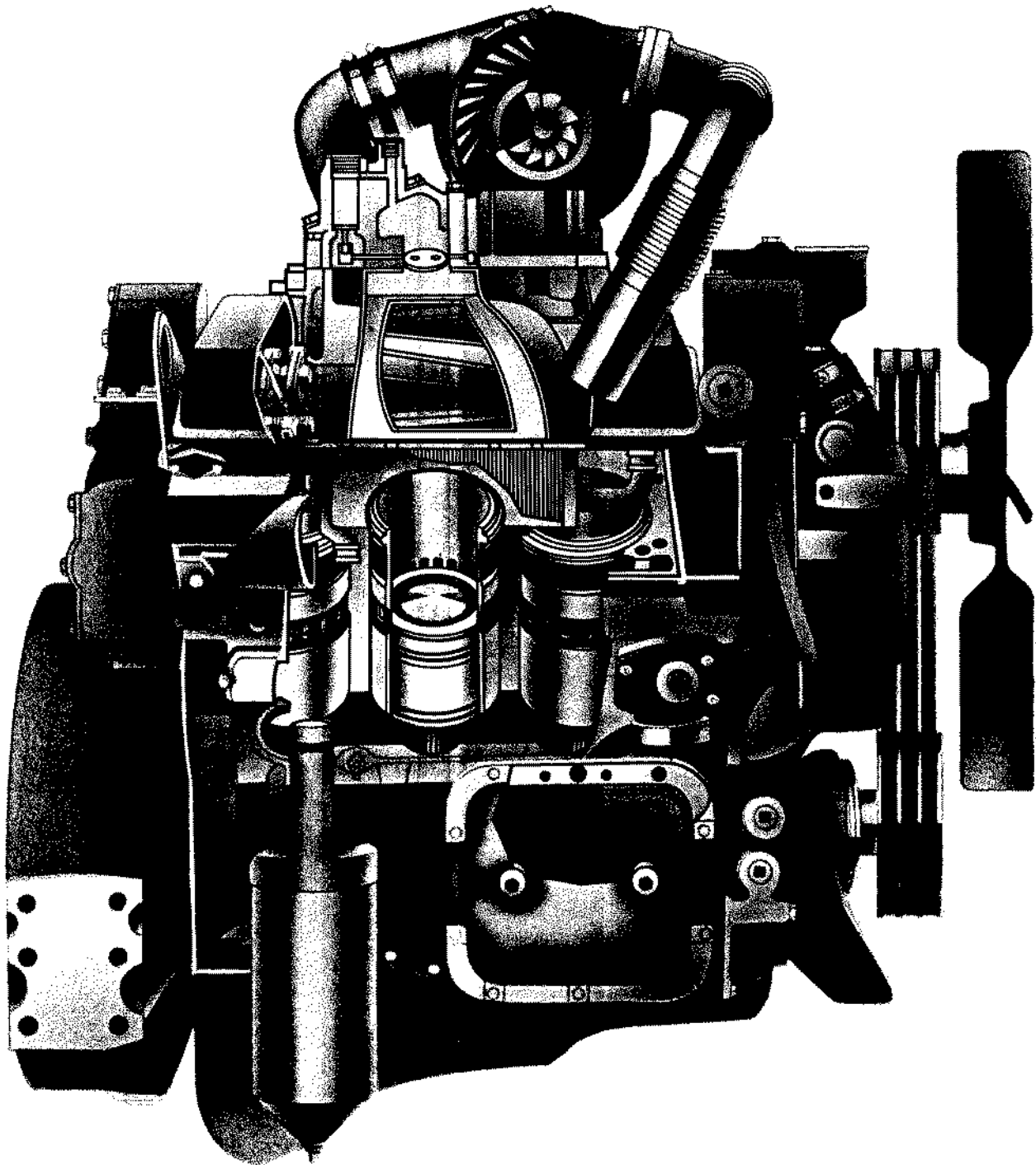


Forward Plan **71&92**



Forward Plan Series 71 and 92... New Standards of Performance and Fuel Efficiency

As a leading producer of diesel engines for construction and industrial equipment for more than 45 years, Detroit Diesel Allison is keenly aware of the changing needs in your industry. In today's tough business climate, users are looking for more durable equipment—more horsepower with greater fuel efficiency—lower life cycle costs—a greater return on investment.

To help you meet these demands, Detroit Diesel Allison has launched a wide-ranging program to introduce innovative design technology to Series 71 and 92 engines—technology that establishes new standards of performance and fuel efficiency. With ratings ranging from approximately 150 to 1000 horsepower, these state-of-the-art diesels will meet a large share of your future power needs.

In addition to significant improvements in power output and fuel

economy, you can depend on the new Forward Plan engines to run longer between overhauls and keep maintenance costs at a minimum. In short, they're engines that can help sell your products in the years ahead. And the people of Detroit Diesel Allison are ready to work closely with you in making these engines a part of your current and future product plans.

Proven Design Principle

Both 71 and 92 Series engines are built on the same proven design principle. The Series designation refers to cubic inch displacement per cylinder—71 and 92 cubic inches respectively. With millions of Series 71 and 92 engines in use, parts and service are available almost anywhere in the world. Diesel mechanics everywhere are familiar with them.

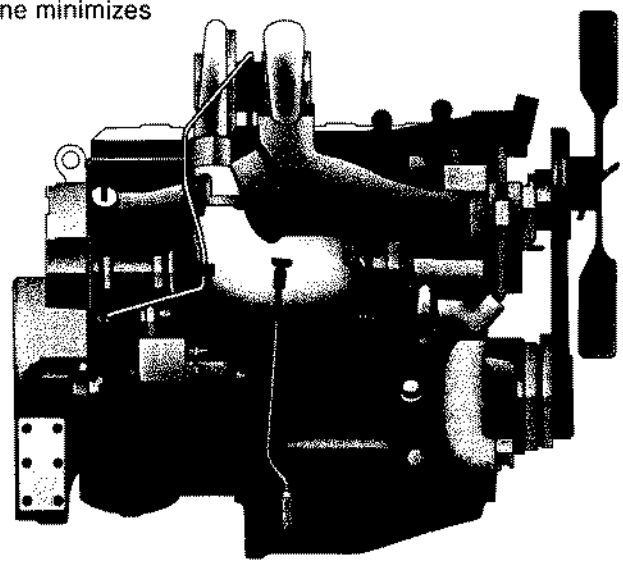
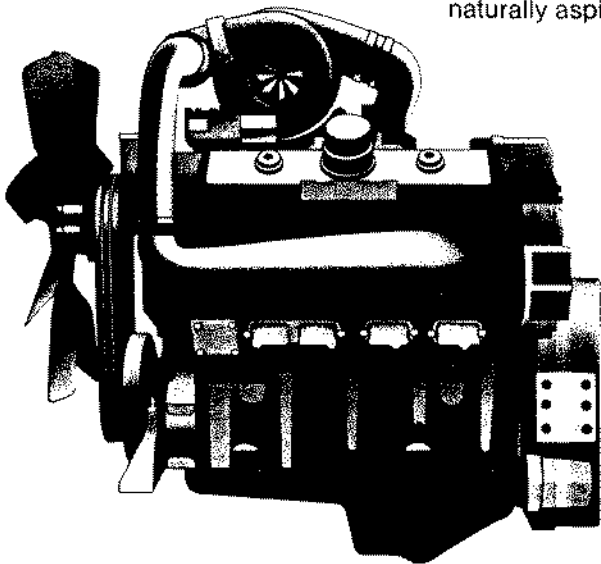
Lower Engineering Costs

Selecting a Forward Plan model to replace an existing Detroit Diesel naturally aspirated engine minimizes

the cost resulting from major design change. You can gain the performance and efficiency needed to meet the demands of the future and stay with the proven Detroit Diesel design.

If you already use a Detroit Diesel turbocharged engine, you have the option of increasing your power or maintaining the current level with less fuel input from smaller injectors.

The thousands of accessories developed over the years for Series 71 and 92 engines are still available—this gives engineers a great deal of installation flexibility. Associated with this are the mounts, radiators, drive systems and other components you have developed for the 71s and 92s—the vast majority of these items are adaptable to the new Forward Plan engines.



Reliability and Durability Improvements Already in Place

The Series 71 and 92 engines currently in production are tougher, more reliable, more productive than ever before. This has been accomplished through the application of new design technology, new manufacturing techniques and high quality control standards.

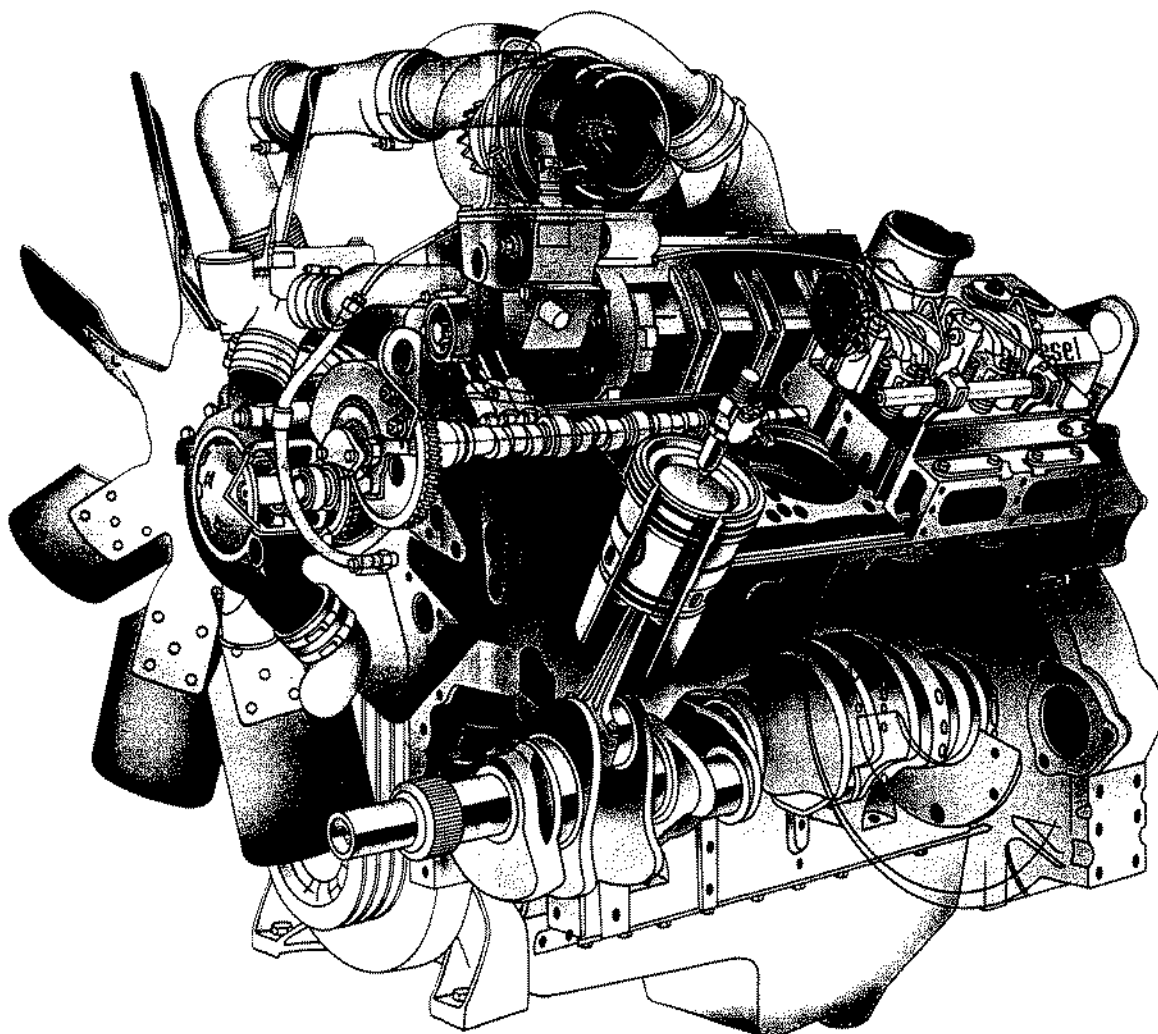
Component improvements which significantly extend life-to-overhaul include piston fire ring, cam and

crankshaft, cylinder block and head, liner seal ring, blower drive system and water pump.

The turbocharged engines being built today deliver 14 to 25 percent more power than their naturally aspirated counterparts while showing a brake specific fuel consumption (BSFC) improvement of up to 10%. Turbocharging also provides up to 11% better high altitude performance and noise levels are reduced by 20 to 30%.

A Commitment To Build Even Better Engines

The Forward Plan for Series 71 and 92 engines is a commitment to building *even better* engines in the years ahead—efficient engines with improved power-to-weight ratios that will provide sales benefits for both you and Detroit Diesel Allison.



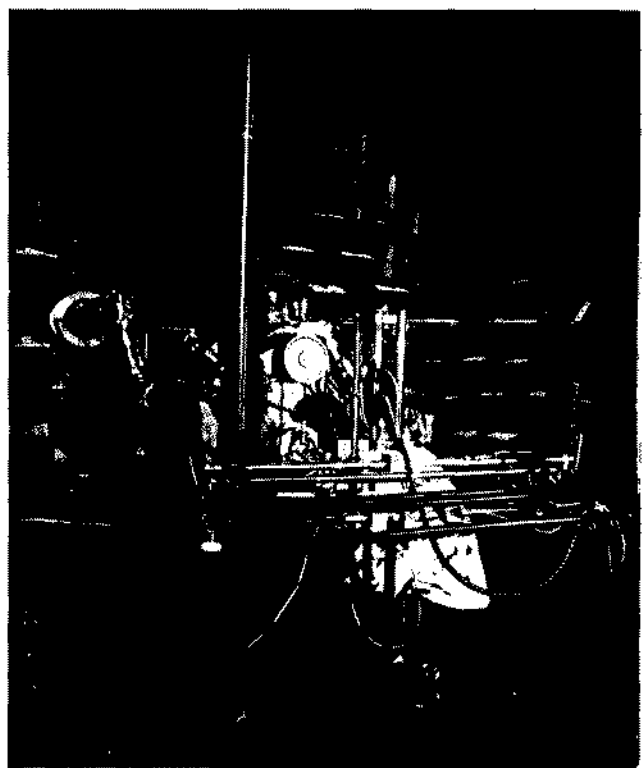
Forward Plan 71&92

Development Capability

Detroit Diesel Allison is well-positioned to handle the Forward Plan commitment. The research and engineering staff, working in the most complete and modern engine development facilities in the industry, was able to carry out extensive studies of air flow and combustion processes. This led to the development of advanced component designs and fuel-saving innovations.

In addition, DDA builds gas turbine engines and a wide variety of heavy-duty automatic transmissions as well as diesel engines. The advantage to DDA and its customers is that new technology in materials and manufacturing techniques can be transferred between the various power products to insure state-of-the-art progress in product development. As a Division of General Motors, DDA is also in a position to draw upon the technical expertise of the entire Corporation.

It's also important to mention DDA's *team concept* for product development. Every new program has input from engineering, manufacturing, quality control, sales and service. This team effort helps produce a quality product for specific market needs. It also helps in producing an efficient, dependable product that's easy to service.



Forward Plan 71&92

A Complete Line of Engines To Meet Your Power Needs

The Forward Plan includes turbo-charged (T) and turbocharged after-cooled (TA) engines from 4 to 16 cylinders with ratings ranging from approximately 150 to 1000 horse-power. Power ratings are well inte-

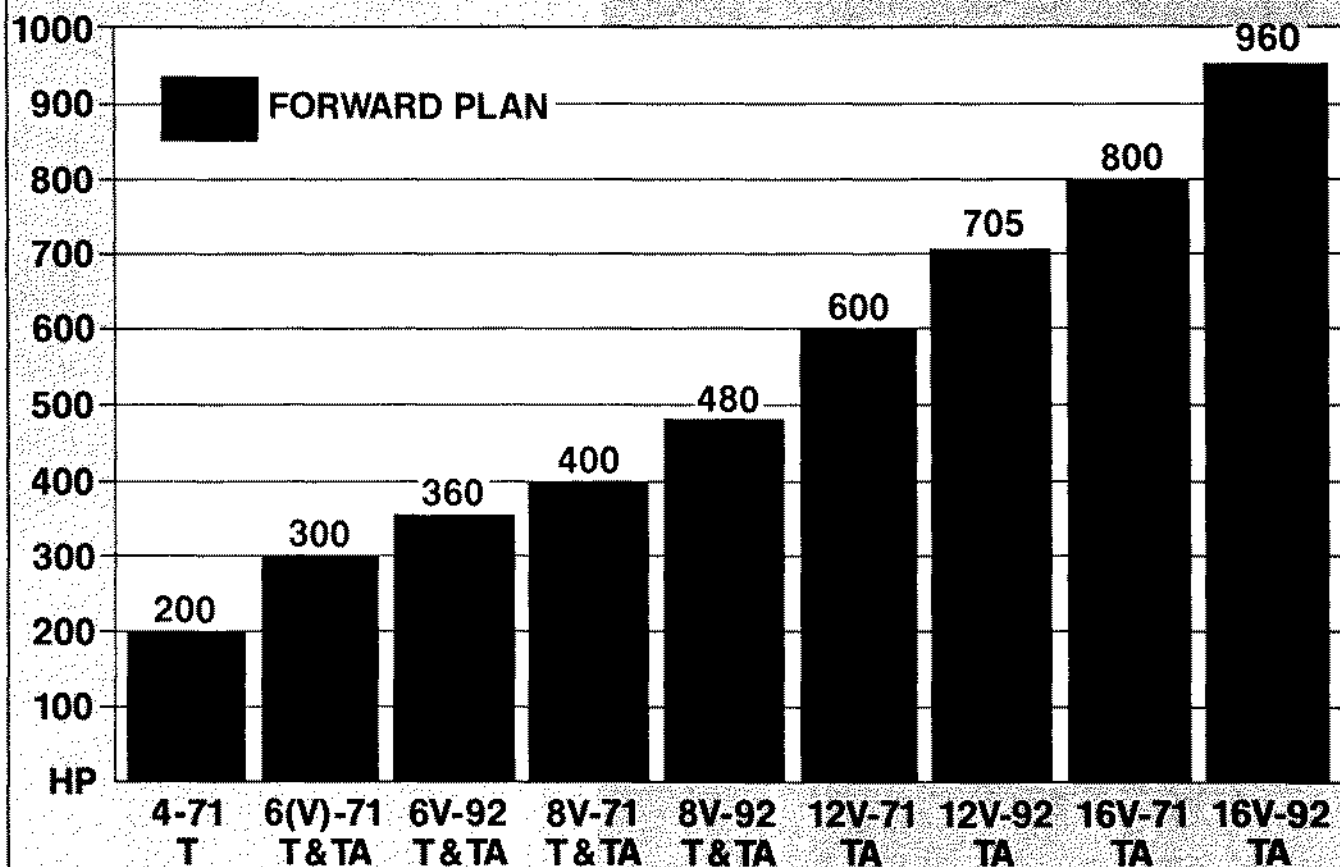
grated between the two Series. There is also some overlap in ratings which gives greater flexibility in engine selection.

The advantages of the Forward Plan are such that we plan a gradual

phasing out of older design turbo configurations. The Forward Plan engines will be phased into production throughout 1984 with the first models becoming available in the second quarter.

HORSEPOWER RATINGS

Forward Plan 71&92



Forward Plan Elements

The Forward Plan for Series 71 and 92 engines includes:

- Advanced Air Induction System
- Improved Combustion Efficiency
- New Piston Rings
- Thermatic Oil Cooler

The air induction system on all engines with six or more cylinders will include:

- Third-Generation High-Efficiency Turbocharger

- New Bypass Blower
- Aftercooler

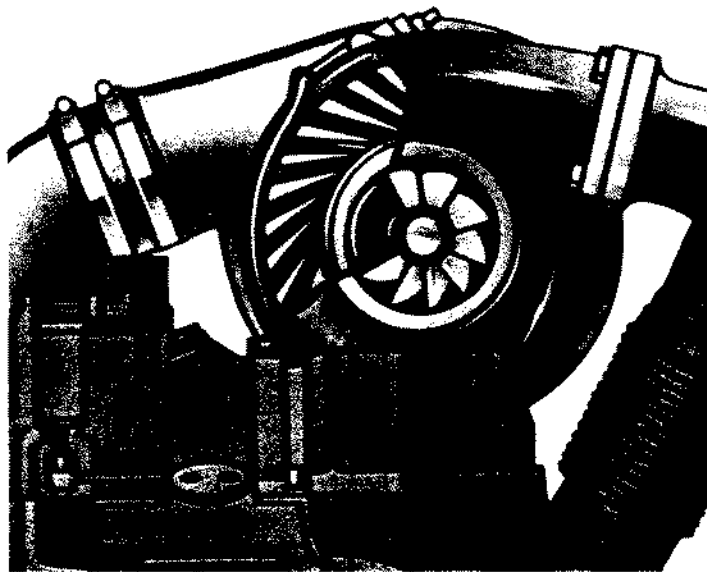
The air induction system on the 4-71T engine will have an advanced design turbocharger and reduced speed blower.

Most of the Forward Plan engine improvements are internal. The air induction system will continue to be located on the side of the in-line models and in the cradle of the vee

models. The turbocharger will be mounted directly on the blower on 6V and 8V models. This eliminates the need for external oil return lines and complicated bracketry. Overall installation dimensions are reduced.

Advanced Air Induction System

New Turbocharger Design

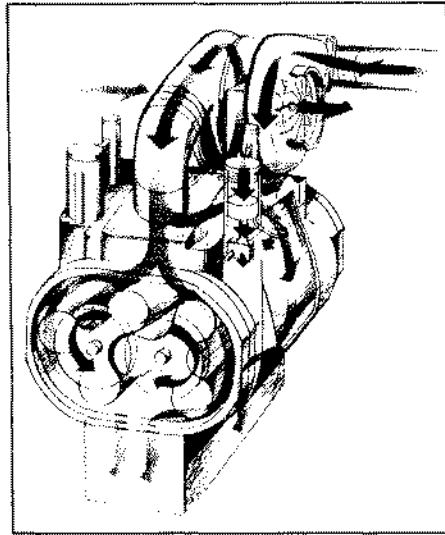
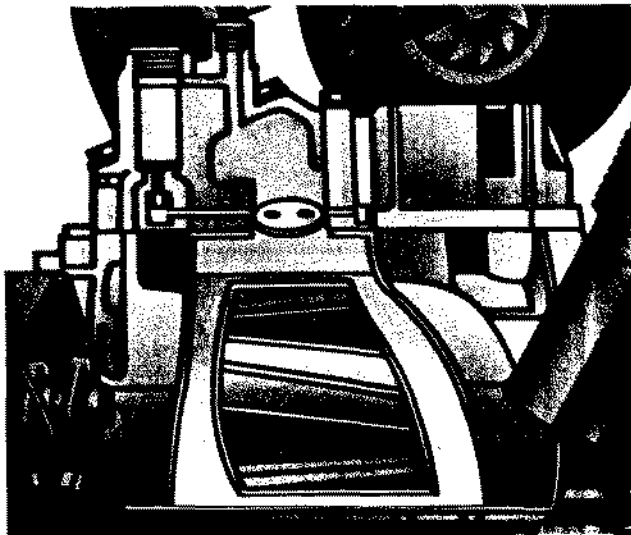


The overall efficiency of the Forward Plan turbo was raised by reshaping the compressor wheel blades.

This new turbo moves air more efficiently into the engine throughout the engine's normal operating range. This is important in maximizing horsepower and fuel economy.

Advanced Air Induction System (Continued)

New Bypass Blower



The new bypass blower is the result of an intensive research and development effort. It produces dramatic improvements in operating efficiency.

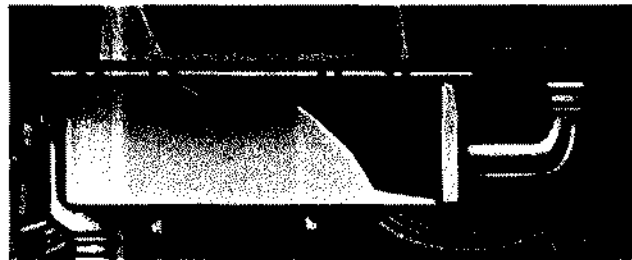
The theory is simple: As the engine speed and load increase, air flow requirements from the blower are reduced. When the turbocharger can provide all of the engine air require-

ments, butterfly valves in the air inlet housing open, allowing incoming air from the turbocharger to bypass the blower lobes and go directly to the combustion chamber. This eliminates the pumping load on the blower which reduces parasitic horsepower losses. The new system optimizes air flow into the engine.

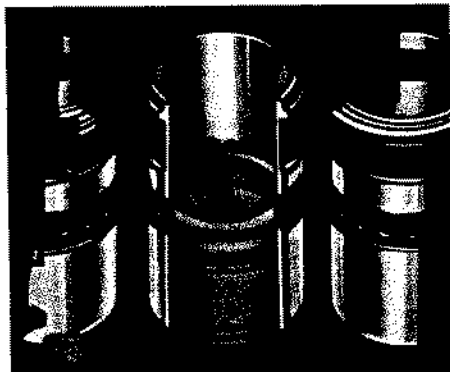
Aftercooler

When air is compressed by a turbocharger or blower, it gains heat. An aftercooler is a heat-exchanging device that allows heat to be transferred to the engine coolant. Cooler and therefore denser air provides more efficient combustion. And cooler intake air also lowers combustion and exhaust temperatures which helps to extend engine life.

An aftercooler is featured on all Forward Plan engines except the 4-71T as part of the new air induction system. Models with 8 cylinders or less will also be available without aftercoolers.



Improved Component Efficiency



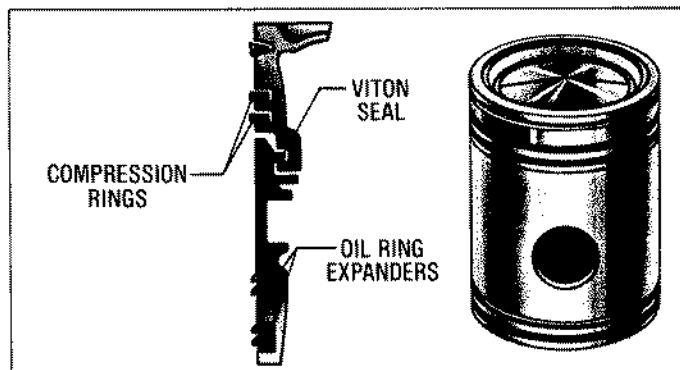
Reshaped Cylinder Liner Ports

The new air induction system allowed our engineers to reshape the ports in the cylinder liners through which air enters the combustion chambers. This also made possible a modification of exhaust timing. These changes contribute to improved thermal efficiency.

The new air induction system im-

proves air flow in the engine and allows for more efficient air-to-fuel ratios. This translates directly into lower BSFC figures and more horsepower without increasing the fuel input. And engine life is not reduced even though the engine is producing more horsepower.

New Piston Rings



The next element of the Forward Plan program enhances durability as well as engine efficiency.

The compression rings will be barrel-faced without a groove. The barrel face provides a uniform

coating of oil on the liner wall to improve ring life. It also reduces sliding friction. The tension of the oil ring

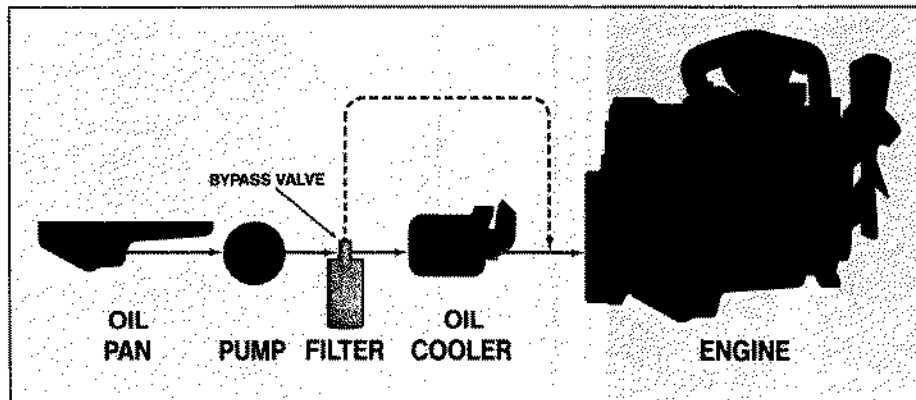
expanders has been reduced on the Series 92. This change also reduces sliding friction and further improves lubrication. A new non-metallic viton seal ring will be used between the piston dome and skirt for longer life.

Based on tests, DDA engineers estimate a 30 to 50% increase in ring life when proper maintenance procedures are followed. We also estimate a concurrent reduction in lube oil consumption. These rings will be more resistant to the effects of high sulfur fuels.

Thermatic Oil Cooler

A Thermatic oil cooler makes a smaller but important contribution to operating efficiency—particularly in

those applications where a large portion of operating time is at light load. The Thermatic system adds a thermostatically controlled bypass valve between the oil filter and the oil cooler. During the engine warm up or whenever the oil is below normal operating temperature, the valve allows oil to bypass the oil cooler. This provides for faster oil warm up. Warm oil provides better lubrication which reduces frictional losses and extends life. As oil temperature reaches the normal operating range, the flow is redirected back through the cooler for efficient oil temperature control.



Forward Plan 71&92

The Primary Benefit... Improved Fuel Economy

Forward Plan 71				
BRAKE SPECIFIC FUEL CONSUMPTION (2100 RPM)				
MODEL	CURRENT		FORWARD PLAN	% IMPROVEMENT - VERSUS
	NA	TURBO		
4-71	.398	.371	.356	11
6(V)-71	.398	.378	.350	12
8V-71	.399	.386	.350	12
12V-71	.399	.378	.350	13
16V-71	.399	.386	.350	12

Converting to a Forward Plan engine model provides a dramatic improvement in fuel efficiency. These charts show what's been accomplished.

In the 71 Series lineup, BSFC will be .350lbs/BHP-HR on the TA models at rated speed. This is a 12 percent improvement over the naturally aspirated engines and an improvement of up to 9 percent over the current turbocharged engines.

Important BSFC advancements have also been made in the 92 Series. TA models will have a rated speed BSFC ranging from .345 to .349. This is approximately a 16 percent gain over the natural engines and up to a 11 percent over the current turbos.

Forward Plan 92				
BRAKE SPECIFIC FUEL CONSUMPTION (2100 RPM)				
MODEL	CURRENT		FORWARD PLAN	% IMPROVEMENT - VERSUS
	NA	TURBO		
6V-92	.413	.372	.345	16
8V-92	.413	.389	.345	16
12V-92	.413	.377	.347	16
16V-92	.413	.389	.349	15

Increased Horsepower Benefits

Forward Plan 71&92

HORSEPOWER COMPARISON (2100 RPM)

MODEL	CURRENT		FORWARD PLAN
	N	TURBO	
4-71	152	190	200
6(V)-71	228	285	300
6V-92	270	330	360
8V-71	304	362	400
8V-92	360	435	480
12V-71	456	553	600
12V-92	533	655	705
16V-71	635	725	800
16V-92	720	860	960

The turbocharged and aftercooled Forward Plan engines will have over 30% more horsepower than their naturally aspirated counterparts and up to 12% more horsepower than the current production turbo models.

The horsepower increases are generally uniform throughout the product line. The Series 71 TA models will produce approximately 50 hp/cylinder; the Series 92 TAs will be rated at approximately 60 hp/cylinder. Lower horsepower ratings will also be available through the application of smaller injectors.

New Technology Delivers Power Plus Economy

Forward Plan technology makes it possible to simultaneously increase horsepower and improve fuel economy.

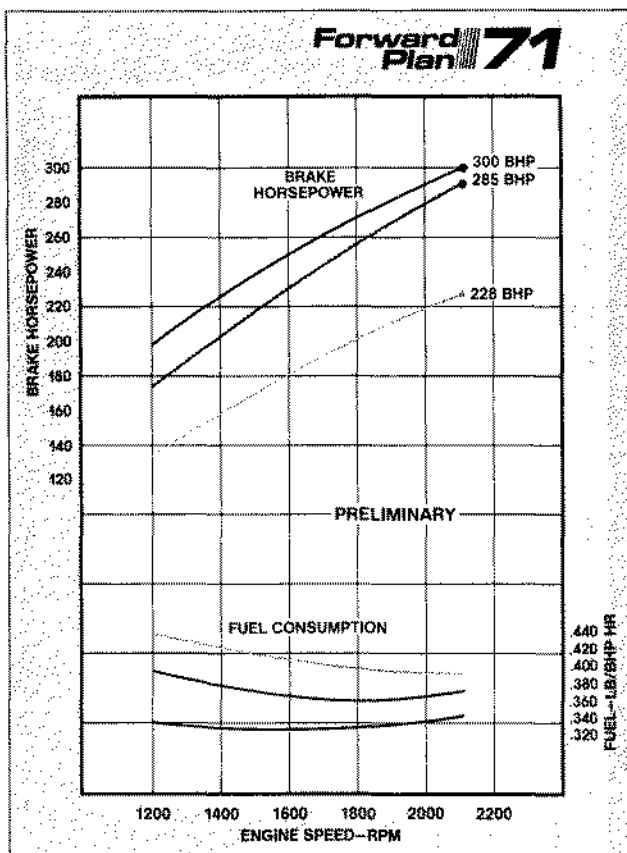
These performance curves for a representative 71 Series engine illustrate the dramatic effects of the Forward Plan improvements across the entire RPM range. Maximum horsepower for the 6-71TA is 31% higher than the naturally aspirated

and 5% higher than the current turbo model. BSFC is better across the entire range—averaging 17% better than the naturally aspirated engine and 8% better than the current turbo-charged model. The low point on the BSFC curve is .337 at 1600 RPM.

In the 92 Series, horsepower gains are also impressive with the Forward

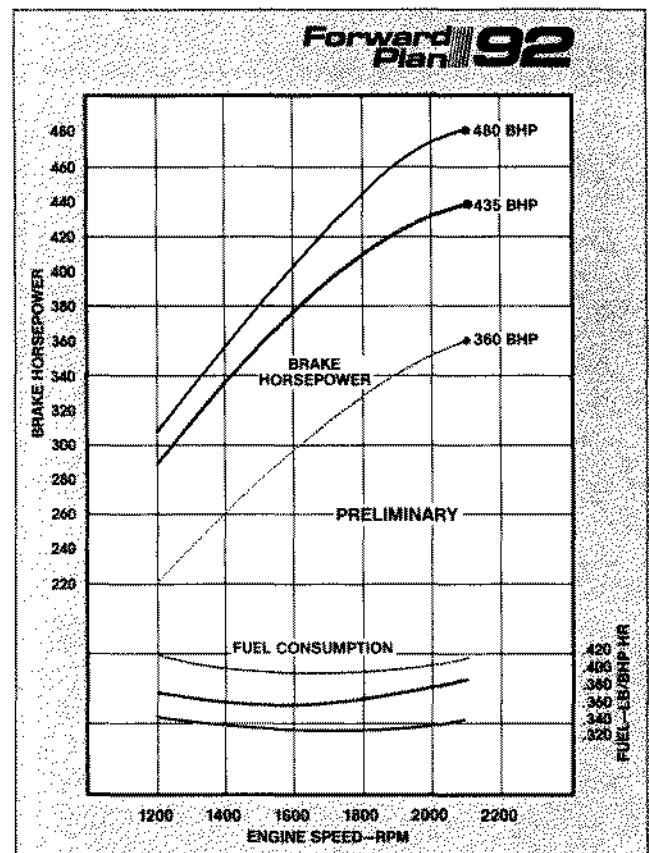
Plan TA models. In fuel economy, with the representative 8V-92 engine, the improvements range from 15% to 17% over the naturally aspirated version and from 6% to 11% over the current turbo models. The low point on the BSFC curve is .335 at 1800 RPM.

6-71 RATINGS COMPARISON



- 6-71N
- 6-71T (CURRENT)
- 6-71TA (FORWARD PLAN)

8V-92 RATINGS COMPARISON



- 8V-92N
- 8V-92T (CURRENT)
- 8V-92TA (FORWARD PLAN)

Forward Plan Engines VS Competition

FUEL ECONOMY COMPARISON		Forward Plan 71	
	CUMMINS NTA 855	CAT 3406 DITA	FORWARD PLAN 8V-71TA
RATED HP	400	380	400
RPM	2100	2100	2100
PEAK TORQUE	1150	1160	1173
RPM	1500	1200	1200
BSFC @ RATED RPM	.378	.365	.350
@ PEAK TORQUE	.372	.361	.345

Forward Plan engines not only match the competition, but in most cases have a clear superiority in fuel efficiency. Here are some examples:

The 8V-71TA competes directly with the Cummins NTA 855 and CAT 3406. These engines produce comparable horsepower and torque, but the 8V-71TA is clearly superior in fuel economy. At rated speed it is 7.4% better than Cummins and 4% better than CAT. At peak torque the advantage is 7.3% and 4.4% respectively.

FUEL ECONOMY COMPARISON		Forward Plan 92	
	CUMMINS KT2300	CAT D348	FORWARD PLAN 16V-92TA
RATED HP	900	900	960
RPM	2100	2000	2100
PEAK TORQUE	2475	2680	2655
RPM	1500	1400	1200
BSFC @ RATED RPM	.371	.374	.349
@ PEAK TORQUE	.352	.372	.355

The 16V-92TA has a higher horsepower rating than either the Cummins KT 2300 or CAT D348. At the same time it is clearly the winner when it comes to fuel efficiency with a BSFC of .349 at rated horsepower and .355 at peak torque. That amounts to 5.9% to 6.7% advantage over the competition at rated RPM.

FUEL ECONOMY COMPARISON		Forward Plan 92	
	DEERE 8955T	FORWARD PLAN 6V-92TA	
RATED HP	356	360	
RPM	2100	2100	
PEAK TORQUE	1130	1000	
RPM	1400	1200	
BSFC @ RATED RPM	.375	.345	
@ PEAK TORQUE	.365	.349	

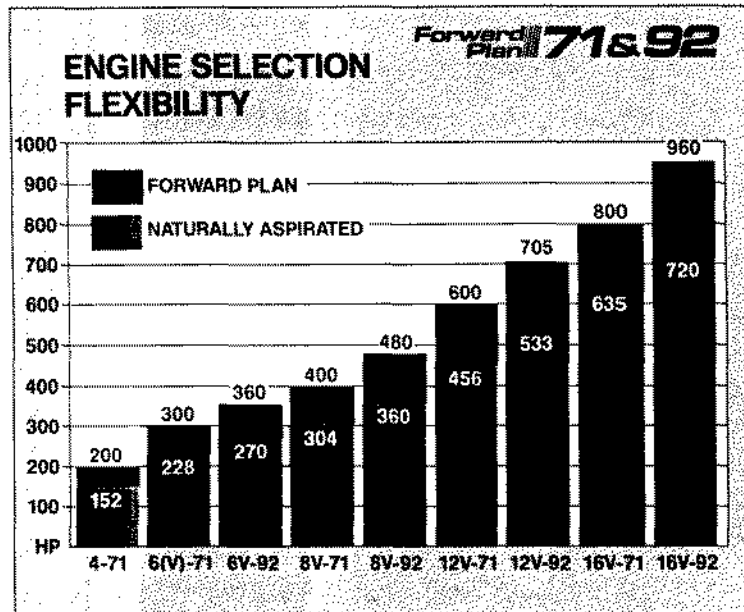
The John Deere 8955T is roughly equivalent in horsepower to the 6V-92TA. However, in fuel economy, the 92 is the clear leader, with an 8% edge at rated speed and 4.4% at peak torque speed.

Engine Selection Flexibility

It's important to recognize that with more power in a durable, compact package, the Forward Plan engines give you an improved power-to-weight ratio as well as added flexibility in engine selection and equipment design. The additional power—a result of efficiency gains, not more fuel input—provides an excellent opportunity to upgrade your equipment.

Where before you might have needed an eight-cylinder configuration to meet your power requirements, you can now get it from a six.

For example, if you currently use an 8V-71N at 304 hp you have the option of using a 6-71TA at 300 hp or a 6V-92TA up to 360 hp. Either of these provide the benefit of two fewer cylinders, more power per cylinder, lower rebuild costs, and the economy



and performance advantages from turbocharging.

Less Heat Rejection

Converting to a Forward Plan engine from a naturally aspirated model provides the additional advantage of less heat rejected to coolant. In the 8V-71N example, total heat rejection is reduced by 1024 BTU/min. with the 6-71TA of comparable horsepower. If the larger 6V-92T at 345 horsepower is selected, total heat

rejection remains approximately the same at 9220 BTU/min. This reduces radiator sizing problems on your Forward Plan installations. In general, the 71 Series will have specific heat rejection ranging from 27 to 31 BTU/hp min. and the 92 will be approximately 28 to 29 BTU/hp min.

Engine Speeds to Suit Application

With Forward Plan engines, you have the option of choosing RPM settings to suit the application. There are many good reasons for operating at reduced RPM—improved fuel economy, greater life-to-overhaul and reduced noise levels. If you should elect to design your equipment around an engine speed below the standard 2100 RPM setting, some horsepower will be forfeited.

LOWER HEAT REJECTION			
MODEL	HP	BTU/M	
8V-71N	304	9424	
6-71TA	300	8400	(1024)
6V-92T	345	9220	(204)