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STANDARDS PUBLICATION NO. WC 62

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Repeated-Spark/Impulse Dielectric Testing

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET, N.W., WASHINGTON, D.C. 20037

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REPEATED-SPARK/IMPULSE DIELECTRIC TESTING

Published by

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Foreword

This Standards Publication has been approved as Authorized Engineering Information.

This Standards Publication was prepared by the NEMA High Performance Wire and Cable Technical Committee, with input from insulating material suppliers and users of high temperature wire.

This publication and other NEMA Standards for high temperature insulated wire and cable are periodically reviewed by the NEMA High Performance Wire and Cable Section for revisions considered necessary to keep them current with technological changes. Proposed revisions should be submitted to:

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Washington, D.C. 20037

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Scope

This Standards Publication discusses the validity of repeat continuity proof testing of insulated wire and some of the considerations that should be kept in mind when relying on such testing to accept incoming wire shipments.

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SECTION 1
REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated sources.

American Society for Testing Materials
1916 Race Street
Philadelphia, PA 19103

D 3032-89A *Test Methods for Hookup Wire Insulation*

National Electrical Manufacturers Association
2101 L Street, N.W.
Suite 300
Washington, DC 20037

WC 52-1985 *High Temperature & Electronic Wire- Impulse Dielectric Testing*
WC 56-1986 *3.0 kHz Insulation Continuity Proof Testing of Hook Up Wire*

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SECTION 2
REPEATED SPARK/IMPULSE DIELECTRIC TESTING OF WIRE INSULATION

2.1 INTRODUCTION

Wire insulation is normally subjected to some alternating type voltage during its manufacture to detect weak spots for subsequent removal before shipment from the manufacturing plant. The type of test voltage generator and voltage level are selected to best detect "faults" without damaging "good" insulation. Some users of wire also test their incoming wire with similar test equipment and at the same voltage. The question arises with regard to how many times an insulated conductor is required to pass this 100% testing at test voltages far in excess of the rated voltage of the construction.

NEMA Standard 1-8-1992

2.2 GENERAL DISCUSSION

During the past 20 years considerable time, effort and expense have gone into development of test equipment and test procedures to assure the continuity of insulation on insulated conductors and shielded, jacketed cables. The work was shared by test equipment manufacturers, wire processors, and OEM's through the SAE subcommittee AE8D-Wire and Cable, and the NEMA High Performance Wire and Cable Technical Committee.

Miles of wire were tested and retested in order to establish suitable test voltages for various continuous end-use voltage ratings. From these efforts, testing standards have been developed such as NEMA Standards Publication WC 52-1985 High Temperature and Electronic Insulated Wire—Impulse Dielectric Testing, ASTM D 3032-89A, Test Methods for Hookup Wire Insulation, and NEMA WC 56-1986, 3.0 kHz Insulation Continuity Proof Testing of Hook Up Wire.

The test equipment and the established test voltages do an excellent job of culling out weak spots in insulation and cable jackets. Wire processors use the testing system several times during the manufacturing operations. The testing is done not only to ensure a quality product for their customers, but also as a means of preventing excessive scrap generation. If one wire with one fault is processed into a multi-conductor cable, the whole cable is lost.

Many papers have been written describing the breakdown voltage of an insulation as a function of the voltage level and the time of application. Experience has shown that insulated wire that has successfully survived 100% insulation continuity testing just prior to packaging and shipment to a customer can, upon retest at the customer location, reveal one or more failures.

If a shipment is returned to the manufacturer, the manufacturer will retest and find the newly created failure points and may, on occasion, find several more. The faults are cut from the lengths, and the surviving wire is returned to the customer. It would be fortunate if, when the customer retests, all the wire passes. It is possible, however, for one or more new failure points to develop. This situation leaves the manufacturer and the customer in a quandary. Each is doing what he is required or allowed to do, in accordance with current specifications. The customers request corrective actions from the manufacturer, and the manufacturer has to explain the degrading effects that repeated voltage testing has on good insulation and that no recourse for correction exists.

It is possible to damage wire in handling during or after spooling. Due to this fact, some end-users have come to realize that a limited number of failures upon 100% retest is expected. Some end-users have found it reasonable to perform 100% retest at reduced test voltages so as not to over-stress the wire insulation. ASTM D 3032 Paragraph 13.2.3 states:

"Because of possible damage in handling, damage caused by repeated testing and variations in the test parameters, comparisons between producer's and consumer's test results are not significant."

2.3 CONCLUSION

The fact that insulated wire has successfully passed 100% insulation continuity proof testing cannot be construed to be a guarantee that it is possible to retest the same wire several times without encountering a failure and on the very next try to discover several failures.

Test specifications require minimum cycles or pulse impacts as well as maximum cycles or pulse impacts. Repeat testing, in effect, will normally violate the maximum number of cycles and/or number of pulse impacts.

ASTM D 3032 Paragraph 13.2.2 states:

"The test may be used as a manufacturing control, as an acceptance test immediately prior to final packaging by the producer, or as in incoming inspection by the user."

NOTE: The ASTM test method does not recommend that the test be conducted by both producer and user, but rather that it be used at either facility.

End-users of insulated wire should consider the possibility that repeat testing at high stress voltages can initiate or promote development of a failure point. Assurance of receipt of an acceptable product can be obtained by using the age old rule of thumb of "double the rate voltage plus 1,000 volts" as a test criterion. This would apply to insulated wire that has already passed 100% continuity proof testing by the wire processor at the required specification voltage.

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NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for their particular needs. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

(Standardization Policies and Procedures, p. 1)

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 2)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the Standards Publication may be capable of otherwise equivalent performance.

(Standardization Policies and Procedures, p. 8)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes:

1. NEMA Standard, which relates to a product, process or procedure commercially standardized and subject to repetitive manufacture, which standard has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon;
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote thereon.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp 7 & 16)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote on the standard.

(Standardization Policies and Procedures, pp. 7 & 16)

Official Standards Proposal

An Official Standards Proposal is an official draft of a proposed standard which is formally recommended to an outside organization(s) for consideration, comment and/or approval, and which has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon. *(Standardization Policies and Procedures, pp 7 & 16)*

Identification of Status

Standards in NEMA Standards Publications are identified in the foreword or following each standard as "NEMA Standard" or "Suggested Standard for Future Design." These indicate the status of the standard. These words are followed by a date which indicates when the standard was adopted in its present form by the Association.

The material identified as "Authorized Engineering Information" and "Official Standards Proposal" is designated similarly.

July 17, 1990

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HIGH PERFORMANCE WIRE AND CABLE SECTION OF THE NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

American Electric Cable Company
Holyoke, MA 01040

Astro Industries, Inc.
Dayton, OH 45432

AT&T
Norcross, GA 30071

Barcel Wire and Cable Corporation
Irvine, CA 92714-5885

Belden Division/
Cooper Industries Inc.
Richmond, IN 47375

Berk-Tek, Inc.
New Holland, PA 17557

Brand-Rex Company
Willimantic, CT 06226

Cable USA, Inc.
Naples, FL 33942

Cablec Continental Cables Company
York, PA 17402-9950

Carol Cable Company, Inc.
Pawtucket, RI 02862

Champlain Cable Corporation
Winooski, VT 05404

Delta Suprenant Wire and Cable
Clinton, MA 01510

Furon Company
Aurora, OH 44202

Harbour Industries, Inc.
Shelburne, VT 05482

Independent Cable, Inc.
Hudson, MA 01749

Kris-Tech Wire Company, Inc.
Rome, NY 13440

Micro-Tek Corporation
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Mohawk Wire & Cable Corporation
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The Okonite Company
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Pacific Electricord Company
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Philadelphia Insulated Wire Company
Moorestown, NJ 08057

Prestolite Wire Corporation
Farmington Hills, MI 48018

Quirk Wire Company, Inc.
West Brookfield, MA 01585

Radix Wire Company
Euclid, OH 44132

The Rockbestos Company
New Haven, CT 06504

Siecor Corporation
Hickory, NC 28603-0489

Specialty Cable Corp.
Wallingford, CT 06492

Teledyne Thermatics
Elm City, NC 27822

Tensolite Company
St. Augustine, FL 32092

Times Microwave Systems, Inc.
Wallingford, CT 06492

Triangle Wire and Cable, Inc.
New Brunswick, NJ 08903

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