

Product: New Holland 9030/9030E Bidirectional Tractor Service Repair Manual

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**BIDIRECTIONAL™
TRACTOR
SERVICE**

9030

Vol. 1
40903000



**BIDIRECTIONAL™
TRACTOR
SERVICE**

9030

Vol. 2
40903000



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- SERIAL NUMBER INFORMATION

This service manual refers to serial number breaks at various times throughout the text. It is important to understand the order in which 9030 Bidirectional tractors were built. The following chart shows how 9030 tractors were built in the following ranges based on year of production:

SERIAL NUMBER RANGE YEAR OF PRODUCTION

0470100 - 0479999	1991
0487501 - 0489999	1992
0932000 - 0939999	1993
0200000 - AND ABOVE	1994 AND ON

An example of correctly identifying a unit follows:

The text reads "units built after *S/N* 0200234 " The tractor being repaired is *S/N* 0487698. 0487698 is a tractor built **before** *S/N* 0200234 and will not *have* the component or feature described in the text.

9030 VERSATILE TRACTOR

SAFETY, OPERATION AND GENERAL INFORMATION

SAFETY PRECAUTIONS

Practically all service work involves the need to drive the tractor. The Operator's Manual, supplied with each tractor, contains detailed safety precautions relating to driving, operating and servicing. These precautions are as applicable to the service technician as they are to the operator, and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or reassembly operations, whether within a workshop facility or out "in the field," consideration should be given to factors that may have an effect upon safety, not only upon the mechanic carrying out the work, but also upon bystanders.

PERSONAL CONSIDERATIONS

- Loose clothing can cause accidents. Check to see that you are suitably clothed.
- Some jobs require special protective equipment.
- **Skin Protection**
Used motor oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and the length of time used oil stays on skin.
- **Eye Protection**
The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiselling, grinding, welding, and painting.
- **Breathing Protection**
Fumes, dust and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.
- **Hearing Protection**
Loud noise may damage your hearing, and the greater the exposure the worse the damage. If the noise is excessive, wear ear protection.
- **Hand Protection**
It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work clean your hands with soap and water. Solvents may harm the skin.
- **Foot Protection**
Substantial or protective footwear with reinforced toe-caps will protect your feet from falling objects. Additionally, oil-resistant soles will help to avoid slipping.
- **Special Clothing**
For certain work it may be necessary to wear flame or acid-resistant clothing.
- Avoid injury through incorrect handling of components. Make sure you are capable of lifting the object. If in doubt, get help.

EQUIPMENT CONSIDERATIONS

- **Machine Guards**
Before using any machine, check to be sure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing from coming in contact with the moving parts of the machine, but also ward off objects that might fly off the machine and cause injury.
- **Lifting Appliances**
Be sure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes are thoroughly checked before use. If in doubt, select stronger equipment than is necessary.

Never stand under a suspended load or a raised implement.
- **Compressed Air**
The pressure from a compressed air line is often higher than 100 psi (6.9 bar). It is perfectly safe, if used correctly. Misuse may cause injury.

Never use compressed air to blow dust, filings and dirt away from your work area unless the correct type of nozzle is fitted and eye protection is used.

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

- **Hand Tools**

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

Never use:

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

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

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

Always keep tools clean and in good working order.

- **Electricity**

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

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

GENERAL CONSIDERATIONS

- **Solvents**

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

- **Housekeeping**

Many injuries result from slipping or tripping on objects or material left lying around by a careless worker. Prevent these accidents from occurring. If you notice a hazard, don't ignore it — remove it.

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

- **Fire**

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

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

- **First Aid**

In the type of work that mechanics are engaged in, dirt, grease, and fine dusts settle upon the skin and clothing. If a cut, abrasion or burn is disregarded, it may be found that a septic condition has formed within a short time. What appears at first to be trivial could become painful and injurious. It only takes a few minutes to have a fresh cut dressed, but it will take longer if you neglect it. Make sure you know where the First Aid box is located.

- **Cleanliness**

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

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

OPERATIONAL CONSIDERATIONS

Use a trailer of at least 10 ton (9080 kg) capacity to haul the tractor.

Chain the tractor securely to the trailer, chock the wheels, set the parkbrake and engage the articulation lock to limit the tractor movement.

***IMPORTANT:** If the tractor is transported on a truck or trailer, cover the muffler outlet so that wind does not spin the turbocharger and damage the bearings.*

Turbocharger turbine freewheeling (turning without engine running) must be avoided since lubrication is not being furnished to the turbocharger bearings under this conditions.

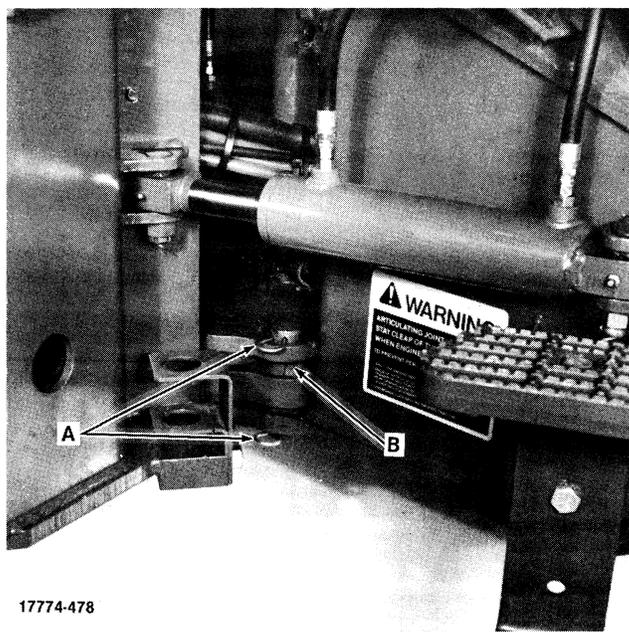
- Park the tractor on a clear, level area. Stop the engine, if at all possible, before performing any service. Center the steering, put all controls in neutral, set the parkbrake, shut down the engine and remove the key. Engage the articulation lock and chock the wheels.
- Place a warning sign on tractors which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended. Always disconnect the ground lead first. When reconnecting, connect the ground lead last.
- Do not attempt to start the engine while standing beside the tractor or attempt to bypass the neutral start switch.

- Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.
- If possible take the unit to an area which has a hard working surface, preferably concrete.
- If it is necessary to raise the tractor for ease of servicing or repair, make sure that safe and stable supports are installed beneath the axle housings, casings, etc., before commencing work.
- Before loosening any hydraulic hose, lower the attachment to the ground, switch off the engine and relieve all hydraulic pressure by operating the control lever several times. This will remove the danger of personal injury from oil pressure or accidentally dropping the attachment.
- Prior to pressure testing, make sure all hoses and connections on the tractor and the test equipment are in good condition and tightly sealed. Pressure readings must be taken with gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment, and to eliminate the possibility of personal injury.



WARNING: ESCAPING FLUID, OF ANY KIND, UNDER PRESSURE, CAN PENETRATE THE SKIN CAUSING SERIOUS INJURY.

- **DO NOT USE YOUR HAND TO CHECK FOR LEAKS. USE A PIECE OF CARDBOARD OR PAPER TO SEARCH FOR LEAKS.**
- **STOP THE ENGINE AND RELIEVE PRESSURE BEFORE CONNECTING OR DISCONNECTING LINES.**
- **TIGHTEN ALL CONNECTIONS BEFORE STARTING THE ENGINE OR PRESSURIZING THE LINES.**



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Articulation Lock

- A Hair pins
- B Lock pin

Figure 1

- **IF ANY FLUID IS INJECTED INTO THE SKIN, OBTAIN MEDICAL ATTENTION IMMEDIATELY OR GANGRENE MAY RESULT.**
- When inflating tires to the recommended pressure for seating beads, use a remote chuck and keep hand away from the tire.
- When inflating tires, beware of over inflation — constantly check the pressure. Over inflation can cause tires to burst and result in personal injury.
- Use the articulation lock, B, Figure 1, during stationary applications, servicing, jacking or overhaul operations. Before installing the lock, drive the tractor to a level surface, put the steering straight, engage the parkbrake, put the gearshift in neutral and stop the engine. Remove the hair pins, A, securing the lock pin in the storage position on the front frame. It may be necessary to start the engine and articulate the frame slightly to be sure the lockpin is engaged.

When disengaging the lockpin, secure it in the storage position with the hair pins.



CAUTION: DO NOT ALLOW PERSONNEL TO ENTER THE ARTICULATION AREA WITH THE ENGINE RUNNING, UNLESS THE ARTICULATION LOCK AND THE PARKBRAKE ARE ENGAGED.

DO NOT INSERT FINGERS THROUGH HOLES WHILE INSTALLING THE ARTICULATION LOCK.

- The cab has three exits which may be used in an emergency — the two doors and the rear window.

Open the rear window by unlocking the two latches. Push the window open at the bottom.

Safety precautions are very seldom the figment of someone's imagination. They are the result of sad experience where, most likely, someone has paid dearly through personal injury.

Heed these precautions and you will protect yourself accordingly. Disregard them and you may duplicate the sad experience of others.

SERVICE SAFETY

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

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

SERVICE TECHNIQUES

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

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

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

Replace o-rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or o-rings, regardless of condition. Always lubricate new seals and o-rings with the same type of lubricant that is contained in the system, i.e., refrigerant lubricant for A/C fittings.

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

HOSES AND TUBES

Always replace hoses and tubes if the flare end connections are damaged.

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

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

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

Be sure any hose which has been installed is not kinked or twisted.

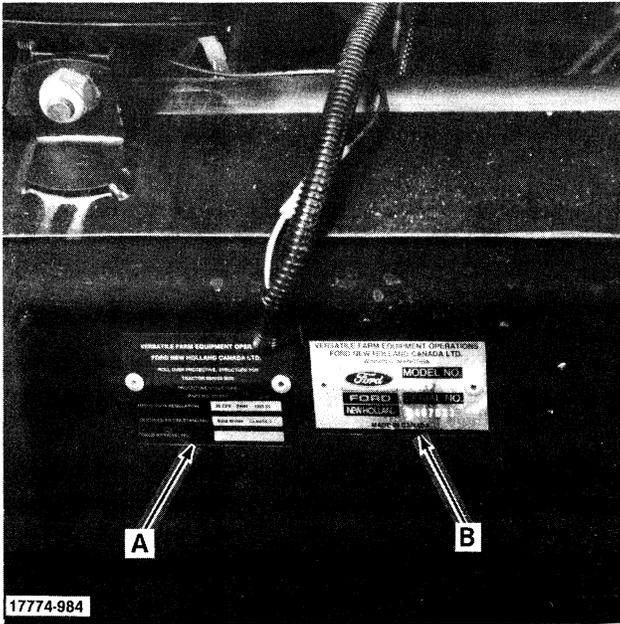
Hose connections which are damaged, dented, crushed or leaking restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from their original position have failed, and will ultimately separate completely.

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

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

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

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



Tractor Serial Number
 A ROPS certification plate
 B Tractor serial number plate

Figure 2



Serial Number on Frame

Figure 3

SERIAL NUMBER LOCATION

The tractor serial number plate, B, Figure 2, is located on the lower left corner of the cab frame. The ROPS certification plate, A, is located next to the tractor serial plate. The serial number is also stamped into the rear frame under the right steering cylinder in the articulation joint, Figure 3.

NOTE: Starting with S/N D200000 (1994 production) the serial number and ROPS certification plate are located on the front right-hand corner of the cab.

The engine serial number is stamped on the oil pan flange on the right side of the engine block, Figure 4. The right hand battery must be removed to access the engine serial number.



Engine Serial Number

Figure 4

FUEL, FLUIDS AND LUBRICANTS

Fuels

The 9030 tractor operates on No. 2 diesel fuel. It will also operate satisfactorily on other fuels within the following specifications:

- Less than one percent sulphur content.
- Sediment and water less than 0.1 percent.
- Cetane number of at least 40. A higher cetane number fuel may be necessary at low temperatures or high altitudes.
- Pour point below the lowest expected temperature.
- Less than 0.02 percent ash content.
- Viscosity of 1.4 to 5.8 mm²/s at 37.8° C (100°F).

Coolant

Water: Clean and preferably soft

Antifreeze: Use a good commercial grade low silicate glycol base antifreeze in the proportions recommended by its manufacturer. Do not use oil base or alcohol base antifreeze. Foaming and jelling could result and damage the cooling system.

IMPORTANT: Do not use a calcium chloride solution. It is harmful to the cooling system.

Check the radiator fluid level in the sight glass. If necessary, top up with a 50/50 solution of ethylene glycol low silicate base antifreeze to which the proper amount of FW-15 additive has been added (16 oz. bottle of FW-15 will treat 2.5 gal. U.S. [9.5 liters] of coolant).

Battery Fluid

Check the battery charge every 90 days with a battery load tester. Recharge the batteries as required. See Electrical System, Section 3.

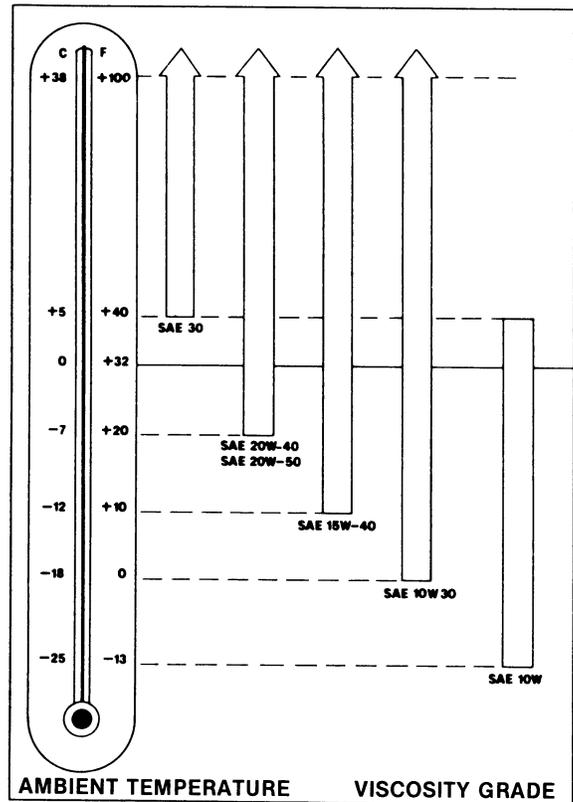
Engine Oil

Check the engine oil daily.

Recommended Engine Oil - FNH Super Premium Engine Oil.

Where the above mentioned oils cannot be used, the chosen oil must, at minimum, meet API (American Petroleum Institute) quality level "CD" or "CE", USA Military specification, MIL-L-2104C or, preferably, API quality "SF/CD", USA Military specification MIL-L-2104D.

Choose the correct viscosity grade from the chart, Figure 5.



Engine Oil Viscosity

Figure 5

NOTE: In areas where prolonged periods of extreme temperatures are encountered, local lubricant practices are acceptable; such as the use of SAE 5W in extreme cold temperatures or the use of SAE 50 in extreme high temperatures.

Differential and Drop Axle Oil

Use SAE 80W90GL5 for temperatures below 90°F (32°C).

Use SAE 85W140GL5 for temperatures above 90°F (32°C).

Transmission Oil

Use FNH 134

*For consistently high ambients above 90°F (32°C) a 20/50 weight oil may be used.

Hydraulic and Hydrostatic System

Use Mercon or Dexron II.

NOTE: The hydraulic/hydrostatic system is filled with Mercon/Dexron II automatic transmission fluid at the factory. This type of oil (Ford MERCON and Dexron II) must be used where the ambient temperature goes below -10°F (-23°C). FNH 134 oil may be used above 4°F (-15°C) if the system is drained and flushed.

PTO Clutch/Splitter Box and Front PTO Transfer Case

Use FNH 134

PTO Drop Box Front/Rear

Use FNH 134

Grease

Use an "EP" lithium base grease having an operating temperature range of +350 to -10°F (+177 to -23°C). The grease must meet N.L.G.I. grades 1 or 2 specifications.

LUBRICATION SCHEDULE

Service intervals recommended in this manual are based on operation under average conditions. Service the tractor more frequently when operating in conditions of severe heat,

cold, dust or humidity. The lubrication schedule lists the points and frequency of lubrication. Refer to the equivalency chart for the lubricant brands meeting the required specifications.

	A S R E Q U I R E D	D A I L Y	W E E K L Y	100	200	300	400	1000	1200	L U B R I C A N T ⁶	N O. O F P O I N T S
									H O U R S O R Y E A R S		
Check engine oil level		X								A	
Check hydraulic/hydrostatic reservoir sight glass level		X								E	
Check radiator sight glass level		X									
Add erosion/corrosion control additive								X			
Check PTO clutch/splitter box sight glass level								X		E	
Clean radiator, grill and oil cooler	X	X									
Check batteries											X
Check air conditioner compressor belt tension											X
Check transmission oil level						X ³				C	
Check differential oil level						X ⁷				D	4
Check drop axle oil level						X ³				D	
Check brake fluid level						X				F	
Check PTO drop box oil level						X				C	
Lubricate the main drivelines and support bearing			X ¹							B	9
Lubricate steering cylinder pins			X ¹							B	4
Lubricate frame pivots			X ¹							B	2
Lubricate oscillating cradle pivots			X ¹							B	2
Drain water separator								X			

1 Lubricate more frequently under continuous use.
 2 Change oil and filter after the first 50 hours of operation and every 200 hours thereafter.
 3 Change oil after the first 50 hours of operation and every 1000 hours thereafter.
 4 Torque wheel bolts after the first half hour of operation, every 50 hours until 400 hours, and every 200 hours thereafter.
 5 Torque rim or clamp every 10 hours until 50 hours, every 50 hours until 400 hours, and every 400 hours thereafter.
 6 See Lubricant Brand Equivalency Chart.
 7 After first 100 hours of use, drain, flush and replace the oil and additive in the Dana Powr-lok® differential.

SAFETY, OPERATION, AND GENERAL INFORMATION

	A S R E Q U I R E D	D A I L Y H O U R S	W E E K L Y H O U R S	100 H O U R S	200 H O U R S	300 H O U R S	400 H O U R S	1000 H O U R S	1200	L U B R I C A N T ⁶	N O. O F P O I N T S
									H O U R S O R Y E A R S		
Lubricate three-point hitch cab end and engine end				X ¹						B	4
Lubricate the PTO drivelines in the pivot area					X ¹			3		A	3
Lubricate window and door hinges	X									A	6
Clean air cleaner filters	X ⁸					X ⁸					
Check air cleaner tube connections		X									
Change air intake filters	X ⁹										
Change engine oil and filter		X ²			X					A	
Change fuel and water separator filters						X					
Check alternator/fan/water pump belt	X										
Change hydraulic/hydrostatic oil filters					X						
Change coolant and add coolant additive								X			
Check transmission oil					X ³			X			
Check drop axle oil					X ³					D	4
Check PTO clutch/splitter box oil					X ¹⁰		X			E	
Check PTO drop box oil					X ¹⁰					C	
Check hydraulic/hydrostatic oil		X ³									
Adjust parkbrake	X										
Check and/or adjust PTO clutch control	X			X							
Drain contamination from fuel tanks					X						
Check wheel bolt torque					X ⁴						
Torque axle mounting bolts					X						
Check and/or change cab air intake filter								X			
Check air-conditioner sight glass for bubbles. Clean condenser	X										
Check PTO transfer case oil					X ¹⁰						

- 1 Lubricate more frequently under continuous use.
- 2 Change oil and filter after the first 50 hours of operation and every 200 hours thereafter.
- 3 Change oil after the first 50 hours of operation and every 1000 hours thereafter.
- 4 Torque wheel bolts after the first half hour of operation, and every 50 hours until 400 hours, and every 200 hours thereafter.
- 5 Torque rim or clamp every 10 hours until 50 hours, every 50 hours until 400 hours, and every 400 hours thereafter.
- 6 See Lubricant Brand Equivalency Chart.
- 7 After first 100 hours of use, drain, flush and replace the oil and additive in the Dana Powr-lok® differential.
- 8 Clean out element as recommended and inspect the inner element. Check indicator light function every 300 hours.
- 9 Replace the air filter yearly or sooner in dusty conditions.
- 10 Change oil every 400 hours.

LUBRICANT BRAND EQUIVALENCY CHART

	IMPERIAL	SHELL	TEXACO	FNH	CLASSIFICATION
A Engine	Essolube XDC	Rotella T	Ursa Super Plus	M2C-121 AMV	Factory fill is SAE 15W40 CC/CE
B Grease	Unirex EP2	Retinex A	Multifak #2	9861804DS	SAE multi-purpose grease, high temp All weather conditions
C Range Transmission	Hydraul 56	Donax TD	Texamatic TDH	134	SAE 20 SF/CD above 40°F (4°C)
	Hydraul 50	Donax TDL		134	SAE 5W20 below 40°F (4°C)
C PTO Drop Box Front/Rear	Hydraul 56	Donax TD	Texamatic TDH	134	SAE 20 SF/CD above 40°F (4°C)
	Hydraul 50	Donax TDL		134	SAE 5W20 below 40°F (4°C)
D Differential Drop Axle (NOTE 1)	Gear Oil GX	Spirax HD	Multigear EP	9613315	SAE 80W90 GL5 SAE 85W140 GL5
E Hydraulic/ Hydrostatic		Dontax TG	Texamatic	Mercon/ Dexron II or 134	Automatic Transmission Fluid
				134	
				134	
PTO Clutch/ Splitter Box					
Front PTO Transfer Case					
Brake Fluid	Atlas Extra Heavy Duty 450	Super H.D. Brake Fluid		FP 209 RM 4312 RM 4352	All Weather Conditions SAEJ 1703 F (Glycol Based) DOT 3/5

NOTE 1: Differentials with Dana Powr-lok® limited slip components must have the lubrication oil drained after the first 100 hours of use. ADD 10 oz of “on-road additive” FNH part #9706315 DS, to each differential, then fill with oil (Ford 9613315 or 80W90-GL5). Repeat the process every 2000 hours or anytime the oil is changed or whenever the differentials chatter.

A 16 oz. bottle of oil additive is available from Ford New Holland dealers as part #9706315 DS

STORING THE TRACTOR

NOTE: Storage refers to periods of approximately six months.

Preparation

1. Change the hydraulic oil.
2. Change the transmission oil.
3. Change the engine coolant.
4. Drain and flush the drop axles. Fill with new oil.
5. Change the engine oil and filters.
6. Start the engine. While the engine is warming up, operate the hydraulics, hydrostatics, steering and axles to distribute the new lubricant to the components. Warm the engine to at least 160°F (70°C). It may be necessary to shield the radiator to achieve this temperature. Stop the engine.
7. Clean the tractor of all debris, dirt and accumulated grease.
8. Drive the tractor to the storage location.
9. Relieve the tension from the alternator and air conditioner compressor belts.
10. Coat the exposed hydraulic cylinder shafts with grease or a rust preventative.

Storing

1. With plastic bags or tape, seal the following openings: air cleaner inlet, exhaust muffler, fuel tank breather and air conditioner air intake screens.
2. Touch up all scratches or chips with Ford New Holland paint.
3. Block up the tractor to remove weight from the tires.

4. Cover the tires if they will be exposed to heat and/or direct sunlight.
5. If the tractor is to be stored outside, cover it with a waterproof canvas or other protective material.

STORING BATTERIES

1. Fully charge the batteries. See Electrical System, Section 3.
2. Remove the batteries from the tractor and store them in a dry, weatherproof area.

REMOVAL FROM STORAGE

1. Remove the protective covering from the tractor tires and seals, from the air cleaner inlet, exhaust muffler, fuel tank breather and the air conditioner air intake screens.
2. Remove the blocks. Lower the tractor onto the tires.
3. Correct any leaks.
4. Inflate the tires to the recommended pressure.
5. Install the fully charged batteries. Tighten the cable clamps at both ends of the cables.
6. Tension the alternator, air conditioner compressor, fan and water pump belts.
7. Check the oil levels of the engine crankcase, axles, transmission, hydraulic/hydrostatic reservoir, master brake cylinder reservoir and oil cooler.
8. If the fuel filters were changed during or after storage, be sure the filters, pump and lines are primed.

INITIAL ENGINE START-UP

Initial start-up can put abnormal loads on the engine cranking system. Do not crank the engine longer than 30 seconds. Allow at least two minutes between cranking cycles to permit the starting motor to cool and the batteries to recover.

***IMPORTANT:** On the initial start of the engine, do not increase the speed above 1,000 rpm, unless absolutely necessary to prevent stalling, until the engine oil pressure is normal.*

1. Set the parkbrake.
2. Set the throttle to idle.
3. Put the FNR lever in neutral and the range control in neutral.
4. If the temperature is below 50°F (10°C), refer to Cold Weather Starting, Section 2 Fuel System.
5. Turn keyswitch on.

6. When the engine starts, be sure the alternator warning light goes out.
7. Warm the engine to at least 120°F (50°C) before putting it under load.

If the engine does not start after a 30-second cranking cycle, repeat the above starting procedure. If the engine still does not start, observe the exhaust during cranking. If the exhaust is clear, the engine is not receiving fuel. Check the following:

8. Dip check the fuel tank level through the fuel tank filler neck.
9. Check for fuel line obstruction or loose union connection.
10. Check the operation of the fuel solenoid valve.
11. Check the fuel system for adequate priming.
12. Check the fuel pump operation for delivery of the fuel.

SECTION 1

ENGINE SYSTEMS

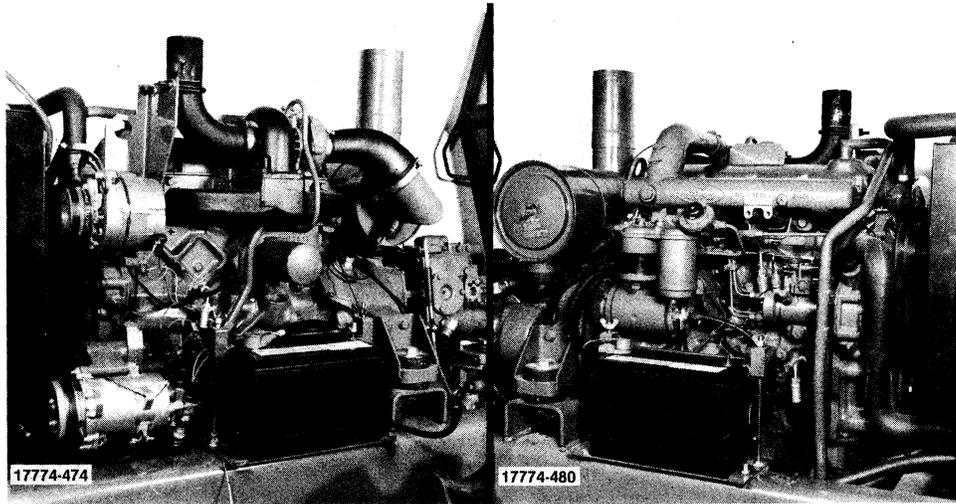
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SECTION 1

ENGINE SYSTEMS

DIESEL ENGINE



Four Cylinder Engine — Left Side
SHIELDS REMOVED FOR CLARITY

Four Cylinder Engine — Right Side
SHIELDS REMOVED FOR CLARITY

Figure 1-1

DESCRIPTION AND OPERATION

This section describes the overhaul and repair of the 4-cylinder direct injection diesel engine.

NOTE: The engine used in the 9030 tractor is of special manufacture. A “BSD” engine is NOT to be used in a 9030. See S/B 4/92-G12 for further information on engine differences between a 9030 and a BSD engine.

The engine, Figure 1-1, features a cross flow cylinder head with the inlet and exhaust manifolds on opposite sides of the head. The combustion chamber is formed in the crown of the piston which has two compression and one oil control ring all located above the piston pin.

The cylinder head assembly incorporates the valves, valve springs, and the spring retainers. Valve guides are an integral part of the cylinder head with replaceable valve seats pressed into the valve ports. Valve guides are not replaceable.

Cylinder Head Assembly

The cylinder head assembly incorporates the valves, valve springs, and rotators. The valve rocker arm shaft assembly is bolted to the cylinder block, through the head. The intake and exhaust manifolds are bolted to the head, the intake on the right side, and the exhaust on the left. The water outlet connection and thermostat are attached to the front of the cylinder head.

Valve guides are integral with the cylinder head, and valves with oversize stems are available for service. Special replaceable cast alloy valve seats are pressed into each valve port, and exhaust valves are fitted with positive valve rotators. The valves use umbrella-type seals.

Valve lash is maintained by self-locking adjusting screws. The cam shaft runs in four replaceable bearings, and is driven by the camshaft idler gear in mesh with the camshaft and crankshaft gears. Camshaft thrust is controlled by a plate secured to the block and located between the camshaft gear and the front journal of the camshaft.

The cylinder head bolts are evenly spaced in a six-point pattern around each cylinder. Diesel engine injectors are mounted outside the rocker cover.

The engine cylinder head is designed with the entire face of the cylinder head flat. The combustion chambers are recessed into the piston crowns.

Crankshaft Assembly

The crankshaft is supported in the cylinder block by five main bearings and the crankshaft end thrust is controlled by a thrust bearing located on the center main bearing.

A crankshaft driven dynamic balancer counteracts out-of-balance forces and thereby reduces engine vibration. The balancer housing is bolted to the bottom of the cylinder block and contains two meshing gears which are driven and timed from a gear on the crankshaft.

Front and rear crankshaft oil sealing is effected by a one piece, single lip type seal.

The piston is connected to the crankshaft by a heavy I-beam connecting rod with a tapered top end. The crankshaft end of the connecting rod has an insert-type copper lead or aluminum tin alloy bearing. The piston end of the connecting rod has a replaceable bronze bushing. The piston pin is a free-floating steel pin held in place in the piston by two snap rings.

Pistons

Pistons are an aluminum alloy with combustion chambers recessed into the piston crowns. Each piston has two compression rings and one oil control ring, all of which are located above the piston pin.

Connecting Rods

The piston connecting rods have replaceable bronze piston pin bushings. A centrally drilled hole facilitates both pressure lubrication of the piston pin bushing and cooling of the piston crown. Full-floating piston pins are retained by two snap rings in each piston.

Manifolds

The aluminum intake and cast iron exhaust manifolds are on opposite sides of the cylinder head for better heat distribution in the head, and less heat transfer to the intake manifold. All tractors are fitted with vertical exhaust systems.

The intake manifolds are connected through tubing to the air cleaner. The turbocharger crossover tube is provided with a tapped hole for installation of an ether cold starting aid kit.

Cylinder Block Assembly

The cylinder block is a cast iron alloy with heavy webbing and deep cylinder skirts. The block features full length water jackets for cooling the cylinders, which are bored integral with the block. Cylinders are in-line and vertical, and numbered from 1 to 4, front to rear.

The oil pan is attached to the bottom of the cylinder block and is the sump for the lubrication system. The engine front cover is attached to the front engine adapter plate forming a cover for the timing gears.

The crankshaft gear is keyed and press fitted on the front of the crankshaft (later engines do not use a key). The crankshaft gear drives the idler gear, which is attached to the front of the cylinder block. The idler gear drives the camshaft gear and the injection pump drive gear.

The camshaft gear is attached to the front of the camshaft by a key, bolt, lock washer, and flat washer. This ensures the gear maintains correct position on the camshaft.

All the timing gears are timed to each other via an identification mark to insure proper gear position in relation to each other.

Lubrication System

Lubrication of the engine is maintained by a gerotor type oil pump mounted at the base of the engine block. The oil pump is driven from the camshaft and draws oil from the engine sump through a wire mesh screen.

A spring loaded relief valve in the pump body limits the pressure in the system by directing excess oil back to the intake side of the pump.

Oil passes from the pump to an external, throw-away, spin-on type filter incorporating a relief valve which permits oil to be bypassed if filter blockage occurs, and so ensures engine lubrication at all times.

Oil flows from the filter to the main oil gallery which runs the length of the cylinder block and intersects the camshaft follower chambers.

The main gallery also supplies oil to the crankshaft main bearings and to the connecting rod journals via drillings in the crankshaft. Drilled passages from each main bearing direct oil to the camshaft bearings.

The idler gear bushing is pressure lubricated through a drilled passage from the front main bearing. The gear has small oil passages machined on both sides which allow the oil to escape.

The timing gears are lubricated by oil from the cam follower chamber and the pressure lubricated idler gear bushing.

The dynamic balancer is lubricated through a drilled passage from the cylinder block intermediate thrust bearing web to the balancer housing. Oil flows through the balancer housing to the drilled balancer gear shafts and on to the bushings in the balancer gears.

Cylinder walls, piston, and piston pins are splash lubricated by the connecting rods and rotating crankshaft.

The connecting rods have a centrally drilled hole which facilitates both pressure lubrication of the piston pin bushing and cooling of the piston crown.

An intermittent flow of oil is directed to the valve rocker arm shaft assembly via a drilled passage in the cylinder block located vertically above No. 1 camshaft bearing. This drilling aligns with a corresponding hole in the cylinder head.

As the camshaft turns, holes in the camshaft and camshaft bearing align and a regulated stream of oil is directed to the cylinder head and on up the rocker arm shaft support bolt to the rocker shaft.

The oil flows from the shaft through drilled holes in each rocker arm bushing to lubricate both ends of the arms. Excess oil flows down the push rods and assists in lubricating the cam followers before draining back into the sump through cored openings in the block.

A water-to-oil type oil cooler, located in the base of the radiator, is connected into the lubrication system main oil gallery and cools a portion of the circulating oil. A restrictor at the oil outlet limits the flow to the cooler and maintains internal lubrication at low engine speeds. Return oil from the cooler is fed back to the engine sump via a pipe tapped into the skirt of the cylinder block.

TROUBLESHOOTING

IMPORTANT: When effecting a repair the cause of the problem must be investigated and corrected to avoid repeat failures.

The following table lists problems and their probable causes with recommended remedy.

SYMPTOM	PROBABLE CAUSES	REMEDY
Engine does not develop full power—	<ol style="list-style-type: none"> 1. Clogged air cleaner 2. Fuel line obstructed 3. Faulty injectors 4. Incorrect valve lash adjustment 5. Burnt, worn, or sticking valves 6. Blown head gasket 7. Incorrect fuel delivery 8. Low cylinder compression 	<ol style="list-style-type: none"> 1. Clean or renew element 2. Clean 3. Clean and reset 4. Check and reset 5. Renew valves and/or guides 6. Check head flatness and fit new gasket 7. Check injectors and pump timing. 8. Renew piston rings or rebore/re-sleeve as necessary

ENGINE SYSTEMS

SYMPTOM	PROBABLE CAUSES	REMEDY
Engine knocks	<ol style="list-style-type: none"> 1. Diluted or thin oil 2. Insufficient oil supply 3. Low oil pressure 4. Excessive crankshaft end play 5. Flywheel or ring gear run out excessive 6. Excessive connecting rod or main bearing clearance 7. Bent or twisted connecting rods 8. Crankshaft journals out-of-round 9. Excessive piston-to-cylinder bore clearance 10. Excessive piston ring clearance 11. Broken rings 12. Excessive piston pin clearance 13. Piston pin retainer loose or missing 14. Excessive camshaft end play 15. Imperfections on timing gear teeth 16. Excessive timing gear backlash 	<ol style="list-style-type: none"> 1. Drain and refill with specified oil and renew filter. Ascertain cause of dilution 2. Check oil level and top up as necessary. Overhaul or renew pump as necessary. Check pump filter not clogged 3. Overhaul pump or relief valve as necessary 4. Install new thrust bearing liner 5. Skim flywheel or fit new ring gear 6. Install new bearing inserts and/or re-grind crankshaft 7. Renew connecting rods 8. Re-grind crankshaft and fit undersize bearing inserts 9. Re-bore/re-sleeve block and fit new pistons 10. Fit new pistons and rings 11. Fit new rings. Check bore/pistons for damage 12. Fit new piston pin and bushing 13. Install new retainer. Check bore/pistons for damage 14. Install new thrust plate 15. Renew timing gear 16. Renew timing gear

ENGINE SYSTEMS

SYMPTOM	PROBABLE CAUSES	REMEDY
<p>Engine overheats</p>	<ol style="list-style-type: none"> 1. Hose connection leaking or collapsed 2. Radiator cap defective or not sealing 3. Radiator leakage 4. Improper fan belt adjustment 5. Radiator fins restricted 6. Faulty thermostat 7. Internal engine leakage 8. Water pump faulty 9. Exhaust gas leakage into cooling system 10. Coolant aeration 11. Cylinder head gasket improperly installed 12. Hot spot due to rust and scale or clogged water jackets 13. Obstruction to radiator air flow 14. Extended engine idling 15. Oil cooler tube blocked 16. Radiator core tubes blocked 	<ol style="list-style-type: none"> 1. Tighten hose connection. Renew hose if damaged 2. Renew radiator cap 3. Repair/renew radiator 4. Re-adjust fan belt 5. Clean with compressed air 6. Renew thermostat 7. Check for source of leakage. Renew gasket or defective parts 8. Overhaul water pump 9. Renew cylinder head gasket. Check head for damage or distortion 10. Tighten all connections and check coolant level is correct. Ensure cylinder head gasket has not blown 11. Renew cylinder head gasket 12. Reverse flush entire cooling system 13. Remove the obstruction 14. Do not allow engine to idle for long periods 15. Clean 16. Check free flow

ENGINE SYSTEMS

SYMPTOM	PROBABLE CAUSES	REMEDY
Low oil pressure	<ol style="list-style-type: none"> 1. Engine oil level low 2. Wrong grade of oil 3. Blocked oil pump sump screen 4. Oil pressure relief valve faulty 5. Oil pump drive shaft worn 6. Excessive oil pump rotor and shaft assembly clearance 7. Excessive main or connecting rod bearing clearances 8. Oil cooler inlet flow restrictor missing from fitting in main gallery 	<ol style="list-style-type: none"> 1. Top up, as necessary 2. Drain and refill with correct grade of oil 3. Clean pump screen 4. Fit new relief valve 5. Renew drive shaft 6. Overhaul pump 7. Install new bearing inserts and/or re-grind crankshaft 8. Install flow restrictor
Excessive oil consumption	<ol style="list-style-type: none"> 1. Engine oil level too high 2. External oil leaks from engine 3. Worn valves, valve guides or seals 4. Blown head gasket or distorted head 5. Oil loss past the pistons and rings 6. Oil cooler leak 7. Turbocharger bearing defective 	<ol style="list-style-type: none"> 1. Reduce oil level 2. Renew gaskets/seals, where necessary. Check mating surfaces for damage or distortion 3. Renew 4. Renew gasket. Check head for damage or distortion 5. Renew rings and/or re bore/re-sleeve block as necessary 6. Repair/renew oil cooler assembly 7. Replace turbocharger
Oil pressure warning lamp fails to operate	<ol style="list-style-type: none"> 1. Bulb burnt out 2. Warning lamp pressure switch faulty 3. Warning lamp circuit faulty 	<ol style="list-style-type: none"> 1. Renew bulb 2. Renew pressure switch 3. Check and renew wiring

SYMPTOM	PROBABLE CAUSES	REMEDY
Excessive exhaust smoke	<ol style="list-style-type: none"> 1. Oil leak on compressor or turbine side of turbocharger 2. Exhaust leak on exhaust manifold side of turbocharger 3. Air cleaner dirty or restricted 4. Excessive fuel delivery 	<ol style="list-style-type: none"> 1. Overhaul turbocharger 2. Fit new gasket 3. Clean 4. Overhaul injection pump/injectors
Coolant temperature gauge fails to reach normal operating temperature	<ol style="list-style-type: none"> 1. Faulty temperature sender switch 2. Incorrect or faulty thermostat 3. Faulty coolant temperature gauge 4. Thermostat missing 	<ol style="list-style-type: none"> 1. Renew sender switch 2. Renew thermostat 3. Renew temperature gauge 4. Install thermostat (engine must have thermostat installed)

ENGINE COMPRESSION TEST

To check compression in the 9030 Diesel engine, use the following procedure:

1. Be sure the battery performance meets specifications.
2. Clean the engine, especially the area around the injectors.
3. Warm up the engine by operating for a minimum of 30 minutes at 1200 rpm.
4. Stop the engine and remove the high-pressure fuel lines and fuel leak-off line from the engine. Cap all the openings in the fuel injection system and fuel injection pump.
5. Remove the injector nozzle and seat washer from each cylinder. Cap the injector nozzle and line to prevent the entry of dirt into the system. Place the injectors in a rack to prevent damage while they are removed from the engine and to keep them in order.

NOTE: If an injector is stuck in the cylinder head and will not pull straight out, turn the injector in a clockwise direction to break it loose. If it is turned in a counterclockwise direction there is a chance that the nozzle and holder could unscrew from each other, allowing the internal components to fall out.

NOTE: The lines should not be capped until residual fuel has been removed from them. Otherwise, when the engine is cranked during the compression test, the fuel remaining in the lines will blow the caps off. Remove the electrical lead from the fuel shut-off valve. Crank the engine until fuel no longer flows from the injector lines.

6. Crank the engine to blow out any loose carbon particles from the injector bores.
7. Install the engine compression tester adaptor FNH 02146 into the injector bore of cylinder No. 1, using a new seat washer and the injector mounting studs and nuts.

8. Connect Compression Gauge FNH 02020 and hose to the adaptor.
9. Crank the engine (speed must be at least 200 rpm) and observe and record the gauge reading. Allow 6-8 puffs per cylinder.
10. Repeat steps 6 through 9 for each cylinder.
11. After completing the compression check, install the injector nozzles using new seat washers. Connect the injector lines back on the engine and attach the connector at the top of the fuel shut-off solenoid.

2. If any of the readings do not meet the above specifications, this indicates that there is leakage at the cylinder head gasket, piston rings or valves.

NOTE: To determine if the rings or valves are at fault, squirt the equivalent of a tablespoon of heavy oil into the combustion chamber, then crank the engine to distribute the oil and repeat the compression test. The oil will temporarily seal leakage past the rings. During a compression test, if the pressure fails to climb steadily and remains the same during the first two succeeding strokes, or fails to climb during the entire test, suspect a sticking valve.

Test Conclusions

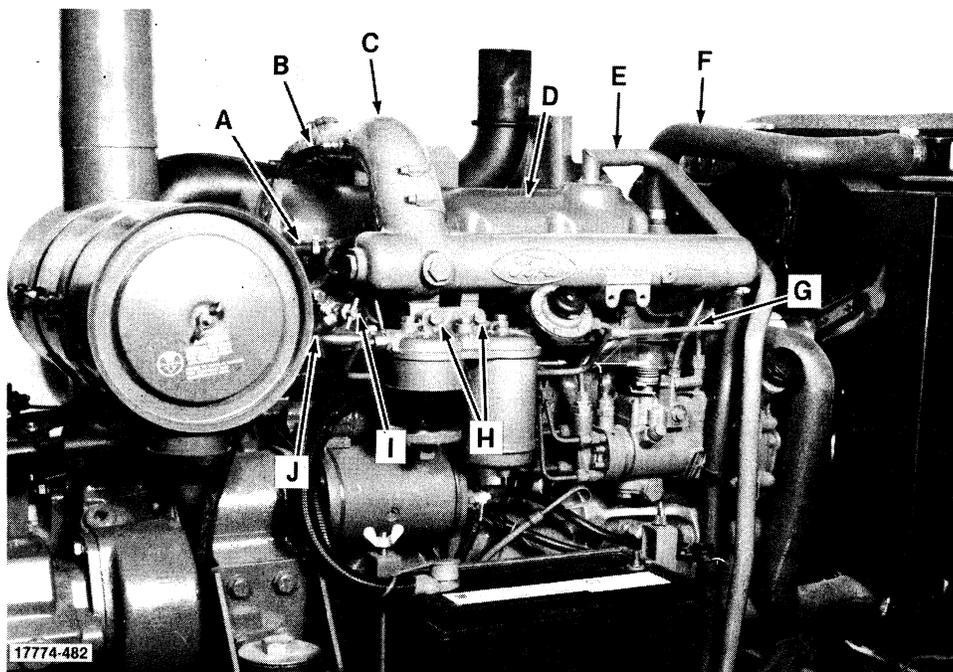
1. Minimum compression must be at least 275 psi (1896 kPa). Also, compression readings from the lowest cylinder must be at least 75 percent of the highest.
3. A low, even compression in two adjacent cylinders may indicate a cylinder head gasket leak. Check this before blaming the rings or valves.

SPECIAL TOOLS

Description	Service Tool Catalog Number
Adjustable Bridge Puller	FNH09539
Shaft Protectors	FNH09212
Step Plate Adaptors	FNH09210
Bushing Kit	FNH09514
Crankshaft Gear - Remover Replacer Replacer Adaptor/Insert	FNH02134 FNH01237
Valve Guide Reamer Kit	FNH02136
Camshaft Bearings Kit	FNH02771
Crankshaft Oil Seal Installer	FNH01301
Keystone Gauge	FNH00180
Cooling System Pressure Tester	OEM 1041
Compression Test Kit	FNH02020
Connecting Rod Bushing Kit	FNH00053
Seal Installer	FNH07536
Water Pump Seal Installer	FNH04672

SECTION 1A

CYLINDER HEAD



Engine — Right Side

A Leak-off line - rear
 B Cold start tube
 C Turbo transfer tube
 D Rocker cover

E Crankcase breather tube
 F Upper radiator hose
 G Leak-off line - front
 H Bolts

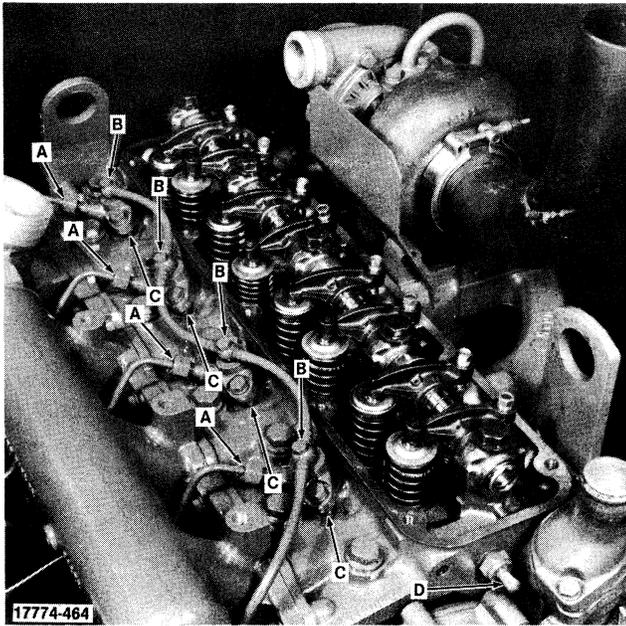
Figure 1A-1

I Heater inlet valve
 J Heater inlet hose

CYLINDER HEAD — REMOVAL

NOTE: The cylinder head can be removed with the engine installed in the tractor. If only the valves are to be adjusted, follow Steps 4 through 7 and then see “Cylinder Head - Installation” in this section.

1. Disconnect the batteries. See “Battery - Removal” Section 3, Electrical, in this manual.
2. Remove the muffler.
3. Drain the radiator and cylinder block. See “Radiator - Removal” in this section.
4. Remove the side panels and hood.
5. Remove the cold start tube, B, Figure 1A-1, and the turbocharger crossover tube, C.
6. Remove the crankcase breather tube, E.
7. Remove the rocker cover, D, and gasket.
8. Close the heater inlet valve, I. Remove and cap the heater inlet line, J.
9. Remove and cap the injector leak-off line. Front, G, and rear, A.
10. Remove and cap the upper radiator hose, F.
11. Remove two bolts, H, securing the fuel filters to the intake manifold.

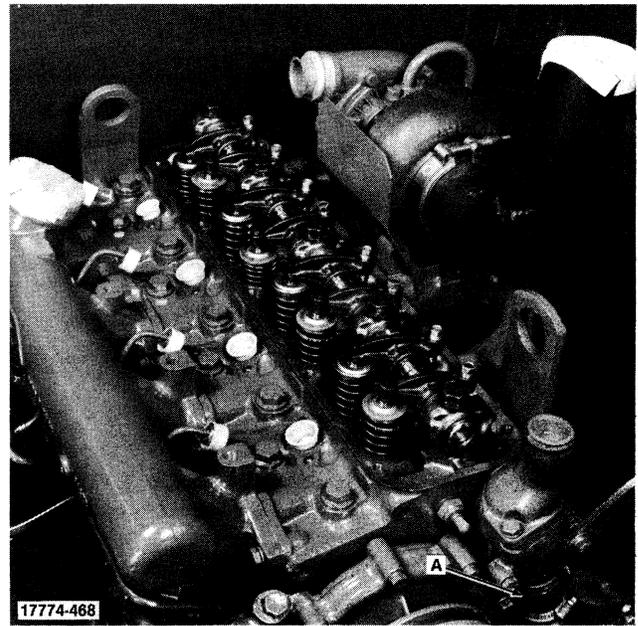


Top of Engine

A Fuel injector lines
B Leak-off line banjo bolts

Figure 1A-2

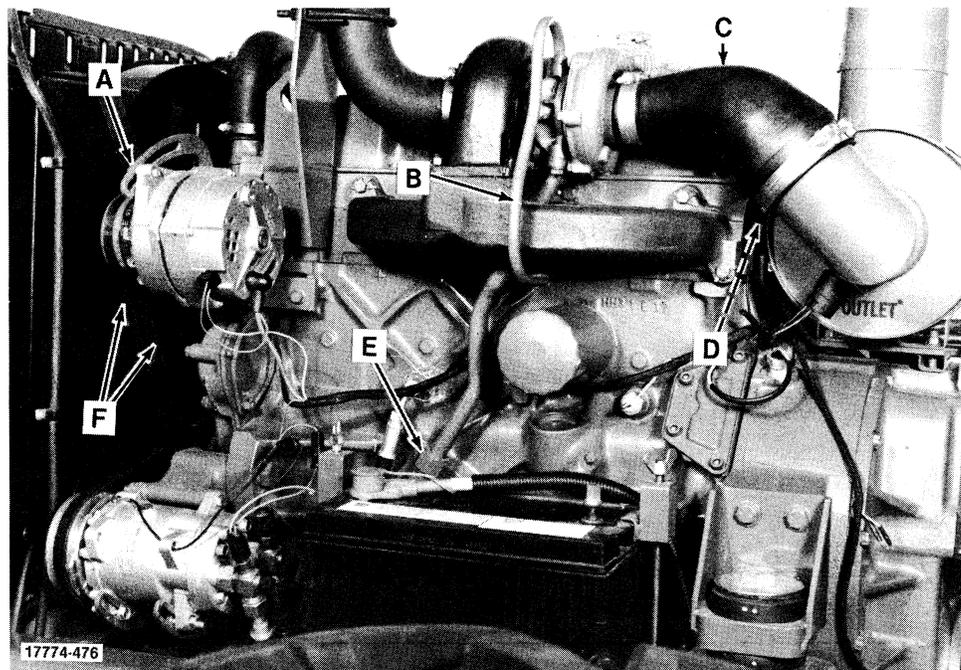
C Fuel injectors
D Coolant temperature sender



Thermostat Bypass Hose

A Thermostat bypass hose

Figure 1A-3



Engine Left Side

A Alternator adjustment bolt
B Turbocharger oil pressure line

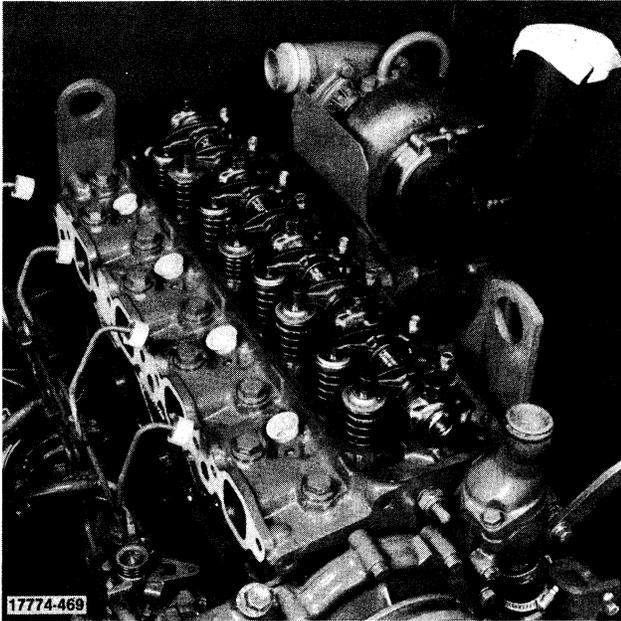
C Turbocharger air inlet hose
D Thermo-Guard™

E Turbocharger oil return tube
F Alternator belts

Figure 1A-4

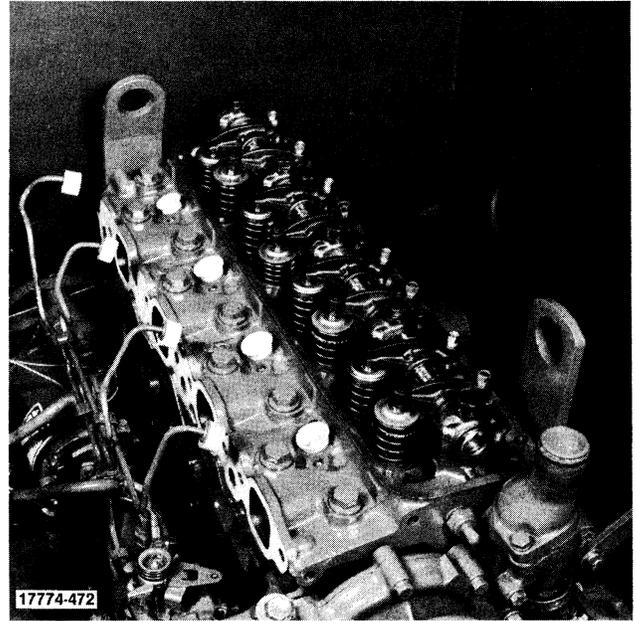
12. Remove and cap the fuel injector lines, A, Figure 1A-2. Remove the fuel injector leak-off lines, B. Remove and cap the fuel injectors, C.
13. Remove the electrical lead from the coolant temperature sender, D.

14. Loosen the clamp on the thermostat bypass hose, A, Figure 1A-3.
15. Remove the alternator adjustment bolt, A, Figure 1A-4, drive belts, F, and adjustment arm. Let the alternator rotate down as far as possible.



Inlet Manifold Removed

Figure 1A-5



Exhaust Manifold Removed

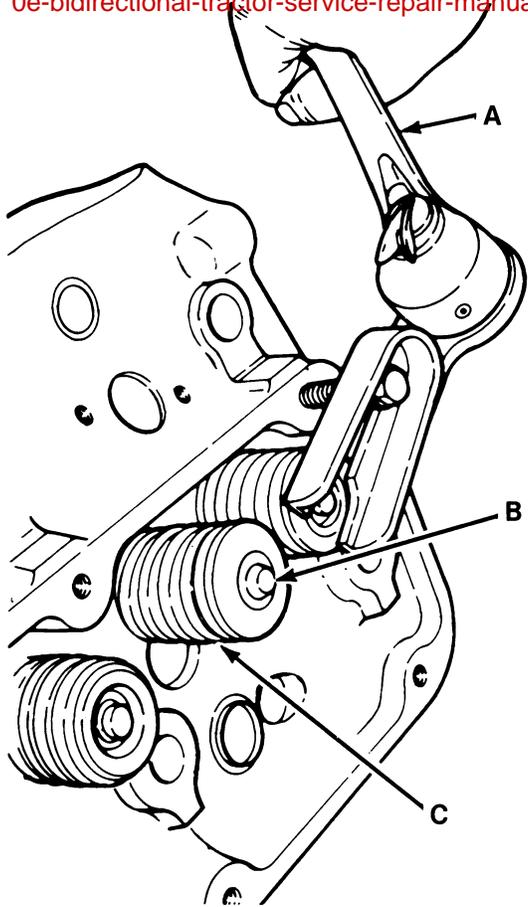
Figure 1A-6

16. Disconnect the turbocharger oil pressure line, B. Disconnect the turbocharger return oil line, E.
17. Remove the turbocharger air inlet hose, C.
18. Disconnect the Thermo-Guard™ electrical lead, D.
19. Loosen the rocker shaft retaining bolts, which also serve as cylinder head bolts, evenly and alternately. Remove the rocker shaft assembly.

NOTE: Leave the bolts in the rocker shaft supports during removal as they retain the supports on the shaft.

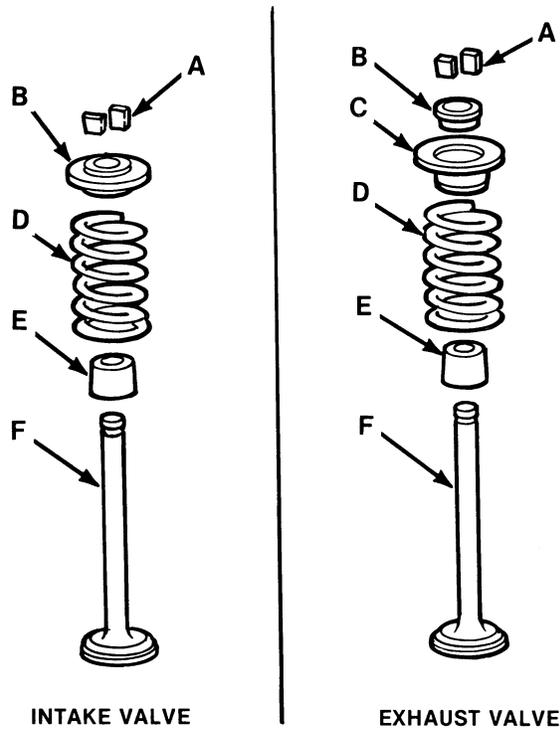
NOTE: At this point if the head gasket only is being replaced, proceed with Steps 22 through 24. If the valves are to be removed, proceed with the complete cylinder head removal procedure.

20. Remove the retaining bolts and lock washers and remove the inlet manifold from the cylinder head, Figure 1A-5.
21. Straighten the lock tabs on the attaching bolts, remove the bolts. Remove the exhaust manifold and turbocharger as an assembly, Figure 1A-6.
22. Remove the push rods and place in a numbered rack.
23. Remove the remaining cylinder head bolts and washers working inwards from the ends toward the center of the head.
24. Attach a suitable lifting device to the cylinder head lifting brackets. Lift the cylinder head assembly from the tractor. If necessary, use the pads provided to pry the cylinder head from the block. Take care not to damage the block or head.
25. Remove the retaining bolts and the thermostat housing from the cylinder head.



Valve Removal
 A Valve spring compressor

Figure 1A-7
 B Retainer locks
 C Spring



Valve Components
 A Retainer locks
 B Retainer
 C Rotator (exhaust valve only)

Figure 1A-8
 D Spring
 E Seal
 F Valve

CYLINDER HEAD — DISASSEMBLY

1. Clean the head of all gasket material and remove the carbon from around the valve heads.
2. Using a valve spring compressor, A, Figure 1A-7, remove the retainer locks, B, spring retainers/rotators, springs, and seals from each valve. See Figure 1A-8 for valve assembly layout.

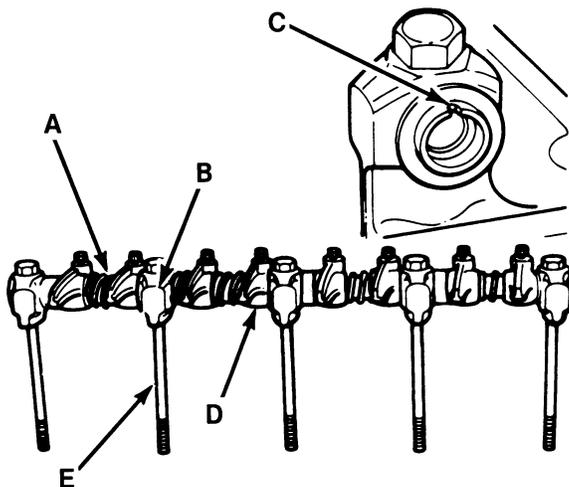
Rocker Arms and Shaft — Disassembly

Refer to Figure 1A-9

1. Remove the bolts that attach the rocker arm shaft to the cylinder head.
2. Remove rocker arms, D, rocker arm shaft supports, B, and springs, A, from the shaft.

Assembly

1. Coat the rocker arm shaft with engine oil prior to assembly. Lubricate the valve pads on all rocker arms.



Rocker Shaft Components
 A Spring
 B Rocker arm shaft support

Figure 1A-9
 C Notch
 D Rocker arm
 E Retaining bolts