EVALUATION TEST PROGRAMME FOR RADIO FREQUENCY, HIGH DATA RATE AND HIGH VOLTAGE CABLE ASSEMBLIES

ESCC Basic Specification No. 2263408

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DCR No.	Change Description

TABLE OF CONTENTS

1 PURPOSE

The purpose of this specification is to establish the procedure to be followed in the evaluation of component capabilities as required for space applications and thereby to anticipate, as far as possible, component behaviour during qualification testing.

Therefore, the aim of such testing shall be to overstress specific characteristics of the component concerned with a view to the detection of possible failure modes.

Additionally, a detailed destructive physical analysis shall be performed to detect any design and construction defects which may affect the reliability of the component and to facilitate failure analysis activities.

2 SCOPE

This specification applies to the following components:

- Radio Frequency Cable Assemblies: composed of one RF cable with two RF connectors, one on each end, designed and manufactured to achieve an RF electrical function.
- High Data Rate Cable Assemblies: composed of at least two high data rate cables with two high data rate connectors, one on each end, designed and manufactured to achieve a high data rate electrical function.
- High Voltage Cable Assemblies composed of one high voltage cable/wire with two high voltage connectors, one on each end, designed and manufactured to achieve a high voltage electrical function.

Components which are not compliant with the above definitions are out of the scope of this specification.

3 RELATED DOCUMENTS

3.1 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 at the date of commencement of the evaluation.

- ESCC Generic Specification No. 3408, RF Cables Assemblies.
- ESCC Generic Specification No. 3xxx, High Data Rate Cable Assembles.
- ESCC Generic Specification No. 3xxx, High Voltage Cable Assembles.
- ESCC Basic Specification No. 20500, External Visual Inspection.
- ESCC Basic Specification No. 20900, Radiographic Inspection Of Electronic Components.
- ESCC Basic Specification No. 21300, Terms, Definitions, Abbreviations, Symbols And Units.
- ECSS-Q-ST-70-02, Thermal Vacuum Outgassing Test for the Screening of Space Materials.
- ECSS-E-20-01, Multipaction Design And Testing.
- ECSS-E-HB-20-05, High Voltage Engineering And Design Handbook.
- MIL-STD-202, Test Method Standard Electronic And Electrical Component Parts
- MIL-STD-1580, Destructive Physical Analysis For Electronic, Electromagnetic, And Electromechanical Parts.

4 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units as specified in ESCC Basic Specification No. 21300 shall apply. Other symbols and abbreviations are defined, as applicable, within the documents referenced in Related Documents herein and in the text of this document.

5 PROCEDURE

Standard components (test vehicles, see Para. 8.1) shall be selected from a homogenous lot at the Manufacturer to be evaluated. These components shall not have been submitted to any screening, but must have been manufactured in conformity with high reliability practice and an established Process Identification Document (PID) or an identifiable process which shall form the basis for a PID, in sufficient quantities to satisfy the test programme.

The tests specified in the programme shall be performed in the sequence shown in Chart 1 (Chart 1A, 1B, or 1C as applicable to the type of cable assembly). All results shall be recorded and failed components submitted to a failure analysis. Probable failure modes and mechanisms shall be determined.

The evaluation test programme shall be performed, under the supervision of the ESCC Executive, by the Manufacturer, or at a test laboratory approved by the ESCC Executive.

6 TEST PROGRAMME SEQUENCE AND SAMPLE DISTRIBUTION

6.1 GENERAL

The number of components chosen for evaluation testing shall depend upon whether a single component type or a family of components is evaluated, and the number of component types chosen to represent the family.

For evaluation of a single component type, the quantities specified in Chart 1 shall apply as applicable to the type of cable assembly.

The component types chosen to represent a family shall cover the range of components to be evaluated and be representative of the different configurations under consideration. They shall also be the most suitable for highlighting those characteristics and parameters that are pertinent to an investigation into failure modes and weaknesses.

The selected test vehicles definition, quantity and distribution shall be as specified by or as agreed with the ESCC Executive.

The above mentioned quantity shall be submitted to the full evaluation procedure whenever a new technology has been applied to the components concerned, such that there is insufficient experience in their production.

6.2 DETAIL SPECIFICATION(S)

Should a Detail Specification(s) for the component(s) to be evaluated not exist, the Manufacturer shall prepare such a document(s) in accordance with the established ESCC format and submit it to the ESCC Executive for provisional approval. This shall then serve as a basis for the ordering and testing of the relevant components. Any unknown parameters used for test set-up or success criteria shall be determined by relevant testing.

6.3 INSPECTION RIGHTS

The ESCC Executive reserves the right to inspect at any time the components processed for evaluation purposes. The Manufacturer shall notify the ESCC Executive at least 3 working days in advance of the date of pre-assembly visual inspection .

6.4 CONTROL DURING FABRICATION

The components shall be produced as defined in Para. 5. Pre-assembly visual inspections shall be performed on the lot to be tested to the extent that this forms part of the Manufacturer's standard procedures. Progress of the components shall be observed closely and recorded, together with an analysis of any rejects. A chart showing the numbers in/out and failure cause for each fabrication stage shall be submitted to the ESCC Executive.

6.5 RESULTS ANALYSIS

All results shall be compared with the Detail Specification(s) and any drift from initial expectation shall be explained. Any update of the Detail Specification(s) shall be justified.

In case of unexpected drift or catastrophic failure, failure analysis including Radiographic Inspection and Destructive Physical Analysis (DPA) shall be performed. Any destructive test shall be submitted to the ESCC Executive for approval prior to testing.

7 INSPECTION

7.1 GENERAL

The components shall be checked to verify their suitability for the Evaluation Test Programme. Defects or deviations from the established ESCC requirements may invalidate the evaluation.

7.2 DIMENSIONS (100%)

All cable assemblies shall be inspected in accordance with Physical Dimensions in the Detail Specification and the results recorded together with any non-conformities. Rejected components shall be replaced.

7.3 RADIOGRAPHIC INSPECTION (100%)

All cable assemblies shall be subjected to Radiographic Inspection according to ESCC Basic Specification No. 20900 or a dedicated procedure to be agreed by the ESCC Executive. Rejected components shall be replaced.

Radiographs shall be retained with supplier manufacturing documentation.

Radiographic examination shall be performed on each completed cable/wire to connector termination.

Views of solder joints shall be taken perpendicularly to the centreline of the connectors.

In particular for cable assemblies with coaxial connectors, radiographs shall be taken of:

- The solder joint between the outer conductor of the cable and the connector body, if one exists.

- The solder joint between the centre conductor of the cable and the centre conductor of the connector, if one exists.

The joints in the radiographs shall be examined against the following acceptance criteria:

- There shall be no evidence of solder projections, spikes, splashes or loose particles.
- Centre conductor :
  - The centre conductor of cable shall be inserted into the contact hole for a minimum of 80% of the cavity length.
  - The centre conductor of cable shall present a straight shape in the connector.
  - The solder in the joint between the pin and the cable centre conductor shall show a maximum of 30% voids within the solder joint.
  - The solder in the joint between the pin and the cable centre conductor shall not show a single void bigger than 25% within the solder joint.
- Outer conductor :
  - The outer conductor has to be inserted into the connector body or ferrule with a minimum of 70% of dedicated length.
  - The outer conductor to connector body joint shall show a maximum of 30% voids within the solder joint.
  - The outer conductor to connector body joint shall not show a single void bigger than 25% within the solder joint.
- Any bend of the cable in 90° connector types shall be smooth and continuous, with uniform foil overlap and braid lay.
- When necessary, part of the radiographic inspection may be performed during the assembly of cable assembly in accordance with PID.

7.4 VISUAL INSPECTION (100%)

All cable assemblies shall be visually inspected in accordance with ESCC Basic Specification No. 20500. Rejected components shall be replaced.

7.5 MARKING AND SERIALISATION (100%)

All cable assemblies shall be marked and serialised in accordance with the standard procedures of the Manufacturer concerned.

7.6 MATERIALS AND FINISHES

All non-metallic materials and finishes, that are not within a hermetically sealed enclosure, of the component being evaluated shall be tested in accordance with ECSS-Q-ST-70-02 to verify its outgassing requirements, unless relevant data is available.

7.7 COMPLETION OF INSPECTION

The completion of inspection shall result in a batch of components that have been verified as to their suitability for the Evaluation Test Programme, i.e. each component has satisfied the requirements of Paras. 7.2 to 7.6.

8 INITIAL ELECTRICAL MEASUREMENTS (100% READ AND RECORD)

These initial electrical measurements shall be made according to Room Temperature Electrical Measurements in the Detail Specification. All characteristics shall be recorded against serial numbers.

8.1 TEST VEHICLES

Unless otherwise specified in the test definition, the cable assemblies submitted to the evaluation shall include 2 additional connectors that each mate with the cable assembly connectors. These connectors shall be receptacles or plugs compatible with the cable assembly connectors (i.e. same connector interface definition). Test vehicle configuration submitted to the evaluation test programme shall be as shown in Figure 1.

Unless otherwise specified in the Detail Specification or test description, the test vehicles shall be of minimum total length 1m.

8.1.1 Test Set-up

The test set-up to be used for performing electrical and thermal measurements on the test vehicles shall be the one shown in Figure 1.

The electrical connection between the power supply equipment and the first connector set or between the measurement equipment and the second connector set, shall not disrupt the performance of the test vehicle.

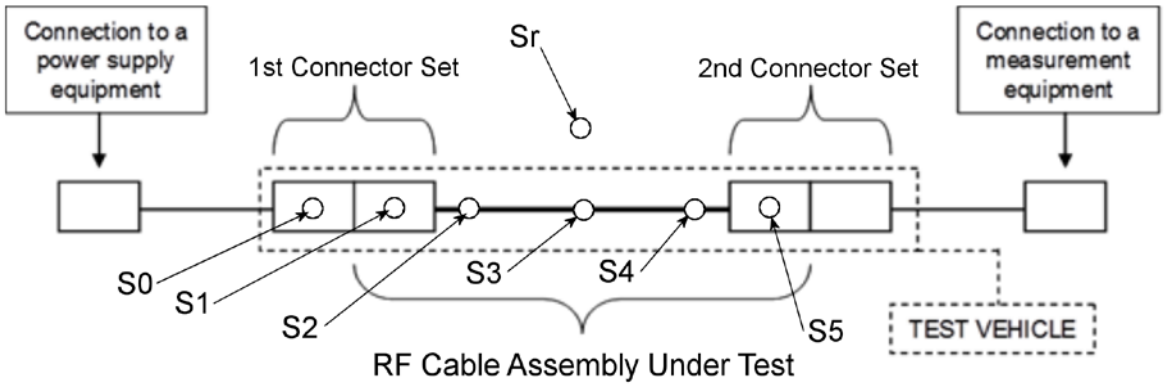


FIGURE 1 - TEST VEHICLE CONFIGURATION

The test set-up to be used for performing thermal measurements on the test vehicle shall include thermal sensors as indicated in Figure 1. A minimum of 6 thermal sensors shall be applied on the test vehicle (S0 to S5). The thermal sensor applied on the input connector (S0) shall represent the conductive temperature. 1 additional thermal sensor shall be glued to the base-plate of the set-up (Sr); it shall represent the radiative temperature. During testing temperature of the base-plate (Sr) shall be monitored when applicable.

Precautions shall be taken during mounting of temperature sensors to avoid any issue during testing under vacuum, such as outgassing, removal of the sensors, etc.

9 EVALUATION TEST PROGRAMME

9.1 GENERAL

The evaluation tests shall be performed as specified in Chart 1 as applicable to the type of cable assembly. The test vehicles shall be randomly divided into the 6 groups and their associated subgroups in the proportions indicated in Chart 1. When a family of components is under investigation, the variations within that family must be represented in each group and subgroup.

When necessary to take into account product specificity, additional testing might be considered and shall be agreed with the ESCC Executive.

9.2 GROUP 1 - CONTROL GROUP

This group shall be retained for comparison purposes. Whenever electrical measurements are made on any test vehicle, these control group test vehicles shall also be measured.

9.3 GROUP 2 - MECHANICAL CAPABILITY

9.3.1 Vibration

The test vehicle(s) shall be subjected to both Random Vibration and Sine Vibration testing. The tests may performed in any order.

The whole test vehicle should be mounted on the vibration generators either directly or by means of a fixture. The connectors shall be mated in the nominal manner as defined in the Detail Specification, to an appropriate connector which is mounted rigidly on the vibration fixture. Some marks shall be applied on the connector sets to detect any relative movement of one of the connectors.

The test vehicle(s) shall be secured to the vibration/shock plate using 2.5 ±0.5mm wide cable-ties, looped through aluminium tie-down posts starting 200 (+25 -0)mm from the reference plane or centreline of the mated connectors and every 200mm minimum thereafter. Appropriate protective padding shall be placed between the outer jacket and tie down plates to prevent damage to the cable/wire.

Mounting fixtures shall enable the test vehicle(s) to be vibrated in 3 mutually perpendicular axes in turn, which should be so chosen that faults are most likely to be revealed.

9.3.1.1 Random Vibration

MIL-STD-202, Test Method 214. Unless otherwise specified, the following conditions shall apply:

- Random Vibration Test Curve:

Envelope: Grms = 38.5	
20 to 60 Hz	+6dB / Octave
60 to 400 Hz	$2g^2$/Hz
400 to 800 Hz	-6dB / Octave
800 to 1000 Hz	$0.5g^2$/Hz
1000 to 2000 Hz	-6dB / Octave

- Duration: 360s in each of the 3 mutually perpendicular axes.
- Continuity shall be monitored during the test. Discontinuities > 1µs shall be detected.
- Data Points:
  On completion of testing, the test vehicle(s) shall be visually inspected for any evidence of physical damage or loosening of parts. Electrical measurements as specified in Room Temperature Electrical measurements in the Detail Specification shall be performed. Coupling torque shall be measured.

9.3.1.2 Sine Vibration

MIL-STD-202, Test Method 204. Unless otherwise specified, the following conditions shall apply:

- Sweep Frequency: 5-200-5Hz. For the entire frequency range of 5 to 200Hz and return to 5Hz, the slope rate shall be 2 Octaves per minute maximum.
  NOTE: Maximum frequency might be extended if resonance frequency exceeds 200Hz.
- Total number of cycles: 9 (3 times in each of the 3 mutually perpendicular axes).
- Vibration Amplitude:
  - 5Hz to 32Hz: 11mm (peak)
  - 32Hz to 200Hz: 45g
- Data Points:
  On completion of testing, the test vehicle(s) shall be visually inspected for any evidence of physical damage or loosening of parts. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed. Coupling torque shall be measured.

9.3.2 Mechanical Shock

The test vehicle(s) shall be subjected to the pyrotechnic shock environment as follows. The following conditions shall also apply:

- Mounting: Same as for Vibration in Para. 9.3.1.
- Shock environment:

All axes	
Frequency (Hz)	Shock Response Spectrum (g) (see Notes below)
100 Hz 1000 Hz 4000 Hz 10000 Hz	40g 900g 4200g 4200g
Tolerances -3dB +6dB	

NOTES:

1. Shock Response Spectrum (SRS) specification is defined by a straight line on a log-log plot. SRS computations shall be made with the absolute acceleration time history using the maxi-max technique and a Q-factor Q = 10. SRS computations shall be made at a minimum of 1/24 octave intervals.
2. The SRS shall be measured and plotted to 10kHz minimum.
3. In case of a shock test based on a hammer or real pyrotechnic device, the input load in the direct and cross talk directions shall be measured using diagonally opposite accelerometers against the test vehicle. The accelerometers being as close as possible to the interface feet of the test vehicle.
4. Half-sine pulse shall not be used to conduct the test.

- Number of shocks: 18 (3 shocks in each direction of the 3 mutually perpendicular axes).
- Data Points:
  On completion of testing, the test vehicle(s) shall be visually inspected for any evidence of physical damage or loosening of parts. Electrical measurements as specified in Room Temperature Electrical measurements in the Detail Specification shall be performed. Coupling torque shall be measured.

9.3.3 Mating Endurance

The endurance test shall be performed on one of the two mated connectors pairs of the test vehicle(s).

The selected connector shall be subjected to a specified number of mating and unmating cycles at a specified rate. Unless otherwise specified in the Detail Specification, the number of cycles for evaluation shall be 200 minimum, and the rate shall be no more than 12 cycles per minute.

During each cycle the selected connector shall be fully mated to the specified torque, and then fully unmated.

Unless otherwise specified in the Detail Specification, the threads of rotational parts shall not be lubricated before or during endurance testing. Solvents and tools shall not be used for cleaning, however the threads and/or interface surfaces may be cleared of debris, at intervals of not less than 50 cycles, by shaking or blowing.

- Data Points:
  At 50, 100 and 200 cycles, and on completion of testing, the selected connector shall be visually inspected for any evidence of physical damage. Any wear to the contacts or threads as a result of the endurance testing shall not be considered as physical damage. The Mating and Unmating Forces shall be measured in accordance with Detail Specification. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

9.3.4 Minimum Bending Radius Evaluation

Not applicable to semi-rigid cable assemblies.

This test shall be performed successively on a minimum of 2 test vehicles.

(a) The first test vehicle(s) shall be wrapped 10 times 360° over a mandrel with a diameter which is equal to the minimum bending radius defined in the Detail Specification. First wrap shall be against the natural flow of the cable/wire. Then second wrap shall be performed according to the natural flow. Then wrapping shall be performed alternately in each direction a total of 5 times. Precautions shall be taken to prevent twisting or bending at the assembly area between the connector and the cable/wire. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed on the test vehicle still wrapped around the mandrel.

The previous operation shall be repeated with successively smaller mandrel diameters until at least one of the electrical measurements is out of specification.

(b) The second test vehicle(s) shall be wrapped 1 times 360° over a mandrel according to the natural flow of the cable/wire with a diameter which equal to the minimum bending radius. Precautions shall be taken to prevent twisting or bending at the assembly area between the connector and the cable/wire. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed on the cable/wire assembly still wrapped around the mandrel.

The previous operation shall be repeated with a continuously decreasing mandrel diameter without re-straightening the cable/wire until at least one of the electrical measurements is out of specification.

9.3.5 CABLE RETENTION FORCE

The connector at one end of the test vehicle(s) shall be held while an axial force is applied to the connector at the other end along the cable/wire direction, by suitable means, The cable retention force shall then be applied for 2 minutes.

External Visual Inspection, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification and interface dimension check shall be performed after each step.

The previous operation shall be repeated by increasing the axial force step by step until either external visual inspection indicates some evidence of physical damage or at least one of the electrical measurements or interface dimensions are out of specification.

9.4 GROUP 3 – STEP-STRESS
The purpose of this group is to determine the maximum rating.

9.4.1 High And Low Functioning Temperature

9.4.1.1 Procedure For Low Functioning Temperature
The test vehicle(s) shall be placed in an oven able to reach a temperature lower than the minimum operating temperature specified in Maximum Ratings in the Detail Specification.

Temperature as measured by Sr shall be set to the minimum operating temperature as specified in Maximum Ratings in the Detail Specification. After a temperature stabilisation time of 30 minutes, electrical measurements as specified High and Low Temperatures Electrical Measurements in the Detail Specification shall be performed on the test vehicle still at low temperature.

Then the temperature in the oven shall be decreased by 10 ±1°C and after a temperature stabilisation time of 30 minutes, electrical measurements as specified High and Low Temperatures Electrical Measurements in the Detail Specification shall be performed on the test vehicle still at low temperature. This step has to be repeated until at least one electrical characteristic of the cable assembly is out of the limit defined in the Detail Specification or until the temperature limit of the oven is reached.

9.4.1.2 Procedure For High Functioning Temperature
A different test vehicle(s) to the one tested in Para. 9.4.1.1 shall be placed in an oven able to reach a temperature higher than the maximum operating temperature specified in Maximum Ratings in the Detail Specification.

Temperature as measured by Sr shall be set to the maximum operating temperature as specified in Maximum Ratings in the Detail Specification. After a temperature stabilisation time of 30 minutes, electrical measurements as specified High and Low Temperatures Electrical Measurements in the Detail Specification shall be performed on the test vehicle still at high temperature.

Then the temperature in the oven shall be increased by 10 ±1°C and after a temperature stabilisation time of 30 minutes, electrical measurements as specified High and Low Temperatures Electrical Measurements in the Detail Specification shall be performed on the test vehicle still at high temperature. This step has to be repeated until the thermal limit of the cable assembly, given by design -10°C, or until the temperature limit of the oven is reached.

9.4.2 RF Power Handling
Only for RF cable assemblies and only if specified in the Detail Specification.

The power handling is the capability of the transmission line to carry a CW RF signal without permanent degradation due to the thermal effect of the RF power dissipation induced by insertion losses.

NOTE: for this test, all the connectors shall be vented

Frequency shall be set to the maximum rating as specified in Maximum Ratings in the Detail Specification (if not specified, frequency shall be equal to maximum of the cable or test equipment).

For each test, new a test vehicle shall be used.

Test description:

(a) Mounting:
The Test vehicle(s) shall be mounted in a vacuum chamber on thermally conductive brackets (to be agreed by ESCC executive). Precautions shall be taken to avoid thermal conduction of the coaxial cable through the base plate. Poor thermally conductive stand-off supports are recommended to hold the coaxial cable. Temperature of the base plate should be monitored when applicable.

(b) Venting preparation for test:
Before power handling test in vacuum, an outgassing period as defined in the Detail Specification shall be performed (with RF OFF). If not defined, a 24 hours outgassing period shall be performed at the reference temperature, T_0, and pressure shall be lower than 1mPa.
- T_0 reference: +100°C (Sr) unless otherwise agreed with the ESCC Executive.

Test set-up shall be implemented in such way to avoid heat transfer from connectors to the base plate.

(c) Test full power in hot vacuum as follows:
- Test temperature: T_{Sr} = +100 ±5°C, unless otherwise agreed with the ESCC Executive.
- Step 1: Increase the RF input power to the test vehicle in steps of 15min minimum in order to reach T_{max} minus 30°C on one of the sensors on the test vehicle (S0 to S5).
- Step 2: After thermal stabilization (temperature variation < ±1°C during 2 hours), if none of the sensors is above T_{max}, increase the RF input power (+1 dB maximum).
- Step 3: Repeat step 2 until one of the sensors is above T_{max}, (The level of power to reach T_{max} shall be defined as P_{eval}).
- Step 4: Maintain P_{eval} for 6 hours. During this step the test vehicle shall not show a total drift of its temperature higher than 10°C. The Maximum RF Power Handling (P_{max}) defined in the Detail Specification shall be defined at least 1dB lower than P_{eval}.
- Step 5 (optional): Continue the procedure by increasing RF power in steps of 0.5dB maximum up to cable assembly break down or the temperature of test vehicle is divergent. At each step thermal stabilization (temperature slope < ±1°C per minute for 2 hours) shall be reached before increasing the power.

- Data Points:
The applied and reflected RF power, and temperature of the test vehicle(s) shall be monitored and recorded during the test. Test vehicle temperature shall be measured as specified in Figure 1 (at S0 to S5).

Pressure of the chamber shall be monitored and recorded during the test.

Any RF breakdown during testing shall be detected (see Figure 2) with the most relevant methods (optical detection, electron avalanche detection, second/third harmonic monitoring, forward/reverse power nulling, etc.) to be agreed by the ESCC Executive (Ref. ECSS-E-20-01).

Electrical parameters as specified in Room Temperature Electrical Measurement or High and Low Temperatures Electrical Measurements, as applicable, in the Detail Specification shall be measured before and after the test at each temperature in order to verify any potential degradation in the test vehicle.

The use of electron seeding during CW power handling testing is not considered mandatory but is recommended.

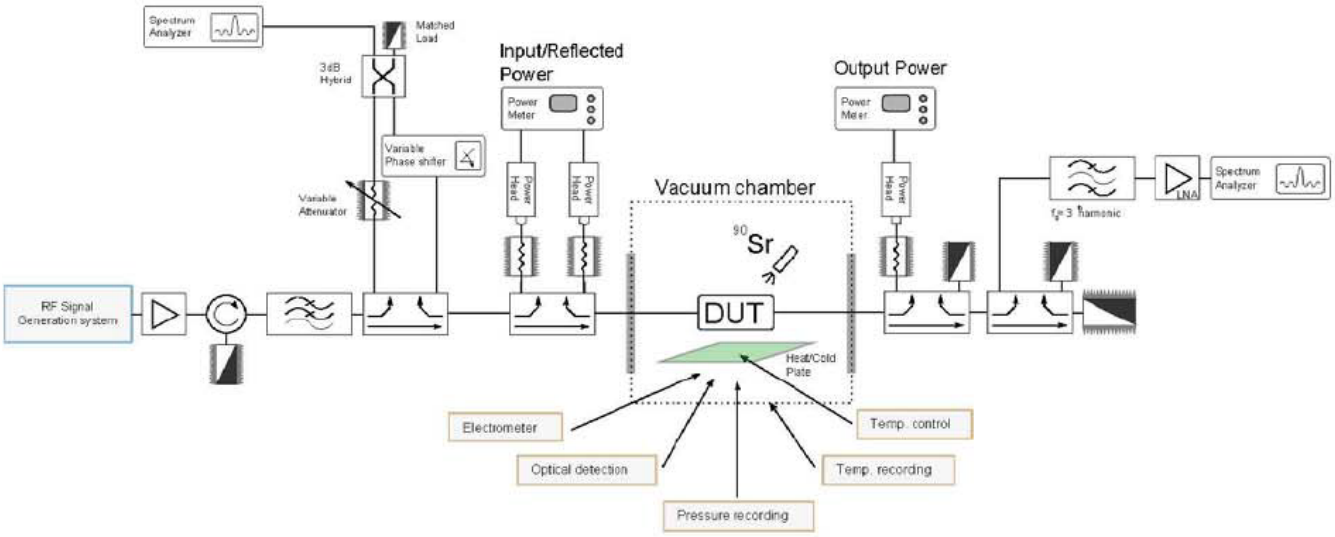


FIGURE 2 - RF BREAKDOWN DETECTION SYSTEM

9.4.3 Multipaction

Only for RF cable assemblies and only if specified in the Detail Specification.

A multipaction test shall be performed in accordance with ECSS-E-20-01. The multipaction classification type shall be as specified in the Detail Specification. Unless otherwise specified, the following conditions shall apply:

- Applied Power: Rated RF pulse power as specified in Maximum Ratings in the Detail Specification.
- Test Temperatures: Minimum and maximum operating temperatures as specified in Maximum Ratings in the Detail Specification. Temperature shall approved by ESCC Executive before the test is done.
- Frequency shall be as specified in Detail specification

9.4.4 Current Overload

Only for high voltage cable assemblies and only if specified in the Detail Specification.

Test Description:

- Electrical Test conditions: to be agreed with the ESCC Executive.
- Pressure: < 1mPa.
- Temperature: +25 ±3°C, +70 ±3°C, +100 ±5°C.
- Stabilisation time: 2 hours minimum.

The current shall be increased until maximum operating temperature of the test vehicle as specified in Maximum Ratings in the Detail Specification, is reached.

- Data Points:
  The temperature of the test vehicle(s) shall be monitored during the test. Test vehicle temperature shall be measured as specified in Figure 1 (at S0 to S5).

  Electrical measurements as specified High and Low Temperatures Electrical Measurements in the Detail Specification shall be performed before and after the test at each temperature.

9.4.5 Corona

9.4.5.1 For RF Cable Assemblies

The test vehicle(s) shall be subjected to corona testing under thermal vacuum in accordance with the following conditions:

(a) Mounting
The test vehicles shall be mounted in a thermal vacuum chamber at ambient pressure by means of a port-plate. Precautions shall be taken to avoid any condensation during testing.

(b) Test Conditions:

- Test temperature shall be ambient temperature.
- Operating frequency: Corona testing shall be performed at three separate frequencies, CW mode at 1GHz plus at intermediate frequency and maximum frequency as defined in Detail Specification.
- Step 1: Apply pulsed RF power as specified in the Detail Specification or as determined using coaxial cable corona analysis, with duty cycle between 1% and 10% and minimum pulse width 10µs.
- Step 2: Start vacuum pumping from ambient pressure, while RF power is ON. Once the pressure in the vacuum chamber has reached 5mPa, maintain the RF power for a duration of 1 hour.

  The test vehicle shall be monitored throughout the test for any corona breakdown/discharge. If corona breakdown/discharge is not detected, pressure shall be increased to ambient pressure and left for 1 hour stabilisation.
- Step 3: repeat steps 1 and 2 with a successive increase of the applied pulse power level until corona breakdown/discharge is detected.
- Step 4: When corona breakdown/discharge is detected, RF power shall be turned OFF as quickly as possible to prevent damage on the test vehicle. Steps 1 and 2 shall then be repeated with a decrease of the applied RF Power level until corona breakdown/discharge is no longer detected.

  This power level defines the Corona Threshold RF Power. The Maximum RF Power Level Without Corona Breakdown defined in the Detail Specification shall be 1dB lower than the Corona Threshold RF Power.

- Step 5: Validation of Corona Power
  Based on the results from step 4, the Maximum RF Power Level Without Corona Breakdown shall be applied without exceeding Maximum RF Power Handling (P_{max}) as determined in Para. 9.4.2.

  Start vacuum pumping from ambient pressure, while CW RF power is ON. Once the pressure in the vacuum chamber has reached 5mPa, maintain the RF power for a duration of 1 hour.

  The test vehicle shall be monitored throughout the test for any corona breakdown/discharge. Corona breakdown/discharge shall not be detected.

- Data Points:
  Prior to mounting of the test vehicle in the vacuum chamber, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  During testing, Insertion Loss and VSWR shall be continuously monitored.

  During testing, the test vehicle(s) shall be continuously monitored for corona breakdown/discharge. Corona breakdown/discharge shall be detected using an appropriate method (e.g. Global method based on the RF signal analysis: Transmit power, Reflected power, 3rd harmonic, phase nulling, Close-to-carrier noise; Local methods: Optical detection, Electron probe) to be agreed by the ESCC Executive.

  On completion of testing, the test vehicle(s) shall be removed from the vacuum chamber and electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  The test results for the Corona Threshold RF Power versus frequency shall be plotted.

9.4.5.2 For High Voltage Cable Assemblies

As per ECSS-E-HB-20-05 Para. 6.1.9. Test conditions shall be as specified in the Detail Specification.

9.4.6 Life

Only applicable to high voltage cable assemblies.

The test vehicle(s) shall be placed in an oven able to reach the maximum operating temperature as specified in Maximum Ratings in the Detail Specification. After a temperature stabilisation time of 30 minutes, the test vehicle(s) shall be submitted to the maximum voltage as specified in Maximum Ratings in the Detail Specification, for a duration of 1000 (+24 -0) hours.

- Data Points:
  Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed every 100 ±12 hours.

  On completion of testing and after a minimum recovery period of 2 hours at room temperature conditions, the components shall be visually inspected for any evidence of physical damage and subjected to radiographic inspection in accordance with ESCC Basic Specification No. 20900.

9.4.7 High Voltage Tests
Only applicable to high voltage cable assemblies.

9.4.7.1 Partial Discharge Test
As per ECSS-E-HB-20-05 Para. 6.1.6.
- Test voltage shall be $1.3U_{max}$ (DC), $1.5U_{max}$ (DC), etc.
- Test environment: insulating liquid

9.4.7.2 Voltage Step Stress Test
As per ECSS-E-HB-20-05 Para. 6.2.1.

9.5 GROUP 4 – THERMAL ENDURANCE

9.5.1 High Temperature Storage
Not applicable to high voltage cable assemblies.

MIL-STD-202, Test Method 108 (non-operating).

The test vehicle(s) shall be subjected to storage at the maximum storage temperature specified in Maximum Ratings in the Detail Specification for a duration of 1000 hours.

- Data Points:
  Prior to testing, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of 100 hours of storage, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of 500 hours of storage, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of testing and after a minimum recovery period of 2 hours at room temperature, the test vehicle(s) shall be visually inspected for any evidence of physical damage and subjected to radiographic inspection in accordance with ESCC Basic Specification No. 20900. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

9.5.2 Temperature Cycling
The test vehicle(s) shall be subjected to temperature cycling. Unless otherwise specified, the following conditions shall apply:

(a) The test vehicle(s) shall be temperature cycled in an air circulating or inert gas purged oven. Precautions shall be taken to ensure that the temperature indicated by the equipment is actually applied to the test vehicles during the test.

(b) Number of cycles: 500.

(c) Exposure Time and Temperature:
- Step 1: 15 minutes after Sr reaches the minimum storage temperature as specified in Maximum Ratings in the Detail Specification.
- Step 3: 15 minutes after Sr reaches the maximum storage temperature as specified in Maximum Ratings in the Detail Specification.

(d) Temperature transfer slope: ≤ 10°C per minute.

- Data Points:
  On completion of 50 cycles and after a minimum recovery period of 2 hours at room temperature conditions, the test vehicle(s) shall be visually inspected for any evidence of physical damage and subjected to radiographic inspection in accordance with ESCC Basic Specification No. 20900. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of 200 cycles and after a minimum recovery period of 2 hours at room temperature conditions, the test vehicle(s) shall be visually inspected for any evidence of physical damage and subjected to radiographic inspection in accordance with ESCC Basic Specification No. 20900. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of the 500 cycles and after a minimum recovery period of 2 hours at room temperature conditions, the test vehicle(s) shall be visually inspected for any evidence of physical damage and subjected to radiographic inspection in accordance with ESCC Basic Specification No. 20900. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

9.6 GROUP 5 – ENVIRONMENTAL CAPABILITY

9.6.1 Radiation

The test vehicle(s) shall be subjected to a radiation test in accordance with the following conditions:

(a) Mounting:
Test set-up atmosphere shall exclude oxygen (i.e. tested under continuous Nitrogen flow or in vacuum).

Test set-up shall be implemented so that the test vehicle temperature (sensors S1 to S5) during testing is limited to ≤ +60°C.

(b) Ambient test temperature during irradiation: T_{amb} = +20 ±10°C.

(c) Radiation source: electron or gamma

(d) Radiation dosage: as specified in the Detail Specification.

(e) Dose rate: ≤ 45Mrad/hour

- Data Points:
  Prior to testing, electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

  On completion of testing and after a minimum recovery period of 2 hours at room temperature conditions, the test vehicle(s) shall be visually inspected for any evidence of physical damage. Electrical measurements as specified in Room Temperature Electrical Measurements in the Detail Specification shall be performed.

NOTES:

1. For electron source radiation, the electron source used for the test shall be a steady-state type. The electron energy shall be sufficient to guarantee 1 to 3MeV energy remaining at the test sample. The radiation cumulated dose shall be approved by the ESCC Executive.

2. For gamma source radiation, the following test procedure shall apply :

(a) Dielectric dosage level:
- o Irradiate to dielectric dosage level as specified in the Detail Specification.
- o On completion of testing, Insertion Loss, Change of Insertion Loss, VSWR and Change of VSWR shall be measured as specified in Room Temperature Electrical Measurements in the Detail Specification.
  Flexing of the cable/wire of the test vehicle during testing shall be avoided.

(b) Cable/wire Jacket dosage level:
- o Irradiate to cable/wire jacket dosage level as specified in the Detail Specification.
- o On completion, the test vehicle(s) shall be visually inspected for integrity of the cable/wire jacket material for any cracking or any particles of the cable/wire jacket material flaking away (both at magnification power x1 and minimum x10).

9.6.2 Cold Bend

3 specimens of cable/wire shall be cut from the test vehicle(s).

The distance between the cable/wire turns wrapped on the mandrel shall not be more than the diameter of the cable/wire; the cable/wire shall make intimate contact with the mandrel.

One end of each specimen shall be clamped on a mandrel whose diameter is 10 times the normal outside diameter of the specimen in its present test condition. Wrap each specimen around the mandrel for one full turn and hold in place with a mechanical device. The specimens shall be placed in a cold chamber and conditioned for 20 hours minimum at the temperature defined in the Detail Specification.

After the conditioning period and while the specimens are still at the test temperature, the specimens shall be wrapped around the mandrel for 3 full, close turns for cables/wires whose nominal outside diameter is less than 12.7mm, or 2 full close turns for cables/wires whose nominal outside diameter is 12.7mm or larger. The mandrel shall be turned at a uniform rate of 15 ±3 revolutions per minute during this operation.

After the turning operation, the specimens shall be removed from the cold chamber and conditioned at room ambient temperature for 1 hour maximum.

The specimens shall be unwrapped from the mandrel and, except at the clamping points, examined for cracks, flaws, or other damage in the outer surface material.

9.7 GROUP 6 – CONSTRUCTION ANALYSIS

The purpose of this analysis, consisting in a series of examinations and evaluations, is to examine the construction of a component and to assess potential reliability hazards. Construction analysis shall be made according to MIL-STD-1580. Each step shall be recorded and a summary of the entire process and the results shall be made.

10 DATA DOCUMENTATION

10.1 GENERAL REQUIREMENTS

An evaluation test report shall be established. This shall comprise of the following:

(a) Cover sheet (or sheets).
(b) List of equipment (testing and measuring).
(c) List of test references.
(d) Sample identification.
(e) Production data.
(f) Inspection data.
(g) Initial electrical measurements.
(h) Group 1 - Control data.
(i) Group 2 - Mechanical Capability data.
(j) Group 3 - Step-Stress data.
(k) Group 4 - Thermal Endurance data.
(l) Group 5 - Environmental Capability data.
(m) Group 6 - Construction Analysis data
(n) Summary of results and conclusions.

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

- Manufacturer's/test house's name.
- Lot identification.
- Date of establishment of the document.
- Page number.

10.2 COVER SHEET(S)

The cover sheet (or sheets) of the evaluation test report shall include as a minimum:

(a) Reference to this document, including issue and date.
(b) Component type and number.
(c) Lot identification.
(d) Manufacturer's/test house's name and address.
(e) Location of the manufacturing plant/test house.
(f) Signature on behalf of the Manufacturer/test house.
(g) Total number of pages of the evaluation test report.

10.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be included in the evaluation test report. Where applicable, this list shall contain the inventory number, Manufacturer 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 references or codes which are necessary to correlate the test data provided with the applicable tests.

10.5 SAMPLE IDENTIFICATION (Para. 6.1)

This shall identify the test vehicles with the drawing references including revision and date.

This shall identify the criteria used for the selection of the particular components used for the tests, when evaluating a range of components by means of representative samples.

10.6 PRODUCTION DATA (Para. 6.4)

The progress of the components through the normal manufacturing processes shall be documented. The components failing a particular process shall be detailed, together with the reason for their removal.

10.7 INSPECTION DATA (Para. 7)

The quantity of components subjected to each test shall be identified together with the serial number and reason for any rejects.

Radiographs shall be provided. Definition of the applied acceptance/rejection criteria shall be provided.

10.8 INITIAL ELECTRICAL MEASUREMENTS (Para. 8)

All data shall be recorded against serial numbers. All test parameters shall be provided. A histogram of component parameters shall be produced.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.9 GROUP 1 - CONTROL DATA (Paras 9.2 & 6.5)

All data shall be recorded against serial numbers. All test parameters shall be provided.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.10 GROUP 2 – MECHANICAL CAPABILITY DATA (Paras. 9.3 & 6.5)

All data shall be recorded against serial numbers. All test parameters shall be provided.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.11 GROUP 3 - STEP-STRESS DATA (Paras. 9.4 & 6.5)

All data shall be recorded against serial numbers. All test parameters shall be provided. Radiographs shall be provided.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.12 GROUP 4 – THERMAL ENDURANCE DATA (Paras. 9.5 & 6.5)

All data shall be recorded against serial numbers. All test parameters shall be provided. Radiographs shall be provided.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.13 GROUP 5 – ENVIRONMENTAL CAPABILITY DATA (paras. 9.6 & 6.5)

All data shall be recorded against serial numbers. All test parameters shall be provided.

As applicable, failure analysis results including radiographs and DPA results shall be provided.

10.14 GROUP 6 - CONSTRUCTION ANALYSIS DATA (Para. 9.7)

All data shall be recorded against serial numbers.

Photographs shall be provided.

Description of components shall be provided.

Microsection / Radiographs shall be provided,

Definition of the applied acceptance/rejection criteria shall be provided.

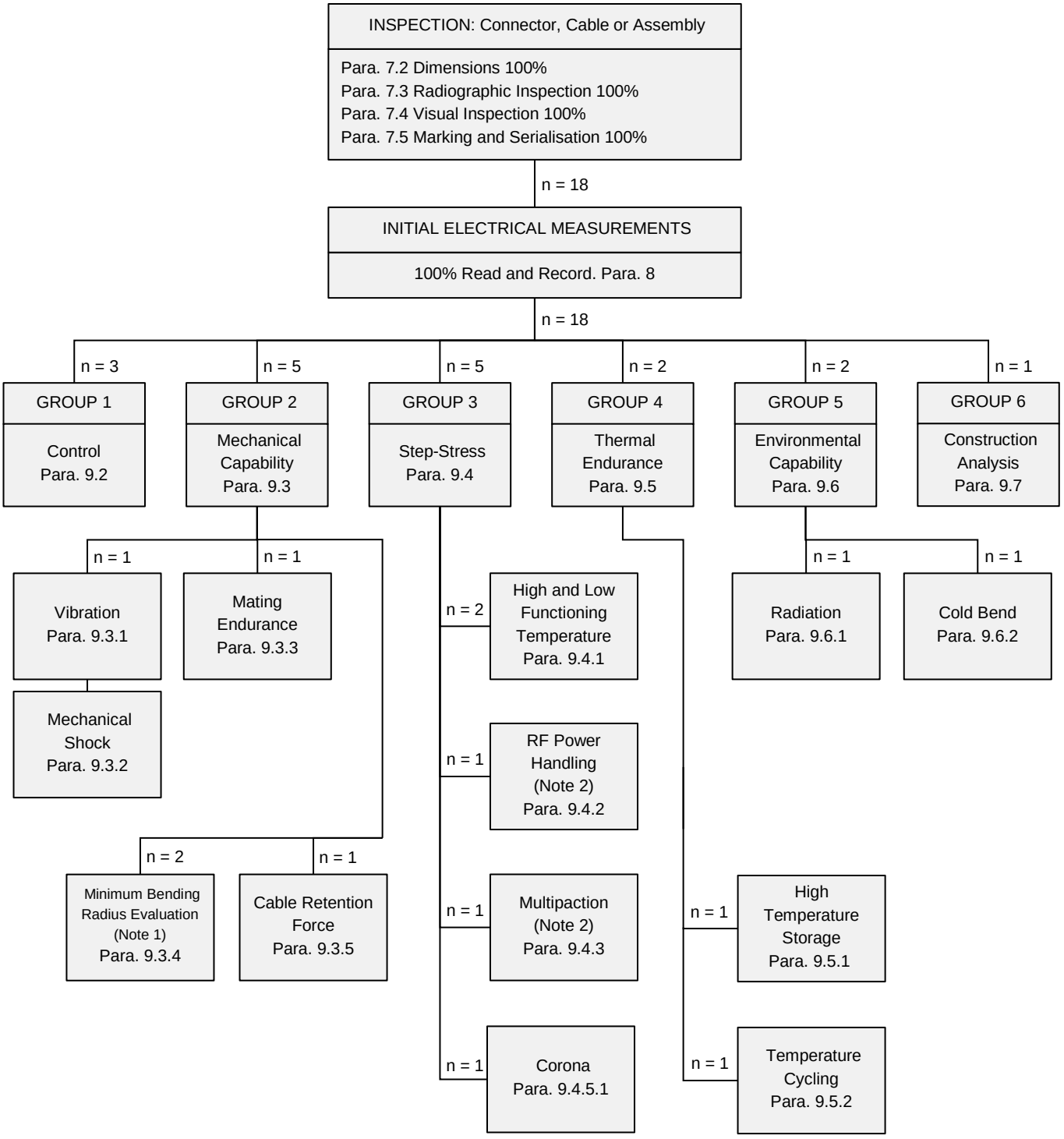
10.15 SUMMARY OF RESULTS AND CONCLUSIONS

The above shall be briefly reviewed, indicating the success or otherwise of the Evaluation Test Programme. Any production screens that need to be introduced into the PID shall be outlined. The discussion shall provide detailed analysis of:

- Drift,
- Distribution
- Derating rules
- Margin
- etc.

CHART 1 - EVALUATION TEST PROGRAMME

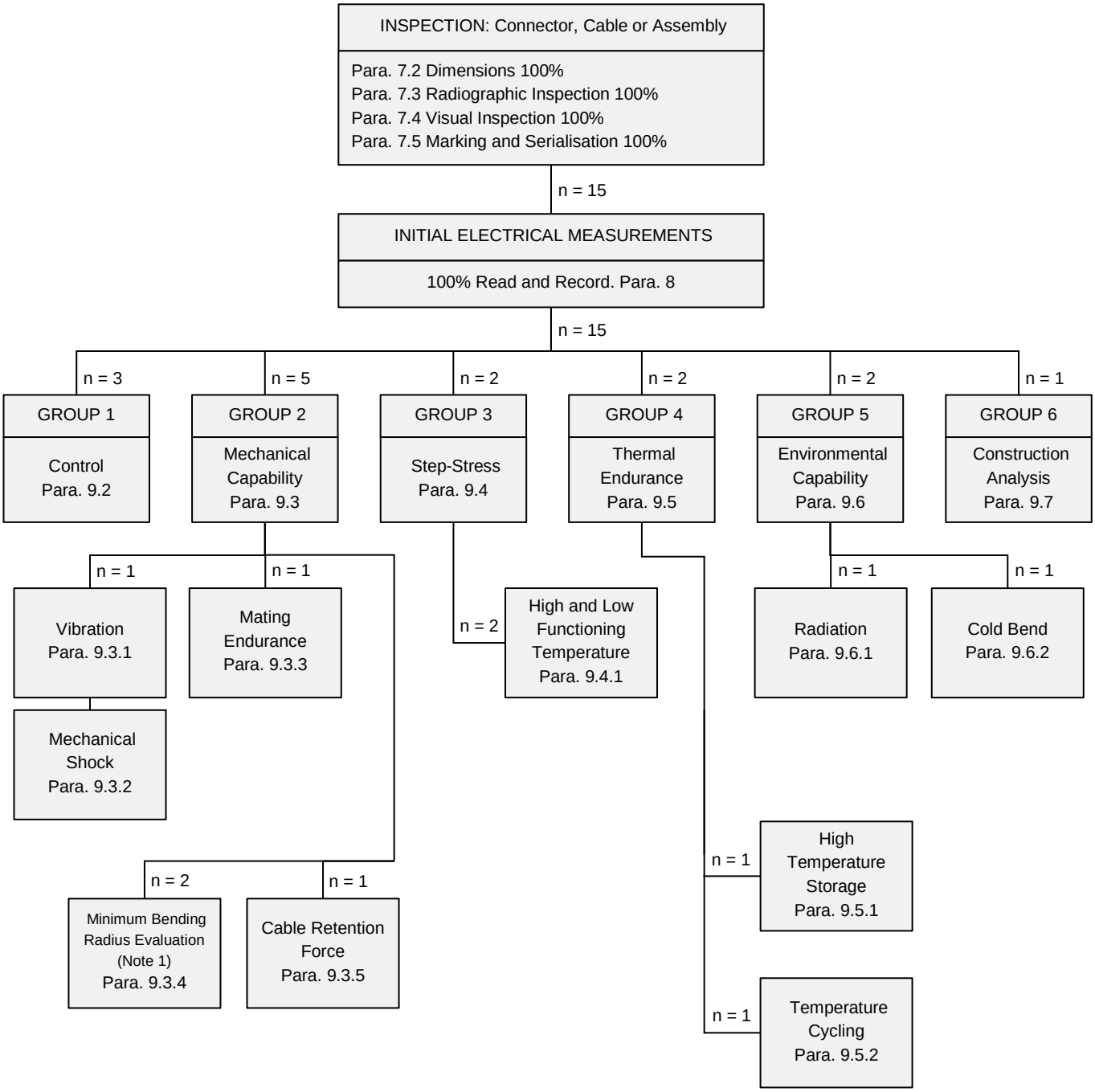
CHART 1A – RF CABLE ASSEMBLIES



NOTES:

1. Not applicable to semi-rigid cable assemblies
2. If specified in the Detail Specification.

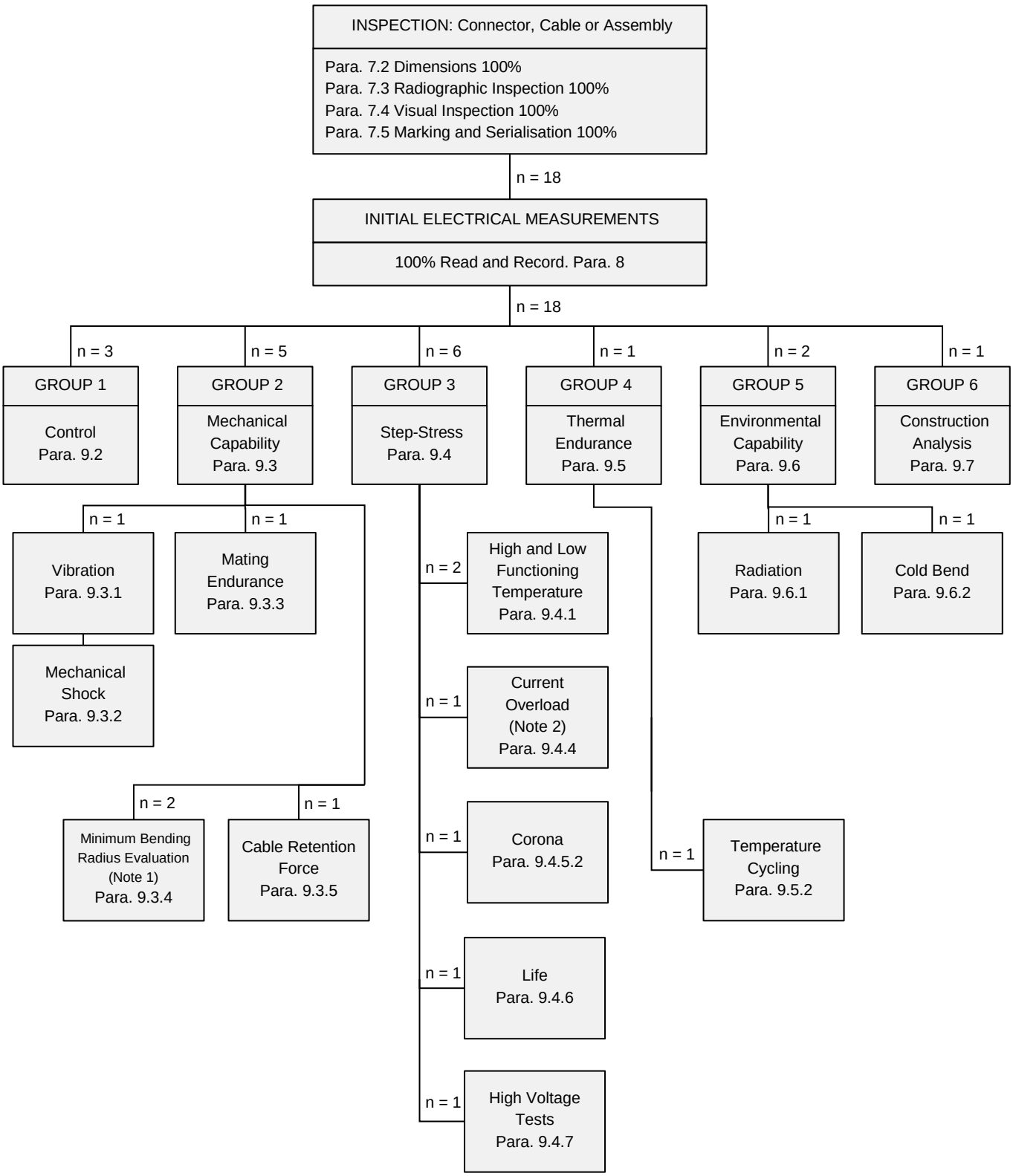
CHART 1B – HIGH DATA RATE CABLE ASSEMBLIES



NOTES:

1. Not applicable to semi-rigid cable assemblies

CHART 1C – HIGH VOLTAGE CABLE ASSEMBLIES



NOTES:

1. Not applicable to semi-rigid cable assemblies
2. If specified in the Detail Specification.