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REV. BASIC

SPECIFICATION FOR COPPER CABLE

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RECORD OF REVISIONS/CHANGES

REV LTR	CHANGE NO.	DESCRIPTION	DATE
Basic		Initial	April 2002

ABBREVIATIONS AND ACRONYMS

AWG	American Wire Gage
C	Celsius
DC	Direct Current
ft	Foot
KSC	John F. Kennedy Space Center
m	Meter
μm	Micrometer
mm	Millimeter
nm	Nanometer
OTV	Operational Television
pf	Pico Farad
sec	Second

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1.0 SCOPE

This specification establishes the minimum requirements for the material, construction, inspection, test, marking, and packaging requirements for a flexible, multiconductor, neoprene-jacketed electrical cable. The cable will be the medium for Alternating Current power and camera control for the Operational Television Video (OTV) cameras at Kennedy Space Center (KSC).

2.0 APPLICABLE DOCUMENTS

The latest issue of the following documents to the extent specified herein. In the event of conflict between this specification and referenced documents, the contents of this specification shall be the superseding requirement.

2.1 Governmental

Title	Document Number
Cable and Wire, Insulated; Methods of Testing	FED-STD-228
Cable, Cord, and wire, Electric Packaging of	MIL-C-12000H
Insulation, Electrical, Synthetic Resin	MIL-I-631D
Marking for shipment and Storage	MIL-STD-129N
Cables, Electrical, General Specification For	KSC-SPEC-E-0031A
Plastic, Molding and Extrusion Material Polyethylene and Copolymers	LP-390C

2.2 Non-Governmental

Title	Document Number
Quality Systems-Model for Quality Assurance in Design, Development, Production, Installation, Servicing	ANSI/ASQC Q9001-1994
Tinned Soft and Annealed Copper Wire for Electrical Purposes	ASTM B33
Silver-Coated Soft or Annealed Copper Wire	ASTM B298
Test Methods for Crosslinked Insulations and Jackets for Wire and Cable	ASTM D470
Standard Classification System for Nylon Injection & Extrusion Materials (PA)	ASTM D 4066
Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi	ASTM G21
Rubber-Insulated Wire and Cable for the Transmission and Distribution of electrical Energy	NEMA WC 3

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement function should be obtained from the procuring activity or as directed by the Contracting Officer.

3.0 REQUIREMENTS

The finished OTV Multiconductor Electrical Cable shall be compliant with the requirements of this document and specified KSC-SPEC-E-0031A requirements. In the event of conflict between KSC-SPEC-E-0031A referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement. KSC-SPEC-E-0031A, Appendix A is not applicable to this cable and disregard all references to the cable specification sheets in KSC-SPEC-E-0031A, Appendix A.

3.1 Materials

The materials used in the manufacturing of this cable shall be compliant to all requirements as stated in this document and the KSC-SPEC-E-0031A paragraphs listed below.

a. As per KSC-SPEC-E-0031A, paragraph 3.3, the materials used in the manufacturing of this cable shall be virgin material (100 percent new material) processed one time only and with only those processes necessary for the manufacturing that material. The manufacturer of the cable shall obtain certifications from their suppliers to this effect and the manufacturer shall certify that the materials supplied under these certifications are used in the manufacture of this cable in conformance with the requirements specified herein.

b. As per KSC-SPEC-E-0031A, paragraph 3.3.1; copper strands comprising the conductors and braided shields shall be tinned, soft-annealed, commercially pure copper conforming to the requirements of ASTM B33.

c. As per KSC-SPEC-E-0031A, paragraph 3.3.2; polyethylene conforming to the requirements for type II, class L, grade 3 or 4 of LP-390C, prior to extruding, shall be used as the primary insulation material for all Conductor Groups.

d. As per KSC-SPEC-E-0031A, paragraph 3.3.5; polymide conforming to the requirements for type III, grade E, of ASTM D4066 shall be used for insulation covering over all Conductor Groups.

e. As per KSC-SPEC-E-0031A, paragraph 3.3.6; polyethylene terephthalate (mylar) used as barrier tape shall conform to the applicable requirements of MIL-I-631D.

f. As per KSC-SPEC-E-0031A, paragraph 3.3.7; polychloroprene (neoprene) shall be used as a double-layer sheath and conform to all the requirements in NEMA WC 3 and in table 1 of KSC-SPEC-E-0031A.

g. As per KSC-SPEC-E-0031A, paragraph 3.3.8, textiles used for separators and tape markers shall consist of fungus-resistant cotton, synthetic thread, or yarn, as applicable, conforming to the applicable fungus resistance requirements of ASTM G21.

3.2 Conductors

The conductors shall be formed by concentrically stranding the number and sizes of tinned copper wire strands as specified in KSC-SPEC-E-0031A; table 2. The strands shall be laid so as to produce a circular cross section of uniform diameter. The conductors used in the manufacturing of this cable shall be compliant to all requirements as stated in this document and the KSC-SPEC-E-0031A paragraphs listed below.

a. As per KSC-SPEC-E-0031A, paragraph 3.5.1, each #20 American Wire Gage (AWG) conductor shall contain 19 individual strands.

b. As per KSC-SPEC-E-0031A, paragraph 3.5.2, each #20 AWG conductor shall be a 32 AWG strand size.

c. As per KSC-SPEC-E-0031A, Table 2, the maximum Direct Current (DC) resistance at 20 degrees Celsius (C) shall be 9.76 ohms/1000 ft. for the # 20 AWG conductor size wire.
d. As per KSC-SPEC-E-0031A, paragraph 3.5.1, each #16 AWG conductor shall contain 19 individual strands.
e. As per KSC-SPEC-E-0031A, paragraph 3.5.2, each #16 AWG conductor shall be a 29 AWG strand size.
f. As per KSC-SPEC-E-0031A, Table 2, the maximum DC resistance at 20 degrees C shall be 4.82 ohms/1000 ft. for the # 16 AWG conductor size wire.
g. As per KSC-SPEC-E-0031A, paragraph 3.5.1, each #12 AWG conductor shall contain 19 individual strands.
h. As per KSC-SPEC-E-0031A, paragraph 3.5.2, each #12 AWG conductor shall be a 25 AWG strand size.
i. As per KSC-SPEC-E-0031A, Table 2, the maximum DC resistance at 20 degrees C shall be 1.92 ohms/1000 ft. for the # 12 AWG conductor size wire.
j. See KSC-SPEC-E-0031A, paragraph 3.5.3 for stranding and length of lay requirements.
k. See KSC-SPEC-E-0031A, paragraph 3.5.4 for splice requirements.

3.3 Conductor Testing

The conductors shall be subjected to an elongation, tin coating, and conductor resistance tests. The following KSC-SPEC-E-0031A paragraphs identify the conductor testing requirements.

a. An elongation test shall be compliant to KSC-SPEC-E-0031A, paragraph 3.5.5.1
b. A tin coating (Individual Strands) test shall be compliant to KSC-SPEC-E-0031A, paragraph 3.5.5.2.
c. A conductor resistance test shall be compliant to KSC-SPEC-E-0031A, paragraph 3.5.5.3.

3.4 Conductor Insulation

The polyethylene insulation materials used on conductors shall be extruded over each conductor or conductor separator, as applicable, in a continuous layer. The insulating materials shall form a close fit over the conductor without adhering to the conductor or adhering to the insulation of the other conductors when fabricated into a cable. After stripping the insulation the conductor shall be clean and in a condition for soldering. After application, the insulating material shall be seamless and free from foreign materials.

The average wall thickness for the polyethylene insulation shall be 0.25 mm (0.01 inch) for the #20 AWG conductors, 0.38 mm (0.015 inch) for the #16 AWG conductors, and 0.51 mm (0.02 inch) for the #12 AWG conductors. The minimum thickness shall be not less than 90 percent of the specified average thickness. The conductor insulation shall be complaint to KSC-SPEC-E-0031A paragraph, 3.6.1 and table 2.

3.5 Conductor Insulation Testing

The polyethylene primary conductor insulation material shall be tested per the following KSC-SPEC-E-0031A paragraphs.

a. As per KSC-SPEC-E-0031A, paragraph 3.6.2.1; tensile strength tests shall be made in accordance with method 3021 of FED-STD-228. Ultimate elongation tests shall be made in accordance in accordance with method 3031 of FED-STD-228.
b. As per KSC-SPEC-E-0031A, paragraph 3.6.2.2, before accelerated aging, the tensile strength and elongation at rupture shall conform to the original requirements specified in KSC-SPEC-E-0031A, table 3.
c. As per KSC-SPEC-E-0031A, paragraph 3.6.2.3, accelerated aging shall be in accordance with ASTM D470. Specimens of polyethylene shall be oven-aged for 48 hours at a temperature of 100 ±1 degrees C. After accelerated aging, the tensile strength and elongation at rupture shall conform to all requirements as specified in KSC-SPEC-E-0031A, table 3.
d. Insulation shrinkage testing shall be compliant to KSC-SPEC-E-0031A, paragraph 3.6.3.
e. Insulation stripping testing shall be compliant to KSC-SPEC-E-0031A, paragraph 3.6.4.
f. Insulation water absorption testing shall be compliant to KSC-SPEC-E-0031A, paragraph 3.6.5.
g. Insulation electrode spark test testing shall be compliant to KSC-SPEC-E-0031A, paragraph 3.6.6.

3.6 Insulation Covering

The insulation covering shall be concentrically applied over the polyethylene primary insulation. The insulation covering material shall be extruded, clear, heat-stabilized polyamide with a minimum wall thickness of 0.05 μm (0.002 inch).

The polyamide insulation covering test shall be compliant to KSC-SPEC-E-0031A, paragraph 3.7.1.1.

3.7 Conductor Shield

The conductor shield shall be a tight-fitting, closely woven braid of tinned copper strands that shall be applied directly over all conductor groups (conductors, conductor insulation, and insulation covering). The braid shall provide a 90 percent minimum coverage over the construction. The braided strands shall be applied to preclude irregularities, breaks, or other discontinuities. The conductor shield strand size and shield angle requirements shall be per KSC-SPEC-E-0031A, table 5. The actual data used to select the shield angle and overall coverage shall be documented and provided for inspection purposes. The conductor shield shall be compliant to KSC-SPEC-E-0031A, paragraph 3.8.

3.8 Conductor Shield Insulation

All shielded conductor groups shall be insulated with an extruded polyethylene material. The polyethylene material shall conform to KSC-SPEC-E-0031A, section 3.3.2. The minimum polyethylene insulation thickness shall be as specified in KSC-SPEC-E-0031A, table 6.

3.9 Finished Cabling

The finished cable shall be compliant to all requirements as specified in this document and to all identified KSC-SPEC-E-0031A paragraphs. The configuration for the finished cable furnished under this specification shall be as shown in Figures 1 through 5.

The finished OTV cable shall contain six isolated conductor groups that comprise the cable core. The cable core shall be wrapped by a barrier tape, covered with an overall shield, wrapped with a separator, and protected with an extruded double-layer sheath. The finished cables maximum outside diameter shall be less than 31.75 mm (1.25 inch).

Conductor group A shall contain three #12 AWG isolated conductors that are twisted and shielded. The # 12 AWG twisted conductors maximum mutual capacitance shall be less than 50 pf/ft and the single end capacitance shall be less than 100 pf/ft.

Conductor group B shall contain three #16 AWG isolated conductors that are twisted and shielded. The #16 AWG twisted conductors maximum mutual capacitance shall be less than 40 pf/ft and the single end capacitance shall be less than 80 pf/ft.

Conductor groups C through F are of identical configuration. They shall contain two # 20 AWG isolated conductors that are twisted and shielded. The # 20 AWG twisted conductors maximum mutual capacitance shall be less than 30 pf/ft and the single end capacitance shall be less than 60 pf/ft.

3.10 Direction and Length of Lay

The direction of lay for the multiple groups of conductors shall be unidirectional right hand or left hand. The length of lay shall be 8 to 16 times the outside diameter of the applicable layer. The direction and length of lay shall be compliant to KSC-SPEC-E-0031A, paragraph 3.10.1.

3.11 Binder

Binding material may be used as a manufacturing aid, provided it does not adversely affect cable flexibility or geometry. The mylar binder tape shall a have a minimum thickness of 0.038 mm (0.0015 inches) and be applied with a 25 to 50 percent overlap. The binding material shall be per and compliant to KSC-SPEC-E-0031A, paragraphs 3.3.6 and 3.10.2.

3.12 Overall Shield

A single-braided overall shield consisting of copper strands shall be applied between the inner barrier tape and the outer barrier tape. The shield shall be constructed to provide 90 percent minimum coverage when calculated in accordance with the equation in paragraph 3.8 in KSC-SPEC-E-0031A. The shield strand size and shield angle shall be constructed per and compliant to KSC-SPEC-E-0031A, table 7. The overall shield shall be compliant to KSC-SPEC-E-0031A, paragraph 3.10.3.

3.13 Barrier Tape

The required barrier tape shall have a minimum thickness of 0.025 mm (0.001 inch) with a 25 to 50 percent overlap. The barrier tape shall be compliant to KSC-SPEC-E-0031A paragraphs 3.3.6 and 3.10.5.

3.14 Filler

Polyolefin filaments used for filler material shall be oriented polyethylene or polypropylene multi-monofilaments capable of meeting all performance requirements as stated in KSC-SPEC-E-0031A, paragraph 3.10.6. The filler material shall be provided within the conductor groups and within the completed cable core as required to maintain a circular cross section.

3.15 Separator

A cable separator consisting of dry, soft, textile braid with a minimum thickness 0.025 mm (0.001 inch) and a minimum of 80 percent coverage shall be applied over the assembled components and under the sheath. The cable separator shall be compliant to KSC-SPEC-E-0031A, paragraphs 3.3.8 and 3.10.7.

3.16 Sheath

The cable jacket shall be a double-layer sheath that consists of a Polychloroprene (Neoprene) compound having the physical properties as specified in NEMA WC 3. The polychloroprene shall be extruded over the cable core to form a well-centered sheath with a nominal wall thickness of 0.125 inch. At any cross section, the minimum thickness of the sheath wall shall not be less than 90 percent of the specified thickness. The sheath shall be extruded over the cable in two layers; the outer layer shall contain at least 50 percent of the total thickness. Application shall be such that the sheath is concentric with the cable conductors. The sheath shall be compliant to KSC-SPEC-E-0031A, paragraphs 3.3.7 and 3.10.8.

The rubber or rubber-like sheath shall be vulcanized and cured in place over the cable core while contained in and restricted by a close-fitting mold. After vulcanizing the rubber or rubber-like sheath, the sheath shall be a firmly bound, strong, high-elastic, homogeneous mass. The rubber or rubber-like sheath shall not be over-vulcanized, sticky, or tacky. The sheath shall not be separable into layers without extreme difficulty, and shall pass the sheath test requirements per KSC-SPEC-E-0031A, paragraph 4.8.7 and table 8.

There shall be a reinforcement between the two sheath layers. The reinforcement shall consist of two serves of 423 mm (16.67 inch) cabled cotton, served in reverse, seven ends, with a 25 mm (1 inch) lay. Equivalent rayon or nylon tire cord may be substituted for the cabled cotton.

3.17 Sheath Testing

The Polychloroprene (Neoprene) sheath on finished cable shall meet all of the requirements specified herein. Before accelerated aging and oil immersion, the tensile strength test and elongation at rupture shall be compliant to the physical properties as specified in KSC-SPEC-E-0031A, table 1. See NEMA WC3 for detailed test requirements.

a. The tensile strength test shall be performed in accordance with Method 3021 of FED-STD228.
b. The ultimate elongation test shall be performed in accordance with Method 3031 of FED-STD-228.
c. The oil resistance test shall be performed in accordance with Method 4221 of FED-STD-228.
d. The accelerated aging of the sheath shall be performed in accordance with ASTM D470.
e. After accelerated aging, the tensile strength shall not be less than 50% and the elongation at rupture shall not be less than 60% of value as specified per KSC-SPEC-E-0031A, table 1.
f. After immersion in oil, the tensile strength and elongation at rupture shall not be less than 60% of value as specified per KSC-SPEC-E-0031A, table 1.

3.18 Color Code

All Conductor insulation shall be color coded as follows (See Figure 2):

a. The three conductors located in conductor group A shall be color coded as follows:
   (1) The insulation for conductor # 1 shall be black.
   (2) The insulation for conductor # 2 shall be white/black.
   (3) The insulation for conductor # 3 shall be white/violet.
b. The three conductors located in conductor group B shall be color coded as follows:
   (1) The insulation for conductor # 8 shall be red.
   (2) The insulation for conductor # 9 shall be white/red.
   (3) The insulation for conductor # 10 shall be white/slate.
c. The two conductors located in conductor group C shall be color coded as follows:
   (1) The insulation for conductor # 4 insulation shall be green.
   (2) The insulation for conductor # 5 insulation shall be white /green.
d. The two conductors located in conductor group D shall be color coded as follows:
   (1) The insulation for conductor # 6 insulation shall be orange.
   (2) The insulation for conductor # 7 insulation shall be white/orange.
e. The two conductors located in conductor group E shall be color coded as follows:
   (1) The insulation for conductor # 11 insulation shall be blue.
   (2) The insulation for conductor # 12 insulation shall be white/blue.
f. The two conductors located in conductor group F shall be color coded as follows:
   (1) The insulation for conductor # 13 insulation shall be yellow.
   (2) The insulation for conductor # 14 insulation shall be white/yellow.

3.19 Cable Marking

The finished cable shall be identified with a printed marking being applied to the outer surface of the sheath. Either ink or hot stamp marking shall be employed. Hot stamping, if used, shall be performed prior to subjecting the cable to the sheath flaws and insulation resistance tests. Ink used for identification shall be of the best quality normally used in good commercial practice. Marking shall be repeated at intervals of not more than 600 mm (2 feet) and may be continuous.

The cable identification marking applied to the outer surface consist of the following:

a. Per Cable Assembly 79K31829
b. Cable type designation: OTVD Camera
c. Manufactures name or code and year manufactured

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Quality Control System

The Contractor shall establish and maintain a quality control system, which satisfies the requirements of ANSI/ASQC Q9001-1994, quality System Model for Quality Assurance in Design, Development, Production, Installation, and Servicing. National Aeronautics and Space Administration retains the right to perform an audit of contractor's system to verify compliance. The supplier is responsible for the performance of all inspection requirements as specified in this document and KSC-SPEC-E-0031A, section 4. The procuring activity or its designated

representative reserves the right to perform any or all inspections set forth in this document to ensure the end items compliance to all requirements.

4.2 Lot

A lot shall consist of all cable produced under substantially the same conditions and offered for acceptance inspection at any one time. One lot shall not be greater than one month's production or 3050 m (10,000 feet), whichever is smaller.

4.3 Samples

Samples furnished for pre-production, quality assurance, acceptance tests, and inspections shall be finished cable in accordance with KSC-SPEC-E-0031A, paragraphs 4.3.1 through 4.3.3.

a. As per KSC-SPEC-E-0031A, paragraph 4.3.1, the pre-production test sample (if required), shall consist of one 30 m (100 feet) in length as a representative sample of the identical material and manufacturing processes to be used in production of this cable.
b. As per KSC-SPEC-E-0031A, paragraph 4.3.2, the quality assurance test sample shall be selected at random from each production lot. The number and length of the quality assurance test samples shall be as required to accomplish all quality assurance tests and inspections as specified in this document or the applicable KSC-SPEC-E-0031A paragraph.
c. Unless otherwise specified by the procuring activity, acceptance tests shall be performed on all cable submitted for acceptance. See KSC-SPEC-E-0031A, paragraph 4.3.3 for requirements.

4.4 Visual and Mechanical Inspection Requirements

The cable shall be inspected for compliance to all visual and mechanical requirements as defined in this document or in accordance with the specified KSC-SPEC-E-0031A paragraph.

4.5 Workmanship

The workmanship shall be such that the completed cable shall meet all requirements as stated in this document and all quality assurance tests and inspections as specified in the applicable KSC-SPEC-E-0031A paragraphs.

4.6 Testing Requirements

All cable inspections and testing shall be performed by the contractor under Government surveillance or as directed by the procuring activity at the installation designated in the contract. Cable production will not be allowed until cable preproduction samples are inspected and tested compliant to all requirements specified herein and accepted by the Government or the Government's Representative.

4.6.1 Preproduction Tests

Before preproduction testing, all cable submitted for testing shall pass all visual inspections and mechanical tests. The preproduction cable testing shall be performed as specified per the KSC-SPEC-E-0031A paragraphs listed below.

a. As per KSC-SPEC-E-0031A, paragraph 4.5.1, all required preproduction cable inspections and tests shall meet or exceed all requirements as specified per KSC-SPEC-E-0031A, paragraphs 3.3 through 3.10.

b. If a pre-production cable sample fails to meet any requirement as specified herein, the preproduction cable sample is rejected. Before a new cable sample can be submitted for a retest, a report shall be submitted to the procuring activity. This report shall address the reasons for the rejected cable and a course of action to prevent a recurrence of the identified defect causing the rejection. As per KSC-SPEC-E-0031A, paragraph 4.5.1.1.

4.6.2 Quality Assurance Tests

Unless otherwise specified in the contract, quality assurance inspections and tests shall be performed on samples from each production lot. The quality assurance tests shall consist of all the inspections and tests specified as per KSC-SPEC-E-0031A, paragraphs 3.2 through 3.10. All cable submitted for quality assurance tests are considered unserviceable but maybe retained for examination by the procuring activity. At the Government's discretion, the Government has the right to waive any test or test results.

If a cable sample fails an inspection or any test specified herein, the entire cable lot represented by the failed sample shall be rejected. At the discretion of the procuring activity, a cable lot represented by the rejected cable sample can be resubmitted for acceptance when accompanied by a detailed report describing the reasons for rejection and the corrective action taken to prevent a recurrence of the defect that caused the rejection. Any reworked cable lot must be accompanied by a detailed report that describes the rejection and resolution details for the reworked cable lot. As per KSC-SPEC-E-0031A, paragraph 4.5.2.2.

4.6.3 Acceptance Tests

Inspection and acceptance tests shall be performed on all cable lots. The electrode spark test shall be performed on all finished conductors prior to cabling. One cable sample from each cable lot shall be inspected for visual and mechanical dimensional requirements. Any cable that fails inspection or acceptance tests shall be rejected. Rejected cable may be resubmitted at the discretion of the procuring activity, after corrective action has been taken. The number and type of defects shall be the basis for permitting a resubmitted cable. Any reworked cable must be accompanied by a detailed report that describes the rejection and resolution details for the reworked cable. After rework, all previously rejected cable shall be subjected to all inspections and acceptance tests specified herein.

4.7 Test Methods and Conditions

All cable testing shall be performed on finished cable components with a temperature range of 20° C to 28° C and with a maximum relative humidity of 80%. Cable conductors shall be tested as specified in paragraph 3.3. All finished cable lots shall be subjected to the following electrical tests.

a. Dielectric strength shall be compliant to KSC-SPEC-E-0031A, paragraph 4.8.5.
b. The cable shall be tested for insulation resistance in accordance with ASTM D470 and shall be compliant to KSC-SPEC-E-0031A, paragraph 4.8.6.
c. Sheath spark tests shall be per Method 6211 of FED-STD-228 and shall be compliant to KSC-SPEC-E-0031A, paragraph 4.8.7.
d. Test equipment requirements shall be per KSC-SPEC-E-0031A, paragraph 4.8.4.

4.8 Test Reports and Certification

A cognizant Government inspector shall validate all submitted certifications and test reports. When such certifications or reports are required, no cable shall be accepted for delivery by the procuring activity prior to receipt of the required certifications or reports.

All certifications, reports of tests, or inspections performed in accordance with the requirements of this document shall be furnished to the procuring activity as specified per KSC-SPEC-E-0031A, paragraphs 4.6.1 and 4.6.2.

4.9 Reinspection

The procurement activity reserves the right to reinspect and retest the cable for any necessary requirement after delivery and before final acceptance. Any or all of the inspections and tests specified herein may be performed to determine conformance to prescribed requirements. Final acceptance shall depend upon evaluation of test results.

5.0 PREPARATION FOR DELIVERY

The contractor shall be responsible for the condition of the equipment delivered at the receiving point designated by the Contracting Officer.

Packaging, packing, and marking shall be in accordance with MIL-C-12000H and as specified herein.

a. As per KSC-SPEC-E-0031A, paragraph 5.1.1; packaging shall be accordance with the level A requirements of MIL-C-12000H.
b. As per KSC-SPEC-E-0031A, paragraph 5.1.1.1; cable shall be delivered on reels or spools. The cable shall be wound on the reel or spool in a manner such that both ends are accessible for testing.
c. As per KSC-SPEC-E-0031A, paragraph 5.1.1.2; cable cutting lengths shall be as specified in the contract. Each individual continuous length of cable shall be packaged on a separate reel or spool.
d. As per KSC-SPEC-E-0031A, paragraph 5.1.2; unless otherwise specified in the contract, packing shall be accordance with the level temperature requirements specified in MIL-C-12000H.
e. As per KSC-SPEC-E-0031A, paragraph 5.1.3; cable reels or spools and exterior shipping containers shall be marked in accordance with MIL-C-12000H and MIL-STD-129N.
f. The marking identification shall include the following information.
    (1) Cable part number
    (2) Specification number
    (3) Length ( ) meters [or ( ) feet]
    (4) Date of manufacturer.
    (5) Name of manufacturer.

5.1 Government Approval

The cable manufacture shall provide the Government the test procedure for the finished cable for review and approval 30 days prior to testing. This shall include test methods, test data sheets, test equipment setups with block diagrams.

The Government shall review and approve all test data on the finished cable before shipment by manufacture.

5.2 Warranty

The manufacture shall furnish factory warranty against defects in materials and workmanship on all cable supplied. The warranty shall be effective at least 5 years after final acceptance of the cable.

5.3 Deviations and Waivers

When the contractor proposes to perform work, which does not conform to the applicable contract drawing requirements and specifications, the contractor shall submit to the Contracting Officer, for approval, a written request for deviation or request for waiver on the non-conforming work. The Contracting Officer approved/denied request will be processed and returned to the contractor, prior to the work being performed to the deviation or waiver.

All contractor deviation and waiver requests shall be submitted on KSC Form 8-69, " Contractor Request to Use Non-Conforming Parts or Materials". The form shall be fully executed and include a proffer of consideration to the Government. The request must be technically supported by justification, rationale, design considerations, calculations, and other data as applicable, which permit ready and conclusive evaluation by the Government as to acceptability or non-acceptability of the deviation or waiver.

Where a requested deviation or waiver on a particular aspect of the work has a relation to, or affects, other aspects of the work, those other aspects of the work shall be clearly identified and referenced. And, if the requested deviation or waiver necessitates a deviation or waiver on other aspects, requests for all such deviations and waivers must be submitted concurrently. Any request not submitted in strict accordance with this provision will not be considered.

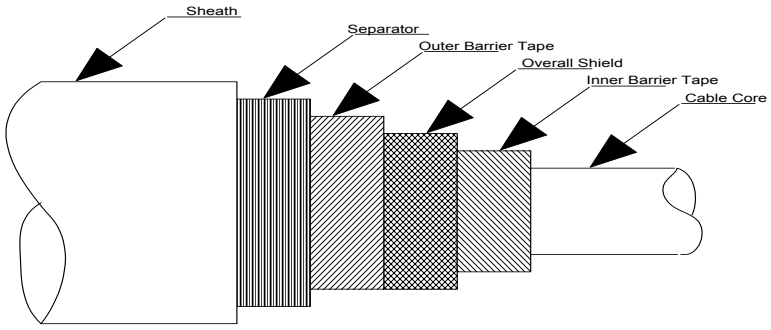

Figure 1 – Cable Sheath Configuration

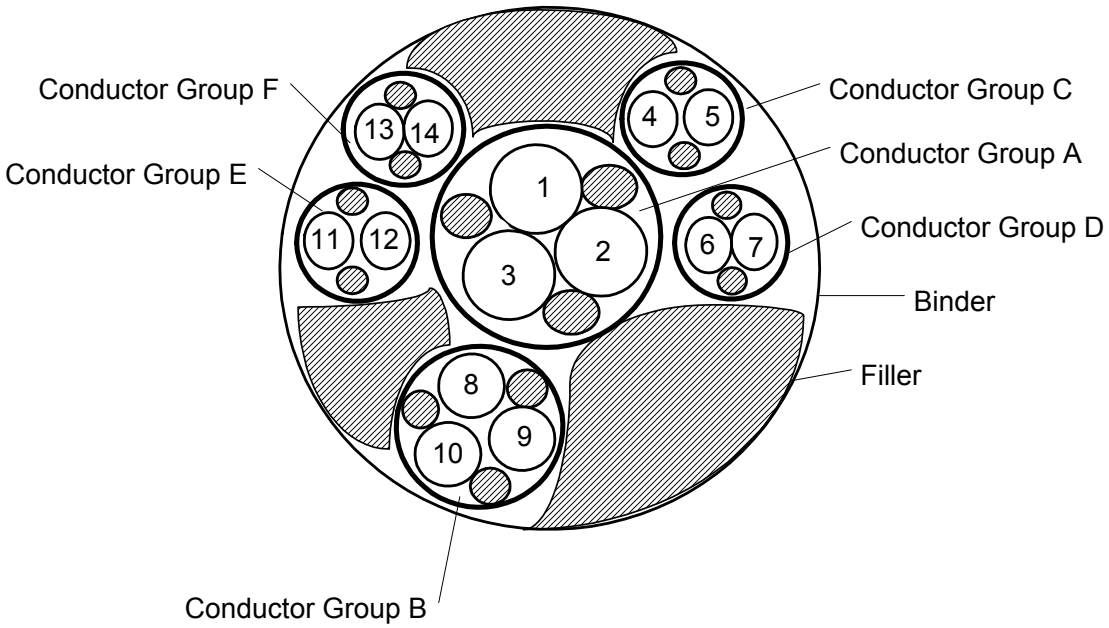

Figure 2 - Cable Core Configuration

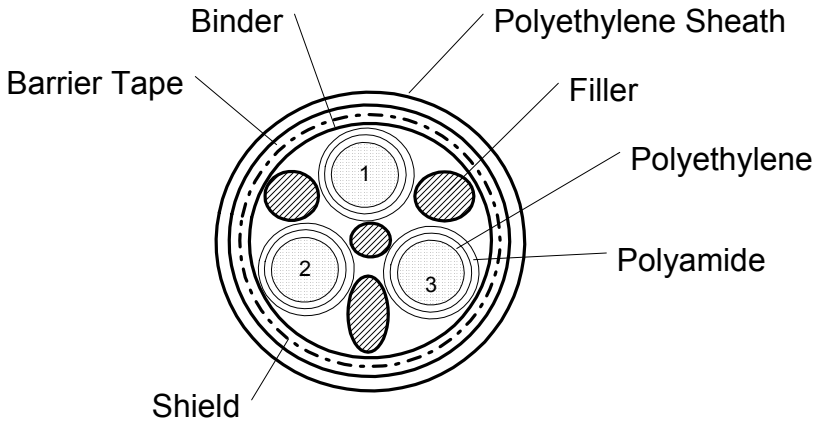

Figure 3 – Conductor Group A

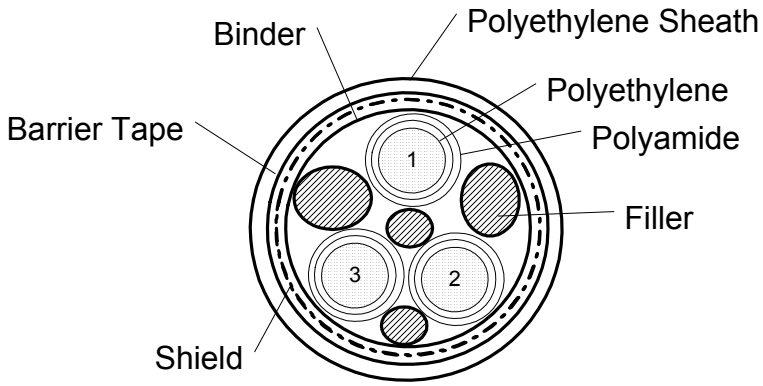

Figure 4 – Conductor Group B

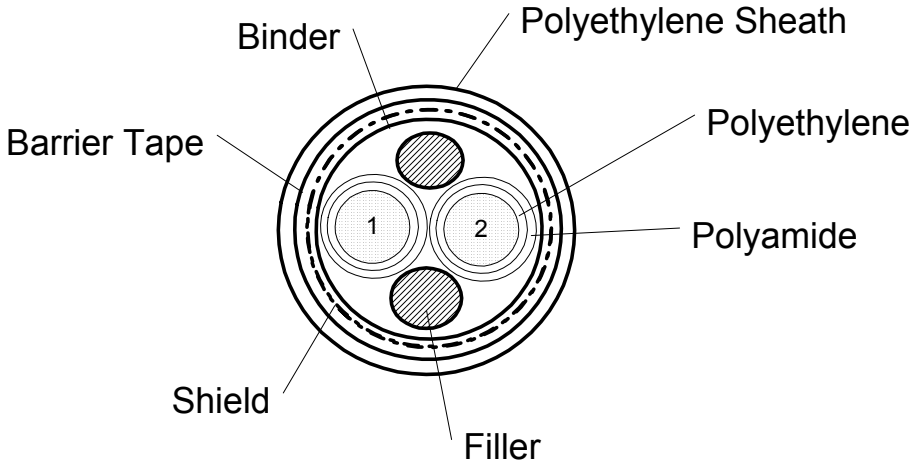

Figure 5 – Conductor Groups C thru F