TECHNICAL SEPECIFICATION FOR MV INDUCTION MOTORS

Prepared and verified	Amir Hajian			

ARDAKAN DRI PLANT	شرکت آهن و فولاد غدیر ایرانیان Iranian Ghadir Iron & Steel Co.
TECHNICAL SEPECIFICATION FOR MV INDUCTION MOTORS	Rev. A / Date: 2025

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1.1 SCOPE

This Specification Describes the Minimum requirements for design, manufacturing, testing and performance in service of Medium Voltage three phase squirrel cage induction motors.

This specification covers only the general requirements, the specific requirements of each assembly (Item No. Rating, etc.) will be shown on Data Sheets and/or drawing which will be part of the request for Quotation and/or Purchase Order.

1.2 Definitions

OWNER:	**Iranian Ghadir Iron & Steel Company (IGISCo).**
CONTRACT:	Shall mean the Agreement between the OWNER and the CONTRACTOR includes documents referred to therein.
PROJECT Area:	Shall it mean the area of ARDAKAN DRI PLANT according to the battery limits which is specified in the CONTRACT.
CLIENT or CUSTOMER :	Shall mean IGISCO as the client and or customer/purchaser.
CONTRACTOR:	This shall mean the party which has entered under a CONTRACT or Agreement with the OWNER for the execution of design and engineering of the PROJECT.
VENDOR or MANUFACTURER:	This will mean any person, firm or business which manufactures or supply materials, equipment or services for the performance of any item of WORK. Shall be synonymous with the term SUPPLIER as defined above.
WORK:	This will mean all and any of the works and / or services to be provided by the CONTRACTOR under the CONTRACT with OWNER.

Within this specification the following definitions shall apply:

2 CONDITIONS AND REGULATIONS

According to the site climatic conditions, following values will be considered as design values for electrical equipment/systems.

Site location:

- Location: Ardakan town near Yazd city
- Latitude / Longitude:
- Altitude of site: 1150 m above Mean Sea Level (M.S.L)

Ambient temperature:

- Max. / Min. outdoor ambient temperature: 48.6 / -16 °C
- Average Max. / Min. air temperature in the summer: 32.9 / 21.9 °C

Design temperature:

- Max. / Min. Indoor temp. for electrical equipment rooms, switch rooms and offices that are air conditioned: 40 / 15 °C
- Max. / Min. Indoor temp. in plant production areas, workshops and covered transformer pens: 48.6 / -16 °C
- Max. outdoor temperature when not exposed directly to the sun: 48.6 °C
- Solar radiation: Strong

Relative humidity

- Max. relative humidity: 44.8 %
- Min. relative humidity: 18.3 %
- Average annual amount of precipitation: ~70mm

Earthquake (seismic factor)

- For design purposes, the base acceleration is: A=0.35g

Wind

- Design wind speed: 130 km/hr.
- Wind prevailing direction is from North West to South East.

Other figures

- Average annual amount of precipitation: ~45 mm
- Design atmospheric pressure: 0.855 bar

- Pollution Level: Very Heavy
- Dust: Iron-Concentrate

3 STANDARDS AND CODES

3.1 GENERAL

The Supplier shall state the codes and standards applicable to the equipment proposed.

In the event of a conflict of technical requirements within the requisition documents, the order of precedence shall be:

(1) Requisition / Purchase Order

(2) Equipment Data Sheet

(3) This specification

(4) Referenced Project Specifications

(5) Referenced Design Codes and Standards

(6) Local Authority or Statutory Regulations

Notwithstanding the above, it is the Supplier's responsibility to bring to the notice of the Purchaser any conflict between the above documents.

The motor shall meet the requirements of this specification in every respect and be suitable for continuous operation at full load within the service and environmental conditions under which they operate.
The equipment shall have a design lifetime of at least 25 years.
Motors shall be designed for a minimum of 25000 hrs continuous operation without maintenance.
Regreasing of bearings or replenishment of lube oil, if required, shall be possible with the machine in operation.
The motor design shall allow at least three consecutive starts from cold against full load torque without injurious heating of insulated windings.
Motors shall be able to overcome starting load inertia as well as accelerating the load to rated speed at 20% reduced voltage.
The minimum accelerating torque shall be at least 30% more than the torque required by the load, at starting and at pull up stage, when the applied voltage is 80% of the nominal voltage .The starting torque shall be at least 100% of the rated full load torque at 80% of the nominal voltage.

Manufacturers shall specify in their tenders the percentage value of residual voltage against which the motor may be reconnected to the supply immediately following loss of supply: however, the motor shall withstand a residual voltage of at least 30% of rated supply voltage with 180° out of phase situation.
The electric motor, including any associated unit transformer, shall be suitable for one of the duties listed below:

- Normal: maximum 1000 starts per year
- Heavy: maximum 3000 starts per year

The Manufacturer shall assign "safe stalled rotor time(s)" for "cold" and "hot" conditions. It shall be the time(s) during which the motor may remain stalled without injurious effects to rotor and stator. The time for the "cold" condition shall assume that the motor is initially at the specified ambient temperature. The time for the "hot" condition shall assume that the motor is initially at the stabilized full load rating temperature.
Non-metallic materials, particularly those introduced for noise reduction, shall be fire resistant, anti-static (in compliance with the requirements of IEC 60079) and stable in the presence of hydrocarbon liquids and vapors or for other conditions that will be specified.

3.2 STANDARDS

Electrical Motors shall be manufactured and tested in accordance with the latest edition of International Electro technical Commission and all applicable sections of other relevant IEC standards with particular reference to:

IEC 60034	Rotating electrical machines
IEC 60072	Dimensions and output ratings for rotating electrical machines
IEC 60085	Recommendations for the classification of material for the insulation of electrical machinery and apparatus in relation to their thermal stability service
IEC 60529	Classification of degree of protection provided by enclosures
ISO-R-1680	Noise level Measurement
IEC 60079	Electrical apparatus for explosive gas atmospheres

When reference is made in this specification to other than IEC Standards, it is understood that equivalent standards are also acceptable.

4 SERVICE CONDITIONS

4.1 Mechanically driven machine

Medium voltage induction motors shall normally be used to drive pumps, blowers, agitators, compressors and other constant / variable-speed, operated equipment.

Motors shall satisfy the speed-torque requirements of the driven equipment over its entire starting and operating range. Motors couplings and drives shall normally be rated to withstand all torques associated with reacceleration and immediate restarts.

Special operating conditions shall be individually considered and specified in conformity with requirements for the driven equipment. Conditions include frequent starting of fans under cold and hot air temperatures and variable or multispeed operation.

4.2 Power supply systems

Motors shall be capable of providing rated output with a combined variation of both voltage and frequency not exceeding 90 to 110 percent above or below rated voltage in which frequency variation shall not exceed – 5 percent and + 5 of rated frequency.

5 CONDENSATION PROTECTION

5.1 Anti-condensation heaters

All MV Motors shall be provided with anti-condensation space-heaters. Space heater leads shall be brought out to a junction box separate from the main power leads junction box.

Space heater voltages are to be as follows:

- 3000 watts or fewer 230 volts, single phase

- Over 3000 watts 400 volts, 3 phase

Space heaters shall have maximum sheath temperature of 200oC or as specified.

Space-heaters shall prevent the formation of condensate in the interior of the motor and shall be positioned so as not to damage the windings during prolonged periods of standstill.

6 DESIGN AND CONSTRUCTION

6.1 MECHANICAL DESIGN

6.1.1 Type of construction

Dimensions shall be in accordance with IEC 72 and 72A.

6.1.2 Enclosure

Degree of protection for motor enclosures shall be IP55 and for terminal boxes shall be IP64 as a minimum for outdoor installation.

-Motors shall be provided with one or more lifting eyebolts, rings, or lugs capable of supporting the weight of the motor. If lugs are concealed by enclosure, nameplates shall be attached to both sides of the motor warning against improper lifting.

The enclosure shall be of ferrous materials, either cast iron or 3 mm minimum thick steel sheet. Bolts and screws shall be made of corrosion resistant material.

6.1.3 Method of cooling

Motors shall be totally enclosed with air-to-air cooling. Sunshades shall be provided by Vendor when specified to limit solar gain.

In the air-to-air cooling system tubes and fans shall be made of material considering the environmental conditions as defined in paragraph 3 (CONDITIONS AND REGULATIONS).

Fan grilles and screens over air passages shall be stainless steel, slotted cast iron or bronze.

Motors shall be fully guarded type. Screens over ventilating openings shall be made of corrosion resisting material.

Drain holes shall be provided at all locations in the enclosure where water might collect. An explosion proof drain shall be provided in explosion proof motors. Plugs shall not be installed in these drains.

External cooling fans shall be made of a corrosion resisting, non-sparking ductile material. Brass, bronze, aluminum, and plastic fans are not acceptable.

Fan covers shall be made of cast iron, stainless steel, or fabricated steel sheet of 1/8 in. (3 mm) minimum thickness. The air intake opening shall be guarded by a grill cast or formed integral with the cover or by a metal screen made of corrosion resisting material.

Air-to-air heat exchanger tubes used in tube type motors shall be made of copper, a copper base alloy, stainless steel, or an aluminum alloy containing not more than 0.2% copper. Material selection shall be suitable for the specified environment.

The ventilating systems for forced-ventilated motors shall have two blowers for supplying air to the motor. Each blower shall have capacity to supply the quantity of air required at the motor's highest continuous overload capability. Motors of motor driven blowers shall be 3-phase.

6.1.4 Resonance speeds and vibration

First resonance speed shall be at least 125% of synchronous speed.

Motor vibration tests shall be carried out. The maximum vibration limits shall be 2.5 mm/s at bearing housing with or without load.

Driven machine vibration limits where more stringent than above, shall also apply to the motor and thus common to machine train.

Rotor and fans shall be dynamically balanced to the relevant balance quality grade required by the standards. Unless otherwise clearly stated and agreed by all balancing shall be with half depth keys.

Rotors shall be dynamically balanced at all speeds with half coupling keyed on the shaft. The use of solder or similar deposits for balancing is not acceptable. Parent metal removal to achieve balance shall be carried out in such a way as not to affect the structural strength of the rotating element.

Vibration shall be measured on the bearings along the three axes and shall not exceed the limits specified in IEC 60034-14. During the measurement, the motor shall run

without load, uncoupled, in free suspension conditions at rated voltage and frequency.

External fan(s) shall be inherently balanced and shall be located so that it is impossible to assemble incorrectly.

6.1.5 Rotors and cooling fans

Flow of cooling air shall be in the direction of the driven equipment.

Direction of rotation shall be clearly indicated on the motor by raised or embossed markings. Bidirectional fans shall have direction arrows with two points.

A magnetic center indicator shall be fitted on the drive end and a reference mark on the motor shaft.

Fans for motors shall be of corrosion resistant material such as brass, bronze, and aluminum.

Aluminum alloy fans should not contain more than 0.2% copper. Fans shall be balanced before assembly on shaft. Plastic or non-metallic fan housing is not acceptable.

Fans shall be inherently balanced and shall be located so that it is impossible to assemble them incorrectly. They shall force the cooling air in the direction of the driving end and preferably be suitable for rotation in either direction.

In the case of motors supplied with unidirectional fans, the direction of rotation for which the motor is arranged shall be clearly indicated by means of a permanent arrow on the non-driving end, preferably on the stator body and not on a removable end shield. Only painted arrows are not acceptable. Fan shall be non-sparking.

For motors that feed by VFD, cooling fans shall be driven by separate motors.

6.1.6 Bearings

Bearing shall be of the anti-friction, sleeve or thrust type as required and approved for the application. They shall be in metric sizes with maximum interchange ability and shall comply with ISO recommendations.
Special Attention shall be paid to ensure that the dismantling of bearing shall be simple and free from risk of damage.

Lubricants which will be used on the site, shall be the subject of agreements between the Manufacturer and the Purchaser. Grease-lubricated bearings shall be packed before motor is shipped.

Motors driven and non-driven end bearings shall be insulated for prevention from bearing corrosion and the circulation of shaft currents through the bearings.

Horizontal motor bearings shall be split capsule type sleeve bearings with split bearing brackets (CARB Bearings).

All non-drive-end motor bearings shall be electrically insulated to prevent the circulation of shaft currents through the bearings .For double-end motor drivers, both bearings shall be insulated and one coupling shall be electrically insulated .Where specified, to facilitate testing when both ends are insulated, a shorting device shall be provided in the drive-end of the bearing housing.

Bearings shall be provided with temperature detectors for motor > 300 kW when specified. The signal shall be analyzed by instruments/DCS.

One detector per bearing, with leads brought out to a separate terminal box. Detectors shall be stainless-steel-sheathed Type J iron-copper-nickel thermocouples, iron-constantan, chromel-alumel type, or PT-100 type, manufactured in accordance with ANSI or IEC standards.

- **Sleeve bearings**

Sleeve bearings shall be used when specified on data sheets.

Preferred lubrication for sleeve bearings shall be self-contained ring oil. Otherwise, a pressurized system from the lube oil system of the driven equipment shall be provided.

Motors shall be capable of running down to standstill, without damaging bearings, in event of total electric power failure.

Oil lubricating sleeve bearings shall have reservoirs of generous capacity effectively covered, so that no dust or other materials can enter the bearing. Oil slingers and catchers shall be designed to prevent the escape of oil from the bearing and creepage along the shaft. Reservoirs shall be provided with drains, tapped fill openings, and separate level

gauge glasses.

A permanent indication of proper oil level shall be provided. For sleeve bearings the end floats shall be within the limits specified in NEMA MG-1.87 and shall be less than ±6 mm.

- **Vertical motors**

Vertical motors shall be equipped with thrust bearings. Thrust bearings shall be self-contained and air cooled. Sunshades shall be provided on exposed motors to protect against solar gain.

- **Antifriction Bearing**

The grease lubricated bearings shall be supplied with inside end caps to prevent grease from migrating into the motor.

The re-lubricating intervals, grease quantity and type of grease shall be indicated on the rating plate or on additional lubricating plate on the motors.

Grease lubricated bearing shall be packed with approved manufacturer's product and subject to prior agreement with Company.

Grease lubricated bearings shall have pressure relief devices which ensure that the old grease will be forced out of the bearing as new grease is added.

The calculated life for ball and roller bearings shall be according to standard B 10 of the Anti-Friction Bearing Manufacturers Association.

6.2 ELECTRICAL DESIGN

6.2.1 Motor ratings and voltages

- **Supply voltage**

Voltage rating shall be in accordance with the data sheets.

Motors > 200 kW shall be 6.6 kV. In special cases motors with rated output between 150 kW and 200 kW may be 400 V subject to compliance with vibration limits.

- **Rated output**

Medium Voltage (MV) motor ratings shall be determined for each case.

- **Duty type conditions**

Motors shall be designed for continuous running operation at rated power, duty service type S1 according to IEC 60034.1.

6.2.2 Differential Relays

Motors 500 kW and larger shall have provisions for differential relay protection. Protection shall be of the self-balancing type utilizing only one set of current transformers (located in the motor) unless otherwise specified. If self-balancing type is not available, conventional type protection utilizing two sets of current transformers (one set in the motor and the other in the controller) may be proposed for approval by the Owner's Engineer. Provisions furnished shall be:

a. For self-balancing type: Three window-type current transformers mounted within the motor terminal box with insulating strips for centering the motor leads in the transformer windows. Vendors shall complete all primary circuits through the transformer windows and provide leads for connection to motor feeder cables.

b. For conventional type: A separate motor lead enclosure mounted externally or within the motor enclosure with facilities for mounting current transformers, one per phase. The type of current transformer to be used, and if they are to be furnished and mounted by Purchaser or vendor, will be specified.

c. Current transformer secondary leads shall be connected to a terminal strip mounted within a separate external terminal box. The terminal strip shall have links, or shorting screws, arranged to permit short circuiting the current transformer secondary windings.

6.2.3 Surge Protection

When specified, motor shall be equipped with surge protection installed in the motor terminal box.

Protection shall consist of:

a. Protective capacitors, and/or

b. Rotating machine type station class lightning arresters.

6.2.4 Induction Motor Performance

Locked rotor current at rated voltage shall be limited to 600% of rated full load value, unless a lower value is specified.

Maximum torque at rated voltage shall be at least 200% of full load value.
Starting performance and duty shall be designed for the specified application, namely:

a. Specified design maximum ambient temperature.

b. Driven equipment data characteristics.

c. Specified power system minimum short circuit MVA at motor terminals.

d. Specified prestart voltage.

e. Specified running voltage prior to interruption (for reacceleration)

Note: Regarding Subparts. d and e above, transformer tap changers (if any) shall be assumed not to operate during starting or reacceleration.
For the specified application, the motor shall be capable of at least 6 evenly spaced starts per day, under design starting conditions, with at least 30 minutes running between starts.

6.2.5 Documentation

Motor data, as listed below, shall be furnished by vendor with all proposals for each induction and synchronous motor. Data corrected to apply to the actual motor supplied shall be furnished with final drawings.

DATA FOR MOTORS OVER 800 hp (600 kW)	INDUCTION	SYNCHRONOUS
Rated full load power factor	X	X
Locked rotor current at 50%, 75% & 100% rated voltage	X	X (1)
Rotor or field Wk^2, lb ft^2 (GD^2, kgm^2) at motor shaft	X	X
Speed vs. torque, speed vs. power factor, and speed vs. current curves based on motor saturation at rated voltage	X	X (1)
Safe time vs. current curve from locked rotor to full load with motor at rated load running temperature (if available)	X	X (1)
Equivalent circuit	X	X
% Max. torque at full voltage	X	X
% pull-in torque at full voltage	—	—
% pull-out torque at full voltage	—	—
% slip at max. torque	X	
For rotor bar (or ring, if governing):		
a. Temp. rise accelerating uncoupled motor to full speed	X	X (1)
b. Max. permissible temperature rise accelerating load	X	X (1)
c. a-c/d-c resistance ratio	X	X (1)
d. Temp. vs. time cooling at standstill	X	X (1)
e. Temp. vs. time cooling at rated hp and voltage	X	X (1)
Max. permissible time at full voltage locked rotor starting at design ambient (40□C unless specified otherwise),seconds	X	X (1)
Max. stator winding temperature by RTD for alarm setting	X	X
Open circuit time constant, seconds	X	X
Symmetrical contribution to 3□ terminal fault:		
a. At 1/2 cycle	X	X
b. At 5 cycles	X	X
% Synchronous reactance, direct axis	—	X
% Synchronous reactance, quadrature axis	—	X
% Transient reactance, direct axis	—	X
% Subtransient reactance, direct axis	—	X
Open circuit saturation curve	—	X

Note:

(1) Operating in the induction mode.

Driven equipment data for each main drive motor shall be obtained through the cooperation of the driven equipment vendor and shall be made available to the motor vendor as follows:

a. Load rated horsepower.
b. Load rated speed, rpm, at equipment shaft.
c. Driven equipment Wk2, lb-ft2 (GD2, kg-m2) at equipment shaft.
d. Gear (if any) Wk2, lb-ft2 (GD2, kg-m 2) referred to motor shaft.
e. Percent gear (if any) power loss at rated load and speed.
f. Speed vs. torque curves for driven equipment:
1. Under design starting conditions.
2. During reacceleration immediately following unplanned shutdown (applies to centrifugal and axial flow machines and should include effect of check valve operating but without machine unloading unless this is guaranteed by interlocks).

6.2.6 Starting conditions

Motors shall be suitable for direct on-line starting between 80 and 100% of rated voltage and shall be capable of two successive starts with the motor already at full load working temperature or three successive starts from ambient temperature (IEC 34.1). Locked rotor current shall be in accordance with the data sheets.

When required by the driven equipment, motors shall be capable of re-energization for reacceleration against 100% residual voltage.

6.2.7 Insulation

All MV motors shall be class F insulated. Temperature rise shall be to class F limit.

All motors shall be designed to operate under unusual conditions of high temperature, high humidity, fungus, salty air and corrosive vapors as mentioned in site conditions.

The insulation shall protect the windings against the effects of corrosive gases and vapors, grease, oil, dust, humidity and stresses due to vibration. Winding shall be adequately braced to prevent any relative movement during operating conditions.

All motors shall have sealed insulation system consisting of a complete encapsulation in epoxy resin. Vacuum pressure impregnated, insulation shall be applied for 6.6 kV

motors. Insulation class of windings shall be class F with temperature rise limited to the temperature of class F insulation, according to IEC 60085 standard.

Stator windings shall be fully insulated for an unearthed system. Adequate insulation shall be provided between coils of different phases which lie together.

The insulation shall be sized based on restarting the motor immediately after loss of power with residual voltage of 40% of the rated voltage. The restarting voltage will be 100% of the rated.

6.2.8 Windings

Stator windings shall be copper wire for all motors.

- For MV motors (P> 500kW) resistance temperature detectors (RTD) shall be embedded in the hot spots of the windings. Six elements shall be installed, two per phase. Elements shall be platinum, three wires with a resistance of 100 Ohms at 0°C. Winding temperature shall be monitored by instruments/DCS.

- For MV motors (500>P> 200kW) PTC temperature detectors shall be embedded in the hot spots of the windings. Six elements shall be installed, two per phase. Winding temperature shall be monitored by instruments/DCS.

6.2.9 Terminal boxes

Terminal boxes shall have degree of protection IP64 minimum and shall be positioned as indicated on the data sheets.

MV motors shall be equipped with main terminal box for motor supply and separate auxiliary terminal boxes for anti-condensation heater, winding temperature detectors, etc.

Box design shall be such that small parts cannot be dropped into the motor frame.

Boxes shall be sized for the space required for the allowable bending radius and stiffness of the motor supply cables and for terminating the phase and earthing conductors.

7 Earthing & Grounding

Motors shall be provided with an earthing bolt external to the terminal box tapped into the frame, complete with locknuts and washers.

Precautionary measures shall be taken to ensure that no incentive sparking can occur between adjacent parts on motors, particularly those which are located in hazardous areas.

8 NOISE LEVEL

Noise level of MV motors shall be according to IEC standards.

9 PLATES

9.1 Rating plates

All motors shall be provided with stainless steel rating plates incorporating the appropriate items on accordance with IEC 60034.1. In addition, the following data shall be indicated:

- The nameplates shall be of stainless steel and shall be mounted on a fixed part of the frame.
- The inscriptions shall be engraved on one or more nameplates and shall be black on white background and in English language.
- The serial number shall always be different, even when the motors are identical.
- On the nameplates the following data shall be shown according to section 9 of IEC 60034-1:

  - The manufacturer’s name and manufacturer’s code number
  - The manufacturer’s serial number and year of manufacture
  - The purchaser’s name and purchase tag number (in a separate name plate)
  - Number of phases and number of poles
  - Frame size

- Degree of protection (IP code) for motor and terminal boxes
- Stator winding connection
- The limit of temperature rise and class of insulation
- Altitude if more than 1000m above sea level
- The rated output power (kW)
- The rated voltage (V)
- The rated frequency (Hz)
- The rated current and locked rotor current (A)
- The rated speed (R.P.M.)
- The rated torque and locked rotor torque (N.m)
- Power factor and efficiency at rated output
- The Maximum/Minimum ambient air temperature
- Liquid coolant quality/pressure/temperature (if applicable)
- Net weight (Kg)

Where applicable the following additional information shall be provided:

- The symbol for explosion proofing (e.g. Ex)
- The symbol for type of protection (e.g. d or e)
- Temperature classification (e.g. T3)
- Apparatus gas group and subdivision (e.g. IIB)
- Certifying authority and certificate number
- Type and size of the bearings, life of the
- Type of lubrication and lubrication intervals and amounts
- Indication of the axial play limitation to be kept by the joint
- Indication of the magnetic balance and of the tolerance range allowed by

the joint with reference to a fixed point in order to check the coupling position.

- A separate data plate will be provided for space heaters.

9.2 Item plate

All motors shall be provided with a stainless-steel item plate separated from rating plate indicating the tag number of the motor.

10 SPARE PARTS

Together with the supply of all equipment, a complete set of spare parts for commissioning shall be proposed for each equipment and to be supplied according to order. Also recommended spare parts list for two (2) years of operation included unit price shall be submitted for all the equipment. The supplied spare parts shall comply with the same specification as the original parts.

11 INSTALLATION, OPERATING & MAINTENANCE INSTRUCTION

Installation, operating, and maintenance instruction shall be provided which cover all the equipment furnished including all protective relays, fuses, auxiliary relays, etc., and shall include time-current curves of each different protective relay and fuse At least 3 copies of mentioned documents shall be provided.

All Drawings Shall be in DWG format.

12 TEST AND INSPECTION

All equipment covered by this specification shall be subject to inspection and testing witnessed by the contractor at the works during manufacture. In certain cases, these activities may extend to sub suppliers.

Acceptance tests shall be in accordance with IEC.

For vibration test refer to 6.1.4.

12.1 Factory acceptance tests

Factory acceptance tests to be carried out on each motor shall include:

- Visual inspection (finish, painting, welds, sheet metal work lifting rings)
- Dimension check
- Check of motor auxiliaries and fittings against the specification / data sheet
- Check of rating plate and additional markings or identification to comply with the specification
- Measurement of winding resistance (cold)
- Measurement of no-load losses
- Measurement to allow calculation of locked rotor current and torque
- High-voltage test plus insulation-resistance test
- Inspection (at no-load) of bearings and mechanical operation of motor
- Measurement of vibration
- Measurement of no-load speed.

Further tests shall be carried out (in addition to factory checks) on at least one motor of each group of identical motors being supplied:

- Measurement of winding resistance (cold and both)
- Measurement of no-load losses
- Measurement to allow calculation of locked rotor current and torque
- High-voltage test and insulation resistance before and after heat run
- Inspection (at full load) of bearings and mechanical operation of motor
- Full load heat run
- Measurement of slip at full load
- Measurement to allow calculation of pull-out torque
- Measurement to allow calculation of efficiency at fully, three-quarter and half load
- Measurement of vibration
- Measurement of noise
- High-voltage and continuity tests on built-in temperature detectors, together with tests to demonstrate satisfactory operation and compliance with stated characteristics.

Complete tests shall not normally be required on all motors, if evidence of type tests on identical machines is produced at the time of tender. In such cases abbreviated tests shall be made on each motor and certified Test Reports provided.

13 PROVISIONS FOR HANDLING AND FIELD ERECTION

Each “shipping section” of stationary structures shall be furnished with removable lifting angles and/or plates suitable for crane hooks.

Each “shipping section” shall also be furnished with removable steel channel base plates which will permit using rollers or dollies without damaging the frame steel of the equipment.

14 SHIPPING

Preparation for shipment shall be in accordance with manufacturer’s standards unless otherwise noted on the requisition for quotation and/or purchase order. The manufacturer shall be solely responsible for the adequacy of the preparation for shipment.

All equipment shall be suitable for standing over long periods outdoors before commissioning.

Each item is to be securely labeled with indestructible tags and the following markings:

a) Destination
b) Purchase order number
c) Purchaser’s equipment number

15 GUARANTEE

The supplier shall replace any damaged equipment resulting from poor workmanship and/or faulty design. The supplier shall also replace any equipment that failed under the following conditions:

a) Failure of the equipment under the pre-commissioning and/or commissioning tests.

b) Equipment failure under normal operation in the specified service, up to 18 months after installation or 36 months after shipment, whichever occurs earlier.