International Association of Oil & Gas Producers

SPECIFICATION

IOGP S-703J

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Version 2.0

Supplementary Specification to IEC 60034-1 for Low-voltage Three-phase Cage Induction Motors

NOTE This version (S-703J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-703.

JIP33 JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
2.0	July 2025	Second Edition
1.0	March 2020	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

This second edition cancels and replaces the first edition published in March 2020. Due to technical writing requirements leading to extensive changes, this second edition should be treated as a new document.

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Introduction

The purpose of the IOGP S-703 specification documents is to define a minimum common set of requirements for the procurement of low-voltage three-phase cage induction motors in accordance with IEC 60034-1, Edition 14.0, 2022, Rotating electrical machines – Part 1: Rating and performance, for application in the petroleum and natural gas industries.

The IOGP S-703 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-703: Supplementary Specification to IEC 60034-1 for Low-voltage Three-phase Cage Induction Motors

This specification defines technical requirements for the supply of the equipment and is written as an overlay to IEC 60034-1, following the IEC 60034-1 clause structure. Clauses from IEC 60034-1 not amended by this specification apply as written. Modifications to IEC 60034-1 defined in this specification are introduced by a description that includes the type of modification (i.e. *Add*, *Replace* or *Delete*) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-703D: Procurement Data Sheet for Low-voltage Three-phase Cage Induction Motors (IEC)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-703L: Information Requirements for Low-voltage Three-phase Cage Induction Motors (IEC)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-703Q: Quality Requirements for Low-voltage Three-phase Cage Induction Motors (IEC)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the PDS or in the purchase order.

The specification documents follow the editorial format of IEC 60034-1 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) IEC 60034-1.

1 Scope

Add new subclause

1.1 Motors included in scope

The scope of this specification includes the following types of electric motors:

– with a wire-wound AC squirrel cage induction type;

– with a rated voltage above 50 V up to and including 1 kV AC;

– with a rated power from 0,12 kW to 500 kW;

– with air cooling;

– suitable for hazardous and non-hazardous area environments;

– for single-speed, converter duty or converter capable applications;

– with close-coupled pumps.

In this specification, the requirements for converter duty applications are also applicable to converter capable applications.

Justification

This subclause indicates the change in scope in comparison with IEC 60034-1. It aligns with the scope of this specification as defined by the work group in the statement of intent.

Add new subclause

1.2 Motors excluded from scope

The scope of this specification excludes the following types of electric motors:

– rated at a voltage exceeding 1 kV AC;

– form-wound squirrel cage;

– fitted with sleeve bearings;

– submersible, subsea, canned or hermetically sealed;

– DC motors;

– single phase;

– synchronous;

– with operated valve actuators.

Justification

This subclause indicates the change in scope in comparison with IEC 60034-1. It aligns with the scope of specification as defined by the work group in the statement of intent.

Add new subclause

1.3 Extended use of this specification

This specification may be used as a basis for the purchase of electric motors that are outside the immediate scope of this specification. The extended use of this specification based on similar construction and cooling methods may include the following:

– motors with a rated power above 500 kW;

– reluctance motors;

– permanent magnet motors;

– induction generators;

– two-speed motors.

The requirements that are outside the scope of this specification are subject to agreement between the purchaser and the manufacturer.

Justification

This subclause indicates equipment, outside the scope of this specification but relevant on account of similar construction and cooling method, that can be used as a basis for procurement with changes as required agreed between the purchaser and the manufacturer.

2 Normative references

Add to first paragraph

The following documents are referred to in this specification, the PDS (IOGP S-703D) or the IRS (IOGP S-703L) in such a way that some or all of their content constitutes requirements of these specification documents.

Add to clause

IEC 60034-2-1:2024, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-7, *Rotating electrical machines – Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)*

IEC 60034-14:2018, *Rotating electrical machines – Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of vibration severity*

IEC TS 60034-25:2022, *Rotating electrical machines – Part 25: AC electrical machines used in power drive systems – Application guide*

IEC 60072-1:2022, *Dimensions and output series for rotating electrical machines – Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60423:2007, *Conduit systems for cable management – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

IEC 61000-2-4:2002 , *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61800-2:2021, *Adjustable speed electrical power drive systems – Part 2: General requirements – Rating specifications for low voltage adjustable speed a.c. power drive systems*

IEEE 519:2014 , *IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems*

ISO 15, *Rolling bearings — Radial bearings — Boundary dimensions, general plan.*

ISO 281, *Rolling bearings — Dynamic load ratings and rating life*

ISO 492, *Rolling bearings - Radial bearings — Geometrical product specifications (GPS) and tolerance values*

ISO 1680, *Acoustics — Test code for the measurement of airborne noise emitted by rotating electrical machines*

ISO 5753-1:2009, *Rolling bearings — Internal clearance — Part 1: Radial internal clearance for radial bearings*

ISO 12944-1:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO 21940-11:2016 including AMD1:2022, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*

ISO 21940-32, *Mechanical vibration — Rotor balancing — Part 32: Shaft and fitment key convention*

Delete from clause

IEC TS 60034-25:2014, *Rotating electrical machines – Part 25: AC electrical machines used in power drive systems – Application guide*

Replace Clause 3 title with

3 Terms, definitions and abbreviated terms

Add new subclause 3.0 to start of clause

3.0 Abbreviated terms

CAS conformity assessment system

Ex explosive atmosphere

GRP * glass reinforced plastic

HSE * health, safety and environment

IRS information requirements specification

PDS procurement data sheet

PTC positive temperature coefficient

QRS quality requirements specification

TEFC * totally enclosed fan cooled

TRS technical requirements specification

* Cited in IOGP S-703J only.

Add new term 3.38

3.38
maximum continuous operating speed
highest rotational speed at which the motor, as-built and tested, is defined for continuous operation, expressed as revolutions per minute [min^{-1}]

Add new term 3.39

3.39
minimum continuous operating speed
lowest rotational speed at which the motor, as-built and tested, is defined for continuous operation, expressed as revolutions per minute [min^{-1}]

4 Duty

4.2 Duty types

4.2.9 Duty type S9 – Duty with non-periodic load and speed variations

In second sentence of fourth paragraph, replace "IEC TS 60034-25:2014" with

IEC TS 60034-25:2022

Justification

Edition 4.0 (2022) supersedes Edition 3.0 (2014).

4.2.10 Duty type S10 – Duty with discrete constant loads and speeds

In second sentence of last paragraph, replace "IEC TS 60034-25:2014" with

IEC TS 60034-25:2022

Justification

Edition 4.0 (2022) supersedes Edition 3.0 (2014).

5 Rating

5.5 Rated output

5.5.2 AC generators

In first paragraph, replace "volt-amperes (VA)" with

kilovolt-amperes (kVA)

Justification

The low-voltage generator (induction generator) power rating is expressed in kVA, which is consistent with supplier catalogues, international standards and industry practices.

5.5.3 Motors

Replace "watts (W)" with

kilowatts (kW)

Justification

The low-voltage motor power rating is expressed in kW, which is consistent with supplier catalogues, international standards and industry practices.

5.6 Rated voltage

5.6.2 AC generators

Replace "7.3" with

7.4

Justification

This incorrect reference is a carryover from the previous edition where the reference was to subclause 7.3 which in the current edition is subclause 7.4. This is understood to be a typographical error.

5.8 Machines with more than one rating

In second sentence of last paragraph, replace "7.3" with

7.4

Justification

This incorrect reference is a carryover from the previous edition where the reference was to subclause 7.3 which in the current edition is subclause 7.4. This is understood to be a typographical error.

Add new subclause

5.9 Efficiency

5.9.1

Duty type S1 motors for single-speed use shall have a minimum rated efficiency class of IE3 in accordance with IEC 60034-30-1.

Justification

Defining minimum efficiency requirements demonstrates the JIP33's intent to reduce carbon emissions and capitalizes on new technologies to ensure that environmental considerations have been addressed. IEC 60034-30-1 defines IE3 (international efficiency standard) as premium efficiency for low-voltage motors.

5.9.2

Converter duty motors shall have a minimum rated efficiency class of IE2 in accordance with IEC TS 60034-30-2.

Justification

Defining minimum efficiency requirements demonstrates the JIP33's intent to reduce carbon emissions and capitalizes on new technologies to ensure environmental considerations have been addressed. IEC 60034-30-1 defines IE3 (international efficiency standard) as premium efficiency for low-voltage motors. As a standard offering, manufacturers typically offer a minimum efficiency of IE2 for converter duty machines. However, when the machine is integrated into a power drive system optimized for the application, the user can benefit from a system that is much more efficient.

6 Site conditions

Add new subclause

6.8 Degree of ingress protection

The minimum degree of ingress protection for the machine shall be as specified in Table 23 and in accordance with IEC 60034-5.

Justification

The degree of ingress protection for motors is governed by the location of installation and the environmental conditions to which the motors are exposed, such as "indoor", "outdoor – onshore" and "outdoor – offshore (fixed/floating)". IEC 60034-5 adequately covers the protections taken against respective environmental conditions.

Add new Table 23

Table 23 – Minimum degree of ingress protection based on the location of the installation

Installation environment	Minimum degree of ingress protection	
	Motor	Terminal box
Indoor	IP55	IP55
Outdoor – onshore	IP55	IP55
Outdoor – coastal / offshore / open deck	IP56	IP56

Justification

Table 23 lists the minimum degree of protection used in the industry based on the location of installation of the motor. The individual parts on the motor such as terminal box and bearing housing can have a higher degree of protection as required.

7 Electrical operating conditions

7.1 Electrical supply

Delete "or as otherwise agreed between the user and the manufacturer" and replace "should be suitable for" with

shall be a minimum of

Justification

This requirement ensures that voltage source converter-fed motors exposed to fast switching transients use stringent IVIC and are specific.

Delete "or as otherwise agreed between the user and the manufacturer" and replace "should be suitable for" with

shall be a minimum of

Justification

This requirement ensures that voltage source converter-fed motors exposed to fast switching transients use stringent IVIC and are specific.

8 Thermal performance and tests

8.1 Thermal class

Replace first paragraph with

The motor insulation system shall be minimum thermal class 155 (F) without exceeding thermal class 130 (B) temperature rise for the motor rated output at the maximum reference coolant temperature.

Justification

Insulation system class F, class B temperature rise is an industry-recognized cost-effective specification facilitating increased motor life by improved winding insulation quality. This insulation specification is acknowledged by manufacturers as the most commonly requested for industrial motors. Therefore, it is compliant with the minimum specification philosophy of JIP33. The use of class F insulation with class B temperature rise gives products a safety margin of 25 °C, allowing a lifetime longer than 20 000 h and aligning with ANSI/NEMA MG1. This can be exploited to increase the loading of the machine for limited periods to operate at higher ambient temperatures or altitudes, or with greater voltage and frequency tolerances. It can also be exploited to extend insulation life. Manufacturers qualify insulation systems by means of functional tests as defined in IEC 60034-18-1:2022, 4.5.

Add to first paragraph

For converter duty motors, the motor insulation system shall be thermal class 155 (F) without exceeding thermal class 130 (B) temperature rise within the operating load envelope at the maximum reference coolant temperature.

Justification

This requirement defines the performance standard, for converter duty motors, which is commonly used throughout the industry, however IEC 60034-1 does not provide a performance requirement on temperature rise limits for converter duty motors. Manufacturers qualify insulation systems by means of functional tests as defined in IEC 60034-18-1:2022, 4.5.

8.6 Determination of winding temperature

8.6.1 Choice of method

Replace first paragraph with

Motor winding temperature shall be measured using the resistance method defined in 8.5.2 and 8.6.2.3.3.

Justification

For low-voltage machines, removal of the ETD and thermometer method of measurement of winding temperature leaves the user with the resistance method only. This is the preferred method since it provides an average reading taken over the entire winding, as opposed to only taking the reading at specific locations using the ETD and thermometer methods.

Delete third paragraph

Justification

For low-voltage machines, removal of the ETD method of measurement of winding temperature leaves the user with the resistance method only. This is the preferred method by operating companies, and subject matter experts agreed to have a consistent method for determination of the winding temperature (i.e. the resistance method) across the rating covered in the scope of this specification. The deletion of this paragraph removes the optionality provided to the manufacturer.

8.6.2 Determination by resistance method

8.6.2.3 Correction for stopping time

8.6.2.3.2 Short stopping time

Replace subclause with

The short stopping time shall be determined by the following steps.

a) Obtain the initial resistance reading after stabilization of the measuring device and within 120 s of switching off power.

b) Take additional readings at 30 s intervals over a period of 5 min following the first reading.

c) Calculate the resistance value at the time of switching off power by means of extrapolation.

d) Use the resistance value at the time of switching off power to confirm the winding temperature.

e) Measure the resistance between the same windings for all readings.

Justification

This paragraph and Table 6 in IEC 60034-1 leave room for inconsistency as the temperature value is accepted when measured within time delay in Table 6. The inconsistent results are due to a drop in the winding temperature between 5 K and 10 K when measured or extrapolated within 120 s after shut-down as compared to the value extrapolated to t = 0. The steps in this paragraph replacement standardize the procedure for measurement of winding resistance across suppliers and entire product range. This procedure makes the measurements comparable and accurate. Hence, this paragraph has been replaced and Table 6 has been deleted. This requirement aligns with IEC 60034-2-1:2024, 5.7.1, paragraph 5 for extrapolation to measure winding resistance at t = 0.

Table 6 – Time interval

Delete Table 6

Justification

The steps stated in this subclause of IEC 60034-1 leave room for inconsistency as the temperature value is accepted when measured within time delay in this table. The inconsistent results are due to a drop in the winding temperature between 5 K and 10 K when measured or extrapolated within 120 s after shut-down as compared to the value extrapolated to t = 0. However, IEC 60034-2-1:2024, 5.7.1, paragraph 5 states a procedure which is revised to ensure extrapolation to measure winding resistance at t = 0. The steps in paragraph 1 of this subclause standardize the procedure for measurement of winding resistance across suppliers and entire product range. This procedure makes the measurements comparable and accurate. Hence, this paragraph has been replaced and Table 6 has been deleted.

8.6.2.3.3 Extended stopping time

Delete subclause 8.6.2.3.3

9 Other performance and tests

9.2 Withstand voltage test

In eighth paragraph, replace "7.3" with

7.4

Justification

This incorrect reference is a carryover from the previous edition where the reference was to subclause 7.3 which in the current edition is subclause 7.4. This is understood to be a typographical error.

10 Information requirements

10.3 Rating plate

Replace first sentence of first paragraph with

Rating and marking plates shall be made of 316L stainless steel.

Justification

Stainless steel rating plates are a readily available standard offering and a proven solution to issues experienced using other methods. For example, industry experience shows that illegibility due to other types of marking plates causes problems such as delayed troubleshooting.

Replace second sentence of first paragraph with

The information included on rating and marking plates shall be stamped or engraved.

Justification

This is a common user requirement to prevent machine information from getting lost over time due to wear and tear. This is a tried, tested and proven industry practice which ensures that the information remains attached to the equipment during its operational life. Although this information is also made available in other associated documents of the equipment, the relevant information is available with the equipment. This requirement is included in most operator specifications but not stated in IEC 60034-1.

In first sentence of second paragraph, replace "The rating plate(s) shall preferably be mounted on the frame of the machine" with

The rating and marking plates shall be attached to a non-removable part of the motor frame with stainless steel 316L fasteners

Justification

As per 10.3, first sentence of first paragraph, this requirement ensures that the fasteners are of the same durability as the rating plate. By ensuring that the rating and marking plates are attached to a non-removable part, there is no chance of the part being mistakenly reattached to a different unit or misplaced during maintenance or breakdown activities.

10.4 Information content

10.4.1 General

In first sentence of first paragraph, replace "10.4.5" with

10.4.6

Justification

Subclause 10.4.6, named "Optional information" in IEC 60034-1, has been renamed "Additional information" in this specification and the list of items included in this subclause has now been added to the list of information to be provided as applicable (i.e. to the list of items subject to the requirement in 10.4.1). It is necessary to include information related to the cooling method, converter capability, torque capability, IVIC level and rated power factor on the rating plate specifically as these are more critical machines. Bearing and bearing lubrication information is required for bearing replacement on site. This is beneficial on the nameplate when maintenance is being performed on site as there is no need to look for the documentation. The mixing of lubricants can damage a bearing.

Delete third sentence of first paragraph

Justification

The list items in 10.4.6 are optional in IEC 60034-1 and have been made additional in this specification. Hence, this requirement is now redundant and has been deleted.

In first sentence of second paragraph, replace "jj)" with

kk)

Justification

This replacement results from the addition of new list item kk) in 10.4.6.

10.4.2 Minimum information requirements

Replace list item k) with

k) The total mass of the motor, if exceeding 25 kg.

Justification

This replacement provides the total mass of the motor for lifting operations and the assessment of the equipment/effort for lifting.

Replace subclause 10.4.6 title with

10.4.6 Additional information

Replace list item gg) with

gg) The types of the bearings, bearing sizes, bearing insulation, type of lubricant, lubrication interval and quantity of lubricant, as applicable.

Justification

This information on bearings is beneficial for maintenance staff during predictive/preventive maintenance activities and provides a means for instant and reliable verification while at site without the need for equipment documentation.

Add new list item kk)

kk) For motors used in hazardous areas, the equipment marking on the nameplate applied to Ex equipment and/or Ex components in accordance with IEC 60079 (all parts).

Justification

By marking the equipment in accordance with IEC 60079 (all parts), the manufacturer confirms that the equipment/components are manufactured, successfully tested and certified for use in accordance with the applicable requirements of the relevant standards.

11 Miscellaneous requirements

11.1 Protective earthing of machines

Replace second sentence of third paragraph with

Motors with frame size 71 and above shall have an ISO metric thread earthing terminal fitted externally on the frame body.

Justification

This requirement ensures that an external earth terminal is fitted on all machines, regardless of size. Industry requirements often dictate that an external earth terminal is required since the reliance on circuit protective conductor or braiding to provide direct connection to the earthing system results in unacceptable earth loop impedance values. Research confirms that though an external earth terminal is more often a standard offering from manufacturers, the requirement of an external earth terminal is stated to ensure that instances do not occur where such terminal is required, but not provided. Motors with frame size 71 and above address ratings 0.37 kW and above which covers almost the entire range of low-voltage motors.

Add to third paragraph

The earthing terminal shall be permanently marked with the symbol  (IEC 60417-5019) to indicate protective earth.

Justification

This requirement is in line with the identification of components on the equipment in accordance with IEC 60417. The marking highlights the purpose of the component and prompts to leave clear access for termination/connection at site.

Add new subclause

11.3 Performance criteria

11.3.1 Single-speed motor starting, re-starting and re-acceleration

11.3.1.1

The motor shall start direct-on-line and accelerate with the rated load at 80 % of the rated voltage applied at the motor terminals.

Justification

The 80 % value allows for upstream system deviations and voltage drop in conductors from the point of supply to the motor location typically incurred in the oil and gas industry. The 80 % value is particularly prevalent in island networks.

11.3.1.2

The motor shall be designed for direct-on-line starting across full line voltage in accordance with Table 24.

Justification

When a motor is subjected to frequent starting, it cannot be loaded at its rated output because of thermal starting losses in the windings. Table 24 establishes the minimum requirements to ensure consistency for these parameters across the industry. These parameters are well established and compliance to these is already the norm.

Add new Table 24

Table 24 – Number of re-starts of motors

Starting condition	Status	Minimum number of consecutive starts [a] per hour
With the initial temperature at or below the maximum ambient temperature	Cold	3
With the initial temperature above the maximum ambient temperature but not exceeding the maximum rated operating temperature	Hot	2
[a] The motor should coast to rest between consecutive starts.		

Justification

When a motor is subjected to frequent starting, it cannot be loaded at its rated output because of thermal starting losses in the windings. Minimum requirements are specified to ensure consistency for these parameters across the industry. These parameters are the current industry standard and compliance to these is already the norm. The values in the table are the current industry norm.

11.3.1.3

Where re-acceleration is required, if power to the motor is interrupted for a duration not exceeding 0,2 s, the motor shall re-accelerate with the full residual voltage in total phase opposition to the supply voltage.

Justification

A power interruption to the motor initiates a decay of the motor flux as per the time constant. The frequency of the residual voltage is proportional to the speed of the motor. Since the duration of 0,2 s is brief, the flux decay is minimal and the residual voltage will also be full. A power supply restoration with a phase difference of 180 degrees (total phase opposition) has the potential to cause severe mechanical stress (electrodynamic shock) to the winding and damage to the shaft, mounting base and foundation. When re-acceleration is required by the purchaser, this requirement ensures that the manufacturer is aware that the motor is subjected to this situation during operation. Accordingly, the manufacturer ensures that the motor frame, shaft and active iron core systems withstand the mechanical stresses developed on power restoration without damage.

11.3.2 Noise

Noise measurements shall be in accordance with ISO 1680.

Justification

ISO 1680 is the recognized reference for noise measurement by most manufacturers and for noise requirements in the oil and gas industry. This requirement ensures consistency going forward, especially with new manufacturers.

Add new subclause

11.4 Design criteria

11.4.1 General

11.4.1.1

The motor shall be designed and constructed for a minimum service life of 25 years excluding parts subjected to wear and tear.

Justification

The motor is expected to provide a minimum useful service life of 25 years in the specified environmental conditions. However, the expectation of minimum useful service life considers that the manufacturer's recommended maintenance activities are performed as per the maintenance plan. High-value assets such as the motor include an expected service life as part of the asset integrity plan.

11.4.1.2

The motor shall be designed for continuous operation of at least six years.

Justification

Operating companies may have a turnaround period ranging from four to six years and motors are expected to operate without interruption for this duration. Major scheduled maintenance is an activity that is performed during the turnaround time that further extends the period of operation and provides an expected service life of 25 years. However, sealed rolling element bearings may need replacement as per the supplier's recommendations to ensure the expected service life of the motor.

11.4.2 Enclosure design

11.4.2.1 General

11.4.2.1.1

Where a motor has a frame size 160 and above, while the motor is mounted in the designated orientation, the motor shall have a drain hole fitted with a specified removable plug at the lowest point.

Justification

Non Ex-db motors being totally enclosed machines heat up during running and the air inside the motor expands. Upon stopping, the air inside the motor cools down and the air volume decreases. The volume increases and decreases depending on the temperature difference to the ambient air. When the motor cools down, it sucks in particles and humidity that can damage the bearing and insulation. The advantage of drain holes is that they prevent ventilation through bearings and terminal box, and provide an alternate path. The review of standard manufacturer offerings shows that machines with a frame size 160 and below are not offered in many cases.

NOTE Ex-db motors are exempted from this requirement.

11.4.2.1.2

Drain plugs shall be accessible with the motor installed in service position.

Justification

This requirement facilitates maintenance activities associated with draining the motor without dismantling any of the parts or components. In some cases, this can require removal of the coupling guard for ease of access.

11.4.2.2 Mounting

11.4.2.2.1

The motor mounting arrangement shall be in accordance with IEC 60034-7.

Justification

The reference to IEC 60034-7 is for the most commonly used mounting methods across suppliers and in industry-wide applications. This requirement standardizes the definition of mounting and provision for installation on the baseplate for driven equipment. It also ensures that motors can be replaced and upgraded. The choice of mounting is as per application / driven equipment specifications and manufacturers' design needs.

11.4.2.2.2

Vertically mounted motors with a downward facing drive end shaft shall be provided with a canopy shielding the upward facing air inlets.

Justification

This requirement ensures that the possibility of water/fluid ingress from around the motor shaft area is fully addressed when motors are vertically mounted and air inlets are upward facing. The canopy (rain cap) fitted over the fan cowl / air inlets of motors mounted with the shaft vertically down prevents rainwater or any sprayed water/fluid from reaching the area near the motor shaft, thereby preventing the water/fluid from following the minor clearance around the motor shaft into the motor. A seepage of water/fluid causes failure of the part (bearing, winding, etc.) that gets exposed to water/fluid.

11.4.2.2.3

Vertically mounted motors with an upward facing drive end shaft shall be provided with a seal in addition to the bearing seal and/or shaft-mounted water flinger to prevent water/fluid ingress through the drive end bearing.

Justification

This requirement ensures that the possibility of water/fluid ingress from around the motor shaft area is fully addressed when motors are vertically mounted and the shaft is facing upwards. The seal / water flinger (water deflector) fitted over the drive end shaft of motors mounted with the shaft vertically up prevents rainwater or any sprayed water/fluid from reaching the area near the motor shaft, thereby preventing the water/fluid from following the minor clearance around the motor shaft into the motor. A seepage of water/fluid causes failure of the part (bearing, winding, etc.) that gets exposed to water/fluid. This requirement addresses operating company experiences where water has accumulated on the face of the upward facing bearing and has over time prematurely deteriorated the bearing seal, causing failure and subsequent interruption of service.

11.4.2.3 Frame

11.4.2.3.1

Frame numbers and fixing dimensions shall be in accordance with IEC 60072-1.

Justification

This requirement reduces variants and ensures that any motor outside of the scope of IEC 60072-1 is assessed by the purchaser to ensure that it is acceptable prior to order placement. Any design outside of the scope of IEC 60072-1 is likely to be unproven and/or can have characteristics or features for which the purchaser requires more information before order placement.

11.4.2.3.2

The motor frame shall be provided with lifting lugs or lifting eyebolts.

Justification

This requirement facilitates safe lifting for installation, removal and refitting of the equipment and heavier frame-mounted add-on assemblies including terminal boxes and terminal box covers. Without this requirement, non-compliance with health, safety and environment (HSE) rules followed in the industry can happen.

NOTE Removal of lifting lugs or lifting eyebolts retains the degree of ingress protection of the motor.

Justification

This note clarifies that the degree of ingress protection is not compromised by providing lifting means, especially in smaller frame size motors which have less frame thickness.

11.4.2.3.3

Frame, stator end-shield and bearing housing of the motor shall be constructed from cast iron.

Justification

Frame end-shields and housings are constructed from cast iron as this material is non-corrosive, non-hygroscopic and non-carcinogenic. The terms non-corrosive, non-hygroscopic and non-carcinogenic are considered non-conclusive, however specifying cast iron is as per existing offering from manufacturers. This requirement necessarily excludes other offerings.

11.4.2.3.4

Where a corrosivity category of C4 or greater is specified, the selection of hardware material used on the frame shall be in accordance with Table 25.

Justification

ISO has defined six corrosivity categories (i.e. C1 - very low, C2 - low, C3 - medium, C4 - high, C5 - very high, CX - extreme) based on a one-year corrosion mass loss or penetration of steel, zinc, copper and aluminium coupons. Environmental conditions contribute directly to the occurrence of corrosion and are therefore accounted for in this specification. The effects of corrosion and the rate at which they occur are consequences of the choice of material, exposure to environmental conditions (both severity and duration) and operational conditions. Where a category greater than C3 is specified, the selection of hardware is done in accordance with these environmental conditions to meet the life cycle requirements. This requirement ensures that the equipment can withstand the environmental conditions and meet the life cycle requirement. Table 25 compiles a preferred selection of readily available material accepted by the oil and gas operating companies for corrosivity category of C4 or greater.

Add new Table 25

1Table 25 – Selection criteria for hardware used on frame

Hardware type	Hardware material
External screws, bolts, nuts and washers of a thread diameter less than or equal to 10 mm	316L stainless steel
External screws, bolts, nuts and washers of a thread diameter greater than 10 mm	Hot-dip galvanized
Grease nipples	316L stainless steel

Justification

ISO has defined six corrosivity categories (i.e. C1 - very low, C2 - low, C3 - medium, C4 - high, C5 - very high, CX - extreme) based on one-year corrosion mass loss or penetration of steel, zinc, copper and aluminium coupons. Environmental conditions contribute directly to the occurrence of corrosion. The effects of corrosion and the rate at which they occur are consequences of the choice of material, exposure to environmental conditions (both severity and duration), and operational conditions. This table considers environmental factors in the selection of hardware in order to meet the life cycle requirements. It also compiles a preferred selection of readily available material accepted by the oil and gas operating companies for corrosivity category of C4 or greater.

11.4.2.3.5

Motor frame components and add-on assemblies heavier than 25 kg, inclusive of terminal box covers, shall be provided with lifting provisions.

Justification

This requirement facilitates safe lifting for installation, removal and refitting of the equipment and heavier frame components, add-on assemblies including terminal boxes and terminal box covers. Without this requirement, non-compliance with HSE rules followed in the industry can happen.

11.4.2.4 Surface finish

11.4.2.4.1

For onshore applications, the protective paint system corrosivity category shall be at least C3 in accordance with ISO 12944-2.

Justification

This requirement specifies the surface finish in relation to the environmental conditions in which the motor is located and drives standardization among operating companies. Therefore, it allows the purchaser to specify environmental conditions from the listed categories in accordance with ISO 12944-2 in the PDS for the selection of the appropriate protective paint system. ISO 12944-2 defines corrosivity categories and these definitions align with several manufacturer options. C3 as the default choice for onshore applications in the PDS sets the essential minimum requirement for the equipment across suppliers.

11.4.2.4.2

For offshore exterior applications, the protective paint system corrosivity category shall be CX in accordance with ISO 12944-2.

Justification

This requirement specifies the surface finish in relation to the environmental conditions in which the motor is located and drives standardization among operating companies. Therefore, it allows the purchaser to specify environmental conditions from the listed categories in accordance with ISO 12944-2 in the PDS for the selection of the appropriate protective paint system. ISO 12944-2 defines corrosivity categories and these definitions align with several manufacturer's options. C3 as the default choice for onshore applications and CX as the default choice for offshore exterior applications in the PDS sets the essential minimum requirement for the equipment across suppliers. A higher option is selectable depending on environmental conditions. CX for offshore is aligned with IOGP S-715.

11.4.2.4.3

The protective paint system durability category shall be at least “medium” in accordance with ISO 12944-1 for all locations.

Justification

This requirement specifies the surface finish in relation to the environmental conditions in which the motor is located and drives standardization among operating companies. Therefore, it allows the purchaser to specify environmental conditions from the listed categories in accordance with ISO 12944-1 in the PDS for the selection of the appropriate protective paint system. For durability, "medium" is the default option as this is considered the lowest reasonable selection for the oil and gas industry (both onshore and offshore) and aligns with the default offering from most manufacturers. More onerous options are available in the PDS, if required.

11.4.3 Cooling

Where a motor is installed outdoor, the motor shall be of totally enclosed fan-cooled design.

Justification

The totally enclosed fan-cooled (TEFC) (which is equivalent to the combined characteristics of 'IP55 and IC411') is the predominant standard for motors in industrial applications.

11.4.4 Rotor

11.4.4.1

Rotors shall be balanced with a half-key fitted in the shaft key-way in accordance with IEC 60034-14 and ISO 21940-32.

Justification

Rotor shaft construction and balancing requirements ensure consistency across operators and manufacturers with a minimum specification. The rotor shaft is balanced in accordance with IEC 60034-14:2018, Clause 7 with the key-way in accordance with ISO 21940-32. This requirement is generally the default for manufacturers but is currently not covered in IEC 60034-1.

11.4.4.2

Rotors shall be balanced in accordance with ISO 21940-11 to meet the specified vibration limits in accordance with IEC 60034-14:2018, Table 1.

Justification

The balance grade is defined to ensure consistency. The PDS presents the option of grade A or grade B, and is selected following a review of machine application and driven load, which can be sensitive to vibration. ISO 21940-11:2016, Table 1 defines actual requirement and level of accuracy required. It also states "Electric motors and generators (of at least 80 mm shaft height) of maximum rated speeds above 950 r/min" as an example of balance quality grade G 2,5. ISO 21940-11 describes the balancing process and IEC 60034-14 defines acceptable vibration magnitude.

11.4.4.3

For converter duty motors, the maximum vibration magnitude limits shall be applicable throughout the defined speed range.

Justification

The balance grade is defined to ensure consistency. ISO 21940-11:2016, Table 1 defines the balancing quality grades for typical machinery categories. The applicable category is "Electric motors and generators (of at least 80 mm shaft height), of maximum rated speeds above 950 r/min". ISO 21940-11 also describes the balancing process. This requirement supplements 11.4.5.4 by stating that the maximum vibration magnitude is applicable not only for the maximum rated speed but also for the entire defined speed range for a converter duty motor.

11.4.4.4

Rotor shaft ends shall be provided with an ISO metric threaded hole to facilitate coupling and rolling element bearing removal.

Justification

This requirement for a threaded hole ensures that maintenance/breakdown activities are facilitated in a timely manner with minimal down-time.

11.4.4.5

Shaft extensions shall be in accordance with IEC 60072-1.

Justification

IEC 60072-1 ensures that dimensions are uniform across manufacturers. This requirement ensures that the motor is replaceable and interchangeable.

11.4.5 Terminal boxes

11.4.5.1

Terminal boxes shall be of the same material as that of the motor frame.

Justification

The material of the motor terminal box is currently not specified in IEC 60034-1. A terminal box with a material different from the enclosure frame material can be provided. This can cause issues where cast iron frames have been provided but the terminal box is made of a material which the design life of the terminal box is not aligned with the material of the body. While it is acknowledged that the majority of manufacturers offer the same material for the frame and terminal box as standard, it is prudent to establish this requirement as an essential minimum.

11.4.5.2

The main terminal box shall permit cable entry from at least three directions, 90° apart, excluding from the motor drive end.

Justification

This requirement for cable entry to terminal box ensures consistency and takes into consideration industry requirements for glanding, markings, terminating, earthing and construction. Three directions, 90° apart is an industry-wide requirement and allows variations to terminal box cable entry direction, depending on incoming cable direction. This facilitates tidy installation and ensures that cable lengths are not unnecessarily long. The drive end is excluded so that cables do not obstruct driven equipment.

11.4.5.3

Terminal box cable entries shall have a metric thread in accordance with IEC 60423:2007, Table 1.

Justification

This requirement ensures that terminal box gland entries are consistent with no variation in thread size/pitch across manufacturers.

11.4.5.4

Cable entries shall be fitted with blanking devices to retain the ingress protection rating of the motor during transportation and storage.

Justification

This requirement ensures that the intended ingress protection rating is maintained during transportation and storage, and until the installation of cables is completed.

11.4.5.5

Where single-core power cables are specified, the gland plate shall be made of non-magnetic material.

Justification

Where single-core cables are used for each phase, the magnetic flux does not cancel out as it does in case of a three-core cable. This causes the individual cable magnetic flux to produce eddy current circulation in the metallic plate, causing overheating of the gland plate. Hence, the gland plate is made of non-magnetic material to prevent eddy current and heating. Though this phenomenon is widely recognized, it is not specified in IEC 60034-1, hence this requirement.

11.4.5.6

Terminal boxes shall have a dedicated earth terminal for individual electrical circuits.

Justification

This requirement ensures the safety associated with each individual electrical circuit on the equipment, which aligns with safety requirements for low-voltage electrical installations. This requirement ensures that the protective earthing connection of all circuits except the one under maintenance remains intact (connected). Anti-condensation heaters, temperature monitoring devices, vibration sensors / probes, etc. are considered individual electrical circuits.

11.4.6 Fans

11.4.6.1

Fan impellers external to the stator end shields shall be keyed or screwed to the rotor shaft.

Justification

Rotors need to be removed for many maintenance operations. If fan impellers are mounted external to the rotor end shields, the fans are removed as part of the rotor removal process. It is important to maintain the same relative position between the rotor and the fan when the fan is reinstalled such that rotor balance is maintained. Keying or screwing to the rotor shaft is a simple and accurate method of ensuring this alignment.

11.4.6.2

Where a corrosivity category greater than C3 has been specified, fan impellers external to the stator end shields shall not be made of aluminium.

Justification

This requirement prohibits aluminium fan impellers in environments with a corrosivity factor greater than C3 due to the increased corrosion that aluminium typically incurs compared to steel or glass reinforced plastic (GRP). However, some internal fans made of aluminium are not prohibited due to protection from the external environmental factors.

11.4.7 Bearing and lubrication

11.4.7.1

Motors with a frame size 132 or below shall have double-sealed grease-lubricated rolling element bearings.

Justification

For low-voltage motors with frame size 132 and below, a simplistic sealed bearing which does not require external re-lubrication is used where possible, as it is fit for the purpose and maintenance free. The sealing used is either metallic shields, or rubber or synthetic seals, and the selection of sealing in bearings is based on the environment and application. This requirement ensures consistency across manufacturer offerings and is the default selection of bearing type. Frame size 132 is considered the threshold above which a re-greaseable bearing offers design life expectancy benefits.

11.4.7.2

Motors with a frame size above 132 shall have re-greaseable rolling element bearings.

Justification

For low-voltage motors with frame size 132 and below, a simplistic sealed bearing which does not require external re-lubrication is used where possible, as it is fit for the purpose and maintenance free. This requirement ensures consistency across manufacturer offerings and is the default selection of bearing type. Frame size 132 is considered the threshold above which a re-greaseable bearing offers design life expectancy benefits.

11.4.7.3

Re-greaseable rolling element bearing housing shall be provided with a labyrinth seal.

Justification

While the re-lubrication is performed via the grease inlet port, the grease follows a guided path through the bearing gaps and pushes out the old, used grease through the grease outlet port or drain plug. The labyrinth seal helps prevent the pressurized grease from leaking from the bearing housing and finding its way between the shaft and the inner bearing cap into the inside of the motor winding. It also prevents loss of grease and ingress of dust or moisture.

11.4.7.4

Where rolling element bearings are re-greaseable, inlet and outlet ports for grease shall be accessible without disassembly of the fan cover and fan.

Justification

This requirement ensures that it is possible to re-lubricate motor bearings while the motor is running without disassembly of fan cover and fan, thereby improving the motor availability while maintaining reliability.

11.4.7.5

Rolling element bearing clearance shall be C3 type in accordance with ISO 5753-1:2009, Table 1, Group 3.

Justification

C3 refers to normal clearance as commonly used to prevent too little internal bearing clearance in operation. This reduces variations and is considered the default choice for low-voltage motors in the oil and gas sector.

11.4.7.6

The minimum L_{10h} bearing design lifetime in accordance with ISO 281 shall be in accordance with Table 26.

Justification

This requirement ensures that operators have stipulated a minimum requirement for the performance of bearings on vertically mounted motors as well as horizontally mounted motors. Bearing life is extended from an average of 40 000 h (existing IEC industry standard) to 50 000 h for horizontally mounted motors. This requirement was reviewed with various manufacturers and confirmation was obtained that they could achieve this requirement without additional cost. The value of 40 000 h for vertically mounted motors has been confirmed as a standard offering from manufacturers. However, it is recognized that the minimum lifetime of 40 000 h and the PDS input on the magnitude of axial force of the load lead to the installation of an angular contact bearing.

Add new Table 26

Table 26 – Minimum L_{10h} bearing design lifetime

Motor mounting type	Minimum L_{10h} bearing design lifetime h
Horizontal	50 000
Vertical	40 000

Justification

This requirement ensures that operators have stipulated a minimum requirement for the performance of bearings on vertically mounted motors as well as horizontally mounted motors. Bearing life is extended from an average of 40 000 h (existing IEC industry standard) to 50 000 h for horizontally mounted motors. This requirement was reviewed with various manufacturers and confirmation was obtained that they could achieve this requirement without additional cost. The value of 40 000 h for vertically mounted motors has been confirmed as a standard offering from manufacturers. However, it is recognized that the minimum lifetime of 40 000 h and the PDS input on the magnitude of axial force of the load lead to the installation of an angular contact bearing.

11.4.7.7

Rolling element bearings shall be re-greaseable with a minimum lubrication interval in accordance with Table 27.

Justification

This requirement ensures that excessive maintenance is not incurred as a result of specifying rolling element bearings. This gives the user consistency for planned maintenance frequency for low-voltage motors. The values stated in Table 27 are aligned with manufacturers' standard offerings.

Add new Table 27

Table 27 – Lubrication intervals of grease-lubricated rolling element bearings

Motor mounting type	Lubrication interval h
Horizontal	≥ 4 000
Vertical	≥ 2 000

Justification

This table ensures that excessive maintenance is not incurred as a result of specifying rolling element bearings. This gives the purchaser consistency for planned maintenance frequency for low-voltage motors. The values stated in this table are aligned with manufacturers' standard offerings.

11.4.7.8

Converter duty motors with frame size 280 or greater shall have an insulated bearing on the non-drive end.

Justification

Where motors are to be used in power drive systems, bearings can be insulated. This is due to the likelihood of a circulating current (shaft current) being created in the rotor. This shaft current passes via the motor bearings to the ground. This shaft current causes washboard-like ridges on the raceways of the bearing known as 'electrical fluting', leading to premature bearing failure. This requirement mitigates such failure.

11.4.7.9

Rolling element bearings shall use grease that contains mineral-based oil and lithium complex thickener.

Justification

This requirement provides consistency for grease specification for rolling element bearings. Lithium-based grease exhibits good stability and provides better performance for high temperature and moisture resistance. The use of such grease prevents premature wear of the rolling element bearings, especially in typical harsh environments of the oil and gas industry.

11.4.7.10

Rolling element bearings shall have a metallic cage.

Justification

Bearing cages are provided to separate the rolling elements to reduce the frictional heat, keep the rolling elements evenly spaced to optimize load distribution, guide the rolling elements in the unloaded zone of the bearing and retain the rolling elements of separable bearings when one bearing ring is removed. Cages are made of metal, plastic or composite material. Though non-metallic cage material is gaining popularity due to their light weight, very low coefficient of friction, higher strength to weight ratio and insulating properties, they do not have adequate life expectancy. Metallic cages offer better performance under high levels of vibration, exhibits good thermal conductivity and increased life expectancy in arduous operating conditions which is desirable in industrial environments.

11.4.7.11

Bearings shall be a metric size and in accordance with ISO 15 and ISO 492.

Justification

These standards specify the dimensional and geometrical characteristics, limit deviations from nominal sizes, and tolerance values of bearings ensuring that standard bearings are used. This supports service/maintenance and inventory management.

11.4.8 Anti-condensation heaters

11.4.8.1

Where an anti-condensation heater is installed, while the motor is not in operation, the anti-condensation heaters provided around stator windings shall keep the temperature inside the motor enclosure 5 K above the ambient air temperature.

Justification

This requirement measures the performance of the anti-condensation heaters. Without a value for temperature rise, there is no assurance that the heater is adequately specified to perform its duty.

11.4.8.2

Anti-condensation heater terminals shall be at least IP2X rated.

Justification

The IP2X rating protects against ingress of solid foreign objects with a diameter greater than or equal to 12,5 mm. The IP2X rating stated for terminals of anti-condensation heater reduces the risk of bridging the heater terminals with motor power cable/terminals inadvertently since the terminal box is small and just about adequate for cable termination. Since the power and heater terminals are adjacent, this degree of protection is a sufficient condition to protect from direct contact.

11.4.8.3

Where an anti-condensation heater is installed, a warning label shall be affixed on the cover of the terminal box to indicate that the anti-condensation heater circuit is energized when the motor is stationary.

Justification

The warning label warns personnel to isolate the low-voltage supply that is from a different source and/or location from the main power source to the machine.

11.4.9 Additional requirements for converter duty motors

The stated continuous motor output ratings for converter duty motors shall be in accordance with IEC 61800-2:2021, 5.3.3.

Justification

The continuous output rating as defined in IEC 61800-2:2021, 5.3.3 is defined in terms of motor shaft parameters as follows:

- *rated torque (M_N) [N·m];*
- *rated speed (N_N) [r/min];*
- *maximum rated speed (N_{NMax}) [r/min];*
- *minimum rated speed (N_{NMin}) [r/min];*
- *minimum speed (N_{Min}) [r/min];*
- *maximum rated safe speed (N_{SNMax}) [r/min];*
- *rated output power (P_{sN}) [kW].*

11.4.10 Motors intended for use in hazardous area

11.4.10.1 Certification

11.4.10.1.1

Motors and their mounted components shall be certified for the specified protection level in accordance with IEC 60079 (all parts).

Justification

IEC 60079 (all parts) specifies the general requirements for construction, testing and marking of Ex equipment and Ex components for the specified protection level and hazardous area. IEC 60079 (all parts) provides guidelines for equipment grouping and equipment protection levels based on the gas group and temperature classification.

11.4.10.1.2

Motors for use in a hazardous area shall be provided with a certificate issued by a notified body or a certification body.

Justification

This requirement ensures that where it may be possible in accordance with IEC 60079 (all parts) to self-certify the equipment, the certification is issued by a notified or certifying body as per oil and gas industry requirements and standard practice.

NOTE A manufacturer's declaration of conformity alone does not satisfy the requirement of 11.4.10.1.2.

11.4.11 Motors intended for close-coupled pump service applications

11.4.11.1

For close-coupled pump service applications, the common shaft of the motor and pump shall be machined from a single billet of heat-treated steel.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

NOTE Close-coupled pump service applications that require non-magnetic shaft materials are exempted from this requirement.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

11.4.11.2

For close-coupled pump service applications, shaft and sealing elements of the electric motor shall be chemically and thermally compatible with the fluid properties specified for the pump.

Justification

The motor shaft can be exposed to pumped fluid material. This requirement ensures that the motor shaft is suitable for the product specification given in the pump data/requisition sheet.

11.4.11.3

For close-coupled pump service applications, if the fluid properties are unavailable, the shaft shall be made of steel type SAE 1035.

Justification

The motor shaft can be exposed to pumped fluid material. This requirement ensures that the motor shaft is suitable for a default minimum material specification if not compliant with the required properties.

11.4.11.4

For close-coupled pump service applications, the shaft run-out shall be in accordance with the precision class specified in IEC 60072-1:2022, Table 3.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

11.4.11.5

For close-coupled pump service applications, the maximum permissible change in the indicator reading of the concentricity of spigot diameter and the perpendicularity of the flange to the shaft shall be in accordance with precision class specified in IEC 60072-1:2022, Table 2.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

11.4.11.6

For close-coupled pump service applications of OH5 type, the thrust bearing shall be located at the non-drive end of the motor.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

11.4.11.7

For close-coupled pump service applications, while the pump is starting, stopping, operating at any point on its characteristic curve or being tested with water, the motor shall withstand the maximum thrust of the pump in both directions of rotation.

Justification

The pump reliability and dynamics are determined by the motor shaft and incur additional constraints over a coupling-connected system.

12 Tolerances

12.1 General

In NOTE 2, replace "IEC Guide 115:2021" with

IEC Guide 115:2023

Justification

Edition 3.0 (2023) supersedes Edition 2.0 (2021).

Bibliography

Add to start of Bibliography

The following documents are informatively cited in the text of this specification, IEC 60034-1, the PDS (IOGP S-703D) or the IRS (IOGP S-703L).

Add to Bibliography

API Standard 610, *Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries*

API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*

IEC GUIDE 115:2023, *Application of measurement uncertainty to conformity assessment activities in the electrotechnical sector*

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IEEE 112:2017 , *IEEE Standard Test Procedure for Polyphase Induction Motors and Generators*

IOGP S-715, *Supplementary Specification to NORSOK M-501 Surface Preparation and Protective Coatings*

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ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods*

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Delete from Bibliography

IEC 60079 (all parts), *Explosive atmospheres*

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