Form-wound Squirrel-Cage Induction Motors—500 Horsepower and Larger

ANSI/API STANDARD 541-2003
FOURTH EDITION, JUNE 2004

American
Petroleum
Institute

Helping You Get The Job Done Right.SM

Form-wound Squirrel-Cage Induction Motors – 500 Horsepower and Larger

Downstream Segment

ANSI/API STANDARD 541-2003
FOURTH EDITION, JUNE 2004

American
Petroleum
Institute

Helping You Get The Job Done Right.SM

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.

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 under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

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.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Standards department telephone (202) 682-8000. A catalog of API publications, programs and services is published annually and updated biannually by API, and available through Global Engineering Documents, 15 Inverness Way East, M/S C303B, Englewood, CO 80112-5776.

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 standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the Director of the Standards department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should be addressed to the Director, Business Services.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards 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

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 federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to API, Standards department, 1220 L Street, NW, Washington, DC 20005.

CONTENTS

Page

Figures

Tables

Form-wound Squirrel-Cage Induction Motors—500 Horsepower and Larger

1 General

1.1 SCOPE

1.1.1 This standard covers the minimum requirements for form-wound squirrel-cage induction motors 500 horsepower (hp) and larger for use in petroleum industry services.

Note 1: This standard is typically utilized for machines that have one or more of the following characteristics:

1. Is in critical service.
2. Is larger than 3000 hp (2250 kW) for speeds 1800 rpm and below.
3. Is rated 800 hp (600 kW) or greater for two-pole (3000 or 3600-rpm) machines of totally-enclosed construction, or rated 1250 hp (930 kW) or greater for two-pole machines of open or guarded construction (including machines with WP-I or WP-II type enclosures).
4. Drives a high-inertia load (in excess of the load Wk^2 listed in NEMA MG-1 Part 20).
5. Uses an adjustable speed drive as a source of power.
6. Is an induction generator.
7. Is a vertical machine rated 500 hp (375 kW) or greater.
8. Operates in abnormally hostile environments.

Note 2: 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 should be indicated on the datasheets (see Appendix A); otherwise it should be stated in the quotation request or in the order.

Note 3: A diamond bullet (♦) at the start of a paragraph indicates additional requirements for motors applied with adjustable speed drives (ASDs).

1.1.2 This standard requires the purchaser to specify details and features. The purchaser shall complete the datasheets in Appendix A.

Note: Guidance for completion of the datasheets is provided in Appendix C.

1.2 ALTERNATIVE DESIGNS

The vendor may offer alternative designs (see 6.1.10).

• 1.3 DIMENSIONS AND STANDARDS

1.3.1 Both the SI and U.S. customary system of units and dimensions are used in this standard. Any data, drawings, or hardware (including fasteners) related to equipment supplied to this standard shall use the U.S. customary system.

1.3.2 This document recognizes two different systems of standards for the manufacturing and testing of electrical machines: the North American ANSI, IEEE, and NEMA standards; and the International IEC and ISO standards. The North American Standards are the base documents. When specified by the purchaser, the corresponding International Standards are acceptable for use as alternatives; however, this must not be construed that they are identical to the North American standards. The selection of which system of standards to be utilized shall depend on the machine's application and site location.

Note: The purchaser should be aware that specific requirements contained within corresponding standards may differ.

1.4 CONFLICTING REQUIREMENTS

In case of conflict between this standard and the inquiry, the inquiry shall govern. At the time of the order, the order shall govern.

1.5 DEFINITION OF TERMS

1.5.1 **Breakdown torque** of a motor is the maximum torque that it will develop with rated voltage applied at rated frequency without an abrupt drop in speed.

1.5.2 **Pull-up torque** of an AC motor is the minimum torque developed by the motor during the period of acceleration from rest to the speed at which breakdown torque occurs. For motors that do not have a definite breakdown torque, the pull-up torque is the minimum torque developed up to the rated speed.

1.5.3 The **locked-rotor torque** of a motor is the minimum torque that it will develop at rest for all angular positions of the rotor, with rated voltage applied at rated frequency.

1.5.4 **Accelerating torque** is the difference between the input torque to the rotor (electromagnetic for a motor or mechanical for a generator) and the sum of the load and loss torque; the net torque available for accelerating the rotating parts.

1.5.5 A **cold start** is a motor start that occurs when the rotor and stator are initially at ambient temperature.

1.5.6 A **hot start** is any restart of the motor that occurs when the motor is at a temperature above ambient temperature.

1.5.7 **Lateral critical speed** is a shaft rotational speed at which the rotor-bearing-support system is in a state of resonance.

Note: The basic identification of critical speeds is made from the natural frequencies of the system and of the forcing phenomena. If the frequency of any harmonic component of a periodic forcing phenomenon is equal to or approximates the frequency of any mode of rotor vibration, a condition of resonance may exist. If resonance exists at a finite speed, that speed is called a critical speed. This standard is concerned with actual resonant speeds rather than various