MATERIAL AND EQUIPMENT STANDARD

FOR

POSITIVE DISPLACEMENT PUMPS - RECIPROCATING

FIRST EDITION

JUNE 2003

This standard specification is reviewed and updated by the relevant technical committee on Jan. 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.

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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 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.

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0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "Positive Displacement Pumps Reciprocating" for use in oil, Gas and Petrochemical Industries and is based on API Standard 674 third edition, December, 2010, and shall be read in conjunction with that document.

Guidance for Use of this Standard The amendments/supplement to API Standard 674 given in this Standard are directly related to the equivalent sections or clauses in API Standard 674. For clarity, the section and paragraph numbering of API Standard 674 has been used as for 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 changes made to the equivalent clause or paragraph of API.

Note 1: This is a revised version of the standard specification for positive displacement pumps – reciprocating, which is issued as revision (1). Revision (0) of the said standard specification is withdrawn.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Jan. 2013. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 368 on Jan. 2013. These modifications are included in the present issue of IPS.

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 Standard contains the minimum requirements for reciprocating positive displace pumps for use in refinery services, chemical, petrochemical and gas plants and where applicable in exploration, production and new ventures. Compliance with the provisions of this specification does not relieve the supplier of the responsibility of furnishing pumps of proper design, mechanically suited to meet operating guarantees at the specified service conditions. No deviation or exception from this Standard shall be permitted without written approval of the Company. Intended deviations shall be listed separately by the Vendor and supported by reasons thereof for Purchaser's consideration. **(Mod.)**

2. NORMATIVE REFERENCE

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 "Engineering Standard for Hazardous Area"

IPS-E-GN-100 "Engineering Standard for Units"

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

IPS-M-EL-131 "Material and Equipment Standard for Low Voltage Induction Motors"

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

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

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

IPS-G-PM-260 "General Standard for Gas Turbines for Petroleum, Chemical and Gas Industry Services"

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

IPS-M-PM-320 "Material and Equipment Standard for Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Application"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM A488 "Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel" **(Mod.)**

4. GENERAL

4.1 Units of Measurement

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

4.3 Conflicting Requirements

In the case of conflict between documents relating to the inquiry or order, the following priority of document (whichever more stringent realized by the Company) shall apply:

First priority : purchase order and variations thereto.

Second priority : data sheets and drawings.

Third priority : this specification.

All conflicting requirements shall be referred to the Purchaser in writing. The Purchaser will issue confirmation document if needed for clarification. **(Add.)**

6. BASIC DESIGN

6.1 General

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

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

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

SOUND PRESSURE LIMIT IN dB	
PUMP	87 dB
PUMP + DRIVER	90 dB

If the equipment produces impulsive and/or narrow band noise (a band width is called a narrow band if f high /f low £1), the above limits shall be taken 5 dB lower, thus 82 dB for pump and 85 dB for pump & driver. The above requirements apply in absence of reverberation and background noise from other sources, and for all operating conditions between minimum flow and rated flow.

In the event that more stringent limits apply then these will be indicated in the data sheet which forms part of the requisition. In such cases, the equipment shall not exceed the sound power or sound pressure limit stated in the requisition. **(Add.)**

6.1.5.3 Where excessive noise from equipment can not be eliminated by low noise design, corrective measures may take the form of acoustic insulation for pipes, gear boxes & etc. Where acoustic insulation and/or noise hoods are proposed, prior approval of the purchaser shall be obtained regarding construction, materials and safety requirements. Noise control measures shall cause neither hindrance to operations nor any obstruction to routine maintenance activities. **(Add.)**

6.1.21 Where the duty requirements demand variable output, then the use of variable speed fluid couplings or other approved variable speed devices on motor driven pumps shall be considered. **(Add.)**

6.2 Selection of Pump Types

6.2.2 Side pot type piston pumps will be acceptable up to 2850 kPa (28.5 bar) and 177°C. Side pot type piston pumps with cast steel cylinder will be acceptable up to 3550 kPa (35,5 bar) and 400°C. **(Add.)**

6.3 Rating

6.3.1 The 3'rd column of Table 3 of API 674 is related to single acting plunger type pumps and the 4'th column of Table 3 is related to double acting piston type pumps. (Mod.)

6.3.1.1 Pump size shall be based on the full load rated speed of the driver. **(Add.)**

6.3.1.2 Slurry pumps (handling liquid with solid content greater than 11.98 kg/m3) shall not have design speeds greater than 110 rpm 1.83 rev./sec.) if either in continuous duty or rated above 75 kW (100 hp) and 7040 kPa (70.4 bar). The maximum allowable speed ratings shall be multiplied by the correction factors shown in Table 1, for various suction conditions. **(Add.)**

TABLE 1 (Add.)

SUCTION CONDITION	**FACTOR**
AVAILABLE NPSH EXCEEDS THAT REQUIRE BY LESS THAN 0.9m	0.8
OPERATING TEMPERATURE BETWEEN 65 AND 175°C	0.67
OPERATING TEMPERATURE ABOVE 175°C	0.5

6.3.8 The steam cylinders of direct acting pumps shall be sized so that maximum pumping conditions can be met with specified minimum initial and maximum exhaust steam pressures, while allowing 70 kPa (0.7 bar) drop in initial steam pressure through steam valve and cylinder ports, and using mechanical efficiencies shown in Table 2. **(Add.)**

TABLE 2 (Add.)

STROKE mm	**MECHANICAL EFFICIENCIES (%) (1)**		
	SPECIFIED DIFFERENTIAL PUMPING PRESSURE (2)		
	2100 kPa (21 bar) OR BELOW		ABOVE 2100 kPa
	PISTON TYPE	PLUNGER TYPE	PISTON OF PLUNGER TUPE
76.2	55	50	45
101.6	60	55	50
152.4	65	60	57
203.2	68	65	62
254.0	72	68	65
304.8	74	70	67
381.0	76	73	71
457.2	78	75	73
508.0	79	77	74
609.6	80	78	75

(1) Use 90% of above values if specified maximum viscosity exceeds 865 cs.

(2) Not steam pressure.

6.5 Cylinder Connection

6.5.14.6 Flanges that are thicker or have a larger outside diameter that required by ANSI may be furnished, but they shall be faced and drilled as specified in (ASME B.16.5 or B.16.47). **(Sub.)**

6.5.14.13 All pumps shall be provided with vent connections DN 20 NPT minimum. Tapped connections shall be provided for completely draining pump cases of horizontal pumps. Drains shall not be less than DN 20. **(Add.)**

6.7 Liquid End Appurtenances

6.7.2 Pistons, plungers and piston rods

6.7.2.4 Solid plungers are preferred. In cases that hollow pistons and/or plungers are used their compartments shall be positively vented. Hollow plungers shall be water cooled for operating temperatures 175°C and over. Hollow plungers shall have at least 3 mm excess wall thickness. **(Sub.)**

6.7.2.6 Liquid end pistons shall be designed to meet the following requirements:

a) Piston packing of the Snap ring type is preferred, but sectional rings with expander spring tempered to hold tension under maximum operating temperature will be considered.

b) Design of pistons shall permit repacking without removing piston from the cylinder.

c) Body and follower type pistons shall contain at least 3 rings of packing.

d) Cast hollow pistons are not acceptable.

e) If specified, 5 digit stroke counters of the non-resetting type shall be fitted. **(Add.)**

6.7.2.7 If steady bearing or guides for plunger side rods are provided, they shall have renewable bushing and means of lubrication. **(Add.)**

6.7.3 Valve seats

Valve seats shall be replaceable. For non corrosive services when pressure is below 2800 kPa gage, seats may be taper threaded into the cylinder. For specified corrosive services and/or when pressure is greater than 2800 kPa gage, seats shall be taper press fitted into the valve plate or cylinder or shall be clamped in place. Valve seats shall have sufficient metal to allow resurfacing. **(Sub.)**

6.7.3.1 Valves may be disc, ball, or wing guided as recommended by manufacture for each specific service. Recommendation shall be based on pressure, NPSH requirement, velocities, viscosity of fluid, etc., and subject to purchaser's approval. In general wing guided valves are preferred, valves shall be arranged to eliminate gas pockets **(Add.)**

6.7.3.2 Coil springs, if used on valves, shall be squared and ground to protect the plate against damage by the spring ends. **(Add.)**

6.7.3.3 The design shall provide sufficient free area through suction valves so that liquid velocities (obtained by dividing design capacity by free area) will not exceed the following:

a) 1.07 m/s for pumping temperature 170°C or below, and maximum viscosity 57 cSt or below with more than 0.9 m excess NPSH available.

b) 0.7 m/s for pumping temperature above 175°C or maximum viscosity above 57 cSt, or less than 0.9m excess NPSH available. **(Add.)**

6.7.3.4 Liquid velocities through discharge valves shall not exceed twice the velocity through suction valves. **(Add.)**

6.7.5 Stuffing boxes, packing and glands

6.7.5.2 All packing glands shall have non sparking metal bushings, positively secured. **(Mod.)**

6.7.5.7 Liquid end stuffing boxes shall have a minimum of 7 rings of packing and a lantern ring for cooling or sealing. For pressures over 7000 kPa (70 bars) forced feed packing lubrication is required.

For temperatures above 148°C extra deep stuffing boxes shall be used. **(Add.)**

6.7.5.8 The lantern ring shall be split type with threaded holes for its removal. **(Add.)**

6.8 Power End Running Gear

6.8.1 The provisions specified in 2.7.1.1 through 2.7.1.4 of API 674 shall apply. **(Sub.)**

6.8.7.1 Enclosed crank case, gear units, and similar mechanisms shall be sealed. Power ends of horizontal pumps including cross heads, shall be completely enclosed in oil tight casings.

Removable covers shall be provided for inspection, cleaning, and minor adjustment of parts. Crank case inspection covers shall be sized or located to permit visual inspection of the entire sump and all critical areas. Shaft openings shall be protected by shaft slingers, labyrinths, seals or packing as required to exclude foreign matter. Any slingers shall be of spark resistant material. Exposed crankshafts or plungers shall be provided with a removable sheet metal cover made of corrosion resisting material. **(Add.)**

6.8.10 The distance piece shall be equipped, with safety guards, gasket solid covers. Access openings for solid covers shall be surfaced and drilled. **(Sub.)**

6.8.14 Connecting rods on power frame reciprocating pumps shall have replaceable Babbitt lined bearings. **(Add.)**

6.9 Direct Acting Pumps

6.8.1 Drain valves shall be provided at each end of gas end cylinders. **(Mod.)**

6.8.4 Steam valves for maximum initial steam temperature exceeding 230°C shall be of the piston type with renewable rings and liners. Piston type steam valves with renewable rings and liners are required for greater than 152 mm stroke continuously operated pumps regardless of initial steam temperature. **(Sub.)**

6.8.5 Steam pistons shall be provided with at least two renewable type piston rings. **(Mod.)**

6.10 Lubrication

6.10.1 Lubrication for Power Pumps

6.10.1.7 As a minimum, the following auxiliaries shall be furnished for the crankcase lubrication system of pumps rated above 75 kW (100 hp) and 7000 kPa(70 bar)gage: an oil filter, start up pump, low oil pressure trip out feature, pressure gage on each side of the oil filter, thermometer, visible level gage on the oil sump, oil flow indicator and surge protection devices. Oil flow indicators shall have dual window, armored, sight glasses mounted in a horizontal run of pipe with a horizontal sight axis. **(Mod.)**

6.10.2 Lubrication for liquid end and power end

6.10.2.5 Belt driven oil lubricator from the power frame driving mechanism is not acceptable. **(Mod.)**

6.11 Material

6.11.1 Material Inspection of Pressure-Containing Parts

6.11.1.1 Cast iron shall not be used for liquid end pressure containing parts handling flammable liquids or toxic materials. **(Mod.)**

6.11.1.2 The manufacturer shall furnish material certificates giving chemical composition and mechanical data for pressure containing parts and for all main components of the pump, in accordance with the requirements of "4.2" of API Standard 674. **(Mod.)**

6.11.1.12 Steam end pressure casings shall be steel, if normal initial steam conditions exceeds 1725 kPa (17.25 brag) or 230°C, or if maximum initial steam temperature exceeds 260°C. **(Add.)**

6.11.1.13 Vendor's proposals to use ceramic materials and coatings shall be submitted to purchaser for approval **(Add.)**

6.11.4 Castings

6.11.4.3.1 The repair of leaks and defects in pressure containing casting by penning or burning in or, by impregnation with plastic or cement compounds is prohibited. Repair by welding or by plugging shall be under taken only in accordance with the procedures detailed below.

Repair by Welding

Weld able grades of steel casting may be repaired by welding subject to the following criteria:

a) Approval by the purchaser shall be obtained before any major (see Note below) weld repair is carried out.

b) All repairs shall meet the inspection requirements and acceptance standards.

c) For steel castings, the repair welding procedure and the repair welder's qualifications shall both be in accordance with ASTM A488. For non ferrous alloy castings, refer to the purchaser for recommended repair procedures. Repair procedures are subject to approval by the purchaser.

Note:

The definition of 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.

d) The total quantity of weld metal deposited shall be less than 10% of the mass of the casting.

e) After weld repair, castings shall be suitably heat treated if this is specified in the relevant material specification.

A major weld repair shall always be followed by a suitable heat treatment.

f) Details of all major weld repairs and of the heat treatment where applicable, shall be recorded and reported to the purchaser.

Repair by Plugging

Cast gray iron or nodular iron may be repaired by plugging within the limits specified in ASTM A278, ASTM A536 or ASTM A395 respectively. The drilled holes for plugs shall be carefully examined by dye penetrant to ensure removal of all defective material.

All necessary repairs not covered by ASTM shall be subject to approval by the purchaser.

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

6.12 Nameplates and Rotation Arrows

6.12.4 In addition to appearing on the nameplate, the pump serial number shall be plainly stamped on the pump casing. The text on nameplates shall be in English language and the data shall be in SI units, unless otherwise specified. Add to information required on nameplates: Year of manufacture, specific gravity, and relief valve set pressure. **(Mod.)**

7. ACCESSORIES

7.1 Drivers

7.1.1 General

7.1.2.2 All electrical motor drivers including auxiliary equipments shall comply with IPS-M-EL-132. **(Sub.)**

7.1.3 Steam turbines shall comply with the requirements of API Std. 611 as amended/ supplemented by IPS-M-PM-240 or API Std. 612 as amended / supplemented by IPS-G-PM-250 whichever is applicable. **(Mod.)**

7.2 Couplings and Guards

7.2.4 Flexible couplings shall be of steel. Lubricated flexible couplings shall be sealed with synthetic rubber or fibrous material. **(Mod.)**

7.2.9 The coupling shall be dynamically balanced when the coupling size-speed relationship is such that balancing is recommended by the coupling manufacturer. **(Add.)**

7.2.10 Unless otherwise specified, guards shall be fabricated of corrosion resisting, non sparking materials. **(Add.)**

7.4 Mounting Plates

7.4.1.4 Replace the «equipment weights more than 250 kg (500 pounds)» to «equipment weights more than 100 kg (225 pounds)». **(Mod.)**

7.4.1.7.1 Anchor bolts will be furnished by the purchaser, unless otherwise specified in data/requisition sheet. **(Sub.)**

7.4.2.6 All base plates shall be provided with at least two holes (10 centimeter minimum diameter) for each bulkhead section for grouting. **(Mod.)**

7.4.2.12 Shaft centerlines of turbine driven pumps shall be sufficiently raised on the base plate to allow piping of turbine steam inlet end drain and leakage connections. **(Add.)**

7.5 Controls and Instrumentation

7.5.1 General

7.4.4.5 A relief valve integral with the pump is not permitted. **(Add.)**

7.7 Pulsation and Vibration Control Requirement

7.7.1 General

7.7.1.4 Pulsation in the liquid flow entering and leaving the pump should not exceed plus or minus 2% of the operating pressure in the suction or discharge manifold respectively. **(Add.)**

8. INSPECTION, TESTING, AND PREPARTION FOR SHIPMENT

8.1 General

8.1.1 When there are a number or series of identical pumps to be inspected and tested, each individual pump shall be inspected and tested in accordance with the requirements of this specification. Random inspection and testing is not permitted. The purchaser representative shall have the right to reject any part of equipment that does not conform to the purchase order. **(Mod.)**

8.2 Inspection

8.2.3 Mechanical Inspection

8.2.3.2 The oil system shall meet the cleanliness required by IPS Standard M-PM-320. **(Sub.)**

8.3 Testing

8.3.1.2 The vendor shall submit to the purchaser for approval a completely detailed description of the proposed test program 2 months before testing and also notify the purchaser not less than 15 days before the date, equipment will be ready for test. **(Sub.)**

8.3.2.4 The liquids with chloride content are not permitted for hydrostatic test of austenitic stainless steel materials. When water is used for hydrostatic test, wetting agent shall be added. **(Mod.)**

8.3.4.9 After satisfactory completion of tests, all equipments shall be stripped for full inspection and measurement of working clearances. **(Add.)**

8.4 Preparation for Shipment

8.4.3.2 Unless otherwise specified the rust preventive applied to unpainted exterior machined surfaces shall be of a type:

a) To provide protection during outdoor storage for a period of twelve months from the time of shipment, exposed to a normal industrial environment, and,

b) To be removable with mineral spirits or any standard solvent. **(Mod.)**

8.4.3.8 Each pump shall be identified as required by the purchase order. No material shall be shipped separately. Miscellaneous parts shall be identified with securely affixed, corrosion resisting metal tags, marked with the item number for which they are intended. All such parts shall be suitably boxed, firmly attached to the base plate and shipped with the unit. **(Sub.)**

8.4.9 Packing used in test shall be removed from the pump and new packing shall be furnished for installation in the field. **(Add.)**

9. VENDOR'S DATA

9.2 Proposals

9.2.3 Technical data

F. Price details for spare parts are required unless otherwise specified by the purchaser. **(Mod.)**

10. GUARANTEE AND WARRANTY

10.1 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. **(Add.)**