

MATERIAL AND EQUIPMENT STANDARD

FOR

POSITIVE DISPLACEMENT COMPRESSORS ROTARY

CONTENTS :	PAGE No.
0. INTRODUCTION	3
1. GENERAL	4
1.1 Scope	4
1.2 Alternative Design	4
1.3 Conflicting Requirements	4
1.4 Definition of Terms	4
1.5 Referenced Publications	4
1.6 Main Vendor.....	5
2. BASIC DESIGN	5
2.3 Casing Connections	6
2.5 Rotors Elements.....	6
2.6 Seals.....	6
2.7 Dynamics	7
2.8 Bearings and Bearing Housings.....	7
2.10 Lube-Oil and Seal-Oil System.....	7
2.11 Materials	7
2.12 Name Plates	8
3. ACCESSORIES	8
3.1 Drivers	8
3.2 Coupling and Guards.....	9
3.3 Mounting Plates	9
3.4 Controls and Instrumentation.....	9
3.5 Piping and Appurtenances.....	11
4. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT.....	11
4.1 General.....	11
4.2 Inspection	11
4.3 Testing	12
4.4 Preparation for Shipment.....	12
5. VENDOR'S DATA	12
5.1 Proposal.....	12
5.2 Contract Data	13

6. GUARANTEE AND WARRANTY 13

 6.1 Mechanical 13

 6.2 Performance 13

APPENDICES :

APPENDIX A TYPICAL DATA SHEETS 14

APPENDIX H PIPE COMPONENTS - NOMINAL SIZE 15

APPENDIX I PIPE FLANGES PRESSURE TEMPERATURE RATING 16

0. INTRODUCTION

This specification gives the amendment and supplement to API Standard 619, second edition may 1985:

"Rotary-Type Positive Displacement Compressors for General Refinery Services".

It shall be used in conjunction with data sheets for Rotary-Type Compressors.

For ease of reference, the clause or section numbering of API Std. 619 has been used throughout this specification.

Clauses in API Std. 619 not mentioned remain unaltered.

For the purpose of this specification, the following definitions shall hold :

- Sub. (substitution) : The API Std. Clause is deleted and replaced by a new clause.
- Del. (Deletion) : The API Std. Clause is deleted without any replacement.
- Add. (Addition) : A new clause with a new number is added.
- Mod. (Modification) : Part of the API Std. Clause is modified, and/or a new description and/or condition is added to that clause.

1. GENERAL

1.1 Scope

This specification, contains the minimum requirements for Rotary-Type Positive Displacement Compressors for use in refinery services, chemical plants, gas plants, petrochemical plants and where applicable, in exploration, production and new ventures.

Compliance by the compressor manufacturer with the provisions of this standard specification does not relieve him of the responsibility of furnishing compressor and accessories of proper design, mechanically suited to meet guarantees at the specified service conditions.

No exception or deviation from this Standard shall be permitted without written approval of the Company. The intended deviations shall be listed separately by the Vendor and supported by reasons thereof for Company's consideration. (Mod.)

1.2 Alternative Design

Unless otherwise specified, equivalent SI Unit System dimensions and ratings shall be substituted. (Mod.)

1.3 Conflicting Requirements

In the case of conflict between documents relating to the inquiry or order, the following priority of documents shall apply:

- First priority : purchase order and variation thereto
- Second priority : data sheets and drawings
- Third priority : this standard specification

All conflicting requirements shall be referred to the Company in writing. The Company will issue confirmation documents if needed for clarification. (Sub.)

1.4 Definition of Terms

Diameter Nominal: The international nomenclature-diameter nominal-written as DN 15, 25, 32, etc., has been used for pipe size in accordance with ISO 6708-1980 (E) and Appendix H in this Standard specification.

Pressure Nominal: The international nomenclature-pressure nominal as PN 20, 50, 68, 100, etc., has been used for flange ratings in accordance with ANSI - ASME B16.5 (1981), ISO 7268 (1983) and Appendix I in this Standard specification. (Mod.)

1.5 Referenced Publications

1.5.1 The latest edition of the following standards, codes, and specifications shall, to the extent specified herein, form part of this Standard:

IPS (IRANIAN PETROLEUM STANDARDS)

E-SF-900 "Noise and Vibration Control"

- M-EL-132 "Induction Motors"
- M-PM-240 "General Purpose Steam Turbines"
- M-PM-250 "Special Purpose Steam Turbines"
- M-PM-260 "Industrial Combustion Gas Turbines"
- M-PM-300 "Special Purpose Gear Units"
- M-PM-310 "Special Purpose Couplings"
- M-PM-320 "Lubrication, Shaft Sealing, and Control Oil Systems for Special Applications"
- M-ME-220 "Shell-and-Tube Heat Exchanger"
- M-ME-245 "Air-Cooled Heat Exchanger"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

- 6708 "Pipe Components-Definition of Nominal Size"
- 7268 "Pipe Components-Definition of Nominal Pressure" (Mod.)

1.6 Main Vendor

Compressor manufacturer shall be considered as main vendor unless otherwise specified. (Add.)

2. BASIC DESIGN

2.1.1 Compressor ratings shall not exceed the limits of the vendor’s design but shall be well within the manufacturer’s actual experience. Only equipment which has proven its reliability is acceptable. (Mod.)

2.1.13 Compressors shall be designed to minimize the generation of noise and shall not exceed the noise limits given in the supplementary clauses below. (Sub.)

2.1.13.1 All definitions, notations, measuring equipment, measuring procedures, test reporting, calculation methods and calculation procedures shall be in accordance with IPS-E-SF-900.(Add)

2.1.13.2 Unless otherwise specified, the following limits shall be met at any measuring location 1 m from the equipment surface:

SOUND PRESSURE	LIMIT IN dB re 20 Pa
COMPRESSOR	87 dB(A)
COMPRESSOR + DRIVER	90 dB(A)

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB(A) lower, thus 82 dB(A) for the compressor and 85 dB(A) for the compressor + driver

The above requirements apply in the absence of reverberation and background noise from other sources, and for all operating conditions between minimum flow and rated flow. (Add.)

2.1.13.3 Where excessive noise from equipment cannot be eliminated by low noise design, corrective measures should, preferably take the form of acoustic insulation for pipes, gearboxes, etc. Where noise hoods are proposed, prior approval of the purchaser shall be obtained regarding construction, material and safety requirements.

Noise control measures shall cause no hindrance to operation nor any obstruction to routine maintenance activities. (Add.)

2.1.15 Unless otherwise specified, compressors and auxiliaries shall be suitable for out door installation in the climatic zone specified. (Mod.)

2.3 Casing Connections

2.3.1 Inlet and outlet connections shall be flanged as specified. (Mod.)

2.3.8 All raised face flanges shall be furnished with a "Stock" finish (continuous spiral grooved gasket surface). (Mod.)

2.5 Rotors Elements

2.5.1 Rotors

2.5.1.2 Rotors and shafts shall be forged and heat-treated steel. (Mod.)

2.6 Seals

2.6.1 Application

2.6.1.1 Shaft seals and seal oil systems shall be suitable for exposure to maximum allowable case-working pressure at maximum allowable temperature.

Compressor design shall maintain a positive internal gas pressure at the seals under all start-up and operating conditions including negative suction pressure during air "run-in" operation. (Mod.)

2.6.1.4 Shaft seals in inert gas service shall be of the manufacturer's standard design.

Shaft seals in toxic material service shall be of the mechanical (contact) or liquid film type. Restrictive ring type seals operated with a sealing liquid are acceptable. (Mod.)

2.6.2 Labyrinth type

For flammable material service, labyrinth seals shall have an injector or an eductor system or a combination of the two systems which will positively prevent air leakage at the atmospheric side of the seal or air leakage into the compressor under all start-up and operating conditions. (Mod.)

2.6.3 Restrictive-ring type

2.6.3.2 For flammable material service, carbon rings shall have an injector or an eductor system or a combination of the two systems which will positively prevent air leakage at the atmospheric side of the seal or air leakage into the compressor under all start-up and operating conditions. (Mod.)

2.6.3.4 Piping down stream of strainer shall be stainless steel. (Mod.)

2.7 Dynamics

2.7.1 Critical speed

2.7.1.8 Rotors with calculated critical speeds falling within the separation margin specified in para. 2.7.1.6 are not acceptable. (Mod.)

2.7.1.10 The compressor vendor, and the driver or gear vendor, shall perform an independent torsional analysis on the complete train using basic equipment dimension and stiffness data. (Mod.)

2.7.2 Vibration and balance

2.7.2.4 After completion of the final balancing of the assembled rotor, the sensitivity of the balancing machine shall be checked and reported. (Mod.)

2.8 Bearings and Bearing Housings

2.8.1 Radial bearings

2.8.1.1 Compressors shall be equipped with sleeve type journal bearings. (Mod.)

2.10 Lube-Oil and Seal-Oil System

2.10.1 A complete pressure oil system, commonly used for both the compressor and the gear unit shall be provided with each unit. The main lube oil pump shall be compressor shaft-driven and the stand-by lube oil pump shall be motor driven. The pumps shall be either gear type or screw type. The lube oil filter shall be of the dual type with a changeover valve and a differential pressure indicator. The lube oil supply line after the filter shall be stainless steel. The lube oil cooler employed shall be of the dual type. (Mod.)

2.10.3 Lube and seal oil systems shall be per IPS-M-PM-320. (Sub.)

2.11 Materials

2.11.2 Casting

2.11.2.5.1 Weldable grade of steel castings may be repaired by welding subject to the following criteria:

- a) approval by the Company shall be obtained before any major weld repair is carried out. (A major weld repair is to be taken as either a removal of more than 50% of the wall thickness, or a length of more than 150 mm in one or more directions, or a total surface area of all repairs exceeding 20% of the total casting surface area);
- b) all repairs shall meet the inspection requirements and acceptance standards for the original material;
- c) the total quantity of weld metal deposited shall be less than 10% of the mass of the casting;
- d) after weld repair, castings shall be suitably heat-treated if this is specified in the relevant material specification;
- e) Details of all major weld repairs, and of the heat-treatment, where applicable, shall be recorded and reported to the Company. (Mod.)

2.11.2.5.2 Details of all repairs shall be recorded and reported to the Company, who shall be informed of the need for plugging before any repair is carried out. (Mod.)

2.11.4 Welding

2.11.4.6.1 The following examinations are required:

- a) butt welded joints of pressure casings shall be 100% radiographed. Inspection procedure for other pressure casing welds shall be approved by the purchaser. Examination methods and acceptance criteria shall be per ASME Code Section VIII, para. UW-51;
- b) welded joints on rotors shall be radiographed. Acceptance standards shall be the same as for butt welded joints;
- c) silencer welds shall be 100% radiographed;
- d) Support leg attachment welds shall be examined by magnetic particle method. Non-magnetic materials may be inspected by dye-penetrant method. (Mod.)

2.11.5 Material inspection

2.11.5.1 All cast steel casing parts shall be examined visually by the manufacturer and shall be free of adhering sand, scale, cracks and hot tears.

Following visual inspection, magnetic particle inspection shall be carried out on all surfaces after machining.

Dye-penetrant inspection shall be used only when magnetic particle inspection is not feasible. (Mod.)

2.11.5.3 When specified, full non-destructive inspection shall be carried out on all critical areas, such as abrupt changes in section, weld ends, at the junction of risers, gates or feeders to the casting, and areas of high stress.

Radiographic inspection shall be applied wherever possible. (Mod.)

2.11.5.4 The inspection requirements specified in 2.11.5.1 and 2.11.5.3 of this specification can be relaxed at the discretion of the Company if the manufacturer can establish proven good experience with the same casing material and same casting technique. The purchaser and manufacturer shall then agree the revised extent of inspection. (Add.)

2.12 Name Plates

2.12.2 The text on nameplates shall be in the English language and the data shall be in SI units unless otherwise is specified. The information on nameplates shall include the year of manufacture. (Mod.)

3. ACCESSORIES

3.1 Drivers

3.1.4 Steam turbine drivers shall conform to API std. 611 as amended/supplemented by IPS-M-PM-240, or API Std. 612 as amended/ supplemented by IPS-M-PM-250, whichever is applicable. (Mod.)

3.1.6 Electric motors for main drivers and for auxiliary drivers shall comply with IPS-M-EL-132. (Mod.)

3.1.7 Gas turbine drivers shall conform to IPS-M-PM-260. (Sub.)

3.1.8 Speed increasers and reducers shall be in accordance with IPS-M-PM-300. (Sub.)

3.2 Coupling and Guards

3.2.2 Coupling and guards and the coupling mounting shall conform to IPS-M-PM-310. (Mod.)

3.2.3 Diaphragm coupling rating and design shall be based on the maximum axial and radial misalignment anticipated during transient and steady state conditions. The shaft end clearances for assembly shall be specified by the vendor. The diaphragms shall be coated with manufacturer's standard coating, suitable for the specified environment, if required. (Mod.)

3.2.6 Deleted. (Del.)

3.3 Mounting Plates

3.3.1 General

3.3.1.2.8 Anchor bolts, nuts and templates shall be furnished by the vendor unless otherwise specified. (Sub.)

3.3.2 Base plate

3.3.2.1 Turbine driven compressors shall be mounted on common base plate.

Motor drivers may be mounted on a common baseplate with compressor and gear or separately on soleplates, as specified in data sheet. (Mod.)

3.4 Controls and Instrumentation

3.4.3 Instrumentation and control panels

3.4.3.1 Unless specified otherwise a free standing local control panel mounted on the compressor platform shall be supplied by the vendor, completely enclosed and sealed and suitable for pressurizing to keep out dust.

The panel shall include all the applicable items listed, together with alarm lights suitably screened to be easily visible in bright sunlight and other process instruments as required.

Access for easy maintenance to this panel shall be provided, and location of the panel shall be so as to facilitate easy control of the equipment.

Consideration may also be given to the installation of a separate ground mounted panel to cover auxiliary equipment mounted on the console if easier operation would result. (Mod.)

3.4.3.3 Minimum Instrumentation and process controls shall be furnished as specified and listed below. Any additional instrumentation and controls as deemed necessary for the smooth and safe operation of the unit under all specified operating conditions shall be provided.

Compatibility of overall compressor control system with the furnished instrumentation and controls, shall be ensured.

- a) pressure and level gages, pressure controls, control valves, thermometers, pressure and temperature switches, and relief valves at the compressor for separate lube oil systems;
- b) pressure and level gages, level controls, pressure controls, control valves, thermometers; pressure and temperature switches flow meters or indicators, and relief valves, for seal oil system;
- c) start and stop push button stations with pilot lights for lube oil pump motor and seal oil pump motor;
- d) dial speed indicator for compressor;

- e) pressure gage for compressor suction;
- f) pressure gage for lube oil pump discharge;
- g) pressure gage for seal oil pump discharge;
- h) pressure gage on air supply for flow regulator to seals;
- i) pressure gage for lube oil to compressor bearings;
- j) pressure gage for lube oil to turbine bearings;
- k) pressure gage for turbine inlet steam;
- l) pressure gage for turbine exhaust steam;
- m) pressure gage for first stage pressure, for multivalve turbines, or for steam chest for single valve turbines;
- n) speed indicator for turbine;
- o) hand indicating speed controller for turbine governor;
- p) differential pressure gage for seal oil;
- q) gage glass for seal oil overhead tank;
- r) high seal oil return temperature. (Mod.)

3.4.4 Alarms and shutdowns

3.4.4.1 The following alarms and shutdowns shall be furnished. Local alarm lights shall indicate green for normal operation and red, independent of shutdown devices.

a) low lube oil pressure;	Alarm and shutdown
b) low differential pressure of seal oil (Low level in overhead tank);	Alarm
c) high differential pressure of seal oil (High level in overhead tank);	Alarm
d) high lube oil temp. of oil cooler;	Alarm
e) low level in lube oil reservoir;	Alarm
f) low level in seal oil reservoir;	Alarm
g) axial movement of compressor shaft;	Alarm & Shutdown
h) main seal oil pump failure;	Alarm & Shutdown
i) main lube oil pump failure;	Alarm & Shutdown
j) start standby lube oil pump;	Alarm
k) start standby seal oil pump;	Alarm
l) high temperature in lube oil reservoir (If heating coil fitted);	Alarm
m) high temperature in seal oil reservoir (If heating coil fitted);	Alarm
n) high cooling water temperature from the casing;	Alarm & Shutdown
o) low inlet cooling water pressure to the casing;	Alarm & Shutdown

p) high thrust bearing temperature. (Mod.) Alarm

3.4.4.7 Replace "other than" from this clause and substitute "including". (Mod.)

3.5 Piping and Appurtenances

3.5.3 Process piping

3.5.3.1 Interstage piping furnished by the vendor shall be designed per ANSI B 31.3. (Mod.)

3.5.4 Instrument piping

All instrument tubing shall be stainless steel. (Mod.)

3.5.5 Intercoolers and aftercoolers

3.5.5.3 Shell and tube intercoolers and after coolers shall be per IPS-M-ME-220.

Coolers shall be sized for the conditions of maximum heat load.

Cooler design pressure and temperature shall be based on maximum operating conditions.

Intercoolers and after coolers shall be provided with facilities to separate, collect and discharge condensate through a continuous drainer. (Mod.)

3.5.5.6 Air coolers used for intercoolers and aftercoolers shall conform to IPS-M-ME-245. (Mod.)

3.5.6 Air intake filters

3.5.6.1 Filter open area shall not be less than two times the compressor inlet opening.

Filter elements shall be type 304 stainless steel. (Mod.)

4. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.1 General

4.1.3 The Vendor shall operate a quality management system to ensure that the technical requirements of this Standard are achieved. Company may require demonstration of the quality system, but this may be waived if the system has been verified recently by an accreditation scheme acceptable to Company.

The Vendor shall ensure that QA requirements specified in the inquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free-issue materials. (Add.)

4.1.4 Company's representative shall have the rights to reject equipment or any parts of equipment which do not conform to the Purchase Order. (Add.)

4.2 Inspection

4.2.4 The oil system furnished shall meet the cleanliness requirements of IPS-M-PM-320. (Sub.)

4.3 Testing

4.3.1 General

4.3.1.2 Delete "5 days" and substitute "15 days". (Mod.)

4.3.1.4 Witnessed means that a hold shall be applied to the production schedule and that the inspection or test shall be carried out with the purchaser or his representative in attendance. For mechanical running or performance test, this requires written notification of a successful preliminary test.

Observed means that the purchaser shall be notified of the timing of the inspection or test; however, the inspection or test shall be performed as scheduled, and if the purchaser or his representative is not present, the vendor shall proceed to the next step. (The purchaser should expect to be in the factory longer than for a witnessed test.) (Mod.)

4.3.1.5 All tests shall be performed in the compressor manufacturer's shop. (Add.)

4.3.2 Pressure tests

4.3.2.3 Delete 30 minutes and substitute 4 hours. (Mod.)

4.3.3 Mechanical running test

4.3.3.1.1 Delete 2 hours and substitute 4 hours. (Mod.)

4.3.3.1.2 Delete 30 minutes and substitute 1 hour. (Mod.)

4.3.3.1.5 The vibration amplitude/frequency sweep shall also be conducted at minimum operating speed for variable speed compressors. (Mod.)

4.3.4 Optional tests

4.3.4.1 When performance testing is specified, performance curves for capacity, discharge pressure, and power shall be developed at 100% speed. Curves shall be based on the test results. A minimum of 5 test readings shall be taken. (Mod.)

4.4 Preparation for Shipment

4.4.1 Delete 6 months and substitute 12 months. (Mod.)

4.4.3.8 Unless approved by the Company, partial and separate shipment of the equipment and material are not allowed. (Mod.)

5. VENDOR'S DATA

5.1 Proposal

j. A list of spare parts for start up and two years of continuous operation, including spare rotor accompanying price list shall be submitted. (Mod.)

5.2 Contract Data

5.2.4 Data

5.2.4.2 e. Alignment diagram including hot and cold alignment data for the train (Mod.)

5.2.4.4 The Vendor shall furnish an illustrated parts list for all equipment supplied. (Mod.)

6. GUARANTEE AND WARRANTY (Add.)

6.1 Mechanical

Unless exception is recorded by the vendor in his proposal, it shall be understood that the vendor agrees to the following guarantees and warranties:

During a period of 12 months after the date of commissioning, the vendor shall , with all possible speed and without cost to the purchaser, replace or repair the goods or any part thereof found to be defective due to faulty material, workmanship or to any act or omission of the Vendor. In particular the Vendor shall reimburse any transportation and other charges incurred by the purchaser in effecting such replacement or repair at the point of use.

The warranty period for repaired or replaced parts shall be 12 months after start-up of the repaired equipment, but not more than 18 months after the equipment repairs are completed. (Add.)

6.2 Performance

The compressor shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet. (Add.)

APPENDICES**APPENDIX A
TYPICAL DATA SHEETS**

SI Units Data Sheets shall be used, unless otherwise specified. (Mod.)

**APPENDIX H
PIPE COMPONENTS - NOMINAL SIZE**

The purpose of this appendix is to establish an equivalent identity for the piping components-nominal sizes in Imperial System and SI System.

TABLE R - 1

Nominal Size		Nominal Size		Nominal Size		Nominal Size	
DN (1)	NPS (2)	DN	NPS	DN	NPS	DN	NPS
15	½	100	4	500	20	1000	40
20	¾	125	5	600	24	1050	42
25	1	150	6	650	26	1100	44
32	1¼	200	8	700	28	1150	46
40	1½	250	10	750	30	1200	48
50	2	300	12	800	32	1300	52
65	2½	350	14	850	34	1400	56
80	3	400	16	900	36	1500	60
90	3½	450	18	950	38	1800	72

1) Diameter nominal , mm.

2) Nominal pipe size, inch. (Add.)

**APPENDIX I
PIPE FLANGES PRESSURE TEMPERATURE RATING**

The purpose of this Appendix is to establish an equivalent identity for the pipe flange nominal pressure temperature ratings in Imperial System and SI System.

TABLE S - 1

PN (1)	ANSI RATING CLASS
20	150
50	300
68	400
100	600
150	900
250	1500
420	2500

1) Pressure Nominal, bar. (Add.)