

September 24, 2010

1

SUBJECT 4703

**OUTLINE OF INVESTIGATION
FOR
PHOTOVOLTAIC WIRE**

Issue Number: 4

SEPTEMBER 24, 2010

Summary of Topics

This new issue of the Subject 4703 outline is being published to include revisions for the:

Addition of aluminum and copper-clad aluminum conductors;

Increase in maximum conductor size;

Addition of new insulation and jacket thickness tables;

Addition of a cold impact test requirement for "-40 C" marking; and

Addition of FV-2 (horizontal flame test) for wire marked "VW-1".

COPYRIGHT © 2010 UNDERWRITERS LABORATORIES INC.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

No Text on This Page

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM**



Documents
Document Sharing Hub

CONTENTS

INTRODUCTION

1 Scope	4
---------------	---

CONSTRUCTION

2 General	4
3 Assembly	4
4 Conductors	4
4.1 General	4
5 Insulation	6
5.1 Thermoplastic Insulation (90°C Dry and Wet, 600 Volts)	6
5.2 Thermoset insulation and jacket (90, 105, 125, or 150°C dry and 90°C wet, 600, 1000, or 2000 volts)	6

TEST PROGRAM

6 Details	10
7 Manufacturing and Production Tests	11

MARKINGS

8 On the Wire	11
9 On the Tag, Reel, or Carton	12

INTRODUCTION

1 Scope

1.1 This Outline covers single-conductor, insulated and integrally or non-integrally jacketed, sunlight resistant, photovoltaic wire rated 90°C, 105°C, 125°C, or 150°C dry and, 90°C wet, 600, 1000, or 2000 V for interconnection wiring of grounded and ungrounded photovoltaic power systems as described in Wiring Systems, Article 690, and other applicable parts of the National Electrical Code (NEC), NFPA 70.

CONSTRUCTION

2 General

2.1 In addition to being stated in the inch/pound units that are customary in the USA, each of the requirements in this outline is also stated in units that make the requirement conveniently useable in countries employing the various metric systems (practical SI and customary). Equivalent – although, not necessarily exactly identical – results are to be expected from applying a requirement in USA or metric terms. Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

2.2 Only materials that are acceptable for the particular use shall be employed in a wire. Wires shall be made and finished with the degree of uniformity and grade of workmanship that are practicable in a well-equipped factory.

2.3 Each material used in a wire shall be compatible with all of the other materials used in the wire.

3 Assembly

3.1 The wire shall consist of a single, insulated, stranded copper, or aluminum conductor, complying with the construction and materials requirements for Type RHW-2 in the Standard for Thermoset-Insulated Wires and Cables, UL 44, or for Type THW-2 in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, with the exceptions noted in Conductors, Section 4 and Insulation, Section 5. For wires rated greater than 90°C. See 6.2.

4 Conductors

4.1 General

4.1.1 Only stranded conductors of copper, copper-clad aluminum, or an acceptable aluminum alloy shall be used in a wire. Conductors shall consist of materials complying with the:

- a) Standard Specification for Soft or Annealed Copper Wire, ASTM B3,
- b) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, ASTM B8,
- c) Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes, ASTM B33,
- d) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors, ASTM B172,
- e) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors, ASTM B173.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM  **Documents**
Document Sharing Hub

- f) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors, ASTM B 231,
- g) Standard Specification for Silver-Coated Soft or Annealed Copper Wire, ASTM B298,
- h) Standard Specification for Nickel-Coated Soft or Annealed Copper Wire, ASTM B355,
- i) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers, ASTM B800,
- j) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation, ASTM B801,
- k) Standard Specification for Compact Round Stranded Copper Conductors Using Single Input Wire Construction, ASTM B835,
- l) Standard Specification for Compact Round Stranded Aluminum Conductors Using Single Input Wire Construction, ASTM B836,
- m) Standard Specification for Compressed Round Stranded Aluminum Conductors Using Single Input Wire Construction, ASTM B901,
- n) Standard Specification for Compressed Round Stranded Copper Conductors, Hard, Medium-Hard, or Soft Using Single Input Wire Construction, ASTM B902.

4.1.2 A copper conductor shall not be smaller than 18 AWG and shall not be larger than 2000 kcmil. An aluminum or copper-clad aluminum conductor shall not be smaller than 12 AWG and shall not be larger than 2000 kcmil. An aluminum conductor shall be an EC-1350 grade aluminum alloy or be of aluminum conductor material (ACM), AA 8000 series alloy. Copper-clad aluminum conductors shall comply with the Requirements for Copper-Clad Aluminum Conductors in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

4.1.3 An 18 or 16 AWG copper conductor shall comply with the requirements for stranded fixture wire conductors in the Standard for Fixture Wire, UL 66 and shall employ a minimum of 7 strands. All other conductors shall comply with the requirements in the Standard for Thermoset-Insulated Wires and Cables, UL 44, or in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, except as modified in this Section.

4.1.4 Metric conductors in accordance with Conductors of insulated cables, IEC 60228, Class 5 may be used instead of AWG sized conductors described in the Standard for Thermoset-Insulated Wires and Cables, UL 44, or in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83. The size of the conductors shall be between 0.825 and 1013 mm². The next largest AWG size shall be used to determine the insulation and/or jacket thickness.

4.1.5 Refer to Table 5.2 of the Standard for Appliance Wiring Material, UL 758, for the temperature limitations of the conductor material used.