2.1 Service Specifications

Frame/Chassis

- Basic design is to metric standard dimensions
- Components and hardware dimensions are combination USA inch and metric
- Stamped and formed frame, welded construction, 10 mm, except cowl 6 mm
- Removable fuel and hydraulic tanks

Cooling System

- TYPE: Crossflow radiator, with transmission oil cooler in radiator side tank
  1) Variable-speed temperature-controlled viscous fan drive (MC, I models).
  2) Coolant recovery system is standard (all models).

- System Pressure (Radiator Cap): 14 psi nominal Limits12-16 psi [83-110 kPa]
- Thermostat: Open (cracking) 175-182°F [65-68°C]
  Fully open 202°F [79°C]

Recommended Coolant: 50% water and 50% *low-silicate* ethylene glycol permanent-type antifreeze containing rust and corrosion inhibitors. Antifreeze protection level -34°F [-37°C].

NOTICE *- The use only of an antifreeze having a low silicate additive content is strongly recommended. Silicates are added to antifreeze to help protect aluminum cylinder heads in automotive engines. During use, the silicate additives may form gummy deposits that can block and seriously damage a cooling system. Low-silicate antifreeze is available for heavy-duty use. Also, some tap waters react adversely with coolant chemicals. If your local tap water is "hard", use distilled water.*

Electrical System

		Engine Model
• System Voltage & Type:	12 volt, negative ground	
• Fuses:	AGC 15 amp (in-line in wiring harness)	
• Indicator Lamps:	No. 57	
• **1** Battery:	12 volt, BCI Group 73	4G54, D176GA
Cold Crank Current:	420 amps @ 0°F [17.8°C]	
• **2** Battery:	12 volt, BCI Group 72	TM27
Cold Crank Current:	320 amps @ 0°F [17.8°C]	
• **3** Battery:	12 volt, BCI Group 31	TMD27 Diesel
Cold Crank Current:	625 amps @ 0°F [17.8°C]	
Cranking Voltage:	9.4 volts, minimum	
No-load Voltage:	12 volts	
Charging Voltage:	13.5 volts, minimum	
• Alternator/Voltage Regulator:	Delco Series 10 SI, Type 100, 12 volt, 37 amp Motorola 9DM, 12 volt, 62 amps (After Oct 1986)	

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Safety and Operational Checks

PM Interval:

A = 8 - 10 hours, or daily
B = 50 - 250 hours, or every month (Typical PM interval)
C = 450 - 500 hours, or every 3 months
D = 900 - 1000 hours, or every 6 months
E = 2000 hours, or every year

Daily Maintenance Checklist	A	B	C	D	E
Check truck for obvious damage and leaks	•				
Check fuel system for leaks, etc.	•				
Check capacity , warning plates, decals	•				
Check condition of tires and wheels	•				
Check pneumatic tire pressure	•				
Check wheel lug nuts or bolts (loose, missing, broken, torque)	•				
Check engine oil level	•				
Check engine coolant level (radiator & recovery tank)	•				
Check fuel level	•				
Check hydraulic sump oil level	•				
Check gauges and instruments	•				
Check warning lights and hourmeter	•				
Check horn operation and other warning devices	•				
Check steering operation	•				
Check service brake operation	•				
Check parking brake operation	•				
Check parking brake linkage for damage, wear, broken parts	•				
Check directional and speed controls operation	•				
Check accelerator and engine speed operation	•				
Check lift, tilt, and aux operation	•				
Check overhead guard condition and bolts	•				
Check upright, lift chains, and fasteners	•				
Check load backrest extension and forks	•				
Check seat deck holddown latch for correct locking	•				

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NOTICE
Nameplates & Decals
Do not operate a lift truck with damaged or missing decals and nameplates. Replace them immediately. They contain important information.

3. Check to be sure all capacity, safety, and warning plates or decals are attached and legible.

4. Inspect the truck, before and after starting engine, for any signs of external leakage: fuel, engine coolant, transmission fluid, etc.

CAUTION
Hydraulic Fluid Pressure
Do not use your hand to check for hydraulic leakage. Use a piece of cardboard or paper to search for leaks. Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. If *any* fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result.

5. Check for hydraulic oil leaks and loose fittings. *Do not use bare hands to check*. Oil may be hot or under pressure.

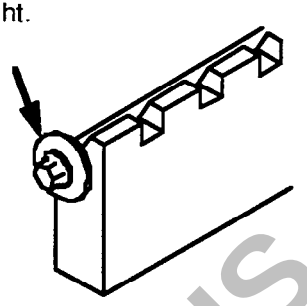
Overhead Guard, Load Backrest, Fork Retainers



1. Be sure overhead guard, load backrest extension, finger guards, and any other safety devices are in place, undamaged, and attached securely.

2. Check overhead guard for damage. Be sure it is properly positioned and all mounting fasteners are in place and tight.

3. Check load backrest for damage. Inspect the welds on the carriage and load backrest for cracks. Be sure that the mounting fasteners are all in place and tight.



4. If load backrest has been removed, a bolt and washer must be in place on each end of the top fork bar to act as a fork stop.

Upright and Lift Chains

IMPORTANT
Uprights and lift chains require special attention and maintenance to maintain them in safe operating condition.

1. Inspect the upright assembly: rails, carriage rollers, lift chains, lift and tilt cylinders.

- Look for obvious wear and maintenance problems, damaged or missing parts.
- Check for any loose parts or fittings. Check for leaks, any damaged or loose rollers, and rail wear. Check for metal flaking in the roller pathways.
- Carefully check the lift chains for wear, rust and corrosion, cracked or broken links, stretching, etc.
- Check that the lift chain anchor fasteners and locking means are in place and tight.
- Check that the lift and carriage chains are correctly adjusted to have equal tension.
- Check and adjust fork height to prevent fork wear.

2. Be sure all safety guards and chain retainers are in place and not damaged. Inspect the carriage stops and cylinder retainer bolts. Check all welded connections.

3. Inspect all lift line hydraulic connections for leaks.

4. Check the lift cylinder rods for wear marks, grooves and scratches.

5. Check the cylinder seals for leaks.

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Gasoline/LPG Engine Troubleshooting Guide

I. Diagnosis Based On Trouble Symptoms

A. Hard Engine Start

1. Starter motor will not crank engine

a) Battery is faulty	Charge or replace battery
b) Ground connection is faulty	Repair
c) Starting switch or relay is faulty	Replace
d) Faulty wiring or connections	Repair or replace
e) Starter motor or solenoid is faulty	Replace
f) Engine oil is too viscous (heavy weight oil)	Change to lighter oil viscosity
g) Internal engine seizure, or engine has hydrostatic lock	Refer to engine repair procedures.
h) Engine timing too advanced	Adjust timing

2. Starter motor rotates, but does not mesh with ring gear correctly

a) Starter motor is faulty	Repair or replace
b) Ring gear worn	Replace ring gear
c) Loose starter mounting bolts	Tighten

3. Engine cranks, but does not start

a) Engine assembly is faulty	Repair engine
b) Fuel system fault-*No fuel in carburetor:*	
1) Fuel tank empty	Check fuel supply
2) Clogged line or fuel filter	Clean or replace
3) Faulty fuel pump (gasoline engine)	Repair or replace
4) Leaking fuel line from tank	Repair
5) Clogged vent on tank or cap (gasoline engine)	Clean
c) Fuel system fault-*Fuel in carburetor:*	
1) Faulty choke (gasoline engine)	Repair
2) Excessive choking, wet spark plugs (gasoline engine)	Clean spark plugs
3) Incorrect carburetor float level (gasoline engine)	Repair or adjust
4) Faulty carburetor (gasoline/LPG)	Clean, repair or replace
5) Water in fuel (gasoline engine)	Clean fuel system
6) Plugged air filter	Replace
d) Ignition system fault	Perform spark test

Disconnect one spark plug wire and form gap to ground. Crank engine and inspect spark.

No spark:

1) Primary wiring circuit is open	Repair
2) Ignition points not closing	Repair or replace
3) Ignition switch is faulty	Replace
4) Coil is faulty	Replace
5) Coil secondary cable disconnected or faulty	Repair or replace

Weak spark:

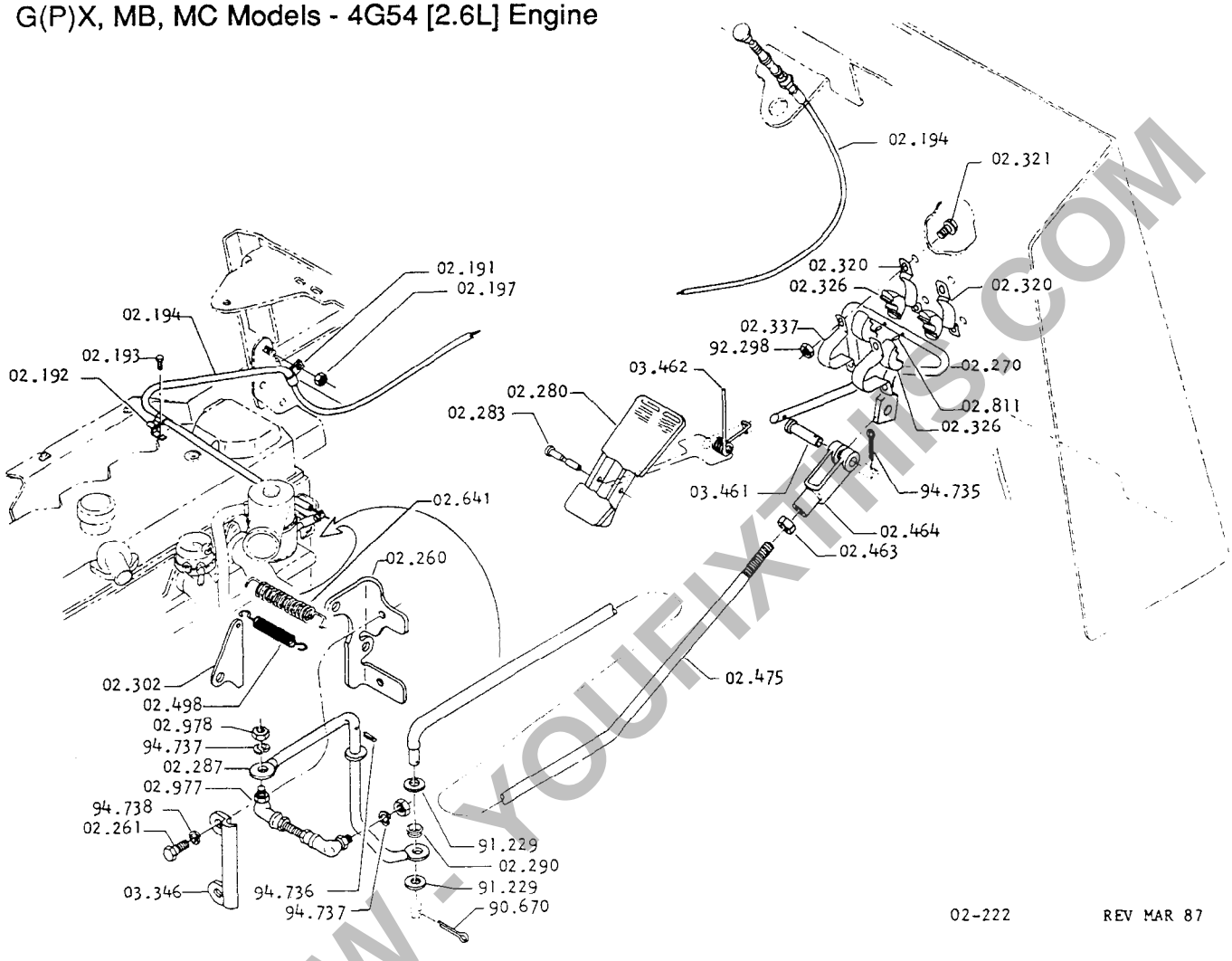
1) Loose ignition wiring connections	Repair
2) Burned or pitted ignition points	Replace
3) Spark plug cables wet or shorted	Repair or replace
4) Condenser is faulty	Replace
5) Distributor cap cracked or shorted	Replace
6) Coil is faulty (weak)	Replace
7) Poor distributor ground	Remove and clean

Refer to Part 6 for standard and electronic ignition system troubleshooting and maintenance.

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Accelerator Pedal and Linkage, Choke Control

G(P)X, MB, MC Models - 4G54 [2.6L] Engine



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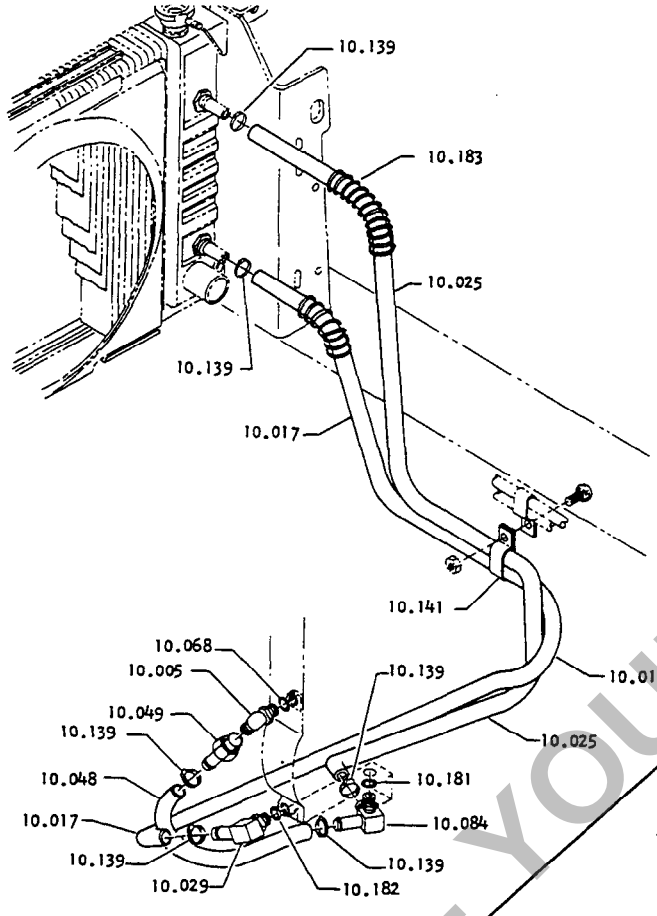
02.191	CLIP, CHOKE CABLE	02.464	CLEVIS, ACCELERATOR CONTROL ROD
02.192	CLIP, CHOKE CABLE	02.475	ROD, ACCELERATOR CONTROL
02.193	FASTENER, CHOKE CABLE CLIP	02.498	SPRING, ACCELERATOR RETURN (INNER)
02.194	CABLE, CHOKE CONTROL	02.641	SPRING, ACCELERATOR RETURN (OUTER)
02.197	FASTENER, CHOKE CABLE CLIP	02.811	RETAINER, ACCELERATOR LEVER
02.260	BRACKET, ACCELERATOR LINKAGE MOUNTING	02.977	ARM, ACCELERATOR LINKAGE
02.261	FASTENER, ACCELERATOR LINKAGE BRACKET	02.978	FASTENER, ACCELERATOR LINKAGE ARM
02.270	LEVER, ACCELERATOR	03.346	BRACKET, ACCELERATOR LINKAGE
02.280	PEDAL, ACCELERATOR	03.461	PIN, ACCELERATOR CONTROL ROD END
02.283	PIN, ACCELERATOR PEDAL PIVOT	03.462	SPRING, ACCELERATOR PEDAL RETURN
02.287	BELLCRANK, ACCELERATOR	90.670	RETAINER, ACCELERATOR CONTROL ROD
02.290	BUSHING, ACCELERATOR BELLCRANK	91.229	WASHER, ACCELERATOR CONTROL ROD RETAINER
02.302	BRACKET, ACCELERATOR RETURN SPRING	92.298	NUT, ACCELERATOR LEVER MOUNTING BRACKET FASTENER
02.320	BRACKET, ACCELERATOR LEVER MOUNTING	94.735	RETAINER, ACCELERATOR CONTROL ROD END PIN
02.321	FASTENER, ACCELERATOR LEVER MOUNTING BRACKET	94.736	RETAINER, ACCELERATOR BELLCRANK
02.326	BEARING, ACCELERATOR LEVER	94.737	LOCKWASHER, ACCELERATOR LINKAGE ARM FASTENER
02.337	BRACKET, ACCELERATOR LEVER MOUNTING	94.738	LOCKWASHER, ACCELERATOR LINKAGE BRACKET FASTENER
02.463	NUT, ACCELERATOR CONTROL ROD CLEVIS		

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Transmission Cooling Lines

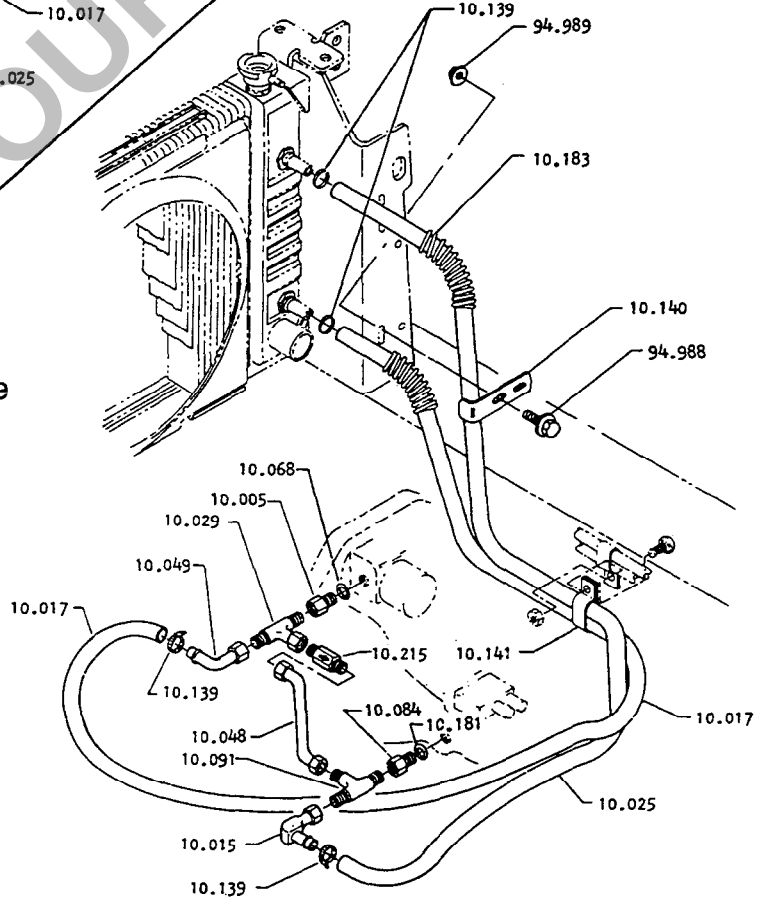
(1) MB, MC, WC, I Models - HR500, HR600 Transaxle



10.005	FITTING, CONVERTER PUMP OUTLET
10.017	LINE, TRANSMISSION COOLER OUTLET
10.025	LINE, TRANSMISSION COOLER INLET
10.029	FITTING, TRANSMISSION COOLER OUTLET LINE
10.048	LINE, CONVERTER PUMP OUTLET
10.049	FITTING, CONVERTER PUMP OUTLET LINE
10.068	SEAL, CONVERTER PUMP OUTLET PORT
10.084	FITTING, TRANSMISSION COOLER INLET LINE
10.139	CLAMP, TRANSMISSION COOLER LINE
10.141	CLIP, TRANSMISSION COOLER LINE
10.181	SEAL, TRANSMISSION COOLER INLET LINE FITTING
10.182	SEAL, TRANSMISSION COOLER OUTLET LINE FITTING
10.183	GUARD, TRANSMISSION COOLING LINES

10-054 REV MAR 85

(2) GC(P)X Models - TA18 Transaxle



10.005	FITTING, CONVERTER PUMP OUTLET
10.015	FITTING, TRANSMISSION COOLER INLET LINE
10.017	LINE, TRANSMISSION COOLER OUTLET
10.025	LINE, TRANSMISSION COOLER INLET
10.029	FITTING, TRANSMISSION COOLER OUTLET LINE
10.048	LINE, CONVERTER PUMP OUTLET
10.049	FITTING, CONVERTER PUMP OUTLET LINE
10.068	SEAL, CONVERTER PUMP OUTLET PORT
10.084	FITTING, TRANSMISSION COOLER INLET LINE
10.091	FITTING, TRANSMISSION SUMP RETURN LINE
10.139	CLAMP, TRANSMISSION COOLER LINE
10.140	CLAMP, TRANSMISSION COOLER LINE
10.141	CLIP, TRANSMISSION COOLER LINE
10.181	SEAL, TRANSMISSION COOLER INLET LINE FITTING
10.183	GUARD, TRANSMISSION COOLING LINES
10.215	VALVE, TRANSMISSION COOLER LINE RELIEF
94.988	FASTENER, TRANSMISSION COOLER LINE CLAMP
94.989	NUT, TRANSMISSION COOLER LINE CLAMP FASTENER

10-075 MAR 89

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4.12 Engine Components

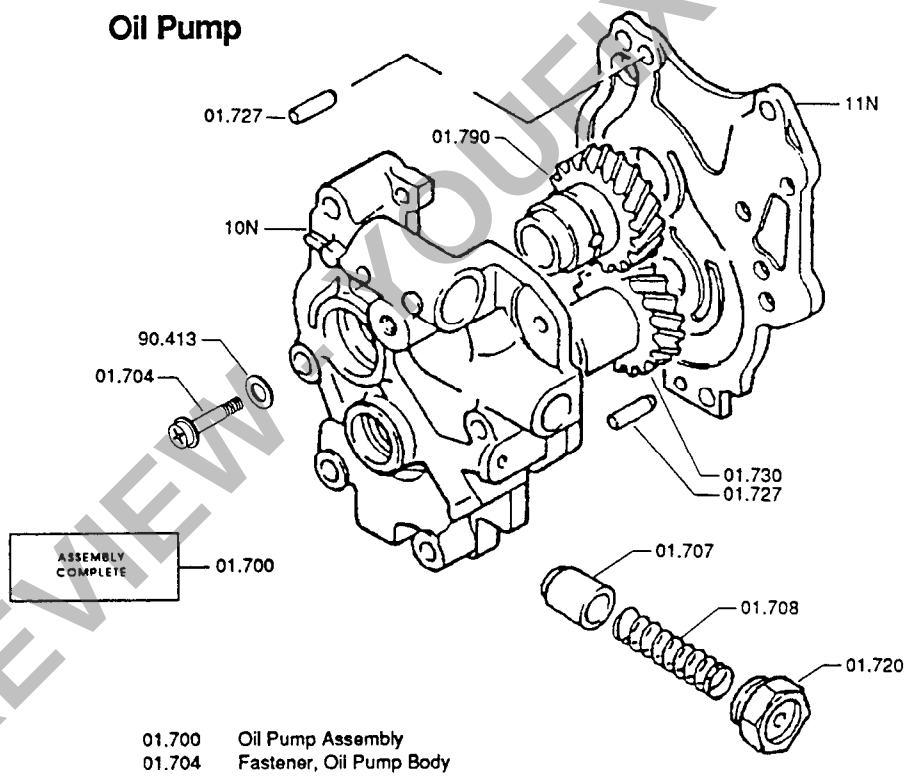
GC(P)X, MB, MC Models - 4G54 [2.6L] Engine

Oil Pump Assembly 4.12-1
Water Pump, Thermostat Housing, Starter 4.12-2
Oil Filter, LPG Carburetor, Governor, Distributor 4.12-3
Oil Filter, Gasoline Carb, Fuel Pump, Gov, Distrib 4.12-4
Rocker Cover, Cylinder Head & Gasket 4.12-5
Front End Cover, Oil Pan & Gasket 4.12-6
Intake and Exhaust Manifold, Gaskets 4.12-7
Exhaust System 4.12-8

This section presents general information on selected engine sub-assemblies showing components that are generally serviceable from the outside of engine without major disassembly of the engine proper. It is provided for information and reference only to assist service personnel in understanding and identifying components and their assembly relationship.

Note - Please check your truck and engine model for specific component arrangement and corresponding service requirement.

Oil Pump



01.700	Oil Pump Assembly	
01.704	Fastener, Oil Pump Body	
01.707	Piston, Oil Pressure Regulating	
01.708	Spring, Oil Pressure Regulating	
01.720	Cap, Oil Pressure Regulating	
01.727	Dowel, Oil Pump Body	
01.730	Gear, Oil Pump Drive	
01.790	Gear, Oil Pump Driven	
90.413	Lockwasher, Oil Pump Body Fastener	
10N	Body, Oil Pump	Use 01.700
11N	Cover, Oil Pump	Use 01.700

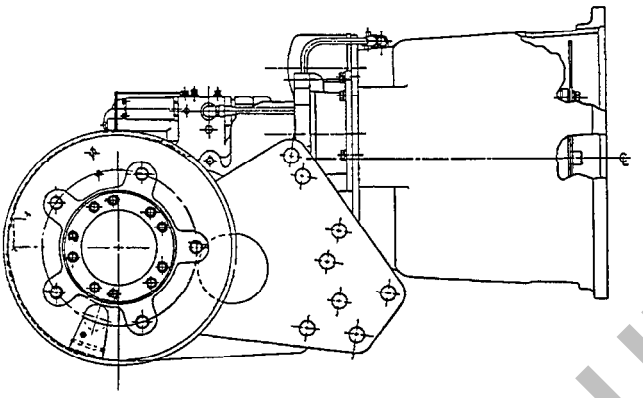
01-064 Rev. MAR 90

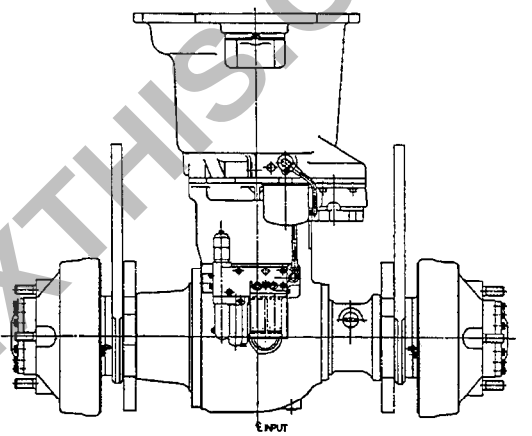
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7.6 TA18 Transaxle

Description and Operation 7.6-1
Specifications and Pictorial Views 7.6-2
Service Information 7.6-4
General Arrangement 7.6-6
Parts Nomenclature 7.6-7
Transaxle Disassembly 7.6-15
Transaxle Reassembly 7.6-21
Brake Adjustment Procedure 7.6-33

Description and Operation





Refer to Section 2.1, Service Specifications for TA-18

Clark Model TA18 transaxle assembly includes:
- torque converter
- single-speed forward and reverse powershift transmission with integral differential and drive axle
- full-floating straight drive axle
- drum-and shoe brakes
- gear-driven pump drive
- electric shift control, hydraulic inching control

Power flow is from torque converter turbine to turbine (clutch) shaft and gears then thru either forward gear or reverse idler shaft to output gear mounted on final drive pinion shaft.

Transmission and differential housed in one-piece transmission case. Torque converter housing joined to transmission case through an adaptor (or spacer) plate. Adaptor plate holds converter stator support and reverse idler outer bearing.

Pump drive driven by converter impeller hub gear through idler gear to pump gear mounted on charging pump shaft.

Final drive pinion gear shaft mounted in tapered roller bearings at both ends in transmission case, and adjusted for mounting distance and ring and pinion gear contact by shim pack installed behind inner tapered roller bearing cup at pinion gear in transmission case. Pinion shaft bearing preload is adjusted with shims behind outer bearing cone on pinion shaft.

Final drive ring gear bolted to differential carrier. Differential supported by opposed tapered roller bearings mounted on inner ends of wheel end housings, which are bolted to openings in transmission case at the sides of the differential. Differential bearing preload and ring gear clearance (backlash) is maintained by shims placed behind differential bearing cones on wheel end housings. Adjustment of differential bearing preload or ring gear backlash requires trial assembly, checking, and disassembly of wheel end housings until correct adjustment is obtained.

Drive axle wheel hubs/brake drums supported by double tapered roller bearings on outer end of wheel end housings. Drive axle shaft flanges bolted to wheel hubs and full-floating in differential. Service brake backing plates bolted to mounting flanges on wheel end housings. Wheel bearings lubricated from transaxle sump.

Control valve mounted on pad at top of transmission case. Oil from charging pump flows thru filter and pressure regulator to control valve thru external oil supply line. Oil from control valve delivered to clutches thru passages in housing and oil distributor sleeve and seal rings at forward-clutch end of turbine/clutch shaft. Excess pump oil volume and converter-out oil flows to oil cooler and returns to transmission housing at base of control valve then thru center of turbine/clutch shaft back to converter.

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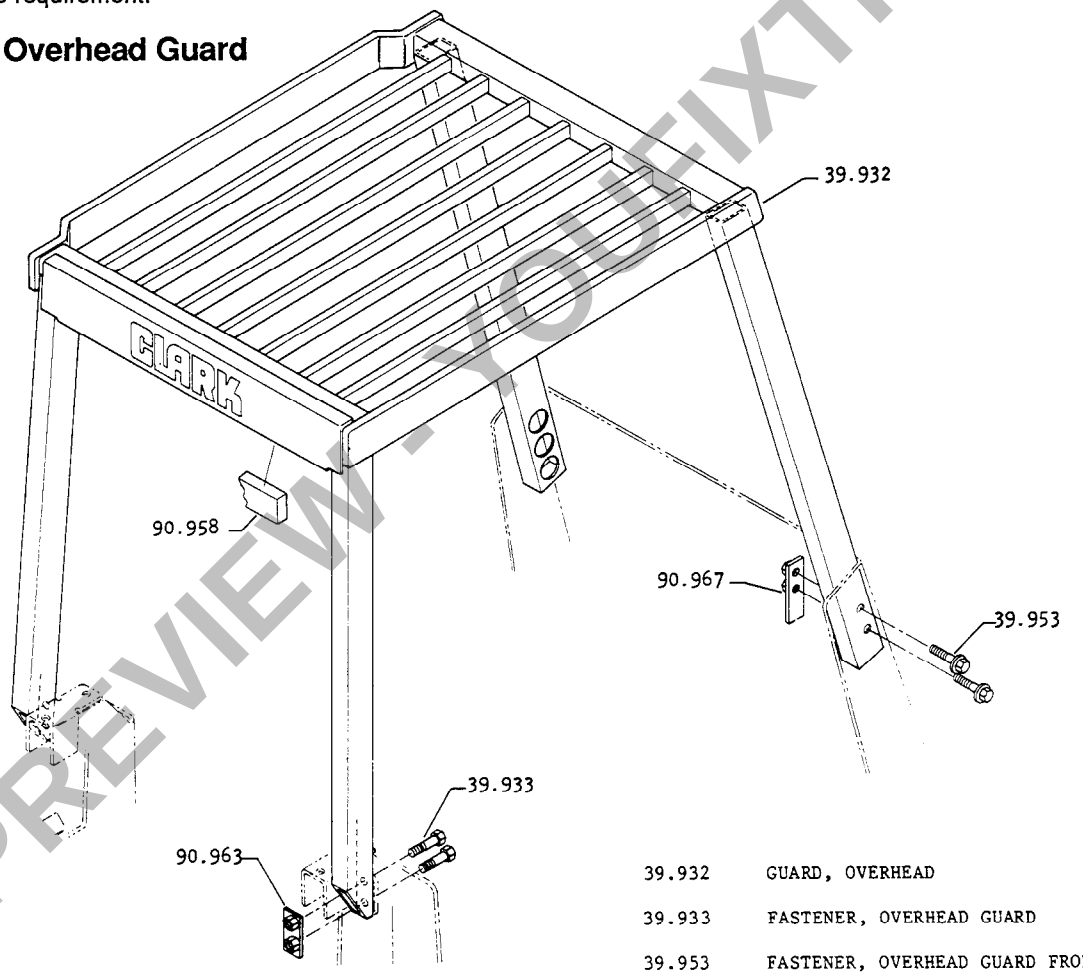
12.2 Chassis Components

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Sheet Metal 12.2-2
Sheet Metal and Trim 12.2-3
Seat Mounting 12.2-4
Seat Assembly 12.2-5
Top Hood and Mounting 12.2-6
Instrument Panel 12.2-7
Frame and Counterweight 12.2-8

This section presents general information on selected major chassis components and sub-assemblies. It is provided for information and reference only to assist service personnel in understanding and identifying components and their assembly relationship.

Note - Please check your truck model for specific component arrangement and corresponding service requirement.

Overhead Guard

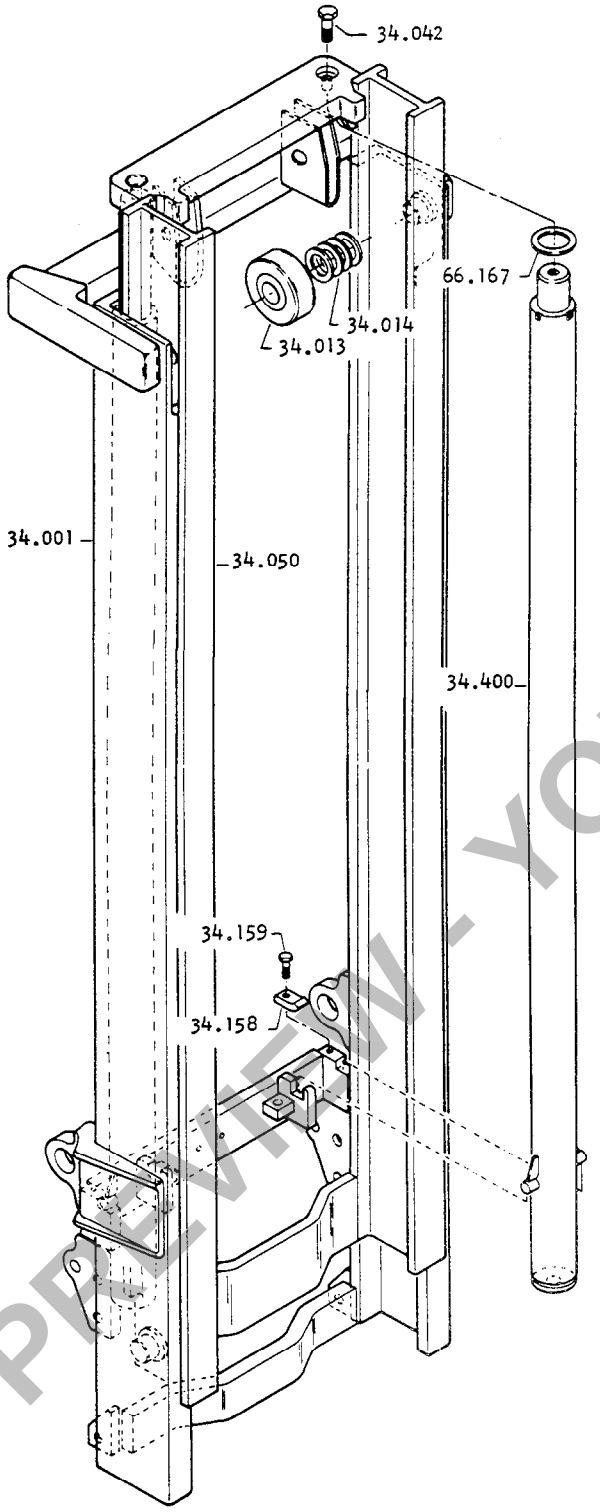


39-522 REV APR 86

39.932	GUARD, OVERHEAD
39.933	FASTENER, OVERHEAD GUARD
39.953	FASTENER, OVERHEAD GUARD FRONT LEG
90.958	DAMPENER, OVERHEAD GUARD VIBRATION
90.963	NUT, OVERHEAD GUARD FASTENER
90.967	NUT, OVERHEAD GUARD FRONT LEG FASTENER

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HIVIS Standard Upright Assembly



UPRIGHT AND LIFT CYLINDER ASSEMBLY COMPLETE — 34.000

■ INDICATES AN ASSEMBLY HAVING SERVICEABLE COMPONENTS ILLUSTRATED ELSEWHERE

34.000	UPRIGHT & LIFT CYLINDER ASSEMBLY
34.001	OUTER RAIL WELDED ASSEMBLY, UPRIGHT
34.013	ROLLER, UPRIGHT
34.014	SHIM, UPRIGHT ROLLER
34.042	FASTENER, LIFT CYLINDER UPPER
34.050	INNER RAIL WELDED ASSEMBLY, UPRIGHT
34.158	RETAINER, LIFT CYLINDER
34.159	FASTENER, LIFT CYLINDER RETAINER
34.400	LIFT CYLINDER ASSEMBLY
66.167	SHIM, LIFT CYLINDER UPPER

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Subject	*Part*
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Specifications	2
Planned Maintenance	3
Engine (Group 00)	4
Fuel System (Groups 02, 03)	5
Electrical System (Groups 11-15)	6
Transaxle (Groups 06, 07, 20)	7
Brakes and Inching System (Groups 22, 23)	8
Steering System (Groups 25, 26)	9
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Safe Maintenance Practices

The following instructions have been prepared from current industry and government safety standards applicable to industrial truck operation and maintenance. These recommended procedures specify conditions, methods, and accepted practices that aid in the safe maintenance of industrial trucks. They are listed here for the reference and safety of all workers during maintenance operations. Carefully read and understand these instructions and the specific maintenance procedures before attempting to do any repair work. When in doubt of any maintenance procedure, please contact your local CLARK dealer.

1. Powered industrial trucks can become hazardous if maintenance is neglected. Therefore, suitable maintenance facilities, trained personnel, and procedures must be provided.

2. Maintenance and inspection of all powered industrial trucks shall be done in conformance with the manufacturer's recommendations.

3. A scheduled planned maintenance, lubrication, and inspection program shall be followed.

4. Only trained and authorized personnel should be permitted to maintain, repair, adjust, and inspect industrial trucks, and in accordance with the manufacturer's specifications.

5. Properly ventilate work area, vent exhaust fumes, and keep shop clean and floor dry.

6. Avoid fire hazards and have fire protection equipment present in the work area. Do not use an open flame to check for level, or leakage of fuel, electrolyte, or coolant. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

7. Before Starting Work On Truck:

a) Raise drive wheels off of floor or disconnect power source and use blocks or other positive truck-positioning devices.
b) Put blocks under the upright rails and carriage, innermast(s), or chassis before working on them.
c) Disconnect battery before working on the electrical system.

8. Before working on engine fuel system of gasoline powered trucks with gravity-feed fuel systems, be sure fuel shutoff valve is closed.

9. Before working on engine fuel system of LP-gas powered trucks, close LP-gas cylinder valve and run engine until there is no more fuel in the system and engine stops running. If engine will not run, close LP-tank valve and vent fuel slowly in a safe area.

10. Operation of the truck to check performance must be conducted in an authorized, safe, clear area.

11. Before Starting To Drive Truck:

a) Be in operating position.
b) Disengage clutch on manual transmissions, or apply brake on trucks with powershift transmission and electric trucks.
c) Put directional control in neutral.
d) Start engine or turn on power.
e) Check functioning of lift and tilt systems, directional and speed controls, steering, brakes, warning devices, and any load handling attachments.

12. Before Leaving The Truck:

a) Stop truck.
b) Fully lower the load engaging means: upright, carriage, forks, or attachments.
c) Put directional control in neutral.
d) Apply the parking brake.
e) Stop the engine or turn off power.
f) Turn off the control or ignition circuit.
g) Put blocks at the wheels, if truck is on an incline.
h) Remove the ignition key (OSHA regulation)

13. Handle LP-gas cylinders with care. Damage such as dents, scrapes, or gouges may dangerously weaken the tank and make it unsafe for use.

14. Brakes, steering mechanisms, control mechanisms, warning devices, lights, governors, lift overload devices, guards and safety devices, lift and tilt mechanisms, articulating axle stops, and frame members must be carefully and regularly inspected and maintained in a safe operating condition.

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This manual is intended for use by persons who are trained and authorized to do lift truck maintenance. It is designed to provide essential information about the correct and safe service maintenance and repair of the lift truck *by trained mechanics or service technicians.*

The information is organized into 14 major Parts of related components or topics as outlined by the Table of Contents at the front of the manual:

- **1** General information including precautions and safe maintenance practices.
- **2** Service specifications and reference information including lubricants, capacities, pressures, etc.
- **3** Planned Maintenance (PM) service procedures.
- **4-13** Adjustment, service and repair procedures for truck components.

In Parts 4-13, the detailed service and repair procedures are arranged in Sections for each procedure, component or subsystem. Some Sections include explanations that cover service procedures common to several components or subsystems.

In general, each Section is written to show and describe the general arrangement, adjustment, removal, disassembly, inspection, repair, and assembly steps that are normally required to service the component. Component specifications (as applicable), information notes and safety messages are included within those procedures. In most cases, specifications are shown in Section 2, Service Specifications, for convenience of reference.

Each Section includes Parts GROUP number(s) at the bottom of each page for cross reference. The Parts GROUP numbers are the same as the component group in the Master Parts Book and Service Parts Book. They are parts system reference numbers; use only the appropriate Parts Manual for ordering parts. **Do not order parts** from numbers shown in this manual.

The Table of Contents lists major headings of Parts of the manual. Additional content listings are placed at the beginning of each Section of the manual, subsection or component heading to simplify reference to multiple topics or procedures covering optional equipment, such as engines and transaxles.

If you cannot find a topic in the respective Table of Contents, check the Alphabetical Subject Index at the back of the manual.

This manual has been made easier to use by providing only specific steps and instructions necessary to explain the activity, component, assembly, or process being worked on. The technician is expected to include obvious additional steps of standard procedure for removal, disassembly, cleaning, inspection, reassembly, installation, etc., as needed.

***To be better prepared** to do the necessary service work, take time to completely read the entire procedure, including any special instructions, before doing any work.*

***The technician is cautioned** and expected to always work in a safe manner by using the correct procedure. Do not take chances which may result in injuries.*

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Gasoline/LPG Engine Troubleshooting Guide

K. High Oil Consumption

1. Oil leaks	Inspect and repair
2. Too high oil level	Check cause. Maintain correct oil level
3. Incorrect grade of oil used	Change to heavier viscosity grade
4. Clogged crankcase breather	Clean
5. Oil pressure too high, stuck relief valve	Repair or replace
6. Piston rings not run-in (seated), due to too smooth cylinder bore finish or glazed condition	Repair or replace rings, deglaze cylinder walls
7. Worn, broken or stuck piston rings and clogged oil control rings	Replace
8. Worn pistons and sleeves	Replace
9. Worn bearings	Replace
10. Worn valve guides and seals	Replace
11. Worn out or malfunctioning PCV valve	Replace

L. Engine Knocks and Other Noises

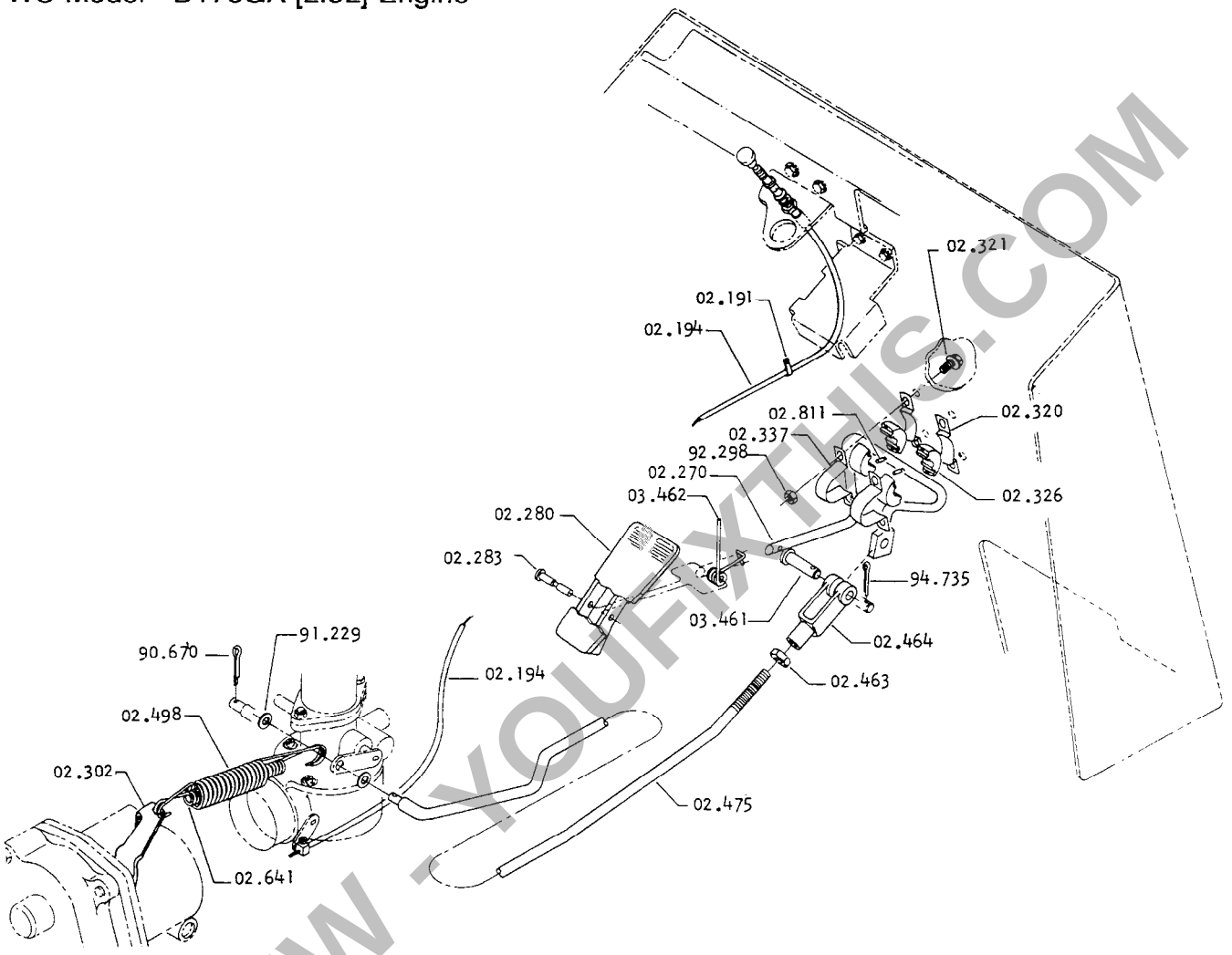
1. Operating knocks - which may be due to: (gasoline engine only)	
a. Preignition. Most common cause is due to incorrect type plugs which are too hot.	Replace plugs with correct heat range
b. Carbon build-up. Noticeable when engine is accelerated when hot.	Clean cylinder head and pistons
c. Incorrect timing. Early (advanced excessively) timing causes knocks similar to carbon build-up, but may tend to kick back when starting.	Adjust timing
d. Fuel. Detonation knock caused by low octane gasoline.	Check fuel specification
e. Overloads, particularly at lower operating speeds.	Review operating methods
2. Mechanical knocks - result from wear, abuse or improper adjustments, which may be due to:	
a. Crankshaft and Main Bearings	
1) Worn or Burned-out Main Bearings - A heavy, dull knock when accelerating under load. Locate by shorting out spark plugs on both sides of the bad bearing.	Repair engine
2) Crankshaft End Play - Excessive end play is indicated by an intermittent knock which will come and go when the load s released and engaged.	
b. Connecting Rod Bearings	
1) Worn or Burned-out Bearings - The worst condition, a light pounding or metallic knock, is noted at idling speed and to about 2/3 maximum speed. Bad bearings can be located by shorting out spark plugs.	Repair engine

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Accelerator Pedal and Linkage, Choke Control

WC Model - D176GA [2.9L] Engine



02-220

02.191	CLIP, CHOKE CABLE	02.464	CLEVIS, ACCELERATOR CONTROL ROD
02.194	CONTROL, CHOKE	02.475	ROD, ACCELERATOR CONTROL
02.270	LEVER, ACCELERATOR	02.498	SPRING, ACCELERATOR RETURN
02.280	PEDAL, ACCELERATOR	02.641	SPRING, ACCELERATOR RETURN
02.283	PIN, ACCELERATOR PEDAL PIVOT	02.811	RETAINER, ACCELERATOR LEVER
02.302	BRACKET, ACCELERATOR RETURN SPRING	03.461	PIN, ACCELERATOR CONTROL ROD END
02.320	BRACKET, ACCELERATOR LEVER MOUNTING	03.462	SPRING, ACCELERATOR PEDAL RETURN
02.321	FASTENER, ACCELERATOR LEVER MOUNTING BRACKET	90.670	RETAINER, ACCELERATOR CONTROL ROD
02.326	BEARING, ACCELERATOR LEVER	91.229	WASHER, ACCELERATOR CONTROL ROD RETAINER
02.337	BRACKET, ACCELERATOR LEVER MOUNTING	92.298	NUT, ACCELERATOR LEVER MOUNTING BRACKET FASTENER
02.463	NUT, ACCELERATOR CONTROL ROD CLEVIS	94.735	RETAINER, ACCELERATOR CONTROL ROD END PIN

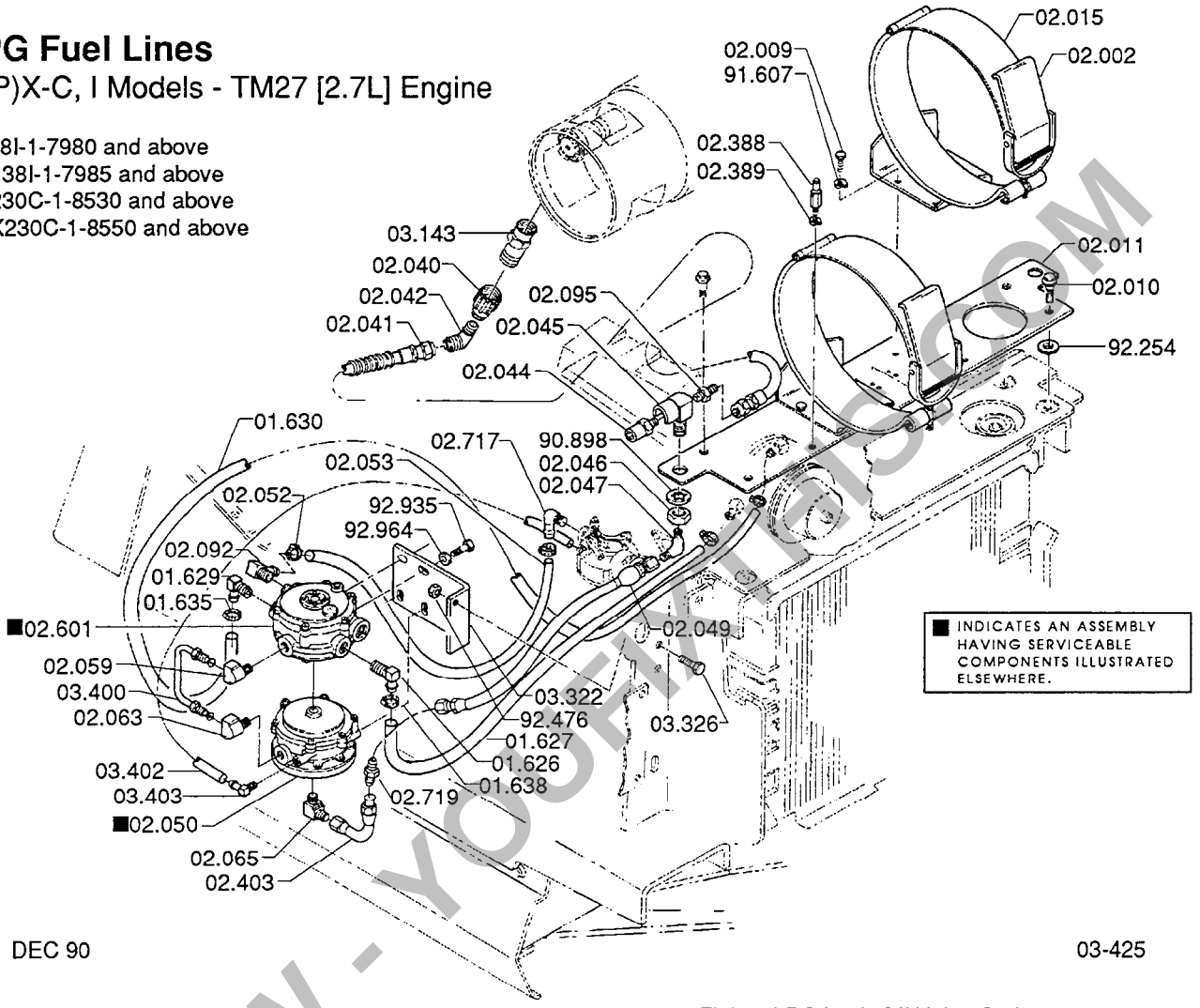
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LPG Fuel Lines

G(P)X-C, I Models - TM27 [2.7L] Engine

G138I-1-7980 and above
GP138I-1-7985 and above
GX230C-1-8530 and above
GPX230C-1-8550 and above



DEC 90 03-425

01.626	Fitting, LPG Vaporizer Water Outlet
01.627	Line, LPG Vaporizer Water Outlet
01.629	Fitting, LPG Vaporizer Water Inlet Line
01.630	Line, LPG Vaporizer Water Inlet
01.635	Clamp, LPG Vaporizer Water Inlet Line
01.638	Clamp, LPG Vaporizer Water Outlet Line
02.002	Clamp Arm, LPG Tank Strap
02.009	Fastener, LPG Tank Mounting Bracket
02.010	Bracket, LPG Tank Mounting
02.011	Fastener, LPG Tank Mounting Bracket
02.015	Strap, LPG Tank Clamping
02.040	Coupler, LPG Tank Quick Disconnect
02.041	Line, LPG Tank Outlet
02.042	Fitting, LPG Tank Outlet Line
02.044	Valve, Hydrostatic Relief
02.045	Adaptor, LPG Three Way
02.046	Fastener, LPG Three Way Adaptor
02.047	Fitting, LPG Adaptor Outlet
02.049	Line, LPG Adaptor Outlet
02.050	Valve, LPG Lock-Off
02.052	Clamp, Vaporizer Fuel Outlet Line
02.053	Line, Vaporizer Fuel Outlet
02.059	Fitting, Vaporizer Inlet
02.063	Fitting, LPG Lock-Off Valve Outlet
02.065	Fitting, LPG Lock-Off Valve Inlet
02.092	Fitting, Vaporizer Outlet
02.095	Fitting, LPG Filter Outlet Line
02.388	Pin, LPG Tank Locating
02.389	Fastener, LPG Tank Locating Pin
02.403	Line, LPG Lock-Off Valve Inlet
02.601	Vaporizer Assembly, LPG
02.717	Fitting, Carburetor Fuel Inlet
02.719	Fitting, LPG Lock-Off Valve Inlet
03.143	Coupler, LPG Tank Quick Disconnect
03.322	Bracket, LPG Vaporizer Mounting
03.326	Fastener, LPG Regulator Mounting Bracket
03.400	Line, LPG Lock-Off Valve Outlet
03.402	Line, LPG Lock-Off Valve Vacuum
03.403	Fitting, LPG Lock-Off Valve Vacuum Port
90.898	Washer, Three Way Adaptor Mounting Fastener
91.607	Lockwasher, LPG Tank Bracket Mounting Fastener
92.254	Washer, LPG Tank Mounting Bracket Fastener
92.476	Nut, LPG Regulator Mounting Bracket Fastener
92.935	Fastener, LPG Lock-Off Valve
92.964	Washer, LPG Lock-Off Valve Fastener

SM520 3/12/91

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5.10 LPG Fuel Lock-Off Valve

IMPCO Model VFF 30

Description and Operation 5.10-1
Lock-Off Valve Maintenance Notes 5.10-2
Lock-Off Valve Removal/Installation 5.10-3
Parts Nomenclature 5.10-4
Overhaul 5.10-5
Disassembly 5.10-5
Reassembly 5.10-7

Description and Operation

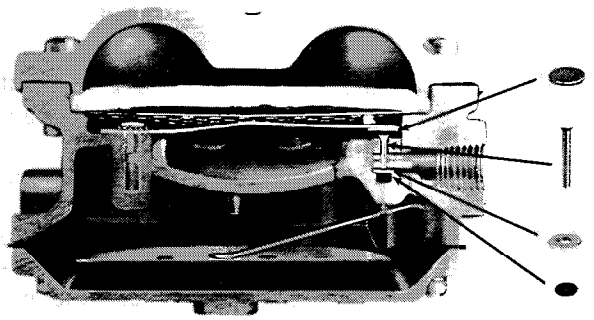


Figure 1. Cross-section of lock-off valve.

The IMPCO carburetion system starts with the filter and fuel lockoff valve. This is the VFF30 fuelock/filter. The fuel lock-off valve is operated by a diaphragm controlled by vacuum via a vacuum line from the carburetor. When a slight vacuum is sensed (2" water column), it opens and allows fuel from the tank to flow through an internal fuel filter and then to the converter (vaporizer-regulator). Any time the engine stops, whether the ignition key switch is on or off, the fuel is shut off automatically. Also, it filters any large particles of solid material, 5 microns and larger, out of the fuel before they reach the high-pressure side of the vaporizer-regulator.

The lock-off valve consists of 1) valve seat, operating pin, O-ring seal for the pin with retaining washer, and spring fitted in the body with a fuel outlet and vacuum inlet port, 2) a fuel filter and screen enclosed with the filter cover including fuel inlet port, and 3) a diaphragm and operating lever, which actuates the valve operating pin, enclosed with the diaphragm cover.

The valve operating pin fits in the valve jet and through the main body from the filter side to the diaphragm side. The operating pin is sealed with an O-ring to prevent leakage around the pin from the inlet and fuel outlet side into the diaphragm housing. The O-ring fits into a recess in the main body under the valve jet and is kept in place with a retaining washer fitted into a slot accessible from the fuel outlet port. The retaining washer is held in place by the valve pin when installed. During disassembly, removal of the valve pin allows retaining washer to be removed through the "Fuel Out" (1/4 NPT) opening.

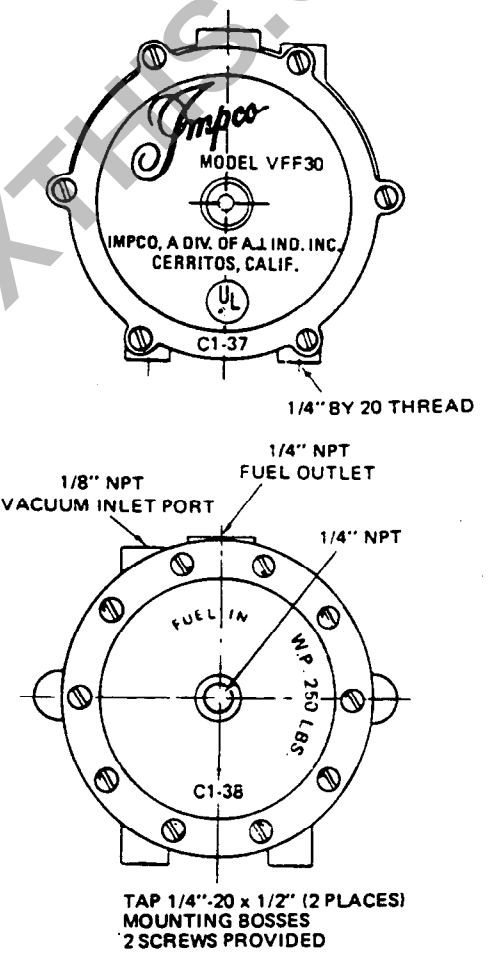
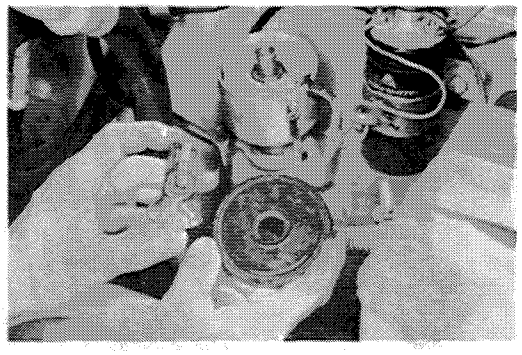


Figure 2. IMPCO VFF30 lock-off valve.

NOTICE - When servicing the lock-off valve, it is important that the valve operating pin and O-ring be lubricated with silicone grease or equivalent. O-ring must be secured with retaining washer. Washer is installed through LP-gas outlet opening and locked in slot with valve pin. Silicone grease will let pin slide easily through O-ring.

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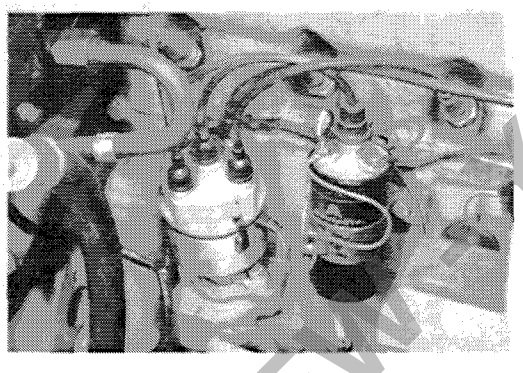


9. Install the dust shield and the rotor. Be sure that the dust shield is correctly seated and positioned according to the locator notch (see marking on dust shield).

Check Centrifugal Advance Governor Mechanism

1. Install the rotor. Turn (rotate) the rotor clockwise and release it to confirm that the rotor returns to the original position smoothly.

Distributor Reassembly



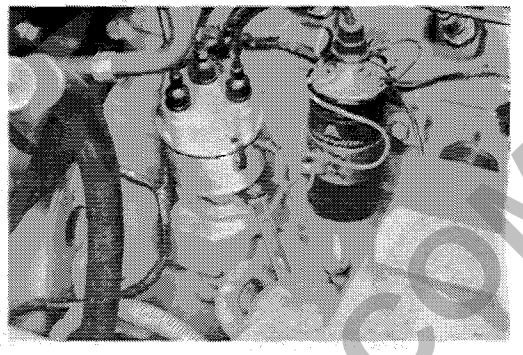
1. Install the distributor cap. Be sure that the distributor cap and dust shield are in place and seated correctly, and the spring clips which hold the cap in place are both installed and latched.

2. Install the coil secondary cable and spark plug cables. Check to be sure that the spark plug cables are all correctly installed and seated in the distributor cap. **Note** - The cap does not have cable designation identification.

Firing Order: 1-2-4-3

Dielectric Grease

The use of a dielectric silicone grease at high-voltage cable connecting points such as coil and distributor cap towers and spark plugs is recommended to ensure good electrical connection and prevent corrosion.



3. If the distributor was loosened and moved, rotate the distributor to put it in its original timing position by lining up the matching marks, as described previously. Tighten the clamp bolt at the base of the distributor.

Checking Dwell Angle

1. Ignition system and engine must be operating.

2. To check dwell angle, install a dwell angle tester (Clark Dynamic Engine Analyzer, Pt. No. 1802047, or equivalent). Follow standard procedure.

Dwell Angle: 31° (26°-36°)
with sensor air gap of [0,203 mm] .008 in.

3. As a further test, decrease engine speed from approximately 1500 rpm to idle speed. If the dwell meter pointer deflects more than 3° under this test, check for loosening of the distributor shaft or ignition module. Also, check for worn distributor shaft bushing.

Refer to distributor specifications, page 6.6-2.

Checking Ignition Timing

Also refer to Section 4.4, Ignition Timing Procedure.

NOTICE - Always check and adjust ignition timing after installing new ignition module or adjusting sensor air gap.

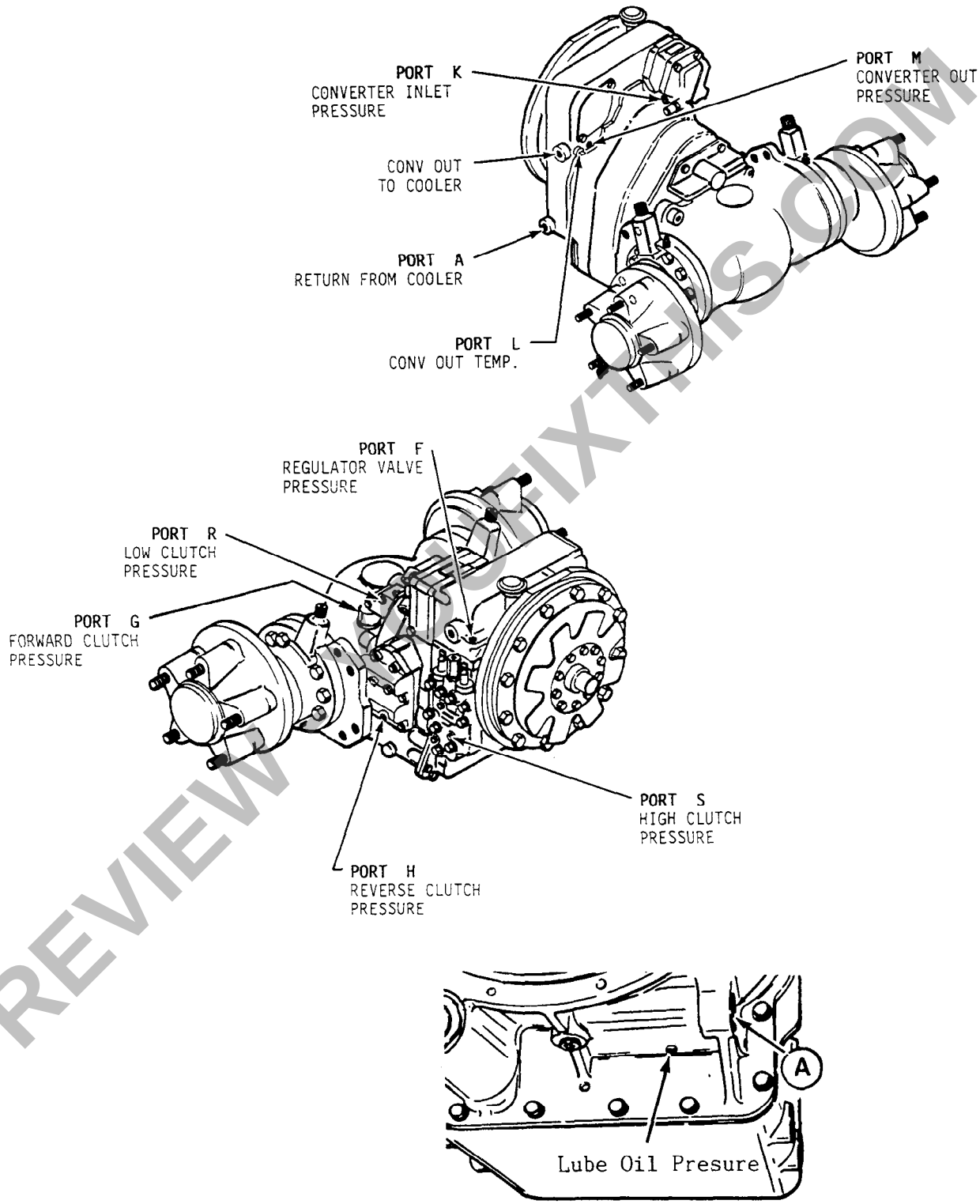
1. Using a dwell meter, check and adjust sensor air gap first and then check ignition timing and advance.
2. Install a tachometer and timing light.
3 Adjust idle speed to 500 rpm.

CAUTION
Engine Fan
Be sure to hold the timing light in a position above the top of the alternator (or radiator) to avoid being too close to the rotating fan blades. Be careful to stay away from the fan when leaning over to see the timing marks.

4. With engine running at 500 rpm idle speed, aim the timing light at the crankshaft pulley and timing pointer.

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HR600 Transmission Pressure Check Points



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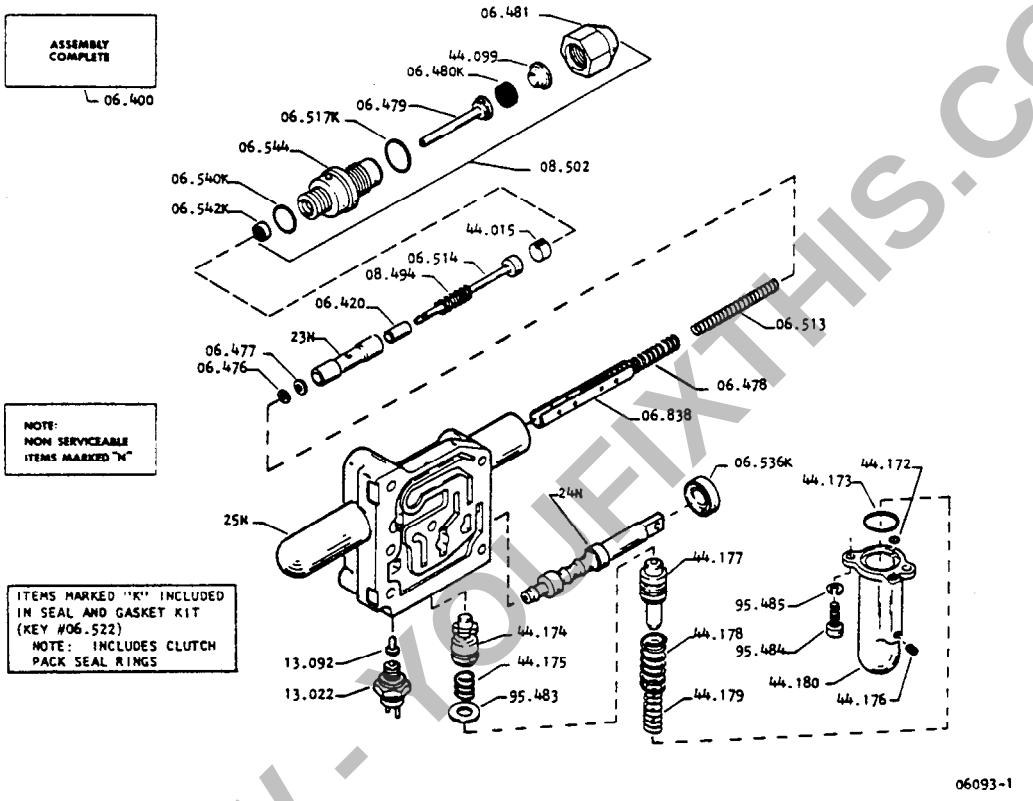
Transmission Control Cover

(Style 2) Incorporating modulator and accumulator

Used on 11FHR510-7 and later models

Dec 1986, Begin Lot 6478 (Cush), 6488 (Pneu) and above

NOTICE *- Refer to Page 7.7-63 for (Style 1) Control Valve (modulator and accumulator in charging pump).*

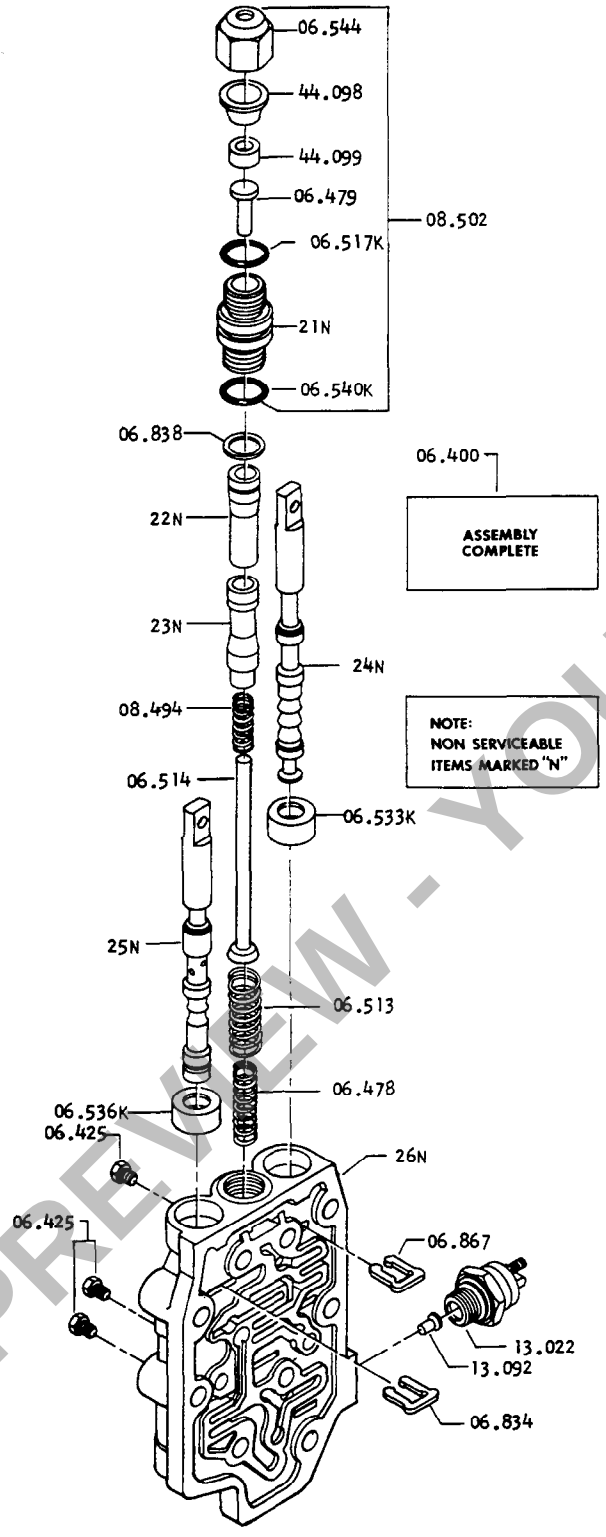


06.400	CONTROL COVER ASSEMBLY, TRANSMISSION	13.092	ACTUATOR, NEUTRAL START SWITCH
06.420	SPACER, INCHING SPOOL RETURN SPRING	44.015	STOP, INCHING VALVE PISTON
06.476	RETAINER, INCHING VALVE PISTON	44.099	STOP, INCHING ACTUATOR PISTON
06.477	WASHER, INCHING VALVE PISTON	41.172	SEAL, SHIFT MODULATOR HOUSING
06.478	SPRING, INCHING VALVE PISTON RETURN (OUTER)	44.173	SEAL, SHIFT MODULATOR HOUSING
06.479	PISTON, INCHING ACTUATOR	44.174	SPOOL, SHIFT MODULATOR
06.480	SEAL, INCHING ACTUATOR PISTON	44.175	SPRING, SHIFT MODULATOR SPOOL
06.481	FITTING, INCHING VALVE ACTUATOR INLET	44.176	PLUG, SHIFT MODULATOR OIL PASSAGE
06.513	SPRING, INCHING VALVE PISTON RETURN (INNER	44.177	PISTON, SHIFT MODULATOR
06.514	PISTON, INCHING VALVE	44.178	SPRING, SHIFT MODULATOR PISTON RETURN
06.517	SEAL, INCHING ACTUATOR INLET FITTING	44.179	SPRING, SHIFT MODULATOR PISTON RETURN
06.536	SEAL, DIRECTIONAL SELECTOR VALVE	44.180	HOUSING, SHIFT MODULATOR
06.540	SEAL, INCHING ACTUATOR PISTON HOUSING	95.483	WASHER, SHIFT MODULATOR PISTON
06.542	SEAL, INCHING ACTUATOR PISTON ROD	95.484	FASTENER, SHIFT MODULATOR TO CONTROL COVER
06.544	HOUSING, INCHING ACTUATOR PISTON	95.485	LOCKWASHER,SHIFT MODULATOR TO CONTROL COVER FAST
06.838	STOP, INCHING VALVE SPOOL	23N	SPOOL, INCHING VALVE USE 06.400
08.494	SPRING, INCHING SPOOL RETURN	24N	VALVE, DIRECTIONAL SELECTOR USE 06.400
08.502	ACTUATOR ASSEMBLY, INCHING VALVE	25N	HOUSING, CONTROL COVER USE 06.400
13.022	SWITCH, NEUTRAL START		

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Control Cover (Valve)

WC, I Models - HR620/621 2-speed transaxle



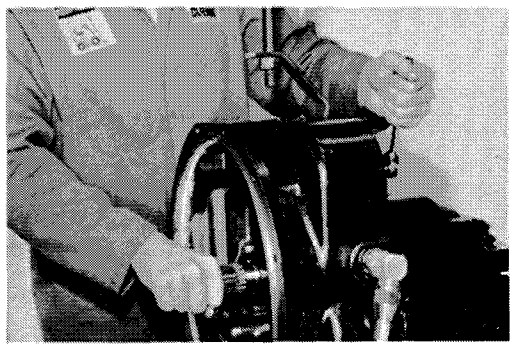
06.400	CONTROL COVER & VALVE ASSEMBLY	
06.425	PLUG, CONTROL COVER OIL PASSAGE	
06.478	SPRING, INCHING PISTON RETURN	
06.479	PISTON, INCHING	
06.513	SPRING, INCHING VALVE	
06.514	ROD, INCHING VALVE	
06.517	SEAL, INCHING PISTON HOUSING	
06.533	SEAL, HIGH & LOW SELECTOR VALVE	
06.536	SEAL, FORWARD & REVERSE SELECTOR VALVE	
06.540	SEAL, INCHING PISTON HOUSING	
06.544	HOUSING, INCHING PISTON	
06.834	STOP, FORWARD & REVERSE SELECTOR VALVE	
06.838	STOP, INCHING VALVE	
06.867	STOP, HIGH & LOW SELECTOR VALVE	
08.494	SPRING, INCHING SPOOL RETURN	
08.502	ACTUATOR ASSEMBLY, INCHING VALVE	
13.022	SWITCH, NEUTRAL STARTING	
13.092	ACTUATOR, NEUTRAL STARTING SWITCH	
44.098	CUP, INCHING PISTON	
44.099	STOP, INCHING PISTON CUP	
21N	HOUSING, INCHING PISTON	USE 08.502
22N	SLEEVE, INCHING VALVE	USE 06.400
23N	SPOOL, INCHING VALVE	USE 06.400
24N	VALVE, HIGH & LOW SELECTOR	USE 06.400
25N	VALVE, FORWARD & REVERSE SELECTOR	USE 06.400
26N	HOUSING, CONTROL COVER & VALVE	USE 06.400

06-084 APR 84

ITEMS MARKED "K" INCLUDED IN TRANSMISSION SEAL AND GASKET KIT (KEY NUMBER 06.522 OF TRANSMISSION ASSEMBLY)

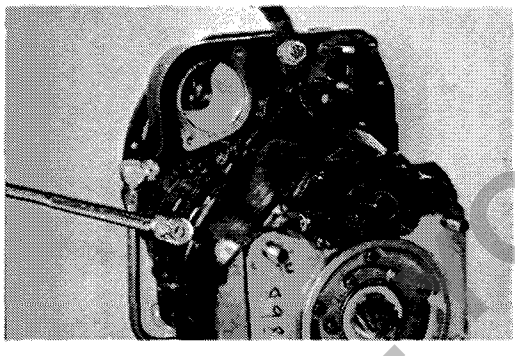
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10. Install converter housing to transmission case mounting bolts and washers. Tighten the bolts gradually, bringing the two housings together. Continue turning the converter turbine shaft to be sure all parts are assembling properly.

IMPORTANT - Do not force the housings together. If restriction is felt, separate the housings and restart the assembly procedure; otherwise damage may occur to the clutch discs.



11. Finish tightening the mounting bolts with a torque wrench. Tighten bolts to torque spec: [50-56 Nm] 37-41 lbf.ft. (Similar to HR620 shown.)

8. Axle Housing Pilot Adaptor Assembly

Note - If transmission was disassembled only without overhaul, or if no new parts affecting reverse clutch/pinion shaft installation were installed, e.g., ring and pinion gear (clutch shaft), bearings, torque converter housing parts, etc., the previous shims under rear bearing cup may be reused, assuming proper bearing preload was present before disassembly.

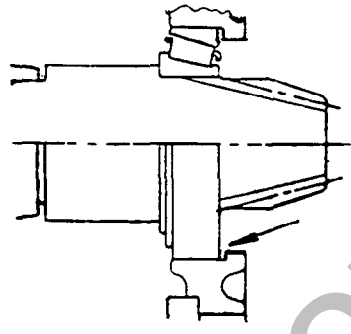
Trial Installation

to Determine Bearing Preload Shim Thickness

1. Tip assembly up onto face of converter housing. Rotate pinion to seat front bearing.

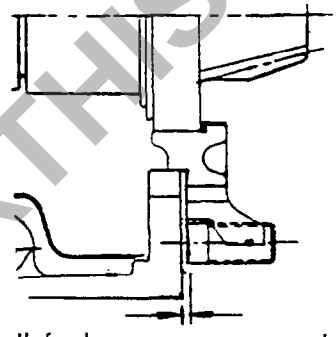
2. Install reverse clutch & pinion shaft rear bearing cup into axle housing pilot adaptor, without shims.

3. Install axle pilot adaptor on transmission case and tighten bolts. Then, push or pry the bearing cup towards bearing cone. Rotate pinion shaft at the same time cup is pushed toward cone to seat bearings.



4. Measure distance (space) between bearing cup and inside end of bore in axle pilot adapter with small feeler gauges. This dimension is the thickness of the shims required for line-to-line fit of the bearings.

Alternate Trial Installation



5. If small feeler gauges are not available, an alternate method would be to install four .020" shims beneath bearing cup. Install axle pilot adaptor and tighten bolts while rotating pinion. Tighten bolts evenly until resistance is felt on pinion. Measure the distance (space) between axle pilot adaptor and transmission case in four places 90° apart. The average of the four measurements will be the amount to subtract from .080 " to determine shim thickness for line-to-line condition.

Bearing Preload

6. Check the bearing preload torque by rotating pinion with a torque wrench.

Bearing preload torque spec: [0.7-1.6 Nm] 6-14 lbf.in.

Note - If preload is too low, remove shims. If too high, add shims. Disassemble axle pilot adaptor, add or remove shims as required, reassemble and check preload.

7. Remove axle pilot adaptor. Install correct shims under bearing cup, install the O-ring seals on adapter mounting face and outer rim and reinstall axle pilot adaptor. Install mounting capscrews and lockwashers. Tighten mounting capscrews to torque spec: [50-55 Nm] 37-41 lbf.ft.

NOTICE - Refer to Section 7.9, HR620 Transaxle Overhaul, for additional final assembly information and assembly of transmission to drive axle, including ring & pinion gear backlash and gear tooth bearing contact pattern checks.

Refer to Section 7.11 for drive axle overhaul.

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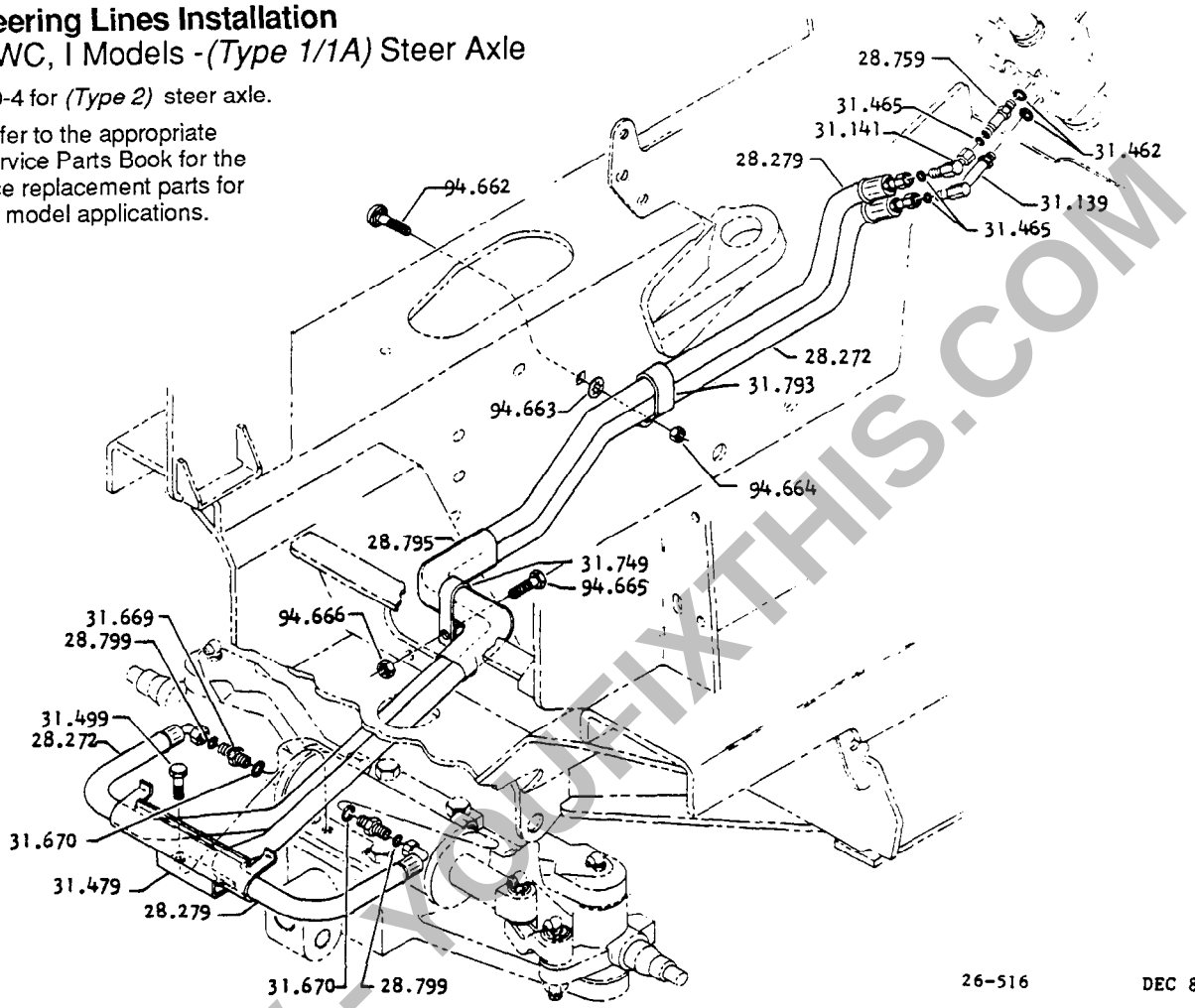
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Power Steering Lines Installation

MB, MC, WC, I Models -*(Type 1/1A)* Steer Axle

See Page 9.0-4 for *(Type 2)* steer axle.

NOTICE - Refer to the appropriate Customer Service Parts Book for the correct service replacement parts for specific truck model applications.



28.272	LINE, STEER CYLINDER INLET
28.279	LINE, STEER CYLINDER INLET
28.759	FITTING, STEER VALVE OUTLET PORT
28.795	PROTECTOR, POWER STEERING LINES
28.799	SEAL, STEER CYLINDER PORT FITTING
31.139	FITTING, STEER VALVE OUTLET PORT
31.141	FITTING, STEER VALVE OUTLET PORT
31.462	SEAL, STEER VALVE OUTLET PORT FITTING
31.465	SEAL, STEER VALVE OUTLET PORT FITTING
31.479	CLAMP, POWER STEERING LINES RETAINING
31.499	FASTENER, POWER STEERING LINES RETAINING CLAMP
31.669	FITTING, STEER CYLINDER PORT
31.670	SEAL, STEER CYLINDER PORT
31.749	CLAMP, POWER STEERING LINES
31.793	CLAMP, POWER STEERING LINES
94.662	FASTENER, POWER STEERING LINES CLAMP
94.663	RETAINER, POWER STEERING LINES CLAMP FASTENER
94.664	NUT, POWER STEERING LINES CLAMP FASTENER
94.665	FASTENER, POWER STEERING LINES CLAMP
94.666	NUT, POWER STEERING LINES CLAMP FASTENER

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9.12 Steer Axle Overhaul
(Type 2)

Preparation For Disassembly 9.12-1
Parts Nomenclature 9.12-2
Disassembly 9.12-3
Parts Inspection 9.12-6
Reassembly 9.12-7

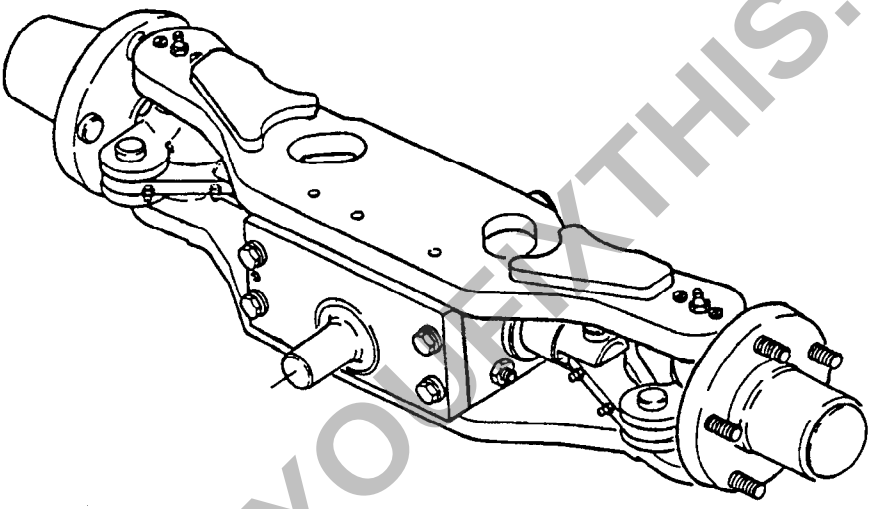


Figure 1. Steer Axle Assembly - *(Type 2)*

(Type 2) Steer Axle

Refer to Section 9.5 for steer axle type specifications and description.

Refer to Section 9.7 for removal of steer axle assembly from truck.

This steer axle has a one-piece fabricated main body assembly using steel box-type construction. The steering cylinder is an integral separate 2-way actuator mounted within the main body and joined to steering knuckles by links similar to *(Type 1A)*. All bearings are replaceable and have lubrication fittings.

***NOTICE** - Please refer to Customer Service Parts Book for the correct service replacement parts for specific truck model (serial number) applications.*

Preparation For Disassembly

***NOTICE** - Cleanliness is of extreme importance in the repair and overhaul of this assembly.*

1. **Before starting disassembly,** thoroughly clean the axle assembly of all accumulations of dirt, oil, corrosion and other substances to prevent contamination of the parts during disassembly and overhaul.
2. **Work in a clean area.**
3. **Keep all parts in order** as disassembly progresses. Take care to properly identify each part and its order of removal. **If necessary**, keep notes and put markings on parts using a non-destructive marker such as a felt- tipped pen.

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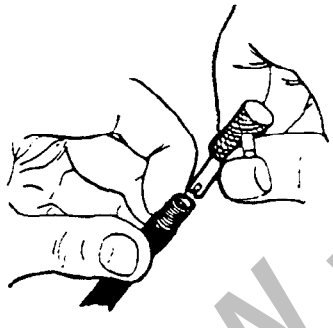
Wheel Disassembly and Tire Removal

CAUTION
To perform these service procedures, it is recommended that you first: • Park truck on a hard, level and solid surface. • Put upright in vertical position and fully lower the forks or attachment. • Put all controls in neutral and turn key switch OFF. • Apply the parking brake and block the wheels.

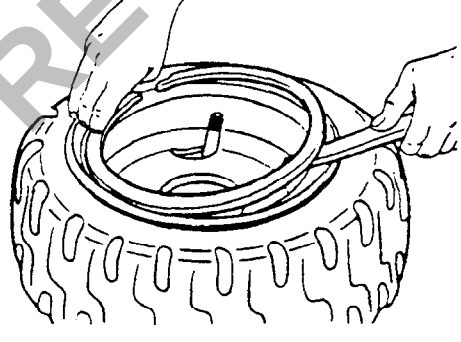
Refer to Section 3.3, Machine Jacking and Blocking, for additional information.

Tires Installed on Standard Lock-Ring Type Wheels

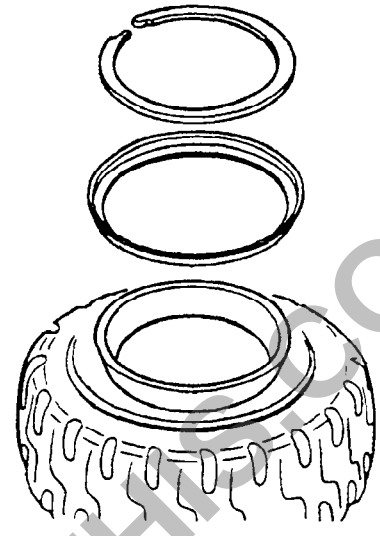
WARNING
Before starting disassembly, remove the air from the tire. Failure to remove the air from the tire can result in serious injury.



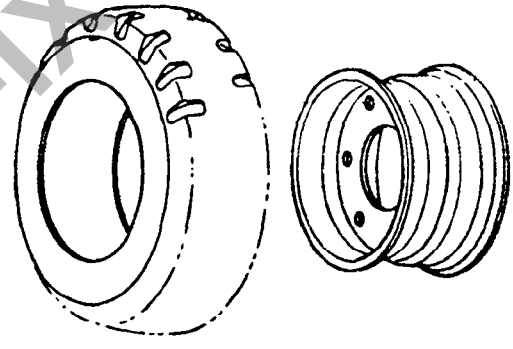
1. Remove valve core from the valve stem to be sure all air is removed.
2. After you remove all air from the tire, loosen and remove the wheel bolts or nuts. Remove wheel from truck.



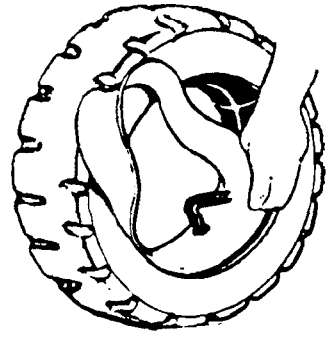
3. Remove lock ring.



4. Remove wheel wedge.



5. Remove tire from wheel.



6. Remove the rubber inner tube protector (flap).
7. Repair tire and/or tube, as needed.

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