

STANDARDS PUBLICATION

KOC STANDARD

FOR

HIGH VOLTAGE INDUCTION MOTORS

DOC. NO. KOC-E-001
(REV. 3)

STANDARDS TEAM

شركة نفط الكويت
Kuwait Oil Company
إحدى شركات مؤسسة البترول الكويتية
A Subsidiary of Kuwait Petroleum Corporation

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ISSUING AUTHORITY:
STANDARDS TEAM

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3	28-08-2019	Issued as KOC Standard	Task Force (TF-E001/R3)	A. Unnikrishnan	Khalid B. Al-Shammari
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FOREWORD

This document **"KOC Standard for High Voltage Induction Motors" (KOC-E-001, Rev. 3)** is intended to provide the minimum requirements for high voltage induction motors for installation at various KOC Facilities within Kuwait. The earlier document KOC-E-001 (Rev. 2) issued in February 1994 has been substantially revised for conformance with the revisions of relevant International / National Standards and incorporation of latest technological developments in this field.

This Standard has been approved by the Standards Team in consultation with the Standards Technical Committee (STC) for use throughout the Engineering and Operational Functions of Kuwait Oil Company (K.S.C.).

This Standard sets out to achieve the following objectives:

a) To provide technical guidance and establish the base document for developing project / material specifications for High Voltage Induction Motors with a view to achieve uniformity, quality, reliability and efficiency in an economical manner.

b) To set out minimum features required, a Datasheet has been included which will act as a checklist to ensure that all requirements for the proper design, construction and operation of High Voltage Induction Motors are covered.

c) To maintain the Health, Safety & Environment (HSE) Management, including Process Safety Management (PSM) requirements for the safety and protection of personnel, environment and assets.

Feedback as well as any comments or suggestions derived from the application of this Standard at any stage of installation and testing are invited and should be directed to:

Team Leader Standards Team

(Chairman, Standards Technical Committee)

Projects Support Services Group, K. O. C.,

P. O. Box - 9758, Ahmadi - 61008,

State of Kuwait.

1.0 SCOPE

1.1 This Standard is intended to provide the minimum requirements for the design, manufacture, inspection & factory testing of High Voltage Induction Motors operating at voltages above 1000 V upto and including 11 kV for use in various KOC Facilities within Kuwait.

1.2 Motors for special applications such as downhole duties, totally submerged or with hollow shafts are not covered in this Standard.

2.0 APPLICATION

2.1 The design, construction, performance, inspection and testing of High Voltage Induction Motors shall fully comply with all the relevant requirements specified in this Standard and the reference Standards / Codes mentioned herein. Specific requirements, if any, shall be indicated in the Project Documents / Datasheet.

2.2 Any exceptions or deviations from this Standard, along with their merits and justifications, shall be brought to the attention of KOC Controlling Team for their review, consideration and amendment by Standards Team (if required).

2.3 Compliance of this KOC Standard does not of itself confer immunity from legal or statutory obligations.

3.0 TERMINOLOGY

3.1 Definitions

For the purpose of this Standard, the following definitions apply:

3.1.1 Cage Induction Motor

An induction motor with secondary cage (squirrel cage) winding(s).

3.1.2 Polarisation Index (PI)

Polarisation index is the quotient of the insulation resistance measured at two (2) different times, usually t_1 = 1 min and t_{10} = 10 min after application of the direct voltage. This is an indicator of the condition of the insulation.

3.1.3 Vacuum-Pressure Impregnation

An insulation system, the components of which are impregnated under vacuum after complete assembly and connection of the winding.

3.2 Abbreviations

For the purpose of this Standard, the following abbreviations apply:

API	American Petroleum Institute
BS	British Standards
DE	Drive End
FAT	Factory Acceptance Test
H_2S	Hydrogen Sulphide
HAC	Hazardous Area Classification
HSE	Health, Safety and Environment
HSEMS	Health, Safety and Environment Management System
HSSE	Health, Safety, Security and Environment
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organisation for Standardisation
ITP	Inspection and Test Plan
KOC	Kuwait Oil Company (K.S.C.)
NDE	Non-Drive End
NFPA	National Fire Protection Association
NO_x	Nitrogen Oxides
PF	Power Factor
PSM	Process Safety Management
QA / QC	Quality Assurance / Quality Control
RTD	Resistance Temperature Detector
SO_x	Sulphur Oxides

4.0 REFERENCE CODES AND STANDARDS

4.1 Conflicts

In the event of conflict between this KOC Standard and the latest editions of Standards / Codes referred herein, or other purchase or contractual requirements, the most stringent requirement shall apply.

4.2 List of Standards, Codes and Specifications

The design, performance, manufacture and testing of High Voltage Induction Motors shall conform, except where otherwise specified, with the current issues and amendments of the applicable Codes and Standards, including but not limited to the following:

4.2.1 International Standards

IEC 60034 (Various Parts)	Rotating Electrical Machines
IEC 60072 (Various Parts)	Dimensions and Output Ratings of Rotating Machines
IEC 60079 (Various Parts)	Explosive Atmospheres
IEC 60085	Electrical Insulation - Thermal Evaluation and Designation
IEC 60529	Specification for Degrees of Protection provided by Enclosures (IP Code)
IEC 60644	Specification for High-Voltage Fuse-Links for Motor Circuit Applications
IEC 61000 (Various Parts)	Electromagnetic Compatibility (EMC)
IEC 62444	Cable Glands for Electrical Installations
IEEE 43	Recommended Practice for Testing Insulation Resistance of Rotating Machinery
IEEE 112	IEEE Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry - Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp)
ISO 281	Rolling Bearings - Dynamic Load Ratings and Rating Life

ISO 2954	Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Instruments for Measuring Vibration Severity
ISO 9000 Series of Standards	Quality Management Systems
ISO 10285	Rolling bearings - Sleeve Type Linear Ball Bearings - Boundary Dimensions and Tolerances
ISO 10817-1	Rotating Shaft Vibration Measuring Systems - Part 1: Relative and Absolute Sensing of Radial Vibration
ISO 13012 (Various Parts)	Rolling Bearings - Accessories for Sleeve Type Linear Ball Bearings
ISO 12944 (Various Parts)	Paints and Varnishes. Corrosion Protection of Steel Structures by Protective Paint Systems

4.2.2 National Standards and Codes

API STD 541	Form-wound Squirrel Cage Induction Motors - 375 kW (500 Horsepower) and Larger
API STD 547	General Purpose Form-wound Squirrel Cage Induction Motors - 185 kW (250 hp) through 2240 kW (3000 hp)
API STD 670	Machinery Protection Systems
BS 4999	General requirements for Rotating Electrical Machines
NFPA 70E	Standard for Electrical Safety in Workplace
NFPA 70EH	Handbook for Electrical Safety in the Workplace

4.2.3 KOC Standards and Recommended Practices

KOC-E-002	KOC Standard for High Voltage Switchgear
KOC-E-003 Part 1	KOC Recommended Practice for Design Basis and Selection of Electrical Systems
KOC-E-003 Part 2	KOC Recommended Practice for Installation and Testing of Electrical Equipment
KOC-E-004 (Parts 1-6)	KOC Recommended Practice for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas
KOC-E-006	KOC Recommended Practice for Power System Studies, Protection and Control

KOC-E-008	KOC Recommended Practice for Selection and Installation of Electric Cables
KOC-E-009	KOC Standard for Low Voltage Switchgear
KOC-E-014	KOC Standard for Variable Speed Drive (VSD) Controller and Soft Starter
KOC-E-023	KOC Standard for Electric Cables
KOC-E-024	KOC Recommended Practice for Earthing and Bonding
KOC-G-002	KOC Standard for Hazardous Area Classifications
KOC-G-004	KOC Standard for Packing, Marking and Documentation
KOC-G-007	KOC Standard for Basic Design Data
KOC-G-009	KOC Standard for Spare Parts and Maintenance Data
KOC-ME-006 Part 2	KOC Standard for Reciprocating Pumps
KOC-ME-006 Part 3	KOC Standard for Positive Displacement Pumps - Rotary
KOC-ME-008 Part 2	KOC Standard for Centrifugal Pumps
KOC-ME-008 Part 3	KOC Standard for Horizontal End Suction Centrifugal Pumps to ASME B73.1
KOC-ME-011	KOC Standard for Process Gas Centrifugal Compressors
KOC-P-001	KOC Standard for Painting and Coating of External Metal Surfaces
KOC-Q-014	KOC Standard for Project QA / QC General Requirements

4.2.4 KOC Health, Safety & Environment Management System (HSEMS) and Process Safety Management (PSM) Procedures

KPC HSSE Policy

KOC.SA.027	Electrical Work Safety Procedure
KOC.SA.022	Electrical Multi-Lockout and Tagout Procedure
KOC.PS.001	Process Safety Management Manual
KOC.PS.006	Procedure for Inherently Safer Design (ISD)

5.0 ENVIRONMENTAL CONDITIONS

5.1 The environmental conditions in Kuwait are severe and shall be considered carefully while selecting High Voltage Induction Motors used for outdoor installation. The High Voltage Induction Motors intended for outdoor installation shall be suitable for continuous operation at a desert location under high ambient temperature and humidity. The atmosphere shall be considered to be dusty, corrosive and may contain traces of Hydrogen Sulphide (H_2S), SO_x / NO_x gases and airborne chemical contaminants.

5.2 For detailed information regarding the environmental, site and utility supply conditions prevailing throughout the KOC Facilities, KOC-G-007 “KOC Standard for Basic Design Data” shall be referred.

6.0 SERVICE CONDITIONS

6.1 General

6.1.1 The High Voltage Induction Motors are normally installed outdoor provided with shelters and shall be suitable for environmental conditions in Kuwait for operation under the temperature from -3 ˚C to 50 ˚C & humidity up to 100 %. In cases where any motor is to be installed in ambient temperature higher than stated above, it shall be specified in the Project Documents / Datasheet.

6.1.2 The Manufacturer / Vendor of High Voltage Induction Motors shall confirm that motors typical of that being supplied have been in operational use without problems, elsewhere under similar service / environmental conditions and reliability of all components in the motors to perform continuously in the service condition specified is guaranteed.

6.2 Hazardous Area Classification and Hazardous Area Certification

6.2.1 The classification of hazardous areas shall be based on the requirements of KOC-G-002 "KOC Standard for Hazardous Area Classification" and the latest edition of relevant International / National Standards / RPs / Code of Practices. For Hazardous Area Classification (HAC) of existing KOC Operating Facilities, KOC’s HAC drawings of the relevant Facility shall be referred.

6.2.2 The motor and accessories to be installed in a hazardous area shall be certified for use in those areas by a testing authority of an International recognition. The list of testing and certifying bodies acceptable to KOC are given in KOC-E-004 Part 2 “KOC Recommended Practice for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas, (Flameproof Enclosure ‘d’)”.

6.2.3 The copies of hazardous area certification documents shall be submitted to KOC for review and approval.

6.2.4 The type of protection of motor required for a particular application shall depend on the Hazardous Area Classification as indicated in Project Documents / Datasheet.

6.2.5 The motors to be used in Hazardous Areas Zone 1 and Zone 2 shall be flameproof enclosure type Ex “d” certified in accordance with the requirements of IEC 60079-1. In case, where large capacity Ex “d” certified motors are not in the production range of Manufacturers for a particular application, Ex “p” certified motors in accordance with the requirements of IEC 60079-2 shall be considered with prior approval from KOC.

6.2.6 The maximum surface temperature of the motor to be used in Hazardous Area shall not exceed the limits of 200 °C (rating of Temperature Class T3) for normal applications in KOC. In cases where the motor to be installed in a more stringent hazardous area (with lesser ignition temperature of gas / vapour), it shall be specified in the Project Documents / Datasheet.

7.0 HEALTH, SAFETY AND ENVIRONMENT

7.1 All applicable HSE requirements as per the relevant International and National Standards shall be considered in the design, material selection and manufacture of the High Voltage Induction Motors. Any material containing asbestos shall not be used in the motors / accessories.

7.2 Relevant KOC HSE requirements, including the Process Safety Management (PSM) requirements and specifically the Procedure for Inherently Safer Design (ISD) shall be adhered to while designing, engineering and material selection of HV Induction Motors so as to safeguard personnel, environment and assets during the use of motors.

7.3 The Manufacturer shall provide KOC with all relevant HSE information and precautionary measures, including Safety Manual(s) pertaining to the handling, operation and maintenance of motors.

8.0 DESIGN REQUIREMENTS

8.1 General

8.1.1 The High Voltage Cage Induction Motors shall be designed and manufactured in accordance with requirements specified in IEC 60034 (Relevant Parts).

8.1.2 The motor design shall be suitable for operation under a frequency variation of -5 % to +2.5 % of the nominal frequency and voltage variation of ± 6 % of rated voltage.

8.1.3 The ratings of induction motors at 3.3 kV shall be limited to 1200 kW and above 1200 kW, it shall be of 11 kV rating for all normal applications.

8.1.4 Where other voltage / frequency ratings are required for any particular applications such as VSD motors, the voltage / frequency ratings shall be specified in the Project Documents / Datasheet or approved by KOC.

8.1.5 For details of Voltage, Frequency and Phase Sequence prevailing in various KOC Facilities, refer to KOC-E-003 Part 1 “KOC Recommended Practice for Design Basis and Selection of Electrical Systems”.

8.1.6 The induction motors shall be three-phase cage induction type, rated for a single voltage suitable for operation on voltage, frequency, load characteristics, operational duty etc. as specified in the Project Documents / Datasheet.

8.1.7 The motor shall be of rugged cast iron / sheet steel construction for using in toughest environmental conditions as specified in Clause 5.0 of this Standard. The material of construction of rotor bars shall be Copper.

8.1.8 The Ingress Protection (IP) rating of motor and terminal boxes shall be as specified in the Project Documents / Datasheet. For details of minimum degree of ingress protection requirements for electrical equipment, KOC-E-003 Part 1 “KOC Recommended Practice for Design Basis and Selection of Electrical Systems” shall be referred.

8.1.9 The motors in Hazardous Area shall be certified for use in such areas in accordance with the requirements of IEC 60079 (Relevant Parts). For details of Hazardous Area Classification and Certification, Sub-Clause 6.2 of this Standard shall be referred.

8.1.10 The Efficiency and Power Factor (PF) of motors shall be as specified in the Project Documents / Datasheet. The minimum efficiency and power factor of the motor shall be 90 % and 0.9 (lagging) respectively, unless otherwise specified in the Project Documents / Datasheet.

8.1.11 For specific requirements of motors for VSD Systems, KOC-E-014 “KOC Standard for Variable Speed Drive (VSD) Controller and Soft Starter” shall be referred.

8.2 Motor Windings

8.2.1 The stator winding of the motor shall be Copper. The winding shall be adequately supported, braced and blocked to provide sufficient rigidity during normal operating conditions. The bracing shall be adequate enough to withstand Direct-On-Line (DOL) starting and re-switching at a value of residual voltage of at least 30 % of rated voltage and 180° out of phase with the supply voltage. Bracing shall be capable of preventing the resonant vibration of over hung end-windings.

8.2.2 The motor winding shall be star connected and all the six winding leads shall be brought out to the terminal box, unless otherwise specified in the Project Documents / Datasheet.

8.2.3 In case of vertical motors "winding support" shall prevent any dropping or permanent displacement of windings.

8.2.4 The insulation of winding shall be Class 'F' and the temperature rise of the motor shall not exceed to that applicable to Class 'B' insulation, unless otherwise specified in the Project Documents / Datasheet.

8.2.5 Impulse voltage withstand levels of stator windings shall be in accordance with the requirements of IEC 60034-15.

8.2.6 Winding insulation shall be non-hygroscopic and oil resistant. The windings shall be vacuum-pressure impregnated and suitably processed to effectively seal them to prevent deterioration during adverse environmental and operational conditions.

8.3 Motor Starting and Running Conditions

8.3.1 Motors shall be suitable for "Direct-On-line (DOL)" starting and shall be of Type-S1 (Continuous Duty), unless otherwise specified in the Project Documents / Datasheet.

8.3.2 Motors for normal applications shall be capable of two (2) successive direct-on-line load-coupled starts repeated at 20 minutes interval at normal running temperature within the Temperature Class T3. Any other specific starting requirements for a particular application shall be specified in the Project Documents / Datasheet.

8.3.3 The motor shall be designed capable of starting and accelerating the connected load to running speed with 80 % of rated voltage at the motor terminals.

8.3.4 The starting current of the motor shall not exceed six (6) times full load current, unless otherwise specified in the Project documents / Datasheets.

9.0 TEMPERATURE DETECTORS

9.1 All motors shall be provided with at least six (6) nos. of embedded (simplex) Resistance Temperature Detectors (RTDs), two (2) per phase, for monitoring stator winding temperature, unless otherwise specified in the Project Documents / Datasheet.

9.2 All motors shall be provided with four (4) nos. of simplex RTD type bearing temperature detectors per bearing unless otherwise specified in the Project Documents / Datasheet. Local bearing temperature indicators shall be provided for 11 kV motors.

9.3 The Resistance Temperature Detectors (RTDs) shall be of Platinum (Pt_{100}), three (3) lead type, unless otherwise specified in the Project Documents / Datasheet. All embedded temperature detectors in a motor shall have same characteristics.

9.4 The temperature detectors shall be wired to a separate independent terminal box.

9.5 Any indicating instruments, alarm and / or other devices as applicable / as specified in the Project Documents / Datasheet shall also be provided separately for local measurements.

10.0 TERMINAL BOXES

10.1 Motor terminal boxes shall conform to the requirements specified in IEC 60034-7.

10.2 Main terminal box for power cables shall be provided on the side (Left or Right viewed from DE) of the motor as specified in the Project Documents / Datasheet, to suit the driven equipment.

10.3 A separate terminal box for differential protection current transformer shall be provided on the opposite side of power cable terminal box, where required. Motors of rating 1200 kW and above shall be provided with differential protection, unless otherwise specified in the Project Documents / Datasheet.

10.4 The terminal box shall be suitably sized with provision for interchanging of any two (2) core connections at the terminal box, without stressing the connections, to facilitate correction of direction of rotation of the motor. The terminal box for power cables shall be designed such that it can be turned by 90° positions to suit cable entry, as per site conditions.

10.5 Separate terminal boxes shall be provided for instrument cables (temperature detectors, vibration sensors etc.), anti-condensation heater cables etc., as applicable. Each of these terminal boxes shall be provided with an internal earth terminal and shall be protected against over-voltage.

10.6 The Hazardous Area Certification for terminal boxes shall be of the same type as for the motor.

10.7 The main terminal box for power cables shall be capable of withstanding pressure build-up resulting from a three phase fault conditions without danger to personnel and plant.

10.8 The spare cable entry holes in the terminal boxes, if any, shall be sealed using appropriate type of certified plugs that maintain the same type / degree of protection of the terminal box to prevent the entry of hazardous gases / ingress of water.

10.9 To prevent moisture entry into the windings during transportation and storage of motors, the terminal boxes shall be provided with desiccant, while delivery of motors.

10.10 The terminals / phase sequence shall be marked in accordance with the requirements of IEC 60034-8, unless otherwise specified in the Project Documents / Datasheet.

11.0 COOLING

11.1 The motor shall be air cooled with fans fitted to the rotor shaft at Non-Drive End (NDE) for providing cooling air flow in the direction of the driven equipment, unless otherwise specified in the Project Documents / Datasheet.

11.2 Fan blades and housings shall be designed and constructed to prevent sparking due to any mechanical contact during operation. Fan shall be of non-corroding metal construction treated with corrosion-resistant coating.

11.3 Where heat exchangers are required for cooling large capacity motors, air-to-air heat exchanger shall be used.

12.0 BEARINGS

12.1 The bearings (Ball / Roller / Sleeve types) used in motors shall be suitable for the applications / type of driven equipment. The driven equipment Manufacturer shall provide the normal thrust exerted by the drive / load in order to design the type of bearing. For guidance on selection of bearings, API 541 shall be referred.

12.2 The horizontal motor shall have two (2) ball / roller bearings, grease packed and sealed for life to prevent the ingress of foreign matter and the loss of grease. Where high radial forces occur in service, the combination of ball and roller bearing shall be suitably used.

12.3 Vertical motors shall have thrust bearings designed to carry the maximum axial thrust (up and down) imposed by the driven equipment.

12.4 The bearings shall be in metric sizes and comply with International Organization for Standardization (ISO) recommended dimensions.

12.5 The bearing design shall provide sufficient damping to minimise the rotor vibration.

12.6 For oil lubricated sleeve bearings, necessary instruments for measuring lube oil level, flow, pressure and temperature shall be provided, as required.

13.0 VIBRATION

13.1 Motors with rating of 550 kW and above shall be equipped with vibration monitoring equipment at each bearing, unless otherwise specified in the Project Documents / Datasheet.

13.2 The vibration monitoring equipment shall be non-contacting proximity probes complying with the requirements of API 670.

13.3 The limits of vibration shall conform to the requirements specified in IEC 60034-14, unless otherwise specified in the Project Documents / Datasheet.

14.0 NOISE LIMITS

The maximum permitted noise level shall be 77 dB(A) at a reference distance of one (1) metre with the motor operating at no-load, rated voltage and frequency.

15.0 LUBRICATION

15.1 Grease lubricated bearing shall have pressure relief devices, which ensure that the new grease displaces the maximum amount of old grease and ejects the surplus grease outside the motor.

15.2 Re-lubrication shall be possible on both oil or grease type bearings without stopping or dismantling the motor in a safe manner.

16.0 ANTI-CONDENSATION HEATER

16.1 The motors shall be provided with a suitably rated anti-condensation heaters. The anti-condensation heaters shall be suitable for operation on a single phase, 50 Hz, 250 V AC supply, unless otherwise specified in the Project Documents / Datasheet.

16.2 The anti-condensation heater shall be of fully insulated design and shall be suitably arranged to provide uniform heating to the stator.

16.3 It shall be ensured that the motor surface temperature shall not exceed the specified limiting temperature of the motor, when the anti-condensation heater is “ON”.

16.4 Anti-condensation heaters of the motors shall be provided with interlocks in such a way that heaters shall be automatically “ON” when power supply to the motor is “OFF” and vice versa.

16.5 A warning label shall be provided to indicate that the “Heater Circuit will be ON when the motor is stationary”.

17.0 EARTHING

17.1 Motors shall be provided with minimum two (2) separate earthing terminals on the frame, suitably marked with the Earthing symbol, for providing connections to the earth grid.

17.2 The earthing terminal shall be suitably sized to accommodate an earthing conductor of cross-sectional area as specified in the Datasheet.

18.0 MECHANICAL HANDLING

18.1 The motors shall be provided with suitable lifting / handling arrangements and suitably arranged jacking points in all three planes, easily identified on the motor and shown in the equipment drawings.

18.2 Where it is intended to use spreader bars for lifting all or part of machine or where special handling precautions are necessary, it shall be indicated on a suitable plate affixed to the external surface of the motor.

19.0 PAINTING

19.1 All motors shall be painted in grey colour, unless otherwise specified in the Project Documents / Datasheet.

19.2 The paint shall withstand salt laden atmosphere with good resistant quality against acid, alkaline and high temperatures.

19.3 For details of painting requirements, KOC-P-001 "KOC Standard for Painting and Coating of External Metal Surfaces” shall be referred.

20.0 NAMEPLATE DETAILS

20.1 Nameplate shall be made of stainless steel and be screw fixed to a non-removable part of the motor frame and shall be stamped with data in accordance with IEC 60034-1. Values given shall be those measured during tests. The information to be given on the nameplate shall include, but not limited to the following:

a) Manufacturer's Name and Country of Manufacture,

b) Serial Number / Frame Size / Year of Manufacture,

c) Enclosure Degree of Protection (IP Code),

d) Hazardous Area Certification / Temperature Class / Gas Group,

e) Duty Class,

f) Insulation Class / Type,

g) Winding Connection / Phase Sequence,

h) Rated Output in kW,

i) Rated Voltage in kV,

j) Rated Current in Amps,

k) Rated Frequency in Hz,

l) Rated Power Factor (Cos Ø),

m) Rated Efficiency,

n) Rated Speed in RPM,

o) Bearing Type / Details,

p) Lubrication Information (as applicable),

q) Rated Noise Level in dB(A),

r) Cooling Method,

s) Anti-Condensation Heater Voltage and Power,

t) Net Weight,

u) Any other information required as specified in the Project Documents / Datasheet or recommended by Manufacturer.

20.2 The direction of rotation of the motor shall be clearly indicated on the motor by raised or embossed markings.

21.0 INSPECTION AND TESTING

21.1 General

21.1.1 All motors shall be subjected to tests at the Manufacturer's Works as per this Standard and relevant International / National Standards.

21.1.2 The Manufacturer shall submit the Inspection & Test Plan (ITP) and Factory Test Procedures to KOC for review / approval.

21.2 Factory Inspection and Testing

21.2.1 The inspection, tests and measurements on HV Induction Motors shall be carried out at Manufacturer's Facility in accordance with the approved FAT Procedures / ITP. The inspection, tests and measurements to be carried out shall include but not limited to the following:

a) Visual Inspection,

b) Nameplate Verification,

c) Datasheet Verification,

d) Measurement of Winding Resistance (Cold and Hot),

e) Measurement of No Load Losses and Current,

f) Measurement of Slip at ¾ Load and Full Load,

g) Measurement of Vibration,

h) Measurement of Winding and Bearing Temperature,

i) Measurement of Lube Oil Level / Pressure / Temperature (as applicable),

j) Measurement of Noise,

k) Measurement of Parameters and Calculation of Locked Rotor Current and Torque,

l) Measurement of Parameters and Calculation of Pull-Up Torque,

m) Measurement of Parameters and Calculation of Starting Torque Characteristic,

n) Measurement of Parameters and Calculation of Efficiency at Full Load, Three-Quarters and Half Load,

o) Measurement of Parameters and Calculation of Power Factor at Full Load, Three-Quarters and Half Load,

p) High Voltage Test plus Insulation Resistance Test before and after Heat Run Test,

q) Determination of Polarisation Index on stator windings,

r) Partial Discharge Test on 11 kV motors,

s) High Voltage and Continuity Tests on Embedded Temperature Detectors with Tests to Demonstrate Satisfactory Operation and Compliance with Stated Characteristics,

t) Direction of Rotation and Phase Sequence Checks,

u) Inspection (at full load) of Bearings and Mechanical Operation of the Motor,

v) Full Load Heat Run Test (carried out at least on one machine of each group of identical machines being supplied, unless otherwise specified in the Project Documents / Datasheet),

w) Momentary Overload Test,

x) Painting Colour and Thickness Checking,

y) Any other tests as specified in the Project Documents / Datasheet.

Note: For additional tests of VSD Motors, "KOC-E-014" shall be referred.

21.2.2 Test Reports / Certificates along with relevant documents for all motors shall be submitted to KOC for review and approval. The motors shall not be delivered to KOC until all applicable tests have been successfully completed and test reports approved by KOC.

21.2.3 For installation and site testing requirements of motors, KOC-E-003 Part 2 "KOC Recommended Practice for Installation and Testing of Electrical Equipment" shall be referred.

22.0 QUALITY ASSURANCE

22.1 The Manufacturer / Vendor shall operate a quality system to ensure that the requirements of this Standard are achieved. The Manufacturer's quality system shall be preferably based on ISO 9000 Series of Standards, certified by Internationally Accredited Certification Bodies.

22.2 Verification of the Manufacturer / Vendor quality system is normally part of the pre-qualification procedure and therefore not detailed in this Standard.

22.3 For details of quality requirements, KOC-Q-014 "KOC Standard for Project QA / QC General Requirements" shall be referred.

23.0 PACKING, MARKING AND DOCUMENTATION

23.1 All Correspondences, Drawings, Catalogues, Instruction Manuals, Datasheets or any other written information shall be in the English language. In case of dual languages, one (1) language shall be English.

23.2 All dimensions, units of measurement, physical constants etc. shall be in SI units, unless otherwise specified in the Project Documents.

23.3 All documents submitted by the Manufacturer / Vendor shall be marked with relevant Purchase Order Number, Project / Contract Number and Manufacturer's Reference Number for ease of tracking. In addition to the hard copies, electronic files of all documents, datasheets, drawings etc. shall be provided in software approved by KOC.

23.4 The documents / drawings of HV Induction Motors to be provided by the Vendor / Manufacturer while submitting the offer for review and approval shall include but not limited to the following:

a) Manufacturer's Name and Address,

b) Completed Datasheet,

c) General arrangement drawings with Dimensions, Weight and all other details such as Arrangement of Terminal Boxes, Lifting Points etc. (as applicable),

d) Mounting Dimensions with Fixing Details,

e) Shaft Dimensions,

f) Bearing Type,

g) Terminal Boxes - Dimensional Details,

h) Cable Termination and Entry Positions Details,

i) Earthing Details,

j) Minimum Clearance Requirements for Maintenance,

k) Type Test Certificates,

l) Inspection and Test Plan (ITP),

m) Details of Temperature Detectors and other Instrumentation sensors / items with all technical details, Type, Serial Number etc. (as applicable),

n) List of Spare Parts for minimum two (2) years of Normal Operation,

o) Paint Colour and Specification,

p) Lifting / Handling Arrangements / Details,

q) Packing Details,

r) Any other specific details required.

23.5 While delivery of HV Induction Motors, the documents / drawings to be submitted by Manufacturer / Vendor to KOC for records shall include but not limited to the following:

a) Manufacturer's Name and Address,

b) Name of the Project,

c) Purchaser's Order Number,

d) Manufacturer's Order or Contract Number,

e) Manufacturer's Drawing Number with Revision Number & Dates,

f) Completed Datasheet,

g) Detailed Drawings showing General Arrangements with Dimensions, Weight and all other Details such as Arrangement of Terminal Boxes, Lifting Points etc. (as applicable),

h) Mounting Dimensions with Fixing Details,

i) Shaft Dimensions,

j) Bearing Type and Lubrication Information (as applicable),

k) Terminal Boxes Dimensional Details,

l) Details of Temperature Detectors and other Instrumentation Sensors / Items used with all Technical Details, Type, Serial Number etc. (as applicable),

m) Cable Termination and Entry Positions Details,

n) Earthing Details,

o) Manuals for Installation, Testing & Commissioning, Operation, Maintenance (including Periodical Maintenance Schedule) etc. and Procedures for Short Term & Long Term Storage,

p) Average Torque Vs Speed Curve during Starting at Rated Voltage and 80 % of Rated Voltage,

q) Current Vs Speed Curve during Starting and various specified loads at Rated Voltage and 80 % of Rated Voltage,

r) Torsional Vibration Analysis Report (as applicable),

s) Schematic Diagrams of Auxiliary Subsystems (e.g. Lube Oil System) as applicable,

t) Warranty Certificate,

u) List of Special Tools,

v) List of Spare Parts for two (2) years of Normal Operation,

w) Paint Colour,

x) Lifting / Handling Arrangements / Details,

y) Packing Details,

z) Reports of Type / Routine / Performance Tests and Special Tests (if any) carried out at Manufacturer's Facility,

aa) Evidence of Quality Checks carried out by Manufacturer,

ab) Any other data / details as specified in the Project Documents / Datasheet.

23.6 For detailed information on packing, marking and documentation, refer to KOC-G-004 "KOC Standard for Packing, Marking and Documentation".

24.0 SPARE PARTS AND MAINTENANCE DATA

24.1 The motor spare parts list required for a minimum period of two (2) years of operation shall be provided.

24.2 For spare parts and maintenance requirements, KOC-G-009 "KOC Standard for Spare Parts and Maintenance Data" shall be referred for guidance.

25.0 APPENDIX - I: DATASHEET FOR HIGH VOLTAGE INDUCTION MOTORS (TYPICAL)

	KUWAIT OIL COMPANY (K.S.C.)		
DATASHEET NO.:	DATASHEET FOR HIGH VOLTAGE INDUCTION MOTOR	REV.	
		PAGE No.:	

A	**INFORMATION / DESIGN DATA - TO BE COMPLETED BY PURCHASER**				
GENERAL INFORMATION / DESIGN DATA					
1	APPLICABLE KOC STANDARD		KOC-E-001		
2	APPLICABLE INTERNATIONAL STANDARD		IEC 60034		
3	SERVICE CONDITIONS	TEMPERATURE			
		RELATIVE HUMIDITY			
4	INSTALLATION LOCATION / SITE				
5	ALTITUDE				
6	DRIVEN LOAD / EQUIPMENT				
7	DRIVEN LOAD INERTIA ($Kg.m^2$)				
8	DRIVE MECHANISM		☐ DIRECT	☐ VEE BELT	☐ GEAR BOX
9	POWER SUPPLY SYSTEM	RATED VOLTAGE	☐ 3.3 kV	☐ 11 kV	_____ kV
		RATED FREQUENCY	50 Hz		
		No. OF PHASES	THREE (3)		
		NEUTRAL	☐ SOLIDLY EARTHED	☐ IMPEDANCE EARTHED	
10	PROSPECTIVE SYSTEM FAULT CURRENT				
11	POWER FREQUENCY WITHSTAND VOLTAGE				
12	IMPULSE VOLTAGE WITHSTAND LEVEL				
13	DIFFERENTIAL PROTECTION REQUIREMENT		☐ REQUIRED	☐ NOT REQUIRED	
14	DUTY TYPE				
15	INSTALLATION AREA		☐ HAZARDOUS	☐ NON- HAZARDOUS	
16	HAZARDOUS AREA CLASSIFICATION		☐ ZONE 1	☐ ZONE 2	
17	GAS GROUP				
18	HAZARDOUS AREA CERTIFICATION, PROTECTION TYPE & TEMPERATURE CLASS				
19	INSULATION CLASS & ALLOWABLE TEMPERATURE RISE				
20	INGRESS PROTECTION				

A CONTD…	INFORMATION / DESIGN DATA - TO BE COMPLETED BY PURCHASER			
21	COOLING METHOD			
22	WINDING CONNECTION			
23	METHOD OF STARTING			
24	PERMISSIBLE VOLTAGE DROP AT STARTING	_____ %		
25	STARTING CURRENT			
26	No. OF STARTS PER HOUR			
27	MOTOR EFFICIENCY			
28	MOTOR POWER FACTOR			
29	MOTOR MOUNTING TYPE	☐ HORIZONTAL	☐ VERTICAL	
30	COUPLING TYPE			
31	DIRECTION OF ROTATION SEEN FROM DRIVE END (DE)	☐ CW	☐ ANTI-CW	
32	WINDING TEMPERATURE DETECTOR Nos. & TYPE			
33	BEARING TEMPERATURE DETECTOR Nos. & TYPE			
34	RESISTANCE TEMPERATURE DETECTOR MATERIAL			
35	LOCAL BEARING TEMPERATURE INDICATOR	☐ REQUIRED	☐ NOT REQUIRED	
36	BEARING VIBRATION MONITOR	☐ REQUIRED	☐ NOT REQUIRED	
37	ANTI-CONDENSATION HEATER VOLTAGE			
38	MAIN TERMINAL BOX (POWER CABLE) MOUNTING (VIEWED FROM DE)	☐ LEFT SIDE	☐ RIGHT SIDE	
39	CABLE ENTRY POSITION	☐ BOTTOM	☐ TOP	☐ SIDE
40	AUXILIARY TERMINAL BOXES OVER-VOLTAGE PROTECTION	☐ NOT REQUIRED	☐ REQUIRED	
41	TERMINAL MARKING DETAILS			
42	CABLE GLAND TYPE			
43	CABLE DETAILS	CORES	SIZE (mm^2)	TYPE
43 (a)	MOTOR			
43 (b)	ANTI-CONDENSATION HEATER			
43 (c)	INSTRUMENTATION			
44	EARTHING CABLE SIZE			
45	NOISE LEVEL			
46	MOTOR PAINTING COLOUR			
47	HEAT RUN TEST	☐ NOT REQUIRED	☐ REQUIRED	
48	ANY OTHER SPECIFIC TESTS (SPECIFY)			
49	ANY SPECIFIC DOCUMENTATION REQUIREMENTS			

B	DETAILS TO BE FURNISHED BY THE MANUFACTURER			
1	NAME OF MANUFACTURER			
2	COUNTRY OF MANUFACTURE			
3	MANUFACTURER'S TYPE DESIGNATION			
4	APPLICABLE INTERNATIONAL STANDARD			
5	FRAME SIZE			
6	RATED OUTPUT	_____ kW		
7	RATED VOLTAGE	_____ VOLTS		
8	RATED CURRENT	_____ AMPS.		
9	RATED POWER FACTOR	_____		
10	INGRESS PROTECTION			
11	HAZARDOUS AREA PROTECTION TYPE			
12	HAC CERTIFYING AUTHORITY AND CERTIFICATE No. & DATE			
13	INSULATION CLASS			
14	TEMPERATURE RISE CLASS			
15	FULL LOAD SPEED	_____ RPM		
16	FULL LOAD CURRENT	_____ AMPS.		
17	LOCKED ROTOR CURRENT	_____ AMPS.		
18	FULL LOAD TORQUE	_____ NM / RPM		
19	LOCKED ROTOR TORQUE	_____ NM / RPM		
20	PULL-UP TORQUE	_____ NM / RPM		
21	PULL-OUT TORQUE	_____ NM / RPM		
22	SPEED - TORQUE CHARACTERISTIC			
22 (a)	AT 100 % RATED VOLTAGE			
22 (b)	AT 80 % RATED VOLTAGE			
23	EFFICIENCY	100 % LOAD	¾ LOAD	HALF LOAD
24	POWER FACTOR (AT VARIOUS % LOAD)	100 % LOAD	¾ LOAD	HALF LOAD
25	STATOR WINDING CONNECTION			
26	No. OF STATOR WINDING TERMINALS			
27	MOTOR ROTATION REVERSIBLE	☐ YES	☐ NO	
28	MOTOR FAN	☐ BI-DIRECTIONAL	☐ UNI-DIRECTIONAL	

B CONTD…	DETAILS TO BE FURNISHED BY THE MANUFACTURER		
29	WINDING TEMPERATURE DETECTOR Nos. & TYPE		
30	BEARING DETAILS		
30 (a)	TYPE		
30 (b)	MAKE, SERIES, SIZE & No.		
30 (c)	METHOD OF LUBRICATION		
30 (d)	LUBRICATION INTERVALS		
30 (e)	TEMPERATURE DETECTOR Nos. & TYPE		
30 (f)	LOCAL TEMPERATURE INDICATOR		
30 (g)	BEARING VIBRATION MONITOR		
31	TERMINAL BOX: TYPE, MOUNTING ARRANGEMENT, CABLE GLAND DETAILS		
32	TERMINAL BOX FAULT RATING		
33	TERMINAL MARKING DETAILS		
34	ANTI-CONDENSATION HEATER RATING		
35	NOISE LEVEL AT ONE (1) METRE AT NO LOAD		
36	TYPE TEST CERTIFICATE REF. No. AND DETAILS		
37	ROUTINE TEST REPORTS		
38	SPECIAL TEST REPORTS, IF ANY		
39	ANY SPECIFIC DOCUMENTATION		
40	COMPLIANCE WITH SPECIFICATIONS / DATASHEET	☐ YES	☐ NO (If 'NO' submit details in a separate sheet)

ACKNOWLEDGEMENT

The draft of this document **"KOC Standard for High Voltage Induction Motors" (KOC-E-001, Rev. 3)** has been circulated to KOC User Teams for their review & comments and the responses received were suitably resolved and incorporated into the document.

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