

Packaged, Integrally Geared Centrifugal Air Compressors for Petroleum, Chemical, and Gas Industry Services

API STANDARD 672
FIFTH EDITION, AUGUST 2019



AMERICAN PETROLEUM INSTITUTE

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.

Users of this standard should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to ensure 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.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Foreword

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.

The verbal forms used to express the provisions in this document are as follows.

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

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

May: As used in a standard, “may” denotes a course of action permissible within the limits of a standard.

Can: As used in a standard, “can” denotes a statement of possibility or capability.

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 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 Terms, Definitions, Acronyms, and Abbreviations | 4 |
| 3.1 Terms and definitions | 4 |
| 3.2 Acronyms and Abbreviations | 10 |
| 4 General | 12 |
| 4.1 Unit Responsibility | 12 |
| 4.2 Nomenclature..... | 12 |
| 5 Requirements..... | 12 |
| 5.1 Units of measurement..... | 12 |
| 5.2 Statutory Requirements | 12 |
| 5.3 Document Requirements | 13 |
| 6 Basic Design | 13 |
| 6.1 General | 13 |
| 6.2 Pressure Casings | 18 |
| 6.3 Casing Connections | 18 |
| 6.4 External Forces and Moments | 19 |
| 6.5 Rotating Elements | 20 |
| 6.6 Seals and Sealing Systems | 21 |
| 6.7 Dynamics | 21 |
| 6.8 Bearings and Bearing Housings | 23 |
| 6.9 Lubrication | 24 |
| 6.10 Materials | 25 |
| 6.11 Nameplates and Rotation Arrows | 27 |
| 6.12 Additional Basic Design Requirements for Special Duty Packages Only | 28 |
| 7 Accessories | 30 |
| 7.1 Drivers..... | 30 |
| 7.2 Couplings and Guards | 31 |
| 7.3 Baseplate/Support Structure | 33 |
| 7.4 Controls and Instrumentation | 34 |
| 7.5 Piping | 41 |
| 7.6 Intercoolers and Aftercoolers | 42 |
| 7.7 Inlet Air Filter | 43 |
| 7.8 Discharge Blowoff Silencer | 43 |
| 7.9 Special Tools | 43 |
| 7.10 Additional Accessories Requirements for “Special Duty” Packages Only | 44 |
| 8 Inspection, Testing, and Preparation for Shipment..... | 45 |
| 8.1 General | 45 |
| 8.2 Inspection..... | 46 |
| 8.3 Testing | 46 |
| 8.4 Preparation for Shipment..... | 49 |
| 8.5 Additional Inspection, Testing, and Preparation for Shipment Requirements for “Special Duty” Packages Only..... | 50 |
| 9 Vendor’s Data..... | 51 |
| 9.1 General | 51 |

Contents

| | Page |
|---|------------|
| Annex A (informative) Typical Datasheets | 52 |
| Annex B (informative) Illustrations of Typical Package Mounting Configurations | 65 |
| Annex C (normative) Dynamics | 68 |
| Annex D (informative) Contract Documents and Engineering Design Data | 84 |
| Annex E (informative) Compressor Control—Inlet Throttle Butterfly | 96 |
| Annex F (normative) Determination of Residual Imbalance | 97 |
| Annex G (normative) Inspector’s Checklist | 105 |
| Annex H (informative) Nomenclature for Integrally Geared Centrifugal Air Compressors | 108 |
| Annex I (normative) External Forces and Moments | 113 |
| Bibliography | 114 |
| Figures | |
| A.1 Typical Datasheets for Centrifugal Air Compressors | 53 |
| B.1 Package with Full Drain-rim Base | 65 |
| B.2 Package with Open-channel Structural Base | 65 |
| B.3 Package with Foot Mounted Base | 66 |
| B.4 Package with Base Integral with Casing | 66 |
| B.5 Package with Split Base (Separate Exchanger Skid) | 67 |
| B.6 Package with Three-point Spherical Bearings Supports | 67 |
| C.1 Undamped Critical Speed Map | 69 |
| C.2 Mode Shapes | 71 |
| C.3 Unbalance Placement and Mode Shapes for Overhung Machines | 72 |
| C.4 Typical Rotor Response Plot | 73 |
| C.5 Plot of Applicable Speed Range of Vibration Limit | 74 |
| C.6 Level 1 Stability Sensitivity Plot | 79 |
| C.7 Stability Experience Plot | 79 |
| D.1 VDDR for Packaged, Integrally Geared Centrifugal Air Compressors | 89 |
| D.2 Description of VDDR | 91 |
| E.1 Typical Performance Curve Showing BFV vs IGV Control | 96 |
| F.1 (Blank) Residual Unbalance Work Sheet | 99 |
| F.2 (Blank) Residual Unbalance Polar Plot Work Sheet | 100 |
| F.3 Sample Residual Unbalance Work Sheet for Left Plane | 101 |
| F.4 Sample Residual Unbalance Polar Plot Work Sheet for Left Plane | 102 |
| F.5 Sample Residual Unbalance Work Sheet for Right Plane | 103 |
| F.6 Sample Residual Unbalance Polar Plot Work Sheet for Right Plan | 104 |
| G.1 Inspector’s Checklist | 105 |
| H.1 Section of Axially (horizontally) Split Compressor | 108 |
| H.2 Section of Radially Split Compressor | 109 |
| H.3 Nomenclature of Package Components, Part 1 | 110 |
| H.4 Nomenclature of Package Components, Part 2 | 111 |
| H.5 Nomenclature of Package Components, Part 3 | 112 |

Contents

| | Page |
|--|------------|
| Tables | |
| 1 | |
| 1 Equipment Monitoring | 39 |
| D.1 VDDR for Packaged, Integrally Geared Centrifugal Air Compressors | 90 |
| D.2 VDDR for Packaged, Integrally Geared Centrifugal Air Compressors | 92 |
| G.1 Inspector's Checklist | 106 |

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 contains data sheets which purchasers are encouraged to use.

Annex B contains illustrations of typical mounting configurations.

Annex C specifies requirements for lateral analysis.

Annex D contains forms which may be used to indicate vendor drawing and data requirements.

Annex E shows the impact for inlet throttle control vs inlet guide vanes.

Annex F specifies requirements for determining residual unbalance.

Annex G contains an inspector's checklist.

Annex H contains illustrations of nomenclature for integrally geared centrifugal air compressors.

Annex I contains information relative to allowable nozzle loads from purchaser's piping.

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 data sheets (see example in Annex A) or stated in the quotation request and purchase order.

In this standard, U.S. customary units (USC) are included in brackets for information.

Packaged, Integrally Geared Centrifugal Air Compressors for Petroleum, Chemical, and Gas Industry Services

1 Scope

1.1 This standard covers the minimum requirements for constant-speed, packaged, general purpose, integrally-geared centrifugal air compressors, including their accessories for use in the petroleum, chemical, and gas industry services. This standard is not applicable to machines that develop a pressure rise of less than 0.35 bar (5.0 psi) above atmospheric pressure, which are classed as fans or blowers.

NOTE Special purpose and process applications, including Process Air Services, are covered by API 617.

- **1.2** Equipment covered by this standard is considered non-critical, usually spared and may be either of two classifications, basic or special duty. The purchaser shall specify which of the two classifications applies.

Basic packages are vendors' standard packages of proven design, and include minimal additional requirements.

Special duty packages are typically specified for installations that require higher availability, and include additional features and requirements.

1.3 Additional or overriding requirements applicable only to packages that have been specified as "Special Duty" are noted at the end of each section (see 6.12, 7.10, 8.5, D.2.5, and D.3.5.5).

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) available at the agreed time, applies. Standards referenced in the documents are undated but refer to the specific editions referenced in this section.

ANSI/API Standard 541, Form-Wound Squirrel Cage Induction Motors—500 Horsepower and Larger

ANSI/API Standard 546, Brushless Synchronous Machines—500 kVA and Larger

API Standard 547, General-purpose Form-wound Squirrel Cage Induction Motors 250 Horsepower and Larger

API Standard 611, General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services

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

ANSI/API Standard 670, Machinery Protection Systems

AGMA 6011¹, Specification for High Speed Helical Gear Units

AGMA 9000-C90, Flexible Couplings—Potential Unbalance Classification

AGMA 9002-B04, Bores and Keyways for Flexible Couplings (Inch Series)

ASME B1.1², Unified Inch Screw Threads (UN and UNR Thread Form)

¹ American Gear Manufacturers Association, 1001 N. Fairfax Street, Suite 500, Alexandria, Virginia, 22314, www.agma.org.

² ASME International, 2 Park Avenue, New York, New York 10016-5990, www.asme.org.