



Petrochemical Research & Technology
Co.

PP-PE Pilot Plant

Document No. :

Rev.: 0

Title :

Inspection & Test Plan for Centrifugal Compressors

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No.	Inspection/Test Items	Procedure & Standards	Inspected By				Remarks
			O	P	V	C	
1	Pre-inspection meeting required for above 100 Kw	Relevant Spec.	X	X	X		(*) Inspector may request to witness the tests.
2	Mill test reports	Relevant material Spec.	R	R	R	X	
3	Material identification and markings	Approved procedure and drawings	S	S	M	X	
4	Storage of materials and welding consumables	Approved procedure and drawings	S	S	M		
5	Non-destructive testing personal qualifications	Approved procedure	R	R	M		
6	RT,UT,MT or PT(Review of all radiographs) (Note 1) (*)	Approved procedure	R	R	M	X	
7	Execution of major repairs	Approved procedure and drawings	H	H	M	X	
8	Welder Qualifications (records or welder's list) Note : If Inspector doubt welder's ability, Inspector may request welder for new qualification test.	ASME Sec. IX or equivalent standards	R	R	M	X	
9	Weld preparation and fit-up	Approved procedure and drawings	S	S	M	X	
10	Workman ship, Cleanliness	Approved procedure and drawings	S	S	M		
11	Heat treatment execution (If applicable) (**)	Approved procedure	R	R	M	X	
12	Adherence to approved procedures (welding, heat treatment, etc)	ASME Sec. IX or equivalent standards	S	S	M	X	
13	Adherence to agreed inspection plan	Approved procedure and drawings	S	S	M		
14	Gas leak test when specified	Min.1.1 times of design press./approved procedure	R	W	M	X	
15	Relief valve test when specified	Approved procedure	R	W	M	X	
16	Check bearings and seals after performance test	Approved procedure and drawings	W	W	M	X	
17	Visual and dimensional inspection at assembled condition before performance test	Approved procedure and drawings	W	W	M	X	
18	Clearance check	Approved procedure and drawings	R	R	M	X	
19	Hydrostatic test when specified	Min 1.5 times of design Pres./ Approved procedure	H	H	M	X	
20	Pneumatic test, when specified	Min 1.1 times of design Pres./ Approved procedure	W	W	M	X	
21	Performance test	Approved procedure	H	H	M	X	
22	Mechanical running test with vibration and bearing temperature measurement	Approved procedure	H	H	M	X	
23	Motor test (when provided) Note : Inspection and witness is required for drivers of 175 Kw and above. Inspection (but no witnessing) is required for drivers below 175Kw	Approved procedure and drawings	W	W	M	X	
24	Hydrostatic test of lube oil unit, when provided	Approved procedure and drawings	W	H	M	X	
25	Shop running test for lube oil unit,when provided	Approved procedure and drawings	W	W	M	X	
26	Visual (cleanliness) and dimensional inspection for lube oil unit after running test	Approved procedure and drawings	R	S	M	X	
27	Sound level test	Approved procedure	H	H	M	X	
28	Installation of wiring and conduit (ex proof examination if required)	Approved procedure and drawings	S	S	M	X	
29	Surface preparation prior to painting , coating, lining	Approved procedure and drawings	S	S	M		
30	Painting, Coating, Lining ,preservation, Pickling and Passivating	Approved procedure and drawings	S	S	M	X	
31	Function, setting and calibration of instruments and controls	Approved procedure and drawings	R	R	M	X	
32	Aux. Items check (spare parts, glands, cables,etc)	Approved procedure and drawings	S	S	M		
33	Name plate, tagging, marking	Approved procedure and drawings	S	S	M		
34	Final visual inspection	Approved procedure and drawings	H	H	M		
35	Preparation for shipment	Approved procedure and drawings	H	H	M		
36	Documentation review prior to release	Approved procedure and drawings	R	R	M	X	



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Note 1 : According to engineering spec. for Compressors.

Abbreviation:

P: Purchaser

W: Witness

M: Vendor's inspection and test

O: Owner

R: Review of documents


H: Hold Point

V: Vendor

X: Required

S: Witness, but spot check basis

C: Certificate/Data to be provide by Vendor

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<p align="center">TITLE: TECHNICAL SPECIFICATION FOR LV MOTOR</p>	

TECHNICAL SPECIFICATION FOR LV MOTOR

		<p>Document No.: 900-SPC-A4-EE-0005</p>	<p>Rev.: 00</p>
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شرکت پژوهش و فناوری پتروشیمی

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1. GENERAL

SCOPE

- 1.1.1 This specification covers the minimum requirements for design, construction, inspection and testing of industrial type low voltage, 50 Hz squirrel cage induction motors for PP&PE – PILOT PLANT of Research and Technology Center of petrochemical Co. Arak, Iran..
- 1.1.2 The scope covers motors for use in class I Divisions 1 & 2, or equivalent, in classified areas and also for general purpose industrial use in safe areas. The motors are mainly intended for centrifugal pump drives, cooling fans and compressors.
- 1.1.3 Detailed specific design requirements for each motor or group of motors are given in Data Sheets.

1.2 STANDARDS & CODES

- 1.2.1 All motors shall generally be designed, manufactured and tested in accordance with the latest edition of International Electrotechnical Commission (IEC) standard and Iranian Petroleum Standard(IPS).
- 1.2.2 Metric SI system of units shall be applied to all dimensions and relevant documents.

1.3 LANGUAGE

- 1. All correspondences and submittals shall be in English.

1.4 SITE CONDITIONS

The equipment and all its components shall be entirely suitable for the site conditions specified as below:

- 1.4.1 Temperature
 - a) Max. ambient temperature 44°C
 - b) Min. ambient temperature -28°C
 - c) Design temperature for outdoor equipment 50°C
 - d) Equipment exposed to sunlight 83°C
- 1.4.2 Relative humidity Max. 86% in Jan.
- 1.4.3 Altitude above sea level 1889 m
- 1.4.4 Wind velocity Max. 120 Km/h
- 1.4.5 Seismic factor In acc. With zone 3 of UBC
- 1.4.6 Special atmosphere Dusty & corrosive

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1.5 DOCUMENTS PRIORITY

In the event of any conflict between this specification, the data sheets, drawings, codes and standards, the priority shall be given in the following order.

- a) Purchase order
- b) Data sheets and/or drawings
- c) This specification
- d) Codes and standards

In any case vendor shall refer the matter with purchaser and obtain clarification before proceeding with any work.

2. DESIGN CHARACTERISTICS

2.1 RATING AND APPLICATION

2.1.1 Voltage and output rating shall be:

RATING	VOLTAGE	PHASE
Below 0.25 KW	230 V	1
0.25 KW and above	400 V	3

2.1.2 Performance duty of motors shall be "S1" according to IEC 34-1, unless stated otherwise.

2.1.3 All equipment covered by this specification shall be designed for severe duty outdoors, totally unprotected from weather unless otherwise specified and for use in a corrosive atmosphere. Motor frames shall be cast iron or steel. Aluminum frames are not acceptable.


2.1.4 Motor driving compressors and reciprocating pumps shall be sized so that the product of the motor name plate rating and the motor service factor shall be at least 110% of the greatest horsepower required (including gear and etc.) for any of the compressor and reciprocating pump operating conditions.

2.1.5 Motors driving centrifugal pumps shall have horsepower rating at least equal to the following percentage of pump design point brake horsepower:

Motor Rating (KW)	Percent of Pump BHP
18.5 and less	125
22 to 55	115
75 and above	110

2.2 SUPPLY VARIATIONS

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Motors shall be capable of operating continuously at their rated torque under the above conditions at any frequency between minus 2% and plus 2% of the nominal frequency together with any voltage between minus 10% and plus 10% of the nominal rating.

2.3 STARTING CONDITIONS

- 2.3.1 Unless otherwise specified, motors shall be designed for direct-on-line starting.
- 2.3.2 Motors shall be capable of two normal starts in succession under the above conditions with the motor at normal running temperature, also a minimum of 3 starts/hour, equally spaced, during normal running conditions.
- 2.3.3 Starting characteristics shall meet the requirements of IEC 34-12.
- 2.3.4 The pull up torque at nominal volts shall not be less than 0.5 times the locked rotor torque and not less than 0.5 times the rated load torque for motors rated less than 100 KW.
- 2.3.5 For motors rated 100 KW and above, the pull up torque at nominal volts shall not be less than 0.5 times the locked rotor torque and not less than 0.3 times the rated load torque.
- 2.3.6 Motors shall be able to overcome starting load inertia as well as accelerating the load to rated speed under both rated and at 20% reduced voltage conditions during starting without injurious heating.
- 2.3.7 When motors are furnished separately or with the driven equipment as a package, the torque characteristics and speed specified shall be the responsibility of the driven equipment vendor.
- 2.3.8 Unless otherwise specified, all motors are for coupled service.

2.4 ENCLOSURE

- 2.4.1 Unless otherwise specified, all motor enclosures shall be of Totally Enclosed Fan-Cooled (TEFC) construction. For outdoor use shall additionally be weatherproof without further protection and equivalent to IP 54 per IEC 34-5.
- 2.4.2 Motor enclosures shall be suitable for the area classification in which they are to be installed.
- 2.4.3 For general purpose use in class I Div.1 classified areas all motors to be explosion-proof flameproof.
- 2.4.4 For general purpose use in class I Div. 2 classified areas all motors to have type of protection "e" (increased safety) or "n" (non-sparking).
- 2.4.5 All single phase motors in classified areas shall be explosion-proof.
- 2.4.6 All motors specified suitable for classified areas shall be certified by an approved and official certifying agency/authority such as UL, FM, BASEEFA, etc.
- 2.4.7 The maximum surface temperature class in classified areas shall be as stated in the Data Sheets
- 2.4.8 Outdoor motors shall be rated for continuous operation under the direct sunlight.

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2.4.9 Where specified in Data Sheets, anti-condensation space heaters for use on 230 V single phase, 50 Hz shall be provided. Terminations are to be brought-out to a cable box separate from the main power lead cable box.

2.4.10 All motors shall be provided with means for preventing the accumulation of moisture inside the motor.

2.4.11 All motors exceeding 20 kg in weight shall be equipped with suitable lifting eyes.

2.5 COOLING

2.5.1 Unless otherwise specified, method of cooling shall be totally Enclosed Fan Cooled (TEFC) and to be suitable for either direction of rotation of the motor. On motors with unidirectional fans, the direction of rotation shall be clearly and permanently marked by an arrow on the non driving end.

2.5.2 The flow direction of the external air shall be from the non-driving end.

2.5.3 Fans for motors shall be of brass, bronze or aluminium. Aluminium alloy fans shall not contain more than 0.2% copper. Fans shall be inherently balanced.

2.5.4 Plastic, fiberglass or other non-metallic fans are not acceptable.

2.6 STATOR WINDINGS

2.6.1 The motor windings shall be braced to prevent any excessive movement during transportation and all operating conditions.

2.6.2 Windings of three phase motors up to and including 75 KW shall be connected in delta. Winding of motors larger than 75 KW shall have six winding ends brought out to the terminal box for either delta or star connection.

2.6.3 Aluminum stators are not acceptable.

2.7 INSULATION AND TEMPERATURE RISE LIMITS

2.7.1 The stator windings shall be fully insulated for an unearthed system.

2.7.2 Unless otherwise specified, the insulation shall be class F according to IEC-85. The temperature rise as measured by increase in resistance method shall not exceed 80 °C for all type of motors, based on 50 °C maximum ambient shade temperature and maximum continuous rating.

2.7.3 The method of application and details of the insulating material shall be clearly stated in Vendor proposal documents.

2.7.4 All windings shall have a tropicalised finish or have an extra insulation coating (double dip and bake).

2.8 ROTOR

2.8.1 Rotors shall be free of inherent axial thrust. They shall be statically and dynamically balanced.

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- a. With full driven key
or
- b. With motor half couplings keyed on the shaft.

2.8.2 Except for motors ordered as spares or replacements, supply of half couplings or pulleys will be in the responsibility of the driven machines manufacturer and shall be delivered rough or pilot bored to the motor manufacturer to finish bore, fit and balance.

2.8.3 Balancing by means of lead or other unstable material is not acceptable. If solder is used, it shall have a melting point not less than 185°C.

2.8.4 Rotor bars shall be securely located in their slots throughout their length.

2.8.5 Brazed copper or copper alloy cage construction is preferred for all rotors. However, cast aluminum rotor cages are acceptable as an alternative for all small motors with ratings up to and including 45 KW.

2.9 BEARINGS AND LUBRICATION

2.9.1 For horizontally mounted motors, preferred types of bearing and lubrication are ball and roller with grease (lithium base).

2.9.2 For vertically mounted motors, bearing type and lubrication shall generally be as in clause 2.9.1 above except for larger machines vendor should put forward alternative proven design.

2.9.3 Grease lubricated bearings shall be packed with grease before dispatch.

2.9.4 Oil lubricated ball/roller bearings shall be provided with constant level oilers.

2.9.5 Fractional horsepower motors supplied with sealed pre-lubricated ball/roller bearings shall be factory sealed, long life type and trouble free guaranteed for five years normal operation under site condition.

2.9.6 The calculated life (ISO B10 “90% survival” under the estimated bearing loads) should comply with the following requirement:

Up to 75 KW	15000 hrs.
75 KW and above	25000 hrs.

2.10 VIBRATION AND NOISE LEVELS

2.10.1 Motors at all speed should be balanced in accordance with the limits of vibration as per IEC 34-14.


2.10.2 Motor noise emission rate for the driven equipment shall not exceed the noise level specified in IEC 34-9.

2.11 SHAFT AND FRAME SIZE

2.11.1 Shafts and frames shall be designed in accordance with IEC 34-7.

2.12 CABLE CONNECTION AND TERMINATION

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- 2.12.1 Terminal boxes shall be located on the left hand side of the motor when viewed from the non-drive end and shall have means for entry from any of the four directions separated by 90°, vertical or horizontal.
- 2.12.2 An earthing terminal of the same capacity as the line terminal shall be fitted externally to the terminal box. Cable boxes are to be adequately designed to withstand internal faults. It may be assumed that all 400 V motors will be protected by MCCB's.
- 2.12.3 It shall be possible in all forms of cable entry to withdraw the motor without breaking or stressing the seal or cable.
- 2.12.4 Conduit entries are to be tapped ISO. Tapped entries on all motors shall provide not less than 5 full threads.
- 2.12.5 Type and size of cables for the main supply, anti condensation heaters and P.T.C. detectors, where applicable, shall be as specified in Data Sheets. All cable boxes shall be equipped with necessary terminal blocks, cable lugs, explosion proof/weatherproof and corrosion resistant brass compression type cable glands to receive the incoming cables.
- 2.12.6 Terminal markings and phase rotation shall be "A-B-C" counter clockwise.
- 2.12.7 All cable terminal boxes shall be made of steel or cast iron. All cover joints shall be fitted with gaskets of polychloroprene or like material to prevent the ingress of moisture and dust. The enclosure shall be suitable for the area classification in which it is to be installed and its degree of protection shall not be less than IP 55 to IEC.

2.13 THERMAL PROTECTION

- 2.13.1 When specified in Data sheets single phase motors shall be fitted with an automatic reset thermal over-current device (T.O.C) in the interior of the motor.

The device shall be matched to the particular application and duty of the "drive" and to be ambient compensated for the highest temperature likely to be encountered inside the motor under site service condition. Motors thus fitted shall carry a warning plate, in English, stating that such a device is fitted and to isolate at the starter or control switch before approaching the motor.


- 2.13.2 Where specified in Data Sheets, three phase motors shall be fitted with six thermal detectors, two per phase of the positive temperature coefficient (P.T.C) type adapted to the temperature rise of the winding and wired out to a separate terminal box.

Vendor shall supply the temperature/time relationship curve with the motor test certificate.

2.14 RADIO INTERFERENCE

- 2.14.1 Where specified in data sheets, motors shall be fitted with radio interference suppression device in compliance with B.S.800.

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2.15 SERIAL NUMBER AND RATING PLATES

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

2.15.2 Rating plates shall be stainless steel or alternatively of a non-corrosive alloy. They shall be fixed to a non-removable part of the frame and show:

- Maker's name
- Frame size and serial number
- Class of rating (continuous or short time)
- Type of protection, gas group(s), temp. class
- Class of insulation
- Type of connection (star or delta)
- Volts, phase, frequency
- Output in KW at full power at tested temperature
- Full load current and full load speed
- Efficiency and power factor at full load
- Type of enclosure (TEFC, other)
- Type and size of bearings
- Standards (IEC or other)
- Purchase order No. and year of ordering
- Locked rotor torque in % FLT
- Locked rotor current in % FLC
- Net weight
- Type of the Lubricant(Grease)
- The lubrication period and the quantity of injection lubricant in every time

2.15.3 A separate nameplate shall be fixed to the frame indicating purchaser's tag number.

2.16 FINISH

2.16.1 Prepared surfaces shall be free from rust, scale, sand, dust and grease before painting.

2.16.2 Finish shall be suitable for highly corrosive and dusty environments.

3. QUALITY ASSURANCE AND PREPARATION FOR SHIPMENT


3.1 INSPECTION

Purchaser reserves the right for inspection at any stage of manufacturing, testing or preparation for shipment. Purchaser inspection shall not relieve vendor of his commitments under the terms of purchase documents and this specification.

3.2 ITP FORMS

The inspection and test plan (ITP) forms covers the minimum verifications, checks, and tests required for LV motors to comply with codes, specification, and/or contractual requirements.

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3.3 PREPARATION FOR SHIPMENT

- 3.3.1 Unless otherwise specified, preparation for shipment shall be in accordance with the manufacturer's standard. The manufacturer shall be solely responsible for the adequacy of the preparation for shipment employed with respect to materials and applications, and provide materials to their commercial carrier systems.
- 3.3.2 Electric motors shall be shipped with bearings lubricated.
- 3.3.3 Silicagel or similar dehydrating compound shall be enclosed in each motor package. Vents shall be waterproof sealed.
- 3.3.4 Rotors shall be locked.

3.4 GUARANTEE

Unless exception is recorded by Vendor in his proposal, it shall be understood that Vendor agrees to the guarantee terms described below:

All equipments and component parts shall be guaranteed by Vendor against defective material, design and workmanship when operated under normal condition for 12 months after being placed in specified service but not exceeding 18 months after date of shipment. If any mal-performance or defects occurs during the guarantee period, Vendor shall make available repaired, altered or replacement parts free of any charges whatsoever direct on the purchaser's job site. Vendor shall make available free of charge to the purchaser qualified representatives as he deems necessary to supervise the removal, repair and replacement of the defective parts in such manner that the guarantee be maintained.

The guarantee period for repaired or replaced parts shall be 12 months after start up of repaired equipment but not more than 18 months after the repaired parts and/or equipment are shipped. The guarantee period for the remaining equipment whose operation is dependent upon the proper performance of the repaired part shall be extended by the number of days of fraction thereof that the equipment had been inoperative because of defects. Field labor charges for works during the guarantee period shall be subjected to negotiation between purchaser and Vendor.

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