

# Wiring Test

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# Purpose

- Develop an improved test method and procedure for aircraft electrical wiring.
- This test method is intended for determining the resistance of electric wire insulation to flame when tested according to the Draft version 5.7.
- This is the new wire test we are currently developing at the FAA Technical Center.

# Test Specimens

- Wire or cable bundles are the preferred test specimens.
- Certain situations may exist in which not enough samples of the wire or cable are available, the wire gage size is too large to bundle, or they are flat cables.
  - In these cases, single wire or cable testing will be allowed. The minimum specimen length, in this test, is 4 inches (101.6 mm).

# Background

- Because of diversity of wall thicknesses (light weight & normal weight) for Composite (POLYTETRAFLUOROETHYLENE/POLYIMIDE) type of wire and cables, we correlate flammability tests using wires and cables construction from the TABLES 1 and 3, to verify results for these most common used wires and cables in the industry.
- With these tests we tried to validate simplified flammability tests using only three specimens of the same wire or cable insulation type, and more commonly used AWG sizes.
- Results will show whether or not we need to perform flammability tests on both, wires and cables, as individual components or bundle flammability tests for wires and cables.

# Test Specimens

- Test specimens are COMPOSITE – POLYTETRAFLUOROETHYLENE/POLYIMIDE wire insulation type, smooth surface, light weight and normal weight, nickel-coated copper conductor, AWG # 20 and 22, compatible with SAE AS22759/187 & /192 specifications.
- For cable construction we used twisted pairs with the same component wires as above, AWG # 20 and # 22, round shields & jacket, compatible with NEMA WC 27500 DK and DR specifications.

# Test Methods and Apparatus

- With exception of number of wires and cables in the bundles and bundle diameters, test methods and apparatus were in accordance with Draft version 5.7 (Flammability Test Method and Criteria for Aircraft Electrical Wiring).
- Tests were performed on individual wires and cables and on bundles with 7 wires and 7 cables.

# Test Specimens

**TABLE 1 - INDIVIDUAL, SINGLE WIRES**

Specimen	Qty	Supplier	Part Number	AWG	Length
A - 1	03	1	AS22759/192-20-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	20	20"
A - 2	03	1	AS22759/192-22-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	22	20"
A - 3	03	1	AS22759/187-20-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	20	20"
A - 4	03	1	AS22759/187-22-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	22	20"
A - 5	03	2	AS22759/192-20-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	20	20"
A - 6	03	2	AS22759/192-22-5 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	22	20"
A - 7	03	2	AS22759/187-20-9 POLYTETRAFLUOROETHYLENE/POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	20	20"

# Test Specimens

**TABLE 2 - BUNDLES WITH 07 WIRES**

Specimen	Qty	Supplier	Part Number	No. of Wires in Bundle	AWG	Length
B - 1	03	1	AS22759/192-20-9 POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	20	20"
B - 2	03	1	AS22759/192-22-9 POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	22	20"
B - 3	03	1	AS22759/187-20-9 POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	20	20"
B - 4	03	1	AS22759/187-22-9 POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	22	20"



# Test Specimens

<b>B - 5</b>	03	2	<b>AS22759/192-20-9</b> POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	20	20"
<b>B - 6</b>	03	2	<b>AS22759/192-22-5</b> POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, LIGHT WEIGHT, NICKEL-COATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	22	20"
<b>B - 7</b>	03	2	<b>AS22759/187-20-9</b> POLYTETRAFLUOROETHYLENE/ POLYIMIDE INSULATED, SMOOTH SURFACE, NORMAL WEIGHT, NICKELCOATED COPPER CONDUCTOR, 260 °C, 600 VOLTS	07	20	20"

# Test Specimens

**TABLE 3 - INDIVIDUAL CABLES**

Specimen	Qty	Supplier	Cable Part Number	AWG	Wall (Comp. Wire)	Length
C - 1	03	1	M27500-20DR2N25 Twisted pair, round shield & jacket	20	LIGHT WEIGHT	20"
C - 2	03	1	M27500-22DR2N25 Twisted pair, round shield & jacket	22	LIGHT WEIGHT	20"
C - 3	03	1	M27500-20DK2N25 Twisted pair round shield & jacket	20	NORMAL WEIGHT	20"
C - 4	03	1	M27500-22DK2N25 Twisted pair round shield & jacket	22	NORMAL WEIGHT	20"
C - 5	03	2	M27500-22WN2N24 Twisted pair round shield & jacket	20	NORMAL WEIGHT	20"

# Test Specimens

**TABLE 4 - BUNDLES WITH 07 CABLES**

Specimen	Qty	Supplier	Cable Part Number	No. of Cables in Bundle	AWG	Wall (Comp. Wire)	Length of bundle
D - 1	03	1	M27500-20DR2N25 Twisted pair, round shield & jacket	07	20	LIGHT WEIGHT	20"
D - 2	03	1	M27500-20DR2N25 Twisted pair, round shield & jacket	07	22	LIGHT WEIGHT	20"
D - 3	03	1	M27500-20DK2N25 Twisted pair round shield & jacket	07	20	NORMAL WEIGHT	20"
D - 4	03	1	M27500-20DK2N25 Twisted pair round shield & jacket	07	22	NORMAL WEIGHT	20"
D - 5	03	2	M27500-22WN2N24 Twisted pair round shield & jacket	07	22	NORMAL WEIGHT	20"

# Results

## INDIVIDUAL, SINGLE WIRES

Specimen	No	Burn Length		Flame-Extinguish Time (sec)	Drip Flame-Extinguish Time	Conductor Exposed	Comments
		inch	mm				
A-1	1	0.62	15.87	0	0	N	
A-1	2	0.75	19.04	0	0	N	
A-1	3	0.75	19.04	0	0	N	
A-2	1	0.56	14.22	0	0	Y	
A-2	2	0.75	19.04	0	0	N	
A-2	3	0.75	19.04	0	0	N	
A-3	1	0.62	15.87	0	0	N	
A-3	2	0.43	10.16	0	0	N	
A-3	3	0.37	9.39	0	0	N	
A-4	1	0.5	12.69	0	0	N	
A-4	2	0.5	12.69	0	0	N	
A-4	3	0.56	14.22	0	0	N	
A-5	1	0.37	9.39	0	0	N	
A-5	2	0.37	9.39	0	0	N	
A-5	3	0.37	9.39	0	0	N	
A-6	1	0.5	12.69	0	0	N	
A-6	2	0.37	9.39	0	0	N	
A-6	3	0.5	12.69	0	0	N	
A-7	1	0.36	9.14	0	0	N	
A-7	2	0.36	9.14	0	0	N	
A-7	3	0.5	12.69	0	0	N	

# Results

## BUNDLES WITH 07 WIRES

Specimen	No	Max Burn Length		Flame-Extinguish Time (sec)	Drip Flame-Extinguish Time	Conductor Exposed	Comments
		inch	mm				
B - 1	1	0.75	19.04	0	0	N	
B - 1	2	0.75	19.04	0	0	N	
B - 1	3	0.75	19.04	0	0	N	
B - 2	1	0.75	19.04	0	0	N	
B - 2	2	0.75	19.04	0	0	N	
B - 2	3	0.62	15.87	0	0	N	
B - 3	1	0.56	14.22	0	0	N	
B - 3	2	0.43	10.9	0	0	N	
B - 3	3	0.75	19.04	0	0	N	
B - 4	1	0.56	14.22	0	0	N	
B - 4	2	0.56	14.22	0	0	N	
B - 4	3	0.56	14.22	0	0	N	
B - 5	1	0.5	12.69	0	0	N	
B - 5	2	0.75	19.04	0	0	N	
B - 5	3	0.5	12.69	0	0	N	
B - 6	1	0.62	15.87	0	0	N	
B - 6	2	0.5	12.69	0	0	N	
B - 6	3	0.56	14.22	0	0	N	
B - 7	1	0.43	10.9	0	0	N	
B - 7	2	0.56	14.22	0	0	N	
B - 7	3	0.56	14.22	0	0	N	

# Results

## INDIVIDUAL CABLES

Specimen	No	Burn Length		Flame-Extinguish Time (sec)	Drip Flame-Extinguish Time	Shield Exposed	Comments
		inch	mm				
C - 1	1	0.5	12.69	0	0	N	
	2	0.62	15.87	0	0	N	
	3	0.62	15.87	0	0	N	
C - 2	1	0.75	18.2	0	0	N	
	2	0.52	13.4	0	0	N	
	3	0.63	16.1	0	0	N	
C - 3	1	0.72	18.2	0	0	N	
	2	0.74	19.2	0	0	N	
	3	0.74	19.1	0	0	N	
C - 4	1	0.67	17.3	0	0	N	
	2	0.67	17.3	0	0	N	
	3	0.67	17.3	0	0	N	
C - 5	1	0.55	14.2	0	0	N	
	2	0.59	15.7	0	0	N	
	3	0.55	14.2	0	0	N	

# Results

## BUNDLES WITH 07 CABLES

Specimen	No	Max Burn Length		Flame-Extinguish Time (sec)	Drip Flame-Extinguish Time	Shield Exposed	Comments
		inch	mm				
D - 1	1	0.56	14.22	0	0	N	
	2	1.25	31.74	0	0	N	
	3	1.25	31.74	0	0	N	
D - 2	1	1.02	25.9	0	0	N	
	2	1.10	27.9	0	0	N	
	3	1.18	29.9	0	0	N	
D - 3	1	1.10	27.9	0	0	N	
	2	1.06	26.9	0	0	N	
	3	1.10	27.9	0	0	N	
D - 4	1	1.14	28.9	0	0	N	
	2	0.90	22.9	0	0	N	
	3	0.90	22.9	0	0	N	
D - 5	1	0.7	17.7	0	0	N	
	2	0.59	14.9	0	0	N	
	3	0.62	15.7	0	0	N	

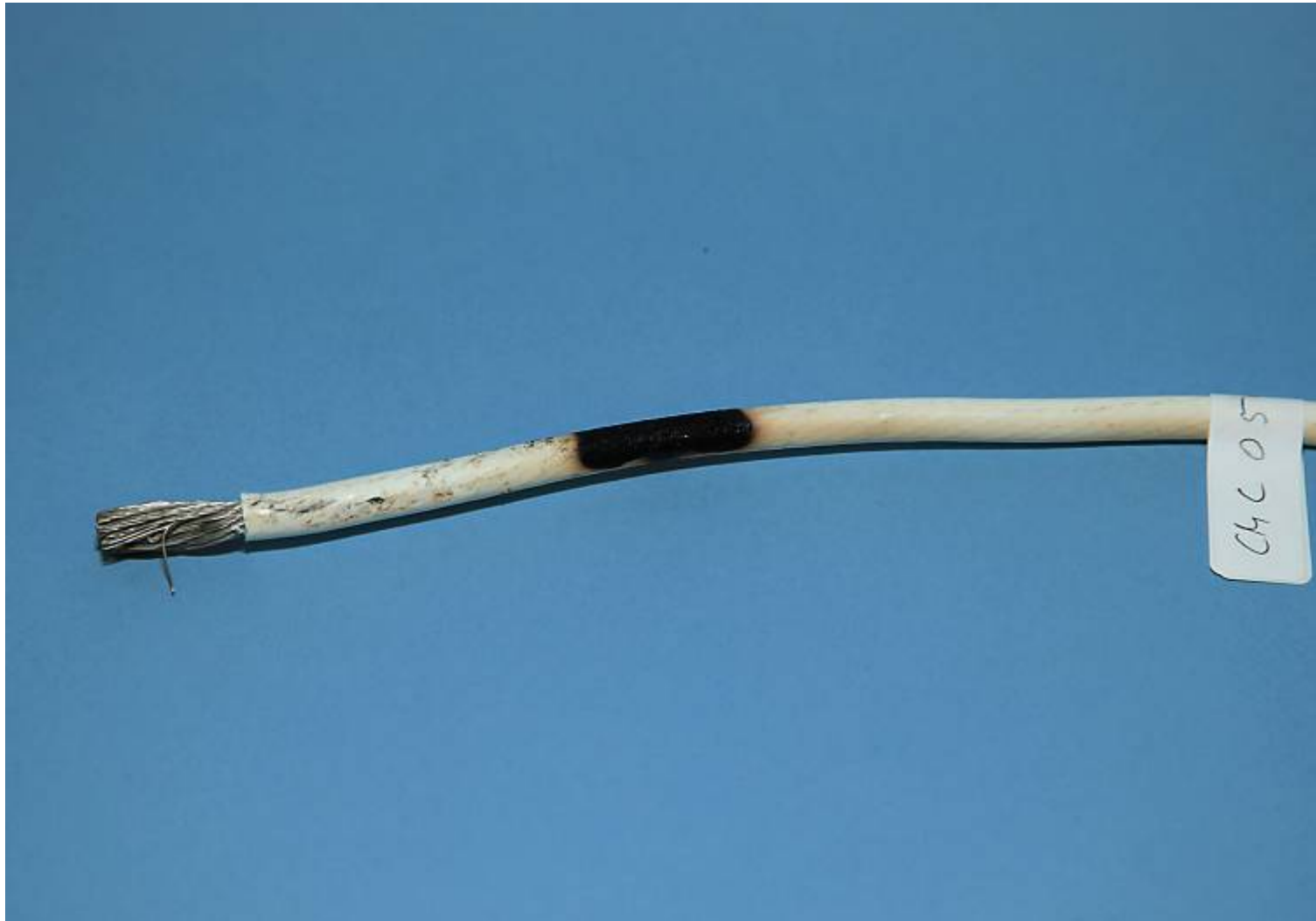
# Conclusions

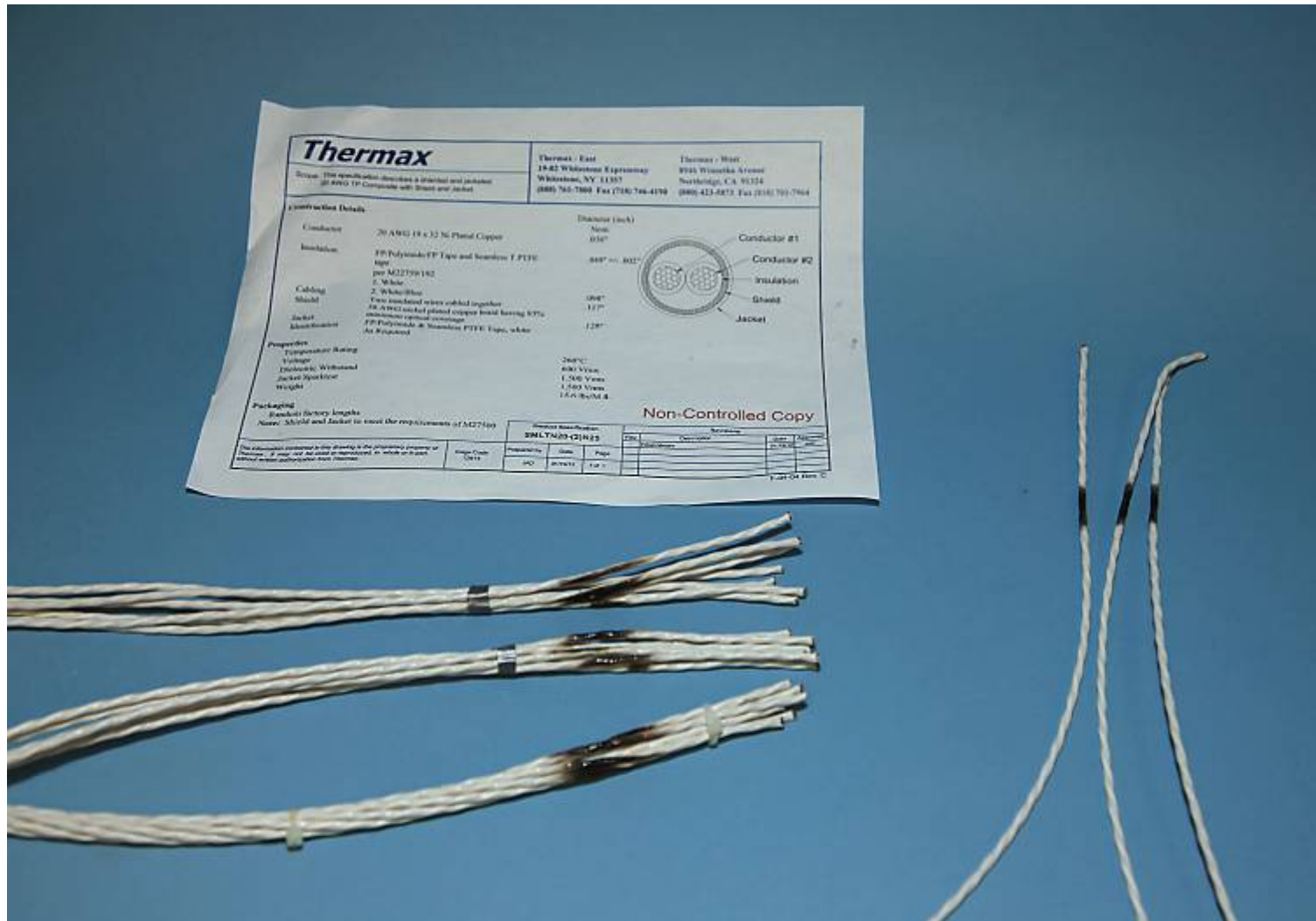
- Results of these tests demonstrate that no significant difference in resistance to flame of electric wire or cable with Composite (Polytetrafluoroethylene/Polyimide) insulation are noted when tested in the wire bundle configuration or as individual components, with different wall thicknesses, or with different AWG.



# Testing Recommendations to Working Group

- Testing three (3) specimens of single wires from same manufacturer of AWG = 20, Normal Weight (as per SAE AS 22759/80 to 92 or /180 to 192).
- Three (3) specimens of the cables, having twisted pair, component wires of AWG = 20, Normal Weight (as per SAE AS 22759/80 to 92 or /180 to 192).from same manufacturer and in accordance with NEMA WC 27500 spec.
- Discussion on testing a single wire versus bundles.



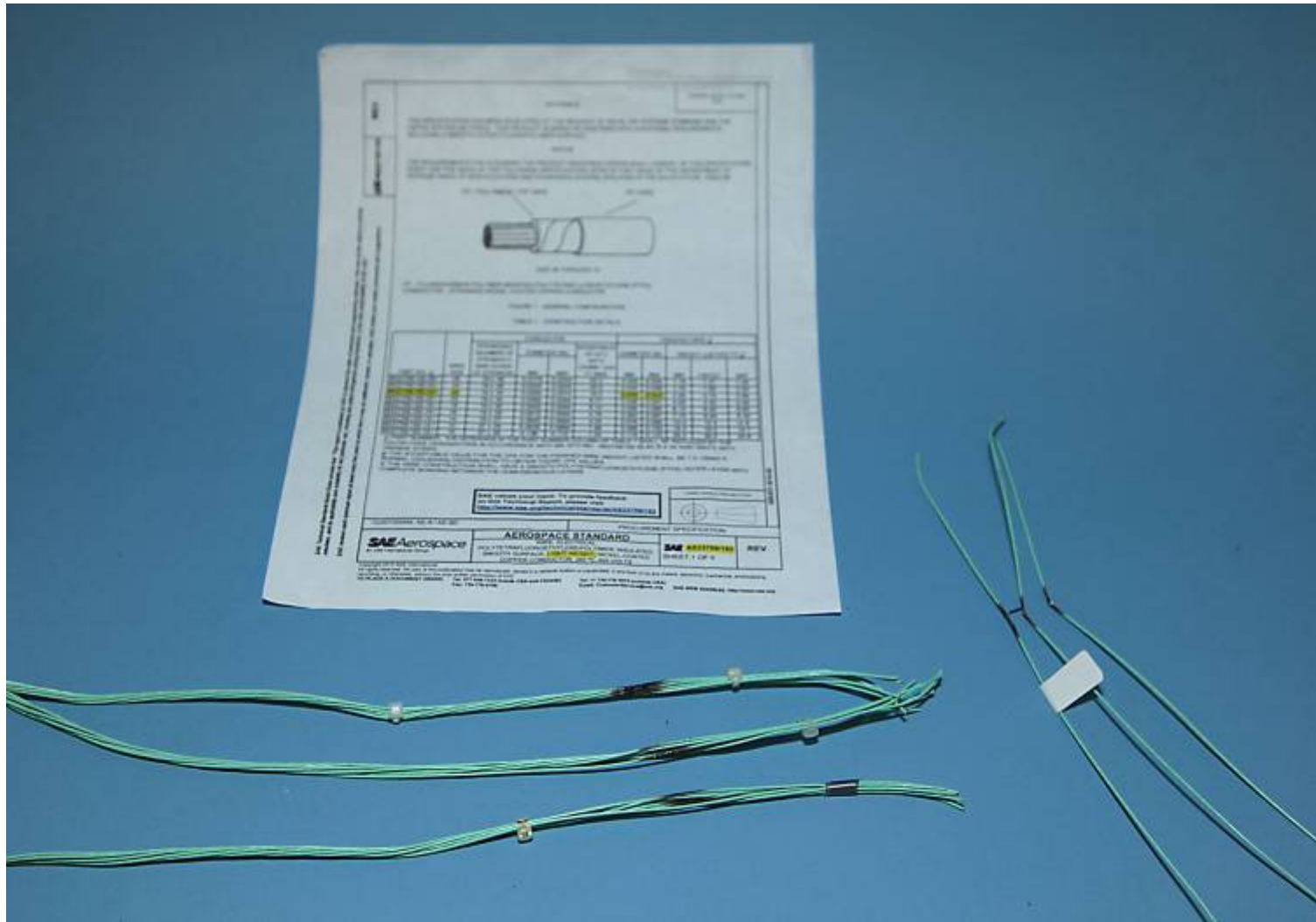




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