

Typical Technical Requirements for Electrical Machines and Components



Stators

- Physical Dimensions:
 - Outside Diameter, OD
 - Inside Diameter, ID
 - Stack Length, L stk
 - Overall Length.
- Configuration:
 - Slotted (number of slots)
 - Slot-less(number of coils)
- Rated Voltage,(V)
- Rated Current, A
- Insulation System
 - Epoxy Coated
 - Insulation Paper
 - Plastic caps
 - Totally encapsulated



Stators

- Winding arrangement:
 - Distributed (normally, coil span defined)
 - Concentrated
- Magnet and lead wire:
 - Type (temperature rating)
 - Size
- Lamination:
 - Material grade
 - Size (thickness of the lamination)
 - Heat treatment
- Stator electrical parameters:
 - Winding resistance, R (typical tolerance +/-10%
 - Winding inductance, L (typical tolerance +/- 15% or for reference)



Stators

- Dielectric test(s) requirements:
 - Voltage. KV
 - Leakage current, mA
 - Duration of the test
 - Surge or partial discharge test
- Special requirements:
 - UL, RoHS, REACH.



Rotor/Shafts

- Physical Dimensions:
 - Max. diameter
 - Overall length
 - Tolerances
- Magnet Type:
 - Rear-earth
 - Ceramic
 - Alnico
- Magnet retention method
 - Carbon fiber
 - Metal sleeve
- Special requirements.
 - Balancing



Induction (asynchronous) Motors

- Physical Dimensions:
 - Outside Diameter
 - Overall Length
 - Shaft extension configuration
 - Standard frame size(NEMA,IEC)
- Configuration:
 - Single phase
 - Three phase
 - Multi phase
 - Connectors
 - Feedback device.
- Rated Voltage, V
- Rated Current, A
- Frequency.
- Insulation System rating



Induction (asynchronous) Motors

- Rated Torque, Tr
- Starting torque, Ts
- Output power, P
- Power factor.
- Stator winding resistance, R (typical tolerance +/-10%)
- Stator winding inductance, L (typical tolerance +/- 15% or for reference)
- Environmental requirements*
- Special requirements:
 - UL, RoHS, REACH.
- * See appendix



Brushed Motors

- Physical Dimensions:
 - Outside Diameter
 - Overall Length
 - Shaft extension configuration
 - Standard frame size(NEMA,IEC)
- Configuration:
 - Permanent magnet
 - Wound field
 - Connectors
 - Feedback device.
 - Brush grade
- Rated Voltage, V
- Rated Current. A
- Insulation System rating



Brushed Motors

- Rated Torque, Tr
- Starting Torque, Ts
- Output power, P
- Efficiency
- Torque Constant, Kt (typical tolerance +/-10%)
- Back EMF Constant, Ke (typical tolerance +/-10%)
- Resistance, R
- Inductance, L
- Speed-Torque Curve with a load point
- Environmental requirement*
- Special requirements:
 - UL, RoHS, REACH.



Brushless DC Motors

- Physical Dimensions:
 - Outside Diameter
 - Overall Length
 - Shaft extension configuration
 - Standard frame size(NEMA,IEC)
- Configuration:
 - Inner or outer stator construction
 - Permanent magnet
 - Permanent magnet material and grade
 - Surface mounted
 - Interior (IPM)
 - Connectors
 - Feedback device.
- Rated Voltage.
- Type of commutation:
 - Sine wave
 - Six step
- Insulation System rating



Brushless DC Motors

- Rated Torque, Tr
- Starting Torque, Ts
- Output Power, P
- Efficiency
- Torque Constant, Kt (typical tolerance +/-10%)
- Back EMF Constant, Ke (typical tolerance +/-10%)
- Resistance, R (typical tolerance +/-10%)
- Inductance, L (typical tolerance +/- 15% or for reference)
- Speed-Torque Curve with a load point
- Environmental requirement*
- Special requirements:
 - UL, RoHS, REACH.
- * See appendix



Stepper Motors

- Physical Dimensions:
 - Standard frame size(NEMA)
 - Overall Length
 - Shaft extension configuration
- Configuration:
 - Inner or outer stator construction
 - Permanent magnet
 - Variable reluctance
 - Hybrid
 - Connectors
 - Feedback device.
- Rated Voltage, V
- Number of phases
- Number of steps per revolution
- Insulation System rating



Stepper Motors

- Pull-out Torque,Tr
- Pull-in Torque, Ts
- Detent/Holding Torque
- Winding/terminal Resistance, R (typical tolerance +/-10%)
- Winding/terminal Inductance, L (typical tolerance +/- 15% or for reference)
- Speed-Torque Curve
- Environmental requirement*
- Special requirements:
 UL, RoHS, REACH.

* See appendix







Environmental Requirement

- Operating temperature.
 - Temperature range or maximum value
- Dust-proof
 - Dust-proof motors protect against dust infiltration with features such as total enclosure and labyrinth seals for shafts. The IP (Ingress Protection) rating for dust-proof motors is IP6x.
- Drip-proof
 - Drip-proof motors contain ventilation openings that are designed so that drops of liquid or solid particles falling from any angle within 15 degrees of vertical cannot enter the motor. Motors with an IP rating of IPx1 through IPx9 are considered dripproof.



Environmental Requirement

Waterproof

- There are several degrees of waterproofing applicable to motors and they are reflected in the IP rating for the motor: IPx1: Protection against vertically falling drops of water (drip-proof). IPx2: Protection against direct sprays of water up to 15 degrees from vertical. IPx3: Protection against direct sprays of water up to 60 degrees from vertical. IPx4: Protection against water sprayed from all directions. IPx5: Protected against high pressure jets of water from all directions. IPx6: Protected against high pressure jets of water from all directions. IPx7: Protected against the effects of immersion up to 1 meter. IPx8: Protected against long periods of immersion under pressure.

Explosion-proof

 Explosion-proof motors have totally enclosed housings that are constructed to withstand internal explosion of a specified gas, vapor, or dust. Should such an explosion occur, the enclosure would prevent the ignition or explosion of the gas or vapor surrounding the motor enclosure. Several explosion-proof ratings are governed by Underwriter's Laboratories (UL).



Environmental Requirement

- Special / Extreme Environment
- Clean Room Use
 - Clean rooms are classified by particulate size and density in the ambient air. One such rating method classifies rooms according to number of particles larger than 0.5 micron in one cubic foot of air. There are various governmental, metric, and international standards. Motors rated for suitability in a clean room will identify the particular standard for which they are rated.
- Cryogenic Use
 - Motors with a cryogenic rating are constructed for extremely low ambient temperatures such as 20 K and below.
 - Radiation-hardened
 - Radiation-hardened motors are constructed of materials designed to withstand highenergy gamma radiation. Ratings are expressed in units such as permissible RADs in total accumulated dose (TAD).

Vacuum Use

 Vacuum-rated motors incorporate features such as lubricant vapor pressure below rated ambient vacuum and construction techniques.







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