General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services

API STANDARD 611
FIFTH EDITION, MARCH 2008

ERRATA 1, MAY 2008
ERRATA 2, JUNE 2019

General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services

Downstream Segment

API STANDARD 611
FIFTH EDITION, MARCH 2008

ERRATA 1, MAY 2008
ERRATA 2, AUGUST 2019

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Foreword

This standard is based on the accumulated knowledge and experience of manufacturers and users of steam turbines. The objective of this standard is to provide a purchase specification to facilitate the procurement and manufacture of steam turbines for use in petroleum, chemical, and gas industry services.

The primary purpose of this standard is to establish minimum requirements. This limitation in scope is one of charter as opposed to interest and concern.

Energy conservation is of concern and has become increasingly important in all aspects of equipment design, application, and operation. Thus, innovative energy conserving approaches should be aggressively pursued by the manufacturer and the user during these steps. Alternative approaches that can result in improving energy utilization should be thoroughly investigated and brought forth. This is especially true of new equipment proposals, since the evaluation or purchase options will be based increasingly on total life costs as opposed to acquisition cost alone. Equipment manufacturers, in particular, are encouraged to suggest alternatives to those specified when such approaches achieve improved energy effectiveness and reduced total life costs without sacrifice of safety or reliability.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

This standard requires the purchaser to specify certain details and features. Although it is recognized that the purchaser can modify, delete, or amplify clauses of this standard, it is strongly recommended that such modifications, deletions, and amplifications be made by supplementing this standard, rather than by rewriting or incorporating clauses thereof into another standard.

API standards are published as an aid to procurement of standardized equipment and materials. These standards are not intended to inhibit purchasers or producers from purchasing or producing products made to other standards.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually and updated quarterly by API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

Page

1 Scope . . . 1
2 Normative References . . . 1
3 Definitions . . . 4
4 General . . . 9
4.1 Unit Responsibility . . . 9
4.2 Unit Conversion . . . 9
4.3 Nomenclature . . . 9
5 Requirements . . . 9
5.1 Dimensions . . . 9
5.2 Statutory Requirements . . . 9
5.3 Conflicting Requirements . . . 9
6 Basic Design . . . 9
6.1 General . . . 9
6.2 Bolting . . . 11
6.3 Pressure Casings . . . 12
6.4 Casing Appurtenances . . . 14
6.5 Casing Connections . . . 14
6.6 External Forces and Moments . . . 16
6.7 Rotating Elements . . . 16
6.8 Seals . . . 17
6.9 Dynamics . . . 17
6.10 Bearings and Housings . . . 20
6.11 Lubrication . . . 27
6.12 Materials . . . 28
6.13 Nameplates and Rotation Arrows . . . 31
7 Accessories . . . 32
7.1 Gear Units . . . 32
7.2 Couplings and Guards . . . 32
7.3 Mounting Plates . . . 34
7.4 Controls and Instrumentation . . . 36
7.5 Piping and Appurtenances . . . 43
7.6 Special Tools . . . 46
7.7 Insulation and Jacketing . . . 46
8 Inspection, Testing and Preparation for Shipment . . . 46
8.1 General . . . 46
8.2 Inspection . . . 47
8.3 Testing . . . 48
8.4 Preparation for Shipment . . . 51
9 Vendor’s Data . . . 53
9.1 General . . . 53
9.2 Proposals . . . 53
9.3 Contract Data . . . 55

Page

Annex A (informative) **General Purpose Steam Turbine Datasheets** 57
Annex B (normative) **Dynamics (Information on Rotordynamic Analysis)** 67
Annex C (informative) **Vendor Drawing and Data Requirements** 77
Annex D (normative) **Lubrication System Schematic** 89
Annex E (normative) **Procedures for Determining Residual Unbalance** 93
Annex F (informative) **Inspector's Checklist** 97
Annex G (informative) **Steam Turbine Nomenclature** 99
Bibliography 103

Figures

1 **Bearing Housing Dimple Locations for Vibration Measurements** 26
2 **Dimple Dimensions** 26
3 **Transducer Mounting Hole Dimensions** 26
A.1 **Datasheets, SI Units** 58
A.2 **Datasheets, USC Units** 61
A.3 **Datasheet Document Map** 64
B.1 **Undamped Unbalanced Response Analysis** 69
B.2 **Typical Mode Shapes** 71
B.3 **Rotor Response Plot** 72
C.1 **Vendor Drawing and Data Requirements Form** 78
D.1 **Lubrication System Schematic** 89
D.2 **Lubrication System Symbols** 90
E.1 **Residual Unbalance Work Sheet** 95
G.1 **Single-stage Turbine** 99
G.2 **Radial Split Single-stage Turbine Key** 100
G.3 **Multi-stage Turbine** 101
G.4 **Radial Split Single-stage Vertical Turbine** 102

Tables

1 **Design Criteria and Specifications for Cooling Water Systems** 11
2 **Arithmetic Average Roughness Height (Ra)** 15
3 **Bearing Selection** 21
4 **Speed Governors** 37
5 **Minimum Requirements for Piping System Components** 45
D.1 **Lube-oil System Schematic** 91

Introduction

Users of this standard should be aware that further or differing requirements may be needed for individual applications. This standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this standard and provide details.

Annex A General Purpose Steam Turbine Datasheets

Annex B Dynamics (Information on Rotordynamic Analysis)

Annex C Vendor Drawing and Data Requirements (VDDR)

Annex D Lubrication System Schematic

Annex E Procedures for Determing Residual Unbalance

Annex F Inspector's Checklist

Annex G Steam Turbine Nomenclature

This standard requires the purchaser to specify certain details and features.

A bullet (•) at the beginning of a paragraph indicates that either a decision by, or further information from, the purchaser is required. Further information should be shown on the datasheets (see Annex A) or stated in the quotation request and purchase order.

General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services

1 Scope

This standard specifies the minimum requirements for general-purpose steam turbines. These requirements include basic design, materials, related lubrication systems, controls, auxiliary equipment and accessories.

This standard includes only general-purpose turbines. General-purpose turbines are horizontal or vertical turbines used to drive equipment that is usually spared, is relatively small in size (power), or is in non-critical service. They are generally used where steam conditions will not exceed a pressure of 48 bar (700 psig) and a temperature of 400 °C (750 °F) or where speed will not exceed 6,000 r/min.

This standard does not cover special-purpose turbines. Special-purpose turbines are those horizontal turbines used to drive equipment that is usually not spared, is relatively large in size (power), or is in critical service. This category is not limited by steam conditions or turbine speed. Requirements for special-purpose turbines are defined in API 612.

In case of conflict between this standard and the inquiry or order, the information included in the order shall govern.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Spec 5L, *Specification for Line Pipe*

API RP 520, (all parts) *Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries*

API Std 526, *Flanged Steel Pressure Relief Valves*

API Std 614, *Lubrication, Shaft-sealing, and Control-oil Systems and Auxiliaries for Petroleum, Chemical and Gas Industry Services*

API Std 670*, Machinery Protection Systems*

API Std 671, *Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services*

API Std 677, *General-purpose Gear Units for Petroleum, Chemical and Gas Industry Services*

API Std 686, *Recommended Practice for Machinery Installation and Installation Design*

ABMA Std 9[1], *Load Ratings and Fatigue Life for Ball Bearings*

ABMA Std 20, *Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types—Metric Design*

AGMA 922[2], *Load Classification and Service Factors for Flexible Couplings*

AGMA 9000, *Flexible Couplings—Potential Unbalance Classification*

[1]American Boiler Manufacturers Association, 8221 Old Courthouse Road, Suite 207, Vienna, Virginia 22182, www.abma.com.
[2]American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314, www.agma.org.