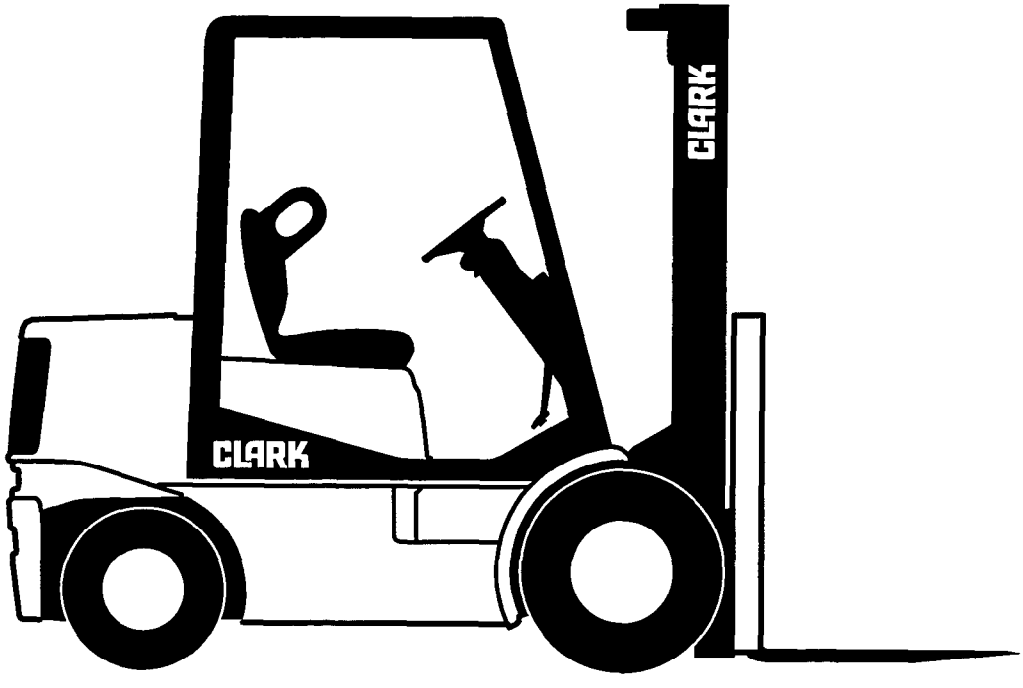
SM-612 Rv 1
CGC/CGP 40/70



ISO 9001 CERTIFIED CLARK

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Lexington, KY
40508

Section 2.
The Planned Maintenance Program

This Section defines a set of basic service procedures, known as the "Planned Maintenance Program," and describes a systematic approach for performing them.

CLARK

GAS LPG or DIESEL
PLANNED MAINTENANCE REPORT

CODE: O.K. | Potential | Urgent

✓ = O.K.
x = Adjust (Not P.M.)
r = Repair or replace
s = Requires shop repair

CUSTOMER

DATE	HOUR METER
DATE LAST P.M.	HRS. LAST P.M.
CUST. P.O. NO.	

MODEL & SERIAL NO.
ATTACHMENT NO.

AUTHORIZED SIGNATURE | INSPECTOR | SPECIAL INSTRUCTIONS

COMMENTS:

A. TEST DRIVE MACHINE
- a. Drive Train Noise
- b. Steering Operation
- c. Service Brake Operation
- d. Inching Operation
- e. Transmission Operation
- f. Clutch Operation
- g. Hydraulic System Operation
- h. Engine Performance
- i. Parking Brake Operation
- j. Pedal Pads & Linkages
- k. Return to Neutral
- l. Pedestrian Warning Devices
- m. Dead Engine Service Brake

00 ENGINE
- a. Mounting
- * b. Head Bolt Torque
- c. RPM - Idle
  - Gov. No Load
  - Tilt By-Pass
- d. Stall RPM
  - Fwd Rev
  - High Low
- e. Inspect Exhaust for Smoke

01 CLEANING & LUBRICATION
- a. Air Clean Truck/Radiator
- b. Lubricate Truck

01 ENGINE LUBRICATION
- a. Check for Leakage
- b. Check Oil Level
- * c. Drain & Replace Oil
- * d. Replace Oil Filter
- e. Filler Cap Condition
- f. Clean Crankcase Breather
- * g. Check/Replace PCV

01 COOLING SYSTEM
- a. Coolant Level/Condition
- b. Temperature Protection
- c. Inspect Fan & Control
- * d. Inspect & Adjust Belts
- * e. Drain/Flush Radiator
- f. Coolant Leakage
- g. Inspect Water Pump

02 FUEL SYSTEM
- a. Check Filler Cap
- b. Check Accelerator & Return Spring
- c. Choke Operation
- d. Fuel Leakage
- e. Inspect Tank Fitting LPG
- f. Lock Off Valve Operation - LPG
- g. Clean/Replace Filter
- h. Glow Plug Operation - Diesel
- i. Idle Up System

02 AIR INTAKE & EXHAUST
- a. Air Filter Condition/Replace
- b. Hoses & Clamps
- c. Muffler & Exhaust

06 & 08 TRANSMISSION
- a. Fluid Level
- * b. Condition of Fluid/Change
- c. Clean Air Vent
- * d. Replace Filter
- e. Fluid Leakage
- f. Inspect Control Linkage

11 IGNITION & CRANKING SYSTEM
- a. Check Neutral Start
- b. Check Anti-Restart
- c. Distributor Condition
- * d. Point Condition/Dwell
- e. Check Engine Timing
- f. Cap and Rotor Condition
- * g. Wiring Condition
- h. Engne Shut Down System

12 BATTERY AND CABLES
- * a. Clean & Check Terminals
- b. Fluid Level
- c. Cranking Voltage

12 CHARGING SYSTEM
- a. Alternator/General Mounting
- * b. Inspect & Adjust Belts
- c. Check Charging Voltage

13 GAUGES-LIGHTS-INDICATORS
- a. Hour Meter Operation
- b. Gauges - All Operate
- c. Lights - All Operate
- d. Wiring Condition
- e. Horn
- f. Operation of Accessories

20 DRIVE AXLE
- * a. Differential Level
- b. Clean Air Vent
- c. Security of Mounting
- d. Check Wheel Bearings

23 WHEELS AND TIRES
- a. Tighten Mounting Bolts
- b. Tire Condition
  - RF LF
  - RR LR
- c. Check Air Pressure

23 BRAKE SYSTEM
- a. Check for Leakage
- b. Cylinder Fluid Level
- c. Clean Vent Cap
- d. Pedal Free Travel
- e. Pedal Drift
- f. Cylinder/Valve Mounting
- g. Service Brake Wear/Adjustment
- h. Parking Brake Wear/Adjustment
- i. Brake Line/Cable Condition

26 STEER AXLE
- a. Security of Mounting
- b. Axle Stop Adjustment
- c. Drag Link Adjustment
- d. Articulation Stops
- e. Check Wheel Bearings

26 STEERING SYSTEM
- a. Check for Leakage
- b. Oil Level - Condition
- c. Security of Mounting
- d. Tilt Column Operation
- e. Steering Control Adjustment

29/30 HYDRAULIC SYSTEM
- a. Check for Leakage
- b. Fluid Level - Condition
- c. Clean/Replace Breather

29/30 HYDRAULIC SYSTEM
- * d. Replace Filter
- e. Linkage Adjustment
- f. Hose Condition
- g. Lift Speed (In./Sec.)
  - No Load
  - Full Load
- h. Drift Test (In./Min.)
  - Lift Cylinder
  - Tilt Cylinder

32 TILT CYLINDERS
- a. Check for Leakage
- b. Cylinder Rod Condition
- c. Mounting Security
- d. Tilt Cylinder Adjustment

34 UPRIGHT-CARRIAGE
- a. Security of Mounting
- b. Roller Condition/Clearance
- c. Chain and Anchor Condition
- d. Chain Adjustment
- e. Latch and Stop Condition
- f. Cylinder Condition
- g. Forks, Locks, Stops
- h. Rail Condition
- i. Trunnion Ring Condition
- j. Check Free Lift Guide

34 LOAD BACK REST
- a. Condition
- b. Security of Mounting

38 SHEET METAL & CWT
- a. Decals-Missing/Condition
- b. Data Plate Condition
- c. Seat Mounting and Operation
- d. Seat Belts (If Equipped)
- e. Door and Deck Latches
- f. C/W Mounting Bolts
- g. Slip Resistance Surfaces

39 OVERHEAD GUARD
- a. Condition
- b. Security of Mounting

53 ATTACHMENTS
- a. Mounting Bolts
- b. Leakage
- c. Operation

** SEE MAINTENANCE INTERVAL IN P.M.A. MANUAL*

59-760-0666/1 September 96

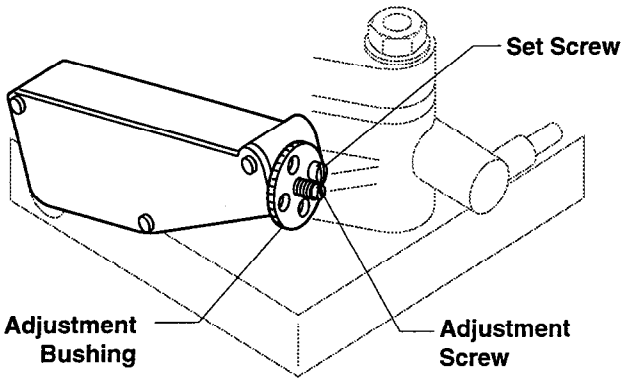
GROUP 00(G)

GAS/LPG ENGINE

Governor Adjustment

Adjust the maximum no-load governed speed. Set screw must be loosened (may be removed) for all governor rpm adjustments.

1. If rpm is over 2700, turn adjustment bushing counterclockwise to lower governed rpm.



2. If rpm is under 2600, turn adjustment bushing clockwise to increase governed rpm.
3. Check for surging (governor does not stabilize quickly enough after rapid acceleration) with no load:

   With surging:

   a. Turn adjustment screw clockwise.
   b. Turn bushing counterclockwise until maximum engine speed is observed (2650±50 rpm).
   c. Check for surging with load applied to engine.

   Without surging:

   a. Turn adjustment bushing clockwise.
   b. Turn adjustment screw counterclockwise to set at maximum no-load governed speed (2650±50 rpm).
   c. Check for surging with load applied to engine.

4. Repeat steps until no-load governed speed is properly adjusted. Tighten set screw (reinstall and tighten, if removed) on adjustment bushing to lock settings.

Perform stall test.

Engine RPM at Stall

Stall rpm is the rpm at which the engine runs with full power applied, the transaxle engaged, and truck movement stopped by an immovable object or by the service brakes (right foot pedal).

Be sure that transaxle fluid level has been checked and is correct (see Group 06) and that braking and inching pedals are adjusted correctly (see Group 23) before you run a stall test.

⚠ CAUTION

Stall tests must be performed with the parking brake off and with the truck placed against a solid barrier (such as a wall or another lift truck) to prevent movement. Make sure that the truck cannot move and that the solid barrier is capable of withstanding the force before you begin.

1. Add load on forks to increase weight and prevent inadvertent drive wheel spin.
2. Place truck against an immovable barrier (such as a wall or another lift truck).
3. Put the directional control lever in forward (or reverse, depending upon truck position to barrier).

NOTE

Use of the POWER SERVICE BRAKES or STEERING HANDWHEEL can affect engine rpm. Do not touch either during the test.

4. Release the parking brake.
5. Slowly push the accelerator pedal fully down and hold it there while you read the tachometer.

IMPORTANT

Do not run engine and converter at stall longer than necessary to take the rpm and vacuum readings, or longer than 30 seconds at one time. Then, shift transmission into neutral for 15 seconds and run the engine at one-half speed for one to two minutes to cool torque converter oil. Excessive temperature, 120° C (250° F) maximum, will overheat the converter and cause damage to converter, seals, and fluid.

Engine rpm at stall should be 1610-1710 rpm for the LPG engine and 1640-1740 for the gasoline engine. See analysis chart.

To test both clutch packs in the transmission, check stall speed with transaxle in forward and reverse.

Engine Specifications Tools

GENERAL DESCRIPTION

Figures 1 - 4

ENGINE CONSTRUCTION

The 4.3L (262 CID) engine is a liquid-cooled 90-degree V6 type with overhead valves, cast-iron block, cylinder heads, and cast-iron balance shaft.

CYLINDER BLOCK

The cylinder block has 6 cylinders arranged in a "V" shape with 3 cylinders in each bank. Starting at the front of the engine, cylinders in the right bank are numbered 1-3-5 and cylinders in the left bank are numbered 2-4-6 (when viewed from the front of the engine). The firing order of the cylinders is 1-6-5-4-3-2. The cylinders are encircled by coolant jackets.

CYLINDER HEADS

The cylinder heads have one intake and one exhaust valve for each cylinder. A spark plug is located between the valves in the side of the cylinder head. The valve guides are integral and the rocker arms are retained on individual threaded in studs.

CRANKSHAFT

The crankshaft is supported by four main bearing inserts. The number four bearing at the rear of the engine is the end thrust bearing. The bearings are retained by bearing caps that are machined with the block for proper alignment and clearances.

CAMSHAFT

The camshaft is supported by four full round, sleeve type bearings. A sprocket on the crankshaft drives a timing chain which in turn drives the camshaft through a sprocket.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Piston pins are offset 1.58750 mm (0.0625 in.) toward the major thrust side (right side) to reduce piston slap as the connecting rod travels from one side of the piston to the other side after a stroke. The pins are a press fit in the connecting rod and a floating fit in the piston.

BALANCE SHAFT

A cast-ductile balance shaft is mounted in the crankcase above and in-line with the camshaft for enhanced engine smoothness under all operating conditions. A camshaft gear drives the gear attached to the balance shaft. The front end of the balance shaft is supported by a ball bearing and the opposite end uses a sleeve bearing.

VALVE TRAIN

The valve train is a ball pivot type. Motion is transmitted from the camshaft through the hydraulic lifter and pushrod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve.

The hydraulic valve lifters with roller followers keep all parts of the valve train in constant contact. Each lifter acts as an automatic adjuster and maintains zero lash in the valve train and eliminates the need for periodic valve adjustment.

INTAKE MANIFOLD

A cast-aluminum intake manifold is used that has an exhaust gas recirculation (EGR) port cast into it for the mixture of exhaust gases with the fuel and air mixture.

VALVE TRAIN COMPONENT REMOVAL

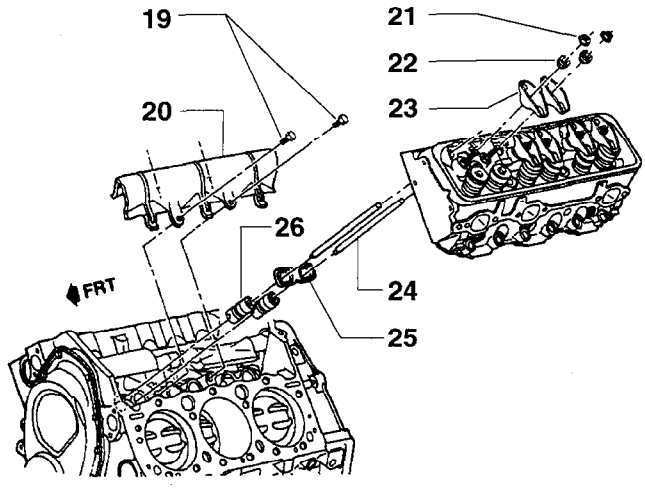


Figure 9 - Valve Train Components

19. Bolt	**23. Rocker Arms**
20. Retainer	**24. Pushrods**
21. Nuts	**25. Restrictor**
22. Balls	**26. Hydraulic Lifter**

Remove or Disconnect

Important

- Store all reusable components in an exact order so they can be reassembled in the sameposition from which they were removed.

1. Rocker arm nuts (21), balls (22), and rocker arms (23).
2. Push rods (24).
3. Bolt (19).
4. Guide assembly (20).
5. Hydraulic lifters (26).

Important

- Remove the lifters one at a time and place them in an organizer rack.

CYLINDER HEAD REMOVAL

Remove or Disconnect

1. Engine lift bracket.
2. Cylinder head bolts.
3. Cylinder heads.
4. Head gaskets.

TORSIONAL DAMPER REMOVAL

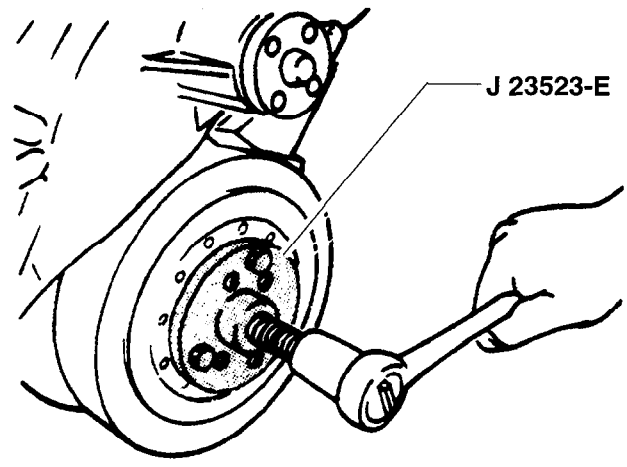


Figure 10 - Removing the Torsional Damper

Tool Required:
J 23523-E Torsional Damper Puller

Remove or Disconnect

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The removal procedures must be followed (with the proper tools) or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper and the engine timing reference.

1. Torsional damper bolt.
2. Torsional damper using J 23523-E (figure 10).
3. Crankshaft key.

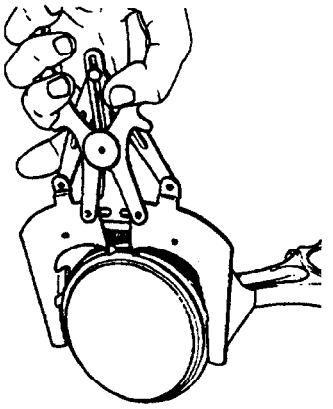


Figure 27 - Removing the Piston Rings

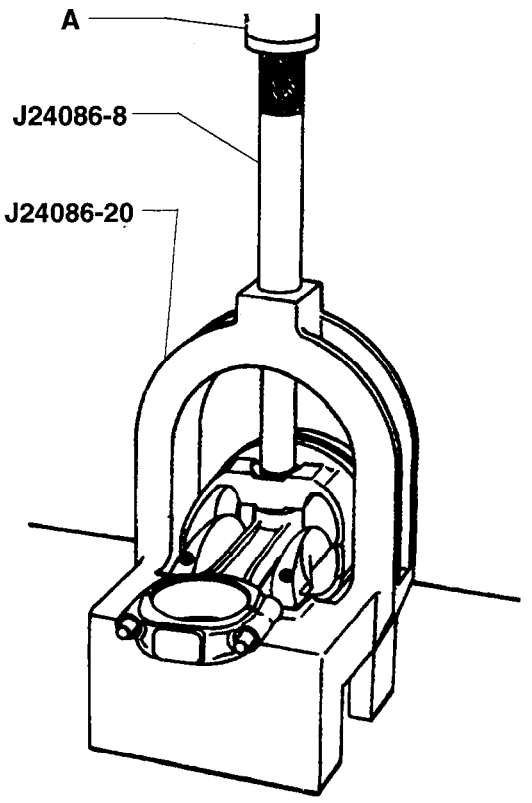


Figure 28 - Removing the Piston Pin

Tool Required:
J 24086-B Piston Pin Remover and Installer

Remove or Disconnect

1. Piston rings. In most cases, the rings should be discarded and replaced with new ones at assembly.
2. Connecting rod bearing inserts. If the inserts are to be reused, place them in a rack so they may be reinstalled in their original connecting rod and cap.
3. Piston pin.
- Place the piston/connecting rod on support fixture J24086-20. Make sure the connecting rod is fully supported.
- Press out the piston pin.

Clean

1. Piston.
- Remove all varnish and carbon deposits. DO NOT USE A WIRE BRUSH.
- Remove the carbon from the ring grooves.
- Oil control ring groove holes.

Inspect

1. Piston pin bore in the piston and connecting rod. Check for scuffing, burrs, etc.
2. Piston for scratches wear, etc.
3. Connecting rod for cracks, nicks, etc. If a suitable jig is available, check the connecting rod for a bent or twisted condition.
4. Piston.
- Ring land for cracking, wear, etc.
- Ring grooves for burrs, nicks, etc.
- Skirts and pin bosses for cracking.
- Skirts for scuffing.
5. Connecting rod bearing inserts for scratches or deep pitting.

MEASURING PISTON PIN TO PISTON CLEARANCE

Figures 29 and 30

Measure

1. Piston pin diameter. Check against "Specifications."

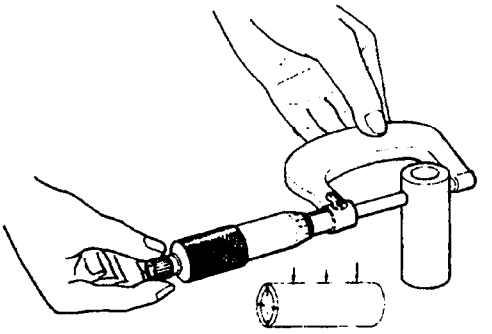


Figure 29 - Measuring Piston Pin Diameter

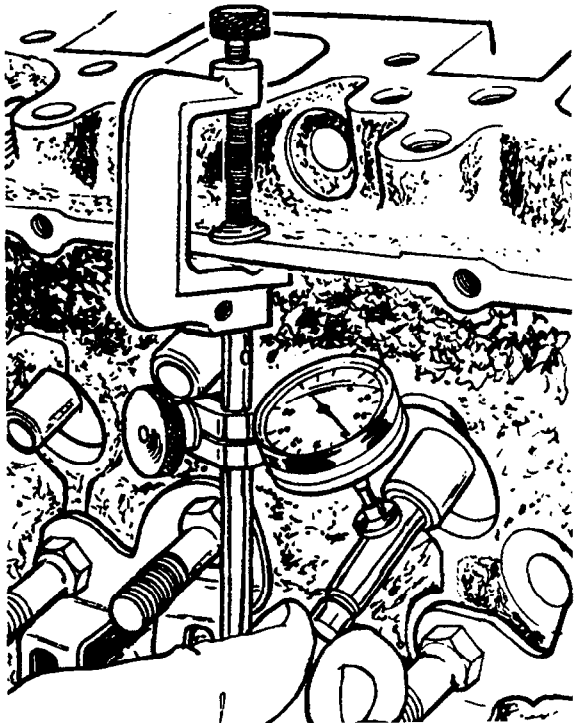


Figure 50 - Measuring Stem-to-Bore Clearance

- Clamp a dial indicator (J 8001 or equivalent) on one side of the cylinder head rocker arm cover gasket rail.
- Locate the indicator so movement of the valve stem from side to side (crosswise to the head) will cause direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide bore.
- Drop the valve head about 1.6 mm (0.0625 in.) off the valve seat.
- Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream the valve guide bores for oversize valves as outlined later in this manual.

2. Valve spring tension. Use J 9666 or equivalent.

- Compress the springs, with dampers removed, to the specified height and check against the specifications chart. Springs should be replaced if not within 44 N (10 lbs.) of the specified load.

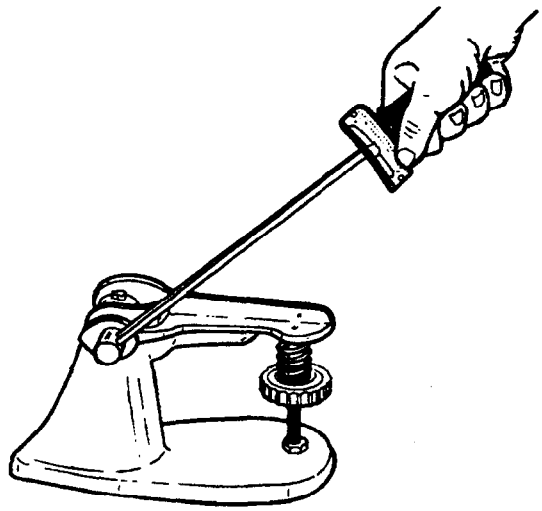


Figure 51 - Measuring Valve Spring Tension

3. Valve spring length. Replace the spring if the length is not as specified.

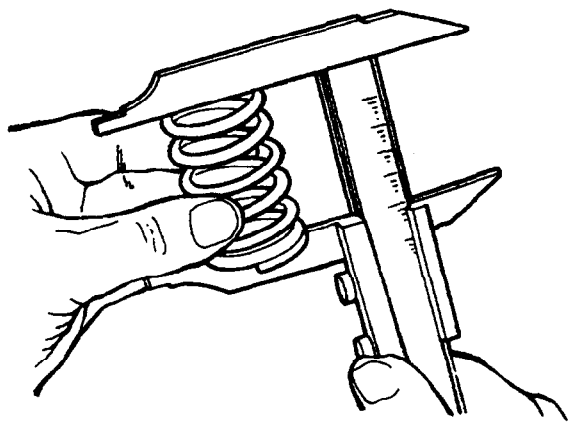


Figure 52 - Measuring Valve Spring Length

REPAIR

Figures 53 and 54

Valve Grinding

Pitted valves must be refaced to the proper angle. Valve stems that show excessive wear, or valves that are warped excessively must be replaced. When an excessively warped valve head is refaced, a knife edge will be ground on part or all of the valve head due the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning, preignition due to heat localizing on this knife edge. If the edge of the valve head is less than 0.80 mm (1 in.) after grinding, replace the valve.

TIMING CHAIN AND SPROCKET INSTALLATION

Figures 69 and 70

Install or Connect

1. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 70).
- The number 4 cylinder is at top dead center of the compression stroke with the timing marks in this position (figure 70).

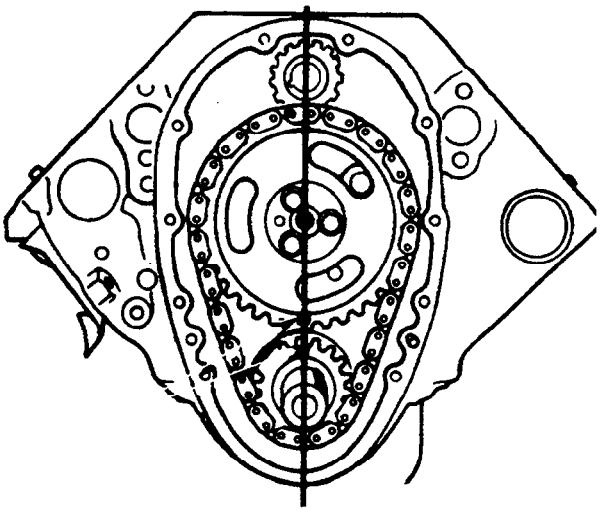


Figure 70 - Camshaft-to-Crankshaft Timing Marks

2. Camshaft sprocket bolts (39) and nut (34).

Tighten

- Camshaft sprocket bolts (39) and nut (34) to 28 N•m (21 lbs. ft.).

FRONT COVER INSTALLATION

1. Front cover gasket to the front cover.
- Use gasket cement to hold the gasket in place.
2. Front cover to the engine.

NOTICE: Refer to "Notice" on page 1.

3. Front cover bolts.

Tighten

- Front cover to block bolts to 14 N•m (124 lbs. in.).

TORSIONAL DAMPER INSTALLATION

Figure 71

Tool Required:
39046 Torsional Damper Puller and Installer

Install or Connect

1. Crankshaft key (if removed).

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with rubber type material. The correct installation procedures with the proper tool) must be followed or movement of the inertial weight section of the hub will destroy the tuning of the torsional damper.

2. Stud (item A., figure 71) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.

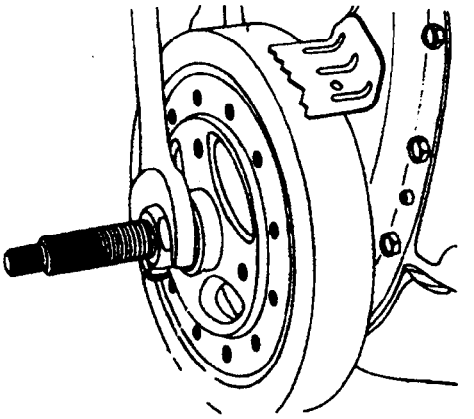


Figure 71 - Installing the Torsional Damper

3. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
4. Bearing, washer, and nut (figure 71).
   a. Turn the nut to pull the vibration damper into place.
   b. Remove the tool.

NOTICE: Refer to "Notice" on page 1.

5. Torsional damper bolt and washer.

Tighten

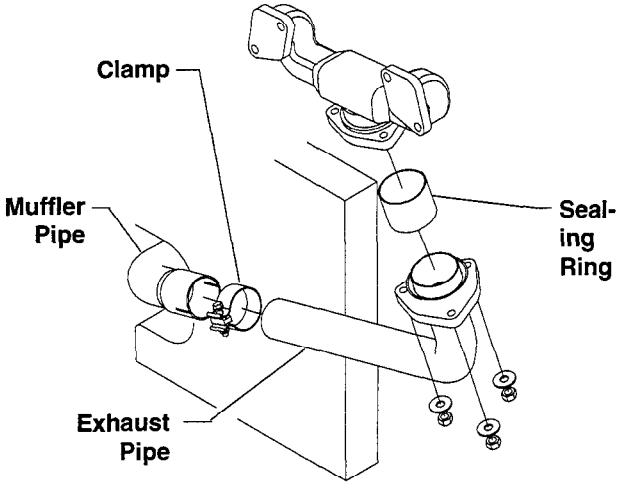
- Bolt to 95 N•m (70 lbs. ft.).

Fastener Tightening Specifications

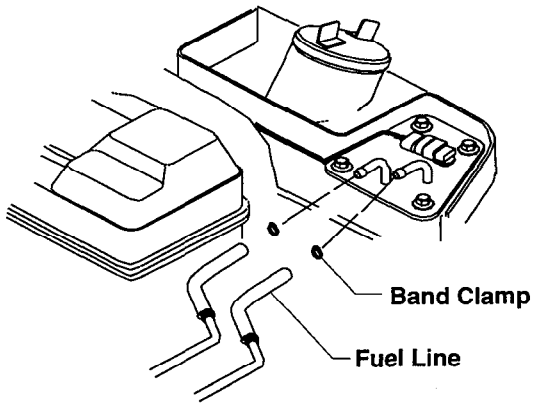
ITEM	N•m	lb. ft.	lb. in.
Balance Shaft Drive Gear Retaining Bolt	16	12	---
Balance Gear Driven Gear Bolt (torque plus a 35° turn)	20	15	---
Balance Shaft Retainer Bolt	14	---	124
Camshaft Sprocket Bolts	28	21	---
Camshaft Thrust Plate Screws	14	---	124
Connecting Rod Bolt Nuts (torque plus a 70° turn)	27	20	---
Coolant outlet Bolts	28	21	---
Coolant Pump Bolts	40	30	---
Crankshaft Rear Oil Seal Retainer Screws and Nuts	15	11	---
Cylinder Head Bolts (in sequence)	90	65	---
EGR Valve Bolt	22	16	---
Engine Block Drain Plug	20	15	---
Exhaust Manifold Bolts			
Center Two Bolts	36	26	---
All Other Bolts	28	20	---
Flywheel Bolts	100	74	---
Flywheel Housing Bolts	44	32	---
Front Cover Bolts	14	---	124
Hydraulic Lifter Guide Assembly	16	12	---
Intake Manifold Bolts (in sequence)	47	35	---
Main Bearing Cap Bolts	110	81	---
Oil Filter Adapter Bolts	22	16	---
Oil Gallery Plug, Left Rear	40	30	---
Oil Gallery Plug, Right Rear	40	30	---
Oil Gallery Plug, Left Side Rear	30	22	---
Oil Pan Bolts	11	---	97
Oil Pan Drain Plug	25	18	---
Oil Pan Nuts	23	17	---
Oil Pan Studs to Oil Seal Retainer or Engine Block	23	17	---
Oil Pressure Fitting	11	---	97
Oil Pump Bolt	88	65	---
Oil Pump Cover Bolts	9	---	80
Rocker Arm Cover Bolts	10	---	90
Rocker Arm Nuts	27	20	---
Rocker Arm Stud	47	35	---
Torsional Damper Bolt	95	70	---

43SPEC3

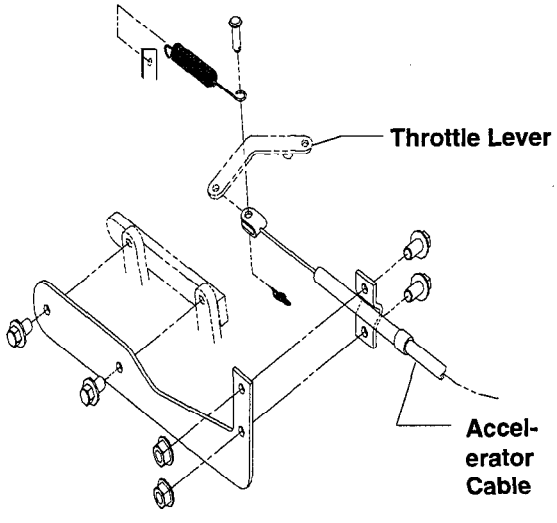
6. Set the engine onto the mounting brackets as shown on page 3. Set mounting nuts in place and hand tighten. The engine may have to be shifted to line up with the transmission.
7. Connect the engine to the transaxle as explained in Group 06.
8. Tighten engine mounting nuts. Check engine manual for torque.
9. Align and connect the exhaust pipe to the engine exhaust manifold using a new sealing ring for reassembly. Tighten bolts. Check engine manual for torque. Replace the clamp and torque the bolt to 18-20 N•m (13.5-14.5 ft-lb).



10. Replace the upper radiator shroud and venturi as described in Group 01.
11. Reconnect the radiator hoses between the radiator and the water pump and the thermostat of the engine, as described in Group 01. Before reinstallation, check that hoses are in good condition with no drying, cracking, or splitting.
12. Uncap and reconnect the fuel line at the fuel tank. Make sure the hose is in good condition with no drying, cracking, or splitting evident. Torque band clamp to 0.8-1.0 N•m (0.6-0.73 ft-lb).



13. Reconnect the wiring. See Group 14 for drawings that show the wiring harness and component connection points on the engine.
14. Reconnect the accelerator cable. See Section 2 for throttle linkage adjustments.



Specifications 11

Pistons and connecting rods

Pistons - AA, YA, YC

Type	"Quadram" combustion bowl, most pistons have controlled expansion, with inserted top ring groove
Diameter of bore for gudgeon pin	34,928/34,934 mm (1.3751/1.3754 in)
Height of piston above top face of cylinder block	0,14/0,36 mm (0.005/0.014 in)
Width of groove for top ring	2,57/2,59 mm (0.101/0.102 in)
Width of groove for second ring	2,55/2,57 mm (0.100/0.101 in)
Width of groove for third ring	4,03/4,06 mm (0.1587/0.1598 in)

Pistons - AB, AC, AD, YB, YD

Type	"Quadram" combustion bowl, controlled expansion, inserted top ring groove, reduced diameter top land.
Diameter of bore for gudgeon pin	38,103/38,109 mm (1.500/1.5004 in)
Height of piston above top face of cylinder block	0,14/0,36 mm (0.005/0.014 in)
Width of groove for top ring	Tapered
Width of groove for second ring	2,56/2,58 mm (0.1008/0.1016 in)
Width of groove for third ring	4,04/4,06 mm (0.1591/0.1598 in)

Pistons - AE, YE

Type	Re-entrant combustion bowl, controlled expansion, inserted top ring groove, high top ring groove
Diameter of bore for gudgeon pin	39,003/39,009 mm (1.5355/1.5358 in)
Difference between height grades	0,045 mm (0.0018 in)
Height of piston above top face of cylinder block	0,4/0,5 mm (0.015/0.020 in)
Width of groove for top ring	Tapered
Width of groove for second ring	2,56/2,58 mm (0.1008/0.1016 in)
Width of groove for third ring	4,04/4,06 mm (0.1591/0.1598 in)

Piston rings - AA, YA, YC

Top compression ring	Barrel face, molybdenum insert, with a chamfer at the top of the inner face
Second compression ring	Taper face, cast iron
Oil scraper ring	Coil spring loaded, chromium faced
Width of top ring	2,48/2,49 mm (0.097/0.098 in)
Width of second ring	2,48/2,49 mm (0.097/0.098 in)
Width of third ring	3,98/3,99 mm (0.1566/0.1571 in)
Clearance of top ring in groove	0,08/0,11 mm (0.003/0.004 in)
Clearance of second ring in groove	0,06/0,09 mm (0.002/0.003 in)
Clearance of third ring in groove	0,04/0,08 mm (0.002/0.003 in)
Gap of top ring	0,40/0,85 mm (0.016/0.033 in)
Gap of second ring	0,30/0,76 mm (0.012/0.030 in)
Gap of third ring	0,38/0,84 mm (0.015/0.033 in)

Fuel system

Bosch fuel injection pump

Type ... ... EPVE

Direction of rotation from drive end ... ... Clockwise

Outlet for number 1 cylinder ... ... "C"

Static timing:

The engine check angle must be used with special tool MS.67B² and with the engine set with number 1 piston at top dead centre (TDC) on compression stroke. The pump mark angle and the piston displacement are checked with the pump plunger set at 1,00 mm (0.039 in) plunger lift.

The code letters are part of the setting code stamped on the side of the fuel injection pump. Some fuel pumps may have the setting code stamped on a modification plate which is fastened to the flange of the pump. If a modification plate is fitted, use the code letters stamped on this plate. A typical setting code is 2643J603DK/1/3020; in this example the code letters are "DK".

Fuel pump code letters	Engine check angle degrees	Pump mark angle degrees	Static timing position degrees before TDC	Piston displacement	
				mm	in
BK	308	314	12	1,78	0.070
CK	308	314	12	1,78	0.070
DK	307	313	12	1,78	0.070
EK	308 1/2	315 1/2	14	2,42	0.095
EK(1)	306 1/2	315 1/2	18	3,99	0.157
EM	288 1/2	295 1/2	14	2,42	0.095
FM	288 3/4	295	12 1/2	1,93	0.076
JM(3)	–	–	6	–	–
JM(2)(3)	–	–	2	–	–
SK(3)	–	–	9	–	–

(1) Engines to build lists YA80433 and YA50360 with the modification plate of the fuel injection pump stamped J609.
(2) Engines to build lists AD70229 and AD70230.
(3) For an engine which does not have pump timing marks which have been put on in the factory, see operation 20A-06A.

Bosch in-line fuel injection pump

Type ... ... MW

Direction of rotation from drive end ... ... Clockwise

Outlet for number 1 cylinder ... ... Drive end of fuel pump

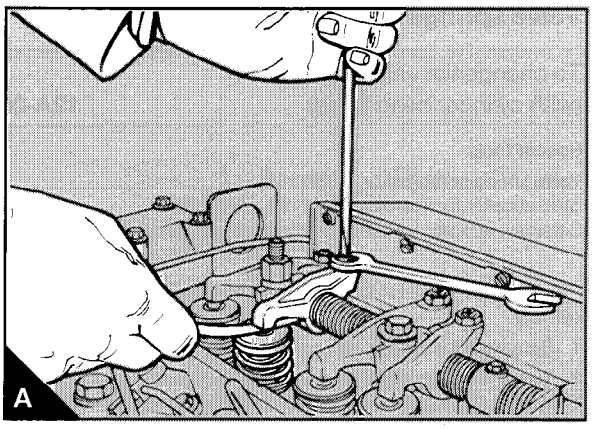
Static timing ... ... 11° BTDC

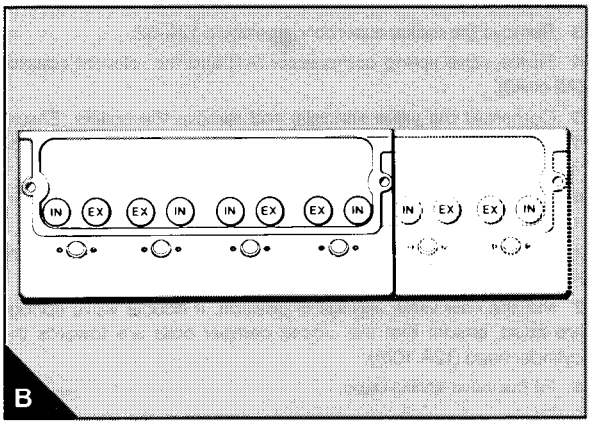
Valve tip clearances

To check and to adjust **12A-05**

The valve tip clearance is measured between the top of the valve stem and the rocker lever (A). With the engine cold, the correct clearances are 0,20 mm (0.008 in) for the inlet valves and 0,45 mm (0.018 in) for the exhaust valves. See B for the position of the valves.

Attention: Number 1 cylinder is at the front of the engine.





Four cylinder engines

1 Turn the crankshaft in the normal direction of rotation until the inlet valve of number 4 cylinder has just opened and the exhaust valve of the same cyliner has not fully closed. Check the clearances of the valves of number 1 cylinder and adjust them, if necessary.

2 With the valves of number 2 cylinder set as indicated above for number 4 cylinder, check/adjust the clearances of the valves of number 3 cylinder.

3 With the valves of number 1 cylinder set, check/adjust the clearance of the valves of number 4 cylinder.

4 With the valves of number 3 cylinder set, check/adjust the clearances of the valves of number 2 cylinder.

Six cylinder engines

1 Turn the crankshaft in the normal direction of rotation until the inlet valve of number 6 cylinder has just opened and the exhaust valve of the same cylinder has not fully closed. Check the clearances of the valves of number 1 cylinder and adjust them, if necessary.

2 With the valves of number 2 cylinder set as indicated above for number 6 cylinder, check/adjust the clearances of the valves of number 5 cylinder.

3 With the valves of number 4 cylinder set, check/adjust the clearances of the valves of number 3 cylinder.

4 With the valves of number 1 cylinder set, check/adjust the clearances of the valves of number 6 cylinder.

5 With the valves of number 5 cylinder set, check/adjust the clearances of the valves of number 2 cylinder.

6 With the valves of number 3 cylinder set, check/adjust the clearances of the valves of number 4 cylinder.

Piston and connecting rod assemblies 13

General description

The crankshaft is a chrome-molybdenum forging which has five main journals for four cylinder engines and seven main journals for six cylinder engines.

End-float is controlled by two half thrust washers on both sides of the centre main bearing.

The main bearings have steel backs with a tin aluminium bearing material except the centre main bearing of six cylinder engines, which has a bearing material of lead bronze with a lead finish. The main bearing caps are made cast iron or spheroidal graphite (SG) iron.

Note: The bearing material of all the main bearings used on Phaser 210Ti engines is lead bronze with a lead finish.

The front and the rear oil seals are "Viton" lip seals with a dust lip to the outside of the main lip and with oil return grooves on the face of the main lip. Engines which have a flywheel housing that is oil filled have an arrangement which uses two "Viton" lip seals. These seals are narrower than the standard seal and are fitted back to back on the crankshaft palm. They do not have a dust lip.

The nose of the crankshaft of four cylinder engines is serrated for location of the front pulley. The location of the front pulley of six cylinder engines is by a key in the crankshaft nose.

The crankshaft pulley of four cylinder engines is held in position by a plain thrust block and three setscrews.The crankshaft pulley of six cylinder engines is held in position by a "Ringfeder" arrangement (14A.03/B).

A separate damper is fastened to the rear face of the crankshaft pulley of six cylinder vehicle engines. An integral damper is built into the pulley of the remainder of six cylinder engines and some four cylinder engines.

A balancer unit is fitted to certain four cylinder engines which have rigid mountings or which are part of the chassis or frame. The purpose of the balancer unit is to reduce the effect of the out-of-balance forces to a satisfactory condition.

To dismantle and to assemble 14A-11

To dismantle

1 Remove the balance weight cover (A8).

2 Release the setscrew and remove the idler gear assembly (A1). Keep the components together as an assembly to protect the needle roller bearing.

3 Prevent movement of the drive shaft (A2) and loosen the nut (A4) of the drive gear for the balance weights (A3). Put a suitable flat distance piece in position between the nut and the balancer frame. Turn the nut until it is against the face of the distance piece. Continue to turn the nut with a suitable spanner until the Loctite seal on the splines of the drive shaft is broken and the gear is loose on the shaft. Remove the nut and the drive gear and remove the drive shaft. Ensure that the needle roller bearings are not damaged when the drive shaft is removed.

4 Release the setscrews which hold the lubricating oil pump and the suction pipe (A10 and A9) to the balancer frame and remove the lubricating oil pump and the suction pipe.

5 Release the setscrews and remove the transfer plate for the lubricating oil (A7) from the rear of the balancer unit. Make a note of the position of the direction arrows on the outside of the transfer plate (14A.14/A or B) to ensure that it can be assembled correctly.

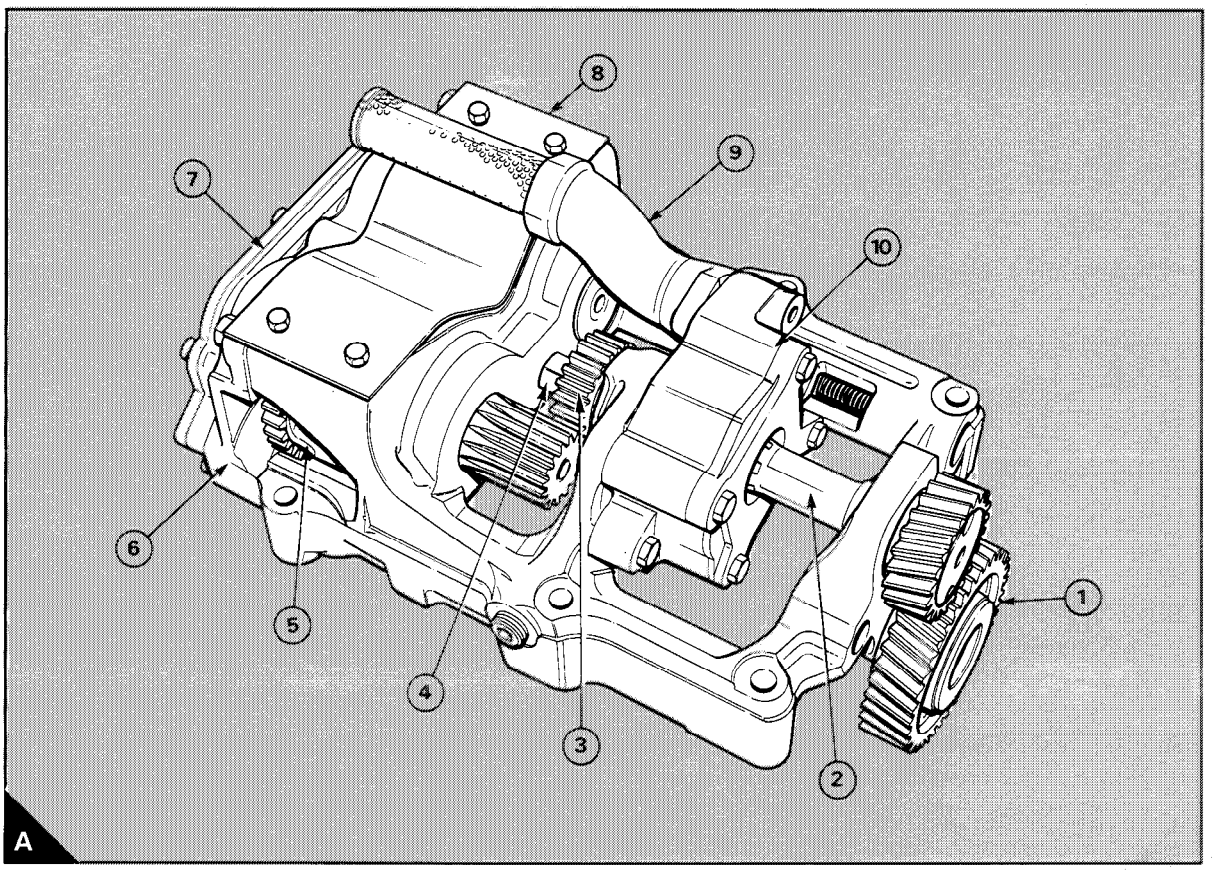
6 Release the setscrews and remove the rear cover of the balancer frame (A6). A hammer and a suitable drift will be necessary to remove the rear cover from the dowels.

7 Remove the balance weights (A5). Ensure that the gear of the driven weight does not damage the bush in the balancer frame.

8 Dismantle the lubricating oil relief valve, operation 19A-09.

9 There are two plugs in the balancer frame, a short tapered plug with a hexagonal socket head and a long plug with a square socket head. These plugs control the flow of oil through the balancer frame. The position of the plugs is decided by which side of the engine the filter is fitted. When the filter is fitted on the left side, the short plug is fitted in the side of the balancer and the long plug is fitted in the bottom (14A.14/A). When the filter is fitted on the right side of the engine, the short plug is fitted in the bottom of the balancer and the long plug is fitted in the side (14A.14/B). Removal of these plugs can cause damage to the threads in the balancer frame and a new balancer frame would then be necessary. When a balancer unit is to be fitted, ensure that the lubricating oil flow through the balancer frame is correct for the position of the lubricating oil filter.

10 Clean the lubricating oil passages with kerosene and dry them with low pressure compressed air.

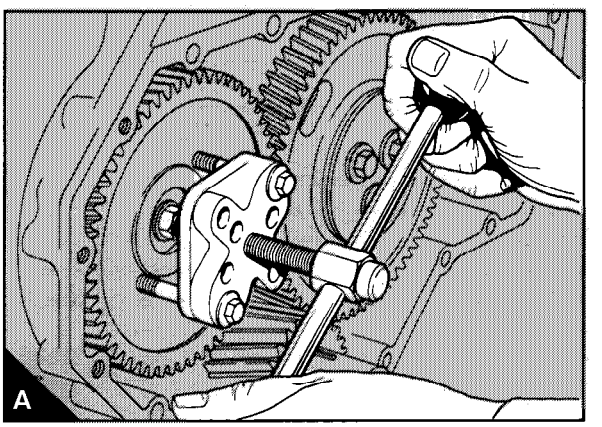


Camshaft gear

To remove and to fit 15A-05

To remove

Special tools:
Gear puller, PD.155C
Adaptors for use with PD.155C, PD.155B-5



1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 Drain the coolant and remove the water pump, operation 21A-02.

6 Remove the timing case cover, operation 15A-01.

7 Turn the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

Note: The fuel pump gear used on engine types AE and YE does not have marked teeth.

8 Remove the setscrew and washer of the camshaft gear and remove the gear with the puller and adaptor (A). Ensure that the key in the camshaft is not lost.

9 Inspect the gear for wear and any other damage and renew it, if necessary.

To fit

1 Ensure that the key in the camshaft is fitted correctly.

2 Remove the idler gear, operation 15A-03.

3 Fit the camshaft gear to the camshaft with the marked teeth towards the front and the keyway correctly aligned with the key. If necessary, lightly hit the gear with a soft face hammer to engage the key into the keyway.

4 Fit the idler gear with the marked teeth in correct mesh, operation 15A-03. If the camshaft has to be turned and a valve hits a piston, disengage the rocker assembly.

5 Fit the washer and the setscrew for the camshaft gear and tighten the setscrew to press the camshaft gear into position. Tighten the setscrew to 78 Nm (58 lbf ft) 8,0 kgf m. If a new camshaft gear has been fitted, check the backlash.

6 Fit the timing case cover, operation 15A-01.

7 Fit the water pump, operation 21A-02.

8 Fit the crankshaft pulley, operation 14A-01.

9 If necessary, fit the fan drive pulley, operation 21A-05.

10 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

11 Fit the fan, operation 21A-04.

12 Fill the cooling system.

To fit a service liner

A service liner is a transition fit of ± 0,03 mm (± 0.001 in) in the parent bore. A special tool will not be necessary to fit some liners, but where a liner is a tight fit, tool PD150B can be used. Do not hit a liner with a hammer.

1 Clean thoroughly the parent bore. Clean the top 50 mm (2.0 in) and the recess for the liner flange with Loctite Safety Solvent or a similar product; use it in accordance with the manufacturer's instructions.

2 Clean thoroughly the outer surface of the liner with Loctite Safety Solvent.

3 Lubricate lightly the parent bore with clean engine lubricating oil, except for the top 50 mm (2.0 in).

4 Engage the cylinder liner (A5) into the parent bore; ensure that the liner is vertical. Put the adaptor PD.150B-17/2 (A4) onto the top of the liner with the shoulder of the adaptor on the liner flange. Put the bearing (A3) into position in the recess in the top of the adaptor with the flat face of the bearing to the bottom of the recess.

5 Fit the threaded rod (A1) through the bearing, the adaptor and the liner until the handle (A2) is against the recess in the bearing. In this position adjust the threaded rod until the end is below the bottom face of the cylinder block.

6 Fit the adaptor PD150B/6 (A6) onto the threaded rod; ensure that the flat face of the adaptor is against the bottom face of the cylinder block. Fit the washer and the nut; ensure that the threaded rod is in the centre of the liner and tighten the nut onto the adaptor.

7 Lubricate the ratchet of the handle and the threaded rod with Shell Spirax oil or an equivalent oil. Operate the handle and press the liner into the parent bore to within 50 mm (2.0 in) of the fitted position. Clean the area below the flange of the liner with Loctite Safety Solvent. Apply Loctite 602 to the top 25 mm (1.0 in) of the outer surface of the liner and under the flange; also apply Loctite 602 to the bottom of the flange recess in the parent bore.

8 Press the liner in to the fully fitted position. Remove the tool and clean the Loctite from the top of the cylinder block.

9 Allow 15 minutes to elapse before the liner bore dimension is checked. The Loctite will reach full strength after 3 hours.

10 With tool PD41D, check that the liner flange is between 0,10 mm (0.004 in) above to 0,10 mm (0.004 in) below the top face of the cylinder block (B).

11 Fit new piston rings, operation 13A-04.

12 Fit the piston and connecting rod assembly, operation 13A-03.

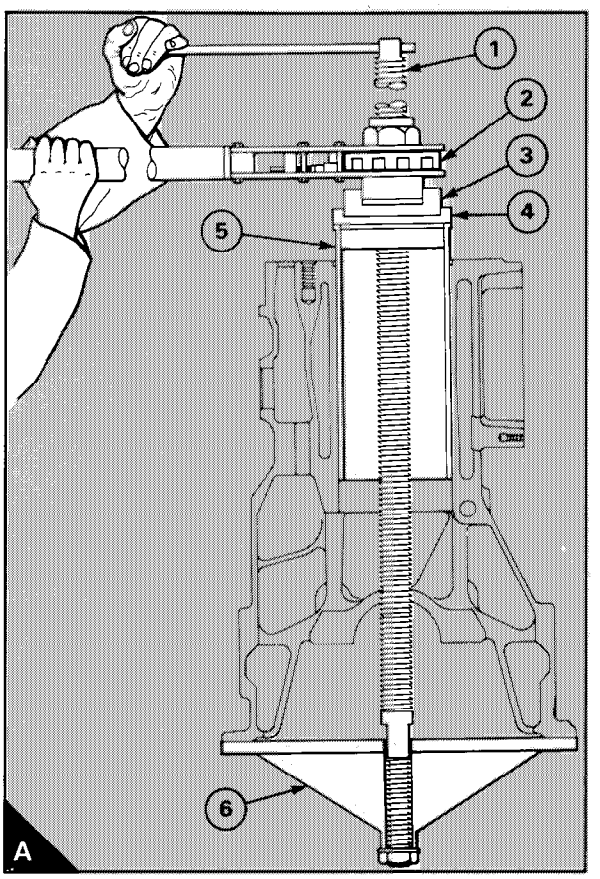
13 If necessary, fit the piston cooling jet, operation 13A-09.

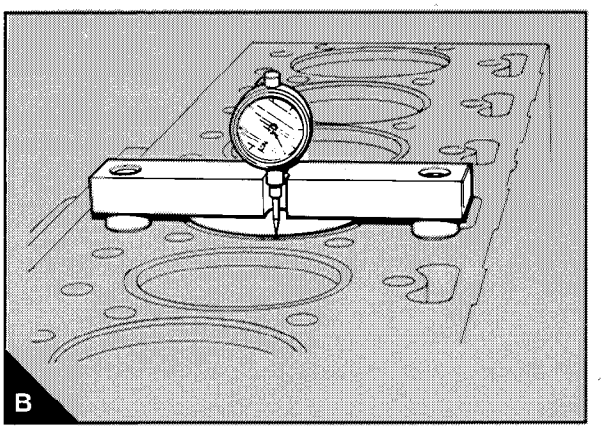
14 Fit the cylinder head assembly, operation 12A-07.

15 Fit the lubricating oil sump, operation 19A-03, and fill it to the correct level with an approved lubricating oil.

Attention: After a new service liner has been fitted, these recommendations are advised for the first 240 km (150 miles) or 5 hours of operation:

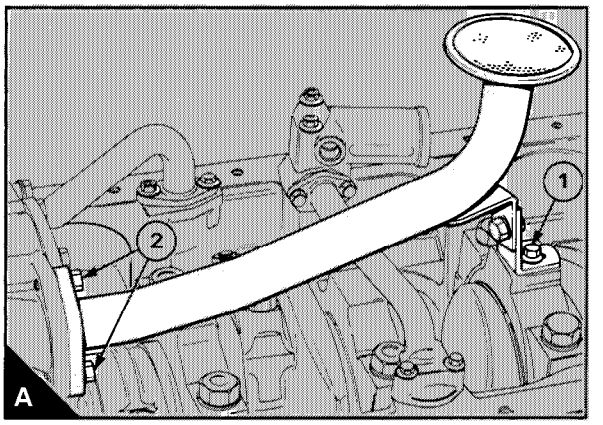
- Do not operate the engine at full load.
- Do not operate the engine at high speed.
- Do not allow the engine to run at low idle speed for extended periods.





Sump

To remove and to fit 19A-03



1 Operate the engine until it is warm.

2 Stop the engine, remove the sump drain plug and its "O" ring and drain the oil. Where necessary, remove the dipstick and the dipstick tube.

3 Provide a support for the sump and remove the setscrews and the two nuts which fasten the sump to the cylinder block and to the timing case. Lower the sump and remove the joint.

4 Wash the sump with clean kerosene, ensure all the kerosene is removed. Clean the flange face of the sump and of the cylinder block. If necessary, renew the felt dust seal which is fitted to the rear of the sump flange on some engines.

5 Fit the sump together with a new joint and ensure the correct location with a setscrew on each side. Fit the remainder of the setscrews and the nuts and tighten all the fasteners to 22 Nm (16 lbf ft) 2,2 kgf m. Fit the drain plug together with a new "O" ring and tighten the plug to 34 Nm (25 lbf ft) 3,5 kgf m. Where necessary, fit the dipstick tube and the dipstick. Fill the sump to the "MAX" level on the dipstick with an approved lubricating oil.

Oil strainer and suction pipe

To remove and to fit 19A-04

The oil strainer is an integral part of the suction pipe. No regular service is necessary but wash the strainer when it is removed. On four cylinder engines which have a balancer fitted,the suction pipe is normally a short pipe which is fastened to the balancer frame and a pipe bracket is not fitted.

1 Remove the sump, operation 19A-03.

2 Release the setscrew which holds the bracket to the main bearing cap (A1).

3 Release the setscrews from the flange of the suction pipe (A2). Remove the suction pipe and strainer. Remove the old joint. Clean the flange face of the oil pump and of the suction pipe.

4 Loosely assemble the bracket of the suction pipe to the correct main bearing cap. Fit the suction pipe to the oil pump together with a new joint. Tighten the setscrews. Tighten the setscrew of the suction pipe bracket. If the clamp type bracket, used on some four cylinder engines, has been removed, ensure that the clamp, bracket and pipe are correctly aligned before the setscrews are tightened. Ensure that there is no stress on the suction pipe.

5 Fit the sump, operation 19A-03, and fill it with an approved oil to the "MAX" level on the dipstick.

To inspect and to correct 19A-05

1 Wash the assembly in kerosene and dry it thoroughly.

2 Check the pipe, the strainer and the welded joints for cracks and other damage. Check that the mounting bracket is secure.

3 If the damaged component cannot be welded correctly, renew the assembly.

Fuel lift pump

To remove and to fit — 20A-03

1 If a heat shield is fitted, remove it. Disconnect the fuel pipes from the fuel lift pump.

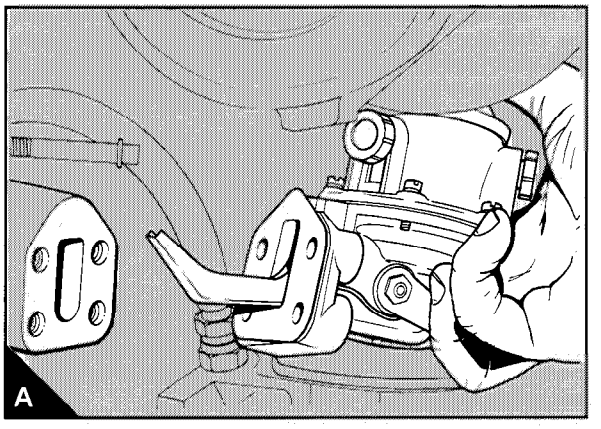
2 Release the setscrews, remove the lock plates and remove the fuel lift pump (A). The lift pump may be difficult to remove from the engine. If this occurs the crankshaft must be rotated until the camshaft eccentric, that operates the lift pump, is in a position which will free the rocker lever of the lift pump.

3 Ensure that the camshaft eccentric is in the minimum lift position before the lift pump is fitted. Clean the joint face of the lift pump and the cylinder block and fit the lift pump together with a new joint. Fit the lock plates and the setscrews and tighten them gradually and evenly to 22 Nm (16 lbf ft) 2,2 kgf m.

4 Connect the fuel pipes and, if necessary, fit the heat shield.

5 Release the vent screw on the fuel filter head and operate the priming lever of the fuel lift pump to eliminate any air between the lift pump and the fuel filter. Operate the lift pump until fuel, free of air, comes from the vent screw. Tighten the vent screw.

6 Operate the engine and check for any fuel or air leakage.



To dismantle and to assemble — 20A-04

To dismantle

1 Clean the outside surfaces of the fuel lift pump.

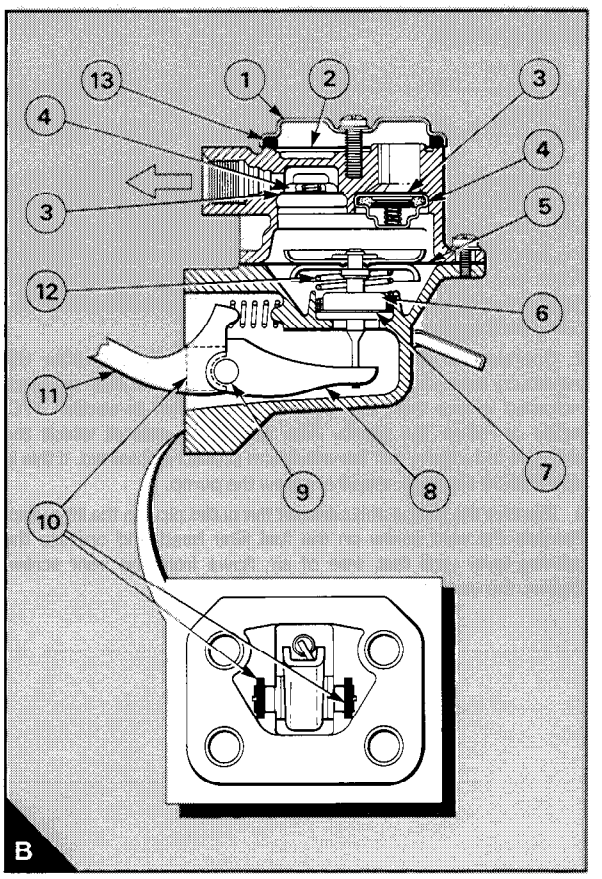
2 Make a mark across the flanges of the two halves of the pump to ensure correct relationship when the pump is assembled.

3 Remove the cover (B1) and the gauze (B2). Release the setscrews and separate the two halves of the pump.

4 Turn the diaphragm assembly (B5) 90° to release the pull rod from the link arm (B8) and remove the diaphragm assembly. Remove the stem seal (B6), the spring seat washer (B7) and the spring (B12) from the pull rod. The diaphragm and pull rod assembly is renewed as an assembly and no service is possible on the diaphragm.

5 The valves (B4) are peened in and can be removed with a suitable lever. Some of the peened metal will have to be removed before the valves can be removed.

6 To remove the link arm: Hold the rocker lever (B11) in a vice and hit the body of the lift pump with a soft face hammer to release the two retainers (B10). Be careful not to damage the joint face of the pump body. Remove the rocker lever, the pin (B9), the link arm and the return spring. Check the components for wear and other damage.



To assemble

1 Thoroughly clean the valve housings. Fit new seat washers (B3) and push the new valves (B4) into position. As the valves are the same, but one valve is fitted in reverse of the other, it is possible to fit the valves upside down. To ensure that the valves are fitted correctly, fit them as shown in B. When the valves are correctly fitted, peen the edge of the valve housings in six places, evenly divided, to keep the valves in position.

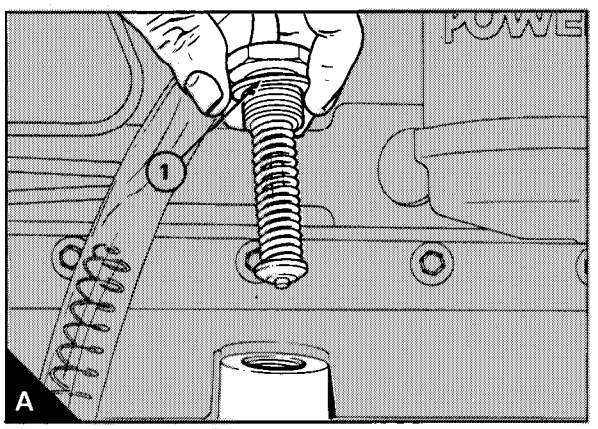
2 Fit the rocker lever (B11), pin (B9) and link arm assembly (B8) into the bottom half of the lift pump. Fit the return spring; ensure that the ends of the spring are in their correct location.

3 With a light hammer and a suitable adaptor, fit two new retainers (B10) in their grooves in the casing until they fasten the pin. Peen the open ends of the grooves to fasten the retainers in position.

Cooling system 21

Cooler by-pass valve

To remove and to fit **21A-09**



1 Release the hexagonal cap and remove the by-pass valve (A).

2 Check the valve spring and the seat for damage and renew the complete assembly, as necessary.

3 Renew the aluminium washer (A1). Fit the by-pass valve into the oil cooler and tighten the cap to 50 Nm (37 lbf ft) 5,1 kgf m.

The by-pass valve is not fitted to the latest oil cooler fitted to most four cylinder engines.

Fault diagnosis

The alternator is so designed that a flow of current indicated by no light at the warning light or a reading shown on an ammeter is enough indication that the system is in correct operation. If the system is in correct operation, no open circuit, voltage or current output checks need to be done on the installation unless:

- The warning light does not show when the alternator is stationary and the switch is in the "on" position or it shows a light when the alternator is in operation.
- No charge current is shown on the ammeter.
- The battery is discharged.
- The battery is hotter than normal which is an indication of loss of voltage control.

If one or more of the above symptoms occur, the procedure indicated below should be applied.

1 Ensure that the battery is in a fully charged condition.

2 Connect a moving-coil voltmeter of good quality, with a range of 0-50 volts, across the positive and negative terminals of the alternator. If an ammeter is not fitted in the electrical circuit, fit a moving-coil ammeter of good quality, with a range of 0-100 ampere, in the wire between the alternator and the positive terminal of the battery.

3 Turn the warning light switch to the "on" position (main switch on instrument panel) when the warning light should be illuminated.

4 Switch on a 10-15 ampere load, for example, lights, fans, etc.

5 Start the engine and operate it at a fast idle speed when either the warning light should be extinguished or the ammeter indicates a small change in the current in relationship to the engine speed.

6 Increase the engine speed for a moment to near maximum speed, when the charge current should be approximately equal to the rating for the alternator, as shown in section 11C.

7 Operate the alternator at approximately half speed (engine speed approximately 1500 rev/min) and remove the electrical load. The voltage should go up to 14 volts for a 12 volt system or 28 volts for a 24 volt system and then remain constant. At the same time the current reading should show a reduction.

Any change in the above data can indicate a fault and the procedure that follows should be used before any components are disconnected. This procedure is not suitable for A127 alternators and, if a fault is found, the alternator should be removed for test by a specialist.

The regulator is a sealed unit and a repair is not possible. If there is a regulator fault, the regulator must be renewed.

If the warning light is not illuminated when the switch is in the "on" position:

Check the bulb.

If no fault:

Check all the connections at the regulator, at the alternator and at the battery.

If no fault:

Turn the switch to the "off" position. Disconnect the wire from the "F" terminal on the alternator and connect a wire between the "F" terminal and the negative terminal on the alternator. Turn the switch to the "on" position.

If the warning light shows, the fault is in the regulator.

If the warning light does not show, the fault is in the alternator.

If the warning light continues to show and the ammeter shows no output when the alternator is in operation:

Check all the connections at the regulator, alternator and battery.

If no fault:

Turn the switch to the "off" position. Disconnect the wire from the "F" terminal on the alternator and connect a wire between the "F" terminal and the negative terminal on the alternator. Turn the switch to the "on" position and operate the engine at fast idle.

If there is no output, there is a fault in the alternator.

If there is an output, there is a fault in the regulator.

If the warning light continues to show when the alternator is in operation and the ammeter shows a reduced output with maximum output only at maximum engine speed or, if the warning light does not show, but there is a reduced output from the alternator with maximum output only at maximum engine speed:

There is a fault in the alternator.

If there is an intermittent light from the warning light and the ammeter needle is not stationary when the battery is charged fully and no load is applied:

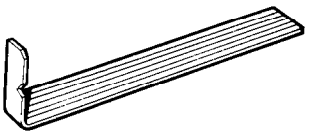
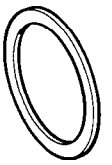
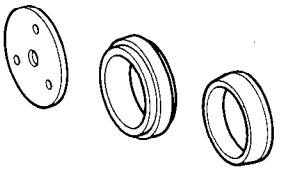
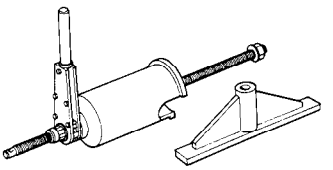
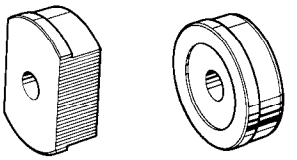
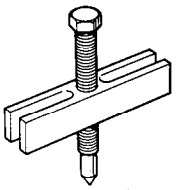
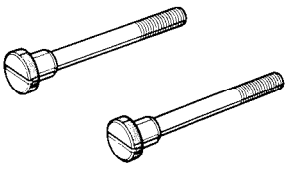
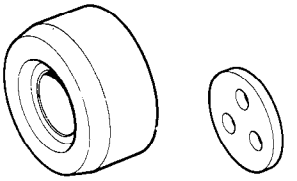
Check for a higher than normal resistance in the negative control wire of the regulator.

If the resistance is normal, there ia a fault in the regulator.

If the battery charge is too high and the ammeter indicates high or maximum output at all times:

Check the positive control wire and its connection at the regulator.

If the wire and its connection are correct, there is a fault in the regulator.

Number	Description	Illustration
PD.67-4	Pointer for use with MS.67B.	
PD.67-5	Distance piece for Bosch pumps; use with MS.67B.	
PD.145D	Replacer tool for crankshaft rear seal.	
PD.150B	Remover/replacer for cylinder liner (main tool).	
PD.150B-17	Adaptors for use with PD.150B.	
PD.155C	Basic puller for camshaft and fuel pump gears.	
PD.155B-5	Adaptors for use with PD.155B.	
PD.163A	Centralising tool for timing case cover.	

11. If the engine has been requiring the addition of large amounts of coolant:
    - Inspect the radiator for blockage of air flow through the fins. Air clean the radiator.
    - Check the tailpipe. Be sure exhaust flow is not blowing into the radiator. Make sure all baffles and shrouds are in place.
    - Check fan belt and cooling fan.
    - Check and make sure the fan is not installed backward. The coined imprinting on the fan blades should be facing the engine for correct operation.
    - Check engine oil to see if it contains coolant.
    - Check the radiator cap to see that it has the correct rating.
    - Pressure test the radiator and cooling system. See "Cooling System Tests" in this Section for procedures to test the radiator and cooling system. Repair any leaks or blockage.
    - Test the engine thermostat. See "Cooling System Tests" in this Section for procedures to test the thermostat. Replace the thermostat if faulty.

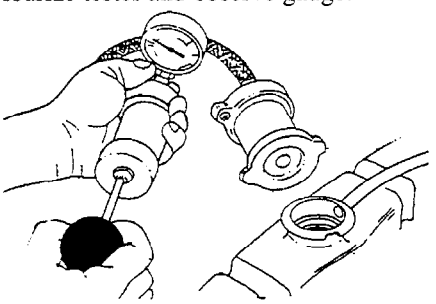
Cooling System Tests

If maintenance and testing of the cooling system is needed, check for both external and internal leaks in the cooling system with an accurate pressure pump and gauge tester.

Testing the Radiator Cap

Test radiator cap for holding pressure.

1. Wash dirt or scale from sealing surfaces with clean water. Wet rubber seal and install cap tightly on tester.
2. Pressurize tester and observe gauge.

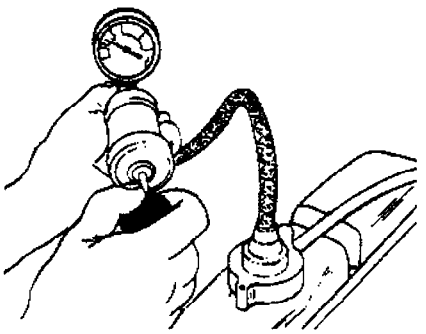


Cap should relieve pressure greater than 7 psi (48 kPa) and hold lesser pressure constant for two minutes. If not, replace cap with new Clark part.

Testing Radiator and Cooling System

Pressure test remainder of cooling system.

1. Wet rubber sealing surface and install tester cap tightly on the radiator fill neck. Pressurize tester to 7 psi (48 kPa).



2. Pressure should hold constant for two minutes. If pressure drops, check for leaks in radiator, hoses, connections, and engine components.

Testing the Thermostat

1. Remove and test the engine thermostat to determine if it closes correctly and opens at the correct temperature:

   Gas/LPG/CNG
   - Open (cracking) at 88°C ± 1.5° (190°F ± 3.5°)
   - Fully open at 96°C (205°F).

   Diesel
   - Open (cracking) at 82°C ± 1.5° (180°± 2.7F)
   - Fully open at 95°C (203°F).

2. Fully immerse the thermostat in a pan of water. Heat slowly while stirring. Use thermometer to measure temperatures at which thermostat valve cracks (starts to open) and fully opens. If not to specifications, replace thermostat.

for specific engine applications. The main metering system is calibrated to deliver a lean mixture for best overall economy. When additional power is required, a vacuum operated power system enriches the air fuel mixture.

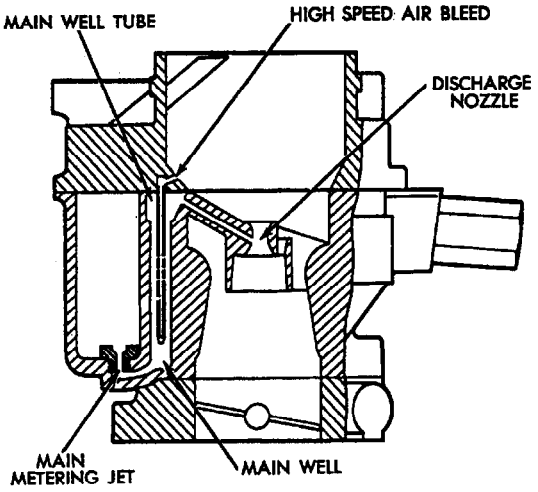


***Figure 7,* Main metering system**

POWER ENRICHMENT SYSTEM MODEL 1940

The power enrichment system consists of a power valve installed near the center of the carburetor body and a vacuum piston installed in the bowl cover. A vacuum passage leads from the top of the piston down to the manifold flange. When the manifold vacuum is high, the vacuum piston is raised to the top of its cylinder and the spring on the piston is compressed. When the manifold vacuum drops to a predetermined level, the spring overcomes the vacuum and pushes the piston stem down. The piston stem in turn pushes the power valve down, opening the power valve and permitting fuel to flow through the power valve, through the power valve channel restriction and into the main well located near the power valve. The power valve originally used in the model 1940 is a three piece valve sold as an assembly. Later model 1940 carburetors used a one piece, two stage power valve. (See Fig. 8)

MODEL 1945 GRADIENT FUEL ENRICHMENT SYSTEM *(Fig. 9 Federal Version)*

The principal difference between the Model 1945 and Model

GRADIENT FUEL ENRICHMENT

(California Requirement Fig. 9)

The valve used in California applications is basically the same as the federal applications. As the throttle approaches wide open, (approximately 80°) a spring loaded rod contacts the vacuum piston stem and fully opens the valve. The mechanical operation occurs regardless of engine vacuum.

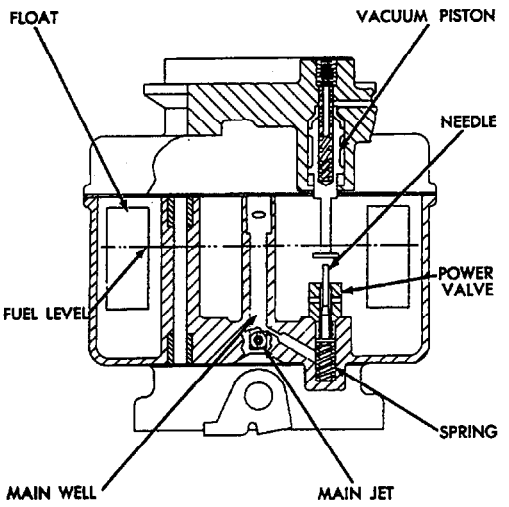
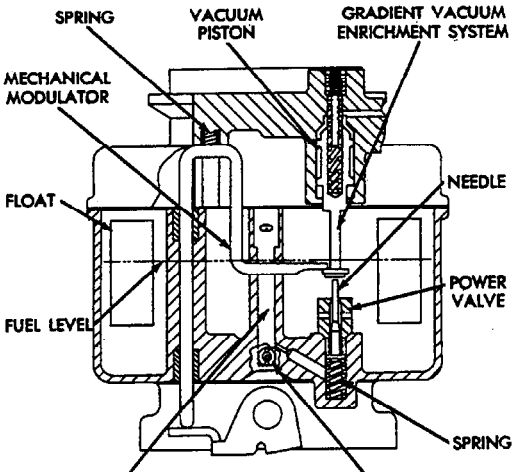


***Figure 8,* Gradient power enrichment system**

Model 1940 two stage, See figure 24.



6. Adjust idle mixture screw slowly until specified RPM is obtained. Turn screw "in" (clockwise). The resulting idle air fuel ratio is near optimum for exhaust emission control. If engine runs rough or if specified RPM cannot be obtained it be necessary to remove the limiter cap and readjust mixture to proper settings.

1. Remove limiter cap. *NOTE: Do not pry.* Use a puller or cut through the side of the cap with a piece of hack saw blade.
2. With engine operating, adjust mixture screw to lean best idle at specified RPM (lean best idle is the point at which engine speed drops approximately 10 RPM due to leanness. If engine still runs rough after these steps, the may be dirt in an idle passage, an incorrect gasket or ignition problem.
3. Install new limiter cap with tab fully counter-clockwise against stop.
4. Make idle speed adjustments per steps 1-6 under "curb idle adjustment".

LOW IDLE SPEED ADJUSTMENT

Low idle speed adjustments must also be made with engine at normal operating temperature, parking brake applied, air cleaner in place, transmission in neutral. The low idle speed must run the engine.

1. With curb idle adjusted to specifications and dashpot adjusted to specified speed or clearance, proceed as follows.
2. Disconnect throttle stop solenoid electrical supply wire. The idle speed should drop as the solenoid plunger retracts.
3. Set the low idle speed to specifications by adjusting the low idle speed adjusting screw (Figure 35).
4. Reconnect throttle stop solenoid electrical supply wire.

FAST IDLE SPEED ADJUSTMENT

1. Remove air cleaner and cap vacuum fittings to heated air control and O.S.A.C. (eliminates vacuum advance) or E.G.R. fittings where they are used.
2. With engine off, but at normal operating temperature, transmission in neutral and parking brake set, open the throttle and close the choke. Attach tachometer.
3. Close throttle to place fast idle screw on highest speed step. Move fast idle cam until screw drops down to second step

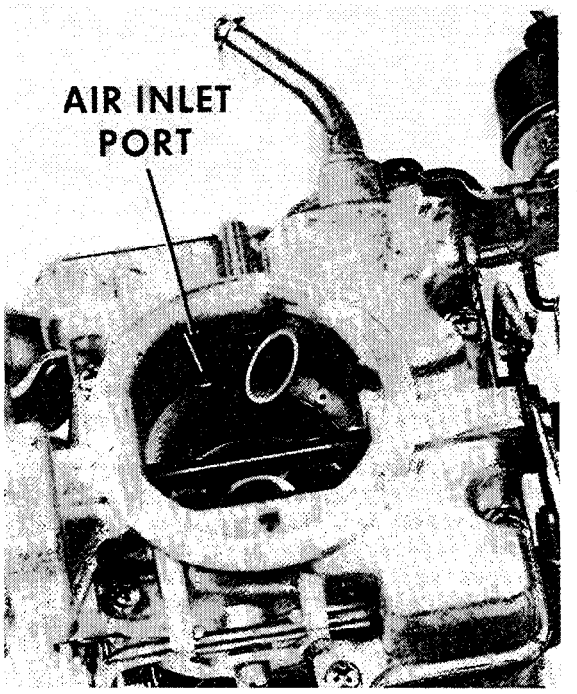
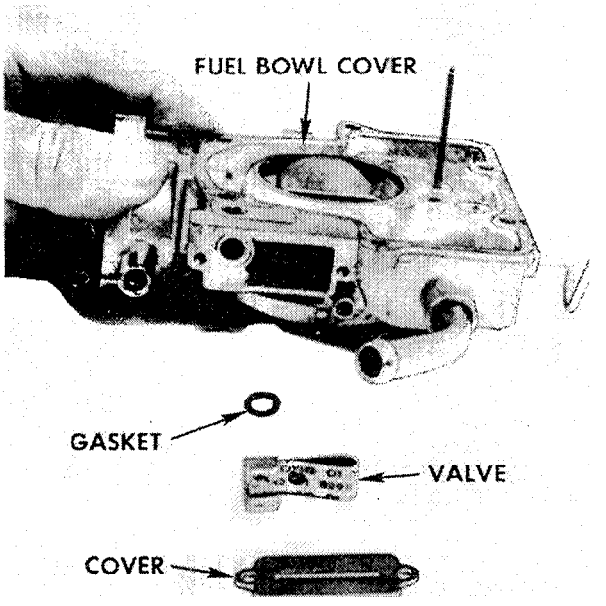


Figure 37, **Hot idle compensator air inlet port.**



c. Before tightening the clamps surrounding the tank, move the tank slightly and observe the level gauge. The gauge pointer should oscillate with the movement of fuel in the tank. A defective gauge can be suspected if the pointer fails to move.

d. Carefully check for system leaks when the tank shut-off valve is first opened if an odor is detected.

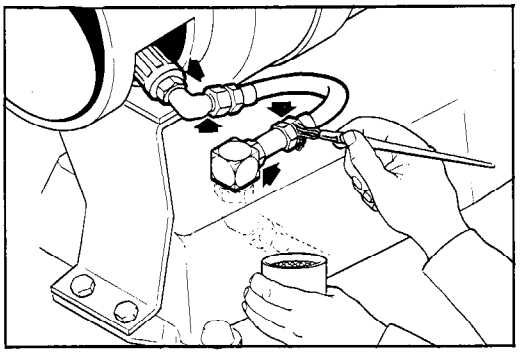


Fig. 14707

LPG LINES

1. Only UL approved high pressure type LPG hose is used between the tank and the vaporizer-regulator. The hose is pressure and temperature stabilized, and specially formulated to carry liquid petroleum gas. It is rayon braid reinforced two tube construction with the outer tube perforated to prevent blistering if seepage occurs. All other hoses in the system are to Clark specification for vacuum or water usage.

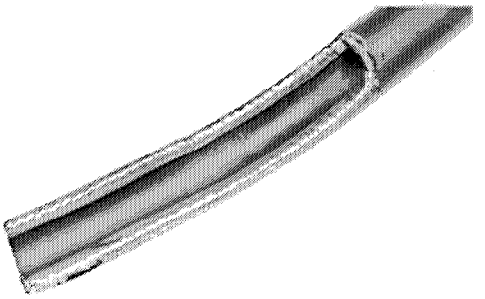


Fig. 19675

W A R N I N G

NEVER SUBSTITUTE FOR UL APPROVED LPG HOSE.

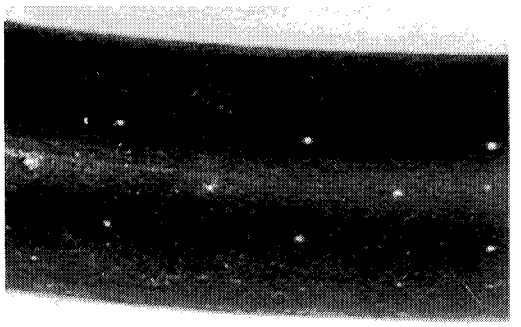


Fig. 19676

2. All lines in the LP Gas system should be inspected periodically (generally every 30 days).

   An odorant is added to LP Gas to help detect leaks. If at any time this odor is detected, shut off the engine and fix the leak.

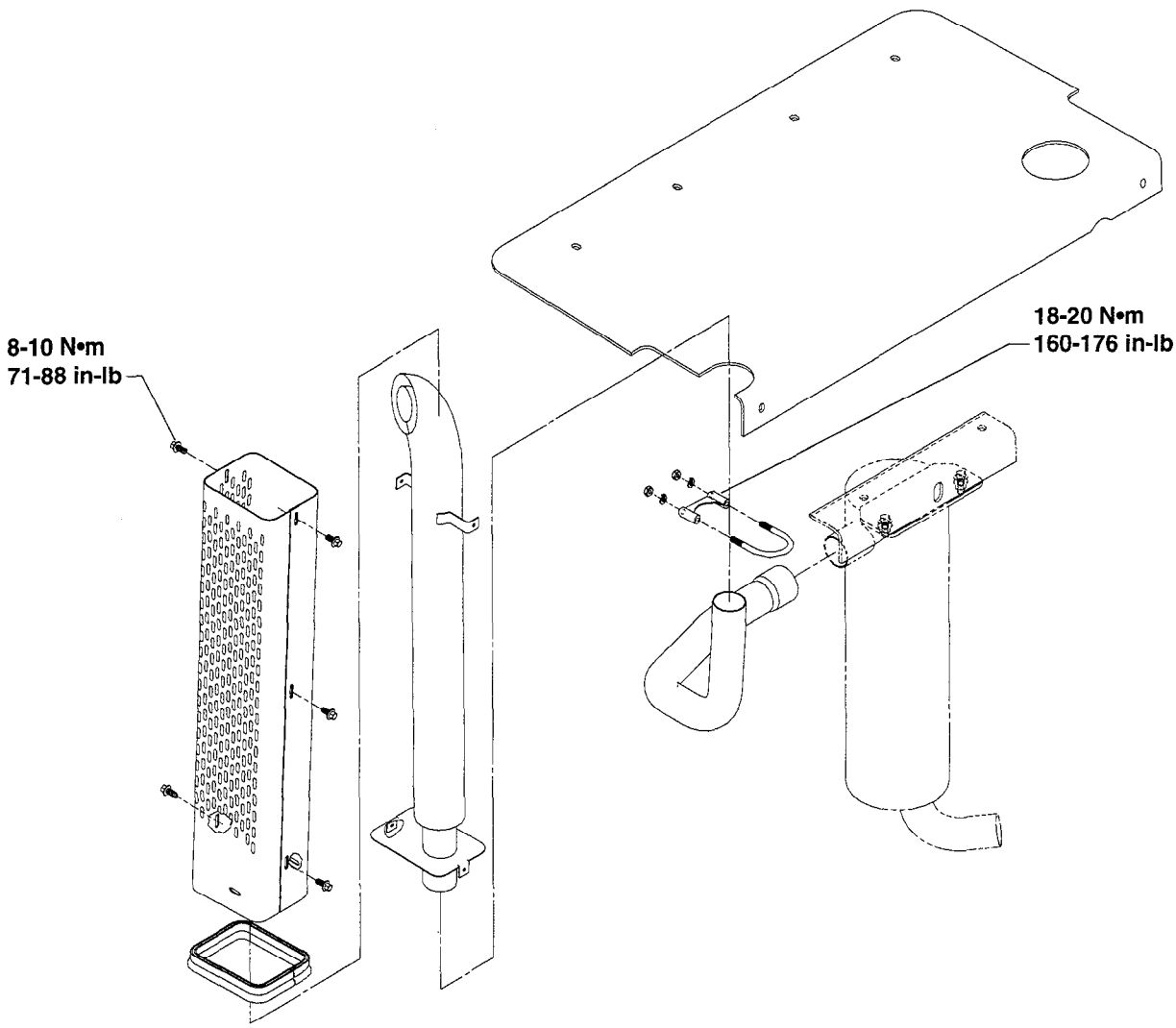
W A R N I N G

LOCATE MACHINE IN A WELL VENTILATED AREA. DO NOT SMOKE OR PERFORM THIS CHECK NEAR OPEN FLAME OR OTHER SOURCES OF IGNITION. DO NOT DISCONNECT ANY LINES WHEN EXHAUST MANIFOLD IS EXCESSIVELY HOT. LP GAS IS HIGHLY FLAMMABLE.

GROUP 03

AIR INDUCTION AND EXHAUST SYSTEMS

Vertical Exhaust



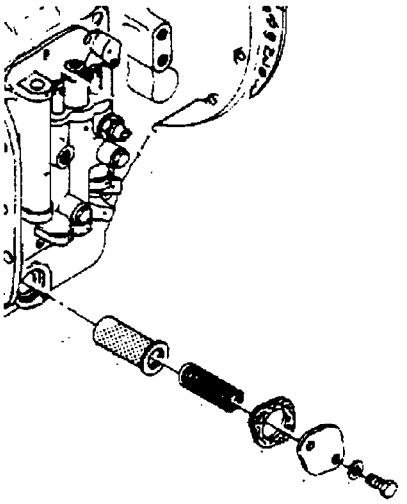
The transaxle and convertor have a common sump and should be drained when hot every 1000 hours.

NOTE

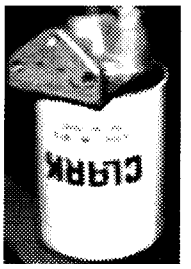
The transaxle filter should be cleaned after 50 hours and them again after 100 hours on any new machine. It should then be changed every 500 hours thereafter, or every other Planned Maintenance interval, and after any transaxle overhaul.

1. Remove both drain plugs to completely drain sump.
2. Clean the magentic plug of all foreign material.

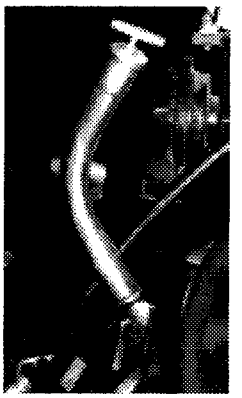
3. Remove and clean the transaxle sump screen. Check the O-rings for damage, nicks, and scratches. Replace the O-rings if in poor condition. Use an approved cleaning solvent to clean the screens. Dry with compressed air.



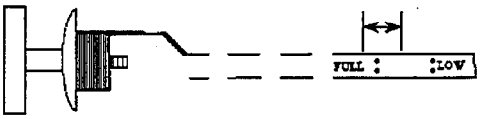
4. Replace the drain plugs and screens.
5. Replace transaxle filter.



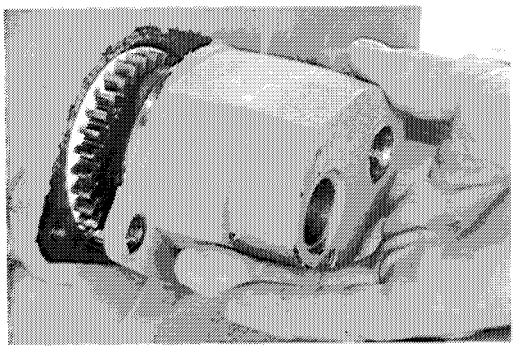
6. Fill the transaxle through dipstick opening in the axle adaptor with AMOCO 1000 automatic transmission fluid.



7. Operate engine at idle for approximately 4 minutes to completely fill the system.
8. Put transmission in neutral, and check fluid level with dipstick. Add fluid as required to bring level to full mark on dipstick.

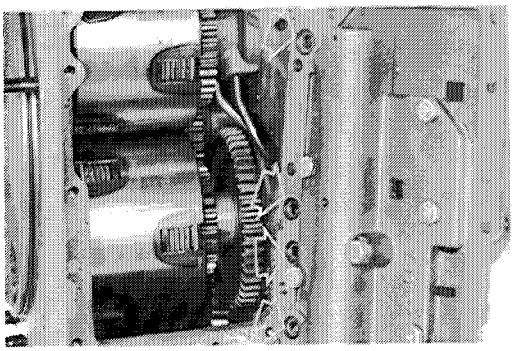


4. Remove the convertor pump from the transmission assembly.



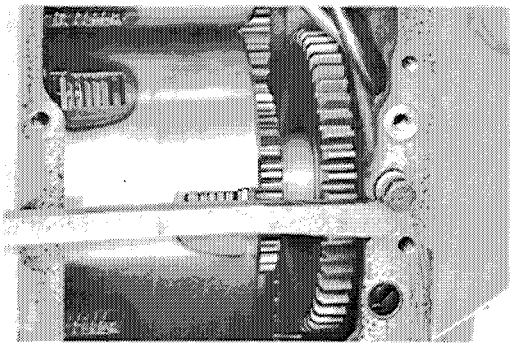
10224

5. Remove the control cover assembly and gasket.



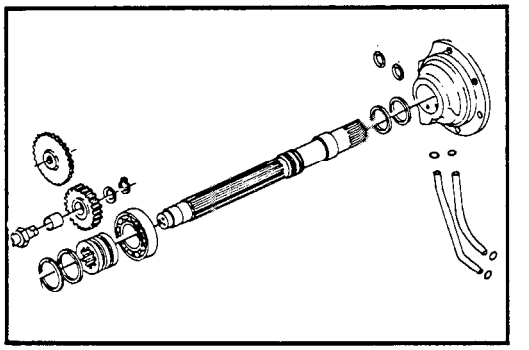
10225

6. Install the control cover capscrews into the oil sleeves. After the capscrews are in place, lift up on the capscrews (while holding the oil tubes) to prevent damage to the tubes.



10226

7. Remove the forward and reverse oil tubes.



25917

31. Remove the intermediate shaft retainer ring on the axle adaptor end of the transmission.

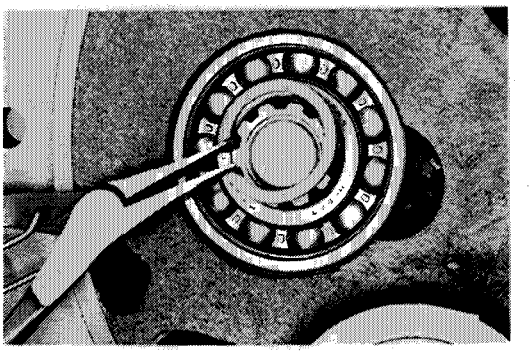


Fig. 10098

32. Remove the intermediate gear retainer ring from the retainer slot and slide to the position as shown.

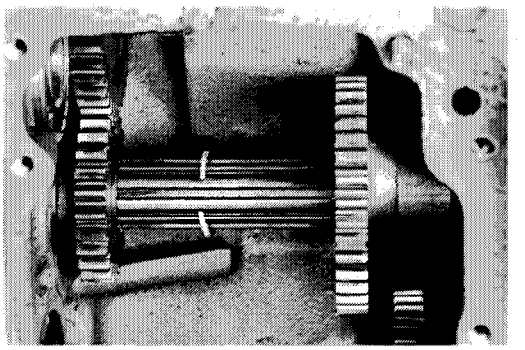


Fig. 10240

33. Use a brass drift to move the intermediate shaft toward the cover end about four inches.

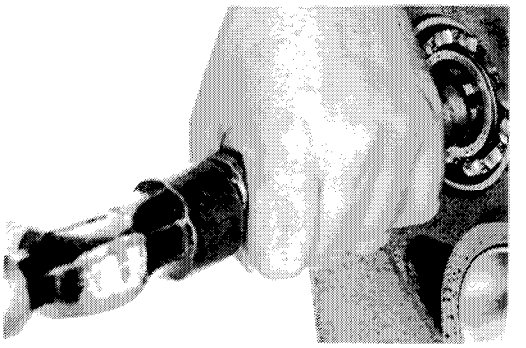


Fig. 10099

34. Remove the intermediate gears and retainer rings by sliding them off the shaft.

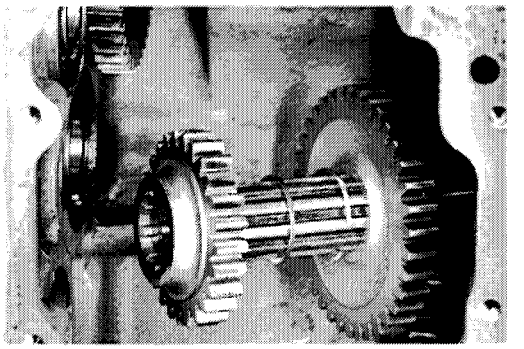


Fig. 10241

23. Turn the gear and watch the inner discs to see if they engage. When the gear has completely entered the discs it should be [6.35 mm] or .250" below the top of the end plate. Install a thrust washer over the shaft with the lubrication grooves toward the gear.

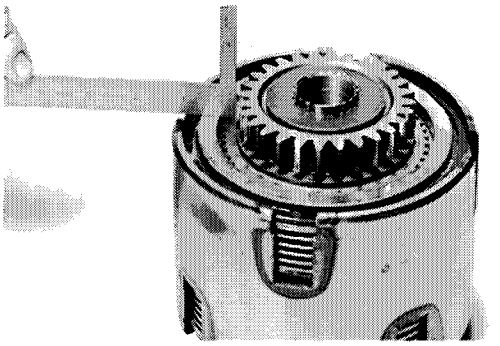


Fig. 8043

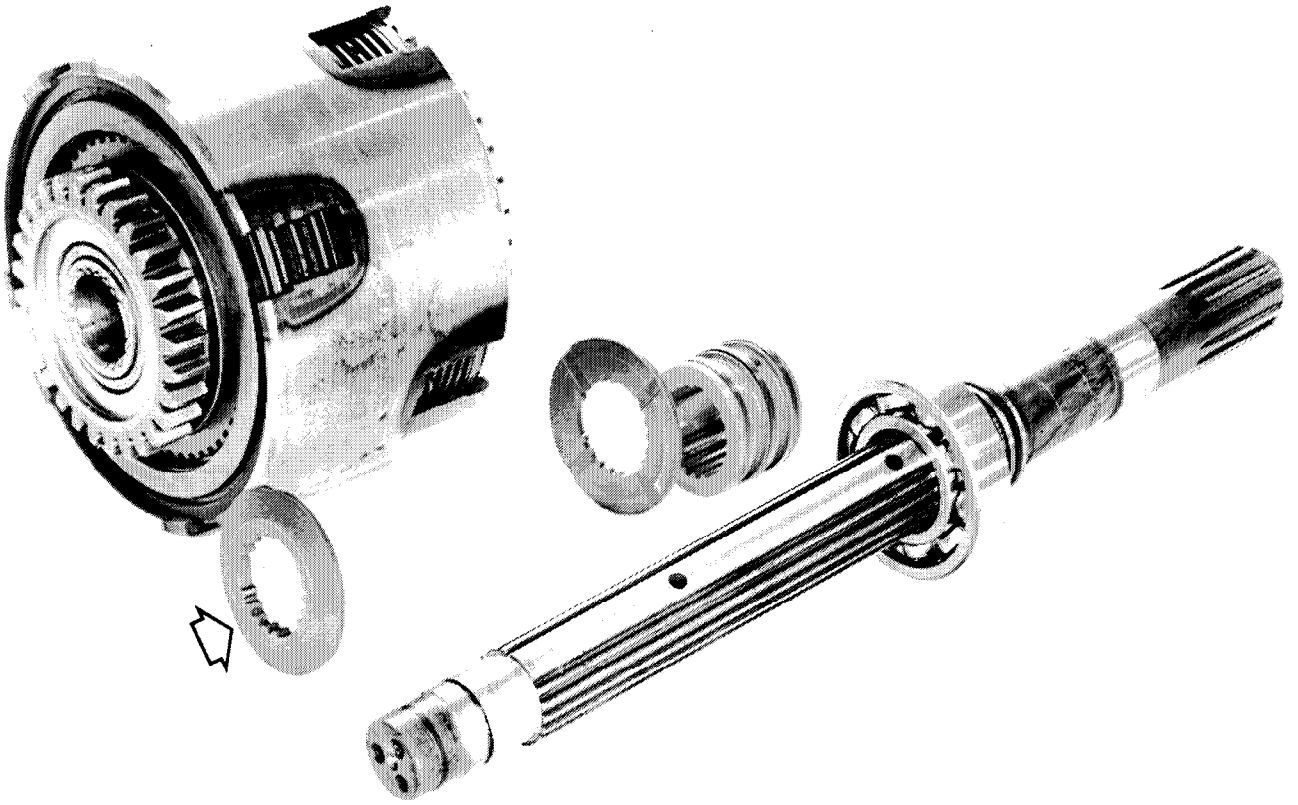


Fig. 10243

Input Shaft Assembly

24. Located at the small gear end of the input shaft is a [6.35 mm] or .250" thrust washer. Make sure this washer is installed in its proper place when the transmission is assembled.

57. Install the forward and reverse oil tubes into the oil distributor. Be careful not to damage the seals in the distributor when installing the tubes.

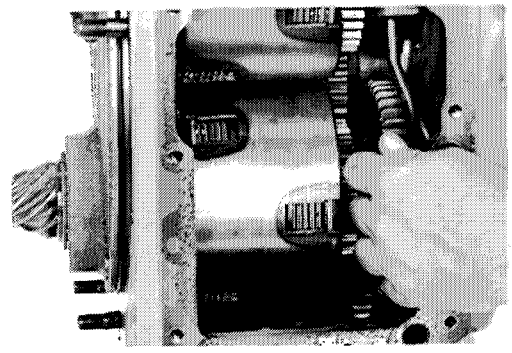


Fig. 10228

58. Install the high and low oil tubes into the oil distributor. Be careful not to damage the oil seals.

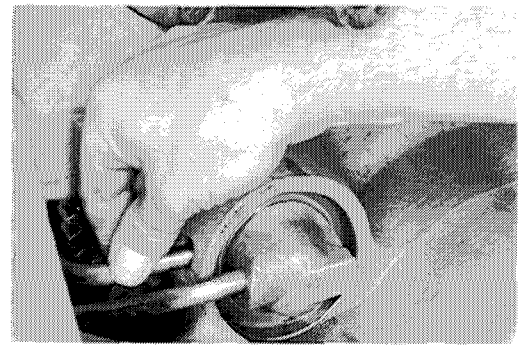


Fig. 10227

59. Install the new seals (1) into the oil tube sleeves and install them on the oil tubes. Be careful not to damage the seals.

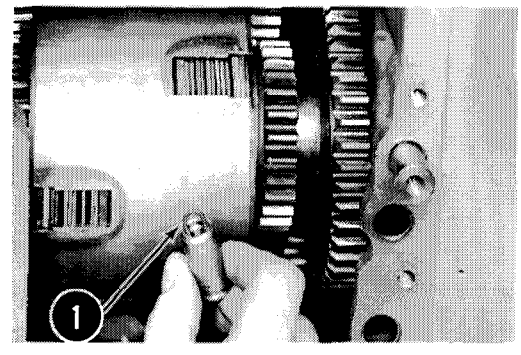


Fig. 22596

60. Install the new "O" rings into position on the control cover.

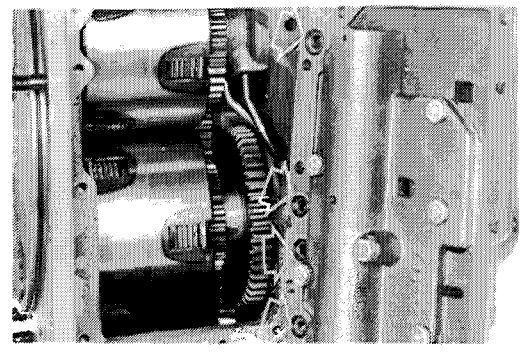


Fig. 10225

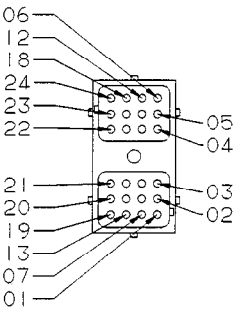
Section 3.

Ignition System Inspection, Timing, and Repair

Section 2.

Instrument Pod Troubleshooting

Wiring Harness Connector to Instrument Pod. Troubleshooting charts on following pages reference these pin numbers.



1. Open (Gas/LPG Truck); Tachometer Input (Diesel)
2. Open
3. Open
4. Power In
5. Open
6. Engine Temperature Gauge
7. Ground
8. Open
9. Open (Gas/LPG Truck); Preheat Light (Diesel Truck)
10. Low LP (Gas/LPG Truck); Fuel Filter Light (Diesel Truck)
11. Engine Oil Pressure Light
12. Charge Light
13. Horn
14. Park Brake Light
15. Transaxle Temperature Warning
16. Open
17. Air Filter Light
18. Ignition
19. Fuel Level Gauge
20. Hydraulic Filter Light
21. Open
22. Open
23. Transaxle Temperature Warning Light
24. Ignition

Section 1.

Electrical Specifications and Wiring Diagrams

Electrical System Specifications

Voltage and Ground

System Voltage: 12 volt

System Ground: Negative

Alternator

Type: 12 volt, 65 amps

Battery

Gas/LPG:

Type: 12 volt

Cold Crank Current: 420 amps at 0° F (-18° C)

Diesel:

Type: 12 volt

Cold Crank Current: 625 amps at 0° F (-18° C)

Starter

Gas/LPG:

Voltage: 12 volts

Output: 1.2 kW

Diesel:

Voltage: 12 volts

Output: 2.2 kW

Starters are equipped with heavy-duty clutch and anti-restart system.

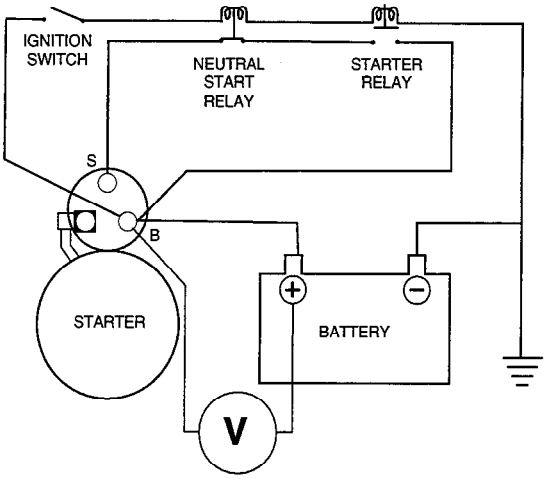
System Protection

Fuse: 5A Direction Control

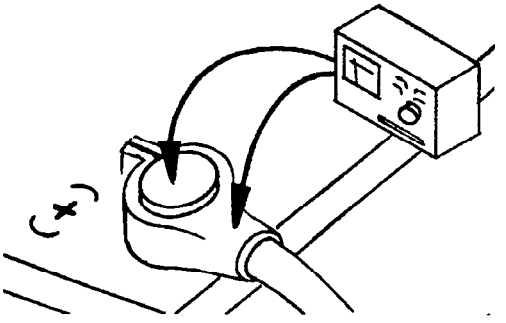
Fuse:15A Ignition, Horn, and Options

Fuse: 15A Headlights

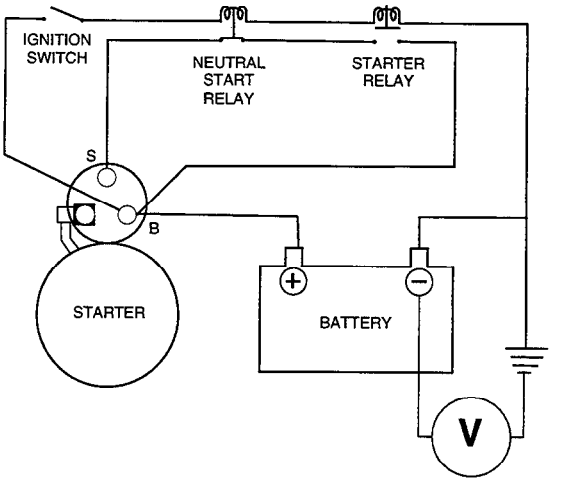
Fuse: 15A Brake Lights



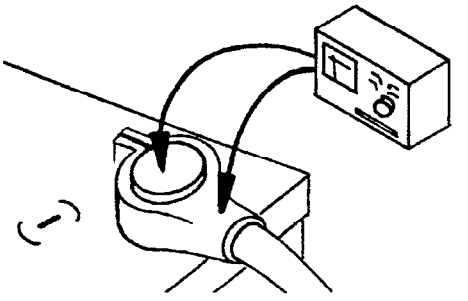
To check positive post battery terminal connection, connect voltmeter from the battery post to the terminal on cable. Crank the engine. A voltage reading above 0 volts indicates a poor connection. Clean the terminal post and cable end. Tighten bolt.



2. Check battery negative (ground) cable and connections. To check negative post battery terminal connection, connect voltmeter from the battery post to the terminal on cable. Crank the engine. A voltage reading above 0 volts indicates a poor connection. Clean the terminal post and cable end. Tighten bolt.

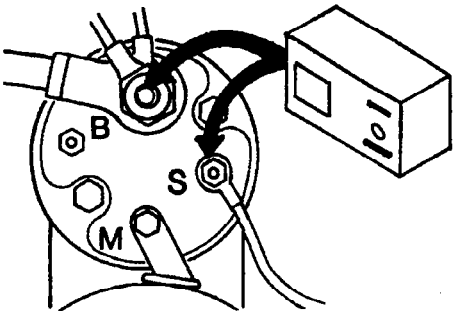


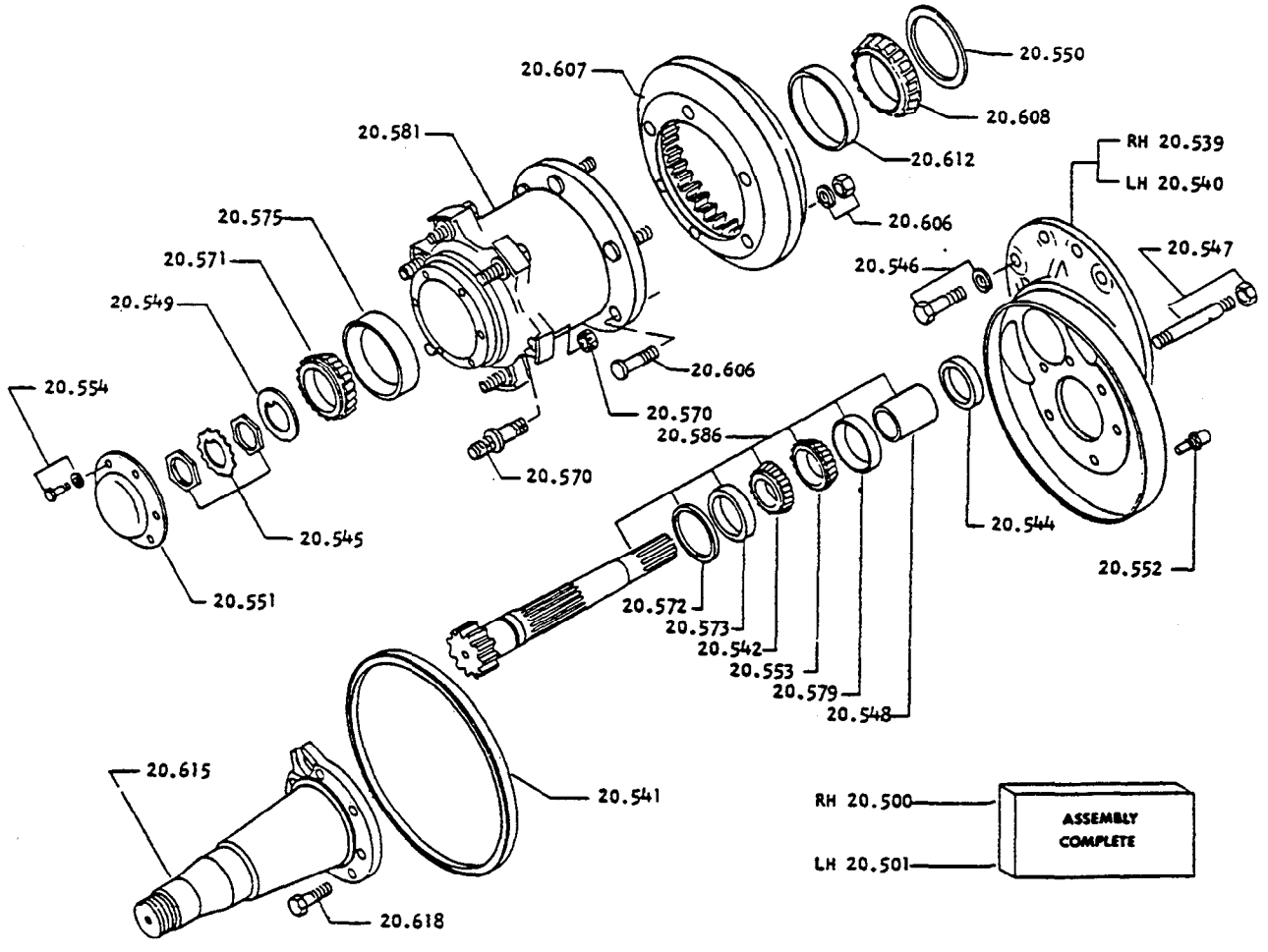
To check negative post battery terminal connection, connect voltmeter from the battery post to the terminal on cable. Crank the engine. A voltage reading above 0 volts indicates a poor connection. Clean the terminal post and cable end. Tighten bolt.



3. Check key switch, starter relay and solenoid circuit.

   Connect a voltmeter across the "Battery" terminal of the solenoid and the "Switch" terminal of the solenoid. A voltmeter reading of 1.0-2.0 volts is expected with the engine cranking. A reading of more than 2 volts indicates excessive resistance. Check the wiring, connections, and switches in this portion of the circuit.





AXLE END ASSEMBLY

20.500	AXLE END ASSEMBLY DRIVE (RH)	20.554	FASTENER, DRIVE AXLE HUB CAP
20.501	AXLE END ASSEMBLY, DRIVE (LH)	20.570	FASTENER, DRIVE WHEEL MOUNTING
20.539	SUPPORT, DRIVE AXLE SPINDLE (RH)	20.571	CONE, DRIVE AXLE HUB OUTER BEARING
20.540	SUPPORT, DRIVE AXLE SPINDLE (LH)	20.572	LOCATOR, DRIVE AXLE SHAFT BEARING
20.541	SEAL, DRIVE AXLE SPINDLE SUPPORT	20.573	CUP, DRIVE AXLE SHAFT BEARING (OUTBOARD)
20.542	BEARING, DRIVE AXLE SHAFT (OUTBOARD)	20.575	CUP, DRIVE AXLE HUB OUTER BEARING
20.544	SEAL, DRIVE AXLE SHAFT	20.579	CUP, DRIVE AXLE SHAFT BEARING (INBOARD)
20.545	FASTENER, DRIVE AXLE HUB BEARING	20.581	HUB & CUP, DRIVE AXLE
20.546	FASTENER, DRIVE AXLE END	20.586	SHAFT, DRIVE AXLE
20.547	FASTENER, DRIVE AXLE END	20.606	FASTENER, DRIVE AXLE INTERNAL GEAR TO HUB
20.548	SLEEVE, DRIVE AXLE SHAFT	20.607	GEAR, DRIVE AXLE INTERNAL
20.549	WASHER, DRIVE AXLE HUB BRG THRUST	20.608	CONE, DRIVE AXLE HUB INNER BEARING
20.550	RETAINER, DRIVE AXLE INNER BRG GREASE	20.612	CUP, DRIVE AXLE HUB INNER BEARING
20.551	CAP, DRIVE AXLE HUB	20.615	SPINDLE, DRIVE AXLE END
20.552	VENT, AXLE END	20.618	FASTENER, DRIVE AXLE SPINDLE
20.553	BEARING, DRIVE AXLE SHAFT (INBOARD)		

TWO PIECE CASE, FOUR PINION
DIFFERENTIAL DISASSEMBLY & REASSEMBLY:

1. Mark the case for correct assembly. Mark the spider-to-case for correct assembly.

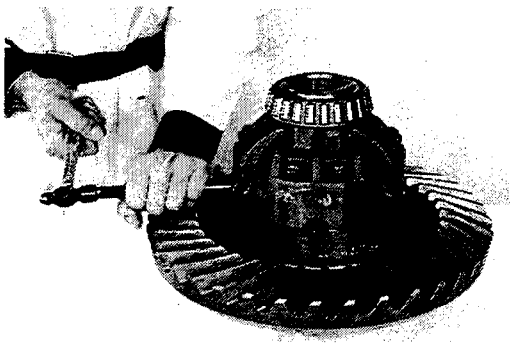


Fig. 17895

2. Remove the bolts from the differential case. Remove the upper half. Use a soft mallet if necessary for removal.

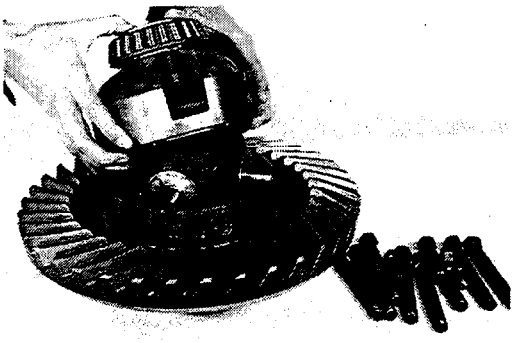


Fig. 17896

3. Remove the side gears, spider, pinions and thrust washers.

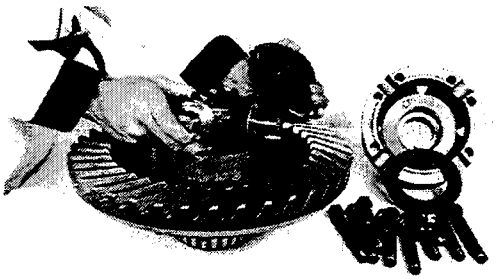


Fig. 17897

4. Remove the case-to-ring gear retainers and remove ring gear.

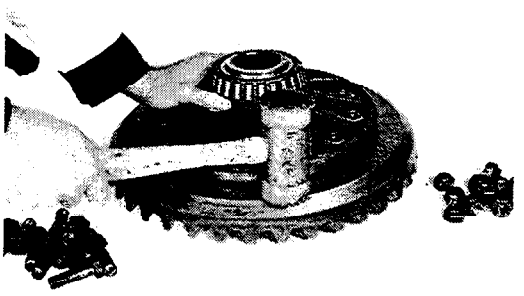


Fig. 17898

⚠ WARNING

SAFE PARKING. Before working on truck:

1. **Park truck on a hard, level, and solid surface, such as a concrete floor with no gaps or breaks.**
2. **Put upright in vertical position and fully lower the forks or attachment.**
3. **Put all controls in neutral. Turn key switch OFF and remove key.**
4. **Apply the parking brake and block the wheels.**

Pneumatic Tire Maintenance Precaution

The following instructions supplement the OSHA requirements. In the event of any conflict or inconsistency between these instructions and the OSHA requirements, the OSHA requirements shall be controlling.

⚠ WARNING

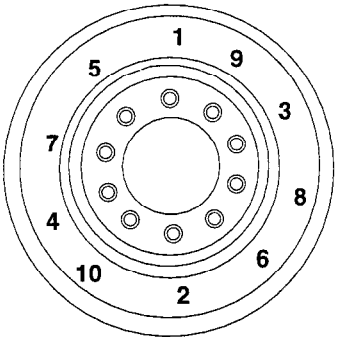
Before you do tire or rim maintenance, read the OSHA rules regarding owner responsibility. Read and understand all maintenance and repair procedures on tires and rims. Do not work on tires or rims unless you have been trained in the correct procedures. Serious injury or death can result if the safety messages are ignored.

1. Do not let anyone mount or demount tires without proper training.
2. Never sit on or stand in front of a tire and rim assembly that is being filled with air. Use a clip-on chuck and make sure the hose is long enough to permit the person filling the tire with air to stand to the side of the tire, not in front or in back of the tire assembly.
3. Never operate a vehicle on only one tire of a dual assembly. The carrying capacity of the single tire and rim is dangerously exceeded, and operating a vehicle in this manner can result in damage to the rim and truck tip-over and driver injury.
4. Do not fill a tire with air that has been run flat without first inspecting the tire, rim, and wheel assembly. Double check the lock ring for damage. Make sure that it is secure in the gutter before filling the tire with air.
5. Always remove all air from a single tire and from both tires of a dual assembly prior to removing any rim components, or any wheel components, such as nuts and rim clamps. Always remove the valve core to remove air from tire. Be sure all air is removed.
6. Check rim components periodically for fatigue cracks. Replace all cracked, badly worn, damaged, and severely rusted components.
7. Do not, under any circumstances, attempt to rework, weld, heat, or braze any rim components that are cracked, broken, or damaged. Replace with new parts or parts that are not damaged, which are of the same size, type, and make.
8. Never attempt to weld on an inflated tire/rim assembly.
9. Clean rims and repaint to stop detrimental effects of corrosion. Be very careful to clean all dirt and rust from the lock ring gutter. This is important to secure the lock ring in its proper position.

   A filter on the air filling equipment to remove the moisture from the air line prevents a lot of corrosion. The filter should be checked periodically to make sure it is working properly.
10. Make sure correct parts are being assembled. Ask your distributor or the manufacturer if you have any doubts.
11. Do not be careless or take chances. If you are not sure about the proper mating of rim and wheel parts, consult a wheel and rim expert. This may be the tire man who is servicing your fleet, the rim and wheel distributor in your area, or the CLARK dealer.
12. Mixing parts of one manufacturer's rims with those of another is potentially dangerous. Always ask manufacturer for approval.
13. Do not use undersized rims. Use the right rims for the job.
14. Do not overload rims. Ask your rim manufacturer if special operating conditions are required.
15. Do not seat rings by hitting with a hammer while the tire is filled with air pressure. Do not hit a filled or partially-filled tire/rim assembly with a hammer.
16. Double check to make sure all the components are properly seated prior to filling tire with air.
17. Have the tire in a safety cage when filling with air.
18. When removing wheels, regardless of how hard or firm the ground appears, put hardwood blocks under the jack.
19. Block the tire and wheel on the other side of the vehicle, before you place the jack in position. Place blocks under the truck frame as near as possible to the jack to prevent the truck from falling if the jack should fail.
20. Remove the bead seat band slowly to prevent it from dropping off and crushing your toes. Support the band on your thigh and roll it slowly to the ground. This will protect your back and feet.

Installation

1. Install wheel and tire assembly on drive axle hub. Begin tightening the lug nuts to seat the nuts in the beveled wheel openings.
2. Use a crisscrossing nut-tightening sequence to torque the lug nuts to a pre-final torque of 54-81 N•m (40-60 ft-lb).



3. Begin the crisscrossing sequence again and torque the lug nuts to 610-678 N•m (450-500 ft-lb).

IMPORTANT

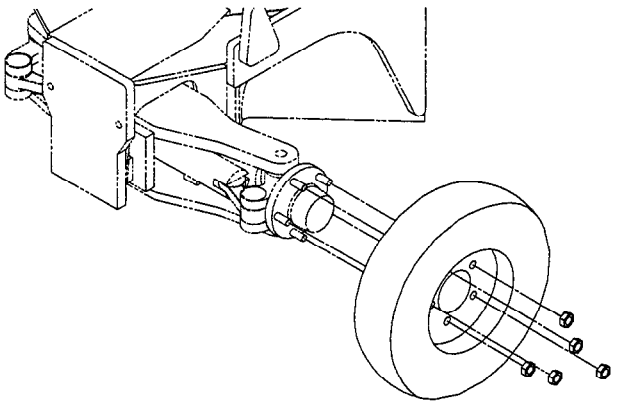
Do not overtorque the lug nuts. Damage to the lug nuts, wheel, or drive-axle hub may result.

4. Lower truck to floor and remove jack.

Steer Wheel Removal/Installation

Removal

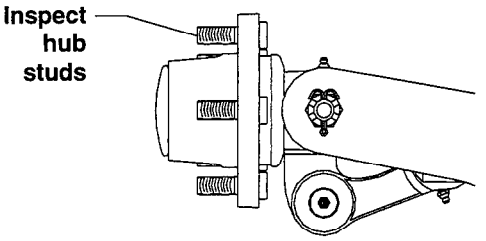
1. Loosen lug nuts then use a portable jack of correct capacity placed under the frame of truck to raise drive wheel off floor. See "Lifting, Jacking, and Blocking" in Group SA for correct, safe procedures for jacking the truck.
2. Remove lug nuts and lift the tire and wheel assembly from drive axle hub.



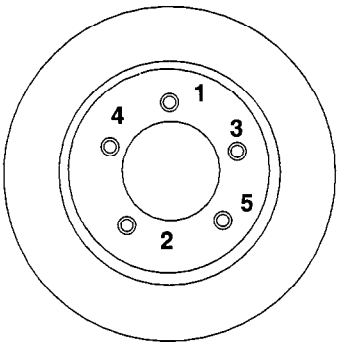
3. Once tire is off the ground enough to rotate freely, remove the lug nuts and lift the wheel from the hub. Use caution when lifting tire and wheel.

Installation

1. Make sure the truck is parked on a flat, hard surface and the jacking and blocking devices are secure to hold the truck in a safe position.
2. Inspect the removed lug nuts for damage to the threads. Also inspect all hub studs for thread damage. Replace any lug nuts or studs that have damaged threads. Make sure studs are secure in the axle hub.



3. Set the wheel on the hub and start the lug nuts on the hub studs. Tighten the nuts only enough to seat the nuts into the beveled openings on the wheel and to secure the wheel on the axle hub.
4. Use a crisscrossing nut tightening sequence to torque the nuts to a pre-final torque of 54-81 N•m (40-60 ft-lb). Make sure all nuts seat into beveled spacer holes correctly.



5. Begin the crisscrossing sequence again and torque lug nuts to 315-350 N•m (415-475 ft-lb)
6. Carefully lower the truck and remove the jack.

Introduction

Figures 1 and 2 show:

- The service brake linkage, which links the brake pedal to the brake valve.
- The inching pedal linkage, which links the inching pedal to the inching valve.
- The inching pedal overlap, which allows the inching pedal to operate the brake pedal.

The illustrations and accompanying text serve as guide to disassembly/assembly and adjustment.

NOTE

FREEPLAY. There should be no freeplay at the brake or inching pedals.

Pedal Height Adjustment

See Figure 1. The brake pedal must be at the same height as the inching pedal. To adjust brake pedal height:

1. Loosen the **eccentric stop's mounting bolt** and nut until the stop can be withdrawn from the hex hole in the brake pedal bracket.
2. Rotate the **eccentric stop** in the **hex hole** until it stops the **brake pedal** at the same height as the **inching pedal**.
3. Torque the stop's mounting bolt and nut 20-25 N•m (14-18 ft-lb).

Overlap Adjustment

See Figure 1. When the inching pedal is depressed, the **strike bolt** threaded into the inching pedal pushes against the **strike lever** on the brake pedal, applying the brake.

The clearance between the top of the **strike bolt** and the **strike lever** controls the "overlap" between when the brakes engage and the clutch disengages.

The clearance is normally about 4 mm (0.16 in). However, the actual overlap should be tested and adjusted as follows:

To test overlap:

1. Drive empty truck up slight incline (2 to 5%) and fully apply inching pedal to engage brakes. Do not operate brake pedal.
2. With truck in forward and engine idling, slowly release inching pedal. Just as truck begins to roll back, clutch should engage and begin to move truck up incline.
3. If result is not satisfactory, set overlap as follows:

To set overlap:

1. Loosen **jam nut**.
2. Turn **strike bolt** to lessen or increase clearance. Less clearance makes brake engage sooner.
3. Tighten **jam nut**.
4. Drive truck and test overlap, as above.

Brake Yoke Adjustment

See Figure 1. The brake yoke and link should float freely when the brake pedal is fully up against its stop (brakes not applied).

To adjust:

1. Make sure the brake valve is fully up against the lip of the lower cowl.
2. Remove the **spring clip** and **pin** from the **yoke**.
3. Loosen the **jam nut** and turn the **yoke** until the holes in the yoke line up with the hole in the **brake link**. Tighten the **jam nut**.
4. Reinstall the **spring clip** and **pin** into the **yoke**.

Operation

The operator applies the parking brake by depressing a foot pedal, which is then held down by a **ratchet.** The depressed pedal tensions a cable that operates a drum and shoe brake on the transmission.

The operator releases the parking brake by pulling up on a release handle. This handle releases the ratchet, and a return spring returns the pedal and cable to the off position. The ratchet also operates the parking brake interlock switch and the parking brake indicator light switch.

Adjustment

1. With the pedal fully raised, tighten adjusting/locking nuts to obtain the dimension shown in illustration below.
2. Actuate and release pedal six to eight times.
3. Check dimensions. Readjust and tighten nuts.

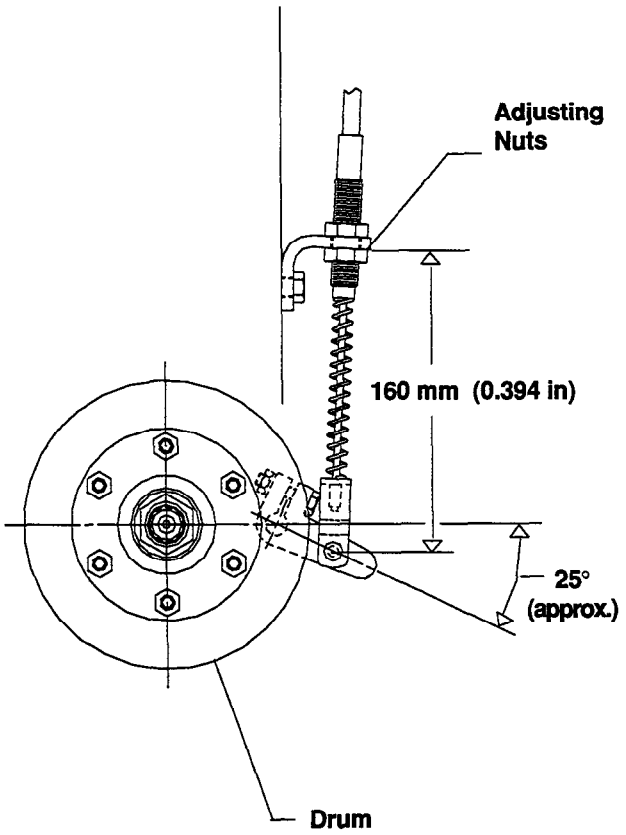


Figure 1. Parking Brake Cable Adjustment Dimensions

Parking Brake Cable Removal and Installation

1. Slacken the parking brake cable, using the adjusting nuts at the drum end of the cable (Figure 2).
2. Remove the drum end of the cable from the bracket and the actuating lever (Figure 2).
3. Remove the ball (at the pedal end of the cable) from its socket and unclip the cable from its mounting bracket (Figure 3).
4. Installation is the reverse of removal. Adjust as described previously on this page.

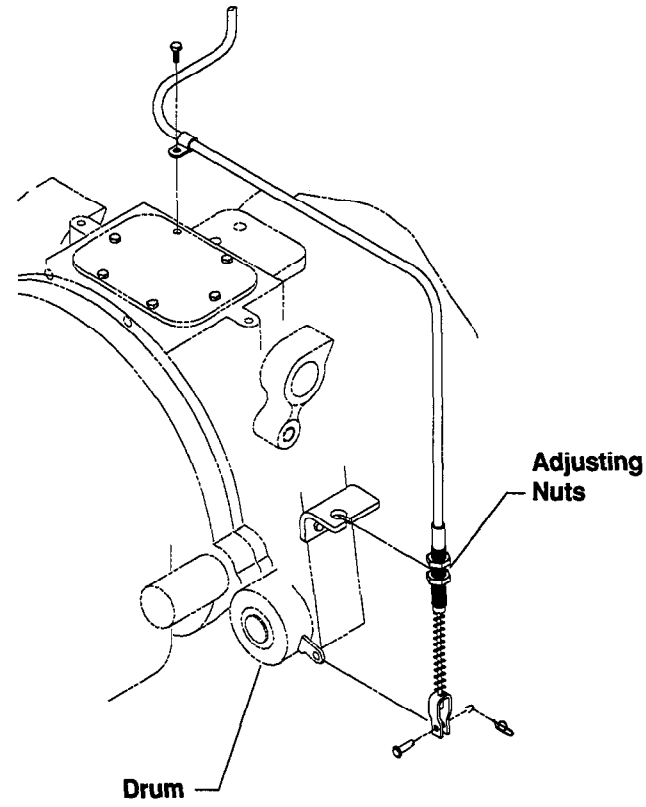
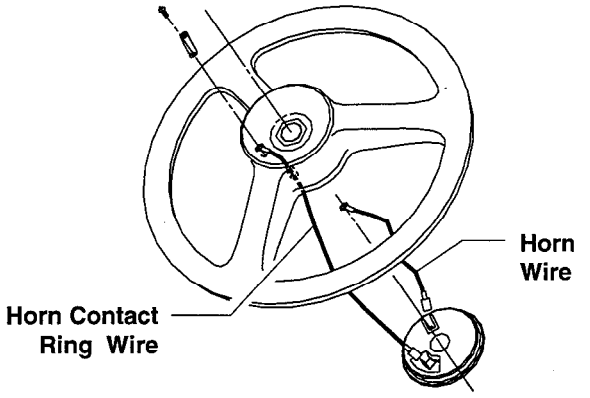
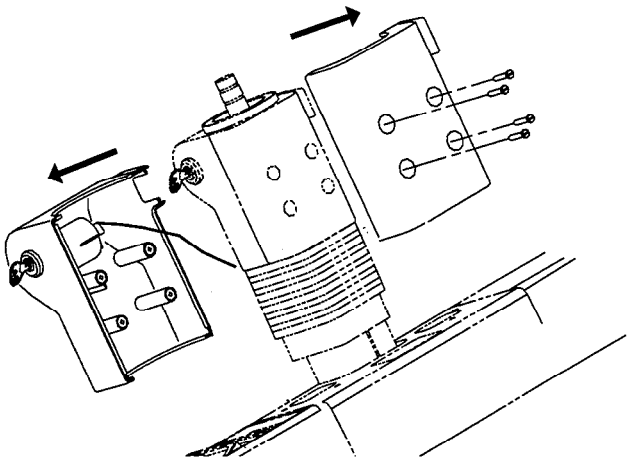


Figure 2. Parking Brake Cable Linkage at Drum End

6. Unplug the horn contact ring wire from the terminal on the bottom of the handwheel.



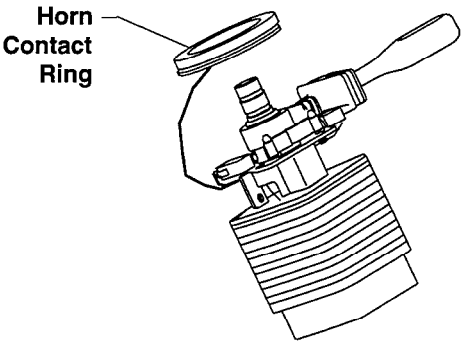
7. Using a 2.5 mm allen wrench, remove the four socket head bolts holding the two halves of the column cover together. Remove the top cover. Gently pull the bottom cover away.



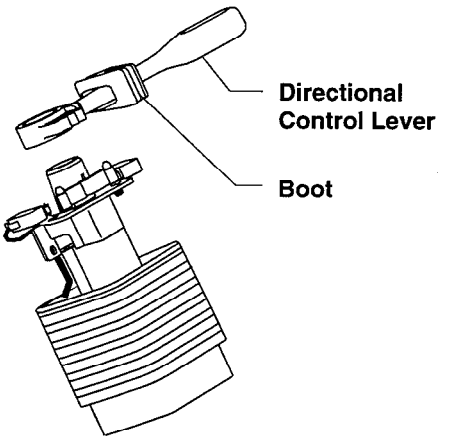
NOTE

Use care when removing the bottom cover as the ignition switch wiring is attached.

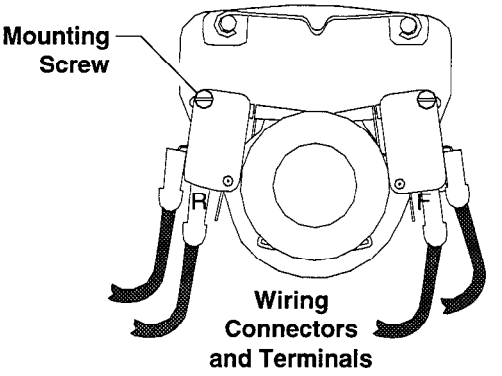
8. Remove the horn contact ring. Unplug the wire from the terminal on the bottom of the ring.



9. Lift the directional control lever and boot off the die-cast base.

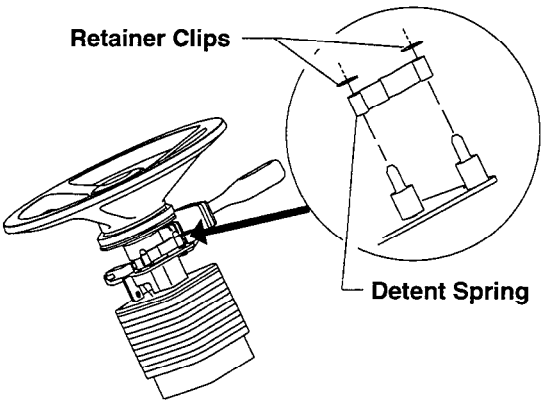


10. Unplug wires from directional switches. Label all wires and terminals for correct connection when reassembling. Remove the direction control switches by removing the mounting screws on the base.



Directional Control Lever Detent Spring Removal

1. If not already disassembled, remove the four socket bolts holding the two sides of the column cover together. Remove the top cover.
2. Pry the two retainer clips from the posts on the directional control base securing the detent spring. Lift spring off posts.



Section 5.

Steering Gear Overhaul

IMPORTANT

Before removing any component for overhaul, make sure the correct repair parts, seals, and gasket sets are available.

NOTE

The following material does not show the load sensing port on the steering gear (steering control unit). The port is located in the center of the other four ports. The load sensing port requires no special overhaul procedures.

Section 2.

Steer Axle
Lubrication and Adjustment

IMPORTANT

Before removing any component for overhaul, make sure the correct repair parts, seals, and gasket sets are available.

⚠ CAUTION

SAFE PARKING. Before working on truck:

1. **Park truck on a hard, level, and solid surface, such as a concrete floor with no gaps or breaks.**
2. **Put upright in vertical position and fully lower the forks or attachment.**
3. **Put all controls in neutral. Turn key switch OFF and remove key.**
4. **Apply the parking brake and block the wheels.**

Section 5.

Steer Cylinder Removal and Replacement

The steer cylinder can be removed from the steer axle without removing the steer axle from the truck.

The cylinder should be overhauled or replaced if indicated by steering problems or troubleshooting information. (See Group 25, Section 2, "Steering System Troubleshooting.")

See Section 6 in this Group for steer cylinder overhaul procedures.

Refer to Section 6, "Steer Cylinder Overhaul," if pressure check or troubleshooting tips indicate a problem with steer cylinder performance.

⚠ CAUTION

SAFE PARKING. Before working on truck:

1. **Park truck on a hard, level, and solid surface, such as a concrete floor with no gaps or breaks.**
2. **Put upright in vertical position and fully lower the forks or attachment.**
3. **Put all controls in neutral. Turn key switch OFF and remove key.**
4. **Apply the parking brake and block the wheels.**

External leakage

- Excessive system pressure; replace pressure control valve on main hydraulic valve.
- Faulty or distorted pump seal gasket; replace seal gasket.
- Damaged surfaces on pump body or cover; correct and replace as required.

Shaft seal leakage

- Damaged or worn seal; replace.
- Shaft scratched or worn or seal nicked; repair (polish) or replace and add new seal.
- Front cover bearing out of position; replace front cover assembly.
- Shaft seal housing bore scratched; replace front cover assembly.
- Improper fit of shaft; replace front cover assembly.
- Contamination; inspect and rebuild.
- Pump run with wrong rotation; replace shaft and pressure loading seals.
- Seal installed backwards; inspect and rebuild.

Pump B Disassembly

IMPORTANT

Keep parts in assembly order as removed to ensure correct reassembly.

Before starting work, ensure that the unit, work area, and all tools are thoroughly clean.

1. Withdraw drive coupling from the driveshaft using a suitable puller. The coupling must not be levered or hammered off the shaft as this will result in internal damage.
2. Lightly mark the end cover, body, and mounting flange (3, 9 and 15) to ensure reassembly in the correct position.
3. Remove bolts and spring washers (1 and 2).
4. Remove end cover (3), body 0- ring (4), bush seal, and back-up seal (6 and 5).
5. Turn the unit over and lightly tap the mounting flange (15) to disengage it from the locating dowels and slide the flange squarely off the shaft.
6. Remove circlip (17) and push the shaft seal (16) squarely out of the mounting flange, taking care not to damage any sealing surfaces.

NOTE

On some pumps two shaft seals are fitted and the external seal must be removed to gain access to the circlip.

7. Remove body 0- ring (4), bush seal and back-up seal (6 and 5).
8. Before removing the internal components, mark the bushes to denote the location in the body. On a plain area away from seal location mark:
   FD = Bush on driveshaft flange end
   Fl = Bush on driven gear flange end
   CD = Bush on driveshaft cover end
   Cl = Bush on driven gear cover end
10. With the unit on its side, hold the driveshaft (11) and pull it squarely out of the body, bringing with it the bushes (7 and 8).
11. Remove driven gear (10) and the two remaining bushes.

Pump B Reassembly

Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid. (Ensure O-ring recess and end faces of body remain dry.) This will assist assembly of components into the body bores.

1. Refit cover end bushes (CD and Cl) into the undowelled end of the body from where they were removed. The 'C' shape cut-out in the bushes must be to the side of the body with the cusp removal flat.
2. Place the end cover (3) against the undowelled end of the body (9) and stand the assembly on the cover so the dowels are uppermost and to the left-hand side.
3. Fit driveshaft (11) and driven gear (10) into their original positions in the body.
4. Re-fit flange end bushes (FD and Fl) into their original bores remembering the 'C' cut-out must be to the side of the body with the cusp removal flat and match the cover end bushes.
5. Fit new body 0-ring (4), bush seal and back-up seal (5 and 6), ensuring that the seals locate correctly in the seal grooves.
6. Fit new shaft seal/seals into the recess in the mounting flange with the 'garter' spring facing into the pump. Refit circlip (17) in groove. (In some pumps two shaft seals are fitted back to back; in this case the outer seal is fitted with the garter spring facing outwards). Remember that if the seal recess was scored, then Loctite hydraulic sealant must be applied to the outer diameter of the seal. Apply a coat of high melting point grease to the shaft seal lips.
7. Fit the shaft seal assembly sleeve, supplied in seal kit, over driveshaft and carefully refit mounting flange (15), ensuring that it locates squarely onto the dowels in the body. Remove assembly sleeve.
8. Hold the whole unit together and carefully turn it over, ensuring it is supported on the mounting flange and not the driveshaft.
9. Remove end cover (3) and fit new body O-ring (4), bush seals and back-up seals (6 and 5).
10. Replace the end cover and refit bolts and spring washers. Torque bolts to 46-51 N•m (34-38 lb-ft).

Final Check

Pour a small amount of clean hydraulic fluid into a port and check that the shaft can be rotated without undue force.

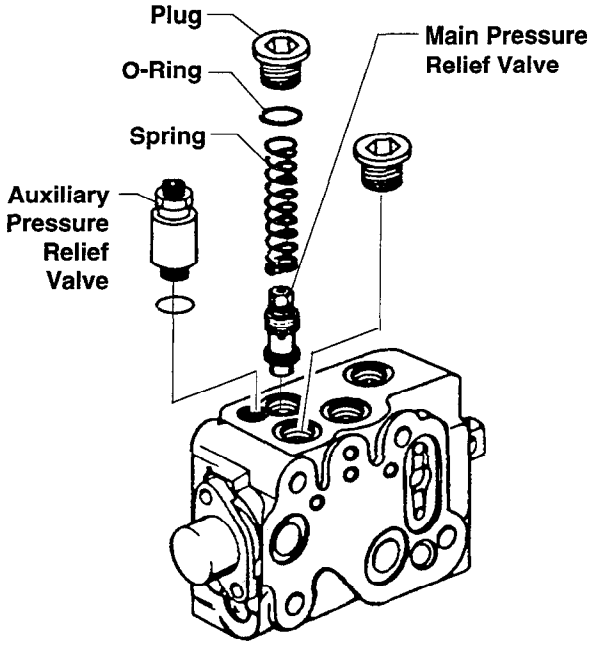
Main Pressure Relief Adjustment

IMPORTANT

Main pressure relief setting is set at the factory and should not be adjusted. If the relief pressure does not measure within the setting range, a hydrostat in the pressure relief valve must be replaced. If you attempt to adjust the hydrostat in the relief valve, your warranty on the equipment may be voided.

To reset the hydraulic system main pressure relief valve:

1. Remove the plug, O-ring, and spring from hydraulic valve port shown in the following illustration.



2. Remove the main pressure relief valve.
3. Screw open the main pressure relief valve and remove the hydrostat in the valve.
4. Replace the hydrostat in the same position with the new unit.

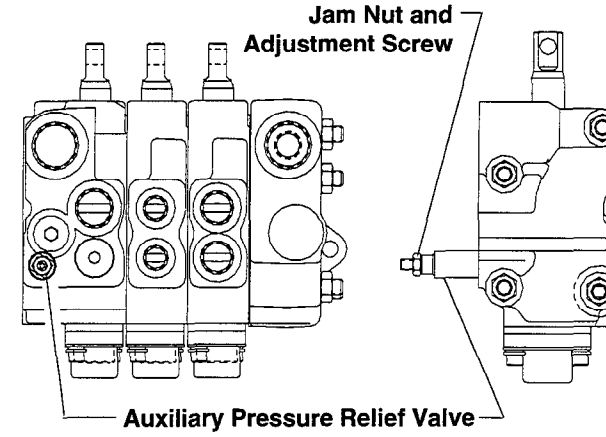
Auxiliary Pressure Relief Adjustment

IMPORTANT

The auxiliary relief setting only applies to a hydraulic valve that has auxiliary sections added.

To adjust the hydraulic system auxiliary pressure relief valve:

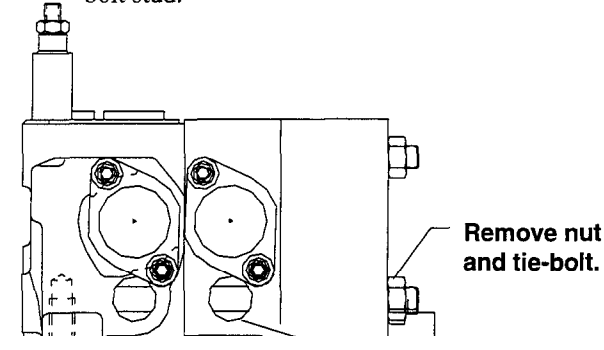
1. Loosen the jam nut on the auxiliary relief valve adjustment screw.



2. Turn the adjustment screw to set the auxiliary pressure relief setting to the normal range.
3. Reset the jam nut on the auxiliary relief valve adjustment screw.
4. Check pressure setting.

Flow Control Adjustments

1. Remove the nut from the main hydraulic valve tie-bolt stud.



Section 1.

Tilt Cylinder Specifications and Description

Specifications

See Group 30 for hydraulic system specifications.

Tilt Cylinder Type: Double-acting

Maximum Operating Pressure: 22,070 kPa (3,200 psi)

Tilt Ranges*:

CGP 40/55	
Std—through 2667 mm (105 in) MFH	8°B-8°F
TSU—through 4775 mm (188 in) MFH	5°B-6°F
TSU—over 4800 mm (189 in) MFH	5°B-3°F
CGC 40/55	
Std—through 4370 mm (169 in) MFH	8°B-9°F
TSU—through 4775 mm (188 in) MFH	6°B-11°F
TSU—over 4800 mm (189 in) MFH	5°B-6°F
CGC 60/70	
Std—through 4039 mm (159 in) MFH	8°B-8°F
TSU—through 5639 mm (222 in) MFH	6°B-10°F
TSU—over 5639 mm (222 in) MFH	5°B-6°F

* Abbreviations: Std = Standard, high-visibility upright; TSU = Triple-stage upright; MFH = maximum fork height; B = back tilt; F = forward tilt. See truck data plate for upright MFH.

Tilt Drift (max. allowable over 5 minutes):

Temperature	Drift
26.7° C (80° F)	0.6°, 4.0 mm, 0.157 in
37.8° C (100° F)	1.1°, 7.0 mm, 0.276 in
48.9° C (120° F)	1.5°, 10.0 mm, 0.394 in

Service Intervals

Tilt Cylinder Drift Test: Every 50-250 hours or each PM.

Tilt Cylinder Check and Adjustment: Every 50-250 hours or each PM.

Tilt Cylinder Rod Seal Condition Check: Every 50-250 hours or each PM.

Tilt Cylinder Mounting Check and Tightening: Every 50-250 hours or each PM.

Tilt Cylinder Rod-End Check and Tightening: Every 50-250 hours or each PM.

Tilt Cylinder Rod-End Lubrication: Every 50-250 hours or each PM.

Fastener Torques

Rod-End Yoke Bolts: 166-193 N•m (122-142 ft-lb)

Rod-End Pin Lock Plate Fasteners: 8-10 N•m (10.8-13.5 ft-lb).

Base Mount Pin Lock Plate Fasteners: 8-10 N•m (10.8-13.5 ft-lb).

Description

The tilt cylinders provide backward and forward tilt of the upright. The forward and back tilt angles are governed by the cylinder stroke and by use of spacers. The tilt cylinders are pin-mounted to the truck frame and upright using yokes, clevises, and pins. Pins are held in place by a lock plate and fastener to prevent the pins from working their way out.

The tilt cylinders are serviced by removing them from the truck and disassembling them for complete overhaul, including installation of new seals and/or other cylinder components.

The tilt lock valve is integrated into the tilt section of the main hydraulic control valve. The tilt lock valve prevents the upright from tilting forward when the truck is not running. The tilt lock valve is not serviceable and must be replaced as a valve section if defective.

Deep gouges or pitted surfaces require replacement of parts.

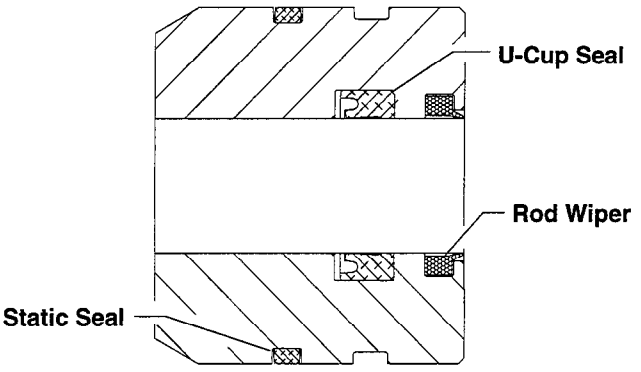
Check the gland, base end, and ports for cracks or damage that could cause failure. Inspect the ports to be sure they are free of contamination and that the threads are clean and not damaged.

5. Put a light coating of hydraulic fluid on all parts. If parts are to be left disassembled for a period of time, e.g., overnight, they should be covered with a clean cloth.

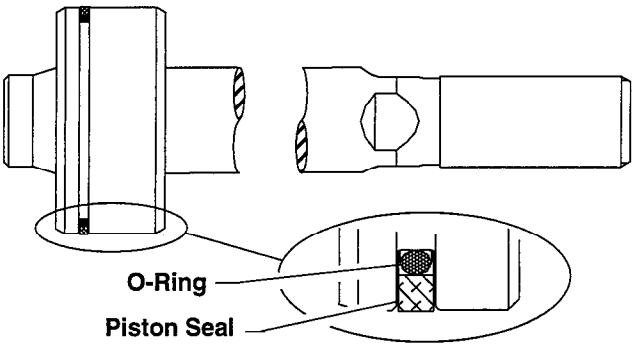
Reassembly

Be sure inside of cylinder and all parts are clean before starting reassembly. Seals may be lubricated with hydraulic oil to assist assembly into cylinder barrel.

1. Install piston rod wiper, rod U-cup, and static seal on the gland. Make sure U-Cup and wiper are installed in proper orientation as shown in the illustration.



2. Replace the piston O-ring and piston seal.

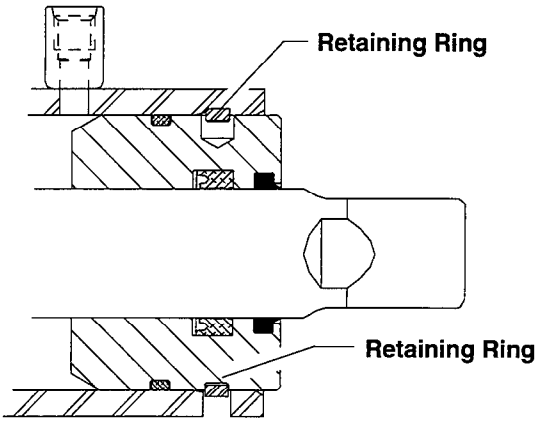


3. Install gland on piston rod. Use gentle pressure and careful movements to avoid damage to the U-cup seal and rod wiper when these parts are moved over the piston rod end.

NOTE

Reassemble cylinder carefully to prevent damage to seal lips and O-rings.

4. Install piston into cylinder barrel. Be careful not to damage the piston seals when installing the piston into end of cylinder.
5. Then, install gland into cylinder. Be careful not to damage gland static seal. Make sure the gland is fully seated in the cylinder barrel.
6. Install the gland retainer ring:



   a. Route the retainer ring through the slot in the cylinder case.
   b. Latch the retainer ring to the hole in the side of the gland.
   c. Use a spanner wrench to rotate the gland and wind the retainer in place.

7. Check the assembly by making sure the piston slides freely in and out of the cylinder.

See Section 3 for replacement procedures; see Section 2 for checks and adjustments before returning the truck to service.

External leakage from lift cylinder

- Gland loose; check and tighten per sepcifications
- Cracked or internally scored cylinder tube; replace tube and all seals.
- Gland static seals (O-rings and back-up ring) damaged; replace seals and back-up ring.
- Gland static seals sealing surface damaged; check groove and bore and repair or replace as necessary.
- Damaged gland back-up seal; inspect and replace seal.
- Piston and rod seal damage; replace piston seals and rod seals.
- Damaged seal groove; check for scratches, nicks, or burrs and repair or replace rod and piston
- Scored or damaged rod; replace rod and all seals.
- In primary cylinder, leaking check valve or check valve O-ring; clean and replace valve if necessary

Oil leak at top of lift cylinder

- Scored cylinder wall; see Section 5.
- Worn or damaged gland rod-seal; see procedures for piston-type cylinders under "Cylinder leaking internally."

Unsatisfactory lift or tilt cylinder drift test results

- Cylinder leaking internally; remove cylinder gland and check. Cylinder should be dry on rod side of piston.

  If fluid is leaking past piston, remove rod and piston and clean and inspect/replace piston seals. On primary cylinder, also clean check valves. See Section 5.
- Cylinder hydraulic fittings loose or worn; check fitting O-rings, tighten fittings according to Group 40, "Hydraulic Fitting Tightening Procedure."
- Check valve worn or damaged; remove rod and piston, clean check valve and replace if necessary.
- Control valve spool linkage malfunctioning, damaged, or worn; see Group 30, Section 5 for linkage adjustment and/or replacement.
- Counterbalance function in main hydraulic control valve malfunctioning, damaged, or worn; inspect and clean or replace if necessary.

6. If no drift does not exceed 25 mm (1 in) in five minutes, retest the upright with a 50% load. Adjust fork width as wide as possible to lift the half-load equally distributed on a 1220 x 1220 mm (48 x 48 in). Refer to truck nameplate for capacity rating.

⚠ CAUTION

Test load must be stable, not extend beyond the pallet, and be secured on the pallet.

Drift Causes and Remedies

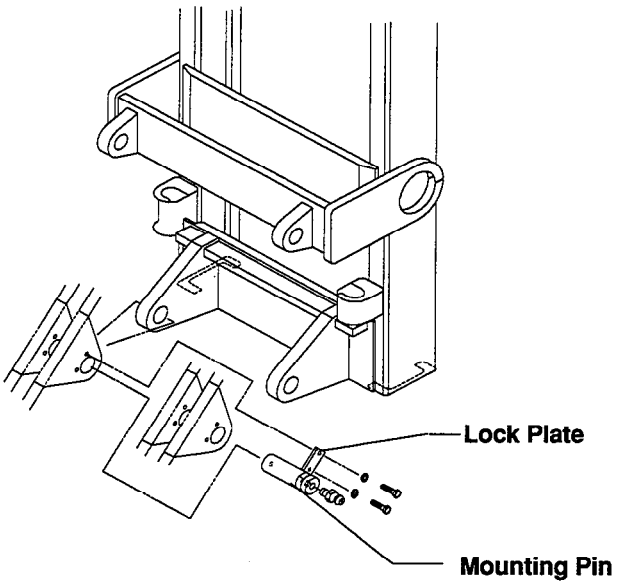
If drift of 25 mm (1 in) or more is evident under a half-load, consider the following causes and remedies:

- The main hydraulic valve is misadjusted, worn, or defective. Fluid is leaking past the valve and causing the upright cylinders to drift. See Group 30 for hydraulic valve troubleshooting and service.
- Upright hydraulic circuit hoses or fittings are leaking. Check the circuit components and repair as necessary.
- Cylinder piston seals are worn, damaged, or defective allowing fluid past the piston causing drift.
- Primary cylinders have a check valve that allows oil to flow back to the rod side of the cylinder. This check valve may be clogged or defective. Inspect the check valve for proper sealing and operation.

Consider rebuilding the cylinders if the first two remedies in this list are not successful. See Section 5 for removal, overhaul, and replacement procedures for primary and secondary cylinders.

Upright Mounting Components

1. Check for missing, broken, bent, or loose mounting pins, lock plates, grease fittings, and fasteners. Inspect mounting bracket for wear and cracks.
2. Lift the upright 305-610 mm (1-2 ft) and tilt the upright fully forward.

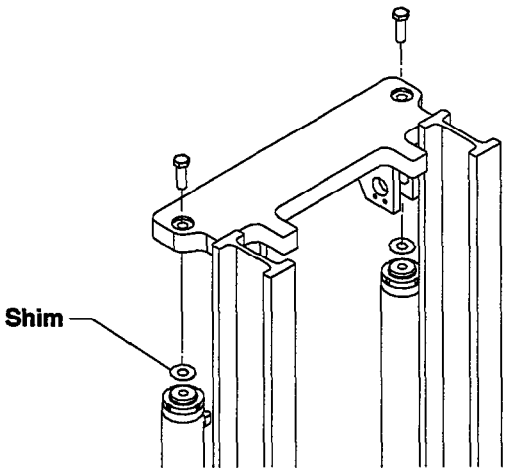


See Section 8, "Upright Removal and Replacement," for procedures to remove and replace the mounting pins.

⚠ CAUTION

Make sure hoisting equipment is of adequate capacity and in good working order.

3. Remove the cylinder rod retaining bolt.



4. Slowly lift the inner (or intermediate) rails off the top of the cylinder to expose the cylinder rod top.

⚠ CAUTION

Block rail in up position.

5. Insert shim(s) over rod end of cylinder with the shorter stroke to compensate for unequal stroke length.
6. Slowly lower the inner or intermediate rail back onto the rod ends.

⚠ WARNING

Do not try to maneuver the cylinder or rails with your hands. Use a prybar.

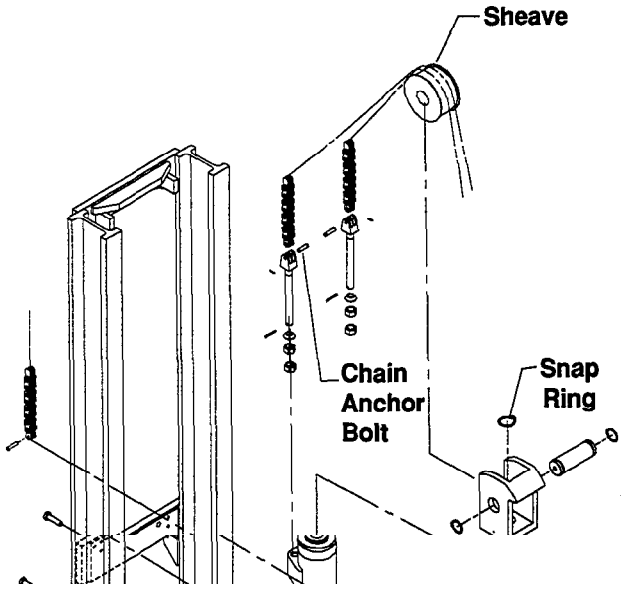
7. Replace cylinder rod retaining bolt to secure rod end into inner or intermediate rail mounting hole. Torque the cylinder rod retaining bolts to 170-190 N•m (125-140 ft-lb).
8. Repeat the racking test and adjustment until no racking is evident during upright lift extension.
9. Check all upright functions before returning the truck to service.

Primary Cylinder Removal and Replacement (TSU Only)

Remove the primary cylinder for replacement only. Cylinder can be overhauled without removing it from the upright. See "Cylinder Overhaul" for procedures.

1. Make sure the cylinder is completely collapsed and pressure is released.
2. Disconnect and cap the hydraulic line at the base of the cylinder.
3. Remove and discard cotter pins from chain anchor bolt pins on the cylinder.
4. Draw the chain through the sheave, and drape the chain over the carriage.
5. Disassemble and remove chain sheave (and hose bracket, if equipped) on the rod end and move assembly off top of rod.
6. Disconnect cylinder mounting bolts and lift cylinder off mounting base.

Use these steps in reverse to replace the cylinder. Check Group 40 for hydraulic fitting tightening procedures.



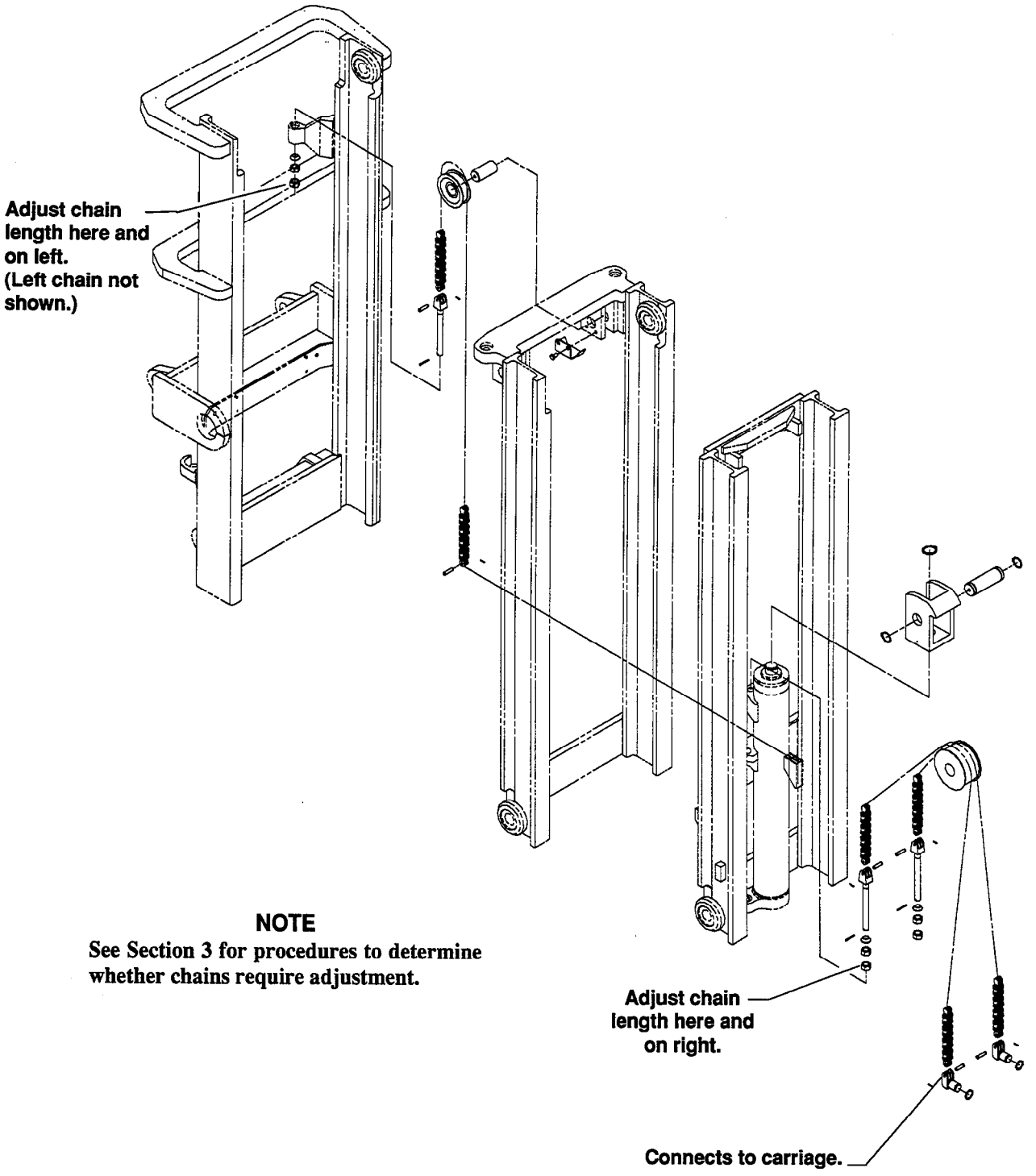


Figure B. Triple Stage Upright Chain Adjustment Points

TABLE OF CONTENTS

TROUBLESHOOTING.

TABLE 2-2. TROUBLESHOOTING (Sheet 2 of 2)

Problem	Possible Cause	Procedure to Correct Problem
MAST ASSEMBLY AND LIFT CYLINDERS		
Rough movement of carriage.	1. Air in hydraulic system.	1. Remove air. Check for loose connections or breaks in lines.
	2. Bent cylinder rod, lift cylinder shell damaged.	2. Repair or replace lift cylinders.
	3. Lowering control valves defective.	3. Repair or replace valves.
	4. Mast out of alignment or defective.	4. Align weldments. Replace defective parts.
Lift cylinder retracts when lift spool is moved to LIFT position	Check valve for lift spool is defective.	Replace valve.
Lift cylinder retracts when lift spool is in NEUTRAL position	1. Cylinder seals have leaks.	1. Replace seals.
	2. Hydraulic line has leaks.	2. Repair leaks. Replace defective parts. Bleed system.
	3. Large leaks between spool and bore.	3. Replace spool O-rings.

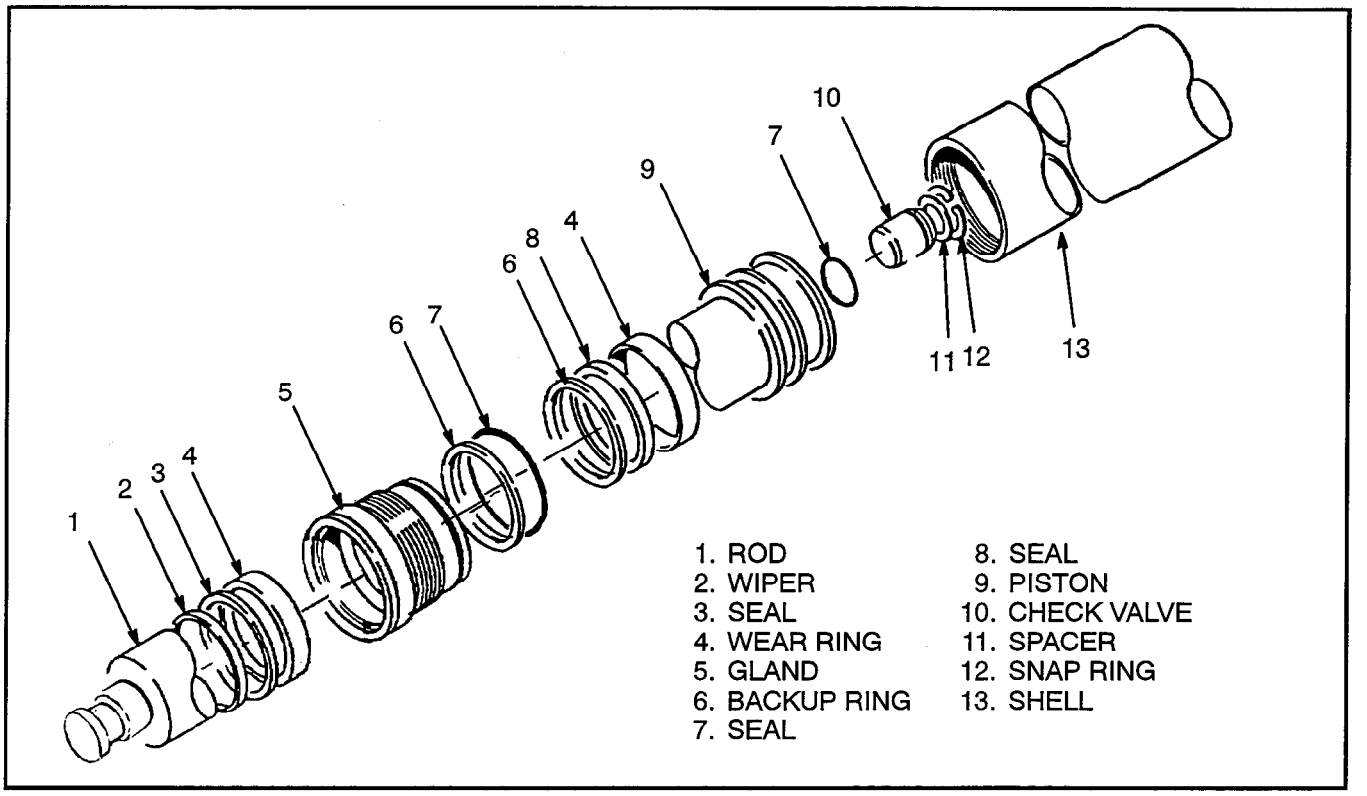


Figure 3-8. Lift Cylinder Parts

Disassembly of the Lift Cylinders. See Figure 3-8.

⚠ WARNING

Lift cylinder parts are heavy. Use a lifting device when moving the parts of the lift cylinder.

NOTE: Clean the outside of the lift cylinder before disassembly to avoid the entry of dirt into the cylinder.

1. Use a spanner wrench to remove the cylinder gland from the shell.
2. Carefully pull the rod assembly from the shell. Make sure to avoid damage to the surface of the rod during removal.

⚠ CAUTION

Use a sling that cannot damage the shell or the rod assembly to move the parts during disassembly.

3. Remove the gland from the rod. Remove the wiper and seal from the bore of the gland. Remove the O-ring from the outside of the gland.
4. Remove the wear ring from the piston. Remove the snap ring, spacer, and check valve assembly from the bore in the piston.
5. Remove the seal and backup ring from the piston. Note the position of the lip seal.

Cleaning and Inspection of the Lift Cylinders.

1. Clean the rod and shell assemblies in solvent.
2. Inspect the rod for nicks, scratches or other defects. Do not reinstall if any defects are found.
3. All metal surfaces on which packing slides must be smooth. Replace or resurface if needed.
4. Put hydraulic oil on all metal surfaces that do not have paint.

Repair of the Lift Cylinders.

1. Use a new packing kit when assembling lift cylinder.
2. Soak packing and seals in hydraulic oil before installing.
3. Do not use sharp tools or instruments when installing packing and seals.
4. When installing seal rings do not stretch them more than necessary.
5. Fit packing evenly and snugly without using force.
6. When packing must be installed over threads or sharp edges, use shim stock or sleeve to protect packing.

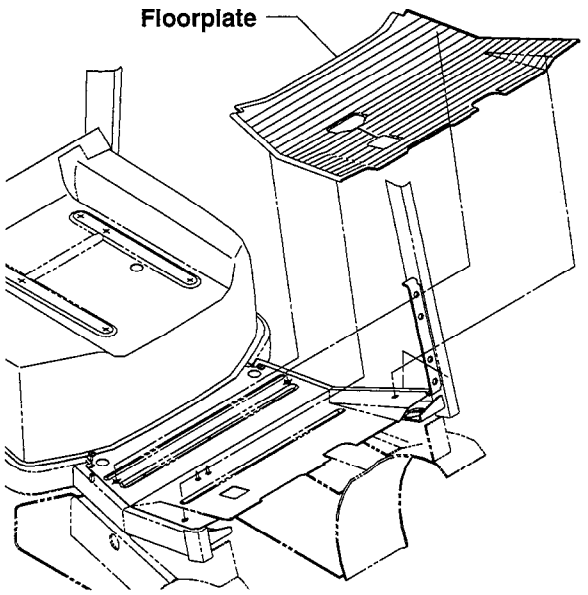
⚠ CAUTION

SAFE PARKING. Before working on truck:

1. **Park truck on a hard, level, and solid surface, such as a concrete floor with no gaps or breaks.**
2. **Put upright in vertical position and fully lower the forks or attachment.**
3. **Put all controls in neutral. Turn key switch OFF and remove key.**
4. **Apply the parking brake and block the wheels.**

Floor Plate Removal and Replacement

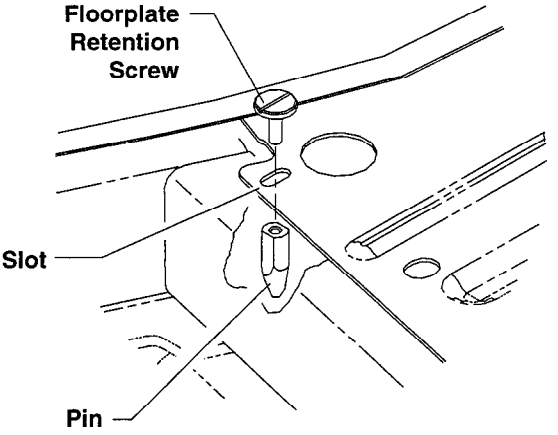
1. Tilt the steering column fully forward.
2. Raise the seat deck.
3. Lift out the operator's compartment floor plate. Rubber mat lifts out with floor plate.



4. To replace the floorplate, position the floor plate so that the retention pins mate with holes in the operator's cell side plates.

Floor Plate Adjustment

1. Remove the pins from the floor plate retention screws.
2. Apply Loctite thread locking compound 271 to threads of the screws.
3. Assemble the screws and pins to the floor plate as shown in the following illustration.



4. Snug the retention screws to the pins but allow movement of the parts in the floor plate slot.
5. Orient and place pins into mating holes in cell sides. Allow the floor plate to rest on the cell sides.
6. Adjust floor plate to center by moving the pins in the slots.

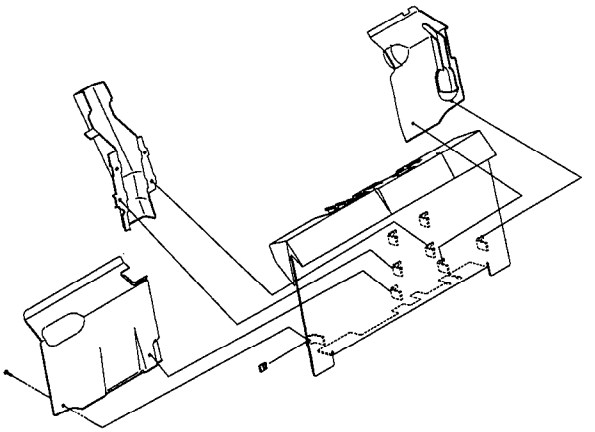
NOTE

Make sure the accelerator pedal has a full stroke and does not bind.

7. Once centered, torque the retention screws into the pins to 8-10 N•m (5.9-7.3 ft-lb).
8. Lower and latch seat deck.

Cowl Covers Removal and Replacement

1. Remove the right, center, and left cowl covers as shown in the following illustration.



2. To replace the cowl covers top lip of the right and left cowl covers must be inserted under the dash prior to fastening covers into position.