MATERIAL AND EQUIPMENT STANDARD

FOR

RECIPROCATING COMPRESSORS

FOR

INSTRUMENT AIR SERVICES

FIRST EDITION

JULY 2006

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2013. 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 is based on internationally acceptable standards and includes 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.

Standards and Research department

No.17, Street14, North kheradmand

Karimkhan Avenue, Tehran, Iran.

Postal Code- 1585886851

Tel: 021-88810459-60 & 021-66153055

Fax: 021-88810462

Email: Standards@nioc.ir

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 documents.

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.

CONTENTS: Page No.

0. INTRODUCTION

This Standard gives the amendment and supplement to API Std, 680 first edition, October 1987 "Packaged Reciprocating Plant and Instrument Air Compressors for General Refinery Services".

It shall be used in conjunction with data sheets for reciprocating air compressors.

Note 1:

This is a revised version of the IPS-M-PM-210 standard specification for "Reciprocating Compressors for Plant and Instrument Air Services", which is issued as original revision of new specification standard of IPS-M-PM-211, for "Reciprocating Compressors for Instrument Air services". The said standard specification is withdrawn.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2013. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 384 on Aug. 2013. These modifications are included in the present issue of IPS.

Guidance for Use of this Standard

For ease of reference, the clause or section numbering of API Standard 680(1987) has been used throughout this specification. Clause in API Standard 680(1987) 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.

SECTION 1– GENERAL

1.1 Scope

This Standard contains the minimum requirements for Double-Acting and Single-Acting Reciprocating Compressors for instrument air service for use in Oil, Gas, Chemical, and Petrochemical Industries and where applicable in exploration, production and new ventures.

Compressors intended for plant air services can comply with either of this specification and or preferably of ISO 8573-1.

Compliance with the provisions of this Standard does not relieve the supplier of the responsibility of furnishing Compressors of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

The main vendor is the Compressor manufacturer, who shall hold unit responsibility for the Compressor package. **(Mod.)**

1.2 Alternative Designs

The International System (SI) of Units, dimension and rating in accordance with IPS-E-GN-100 shall be used, unless otherwise specified. **(Mod.)**

1.3 Conflicting Requirements

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

First priority : Purchase order (including attachments) and variations thereon.

Second priority : Data-requisition sheets and drawings.

Third priority : This specification.

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

Should the Vendor's interpretation suggest a conflict between specifications, data sheets or purchase requisition, the Vendor shall obtain clarification before proceeding with any work. **(Sub.)**

1.5 Referenced Publications

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-E-EL-110 "Electrical Area Classification and Extent".

IPS-E-GN-100 "Units"

IPS-G-ME-220 "Shell and Tube Heat Exchangers"

IPS-G-ME-245 "Air Cooled Heat Exchanger"

IPS-G-SF-900	"Noise and Vibration Control"
IPS-M-EL-132	"Induction Motors"
IPS-M-PM-115	"Centrifugal pumps for general services"
IPS-M-PM-240	"General Purpose Steam Turbine"
IPS-G-PM-250	"Petroleum, Petrochemical and Natural Gas Industries-Steam Turbines - Special -Purpose Applications"
IPS-G-PM-260	"Gas Turbines for Petroleum, Chemical and Gas Industry Services"
IPS-M-PM-300	"Special Purpose Gear Units for Process Services"
IPS-M-PM-320	"Lubrication, Shaft Sealing and Control Oil System for Special Purpose Application"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

8573-1	“Compressed air contaminants and Purity Classes”

SECTION 2 – BASIC DESIGN

2.1 General

2.1.3 All equipment furnished shall be designed to minimize the generation of noise and shall not exceed the noise limits given in the supplementary clauses below: **(Sub.)**

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

2.1.3.2 The maximum allowable value of the noise limit (sound pressure level) for a compressor and its driver shall not individually exceed 85 dB(A) at 1 meter from their body .

The above requirements apply in the absence of reverberation and background noise from other sources, and for all operating conditions.

In the case of emitting fluctuating or intermittent noise, temporary excursions above the equipment noise limit may be permissible provided that such excursions can not be avoided by selecting a less noisy acceptable alternative. **(Add.)**

2.1.3.3 The equipment noise data sheet shall be returned with the tender and shall provide the following information:

a) Un-silenced sound pressure and sound power dB(A) levels in octave bands and overall value of the equipment;

b) Sound pressure and sound power dB(A) levels in octave bands and overall value of the equipment together with information of any silencing measures that may be required to meet the specified noise limits;

c) If the specified limits cannot be met, the minimum attainable sound pressure sound power dB(A) levels

All noise level quoted shall have an upper tolerance of +0dB. If the components of a train will be provided by different suppliers, separate equipment noise data sheets shall be prepared.

Note: where a supplier provides all the similar compressors in a project, a list of guaranteed noise levels and spectra per item will be acceptable.
(Add.)

2.1.3.4 Where sound silencers are proposed, prior approval of the Purchaser shall be obtained.

Noise control measures shall cause neither hindrance to operation nor any obstruction to routine maintenance activities. **(Add.)**

2.1.7 Electrical components and installation shall meet the requirement of IPS-E-EL-110 "Electrical Area classification and extent". **(Mod.)**

2.1.13 Unless otherwise specified, all equipments shall be designed for outdoor installation. **(Mod.)**

2.2 Allowable Speeds

2.2.1 Piston speed for non-lubricated cylinders are to be limited to 3.8 m/s. **(Mod.)**

2.6 Compressor Cylinder

2.6.1 General

2.6.1.1 Compressor cylinders shall be non-lubricated dry type. **(Mod.)**

2.6.1.5 Liners shall extend full length of the cylinder and shall be pinned or dowelled from outside to prevent possible rotation. **(Mod.)**

2.6.1.7.2 Air Coolers shall be sized for 20% extra surface inclusive of fouling (internal and external) factors. **(Mod.)**

2.6.1.12 Unless other types specified**,** pumps in the cooling system shall be centrifugal type and shall be of the vertical close coupled type,. Pumps shall comply with IPS-M-PM-115 "Centrifugal pumps for general services".

Pumps shall have nodular cast iron or steel casings. The type of drivers shall be as indicated in the data sheet. Each pump shall have a suction strainer, which shall be provided with a 40 mesh SWG 32 stainless screen. **(Add.)**

2.7 Valves

2.7.8 Metal valve disks or plates and damper plates shall not be punched. Valves and valve seats shall be made of stainless steel and valve springs from corrosion resistant material as well. **(Mod.)**

2.7.9 Cylinder unloading shall be accomplished by either valve depressors or plug-type unloaders. The use of the latter needs the approval of the purchaser. Valve lifters shall not be used. When valve depressors are specified, all inlet valves of the cylinder ends involved shall be provided with unloaders.

Where plug-type unloaders are used, the number of unloaders is determined by the area per plug opening, the total of which must be equal to or greater than one half of the total free lift area (or at least flow area) of all suction valves on that end.

Unloaders shall be pneumatically operated, unless specifically stated otherwise on the data sheet. Manual overrides on pneumatically operated unloaders are not permitted.

If actuators are specified, unloaders on valve depressors shall be capable of maintaining the suction valve fully depressed without any plate fluttering, while operating on the minimum specified instrument air pressure.

Pneumatically operated unloaders shall be piped by the manufacturer in such a way that incorrect selection between stages and cylinder ends shall not occur. The vendor shall provide the purchaser with a system of properly sequenced unloader operation (see 3.6.2). **(Add.)**

2.8 Piston and Piston Rods

2.8.1 The use of cutter pin for positive locking device shall be agreed upon by the Purchaser and the Vendor. **(Mod.)**

2.8.3 In case of using segmented wear band, the attaching provision to the piston shall be agreed upon by the Purchaser and the vendor. **(Mod.)**

2.8.4 Vendor shall clarify, if any wire-wooling tendency has been experienced for the piston rod area under oil wiper and type of provision which is recommended. **(Mod.)**

2.9 Crankshafts, Bearings, and Crossheads

2.9.1 When over-sizing of bearings are practicable, Vendor shall advise in his proposal method of shaft under-sizing and/or any other shaft repolishment. **(Mod.)**

2.11 Stuffing Boxes and Packing

2.11.2 Gland flanges shall be bolted to the cylinder with at least four stud bolts. Cap bolts are not allowed.

The construction of the stuffing box/distance pieces shall be such that the packing case assembly can be installed as a whole .If this is not possible, the packing case and flange may be separated in sub-assemblies, which shall be provided with separate tiebolts in order to maintain positive alignment during installation in the stuffing box. Packing cases shall be designed to accommodate piston rod movements. **(Mod.)**

2.12 Compressor Frame Lubrication

2.12.2 Lubrication systems shall consist of a twin full-flow oil filter. **(Mod.)**

2.12.3 The pump shall be a rotary internal screw-or gear-type pump. **(Mod.)**

2.12.5 When specified the relief valve discharge line shall be provided with a sight glass. **(Mod.)**

2.12.6 Oil coolers shall comply with IPS-G-ME-220. The vendor shall design the lubrication oil system such that the oil pressure at cooler outlet will be at least 1 bar higher than the maximum water pressure stated in the data sheet, to prevent contamination of the lubricating oil in case of cooler failure. **(Mod.)**

2.12.7 Oil filters shall be of disposable type. **(Mod.)**

2.12.10 Crank shaft oil seals shall be preferably replaceable without need to remove either coupling or flywheel. **(Add.)**

2.13 Cylinder and Packing Lubrication

2.13.4 Every reciprocating compressor having a compression cylinder that is designed and intended to function without liquid lubrication shall be provided with a caution notice to that effect. (See clause 2.6.1.1). **(Add.)**

2.14 Materials

2.14.4 Welding

2.14.4.2 Casting repair and procedures shall be subjected to approval by the purchaser. **(Mod.)**

2.14.6 Material inspection

2.14.6.1 Full non-destructive inspection shall be carried out on all critical areas of cylinder castings, such as abrupt changes in section, weld ends, at the junction of risers, gates or feeders to the casting and areas of high stress. Prior to inspection, the purchaser and manufacturer shall agree the critical areas and the type of nondestructive testing which shall be applied. Radiographic inspection shall be applied wherever possible. Ultrasonic inspection shall be used where radiography is not possible. **(Mod.)**

2.14.6.4 All casting and forging surfaces shall be examined visually by the manufacturer. Dye-penetrant inspection shall be used only when magnetic particle inspection is not feasible. **(Add.)**

2.15 Nameplates and Rotation Arrows

2.15.3 The text on the nameplates shall be in English language. The information on the nameplates shall include the year of manufacture. Unless otherwise specified, all data on nameplates shall be in SI units. **(Mod.)**

SECTION 3 – ACCESSORIES

3.1 Drivers

3.1.7 Electric motors for main drivers as well as auxiliary drivers shall be as specified in the data sheet and shall also comply with IPS-M-EL-132 and IPS-E-EL-110. **(Sub.)**

3.1.8 Steam turbine drivers shall conform to IPS-M-PM-240 or IPS-G-PM-250 whichever is applicable. **(Mod)**

3.3 Reduction Gears

The gear unit design shall conform to IPS-M-PM-300. **(Mod.)**

3.4 Belt Drivers

3.4.1 Belt drives may be used for Compressors 112 kw or less whenever approved by the Purchaser. **(Mod.)**

3.5 Base Plates

3.5.5 The equipment feet and baseplates shall equipped with vertical jackscrews to ease shim installation. **(Sub.)**

3.5.11 Unless otherwise specified, anchor bolts shall be provided by Vendor. **(Sub.)**

3.5.12 For compressor below 112 kilowatts, skid shall be furnished to accommodate all equipment of each compressor package being furnished and to allow shipment and setting in place as a unit. Skid will be grouted under main support members only. **(Add.)**

3.5.13 Ends of main longitudinal members shall be rounded to permit pulling on to rollers and shall be fitted with a transverse piece of pipe to provide purchaser for pulling. **(Add.)**

3.6 Controls and Instrumentation

3.6.3 Control station

3.6.3.1 A local free standing control cabinet shall be supplied for each compressor unit. **(Mod.)**

3.6.3.3 Change item a. as per following:

a) Pressure gages.

1) Bearing oil header pressure (down stream of filter)

2) Compressor interstage, and discharge pressure. **(Mod.)**

3.6.4 Instrumentation

3.6.4.1 Add the following items to this clause:

e) Frame oil level sight gage.

f) Coolant surge tank level sight gage.

g) Coolant flow sight indicator.

h) Thermowell (test connection) intercooler and aftercooler inlets and outlets. **(Mod.)**

3.6.5 Alarms and shutdowns

3.6.5.1 General

Direct switches in alarm and shutdown are not allowed. A combination of signal transmitter with switch and/or trip amplifier shall always be used. **(Mod.)**

3.6.5.2 Alarm and trip switches

3.6.5.2.2 Alarm and shutdown devices shall be energized at normal operating conditions of the system and be installed such that device failure, power supply failure, wire breakage etc, will cause alarm and/or shutdown. **(Sub.)**

3.6.5.2.6 As a minimum alarm and trip shall be as per following table: **(Add.)**

ITEM	DESCRIPTION	ALARM	TRIP
1	FINAL STAGE INLET AIR TEMP.	X	X
2	MAIN OIL PUMP PRESS.	X	X
3	OIL TEMP.	X	X
4	BEARING OIL PRESS.	X	X
5	STAGE VIBRATION LEVEL	X	X
6	POWER SUPPLY VOLTAGES	X	X
7	OIL TANK LEVEL	X	X
8	INLET AIR FILTER DELTA P	X	X
9	OIL FILTER DELTA P	X	X
11	COOLING WATER FLOW	X	X
12	LUBRICATOR RESERVOIR	X	X

3.7 Piping and Appurtenances

3.7.1 General

3.7.1.5 Threaded connections are not allowed, except in the following cases:

- Cooling water piping (not cooling oil for packing cooling).

- Connections to the distance piece compartments for cooling, lubrication and venting purposes.

- Cylinder and packing lubrication connections.

Seal welding of threaded connections is not allowed. If welded connections are required, only full penetration butt welded connection are permitted. **(Mod.)**

3.7.1.13 The piping design shall provide access for chemical or mechanical cleaning and Inspection. Piping close to the compressor shall be arranged to allow maintenance access to both sides of all cylinders. **(Mod.)**

3.8 Intercoolers and Aftercooler

3.8.1 Shell and tube heat exchangers shall be designed in accordance with IPS-G-ME-220. **(Mod.)**

3.8.7 When air coolers are specified, they shall be in accordance with IPS-G-ME-245. **(Sub.)**

3.10 Pulsation Controls

3.10.2 The compressor vendor shall furnish the discharge pulsation suppression device and any other stage dampers when required. Pulsation suppression devices are not required at the suction of an air compressor with an atmospheric intake line, or at the interstage of an internal interstage cooler unless calculations indicate pulsations are likely to occur.

The use of intercoolers and/or aftercooler as pulsation suppression device is not permitted.

For multiple adjacent cylinders operating at different pressure levels, the individual pulsation suppression device may be combined, when possible, in a single vessel with internal partitions. **(Mod.)**

3.10.3 The suppression device volume shall be at least six times the total piston displacement of all the cylinders connected to the suppression device, and the suppression device diameter shall be at least twice the diameter of the largest connected nozzle. Orifices shall not be utilized for pulsation suppression unless approved by the purchaser.

Internals, such as baffles, tubes, or any construction other than the partitions of combined pulsation suppression device, shall not be used. **(Mod.)**

3.10.4 Each internal compartment preferably should accessible for inspection. **(Add.)**

SECTION 4– INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

4.1 General

4.1.6 All certificates shall contain the following information as a minimum:

- Name of purchaser.
- Purchase order number and date.
- Manufacture's order number.
- Identification number of certificate and its date of issue.
- Material specification(s).
- Dimensions in SI units, unless otherwise specified or approved.
- Material charge number, or batch number.
- Mechanical properties recorded from test results.
- Chemical composition recorded from results of chemical analysis.
- NDT methods and results, whenever applicable
- Heat treatment procedures, furnace charge number and heat treatment records, where applicable any supplementary or additional information as may be required. **(Add.)**

4.3 Testing

4.3.1 General

4.3.1.2 Delete 5 and substitute 15 working days.

4.3.3 Mechanical running test

4.3.3.6 Post-test inspection shall include the following as a minimum:

- Internal surface of cylinder liners to be checked for required surface finish and material imperfections.

- Piston rings and rider rings to be checked for gap clearance, groove clearance and bearing surface.

- Piston rod to be checked on packing area surface and run-out, which shall be in accordance with the limits of (2.6.1.4.).

- All valve assemblies to be checked for correct lifting height of valve plates and leakage (leakage test of valves to be done either with air or with low viscosity solvent; water is not allowed).

- Main bearings, crank bearings and crosshead to be checked for correct bonding of babbit material to the base metal and for correct bearing surface.

- Crankshaft journal, crank pin and crosshead pin to be checked for the bearing contact area.

- Crankcase to be internally inspected to check:

- Locking device of all bearing bolt nuts.

- Correct fitting of lubricating oil piping to main bearings.

- Correct securing of lubricating oil piping in the crank- case. **(Mod.)**

4.3.3.7 The vibration of new machine shall be according to class A of ISO 10816-6 (Mechanical Vibration –Evaluation of machine vibration by measurements on non-rotating parts).

4.3.4.1 The machine shall be tested in accordance with the ASME power test code PTC and ISO 1217 (Displacement compressors Acceptance Tests). **(Mod.)**

4.3.4.2 Complete-unit tests

Details of the extent and the procedure of test shall be included in the proposal. The final version of the test procedure shall be subject to the Purchaser's approval. **(Mod.)**

4.4 Preparation for Shipment

4.4.1 The preparation shall make the equipment suitable for 18 months of outdoor storage from the time of shipment. **(Mod.)**

4.4.3.8 Separate shipment of the material is not permitted. **(Mod.)**

SECTION 5 – VENDOR'S DATA

5.1 Proposals

A list of spare parts for two years of continuous operation, including price list shall be submitted.

Vendor proposal for spare parts shall include proposed method of protection from corrosion during shipment and subsequent storage. **(Mod.)**

5.2 Contract Data

5.2.4 Data

5.2.4.3 Add "Illustrated " before parts list. **(Mod.)**

SECTION 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:

a) All equipment and component parts shall be warranted by the vendor against defected materials, design and workmanship for 1 years after start-up or 18 months after shipment, whichever is longer.

b) If any mal-performance or defects occur during the guarantee and warranty period, the vendor shall make all necessary alterations, repairs and replacements free of charge, with no field labor charges, on the purchaser's job site. **(Add.)**

6.2 Performance

The equipment shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheets. **(Add.)**

APPENDICES

APPENDIX A

SI data sheets shall be used unless otherwise specified. **(Mod.)**

APPENDIX D

Repairs to gray and nodular iron castings.

Any repair mod/or repair method is subject to the explicit approval of the Purchaser. **(Sub.)**