

GENERAL SUPPLY RULES FOR LV INDUCTION MOTORS

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MOTOR OIL (HELLAS) – CORINTH REFINERIES S.A.

1. GENERAL

1.1. Scope

This general supply rule, together with the job specification for supply if any, lays down the principal rules to be followed in the design, manufacture and testing of LV induction motors which ones will be new and without any deficiency.

1.2. Specifications

- (a) Should any conflict arise among the documents, the job specification for supply will prevail over the others including this JSS.
- (b) Manufacturer must declare in the offer any exception and/or deviation from the specifications.
- (c) The lack of any declaration and/or deviation will be considered as full compliance with the specifications.

1.3. Codes

The LV induction motors will comply with the requirements of following applicable codes and standards. These codes and standards will be applied with the latest applicable issue available at the moment of awarding of the order.

- International Electro-technical Commission: IEC
- European Directive: ATEX 94/9/EC Explosive Atmosphere

2. DESIGN

2.1. Ambient Conditions

- (a) The LV induction motors shall be suitable for outdoors installation with typical atmosphere of chemical plant or refinery (dusty, marine and corrosive).
- (b) Unless otherwise specified, the ambient to be considered shall be those specified in the IEC Standards; no seismic disturbances, nor environment pollution shall be considered if not particularly required on project specifications.
- (c) The relative humidity shall be taken to be 90% maximum at 40°C.

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2.2. Power Supply Features

- (a) Motors shall be capable of providing their rated output with a combined variation of both voltage and frequency not exceeding 95 to 105 percent above or below the rated voltage in which the frequency variation shall not exceed - 2 percent and + 2 percent of rated frequency.
- (b) Total harmonic distortion (THD) of the supply network voltage will not exceed 5%.
- (c) Motors shall be capable of re-acceleration on full opposite residual voltage.

2.3. Hazardous Area

All electrical equipment installed within an hazardous area shall comply with the classification of the area in accordance with the IEC 60079 & ATEX 94/9/EC.

2.4. Mechanical Driven Machine

- (a) Induction motors will generally be used to drive pumps, blowers, agitators, compressors and other constant-speed operated equipment.
- (b) Motor shall satisfy the speed-torque requirements of the driven equipment over its entire starting and operating range.
- (c) Special operating conditions will be individually considered and be specified in conformity with the requirements for the driven equipment. Such conditions include frequent starting of fans under cold and hot air temperatures and variable or multispeed operation.

2.5. General Design Requirement

- (a) Unless specified otherwise, motors shall be suitable for Direct On-Line starting
- (b) Rated output in kW shall be in accordance with I.E.C 60072 and 60072A
- (c) Duty type service: Motor shall be designed for continuous running operation at rated power, duty service type S1 according to I.E.C 60034.1.
- (d) Starting characteristics:

- General

The requirements related to the motor torque capabilities, as described in this section, are all based on a situation where the motor is at full load operating temperature and with rated voltage and frequency applied, unless otherwise stated.

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- Starting current

For LV motor the locked rotor apparent power shall comply with IEC 60034-12. However, for motors with rated output in excess of 55 kW, the starting current will be lower the 7.0 time the rated current of the motor. More stringent limitations could be specified in the requisition/data sheet.

- Number of sequential starts

At any voltage between 80% to 100% rated voltage, motors shall be capable of:

- Three successive starts with the motor initially at maximum ambient temperature.
- Two successive starts with the motor initially at full load operating temperature.

Another starting sequence of two successive starts shall be allowed after a cooling period of 30 minutes at standstill.

(e) Stator winding and insulation class

The insulation materials of stator windings shall be at least class F. The motor shall be designed for a maximum permissible temperature rise limited to the one corresponding to a class B.

(f) Vibration

The maximum vibration levels shall be as given in the I.E.C standard 60034-14.

(g) Noise level

The sound pressure level shall be as stated in the requisition documents. The noise pressure level shall be measured at no load.

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3. FABRICATION

3.1. Motor Housing

- (a) The degree of protection for motor enclosures and terminal boxes shall be IP 55 for outdoor installation.
- (b) Products that are toxic to the environment or that are considered potential carcinogens shall not be used.
- (c) The use of hygroscopic materials should be avoided. The materials used shall be selected to prevent contact corrosion.
- (d) Transport units heavier than 25 kg shall have eyebolts, lugs or extension pieces clearly identifiable to be used for hoisting. Eyebolts shall not be part of the equipment type of protection.
- (e) Motors weighing over 600 kg shall have jacking bolts or facilities to lift the motor with the aid of a mechanical jacking device to facilitate the alignment of the motor with the driven equipment.
- (f) Motors shall be provided with external earthing facilities. The earthing facility shall be clearly marked with the appropriate symbol.

3.2. Stator Frame

- (a) All motor frames and bearing end-shields shall be constructed of ferrous metals.
- (b) Motor frames made of aluminium alloy are not acceptable.
- (c) Motor frame including bearing supports shall have sufficient strength and rigidity to avoid distortion or increased vibration as a result of external mechanical forces, e.g., tightening of fixing bolts.
- (d) Castings shall be sound and free of shrink holes, cracks, scale or other similar injurious defects. Surface of castings shall be cleaned by shot blast, pickling or other standard methods.

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3.3. Anti-Condensation Heaters

- (a) Adequate provisions shall be made to avoid deterioration of the motor caused by condensation.
- (b) Heaters are not required on LV motors unless otherwise specified. Notwithstanding, vendor will decide whether the space heaters will be provided as a consequence of the specified ambient conditions, type of the motors and insulation features.
- (c) If required, anti-condensation heaters shall be of a fully insulated design and suitable for 220-254 Volts single phase supply, unless otherwise specified.
- (d) Anti-condensation heaters shall be arranged to provide uniform heating of stator and, if applicable, rotor windings and should maintain the temperature of the motor windings approximately 5°C above ambient temperature.
- (e) The surface temperature of the heater element or of the motor enclosure shall not exceed the specified limited temperature.
- (f) The connecting leads of the heater elements shall be brought out to terminals in a separate heater terminal box mounted on the motor frame. A prominent warning label "Warning - Circuit May Be Live" shall be provided.
- (g) As an alternate and subject to TECHNIPETROL's approval, anti-condensation heaters will be mounted in the power terminal box provided that segregation is obtained between terminals.

3.4. Windings

- (a) Stator windings of LV motors shall be made of high quality enameled wire with suitable ground and phase insulation.
- (b) The windings shall have their 6 leads accessible in the terminal box to allow star or delta coupling.
- (c) Unless otherwise specified, windings shall be suitable to be connected in delta when the motor is fed in 400V and in star when the motor is fed under 690V.
- (d) After installation of the windings and connection of the coils, the windings shall be fully impregnated to restrict the movement of the coils and to realize adequate heat dissipation. Impregnation by means of submerging the complete stator is preferred. Coating by painting is not recognized as impregnation and is not acceptable.

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- (e) Curing of the insulation material shall be performed at the appropriate elevated temperature. During the curing process the stator should be continuously rolled to avoid voids in the insulation.
- (f) Two speed motors shall have separate windings. Dhalander motor type is not authorized.

3.5. Terminal Boxes

- (a) A terminal box of sturdy construction shall be provided with ample space for connecting the cable(s) as indicated on the requisition/data sheet.
- (b) Unless otherwise stated in the requisition, the terminal boxes shall be located at the top in a way that the cable connection can be made from four sides at 90°.
- (c) Inside the terminal box, an earthing clamp or bolt of adequate dimensions shall be provided for connection of the cable earthing. The earthing facility shall be clearly marked with the appropriate symbol.
- (d) The design of the terminal box shall be such as to prevent small parts from dropping into the motor housing.
- (e) Exd terminal boxes shall have ISO metric threaded entries provided with adequate threaded plug.
- (f) Gland plates to be used for single core cables shall be made of non-magnetic material.
- (g) All the motors shall be equipped with terminal boxes of cast iron or steel.

3.6. Bushings and Terminals

- (a) Terminal marking of the main cable connections and the direction of the rotation shall be in accordance of IEC 60034-8.
- (b) Terminal marking of auxiliary cable connections shall be in accordance with the relevant motor wiring diagrams.
- (c) Terminal blocks should be made of synthetic resin. The use of porcelain is not allowed.
- (d) Terminal connections shall be constructed in such ways that direct contact between screws, bolts or nuts and the conductor is avoided. Connections shall be secured against loosening.

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3.7. Rotor, Fans and Coupling

3.7.1. Rotor

- (a) The shaft shall be made of one-piece, heat-treated steel.
- (b) Welding on finished shafts is not allowed. Shafts and/or spiders subjected to welding shall be post-weld stress relieved.
- (c) Rotors of all motors shall be dynamically balanced at nominal speed with half the key (HK) fitted in the key way(s). The shaft-end should be permanently marked with the indication 'HK'.
- (d) If metal is to be removed to achieve dynamic or static balance it shall be removed in a manner that maintains the structural integrity of the rotor and does not result in harmful or distorted hot spots.
- (e) The direction of the rotor shall be clearly and adequately indicated by mean of an arrow at the non-driving end.

3.7.2. Fans

- (a) The external fan, and if applicable the separately mounted internal fan(s), shall be individually balanced.
- (b) Motors with rated output up to 30 kW are exempt from this requirement.
- (c) External fans shall be keyed to the shaft. For motors with rated output up to 30 kW alternative fixing methods may be considered.
- (d) The external fans shall be of non-corroding material or shall be treated with a corrosion resistant coating.
- (e) The flow of cooling air shall be in the direction of the driven equipment.
- (f) Motors fitted with unidirectional fans shall be provided with an arrow permanently indicating the direction of rotation. Indication by means of a painted or adhesive arrow is not acceptable.

3.7.3. Coupling

The coupling design shall be based on the maximum transient torque that can be expected at the coupling in case of a two or three-phase short-circuit at the motor terminals.

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3.8. Bearings

- (a) Motors shall be equipped with life lubricated bearing. However, for special drives with high radial forces the application of roller bearings or a combination of ball and roller bearings at the drive-end side may be necessary. Re-greasing can be possible and grease relieves valve proposed for large motors to be installed in a high temperature environment.
- (b) Bearings shall be protected to eliminate contamination, loss of lubricant and to prevent intrusion of fine dust and sand particles.
- (c) As far as vertical motors are concerned, the bearing shall withstand the thrusts of both driven machine and motor itself.
- (d) Bearings shall be in metric sizes and comply with ISO 15 and ISO 1132.
- (e) Vertical motors driving direct-coupled pumps shall have the thrust bearing at the non-drive end (NDE).
- (f) The use of angular contact bearings shall be restricted to vertical motors where the bearings have to withstand high axial forces. All rolling element bearings shall have a metallic cage (steel cage is preferred).
- (g) Rotors of motors equipped with roller bearings shall be secured during transport to avoid damage to the bearing(s).

3.9. Plates

- (a) The rating plates shall be made of stainless steel and be fixed to a non-removable part of the frame.
- (b) Information provided on the rating plates shall be in accordance with IEC 60034-1 and ATEX 94/9/EC.
- (c) In addition to those items the following data shall be indicated:
 - Type of enclosure in accordance with I.E.C 60034.5 (IP classification),
 - Bearing and lubrication references,
 - Purchase order number and year of manufacture,
 - Weight.
- (d) The values provided shall be actually measured and shall be based on the specified operating conditions.
- (e) Item plates: All motors shall be provided with a stainless steel item plate separated from rating plate indicating the tag number of the motor.

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- (a) The motors shall have a surface finish that complies with the Vendor's standard for increased protection against corrosion for the climatic conditions specified.
- (b) The paint system shall provide adequate protection against the adverse effects of climate.
- (c) Parts of the motor normally shielded by the fan cover and the inside of the fan cover shall, with respect to corrosion protection, be treated in a similar manner as normally exposed parts.

3.11. Corrosion Protection

Motors shall be equipped with:

- (a) stainless steel screws,
- (b) stainless steel nipple, if any,
- (c) Corrosion resistant drains hole plug, if any.

4. EXPEDITING INSPECTIONS AND TESTS**4.1. Fabrication and Quality Control Plan and Inspections**

- (a) Inspection and testing activities shall be defined by the Manufacturer on the Fabrication and quality control plan based on the minimum requirements established on TECHNIPETROL Inspection and Test Plan ITP 1691.
- (b) During the manufacturing period, the LV induction motors could be subject to inspection by TECHNIPETROL inspectors or by others appointed by TECHNIPETROL or by the CLIENT. Accessory material could be subject to inspection too.
- (c) The Manufacturer shall allow the free access of inspectors to the workshop, shall give all information required and shall make available all copies of internal orders to other sub-suppliers.

4.2. Test Procedure

- (a) The tests shall be carried out in Manufacturer workshop at his care and expense.

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- (b) Even in case TECHNIPETROL or the CLIENT waives to witness the tests the Manufacturer shall draw up the certificate of the tests carried out containing a full report and all the results and the measures of the tests.
- (c) The tests shall be carried out in accordance with the requirements of IEC codes and of the Inspection and Test Plan.