Date of issue:
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IOGP S-745, Supplementary Specification to IEC 60034-1 for High-voltage Synchronous Machines, First Edition, April 2024

ADDENDUM 1

This addendum (Version 1.01) replaces Edition 1.0 published in April 2024.

NOTE: In addition to the updates listed below, minor editorial/typographical amendments may have been made.

List of updates

Clause/subclause	Description
1	Figure 15 amended Subclause 1.2 amended
2	References IEC 60034-14:2018, IEC 60034-15:2025, IEC 60034-27-4:2018, IEC 60034-29, IEC TS 60034-32:2016, IEC 60204-1:2016, IEEE 421.5:2016, IEEE 1110:2019 and IEEE 1799:2022 added
8.1	Replacement of first paragraph amended Addition to subclause amended
8.6	New subclause 8.6.2.3.2 replacement
9.1	New addition to subclause (after third one) including new NOTE
Table 16	Table amended
11.1	New addition to subclause (after replacement of fourth paragraph) Second addition to subclause amended
Table 26	Third column heading amended
11.3.5	New subclause 11.3.5.3 added Subclause 11.3.5.3 * renumbered to 11.3.5.4
11.4.2.2	New subclause 11.4.2.2.3 including subclauses 11.4.2.2.3.1 through 11.4.2.2.3.11
Table 27	Table amended with new row "Removable drain plug"
11.4.2.3	New subclauses 11.4.2.3.6, 11.4.2.3.7 and 11.4.2.3.8 added
11.4.4	New NOTE 1 and NOTE 2 added Subclause 11.4.4.2 amended New subclause 11.4.4.3 added (and subsequent subclauses renumbered accordingly) New subclauses 11.4.4.7 through 11.4.4.11 added
11.4.5	Subclause 11.4.5.14 amended New subclauses 11.4.5.16 and 11.4.5.17 (including NOTE) added
11.4.7	New subclauses 11.4.7.11 and 11.4.7.12 added
11.4.8	New subclauses 11.4.8.4 and 11.4.8.5 added

List of updates *(continued)*

Clause/subclause	Description
11.4.9.2	Subclause 11.4.9.2.3 amended
11.4.16	Subclause 11.4.16 heading amended Subclause 11.4.16.1.2 amended Subclause 11.4.16.3 amended
11.4.17.1	Subclause 11.4.17.1.1 amended
11.4.17.3	New subclause 11.4.17.3.7 added
11.4.17.4	Subclause 11.4.17.4.4 amended New subclause 11.4.17.4.5 added
11.4.18	Subclause 11.4.18.2 amended Subclause 11.4.18.7 amended New subclauses 11.4.18.13 and 11.4.18.14 added (and subsequent subclauses renumbered accordingly) New subclause 11.4.18.18 added
* Clause/subclause number from Edition 1.0.	

International Association of Oil & Gas Producers

SPECIFICATION
IOGP S-745

April 2026
Version 1.01

ADDENDUM 1 TO FIRST EDITION (APRIL 2024)

Supplementary Specification to IEC 60034-1 for High-voltage Synchronous Machines

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.01	April 2026	Addendum 1
1.0	April 2024	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).

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Introduction

The purpose of the IOGP S-745 specification documents is to define a minimum common set of requirements for the procurement of high-voltage synchronous machines in accordance with IEC 60034-1, Edition 14.0, February 2022, Rotating electrical machines – Part 1: Rating and performance, for application in the petroleum and natural gas industries.

The IOGP S-745 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-745: Supplementary Specification to IEC 60034-1 for High-voltage Synchronous Machines

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-745D: Procurement Data Sheet for High-voltage Synchronous Machines (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-745L: Information Requirements for High-voltage Synchronous Machines (IEC)

The IRS defines the 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 which invoke information requirements.

IOGP S-745Q: Quality Requirements for High-voltage Synchronous Machines (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 Scope boundaries/configurations

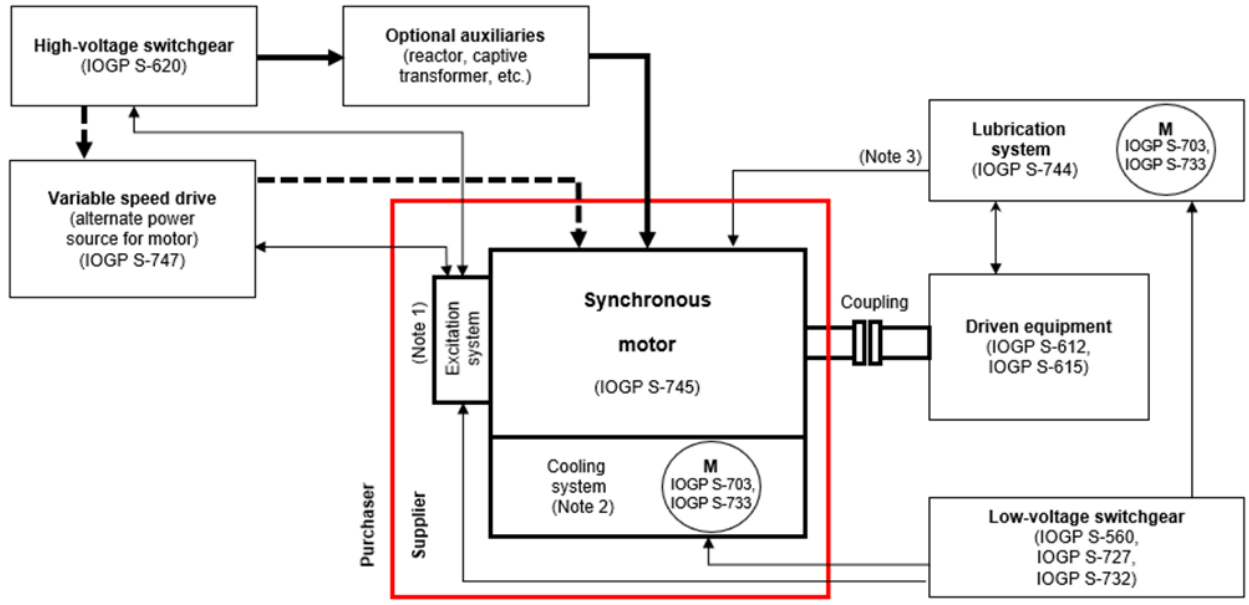
The scope boundary/configuration and the rating specification and range of the machine covered by this specification are in accordance with Table 23, Figure 14 and Figure 15.

Add new Table 23

Table 23 – Scope boundaries

Parameter	Details
Voltage	Above 1 kV and up to 15 kV 50 or 60 Hz
Synchronous machine power	500 kVA and above
Speed	Up to 3 000 rpm for 50 Hz Up to 3 600 rpm for 60 Hz
Speed with variable speed drive	From 0 up to 3 000 rpm for 50 Hz From 0 up to 3 600 rpm for 60 Hz
Excitation system	Brushless
Stator windings	Form wound
Motor power source	DOL, VSD types (VSI, CSI, LCI)
Location	Onshore, LNG vessel, offshore installations (topside and FPSO)
Environment	Non-hazardous, hazardous

Add new Figure 14



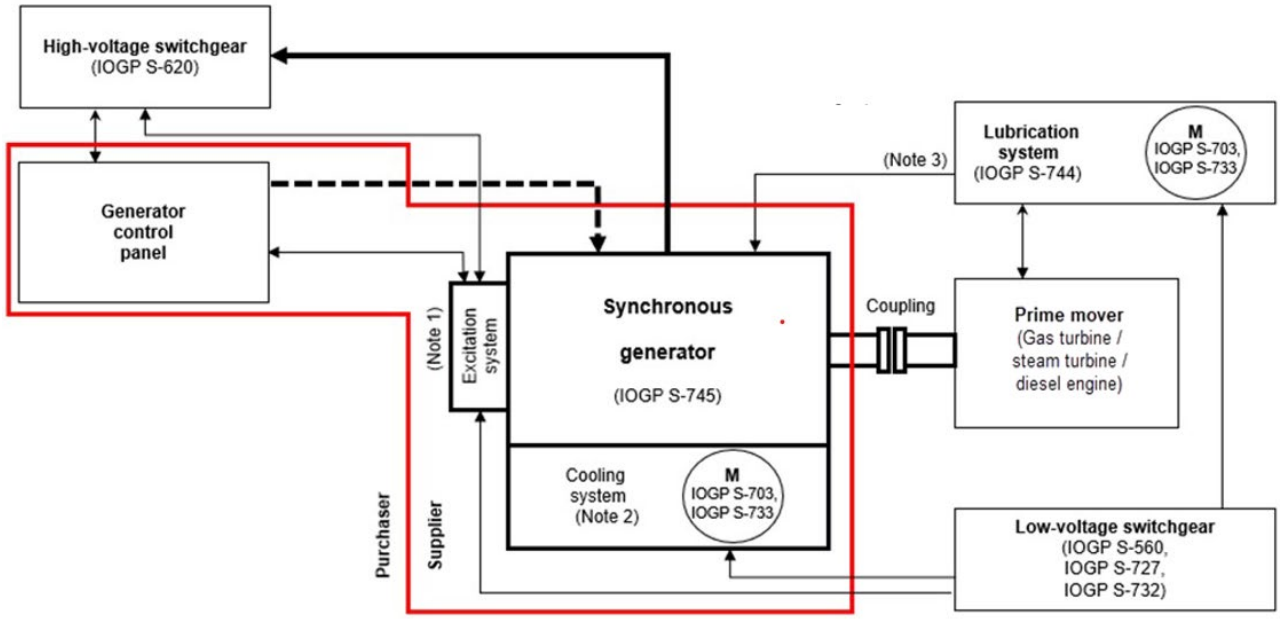
Note 1 The excitation panel is part of the excitation system and located as per project requirements.

Note 2 The cooling system motor is optional.

Note 3 The lubrication system could be independent or shared with the driven equipment as per project requirements.

Figure 14 – Scope boundary diagram – Synchronous motor

Add new Figure 15



Note 1 The excitation panel is part of the excitation system and located as per project requirements.

Note 2 The cooling system motor is optional.

Note 3 The lubrication system could be independent or shared with the driven equipment as per project requirements.

Figure 15 – Scope boundary diagram – Synchronous generator

Add new subclause

1.2 Exclusions

The scope of this specification excludes super synchronous motors.

2 Normative references

Add to first paragraph

The following publications are referred to in this document, the PDS (IOGP S-745D) or the IRS (IOGP S-745L) in such a way that some or all of their content constitutes requirements of this specification.

Add to clause

ANSI/NEMA MG 1, *Motors and Generators*

API Standard 546:2022, *Brushless Synchronous Machines—500 kVA and Larger*

API Standard 670, *Machinery Protection Systems*

BS 4999-140, *General requirements for rotating electrical machines — Part 140: Specification for voltage regulation and parallel operation of a.c. synchronous generators*

IEC 60034-2-1:2014, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-4-1:2018, *Rotating electrical machines – Part 4-1: Methods for determining electrically excited synchronous machine quantities from tests*

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

IEC 60034-8:2007+AMD1:2014 Edition 3.1 CSV, *Rotating electrical machines – Part 8: Terminal markings and direction of rotation*

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 60034-15:2025, *Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines*

IEC 60034-18-41:2014+AMD1:2019 Editions 1.1 CSV, *Rotating electrical machines – Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters – Qualification and quality control tests*

IEC 60034-18-42:2017+AMD1:2020 Edition 1.1 CSV, *Rotating electrical machines – Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests*

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

IEC 60034-27-1, *Rotating electrical machines – Part 27-1: Off-line partial discharge measurements on the winding insulation*

IEC 60034-27-3, *Rotating electrical machines – Part 27-3: Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines*

IEC 60034-27-4:2018, *Measurement of insulation resistance and polarization index of winding insulation of rotating electrical machines*

IEC 60034-29, *Rotating electrical machines – Part 29: Equivalent loading and superposition techniques – Indirect testing to determine temperature rise*

IEC TS 60034-32:2016, *IEEE Guide for Testing Turn Insulation of Form-Wound Stator Coils for Alternating-Current Electric Machines*

IEC 60072-2, *Dimensions and output series for rotating electrical machines – Part 2: Frame numbers 355 to 1000 and flange numbers 1180 to 2360*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60092-101, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

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

IEC 60529:1989+AMD1:1999+AMD2:2013 Edition 2.2 CSV, *Degrees of Protection Provided by Enclosures (IP Code)*

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61800-2:2021, *Adjustable speed electrical power drive systems – Part 2: General requirements – Rating specifications for adjustable speed AC power drive systems*

IEEE 115:2019, *IEEE Guide for Test Procedures for Synchronous Machines Including Acceptance and Performance Testing and Parameter Determination for Dynamic Analysis*

IEEE 421.5:2016, *IEEE Recommended Practice for Excitation System Models for Power System Stability Studies*

IEEE 522, *IEEE Guide for Testing Turn Insulation of Form-Wound Stator Coils for Alternating-Current Electric Machines*

IEEE 1110:2019, *IEEE Guide for Synchronous Generator Modeling Practices and Parameter Verification with Applications in Power System Stability Analyses*

IEEE 1255, *IEEE Guide for Evaluation of Torque Pulsations During Starting of Synchronous Motors*

IEEE 1799:2022, *IEEE Recommended Practice for Quality Control Testing of External Discharges on Stator Coils, Bars, and Windings*

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

ISO 12944-1, *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 AMD 1, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour AMENDMENT 1 — First Edition*

ISO 21940-12, *Mechanical vibration — Rotor balancing — Part 12: Procedures and tolerances for rotors with flexible behaviour*

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

Delete from clause

IEC 60034-8:2007, *Rotating electrical machines – Part 8: Terminal markings and direction of rotation*

IEC 60034-8:2007/AMD1:2014, *Amendment 1 Rotating electrical machines – Part 8: Terminal markings and direction of rotation*

IEC 60034-18-41:2014, *Rotating electrical machines – Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters – Qualification and quality control tests*

IEC 60034-18-41:2014/AMD1:2019, *Amendment 1 Rotating electrical machines – Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters – Qualification and quality control tests*

IEC 60034-18-42:2017, *Rotating electrical machines – Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests*

IEC 60034-18-42:2017/AMD1:2020, *Amendment 1 Rotating electrical machines – Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests*

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

AVR automatic voltage regulator

Ex explosive atmosphere

FAT factory acceptance test

HMI human-machine interface

IRS	information requirements specification
LSZH *	low smoke zero halogen
MOV *	metal oxide varistor
MRB *	manufacturer's record book
MTTR *	mean time to repair
PDS	procurement data sheet
PE	protective earthing
PMG	permanent magnet generator
QRS	quality requirements specification
RTD	resistance temperature device
TRS	technical requirements specification
VDR *	voltage dependent resistor
VPI	vacuum pressure impregnated

* Cited in IOGP S-745J only.

Add new term 3.38

3.38
critical speed
shaft rotational speed at which a machine component (e.g. shaft, rotor) is in a state of resonance

Add new term 3.39

3.39
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 3.40

3.40
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

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

5 Rating

5.5 Rated output

5.5.2 AC generators

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

kilovolt-amperes (kVA)

5.5.3 Motors

Replace "watts (W)" with

kilowatts (kW)

5.5.4 Synchronous compensators

Replace "volt-amperes (VA)" with

kilovolt-amperes (kVA)

5.6 Rated voltage

5.6.2 AC generators

In third paragraph, replace "7.3" with

7.4

5.7 Preferred combinations of voltages and outputs

Add new NOTE

NOTE For synchronous machines, the minimum rated output is 500 kVA for rated voltage 1 kV and above.

5.8 Machines with more than one rating

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

7.4

Add new subclause

5.9 Efficiency

Synchronous machines shall have minimum efficiency in accordance with Table 24.

Add new Table 24

Table 24 – Minimum efficiency of synchronous machine

Machine configuration	Minimum efficiency value %
2 poles	98,0
4 poles	97,5
6 poles / 8 poles	> 97,0

6 Site conditions

Add new subclause

6.8 Degree of ingress protection

The minimum degree of ingress protection for a synchronous machine shall be as specified in Table 25 and in accordance with IEC 60034-5.

Add new Table 25

Table 25 – Minimum degree of ingress protection based on the location of the installation

Installation environment	Minimum degree of ingress protection	
	Machine	Terminal box
Indoor	IP44	IP55
Outdoor – coastal and onshore	IP55	IP55
Outdoor – offshore / open deck	IP56	IP56

8 Thermal performance and tests

8.1 Thermal class

Replace first paragraph with

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

Add to subclause

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

Add new NOTE 3

NOTE 3 Machine insulation systems include all windings of stator, rotor, exciter and permanent magnet generator (PMG), where provided.

8.6 Determination of winding temperature

8.6.1 Choice of method

Delete second paragraph (including NOTE)

Delete third paragraph

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.

9 Other performance and tests

9.1 Routine tests

Add to subclause

A "soft foot" check in accordance with API Standard 546:2022, 6.3.1.15 shall be made prior to mechanical running tests.

Add to subclause

For flooded lubrication systems, factory tests shall be carried out using the specified lube oil viscosity with the oil temperature maintained within the range of operating values recommended by the manufacturer.

Add to subclause

During vibration severity tests, the lube oil inlet temperature shall be adjusted to the maximum temperature permitted by the lubrication system design.

Add to subclause

If the machine is equipped with permanently installed shaft vibration sensors, the following data shall be plotted (Bode plots) during coastdown from maximum continuous operating speed to 10 % of the rated speed:

a) synchronous vibration amplitude, one per revolution;

b) overall vibration amplitude;

c) phase angle versus speed.

NOTE If the machine is subject to a temperature rise test, one plot shall be for cold machine (stable no-load condition) and one plot for hot machine.

Add to subclause

When bearing modification or replacement is undertaken during testing, bearing-related tests shall be repeated to reassess the bearing performance.

Add new NOTE

NOTE Cosmetic repairs such as removal of scratches that do not otherwise affect motor performance are not a reason for retesting.

Table 16 – Tests for synchronous machines assembled and tested in the manufacturer's factory

Replace Table 16 with

Test No.	Test description [g]	Reference standard	Remarks
Routine tests			
1	Visual inspection	Approved drawings and documents	
2	Air-gap measurement between stator and rotor of main machine and exciter	API Standard 546:2022, 4.4.7.2.4	In-process test or test during factory acceptance test (FAT)
3 [d]	Measurement of ohmic resistance of exciter, rotor and stator windings referred to 25 °C	IEC 60034-2-1:2014, 5.7.1	
4	Measurement of insulation resistance of stator windings	IEC 60034-27-4: 2018	Test also carried out post withstand voltage test
5 [d]	Check of phase sequence/direction of rotation and terminal markings	IEC 60034-8:2014, 6.7	Including excitation system
6	No-load characteristic and losses	IEC 60034-4-1:2018, 6.4	
7	Short-circuit characteristics and losses	IEC 60034-4-1:2018 6.5	
8	Verification of magnetic centre and end play (where sleeve bearings are provided)	API Standard 546:2022, 4.4.9.3	
9 [d]	Withstand voltage test for stator, rotor, exciter armature, exciter field and PMG (if applicable)	IEC 60034-1:2022, 9.2	
10	Measurement of insulation resistance of insulated bearings	IEEE 115:2019, 4.6.4	
11	Measurement of electrical and mechanical run-out	IEC 60034-14:2018, Clause 9 API Standard 546:2022, 6.3.3	Refer to API Standard 546 for test procedure and IEC 60034-14 for acceptance criteria
12 [d]	No-load excitation current at rated voltage by open-circuit test	IEC 60034-1:2022	
13	Functional tests of auxiliary devices and controls	Manufacturer's standard	Including control panels in scope of supply
14	Withstand voltage tests on resistance temperature devices (RTDs)	IEC 60034-1:2022, 9.2	
15	Insulation resistance tests on RTDs and space heaters where applicable	IEC 60204-1:2016, 18.3	
16	Vibration test at no load	IEC 60034-14:2018, Clause 8 and Clause 9	
17	Rotor earth fault detection test	Manufacturer's standard	If applicable
18	Bearing oil tightness test		

Table 16 *(continued)*

Test No.	Test description [g]	Reference standard	Remarks
Performance tests [e]			
1	Locked rotor current test	IEC 60034-4-1:2018, 6.24	Test for single-speed motor
2	Locked rotor torque test	IEEE 115:2019, 8.2.2	Test for single-speed motor
3	Temperature rise test	IEC 60034-1:2022, Clause 8 or IEC 60034-29 [a]	
4	Sleeve bearing inspection	API Standard 546:2022, 6.3.2	
5	Determination of efficiency at 100 %, 75 % and 50 % load at rated power factor	IEC 60034-2-1:2014, Clause 7	
Special tests [f]			
1	Rated rotor temperature vibration test (i.e. heat run test)	API Standard 546:2022, 6.3.5.2	Alternately testing (procedure, purpose, etc.) to be agreed between purchaser and manufacturer
2	Measurements of shaft voltage at no-load	IEC 60034-1:2022, 9.14	
3	Bearing temperature rise at no-load	API Standard 546:2022, 6.3.2	
4	Tests for the construction of no-load V curve	API Standard 546:2022, 6.3.5.1.1	
5	Noise level at no load	ISO 1680:2013	
6	Measurement of moment of inertia	Manufacturer's standard	
7	Measurement of torque and current as function of speed during starting	IEEE 115:2019, 8.3 IEEE 1255:2000	
8	Dielectric dissipation test (tan δ) on stator windings	IEC 60034-27-3:2016	Test performed with stator winding installed in frame
9	Partial discharge test on complete stator	IEC 60034-27-1:2017 IEC 60034-27-2:2023	Test performed with stator winding installed in frame
10	Stator external discharge test	IEEE 1799:2022	In process test
11	Sealed winding conformance test	ANSI/NEMA MG 1	In process test
12	Unbalanced response test	API Standard 546:2022, 6.3.5.3	
13	Bearing housing natural frequency test	API Standard 546:2022, 6.3.5.4	
14	Stator core test	API Standard 546:2022, 6.3.4.1	In process test
15	Surge comparison test on complete stator assembly	IEEE 522	In process test
16	Sample coil test	API Standard 546:2022, 6.3.4.2, IEC 60034-15:2025, IEC 60034-27-1:2017, IEC 60034-27-3:2016	
17 [h]	Sudden short-circuit test	IEC 60034-4-1:2018, 6.11	
18	Heat exchanger performance verification test	API Standard 546:2022, 6.3.5.5	

Table 16 *(continued)*

Test No.	Test description [g]	Reference standard	Remarks
19	Hydrostatic pressure test of heat exchanger tubing devices [d]	Design code [c]	
20	Generator control panel functional test	Manufacturer's standard	Tests (e.g. procedure, purpose) to be agreed between purchaser and manufacturer
21	Generator waveform analysis	IEC 60034-1:2022, 9.11	
22	Rotor impedance test at rated frequency for the machine (stator frequency)	Manufacturer's standard	
23 [h]	Test for determination of unsaturated negative-sequence reactance $X_{(2)}$	IEC 60034-4-1:2017, Table 1	
24 [h]	Test for determination of unsaturated zero-sequence reactance $X_{(0)}$	IEC 60034-4-1:2017, Table 1	
25 [h]	Test for determination of direct-axis open circuit time constant T'_{do}	IEC 60034-4-1:2017, Table 1	
26	End winding impact test (Experimental modal analysis)	IEC TS 60034-32:2016, 5.2	
27	Overspeed test	IEC 60034-1:2022, 9.7	

[a] IEC 60034-29 shall be used as the reference standard where testing to IEC 60034-1 is restricted due to the limitations of the test facilities.

[b] Heat exchanger testing is performed at the heat exchanger manufacturer's premises.

[c] Heat exchanger design code should be confirmed by the supplier.

[d] Tests listed in the original table.

[e] Where one or more than one identical motor is purchased, the listed performance tests are carried out on at least one motor. However, the need for the performance tests and the number of motors to be tested may be agreed between the purchaser and the manufacturer.

[f] The special tests required to be performed in IOGP S-745D shall be specified.

[g] Tests shall be performed with project-specific sensing, monitoring and protection devices mounted on the machine.

[h] Quantities corresponding to both unsaturated and saturated state of the machine shall be derived from tests. When sudden short-circuit test cannot be performed at rated armature voltage, tests at 30 %, 50 % and 70 % of rated armature voltage shall be performed. Saturated quantities shall be found by extrapolation method.

9.2 Withstand voltage test

In eighth paragraph, replace "7.3" with

7.4

10 Information requirements

10.3 Rating plate

Replace first sentence of first paragraph with

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

Replace second sentence of first paragraph with

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

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

10.4 Information content

10.4.1 General

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

10.4.6

Delete third sentence of first paragraph

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

kk)

10.4.2 Minimum information requirements

Replace list item j) with

j) Efficiency at full load.

Replace list item k) with

k) The total mass of the machine.

Replace subclause 10.4.6 title with

10.4.6 Additional information

Replace list item gg) with

gg) On a separate rating plate, the types of the bearings, bearing sizes, clearance, bearing insulation, shaft and housing fit for drive end and non-drive end bearings, type of lubricant, minimum and maximum

allowable quantity of lubricant, maximum and minimum oil temperature/pressure/flow rate for flood lubricated bearings and oil viscosity.

Add new list item kk)

kk) For machines used in hazardous areas, the equipment marking on a separate nameplate applied to Ex Equipment and/or Ex Components in accordance with IEC 60079.

11 Miscellaneous requirements

11.1 Protective earthing of machines

Replace fourth paragraph with

The machine shall have two diagonally opposite earthing bosses with M12 internal threads, fitted externally on the machine frame.

Add to subclause

When the corrosivity category is C4 or greater, the two diagonally opposite fitted earthing bosses shall be made of 316L stainless steel and welded to the machine frame.

Add to subclause

The machine shall have means for connecting all conducting external cable sheaths and protective earthing cables inside every terminal box.

Add to subclause

The earthing boss shall be permanently marked with the symbol  (IEC60417-5019) to indicate protective earth.

Add to subclause

The machine shall have bonding straps across joints within or between the machine frame components.

Add new subclause

11.3 Performance criteria

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

11.3.1.1

For motors without specific starting requirements, the locked rotor current inclusive of the tolerance shall be lower than five times the rated current.

11.3.1.2

The motor shall be designed for direct-on-line starting across full line voltage in accordance with Table 26.

Add new Table 26

Table 26 – Number of re-starts of motors

Starting condition	Status	Minimum number of consecutive starts [a]
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.		

11.3.1.3

Motors shall be designed and constructed for a lifetime minimum of 5 000 full voltage starts.

11.3.1.4

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

11.3.1.5

The locked rotor withstand time under hot condition shall be greater than the time required to accelerate the specified driven load at 80 % of rated voltage at the motor terminals plus 5 s.

11.3.1.6

Inclusive of the negative tolerance, the accelerating torque of the motor at the rated frequency with 80 % of the rated voltage applied at the motor terminals shall be at least 10 % of the full load torque at any point.

11.3.2 Transient air gap torques

The rotor shaft and active iron core systems shall withstand a two-phase short-circuit current at the motor terminals for 0,2 s.

11.3.3 Pulsating torques

11.3.3.1

For motors driving pulsating loads such as reciprocating compressors, the minimum value of the pull-out torque at 80 % of the rated voltage shall be more than the peak value of the pulsating torque.

11.3.3.2

The inertia of the motor driving equipment requiring variable torque during each revolution shall restrict the stator current variation to 40 % of the motor rated current.

11.3.4 Critical speed

11.3.4.1

For single-speed machines, the lateral natural frequencies that result in resonance amplification of vibration amplitudes shall fall outside the band of synchronous speed ± minimum 15 %.

NOTE Well-damped resonances with an amplification factor less than 2.5 are not considered critical speeds.

11.3.4.2

For converter duty motors, the lateral natural frequencies that result in resonance amplification of vibration amplitudes shall fall outside the band of operating speed range ± minimum 15 %.

11.3.5 Noise

11.3.5.1

The sound pressure level of the machine operating at rated speed and no load when fed with sinusoidal supply voltage, measured in any direction at a distance of 1 m, shall be less than 85 dB(A).

11.3.5.2

Machines shall meet the noise limits by design without implementing corrective measures.

11.3.5.3

Noise abatement measures implemented to meet the noise limits shall be indicated on the drawings for approval by the purchaser.

11.3.5.4

Noise measurements shall be in accordance with ISO 1680.

Add new subclause

11.4 Design criteria

11.4.1 General

11.4.1.1

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

11.4.1.2

The machine shall be designed for continuous operation of at least six years, excluding oil change of self-lubricated sleeve bearings.

11.4.1.3

The machine shall be constructed with components, materials and design features that have proven service in the industry for at least two years.

11.4.2 Enclosure design

11.4.2.1 General

11.4.2.1.1

The machine enclosure shall have a low point drain hole with a removable plug.

11.4.2.1.2

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

11.4.2.2 Mounting

11.4.2.2.1

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

11.4.2.2.2

Frame supports shall be provided with two vertical pilot holes for the installation of alignment dowels.

11.4.2.2.3 Mounting surfaces and alignment

11.4.2.2.3.1

Mounting surfaces shall be machined to a finish of at least 6,3 µm arithmetic average roughness (Ra).

11.4.2.2.3.2

Mounting surfaces shall be machined within a flatness of 40 µm per linear meter of the mounting surface.

11.4.2.2.3.3

Mounting surfaces shall be in the same horizontal plane within 125 µm.

11.4.2.2.3.4

The upper machined or spot faced surface shall be parallel to the mounting surface.

11.4.2.2.3.5

Mounting planes shall be parallel to each other within 0,17 mm per metre.

11.4.2.2.3.6

Horizontal machine mounting planes shall be parallel to the horizontal plane through the bearing centreline within 0,17 mm per metre.

11.4.2.2.3.7

The mounting surface on a vertical machine shall be machined perpendicular to the centreline of the machine.

11.4.2.2.3.8

The mounting surface on a vertical machine shall not deviate from the perpendicular plane by more than 0,17 mm per metre.

11.4.2.2.3.9

Hold-down bolt holes shall be drilled perpendicular to the mounting surfaces of the machine.

11.4.2.2.3.10

Hold-down bolt holes shall be machined or spot faced to a diameter of at least three times that of the bolt hole.

11.4.2.2.3.11

Frame supports shall be provided with two vertical pilot holes for the installation of alignment dowels.

11.4.2.3 Frame

11.4.2.3.1

Frame numbers and fixing dimensions shall be in accordance with IEC 60072-2.

11.4.2.3.2

The machine frame and add-on assemblies inclusive of terminal box covers heavier than 25 kg shall be provided with lifting lugs or lifting eyebolts.

11.4.2.3.3

Foot-mounted machines shall be provided with vertical jacking provisions and, when a soleplate is included in the scope of supply, with horizontal jacking provisions.

11.4.2.3.4

Where a corrosivity category of C4 or greater is specified, the selection of hardware used on the frame shall be in accordance with Table 27.

Add new Table 27

Table 27 – 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 with a thread diameter greater than 10 mm	Hot-dip galvanized
Cooling air inlet protection mesh	316L stainless steel
Removable drain plug	316L stainless steel

11.4.2.3.5

Machines with a frame size 630 and above shall have removable inspection covers for the following:

– where applicable, inspection of coil end turns, exciter, synchronizing controls and rotor windings;

– inspection of air gap in at least three positions located 90° apart.

NOTE The provision of inspection covers is not possible in all situations and deviations, if any, are brought to the attention of the purchaser.

11.4.2.3.6

The frame of the assembled machine shall be free from structural resonance between 40 % and 60 % range of the operating speed.

11.4.2.3.7

The frame of the assembled machine shall be free from structural resonance within ± minimum 15 % around speed frequency, twice speed frequency, power frequency and twice power frequency.

11.4.2.3.8

The magnitude of the vibration on the machine frame, including the main terminal boxes, excluding the bearings, shall not exceed 4.5 mm/s (RMS) in any direction.

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.

11.4.2.4.2

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

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.

11.4.3 Cooling

11.4.3.1 General

11.4.3.1.1

Machine cooling shall be selected from the cooling methods listed in Table 28, in accordance with IEC 60034-6 and the specified degree of ingress protection.

Add new Table 28

Table 28 – Machine cooling method

Cooling method	Code
Frame surface cooled machine using surrounding medium with self-circulation of secondary coolant	IC4A1A1
Machine with an integral heat exchanger using surrounding medium with self-circulation of secondary coolant	IC5A1A1
Machine-mounted heat exchanger using surrounding medium with self-circulation of secondary coolant	IC6A1A1
Machine-mounted heat exchanger using remote medium with self-circulation of primary coolant	IC7A1W7
Machine-mounted heat exchanger using surrounding medium with self-circulation of primary coolant	IC8A1W7

11.4.3.1.2

The operating frequency, or frequencies for converter duty motors, and operating frequency multiples of the machine shall not trigger the natural frequency of vibration of any cooling system components.

11.4.3.2 Air-cooled heat exchangers

11.4.3.2.1

Cooling air tubes shall be accessible for cleaning without removal of the exchanger assembly.

11.4.3.2.2

A three-wire Pt-100 temperature sensor shall be provided to monitor the heat exchanger outlet air temperature.

11.4.3.2.3

Air-cooled heat exchangers shall be in accordance with API Standard 546:2022, 4.4.10.8.

11.4.3.3 Water-cooled heat exchangers

11.4.3.3.1

Water-cooled heat exchangers shall be provided with low point drains and air release vents.

11.4.3.3.2

Water-cooled heat exchangers shall have provision for leakage or condensation collection and drainage of coolant.

11.4.3.3.3

Water-cooled heat exchangers shall be provided with 20 % spare tubes.

11.4.3.3.4

Water-cooled heat exchanger tube bundles shall have provisions for plugging and isolating the leaking tubes.

11.4.3.3.5

Water-cooled heat exchangers shall be in accordance with API Standard 546:2022, 4.4.10.8.

11.4.3.3.6

When the required parameters on the water side are not available from the purchaser, cooling water system design criteria shall be in accordance with API Standard 546:2022, Table 7.

11.4.4 Stator windings

11.4.4.1

Winding coils shall be of a form-wound, fully vacuum pressure impregnated (VPI) construction.

NOTE 1 The main stator windings can be form-wound design based on mica and epoxy subject to owner approval.

NOTE 2 A resin rich system can be acceptable subject to owner approval.

11.4.4.2

For machines with a rated voltage of 3 kV and above, windings shall be provided with an anti-corona protection system in the slot of the coil.

11.4.4.3

For machines with a rated voltage of 6 kV and above, field stress grading tape shall be used for anti-corona protection.

11.4.4.4

Winding coils shall have uniform insulation levels rated for line-to-line voltage.

11.4.4.5

Winding connections, except those completed in the main terminal box, shall be brazed using a silver-based brazing material.

11.4.4.6

The windings of the machine shall be star connected.

11.4.4.7

Winding coils shall be tightly wedged in stator slots prior to vacuum pressure impregnation.

11.4.4.8

The stator winding system including end windings, connections and circuit rings shall be securely and uniformly supported and braced in the radial and circumferential directions.

11.4.4.9

The terminal lead extensions from the stator winding to the terminal box shall be braced and supported securely in a manner that allows for thermal expansion and movement during starting, and prevent chafing.

11.4.4.10

The terminal lead extensions from the stator winding to the terminal box shall be insulated, and separated from terminal leads and surfaces of different potential.

11.4.4.11

Magnetic stator slot wedges shall not be used.

11.4.5 Rotor

11.4.5.1

The shaft of the rotor shall be manufactured from a single piece of heat-treated forged steel.

11.4.5.2

Where shaft keys are provided, rotors shall be balanced with a half-key fitted in the shaft keyway in accordance with IEC 60034-14 and ISO 21940-32.

11.4.5.3

Rotors shall be balanced to restrict the residual unbalance below the permissible limit determined by the specified balance quality grade.

11.4.5.4

Rotors with rigid shaft characteristics shall be balanced in accordance with ISO 21940-11.

11.4.5.5

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

11.4.5.6

Rotors with flexible shaft characteristics shall be balanced at rated speed in accordance with ISO 21940-12.

11.4.5.7

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

11.4.5.8

For machines with sleeve bearings, the rotor shall be permanently marked to be visible in operation and standstill position with the magnetic centre and limits of permissible shaft axial movement.

11.4.5.9

Shaft extensions shall be in accordance with IEC 60072-2.

11.4.5.10

The proximity probe sensing areas on the rotor shaft shall be concentric with the bearing journal, free from stencil and scribe marks and from surface discontinuity.

11.4.5.11

The proximity probe sensing areas on the rotor shaft shall not be metallized, sleeved or plated.

11.4.5.12

The proximity probe sensing areas on the rotor shaft shall achieve a surface finish of maximum of 0.8 µm arithmetic average roughness.

11.4.5.13

The electrical and mechanical runout of the rotor shaft supported on v-blocks shall be measured at least every 10° of rotation on each probe location with the rotor rotated through the full 360°.

11.4.5.14

When proximity probes are provided, the electrical and mechanical runout of the rotor shaft in the assembled machine shall be measured at slow roll speed (200 rpm to 300 rpm).

11.4.5.15

Rotor balance corrections shall be in accordance with API Standard 546:2022, 4.4.6.3.2.

11.4.5.16

Components on the rotor assembly shall not be repaired by plating, plasma spray, metal spray, impregnation and welding unless approved by the purchaser.

11.4.5.17

The rotor winding insulation system shall be adequately rated for expected overvoltages or provided with overvoltage protection.

NOTE Overvoltage protection can be via bypass thyristors, varistors or a discharge resistor.

11.4.6 Terminals

Terminal bushings and post insulators shall be made of cycloaliphatic epoxy resin material.

11.4.7 Terminal boxes

11.4.7.1

The main terminal box shall be made of fabricated steel with a thickness greater than or equal to 3 mm.

11.4.7.2

Main and neutral terminal boxes shall have terminal markings and the direction of rotation in accordance with IEC 60034-8.

11.4.7.3

Where provided, threaded cable gland entries shall have a metric thread in accordance with IEC 60423:2007, Table 1.

11.4.7.4

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

11.4.7.5

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

11.4.7.6

Where provided, the neutral terminal box shall be located on the opposite side of the main terminal box.

11.4.7.7

For non-Ex db main terminal boxes, a corrosion-resistant pressure-relief diaphragm shall be incorporated in the terminal box.

11.4.7.8

The discharge of the pressure-relief diaphragm shall be located on the back panel of the terminal box and directed towards the machine frame.

11.4.7.9

The bottom of the terminal box shall be higher than the mounting surface of the machine.

11.4.7.10

Machine auxiliaries and instruments shall be wired to separate auxiliary terminal boxes mounted on the side of the machine.

11.4.7.11

The terminals forming a terminal block shall be arranged and positioned in an accessible manner for carrying out external cabling, testing, inspection and maintenance, following the termination of cables.

11.4.7.12

Terminal blocks for different voltages shall be segregated.

11.4.8 Fans

11.4.8.1

Separable fans shall be permanently indexed angularly and axially.

11.4.8.2

Independently mounted fan impellers shall be keyed or shrink fitted to the rotor shaft.

11.4.8.3

Machines with unidirectional fans shall have a permanently affixed label with an arrow indicating the direction of rotation.

11.4.8.4

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

11.4.8.5

Fan impellers shall not be made of plastic.

11.4.9 Bearing and Lubrication

11.4.9.1 Bearing insulation

11.4.9.1.1

Bearings shall be electrically insulated.

11.4.9.1.2

When insulated bearings are used, a shaft grounding system shall be provided at the drive end of the rotor shaft.

NOTE If an insulated coupling has been specified, a shaft grounding system is provided at the non-drive end of the rotor shaft.

11.4.9.1.3

The bearing housing shall bear a prominent label to indicate the use of insulated bearings.

11.4.9.2 Sleeve bearings

11.4.9.2.1

Sleeve bearings shall be spherical seated and self-aligning.

11.4.9.2.2

Replacement of sleeve bearing liners, pads and shells shall be possible without disassembly of the lower half of the end bells, plates and ductwork or without disassembly of the coupling on the machine.

11.4.9.2.3

A permanently installed jacking oil system shall only be installed if premature babbitt wear cannot be avoided without hydrostatic jacking.

11.4.9.2.4

Self-lubricated sleeve bearings shall be provided with an oil level indicator.

11.4.9.2.5

Sleeve bearings with a ring lubricating system shall permit the visual inspection of oil ring operation while the machine is running.

11.4.9.2.6

For flooded lubrication systems with a lube oil re-circulation circuit, a flow indicator shall be provided in the lube oil return lines.

NOTE The terms "flooded lubrication" and "forced lubrication" may be used interchangeably.

11.4.9.2.7

Machines shall have provision for two non-contacting vibration measurement proximity probes per sleeve bearing and one phase reference transducer in accordance with API Standard 670.

11.4.9.2.8

Oil and bearing temperatures shall be in accordance with API Standard 546:2022, 4.4.7.1.14.

11.4.9.2.9

The flooded lubrication system shall have redundant oil pumps.

11.4.9.2.10

The flooded lubrication system shall have provision for topping up the oil level while the machine is in operation.

11.4.9.2.11

If the flooded lubrication system fails or is switched off, the machine shall rundown safely.

11.4.9.2.12

The flooded lubrication system of the motor shall be separate from the seal and lube oil system of the hydrocarbon gas compressor unless a dry gas seal system is provided that prevents the following:

– seal gas from entering the lube oil system;

– lube oil from penetrating the dry gas seals.

11.4.9.2.13

When low-speed barring is required, the machine bearing shall be lubricated irrespective of the specified lubrication system.

11.4.10 Lateral analysis

When specified, lateral analysis shall be carried out for test floor and final site conditions in accordance with API Standard 546:2022, 4.4.6.2.1.

11.4.11 Torsional analysis

When specified, torsional analysis shall be performed in accordance with API Standard 546:2022, 4.4.6.2.2.

11.4.12 Monitoring and protection devices

11.4.12.1 General

11.4.12.1.1

External connections between machine-mounted devices and respective terminal boxes shall be routed in steel conduits clamped on the machine frame.

11.4.12.1.2

Each wire of the mounted device shall be connected to an individual terminal in the respective terminal box.

11.4.12.1.3

Three-wire Pt-100 platinum resistance temperature sensors in accordance with IEC 60751 shall be used for temperature detection.

11.4.12.2 Winding temperature sensors

Two winding temperature sensors per phase shall be installed to detect the highest temperatures of the stator winding.

11.4.12.3 Bearing temperature sensors

11.4.12.3.1

Two bearing temperature sensors per bearing shall be installed.

NOTE Where space constraints prevent the installation of two independent bearing temperature sensors on the bearing housing, an alternative solution can be proposed.

11.4.12.3.2

Where bearing insulation is provided, the integrity of bearing insulation shall remain uncompromised on the installation of the temperature sensor.

11.4.12.4 Heat exchangers

11.4.12.4.1 Air-cooled heat exchangers

For air-cooled heat exchangers, a three-wire Pt-100 temperature sensor shall be provided to measure the temperature of the cooling air leaving the heat exchanger.

11.4.12.4.2 Water-cooled heat exchangers

11.4.12.4.2.1

For water-cooled heat exchangers, three-wire Pt-100 temperature sensors shall be provided to monitor the inlet and outlet air temperatures.

11.4.12.4.2.2

Water-cooled heat exchangers shall be provided with leakage detection.

11.4.12.5 Partial discharge monitoring

11.4.12.5.1

Where stator winding partial discharge sensors are provided, the low voltage lead wires shall be connected to the terminals in a dedicated terminal box mounted on the machine frame.

11.4.12.5.2

Where stator winding partial discharge sensors are provided, the line conductor terminal box shall be sized to adhere to the installation requirements of the supplier of the sensors.

11.4.12.5.3

Where stator winding partial discharge sensors are provided for machines used in a hazardous area, the sensors shall have an independent hazardous area certification.

11.4.13 Excitation system

11.4.13.1 General

The excitation system of the synchronous machine shall be of brushless type.

11.4.13.2 Components

11.4.13.2.1

The exciter shall be protected against over voltage.

11.4.13.2.2

The excitation system shall monitor and indicate failure of the rotating rectifier.

11.4.13.3 Controls

The excitation system controller shall be microprocessor based, with digital communication features and interface ports compatible with the specified protocol of the higher-level automation system.

11.4.14 Anti-condensation heaters

11.4.14.1

Anti-condensation heaters provided around stator windings or within power terminal boxes shall keep the inside temperature 5 K above the ambient air temperature while the machine is not in operation.

11.4.14.2

Anti-condensation heaters shall be wired to terminals in a separate terminal box mounted on the machine frame.

11.4.14.3

A warning label stating "External voltage source" shall be affixed on the cover of the anti-condensation heater terminal box.

11.4.15 Additional requirements for converter duty motors

11.4.15.1

Converter duty motors shall be in accordance with IEC TS 60034-25.

11.4.15.2

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

11.4.15.3

When specified, torsional analysis of converter duty motors shall be in accordance with IEC 61800-2:2021, 5.13.2 and API Standard 546:2022, 4.4.6.2.2.

11.4.16 Machines intended for use in hazardous area

11.4.16.1 Certification

11.4.16.1.1

Machines and their mounted components shall be certified for the specified protection type in accordance with IEC 60079.

11.4.16.1.2

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

NOTE A manufacturer's declaration of conformity alone does not satisfy the requirement of 11.4.16.1.2.

11.4.16.2 Converter duty motors

For converter duty motors, the hazardous area certification shall cover the combined converter and motor over the speed/load operating range.

11.4.16.3 Flameproof (type Ex db)

Machines with protection level Ex db shall have terminal boxes with protection level Ex eb.

11.4.16.4 Pressurized (type Ex pxb and Ex pzc)

The pressurization unit shall provide the following status information:

– purge cycle in progress;

– purge cycle complete;

– pressurized;

– pressure low / pressure fail.

11.4.17 Additional requirements for synchronous generators

11.4.17.1 General

11.4.17.1.1

Three-phase synchronous generators with rated outputs of 10 MVA and above driven by steam turbines or combustion gas turbines and three-phase synchronous Mvar compensators with a rated output of 10 MVA and above shall be in accordance with IEC 60034-3.

11.4.17.1.2

The overcurrent capability of the generator shall be in accordance with IEC 60034-3.

11.4.17.2 Excitation system

The field forcing capability of the excitation system shall allow the generator to provide a short-circuit current equivalent to three times the rated current for at least 10 s.

11.4.17.3 Automatic voltage regulator (AVR)

11.4.17.3.1

The automatic voltage regulator (AVR) shall have manual and automatic control modes.

11.4.17.3.2

The AVR shall have a set point adjustment range of ±10 % of the nominal generator output voltage at the rated load.

11.4.17.3.3

The AVR shall keep a steady state voltage regulation within ±0,5 % of the nominal generator output voltage from no load to rated load at power factors varying from 0,5 lag to unity.

11.4.17.3.4

The AVR shall have over-excitation protection.

11.4.17.3.5

The AVR shall automatically switch to manual excitation without change in set-point upon failure of the AVR.

11.4.17.3.6

The power factor controller function in the AVR shall keep the power factor regulation within ±2,5 % of the set value of the power factor.

11.4.17.3.7

The AVR shall be insensitive to temperature changes and vibration.

11.4.17.4 Generator control and monitoring

11.4.17.4.1

The control panel shall have a double voltmeter, a double frequency meter synchroscope with rotating LED-type lamps, a timer, an auto-synchronizer and a synchro-check relay for synchronization in manual and automatic modes.

11.4.17.4.2

The control panel shall be equipped with local human-machine interface (HMI) for display of the single line diagram with operating status, operating parameter values, alarms, events and fault diagnostics.

11.4.17.4.3

The control panel shall have a microprocessor-based generator control and protection relay with a remote communication facility for transmission of alarms and data over the specified protocol.

11.4.17.4.4

The generator control panel shall include the following commands for operation/selection:

a) open generator circuit breaker;

b) close generator circuit breaker;

c) start synchronization;

d) speed control – raise/lower;

e) excitation voltage control – raise/lower;

f) push button for lamp test;

g) local/remote selector switch;

h) auto/manual synchronization switch;

i) isoch/droop selector switch;

j) AVR control mode.

11.4.17.4.5

The following operating parameters shall as a minimum be visible from the generator control panel front:

a) generator current in each phase (L1, L2, L3);

b) generator phase voltage for each phase (L1-N, L2-N, L3-N);

c) generator line-line voltage (L1-L2, L2-L3, L3-L1);

d) generator frequency;

e) excitation current;

f) generator active power;

g) generator reactive power;

h) accumulated energy produced by the generator;

i) accumulated running hours for the generator.

11.4.18 Constructional requirements for control panel

11.4.18.1

The control panel for the machine excitation system, generator controls, and metering and protection system shall be floor mounted, free-standing and self-supporting steel cabinet enclosure.

11.4.18.2

The control panel shall have a degree of ingress protection of at least IP21 with doors closed for indoor locations and at least IP44 with doors closed for outdoor locations in accordance with IEC 60529.

11.4.18.3

Live components and parts accessible with the control panel door open shall have a degree of ingress protection of at least IPXXB in accordance with IEC 60529.

11.4.18.4

The internal layout within the control panel shall permit operation and maintenance from the front only.

11.4.18.5

The control panel doors shall be hinged with an opening of at least 110°.

11.4.18.6

The control panel shall be equipped with a door stay to secure the hinged doors in the open position.

11.4.18.7

Insulation material of internal wires and cable trunking in the control panel shall be zero halogen and flame retardant, and have a low smoke index.

11.4.18.8

The mounting height of push buttons, displays, and protection and metering devices on the control panel shall be less than 1 800 mm from the floor level.

11.4.18.9

Wiring ends on terminals shall be labelled with alphanumeric character wire markers in accordance with the wiring diagram.

11.4.18.10

Each wire for external control wiring shall be terminated on an individual terminal.

11.4.18.11

Terminals shall be segregated in accordance with the voltage levels and type of signals.

11.4.18.12

The control panel shall be cooled by natural ventilation unless a component installed within the panel requires forced ventilation.

11.4.18.13

When dust filters are provided on louvers, filters shall be replaceable with ease during operation without power disconnection.

11.4.18.14

If the control panel is provided with a cooling fan, a dust filter shall be provided.

11.4.18.15

A main protective earth (PE) shall be provided with an extension on two sides of the control panel for external connections.

11.4.18.16

Metal parts of the control panel shall have electrical continuity and connection to the main protective earth.

11.4.18.17

Proprietary components or hardware installed in the control panel for machine control systems shall be declared upfront.

11.4.18.18

Components inside the control panel and door mounted components shall be labelled in accordance with the identifications given in the wiring diagrams.

12 Tolerances

12.1 General

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

IEC Guide 115:2023

12.2 Tolerances on values of quantities

Table 22 – Schedule of tolerances on values of quantities

Add new NOTE 2

NOTE 2 For synchronous motors driven by variable frequency drive, locked rotor current and locked rotor torque tests are not required.

13 Electromagnetic compatibility (EMC)

13.1 General

Replace first paragraph with

The EMC requirements specified in Clause 13 shall apply to all electrical machines included in the scope of this specification.

13.2 Immunity

13.2.2 Machines incorporating electronic circuits

Add to subclause

Peripheral control and excitation equipment of synchronous machines (e.g. AVR, exciter, control panels) designed to be installed and operated in an industrial environment shall comply with immunity requirements in accordance with IEC 61000-6-2.

13.3 Emission

Add to subclause

Peripheral control and excitation equipment of synchronous machines (e.g. AVR, exciter, control panels) designed to be installed and operated in an industrial environment shall comply with emission requirements in accordance with IEC 61000-6-4.

Bibliography

Add to start of Bibliography

The following documents are informatively cited in the text of this document, IEC 600034-1, the PDS (IOGP S-745D) or the IRS (IOGP S-745L).

Add to Bibliography

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*

IEC 60034-7:2020, *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 60034-18-1:2022, *Rotating electrical machines – Part 18-1: Functional evaluation of insulation systems – General guidelines*

IEC 61082-1, *Preparation of documents used in electrotechnology – Part 1: Rules*

IEC 61355-1, *Classification and designation of documents for plants, systems and equipment – Part 1: Rules and classification tables*

IEC 61892-5, *Mobile and fixed offshore units – Electrical Installations – Part 5: Mobile units*

IOGP S-560, *Supplementary Specification to IEC 61439-1 and IEC 61439-2 for Low-voltage Switchgear and Controlgear*

IOGP S-612, *Supplementary Specification to API Standard 672 Packaged, Integrally Geared Centrifugal Air Compressors*

IOGP S-615, *Supplementary Specification to API Standard 610 for Centrifugal Pumps*

IOGP S-620, *Supplementary Specification to IEC 62271-200 for High-voltage Switchgear and Controlgear*

IOGP S-703, *Supplementary Specification to IEC 60034-1 Low Voltage Three Phase Cage Induction Motors*

IOGP S-704, *Supplementary Specification to IEC 60034-1 High Voltage Three-phase Cage Induction Motors*

IOGP S-727, *Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear*

IOGP S-732, *Supplementary Specification to UL 845 Low Voltage Motor Control Centers*

IOGP S-733D, *Data Sheet for Low Voltage Motors (IEEE Std 841)*

IOGP S-747, *Supplementary Specification to IEC 61800-2 High-voltage AC Drive Systems*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country code*

ISO 9001, *Quality management systems — Requirements*

ISO 10005, *Quality management — Guidelines for quality plans*

ISO 10209, *Technical product documentation — Vocabulary — Terms relating to technical drawings, product definition and related documentation*

ISO 13880:1999, *Petroleum and natural gas industries — Content and drafting of a technical specification*

ISO 19901-5, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight management*

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

Delete from Bibliography

IEC 60079 (all parts)*, Explosive atmospheres*

IEC GUIDE 115:2021*, Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*

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