ISLAMIC REPUBLIC OF IRAN
MINISTRY OF PETROLEUM

IPS-M-PM-240(1)

IRANIAN PETROLEUM STANDARD

MATERIAL AND EQUIPMENT STANDARD
FOR
GENERAL 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.

IRANIAN PETROLEUM STANDARDS.

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

Tel. : 66153055
: 88810460
Fax. : 88810462

June 2002

MATERIAL AND EQUIPMENT STANDARD

FOR

GENERAL PURPOSE STEAM TURBINES

FIRST EDITION

JUNE 2002

This Standard is the property of Iranian Ministry of Petroleum. All rights are reserved to the owner. Neither whole nor any part of this document may be disclosed to any third party, reproduced, stored in any retrieval system or transmitted in any form or by any means without the prior written consent of the Iranian Ministry of Petroleum.

CONTENTS : PAGE No.

0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "General Purpose Steam Turbines" for use in oil, Gas and Petrochemical Industries and is based on API Standard 611, Fourth edition June 1997, and shall be read in conjunction with that document.

Note: This is a revised version of the standard specification for general 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 611 given in this Standard are directly related to the equivalent sections or clauses in API Standard 611. For clarity, the section and paragraph numbering of API Standard 611 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

1. SCOPE

1.1 Purpose

This Specification contains the minimum requirements for general purpose steam turbines for use in refinery services, chemical plants, gas plants, 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 the 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 company's consideration. **(Sub.)**

1.2 Alternative Designs

Equivalent SI Unit System dimensions and ratings 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 documents (whichever more stringent realized by 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.)**

2. REFERENCES

2.1 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.

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A-609 "Ultrasonic Examination of Carbon and Low-alloy Steel Castings"

E-125 "Magnetic Particle Indications on Ferrous Castings"

E-186 "Heavy-walled (51 to 114 mm) Steel Castings"

E-280 "Heavy-walled (114 to 305 mm) Steel Castings"

E-446 "Steel Castings up to 51 mm in Thickness"

IPS (IRANIAN PETROLEUM STANDARD)

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

IPS-M-EL-132 "Material and Equipment Standard for Three Phase Squirrel Cage Induction Motors"

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

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

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

3. DEFINITIONS

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

3.32 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 B16.5.1981, ISO 7268-1983. **(Add.)**

4. BASIC DESIGN

4.1 General

4.1.1 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. **(Mod.)**

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

4.1.12 The equipment trains shall comply with the requirements of IPS-G-SF-900 (general standard for noise control and vibration) and Clauses 4.1.12.1 & 4.1.12.2 of this Standard. **(Mod.)**

4.1.12.1 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 µPa
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 + driven equipment.

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 operating conditions between minimum flow and rated flow.

4.1.12.2 Noise control measures shall cause no hindrance to operations nor any obstruction to routine maintenance activities.

4.1.14 All equipment covered by this standard specification shall be designed for outdoor operations totally unprotected from weather, unless otherwise specified on steam turbine data sheet. **(Mod.)**

4.1.17 Vendor shall state the total temperature of the exhaust steam and advise the maximum allowable exhaust steam temperature when running the turbine at low efficiency during start-up. **(Add.)**

4.2 Pressure Casings

4.2.5 Casing for horizontal turbines rated above 75 kW shall be axially split type. **(Mod.)**

4.2.7 All casing drains shall be located and arranged for ease of access for piping connection at the job site without removal of turbine from its mounting plate. **(Mod.)**

4.4 Casing Connections

4.4.3 All turbine casings shall be provided with drains in the lowest parts of the casing. These connections shall not be less than DN 20. Connections for drains, vents, pressure gages, etc. shall be made with threaded extra heavy pipe nipples, back welded to the turbine case when the casing is made of steel. Connections shall be readily accessible when turbine and driven equipment are assembled on the base. **(Mod.)**

4.4.3.4 Unless otherwise specified, all cooling water and lube oil piping connections shall be located on the lower half of a horizontally split turbine. Auxiliary piping, as well as conduit, etc. shall be installed in such a manner so as to avoid attachment to or interference with the removal of the upper casing half and rotor. **(Mod.)**

4.4.3.8 Drain connections shall be provided for the steam chest, exhaust casing, casing packing glands, and cooling jackets. Gage connections shall be provided for the steam-ring chamber on single-valve turbines and for the first stage of multistage turbines. Gages shall be furnished and local board mounted when specified on the steam turbine data sheet. **(Add.)**

4.4.6.5 Vendor shall quote mating flange in the proposal when connections larger than those covered by ASME/ANSI B 16.5 are supplied. **(Mod.)**

4.4.9 Mounting flanges for vertical turbines shall be made of steel. **(Mod.)**

4.5 External Forces and Moments

Many factors, such as heavy piping loads, misalignment at operating conditions, and improper supporting structure, may adversely affect site performance. In order to minimize these factors, the manufacturer shall review and comment upon the purchaser's piping and foundation drawings for pump and fan turbine drivers. **(Mod.)**

4.6 Rotating Elements

4.6.3 Bladeing

4.6.3.3 Replaceable inlet nozzle blocks shall be preferred.

Welded in design shall be considered. Stationary bladeing shall be mounted in replaceable diaphragms. **(Add.)**

4.7 Seals

4.7.4 A gland steam condenser is required for turbines rating 300 kW and above. They shall be of shell and tube type and TEMA "C" construction. **(Mod.)**

4.7.5 Delete "When Specified" from this Clause. **(Mod.)**

4.8 Dynamics

4.8.2 Lateral analysis

4.8.2.2 Delete "When Specified" from this Clause. **(Mod.)**

4.8.2.3 The actual critical speeds below operation speeds for flexible shaft turbines shall be verified during the shop running test. **(Add.)**

4.8.3 Torsional analysis

4.8.3.5 Delete "When Specified" from this Clause. **(Mod.)**

4.8.4 Vibration and balancing

4.8.4.5 For maximum continuous speed of 6001 rpm and above, the vibration measured on the shaft shall not exceed the following:

Peak-to-peak amplitude (including total run out), 2.78 $\sqrt{1}$ /rpm in mm. **(Mod)**.

4.9 Bearings and Bearing Housings

4.9.1 Anti-friction bearings are not acceptable on turbines rated above 75 kW. **(Mod.)**

4.9.2 Multistage turbines shall have hydrodynamic thrust bearings. **(Mod.)**

4.9.19 Constant-level oilers with Pyrex glass containers and protecting wire cages are required. **(Mod.)**

4.9.30 Provisions for oil mist lubrication to the mechanical governor spindle bearing shall also be supplied. **(Mod.)**

4.9.31 Cooling coils (including fittings) shall be of type 316 stainless steel. **(Mod.)**

4.9.32 For all multistage turbines and when specified for single stage turbines provision shall be made for mounting two radial vibration probes. **(Mod.)**

4.10 Lubrication

4.10.6.3 Oil rings for start-up lubrication shall be supplied. **(Mod.)**

4.10.6.4 Oil coolers shall have water through the tubes and TEMA class "C" construction. Tubes should be Admiralty, 5/8" OD and 16 BWG. **(Mod.)**

4.10.6.5 Dual, full flow lube oil filters with maximum clean pressure drop of 35 kPa. (0.35 bar) to filter particle exceeding 10 micron size and a continuous flow transfer valve shall be provided. **(Mod.)**

4.10.6.7 The filter pressure gage shall be a single unit connected to the inlet and the outlet by a 3 way valve. The 3 way valve shall not permit the filter to be bypassed. Gages shall have stainless steel bourdons and movements. **(Mod.)**

4.10.6.9 An automatically controlled stand-by pump, separately driven, for equipment requiring rapid starting or operation at idling speeds. **(Mod.)**

4.10.6.10 Delete "When Specified". **(Mod.)**

4.10.6.11 Delete "When Specified". **(Mod.)**

4.10.6.12 Delete "When Specified". **(Mod.)**

4.10.6.13 Coolers and filters are to have plugged vent and drain connections. **(Add.)**

4.10.8 Delete "When Specified" from this clause. **(Mod.)**

4.11 Materials

4.11.1 General

4.11.1.1 Materials of construction shall be as specified in the data sheet. The manufacturer may suggest other materials if, based on his experience, these would render equal or better service. **(Mod.)**

4.11.2 Casting

4.11.2.3.2 Pressure retaining cast iron parts, shall not be repaired by welding. **(Mod.)**

4.11.3 Welding

4.11.3.2 Details of all repairs, and of the heat treatment or plugging where applicable shall be recorded and reported to the purchaser. **(Mod.)**

4.12 Nameplates and Rotating Arrows

4.12.3 The text on nameplates shall be in English and unless otherwise specified the data shall be in SI units. The information on nameplates shall include the year of manufacture. The equipment Item No. also shall be stamped on the nameplate of both gear and turbine. On insulated turbines the nameplate shall be extended so as to be visible. **(Mod.)**

5. ACCESSORIES

5.1 Gear Units

5.1.2 Integral gears are not acceptable. **(Mod.)**

5.1.3 Gears shall be of double helical type and at least equal to AGMA 420.04 for shaft speeds less than 3600 revolutions per minute. For shaft speeds of 3600 revolutions per minute or higher, gears shall comply with AGMA 421.06 and IPS-M-PM-300 as specified on the gear data sheet. **(Mod.)**

5.1.5 The AGMA service factor will be specified on the gear data sheet. **(Add.)**

5.2 Coupling and Guards

5.2.2 Dry flexible disk coupling with restrained spacer and stainless steel disks shall be used.**(Mod.)**

5.2.8 The assembled coupling shall be balanced to a tolerance which will permit satisfactory performance at speeds up to 110% of maximum continuous speed of the turbine without damage at 110% of tripping speed. **(Mod.)**

5.2.10 Non-sparking guards shall be furnished. **(Mod.)**

5.3 Mounting Plates

5.3.1 General

5.3.1.1 The equipment shall be furnished with a base plate unless otherwise specified. The base plate shall be common to the turbine and driven equipment. Turbine drawings must define

maximum dimensions, including insulation and jacketing where supplied. The supplier of the driven equipment will furnish the base plate and coordinate whatever information and data are required to complete the mounting. **(Mod.)**

5.3.1.2.10 The manufacturer shall supply all necessary foundation bolts unless otherwise specified. **(Sub.)**

5.3.1.2.12 Sufficient clearance shall be provided between the case drain connection and the base plate for installation of a threaded pipe elbow and a valve for drain connection. **(Add.)**

5.3.2 Base plate

5.3.2.5 When lifting the base plate complete with all equipment mounted, beam deflection shall not exceed l/1200, where 'l' is the total length of the beam in millimeters. **(Mod.)**

5.4 Controls and Instrumentation

5.4.2 Control system

5.4.2.2 For parallel driven equipments NEMA class D governors shall be supplied. **(Mod.)**

5.4.2.3 A hand speed changer is required for all turbines, except those turbines equipped with remote speed control signals. Individual requirements will be specified. **(Mod.)**

5.4.4 Instrumentation

5.4.4.1 Delete "When Specified" from this clause. **(Mod.)**

5.4.5 Alarms and shutdowns

5.4.5.3.2 Alarm and shutdown systems shall be normally energized, deenergized to alarm or trip. **(Sub.)**

5.5 Piping and Appurtenances

5.5.1 General

5.5.1.13 Spiral-wound metal or metal-jacketed flange gaskets shall be used. Flat-faced piping flanges shall have full-faced gaskets. **(Add.)**

5.5.1.14 All piping shall be thoroughly cleaned of rust and weld spatters and properly protected on the inside **(Add.)**

5.5.2 Oil piping

5.5.2.3 18-8 Cr-Ni stainless steel piping shall be provided for all circulating lube and control oil systems without filters. 18-8 CrNi stainless steel piping or tubing for pressurized oil systems shall be provided downstream of the lube oil filter to the turbine bearings and any control oil system. Copper or copper base alloys are unacceptable. **(Add.)**

5.7 Insulation and Jacketing

5.7.1 Ceramic tile blanket type insulation shall be furnished unless otherwise specified. (Insulation shall not interfere with access to turbines for operation or maintenance). Insulation shall not contain asbestos. **(Mod.)**

6. INSPECTION AND TESTING

6.1 General

6.1.1 All turbines shall be inspected during fabrication and assembly by purchaser's representative. **(Mod.)**

6.2 Inspection

6.2.1 General

6.2.1.3 Full non-destructive inspection shall be carried out, on all critical areas, such as abrupt changes in section, weld ends, at the junction of riser, and areas of high stress. Radiographic inspection shall be applied when magnetic-particle inspection is not feasible. **(Mod.)**

6.2.2 Material inspection

6.2.2.1 General

6.2.2.1.1 Following visual inspection and if specified, magnetic particle inspection shall be carried out on all surfaces including machined gasket sealing surfaces. **(Mod.)**

6.2.2.2 Radiography

6.2.2.2.2 For each type of defect, the degree of severity shall not exceed the limits in the following Table:

Thickness mm	Gas and Blow holes	Sand spots And inclusions	Internal Shrinkage Types 1, 2, 3 and 4	Cracks and hot tears
Below 25	2	2	2	
25-50	3	3	2	Not allowed
51-114	3	3	2	
over 114	3	3	2	

(Mod.)

6.2.2.4 Magnetic particle inspection

6.2.2.4.2 Type I defect (linear discontinuities) in Table 4 is not allowed. **(Mod.)**

6.2.3 Mechanical inspection

6.2.3.2 Any portion of the oil system furnished shall meet the cleanliness requirements of API Standard 614 as amended and supplemented by IPS-M-PM-320. **(Sub.)**

6.3 Testing

6.3.1 General

6.3.1.2 Replace 5 working days by 15 working days. **(Mod.)**

6.3.2 Hydrostatic test

6.3.2.3 The hydrostatic test shall be considered satisfactory when neither leaks nor seepage through the casing or casing joint is observed for a minimum of 4 hours. **(Mod.)**

6.3.3 Mechanical running test

6.3.3.1.2 Delete "When Specified" from this clause. **(Mod.)**

6.3.3.1.3 Oil system components down stream of the filters shall meet the cleanliness requirements of IPS-M-PM-320. **(Mod.)**

6.3.3.2 Delete 1-hour from this Clause and substitute 4-hour. Multistage turbines shall be no load tested at max. continuous speed for a minimum period of two hours. **(Mod.)**

6.3.3.3.4 Vibration, oil temperature and speed shall be recorded every 20 minutes throughout the mechanical running test. **(Mod.)**

6.3.3.3.8 The test shall be carried out with the half coupling and idling adaptor in place (resulting in a moment equivalent to that of the contract half coupling plus one half of the coupling spacer.) **(Add.)**

6.4 Preparation for Shipment

6.4.3.9 Separate shipment of materials is not permitted. **(Mod.)**

7. VENDOR'S DATA

7.1 General

7.1.1 All drawings and other data shall be listed in specific requirements. Additional drawings required to completely define the unit and accessories being furnished shall be supplied in time, if necessary.

7.2 Proposals

7.2.3-f A spare parts quotation will be required with the proposal. Spare parts recommended for purchase for each item furnished (including any auxiliary equipment) shall include sufficient parts for continuous operations for a period of 2 years. (This list normally shall include all rotating parts, all stationary wearing parts and valve parts, spring and other parts subject to possible wear or breakage). Proposal shall include a complete priced spare part list. **(Mod.)**

8. GUARANTEE AND WARRANTY **(Add.)**

8.1 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.

8.2 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.

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