

MATERIAL AND EQUIPMENT STANDARD

FOR

GENERAL PURPOSE STEAM TURBINES

FOR

PETROLEUM, CHEMICAL

AND GAS INDUSTRY SERVICES

SECOND EDITION
JULY 2012

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS is based on internationally acceptable standards and includes selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract documents.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of "General Purpose Steam Turbines for Petroleum, Chemical and Gas Industry Services" for use in oil, Gas and Petrochemical Industries and is based on API Standard 611, Fifth edition March 2008, and shall be read in conjunction with that document.

Note 1:

This is a revised version of this standard, which is issued as revision (1)-2002. Revision (0)-1993 of the said standard specification is withdrawn.

Note 2:

This is a revised version of this standard, which is issued as revision (2)-2012. Revision (1)-2002 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 far 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

This standard 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 and submitted for company's consideration. **(Sub.)**

2. NORMATIVE REFERENCES

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"

4.2 Alternative Designs

Equivalent SI Unit System dimensions and ratings in accordance with [IPS-E-GN-100](#) shall be used, unless otherwise specified. **(Mod.)**

5.3 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.)**

6. BASIC DESIGN

6.1 General

6.1.1 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.)**

6.1.5 Equipment shall be designed to run to at least 110% of the trip speed without damage. Turbines shall be capable of continuously operating at relief valve set pressure without damage. **(Sub.)**

6.1.6 General-purpose turbines shall be capable of immediate start-up to full load without preliminary warm-up period and without the benefit of a motor-driven lube oil pump or other energized electric circuitry. The purchaser shall provide of proper drainage of inlet piping and of casing drains, steam chest and packing glands. **(Sub.)**

6.1.7 Deleted the second sentence of this clause **(Mod.)**

6.1.8 Replace "minimize" with "prevent". **(Mod.)**

6.1.9 Any maintenance item heavier than 20kg shall be provided with lifting lugs or similar dedicated fixed lifting point (s).

Screw-in eyebolts are only acceptable for bearing housing covers and for internal components where other lifting arrangements are impractical. Holes for eyebolts shall be permanently marked with the correct bolt size information should be clearly indicated in the instruction manual. **(Mod)**

6.1.10 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.)**

6.1.12 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.)**

6.1.12.1 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.

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

6.1.14 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.)**

6.1.17 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.)**

6.3 Pressure Casings

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

6.3.9 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.)**

6.5 Casing Connections

6.5.2 If the main inlet and outlet connections are class 900 or above socket-welded connections shall not be used. In these cases full penetration butt-welded connections are required. **(Mod)**

6.5.10 (b) Replace sub-clause "b" by "cast iron shall not be used". **(Mod)**

6.5.10 (g) Delete "If specified" from this sub-clause. **(Mod)**

6.5.13 "cast iron" shall be deleted from this clause. Vertical turbines shall not be used without the approval of the owner. **(Mod)**

6.5.15 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. **(Add.)**

6.5.16 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. **(Add.)**

6.5.17 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.)**

6.6 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.)**

6.7 Rotating Elements

6.7.2.4 Replace "corrosion-resistant" by "corrosion-resistant and erosion-resistant". **(Mod)**

6.7.3 Bladeing

6.7.3.3 Replaceable inlet nozzle blocks shall be preferred.

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

6.8 Seals**6.8.3 Delete this clause**

6.8.5 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.)**

6.8.6 Delete "If Specified" from this Clause. **(Mod.)**

6.9 Dynamics**6.9.2 Lateral analysis**

6.9.1.3 The turbine vendor shall supply all necessary information for lateral and torsional analyses to the vendor who has unit responsibility. **(Mod.)**

6.9.2.3 Delete "If Specified" from this Clause. **(Mod.)**

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

6.9.3 Torsional analysis

6.9.3.1 Delete "If Specified" from this Clause. **(Mod.)**

6.9.3.3 Delete "preferably" in the first sentence. **(Mod.)**

6.9.4 Vibration and balancing

6.9.4.4 Delete "If specified" from this clause. **(Mod.)**

6.10 Bearing and Housings**6.10.1 Bearings- General**

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

6.10.1.10 Belt drives shall not be used. **(Sub.)**

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

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

6.10.4.4 Vibration measurement

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

6.11 Lubrication

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

6.12 Materials**6.12.2 Casting**

6.12.2.3 (c) Delete "If specified" from this clause. **(Mod.)**

6.12.2.3 (e) Pressure retaining cast iron parts, shall not be repaired by welding. **(Add.)**

6.12.4 Welding

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

6.12.4.5 (b) Delete "If specified" from this clause. **(Mod.)**

6.13 Nameplates and Rotating Arrows

6.13.4 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.)**

7. ACCESSORIES**7.1 Gear Units**

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

7.1.3 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.)**

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

7.2 Coupling and Guards

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

7.2.7 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.)**

7.2.11 (c) Delete "If specified" from this clause. **(Mod.)**

7.3 Mounting Plates

7.3.1 General

7.3.1.1 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.)**

7.3.2.15 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.)**

7.3.2.16 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. **(Add.)**

7.4 Controls and Instrumentation

7.4.2 Governing control system

7.4.2.1 General

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

7.4.2.2 Electronic governing system

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

7.4.2.3.9 Turbines with rated power of 750kw or more shall be equipped with a trip valve exercise **(Add.)**

7.4.4 Instrumentation

7.4.4.2 Delete "Unless otherwise specified" from this clause. **(Mod.)**

7.4.5 Alarms and shutdowns**7.4.5.3 Alarm and trip (switches & transmitters)**

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

7.5 Piping and Appurtenances**7.5.1 General**

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

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

7.5.1.15 Threaded connections shall not be seal welded. **(Add.)**

7.5.2 Oil piping

7.5.2.5 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.)**

7.7 Insulation and Jacketing

7.7.1 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.)**

8. INSPECTION AND TESTING**8.1 General**

8.1.2 Delete "If specified" from this clause. **(Mod.)**

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

8.2 Inspection

8.2.1 General

8.2.1.1 (f) Delete “If specified” from this sub-clause. **(Mod.)**

8.2.1.3 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.)**

8.2.2 Material inspection

8.2.2.1 General

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

8.2.2.2 Radiography

8.2.2.2.1 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	Not allowed
25-50	3	3	2	
51-114	3	3	2	
over 114	3	3	2	

(Add.)

8.2.3 Mechanical inspection

8.2.3.2 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.)**

8.3 Testing

8.3.1 General

8.3.1.3 Replace 10 working days by 15 working days. **(Mod.)**

8.3.2 Hydrostatic test

8.3.2.3 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.)**

8.3.3 Mechanical running test

8.3.3.1 (b) Delete "If Specified" from this clause. **(Mod.)**

8.3.3.1 (c) Oil system components down stream of the filters shall meet the cleanliness requirements of [IPS-M-PM-320](#). **(Mod.)**

8.3.3.2 (e) 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.)**

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

6.3.3.3.1 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.)**

8.4 Preparation for Shipment

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

9. VENDOR'S DATA**9.1 General**

9.1.1 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.

9.2 Proposals

9.2.3 (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.)**

9.2.4 Delete "If specified" from this clause. **(Mod.)**

10. GUARANTEE AND WARRANTY**(Add.)****10.1 Mechanical**

Unless exception is recorded by the vendor in his proposal, it shall be understood that the vendor agrees to the following guarantees and warranties:

During a period of 12 months after the date of commissioning, the vendor shall with all possible speed and without cost to the purchaser, replace or repair the goods or any part thereof found to be

defective due to faulty material, workmanship or to any act or omission of the vendor. In particular the vendor shall reimburse any transportation and other charges incurred by the purchaser in effecting such replacement or repair at the point of use.

10.2 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.