

**ANSI/NEMA WC 74
ICEA S-93-639-2012**

**5-46KV Shielded Power Cable for Use in the
Transmission and Distribution of Electric Energy**

This is a preview. Click [here](#) to purchase the full publication.

This is a preview. Click [here](#) to purchase the full publication.



**Approved as an American National Standard
ANSI Approval Date: December 18, 2012**

**Insulated Cable Engineers Association, Inc. Publication No. ICEA S-93-639
NEMA Standards Publication No. WC 74-2012**

*5-46kV Shielded Power Cable for Use in the Transmission and Distribution
of Electric Energy*

Prepared and Sponsored by:

Insulated Cable Engineers Association, Inc.
P.O. Box 1568
Carrollton, Georgia 30112

www.icea.net

Published by:

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

www.nema.org

© Copyright 2012 by the National Electrical Manufacturers Association and the Insulated Cable Engineers Association, Incorporated. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

This is a preview. Click here to purchase the full publication.

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) and the Insulated Cable Engineers Association (ICEA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together persons who have an interest in the topic covered by this publication. While NEMA and ICEA administers the process and establishes rules to promote fairness in the development of consensus, they do not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA and ICEA disclaims liability for personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA and ICEA disclaims and makes no guaranty or warranty, expressed or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA and ICEA do not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA and ICEA are not undertaking to render professional or other services for or on behalf of any person or entity, nor are NEMA and ICEA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA and ICEA have no power, nor do they undertake to police or enforce compliance with the contents of this document. NEMA and ICEA do not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this document shall not be attributable to NEMA and ICEA and is solely the responsibility of the certifier or maker of the statement.

CONTENTS

	Page
SECTION 1 GENERAL	1
1.1 SCOPE.....	1
1.2 GENERAL INFORMATION	1
1.3 INFORMATION TO BE SUPPLIED BY PURCHASER.....	1
1.3.1 Characteristics of System on Which Cable is to be Used.....	1
1.3.2 Quantities and Description of Cable	2
1.4 DEFINITIONS AND SYMBOLS.....	2
SECTION 2 CONDUCTOR.....	5
2.1 PHYSICAL AND ELECTRICAL PROPERTIES.....	5
2.1.1 Copper Conductors.....	5
2.1.2 Aluminum Conductors.....	5
2.2 OPTIONAL WATER BLOCKING COMPONENTS FOR STRANDED CONDUCTORS.....	6
2.3 CONDUCTOR SIZE UNITS.....	6
2.4 CONDUCTOR DC RESISTANCE PER UNIT LENGTH.....	6
2.4.1 Direct Measurement of dc Resistance.....	6
2.4.2 Calculation of dc Resistance Per Unit Length.....	6
2.5 CONDUCTOR DIAMETER	7
SECTION 3 CONDUCTOR SHIELD (STRESS CONTROL LAYER).....	13
3.1 MATERIAL.....	13
3.2 PHYSICAL REQUIREMENTS	13
3.3 ELECTRICAL REQUIREMENTS	13
3.3.1 Extruded Semiconducting Material	13
3.3.2 Extruded Nonconducting Material (For EPR Insulation Only).....	13
3.3.2.1 Withstand Test.....	13
3.3.3 Semiconducting Tape	14
3.4 CROSSLINKED (THERMOSET) REQUIREMENTS.....	14
SECTION 4 INSULATION.....	15
4.1 MATERIAL.....	15
4.2 INSULATION THICKNESS	16
4.2.1 Selection of Proper Thickness	16
4.3 INSULATION REQUIREMENTS	16
SECTION 5 INSULATION SHIELDING.....	22
5.1 SHIELDING OF INSULATED CABLE.....	22
5.1.1 Insulation Shield.....	22
5.2 REMOVABILITY OF INSULATION SHIELD.....	23
5.2.1 Discharge-Free Cable Designs With Extruded Insulation Shields	23
5.2.2 Discharge-Resistant Cable Designs With Extruded Insulation Shields	23
SECTION 6 METALLIC SHIELDING (SEE APPENDIX G).....	26
6.1 GENERAL.....	26
6.2 METAL TAPES	26
6.2.1 Helically Applied Tape(s).....	26
6.2.2 Longitudinally Applied Corrugated Tape.....	26
6.3 COPPER WIRES, STRAPS, SHEATH OR ARMOR	26
6.4 MULTIPLE-CONDUCTOR CABLES.....	27
SECTION 7 COVERINGS	28
7.1 JACKETS.....	28

7.1.1	Crosslinked and Thermoplastic Jackets - General	28
7.1.2	Neoprene, Heavy-Duty Black (CR-HD)	28
7.1.3	Neoprene, General Purpose (CR-GP).....	28
7.1.4	Polyvinyl Chloride.....	28
7.1.5	Low and Linear Low Density Polyethylene (LDPE & LLDPE).....	28
7.1.6	Medium Density Polyethylene, Black (MDPE).....	28
7.1.7	High Density Polyethylene (HDPE).....	28
7.1.8	Nitrile-butadiene/Polyvinyl-chloride, Heavy-Duty (NBR/PVC-HD)	29
7.1.9	Nitrile-butadiene/Polyvinyl-chloride, General – Purpose Duty (NBR/PVC-GP).....	29
7.1.10	Chlorosulfonated Polyethylene, Heavy Duty (CSPE-HD)	29
7.1.11	Chlorinated Polyethylene, Thermoplastic (CPE-TP).....	29
7.1.12	Chlorinated Polyethylene, Crosslinked, Heavy Duty (CPE-XL-HD)	29
7.1.13	Polypropylene (PP).....	29
7.1.14	Thermoplastic Elastomer (TPE).....	29
7.1.15	Low Smoke Halogen Free Jackets (LSHF).....	29
7.1.16	Repairs.....	30
7.1.17	Test for Suitability for Exposure to Sunlight.....	30
7.1.18	Optional Tray Cable Flame Test Requirement.....	30
7.1.19	Separator Under Jacket.....	30
7.1.20	Jacket Thickness.....	33
7.1.21	Jacket Irregularity Inspection.....	33
7.2	METALLIC AND ASSOCIATED COVERINGS.....	34
7.2.1	General.....	34
7.3	DIVISION I.....	35
7.3.1	Metallic Sheaths.....	35
7.3.2	Flat Steel Tape Armor.....	37
7.3.3	Interlocked Metal Tape Armor	39
7.3.4	Continuously Corrugated Metal Armor.....	40
7.3.5	Galvanized Steel Wire Armor For Submarine Cables	41
7.3.6	Bedding Over Cable Cores To Be Metallic Armored.....	44
7.3.7	Outer Servings.....	45
7.3.8	Crosslinked Jackets Over Metallic Sheaths and Armors	45
7.3.9	Thermoplastic Jackets Over Metallic Sheaths or Armors.....	46
7.4	DIVISION II	47
7.4.1	Borehole Cable (Suspended at One End Only)	47
7.4.2	Dredge Cable	48
7.4.3	Shaft Cable	49
7.4.4	Vertical Riser Cable	49
7.5	DIVISION III.....	50
7.5.1	Buried Land Cables	50
SECTION 8 ASSEMBLY, FILLERS, AND CABLE IDENTIFICATION.....		51
8.1	ASSEMBLY OF MULTIPLE-CONDUCTOR CABLES	51
8.2	FILLERS.....	52
8.3	CONDUCTOR IDENTIFICATION	52
8.4	CABLE IDENTIFICATION	52
SECTION 9 PRODUCTION TESTS AND TEST METHODS.....		54
9.1	GENERAL.....	54
9.1.1	Testing and Test Frequency.....	54
9.1.2	Test Methods.....	54
9.1.3	Number of Test Specimens from Samples.....	56
9.2	THICKNESS MEASUREMENTS.....	56
9.2.1	Beddings and Servings	56
9.2.2	Other Components	56
9.3	SAMPLES AND SPECIMENS FOR PHYSICAL AND AGING TESTS	56

9.3.1 General.....	56
9.3.2 Sampling.....	56
9.3.3 Size of Test Specimens.....	57
9.3.4 Specimens with Bonded Layers.....	57
9.3.5 Specimen Surface Irregularities	57
9.3.6 Specimens for the Aging Tests	58
9.3.7 Calculation of Area of Test Specimens	58
9.4 AGING TESTS.....	59
9.4.1 Air Oven Aging Test.....	59
9.4.2 Oil Immersion Test	59
9.5 HEAT SHOCK TEST.....	59
9.6 COLD-BEND TEST.....	60
9.7 TIGHTNESS OF POLYETHYLENE JACKET TO SHEATH TEST	60
9.8 ELECTRICAL TESTS ON COMPLETED CABLES.....	60
9.8.1 Voltage Tests.....	60
9.8.2 Partial-Discharge Test Procedure	61
9.9 ADHESION (INSULATION SHIELD REMOVABILITY TEST).....	61
9.10 HOT CREEP TEST.....	61
9.11 SOLVENT EXTRACTION	61
9.12 WAFER BOIL TEST FOR EXTRUDED THERMOSET SHIELDS	61
9.12.1Insulation Shield Hot Creep Properties	61
9.13 WATER CONTENT.....	61
9.13.1Water Under the Jacket.....	62
9.13.2Water in the Conductor	62
9.13.3Water Expulsion Procedure.....	62
9.13.4Presence of Water Test.....	62
9.14 VOLUME RESISTIVITY.....	62
9.15 RETESTS	62
9.15.1Physical and Aging Properties and Thickness.....	62
9.15.2Other Tests	63
SECTION 10 QUALIFICATION TESTS.....	64
10.1 ACCELERATED WATER ABSORPTION TEST, ELECTRICAL METHOD AT 60HZ.....	64
10.2 INSULATION RESISTANCE TEST.....	64
10.3 DRY ELECTRICAL TEST FOR CLASS III INSULATIONS ONLY	65
10.3.1Test Samples.....	65
10.3.2Test Procedure	65
10.3.3Electrical Measurements	65
10.4 TEST FOR DISCHARGE RESISTANT INSULATION (EPR CLASS IV INSULATION ONLY).....	65
10.5 BRITTLENESS TEST FOR SEMICONDUCTING SHIELDS.....	66
10.6 TRAY CABLE FLAME TEST.....	66
10.7 SUNLIGHT RESISTANCE TEST	66
10.8 DIELECTRIC CONSTANT AND DISSIPATION FACTOR.....	66
10.9 HALOGEN CONTENT OF NON-METALLIC ELEMENTS	67
10.10 SMOKE GENERATION TEST.....	67
10.11 ACID GAS EQUIVALENT TEST	67
10.12 ENVIRONMENTAL STRESS CRACKING TEST	67
10.13 ABSORPTION COEFFICIENT	67
10.14 DIELECTRIC CONSTANT AND VOLTAGE WITHSTAND FOR NONCONDUCTING STRESS CONTROL LAYERS	67
SECTION 11 CONSTRUCTIONS OF SPECIFIC TYPES.....	68
11.1 PREASSEMBLED AERIAL CABLE.....	68
11.1.1Scope.....	68
11.1.2Conductors.....	68
11.1.3Insulation.....	68
11.1.4Cable Types	68

11.1.5Jacket.....	69
11.1.6Identification.....	69
11.1.7Assembly	69
11.1.8Messenger.....	69
11.1.9Design Criteria.....	69
11.1.10 Tests.....	70
APPENDIX A INDUSTRY STANDARD REFERENCES (NORMATIVE).....	72
APPENDIX B EMERGENCY OVERLOADS (NORMATIVE).....	75
APPENDIX C PROCEDURE FOR DETERMINING DIMENSIONAL REQUIREMENTS OF JACKETS AND ASSOCIATED COVERINGS (NORMATIVE).....	76
APPENDIX D OPTIONAL FACTORY DC TEST (INFORMATIVE).....	79
APPENDIX E REPRESENTATIVE TENSILE STRENGTH AND ELONGATION OF NONMAGNETIC METALS (INFORMATIVE)	80
APPENDIX F VOLTAGE TESTS AFTER INSTALLATION (INFORMATIVE).....	81
APPENDIX G SHIELDING (INFORMATIVE).....	82
APPENDIX H ADDITIONAL CONDUCTOR INFORMATION (INFORMATIVE).....	84
APPENDIX I RECOMMENDED BENDING RADII FOR CABLES (INFORMATIVE).....	87
APPENDIX J ETHYLENE ALKENE COPOLYMER (EAM) (INFORMATIVE).....	90

Foreword

This Standards Publication for 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy was developed by the Insulated Cable Engineers Association (ICEA) and approved by the National Electrical Manufacturers Association (NEMA).

ICEA/NEMA Standards are adopted in the public interest and are designed to eliminate misunderstanding between the manufacturer and the user and to assist the user in selecting and obtaining the proper product for his particular need. Existence of an ICEA/NEMA Standard does not in any respect preclude the manufacture or use of products not conforming to the standard. The user of this Standard is cautioned to observe any health or safety regulations and rules relative to the manufacture and use of cable made in conformity with this Standard.

Requests for interpretation of this Standard must be submitted in writing to:

Insulated Cable Engineers Association
P.O. Box 1568
Carrollton, GA 30112, USA

An official written interpretation will be provided once approved by ICEA and NEMA. Suggestions for improvements gained in the use of this Standard will be welcomed by the Association.

< This page is intentionally left blank. >