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Standard for Industrial Control and Systems: Adjustable-Speed Drives

National Electrical Manufacturers Association

NEMA ICS 7-2020

Industrial Control and Systems: Adjustable-Speed Drives

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Foreword

This Standards publication was prepared by a technical committee of the NEMA Industrial Automation Control Products and Systems Section. It was approved in accordance with the bylaws of NEMA and supersedes the indicated NEMA Standards publication. This document supersedes ICS 7-2000.

Previous editions of this Standard included Parts 2-7 and Annex A and B. These have been removed and dispositioned as follows: Parts 2, 3, and Annex B were essentially application information and have been transferred to be part of the Application Guide for AC Adjustable Speed Drive Systems.

In the interest of harmonization, Parts 4, 6, and Annex A of ICS 7-2000 have been replaced by NEMA ICS 61800-2-2005. Additionally, for coordination, Part 5 of ICS 7-2000 has been replaced by NEMA ICS 61800-1-2002; and, Part 7 of ICS 7-2000 has been replaced by NEMA ICS 61800-4.

This Standards publication provides practical information concerning ratings, construction, test, performance, and manufacture of industrial control equipment. These Standards are used by the electrical industry to provide guidelines for the manufacture and proper application of reliable products and equipment and to promote the benefits of repetitive manufacturing and widespread product availability.

NEMA Standards represent the result of many years of research, investigation, and experience by the Members of NEMA, its predecessors, its Sections, and Committees. They have been developed through continuing consultation among manufacturers, users, and national engineering societies and have resulted in improved serviceability of electrical products with economies to manufacturers and users.

One of the primary purposes of this Standards publication is to encourage the production of reliable control equipment which, in itself, functions in accordance with these accepted Standards. Some portions of these Standards, such as electrical spacings and interrupting ratings have a direct bearing on safety; almost all of the items in this publication, when applied properly, contribute to safety in one way or another.

Properly constructed industrial control equipment is, however, only one factor in minimizing the hazards which may be associated with the use of electricity. The reduction of hazard involves the joint efforts of the various equipment manufacturers, the system designer, the installer, and the user. Information is provided herein to assist users and others in the proper selection of control equipment.

The industrial control manufacturer has limited or no control over the following factors which are vital to a safe installation:

a. Environmental conditions
b. System design
c. Equipment selection and application
d. Installation
e. Operating practices
f. Maintenance

This publication is not intended to instruct the user of control equipment with regard to these factors except insofar as suitable equipment to meet needs can be recognized in this publication, and some application guidance is given.

This Standards publication is necessarily confined to defining the construction requirements for industrial control equipment and to providing recommendations for proper selection for use under normal or certain specific conditions. Since any piece of industrial control equipment can be installed, operated, and maintained in such a manner that hazardous conditions may result, conformance with this publication does not by itself assure a safe installation. When, however, equipment conforming with these Standards is properly selected and is installed in accordance with the *National Electrical Code*® (*NEC*) and properly maintained, the hazards to persons and property will be reduced.

To continue to serve the best interests of users of Industrial Control and Systems equipment, the Industrial Automation Control Products and Systems Section is actively cooperating with other Standardization organizations in the development of simple and more universal metrology practices. In this publication, the U.S. customary units are gradually being supplemented by those of the modernized metric system known as the International Systems of Units (SI). This transition involves no changes in Standard dimensions, tolerances, or performance specifications.

NEMA Standards publications are subject to periodic review. They are revised frequently to reflect user input and to meet changing conditions and technical progress. Proposed revisions to this Standards Publication should be submitted to:

NEMA Technical Operations Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

This Standards publication was developed by the Industrial Automation Control Products and Systems Section. Section Approval of the Standard does not necessarily imply that all section Members voted for its approval or participated in its development. At the time it was approved, the section was composed of the following Members:

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Part 1
General Standards for Drive Converters, Drives, and Drive Systems

1 General

1.1 Scope

The Standards in this part apply to drive converters, drives, and drive systems. The Standards in this part apply to all other parts of ICS 7 unless otherwise specified.

1.2 Normative References

The definitions and Standards of NEMA Standards Publication 250, ICS 1, ICS 7.1, ICS 6, ICS 61800-1, ICS 61800-2, ICS 61800-4, and ICS 61800-6 also apply to this part unless otherwise stated.

2 Definitions

It is acknowledged that there are differences between the terminology and diagrammatic representation of an adjustable speed drive system in this document and those in NEMA ICS 61800-1, -2, -4, and -6. These are retained as they represent the historic practices used in North America.

For the purposes of this Standards publication, the following definitions apply:

control circuit: A circuit containing those parts of a power converter that perform logic functions or which furnish control signals to the power circuit.

Examples of functions encompassed by the control circuit are gating, sequencing, regulation, protection, control interface, and local control. (See Figure 1-2-1)

controller: See power converter.

coordinated drive system: One or several drive systems operated in coordinated fashion under the control of a system director to achieve the required control of a process. (See Figure 1-2-1)

direct vector control: A field-oriented control scheme that directly regulates the motor flux vector in order to produce controllable motor torque. Such a scheme could employ the use of Hall effect transducers or air gap flux sense windings for the measurement of the motor air gap flux with the necessary modifications to approximate the rotor flux. The rotor flux would then be used as the feedback in the direct vector control regulator.

drive: A combination of the power converter, motor, and motor mounted auxiliary devices. Examples of motor mounted auxiliary devices are encoders, tachometers, thermal switches and detectors, air blowers, heaters, and vibration sensors. (See Figure 1-2-1) synonyms: Adjustable Speed Drive, variable frequency drive, BASIC DRIVE MODULE (BDM)

drive system: An interconnected combination of equipment that provides a means of adjusting the speed of a mechanical load coupled to a motor. A drive system typically consists of a drive and auxiliary electrical apparatus. (See Figure 1-2-1) synonyms: Module Drive System, COMPLETE DRIVE MODULE (CDM), Power Drive System (PDS)