
	<p>Toase-ehe Park Sanati Gohar Ofogh Petrochemical Co.</p> <p>CONCEPTUAL, BASIC and DETAIL DESIGN ENGINEERING OF STYRENE PARK OFFSITE</p>		
	<p>Document Title : Specification For Low Voltage Motors</p>		
	<p>Document No. : EI027-000-EB-EL-SPC-002</p>		<p>Rev. 3</p>

STYRENE PARK OFFSITE

Document Title:

Specification For Low Voltage Motors

Document No:

EI027-000-EB-EL-SPC-002

R3	25.01.2020	ISSUED FOR INFORMATION	M.O	S.B	R.M
2	22.02.15	APPROVED FOR DESIGN	A.SH	L.J	S.M
1	10.12.15	ISSUED FOR APPROVE	A.SH	L.J	S.M
0	14.11.15	ISSUED FOR COMMENT	A.SH.	L.J	S.M
Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED



Toase-ehe Park Sanati Gohar Ofogh
Petrochemical Co.
**CONCEPTUAL, BASIC and DETAIL
DESIGN ENGINEERING OF STYRENE
PARK OFFSITE**



BINA EPC Contractor Co.
(Executor of Oil, Gas, Petrochemical & Power Industries)

Document Title : **Specification For Low Voltage
Motors**

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REVISION RECORD SHEET

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1	X	X		X				41							
2	X	X		X				42							
3	X	X		X				43							
4	X	X		X				44							
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1. INTRODUCTION



- Creation and development of chain units of Styrene Monomer is the mission of Gohar Ofogh Industrial Park. This Company joint investment of 4 companies including JPC, Asaluyeh Sadaf Chemical, Kimia Sanaye Dalahoo and Entekhab Group and is located in Asaluyeh.
- Feed and utility lines and network construction, Styrene Monomer tank construction, Peroxide and its sidelong equipment warehouse are among this company's missions.
- Some of the ongoing Projects of this company are:
- ABS-Rubber project
- ESBR project
- EPS project
- Poly Styrene

1.1 Applicable codes and standards

- 1.1.1** Design, materials, fabrication, inspection, testing and certification shall be in accordance with the requirements of the specified codes. Codes specified shall be taken as the latest issue including all appendices issued at the contract effective date. The SUPPLIER is responsible for implementing any regulations concerning the design, fabrication, testing and inspection of Low Voltage Induction Motor, which are mandatory to any applicable statutory or local regulations.
- 1.1.2** Before PO placement the CONTRACTOR and the SUPPLIER shall agree which editions/dates of the codes and specifications apply. The agreement shall be recorded in the updated specification issued for purchase.
- 1.1.3** The design of any part of supply, which is not covered by the specified code or this specification, shall be carried out according to the SUPPLIER'S standard and shall be agreed with the CLIENT / CONTRACTOR.
- 1.1.4** The design codes and standards shall be as indicated below and/or stated on the equipment data sheet.

IRANIAN PETROLEUM STANDARD (IPS)

- | | |
|--------------------|---|
| 1) IPS-M-EL-131(2) | Material and Equipment Standard for Low Voltage Induction Motor |
| 2) IEC 60072 | Dimensions and output series for rotating electrical machines |
| 3) IPS-E-EL-100 | Engineering Standard for Electrical System Design |
| 4) IPS-G-SF-900 | General Standard for Noise Control and Vibration |

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International Electrotechnical Commission (IEC)

- | | |
|---------------------|--|
| 5) IEC 60034 series | Rotating machines |
| 6) IEC 60079 series | Electrical apparatus for explosive gas atmosphere |
| 7) IEC 60529 | Degrees of protection provided by enclosures (IP code) |
| 8) IEC 61241 | Electrical apparatus for use in the presence of combustible dust |

ISO (International Standard Organization)

- | | |
|----------------|--|
| 9) ISO 10816-1 | Mechanical vibration |
| 10) ISO 281 | Rolling bearings |
| 11) ISO 1940/1 | Balance quality requirement for rigid rotors |

The design shall be performed based on the requirements detailed in this specification. Priority shall be determined as follows, unless agreed to by CLIENT:



- Data sheet
- Drawings
- This job specification.
- Other job specification mentioned in this document
- IPS Standards
- International Code & Standards
- The Most Stringent Codes or Standards

1.2 Reference documents

Electrical Design Criteria

1.3 Conflicting requirement

This document shall be read in conjunction with the applicable IPS. It is SUPPLIER's responsibility to ensure that the relevant IPS is reviewed and in the event of conflict between IPS and this document or other international standards, the issue shall be referred to CLIENT for approval. However, in general any additional requirements shall be applied.

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2. DEFINITIONS

For the purpose of simplifying the names of the PARTIES involved in the execution of the PROJECT, the following shortened nomenclatures are used in this procedure:

Project Name: Styrene Park Offsite
Client: Gohar Ofogh Petrochemical Co.
Consultant: BINA EPC Contractor Co.

Vendor/Manufacturer Who is responsible for fabrication and supplying the equipment



3. DESIGN CONDITION

The electrical equipment shall be designed in due consideration of following design conditions, unless otherwise specified:

- Max. outdoor Recorded Temperature +48°C
- Max. indoor Recorded Temperature +45°C
- Min. outdoor Recorded Temperature 10°C
- Min. indoor Recorded Temperature 5°C
- Electrical Motor design Temp.(Min/Max) 0°C/50°C
- Humidity 80%
- Soil Temperature 30°C

4. SERVICE CONDITIONS

The motor specified herein will be generally installed outdoor in areas where the presence of flammable gas or vapor is foreseen. In case where the motor will be installed indoor, it will be indicated in data sheet. In order to permit the proper selection and installation of the electrical motors, the areas in which the motor will be installed are classified.

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The electrical motor shall meet the requirements of the classified areas as specified in this specification and indicated in data sheet.

The maximum and minimum ambient air temperature, relative humidity and the elevation of the location in which the motor will be installed will be indicated in data sheet. The ambient air temperature shall in no case be assumed less than 40°C.

The conditions during transport and storage will be a temperature range of -25°C to 60°C and relative humidity of up to 98%. The equipment subjected to these extreme conditions without being operated shall not be damaged and shall operate normally under the specified conditions.

The low voltage system is generally 400/230 Volt, 50 Hz with solidly earthed neutral.

5. AREA CLASSIFICATION

The industrial areas in the Iranian Petroleum Industry shall be classified as zone 0, zone 1, zone 2 and non-hazardous area as defined in IEC 60079-10. The areas classified as zone 0, zone 1 and zone 2 are generally referred to as hazardous areas.

The extent of each hazardous area zone and the distance in any direction from the source of release of flammable substances to another zone or to non-hazardous area shall be estimated according to the guidelines and demonstrated examples outlined in API RP505.

The area classification zone and the gas group classification of the location in which the motor is to be installed will be indicated in data sheet/s.

The type of motor enclosure suitable for installation in each zone and each gas group together with the temperature class of the motor shall be according to the requirements of this specification and shall be stated by the motor supplier in data sheet/s.

Motors for use in classified areas shall be certified by recognized international or national certifying authorities. The certificate issued by Underwriters Laboratories Inc. (UL) of USA, the Ex Certification Bodies of IEC and the Notified Bodies of ATEX is acceptable. The certifying authority and the certificate number shall be stated in data sheet/s by the motor supplier.

6. GENERAL REQUIREMENTS

6.1 Voltages and Output Ratings

The voltage levels adapted in the oil, gas and petrochemical industries of Iran are based on the IEC recommendation No 60038.



The low voltage system is generally 400/230 volt with solidly earthed neutral.

The motors with nominal voltages of 400 volt and below are referred to as low voltage (LV) motors.

The voltage of the motors rated up to 0.4 kW can be selected as 230 volt single phase and neutral. If capacitor type single phase motor is used, the capacitor shall be metal clad with paper dielectric. Motors for critical services such as compressor auxiliaries, lube oil systems, special pumps, etc. shall be 400 volts, 3 phase.

The voltage of the motors 0.4 kW up to 150 kW shall be 400 volt three phase. The voltage of 150 kW motors can be selected as 400 volt or 6000 volt depending upon the availability of such voltages.

Motors shall be capable of operating continuously at rated torque at any frequency between -2% and +2% of the nominal frequency together with a voltage variation of $\pm 5\%$. The nominal frequency is 50Hz.

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6.2 Motor Sizing

Frame sizes and dimensions and the kW ratings of the motors shall be in accordance with IEC 60072-1.

Motors shall be sized, taking into consideration the appropriate multiplying factor/s related to each type and size of the driven equipment. The size of the motors versus the driven equipment shall be according to the recommendations of the driven equipment specifications.

6.3 Motor Application

Motors will generally be used to drive pumps, compressors, blowers, agitators and other constant speed equipment.

The type of driven load and the torque requirement will be specified in request for quotation and/or data sheet. Motor shall satisfy the speed torque requirement of the driven equipment over its entire starting and operating range.

When motors are furnished with the driven equipment, verification of the torque speed characteristic of the motor vs. the torque requirement of the load is the responsibility of the driven equipment supplier.

When motors are directly ordered by the purchaser, the torque requirement of the load will be indicated in data sheet.

6.4 Motor Starting

Unless otherwise specified in data sheet, motors shall be suitable for Direct On Line Starting.

Upon the approval of company representative, star delta starting may be employed for special cases.

The starting performance and pull up torque of the motors shall be generally design N in accordance with IEC 60034-12.

The motor design shall allow without injurious heating of insulated windings, at least three successive starts from cold against full load torque and two successive starts with the motor initially at full load operating temperature.

Motors shall be able to overcome starting load inertia as well as accelerating the load to rated speed, when the applied voltage is 80% of the nominal voltage.

In case of power interruption during operation, the motor may be reconnected to the supply voltage at any time. The residual voltage and phase angle of any possible magnitude shall not have any detrimental effect on the motor.



6.5 Motor Duty

Unless otherwise indicated in data sheet/s the duty of the motor shall be duty type S1, continuous running duty, as defined in IEC 60034-1.

6.6 Method of Cooling

The low voltage motors shall be totally enclosed fan cooled designated by characteristic numerals IC 4A1A1 (or simplified IC411) as defined in IEC 60034-6 second edition.

For small motors where the temperature rise is within the acceptable value, the cooling type IC4A1A0 (or simplified IC410) is acceptable.

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6.7 Direction of Rotation

The direction of rotation shall be coordinated with the driven equipment vendor and shall be indicated in data sheet. Otherwise, the direction of rotation shall be clockwise when viewed from the driving end of the motor. The direction of rotation for motors shall be clearly indicated on the motor frame by means of an arrow in a durable and permanent manner.

6.8 Noise Level and Noise Reduction

Noise level shall not exceed 85 db at 1 (one) meter. Coverage shall be used for motors with noise level above 85 db to decrease it to Maximum 85 db at 1 (one) meter distance. Materials used for noise reduction for the motors to be installed in hazardous areas shall be fire resistant, antistatic and stable in the presence of hydrocarbon liquids and vapors. The application of noise reducing features shall be covered by the certification for use in hazardous areas.



6.9 Vibration

Vibration level of the motors shall conform to the requirements of IEC 60034-14.

7. CONSTRUCTION REQUIREMENTS

7.1 Enclosure

The motor enclosure shall be suitable for the site climatic condition indicated in data sheet. Motor frame, fan cover and bearing end shields shall be made of steel sheet or cast iron. Bolts and screws shall be made of corrosion resistant material. Aluminum frame is acceptable for motor sizes up to and including 7.5 kW for indoor use in non hazardous areas only. Aluminum frame isn't acceptable for installation in hazardous areas. The degree of protection of motors and auxiliaries shall be at least IP 55. The degree of protection of terminal box and bearing housings shall be IP 55. Motors installed outdoor which are directly exposed to sun radiation shall be protected by sun canopy. In hazardous areas classified as zone 0 no electrical motor shall be installed. In hazardous areas classified as zone 1, the motors shall be flameproof Exd according to IEC 60079-1. The gas group classification of Exd motors shall be at least group IIB if not indicated otherwise in data sheet. Where hydrogen is present, the gas group classification shall be group IIC. The temperature class of Exd motors shall be suitable for the appropriate gas in the subject area and shall in no case be more than 200°C (T3) according to IEC 60079-8. The IEC designation for such motor is (Exd IIB T3). In hazardous areas classified as zone 2, the motors shall be increased safety Exe according to IEC 60079-7 or flameproof Exd. The temperature class of Exe motors shall be suitable for the appropriate gas in the subject area and shall in no case be more than 200°C (T3). The IEC designation for such motor is (Exe IIX T3). The use of Exn type motors in non-hazardous area is acceptable. Certificate of conformity shall be supplied for all Ex type motors. The certificate number and certifying authority shall be indicated in data sheet at quotation stage. Motors shall be designed to prevent the accumulation of moisture within the enclosure. Anti-condensation heater/s is not required for low voltage motors unless otherwise specified.

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The enclosure of motors except Exd types shall be equipped with a drain hole with the same degree of protection as the motor enclosure.

Vertical motors with downward drive end shaft shall be provided with a rain cowl over the air inlets to prevent water entry into the motor. Precautions shall be taken to preclude water ingress through mechanical gaps.

Vertical motors with upward drive end shaft shall be provided with flinger rings on the motor shaft to prevent water ingress along the shaft of the motor under running and stop condition.

Earthing bolt/s shall be provided on the motor frame for connection to the earthing cable.

Exposed surfaces shall be given a coating of rust preventive to provide protection against rust. The motor frame shall be painted in accordance with manufacturer standard practice. The finish shall be suitable for the environmental conditions indicated in data sheet.

Heavy motors shall have jacking bolts to lift the motor in order to facilitate the alignment of the motor with the driven equipment. Lifting lugs shall be provided for motors weighing more than 30 Kilograms.

7.2 Winding and Winding Connection

Stator windings of low voltage motors shall be made of high quality enameled copper wire with suitable insulation.

The windings shall have their six leads accessible in the terminal box to allow star or delta connection. Windings shall be connected in delta at the manufacturers work.

After installation of the windings and connection of the coils, the windings shall be fully impregnated to restrict the movement of the coils and to achieve adequate heat dissipation. Impregnation shall be performed by means of submerging the complete stator. Coating or painting is not acceptable.

Curing of the stator coils after impregnation shall be performed at the appropriate elevated temperature.

Two speed motors shall have separate windings.

Dhalander motor type can only be used for special applications upon prior approval of company representative.

Windings shall be adequately braced to prevent any relative movement during operation.

Windings shall be able to withstand the dynamic forces from starting and restarting against the maximum residual voltage.



7.3 Insulation

Insulation materials shall be class F as defined in IEC 60034-18. The rating of motor shall be based on class B temperature rise for all parts of the motor.

All insulated windings shall be non-hygroscopic, oil resistant and the materials shall be resistant to flame propagation. Insulation shall comply with the requirements of IEC 60085.

Stator windings shall be fully insulated for an unearthed system.

The insulation shall be sized based on restarting of the motor immediately after loss of power with residual voltage of any possible magnitude and phase angle. The restarting voltage shall be assumed 100% of the rated voltage.

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7.4 Bearing and Lubrication

Bearings of low voltage motors shall be grease lubricated anti-friction rolling element type (ball and/or roller bearing) as proposed by the motor manufacturer. All rolling element bearings shall be with metallic cage. Bearings shall be in metric sizes with maximum interchangeability and shall comply with ISO recommendations (ISO 15 and ISO 1132).

Special attention shall be paid to ensure that dismantling of bearings shall be simple and free from risk of damage.

Low voltage motor bearings shall be regreasable. Pre-lubricated bearings can only be used for motors up to and including 7.5kW provided that the service life is guaranteed to be more than 40,000 working hours.

Special rolling element bearings such as Deep Groove bearings shall be used for motors with synchronous speed above 1500 RPM.

The lubricating intervals, quantity and type of grease shall be indicated on the motor nameplate or on an additional plate fixed on the motor frame.

Grease lubricated bearings shall have grease relief devices which ensures that the old grease will be forced out of the bearing when new grease is added. Relubrication shall be possible with the motor in operation and without dismantling parts.

The grease lubricated bearings shall be supplied with inside end caps to prevent grease from migrating into the motor.

Grease lubricated bearings shall be packed with grease before the motor is dispatched.

Vertical motors shall include suitable bearings to withstand the thrust of the motor rotor and the external thrusts from the driven equipment. The design of thrust bearing for vertical motors shall be submitted for purchaser's approval.

7.5 Rotor

The rotor core shall be made of annealed high quality insulated steel laminations

The shaft shall be made of one piece heat treated steel.

The rotor cage shall be copper or pressure die cast aluminum.

The rotor and internal fan shall be dynamically balanced at nominal speed with half the key fitted in the key way.

Balancing weights if fitted shall not be lead or similar ductile material. The rotor design shall allow the addition of balancing weights.

Shaft extension shall be in accordance with IEC 60072-1. The design of the shaft end and coupling shall be in accordance with the instruction of the driven equipment manufacturer.

7.6 Cooling Fans



Cooling fans shall be made of non-sparking anti-static material.

Metallic fans made of aluminum, cast iron or steel is preferred.

External fan shall be balanced before assembling on the motor shaft.

The external fan shall force the cooling air in the direction of the driving end.

Bidirectional fan is preferable. For motors fitted with unidirectional fans, a permanent arrow shall indicate the direction of rotation. It shall not be possible to assemble the unidirectional fan on the shaft of the motor incorrectly.

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7.7 Terminal box

Motor terminal box/s, including removable cover/s shall be made of steel sheet or cast iron. Aluminum terminal boxes are acceptable for motors up to and including 7.5 kW rating with aluminum enclosure.

Unless otherwise specified, the main power terminal box shall be positioned on the right hand side of the motor enclosure when looking at or facing the driving end. The cable/s to the main terminal box will rise from the floor. Main terminal box installed on top of the enclosure can be acceptable upon prior approval of company representative.

In case where other additional connections to the motor are specified, they shall be terminated in box/s separate from the main terminal box.

The degree of protection of terminal boxes shall be at least IP55. Terminal boxes for motors in offshore installations shall be IP56. The design of the terminal boxes shall be such as to prevent small objects from dropping into the motor housing.

The main terminal box shall withstand the effects of short circuits inside the terminal box without being damaged and without emission of flame. The short circuit capability of the terminal boxes shall be as per IEC recommendations.

Terminal boxes for EX motors shall be with the same protection degree as the motor itself. Exact EX code for different types of motors will be indicated in related data sheets.

Terminal boxes shall have ISO metric threaded entry as per IEC 60423, complete with threaded plug (cable gland will be supplied by EPC contractor).

Terminal boxes shall be sized to have enough space for cable/s connections. The sizes of the power cable/s are indicated in data sheet.

Means shall be included in terminal boxes to prevent slackening of connections due to vibration.

Inside the main terminal box an earthing terminal shall be provided for earthing the cable shields. Such terminal shall be clearly marked with earthing symbol.



The phase sequence associated with the direction of rotation of the motor shall be clearly indicated on the motor terminals. Terminal markings shall be made in a clear and permanent manner according to IEC 60034-8.

7.8 Nameplate

Each motor shall be provided with nameplate/s securely fixed to the non-removable part of the motor frame. The nameplate/s shall be made of stainless steel.

Nameplates shall be durably marked with the items specified in IEC 60034-1 as far as they apply, and shall also include the following items. The items need not all be on the same plate.

- Maximum ambient air temperature, if other than 40°C
- Class of insulation
- Degree of protection IP code of the motor enclosure and terminal box
- Type and size of bearings
- Type of lubricant and lubricating intervals
- Explosion protection type of the machine, terminal box and auxiliary devices in accordance with the recommendations of IEC 60079 series
- Gas group and temperature group of the motor in accordance with IEC 60079 series

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When special features are embodied, a plate showing appropriate instructions shall be fixed to the motor frame.

In addition to motor nameplate/s, a separate identification plate engraved with the motor identification number given on data sheet shall be attached to the non-removable part of the frame. It shall be possible to replace such plate by a similar plate.

8. TEST AND INSPECTION

The equipment under this specification shall be factory tested. Certified copies of test reports and/or certificates shall be submitted to the purchaser. The numbers of certified copies required will be specified by the purchaser in the purchase order.

The purchaser's inspectors shall be granted the right for inspection at any stage of manufacture and testing. Purchaser will require the presence of his nominated representative to witness the final inspection and performance tests. For such purpose a type test on an identical machine is acceptable. The supplier shall inform the date of such tests at least two months in advance.



Type tests and routine tests shall be carried out according to the recommendations of IEC 60034-1 and the relevant IEC publications referred to therein. The final performance test shall include at least the following:

- Insulation resistance test on windings
- Measurement of winding resistance (cold)
- Measurement of winding resistance (hot)
- Bearing temperature rise
- No load current
- Current unbalance at full load
- Locked rotor current
- Locked rotor torque
- Torque speed curve
- No load losses
- Direction of rotation
- Slip and nominal speed at full load
- Vibration severity
- Noise test
- Bearings inspection

9. SPARE PARTS

Together with the supply of motors under this specification, a complete set of spare parts for commissioning shall be supplied for each motor. The supplied spare parts shall comply with the same specifications as the original parts and shall be fully interchangeable with the original parts without any modification. Spare parts shall be preserved to prevent deterioration during transport and storage in a humid tropical atmosphere.

The vendor shall also supply a list of recommended spare parts for two years of operation.

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10. DOCUMENTATION

The vendor shall supply the necessary information with the quotation to enable evaluation of the submitted proposal. General documents/drawings are not acceptable unless they are revised to show the equipment proposed.

The documents to be supplied with the quotation shall at least include the following:

- Completed enquiry data sheet/s.
- Summary of exceptions/deviations to this standard specification.
- Brochures and catalogues containing description of typical motors.
- Torque-speed curves.
- Preliminary dimensional drawings.
- Approximate shipping weights and sizes.
- Copies of relevant certification documents.

The documents which shall be supplied together with the equipment shall at least include the following:

- Updated and completed enquiry data sheet/s.
- General arrangement drawings showing main dimensions, arrangement of components and terminal boxes.
- Windings connection diagrams
- List of components, showing complete reordering information for all replaceable parts.
- Bearing arrangement drawing with bearing replacement procedure.
- Installation, operation and maintenance instruction/s.
- Recommended spare parts list for two years of operation.
- Test reports for type tests and routine tests.
- Certificates of conformity for Ex type motors.

11. PACKING FOR SHIPMENT

The supplier of the equipment under this specification is the sole responsible for packaging and preparation for shipment.

The packaging and preparation for shipment shall be adequate to avoid mechanical damage during transport and handling.



Motors shall be shipped with bearing lubricated.

Rotors shall be locked during shipping to avoid damage to the bearings.

Depending on motor size and weight, motors shall be securely fastened to a hardwood skid or pallet suitable for fork truck handling, and shall be covered for protection against dirt and moisture during transport and outdoor storage.

Open cable entries on motor terminal box shall be adequately sealed before the motor is dispatched from the manufacturer's works.

Each motor package/container shall be provided with permanently attached identification tag containing necessary information together with the motor identification number.

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Silica gel or similar dehydrating compound shall be enclosed in each motor package/container.
Shipping documents with exact description of equipment for custom release shall be supplied, with the equipment.

12. GUARANTEE

The supplier of the equipment under this specification shall guarantee the equipment and shall replace any damaged equipment/parts resulting from poor workmanship and/or faulty design.

The supplier shall replace any equipment/part failed under the following condition:

- Failure under startup and commissioning tests performed according to IEC recommendations.
- Failure under normal usage for a period of 18 months, not exceeding 24 months from the date of dispatch from the manufacturers works.
- Supply of spare parts for at least 10 years shall be guaranteed by vendor.