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NEMA MW 820-2016

Standard for Conductor Softness Testing Methods

National Electrical Manufacturers Association

NEMA MW 820-2016

Conductor Softness Testing Methods

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FOREWORD

This publication is periodically reviewed by the NEMA Magnet Wire Section for revisions considered to be necessary to keep it up to date with changes in technology and regulations.

Proposed or recommended revisions should be submitted to:

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

MW 820 was developed by the Magnet Wire Section of NEMA. At the time this edition was approved, the Magnet Wire Section had the following members:

Condumex Inc.	México, D.F., México
Elektrisola Inc.	Boscawen, NH
Essex Group Inc.	Fort Wayne, IN
Magnekón	San Nicolas, NL, México
MWS Wire Industries	Westlake Village, CA
Rea Magnet Wire Company Inc.	Fort Wayne, IN

INTRODUCTION

The testing of conductor “softness” incorporates different metallurgical principles such as ductility, malleability, and surface hardness characteristics. The purpose of MW 820 is to present different wire testing methodologies used by magnet wire manufacturers and users to characterize the “softness of the conductor” in order to predict how well the magnet wire will wind and be formed into its final desired shape and position.

SIGNIFICANCE AND USE

NEMA MW 1000 describes two different conductor softness test methods. Total percent elongation and springback test methods and specifications are described in NEMA MW 1000, part 3, section 3.4, Elongation, and section 3.7, Springback. The intent is not to duplicate these test methods, but it is important to recognize and reference them in this publication. Other test methods for conductor malleability and formability need to be described.

Maximum formability is desirable because it facilitates winding magnet wire more compactly, yields coils that will retain their shape best after removal from the winding forms, and permits the most rapid possible winding with minimum force, minimum wire breakage, and reduced abrasive effects. Each of these test methods provides a more significant measure of formability than do tests for hardness, tensile strength, or total percentage of elongation.

These test methods do not necessarily cover identical zones of the total stress-strain region. The springback method employs mild bending, hence a combination of elongation and compression. The low-stress elongation method employs very slight elongation, and the elastic ratio method employs the greatest elongation. Both the low-stress elongation and springback methods allow the deformed film insulated magnet wire to return partially or entirely to the unstressed condition, while the elastic ratio method does not.

Section 1
General

1.1 Scope

This publication describes ultimate tensile, yield strength, elastic ratio, low-stress elongation (LSE), and Rockwell hardness test methods and the equipment that may be used to determine these measurements.

1.2 References

The following references are to the current revision of each of the standards listed below:

The Aluminum Association, Inc.
1525 Wilson Blvd. Suite 600
Arlington, VA 22209

ANSI: H35.1 *American National Standard Alloy and Temper Designation Systems for Aluminum*

American Society for Testing Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

ASTM B152 *Standard Specification for Copper Sheet, Strip and Rolled Bar*
ASTM B233 *Standard Specification for Aluminum 1350 Drawing Stock for Electrical Purposes*
ASTM B279 *Standard Test Method for Stiffness of Bare Soft Square and Rectangular Copper and Aluminum Wire for Magnet Wire Fabrication*
ASTM D1676 *Standard Test Methods for Film-Insulated Magnet Wire*
ASTM E18 *Standard Test Methods for Rockwell Hardness of Metallic Materials*

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NEMA MW 1000 *Magnet Wire*

1.3 Definitions

elongation (of magnet wire): maximum percent that a magnet wire can be stretched before it ruptures or breaks, also referred to as its breaking point

elastic ratio/modulus (of magnet wire): ratio of load at 5 percent elongation divided by load at break, expressed as a percentage value

formability (of magnet wire): characteristic that permits the magnet wire conductor to maintain the shape into which it has been formed

hardness/indentation hardness: depth of penetration of an indenter under a large load compared to the penetration made by a preload

low-stress elongation (LSE) (of magnet wire): amount of permanent deformation caused by short-time application of a force near the yield strength, expressed as a percentage of elongation of the magnet wire

malleability (of magnet wire): characteristic of the magnet wire conductor that allows it to be stretched and formed into shape