engine OPERATORS MANUAL

INTERNATIONAL

C-152, C-196, C-304, C-345,
C-392, C-446, C-549, C-605

CARBURETED ENGINES

OPERATION AND MAINTENANCE MANUAL

FORM 1 171 482 R1

JUNE, 1980

(Supersedes Form 1 008 700 R2)

ENGINES
COMPONENTS GROUP

It is the policy of International Harvester Company to improve its products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to make such changes on products sold previously.

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

Periodic revisions may be made to this publication and mailed automatically to industrial engine servicing dealers. It is recommended that customers contact their industrial engine servicing dealer for information on the latest revision.

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WARNING

Misuse or modification of these engines can cause:

Mechanical breakdown
Property damage
Injury or death

Always use proper safety precautions. Tell your workers how to work safely.

FOREWORD

This manual is provided to give the operator essential information regarding proper operation and maintenance of International Harvester carbureted engines used in original equipment manufacturers applications.

This manual contains information and instructions on proper operation. To keep the unit operating at its maximum efficiency, the manual should be read by the operator and by those responsible for the maintenance of the unit.

An important item in prolonging the life of the unit is to keep dirt and other foreign particles away from its vital parts. International Harvester has taken *precautions in the design of the equipment to safegaurd against dirt* and other foreign materials from reaching the working parts under normal operating conditions. The operator must also take precautions to assure that the oil, water, and fuel are always kept clean, and that air for combustion is always filtered. This can be accomplished by the proper storage and handling of fuel and lubricating oil specifications and change intervals, fuel specifications, maintenance of filters, air cleaner servicing, and proper care of the cooling system.

To assure the best results and maintain the high quality of the equipment, it is important that International Harvester parts are always used when new *parts are required.* IMPORTANT: ALWAYS FURNISH MODEL AND ENGINE "AU" IDENTIFICATION NUMBER WHEN ORDERING PARTS.

Many owners of International Harvester engines rely upon the Service Department of our Dealers for all work other than routine maintenance and adjustment. This practice is encouraged as our Dealers are kept well informed by the factory regarding the most up-to-date methods of servicing IH engines and equipment and are equipped to render the most competent service.

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AVOID ACCIDENTS

MOST ACCIDENTS, WHETHER THEY OCCUR IN INDUSTRY, ON THE FARM, AT HOME OR ON THE HIGHWAY, ARE CAUSED BY THE FAILURE OF SOME INDIVIDUAL TO FOLLOW SIMPLE AND FUNDAMENTAL SAFETY RULES OR PRECAUTIONS. FOR THIS REASON MOST ACCIDENTS CAN BE PREVENTED BY RECOGNIZING THE REAL CAUSE AND DOING SOMETHING ABOUT IT BEFORE THE ACCIDENT OCCURS.

REGARDLESS OF THE CARE USED IN THE DESIGN AND CONSTRUCTION OF ANY TYPE OF EQUIPMENT THERE ARE MANY CONDITIONS THAT CANNOT BE COMPLETELY SAFEGUARDED AGAINST WITHOUT INTERFERING WITH REASONABLE ACCESSIBILITY AND EFFICIENT OPERATION.

IT IS THE RESPONSBILITY OF USERS TO PROVIDE AND INSTALL GUARDS OR SAFETY DEVICES WHICH MAY BE REQUIRED BY RECOGNIZED SAFETY STANDARDS OR BY THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 AND ITS SUBSEQUENT PROVISIONS.

A careful operator is the best insurance against an accident. The complete observance of one simple rule would prevent many thousand serious injuries each year. That rule is:

Never attempt to clean, oil or adjust a machine while it is in motion.

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF SUBJECTS

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USE OF MANUAL

This manual provides instructions on operation, lubrication and maintenance for C-152, C-196, C-304, C-345, C-392, C-446, C-549 and C-605 carbureted engines for industrial and on-highway use. The basic engine and its electrical, fuel and cooling systems are included; however, some illustrations and text in this manual are typical for all engine families and may not cover your engine in detail. Please disregard any instructions on engine components that are not applicable to your engine. If in doubt, refer to the engine parts catalog shipped with your engine.

Throughout this manual, the use of terms "left," "right," "front" and "rear" must be understood to avoid confusion. "Front" indicates the fan end of the engine. "Rear" indicates the flywheel end. Whenever the terms "right" or "left" are used, it means from a rear position looking toward the fan end.

ENGINE GENERAL DESCRIPTION

The engines covered in this manual are all carburetor type and use either gasoline, liquefied petroleum gas (LPG) or natural gas (NG) for fuel.

Two types of ignition systems are used; conventional breaker point type and electronic controlled type.

The V-8 engines have eight cylinders arranged in a 90° "V" shape with four cylinders in each bank.

The four cylinder engines have four cylinders arranged in-line with the cylinders inclined to the right.

All engines have cast iron cylinder blocks of one piece construction.

The crankshaft, of forged alloy steel, is supported by five insert-type main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The camshaft is supported by insert-type bearings pressed into the block and is driven by a drive gear keyed to the crankshaft. The end thrust of the camshaft is controlled by a thrust flange located between the front camshaft journal and the camshaft gear.

The aluminum-alloy pistons are fitted with compression rings and an oil ring and are used in the engine with forged steel connecting rods. A hardened and ground piston pin connects the piston to the connecting rod. The piston pin is secured in the piston with two locking rings. The lower end of the connecting rod and cap contain locking type bearing inserts. The rods and caps are numbered for identification and reassembly.

The hydraulic valve lifters contribute to engine quietness and maintain zero valve lash or tappet clearance. This eliminates the need for periodic valve adjustment.

The cylinder head assemblies feature a high turbulence type of combustion chamber which provides superior combustion characteristics to produce very high volumetric and thermal efficiencies. The cylinder heads used are equipped with a positive valve rotating mechanism (on the exhaust valve only) located at the base of each exhaust valve spring.

HOW TO IDENTIFY YOUR ENGINE

Your engine is identified by an engine model number, an engine application designation called an "AU" number and an engine serial number. The model and application numbers are stamped on an engine data plate along with the maximum idle and full load speeds.

CG-7791

Figure 1. ENGINE DATA PLATE

The plate is attached to the left side or top of the flywheel housing on your engine.

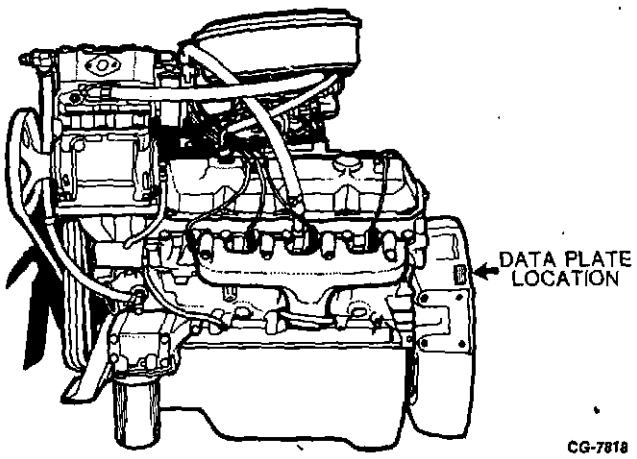


Figure 2. DATA PLATE IS ON LEFT SIDE OR TOP OF FLYWHEEL HOUSING

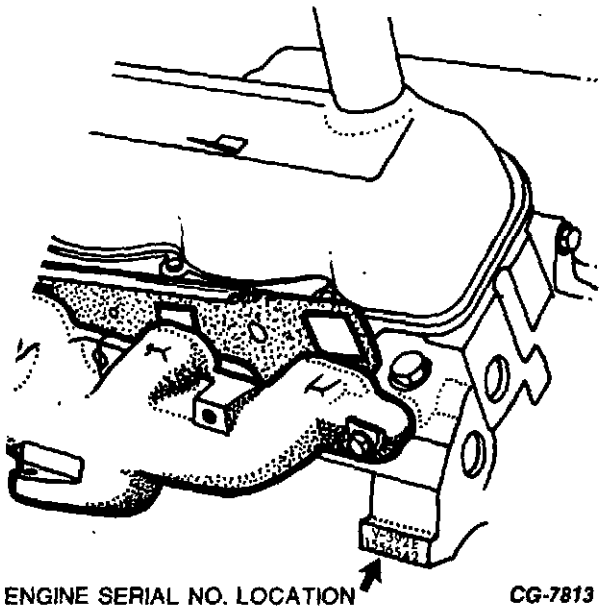


Figure 4. C-304, 345, 392 ENGINES ON CRANKCASE RIGHT BANK UPPER FRONT

The engine serial number is stamped directly on the crankcase (engine block) as follows.

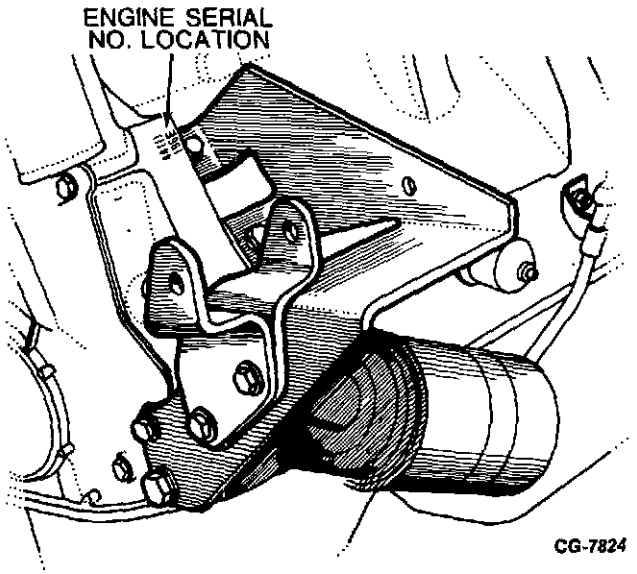


Figure 3. C-152, 196 ENGINES ON LEFT SIDE UPPER FRONT

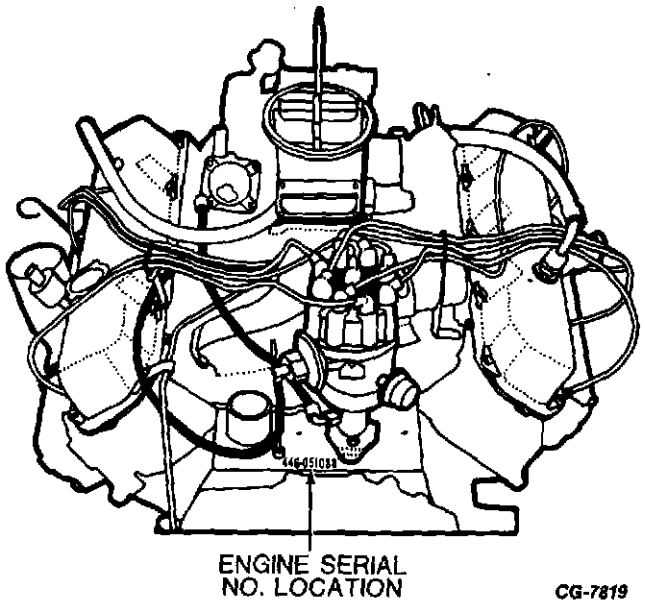


Figure 5. C-446 ENGINES IN FRONT OF DISTRIBUTOR

Continued on next page

HOW TO IDENTIFY YOUR ENGINE (Continued)

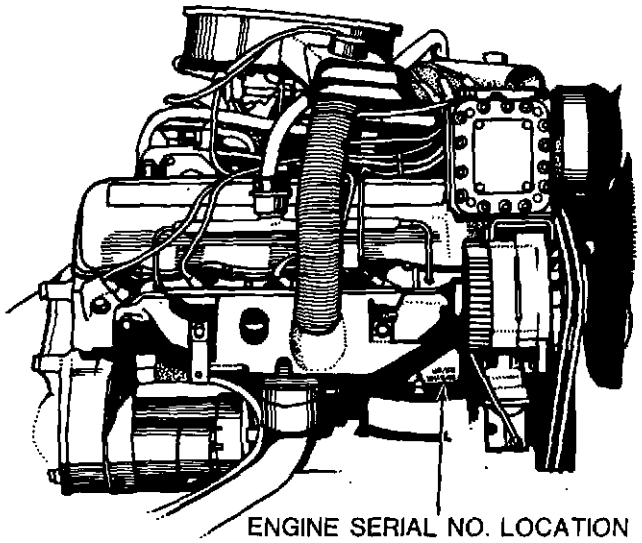


Figure 6. C-549 ENGINES ON TOP OF CRANKCASE RIGHT BANK FRONT CORNER

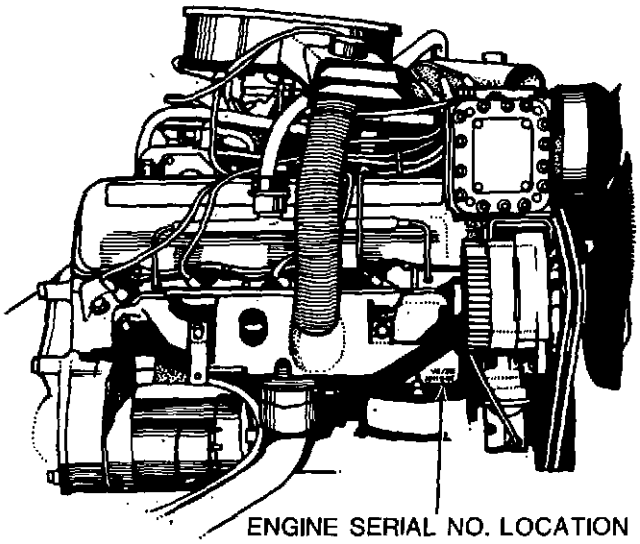


Figure 7. C-605 ENGINES ON TOP OF CRANKCASE RIGHT BANK FRONT CORNER

When in need of parts, always specify engine model, AU-designation and engine serial numbers. For ready reference, write your data numbers below.

Engine Model Family: _____
AU-Designation: _____
Engine Serial Number: _____

SAFETY PRECAUTIONS

This symbol is used to call your attention to safety precautions that should be followed by operator, maintenance and service personnel to avoid accidents. When you see this symbol, heed its warning. Become alert. Your safety is involved. Many hours of lost time and much suffering is caused by the failure to practice simple safety rules.

It is too late to remember what should have been done after the accident has happened.

OPERATION

1. Read this manual carefully to acquaint yourself with the engine. Operating unfamiliar equipment can cause accidents.

2. Do not wear rings, wrist watches, jewelry, loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned, or unzipped jackets that can catch on moving parts. Do wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, and safety glasses or goggles.

3. Long hair should be tied up short to prevent it from becoming entangled in moving parts.

4. Engine should be operated only by those who are responsible and delegated to do so.

5. Quick access to a FIRST AID KIT should be provided at all times to treat minor cuts and scratches.

6. It is recommended that a FIRE EXTINGUISHER be provided at an easy to get to location.

7. Keep engine exhaust system and exhaust manifolds clear of combustible material. Equip machine with screens and guards when working under conditions of flying combustible material.

8. Do not run the engine in closed area without proper ventilation to remove deadly exhaust gases.

9. Starting fluid is flammable. Follow the recommendations outlined in this manual and those marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. Do not puncture or burn containers. Follow the recommendations of the manufacturer for storage and disposal.

10. Never use starter fluid near lighted smoking materials or open flame or sparks due to the flammability of the fluid.

11. Do not place head, body, limbs, feet, fingers, or hands near a rotating fan or belt. Be especially alert around a pusher fan.

12. Keep the operator's area clean and free of obstructions.

13. Always shift transmission to neutral, stop engine, set brake and remove start key before permitting anyone to inspect, clean, lubricate, adjust or repair any part of the engine or its attachments, unless otherwise specifically recommended in this manual.

14. Be sure that the gear shift lever is neutral before starting the engine.

15. Be sure that everyone is clear of the machine before starting the engine and mechanism.

16. Use extreme caution when removing the radiator cap. Loosen very slowly and avoid pressurized steam that might be in the radiator. Allow engine to cool before removing cap.

17. Electric storage batteries give off highly inflammable hydrogen gas. To prevent possible explosion, never allow lighted smoking material, an open flame or electrical sparks near the battery. Do not lay tools or other conductive materials on the battery where they may cause short circuits and sparks.

18. Fluid in electric storage batteries contains sulfuric acid which can cause severe burns. Avoid all contact of fluid with eyes, skin or clothing. If contact does occur, flush off immediately with large amounts of water. Get prompt medical attention.

19. Always stop engine when refueling. Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow. To reduce the chance of a static electricity spark. Keep contact until after fuel flow is shut off. Do not smoke or have open flame in the refueling area.

20. Always be sure that all shields, guards, and access covers are in place when engine is in operation.

21. Never attempt to check or adjust fan belts when engine is running.

22. Always permit parts that contain hot fluid to cool to a safe temperature before handling or disconnecting.

MAINTENANCE AND SERVICE

1. Follow all safety precautions listed above and those listed below.

2. Shop or field service platforms and ladders used to maintain or service engine should be constructed and maintained according to OSHA requirements.

3. Disconnect batteries and TAG all controls according to OSHA requirements to warn that work is in progress.

4. Never use gasoline or diesel fuel or other flammable fluid for cleaning parts. Use authorized commercial, non-flammable, non-toxic solvents.

5. When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 30 psi (207 kPa) according to OSHA requirements.

6. Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

7. Never align holes with finger or hands. Use the proper aligning tool.

8. Remove sharp edges and burrs from reworked parts.

9. Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.

10. Be sure all mechanics tools are in good condition. Do not use tools with muchroomed heads. Always wear safety glasses with side shields.

11. Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

12. Do not adjust engine fuel pump when the machine is in motion.

13. Never lubricate engine while in operation.

Continued on next page

MAINTENANCE AND SERVICE (Continued)

14. Avoid running engine with open unprotected air inlets. If such running is unavoidable for service reasons, place protective screens over all inlet openings before servicing engine.

15. Disconnect batteries before working on electrical system.

16. Be sure to connect the booster cables to the proper terminals (+ to +) and (– to –) at both ends. Avoid shorting clamps.

17. BATTERY GAS IS HIGHLY FLAMMABLE. Leave battery box open to improve ventilation when charging batteries. Never check charge by placing metal object across the posts. Keep sparks or open flame away from batteries. Do not smoke near battery to guard against the possibility of an accidental explosion.

18. Do not charge batteries in a closed area. Provide proper ventilation to guard against an accidental explosion from an accumulation of gases given off in the charging process.

19. Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for suspected pressure leaks. DO NOT USE HANDS. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

20. Shut off engine and be sure all pressure in system has been relieved before removing panels, housing covers, and caps.

21. When making pressure checks use the correct gauge for expected pressure.

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF SUBJECTS

Printed in United States of America.

PREPARING ENGINE FOR OPERATION

CAUTION

For personal protection, observe the following safety precautions.

SAFETY PRECAUTIONS

- Never operate an engine in an enclosed building unless the exhaust is properly ventilated. See "Ventilation for Engines Inside Buildings" on page

- Because of fire hazards, do not use gasoline for cleaning parts, especially when service is performed inside building. A less flammable fluid, such as a commercial solvent or kerosene, should be used.

- Never attempt to clean or oil the engine while the engine is operating.

Liquified Petroleum Gas or Natural Gas Engines

CAUTION

Safety precautions in the handling of butane-propane cannot be over-emphasized. There are state, county or city laws, ordinances, and fire regulations covering the utilization of liquefied petroleum gas or natural gas. Such laws, ordinances and fire regulations on this subject must be adhered to in addition to the safety rules given below.

Where local rules are more stringent than these given, the local rules are to be given priority.

These rules apply to servicing any engine using liquefied petroleum gas (butane-propane) or natural gas for engine fuel regardless of the nature of the work to be performed.

- Select a location for servicing these engines where there will be good air circulation. This is to avoid accumulation of gas-air mixtures in and about the engine caused by undetected leaks.

Such location must be as far as possible from steam cleaners, hot water cleaners, hot dip tanks, etc., and other devices operating with an open flame.

- Shut off the main valves at the fuel tanks and allow the engine to run until all fuel in the system, from the tank to the engine, is exhausted. In the event the engine is inoperative, shut the valve at the tank. Vent the fuel system of liquefied petroleum or natural gas outside the building before moving the engine into the shop.

- "DANGER" signs must be placed on both sides of the engine. There is to be no smoking in the vicinity. No work is to be performed on this engine or on others in a nearby zone involving open flames, such as cutting, welding, grinding, chiseling or any similar operation which may produce sparks.

- A fire extinguisher (dry powder or carbon dioxide) must be placed adjacent to the mechanic's working area, handy for immediate use. When liquefied petroleum gas ignites, it should be allowed to burn, if possible, until the source of fuel is shut off. Extinguishing the fire before this is accomplished can result in dangerous accumulations of gas which might cause a more serious flash or explosion.

- After completing service work and before starting the engine, allow air to circulate around the engine to remove any possible gas accumulation.

- Never use liquefied petroleum gas from the fuel tanks for cleaning parts. This is mentioned because inspections have revealed that operators have used it as a substitute for solvents and compressed air, not realizing the extreme danger of this practice.

- Whenever the nature of service work requires any operation on the fuel system, the following must be observed:

1. All threaded connections should be treated with an insoluble lubricant (thread sealer 1H part no. 634016C1). Replace worn or defective fittings.

2. After connecting the fuel system, check it for leaks. Leaks are not permissible. Odorants, which are strong smelling compounds (an odor similar to spoiled cabbage), are added to liquefied petroleum gas as warning agents to indicate the leakage of even small quantities of gas.

3. A lather of soap, brushed on with a soft brush, will indicate the presence of leaks, which are dangerous and wasteful. Never use an open flame to check for leakage.

Pay particular attention to short lengths of rubber hose used anywhere in the piping system to relieve stress and vibration.

- Any necessary work on liquefied petroleum gas or natural gas fuel tanks must be performed by qualified concerns who normally service such containers and who are familiar with local regulations, inspections and tests after any repairs are made.

- It is important to remember that all liquefied petroleum gas systems are pressurized. Be certain that the tank valves are tightly closed and all fuel has been exhausted from the lines before starting any repair work on the fuel system.

Gasoline Engines

CAUTION

Gasoline volatility has been increasing in recent years. From one standpoint that's beneficial because it makes engines start more easily and run better in cold weather. On the other hand, it's bad because it makes gasoline more dangerous to use and requires greater precautions. Observe the following basic gasoline safety rules.

- Always tighten fuel cap securely.

- Never take cap off or refuel when engine is running or hot.

- Don't smoke while refueling or anywhere near gasoline.

- When filling your tank, maintain control of the nozzle.

- Don't fill your tank to capacity. Allow room for expansion.

- Wipe up any spills immediately.

- Keep your engine properly maintained.

- Keep your engine clean - free of trash and oil.

- Don't operate your engine near open fires.

- Never use gasoline for cleaning parts.

- Schedule your gasoline purchasing so you won't hold "winter gas" over to spring. In many climates, gasoline is blended to have higher volatility in cold weather. This same fuel becomes more explosive in warmer weather, so avoid seasonal carry-over.

- Make sure everyone who operates your engine follows the safety rules listed in this manual.

VENTILATION FOR ENGINES INSTALLED INSIDE OF BUILDINGS

Engines installed inside buildings, sheds or cabs should be the open type; that is, with the engine hood and back panel removed to permit free circulation of fresh air around the engine, radiator, etc. Steps must be taken to carry the waste heat to the outside, or to change the air in the engine room rapidly.

The exhaust pipe should be arranged to provide the shortest possible length within the engine room. The part of the exhaust pipe inside the building should be surrounded with a light steel tube, sufficiently large to permit a two-inch to four-inch air space all around. This space should be ventilated to the outside. Another method of insulation is to cover the exhaust pipe completely with at least two inches of air-cell asbestos.

Where the door or window area is restricted, galvanized ducts extending from the ceiling above the engine to the top of the building are recommended to carry off the hot air. Not less than two ducts, 24 x 24 inches in cross section, should be installed. At the same time, as many openings in the sides of the engine room as possible should be provided to let in cool outside air. Openings to the north or to a shaded side of the building are preferred.

STEPS TO FOLLOW BEFORE STARTING NEW ENGINE

The following steps must be observed.

1. Check the cooling system level and fill if necessary.

2. Check the oil in the engine crankcase, (see "Lubricant Recommendations") the air cleaner oil cup (wet type - if equipped), and power take-off (if equipped) to be sure they are filled to the correct levels with the proper grades of oil for the prevailing temperature.

3. Be sure battery is connected properly. Connect the battery cable to the "BAT" terminal on the cranking motor solenoid and to the positive

Continued on next page

STEPS TO FOLLOW BEFORE STARTING NEW ENGINE (Continued)

(+) terminal on the battery. Connect the ground strap from the engine block to the negative (-) terminal on the battery.

4. Be sure the alternator is connected properly. If the alternator is not connected, refer to the alternator manufacturer's service manual or to the proper IH alternator service manual (listed in "Technical Publications" section) before connecting alternator to battery. If alternator does not charge, refer to "Magnetizing the Rotor" on page 55.

5. Fill fuel tank (see "Lubricant-Fuel-Coolant Recommendation" section). Keep fuel tank full to prevent condensation.

CAUTION

Never fill the fuel tank when near an open flame or when the engine is operating. Keep the funnel or hose nozzle, used for pouring in the fuel, in contact with the metal of the tank to avoid the possibility of an electric spark igniting the gas. Do not light matches near gasoline, as the air within a radius of several feet is permeated with a highly explosive vapor.

OPERATING THE ENGINE

STARTING THE ENGINE

Depending on the engine application, different starting procedures are used for gasoline engines. For special applications, such as air compressors, refer to the manufacturer's starting and operating procedures.

The following is a basic starting procedure for gasoline engines.

1. Close the choke (manual choke only). Depress accelerator pedal or pull throttle control to its extreme and return to idle position. This will set the fast idle. Turn on ignition switch and start engine. (Check all gauges immediately after starting, again upon reaching operating temperature and frequently during operation. If any of the gauges do not register properly, stop the engine, locate and correct the cause. Shut engine down if oil pressure does not register on gauge within 30 seconds after engine start.) Release accelerator pedal or push in throttle control.

NOTE: Crank engine for 30 seconds at a time; if engine does not start, allow cranking motor to cool two or three minutes before cranking again.

After engine has reached operating temperature, open choke completely.

Engines equipped with LPG or natural gas carburetors, refer to manufacturer's starting procedure.

2. Do not operate the engine under load until it reaches operating temperature.

3. Never operate engine over specified governed speed shown on name plate.

4. Never pour cold coolant into radiator if the engine is over heated. Allow engine to cool down, start engine, while at idle speed slowly pour coolant into radiator.

HOW TO READ OIL LEVEL GAUGE

Read oil level gauge correctly as follows. Let engine run until operating temperature is reached (see "Operating Ranges and Limits"). Stop engine. Check oil level gauge 15 minutes after engine shut-off. Inspect oil level gauge to insure engine crankcase oil level is at least up to low mark ("Add") on gauge to avoid engine damage. When oil level is at or below low mark ("Add") with engine at operating temperature, add oil. DO NOT fill above "Full" mark as this may increase oil consumption. DO NOT add oil when engine is cold. Oil will be thrown out during subsequent engine operation due to its expansion qualities as temperatures increase, resulting in a false engine oil consumption complaint.

OIL AND COOLANT OPERATING RANGES AND LIMITS

Coolant temperature operating range . 180°-200°F
Oil temperature operating range .... 180°-255°F
Oil pressure operating range ..... 8-60 PSI
(Lowest oil pressure reading at low idle; highest reading at high idle)

If coolant or oil temperatures consistently run below 180°F contact your nearest IH engine dealer or refer to diagnostic procedures included in Maintenance and Diagnostic Manuals for Carbureted Engines Certified for on-Highway Use. (See "Technical Publications"). Perform diagnostic check and repair.

If coolant or oil temperatures exceed the upper limits of the range shown above, shut down engine immediately to avoid serious engine damage. Contact your nearest IH engine dealer or refer to diagnostic procedures as described above. Perform diagnostic checks and repair.

If oil pressure falls below 8 psi or exceeds 60 PSI at any time, shut down engine immediately to avoid serious engine damage. Contact your nearest IH engine dealer or refer to diagnostic procedures as described above. Perform diagnostic checks and repair.

COLD WEATHER OPERATION

In order to operate the engine in temperatures of +32°F or lower, observe the following instructions:

Fuel System

Use only a fuel conforming to the proper specifications as shown under fuel specifications on page 17.

GASOLINE ENGINES ONLY: Fill the fuel tank at the end of each day's work to prevent condensation of moisture in the tank.

Lubrication

Lubricate the engine completely with lubricants specified for operation below +32°F as outlined in "Lubricant Recommendations" on page 16.

Cooling System

When the air temperature is consistently at the freezing point (+32°F) or lower, install anti-freeze in the cooling system.

Before installing anti-freeze in the system, make the following check:

1. Check the system for leaks.

2. Inspect all hoses and tighten all hose clamps. Install new hoses if necessary.

3. Drain and clean the system. Refer to "Draining the Cooling System" and "Cleaning the Cooling System" on page 47.

4. Check the operating condition of the thermostat. Refer to "Thermostat" on page 47.

5. Check the condition and tension of the fan and water pump belts and generator belt. Replace the belts if necessary. Refer to "Drive Belt Tension" on page 42.

6. Be sure radiator drain valve and the crankcase drain valve are closed, and all connections are securely tightened.

7. Install the required amount of anti-freeze (refer to "Anti-Freeze Solution" on page 19) into the engine and fill the system with coolant as outlined under "Filling the Cooling System" on page 47.

8. Start the engine. After normal operating temperature has been reached, check the system to be sure there are no leaks.

Battery

When the air temperature drops to +32°F or lower, the efficiency of the battery decreases rapidly. At temperatures of -20°F or lower, it may be necessary to raise battery temperature by applying heat from a suitable source.

It is especially important to keep the battery at full charge for cold weather operation. Check the specific gravity of the battery electrolyte at frequent intervals, and keep the battery as fully charged as possible. Add distilled water to the battery in freezing temperatures only when the engine is to operate for several hours to thoroughly mix the water and the electrolyte, or damage to the battery will result from the water freezing.

CAUTION

Batteries give off highly inflammable gas. Never allow sparks or open flame near the batteries. Avoid spilling any electrolyte on hands or clothing.

WARM WEATHER OPERATION

Lubrication

Lubricate the engine completely with the lubricants specified for operation above +32°F as outlined in "Lubricant Recommendations" on page 16.

Fuel System

GASOLINE ENGINES ONLY: Fill the fuel tank at the end of each day's work to prevent condensation of moisture in the tank.

Continued on next page

WARM WEATHER OPERATION (Continued)

Battery

Inspect the battery frequently to be sure the electrolyte is at the correct level.

Cooling System

To prevent overheating, these steps must be followed:

1. Clean and flush the internal parts of the cooling system. (Refer to "Cleaning the Cooling System" on page 47). When filling the cooling system, follow the method described under "Filling the Cooling System" on page 47).

2. Insects and dirt must be cleaned from the external part of the radiator. (Refer to "Cleaning the Radiator Core" on page 47.

3. Check the condition and tension of the fan and water pump belts and generator belt. Replace the belt if necessary. Refer to "Drive Belt Tensions" on page 42.

4. Check the operating condition of the thermostat. Refer to "Thermostat" on page 47.

STORING ENGINES

Gasoline Engines

When the engine is not to be used for a period of time, it must be stored in a dry and protected place. Leaving equipment outdoors, exposed to the elements, will result in materially shortening its life.

The following procedure must be followed when the engine is placed in storage for 30 days or more and the lubrication procedures repeated every six months.

We recommend that caution be taken in starting an engine that has been in storage. Refer to the procedure shown under "Starting Engines That Have Been in Storage" on page 13.

1. Thoroughly wash or clean the engine.

2. Run the engine long enough to warm the oil in the crankcase. Drain the crankcase, change the lubricating oil filter element (as described on page 37) and fill the crankcase. (Refer to the "Lubricant and Oil Classification Recommendations" on page 16, for the correct viscosity of oil used for the prevailing temperature.)

3. Completely lubricate the rest of the engine.

4. Drain the fuel from the fuel tank and carburetor and replace the fuel pump filter. (Refer to "Fuel Pump Filter" on page 42).

> **NOTE:** Present-day grades of gasoline have a tendency to form gum; therefore, it is necessary that the gasoline tank and carburetor be completely drained of fuel when the engine is to be out of service for more than two weeks. These gum deposits can be dissolved with a mixture of one part alcohol and one part benzol, or with acetone.

5. Remove the spark plugs and pour one tablespoonful of Grade-30 lubricating oil into each cylinder. Crank the engine two or three times to distribute the oil over the cylinder walls; then reinstall the spark plugs.

6. Remove the valve housing cover and flush the valves, rocker arms and push rods with Grade-30 lubricating oil. (If any evidence of rust is found, remove it before lubricating.) Use a paint brush to coat the inside of the valve cover with Grade-30 lubricating oil. Install the valve housing cover.

7. If engine is equipped with oil cooler or heat exchanger, take one of the following precautions when draining for storage in freezing temperatures:

   a. Fill the cooling system with anti-freeze solution, then drain.

   b. If only water is used, drain the engine, then blow out the residual water in the cooler tubes with compressed air. DO NOT RELY UPON DRAINING WATER.

   c. Install a "RADIATOR DRAINED" tag.

8. Remove and clean the crankcase ventilator metering valve (if equipped).

9. Completely service the air cleaner as outlined under "Air Cleaner" on pages 39 and 40.

10. Remove the air cleaner intake cap and store it in a clean dry place. Cover or plug the exhaust pipe and the air cleaner pipe.

11. Remove the battery and store it in a cool, dry place above freezing (+32°F). The battery must be fully charged at the time of storage. Check the battery liquid level at least once a month for

water level and specific gravity. Never allow the battery to run down below 3/4 full charge while in storage.

Liquefied Petroleum and Natural Gas Engines

Follow the same procedure used for preparing the gasoline engines for storage, except as follows:

1. If the fuel lines are going to be disconnected from the engine; close the supply valve on the fuel line. Run the engine until it stops from lack of fuel, and proceed as follows:

LIQUEFIED PETROLEUM GAS ENGINES: Disconnect the fuel line at the fuel inlet. Plug the fuel inlet. Cover the end of the fuel inlet line.

NATURAL GAS ENGINES: Disconnect the fuel line at the fuel inlet. Plug the fuel inlet. Cover the end of the fuel inlet line.

2. Remove the drain plug (headless, slotted) from the bottom of the regulator and drain off any accumulation of water. Install the plug.

3. Replace the fuel filter element on liquefied petroleum gas engines. (Refer to page 42).

STARTING ENGINES AFTER STORAGE

1. Install a fully charged battery and be sure the proper connections are made. (Refer to instructions under "Starting New Engines.")

2. Remove the spark plugs and pour a mixture of one-half gasoline and one-half light lubricating oil into each cylinder; one ounce (two tablespoonfuls) per cylinder is enough.

3. Remove the valve housing cover and flush the valve and valve operating mechanism with the same mixture.

4. Crank the engine rapidly until the excess oil has been blown out of the spark plug holes. This operation will loosen any tight piston rings and wash old, gummy oil from the valves and pistons.

5. Drain and flush out the crankcase with kerosene or flushing oil and fill with the specified lubricating oil. (Refer to the "Lubricant and Oil Classification Recommendations" on page 16.) Be sure a new element has been installed in the lubricating oil filter.

6. Remove the exhaust pipe and the air cleaner opening plugs and/or covers.

7. Install the exhaust pipe.

8. AIR CLEANER (WET TYPE ONLY): Remove and clean the oil cup. Refer to "Oil Bath Type Air Cleaner" on page 40.

9. Install the air intake cap.

10. Install the spark plugs after cleaning and setting the taps (refer to "Spark Plugs" on page 39).

11. Be sure the cooling system drains are closed and fill the cooling system. Check for leaks and loosen connections. Remove the "RADIATOR DRAINED" tag.

12. If the fuel lines have been disconnected from the engine, remove the plugs from the fuel inlet. Remove the covers from the fuel inlet lines. Reconnect the fuel inlet lines being sure the connections are tight.

13. Fill the fuel tank or tanks.

14. Start the engine and let it run slowly; observe if any valves are sticking. If so, pour a small quantity of kerosene on the valve stems until loose.

CAUTION

Do not run the engine rapidly or operate it at high speed immediately after starting. Keep the doors wide open or move the engine outside the storage room immediately to avoid danger from exhaust gas.

15. Install the valve housing cover. Tighten the valve cover bolts.

16. After the engine has been run long enough to clean the excess oil out of the cylinders, the spark plugs should be removed and checked for oil fouling. If fouled, clean and reinstall them in the engine.

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF SUBJECTS

Printed in United States of America.

LUBRICANT RECOMMENDATIONS

The crankcase was filled at the factory with engine oil for operation in an ambient temperature range of -23°C to 32°C (-10°F to 90°F). For engine operation above or below this range, change to correct viscosity. See chart below.

For International Harvester's engine oil recommendation for IH carbureted OEM engines see recommended engine oil classification shown below.

Choosing proper engine lubrication and following recommended oil-change intervals is essential to good engine starting, performance and long-term durability. These responsibilities rest with the engine operator. He should have his lubricants supplier confirm that the products being provided meet specific recommendations for his engines.

Failure to use the proper lubricants and following recommended oil-change intervals could void the new-engine warranty.

Choosing an engine oil, as outlined in this bulletin, of correct quality and proper viscosity (or thickness) is essential to providing long engine life and good engine starting. Specific information on brand name, quality and viscosity of many commercial engine oils distributed throughout the world is contained in a booklet entitled:

"EMA Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines"

Engine Manufacturers Association
One Illinois Center
111 East Wacker Drive
Chicago, Illinois, U.S.A. 60601

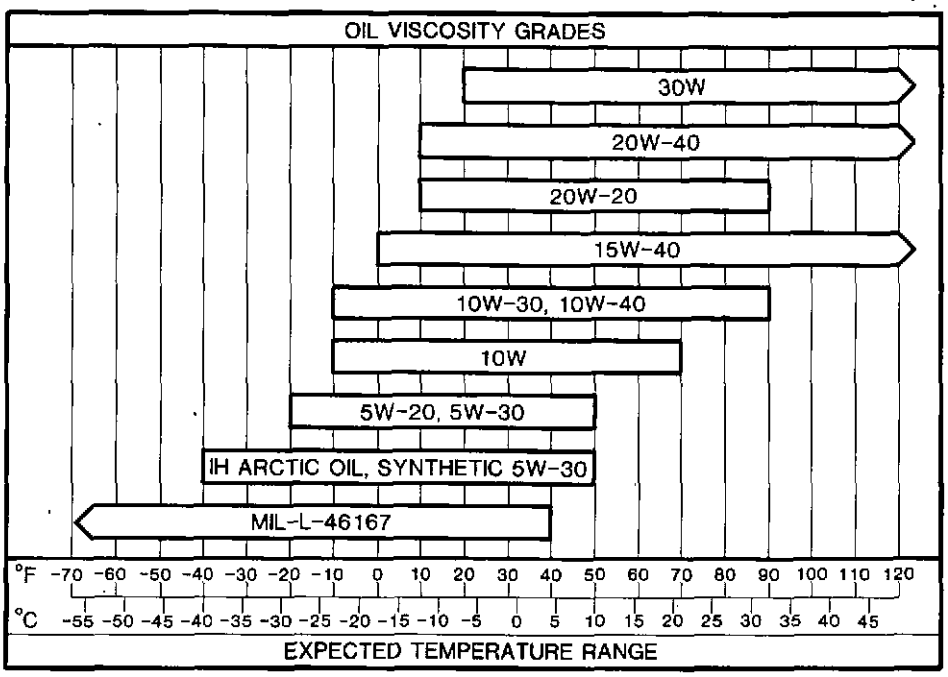
There are many supplementary fuel and oil additives for sale. If you follow our fuel, lubricant and oil-change interval recommendations, your engine should not need these additives.

RECOMMENDED OIL TYPES AND GRADES

Viscosity is specified by the SAE (Society of Automotive Engineers) Viscosity Grade. Use chart below to choose proper viscosity grade for the lowest temperature range you expect before your next oil change.

RECOMMENDED OIL CLASSIFICATIONS

Oil quality is described by either the API (American Petroleum Institute) engine service classifications or by the U.S. Army engine oil specifications. As detailed in this section, the oil quality recommended depends upon type of engine (diesel or spark ignition), design of engine (turbocharged or naturally-aspirated), and the application in which the engine is used (on-highway truck or off-highway service). Find type, design and application of your engine in the following sections, and then choose the correct oil quality.



CG-7721

Gasoline Engines

Preferred: Oils meeting API classification SF or SF/CC, or U.S. Army specification MIL-L-46152A. To get the best fuel economy (miles per gallon), use a fuel-efficient engine oil. They are identified by words such as: "Energy Saving," "Conserves Gasoline" or "Friction Reducing."

Acceptable: So-called "universal" oils meeting API classification SF/CD.

Not Acceptable: Oils meeting only CC, CD, or CD/SC, API classifications, or meeting only the MIL-L-2104C, U.S. Army specification. Use of these oils could reduce engine life.

LPG and Natural Gas Engines

Preferred: Use IH Low Ash Engine Oil, or IH Interseason Engine Oil. They are specifically formulated for this application.

Acceptable: Oils meeting API Classification SF or SF/CC, or U.S. Army specification MIL-L-46152A, and with sulfated ash contents of less than 1.0 mass percent.

Not Acceptable: Oils meeting only CC, CD, or CD/SC, API classifications, or meeting only the MIL-L-2104C, U.S. Army specification. Use of these oils could increase engine deposits and wear, and reduce valve life.

FUEL REQUIREMENTS

GASOLINE

Your gasoline engine is designed to operate efficiently in normal operations on "Regular" grade fuels of at least 91 RON (Research Octane Number) or 86.5 anti-knock index designation. (The latter figure is now generally posted on fuel dispensing pumps.) "Low Lead" fuel containing at least .13 gpl (0.5 gpg) lead, or the equivalent additive, per gallon may be used.

Continuous use of gasoline which is completely free of lead, or other lubricating additives such as phosphorous, is not recommended. Prolonged use of such fuel can cause excessive exhaust valve seat wear resulting in loss of emission control, poor performance and possible engine failure.

Because of this, it is recommended that you alternate to regular grade fuel every fourth tank. The alternating fuel method is not necessary with use of low lead content fuel as it can be successfully used without any harm to your engine.

Use of a fuel which is too low in anti-knock quality will result in "spark knock." Since anti-knock quality of all "regular" grade gasolines is not the same and factors such as altitude, terrain and air temperature affect operating efficiency, knocking may result even though you are using the grade of fuel recommended for your engine. Continued engine operation under "spark-knock" conditions can cause severe engine damage. At these times a higher anti-knock quality gasoline is required to prevent engine damage. If knocking persists with higher grade fuel, it is recommended an IH or suitably qualified service outlet be contacted as engine repairs may be needed.

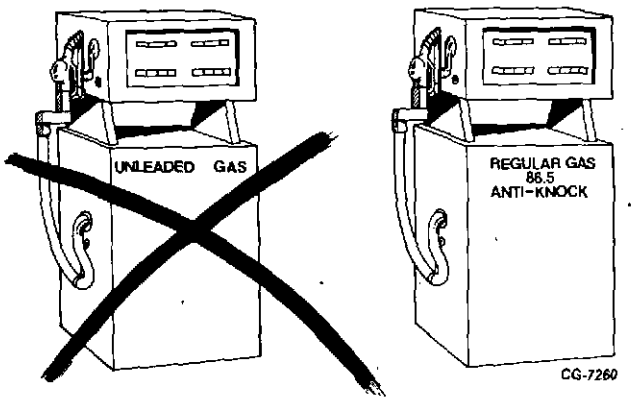


Figure 8. **USE CORRECT FUEL FOR YOUR ENGINE**

For fuels of lower Research octane number, the timing may require retarding (approximately one degree retard from factory setting for each decrease of one octane number). Overseas fuels may, in many areas, be considerably lower in Research octane number than regular grade fuels obtainable in the USA. Advancing the timing beyond the initial factory setting is not recommended and may only result in adverse effects. There is no particular advantage in using a fuel having a higher anti-knock value than the engine requires.

Continued on next page

FUEL REQUIREMENTS (Continued)

LPG AND NG FUEL

It is recommended that LP gas fuel meeting the Natural Gas Processor's Association (NGPA) specification for propane HD5 be used if available.

USE OF GASOHOL

As a major international producer of gasoline engines, International Harvester has investigated the feasibility and advisability of using alcohol fuels for its gasoline engines. The following policy has been formulated based on these investigations.

Gasohol, defined as a mixture of 10% anhydrous ethyl alcohol, and 90% unleaded gasoline (by volume), may be used for IH gasoline engines without engine modification and without affecting warranty provisions. Engine performance, economy and durability will not be significantly affected, but the user may notice the following:

- Slightly harder starting, especially in cold weather.
- Poorer driveability; a tendency for the engine to hesitate and stumble especially when cold.
- Increased tendency to vapor lock and stall in hot weather.
- Shorter fuel filter, carburetor seal and hose life.

NOTE: When gasohol is used in IH gasoline engines designed to operate on regular grade (leaded) fuel, it is recommended to alternate to regular grade (leaded) fuel every fourth tank.

When using gasohol for fuel, it is extremely important that the owner/operator take special precautions to ensure that no water is introduced into the fuel tank. Even small amounts of water will cause alcohol to separate from gasoline. If this happens, the engine may stall, misfire or not start at all. To minimize chances for water contamination, buy fuel only from reputable, well-known dealers and keep fuel tank full to prevent condensation.

Gasoline-based fuels containing greater than 10 percent ethanol (by volume), pure ethanol and any amount or concentration of methyl alcohol are not recommended for IH gasoline engines. Use of these fuels will void all warranty provisions and may result in unacceptable engine operation and driveability.

COOLANT RECOMMENDATIONS

To keep the cooling system free of rust and sludge and to minimize corrosion and scale deposits, add a cooling system conditioner. To keep it from freezing during cold weather, also add anti-freeze. Use the following information in the care of your cooling system.

WATER

Use clean water inhibited with IH Cooling System Conditioner to minimize corrosion and scale deposits. Never use water alone.

Clean water should comply with the following requirements before adding conditioner.

1. Total hardness – Not to exceed 170 parts per million (10 grains/gal. max.) to prevent scale deposits. If greater, then water should be softened.
2. Chlorides – Not to exceed 40 parts per million (2.5 grains/gal. max.) and sulfates not to exceed 100 parts per million (5.8 grains/gal. max.) to prevent corrosion. If greater, the water should be distilled, deionized or demineralized.
3. Dissolved solids – Not to exceed 340 parts per million (20 grains/gal. max.) to minimize sludge deposits, scale deposits, corrosion, or a combination of these. If greater, treat as noted above.

COOLANT ADDITIVES

Coolant Conditioners

All cooling system inhibitors become depleted through normal operation and additional cooling conditioner must be added to the coolant every 500-1000 hours of engine operation at the rate of one pint for each eight gallons of cooling capacity to maintain original strength levels.

The use of a new IH Cooling System Conditioner (690 126 C1), is recommended. This product is a complete inhibitor system, of a non-chromate type, which provides corrosion protection, pH control for maintaining an acid-free coolant, and water softening to prevent the formation of mineral deposits. It is suitable for use in all systems being compatible with both water and ethylene glycol antifreeze solutions.

Do not use soluble oil as a corrosion inhibitor. It requires careful control of concentration level to prevent adverse effects on heat transfer.

Do not use additives or solutions that claim to improve heat transfer and prevent engine overheating. Tests indicate that none perform as claimed; in fact, some may do severe damage. There are no miracle additives that will increase heat transfer; conditioned water is still the best coolant.

Antifreeze

IH Antifreeze permanent type (ethylene glycol) is recommended. This product, specifically formulated for IH equipment, contains all necessary and proper inhibitors and has been thoroughly evaluated for optimum effectiveness. DO NOT use methanol or alcohol as an antifreeze.

IH Antifreeze is now compatible with both chromate and non-chromate corrosion resistors.

Do not use antifreeze year-round where ambient temperatures exceed 100°F except on units equipped with an automotive type, combination air conditioner-heater coil in the cab. Seasonal changes are recommended to replace inhibitors which may become exhausted and to flush out the system. When inhibitors become depleted, the antifreeze becomes a corroding agent which attacks and coats the metallic surfaces of the cooling system, thus reducing heat transfer.

The boiling point of ethylene glycol solutions is higher than plain water, but their ability to transfer heat is less. In hot weather, this difference will result in coolant temperatures running hotter than with water and where oil-to-water coolers are used, the transmission oil temperatures will run hotter.

Do not use antifreeze with sealer or anti-leak additives. These additives may cause plugging problems throughout various areas of the cooling system and will restrict coolant flow.

A minimum volume of 30% antifreeze is required to provide suitable corrosion protection. A concentration greater than 68% will adversely affect freeze protection and heat transfer rates.

The following table shows the percentage of antifreeze solution required for the various temperatures.

Freezing Point (Fahrenheit)	USE IN COOLING SYSTEM
	IH Premium (Ethylene) Glycol-Permanent Type)
+20°	16%
+10°	25%
0°	33-1/3%
-10°	40%
-20°	45%
-30°	50%
-40°	54%
-50°	58%
-60°	62%
-70°	65%

NOTE: Do not mix brands of anti-freeze solutions. Mixed solutions make it impossible to determine if the cooling system has adequate protection against freezing. When testing the solution, be sure the system is at normal operating temperature. This is necessary to obtain an accurate reading.

Check the solution frequently and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

NOTES

SPECIFICATIONS AND CAPACITIES 4

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Printed in United States of America.

SPECIFICATIONS

ENGINE MODEL	C-152	C-196
Number of Cylinders	4	
Bore	98.425 mm (3.875")	104.775 mm (4.125")
Stroke	81.737 mm (3.218")	92.868 mm (3.656")
Displacement	2.5 litre (152 cu.in.)	3.2 litre (196 cu.in.)
Compression Ratio	8.19:1	8.02:1
Brake H.P. (Max.)*	65 kw (86.9 hp) @ 4400 RPM	83 kw (110.8 hp) @ 4000 RPM
Brake H.P. (Net)*	59 kw (80 hp) @ 4400 RPM	76 kw (102.7 hp) @ 4000 RPM
Torque (Max.) N•m (lb. ft.)*	183 N•m (135 lb.ft.) @ 2400 RPM	245 N•m (181 lb.ft.) @ 2000 RPM
Torque (Net) N•m (lb. ft.)*	176 N•m (129.8 lb.ft.) @ 2400 RPM	238 N•m (176.1 lb.ft.) @ 2000 RPM
Weight (with Std. Accessories)	229 kg (505 lbs.)	247 kg (545 lbs.)
Recommended Max. Speed RPM	4000	
Idle Speed Range RPM	450 – 500	
Fast Idle Speed RPM	2000	
Spark Plug	RJ-10Y	
Spark Plug Gap Gasoline Engines LPG and NG Engines	 .88 mm (.035") .38 mm (.015")	
Distributor Point Gap (Standard Ignition)	.41 – .51 mm (.016" – .020")	
Dwell (Degrees) (Standard Ignition)	24 – 34	
Firing Order	1 – 3 – 4 – 2	
Trigger Wheel to Sensor Air Gap (Electronic Ignition)	.20 mm (.008")	
Dwell (Degrees) (Electronic Ignition)**	24 – 34	
Timing Check Points[2]	@ 500 RPM	@ 1200 RPM / @ 2000 RPM
Gasoline Engines	TDC	20° / 29°
LPG and NG Engines	5°	25° / 34°
Engine Timed from (Cylinder No.)	1	

*For gasoline engines only.
**Requires special dwell meter.

1 Vacuum to distributor disconnected
2 Timing setting is at 500 RPM for all engines (except for air compressor engines at 1200 RPM)

ENGINE MODEL	C-304	C-345	C-392
Number of Cylinders	8		
Bore	98.4 mm (3.876")		104.7 mm (4.125")
Stroke	81.76 mm (3.218")		76.2 mm (3.656")
Displacement	5 litre (304 cu.in.)	5.6 litre (345 cu.in.)	6.4 litre (392 cu.in.)
Compression Ratio	8.19:1	8.28:1	8.0:1
Brake H.P. (Max.)*	144 kw (193.1 hp) @ 4400 RPM	147 kw (196.7 hp) @ 4000 RPM	176 kw (235.6 hp) @ 4000 RPM
Brake H.P. (Net)*	134 kw (180 hp) @ 4400 RPM	119 kw (161 hp) @ 3800 RPM	137 kg (185 hp) @ 3600 RPM
Torque (Max.) N•m.* (lb.ft.)	368 N•m (272.5 lb.ft.) @ 2800 RPM	418 N•m (309 lb.ft.) @ 2200 – 2400 RPM	483 N•m (356.5 lb.ft.) @ 2800 RPM
Torque (Net) N•m.* lb.ft.)	355 N•m (262 lb.ft.) @ 2600 RPM	386 N•m (285 lb.ft.) @ 2200 RPM	410 N•m (303 lb.ft.) @ 2800 RPM
Weight (with Std. Acces.)	316 kg (698 lbs.)	329 kg (727 lbs.)	347 kg (765 lbs.)
Governed Speed RPM, (no load)	4000	3800	3600
Recommended (non governed) Max. Speed RPM	4000	3800	- - - -
Idle Speed Range RPM	675-725		
Fast Idle Speed RPM	2200		
Spark Plug	RJ-10Y		
Spark Plug Gap Gasoline Engines LPG and NG Engines	 .88 mm (.035") .38 mm (.015")		
Distributor Point Gap (Std. Ignition)	.41 – .51 mm (.016" – .020")		
Dwell (Degrees) (Std. Ignition)	28 – 32		
Firing Order	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2		
Trigger Wheel to Sensor Air Gap (Electronic Ignition)	.20 mm (.008")		
Dwell (Degrees) (Electronic Ignition)	24 – 34		
Initial Timing Setting Gasoline Engines LPG and NG Engines	 TDC 5° BTDC	 TDC 10° BTDC	 TDC 5° BTDC
Engine Timed From (Cylinder No.)	8		

*For gasoline engines only.

ENGINE MODEL	C-446
Number of Cylinders	8
Bore	104.775 mm (4.125")
Stroke	106.172 mm (4.180")
Displacement	7.3 litre (446 cu.in.)
Compression Ratio	8:1 (9.5:1 for NG engine only)
Brake H.P. (Net) (2 bbl.)*	- - - -
Brake H.P. (Net) (4 bbl.)*	175 kw (235 hp) @ 3600 RPM
Torque (Net) N•m (lb.ft.)* (2 bbl.)	- - - -
Torque (Net) N•m (lb.ft.)* (4 bbl.)	521 N•m (385 lb.ft.) @ 2800 RPM
Weight (with Std. Accessories)	399 kg (880 lbs.)
Governed Speed RPM	3600
Recommended Max. Speed RPM	- - - -
Idle Speed Range RPM	525 – 575
Fast Idle Speed RPM	2400
Spark Plug	Standard RBN–13Y Severe Service RBN-4
Spark Plug Gap Gasoline LPG or NG	 .88 mm (.035") .38 mm (.015")
Firing Order	1 – 2 – 7 – 3 – 4 – 5 – 6 – 8
Electronic Ignition Trigger Wheel to Sensor Air Gap Dwell (Degrees)	 .2 mm (.008") 24 – 34
Initial Timing Setting Gasoline Engine Except AU-78377, 78382, 79036 For AU-78377, 78382, 79036 LPG and NG Engines	 5° BTDC 1° BTDC 18° BTDC @ 500-700 RPM
Engine Timed From (Cylinder No.)	1

*For gasoline engines only.

ENGINE MODEL	C-537	C-605
Number of Cylinders	8	
Bore	117.48 mm (4.625")	
Stroke	101.60 mm (4.000")	114.30 mm (4.500")
Displacement	8.8 litre (537 cu.in.)	9.9 litre (605 cu.in.)
Compression Ratio	7.5:1	7.5:1 (9.5:1 for NG only)
Brake H.P. (Net) (2 bbl.)	155 kw (208 hp) @ 3200 RPM	
Brake H.P. (Net) (4 bbl.)	175 kw (236 hp) @ 3200 RPM	191 kw (257 hp) @ 3200 RPM
Torque (Net) N•m (lb.ft.) (2 bbl.)	562 N•m (415 lb.ft.) @ 2000 RPM	
Torque (Net) N•m (lb.ft.) (4 bbl.)	581 N•m (429 lb.ft.) @ 2000 RPM	581 N•m (429 lb.ft.) @ 2000 RPM
Weight (with Std. Accessories)	549 kg (1210 lb.)	
Governed Speed (no load)	3400 RPM	
Idle Speed Range RPM	500 – 550	
Fast Idle Speed RPM	2000	
Spark Plug Gasoline Engines LPG and NG Engines	 RN-11Y RN-6	
Spark Plug Gap	Gasoline .76 mm (.030")	
Firing Order	1 – 8 – 7 – 3 – 6 – 5 – 4 – 2	
Electronic Ignition Trigger Wheel to Sensor Air Gap Dwell (Degrees)	 .2 mm (.008") 24 – 34	
Initial Timing Setting Gasoline Engines LPG Engines NG Engines	 7° BTDC 14° BTDC @ 700 RPM 18° BTDC @ 550-650 RPM	
Engine Timed from Cylinder No.)	1 or 6	

ENGINE MODEL	C-549
Number of Cylinders	8
Bore	117.48 mm (4.625")
Stroke	109.53 mm (4.3125")
Displacement	9 litre (549 cu.in.)
Compression Ratio	7.57:1
Brake H.P. (Max.) Brake H.P. (Net)	190 kw (256 hp) @ 3400 RPM 171 kw (230 hp) @ 3200 RPM
Torque (Max.)N•m (lb.ft.) Torque (Net) N•m (lb.ft.)	684 N•m (505 lb.ft.) @ 2000 RPM 649 N•m (479 lb.ft.) @ 1600 RPM
Weight (with Std. Accessories)	563 kg (1241 lbs.)
Governed Speed RPM	3400
Idle Speed Range RPM	500 – 550
Spark Plug	RJ-6
Spark Plug Gap Gasoline Engines LPG and NG Engines	 .76 mm (.030") .38 mm (.015")
Distributor Point Gap (Standard Ignition) Dwell (Degrees) (Standard Ignition)	.36 mm (.014") 28 – 32
Firing Order	1 – 8 – 7 – 3 – 6 – 5 – 4 – 2
Initial Timing Setting Gasoline Engines LPG and NG Engines	 7° BTDC TDC
Engine Timed from (Cylinder No.)	1

ENGINE CRANKCASE OIL CAPACITY

Capacities shown are without oil filter change. With oil filter change, add one quart per filter.

ENGINE MODEL	CAPACITY
C-152	4.7 Liter (5 Quarts)
C-196	4.7 Liter (5 Quarts)
C-304	7.6 Liter (8 Quarts)
C-304*	4.7 Liter (5 Quarts)
C-345	7.6 Liter (8 Quarts)
C-345*	4.7 Liter (5 Quarts)
C-392	7.6 Liter (8 Quarts)
C-446	7.6 Liter (8 Quarts)
C-537	11.4 Liter (12 Quarts)
C-549	11.4 Liter (12 Quarts)
C-605	11.4 Liter (12 Quarts)

*With Optional Size Oil Pan Only.

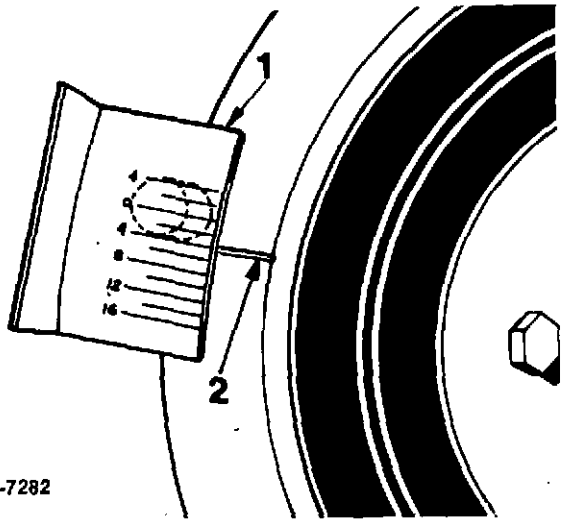

Figure 10. C-446 ENGINE

ENGINE TIMING MARK LOCATION

NOTE

Reference 1 — Timing Indicator

Reference 2 — Timing Mark

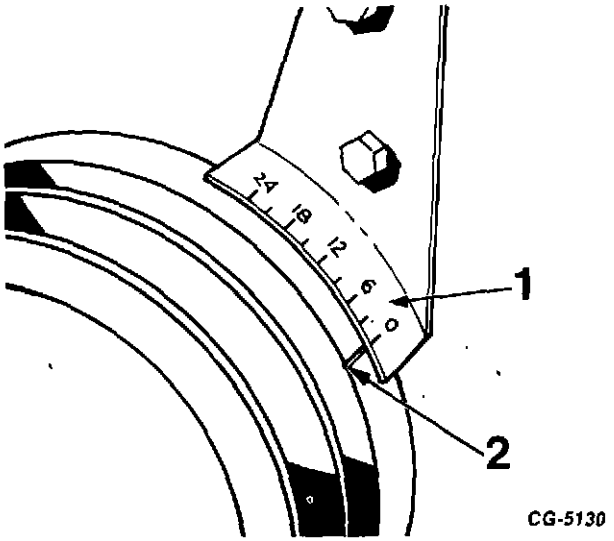

Figure 11. C-605 ENGINE

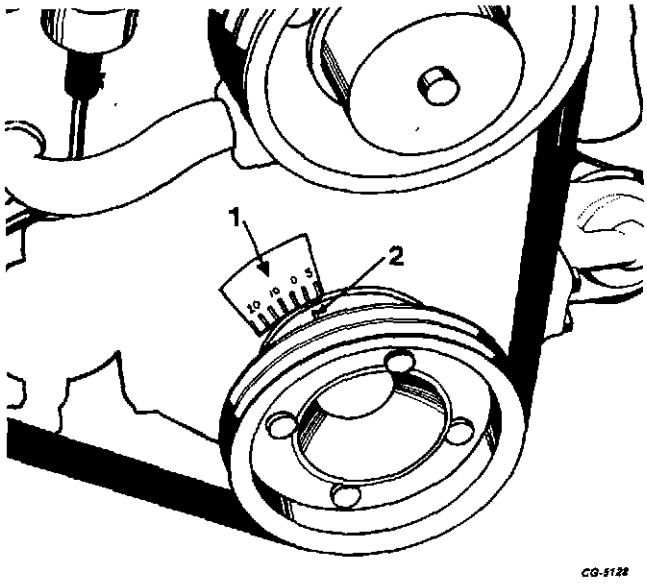

Figure 9. C-152, C-196, C-304, C-345, C-392 ENGINES

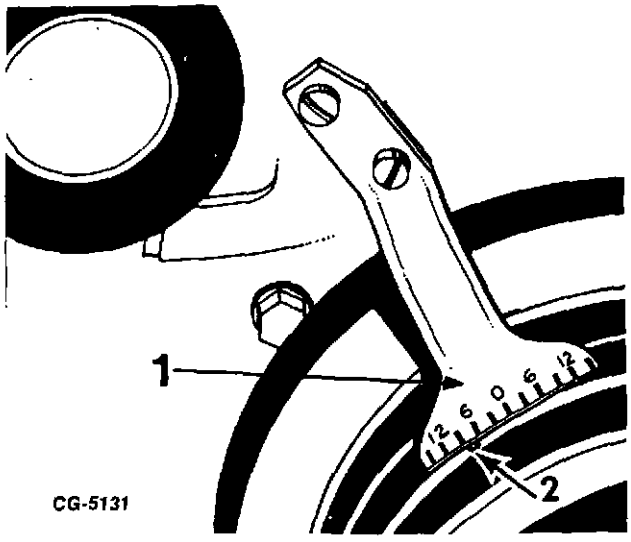

Figure 12. C-549 ENGINE

SPARK PLUG CABLE ROUTING AND TIMING DIAGRAMS (By Engine)

SPARK PLUG CABLE ROUTING FOR C-196, C-152 ENGINES
(Coil Mounted on Right Side)

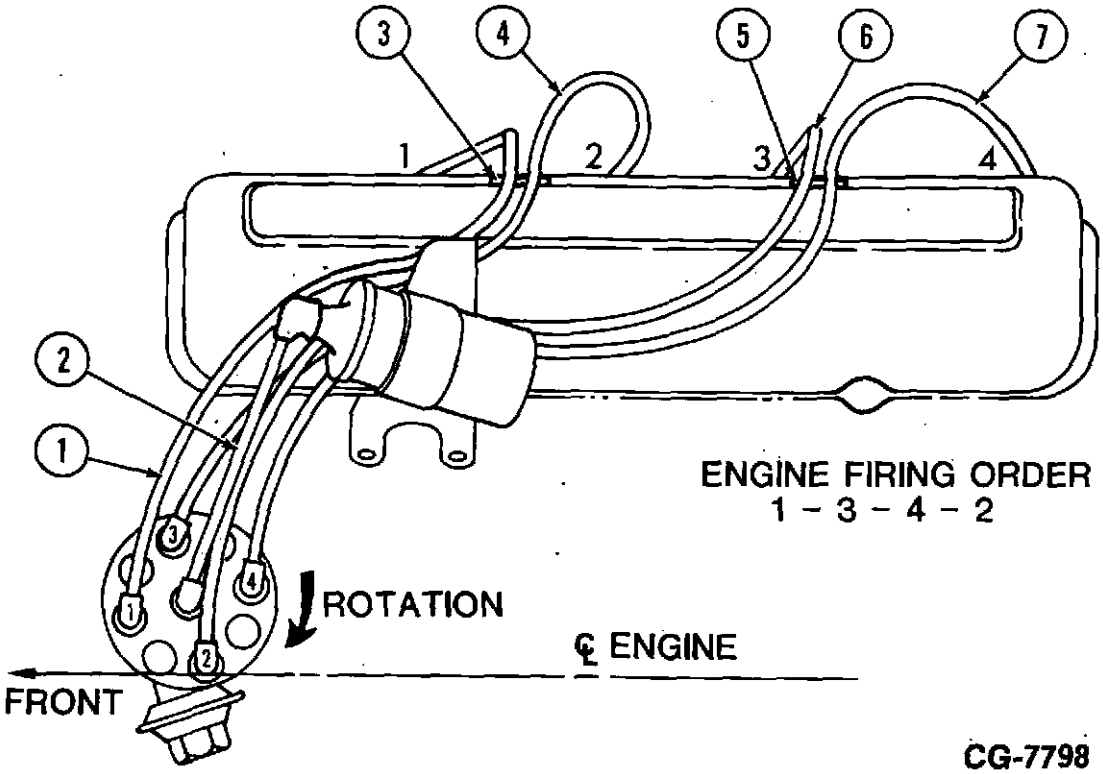

Figure 13. SPARK PLUG CABLE ROUTING FOR C-152, C-196 ENGINES

LEGEND

1. Cable Assembly Distributor to Spark Plug (No. 1 Cylinder)
2. Cable Assembly, Distributor to Coil.
3. Retainer, Spark Plug Cable.
4. Cable Assembly, Distributor to Spark Plug (No. 2 Cylinder).
5. Retainer, Spark Plug Cable.
6. Cable Assembly, Distributor to Spark Plug (No. 3 Cylinder)
7. Cable Assembly, Distributor to Spark Plug (No. 4 Cylinder).

SPARK PLUG CABLE ROUTING FOR C-152, C-196 ENGINES
(Coil Mounted on Left Side)

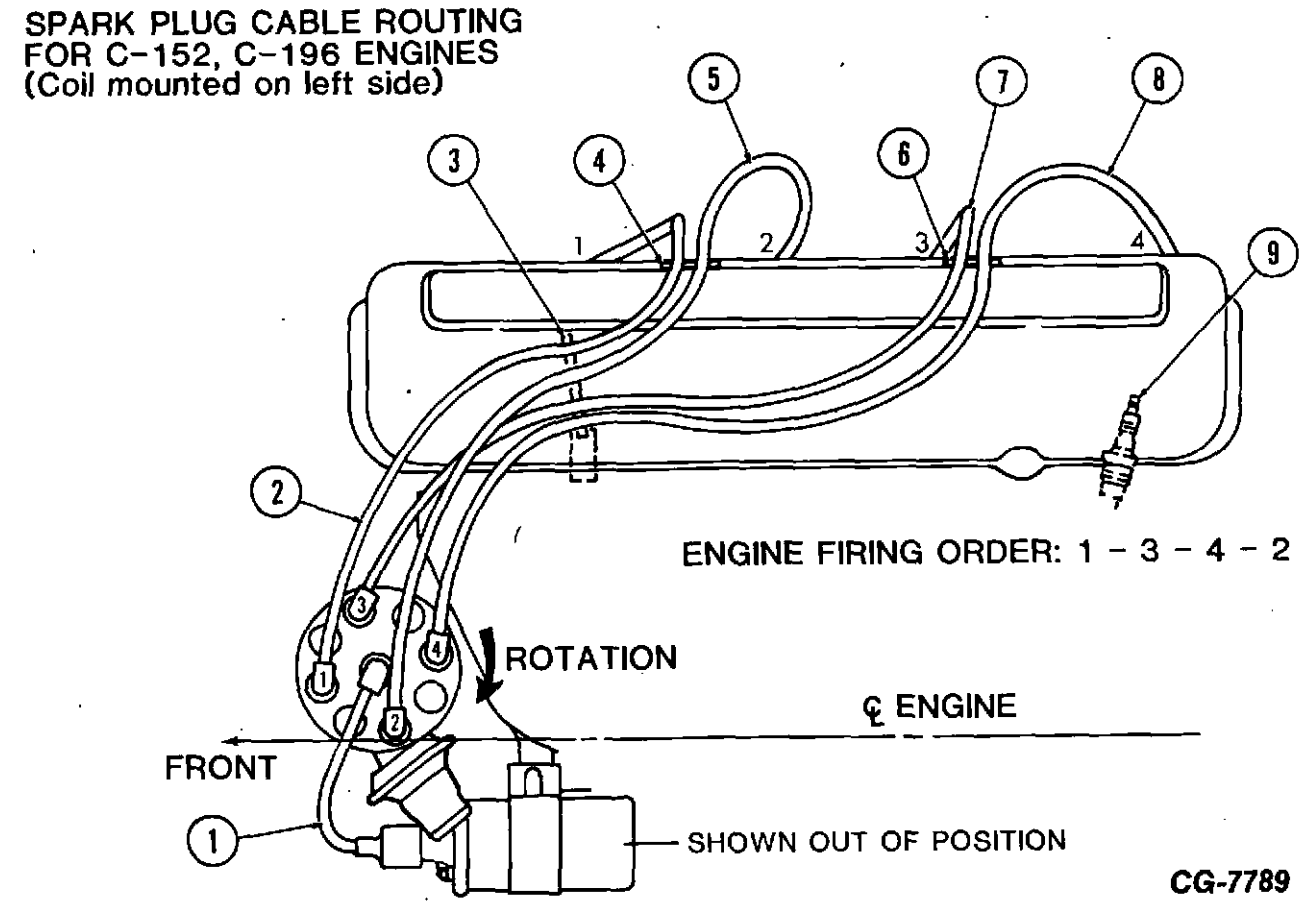

Figure 14. SPARK PLUG CABLE ROUTING FOR C-152, C-196 ENGINES

LEGEND

1. Cable Assembly, Distributor to Coil.
2. Cable Assembly, Distributor to Spark Plug (No. 1 Cylinder).
3. Retainer, Spark Plug Cable.
4. Retainer, Spark Plug Cable.
5. Cable Assembly, Distributor to Spark Plug (No. 2 Cylinder).
6. Retainer, Spark Plug Cable.
7. Cable Assembly, Distributor to Spark Plug (No. 3 Cylinder).
8. Cable Assembly, Distributor to Spark Plug (No. 4 Cylinder).
9. Plug, Spark w/Gasket.

SPARK PLUG CABLE ROUTING FOR C-304, C-345, C-392 ENGINES

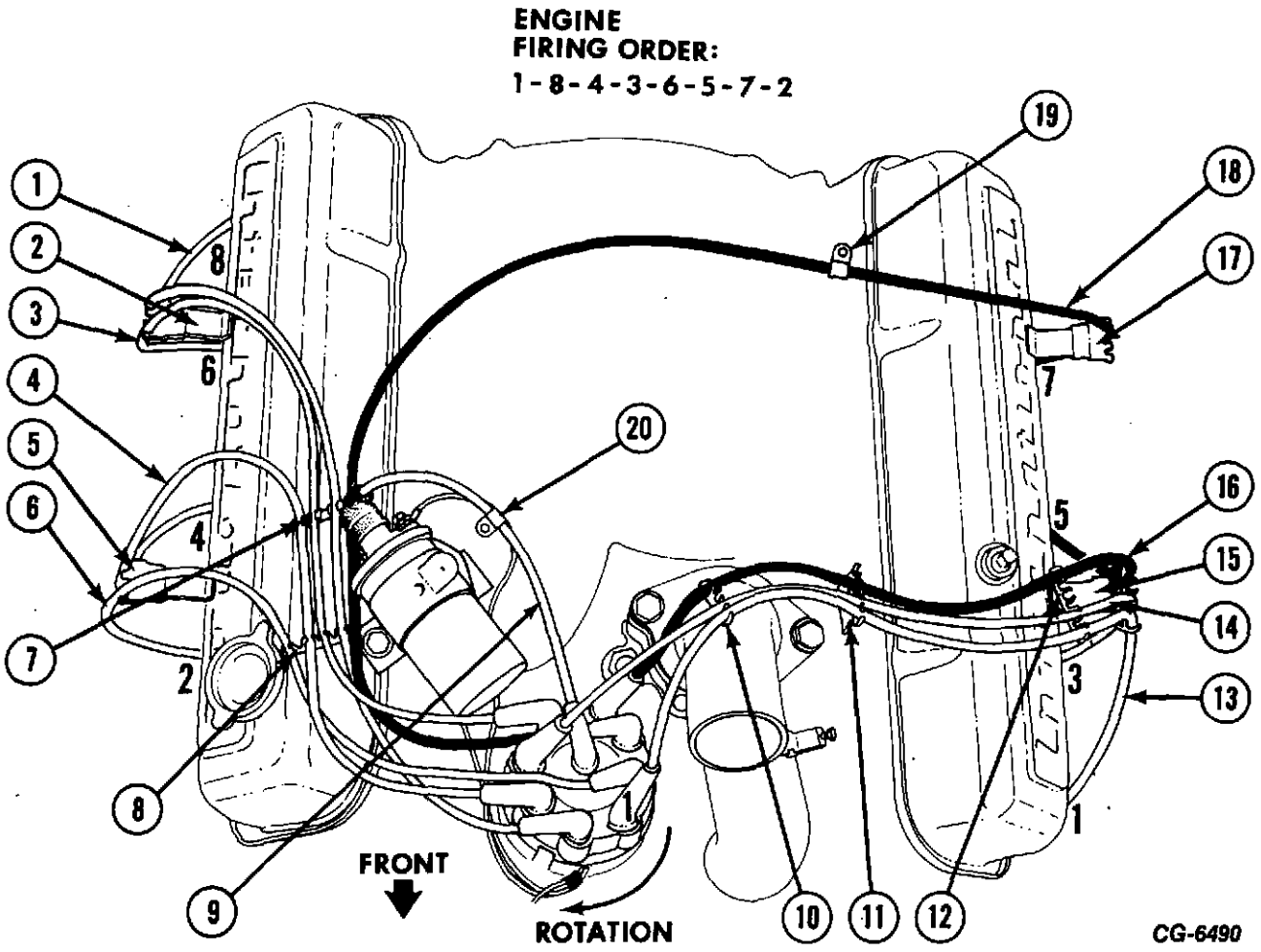

Figure 15. SPARK PLUG CABLE ROUTING FOR C-304, 345, 392 ENGINES

LEGEND

1. Cable Assembly, Distributor to Spark Plug (No. 8 Cylinder).
2. Retainer, Spark Plug Wire.
3. Cable Assembly, Distributor to Spark Plug (No. 6 Cylinder).
4. Cable Assembly, Distributor to Spark Plug (No. 4 Cylinder).
5. Retainer, Spark Plug Wire.
6. Cable Assembly, Distributor to Spark Plug (No. 2 Cylinder).
7. Retainer, Spark Plug Wire.
8. Retainer, Spark Plug Wire.
9. Cable Assembly, Distributor to Coil.
10. Retainer, Spark Plug Wire.
11. Retainer, Spark Plug Wire.
12. Retainer, Spark Plug Wire.
13. Cable Assembly, Distributor to Spark Plug (No. 1 Cylinder).
14. Cable Assembly, Distributor to Spark Plug (No. 3 Cylinder).
15. Retainer, Spark Plug Wire.
16. Cable Assembly, Distributor to Spark Plug (No. 5 Cylinder).
17. Retainer, Spark Plug Wire.
18. Cable Assembly, Distributor to Spark Plug (No. 7 Cylinder).
19. Retainer, Spark Plug Wire (Not on all models).
20. Clip (Not on all models).

NOTE: With Holley distributor, ignition coil is mounted 180° from what is shown above. This only affects length of distributor-to-coil cable. No other wiring or cables are affected.

SPARK PLUG CABLE ROUTING FOR C-446 ENGINES

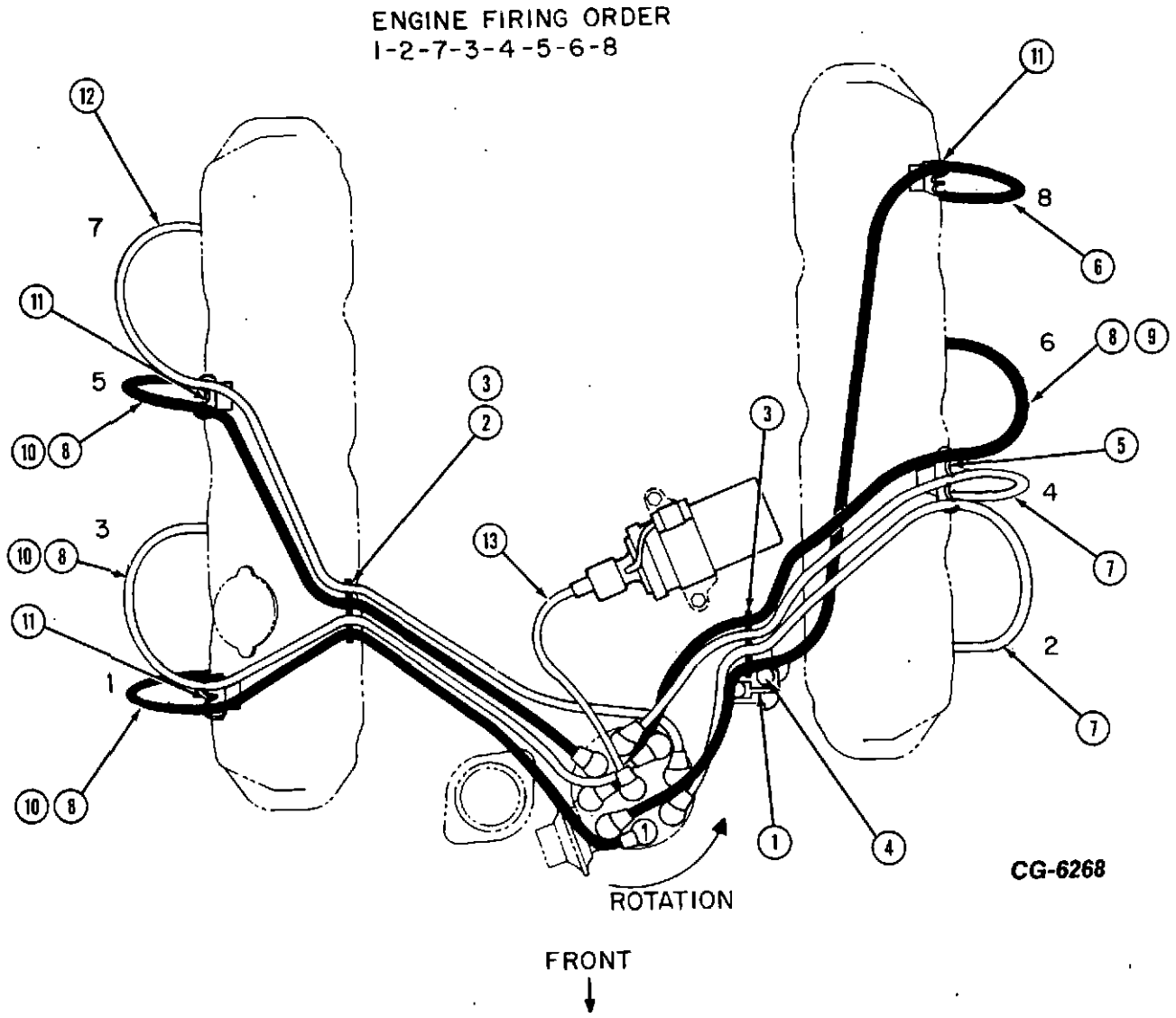

Figure 16. SPARK PLUG CABLE ROUTING FOR C-446 ENGINES

LEGEND

1. Bracket, Spark Plug Wire.
2. Extension, Cable Retainer (Use Cover Mounting Bolt).
3. Retainer, 4 Wire.
4. Washer, .375 Lock and Bolt HH .375 - 16 UNC .75.
5. Retainer, 3 Wire.
6. Cable Assembly, No. 8 Plug to Distributor (446 775 C94) w/Holley (487 827 C91) w/Prestolite.
7. Cable Assembly, No. 2 & 4 Plug to Distributor (446 772 C94) w/Holley (487 823 C91) w/Prestolite.
8. Cable Assembly, No. 1, 3, 5 & 6 Plug to Distributor (446 771 C94) w/Holley Only.
9. Cable Assembly, No. 6 Plug to Distributor (487 825 C91) w/Prestolite Only.
10. Cable Assembly, No. 1, 3 & 5 Plug to Distributor (487 824 C91) w/Prestolite Only.
11. Retainer, 2 Wire Holley and Prestolite.
12. Cable Assembly, No. 7 Plug to Distributor (446 774 C94) w/Holley (487 826 C91) w/Prestolite.
13. Cable Assembly, Distributor to Coil.

SPARK PLUG CABLE ROUTING FOR C-605 ENGINES

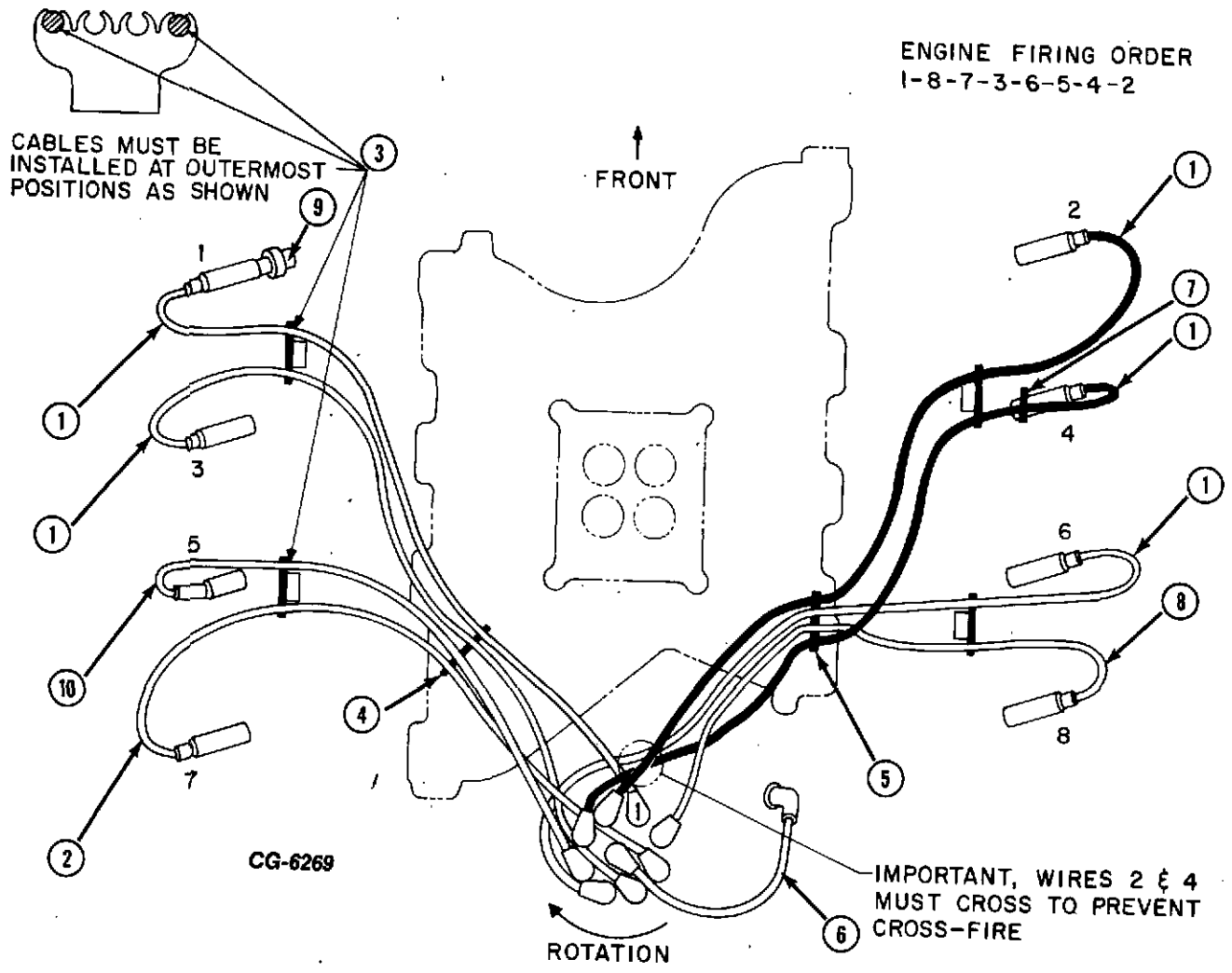

Figure 17. SPARK PLUG CABLE ROUTING FOR C-605 ENGINES.

LEGEND

1. Cable Assembly, Distributor to Spark Plug (No. 1, 2, 3, 4 & 6 Cylinders).
2. Cable Assembly, Distributor to Spark Plug (No. 7 Cylinder).
3. Retainer, Spark Plug Wire (See Reference in Drawing).
4. Retainer, Spark Plug Wire.
5. Extension, Clip and Retainer (Use existing Manifold Bolt and Lock Washer, Omit Flat Washer).
6. Cable Assembly, Distributor to Coil.
7. Retainer, Spark Plug Wire.
8. Cable Assembly, Distributor to Spark Plug (No. 8 Cylinder).
9. Spark Plug Assembly.
10. Cable Assembly, Distributor to Spark Plug (No. 5 Cylinder).

SPARK PLUG CABLE ROUTING FOR C-549 ENGINES

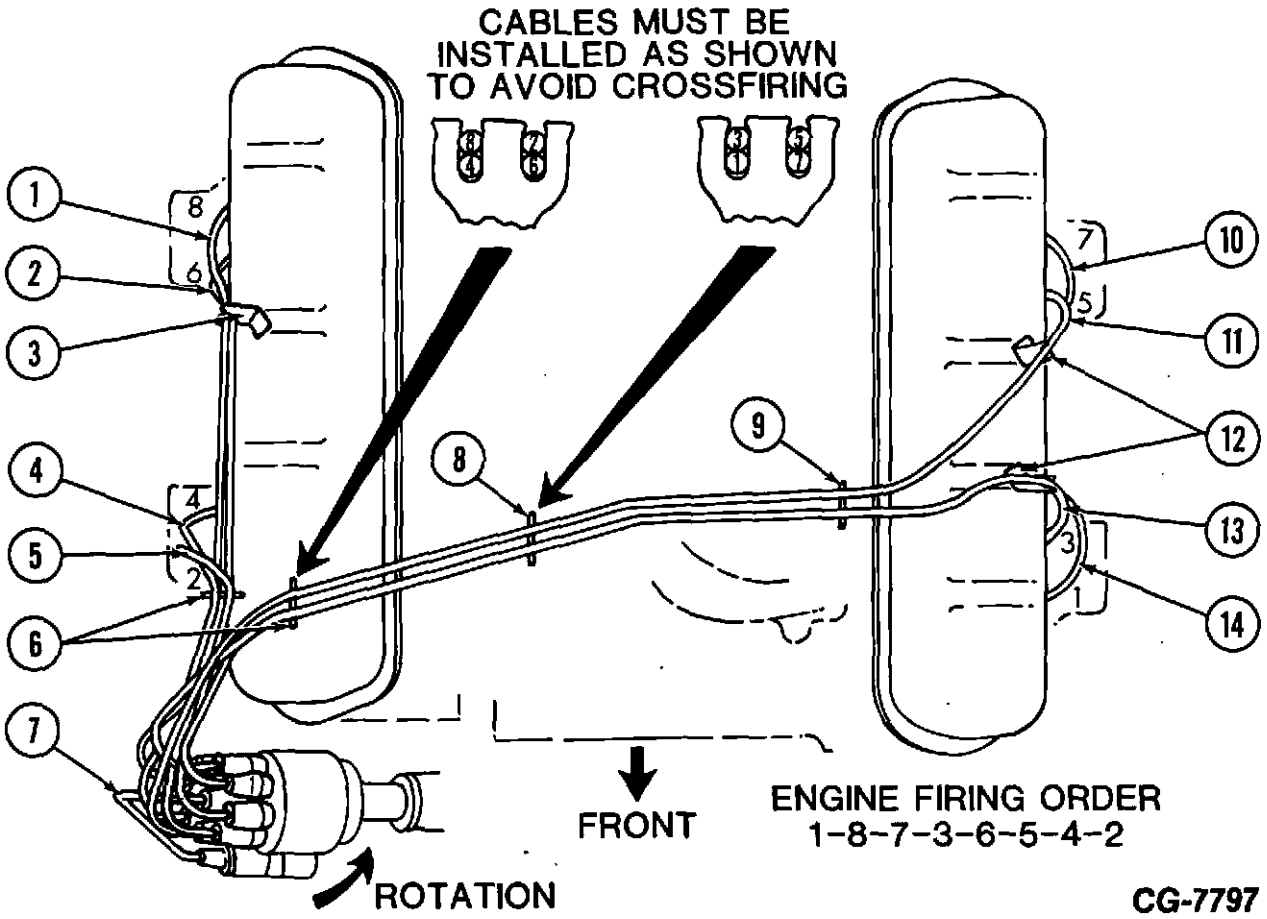

Figure 18. SPARK PLUG CABLE ROUTING FOR C-549 ENGINES

LEGEND

1. Cable Assembly, Distributor to Spark Plug (No. 8 Cylinder).
2. Cable Assembly, Distributor to Spark Plug (No. 6 Cylinder).
3. Bracket, Spark Plug Cable.
4. Cable Assembly, Distributor to Spark Plug (No. 4 Cylinder).
5. Cable Assembly, Distributor to Spark Plug (No. 2 Cylinder).
6. Bracket, Spark Plug Cable.
7. Cable Assembly, Distributor to Coil.
8. Bracket, Spark Plug Cable.
9. Bracket, Spark Plug Cable.
10. Cable Assembly, Distributor to Spark Plug (No. 7 Cylinder).
11. Cable Assembly, Distributor to Spark Plug (No. 5 Cylinder).
12. Bracket, Spark Plug Cable.
13. Cable Assembly, Distributor to Spark Plug (No. 3 Cylinder).
14. Cable Assembly, Distributor to Spark Plug (No. 1 Cylinder).

REQUIRED MAINTENANCE 5

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF PARTS

Printed in United States of America.

REQUIRED MAINTENANCE OPERATIONS INTERVAL CHART

Each numbered maintenance step under Required Maintenance Operations on the Chart is completely explained under the corresponding number in the following text.

REQUIRED MAINTENANCE OPERATIONS	(Mileage, Months or Operation Hours, Whichever Occurs First)														
KM	6400	12800	19200	25600	32000	38400	44800	51200	57600	64000	70400	76800	83200	89600	96000
Miles	4000	8000	12000	16000	20000	24000	28000	32000	36000	40000	44000	48000	52000	56000	60000
Mos.	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
Hours	125	250	375	500	625	750	875	1000	1125	1250	1375	1500	1625	1750	1875
1. Change Engine Oil and Oil Filter.*	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
2. Check and clean Dist. Cap & Rotor or replace, if necessary. Replace Breaker Points & Condenser, where used.			I			I			I			I			I
3. Check Ignition Cables & Measure Resistance and Replace if necessary.			I			I			I			I			I
4. Replace all Spark Plugs, Check Required Voltage, Replace any defective Plugs.			R			R			R			R			R
5. Check Coil Output Voltage & Replace Coil if necessary.			I			I			I			I			I
6. Check Initial Advance and Adjust if necessary.			I			I			I			I			I
7. Clean or Replace Air Cleaner Filter.			I			I			I			I			I
8. Check Operation of Inlet Air System Valve and Service or Replace if necessary.			I			I			I			I			I
9. Check Curb Idle Speed and Air/Fuel Mixture and Adjust as necessary.			I			I			I			I			I
10. Replace Fuel Filter.			R			R			R			R			R
11. Check Drive Belt Tension. Replace if necessary.			I			I			I			I			I

R = Replace I = Inspect, Correct, Replace if necessary

* LPG and NG engines slightly different. See Operation 1 on following page.

REQUIRED MAINTENANCE OPERATIONS

To achieve peak performance and maximum fuel economy, keep your IH engine properly tuned and maintained.

Monitor your engine's performance carefully. If you follow the required and recommended maintenance schedule, your engine will be kept at optimum operating efficiency.

OPERATION 1 – ENGINE OIL AND FILTER

Change engine oil and oil filter at these recommended intervals:

Gasoline Engines at 6400 km (4000 miles), 5 months or 125 hours of operation, whichever occurs first.

LPG and NG Engines at every 200 hours of operation.

Use the following procedure for changing oil and filter.

1. Remove oil drain plug from bottom of oil pan and drain oil.

2. Service the oil filter according to the following instructions for the type of oil filter on your engine.

Service instructions for replaceable element type oil filter:

a. Remove drain plug in bottom of filter and drain oil from filter. Reinstall drain plug.

b. Loosen filter body retaining bolt and remove filter body and element. Check condition of filter body to base gasket. Replace if necessary.

c. Wash filter body in cleaning fluid, making sure all sediment is removed from inside filter body.

d. Position new filter element with large hole end of element toward filter base. Filter element must be seated on pilot on base to avoid damge to element when body is installed.

e. Install filter body and bolt with spring assembly to filter. Make sure filter body seats on gasket seal in base. Tighten retaining bolt to 41-47 N•m (30-35 ft. lbs.) torque.

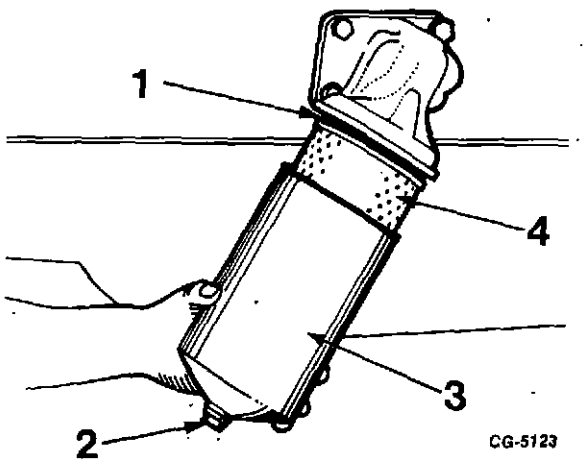

Figure 19. REPLACEABLE ELEMENT-TYPE FILTER

1. Gasket, base
2. Bolt, retaining
3. Body
4. Element

Service Instructions for Spin-On Type Oil Filter:

a. Remove oil filter assembly by turning counterclockwise with hands or suitable tool. Clean filter mounting pad.

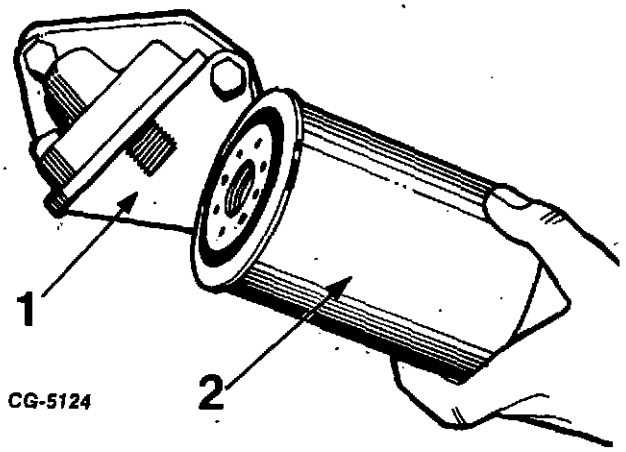

Figure 20. SPIN-ON TYPE OIL FILTER

1. Base
2. Filter

b. Coat gasket on new filter with film of grease.

c. Place new filter in position on center tube (threaded). Hand tighten 1/2 to 3/4 of a turn after gasket first contacts base of mounting pad. DO NOT OVER TIGHTEN.

Continued on next page

OPERATION 1 – ENGINE OIL AND FILTER (Continued)

Service Instructions for Spin-On Type Oil Filter: (Continued)

3. Refill engine crankcase to proper oil level with recommended type and grade of oil. (See chart in "Lubricant-Fuel-Coolant Recommendations" section.) Make sure you add the correct amount of clean oil by referring to the oil capacity chart for your engine in "Specifications and Capacities" section.

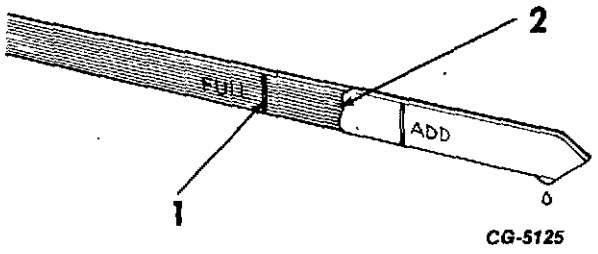

Figure 21. PROPER OIL LEVEL

1. Preferred Oil Level. 2. Sufficient Oil Level.

4. Add sufficient oil to bring the oil level between "Add" and "Full" marks on oil dipstick.

5. Start engine and run for at least five minutes to warm oil and check for leaks. Recheck and add sufficient oil to bring oil level between "Add" and "Full" marks on oil dipstick. (Refer to "Operation" section for more information on proper oil level gauge reading.)

OPERATION 2 – DISTRIBUTOR CAP AND ROTOR

Clean and inspect distributor cap and rotor for cracks, carbon tracks, burned or corroded terminals. Replace if necessary.

Check dwell and adjust if necessary. (Dwell angle is shown under "Specifications and Capacities" section). Replace points and condenser where used. Refer to distributor service manual for instructions on adjusting dwell.

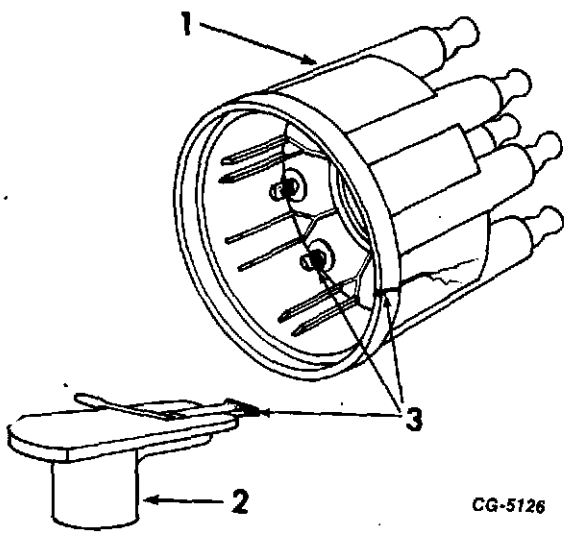

Figure 22. INSPECT DISTRIBUTOR CAP AND ROTOR

1. Cap
2. Rotor
3. Cracks, tracks or corrosion

OPERATION 3 – IGNITION CABLES

Inspect high tension ignition (spark plug) cables for cracks or deterioration and replace defective cables. Refer to "Spark Plug Cable Routing Diagrams" on pages 34-39 for correct installation of cables.

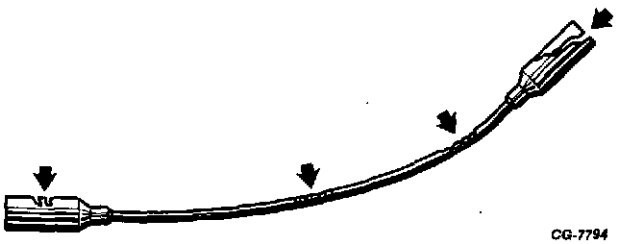

Figure 23. INSPECT HIGH TENSION CABLES

IMPORTANT

When replacing high tension spark plug cables, be sure cables are routed to proper spark plugs. Refer to cable routing diagrams in "Specifications and Capacities" section.

For high tension cable resistance test, refer to distributor service manual.

OPERATION 4 – SPARK PLUGS

Remove old spark plugs. Check gap of new spark plugs (see "Specifications and Capacities" section) before installing and adjust if necessary. Install new spark plugs and torque to specifications. Refer to "Spark Plug Cable Routing Diagrams" for correct cable installation.

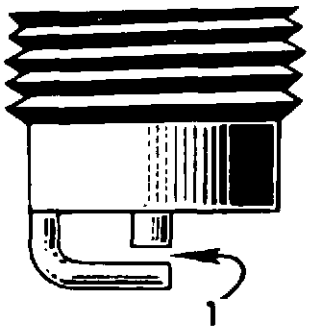

Figure 24. CHECK SPARK PLUG GAP

1. Gap

For further information on spark plugs, refer to "Spark Plug Service Manual, CGES-280.

OPERATION 5 – IGNITION COIL

Inspect ignition coil tower for cracks or carbon tracking. Inspect primary terminals for corrosion or looseness. Replace coil if any of these conditions are found.

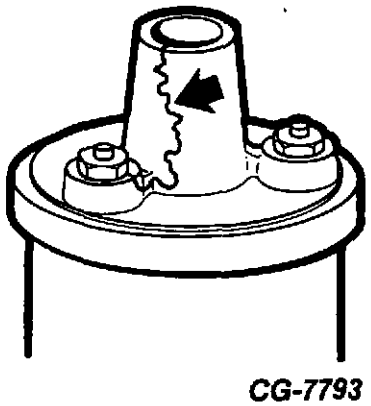

Figure 25. INSPECT IGNITION COIL

For ignition coil resistance and voltage output tests, refer to distributor service manual.

OPERATION 6 – IGNITION TIMING

Check ignition timing and adjust if necessary.

1. Connect timing light to the cylinder shown in the specification for your engine.

2. Disconnect and plug vacuum advance hose, where used.

3. Start engine and operate until normal operating temperature is reached.

4. Observe engine idle speed. Speed must be within specifications. Adjust speed to specifications, if necessary.

5. Loosen distributor clamp and adjust timing to specifications of your engine, if necessary. Tighten distributor clamp and recheck timing.

6. Stop engine, reconnect vacuum advance hose (where used) and remove timing light.

For location of engine timing mark and timing specifications for your engine, refer to "Specifications and Capacities" section.

OPERATION 7 – AIR CLEANER FILTER

Clean or replace air cleaner filter according to the following instructions for the type of air cleaner on your engine.

Instructions for Dry-Type Air Cleaner:

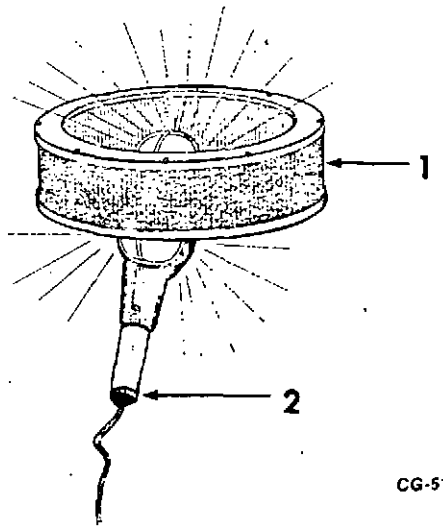

Figure 26. INSPECT DRY-TYPE AIR CLEANER FILTER

1. Filter 2. Service Light

Continued on next page

OPERATION 7 – AIR CLEANER FILTER (Continued)

Instructions for Dry-Type Air Cleaner: (Continued)

a. Remove air cleaner element. Clean any accumulation of dirt from air cleaner-housing. Tap element lightly on a flat surface or use low air pressure to remove dirt particles. Blow air from inside filter element to outside.

b. Check element for punctures or splits by looking through filter paper toward light held in center element. Do not wash element. Replace with new element if necessary.

Instructions for Oil Bath-Type Air Cleaner:

a. Remove air cleaner from engine. Remove oil sump and drain oil. Wash sump and mesh filter element in solvent and dry with compressed air.

b. Refill sump and oil mesh element with engine oil of same viscosity used in engine. Allow excess oil to drip from element before reassembly. Reinstall air cleaner.

OPERATION 8 – MODULATED AIR INLET SYSTEM

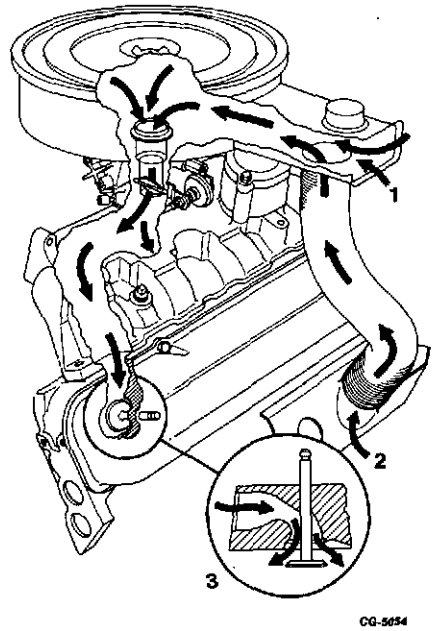

Figure 27. MODULATED AIR INLET SYSTEM

1. Cold Air
2. Hot Air
3. Air/Fuel Intake Port

The following information applies only to air cleaners supplied by International Harvester for your engine. If in doubt, refer to your engine parts catalog for all the parts supplied by IH for your particular engine.

The modulated air cleaner used on International gasoline engines consists of a thermostatically controlled damper connected to an exhaust manifold stove to provide faster engine warm-ups in any weather.

The damper is operated automatically by a thermal pellet or a vacuum motor. The thermal pellet or the temperature sensor vacuum switch react to ambient under hood temperatures, opening or closing the damper. When the damper is open, under hood air enters the carburetor. When the damper closes, preheated air from the exhaust manifold enters the carburetor.

Thermal Pellet-Type Air Cleaner

Procedure for servicing the thermal pellet type air cleaner is as follows:

1. With the engine cold and ambient under hood temperature below 50°C (90°F), the damper should be closed to the cold air inlet (open to the hot air inlet). This closed to cold air inlet can be checked by looking in the end of the inlet.

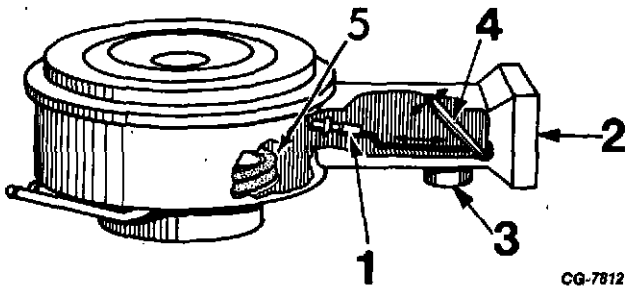

Figure 28. PELLET TYPE MODULATED AIR CLEANER

1. Thermal Pellet
2. Air Inlet
3. Pre-Heated Air
4. Damper
5. Charcoal Rings

2. With the engine at operating temperature and the ambient under hood temperature above 75°C (135°F), the thermal pellet should open the damper allowing cold air to enter the air cleaner and at the same time shut off the hot air inlet.

3. If the damper does not operate as described above, reach in the inlet, move the damper open and check to see if it is sticking. If damper is moving freely and the linkage is connected, then the thermal pellet must be at fault and should be replaced.

When replacing the thermal pellet do not tighten the pellet assembly with a tool. Tighten finger tight only. Use locking compound on the threads to secure in place. If a tool is used, too much pressure may be applied changing the calibration of the thermal pellet and linkage assembly.

Sensor Controlled Vacuum Chamber Air Cleaner

Procedure for servicing the sensor controlled vacuum chamber type air cleaner is as follows:

1. Test should be conducted when ambient temperatures of the vehicle are less than 24 deg. C (75 deg. F) and engine started cold. Air cleaner must have all hoses, piping and cover in place. No leaks permitted.

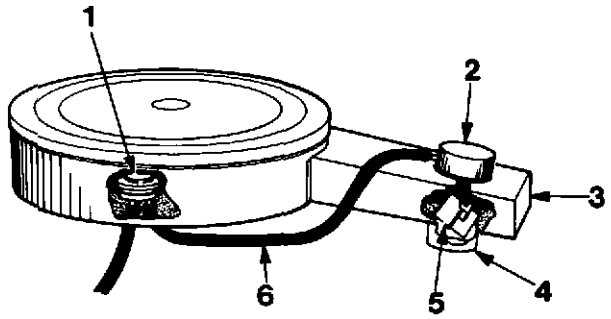

Figure 29. VACUUM CONTROLLED AIR CLEANER

1. Sensor	4. Preheated Air
2. Vacuum Motor	5. Damper
3. Air Inlet	6. Vacuum Hose

2. With engine off, inlet tube damper should be in full down position to close heat tube inlet pipe from exhaust manifold stove. Damper position can be determined by looking in end of inlet tube. If damper assembly is not in the correct position, vacuum chamber should be removed and damper movement loosened. Replace vacuum chamber (located on top of inlet tube) and recheck damper position.

To replace vacuum chamber (cannot be replaced on air cleaners used on 4-196 engines) bend tab nearest inlet tube entrance down from inside tube. Disconnect vacuum hose and lift vacuum chamber, sliding the rear tab out of its slot disengaging damper hook from damper. Attach new chamber by engaging hook in damper, sliding rear tab into its slot and fitting front tab into place. A spring preload should be felt when vacuum chamber is pressed firmly against top of inlet tube. If no preload is felt, check the installation or be sure parts are not faulty. Press front vacuum chamber tab firmly against tube inside surface. Connect vacuum hose.

3. Start engine and note that damper has rotated up to close off cold air inlet. Observe damper position by looking in the inlet tube. If damper did not immediately close cold air inlet, proceed as follows:

a. Shut off engine and disconnect the two hoses from sensor.

b. Connect the two hose ends together using suitable tubing.

c. Restart engine and again check damper location.

If damper fully closes cold air inlet, temperature sensor is defective and must be replaced (located inside air cleaner body).

To replace temperature sensor, disconnect two vacuum hoses attached to sensor inlet and outlet tubes on underside of air cleaner body. Remove clamps or speed nuts from tubes and lift sensor from body. Position new sensor and gasket inside air cleaner body. Firmly press two new speed nuts or clamps on tubes to hold sensor in place. Attach vacuum hoses to sensor tubes.

If damper does not close cold air inlet, sensor is okay, but damper has bind or vacuum chamber is defective. Remove vacuum chamber and check damper for free movement. If damper moves freely, replace vacuum chamber.

4. After a cold start, operate engine for 10 minutes at medium RPM. When engine is at normal operating temperature, slow engine to idle and observe position of inlet tube damper. If damper has not rotated all or part way down to allow some cold air to enter inlet tube, replace temperature sensor.

OPERATION 9 – IDLE SPEED AND FUEL MIXTURE

Check idle speed and air/fuel mixture according to the following instructions for the type of engine you have.

For LPG or natural Gas engines, refer to carburetor manufacturer's service manual.

For Gasoline engines, proceed as follows:

Idle speed and fuel mixture adjustments must be made with air cleaner in place. Where engine is used in a vehicle the transmission must be in neutral with the parking brake applied.

To compensate for fuel and temperature variations when setting idle mixture, observe these precautions:

- Do not idle engine continuously for more than three minutes at one time.
- After each three minutes of idling, increase engine speed to 2000 rpm for one minute.
- Continue with idle adjustment procedure. Do not idle engine for more than three minutes without repeating above precautionary step.

Idle Adjustment Procedure

1. Connect tachometer to engine. (Tachometer should have an expanded scale of 400 to 800 or 0 to 1000 rpm and 1 to 2% accuracy.

2. Remove limiter cap(s). To prevent damage to screw threads or seat, file or grind away the side of the cap. Do not pry cap off.

3. Operate engine until it reaches normal operating temperature.

4. Gently seat idle mixture screws.

5. Carefully adjust idle mixture screws (equal number of turns) to produce maximum idle speed.

6. Carefully adjust curb idle speed screw to give engine speed higher than mid point of idle speed range per specifications. Then carefully adjust idle mixture screw(s) (equal number of turns) in until mid point of idle speed range specification is obtained.

7. Install new plastic (service) limiter cap(s) with tab in mid position.

OPERATION 10. FUEL FILTER

Replace fuel filter. Inline fuel filters are used on IH engines. This type of filter is inexpensive and easy to replace.

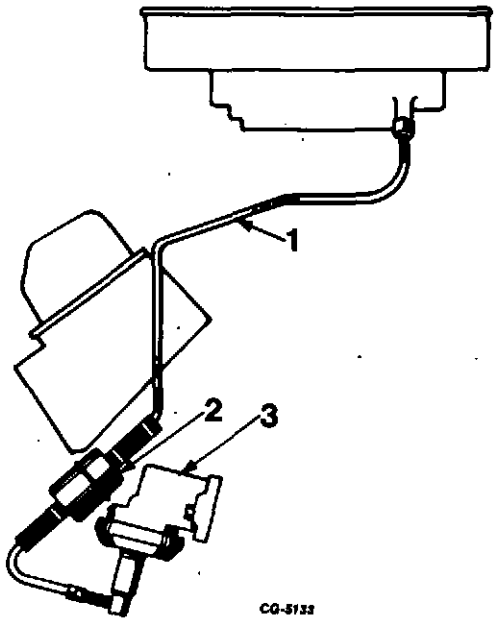

Figure 30. REPLACE INLINE FUEL FILTER

1. **Line, Pump to Carburetor**
2. **Filter, Fuel**
3. **Pump, Fuel**

OPERATION 11 – DRIVE BELT TENSION

Accessory drive v-belts require correct installation, tension, alignment and maintenance. Neglect of these factors causes short belt and pulley life, cooling problems and bearing failures.

New belts, including replacement, experience a break-in period and initially loosen tension during groove seating. New belt initial installation tension is higher than the retension value applied to a used belt (run five minutes or longer). This is done to minimize the number of belt adjustments and prevent belt operation under low tension during the break-in period.

Check for proper belt tension with belt Tension Gauge SE-2312.

Belt tension must be made at mid-point between pulleys at the longest belt span.

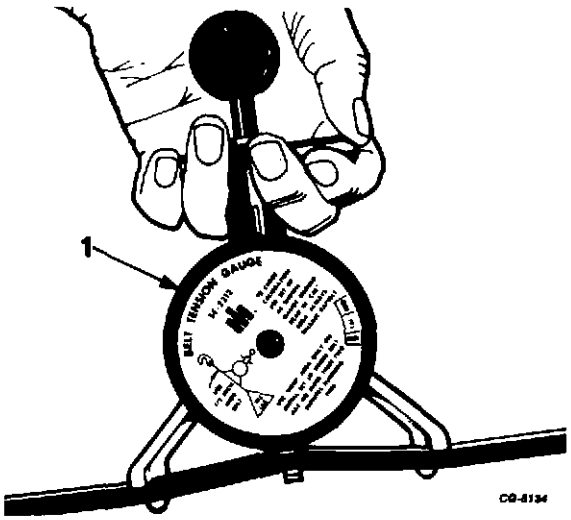

Figure 31. CHECK BELT TENSION WITH GAUGE

1. Gauge, SE-2312

1. Grasp gauge and depress ball handle all the way down. Make certain hook extends beyond legs to pick up the belt.

2. Apply gauge to belt. Be sure belt is positioned between nose piece and hook and the nose piece is centered on belt.

3. Release ball handle quickly. A slow release may present full return of hook, thus giving a false reading.

4. Observe the area of gauge face indicated at the index mark. If index mark does not indicate a NEW reading on a used belt, it will be necessary to increase or decrease belt tension as required.

5. Before changing belt tension, repeat Step 3 several times to become familiar with gauge operation. Observe gauge reading each time operation is repeated. Check tension of both belts when so equipped.

To establish tension of a loose belt, apply SE-2312 gauge to the belt and make the adjustment. Tighten belt until proper area for belt indicated at index mark on gauge. Lock adjustment and recheck belt tension. Readjust if necessary.

When using SE-2312 belt tension gauge, remember to set new belts (belt with less than five minutes running time) to the NEW area on gauge face and used belts (with more than five minutes running time) to USED area on gauge.

Belt tension may also be checked by using a straight edge and scale as illustrated.

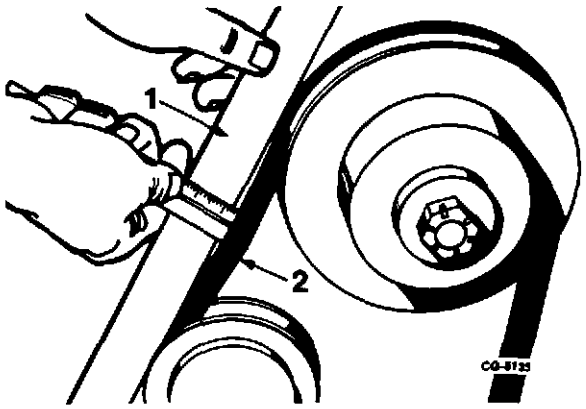

Figure 32. CHECK BELT TENSION BY HAND

1. *Straight Edge*
2. Belt

Approximately 12.7 mm (1/2 inch) deflection should be measured. The deflection measurement should be made between pulleys at mid-point of longest belt span.

For engine tune-up and adjustment information on emission controlled engines, refer to "Maintenance and Diagnostic Manual for Carbureted Engines Certified for On-Highway Use." (See "Technical Publications" section).

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF PARTS

Printed in United States of America.

COOLING SYSTEM

The pressure-cooled system will not operate properly unless cooling system is tight. The radiator cap must be properly tightened to the stop. Gasket surface of cap must be in good condition. Radiator cap regulating valve and thermostat must operate properly. The system must not have loose connections or leaks. Unless these instructions are followed, pressure will not be maintained and loss of coolant and consequent overheating will result.

PREVENTIVE MAINTENANCE

The best way to avoid overheating problems is through preventive maintenance; keeping the components in top operating condition. This includes keeping the inside as well as the outside of engine and radiator clean and:

1. Thoroughly flush system with water before installing antifreeze or cooling conditioner. If system has been permitted to become rusty or dirty, use IH Cooling System Cleaner and Neutralizer carefully following cleaning recommendations on container.

2. For rust prevention during winter, a fresh filling of IH permanent type antifreeze is recommended. In spring, drain and discard the old antifreeze solution, as rust inhibitor may be exhausted from contamination and continued use.

3. During warm weather, it is necessary that IH Conditioner be added to coolant (water) to protect cooling system after draining antifreeze. This inhibitor solution should be drained and discarded in the fall before installing antifreeze.

4. Draining cooling system in freezing temperature. The cooling system of all engines, when drained, will retain some coolant in pockets. This is especially true in engines equipped with oil coolers or heat exchangers having a tube bundle. If only water is used, and these engines are drained and then exposed to freezing temperatures, water retained in cooler tubes will freeze, possibly rupturing one or more of the tubes. The resulting leak will be difficult to locate and could eventually damage engine by mixing water in the crankcase oil.

IMPORTANT

To avoid possible damage in engines equipped with oil coolers or heat exchangers, take one of the following precautions when draining for shipment or storage in freezing temperatures:

a. Fill cooling system with antifreeze solution, operate until thermostat opens or until circulation is observed in radiator or heat exchanger circuit, then drain.

b. If only water is used, drain engine then blow out residual water in the cooler tubes with compressed air through one of the drain cocks or plugs, preferably the one on the cooler. Do not rely upon only draining the water.

Radiator Cap

A regulating pressure valve, built into the radiator cap, is designed to open at approximately seven pounds per square inch.

CAUTION

The pressure type cap is provided with a safety stop to allow pressure or any steam to escape while cap is being removed, should the engine run very hot.

Turn cap to left (counterclockwise) to safety stop until pressure is released; then press down on cap and continue to turn until cap is free to be removed.

NOTE: Do not attempt to repair or replace any of the regulating valve parts. If valve is faulty, replace it with a new radiator cap of the same type.

Draining the Cooling System

Drain cooling system immediately after stopping engine while most of the sediment is in suspension.

1. Remove radiator cap.

2. Open radiator and crankcase drain valves.

3. LIQUEFIED PETROLEUM GAS ENGINES ONLY: Open water drain valve.

4. Allow system to drain completely. Be sure drain outlets do not plug up during draining.

5. Close all drain outlets.

Cleaning the Cooling System

Drain and thoroughly flush cooling system once a year or more often if necessary. Appearance of rust in radiator or in coolant is an indication that the inhibitor has become weakened, and it is possible that some sludge has accumulated in the system. When this condition exists, proceed as outlined below:

1. Run engine until it reaches operating temperature; then stop engine and drain cooling system. Refer to "Draining the Cooling System" in this section.

2. Fill cooling system with clean coolant. Refer to "Filling the Cooling System" on this page.

3. Add a flushing compound that is compatible with aluminum to cooling system in accordance with instructions furnished with the compound.

4. Start engine and flush system as directed by instructions furnished with compound.

5. After system has been flushed and thoroughly cleansed of the compound, refill with clean coolant. Refer to "Filling the Cooling System" on this page.

Cleaning the Radiator Core

For best results, clean the radiator core every 50 hours. Blow out insects and dirt from radiator core air passages using air or water under pressure. Engine overheating is often caused by bent or clogged radiator fins. When straightening bent fins, be careful not to injure tubes or to break bond between fins and tubes.

FILLING THE COOLING SYSTEM

1. Close all drain valves.

2. Remove radiator cap. Install coolant slowly until radiator is partially filled.

3. Add a cooling system corrosion inhibitor (for warm weather operation) or IH anti-freeze (when the air temperature is consistently at the freezing point (+32°F and lower) according to instructions printed on each container.

NOTE: Use only a corrosion inhibitor that is compatible with aluminum. Do not use inhibitors labeled as "acid neutralizers."

4. Continue to install coolant until it reaches the level of the radiator baffle. Wait a few minutes to allow for escape of air; then add coolant as needed until coolant reaches the level of the radiator baffle.

5. Install radiator cap. Start and run engine until operating temperature is reached. Stop engine, remove radiator cap and recheck level. Add coolant, if needed, until required level is one inch below filler neck. Install radiator cap.

ADDING COOLANT TO OVERHEATED SYSTEM

CAUTION

Use caution when removing radiator cap to add coolant. Be sure all pressure is released before removing cap.

If engine is very hot, let it cool slowly by shutting it off for a period of time until it cools. Then add coolant slowly. DO NOT POUR COLD COOLANT INTO HOT RADIATOR.

THERMOSTAT

The thermostat is the nonadjustable type and incorporated in the cooling system for the purpose of retarding or restricting circulation of coolant to achieve rapid engine warm-up. Thermostat operating range is +180°F to +200°F.

NOTE: Permanent type anti-freeze must be used with this thermostat.

Continued on next page

THERMOSTAT (Continued)

Engine overheating and loss of coolant is sometimes due to inoperative thermostat. When this condition exists, remove and check thermostat.

1. Drain cooling system to a level below the thermostat housing. Refer to "Draining the System" in this section.

2. Loosen hose clamp securing radiator inlet hose to thermostat housing and remove hose.

3. Remove retaining ring securing thermostat in thermostat housing.

4. Remove thermostat from housing.

After removal, check thermostat as described below.

1. Clean thermostat. Replace thermostat if coated with scale as this will not allow proper operation.

2. Check thermostat as follows:

   a. Suspend thermostat and a thermometer in a container of water.

   NOTE: Do not allow either one to contact container sides or bottom.

   b. Heat water and carefully note temperature when thermostat starts to open (approx. +180°F) and when fully open (approx. +200°F).

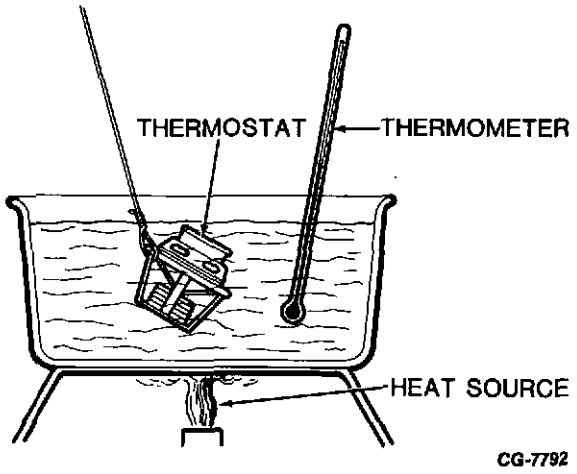

Figure 33. CHECKING THERMOSTAT

1. **Thermometer**
2. **Thermostat**
3. **Heat Source**

   c. If thermostat does not function as described, replace it.

After checking, reinstall thermostat.

1. Install thermostat (spring end down) into housing and secure in place with retaining ring.

2. Install and secure radiator inlet hose to thermostat housing with the hose clamp.

3. Fill cooling system. Refer to "Filling the System" in this section.

4. Operate engine: inspect heat indicator gauge for correct thermostat performance and observe all cooling system hoses and points of connections for leaks. Correct all leaks no matter how minor.

WATER PUMP

No lubrication of the pump is required as bearings are of a permanently sealed type and are packed with a special lubricant for the life of the bearings.

The water pump requires no attention other than replacing the bearings when they show excessive looseness or if a water leak develops which indicates that a damaged or badly worn seal needs replacement.

CLEANING PROCEDURE FOR ENGINES CONTAMINATED WITH ANTI-FREEZE

A cooling system leak can sometimes permit antifreeze (ethylene glycol) to contaminate engine oil. This contamination causes formation of sludge and varnish which can harm engine and cause it to "seize" (fail). Use of Butyl Cellosolve (from Union Carbide Corporation) or Butyl Jaysolve (from Exxon Chemical Company, U.S.A.) proves to be very effective in cleaning engines contaminated with anti-freeze (ethylene glycol) if these steps are followed:

1. Repair cause of contamination, especially if it is a leak in the cooling system. (Refer to CGES-215 or see your authorized IH dealer.)

2. If engine is not "seized," go on to Step 3. If engine is "seized," do the following first.

   a. Pour about 1/4 pint of pure Butyl Cellosolve or Butyl Jaysolve into each cylinder, then spray valve stems and any other accessible parts with the pure chemical.

WARNING

Butyl Cellosolve, Butyl Jaysolve and ethylene glycol are poisonous. Do not swallow.

b. Allow solvent to sit until engine parts will move. Time required for solvent to loosen "seized" parts may vary from a few minutes to a number of hours, depending on how badly engine is seized. Once engine can be started, go on to following steps.

3. Drain crankcase and fill it to proper level (See Chart on page 27) with a mixture of 50% Butyl Cellosolve or Butyl Jaysolve and 50% of engine oil. (See Lubricant Recommendations on page 16.) Avoid spilling any solvent on painted surfaces as it will dissolve lacquer.

4. Install new oil filters.

5. Run engine at low idle RPM for approximately 60 minutes. In cases of very heavy sludge, a longer running time may be required.

6. Stop the engine. Immediately drain crankcase, allowing time for solvent-oil mixture to run off crankcase surfaces.

7. Install new oil filters.

8. Refill engine with fresh engine oil. SAE 10W oil is preferred but any other viscosity grade oil of proper quality may be used. (See Lubrication Chart on page 16.)

9. Run engine at low idle RPM for 30 minutes.

10. Stop the engine. Immediately drain crankcase.

11. Install new oil filters.

12. Refill crankcase with the proper quality and viscosity grade oil for ambient air temperature.

13. The engine may now be operated normally.

ELECTRICAL SYSTEMS

ALTERNATOR CHARGING SYSTEMS

The electrical charging system is selected by the engine purchaser for his particular engine application. Because of several alternator combinations, it is recommended that the alternator manufacturer's service manual or appropriate alternator service manual (See "Technical Publications" section) be referred to when alternator and/or regulator information is needed.

Precautions

The electrical generating system now incorporates a direct diode rectified generator (alternator w/ integral regulator) which requires special handling and procedures different from those associated with the old style DC generator.

CAUTION

Before working on any part of electrical system, disconnect battery ground cable until all electrical work has been completed.

Repair or replace all broken wires immediately. All terminals must be clean and securely fastened; never paint connections.

Alternator w/Integral Regulator

The alternator incorporates a built in transistorized voltage regulator. The alternator requires no lubrication since it's bearings are factory lubricated for life and require attention only at time of major overhaul. The integral regulator is sealed by the manufacturer.

NOTE: The unit electrical system is negative ground. Be CERTAIN the ground polarity is correct when:
a. Installing a new battery.
b. Connecting a battery charger.
c. Using a booster.
Failure to observe proper polarity will result in damage to the alternator.

NEVER use a fast charger as a booster to start the engine.

NEVER unhook a battery terminal while engine is running.

NEVER disconnect alternator cable while engine is running.

DO NOT POLARIZE THE ALTERNATOR.

DO NOT SHORT ACROSS OR GROUND ANY TERMINALS OF THE ALTERNATOR OR REGULATOR.

Continued on next page

ALTERNATOR CHARGING SYSTEMS (Continued)

Magnetizing The Rotor

The rotor normally retains magnetism to provide voltage build-up when the engine is started. After disassembly or servicing (and possibly after shipping), it may be necessary to re-establish rotor magnetism. Follow these procedures for IH or Delco-Remy Alternators.

Delco-Remy

To magnetize your Delco-Remy alternator rotor, connect the integral charging system to the battery in a normal manner. Then momentarily connect a jumper lead from the battery positive post to the integral charging system relay terminal.

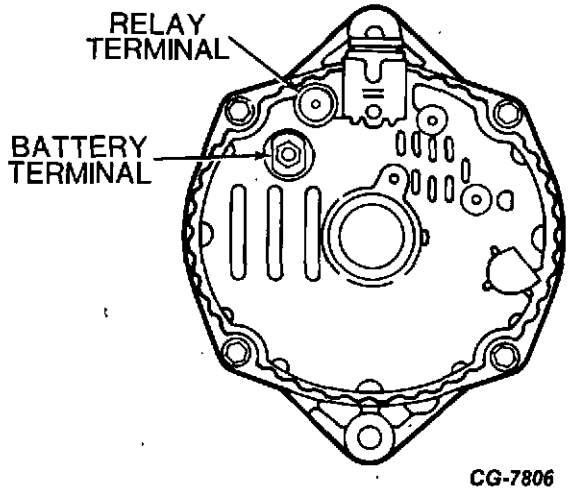

Figure 34. DELCO-REMY RELAY TERMINAL POSITION (OPTION A)

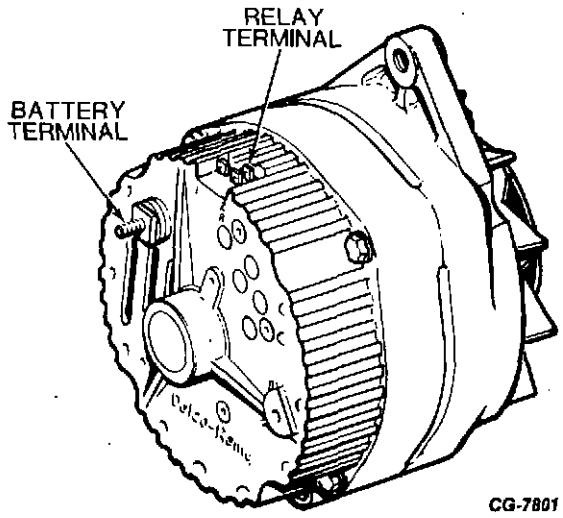

Figure 35. DELCO-REMY RELAY TERMINAL POSITION (OPTION B)

IH

To magnetize your IH alternator rotor, connect alternator to battery (positive to positive and negative to negative). Attach a jumper wire to alternator ground stud. The other end of jumper wire is then inserted into hole in end cover. This procedure will energize the field coil and re-establish magnetic field properties of the alternator.

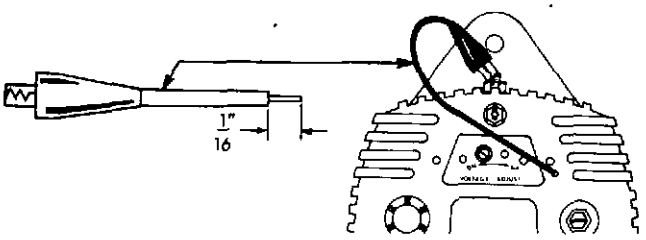

Figure 36. INSERT WIRE IN IH ALTERNATOR

VOLTAGE REGULATOR

This engine is equipped with a transistor type voltage regulator. This regulator incorporates a voltage adjustment that can be used to maintain the battery in a satisfactory charge condition, thereby obtaining maximum battery life.

When to Adjust the Regulator

1. If battery uses too much water at normal setting (position "2" on the cap aligned with the arrow) reduce voltage setting by aligning position "LO" on the cap (2) with the arrow.

2. If battery is consistently under charged at normal setting (position "2" on the cap aligned with the arrow), increase voltage setting by aligning the "3" position on cap with the arrow. If further increase is desired, align "HI" position on cap with arrow.

> **NOTE:** If either of the conditions in Steps 1 or 2 persists after making the adjustment, consult your authorized International Engine Distributor or Dealer.

Adjustment

1. To adjust regulator setting, remove voltage adjustment cap (2) from alternator.

2. Position cap until desired setting is aligned with the arrow on alternator. Refer to Steps 1 and 2 under "Voltage Regulator" for desired setting.

3. Reinstall cap in alternator.

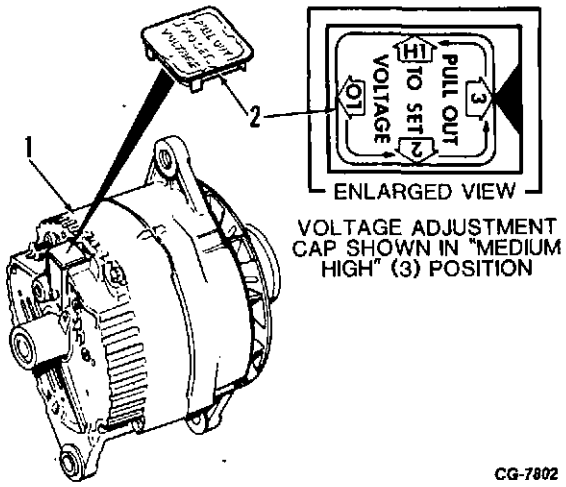

Figure 37. VOLTAGE ADJUSTMENT CAP

1. Alternator 2. Cap

IGNITION SYSTEMS

BREAKER POINT DISTRIBUTORS

Holley Model 1510

This distributor is composed of a mechanical and vacuum advance mechanism and can be purchased with or without centrifugal governor and tachometer drive.

This distributor has the following features:

- A large upper distributor bushing with lifetime lubrication.
- The fully-enclosed distributor includes a dust cover with seal which materially extends distributor life in off-highway or under extreme dusty operating conditions.
- Contact points are secured by two screws to a movable sliding upper plate having three nylon buttons. Any resulting wear to the buttons is absorbed by a pressure spring, which secures upper and lower plates together.
- The governor portion of the distributor consists of the spinner valve positioned through the distributor shaft. The principle of operation is similar to other governor systems used on IH vehicles in that air is supplied from the spinner valve to a diaphragm unit attached to the carburetor throttle body.
- Positive locking governor adjustment feature.
- The governor speed adjusting feature on this distributor requires particular attention, since the adjustment is made with an inexpensive special tool designed to engage a threaded spring type adjusting screw. The use of a screwdriver or any other tool not designed to engage the adjusting screw (tang) will damage the adjustment feature.

For service information see Holley Model 1510 Service Manual, CTS-2482 for 4 cylinder engines and CTS-2481 for 8 cylinder engines.

Prestolite Model IDN-4100 Series

The distributor is conventional with the usual distributor cam, contact points and condenser. A standard type ignition coil is used.

The distributor cap featuring superior physical and dielectric strength incorporates male (spark plug type) terminals. A resistor type rotor, interference suppression type high tension cables and resistor type spark plugs are used to meet radio frequency interference standards.

All distributors have a mechanical (centrifugal) spark advance system. Most distributors also have a vacuum operated spark advance system. The advance systems automatically provide the optimum spark timing for various engine speed and load conditions.

The mechanical (centrifugal) advance system is built internally into the distributor and consists of two flyweights which pivot on long-life, low-friction bearings and are controlled by calibrated springs which tend to hold the weights in the no-advance position. The flyweights respond to changes in engine (distributor shaft) speed and rotate the trigger wheel to advance the spark as engine speed increases and retard the spark as engine speed decreases.

The vacuum advance system incorporates a vacuum disphragm unit which rotates the distributor sensor plate in response to changes in carburetor throttle bore vacuum.

Continued on next page

BREAKER POINT DISTRIBUTORS (Continued)

Prestolite Model IDN-4100 Series (Continued)

The two systems, mechanical and vacuum operate independently, yet work together to provide proper spark advance.

For service information see Prestolite Model IDN-4100 Service Manual, CGES-150.

BREAKERLESS ELECTRONIC IGNITION DISTRIBUTORS

Holley Model 1530 (Remote Ignition Control)

The electronic (breakerless) ignition system consists of three major component units: a distributor, an ignition coil and an electronic ignition control. These components are shown in Figure 38.

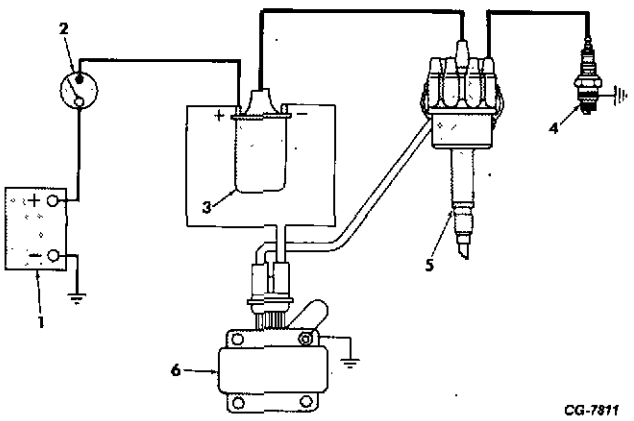

Figure 38. HOLLEY MODEL 1530 ELECTRONIC IGNITION DISTRIBUTOR

1. **Battery**
2. **Ignition Switch**
3. **Coil**
4. **Spark Plug**
5. **Distributor**
6. **Electronic Ignition Control**

The distributor is conventional except that a sensor and trigger wheel replace the usual contact points, condenser and distributor cam.

A standard type ignition coil is used.

The electronic ignition control is a completely solid state unit designed for troublefree service. Its component parts are permanently sealed in a waterproof and vibration resistant compound enclosed in an aluminum case. The ignition control unit electronically "makes" and "breaks" the ignition primary circuit in response to triggering signals from the sensor in the distributor.

Because primary (low voltage) current is regulated within the electronic ignition control, a ballast resistor or resistance wire is not required. All ignition system wiring connectors are water resistant. Interference suppression type, high tension ignition cables are used to meet radio frequency interference standards.

The sensor is a small coil, wound of fine wire, which receives an alternating current signal from the electronic ignition control. The sensor is, very simply, a metal detector. The metal that the sensor detects is the teeth of the trigger wheel. Trigger wheels of distributors for four-cylinder engines have four (4) teeth. Distributors for eight-cylinder engines have eight (8) teeth on the trigger wheel. Whenever the leading edge of a trigger wheel tooth lines up with the center of the sensor coil, a signal is sent to the electronic ignition control. When the electronic ignition control receives the signal from the sensor, it opens ("breaks") the coil primary circuit. As in a conventional system, opening the coil primary circuit induces high voltage in the coil secondary circuit which is conducted from the coil to the distributor cap and travels through the rotor and the secondary cables to the spark plugs.

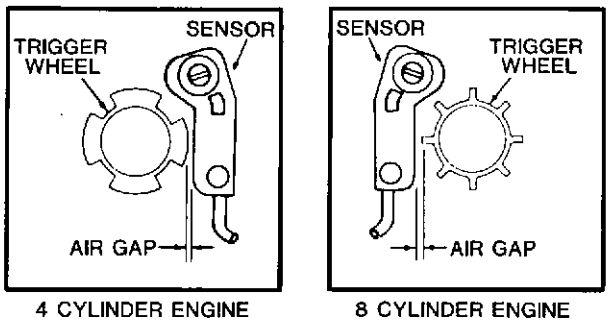

Figure 39. TRIGGER WHEEL-TO-SENSOR AIR GAP

Dwell angle is determined by the angle between adjacent teeth of the trigger wheel and by the air gap between the ends of the trigger wheel teeth and the sensor. Since there are no wearing surfaces connected with the trigger wheel and sensor, dwell remains constant and should not require adjustment for the service life of the distributor.

All distributors have a mechanical spark advance system to establish the optimum spark timing setting for various engine speed and load conditions.

The mechanical (centrifugal) advance system is built internally into the distributor and consists of two flyweights which pivot on long life, low friction bearings and are controlled by calibrated springs which tend to hold the weights in the no-advance position. The flyweights respond to changes in engine (distributor shaft) speed and rotate the trigger wheel to advance the spark as engine speed increases and retard the spark as engine speed decreases. Mechanical advance characteristics can be adjusted by bending the hardened spring tabs to alter spring tension.

Some distributors also have a vacuum spark advance system. The vacuum advance system incorporates a vacuum diaphragm unit which rotates the distributor sensor plate in response to changes in carburetor throttle bore vacuum.

The two systems (mechanical and vacuum) operate independently, yet work together to provide proper spark advance.

For engines equipped with a governor, the distributor incorporates a governor control unit. This unit consists of a rotating, centrifugally operated valve which is driven by the distributor shaft. Some distributors are also equipped with a mechanical tachometer drive which is driven by the distributor shaft. For service information see Holley Model 1530 Service Manual CTS-2665, and Appendix A of this manual.

Prestolite Model IDN-4000 Series (Integral Ignition Control)

The electronic ignition system (Figure 39) consists of two major component units -- a distributor and an ignition coil.

The distributor is conventional except that a trigger wheel and an electronic control unit (circuit board and sensor) replace the usual distributor cam, contact points and condenser. A standard type ignition coil is used.

The electronic control unt is associated with the primary (low voltage) section of the ignition system. The control unit electronically "makes" and "breaks" the ignition primary circuit in response to rotation of the trigger wheel.

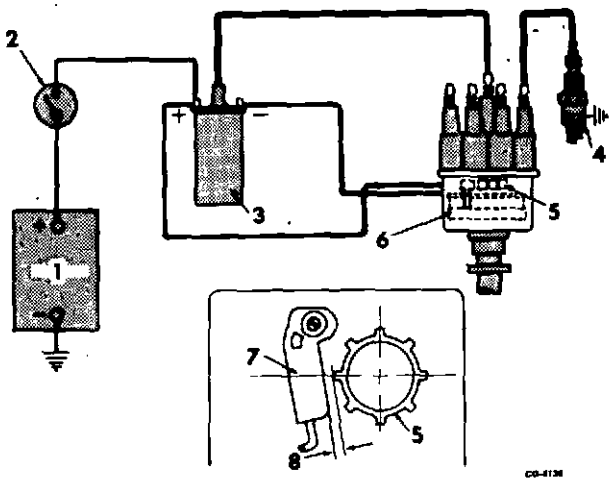

Figure 40. PRESTOLITE MODEL IDN-4000 SERIES ELECTRONIC IGNITION DISTRIBUTOR

1. Battery
2. Ignition Switch
3. Ignition Coil
4. Spark Plug
5. Trigger Wheel
6. Integral Electronic Control Unit
7. Sensor
8. Air Gap

The control unit circuit board is a completely solid state unit designed for trouble free service. Its electronic components are permanently sealed in a waterproof and vibration resistant compound.

The sensor is a small coil, wound of fine wire, which is very simply a metal detector. The metal that the sensor detects is the teeth of the trigger wheel.

The electronic circuit board and sensor are mounted on the distributor plate assembly. The sensor leads are soldered directly to the circuit board. The sensor and electronic control unit (circuit board, sensor and plates) are provided for service.

Trigger wheels of distributors for four-cylinder engines have four (4) teeth. Distributors for eight-cylinder engines have eight (8) teeth on the trigger wheel.

Distributor primary wiring consists of two leads connected to the ignition coil primary terminals. The red wire from the distributor connects to the coil positive (+) terminal. The brown wire from

Continued on next page

BREAKERLESS ELECTRONIC IGNITION DISTRIBUTORS (Continued)

Prestolite Model IDN-4000 Series (Integral Ignition Control) (Continued)

the distributor connects to the coil negative (-) terminal. (See Figure 41.) A third (white) wire from the distributor connects to the deceleration throttle modulator (DTM), where used. Because primary (low voltage) current is regulated within the electronic control unit, a ballast resistor or resistance wire is not required in the primary circuit.

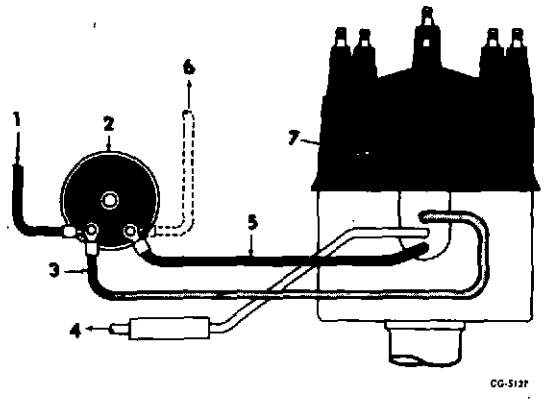

Figure 41. DISTRIBUTOR PRIMARY WIRING

1. From Ignition Switch
2. Ignition Coil
3. Red Wire
4. White Wire - To Deceleration Throttle Modulator Where Used
5. Brown Wire
6. To Governor Control Unit Where Used
7. Distributor

The secondary (high voltage) components are: coil tower, distributor cap, rotor, high tension cables and spark plugs. The new distributor cap featuring superior physical and dielectric strength incorporates male (spark plug type) terminals. A resistor type rotor, interference suppression type high tension cables and resistor type spark plugs are used to meet radio frequency interference standards.

All distributors have a mechanical (centrifugal) spark advance system. Most distributors also have a vacuum operated spark advance system. The advance systems automatically provide the optimum spark timing for various engine speed and load conditions.

When the ignition key is turned on, an oscillating signal is set up in the sensor circuit. This creates a field around the sensor. When a trigger wheel tooth enters the sensor's field, it squelches or reduces the strength of the oscillating signal. This weakened sensor signal is detected by what is called a demodulator circuit in the electronic circuit board. The demodulator circuit controls a transistor to turn off the current in the primary circuit of the coil. When the transistor is turned "off," it opens ("breaks") the coil primary circuit. As in a conventional system, opening the coil primary circuit induces high voltage in the coil secondary circuit which is conducted from the coil to the distributor cap and travels through the rotor and the secondary cables to the spark plugs. When the trigger wheel tooth leaves the sensor's field, the transistor is turned "on" to close ("make") the coil primary circuit.

Dwell angle is determined by the angle between adjacent teeth of the trigger wheel and by the air gap between the ends of the trigger wheel teeth and the sensor. Since there are no wearing surfaces connected with the trigger wheel and sensor, dwell remains constant and should not require adjustment for the service life of the distributor.

The mechanical (centrifugal) advance system is built internally into the distributor and consists of two flyweights which pivot on long life, low friction bearings and are controlled by calibrated springs which tend to hold the weights in the no-advance position. The flyweights respond to changes in engine (distributor shaft) speed and rotate the trigger wheel to advance the spark as engine speed increases and retard the spark as engine speed decreases.

The vacuum advance system incorporates a vacuum diaphragm unit which rotates the distributor sensor plate in response to changes in carburetor throttle bore vacuum.

The two systems, mechanical and vacuum operate independently, yet work together to provide proper spark advance.

For service information see Prestolite Model IDN-4000 Service Manual, CGES-145.

GOVERNOR SYSTEMS

ELECTRONIC VACUUM MODULATING GOVERNOR
(Used with Carburetor models 2300EG and 4150EG)

The electronic vacuum modulating governor (EVM) system (Figures 42 and 43) consists of a remote mounted electronic control unit (ECU), a three-way solenoid vacuum valve and vacuum diaphragm are an integral part of the carburetor. The ECU receives the engine speed signal from the negative side of the ignition coil. This engine speed signal switches the ECU (when governed engine speed is reached) to allow current to flow through the solenoid vacuum valve. The solenoid vacuum valve provides correct governor vacuum to the vacuum diaphragm. The vacuum diaphragm acting against the governor spring thereby controls the throttle position to regulate engine speed.

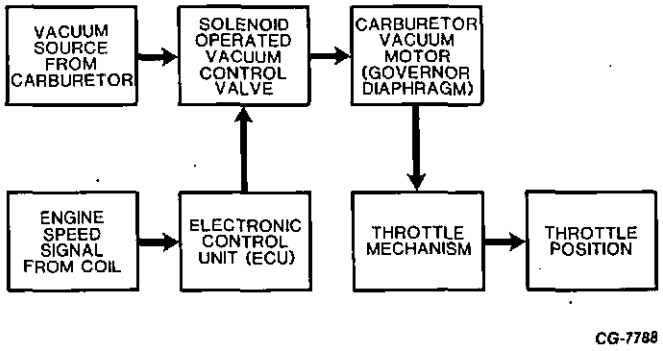

Figure 42. EVM GOVERNOR SYSTEM BLOCK DIAGRAM

Internal clean air is supplied to both the solenoid side of the solenoid valve and to the high pressure side of the governor diaphragm. The cone-tipped side of the solenoid valve connects the venturi and intake manifold vacuum to the low pressure side of the governor diaphragm. In an underspeed or current off condition, the solenoid return spring closes the source vacuum port, thereby venting the low pressure side of the governor diaphragm directly to the clean air source. In this mode, the zero or near zero pressure differential across the governor diaphragm prevents any governing action.

As the engine approaches governed speed, current is applied to the solenoid which pulls the valve against the return spring, closes the port to clean air and connects the governor diaphragm to source vacuum. Modulation between the extremes of solenoid valve full-off and full-on is accomplished by varying the percentage on-time of the current to the solenoid. This results in an average valve opening that is proportional to percent on-time and provides the desired governing action. The speed is factory preset within the electronic control unit.

For service information see Engine Division Service Manual CGES-120 for 2300EG carburetor and CGES-125 for 4150EG carburetor.

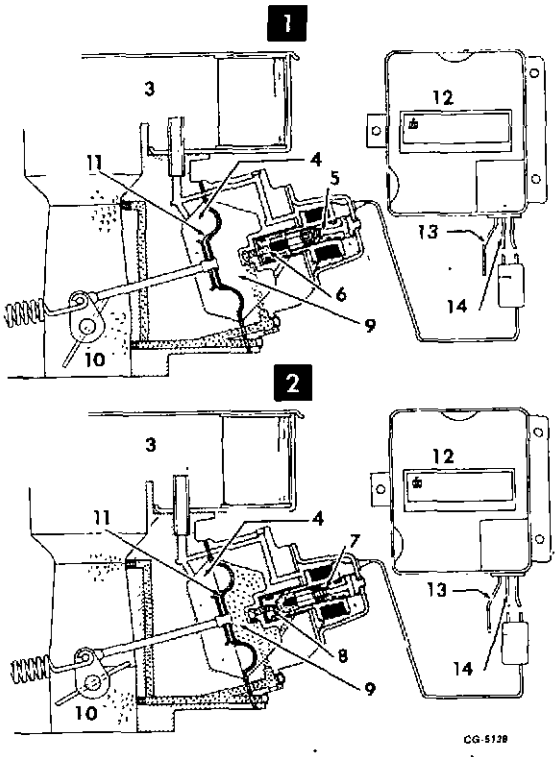

Figure 43. EVM GOVERNOR OPERATION

[1] BELOW GOVERNOR SPEED
(Solenoid Valve Not Energized)
[2] AT GOVERNOR SPEED
(Solenoid Valve Energized)

3. Internal Clean Air
4. High Pressure Side
5. Clean Air Port Open
6. Vacuum Port Closed
7. Clean Air Port Closed
8. Vacuum Port Open
9. Low Pressure Side
10. Vacuum
11. Throttle Control Governor Diaphragm
12. Electronic Control Unit
13. Battery Supply
14. To Negative Side of Coil

AUTOMATIC VELOCITY-TYPE GOVERNORS (C-196 Engines)

Velocity-type governors, installed between the carburetor and intake manifold on some C-196 engines, are vacuum-operated fuel flow devices which operate in response to the condition existing in the engine intake manifold. The velocity governor controls engine rpm to a predetermined limit. Governors used on IH industrial engines act as load sensing rpm limiters. The governors are manufactured by either Hoof Products Company or by Introl. These governors, sold under IH part number, 392 114 C91, are virtually identical in function but have some differences in maintenance and adjustment procedures, as shown below. Each governor has a name plate on the side which identifies it as a Hoof or Introl product. For complete servicing information, refer to 1920C Carburetor Service Manual, CGES-250.

Introl Governor Maintenance and Adjustment

Occasional cleaning of the Introl governor air filter is necessary. This element is assembled in governor body beneath a perforated cover. Clean as follows:

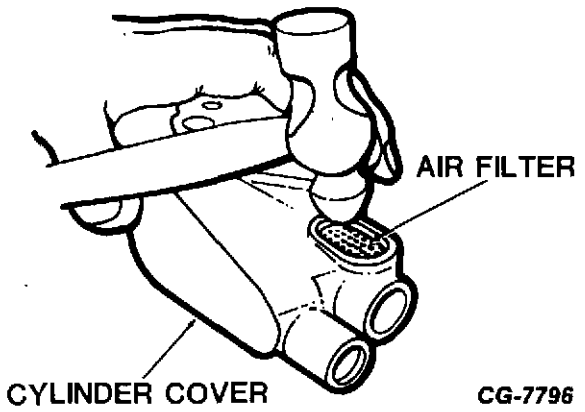

Figure 44. UNDERSIDE OF INTROL GOVERNOR

1. Pry out metal cover carefully with a sharp punch. Lift out filter felt and inner cover. Wash felt in cleaning solvent then allow to dry.

2. Blow out stabilizer cylinder and piston by directing compressed air in sudden bursts through the atmospheric hole in the air filter chamber.

3. Install inner cover. Replace felt in governor body. Install outer cover. It may be necessary to bend cover to install; if so, flatten by tapping with hammer (Figure 44.)

The Introl governor may be adjusted as follows:

1. Bring engine to normal operating temperature.

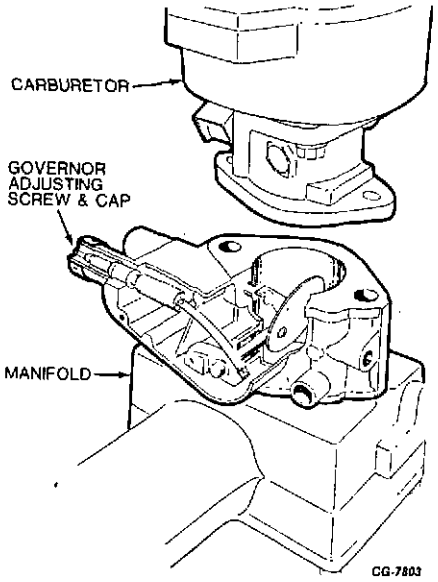

Figure 45. ADJUSTING INTROL GOVERNOR

2. Remove seal from adjusting screw cap.

3. Check governor setting against accurate tachometer (use master tachometer of known accuracy to calibrate your tachometer.)

4. Turn adjusting screw:

   a. Clockwise to decrease speed.
   b. Counterclockwise to increase speed.

> **NOTE:** Under no circumstances should governor be set faster than settings shown under "Specifications." Never exceed engine speed of 4,000 rpm.

Hoof Governor Adjustment

The Hoof governor may be adjusted as follows:

1. Bring engine to normal operating temperature.

2. Check governor setting against accurate tachometer. (Use master tachometer of known accuracy to calibrate your tachometer.)

3. Turn governor adjusting screw:

   a. Clockwise to decrease speed.
   b. Counterclockwise to increase speed (See NOTE above.)

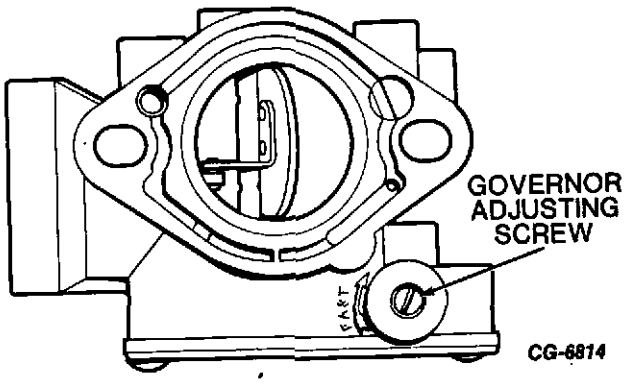

Figure 46. ADJUSTING HOOF GOVERNOR

CONSTANT SPEED GOVERNOR (C-549 Engines)

1. Adjust speed control screw (9) to dimension "A" (approximately 7/8") by turning speed control nut (8). Hold screw from turning with screwdriver. Do not allow governor spring to twist, otherwise damage to spring may result.

2. Adjust the throttle rod (1). With the governor lever (4) in the weights closed position (held in place by spring tension) the rod should just hold the throttle lever (3) in the wide open position against the internal stop. Then, shorten rod by 1-1/2 to two turns.

3. Tighten rod locknuts. Check for binding in both ball joints.

4. Set speed regulation adjustment screw (6) to dimension "B" (approx. 1/2").

5. Speed Setting -- No load.

   a. Set "high idle" by turning the speed control nut (see Step 1) to produce the required high idle speed.

Continued on next page

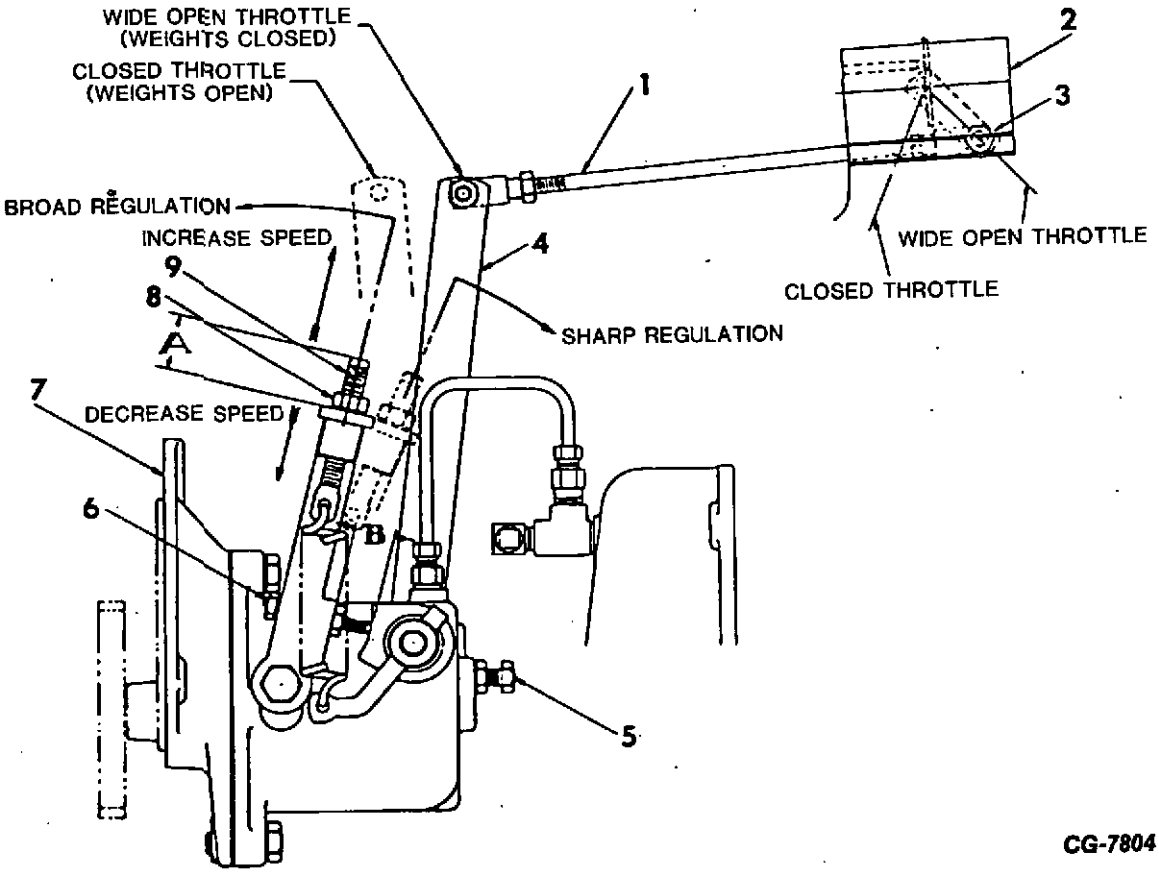

Figure 47. GOVERNOR CONTROL ADJUSTMENT (Constant Speed)

1. Rod, Throttle
2. Body, Throttle
3. Lever, Throttle
4. Lever, Governor
5. Screw, Bumper
6. Screw, Regulation
7. Governor
8. Nut, Speed Control
9. Screw, Speed Control

CONSTANT SPEED GOVERNOR (C-549 Engines) (Continued)

b. If surging occurs at "high idle," turn in the bumper screw (5) just enough to dampen the surge.

NOTE: DO NOT use the bumper screw (5) for speed adjustment.

6. Speed Setting -- Engine loaded.

a. Set engine load to maximum rated power. Adjust speed control nut (8) to attain rated power speed.

b. Remove load and note high idle speed. If this speed is too high (broad regulation), back out speed regulation screw (6). If high idle speed is too low (sharp regulation), turn screw in.

c. Again load engine to maximum rating and reset speed nut (8) if required.

d. Run engine thru varying step load values.

NOTE: If surging occurs when changing load, regulation setting is too sharp on dimension "B" must be increased.

e. If surging occurs at "high idle," see Step 5b.

STARTING MOTORS

STANDARD DUTY ENCLOSED SHIFT LEVER TYPE (Used on C-152, C-196, C-304, C-345, C-392 and C-446 Engines)

The enclosed shift lever type starting motor is equipped with a drive end housing which encloses the entire shifting mechanism and solenoid plunger, protecting them from dirt, splash and icing conditions.

The solenoid is mounted on the flange of the drive end housing and operates the overrunning clutch drive by means of a linkage and shift lever. When the control switch closes the starting circuit the solenoid is energized shifting the pinion into mesh with the ring gear on the engine flywheel and closing the main contacts inside the solenoid. When the contacts inside the solenoid close, battery current is then supplied to the motor causing the armature to rotate. Torque is transmitted by the clutch from the starting motor armature to the flywheel. To protect the armature from excessive speeds when the engine starts the clutch is designed to "overrun" or turn faster than the armature which permits the pinion to disengage itself.

Lubrication

Starting motor requires no lubrication except at overhaul; if motor is disassembled for any reason, lubricate as follows:

1. Oil wicks should be resaturated if equipped.

2. Bushings should be coated with a medium grade of engine oil.

3. The armature shaft should be coated lightly with a medium grade of engine oil.

4. The drive assembly should be wiped clean.

5. Relubricate the sprag clutch with a medium grade of engine oil.

For service information see IH Standard Duty Starter Motor Service Manual, CGES-265.

IMPORTANT

Do not clean in any degreasing tank or with grease dissolving solvents, this will dissolve the lubricant in the clutch mechanism.

IMPORTANT

Avoid excessive lubrication.

HEAVY DUTY ENCLOSED SHIFT LEVER TYPE (Used on C-537, C-549 and C-605 Engines)

Heavy duty, enclosed shift lever type starting motors are designed to protect the shift lever and solenoid plunger from dirt, splash and icing conditions.

The nose housing can be rotated to obtain a number of different solenoid positions with respect to the mounting flange, which permits a variety of mounting applications.

NOTE: Be sure to mark the location of the nose housing in some manner to assure proper location of nose housing-to-lever housing upon reassembly of starting motor.

Either the intermediate duty or the heavy duty overrunning type sprag clutches may be used on the heavy duty starting motors with the enclosed shift lever. Both types of clutches are shifted into mesh with the flywheel ring gear by action of the solenoid. When the drive pinion is engaged with the flywheel, the pinion will not be permitted to disengage until the engine has started and the solenoid circuit is interrupted.

Some of the heavy duty starting motors feature a seal between the shaft and lever housing, and all of the heavy duty starting motors with the enclosed shift lever have a rubber boot or linkage seal over the solenoid plunger. These seals prevent the entry of dirt and oil into the motor main frame.

Lubrication

Lubrication is provided for the bronze bushings located in the commutator end frame, lever housing and the nose housing, by an oil saturated wick that projects through each bushing and contacts the armature shaft. Oil can be added to the wicks by removing the pipe plugs.

The starting motor should be lubricated whenever it is disassembled with SAE-10 oil. All the wicks should be saturated, reservoirs filled and the splines underneath the clutch should be lubricated with a light coat of oil.

Some of the starting motors are equipped with a large oil reservoir for each wick, also "O" rings are used at various locations to resist entry of dirt and mositure. The starting motors which utilize the large oil reservoirs and the "O" ring are called "long life motors."

For service information see IH Heavy Duty Starter Motor Service Manual, CGES-230.

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF SUBJECTS

TECHNICAL PUBLICATIONS 7

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International Industrial Engines are complemented by a complete and current selection of service manuals, operator's manuals and parts catalogs. The manuals and catalogs assist the owner in operation and maintenance of his International Industrial Engine by providing proper service and operational procedures as well as service parts listings. Recommended maintenance schedules and procedures must be followed to ensure the most economical and efficient operation of the engine.

Each International Industrial Engine is delivered with an operator's manual, parts catalog and dealer directory. If these copies are misplaced or extra copies are required, use the order blank located in the back of this book for ordering. This order blank should also be used for ordering service manuals. A complete list of service literature and parts catalogs is included on the following pages. Mail order to:

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NOTE: Prices are listed on the order blank in back of book.

SERVICE MANUALS

Service manuals provide service disassembly and reassembly procedures and overhaul procedures and specifications for basic engines and components. Due to variations of trim parts within an engine family, each component for your engine should be positively identified prior to ordering a service manual.. Refer first to engine parts catalog shipped with your engine. It contains the itemized list of specific components of your particular IH engine. If further assistance is required, contact the following:

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Engine Division – Industrial Engine Sales
401 North Michigan Avenue
Chicago, Illinois 60611
Telex: 253547
Phone: 312 – 836-2000

Note that all service procedures for emissions related equipment on certified carbureted engines (emissions air pump, exhaust gas recirculation valve, etc.) are covered in the appropriate "Maintenance and Diagnostic Manual for Carbureted Engines Certified for On-Highway Use."

DESCRIPTION	FORM NO.
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AIR INJECTION PUMP	CTS-2442
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105, 145 Amp, Delco-Remy 40SI	CTS-2551
65, 85 Amp, Delco-Remy 27SI	CTS-2552
37, 62 Amp, Motorola	CTS-2630
65, 85, 105, 130 Amp. Leece Neville 2300JB-2700JB	CTS-2661
75, 105 Amp, Leece Neville 4625JA-4425JA	CTS-2662
90 Amp, Delco-Remy 30SI	CTS-2724
65, 85, 105, 145 Amp, IH	CTS-2743
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C-152	CTS-2175
C-196	CGES-260
C-304/345/392	CGES-160
C-446	CGES-210
C-549	CTS-2423
C-605	CTS-2683
CARBURETORS	
1904C Holley	CTS-2064
1920C Holley	CGES-250
1940C Holley	CGES-110
2140G Holley	CTS-2058
2210C Holley	CGES-115
2300C, G, EG Holley	CGES-120
4150G, EG Holley	CGES-125

LPG and NG carburetors are supplied by original equipment manufacturers.

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Single Plate 12 to 14 inch (C-446 Engine)	CTS-2039
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1510 Holley (Breaker Point for 8 Cylinders)	CTS-2481
1530 Holley (Breakerless)	CTS-2665
IDN-4000 Prestolite (Breakerless)	CGES-145
IDN-4000 Prestolite (Breaker Point)	CGES-150
FUEL PUMP	CTS-2050
IGNITION COILS AND CONDENSORS	CTS-2013
LPG FUEL SYSTEM	
Century Equipment	CTS-2670
POWER STEERING PUMP	
Eaton (C-446 Engine)	CTS-2297
SPARK PLUGS	CGES-280
STARTING MOTORS	
Standard	CGES-265
Heavy Duty	CGES-230

OPERATOR'S AND MAINTENANCE MANUALS

Engine operator's and maintenance manuals provide a general description of your engine, instructions for operation, lubrication and simple maintenance. It includes service intervals and engine tune-up specifications. Copy of manual is shipped with new engine.

DESCRIPTION	FORM NO.
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1976 Emissions Standards	CTS-2694
1977 Emissions Standards	CTS-2721
1978 Emissions Standards	CTS-2733
1979 Emissions Standards	
Light Duty *	CTS-2751
Medium/Heavy Duty*	CGES-135
1980 Emissions Standards	CGES-215
OPERATOR AND MAINTENANCE MANUALS FOR CARBURETED INDUSTRIAL USE ENGINES	
C-549 Engine - Below Serial no.	1 085 521 R3
C-549 Engine - Above Serial no.	1 171 482 R2
C-152/196/304/345/392/446/605 Engines	1 171 482 R2

*Light Duty includes C-196, 304, 345 engines; Medium/Heavy Duty includes C-345, 392, 446, 537 (same as 605) engines.

CATALOGS

Engine parts catalogs show illustrations and service part numbers of all serviceable engine parts for each application within an engine family. Includes parts supplied by IH. For parts not contained in IH engine parts catalog, refer to your original equipment manufacturer. Copy shipped with new engine.

*C-152	1 008 715 R3
*C-196	1 008 715 R3
*C-304/345/392	1 008 716 R1
*C-446	1 008 717 R1
*C-549	PU-50D
*C-605	1 008 719 R2

*Also available in microfiche

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	CGES-210	C-446 Engine		4.90	
	ISS-1034	C-549 Engine w/Serial Number Below 170 679		22.10	
	CTS-2423	C-549 Engine w/Serial Number 170 679 Up		4.48	
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		CARBURETOR SERVICE MANUALS			
	CTS-2064	1904C Holley		1.75	
	CGES-250	1920C Holley		2.24	
	CGES-110	1940C Holley		2.24	
	CTS-2058	2140G Holley		1.40	
	CGES-115	2210C Holley		2.52	
	CGES-120	2300C, G, EG Holley		3.08	
	CGES-125	4150G, EG Holley		3.78	
		DISTRIBUTOR SERVICE MANUALS			
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	CTS-2665	1530 Holley Breakerless Electronic		2.80	
	CGES-145	IDN-4000 Prestolite Breakerless Electronic		2.52	
	CGES-150	IDN-4100 Prestolite Breaker Point		1.89	
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	CTS-2666	Air Compressor - BW Model 501		0.84	
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	CTS-2297	Power Steering Pump (Eaton) for C-446 so equipped		0.56	
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	CTS-2751	C-196, 304, 345 Engines Meeting 1979 Emissions Standards		7.21	
	CGES-135	C-345, 392, 446 Engines Meeting 1979 Emissions Standards		8.61	
	CGES-215	Engines Meeting 1980 Emissions Standards		7.49	
	1 085 521 R3	C-549 Engine w/Serial No. Below 170 679 (Industrial Use)		6.20	
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	CTS-2551	105, 145 Amp, Delco-Remy 40 SI		0.84	
	CTS-2552	65, 85 Amp, Delco-Remy 27 SI		0.84	
	CTS-2630	37, 62 Amp, Motorola		0.84	
	CTS-2661	65, 85, 105, 130 Amp, Leece Neville 2300-2700JB		0.98	
	CTS-2662	75, 105 Amp, Leece Neville 4625-4425JA		0.98	
	CTS-2743	65, 85, 105, 145 Amp, International		0.70	
		BASIC ENGINE SERVICE MANUALS			
	CTS-2175	C-152 Engine		2.18	
	CGES-260	C-196 Engine		4.90	
	CGES-160	C-304/345/392 Engine		4.48	
	CGES-210	C-446 Engine		4.90	
	ISS-1034	C-549 Engine w/Serial Number Below 170 679		22.10	
	CTS-2423	C-549 Engine w/Serial Number 170 679 Up		4.48	
	CTS-2683	C-605 Engine		4.76	
		CARBURETOR SERVICE MANUALS			
	CTS-2064	1904C Holley		1.75	
	CGES-250	1920C Holley		2.24	
	CGES-110	1940C Holley		2.24	
	CTS-2058	2140G Holley		1.40	
	CGES-115	2210C Holley		2.52	
	CGES-120	2300C, G, EG Holley		3.08	
	CGES-125	4150G, EG Holley		3.78	
		DISTRIBUTOR SERVICE MANUALS			
	CTS-2481	1510 Holley Breaker Point		1.96	
	CTS-2665	1530 Holley Breakerless Electronic		2.80	
	CGES-145	IDN-4000 Prestolite Breakerless Electronic		2.52	
	CGES-150	IDN-4100 Prestolite Breaker Point		1.89	
		MISCELLANEOUS SERVICE MANUALS			
	CTS-2056	Air Cleaners - Dry, Modulated or Oil Bath Types		0.56	
	CTS-2666	Air Compressor - BW Model 501		0.84	
	CTS-2442	Air Injection Pump		0.56	
	CTS-2518	Clutch for C-304, 345, 392 Engines so equipped		0.56	
	CTS-2039	Clutch for C-446 Engine so equipped		0.56	
	CTS-2050	Fuel Pump		0.56	
	CTS-2013	Ignition, Coils and Condensers		0.56	
	CTS-2670	LPG Fuel System (Century Equipment)		1.68	
	CTS-2297	Power Steering Pump (Eaton) for C-446 so equipped		0.56	
	CGES-280	Spark Plugs		0.56	
	CGES-265	Starter Motor for C-152, 196, 304, 345, 392, 446 Engines		1.40	
	CGES-230	Starter Motor for C-549, 605 Engines		1.40	
		OPERATION AND MAINTENANCE MANUALS			
	CGS-2694	Engines Meeting 1976 Emissions Standards (On-Highway Use)		3.50	
	CTS-2721	Engines Meeting 1977 Emissions Standards		6.72	
	CTS-2733	Engines Meeting 1978 Emissions Standards		8.33	
	CTS-2751	C-196, 304, 345 Engines Meeting 1979 Emissions Standards		7.21	
	CGES-135	C-345, 392, 446 Engines Meeting 1979 Emissions Standards		8.61	
	CGES-215	Engines Meeting 1980 Emissions Standards		7.49	
	1 085 521 R3	C-549 Engine w/Serial No. Below 170 679 (Industrial Use)		6.20	
	1 171 482 R2	C-549 Engine w/Serial No. 170 679 Up (Industrial Use)		5.53	
	1 171 482 R2	C-152, 196, 304, 345, 392, 446, 605 Engines (Industrial Use)		5.53	
		PARTS AND SERVICE DEALER DIRECTORY			
	CGE-300	Industrial Engines - Canada, United States		4.00	
		PARTS CATALOGS			
	1 008 715 R3	C-152, 196 Engines	Paper	5.00	
			Microfiche	4.00	
	1 008 716 R1	C-304, 345, 392 Engines	Paper	5.00	
			Microfiche	4.00	
	1 008 717 R2	C-446 Engines	Paper	5.00	
			Microfiche	4.00	
	PU-50D	C-549 Engines	Paper	15.50	
			Microfiche	4.00	
	1 008 719 R3	C-605 Engines	Paper	5.00	
			Microfiche	4.00	
				Total Price $	

Enclose check or money order in U.S. funds payable to International Harvester Company. Do not send cash. Please allow 30 days for delivery. All orders will be filled based on availability. If publication ordered is out of stock, remittance will be returned under separate cover.

FORM NO. A

REFER TO TABLE OF CONTENTS
FOR COMPLETE LISTING OF SUBJECTS

APPENDIX A 8

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DIAGNOSTIC PROCEDURES FOR BREAKERLESS ELECTRONIC IGNITION DISTRIBUTOR (Holley Model 1530 w/Remote Ignition Control)

SERVICE PRECAUTIONS

The following precautions must be observed when performing service operations on the electronic ignition system:

1. Do not use a test lamp to check continuity of the distributor sensor unit. The fine wire (No. 38 gauge) used in construction of the sensor coil will be damaged beyond repair if subjected to a current exceeding 40 milliamps (.040 amp.)

2. Do not connect distributor sensor or tester switch SE-2503 to a 12 volt circuit. When making tests, be sure to make test connections as shown under IGNITION SYSTEM OPERATION AND TROUBLE SHOOTING TEST.

3. Damage to ignition system components can result from incorrect wiring connections. Whenever engine wiring harness is disconnected from electronic ignition control and/or ignition coil, wires should be marked or tagged to assure correct reconnection.

Electronic ignition control and ignition coil primary wiring connections are shown in Figure 48. Engine wiring circuits vary between vehicle models. For circuit identification, refer to appropriate vehicle wiring diagrams in Service Manual.

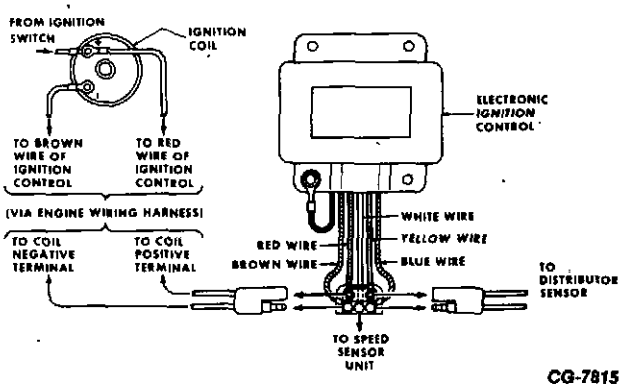

Figure 48. IGNITION CONTROL AND COIL PRIMARY WIRING

4. Multi-wire connectors on electronic ignition system components are treated with a special conductive lubricating/sealing compound (grease). Its purposes are to lubricate the metal contact surfaces and to prevent entry of mositure into the connection. The lubricant/sealer should not be cleaned from the connector terminals.

At the time of ignition system service, if the terminals appear dry or if ignition system components are being replaced, the connectors should be protected by filling the female cavities of the connectors with lubricant/sealer before assembly. The lubricant/sealer compound is available through IH parts outlets under part number 472 141 C1.

5. In the event of ignition coil replacement, only ignition coil IH part number 191 455 R91 should be used on vehicles equipped with the IH electronic ignition system.

Use of incorrect ignition coil could result in damage to the electronic ignition control.

ADJUSTING DISTRIBUTOR AIR GAP

1. Adjust trigger wheel-to-sensor air gap as follows:

a. Rotate trigger wheel until one tooth is aligned with centerline of sensor (trigger wheel tooth perpendicular to flat surface of sensor) (Figure 49.)

b. Using feeler gauge, measure air gap between sensor and end of tooth (Figure 49.) Move sensor as needed to obtain specified air gap (.02 mm – .008"). Tighten sensor mounting screw and recheck air gap.

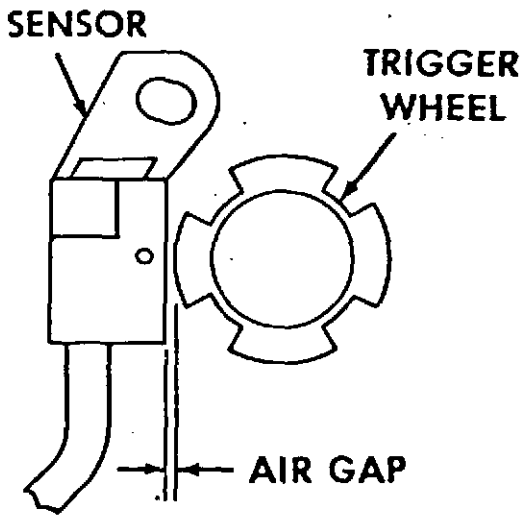

Figure 49. TRIGGER WHEEL TO SENSOR AIR GAP

Use dwell meter that will read electronic ignition system dwell.

2. Connect dwell meter to engine. Operate engine at specified curb idle speed and observe dwell reading. If dwell reading is not within specified limits, stop engine and adjust trigger wheel-to-sensor air gap to obtain specified dwell. Dwell decreases as sensor is moved closer to trigger wheel and increases as sensor is moved away from trigger wheel. Dwell is affected approximately one-half (1/2) degree per 0.025 mm (.001") of sensor movement.

3. Operate distributor at 300 RPM (with 12-13 volts primary input) and observe dwell reading. Dwell should be within specified limits.

a. If dwell reading is within specified limits, trigger wheel-to-sensor gap is satisfactory.

b. If dwell reading is not within specified limits, loosen sensor mounting screw and adjust trigger wheel-to-sensor air gap as required to obtain specified dwell. Move sensor toward trigger wheel to decrease dwell or away from trigger wheel to increase dwell. Dwell is affected approximately one-half (1/2) degree per .001" of sensor movement. After correct dwell is obtained, tighten sensor mounting screw.

DIAGNOSTIC CHECK LIST

FOR IH ELECTRONIC IGNITION SYSTEM
(Holley Model 1530 w/Remote Ignition Control)

REFERENCES

Service Manual for Holley Model 1530 Distributor, CTS-2665.

EQUIPMENT REQUIRED

DC Voltmeter.

Jumper Wire 912-18 inches long with clip at each end.

Tester Switch SE-2503.

Insulated Pliers (grippers) for handling high tension cable.

1. INSPECT WIRING

   a. Check sensor wiring connectors.

   b. Inspect ignition primary circuit.

   c. Be sure dash panel connector terminals are clean and tight (locking tangs engaged.)

   d. Inspect secondary (high tension) cables.

   e. Be sure ignition wires are routed correctly.

   f. Be sure ignition control (module) mounting bolts are tight.

2. TEST BATTERY VOLTAGE

   a. Test and record battery voltage.

Spec.	As Found
12-13V	

If necessary, charge or replace battery.

3. TEST PRIMARY VOLTAGE

   a. Connect voltmeter between coil positive (+) terminal and ground.

   b. Turn ignition "ON" and record voltage.

Spec.	As Found
12-13V	

If voltage equals battery voltage, proceed to Step 4.

If voltage is noticeably less than battery voltage, a high resistance exists between battery and coil. Make necessary corrections.

4. TEST SPARK AT PLUG

   a. Disconnect cable from one spark plug.

Continued on next page

4. **TEST SPARK PLUG (Continued)**

b. Using insulated pliers hold cable terminal about 1/2 inch away from engine.

c. Crank engine and observe for spark. If spark occurs, ignition system is satisfactory.

If no spark occurs, reconnect cable to spark plug and proceed to Step 5.

5. TEST SPARK AT DISTRIBUTOR CAP

a. Disconnect cable from center terminal of distributor cap.

b. Push boot back and clip end of jumper cable over ignition cable 1/4-1/2 inch away from metal terminal. Ground other end of jumper wire to engine.

c. Crank engine and observe for spark between jumper wire clip and cable terminal.

If spark occurs, check for faulty distributor cap, rotor or spark plug cables.

If no spark occurs, leave jumper wire in place and proceed to Step 6.

6. TEST SENSOR

a. Disconnect distributor from engine wiring harness. Plug tester switch into wiring harness.

b. Turn ignition "ON." Press tab of tester switch and observe for spark between jumper wire clip and cable terminal.

If spark occurs, replace distributor sensor unit.

If no spark occurs, disconnect tester switch and proceed to Step 7.

7. TEST SENSOR WIRING CIRCUIT

a. Disconnect distributor wiring connector from ignition control (module). Plug tester switch into ignition control.

b. Turn ignition "ON." Press tab on tester switch and observe for spark between jumper wire clip and cable terminal.

If spark occurs, replace wiring circuit between ignition control and distributor.

If no spark occurs, disconnect tester switch, reconnect distributor wiring circuit to control and proceed to Step 8.

8. TEST IGNITION CONTROL AND COIL

a. Connect voltmeter between coil negative (–) terminal and ground.

b. Turn ignition "ON" and record voltage.

Spec.	As Found
5-8V	

If voltage is under 5 volts or over 8 volts, replace coil.

c. Disconnect distributor from engine wiring harness. Plug tester into wiring harness.

d. With ignition "ON," press tab on tester switch and observe voltmeter. Voltage should increase to battery voltage.

Spec,	As Found
12-13V	

e. Release tab on tester switch and observe voltmeter. Voltage should drop to 5-8 volts.

If voltage does not switch up and down, replace electronic ignition control (module.)

If voltage switches up and down but spark does not jump between jumper wire clip and cable terminal, replace coil.

9. RETEST SPARK AT PLUG

a. After replacement of components, retest for spark at plug, Step 4.

b. Disconnect test equipment. Make sure wiring connectors are clean and tight.

10. CHECK DWELL

a. Connect dwell meter to engine.

b. Operate engine at idle speed and record dwell.

Spec.	As Found
26-32	

If necessary, adjust dwell.

11. CHECK TIMING

a. Connect timing light to engine.

b. Operate engine at idle speed and check timing.

(Distributor vacuum hose disconnected and plugged.)

If necessary, adjust timing.

SENSOR WIRING CONNECTOR CHECK

Intermittent or complete failure of the electronic ignition system may be caused by excessive resistance at the molded, two-way connectors which connect the distributor sensor and the electronic ignition control (module) to the engine wiring harness (distributor sensor circuit.)

High resistance at these connectors can result from loose physical fit between male and female terminals or oxidation (corroding) of terminals due to interaction of dissimilar materials in terminals of wiring harness and sensor and ignition control. In some cases oxidation is aggravated by a lack of lubricant/sealer (grease) in connectors permitting entry of moisture.

When diagnosing ignition system problems, always check for poor contact at the molded, two way connectors before condemning the distributor sensor and/or the electronic ignition control (module.) Sometimes engine can be started by re-establishing contacting through the connector, either by disconnecting and reconnecting the plug or by squeezing or wiggling the connector. This indicates a faulty connector which should be replaced.

To ease replacement of wiring harness connectors, a substitute sensor wiring cable (with improved connector terminals) to bypass the existing distributor-to-module circuit in the engine wiring harness is available through service parts channels under IH part number 480 085 C91.

NOTE: The above service information is included for service reference only until it can be added to CTS-2665, Service Manual for Holley Model 1530 Distributor. At such time this information is added to CTS-2665, Appendix A will be deleted from this manual.

COMPONENTS GROUP

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