



GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 215

**Petroleum, Petrochemical, and Natural Gas
Industries - Steam Turbines -
Special-purpose Applications
according to API Standard 612**

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1. Scope

This specification covers the minimum requirements necessary for design, selection of materials, construction, inspection, testing and preparation for shipment related to the equipment subject of this specification.

The purpose of this specification is to respond to bullet points or to supplement or to amend or to clarify the requirements of [API STD 612](#).

The paragraph numbering is identified in the same way as in [API STD 612](#). Additional provisions that are not covered by [API STD 612](#) are identified by extrapolation of the numbering chronology.

Paragraphs of [API STD 612](#) not mentioned in this document are fully applicable.

Paragraphs of [API STD 612](#) starting by "Unless otherwise specified", not identified by a bullet point and not specifically addressed in this document, are fully applicable.

2. Reference documents

This document is the TOTAL E&P transposition of the TOTAL S.A. Harmonized GS GR MEC 612.

The reference documents listed below form an integral part of this General Specification.

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

External Documents

Reference	Title
API STD 611	General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services
API STD 612	Petroleum, Petrochemical, and Natural Gas Industries - Steam Turbines - Special-purpose Applications
EN 10204	Metallic products - Types of inspection documents
ISO 10474	Steel and steel products - Inspection documents
NEMA SM 24	Land Based Steam Turbine Generator Sets 0 to 33,000 kW



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Reference	Title
GS EP INS 109	Instrument cabinets
GS EP MEC 240	Special Purpose Couplings for Petroleum, Chemical, and Gas Industry Services according to API Standard 671
GS EP MEC 281	Lubrication, Shaft Sealing, and Oil Control Systems and Auxiliaries according to ISO 10438 / API Standard 614
GS EP SAF 050	Fire and Gas System and Fire Extinguishing System for Packaged Rotating Machinery Enclosures

3. Applicability

This specification applies to offshore and onshore applications.

4. Definitions of terms

For the purpose of this document, the following terms and definitions apply:

Company: Any entity of the TOTAL Group mentioned in the contract or the order.

5. Comments and/or additions to **API STD 612 7th Edition**

Special Purpose Steam Turbines shall be in accordance with **API STD 612 7th Edition**, August 2014.

API	Requirements
3. Terms and definitions	
3.13 General-purpose turbine Horizontal or vertical turbines used to drive equipment that is usually spared. NOTE: General-purpose steam turbines are intended for applications where the inlet gauge pressure does not exceed 4800 kPa (700 psi) and the inlet temperature does not exceed 400°C (750°F), and where the speed does not exceed 6000 r/min.	The "power" criteria of classification between general-purpose specification (API STD 611) and special-purpose specification (API STD 612) shall be 1000 kW.
3.24 Maximum continuous speed Highest speed at which the turbine, as built and tested, is capable of continuous operation, at any of the specified steam conditions.	Maximum continuous speed shall be equal to 105 % of rated speed.
3.51 Special-purpose turbines Horizontal turbines used to drive equipment that are usually not spared and are used in uninterrupted continuous operation in critical service. NOTE: This category is not limited by steam conditions, power or turbine speed.	Refer to paragraph 3.13.
(New paragraph) Worst steam conditions	"Worst steam conditions" refer to steam conditions that lead to minimum turbine shaft delivered power at a given speed with full open governor valve(s). These conditions include simultaneously minimum inlet conditions, maximum exhaust conditions, but also maximum intermediate extraction conditions and minimum intermediate admission conditions.

API	Requirements
4. General	
4.2 Dimensions Drawings and maintenance dimensions shall be in SI units or U.S. customary (USC) units. Use of a SI datasheet indicates that SI units shall be used. Use of a USC datasheet indicates that USC units shall be used. Typical datasheets in both systems of units are given in Annex A.	Dimensions shall be in SI units.
6. Basic Design	
6.1 General	
6.1.1 The purchaser shall specify the period of uninterrupted continuous operation, during which time the equipment should not require shutdown to perform maintenance or inspection. NOTE: It is recognized that achievement of this objective requires a joint effort of the purchaser, vendor, and user.	This paragraph is not applicable. Maintenance of steam turbines is exclusively on condition.
6.1.3 The vendor who has unit responsibility shall ensure that all sub-vendors comply with the requirements of this standard.	For turbo-compressors shaft line, when the components are supplied from different Vendors, the unit responsibility shall be given to compressor manufacturer. For turbo-generator sets the turbine Vendor shall assume full responsibility for the mechanical design of the shaft line even if he does not directly supply all the equipment. Vendor who has unit responsibility shall be responsible for: - Verification of the shaft line transmission components ratings. - Lateral analysis (or verification) of the various shaft line components. - Torsional analysis of the shaft line based on component construction data. - Start-up time and conditions. Calculation reports in respect of the above four items shall be submitted to the Purchaser.

API	Requirements
● 6.1.4 The purchaser shall specify the equipment's normal operating point and any other required operating points, including the inlet and exhaust steam conditions and any extraction or induction steam quantities and pressures. The purchaser shall also specify the maximum and minimum values of the inlet, exhaust, and extraction/induction steam conditions.	Refer to Project Specification or data sheets.
6.1.5 Unless otherwise specified, steam purity limits shall be in accordance with IEC 60045-1 and NEMA SM 24.	Refer to Project Specification or data sheets.
6.1.8 Turbines shall be capable of the following: a) operation at normal power and speed with normal steam conditions, with the steam rate certified by the manufacturer at these conditions; b) delivering rated power at its corresponding speed with coincident minimum inlet and maximum exhaust conditions specified; NOTE: To prevent oversizing or to obtain higher operating efficiency or both, it may be desirable to limit maximum turbine capability by specifying normal power or a selected percentage of rated power instead of rated power at the conditions specified. c) continuous operation at maximum continuous speed and at any other speed within the range specified, with a maximum continuous speed of at least 105 % of rated speed; d) continuous operation at rated power and speed with maximum inlet steam conditions and maximum or minimum exhaust steam conditions; e) continuous operation at the lowest speed at which maximum torque is required with minimum inlet and maximum exhaust conditions, with the purchaser specifying both the speed and torque values required; f) continuous operation at specified conditions for extraction and/or induction;	Vendor shall provide with the offer all required data as clearly indicated in Purchaser's data sheet. The list of references of each selected turbine stage shall be given with the proposal. When specified in the Project Specification, a CFD analysis shall be performed with the proposal. a) The normal power and speed associated with normal conditions shall be the guarantee point. The steam rate shall be guaranteed without positive tolerance. b) The turbine shall be capable of delivering the rated power at its corresponding speed with the worst steam conditions. e) The turbine Vendor shall clearly indicate the maximum continuous torque at the minimum allowable speed.

API	Requirements
g) operation with variations from rated steam conditions and steam purity levels recommended in IEC 60045-1 or NEMA SM 24; NOTE: Regardless of the design limit of any turbine component, the turbine should not be operated or rerated outside the nameplate limits without a thorough design review. h) Operation uncoupled with maximum inlet steam conditions. Governing instability and high acceleration rates can occur and may require action such as throttling of the inlet pressure. Care should also be taken when operating at no or light load (in any turbine section) and high speed or uncoupled, as typically applicable for generator sets, but occasionally also applicable to mechanical drive applications. This type of operation may require reducing the inlet temperature to keep exhaust and/or extraction temperature within acceptable limits for the turbine, piping, and (if applicable) condenser. One concern that should be evaluated is the risk of the rotor expansion above the normal case when the turbine is operated at high exhaust temperatures.	
● 6.1.11 If specified, the vendor's representative shall witness: a) a check of the piping alignment performed by unfastening the major flanged connections of the equipment; b) the initial shaft alignment check; c) Shaft alignment at operating temperature. NOTE 1: Many factors can adversely affect site performance. These factors include such items as piping loads, alignment at operating conditions, supporting structure, handling during shipment, and handling and assembly at the site. NOTE 2: Further information on machinery installation and installation design is given in API 686.	This paragraph is applicable.

API	Requirements
● 6.1.17 Control of the sound pressure level (SPL) of all equipment furnished shall be a joint effort of the purchaser and the vendor. The equipment furnished by the vendor shall conform to the maximum allowable SPL specified. The vendor shall provide details of any special measures taken to achieve the stated levels. The vendor shall ensure these noise limits are specified to all sub-suppliers. In order to determine compliance, the vendor shall provide both maximum sound pressure and sound power level data per octave band for each principal component supplied.	Refer to Project Specification or data sheets.
● 6.1.18 Motors, electrical components, and electrical installations shall be suitable for the area classification (class, group, and division or zone) specified by the purchaser and shall meet the requirements of the applicable sections of IEC 60079 or NFPA 70, Articles 500, 501, 502, and 504, as well as any local codes specified (and, if requested by the vendor, furnished) by the purchaser.	Refer to Project Specification and data sheets.
● 6.1.19 The equipment, including all auxiliaries, shall be suitable for operation under the environmental conditions specified by the purchaser. These conditions shall include whether the installation is indoors (heated or unheated) or outdoors (with or without a roof), maximum and minimum temperatures, unusual humidity, and dusty or corrosive conditions.	Refer to Project Specification.
● 6.1.20 The equipment, including all auxiliaries, shall be suitable for operation, using the utility conditions specified by the purchaser.	This paragraph is applicable. Refer to Project Specification for utility conditions details.

API	Requirements
6.2 Nameplates and rotation arrows	
6.2.4 Data shall be clearly stamped on the nameplate and shall include, but not be limited to, the following: a) purchaser's equipment item number (may be on a separate nameplate if there is insufficient space on the rating nameplate); b) vendor's name; c) year ship; d) serial number; e) size and type; f) rated power and speed; g) all lateral critical speeds less than trip speed; h) the next lateral critical speed greater than trip speed; i) maximum continuous speed; j) trip speed; k) normal and maximum inlet steam temperature and pressure; l) normal and maximum exhaust steam pressure; m) Number of teeth in the multi-toothed surface provided for speed sensing.	SI units shall be used on the nameplate.
7. Casings	
7.1 Pressure casings	
7.1.1 All pressure parts shall be suitable for operation at the most severe conditions of coincident pressure and temperature predicted with the specified steam conditions.	Condensing turbine exhaust casing shall be designed taking into account transient situation such as start-up periods. Exhaust casing shall be able to withstand higher operating temperature and pressure. Should the exhaust casing be unable to withstand those transient conditions, then vendor shall provide a complete water condensate injection manifold, including piping, valves, injection nozzles and temperature detection and control system.

API	Requirements
7.1.12 The steam chest and casing shall be provided with connections to ensure complete drainage. Drain connections shall be DN 25 (NPS 1) minimum size.	Turbine with top exhaust flange connection shall have exhaust casing drains.
7.1.15 Bolting shall be furnished as follows. ● f) If specified, the main casing joint studs and nuts shall be designed for the use of hydraulic bolt tensioning. The vendor shall provide procedures and any special tooling required.	This paragraph is applicable.
7.2 Casing connections	
● 7.2.1 The purchaser shall specify the orientation of the main inlet and outlet steam connections. All connections shall be suitable for the maximum allowable working pressure(s) of the casing. Flanged connections shall be integral with the casing or, for casings of weldable material, may be formed by a socket-welded or butt-welded pipe nipple or transition piece, and shall terminate with a weld-neck or socket-weld flange.	Refer to Project Specification. Main flanged connections shall be integral with the casing.
7.2.3 Casing openings for piping connections shall be at least DN 20 (NPS 3/4) and shall be flanged or machined and studded. Flanged connections shall be installed as follows: a) Pipe nipples shall be provided with a weld-neck or socket-weld flange. b) The nipple and flange materials shall meet the requirements of 7.2.2.	In case of studded flange connections, the Supplier shall provide the interconnecting spool pieces fully assembled. These spool pieces shall be considered as part of the main casing and shall also be used for the hydro test. The material shall be the same as the casing. The data sheet shall specify the orientation of the inlet and outlet flanges. Drawings of the proposed connections shall be submitted to Company for approval prior to fabrication. All drains shall be individually valved and routed to a single skid edge connection. For casings with pressure rating 600 lbs and above, drains shall have two isolating valves. Valves and flanges shall comply with applicable piping classes.

API	Requirements
7.2.6 Steel flanges shall conform to ISO 7005-1 Series 1 or ISO 7005-2 Series 1 [or ASME B16.1, ASME B16.5, ASME B16.42, or ASME B16.47 (Series B)], as specified. Flanges other than those covered in ISO 7005-2 shall conform to the dimensional requirements specified above. ISO 7005-1 (steel flanges) PN20, PN50, PN110, PN150, PN260, and PN420 are designed to be interchangeable with ASME B16.5 and MSS SP-44 flanges. ISO 7005-1 flanges are not identical to ASME B16.5 and MSS SP-44 flanges but are deemed to comply with the dimensions specified in the ASME B16.5 and MSS SP-44. ISO PN2.5 and PN6 do not have a corresponding ASME class, and ASME Classes 75, 400, and 800 do not have corresponding ISO PN designations. These PN and class flange ratings should therefore not be used.	Steel flanges shall conform to ASME standards.
● 7.2.6.3 If ISO 7005-1 has been specified, materials shall be in accordance with ISO 7005-1 as specified. The pressure temperature ratings shall correspond to the materials specified.	This paragraph is applicable.
● 7.2.11 If specified, appropriate casing connections with valves shall be provided for an inert gas blanket to be used as preservation during long periods of standstill.	This paragraph is not applicable.
● 7.2.13 If specified, permanent connections with valves shall be provided to provide wet and dry preservation of the steam turbine during stand still.	This paragraph is applicable.
7.3 Internal stationary components	
7.3.2 All non-control stage stationary blading shall be mounted in replaceable diaphragms or blade carriers. Nozzles or blades welded to the diaphragm are preferred. Partial blading at the diaphragm split line shall be designed to prevent failure of the thin part of the blading during turbine operations.	For turbine of reaction type, stationary blading shall be mounted in replaceable blade carriers to allow a quick replacement in case of damage.

API	Requirements
7.4 External forces and moments	
7.4.1 Turbines shall be designed to withstand external forces and moments at least equal to the values calculated in accordance with NEMA SM 24.	The turbine shall be designed to withstand external forces and moments at least equal to 3 times the values calculated in accordance with NEMA SM 24 . The turbine base plate shall be designed accordingly.
7.5 Material Inspection of pressure casings	
7.5.2 If radiographic, ultrasonic, magnetic particle, or liquid penetrant inspection of welds or materials is required by the ASME BPVC or specified, the procedures and acceptance criteria in Table 2 shall apply, except as required by 7.5.4. Alternative standards may be proposed by the vendor for approval by the purchaser.	This paragraph is applicable.
8. Rotating elements	
8.1 General	
8.1.2 Rotors shall be of integrally forged construction. With purchaser's approval, built up rotors (disks shrunk on the shaft) may be applied if blade tip velocities are less than 250 m/s (825 ft/s) at maximum continuous speed or if stage inlet steam temperatures are less than 440°C (825°F).	Built-up rotors (disks shrunk on the shaft) are not allowed.
8.1.4 If specified, provisions shall be made for field balancing without disassembly of the turbine. The vendor shall describe these provisions and the method of use in the proposal.	This paragraph is applicable.
8.2 Shafts	
8.2.4 Shafts shall be capable of transmitting torque at least equal to the torque determined by potential maximum power at maximum continuous speed. The shaft end design shall conform to the requirements of API 671.	The shaft shall be capable of transmitting a torque corresponding to 120% of the maximum calculated power at corresponding speed. This comment is also applicable to the coupling design. The shaft end shall be of taper type and designed for hydraulically fitted coupling. An integral flange forged with the shaft shall be submitted to owner's approval.

API	Requirements
9. Rotor dynamics	
9.1 General	
● 9.1.3 If specified, the vendor with unit responsibility shall communicate the existence of any undesirable running speeds in the range from zero to trip speed. This shall be illustrated by the use of Campbell diagram, submitted to the purchaser for review and included in the instruction manual. NOTE: Examples of undesirable speeds are those associated with rotor lateral critical speed with amplification factors greater than or equal to 2.5, train torsional natural frequencies, and blading modes.	This paragraph is applicable.
9.2 Lateral analysis	
9.2.1 Critical speeds and their associated amplification factors shall be determined by means of a damped unbalanced rotor response analysis. The results of the analysis shall be provided in report form. As a minimum the report should include the results of 9.2.3 through 9.2.14, and 9.3. See Figure 1.	The undamped critical speed map shall be provided with the offer. The analysis shall be conducted up to 2 times 125% of trip speed.
● 9.2.6 If specified, the vendor with train responsibility shall provide a train lateral analysis.	This paragraph is not applicable.