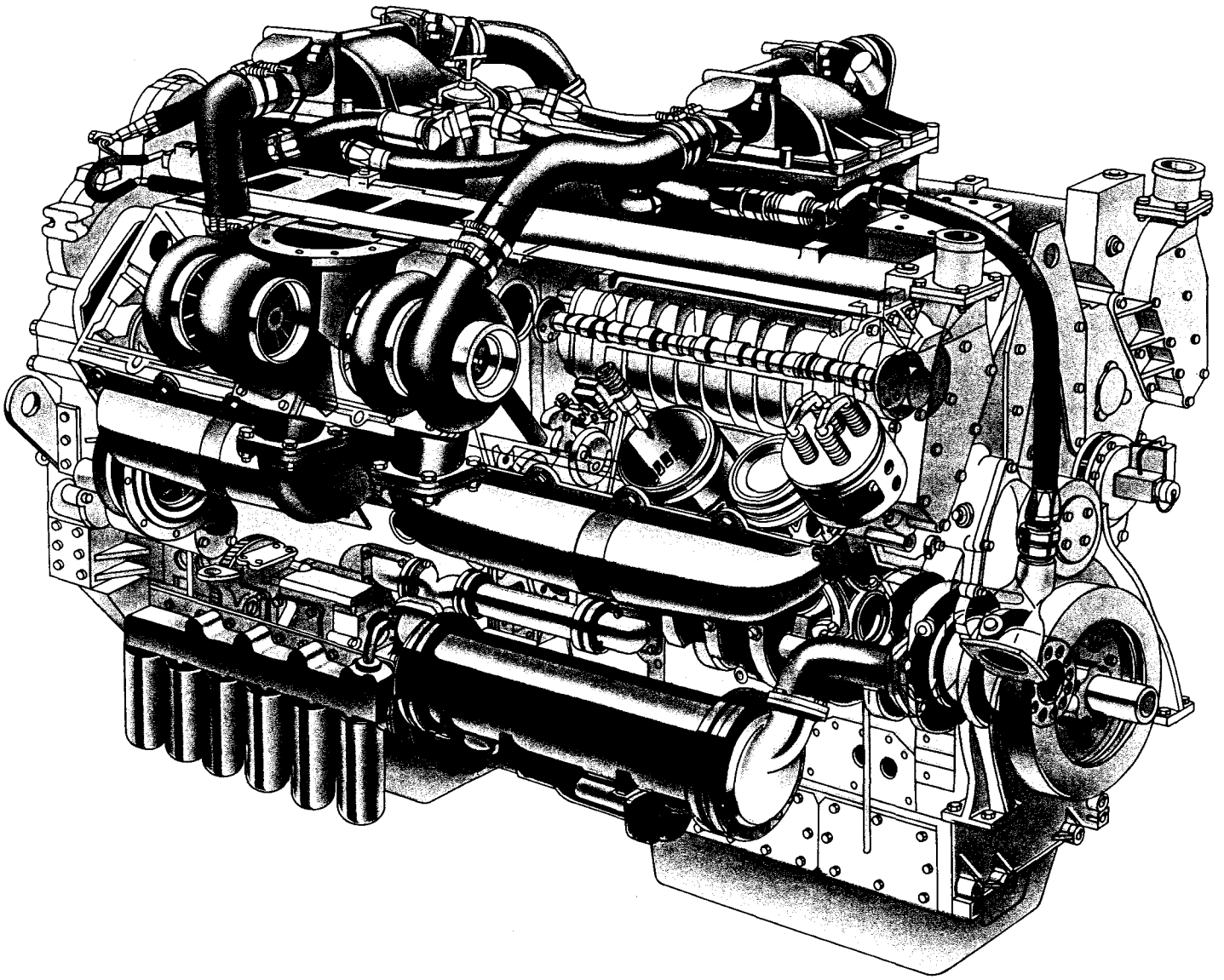
DETROIT DIESEL

The Right Choice for Power Generation



Parts And Service Support After The Sale

Your dealer maintains a stock of quality Detroit Diesel parts and is ready to respond to your needs before, during and after the sale. No matter what those happen to be—including technical support. His servicemen have been trained by our DDC distributor, or at our world training headquarters. He is an expert in the proper application, care and maintenance of your Series 60 engine.

Detroit Diesel Corporation is committed to providing leadership in truck engine value by dedicated people and applied technology. Nowhere is this commitment more evident than in our Series 60 engine.

DETROIT DIESEL ®
CORPORATION

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6SA303 9003 As technical advancements continue, specifications will change. Litho in U.S.A.

Highly Skilled Work Force

It takes a highly skilled and experienced work force to operate the sophisticated machines and computers required to maintain the world class standards for the Series 60.

Each worker we accepted has a minimum of 18 years experience in diesel engine manufacturing. And each is required to participate in an on-going $2 million training program, and receive a minimum of 178 hours , and sometimes as many as 1600 hours, on subjects such as: Computer Numerical Control machine tool programming, robotics, electronics, mathematics, laser machine alignment, statistical process control methods, vibration analysis, and coordinate measurement gauging systems.

Some course work is the equivalent of a two year college associate degree.

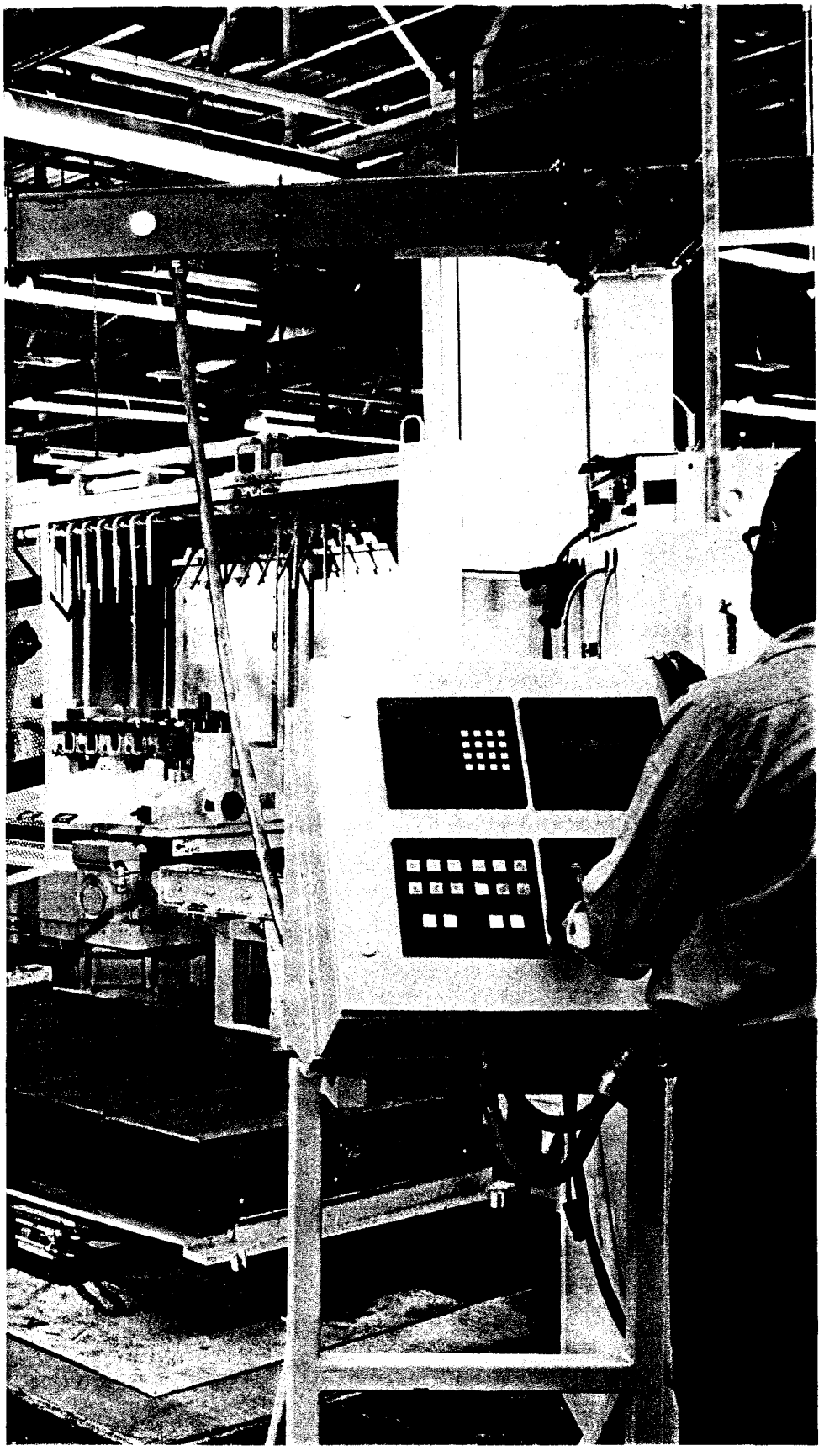
They're All Team Players

There is a new team-oriented manufacturing philosophy at DDC whereby traditional job classifications disappear and are replaced by a total commitment to the goal of world class quality.

Because Series 60 people know more, and have greater capabilities, responsibility for maintaining quality is invested in them, along with the authority to shut down the process at any time, if necessary, rather than compromise quality.

By fulfilling multiple roles as assembler, process engineer and quality inspector, each person has become the focal point of the manufacturing process, not an extension of an assembly line.

When responsible people have power over what they do, quality has nowhere to go but up.



Computerized Manufacturing From Beginning To End

We operate one of the largest computer-controlled flexible manufacturing systems in the world. The result is a unique ability to increase both manufacturing efficiency and product quality, while reducing processing cost and cost to the customer.

Our Redford, Michigan plant is one of the first with totally integrated computer controlled communications system. Gauging equipment, machine tools, computerized assembly systems, and automatic guided vehicles link together to act as an electronic nervous system.

It carefully monitors, records, compares and reports every critical function and activity to prevent problems before they occur.

For instance, if even one bolt is improperly torqued during assembly, the engine will not proceed to the next assembly station until the problem is diagnosed and corrected. Each part must also be verified by machinists, assemblers, and engineers as meeting all specification requirements on a 100 percent basis.

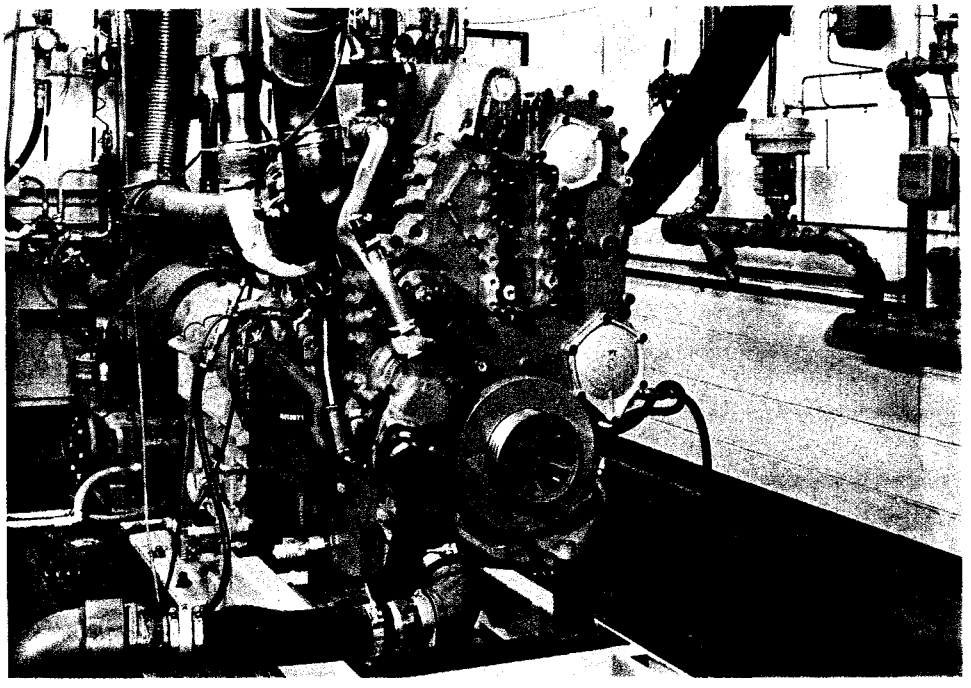
We use the term "zero deviation" to describe the quality standard set for the Series 60. It means no deviations are allowed. Each engine is built to the highest level of quality the first time —every time.

Production Tests— Each Series 60 engine produced must undergo 25 individual checks. These checks cover horsepower, fuel consumption, turbo performance, oil pressure, and oil temperature, just to name a few.

Random Tests— In addition, we have implemented random selection tests conducted by quality audit people for product verification. Engines are randomly selected to undergo extensive dynamometer testing, and are then disassembled for analysis and comparison.

Field Tests— are also conducted to confirm laboratory test results. We fully understand the importance of monitoring the field performance of our Series 60 engines. A comprehensive program has been implemented that continually feeds engine operating data back to the factory and to engineers for analysis and design improvements.

Detroit Diesel's testing standards are the highest in the industry. Because we want your Series 60 to set new standards of quality and performance.



Probing For The Weak Link

When you set out to design and build an engine as unique as the Series 60 you have to revise your way of looking at testing.

We took a 180 degree turn from the traditional "success" concept of testing which says, "If it isn't broken, don't fix it."

Instead, we're using new "failure-based" testing procedures, combined with statistical methods of analysis and computer simulation, to accurately predict and demonstrate the reliability of Series 60 components.

It all began in the earliest concept stages using Finite Element Analysis, a method of modeling a part by computer that allowed us to accelerate the design process and increase part reliability. The computer model was subjected to simulated forces, pressures, and temperatures normally found in actual use to determine failure limits and make improvements before the part was finalized.

Actual prototype parts and engines were then subjected to "probe" tests purposely designed to force component failures. We are the first diesel engine manufacturer to use this method.

Probe testing is a statistically based method widely used in the critically precise aerospace and electronics industries. It allows a better understanding and more accurate predicting of the effects of increased pressure, temperatures, RPM, and fuel rate on component life at predetermined mileage points during operation. Stress factors are increased well above normal operating conditions until the part has failed.

A typical probe test would take a 400 HP engine with 200,000 test miles and increase stress factors in ten steps every 200 hours. After 2000 hours, the engine would produce over 550 HP at 2300 RPM.

Tests That Never End

In addition to probe tests, there are a number of other on-going procedures which monitor engine quality from before the manufacturing process begins until after the engine leaves the assembly line. They include:

SPATE, a Thermoelastic Stress Analyzer that identifies high stress areas as "hot spots."

OPTRON, an Electro-Optical Tracking System that measures and records the motion of operating parts without contact.

Test Cells. These computerized and programmable quality/audit verification cells—along with a teardown area— confirm and maintain high quality, not only during production, but in development of the Series 60 engine.

Development Tests—at each stage of development, prototype engines are subjected to a battery of tests, to ensure engineering design and function.

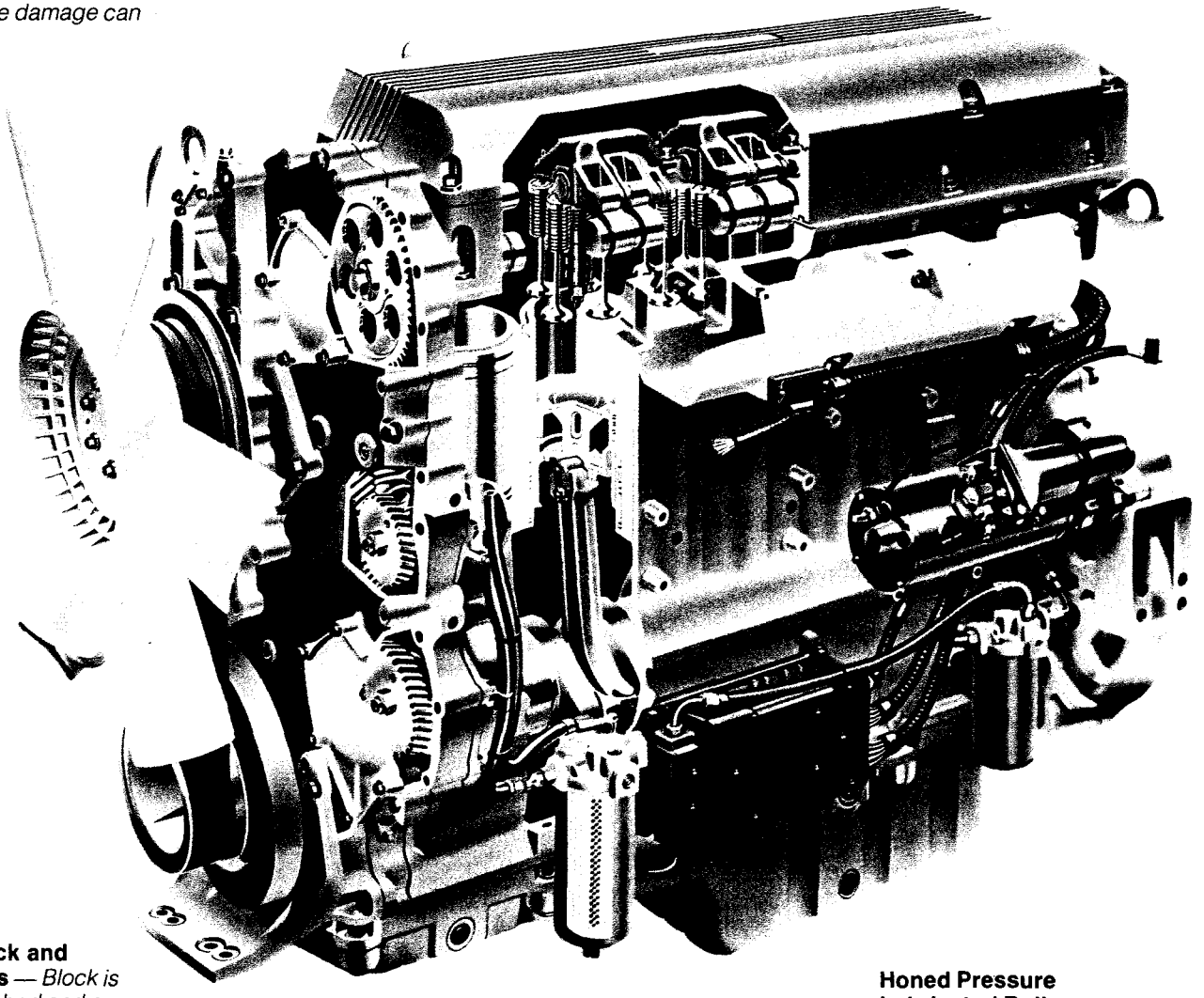
Development engines placed in laboratory and field testing service and monitored by individual engineers assigned to them, have accumulated the equivalent of 17 million combined miles of testing which is much more than past industry practice.

ıid Weep Hole — *is ›vided in the unlikely currence of an upper seal ter leak. It will leak exter- lly instead of internally to crankcase. This also ›ws easy identification of a ›blem before damage can cur.*

Dual Thermostats — *reduce flow loss in the water circuit for better economy, and provide backup to assure optimum coolant flow.*

Overhead Camshaft — *design optimizes intake and exhaust air passages in the cylinder head for easier engine breathing, and minimizes valve train losses.*

Eight Head Bolts per Cylinder — *provide a uniform load on the gasket and liner to reduce stress on the liner flange and block counterbore.*



/linder Block and tegral Webs — *Block is tensively ribbed and con- ured for maximum rigidity id sound reduction, without cessive weight. Five egral webs, plus front and ar bulkheads support the ankshaft in seven main earings.*

Redundant Internal Seals — *provide an extra seal in the event of primary seal malfunction.*

Grade Eight Fasteners — *are stronger than are commonly used on heavy-duty engines, thus improving gasket loads and decreasing likelihood of breaking.*

Honed Pressure Lubricated Rollers — *improve roller bearing life since lubrication is consistently supplied in the middle of the bearing, as opposed to splash systems which have a more random lubrication supply.*

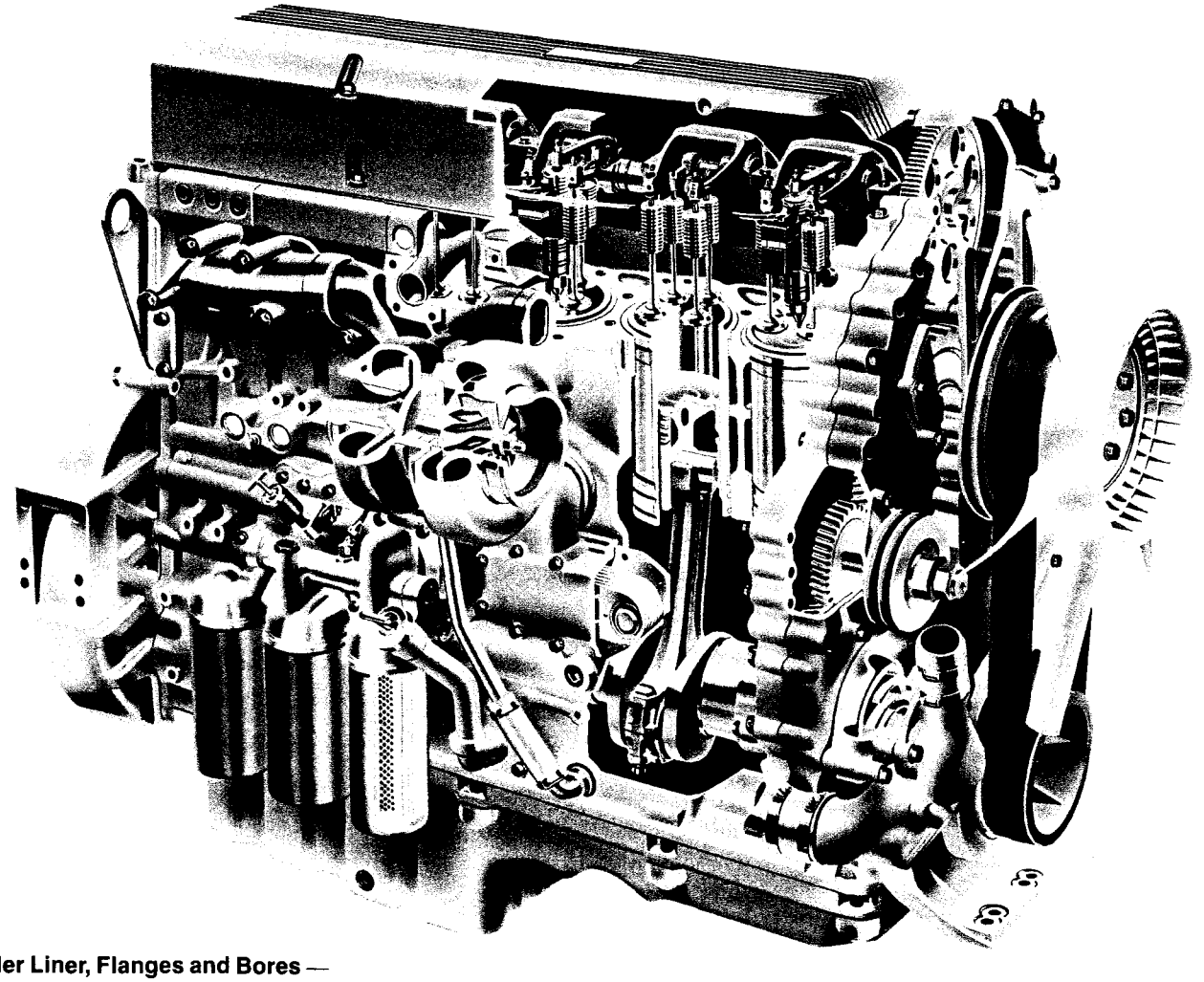
Viewed From Any Angle, The Series 60 Diesel Has All The Makings Of A World Class Engine

High Efficiency Turbocharger — *uses a pulsed-recovery exhaust manifold that provides increased heat flow contributing to fuel efficiency.*

Parallel Ports — *This unique configuration allows for very short intake and exhaust ports for efficient air flow, low pumping losses and reduced heat transfer.*

Iron Crosshead Pistons — *They allow the top ring to be placed much closer to the top of the piston. This reduces the dead volume above the top ring and improves fuel economy.*

Gasket Eliminator — *reduces engine service time since it is not necessary to get a separate gasket to complete a repair.*



Cylinder Liner, Flanges and Bores — *Plateau honing minimizes piston ring break-in and allows quicker ring seal. Flanges at the liner upper ends seat in counterbores in the block deck and project slightly above it to compress the head gasket for a good seal. Cylinder bores feature replaceable, wet-type cylinder liners.*

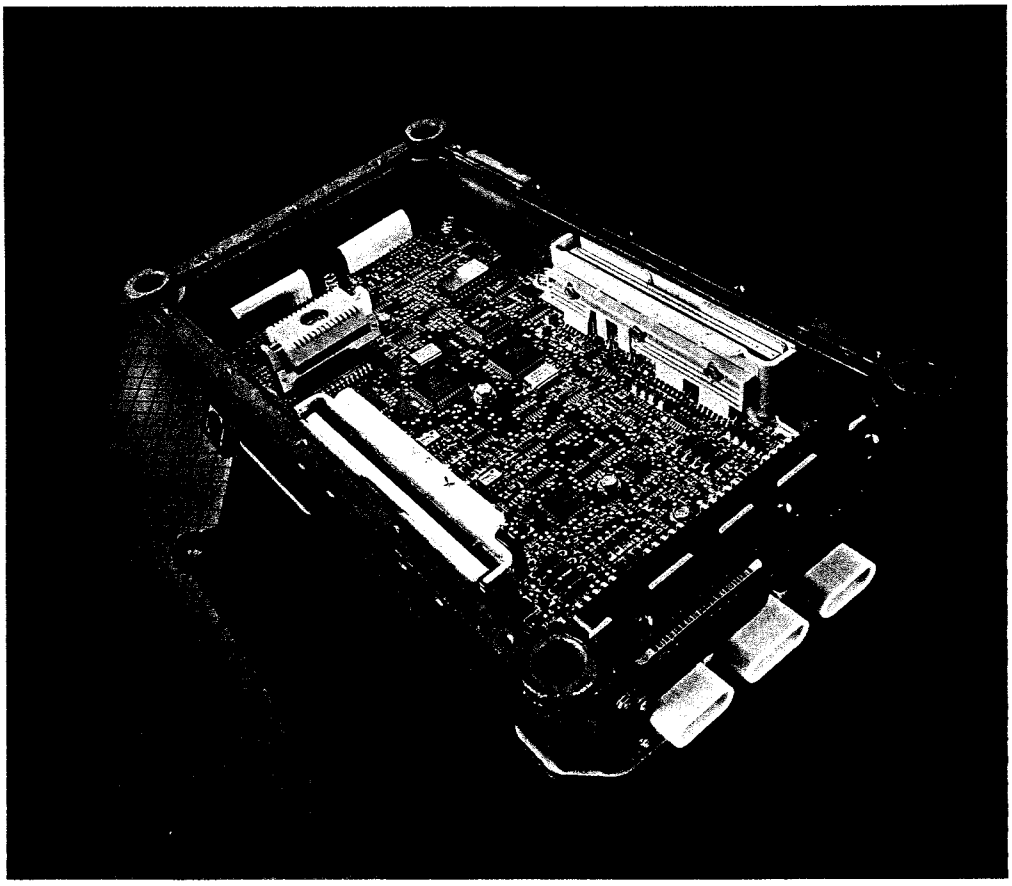
Isolators — *reduce engine noise.*

Crankshaft, Main and Rod Bearings — *Crankshaft is forged induction hardened steel for high strength, and features computer positioned oil passages to promote a thick oil film in the highest loaded sections. Large main and rod bearings increase bearing life and tolerance to wear.*

- Variable injection timing provides exceptional fuel economy, by taking into consideration the temperature, the load, the speed and turbo-boost.

Electronic controls provide these additional benefits:

- Electronic diagnostic procedures can be used to help locate specific problems.
- Since electronics control injection timing as well as the quantity of fuel, the Series 60 can start unaided down to 10°F (−12°C).
- It is now possible to control the maximum road speed within the most efficient engine operating range.
- Electronic controls are also designed to economically incorporate cruise control for truck applications.

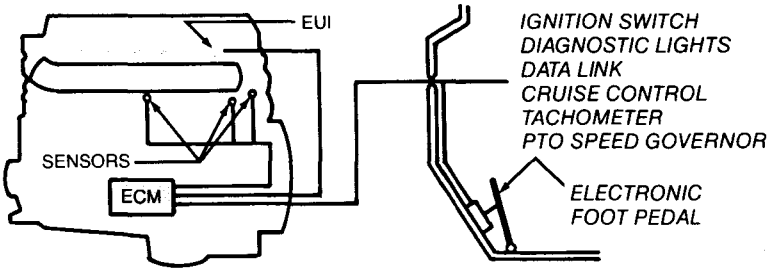


Electronic Control Module

Integral Electronic Controls

The Series 60 features integral electronic controls called Detroit Diesel Electronic Controls (DDEC). Its major components are the Electronic Control Module (ECM) and the Electronic Unit Injectors (EUI). The ECM is the brain of the system, receiving electronic inputs from the driver as well as engine mounted sensors that provide information electronically, such as oil pressure and temperature, speed and intake manifold pressure. This information is used to control both the quantity of fuel injected and injection timing.

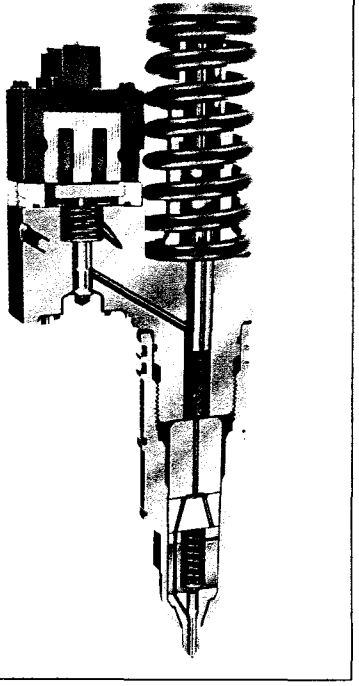
The electronics contain a PROM (Programmable Read Only Memory) which is mounted in the ECM and encoded with your engine's performance characteristics. Included in the PROM is information to control the horsepower rating, torque curve, maximum engine speed and optional protection devices. The ECM processes this information and sends electronic signals to the Electronic Unit Injectors where the precise amount of fuel is injected.



ECM-ELECTRONIC CONTROL MODULE
EUI-ELECTRONIC UNIT INJECTORS

The Leader in Electronic Injectors

We have more experience building unit injectors than any other manufacturer in the entire world. We pioneered the unit injector over one-half century ago.

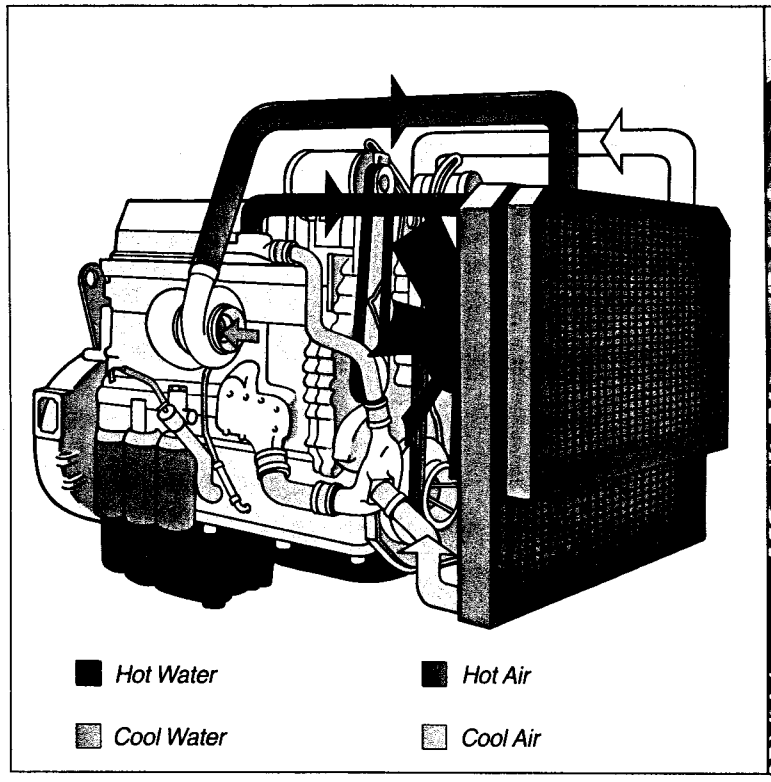


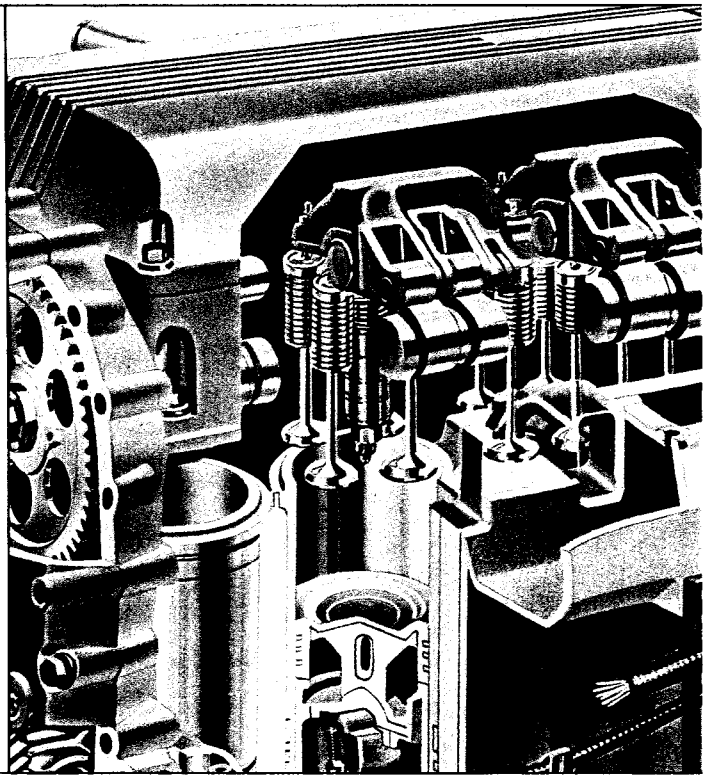
Based on that experience we applied electronic technology to the proven unit injector.

This electronic unit injector works on the same basic principle as the mechanical unit injector with the simple addition of an electronically controlled solenoid valve that meters and times fuel input.

The electronic system is self compensating and virtually eliminates tune-ups. With electronic controls, fuel economy is improved in the following ways:

- The high speed sensor limits maximum RPM to a preset value; and, in this way, there is precise control over maximum vehicle speed.





Air-to-Air Charge Cooling

To enhance fuel economy, the Series 60 has been designed to use air-to-air charge cooling. Air-to-air offers fuel economy gains of 2-5% over traditional intake air cooling systems.

Incoming air is compressed by the turbocharger and directed to a finned heat exchanger in front of the vehicle's radiator. The heat exchanger uses no liquid coolant but relies instead on ram air for cooling the charge air, resulting in lowering intake air temperature from approximately 300°F (149°C) to below 100°F (38°C).

This cooler air aids combustion, thereby increasing fuel economy.

Other advantages include increased reliability and lower maintenance. An air-to-air system is totally separated from the engine cooling system, requires none of the complex plumbing of reduced flow systems, and is less affected by sensitive cooling liquid chemistry.

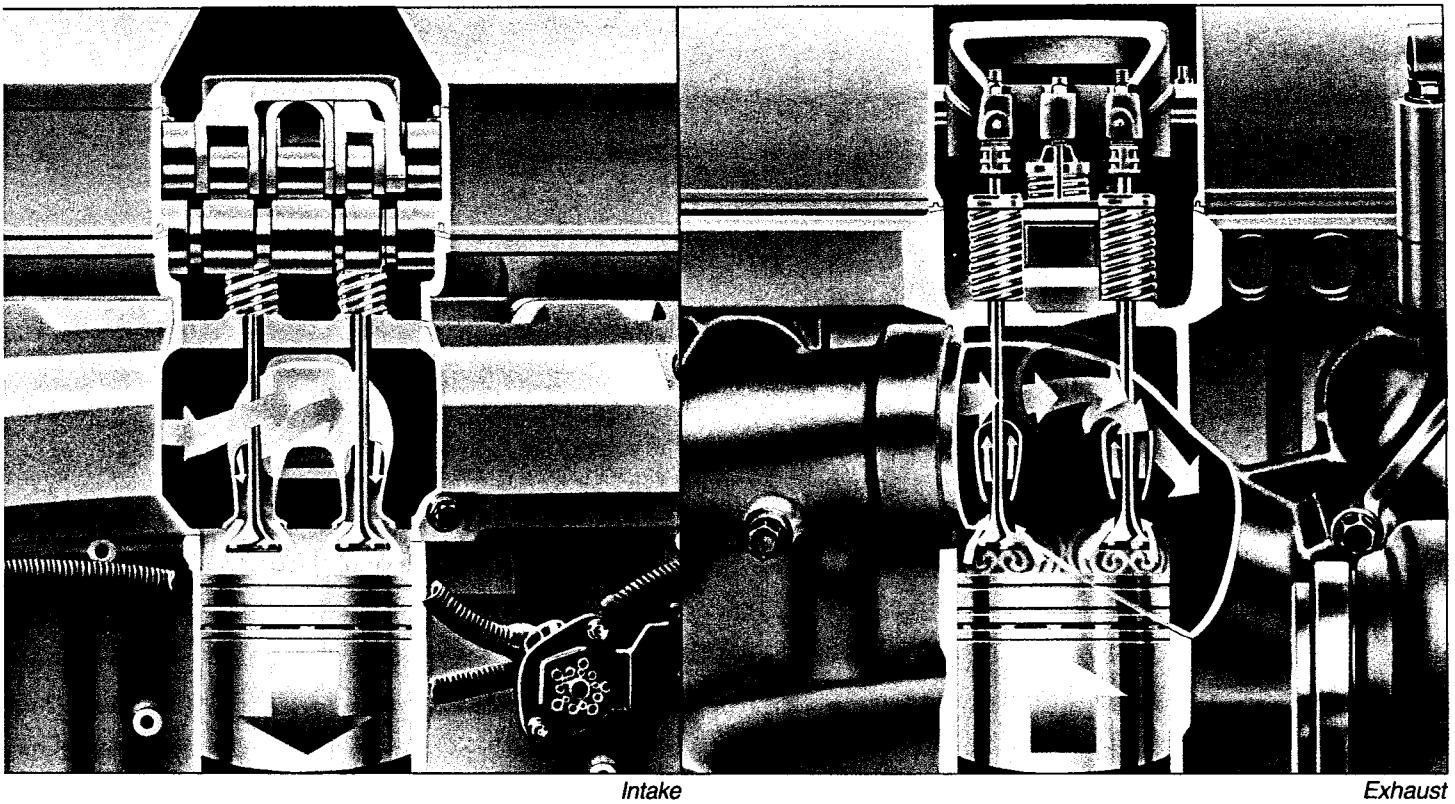
Overhead Camshaft

The overhead cam design allowed us to optimize the design of the intake and exhaust air passages in the cylinder head for easier breathing. By eliminating the pushrods and lifters the fuel injection and valve operating system are stiffened. This results in precise control of injection and valve events.

The injector plunger is mechanically actuated by the cam/rocker arm mechanism and generates up to 20,000 PSI injection pressure. The overhead camshaft assembly has relatively low contact stress, fewer parts, 40 less wear surfaces and special roller and lobe finishing. It is also a simpler design, making it much easier to service.

8 Headbolts Per Cylinder

As an added benefit of overhead camshaft construction there was space available to accommodate eight head bolts per cylinder. Almost equally spaced, the head bolts provide a uniform load on the gasket and liner. There are almost a million pounds of force holding the head to the block.

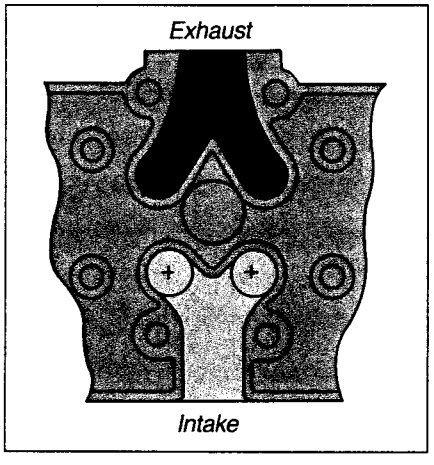


Intake *Exhaust*

Vital Features Of The Series 60

Parallel Port Configuration

The intake and exhaust port configuration of the Series 60 is unique. The four valves per cylinder are located 90 degrees from what is seen on traditional engines. This parallel port configuration allows for very short, unobstructed intake and exhaust ports for efficient air flow, low pumping losses, and reduced heat transfer, allowing the engine to breathe more freely and run cooler.



Fuel Efficient

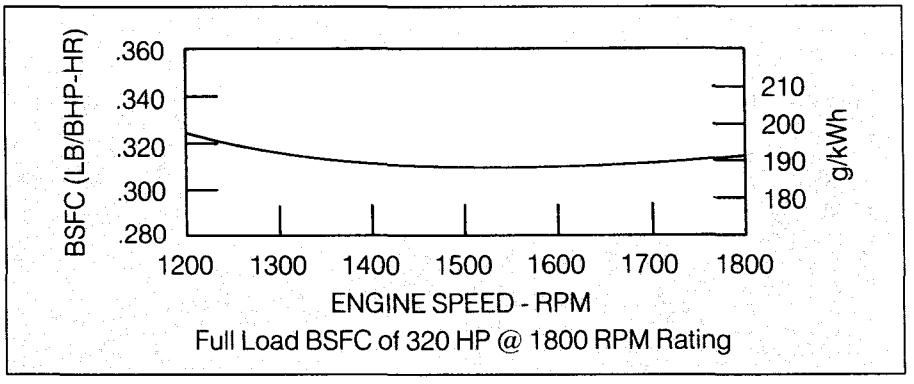
The brake specific fuel consumption (BSFC) at full load, which is an important indicator of fuel economy in heavy-duty truck use, is shown for the 320 HP @ 1800 RPM rating. The rated and minimum BSFC values of .315 and .311 lb/bhp-hr (192 and 189 g/kWh) are lower than competitive engines of this power level.

Other 1800 RPM ratings for both 11.1 and 12.7 L engines have similar BSFC values. The rated BSFC is somewhat higher, of course, for the 2100 RPM ratings.

Our field tests of the Series 60 have shown it to have a fuel economy advantage over competitive engines from 2 to 15 percent. The tests were run against competitive engines of like horsepower and application.

The typical results of these tests are as follows:

- A 12.7 liter Series 60 engine, used in a steel hauling operation where GCW weights are 80,000 pounds or higher, averaged 9% better fuel economy than two competitive engines.
- Over a 2,460 mile stretch of road, a Series 60-equipped truck, averaging 7.01 MPG, required 87 gallons less fuel than a test truck with a competitive engine.



Full Load BSFC of 320 HP @ 1800 RPM Rating

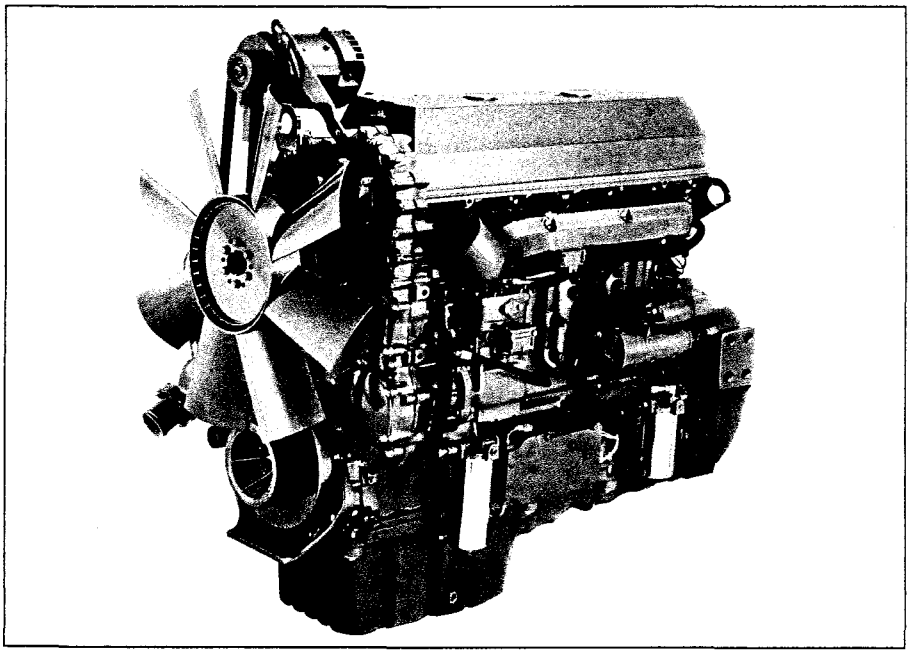
Integral Electronic Controls Offer Numerous Advantages

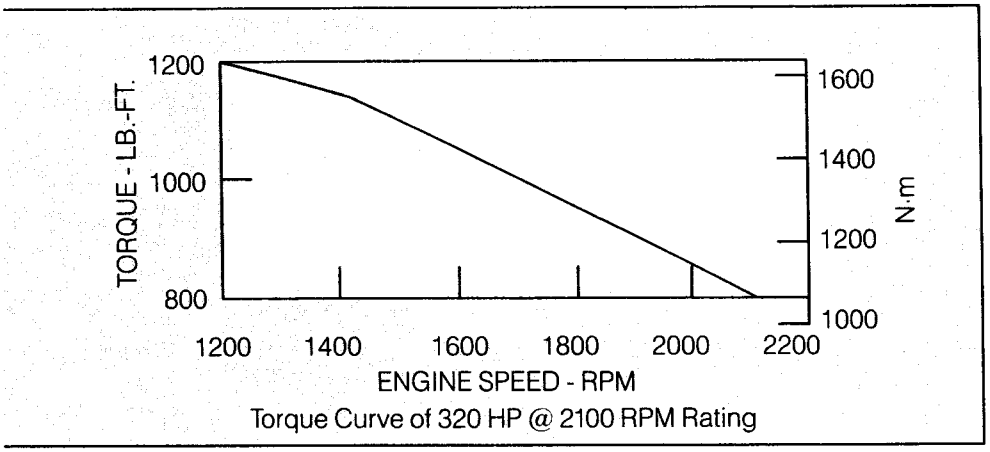
Series 60 electronic controls in addition to offering fuel economy benefits, aid startability. Cold starts are greatly improved and transient smoke is practically eliminated because the system automatically adjusts timing and fuel metering based on engine RPM and oil temperature.

In addition, the system enables service technicians to quickly diagnose engine malfunctions by using a simple inexpensive hand held diagnostic reader, thereby reducing maintenance time and cost.

We Back What We Build

To show our confidence, the Series 60 engine carries a two-year, unlimited mileage warranty. In addition, you can purchase extended service coverage up to five years/500,000 miles. For complete warranty detail see your authorized DDC distributor or dealer.





Torque Curve of 320 HP @ 2100 RPM Rating

Series 60 Torque Rise

Engine	Maximum Power	Peak Torque (@ 1200 RPM)	Torque Rise
11.1L Ratings:	250 HP @ 2100 RPM	970 lb-ft	55%
	250 HP @ 1800 RPM	1100 lb-ft	51%
	285 HP @ 1800 RPM	1100 lb-ft	32%
	285 HP @ 2100 RPM	1100 lb-ft	54%
	320 HP @ 1800 RPM	1150 lb-ft	23%
	320 HP @ 1800 RPM	1200 lb-ft	29%
	320 HP @ 2100 RPM	1200 lb-ft	50%
	350 HP @ 1800 RPM	1250 lb-ft	22%
12.7L Ratings:	365 HP @ 2100 RPM	1400 lb-ft	53%
	365 HP @ 1800 RPM	1400 lb-ft	31%
	400 HP @ 1800 RPM	1400 lb-ft	20%
	400 HP @ 2100 RPM	1400 lb-ft	40%
	425 HP @ 1800 RPM	1400 lb-ft	11%
	425 HP @ 2100 RPM	1400 lb-ft	32%

Built To Perform Efficiently

The Series 60 is truly a driver's engine. All of the automotive ratings develop peak torque at the relatively low speed of 1200 RPM for outstanding driveability. The high torque rise increases acceleration at lower engine speeds while reducing transmission shifting. The torque rise of the various truck ratings varies from 20% to 55%. For example, the torque curve for the 320 HP rating at 2100 RPM has a torque rise of 50%.

Here are some typical driver comments:

"Excellent response. Do not have to stand on it. It does all the work by itself. Pulls the same, loaded or unloaded, head winds or side winds— 61 MPH, period!"

"Didn't have to shift from Davenport, Iowa to Kansas City (all rolling hills). Left in ninth gear and never went below 1,300 RPM. Passed two test trucks with competitive engines on hills. The other drivers couldn't believe it was 320 HP. Thought it had to be a 435."

"Left Kansas City for San Antonio two hours after the other truck equipped with a competitive engine. Got to San Antonio ahead of it. Still don't know where he's at."

Series 60 Specifications and Ratings

There are fourteen automotive power ratings to choose from, each rating intended to accomplish a specific trucking job.

1800 RPM models provide maximum fuel economy. They are ideal for fleets that want to control vehicle speed and fuel consumption. They virtually guarantee excellent fuel economy, yet perform well due to their excellent torque-rise over a wide operating range.

2100 RPM models provide maximum performance. They are designed for operators who want to have full control of the vehicle's speed. Properly operated and geared, they can be as economical on fuel as the 1800 RPM models, and they possess greater performance potential.

Engine Type: Four cycle/inline
Description: Turbocharged/Air-to-air charge cooled
No. of Cylinders: 6

Models	11.1 Liter	12.7 Liter
Bore & Stroke	5.12 X 5.47 in (130 X 139 mm)	5.12 X 6.30 in (130 X 160 mm)
Horsepower Range	250 - 350	365 - 425
RPM Range	1800 - 2100	1800 - 2100

High torque rise 2100 RPM models are designed for applications where the truck operates both on and off the highway, such as in construction or lumbering. They offer constant horsepower from around 1500 RPM, to provide excellent tractive effort in soft footing and steep grades.

Series 60 Performance Ratings and Applications

Engine	BHP @ RPM	Peak Torque	RPM Operating Range	Typical Application
Series 60 11.1 Liter	250 HP @ 1800 RPM	1100 lb ft @ 1200 RPM	600	Pick-up and Delivery Fleet/Economy
	250 HP @ 2100 RPM	970 lb ft @ 1200 RPM	900	On-Off Highway/Performance
	285 HP @ 1800 RPM	1100 lb ft @ 1200 RPM	600	Fleet/Economy Leasing/Common Carrier
	285 HP @ 2100 RPM	1100 lb ft @ 1200 RPM	900	On-Off Highway
	320 HP @ 1800 RPM	1150 lb ft @ 1200 RPM	600	Fleet/Performance/Economy
	320 HP @ 1800 RPM	1200 lb ft @ 1200 RPM	600	Fleet/Performance/Economy
	320 HP @ 2100 RPM	1200 lb ft @ 1200 RPM	900	On-Off Highway
	350 HP @ 1800 RPM	1250 lb ft @ 1200 RPM	600	Private Carrier/Contract Carrier/Owner Operator/ Economy
Series 60 12.7 Liter	365 HP @ 2100 RPM	1400 lb ft @ 1200 RPM	900	On-Off Highway
	365 HP @ 1800 RPM	1400 lb ft @ 1200 RPM	600	Higher Torque/Economy/Private Carrier/Contract Carrier
	400 HP @ 1800 RPM	1400 lb ft @ 1200 RPM	600	Maximum Performance/Economy/Owner Operator/ Specialty Fleet
	400 HP @ 2100 RPM	1400 lb ft @ 1200 RPM	900	Maximum Performance/Owner Operator/Specialty Fleet
	425 HP @ 1800 RPM	1400 lb ft @ 1200 RPM	900	Maximum Performance/Owner Operator/Specialty Fleet
	425 HP @ 2100 RPM	1400 lb ft @ 1200 RPM	900	Maximum Performance/Owner Operator/Specialty Fleet