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MINISTRY OF PETROLEUM

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IRANIAN PETROLEUM STANDARD

IPS

MATERIAL AND EQUIPMENT STANDARD FOR CENTRIFUGAL PUMPS FOR PROCESS SERVICES

FIRST REVISION
JUNE 2002

DEPUTY MINISTER
FOR
ENGINEERING & TECHNOLOGY
RESEARCH AND STANDARDS

FOREWORD

This Standard is intended to be used within and for Iranian Ministry of Petroleum (N.I.O.C, N.I.G.C, N.P.C., N.I.O.R.D.C. and other affiliate organizations and companies) and has been prepared on the basis of the recognized standards, scientific publications, technical documents, accumulated knowledge and experiences in petroleum industries at national and international levels.

Iranian Petroleum Standards are prepared by Iranian Petroleum Standards Organization reviewed and amended by the relevant technical standard committees to incorporate acceptable comments made by oil, gas and petrochemical experts.

Standards are finally approved by the "Standards High Council" of Iranian Ministry of Petroleum.

Iranian Petroleum Standards (IPS) are subject to amendment withdrawal, if required, thus the latest edition of IPS shall be applicable.

Any comment or recommendation submitted to the "Iranian Petroleum Standards Organization" will be evaluated in the relevant technical committee and will be considered in the next revision, upon approval.

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 etc.

"PURCHASER" : Means the "Company " Where this standard is 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.

"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.

"SHOULD" : Is used where a provision is advisory only.

"SHALL" : Is used where a provision is mandatory.

IRANIAN PETROLEUM STANDARDS.

No. 19, Street 14, North Kheradmand Karimkhan Avenue, Tehran, Iran.

Tel. : 66153055
: 88810460
Fax. : 88810462

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MATERIALS AND EQUIPMENT STANDARD

FOR

CENTRIFUGAL PUMPS FOR PROCESS SERVICES

FIRST EDITION

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0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "Centrifugal Pumps for Process Services" for use in oil, Gas and Petrochemical Industries and is based on API Standard 610, eight editions Aug. 1995 and shall be read in conjunction with that document.

Note: This is a revised version of the standard specification for centrifugal pumps for process services, which is issued as revision (1). Revision (0) of the said standard specification is withdrawn.

Guidance for Use of this Standard

The amendments/supplement to API Standard 610 given in this Standard are directly related to the equivalent sections or clauses in API Standard 610. For clarity, the section and paragraph numbering of API Standard 610 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 button 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. GENERAL

1.1 Scope

1.1.3 Ring section casing with external tie bolts shall not be used for multi stage pump handling flammable and toxic fluid or for boiler feed pump **(Mod.)**

1.1.4 Pump that do not require full compliance with API standard 610 should meet the requirements of IPS-M-PM-115 **(Mod.)**

1.1.5 Selected equipment shall be, in all respect, well within the range of the manufacturer's proven experience, and shall not involve the use or application of any prototype design or components.

(Add.)

1.2 Alternative Design

1.2.2 Pumps supplied to this standard shall have SI dimension and comply with applicable ISO Standards, unless otherwise specified in the data sheets or purchase orders.

1.3 Conflicting Requirements

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

- First priority : Purchase order and variations thereto
- Second priority :Data sheets and drawings
- Third priority :This standard specification **(Sub.)**

1.4 Definition of Terms

1.4.58 Pipe size

The international nomenclature diameter nominal written as DN 15, 20, 25, 32, 40, etc. has been used for pipe size in accordance with ISO 6708-1980. **(Add.)**

1.4.59 Pressure - temperature ratings

The international nomenclature "pressure nominal" written as PN 20, 50, 68, 100, 150, etc. has been used for flange ratings in accordance with ANSI-ASME B 16.5-1981, ISO 7268-1983.**(Add.)**

1.5 Referenced Publications

1.5.1 The latest editions of the following standards, codes and specifications shall be applied in addition to those stated in API Standard 610, 8th. edition 1995. **(Mod.)**

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-M-EL-132	"Induction Motors"
IPS-M-PM-115	"Centrifugal Pumps for General Services"
IPS-M-PM-240	"General Purpose Steam Turbines"
IPS-M-PM-250	"Special Purpose Steam Turbines"

IPS-M-PM-260	"Combustion Gas Turbines"
IPS-M-PM-270	"Expansion Turbines"
IPS-M-PM-290	"Internal combustion diesel engine"
IPS-M-PM-320	"Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Application"
IPS-G-SF-900	"Noise and Vibration Control"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

2954	"Mechanical Vibration of Rotating Machinery"
6708	"Pipe Components-Definitions of nominal pressure"

1.5.2 Delete this clause of API Standard. **(Del.)**

2. BASIC DESIGN

2.1 General

2.1.8 NPSH required shall be less than NPSH available by at least 500 mm. **(Mod.)**

2.1.11 Pumps shall have stable head capacity curves which continuously rise to shut off. **(Mod.)**

2.1.14 Pumps shall be designed to minimize the generation of noise and shall not exceed noise limits given in IPS-G-SF-900.

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

	Sound Pressure Limit in dB re 20 mPa
Pump	85 dB
Pump + driver	90 dB

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB lower, thus 80 dB for pump and 85 dB for pump + driver.

Noise levels shall have an upper tolerance of+0 dB.

The above requirements apply in absence of reverberation and background noise from other sources and for all specified operating region preferably within allowable operating region.**(Sub.)**

2.1.17 Liquid cooling shall be offered for the bearing pumping temperatures of above 150°C **(Mod.)**

2.1.29 Unless otherwise specified, pumps and auxiliaries shall be suitable for outdoor installation. **(Mod.)**

2.1.30 Where multi stage pumps require a balancing device, this shall be of a type not involving close Axial clearances. **(Add.)**

2.2 Pressure Casing

2.2.4 Pump regions that are subject to the suction pressure are to be designed for the maximum allowable working pressure. **(Mod.)**

2.2.5 The inner casing of double casing pumps shall be designed to withstand the maximum differential pressure plus 5%, or 350 kPa(gage), whichever is greater. **(Mod.)**

2.2.5.1 Pressure casings shall not be of the multiple segmented type for the inner casing of double casing pumps unless otherwise approved. **(Add.)**

2.2.6

d. Boiler feed water pump. **(Mod.)**

2.3 Nozzles and Pressure Casing Connections

2.3.2.1 All pumps shall have suction flanges of the same ANSI pressures /temperature ratings as the discharge flanges to permit testing under the required full test pressure. If bored and tapped nozzles are the manufacturer's standard practice, they may be used for sizes DN 40 and smaller in non hazardous services. Flanged nozzles shall be used for pipe sizes DN 50 and larger. Screw on flanges shall not be used. **(Mod.)**

2.3.3.10 For horizontal multistage pumps, provision shall be provided for complete drainage of all stages unless otherwise specified. **(Mod.)**

2.5 Rotors

2.5.11 Shaft sleeves are required for all pumps. Shaft sleeves shall be coated with Colmonoy 6 or stellite 6 over the area in contact with the flexible sealing member. Materials with better performance may be used if approved by the purchaser. **(Add.)**

2.6 Wear Ring and Running Clearances

2.6.3 Axial threaded dowels are preferred. Tack welding of wear ring is not permitted. **(Mod.)**

2.7 Mechanical Shaft Seals

2.7.1 Mechanical seal selection shall be based on the following criteria:

a) All normal services, conventional mechanical seals, temperature range 0-120°C.

b) For temperature range 120°C up to 315°C conventional mechanical seals with auxiliary cooling and product circulation facilities where character of pumping liquid permits such application.

c) For hot services where pumping liquid is dense viscous and dirty, 232°C to 427°C pumps shall use appropriate approved packing unless otherwise specified on the data sheet.

d) Bellows type seals with oil metallic parts shall be used for hot services where liquid is clean , and dead-end operation is preferred, 232°C up to 427°C. **(Mod.)**

2.7.3.5 The static pressure rating of seals at both ends shall be no less than the maximum allowable working pressure of the pump casing. **(Mod.)**

2.7.3.14 The seal end plate at the throttle bushing shall be provided with minimum DN15 NPT vent and drain connections for external water/steam quench. **(Mod.)**

2.7.3.16 Vertical, in-line close-coupled pumps shall be equipped with a vent line and valve at the highest point of the shaft sealing space. **(Mod.)**

2.7.3.19 Where filter are required in seal flushing lines, these shall be of the cyclone type.**(Mod.)**

2.7.3.24 Unbalanced mechanical seals are unacceptable for pumps in process services. **(Add.)**

2.7.3.25 Pumps equipped with mechanical seals shall be designed so that the mechanical seals can easily be removable with minimum dismantling of other parts of the pump. **(Add.)**

2.7.3.26 The arrangement of pump stuffing box and seal gland shall be designed to accommodate both mechanical type seals braided type packing. **(Add.)**

2.9 Bearings and Bearing Housings

2.9.1 Bearings

2.9.1.2 When hydrodynamic thrust bearings are proposed, the following shall apply:

a)Pump hydraulic design shall be such that axial loads are unidirectional under all operating conditions.

b) The pump vendor shall submit with his bid, curves showing the variations of axial load with capacity (Zero flow to % 125 flows) for design internal clearances and two times design internal clearances.

For variable speed units. Similar curves for maximum continuous speed and minimum continuous speed shall be submitted. **(Mod.)**

2.9.2 Bearing Housings

2.9.2.3 Sufficient cooling, including an allowance for fouling, shall be provided to maintain oil and bearing temperatures as follows, based on the specified operating conditions and the ambient temperature specified in the data sheet or 43 °C 110 F° of whichever is higher. **(Mod.)**

2.9.2.4 When salty water is specified by purchaser for cooling, the materials to be employed in the cooling system shall be approved by purchaser. **(Mod.)**

2.10 Lubrication

2.10.5 Where a pressure lubrication system is specified, the system shall be designed in accordance with IPS-M-PM-320. **(Sub.)**

2.11 Materials

2.11.1.1 For duties where 12% Cr. steel is specified as the casing material grade CA6NM is preferred. **(Mod.)**

2.11.1.11 Pumps handling sea water or brine above 40°C (104°F) Contaminated with oil and H2S shall be fabricated in a super duplex stainless steel or a more corrosion resistant material.**(Mod.)**

2.11.1.13 The manufacturer's quality control program shall be made available for review by the purchaser, or his representative, at the inquiry stage or whenever requested. **(Add.)**

2.11.3.5.6 Visual inspection plus magnetic particle or liquid penetrant inspection plus radiographic or ultrasonic inspections are required for suction and discharge nozzle welds. **(Mod.)**

2.11.3.5.7 With reference to API Standard 610 eighth edition Appendix G Table G-1 welds for use in the following services shall be stress relieved.

a) MEA, DEA, TEA-STOCK SOLUTIONS

b) Hydrofluoric acid concentration greater than 96%. **(Add.)**

2.12 Nameplates and Rotation Arrows

2.12.2 The text on nameplates shall be in English language and the data shall be as specified in data sheets. **(Mod.)**

3. ACCESSORIES

3.1 Drivers

3.1.5 Motors for the pump drivers shall be in accordance with IPS-M-EL-132, and characteristics specified in data sheets. **(Sub.)**

3.1.9 Steam turbines shall comply with the requirements of IPS-M-PM-240, or IPS-M-PM-250. **(Mod.)**

3.1.10 Unless otherwise specified, gears shall conform to IPS-M-PM-300. **(Sub.)**

3.1.13 Gas turbine for the pump drivers shall be in accordance with IPS-M-PM-260. Diesel engines for the pump drivers shall be in accordance with IPS-M-PM-290. Gas engines shall comply with the requirements of IPS-M-PM-290. **(Add.)**

3.1.14 For motor drivers, the gland connection of the conduit box shall be so arranged as to permit cable connection without excessive bending. **(Add.)**

3.2 Coupling and Guards

3.2.2 The couplings shall be meta stream flexible spacer type made of steel hubs and laminated disc of stainless steel construction, unless otherwise specified. **(Mod.)**

3.2.7 Couplings of operating at speeds above 4000 revolutions per minute and couplings for high energy pumps shall be dynamically balanced. **(Mod.)**

3.2.12 The coupling guard shall be of non sparking material. **(Mod.)**

3.3 Base plate

3.3.20 Unless otherwise specified anchor bolts will be furnished by the vendor. **(Sub.)**

3.4 Instrumentation

3.4.3 Vibration, position, and temperature detectors

3.4.3.1 Sleeve bearing pumps shall have a provision to permit shaft vibration measurements using a non contact vibration probe at each bearing, when required by specific condition. **(Mod.)**

3.5 Piping and Appurtenances

3.5.1 General

3.5.1.1 Standard materials for cooling water piping shall be seamless steel piping. Copper tubing and brass fittings are not acceptable. **(Mod.)**

3.5.1.15 Openings shall be identified with metal tags preferably riveted as to their intended services. **(Add.)**

3.5.2 Auxiliary process fluid piping

3.5.2.8 Valves are required on all vent connections. Valves are also required on drain connections on pumps in corrosive or toxic duties, and elsewhere where specified by the purchaser, vent outlets shall be taken down to the base plate. **(Sub.)**

3.5.2.10.1 For corrosive and sour services attention is drawn to possibility of crevice corrosion at socket welded fittings. For these services the design of all welded joints shall be subject to the purchaser approval.. **(Mod.)**

4. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

4.1 General

4.1.4 The vendor shall operate a quality management system to ensure that the technical requirements of this Standard are achieved. Purchaser 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 purchaser.

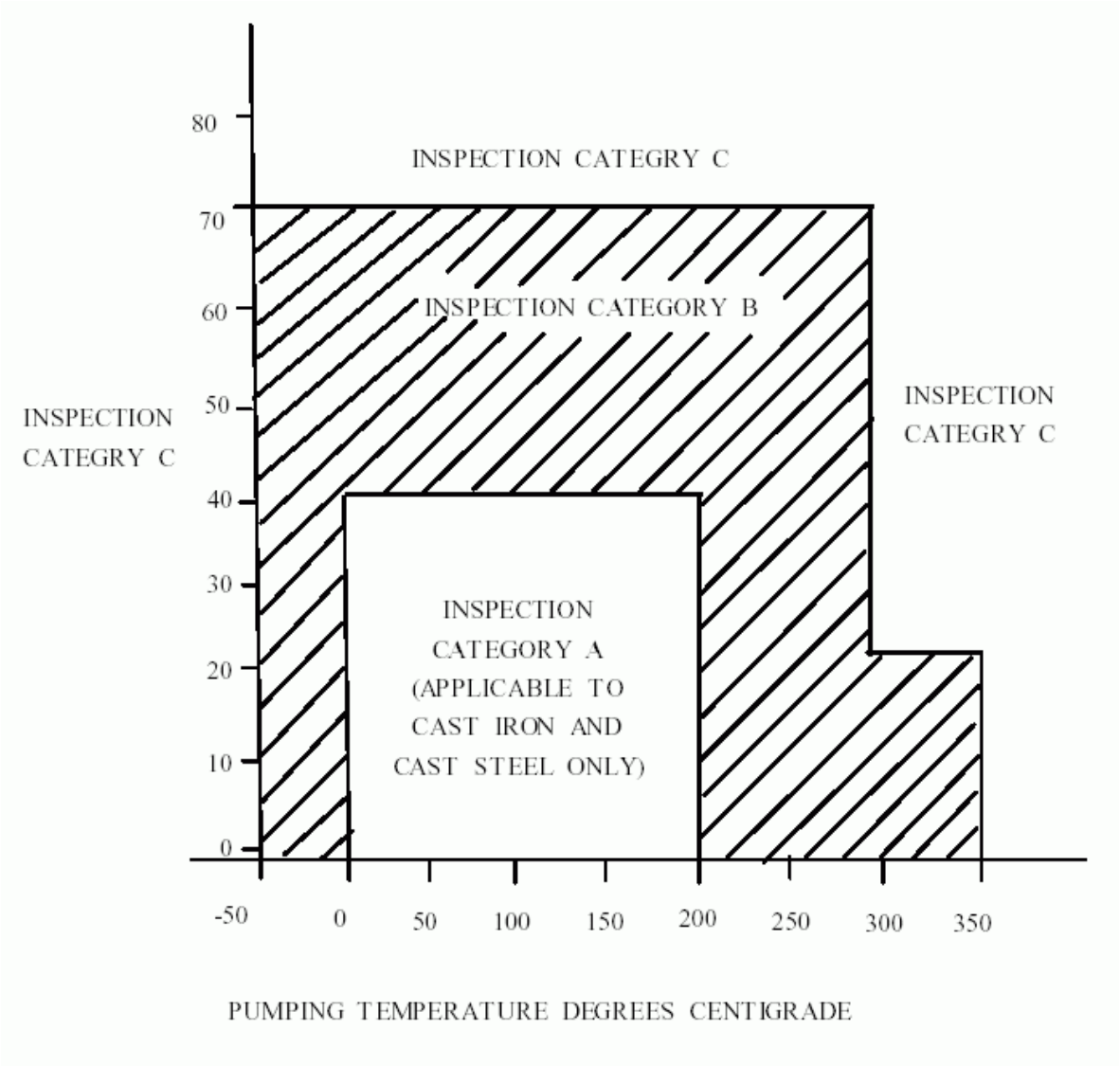
The vendor shall ensure that QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials. **(Mod.)**

4.1.8 Purchaser's representative shall have the right to reject any parts of equipment which do not conform to the Purchase Order. **(Add.)**

4.2 Inspection

4.2.1 General

4.2.1.3 Pressure-containing castings shall be inspected in accordance with the requirements of the relevant inspection category. The inspection category shall be determined from the relationship of maximum allowable working pressure and pumping temperature as shown in Fig. 1 of this Standard. However, Category A shall be limited to casing manufactured from cast iron and cast steel. For other materials within the Category A envelope, Category B inspection is required.



INSPECTION CATEGORIES FOR PRESSURE - CONTAINING CASTINGS

Fig. 1

The minimum inspection requirements shall be as follows:

Category A

Visual inspection in accordance with following Paragraph.

All surfaces shall be visually inspected to ensure conformity with relevant specification.

Prior to inspection, the surfaces shall be prepared by shot blasting, grinding, or both.

Category B

Visual inspection (Category A) and magnetic particle or liquid penetrant inspection in accordance with 4.2.2.4 or 4.2.2.5 of this IPS Standard and/or API Standards.

Liquid penetrant inspection shall be employed only when magnetic particle inspection is not feasible.

Liquid penetrant inspection shall be applied to all accessible surfaces including those exposed by machining.

Category C

Category B inspection, together with radiography or ultrasonic inspection in accordance with 4.2.2.2 or 4.2.2.3 of this IPS Standard and API Std.

Ultrasonic inspection shall be employed when radiography is not feasible, and its application shall always be considered when section thickness exceeds 50 mm.

Defect acceptance levels for ultrasonic inspection shall be subject to approval by the purchaser. **(Sub.)**

4.2.2 Material inspection

4.2.2.2 Radiography

4.2.2.2.1 Areas of the casting to be examined by radiography shall be subject to approval by purchaser prior to examination, but shall include any regions of abrupt section change, weld ends, and areas adjacent to feeders and risers. **(Mod.)**

4.2.2.4 Magnetic particle inspection

4.2.2.4.1 Magnetic particle inspection when specified shall be applied to all accessible surfaces, including those exposed by machining. **(Add.)**

4.2.2.4.2 For each type of defect, the degree of severity shall not exceed the following limits.

TYPE	DEFECT	MAXIMUM SEVERITY LEVEL
I	LINER DISCONTINUITIES (HOT TEARS AND CRACKS)	NOT ACCEPTABLE
II	SHRINKAGE	2
III	INCLUSIONS	2
IV	INTERNAL CHILLS AND UNFUSES CHAPLETS	1
V	POROSITY	1
VI	WELDS	1

(Mod.)

4.3 Testing

4.3.1 General

4.3.1.2 Change 6 weeks to 8 weeks. **(Mod.)**

4.3.1.3 Change 5 days to 15 days. **(Mod.)**

4.3.2 Hydrostatic test

4.3.2.4 Change 30 minutes to 4 hours. **(Mod.)**

4.3.3 Performance test

4.3.3.2.1 Test data shall also be measured at all other operating points specified on data sheet. **(Mod.)**

4.3.3.2.3 Variable speed pumps shall be tested additionally at maximum continuous speed and at minimum allowable speed. **(Mod.)**

4.3.3.2.5 Tests shall include a 4 hour run at maximum continuous speed and rated capacity. **(Add.)**

4.3.3.3.2 When pumps are fitted with hydrodynamic thrust bearings, axial loads shall be measured during the performance test. The flow rates at which axial loads are to be measured shall be subject to agreement between purchaser and the vendor, but should normally be shutoff, minimum continuous stable flow, midway between minimum and rated flow, and 125% of rated flow. For variable speed units, axial loads shall be measured at maximum continuous speed and minimum continuous speed. **(Mod.)**

4.3.3.4.4 Oil system components downstream of the filters shall meet the cleanliness requirements of IPS-M-PM-320. **(Add.)**

4.3.4 Optional tests

4.3.4.1 NPSH test

4.3.4.1.4 Where NPSH margin is below 0.6m, water a witness test shall be performed. **(Add.)**

4.3.4.2 Complete unit tests

All pumps shall be tested at rated speed, in cases where such testing is impractical because of excessive pressure generation, excessive power requirements or because of pump length (vertical pumps), the vendor shall submit alternative testing procedures with the proposal. **(Mod.)**

4.3.4.3 Sound level test

Sound level tests shall be performed in accordance with IPS-G-SF-900. **(Sub.)**

Sound tests shall be made with the pump operating at rated speed and rated power. **(Sub.)**

4.4 Preparation for Shipment

4.4.3.1 Packing used in tests shall be removed from the pump and new packing furnished for installation in the field suitable to the duty. **(Sub.)**

4.4.3.10 Each pump shall be properly identified as required by the purchaser order. No material shall be shipped separately. Miscellaneous parts shall be properly tagged or 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. **(Mod.)**

5. SPECIFIC PUMP TYPES

5.2.2.2 When specified is deleted

5.2.5 Bearing and Bearing Housing

5.2.5.2.6 When specified, the hydrodynamic thrust bearings designs shall incorporate the necessary features for installations of load measuring instrumentation. **(Add.)**

5.2.6 Lubrication

5.2.6.2

b. Facilities shall be provided to regulate the lubricating oil temperature. **(Mod.)**

F. The auxiliary oil pump shall ensure adequate lubrication to all main bearings before the main shafts start to rotate.

5.2.6.6 Where a pressure lubrication system is specified, the system shall be designed in accordance with IPS-M-PM-320(0). **(Sub.)**

5.2.9 Preparation for Shipment

5.2.9.1 The spare rotor or element shall be crated in a metal container for transportation and storage. The crating method shall be suitable for at least 4 years storage. The container shall be equipped for nitrogen blanketing. **(Mod.)**

6. VENDOR'S DATA

6.2.3 Technical data

F. A list of spare parts recommended, including itemized price list, shall be submitted for start-up and normal maintenance, items and quantities shall be according to table 6.1 as a minimum. **(Sub.)**

L. When specified is removed.

7. GUARANTEE AND WARRANTY

7.1 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.)**

7.2 Performance

The pump shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet. Performance tolerances should be as detailed in API 610 clause 4.3.3.3.3. **(Add.)**

APPENDICES

APPENDIX C

STUFFING BOXES FOR PACKING

C.2 The inlet and outlet connections shall be suitably plugged where no liquid injection is required, irrespective of whether a mechanical seal or conventional packing is used. **(Mod.)**

APPENDIX H

MATERIALS AND MATERIAL SPECIFICATIONS FOR PUMP PARTS

Mechanical Seal Notes

6. Copper or bronze filled carbon of other copper bearing materials shall not be used. **(Mod.)**

Note to Users

The IPS Standards 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 publications are based on internationally acceptable standards and include selections from the options 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 or diversity of conditions of each project or work.

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 users of IPS publications are therefore requested to send their views and comments, including any addendum prepared for particular cases to the Ministry of Petroleum, Standards and Research Organization. These comments and recommendations will be reviewed by the relevant technical committee and will be incorporated in the formal revision of the relevant IPS. The IPS publications are reviewed and revised approximately every five years.

IRANIAN PETROLEUM STANDARDS

No. 19, Street 14, North kheradmand Karimkhan Avenue, Tehran, Iran

Tel: 66153055

88810460

Fax: 88810462

Email: petrostand@nioc.org