Weather Protected Type II (WPII)
Totally Enclosed Fan-Cooled (TEFC)
Totally Enclosed Air to Air Cooled (TEAAC)
1.0 Scope
This specification covers AboveNEMA medium voltage, form-wound, squirrel cage induction motors, horizontally mounted, single speed (or optional variable speed), 3 phase, 250 HP and larger intended on being installed in general purpose petroleum, chemical and other industrial applications.

The intention is to provide high performing, quality designed motors, with concise and simplified motor data sheets.

Motors are designed for 25 year service life.

An unchecked box at the beginning of a paragraph indicates a decision is available for the customer. This information should be indicated on the motor data sheets attached at the end of this specification. A separate data sheet set is recommended for each motor rating purchased.

2.0 General Design
0º to 40º C

3,300 feet (1000 meters) or less.

☐ When specified alternate values are required.

Motors are designed be installed on a rigid mounting surface.

Motors are designed to be installed in areas or supplementary enclosures, which do not interfere with the ventilation of the motor.

Motors are designed to be suitable for installation in a Class 1, Group C/D, Div 2, T3 Area.

☐ Alternate areas can be specified on the motor data sheet.

Motors are designed for use on a grounded power system.

☐ When specified motor sound pressure level shall not exceed 85 dBA at 1 meter when operating at no load, full speed, full voltage, on sine wave power.

3.0 Stator Design

☐ Unless otherwise specified on the motor data sheet, the motors shall be designed for full voltage starting (90% min at the motor terminals).

Motor insulation shall be NEMA Class F-VPI Insulation.

☐ Unless otherwise specified on the motor data sheet, the motors shall be designed with 1.0 SF, Class B Temperature Rise by resistance (80ºC) at 1.0 service factor.

Core laminations shall be C-5 quality. This is to permit stator burnouts up to 400ºC without damage to the core plate. Lamination steel shall not have any burrs larger than 0.003 inches after punching.

Stator core end plates to be solid steel plates for solid core retention, not welded stacks of core punchings.

All insulated stator winding conductors shall be copper.
Stator coils shall be surge tested to meet or exceed IEEE 522 Standards, before stator insertion. Stator end turn connections shall be fully braced to withstand repeated full voltage starts and full voltage bus transfer from one source to another within a transfer time not exceeding 6 cycles. Stator shall be braced for 5,000 (minimum) full voltage starts. 60% (min) LRT, 175% (min) BDT (NEMA MG 1 Part 20.41). 650% (max) Locked Rotor Amps.

Suitable for 3 (min) consecutive cold, or 2 (min) consecutive hot starts based on 90% minimum starting voltage, centrifugal load curve and a load inertia defined by NEMA MG 1, Part 20.

4.0 Rotor Design & Balance
Rotor cage design shall be aluminum die cast (ADC) or fabricated copper bar. Fabricated aluminum rotors are prohibited.

All motors 1250 HP and above shall be supplied with rotor cage designs of fabricated copper.

☐ When specified fabricated copper bar construction shall be required below 1250 HP.

Copper Bar rotor cores shall be retained on the motor shaft with a shoulder on one end and with keys on the other end.

Copper bars are to be pressed into the rotor core using full-length steel shims to prevent damage during insertion and provide smooth surface for thermal expansion. Copper rotor bars are to be swaged only in one location on each bar, at the center of the rotor core.

Copper end connectors are to be attached to the rotor bars using an automated electric, induction braze procedure to simultaneously braze all rotor bars.

Rotor cage braze material shall be phosphorous-free.

Rotor assemblies shall be provided with axial venting on all rotors. These vents promote even rotor heating and prevent incidence of “hot” rotor vibration.

Rotor assemblies shall be provided with radial venting on all WPII and TEAAC rotors.

Rotor assemblies are to be balanced at synchronous speed.

Rotor assemblies are to be protected by corrosion-resistant paint.

4.1 Shaft
The standard shaft material to be AISI 4140, AISI 1045 or AISI 4340 steel.

5.0 Bearing Design
Sleeve bearings shall be supplied which feature split bearing capsules and air gap measurement holes. This permits inspection of the motor windings without complete disassembly of the bearing arrangement.
Sleeve bearings shall be designed with a steel backed shell and located within 3/32" of magnetic center, to prevent the rotor axial thrust from being continuously applied against either end of the bearing.

Sleeve bearing metal temperature shall not exceed 93°C at rated (1.0 SF) load over 40°C ambient. The shaft of sleeve bearing motors shall be marked to indicate the rotor end float limits.

☐ When specified Anti-Friction (A/F) bearings shall be supplied (option is not available on all motors, including 2-pole motors on frame sizes larger than 58/12). Grease lube is standard; oil mist lube can be selected. The bearings feature 100,000-hour (min) L10 life.

As a minimum, one bearing shall be insulated.

☐ When specified both bearings shall be insulated, with a grounding strap supplied on the drive end bearing.

5.1 Bearing Shaft Seals
TEFC & TEAAC motors shall be supplied with IP54 rated shaft seals.
WPII motors (IP24W) shall be supplied with IP44 rated shaft seals
☐ When specified Inpro brand IP55 rated shaft seals shall be supplied.

6.0 Vibration
Motor vibration not to exceed 0.10 inch per second (unfiltered overall, 0 - p) when measured on the motor bearing housing, at no load.

When supplied with shaft proximity probes, the unfiltered motor vibration shall not exceed 1.5 mils (0.0015 inch, p-p) on the motor shaft per API® 541 5th Edition, Figure 3.

7.0 Frame Design
The enclosures shall use cast iron or fabricated steel stator frame, bearing housing and fan housing (if applicable).

Mounting feet surfaces are to be machined on a common horizontal plane within 0.005 inch.

The motor frame shall include provisions for vertical jackscrews (4) and pilot holes (2) for dowels.

Motors shall be equipped with a drain located at the lowest point so as to eliminate condensation from the motor interior.

8.0 Terminal Boxes
For motors less than 1250 HP, the main motor terminal box shall be a fabricated steel, including standoff insulators, silver-plated copper bus bars, a removable bottom plate, pressure relief panel, ground bus, ground lug and drain plug. For units 4160V and lower, this box can rotate in steps of 90 degrees (unless other terminal box options are chosen). F1 location is standard.

Motors 1250 HP and larger, the main terminal box shall a fabricated steel, NEMA MG1 Type II sized main terminal box, including standoff insulators, silver-plated copper bus bars, a removable
bottom plate, pressure relief panel, ground bus, ground lug and drain plug. This box typically requires foot support by the customer and is mounted in the F1 location as standard.

All boxes shall be meet NEMA 4X protection classification.

8.1 **Auxiliary Terminal Boxes**

All motor accessory leads (RTD’s, space heaters), when equipped shall be terminated on terminal blocks in separate cast iron, terminal box(es) from the main motor leads. As a minimum, RTD’s shall be separated from space heater leads by an electric barrier and supplied with separate, NPT-threaded customer access openings.

- When specified auxiliary terminal boxes shall be constructed of 316 SS.

Accessory terminal blocks shall be screw type with an electrical rating of 600V.

9.0 **Ground Connectors**

Motors shall feature two grounding pads with threaded holes, one located on each side of the motor frame.

- When specified copper ground pads shall be required.

10.0 **Nameplates**

The motor nameplates shall be 300 series stainless steel, meet the minimum requirements of NEMA MG 1 and shall be sized and proportioned to permit legible presentation, attached with stainless steel pins.

Uni-directional motors shall be equipped with a rotation arrow.

11.0 **Features**

11.1 **Space Heaters**

Space heaters (T3 temperature code, ≤ 200 °C) shall be provided. Space heaters shall be rated 240 volts for operation on either 240 or 120 volts, single-phase, 60Hz power.

11.2 **Stator RTDs**

Motors shall have six (2 per phase) winding temperature detectors (RTD) evenly distributed in the stator winding. Unless otherwise specified, resistance temperature detector elements shall be platinum, three wire, 100Ω at 32°F (0°C) elements with 22 AWG (minimum size) stranded, tinned copper wire leads.

11.3 **Bearing RTDs**

Bearing temperature detectors shall be installed so that they measure bearing metal temperature. Unless otherwise specified on the motor data sheets, the bearing detectors shall be tip sensitive, stick type, dual element, 100Ω platinum RTD’s, 1 per bearing.
11.4 Bearing Lubrication
Self-lubricated sleeve bearings shall be supplied with constant-level oilers with a wire cage.
All bearing lubrication piping shall be stainless steel, schedule 40 (min).
Self-lubricated bearings are supplied as standard, except where speed, bearing size and/or ambient temperature require the addition of forced/flood lubrication on sleeve bearings.

11.5 Vibration Monitoring
☐ When specified, vibration monitoring of the bearing housing or of the shaft is required. Sleeve bearing motors can be supplied with Bently-Nevada® proximity vibration probes and proximity sensors, 2 per bearing. Proximity sensors will be terminated in a motor-mounted auxiliary terminal box.

On shafts furnished with vibration measuring proximity probes (or provisions for), the combined electrical and mechanical run-out shall not exceed 0.00045 inches in the monitoring areas.

11.6 Hardware
All fasteners shall be corrosion-resistant. 300 series stainless steel is required up to ½” (min).

12.0 Testing

12.1 Standard Factory Tests
Each motor is given a Routine Test in accordance with NEMA MG1 and IEEE Std. 112 to assure that it is free from electrical and mechanical defects. Included in the test are:
   a. Measurement of winding resistance
   b. No-load readings of current, power & nominal speed at normal voltage and frequency. For other frequencies than 60 Hz, 60 Hz readings will be taken
   c. Mechanical vibration
   d. Direction of rotation versus phase sequence
   e. Insulation resistance
   f. AC High-potential test

12.2 Optional Complete Test
☐ When specified a Complete Test shall be performed per the applicable sections of NEMA MG 1 and IEEE 112 including:
   a. Efficiency test in accordance with IEEE Std. 112 Method F(1) or E(1), at 100%, 75% and 50% of full load
   b. Determination of power factor at 100%, 75% and 50% of full load
   c. Determination of locked-rotor (zero-speed) torque and current
   d. Temperature tests
   e. Determination of full-load current and slip
   f. Determination of breakdown torque.
   g. Determination of vibration at rated temperature
13.0 Painting
All motors shall be provided with a Siemens Harsh Duty Paint process consisting of a SP-3 prep; high quality alkyd or zinc-rich powder primer of exterior surfaces; intermediate two-part epoxy primer of exterior surfaces; two-part acrylic-polyurethane finish. The finish color shall be Siemens Motor Blue.

14.0 Submittal Data
a. Motor electrical performance data sheet
b. Motor performance curves (Speed vs. Torque, Speed vs. Current, Safe Stall)
c. Acceleration time (upon receipt of customer load data)
d. Motor dimensional print.
e. In-process test report(s) (when optional tests are purchased)
f. Final test report
g. Instruction manual
h. ☐ Spare parts list with pricing (Upon request and after completion of BOM).

15.0 Preservation and Packing
Motors shall be prepared for short term storage prior to shipping. Exterior machined surfaces, including shafts, shall be given a coating of rust-inhibiting compound prior to shipment.

All equipment shall be packed, securely anchored (skid mounted when required) and protected for the shipment method required. All un-mounted parts shall be suitably boxed for shipment.

The rotor of sleeve-bearing motors is to be blocked to prevent axial and radial movement during shipment. External tags shall indicate removal of blocking material is required prior to start-up.

16.0 Quality
All motors shall be manufactured in an ISO 9001, ISO 18001 and ISO 14001 approved facility.

☐ When specified, CSA Certification for US, and/or Canadian, Div 2 or Zone 2 hazardous areas according to NEC standards shall be required.
### Motor Data Sheet

**End Customer**

**Project Name / Location:**

**Environment:**
- 0 – 40°C Ambient
- 3300 ft / 1000m or less Altitude

*Replace Standard with:*
- Min: _____°C  Max: _______°C
- Altitude: ____________

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<th>HP</th>
<th>RPM</th>
<th>Hz</th>
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**Application:**
- Centrifugal Pump
- Centrifugal Compressor
- Reciprocating Compressor
- Screw Compressor
- Fan  
  - Inertia Value: __________
- Other: _________________

**Enclosure:**
- TEFC (Fin-Cooled)
- TEAAC (Air-to-Air Cooled, Aluminum Tubes)
- WPII w/:
  - 300 Series, Stainless Steel Filters
  - Provisions for Differential Pressure Switch
  - Dwyer 1950-1 Differential Pressure Switch
  - Dwyer 2000 Series Differential Pressure Gauge

**Rotor Cage:**
- Standard
- Fabricated Copper *(Std. 1250 HP & Above)*

**Service Factor:**
- 1.0
- 1.15

**Temperature Rise (on 60 Hz Sine Wave Power):**
- Class B by resistance @ 1.0 S.F. (80°C Rise) over 40°C Ambient *(Std)*

*Replace Standard with:*
- Class B by resistance @ 1.15 S.F. (90°C Rise) over 40°C Ambient
- Class B by RTD @ 1.0 S.F. over 40°C Ambient
- _____°C Rise @ _____ S.F. by Res. Det over _____°C Ambient.

**Hazardous Area:**
- Class 1, Group C/D, Div 2, Temp Code T3 *(Std)*

*Replace Standard with:*
- Class _____ Group _____ Zone/Div _____ Temp Code_____
Noise Limitation:  
- 85 dBA (Max) @ 1 meter, typical (add 2 dBA to guarantee), no load.  
- 85 dBA (Max) @ 1 meter, guaranteed, no load.  

Certifications:  
- CSA per NEC  
- CSA-US per NEC  

Motor Starting/Drive:  
- Full Voltage (90% Minimum Voltage)  
- Direct on Line Starting Not Required.  
- Reduced Voltage Start %**,  
  (**If below 90%, Load WK @ Motor Shaft & Speed Torque Curve of Driven Equipment required)  
- Other:______________________________

Optional VFD Duty Requirements:  
- 15 – 60 Hz Variable Torque  
- ____ to ____ Hz Variable Torque  
- ____ to ____ Hz Constant Torque  
- ____ to ____ Hz Constant Power  
- Siemens GH180 VFD  
- VFD Brand/Model:__________________________  
- NEMA MG1 Part 31 Insulation (Not necessary with Siemens GH180 or GH150)  
- Other:______________________________

Bearings:  
- Sleeve (Std)  
- Anti-Friction

Lubrication:  
- Sleeve Bearings:  
  - Self Lubricated Required  
  - Constant Level Oilers (Oil-Rite®) -(n/a deleted w/ flood lube bearings)  
  - Provisions for Flood Lube  
  - Other:______________________________

  Anti-friction Bearings:  
- Grease  
- Oil Mist  
- Provision for Oil Mist

Shaft Seals:  
- IP 55 Inpro Brand Shaft Seals.

Shaft Extension:  
- Standard Short (unless otherwise specified)  
- Keyless (Required for Recip Compressor Motors)  
- Diameter (Required for Recip Compressor motors to match compressor shaft)  
- Special ________________________________
Auxiliary Terminal Box(es):
- Cast Iron
  Replace Standard with: 316 Stainless Steel
- Location Requirements: ________________________________

Main Terminal Box:
- Location:
  - F1 (Left Side Facing Drive End) Standard
    Replace Standard with:
    - F2

Material & Size:
- Fabricated Steel, NEMA Type I (Standard < 1250 HP)
- Fabricated Steel, NEMA Type II (Standard 1250 HP and above)

Accessories (available with Type II box only):
- Lightning Arrestors
- 120 V Space Heater
- Differential CT’s (3, C10, Self-Balancing 50/5 Ratio)
- Other: ________________________________

Motor Frame / Enclosure
- Space Heaters (T3 Temperature Code): 120 / 240 Volt (Standard)
- Copper Ground Pads
- Vertical Jacking Screws
- 2-Piece Sole Plates – w/ Vertical Jacking Provisions (Siemens Design)
- Other: ________________________________

Winding Temperature Device:
- RTD’s – 6 (2 / Ph.) 100 ohm Platinum DIN Std
  Replace Standard with:
  - Other: ________________________________

Bearing Electrical Protection:
- One Bearing Insulated (Std)
  Replace Standard with:
  - Both Bearings Insulated (with Ground strap on Drive End)

Bearing Temperature Monitoring:
- RTD’s – (1) 100 ohm Platinum Dual Element per Brg – Stick Type
  Replace Standard with:
  - RTD’s – (2) 100 ohm Platinum Dual Element per Brg – Stick Type
  - RTD’s – (2) 100 ohm Platinum Dual Element per Brg – Embedded per API® 670
  - Other: ________________________________
Bearing Housing Vibration Monitoring:
- □ Bently-Nevada® Velomitors (1/Brg) – Horizontal Plane
- □ Robertshaw® 365 Vibraswitch® Vibration Switch (Drive end Brg – Horizontal Plane)
- □ PMC Beta® 440 D/R Vibration Switch (Drive end Brg – Horizontal Plane)
- □ Metrix® 162VTS Vibration Transmitter (1/Brg) – Horizontal Plane
- □ Other: ______________________________________

Shaft Vibration Monitoring:
- □ Bently-Nevada® Proximity Vibration Probes and Proximity sensors, 2 per bearing.
  Proximity sensors will be terminated in a motor-mounted auxiliary terminal box
- □ Bently-Nevada® Phase Monitoring Probe (Requires preceding option to be purchased)

Software:
- □ Motor GA/Outline, Motor Data Sheet, Performance Curves, Test Reports, Instruction Manuals.
- □ Shaft Data for Torsional Analysis (by Others). (Std with Recip Compressor Motors)
- □ Current Pulsation Analysis (Optional for Recip Compressor Motors)
- □ Lateral Critical Speed Analysis
- □ Spare Parts List

Testing:
- □ Routine
- □ Complete
- □ Rotor Balance
- □ DC Hi-Potential
- □ Polarization Index
- □ Unbalance Response
- □ ____________
- □ ____________
  □ Unwitnessed (Std) □ Unwitnessed □ Witnessed
  □ Unwitnessed □ Witnessed
  □ Unwitnessed (Std) □ Witnessed
  □ Unwitnessed □ Witnessed
  □ Unwitnessed □ Witnessed
  □ ____________ □ Unwitnessed □ Witnessed
  □ ____________ □ Unwitnessed □ Witnessed

Additional Requirements /Features: ______________________________________
________________________________________________________________________
________________________________________________________________________

(Note, this specification is intended to be an alternative to API specifications. It is not intended to be used in conjunction with API specifications.)