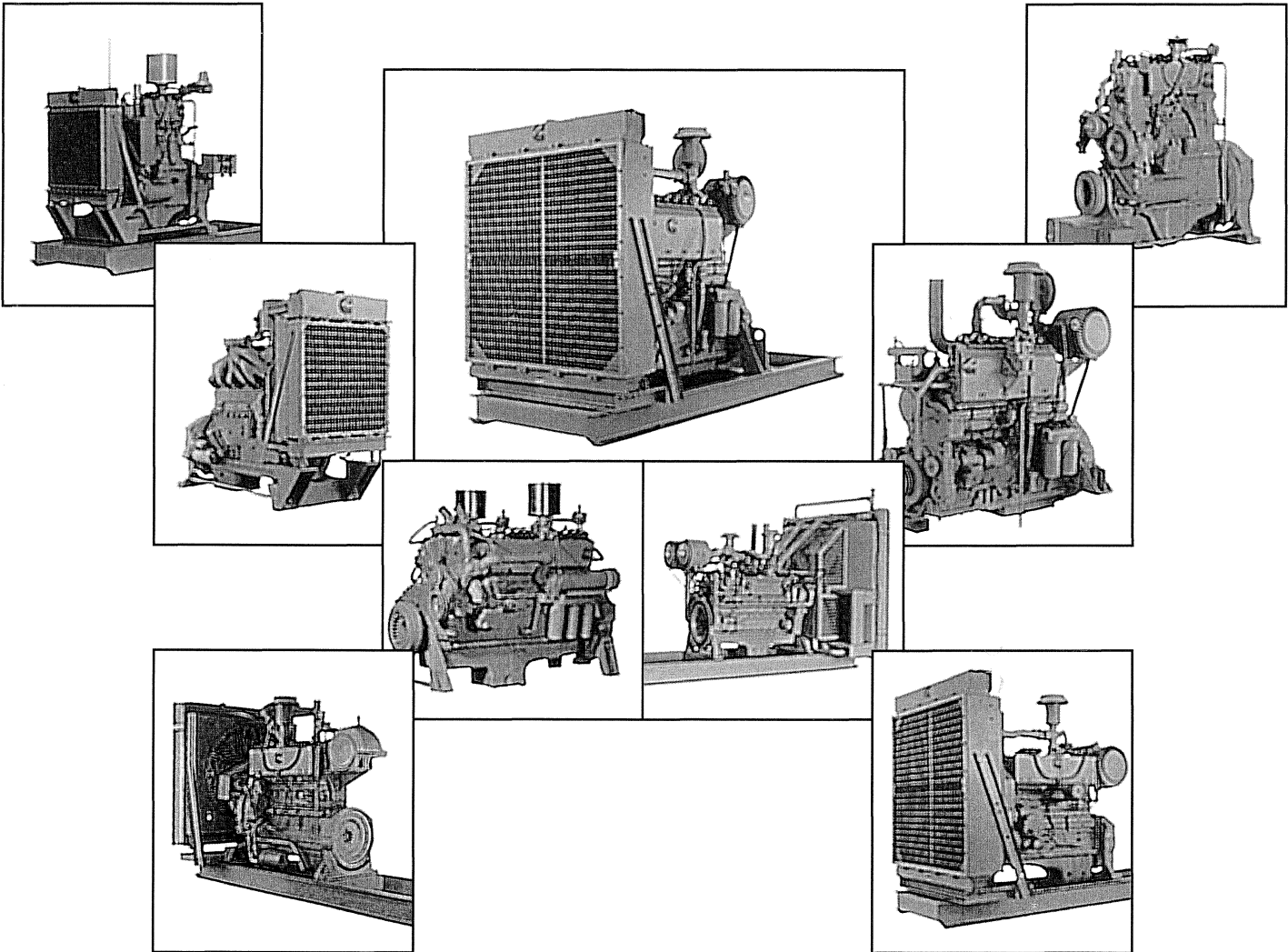
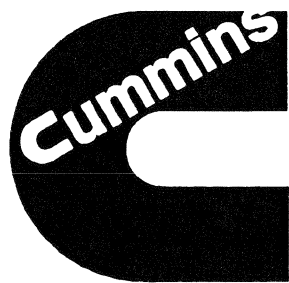




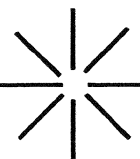
# Natural Gas Engines



## OPERATION AND MAINTENANCE MANUAL



# Natural Gas Engines



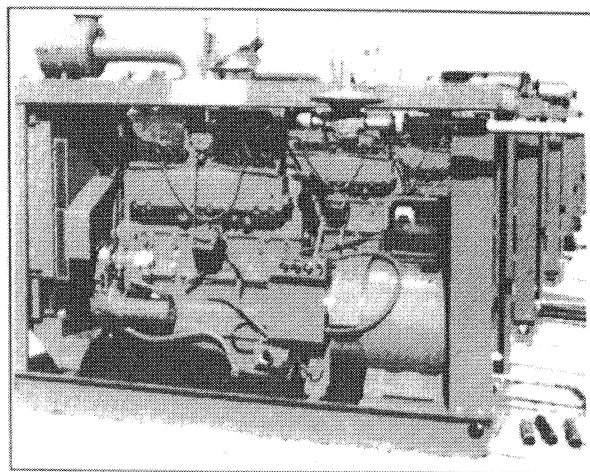
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## OPERATION AND MAINTENANCE MANUAL



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### Important Reference Numbers

The blank spaces provided below are for recording engine identification data and part numbers of frequently used maintenance items. These reference numbers will be needed for ordering replacement parts or requesting service.

**Engine Model** \_\_\_\_\_

**Serial Number** \_\_\_\_\_

### Filter Part Numbers:

..Air Cleaner \_\_\_\_\_

..Oil (Full Flow) \_\_\_\_\_

..Oil (ByPass) \_\_\_\_\_

..Fuel-Gas \_\_\_\_\_

..Coolant \_\_\_\_\_

### Belt Part Numbers:

..Fan Belt \_\_\_\_\_

..Water Pump Bel \_\_\_\_\_

..Auxiliary Water Pump Belt \_\_\_\_\_

..Alternator Belt \_\_\_\_\_

Spark Plug \_\_\_\_\_

Spark Plug Wires \_\_\_\_\_

Ignition Coils \_\_\_\_\_





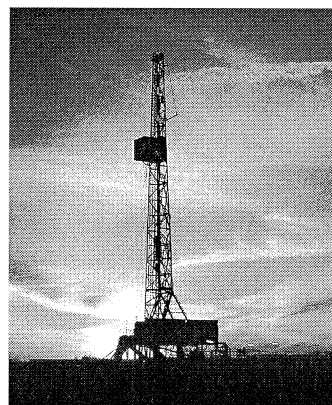
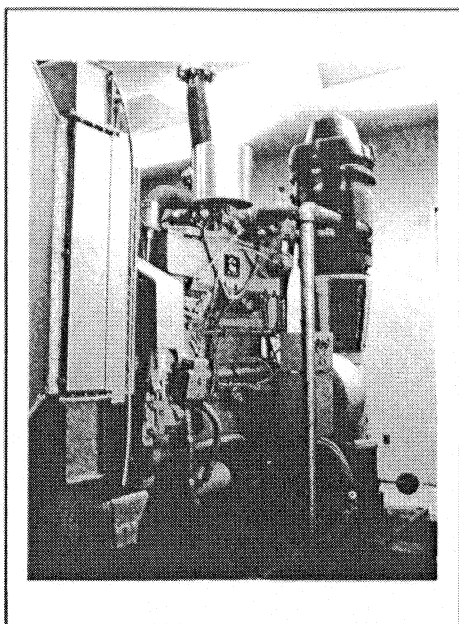
## Section 1 - Engine and Component Identification

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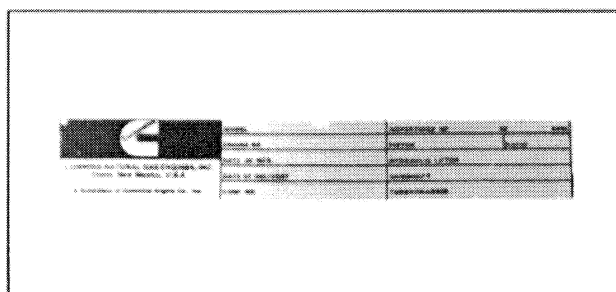
### Engine Model Specifications:

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### Engine Dataplate

Refer to the enclosed illustration for the dataplate location.



### Photo #1-01 - Engine Dataplate

Note: The engine dataplate must not be changed unless approved by Cummins Natural Gas Engines, Inc.

The engine dataplate shows specific information about your engine, such as

- . Model Type
- . Engine Serial Number
- . Date of Manufacture
- . Date of Delivery
- . Configuration No.
- . Advertised HP (Horsepower)
- . Rated RPM (Revolutions Per Minute)
- . Piston Part Number
- . Compression Ratio
- . Camshaft Part Number
- . Turbocharger Part Number

\* The date of delivery will be stamped on the dataplate by the local Cummins Distributor or authorized CNGE Dealer at the time of new engine inspection. The date of delivery will be used as a starting point to measure warranty for the end user customer.

## ENGINE AND COMPONENT IDENTIFICATION (Cont'd)

### How to Identify Your Engine

The model name provides the following data:

**G T A 855 B**

- B** = Higher Hp than Model
- A** = "A" & Piston Cooled
- 855** = Displacement (C.I.D.)
- T** = Aftercooled
- G** = Turbocharged
- G** = Gas Engine-Spark Ignited

**G T A 19**

- 19** = Displacement (Liters)
- A** = Aftercooled
- T** = Turbocharged
- G** = Gas Engine-Spark Ignited

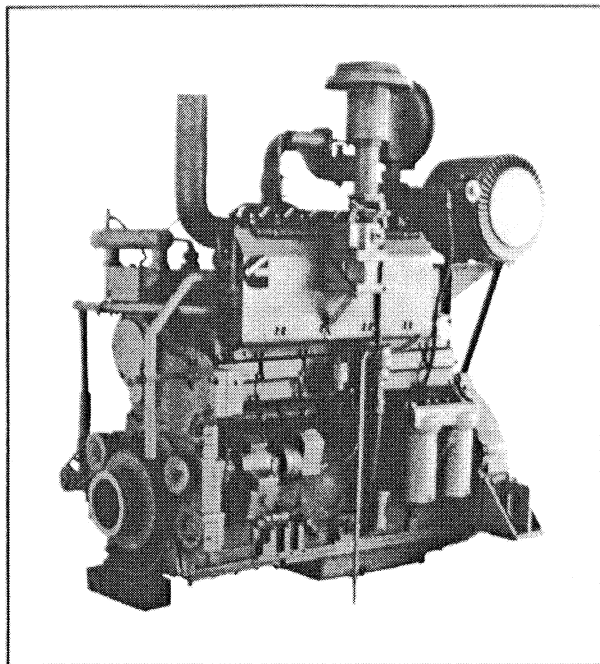


Photo: # 1-02 - GTA19

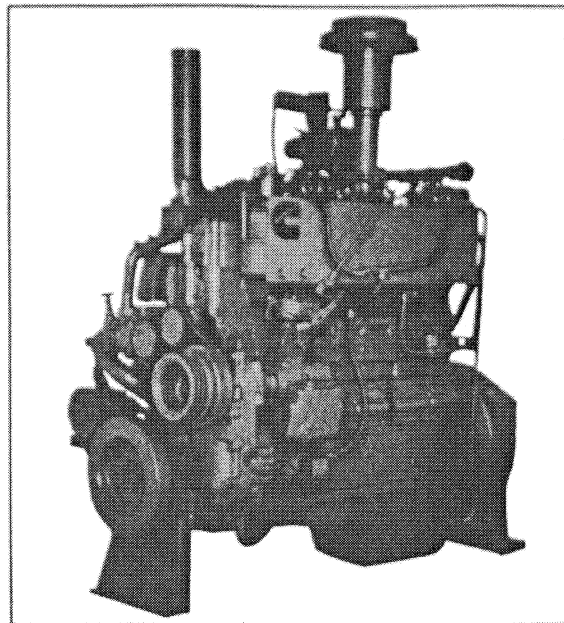


Photo # 1-03 - GTA855B

### Turbocharger Data Plate

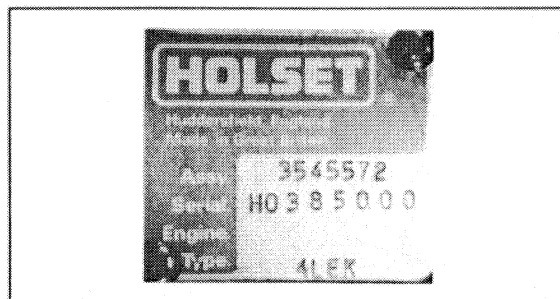


Photo # 1-04 Turbocharger Data Plate

### External Engine Components

The illustrations that follow show the locations of the major external engine components, filters and other service and maintenance points. Some external components will be at different locations for different engine models.

Note: The illustrations are only a reference to show a typical engine.

## Engine and Component Identification (Cont'd)

### GTA855-B - Aftercooler Side

1. Fan Hub
2. Aftercooler
3. Ignition Generator
4. Alternator
5. Ignition Coils
6. Governor
7. Throttle Butterfly
8. Vibration Damper
9. Gas Regulator
10. Fuel Shutoff Valve
11. Fuel Primer
12. Boost Limiter
13. Air Cleaner

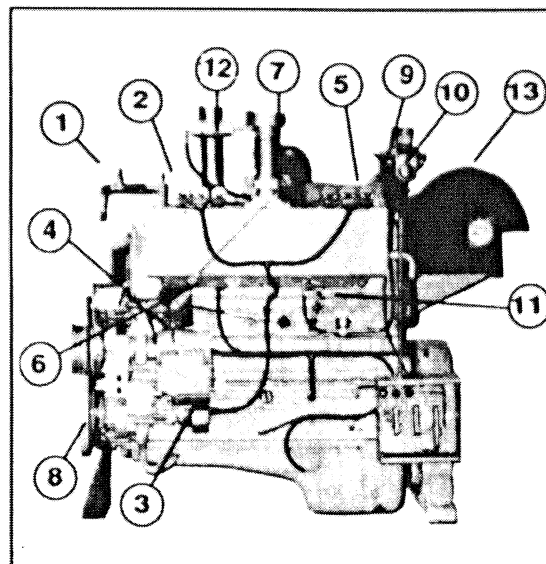


Photo # 1-05 GTA855-B Aftercooler Side

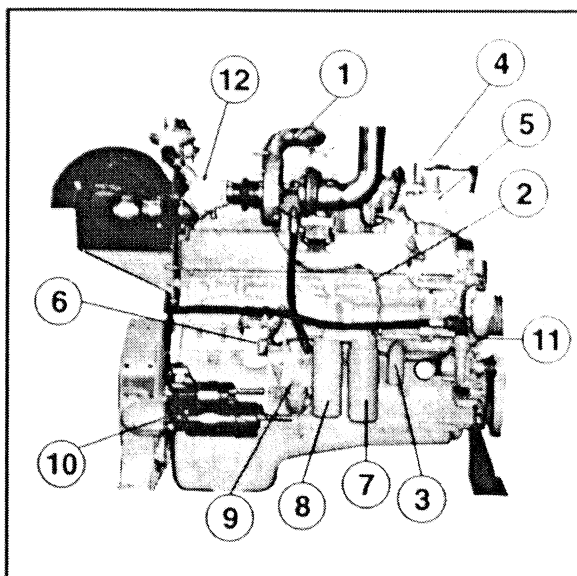


Photo # 1-06 - GTA855-B Exhaust Side

### GTA855-B - Exhaust Side

1. Turbocharger
2. Oil Cooler
3. Coolant Inlet
4. Coolant Outlet
5. Thermostat Housing
6. Coolant Filter
7. Lubricating Oil Full Flow Filter
8. Lubricating Oil By-Pass Filter
9. Dipstick Location
10. Starter
11. Auxiliary Water Pump
12. Carburetor

## Engine Model Specifications

Note: Listed below are the general specifications for each engine model. Refer to the specific System Section for additional specifications.

### G12

EngineSpeed(RPM) at standard rating- - - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No.of cylinders - - - - - 6  
 Displacement - - - - - 12.2 liters [743 C.I.D.]  
 Bore - - - - - 130mm [5.125 in.]  
 Stroke - - - - - 153mm [ 6.0 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5 : 1, 10 : 1, 12 : 1  
 Propane - - - - - 8.5 : 1, 10 : 1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 2600 lbs.  
 Firing Order- - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .69mm [.027 in.]

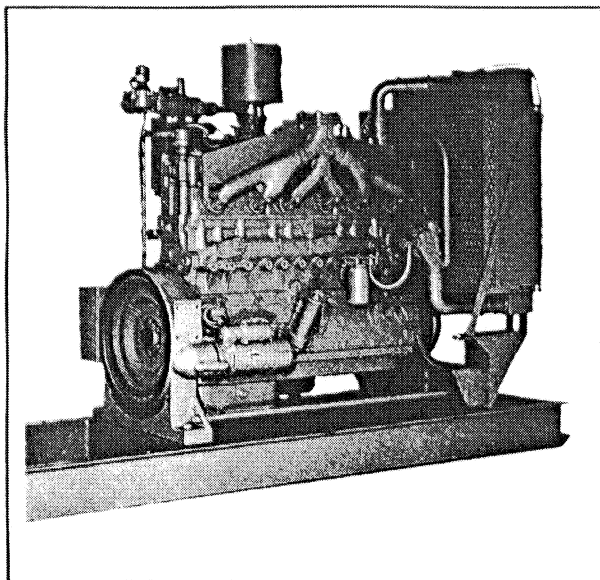


Photo # 1-07 - G12

### GTA12

EngineSpeed(RPM) at standard rating- - - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No.of cylinders - - - - - 6  
 Displacement - - - - - 12.2 liters [743 C.I.D.]  
 Bore - - - - - 130mm [5.125 in.]  
 Stroke - - - - - 152mm [ 6.0 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5:1, 10:1  
 Propane - - - - - 8.5:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 2700 lbs.  
 Firing Order - - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .69mm [.027 in.]

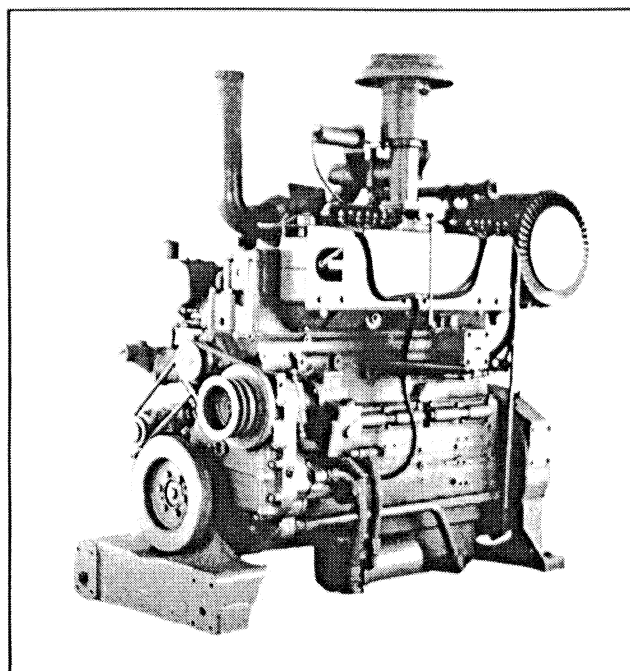
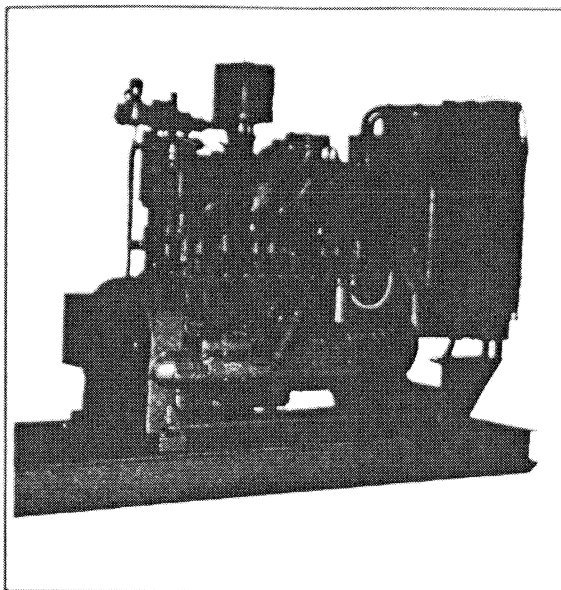


Photo # 1-08 - GTA12



**Photo # 1-09 - G855**

### **G855**

Engine Speed (RPM) at standard rating - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No. of cylinders - - - - - 6  
 Displacement - - - - - 14.0 liters [855 C.I.D.]  
 Bore - - - - - 140mm [5.5 in.]  
 Stroke - - - - - 152mm [6.0 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5:1, 10:1, 12:1  
 Propane - - - - - 8.5:1, 10:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 2870 lbs.  
 Firing Order - - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .85mm [.033 in.]

### **GTA855-A**

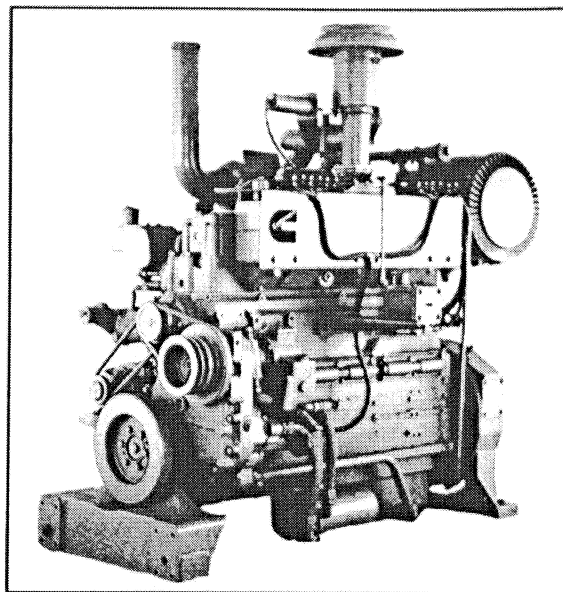
Engine Speed (RPM) at standard rating - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No. of Cylinders - - - - - 6  
 Displacement - - - - - 14.0 liters [855 C.I.D.]  
 Bore - - - - - 140mm [5.5 in.]  
 Stroke - - - - - 152 mm [6.0 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5:1, 10:1  
 Propane - - - - - 8.5:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 2970 lbs.  
 Firing Order - - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .85mm [.033 in.]



**Photo # 1-10 - GTA855-A**

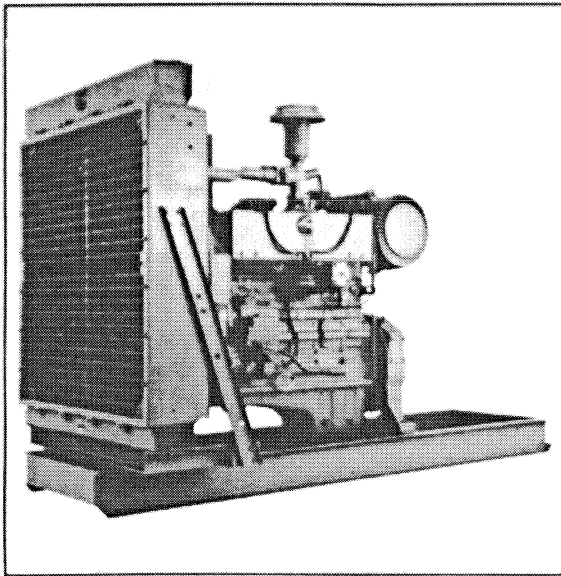


Photo # 1-11 - GTA855-B

**GTA855-B**

Engine Speed (RPM) at standard rating - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No. of Cylinders - - - - - 6  
 Displacement - - - - - 14.0 liters [855 C.I.D.]  
 Bore - - - - - 140 mm [5.5 in.]  
 Stroke - - - - - 152 mm [6.0 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5:1, 10:1  
 Propane - - - - - 8.5:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 2970 lbs.  
 Firing Order - - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .85mm [.033 in.]

**GTA19**

Engine Speed (RPM) at standard rating - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No. of Cylinders - - - - - 6  
 Displacement - - - - - 18.8 liters [1150 C.I.D.]  
 Bore - - - - - 159 mm [6.25 in.]  
 Stroke - - - - - 159 mm [6.25 in.]  
 Available Compression Ratio  
 Natural Gas - - - - - 8.5:1, 10:1  
 Propane - - - - - 8.5:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 3800 lbs.  
 Firing Order - - - - - 1-5-3-6-2-4  
 Valve Settings (Room Ambient Temperature)  
 Intake Valve - - - - - .36mm [.014 in.]  
 Exhaust Valve - - - - - .69mm [.027 in.]

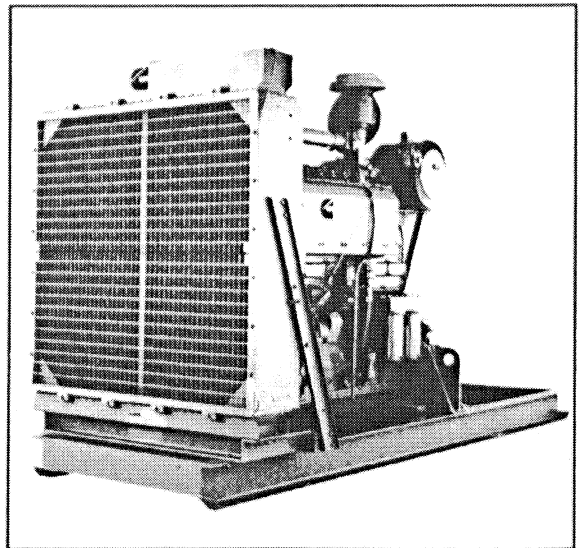


Photo # 1-12 - GTA19

**GTA28**

Engine Speed (RPM) at standard rating - - - 1800

Note: Refer to the engine datasheet for optional engine speed rating.

No. of Cylinders - - - - - 12

Displacement - - - - - 28.0 liters [1710 C.I.D.]

Bore - - - - - 140 mm [5.5 in.]

Stroke - - - - -152 mm [6.0 in.]

### Available Compression Ratio

Natural Gas- - - - - 8.5:1, 10:1

Propane - - - - - 8.5:1

Note: Refer to engine dataplate for your specific compression ratio.

Dry Engine Weight - - - - - 6960 lbs.

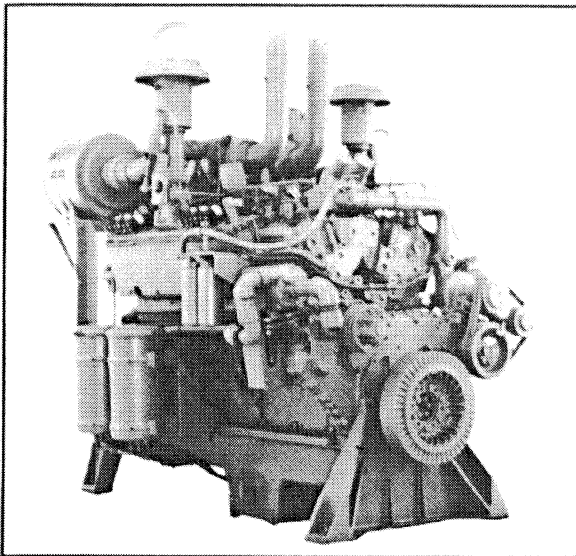
Firing Order - - - - - 1L-6R-2L-5R-4L-3R

6L-1R-5L-2R-3L-4R

Valve Settings (Room Ambient Temperature)

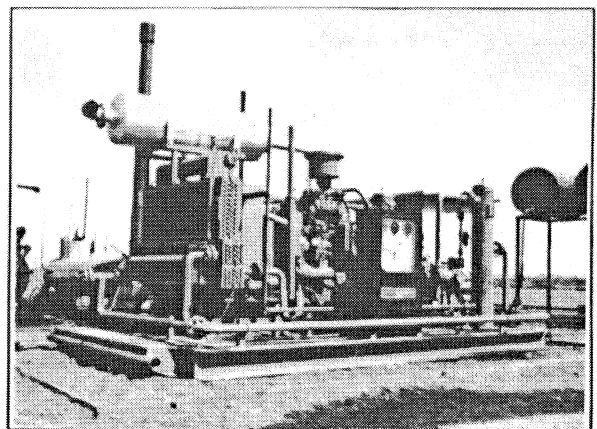
Intake Valve - - - - - .36mm [.014 in.]

Exhaust Valve - - - - - .85mm [.033 in.]



**Photo # 1-13 - GTA28**

### Reference Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



**SECTION 2 - INTRODUCTION****Contents**

About the Manual	----- 2-1
Abbreviations Used in this Manual	----- 2-1
Safety Precautions / Warnings	----- 2-2

**INTRODUCTION****About the Manual**

This manual contains information needed to correctly operate and maintain your engine as recommended by Cummins Natural Gas Engines, Inc. Additional service literature (Shop Manual, Troubleshooting and Repair, etc. ) that is primarily for the CUMMINS DIESEL may contain information that will be helpful and can be ordered from your local Cummins distributor.

This manual does not cover equipment maintenance procedures. Consult the equipment manufacturer for specific maintenance recommendations.

Both metric and U.S. customary values are listed in this manual. The metric value is listed first, followed by the U.S. customary in brackets.

Each section is preceded by a "Table of Contents" page to aid in locating information more quickly.

**Abbreviations Used in this Manual**

A	Aftercooled
API	American Petroleum Institute
ASTM	American Society of Testing and Materials
BHP	Brake Horsepower
BTU	British Thermal Units
C	Celsius
CCW	Counter Clockwise
C.I.D.	Cubic Inch Displacement
CM	Centimeter
cSt	Centistokes
CW	Clockwise
cu.	Cubic
DBTDC	Degrees Before Top Dead
Center	
DCA	Diesel Coolant Additive

F	Fahrenheit
FTM	Federal Test Method
ft.	Feet
ft-lb	Foot Pound
"G"	Ground
"G"	Gas-Spark Ignited
"H"	High
Hg	Mercury
HHV	High Heat Value
HP	Horsepower
hr.	Hour
H <sub>2</sub> O	Water
in.	Inch
in-lb	Inch Pound
kg	Kilogram
kPa	Kilopascal
"L"	Low
l	Liter
lb.	Pound
LHV	Lower Heat Value
max.	Maximum
m	Meter
min.	Minimum
mm	Millimeter
MPa	Megapascal
NA	Naturally Aspirated
N	Newton
N•m	Newton-meter
O <sub>2</sub>	Oxygen
OEM	Original Equipment Manufacturer
ppm	Parts Per Million
psi	Pounds Per Square Inch
PWB	Parts Warranty Bulletin
qt.	Quart
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
ST	Service Tool
T	Turbocharged
(™)	Trademark
U.S.	United States
"VS"	Valve Set
WB	Warranty Bulletin
W.C.	Water Column
WF	Water Filter

## General Safety Precautions and Warnings

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that must be followed to provide personal safety. Special safety precautions have been included in the procedures when they apply.

**Note:** It is not possible for Cummins Natural Gas Engines, Inc. to anticipate every possible circumstance that can involve a potential hazard.

**Warning** Disconnect the battery and discharge any capacitors before beginning any repair work. Disconnect the air starting motor, if equipped, to prevent accidental engine starting. Put a "Do Not Operate" tag in the operator's compartment or on the controls.

**Warning** Always shut down your CNG Spark-Ignited engine by either using an automatically operated fuel shutdown valve as close to the engine as possible or by shutting off the manual shutoff valve upstream of the gas pressure regulator and allowing the engine to burn off all residual fuel-gas. CNGE recommends that all fuel-gas be shut off before turning off the ignition switch.

**Warning** Use ONLY the correct crankshaft barring techniques for manually rotating the crankshaft. Do not attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s), causing premature fan failure. Always shut off the fuel supply and ground the ignition before manually barring the engine.

**Warning** If an engine has been operating, and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.

**Warning** Do not work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or correct stands to support the product before performing any service work.

**Warning** To avoid burns, be alert for hot component parts just after the engine has been shut off and hot fluids in lines, tubes, and compartments.

**Warning** Relieve all pressure in the air, fuel, oil, and cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that uses pressure. Do not check for pressure leaks with your hand. High pressure oil or water can cause personal injury.

**Warning** Corrosion inhibitor contains alkali. Do not get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do not swallow internally. If skin is contacted, immediately wash with soap and water. In the event eyes are contacted, immediately flood with water for a minimum of fifteen minutes. **IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.**

**Warning** Always use tools that are in good condition. Make sure you understand how to use them before performing any service work.

**Warning** Always use the same fastener part number (or equivalent) when replacing fasteners. Do not use a fastener of lesser quality if replacements are necessary.

**Warning** Never use gasoline or other flammable materials to clean parts. Always use approved cleaning solvent.

**Warning** Use caution when working around a spark-ignited CNG engine. Never expose the engine to an open flame or spark.

## SECTION 3 - OPERATING PRINCIPLES

### CONTENT

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Table #3-01 Industrial  
Continuous Duty  
HP Ranges - - - - - page 3-2

Cummins Natural Gas  
Combustion Cycle - - - - - page 3-2

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Manual Gas Shut-Off Valve - - - - - page 3-4

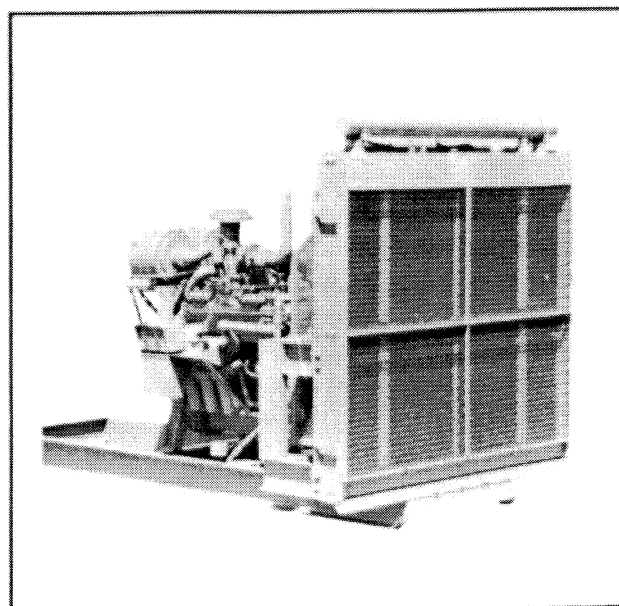
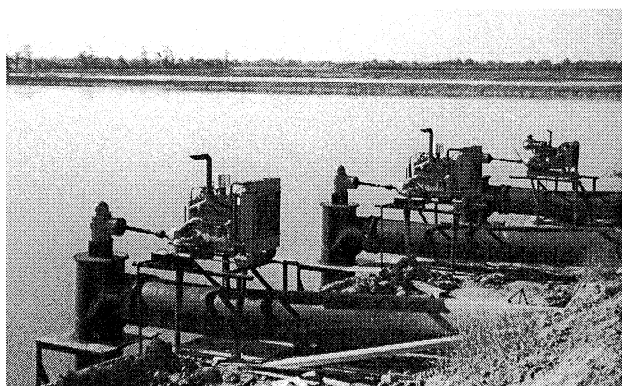
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Automatic Gas Shut-Off Valve - - - - - page 3-5

Engine Mounted Pressure  
Regulator - - - - - page 3-5

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### The Fuel System

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Shielded Ignition - - - - - page 3-7

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The Cooling System - - - - - page 3-9

Aftercooler Circuit - - - - - page 3-9

The Air System - - - - - page 3-11

## CUMMINS NATURAL GAS ENGINES OPERATING PRINCIPLES

The most satisfactory service can be expected from a CNGE Spark-Ignited Engine when the operation procedure is based on a clear understanding of the engine working principles. Each part of the engine affects the operation of every other working part and of the engine as a whole. CNGE Engines described in this manual are four-stroke-cycle engines that burn a spark-ignited, controlled mixture of fuel-gas and air. The fuel-gas may be a pipeline quality of natural gas or a liquid propane gas (HD-5) or in some cases a "field" gas.

Horsepower ratings and other engine specifications are tabulated in Table #3-01.

**Table #3-01 - Industrial - BHP -  
Continuous Duty \*\***

Engine Models	Displ. Cu. In.	Aspiration *	HP Range
G12	743	N	98 to 167
G855	855	N	117 to 200
GTA12	743	TA	167 to 250
GTA855-A	855	TA	184 to 275
GTA855-B	855	TA	189 to 304
GTA19	1150	TA	256 to 400
GTA28	1710	TA	400 to 630

\* N = Naturally Aspirated  
T = Turbocharged  
A = Aftercooled

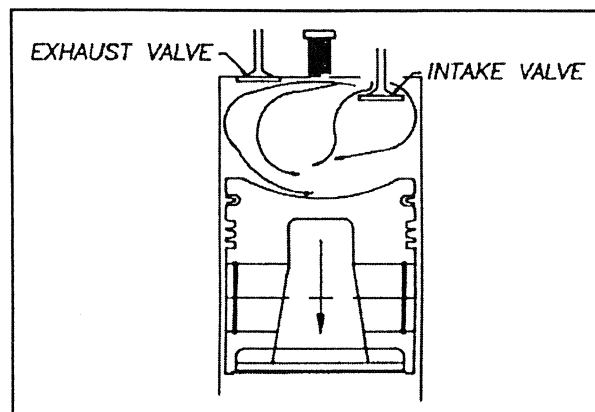
\*\* Continuous horsepower ratings are based on operation up to 457m [1500 ft.] and 38°C [100°F] on naturally aspirated engines and 1524m [5000 ft.] and 38°C [100°F] on turbocharged engines.

## Cummins Natural Gas Combustion Cycle

CNGE engines operate under the principle of a four cycle engine. A four cycle engine will go through four strokes of the piston during two complete revolutions of the crankshaft. The four strokes in proper order are: Intake Stroke, Compression Stroke, Power Stroke, and Exhaust Stroke.

### Intake Stroke

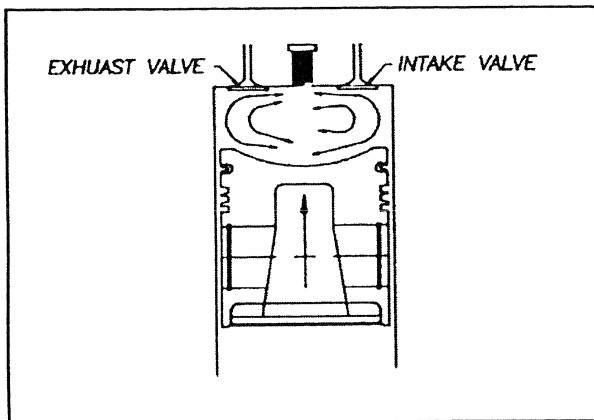
During the intake stroke, the piston travels downward permitting air and fuel-gas mixture from the carburetor to enter the combustion chamber through the open intake valves.



Sketch #3-02 - Intake Stroke

### Compression Stroke

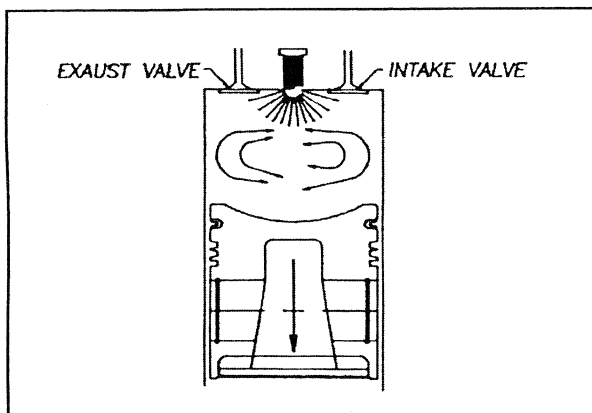
At the end of the intake stroke, the intake valves close and the piston starts upward on the compression stroke. The exhaust and intake valves remain closed. At the end of the compression stroke, the air and fuel-gas mixture in the combustion chamber are forced by the piston to occupy a space that is considerably smaller than the space it occupied at the beginning of the stroke. For example: if the space is reduced by a factor of twelve, we would say that the compression is 12:1. Near the end of the compression stroke and before top dead center, the mixture will be ignited by the spark plug.



Sketch #3-03 - Compression Stroke

### Power Stroke

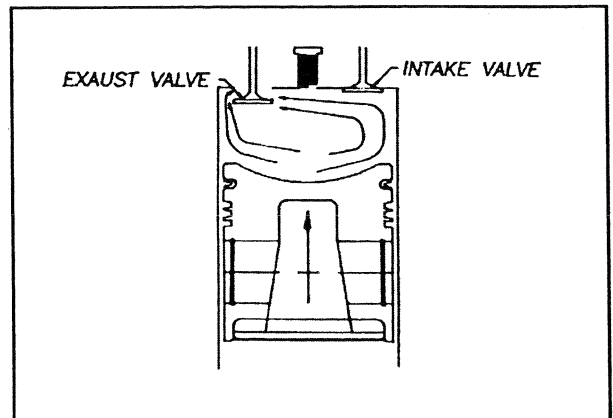
During the power stroke, with both the intake and exhaust valves closed, the burning fuel causes an increase in temperature, expanding the gas volume and increasing the pressure above the piston, which pushes the piston downward and adds impetus to the crankshaft rotation.



Sketch #3-04 - Power Stroke

### Exhaust Stroke

During the exhaust stroke, the exhaust valves are open, the intake valves are closed, and the piston is on its upstroke. The upward travel of the piston forces burned gases out of the combustion chamber through the open exhaust valve ports in to the exhaust system.



Sketch #3-05 - Exhaust Stroke

### The Fuel System

Fuel must be clean, free of acids, sulphur, and halogen compounds, water, pipe scale, and other foreign materials that could cause corrosion or abrasion of cylinder liners, bearings, and internal engine parts. Dry processed natural gases usually have the liquids removed and contain primarily methane and a small percent of ethane gases. This type of gas is generally about 1000 BTU/cu. ft. H.H.V. (high heat value) and can be used in all Cummins Natural Gas Engines.

The application of CNGE engines on HD-5 liquid propane and non-processed gas requires careful analysis of the fuel to decide the proper compression ratio selection. Check with your CNGE dealer or distributor for proper compression ratio and power rating for individual applications.

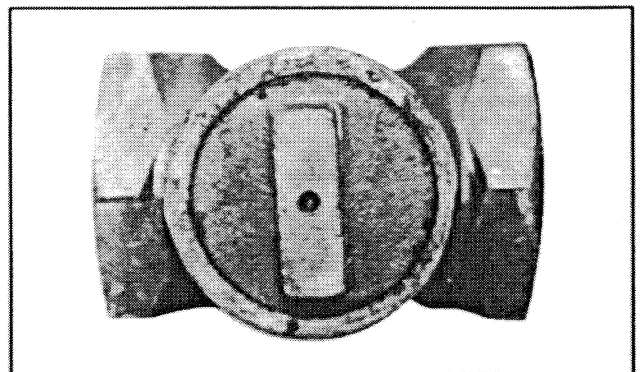
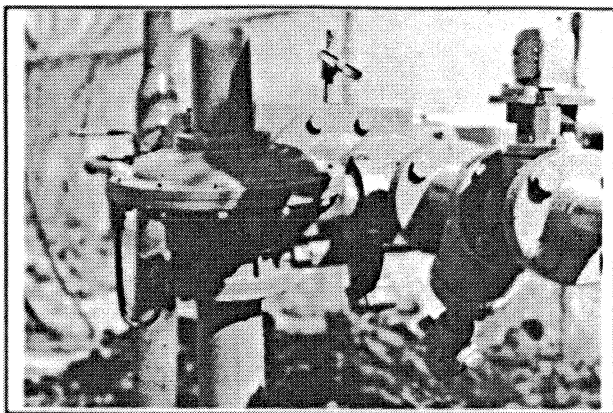


Photo #3-06 - Manual Gas Shut-Off Valve



**Photo #3-07 - Line Pressure Regulator**

Located between the gas supply line and the engine intake manifold are the following units that make up the fuel system:

1. Manual Gas Shut-Off Valve
2. Line Pressure Regulator
3. Gas Filter
4. Automatic Gas Shut-Off Valve
5. Engine Mounted Pressure Regulator
6. Carburetor
7. Butterfly Valve
8. Charge Air Cooler (Turbocharged)
9. Boost Limiter (Turbocharged Engines)

### Manual Gas Shut-Off Valve

This valve, on dry pipeline natural gas, will generally be found upstream on the gas system. The local gas company will normally supply this valve.

### Line Pressure Regulator

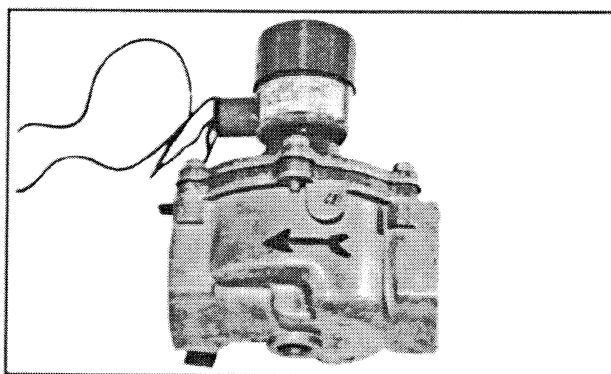
The line gas pressure regulator is required to reduce the gas from its line pressure down to a maximum of 125 psi or less. The minimum outlet pressure must never be lower than 2 psi if the Engine Mounted regulator is a Fisher regulator, or 15 inches of W.C. (water column) if a Maxitrol regulator.

### Gas Filter

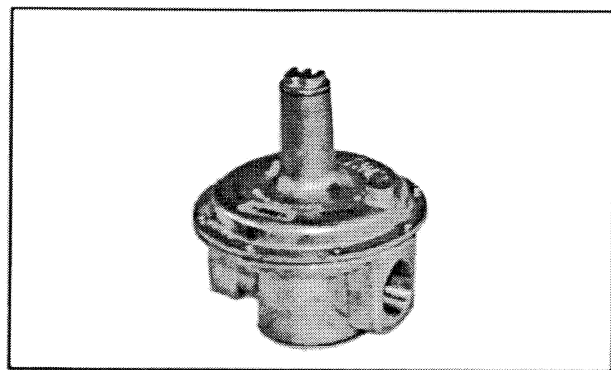
The filter is a single pass element made of pleated paper and will filter down to a five micron particle size. The filter should be inspected regularly and replaced when necessary. Refer to the maintenance schedule listed in this manual.

This filter may plug prematurely if subjected to liquid contaminants in the fuel-gas causing a restriction of gas flow.

**CAUTION:** It is important that the filter is installed with the gas flow going from the outside toward the inside of the element.



**Photo #3-08 - Automatic Gas Shut-Off Valve**



**Photo #3-09 - Engine Pressure Regulator**

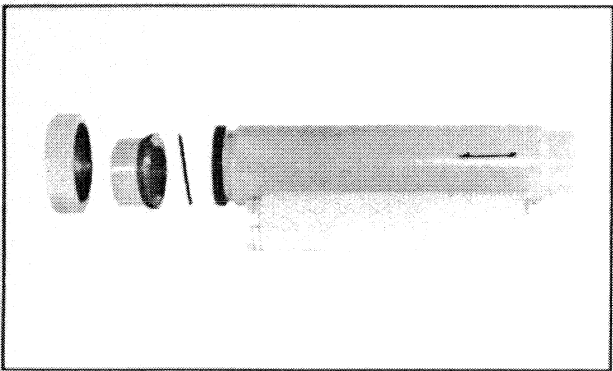


Photo #3-10 - Gas Filter

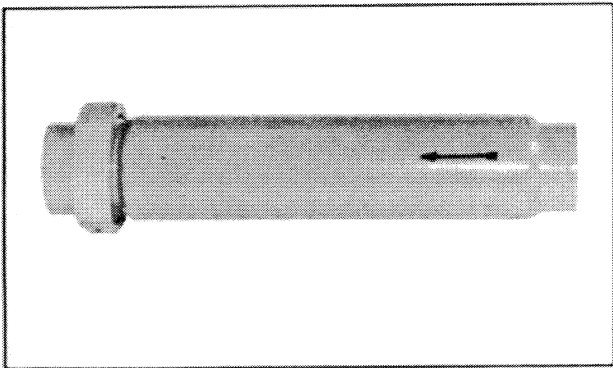


Photo #3-11 - Gas Filter

### Automatic Gas Shut-Off Valve

A gas shut-off valve may be mounted between the line pressure regulator and the gas filter to assure a positive gas shut-off. The valve may be operated manually, electrically, or actuated from the ignition system or oil pressure as a safety system.

**CAUTION:** When installing the gas shut-off valve, it is important to insure that the arrow (if equipped) is pointing in the direction of gas flow.

**CAUTION:** Do not mount gas shut-off valve between engine mounted regulator and carburetor.

### Engine Mounted Pressure Regulator

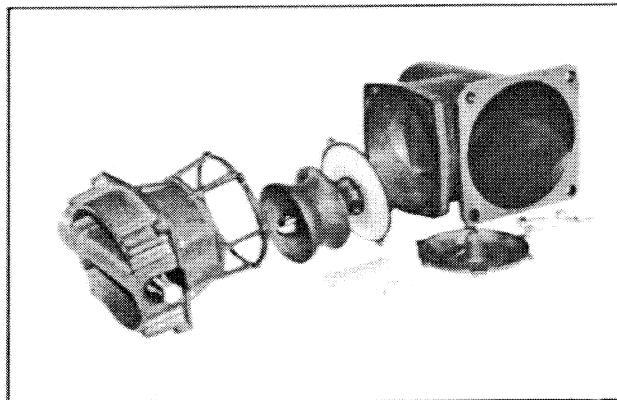
The engine mounted pressure regulator will reduce the gas pressure at the engine down to a working pressure at the carburetor of from three to five inches of W.C.. Refer to Table 3-12 for information concerning specific regulators.

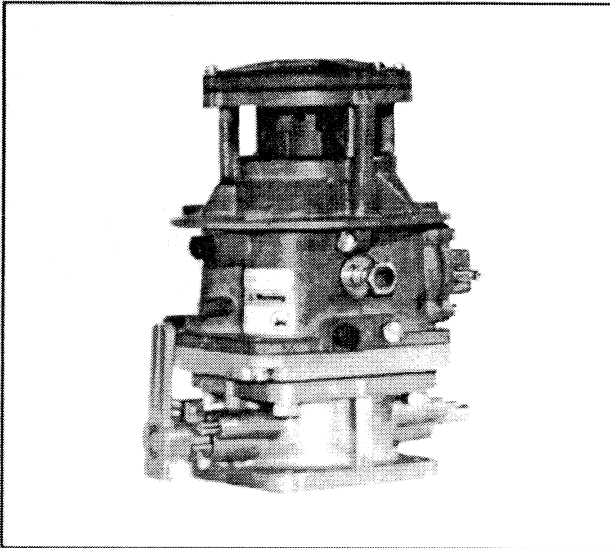
Table #3-12 - Gas Pressure Regulators

Engine Models	Regulators (Maxitrol)
G12	RV 60
G855	RV 60
G28	RV 60
GTA12	RV 81
GTA855-A	RV 81
GTA855-B	RV 81
GTA19	RV 91
GTA28	RV 91

**Note:** Regulators have been sized for a gas flow with an LHV of 905 BTU at 0.6 specific gravity at 16° C [60° F].

Photo #3-13 - Disassembled Carburetor





**Photo #3-14 - Carburetor**  
**Carburetor**

The air-gas valve controls the air-gas mixture that flows through the carburetor. The air-gas valve meters both air and fuel gas in proper proportions at any throttle setting. It also seals gas flow when the engine is off and provides an automatic choke action during starting.

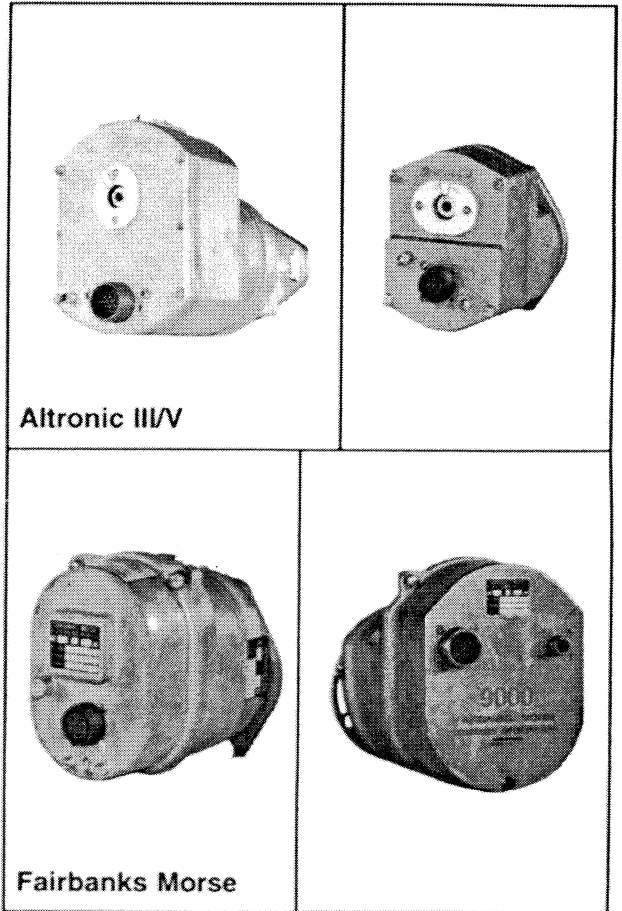
The butterfly valve controls the flow of air through the carburetor on to the intake manifold. The air metering valve, which is mounted on a diaphragm, measures this air flow. As the air flow increases, the higher the air metering valve will rise.

The gas metering valve that is connected directly to the air valve will rise the same amount. The gas valve is designed to admit the correct amount of gas at any height to which the air metering valve rises. The natural gas pressure to the carburetor inlet should be between three to five inches of W.C. from no load to a full load condition.

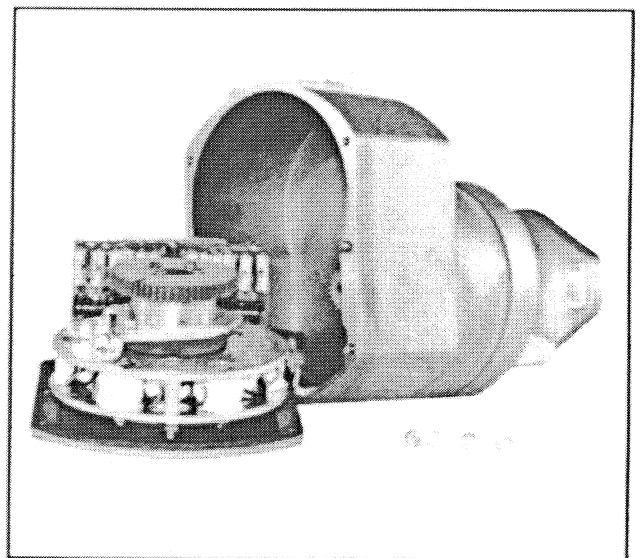
Refer to Table #3-15 for the specific carburetor for your engine model.

**Table #3-15 - Carburetors**

Engine Model	Impco Model #
G12	425
G855	425
GTA12	600 VF(vari-fuel)
GTA855-A	600 VF
GTA855-B	600 VF
GTA19	600 VF
GTA28	600 VF(2)



**Photo #3-16 - Ignition Generators**



**Photo #3-17 - Altronic III Breakdown**



## IGNITION SYSTEM

The Cummins Natural Gas Engine currently uses the Altronic Ignition System as standard with the Fairbanks Morse System as an option.

The Altronic V is used on the G8, G12, GTA12, G855, GTA855-A & -B engine models and the Altronic III is also available as an option on the four and six cylinder engines.

The Altronic III unit is a self-contained 12-pole permanent magnet alternator powering a solid state timing and distribution circuit. A wiring harness and ignition coil for each spark plug complete the system.

The Altronic V unit is a self-powered, low tension, capacitor discharge ignition system consisting of an 8-pole permanent magnet alternator, timing, and distribution circuits. A wiring harness and one ignition coil per cylinder complete the system.

Some applications may require the use of a shielded ignition system. This generally means that the spark plug, spark plug coil, low tension wires, and spark plug wires are inside the protective shield.

There are two types of shielded spark plugs: (1) Aircraft style shielded spark plugs, and (2) Shielded integral coil spark plugs. CNGE recommends the use of aircraft style shielded plugs when shielded ignition systems are required.

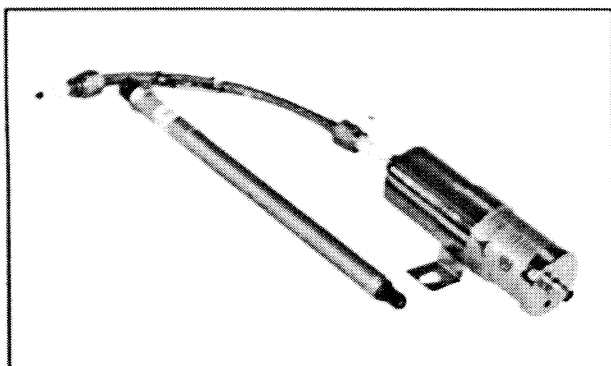


Photo #3-18 - Shielded Ignition System

## Primer Valve

On low pressure systems, a gas primer is used to promote starting. CNGE uses two types of primer valves.

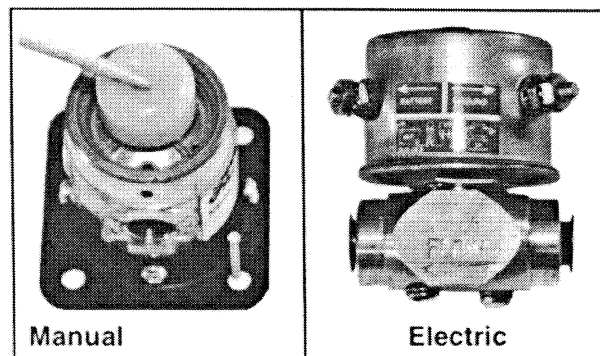


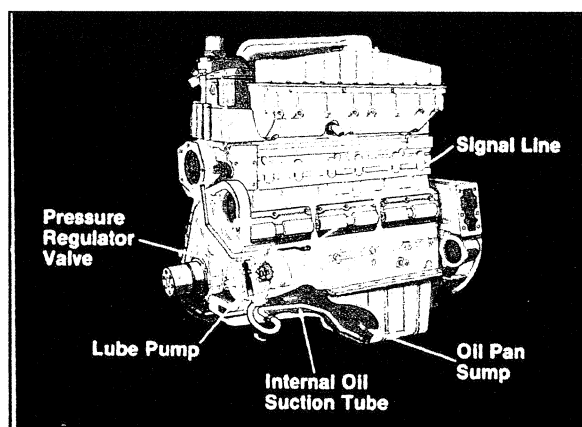
Photo #3-19 - Gas Primer Valve

## THE LUBRICATION SYSTEM

Cummins Natural Gas Engines, Inc. engines are pressure lubricated. The pressure is supplied by a gear-driven positive displacement lubricating oil pump.

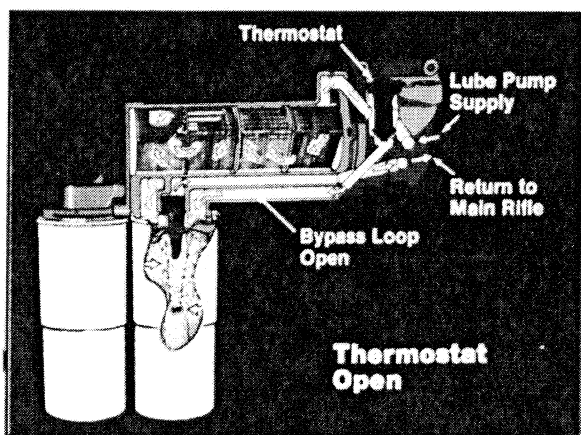
A pressure regulator is mounted in the lubricating oil pump housing to control lubricating oil pressure.

A by-pass valve is provided in the full-flow oil filter as insurance against interruption of oil flow by a dirty or plugged element.



Flow Diagram #3-20 - Lube Oil System  
GTA855-B

1. Oil is drawn into the pump through an external oil line connected to the oil pan on all G12, GTA12 and the small cam G/GTA855 engines.  
The GTA28, GTA19 and the GTA855-B (Big Cam III) engines use an internal oil suction line to the engine oil pump.
2. Oil flow on the twelve cylinder engines (GTA28) is from the oil pump to the engine mounted oil cooler directly into the engine mounted full flow oil filter. From the filter, the oil flows through the rear of the cylinder block to the main oil rifle. The oil then flows to each bank and to all moving parts within the engine.

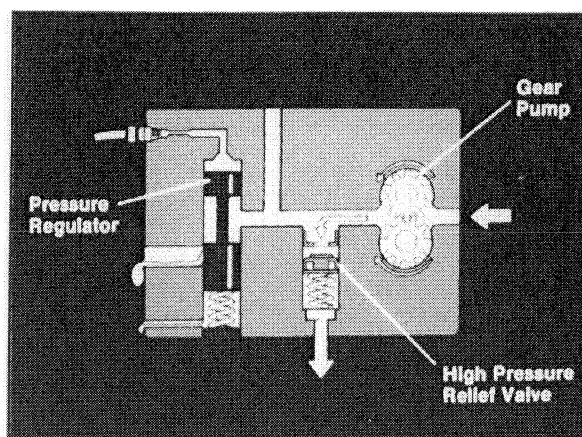


**Flow Diagram #3-21 - Lube Oil System  
GTA855-B**

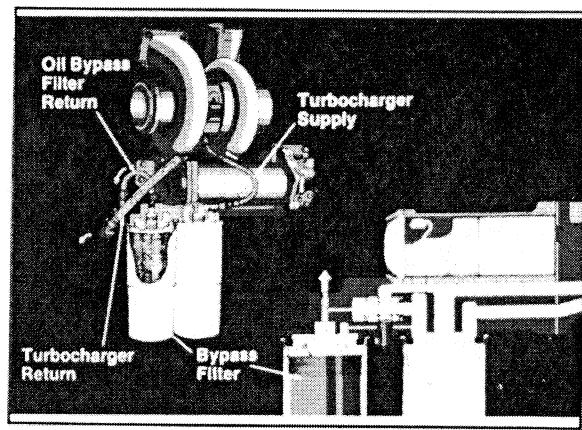
3. Engine oil flow on four and six cylinder engines is from the pump through a full-flow filter back again into the pump casting, to the cylinder block, to the oil cooler, and then to the block cross drilling to the main oil rifle.

An oil header, drilled the full length of the block on the accessory drive side, delivers oil to branch passages and on to moving parts within the engine.

The filter is mounted directly to the rear of the pump or directly beneath the oil pump. On some models, the filter is mounted below the oil cooler package.



**Flow Diagram #3-22 - Lube Oil System  
GTA855-B**



**Photo #3-23 - Lube Oil System  
GTA855-B**

4. Oil pipes, or a combination of pipes and passages, carry oil from the oil galley to the upper rocker housings and various drilling throughout the block, crankshaft, connecting rods, rocker levers, and oil spray nozzles completing the oil circulating system.
5. Lubricating oil pressure is controlled by a pressure regulator located in the lubricating oil pump casting.
6. Turbocharged engine applications at the high load factors when operating under a continuous or prime power rating may require a bypass filter in the lubricating oil circuit. The addition of the by-pass filter will help remove the smaller wear particles that can create premature engine wear.

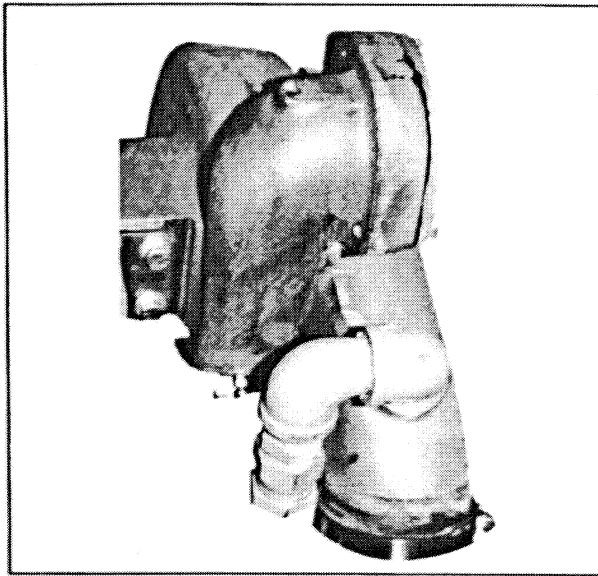
*Lube Oil Specifications are in Section 7 & 17.*

## THE COOLING SYSTEM

On four and six cylinder engines, except the GTA19, coolant is circulated by a centrifugal-type water pump mounted in the block at the gear cover end and driven by a belt(s) from the accessory drive. The GTA19 has a gear driven water pump.

The water circulates through the water header around the wet-type cylinder liners and through the cylinder head. Discharge connections between the heads are provided by a water manifold.

The water manifold houses a single thermostat to control engine operating temperature.



**Photo #3-25 - GTA28 - Water Pump**

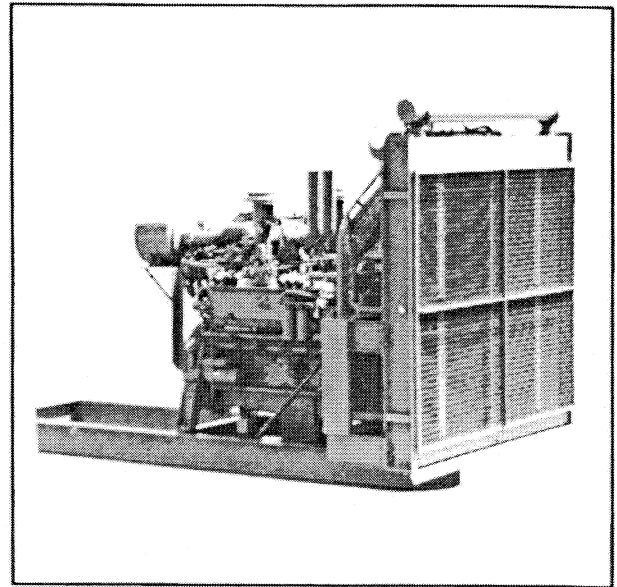
On 12 cylinder engines, coolant is circulated by a centrifugal-type water pump mounted on the front of the engine and driven by belts from the accessory drive.

The coolant is drawn from the radiator or heat exchanger by the water pump and delivered to the oil cooler, then to the center of the block, through the ports, to the cylinder block water jackets and the cylinder heads.

Then, the coolant flows into a return header surrounding the water-cooled exhaust manifolds (if equipped). The hot exhaust quickly warms the cold water when the engine is started and keeps it warm during slow-speed and light-speed operations.

From the header, the water goes to the thermostat housing where it is directed to the radiator for cooling. If the water has not been heated sufficiently enough to actuate the thermostats (vented type), it will be directed through a by-pass tube to the water pump for recirculation.

The engine coolant is cooled by a radiator or by heat exchangers, depending on the type of installation.



**Photo #3-26 - GTA28 - Radiator**

### Irrigation Application

The cooling system on irrigation engines consists of a cooling coil in the product water discharge line. This enables the engine to have a cooling system, without the use of a radiator.

### Aftercooler Circuit- Water to Air

Whenever water-cooled aftercoolers are used on turbocharged Cummin Natural Gas Engines, an auxiliary water pump circulates water through the aftercooler and its separate heat exchanger or radiator core.

### Aftercooler Circuit- Air to Air

Several models of CNGE engines use an aftercooler section that uses an air-to-air section of the engine radiator package.

Cummins Natural Gas Engines, Inc. recommends that all cooling systems used on CNGE