6SE184 (REV. 2/74)

EL MORRO
MODEL 7163-7005-16V-71
S/N 16VA008270

Service Manual

Detroit Diesel Engines

V-71

Detroit Diesel Allison
Division of General Motors Corporation
Detroit, Michigan 48228

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CONTENTS

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SCOPE AND USE OF THE MANUAL

This manual covers the basic V-71 diesel engines built by the Detroit Diesel Allison Division of General Motors Corporation. Complete instructions on operation, adjustment (tune-up), preventive maintenance and lubrication and repair (including complete overhaul) are covered. The manual was written primarily for persons servicing or overhauling the engine and, in addition, contains all of the instructions essential to the operators and users. The maintenance and overhaul procedures are common to all V-71 engines and therefore apply to all engine models.

The manual is divided into numbered sections. The first section covers the engine (less major assemblies). The following sections cover a complete system such as the fuel system, lubrication system or air system. Each section is divided into sub-sections which contain complete maintenance and operating instructions for a specific sub-assembly on the engine. For example, Section 1, which covers the basic engine, contains sub-section 1.1 pertaining to the cylinder block, sub-section 1.2 covering the cylinder head, etc. The subjects and sections are listed in the Table of Contents on the preceding page. Pages are numbered consecutively, starting with a new Page 1 at the beginning of each sub-section. The illustrations are also numbered consecutively, beginning with a new Figure 1 at the start of each sub-section.

Information regarding a general subject, such as the lubrication system, can best be located by using the Table of Contents. Opposite each subject in the Table of Contents is a section number which registers with a tab printed on the first page of each section throughout the manual. Information on a specific sub-assembly or accessory can then be found by consulting the list of contents on the first page of the section. For example, the cylinder liner is part of the basic engine, therefore, it will be found in Section 1. Looking down the list of contents on the first page of Section 1, the cylinder liner is found to be in sub-section 1.6.3. An Alphabetical Index at the back of the manual has been provided as an additional aid for locating information.

SERVICE PARTS AVAILABILITY

Genuine Detroit Diesel "Factory-Engineered" replacement parts are available from authorized Detroit Diesel Service Outlets conveniently located within the United States, in Canada from the distribution organization of Diesel Division, General Motors of Canada Limited, and abroad through the sales and service outlets of General Motors Overseas Operations Divisions.

CLEARANCES AND TORQUE SPECIFICATIONS

Clearances of new parts and wear limits on used parts are listed in tabular form at the end of each section throughout the manual. It should be specifically noted that the "New Parts" clearances apply only when all new parts are used at the point where the various specifications apply. This also applies to references within the text of the manual. The column entitled "Limits" lists the amount of wear or increase in clearance which can be tolerated in used engine parts and still assure satisfactory performance. It should be emphasized that the figures given as "Limits" must be qualified by the judgment of personnel responsible for installing new parts. These wear limits are, in general, listed only for the parts more frequently replaced in engine overhaul work. For additional information, refer to the paragraph entitled *Inspection* under *General Procedures* in this section.

Bolt, nut and stud torque specifications are also listed in tabular form at the end of each section.

PRINCIPLES OF OPERATION

The diesel engine is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine.

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression.

The Two-Cycle Principle

In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes respectively as shown in Fig. 1. In contrast, a four-cycle engine requires four piston strokes to complete an operating cycle; thus, during one half of its operation, the four-cycle engine functions merely as an air pump.

A blower is provided to force air into the cylinders for expelling the exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports as shown in Fig. 1 (scavenging).

The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to compression as shown in Fig. 1 (compression).

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion chamber by the unit fuel injector as shown in Fig. 1 (power). The intense heat generated during the high compression of the air ignites the fine fuel spray immediately. The combustion continues until the fuel injected has been burned.

The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about half way down, allowing the burned gases to escape into the exhaust manifold as shown in Fig. 1 (exhaust). Shortly thereafter, the downward moving piston uncovers the inlet ports and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, in other words, in two strokes; hence, it is a "two-stroke cycle".

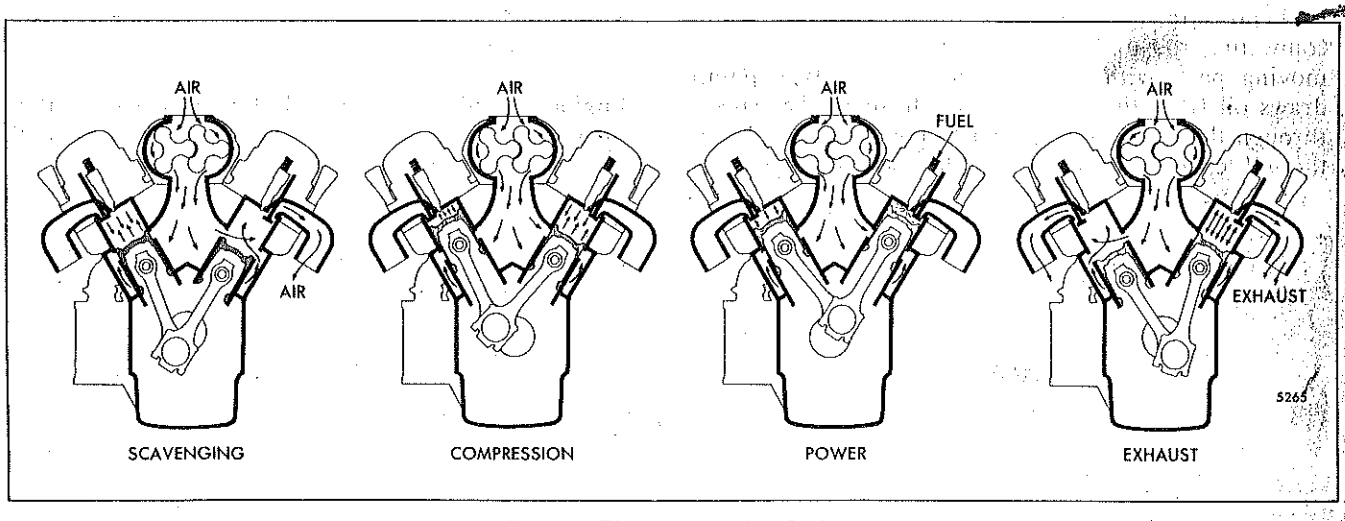


Fig. 1 - The Two-Stroke Cycle

GENERAL DESCRIPTION

The two-cycle diesel engines covered in this manual are produced in 6, 8, 12 and 16 cylinder models having the same bore and stroke and many of the major working parts such as injectors, pistons, connecting rods, cylinder liners and other parts that are interchangeable.

All cylinder blocks are symmetrical in design thus permitting oil cooler or starter installation on the same side or on opposite sides of the engine, depending upon the installation requirements. The engines are built with right-hand or left-hand crankshaft rotation. For example, the crankshaft in an RC engine, viewed from the flywheel end, will rotate counterclockwise, the oil cooler will be mounted on the right-hand side of the engine and the starter will be on the left-hand side (Fig. 2).

The meaning of each digit in the model numbering system is shown in Fig. 2. The letter L or R indicates left or right-hand engine rotation as viewed from the front of the engine. The letter A, B, C or D designates the location of the starter and oil cooler as viewed from the rear of the engine.

Each engine is equipped with an oil cooler, lubricating oil filter, fuel oil strainer, fuel oil filter, air cleaner or silencer, governor, heat exchanger and raw water pump or fan and radiator, and starting motor.

Full pressure lubrication is supplied to all main, connecting rod and camshaft bearings, and to other moving parts within the engine. A gear-type pump draws oil from the oil pan through an intake screen, through the oil filter and then to the oil cooler. From the oil cooler, the oil flows through passages that connect with the oil galleries in the cylinder block and cylinder heads for distribution to the bearings, rocker arm mechanism and other functional parts.

Coolant is circulated through the engine by a centrifugal-type water pump. Heat is removed from the coolant, which circulates in a closed system, by the heat exchanger or radiator. Control of the engine temperature is accomplished by thermostats which regulate the flow of the coolant within the cooling system.

Fuel is drawn from the supply tank through the fuel strainer by a gear-type fuel pump. It is then forced through a filter and into the fuel inlet manifolds in the cylinder heads and to the injectors. Excess fuel is returned to the supply tank through the fuel outlet manifolds and connecting lines. Since the fuel is constantly circulating through the injectors, it serves to cool the injectors and also carries off any air in the fuel system.

Air for scavenging and combustion is supplied by a blower which pumps air into the engine cylinders via the air box and cylinder liner ports. All air entering the blower first passes through an air cleaner or silencer.

Engine starting is provided by either a hydraulic or electric starting system. The electric starting motor is energized by a storage battery. A battery-charging generator, with a suitable voltage regulator, serves to keep the battery charged.

Engine speed is regulated by a mechanical or hydraulic type engine governor, depending upon the engine application.

7 0 8 2 – 7 2 0 1

SERIES 71 V ENGINES	NUMBER OF CYLINDERS	APPLICATION DESIGNATION (see below)	BASIC ENGINE ARRANGEMENT AND DRIVE SHAFT ROTATION (see below)	DESIGN VARIATION (see below)	SPECIFIC MODEL NUMBER

APPLICATION DESIGNATION:

7082-7200	MARINE
7083-7200	INDUSTRIAL F-F
7084-7200	POWER-BASE
7085-7200	GENERATOR
7087-7200	AUTOMOTIVE F-F
7088-7200	SPECIAL

DESIGN VARIATION:

7082-7000	V-71 "N" ENGINE
7082-7100	2 VALVE HEAD
7082-7200	4 VALVE HEAD
7082-7300	TURBOCHARGER
7082-7500	CUSTOMER SPEC. ENGINE

BASIC ENGINE ARRANGEMENTS:

Rotation: L (left) and R (right) designates rotation viewed from the front of the engine.

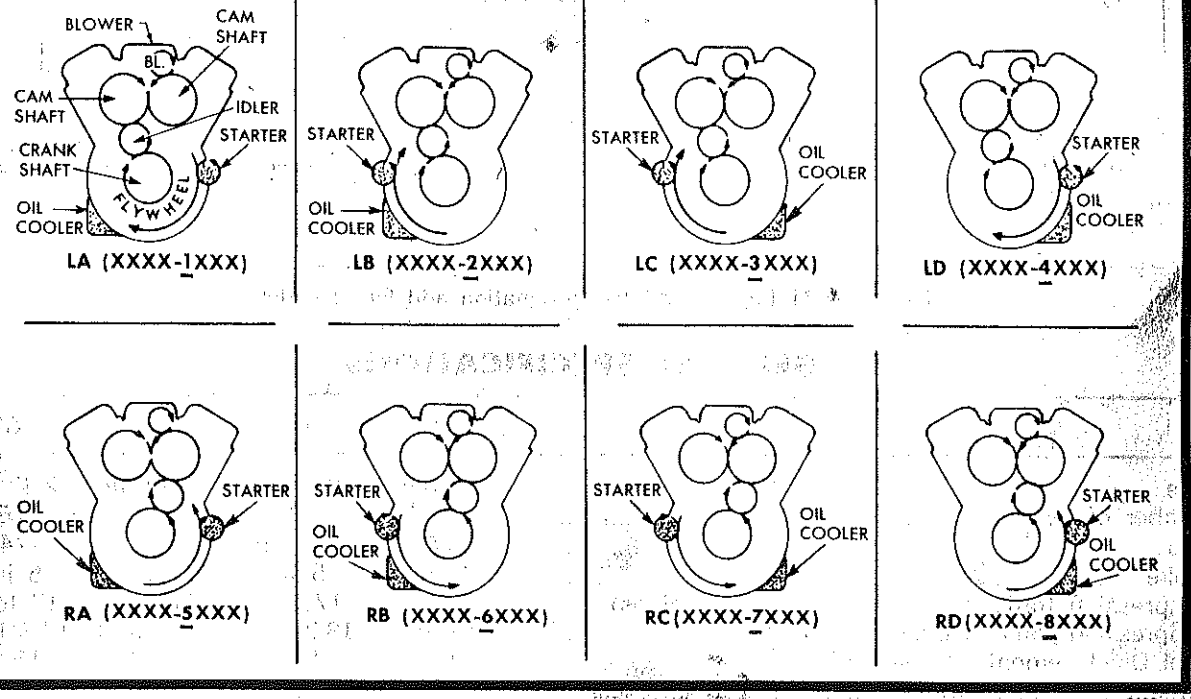
Type: A-B-C-D designates location of starter and oil cooler as viewed from the rear (flywheel) end.

Cylinder Bank: Left and right cylinder banks are determined from rear of engine.

DRIVE SHAFT ROTATION:

7242-0200	LEFT-HAND
7242-9200	RIGHT-HAND

Drive shaft rotation: shaft rotation on multiple units is determined from the rear of the unit.



ALL ABOVE VIEWS FROM REAR OF ENGINE

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Fig. 2 - Model Numbering, Rotation and Accessory Arrangements

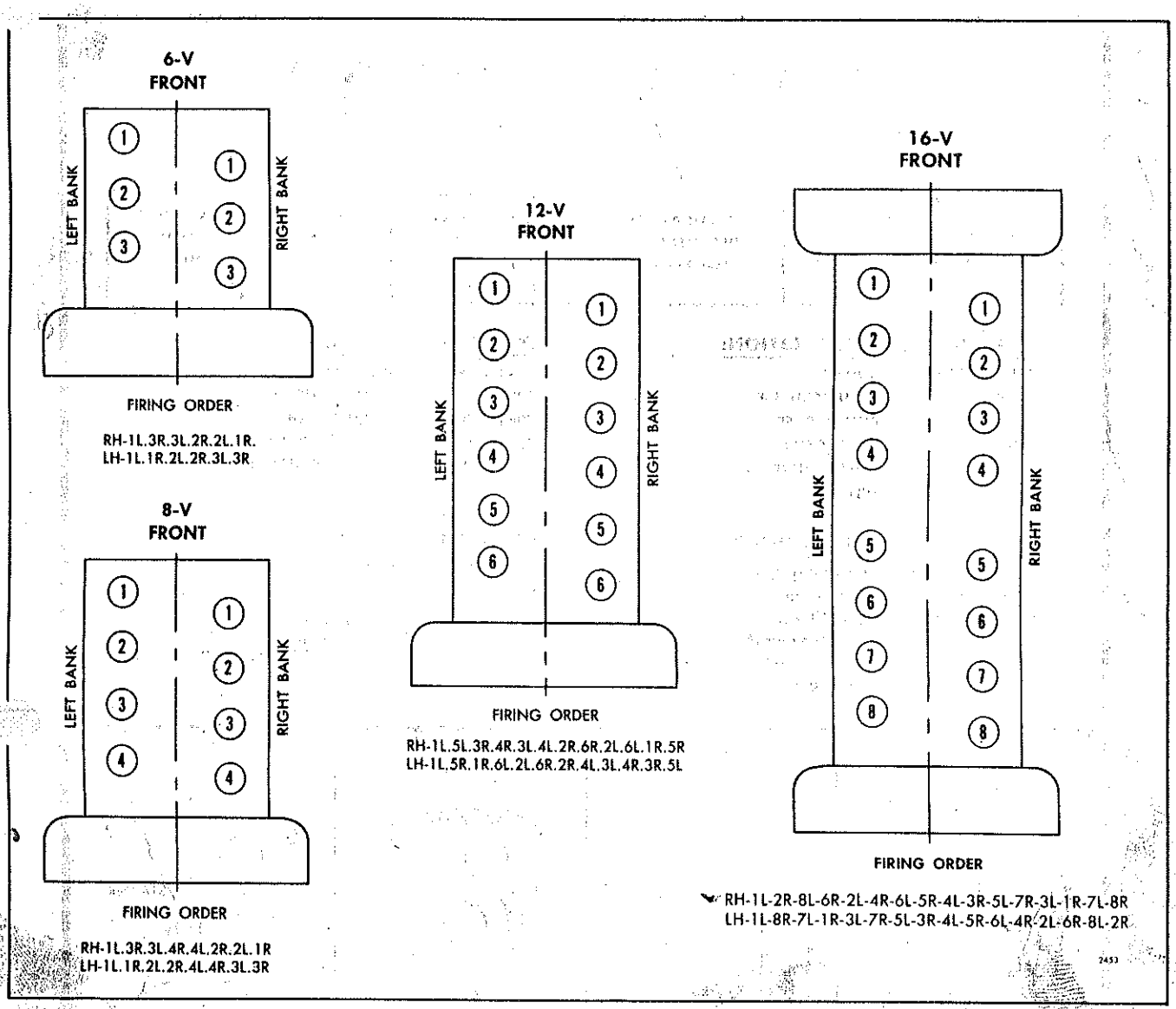


Fig. 3 - V-71 Engine Cylinder Designation and Firing Order

GENERAL SPECIFICATIONS

	6V	8V	12V	16V
Type	2 Cycle	2 Cycle	2 Cycle	2 Cycle
Number of Cylinders	6	8	12	16
Bore	4 1/4 in.	4 1/4 in.	4 1/4 in.	4 1/4 in.
Stroke	5 in.	5 in.	5 in.	5 in.
Compression Ratio (Nominal) (Standard Engines)	17 to 1	17 to 1	17 to 1	17 to 1
Compression Ratio (Nominal) ("N" Engines)	18.7 to 1	18.7 to 1	18.7 to 1	18.7 to 1
Total Displacement - Cubic Inches	426	568	852	1136
Number of Main Bearings	4	5	7	10

ENGINE MODEL, SERIAL NUMBER AND OPTION PLATE

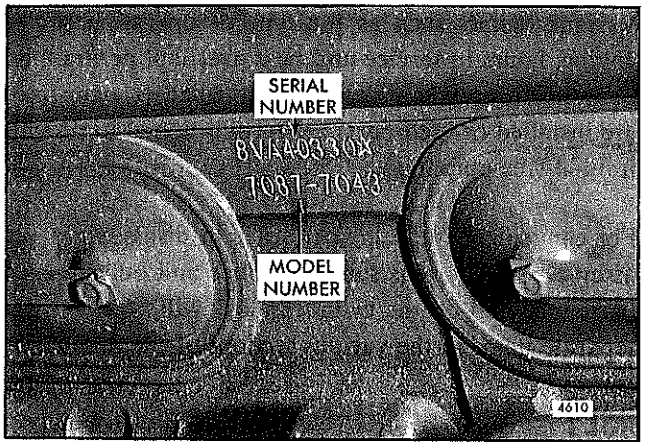


Fig. 4 - Typical Engine Serial Number and Model Number As Stamped on Cylinder Block

The engine serial number and the engine model number are stamped on the cylinder block (Fig. 4).

An option plate, attached to one of the valve rocker covers, is also stamped with the engine serial number and model number and, in addition, lists any optional equipment used on the engine (Fig. 5). Where required, a smoke emission certification plate is installed next to the option plate.

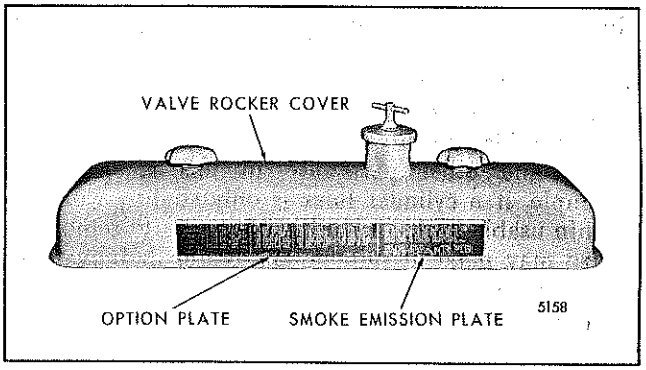


Fig. 5 - Option Plate

With any order for parts, the engine model number and serial number must be given. In addition, if a type number is shown on the option plate covering the equipment required, this number should also be included on the parts order.

All groups of parts used on a unit are standard for the engine model unless otherwise listed on the option plate.

Power take-off assemblies, torque converters, marine gears, etc. may also carry name plates. The information on these name plates is also useful when ordering replacement parts for these assemblies.

GENERAL PROCEDURES

In many cases, a serviceman is justified in replacing parts with new material rather than attempting repair. However, there are times where a slight amount of reworking or reconditioning may save a customer considerable added expense. Crankshafts, cylinder liners and other parts are in this category. For example, if a cylinder liner is only slightly worn and within usable limits, a honing operation to remove the glaze may make it suitable for reuse, thereby saving the expense of a new part. Exchange assemblies such as injectors, fuel pumps, water pumps and blowers are also desirable service items.

Various factors such as the type of operation of the engine, hours in service and next overhaul period must be considered when determining whether new parts are installed or used parts are reconditioned to provide trouble-free operation.

For convenience and logical order in disassembly and assembly, the various sub-assemblies and other related parts mounted on the cylinder block will be treated as separate items in the various sections of the manual.

DISASSEMBLY

Before any major disassembly, the engine must be drained of lubricating oil, water and fuel. On engines cooled by a heat exchanger, the fresh water system and raw water system must both be drained. Lubricating oil should also be drained from any transmission attached to the engine.

To perform a major overhaul or other extensive repairs, the complete engine assembly, after removal from the engine base and drive mechanism, should be mounted on an engine overhaul stand; then the various sub-assemblies should be removed from the engine. When only a few items need replacement, it is not always necessary to mount the engine on an overhaul stand.

Parts removed from an individual engine should be kept together so they will be available for inspection and assembly. Those items having machined faces, which might be easily damaged by steel or concrete, should be stored on suitable wooden racks or blocks, or a parts dolly.

CLEANING

Before removing any of the sub-assemblies from the engine (but after removal of the electrical equipment), the exterior of the engine should be thoroughly cleaned. Then, after each sub-assembly is removed and disassembled, the individual parts should be cleaned. Thorough cleaning of each part is absolutely necessary before it can be satisfactorily inspected. Various items of equipment needed for general cleaning are listed below.

The cleaning procedure used for all ordinary cast iron parts is outlined under *Clean Cylinder Block* in Section 1.1; any special cleaning procedures will be mentioned in the text wherever required.

Steam Cleaning

A steam cleaner is a necessary item in a large shop and is most useful for removing heavy accumulations of grease and dirt from the exterior of the engine and its sub-assemblies.

Solvent Tank Cleaning

A tank of sufficient size to accomodate the largest part that will require cleaning (usually the cylinder block) should be provided and provisions made for heating the cleaning solution to 180 ° F.-200 ° F.

Fill the tank with a commercial heavy-duty solvent which is heated to the above temperature. Lower large parts directly into the tank with a hoist. Place small parts in a wire mesh basket and lower them into the tank. Immerse the parts long enough to loosen all of the grease and dirt.

Rinsing Bath

Provide another tank of similar size containing hot water for rinsing the parts.

Drying

Parts may be dried with compressed air. The heat from the hot tanks will quite frequently complete the drying of the parts without the use of compressed air.

Rust Preventive

If parts are not to be used immediately after cleaning, dip them in a suitable rust preventive compound. The rust preventive compound should be removed before installing the parts in an engine.

INSPECTION

The purpose of parts inspection is to determine which parts can be used and which must be replaced. Although the engine overhaul specifications given throughout the text will aid in determining which parts should be replaced, considerable judgment must be exercised by the inspector.

The guiding factors in determining the usability of worn parts, which are otherwise in good condition, is the clearance between the mating parts and the rate of wear on each of the parts. If it is determined that the rate of wear will maintain the clearances within the specified maximum allowable until the next overhaul period, the reinstallation of used parts may be justified. Rate of wear of a part is determined by dividing the amount the part has worn by the hours it has operated.

Many service replacement parts are available in various undersize and/or oversize as well as standard sizes. Also, service kits for reconditioning certain parts and service sets which include all of the parts necessary to complete a particular repair job are available.

A complete discussion of the proper methods of precision measuring and inspection are outside the scope of this manual. However, every shop should be equipped with standard gages, such as dial bore gages, dial indicators, and inside and outside micrometers.

In addition to measuring the used parts after cleaning, the parts should be carefully inspected for cracks, scoring, chipping and other defects.

ASSEMBLY

Following cleaning and inspection, the engine should be assembled using new parts as determined by the inspection.

Use of the proper equipment and tools makes the job progress faster and produces better results. Likewise, a suitable working space with proper lighting must be provided. The time and money invested in providing the proper tools, equipment and space will be repaid many times.

Keep the working space, the equipment, tools and engine assemblies and parts clean at all times. The area where assembly operations take place should, if possible, be located away from the disassembly and cleaning operation. Also, any machining operations should be removed as far as possible from the assembly area.

Particular attention should be paid to storing of parts and sub-assemblies, after removal and cleaning and prior to assembly, in such a place or manner as to keep them clean. If there is any doubt as to the cleanliness of such parts, they should be recleaned.

When assembling an engine or any part thereof, refer to the table of torque specifications at the end of each section for proper bolt, nut and stud torques.

WORK SAFELY

A serviceman can be severely injured if caught in the pulleys, belts or fan of an engine that is accidentally started. To avoid such a misfortune, take these precautions before starting to work on an engine:

Disconnect the battery from the starting system by removing one or both of the battery cables. With the electrical circuit disrupted, accidental contact with the starter button will not produce an engine start.

Make sure the mechanism provided at the governor for stopping the engine is in the stop position. This will mean the governor is in the no-fuel position. The possibility of the engine firing by accidentally turning the fan or, in the case of vehicle application, by being bumped by another vehicle is minimized.

Some Safety Precautions To Observe When Working On The Engine

1. Consider the hazards of the job and wear protective gear such as safety glasses, safety shoes, hard hat, etc. to provide adequate protection.

When lifting an engine, make sure the lifting device is fastened securely. Be sure the item to be lifted does not exceed the capacity of the lifting device.

3. Always use caution when using power tools.

4. When using compressed air to clean a component, such as flushing a radiator or cleaning an air cleaner element, use a safe amount of air. Recommendations regarding the use of air are indicated throughout the manual. Too much air can rupture or in some other way damage a component and create a hazardous situation that can lead to personal injury.

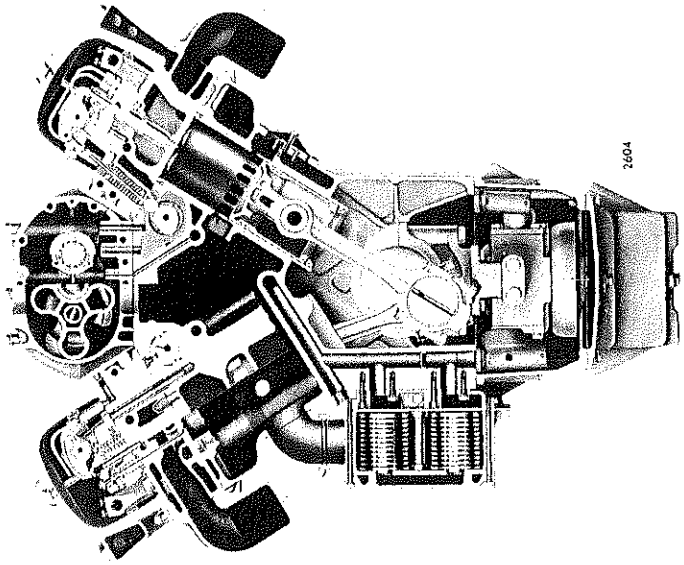
5. Avoid the use of carbon tetrachloride as a cleaning agent because of the harmful vapors that it releases. Use perchlorethylene or trichlorethylene. However, while less toxic than other chlorinated solvents, use these cleaning agents with caution. Be sure the work area is adequately ventilated and use protective gloves, goggles or face shield, and apron.

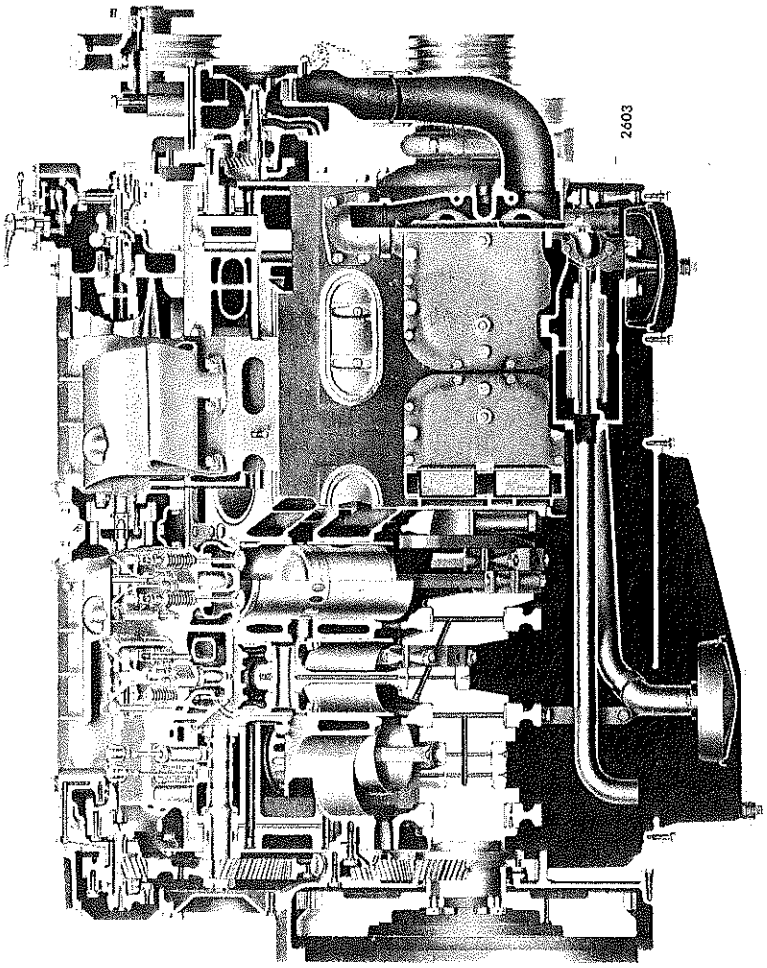
Exercise caution against burns when using oxalic acid to clean the cooling passages of the engine.

6. Use caution when welding on or near the fuel tank. Possible explosion could result if heat build-up inside the tank is sufficient.

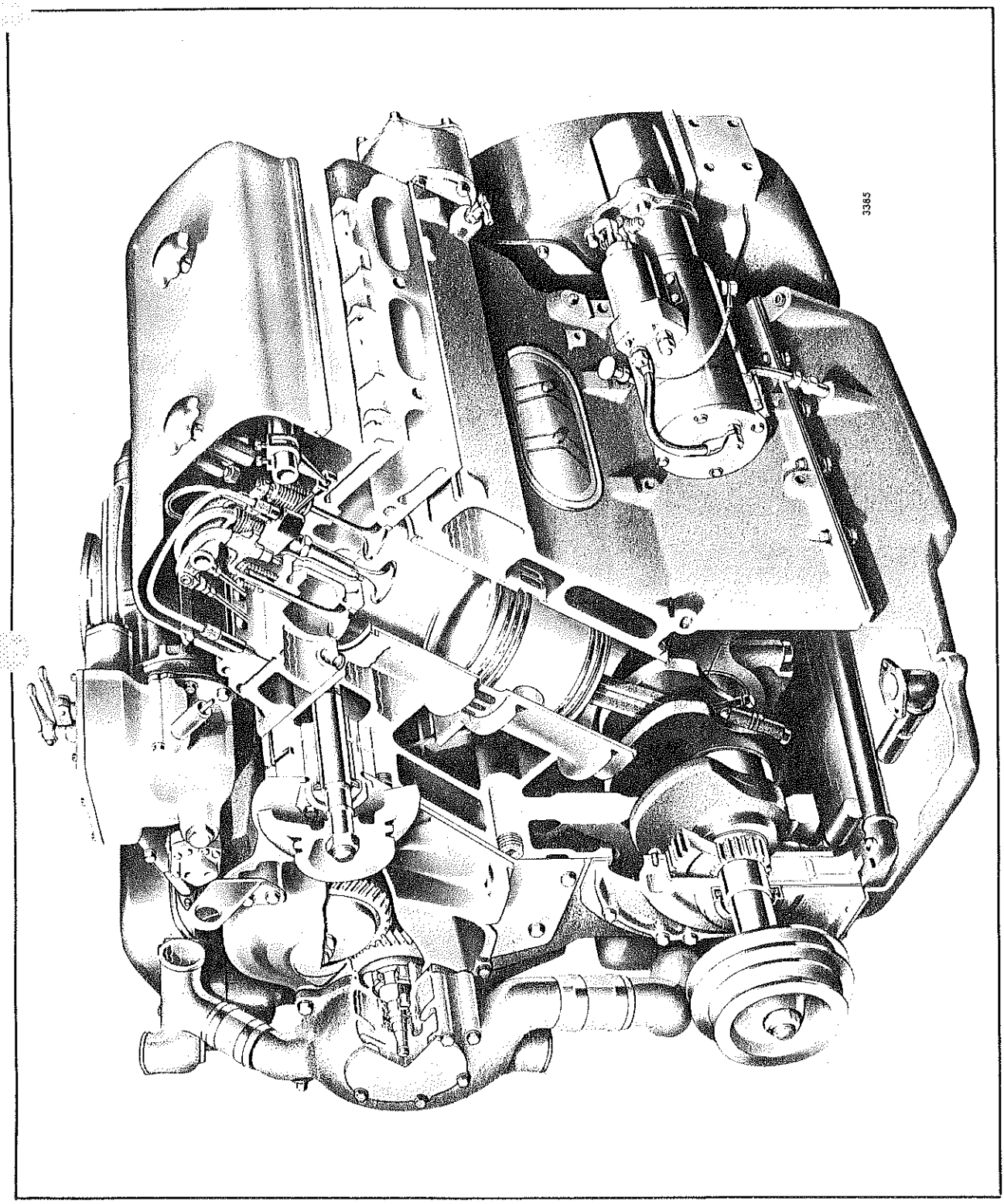
7. Avoid excessive injection of ether into the engine during start attempts. Follow the instructions on the container or by the manufacturer of the starting aid.

8. When working on an engine that is running, accidental contact with the hot exhaust manifold can cause severe burns. Remain alert to the location of the rotating fan, pulleys and belts. Avoid making contact across the two terminals of a battery which can result in severe arcing.

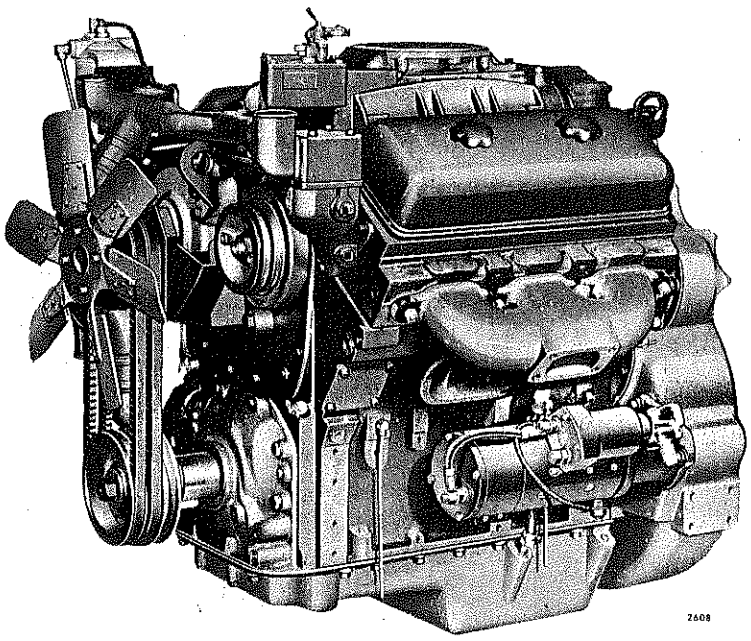




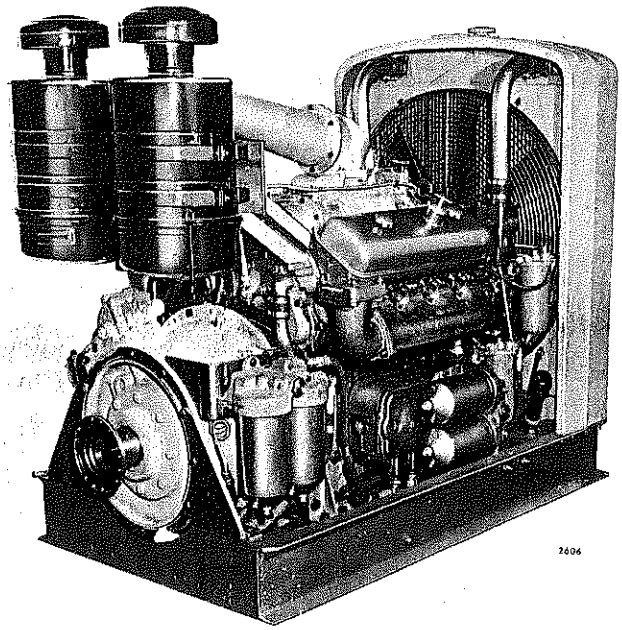
Cross-Section of Typical V-71 Engine



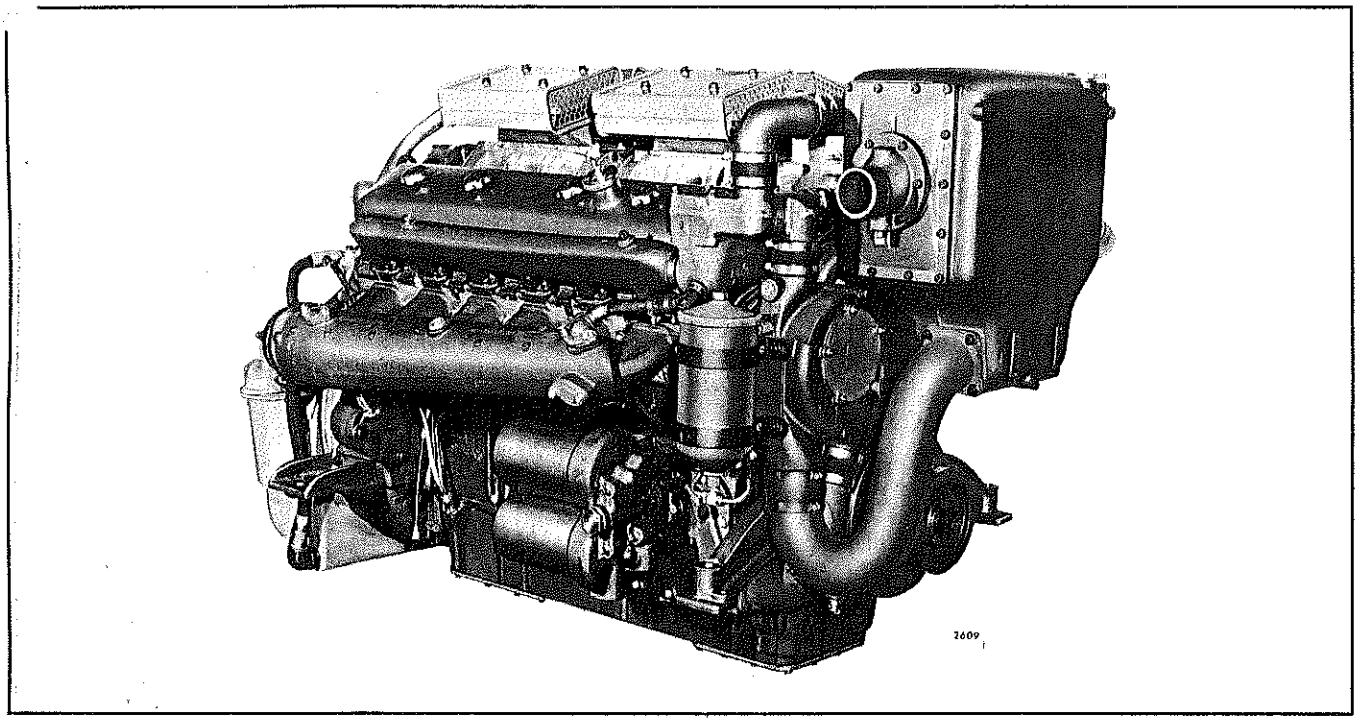
Three-Quarter Cutaway View of V-71 Engine



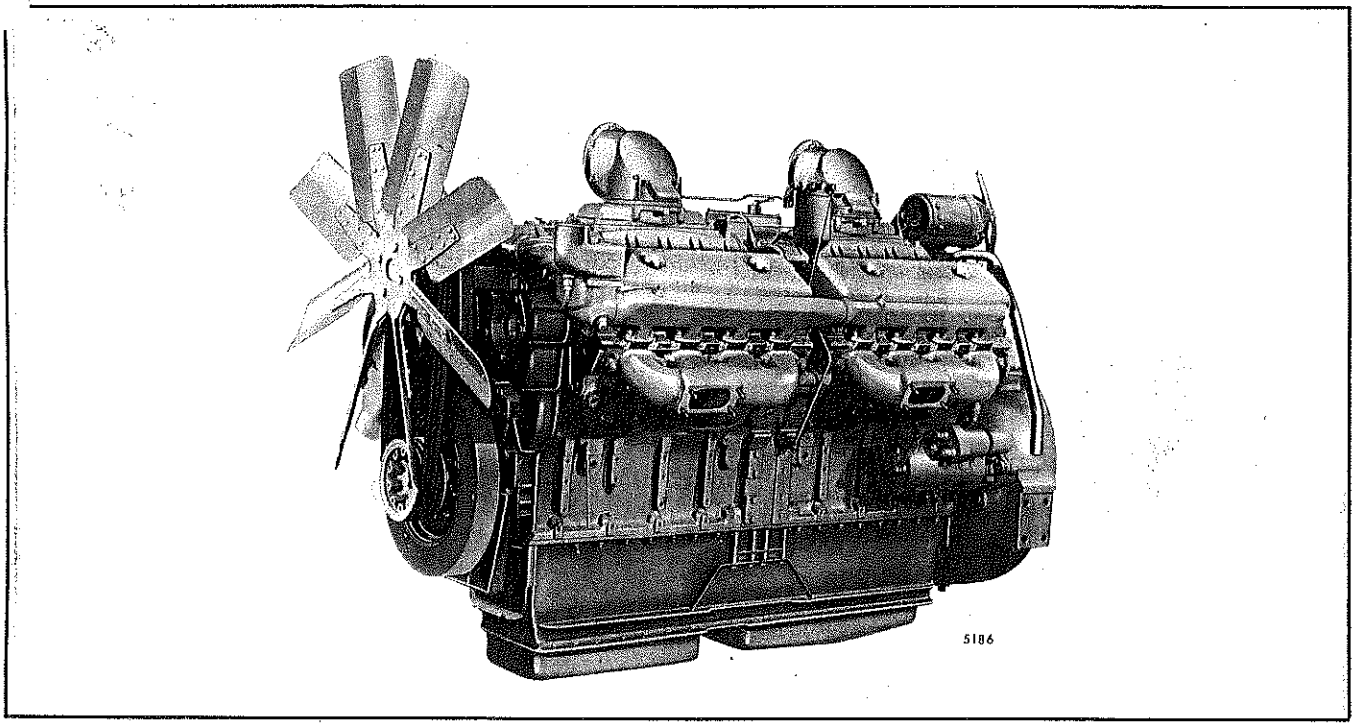
Typical Fan-to-Flywheel Engine (6V)



Typical Industrial Torque Converter Engine (8V)



Typical Marine Propulsion Engine (12V)



Typical Fan-to-Flywheel Engine (16V)

SECTION 1

ENGINE (less major assemblies)

CONTENTS

CYLINDER BLOCK

The cylinder block (Fig. 1) serves as the main structural part of the engine. Transverse webs provide rigidity and strength and ensure alignment of the block bores and bearings under load.

The block is bored to receive replaceable cylinder liners. The current cylinder block is designated as a water-below-port block and is designed to provide water cooling below the air inlet port belt. The former cylinder block was designated as a dry block.

An air box between the cylinder banks and extending around the cylinders at the air inlet port belt conducts the air from the blower to the cylinders. Air box openings on each side of the block permit inspection of the pistons and compression rings through the air inlet ports in the cylinder liners. The air box openings in the current cylinder block assembly are approximately 1 7/8 " x 3 1/8 " and are covered with cast covers (Fig. 2). The stamped steel covers used on the former cylinder block covered openings which were approximately 3 " x 6 1/2 ".

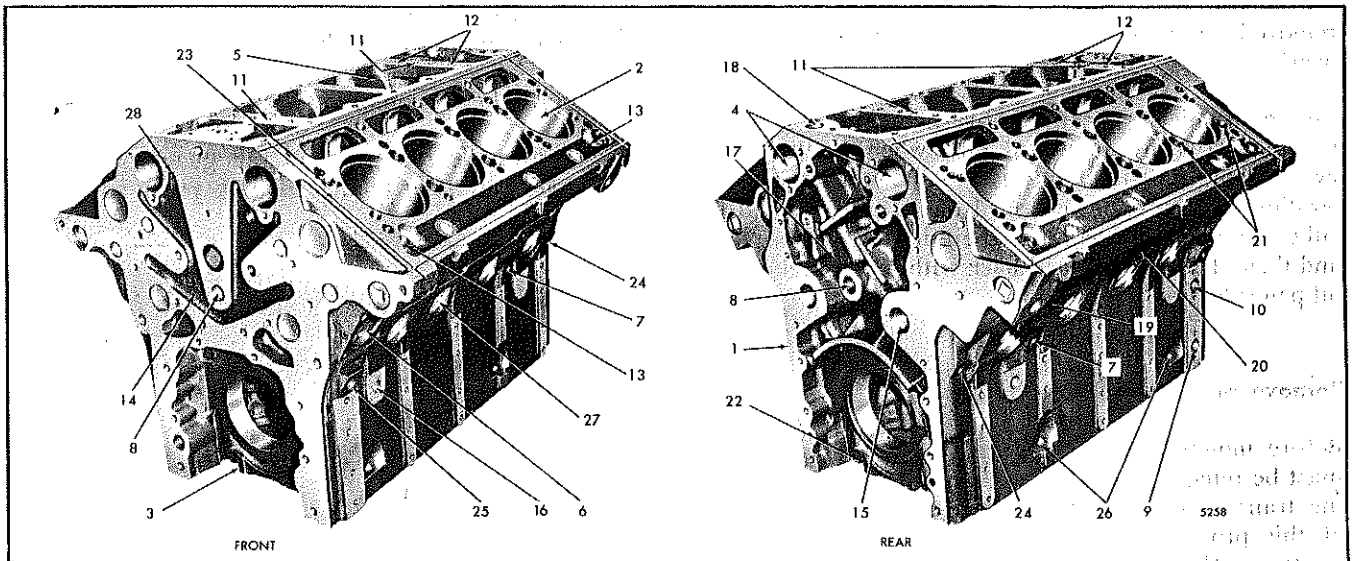
The camshaft bores are located on the inner side of each cylinder bank near the top of the block.

The upper halves of the main bearing supports are cast intergral with the block. The main bearing bores are line-bored with the bearing caps in place to ensure longitudinal alignment. Drilled passages in the block carry the lubricating oil to all moving parts of the engine, eliminating the need for external piping.

The top surface of each cylinder bank is grooved to accommodate a block-to-head oil seal ring. Also, each water or oil hole is counterbored to provide for individual seal rings.

Each cylinder liner is retained in the block by a flange at its upper end. The liner flange rests on an insert located in the counterbore in the block bore. An individual compression gasket is used at each cylinder.

When the cylinder heads are installed, the gaskets and seal rings compress sufficiently to form a tight metal-to-metal contact between the heads and the block.



1. Cylinder Block
2. Bore for Cylinder Liner
3. Front Main Bearing Cap
4. Bores for Camshafts
5. Air Box
6. Water into Block
7. Water Drain
8. Main Oil Gallery
9. Oil Passage from Pump to Oil Filter
10. Oil Passage from Oil Cooler
11. Oil Drain Passages to Blower
12. Oil Drain Passages from Blower
13. Oil Drain from Cylinder Head
14. Oil Drain Passages
15. Oil Passage (Idler Gear Bearing)
16. Oil Return Passages to Crankcase
17. Crankcase Breather Cavity
18. Crankcase Breather Outlet
19. Air Box Drain
20. Inspection Hole Opening
21. Water Passages to Cylinder Head
22. Rear Main Bearing Cap
23. Oil Passage to Cylinder Head
24. Oil Gallery
25. Oil Gallery
26. Dipstick Hole or Oil Return Passage to Crankcase
27. Core Hole for Water Jacket
28. Oil Tube

Fig. 1 - Cylinder Block (8V Engine)

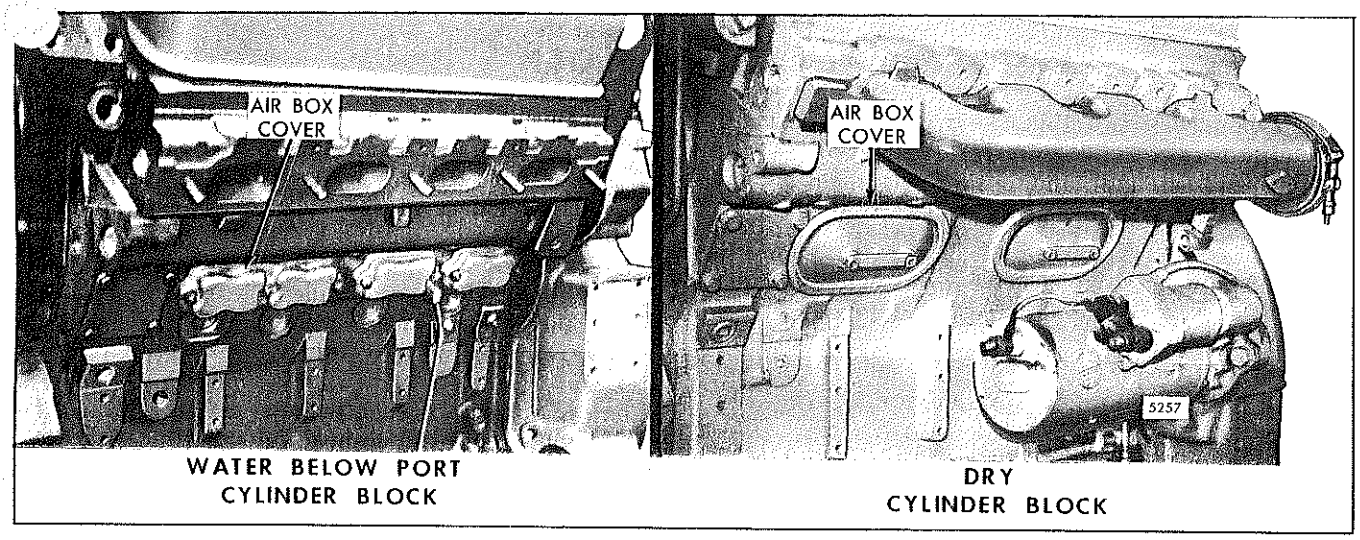


Fig. 2 - Comparison of Current and Former Cylinder Blocks

New service replacement cylinder block assemblies include the main bearing caps and bolts, dowels and the necessary plugs.

Since the cylinder block is the main structural part of the engine, the various sub-assemblies must be removed from the cylinder block when an engine is overhauled.

The hydraulically operated overhaul stand (Fig. 3) provides a convenient support when stripping a cylinder block. The engine is mounted in an upright position. It may then be tipped on its side, rotated in either direction 90 ° or 180 ° where it is locked in place and then, if desired, tipped back with either end or the oil pan side up.

Remove and Disassemble Engine

Before mounting an engine on an overhaul stand, it must be removed from its base and disconnected from the transmission or other driven mechanism. Details of this procedure will vary from one application to another. However, the following steps will be necessary.

1. Drain the cooling system.

2. Drain the lubricating oil.

3. Disconnect the fuel lines.

4. Remove the air silencer or air cleaner and mounting brackets.

5. Remove the turbocharger, if used.

6. Disconnect the exhaust piping and remove the exhaust manifolds.

7. Disconnect the throttle controls.

8. Disconnect and remove the starting motor, battery-charging generator and other electrical equipment.

9. Remove the air compressor, if used.

10. Remove the radiator and fan guard or the heat exchanger and other related cooling system parts.

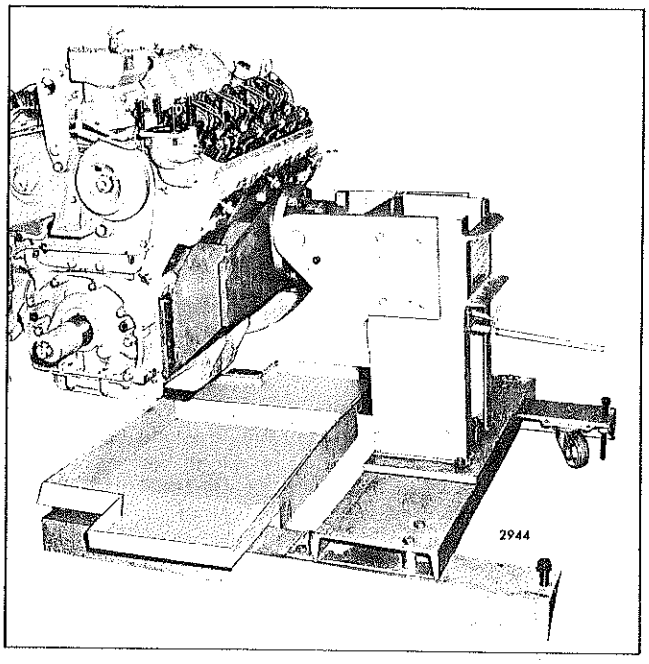


Fig. 3 - Engine Mounted on Overhaul Stand

11. Remove the air box drain tubes and fittings.

12. Remove the air box covers.

13. Disconnect any other lubricating oil lines, fuel lines or electrical connections.

14. Separate the engine from the transmission or other driven mechanism.

15. Remove the engine mounting bolts.

16. Use a chain hoist and suitable sling attached to the engine lifting brackets to lift the engine from its base.

CAUTION: Do not lift the engine by the webs in the air inlet opening at the top of the cylinder block.

17. Mount the engine on the overhaul stand. For 6V and 8V engines, use overhaul stand J 6837-01 with adaptor J 8601-01. For 12V and 16V engines, use overhaul stand J 9389 and adaptor J 8650.

CAUTION: Check the fastenings carefully to be sure the engine is securely mounted to the overhaul stand before releasing the lifting sling. Severe injury to personnel and destruction of engine parts will result if the engine breaks away from the overhaul stand.

18. With the engine mounted on the overhaul stand, remove all of the remaining sub-assemblies and parts from the cylinder block.

The procedure for removing each sub-assembly from the cylinder block, together with disassembly, inspection, repair and reassembly of each, will be found in the various sections of this manual.

After stripping, the cylinder block must be thoroughly cleaned and inspected.

Clean Cylinder Block

Scrape all gasket material from the cylinder block. Then remove all oil gallery plugs and core hole plugs (except cup plugs) to allow the cleaning solution to contact the inside of the oil and water passages. This permits more efficient cleaning and eliminates the possibility of the cleaning solution attacking the aluminum core hole plug gaskets (if used).

If a core hole plug is difficult to remove, hold a 3/4 " drift against the plug and give it a few sharp blows with a one pound hammer. With a 1/2 " flexible ndle and a short extension placed in the untersunk hole in the plug, turn the plug slightly in e direction of tightening. Then turn it in the opposite direction and back the plug out. To remove the special plugs (Fig. 15) in the current water-below-port cylinder block, use tool J 23019. For the former dry block, use tool J 21996-01.

Clean the cylinder block as follows:

1. Remove the grease by agitating the cylinder block in a hot bath of commercial heavy-duty alkaline solution.

2. Wash the block in hot water or steam clean it to remove the alkaline solution.

3. If the water jackets are heavily scaled, proceed as follows:

a. Agitate the block in a bath of inhibited commercial pickling acid.

b. Allow the block to remain in the acid bath until the bubbling stops (approximately 30 minutes).

c. Lift the block, drain it and reimmerse it in the same acid solution for 10 minutes.

d. Repeat Step "C" until all scale is removed.

e. Rinse the block in clear hot water to remove the acid solution.

f. Neutralize the acid that may cling to the casting by immersing the block in an alkaline bath.

g. Wash the block in clean water or steam clean it.

4. Dry the cylinder block with compressed air.

5. Make certain that all water passages, oil galleries and air box drain openings have been thoroughly cleaned.

NOTE: The above cleaning procedure may be used on all ordinary cast iron and steel parts of the engine. Mention will be made of special cleaning procedures whenever necessary.

6. After the block has been cleaned and dried, coat the threads of the plugs with sealant and, using new gaskets, reinstall the core hole plugs. Tighten the 1 3/4 "-16 plugs to 150-180 lb-ft torque and the 2 1/2 "-16 plugs to 230-270 lb-ft torque.

CAUTION: Excessive torque applied to the core hole plugs may result in cracks in the water jacket.

If for any reason the cup plugs in the water jackets were removed, install new plugs as follows:

a. Clean the cup plug holes and apply Permatex

No. 1 sealant, or equivalent, to the outer diameter of the plugs.

b. Drive the plugs in place with handle J 7079-02 and adaptor J 21849 (for 2 " diameter plugs) or adaptor J 21850 (for 1 5/8 " diameter plugs).

Pressure Test Cylinder Block

After the cylinder block has been cleaned, it must be pressure tested for cracks or leaks by either one of two methods.

METHOD "A"

This method may be used when a large enough water tank is available and the cylinder block is completely stripped of all parts.

1. Seal off the water inlet and outlet holes air tight. This can be done by using steel plates and suitable rubber gaskets held in place by bolts. Drill and tap one cover plate to provide a connection for an air line.

2. Immerse the block for twenty minutes in a tank of water heated to 180 °-200 °F.

3. Apply 40 psi air pressure to the water jacket and observe the water in the tank for bubbles which indicate the presence of cracks or leaks in the block. A cracked cylinder block must be replaced by a new block.

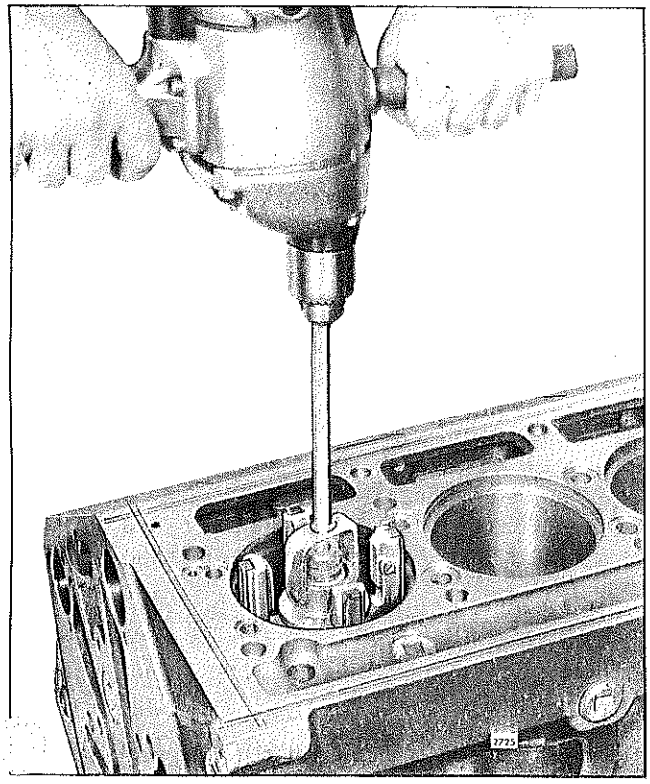


Fig. 4 - Honing Cylinder Block Bore

4. After the pressure test is completed, remove the block from the water tank. Then remove the plates and gaskets and dry the block with compressed air.

METHOD "B"

This method may be used when a large water tank is unavailable, or when it is desired to check the block for cracks without removing the engine from the equipment which it powers. However, it is necessary to remove the cylinder heads, blower, oil cooler, air box covers and oil pan.

1. Attach sealing plates and gaskets as in Method "A". However, before attaching the last sealing plate, fill the water jacket with a mixture of water and one gallon of antifreeze. The antifreeze will penetrate small cracks and its color will aid in detecting their presence.

2. Install the remaining sealing plate and tighten it securely.

3. Apply 40 psi air pressure to the water jacket and maintain this pressure for at least two hours to give the water and antifreeze mixture ample time to work its way through any cracks which may exist.

4. At the end of the test period, examine the cylinder bores, air box, oil passages, crankcase and exterior of the block for presence of the water and antifreeze mixture which will indicate the presence of cracks. A cracked cylinder block must be replaced by a new block.

5. After the test is completed, remove the plates, drain the water jacket and blow out all of the passages in the block with compressed air.

Inspect Cylinder Block

After cleaning and pressure testing, inspect the cylinder block.

Since most of the engine cooling is accomplished by heat transfer through the cylinder liners to the water jacket, a good liner-to-block contact must exist when the engine is operating. Whenever the cylinder liners are removed from an engine, the block bores must be inspected.

NOTE: Before attempting to check the block bores, hone them throughout their entire length until about 75% of the area above the ports has been "cleaned-up".