

GE Energy

Oil & Gas

Motors and Generators



imagination at work

Experience Matters



We have manufactured motors and generators for over 125 years. In 1879, GE founder, Thomas Edison constructed the first electric motor for a 110 to 120 volt line at Menlo Park, NJ. This device still exists and is operative! It is located in the Edison Historical Collection in New Jersey.

GE's experience in the Oil and Gas Industry spans over a century

GE offers a complete motor/drive/generator solution for most upstream, midstream, and downstream applications. With an increasing need for oil and gas exploration, production, storage, transportation, and refining, the environments are becoming more extreme. It may be a deep offshore production facility, a Gas to Liquids (GTL) facility in Saudi Arabia, or the extreme cold environments of the Canadian Oil Sand fields. Motors and generators provide a lifeline to driven equipment, which is critical to the production and operation of these facilities. Strict adherence to industry and customer specifications are crucial to assure optimal uptime.

GE motors adhere to many standards such as: NEMA, IEC, API 541 4th ed, API 546, API 547, API 661, IEEE-841, CSA, CE, ABS, ATEX, Ex-p, Ex-n, Ex-e, Div 1, and Div 2.

GE Advantages

We are known for designing products with a high mechanical integrity and superior electrical design.

- GE's legendary Global Research Center is committed to the oil and gas industry by developing new products that customers need with more output per frame and increased efficiency
- GE brings over 125 years of industry experience
- GE utilizes state-of-the-art design tools such as distribution analysis
- GE motors are known for high reliability and efficiency



A 66,000 HP (50,000 KW) machine for a main air compressor in an air separation unit. This machine has an efficiency value of 98.82%.

Upstream



Upstream consists of all activities relevant to the exploration and production sectors within the oil and gas industry. Extreme cold or hot environments are just a few of the conditions around the globe for upstream applications. Many offshore sites are remote and equipment is installed in confined spaces. GE Motors can meet these demanding requirements with a full range of robust and compact electric motors, generators, and Adjustable Speed Drives (ASDs).

Motor Applications

For offshore platforms and Floating Production Storage and Offloading (FPSO) facilities, GE offers synchronous generators for power generation. Induction (asynchronous) or synchronous centrifugal compressor motors with low inrush designs are available. This also applies to many types of pump motors such as sea water lift, water injection, and various high pressure pumps.



Oil well pump jack

- 1 Oil/Gas field
- 2 Offshore production platform
- 3 Subsea application
- 4 LNG liquefaction facility



Midstream



Midstream is a term commonly used for those industry activities that apply to the processing, storage, and transportation of crude oil and natural gas. Transporting crude oil and natural gas for processing involves operating and maintaining an extensive infrastructure. This involves a massive network of pipelines, booster stations, gathering and processing plants, and storage tanks. Uptime is essential because any equipment failure in one of these processes can disrupt the crucial supply of oil and gas.

Motor Applications

Common applications are pipeline pumps, blowers, and compressors for the transportation of oil and gas. GE offers a motor for most centrifugal and reciprocating compressors, and a full line of pump motors for vertical high-thrust and large horizontal applications. GE also offers either PWM or LCI ASD.



Liquefied natural gas (LNG) receiving terminal

- 1 Re-injection plant
- 2 Oil/Gas processing plant
- 3 Pipeline inspection device
- 4 Gas boosting station
- 5 Oil boosting station
- 6 Re-injection plant
- 7 LNG receiving terminal



Downstream



Downstream operations include oil refining, marketing, and natural gas transmission and distribution. This includes by-products such as chemicals and fertilizers.

Motor Applications

This sector represents the most diverse range of applications requiring new products with the best technologies. With increasing output requirements for rotating equipment, the need for large induction (asynchronous) and synchronous machines is important. Of course, reliability and safety are always a top priority for this segment. For refrigerant compressors or main air blowers, GE offers motors and ASDs up to 100,000 HP (75,000 kW), and for reciprocating compressors GE offers motors exceeding 27,000 HP (20,000 kW).



4,000 HP (3,000 kW), 327 RPM API 546 machine for a large refinery

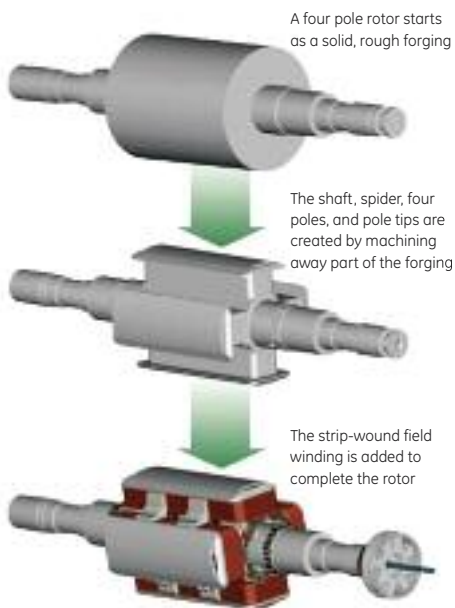
- 1 Power generation plant
- 2 Refinery/Petrochemical plant



GE Products

GE offers both induction (asynchronous) and synchronous motors for many types of centrifugal compressors. GE's induction motor line is offered from 1 to 17,000 HP (.75 to 13,000 kW) per NEMA or IEC standards as well as API 541 and 547.

GE's synchronous motor line is available up to 100,000 HP (75,000 kW) per NEMA or IEC standards as well as API 546. For our four and six pole synchronous machines, GE Motors utilizes a solid cylindrical forging. With this design we eliminate the need for bolted pole tips and improve reliability while offering best-in-class efficiencies.



A full range of reciprocating compressor motors from 200 HP (150 kW) to over 27,000 HP (20,000 kW) is available. With over 75 years of industry experience, we offer both induction (asynchronous) or synchronous for these applications. Shaft extensions for both friction and keyed couplings—as well as integral forged flanges—are available.

GE synchronous generators are commonly used for captive power production. Up to 75 MVA generators are available that meet NEMA, IEC, and API 546 requirements.

A skid-mounted generator and gearbox are available for a quicker system integration (as seen below).



GE offers a motor for most pump applications. This includes many types of high pressure API 610 pumps. For the large barrel pumps typically used in sea water injection GE has provided both induction and synchronous motors.



7,000 HP (5,200 kW), four pole, TEAC, 13.2 kV induction motor for a Natural Gas Liquids (NGL) project in the Middle East

We offer one of the most extensive vertical motor lines in the world with capabilities up to 12,500 HP (9,300 kW). GE offers normal, in-line, or high thrust configurations for applications such as sea water lift and jockey pumps.



2,250 HP, 400 RPM, TEAC vertical motor for a sea water lift pump

GE's X\$D Ultra7 841 is an ideal choice for any low-voltage NEMA motor application. It features 0.04 inches per second (IPS) vibration which is half the IEEE-841 specification. This motor has the highest overall efficiency in the industry and a 2000 volt insulation system which exceeds NEMA MG1 part 31 for motors operating on ASDs. For added protection against contamination, this motor also includes a non-contact labyrinth seal on both the drive and opposite drive ends. For increased safety, the motor is manufactured with four lifting lugs integrally cast into the frame. All this is backed with a 60/66 month warranty.



X\$D Ultra® 841

GE Motors has a full line of ASDs from small micro sizes up to medium-voltage drives of 100,000 HP (75,000 kW). GE also has the ability to package the drives with transformers and powerhouses. Common applications requiring ASDs are large pumps and compressors using medium- or high-voltage drives.



Low voltage ASDs

As compared to a traditional pipeline compressor mechanical drive, GE Motors offers an electric motor and ASD solution. This will reduce maintenance and operating costs along with greenhouse gas emissions.

In pipeline pump applications, energy savings and improved flow control can be realized by utilizing a GE electric motor and ASD. GE's typical drive solution utilizes medium-voltage IGBT's with a 24 pulse converter that exceeds IEEE 519-1992. It also features a heat pipe cooling technology that allows for a more compact design with low noise. It comes with a standard 60 month warranty.

Facilities that utilize cooling towers may require low-voltage motors for heat exchangers. GE Motors offers an excellent solution for these tough applications: The X\$D Ultra7 661 complies with IEEE-841 requirements. These motors fully comply with API 661 and are specifically designed for heat exchanger applications for the oil and gas industry. Other features include IP-55 protection and a roller bearing (for belted loads only). For increased safety, a four-point lifting system is cast into the frame. All this is backed with a 60/66 month warranty.



Medium-voltage ASDs



30,000 HP driver package for compressor application, including skid, motor, gearbox, lube oil system, LCI, and switchgear (not pictured)

Applications

| Motor Applications | Requirements | GE Products | Standards |
|--|--|---|--|
| Blowers | Starting restriction considerations, ASD option | X\$D Ultra® X\$D Ultra® 841 Series 9000™ Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, IEEE-841, API 541, 546, and 547 |
| Booster pumps | Vertical or horizontal mounts, harsh environment | X\$D Ultra® X\$D Ultra® 841 Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, IEEE-841, API 541, 546, and 547 |
| Centrifugal compressors Axial compressors | Starting restriction considerations, ASD option or low inrush design | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, 546, and 547 |
| Chemical process ANSI pumps API process pumps (API 610) | Vertical or horizontal mounts, harsh environment | X\$D Ultra® X\$D Ultra® 841 Energy \$aver® Vertical Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, IEEE-841, API 541, 546, and 547 |
| Cooling medium pumps | Vertical or horizontal mounts, harsh environment | X\$D Ultra® X\$D Ultra® 841 Energy \$aver® Vertical Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, IEEE-841, API 541, 546, and 547 |
| Extruders | Special starting requirements, ASD option | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, and 546 |
| Heat exchangers | Vertical or horizontal mounts, belt load considerations | X\$D Ultra® X\$D Ultra® 841 X\$D Ultra® 661 | NEMA, IEC, IEEE-841, and API 661 |
| Jockey pumps | Vertical or horizontal mounts, harsh environment | X\$D Ultra® X\$D Ultra® 841 Energy \$aver® Vertical | NEMA and IEEE-841 |
| Pipeline compressors | Starting restriction considerations, ASD option | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, 546, and 547 |
| Pipeline pumps | Starting restriction considerations, ASD option | Energy \$aver® Vertical Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, IEEE-841, API 541, 546, and 547 |
| Reciprocating compressors (high speed) | Natural gas transmission, special motor shafts and load considerations | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, and 546 |
| Reciprocating compressors (slow speed) | API 618, torque pulsation review required, high rotor inertia | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, 546, 547, and 618 |
| Sea water lift pumps | Vertical mount offshore applications, motor may carry thrust load | Energy \$aver® Vertical Custom 8000™ Quantum™ LMV | NEMA, IEC, IEEE-841, and API 541 |
| Synchronous generators | Harsh offshore environments, ambient temperature evaluation | Series 9000™ | NEMA, IEC, and API 546 |
| Transfer pumps | Vertical or horizontal mounts, harsh environment | Energy \$aver® Vertical Custom 8000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, and 547 |
| Water injection pumps | Starting restriction considerations, ASD or low inrush design | Custom 8000™ Series 9000™ Pegasus™ MHV Quantum™ LMV | NEMA, IEC, API 541, and 546 |

People, Service and Systems



GE Motors has teams of highly motivated and technically skilled application engineers, sales, and project support staff that help to ensure you have an optimal and cost-efficient solution for your needs.

Pre-Order and Product Application Support

- Experienced inside and outside sales force
- Application engineering available to optimize your solution (factory and field)
- Web-based tools customized for each user's needs
 - Pre-order product information
 - Order and project management
- Spare parts program
 - Minimize downtime with an adequate spare parts inventory plan for your GE motors
 - Performance Enhancement Program (PEP) – GE can evaluate your existing machines (GE or otherwise) to find efficiency or power output opportunities within the existing frames

Order and Project Management Support

- Design, application, and specification reviews
- Documentation for approval and as built
- Project coordination
- Inspection plans
- Test scheduling
- Shipping coordination
- Start-up and commissioning support
- Worldwide service capabilities



Technology



GE Motors continuous product development allows us to bring new solutions for oil and gas applications. We have a proven design process utilizing the latest three-dimensional modeling tools. These allow us to custom build the machine on a computer to meet or exceed customer expectations as well as conforming as requested to the latest standards. Among the tools used are:

- **Electromagnetic Finite Element Analysis**
 - Flux distribution analysis
 - Computational fluid dynamics
- **3D Solid Modeling**
 - Stress analysis
 - Four pole rotor
 - Wound stator
 - Dynamic modal analysis



Product Development



The **Pegasus™ MHV** Horizontal AC Induction motor is a result of a significant investment in design, engineering, and manufacturing equipment. Pegasus™ MHV yields more horsepower per frame size, has an improved efficiency and

power factor with a more compact design. It is offered in a range from 500 to 22,000 HP (300 to 16,000 kW) in NEMA or IEC.



The **X\$D Ultra® 841** motor is a TEFC (totally enclosed fan cooled) Industrial AC Motor ranging from 1 to 300 horsepower. It meets or exceeds NEMA Premium® Nominal Efficiency Standards and exceeds the minimum guarantee. Therefore, improved energy consumption and usage are dramatically realized, leading to its certification as a GE product of ecomagination. It also complies with the IEEE-841 specification.



The **Quantum™ LMV** TEFC Induction motor was designed by a global engineering team yielding a motor for worldwide applications. This motor uses an innovative D-Duct heat transfer

technology (patent pending). This unique internal structure allows for maximum airflow. This more compact design yields more horsepower per frame size and has an improved efficiency and power factor. The Quantum LMV is offered from 350 to 2000 HP (200 to 1,500 kW) per NEMA or IEC up to 6600 volts.



The **Series 9000-RCM** is a synchronous single-bearing reciprocating compressor motor. A self-contained enclosure will now be a standard offering for certain frames which will allow a simple design for Ex-p (purge and pressurization) when required. It has easy access for air gap inspection that may be done by one person—which significantly reduces the time and equipment required for maintenance. As an option, these machines can be shipped fully assembled which allows for a quicker installation time.





For more information, please contact your GE sales representative.

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