ISLAMIC REPUBLIC OF IRAN
MINISTRY OF PETROLEUM

IPS-M-PM-250(1)

IRANIAN PETROLEUM STANDARD

MATERIAL AND EQUIPMENT STANDARD
FOR
SPECIAL PURPOSE STEAM TURBINES

FIRST EDITION
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.

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June 2002

MATERIAL AND EQUIPMENT STANDARD

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SPECIAL PURPOSE STEAM TURBINES

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0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "Special Purpose Steam Turbines" for use in oil, Gas and Petrochemical Industries and is based on API Standard 612, fourth edition 1995, and shall be read in conjunction with that document. This First(1) edition, which is a new revision of the "IPS" of the same title and number, and has been technically revised, cancels and replaces the original(0) edition dated Aug. 1993.

Note: This is a revised version of the standard specification for special purpose steam turbines, 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 612 given in this Standard are directly related to the equivalent sections or clauses in API Standard 612. For clarity, the section and paragraph numbering of API Standard 612 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 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

1.1.1 This Specification, contains the minimum requirements for special-purpose steam turbines for use in refinery services, in chemical, gas, and petrochemical plants and where applicable, in exploration, production and new ventures.

Compliance with the provisions of this standard specification does not relieve the vendor of his responsibility of furnishing turbines of proper design, mechanically suited to meet operating guarantees at the specified service conditions. No deviations or exceptions from this standard shall be permitted, without explicit approval of the Company.

Intended deviations shall be separately listed by the vendor, supported by reasons thereof and submitted for the Company's consideration. **(Sub.)**

1.2 Alternative Design

Turbines supplied to this Standard shall have SI dimension and comply with applicable ISO standards, unless otherwise specified in the data sheets or purchase orders. **(Sub.)**

1.3 Conflicting Requirements

In the case of conflict between documents relating to the inquiry or order, the following priority of documents, (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.)**

1.5 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)

M-PM-105 "Centrifugal Pumps for Process Services"

M-PM-300 "Special Purpose Gear Units"

M-PM-310 "Special Purpose Coupling"

M-PM-320 "Lubrication, Shaft Sealing, and Control Oil System for Special Purpose Applications"

G-ME-250 "Miscellaneous Heat Exchanger"

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

E-SF-900 "Noise and Vibration Control"

IS0 (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

6708 "Pipe Components-Definition of Nominal Size"

6268 "Pipe Components-Definition of Nominal, Pressure" **(Mod.)**

2. BASIC DESIGN

2.1 General

2.1.1 Add to this clause:

Turbine ratings shall not exceed the limits of the vendor's design, but shall be well within the range of the manufacturer's actual experience. Only equipment which has proven its reliability in service is acceptable.

Manufacturer shall prepare and submit in his proposal the lists showing steam turbines of the same frame size or model previously manufactured and operating under similar conditions of service, speed and power, and location of such installations. **(Mod.)**

2.1.4 Add to this clause:

The manufacturer shall specify the limits of variation from rated steam conditions which the turbine can accept.

If this point is not specified on the data sheet by the purchaser, the vendor of the driven equipment shall provide this data to the turbine vendor.

Turbines will be washed at normal speed and reduced load. The turbine vendor shall confirm suitability of its turbine for the following procedure in its proposal, and recommend any special precautions required to protect the equipment.

1) Method of washing:

Washing of a steam turbine down to about 8°C of superheat, holding the temperature at this near saturation value for a definite period of time and then gradually restoring the temperature to its initial value.

2) Facility requirements:

Desuperheating shall be by the injection of high pressure, high purity water such as condensate or polished demineralized water. The desuperheated steam shall pass through a steam separator drum to remove any free water prior to entering the turbine. The change in steam temperature during washing shall be automatically controlled such that the temperature shall not vary by more than 1°C per minute. **(Mod.)**

2.1.6 The combined performance of the turbine and its driven equipment after installation shall be the responsibility of the vendor, who has been nominated as being responsible for the complete unit. **(Sub.)**

2.1.7 Delete "when specified" from last sentence of this clause. **(Mod.)**

2.1.12 Control of the sound pressure level (SPL) of all equipment furnished shall comply with 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 level Limit in dB	re 20 mPa
Turbine	87 dB (A)
Turbine + driven equipment	90 dB (A)

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB(A) lower, thus 82 dB(A) for the turbine and 85 dB(A) for the turbine and driven equipment. Sound pressure 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 operating conditions between minimum flow and rated flow. **(Sub.)**

2.1.16 On multistage condensing type turbines care should be exercised in the design to eliminate the possibility of interstage silicate deposit, build-up on turbine blading and to minimize erosion on the last stages of turbine blading. **(Add.)**

2.2 Pressure Casings

2.2.9 Add to this clause:

Drain connections shall be DN 40 flanged minimum. **(Mod.)**

2.3 Casing Appurtenances

2.3.3 A sentinel warning valve shall be installed on the exhaust casing of all turbines. It shall be set at 0.35 bar gauge (5 psig) on condensing turbines for non-condensing turbines it shall be set at either 0.7 bar gauge (10 psig) or 10 percent above the maximum exhaust pressure whichever is greater. **(Add.)**

2.4 Casing Connections

2.4.6.4 For nozzle connections over DN 600. Vendor shall furnish mating pipe flanges per the following:

a) Flanges shall be welding neck type with bolt hole spacing and bolt circle diameter exactly matching the machine flanges.

b) Each flange shall be furnished with at least 3 dowel pins each machined with a close fit tolerance to the diameter of the bolt holes bore.

c) The turbine shall be shipped with flanges bolted in place and with dowel pins installed. Each flange (turbine and pipe), dowel pin and bolt replacement for the dowel pin shall be positively identified. For connections to surface condenser, expansion bellows shall be provided as a separate flanged spool connection for condensing steam turbines. **(Sub.)**

2.4.10 Vendor shall provide readily accessible flanged casing connection(s) for injection of dry gas purge during extended outage. If connection for other purpose exist which can also be used for

this purpose, vendor shall indicate it in proposal and on general arrangement drawing(s). **(Add.)**

2.6 Rotating Elements

2.6.1 Rotors

2.6.1.1 Add to this clause:

Rotors shall be of integrally-forged construction. **(Mod.)**

2.6.3 Blading

2.6.3.2 Replace the first sentence by:

All blades shall also be mechanically suitable for operation with steam conditions at the pressure relief valve settings in the inlet, extraction, and exhaust system or any combination of maximum or minimum attainable steam conditions. **(Mod.)**

2.6.3.3 Replaceable blade inlet nozzle blocks are preferred. Welded in design shall be considered. Stationary blading shall be mounted in replaceable diaphragms. **(Add.)**

2.7 Shaft Seals

2.7.1 Outer glands shall be sealed with replaceable labyrinth packing. Details and materials of construction of the outer gland shall be clarified. **(Sub.)**

2.7.5 Delete "Bullet "and" unless otherwise specified" from first sentence. **(Mod.)**

2.9 Bearing and Bearing Housings

2.9.3 Bearing housing

2.9.3.1 Add to this clause:

All bearing housings shall be furnished with either vendor's standard breather or a DN 25 minimum vent connection fitted with a steel pipe plug. **(Mod.)**

2.9.4 Grounding

2.9.4.1 Grounding brushes shall be replaceable while the turbine is operating. **(Add.)**

2.10 Lubrication and Control - Oil System

2.10.4 All oil systems and components shall conform to IPS-M-PM-320. **(Sub.)**

2.10.5 Add to this clause:

Unless otherwise specified, the driven equipment and turbine shall have a common lube oil system. The turbine vendor and the driven equipment vendor shall mutually decide and agree on oil characteristics. **(Mod.)**

2.11 Materials

2.11.1 General

2.11.1.1 Materials of construction shall be as specified in the data sheet and/or this standard. The manufacturer may suggest other materials if, based on his experience, these would render equal or better service. (See API Standard 612 paragraph 3.6 for requirements for auxiliary piping material). **(Sub.)**

2.11.1.2 Add to this clause:

When vendor's quoted material specification is DIN, JIS or other acceptable international standard, the proposal shall indicate the nearest above named specification equivalent along with exact and specific deviations, (chemical & physical properties, testing, etc.) for purchaser's evaluation of equivalence for service intended. **(Mod.)**

2.11.1.15 Add to this clause:

For operating temperatures below-29°C (-20 F) and for other low ambient temperatures, steels shall have, at the lowest specified temperature, an impact strength sufficient to quality under the minimum charpy V-notch impact energy requirements of section 8, Division 1, UG-84, of the ASME code. For materials and thicknesses not covered by code the vendor shall indicate in the proposal the recommended inspection and testing level. **(Mod.)**

2.11.2 Casting

2.11.2.3.3 All repairs shall meet the inspection requirement and acceptance standards for the original material. **(Add.)**

2.11.3 Welding

2.11.3.5.1 All welds in auxiliary piping, including seal welds and pipe to case welds, shall be heat treated, hardness tested in accordance with ANSI B 31.3 and examined by magnetic particle or dye penetrant. Vendor may propose radiography for special cases in the proposal. **(Sub.)**

2.12 Nameplates and Rotation Arrows

2.12.3 Add to this clause:

The text on nameplates shall be in the English language and unless otherwise specified the data shall be in SI Units. The information on nameplates shall include the year of manufacture. **(Mod.)**

3. ACCESSORIES

3.1 Couplings and Guards

3.1.2 Add to this clause:

Couplings and guards shall conform to IPS-M-PM-310. **(Mod.)**

3.2 Mounting Plates

3.2.1.1 The turbine shall be provided with a base plate, unless otherwise specified. **(Sub.)**

3.2.1.2.10 Anchor bolts will be furnished by the manufacturer unless otherwise specified. **(Sub.)**

3.3 Gear Units

Gear units shall conform to IPS-M-PM-300. **(Sub.)**

3.4 Controls and Instrumentation

3.4.2 Over speed shutdown system

3.4.2.1 Add to this clause:

Unless otherwise specified, the governor shall be of the Woodward or approved equivalent oil hydraulic type. **(Mod.)**

3.4.2.4.1 Add to this clause:

The trip & throttle valves shall include a 110 Volt D.C. solenoid trip mechanism. **(Mod.)**

3.4.4 Instrument and control panels

3.4.4.1 A free stand instruments panel shall be provided and shall include all panel-mounted instruments for the turbine and driven units.

Followings are the minimum requirement of panel-mounted instruments for turbine.

1) Steam inlet pressure gage.

2) Exhaust steam pressure gage.

3) Steam chest pressure gage.

4) First stage pressure gage on multistage turbines.

5) Extraction pressure gage.

6) Pressure gage for first stage after extraction section.

7) Steam seal pressure gage.

8) Lube oil pressure gage.

9) Indicator for an electronic tachometer.

10) Gages for driven equipment.

11) Each bearing oil temperature gage.

12) Bearings oil pressure gage.

13) Temperature recorder for thrust bearing shoes.

14) Alarms and indicator light.

15) Other instrument specified on data sheet and recommended by Vendors. **(Sub.)**

3.4.4.2 Add to this clause:

All instruments and controls, including alarm and shutdown sensing devices, shall be installed with sufficient valving for isolation to permit testing and removal while the system is in operation.**(Mod.)**

3.4.4.4 Delete "when specified" from this clause. **(Mod.)**

3.4.6 Alarms and shutdowns

3.4.6.1.1 Add to this clause:

As a minimum following alarm and trip switches shall be furnished.

1) Low lube oil pressure alarm and trip.

2) High vibration level alarm and trip.

3) High oil filter differential pressure.

4) High and low level alarm for condenser.

5) Low oil reservoir level alarm.

6) Inlet steam temperature alarm and trip.

7) Turbine back pressure alarm.

8) Steam low pressure alarm.

9) Shaft position alarm and trip.

10) High thrust bearing shoe temperature alarm and trip. **(Mod.)**

3.6 Piping and Appurtenances

3.6.1 General

3.6.1.3 Add to this clause:

Where needed for start-up and operation, drains with valve and plugs shall be provided at low points in the piping systems and vent connections with valves and plugs shall be provided at all high points of the piping system. Vents and drains, including casing drains, shall be piped to the edge of base plates or subassemblies, unless mutually agreed otherwise. Horizontal drain suns shall slope continuously 40 mm per meter toward the reservoir. **(Mod.)**

3.6.2 Oil piping

3.6.2.3 Add to this clause:

Following fabrication, stainless steel oil and control oil pipes shall be flushed clean with solvent prior to shipment, oil piping shall be in accordance with IPS-M-PM-230. **(Mod.)**

3.6.2.4 By-passing system for the bearing during shop and field prestart up oil flushing operation shall be provided without disassembling bearing housing. **(Add.)**

3.7 Insulation and Jacketing

3.7.1 Delete "when specified" from first sentence. Ceramic insulation blanket-tile shall be required.

(Mod.)

3.7.2 Add to this clause:

Insulation materials shall be furnished by the turbine vendor. **(Mod.)**

3.9 Turning Gear

3.9.1 A turning gear shall be furnished by the vendor if the turbine requires rotation of the shaft to avoid shaft thermal distortion (during turbine start-up or immediately following a shut down). Turning gear drive type shall be specified on the data sheet. **(Sub.)**

3.10 Turbine Exhaust Condenser **(Add.)**

3.10.1 Condensers, if Water-Cooled, shall comply with the requirements of IPS-G-ME-250. If air-cooled condensers are specified, the equipment shall be in accordance with IPS-G-ME-245.**(Add.)**

3.10.2 Water-Cooled condensers shall be designed to be split into two independent halves on the water side, to allow for cleaning of the separate halves without interruption to operation of the turbine at loading which will be specified in the data sheet. **(Add.)**

3.10.3 The connection between turbine and condenser shall be designed so that it can be removed and replaced without the need for dismantling the turbine casing. **(Add.)**

3.10.4 Adequate inspection openings shall be provided in the end covers of the water boxes and in the condenser hot well for inspection and access. **(Add.)**

3.10.5 For steam-driven air ejectors, the ejector nozzles shall be of 13% Cr-type stainless steel and protected against clogging by 32 mesh basket-type steam strainers. **(Add.)**

The ejector equipment shall be complete with all interconnecting piping, including valves, traps, etc., and with connections for pressure gages required for proper operation. Ejector equipment shall be fully spared. **(Add.)**

3.10.6 Two condensate extraction pumps shall be installed, one for normal operation and one for stand-by duty. Unless otherwise specified, the main pumps shall be steam-turbine driven and the stand-by pump shall be electric-motor-driven. Each pump shall be capable of handling the maximum flow of condensate plus 20%, and shall be provided with a minimum flow protection. Pumps shall be centrifugal-type and shall comply with IPS-M-PM-105 **(Add.)**

3.10.7 A water-sealed atmospheric relief valve shall be provided, and sized for full steam flow at 2 kPa (ga) back pressure. The condenser shall be capable of withstanding this pressure for prolonged periods. **(Add.)**

3.10.8 The manufacturer shall provide a connection for a pressure switch to activate an alarm under high-pressure conditions. **(Add.)**

3.10.9 The main condenser condensate sump or hot well shall be sized to provide a three-minute hold-up at maximum flow rate, and shall be provided with suitable level glasses and connections for level controller, condensate outlet, drains and high/low-level alarms. **(Add.)**

3.11 Washing Facilities

In case of requirement for blade washing and drying facilities, vendor shall specify the system and its equipment in the proposal. **(Add.)**

4. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

4.2 Inspection

4.2.1 General

4.2.1.1 Add to Item a:

AS a minimum the certificate shall contain the following information:

- Name of manufacturer
- Purchase order number and date
- Manufacturer's order number
- Identification number of certificate and its date of issue
- Material specification(s)
- Dimensions in SI Units (unless specified otherwise)
- Material charge number, batch number or heat-lot number

- Chemical composition recorded from results of chemical analyses

- Mechanical properties recorded from test results

- NDT methods and results, where applicable

- Heat treatment procedures, furnace charge number and heat treatment records, where applicable

- Such supplementary or additional information as may be required. **(Mod.)**

4.2.1.3 Add to this clause:

Shaft and wheel forgings shall be ultrasonically inspected. Vendor shall identify blading inspection method(s) in proposal. **(Mod.)**

4.2.2 Material inspection

4.2.2.1 Add to this clause:

All surfaces of the steel casting including machined faces shall be magnetic particle examined. **(Mod.)**

4.2.2.2.2 Add to this clause:

When the thickness of pressure containing parts to be welded exceeds the thickness limits of table UCS-56 of ASME code Sec. VIII div. I, welds shall be 100% radiographed in accordance with paragraph 4.2.2.1.1 of API 612. **(Mod.)**

4.2.3 Mechanical inspection

4.2.3.2 Any portion of the oil system furnished with the turbine shall meet the cleanliness requirements of IPS-M-PM-320. **(Sub.)**

4.2.3.3 Delete "when specified" from this clause. **(Mod.)**

4.3 Testing

4.3.2 Hydrostatic test

4.3.2.6 Use of any type of gaskets in axial split joint, including string or tape, is not permitted during hydrostatic testing. **(Sub.)**

4.3.3 Mechanical running test

4.3.3.2.8 Reading shall be logged, as a minimum, every 20 minutes during the 4 hours run at maximum continuous speed. **(Add.)**

4.3.3.3.3 Add to this clause:

The measurement shall be recorded on deceleration (coast down). **(Mod.)**

4.3.5 Rotor over speed test

Each rotor shall be subjected to an over speed test of at least 115% of maximum continuous speed for a minimum duration of 3 minutes. After the over speed test, the rotor shall be checked for cracks and defects by magnetic particle inspection, and shall then be rebalanced. **(Add.)**

4.4 Preparation for Shipment

4.4.3.9 Add to this clause:

No material shall be shipped separately. Miscellaneous parts shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. All such parts shall be suitably boxed and shipped with the unit.
(Mod.)

5. VENDOR'S DATA

5.2 Proposals

5.2.1 Add to this clause:

In the second sentence, Replace "with this standard" by "with this IPS Standard". **(Mod.)**

5.2.3 Technical data

p. The proposal shall include separate price list for spare parts for start-up and two years of continuous operation including spare rotors. **(Add.)**

5.3 Contract Data

5.3.6.1 Add to this clause:

The manufacturer shall recommend safe operating vibration amplitudes, along with alarm and shutdown criteria, and include them in the operating manual. (Refer to page 93 & 94 of API-612 4th Edition). **(Mod.)**

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:

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.)**

6.2 Performance

The turbine and all auxiliaries shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet, and the operating range between those points. The thermodynamic performance guarantee point shall be the normal operating point or other point indicated " guarantee' on the data sheets. the steam rate at the guarantee point shall not exceed the value stated in the proposal. **(Add.)**

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.

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