# MATERIAL AND EQUIPMENT STANDARD

# FOR

# ROTARY-TYPE POSITIVE DISPLACEMENT COMPRESSORS

# FOR

# PETROLEUM, PETROCHEMICAL AND NATURAL GAS INDUSTRIES

**FIRST EDITION**

**JUNE 2002**

**This standard specification is reviewed and updated by the relevant technical committee on April 2012. The approved modifications are included in the present issue of IPS.**

**FOREWORD**

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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**GENERAL DEFINITIONS**

Throughout this Standard the following definitions shall apply.

**COMPANY :**

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

**PURCHASER :**

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

**VENDOR AND SUPPLIER:**

Refers to firm or person who will supply and/or fabricate the equipment or material.

**CONTRACTOR:**

Refers to the persons, firm or company whose tender has been accepted by the company.

**EXECUTOR :**

Executor is the party which carries out all or part of construction and/or commissioning for the project.

**INSPECTOR :**

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

**SHALL:**

Is used where a provision is mandatory.

**SHOULD:**

Is used where a provision is advisory only.

**WILL:**

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

**MAY:**

Is used where a provision is completely discretionary.

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## 0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "Positive Displacement Compressors Rotary" for use in petroleum, petrochemical and natural gas Industries and is based on API" Standard 619, Fifth edition, December 2010, and shall be read in conjunction with that document.

**Note 1:**

**This is a revised version of this standard, which is issued as revision (1)-2002. Revision (0)-1993 of the said standard specification is withdrawn.**

**Note 2:**

**This standard specification is reviewed and updated by the relevant technical committee on April 2012. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 339 on April 2012. These modifications are included in the present issue of IPS.**

### Guidance for Use of this Standard

The amendments/supplement to API Standard 619 given in this Standard are directly related to the equivalent sections or clauses in API Standard 619. For clarity, the section and paragraph numbering of API Standard 619 has been used as far as possible. Where clauses in API are referenced within this Standard, it shall mean those clauses are amended by this Standard. Clauses in API that are not amended by this Standard shall remain valid as written.

The following annotations, as specified hereunder, have been used at the bottom right hand side of each clause or paragraph to indicate the type of change made to the equivalent clause or paragraph of API.

| | | |
|---|---|---|
| **Sub. (Substitution)** | : | The clause in API shall be deleted and replaced by the new clause in this Standard. |
| **Del. (Deletion)** | : | The clause in API shall be deleted without any replacement. |
| **Add. (Addition)** | : | The new clause with the new number shall be added to the relevant section of API. |
| **Mod. (Modification)** | : | Part of the clause or paragraph in API shall be modified and/or the new description and/or statement shall be added to that clause or paragraph as given in this Standard. |

## 1. SCOPE

This specification contains the minimum requirements for Rotary-Type Positive Displacement Compressors for petroleum, petrochemical and natural gas industries, 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. **(Sub.)**

### 1.1 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. **(Add.)**

## 2. NORMATIVE REFERENCED

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

**IPS (IRANIAN PETROLEUM STANDARDS)**

IPS-G-SF-900 "General Standard for Noise Control and Vibration"

IPS-M-EL-132 "Material and Equipment Standard for Medium and High Voltage Induction Motors"

IPS-M-PM-240 "Material and Equipment Standard for General Purpose Steam Turbines"

IPS-G-PM-250 "General Standard for Petroleum, Petrochemical and Natural Gas Industries-Steam Turbines-Special-Purpose Application"

IPS-M-PM-300 "Material and Equipment Standard for Special Purpose Gear Units"

IPS-M-PM-310 "Material and Equipment Standard for Special Purpose Couplings"

IPS-M-PM-320 "Material and Equipment Standard for Lubrication, Shaft Sealing, Oil Control System and Auxiliaries"

IPS-G-ME-220 "General Standard for Shell and Tube Heat Exchangers"

IPS-G-ME-245 "Engineering and Material Standard for Air Cooled Heat Exchangers" **(Mod.)**

## 3. TERMS AND DEFINITIONS

Refer to API 619 definitions.

## 4. GENERAL

### 4.1 Pressure Design Code

The Pressure Design Code shall be in accordance with ASME Sec. VIII. **(Sub.)**

### 4.2 Unit Responsibility

**4.2.1** Compressor manufacture shall be consider as main vendor unless otherwise specified. **(Add.)**

### 4.3 Units of Measuremet

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified. **(Mod.)**

## 5. BASIC DESIGN

### 5.1 General

**5.1.1** 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.)**

**5.1.8** Provision shall be made for complete venting and draining of the system or systems. **(Mod.)**

**5.1.10**

**a)** All left-handed threads shall be clearly marked.

**b)** Any maintenance item with a mass greater than 20 kg shall be provided with lifting lugs or similar dedicated fixed lifting point(s). Screw-in eye-bolts may be used only for bearing housing covers and for internal components where other lifting arrangements are impractical. Holes for eye-bolts shall be permanently marked with the correct bolt size to be used. If this marking is impractical, bolt size information should be clearly indicated in the instruction manual. **(Mod.)**

**5.1.16** “If Specified” IS deleted. **(Mod.)**

**5.1.17** “If Specified” IS deleted. **(Mod.)**

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

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

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

| Equipment | Sound Pressure Limit in dB Reference Equivalent (RE) 20 µPa |
|---|---|
| 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.)**

**5.1.19.3** 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.)**

**5.1.22** Unless otherwise specified, compressors and auxiliaries shall be suitable for out door (without roof) installation in the climatic zone specified. **(Mod.)**

**5.1.26** The process gas discharge temperature at the normal operating point shall be at least 20°c below the maximum allowable temperature. **(Add.)**

**5.2.7** Flooded screw compressors shall not be used. **(Sub.)**

**5.3 Casing Connections**

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

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

**5.4.1** For each main process nozzle the manufacture shall furnish in tabular format the following data:

- The maximum allowable forces and moments and combinations thereof for satisfactory continuous operation;
- The maximum allowable forces and moments and combinations thereof under transient conditions such as start-up and (emergency) shut-down;
- Expected nozzle movements due to thermal expansion between the cold static and normal full load operating conditions;
- Any expected movement in addition to the above as a result of transient conditions. **(Mod.)**

**5.5 Rotating Elements**

**5.5.1 Rotors**

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

**5.5.1.7** Seal strips shall be integral with the rotor bodies unless otherwise approved by the principal. **(Add.)**

**5.5.1.8** Vendors shall demonstrate for screw compressors that the female rotor always absorbs enough power to avoid gear flutter. **(Add.)**

**5.6 Saft Seals**

**5.6.1 General**

**5.6.1.1** 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.)**

**5.6.1.8** 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.)**

**5.6.3.1 Labyrinth type**

For flammable material service, labyrinth seals shall have an injector or an educator 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.)**

**5.6.3.2 Restrictive-ring type**

For flammable material service, carbon rings shall have an injector or an educator 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.)**

**5.6.3.3.1** For mechanical contract seals the vendor shall state the normal and guaranteed internal and external oil leak rates. **(Mod.)**

**5.7 Dynamics**

**5.7.1 General**

**5.7.2.3** Are not acceptable. **(Add.)**

**5.8 Bearings**

**5.8.2.4** Fooling element bearings shall have brass cages. **(Add.)**

**5.8.3 Hydrodynamic bearings**

**5.8.3.2.5** Compressors shall be equipped with sleeve type journal bearings. **(Add.)**

**5.10 Lube-Oil and Seal-Oil System**

**5.10.1.1** 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 standby 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.)**

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

**5.11 Materials**

**5.11.2 Casting**

**5.11.2.2.4** 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.)**

**5.11.4 Welding**

**5.11.4.4** All accessible areas of welds on built-up rotors shall be inspected by magnetic particle examination. Dye penetrant inspection shall be used only magnetic particle inspection in not feasible. **(Sub.)**

**5.11.4.11** 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 dyepenetrant method. **(Mod.)**

### 5.12 Name Plates and Rotation Arrows

**5.12.3** 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.)**

## 6. ACCESSORIES

### 6.1 Drivers

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

**6.1.3** 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.)**

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

### 6.2 Coupling and Guards

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

**6.2.3** 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.)**

**6.2.6** Guards shall be made of one of the following spark-resisting materials:

**a)** Aluminum or aluminum alloys with a maximum content of 2% magnesium or 0.2% copper

**b)** Copper or copper based alloys. **(Add.)**

**6.2.7** Couplings with a maximum continuous speed higher than 5000 r/min shall receive residual unbalance verification in accordance with API 671. **(Add.)**

### 6.3 Mounting Plates

#### 6.3.1 General

**6.3.1.1** The equipment shall be furnished with a base plate. **(Sub.)**

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

**6.3.2 Base plate**

**6.3.2.5** Deflection while lifting shall not exceed 1:1200 **(Mod.)**

**6.4 Controls and Instrumentation**

**6.4.1.3** 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.)**

**6.4.3.5** 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 multivalent 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. **(Add.)**

### 6.4.4 Instrumentation

**6.4.5.1.2** 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 |

**6.4.5.5.2.10** All instruments and controls including shutdown sensing devices shall be installed with sufficient valuing or thermo wells to permit the removal of instruments and controls while the system is in operation. **(Add.)**

### 6.5 Piping

### 6.5.4 Process piping

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

### 6.6 Intercoolers and after coolers

**6.6.3** Shell and tube intercoolers and after coolers shall be per IPS-G-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.)**

**6.6.6** Air coolers used for intercoolers and after coolers shall conform to IPS-G-ME-245. **(Mod.)**

**6.6.9** Coolers shall not be installed on top of the compressor. **(Mod.)**

**6.7.1** Filter open area shall not be less than two times the compressor inlet opening. Filter elements shall be type 304 stainless steel. **(Mod.)**

## 7. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

### 7.1 General

**7.1.7** 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 subcontractors and to any free issue materials. **(Add.)**

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

### 7.2 Inspection

#### 7.2.2 Material inspection

**7.2.2.1.1** 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.)**

**7.2.2.1.4** The inspection requirements specified in 6.2.2.1 and 6.2.2.4.2 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 extend of inspection. **(Add.)**

**7.2.2.4.1** 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-penetrate inspection shall be used only when magnetic particle inspection is not feasible. **(Add.)**

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

### 7.3 Testing

#### 7.3.1 General

**7.3.1.3** Delete "5 days" and substitute "15 days". **(Mod.)**

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

**7.3.2** Hydrostatic tests

**7.3.2.4** Delete 30 minutes and substitute 4 hours. **(Mod.)**

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

### 7.4 Preparation for Shipment

**7.4.1** Delete 6 months and substitute 12 months. **(Mod.)**

## 8. GUARANTEE AND WARRANTY (Add.)

### 8.1 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.)**

### 8.2 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.)**