

Turbomachinery Systems

For Oil and Gas Applications



COMPRESSOR SETS



MECHANICAL DRIVE PACKAGES



GENERATOR SETS



CENTRIFUGAL GAS COMPRESSORS

Performance to Power the Oil and Gas Industry

Since Solar Turbines Incorporated entered the industrial gas turbine business in 1960, the fleet of Solar gas turbines installed worldwide has grown to more than 12,000 units and those turbines have logged well over 1.1 billion hours in 92 countries.

Customers are operating Solar turbines in the toughest, most challenging environments, including remote arctic, desert, tropical and offshore areas. Our rugged, robust, highly reliable gas turbines offer competitive efficiencies in their power class with the most durable products available.

Solar offers factory packaged gas turbine-driven compressor sets, mechanical-drive packages and generator sets in the 1-to-15 MW output range.

Single-Source Advantages

Solar Turbines designs and manufactures its gas turbines and turbomachinery packages to ensure maximum systems compatibility and integration, plus high performance, reliability, availability, efficiency and long life in the most demanding applications. As the customer's single source, Solar can also provide:

- Commissioning
- Technical training
- Field service
- Certified parts
- Repairs, overhauls, upgrades
- Complete project operation and maintenance
- Engineering, procurement, and construction (EPC)
- Contract power and leasing
- Financing programs

Efficiency

Solar® turbines are designed for efficient, simple-cycle operation and they can provide overall system thermal efficiencies from 70-80% when both their shaft power and exhaust heat energy are harnessed.

Transportability

Solar turbine packages are lightweight and compact for easy transportation and installation.

A gas turbine package's high power density, ease of transport by standard conveyances and easy installation can pay off in lower installed cost per horsepower.

Availability

Durability and reliability are only part of the Solar turbine availability story. The units have many built-in features for temperature and vibration instrumentation, rapid component removal and easy inspection to speed maintenance and maximize availability.

Customized Packages

Solar builds complete turbomachinery packages that are ready to go to work...no matter where the job may be. From pre-engineered designs to highly specialized requirements, Solar can provide the solution for your needs. Solar designs and manufactures its gas turbines and turbomachinery packages under quality management systems, maintaining ISO 9001 certification since 1992.



Pipeline
Compression
Titan 130





Gas
Transmission
Taurus 60

Compressor sets, which utilize Solar's family of centrifugal gas compressors, are designed for applications in the oil and gas industry such as:

- Natural gas gathering
- Transmission
- Storage/withdrawal
- Gas lift
- Export sales gas

Mechanical-drive packages are ideally suited for driving:

- Centrifugal compressors produced by other suppliers for air, process and refrigeration applications.
- Reciprocating compressors

The versatile mechanical drives also power pumps for:

- Transporting crude oil
- Transporting liquid products
- Waterflood

Generator sets, rated from 1-to-15 MWe, are used worldwide for a variety of applications including:

- Offshore platform and FPSO power generation
- Gas production and process facility power generation
- Cogeneration

Whether designed in single-shaft, constant-speed or of two-shaft, variable-speed configuration, Solar's line of industrial gas turbines is designed with:

- Axial-flow air compressors
- Single annular combustors
- Axial-flow gas generator turbines and power turbines

The two-shaft configurations are designed especially for mechanical drive applications and their power turbine is mechanically independent of the gas generator to provide optimal control over a wide range of speeds and loads.

The single-shaft configurations are designed specifically for power generation and use an epicyclic speed-reduction gearbox to couple the gas turbine to the generator.

The *Mars* gas turbine is available only in a two-shaft configuration for all applications.



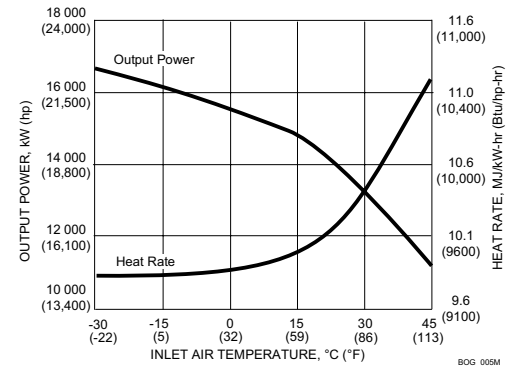
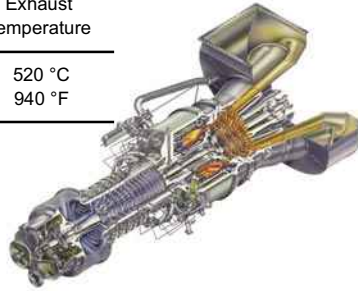
Power
Generation
Taurus 60S

Performance Coverage - Mechanical Drives

The following curves provide performance data for *Titan*™ 130, *Mars*® 100, *Taurus*™ 70 and *Taurus* 60 mechanical drive packages and generator sets at full load under ISO conditions: 15°C (59°F), sea level, natural gas fuel, 60% relative humidity, zero inlet and exhaust losses. Power and efficiency ratings are nominal at the generator terminals. For performance information on our entire range of equipment including *Mars* 90, *Centaur*® 50, *Centaur* 40 and *Saturn*® 20 gas turbines, please visit our website at www.solarturbines.com or contact Solar's sales office nearest you.

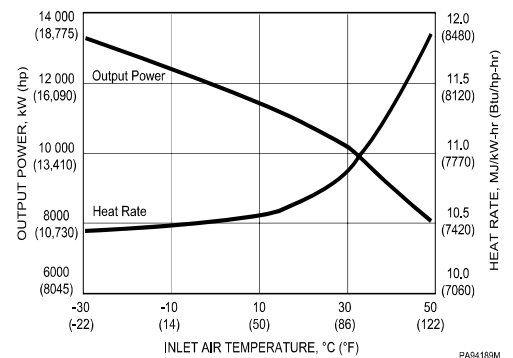
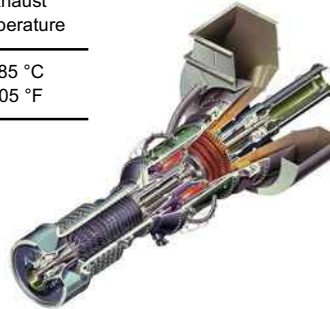
Titan 130 Mechanical Drive Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
15 290 kW 20,500 hp	9940 kJ/kW-hr 7025 Btu/hp-hr	180 050 kg/hr 396,940 lb/hr	520 °C 940 °F



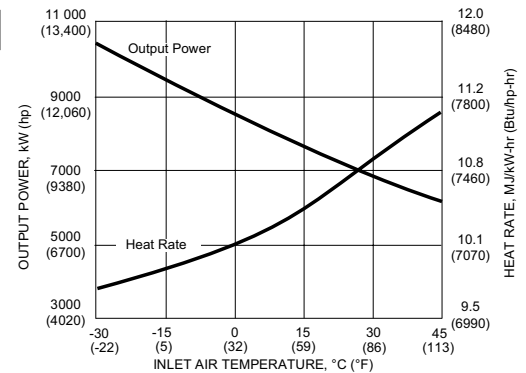
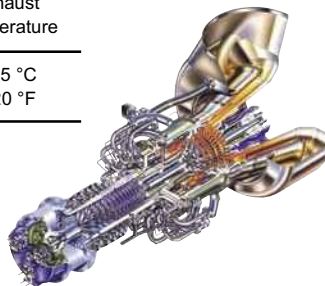
Mars 100 Mechanical Drive Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
11 185 kW 15,000 hp	10 595 kJ/kW-hr 7490 Btu/hp-hr	152 280 kg/hr 335,560 lb/hr	485 °C 905 °F



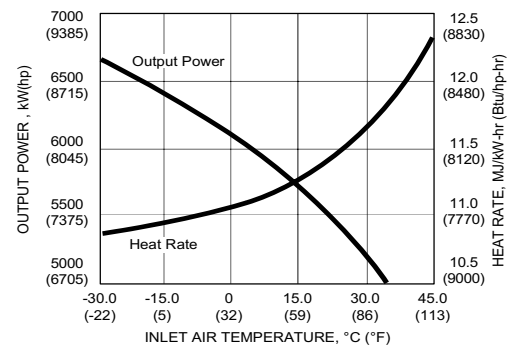
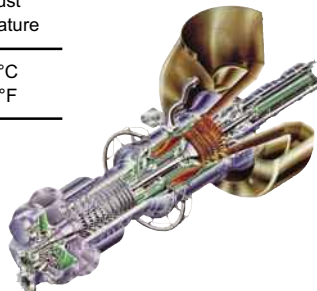
Taurus 70 Mechanical Drive Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
7690 kW 10,310 hp	10 340 kJ/kW-hr 7310 Btu/hp-hr	95 630 kg/hr 210,830 lb/hr	495 °C 920 °F



Taurus 60 Mechanical Drive Performance

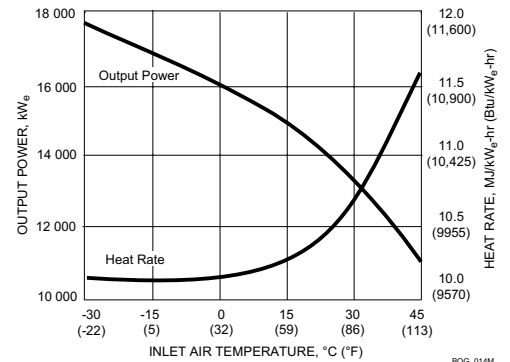
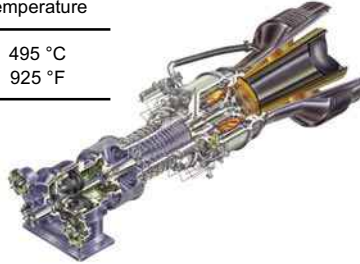
ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
5740 kW 7700 hp	11 265 kJ/kW-hr 7965 Btu/hp-hr	77 875 kg/hr 171,690 lb/hr	510 °C 950 °F



Performance Coverage - Generator Sets

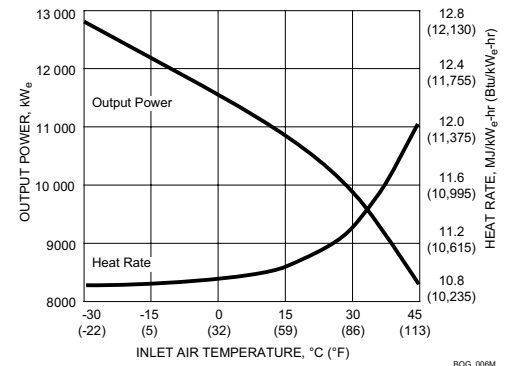
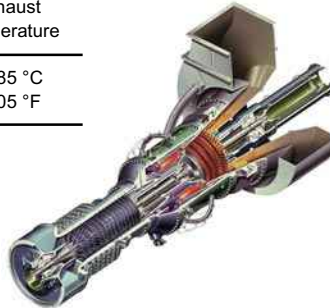
Titan 130 Generator Set Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
15 000 kWe	10 230 kJ/kW _e -hr 9695 Btu/kW _e -hr	179 250 kg/hr 395,180 lb/hr	495 °C 925 °F



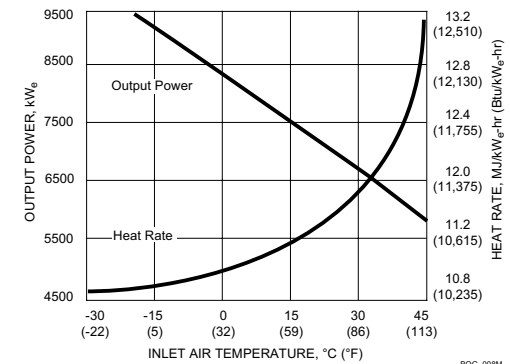
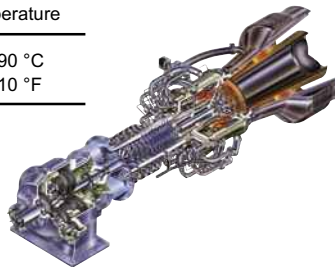
Mars 100 Generator Set Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
10 695 kWe	11 090 kJ/kW _e -hr 10,515 Btu/kW _e -hr	149 930 kg/hr 330,540 lb/hr	485 °C 905 °F



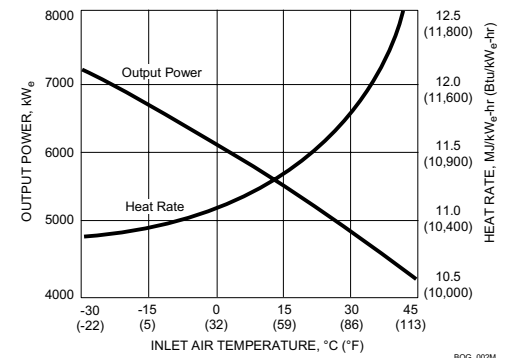
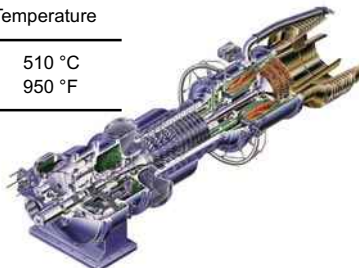
Taurus 70 Generator Set Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
7520 kWe	10 650 kJ/kW _e -hr 10,100 Btu/kW _e -hr	97 000 kg/hr 213,840 lb/hr	490 °C 910 °F



Taurus 60 Generator Set Performance

ISO Continuous Duty Output	Heat Rate	Exhaust Flow	Exhaust Temperature
5670 kWe	11 430 kJ/kW _e -hr 10,830 Btu/kW _e -hr	78 280 kg/hr 172,575 lb/hr	510 °C 950 °F



Performance in Product Development

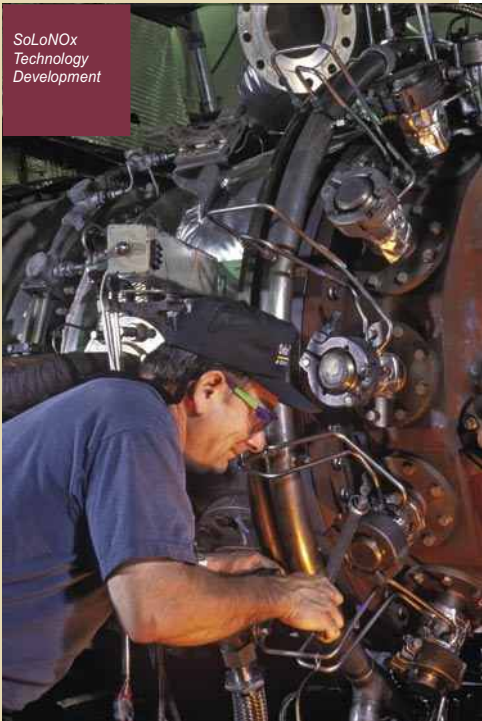
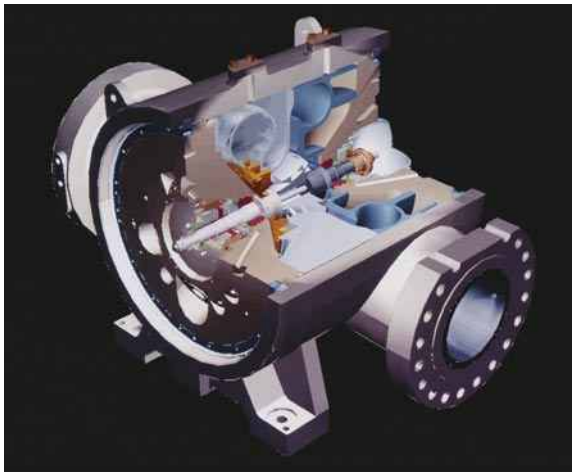
Solar gas turbines have low exhaust emissions levels and can meet virtually any current clean-air standards. Solar offers gas turbine engines with pollution- prevention SoLoNOx™ technology. This advanced system utilizes lean-premixed dry combustion technology, the most cost-effective approach to pollution prevention, since they do not consume water or require complex and costly “add-on” emissions clean-up devices to attain very low NOx and CO emissions. More than 1200 gas turbines with SoLoNOx technology have been installed worldwide and are designed to deliver the same ruggedness, reliability and operating flexibility for which Solar gas turbines are known.



Pipeline
Compression
Mars 90S

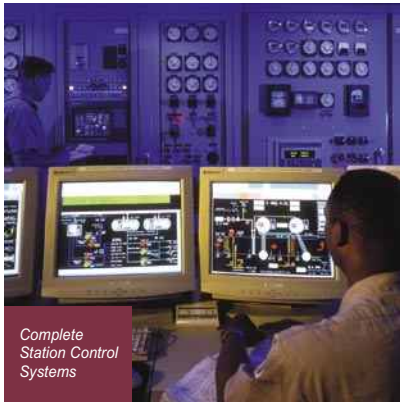
Centrifugal Natural Gas Compressors

Solar manufactures seven centrifugal natural gas compressor families, which incorporate many American Petroleum Institute (API) required features plus outstanding ruggedness, reliability and operational flexibility. They have pre-designed, standardized components for maximum interchangeability and enhanced availability. Rapid field restaging is made possible because of their modular designs. Solar gas compressors have from 1 to 10 stages to handle flows from 4.25 to 566 m³/min (150 to 20,000 ft³/min) and discharge pressures to 24 100 kPa (3500 psi).



SoLoNOx
Technology
Development

Pipeline Compressors		Multi-Stage Compressors	
	Number of Stages		Number of Stages
C40	1-2	C16	1-10
C45	1-3	C33	1-9
C65	1-2	C40	1-6
		C50	1-5
		C51	1-8



Solar has designed, installed and supported packages worldwide. Additionally, we have extensive experience meeting code requirements such as API, ATEX, CENELEC, CSA, NEC. Typical package options include:

Start Systems

- AC direct-drive - VFD
- Pneumatic
(mechanical drive/compressor sets)

Fuel Systems

- Natural gas
- Associated gas
- Distillates
- Natural gas liquids (NGL)
- Liquefied petroleum gases (LPG)
- Hydrogen Blends
- Medium-Btu gases (such as coalbed methane, landfill, etc.)
- Dual- and tri-fuel systems

Lube Oil System

Oil system pump supply

- Engine-driven
- AC-Motor driven

Integral lube oil tank reservoir

- Carbon steel
- Stainless steel

Lube oil cooling exchanger

- Water-to-oil
- Air-to-oil
- Low noise

Lube oil filters

- Dual with transfer valve

Control and Monitoring System

- Turbotronic® microprocessor-based
- Onskid control
- Remote console option

Monitoring

- Remote
- Vibration
- Temperature
- Trending
- History

Displays

- Remote console
- Onskid digital displays

Skid Mounting System

- Multiple-point
- Three-point for offshore duty
- Floating platform capability

Mechanical Drives/Compressor Sets

Controls

- Process
- Surge control
- Sequencing of multiple units

Generator Sets

Generators

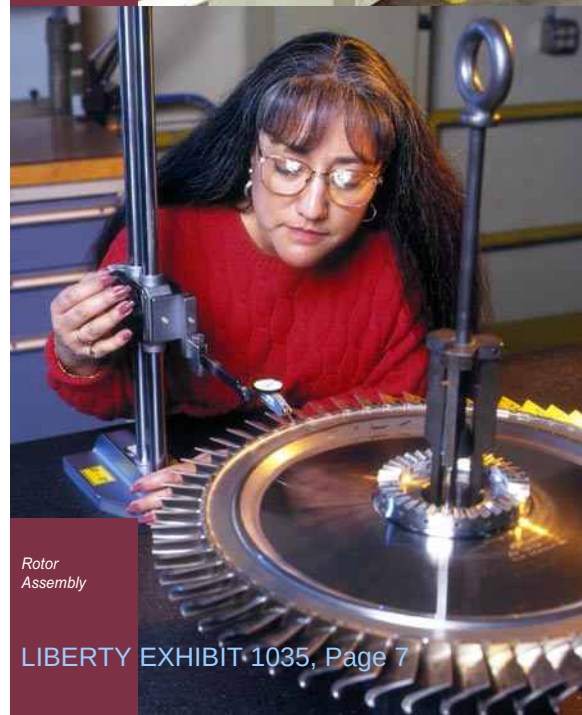
- 50 Hz standard voltages
- 60 Hz standard voltages

Controls

- Kilowatt control
- Auto start and synchronizing

Fast Delivery

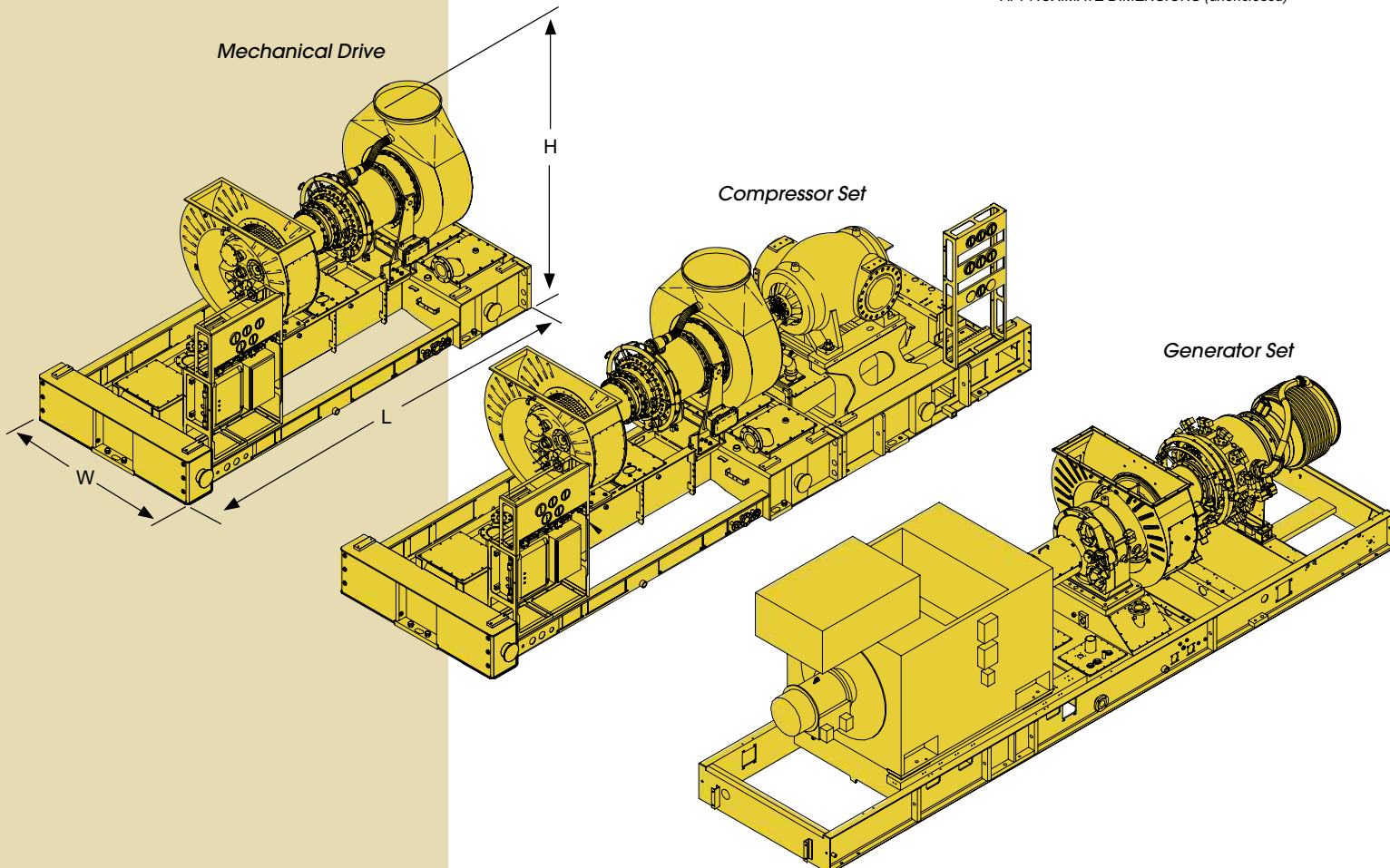
World-class manufacturing facilities, processes and skilled personnel enable Solar to provide the shortest possible lead times for fully engineered packages tested to fulfill specific customer requirements.



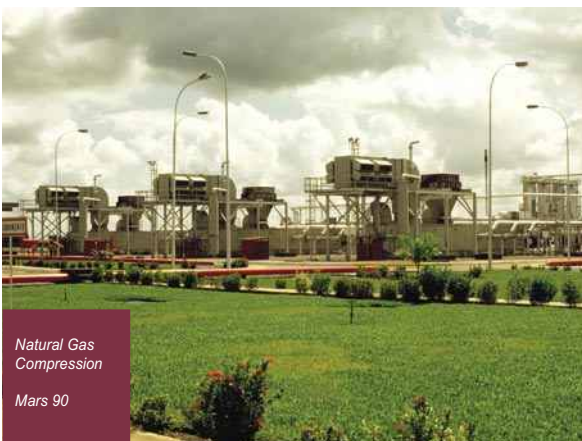
Package Dimensions

GAS TURBINE MODEL	Titan 130	Mars 100	Mars 90	Taurus 70	Taurus 60	Centaur 50	Centaur 40	Saturn 20
GENERATOR SETS								
Length, m (ft, in.)	14.2 (46'6")	14.6 (48'0")	14.6 (48'0")	11.9 (39'0")	9.8 (32'2")	9.8 (32'2")	9.8 (32'2")	5.8 (18'11")
Width, m (ft, in.)	3.0 (10'0")	2.8 (9'2")	2.8 (9'2")	2.9 (9'6")	2.5 (8'2")	2.5 (8'2")	2.5 (8'2")	1.7 (5'5")
Height, m (ft, in.)	5.2 (17'0")	5.2 (17'0")	5.2 (17'0")	4.9 (16'0")	3.6 (12'0")	3.6 (12'0")	3.6 (12'0")	2.0 (6'7")
Dry Weight, kg (lb)	83 700 (184,000)	82 200 (181,200)	82 200 (181,200)	55 000 (121,000)	33 175 (73,000)	32 705 (72,000)	32 640 (71,900)	9980 (22,000)
MECHANICAL DRIVES								
Length, m (ft, in.)	9.8 (32'0")	9.0 (29'6")	9.0 (29'6")	7.3 (24'0")	5.5 (18'3")	5.5 (18'3")	5.5 (18'3")	4.7 (15'4")
Width, m (ft, in.)	3.0 (10'0")	2.8 (9'2")	2.8 (9'2")	2.7 (9'0")	2.6 (8'5")	2.6 (8'5")	2.6 (8'5")	1.9 (6'3")
Height, m (ft, in.)	3.2 (10'6")	2.9 (9'6")	2.9 (9'6")	3.0 (9'11")	2.7 (8'11")	2.7 (8'11")	2.7 (8'11")	2.1 (6'9")
Dry Weight, kg (lb)	35 400 (78,000)	29 200 (64,400)	29 205 (64,400)	20 500 (45,200)	11 200 (24,600)	11 200 (24,600)	11 200 (24,600)	6400 (14,100)
COMPRESSOR SKIDS - TYPICAL ADDITIONAL DIMENSIONS								
	TYPICAL COMPRESSOR SKID							
	ONE BODY			TWO BODY			THREE BODY	
Length, m (ft, in.)	4.0 (13'0")			5.8 (19'0")			7.9 (26'0")	
Dry Weight, kg (lb)	16 783 (37,000)			23 587 (52,000)			30 391 (67,000)	

APPROXIMATE DIMENSIONS (unenclosed)



Typical Applications



Expertise at a Project Level

Because we are totally focused on the industrial gas turbine market, Solar Turbines leads the industry in offering a multitude of application choices. We provide several key services that help facilitate the success of your project. From designing complete turnkey modular installations to providing customized financial services, Solar is your single source solution provider.



Construction Services

Solar can provide single-source capability to design, build and commission a complete compressor station, power plant or offshore module for any number of fixed or floating platforms.

Prefabricated Modules

Solar turbine packages are available in compression, mechanical-drive and power generation modules that can be installed and commissioned with a minimum of on-site work. Fully pre-engineered and prefabricated, these single- or multiple-unit modularized stations are self-contained, weatherproof and acoustically lined, and are

especially well-suited for offshore and remote installations.



Financial Services

Working in conjunction with Caterpillar Financial Services, Solar offers a full array of financing products as options to direct purchase by our customers. Financing can be arranged for the gas turbine package or structured to include an entire turnkey plant, and

terms can range from 1 through 15 years. Available financing options include finance leases, operating leases, government leases, project financing and compression services.

Compression Services Agreement

Solar's Compression Services Agreement is designed to bring the full array of our compression products and services to our customers in one simple contract. We recognize the growing desire of companies to utilize alternatives to direct investment/operations to meet some or all of their compression requirements, saving investment capital for their core business needs. Solar, as a full service provider, has the capability to build, finance and operate and maintain a plant tailored to your specific compression requirements, all through one integrated contract. We would be happy to provide further information on Solar's Compression Services Agreement including project specific proposals.

Worldwide Support Services



Life-Cycle Extension Services

- Compressor restage and repair
- Remanufactured parts
- Package refurbishment
- Controls retrofits

Solar Turbines provides one-stop, full service, worldwide support and complete OEM solutions through our global network of overhaul centers, parts depots, field service offices and training facilities. We are committed to providing our customers with the lowest possible life-cycle costs for their turbomachinery. Our support philosophy is one of flexibility...from customers who want full service contracts to customers who want to arrange their own maintenance programs. Solar has a solution for you.

Field Service

- 37 strategic locations worldwide
- Fast response - around the clock
- Ready access to Solar's technical experts

Parts Support

- Seven days a week/24 hours a day ordering and shipment
- Solar certified parts stocked at seven depots worldwide

Overhauls/Repairs/Upgrades/Upgrades

- Eight overhaul facilities worldwide
- Eight exchange engine fleet locations worldwide - minimizing downtime
- 13 repair/refurbishment locations

Training

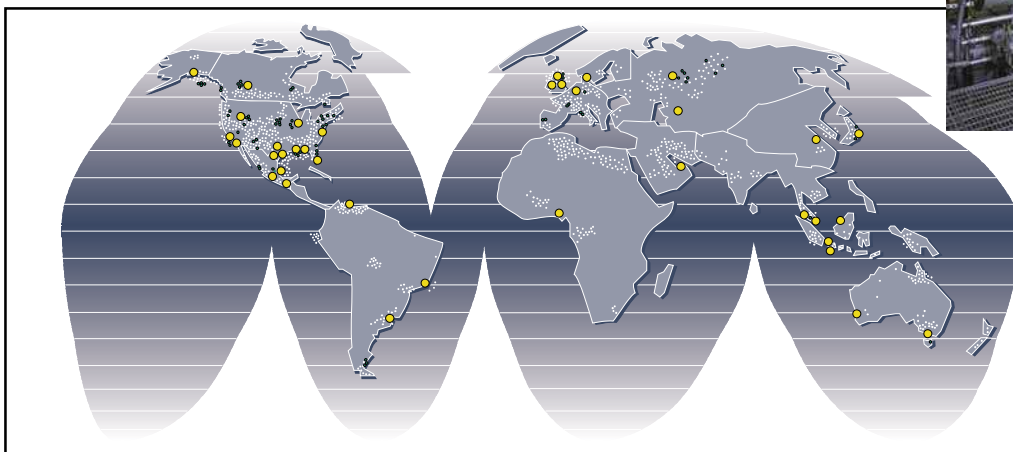
- All aspects of Solar turbomachinery systems
- More than 30 courses available
- At Solar's factory or your field site



Machinery Management Services

Solar has developed a broad range of services we can customize to fit your needs including:

- Compression services
- Full-service operation and maintenance
- Fleet management
- Maintenance management
- Equipment health monitoring
- Contract maintenance
- Consulting services
- Compression services
- Condition assessment
- Remote monitoring and diagnostics
- e-Collaboration



Solar® Turbines

A Caterpillar Company

Solar has been a pioneer in the design, manufacture and packaging of gas turbine systems for more than 50 years and is a world leader in the mid-range industrial gas turbine business. As a result, customers spanning the globe know they can rely on Solar to provide rugged, reliable turbomachinery systems, responsive service and unrivalled technical assistance and service parts availability anywhere in the world.



www.solarturbines.com



For more information about Solar gas turbine-driven compressor sets, mechanical-drive packages and generator sets or our broad range of customer support services, please contact:

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or your nearest Solar sales office.

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Miami, FL; New Orleans, LA;
New York City (Upper Saddle River, NJ); and Salt Lake City, UT

Outside the U.S., please contact:

Solar Turbines Europe S.A.

Brussels (Gosselies), Belgium; London (Bracknell, England) U.K.; and Dubai, UAE.

Caterpillar Overseas S.A.

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Beijing, People's Republic of China

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