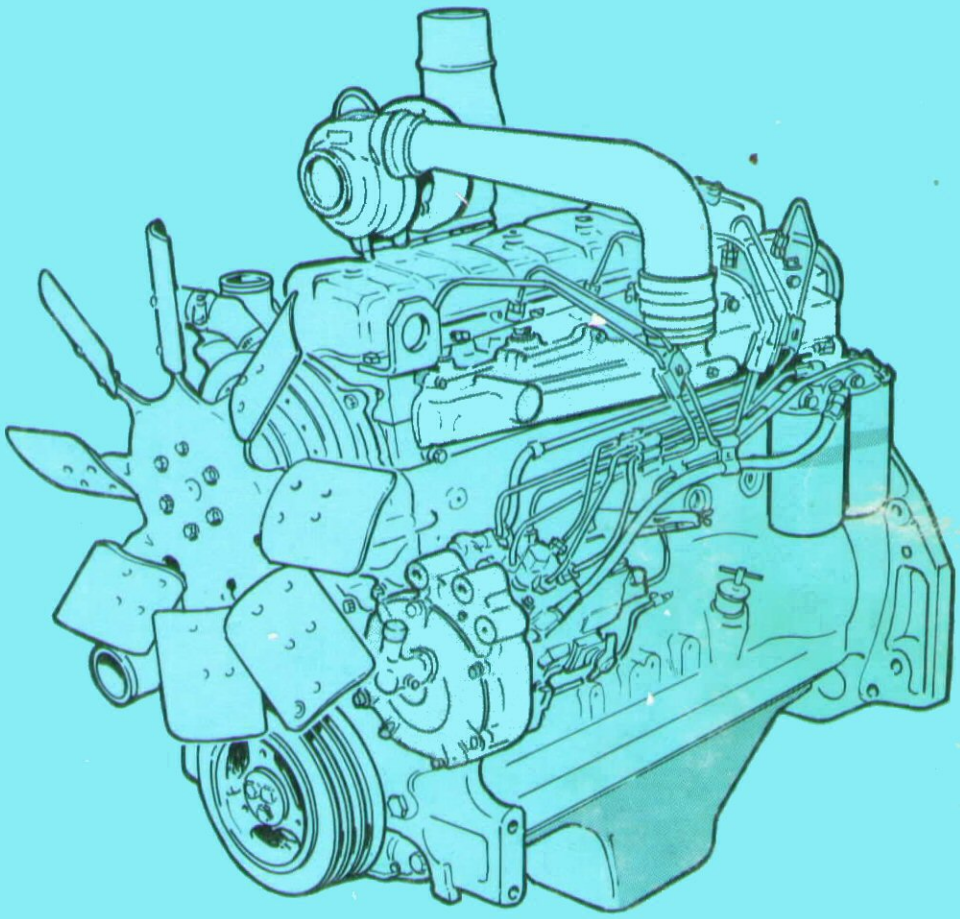
Service Manual



GSS-1427

300 & 400 SERIES DIESEL ENGINES & FUEL SYSTEM (American Bosch)

INTERNATIONAL HARVESTER COMPANY
FARM EQUIPMENT DIVISION
401 NORTH MICHIGAN AVENUE • CHICAGO, ILLINOIS, 60611, U.S.A.

Due to a continuous program of research and development, some procedures, specifications and parts may be altered in a constant effort to improve our products.

When changes and improvements are made in our products, periodic revisions may be made to this manual to keep it up-to-date. It is suggested that customers contact their dealer for information on the later revision.

300 and 400 Series Diesel Engines and Fuel Systems (U.D.T.S. – formerly American Bosch) (Robert Bosch)

GSS-1427-B W/Revision 1
June, 1984

CAUTION: Some photographs in this manual may show shields or cover panels removed for purposes of clarity. NEVER OPERATE Unit without all shields and cover panels in place.

General Contents

TORQUE VALUES FOR HOSE CLAMPS

The following chart provides the tightening torques for hose clamps used in all rubber applications (radiator, air cleaner, operating lever boots, hydraulic system, etc.)

Clamp Type and Size	Torque Plus or Minus 5 lbf-in (0.6 N·m)			
	Radiator, Air Cleaner, Boots, etc.		Hydraulic System System	
	N·m	lbf-in	N·m	lbf-in
"T" Bolt (Any Diameter)	7	60	5	45
Worm Drive — 1-3/4" Open Diameter and Under	3	25	5	45
Worm Drive — Over 1-3/4" Open Diameter	5	45	5	45
Worm Drive – All "Ultra Tite"	11	100	—	—

SPECIAL SERVICE TOOLS REQUIRED

SECTION 1	Engine
0- 6-4	Valve guide driver
89- 10-17	Puller (for vibration dampener)
15- 13-1	Compression tester gauge (0-1000 psi)
15- 14-16	Compression tester adapter
17- 22-2	Wet sleeve puller
17- 25-13	Nozzle sleeve remover adapter
04- 33-3	Puller (for vibration dampener)
17- 52A	Engine stand
17- 52-14	Engine attaching plate
15- 67-1	Dial indicator
04- 68-3	Piston ring "drop" fixture
04-101	Camshaft bearing puller and installer set
15-115-1	Thermomelt sticks pencil (388°F)
16-148-3	Nozzle sleeve installer
04-149-3	Rear oil seal and wear sleeve installer
04-549	MT-2 Ring tool

SECTION 2	Fuel System
14- 2-78	Adapter (610 082 C1*)
14- 57-3	O-ring tool
18- 66-1	Wash tank
15- 67-1	Dial indicator
05- 70-1	Holding fixture
05- 70-5	Holding wrench
15- 71A	Nozzle tester
15- 72A	Injection nozzle adapter kit
15- 97-33	Fitting (use with Fuel Rater - 2 required)
15- 97-36	Fitting (use with Fuel Rater)
15- 97-37	Fitting (use with Fuel Rater)
05-111-2	Puller
15-3005	Diesel tachometer
15-126	Diesel field test kit
15-126-2	Thermocouple (use with test kit FES 126)
15-126-4	0-30 psi gauge (use with test kit FES 126)

*Order through Parts Distribution Center.

Refer to Agricultural Equipment Special Service Tools and Equipment Manual PSB-11, for prices and ordering procedure.

SECTION 2	Fuel System - Continued
15-136	Fuel Rater Model U-7500A Test stand (Bacharach no. 67-8026) w/built in pressure lube oil unit Accessory set for testing Model 100 pump on FES 137-5 test stand (Bacharach no. 67-8123) Accessories for testing Model 100 pump on Model U-7000 and U-7500 test stands (Bacharach no. 67-3969) Pressure lubricating oil supply unit required for testing Model 100 pumps on Model U-7000 and U-7500 test stands (Bacharach no. 67-7227)
05-137-20	SAE Test nozzles (.05 MM)
05-500	American Bosch Model 100 series injection pump kit (includes the following)
05-500-1	Governor tension spring removing and installing tool (2 pieces)
05-500-2	Drip tube assembly
05-500-3	Plunger lift measuring tool
05-500-4	Holding fixture with funnel and tube
05-500-5	Torque cam angle and protractor
05-500-6	Governor spring adjusting gauge
05-500-7	Delivery valve checking fixture
05-500-8	Plunger spring compressor tool
05-500-9	Governor drive gear nut spanner socket
05-500-10	Holding bar
05-500-11	Support bar
05-500-12	Support block
05-500-13	Arkansas stone

SECTION 3	Turbocharger
14- 57-3	O-ring tool
15- 67-1	Dial indicator
15-126	Diesel field test kit
15-126-2	Thermocouple (for use with test kit FES 126)

Refer to Agricultural Equipment Special Service Tools and Equipment Manual PSB-11, for prices and ordering procedure.

GENERAL SHOP PRACTICES FOR ENGINE OVERHAUL

Diesel Engines

Engine Overhaul Procedures

Engine rebuild failures can occur because of poor shop practices. The information provided under the section of "General Shop Practices for Engine Overhaul" is not to supersede, nor is it intended to be all inclusive of all information available to service personnel through other International Harvester Publications as well as this service manual. The intention of this section is to present common procedures viewed in the field and to present sound shop practices recommended for engine overhauls.

Sources of Debris in Engines

Some types of failures may result in contamination (that is metal debris) being distributed throughout the entire engine to varying degrees. Service personnel should note that such debris may be accumulated in the oil pump assembly, oil filter base housing, injection pump, oil cooler, oil pressure relief valve and/or oil supply galleys in the head and block.

The degree of the failure, the size, volume, type and location of the contaminant are all factors that determine the extent of cleaning necessary. All reuseable engine parts are considered cleanable, except under certain circumstances, such as the oil cooler. The oil cooler should be replaced when a large collection of metal contaminants are found in the oil pan and/or lube system, which could have blocked or restricted its passages. However, the oil cooler may be successfully cleaned of light suspended contaminants such as antifreeze by flushing in a good cleaning solvent such as Union Carbide's Butyl Cellosolve.

When failures such as piston scoring, rod failures, or (dusting) failure from an air induction leak occurs, it is recommended that the crankcase and cylinder head be steam cleaned or boiled out in a hot tank. Failure to do so often results in very short rebuild life.

Properly Assemble and Test the Air Induction System

Proper assembly and servicing of the air induction system is of vital importance in preventing a dusted engine and in obtaining optimum performance testing.

Air Induction System Testing

The introduction of dirt through the air induction system will cause excessive wear of the rings and cylinder sleeves and premature engine failure. The air induction system, composed of an air cleaner assembly, intake pipe, hoses and clamps, must be completely sealed to prevent unfiltered air from entering the engine. The air cleaner must be the only source of air to the engine.

An improved air induction hose clamp is now available for use on all machines. The new clamp is torqued at 11.2 to 13.8 N·m (100 to 125 in. lbs.) resulting in a better seal at the hose connections.

To insure that all air passages through the air cleaner, the air cleaner element seals and gaskets must always be in excellent condition. Hold down nuts should never be overtightened. Overtightening will cause distortion of the main element housing and filter element housing, allowing air to bypass the filter assembly.

Visually inspect element seals and canister sealing area for signs of the seal sticking. If sticking is evident, replace the element and remove all seal material from the canister. If seal material is not removed, the new filter element may not seal properly.

Check the element for damage caused by improper handling or storage. Never tap an element on a hard surface or use more than 690 kPa (100 psi) of air pressure to clean a filter element. Improper cleaning procedures can damage the element and allow the engine to be damaged in a few hours.

In addition to the air cleaner element, the remainder of the air induction system must be properly maintained. This can best be checked by pressurizing the air induction system. The procedure is applicable to both turbocharged and naturally aspirated engines. A naturally aspirated engine will operate under negative manifold pressure at all times. A turbocharged unit will operate with a negative pressure from the air filter to the turbocharger and a positive pressure from the turbocharger to the engine. If leaks between the turbocharger and engine are present, poor performance may be encountered.

The tools and materials required to pressurize the air induction system include a roll of duct tape, paint brush, liquid soap, one-quarter inch air hose with push lock male pipe fittings and quick disconnect fittings, pressure regulated air source and 0-100 kPa (0-15 psi) pressure gauge.

The safety element should be taped completely so no air can escape through the filter assembly. The tape must overlap so there are no gaps where air leakage can occur. Install the taped element. Remove the air cleaner indicator line or intake manifold plug and install the 0-100 kPa (0-15 psi) pressure gauge. This gauge will indicate actual air pressure in the air induction system during the test procedure. Attach a regulated air source to the intake manifold pressure test port. Pressurize the intake system to 20 kPa (3 psi).

In a container, mix the liquid soap with water. Use the paint brush to systematically soap all air induction system connections. Include hoses, metal pipe, ether can holder, ether and air restriction sending unit connections and the turbocharger. If a leak is found, it should be corrected immediately.

If an engine failure indicates the ingestion of dirt into the engine, the air induction system should be tested as explained. This procedure should also be performed any time the air induction system is suspect to insure the customer maximum service.

The above procedure is also covered in an SIS film, "AIR INDUCTION SYSTEM TESTING".

Cleaning Pistons and Sleeves

As received in shipping packages from PDC's, pistons and sleeves require cleaning prior to installation into crankcases. It is essential that all contamination be removed from surfaces of pistons and sleeves. The wiping of a sleeve and/or piston with a treated pad and/or an oil soaked rag is <u>not</u> sufficient to clean out the minute metal particles.

It is recommended that parts as received, as well as those reinstalled, should be washed in a hot liquid detergent and water solution, rinsed and dried, then coated with a thin film of clean 30 weight

engine oil to prevent rust. Detergent acts to "lift up" the metal particles. Using hot water or a steam gun will provide adequate heat for the sleeve and/or piston to evaporate the water off. Wipe repeatedly with light engine oil and clean rags until a clean white rag shows no evidence of discoloration from the piston and/or sleeve.

Pistons and Sleeves

Pistons and sleeves furnished for diesel engines are not matched. New diesel engine pistons and sleeves may be intermixed. Pistons and sleeves being reused must be kept in sets and reinstalled in the same bore from which they were removed. This is also true when only piston rings and/or O-rings/seals are replaced.

Skirt clearance can be obtained by first measuring the piston 90 degrees from the pin hole near the bottom of the skirt. The I. D. of the sleeve should then be measured in the middle area of sleeve. By comparing sleeve I. D. to piston O. D., the skirt clearance can be determined. Piston and sleeve clearance can be measured most accurately using micrometers. Refer to the appropriate service manuals for skirt clearance specifications.

Knurling of pistons is not an approved practice. Knurling of the piston deforms the O. D. of the piston. This may cause heavy piston to sleeve contact, resulting in scoring.

Installation of Sleeves

Sleeve O-rings should be coated with clean engine oil and when applied, any excess will easily run off. Excessive application of a more solid lubricant may cause marginal deformation of the sleeve diameter.

Installing Pistons and Sleeves

Sleeves must be installed in the crankcase and clearances checked, using only the piston to be installed on that sleeve. Prior to installation of the sleeve, clean the crankcase bore. If not properly cleaned, the sleeve will be distorted, causing damage to piston and rings. Pistons and (wet) sleeves can be measured in their free state, at room temperature, using micrometers.

Rotate Wet Sleeves

When wet sleeves are reinstalled in diesel engines, service personnel may elect to rotate the sleeve 90° from its original position if signs of cavitation exist. This provides a new surface to resist the effects of cavitation and erosion, lengthening the useful life of the sleeve.

Ribbon Fitting

Ribbon fitting of pistons and sleeves is no longer recommended.

Honing/Deglazing

New IH cylinder sleeves do not require honing or deglazing prior to installation.

All Neuss engines, 300 & 400 series engines and the V-800 engines, use sleeves that are plateau honed and should never be honed or deglazed. Service equipment used in the field cannot produce the plateau honed surface required to provide extended ring life.

A common term used today when examining cylinders and sleeves is that the ring travel area is "glazed". The definition of "glazed" can vary widely from one observer to another.

The following is offered as the correct definition:

A sleeve that no longer has evidence of a cross hatch pattern, whether isolated to certain areas of the ring travel or in the entire ring travel area, is simply "worn".

A sleeve that appears shiny or has what appears to be a brown or yellow varnish in the ring travel area is "glazed". Glazing occurs when fuel and oil deposits and combustion soot accumulate on the wear surface of the cylinder walls. If a sleeve is reinstalled without removal of the glaze or varnish, it is possible the engine may consume excessive amounts of oil as the piston rings may not make proper sealing contact with the cylinder walls.

It should be noted that the glaze which can accumulate on diesel cylinders and sleeves can be removed using a 50/50 mix of hot water and liquid detergent.

Cleaning the Cylinder Head

Failure to clean valve guides prior to reassembly can cause premature valve guide wear, high engine oil consumption, and in extreme conditions valve breakage. All guides furnished as service parts are reamed to size. Since they are a press fit in the head, it is necessary to ream them again to remove any possible burrs or slight distortion caused by the installation.

Valve guides installed in used cylinder heads and new service cylinder heads must be cleaned as outlined below.

1. Coat a nylon brush (which has a slightly larger diameter than the I.D. of the valve guide) with soap and hot water.

2. Insert the brush into the I.D. of valve guide, and with a turning motion, run the brush through to insure removal of gum, carbon deposits and rust preventative from the guide and spiral grooves.

3. Rinse with hot water, dry thoroughly.

4. Thoroughly coat the guide with clean engine oil after the cleaning operation is complete

IMPORTANT: When installing the valves and retainers, do not use grease. Grease may stop the flow of oil into the valve guide and cause valve guide wear.

Keep Engine Components Clean at All Times

Prior to and during installation of engine components, assemblies must be covered and not exposed to contamination. Failure to provide clean parts will result in premature internal engine wear and/or high oil consumption.

SEALING COMPOUND USE

LOCTITE RETAINING AND SEALING COMPOUNDS

Compound Description

These products are single component, self-curing, polyester compounds which remain liquid while exposed to air, and harden by chemical action into tough structural solids when confined between closely mated metal parts. These compounds will resist solvents, heat, shock and vibration and are intended to provide a positive seal against leakage, and shear strength resistance to loosening when used in the assembly of threaded, slip fit, or press fitted parts.

Loctite Grades (General Usage)

1. GRADE B (YELLOW) — Straight threaded fasteners.

2. GRADE "AVV" (RED) — Straight threaded fasteners; higher strength for studs, etc.

3. PLASTIC GASKET (RED) — Use as seal between mating surfaces (face sealant).

4. HVV (UNFILLED PIPE SEALANT) — Use on tapered pipe threads.

5. HYDRAULIC SEALANT — Use on fuel fittings with straight pipe threads.

NOTE: ***Once cured, these compounds have an operating temperature range of -55°C to 150°C (-65 to 300°F) and will resist attack by oils, chemicals, hydraulic fluids and solvents.***

Exceptions DO NOT use Loctite:

1. Where other means of retaining the assembly are provided such as, prevailing torque fasteners (fasteners with distorted threads or plastic inserts), lock washers, lock plates and lock wires.

2. On items requiring frequent servicing.

3. When the operating temperature exceeds 150°C (300°F). (Example: Engine Exhaust Systems).

4. On brass fittings and plugs.

SURFACE PREPARATION

Plain and Phosphate Coated Parts

Clean the surfaces where compounds are to be applied to remove heavy coatings of oil grease and dirt (rust or light oil film are not detrimental). Normal shop practice of cleaning or degreasing is adequate. Phosphate and oiled hardware is used in the "as received" condition.

Zinc or Cadmium Plated Parts or for Rapid Hardening

At least one of the mating surfaces should be degreased with a cleaning solution to which concentrated primer has been added. (1 part primer concentrate to 30 parts trichlorethylene or 1-1-1 trichlorethylene). Allow surfaces to dry for 3 to 6 minutes before applying compound.

Drawbar Studs or Special Stud Applications

Degrease parts with a cleaning solution to which concentrated primer has been added. (1 part primer concentrate to 30 parts trichlorethylene or 1-1-1 trichlorethylene). Allow surfaces to dry for 3 to 6 minutes before applying compound. In blind holes be sure to remove all chips and oil.

Face Sealant (Plastic Gasket)

Mating parts must be cleaned as for plain and phosphate coated parts.

APPLICATION

Cap Screws and Pipe Threads

Fill the first 2 to 3 leading threads in area of engagement with compound. For large quantities of cap screws, may also be applied by tumbling method (refer to manufacturer's instructions).

Studs

Apply by hand to individual studs. Fill full length of thread with one strip on diameters up to 25 mm (1 inch), two strips 180° apart on diameters up to 50 mm (2 inches), and three strips 120° apart on diameters over 50 mm (2 inches). In all cases apply one strip into tapped holes.

Blind hole applications — apply enough compound to fill the bottom 2 to 3 threads of engagement, then insert stud. If engagement length exceeds one diameter use proportionally more compound.

For non-seated studs (studs that can go deeper in hole than required) turn stud one turn deeper than required. After bubbling stops, apply a ring of compound around stud at top of hole, then turn back to required height.

Face Sealant (Plastic Gasket)

Spread an even coat 1 cc per 260 cm^2 (40 sq. inches) on one of the mating surfaces. Assemble and tighten bolts.

NOTE: ***On crawler tractor applications only, when compound is used as a gasket, bolts which attach the parts should be coated with MPL (gear lubricant) to prevent compound from sticking to bolts.***

APPLICATION AT LOW TEMPERATURES

1. Without special precautions, these compounds can be applied and will cure at temperatures down to 10°C (50°F), and at that temperature full strength will be obtained within 72 hours.

2. At temperatures from 10° to -18°C (50° to 0°F), the use of primer is recommended.

3. If necessary, the compounds can be applied at temperatures below -18°C (0°F), only if heat is used to accelerate the cure as follows:

65°C (150°F) for 60 minutes
93°C (200°F) for 45 minutes
120°C (250°F) for 30 minutes

SETTING TIME (BEFORE PLACING IN OPERATION)

1. Normal time for compound grades without use of any primer — 6 to 24 hours at room temperature with machined carbon steel parts. Higher temperatures will accelerate cure and lower temperatures will retard cure. Other base metals will provide more or less catalytic effect on cure.

2. Primed surfaces — 2 to 6 hours. This may be speeded by pretreating mating surfaces with special primers. Some metals (such as zinc and cadmium plate, anodized aluminum, and passivated stainless steel) are inactive and require heat or primer to cure the compound.

3. A fast curing type primer will fix parts for normal handling in 10 to 15 minutes and will achieve 75 percent of ultimate strength in 1 hour and full cure in 2 to 4 hours.

REMOVAL

Parts difficult to remove can be preheated to 205° to 260°C (400° to 500°F) prior to removal.

Section 1

ENGINE

Contents

SPECIAL NUT AND BOLT TORQUE DATA (In Foot Pounds)

Alternator pulley nut	
w/. 87 Inch dia. shaft	102 N·m (75 ft. lbs.)
w/. 67 Inch dia. shaft	68 N·m (50 ft. lbs.)
Breather housing nuts - (414, 436, 466 Series)	16 N·m (12 ft. lbs.)
Camshaft thrust plate bolt	27 N·m (20 ft. lbs.)
Connecting rod bolts	176 N·m (130 ft. lbs.)
Crankcase front plate bolt	27 N·m (20 ft. lbs.)
Cranking motor mounting bolts	115 N·m (85 ft. lbs.)
Crankshaft main bearing cap bolt	156 N·m (115 ft. lbs.)
Crankshaft pulley retainer bolts	170 N·m (125 ft. lbs.)
*Cylinder head bolts	225 N·m (165 ft. lbs.)
Cylinder head valve cover bolt	2.8 N·m (25 in. lbs.)
Exhaust manifold nuts	77 N·m (57 ft. lbs.)
Exhaust outlet elbow to cylinder head bolt (414, 436, 466 Series)	230 N·m (170 ft. lbs.)
Flywheel bolts	149 N·m (110 ft. lbs.)
Flywheel housing mounting bolts	142 N·m (105 ft. lbs.)
Idler gear carrier bolt	115 N·m (85 ft. lbs.)
Injection nozzle holder retaining bolt	27 N·m (20 ft. lbs.)
Injection pump drive gear bolts	41 N·m (30 ft. lbs.)
Intake manifold bolt	27 N·m (20 ft. lbs.)
Intercooler mounting bolts	20 N·m (15 ft. lbs.)
Oil filter by-pass valve cap	68 N·m (50 ft. lbs.)
Oil pan drain plug	45 N·m (33 ft. lbs.)
Oil pan bolts	27 N·m (20 ft. lbs.)
Oil pressure regulating valve cap nut	230 N·m (170 ft. lbs.)
Turbocharger air hose clamps	5 N·m (45 in. lbs.)
Turbocharger mounting bolts	47 N·m (35 ft. lbs.)
Tachometer drive thrust plate nuts	27 N·m (20 ft. lbs.)

*To be torqued in sequence and steps as shown on the cylinder head torque pattern chart in "Installation" of cylinder head.

NOTE: All engine bolts are type 8. However, except for special torques, they are to be torqued to type 5 specifications.

Product Idenficiation by Serial Number

467 **B** **T2** **U** **012345** *

Cubic Inch Displacement, Combustion Style, and/or Injection Pump

- **466** 466 cubic inch, w/American Bosch injection pump
- **467** 466 cubic inch w/"B" style combustion and American Bosch injection pump
- **468** 466 cubic inch w/"B" style combustion and Robert Bosch injection pump.

Type Diesel

- **D** Naturally Asperated
- **T** Turbocharged
- **B** Turbocharged and Intercooled

End Use

- **T2** Agricultural or Industrial Tractor
- **F2** Agricultural Implement
- **U2** Power Unit
- **B2** Marine
- **C2** Crawler
- **H2** Hough product
- **M2** Truck
- **P2** Off-Highway Truck
- **S2** Self-propelled Scraper

Country of Origin

- **U** United States
- **C** Canada
- **D** Germany
- **E** England
- **J** Japan

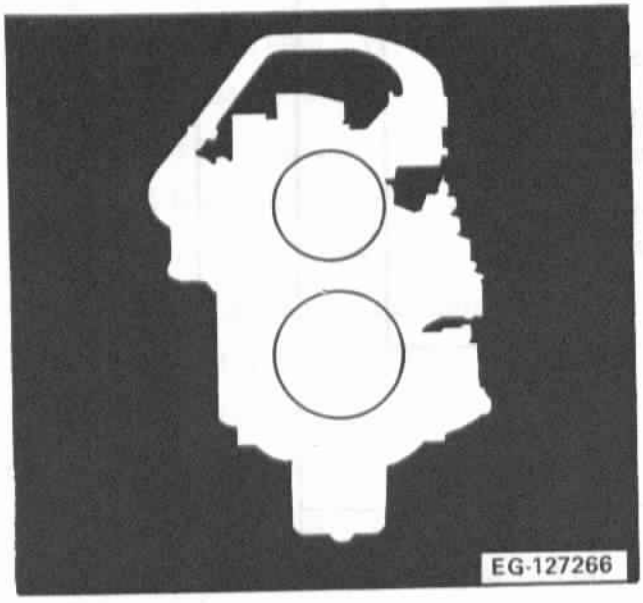
Sequence Number

* **Denotes End of Number**

The engine serial number **467BT2U012345*** denotes an engine of 466 cubic inch displacement w/"B" style combustion, American Bosch injection pump, turbocharged and intercooled Diesel, for Agricultural or Industrial tractor, manufactured in the United States and identified as twelve thousand three hundred and forty five for production and record purposes.

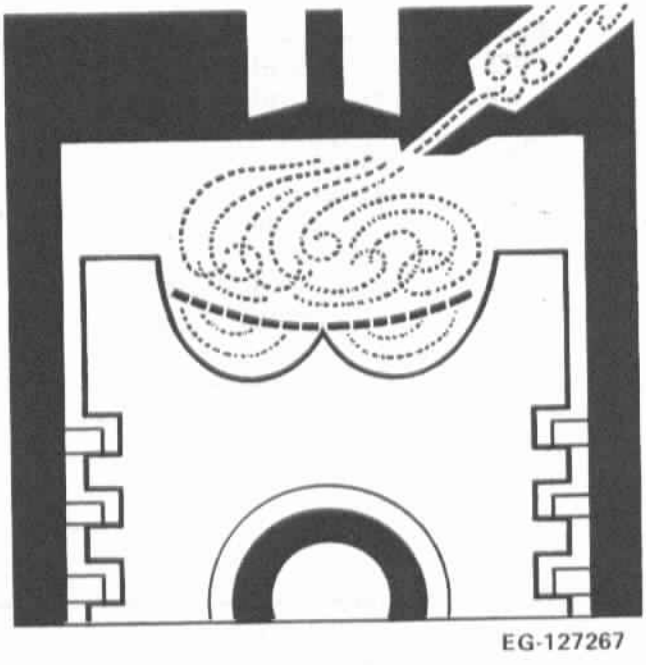
ENGINE FEATURES

DESCRIPTION

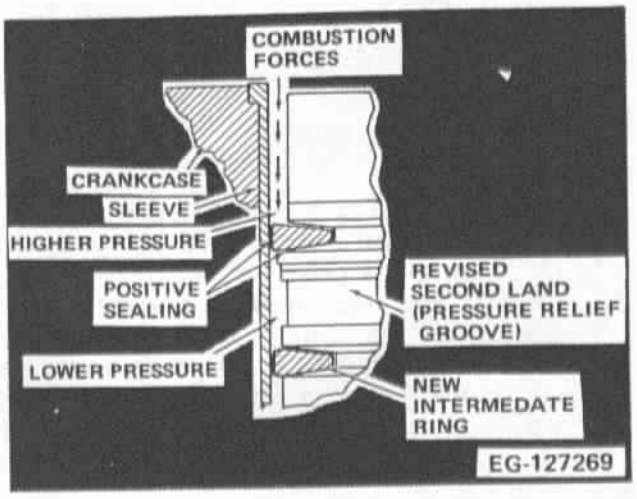


The 300/400 Series comprise a line of premium quality mid-range engines used in various Agricultural Equipment, Construction Equipment, On-Highway Truck and OEM applications.

All are direct starting, valve-in-head type with direct fuel injection.

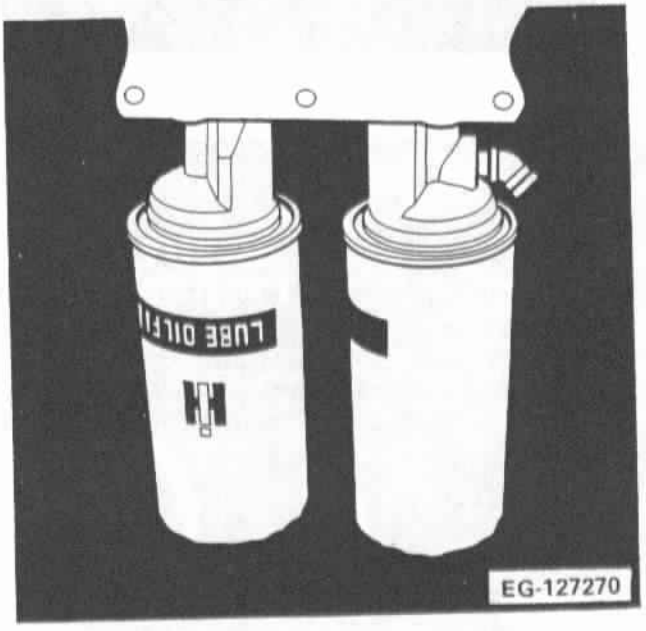


The cylinder head design initiates a swirling motion to the air entering the cylinders from the intake manifold to create high turbulence air-to-fuel mixing, resulting in greater efficiency.

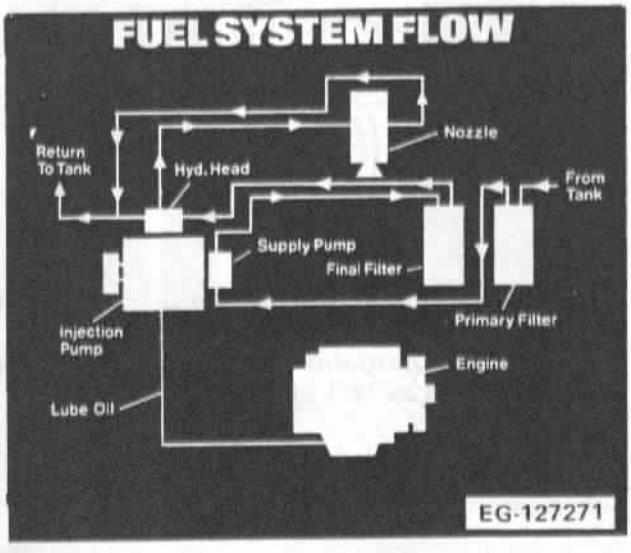


DESCRIPTION

The Turbocharged 400 Series Engines incorporates a "BALANCE PRESSURE" PISTON with a revised second land configuration and top ring groove and a new INTERMEDIATE PISTON RING. These technological advances provide a more positive seal for the top ring against the bottom of the top ring groove and cylinder wall (sleeve). Engine oil control is improved significantly.

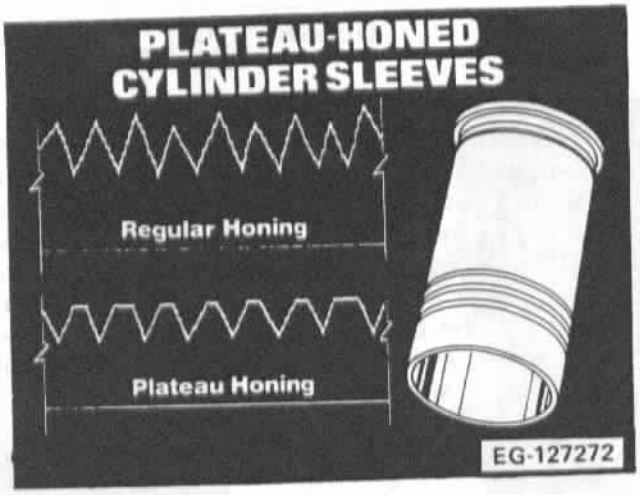


For ease of service all 300/400 series engines are equipped with two spin-on, throw-away type oil filters.



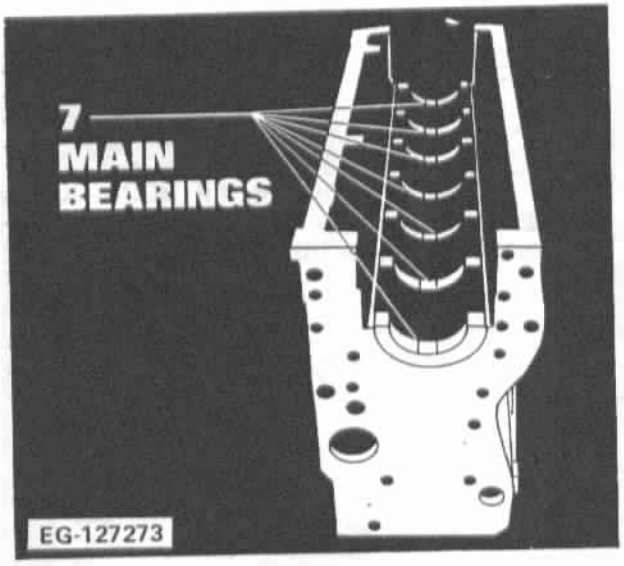
A fuel system which accurately meters the required amount of fuel for complete combustion, and provides complete governor control for power take off applications without the additional cost of add-on governors.

Incorporated in a built-in timing advance and excess fuel control device which allows smooth, quiet, and unaided starting down to 20°F. or below.

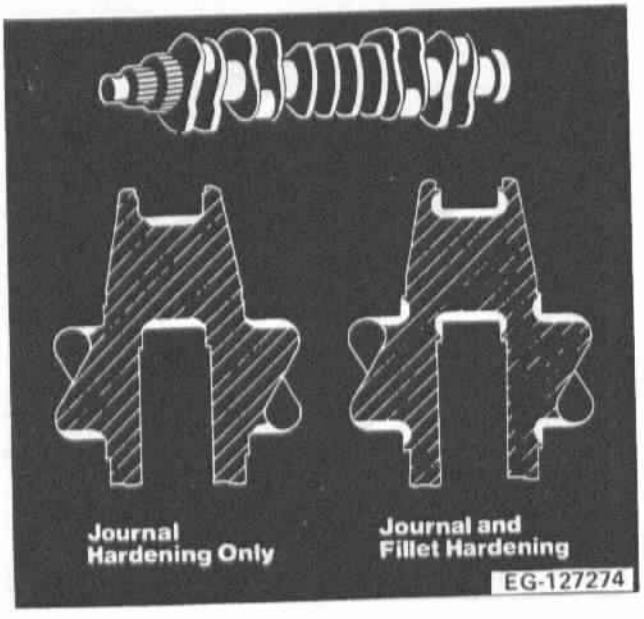


DESCRIPTION

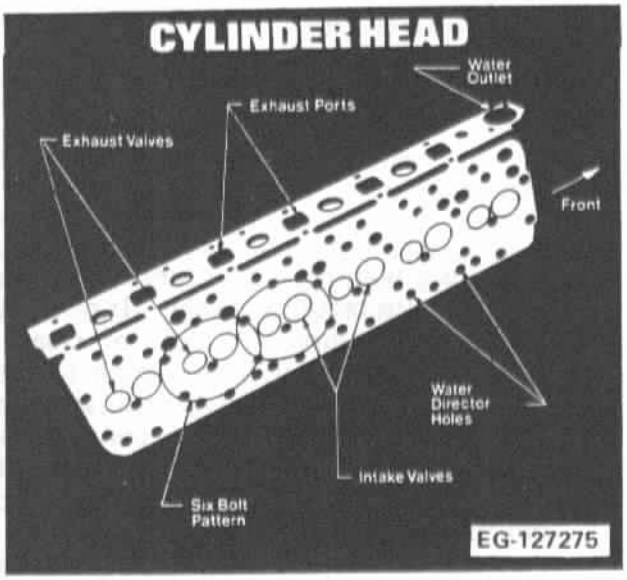
Cylinder sleeves are of the replaceable, wet-type which are surrounded by water to provide immediate positive heat dissipation. The sleeves are machined by a special process called Plateau-Honing. This process provides a sleeve finish which results in rapid engine run-in. Induction hardening of the sleeves I.D. results in low wear rates and long life. (Hardening is used only on certain applications with higher HP ratings).



The block is made of high strength alloy iron which minimizes weight without sacrificing engine rigidity. An outstanding feature of the 400 series engines is that crankshaft wear is distributed over 7 main bearings.

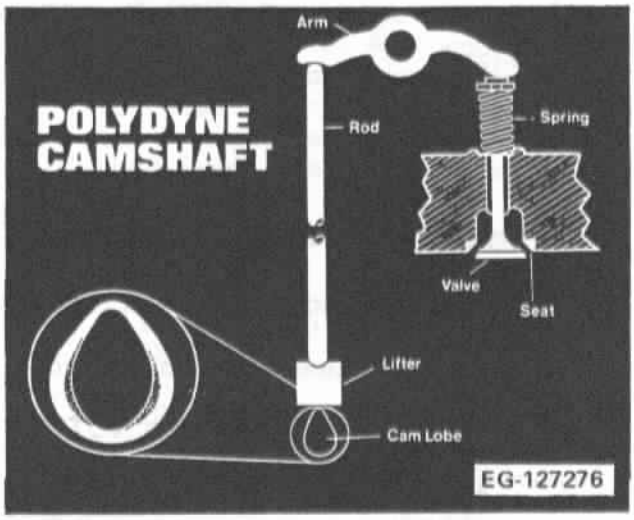


The crankshaft is constructed of induction hardened forged steel; International not only induction hardens the journal areas, but the fillet areas as well on 466 Series Engines.



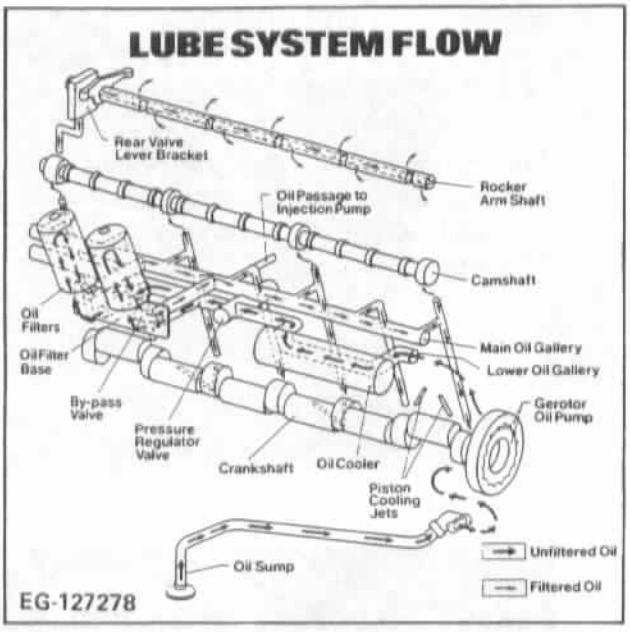
DESCRIPTION

The cylinder head is a one piece, iron alloy casting with a six bolt pattern around each cylinder which assures positive head gasket sealing.



The camshaft is a steel forging with induction hardened lobes. It is a "Polydyne" design camshaft which means that valve travel speed is reduced just before valve seating to allow gentle seating of valves. As a result of this "Polydyne" design camshaft, superior valve life can be achieved.

The lubrication system in the Turbocharged 400 series engines addresses the problem of on-the-spot immediate cooling with twelve oil cooling jets installed in the main bearing webs, two per cylinder. These cooling jets facilitate piston and wrist pin cooling, thus eliminating the possibility of heat build-up in these hard-working high friction areas.



DESCRIPTION

A unique feature of this lubrication system is the pressure regulating valve. It not only controls the pressure and flow of clean oil released from the oil filters going to the main oil gallery and other critical areas of the engine, but this oil regulator controls the flow of unfiltered oil entering the filters. Excess unfiltered oil is dumped back into the oil pan before it can reach the filters. This added control eliminates the possibility of overloading the filters by dumping oil before filtering, thus adding to oil filter life.

ENGINE START-UP

1. Run at low idle and check rocker arm lubrication — reinstall valve cover.
2. Inspect visually for coolant and oil leaks.
3. Start engine run-in **(See NOTE).**

   NOTE: ***Follow specified engine run-in procedures. Failure to do so will result in engine failure such as piston/sleeve scoring and/or excessive oil consumption.***

4. Retorque cylinder heads at specified time period during run-in. Failure to do so will result in head gasket failure.
5. Complete engine run-in.
6. Obtain In-Chassis Engine Performance Data.
7. Retorque all external fasteners (Nuts, bolts and hose lamps).
8. Engine can now be placed back into service.

   NOTE: ***Follow-up should be made per after delivery service for specific application. This follow-up service must be made on engine if complete engine disassembly was necessary.***