

MATERIAL AND EQUIPMENT STANDARD

FOR

THREE PHASE SQUIRREL CAGE INDUCTION MOTORS

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1. SCOPE

This standard specification covers the minimum technical requirement for design, manufacture quality control, testing, finishing and shipment of 3 phase squirrel cage electric induction motors upto 4000 kw. for operation on supplies up to and including 11000 volt 3 phase a.c. for use in oil, gas and petrochemical industries.

2. SERVICE CONDITIONS

2.1 Environmental Conditions

See attachment No. 1

2.2 Electrical Condition

Motors shall comply with the requirement of IEC 34.1 Section 4 Clause 12 and shall be suitable for a frequency variation of minus 5% to plus 2% of the nominal frequency co-incident with voltage variation of 95% to 105% of rated voltage. For frequency, fault level and system neutral earthing see data sheet.

3. REFERENCES

Induction motors shall be designed, constructed, tested and quality controlled to the requirements of the editions of the following standards that are in effect at the time of publication of this Standard. The applicability of changes in standards that occur after the date of this Standard shall be mutually agreed upon by the Company and supplier.

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

IEC 27	"Letters, Symbols to be used in Electrical Technology."
IEC 34	"Rotating Electrical Machines."
IEC 34.1 Part 1	"Rating and Performance."
IEC 34.2 Part 2	"Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests, (Excluding Machine for Traction Vehicles)."
IEC 34.5 Part 5	"Classification of Degrees of Protection Provided by Enclosures for Rotating Machines".
IEC 34.6 Part 6	"Method of Cooling of Rotating Machinery".
IEC 34.7	"Symbols for Type of Construction and Mounting Arrangements of Rotating Electrical Machinery."
IEC 34.8 Part 8	"Terminal Marking and Direction of Rotation of Rotating Machine."
IEC 34.9 Part 9	"Noise Limits."
IEC 34.11 Part 11	"Built in Thermal Protection Chapter 1: Rules for Protection of Rotating Electrical Machines."

IEC 34.12 Part 12	"Starting Performance of Single Speed Phase Cage Induction Motors for Voltages upto and Including 600 V."
IEC 34.14	"Mechanical Vibration of Certain Machines with Shaft Height 56 mm and Higher. Measurement, Evaluation and Limits of Vibration Severity."
IEC 50(411)	"International Electrotechnical Vocabulary Rotating Machines."
IEC 72	"Dimensions and Output Rating for Rotating Electrical Machines. Frame No. 56 to 400 and Flange number F 55 to FF 1080 and FT 55 to FT 1080."
IEC 72 A	"Dimensions and Output Ratings for Foot Mounted Electrical Machines with Frame Numbers 355 to 1000."
IEC 79	"Electrical Apparatus for Explosive Gas Atmospheres."
IEC 79.0 Part 0	"General Requirements."
IEC 79.1 Part 1	"Construction and Test of Flameproof Enclosures of Electrical Apparatus(Type of Protection d)."
IEC 79.7 Part 7	"Construction and Test of Electrical Appa-Apparatus-Type of Protection 'e'".
IEC 79.15 Part 15	"Electrical Apparatus with Type of Protection 'n'."
IEC 85	"Thermal Evaluation and Classification of Electrical Insulation".
IEC 445	"Identification of Equipment Terminals and of Terminations of Certain Designated Conductors Including General Rules of an Alphanumeric System".

BSI (BRITISH STANDARDS INSTITUTION)

BS 4999 Part 145	"Specification for Winding Termination"
BS 5512	"Rolling Bearing."
BS 6121 Part 1	"Mechanical Cable Glands." "Metallic Glands."

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 3266	"Eyebolts for General Lifting Purpose"
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Notes:

1) Where standards other than IEC are used it is understood that equivalent IEC standard is accepted.

2) The testing and certification by the following authorities are acceptable.

2.1) Association of short circuit Testing Authorities (ASTA).

2.2) European Organization for Testing and certification (EOTC) under CENELEC administration.

2.3) Electrical Equipment certification services (EECS).

4. UNITS

This standard is based on International System of Units, (SI) except where otherwise specified.

5. DUTY RATING

5.1 Unless otherwise specified motors shall be rated with the requirements of:

- a) IEC 34.1 clause 4 for continuous running duty type SI
- b) IEC 34.1 clause 5 for maximum continuous rating (m.c.r)
- c) IEC 34.1 clause 9 for a single voltage operation

6. GENERAL CHARACTERISTICS

6.1 Motors shall be suitable for direct on line starting.

6.2 Unless otherwise specified, motors upto and including 630 Kw shall have design "N" starting performance and pull-up torque in accordance to Table 1 of IEC 34.12, and locked rotor apparent power not less than figures given in Table 11 of the same standard.

6.3 When reduced voltage tests are carried out, the estimated starting "KVA" and locked rotor torque at rated voltage shall be included in the test certificates together with their deviation from the test results.

6.4 The locked rotor torque characteristics shall be sufficient to meet the specified requirements of the driven load. The torque characteristics during run-up shall be adequate for starting the driven load under the most arduous conditions specified.

In any event the motor starting torque at 100% rated voltage, and at all speeds between standstill and the speed at the pullout torque point, shall not be less than 1.7 times the torque obtained from a load curve which varies as the square of the speed, and is equal to 1.0 P.U. motor rated torque tabulated in IEC 34.12 Table 1.

6.5 Motors shall be capable of recovering normal operation in the event of a system disturbance causing temporary loss of supply voltage of periods of upto 0.2 seconds (fault clearance time) followed by a sudden restoration, initially to 60% rated voltage for 3 seconds, then followed by a sudden restoration to 80% voltage, from which voltage the motors shall then be capable of accelerating and ultimate recovery under the most arduous load conditions,

6.6 Manufacturers shall, specify in their Tenders the percentage value of residual voltage against which the motor may be reconnected to the supply immediately following loss of supply, however the motor shall withstand a residual voltage of at least 30% of rated supply voltage with 180° out of phase situation.

6.7 The frequency of starting shall be in accordance with IEC 34.12 clause 6.

6.8 The electric motor, including any associated unit transformer shall be suitable for one of the duties listed below:

- Normal : maximum 1000 starts per year.
- Heavy : maximum 3000 starts per year.
- Extra Heavy : maximum 20,000 starts per year.

6.9 The Manufacturer shall assign "safe stalled rotor time(s)" for "cold" and "hot" conditions. These shall be the time(s) during which the motor may remain stalled without injurious effects to rotor and stator.

The time for the "cold" condition shall assume that the motor is initially at the specified ambient temperature.

The time for the "hot" condition shall assume that the motor is initially at the stabilized full load rating temperature.

6.10 In addition to the requirements of Clause 6.9 above, all motors shall also be suitable for limited "Jogging" during commissioning and testing following maintenance operations.

In order that the capacity of the motor for repetitive starting of this kind several times in succession during commissioning and maintenance operations may be established, the Manufacturer shall assign factors by which the "cold" and "hot" safe stalled times shall be multiplied in order to determine the sum of repeated partial starting times which may be permitted before the machine is either stopped for 30 minutes or run continuously.

7. MATERIALS

7.1 All external parts shall be of ferrous metals.

7.2 Consideration may be given to the inclusion of non-ferrous materials provided that the parts concerned are listed in the Tender with details of the particular materials proposed and, in the case of aluminum, the particular alloy.

7.3 Protection shall be provided against galvanic action between dissimilar metals.

7.4 Non-metallic materials, particularly those introduced for noise reduction, shall be fire resistant, antistatic (in compliance with the requirements of IEC 79.0 and stable in the presence of hydrocarbon liquids and vapors or for conditions that will be specified.

8. WINDINGS AND INSULATION

8.1 All Motors-General Requirements

8.1.1 The insulation of the windings shall be Class 'F', but the temperature rise of the machine shall be limited to that applicable to Class 'B' insulation.

8.1.2 All windings shall be adequately supported, braced and blocked to provide sufficient rigidity during normal conditions of service.

8.1.3 All insulated windings shall be non-hygroscopic, oil resistant and the materials resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them and thus to prevent deterioration from adverse environmental conditions at site during the construction period, when they may be lying idle for long periods, and also during normal operation.

8.1.4 Stator windings shall be connected in 'Star' unless otherwise agreed with the Purchaser, however the six terminal of L.V. motors shall be brought in the same terminal box. In case of M.V. motors, a second neutral (star point) box shall be located on the opposite side of the main box.

8.2 Additional Requirements for M.V. Motors

8.2.1 Motors shall be entirely suitable for switching by all normal switching devices including air, minimum oil, SF 6 and vacuum break types of contactor and circuit breaker and the life expectancy shall not be affected, irrespective of the switching device used.

8.2.2 Manufacturers shall take account of the characteristics of possible switching transients (rise time, amplitude and associated rate of change of voltage), the transient distribution within the windings of the motor, and the resulting peak interturn voltage level.

8.2.3 Round wire type coils relying solely on enamel insulation and random wound coils are not acceptable.

Normal requirements for surge withstand capability and testing are specified in Clause 8.2.5 below. Unless otherwise specified, motors supplied shall comply with these normal requirements.

8.2.4 Certain motor applications dictated by the motor duty, cable type, circuit configuration or any combination of these, as specified by the Purchaser may, produce higher voltage surge levels than those considered by Clause 8.2.5.

For these motor applications the Manufacturer shall either:-

- a) confirm compliance with the special higher motor insulation and test requirements specified in Clause 8.2.6; or;
- b) confirm that suitable, proven surge protection can be offered, with the guarantee that it will reduce the motor interturn insulation voltage stress level permitting application of motors complying with Clause 8.2.5.

8.2.5 Surge withstand: normal requirements

8.2.5.1 The surge withstand capability of a winding to earth shall be a peak voltage of $(4U_n + 5kV)$, and a wavefront rise time to the peak voltage of 1.2 microseconds.

8.2.5.2 The surge withstand capability of the coil interturn insulation shall be a peak voltage 'U_{peak}':

$$U_{peak} = \frac{kx^p}{3} \sqrt{2} U_n \quad \text{with } k = 3$$

with a wavefront rise time to peak of not greater than 0.5 microseconds.

8.2.5.3 The normal peak voltage levels for standard rated line voltages are given in Table 1.

8.2.6 Surge withstand: special requirements

8.2.6.1 Where special surge withstand requirements are specified and unless otherwise agreed between the Purchaser and the Manufacturer, the motors shall comply with the requirements of Clause 8.2.5 except that the surge withstand capability of the coil interturn insulation shall be a peak voltage 'U_{peak}' where

$$U_{peak} = \frac{kx^p}{3} \sqrt{2} U_n \quad \text{with } k = 5$$

8.2.6.2 The special peak voltage levels for standard rated line voltages are given in Table 1.

TABLE 1 - SURGE WITHSTAND REQUIREMENTS

RATED LINE VOLTAGE (kV)	EARTH INSULATION SURGE WITHSTAND FOR 1.2/50 MICROSEC WAVE (kV PEAK)	COIL INTERTURN INSULATION SURGE WITHSTAND (kV PEAK)	
		NORMAL	SPECIAL
3.3	18.0	8.0	13.5
6.6	31.0	16.0	27.0
11.0	49.0	27.0	45.0

8.2.6.3 Type tests and routine Quality Assurance Tests shall be carried out with a peak voltage across the coil leads given by:

$$U_{peak} = \frac{5\phi}{p} \frac{p}{3} \frac{2.U_n}{p}$$

with a wave front rise time to peak not greater than 0.5 microseconds.

8.3 Built in Temperature Detection

8.3.1 Motors for rated voltages up to 1000 V shall, when specified, have built in thermal protection in accordance with IEC 34.11 and the details shall be agreed between the Purchaser and Manufacturer.

8.3.2 Motors for rated voltages above 1000 V shall be provided with at least nine embedded temperature detectors for monitoring stator winding temperature.

The detectors shall be wired to a terminal box separate from the main and heater terminal boxes and shall be protected against overvoltage by a method to be agreed.

8.3.3 The type of temperature detector to be used, i.e. RTD will be specified or shall be agreed. In each motor all embedded temperature detectors shall have the same characteristics.

Details of the characteristics and mode of operation shall be included with the tender and be confirmed on the motor test certificate, together with details of the type tests and routine tests carried out before fitting to the motor.

9. CABLE TERMINATIONS

9.1 General

9.1.1 Terminations shall comply with BS 4999, Part 145, IEC 79.15 and, when the Purchaser specifies aluminum cable, BS 5372.

9.1.2 Terminal markings shall be U-V-W and provided in a clear and permanent manner. The direction of rotation shall be in accordance with IEC 445.

9.1.3 Terminal arrangements shall have adequate space to accommodate easily the size and type of cable specified. Means shall be provided to prevent accidental reduction of the clearance at terminals due to loose strands or the movement of uninsulated cable lugs. Explosion protected equipment shall also be suitable for the use of uninsulated cable lug type conductor terminals without invalidating the Certification and this shall be confirmed in the Tender.

9.1.4 Sealing gaskets of polychloroprene or other appropriate material shall be included at terminal box joints. In the case of explosion protected type Ex(d) flameproof equipment preference will be given to the weatherproof type.

9.1.5 Heater or other additional connections shall be clearly identified. Circuits shall be separated and terminals fully shrouded.

9.1.6 The earthing terminal shall be external to the terminal box unless specified otherwise.

9.1.7 Component parts of the frame shall be adequately bonded together and to the earth terminal in order to prevent arcing and sparking in service.

9.2 Terminations for Rated Voltages Up to 1000 V.

9.2.1 Terminations shall be assumed to be protected by energy limiting devices.

9.2.2 Motors shall have terminal boxes suitable for accepting cables from any of the four directions at right angles in the plane of the terminal box. The terminal box shall be positioned in accordance with IEC 72 clause 4.

9.2.3 For copper conductors, terminations shall be suitable for the minimum conductor sizes, as shown in Table 2.

TABLE 2

MOTOR RATING (kW)	CONDUCTOR SIZE (mm²)
0- 7.5	6
8.0- 15.0	10
16.0- 22.0	16
23.0- 37.0	25
38.0- 50.0	35
51.0- 75.0	70
76.0- 90.0	95
91.0-110.0	120
111.0-150.0	150

9.2.4 Mechanical metallic cable gland to BS 6121 shall be provided.

9.2.5 Heater or other connections shall be clearly identified. The circuits shall be separated and fully shrouded.

9.3 Terminations for MV. Motor

9.3.1 Terminations shall be either of the separable insulated connector type or shall be contained within a terminal box.

9.3.1.1 Terminations of the separable insulated connector type shall be contained within an enclosure (IP 21 Minimum) to give mechanical protection. Means of support for the cable shall be provided.

9.3.1.2 Terminal boxes shall be of one of the types described in Appendix C1 and shall be of a type tested design (Category A or B as described in Appendix C2) suitable for the specified short circuit level and the specified method of short circuit protection adopted for the motor.

9.3.2 Unless otherwise specified by the Purchaser, motors shall have the terminations positioned on the right hand side when looking at (facing) the driving end and be suitable for accepting the cable(s) rising from below.

9.3.3 Explosion protected type Ex (d) flameproof terminal boxes shall be of the fault containment type suitable for the specified nominal short circuit MVA at the motor terminals and fault clearance time, while meeting the requirements of the flameproof construction.

9.3.4 Heater or other additional connections shall be brought out to a terminal box separate from the main terminal box and clearly identified.

9.4 Cable Entries

9.4.1 Each terminal box shall have cable entry(ies) with thread of ISO form according to IEC 423 for all forms of cable connection, it must be possible to remove the motor without breaking or stressing the seal or the cable.

9.4.2 Where PVC or rubber insulated and sheathed multi core cable is specified a compression gland of approved design may be proposed.

9.4.3 Cable glands suitable for lead covered and armored cable shall be of a compression type.

9.4.4 The type and size of cables to motors will be given in data sheet.

10. ROTOR

10.1 The rotor and internal fan(s), if fitted, shall be dynamically balanced.

10.2 External fans shall be independently balanced and shall be located so that it is impossible to assemble them on the shaft of the machine incorrectly.

10.3 Balance weights, if fitted, shall not be of lead or similar ductile material and the rotor design shall allow for the addition of balancing weights.

10.4 The direction of the air flow shall be such that air is not drawn from the direction of the driven unit.

10.5 In the case of unidirectional motors, it is essential that this is stated in the Tender. The direction of rotation shall be clearly and permanently indicated by means of an arrow on the external surface of the frame at the non-drive end. A painted or adhesive type method of indication is unacceptable.

10.6 The shaft ends shall be provided with a suitably threaded hole or holes to facilitate the removal of coupling.

10.7 Cage construction shall be from brazed copper or copper alloy. Pressure die or centrifugal cast aluminum alloy cages are not acceptable.

10.8 Rotor bars shall be securely locked in the core slots throughout their entire length. A form of driven key bar type construction is preferred especially on two pole machines at the top end of output range.

10.9 On occasion, rough bored half coupling or pulleys shall be supplied as free issue from the supplier of the driven equipment for the motor manufacturer to finish bore, fit and balance with rotor, otherwise if no pulley or coupling is issued, the rotor to be balanced with a half depth key in position.

10.10 The first critical speed of stiff rotors shall be at least 125% of synchronous speed. For flexible rotors the first critical speed shall be between 60% and 80% of the synchronous speed and the second critical speed shall be at least 125% of the synchronous speed. These figures shall apply to the machine under operating conditions on site.

11. COOLING

11.1 Method of cooling shall comply with that specified in data sheet in conjunction with requirements of IEC 34.6.

11.2 Fans for motors should be of brass, bronze or aluminum alloy. Plastic or non metallic fan housing are not acceptable.

Aluminum alloy fans shall not contain more than 0.2% copper and shall be balanced before assembly on shaft.

Plastic fiberglass or other non metallic fans are not acceptable

11.3 Fan Shall be Non Sparking

12. BEARINGS AND LUBRICATION

12.1 Ball and Roller Bearings

12.1.1 Bearings shall be in Metric sizes and comply with the International Standards Organization's (ISO) recommended dimensions.

12.1.2 Rolling element centered cage bearings shall be fitted. The use of plastic cages shall be avoided.

12.1.3 If ball bearings are fitted at both driving and non-driving ends, a well proven method must be employed at one end to permit differential expansion between shaft and frame.

12.1.4 Shaft axial expansion can take place towards the coupling end and this shall be stated, together with the estimated amount according to the temperature rise of the motor, so that due allowance can be made during alignment of the motor, coupling and driven unit.

12.1.5 Ball and Roller bearings shall be fitted having C3 radial internal clearance (greater than normal) unless agreed otherwise.

12.1.6 On both oil and grease lubricated bearings it shall be possible to relubricate in safety without stopping or dismantling the motor. The relubrication interval for grease lubricated bearings shall be specified by the Manufacturer, when using the lubricant recommended by the Manufacturer, or when using the specified lubricant.

12.1.7 Unless agreed otherwise, the minimum relubrication interval for grease lubricated bearings, irrespective of actual running hours, shall be not less than 4000 hours for horizontal motors and 3000 hours for vertical motors.

12.1.8 Grease lubricated bearings shall have pressure relief devices which ensure that the new grease displaces the maximum amount of old grease and automatically ejects any surplus to the outside of the motor casing.

12.1.9 Pre-lubricated bearings will be considered provided that the service life under the specified operating conditions is satisfactory and is agreed by the Purchaser. An acceptable service life without regreasing is considered to be not less than 40,000 hours.

12.1.10 The rated life of ball and roller bearings, when calculated in accordance with ISO Recommendation 281-1 shall be in excess of 40,000 hours when considering only the forces generated by the motor, and in excess of 32,000 hours when considering the additional forces generated by the driven unit as specified by the Purchaser.

12.1.11 Oil lubricated bearings shall normally be provided with constant level reservoir systems. Oil throwers or seals shall be provided to prevent the escape of oil and level indicators shall be fitted. Where the Purchaser requires the constant oil level to be maintained for a purge oil mist system, he shall provide the Vendor with sufficient data on the oil mist system to enable him to design the bearing assemblies accordingly.

12.1.12 When it is proposed to employ other than a constant level reservoir system, e.g. a pressure fed oil system or a pure oil mist system, then full details shall be made available by the Proposer (Vendor or Purchaser) for consideration and acceptability.

12.2 Sleeve Bearings

12.2.1 Means of access for measuring the air gap between rotor and stator at both ends, or of otherwise ensuring that the rotor remains within the recommended limits of concentricity within the bore of the stator shall be provided.

12.2.2 Means of ensuring an adequate supply of lubricant to all parts of the bearing surface, including during run-down, shall be provided. Such means will normally take the form of oil rings, discs or similar devices. Oil throwers or seals shall be provided to prevent the escape of oil and oil level indicators shall be fitted.

12.2.3 When it is proposed to employ a pressure fed oil system or an oil mist lubrication system, full details of the system shall be made by the Proposer (Vendor or Purchaser) for consideration and acceptability.

12.3 Lubricants

12.3.1 Lubricants which will be used on the site shall be the subject of agreements between the Manufacturer and the Purchaser.

12.3.2 Grease lubricated bearings shall be packed with shell alvania R2 or R3 (Exxon Beacon EP2 or EP3) before motor is shipped.

Other lubricants will be acceptable subject to agreement between manufacturer and purchaser.

12.4 Limiter End Float (LEF)

12.4.1 Motors without thrust or location bearings shall be defined as such in the initial Tender and on the Manufacturer's drawings. The amount of permissible end float should be stated, so that a suitable coupling may be supplied to keep the rotor within the specified limit of movement.

12.4.2 The motor rating plate shall be marked LEF. The correct running position of the rotor shall be permanently marked, together with the limits of permissible movement, and it shall be possible to observe the rotor position at all times, relative to the above marks.

12.5 End Thrust

12.5.1 Vertical motors shall normally be fitted with bearings to withstand the forces generated by the motor. When the motor is to be subject to the additional forces generated by the driven equipment, this will be specified by the Purchaser.

12.6 Bearing Insulation

12.6.1 All sleeve bearings shall be fully insulated from the motor carcass and/or bedplate to prevent a flow of shaft current unless type tests demonstrate that the shaft voltage measured at any speed and load conditions across the ends of the shaft is less than 150 mV rms.

12.6.2 The method of insulation shall be permanent and non-deteriorating.

12.6.3 An earthing connection, which shall be removable for test purposes, shall be provided at the drive end bearing and care shall be taken not to bridge bearing insulation by any other connection.

13. DIRECTION OF ROTATION

The terminals of the three phase machines shall be designated in alphabetical sequences of the terminal designation U_1 , V_1 , W_1 conforming to chronological sequence of phases (L_1 , L_2 , L_3 of the connection line) at clockwise rotation.

This applies also for machines not suitable for clockwise rotation. For anti clockwise rotating machines two outside connection lines (phase L_1 , L_2 , L_3) shall be interchanged.

Motors suitable only for one direction of rotation shall be marked accordingly on the rating plate indicating the sense of rotation by means of an arrow.

It should be stated in which sequence the terminals shall be connected with phases L_1, L_2, L_3 of connection line i.e.:

clockwise rotation " U_1, V_1, W_1 "

anti-clockwise rotation " V_1, U_1, W_1 "

14. NOISE LEVEL

Noise level shall be in accordance with the requirements stated in data sheets but in the event of no requirement made the noise level shall not exceed 85 db (A).

15 . VIBRATION

Vibration levels shall be to the Purchaser's stated requirements, but in the event of no requirement being stated, then the motor shall conform to requirements of IEC 34.14.

16. CONSTRUCTION AND MOUNTING ARRANGEMENT

For type of construction and mounting arrangements see data sheet in conjunction with the requirements of IEC 34.7.

17. ENCLOSURE

17.1 All electrical motors shall have ingress protection specified in data sheet and shall meet the requirements of the area classification in which to be installed. (This is detailed in data sheet.)

17.2 In all cases terminal boxes shall have enclosure type IP 55.

17.3 In offshore and coastal installations motors, auxiliaries the terminal boxes and bearings housing shall have an ingress protection of IP 56.

17.4 All enclosure materials shall be of ferrous metal: cast iron or sheet steel.

18. ADDITIONAL REQUIREMENTS FOR MOTORS IN POTENTIALLY EXPLOSIVE ATMOSPHERES

18.1 The enclosure of motors to be installed in hazardous areas shall be in compliance with the requirements of following, according to pertinent area classification.

18.1.1 IEC publication 79.0 Part '0' Electrical Apparatus for Explosive Gas Atmosphere General Requirements"

18.1.2 IEC publication 79.1 Part 1 "Construction and Test of Flameproof Enclosure of Electrical Apparatus Type of Protection Exd (EExd)"

18.1.3 IEC publication 79.7 Part 7, "Construction and Test of Electrical Apparatus Type Exe (EExe)"

18.1.4 IEC publication 79.15 Part 15 "Electrical Apparatus with Type of Protection 'n'"

18.2 Components for cable glands conduit fittings and stopping plugs shall be subject to approval of "EOTC" or "EECS"

18.3 When single core wires through explosion proof conduit are connected to terminal of explosion proof equipment, sealing fittings shall be incorporated at the entrance point to prevent transmission of flame or gas vapor to other parts of the plant.

18.4 Compliance with data sheet in conjunction with:

18.4.1 Grouping of released gas/vapor in site.

18.4.2 Ignition temperature of released gas/vapor.

18.4.3 Temperature class of equipment.

19. CONDENSATION PROTECTION

19.1 All medium voltage motors shall be equipped with space heaters, space heater voltages to be as follows:

3000 watts or less	230 volt	single phase
over 3000 watts	400 volt	three phase

19.2 Space heaters shall have maximum sheath temperature of 200°C or as specified.

19.3 Space heater leads shall be brought out to junction box separate from the main power leads junction box.

19.4 With the exception of fractional horsepower motors, all totally enclosed motors should be provided with a means of preventing the accumulation of moisture inside the motor, i.e. they shall be provided with a drain plug.

20. LIFTING POINTS

20.1 lifting points shall be provided for each motor weighting more than 30 kg.

20.2 Lifting points which are an integral part of the frame are preferred. Where this is not the case and the lifting is by the use of eye bolts, they shall be of the collar pattern and in compliance with the requirements of ISO 3266.

21. GROUNDING BOLTS

21.1 All motors shall be equipped with a grounding bolt on motor frame and in each connection box.

22. SERIAL No. AND RATING PLATES

22.1 The serial number shall be stamped permanently on a non removable part of the frame.

22.2 Rating plates shall be of stainless steel and be fixed to a non removable part of the frame.

The manufacturer’s standard nameplate supplemented by an auxiliary nameplate is acceptable.

22.3 Rating plate shall give the following information and values which shall be as far as possible measured values:

- Purchaser’s name and order number
- Standard number as appropriate
- Name of manufacturer
- Manufacturer’s serial number frame reference and date of manufacture
- Rated frequency
- Number of phases
- Rated output (kw.)
- Rated voltage (V.)
- Speed at rated output (Rev/m)
- Current at rated output
- Power factor at rated output
- Design to IEC 34.12
- Degree of protection of motor and terminal box

- Winding connection star or delta
- Class of insulation (IEC 85)
- Ambient temperature (if other than 40°C)
- Liquid coolant quality if applicable
- Liquid coolant temperature if other than 25°C
- Altitude if in excess of 1000 m
- Locked rotor torque as p.u. value of full load torque
- Locked rotor current as p.u. value of full load current
- Safe stalled time (cold/hot)
- Efficiency at rated output
- Type, size and fit of bearings
- End float limits if applicable
- Net weight

Note:

Where explosion proofing is required, the following additional information shall be provided on the rating plate or auxiliary name plates.

- The symbol for explosion proofing (Ex)
- The symbol for type of protection (d)
- Temperature classification (T_3)
- Apparatus gas group and subdivision (IIB)
- Frequency of starting if this form part of the temperature classification
- Any special qualification
- Certifying authority and certificate number
- Every insulated bearing shall have a warning plate or label affixed near to it with the following wording:

Care shall be taken not to bridge the insulation.

23. INSPECTION, QUALITY CONTROL AND QUALITY RECORDS

See attachment No. 2

24. TESTS AND CERTIFICATION

24.1 General Requirements for Tests

See attachment No. 3

24.2 Specific Requirements for Tests

The test shall consist of but shall not necessarily be limited to:

24.2.1 Abbreviated tests:

- Measurement of winding resistance (cold)
- Measurement of no load losses and current
- Measurement to allow calculation of locked rotor current
- High voltage test plus insulation resistance test
- Inspection (at no load) of bearings and mechanical operation of the motor

- Vibration check
- High voltage and insulation tests on built in temperature detectors
- Direction of rotation and phase sequence checks

For motors rated above 1000 volt:

- Determination of polarization index. (The polarization index is the ratio of the insulation resistance of a machine winding measured at one minute after voltage has been applied divided into measurement after 10 minutes.)

24.2.2 Complete tests

- Measurement of winding resistance (hot and cold)
- Measurement of no load losses and current
- Measurement to allow calculation of locked rotor current
- High voltage after heat run and insulation resistance before and after heat run
- Inspection (at full load) of bearings and mechanical operation of motor
- Full load heat run
- Measurement of slip at full load
- Measurement to allow calculation of pull out torque
- Measurement to allow calculation of starting torque characteristic
- Momentary overload
- Measurement to allow calculation of efficiency at full load, three quarter, and half load
- Measurement to allow calculation of power factor at full load, three quarters and half load
- Measurement of vibration
- Measurement of noise
- High voltage and continuity tests on built in temperature detectors with tests to demonstrate satisfactory operation and compliance with stated characteristics
- Direction of rotation and phase sequence tests
- Unless otherwise agreed, for machines above 1000 volt determination of the polarization index
- Motors up to and including 150 kW:

Complete tests will not normally be required if evidence of type tests on identical machines is produced at the time of tender

- Motors above 150 kW:

Complete tests shall be made on at least one motor of each group of identical motors being supplied and these tests will be witnessed at the discretion of the purchaser’s inspector.

Abbreviated tests shall be made on the remaining motors of each group and certified test reports of all these tests shall be provided.

25. FINISH

Manufacturer standard finish is acceptable provided that it is compatible with specified environmental conditions given in attachment No. 1, unless otherwise specified in data sheet.

26. INFORMATION TO BE SUPPLIED WITH THE ENQUIRY BY THE PURCHASER

- | | |
|-----------------------|---------|
| 1) Rated Output | (kW) |
| 2) Rated Line Voltage | (V) |
| 3) Rated Frequency | (Hz) |
| 4) Synchronous Speed | (Rev/m) |

- 5) Direction of Rotation
- 6) The Moment of Inertia of the driven load (kg. m²), and the starting characteristics of the load or any other load description.
- 7) For motors rated in excess of 1000 V, the maximum fault level (kA or MVA) and duration together with the method of short circuit current protection.
- 8) Method of earthing of the system to which the machine is to be connected.
- 9) Type of protection class, apparatus group or subgroup, temperature classification (IEC 79). e.g. Ex d IIB T5.
- 10) Type of switching device to be employed.
- 11) Arrangement
 - a) Enclosure degree of protection. (e.g. IP55).
 - b) Cooling
 - c) Construction
- 12) Temperature detectors, if required.
- 13) Motor heaters and supply details.
- 14) Departures from standard site conditions. (See attachment No. 1.)
- 15) Any requirements or characteristics which are different from, or additional to, those specified in this document.

27. INFORMATION T O BE SUPPLIED WITH THE TENDER BY THE MANUFACTURER

- 1) Rated Output (kW)
 - a) Continuous maximum rating or
 - b) Short time rating.
- 2) Nominal Line Voltage.
- 3) Nominal Frequency. (Hz)
- 4) Speed at Full Load. (Rev/m)
- 5) Coolant Inlet Temperature.
- 6) Temperature Rise if other than Class B.
- 7) Direction of Rotation, if unidirectional.
- 8) Manufacturer's Type Designation.
 - a) Make.
 - b) Enclosure. (IEC 34.5)
 - c) Cooling. (IEC 34.6)
 - d) Construction.
 - e) Frame size.
- 9) Applicable National Standard.
- 10) Connection. (Star or Delta)
- 11) Rated Current (A)
- 12) Efficiency and Power Factor:
 - a) At Full Load
 - b) At Threequarters Load
 - c) At Half Load

- 13) Locked Rotor Current (as per unit of Full Load Current)
- 14) Speed Torque Characteristic
 - a) At 100% Rated Voltage
 - b) At 80% Rated Voltage
- 15) The Moment of Inertia of The Motor Rotating Parts (kg. m²)
- 16) Bearings
 - a) Type
 - b) Make, series, size and fit
 - c) Method of Lubrication
 - d) Grease lubrication interval (ball and roller bearings)
 - e) Method of shaft location and limits of end float (where applicable)
- 17) Terminal Box Type, Mounting arrangement and cable gland details
- 18) Terminal Box fault rating and type test category
- 19) Whether a drain device is fitted or the method by which freedom from the effects of condensation is guaranteed
- 20) Dimensional drawings, including shaft details
- 21) Earliest time when certified drawings can be supplied
- 22) Coupling or Pulley details, where supplied
- 23) Installed Weight (kg)
- 24) Sound Pressure at No Load.
- 25) Noise generation characteristics across eight octave bands expressed as a sound pressure level measured at 1m nominal reference radius when the machine is running at Full Load.
- 26) Parts manufactured of Non ferrous metals or non metallic materials (where applicable) excluding electrical conductors and insulating materials but including details of Aluminum Alloy.
- 27) Type of Protection Class, Apparatus Group or Subgroup and Temperature Classification.
- 28) Copy of Certificate issued by the Certifying Authority, where applicable.
- 29) For motors rated in excess of 1000 V, Quality Assurance specification for stator coils.
- 30) Confirmation of suitability for switching device.
- 31) Estimated run up time of the motor at rated voltage:
 - a) When uncoupled.
 - b) When coupled to rated load.
- 32) Details and characteristics of built in temperature detectors, if applicable.
- 33) For motors rated in excess of 1000 V the equivalent circuit parameters for both the running and locked rotor conditions.
- 34) Per Unit values of residual voltage 180° out of phase at which the motor can be re-connected to the supply immediately after disconnection.
- 35) Confirmation that the machine complies in all respects with this specification or details of any deviations. Manufacturer/supplier shall also submit the following information:

- 1) Report of experience and, background of major clients and annual sale for similar equipment.
- 2) Reference list showing the successful operation of equipment offered in major oil industries.
- 3) Drawings and documents ticked under column required "with quotation", and "with order" in appendix No. 2.

28. PACKING

For general requirements see attachment No. 4.

29. SHIPMENT

For general requirements see attachment No. 5.

30. GUARANTEE

See attachment No. 6.

31. SPARE PARTS

See attachment No. 7.

32. LANGUAGE

See attachment No. 8.

33. COORDINATION RESPONSIBILITY WITH OTHERS

See attachment No. 9.

APPENDICES

APPENDIX A

EXAMPLE OF TYPICAL DATA SHEET FOR a.c. 3 PHASE SQUIRREL CAGE INDUCTION MOTOR

- Project Name

- Specification Number

- Area Classification to IEC 79.10:

Safe	Zone 2	Zone 1
------	--------	--------

Explosion Protection

Apparatus Group or Subgroup

Ignition Temperature of Released Gas/Vapor

Group of Gas in Site

Temperature Class of Equipment

- Motor Title

- Frame Size

- Rated Output..... kW

- Service Factor At Temperature Rise

- Rated Line Voltage Volts

- Rated Frequency Hz

- Synchronous Speed Rev./m

- Noise leveldb(A)

- Maximum rms value of the vibration velocity for the shaft heightmm.....mm/s

- Direction of Rotation:

 clockwise.....anticlockwise

- Class of Insulation

- The Moment of Inertia of the Driven Load (kg. m) and the Starting Characteristic of the Load or Any other Load Characteristic

.....

.....

.....

Maximum Fault Level:..... kA

Duration of Fault..... seconds

-Method of Short Circuit Protection:

.....

.....
.....

- Method of Neutral Earthing of System:

.....
.....
.....

- Type of Switching Device to be Employed:

.....
.....

- Stator Winding Connection:

- Star.....
- Delta.....
- Star in Starting, Delta in Running

- Type of Terminal Box (See Appendix C):

.....

- 1) Phase segregated pressure containing:
- 2) Phase segregated partial pressure containing:
- 3) Phase segregated pressure relieving:
- 4) Phase insulated pressure relieving:

- Arrangement:

- Enclosure Degree of Protection:
- Type of Cooling:
- Type of Construction:

- Temperature Detectors:

.....

- Motor Heater and Supply Details:

.....

- The Position of Terminal Box Viewed from the Drive End:

.....

- The Orientation of Terminal Box:

.....

- Description of:

Cable Size and Type.....	Cable Gland-----	required
-		not required
Conduit and Wire		

- Accessories:

Drain Plug(s)
 Lifting Eye Bolt(s)
 Earthing Bolt(s)

- Issue of Half Coupling: required
 not required

OPTIONS

At discretion of the Client’s Engineer the following options may be specified at the inquiry stage:

Stator winding designated for continuous operation in delta with six ends out for star/delta starting, into a common terminal box (LV motors only):

.....

A temperature class to IEC 79.0 Part 0 other than T3 (200°C) for Zone 2 motors e.g. T4 (135°C), T5 (100°C) or T6 (85°C):

.....

Addition of P.T.C. (positive temperature coefficient) thermistors for protection of winding (LV motors only):

.....

Combined tests with driven equipment:

.....

Provision of loose foundation bolts and or plates with the motor:

.....

Direction of rotation to be anti-clockwise when facing the drive end of the motor:

.....

The fitting of a certified flameproof moisture trap(s) and drain(s) to Zone 1 motors:

.....

A full set of class F stator winding coils (not 1/3 set), and all other necessary materials for Zone 1 and Zone 2 cage motors if of barrel type construction, or a class F stator 'pack' if the type of motor construction is suitable for stator pack replacement. Coils or stator "packs" to be boxed for long term dry storage in Iran and to be arranged so that the insulation can be checked periodically without having to disturb the box or packing.

Note:

Check to be carried out before ordering to ensure that identical coils or stator packs are not already held in stock for identical motors.

A full set of roller, ball or sleeve type bearing if they are not already a store stock item:

.....

The fitting of a dial type thermometer to each motor bearing complete with adjustable tamperproof non sparking trip and alarm contacts and a terminal box certified to suit the motor classification:

.....

.....
.....

Provision of weatherproof detector switch certified as suitable for use in a Zone 1 or Zone 2 classified area as required to suit the overall electrical installation:

.....
.....
.....
.....

APPENDIX B
LIST OF DRAWINGS, DOCUMENTS, MANUALS AND CERTIFICATES
TO BE SUBMITTED BY MANUFACTURER

DESCRIPTION	REQUIRED WITH QUATATION	CERTIFIED INFORM. REQ. WITH ORDER			NUMBER OF WEEKS BEFORE DELIVERY
		NO. OF COPIES		NUMBER OF WEEKS AFTER ORDER	
		REPRO-DICIBLES	PRINTED MATTER		
A DRAWING AND OTHER DOCUMENTS:					
a) ELECTRICAL EQUIPMENT:					
1. DIMENSIONED OUTLINES AND FOUNDATION DETAILS					
INCLUDING: CABLE ENTRIES AND CLEARANCES					
2. DETAILS AND CROSS-SECTIONAL ARRANGEMENT					
3. MOUNTING DETAILS					
4. PERFORMANCE DATA (TYPICAL)					
5. PARTS / MATERIAL LIST					
6. RELEVANT CATALOGUES					
7. NAME PLATES					
8. LIST OF FINAL LABELS					
b) TERMINATION:					
1. CONNECTION DIAGRAM					
2. TERMINAL BOX ARRANGEMENT					
3. CONNECTION AND TERMINAL DESIGNATION					
c) ELECTRICAL REFERENCE DOCUMENTS:					
1. GENERAL DESCRIPTION					
2. EQUIPMENT SPECIFICATION					
3. PERFORMANCE DATA (ACTUAL)					
4. DRAWINGS / PARTS / MATERIALS LIST					
B INSTRUCTION MANUALS : (FOR ALL REQUIRED ITEMS)					
1. INSTALLATION, COMMISSIONING AND INSPECTION					
2. OPERATION AND MAINTENANCE					
C SPARE PARTS REQUIREMENTS:					
1. ILLUSTRATED SPARE PARTS					
2. RECOMMENDED COMMISSIONING SPARE LIST					
3. RECOMMENDED SPARES FOR THREE YEARS OPARATION					
D CERTIFICATION:					
1. PERFORMANCE TEST, MATERIALS CERTIFICATES AND CURVES					

APPENDIX C

C1- Terminal Box Types

1 Phase Segregated Pressure Containing Terminal Box

A terminal box so designed that the protection of the phase conductors against electrical failure within a single compartment terminal box is by insulation and by earthed metal so as to restrict electrical breakdown to an earth fault. Phase to phase faults can only occur due to simultaneous earth faults.

Additionally, the terminal box is so designed that the products of an electrical breakdown within the terminal box are completely contained within the box.

2 Phase Segregated Partial Pressure Containing Terminal Box

A terminal box so designed that the protection of the phase conductors against electrical failure within the terminal box is by insulation and additionally by earthed metallic barriers forming complete distinct, individual phase compartments so as to restrict electrical breakdown to an earth fault. Phase to phase faults can only occur due to simultaneous earth faults.

Additionally the terminal box is so designed that the products of an electrical breakdown within the terminal box are either contained inside the box when the fault energy is low, or are released to the inside of the motor when the fault energy is excessive. Release to the motor interior will be consequent upon rupture of an appropriate pressure relieving disc.

3 Phase Segregated Pressure Relieving Terminal Box

A terminal box so designed that the protection of the phase conductors against electrical failure within the terminal box is by insulation and additionally by earthed metallic barriers forming complete distinct, individual phase compartments so as to restrict electrical breakdown to an earth fault. Phase to phase faults can only occur due to simultaneous earth faults.

Additionally the terminal box is so designed that the products of an electrical breakdown within the terminal box are relieved through a pressure relief diaphragm to the outside of the terminal box. Pressure relief shall be in a location between the motor and the terminal box, arranged so that the potential for injury to personnel is minimized.

Additional ducts and/or deflector plates shall be provided when specified.

4 Phase Insulated Pressure Relieving Terminal Box

A terminal box so designed that the protection of the phase conductors against an electrical failure within the terminal box is by insulation such that there are no bare conductors or connectors in the terminal box.

Additionally the terminal box is so designed that the products of an electrical breakdown within the terminal box are relieved through a pressure relief diaphragm to the outside of the terminal box. Pressure relief shall be in a location between the motor and the terminal box, arranged so that the potential for injury to personnel is minimized.

Additional ducts and/or deflector plates shall be provided when specified.

C2- Type Tests for Terminal Boxes

1 Type Test Categories

Category A

Applicable to terminal box assemblies for use with motors that in service are provided with protective devices, which under conditions of short circuit are energy limiting e.g. HBC fuses to IEC 264.1 and IEC 282.1

Category B

Applicable to terminal box assemblies for use with motors that in service are provided with protective devices which are slower acting than HBC fuses, e.g. conventional circuit breakers.

Type tests shall be made with the terminal box assemblies connected to an electrical system having a nominal short MVA capacity not less than that specified by the Purchaser.

Category A testing is not required for motors rated at 1000 V and lower.

1.1 Category A Type Tests

The supply to the terminal box assemblies shall include protective devices similar to or possessing the same fault energy limiting characteristics as the protective devices specified by the Purchaser.

1.2 Category B Type Tests

The supply to the terminal box assembly shall include a circuit breaker arranged to disconnect the supply 0.25 seconds after it has been energised.

2 Test Conditions

The terminal box assemblies used shall be identical with those used in service in all details likely to affect their performance during individual type tests, and for the purpose of the tests, shall be mounted in a manner representative of service conditions.

The terminal box assemblies shall be tested under conditions of:

- a) A three phase through fault and, where applicable, followed by;
- b) a single phase to earth fault in the terminal compartment.

C3- Test Results

The terminal box shall be deemed to have failed if:

- a) There is a disintegration of the outer enclosure or emission of flame other than through specifically designed vents.
- b) On the through fault test any fault on the outgoing side of the assembly is transferred to the interior of the assembly.
- c) Any single phase to earth fault develops into a phase to phase fault.

Records of type tests shall be considered as evidence of the compliance of terminal box assemblies with the requirements of the relevant clauses of the specification, and the Manufacturer shall hold such records, together with detailed drawings of the terminal box assemblies and a record of any alterations that have been made in them subsequent to the type tests.

**ATTACHMENTS
GENERAL**

**ATTACHMENT 1
ENVIRONMENTAL CONDITIONS**

1.1 Site elevation : ----- meters above sea level.

1.2 Maximum ambient air temperature : ----- degree centigrade.

(Bare metal directly exposed to the sun can at times reach a surface temperature of ----- degree centigrade.

1.3 Minimum air temperature : ----- degree centigrade.

1.4 Relative humidity : ----- percent.

1.5 Atmosphere : saliferous, dusty corrosive and subject to dust storms with concentration of 70 - 1412 mg/cubic meter, H₂S may be present.

1.6 Lightning storm isoceraunic level : ----- storm days / year.

1.7 Maximum intensity of earthquake ----- richters.

Note:

Blanks to be filled by client.

**ATTACHMENT 2
INSPECTION / QUALITY CONTROL, AND QUALITY RECORDS**

2.1 Inspection / Quality Control

2.1.1 The purchaser's inspector, or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the equipment, to carry out necessary inspection at any stage of work.

2.1.2 Inspection may include the visit to quality control laboratories, work shops, testing bays etc.

2.1.3 The supplier shall make available technical data, test pieces and samples that the purchaser's representative may require for verification in conjunction with pertinent equipment.

If required the supplier shall forward the same to any person or location that the purchaser's representative may direct.

2.2 Quality Records

2.2.1 The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements.

2.2.2 Quality record shall be legible and relevant to the product involved.

2.2.3 Quality records that substantiate conformance with the specified requirements, shall be retained by manufacturer and made available on request by purchaser.

2.2.4 The supplier shall establish and maintain procedure for identification collection, indexing, filing, storage, maintenance and disposition of quality records.

2.2.5 Supplier shall submit to purchaser: reports, test, schedules, and test certificates (in ----- copies) on completion of tests.

Note:

Blanks to be filled by client.

**ATTACHMENT 3
TESTS AND CERTIFICATION**

3.1 General Requirements

3.1.1 Test procedure as proposed by the supplier shall be agreed upon, and approved by the purchaser before any test is carried out.

3.1.2 Purchaser may require witnessed tests to be carried out in the presence of his nominated representative who should be informed at least ----- weeks in advance of the date of the tests and confirmed ----- weeks before the tests.

3.1.3 Test certificates and test reports shall refer to the serial No. of the equipment tested and must bear the purchaser's name, order No. and manufacturer's name and seal.

The certificates shall be approved by the purchaser before shipment instruction are given.

3.1.4 Approval by the purchaser's inspector or representative shall not relieve the vendor of his commitments under the terms of this specification or any associated order.

3.1.5 The equipment may be rejected if measurement and inspection reveal any discrepancies between quoted figures resulting in purchase order and those measured actually.

3.1.6 Any charges incurred by the tests quoted under heading of specific requirements for tests to be quoted as a separate item and are not to be included in the cost of the equipment.

Note:

Blanks to be filled by client.

ATTACHMENT 4 PACKING

4.1 Equipment must be carefully packed to provide necessary protection during transit to destination and shall be in accordance with any special provision contained in the order.

4.2 Special attention must be given to protection against corrosion during transit, and silica gel or similar dehydrating compound shall be enclosed.

4.3 The method of cleaning preserving and the details of packing including moisture elimination, cushioning, blocking and crating shall be such as to protect the product against all damages or defects which may occur during handling, sea shipment to the port and rough road haulage, to site and extended tropical open air storage generally as client general conditions of purchase see attachment No. 10

4.4 All bright and machined parts must be given the protection against corrosion.

4.5 Ancillary items forming an integral part of the equipment should be packed preferably in a separate container if the equipment is normally cased or crated.

Alternatively the ancillary items should be fixed securely to the equipment and adequate precautions taken to ensure that the item do not come loose in transit or be otherwise damaged.

4.6 The supplier shall provide methods of handling to prevent damage and or deterioration during transit.

4.7 Where deemed necessary each shipping section shall be furnished with removable steel angles.

4.8 The requirements of above items shall not relieve the supplier of any of his responsibilities and his obligations for delivery of equipment in a sound undamaged and operable conditions at site.

4.9 Identification for Shipment

The marking and labels of products should be legible durable and in accordance to specification.

Identification should remain intact from the time of initial despatch at work to the final destination.

Marking shall be adequate for identifying a particular equipment in the event that a recall or inspection becomes necessary.

**ATTACHMENT 5
SHIPMENT**

- 5.1** Electric motors shall be shipped with bearings lubricated.
- 5.2** Silicagel or similar dehydrating compound shall be enclosed in each motor package.
- 5.3** Vents shall be waterproof sealed.
- 5.4** Rotors shall be locked.
- 5.5** Preparation for shipment shall be in accordance with manufacturer's standard unless otherwise noted on the request for quotation and or purchase order.
- 5.6** The manufacturer shall be solely responsible for the adequacy of the preparation for shipment employed with respect to materials, and shall provide materials to their destination in exwork condition when handled by commercial carrier systems.
- 5.7** The greatest care must be taken to ensure that shipping and associated documents with exact description for custom release are accompanied with the shipment.

**ATTACHMENT 6
GUARANTEE**

6.1 Clearance of Defects

The supplier shall guarantee his equipment during commissioning and for one year operation starting from the completion of seven days continuous service test in site at full load against the following defects:

- All operational defects
- All material defects
- All constructional and design defects

6.2 Replacement of Defective Parts

All defective parts shall be replaced by the supplier in the shortest possible time free of charge including dismantling reassembling at site and all transportation cost. The above mentioned period shall not however be longer than 18 months from the date of dispatch from the manufacturer's works.

6.3 Supply of Spare Parts

Further more the supplier shall guarantee the provision of spare parts to the purchaser for a minimum period of -----
-years from the date of despatch.

6.4 After Sale Technical Services

6.4.1 Commissioning

6.4.1.1 The supplier shall quote if required for the services of competent engineer(s) and or technician(s) to assist in installation' commissioning and testing of the equipment at site on a per diem basis.

6.4.1.2 The quoted rates shall be irrespective of duration and frequency and the supplier shall guarantee the services of the engineer(s) and technician(s) on the specified date within a minimum of ----- weeks advance notice by the purchaser.

6.4.2 Training

6.4.2.1 The purchaser may require the supplier to arrange for training of his personnel in the manufacturing plant and or in site for the operation and maintenance of the equipment offered.

6.4.2.2 The supplier shall quote (if required) for the cost of any of above mentioned services on a per person per diem basis. The program for the training shall be prepared by mutual agreement. An advance notice of ----- weeks minimum, is required by purchaser for the commencement of training program.

Note:

Blanks to be filled by client.

ATTACHMENT 7

SPARE PARTS

- 7.1** All spare parts shall comply with the same standards, specification and tests of the original equipment and shall be fully interchangeable with the original parts without any modification at site.
- 7.2** They shall be correctly marked in accordance with client reference and manufacturer part numbers, giving also the purchaser's order number.
- 7.3** Spare parts shall be preserved to prevent deterioration during shipment and storage in humid tropical climate.
- 7.4** List of recommended spare parts and interchangeability with spare parts of similar equipment shall be submitted by supplier.

**ATTACHMENT 8
LANGUAGE**

8.1 All correspondences drawings, documents, certificates, including testing, operation and maintenance manuals and spare part lists etc. shall be in English.

8.2 Offers in other languages will not be considered.

**ATTACHMENT 9
COORDINATION RESPONSIBILITY WITH OTHERS**

- 9.1** In case the equipment ordered should be mounted on, aligned, connected, adjusted, or tested with the equipment of other manufacturer(s) the supplier shall contact directly the said manufacturer(s) and supply and obtain all dimensional and technical informations and arrange for any interconnecting equipment and combined test that may be required.
- 9.2** The supplier shall be responsible for correct and timely communication with the said manufacturer(s) and for any delay and/or cost claims arising from such communications.
- 9.3** Copies of all correspondence should be sent to purchaser.
- 9.4** The name and address of the manufacturer(s) will be given as soon as their orders have been confirmed.

**ATTACHMENT 10
GENERAL CONDITIONS OF PURCHASE**

This document will be submitted by purchaser at the time of ordering.

**ATTACHMENT 11
SAMPLE OF PURCHASER'S DRAWING TITLE BLOCK**

DRAWING NO.	DESCRIPTION
REFERENCE DRAWINGS	
D	
C	
B	
A	
REV	DATE
	DESCRIPTION
	REF
	CHK
	APP
THE NAME OF RELEVANT COMPANY	
	
DRAWING TITLE :	
DRN. BY	SCALE
MICRO FILM CODE	PROJECT NO.
CHK. BY	APP. BY
JOB NO.	AREA CODE
DWG. NO.	SHEET
REV.	

Note:

Appropriate Nomenclature and Registered mark shall be used for quotation and order.

**ATTACHMENT 12
INSTRUCTIONS OF PURCHASER ABOUT DRAWINGS**

- 12.1** Purchaser's drawing title block, "the sample of which is given in attachment No. 11 shall be shown in the right lower corner of the drawings.
- 12.2** Drawings are to be protected and packed. Negatives must be dispatched in a strong card board cylinder.
- 12.3** Drawings must be rolled and not folded.
- 12.4** All drawings, documents and literatures shall be forwarded under cover of a fully detailed letter to purchaser whose addresses is given in attachment No. 14.

**ATTACHMENT 13
MATERIAL, LAYOUT AND LETTERING OF LABELS**

Label material to be "Traffolite" 5 mm. Thick having two outer layers and to be engraved into the white layer to give black lettering on a white background.

LETTER TYPE

TYPE	HEIGHT	WIDTH mm	STROKE	CASE		LETTERS / 25 mm	SAMPLE
A	5	WIDE	LIGHT	UPPER	CASE	7½ ± 1.2mm. TOL	ABCDEFGHIJKLM
B	5	WIDE	HEAVY	"	"	7½ ± 1.2mm. TOL	
C	5	NARROW	LIGHT	"	"	11 ± 2.5mm. TOL	
D	5	NARROW	HEAVY	"	"	11 ± 2.5mm. TOL	
E	3	WIDE	LIGHT	"	"	10 ± 1.2mm. TOL	
F	3	WIDE	HEAVY	"	"	10 ± 1.2mm. TOL	
G	3	NARROW	LIGHT	"	"	15 ± 1.2mm. TOL	
H	10	WIDE	HEAVY	"	"	3½	
J	12	WIDE	HEAVY	"	"	2½	

Note:

Height is in milli meters.

(to be continued)

**ATTACHMENT 13
LAYOUTS**

LAYOUT 1		LETTERS MAX / LINE	8 MIN		8 MIN
LETTER TYPE	G	28	25	LINE 1	4 DIA HOLES
	E & F	19	4	LINE 2	
				64	4
LAYOUT 2		LETTERS MAX / LINE	8 MIN		8 MIN
LETTER TYPE	G	28	25	LINE 1	4 DIA HOLES
	E & F	19	4	LINE 2	
				64	4
LAYOUT 3		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B	22	32	LINE 1	4 DIA HOLES
	C & D	23	5	LINE 2	
	E & F	30			
	G	45			
				100	5
LAYOUT 4		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B	22	32	LINE 1	4 DIA HOLES
	C & D	23	5	LINE 2	
	E & F	30		LINE 3	
	G	45			
				100	5
LAYOUT 5		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	H	15	32	LINE 1	4 DIA HOLES
	J	10	5		
				130	5
LAYOUT 6		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B	28	32	LINE 1	4 DIA HOLES
	C & D	40	5	LINE 2	
	E & F	40			
	G	58			
				130	5
LAYOUT 7		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B	28	32	LINE 1	4 DIA HOLES
	C & D	40	5	LINE 2	
	E & F	40		LINE 3	
	G	58			
				130	5

ALL DIMENSIONS ARE GIVEN IN mm.
MIN = MINIMUM

