Industrial Steam Turbines
GE Industrial Steam Turbines

Industries Served

Technology

Reaction Series
- SC/SAC series
- SNC/SANC series
- A5/A9 series
- SG series
- SDF series

Impulse Series
- MP/MC series
- Boiler Feed Pumps
- P/C series
- Navy

Product Development

Service

Training

Test Facilities

Installations
Tradition, Experience and Innovation

GE offers a complete range of Industrial Steam Turbines to meet the most challenging requirements of the Oil & Gas and Power Generation Industries. Customized solutions, a perfect match with the driven compressor, and a modular design philosophy ensure optimum efficiency without compromising reliability and availability. Using an integrated approach that includes extended scope capabilities, parts, services, repair and project management, we contribute to our Customer’s success. The Industrial Steam Turbine product is part of the GE Steam Turbine product line that also includes large units for Fossil, Nuclear and Combined Cycle applications.
GE’s Oil & Gas business has extensive experience in Steam Turbines for both mechanical drive and generator drive applications in chemical/petrochemical, refinery, gas-to-liquids and industrial plants. Our turbines are designed for top thermodynamic and mechanical performance as stand-alone drivers or as part of a complete turbo set. Our total system capabilities ensure the optimization of the match between the steam turbine and the driven machines and provide all the advantages of a single source of responsibility for the complete turbocompressor unit. Our know-how, qualifications and thermal cycle design capabilities also enable us to offer integrated, multi-product, optimized solutions for oil & gas, industrial and public utility power generation.

Industries Served

- **Industrial Power Generation**
  - Combined Cycles
  - Cogeneration
  - Waste to Energy

- **Geothermal Power Generation**
- **Oil & Gas**
  - Urea / Ammonia
  - Ethylene
  - Methanol
  - Refinery
  - Syn-fuels
  - Process Air
  - GTL
  - LNG
  - Power Generation

- **Boiler Feed Pumps**

- **Navy**
  - Power Generation
  - Propulsion
**Technology**

**Different Technologies for Different Needs**

The GE Steam Turbine product line includes both impulse and reaction technology. Impulse turbines, mainly used for small power generation (geared) applications, are manufactured in our plant in Le Creusot, France. This plant encompasses more than a century of experience in steam turbine technology. Reaction steam turbines, used for Oil & Gas applications and industrial power generation, are manufactured in Florence, Italy, where GE’s Oil & Gas Business headquarters is also located. All products are based on a modular turbine design that insures reliability and a high level of performance. The machines are customized using pre-engineered, field-proven stator and rotor components. Every steam path is optimized for the specific thermal cycle requirements to provide high efficiency over the entire operating range.

The inlet and exhaust sections are configured to satisfy plant configuration needs. Inlet sections are selected from a large array of modules with single or multi-valve configuration to satisfy the needs from the smallest capacities to the largest, such as geothermal applications. The turbine exhaust can be furnished with either a radial or axial configuration. The low pressure stages are selected from a very large family of three-dimensional stages having variable or fixed speed capabilities, as dictated by the needs of the specific application.

When one or more controlled steam admission/extraction points are required, the optimum valve system can be found from a selection of multi-valves, throttling valves, and grid valves.
SC/SAC series

Modular Design for a Variety of Applications

SC/SAC series Steam Turbines use both impulse and reaction blades for top efficiency over a broad range of operating conditions. Used in condensing configurations, they virtually cover the gamut of Oil & Gas and Industrial Power Generation applications. The modular structured design permits a high degree of customization to meet the specific steam cycle needs, and can provide controlled or uncontrolled extraction/injection of steam at any possible intermediate pressure level. The inlet section has a hydraulically actuated multi-valve system (up to five valves); the steam flow is controlled by partial or full arc of admission. Controlled extractions can be handled with a multi-valve system similar to that used in the inlet section, or with off-shell throttling valves depending on the pressure levels and application requirements. The exhaust section is in a separate casing flanged to the high pressure section. It can be radial (upward or downward flow) or axial. Design meets API 612 requirements.
**SC/SAC series**

**KEY FEATURES**
- Single Flow
- Impulse/Reaction blades
- Condensing
- Sliding and/or fixed pressure control
- Up to two controlled extractions available
- Axial or Radial (up/down) exhaust
- Base or Foundation mounting

**PRODUCT CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Power Rating</td>
<td>2 to 100 MW</td>
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<tr>
<td>Speed Range</td>
<td>3000 to 15000 rpm</td>
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<tr>
<td>Rated Steam Conditions</td>
<td>140 bar (2030psi)</td>
</tr>
<tr>
<td></td>
<td>540 °C (1000 °F)</td>
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<tr>
<td>Arrangement</td>
<td>Single casing</td>
</tr>
<tr>
<td>Condensing LP Stages</td>
<td>Up to 26” (50Hz)</td>
</tr>
<tr>
<td></td>
<td>Up to 23” (60Hz)</td>
</tr>
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</table>
SNC/SANC series Steam Turbines have both impulse and reaction blades for top efficiency over a broad range of operating conditions. Used in backpressure configurations, they virtually cover the gamut of Oil & Gas and Industrial Power Generation applications. The modular structured design permits a high degree of customization to meet the specific steam cycle needs, and can provide controlled or uncontrolled extraction/injection of steam at any possible intermediate pressure level. The inlet section has a hydraulically actuated multi-valve system (up to five valves); the steam flow is controlled by partial or full arc of admission. Controlled extractions can be handled with a multi-valve system similar to that used in the inlet section, or with off-shell throttling valves depending on the pressure levels and application requirements. The exhaust flange is radial with upward or downward flow. Design meets API 612 requirements.
SNC/SANC series

**KEY FEATURES**
- Single Flow
- Impulse/Reaction blades
- Backpressure
- Sliding and/or fixed pressure control
- Up to two controlled extractions available
- Axial or Radial (up/down) exhaust
- Base or Foundation mounting

**PRODUCT CHARACTERISTICS**

<table>
<thead>
<tr>
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<tr>
<td>Power Rating</td>
<td>2 to 100 MW</td>
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<tr>
<td>Speed Range</td>
<td>3000 to 15000 rpm</td>
</tr>
<tr>
<td>Rated Steam Conditions</td>
<td>140 bar (2030psi) 540 °C (1000 °F)</td>
</tr>
<tr>
<td>Arrangement</td>
<td>Single casing</td>
</tr>
<tr>
<td>Max Backpressure</td>
<td>60 bar (870 psi)</td>
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</table>
A5/A9 series

Single Casing Reheat Turbines

Single casing Reheat Steam Turbines provide the most effective solution for small reheat applications. These turbines are configured with a central admission and back-to-back flow path to reduce temperature gradients and keep thermal stress to a minimum. The A5 model has shell-mounted valves for inlet and reheat. This solution, suitable for the lowest temperature range, permits the most effective reduction of entrapped steam. The A9 model has off-shell valves to improve shell symmetry and reduce thermal distortion. Design meets API 612 requirements.
A5/A9 series

KEY FEATURES
- Back-to-Back configuration
- Central admission
- Impulse/Reaction blades
- Condensing
- Sliding and/or fixed pressure control
- Radial (up/down) exhaust
- Foundation mounting

PRODUCT CHARACTERISTICS

<table>
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<tr>
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<th>Specification</th>
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<tr>
<td>Speed Range</td>
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<tr>
<td>Rated Steam Conditions</td>
<td>140 bar (2030psi)</td>
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<td>565 °C (1050 °F)</td>
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<tr>
<td>Arrangement</td>
<td>Single casing</td>
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<tr>
<td>Condensing LP Stages</td>
<td>Up to 26” (50Hz)</td>
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<tr>
<td></td>
<td>Up to 23” (60Hz)</td>
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</table>
SG series

Geothermal Steam Turbines

SG series Steam Turbines have a unique design to withstand direct geothermal steam conditions (saturated or slightly superheated steam, presence of corrosive contaminants, low pressure). The special inlet section has a large volumetric flow capability. Partial arc of admission control permits maintenance of full turbine capacity with time varying well production. Butterfly type valves, generally installed on admission piping, provide normal control. The shaft material is a high alloy steel, selected to limit corrosion. Low pressure stages have a special stellite coating to limit erosion by water droplets. The unshrouded configuration of these stages avoids erosion of shrouds and permits water film slippage along stators. For particularly aggressive steam compositions, special materials are available for the blades located within the dew point region. Special features are also employed to avoid the formation of deposits inside the sealing labyrinths. Design meets API 612 requirements.

40 MW SG Steam Turbine rotor

KEY FEATURES
- Single Flow/Double Flow
- Impulse/Reaction blades
- Sliding and/or fixed pressure control
- Axial or Radial (up/down) exhaust
- Foundation mounting

PRODUCT CHARACTERISTICS

<table>
<thead>
<tr>
<th>Feature</th>
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<tr>
<td>Power Rating</td>
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<tr>
<td>Speed Range</td>
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<td>Rated Steam Conditions</td>
<td>30 bar (435psi)</td>
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<td>300 °C (572 °F)</td>
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<tr>
<td>Arrangement</td>
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<tr>
<td>Condensing LP Stages</td>
<td>Up to 26” (50Hz)</td>
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<tr>
<td></td>
<td>Up to 23” (60Hz)</td>
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</table>
SDF series

Double Flow Steam Turbines

SDF Steam Turbines are of the double flow type to accommodate low pressure steam. They can be used like a low pressure body of a two casing turbine, or like a stand alone turbine for low pressure steam conditions. A special design has been developed for geothermal applications (SDFG model); the turbine is equipped with a control stage for each flow to maintain turbine operability with time varying well production. Another special application of this model is as a driver for Air Compressors in Gas-to-Liquids plants, where the large amount of low pressure steam requires an off-shell valve arrangement and a unique inlet configuration. Design meets API 612 requirements.

Key Features
- Double Flow
- Impulse/Reaction blades
- Condensing
- Sliding and/or fixed pressure control
- Radial (up/down) exhaust
- Base or Foundation mounting

Product Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
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<tr>
<td>Power Rating</td>
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<tr>
<td>Speed Range</td>
<td>3000 to 15000 rpm</td>
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<tr>
<td>Rated Steam Conditions</td>
<td>30 bar (435 psi) 300 °C (572 °F)</td>
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<tr>
<td>Arrangement</td>
<td>Single casing</td>
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<tr>
<td>Condensing LP Stages</td>
<td>Up to 26” (50Hz) Up to 23” (60Hz)</td>
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</tbody>
</table>
MP/MC series

Backpressure or Condensing Low-medium Power Steam Turbines

MP/MC series Steam Turbines have impulse blades for high reliability and efficiency over a broad range of operating conditions.

Used in backpressure or condensing configurations, they cover Oil & Gas and Industrial Power Generation applications up to approximately 40MW.

The modular structured design permits a high degree of customization to meet the specific steam cycle needs, and can provide controlled or uncontrolled extraction/injection of steam at any possible pressure level for optimum integration with the Customer’s Balance of Plant.

The inlet section has a hydraulically actuated multi-valve system; the turbine is controlled by partial or full arc of admission.

The complete series is equipped with spring-backed seals between the rotor shaft and the static parts, insuring perfect preservation of efficiency over time.

Controlled extractions can be handled with a chest valve system similar to that of the inlet section, or with an internal grid-valve offering a compact and efficient solution for very large and variable extraction flows. The inlet and extraction valves can be actuated by a dedicated high pressure hydraulic oil system that achieves perfect setting of valve position and optimized trip actuation suitable for Power Generation requirements.

The exhaust flange orientation can be axial or radial (upward/downward) to accommodate the Customer’s layout and for building optimization.

Design meets API 612 requirements.
MP/MC series

KEY FEATURES
- Single Flow
- Impulse blades
- Condensing or Backpressure
- Multi valves
- Extraction / Injection
- Axial or Radial (up/down) exhaust
- Optimized with Balance of Plant
- Base or foundation mounting

PRODUCT CHARACTERISTICS
<table>
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<td>Rated Steam Max Inlet</td>
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<td>Conditions</td>
<td>140 bar (2030psi), 540 °C (1000 °F)</td>
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<tr>
<td>Arrangement</td>
<td>Single casing</td>
</tr>
<tr>
<td>Max Backpressure</td>
<td>60 bar (870psi)</td>
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</table>
Boiler Feed Pumps

MC Steam Turbine for Boiler Feed Pump Applications

Boiler Feed Pump Turbines (BFPT), generally of the condensing and multi-valve type (MC series), have impulse blades for high reliability and efficiency and are suitable for operation over a very broad speed range. The modular structured design permits a high degree of customization for main power generation steam turbo-generation unit optimization.

The inlet section includes a multi-valve system sized to match with traditionally low steam inlet conditions. These designs are suitable for a secondary steam inlet (dual inlet) to allow operation with high pressure steam for plant start-up sequences and overload cases. Speed can be optimized in conjunction with pump suppliers.

The complete series is equipped with spring-backed seals between the rotor shaft and the static parts insuring perfect preservation of efficiency over time.

The exhaust flange orientation can be axial or radial (upward/downward) to accommodate the Customer’s layout for building optimization.

Design meets API 612 requirements.
Boiler Feed Pumps

**KEY FEATURES**
- Single Flow
- Impulse blades
- Single or dual inlet
- Broad operating speed range
- Condensing
- Multi valves
- Axial or Radial (up/down) exhaust
- Base or foundation mounting

**PRODUCT CHARACTERISTICS**

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<table>
<thead>
<tr>
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<tbody>
<tr>
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<td><strong>Speed Range</strong></td>
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<td><strong>Rated Steam Conditions</strong></td>
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<td><strong>Arrangement</strong></td>
<td>Single casing</td>
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MC/BFP Steam Turbine cross section
P/C series

Backpressure or Condensing Small Power Steam Turbines

P/C series Steam Turbines have impulse blades to provide high reliability and efficiency over a broad range of operating conditions. Used in backpressure or condensing configurations, they cover small power services in Oil & Gas and Industrial Power Generation applications. The modular structured design permits high customization levels to meet specific steam cycle needs. The inlet section has a single valve that is hydraulically actuated. Spring-backed seals between the rotor shaft and static parts insure perfect preservation of efficiency over time. The exhaust flange is radial (upward/downward). Design meets API 612 requirements.

KEY FEATURES
Single Flow
Impulse blades
Condensing or Backpressure
Single valve
Radial (up/down) exhaust
Base mounting

PRODUCT CHARACTERISTICS

<table>
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<tbody>
<tr>
<td>Power Rating</td>
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<tr>
<td>Speed Range</td>
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<td>Rated Steam Conditions</td>
<td>80 bar (1160psi) 480 °C (900 °F)</td>
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<td>Arrangement</td>
<td>Single casing</td>
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<tr>
<td>Max Backpressure</td>
<td>20 bar (290psi)</td>
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</table>
Navy Steam Turbines, generally of the condensing type (C or MC series), use impulse blading for very high reliability and efficiency. They serve in both Power Generation and Propulsion applications for ships and submarines. The design is highly customized to take into consideration very stringent and complex operating conditions and specific requirements such as compactness, very low noise and vibration levels, and the possibility of reverse rotation (dual flow). These turbines can handle very stringent steam conditions (high moisture level). They can be tested with specialized equipment (including an anechoic chamber) that is available at our Le Creusot plant (France). Many innovations in these machines are transferred into industrial applications.
Product Development

**Driving Technology to Excellence**

GE’s Oil & Gas business is committed to innovation and constant improvement of its Industrial Steam Turbine product line in order to provide outstanding products to its Customers. Engineering synergies with GE’s Large Steam Turbine product line are the foundation of our innovations in Industrial Steam Turbine technology. Engineers and scientists from GE’s Global Research Center and aerodynamic experts from GE’s Aviation business help drive the development of advanced design technology and tools that are applied daily in developing steam turbine solutions that provide added value to our Customers.

GE’s commitment to continuous product development has led to the recent addition of the low pressure stage test facility in Schenectady, NY. This test vehicle is a fundamental tool for developing steam turbine technology, and permits the full validation of all new low pressure stage designs for fixed or variable speed applications. Continuous testing also permits the development of Computational Fluid Dynamic tools tailored to rigorous engineering processes assuring that new product designs are optimized before they are released for manufacturing.
GE is dedicated to providing the highest quality complete service solutions for the entire Steam Turbine product line. GE’s Oil & Gas business provides a broad range of value-added services to keep machines operating at peak efficiency and performance. Our Global Services organization supplies Conversions, Modifications and Uprates (CM&Us), Contractual Service Agreements (CSA), high technology overhauls, repairs, and uprated parts (OEM design and production). We also provide field service support for installation, startup, commissioning, on-site inspections, overhauls and emergency repairs.

GE equipment is designed for long term operation and the latest technology advances developed for new machines can be applied to the operating fleet of mature units. In addition, customized solutions can be engineered to meet specific Customer requirements. This means having a solid pathway to ensure high performance over the life of the machine. The benefits of our CM&Us are increased performance and improved economics achieved through:

- enhanced output efficiency
- improved reliability
- reduced inspection intervals
- reduced maintenance cost
- compliance with environmental regulations

The Oil & Gas business, as part of GE, has access to an expanded set of capabilities and best practices, which have been used to create and implement new Client-focused services.
Training

GE’s Oil & Gas business offers Training for the operation and maintenance of its complete line of machinery and equipment. This Training can be provided either at the Client’s site or at the Learning Center located at GE Oil & Gas facility in Florence, Italy. Instructors are field-seasoned experts who combine their understanding of theory with practical experience. The high quality training they provide is a prerequisite for improving the skills of on-site operating and maintenance personnel, to ensure safety and superior equipment efficiency and availability.

Courses and documentation are designed to meet Customers’ needs, focusing on GE machinery and equipment actually installed at their sites.

Traditional training tools are strengthened through computer-based training and interactive multimedia technology. Courses and technical literature can be provided in a variety of languages.

CENTER OF EXCELLENCE FOR TRAINING
Florence Learning Center Facilities:
- 5600 m² of space
- More than 20 training rooms
- Speedtronic Mark V & Mark VI
- Bently Nevada simulators
- Laboratories
- Multimedia rooms
- Conference center
- Auditorium seating for 230 (under completion)

TRAINING SOLUTIONS:
- Suitable for all levels in your organization
- Tailored to your specific needs
- Pre-scheduled offerings or on request
- Various languages
- Formal classroom training and interactive learning

COVERED EQUIPMENT
Steam Turbines, Gas Turbines, Centrifugal Compressors, Reciprocating Compressors, Expanders, Pumps, Control Panels, ...
Test Facilities

The Florence Test Facilities are equipped with 4 test benches and a complete steam plant, with 70 t/h of live steam at 50 bar/450°C available. The Le Creusot Test site is equipped with 5 test benches supplied from a steam plant capable of generating 28 t/h of steam at 45 bar/450°C. Le Creusot also features a large anechoic chamber with a suspended low frequency foundation block for vibration and noise measurements. Mechanical string tests can be conducted on complete trains both in Florence and at Le Creusot. Full load, full pressure tests can be carried out up to the capacity of the respective steam plants.
Installations

Generator Driver Steam Turbine in Combined Cycle (Italy)

Generator Driver Steam Turbine Plant fueled with Solid Refuse (Italy)
Installations

Steam Turbine driven Recycle Compressor
(Saudi Arabia)

Steam Turbine driven CO₂ compressor
(Qatar)
Installations

Boiler Feed Pump Steam Turbine (Japan)

Steam Turbine driven Generator in Cogeneration Plant (USA)