WIRE AND CABLE, ELECTRIC, PTFE TAPE WRAPPED, COPPER OR COPPER ALLOY

1. SCOPE

1.1 SCOPE

This specification covers PTFE tape wrapped wire, unshielded and unjacketed cables, and shielded or shielded and jacketed single- and multiple-conductor cables. This insulation may be used alone or in combination with other insulation materials and is intended for use as a high temperature system in military, aerospace, and general purpose hookup wire applications.

1.2 CLASSIFICATION

Products in accordance with this specification shall be of the following types, as specified in the applicable specification sheet.

Finished Wire: A single conductor, insulated as specified in the applicable specification sheet.

Finished Cable: Any construction other than finished wire, utilizing a wire or wires with or without shielding, and with or without an outer jacket.
(NOTE: Jacketed constructions are only available with shielding.)

1.2.1 Temperature Rating

The maximum conductor temperature of the finished wire and cable for continuous use shall be as specified in the applicable specification sheet.

2. APPLICABLE DOCUMENTS

2.1 GOVERNMENT-FURNISHED DOCUMENTS

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

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2.1.1 Department of Transportation, Federal Aviation Administration

FEDERAL AVIATION REGULATIONS (FAR)

Part 25 Airworthiness Standards: Transport Category Airplanes

(Copies of Department of Transportation, Federal Aviation Administration documents may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402; or at www.faa.gov.)

2.2 OTHER PUBLICATIONS

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.2.1 American Society for Testing and Materials (ASTM)

B 1	Standard Specification for Hard-Drawn Copper Wire
B 3	Standard Specification for Soft or Annealed Copper Wire
B 33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
B 193	Standard Test Method for Resistivity of Electrical Conductor Materials
B 624	Standard Specification for High-Strength, High-Conductivity Copper-Alloy Wire for Electronic Application
D 3032	Standard Test Methods for Hookup Wire Insulation
D 4591	Standard Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry

(Copies of ASTM documents may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; or at www.astm.org.)

2.2.2 National Electrical Manufacturers Association (NEMA)

WC 27500 Standard for Aerospace and Industrial Electrical Cable

(Copies of NEMA documents may be obtained from the National Electrical Manufacturers Association, 1300 North 17th Street, Rosslyn, Virginia 22209; or at www.nema.org.)

2.2.3 Society of Automotive Engineers (SAE)

AS4373	Test methods for Insulated Electric Wire
AS22759	Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy

(Copies of SAE documents may be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001; or at www.sae.org.)

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3. REQUIREMENTS

3.1 SPECIFICATION SHEETS

The requirements for the individual wires and cables furnished under this specification shall be as specified herein and in accordance with the applicable specification sheet. In the event of a conflict, the requirements of the specification sheet shall govern.

3.2 QUALIFICATION

The finished wire and cable furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein (see 4.2).

3.3 MATERIALS

Materials not specifically designated herein shall be of the quality and form best suited for the purpose intended. Unless otherwise specified, the materials shall meet the following requirements:

3.3.1 Conductor Materials

Conductor materials shall be in accordance with AS22759 and the applicable specification sheet.

3.3.2 Shield Materials

Shield materials shall conform to the requirements of WC 27500 and the applicable specification sheet.

3.3.3 Insulating Materials

Insulating materials, used for wire insulation or cable jackets, shall be wrapped and sintered PTFE tape, and as specified in the applicable specification sheet.

3.4 CONSTRUCTION

Construction of the wire and cable shall be as specified herein and in the applicable specification sheet.

3.4.1 Conductor Construction

3.4.1.1 Conductor Diameter

Diameters shall be in accordance with AS22759 and the applicable specification sheet.

3.4.1.2 Conductor Splices

Splices shall be in accordance with AS22759.

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3.4.1.3 Conductor Stranding

Stranding shall be in accordance with AS22759 and the applicable specification sheet.

3.4.2 Shield Construction

Shields shall be in accordance with WC 27500 and the applicable specification sheet.

3.4.3 Insulation and Jacket Construction

Insulation and jacket tapes shall be constructed as specified in the applicable specification sheet and shall be applied in contrahelical layers.

3.5 FINISHED WIRE AND CABLE

3.5.1 Finished Wire

Finished wire shall conform to the requirements of Table 1 and to those of the applicable specification sheet.

3.5.2 Finished Cable

Finished cable shall conform to the requirements of Table 2 and to those of the applicable specification sheet. Component wires used in the cable shall conform to the requirements of 3.5.1, prior to cabling.

3.5.3 Insulation/Jacket State of Sinter

When wire insulation or cable jacket is tested in accordance with ASTM D 4591, the first heat energy to melt shall be less than 25 joules/gram.

3.5.4 Wrinkles

When finished wire is tested in accordance with 4.4.6, there shall be no wrinkling of the insulation.

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TABLE 1. PROPERTIES OF FINISHED WIRE

Examination or Test	Requirement	Test Method	*Inspection Class
Blocking	Specification Sheet and AS22759	AS22759	Q
Color	Specification Sheet	4.4.1	P
Conductor Diameter	Specification Sheet and 3.4.1.1	4.4.1	P
Conductor Elongation and Breaking Strength	AS22759	AS22759	V
Conductor Material	Specification Sheet and 3.3.1	4.4.1	V
Conductor Resistance	Specification Sheet	AS22759	P
Conductor Splices	3.4.1.2	4.4.1	V
Conductor Stranding	Specification Sheet and 3.4.1.3	4.4.1	V
Durability of Identification	Specification Sheet	AS22759	P
Finished Wire Diameter	Specification Sheet	4.4.1	P
Flammability	Specification Sheet	FAR Part 25	Q
Identification of Product	Specification Sheet	4.4.1	P
Insulation Construction	Specification Sheet and 3.4.3	4.4.1	P
Insulation Elongation and Tensile Strength	Specification Sheet	AS22759	P
Insulation Flaws	Specification Sheet	AS22759	100%
Insulation Material	Specification Sheet and 3.3.3	4.4.1	V
Insulation Resistance	Specification Sheet	AS22759	Q
Insulation State of Sinter	3.5.3	ASTM D 4591	P
Low Temperature-Cold Bend	Specification Sheet and AS22759	AS22759	Q
Strip Force	Specification Sheet	4.4.3	P
Thermal Shock Resistance	Specification Sheet	4.4.4	P
Weight	Specification Sheet	AS22759	P
Workmanship	AS22759	AS22759	P
Wrinkles	Specification Sheet and 3.5.4	4.4.6	P

*Inspection Class (see 4.3.1):
P = In-Process or Lot Test
100% = 100% Finished Product Test
Q = Qualification Test
V = Vendor Test

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TABLE 2. PROPERTIES OF FINISHED CABLE

Examination or Test	Requirement	Test Method	*Inspection Class
Blocking	WC 27500	WC 27500	Q
Cabling	WC 27500	WC 27500	P
Color	Specification Sheet	4.4.1	P
Conductor and Shield Continuity	WC 27500	WC 27500	100%
Dielectric Withstand	Specification Sheet and WC 27500	WC 27500	100%
Dimensions	Specification Sheet	4.4.1	P
Durability of Identification	Specification Sheet	AS22759	P
Flammability	Specification Sheet	FAR Part 25	Q
Identification of Product	Specification Sheet	4.4.1	P
Jacket Construction	Specification Sheet and 3.4.3	4.4.1	P
Jacket Elongation and Tensile Strength	Specification Sheet	WC 27500	P
Jacket Flaws	Specification Sheet	WC 27500	100%
Jacket Material	Specification Sheet and 3.3.3	4.4.1	V
Jacket Removability	WC 27500	WC 27500	P
Jacket Shrinkage	Specification Sheet	4.4.2	P
Jacket State of Sinter	3.5.3	ASTM D 4591	P
Jacket Thickness	Specification Sheet	WC 27500	P
Low Temperature-Cold Bend	WC 27500	WC 27500	Q
Shield Construction	Specification Sheet and 3.4.2	4.4.1	P
Shield Coverage	Specification Sheet	WC 27500	P
Shield Material	Specification Sheet and 3.3.2	4.4.1	V
Weight	Specification Sheet	4.4.5	P
Workmanship	WC 27500	WC 27500	P

*Inspection Class (see 4.3.1):
P = In-Process or Lot Test
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4. QUALITY ASSURANCE PROVISIONS

4.1 RESPONSIBILITY FOR INSPECTION

The supplier is responsible for the performance of all inspection tests specified herein. The supplier may utilize his own or any other inspection facility and services acceptable to the buyer. Inspection records of the examinations and tests shall be kept complete and available to the buyer as required.

4.2 QUALIFICATION INSPECTION

Qualification inspection shall consist of all tests listed in Table 1 for wire and in Table 2 for cable. Requalification testing shall be performed any time changes in materials or processes occur that are deemed to have the potential for significantly altering the form, fit, function or appearance of the product.

4.2.1 Sampling for Qualification Inspection

Samples of wire or cable for qualification inspection shall be taken from production lots which have been manufactured under the most current Quality Control Plan. Qualification of the complete product line consists of testing one construction in each specified wire and cable range as follows:

Wire Range	Qualification Construction
10 AWG and smaller	16 thru 22 AWG
8 AWG and larger	8 thru 4 AWG

Cable Range	Qualification Construction
10 AWG and smaller	16 thru 22 AWG
8 AWG and larger	8 thru 4 AWG

4.3 QUALITY CONFORMANCE INSPECTION

Quality conformance inspection consists of a series of tests and inspections that assure that raw materials and manufacturing processes are consistent and result in products that conform to specification requirements.

4.3.1 Inspection Classification

a. Vendor Control (V): Requirements for raw materials such as conductor, insulation and jacket materials over which the vendor has control and responsibility.

b. Process Control (P): Inspections performed on samples taken from the lots of wire or cable. Inspections may be performed on finished wire and cable or after the process which establishes the specified characteristic. The Quality Control Plan establishes the frequency of inspection based on process control data.

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c. One Hundred Percent (100%): Tests performed on the total length of each wire or cable. Tests may be performed on the finished product or "in process", as applicable.

d. Qualification (Q): Tests performed only at the time of initial qualification or requalification.

4.4 TEST METHODS

4.4.1 Examination of Product

All samples shall be examined carefully to determine conformance to this specification and to the applicable specification sheet with regard to requirements not covered by specific test methods.

4.4.2 Jacket Shrinkage

One inch *(25 mm)* of jacket shall be removed from each end of a 12-inch *(305-mm)* specimen of finished cable using a razor blade or equivalent tool. The length of exposed shielding at each end of the specimen shall be measured to the nearest 0.01 inch *(0.3 mm)*. The specimen shall then be exposed to the rated temperature of the cable in an air flow oven for a period of six hours. After removal of the test specimen from the oven, and allowing it to cool to room temperature, the shrinkage of the jacket shall be measured as the greatest additional distance from the jacket edge to the end of the shield. The reported value shall be the larger of the two measurements obtained from each of the cable ends.

4.4.3 Strip Force

The strip force test shall be performed in accordance with ASTM D 3032, Section 27, using a crosshead speed of 20 inches *(508 mm)* per minute, except that the test specimens shall be prepared as follows:

a. Flush cut three 6-inch *(152-mm)* lengths.

b. Using a razor blade, remove 5 inches *(127 mm)* of insulation from one end leaving the remaining one inch *(25 mm)* length undisturbed.

c. Flush cut the one inch *(25 mm)* length such that 0.50 ± 0.03 inch *(12.7 ± 0.8 mm)* of insulation remain on the test specimen.

4.4.4 Thermal Shock Resistance

Testing shall be in accordance with AS22759, except that the shrinkage shall be based on the distance from the insulation to the outer layer of the conductor strands.

4.4.5 Weight

The weight of each lot of finished cable shall be determined in accordance with the procedure for finished wire in AS22759.

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4.4.6 Wrinkles

The test specimen shall be wrapped around a mandrel as specified in the applicable specification sheet for one full turn. The resulting coil shall then be slid off the mandrel and examined for wrinkles without magnification.

5. PREPARATION FOR DELIVERY

5.1 PACKAGING AND PACKING

All layers of wire and cable shall be wound on spools or reels (see 5.1.3) with sufficient tension to prevent shifting of layers and creation of crossovers within layers.

5.1.1 Finished Wire

Finished wire lengths shall be wound on spools or reels with the ends spliced together to provide one mechanically and electrically continuous length. Unless otherwise specified, the minimum continuous length between splices shall be 50 feet *(15 m)*.

5.1.2 Finished Cable

Finished cable lengths shall be wound on spools or reels with all ends exposed. There shall be no more than 5 lengths per spool or reel and no length shall be less than 50 feet *(15 m)*.

5.1.3 Spools and reels

Spools and reels shall be of a nonreturnable type. Each spool and reel shall have an appropriate diameter for the respective wire or cable size. In no case shall the barrel of the spool or reel have a diameter less than 3.5 inches *(89 mm)*. Spools and reels shall be suitably finished to prevent corrosion under typical storage and handling conditions. Loaded plastic spools shall not exceed 50 pounds *(23 kg)*. Loaded wooden reels shall have no weight restriction.

5.1.4 Containers

Unless otherwise specified (see 6.1), finished wire and cable shall be delivered in standard commercial containers so constructed as to ensure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery.

5.2 LABELING REQUIREMENTS

All spools and reels shall be identified with the following information:

Manufacturer's Part Number
Lot Number
Quantity in Feet *(or Meters)*
Name of Manufacturer

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6. NOTES

6.1 ORDERING DATA

Procurement documents should specify the following:

a. Title, number, and date of this specification
b. Applicable specification sheet part number
c. Quantity
d. Special preparation for delivery requirements, if applicable (see Section 5)

6.2 METRIC UNITS

Unless otherwise specified, the metric units (where shown in parentheses) are for information only.

6.3 AS22759

Wherever AS22759 refers to "applicable specification sheet", use the applicable Tyco Electronics specification sheet (see 3.1).

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