Industrial Motors
Introduction to TMEIC Motors

TMEIC combines the best of Toshiba and Mitsubishi-Electric's experience in building motors that goes back over 100 years. TMEIC's motor offering includes induction motors from a few hundred horsepower, up to synchronous motors over 100,000 hp, driving a wide range of industrial applications such as pumps, fans, grinding, conveyors, and compressors.

In addition to applications directly connected to utility power, TMEIC motors can be matched with Variable Frequency Drives for ease of starting and for speed control. The VFD allows motor speeds as high as 12,000 rpm. This chart below and pages 4 & 5 illustrate the range of motors available.

<table>
<thead>
<tr>
<th>rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>3000</td>
</tr>
<tr>
<td>6000</td>
</tr>
<tr>
<td>9000</td>
</tr>
<tr>
<td>12000</td>
</tr>
<tr>
<td>15000</td>
</tr>
</tbody>
</table>

Expansion of the oil and gas industry has created demand for large motors to drive gas compressors and oil pumps. These motors are located in the production areas and on interstate pipelines, and are usually designed with explosion protection. For special applications such as driving large compressors and blowers, motor ratings can reach or exceed 100,000 hp.

Meeting the demand for large motors for the metals industry, TMEIC has produced large synchronous and induction motors for the operation of steel rolling mills. The power levels for these motors go up to about 10 MW. They are covered in a separate brochure.

High-Quality Design, Manufacturing, and Testing

TMEIC produces high-quality motors by employing the best design, manufacturing, and test procedures. Advanced computer aided design and analysis allows motor performance to be predicted in advance. The world class manufacturing automation system produces high-quality parts, on time, with no exceptions. These automated systems produce components and assemblies meeting the highest quality requirements, delivery schedule, and long life.

Continuous Improvement
The manufacturing system has specified standards, and the actual performance is measured against these. Continuous quality improvement is built in, with product quality steadily improving as a natural outcome.

Excellent Motor Design Tools – Extensive CAD and Computerized Finite Element Analysis

TMEIC motor engineers make extensive use of computer aided design to produce their detail and assembly drawings, both two-dimensional and three-dimensional.

High-Quality Manufacturing – Computer Control and Robotics

Manufacturing procedures make use of computer control and robotics to increase the speed of the work, maintain accuracy, and ensure repeatability of the operations. Examples include:

- Air duct plate robotic assembly
- Segmented core lamination robotic assembly
- Round core lamination robotic assembly
- Rotor field core robotic assembly
- Computer controlled core stamping

World-Class Motor Test

TMEIC's fully instrumented computer automated test (CAT) facilities allow motors to be load and speed tested. The example facility shown here was built to test large motors and drives at high speed. This back-to-back test arrangement used:

- Variable frequency drive to provide power and desired speed to the test motor
- Generator to load the test motor
- Variable frequency drive to recycle power back to the supply

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Reliability</td>
<td>Many years of excellent trouble-free service</td>
</tr>
<tr>
<td></td>
<td>under difficult working conditions</td>
</tr>
<tr>
<td>High Efficiency</td>
<td>Low electrical losses for high power conversion</td>
</tr>
<tr>
<td></td>
<td>efficiency</td>
</tr>
<tr>
<td>High Strength Insulation</td>
<td>Withstand surge and minimizes electrical</td>
</tr>
<tr>
<td></td>
<td>shorts and winding fatigue failure</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>High Mechanical Strength</td>
<td>Minimizes mechanical deflection and vibration</td>
</tr>
<tr>
<td></td>
<td>for longer equipment life</td>
</tr>
</tbody>
</table>

Benefits

- Many years of excellent trouble-free service under difficult working conditions
- Low electrical losses for high power conversion efficiency
- Withstand surge and minimizes electrical shorts and winding fatigue failure
- Minimizes mechanical deflection and vibration for longer equipment life

Features

- High Reliability resulting from use of proven design technology, manufacturing expertise, wide use of robotics, tight quality control, and testing
- High Efficiency resulting from detailed analysis of the electromagnetic field patterns and ventilating air flows
- High Strength Insulation applied by robotic insulation winding and oversized epoxy resin vacuum impregnation tanks creates strong support and insulation
- High Mechanical Strength through use of static and dynamic strength analysis of stator frame, rotor, shaft and bearings. Motor shafts are made of forged steel with high tensile strength

Benefits

- Many years of excellent trouble-free service under difficult working conditions
- Low electrical losses for high power conversion efficiency
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- Low electrical losses for high power conversion efficiency
- Withstand surge and minimizes electrical shorts and winding fatigue failure
- Minimizes mechanical deflection and vibration for longer equipment life
# TMEIC Motor Product Overview

## Induction Motors

<table>
<thead>
<tr>
<th>Product</th>
<th>LV and MV TM21* -FII</th>
<th>Mill Motors TM-AC</th>
<th>MV Motors TM21-G</th>
<th>MV Motors TM21-Mill</th>
<th>MV Motors TM21-L</th>
<th>Vertical Motors TM21-VL &amp; VLL</th>
<th>High Speed (Custom design)</th>
<th>Main Drive Motor (Custom design)</th>
<th>Medium-High Power (Custom design)</th>
<th>High-Speed (Custom design)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power</strong></td>
<td>37-1,400 kW (50-1,870 hp)</td>
<td>44-370 kW (59-490 hp)</td>
<td>Up to 23,000 kW (30,800 hp)</td>
<td>Up to 3,550 kW (4,750 hp)</td>
<td>Up to 18,500 kW (25,000 hp)</td>
<td>Up to 6,500 kW (8,700 hp)</td>
<td>Up to 8,000 kW (10,720 hp)</td>
<td>12,000 kW</td>
<td>Up to 80,000 kW (107,240 hp)</td>
<td>Up to 80,000 kW (107,240 hp)</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>Up to 3,600 rpm</td>
<td>Up to 1,300 rpm</td>
<td>Up to 3,600 rpm</td>
<td>Up to 3,600 rpm</td>
<td>Up to 3,600 rpm</td>
<td>Up to 1,800 rpm, option &gt; than 30 poles</td>
<td>Up to 11,800 rpm on VFD power</td>
<td>Up to 1,540 rpm</td>
<td>Very low speed up to 3,600 rpm</td>
<td>Up to 6,500 rpm</td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>Up to 6.9 kV</td>
<td>420 Vac max.</td>
<td>2 – 11 kV</td>
<td>2 – 11 kV</td>
<td>2 – 13.8 kV</td>
<td>2.3 – 11 kV</td>
<td>Up to 6.6 kV</td>
<td>3.3 – 13.8 kV</td>
<td>Up to 13.8 kV</td>
<td></td>
</tr>
</tbody>
</table>

## Enclosure

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical View</strong></td>
<td>![Image](103x575 to 198x658)</td>
<td>![Image](201x578 to 290x654)</td>
<td>![Image](300x579 to 383x654)</td>
<td>![Image](409x576 to 490x656)</td>
<td>![Image](512x577 to 601x655)</td>
<td>![Image](656x575 to 740x658)</td>
<td>![Image](890x577 to 957x656)</td>
<td>![Image](988x581 to 1082x651)</td>
<td>![Image](1101x581 to 1196x652)</td>
<td>![Image](1242x780 to 1337x924)</td>
<td>![Image](1463x571 to 1558x650)</td>
</tr>
</tbody>
</table>

## Classified Area

<table>
<thead>
<tr>
<th>Rotor</th>
<th>Aluminum die cast rotor or Copper rotor bars</th>
<th>Copper rotor bars</th>
<th>Copper roller bars</th>
<th>Op. copper rotor bars</th>
<th>Copper roller bars</th>
<th>Copper rotor bars</th>
<th>Copper rotor bars</th>
<th>Copper roller bars</th>
<th>Copper roller bars</th>
<th>Salient Poles</th>
<th>Cylindrical solid rotor for two-pole, salient pole all others</th>
<th>Cylindrical solid rotor, two-pole</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bearing Options</strong></td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Ball &amp; roller bearings, grease lubrication</td>
<td>Magnetic bearings</td>
<td>Sleeve Bearings</td>
<td>Sleeve bearings</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>920 to 2,720 mm (36 to 107 in)</td>
<td>1,074 to 1,792 mm (42 to 71 in)</td>
<td>1,580 to 4,130 mm (62 to 162 in)</td>
<td>2,400 mm and up (95 in and up)</td>
<td>2,500 to 6,000 mm (98 to 236 in)</td>
<td>Aprox. 100 mm (83 in)</td>
<td>5,550 to 2,050 mm (219 to 787 in)</td>
<td>Approx. 8,100 mm (319 in)</td>
<td>8,100 mm (319 in)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TM21-M and TM21-L Series Induction Motors

TMEIC offers a range of medium voltage induction motors for larger industrial applications such as fans, blowers, pumps, mills, compressors and conveyors. These motors offer higher efficiency and higher power factor than any previous design. The TM21-M and TM21-L have rugged fabricated steel frames. Aluminum rotor bars are standard on the TM21-M, and copper rotor bars are standard on the TM21-L. Both series can be customized with different top enclosures for selected types of protection and cooling. The arrows in the illustrations below indicate airflow.

**Open Drip Proof Type ODP/IP22**

A drip-proof type motor has a cooling air intake and hot air exhaust window located at the top of the hood. Openings are covered by screens and enclosure is constructed to prevent intrusion of water drips and other foreign materials into the motor and meets NEMA WP-I requirements.

**Totally-Enclosed Air-Water-Cooled Type TEWAC/IP55**

Includes an air-to-water heat exchanger in the air housing above the motor. A drain in the air housing protects the motor from damage caused by water leakage.

**Totally-Enclosed Air-Air Cooled Type TEAAC/IP55**

In a corrosive or harmful environment, a totally-enclosed fan-cooled motor can be applied. An external fan directs fresh air through the pipes in the air housing above the motor. The pipes serve as a heat exchanger in which outside fresh air passing through cools the hot air inside.

**NEMA Weather-Protected WP-II/IP24**

This motor is designed for outdoor operation. The air housing is in accordance with NEMA WP-II, and features three right-angled turns for air intake, dropping velocity below 3 m/sec (600 ft/min.), trapping water, dust, and foreign materials.

**High-Speed Induction Motors**

For very high speeds, induction motors are used. These are custom designed for special applications such as driving gearless compressors.

**High Speed Motor and Drive Systems**

TMEIC's unique capabilities in designing high speed motors for direct-drive solutions eliminate speed increasing gearboxes or mechanical clutches. The net result of this solution is lower cost, smaller footprint, higher system efficiency, smaller parts and spares inventory to maintain, and worry-free service.

**Conventional Solution**

- Rotor – Squirrel cage with aluminum rotor bars specially designed with stiff-shaft low vibration
- Stator – Two pole windings, spring mounted for vibration isolation
- Bearings – Oil-fed sleeve bearings or Magnetic bearings

Data for typical high speed induction motors are shown below.

**Power**

- Up to 8000 kW

**Supply Voltage**

- 2.3-11 kV

**Poles/Speed**

- 2 Poles to 12,000 rpm

**Enclosure**

- Totally Enclosed Water to Air Cooling TEWAC/IP55 or Air to Air TEAAC/IP55

**Classified Areas**

- Exn, Exe, or Exp Protection

**Available Standards**

- IEC, NEMA, BS, AS

**Data for typical high speed induction motors**

- 11,900 rpm, 1.8 MW, Induction Motor

**High-Speed Induction Motors**

- Power
  - Up to 8000 kW
- Supply Voltage
  - 2.3-11 kV
- Poles/Speed
  - 2 Poles to 12,000 rpm
- Enclosure
  - Totally Enclosed Water to Air Cooling TEWAC/IP55 or Air to Air TEAAC/IP55
- Classified Areas
  - Exn, Exe, or Exp Protection
- Available Standards
  - IEC, NEMA, BS, AS
- Rotor – Squirrel cage with aluminum rotor bars specially designed with stiff-shaft low vibration
- Stator – Two pole windings, spring mounted for vibration isolation
- Bearings – Oil-fed sleeve bearings or Magnetic bearings

**Fundamental Building Block 21-M and 21-L**

- **IC01, IC61 and IC81W cooling per IEC Standard construction are available by changing the top-mounted air housing.**
- **The main terminal box can be rotated every 90°, and is large enough for easy cable connection.**
- **International standards such as IEC, NEMA, BS, AS, etc.**
- **Optional classified areas: Exn, Exe, or Exp Extd**
- **Insulation Class F, B Rise design is standard**

**Fundamental Building Block 21-M and 21-L**

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- **The main terminal box can be rotated every 90°, and is large enough for easy cable connection.**
- **International standards such as IEC, NEMA, BS, AS, etc.**
- **Optional classified areas: Exn, Exe, or Exp Extd**
- **Insulation Class F, B Rise design is standard**

**TM21-M and TM21-L Series Induction Motors**

- **Power**
  - 50 Hz (260-2,800 kW, 220-1,800 hp)
  - 60 Hz (200-3,550 kW, 450-1,800 hp)
- **Voltage**
  - 2 kV - 11 kV
- **Speed**
  - Up to 3,600 rpm
- **Poles**
  - From 2 up to 10
- **Rotor**
  - Aluminum Casting

**TM21-L**

- **Power**
  - 50 Hz (450-1,650 kW, 600-2,200 hp)
  - 60 Hz (450-1,800 kW, 600-2,500 hp)
- **Voltage**
  - 2 kV - 11 kV
- **Speed**
  - Up to 3,600 rpm
- **Poles**
  - From 2 up to 24
- **Rotor**
  - Copper Bar
Medium-High Power Synchronous Motors

TMEIC custom designs and builds medium and high power synchronous motors for special applications such as driving mills, blowers, pumps and compressors. The example shown here is a 53 MW synchronous motor for a steel mill blower. It runs at 3,000 rpm with a 10 kV supply. Data for typical synchronous motors are shown below.

<table>
<thead>
<tr>
<th>Power</th>
<th>2000 kW up to 80 MW, either Utility Fed or VFD Powered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>3.3-13.8 kV</td>
</tr>
<tr>
<td>Poles/Speed</td>
<td>Up to 34 Poles/Up to 3,600 rpm</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Totally Enclosed Water to Air Cooling – TEWAC/TEAAC or TEAAC/IP55 – Other Enclosures Available</td>
</tr>
<tr>
<td>Classified Areas</td>
<td>Exn/Exp Protection Available</td>
</tr>
<tr>
<td>Available Sync Field Designs</td>
<td>Brush Type, DC Brushless, AC Brushless</td>
</tr>
</tbody>
</table>

Low Speed Induction Machines

TMEIC’s unique capabilities in designing low speed motors for direct-drive solutions eliminate speed decreasing gearboxes or mechanical clutches. The net result of this solution is lower cost, smaller footprint, higher system efficiency, lower parts and spares inventory to maintain, and worry-free service.

Advantages
- Cost savings – individual approval tests & expensive full load tests eliminated
- Reduced testing requirements lowers delivery time
- Simpler Exn designs reduce machine costs (when compared to alternative inner pressurized or flammable enclosures)
- Lower cost of ownership – eradication of the air supply system required for inner pressurized machines minimizes maintenance and operating cost

Special Features
- High efficiency saves energy
- Low vibration and noise
- High reliability
- Meet international standards such as IEC, EN, BS, NEMA
- Easy installation
- Quick delivery

Large High-Speed 2-Pole Synchronous Motors

TMEIC builds a range of custom designed, high-speed, high-power synchronous motors for driving large compressors.

The example on the left shows a 25 MW synchronous motor designed for variable speed operation from 2,500 to 3,780 rpm with a 7 kV variable frequency drive.

Other TMEIC designs are available for synchronous motor top speeds up to 6200 rpm. This can allow large compressors to be driven without a gearbox.

<table>
<thead>
<tr>
<th>Power</th>
<th>15 MW (20,100 hp) up to 80 MW (107,200 hp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>3.3 kV to 13.8 kV</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Totally Enclosed Water to Air Cooled – TEWAC/IP55 or TEAAC/IP55 – Other Enclosures Available</td>
</tr>
<tr>
<td>Classified Areas</td>
<td>Exp certification for use in hazardous areas Zone 1 &amp; 2 using an internal pressurization system</td>
</tr>
<tr>
<td>Motor Speed</td>
<td>Up to 6,500 rpm</td>
</tr>
<tr>
<td>Insulation Class</td>
<td>Class F</td>
</tr>
</tbody>
</table>

Power – Motor output levels up to 80 MW (107,200 hp) are available, and speeds up to 6,200 rpm when used with a matched variable frequency drive such as the TMEICTMdrive®-XL85.

Rotor – The rotor is a two pole, cylindrical design with a shaft mounted brushless exciter.

Bearings and Maintenance – Oil lubricated sleeve bearings are used. No slip rings are required with the brushless exciter.

Quality Manufacturing and Standards – TMEIC’s motor manufacturing is certified to ISO 9001 and ISO 14001. Motors can be certified by third party agencies such as CSA, Lloyd’s and Baseefa. Motors can be designed to international standards such as IEC, NEMA, BS, and AS.

Advantages
- Cost savings – individual approval tests & expensive full load tests eliminated
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Special Features
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- Easy installation
- Quick delivery

Motor Cooling uses a water-air heat exchanger with two shaft-mounted fans forcing cool air inwards through the rotor and windings

Brushless Exciter has a rotor mounted three-phase winding, which feeds high reliability diodes on the shaft supplying DC power to the rotor field winding.

Medium-High Power Synchronous Motors

Up to 3,600 rpm, 53 MW, Synchronous Motor

Rotor – Cylindrical solid rotor for 2 pole, salient pole for 4 to 34 poles

Bearings – Oil-fed sleeve bearings

High Speed 25 MW, 3,780 rpm Synchronous Motor

Power 60 HZ

15 MW (20,100 hp) up to 80 MW (107,200 hp)

Supply Voltage

3.3 kV to 13.8 kV

Enclosure

Totally Enclosed Water to Air Cooled – TEWAC/IP55 or TEAAC/IP55 – Other Enclosures Available

Classified Areas

Exp certification for use in hazardous areas Zone 1 & 2 using an internal pressurization system

Motor Speed

Up to 6,500 rpm

Insulation Class

Class F

SAG Mill and Motor

High-Speed Synchronous Motor – Internal Details
Hazardous Area Protection and Low & Medium Voltage Motors

Types of Explosion Protected Machines

TMEIC provides motors with different levels of explosion protection for a range of operating environments found in the process industries, in particular the Oil & Gas industry. Protection in dust environments, Zone 22, is available as ExtD according to IEC61241-1.

- Exn – Non-Sparking - Machines which, in normal operation, do not produce dangerous sparks or temperatures in normal service or starting. Special increased safety measures are taken.

- Exe – Increased Safety - Machines that do not produce dangerous sparks or temperatures in normal service or starting. Protection in dust environments, Zone 22, is available as ExtD.

- Exp – Inner Pressurized - Explosive gas that may cause ignition is excluded from the inside of the machine. The motor housing is pressurized with air to ensure no gases enter.

- Exd – Flame Proof Enclosure - Machines are constructed to contain an internal explosion and prevent the transmission of flame to the external atmosphere. The temperature of operation is such that it cannot ignite the surrounding gas.

Global Protection and Certification

Explosion protection certification for TMEIC’s motors has been obtained around the world, as illustrated in this table.

<table>
<thead>
<tr>
<th>Standard</th>
<th>USA</th>
<th>UK</th>
<th>Europe</th>
<th>China</th>
<th>Korea</th>
<th>Russia</th>
<th>Australia</th>
<th>Canada</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification</td>
<td>NEC</td>
<td>EN</td>
<td>EN + ATEX</td>
<td>GB</td>
<td>IEC or KS</td>
<td>IEC or AS</td>
<td>IEC or GOST</td>
<td>CSA</td>
<td>IEC or EN</td>
</tr>
<tr>
<td>Body</td>
<td>FM, UL, etc.</td>
<td>Baseefa</td>
<td>Baseefa, PTB, etc.</td>
<td>COST</td>
<td>KOSHA</td>
<td>CCVE</td>
<td>TestSafe</td>
<td>Baseefa</td>
<td>Baseefa</td>
</tr>
</tbody>
</table>

TM21-FII Series Totally Enclosed Fan Cooled Low and Medium Voltage Motors

TM21-FII Series motors are widely applied in industrial applications such as small and medium size fans, blowers, compressors, pumps, and conveyors. They are tough and suitable for harsh conditions.

- Power – The TM21-FII series power output ranges from 37 kW (50 hp) to 1400 kW (1,850 hp). With a choice of poles, the series provides a selection of speeds from 720 rpm up to 3,600 rpm.

- Frame – The TM21-FII series have a cast iron fin frame with improved ventilation flow.

- Rotor – The squirrel cage rotor is a highly-reliable aluminum die-casting.

Power Output | 37 kW (50 hp) up to 1400 kW (1,850 hp)
Number of Poles | 2 P up to 10 P
Supply Voltage | Up to 6,600 V
Enclosure | Totally Enclosed Fan Cooled: IEFC/CP165
Classified Areas | Exn, Ec, Exe
Frame Size | 250 ~ 500 (IEC basis)
Temperature Ratings | Class F Insulation, Class B Design - Optional Class F and Class F Rise

bearings and Maintenance – Ball and roller bearings or oil lubricated sleeve bearings are applied based on rating and application requirements. Optimized design makes re-greasing simple. Quality Manufacturing and Standards – TMEIC manufacturing is certified to ISO 9001 and ISO 14001. Motors can be certified by third party agencies such as Lloyd’s, CSA, Baseefa, and etc. Motors can be designed to international standards such as IEC, NEMA, BS, AS, etc. Manufacturing procedures to obtain the highest reliability include Vacuum Pressure Impregnation of the insulation, employing a forged rotor with integral pole bodies for the maximum shaft rigidity and higher critical speed, and accurate rotor shaft balancing.

Reliability - All generators are built in the same plant as, and to the same high standards as the large motors. Manufacturing procedures to obtain the highest reliability include Vacuum Pressure Impregnation of the insulation, employing a forged rotor with integral pole bodies for the maximum shaft rigidity and higher critical speed, and accurate rotor shaft balancing.

Maintenance - Easy maintenance is realized using a brushless AC exciter with a permanent magnet generator. The oil-fed sleeve bearings employ a floating labyrinth seal to prevent leakage, and positive internal pressure to prevent oil entering the generator. The cutaway drawing in the upper left shows a typical four-pole generator with top mounted air cooler and water heat exchanger.

TM21-TG

TMEIC produces a range of high-quality, custom designed generators for power by turbines or diesels. The four-pole designs provide power levels up to 50,000 kVA at 50 or 60 Hz, 1500 rpm or 1800 rpm. Higher speed two-pole generators provide power levels up to 100,000 kVA.

Generators – Diesel and Turbine Driven

Reliability - All generators are built in the same plant as, and to the same high standards as the large motors. Manufacturing procedures to obtain the highest reliability include Vacuum Pressure Impregnation of the insulation, employing a forged rotor with integral pole bodies for the maximum shaft rigidity and higher critical speed, and accurate rotor shaft balancing.

Maintenance - Easy maintenance is realized using a brushless AC exciter with a permanent magnet generator. The oil-fed sleeve bearings employ a floating labyrinth seal to prevent leakage, and positive internal pressure to prevent oil entering the generator. The cutaway drawing in the upper left shows a typical four-pole generator with top mounted air cooler and water heat exchanger.
Global Support

Wherever You Are, We Are Right Next Door

TMEIC has the capability to provide world-wide service support with trained field service engineers. Spare parts depots are strategically located close to main industrial centers.

**In Asia & Pacific:** Customers are supported by TMEIC service personnel and the TMEIC factory in Japan.

**In North America:** Customers are supported by TMEIC factory service personnel from Roanoke, Virginia.

**In Europe:** Customers are supported by TMEIC European service personnel.

**Motor and Generator Service:** EASA and IPS Service Centers support TMEIC motors and generators across North America.

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