



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 111

Induction motors

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1. Scope

This specification defines the minimum requirements for design, manufacture, inspection and testing of LV and HV fixed speed induction motors. It is to be read in conjunction with the corresponding Project specification and/or data sheets. The MANUFACTURER shall clearly identify in his technical offer any deviation to these specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Design and engineering shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and regulations shall be used
- COMPANY Particular Specifications and data sheet (if any)
- COMPANY General Specifications
- Applicable International Electro-technical Commission (IEC) Standards
- Applicable CENELEC Standards
- Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued.

Standards

Reference	Title
IEC 60034	Rotating electrical machines
IEC 60072	Dimensions and output series for rotating electrical machines
IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60085	Thermal evaluation and classification of electrical insulation
IEC 60279	Measurement of the winding resistance of an a.c. machine during operation at alternating voltage
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
ISO 281	Rolling bearings - Dynamic load ratings and rating life
ISO 2954	Requirements for instruments for measuring vibration severity
ISO 8821	Mechanical vibration - Balancing - Shaft and fitment key convention
ISO 10816	Mechanical vibration - Evaluation of machines vibration by measurements on non-rotating parts

Reference	Title
ISO12944-2	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1: General introduction
ISO 4628-3	Evaluation of paint and varnish defects. Designation of intensity, quantity and size of common types of defect - Part 3: Designation of degree of rusting
EN 50014	Electrical apparatus for potentially explosive atmospheres

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
94/9/EC (ATEX 100a ¹ / ATEX 95 ²)	European Directive 94/09/EC (23/03/94) on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
1999/92/EEC (ATEX 118 ¹ / ATEX 137 ²)	European Directive 1999/92/EEC (16/12/99) on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

¹ Reference to Articles 100/118 of the Treaty of Rome.

² Reference to Articles 95/137 of the Treaty of Amsterdam.

Total General Specifications

Reference	Title
GS COR 350	External protection of offshore and related structures and equipment by painting

3. Environmental conditions

The motors shall be generally installed outdoor and shall be designed to operate in the site conditions of installation as defined in the data sheet.

4. Motors for hazardous area

ATEX European directives 94/9/EC and 1999/92/EEC shall be applied to motors installed in hazardous areas.

For category 3 equipment, certification by Manufacturer is not accepted. A "Statement of compliance" shall be delivered by a Notified Body.

Motors and accessories shall bear their own marking, according to the mode of protection used.

5. Definition of the equipment

5.1 Rated output

The rated output of the motor shall be in accordance with IEC 60072 for motor up to 1000 kW.

5.2 Speed

Preferred synchronous speed is 1500 rpm (50 Hz) or 1800 rpm (60 Hz).

5.3 Service conditions

Unless otherwise specified, motors shall be designed for duty type S1: continuous running duty as defined in IEC 60034-1.

5.4 Enclosures degree of protection

Unless otherwise specified on the data sheet or project specification, motors installed outdoor shall have a degree of protection IP 55 according to IEC 60034-5.

Unless otherwise specified, motors for indoor installation shall have a degree of protection IP 23 according to IEC 60034-5.

When there is a risk of the ingress of particles suspended in the air, the degree of protection IP 23 W shall be specified on the data sheet.

The mechanical shock protection rating shall be at least IK08 (or a shock energy of five joules).

5.5 Rotor

Unless otherwise specified, the MANUFACTURER standard shall be required for LV motor rated up to 200 kW. For LV motors rated from 200 kW and above and HV motors, copper or copper alloy cages shall be specified.

In corrosive atmosphere, rotor shall be protected against corrosion by an appropriate treatment.

5.6 Insulation class

HV motors insulation shall be class "F", provided by vacuum pressure Impregnation process.

LV motors insulation shall be insulation "H" or "F", according to MANUFACTURER standard.

Temperature rise class Temperature rise shall be class "B" when insulation class is "F" and "F" when insulation class is "H".

Temperature rise at rated power must remain below the values defined by clause 16 of [IEC 60034-1](#), with no tolerance for voltage values between 0.9 and 1.1 rated voltage inclusive.

LV motors rated from 200kW and above and HV motors shall be fitted with thermal probes mounted at the hottest points of the windings (two groups of three PT100 type probes), and with a temperature probe for each bearing.

5.7 Starting conditions

5.7.1 Starting current

Unless otherwise specified in the datasheet, the starting current shall be :

$SC/FLC \leq 6.5$ for LV motors (tolerance of 20 % according to [IEC 60034-1](#))

$SC/FLC \leq 5$ for HV motors (including the tolerance of 20 %)

5.7.2 Starting frequency

Unless otherwise specified, motors shall be designed for heavy duty 3000 starts/year

All motors must be able to withstand at least :

3 consecutive starts at 80% U_n with load inertia according to [IEC 60034-12](#)

2 hot successive starts at full load temperature

3 cold successive starts at maximum ambient temperature.

The interval between two sets of N attempts of starting shall not exceed one hour.

5.7.3 Re-acceleration

When required in the data sheet motors must be able to re-accelerate after a 30% - 0.3 s voltage dip.

5.8 Noise levels

Unless otherwise specified, the noise level limit shall as defined according [IEC 60034-9](#). The MANUFACTURER will have to confirm if this value is easily achievable with standard equipment.

5.9 Humidity protection

Motors shall be designed to operate properly in the environmental and climatic conditions defined in the data sheet or in the related project particular specification.

For motors rated 22 kW and above, a space heater shall be used. It shall be of a fully insulated design and suitable for 230 VAC supply, unless otherwise specified.

For HV motors, the connecting leads shall be brought out to terminals in a separate terminal box mounted on the machine frame.

5.10 Cooling

Unless otherwise specified, motors shall be air-to-air cooled. In case this cannot be possible, the cooling mode shall be defined with the MANUFACTURER.

In case of air-to-air exchanger, tubes shall be made of corrosion resistant material suitable for the environmental conditions.

In case of sea water exchanger, tubes shall be double tubes made of corrosion resistant material. Fins, end plates and shells must be made of corrosion resistant material too. Cooling water leakage detection shall be provided.

The motor's MANUFACTURER will specify accurately in his offer the material composition used for each component.

5.11 Bearings

5.11.1 General

Machines installed on structure subject to vibration shall be fitted with pre-load bearings.

- For motors rated 500 kW and above:
 - A measuring point shall be provided for the use of an accelerometer, an eddy current probe or a special winding monitoring device.
- For motors rated 1000 kW and above:
 - Unless otherwise specified, bearings shall be of lubricated sleeve types. They shall be either oil flooded, oil injected, or oil ring lubricated.

For large machines, tilting pad bearings may be used.

The type of the oil shall be the same for the all shaft line.

5.11.2 Bearing currents

For the motors rated 690V and above, the MANUFACTURER shall use all possible technical and durable means to cancel out bearing currents that are liable to affect the life of the motor and of the driven machine.

The non-drive-end bearing shall be fully insulated from the frame to prevent the flow of shaft currents. This bearing shall be adequately labelled to indicate the presence of insulation. Shaft earthing shall be via the drive-end bearing.

5.12 Mechanical vibration and balancing

When required by project specification vibration probes shall be installed on each bearing:

- Proximity probes (X,Y) for sleeve bearings
- Accelerometers for ball and roller bearings.

The maximum vibration level shall remain within the tolerances of the standard [ISO 10816-3](#).

The following maximum levels of vibration shall apply for all motors when rigid mounted (installed on driven equipment skid) from no load to full load conditions :

- HV motors: 60 μm peak to peak **including run-out** and 3 mm/s RMS measured on bearing housing in any direction.
- LV motor : 4 mm/s RMS measured on bearing housing in any direction.

These values are global unfiltered values.

On request, the MANUFACTURER shall specify the maximum vibration level that the machine can withstand without risk of deterioration, whatever the cause of the vibration and the installation conditions to ensure this level.

5.13 Shafts and shaft ends

These shall be of standard dimensions.

The particular stresses (axial, radial and torsional) to which the motor shaft may be subject shall be specified on the data sheet.

5.14 Shaft lines

For large power motors, the driven machine SUPPLIER shall draw up shaft line calculations (calculating critical torsional speed and critical deflection speed; dynamic analysis of rotor oscillation according to unbalances to be specified during the study).

Where appropriate, the SUPPLIER shall ensure that the total moment of inertia will not compromise the specified degree of irregularity, and that the simple current variations do not under any circumstances exceed I rated $\pm 30\%$.

5.15 Frame and terminal boxes

Unless otherwise indicated, the MANUFACTURER standard shall be adopted (aluminium and aluminium alloys are prohibited for offshore application).

If a terminal box of steel plate no more than 3 mm thick is used, stainless steel 316L shall be required for corrosion resistance.

Power terminal box shall be sized according to connection constraints (cable type Cu or Al, cross-section, bending radius, lug size, etc.).

For HV cables, clamping devices to withstand short circuit currents shall be provided within the main terminal box for cable connections, to separate and support the conductors.

Non magnetic gland plates shall be provided for single core cables.

For LV motors, the power terminal box must be adjustable for connection from any one of four directions. For the other machines the terminal box shall be located on the side, cable entering from below unless otherwise specified.

The auxiliary circuits (temperature probes, speed and vibration detector, etc.) shall be connected at terminals in one or more auxiliaries terminal boxes associated with the motor.

The stator connections shall be marked in accordance with the IEC standard.

5.16 General requirements related to EEx"p" design

An automatic leakage compensation unit shall be supplied by the motor MANUFACTURER and shall ensure the necessary purging cycle prior to the motor start and maintain the minimum required pressurisation during motor operation.

No external power supply shall be required. All the controls shall be performed from the Instrument Air supplied by others.

All hardware shall be preferably mounted on the motor pressure control cabinet

Any pressure decrease under a pre-set threshold (1mbar for example) shall initiate immediate equipment shut down and shall be signalled remotely to the Process Control System.

6. Painting

Painting system shall be suitable for the site environmental conditions. The Coating shall comply with COMPANY General Specification **GS COR 350** requirements. The MANUFACTURER may submit his coating system for protection against external corrosion for COMPANY approval.

Proposed coating must be suitable for the category of corrosion defined for the site of installation as per [ISO 12944-2](#), and shall provide a warranty of 5 years - with a rusting degree Ri = 2.

Atmospheric category of corrosivity of site of installation shall be defined on the data sheet:

Category	Description
C1	Very low corrosive atmosphere
C2	Low corrosive atmosphere
C3	Fairly corrosive atmosphere
C4	Highly corrosive atmosphere
C5-I	Atmosphere of very high corrosivity level (Industrial)
C5-M	Atmosphere of very high corrosivity level (marine) – Coastal , Offshore areas

Colour shall be of MANUFACTURER's standard, unless otherwise specified in the project specification.

7. Tests

7.1 Factory tests

7.1.1 Routine tests

These shall be carried out on all machines ordered.

A test certificate shall be supplied for each machine.

7.1.2 Full set tests

These may be performed for one or all of the machines.

When carried out for just one machine, the customer or his representative shall choose the machine.

These tests shall comply with [IEC 60034](#) and shall be listed in the data sheet.

7.2 On-site tests

Tests may be carried out on site, subject to agreement with the MANUFACTURER.

8. Documentation

As a minimum and unless defined in a project particular specification, the following drawings and documentation shall be supplied in a timely manner according to the specified schedule:

- Motor overall arrangements
- Completed Data sheet
- Foundation guide details if required
- Arrangement details of auxiliary equipment
- Layout of connection boxes
- Wiring and termination diagrams
- Operation and maintenance manuals
- Type test report if required
- FAT report
- Type examination certificates delivered by notified bodies.