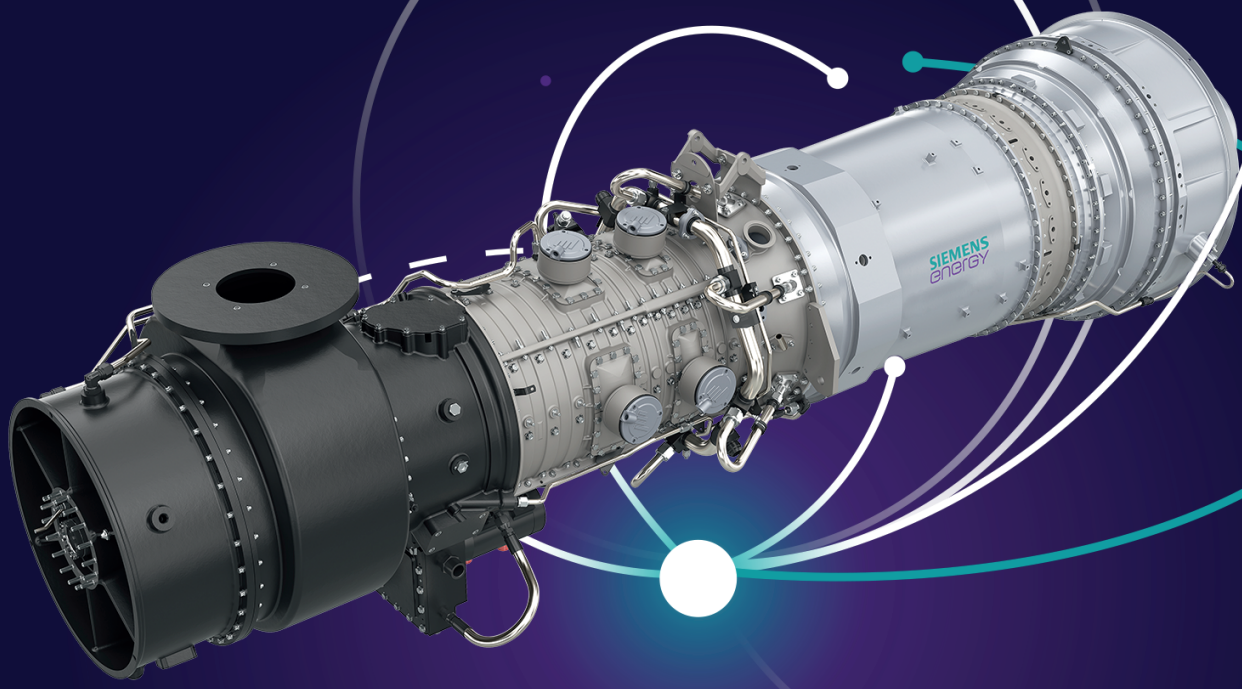
SIEMENS energy

SGT-A05

Aeroderivative Gas Turbine



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SGT-A05 Aeroderivative Gas Turbine

Easily deployable for dependable, efficient and flexible power for CHP, standby and mobile power applications

More than 1,720 SGT-A05 gas turbines have been sold for industrial use to more than 500 customers in 55 countries, accumulating an impressive 133 million operating hours since its introduction in 1963.

Today, these engines are delivered to our customers through a network of distributors who incorporate the engine into complete generator sets, both stationary and mobile.

All Siemens Energy distributors are carefully chosen for their engineering and manufacturing capabilities and commitment to adhere to Siemens Energy standards for quality and delivery.

Industrialized Aeroderivative Gas Turbine

Originally developed for use in aviation, the SGT-A05 gas turbine variants are flexible,compact and lightweight designs that are ideally suited for decentralized power generation offering high efficiency and fast start-up capabilities.

Fast start-up and power flexibility means that the SGT-A05 gas turbine can quickly handle changes in power requirements, making it the perfect fit for decentralized power generation or emergency power deployment.

SGT-A05 KB7HE Aeroderivative gas turbine.
Designed for use in power generation and oil & gas applications, features of the SGT-A05 gas turbine include:

Market Leading Performance

Continued investment and development in the SGT-A05 to meet the rapidly changing customer environment

At Siemens Energy we understand the rapidly changing nature of today's industrial and commercial environment, in which market requirements and operating conditions can vary significantly – and often unpredictably. So we design our products and services to help ensure Siemens Energy customers maintain performance and increase profitability throughout the life of their power generation project.

SGT-A05 Aeroderivative Gas Turbine variants

The SGT-A05 gas turbine variants produce electrical power output between 4 and 5.8 MW for applications such as base load, combined heat and power, mobile power and emergency power.

SGT-A05 variants are fulfilling the requirements of a wide spectrum of applications in terms of efficiency, reliability, flexibility and environmental compatibility.

SGT-A05 gas turbine variants offer low life-cycle costs and an excellent return on investment.

Reducing exhaust emission for our customers and their communities

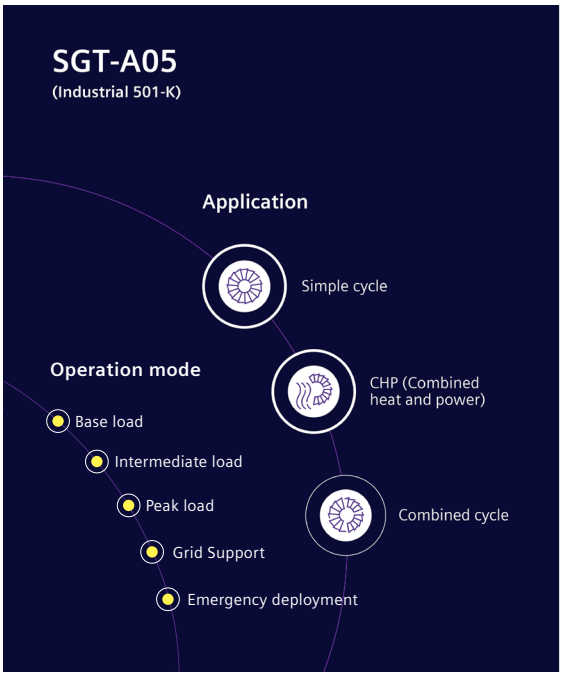
SGT-A05 is offered with either standard rich burn or advanced lean-burn combustion technology available with the Dry Low Emission (DLE) system.

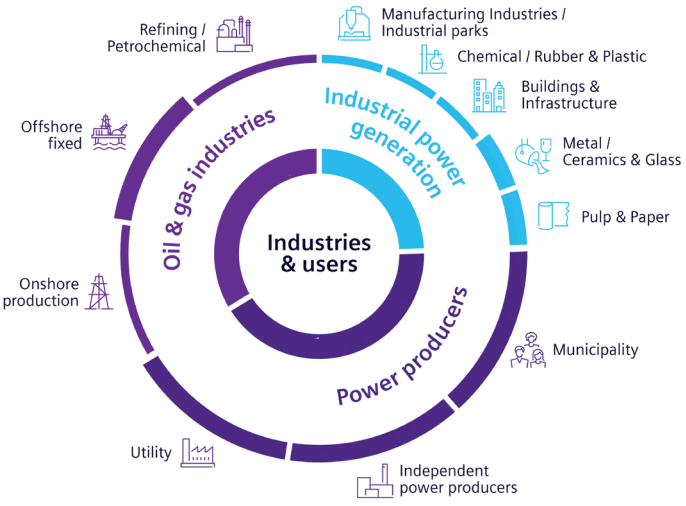
The DLE system achieves emission levels better than 25 vppm NOx and 50 vppm CO. The DLE System has achieved single digit NOx.*

50% turndown capability with emission compliance is available on the DLE system. Siemens Energy continues to invest in further enhancing the emission and turndown capabilities of the SGT-A05 gas turbine.

Water and steam injection diluent options are available for emissions reduction with standard rich burn combustion configurations.

**Emission performance based on package configuration and fuel quality.*





Decarbonization @ Siemens Energy

Currently, SGT-A05 is capable of operating on 30% vol. hydrogen with minimal hardware changes on DLE and WLE systems.

"In answering the question of how we can meet the world's growing energy needs while protecting the climate, hydrogen will be an important lever. It allows to decarbonize different sectors and to transport or store renewable energy. At Siemens Energy, we will continue to drive the development of a hydrogen economy."

Christian Bruch, CEO Siemens Energy

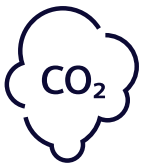
The world is hungry for energy, and climate change calls for lower emissions. Our customers need innovative solutions to succeed as carbon neutrality will drive significant changes in the market. We have a solution to navigate these changes.

Gas turbines remain an important element in the power generation as electrification trends toward full decarbonization and the hydrogen economy start to unfold. SGT-A05 gas turbines can run on a wide range of fossil fuels today as we prepare to run on carbon-neutral fuels when needed. Please contact us to find out how.

Reliability, availability, and grid stability will continue to be important features in an energy environment with increased penetration of renewable energy. The fast-starting feature of the SGT-A05 gas turbines, combined with carbon neutral fuels, makes this equipment the ideal future-proof investment for projects such as data centers, peaking and baseload units. The SGT-A05 will be capable of handling the hydrogen blended into existing natural gas infrastructure or run as a standalone fuel.

Carbon neutral fuels are one of the most important future technologies to reduce greenhouse gases and drive climate change, especially in industrial applications. The SGT-A05 gas turbine technology enables our customers to supply energy sustainably, reliably, and economically.

Decarbonization impact



- Reduction in CO_2 footprint with carbon neutral fuels, such as hydrogen
- Utilization of hydrogen from industry by-product (e.g., petrochemical)

More customer benefits

- Upgrading Siemens Energy gas turbines to carbon neutral fuel capability protects existing assets and future investments for a fully decarbonized world
- Low NOx emissions through DLE or WLE technology (dry/wet low emission)

Decarbonizing energy one step at a time

The SGT-A05 operational and fuel flexibility enables the transition to reliable and environmentally sustainable energy. Therefore, owners of existing and new SGT-A05 gas turbine power plants can be confident of their plants' roles in supporting the future energy transition.

Applicable for baseload, back-up and combined heat and power generation, the SGT-A05 Hydrogen conversions will feature:

- Minimal hardware changes at lower H_2 blends
- Significant CO_2 reductions at higher H_2 blends
- No power derate all the way up to 100% H_2.

No power reduction, even at 100% H_2.

SGT-A05 Gas Turbine Variants

Now even stronger with SGT-A05 KB7HE

Based on proven aeroderivative design, the SGT-A05 gas turbines are flexible, compact and lightweight designs that are ideally suited for decentralized power generation offering high efficiency and fast start-up capabilities. Our current offering includes variants of the proven KB5 and KB7 engines:

SGT-A05 KB7HE, SGT-A05 KB7S and SGT-A05 KB5S

Fuel Flexibility

The SGT-A05 is known for its high fuel flexibility, which will accommodate a wide variety of possible applications and requirements.

Fuels include, but are not limited to natural gas, liquid fuels (e.g. diesel and ethanol) and low energy gas fuels.

Fuel system options include DLE, dual fuel, and water injection.

Fast Start-up

Thanks to advanced engineering, the SGT-A05 gas turbines provide fast start-up capability: You will have full engine power available within 60 seconds in all conditions. This includes hot restarts, with no need to go into idle condition. The SGT-A05 engine also offers black start capability.

Excellent Load Following

Emissions control available down to below 50% power. Our non-DLE variant can adjust to any power that is required for the site. All our gas turbines easily accept instantaneous increases / decreases in power output, making this the perfect solution for Island mode operations.

SGT-A05 gas turbine variants specification

Simple cycle power generation

	SGT-A05 KB5S	SGT-A05 KB7S	SGT-A05 KB7HE
Power Output*	4.0 MW(e)	5.4 MW(e)	5.8 MW(e)
Fuel	Natural gas, liquid fuel, dual fuel; other fuels on request; automatic changeover from primary to secondary fuel at any load		
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Electrical Efficiency*	29.7%	32.3%	33.2%
Heat Rate*	12,137 kJ/KWh	11,146 kJ/kWh	10,889 kJ/kWh
Turbine Speed	14,200 rpm	14,600 rpm	14,600 rpm
Pressure Ratio	10.3 : 1	14.2 : 1	14.4 : 1
Exhaust mass flow	15.4 kg/s	21.3 kg/s	21.4 kg/s
Exhaust Temperature	560 °C (1,040 °F)	495 °C (923 °F)	508 °C (946 °F)
NOx emissions	≤ 25 ppmvd at 15% O_2 on fuel gas (with DLE)		

* Nominal uninstalled new engine performance with no inlet or exhaust ducting losses, ISO conditions, 0% relative humidity, gaseous fuel with lower heating value of 20,400 BTU/lb (47,496 kJ/kg). Assumes 98.5% generator efficiency and 60 kw shaft gearbox power loss. Power, efficiency and heat rate all based on electrical power output measured at generator terminals. Please see your local Siemens Energy distributor or Siemens Energy representative for specific performance and emissions for your particular project and site conditions.

SGT-A05 Gas Turbine Variants

SGT-A05 KB7HE

Market Leading Gas Turbine

Taking advantage of the already proven and trusted SGT-A05 KB7S gas turbine, the SGT-A05 KB7HE provides performance enhancements using a High Efficiency Compressor upgrade. Based on the proven aeroderivative gas turbine technology, the SGT-A05 KB7HE is an outstanding solution for power generation applications.

Existing SGT-A05 KB7S can easily retrofit to SGT-A05 KB7HE as a cost competitive investment.

SGT-A05 KB7HE is the highest horsepower version (simple cycle) of the SGT-A05 series of engines.

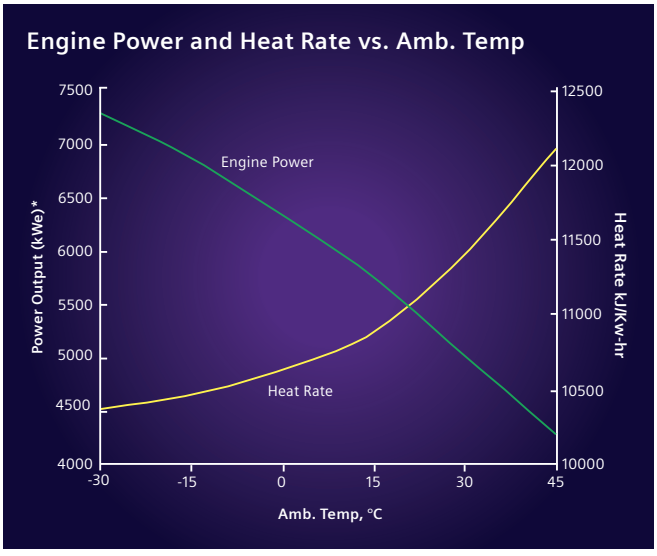
- Higher Power – 8% power increase (8000 SHP) at ISO conditions*
- Lower Fuel Burn
- Fuel Flexibility – Same fuel options as current SGT-A05
- Proven non-DLE dual fuel configuration and combustion system
- Heat Rate – 2.3 % improvement.*

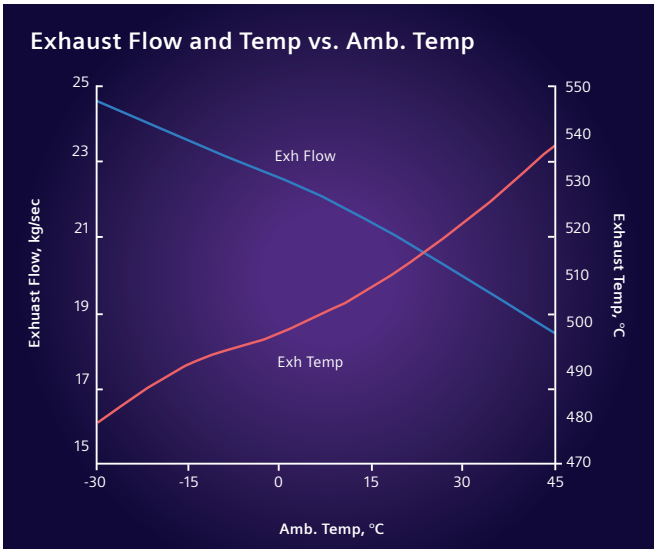
The aeroderivative SGT-A05 KB7HE gas turbine has a best in class

33.2%

electrical efficiency

**Compared with SGT-A05 KB7S*





Measured at the generator terminals excluding package inlet and outlet losses but including gearbox and generator losses
Fuel – typical North American natural gas

SGT-A05 Gas Turbine Variants

SGT-A05 KB7S

A single stage boost compressor, improved vane cooling, higher strength turbine blades and many other enhancements have been incorporated for improved performance, durability and operating cost.

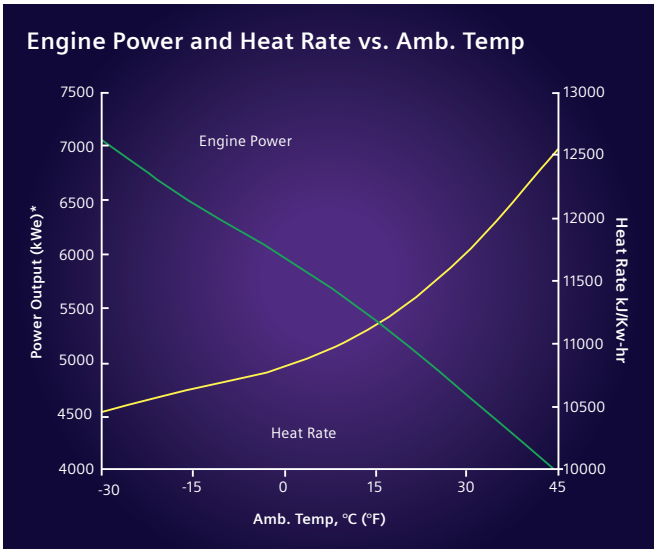
The aeroderivative design of the SGT-A05 series engine provides a lightweight, modular product that helps lower operating costs through reduced fuel consumption, extended hot section life and ease of maintenance.

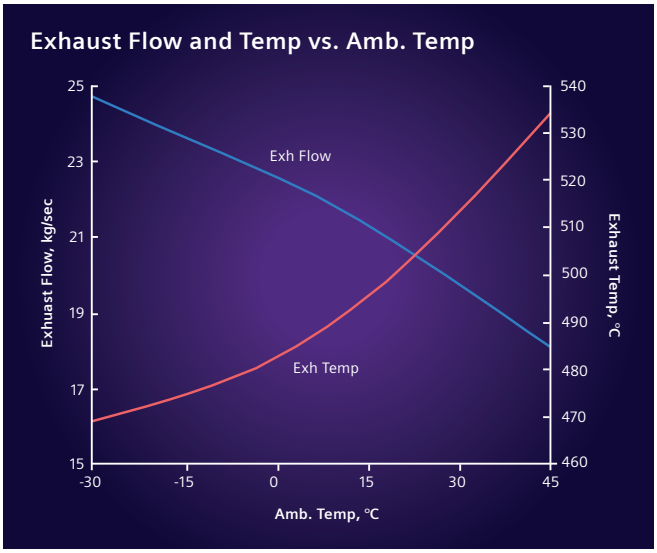
- Effusion cooled combustion liners
- Core engine commonality with SGT-A05 family
- Addition of single stage compressor boost module
- Natural gas, mid-BTU gas options, liquid and dual fuel configurations
- 5 MW power class
- Competitive operating cost.

The aeroderivative SGT-A05 KB7S gas turbine has a best in class

32.3%

electrical efficiency





Measured at the generator terminals excluding package inlet and outlet losses but including gearbox and generator losses
Fuel – typical North American natural gas

SGT-A05 Gas Turbine Variants

SGT-A05 KB5S

The current engine design is the evolutionary result of continuous improvements since the first release in 1963.

Continued product enhancement has improved the reliability, performance, power, and efficiency of the SGT-A05 to better serve the needs of our customers.

Siemens Energy knows there is more to customer satisfaction than manufacturing a quality gas turbine engine. Beginning with the finest designs, the most advanced manufacturing techniques and rigid verification testing, our team continues to serve our customers with a global network of support.

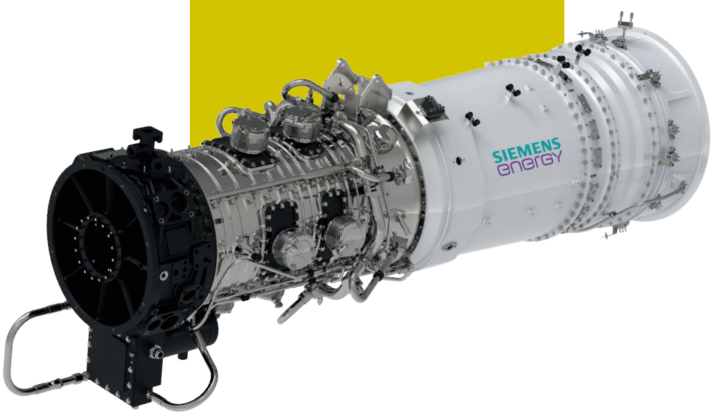
The SGT-A05 KB5S has accumulated millions of hours of operation since its introduction.

- Competitive operating cost
- 4 MW power class
- Single shaft cold end drive
- Standard effusion cooled combustion liners
- Core engine commonality with SGT-A05 family
- Natural gas, mid-BTU gas options, liquid and dual fuel configurations.

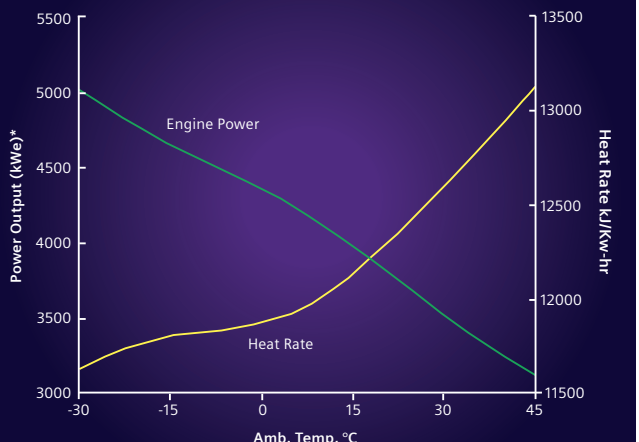
The aeroderivative SGT-A05 KB5S engine has a best in class

29.7%

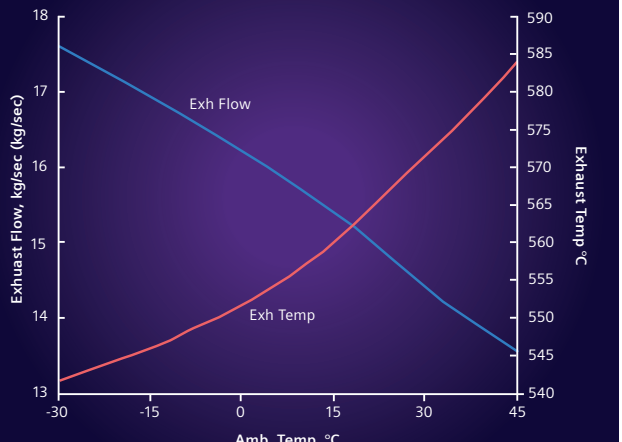
electrical efficiency



Engine Power and Heat Rate vs. Amb. Temp



Exhaust Flow and Temp vs. Amb. Temp



Measured at the generator terminals excluding package inlet and outlet losses but including gearbox and generator losses
Fuel – typical North American natural gas

SGT-A05 Mobile Power Unit

Power on-site in a single package

SGT-A05 Mobile Power Unit (MPU)

This mobile power unit offers class leading gross electrical efficiency performance in a single trailer package. The SGT-A05 core engine, based on the aeroderivative technology, offers a rugged and robust design which is capable of operating on a wide range of liquid and natural gas fuels.

The unit can be operated in remote locations and can be effective as a microgrid power source or could be connected to an existing grid network.

- Up to 5.8 MWe of electrical output
- Various configurations and voltage output are available
- Total set up time on site of less than 2 hours
- Rapid power demand response, MPU can deliver full power within 1 minute of starting.

SGT-A05 Mobile Power Unit solution is available from Siemens Energy as the Via5.8 or from Siemens Energy authorized packagers who offer similar mobile power solutions.

SGT-A05 Mobile Power Unit

Fast power
Ready in less than 2 hours. Rapid deployment time on site

Superior value
Fuel flexibility: liquid and gas

Trusted technology
Proven, flexible turbomachinery

Noise Emissions
Market leading near and far field noise abatement options available

- Based on SGT-A05 aero-derivative gas turbine
- Single-trailer, self-contained design
- On site commissioning time is <2 hours
- Low-noise option for < 85 dBA near-field and < 65 dBC far field
- Designed for in field servicing including gas turbine exchange.

Application modes of operation:

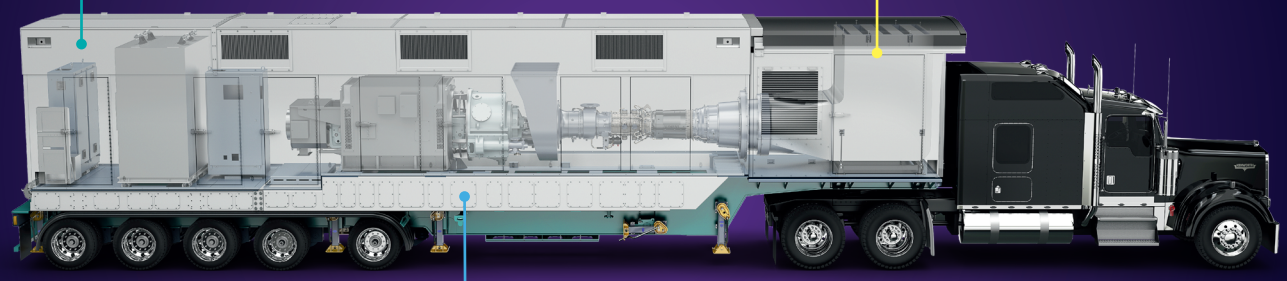
- Prime power for remote operations such as O&G and mining
- Temporary power demand, e.g. military, government, construction, utilities, drilling areas
- Peaking, transmission congestion relief, renewable contact hedging
- Standby emergency power
- Replacement of aged power plants in developed countries (temporary outages)
- Critical process power supply chemical, pharmaceutical, data hubs, hospitals, universities etc.
- Distributed generation for grid support.

Switchgear enclosure

- Switchgear
- Unit control panel
- Motor control center
- Starter control panel
- Auxiliary transformer
- Purge air cooler
- Instrument air compressor

Exhaust enclosure

- Exhaust enclosure cover
- Enclosure ventilation exhaust
- Lubrication oil cooler



Trailer

- Five axle unit
- Steerable forward two axles
- Lifting forward axle
- Cross wind rated design
- Ten landing legs

Ventilated enclosure

- Gas turbine
- GT lube oil (synthetic)
- Air inlet silencers
- GT enclosure ventilation
- Fire protection system
- Dual gas fuel inlets
- Ventilation air inlets
- Gearbox
- A/C generator

Customer supplied

480 V starting generator

Increased Operating Benefits

Improved performance through advanced engineering

The SGT-A05 is known for its high fuel flexibility, which will accommodate a wide variety of possible applications. Fuels include, but are not limited to natural gas, liquid fuels (e.g. diesel and ethanol) and low energy gas fuels.

Fuel system options include DLE, dual fuel, steam and water injection.

In addition to the fuel flexibility, SGT-A05 accommodates a wide variety of customer requirements. The compact design of the engine permits application versatility and ease of removal and replacement. The SGT-A05 measures less than 2.7 meters (8 feet) long and weighs less than 766 Kg (1,690 pounds).

The SGT-A05 is proven to operate in various challenging conditions and locations around the world including the North Sea, West Africa, Siberia, Brazil, Alaska, South East Asia and the desert regions of the Middle East.

The SGT-A05 engine has been shock qualified to Mil-S-901C, which makes it particularly suitable for areas with frequent or severe seismic activity.

Advanced Engineering

Core engine commonality of all SGT-A05 variants:

- Highest power density in weight class
- Advanced materials including additive manufacturing
- All SGT-A05 engines are built to meet stringent industry quality standards including ISO 9001 and AS9100
- Full engine power available within 60 seconds
- Black Start capability
- Modular gas turbine configuration optimizes spares requirements, minimizes cost of ownership and simplifies engine maintenance.

Low Emissions Solutions

Four combustion systems are available, based on customer need:

- Diffusion combustion system can operate on liquid or gas fuel
- Wet Low Emissions combustion system utilizes nozzle steam or water
- Dry Low Emissions combustion system achieves better than 25vppm NOx and 50vppm CO (gas fuel only).

Reliable, Easy Installation and Maintenance

Our comprehensive portfolio of services provides low life cycle cost and optimum performance throughout the turbine's life cycle: Long Term Programs (LTP), Overhaul service, field service, spare parts, service exchange, remote diagnostic service and modernization and upgrades.

The modular, compact design of the SGT-A05 facilitates onsite maintenance, since the modules can be quickly replaced. A direct core engine exchange is possible and can be executed in a single 8 hr work shift.

Simple, inexpensive to maintain

- Rugged, reliable performance with up to 32,000 hours baseload duty between full overhaul
- Over 98% demonstrated availability/reliability
- Lightweight and aeroderivative design.

Photo credit: Centrax Limited

Reference Case: HERA Cogeneration Plant in Bologna

The company operates in the distribution of gas, water, energy and waste disposal in various provinces throughout Italy, including Bologna, Modena, Ravenna, and Rimini.

Location
Bologna, Italy

Commissioning Date
Autumn 2017

Packager
Centrax Gas Turbines, Ltd.

Application
Cogeneration

Gas Turbine Model
2 x SGT-A05 KB5S DLE

Electricity Generated
7.8 MW

Customer Benefits
The new equipment helps to achieve an annual reduction of around 21.000 kg of NOx and 2,500 tons of CO_2 in each 3000hr operating season.

Photo credit: Centrax Limited

Packaged for Success

Package features for dependable, efficient and flexible heat and power CHP, standby and mobile power applications.

The SGT-A05 packages are designed with noise suppression, access doorway, as well as safety interlocks supporting the health and safety of the operation and maintenance staff. The packages are compact and easily transported, installed and maintained.

Lubricating Oil System

- Common synthetic lube oil system for both engine and package
- Lube system components are integral to package design incl. heaters and coolers to meet environmental needs.

Fuel System

- On-skid fuel system includes all components needed to control fuel during start-up and operation
- Operates on natural gas, liquid, dual fuel, and low BTU gas with steam or water injection.

Low Emissions

Both Dry Low Emissions (DLE) and Wet Low Emissions (WLE) systems are available for all SGT-A05 gas turbine variants.

Baseplate

- Sturdy, but small, lightweight footprint
- Design allows easy access for maintenance
- Jib boom provides easy installation or removal of gas turbine.

Electrical

Available to meet local standards as needed.

Air Intake System

- Clean and uniform airflow to the gas turbine
- Includes filter assembly, silencer and flow direction geometry
- Filtration system is available to handle extreme environments.

Gas Turbine Enclosure

- Acoustic enclosures meet a wide range of requirements and environments
- Enclosures shipped ready for installation and commissioning.

Water Wash System

- Maintains performance by preventing build-up of contaminants in the engine compressor
- Pump or compressed air system includes storage tanks, pressure gauges, valves and piping.

"All Siemens Energy distributors are carefully chosen for their engineering and manufacturing capabilities and commitment to adhere to Siemens Energy standards for quality and delivery."

Photo credit: Jereh Group

Complete Customer Care for the SGT-A05 Gas Turbine

Customer support throughout the life of the engine

The global infrastructure of Siemens Energy and its distributors provides customers with the support they need at any time, anywhere in the world. Service centers in every region of the world, combined with a responsive spares program and expert field service representatives, all unite to provide a comprehensive system of service to keep our customers' equipment running reliably.

Engine Lease

Engine lease programs are as varied as our customers' needs. Whether for routine maintenance, or in an emergency, engines can be made available to minimize disruptions to daily operations.

Spares

A worldwide spares inventory allows parts to be delivered anywhere in the world, and as the Original Equipment Manufacturer (OEM), Siemens Energy together with our authorized service providers are committed to supplying only the highest quality parts, whether new or refurbished to in order to meet customer's requirements.

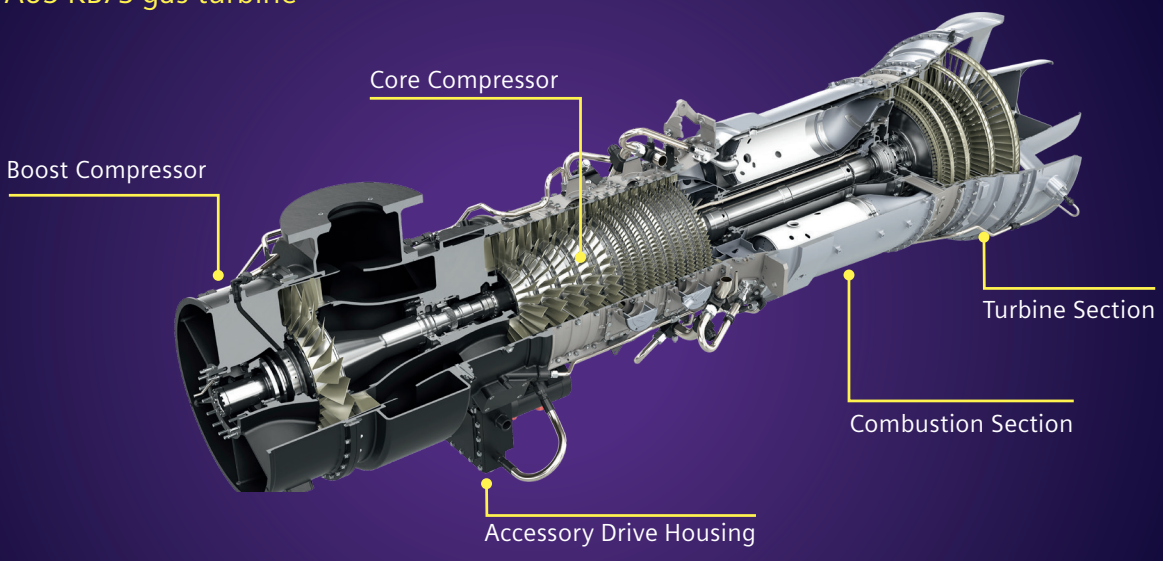
Field Service

Twenty-four hours a day, seven days a week, expert field service engineers work to install, maintain and service customer equipment. Their high level of skill allows them to respond rapidly and effectively to a range of situations that may arise. They also provide training and equipment monitoring. Field service is provided by the distributor network or Siemens Energy.

Modernizations and Upgrades

Upgrades to existing equipment are an attractive option for many customers, and a dedicated team of engineers and project managers work to ensure that the customer's equipment is providing the most power, efficiency and reliability possible. There are currently more than ten different upgrades available for the SGT-A05 gas turbine. Upgrades include SGT-A05 KB7HE upgrade, a conversion to Dry Low Emissions (DLE), dual fuel conversion and more.

SGT-A05 KB7S gas turbine



A Global Network

SGT-A05 Packagers, Maintenance, Repair and Overhaul Centers (MROC) and Heavy Maintenance Centers (HMC)

Our customers may be located in diverse regions around the world, but they all have one thing in common. They all require timely and accurate support to purchase, install and maintain their SGT-A05 gas turbines and equipment. That's why we continually invest in our global infrastructure from distributors to repair and overhaul facilities

General SGT-A05 and Aftermarket Inquiries

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