Form-wound Squirrel Cage Induction Motors—375 kW (500 Horsepower) and Larger

API STANDARD 541
SIXTH EDITION, OCTOBER 2026



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. The use of API publications is voluntary. In some cases, third parties or authorities having jurisdiction may choose to incorporate API standards by reference and may mandate compliance.

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 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.

Copyright © 2026 American Petroleum Institute

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

1 General 1
1.1 Scope 1
1.2 Alternative Designs 2
1.3 Dimensions and Standards 2
1.4 Conflicting Requirements 2

2 Normative References 3

3 Terms, Definitions, Acronyms, and Abbreviations 9
3.1 Terms and Definitions 9
3.2 Acronyms and Abbreviations 15

4 Basic Design 15
4.1 General 15
4.2 Electrical Design 18
4.3 Winding and Insulation Systems 22
4.4 Mechanical Design 24
4.5 Vertical Motors 51

5 Accessories 52
5.1 Terminal Boxes 52
5.2 Winding Temperature Detectors 54
5.3 Bearing Temperature Detectors 55
5.4 Space Heaters 55
5.5 Screens and Filters 56
5.6 Alarms and Control Devices for Motor Protection 56
5.7 Ground Connectors 57
5.8 Vibration Detectors 57

6 Inspection, Testing, and Preparation for Shipment 58
6.1 General 58
6.2 Inspection 59
6.3 Final Testing 61
6.4 Preparation for Shipment 77

7 Guarantee and Warranty 78

8 Vendor's Data—General 78

Annex A (informative) **Induction Motor Datasheets 79**

Annex B (normative) **Vendor Drawing and Data Requirements 107**

Annex C (informative) **Datasheet Guide 110**

Annex D (normative) **Procedure for Determination of Residual Unbalance 157**

Annex E (informative) **Procedure and Guidance for Determining the Allowable Resultant Vector Change During a Heat Run Test 165**

Annex F (informative) **Alternate Criteria for Defining a Well-damped Resonance 168**

Annex G (normative) **Super Synchronous High-speed Motor Applications 170**

Annex H (informative) **Contract Documents and Engineering Design Data 173**

Annex I (informative) **Guidance and Alternate Procedures for Balance Check with Half Coupling 182**

Bibliography 184

Figures

1 Typical Rotor Mode Shapes 36
2 Shaft Vibration Limits (Metric Units, Relative to Bearing Housing Using Noncontact Vibration Probes) for All Hydrodynamic Sleeve Bearing Machines with the Machine Securely Fastened to a Massive Foundation 63
3 Shaft Vibration Limits (US Customary Units, Relative to Bearing Housing Using Noncontact Vibration Probes) for All Hydrodynamic Sleeve Bearing Machines with the Machine Securely Fastened to a Massive Foundation 63
4 Bearing Housing Radial and Axial Vibration Limits (Metric Units) for Sleeve and Antifriction Bearing Machines with the Machine Securely Fastened to a Massive Foundation 63
5 Bearing Housing Radial and Axial Vibration Limits (US Customary Units) for Sleeve and Antifriction Bearing Machines with the Machine Securely Fastened to a Massive Foundation 64
6 Adjacent Core 71
D.1 Residual Unbalance Worksheet 159
D.2 Residual Unbalance Polar Plot Worksheet 160
D.3 Sample Residual Unbalance Worksheet for Left Plane 161
D.4 Sample Residual Unbalance Polar Plot Worksheet for Left Plane 162
D.5 Sample Residual Unbalance Worksheet for Right Plane 163
D.6 Sample Residual Unbalance Polar Plot Worksheet for Right Plane 164
E.1 Example of a Polar Plot Complying with 6.3.3.13 166
E.2 Example of a Polar Plot Not Complying with 6.3.3.13 166
E.3 Example of a Polar Plot Not Complying with 6.3.3.12 167
E.4 Possible Option if a Motor Fails Basic Specification Criteria 167
F.1 Evaluation of Amplification Factor from Speed Amplitude Plots 169

Tables

1 Power Ratings 18
2 Voltage Ratings for Three-phase 60 Hz Systems 18
3 Voltage Ratings for Three-phase 50 Hz Systems (British Standards) 18
4 Voltage Ratings for Three-phase 50 Hz Systems (General) 19
5 Starting Capabilities 21
6 Machine Enclosures and Corresponding NEMA or IEC Specifications 25
7 Cooling Water System Design Criteria 26
8 Face and Mounting Rabbet Runout Levels 51
9 Maximum Severity of Defects in Castings 60
10 DC Test Voltages for Insulation Resistance and Determination of Polarization Index 66
11 DC High-potential Test Voltage Levels 74

Form-wound Squirrel Cage Induction Motors—
375 kW (500 Horsepower) and Larger

1 General

1.1 Scope

1.1.1 This standard covers the minimum requirements for special-purpose form-wound squirrel cage induction motors 375 kW (500 hp) and larger for use in petroleum, chemical, and other industry applications. This standard can also be used for induction generators by substituting “generator” for “motor,” where applicable.

Notes following a paragraph in Sections 1 through 8 are informational only and are not enforceable as part of this standard.

NOTE A special-purpose machine typically has one or more of the following characteristics:

1) is in an application for which the equipment is designed for uninterrupted, continuous operation in critical service and for which there is usually no installed spare equipment;

2) is larger than 2250 kW (3000 hp) for speeds 1800 rpm and below;

3) is rated 600 kW (800 hp) or greater for two-pole (3000 rpm or 3600 rpm) machines of totally enclosed construction, or rated 930 kW (1250 hp) or greater for two-pole machines of open or guarded construction, including machines having an IP rating of 2X or weather protected type I (WP-I) or weather protected type II (WP-II) enclosures;

4) drives a high-inertia load (in excess of the load Wk^2 listed in NEMA MG 00001, Part 20);

5) uses an adjustable speed drive (ASD) as a source of power;

6) is an induction generator;

7) is a solid shaft vertical machine rated 375 kW (500 hp) or greater; or

8) operates in harsh environments where equipment can be subject to low or high temperature, high moisture and humidity, exposure to chemicals, and/or high mechanical stress.

Some paragraphs have been intentionally left blank to align paragraph numbers with API 546.

A round bullet (●) at the beginning of a paragraph indicates that either a decision is required or further information is to be provided by the purchaser. This information may be indicated on the datasheets (see Annex A); otherwise, it should be stated in the quotation request or in the order.

A diamond bullet (♦) at the start of a paragraph indicates additional requirements for motors applied with an ASD.

1.1.2 The purchaser specifies machine details and features by completing the associated sections of the datasheets in Annex A.

NOTE Guidance for completion of the datasheets is provided in Annex C.

1.1.3 The vendor completes the details and features by completing the vendor sections of the datasheets (see Section 8 and Annex A).