

MATERIAL AND EQUIPMENT STANDARD

FOR

POSITIVE DISPLACEMENT PUMPS - RECIPROCATING

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0. INTRODUCTION

This Specification gives the amendment and supplement to API Standard 674, First edition, May, 1980 reaffirmed, December 1987 "Positive Displacement Pumps Reciprocating".

It shall be used in conjunction with data/requisition sheets for reciprocating pumps.

For ease of reference, the clause (or paragraph) numbering of API Std. 674 has been used throughout of this Specification.

Clauses (paragraphs) in API Std. 674 not mentioned remain unaltered.

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

- Sub. : (Substitution) the API Std. clause (or paragraph) is deleted and replaced by a new clause (or paragraph).
- Del. : (Deletion) the API Std. clause (or paragraph) is deleted without any replacement.
- Add. : (Addition) a new clause (or paragraph) with a new number is added.
- Mod. : (Modification) part of the API Std. clause (or paragraph) is modified and/or a new statement or comment is added to that clause (or paragraph).

1. GENERAL

1.1 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.)

1.2 Alternative Design

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

1.3 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. (Sub.)

1.4 Definitions of Terms

Diameter Nominal (DN)

Pressure Nominal (PN)

1.5 Reference Publications

1.5.1 The latest editions of the following standards, to the extent specified herein, form part of this standard.

IPS (IRANIAN PETROLEUM STANDARDS)

M-PM-240 "General Purpose Steam Turbine"

M-PM-250 "Special Purpose Steam Turbine"

M-EL-132 "Induction Motors"

M-PM-300 "Special Purpose Gear Units for Process Services"

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

- E-SF-900 "Noise and Vibration Control"
- E-EL-110 "Electrical Area Classification and Extent"
- M-PM-260 "Industrial Combustion Gas Turbines"
- E-GN-100 "Units"

AFBMA (ANTI FRICTION BEARING MANUFACTURERS ASSOCIATION)

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A-488 (Mod.)

2. BASIC DESIGN

2.1 General

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

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

2.1.2.2 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 $f_{high}/f_{low} \leq 1$), 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.).

2.1.2.3 Where excessive noise from equipment can not be eliminated by low noise design, corrective measures may take the form of acoustic insulation for pipes, gearboxes, 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.).

2.1.10 Pump and auxiliaries shall be suitable for outdoor installation.

The environmental conditions in which the equipment will operate shall be specified in the data sheet, and manufacturer shall indicate in his proposal any special protection required by the purchaser. (Sub.).

2.1.11 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.)

2.2 Selection of Types

2.2.4 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.)

2.3 Rating

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

2.3.1.2 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). (Add.)

2.3.2 The maximum allowable speed ratings shall be multiplied by the correction factors shown in Table 1, for various suction conditions. (Sub.)

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

2.3.12 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 OF PLUNGER TUPE
	PISTON TYPE	PLUNGER TYPE	
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.

2.4 Cylinder and Pressure Retaining Parts

2.4.3 Corrosion allowance for "liquid end pressure casing " shall not be less than 3 mm. (Mod.)

2.5 Cylinder Connection

2.5.6 The minimum length for shanks shall be 35 mm. (Mod.)

2.5.7.3 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 ANSI B.16.5 (Sub.).

2.5.7.6 Flanges that are not forged or cast integral with the cylinder shall be socket welded to the pump cylinder. Screwed and seal welded flanges are not acceptable. (Add.).

2.5.11 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.).

2.6 Liquid End Appurtenances

2.6.2 Pistons, plungers and piston rods

2.6.2.4 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.).

2.6.2.6 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 packings.
- d) Cast hollow pistons are not acceptable.
- e) If specified, 5 digit stroke counters of the non-resetting type shall be fitted. (Add.)

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

2.6.3 Valve seats

Valve seats shall be replaceable. For noncorrosive 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.)

2.6.3.1 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.)

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

2.6.3.3 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.)

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

2.6.5 Cooling or heating

Cooling or heating, if required for liquid ends, shall surround liquid cylinders and stuffing boxes.

Provisions for complete venting and draining of the system shall be considered. (Mod.)

2.6.6 Stuffing boxes, packing and glands

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

2.6.6.4 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 bar)forced feed packing lubrication is required. For temperatures above 148°C extra deep stuffing boxes shall be used. (Mod.)

2.6.6.6 Liquid end stuffing box packing shall be square, 100 mm² minimum size. (Sub.)

2.6.6.7 The lantern ring shall be split type with threaded holes for its removal. (Mod.)

2.7 Power End and Running Gear

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

2.7.7.1 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.)

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

2.7.15 Connecting rods on power frame reciprocating pumps shall have replaceable babbitt lined bearings. (Add.)

2.8 Gas End, Direct Acting Pumps

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

2.8.4 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.)

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

2.9 Lubrication

2.9.1 Lubrication, Power Pumps

2.9.1.6 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.)

2.9.2 Lubrication, liquid end and gas end

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

2.10 Material

2.10.1 General

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

2.10.1.2 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.)

2.10.1.8 Materials for components exposed to wet hydrogen sulfide, including trace quantities, shall conform to the requirements of NACE Standard MR-01-75, latest edition. (Mod.)

2.10.1.9 Steam end pressure casings shall be steel, if normal initial steam conditions exceeds 1725 kPag (17.25 barg) or 230°C, or if maximum initial steam temperature exceeds 260°C. (Add.)

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

2.10.2 Castings

2.10.2.3 The repair of leaks and defects in pressure containing casting by peening 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

Weldable 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.

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.

- 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.

- 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. (Sub.)

3. ACCESSORIES

3.1 Drivers

3.1.5 & 3.1.6 All electrical motor drivers including auxiliary equipments shall comply with IPS-M-EL-132. (Sub.)

3.1.7 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-M-PM-250 whichever is applicable. (Mod.)

3.2 Couplings (3.2)

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

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

3.3 Guards

3.3.1 Unless otherwise specified, guards shall be fabricated of corrosion resisting, non sparking materials. (Mod.)

3.4 Mounting Plates

3.4.2 Delete 1000 pounds (454 Kg) from this clause and replace by 100 kg (Mod.)

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

3.4.10.10 All baseplates shall be provided with at least two holes (10 centimeter minimum diameter) for each bulk-head section for grouting. (Mod.)

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

3.6 Nameplates and Rotation Arrows

3.6.4 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 is specified.

Add to information required on nameplates: Year of manufacture, specific gravity, Hydrostatic test pressure and relief valve set pressure. (Mod.)

3.7 Piping and Appurtenances

3.7.1.10 The minimum size of cooling water connections shall be DN 20. (Mod.)

3.7.4.2 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. (Mod.)

4. INSPECTION AND TESTS

4.1 General

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.)

4.2 Inspection

4.2.1 Change the first paragraph of this clause as per following: the vendor shall keep the following data available for at least five years for examination by the purchaser or his representative upon request.

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

4.3 Tests

4.3.1.2 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.)

4.3.2.1 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.)

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

4.4 Preparation for Shipment

4.4.2.2 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.)

4.4.2.8 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 baseplate and shipped with the unit. (Sub.)

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

5. GUARANTEE AND WARRANTY

5.1 Mechanical

The guarantee period for replacement parts shall begin at the time the replacement part is installed. (Mod.)

6. VENDOR'S DATA

6.1 Proposals

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

6.2 Contract Data

6.2.2 Data

6.2.2.3 The vendor shall furnish an illustrated part list for all equipment supplied. (Mod.)

APPENDICES**APPENDIX A
RECIPROCATING PUMP DATA SHEETS**

Unless otherwise specified, SI Unit data sheets shall be used.

**APPENDIX D (Add.)
PIPE COMPONENTS NOMINAL SIZE**

The purpose of this Appendix is to present the equivalent identities for the piping component nominal size in imperial and SI systems.

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.

**APPENDIX E (Add.)
PIPE FLANGE PRESSURE TEMPERATURE RATING**

The purpose of this Appendix is to present the equivalent identities for the pipe flange nominal pressure temperature ratings in imperial and SI system.

PN Rating - *Bar (1)	ANSI Rating CLASS
20	150
50	300
65	400
100	600
150	900
250	1500
420	2500

* The indicated PN ratings are introduced by ISO Standard No. 7268