CABLES, COAXIAL, RADIO FREQUENCY,

FLEXIBLE,

ESCC Generic Specification No. 3902

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Pages 1 to 31

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space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	April 1995		
Revision 'A'	August 1997		
Revision 'B'	December 1997		
Revision 'C'	April 1999		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference / Item	Approved DCR No.
		This issue supersedes Issue 3 and incorporates all modifications defined in Revisions 'A' and 'B' to Issue 3 and the changes introduced by the following DCRs:-	
		Cover page	None
		DCN	None
		Para. 2.1 : Delete reference to ESA/SCC No. 21500	21078
		: Add reference to ESA/SCC No. 24600	21078
		: Add reference to ESA/SCC No. 24600 in first sentence	21078
		Para. 4.5 ; Rewrite first sentence	23605
		Chart IV : Add Anthony and Brown test	23671
		Chart V : Add Anthony and Brown test	23671
		Para. 9.21 : Delete fluids (c), (d) and (g) and renumber remainder	221234
'A'	Aug. '97	Implementation of Policy DCR 21107 is completed by the changes introduced by the following DCR:-	
		P1. Cover page	None
		P2. DCN	None
		P4. T of C : Para. 10.1.4 entry added	23866
		: Para. 10.2 renumbered to "27A"	None
		P8. Para. 4.1 : Second paragraph amended	23866
		: New paragraph added	23866
		Para. 4.1.3 : Second sentence amended	23866
		Para. 4.1.4 : Text amended	23866
		P12. Chart I : Lot Acceptance Box moved and "(1)" added	23866
		: Note added	23866
		P14. Para. 8.2.1 : In the last paragraph, both sentences amended	23866
		P15. Para. 8.4 : In the last paragraph, "either" and all after "months" deleted	23866
		P20. Para. 9 : New text added	23866
		Para. 9.4.1 : "(c)" moved to Page 21	None
		P21. Para. 9.4.1 : "(c)" added from Page 20	None
		P27. Para. 10.1 : "(when applicable)" added to (g)	23866
		Para. 10.1.2 : Existing text deleted and new text added	23866
		Para. 10.2 : Moved to Page 27A	None
		P27A. : Page added	None
		Para. 10.1.4 : New paragraph added	23866
		Para. 10.2 : Added from Page 27	None
		: (e) amended	23866
		P28. Para. 10.3 : First sentence amended	23866
		Para. 10.6 : In the second paragraph, second sentence amended	23866
		: Last paragraph deleted	23866
		P29. Para. 11 : In (b), "(when applicable)," added after "testing"	23866
		: In the last sentence, ", when requested," added after "copied"	23866
'B'	Dec. '97	P1. Cover page	None
		P2. DCN	None
		P2A. DCN : Page added	None
		P3. T of C : Para. 2.2 Page number changed to 6	None
		P4. T of C : Paras. 9.22 and 9.24 entries made "Not Applicable"	221396
		P6. Para. 2.2 : Title and first 5 documents added from Page 7	None
		P7. Para. 2.2 : ESA PSS-01-721 and 729 added	221396

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		P10. Para. 4.5	: New second sentence added	221396
		Para. 5.3.2	: 5th and 6th alineas moved to Page 11	None
		P11. Para. 5.3.2	: 5th and 6th alineas added from Page 10	None
		P18. Chart IV	: Flammability and Outgassing Boxes deleted	221396
		P25. Para. 9.22	: Title and text deleted and "Not Applicable" added	221396
		Para. 9.24	: Title and text deleted and "Not Applicable" added	221396
'C'	Apr. '99	P1. Cover page		None
		P2A. DCN		None
		P14. Para. 8.2.1	: New second sentence added to last paragraph	21111
		P27. Para. 10.1.2.1	: Item (b), "PDA figure and" deleted from text	21119
			: Item (c) rewritten	21119

TABLE OF CONTENTS

1. INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification approval, procurement, including lot acceptance testing, and delivery of Cables, Coaxial, Radio Frequency, Flexible, for space applications.

This specification contains the appropriate inspection and test schedules and also specifies the data documentation requirements.

1.2 APPLICABILITY

This specification is primarily applicable to the granting of qualification approval to a component in accordance with ESA/SCC Basic Specification No. 20100 and the procurement of such components from qualified Manufacturers.

2. APPLICABLE DOCUMENTS

The following documents form part of, and shall be read in conjunction with, this specification. The relevant issues shall be those in effect on the date of placing the purchase order.

2.1 ESA/SCC SPECIFICATIONS

No. 20100, Requirements for the Qualification of Standard Electronic Components for Space Application.

No. 20500, External Visual Inspection.

No. 20600, Preservation, Packaging and Despatch of SCC Electronic Components.

No. 21300, Terms, Definitions, Abbreviations, Symbols and Units.

No. 21700, General Requirements for the Marking of SCC Components.

No. 22800, ESA/SCC Non-conformance Control System.

No. 24600, Minimum Quality System Requirements.

With the exception of ESA/SCC Basic Specifications Nos. 20100, 21700, 22800 and 24600, where Manufacturers' specifications are equivalent to, or more stringent than, the ESA/SCC Basic Specifications listed above, they may be used in place of the latter, subject to the approval of the appropriate Qualifying Space Agency.

Such replacements shall be clearly identified in the applicable Process Identification Document (P.I.D.) and listed in an appendix to the appropriate Detail Specification.

Unless otherwise stated herein, references within the text of this specification to "the Detail Specification" shall mean the relevant ESA/SCC Detail Specification.

2.2 OTHER (REFERENCE) DOCUMENTS

MIL-C-17, Cables, Radio Frequency, Flexible and Semi-rigid, General Specification for.

MIL-P-26536, Propellant, Hydrozine.

MIL-P-26539, Propellant, Nitrogen Tetroxide.

IEC Publication No. 68-2, Basic Environmental Testing Procedures.

FED-STD-228, Cables and Wires, Insulated, Methods of Sampling and Testing.

ASTMB-298-74, Silver-coated Soft or Annealed Copper Wire.

ESA PSS-01-702, A Thermal Vacuum Test for the Screening of Space Materials.

ESA PSS-01-720, Determination of the Susceptibility of Silver-plated Copper Wire/Cable to "Red Plague" Corrosion.

ESA PSS-01-721, Flammability Testing for the Screening of Space Materials.

ESA PSS-01-729, The Determination of Offgassing Products from Materials and Assembled Articles to be used in Manned Space Vehicle Crew Compartment.

2.3 ORDER OF PRECEDENCE

For the purpose of interpretation and in case of conflict with regard to documentation, the following order of precedence shall apply:-

(a) ESA/SCC Detail Specification.

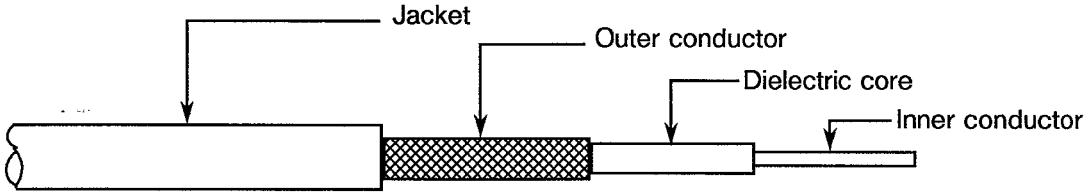
(b) ESA/SCC Generic Specification.

(c) ESA/SCC Basic Specification.

(d) Other documents, if referenced herein.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 shall apply. Furthermore, the following terms shall apply:



NOTES

1. In this specification, the words "coaxial cable(s)" are replaced by the word "component(s)".

- The production lot of individual silver-plated strands shall consist of the total length of strand of one size being finally available in one continuous length, or in various pieces, which has been drawn to its final dimensions in one continuous process.
- The production lot of finished wire shall consist of the total length of wire being finally available either in one continuous length, or in separate pieces, which has been produced successively:
  - In one continuous processes for stranding of the conductor.
  - In one continuous process for wrapping and heat-sealing of tapes.
  - In one continuous process for application of the top coat.

  Wire lengths, which have been separated for practical reasons or, for instance because of partial failure of the insulation during the Impulse Dielectric Test, shall be considered to belong to the same production lot.

- The production lot of finished cables shall consist of the total length of cable which has been produced successively:
  - In one continuous process for twisting of wires.
  - In one continuous process for the application of the shield.
  - In one continuous process for wrapping and heat-sealing of tapes.

  Cables lengths, which have been separated for practical reasons or because of partial failure of the jacket during the Spark Test, shall be considered to belong to the same production lot.
- The term "continuous process" as used above is defined as a manufacturing operation which may have been discontinued for standard or routine interruptions only, but not for disruptions which require resetting of machines or process parameters.

4. REQUIREMENTS

4.1 GENERAL

The test requirements for qualification approval of a component shall comprise final production tests (see Chart II) and qualification testing (see Chart IV).

The test requirements for procurement of components shall comprise final production tests (Chart II) together with, when applicable, a level of lot acceptance testing (see Chart V) to be specified by the Orderer.

If a Manufacturer elects to eliminate a final production test by substituting an in-process control or statistical process control procedure, the Manufacturer is still responsible for delivering components that meet all of the performance, quality and reliability requirements defined in this specification and the Detail Specification.

4.1.1 Specifications

For qualification approval, procurement (including lot acceptance testing) and delivery of components in conformity with this specification, the specifications listed in Section 2 of this document shall apply in total unless otherwise specified herein or in the Detail Specification.

4.1.2 Conditions and Methods of Test

The conditions and methods of test shall be in accordance with this specification, the ESA/SCC Basic Specifications referenced herein and the Detail Specification.

4.1.3 Manufacturer's Responsibility for Performance of Tests and Inspections

The Manufacturer shall be responsible for the performance of tests and inspections required by the applicable specifications. These tests and inspections shall be performed at the plant of the Manufacturer of the components unless it is agreed by the Qualifying Space Agency prior to commencing qualification testing, or procurement, to use an approved external facility.

4.1.4 Inspection Rights

The Qualifying Space Agency (for qualification approval or for a procurement) reserves the right to monitor any of the tests and inspections scheduled in the applicable specifications.

4.1.5 Pre-encapsulation Inspection

Not applicable.

4.2 QUALIFICATION APPROVAL REQUIREMENTS ON A MANUFACTURER

To obtain and maintain the qualification approval of a component, or family of components, a Manufacturer shall satisfy the requirements of ESA/SCC Basic Specification No. 20100.

4.3 DELIVERABLE COMPONENTS

Components delivered to this specification shall be processed and inspected in accordance with the relevant Process Identification Document (P.I.D.). Each delivered component shall be traceable to its production lot. Components delivered to this specification shall have completed satisfactorily all tests to the testing level and lot acceptance level specified in the purchase order (see Para. 4.3.2).

ESA/SCC qualified components delivered to this specification shall be produced from lots that are capable of passing all tests, and sequences of tests, that are defined in Charts IV and V. The Manufacturer shall not knowingly supply components that cannot meet this requirement. In the event that, subsequent to delivery and prior to operational use, a component is found to be in a condition such that it could not have passed these tests at the time of manufacture, this shall be grounds for rejection of the delivered lot.

4.3.1 Lot Failure

Lot failure may occur during final production tests (Chart II) qualification testing (Chart IV) or lot acceptance testing (Chart V).

Should such failure occur, the non-conformance procedure shall be initiated in accordance with ESA/SCC Basic Specification No. 22800.

Should such failure occur during procurement, the Manufacturer shall notify the Orderer by telex within 2 working days, giving details of the number and mode of failure and the suspected cause.

In the case where qualification approval has been granted to the component, he shall, at the same time by the same means, inform the Qualifying Space Agency in order that the latter may consider its implications.

No further testing shall be performed on the failed components except on instruction from the Orderer. The Orderer shall inform the Manufacturer and the Qualifying Space Agency within 2 working days of receipt of the telex, by the same means, what action shall be taken.

In the case when lot failure occurs during qualification testing, the Manufacturer shall immediately notify the appropriate Qualifying Space Agency who will define a course of action to be followed. No further testing shall be performed on the failed components.

4.3.2 Testing and Lot Acceptance Levels

This specification defines 1 level of testing severity which is designated by the letter 'B' (see Chart I) and 3 levels of lot acceptance testing (see Chart V).

The lot acceptance levels are designated 1, 2 and 3 and are comprised of tests as follows:-

Level 3 (LA3) - None;

Level 2 (LA2) - Endurance and Electrical Subgroup;

Level 1 (LA1) - Mechanical Subgroup

plus Endurance and Electrical Subgroup.

The required testing level and lot acceptance level shall both be specified in a purchase order.

4.4 MARKING

All components procured and delivered to this specification from a source qualified according to ESA/SCC Basic Specification No. 20100 shall be marked in accordance with ESA/SCC Basic Specification No. 21700. Thus, they shall bear the ESA symbol to signify their conformance to the ESA/SCC qualification approval requirements and full compliance with the requirements of this specification and the Detail Specification.

Components procured from sources which are not ESA/SCC qualified, provided that they fully

comply with the procurement requirements of this specification and the Detail Specification, may bear the SCC marking **with the exception of the ESA symbol**.

N.B. In this case, i.e. for coaxial cables, the support (spool) only shall be marked.

4.5 MATERIALS AND FINISHES

All non-metallic materials and finishes, that are not within a hermetically sealed enclosure, of the components specified herein shall meet the outgassing requirements as outlined in ESA PSS-01-702.

All insulation materials of the components specified herein shall meet the flammability requirements outlined in ESA PSS-01-721 and the offgassing requirements outlined in ESA PSS-01-729.

Specific requirements for materials and finishes are specified in the Detail Specification.

5. PRODUCTION CONTROL

5.1 GENERAL

The minimum requirements for production control, which are equally applicable to procurement, are defined in ESA/SCC Basic Specification No. 20100, Para's 5.1 and 5.2.

5.2 PROTECTION OF SILVER-PLATED STRANDS

5.2.1 Packaging of Individual Wire Strands

After inspection by Quality Control personnel, individual wire strands shall be stored and shipped on spools that are pacakged in sealed transparent plastic bags in accordance with Section 12, alineas (h) and (i).

5.2.2 Processed Strands and Braids

Partly processed strands and braids such as those awaiting insulation covering, shall be kept under maximum humidity of 70% as briefly as possible.

5.3 SPECIAL IN-PROCESS CONTROLS

The following in-process controls are applicable.

5.3.1 Insulation Flaws (Spark Test)

After application of the dielectric and prior to application of the outer conductor, 100% of the core shall pass the insulation flaw test without breakdown. Voltage and frequency shall be as specified in the Detail Specification.

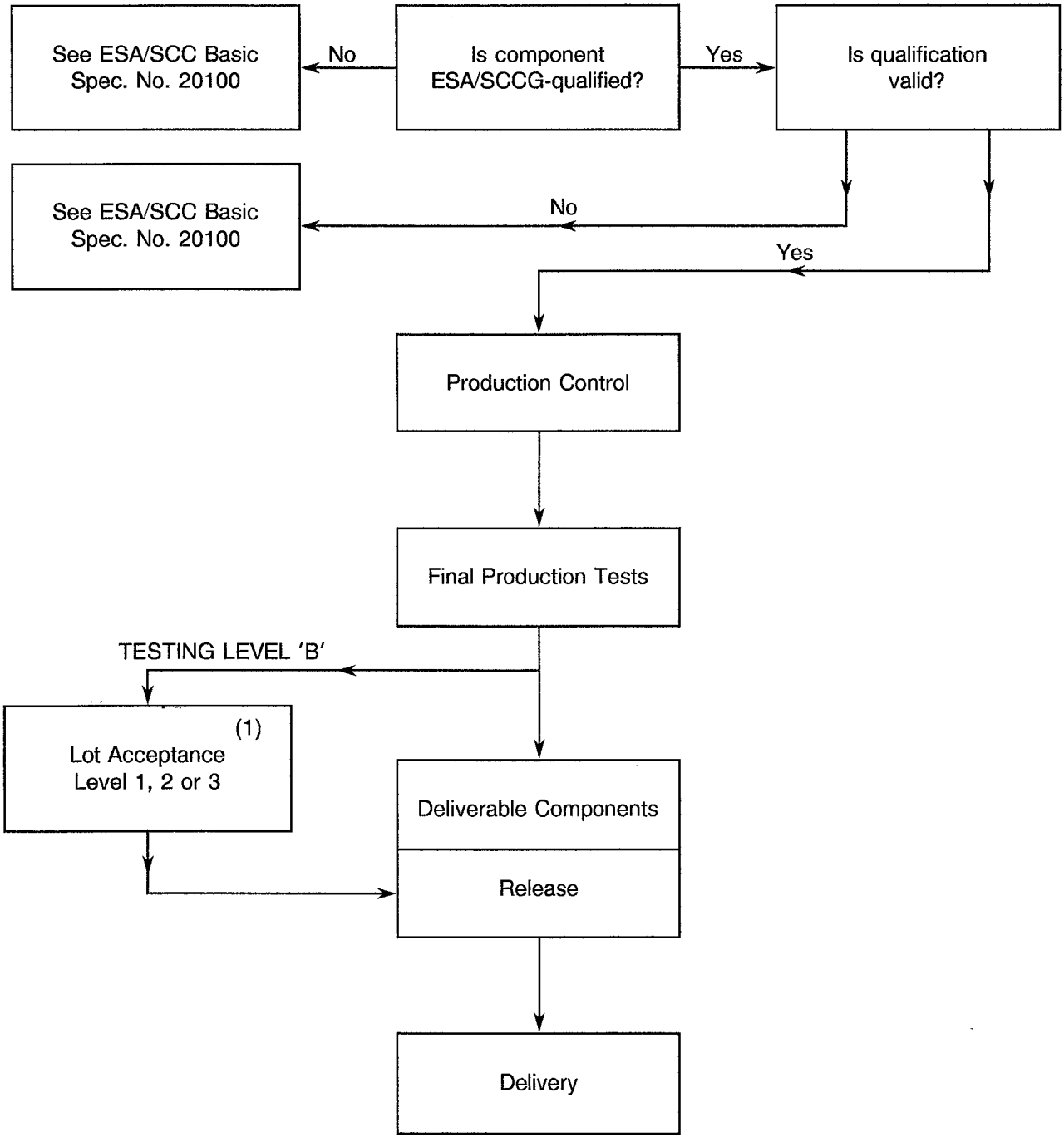
5.3.2 Microsectioning of Strands

The silver coating of the copper strands and the strand diameter shall be evaluated by microsectioning, using the following procedure on one sample of each production lot of strands:

- As necessary, the samples of single pieces of strands or (untwisted) pieces of stranded conductor or shield shall be electroplated with a coating of not less than 25µm of copper or nickel to protect the edges during subsequent grinding and polishing.
- The speciment shall be moulded in a low exotherm casting resin.
- The specimen shall be ground and polished transversely to its axis by use of appropriate grinding paper and diamond paste (down to 0.25µm diamond paste).
- The polished specimen shall be etched in a fresh solution of ammonia containing a few drops of hydrogen peroxide.

- The etched cross-section shall be examined with a metallographic microscope at a magnification of not less than X400.
- The silver plating shall be uniform and concentric around the copper strand such that no area around the circumference is covered by less than 2µm of silver.
- Single points, caused by eccentric copper or minute scratches, that are covered with not less than 1.5µm of silver are permitted provided they do not exceed 3 in number around the microsectioned strand circumference.
- The coating shall be free from porosity, scratches, marks, impurities, corrosion and other defects which disrupt the continuous and complete coating of the copper by silver.
- In case of failure, the total length of strands constituting the production lot shall be rejected.

CHART I - TESTING LEVELS



NOTES

1. When applicable.

6. FINAL PRODUCTION TESTS

6.1 GENERAL

Unless otherwise specified in the Detail Specification, all components used for qualification testing and all components for delivery, including those submitted to lot acceptance tests, shall be subjected to tests and inspections in accordance with Chart II.

Unless otherwise specified in the Detail Specification, the tests shall be performed in the order shown.

Any components that do not meet these requirements shall be removed from the lot and at no future time be re-submitted to the requirements of this specification.

6.2 TEST METHODS AND CONDITIONS

The applicable test methods and conditions are specified in the paragraphs referenced in Chart II of this specification.

6.3 FAILURE CRITERIA

6.3.1 Parameter Limit Failure

A component shall be counted as a limit failure if one or more parameters exceed the limits shown in Tables 2 or 3 of the Detail Specification.

6.3.2 Other Failures

A component shall be counted as a failure in any of the following cases:

- Mechanical failure.
- Handling failure.
- Lost component.

6.4 FAILED COMPONENTS

A component shall be considered as a failed component if it exhibits one or more of the failure modes described in Para. 6.3 of this specification.

6.5 LOT FAILURE

In case of lot failure, the Manufacturer shall act in accordance with the requirements of Subpara. 4.3.1 of this specification. For the purpose of this specification, 1 failure in any of the following tests and inspections shall constitute a lot failure:

- 9.1 : External Visual Inspection.
- 9.3 : Dimension Check.
- 9.5, 9.7 and 9.8 : Electrical Measurements.
- 9.9 : Stripping Capability.

6.6 DOCUMENTATION

Documentation of final production test data shall be in accordance with the requirements of Para. 10.6 of this specification.

7. BURN-IN AND ELECTRICAL MEASUREMENTS

Not applicable.

8. QUALIFICATION APPROVAL AND LOT ACCEPTANCE TESTS

8.1 QUALIFICATION TESTING

8.1.1 General

Qualification testing shall be in accordance with the requirements of Chart IV of this specification. The tests to Chart IV shall be performed on the samples specified in the paragraphs of Section 9, chosen at random from a length of cable which has successfully passed the tests in Chart II for Testing Level 'B'. These samples constitute the qualification test lot.

The applicable test requirements are detailed in the paragraphs referenced in Chart IV.

The conditions governing qualification testing are given in ESA/SCC Basic Specification No. 20100, Para 5.3 and, for the extension or renewal of qualification approval, in Para's 6.3 and 6.4.

8.1.2 Distribution within the Qualification Test Lot

Not applicable.

8.2 LOT ACCEPTANCE TESTING

8.2.1 General

The sample sizes of the 3 lot acceptance levels are specified in Chart V. All components assigned to a subgroup shall be subjected to all of the tests of that subgroup in the sequence shown.

The tests to Chart V shall be performed on the specified sample which shall have been chosen, whenever possible, at random from the proposed delivery lot. The applicable test requirements are detailed in the paragraphs referenced in Chart V.

As a minimum for procurement of non-qualified components, lot acceptance level 3 tests shall apply. For procurement of qualified components, lot acceptance testing shall be performed if specified in a purchase order. Procurement lots ordered with a lot acceptance test level shall be delivered only after successful completion of lot acceptance testing.

8.2.2 Distribution within the Sample for Lot Acceptance Testing

Where a Detail Specification covers a range or series of components that are considered similar, then it may be necessary that the sample for lot acceptance testing be comprised of component types so selected that they adequately represent all of the various mechanical, structural and electrical peculiarities of the procured range or series.

The distribution of the component types will normally vary from procurement to procurement and shall be as specified by the Orderer:-

(a) In the case of manufacture of variants of the same wire size, the lot acceptance tests shall be performed on the most complex variants and thus all variants will be qualified.

(b) In the case of manufacture of variants of different wire sizes, the lot acceptance tests shall be performed on each size.

A qualified lot may be divided for delivery purposes.

8.2.3 Lot Acceptance Level 3 Testing (LA3)

No tests or inspections are required for this level.

8.2.4 Lot Acceptance Level 2 Testing (LA2)

Lot acceptance level 2 testing shall comprise tests on an endurance and electrical subgroup. The following shall apply:-

(a) The tests in this subgroup are considered to be destructive and therefore components of testing level 'B' so tested shall not form part of the delivery lot.

8.2.5 Lot Acceptance Level 1 Testing (LA1)

Lot acceptance level 1 testing shall comprise the tests for LA2 (endurance and electrical subgroup) plus tests on a mechanical subgroup. For the endurance and electrical subgroup, the requirements and conditions for LA2 (see Subpara 8.2.4) shall apply.

For the mechanical subgroup, the following shall apply:-

(a) The tests in this subgroup are considered to be destructive and therefore components of testing level 'B' so tested shall not form part of the delivery lot.

8.3 FAILURE CRITERIA

The following criteria shall apply to qualification testing and to lot acceptance testing.

8.3.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:

- Components which fail during tests for which the pass/fail criteria are inherent in the test method, e.g. solderability, resistance to solvents, etc..

8.3.2 Electrical Failures

The following shall be counted as component failures:-

(a) Components which, when subjected to electrical measurements, in accordance with Table 2 of the Detail Specification, fail one or more of the applicable limits.

8.3.3 Other Failures

The following additional failures may also occur during qualification testing or lot acceptance testing:-

(a) Components failing to comply with the requirements of ESA/SCC Basic Specification No. 20500.

(b) Lost components.

8.4 FAILED COMPONENTS

A component shall be considered as failed if it exhibits one or more of the failure modes detailed in Para 8.3 of this specification. The allowable number of failed components per Subgroup, the aggregate failure constraints and the permitted distribution of such failures are shown at the foot of Charts IV and V of this specification.

When requested by the Qualifying Space Agency or the Orderer, failure analysis of failed components shall be performed by the Manufacturer and the results provided.

Failed components from successful lots shall be marked as such and be stored at the Manufacturer's plant for 24 months.

8.5 LOT FAILURE

A lot shall be considered as failed if the allowable number of failures according to Chart IV or V of this specification, as relevant, has been exceeded.

In the case of lot failure, the Manufacturer shall act in accordance with Subpara 4.3.1 of this specification.

8.6 DOCUMENTATION

For qualification testing, the qualification test data shall be documented in accordance with the requirements of Para 10.8 of this specification.

In the case of lot acceptance testing, the data shall be documented in accordance with the requirements of Para 10.9.

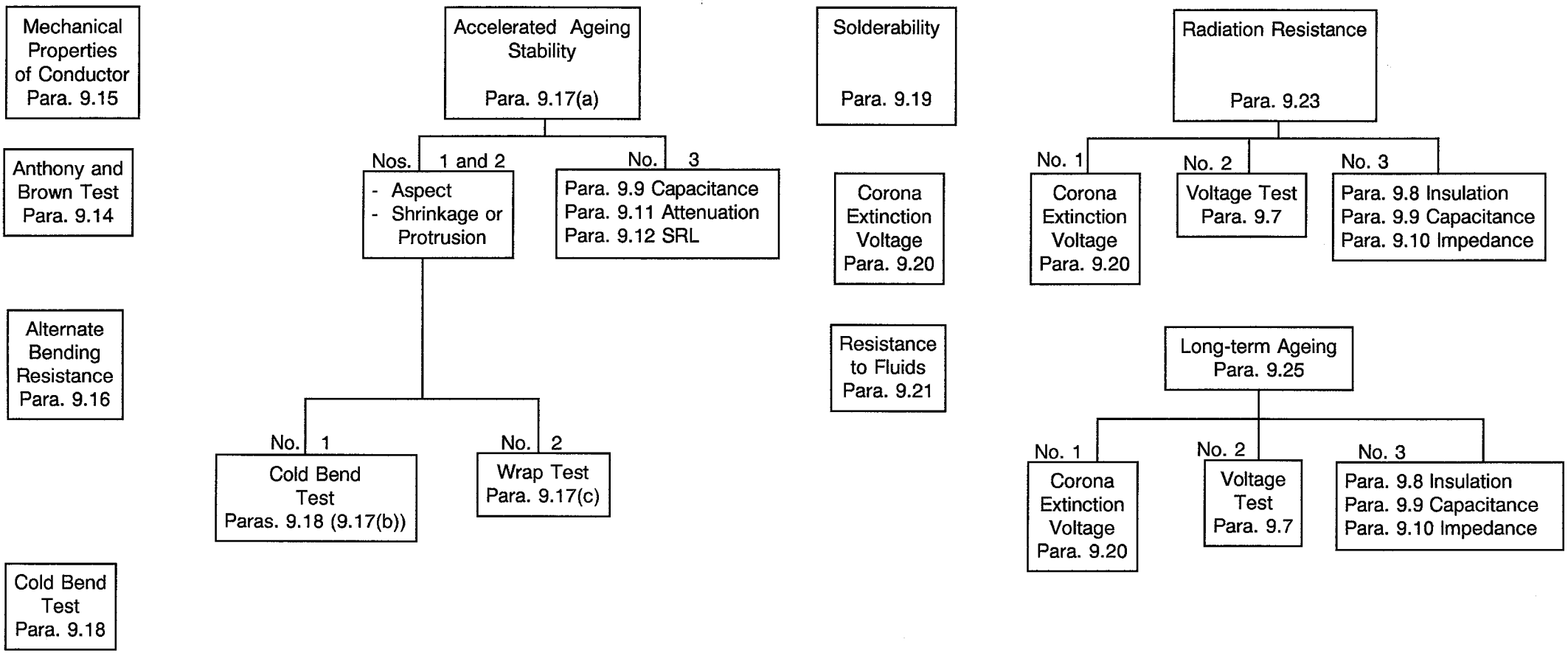
CHART II - FINAL PRODUCTION TESTS

Production and Controls in accordance with Section 5 of this Specifitcation	
Para 9.1	External Visual Inspection
Para 9.2	Weight
Para 9.3	Dimensions
Para 9.4	Coating tests
Para 9.5	Conductor resistance
Para 9.6	Dielectric strength of jacket
Para 9.7	Voltage Test
Para 9.8	Insulation resistance
Para 9.9	Capacitance
Para 9.10	Characteristic impedance
Para 9.11	Attenuation
Para 9.12	Structural return loss
Para 9.13	Adhesion of conductor
Para 9.19	Solderability
Para 4.4	Marking
TO CHART IV OR V	

CHART III - BURN-IN AND ELECTRICAL MEASUREMENTS

Not applicable.

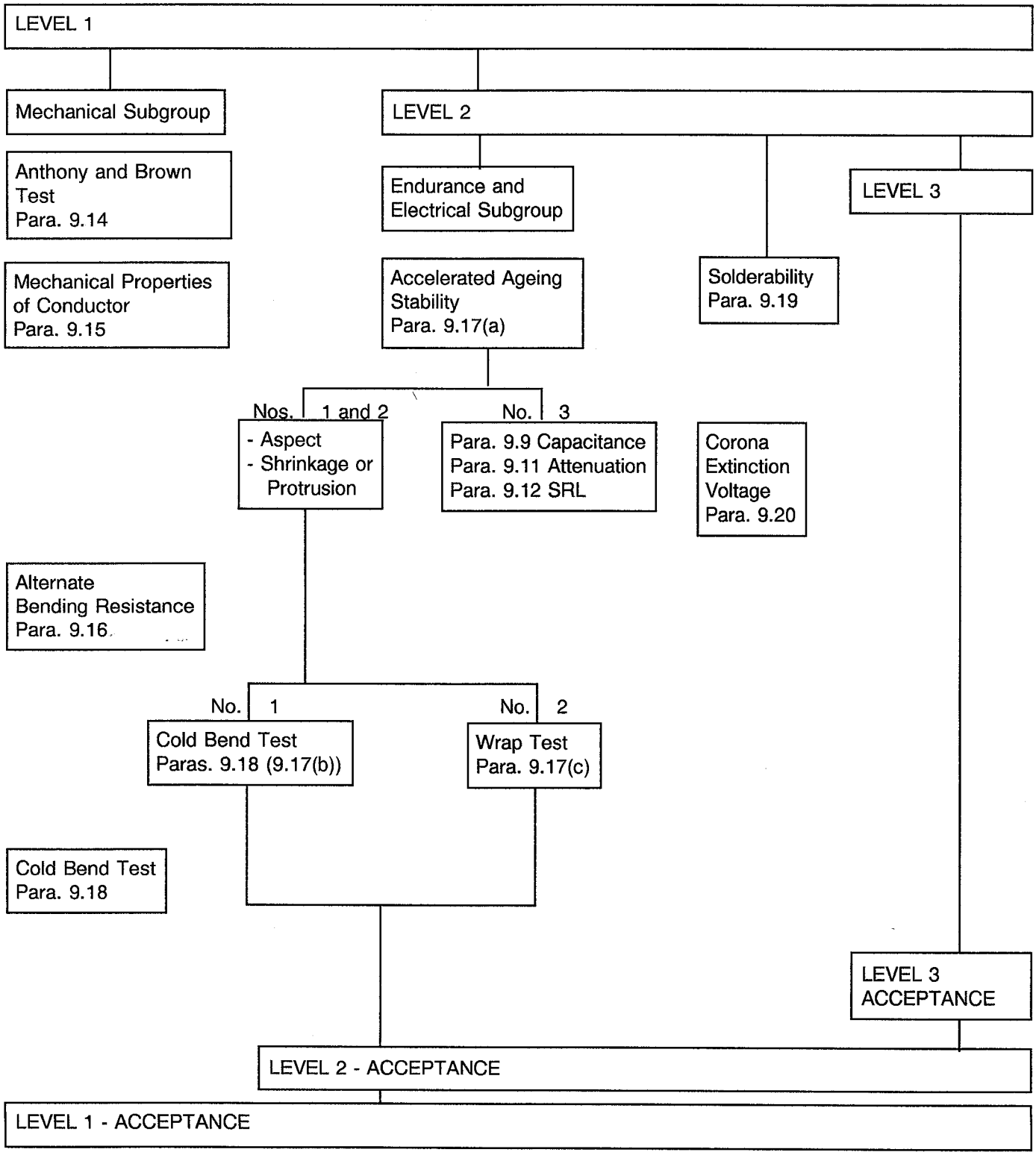
CHART IV - QUALIFICATION TESTS



NOTES

1. For allowable failures, see Paragraph 8.3.
2. Except for tests numbered 9.1 to 9.15 inclusive, samples shall be taken at random from the ends of existing lengths.

CHART V - LOT ACCEPTANCE TESTS



NOTES

1. For allowable failures, see Paragraph 8.3.
2. Except for tests 9.1 to 9.15 inclusive, samples shall be taken at random from the ends of existing lengths.

9. TEST METHODS AND PROCEDURES

The test methods, conditions and procedures are specified in the following paragraphs.

Whenever sampling is specified at the start and upon completion of lot production, this shall be understood to mean:

- The first and last assembled lengths that were marked during production.

If a Manufacturer elects to eliminate or modify a test method or procedure, the Manufacturer is still responsible for delivering components that meet all of the performance, quality and reliability requirements defined in this specification and the Detail Specification.

Documentation supporting the change shall be approved by the Qualifying Space Agency and retained by the Manufacturer. It shall be copied, when requested, to the Qualifying Space Agency.

The change shall be specified in the Detail Specification and in the P.I.D.

9.1 EXTERNAL VISUAL INSPECTION

The cables shall be visually inspected over their full lengths in accordance with the requirements of ESA/SCC Basic Specification No. 20500.

9.2 WEIGHT

The length and weight of a specimen with a minimum length of 3 metres shall be measured accurately; the resultant measurements shall be converted into kilogrammes per 1000 metres. The calculated value shall be in accordance with the requirements of the Detail Specification.

9.3 DIMENSIONS

The dimensions and detailed construction of the inner conductor, dielectric core, outer conductor and jacket shall be verified on the basis of the Detail Specification, using 2 samples with a length of 10cm: 1 taken from the start and 1 from the end of the component.

9.4 COATING TESTS (INNER AND OUTER CONDUCTOR STRANDS)

9.4.1 Silver-coated Wires

(a) **Continuity** (ASTM-B-298-74) (Inner Conductors only)

3 specimens shall be taken of strands, not less than 15cm, from a conductor previously straightened by hand. Degrease the specimens for 3 minutes in a solution consisting of alcohol and ether in equal proportions; then wipe them clean with a dry cloth after rinsing in distilled water. Specimens cleaned in this way shall not be touched subsequently by hand.

Immerse the specimens for 30 seconds in a solution of sodium polysulphide of a specific gravity of 1.142 at 20°C; wash them carefully in water. Then immerse the specimens for 15 seconds in hydrochloric acid solution of a specific gravity of 1.088 at 20°C. Wash them carefully in water.

On examination of the specimens with the naked eye, no adherent or clearly visible black spots shall be observed. Any blackening occurring less than 15mm from each end shall, however, not be taken into consideration.

(b) **Adhesion** (Inner Conductors only)

3 strand specimens with a minimum length of 15cm shall be taken from a conductor previously straightened by hand. 1 strand shall be wound around a mandrel of the same diameter as that of the wire, so as to form 5 turns of a close helix. The metal coating shall be examined with the naked eye; no detachment shall be observed.

(c) **Silver Thickness** (ASTM-B-298-74, Appendix, Method A)

The silver coating on inner and outer (Note 1) conductor strands shall be shown, by any convenient method, to be not less than specified in the Detail Specification.

NOTES

1. Outer conductor strands to be cut off before braiding.

9.4.2 Other Coatings

Other coatings, if applicable, shall be prescribed by the Detail Specification.

9.5 Conductor Reistance

The d.c. resistance of the inner conductor shall be verified by any suitable equipment giving an accuracy of at least 1%. This measurement shall be performed on a sample of 1metre long. If the room temperature is not +20°C, the measured value R_Θ of the ohmic resistance shall be related to +20°C by application of the following formula:-

$$R_{20} = \frac{R\Theta}{1 + \alpha(\Theta - 20)},$$

Where α is defined in the Detail Specification.

The result shall be as defined in the Detail Specification. The conductor resistance shall be measured also over the full length of the coaxial cable; however, taking into account inaccuracy in cable length, the maximum conductor resistance shall not exceed the specified value by more than 3%.

9.6 Dielectric Strength of Jacket

The full length of coaxial cable shall be tested for dielectric strength of the jacket in accordance with Method 6211 of FED-STD-228.

The test voltage specified in the Detail Specification shall be applied at a frequency of 50Hz between the outer conductor and the outer surface of the jacket.

During the testing of cables in this manner, there shall be no breakdown, flash-over or spark-over.

9.7 Voltage Test

The specimen shall be tested according to Method 6111 of FED-STD-228 except that the specimen shall not be immersed in water, but tested dry.

The test voltage specified in the Detail Specification shall be applied at a frequency of 50Hz to all samples for a minimum of 1 minute. The test voltage shall be applied between the inner and outer conductor with the outer conductor grounded.

During the testing of cables in this manner, there shall be no breakdown, flash-over or spark-over.

9.8 Insulation Resistance

A specimen with a minimum length of 30 metres shall be tested according to Method 6031 of FED-STD-228, except that it shall not be immersed in water, but tested dry.

The details mentioned in MIL-C-17, Paragraphs 4.8.5(a) and (b) shall be applicable. The test voltage shall be applied between the inner and outer conductor with the outer conductor grounded.

The insulation resistance per km shall be as defined in the Detail Specification.

9.9 Capacitance

The specimen's capacitance shall be measured in picofarads per metre with an accuracy of ±1% over a length of coaxial cable which is least 100 times the diameter of the dielectric, at a frequency of 1KHz.

The capacitance shall be measured between the inner and outer conductor, with the outer conductor grounded. The measured capacitance shall be within the limits specified in the Detail Specification.

9.10 Characteristic Impedance

The characteristic impedance shall be calculated from the velocity rate and the capacitance measured in accordance with Para. 9.9 of this specification on a sample with a length of 15 metres.

The velocity rate shall be determined with an accuracy of ±0.5% at a frequency of approximately 200MHz. The characteristic impedance shall be calculated from:-

$$Z = \frac{1}{V_r \, c \, C},$$

where V_r = velocity rate,

c = velocity in free space in metres/second,

C = capacitance in farads/metre.

The calculated characteristic impedance shall be within the limits specified in the Detail Specification.

9.11 Attenuation

The attenuation (insertion) loss shall be determined as per specification MIL-C-17, Para. 4.8.8, using a sample with a length of 15 metres; the result shall be expressed in dB/metre. The attenuation shall be as specified in the Detail Specification.

9.12 Structural Return Loss (SRL)

The structural return loss shall be determined as per specification MIL-C-17, Para. 4.8.9, using a 15 metres long sample.

The structural return loss, expressed in dB, shall be as specified in the Detail Specification.

9.13 Adhesion of Inner Conductor

The adhesion of the inner conductor shall be tested on two 15 centimetre long samples as per specification MIL-C-17, Para. 4.8.1.4.

The adhesion of the inner conductor shall be within the limits specified in the Detail Specification.

9.14 Anthony and Brown Test (Applicable to silver-plated wires only)

This test shall be performed in accordance with ESA PSS-01-720 on a sample as specified therein.

Acceptance Criteria:

- Codes 0 to 3: Accept.
- Codes 4 to 5: Reject.

Failure of this test entails failure of the complete qualification or lot acceptance.

9.15 Mechanical Properties of Conductor

The tensile characteristics of both inner and outer conductors (Note 1) shall be measured by means of a tensile tester with an accuracy which is adequate to measure the elongation and pull strength within 1%. The tensile rate shall be 250mm per minute and the length of the specimen between grips shall be 250 ± 5 mm.

The elongation shall be registered at the breaking of the first strand. This test shall be performed on 2 groups of 3 samples with a length of 30 centimetres: 1 group from the start, the other from the end of the component. This test shall be performed on the whole inner conductor and on strands of the outer conductor only (Note 1). The results shall be as specified in the Detail Specification.

NOTES 1. The outer conductor strands shall be cut off before braiding.

9.16 Alternate Bending Resistance

This test shall be performed successively on 3 samples. Each sample shall be 30 centimetres long and vertically inserted between two rollers with a diameter which is 10 times the cable diameter. The samples shall be subjected to alternate bending on both sides of the rollers as shown in Appendix I at a rate of 8 cycles of 180° per minute. The weight required for straightening the cable shall be as specified in the Detail Specification.

The test shall be performed until the break of the inner conductor occurs. In each case, the total number of cycles recorded shall not be less than that defined the Detail Specification.

9.17 Accelerated Ageing Stability

3 specimens shall be cut from the sample unit as follows:

- Length of first specimen ≥ 150 times the cable diameter.
- Length of second specimen ≥ 75 times the cable diameter.
- Length of third specimen ≥ 100 times the cable diameter.

Initial measurements or preconditioning:

- The extremities of the first 2 specimens shall be cut such that the insulation and conductor are flush at both ends.
- Of the third specimen, the capacitance, attenuation and structural return loss shall be measured as specified in paragraphs 9.9, 9.11 and 9.12 respectively of this specification.

(a) **First Test** (To be performed on all 3 specimens)

The specimens shall be exposed for 7 days in an air-circulation oven to the temperature specified in the Detail Specification.

After the 7-day period, the specimens shall be removed from the oven and allowed to remain at room temperature for 24 hours. The first 2 specimens shall then be checked for aspect and shrinkage or protrusion of the dielectric. Any shrinkage or protrusion shall not exceed the values specified in the Detail Specification.

Of the third specimen, the capacitance, attenuation and structural return loss shall be measured; the results shall not exceed the values specified in the Detail Specification.

(b) **Second Test** (Cold bend test on the first specimen only)

This test shall be performed as prescribed in Para. 9.18 of this specification. The specimen shall be examined for cracks, flaws or other damage in the jacket material. Any shrinkage or

protrusion of the dielectric shall not exceed the values specified in the Detail Specification.

(c) **Third Test** (On second specimen only)

The specimen shall be wrapped entirely around a mandrel having a diameter of 10 times the external diameter of the cable, and then unwound. This operation shall be repeated 10 times.

The specimen shall then be examined for cracks, flaws or other damage in the jacket material. Any shrinkage or protrusion of the dielectric shall not exceed the values specified in the Detail Specification.

9.18 Cold Bend Test

This test shall be performed as described in Specification MIL-C-17, Para. 4.8.20, the parameters concerned being specified in the Detail Specification. The lengths of the samples shall be ≥ 150 times the cable diameter.

After the test, the specimens shall be examined for cracks, flaws or other damage in the outer surface material.

9.19 Solderability

This test shall be performed according to IEC 68-2-20, Test 'Ta', Method 1, except that the ageing condition shall be deleted.

The test specimen shall have a length of 15cm and be stripped of insulation over a length of 5cm from the end to be tested.

9.20 Corona Extinction Voltage

This test shall be performed as specified in Para. 4.8.6 of MIL-C-17. The sample shall be approximately 1.5 metres long and the value recorded as extinction voltage shall not be less than that prescribed in the Detail Specification.

9.21 Resistance to Fluids (1 specimen per fluid)

After having been subjected to the immersion test, the specimen shall show no evidence of cracking and shall withstand the voltage test (see Para. 9.7) without breakdown or flash-over. The increase in the specimen's diameter shall not exceed 5%.

10 separate specimens with a length of 60 centimeters shall be immersed to with 15cm of their ends in each of the following fluids (a) through (g) for 30 minutes at normal room temperature:-

(a) Ethyl alcohol, ACS grade, 99.5% pure.

(b) Isopropyl alcohol, best commercial grade, 99% pure.

(c) Acetone, electronic grade.

(d) Xylene, electronic grade.

(e) Propellant, hydrazine, Military Specification MIL-P-26536.

(f) Propellant, nitrogen tetroxide, Military Specification MIL-P-26539.

(g) Propellant, dimethylhydrazine (UDMH), ARIANE grade.

Upon removal from the liquids, the specimens shall remain for 1 hour in free air at room temperature. Subsequently, 25mm of insulation shall be removed from each end of the specimen. The specimen shall then be subjected to the voltage test (see Para. 9.7). During the immersion tests, the bend of the specimen shall not be less than 6 times its specified maximum diameter.

9.22 Not Applicable.

9.23 Radiation Resistance

3 specimens with a length of 1 metre shall be subjected to a radiation dosage of 1 Megarad. The radiation rate shall not exceed 0.1 Megarad per minute. After irradiation, the specimens shall not show any crack and shall withstand the following tests:-

(a) **First specimen**

Corona extinction voltage (see Para. 9.20).

(b) **Second specimen**

Voltage test (see Para. 9.7).

(c) **Third specimen**

Insulation resistance, capacitance and characteristics impedance (see Paras. 9.8, 9.9 and 9.10 respectively).

9.24 Not Applicable.

9.25 Long-term Ageing Test

3 specimens shall be cut from the sample unit as follows:

- Length of first specimen ≥ 150 times the cable diameter.
- Length of second specimen ≥ 75 times the cable diameter.
- Length of third specimen ≥ 75 times the cable diameter.

From each end of the specimens, 25mm of insulation shall be removed. The specimens shall then be placed in a gravity-convected air oven and aged for a period of 2000 hours. They shall be maintained at the constant temperature specified in the Detail Specification. Upon completion of the conditioning period, the specimens shall be subjected to:-

(a) **First specimen**

Corona extinction voltage (see Para. 9.20).

(b) **Second specimen**

Voltage test (see Para. 9.7).

(c) **Third specimen**

Insulation resistance, capacitance and characteristic impedance (see Paras. 9.8, 9.9 and 9.10 respectively).

10. DATA DOCUMENTATION

10.1 GENERAL

For the qualification approval records and with each component delivery, a data documentation package is required. Depending on the testing level and lot acceptance level specified for the component, this package shall be compiled from:-

(a) Cover sheet (or sheets).

(b) List of equipment (testing and measuring).

(c) List of test references.

(d) Special in-process control test data (when required by the Detail Specification).

(e) Final production test data (Chart II) (but see Para 10.6).

(f) Qualification test data (Chart IV).

(g) Lot acceptance test data (Chart V) (when applicable).

(h) Failed component list (see Para. 8.4) and failure analysis report (see Para 8.4).

(i) Certificate of Conformity.

Items (a) to (i) inclusive shall be grouped, preferably as subpackages and, for identification purposes, each page shall include the following information:

- ESA/SCC Component number.
- Manufacturer's name.
- Lot identification.
- Date of establishment of the document.
- Page number.

10.1.1 Qualification Approval

In the case of qualification approval, the items listed in Para 10.1 (a) to (i) less item (g) are required.

10.1.2 Testing Level 'B'

10.1.2.1 Qualified Components

For deliveries of qualified components, the following documentation shall be supplied:-

(a) Cover sheet (if all of the information is not included on the Certificate of Conformity).
(b) Certificate of Conformity (including range of delivered spool numbers).
(c) Attributes record of measurements, tests and inspections performed in Chart II and Chart V (where applicable).
(d) Failed components list.

10.1.2.2 Unqualified Components

For deliveries of unqualified components, the documentation to be supplied shall be in accordance with Para. 10.1.2.1 plus the following:-

(a) Special in-process control data (where applicable).
(b) Failure analysis report on failed components.

10.1.3 Testing Level 'C'

Not applicable.

10.1.4 Data Retention/Data Access

If not delivered, all data shall be retained by the Manufacturer for a minimum of 5 years during which time it shall be available to the Qualifying Space Agency and the Orderer, if requested, for review. The Manufacturer shall deliver variables Data/Reports to the Orderer if required by the Purchase Order.

10.2 COVER SHEET(S)

The cover sheet(s) of the data documentation package shall include as a minimum:-

(a) Reference to the Detail Specification, including issue and date.

(b) Reference to the applicable ESA/SCC Generic Specification, including issue and date.

(c) Component type and number.

(d) Lot identification.

(e) Range of delivered spool numbers.

(f) Number of purchase order.

(g) Information relative to any additions to this specification and/or the Detail Specification.

(h) Manufacturer's name and address.

(j) Location of the manufacturing plant.

(k) Signature on behalf of Manufacturer.

(l) Total number of pages of the data package.

10.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be prepared, if not in accordance with the data given in the Process Identification Document (P.I.D.). Where applicable, this list shall contain inventory number, Manufacturer's type number, serial number, etc. This list shall indicate for which tests such equipment was used.

10.4 LIST OF TEST REFERENCES

This list shall include all Manufacturer's references or codes which are necessary to correlate the test data provided with the applicable tests specified in the tables of the Detail Specification.

10.5 SPECIAL IN-PROCESS CONTROL DATA

As specified in the Detail Specification.

10.6 FINAL PRODUCTION TEST DATA (CHART II)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after, each test, measurement and inspection of Chart II.

The final production test data shall form an integral part of the data documentation package, but it is not a mandatory requirement that it be delivered with the qualification lot or delivery lot. However, the data package to be delivered shall contain the information as detailed in Para. 10.1.2 or at least shall contain a list of final production tests actually performed and a certification that the data is available for review.

10.7 BURN-IN AND ELECTRICAL MEASUREMENT DATA (CHART III)

Not applicable.

10.8 QUALIFICATION TEST DATA (CHART IV)

All data shall be referenced to the relevant serial numbers. Detailed records shall be provided of the components submitted to each test in each of the subgroups and of those rejected. Detailed data shall be provided of all electrical measurements made in accordance with Table 6 of the Detail Specification, as and where applicable.

10.9 LOT ACCEPTANCE TEST DATA (CHART V)

10.9.1 Testing Level 'B'

All data shall be referenced to the relevant serial numbers. Detailed records shall be provided of the components submitted to each test in each of the subgroups (as relevant to the lot acceptance level) and of those rejected.

Detailed data shall be provided of all electrical measurements made in accordance with Table 6 of the Detail Specification, as and where applicable.

10.9.2 Testing Level 'C'

Not applicable.

10.10 FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT

The failed component list and failure analysis report shall provide full details of:-

(a) The reference number and description of the test or measurement performed as defined in this specification and/or the Detail Specification.

(b) The serial number (if applicable) of the failed component.

(c) The failed parameter and the failure mode of the component.

(d) Detailed failure analysis, if requested.

10.11 CERTIFICATE OF CONFORMITY

A Certificate of Conformity shall be established as defined in ESA/SCC Basic Specification No. 20100.

11. DELIVERY

For qualification approval, the disposition of the qualification test lot and its related documentation shall be as specified in ESA/SCC Basic Specification No. 20100 and the relevant paragraphs of Section 10 of this specification.

For procurement, for each order, the items forming the delivery are:-

(a) The delivery lot.

(b) The components used for lot acceptance testing, (when applicable), but not forming part of the delivery lot (see Subpara's 8.2.3, 8.2.4 and 8.2.5).

(c) The relevant documentation in accordance with the requirements of Section 10 of this specification.

In the case of a component for which a valid qualification approval is in force, all data of all components submitted to LA1 and LA2 testing shall also be copied, when requested, to the relevant Qualifying Space Agency.

12. PACKAGING AND DESPATCH

The packaging and despatch of components to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 20600 and the following rules:-

(a) All finished coaxial cables shall be packaged on spools.

(b) One spool shall only receive finished coaxial cable from a unique lot.

(c) All finished coaxial cable ends shall be accessible over a length of at least 10cm without the cables having to be unwound from the spool.

(d) No more than 3 lengths of cable shall be wound on the same spool; each cable end shall be marked.

(e) No spool shall receive more than 400 metres of finished coaxial cable; no unit length shall be less than 30 metres.

(f) Spool hubs shall be cylindrical and have a diameter exceeding 50 times the maximum external cable diameter.

(g) The ends of finished wire shall be sealed with heat-shrinkable caps or other suitable means of protection against possible ingress of moisture under the insulation. The seals shall be renewed whenever a piece of wire has been cut off for testing or other use.

(h) For storage, the wire or cable spools shall be heat-sealed into polyethylene bags. The bags shall be sufficiently large to enable resealing at least twice. The humidity indicators shall be placed such that they can be inspected easily without breaking the moisture seal. Polyvinylchloride shall not be used as packaging or packing material.

Desiccant or dry nitrogen shall be used in the package. An easy means for indicating that the humidity is below 50% RH shall be provided, capable of being read without opening the package.

(i) For shipment, the bags specified under (h) shall be placed in another polyethelene bag which shall be sealed to prevent damage to the primary package. This second bag may be removed for further storage.

APPENDIX I

ALTERNATE BENDING RESISTANCE TEST RIG