LM500 Industrial

Outlook

- Industrial sales for power generation and gas compression very limited
- Successful sales of marine versions to Japan and South Korea may revive interest
- Offshore oil and gas industry may follow naval examples and use the LM500 for power generation on board ships and other floating platforms
- LM500 Industrial turbine no longer advertised on GE's website

Orientation

Description. The LM500 is a derivative of the General Electric TF34 aircraft engine. The industrial version is primarily used as a mechanical drive unit for gas compression and pipeline pumping applications.

Sponsor. The Industrial LM500 was privately developed by GE.

Power Class. Current versions of the LM500 deliver 4.57 MW, with a thermal efficiency of 31 percent at ISO conditions.

Status. Likely available for production.

Total Produced. Approximately 23 LM500 power generation and mechanical drive gas turbines have been procured.

Application. The LM500 industrial gas turbine has been used to power a small number of electrical power generation facilities, mostly providing emergency backup for critical requirements in the event of a blackout.

Price Range. The estimated cost of an industrial LM500 gas turbine in 2021 U.S. dollars is $2.5 million.

Competition. The primary competitor to the Industrial LM500 is the Solar gas turbine family.

LM500 Industrial

Contractors

Prime

GE Marine	http://www.geaviation.com/marine/engines/military, 2901 E Lake Rd, Erie, PA 16531 United States, Tel: + 1 (630) 893-3344, Prime
IHI Corporation	http://www.ihi.co.jp, Toyosu IHI Bldg, 1-1, Toyosu 3-chome, Koto-ku, Tokyo, Japan, Tel: + 81 3 6204 7800, Fax: + 81 3 6204 8800, Licensee

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Dimensions

	Metric Units	U.S. Units
Length	3.66 m	12 ft
Width	1.65 m	5.5 ft
Height	1.65 m	5.5 ft
Weight	2,779 kg	6,173 lb
Inlet Duct Flow Area	1.12 sq m	12 sq ft
Exhaust Duct Flow Area	0.65 sq m	7 sq ft

Performance

	Power Rating	SFC	Compression Ratio	Exhaust Mass Flow	Exhaust Temp.
U.S. Units	6,130 shp	0.443 lb/hp-hr	14.5:1	36 lb/sec	1,049ºF
Metric Units	4.57 MW	0.269 kg/kWh	14.5:1	16.4 kg/sec	565°C

Design Features. GE's Industrial LM500 gas turbine is a CF34 engine without its fan and is very similar in materials and design to GE's LM2500. The LM500 is a simple-cycle, two-shaft gas turbine with an aerodynamically coupled power turbine. It incorporates a variable stator compressor driven by an air-cooled, two-stage turbine.

The LM500's single-shaft gas generator consists of a 14-stage, 14.5:1-pressure-ratio high-pressure (HP) compressor with variable inlet guide vanes and variable stator vanes in the first five stages, a machined ring (annular) combustor with 18 externally mounted fuel injectors, and an air-cooled two-stage HP turbine. The aerodynamically coupled power turbine on the second shaft has four stages. The output shaft to which the load is connected is on the air inlet end of the engine.

The gas turbine has been fully integrated on a common base with a 4-MW generator and all auxiliary equipment. An epicyclic gearbox is used to reduce power turbine output speed from 7,000 rpm to the 1,800 rpm required at the four-pole generator. The auxiliary equipment layout is designed to minimize weight and allow for ease of maintenance.

Operational Characteristics. The LM500 is designed using corrosion-resistant materials for long life in adverse environments. It has built-in borescope ports and a water wash manifold for compressor cleaning. The low-speed shaft, with no differential bearings, provides for front-end drive. It is built for fast start-up, good stall margin, and flexibility of control over a wide speed and power range.

The two-stage, air-cooled HP turbine permits high turbine inlet temperatures for high efficiency with long hot-section parts life. GE provides a lube oil, ignition, and starting system along with a digital engine control system. The LM500 engine is designed with a split casing for ease of maintenance.

Program Review

Background. The General Electric LM500 is an industrial and marine gas turbine machine derived from the GE Aircraft Engines TF34 high-bypass-ratio turbofan aircraft engine that was developed for the Lockheed-California/U.S. Navy S-3A Viking ASW aircraft and Fairchild Republic/U.S. Air Force A-10 Thunderbolt II low-level-attack aircraft, and then used under the civil designation CF34 in the Canadair Challenger 601 aircraft.

In a unique use of the LM500, the University of Texas Center for Electromagnetics selected the GE gas turbine for use in the U.S. Army's Electromagnetic (EM) Gun Weapon Systems Demonstrator Program. The LM500 powered a compensated pulse alternator designed to store 210 MJ at 8,600 rpm. The EM demonstrator was called a Range Gun; it is a self-contained 90mm rail gun capable of launching a salvo of nine projectiles with a muzzle velocity energy of 9 MJ at velocities of 8,200-13,120 feet per second (2,500-4,000 m/sec). The Army has tested EM cannon for potential use in the next generation of main battle tank armament systems.

The Industrial LM500 gas turbine engine development program was completed in August 2004. Operational string testing of the integrated gas turbine generator set was completed in January 2005, with full power plant testing taking place later in 2005 at the Land Based Test Site, in Philadelphia.

In 2010, one of three Industrial LM500s installed in the Hoffmann La-Roche plant at Nutley, New Jersey, to provide uninterrupted power generation developed major increases in vibration when running. This required the unit to be shut down for evaluation. A technical analysis showed that the sudden increase in vibration may have been caused by a shaft or casing crack, which opens up under increasing load. This crack could open up further as the load transmitted through the gearbox was increased. This was confirmed by penetrant testing that revealed that a crack had formed on the foot of the gearbox casing. The crack was welded shut and, subsequently, the vibration of the gearbox was reduced to the earlier acceptable levels. This is a rare confirmed example of an LM500 power generation installation.

Gas compression applications have accounted for the majority of Industrial LM500s to date. These, however, represent only a small proportion of LM500 sales, with the vast majority going to the marine propulsion and generation sectors.

Funding

Development of the Industrial LM500 was funded using corporate resources.

Contracts/Orders & Options

No contractual data for Industrial LM500s is currently available.

Worldwide Distribution/Inventories

As of 2022, a total of eight LM500 units are believed to have been installed for power generation purposes and 15 as compressor units for pipeline applications.

Forecast Rationale

The industrial LM500 utilizes comparatively old technology. That does not necessarily equate to putting the LM500 out to pasture, though, as it is a tried-and-tested turbine in both power generation and gas compression duties. Although General Electric does not advertise this particular turbine, there may be a future for it.

Normally the LM500 would be considered defunct, but a renaissance of sorts has happened with its marine sibling. The Japanese and South Koreans have purchased the marine LM500 for their Hayabusa and Chamsuri II patrol boats, respectively. This surge of production is being matched by major interest in floating production, storage and offloading (FPSO) platforms for oil exploration and the gas industry's equivalent floating natural gas platforms.

The use of LM500s for power generation and compression on these ships would offer significant

LM500 Industrial

benefits, since the turbines are already marinized and have demonstrated success in difficult environments.

As both the marine and industrial LM500s are similar, it is not beyond the realm of possibility that the industrial machine might see a revival. Forecast International is not currently forecasting any future production, as little public information warrants it; however, the situation is being monitored closely. The industrial LM500 could make a comeback.

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