

METRIC

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January 4, 1977

**WIRE AND CABLE APPLICATIONS,
STANDARD FOR**

ENGINEERING DEVELOPMENT DIRECTORATE

National Aeronautics and
Space Administration

John F. Kennedy Space Center

KSC FORM 16-12 (REV. 6/95) PREVIOUS EDITIONS ARE OBSOLETE



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WIRE AND CABLE APPLICATIONS,
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Approved:



Walter T. Murphy
Director of Engineering Development

JOHN F. KENNEDY SPACE CENTER, NASA

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ABBREVIATIONS AND ACRONYMS

A	glass or other suitable braid material, abbreviation for
AC, ac	alternating current
Al	aluminum
AWG	American Wire Gage
BR	Butylrubber
CLP	cross-linked propylene rubber
cond.	conductor(s)
construct.	construction
CU	copper
°C	degree Celsius
DB	double braid
EPR	ethylene propylene rubber
Gnds.	grounds
Insul.	insulation
kcmil	thousands of circular mils
KSC	John F. Kennedy Space Center
LC/PC	lead covered neoprene jacket
MI	mineral-insulated
NASA	National Aeronautics and Space Administration
No., #	number
OAS	overall shield
PA	polyamide (nylon)
PC	polychloroprene (neoprene)
PE	polyethylene
PI	paper-insulated
PVC	polyvinyl-chloride
RHW	synthetic rubber, weatherproof and heat-resistant
SA	high-temperature silicone
SC	single conductors
SPEC	specification
STD	standard
temp.	temperature

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JOHN F. KENNEDY SPACE CENTER, NASA
WIRE AND CABLE APPLICATIONS, STANDARD FOR

1. SCOPE

This standard provides information applicable to the selection and applications of the standard 60-hertz alternating current (ac) power wires and cables that shall be used at the John F. Kennedy Space Center (KSC), NASA. These wires and cables shall be used for all new installations and replacement of existing wires and cables in order to minimize spare requirements and to utilize wires and cables which have proved reliable. Wires and cables have been categorized in general groups according to intended use, electrical characteristics, and wire and cable mechanical characteristics. This standard does not present complete construction data; however, specific KSC specification numbers for complete requirements are given herein. Should additional wire and cable construction data be needed other than that given herein, the user should consult the applicable referenced specification. When specifying wires and cables, the designer shall designate applicable specifications listed herein.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

2.1 Governmental.

2.1.1 Specifications.

John F. Kennedy Space Center (KSC, NASA)

KSC-SPEC-E-0018	AC Power Cable, General Purpose, Single Conductor, 600 Volts, 60 Hertz, Procurement of, Specification for
KSC-SPEC-E-0019	AC Power Cable, Multi-Conductor, 600 Volts, 60 Hertz, Procurement of, Specification for

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KSC-SPEC-E-0020	AC Power Cable, Mineral Insulated, 600 Volts, 60 Hertz, Procurement of, Specification for
KSC-SPEC-E-0021	AC Power Cable, Interlocked Armored, 600 Volts, 60 Hertz, Procurement of, Specification for
KSC-SPEC-E-0022	AC Power Cable, 5,000 Volts, 60 Hertz, Procurement of, Specification for
KSC-SPEC-E-0023	AC Power Cable, 15,000 Volts, 60 Hertz, Procurement of, Specification for

2.1.2 Standards.

John F. Kennedy Space Center (KSC), NASA

KSC-STD-E-0006	Instrumentation and Communications Cable Applications, Standard for
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(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

3. DEFINITIONS

Not applicable.

4. GENERAL REQUIREMENTS

The following paragraphs provide explanatory information related to the information given in table 1. When specifying wires and cables, the designer shall designate applicable specifications listed in the table.

4.1. Grouping. - Wires and cables have been grouped by normal intended usage; however, there may be some overlap in cables, wires, and cords to allow the user greater freedom in his selection. The groups consist of general purpose wire and cables, Teflon wire, portable cords, portable power cable, mineral-insulated wire,

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Table 1. Wire and Cable Selection

Type	Temp. Rating	No. of Cond.	Sizes	Cond. Insul.	Sheath (Jacket)	Specifications
GENERAL PURPOSE WIRE AND CABLE - 600 VOLTS, SC/UNSH						
TW	60 °C	1	#12 - #8	PVC	.	KSC-SPEC-E-0018
THW	75 °C	1	#12 - 500 kcmil	PVC	.	KSC-SPEC-E-0018
THWN	75 °C	1	#12 - 500 kcmil	PVC	PA	KSC-SPEC-E-0018
THHN	90 °C*	1	#12 - 500 kcmil	PVC	NYLON	KSC-SPEC-E-0018
RHW	75 °C	1	#12 - 500 kcmil	RHW	.	KSC-SPEC-E-0018
RHH	90 °C	1	#12 - 500 kcmil	RHW	.	KSC-SPEC-E-0018
USE	75 °C	1	#12 - 500 kcmil	RHW	PC	KSC-SPEC-E-0018
USE	75 °C	2-3	#12 - #2	RHW	PC	KSC-SPEC-E-0019
XHHW	75 °C 90 °C*	1	#12 - 500 kcmil	PE	PVC	KSC-SPEC-E-0018
SA	125 °C	1	#12 - #4/0	S	A	KSC-SPEC-E-0018
TEFLON WIRE - 600 VOLTS, SC/UNSH						
TFE	150 °C	1	#12, #10	TEFLON	.	KSC-SPEC-E-0018
PORTABLE CORDS - 600 VOLTS, SC/UNSH						
SO	60 °C	2-4	#12, #10	BR	PC	KSC-SPEC-E-0019
STO	60 °C	2-4	#12, #10	PE	PC	KSC-SPEC-E-0019
PORTABLE POWER CABLE - 600 VOLTS, SC/UNSH						
W	75 °C	2-4	#8 - #4/0	BR	PC	KSC-SPEC-E-0019
G	75 °C	4 + Gnds	#8 - #4/0	BR	PC	KSC-SPEC-E-0019
MINERAL INSULATED WIRE - 600 VOLTS, SC/UNSH						
MI	85 °C	1-4	#12 - #4/0	MI	CU	KSC-SPEC-E-0020
INTERLOCKED ALUMINUM ARMORED CABLE - 600 VOLTS, SC/UNSH						
N/A	90 °C	3	#8 - 500 kcmil	CLP	AL	KSC-SPEC-E-0021
MEDIUM VOLTAGE POWER CABLE - 5,000 VOLTS, SC/OAS (Concentric Neutral)						
5 kV-EPR	90 °C	1	#2/0-750 kcmil	EPR	PE	KSC-SPEC-E-0022
MEDIUM VOLTAGE POWER CABLE - 15,000 VOLTS, SC/OAS (Concentric Neutral)						
15 kV-EPR	90 °C	1	#2/0-750 kcmil	EPR	PE	KSC-SPEC-E-0023

* Dry locations

NOTES: 1. Size. - Wire sizes based on thousands of circular mils (kcmil) or AWG numbers, as applicable.

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Table 1. Wire and Cable Selection (cont)

2. Construction Type. - Abbreviations used to indicate cable construction are as follows:
 - a. MI - Mineral-insulated
 - b. OAS - Overall shield
 - c. SC - Single conductors
 - d. UNSH - Unshielded

3. Construction Type. - Abbreviations used to indicate cable construction are as follows:
 - a. BR - Butyl rubber
 - b. CLP - Cross-linked polyethylene
 - c. EPR - Ethylene propylene rubber
 - d. MI - Mineral-insulated (magnesium oxide)
 - e. PI - Paper-insulated
 - f. PE - Polyethylene
 - g. PVC - Polyvinyl-chloride
 - h. RHW - Synthetic rubber (weatherproof and heat-resistant)
 - i. SA - High-temperature silicone

4. Sheath. - Abbreviations for types of sheath of outer jacket are as follows:
 - a. A - Glass or other suitable braid material (asbestos shall not be used)
 - b. AL - Aluminum
 - c. CU - Copper
 - d. DB - Double braid
 - e. LC/PC - Lead covered, neoprene jacket
 - f. PA - Polyamide (nylon)
 - g. PC - Polychloroprene (neoprene)
 - h. PE - Polyethylene
 - i. PVC - Polyvinyl-chloride

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and interlocked aluminum armored cable, 5-kilovolt (kV)-EPR and 15-kV-EPR. Different types of insulation for various conductors are also given in table 1. The general description and intended use of each cable and wire is given in 5.1.

4.2 Voltage. - The voltage rating for the wire and cable tabulated in this standard will fall into one of three classifications; 600 volts, 5,000 volts, or 15,000 volts. Applicable voltage ratings are shown in table 1. This standard does not cover wires and cables having a nominal rating of less than 600 volts.

4.3 Temperature. - Temperature rating of each wire or cable will be as indicated in table 1.

4.4 Conductors. - Conductors are all soft-annealed copper. Conductors No. 10 American Wire Gage (AWG) and smaller shall be solid; or when required for a particular application, stranded. Conductors No. 14 AWG or smaller are considered control wiring and are not included in this standard. For such, refer to KSC-STD-E-0006.

4.5 Shielding. - Conductor shielding as applicable to 60-hertz power cables in this standard will apply only to 5,000-volt and 15,000-volt cables. For cables rated 600 volts or less which require shielded conductors or overall shield (OAS) cables, KSC-STD-E-0006 shall apply.

5. DETAILED REQUIREMENTS

5.1 Cable Descriptions.

5.1.1 General Purpose Wire and Cable.

- a. Type RHH - Heat-resistant rubber, 600-volt, 90 degree Celsius (°C); for use in dry locations.
- b. Type RHW - Moisture- and heat-resistant rubber, 600-volt, 75 °C; for use in dry and wet locations.
- c. Type SA - Heat-resistant Silicone, 600-volt, 125 °C; for use in dry locations (high temperatures).
- d. Type THHN - Heat-resistant thermoplastic, 600-volt, 90 °C; for use in dry locations.
- e. Type THW - Moisture- and heat-resistant thermoplastic, 600-volt, 75 °C; for use in dry and wet locations.

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- f. Type THWN - Moisture- and heat-resistant thermoplastic, 600-volt, 75 °C; for use in dry and wet locations.
- g. Type TW - Moisture-resistant thermoplastic 600-volt, 60 °C; for use in dry and wet locations.
- h. Type USE - Moisture- and heat-resistant rubber with neoprene sheath; 600-volt, 75 °C; for use in dry and wet locations as aerial, direct burial or open wiring.
- i. Type XHHW - Moisture- and heat-resistant, cross-linked synthetic polymer, 600-volt, 75 °C for wet locations and 90 °C for dry locations.

5.1.2 Teflon Wire. - Type TFE - Teflon insulated wire, 600-volt, 150 °C; for special application.

5.1.3 Portable Cords.

- a. Type SO - Rubber insulated, flexible conductors in highly resistant (to oil, grease, alkalis, sunlight, ozone and flame) neoprene sheath, 600-volt, 60 °C; for hard usage in dry and wet locations.
- b. Type STO - Thermoplastic insulated, flexible conductors in highly resistant (to oil, grease, alkalis, sunlight, ozone and flame) thermoplastic sheath, 600-volt, 60 °C; for hard usage in dry and wet locations.

5.1.4 Portable Power Cable.

- a. Type G - Similar to Type W, except for additional braid covered flexible ground conductors.
- b. Type W - Heat-resistant rubber insulated, flexible conductors in highly resistant (to abrasion, impact, aging, oil, ozone and flame) neoprene sheath, 600-volt, 75 °C; extra hard usage in dry or wet locations.

5.1.5 Mineral-Insulated Cable. - Type MI - Mineral insulated (magnesium oxide) with copper sheath, 600-volt, 85 °C; for use in dry and wet locations.

5.1.6 Armored Cable. - Interlocked Aluminum Armored Cable - Cross-link polyethylene insulation, 600-volt, 90 °C; for indoor and outdoor installation.

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5.1.7 Medium Voltage Power Cable.

- a. Type EPR, 5,000 Volts - Ethylene propylene rubber with polyethylene jacket. The cable shall be shielded and rated 133-percent insulation level for a grounded neutral system, suitable for aerial or duct installation. See referenced specification for shield size and other requirements.
- b. Type EPR, 15,000 Volts - Ethylene propylene rubber with polyethylene jacket. The cable shall be shielded and rated 133-percent insulation level for a grounded neutral system, suitable for aerial or duct installation. See referenced specification for shield size and other requirements.

5.2 Request for Waiver. - Should a requirement exist for a cable or wire type not listed in this standard, a waiver may be requested. Requests for waivers shall contain supporting technical information on the cable or wire type needed and technical justifications as to why the cable or wire type must be used. Request for waivers should be addressed to Electrical Division, Engineering Development Directorate, John F. Kennedy Space Center, NASA, Kennedy Space Center, Florida 32899.

6. NOTES

Intended Use. - This standard is intended to be used by designers in the selection of cables or wires for new installation and cable replacement at KSC.

NOTICE. When KSC drawings, specifications, or other data are used for any purpose other than in connection with a definitely related KSC procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the KSC may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodian:

NASA - John F. Kennedy Space Center

Preparing Activity:

John F. Kennedy Space Center
Electrical Division
Engineering Development Directorate

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
KSC-STD-E-0014B

2. DOCUMENT DATE
September 17, 1996

3. DOCUMENT TITLE

Wire and Cable Applications, Standard for

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include Zip Code)*

d. TELEPHONE *(Include Area Code)*

7. DATE SUBMITTED

B. PREPARING ACTIVITY

a. NAME

Director of Engineering Development

d. TELEPHONE *(Include Area Code)*

(407) 867-2565

c. ADDRESS *(Include Zip Code)*

National Aeronautics and Space Administration, Mail Code: DE
Kennedy Space Center, FL 32899