



AEROSPACE STANDARD

AS5419™**REV. B**

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Superseding AS5419A

(R) Cable, Thermocouple Extension, Shielded and Unshielded

RATIONALE

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Documents

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1. SCOPE

1.1 Scope

This SAE Aerospace Standard (AS) covers the requirements for thermocouple extension cable. Manufacturers of primary thermocouple wire in accordance with this specification must be qualified to the similar wire type specified in Table 1.

1.2 Classification

The cable shall be of the following types and shall be furnished in the basic wire size and basic wire type and shield and jacket styles, as specified.

Unjacketed - Two wires spirally laid or duplex paralleled without an overall outer jacket.

Jacketed - Two wires spirally laid or duplex paralleled with an overall outer jacket.

Shielded - Two wires spirally laid or duplex paralleled with one or two overall shields.

Shielded and Jacketed - Two wires spirally laid or duplex paralleled with one or two shields and one or two jackets.

1.2.1 Cable Designation

Cable shall be identified by a combination of digits and letters in accordance with the following (see 3.4.1):

AS5419	A	22	JF	KXS	N	06
Aerospace Standard (see 1.2.1.1)	(see 1.2.1.1.1)	Conductor Size (see 1.2.1.2)	Basic Wire Construction (see 1.2.1.3)	EMF Designator (see 1.2.1.4)	Shield Style and Material (see 1.2.1.5)	Jacket Material (see 1.2.1.6)
Example: AS5419A22JFKXSN06						

Figure 1

1.2.1.1 Cable Specification Number

The finished cable shall be identified by the number of this specification.

1.2.1.1.1 Cable Configuration and Braid Shield Coverage

When a minimum shield coverage of 85% is required, specify:

“A” for spiral laid cable configuration

“B” for duplex parallel cable configuration

When a minimum shield coverage of 90% is required, specify:

“C” for spiral laid cable configuration

“D” for duplex parallel cable configuration

1.2.1.2 Conductor Size

The basic wire size shall be identified. All wires used in the cable shall be of the same size.

1.2.1.3 Basic Wire Construction

A letter symbol shall be used to designate the insulation-type specification in accordance with the applicable slant sheet in Table 1.

Table 1 - Component wire construction

	Symbol Sequence	SAE Designation
JF	Similar to MIL-DTL-25038/3	AS5419/1
TA	Similar to AS22759/8	AS5419/2
RC	Similar to AS22759/11	AS5419/3
ML	Similar to AS81044/12	AS5419/4
SP	Similar to AS22759/43	AS5419/5
WP	Similar to AS22759/91	AS5419/6
WJ	Similar to AS22759/86	AS5419/7
DP	Similar to AS22759/191	AS5419/8
DJ	Similar to AS22759/186	AS5419/9

1.2.1.4 EMF Designator

A letter symbol shall be used to designate the EMF type as defined per the individual wire specification.

1.2.1.5 Shield Style and Material

The shield style and material of the overall shields shall be designated by a single letter(s) as shown in Table 2.

Table 2 - Shield style and material

Symbol Single Shield Style	Symbol Double Shield Style	Shield Material 1/	Maximum Temperature Limit for Shield Material (Information Only)
U	---	No shield	---
T	V	Tin-coated copper, round	150 °C (302 °F)
S	W	Silver-coated copper, round	200 °C (392 °F)
N	Y	Nickel-coated copper, round	260 °C (500 °F)
F	Z	Stainless steel, round	400 °C (752 °F)
C	R	Nickel-clad copper (27%), round	400 °C (752 °F)
M	K	Silver-coated high-strength copper alloy, round	200 °C (392 °F)
P	L	Nickel-coated high-strength copper alloy, round	260 °C (500 °F)
G	A	Silver-coated copper, flat	200 °C (392 °F)
H	B	Silver-coated high-strength copper alloy, flat	200 °C (392 °F)
NF	ND	Nickel-coated copper, flat	260 °C (500 °F)
J	D	Tin-coated copper, flat	150 °C (302 °F)
E	X	Nickel-coated high-strength copper alloy, flat	260 °C (500 °F)
I	Q	Nickel chromium alloy, flat	400 °C (752 °F)
HS	HD	Heavy Silver-coated copper, round	200 °C (392 °F)

1/ Refer to ANSI/NEMA WC 27500.

1.2.1.6 Jacket Material and Temperature Rating

The single jacket symbol shall be used for cables with an outer jacket only. The double jacket symbol shall be used in conjunction with a double shield symbol to describe constructions with a jacket in-between two shields, with another jacket over the outer shield. The single jacket symbol shall be used in conjunction with the double shield symbol to describe constructions with two overlaid shields with a single outer jacket. Unless otherwise specified (see 6.2.1.f), jacket colors shall be as specified under the jacket materials as follows:

Table 3 - Jacket style and material

Single Jacket Symbol	Double Jacket Symbol	Jacket Material	Temperature Limit for Jacket Material (Information Only)
00	00	No jacket	---
04	54	Polyester braid impregnated with high-temperature finishers over polyester tape	150 °C (302 °F)
05	55	Extruded clear fluorinated ethylene propylene (FEP)	200 °C (392 °F)
06	56	Extruded or taped and fused white polytetrafluoroethylene (PTFE)	260 °C (500 °F)
07	57	White polytetrafluoroethylene (PTFE) treated glass braid impregnated and coated with polytetrafluoroethylene finisher over pre-sintered polytetrafluoroethylene tape	260 °C (500 °F)

Table 3 - Jacket style and material (continued)

08 ^{1/}	58 ^{1/}	Crosslinked white extruded polyvinylidene fluoride (PVF ₂)	150 °C (302 °F)
09	59	Extruded white fluorinated ethylene propylene (FEP)	200 °C (392 °F)
11 ^{2/}	61 ^{2/}	Tape of natural polyimide combined with clear fluorinated ethylene propylene (FEP) wrapped and heat sealed with (FEP) outer surface	200 °C (392 °F)
12 ^{2/}	62 ^{2/}	Tape of natural polyimide combined with fluorinated ethylene propylene (FEP) wrapped and heat sealed with polyimide outer surface	200 °C (392 °F)
14	64	Extruded white ethylene-tetrafluoroethylene (ETFE) copolymer	150 °C (302 °F)
15	65	Extruded clear ethylene-tetrafluoroethylene (ETFE) copolymer	150 °C (302 °F)
16	66	Braid of aromatic polyamide with high-temperature finisher over pre-sintered polytetrafluoroethylene (PTFE) tape	200 °C (392 °F)
20	70	Extruded white perfluoroalkoxy (PFA)	260 °C (500 °F)
21	71	Extruded clear perfluoroalkoxy (PFA)	260 °C (500 °F)
22	72	Tape of opaque polyimide combined with clear fluorinated ethylene propylene (FEP) wrapped and heat sealed with polyimide outer surface	200 °C (392 °F)
23	73	White crosslinked extruded modified ethylene-tetrafluoroethylene copolymer (XLETFE)	200 °C (392 °F)
24	74	Tape layer of white polytetrafluoroethylene (PTFE) wrapped over a tape layer of natural polyimide combined with FEP and heat sealed	260 °C (500 °F)
25	75	Smooth Surface tape layer of white polytetrafluoroethylene (PTFE) wrapped over a tape layer of natural polyimide combined with FEP and heat sealed	260 °C (500 °F)
26	76	Extruded, white, low fluoride, crosslinked modified, ethylene- tetrafluoroethylene (XLETFE)	200 °C (392 °F)
^{1/} Jacket material 08 and 58 is not to be used for cables having a diameter of 0.401 inch (10.19 mm) or greater.			
^{2/} Not for U.S. Department of Defense (Navy).			

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS4373	Test Methods for Insulated Electric WireAS22759Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy
AS81044	Wire, Electrical, Crosslinked Polyalkene, Crosslinked Alkane-Imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
AS29606	Wire, Electric, Stranded, Uninsulated Copper, Copper Alloy or Aluminum, or Thermocouple Extension

2.2 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

FED-STD-228	Cable and Wire, Insulated; Methods of Testing
MIL-DTL-25038	Wire Electrical, High Temperature, Fire Resistant, and Flight Critical
MIL-STD-104	Limit for Electrical Insulation Color
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
SAM System Awards Management*	

*Available from <https://www.sam.gov/portal/public/SAM/>.

2.3 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI/ASTM B3	Soft or Annealed Copper Wire
ANSI/ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ANSI/ASTM B298	Silver Coated Soft or Annealed Copper Wire
ANSI/ASTM B355	Nickel Coated Soft or Annealed Copper Wire
ANSI/ASQC Z1.4	Sampling Procedures and Tables for Inspection by Attributes
ANSI/NEMA WC 27500	American National Standard for Aerospace and Industrial Electrical Cable

2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A313	Wire, Steel, Corrosion-Resisting
ASTM B170	Oxygen Free Electrolyte Copper Refinery Shapes
ASTM B272	Copper Flat Copper Products With Finished (Rolled or Drawn) Edges (Flat Wire and Strip)
ASTM B624	High Strength, High Conductivity Copper Alloy Wire for Electronic Application Standard Specification for
ASTM D3032	Hookup Wire Insulation, Standard Methods of Testing

3. REQUIREMENTS

Metric units provided herein are soft metric conversions. In the event of conflict, English units shall be used to determine the final result.

3.1 Materials

3.1.1 Copper Shield Round Strand Material

Before shielding, the copper strands used in shields shall be annealed or soft-drawn copper wire from commercially pure copper and shall conform to ASTM B3. Nickel plated strands shall conform to ASTM B3 or ASTM B170. It shall be possible to solder or crimp the material to approved terminals. Wire shall be free from lumps, kinks, splints, abrasions, scraped or corroded surfaces, and skin impurities.

3.1.2 Stainless-Steel Shield Material

Before shielding, the stainless steel strands shall conform to ASTM A313. It shall be possible to crimp the wire to approved terminals. The wire shall be free from kinks, abrasions, or scraped surfaces.

3.1.3 High-Strength Copper Alloy Shield Round Strands

Before shielding, the high-strength copper alloy strands shall conform to ASTM B624, except that the minimum tensile strength shall be 55000 lbf/in² (2633 kn/m²), the minimum elongation shall be 6%, and the conductivity shall be 80% (minimum), as stated in NBS Handbook 100.

3.2 Construction

Construction shall comply with the classification given in 1.2. Combinations of shield style and material, basic wire specification, and jacket materials shall be restricted to those allowed in Table 5, unless otherwise approved by the preparing activity of this standard.

3.2.1 Basic Wire

The basic wire (primary) shall meet all the requirements as defined herein. Unless otherwise specified, the cable manufacturer is responsible for assuring that the basic wire requirements are as specified.

3.2.2 Cable Layup

The required number of wires for multiconductor construction determined by the cable designation shall be cabled with a left-hand lay. The lay of the individual wires shall be not less than six, nor more than 16, times the outside major axis diameter of the unshielded, unjacketed cable, as calculated in 4.5. The basic wire shall not be spliced. When cables are cut, wires will maintain proper sequence and shall not splay more than twice the diameter of the cable.

3.2.2.1 Fillers and Binder Tapes

Fillers and binder tapes, if used, shall be of a fungus-resistant material with a temperature equivalent to the cable rating without fillers and tape. Fillers and binders shall also be easily removable from the finished cable without adherence to the underlying insulation.

3.2.3 Shield

When the cable designation specifies that a shield is to be incorporated in the cable construction, either a closely woven braid using round strand or a closely woven braid of flat strand shall be applied over the basic cable.

3.2.3.1 Round Shield

3.2.3.1.1 Round Shield Strand Material

Before application to the cable, individual tin, silver, or nickel-coated copper strands shall have a minimum elongation of 6%.

3.2.3.1.2 Round Copper or Copper Alloy Strand Size

Cables with braided shields using round copper or round copper alloy strands shall conform to Shield Groups A or B. The core diameter referred to in Groups A or B shall be the nominal outside core diameter of the unshielded, unjacketed cable equal to the basic wire diameter multiplied by a factor of 1.64. The following component wires Type RC, Type ML, Type SP, Type WP, Type WJ, Type DP, and Type DJ shall conform to Shield Group B. All other braided shields with round shield strands shall conform to Shield Group A.

Table 4 - Shield size

Group A Cable OD	Group B Cable OD	Shield Size
0.000-0.060 inch (0.000-1.524 mm)	0.000-0.250 inch (0.000-6.35 mm)	38 AWG
0.061-0.310 inch (1.525-7.847 mm)	0.251-0.400 inch (6.36-10.16 mm)	36 AWG
0.311-0.750 inch (7.848-19.05 mm)	0.401-1.000 inch (10.17-25.4 mm)	34 AWG
0.751 inch (19.06 mm) and larger	1.001 inch (25.5 mm) and larger	32 AWG

3.2.3.1.3 Round Shield Strand Coating

3.2.3.1.3.1 Tin-Coated Copper Strands

When the cable designation specifies a tin coated shield, the individual strands shall be coated uniformly with a smooth, continuous layer of commercially pure tin. Prior to braiding, the strands shall meet the requirements of ASTM B33. The thickness of the tin coating shall be 250 µin (6.35 µm) maximum.

3.2.3.1.3.2 Silver-Coated Copper and High-Strength Alloy Strands

When the cable designation specifies a silver coated copper shield, the individual strands shall be coated uniformly with a smooth continuous layer of commercially pure silver. Prior to braiding, silver-coated copper strands shall meet the requirements of ASTM B298. Silver-coated high-strength copper alloy strands shall meet the requirements of 3.1.3, and the adhesion and continuity of coating requirements of ASTM B298. The thickness of the silver shall be not less than 40 µin (1.02 µm), except for shield styles HS and HD, which shall be 80 µin (2.04 µm).

3.2.3.1.3.3 Nickel-Coated Copper and High-Strength Alloy Strands

When the cable designation specifies a nickel-coated shield, the individual strands shall be coated uniformly with a smooth, continuous layer of commercially pure nickel having a coating thickness of not less than 50 µin (1.27 µm), nor greater than 250 µin (6.35 µm). The wire shall meet the coating requirements of ASTM B355 prior to braiding.

3.2.3.1.3.4 Nickel-Clad Copper Strands

When the cable designation specifies a nickel clad copper shield, the individual strands shall have a nickel coating having a cross-sectional area that is 27% minimum of the total cross-sectional area of the drawn strand. The wire shall meet the coating requirements of ASTM B355 prior to braiding.

3.2.3.1.4 Stainless-Steel Shield

3.2.3.1.4.1 Stainless-Steel Strand Size

On cable with outside diameter (under the shield) of less than 0.060 inch (1.52 mm), the strand size shall be AWG 40. On cable with an outside diameter of 0.060 to 0.120 inch (3.05 mm), the strand size shall be AWG 38. On cable with outside diameter of 0.121 inch (3.07 mm) and larger, the strand size shall be AWG 36.