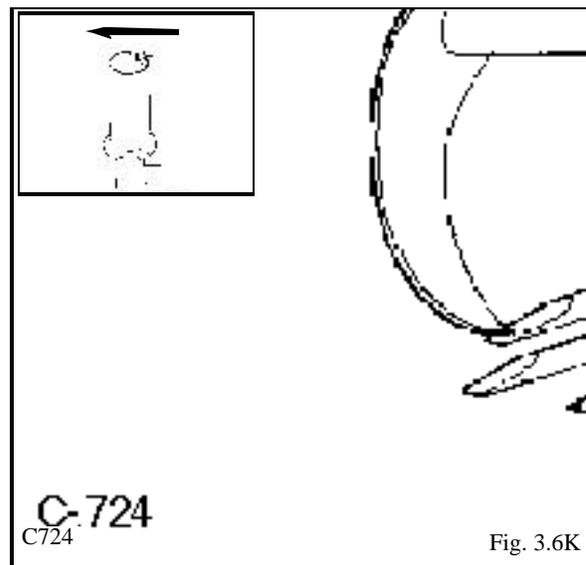
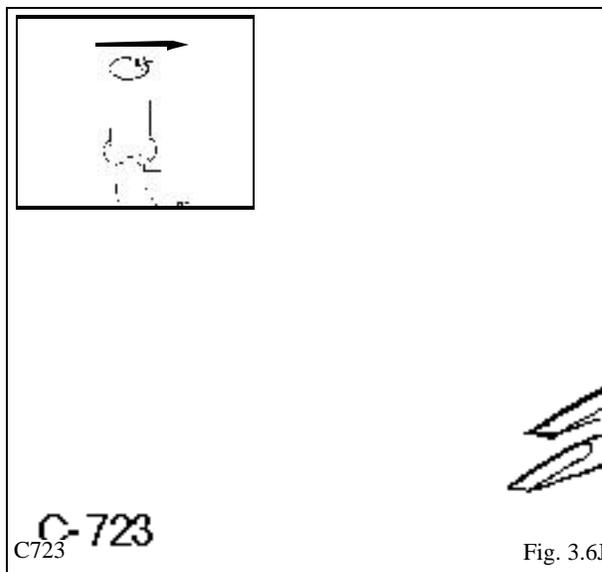
To operate an attachment such as a grapple fork the Left Hand Control Lever will be used. Push right of neutral on the Auxiliary Hydraulic Control Switch to open the grapple (See Fig. 3.6J), or push on the heel of the auxiliary control pedal if so equipped.

To close the grapple (Fig. 3.6K), push left of neutral on the Auxiliary Hydraulic Control Switch, or push down on the toe of the auxiliary pedal if so equipped. The boom and the bucket pedals can be used to raise and tilt the grapple as with a bucket.

To operate an attachment which requires a constant flow of oil such as a backhoe or sweeper, a toggle switch on the L.H. instrument panel should be placed in the ON position.

When the auxiliary circuit is not in use switch to the OFF position otherwise starting the loader may be difficult or impossible and damage to the starter may occur.

NOTE: The optional right hand control lever Auxiliary Control Switch, if equipped, operates a Horn, or Hi-Flow hydraulics.



NOTES

SECTION 5 ELECTRICAL

Specifications	5.1
Wiring Schematics	5.2
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Manifold Pre-Heat.....	5.5
Battery	5.6
Electrical Panel	5.7
Starter Circuit	5.8
Charging Circuit.....	5.9
Safety Circuit	5.10
Auxiliary Circuit	5.11
Accessory Circuit.....	5.12
Trouble Shooting.....	5.13

SPECIFICATIONS 5.1

T243HDS,T245HDS Models only

Ignition	12 Volts
Grounding	Negative
Alternator Brand.....	Bosch
Alternator Rating	55 Amp
Alternator Type	Internal Regulator
Batteries	Two (2) x 12v
Battery Rating	730 CCA, .....125 Reserve Minutes (each)
Battery Type.....	SERV 3478
Starter Brand.....	Bosch
Pre - Heater	One (1)
Pre - Heater Location	Manifold
Circuit Breaker	50 Amp
Fuse Rating:	
Shut Off Solenoid	15 Amp
Seat Belt Safety	15 Amp
Horn	10 Amp
Aux. Hydraulics.....	10 Amp
Starter	40 Amp Relay
Manifold Heater	40 Amp Relay



SPECIFICATIONS 5.1

T245HDK, ProTough 2200 Models

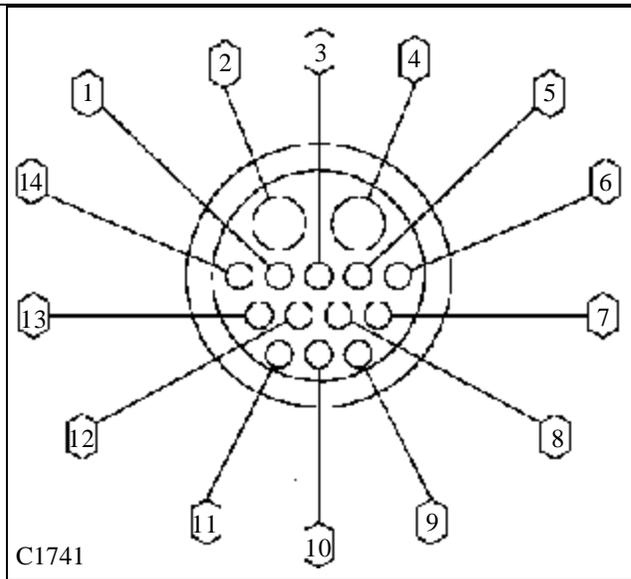
Ignition	12 Volts
Grounding	Negative
Alternator Brand	Kubota
Alternator Rating	60 Amp
Alternator Type	Internal Regulator
Batteries	Two (2) T245HDK
Batteries.....	One (1) ProTough 2200
Battery Rating	730 CCA,
.....	125 Reserve Minutes (each)
Battery Type.....	SERV 3478
Starter Brand	Kubota
Glow plugs	Four (4)
Glow plugs location	Cylinder head
Circuit Breaker	50 Amp
Fuse Rating:	
Shut Off Solenoid	15 Amp
Seat Belt Safety	15 Amp
Horn	10 Amp
Aux. Hydraulics T245HDK only	10 Amp
Starter	40 Amp Relay
Glow plugs	40 Amp Relay



WIRING SCHEMATIC 5.2

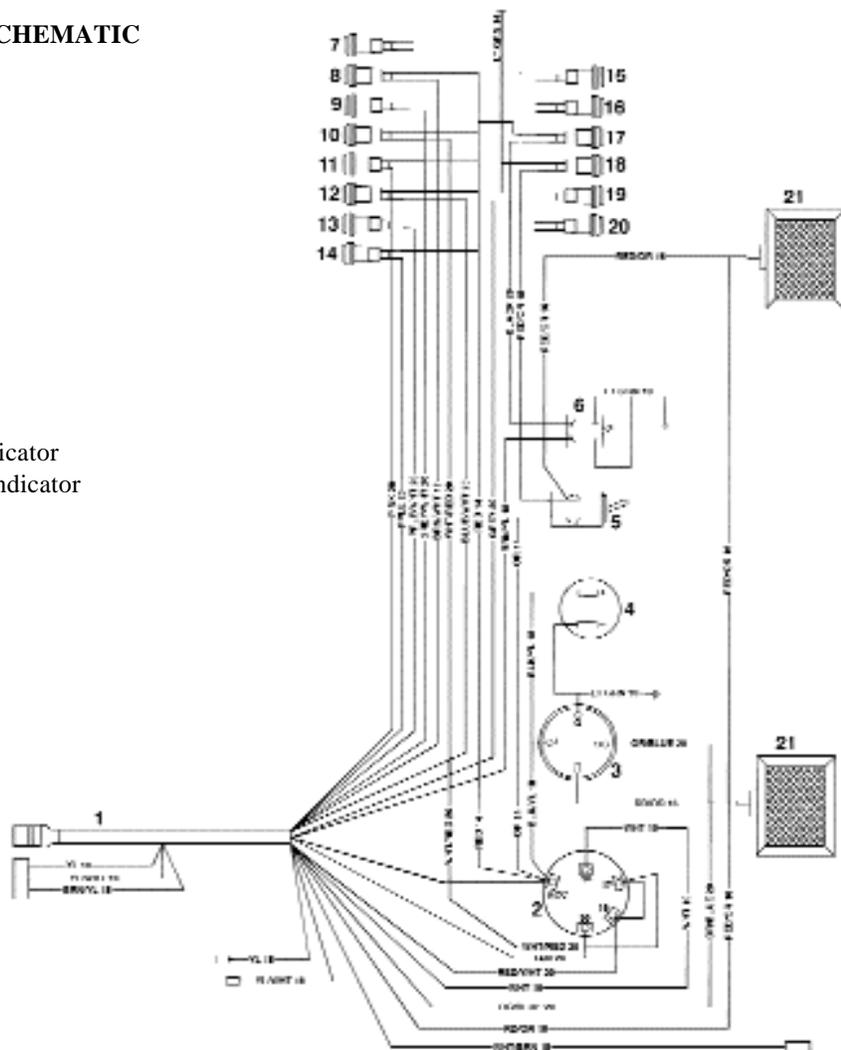
Diagram C1741 shows the wire color and function of each pin in the main wire harness plug, ROPS side.

PIN	WIRE COLOR	FUNCTION
1	Purple	Eng. oil press. indicator
2	White	Ignition (30)
3	Red / Wht	Ignition (19)
4	Blk / Wht	Ignition (acc)
5	Tan	Ignition (50)
6	Grey	Seat belt indicator
7	Grey / Wht	Alternator (L) indicator
8	Blue / Wht	Hyd. temp. indicator
9	Org / Blue	Fuel level (+) gauge
10	Red / Org	Headlight
11	Brn / Wht	Brake light
12	Wht / Brn	Horn
13	Purple / Wht	Coolant temp. indicator
14	Pink	Air filter indicator

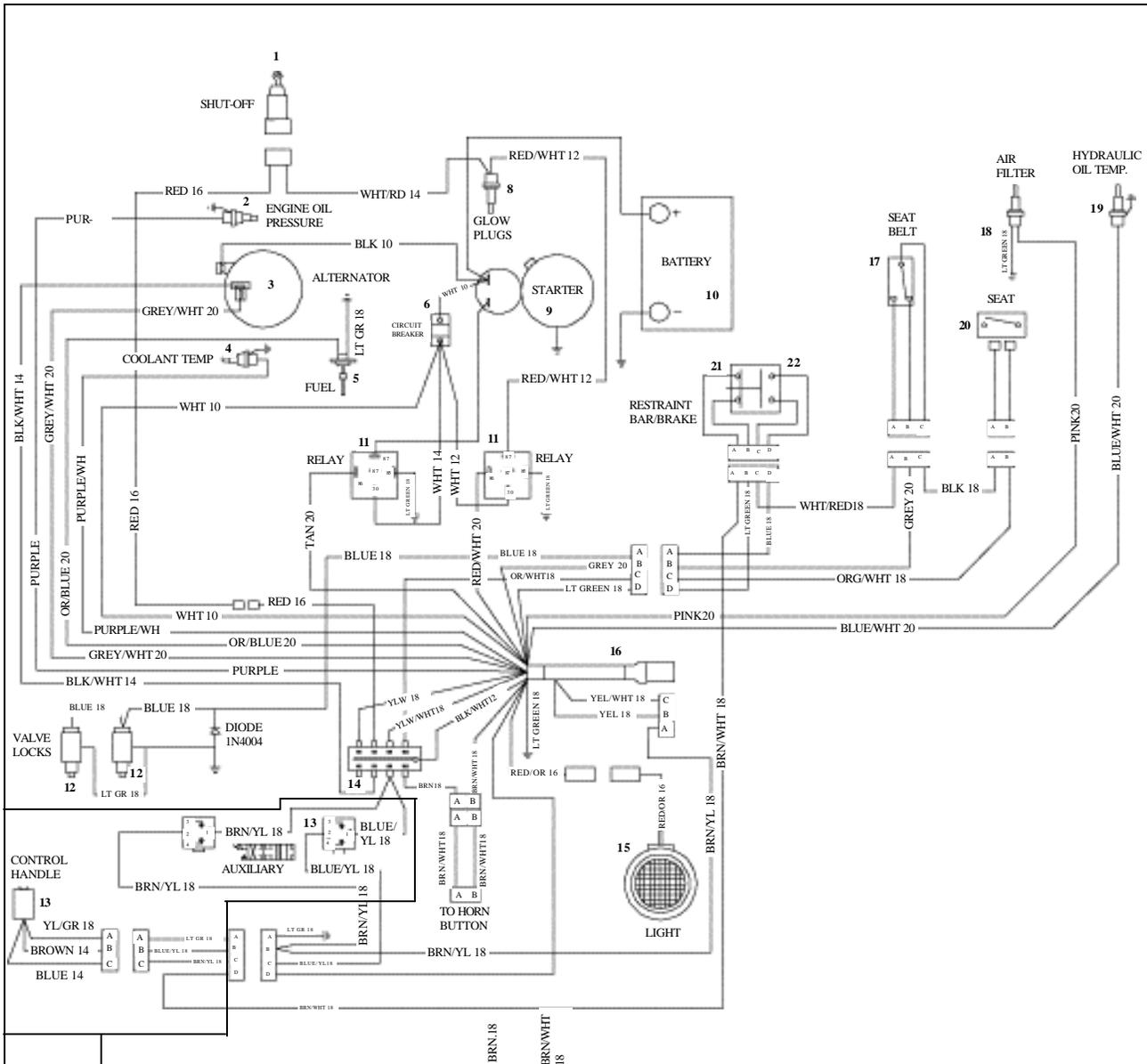


T245HDK WIRING SCHEMATIC

- 1 ROPS wire harness
- 2 Ignition switch
- 3 Fuel gauge
- 4 Hour meter
- 5 Headlight switch
- 6 Auxiliary switch
- 7 Charge pressure indicator
- 8 Brake light indicator
- 9 Battery indicator
- 10 Pre-heat indicator
- 11 Air filter indicator
- 12 Hydraulic oil temperature indicator
- 13 Engine coolant temperature indicator
- 14 Engine oil pressure indicator
- 15 Hi-flow hydraulic indicator
- 16 Auxiliary rear indicator
- 17 Auxiliary front indicator
- 18 Headlight indicator
- 19 Seat belt indicator
- 20 Low fuel indicator
- 21 Front headlights



WIRING SCHEMATIC 5.2



WIRE SCHEMATIC

T245HDK, ProTough 2200 Models

N/A FOR THE PROTOUGH 2200 MODELS

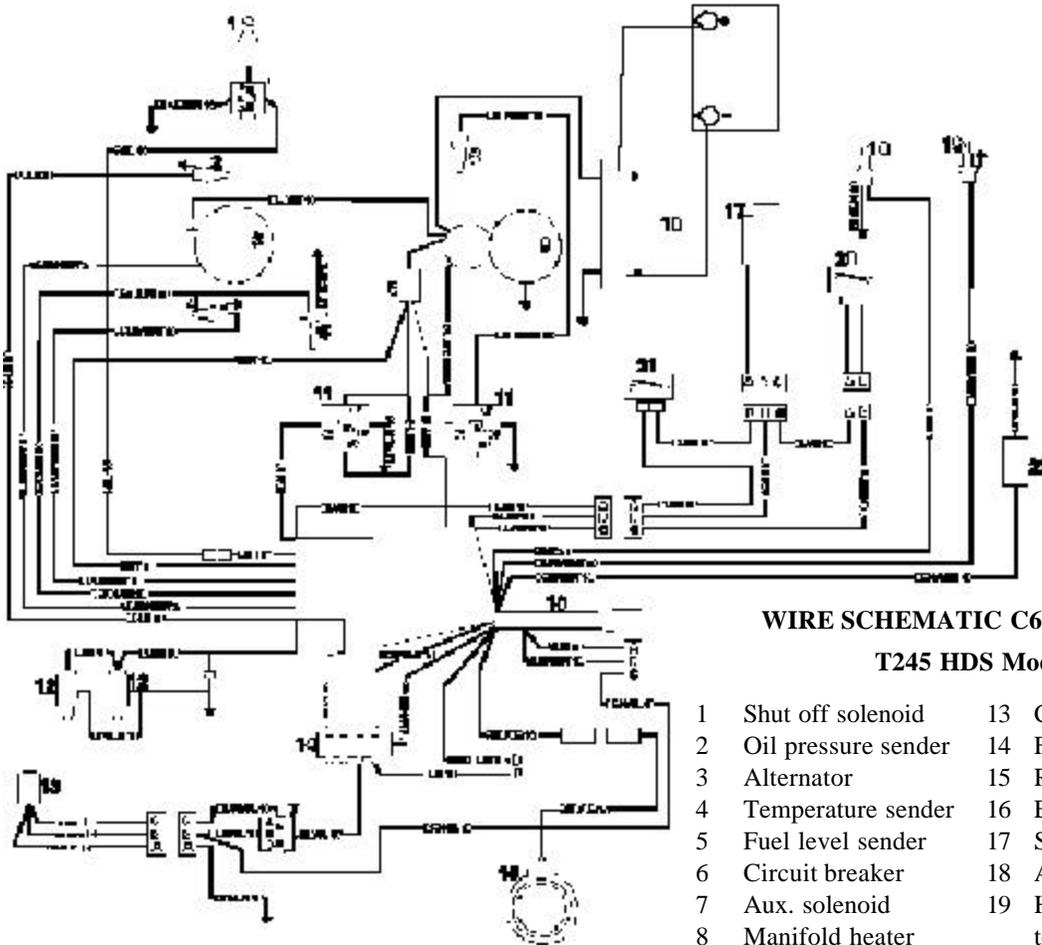
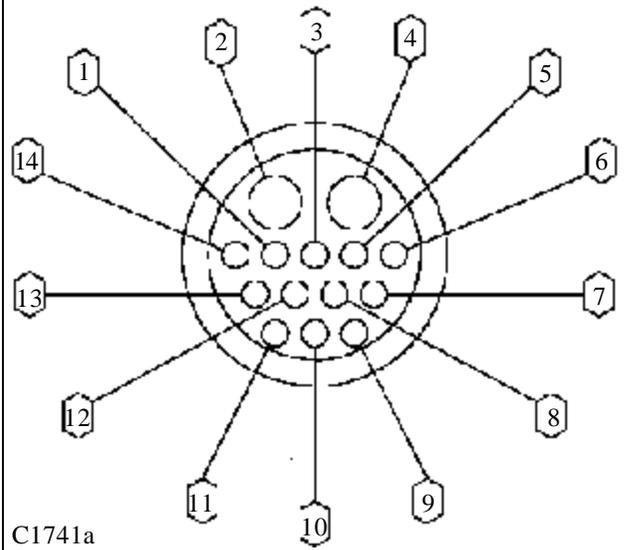
- | | |
|-----------------------|-------------------------------------|
| 1 Shut off solenoid | 13 Control handle |
| 2 Oil pressure sender | 14 Fuse panel |
| 3 Alternator | 15 Rear work light |
| 4 Temperature sender | 16 Engine harness |
| 5 Fuel level sender | 17 Seat belt switch |
| 6 Circuit breaker | 18 Air filter sender |
| 7 Aux. solenoid | 19 Hydraulic oil temperature sender |
| 8 Manifold heater | 20 Seat switch |
| 9 Starter | 21 Restraint switch |
| 10 Battery | 22 Brake switch |
| 11 Relay | |
| 12 Valve locks | |

C2819

WIRING SCHEMATIC 5.2 TO S/ N LM000288

Diagram C1741a shows the wire color and function of each pin in the main wire harness plug, Engine side.

PIN	WIRE COLOR	FUNCTION
1	Tan	Starter relay
2	Blk / Wht	Fuse block
3	Red / Wht	Glow plug relay
4	White	Circuit breaker
5	Purple	Engine oil pressure
6	Pink	Air filter
7	Purple / Wht	Coolant temperature
8	Wht / Brn	Horn button
9	Brn / Wht	Brake light
10	Red / Org	Rear light
11	Org / Blue	Fuel level (+)
12	Blue / Wht	Hydraulic temperature
13	Grey / Wht	Alternator (L)
14	Grey	Seat belt



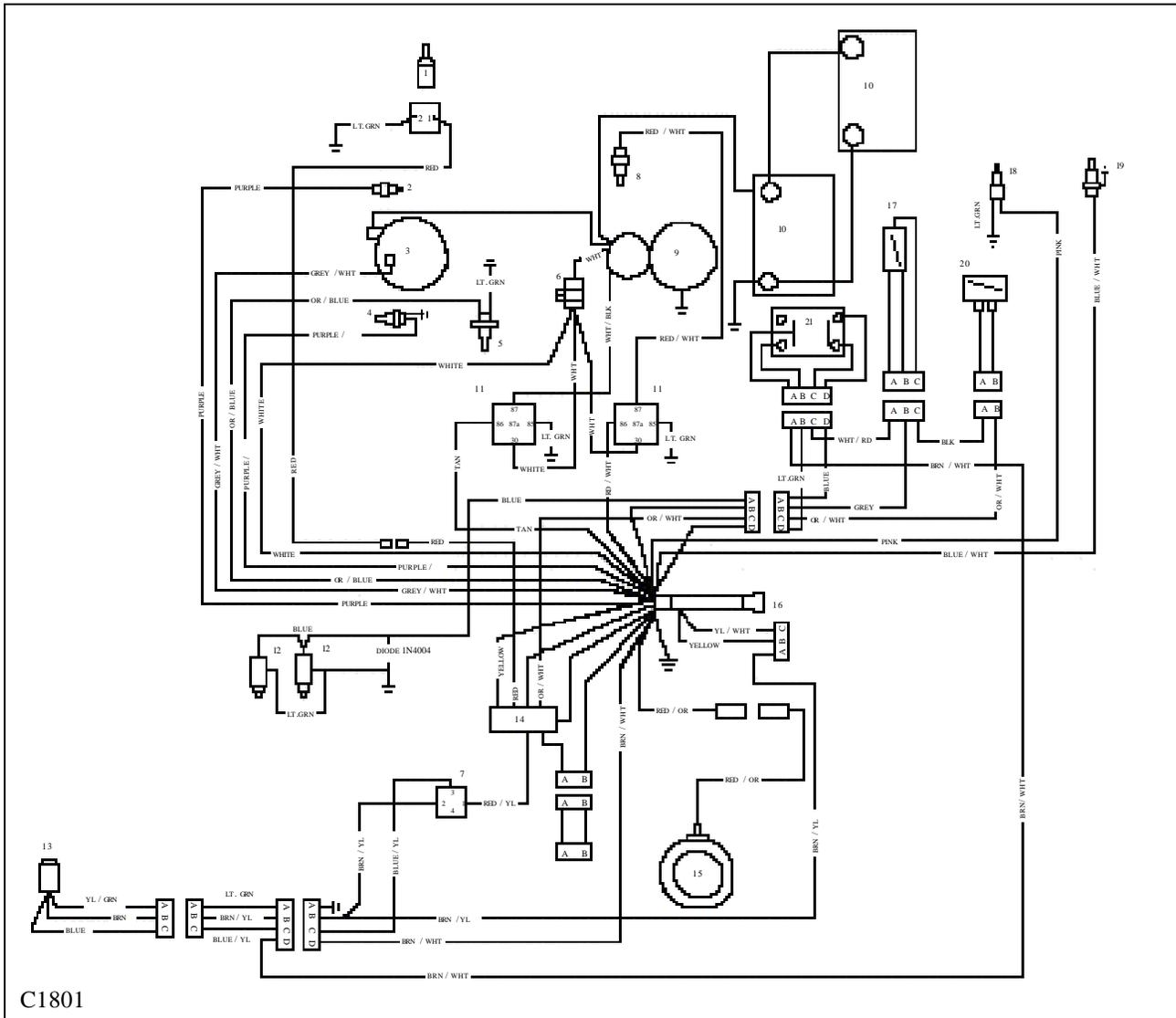
WIRE SCHEMATIC C646 LEGEND T245 HDS Model

- | | |
|-----------------------|-------------------------------------|
| 1 Shut off solenoid | 13 Control handle |
| 2 Oil pressure sender | 14 Fuse panel |
| 3 Alternator | 15 Rear work light |
| 4 Temperature sender | 16 Engine harness |
| 5 Fuel level sender | 17 Seat belt switch |
| 6 Circuit breaker | 18 Air filter sender |
| 7 Aux. solenoid | 19 Hydraulic oil temperature sender |
| 8 Manifold heater | 20 Seat switch |
| 9 Starter | 21 Restraint switch |
| 10 Battery | 22 Brake switch |
| 11 Relay | |
| 12 Valve locks | |

C646

WIRING SCHEMATIC 5.2

S / N LM000289 ONWARD



WIRE SCHEMATIC C1801 LEGEND

243 HDS Model

- | | |
|-----------------------|----------------------|
| 1 Shut off solenoid | 13 Control handle |
| 2 Oil pressure sender | 14 Fuse panel |
| 3 Alternator | 15 Rear work light |
| 4 Temperature sender | 16 Engine harness |
| 5 Fuel level sender | 17 Seat belt switch |
| 6 Circuit breaker | 18 Air filter sender |
| 7 Aux. solenoid | 19 Hydraulic oil |
| 8 Manifold heater | temperature sender |
| 9 Starter | 20 Seat switch |
| 10 Battery | 21 Restraint / brake |
| 11 Relay | switch |
| 12 Valve locks | |

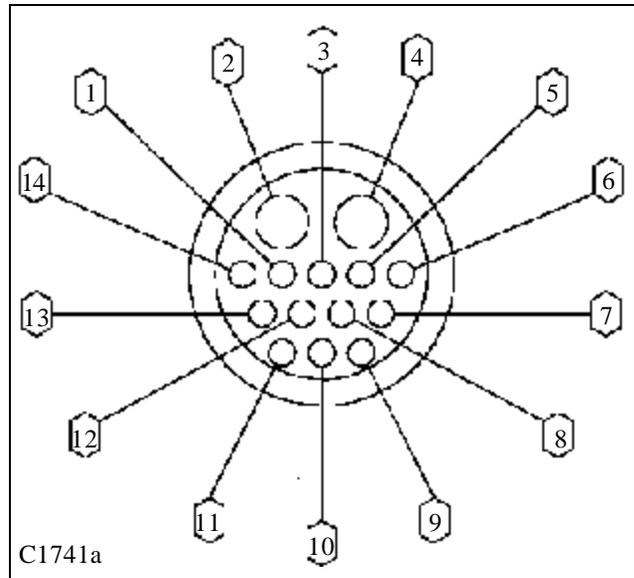
NOTE: The main engine wiring harness pin number and wire color for S / N LM000289 Onward is the same as previous loaders, as shown on wiring schematic C1741a on the previous page. The ROPS harness' are the same, no changes as shown in schematics C648 and C1741.



WIRING SCHEMATIC 5.2

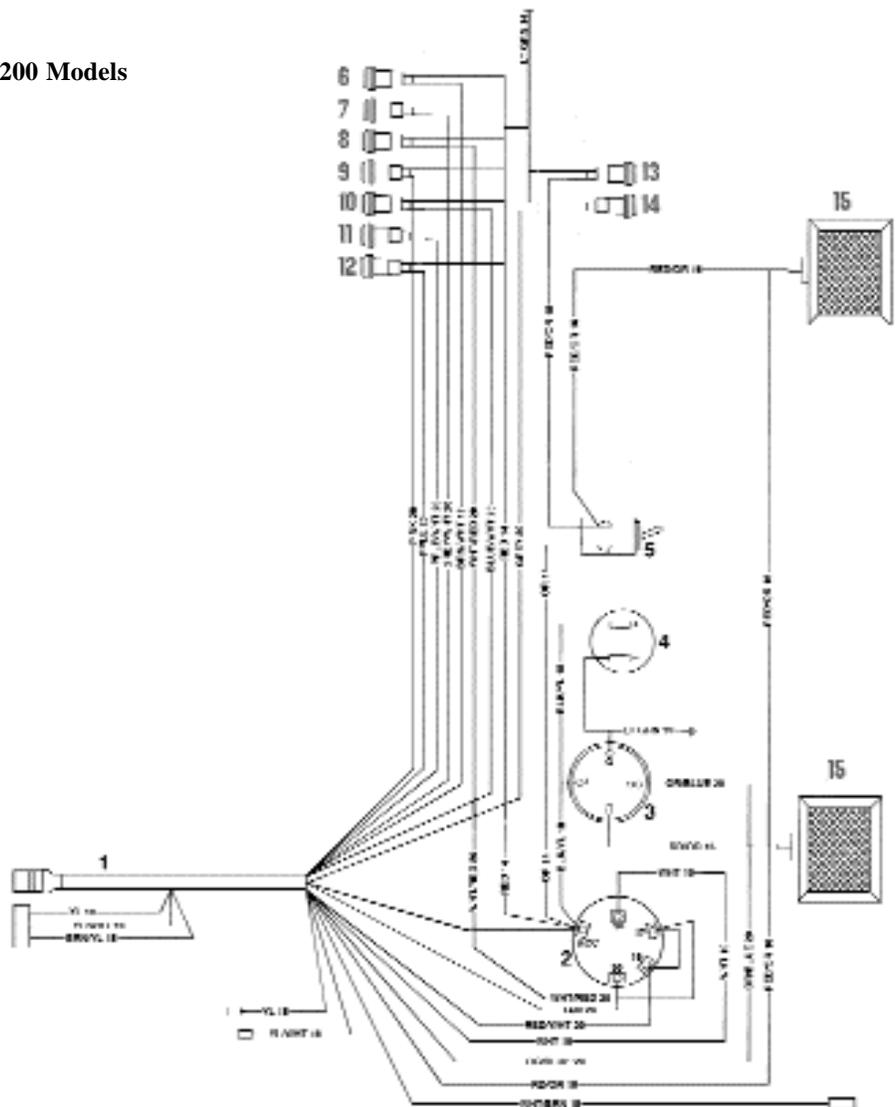
Diagram C1741a shows the wire color and function of each pin in the main wire harness plug, Engine side.

PIN	WIRE COLOR	FUNCTION
1	Tan	Starter relay
2	Blk / Wht	Fuse block
3	Red / Wht	Glow plug relay
4	White	Circuit breaker
5	Purple	Engine oil pressure
6	Pink	Air filter
7	Purple / Wht	Coolant temperature
8	Wht / Brn	Horn button
9	Brn / Wht	Brake light
10	Red / Org	Rear light
11	Org / Blue	Fuel level (+)
12	Blue / Wht	Hydraulic temperature
13	Grey / Wht	Alternator (L)
14	Grey	Seat belt



Electrical System ProTough 2200 Models

1. ROPS Wire Harness
2. Ignition Switch
3. Fuel Gauge
4. Hour Meter
5. Light Switch
6. Brake Indicator Light
7. Battery Indicator Light
8. Pre-Heat Indicator Light
9. Air Filter Indicator Light
10. Hydraulic Oil Temperature Indicator Light
11. Engine Coolant Temperature Indicator Light
12. Engine Oil Pressure Indicator Light
13. Lights Indicator Light
14. Seat Belt Indicator Light
15. Front Work Lights



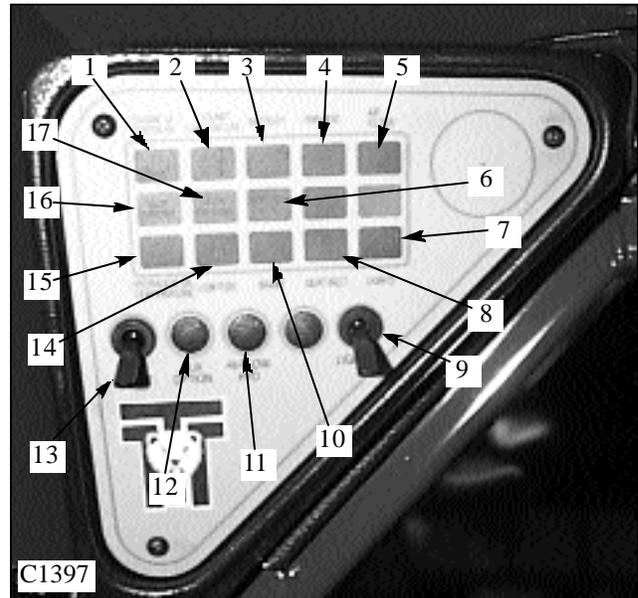
C2901

NOTES

INSTRUMENTATION 5.3

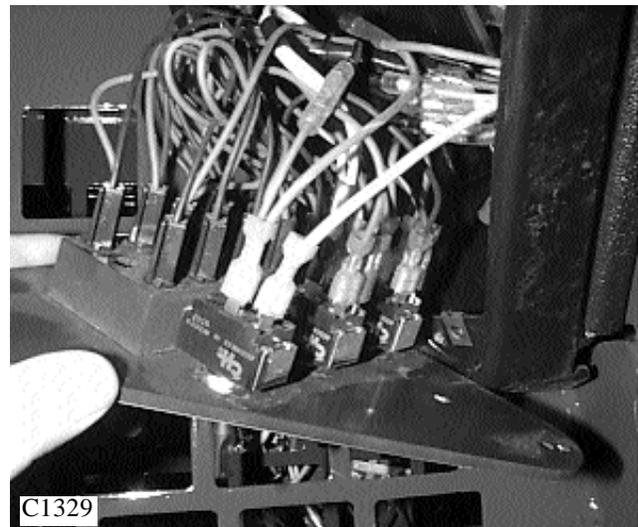
LEGEND FOR FIGURE C1397

- 1 Engine oil pressure
- 2 Engine coolant temperature
- 3 Alternator indicator
- 4 Engine preheat indicator
- 5 Air filter restriction indicator
- 6 Hi -flow hydraulics indicator
- 7 Headlight indicator
- 8 Seat belt indicator
- 9 Headlight switch
- 10 Parking brake indicator
- 11 Hi -flow hydraulic switch
- 12 Optional switch location
- 13 Auxiliary hydraulic switch
- 14 Hydraulic charge pressure indicator
- 15 Hydraulic oil temperature indicator
- 16 Auxiliary hydraulics indicator indicator
- 17 Option switch indicator

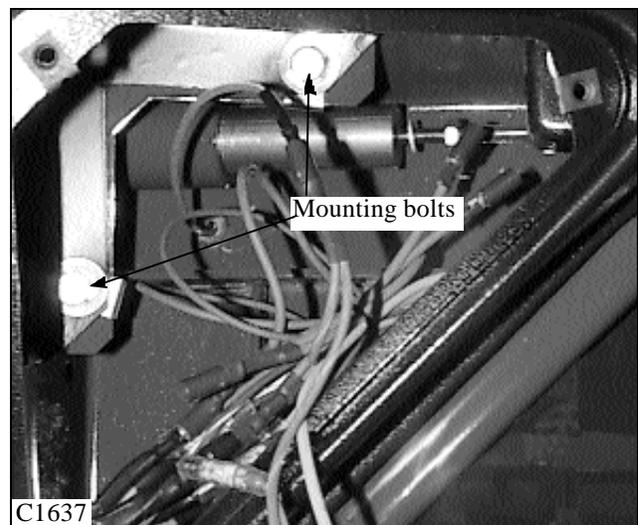


To replace a malfunctioning switch or indicator light:

- 1 Remove the three screws retaining the electrical panel to the dash pod. (fig. C1397, C1329)
- 2 Disconnect the spade terminals on the rear of the switch. (fig. C1329)
- 3 Remove the switch by unscrewing the knurled nut on the front of the electrical panel.
- 4 Replace an indicator light by turning out the bulb and disconnecting the wire ends from the wiring harness.
- 4 Replace the switch, indicator light and panel in the reverse order.



If the dash pod is damaged, remove the two mounting bolts and slip over the dash panel. (fig. C1637)
Disconnect all panel wiring if replacing the complete unit. Replace the parts in reverse order. Follow the wiring schematics to properly locate the switches and wiring in position.



INSTRUMENTATION 5.3

Replacement

To replace a faulty gauge, meter or switch in the right hand dash panel:

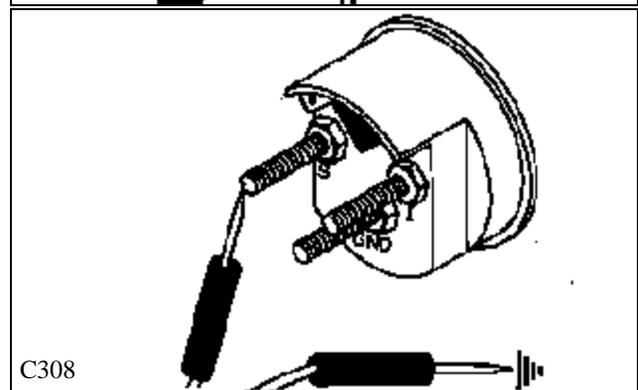
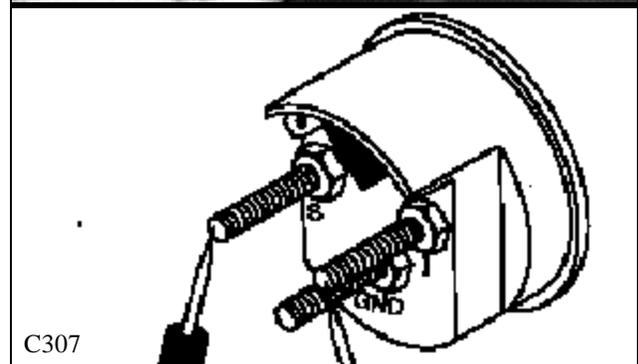
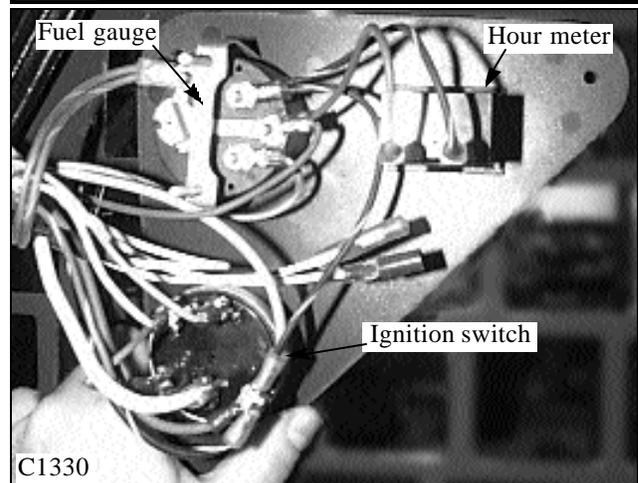
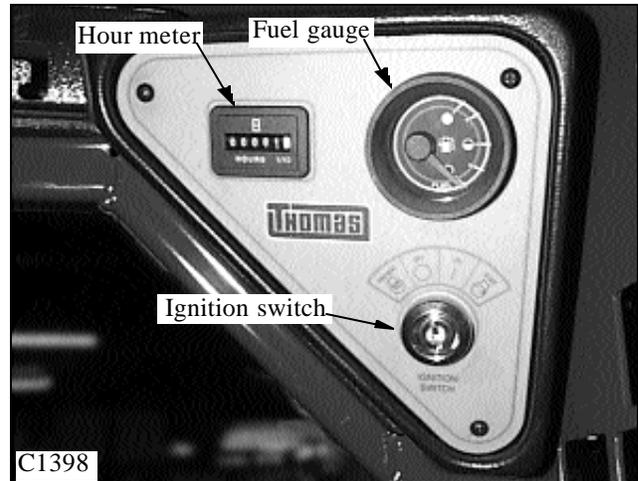
- 1 Remove the three screws retaining the dash panel to the dash pod. (fig. C1398)
- 2 Access the rear of the dash panel.
- 3 Remove the wiring from the effected part.
- 4 The fuel gauge is retained by a bracket and 2 mounting nuts. Remove the nuts and the gauge can be replaced.
- 5 The ignition switch is retained by the knurled nut on the outside of the dash panel. Remove the nut and the switch can be replaced.
- 6 The hour meter is retained in the dash panel with molded in tabs. Squeeze the tabs together and the hour meter can be replaced.

Testing the Fuel Gauge

- 1 Remove the right hand dash panel to access the gauge. (fig. C1330)

- 2 With the ignition switch off, connect an ohmmeter between the "S" terminal and the "I" terminal. (fig. C307)
 - 3 An ohmmeter reading of 150 to 250 ohms is normal. A higher or lower reading means the gauge is faulty and needs to be replaced.
- NOTE: If the fuel gauge test results were good and the gauge still fails to function do the following test.

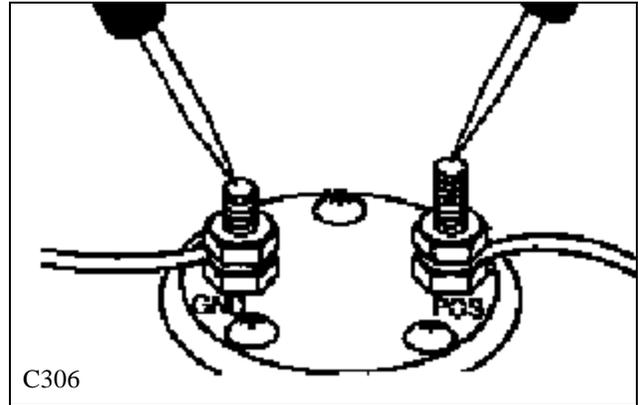
- 1 With the ignition switch off, connect an ohmmeter between the "S" terminal and the other end to ground.
 - 2 An ohmmeter reading of 50 to 500 ohms is normal. A higher or lower reading means the wire going to the "S" terminal is faulty.
- NOTE: If the test is good, check the fuel sending unit in the fuel tank for failure.



INSTRUMENTATION 5.3

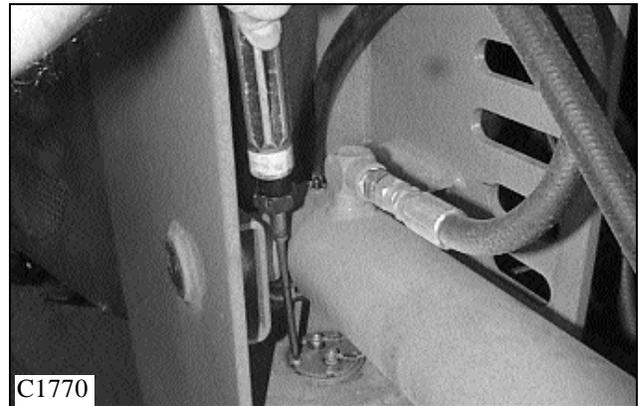
Testing the Fuel Sender

- 1 With the ignition switch off, connect an ohmmeter between the positive and negative terminals of the fuel sending unit. (fig. C306)
- 2 An ohmmeter reading of 50 to 500 is normal. A reading higher or lower means a faulty sender and will need replaced.



Replacement

- 1 Remove any attachment, raise the boom arms and engage the boom support pins. Shut off the engine and engage the parking brake.
- 2 Remove the two wires connected to the fuel sending unit. The fuel sender is located just below the lift cylinder, right hand side, on the fuel tank.
- 3 Remove the five screws retaining the sender to the fuel tank.
- 4 Remove the sending unit and discard the gasket.
- 5 Install a new sending unit and gasket. Use gasket sealant on both sides of the gasket.
- 6 Use thread sealant on the screws and torque the screws to 20 inch / lbs. (fig. C1770)
- 7 Connect the sender wires taking care not to overtighten the nuts and stripping the studs. Green wire is ground.



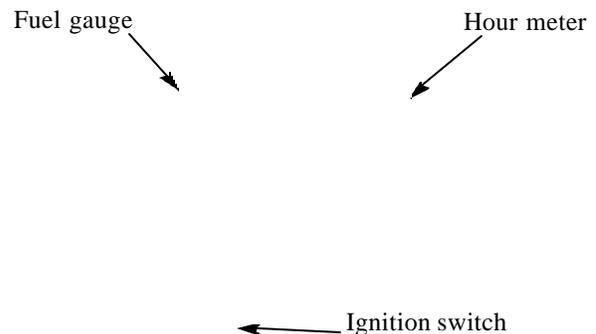
Testing the Hour Meter

The hour meter records the number of engine operating hours.

To check the hour meter, remove the three screws retaining the right hand dash panel to the dash pod. (fig. C1398, C1330)

Using a 12 volt test meter, connect the positive lead to the positive terminal of the hour meter and the ground lead of the tester to a good ground. Turn the ignition switch to the "RUN" position.

A reading of 12 volts means the hour meter is defective. No voltage reading means there could be a problem in the wire running from the "ACC" terminal on the ignition switch to the positive side of the hour meter or a defective ignition switch.



C1330

IGNITION SWITCH 5.4

Ignition Switch Testing

The ignition switch is a four position switch. OFF, PRE-HEAT, RUN and START. Turning the key counterclockwise will engage the PREHEAT. To activate the starter, turn the key clockwise. When the key is released it will return to the RUN position.

Before performing any test to the ignition switch, disconnect the negative or ground wire from the battery terminal. Remove the three screws retaining the right hand dash panel to the dash pod to access the ignition switch.

TEST 1: "RUN" POSITION.

Connect an ohmmeter across the terminals marked 30 and ACC. (fig. C297) Turn the ignition switch to the run position.

A low resistance reading is normal. High resistance reading means you will have to replace the ignition switch.

TEST 2: "START" POSITION.

(a) Connect an ohmmeter between the terminals marked 30 and 50 on the ignition switch. (fig. C298) Turn the ignition switch to the "START" position and observe the ohm readings.

(b) Connect the ohmmeter leads across terminals marked 30 and 17 on the ignition switch. (fig. C299) Turn the ignition switch to the "START" position and observe the ohmmeter reading.

Low resistance reading is normal.

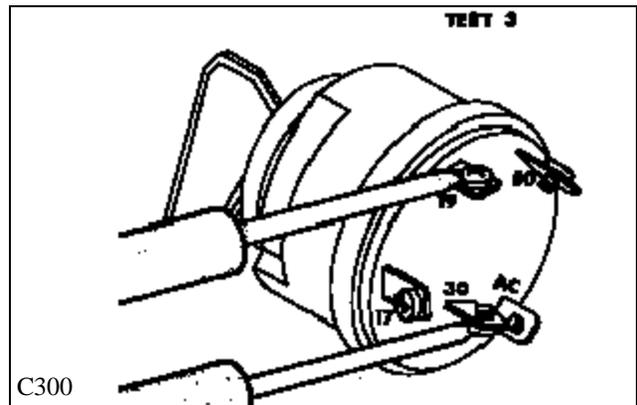
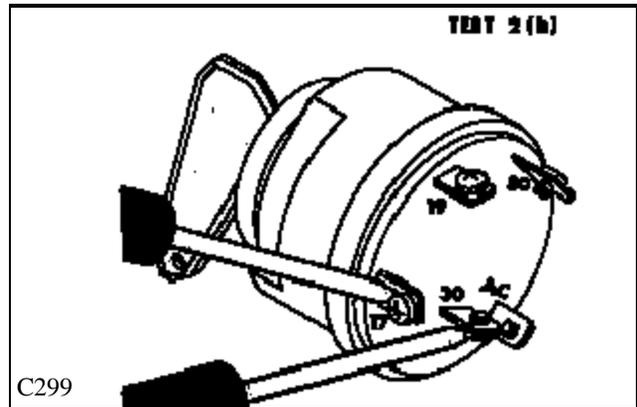
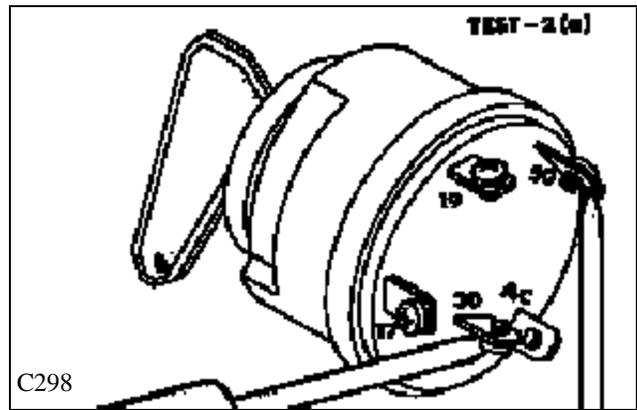
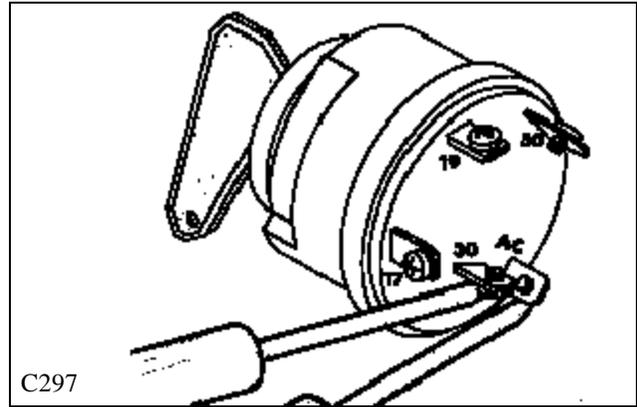
High resistance reading means the ignition switch needs replacement.

TEST 3: "HEAT" POSITION.

Connect the ohmmeter leads between the terminals marked 30 and 19 on the ignition switch. (fig. C300) Turn the ignition switch to the "HEAT" position and observe the ohmmeter readings.

Low resistance reading normal.

High resistance reading, replace the ignition switch.



MANIFOLD PRE-HEATER 5.5

Testing the Manifold Pre-Heater

Before performing any test on the manifold pre-heater, disconnect the ground wire from the battery.

TEST 1: MANIFOLD HEATER.

With the ignition switch off, connect one end of the ohm-meter lead to the manifold heater terminal and the other lead end to a clean ground.

A reading of 1.5 ohms is normal.

An infinite or 0 reading means the heater is defective.

TEST 2: IGNITION SWITCH to MANIFOLD HEATER.

Remove the three screws retaining the right hand dash panel to the dash pod. (fig. C1398, C1330) With the ignition switch off, disconnect the red / white wire from ignition terminal 19. Connect one ohmmeter lead to the terminal marked 19 on the ignition switch and the other lead to the red / white wire.

Low to 0 reading means good continuity.

High reading means the red / white wire from the ignition switch to the manifold heater is defective.

TEST 3 IGNITION SWITCH "HEAT" POSITION.

Connect the ohmmeter leads between the terminals marked 30 and 19 on the ignition switch. (fig. C300) Turn the ignition switch to the "HEAT" position and observe the ohmmeter readings.

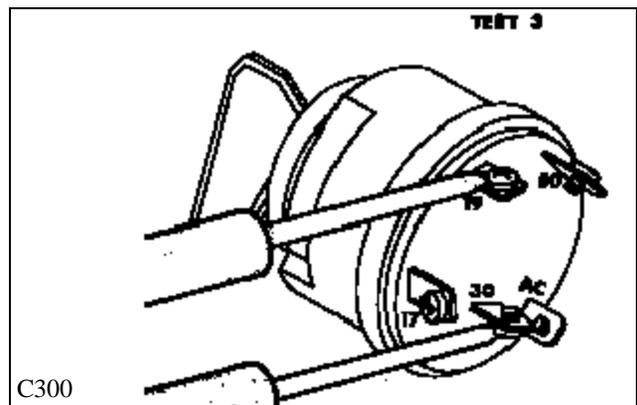
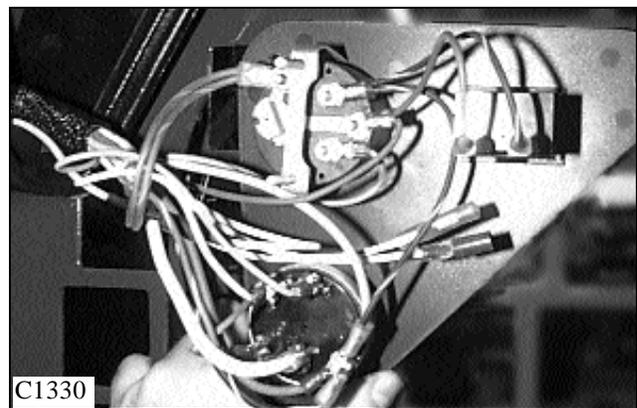
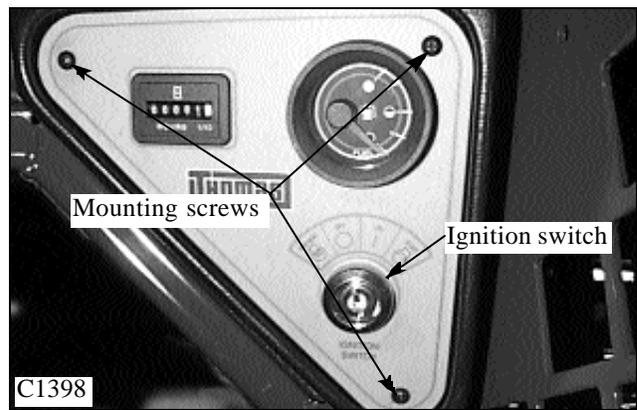
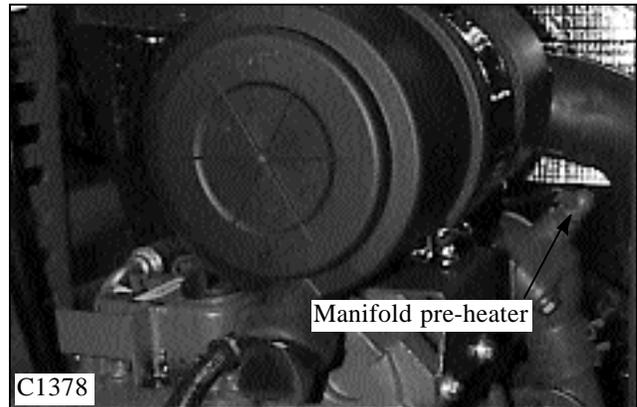
Low resistance reading normal.

High resistance reading, replace the ignition switch.

Pre-Heat Indicator

Check the ignition switch terminals 17 and 19 with an ohmmeter. If there is good continuity between the two terminals the bulb or wiring is bad on the pre-heat indicator light.

To change the indicator bulb, remove the three screws retaining the left hand dash panel to the dash pod. Select the proper bulb, twist and pull the bulb from the dash panel. Disconnect the wires and replace the bulb in reverse order.



BATTERY 5.6

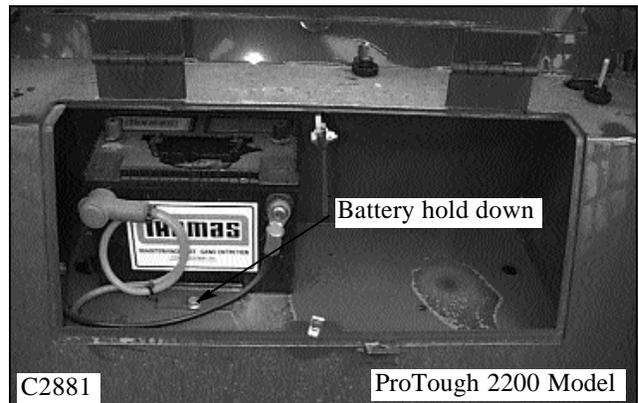
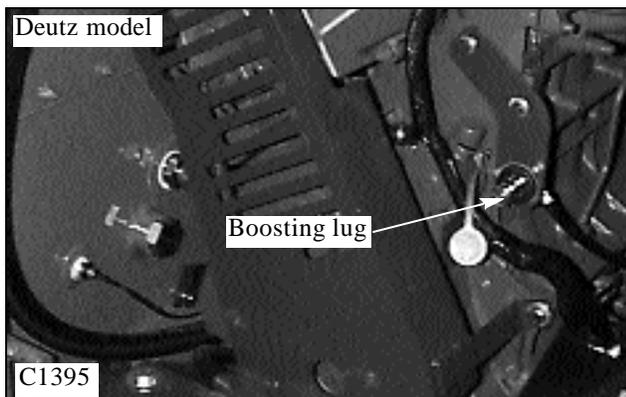
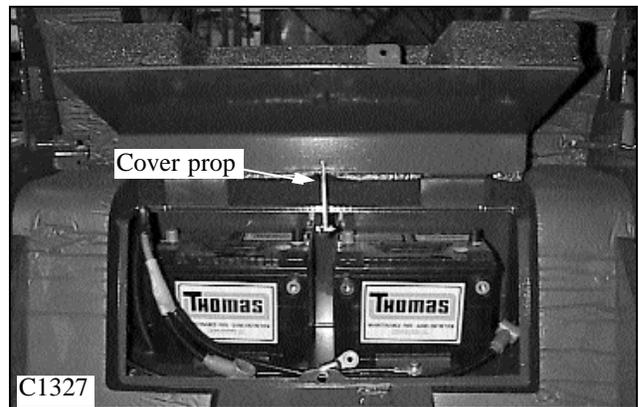
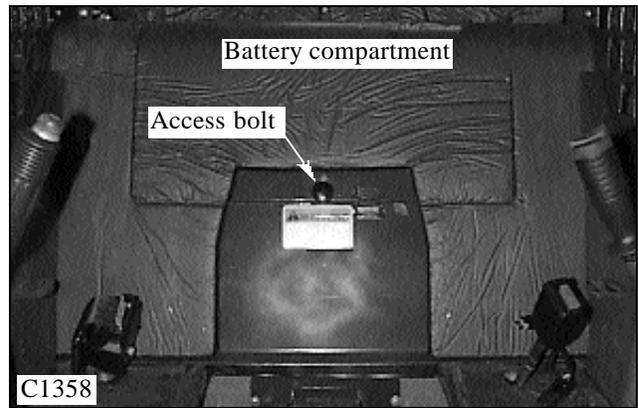
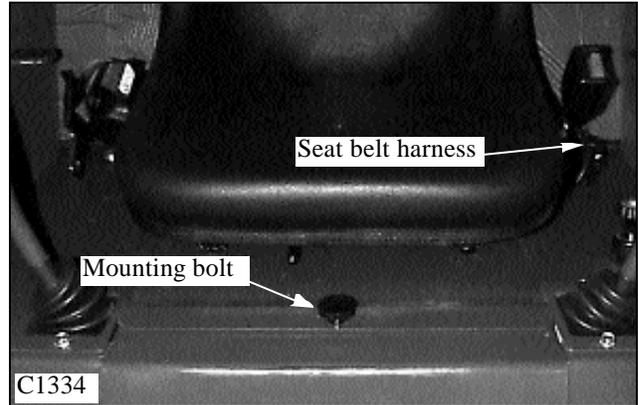
Removal and Inspection

The batteries are located in the ROPS behind the operators seat. To remove the battery:

- 1 Remove the seat mount retaining bolt and disconnect the seat belt wiring harness. (fig. C1334)
- 2 Pull up and toward the front of the loader and remove the seat. Be careful to not catch any electrical wiring while removing.
- 3 Remove the access bolt from the battery compartment cover (fig. C1358). Note: The ProTough 2200 is equipped with only one (1) battery. (Figure C2881).

WARNING	Batteries contain sulfuric acid which can harm the eyes and skin on contact. Always wear goggles and protective clothing while servicing the battery. Flush skin or eyes with water upon contact. Consult a physician.
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- 4 Raise the battery compartment cover and latch the prop bar in place. (fig. C1327)
- 5 Disconnect both battery ground terminals first. Then disconnect the positive cables from the battery. (fig. C1327)
- 6 Remove the bolt securing the battery hold down bracket. (fig. C2881)
- 7 Carefully remove the battery from the compartment.
- 8 Inspect the battery cables for corrosion and damage. Remove any corrosion using a wire brush and a soda solution. Replace the cables having damaged or deformed ends.
- 9 Clean the outside of the battery case if the battery is to be reused. Flush the terminal areas with a soda solution taking care not to allow the solution into the battery cells. Remove corrosion from the battery terminals with a wire brush..

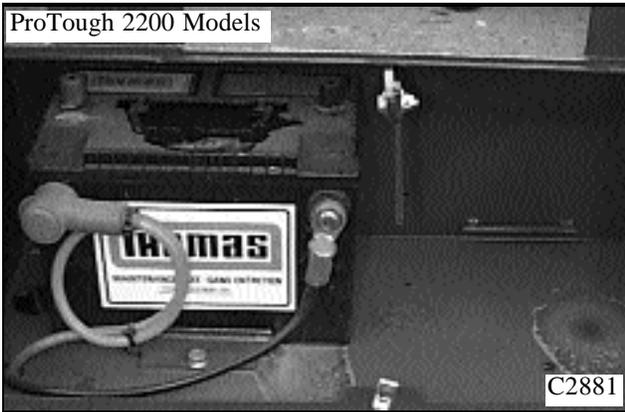
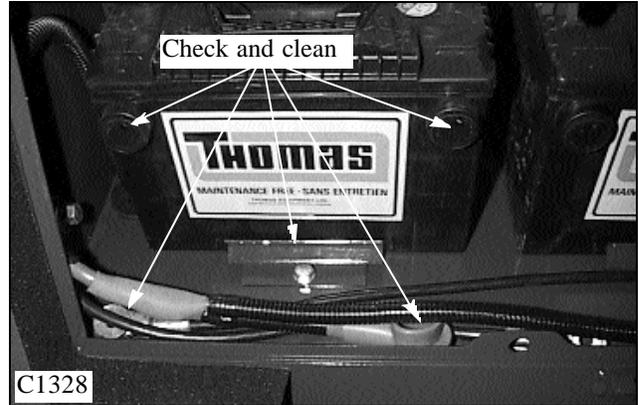


5

BATTERY 5.6

Removal and Inspection

10 Inspect the battery case for cracks that may allow electrolyte to leak into the environment. Inspect the batteries on a regular basis for damage such as cracks or a broken case. Inspect the battery cables for tightness and corrosion. Remove any corrosion and coat the terminals with a dielectric grease. Check the battery hold downs to be sure they are properly retaining the battery in the compartment. (fig. C1328)



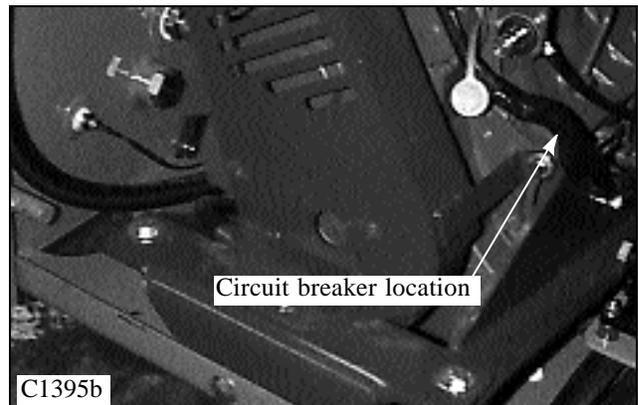
WARNING

Batteries contain sulfuric acid which can harm the eyes and skin on contact. Always wear goggles and protective clothing while servicing the battery. Flush skin or eyes with water upon contact. Consult a physician.

Circuit Breaker

The circuit breaker is located in the engine harness, right hand side of engine. The circuit breaker is covered by loom and is not immediately visible to the eye.

- 1 Disconnect the battery grounds before testing or replacing the circuit breaker.
- 2 Strip the loom covering back to access the circuit breaker.
- 3 Remove the two nuts retaining the wires to the circuit breaker.
- 4 Using an ohmmeter, connect a lead to each of the stud terminals and take a reading. Low resistance is normal.

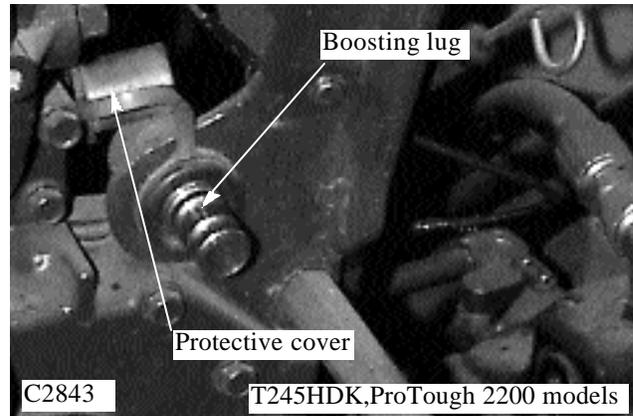


BATTERY 5.6

Boosting

In the event the loader has failed to start and requires boosting, a boosting lug or post is located in the engine compartment. (fig. C637)

- 1 Open the rear door and raise the engine compartment cover.
- 2 Remove the red rubber protective cover from the boosting lug. (fig. C2843,C1395)
- 3 The ignition must be in the off position.
- 4 Connect the positive cable from the 12 volt boosting supply to the boosting lug on the loader.
- 5 Connect the negative ground cable to the boosting supply first, and then to a clean ground on the loader engine. Keep the cables away from any moving parts.
- 6 Start the engine.
- 7 Remove the negative ground cable from the engine first and then the boosting supply. Remove the positive cable from the boosting lug.



WARNING

Batteries contain sulfuric acid which can harm the eyes and skin on contact. Always wear goggles and protective clothing while servicing the battery. Flush skin or eyes with water upon contact. Consult a physician.

Boosting Without a Boosting Lug.

The ignition must be in the OFF position. The booster battery to be used must be 12 volt. Connect the end of the first cable to the positive (+) terminal of the booster battery. Connect the other end of the same cable to the loader battery positive (+) terminal, or to the boosting lug. (See Fig 3.10). Connect the end of the second cable to the negative (-) terminal of the booster battery. Connect the other end of the same cable to a ground. Keep cables away from moving parts. Start the engine. After the engine has started, disconnect the end of the second cable from the negative (-) terminal of the booster battery. Disconnect the other end of the same cable from the ground. Disconnect the end of the first cable from the positive (+) terminal of the booster battery. Disconnect the other end of the same cable from the loader battery positive (+) terminal, or boosting lug.

IMPORTANT

Always check the seat switch and seat belt wiring when removing / replacing the seat assembly. Take care not to pinch the wiring while removing or installing the seat.

ELECTRICAL PANEL 5.7

The loader is equipped with a 12 volt, negative ground electrical system. The fuse and relay panels are located in the engine compartment, attached to the underneath of the engine cover. (fig. C1357)

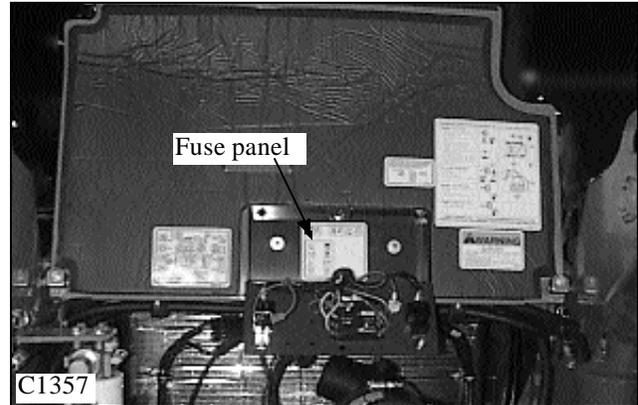
To access the electrical panel:

- 1 Open the rear door and raise the engine cover.
- 2 Remove the bolt holding the electrical panel cover closed.
- 3 Open the cover and all fuses and relays will be exposed. (fig. C814)

Visually check the fuses for burnt contacts.

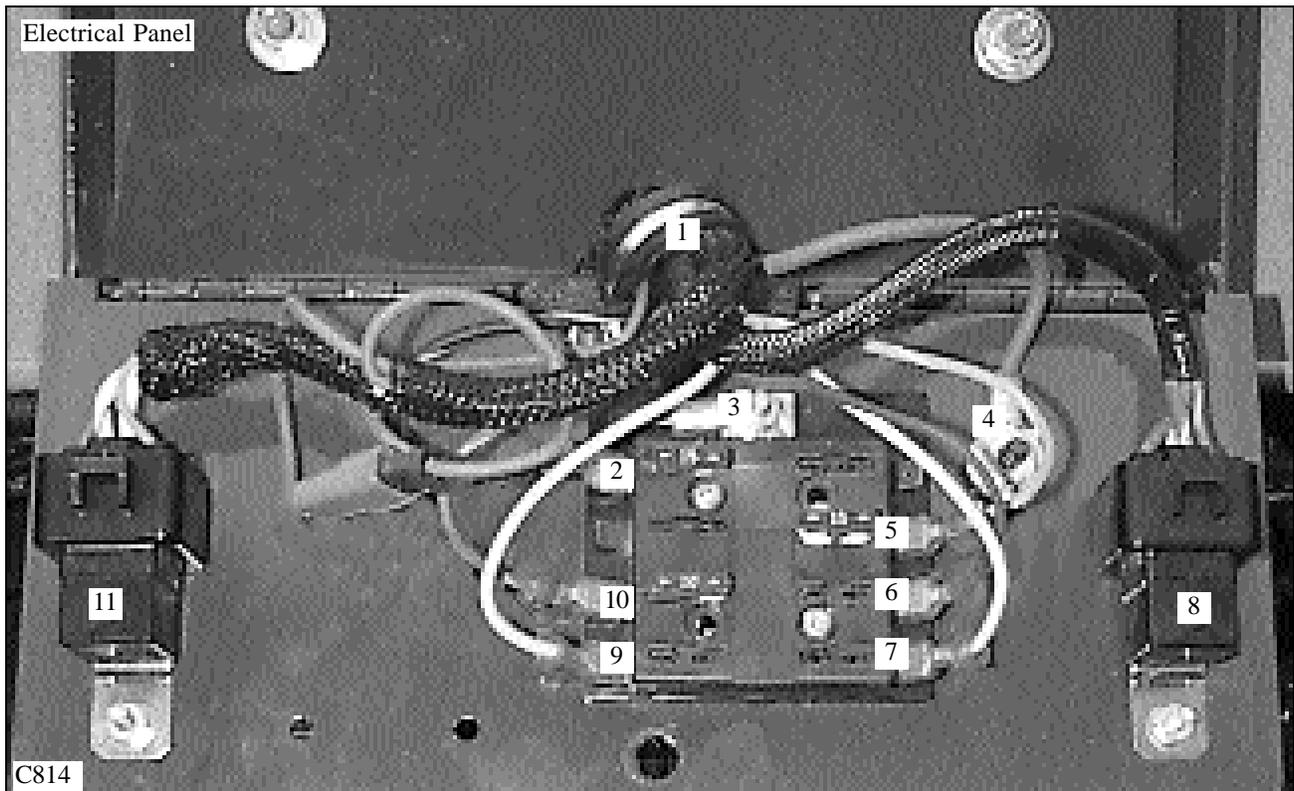
The relays are identical and may be checked by swapping one for the other to trace a malfunction. If changing the relays around does not repair the problem, the problem is somewhere else.

The ground bolt should be checked occasionally for corrosion and cleaned if necessary. Use a dielectric grease to protect the ground point from the elements.



ELECTRICAL PANEL DIAGRAM LEGEND.(fig. C814)

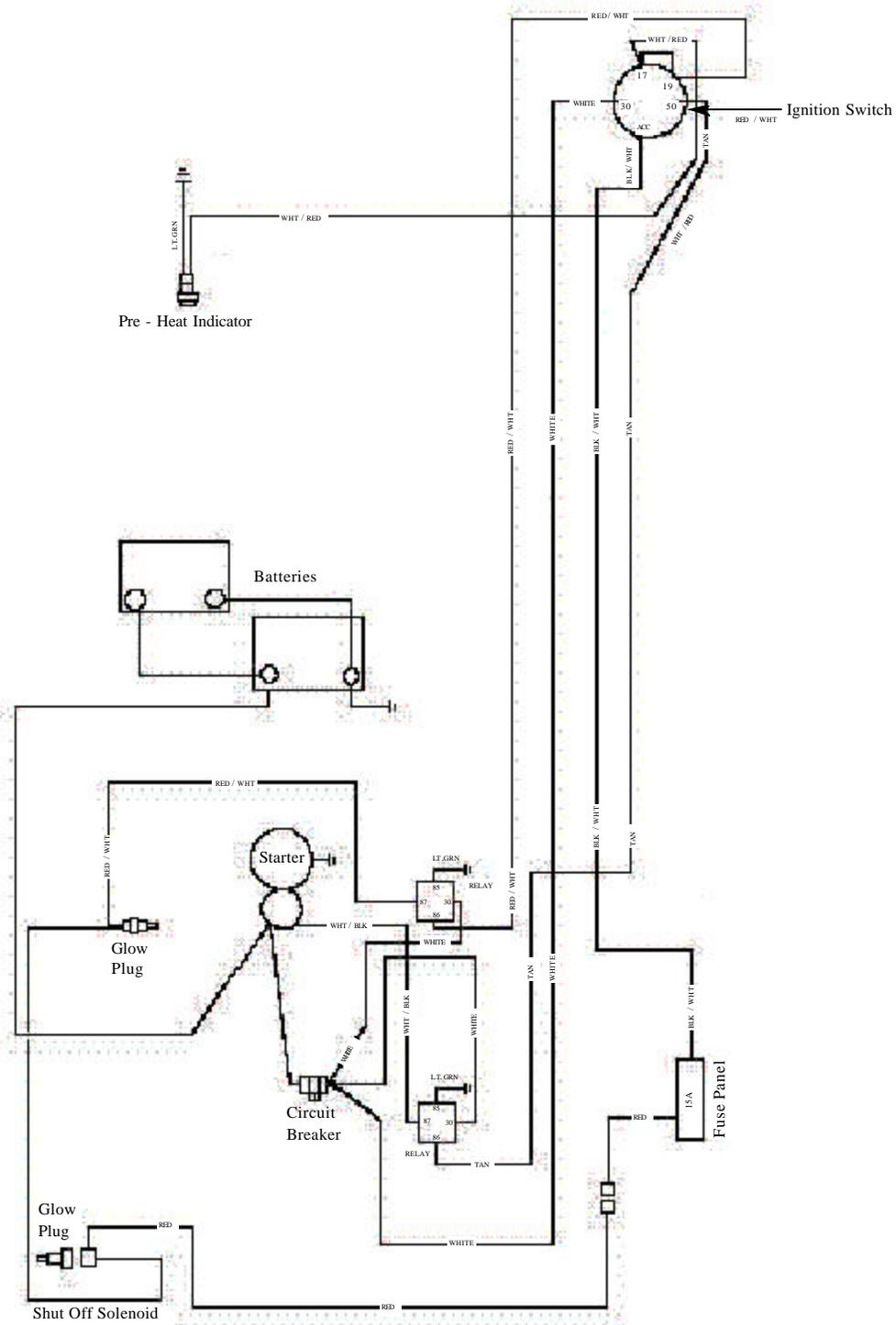
- | | |
|---|--|
| 1 Engine harness | 7 Option (YL / WH) |
| 2 Engine Shut Off (15 Amp, RED) | 8 Manifold Heater Relay (40 Amp) |
| 3 Power Inlet From Ignition Switch Acc (BLK / WH) | 9 Option (YL) |
| 4 Grounding Point (LT GRN) | 10 Auxiliary Solenoid (10 Amp, RED / YL) |
| 5 Safety Switches (15 Amp, OR / WH) | 11 Starter Relay (40 Amp) |
| 6 Horn / Option (10 Amp, BRN) | |



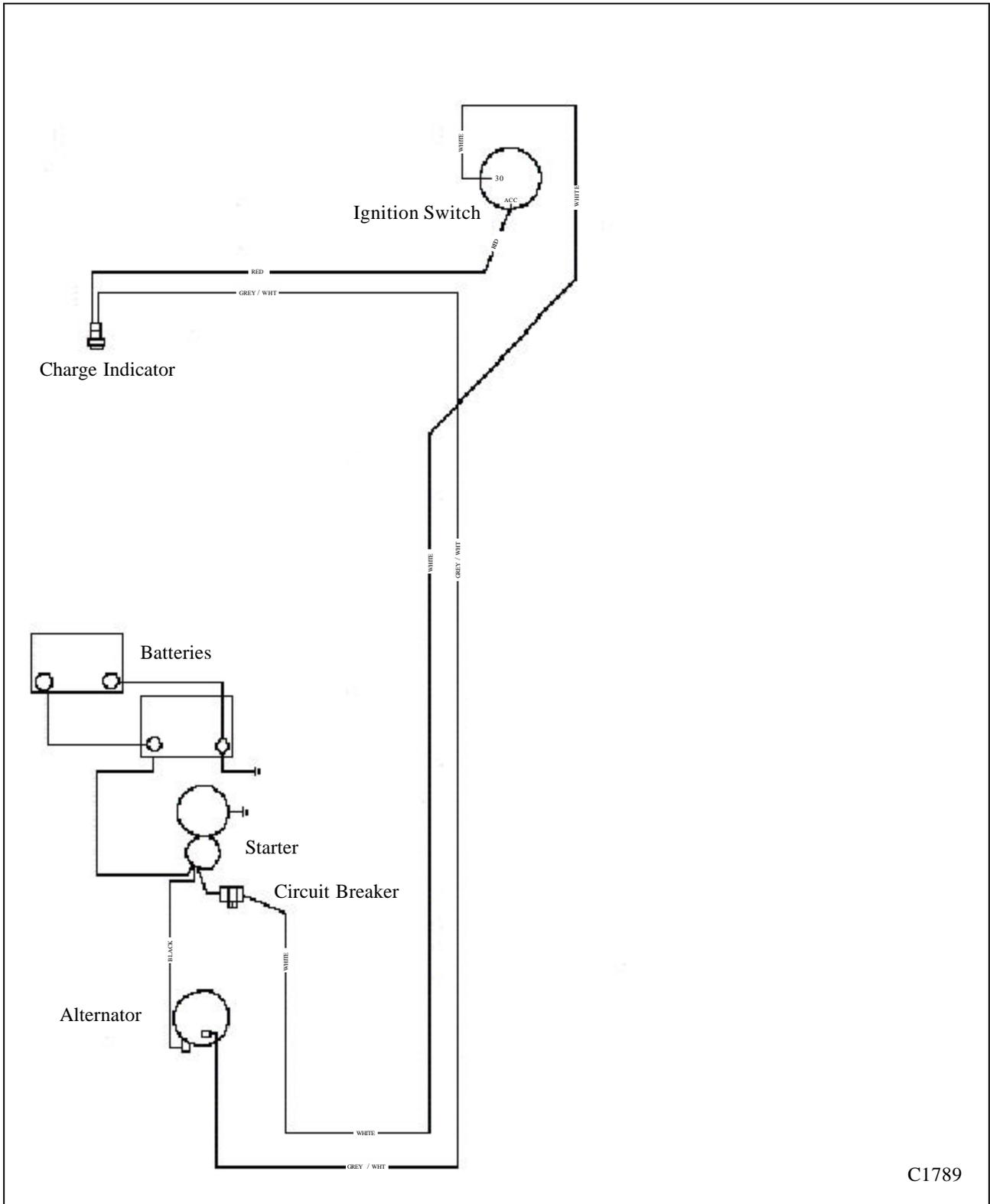
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STARTING CIRCUIT 5.8

5

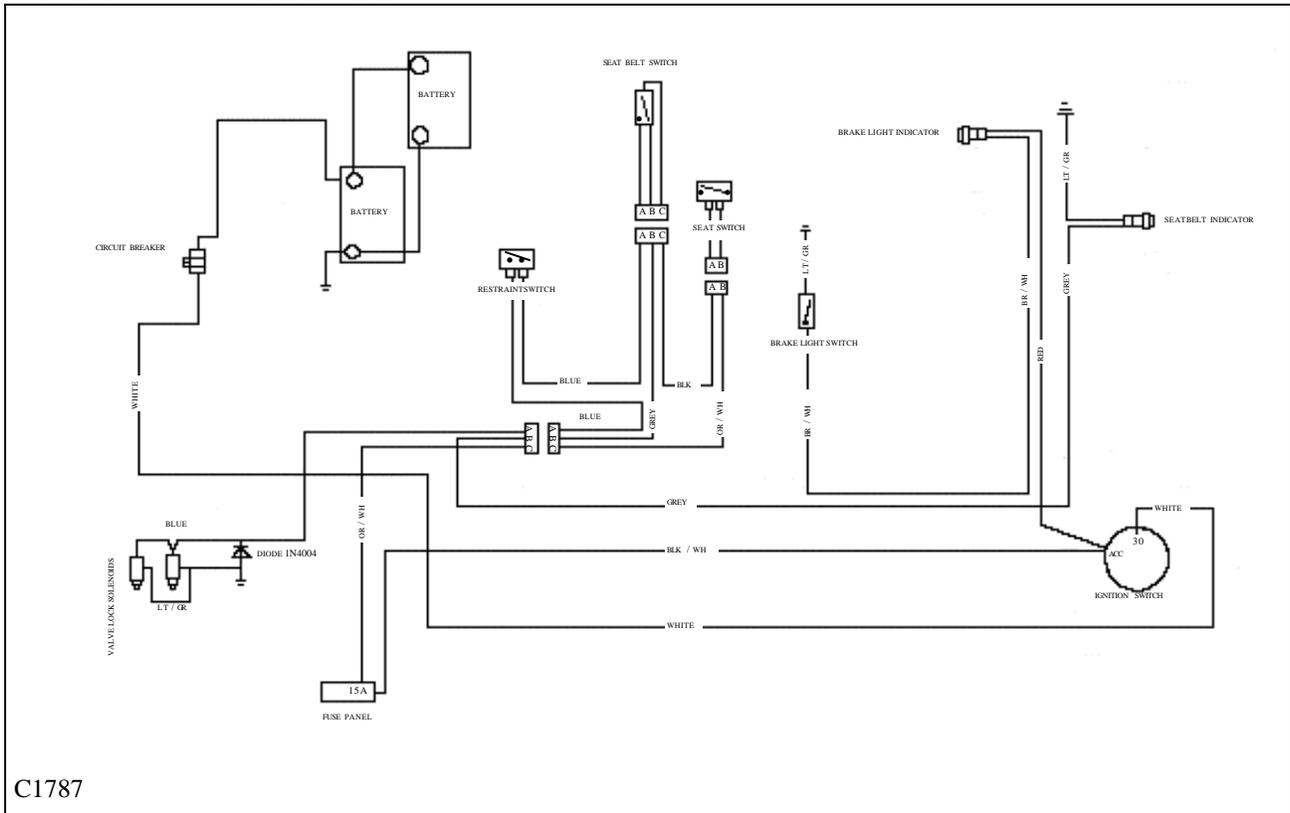


CHARGING CIRCUIT 5.9

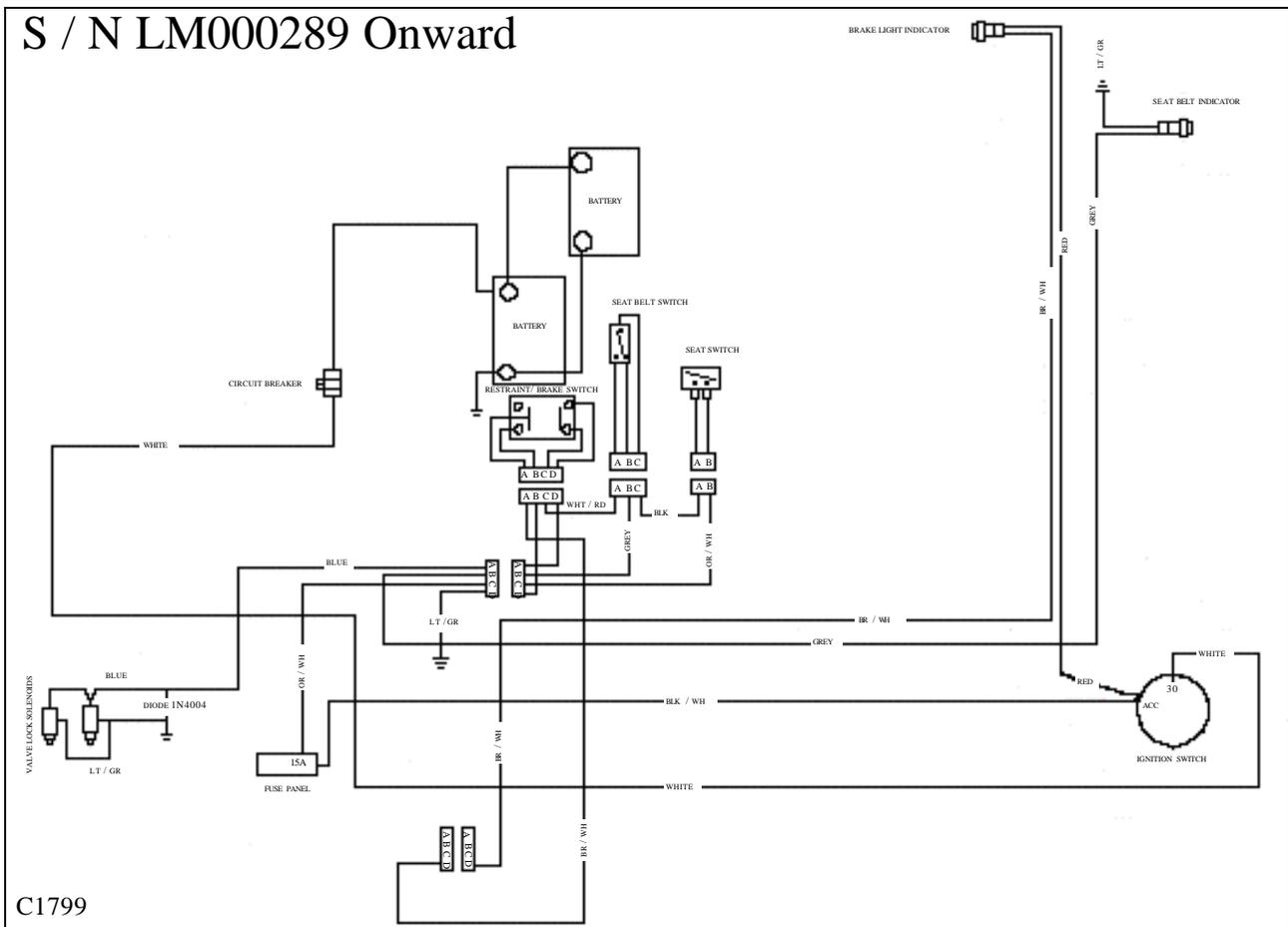


SAFETY CIRCUIT 5.10

To S / N LM000288



S / N LM000289 Onward



SAFETY CIRCUIT 5.10

There are various safety switches used on the loader to prevent accidental personal injuries. Never bypass or modify the switches or mounts. Doing so could cause personal injury.

DANGER

Operating the loader without the safety devices properly functioning could result in serious or fatal injury.

There are three switches used to prevent the hydraulic system from being engaged to prevent accidental injury.

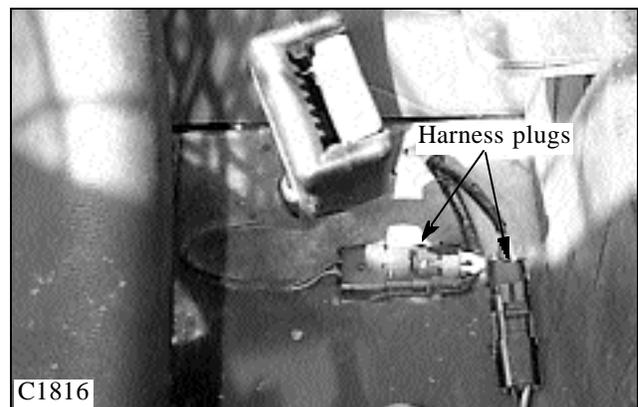
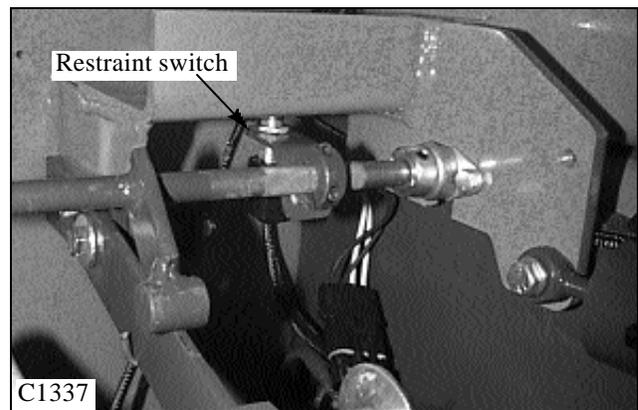
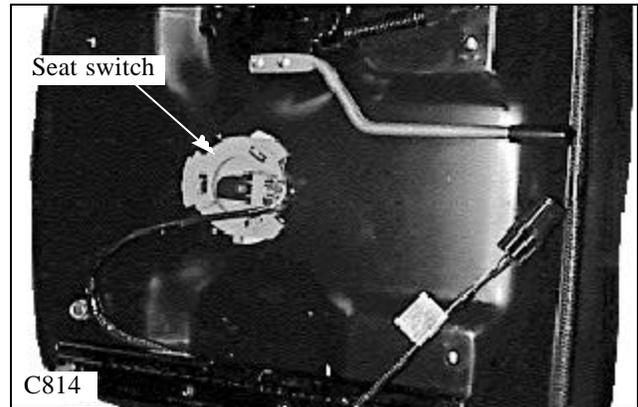
1 A pressure switch in the bottom of the operators seat assembly. The boom arms and tilt functions will only operate with the operator seated. (fig. C814) No adjustment is required, but the wiring should be checked every time the seat assembly is removed for pinching and bare wires. Replace the seat harness if defective to prevent downtime.

2 A momentary switch is located on the control lever locking linkage. (fig. C1337) The lock linkage arm is connected to the restraint bar via cable. The switch is adjustable and must activate the switch when the restraint bar is lowered to release the hydraulic system locks. Due to cable stretch or mechanical wear, this switch may need to be periodically adjusted. The switch will need to be inspected and adjusted after changing the restraint bar cable or adjusting the control locks.

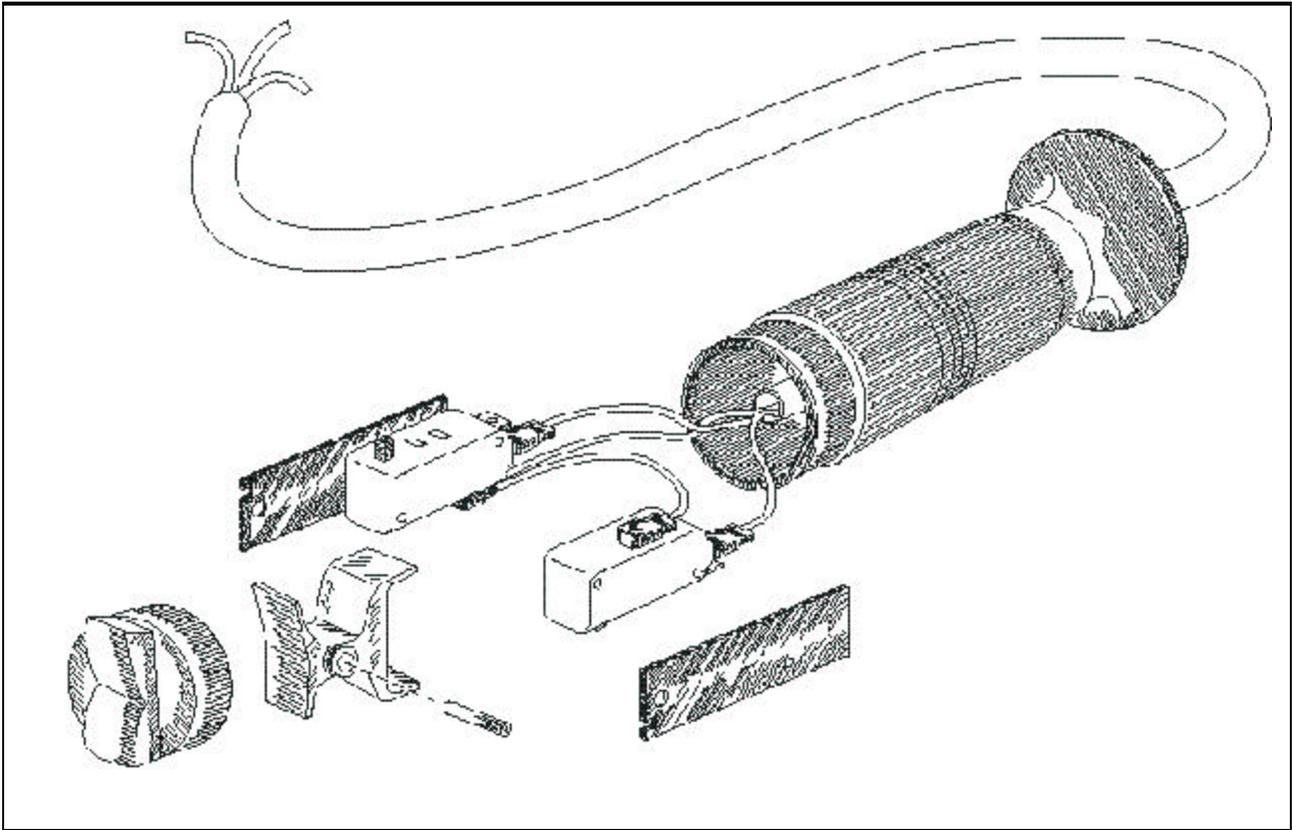
3 A switch is also built into the seat belt assembly. The hydraulic system will only function while the seat belt is fastened. No adjustment is required. If a failure has occurred in the seat belt mechanism it must be replaced. Check the seat belt wiring every time the seat is removed or replaced for pinching or bare wires. (fig. C1816)

IMPORTANT

Always check the seat switch and seat belt wiring when removing / replacing the seat assembly. Take care not to pinch the wiring while removing or installing the seat.



ELECTRIC AUXILIARY CIRCUIT 5.11



Switch mount

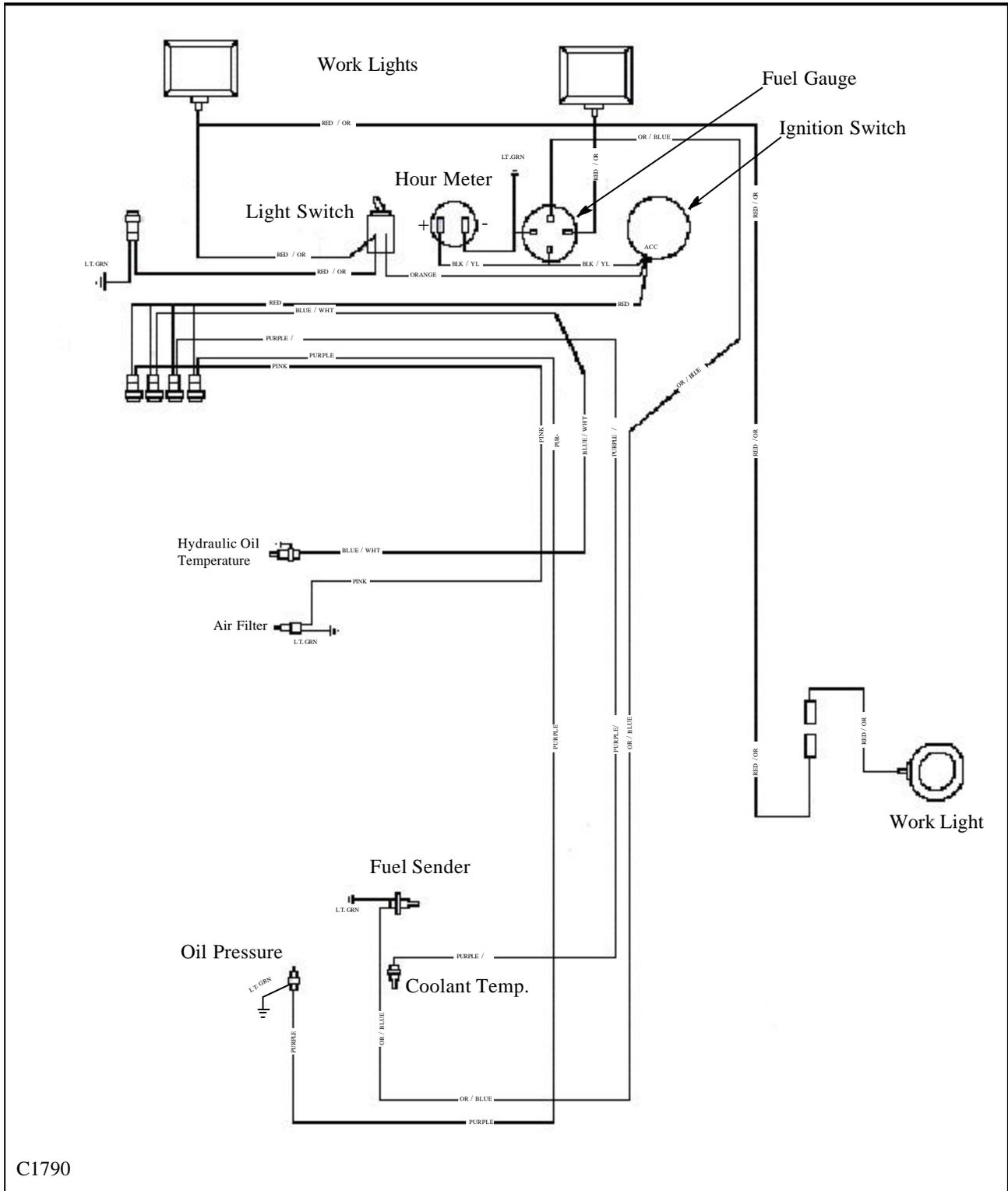
Rocker

Pin

Cover

C1791

ACCESSORIES CIRCUIT 5.12



5

C1790

TROUBLE SHOOTING 5.13

STARTING SYSTEM

Problem	Cause	Corrective Action	Section
Starter will not engage.	Battery discharged.	Check the battery and charge or replace.	5.6
	Loose or disconnected wiring.	Check and repair.	
	Defective ignition switch.	Check the switch and replace if necessary.	5.4
	Defective starter solenoid.	Check and replace if necessary.	
	Defective relay.	Check and replace.	5.7
	Defective starter.	Check and replace if necessary.	
Starter motor turns but does not engage.	Defective overrunning clutch or low battery charge.	Replace starter or parts. Check the battery and charging system.	7
Pinion engages but engine does not turn over.	Defective starter.	Check and replace.	
	Low battery charge.	Check and repair.	5.6
	Engine seizure.	Check and replace.	7
	Hydrostatic pump failure.	Check and replace.	2
Starter motor rotates a full speed before pinion engages.	Defective pinion spring.	Check and replace.	
Starter remains engaged after the engine has started.	Faulty ignition switch.	Check and replace.	5.4
	Defective solenoid.	Check and replace.	



SAFETY LOCKING MECHANISM

Problem	Cause	Corrective Action	Section
Control locks will not release.	Blown fuse.	Check fuse and replace with 15 Amp.	5.7
	Safety switch out of adjustment or defective.	Remove the seat, check and adjust or replace.	5.8
	Defective lock solenoid.	Check and replace.	5.8
	Defective lock mechanism.	Check and replace.	1.4 / 5.8
	Short in wiring harness.	Check for proper grounding, repair or replace harness.	

TROUBLE SHOOTING 5.13

CHARGING SYSTEM

Problem	Cause	Corrective Action	Section
Battery low in charge.	Faulty wiring or connections.	Check and repair or replace.	
	Drive belt slipping.	Check and adjust.	7
	Defective battery.	Test battery and replace if necessary.	
	Defective alternator or regulator.	Check charging output, approximately 14 volts. Replace if necessary.	
Alternator overcharging and battery overheats.	Defective battery.	Test battery and replace if necessary.	
	Defective regulator	Check charging output, approximately 14 volts. Replace if necessary.	
Low or no output voltage from alternator.	Drive belt slipping.	Check and adjust.	7
	Faulty wiring or connections.	Check and repair or replace.	
	Defective alternator or regulator.	Check charging output, approximately 14 volts. Replace if necessary.	
Charge indicator light flickers or runs dim.	Faulty wiring or connections.	Check and repair or replace.	
	Dirty alternator slip rings or brushes.	Check and repair or replace.	
Charge indicator goes out but becomes brighter as the engine RPM increases.	Faulty wiring or connections.	Check and repair or replace.	
Charge indicator light is on while the engine is operating.	Drive belt slipping.	Check and adjust.	7
	Defective alternator or regulator.	Check charging output, approximately 14 volts. Replace if necessary.	



NOTES

SECTION 6 MAINFRAME

Quick - Tach.....	6.1
Boom Arms	6.2
Boom Supports	6.3
ROPS	6.4
Rear Door.....	6.5



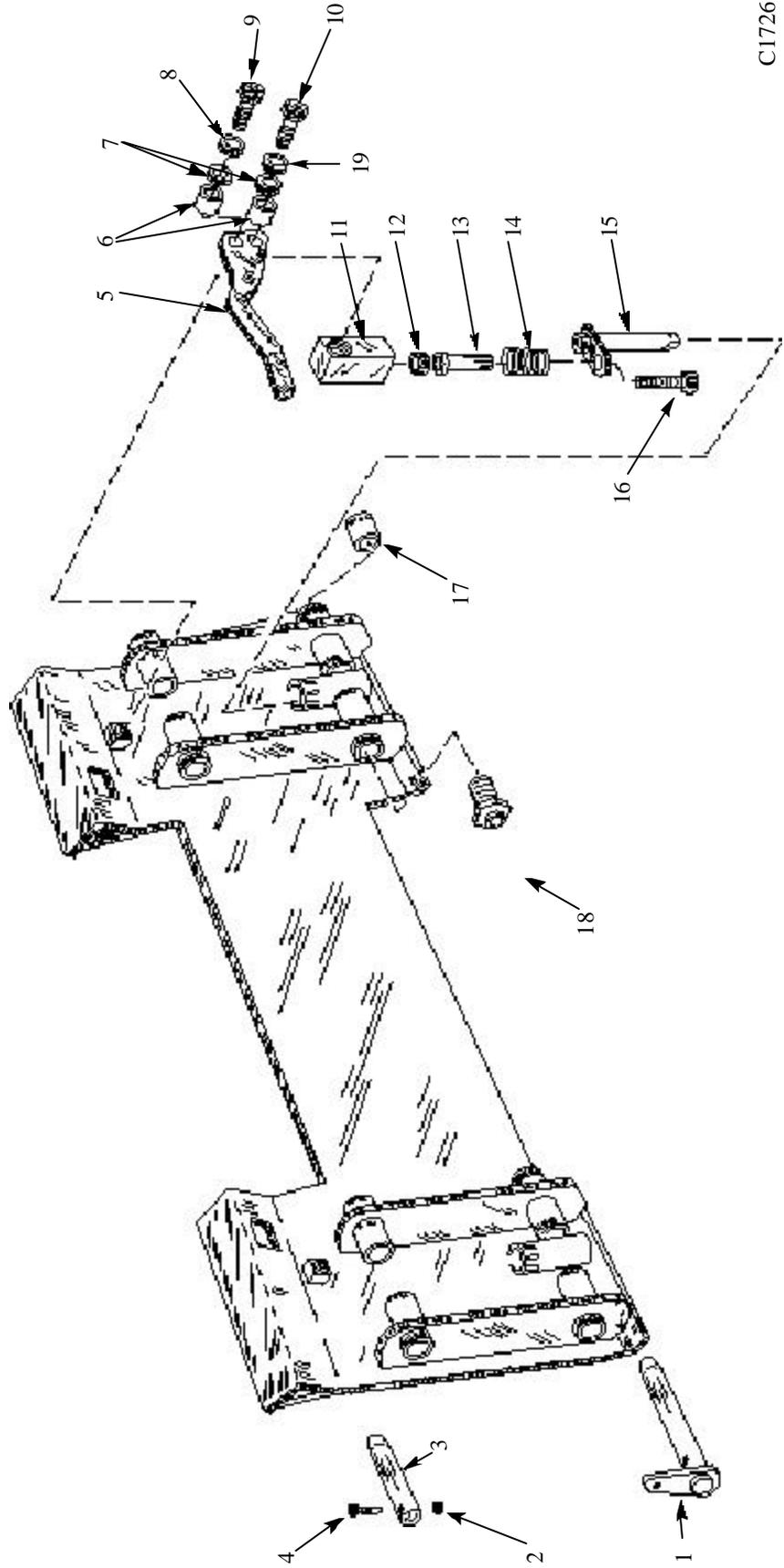
QUICK - TACH 6.1

C1726

6

- 1 Pin assembly
- 2 Lock nut
- 3 Pin
- 4 Bolt
- 5 Lock handel
- 6 Bushing
- 7 Washer
- 8 Washer
- 9 Bolt
- 10 Bolt

- 11 Linkage block
- 12 Nut
- 13 Bushing
- 14 Spring
- 15 Lock pin
- 16 Bolt
- 17 Hardened bushing
- 18 Grease fitting (not all models)
- 19 Lock washer



QUICK - TACH 6.1

Preventative Maintenance

use fittings

To keep the quick - tach locking pins and linkage working freely and to prevent bushing and pin wear, the quick - tach must be lubricated every 8 hours of operation.

More often if the application dictates.

Lubricate the quick - tach as follows:

- 1 Remove the attachment from the loader quick - tach.
- 2 Clean any dirt build up around the linkage assembly.
- 3 Lubricate the grease fittings on each of the lock pin bushings with a good quality lithium based grease until the excess amount flows past the pins. (fig. C1824, C1824a))



QUICK - TACH 6.1

Removal



QUICK - TACH 6.1

Disassembly & Inspection

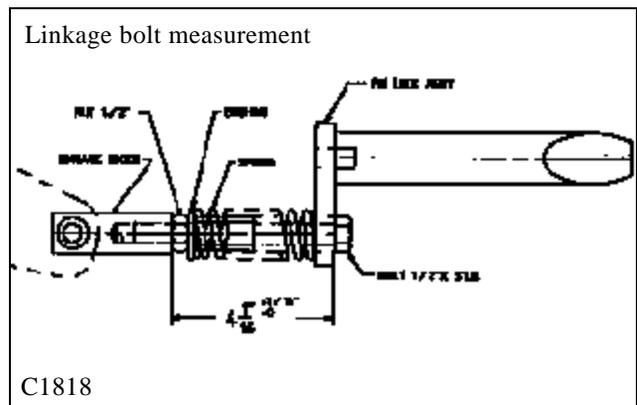
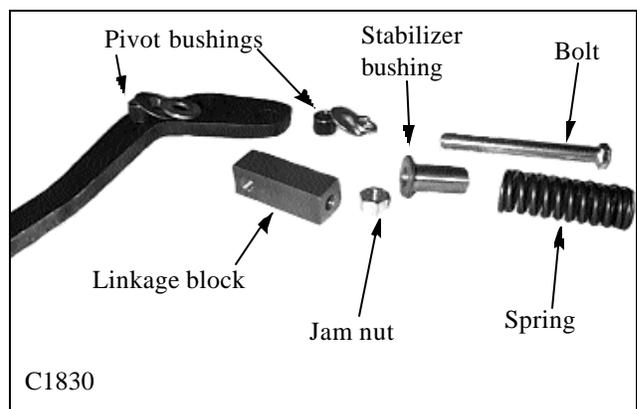
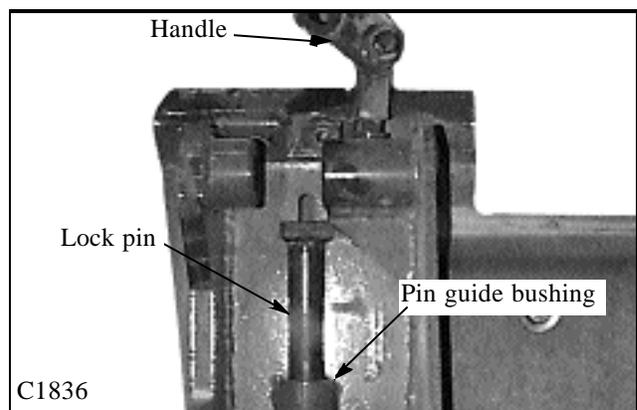
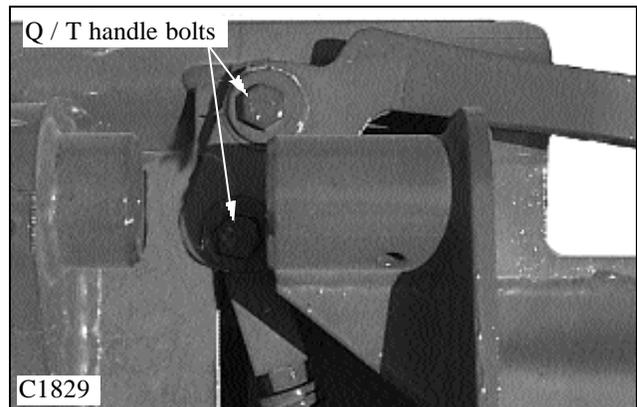
Follow the exploded schematic on the 2nd page of this section to assist in taking apart the locking mechanism, and to assemble the system back together. Please note that the quick - tach does not have to be removed to service or replace locking mechanism parts.

- 1 Remove the bolt retaining the lock handle to the lock linkage. (fig. C1829)
- 2 Remove the bolt retaining the lock handle to the quick - tach frame. (fig. C1829)
- 3 Pull the locking pin and linkage out of the guide bushing. (fig. C1836)
- 4 Loosen the jam nut on the linkage block. Remove the bolt holding locking pin to the lock linkage block.
- 5 Separate the parts and inspect the spring for broken or sacking (compressed) coils. (fig. C1830) Replace parts as required.
- 6 Inspect the locking pin for wear. Make sure the beveled end of the pin is not worn or broken off the opposite side of the bevel. Check the fit of the pin in the quick - tach guide bushing. If the pin or bushing is excessively worn replace the pin or complete quick - tach assembly.
- 7 Inspect the lock handle mounting holes for fit against the handle pivot bushings. Replace the handle or pivot bushings as required if the fit is sloppy. (fig. C1830)
- 8 Check the fit of the lower pivot pins in the quick - tach. Discard worn pins and replace the hardened bushings in the quick - tach if so equipped.
- 9 Check and replace any grease fittings that are damaged or defective.

Assembly

Upon assembling the locking mechanism to the quick - tach, use 242 Loctite (blue) on all the mounting nuts and bolts.

- 1 When assembling the locking pin to the spring, bushing and linkage block, adjust the length of the bolt to 4 1/16 inches. (103mm). This is measured from under the head of the bolt up to, and against the linkage block. (fig. C1818) **This is very crucial for lock pin engagement to the attachment.**
- 2 Replace the rest of the lock mechanism in the reverse order above.
- 3 Lubricate all pins and bushings.
- 4 Check the lock mechanism by cycling the lock levers to ensure correct engagement through the attachment and sufficient pressure to hold the lock system down in the over - center position. (Engages and stay in the locked position)



BOOM ARMS 6.2

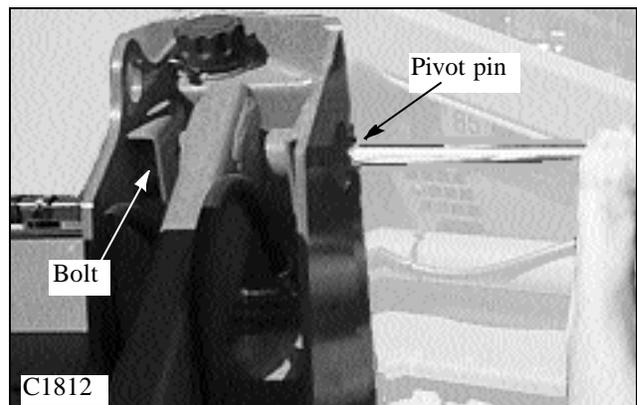
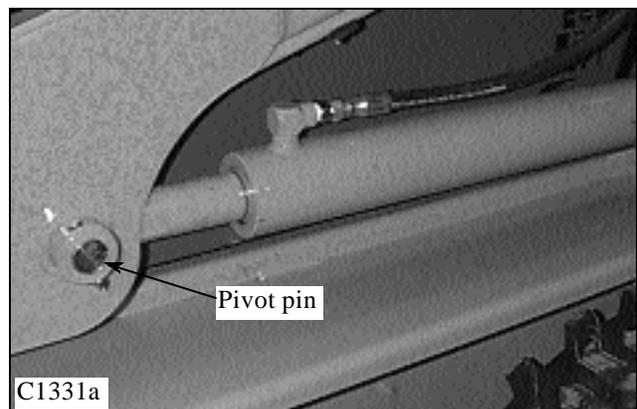
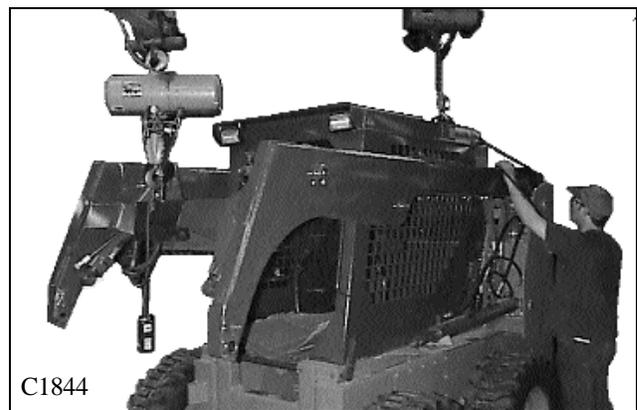
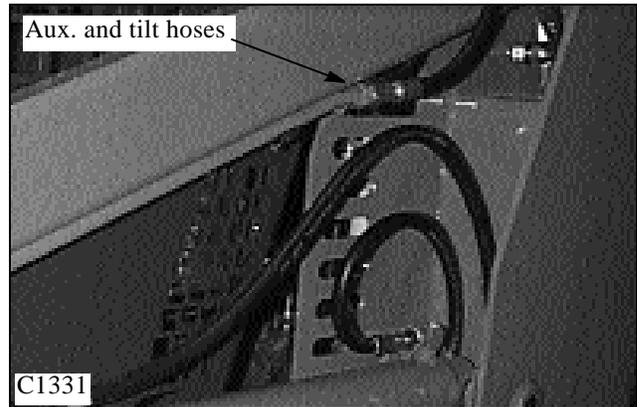
Removal

- 1 Lower the boom arms and shut off the engine. Turn the ignition key to the "RUN" position and cycle the boom and tilt controls to relieve hydraulic backpressure. Lock the boom lift control in the float position.
- 2 Return the key to the "OFF" position and engage the parking brake. (raise the restraint bar)
- 3 Remove the quick - tach assembly from the boom arms. (See Section 6.1)
- 4 Disconnect the hydraulic hoses between the boom arm and reservoir tanks. Cap the open hose ends to prevent contamination. (fig. C1331)
- 5 Fasten chains or lifting straps with an adequate capacity to sustain the weight of the boom arms. Most of the weight is at the front of the boom arms. Attach one set of straps as close as possible to the front, (fig. C1844), and the other set approximately half way toward the rear.
- 6 Raise the boom arms, with an over head hoist, enough to take the weight of the lift cylinders. Remove the bolts from the pivot pins in the lift cylinders that are mounted in the boom arms. (fig. C1331a)
- 7 Remove the pins by reaching between the ROPS and the boom arm and pushing the pin out toward you. Take care not to let the lift cylinder fall on your hand.
- 8 Remove the bolts from the upper rear boom arm pivot pins mounted through the main frame. (fig. C1812)
- 9 Remove the pivot pins using an appropriate drift punch and hammer. Use care, do not broom up the end of the pins.
- 10 Raise the boom arms enough to free from the loader and remove them.

6

Installation

- 1 Upon installation follow the above procedure in the reverse order.
- 2 Replace any worn or gouged pins and bushings
- 3 All stationary bushings should be coated with anti - seize compound to assist ease of future disassembly. Do not get the anti - seize compound on moving or pivoting parts. The compounds contain abrasives that may cause premature wear of pivot pins and bushings.
- 4 Torque the hydraulic hose fittings at 45 lbs / ft. (61 Nm)



BOOM ARM SUPPORTS 6.3

For safety while performing regular service or maintenance work, the loader is equipped with boom supports. (fig. C1823) The boom supports, when extended, prevent the boom arm from lowering when servicing the hydraulic system, controls or other repair work while the engine is not operating.

The boom supports should be greased every 8 hours of use and engagement depth should be checked every time the supports are used.

1 Raise the boom arms, extent the boom supports and allow the boom arms to lower onto the supports. Do not pressure the hydraulic system against the boom supports.

2 Shut off the engine and engage the parking brake.

3 Measure the distance the boom support pins are protruding past the inner boom arm plate. Proper adjustment should have the support pin protruding past the inner boom arm plate by 1/4 of an inch. (6.5mm) (fig. C1823)

4 Adjust the engagement depth by removing the 3 screws each on the left and right dash panels to access the support pins and linkage. (fig. C1397) Only remove one side if there is only one side to be adjusted.

5 Loosen the jam nut on the support pin linkage. (fig. C1637) Use care to not damage the plastic center dash panel.

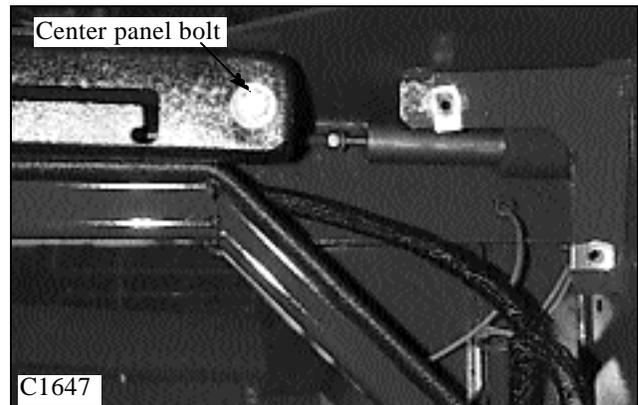
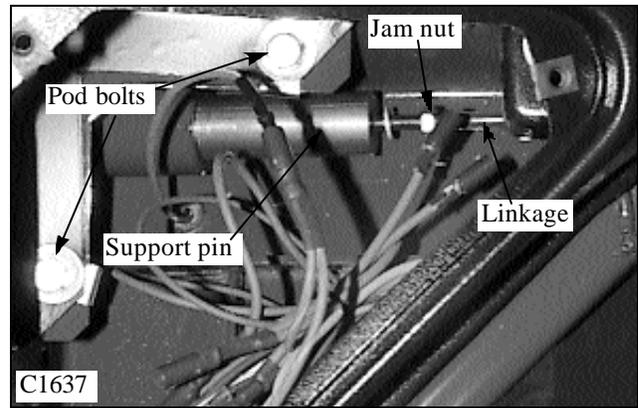
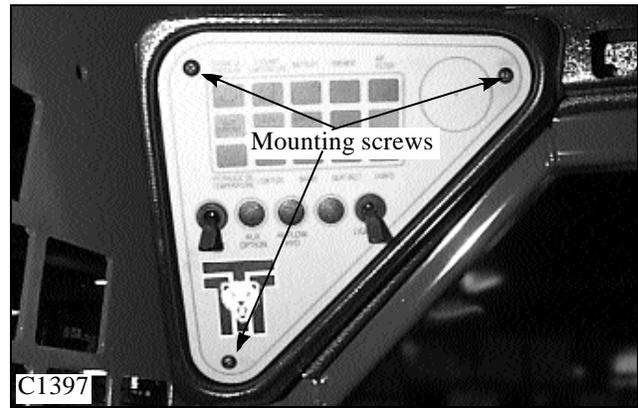
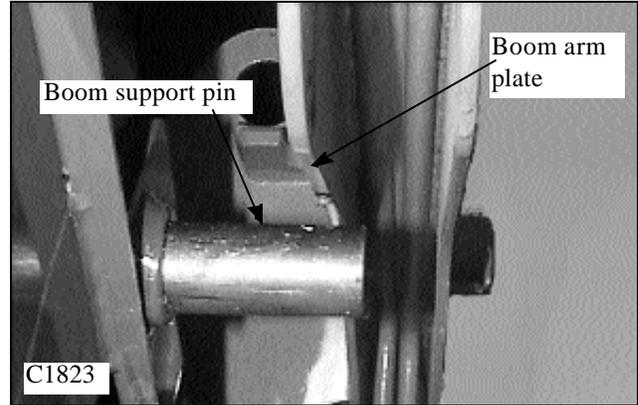
6 Screw the pin in or out the amount necessary to get the proper adjustment for support pin engagement on the boom arms.

7 To remove the support pins and linkage, remove both dash panels and pods to access the center boom support panel bolts. (fig. C1647)

8 Remove the bolts and center panel and the support pins and linkage may be removed, serviced or repaired.

9 Apply 242 Loctite (blue) to the nut and tighten it against the support pin when installing.

10 Lubricate the boom support pins and replace the dash panels.

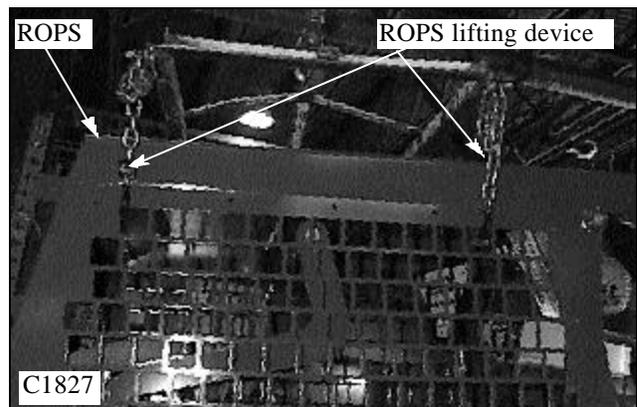
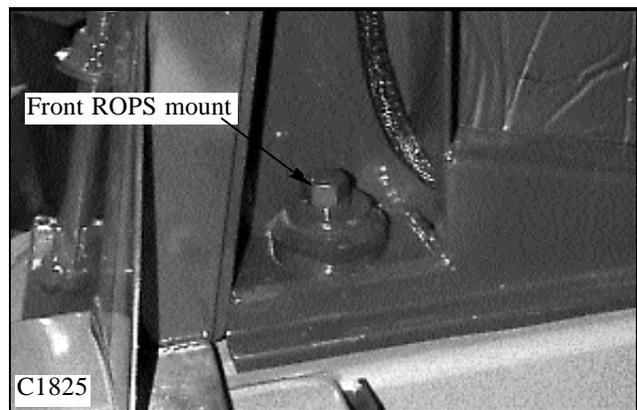
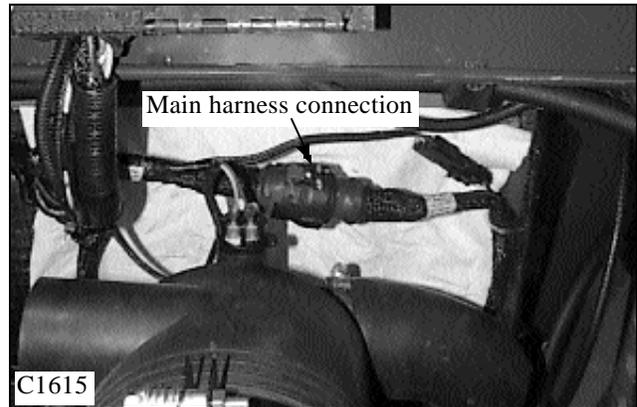


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ROPS 6.4

Removal

- 1 Lower the boom arms, shut off the engine and engage the parking brake.
- 2 Remove the seat assembly and the hydrostatic shield and disconnect the battery terminals as outlined in Section 5.
- 3 Disconnect the ground cable from the mainframe and engine.
- 4 Disconnect the positive cable from the starter.
- 5 Disconnect the main wiring harness plug. (fig. C1615)
- 6 Remove any cable ties that may be used to tie wiring and hoses to the ROPS. Check the engine compartment and the hydrostatic pump area for wiring connections and ties that will need to be disconnected from accessory circuits.
- 7 Unhook the restraint bar cables from the control lever locking device and the brake activator linkage. You may need to lower the restraint bar to release the brake cable. See Section 4 for assistance if required.
- 8 Remove the nuts and washers on the ROPS isolator mounts. There are two in the front (fig. C1825) and two in the rear. (fig. C1826)
- 9 Attach chains or straps with a sufficient load rating to safely raise the ROPS from the frame. (fig. C1827)
- 10 Raise the ROPS using an over head hoist. Check for wiring that may still be connected and remove as required.

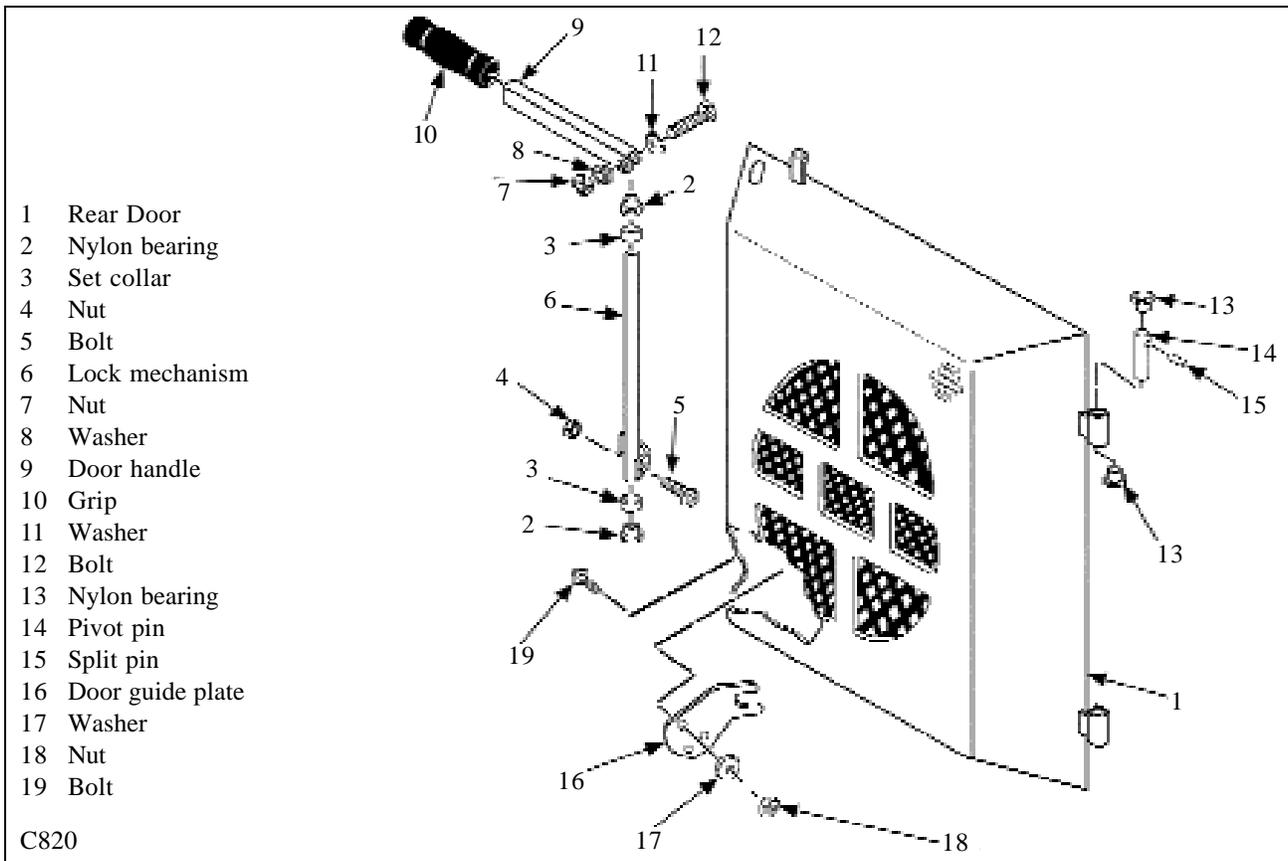


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Installation

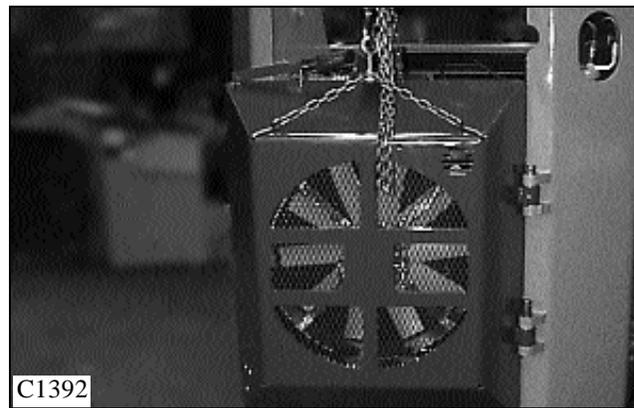
- 1 Upon assembling the ROPS to the loader mainframe, ensure the mounting isolators are in serviceable condition. Replace any worn, damaged or weathered isolators.
- 2 Reverse the removal procedure taking care not to pinch any wiring and connections.
- 3 Torque the ROPS mounting isolator nuts at 60 lbs / ft. (81.5 Nm)
- 4 See Section 4 for proper adjustment of the control lock and brake cables.

REAR DOOR 6.5



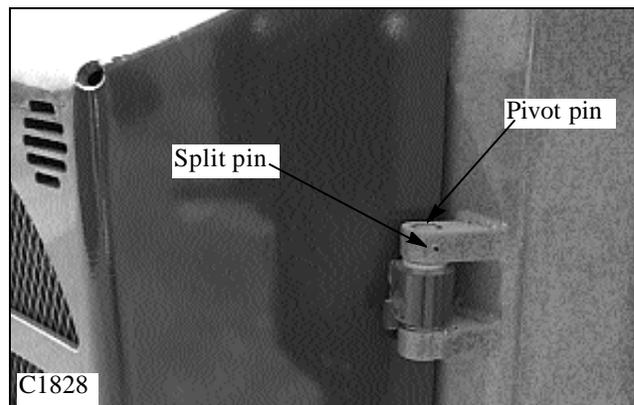
Removal

- 1 Open the rear door and remove the cooler assembly as outlined in Section 1.7. Use caution and allow the cooler assembly to rest on the ground without disconnecting the hydraulic and engine cooler hoses.
- 2 Attach chains to the rear door. (fig. C1392)
- 3 Raise the chains, using an over head hoist, enough to take the weight of the door off the pivot bushings.
- 4 Remove the split pins retaining the door pivot pins to the loader main frame, (fig. C1828), and remove the pins.
- 5 Replace any worn or damaged pivot bushings as required.



Installation

- 1 Reinstall the rear door in the reverse order above.
- 2 Adjust the door guide plate so the door looks level with the engine cover and the door slides freely into the closed position.
- 3 Adjust the door latch linkage bolt to provide an even fit around the outside of the door.



6

NOTES

SECTION 7

ENGINE

Specifications	7.1
Trouble Shooting	7.2
Distribution / Service Centers	7.3
Filters	7.4
Engine Cooler	7.5
Alternator And Belt	7.6
Sending Units	7.7
Manifold Heater	7.7
Stop Solenoid	7.8
Starter	7.8
Thermostat	7.9
U-joint	7.10
Removal / Replacement	7.11

SPECIFICATIONS 7.1

Make Kubota
Model . . . V3300 T - TMS
No. of Cyls.. . . . 4
Horsepower 87 (64.7 Kw) @2600 RPM
Max. High Idle 2600 RPM
Max. Torque 206ft./lbs (280Nm)@ 1400 RPM
Displacement 202.53 in.³ (3318 c.c.)
Engine Oil 14 qt. (13.2 liters)
Firing Order 1 - 3 - 4 - 2
Alternator 60 Amp (Internal Regulator)
Oil Check Daily
Oil Change . . . 150 hrs.
Filter Change . 300 hrs.



SPECIFICATIONS 7.1

Manufacturer	Deutz
Model	BF4M1011F
S / N Location	Valve Cover
Displacement	2.9 £
Cooling Type	Oil
Rotation, Flywheel Side	CCW
Firing Order	1-3-4-2
# 1 Cyl.	Flywheel Side
Valve Clearance,	.0.3mm Intake
(Cold)	.0.5mm Exhaust
Low Idle	1400 RPM Minimum
Hi Idle	2800RPM Maximum
Oil Cooler Rating	1849 BTU
Oil Capacity w / Cooler	14 £ (14.8Qt)
Oil Filter P / N	42650
Fuel Filter P / N	42649
Primary Air Filter P/N	42402
Safety Air Filter P/N	42403
Repair Manual P/N	43134



TROUBLE SHOOTING 7.2

SYMPTOMS

POSSIBLE CAUSE

1. Hydraulic System

Problem	Cause	Remedy
Loss of Hydraulic power (no flow from gear pump)	Reservoir low on fluid	Replenish with 10W30 or 20W50 API SE/CD oil. Check for hose or fitting leaking
	Universal joint between engine and pump failure	Inspect and replace damaged parts. Check for misalignment between engine and pumps
	Spline coupling failure between front and rear hydrostatic pump	Inspect coupling for sheared splines. Also check pump shaft bearings.
	Hydraulic gear pump not functioning	Inspect and repair.
Loss of hydraulic power (flow from gear pump)	Reservoir low on fluid	Replenish with 10W30 or 20W50 API SE/CD oil.
	Foot pedal linkage disconnected or binding	Inspect and adjust.
	Auxiliary Hydraulics engaged	Disengage.
	Relief valve failure in control valve	Check pressure and adjust.
Hydraulic action jerky	Reservoir low on oil	Replenish with 10W30 or 20W50 API SE/CD oil.
	Air in hydraulic system	Check for leaks between the reservoir and pump. Bleed system by extending and retracting lift cylinders several times.
	Anticavitation check valve not functioning.	Check and repair or replace.
Hydraulic overheat	Cooler fan blocked or fan not turning	Clean fan area or repair or replace faulty drive system components
	Broke hydraulic fluid line	Repair or replace defective line. Replenish with 10W30 or 20W50 API SE/CD oil
Fan turning too slow	Blocked or broken relief valve	Repair or replace defective valve

Problem	Cause	Remedy
Boom raises slowly at full engine RPM	Anti-cavitation check valve not functioning	Inspect and repair or replace
	Reservoir low on oil	Replenish with 10W30 or 20W50 API SE/CD oil
	Foot pedal linkage binding	Inspect and adjust
	Auxiliary engaged Engine RPM too slow	Disengage
	Anticavitation check valve spring broken	Check RPM and reset
	Main relief or port relief valve in control valve faulty	Replace
	Internal leakage in pump due to wear	Check pressure if necessary - adjust
	Oil bypassing one or both lift cylinder piston seals	Check pump flow and repair or replace pump as necessary.
	External leak between or at control valve and cylinders	Install new piston seal kits
Lift or tilt cylinders will not support a load	Control valve spool not centering	Check for leaks and correct.
	Oil leaking by one or both cylinder piston seals	Check for sticking foot pedal linkages.
	Reservoir low on fluid	Check for broken or stuck return spring on valve spool
	Oil cooler plugged or dirty (also check engine radiator)	Install new piston seal kits
Hydraulic fluid overheating	Auxiliary engaged Engine RPM too slow	Replenish with 10W30 or 20W50 API SE/CD oil.
	Incorrect temperature sensor	Clean cooling fins.
		Disengage
		Check RPM and adjust.
		Replace.
Foot pedals do not operate smoothly	Foot pedal linkages out of adjustment	Adjust foot pedal linkages.
	Foot pedal linkages need lubrication	Lubricate with a silicone based lubricant.
	Cable binding	Check routing for kinks etc.



7.2 TROUBLESHOOTING

No power on one side, both directions	Reservoir low on oil	Replenish with 10W30 or 20W50 API SE/CD oil. Check for hose or fitting leak.			
	Disconnected control linkage	Reconnect and adjust linkage.			
	Bolt sheared on pump pintle lever	Replace. Check pintle lever for loose bolt or excessive play.			
	High pressure line failure	Replace line. Ensure new line fits without being forced. If necessary stress relieve.			
	Drive chain failure	Replace chain or connection link. Adjust tightener tension.			
	Motor shaft or key failure	Inspect and repair defective parts. Check motor mounting bolts.			
No power on one side, one direction only	Defective relief valve	Replace defective valve.			
No power on both sides, also loss of hydraulic power	Reservoir low on oil	Replace with 10W30 or 20W50 API SE/CD oil. Check for hose or fitting leak.			
	Universal joint failure between engine and pump	Inspect and replace damaged parts. Check for misalignment between engine and pumps.			
	Drive coupling between front and rear pump failure	Inspect couplings for sheared splines, replace. Also check support bearings in pumps.			
	Check system pressure	If low ,consult dealer or Thomas Service Dept.			
Gradual loss of power as machine warms up	Excessive internal leakage in pump and/or motor	Consult dealer or Thomas Service Dept.			
System erratic and/or noisy	Air in system due to low oil level in reservoir	Replenish with 10W30 or 20W50 API SE/CD oil.			
	Air in system due to leak at suction fitting	Check fittings and tighten.			
	Internal pump or motor wear caused by over-speeding	Consult dealer or Thomas Service Dept.			
	Excessive play in linkage or pintle lever	Adjust linkage and tighten or replace pintle lever.			
Machine will not travel in a straight line	Control levers binding	Check that shields are not stopping lever from full travel. Adjust Tracking			

Problem	Cause	Remedy
Final drive transmission noisy	No lubricating oil Axles have too much end play Parking brake damaged or out of adjustment Chain loose	Check and bring oil to the proper level. Use 10W30 SE/CD Engine oil Preload axle bearings removing all end play. Inspect and adjust or replace damaged parts, Replace the chain.



7.2 TROUBLESHOOTING

4. Control Levers		
Problem	Cause	Remedy
Control levers will not centre	Linkage out of adjustment	Adjust, check for wear at rod ends, loose counter nuts
	Linkage Disconnected	Reconnect, check for wear at rod ends, loose counter nuts
	Centering Spring Broken	Replace
	Linkage Binding	Binding of spring bushing in spring box. Align spring box with linkage
Control levers binding with safety shields or sound insulation.		Adjust
Control lever bearings binding in lever assembly. Inspect, replace or clean as required		
Machine operates erratically	Control Lever Linkage loose	Inspect linkage for wear at rod ends, loose counter nuts.
	Bolt in pintle lever worn or broke	Replace bolt. Inspect pintle lever for wear at bolt hole. Ensure bolt clamping lever to pump shaft is tight
		See also troubleshooting guide for hydrostatic system
Machine will not travel in a straight line	Linkage binding	Adjust
	Control lever travel out of adjustment	Adjust
Control levers do not operate smoothly	Internal pump and/or motor leakage	See troubleshooting hydrostatic system
	Control lever linkages out of adjustment	Adjust control lever linkages.
	Control lever linkages need lubrication	Lubricate with a silicone based lubricant.

5. Electrical		
Problem	Cause	Remedy
Engine will not crank over	Battery failure	Check battery - charge or replace
	Battery cable failure	Check for loose or corroded connectors. Tighten and clean as required. Use dielectric grease to prevent corrosion. Check continuity of cables and replace
	Starter failure	Repair or replace
	Fuse burnt	Check and replace
	Defective relay	Check relay continuity if defective, replace
	Ignition switch failure	Check continuity, repair or replace
Engine cranks over, but will not start	Auxiliary hydraulics engaged	Engine will smoke, but not run unassisted by starter. Disengage auxiliary hydraulics .
	Defective manifold heater relay	Check continuity and if defective replace
	Defective manifold heater	Check continuity and if defective replace
	Broken connection or defective wire	Disconnect the ROPS harness from the engine harness. Open the dash panel and check continuity of the circuit not functioning properly in both engine and ROPS harness.
Loader starts, but foot controls will not release	No fuel	Check fuel levels and system.
	Electric solenoids not releasing valve spools	Defective solenoid or binding solenoid locks. Loosen screws and re-adjust. Check continuity of connectors and wire

7.2 TROUBLESHOOTING

Diesel Engine

FAULT	REMEDY
Engine fails or is difficult to start	Check P
Engine starts but runs unevenly or stalls	Adjust E
Engine overheats. Temperature monitor gives warning	Replace W
Engine gives poor performance	Clean R
Engine not firing on all cylinders	Top Up A
Engine has little or no oil pressure	Drop Level S
Engine oil consumption excessive	
Engine smokes - blue	
white	
black	
CAUSE	
• Below starting limit temperature	P
• Oil level too low	A
• Oil level too high	P / S
• Excessive inclination of engine	S
• Incorrect lube oil SAE class or quality	W
• Fuel quality not as per operating manual	W
• Air cleaner clogged / turbocharger defective	P / W
• Air cleaner service switch / indicator defective	P / W
• Charge air line leaking	P
• Oil cooler clogged	P / R
• Cooling fan defective	P / W
• Cooling air temp. rise / heating short circuit	P
• Resistance in cooling system too great / quantity too small	P
• Battery defective or discharged	P / W
• Electrical cable to starter system loose, oxidized	P
• Starter defective or pinion does not engage	P
• Solenoid defective (release switch)	P
• Incorrect valve clearance	E
• Leaking injection line	P
• Injection valve defective	P / W

7.2 TROUBLESHOOTING

Engine Cont'd

PROBLEM	CAUSE	REMEDY
Engine will not turn over	Engine jammed, battery discharged, starter malfunctioning, wires disconnected.	Check engine to find the problem and repair it. Recharge battery, repair or replace starter, reconnect wires.
Engine turns over slowly but does not start	Increased resistance of moving parts. Excessively high viscosity of fuel or engine oil at low temperature	Repair or replace. Use specified fuel or engine oil.
Engine turns over at normal speed but does not start	No fuel, compression pressure too low, piston ring and cylinder worn, improper valve clearance, defective fuel system, restricted air cleaner	Replenish fuel, replace head gasket and tighten cylinder head screws, check cylinder and piston ring, replace if necessary, adjust valve clearance, check fuel line, clean or replace.
Rough low speed running and idling. Rough high speed running.	Idle adjustment, incorrect governor adjustment, improper valve clearance. Incorrect governor adjustment. Incorrect governor adjustment	Governor, adjust valve clearance. Adjust governor.
Engine speed does not increase	Clogged air cleaner	Adjust governor. Clean or replace air cleaner.
Deficient output	Improper intake or exhaust valve sealing, incorrect governor adjustment, excessive carbon in engine, improper valve clearance, piston ring and cylinder worn, clogged air cleaner Improper valve clearance, rattles from loosely mounted external components	Replace defective valve, adjust governor, remove carbon, adjust valve clearance, replace worn piston rings, clean or replace clogged air cleaner. Adjust valve clearance, retighten external components.
Engine is noisy	Stale or diluted fuel will contaminate injectors, causing a severe knock or rattle.	Have injectors cleaned. Always keep clean, fresh fuel in your machine.

7. Park Brake

PROBLEM	CAUSE	REMEDY
Brake will not hold machine	Slack in cables out of adjustment	Adjust tightening nuts on cables.
	Cable mounts or end loose or disconnected	Inspect, tighten or reconnect as required.
	Cable kinked or broken	Replace.
	Brake damaged or worn	Inspect and replace worn or damaged parts.
Brake will not release	Cables kinked or binding	Inspect, replace, clean or adjust as required.

7.2...ATTACHMENTS AND BUCKETS

7.2 ALLIED ATTACHMENTS AND APPROVED SUPPLIERS

NOTE: All orders for approved Allied Products and requests for warranty, service or parts must be placed with the following companies. Be sure to refer to the attachment manufacturer's operating and safety instructions before operating.

ROCK HOUND

KEM ENTERPRISES INC.
18425 8th AVE. S.W.
SEATTLE, WA 98166
(TEL.) 206-453-9213
800-426-5615
FAX: 206-453-9218

GRADER RAKE

FRONT RUNNER CORPORA-
TION
100 E. LEE RD. BOX 122
LEE, IL 60530
TEL: 800-747-2132 OR
815-824-2132
FAX: 815-824-2620

SNOW BLOWER

ERSKINE MANUFACTUR-
ING CO. INC.
121 BRADLEY BLVD. P.O.
BOX 100
ERSKINE, MN 56535
(TEL.) 218-687-4045
(FAX.) 218-687-5293

4:1 BUCKET

CONSTRUCTION ATTACH-
MENTS INC.
557 WILKES BORO BLVD. NE
LENOIR, NC 28645
TEL: 800-255-4461
TEL: 704-758-2674
FAX: 704-754-1887

ROLL OUT BUCKET

TINK INC.
2361 DURHAM-DAY-
TON HWY
DURHAM, CA 95938
TEL: 800-824-4163
TEL: 916-895-0897
FAX: 916-895-0751

ROCK SAW

ALITEC
802 EAST MAIN ST.
BROWNSBURG, IN
46112
TEL: 317-852-8622
FAX: 317-852-8638

GRADER

PALM MFG. & SALES INC.
53800 C.S.A.H. 16
GROVE CITY, MN 56243
TEL: 800-332-7256
TEL: 612-857-2874
FAX: 612-857-2086

SNOW BLADE

SNOW WOLF
JLM LANDSCAPE
6026 PILLSBURY AVE.
SO.
MINNEAPOLIS, MN
55419
TEL: 800-905-2265
TEL: 612-861-5047

GRADE MASTER

PALM MFG. & SALES INC.
53800 C.S.A.H. 16
GROVE CITY, MN 56243
TEL: 800-332-7256
TEL: 612-857-2874
FAX: 612-857-2086

HARLEY-POWER BOX RAKE

GLEN MAC INC.
P.O. BOX 2135
JAMESTOWN, ND 58402
TEL: 800-437-9779
TEL: 701-252-9300
FAX: 701-252-1978

LANDSCAPE RAKE

YORK RAKE DIVISION
YORK MODERN CORP.
P.O. BOX 488
UNADILLA, NY 13849
TEL: 607-369-7111
FAX: 607-369-2625

VIBRATORY ROLLER

ALITEC
802 EAST MAIN ST.
BROWNSBURG, IN 46112
TEL: 317-852-8622
FAX: 317-852-8638

PALLET FORKS (CLASS II I.T.A. FORKS)

KENHAR PRODUCTS
BOX 1508
GUELPH, ON N1H 6N9
TEL: 800-265-2724
TEL: 519-763-3675
FAX: 519-763-4714

FILTERS 7.4

Recommended Service Intervals Initial Thereafter
 Oil and filter150 HRS500 HRS
 Fuel filter.....500 HRS500 HRS
 Primary air element500 HRS. Or as service
indicator dictates.
 Safety element.....As service indicator
dictates.
 Service intervals provided 5W40 API classification CF
 semi synthetic oil is used. Use only Deutz, Kubota or
 Thomas approved filters.

Engine oil and filter changes should be made with the engine warm, to assist draining.

1 Remove the cap on the oil drain hose located at the bottom left side of engine. A half moon shaped cut out in the belly pan is provided to route the hose into a drainage container. (fig. C1396). Be prepared to contain 14 litres (14.8 Qt) of oil.

2 Remove the engine oil filter, located toward the fly-wheel end left side of engine. (fig. C638). Check to make sure the o-ring came off with the filter. Remove from the housing if still stuck to the block.

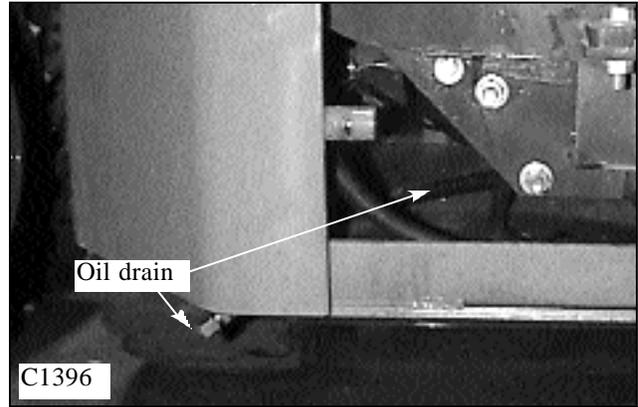
3 Apply clean engine oil to the new filters o-ring. Tighten filter on hand tight.

4 Replace the oil drain hose cap.

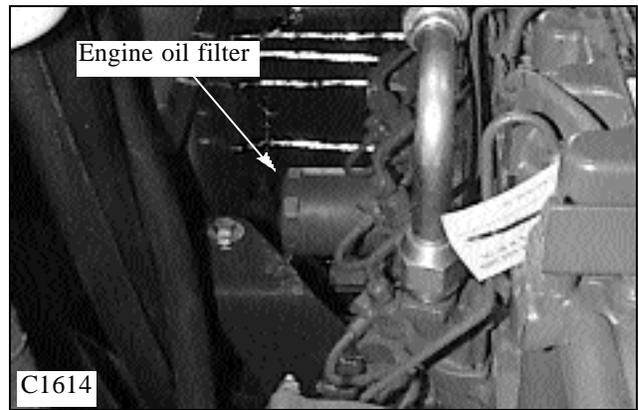
5 Remove the drain plug in engine oil cooler. (fig. C815) Be prepared to contain approximately 4 litres (4.25 Qt) of oil.

6 Replace the drain plug.

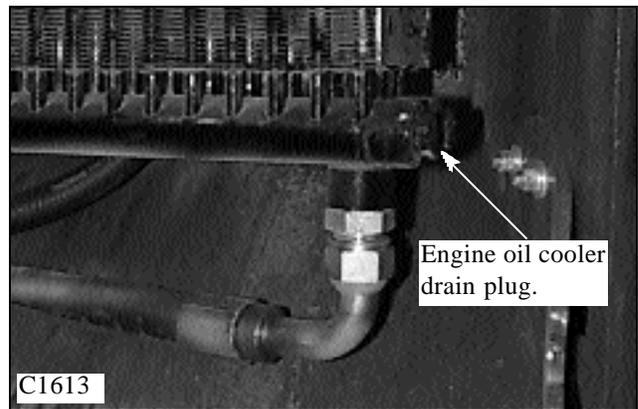
Please dispose of waste oil in an environmentally friendly manner.



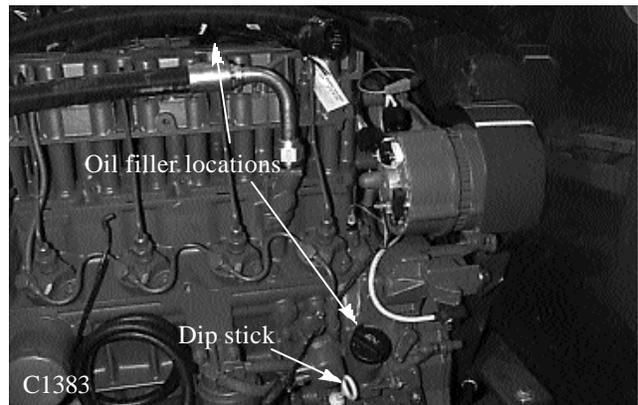
C1396



C1614



C1613



C1383

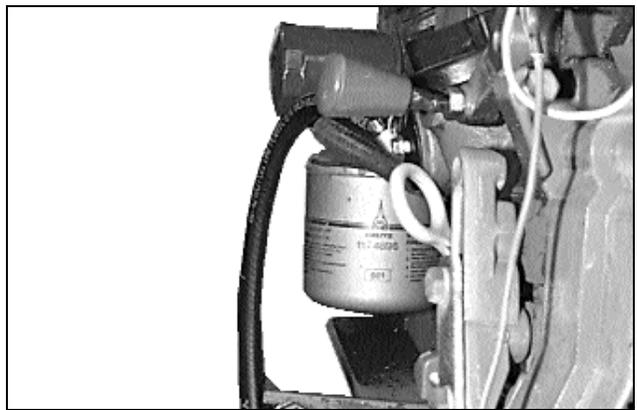
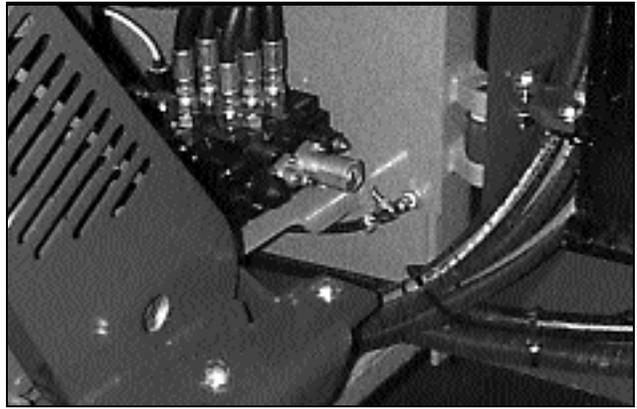
7

IMPORTANT

Follow the instructions closely when replenishing the engine oil. Adding too much at once may cause hydraulic lock.

NOTE: Use the following start-up procedure after draining the engine crankcase and oil cooler.

- 1 Add 10 litres (10.5 Qt) of API CF engine oil. (fig. C1383)
- 2 Start engine and check for leaks.
- 3 Warm engine fully to allow thermostat to open and replenish the oil cooler.
- 4 Shut down the engine and allow to cool for 15 to 20 minutes.
- 5 Top up the crankcase oil to the full mark on the dipstick., approximately 3 to 4 more litres. (3 to 4 Qt) Do not over fill. It is very important to allow ample time for the oil to drain back to the crankcase. Not doing so may result in over filling, excessive oil consumption, or possible hydraulic lock.



Service indicator
sender

Retaining
latches

ENGINE COOLER 7.5

ENGINE COOLER 7.5

ProTough 2200 Model Only.

The hydraulic oil cooler is mounted to the inside of the rear door. (fig. C2882). Oil returning from the control valve is circulated through the oil cooler before being sent on to other parts of the hydraulic system.

An engine driven cooling fan drives air through the oil cooler when the rear door is closed.

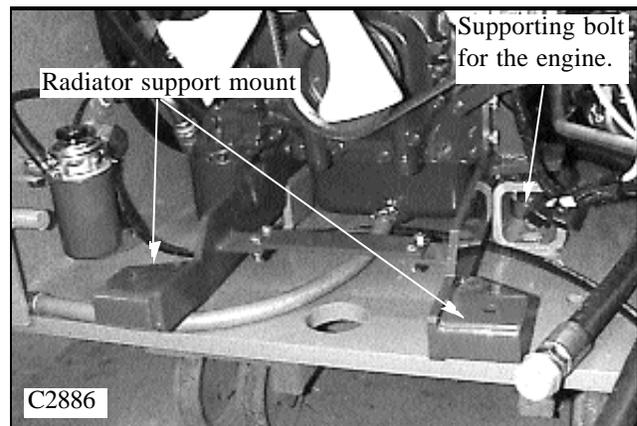
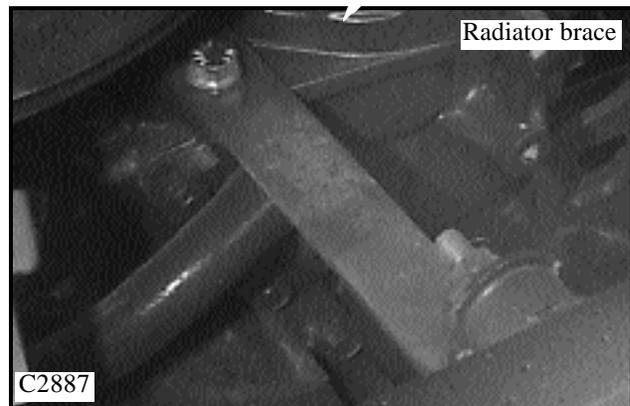
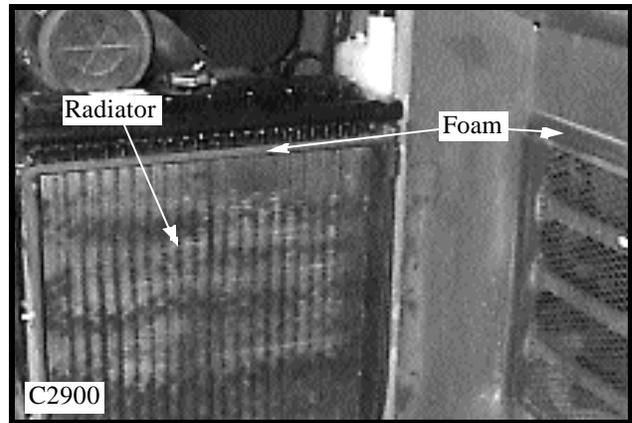
The oil cooler is rated at 440 BTU / minute.

The oil cooler should be checked daily for dirt build up on the cooling fins. If air flow is restricted through the cooling fins, over heating of the hydraulic system may occur. Clean any dirt build up with compressed air. Flush with water if necessary.

The oil cooler is surrounded by a shroud. The outer edge of the shroud holds a layer of sealing foam that presses against the engine radiator when the rear door is closed. This directs the air, driven by the engine cooling fan, through the hydraulic oil cooler. The sealing foam and adjustment should be checked at every service interval.

Cooler Replacement

- 1- Lower the boom arms, engage the parking brake and shut off the engine.
- 2- Open the rear door and remove the cooler shroud.
- 3- Connect a vacuum system to the oil reservoir filler spout, if available, or drain the hydraulic oil reservoir. Be prepared to contain 50 liters of fluid (13 gal). Use clean containers if the oil is to be reused. If disposal is required be environmentally friendly.
- 4- Remove the cooler hoses. Plug the open hoses and cooler ports to prevent contamination.
- 5- Remove the bolts which secures the radiator/oil cooler the support mount.(C2886)
- 6- Remove the radiator brace which is connected to the radiator/oil cooler and the engine.(Figure C2887)
- 7- Remove the cooler.
- 8- Remove the fittings from the oil cooler.
- 9- Inspect the fitting o-rings for damage and replace if necessary.
- 10- Install the fittings into the new or repaired oil cooler following the torque chart on section 1.10. Be sure to support the cooler as the fittings are tightened to prevent damaging the cooler.
- 11- Replace the cooler, cooler lines and cooler shroud. Follow the torque chart on section 1.10 when tightening the hydraulic hoses.
- 12- Replenish the hydraulic fluid as required. Check for system leaks and check the fit of the shroud seal to the engine radiator. Adjust if necessary.



WARNING
To avoid eye injury, use safety goggles when cleaning with compressed air.



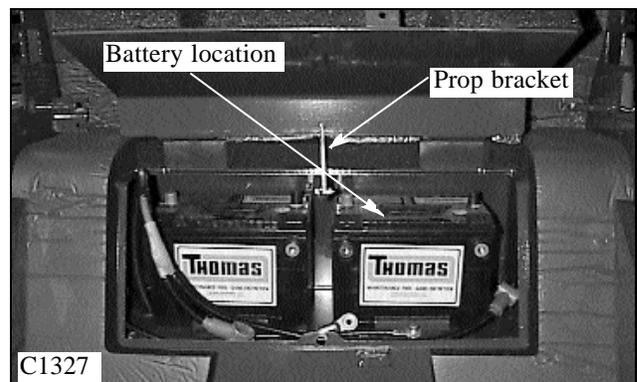
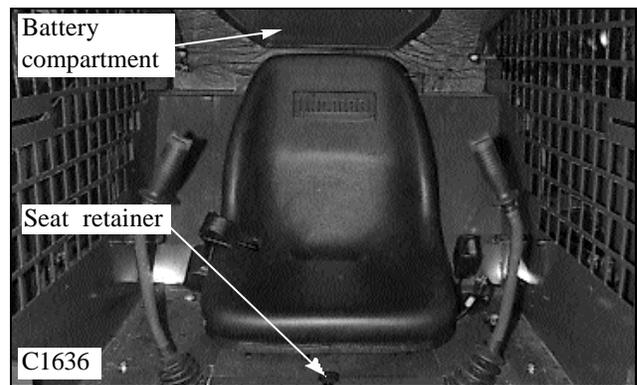
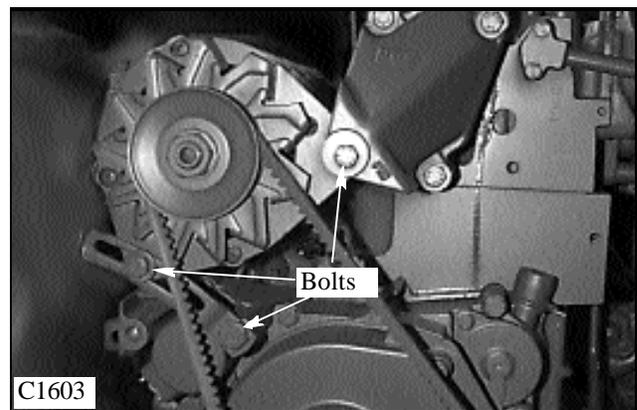
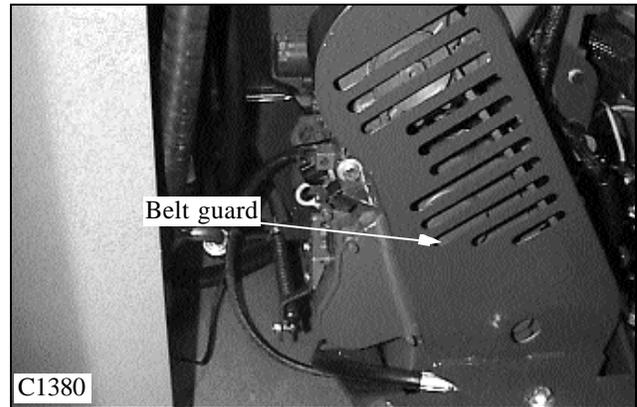
ALTERNATOR AND BELT 7.6

Belt Replacement

- 1 Servicing or replacing the alternator drive belt is accomplished by removing the safety guard around the alternator and belt. (fig. C1380)
 - 2 Belt tension should read 20 lbs (9.1 Kg) push, measured half way between alternator and crank pulleys, at 3 / 8 of an inch (9.5 mm) deflection.
 - 3 Make belt adjustments, or replace, by loosening the three mounting bolts. (fig C1603) Pivot the alternator to tension the belt properly and retighten the bolts.
- NOTE: If you have a high flow equipped machine, you will need to remove it's guard, and or remove the cogged belt to access alternator V-belt.

Alternator Replacement

- 1 To replace the alternator you must first disconnect the battery grounds. The batteries are accessed by removing the seat (fig. C667) and opening the battery compartment hinged door. It has a prop bracket to hold it open. (fig. 1327)
- 2 Disconnect the electrical leads and tag the wire locations for reassembly purposes.
- 3 Remove the three mounting bolts and the alternator.
- 4 Replace in reverse order.



SENDING UNITS & PREHEATER 7.7

Oil pressure and temperature sending switches are located just behind the alternator, left hand side of engine block.

(fig. C1383)

Disconnect sender wire and remove switch. Make sure the sealing gasket comes off with the old sender. Replace in reverse order.

NOTE: The temperature sending unit has two male spade terminals. You must be certain to connect to the smaller one. Incorrect hook up will result in incorrect or false readings.

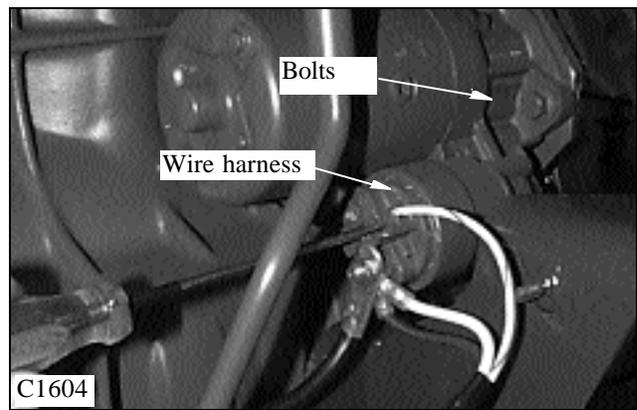
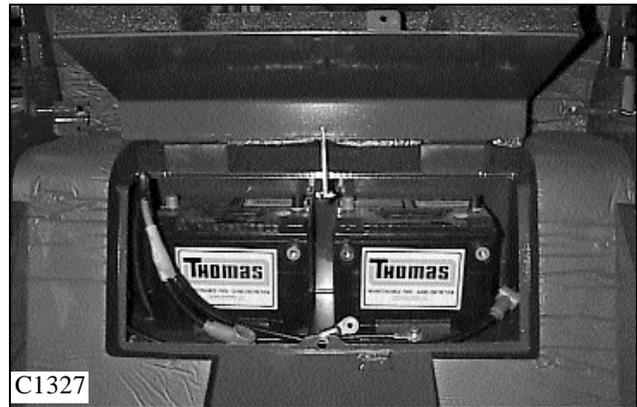
C1383



STARTER & STOP SOLENOID 7.8

The engine starter is located on the right hand side of the engine block. Before attempting repairs to the electrical system, disconnect both battery grounds. Batteries are accessed by removing the seat and opening the hinged battery compartment door.

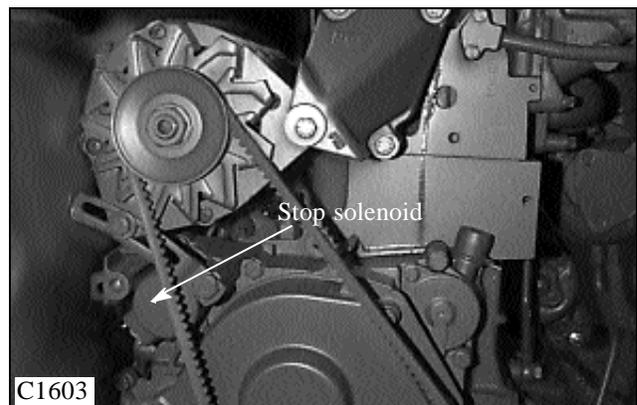
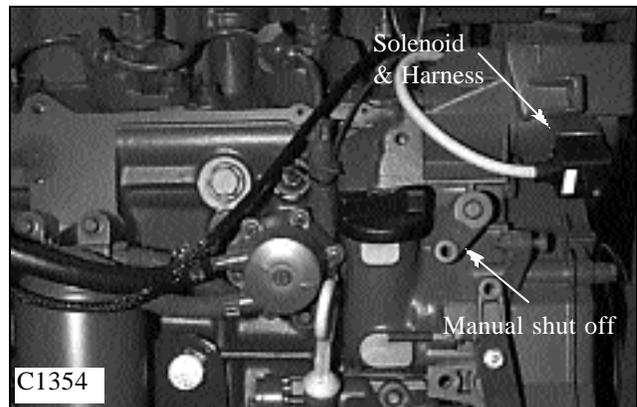
- 1 Disconnect the starter solenoid wires. (fig. C1604)
- 2 Remove the two bolts retaining the starter to the mounting plate.
- 3 Reverse procedure for reassembly. Torque bolts to 43.5Nm. (32 lbs / ft.)



The engine stop solenoid is located below, and just behind the alternator. (fig. C1603)

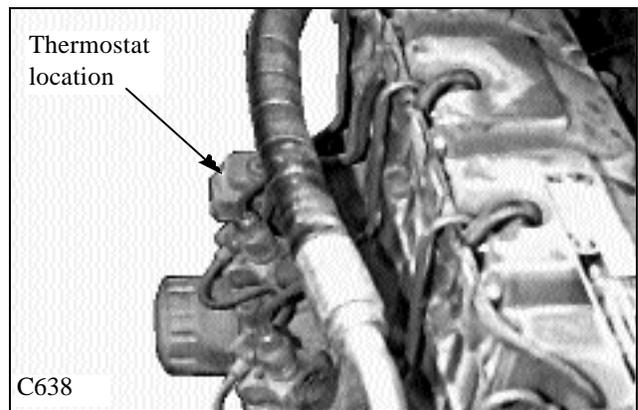
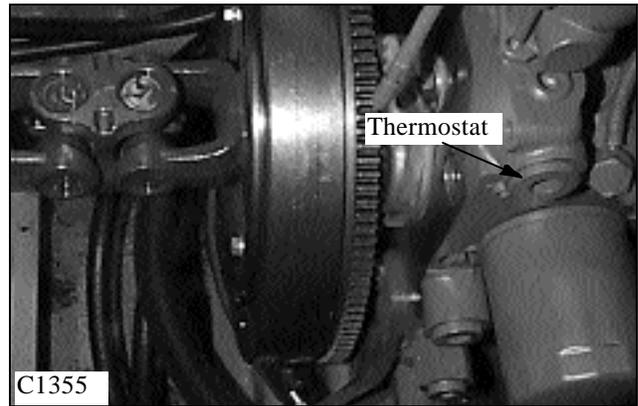
- 1 To access the stop solenoid you must first remove the alternator belt guard.
- 2 Disconnect the solenoid wiring plug. This plug connection has a small LED light, built in, that illuminates when the solenoid is receiving 12VDC. (Ignition switch in the run position.) This may help you diagnose a fuse or wiring problem.
- 3 Remove the two bolts retaining the stop solenoid. Pull out solenoid assembly.
- 4 Check o-ring, replace if necessary.
- 5 Reverse order for reassembly. Tighten bolts to 9 Nm. (6.5 lbs / ft.) Be sure to install with wiring connection pointing away from the block.

The Deutz engine is also equipped with a manual, mechanical, fuel shut off. It is located left hand side of engine block, close to the lower oil fill cap. (fig. C1354)



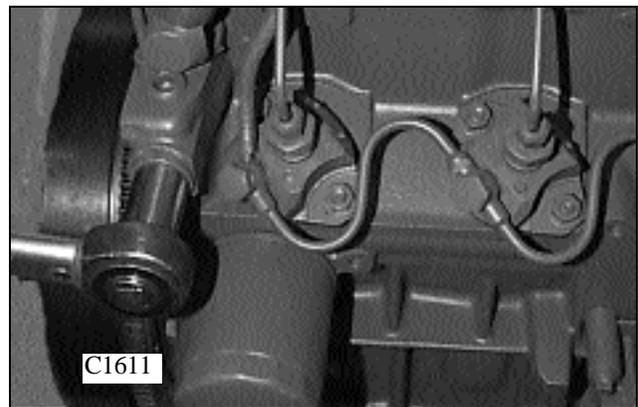
THERMOSTAT 7.9

The engine temperature thermostat is located toward the flywheel end of the engine, left hand side, just above and rearward of the engine oil filter. (fig. C1355)

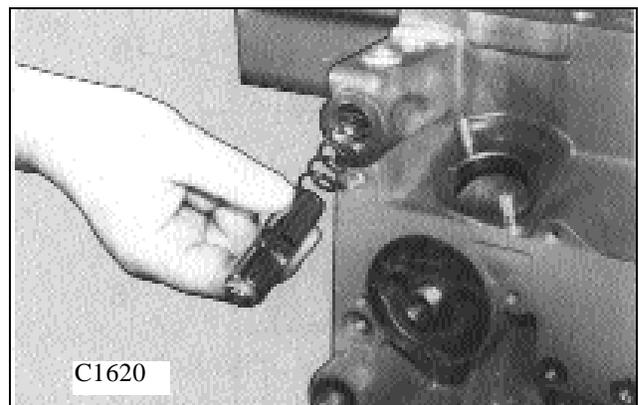


- 1 Remove socket hex plug. (fig.C1611)

7 NOTE: The thermostat is an integral part of the oil pressure and cooling system. Do not operate without a thermostat installed.

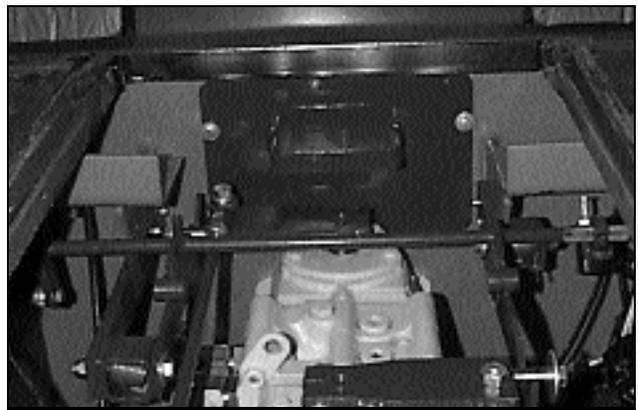
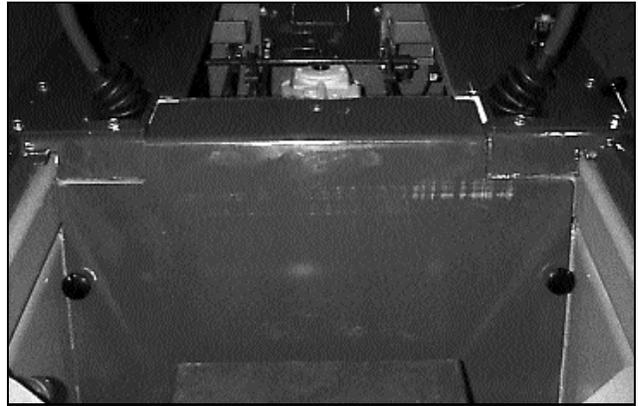


- 2 Remove thermostat and spring. (fig. C1620)
- 3 Replace in reverse order. Check the sealing ring, replace if necessary. Torque socket hex plug to 111 Nm. (82 lbs / ft)



For servicing the u-joint, you will need to raise the liftarms, and engage the boom support pins.

1 Remove the seat assembly and hydrostatic shield. Both can be removed without tools, by unscrewing the retaining knobs. (fig. C1339) Do not forget to unplug the seat safety wiring harness.



C1325

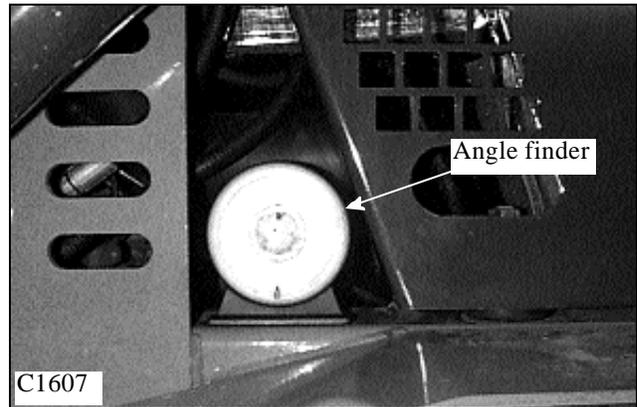




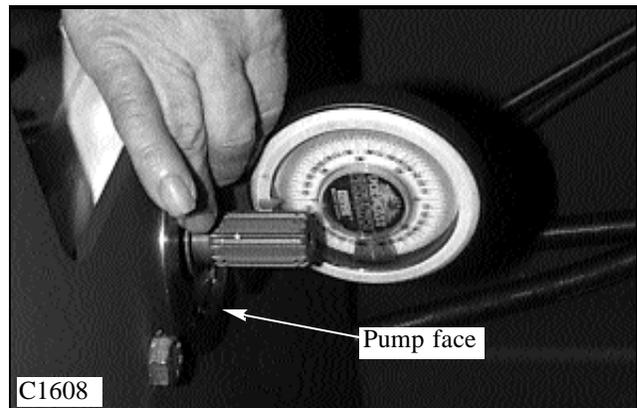
U-JOINT 7.10

If the engine has been removed, the u-joint alignment will need to be verified. The u-joint offset must be no greater than 4 degrees, horizontal. The vertical alignment must be the same.

1 Take a static measurement of the loader chassis, with an angle finder gauge. (fig. C1607) This angle, in degrees, will need to be subtracted, or added, to the measured vertical and horizontal measurements to get an accurate reading.



2 Vertical measurements need to be taken on the hydraulic tandem pump mounting face, and the u-joint flywheel mounting plate, with engine sitting in place on its isolator mounts. (fig. C1608 and C1609)



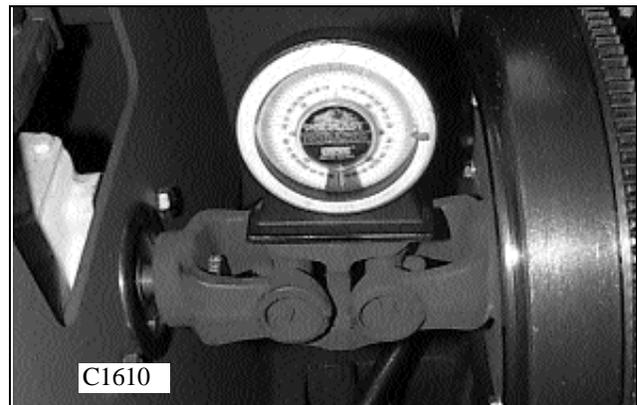
3 Horizontal angle is measured across the two u-joint cross'. (fig. C1610) Don't forget to allow for natural angle the loader chassis may be sitting at.



4 The slip yoke must also be fully engaged onto the hydraulic tandem pump splined input shaft. Allow the yoke to slide onto the spline until it just meets the second machined groove, closest to the pump seal. Do not let the slip yoke get too close to the pump input seal. Maintain approximately 13 / 32 inch clearance between end of yoke and pump input seal.

5 After final angle inspection, make sure there is adequate clearance between the motor mount and the engine cooler assembly. If necessary readjust the engine location to maintain 1 / 4 inch (7mm) clearance minimum.

6 Torque the three motor mount isolator bolts to 60 ft / lbs. (88 Nm)



7

ENGINE REMOVAL & INSTALLATION 7.11

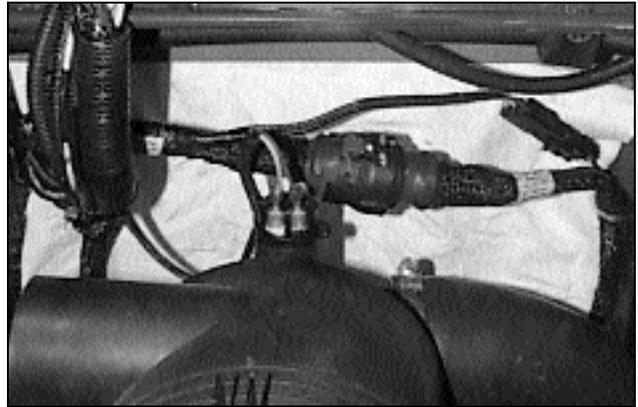
- 1 Raise the liftarms and engage the boom support pins.
- 2 Remove the seat and hydrostatic shield.
- 3 Access the battery compartment and disconnect both battery ground cables from the battery terminals.

Connection

C1364



ENGINE REMOVAL & INSTALLATION 7.11



ENGINE REMOVAL & INSTALLATION 7.11



C1601

ENGINE REMOVAL & INSTALLATION 7.11



ENGINE REMOVAL & INSTALLATION 7.11

2 When mounting the u-joint adapter plate to the engine flywheel, torque the bolts to 20 ft / lbs.(27 Nm)
(fig. C1606)

C1640

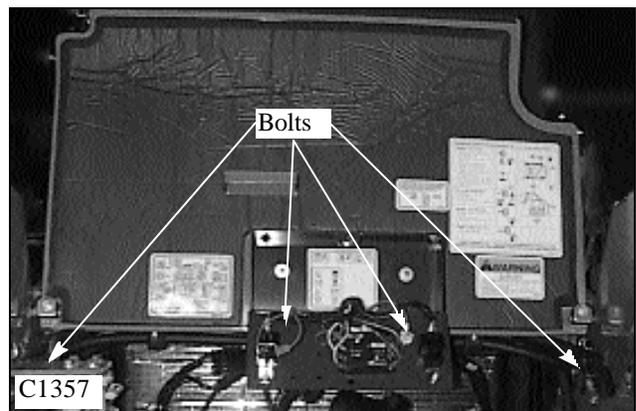
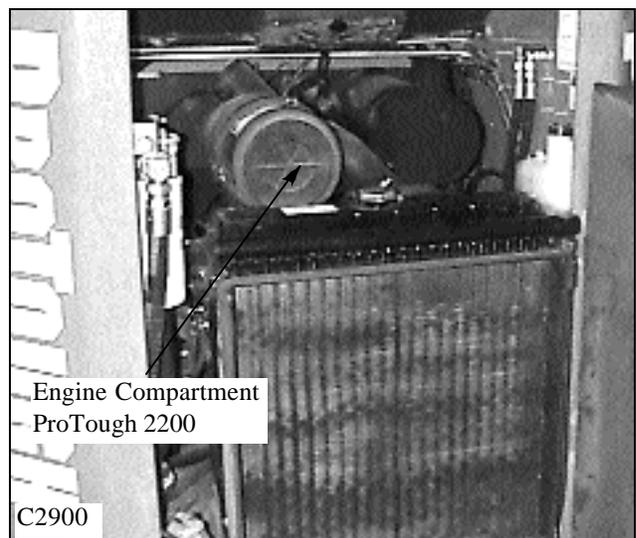
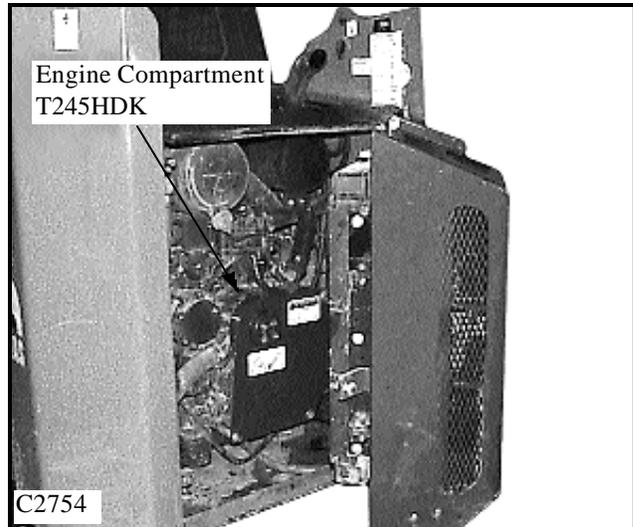
ENGINE REMOVAL & INSTALLATION 7.11

Kubota Engines

Removal

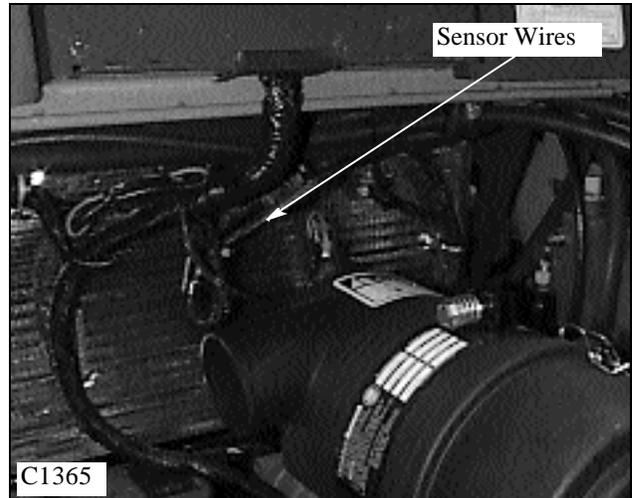
The following procedures describe the removal of the engine from the T245HDK and the ProTough 2200 models. Figures C2754 and C2900 show the locations of the engines.

- 1 Raise the liftarms and engage the boom support pins.
- 2 Remove the seat and hydrostatic shield.
- 3 Access the battery compartment and disconnect both battery ground cables from the battery terminals.
- 4 Shut off the fuel line petcock located inside the engine compartment, lower right hand side of frame. Refer to Figure C2757.
- 5 Loosen fuel line clamp and disconnect fuel line.
- 6 Disconnect the fuel return line (Fig. C1364)
- 7 Replace drain plugs and caps.
- 8 Remove the two bolts holding the fuse box assembly to the engine cover. (Fig. C1357)
- 9 Remove the engine compartment pivot bolts and clamps.(Fig. C1357)
- 10 Remove the engine cover.
- 11 Disconnect the air filter sensor wires located at the rear of the air cleaner canister. (Fig. C1365)
- 12 Remove the air cleaner canister assembly.(Fig. C2900)
- 13 Plug or cover any open intake passages to prevent contamination.



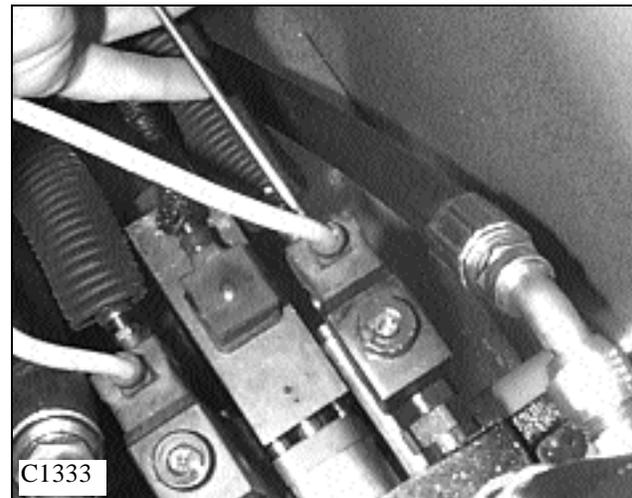
ENGINE REMOVAL & INSTALLATION 7.11

14 Disconnect the engine harness connector, by pushing down on the spring loaded locking tab and twisting the plug connection counter clockwise.



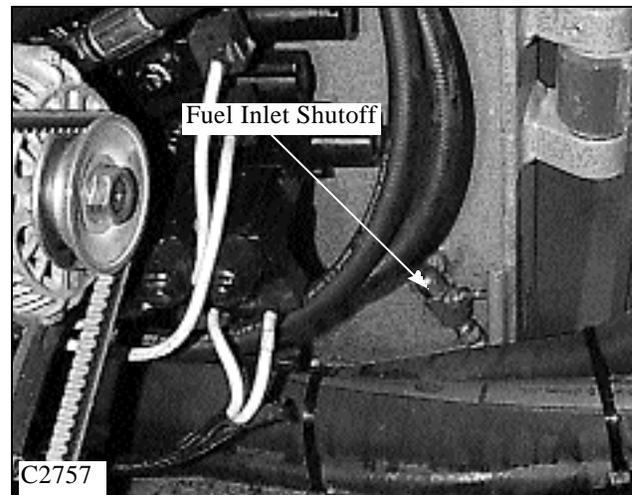
15 Remove the nut from the mainframe grounding point and unhook all ground wires.

16 Disconnect the starter wiring. Note the wire locations for reassembly. You will also need to either disconnect the wiring from the boosting lug or remove the boosting lug mount from the engine.



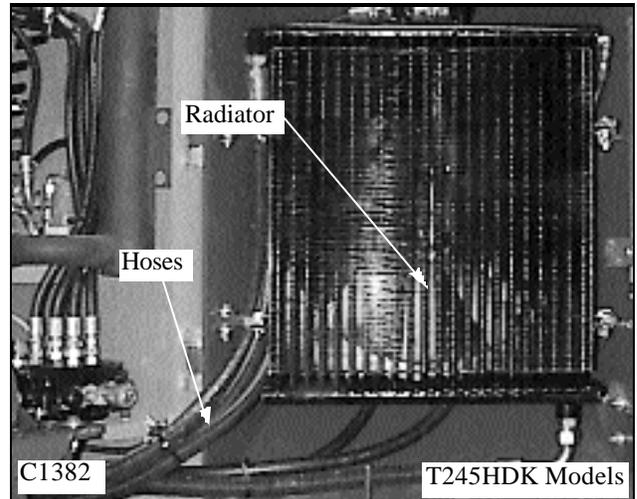
17 Disconnect all hydraulic control valve wiring connections. Note the wire locations for the valve locks and the electric operated auxiliary solenoid.

18 Disconnect the throttle linkage at the mounting bracket and the pivot ball socket joint.

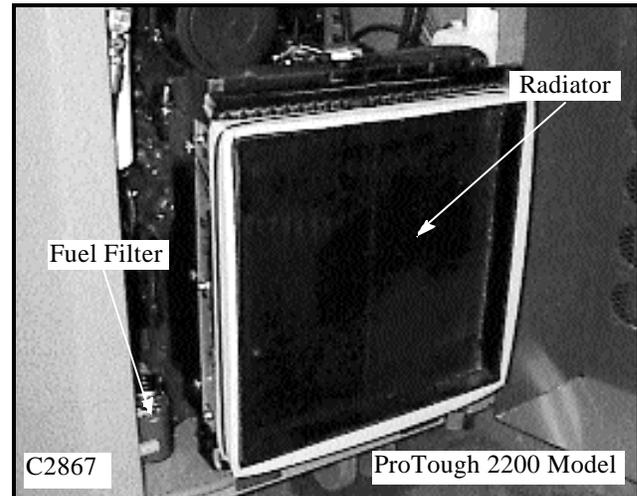


ENGINE REMOVAL & INSTALLATION 7.11

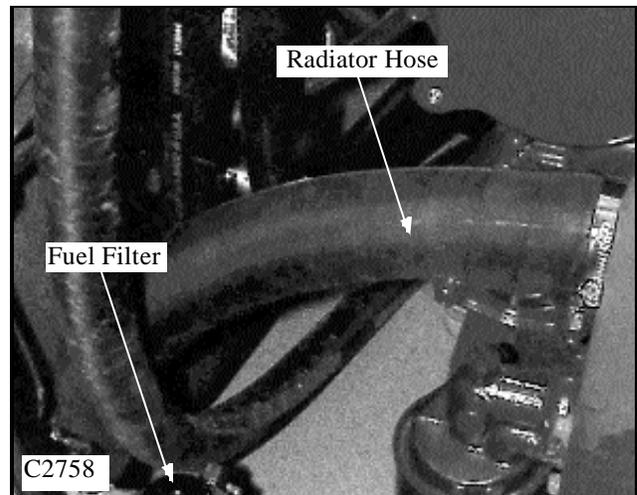
19 Disconnect the radiator which is located on the rear door of the T245HDK. Refer to Figure C1382.



20 Disconnect the radiator which is located on the support mount designed for the ProTough2200. Refer to Figure C2867.

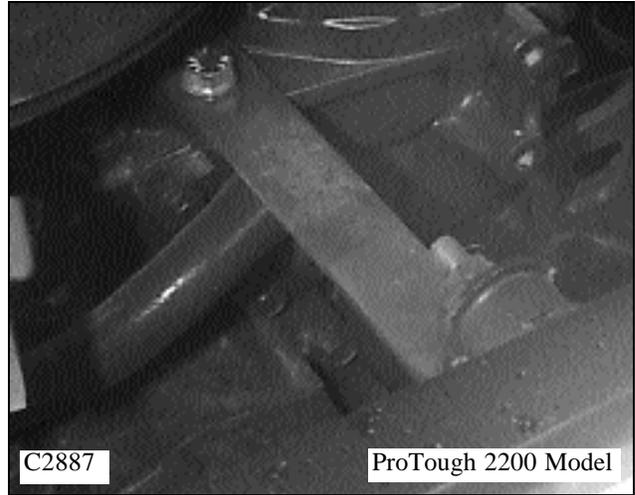


21 Disconnect the radiator hoses and drain the coolant as required. Refer to Figure C2758.

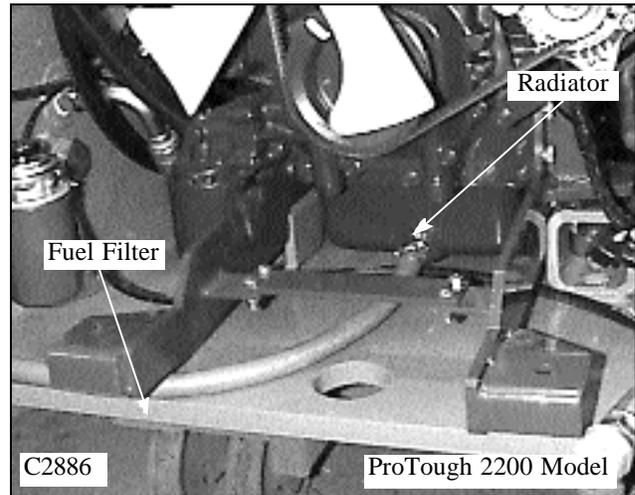


ENGINE REMOVAL & INSTALLATION 7.11

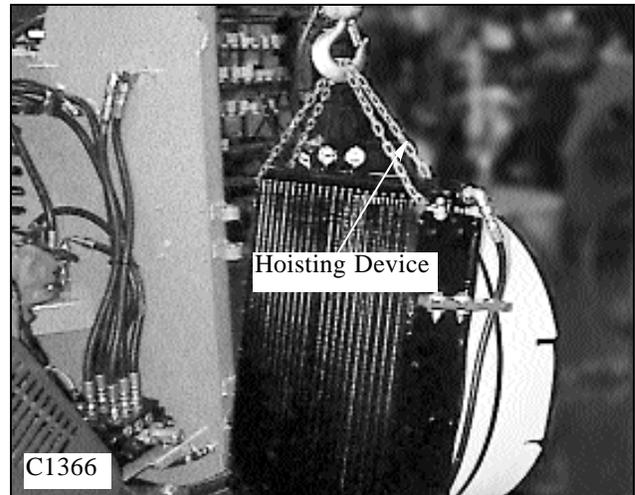
22 Disconnect the radiator brace which is located at the top of the radiator and is connected to the radiator and engine. This item is applied to the ProTough2200 model only. Refer to Figure C2887.



23 Disconnect the radiator which is located on the support mount designed for the ProTough2200. Refer to Figure C2867 and Figure C2886.

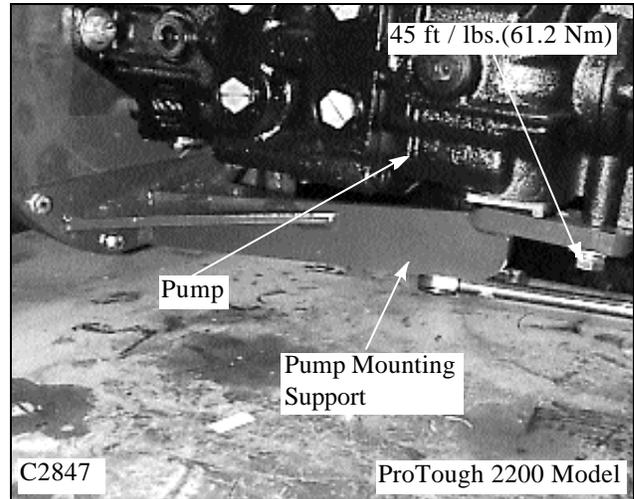


24 Once the radiator has been disconnected, the radiator should be lifted away using a lifting device. Refer to Figure C1366

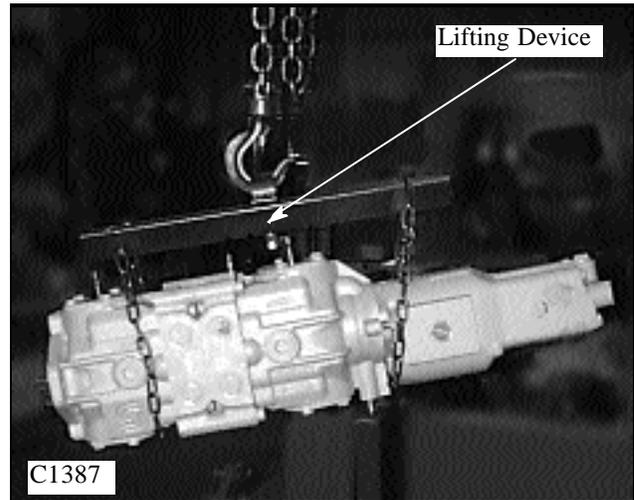


ENGINE REMOVAL & INSTALLATION 7.11

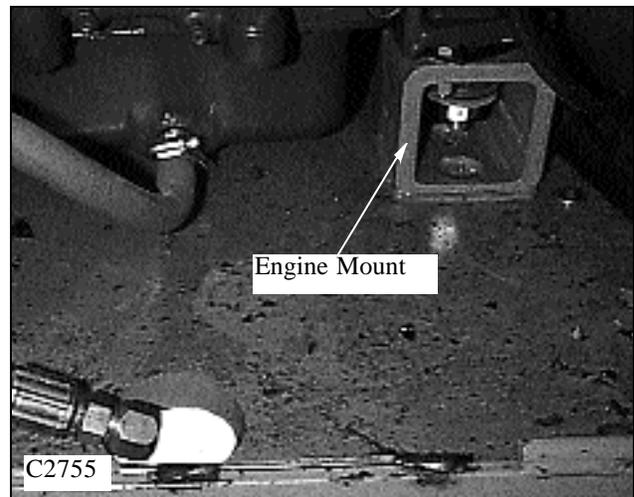
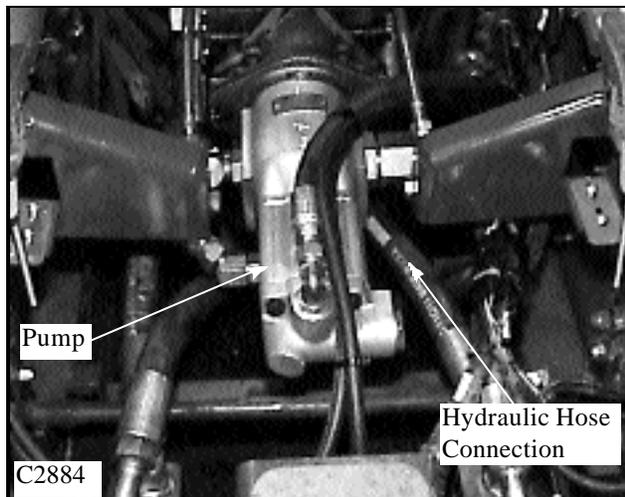
25 Disconnect the pump from the engine. The pump rests on the pump mounting support which is connected to the pump mount plate. Refer to Figure C2847.



26 Once the pump has been disconnected use a lifting device to remove it (if required). If the pump is to remain, it should be supported by some means such as a lifting device etc. This procedure will eliminate the need to remove the hydraulic hose connections to the pump. Refer to Figures C1387 and C2884.

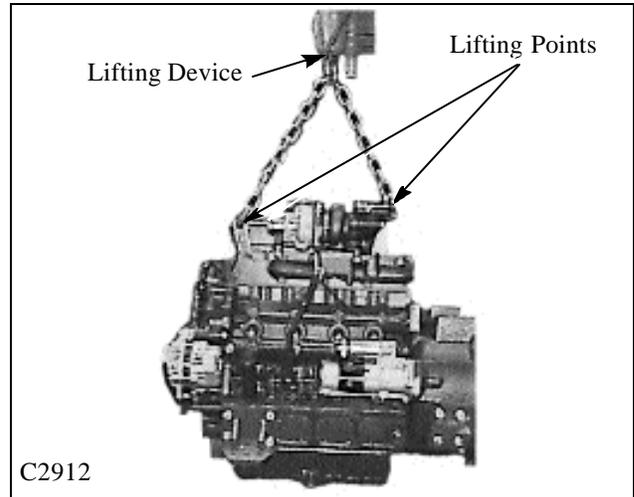


27 Once the previous procedures have been applied, removal of the engine can proceed. Disconnect the bolts which secures the engine to the loader mounts once this is completed the engine is ready for removal. Refer to Figure C2755.



ENGINE REMOVAL & INSTALLATION 7.11

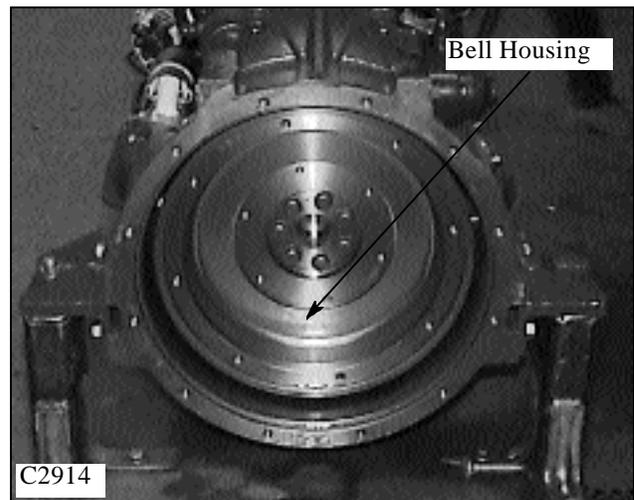
28 Removal of the engine is accomplished by using a lifting device as shown in Figure C2912.



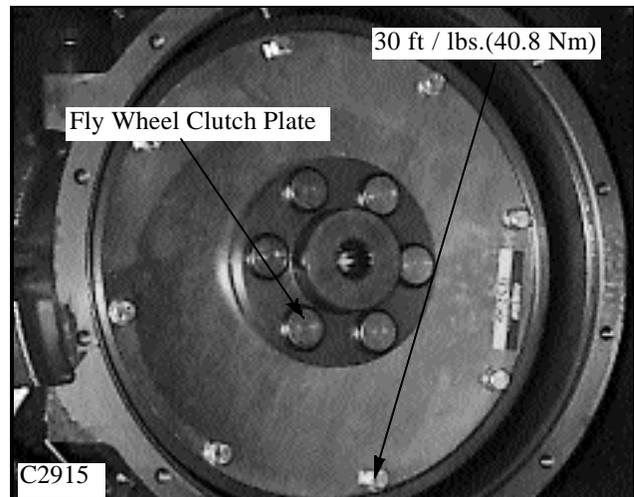
Installation

Installation of the engine is accomplished by using a lifting device as shown in Figure C2912. If the engine is being replaced with a new assembly, the engine will require some preparation.

1 Prepare the bell housing for the installation of the fly wheel clutch plate.(Figure C2914)

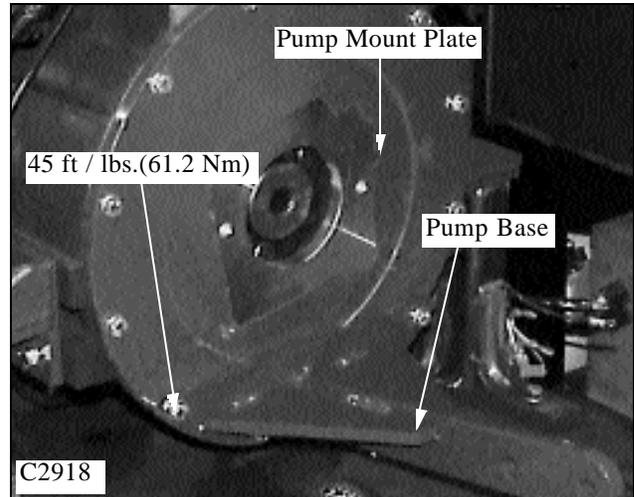


2 Remove the protective rust preventative coating from the flywheel. Use a solvent to remove. The flywheel must be cleaned to the surface metal. Figure C2915.

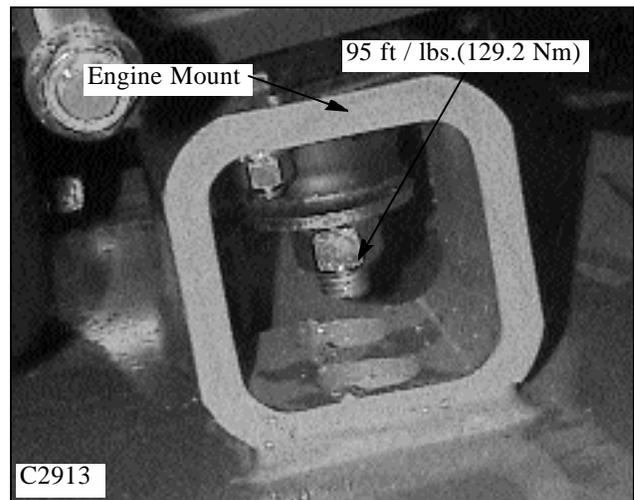


ENGINE REMOVAL & INSTALLATION 7.11

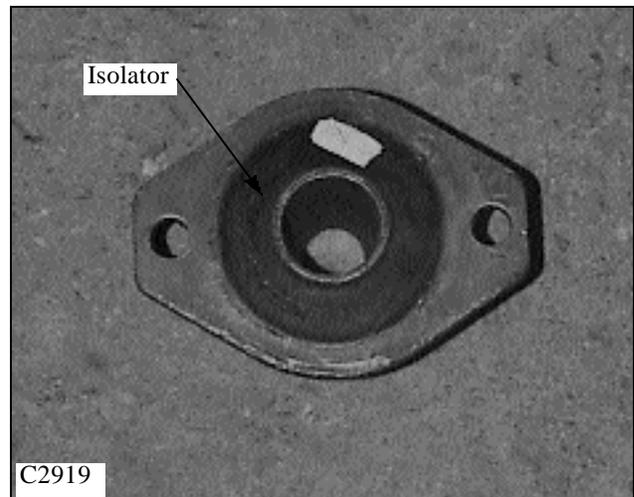
3 Install the pump mount plate and pump base support. (Fig. C2918)



4 Install the engine to the mounts. Apply Loctite 242 (blue) to the treads of the mounting bolts. Torque the bolts to 95 ft/lbs. (129.2 Nm). (Fig. C2913)



5 Check the engine mounting isolators in the loader frame. Make sure the isolators are not separating or the rubber is not deteriorated in any way. Replace the isolators as required. Figure C2919)



ENGINE REMOVAL & INSTALLATION 7.11

6 Install the pump after the engine is secured and the pump base support is installed. (Fig. C2916)

7 After the pump is installed make sure the bolts are torqued to their required values. (Fig. C2917)

8 Paint must be removed from the engine block where the engine mount bolts attach to the side of the engine, this will provide proper electrical grounding.

9 Install the engine mounts. Apply Loctite 242 (blue) to the threads of the mounting bolts. Torque the mounting bolts to 95 ft / lbs. (129.2 Nm).

10 Install the engine temperature sender.

11 Install the engine shut - off solenoid.

12 Install the engine wire harness and connect the various electrical connections, routing the wires carefully to prevent chaffing. Tie the wires with Zip ties as required. Be sure all ground points are clean and there are no loose wires hanging.

13 Install the radiator and hoses.

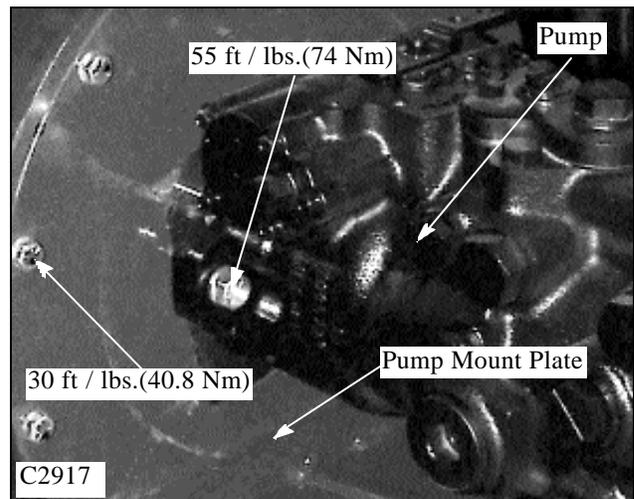
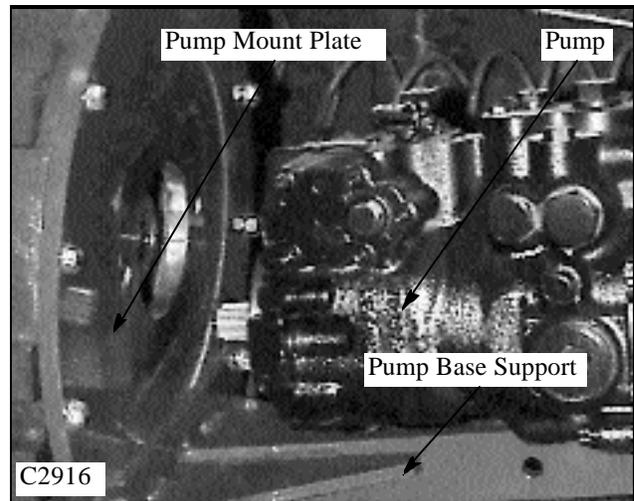
14 Install the fan guard to the radiator shroud.

15 Install the upper radiator mounting bracket.

16 Add radiator coolant.

17 Connect starter and hydraulic control wiring.

18 Connect throttle linkage.



ENGINE REMOVAL & INSTALLATION 7.11

19 Connect mainframe grounding nut.

20 Turn on fuel line petcock.

21 Connect fuel line and fuel line return.

22 Reinstall fuel box assembly.

23 Reinstall engine compartment cover.

24 Reinstall the air cleaner canister assembly and the exhaust system.

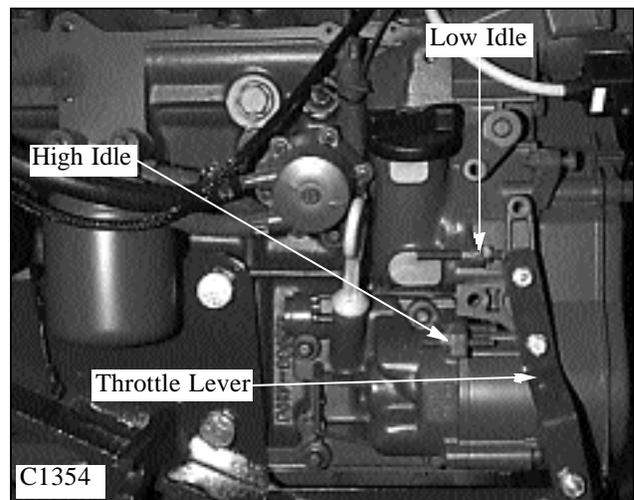
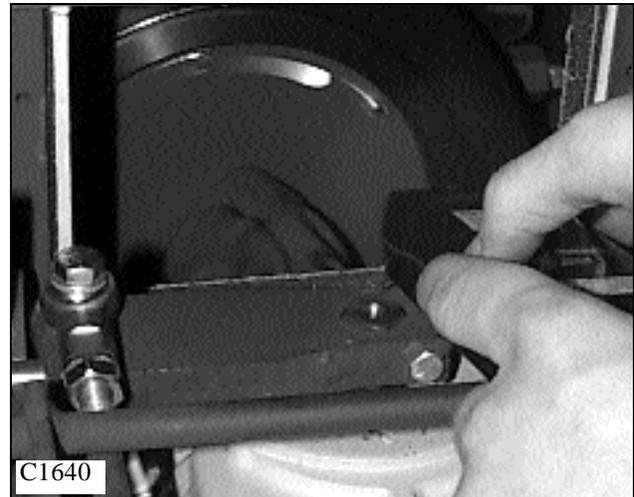
25 Connect air filter sensor.

26 Connect battery ground cables.

27 Bleed the fuel lines.

28 Test fire the engine.

29 Make the necessary RPM adjustments after engine start up procedure has been followed. Minimum engine idle is 1200 RPM. Maximum engine idle is 2700RPM (Figure C1354). Recommended use of a photo sensor tachometer, with reflective tape attached to the engine flywheel. (Figure 1640) Make sure the throttle lever is contacting the idle adjustment screws when taking RPM readings.



NOTES

SECTION 8

MAINTENANCE & SPECIFICATIONS

Preventative Maintenance Schedule.....	8.1
50 Hour Service Check	8.2
Specifications.....	8.3
Torque Specifications	8.4
Sound Power Level Specifications.....	8.5
Special Tools.....	8.6



8. 1 PREVENTIVE MAINTENANCE SERVICE SCHEDULE

ITEM	SERVICE REQUIRED	8 HOURS	50 HOURS	150 HOURS	500 HOURS	1000 HOURS
Engine Oil	Check level and add if necessary. Use 5W40 API Classification CF oil.					
Hydraulic Oil	Check level and add if necessary. Use 10W30 API Classification SE/CD or 20W50 API Classification SE/CD oil.					
Radiator & Oil Cooler	Check cooling fins for dirt. If necessary blow out with compressed air.					
Air Cleaner	Empty dust cap. Check condition indicator and service or replace element as required.					
Tires and Wheel Nuts	Check for low pressure or tire damage. inflate standard tires 50 PSI (345 KPa), flotation tires 40 -45 PSI (2761-310 KPa). Check wheel nut torque 100-110 ft. lbs. (136-149 N.M.)					
Safety Equipment: Note: ProTough2200 is not equipped with boom lock downs.	Check all safety equipment for proper operation and condition. Seat belt, boom supports, quick-tach locks, parking brake, steering locks, safety treads, front shield, cab side screens and boom lock down. If necessary lubricate foot pedal and steering control linkages, springs and shafts with a silicone based lubricant. If necessary repair or replace.					
Decals	Check for damaged safety or instruction decal's. If necessary replace. (See Section 8.6)					
Lubrication	Grease all hinge pin fittings until excess shows.					
Hydraulic Oil Filter	Replace hydraulic oil filter element. Initial change only. (See Section 1.6)					
Safety System Linkages and Springs	Check and if necessary adjust. Lubricate foot pedal lock springs, shaft and linkage with a silicone based lubricant.					
50 Hour Service	Perform complete 50 hour service. (See Section 8.2)					
Final Drive	Check chain and sprocket condition. Check every 150 hours. (Section 3.3)					
Engine Oil	Replace engine oil. Use 5W40 API Classification CF oil. (See Section 7.4). Initial change only.					
Engine Oil Filter	Replace engine oil filter. (See Section 7.4). Initial change only.					
Hydraulic Oil Filter	Replace hydraulic oil filter element. (See Section 1.6)					
Preventative Maintenance Service Check	It is recommended as a preventative maintenance procedure that the 50 hour service be repeated every 150 hours.					
Fan Shaft - set screws	Check torque, 60 in. lbs. (16.3 Nm) See Thomas Dealer for inspection. (See Section 1.7)					
Engine Oil	Replace engine oil. Use 5W40 API Classification CF oil. See 4.8-3. Replace every 500 hours.					
Engine Oil Filter	Replace engine oil filter. (See Section 7.4). Replace every 500 hours.					
Engine Fuel Filter	Replace engine fuel filter. (See Section 7.4). Replace every 500 hours.					

continued

8. 1 PREVENTIVE MAINTENANCE SERVICE SCHEDULE (cont'd)

ITEM	SERVICE REQUIRED	8 HOURS	50 HOURS	150 HOURS	500 HOURS	1000 HOURS
Hydraulic Oil	Change hydraulic oil. Replace with 10W30 A.P.I. Classification SE/CD oil or 20W50 A.P.I. classification SE/CD.					
Final Drive	Change final drive lubricating oil. Use 10W30 A.P.I. Classification SE/CD oil. (See Section 3.2)					
Hydraulic Reservoir Filters	Remove and replace the 100 micron suction element in the oil reservoir. (See Section 1.8)					
Valve Clearance Check	See Thomas Dealer for inspection.					
Injector Check	See Thomas Dealer for inspection.	3000 Hours				
Timing Belt	To be replaced. See Thomas Dealer for proper part number.	4500 Hours				

NOTE: For complete engine service details refer to the engine manufacturers service manual. Specify Deutz Model # BF4M1011F for this manual. **Thomas** p / n 43134



WARNING

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

- **DO NOT** use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.
- Stop engine and relieve pressure before connecting or disconnecting lines.

Tighten all connections before starting engine or pressurizing lines.

If any fluid is injected into the skin obtain medical attention immediately



WARNING

To avoid personal injury service repairs must be performed by an authorized Thomas dealer.



8.2 50 HOUR SERVICE CHECK

The following service check is to be performed by your dealer after the first 50 hours of operation.

1 Engine

1.1 Oil Cooler for Leakage and Dirt:

If necessary flush the oil cooler with compressed air. A dirt buildup on the oil cooler cooling fins can cause both engine and hydraulic system overheating. Check the foam sealing ring on the fan drive.

1.2 V Belt Tension and Condition:

Check V belt for cuts or wear, if necessary replace. Check tension and adjust as shown in Section 7.6.

1.3 Fuel System for Leaks:

Make a visual inspection of fuel system for leaks and potential hazards such as fuel line(s) touching exhaust manifold, flywheel, etc. Replace fuel filter every 1000 hours.

1.4 Air Intake and Cleaner System:

Visually inspect the air cleaner system and be sure all hose clamps are secure. Check that the filter blocked warning light has gone out after start up.

1.5 Exhaust System:

Visually inspect the exhaust system and ensure all clamps are secure and the manifold bolts/nuts are tight.

1.6 Engine Speed:

Check and if necessary adjust engine R.P.M. See specifications.

1.7 Mounting Bolts:

Verify that the engine cross member mounting bolts, located at the loader rear, are torqued to 45- 50 ft. lbs (61-68 N.M.).

IMPORTANT

Keep the rear door closed except for servicing. Make sure the door is closed and latched before operating the loader.

2 Hydraulic / Hydrostatic

2.1 Hydraulic Oil Filter:

Change the hydraulic filter now and every 150 hours after the initial change. Lubricate the filter cartridge seal with system fluid.

2.2 Hydrostatic Charge Filter: (Not used on Protough 2000 Model).

Change this hydraulic filter now. This filter is equipped with an indicator which indicates a blocked filter condition. Change this filter when indicating a blocked condition or every 150 hours whichever is first.

2.3 Hydraulic Oil Level:

If oil is visible in the oil level sight glass the level is satisfactory.



To avoid personal injury, lower the boom arms, shut off the engine, raise the seat bar and cycle the hydraulic and steering controls to ensure they are locked. Then, Unlatch the seat belt and exit the loader. Do not enter or exit with the engine running unless as specified in this manual or under specific service and backhoe operating procedures.

2.4 Hoses and Pipes:

Make a visual inspection of all hydraulic lines and fittings for leaks. Check that steel lines do not touch one another.

2.5 Cylinders:

Inspect cylinders for leaks. Extend cylinders and check for rod damage.

2.6 Hydraulic Functions:

Check that the following operate properly: control valve float position, auxiliary hydraulic detent, hydraulic cylinders and fan drive.

2.7 Pumps & Motors, Leakage:

Inspect pumps and motors for leaks.

2.8 Oil Cooler:

Inspect the oil cooler for leaks, fin damage or clogged with dirt. If necessary flush fins with compressed air.

2.9a Fan Drive:

Inspect fan and motor to ensure there is no build up of dirt or trash. Use compressed air to clean area. Check that fan will rotate with no noticeable binding. Inspect all hydraulic hoses for leaks.

2.9b Fan Drive:

Inspect fan to ensure there is no build up of dirt or trash. Use compressed air to clean area. Check that fan will rotate with no noticeable binding. Inspect all hydraulic hoses for leaks.

3 Final Drive

3.1 Oil Level:

Check lubricating oil level. If necessary add 10W30 API classification SE/CD oil.

3.2 Drive Chain Condition:

Check drive chains for any sign of wear or damage. Check lubrication oil in housing for signs of contamination.

3.3 Hydrostatic Motor Mounting Bolts:

Check torque 85-90 ft. lbs. (115-122 N.M.)

3.4 Axle Bearing End Play:

Axle bearings are preloaded and must have no end play. Inspect and adjust if necessary.

3.5 Idler Sprocket Bearing End Play:
The idler sprockets are preloaded and must have no end play. Inspect and adjust if necessary.

If additional oil is required use only 10W30 API classification SE/CD oil. Fill to the top or maximum check point.

4 Controls and Safety Equipment

4.1 Control Levers, Operation and Linkage:

Check that the steering levers operate freely without binding, they return to neutral when released and the machine travels in a straight line with both levers in forward position. Ensure control levers lock in neutral with seat bar up. Lubricate linkage with a silicone based lubricant.

4.2 Foot Pedals, Operation and Linkage:

Check that the foot pedals operate freely without binding. Before leaving the operator seat, ensure the pedals are locked, raise the safety bar and unbuckle the seat belt, to test the seat switch, grasp the seat bar and raise your weight off the seat and check pedals at the same time to ensure they are locked. Lubricate linkage with a silicone based lubricant.

4.3 Engine Throttle Control:

Check that the throttle control operates freely without binding or slackening off due to vibration. Inspect the friction lock to ensure proper operation.

4.4 Parking Brake:

Check that the parking brake engages and completely disengages. Park Brake automatically engages with seat bar up.

4.5 Boom Support Operation:

Check that the boom supports operate without binding.

NOTE: Ensure the boom supports are fully retracted before raising or lowering the boom.

4.6 Quick-Tach, Operation & Linkage:

Ensure the quick-tach linkage operates smoothly without binding and engages completely.

4.7 Seat Belt:

Check seat belt condition. If necessary replace. For your safety, the loader is equipped with electrically activated safety devices through the seat and seat belt. Consult your repair manual for repairs.(See Section 5)

4.8 Check that the boom lock down operates properly and fully engages to lock the boom in the front of the main frame.

5 Electrical

5.1 Batteries X 2:

(ProTough 2200, Equipped with one (1) battery)
Maintenance Free.

5.2 Battery Terminals:

Check battery terminals for corrosion. If necessary, clean.

5.3 Operation of Starter:

Engage and disengage the starter several times to ensure it's working properly. To prevent starter damage do not engage for more than 15 seconds.

Allow 1 minute between starting attempts for cooling the starter.

5.4 Operation of Electrical Equipment:

Make a complete check of all electrical equipment, gauges, warning devices, manifold heater indicator, work lights, seat belt switch, seat bar switch and all optional equipment to ensure they are operating correctly.

6 Grease/Lubrication

Lubricate the following points with a good quality grease. Numbers marked () indicate the number of fittings at each location.

Rear Boom Pivots (2)

Boom Cylinder Bushings (4)

Bucket Cylinder Bushings (4)

Engine Universal Joint (2) (T243HDS,T245HDS only.)

Boom Support (2)

Quick-Tach Pivot and lock pins (4)

Boom Lock Down (4)

7 General

7.1 Tire Pressure:

Check tire pressure and if necessary inflate to the following pressures:

12.00 x 16.540 - 45 PSI (276-310 KPa)

Flotation tires may be inflated to 50 PSI (345 KPa) on hard flat surfaces.

7.2 Wheel Nut Torque:

Check and torque wheel nuts to 100-110 ft. lbs. (136-149 N.M.).

7.3 Condition of Cab:

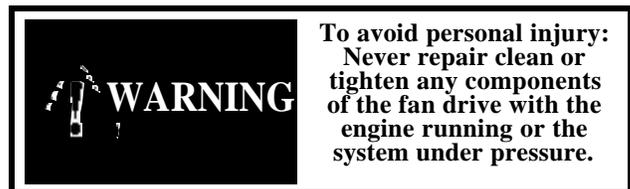
Inspect both the seat and seat belt. Ensure all safety and instruction decals are in place. Inspect sound insulation, side windows and door operation for machines equipped with cab enclosure kits. Inspect for structural damage and alterations to R.O.P.S. / F.O.P.S.

7.4 Condition of Shields and Safety Equipment:

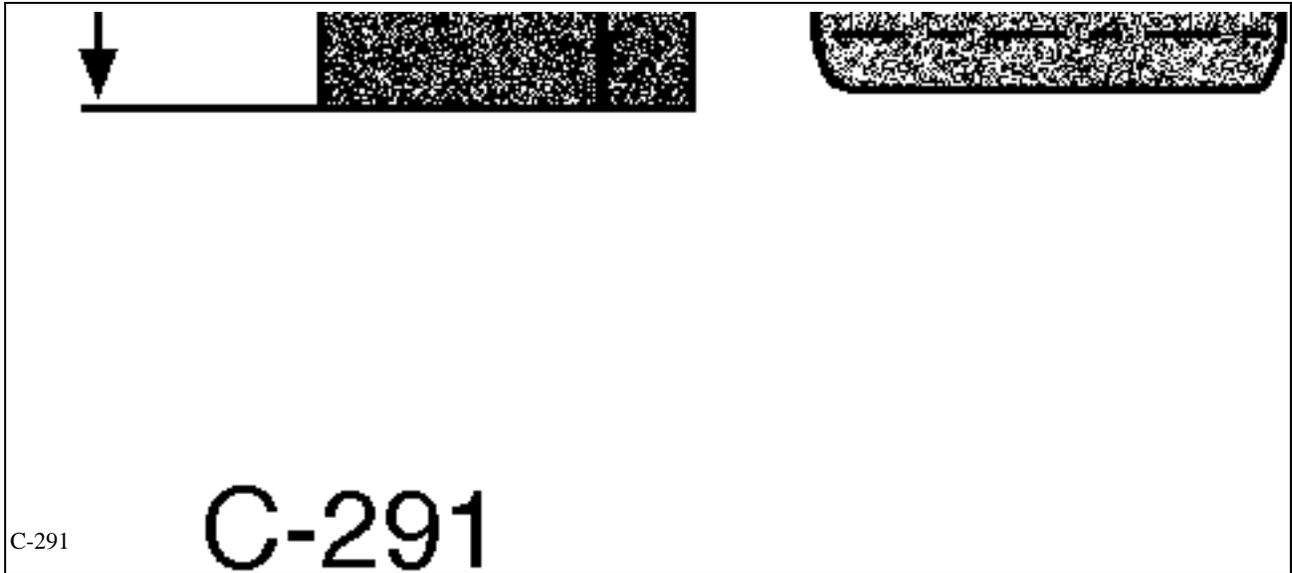
Inspect and ensure all shields are in place and securely fastened. Inspect and ensure all safety equipment is working properly. Ensure owners and operators manual, safety manual and all safety and instruction decal's are in place. if necessary replace. If the safety controls are malfunctioning or require adjustment consult your **Thomas** Equipment Dealer for service.

7.5 General Condition:

Make a general inspection of the machine looking for loose or missing parts, oil leaks, etc.



8.3 LOADER SPECIFICATIONS T245HDS & T243HDS MODELS



Dimensions: (With Std. Tires & Dirt Bucket)

A. Overall Operating Height	156" (3962 mm)
B. Height to hinge pin	123" (3124 mm)
C. Overall vehicle height	84" (2134 mm)
D. Overall length with bucket	145" (3683mm) / 148" (3759 mm)
E. Dump angle	29° / 36°
F. Dump height	96" (2438 mm)
G. Reach — fully raised	22" (559 mm)
H. Height at 45° dump angle	81.75" (2076 mm)
I. Reach at 45° dump angle	25.5" (648 mm)
J. Maximum roll back at ground	22°
K. Maximum roll back fully raised	93°
M. Wheel base	42.75" (1086 mm)
N. Overall length less bucket	119.75" (3042 mm)
O. Ground clearance	9" (229 mm)
P. Maximum grading angle – bucket	89°
Q. Angle of departure	28°
R. Bucket width	73" (1854 mm)
S. Clearance circle – front – less bucket	59.5" (1511 mm)
T. Clearance circle – front – with bucket	84" (2134 mm)
U. Clearance circle – rear	72.625" (1845 mm)
V. Overall width – less bucket	70.5" (1791 mm)
W. Tread	59"(1499 mm)

Dimensions: (With Std. Tires & Dirt Bucket)

Tipping Load SAE	4800 lbs. (2178 kg)
Rated operating capacity	2400 lbs. (1089 kg)
Operating weight	7800 lbs. (3538 kg)
Shipping weight	7225 lbs. (3062 kg)
Travel speed	6.6 mph (10.6 km/hr)

Controls

VEHICLE: Steering direction and speed controlled by two hand operated control levers.
HYDRAULICS: Boom lift and bucket tilt are controlled by separate foot pedals or hand controls (Optional) Aux hydraulics controlled by electric solenoid.
ENGINE: Key type ignition switch.and shutoff, hand throttle.

Engine

Make and model Deutz BF4M1011F
Cylinders 4 Inline
Cooling system Oil type 5W40 CF
Displacement 178 cu. in.(2919 cc)
Horsepower 83 (61.9 Kw)
ISO Net Kw 61 Kw at 2800 RPM
Max Torque 185 ft. lbs. 250 Nm @ 1600 RPM
Fuel type Diesel No. 2
Air cleaner Replaceable Dry Cartridge w/indicator
Maximum governed RPM (full load) 2800 RPM

Hydraulic System

Pump type Gear
Pump capacity T-245HD'S' 20.5 GPM (77.6 LPM)
Control valve Series type with float on lift and electric auxiliary
System relief pressure (Zero Flow) 3000 PSI (206.9 Bar)
Port A Relief on Lift Circuit 2450 PSI(169 Bar)
Port B Relief on Lift Circuit 3200 PSI(218 Bar)
Port Relief on Tilt Circuit 3200 PSI(218 Bar)
Fan Relief setting 1856 PSI (128 Bar)
Filtration (Main) 5 micron
Filtration (Charge) 5 micron
Hydraulic fluid 10W30 /20W50 API Class, SE/CD
Cylinders (double acting) Lift Tilt
Bore dia. 3 in. 3 in.
Rod dia. 2 in. 1.5 in.

Hydrostatic Transmission & Final Drive

Pump type Two in line, axial piston
Pump displacement 2.65 cu. in. (43.43 cm³)
Motor type Geroler, torque motor
Pump capacity 2800 RPM/ 32.1 GPM 120 LPM
System relief setting 4712 P.S.I. (325 Bar)
Final drive No. 100 roller chain running in an oil bath

Electrical

Alternator 55 amp
Battery 2 X 12 v
Type (BCIGROUP) 34/78
Cranking amps 730 each
Reserve capacity 125
Starter 12 volt 2.2 KW

Tires

Standard 12.00 x 16.5, 6 ply 50 P.S.I. (345 KPa)

Fluid Capacities

Fuel tank 23 gal. (87.1 l)
Final drive transmission 5 gal. (23 l)
Hyd. Reservoir 21 gal (79.5 l)
Engine oil 14.8 qt (14 l)

Xtreme Flow Package

Hydraulic Flow Rating 148 L/M (39 GPM)
Relief Pressure 207 Bar (3000 PSI)
Hydraulic Horsepower Output 73.5 (55 Kw)

8. 4 TORQUE SPECIFICATIONS

Loader

Wheel nuts (32) 100-110 lbs. ft. (136-149 Nm)
Hydrostatic pump mtg. bolts (3) 80-85 lbs. ft. (109-115 Nm)
Hydrostatic motor mtg. bolts (4) 80-85 lbs. ft. (109-115 N.M.)

Hydraulic / Hydrostatic

Hydraulic filter, case 30 lbs. ft. (41 N.M.)

Bolts & Nuts

	Torque Lbs. ft. (N.M.)
1/4-20	5-7 (6.7-9.5)
5/16-18	1215 (16-20)
5/16-24	12-15 (16-20)
3/8-16	17-22 (23-30)
3/8-24	22-27 (30-37)
7/16-14	30-35 (41-47)
7/16-20	40-45 (54-61)
1/2-13	45-50 (61-68)
1/2-20	50-60 (68-81)
9/16-12	60-70 (81-95)
9/16-18	65-75 (88-102)
5/8-18	100-110 (136-139)

8. 5 SOUND POWER LEVEL SPECIFICATION

LPA Sound level at operators ear. 85 dB(A)
LWA Adjusted sound level 104 dB(A)

8.3 LOADER SPECIFICATIONS T245HDK & ProTough2200 MODELS ONLY.



C-291

Dimensions: (With Std. Tires & Dirt Bucket)

A. Overall Operating Height	157" (3988 mm)
B. Height to hinge pin	123.75" (3143 mm)
C. Overall vehicle height	84" (2134 mm)
D. Overall length with bucket	144.25" (3664 mm)
E. Dump angle	36°
F. Dump height	96.75" (2458 mm)
G. Reach — fully raised	21.5" (546 mm)
H. Height at 45° dump angle	80.25" (2038 mm)
I. Reach at 45° dump angle	25.25" (641 mm)
J. Maximum roll back at ground	20°
K. Maximum roll back fully raised	87°
M. Wheel base	44.75" (1137 mm)
N. Overall length less bucket	117.25" (2978 mm)
O. Ground clearance	9" (229 mm)
P. Maximum grading angle – bucket	88°
Q. Angle of departure	28°
R. Bucket width	73" (1854 mm)
S. Clearance circle – front – less bucket	59.5" (1511 mm)
T. Clearance circle – front – with bucket	47.63" (1210 mm)
U. Clearance circle – rear	70.5" (1791 mm)
V. Overall width – less bucket	70.75" (1797 mm)
W. Tread	58.5" (1486 mm)

Operational: (With Std. Tires & Dirt Bucket)

Tipping Load SAE	4700 lbs. (2136 kg)
Rated Operating Capacity	2200 lbs. (999 kg)
Operating Weight	8000 lbs. (3636 kg)
Shipping weight	7300 lbs. (3318 kg)
Travel speed	6.2 mph (10.0 kph)

Controls

- VEHICLE:** Steering direction and speed controlled by two hand operated control levers.
- HYDRAULICS:** Boom lift and bucket tilt are controlled by separate foot pedals or hand controls Aux hydraulics controlled by hand lever.
- ENGINE:** Hand throttle, key type ignition switch and shutoff.

Engine

Make and model	Kubota V3300 - T
Cylinders	4 Inline
Cooling system	Liquid
Displacement	202.5 cu. in.(3318 cc)
Horsepower	87 @ 2600 RPM
Net Kw (ISO 9249)	64.7 Kw @ 2600 RPM
Max Torque	206 ft. lbs. 280 N.m. @ 1400 RPM
Fuel type	Diesel No. 2
Air cleaner	Replaceable Dry Cartridge w/indicator
Maximum governed RPM (no load)	2700 RPM

Hydraulic System

Pump type	Gear	
Pump capacity (theoretical)	20.5GPM(77.6LPM)	
Control valve	Series type with float on lift and auxiliary	
Filtration (Main)	.5 micron	
Hydraulic fluid	.10W30/20W50API Class, SE/CD	
Cylinders	(Double acting)	
	Lift	Tilt
Bore dia.	ProTough 2200 2.5in	2.5in
Rod Dia.	ProTough 2200 1.5in	1.5in
Bore dia.	T245HDK 3.0in	3.0in
Rod Dia.	T245HDK 2.0in	2.0in

Hydrostatic Transmission & Final Drive

Pump type Two in line, axial piston
Pump displacement 2.65 cu. in. (43.43 cm³)
Motor type Geroler, torque motor
Pump capacity 2700 RPM/ 32.1 GPM 120 LPM
System relief setting 4712 P.S.I. (325 Bar)
Final drive . . . No. 100 roller chain running in an oil bath

Electrical

Alternator 60 amp
Battery ProTough 2200, 1 x 12 v
Battery T245 HDK, 2 x 12v
Type (BCIGROUP) 34/78
Cranking amps 730 each
Reserve capacity 125
Starter 12 volt 2.5 KW

Tires

Standard 12.00 x 16.5, 6 ply
40 - 45 P.S.I.
(276-310 KPa)

Fluid Capacities

Fuel tank 23 gal. (87.1 l)
Final drive transmission 3.5 gal. (13.2 l)
Hyd. Reservoir 21 gal (79.5 l)
Engine oil 14 qt (13.2 l)

5.2 TORQUE SPECIFICATIONS

Wheel nuts (32) 100-110 lbs. ft. (136-149 N.M.)

Bolts & Nuts

Torque *Lbs. ft. (N.M.)*

1/4-20	5-7 (6.7-9.5)
5/16-18	12-15 (16-20)
5/16-24	12-15 (16-20)
3/8-16	17-22 (23-30)
3/8-24	22-27 (30-37)
7/16-14	30-35 (41-47)
7/16-20	40-45 (54-61)
1/2-13	45-50 (61-68)
1/2-20	50-60 (68-81)
9/16-12	60-70 (81-95)
9/16-18	65-75 (88-102)
5/8-18	100-110 (136-139)

5.3 SOUND POWER LEVEL SPECIFICATION

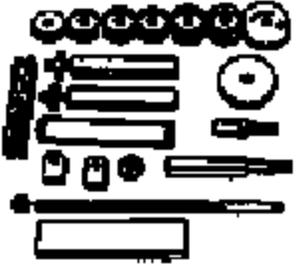
LPA Sound level at operators ear. 85 dB(A)
LWA Adjusted sound level 104 dB(A)

8.6 SPECIAL TOOLS

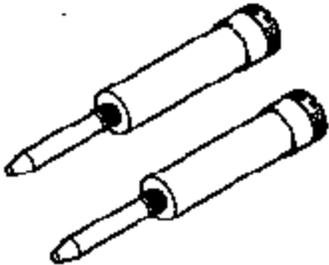
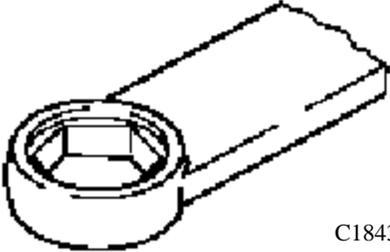
P/N	ILLUSTRATION	DESCRIPTION	MODEL
955280		AXLE INSTALLATION TOOL-To install axle in final drive housing. Quantity-1	T103 T133 T133'S'
960849 955281		SEAL INSTALLATION TOOL-To install axle seal in final drive housing. Quantity-3 required	T103 T133 T133'S'
955283 (T103 / 133 / 135) 957372 (173 / 203 / 233 / 243 / 245)		AXLE EXTRACTOR TOOL- To remove axle from final drive housing. Quantity-1	T103 T133 T135 T173HL T173HL'S' T173HL'S'II T203HD T233HD T243HDS T245HDS
960986		SEAL INSTALLATION TOOL-To install axle seal in final drive housing. Quantity-1	T83
958674		SEAL INSTALLATION TOOL-To install axle seal in final drive housing. Quantity-1	T173HL T173HL'S' T173HL'S'II T203HD T233HD T243HDS T245HDS
959849		CHAIN TENSION TOOL-To test chain tension.	T103 T133 T133'S'
U-1288	Universal Tool Kit	1 each. Combination wrench 7/16", 1/2", 9/16",11/16" 3/4", 1 1/16",1 1/4". Sockets, 1", 1/2" drive, 7/8", 1/2" drive, tool pouch, allen wrench 5/32" and 1/8"	ALL MODELS



8.7 SPECIAL TOOLS (Cont'd)

Order #	Illustration	Description	Models
916-30042-01 25197		Dry Liner Puller - Used for removing and installing the dry liner of the engine. Consists of: 304742 (64mm); 304743 (68mm); 30744 (75mm) 304745 (76mm); 304746 (82mm); 304747 (105mm); Removing Plates; 304748 Installing Plate	KUBOTA
07909-30202-01 25198		Diesel Engine Compression Tester - Used to measure diesel engine compression and diagnosis of need for major overhaul.	KUBOTA
07916-30820-01 25199		Crankshaft Nut Socket - Used to take off and fix the crankshaft nut. (46 mm).	KUBOTA
07916-30840-01 25200		Nozzle Remover Socket - Used to unfasten the screw type nozzle holders.	KUBOTA
70090-01125-01 25201		Nozzle Disassembly Socket - Used in place of a vice for disassembly and repair of nozzles.	KUBOTA
960456		Hydraulic Flow and Pressure Gauge Assembly.	All Models

8.7 SPECIAL TOOLS (Cont'd)

P/N	ILLUSTRATION	DESCRIPTION	MODEL
42530		TOOTHED BELT TENSION GAUGE Quantity-1	DEUTZ ONLY T243 HDS T245HDS
42531		ADJUSTING PIN FOR CRANKSHAFT AND CAMSHAFT Quantity-1	DEUTZ ONLY T243 HDS T245HDS
42535	 <p style="text-align: right;">C1843</p>	CAMSHAFT DOLLY Used To Assist Tightening of Camshaft Pulley Bolt	DEUTZ ONLY T243 HDS T245HDS



8.7 SPECIAL TOOLS (Cont'd)

P/N	ILLUSTRATION	DESCRIPTION	MODEL
43979	 <p>C1840</p>	CHAIN PULLER	ALL MODELS
43980	 <p>C1841</p>	SPANNER WRENCH 2'' - 4 3/4'' To Repair Hydraulic Cylinders	ALL MODELS
43981	 <p>C1837</p>	PHOTO SENSOR / WHEEL SPEED TACHOMETER (Dual Function)	ALL MODELS
	 <p>C1839</p>	FORCE GAUGE, PUSH PULL For Measuring Restraint Bar Brake Cable Adjustment. Special Order Only	T173HLS T173HLS II T243HDS T245HDS