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| Assets Planning and Delivery Group  Engineering |

DESIGN STANDARD DS 26-15

Type Specifications – Electrical

Type Specification for High Voltage Submersible Bore

Hole Cage Induction Motor

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| version 2  revision 1 |
| MAY 2023 |

**FOREWORD**

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

[Overview of Western Australia’s Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)](https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf)

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer - Electrical, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

**Head of Engineering**

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**REVISION STATUS**

**The revision status of this standard is shown section by section below:**

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# GENERAL

This Specification covers the requirements for the design, manufacture, assembly, inspection, factory testing, packaging, transport to site, on-site assembly, on-site testing and commissioning of a High Voltage submersible cage induction motor and associated shaft seal unit.

The motor shall be supplied to site complete with all necessary accessories and miscellaneous material, minor parts and other such items necessary to complete assembly, testing and commissioning of the motor.

The installation and connection of the motor will be carried out by others in accordance with the Contractor’s instructions.

The Contractor shall return to site to commission the motor once the electrical and mechanical installation at the site has been completed.

# SITE

The motor will be installed in a bore hole on a site, the location of which shall be as detailed in the Annexure. Access to the site shall be as detailed in the Annexure.

The inside diameter of the bore hole and the depth of installation of the motor below ground level shall be as detailed in the Annexure.

# OPERATING ENVIRONMENT

The motor shall be suitable for continuous operation fully submerged in water under the environmental conditions detailed in the Annexure.

# OPERATING MODE

The motor shall be used to drive a centrifugal bore hole pump and the mode of operation for the motor shall be as detailed in the Annexure.

# WORK BY THE PRINCIPAL

If so specified in the Annexure, the motor shall be supplied to the Principal as part of a bore hole motor pump set. The Principal will install the motor pump set in the bore hole and will connect the unit both hydraulically and electrically. Other work to be performed by the Principal shall be as detailed in the Annexure.

# INFORMATION TO BE PROVIDED BY THE CONTRACTOR

The Contractor shall provide the following documentation in respect to the motor and shaft seal unit at the times shown hereunder:

1. General Arrangement Drawings including

certified mounting dimensions 28 days after date of order

1. Final Design Equivalent Circuit Values

(confirming values in the Contractor’s offer) 28 days prior to factory tests

1. Inspection and Test Plan 28 days prior to factory test
2. Factory Test Certificates within 7 days of the tests and at least 7 days prior to dispatch to site
3. Operating and Maintenance Manual On delivery

# CONTRACTOR’S DRAWINGS

1. All drawings provided by the Contractor shall be in accordance with the latest issue of the Water Corporation Design Standard DS24 – Electrical Drafting
2. All drawings shall be prepared in AutoCAD format, Release 2018 or later software
3. Drawings shall be prepared on the “Electrical” A1 metric drawing sheet and title block provided in the Water Corporation eXternal (WCX) package (available for download) in accordance with the Water Corporations Design Standard DS80
4. The drawings shall provide within the title block, the details to identify the drawing, including but not limited to its title, plan number, revision status, date of issue, Corporate project number, contractor’s name and reference number (if applicable)
5. Drawings’ detail shall include, but not limited to, the general arrangement, panel layout, power and control circuit diagrams and equipment specifications, as required
6. The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings

# STANDARDS

The workmanship, equipment and materials provided in accordance with this Specification shall comply in design, construction, rating and performance with the current relevant Australian or International Standards and Codes.

In the absence of current relevant Australian or International Standards and codes, compliance shall be with relevant National Standards together with the requirements of competent Authorities having jurisdiction over all or any part of the design, manufacture, installation and operation of the equipment.

Specific reference is made within Specification to the following Australian and International standards:

Except where specified otherwise in this Specification, the motor shall comply with the requirements of AS 60034.1.

~~AS 1359.101 Rotating electrical machines - General requirements - Rating and performance~~

AS 1359.102.1 Rotating Electrical Machines - Methods of determining losses and efficiency - General

AS 1359.114 Rotating electrical machines - Vibration measurement and limits

AS 60034.1 Rotating electrical machines - Rating and performance

(IEC 60034-1 modified)

AS 60034.5 Rotating electrical machines - Degrees of protection provided by the integral design of rotating electrical machines (IP Code) (identical to IEC 60034-5)

AS 60034.7 Rotating electrical machines - Classification of types of construction, mounting, arrangements and terminal position (IM Code) (identical to IEC 60034-7)

AS 60034.8 Rotating electrical machines - Terminal markings and direction of rotation (IEC 60034-8 modified)

AS/NZS ISO 9001 Quality Management Systems – Requirements

IEC 60034-1 Rotating electrical machines - Rating and performance

IEC 60034-2-1 Rotating electrical machines - Standard methods for determining losses and efficiency from tests

IEC 60034-6 Rotating electrical machines - Methods of cooling (IC Code)

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

IEC 60034-18 Rotating electrical machines - Functional evaluation of insulation systems

IEC 60085 Electrical insulation - Thermal evaluation and designation

NEMA MG 31 Performance standards applying to all machines - Definite purpose inverter fed polyphase motors

# QUALITY ASSURANCE

The motor shall be manufactured under a Quality System certified by an Accredited Authority to be in accordance with AS/NZS ISO 9001, or an approved equivalent.

# POWER SUPPLY TO MOTOR

1. The motor shall be rated for operation from a 3-phase power supply with a phase sequence of RWB and a solidly grounded neutral.
2. If the motor is to be installed in a deep bore hole and is to be converter supplied the power supply to the motor shall be via a sine filter so that the total harmonic distortion in the output voltage is less than 10 %.
3. Other power supply characteristics shall be as detailed in the Annexure.

# MOTOR TYPE

The motor shall be a 2-pole cage induction motor type generally in accordance with AS 60034.1 and shall be suitable for operation in the mode detailed in the Annexure.

# MOTOR DUTY AND RATING

The motor shall be rated for duty S1 in accordance with AS 60034.1. The motor maximum power output rating shall be as specified in the Annexure. The motor maximum power output rating shall be at the motor’s rated frequency, shall be at the above duty rating and shall be under the specified operating conditions.

The motor shall have torque versus speed, current versus speed and power factor versus speed characteristics in accordance with the characteristics submitted in the Contractor’s Tender.

# DIRECTION OF ROTATION

The motor direction of rotation in accordance with AS 60034.8 shall be as specified in the Annexure.

# TYPE OF CONSTRUCTION

The motor type of construction and mounting arrangement shall be AS 60034.7 designation IM 8451.

# ENCLOSURE

The motor shall be of the submersible construction type and protected to AS 60034.5 classification IP68. The motor enclosure including cable terminations shall be designed and constructed so as to exclude water completely when the motor is installed and operating in the operating conditions specified in the Annexure.

# COOLING

## General

The type of motor cooling used by the motor shall be one of the following:

(b) IEC 60034-6 designation IC4W1,

(d) IEC 60034-6 designation IC4U1

## IC4W1 Primary Coolant

If the cooling designation is IC4W1, the primary coolant shall be distilled water mixed with food grade additives for freeze and rust protection.

## IC4U1 Primary Coolant

If the cooling designation is IC4U1, the primary coolant shall be a non-toxic high dielectric strength mineral or synthetic oil of a type certified by an independent authority to be suitable for in potable water applications.

## Primary Coolant Circulation

The primary coolant shall be circulated positively within the motor so as to facilitate internal heat transfer and to provide adequate lubrication to the motor bearings.

A coolant reservoir complete with stainless steel coolant filter shall be provided at the bottom of the motor so as to provide additional cooling capacity and to remove contaminants from the primary coolant.

## Secondary Coolant Circulation

The secondary coolant shall be the water drawn by the driven pump through the space between the motor body and the bore hole casing.

# VIBRATION LEVEL

The motor shall be designed and constructed so that the vibration severity level in a state of free suspension shall not exceed vibration grade R over the frequency range 10 Hz to 1 kHz in accordance with AS 1359.114. The works test shall be conducted with the half key fitted.

# TERMINATIONS

The motor shall be provided with a waterproof termination facility suitable for providing a waterproof termination of the down hole cable specified in the Annexure. If the termination is not of the plug-in type, it shall be such that it is able to be remade conveniently and without significant cable loss.

# WINDINGS

## General

The motor windings shall be:

1. designed to have an even temperature distribution free from hot spots, and
2. suitably braced to give adequate rigidity under short circuit and starting conditions.

## Insulation

1. The winding insulation system shall have been developed on the basis of functional evaluation in accordance with IEC 60034.18
2. The winding insulation shall be such that it is completely unaffected by the motor’s primary coolant.
3. In addition, if the primary coolant is oil, the winding insulation shall have a high resistance to water absorption.

## Rated dV/dt

1. While the motor will not be supplied directly from a converter, it may be subject to limited impulse voltage surges due to lightning surges in the power supply system.

Consequently the motor shall be supplied with insulation reinforced at least to the level appropriate for motors suitable for direct converter supply in accordance NEMA MG 31

1. Thus the motor insulation single amplitude zero-to-peak line-to-line 1 microsecond rise time impulse voltage rating shall be not less than 2.0 times the motor rated line-to-line voltage.
2. Similarly the motor insulation single amplitude zero to peak line-to-earth 1 microsecond impulse rise time voltage rating shall be not less than 2.5 times the motor rated line-to- line voltage.

## Winding Temperature Rise

The winding maximum temperature shall not exceed the insulation rated maximum temperature rating when:

1. the motor is running under load with rated R.M.S. current,
2. the water temperature is at the maximum temperature specified in the Annexure,
3. the motor is installed in a bore hole casing of the diameter specified in the Annexure, and
4. the pumped water flow rate is at 80% of the maximum pumped flow rate specified in the Annexure.

# SHAFT SEALING

## General

The motor shall be equipped with an effective shaft sealing system providing:

1. Isolation of the motor primary coolant from the water in the bore hole and from the water in the pump, and
2. Compensation for primary coolant expansion during thermal cycling.

## Seal Type

Motor shaft seals shall be mechanical seals. Mercury seals shall not be permitted.

The shaft sealing system may be either a separate bolt on unit installed between the motor and the pump or may be integral within the motor proper.

## Seal Lubrication

The shaft seal shall be lubricated with the motor primary coolant.

# BEARINGS

## General

1. The motor shall be fitted with journal radial bearings and heavy duty self-aligning thrust bearings.
2. All motor bearings shall be lubricated with the motor primary coolant.

## Thrust Bearing Load

1. Thrust bearing shall be provided in the motor proper and in the bolt on shaft sealing unit if the latter exists.
2. Thrust bearings shall be provided capable of carrying not less than twice the maximum down thrust generated by the weight of the motor/ pump rotors and the hydraulic loads.
3. If thrust bearings are provided in the bolt on sealing unit, the thrust bearings in the motor shall be capable of carrying not less than twice the weight of the motor rotor.

## Bearing Life

Radial and thrust bearings within the motor (and within the bolt on shaft seal unit if the latter is fitted) shall have a rated life of not less than 60,000 hours.

# DOWN HOLE CABLE

The motor shall be provided with down-hole motor feed cable as specified in the Annexure.

Cable phase conductors shall be fully annealed high conductivity copper.

The armour material shall be galvanized steel, stainless steel or Monel metal as specified in the Annexure.

# WORK TESTS

## General

The Contractor shall submit the motor to works tests as detailed hereunder and shall provide the Principal with certified test certificates including the actual test results recorded.

The Contractor shall make provisions for such tests to be witnessed if witnessed testing is specified in the Annexure.

## Efficiency Tests

Motor efficiency tests shall be carried out by the summation of losses method in accordance with either AS 1359.102.1 or IEC 60034-2-1.

Efficiency tests shall be made at 50% load, at 75% load and at 100% load.

## Withstand Voltage Tests

The motor windings shall be submitted to power frequency phase to earth voltage withstand tests with a test voltage of not less than 1.7 times motor rated line to line voltage. Otherwise the tests shall be in accordance with either AS 60034.1 or IEC 60034-1.

## Other Performance Tests

The motor shall be type tested in accordance with a recognized national standard to substantiate all of the other performance values included in the Contractor’s tender.

# LIQUIDATED DAMAGES FOR LOW EFFICIENCY

In addition to any liquidated damages specified in the General Conditions of Contract, the Contractor shall be liable to the Principal for liquidated damages in respect to failure of the motor to achieve the efficiency level quoted previously by the Contractor in the Tender Response Schedule. Such liquidated damages shall be calculated on the basis of the capitalised cost of losses quoted in the Annexure and the amount by which the full load test efficiency falls short of 99% of the quoted full load efficiency.

# DELIVERY AND INSTALLATION

The Contractor shall deliver, unload, unpack and assemble as necessary the complete motor and shaft seal unit at the site.

The Contractor shall inspect the unpacked motor and shaft seal unit and shall ensure that these are undamaged.

The Contractor shall give the Principal seven days’ notice when the motor will be ready for installation.

The installation of the motor and shaft seal unit shall be completed by the Principal in the presence of the Contractor and to the Contractor’s satisfaction.

# ON SITE TESTING

Before the Contractor makes the motor available to the Principal for connection to the electrical system, the Contractor shall carry out the following tests:

1. insulation resistance test,
2. Withstand voltage test at 80 % of the test voltage specified in Table 16 of AS 60034.1 or IEC 60034-1

The Contractor shall supply all equipment, materials and labour for such testing and shall make the results of such tests available to the Principal at the time that the motor is made available for connection to the electricity supply.

# AS CONSTRUCTED INFORMATION

The Contractor shall provide as-constructed information on all drawings detailing all changes and modifications made during the construction and installation phases of the project.

The contractor shall submit drawings in both AutoCAD and PDF formats in accordance with the Drawing Submission Process. Adequate contrast within the PDF image shall be maintained between drawing content and background to ensure the clarity and quality of the drawings.

# MANUALS

The Contractor shall supply 3 copies of comprehensive instruction manuals for the motor and shaft seal, written in English and covering the complete operation and maintenance requirements of all equipment supplied under the Contract.

The manuals shall be printed on high grade A4 size paper and shall be bound in a high grade A4 size loose leaf binder.

Information included in the manuals shall include:

1. operating instructions,
2. safety instructions and warnings,
3. maintenance instructions and schedules,
4. recommended spare parts and special tool list,
5. as constructed drawings, and
6. test reports and test certificates.

**Annexure to Specification**

**for**

**High Voltage Submersible Bore Hole Cage Induction Motor**

**Project:** …………………………………………………………………………………………….

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Site Location: ……………………………………………………………………………………………

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Type of Access to Site: ………………………………………………………………………………………

………………………………………………………………………………………………………………….

………………………………………………………………………………………………………………….

Bore Hole Internal Diameter: ……………………………………….metres

Depth of Installation below ground level: …………………………metres to motor DE

Operating Environment -

Minimum pumped flow rate: ………………………………………Ml/day

Maximum head of water above the motor: ……………………………………….metres

Maximum water temperature: …………………………………………...oC

Sediment concentration: …………………………………………mg/l

Water chemical composition:

Predicted or test values: ………………………………………………

Total soluble salts: ………………..mg/l pH: ……………………………………….

Sodium: ………………..mg/l Potassium: …………………………... mg/l

Magnesium: ………………..mg/l Calcium: …………………………... mg/l

Bicarbonate: ………………..mg/l Sulphate: …………………………... mg/l

Chloride: ………………..mg/l Nitrogen: …………………………... mg/l

Carbonate: ………………..mg/l Silica: …………………………...mg/l

Iron: ………………..mg/l Alkalinity (as CaCO3): …….……….... mg/l

**Annexure to Specification**

**for**

**High Voltage Submersible Bore Hole Cage Induction Motor**

To be supplied as part of a combined pump set, (yes or no): ………………………………………………

Additional work to be done by the Principal: ……………………………………………………………

………………………………………………………………………………………………………………….

………………………………………………………………………………………………………………….

Operating Mode -

Fixed or variable speed:

Maximum Operating Load: ……………………………….kW at ………………….. Hz

Type of Starter: ………………………………………………………………….

Estimated Annual Running Time: ………………………….hours

Capitalised Cost of Losses: …………………………$/kW

Power supply to fixed speed motor: ………………………………...

Frequency: ………………………….Hz

Frequency tolerance: +/- …………………..%

Phase to phase voltage: ……………………………kV, with neutral grounded solidly

Voltage tolerance (long term): …………………………%

Impedance of electrical supply system to motor: …………… + j ……………………. ohm

Power supply to motor from converter:

Maximum frequency (i.e. 50 Hz or 60 Hz) ………………….Hz

Phase to phase voltage at 60 Hz: …………………………….. kV

Motor operating frequency range: ……………………………..Hz to ………………………….

Total Harmonic Distortion in controller output voltage: …………………………………….%

Voltage waveform, (raw PWM or filtered sine wave): ……………………………………….

Neutral grounded or floating: …………………………………………………………………..

**Annexure to Specification**

**for**

**High Voltage Submersible Bore Hole Cage Induction Motor**

Motor rated frequency (60 Hz or 50 Hz): …………………………………………...Hz

Motor power output S1 duty rating at above frequency: ………………………………………….kW

Direction of rotation as per AS 60034.8: ………………………………………………………………….

If fixed speed operation: ……………………………………………………………………………….

Maximum locked rotor current: ……………………………………………..…… amps

Minimum locked rotor torque: …………………………………………...newton metres

Minimum pull up torque: …………………………………………...newton metres

Minimum break down torque: …………………………………………...newton metres

Pump static and hydraulic down thrust: ………………………..…………………………newtons

………………………………………………………………………………………………………………….

Down Hole Cable -

Voltage Rating: ………………………….…………………………..kV phase to phase

Conductor Size: …………………………..…………………………………………mm2

Insulation Maximum Operating Temperature Rating: ……………………………………..oC

Insulation Maximum Short Circuit (5 sec)

Temperature Rating: ……………………………………….………………………………oC

Profile (i.e. flat or round): …………...............………………………………………………….

Armour material: ……………………………..………………………………………………….

Length to be Supplied: ……………………….……………………………………………metres

Witnessed Tests (required or not required): ……………..…………………………………………………….

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Specification for H.V. Submersible Bore Hole Cage Induction Motor**  **Tender Technical Response Schedule** | | | | | |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | | **Comments** |
|  |  |  | **Yes** | **No** |  |
| **1** | **General** |  |  |  |  |
| **2** | **Site** |  |  |  |  |
| **3** | **Operating Environment** |  |  |  | Detail of materials and surface coatings to be attached |
| **4** | **Operating Mode** |  |  |  |  |
| **5** | **Work by Principal** |  |  |  |  |
| **6** | **Information from Contractor** |  |  |  |  |
|  | Equivalent Circuit Values |  |  |  | Stator resistance ohms = |
|  |  |  |  |  | Stator reactance ohms = |
|  |  |  |  |  | Rotor resistance ohms = |
|  |  |  |  |  | Rotor reactance ohms = |
|  |  |  |  |  | Magnetizing conductance mhos = |
|  |  |  |  |  | Magnetizing susceptance mhos = |
|  |  |  |  |  | Turns ratio = |
|  |  |  |  |  | Friction loss kW = |
| **7** | **Contractor’s Drawings** |  |  |  |  |
| **8** | **Standards** |  |  |  |  |
| **9** | **Quality Assurance** |  |  |  |  |
| **10** | **Power Supply to Motor** |  |  |  | Rated Hz |
|  |  |  |  |  | At rated Hz, rated kV = |
|  |  |  |  |  | Frequency range = ..…..Hz to ..…..Hz |
| **11** | **Motor Type** |  |  |  |  |
|  |  |  |  |  | Stator star or delta connected ? |
|  |  |  |  |  | Rated Hz synchronous r.p.m. = |
| **12** | **Motor Duty and Rating** |  |  |  | Duty type = |
|  |  |  |  |  | Rated Hz rated kW = |
|  |  |  |  |  | Stator rated Hz FLC amps = |
|  |  |  |  |  | Stator rated Hz NLC amps = |
|  |  |  |  |  | Rated Hz locked rotor torque Nm = |
|  |  |  |  |  | Rated Hz pull up torque Nm = |
| **Specification for H.V. Submersible Bore Hole Cage Induction Motor**  **Tender Technical Response Schedule** | | | | | |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | | **Comments** |
|  |  |  | **Yes** | **No** |  |
|  |  |  |  |  | Rated Hz breakdown torque Nm = |
|  |  |  |  |  | *Torque vs Hz & Current vs Hz characteristics to be attached* |
|  |  |  |  |  | *Current versus Hz characteristic to be attached* |
|  |  |  |  |  | *Power factor vs Hz characteristics to be attached* |
|  |  |  |  |  | Rated Hz power factor at 0.5 load = |
|  |  |  |  |  | Rated power factor at 0.75 load = |
|  |  |  |  |  | Rated power factor at full load = |
|  | Guaranteed minimum efficiency |  |  |  | Rated Hz efficiency % at 0.5 load = |
|  | Guaranteed minimum efficiency |  |  |  | Rated Hz efficiency % at 0.75 load = |
|  | Guaranteed minimum efficiency |  |  |  | Rated Hz efficiency % at full load = |
| **13** | **Direction of Rotation** |  |  |  |  |
|  |  |  |  |  | C/W or Anti C/W ………………….. |
| **14** | **Type of Construction** |  |  |  | IM rating = |
|  |  |  |  |  | Overall weight kg = |
|  |  |  |  |  | Rotor weight kg = |
|  |  |  |  |  | Shaft diam mm = |
|  |  |  |  |  | Overall length metres = |
|  |  |  |  |  | Overall diam. Mm = |
| **15** | **Enclosure** |  |  |  | IP rating = |
| **16** | **Type of Cooling** |  |  |  |  |
| 16.1 | General |  |  |  | Cooling type = |
| 16.2 | IC4W1 Primary Coolant |  |  |  |  |
| 16.3 | IC4U1 Primary Coolant |  |  |  |  |
| 16.4 | Primary Coolant Circulation |  |  |  |  |
| 16.5 | Secondary Coolant Circulation Min. Allowable Velocity |  |  |  | AI FLC m/s = |
|  |  |  |  |  | At max load m/s = |
|  |  |  |  |  | At min load m/s = |
| **17** | **Vibration Level** |  |  |  | Vibration mm/s rms = |
|  |  |  |  |  |  |
| **Specification for H.V. Submersible Bore Hole Cage Induction Motor**  **Tender Technical Response Schedule** | | | | | |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | | **Comments** |
|  |  |  | **Yes** | **No** |  |
| **18** | **Terminations** |  |  |  |  |
|  | Type |  |  |  | *Details to be attached* |
| **19** | **Windings** |  |  |  |  |
| 19.1 | General |  |  |  |  |
| 19.2 | Insulation |  |  |  | AS 2768 insulation class = |
| 19.3 | Winding Temperature Rise |  |  |  | Temp. rise deg. C = |
| 19.4 | Winding dV/dt Rating p-p |  |  |  | Rated 1.0 microsec. Pulse kV = |
|  | Winding dV/dt Rating p-e |  |  |  | Rated 1.0 microsec. Pulse kV = |
| **20** | **Shaft Seal Unit** |  |  |  |  |
| 20.1 | General |  |  |  | Overall weight kg = |
| 20.2 | Seal Type |  |  |  | Rotor weight kg = |
| 20.3 | Seal Lubrication |  |  |  | Shaft diam. mm = |
|  |  |  |  |  | Overall length metres = |
|  |  |  |  |  | Overall diam. Mm = |
|  |  |  |  |  | Rated axial thrust, kg = |
|  |  |  |  |  | *(Arrangement drawing to be attached)* |
| **21** | **Bearings** |  |  |  |  |
| 21.1 | General |  |  |  | Rated axial thrust, kg = |
| 21.2 | Thrust Bearing Load |  |  |  | Rated axial thrust, kg = |
| 21.3 | Bearing Life |  |  |  |  |
| **22** | **Down Hole Cable** |  |  |  |  |
|  |  |  |  |  | Rated kV = |
|  |  |  |  |  | Conductor sq. mm = |
|  |  |  |  |  | Insulation max. operating degrees C = |
|  |  |  |  |  | Insulation max. 5 seconds degrees C = |
|  |  |  |  |  | Profile = |
|  |  |  |  |  | Armour material = |
| **23** | **Works Tests** |  |  |  |  |
| 23.1 | General |  |  |  |  |
| 23.2 | Efficiency Tests |  |  |  |  |
| 23.3 | Withstand Voltage Test |  |  |  |  |
| **Specification for H.V. Submersible Bore Hole Cage Induction Motor**  **Tender Technical Response Schedule** | | | | | |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | | **Comments** |
|  |  |  | **Yes** | **No** |  |
| 23.4 | Other Performance Tests |  |  |  | *(Details of proposal to be attached)* |
|  | Availability of Type Tests |  |  |  | *Currently available, yes or no?* |
| **24** | **Liquidated Damages** |  |  |  |  |
| **25** | **Delivery and Installation** |  |  |  |  |
| **26** | **On Site Testing** |  |  |  |  |
| **27** | **As Constructed Information** |  |  |  |  |
| **28** | **Manuals** |  |  |  |  |

END OF DOCUMENT