REPRODUCTION ASSEMBLY SHEET

(See Reverse Side for Instructions)

WORK ORDER NO.

DATE
September 3, 2008

CUSTOMER CONTACT
Debby Doxey

TELEPHONE NO.
867-4703

SHEET 1 OF 1

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CABLE, ELECTRICAL, SHIELDED, JACKETED, FOR HARNESS ASSEMBLIES, GENERAL SPECIFICATION FOR

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CABLE, ELECTRICAL, SHIELDED, JACKETED, FOR HARNESS ASSEMBLIES, GENERAL SPECIFICATION FOR

Approved by:

Patrick A. Simpkins
Director of Engineering

JOHN F. KENNEDY SPACE CENTER, NASA

CONTENTS

TABLES

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

°	degree
°C	degree Celsius
ASTM	american Society for Testing and Materials
AWG	American Wire Gauge
DC	direct current
F	farad
ft	foot
g	gram
IPC	Association Connecting Electronics Industries
KSC	John F. Kennedy Space Center
M	mega (1×10^{6})
MIL	military
NASA	National Aeronautics and Space Administration
p	pico (1×10^{-12})
psig	pound per square inch gauge
rms	root mean square
SPEC	specification
STD	standard
V	volt
Ω	ohm

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CABLE, ELECTRICAL, SHIELDED, JACKETED, FOR HARNESS ASSEMBLIES, GENERAL SPECIFICATION FOR

1. SCOPE

1.1 General

This specification covers the requirements for flexible cables of the following construction:

Conductors:	Stranded, tin-coated copper
Finished wire:	Polyethylene-insulated, with polyamide covering
Cabling:	One to six conductors, twisted
Shielding:	Braided overall shield
Jacket:	Polyvinyl chloride
Voltage rating:	600 volts (V) root mean square (rms)
Temperature:	75 degrees Celsius (°C), maximum, continuous

1.2 Application

Cables covered by this specification are intended for use in fabricating cable harness assemblies but are suitable for general use in medium-duty applications (see 6.1).

1.3 Detail Requirements.

Detail requirements for specific types of cables are contained in individual detail specification sheets. Detail specification sheets are identified by this general specification number, followed by a virgule and an Arabic numeral. Detail specification sheets appear at the end of this specification.

1.4 Classification

Cables covered by this specification are classified by type and part number.

1.4.1 Cable Type

Type classification is established by the number of conductors in the cable. Type designations for cables covered by this specification are as follows.

NOTE

All conductors are considered to be insulated.

Cable Type	Number of Conductors	Description
SSI	1	One (single) conductor, shielded, with jacket (insulation) over shield.
PTSI	2	Two conductors (pair), twisted together, with overall shield, and jacket over shield.
TTSI	3	Three conductors (triple), twisted together with overall shield, and jacket over shield.
QTSI	4	Four conductors (quad), twisted together, with overall shield, and jacket over shield.
5TSI	5	Five conductors, twisted together, with overall shield, and jacket over shield.
6TSI	6	Six conductors, twisted together, with overall shield, and jacket over shield.

1.4.2 Cable Part Number

The cable part number shall consist of the cable type designator suffixed with the AWG size of the conductors.

Example: TTSI #16 (three #16 AWG conductors, twisted, with overall shield and jacket)

2. APPLICABLE DOCUMENTS

2.1 Government

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of issue of invitation for bids or request for proposals shall apply.

2.1.1 Specifications

Federal

L-P-390	Plastic, Molding and Extrusion Material, Polyethylene and Copolymers (Low, Medium, and High Density)

Military

MIL-DTL-12000	Cable, Cord, and Wire, Electric; Packaging of

2.1.2 Standards

Federal

FED-STD-228	Cable and Wire, Insulated; Methods of Testing

Military

MIL-STD-129	Military Marking for Shipment and Storage

(Copies of specification, standards, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 Non-Government

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of issue of invitation for bids or request for proposals shall apply.

American Society for Testing and Materials (ASTM)

ASTM B 33	Standard Specification for Tinned Soft and Annealed Copper Wire for Electrical Purposes

ASTM B 193	Standard Test Method for Resistivity of Electrical Conductor Materials
ASTM D 374	Standard Test Methods for Thickness of Solid Electrical Insulation
ASTM D 470	Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable
ASTM D 2220	Standard Specification for Poly(Vinyl Chloride) Insulation for Wire and Cable, 75 °C Operation
ASTM D 4066-01a	Standard Classification System for Nylon Injection and Extrusion Materials (PA)

Association Connecting Electronics Industries (IPC)

IPC J-STD-005	Requirements for Soldering Pastes
IPC J-STD-006	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-fluxed Solid Solders for Electronic Soldering Applications

3. REQUIREMENTS

3.1 Product Requirements

All cable furnished under this specification shall conform to all requirements specified herein and in the detail specification sheets.

3.2 Test and Inspection Requirements

Unless specifically waived by the procuring activity, all quality assurance and acceptance tests and inspections specified in 4.4 and 4.5 shall be performed on all cable furnished under this specification. Preproduction tests need not be performed unless specified by the procuring activity.

3.3 Materials

The materials to be used in manufacturing cables to this specification shall be as specified in 3.3.1 through 3.3.4.

3.3.1 Copper Strands

Copper strands constituting the conductors and braided shields shall be tinned, soft-annealed, commercially pure copper conforming to the requirements of ASTM B 33.

3.3.2 Polyethylene

Polyethylene conforming to the requirements for Type II, grade 1 or 2, of L-P-390 shall be used as the conductor primary insulation material.

3.3.3 Polyamide

Polyamide conforming to Group 6 (612 Nylon), Class 1 of ASTM D 4066-01A shall be used for insulation covering material.

3.3.4 Polyvinyl Chloride

Polyvinyl chloride conforming to the requirements of ASTM D 2220 shall be used for jacket material.

3.4 Construction

Construction of the cable shall be as specified herein and in the detail specification sheets.

3.4.1 Conductors

Conductors shall be formed by stranding tinned copper wire having a uniformly circular cross section. Finished-conductor sizes are specified in the detail specification sheets by the AWG size approximating the finished-conductor diameter.

3.4.1.1 Number of Strands

Each conductor size shall contain the number of individual strands specified in Table 1.

Table 1. Conductor Requirements

Conductor Size (AWG)	Stranding Requirements		Primary-Insulation Wall Thickness (inches)	Max. DC Resistance at 20 °C (Ω/1,000 ft)
	Number of Strands	Strand Size (inches)		
24	19	0.0050	0.010	24.90
22	19	0.0063	0.010	15.50
20	19	0.0080	0.010	9.70
18	19	0.0100	0.015	6.08
16	19	0.0113	0.015	4.76
14	19	0.0142	0.020	2.99
12	19	0.0179	0.020	1.88
NOTE: The finished-conductor sizes approximate the AWG sizes shown.				

3.4.1.2 Strand Size

The strands constituting each conductor size shall have the diameters specified in Table 1.

3.4.1.3 Stranding and Length of Lay

Conductors shall be formed by concentric lay stranding. It is optional for the direction of lay for the successive layers to be alternately reversed (true concentric lay) or to be in the same direction (unidirectional lay). The strands shall be uniformly laid so as to produce a geometrically arranged conductor, circular in cross section and free of any mechanical damage, such as crossovers, high strands, or other irregularities. The direction of lay of the individual strands in the outer layer of the conductor shall be left hand. The length of lay of the strands in each layer shall be 8 to 16 times the diameter of that layer.

3.4.1.4 Splices

In no case shall the whole conductor be spliced at one point. Splices in individual strands shall be butt-brazed. There shall not be more than one strand-splice in any 10-foot (ft) length of conductor. Strand splices shall be distributed throughout the conductor in such a manner that the physical and electrical properties of the conductor will not be adversely affected.

3.4.2 Conductor Insulation

Polyethylene insulation material shall be extruded concentrically over each conductor in a continuous layer, and so cured, processed, and maintained as to provide accurate centering of the conductor and retention of a circular cross section.

3.4.2.1 Insulation Wall Thickness

The average insulation wall thickness shall be as specified in Table 1. The minimum thickness shall be not less than 90 percent of the specified average thickness.

3.4.3 Insulation Covering

Each insulated conductor shall have an insulation covering concentrically applied over the primary insulation. The insulation covering material shall be extruded, clear, heat-stabilized polyamide with a wall thickness of 0.002 inch.

3.4.4 Cabling

The requisite number of insulated conductors, of the size and quantity specified in the detail specification sheets, shall be cabled together with a unidirectional lay.

3.4.4.1 Direction and Length of Lay

The direction of lay of multiple conductors may be either right hand or left hand. The length of lay shall be 8 to 16 times the outside diameter of the multiple.

3.4.5 Overall Cable Shield

A tight-fitting, closely woven braid of tinned copper strands shall be applied directly over the cabled conductors. Strand diameters and braid angles shall be as specified in Table 2. The braid shall be applied so as to provide an 85-percent minimum coverage over the cabled conductors. The braided strands shall be applied so as to preclude kinks, breaks, abrasions, or other irregularities in the shield strands.

Table 2. Shield Requirements

Diameter Under Shield (inches)	Strand Diameter (inches)	Braid Angle (+5°, –10°)
0.250 and under	0.0050	30
0.251 to 0.350	0.0063	30
0.351 to 0.400	0.0063	35
0.401 to 0.500	0.0063	40

3.4.6 Jackets

A single layer of white polyvinyl chloride shall be extruded over the shielded cable to form a well-centered jacket. The average jacket thickness shall be as specified in the detail specification sheets. Minimum thickness of the jacket at any point shall be at least 90 percent of the specified average thickness. After being extruding, the jacket shall not adhere to the underlying shield.

3.5 Performance and Product Characteristics

Finished cables, and all components thereof, shall conform to the requirements specified in 3.5.1 through 3.5.3.

3.5.1 Conductors

Finished conductors shall meet all the requirements specified in 3.5.1.1 through 3.5.1.3.

3.5.1.1 Elongation

When tested as specified in 4.8.2.1.1, the individual copper strands of the conductors shall meet the elongation requirements specified in ASTM B 33, Table I.

3.5.1.2 Tin Coating (Individual Strands)

When tested as specified in 4.8.2.1.2, cracking or parting of the tin coating shall be cause for rejection. Blackening of the copper shall be cause for rejection. Blackening within 0.5 inch of the cut end will be permissible.

3.5.1.3 Conductor Resistance

When measured as specified in 4.8.3.3.5, the direct-current (DC) resistance per 1,000 ft of conductor, at 20 °C, shall not exceed the values specified in Table 1.

3.5.2 Conductor Insulation

Conductor insulation on finished conductors shall meet all of the requirements specified in 3.5.2.1 through 3.5.2.9.

3.5.2.1 Tensile Strength and Ultimate Elongation

When conductor insulation is tested as specified in 4.8.2.2.1 and 4.8.2.2.2, the tensile strength and elongation at rupture shall be as specified in 3.5.2.1.1 and 3.5.2.1.2.

3.5.2.1.1 Original Requirement

Before the conductor insulation is tested for accelerated aging, the tensile strength and elongation at rupture shall conform to the original requirement value specified in Table 3.

Table 3. Physical Requirements for Insulation and Jacket Materials

Physical Property	Polyethylene	Polyvinyl Chloride
Original Requirement		
Tensile strength, minimum (psig)	1400	2000
Elongation at rupture, minimum (percent)	350	150
Aging Requirement		
Tensile strength, minimum (percentage of original value)	75	80
Elongation at rupture, minimum (percentage of original value)	75	75

3.5.2.1.2 Aging Requirement

After the conductor insulation is tested for accelerated aging as specified in 4.8.2.2.3, the tensile strength and elongation at rupture shall conform to the aging requirement value specified in Table 3.

3.5.2.2 Polyamide Covering

When tested as specified in 4.8.2.2.4, the specimen shall be free from any tears or cracks when examined under 5× magnification. Wrinkles shall not be cause for rejection.

3.5.2.3 Shrinkage

When tested as specified in 4.8.2.2.5, the shrinkback of insulation from either end of the conductor shall not exceed 0.0625 inch.

3.5.2.4 Free Stripping

When tested as specified in 4.8.2.2.6, all insulations shall be easily removable, without adhering to the conductor. The solder shall flow freely and shall produce an evenly tinned surface.

3.5.2.5 Water Absorption

The increase in specific inductive capacity of the insulation material shall not exceed 3 percent when tested in accordance with 4.8.2.2.7. Total capacitance of insulated conductors size 18 AWG and smaller shall not exceed 110 picofarads (pF) per foot at completion of the 7-day test.

3.5.2.6 Cold Bend

When tested as specified in 4.8.3.1, the conductor insulation shall exhibit no electrical breakdown and shall show no visible signs of cracking or other damage when examined under 3× magnification.

3.5.2.7 Insulation Flaws

When subjected to the electrode spark test specified in 4.8.2.2.8, the conductor insulation shall exhibit no electrical breakdown. If insulation breakdown occurs at any point, the conductor insulation shall not be repaired, but the section of conductor containing the failure point shall be cut out and removed from production.

3.5.2.8 Insulation Dielectric Strength

When tested as specified in 4.8.3.3.2, conductor insulation shall exhibit no electrical breakdown.

3.5.2.9 Insulation Resistance

When tested as specified in 4.8.3.3.3, the insulation resistance of all conductors shall equal or exceed the values specified in Table 4.

Table 4. Insulation Resistance Test Requirements

Conductor Size (AWG)	Spark Test Voltage (kV)	Inspection Test Voltage (kV)	Min. DC Resistance at 20 °C (MΩ/1,000 ft)
24	3.0	1.5	12,765
22	3.0	1.5	10,610
20	3.0	1.5	10,400
18	3.0	1.5	10,205
16	3.0	1.5	9,235
14	4.0	2.0	9,265
12	4.0	2.0	8,070

3.5.3 Jackets

Polyvinyl chloride jackets on finished cable shall meet all of the requirements specified in 3.5.3.1 through 3.5.3.3.

3.5.3.1 Tensile Strength and Ultimate Elongation

When the jacket is tested as specified in 4.8.2.3.1 and 4.8.2.3.2, its tensile strength and elongation at rupture shall be as specified in 3.5.3.1.1 through 3.5.3.1.3.

3.5.3.1.1 Original Requirement

Before the jacket is tested for accelerated aging as specified in 4.8.2.3.3, its tensile strength and elongation at rupture shall conform to the original requirement value specified in Table 3.

3.5.3.1.2 Aging Requirement

After the jacket is tested for accelerated aging as specified in 4.8.2.3.3, its tensile strength and elongation at rupture shall conform to the aging requirement value specified in Table 3.

3.5.3.1.3 Oil Resistance Requirement

After the jacket is immersed in oil as specified in 4.8.2.3.4, its tensile strength and elongation at rupture shall be not less than 85 percent of the original requirement value specified in Table 3.

3.5.3.2 Jacket Flaws

When subjected to the jacket flaw test specified in 4.8.3.3.1, the jacket shall exhibit no electrical breakdown. If jacket breakdown occurs at any point, the jacket shall not be repaired, but the section of cable containing the failure point shall be cut out and removed from production.

3.5.3.3 Jacket Resistance

When measured as specified in 4.8.3.3.4, the jacket resistance in megohms (MΩ) for 1,000 ft of cable shall be not less than the value specified in the applicable detail specification sheets.

3.6 Dimensions

Dimensions of the finished cable shall be as specified in the detail specification sheets.

3.7 Cable Marking

The finished cable shall be identified by a printed marking applied to the outer surface of the jacket.

3.7.1 Cable Identification

The cable identification mark applied to the outer surface of the jacket shall consist of the following:

a. detail specification number,

b. cable part number (see 1.4.2), and

c. manufacturer's name or code and the year manufactured.

3.7.2 Method of Marking

Either ink or hot-stamp marking shall be employed. Hot-stamping, if used, shall be performed prior to subjecting the cable to the jacket flaw test and insulation resistance test. Ink used for identification shall be of the best qualify normally used in good commercial practice. Marking shall be repeated at intervals of not more than 24 inches and may be continuous.

3.7.3 Marking Durability

The marking on the jacket shall be capable of withstanding 100 cycles (200 strokes) of abrasive action when tested as specified in 4.8.3.2. All letters and numerals within the tested area shall be legible at completion of the test.

3.8 Workmanship

Workmanship shall be such that the completed cable is capable of meeting all requirements of this specification, the detail specification sheets, and any referenced subsidiary specification or other document when subjected to the inspections and tests specified in Section 4.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The supplier is responsible for the performance of all inspections specified herein. The procuring activity, or its designated representative, reserves the right to perform any or all of the inspections set forth in this specification to ensure that the end item conforms to all specified requirements.

4.2 Lot

A lot shall consist of all cable of any one design 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 10,000 ft, whichever is smaller.

4.3 Samples

Samples furnished for preproduction, quality assurance, and acceptance test and inspections shall be finished cable in accordance with 4.3.1 through 4.3.3.

4.3.1 Preproduction Test Sample

The preproduction test sample, when required, shall consist of one 100-ft length of cable representative of the identical material and manufacturing processes to be used in production of cables covered by this specification.

4.3.2 Quality Assurance Test Sample

The quality assurance test sample shall be selected at random from each production lot submitted for acceptance. The number and length of quality assurance test samples to be submitted shall be as required to perform all quality assurance tests and inspections specified herein.

4.3.3 Acceptance Test Sample

Unless otherwise specified by the procuring activity, acceptance tests shall be performed on all cable submitted for acceptance. One 5-ft sample from each production lot of cable shall be submitted for the visual and dimensional inspections. When specified in the contract, additional samples, of the number and length specified in the contract, shall be furnished to the procuring activity.

4.4 Visual and Mechanical Inspection Requirements

Cable shall be inspected to determine compliance with 3.4, 3.6, 3.7, and 3.8. The inspections specified in Table 5 shall be performed. After visual and mechanical inspections are complete, packaging, packing, and marking shall be inspected to determine conformance to the requirements of Section 5.

Table 5. Visual and Mechanical Inspections

Test	Requirement Paragraph	Inspection Method
Minimum thickness of insulation	3.4.2.1	ASTM D 374, Methods A and C
Length of lay	3.4.4.1	FED-STD-228, Method 1521
Shield coverage	3.4.5	FED-STD-228, Method 8121
Minimum and average thickness of jacket	3.4.6	FED-STD-228, Method 1331
Maximum diameter of completed cable	3.6	Direct measurement
Cable marking	3.7	Visual
Workmanship	3.8	Visual

4.5 Testing Requirements

Tests shall be performed as specified in 4.5.1 through 4.5.3. Tests methods shall be as specified in 4.8. All cable submitted for testing shall have passed the visual and mechanical inspections specified in 4.4.

4.5.1 Preproduction Tests

4.5.1.1 Preproduction Test Requirements

Preproduction tests, when required, shall consist of all the tests and inspections specified in Table 6. The preproduction test sample shall meet all requirements specified herein. Preproduction inspections and tests shall be performed by the contractor under Government surveillance, or as directed by the procuring activity, at the installation designated in the contract. Cables subjected to these tests shall be considered unserviceable but may be retained for inspection by the procuring activity.

Table 6. Preproduction and Quality Assurance Tests

Test	Requirement Paragraph	Method and Condition Paragraph
Visual and mechanical inspection	3.4, 3.6, 3.7, 3.8	4.4
Conductor		
Elongation of strands	3.5.1.1	4.8.2.1.1
Coating	3.5.1.2	4.8.2.1.2
Conductor resistance	3.5.1.3	4.8.3.3.5
Insulation		
Tensile strength	3.5.2.1	4.8.2.2.1
Ultimate elongation	3.5.2.1	4.8.2.2.2
Melting point of polyamide	3.5.2.2	4.8.2.2.4
Shrinkage	3.5.2.3	4.8.2.2.5

Test	Requirement Paragraph	Method and Condition Paragraph
Insulation (continued)		
Stripping	3.5.2.4	4.8.2.2.6
Water absorption	3.5.2.5	4.8.2.2.7
Cold bend	3.5.2.6	4.8.3.1
Insulation flaws	3.5.2.7	4.8.2.2.6
Dielectric strength	3.5.2.8	4.8.3.3.2
Insulation resistance	3.5.2.9	4.8.3.3.3
Jacket		
Tensile strength	3.5.3.1	4.8.2.3.1
Ultimate elongation	3.5.3.1	4.8.2.3.2
Accelerated aging	3.5.3.1.2	4.8.2.3.3
Oil resistance	3.5.3.1.3	4.8.2.3.4
Jacket flaws	3.5.3.2	4.8.3.3.1
Jacket resistance	3.5.3.3	4.8.3.3.4
Cable		
Jacket marking durability	3.7.3	4.8.3.2

4.5.1.2 Preproduction Test Rejection

If the preproduction sample fails to meet the requirements of any test or inspection specified herein, the preproduction sample shall be rejected. Before a new preproduction sample is submitted, a detailed report shall be forwarded to the procuring activity, documenting the rejection and the action taken to prevent recurrence of the defect causing the failure. A reworked preproduction sample shall not be submitted. Production lots will not be considered for acceptance until the preproduction sample has been approved.

4.5.2 Quality Assurance Tests

4.5.2.1 Quality Assurance Test Requirements

Unless otherwise specified in the contract, quality assurance test and inspections shall be performed on samples from each production lot. The quality assurance tests shall consist of all of the tests and inspections specified in Table 6. Cable subjected to the quality assurance tests shall be considered unserviceable but may be retained for examination by the procuring activity.

4.5.2.2 Quality Assurance Test Rejection

If a quality assurance test sample fails any of the tests or inspections specified herein, the entire lot represented by the sample shall be rejected. Before the rejected lot, or any subsequent lot of the same design, can be resubmitted for acceptance, a detailed report shall be forwarded to the procuring activity, documenting the rejection, the action taken to prevent recurrence of the defect causing failure, and the proposed corrective action on the lot represented by the rejected sample. The nature of the defect causing failure and the corrective action taken will be the basis for

permitting resubmittal. Any reworked lot shall be accompanied by a detailed report, documenting the previous rejection and corrective action taken.

4.5.3 Acceptance Tests

4.5.3.1 Acceptance Test Requirements

Acceptance test and inspections shall consist of all of the inspections and tests specified in Table 5 and Table 7. Acceptance tests and inspections shall be performed on all cable in each lot. The electrode spark test shall be performed on all finished conductors prior to cabling. One sample from each lot of cable shall be inspected for visual and dimensional requirements.

Table 7. Acceptance Test

Test	Requirement Paragraph	Method and Condition Paragraph
Visual and mechanical inspection	3.4, 3.6, 3.7, 3.8	4.4
Electrical		
Conductor resistance	3.5.1.3	4.8.3.3.5
Insulation flaws	3.5.2.7	4.8.2.2.6
Dielectric strength	3.5.2.8	4.8.3.3.2
Insulation resistance	3.5.2.9	4.8.3.3.3
Jacket flaws	3.5.3.2	4.8.3.3.1
Jacket resistance	3.5.3.3	4.8.3.3.4

4.5.3.2 Acceptance Test Rejection

Any cable that fails any acceptance test or inspection 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 resubmittal. Any reworked cable shall be accompanied by a detailed report documenting the previous rejection and corrective action taken. After rework, all previously rejected cable shall be subjected to all acceptance tests and inspections specified herein.

4.6 Test Reports and Certification

Certification and reports of tests and inspections performed in accordance with the requirements of this specification shall be furnished to the procuring activity as specified in 4.6.1 and 4.6.2. Certifications and test reports shall be validated by the cognizant Government inspector. When such certifications or reports are required, no cable shall be accepted for delivery by the procuring activity prior to receipt of the certification or reports.

4.6.1 Component Material Certification

The supplier shall certify to the procuring activity that the component materials listed in Table 8 used in the manufacture of cables furnished under this specification are in accordance with the applicable referenced specifications and requirements. When requested, reports of tests verifying compliance with the applicable referenced specifications and requirements shall be furnished to the procuring activity.

Table 8. Component Material Inspection

Material	Requirement Paragraph	Inspection Method
Copper strands	3.3.1	In accordance with the applicable referenced specification unless otherwise indicated.
Polyethylene	3.3.2	
Polyamide	3.3.3	
Polyvinyl chloride	3.3.4	

4.6.2 Test and Inspection Certification

The supplier shall certify to the procuring activity that all test and inspection requirements specified herein have been satisfied and that all cable furnished conforms to all requirements specified herein. When requested, reports of tests and inspections shall be furnished to the procuring activity.

4.7 Reinspection

The procuring activity reserves the right to reinspect and retest the cable for any 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.

4.8 Test Methods and Conditions

All tests shall be performed in accordance with the methods and under the conditions specified in 4.8.1 through 4.8.3.

4.8.1 Test Conditions

Unless otherwise specified, tests shall be performed at temperatures of 20 °C to 28 °C and maximum relative humidity of 70 percent.

4.8.2 Cable Component Tests

Unless otherwise specified, all tests specified herein shall be performed on cable components that have been removed from finished cables.

4.8.2.1 Conductor Tests

Cable conductors shall be tested as specified in 4.8.2.1.1 and 4.8.2.1.2.

4.8.2.1.1 Elongation Test

Elongation of the copper conductor strands shall be measured in accordance with ASTM B 33. Seven strands taken from any one conductor of the sample shall be tested to determine compliance with 3.5.1.1. If the results of the elongation tests on the strands are found to be below the specified value, the remainder of the strands in the conductor shall be tested. The average of all the strands tested shall determine acceptance or rejection of the lot.

4.8.2.1.2 Coating Test

The continuity and adherence of tin coating on strands shall be tested in accordance with ASTM B 33. A minimum of eight specimens from the sample shall be tested to determine compliance with 3.5.1.2.

4.8.2.2 Conductor Insulation Tests

Conductor insulation shall be tested as specified in 4.8.2.2.1 through 4.8.2.2.8.

4.8.2.2.1 Tensile-Strength Test

The tensile strength of the conductor insulation shall be measured before and after accelerated-aging tests. Tensile strength shall be tested in accordance with FED-STD-228, Method 3021.

4.8.2.2.2 Ultimate-Elongation Test

The ultimate elongation of the conductor insulation shall be measured before and after accelerated-aging tests. Ultimate elongation shall be tested in accordance with FED-STD-228, Method 3031.

4.8.2.2.3 Accelerated-Aging Test

Accelerated aging shall be tested in accordance with ASTM D 470. Specimens of polyethylene shall be oven-aged for 48 hours at a temperature of 100 °C ±1 °C.

4.8.2.2.4 Polyamide Insulation Covering Test

A specimen of finished conductor of sufficient length shall be wrapped 2½ turns around a metal mandrel of a diameter six times the outside diameter of the specimen and secured in this position by tape or other means to prevent unwrapping during tests. The specimen and the mandrel shall be placed in a gravity-convection-type oven at a temperature of 94 °C±5 °C for a period of 24 hours ±1 hour. The specimen and mandrel shall be removed from the oven and allowed to cool to room temperature in a silica gel desiccator or equivalent. The specimen shall be removed from the desiccator, straightened, and examined under 5× magnification to determine compliance with 3.5.2.2.

4.8.2.2.5 Insulation Shrinkage Test

An 8-inch specimen shall be cut from a finished conductor and cut to 6 inches, leaving the conductor flush with the insulation on each end. The specimen shall be heated in a forced-convection air oven at 99 °C ±1 °C for 24 hours ±1 hour. The specimen shall be removed and allowed to cool to room temperature. Insulation shrinkback from conductor ends shall be measured to determine compliance with 3.5.2.3.

4.8.2.2.6 Insulation Stripping Test

Three specimens, 6 inches in length, shall be cut from a finished conductor. A 0.5-inch length of insulation shall be stripped from one end of each specimen. The stripped end of each specimen shall be dipped in a solder pot containing SN-60 solder without flux, conforming to the requirements of IPC J-STD-005 and IPC J-STD-006, at 320 °C for 5 seconds. Each specimen shall be inspected to determine compliance with 3.5.2.4.

4.8.2.2.7 Water Absorption Test

The increase in specific inductive capacity of the insulation material as a result of water absorption shall be measured in accordance with ASTM D 470, specifically, "Accelerated Water Absorption Test – Section 72." The insulation covering shall not be removed from the test specimen. The test shall be performed with a water bath temperature of 50 °C ±1 °C for a duration of 7 days. Compliance with 3.5.2.5 shall be determined.

4.8.2.2.8 Electrode Spark Test

After extrusion of the polyethylene insulation material, and before covering, the insulation to be used in cable manufacture shall be passed through an electrode spark device that will subject 100 percent of the insulation surface to the test voltage specific in Table 4. FED-STD-228, Method 6211, shall be used in conducting this test. Speed of travel through the device shall be adjusted so that every point on the insulation surface maintains contact with the electrode for at least 0.25 second. Compliance with 3.5.2.7 shall be determined.

4.8.2.3 Jacket Tests

The polyvinyl chloride cable jacket shall be tested as specified in 4.8.2.3.1 through 4.8.2.3.4.

4.8.2.3.1 Tensile-Strength Test

The tensile strength of cable jacket material shall be measured before and after accelerated-aging tests and oil resistance tests. Tensile strength shall be tested in accordance with FED-STD-228, Method 3021.

4.8.2.3.2 Ultimate-Elongation Test

The ultimate elongation of cable jacket material shall be measured before and after accelerated-aging tests and oil resistance tests. Ultimate elongation shall be tested in accordance with FED-STD-228, Method 3031.

4.8.2.3.3 Accelerated-Aging Test

Accelerated aging shall be tested in accordance with ASTM D 470 and ASTM D 2220.

4.8.2.3.4 Oil Resistance Test

Oil resistance shall be tested in accordance with ASTM D 2220.

4.8.3 Finished-Cable Tests

Finished cables shall be tested as specified in 4.8.3.1 through 4.8.3.3.

4.8.3.1 Cold-Bend Test

Two specimens of cable shall be subjected to cold-bend testing at –30 °C ±1 °C. The specimens shall be placed in the cold chamber in an unflexed position and maintained at the required temperature for a minimum of 4 hours. While at that temperature, each specimen shall be bent around a mandrel at a rate of one turn per 30 seconds for one complete turn. The mandrel diameter shall be not greater than eight times the outside diameter of the finished cable. The insulated conductors shall then be removed from the jacket, examined under 3× magnification, and tested by application of the inspection test voltage specified in Table 4 for 1 minute while submerged in water to determine compliance with 3.5.2.6.

4.8.3.2 Marking Durability Test

A short specimen of finished cable shall be firmly clamped in a horizontal position, with the surface area containing the marking freely exposed. A steel mandrel with a diameter of 0.025±0.001 inch shall be rubbed repeatedly over the surface at the marking so that the longitudinal axis of the mandrel and specimen will be at right angles to each other. A weight shall be affixed to the jig holding the rubbing mandrel so that the combination of jig and weight exerts a

500-gram (g) thrust normal to the surface. A motor-driven reciprocating cam mechanism and counter shall be used to permit an accurately measured number of abrasion strokes. The length of the stroke in one directions shall be 3.8 inches, and the frequency of the stroke shall be 120 strokes per minute (each stroke consisting of a 180° rotation of the eccentric drive mechanism). Direction of motion shall be along the axis of the cable and perpendicular to the axis of the mandrel. Compliance with 3.7.3 shall be determined.

4.8.3.3 Electrical Tests (Completed Cable)

Unless otherwise specified in the contract, every length of cable in every lot shall be subjected to the electrical tests specified in 4.8.3.3.1 through 4.8.3.3.5. The tests shall be performed on the completed cable in the sequence listed herein.

4.8.3.3.1 Jacket Flaw Test

The finished cable shall be passed through a spark test device that will subject 100 percent of the jacket surface to the test voltage specified in the detail specification sheets, applied between the jacket and the cable shield. The speed of travel through the device shall be adjusted so that every point on the jacket surface maintains contact with the test voltage for at least 0.20 second. Compliance with 3.5.3.2 shall be determined.

4.8.3.3.2 Dielectric-Strength Test

Voltage shall be applied between adjacent conductors and between conductors and shield for a period of at least 30 seconds on each completed length of cable. Conductors may be tested singly against all other conductors or arranged in two or more groups, provided that full voltage is impressed between adjacent conductors and between each conductor and the shield. The test voltage shall be attained by raising the inspection test voltage from zero to the value specified in Table 4 within 20 seconds. Compliance with 3.5.2.8 shall be determined.

4.8.3.3.3 Insulation Resistance Test

Each conductor of every length of finished cable shall be tested for insulation resistance in accordance with ASTM D 470. The test potential shall be 500 VDC minimum. Temperature correction factors shall be applied as applicable. Compliance with 3.5.2.9 shall be determined.

4.8.3.3.4 Jacket Resistance Test

Jacket resistance shall be measured by immersing each completed length of cable in a conductive container of water and measuring the resistance between the overall shield of the cable and the conductive container. The water temperature shall be maintained at 20 °C ±1 °C for the duration of the test. The cable shall be completely immersed in the water, except for approximately 1 ft at each end. The cable shall be suspended in the bath as near the center of the container as possible. The cable jacket shall not be in contact with the container. Tests shall be performed with a megohmmeter with a minimum output voltage of 500 VDC, capable of resistance measurements

between 0.5 and at least 10,000 MΩ, with a measurement accuracy of at least 5 percent. The instrument shall provide for the use of guard rings for cancellation of surface leakage currents. The two ends of the overall shield shall be connected together and the test voltage applied between the shield ends and the container. Resistance measurements shall be made after an electrification period of 1 minute. Compliance with 3.5.3.3 shall be determined.

4.8.3.3.5 Conductor Resistance Test

Conductor resistance shall be measured in accordance with ASTM B 193, except that the measurements shall be made with an accuracy of 0.1 percent. To determine the added length of conductor required because of cabling, conductors shall be removed from a 5-ft length of cable. The straightened length of the conductors shall be measured, and the ratio of straightened length of conductor to original length of cable shall be computed. Every conductor in every cable shall be tested to determine compliance with 3.5.1.3.

5. PREPARATION FOR DELIVERY

5.1 Packaging, Packing, and Marking

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

5.1.1 Packaging

Packaging shall be in accordance with the Level A requirements of MIL-DTL-12000 and as specified in 5.1.1.1 and 5.1.1.2.

5.1.1.1 Reels and Spools

Cable shall be delivered on nonreturnable reels or spools. The cable shall be wound on the reel or spool so that both ends are accessible for testing.

5.1.1.2 Cable Lengths

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.

5.1.2 Packing

Unless otherwise specified in the contract, packing shall be in accordance with the Level C requirement of MIL-DTL-12000.

5.1.3 Marking

Cable reels or spools and exterior shipping containers shall be marked in accordance with MIL-DTL-12000 and MIL-STD-129. The identification shall include the following information:

a. cable part number,

b. KSC-SPEC-E-0024/x,

c. length ( ) feet,

d. date of manufacture, and

e. name of manufacturer.

6. NOTES

6.1 Intended use

Cables covered by this specification are suitable for use in wet or dry locations in applications where they will not be subjected to severe mechanical abuse. The cables are designed to operate with a maximum continuous surface temperature of 75 °C and at a maximum of 600 V rms. The cables are not recommended for use in applications where they will be subject to heavy impact or abrasive wear such as frequent foot or vehicle traffic, nor for direct burial as a permanent installation.

6.2 Ordering Data

Procurement documents shall specify the following:

a. title, number, and date of this specification, and the applicable detail specification sheet number,

b. cable part number,

c. total length of cable required,

d. minimum cutting lengths,

e. whether a preproduction sample is required (see 4.3.1),

f. where preproduction tests will be conducted (see 4.5.1),

g. whether acceptance inspection samples are required to be furnished to the procuring activity (see 4.3.3),

h. number and length of inspection samples (see 4.3.3), and

i. whether special packing is required (see 5.1.2).

6.3 Detail Cable Specification Sheets

A list of detail specification sheets appears at the end of this general specification.

6.4 Definitions

The following definitions apply when the terms listed are used in this document.

a. **cable:** two or more conductors insulated from each other and contained in a common covering; two or more conductors insulated from each other and twisted or molded together without a common covering; or one insulated conductor with a metallic covering, shield, or outer conductor.

b. **completed or finished cable:** cable on which all manufacturing operations have been completed and that is ready to be submitted for inspection and testing.

c. **concentric lay:** a conductor or cable buildup composed of a central core surrounded by one or more layers of helically wound strands or insulated conductors. Successive layers are laid in a reverse direction.

d. **conductor:** a bare wire or combination of bare wires suitable for carrying an electric current.

e. **cutting length:** the continuous, unspliced length in which cable is to be furnished.

f. **direction of lay:** the lateral direction, either right-hand or left-hand, in which a strand or insulated conductor passes over the top as it recedes from an observer looking along the axis of the conductor or cable.

g. **elongation:** extension between bench marks produced by a tensile force applied to a specimen and expressed as a percentage of the original distance between the marks on the unstressed specimen. Ultimate elongation is the elongation at the moment of rupture.

h. **finished conductor:** the metal conductor with insulation and any insulation covering applied.

i. **insulation:** materials molded or extruded onto conductors and offering very high resistance to current flow.

j. **insulation covering:** a material applied over the insulation for the purpose of protecting the insulation.

k. **insulation resistance:** the electrical resistance offered by insulating material to an impressed direct-current potential tending to produce a leakage current through the material.

l. **length of lay:** the axial length of one complete turn of any helically wound strand or insulated conductor.

m. **stranded conductor:** a conductor composed of two or more bare wires.

n. **tensile strength:** the force, per unit of original cross-sectional area of the un-stressed specimen, required to stretch the specimen to a stated elongation.

o. **unidirectional lay:** concentric lay constriction with successive layers laid in the same direction.

p. **wire:** a single conductor, either solid or stranded, capable of carrying current in an electrical circuit. A wire may be bare or insulated but does not have a metallic covering, jacket, or shield. Bare "wire" and "conductor" are synonymous.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Engineering Directorate,
Electrical Design Branch

**CABLE, ELECTRICAL, SHIELDED, JACKETED
FOR HARNESS ASSEMBLIES
GENERAL SPECIFICATION FOR**

The following detail specification sheets for specific cable types form a part of KSC-SPEC-E-0024:

KSC-SPEC-E-0024/1	Cable, Electrical, Shielded, Jacketed, Type SSI
KSC-SPEC-E-0024/2	Cable, Electrical, Shielded, Jacketed, Type PTSI
KSC-SPEC-E-0024/3	Cable, Electrical, Shielded, Jacketed, Type TTSI
KSC-SPEC-E-0024/4	Cable, Electrical, Shielded, Jacketed, Type QTSI
KSC-SPEC-E-0024/5	Cable, Electrical, Shielded, Jacketed, Type 5TSI
KSC-SPEC-E-0024/6	Cable, Electrical, Shielded, Jacketed, Type 6TSI

CABLE, ELECTRICAL, SHIELDED, JACKETED
TYPE SSI
DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for single-conductor, shielded, jacketed, electrical cable.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies, General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General Requirements: The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 Classification: Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 Type: SSI.

3.2.2 Part Number: Type designation suffixed with conductor AWG size, as shown in Table 1/1.

3.3 Materials: All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall consist of the following:

a. a single insulated conductor,

b. a shield over the insulated conductor, and

c. a jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 1/1.

Table 1/1. Cable Construction – Type SSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
SSI #24	24	0.015	0.105	2.0	300
SSI #22	22	0.015	0.115	2.0	270
SSI #20	20	0.015	0.123	2.0	240
SSI #18	18	0.015	0.144	2.0	210
SSI #16	16	0.015	0.151	2.0	190
SSI #14	14	0.015	0.176	2.0	160
SSI #12	12	0.015	0.195	2.0	150

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaws test voltage shall be as specified in Table 1/1.

5. PREPARATION FOR DELI VERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
Electrical Division
Engineering Directorate

CABLE, ELECTRICAL, SHIELDED, JACKETED TYPE PTSI DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for two-conductor electrical cable, with overall shield and jacket.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies, General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General Requirements: The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 Classification: Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 Type: PTSI.

3.2.2 Part Number: Type designation suffixed with conductor AWG size, as shown in Table 2/1.

3.3 Materials: All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall consist of the following:

a. two insulated conductors, twisted together,

b. an overall shield over the cabled conductors, and

c. a jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 2/1.

Table 2/1. Cable Construction – Type PTSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
PTSI #24	24	0.015	0.161	2.0	180
PTSI #22	22	0.015	0.174	2.0	160
PTSI #20	20	0.015	0.191	2.0	150
PTSI #18	18	0.020	0.243	2.0	160
PTSI #16	16	0.022	0.260	2.0	160
PTSI #14	14	0.027	0.326	2.5	160
PTSI #12	12	0.031	0.371	3.0	160

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaws test voltage shall be as specified in Table 2/1.

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
Electrical Division
Engineering Directorate

CABLE, ELECTRICAL, SHIELDED, JACKETED
TYPE TTSI
DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for three-conductor electrical cable, with overall shield and jacket.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies, General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General Requirements: The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 Classification: Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 Type: TTSI

3.2.2 Part Number: Type designation suffixed with conductor AWG size, as shown in Table 3/1.

3.3 Materials: All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall consist of the following:

a. three insulated conductors, twisted together,

b. an overall shield over the cabled conductors, and

c. a jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 3/1.

Table 3/1. Cable Construction – Type TTSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
TTSI #24	24	0.015	0.169	2.0	160
TTSI #22	22	0.015	0.183	2.0	160
TTSI #20	20	0.017	0.205	2.0	160
TTSI #18	18	0.022	0.260	2.0	160
TTSI #16	16	0.024	0.278	2.0	160
TTSI #14	14	0.029	0.348	2.5	160
TTSI #12	12	0.033	0.396	3.0	160

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaws test voltage shall be as specified in Table 3/1.

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
Electrical Division
Engineering Directorate

CABLE, ELECTRICAL, SHIELDED, JACKETED
TYPE QTSI
DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for four-conductor electrical cable, with overall shield and jacket.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies, General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 **General Requirements:** The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 **Classification:** Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 **Type:** QTSI.

3.2.2 **Part Number:** Type designation suffixed with conductor AWG size, as shown in Table 4/1.

3.3 **Materials:** All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall be as follows:

a. Four insulated conductors, twisted together.

b. An overall shield over the cabled conductors.

c. A jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 4/1.

Table 4/1. Cable Construction – Type QTSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
QTSI #24	24	0.015	0.183	2.0	160
QTSI #22	22	0.017	0.202	2.0	160
QTSI #20	20	0.019	0.227	2.0	160
QTSI #18	18	0.024	0.287	2.5	160
QTSI #16	16	0.026	0.307	2.5	160
QTSI #14	14	0.032	0.386	3.0	160

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaws test voltage shall be as specified in Table 4/1

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
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Engineering Directorate

CABLE, ELECTRICAL, SHIELDED, JACKETED TYPE 5TSI DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for five-conductor electrical cable, with overall shield and jacket.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies, General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General Requirements: The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 Classification: Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 Type: 5TSI.

3.2.2 Part Number: Type designation suffixed with conductor AWG size, as shown in Table 5/1.

3.3 Materials: All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall be as follows:

a. Four insulated conductors, twisted together.

b. An overall shield over the cabled conductors.

c. A jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 5/1.

Table 5/1. Cable Construction – Type 5TSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
5TSI #24	24	0.017	0.202	2.0	160
5TSI #22	22	0.019	0.224	2.0	160
5TSI #20	20	0.021	0.251	2.0	160
5TSI #18	18	0.027	0.319	2.5	160
5TSI #16	16	0.029	0.346	2.5	160
5TSI #14	14	0.036	0.428	3.0	160

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaw test voltage shall be as specified in Table 5/1.

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
Electrical Division
Engineering Directorate

CABLE, ELECTRICAL, SHIELDED, JACKETED
TYPE 6TSI
DETAIL SPECIFICATION FOR

This detail specification sheet forms a part of the latest issue of KSC-SPEC-E-0024.

1. SCOPE

This specification covers the detail requirements for six-conductor electrical cable, with overall shield and jacket.

2. APPLICABLE DOCUMENTS

The following document, of the issue in effect on the date of issue of invitation for bids or request for proposals, forms a part of this specification.

John F. Kennedy Space Center

KSC-SPEC-E-0024	Cable, Electrical, Shielded, Jacketed, For Harness Assemblies General Specification For

(Copies required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General Requirements: The cable shall be in accordance with KSC-SPEC-E-0024 and as specified herein.

3.2 Classification: Cables manufactured to this specification shall be classified by type and part number, according to 3.2.1 and 3.2.2.

3.2.1 Type: 6TSI.

3.2.2 Part Number: Type designation suffixed with conductor AWG size, as shown in Table 6/1.

3.3 Materials: All materials shall be as specified in KSC-SPEC-E-0024.

3.4 Configuration: The cable configuration shall consist of the following:

a. four insulated conductors, twisted together,

b. an overall shield over the cabled conductors, and

c. a jacket over the shield.

3.5 Construction: The cable shall be constructed in accordance with KSC-SPEC-E-0024 and the requirements in Table 6/1.

Table 6/1. Cable Construction – Type 6TSI

Part Number	Conductor Size (AWG)	Jacket Thickness (inches)	Max. Cable Diameter (inches)	Jacket Test Voltage (kV)	Insulation Resistance (MΩ/1,000 ft)
6TSI #24	24	0.018	0.229	2.0	160
6TSI #22	22	0.020	0.243	2.0	160
6TSI #20	20	0.023	0.275	2.5	160
6TSI #18	18	0.030	0.357	3.0	160
6TSI #16	16	0.032	0.380	3.0	160
6TSI #14	14	0.039	0.472	3.0	160

4. QUALITY ASSURANCE PROVISIONS

Test and inspection requirements shall be as specified in KSC-SPEC-E-0024. The jacket flaws test voltage shall be as specified in Table 6/1.

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as specified in KSC-SPEC-E-0024.

6. NOTES

The notes contained in KSC-SPEC-E-0024 shall apply.

Custodian:

NASA – John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Preparing Activity:

John F. Kennedy Space Center
Electrical Design Branch
Electrical Division
Engineering Directorate

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INSTRUCTIONS

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER KSC-SPEC-E-0024A	2. DOCUMENT DATE August 6, 2008

3. DOCUMENT TITLE
Cable, Electrical, Shielded, Jacketed, for Harness Assemblies, General Specification 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

8. PREPARING ACTIVITY

a. NAME Electrical Design Branch, Electrical Division, Engineering Directorate	b. TELEPHONE *(Include Area Code)* 321-867-6537

c. ADDRESS *(Include Zip Code)*
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