

DETROIT DIESEL

Engines For Defense



DETROIT DIESEL



Synerg

Detroit Diesel Corporation

DDC is a manufacturer and distributor of a diversified line of heavy-duty two and four stroke cycle diesel engines with ratings up to 3700 HP. The high technology Series 60 engine is Detroit Diesel's flagship product. It sets the industry standard as the first production engine designed around electronically tuned injectors. It provides heavy-duty on- and off-highway service up to 825 HP.

Detroit Diesel military engines are adapted from high volume commercial products. This provides substantial savings for military customers and will meet the requirements of NDI for selection of power plants. Recent examples include 6 and 8 cylinder engines that combine high power-to-weight ratios and low heat rejection for 15 to 50 ton armored vehicles.

U.S. and Allied defense organizations currently rely on Detroit Diesel engines for use in:

- Heavy trucks (Palletized Loading System)
- HEMTT, M-915/916 Truck Tractor
- Heavy Equipment Transporter, Marine Corps LVS
- Combat vehicles (M-113 APC, M-109 Howitzer)
- Light Armored Vehicle

Over 80% of all U.S. Army heavy trucks have Detroit Diesel engines. Detroit Diesels are also the engines of choice for many marine and ground support applications.



Combining Forces

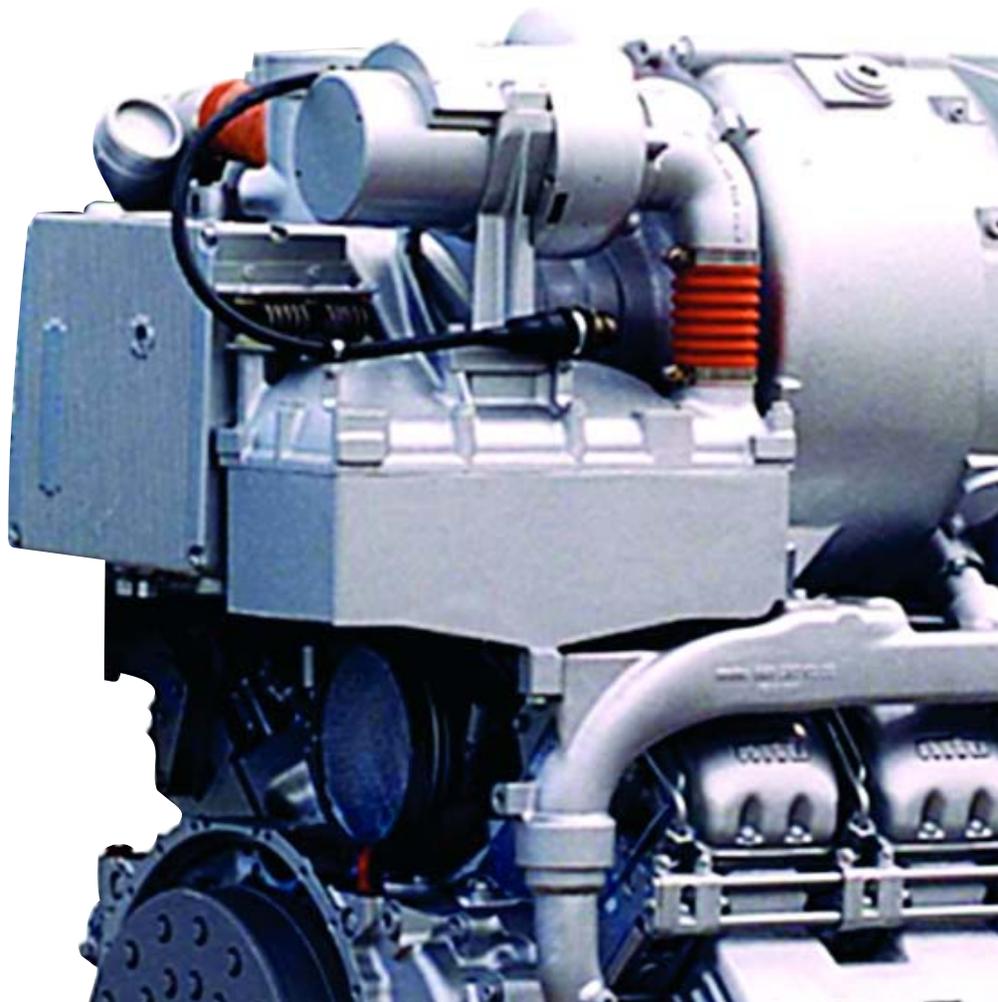
In the global defense market, there are two names synonymous with high performance, diesel power—Detroit Diesel and MTU. Now these two companies are combined within the DaimlerChrysler family to bring world class powerpack system solutions to North America.

Detroit Diesel and MTU have more than 125 years of combined experience in supplying engines to the defense market. Detroit Diesel is the number one supplier of heavy duty engines to the US Army, while MTU leads the free world in supplying

propulsion systems for tanks and other combat vehicles. Working together, we are a driving force in the success of our customers.

Low Life Cycle Costs

Our engines have demonstrated low life cycle costs for the benefit of our customers. With our history and expertise, we can address the specific requirements of the defense market to create the best possible propulsion system solution for our customers. We can integrate all powerpack sub systems to maximize total power



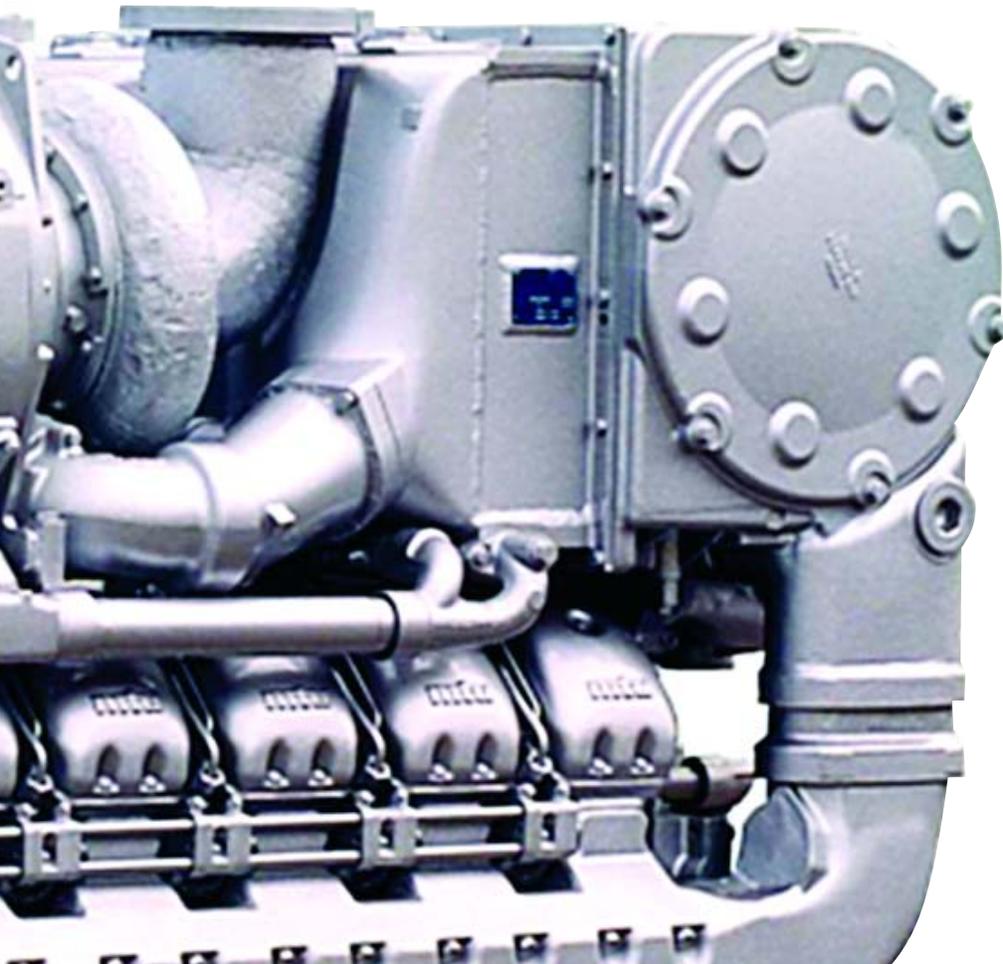
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density and eliminate dead space and redundant hardware.

These powerpack system solutions can be applied in totally new vehicles such as the USMC Advanced Amphibious Assault Vehicle and the US Army Future Combat Systems, or applied as upgrades for the thousands of combat and combat support vehicles operated all over the world.

Our heavy duty engines are based on a family concept that provides a high degree of commonality within the family resulting in ease of maintenance and low operating costs. Varying

power requirements can be met within the parameters of a single family of engines with multiple cylinder configurations. The many different families offered by MTU and Detroit Diesel provide total coverage of horsepower demands in the marketplace.

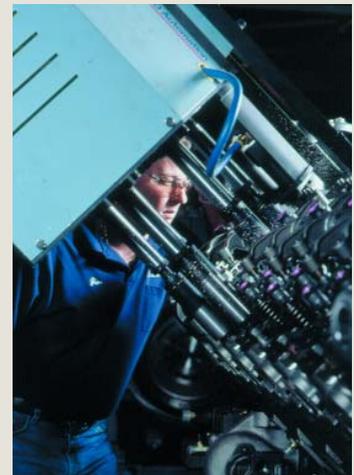


MTU

MTU is one of the world's leading suppliers of diesel engines and complete propulsion systems for off-highway applications such as marine and rail-bound vehicles, heavy land-based vehicles and decentralized power generation systems. The drive components used include diesel engines, gas engines and gas turbines as well as fuel cells (presently in field trials). In addition, MTU produces drive shafts for passenger cars and lightweight commercial vehicles. Through its subsidiary L'Orange, the product range also includes injection systems for diesel, heavy oil and gas engines.

Worldwide Presence

Together with its subsidiaries MTU Asia Pte. Ltd., MTU Australia PTY. Ltd. and L'Orange GmbH, MTU Friedrichshafen forms the MTU Group. With a total of eleven subsidiaries and sales companies, MTU is represented in all continents of the world. Last year, MTU further expanded its global presence by establishing three new sales companies in Japan, South Africa and France.



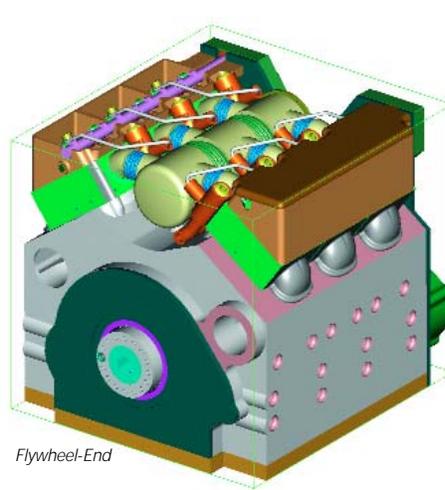
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Diesel Power For Transformation

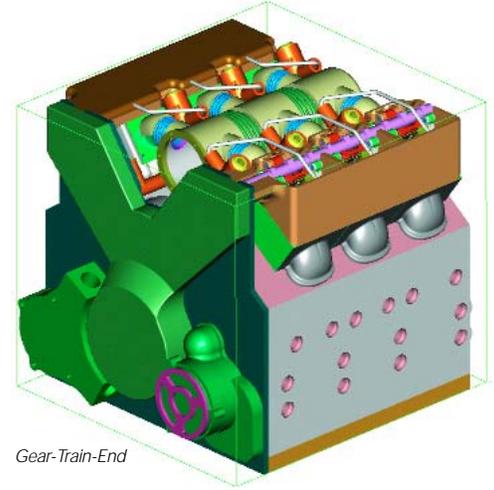
MTU is the world leader in designing engines specifically for combat vehicles. These engines were created with the sole objective of providing reliable, durable, and efficient diesel power in a compact package that would meet all of the stringent requirements of the defense market.

As the market requirements evolved, so did MTU's engine concepts. Over several decades, three complete diesel engine families evolved to drive the Leopard Tanks of the German Army and were ultimately used by armed forces all around the world in various applications.

Now a fourth generation engine, the MT890 is about to emerge. Working together, Detroit Diesel and MTU will deliver two prototypes to the US Army for evaluation of propulsion systems with new levels of power density. Tailored for use in a hybrid drive package, these engines will be the perfect solution for the Future Combat Systems.



Flywheel-End



Gear-Train-End

The Basic Design Of The MT890 Engine Family

This family is based on a highly compact, high speed, 4-stroke diesel engine with the following features:

- 1 liter swept volume per cylinder
- Integrated design of accessories such as pumps, filters and oil system
- State-of-the-art common rail injection
- Fully digitized engine management
- Weight optimized parts

- 6V, 8V, 10V, 12V, 16V: 60° V-Form
- Bore/Stroke: 109/107 mm
- Displacement, cylinder: 1.0 Liter
- Max. speed: 4,250 rpm
- Power range: 550 to 1,470 kW (750 to 2,000 HP)
- Power-to-volume ratio: 1,200 to 1,360 kW/m³ (46,2 to 52,4 HP/ft³)
- Weight-to-power ratio: 0.94 to 0.81 kg/kW (1,52 to 1,31 lbs/HP)
- Integral aluminum crankcase
- Common rail fuel injection system
- High-temperature cooling system
- Sequential turbocharging
- Split cooling system
- Electronic engine management



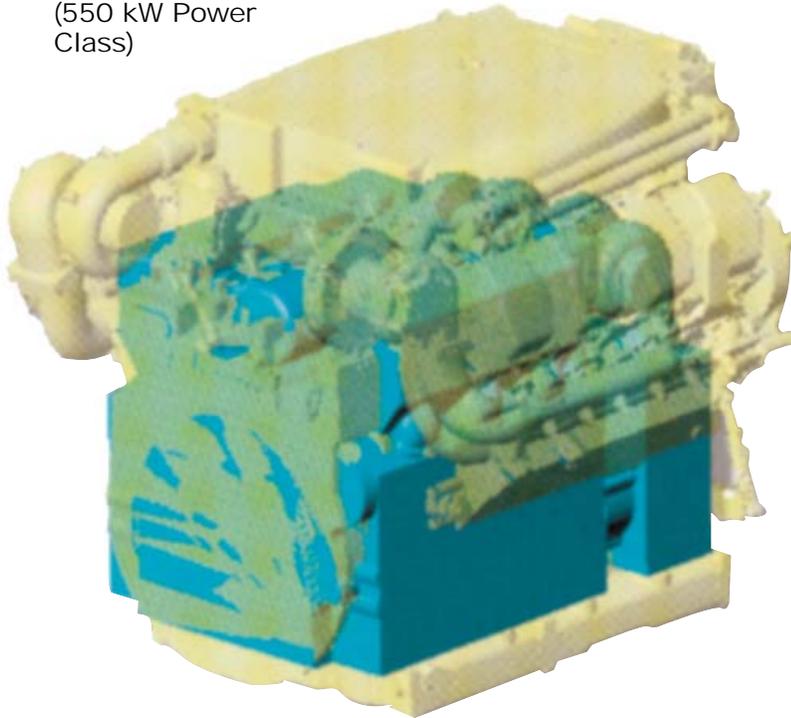
Information

The Series 890, fourth generation engine will reduce the volume and weight of the propulsion system by over 50% compared to the current Series 880, which is already known as the most compact and powerful diesel engine in the world market. Reliability, durability and fuel economy will be maintained by keeping key design parameters within those levels demonstrated in the third generation AAV engine.

For the customer, this means that rugged diesel power and its inherent fuel efficiency can be the right choice for future combat vehicles. There is no need to trade off power density for performance or fuel economy; all three can be provided from the same diesel power system solution.

Detroit Diesel plans to produce the new engine at one of its existing facilities. We will draw upon our global vendor base of proven suppliers to create a world class product built in the USA.

Size Comparison
6V890 to 8V199
(550 kW Power Class)



Power Density Comparison

	OM502	8V 199	6V890
Power Output/RPM	571 HP/1800	816 HP/2300	750 HP/4250
Weight Including Charging And Air Filtration System	2690 lb	2700 lb	1146 lb
Weight-To-Power Ratio	4.71 lb/HP	3.31 lb/HP	1.52 lb/HP
Volume Including Charging And Air Filtration System	41.3 ft ³	38.85 ft ³	15.20 ft ³
Power-To-Volume Ratio	13.8 HP/ft ³	21.0 HP/ft ³	46.2 HP/ft ³

Compared to a militarized truck engine of the same power range there is a reduction of 60%.

Legacy

EuroPowerPack

A special position among powerpacks is held by the **EuroPowerPack** based on MTU's MT 883 engine—a drive system developed by MTU for the third generation of Main Battle Tanks. The integration of all the components into one system results in a small overall size and low weight.

Thanks to these characteristics, the EuroPowerPack presently represents **the most compact drive unit** in its power class for MBT application.

The EuroPowerPack is designed principally as a rear drive unit, the MT 883 engine being combined with the Renk HSWL 295 TM transmission. Power transmission to the gearbox, which is mounted parallel to the engine, is by means of a transfer gearbox.

In this way, the EuroPowerPack achieves an approximate **950 mm reduction in length** when compared, for example, with the original drive unit in the Abrams tank.

Thanks to the small installation dimensions, there is—in comparison with the original drive system—a free space of approximately 3 cubic meters, which can be used for the provision of additional fuel tanks, ammunition space or automatic loaders.



Diesel Power For The Legacy Fleet

Detroit Diesel has been the number one supplier of heavy duty diesel engines to the US Army for several decades. Our two cycle and S60's engines provide proven, dependable diesel power to move the Army. These engines come from a commercial base and are classic examples of Commercial Off The Shelf (COTS) material. All have been NATO tested and proven in difficult combat situations.

New production of these engines continues to support the defense market. In addition, we have made a commitment to support the fleet with high quality, factory remanufactured engines. Reman engines are now in service in the Army M113 and heavy truck fleets, and in the USMC Light Armored Vehicle fleet.



Fleets

New Choices

Working with other DaimlerChrysler affiliates, we are now prepared to offer new fleets of commercial derivative engines to upgrade the Legacy fleet. Our new Series 199 and Series 900 engines provide advantages in fuel economy and emissions, while maintaining the high levels of reliability and durability demonstrated over several generations by our current engines. The engine family concept increases the potential for commonality of key propulsion system components across the various fleets.

Introducing upgrade engines to the fleet will provide an opportunity to reduce the operating costs and logistics footprint of these vehicles as they continue in service for the long term planning horizon. Whether it is for combat vehicles, combat support or tactical trucks, we have engines that the Armed Forces can count on to keep the Legacy fleet moving for years to come.

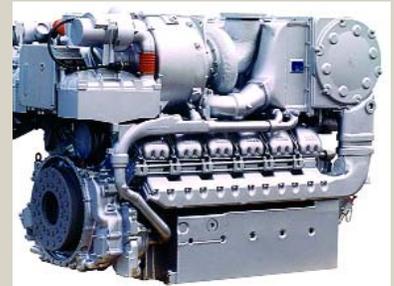
MT 880 Diesel Engines

The 880 Series is MTU's third generation of engines specifically designed for combat vehicles. Following upon the highly successful families of engines designed for the Leopard 1 and 2 tanks, the 880 is today's benchmark for high performance, reliability and low life cycle cost, all in a compact package.

The engine is available in 8V and 12V configurations with ratings from 1000 to 2740 HP at rated engine speeds from 2700 to 3300 rpm. The engines feature digitized electronic controls and common rail fuel injection.

The first US application of the MT880 is for the new, USMC Advanced Amphibious Assault Vehicle. This 12V package advances the state of development for the 880 to its highest level.

Other applications for the 880 include the PzH 2000 Howitzer, the LeClerc Tropicalise, the K9 Thunder, Merkava 4, Leopard 2, and Challenger 2E. A prototype Abrams M1 has also been built and demonstrated in the US and abroad.





Global Solutions

Armed Forces around the world depend upon diesel power from MTU and Detroit Diesel. Over 100,000 engines are now in service in dozens of countries. We deliver a scope of supply as simple as a bare engine or as involved as a complete, integrated powerpack. MTU is now in serial production on the Europack for heavy tanks and will soon go to serial production on the AAV propulsion system. Our products benefit from expert development processes and total system validation prior to serial production.

Together, MTU and DDC have developed two new families of diesel engines for commercial applications, the S2000 and S4000. These, and all of our products, are built within systems that are ISO 9000 compliant. We have pioneered the development and serial production of electronic controls for diesel engines plus other innovations that keep us in the forefront of technology.

parts and service are available everywhere. There are specially trained logistics teams available to provide tailor made maintenance concepts for the defense market. We also offer factory remanufactured engines that can bring your engines back to "zero hour/zero mile" condition, complete with new engine warranty.

Global Support

We have harmonized our service support system around the world to assure our customers that genuine



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