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EVALUATION TEST PROGRAMME FOR OPTICAL FIBRE CABLE ASSEMBLIES

ESCC Basic Specification No. 2263420

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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 constructional 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 **APPLICABLE DOCUMENTS**

2.1 **GENERAL**

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.

2.2 **ESCC SPECIFICATIONS**

- ESCC Generic Specification No. [3420](#) for Optical Fibre Cable Assemblies.
- The relevant ESCC Detail Specification.
- Basic Specification No. [20500](#), External Visual Inspection.
- Basic Specification No. [21300](#), Terms, Definitions, Abbreviations, Symbols and Units.
- Basic Specification No. [22900](#), Total Dose Steady-State Irradiation Test Method.

Unless otherwise stated herein, reference within the text of this specification to “the Detail Specification” shall mean the relevant ESCC Detail Specification.

2.3 **OTHER REFERENCE DOCUMENTS**

- ECSS-Q-ST-70-02, Thermal Vacuum Outgassing Test for the Screening of Space Materials.
- IEC 61300, Fibre Optic Interconnecting Devices and Passive Components - Basic Test and Measurement Procedures.
- IEC 60068 Part 2, Basic Environmental Testing Procedures.
- MIL-STD-810, Environmental Engineering Considerations and Laboratory Tests.

3 **TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

The terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. [21300](#) shall apply. In addition the following definitions shall apply:

- Patchcord: A length of optical fibre or cable, terminated at both ends with identical optical connectors.
- Hybrid Patchcord: A patchcord terminated with 2 different optical connectors types, one being the connector to be tested, the other a suitable connector to facilitate testing.
- Mating Adapter: Female component in which two optical connectors are inserted and aligned.

4 PROCEDURE

Standard optical fibre cable assemblies shall be selected from a homogeneous lot at the Manufacturer to be evaluated. These components shall not have been submitted to any screening, but must have been manufactured and assembled in conformity with high reliability practice and an established Process Identification Document (PID) or an identifiable process which shall form the basis for the PID.

The tests specified in the programme shall be performed in the sequence shown in Chart I.

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.

5 TEST PROGRAMME SEQUENCE AND SAMPLE DISTRIBUTION

5.1 SELECTION OF COMPONENTS FOR EVALUATION TESTING

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

The optical fibre cable assembly 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.

Components used for evaluation testing shall comprise optical connectors assembled with the optical fibre and/or optical cable as specified in the Detail specification. The configuration of each test structure type (see Para. 3) to be used for each test shall be as specified in the applicable test in Para. 7.

The minimum quantity of test structure types used for each test programme shall be 57 Hybrid Patchcords, 7 Patchcords and 35 Mating Adapters.

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

5.2 DETAIL SPECIFICATION(S)

Should a Detail Specification(s) for the optical fibre cable assembly 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.

5.3 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 three working days in advance of the date of pre-assembly visual inspection of components.

5.4 CONTROL DURING FABRICATION

The components shall be produced as defined in the Procedure section in this specification. Pre-assembly visual inspection shall be performed on the lot of components 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 number in/out and failure cause for each fabrication stage shall be submitted to the ESCC Executive.

6 INSPECTION

6.1 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. For each measurement or inspection performed, the results shall be summarised in terms of component type, quantity tested, quantity passed and quantity rejected. If any components are rejected, the reasons shall be clearly identified.

6.2 DIMENSIONS

All components shall be inspected (go-no-go) in accordance with the Physical Dimensions of the Detail Specification, including the end-face geometry. Where gauges exist, these may be used.

Rejected components shall be replaced.

6.3 WEIGHT

All components shall be weighed to an accuracy of 0.1 grammes.

6.4 EXTERNAL VISUAL INSPECTION (100%)

All components shall be inspected in accordance with ESCC Basic Specification No. [20500](#).

In addition, Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35. If necessary, the end-face surface may be cleaned using an appropriate method.

The components shall show no evidence of defects or damage such as cracks, breaks, contamination or embedded foreign material.

Rejected components shall be replaced.

6.5 MARKING AND SERIALISATION (100%)

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

6.6 MATERIALS AND FINISHES

All non-metallic materials and finishes of the optical fibre cable assemblies specified herein shall be tested in accordance with ECSS-Q-ST-70-02 to verify its outgassing requirements, unless relevant data is available.

6.7 OPTICAL AND GEOMETRICAL MEASUREMENTS (100%)

All components shall be subjected to Room Temperature Optical and Geometrical Measurements as specified in the Detail Specification at an ambient temperature of $+22 \pm 3^{\circ}\text{C}$.

All characteristics shall be recorded against serial numbers.

Rejected components shall be replaced.

6.8 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 inspection requirements herein.

7 EVALUATION TEST PROGRAMME

7.1 GENERAL

The evaluation tests shall be performed as specified in Chart I. The test structure types and quantities required for testing are specified in Chart I and in the paragraphs below.

All failed components shall be analysed. The depth of analysis shall depend upon the circumstances in which failure occurred and upon whether useful information may be gained. As a minimum, the failure mode shall be determined in each case. Components not failing catastrophically, i.e. those displaying out-of-tolerance optical parameters, shall not be removed from the test sequence, but monitored to observe degradation trends.

7.2 GROUP 1 - CONTROL GROUP

This group shall be retained for comparison purposes. Whenever optical and geometrical measurements are made on any sample under test, these components shall also be measured.

- Test Structures required: 1 Hybrid Patchcord, 1 Patchcord and 1 Mating Adapter.

7.3 GROUP 2 - DESTRUCTIVE TESTS

7.3.1 Temperature Step Stress

Test structures shall be subjected to a sequence of temperature steps over the range -190°C to $+190^{\circ}\text{C}$. Testing shall be in accordance with IEC 61300-2-18 with the following conditions:

- Test Structures required: 8 Hybrid Patchcords with 4 Mating Adapters (4 mated sets).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature steps (T_{amb}):
 - i. -40°C to $+80^{\circ}\text{C}$ in steps of $+30^{\circ}\text{C}$ followed by:
 - ii. $+90^{\circ}\text{C}$ to $+190^{\circ}\text{C}$ in steps of $+10^{\circ}\text{C}$ followed by:
 - iii. -40°C to -190°C in steps of -10°C
- Dwell time at each temperature step: 1 hour
- Temperature gradient: $1^{\circ}\text{C}/\text{minute}$

- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Return Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

Analysis of the results of this test shall be used to determine the most effective extreme temperatures (T_{max} and T_{min}) for the Temperature Cycling, Rapid Change of Temperature and High Temperature Storage tests in Groups 4 and 5.

7.3.2 Constructional Analysis

Test structures shall be subjected to constructional analysis to characterise all the external and internal mechanical and material details. Details of the tests and inspections included in the constructional analysis shall be agreed with the ESCC Executive.

- Test Structures required: 1 Patchcord and 1 Mating Adapter.

7.4 GROUP 3 - ASSEMBLY TESTS

7.4.1 Torsion

Test structures shall be subjected to a sequence of torsion test steps to destruction, in accordance with IEC 61300-2-5 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set) with 30cm free fibre/cable length.
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Tensile load steps:
 - i. 5N to 15N in steps of 1N followed by:
 - ii. 11N to destruction in steps of 5N
- Tensile load direction: along connector longitudinal axis
- Twist angle (1 cycle): $\pm 180^\circ$
- Number of twist cycles at each load step: 25
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.4.2 Static Side Load

Test structures shall be subjected to a sequence of static side load test steps to destruction, in accordance with IEC 61300-2-42 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set) with 30cm free fibre/cable length.
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Applied load steps:
 - i. 1N to 15N in steps of 1N followed by:
 - ii. 3N to destruction in steps of 1N
- Applied load direction: 90° to the connector longitudinal axis
- Duration of each load step: 1 hour
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.4.3 Cable Retention

Test structures shall be subjected to a sequence of cable retention test steps to destruction, in accordance with IEC 61300-2-4 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set) with 30cm free fibre/cable length.
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Tensile load steps:
 - i. 5N to 50N in steps of 5N followed by:
 - ii. 20N to destruction in steps of 5N
- Tensile load direction: along connector longitudinal axis
- Duration of each load step: 2 minutes
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5 GROUP 4 - ENVIRONMENTAL TESTS

7.5.1 Temperature Cycling I

Test structures shall be tested in accordance with IEC 61300-2-22 with the following conditions:

- Test Structures required:
 - 6 Hybrid Patchcords, 3 Patchcords with 6 Mating Adapters (3 mated sets) plus:
 - 6 Hybrid Patchcords with 3 Mating Adapters (3 mated sets).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes: between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 1 hour
- Temperature gradient: 1°C/minute
- Number of cycles: 200
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Return Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.2 Rapid Depressurisation

Test structures shall be tested in accordance with MIL-STD-810, method 500, procedure III with the following conditions:

- Test Structures required:
 - 2 Hybrid Patchcords, 1 Patchcord with 2 Mating Adapters (1 mated set) plus:
 - 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Test temperature: room ambient.
- Start pressure: room ambient
- End pressure: 5kPa
- Time to depressurisation: 5s maximum
- Number of depressurisation cycles: 5
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.3 Humidity Cycling

Test structures shall be tested in accordance with IEC 61300-2-46 with the following conditions:

- Test Structures required:
 - 2 Hybrid Patchcords, 1 Patchcord with 2 Mating Adapters (1 mated set) plus:
 - 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between $T_{min} = +25^{\circ}\text{C}$ and $T_{max} = +55^{\circ}\text{C}$.
- Dwell time at temperature extremes: 9 hours
- Temperature gradient: $10^{\circ}\text{C}/\text{hour}$
- Relative humidity: 95%
- Number of cycles: 6
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.4 Temperature Cycling II (after Rapid Depressurisation and Humidity Cycling)

Test structures shall be tested in accordance with IEC 61300-2-22 with the following conditions:

- Test Structures required:
 - 6 Hybrid Patchcords, 3 Patchcords with 6 Mating Adapters (3 mated sets) plus:
 - 6 Hybrid Patchcords with 3 Mating Adapters (3 mated sets).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 1 hour
- Temperature gradient: $1^{\circ}\text{C}/\text{minute}$
- Number of cycles: 300
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Return Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.5 Random Vibration

Test structures shall be tested in accordance with IEC 60068-2-64 with the following conditions:

- Test Structures required: 6 Hybrid Patchcords with 3 Mating Adapters (3 mated sets).
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Frequency range: 20Hz to 2000Hz
- Acceleration level: 35g rms
- Shape of acceleration spectral density curve:
 - From 20Hz to 100Hz, power spectral density (PSD) changing by +3dB/Octave
 - From 100Hz to 300Hz, PSD constant at 2.2g²/Hz
 - From 300Hz to 2000Hz, PSD changing by -5dB/Octave
- Axis: X, Y and Z
- Duration: 7.5 minutes in each axis
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Transient Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.6 Mechanical Shock

Test structures shall be tested in accordance with IEC 60068-2-27 with the following conditions:

- Test Structures required: 6 Hybrid Patchcords with 3 Mating Adapters (3 mated sets).
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Pulse shape: Half-sinus
- Peak Acceleration: 500g
- Duration: 2ms
- Axis: X1, Y1 and Z1
- Number of shocks: 3 in each axis (9 total)
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Transient Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.7 Temperature Cycling III (after Random Vibration and Mechanical Shock)

Test structures shall be tested in accordance with IEC 61300-2-22 with the following conditions:

- Test Structures required: 12 Hybrid Patchcords with 6 Mating Adapters (6 mated sets).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 1 hour
- Temperature gradient: 1°C/minute
- Number of cycles: 100
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Return Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.8 Rapid Change of Temperature

Test structures shall be tested in accordance with IEC 61300-2-47 with the following conditions:

- Test Structures required:
 - 2 Hybrid Patchcords, 1 Patchcord with 2 Mating Adapters (1 mated set) plus:
 - 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 30 minutes.
- Transfer time between temperature extremes: 1 minute maximum.
- Number of cycles: 10
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.9 Low Pressure

Test structures shall be tested in accordance with IEC 60068-2-13 with the following conditions:

- Test Structures required:
 - 2 Hybrid Patchcords, 1 Patchcord with 2 Mating Adapters (1 mated set) plus:
 - 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: Using normal mounting provisions.
- Test structures shall be active during the test.
- Test pressure: $\leq 1\text{mPa}$.
- Test temperature: room ambient.
- Duration: 8 hours
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.10 Radiation

Test structures shall be tested in accordance with ESCC No. [22900](#) with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: Using normal mounting provisions.
- Test structures shall not be active during the test.
- Test temperature and relative humidity: room ambient.
- Radiation source: Cobalt 60.
- Total ionising dose: 1Mrad(Si)
- Dose rate: circa 8krad(Si)/hour
- Data Points:

On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.11 Temperature Cycling IV (after Radiation)

Test structures shall be tested in accordance with IEC 61300-2-22 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 1 hour
- Temperature gradient: 1°C/minute
- Number of cycles: 100
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss and Return Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.5.12 Temperature Cycling V (with Polarisation Extinction Ratio Measurements)

Only applicable to components with polarization maintaining optical fibre/cable.

Test structures shall be tested in accordance with IEC 61300-2-22 with the following conditions:

- Test Structures required: 4 Hybrid Patchcords with 2 Mating Adapters (2 mated sets).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Temperature extremes (T_{amb}): between T_{min} and T_{max} , as determined in Para. 7.3.1.
- Dwell time at temperature extremes: 1 hour
- Temperature gradient: 1°C/minute
- Number of cycles: 3
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Polarization Extinction Ratio shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio and End-face Geometry shall be measured both before and after the test.

7.6 GROUP 5 - ENDURANCE TESTS

7.6.1 Mating Durability

Test structures shall be tested in accordance with IEC 61300-2-2 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: The mating adapter is secured using its normal mounting provisions to a rigid mounting fixture.
- Test structures shall be active during the test.
- Number of mating/demating cycles: 500 (manual on one side)
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Variation of Insertion Loss shall be monitored and recorded during testing.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

7.6.2 High Temperature Storage

Test structures shall be tested in accordance with IEC 61300-2-18 with the following conditions:

- Test Structures required: 2 Hybrid Patchcords with 1 Mating Adapter (1 mated set).
- Mounting: mating adapters shall be secured to mounting fixtures using their normal mounting provisions. The thermal conduction of the mounting shall be low such that the test structure can be considered thermally isolated.
- Test structures shall be active during the test.
- Test temperature (T_{amb}): T_{max} , as determined in Para. 7.3.1.
- Duration: 5000 hours.
- Data Points:
On completion of testing the components shall be visually examined.

Optical Connector End-face Visual Inspection shall be performed in accordance with IEC 61300-3-35 both before and after the test.

Insertion Loss, Return Loss, Polarization Extinction Ratio (as applicable) and End-face Geometry shall be measured both before and after the test.

8 DATA DOCUMENTATION

8.1 GENERAL REQUIREMENTS

An evaluation test report shall be established. This shall comprise 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 optical and geometric measurements data
- (h) Group 1 – Control Group data
- (i) Group 2 – Destructive Tests data
- (j) Group 3 – Assembly Tests data
- (k) Group 4 – Environmental Tests data
- (l) Group 5 – Endurance Tests data
- (m) Failure Analysis results
- (n) Summary of results and conclusion

Items (a) to (n) inclusive shall be grouped, preferably as sub-packages, 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

8.2 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) Optical fibre cable assembly 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 report

8.3 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, calibration status etc. This list shall indicate for which test such equipment was used.

8.4 LIST OF TEST REFERENCES

This list shall include all references or codes that are necessary to correlate the test data provided with the applicable tests.

8.5 SAMPLE IDENTIFICATION

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

Full details of all selected components shall be provided including all component type, optical connector type and optical fibre/cable type information.

8.6 PRODUCTION DATA

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

8.7 INSPECTION DATA

The number of optical fibre cable assemblies subjected to each test shall be identified together with the number and reason for any rejects.

8.7.1 Initial Optical and Geometrical Measurements

All data shall be recorded against serial numbers. A histogram of parameters and a table of shall be produced.

8.8 GROUP 1 - CONTROL GROUP DATA

All optical and geometrical measurements data shall be recorded against serial numbers.

8.9 GROUP 2 - DESTRUCTIVE TESTS DATA

8.9.1 Temperature Step-Stress Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test step temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.
- (f) Full details of the required analysis of the test results.

8.9.2 Constructional Analysis Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) External and internal visual examination results.
- (b) Photographic records of all inspections.
- (c) Radiographic images.
- (d) Materials and finishes material analysis results.
- (e) Marking test results
- (f) Microsection analysis results.

8.10 GROUP 3 - ASSEMBLY TESTS DATA

8.10.1 Torsion Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (b) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (c) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (d) Final visual examination results including photographs were relevant.

8.10.2 Static Side Load Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (b) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (c) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (d) Final visual examination results including photographs were relevant.

8.10.3 Cable Retention Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (b) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (c) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (d) Final visual examination results including photographs were relevant.

8.11 GROUP 4 - ENVIRONMENTAL TESTS DATA

8.11.1 Temperature Cycling I Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.2 Rapid Depressurisation Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test pressure versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.3 Humidity Cycling Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature and relative humidity versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.4 Temperature Cycling II Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.5 Random Vibration Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) Vibration spectrum details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.6 Mechanical Shock Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) Shock profile details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.7 Temperature Cycling III Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.8 Rapid Change of Temperature Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (c) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (d) Final visual examination results including photographs were relevant.

8.11.9 Low Pressure Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test pressure versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.10 Radiation Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All radiation dose versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.11 Temperature Cycling IV Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.11.12 Temperature Cycling V Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.12 GROUP 5 - ENDURANCE TESTS DATA

8.12.1 Mating Durability Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (b) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (c) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.

8.12.2 High Temperature Storage Data

All data shall be recorded against serial numbers.

A test summary shall be produced which shall include:

- (a) All test temperature versus time details.
- (b) All optical measurements monitoring data recorded during testing. Measurements shall also be plotted on a graph showing variation of the characteristics during the test.
- (c) All optical and geometrical measurements data recorded before and after testing. Changes in all tested characteristics shall be calculated and recorded.
- (d) All Optical Connector End-face Visual Inspection data recorded before and after the test including photographic records.
- (e) Final visual examination results including photographs were relevant.

8.13 FAILURE ANALYSIS RESULTS

A failure analysis report for all failures during evaluation testing shall be part of the data delivery.

8.14 SUMMARY OF RESULTS AND CONCLUSION

The evaluation data results shall be briefly reviewed, indicating the success or otherwise of the evaluation test programme. Any production or testing changes that need to be introduced into the PID shall be outlined.

Recommendations/deviations pertaining to the Detail Specification or the qualification programme shall also be outlined.

8.15 CHART I - EVALUATION TEST PROGRAMME

