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DIAMOND MFS Terminated Ribbon Lot acceptance Report

Batch d21b

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1 Overview

In this document we report on the lot acceptance tests carried out on 6 randomly sampled ruggedized ribbons terminated with MF-A2 connectors. The samples were delivered as batch d21. Table 1 shows the sample history and Table 2 the list of the samples.

Batch delivery	Sumitomo Harnesses Batch	Delivery Date	Quantity Delivered	Length	Quantity Sampled	Diamond Serial Numb
D21b	B20	Feb. 2006	22	2.40m	1	20
			14	2.55m	1	4
			14	2.70m	1	7
			52	3.00m	1	38
			14	3.15m	1	9
			14	3.30m	1	11

Table 1: sample history

Diamond S/N	Diamond QR-MFS-code 33013062200XXX	Sumitomo QR-sMU code 3301306210XXXX
20	565	457
4	596	415
7	814	548
38	559	559
9	900	1682
11	819	475

Table 2: List of MFS terminated fanouts samples

The acceptance tests performed on the Sumitomo harnesses were reported separately in document CMS-TK-QC-0027.

2 Production tests and results

The procedure for production qualification is described in document CMS-TK-QP-0008. The sequence followed for this acceptance test is illustrated in Figure 1. The specifications tested are shown in Table 3.

The 6 selected terminated fibre ribbons underwent visual inspection, geometrical tests and optical tests.

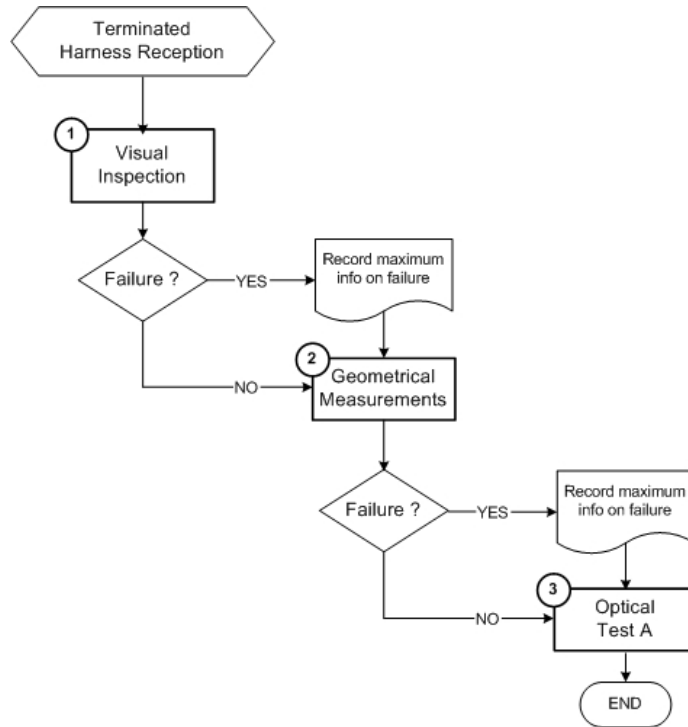


Figure 1: Flow chart of the procedure.

#	Specification to be tested	Test Specifications				CERN Testing Production Acceptance
		Min	Typ	Max	Units	
3.1	Number of channels		12			①
3.2	Operation Wavelength		1310		nm	
3.3	Connector type (multi-fibre)		MFA2			①
3.4	Number of mating cycles	20				
3.5	Random mate insertion loss			1.2	dB	③
3.6	Return loss	50			dB	③
3.7	Tensile load on connector			10	N	
3.8	Ribbon length L_{FANOUT}	240,255,270,300,315,330 (-0/+5)			cm	②
3.9	Naked ribbon section length L_{R}	30 (-0/+3)			cm	②
3.61	Magnetic field			4	T	
3.62	Hadronic fluence			1×10^{12}	cm^{-2}	
3.63	Gamma radiation dose			100	Gy(Si)	
3.64	Temperature	-20		70	°C	
3.65	Operating humidity			60	%	
3.81	Material composition		Halogen-free, flame retardant material			

Legend:

① Visual Inspection ② Geometrical measurement ③ Optical Test

Table 3: Validation Programme overview.

2.1 Visual inspection

- All samples were terminated correctly with MFS MF-A2 connectors as specified.
- The packaging by Diamond is acceptable and the coil diameter is in specification.
- The QR labels were properly attached according to the specification and could be read without trouble.
- The ribbon orientation into the MFS connector was as specified.

2.2 Geometrical measurement

All fibres of each sample were measured. The total length was measured with a high resolution OTDR. Table 4 shows that all ribbons are within specifications for the nominal length (Table 3).

The naked ribbon length was measured with a ruler from the edge of the sheath to the end of the MFS ferrule. Measurement results are shown in Table 5. All naked ribbons were found less to be in specification.

Channel number	Length (m) QR 457	Length (m) QR 415	Length (m) QR 548	Length (m) QR 559	Length (m) QR 1682	Length (m) QR 475
1	2.426	2.585	2.740	3.028	3.181	3.326
2	2.423	2.582	2.738	3.025	3.181	3.324
3	2.421	2.583	2.736	3.028	3.185	3.328
4	2.427	2.578	2.743	3.032	3.186	3.328
5	2.431	2.592	2.738	3.029	3.174	3.321
6	2.428	2.575	2.740	3.027	3.181	3.326
7	2.429	2.574	2.745	3.031	3.176	3.325
8	2.425	2.593	2.744	3.029	3.182	3.327
9	2.422	2.583	2.737	3.026	3.178	3.331
10	2.429	2.582	2.737	3.027	3.182	3.325
11	2.430	2.591	2.737	3.032	3.182	3.334
12	2.430	2.593	2.727	3.032	3.180	3.326
Average	2.43	2.58	2.74	3.03	3.18	3.33

Table 4: length of MFS terminated fanouts

Sumitomo QR-sMU code	Lengths (cm)
457	31
415	31.5
548	30.3
559	31.3
1682	31.3
475	31.3

Table 5: Naked ribbon lengths

2.3 Optical measurements

Optical properties were measured using the setup shown in Fig. 2. We note that the whole fanout insertion loss was measured with the sMU connectors mated to a second fanout attached to the measurement head. The measured values thus include MFS and sMU connector losses.

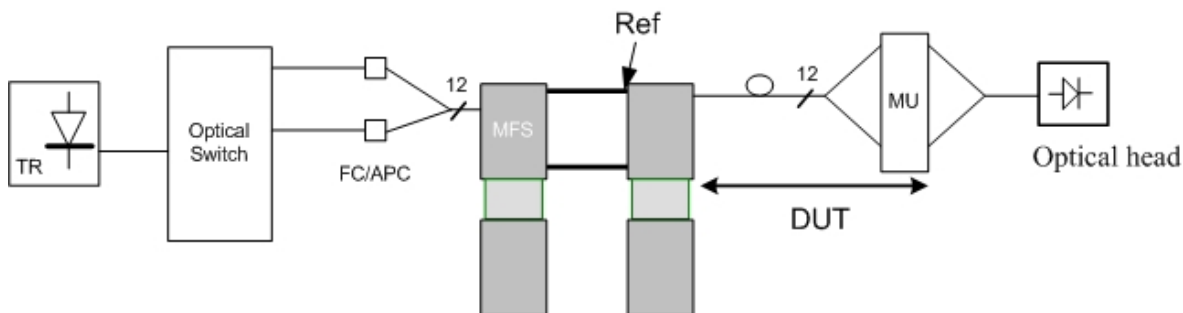


Fig.2: Schematic measurement setup for optical measurements.

2.3.1. Random mate insertion loss (all fibre channels).

The insertion loss (IL) is defined as the Log of the ratio of optical powers measured before (P_0) and after (P_1) insertion of the device under test. The optical powers (P_0 and P_1) were measured with a large area detector in an optical head receptacle.

$$\text{Insertion loss: } IL = 10 \text{Log} \frac{P_0}{P_1}$$

2.3.1.a Acceptance criteria

The acceptance criterion is such that the insertion loss of the MFS connector shall be less than **1.2 dB**.

2.3.1.b Results

The results are shown in Fig. 3: all the fanout ribbons were found to be within the specified limit.

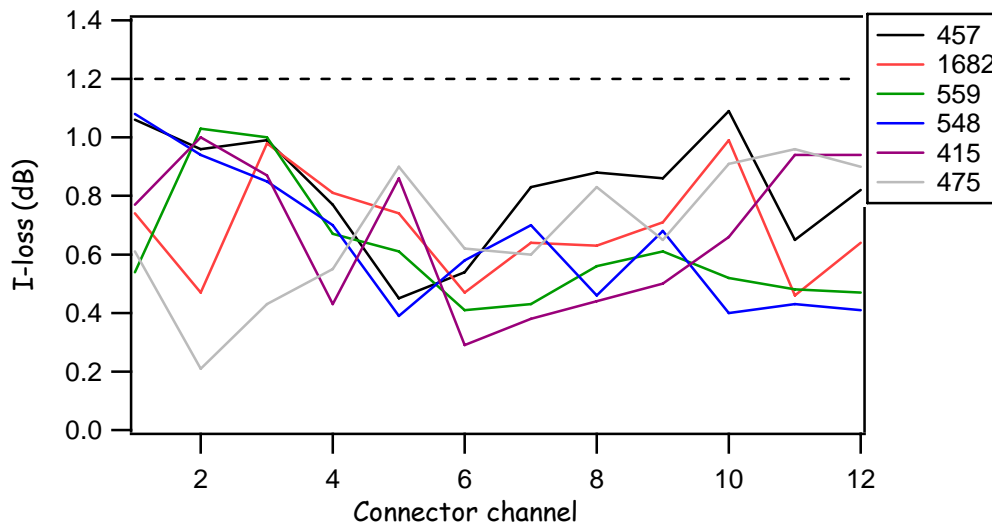


Fig.3: Insertion loss of MFS terminated fanouts

2.3.2. Return loss (all fibre channels).

The return loss (RL) is defined as the Log of the ratio of the reflected optical powers measured during referencing (P_{ref}) and after (P₁) insertion of the device under test (DUT).

$$\text{Return loss: } RL = 10\text{Log} \frac{P_{\text{ref}}}{P_1} + 14.7^{(1)}$$

2.3.2.a Acceptance criteria

The acceptance criterion is such that the return loss shall be greater than **50dB**.

2.3.2.b Results

The results are shown in Fig. 4. All devices were well within the specified limit.

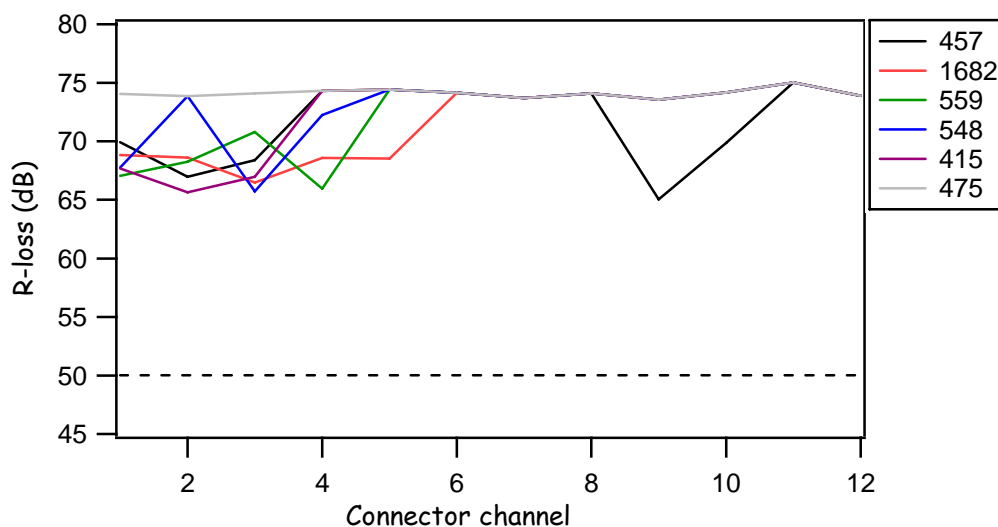


Fig.4: Return loss of MFS terminated fanouts.

⁽¹⁾ Formula valid if using a reference with perfect glass-air interface.

2.3.3. Comparison of IL measured at CERN and Diamond.

The comparison between CERN data and Diamond manufacturing data is shown in Figure 5.

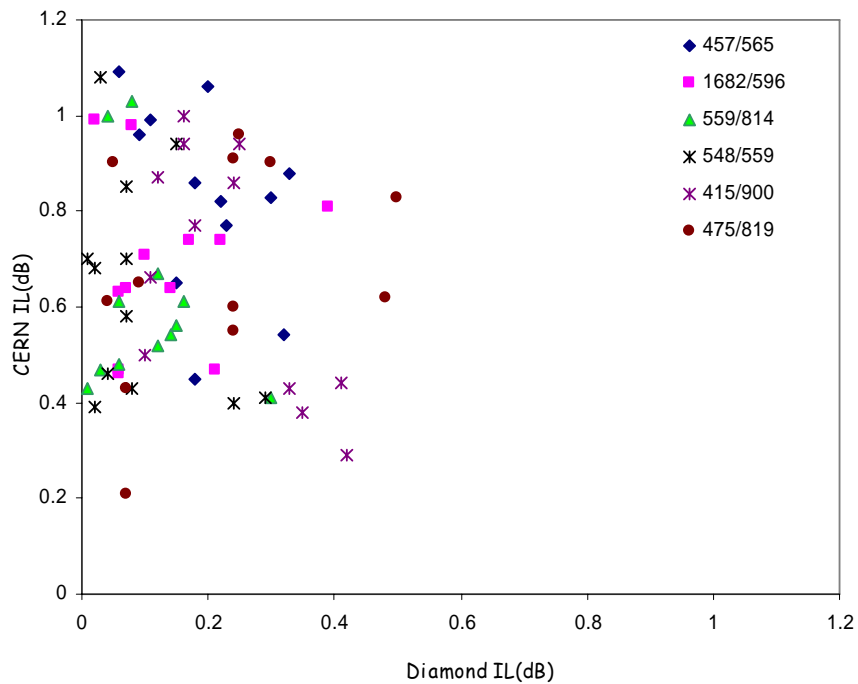


Fig. 5: Comparison of IL measured at CERN and Diamond.

3 Conclusions

The 6 MFS terminated ribbons sampled from batch d21b are in specification. All 130 ribbons supplied by Diamond as part of batch d21 are thus accepted.