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10 SERIES
GENERAL

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780CK Loader Backhoe

A detailed line drawing of a complex industrial machine, likely a steam engine or pump. The machine features a large horizontal cylindrical body with various pipes, valves, and fittings. A prominent vertical pipe with a valve is on the left. The drawing is a technical illustration, showing the intricate details of the machinery.

General

Piston and Connecting Rods

Main Bearings

Main Bearings	
Number of Bearings	5
Type Bearings	Replaceable Precision Steel Back, Copper-Lead Alloy Liners

Engine Lubricating System

Crankcase capacity	10 Qts. (9.4 litre)
with Filter Change	11 Qts. (10.34 litre)
Oil Pressure	46 to 59 Pounds with Engine Warm and Operating At Rated Engine Speed
Type System	Pressure and Spray Circulation
Oil Pump	Gear Type
Oil Filter	Full Flow Spin on Type

Fuel System

Fuel System	
Fuel Injection Pump	Robert Bosch, Type PES Multiple Plunger
Pump Timing	30 Degrees Before Top Dead Center (Port Closing)
Fuel Injectors	Pencil Type (Opening Pressure 2800 PSI)
Fuel Transfer Pump	Plunger Type, Integral Part of Injection Pump
Governor	Variable Speed, Fly-Weight Centrifugal Type, Integral Part of Injection Pump
1st Stage Fuel Filter	Full Flow Spin on Type
2nd Stage Fuel Filter	Full Flow Spin on Type

Section 1023

SPECIFICATION DETAILS 336BD AND 336BDT ENGINE

Written In *Clear
And
Simple
English*

FRACTION to DECIMAL to MILLIMETER CONVERSION TABLE

Fraction	Decimal	MM	Fraction	Decimal	MM	Fraction	Decimal	MM
1/64	.0156	0.397	23/64	.3593	9.128	45/64	.7031	17.859
1/32	.0312	0.794	3/8	.3750	9.525	23/32	.7187	18.256
3/64	.0468	1.191	25/64	.3906	9.922	47/64	.7343	18.653
1/16	.0625	1.587	13/32	.4062	10.319	3/4	.7500	19.050
5/64	.0781	1.984	27/64	.4218	10.716	49/64	.7656	19.447
3/32	.0937	2.381	7/16	.4375	11.113	25/32	.7812	19.844
7/64	.1093	2.778	29/64	.4531	11.509	51/64	.7968	20.240
1/8	.1250	3.175	15/32	.4687	11.906	13/16	.8125	20.637
9/64	.1406	3.572	31/64	.4843	12.303	53/64	.8281	21.034
5/32	.1562	3.969	1/2	.5000	12.700	27/32	.8437	21.431
11/64	.1718	4.366	33/64	.5156	13.097	55/64	.8593	21.828
3/16	.1875	4.762	17/32	.5312	13.494	7/8	.8750	22.225
13/64	.2031	5.159	35/64	.5468	13.890	57/64	.8906	22.622
7/32	.2187	5.556	9/16	.5625	14.287	29/32	.9062	23.019
15/64	.2343	5.953	37/64	.5781	14.684	59/64	.9218	23.415
1/4	.2500	6.350	19/32	.5937	15.081	15/16	.9375	23.812
17/64	.2656	6.747	39/64	.6093	15.478	61/64	.9531	24.209
9/32	.2812	7.144	5/8	.6250	15.875	31/32	.9687	24.606
19/64	.2968	7.541	41/64	.6406	16.272	63/64	.9843	25.003
5/16	.3125	7.937	21/32	.6562	16.669	1	1.0000	25.400
21/64	.3281	8.334	43/64	.6718	17.065			
11/32	.3437	8.731	11/16	.6875	17.462			

INCH to MILLIMETER CONVERSION TABLE

Inch	MM	Inch	MM	Inch	MM	Inch	MM
1	25.400	6	152.000	10	254.000	60	1,524.000
2	50.800	7	177.800	20	508.000	70	1,778.000
3	76.200	8	203.200	30	762.000	80	2,032.000
4	101.600	9	228.600	40	1,016.000	90	2,286.000
5	127.000	10	254.000	50	1,270.000	100	2,540.000

SECTION

21

GENERAL ENGINE SERVICE AND REMOVAL

STALL CHECKS TO TEST CONDITION OF ENGINE, TORQUE CONVERTER AND EQUIPMENT HYDRAULIC SYSTEM

During these tests, engine speed will be recorded at full throttle when the converter and/or equipment hydraulic systems are installed. The results of these tests can help determine whether wear or other faults exist in the engine, converter, or equipment hydraulic system.



WARNING: The parking brake must be able to hold the tractor during the tests. If required, repair and adjust the parking brake and block the tractor wheels.

Oil Temperature

Before making the tests to follow, bring the transmission oil and equipment hydraulic oil to operating temperature. Apply the parking brake. Start the engine. With engine at low idle, shift into forward, high. Speed engine up to about 2/3 speed and roll back the bucket. Hold until normal operating temperature is recorded on the converter temperature gauge.

CAUTION: Watch gauge carefully to prevent overheating.

Test 1 - Combined Converter Equipment Hydraulic Stall Test

1. Apply parking brake. With engine at low idle, shift into forward, high range.
2. Increase engine speed to full throttle. Tilt bucket back and hold lever back to open the main relief valve. Record the engine rpm.

Test Summary

Engine speed should be 1320 ± 50 rpm (naturally aspirated engine) or 1750 ± 50 rpm (turbocharged). If engine speed is below specifications or if the engine quits, it may be due to:

- a. Engine worn, damaged, or improperly adjusted.

- b. Excessive hydraulic pressure in equipment circuit or mechanical faults in the transmission/converter and/or equipment hydraulic system.

If engine speed is above specifications, it indicates inefficiency in the converter and/or equipment hydraulic system. Possible sources of the trouble are:

- a. Internal leakage.
- b. Worn charging or equipment pump.
- c. Low main relief valve setting.

To narrow down the problem area, conduct Tests 2 and 3. If one system tests satisfactory and the other system tests unsatisfactory, it shows that the engine is O.K.

If both systems test unsatisfactory, the cause of the trouble is very likely the engine.

Test 2 - Converter Stall Test

1. Apply parking brake. With engine at low idle, shift into forward, high range.
2. Increase engine speed to full throttle. Record the engine rpm.

Test Summary

Engine speed should be 1950 ± 50 rpm (naturally aspirated engine) or 2150 ± 50 rpm (turbocharged). If within this range, proceed to Test 3. If engine speed is below specifications, a worn engine or faulty transmission/converter could be the trouble source. Perform Test 3. If this test is also unsatisfactory, it can be concluded that the engine is at fault.

However, if Test 3 is satisfactory it indicates transmission/converter problems. Make necessary repairs and adjustments, then repeat Test 2.

If engine speed is above specifications, the converter hydraulic system is inefficient.

This may be caused by internal leakage of oil, wear in the charging pump, or a faulty regulator valve.

Test 3- Equipment Hydraulics Stall Test

1. Place bucket on ground. Operate engine at full throttle.
2. Tilt bucket back and hold lever in power position to open the main relief valve. Record the engine rpm.

Test Summary

Engine speed should be 2230 ± 50 rpm

(naturally aspirated engine) or 2220 ± 50 rpm (turbocharged).

If engine speed is above specifications, it indicates engine wear or excessive pressure or restriction somewhere in the system. Check main relief valve pressure setting. If faulty, repair or adjust. Repeat Test 3. If engine speed is still low, the engine is likely at fault.

If engine speed is above specifications, the equipment hydraulic system is inefficient, indicating leakage, pump wear, or a low main relief valve setting.

ENGINE REMOVAL

The engine is removed by lifting it out of the tractor after it has been separated from the transmission. The transmission remains in the tractor. Have on hand a two-ton hoist and a supply of assorted, clean caplugs. Tag or mark wires, tubes, hoses, etc. as they are disconnected or removed for proper reinstallation.

1. Make necessary preparations:

- a. Lower the loader bucket to the ground. Block the tractor so it cannot move.
- b. Remove floor plates and engine side plates, if so equipped.

2. Drain the following:

- a. Radiator
- b. Engine crankcase

3. Remove the following:

- a. Air cap
- b. Exhaust stack and tubing
- c. Hood
- d. Grille and radiator shroud
- e. Starter.

CAUTION: When removing the starter, disconnect the battery negative (-) cable first.

4. Disconnect the following:

- a. Air compressor air lines
- b. Tachometer cable
- c. Fuel lines. Close fuel shutoff valve.
- d. All wiring that will interfere with removal.
- e. Throttle linkage from backhoe and foot pedal at left side of engine.
- f. Unclamp steering cylinder lines on right hand side.

5. Remove the radiator and oil cooler:

- a. Disconnect the hydraulic lines (two from transmission to the radiator and attached oil cooler. Close openings with caplugs.

NOTE: Some oil may drain out of hydraulic reservoir when steering circuit line to reservoir is disconnected.

- b. Remove the upper and lower radiator hoses.
 - c. Attach a hoist to the shroud. Remove shroud mounting bolts. Lift the shroud and radiator assembly free of the tractor, using caution not to damage the fan blades or radiator.
6. Place floor jacks or other suitable supports under the transmission.
 7. Attach a lifting sling to the engine.
 8. At this point make sure that everything necessary (excepting the front engine mounting bolt) has been removed or disconnected.
 9. Remove the engine-to-chassis mounting bolt and associated hardware at the front of the engine.
 10. Carry the engine forward until it is clear of the hydraulic reservoir, then lift it from the tractor.

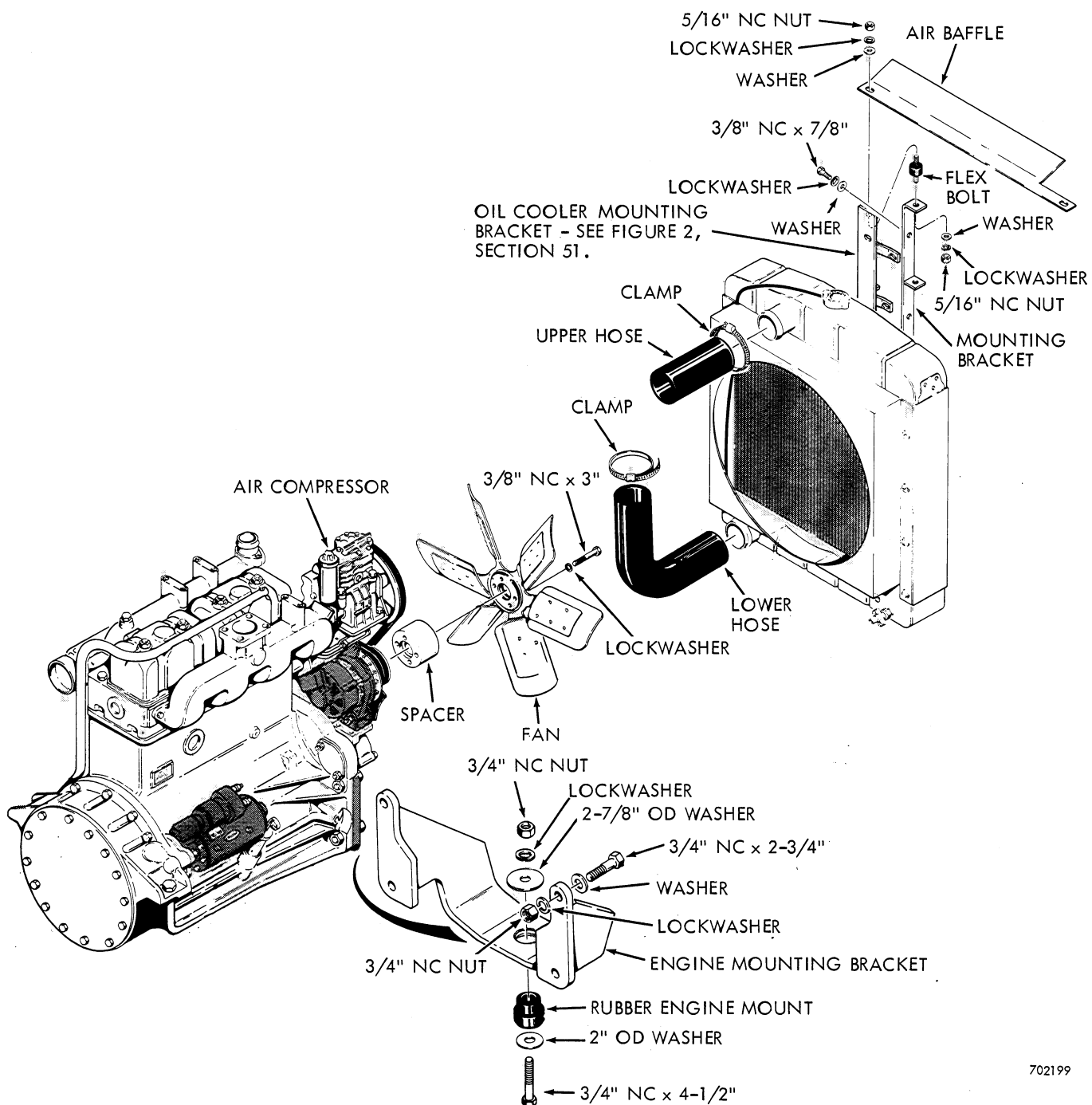
ENGINE INSTALLATION

The engine is installed in the reverse order of the removal. Refer to Figures 1 and 2 for details of mounting the engine and throttle linkage. Torque specifications are on page 11.

Before installing the engine, lubricate the starter. Remove three slotted plugs and saturate wicks with SAE 10 engine oil.

For pictures and drawings of hydraulics, wiring, linkages, etc., refer to the various sections of this manual as required.

When the engine has been installed, service all the filters and install coolant and engine oil as specified in Section 13.



702199

Figure 1 - Engine and Radiator Installation

ADJUSTMENT/INSTALLATION OF THROTTLE LINKAGE

Specifications

Low idle speed 750 ± 50 rpm
High idle speed (no load)
 N.A. engine 2350 ± 50 rpm
 Turbocharged engine . . . 2400 ± 15 rpm

Adjustments

Refer to Figures 2 and 3.

1. Disconnect the throttle rod at the injection pump. Check engine speed and make required adjustments at injection pump as described in Section 32, pages 6-10.
2. When the injection pump is in correct adjustment, adjust the accelerator and backhoe throttle linkage:
 - a. Adjust low idle speed to specifi-

cations by turning the adjustment bolt at left rear of engine, Figure 2.

- b. Check accelerator pedal for the 00" dimension shown in Figure 2. If required, adjust the linkage. Recheck low idle speed and adjust, if necessary.
- c. Adjust stop bolt, Figure 2, to contact accelerator pedal at high idle.
- d. Position backhoe throttle lever for low idle speed. Adjust the cable stop, Figure 3, to within $1/4$ " of the turnbuckle on the throttle rod.
- e. Adjust the "feel" of the backhoe throttle lever by turning the adjusting bolt on the control console, Figure 3.

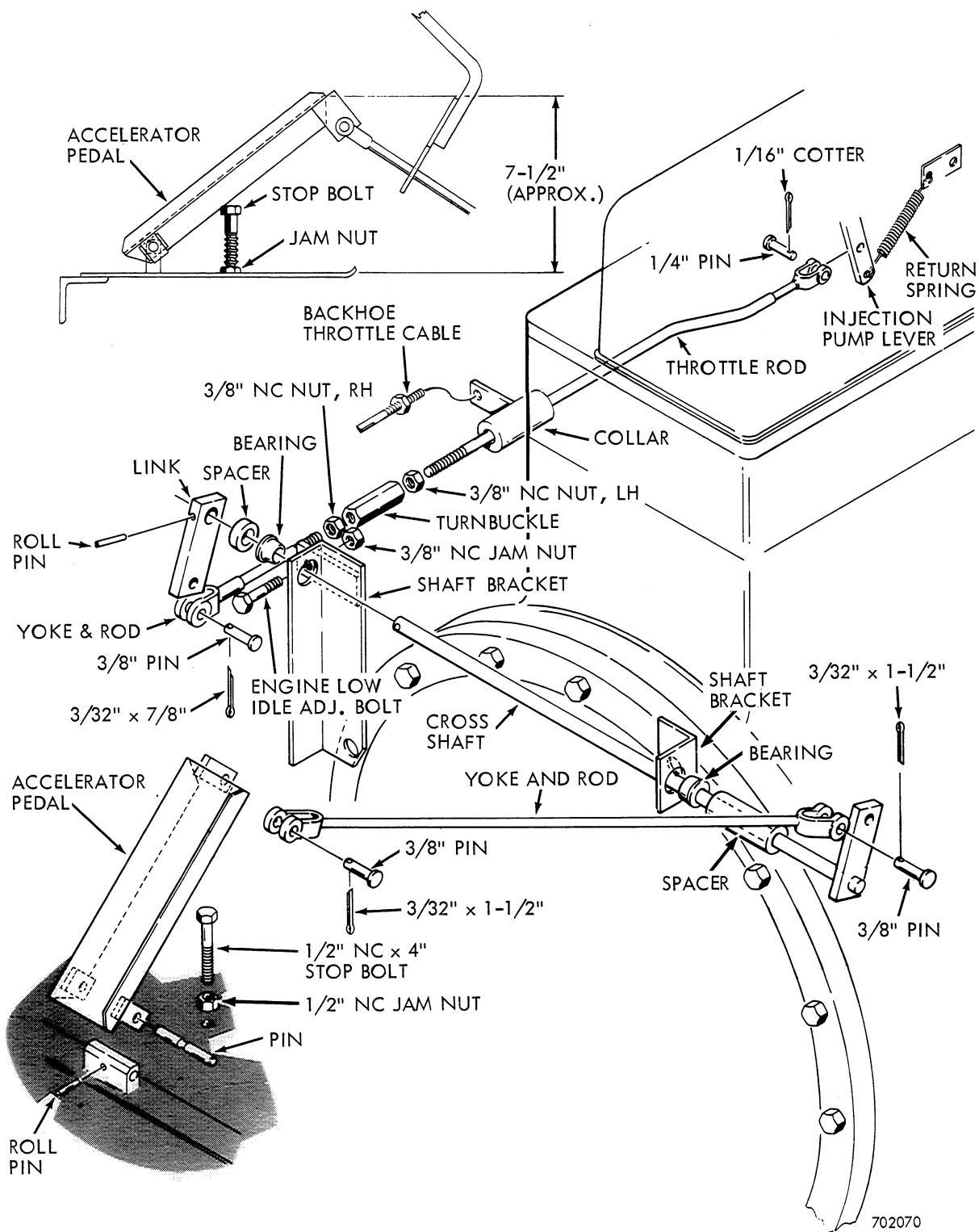


Figure 2 - Exploded View of Accelerator Linkage

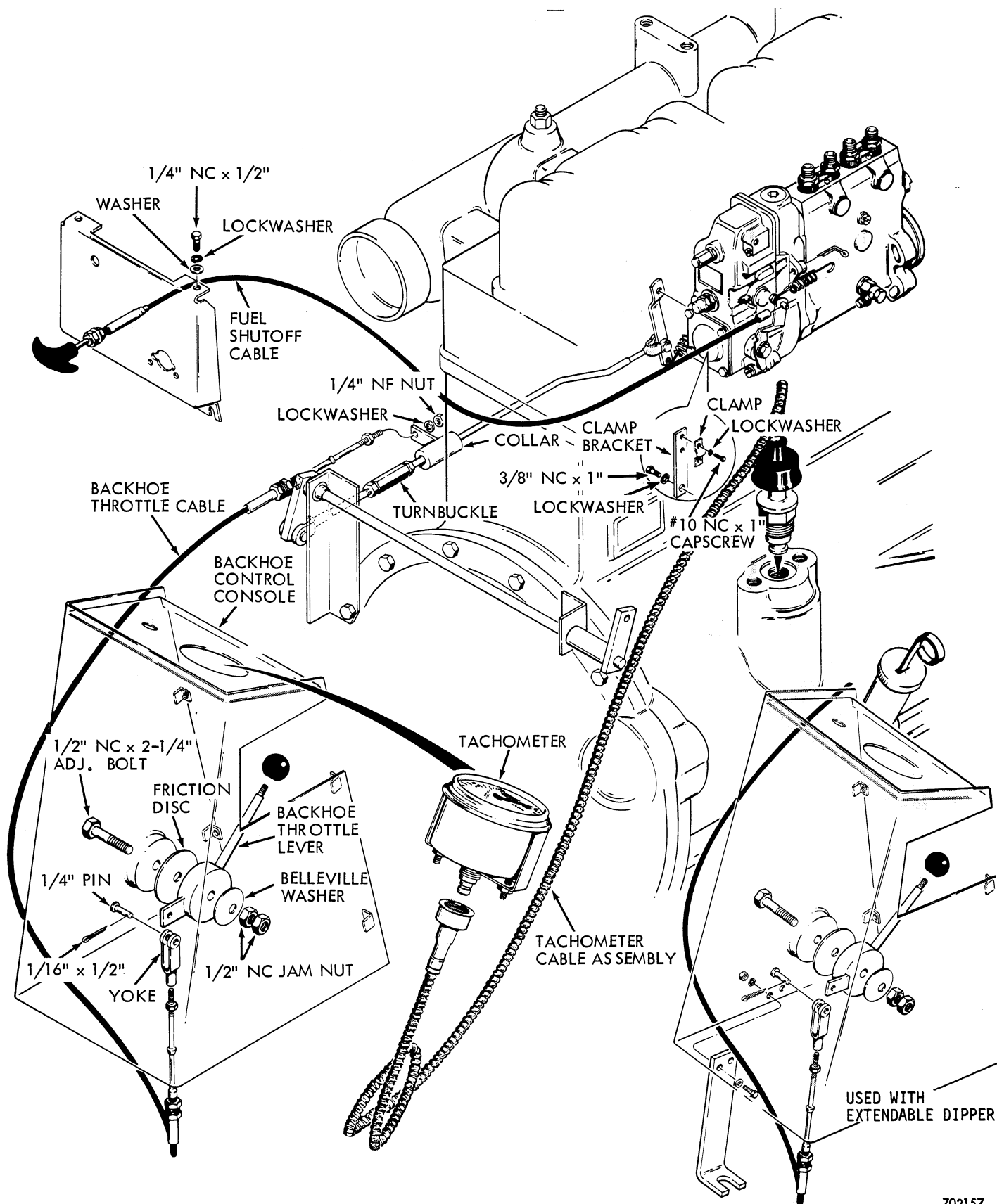


Figure 3 - Exploded View of Backhoe Throttle Linkage

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INSTALLATION OF CONVERTER DRIVE RING ON ENGINE FLYWHEEL

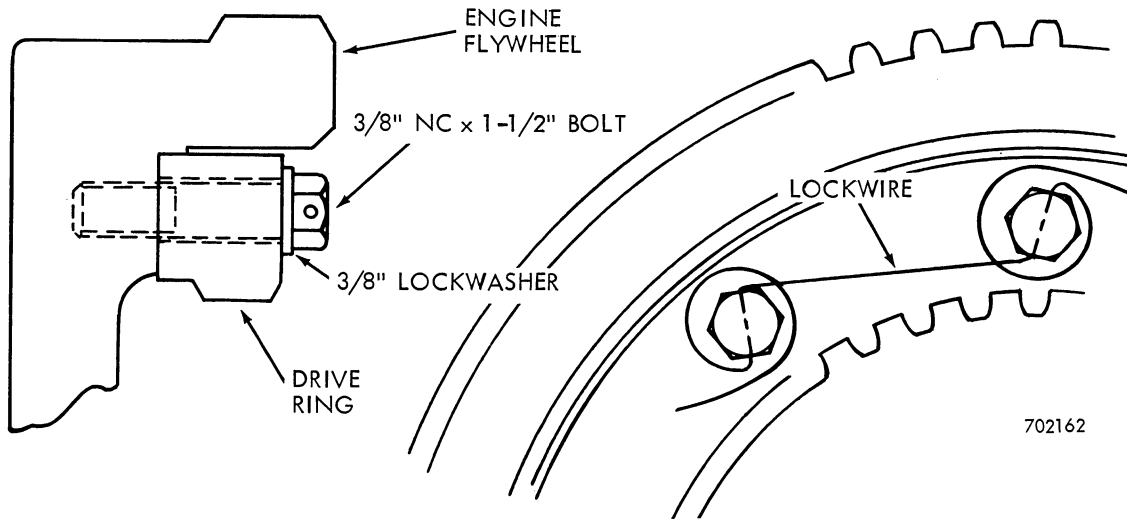


Figure 4 - Drive Ring Installation

1. Install drive ring on flywheel and torque bolts 20-25 foot pounds above the torque required to run bolts in place. When torquing drive ring bolts do not tighten consecutive bolts; tighten opposites.
2. Lock wire bolts with continuous wire so it does not interfere with gear teeth.

CAUTION: Bolts and washers supplied with the drive ring must be used. The use of washers with a smaller O.D. than those supplied will result in damage to the drive ring.



2

The air cleaner filter element must be serviced when the red band on the air cleaner restriction indicator remains in full view. In addition to filter service the dust cup should be cleaned daily or more often as conditions warrant.

Filter Element Service

The preferred method of cleaning the filter is by washing. Washing the filter results in restoring the filter to an almost new condition and longer intervals between servicing. It is recommended that a spare filter be available to allow sufficient drying time for the serviced filter and to reduce machine downtime.

Wash the filter in Case Filter Element Cleaner (Part No. A40910) according to instructions on container. Rinse thoroughly. Do not use water pressure over 40 psi at nozzle. Set filter aside to dry. Do not use compressed air to dry.

Use of compressed air to clean the filter is permissible but not recommended as it does not remove carbon and soot. When using compressed air, use no more than 30 psi at nozzle.

Inspect filter after it is clean and dry. Place a light inside filter and inspect for holes, tears, and dented or bent metal

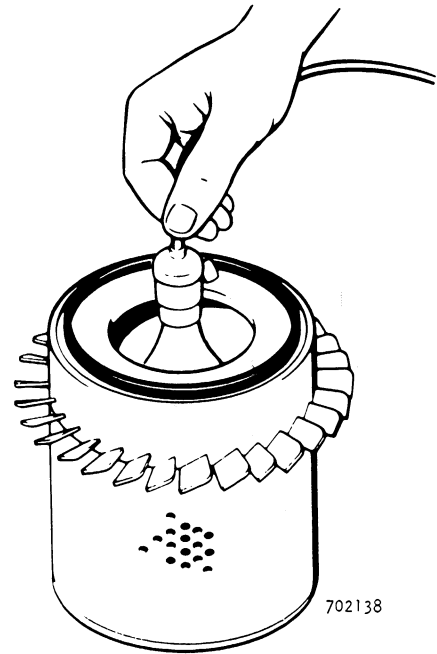


Figure 2 - Inspecting The Element

covering. If metal covering is dented or bent, inspect filter paper for holes or rub spots in that area. If holes or rub spots are noted, discard filter and install new filter element.

NOTE: Inspect new filter element for defects in the same manner. Do not accept a defective filter.

The filter must be replaced after it has been cleaned six times or once a year, whichever occurs first.

AIR CLEANER RESTRICTION INDICATOR

Specifications

Case No. A17652
Manometer Test
Inches of water. 20"±1.9"
Inches of mercury. 1.46"

Trouble Shooting

Refer to Figure 1.

1. The condition indicator is serviced as assembly only. It is non-adjustable.
2. If condition indicator troubles are suspected, first check out the safety filter (see below).
3. Check fittings for tightness. Check the tube and fittings for visible damage.
4. If a distributor tester equipped with a manometer is available, the restriction indicator can be tested as follows:
 - a. Remove the restriction indicator from the engine and attach the manometer hose to indicator.
 - b. Turn on the tester. Turn tester vacuum regulator switch on and slowly increase the vacuum until the red signal band appears. The red band should completely cover the green band at 20" of water or 1.46" of mercury.
 - c. If the condition indicator does not meet this specification, it should be replaced. The indicator is nonadjustable.

Safety Filter (Filtered Fitting)

A safety filter is built into the connector which joins the tube from restriction indicator to the air intake line. This filter prevents unfiltered air from entering the engine, if the tube to the restriction indicator or the indicator itself becomes damaged.

The safety filter will plug up with continued operation if a leak occurs. When the filter becomes plugged the restriction indicator will fail to operate.

Checking For Plugged Condition Filter

Refer to Figure 1.

1. Remove the air cleaner cap and seal off the air cleaner intake opening.
2. Start the engine. If the red signal band in the restriction indicator fails to appear, the safety filter is plugged and must be serviced.

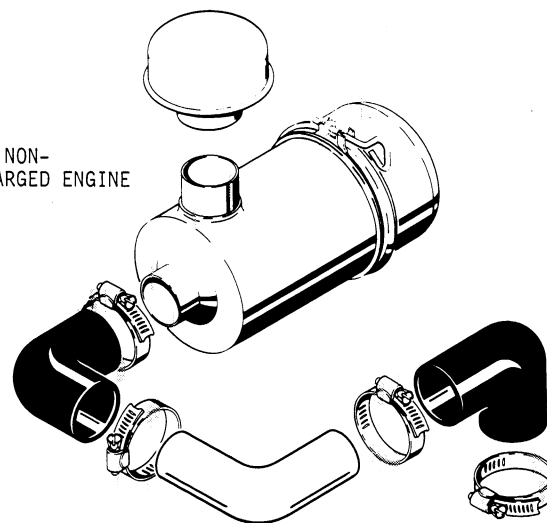
Servicing Safety Filter

1. Disconnect the tube from the restriction indicator at the connector with the safety filter. Remove the connector.
2. Try to clean the filter with compressed air. If it cannot be cleaned, replace the connector. Repeat the test above to make sure problem is corrected.

NOTE: Install connector to that filter and pinhole opening is toward the restriction indicator.

NOTE: REFER TO SECTION 24
FOR SERVICE INFORMATION.

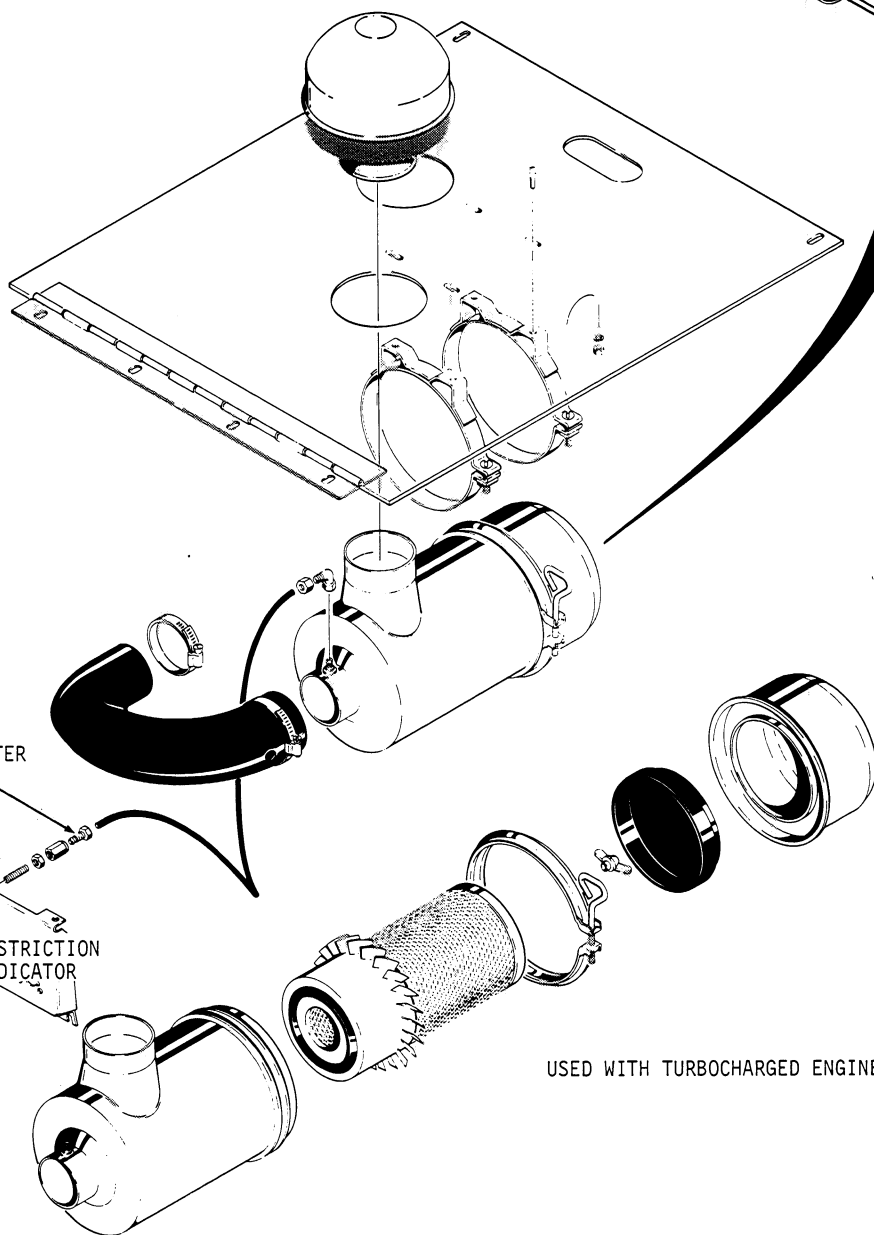
USED ON NON-
TURBOCHARGED ENGINE



SAFETY FILTER

RESTRICTION
INDICATOR

USED WITH TURBOCHARGED ENGINE



730682

Figure 1 - Air Cleaner Installation After S/N 5500550

GENERAL INFORMATION

Before making any repairs or adjustments on an engine, a mechanic or technician must properly diagnose the trouble.

Locating the trouble and repairing it is only part of the job, a technician must find and eliminate the cause of the trouble as well. Too many repairs are made with no thought to removing the causes that made the repair necessary.

For any engine to start or perform properly, three main requirements must be present.

1. FUEL
2. COMPRESSION
3. IGNITION

When any of these requirements are not present or limited by some mechanical reason the engine will not start or fails to operate properly throughout the power range.

1. FUEL. Fuel system problems can be present anywhere from the fuel tank, through the filters and injection pump as well as the injectors. Correct injection pump timing is important in the overall fuel system performance.

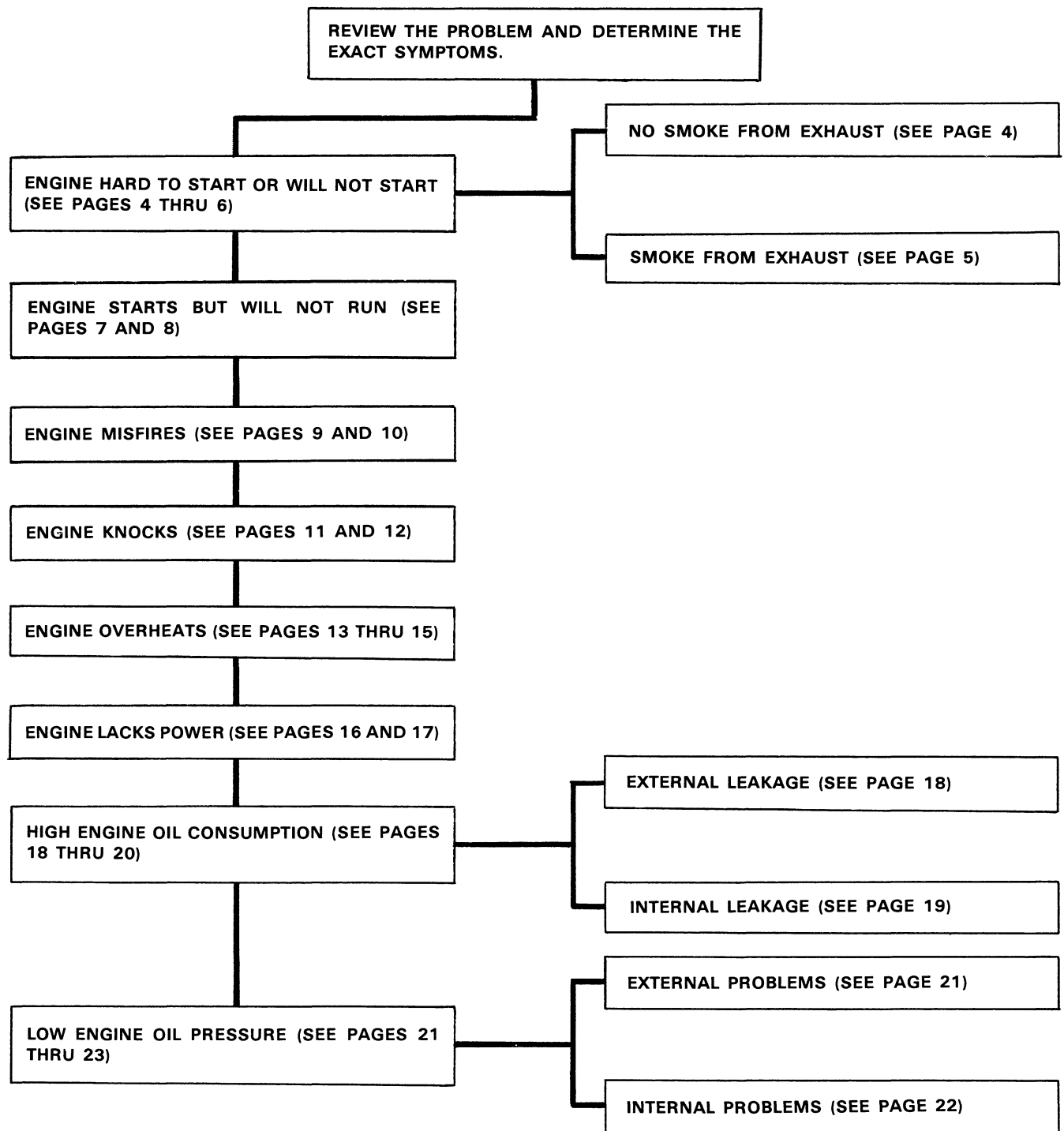
2. COMPRESSION. Compression on an engine is related to the "breathing function".

Proper compression is affected by the air cleaner condition, muffler restriction, valve condition and operation including proper valve adjustment, cylinder head gaskets condition of sleeves, rings, pistons, camshaft, and camshaft timing.

3. IGNITION. Ignition is the result of adequate compression to develop enough heat in the air charge on the compression stroke to fire the fuel being injected into the engine cylinders. Proper spray pattern and atomization of the fuel by the injector is very important. Timing the fuel injection pump to the engine to a precise degree BTDC is a vital requirement for proper ignition.

The engine diagnosis contained in the following pages covers many trouble symptoms, the causes, and what will be necessary to repair or eliminate the problem. Under each symptom are listed the most common and re-occurring problems progressively to the not so common problems. Locate your problem symptom in the diagnosis chart and refer to the pages listed for the probable causes and remedies.

ENGINE DIAGNOSIS CHART



ENGINE HARD TO START OR WILL NOT START

NO SMOKE FROM EXHAUST

1. Fuel Shut-Off Not Open Completely.

Improper cable adjustment, damaged cable, cable slipping in clamps, misadjusted or inoperative solenoid will not completely return fuel shut-off lever to open position. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.

2. Final Air Filter Plugged

A dirty filter will cause rich fuel mixture and low engine power. Check filter restriction indicator and service final air filter if required.

3. Slow Cranking Speed

Starter must crank engine 200 to 300 RPM in order to ignite the diesel fuel. Check engine RPM while cranking. If cranking is slow, check starter amperage draw to help determine the following defective areas: batteries, cables, solenoid, and starting motor.

Slow cranking speed can be caused by the following internal and external engine defects: scuffing and scoring of pistons and sleeves, improper crankshaft or camshaft end play, defective rod or crank bearings, oil pump, air compressor, water pump or hydraulic pump.

4. Fuel Supply Shut Off or No Fuel

Check that fuel tank shutoff valve is open. Check fuel supply in tank.

5. Air In Fuel System

Bleed fuel system until fuel flows steadily with no bubbles. Check for air leaks at fittings between tank and fuel pump.

6. Camshaft Damaged

A sheared key in the cam drive gear or a broken cam shaft will throw valve timing out of sequence affecting engine operation. Remove cylinder head cover and check valve timing in reference to crankshaft timing marks with a dial indicator.

7. Fuel Injection Nozzle Not Seated In Head.

A nozzle that is not seated in the cylinder head will let compression leak by and not produce enough heat to fire the injected fuel. Check for damaged nozzle gasket or seals, loose nozzle, or broken stud.

8. Fuel Line Plugged

A fuel line plugged with dirt will not let fuel through to the injection pump. Remove line at fuel filters and check for fuel flow through line.

9. Clogged Fuel Filter

Check and service fuel filters.

10. Wrong Fuel or Contaminated Fuel

Wrong fuel or contaminated fuel can cause the unit not to run, or to have preignition and detonation causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

11. Sticking Rack Control

A sticking rack control will not let the fuel injection pump accept any fuel. Remove cap from front of injection pump to see if rack moves when throttle lever is moved.

12. Piston Rings Worn

As piston rings become worn, they lose tension and ability to seal and wipe lubrication oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly sleeve and pistons.

13. Injection Pump Malfunction

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump.

ENGINE HARD TO START OR WILL NOT START

SMOKE FROM EXHAUST

1. Slow Cranking Speed

Starter must crank engine 200 to 300 RPM in order to ignite the diesel fuel. Check engine RPM while cranking. If cranking is slow, check starter amperage draw to help determine the following problem areas: batteries, cables, solenoid, and starting motor.

Slow cranking speed can be caused by the following internal and external engine defects: scuffing and scoring of pistons and sleeves, improper crankshaft or camshaft end play, worn rod or crank bearings, oil pump, air compressor, water pump or hydraulic pump.

2. Fuel Shut-Off Not Open Completely.

Improper cable adjustment, damaged cable, cable slipping in clamps, misadjusted or inoperative solenoid will not completely return fuel shut-off lever to open position. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.

3. Low Compression

Low compression on several cylinders makes the engine hard to start and also does not generate enough heat to properly fire on all cylinders and continue running. Make a compression check on the engine.

4. Final Air Filter Plugged

A dirty filter will cause rich fuel mixtures and low engine power. Check filter restriction indicator and service final air filter if required.

5. Fuel Injection Nozzles Malfunctioning

Low cracking pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.

6. Engine Timing Incorrect

Combustion will not occur in the cylinder at the correct moment (degrees BTDC) if the engine timing is incorrect. This can cause pre-ignition or detonation and serious damage to the engine. Check for proper engine timing.

7. Piston Rings Worn

As piston rings become worn, they lose tension and ability to seal and wipe lubricating oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly sleeve and pistons.

8. Valve Push Rods Bent

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinguished by excessive valve tappet noise. Remove cylinder covers and check for bent push rods.

9. Clogged Fuel Filter

Check and service fuel filters.

10. Fuel Injection Nozzle Not Seated In Head

A nozzle that is not seated in the cylinder head will let compression leak by and not produce enough heat to fire the injected fuel. Check for damaged nozzle gasket or seals, lose nozzle, or broken stud.

11. Tune-up Specifications Wrong

Check engine and unit serial number plates for correct specifications when performing engine tune-up.

12. Piston and Sleeves Scuffed and Scored

Scuffing starts as a very small surface disturbance of torn out metal particle. This helps break down lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubrication system or cooling system, incorrect timing, detonation, pre-ignition, lugging or overloading, improperly fitted parts, and improper break-in procedure. Remove piston assemblies and inspect.

ENGINE HARD TO START OR WILL NOT START

SMOKE FROM EXHAUST (Cont'd)

13. Cylinder Head Gasket Blown

A blown cylinder head gasket will cause one or two cylinders to lose power and cause an engine miss. It can also cause cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket or, remove thermostats and fan belts, run engine, and check for gas bubbles rising in coolant in the water manifold.

14. Piston Ring Installation Faulty or Broken Rings

Many times piston rings are installed wrong, upside down, wrong size, or expanders are cut-off on three piece oil rings and overlapping the expander. Be sure to carefully read instructions before installing piston rings. Damaged rings can cause scoring of the pistons and sleeves and cause the engine to use oil.

15. Valves sticking

Sticking valves can be caused by improper replacement of valve guides, no lubrication, rust vapors, bent valves, or carbon. A stick-

ing valve will cause an engine miss and the valve could also hit the piston causing internal damage.

16. Wrong Fuel or Contaminated Fuel

Wrong fuel or contaminated fuel can cause the unit not to run or to have preignition and detonation causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

17. Injection Pump Malfunction

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump.

18. Fuel Injection Line Cracked.

A cracked, chaffed or damaged fuel injector line will allow the fuel to escape externally and not inject fuel into the cylinder. This will cause an engine miss and low horsepower. Leaking fuel from a damaged injector line can easily be seen.

ENGINE STARTS BUT WILL NOT RUN

1. Fuel Shut-Off Not Open Completely

Improper cable adjustment, damaged cable, cable slipping in clamps, misadjusted or inoperative solenoid will not completely return fuel shut-off lever to open position. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.

2. Final Air Filter Plugged

A dirty filter will cause rich fuel mixtures and low engine power. Check filter restriction indicator and service final air filter if required.

3. Air In Fuel System

Bleed fuel system until fuel flows steady with no air bubbles. Check for air leaks at fittings between fuel tank and injection pump.

4. Low Fuel Supply

Check fuel supply in tank and refill if necessary.

5. Injection Pump Rack Control Sticking

A sticking rack control will not allow the fuel injection pump to accept any fuel. Remove cap from front of pump and check that rack moves when throttle lever is moved.

6. Low Compression

Low compression on several cylinders makes the engine hard to start and also does not generate enough heat to properly fire on all cylinders and continue running. Make a compression check on the engine.

7. Valve Push Rods Bent

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinguished by excessive valve tappet noise. Remove cylinder covers and check for bent push rods.

8. Camshaft Damaged

A sheared key in the cam drive gear or a broken camshaft will throw valve timing out of sequence, affecting engine operation. Remove cylinder cover and check valve timing in reference to crankshaft timing marks with a dial indicator.

9. Wrong Fuel or Contaminated Fuel

Wrong fuel or contaminated fuel can cause the unit not to run or to have preignition and detonation causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

10. Clogged Fuel Filter

Check and service fuel filters.

11. Fuel Injection Nozzles Malfunctioning

Low cracking pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.

12. Cylinder Head Gasket Blown

A blown cylinder head gasket will cause one or two cylinders to lose power and cause an engine miss. It can also cause cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket or, remove thermostats and fan belts, run engine, and check for gas bubbles rising in coolant in the water manifold.

13. Piston Rings Worn

As piston rings become worn, they lose tension and ability to seal and wipe lubricating oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly sleeve and pistons.



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ENGINE STARTS BUT WILL NOT RUN (Cont'd)

14. Valves Sticking

Sticking valves can be caused by improper replacement of valve guides, no lubrication, rust vapors, bent valves, or carbon. A sticking valve will cause an engine miss and the valve could also hit the piston causing internal damage.

15. Injection Pump Malfunction

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16. Fuel Injector Line Cracked

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cause an engine miss and low horsepower. Leaking fuel from a damaged injector line can easily be seen.

17. Injection Pump Timing Incorrect

A fuel injection pump timed at wrong degrees, wrong stroke, or marks moved on pulley, will inject fuel into the cylinders at the wrong time, causing rough running, detonation, preignition, low horsepower and other damage to the engine. Check for proper pump timing.

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