

IEEE Recommended Practice for Cement Plant Electric Drives and Related Electrical Equipment

Sponsor

**Cement Industry Committee
of the
IEEE Industry Applications Society**

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IEEE Standards Board

Abstract: All electric drives, including motors and control wiring associated with machinery or equipment commonly used in the manufacturing areas of cement plants are covered. Recommendations are not intended to apply to power distribution circuits. These recommendations apply to electrical equipment having a supply voltage of 13 800 V or less.

Keywords: cement plant, electrical drives, practices

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Introduction

(This introduction is not a part of IEEE Std 499-1997, IEEE Recommended Practice for Cement Plant Electric Drives and Related Electrical Equipment.)

Electrical equipment is the major factor in the powering and control of cement plants. As management demands more precision for quality control, greater production capacity, and less production cost, more and more emphasis is placed on the performance of the plant's installed electrical equipment.

The Cement Industry Committee has analyzed many areas pertaining to such requirements, and through the working groups recommended practices have evolved for this industry.

The recommended practices listed herein pertain to the Drives and Related Products Working Group. This evaluation update is in a form of an agreement reached by all members of the working group and the committee in general. Certainly, specific plant conditions could and probably would alter such a recommendation in a certain area; however, in general, it is hoped the practices are a good guideline for the industry.

This recommended practice is a revision of IEEE Std 499-1989.

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IEEE Recommended Practice for Cement Plant Electric Drives and Related Electrical Equipment

1. Overview

1.1 Scope

This recommended practice applies to all electric drives including motors, control, and control wiring associated with machinery or equipment commonly used in the manufacturing areas of cement plants. The recommendations made here are intended as a guide and may be supplemented where special needs exist. They are not intended to apply to power distribution circuits.

These recommendations apply to electrical equipment having a supply voltage of 13 800 V or less. Voltages higher than this are not covered by this recommended practice.

1.2 Purpose

The purpose of this recommended practice is to define and recommend practice for electric drives and related electrical equipment for installation in the cement industry in order to promote the following:

- Safety to personnel and equipment
- Maximum reliability with minimum loss of production
- Reduced maintenance and increased life of equipment
- Clarification of needs and conditions to reduce special engineering and chance of error in specification
- Overall economy

1.3 Use of recommendations

It is urged that users and manufacturers cooperate with the working group to help formulate recommendations that will ensure the use of proven equipment and methods. The objective is to establish recommendations that will assist in preparing specifications for electric drives for cement plant equipment and their installation.

1.4 Terminology

The following words should be used as described:

- nominal.* An approximate or rated value; for the purposes of this recommended practice, $\pm 10\%$.
- should.* Used to indicate that which, at the present time, is considered a recommendation (e.g., advised but not required).

1.4.1 Special use of terms

The terms “suitable,” “adequate,” “effective,” and “securely” denote conditions determined by the user or the user’s representative after taking cognizance of all codes, standards, or practices applicable to the situation.

1.5 Drawings

Electrical drawings should be labeled in English, neat and easily readable, and properly annotated to avoid confusion in referring from one drawing to another. Graphic and terminal markings symbols should be in accordance with the standards listed in Clause 9.

Prints of electrical drawings should be made on medium-weight print paper and be of such size that they can be neatly and conveniently folded to 8 1/2 in × 11 in (21.59 × 27.94 mm) size. Elementary (or schematic) electrical diagrams should be furnished by manufacturers whenever special electrical equipment is involved, or where two or more electrical devices (other than motor and control, except direct current) are interconnected to form an electrical system. Ratings of fuses, current transformers, potential transformers, circuit breakers, etc., should be designated on the diagram.

Installation, maintenance, and operating instructions (including a detailed parts list) should be furnished by machinery manufacturers, as required by users for each piece of electrical hardware.

Designation of electrical devices and machinery should be in accordance with the standards listed in Clause 2.

1.6 Nameplates or identification plates

Permanent noncorroding plates with deeply indented or highly raised characters should be securely fixed to each electrical machine or control assembly. Devices within enclosures should likewise have permanent noncorroding nameplates, but characters need not be indented or raised as for machines and assemblies whose plates are exposed directly to the weather and indiscriminate painting. Nameplates should be securely and permanently affixed to devices. Adhesive of any type should not be used.

2. References

This recommended practice shall be used in conjunction with the following publications. It is assumed that apparatus mentioned herein shall comply with the latest edition of the National Electrical Code® (NFPA 70-1996). Cognizance of local codes must also be taken by the user to ensure that equipment involved complies therewith. Compliance with NEMA and ANSI standards is also assumed where applicable to the equipment involved. When the following standards are superseded by an approved revision, the revision shall apply.

IEEE Std 113-1985, IEEE Guide on Test Procedures for DC Machines (ANSI).¹

IEEE 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (ANSI).²

IEEE 242-1986 (Reaff 1991), IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (ANSI).

IEEE Std 277-1994, IEEE Recommended Practice for Cement Plant Power Distribution (ANSI).

¹IEEE Std 113-1985 has been withdrawn; however, copies can be obtained from Global Engineering, 15 Inverness Way East, Englewood, CO 80112-5704, USA, tel. (303) 792-2181.

²IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

IEEE Std 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems (ANSI).

NEMA ICS 1-1993, Industrial Control and Systems: General Requirements.³

NEMA ICS 2-1993, Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

NEMA ICS 3-1993, Industrial Control and Systems: Factory Built Assemblies.

NEMA ICS 6-1993, Industrial Control and Systems: Enclosures.

NEMA MG 1-1993, Motors and Generators.

NFPA 70-1996, National Electrical Code® (NEC®).⁴

3. Voltage ratings

3.1 General plant

The voltage ratings for equipment in the general plant area should be as described in 3.1.1 through 3.1.6.

3.1.1 AC motors and controllers

The voltage ratings of ac motors and controllers should be in accordance with Table 1.

Table 1—AC motor and controller voltage ratings

Distribution system nominal voltage	Motor and controller power voltage rating
13 800	13 200
6900	6600
4800	4600
4160	4000
2400	2300
600	575
480	460
240	230
208	200
120	115

³NEMA publications are available from the National Electrical Manufacturers Association, 1300 N. 17th St., Ste. 1847, Rosslyn, VA 22209, USA.

⁴NFPA publications are available from Publication Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA.

3.1.2 Portable electric shovels

The voltage rating of portable electric shovels (with ac motors driving motor generator set conversion units) should be selected to suit the available system voltage with due consideration to the possibility of long lines and cables and related large voltage drop.

3.1.3 DC motors

Typical voltage ratings now in use for dc motors supported by motor-generator sets are listed below:

120 V	10 hp (7.5 kW) maximum
240 V	15–200 hp (11–150 kW) inclusive
250 V	Motors over 200 hp (150 kW)
500 V	Motors over 200 hp (150 kW)
700 V	Very large drives

Many other voltages are used, particularly with thyristor packaged drives.

3.1.4 Field excitation

The voltage rating for field excitation of separately excited machines should be 125 V or 250 V, except when some factors of special design require other voltages to be used.

3.1.5 DC controls

The voltage rating of dc controls should be 240 V nominal, except when other plant equipment requires other voltages and coordination.

3.1.6 Surge arresters

The voltage ratings of surge arresters and their systems should be in accordance with the recommendations of IEEE Std 277-1994.⁵

3.2 Plant wiring

Interconnecting (remote) wiring at the plant site used to interconnect drives and related control apparatus should be considered as plant wiring. Plant wiring should conform to the NFPA 70-1996 and applicable local codes and should be performed in a neat and workmanlike manner with trade approved devices. A plant grounding conductor of suitable size should interconnect all electrical equipment. The ground conductor should be installed in the same conduit with the phase conductors.

3.2.1 Motor-control conductors

Conductors to motors and conductors for control wiring should be of adequate cross section to minimize voltage drops and should be stranded for flexibility. Insulation should be of approved 600 V (or higher) types capable of a maximum operating temperature of at least 75 °C except in those locations where high ambients exist, such as those encountered near a kiln or clinker cooler, where higher temperature insulation should be

⁵Information on references can be found in Clause 2.

used. Minimum conductor size should be AWG No. 12 stranded for adequate strength during installation. Where physical strength does not determine size, control wiring may be smaller, and fixed by other factors. Conductors should be legibly and permanently tagged or marked at each end. Terminating points should also be clearly identified.

3.2.1.1 High-temperature applications

Mineral insulated conductors with corrosion-resistant sheaths may be used where electric circuits are attached to a kiln shell. Mineral insulated conductors may also be used in any high-temperature application within their ratings except where flexibility is required. Applicable terminating fittings should be used with mineral insulated cable. Sheaths should not be welded or brazed directly to supporting surfaces. Cables should be rigidly supported and protected from vibration.

3.2.1.2 Low-level signal cable

Shielded single or multiconductor cable should be used for low-level signals or sensitive control circuits and should be properly supported to protect insulation and conductors. The conductors should be stranded and of a cross section suitable for the application without reference to the size indicated in 3.2.1. Insulation may be approved for 300 V for low-level signal circuits and, in addition, should be suitable for the environment. The shield should be securely grounded to the plant grounding conductor at one point only. The preferable point is at the point of termination in the central control room or electrical equipment room. Fittings used with multiconductor cables should be dust-protecting to prevent the entrance of noncombustible dust. In atmospheres heavily laden with coal dust, Class II fittings should be used.

3.2.1.3 Terminal lugs

Terminal lugs should be of, or equal to, an approved compression type, and of ample size to minimize heating. Lugs should be installed with approved tools to provide low resistance termination. All terminations should be made with lugs or other approved devices in accordance with the desires of the user. Aluminum conductors, if used, should be terminated and connected in strict accordance with manufacturers' recommendations.

3.2.1.4 Splices

Conductor splices should only be in junction boxes, not within conduit runs. Taped splices should be made with permanently flexible tape that will not support combustion.

3.2.2 Conduit

Conduit used for motor and control wiring should be of approved metallic types and should not be smaller than 3/4 in (1.91 mm) nominal size. Conduit should be protected with a corrosion resistance finish and approved for the installation. Where protected from the elements and physical damage, such as in offices, electrical metallic tubing may be used. When conduit encloses a circuit that must be shielded from external magnetic fields, the conduit should be made of paramagnetic materials and the conductors should be twisted to minimize inductance and capacitance between circuits. Flexible connections to fixed equipment, such as belt connected motors and their motor mounted devices, limit switches requiring occasional adjustment, and other equipment that may require slight movement for adjustment should be made with a dust- or liquid-tight flexible metal conduit, or both.

Conduit fittings and terminating enclosures should be metal. Conduit runs should be terminated in suitable indoor dust-tight (NEMA Type 12) or outdoor rainproof (NEMA Type 3R) or indoor and outdoor dust-tight and watertight (NEMA Type 4) metallic enclosures. Conduit bushings should be of the insulated type. Flexible metallic conduit should be suitably terminated with approved fittings to prevent the entrance of dust or moisture.