

Using Parallel Optics/Array Connector Systems

Netcoms 2011

A collage of city skyscrapers at night, with green light trails streaking across the scene. The text 'Network solutions' is overlaid in white on a dark blue background.

Network
solutions

that
power business

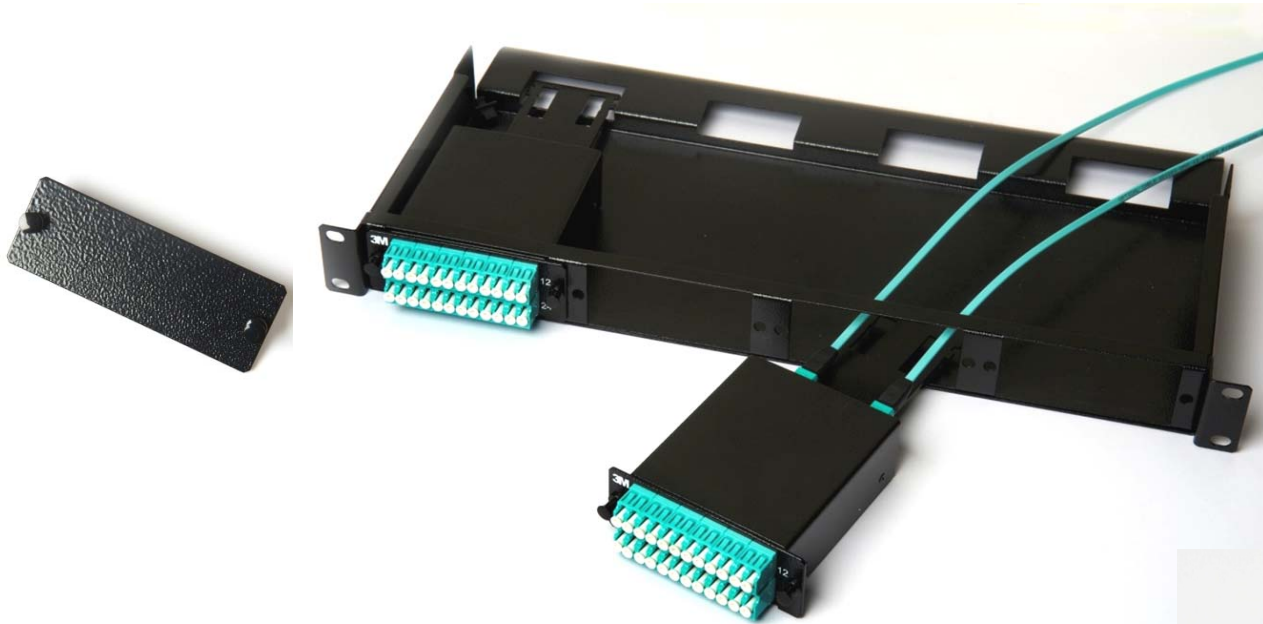


Agenda

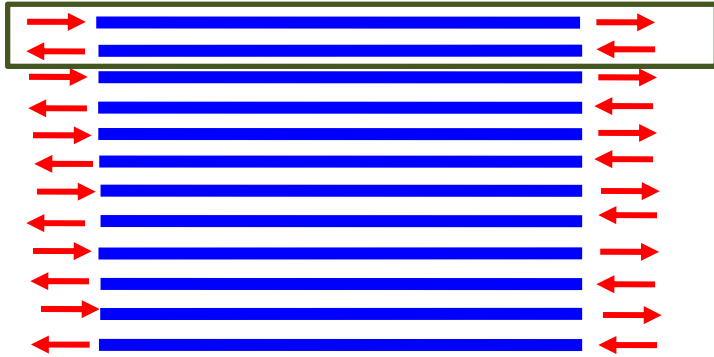
- Introduction to multimode MPO and preterminated fibre
- From two fibre to twenty fibre paths
- MPO Standards
 - *Performance, mechanical interface and optical interface*
 - *Loss and return loss*
- Polarisation
 - *The three standard types*
 - *Interoperability?*
- Installing and testing the system
 - *Don't neglect the time required for testing*
- Inspecting and caring for the system



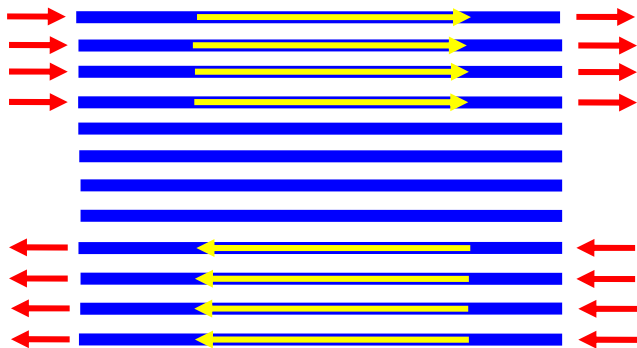
MPO Based Product



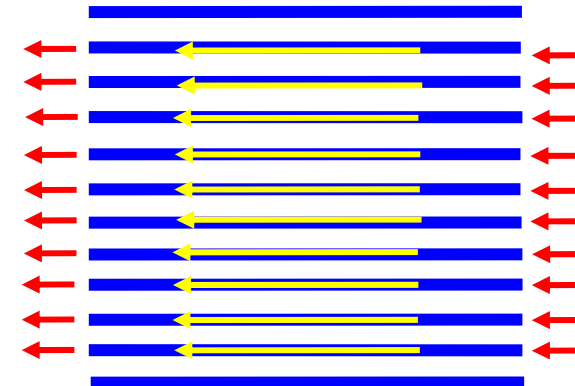
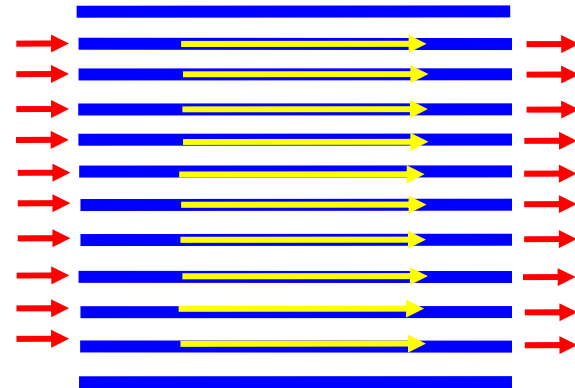
From Two to Twenty Fibres – parallel transmission – 40G & 100G



- 4x10G transmission paths in each direction at 850nm



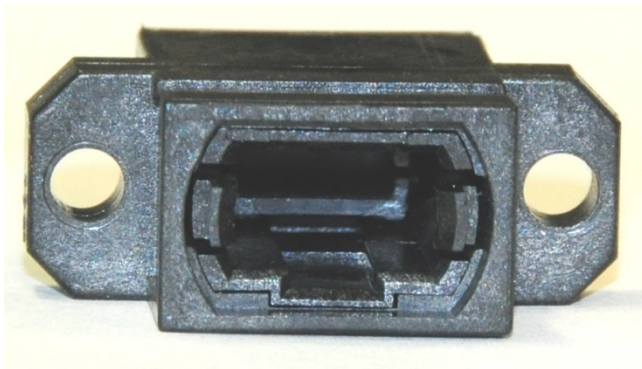
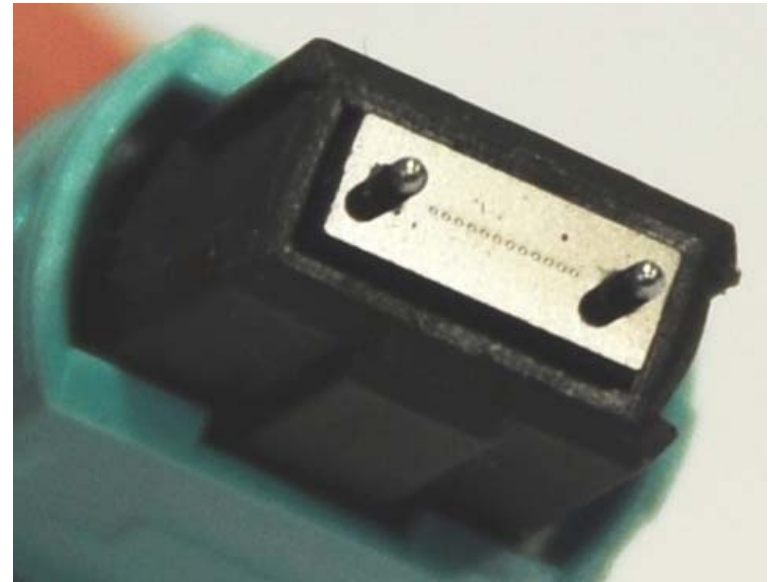
- 10x10G transmission paths in each direction



Loss Values

Network Application	Wavelength (nm)	Channel Insertion Loss (dB)	Length (m)
<i>Multimode</i>		OM3/OM4	
IEEE 100BASE-SX	1300	6.3	2000
IEEE 1000BASE-SX	850	3.56	550
IEEE 10GBASE-SR/SW	850	2.6	300
IEEE 40GBASE-SR4	850	1.9/1.5	100/150

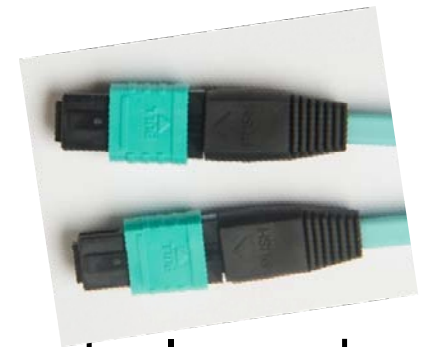
MPO Connector and Adapter



MPO Connector Standards (1)



- **Performance standards** are independent of connector type
- Relevant standard: IEC 61753-1 Ed. 1.0: Fibre optic interconnecting devices and passive components performance standard - Part 1: General and guidance for performance standards
- **Mechanical Interface Standards:** Two standards in draft – for single and dual row MPOs.:
 - *IEC 61754-7-1 Ed. 1.0: Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces – Part 7-1: Type MPO connector family - single fibre row*
 - *IEC 61754-7-2 Ed. 1.0: Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces – Part 7-2: Type MPO connector family - Double fibre row*



MPO Connector Standards (2)

- **Optical Interface Standard**
- Publically available pre-standard available for single-mode 8° angle thermoset ferrule. IEC PAS 61755-3-32
- Two draft standards (thermoset and polyphenolene materials) on hold waiting for more interface work.
- Insertion loss and return loss are dependent on the alignment and contact of two fibres. The losses must be held over all the extremes of the environment.
- Insertion loss standards: ≤ 0.6 dB for 97% of connectors
0.3 dB average
- Return Loss – better than 20 dB



Optical Interface (IEC 61755-3-31)

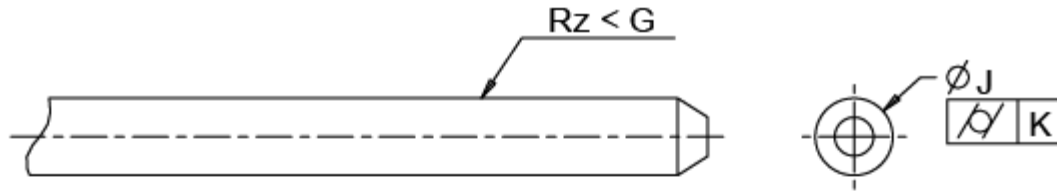
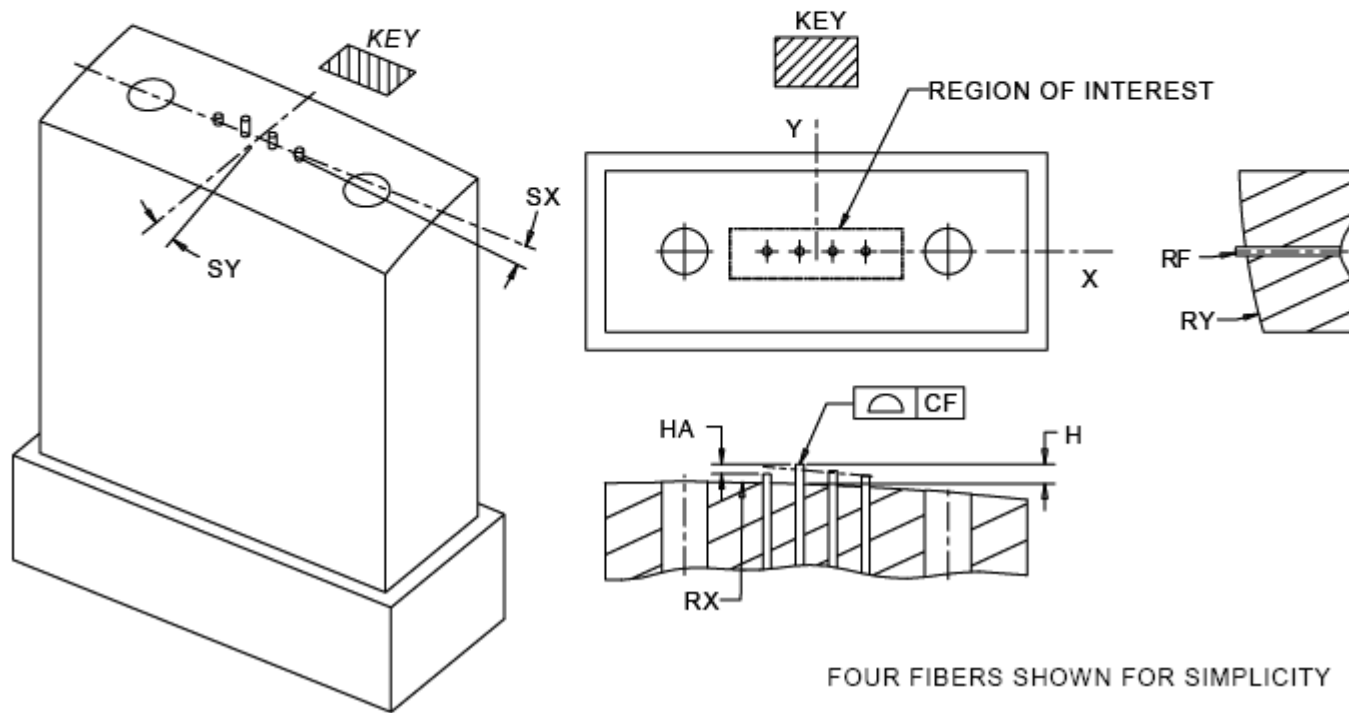
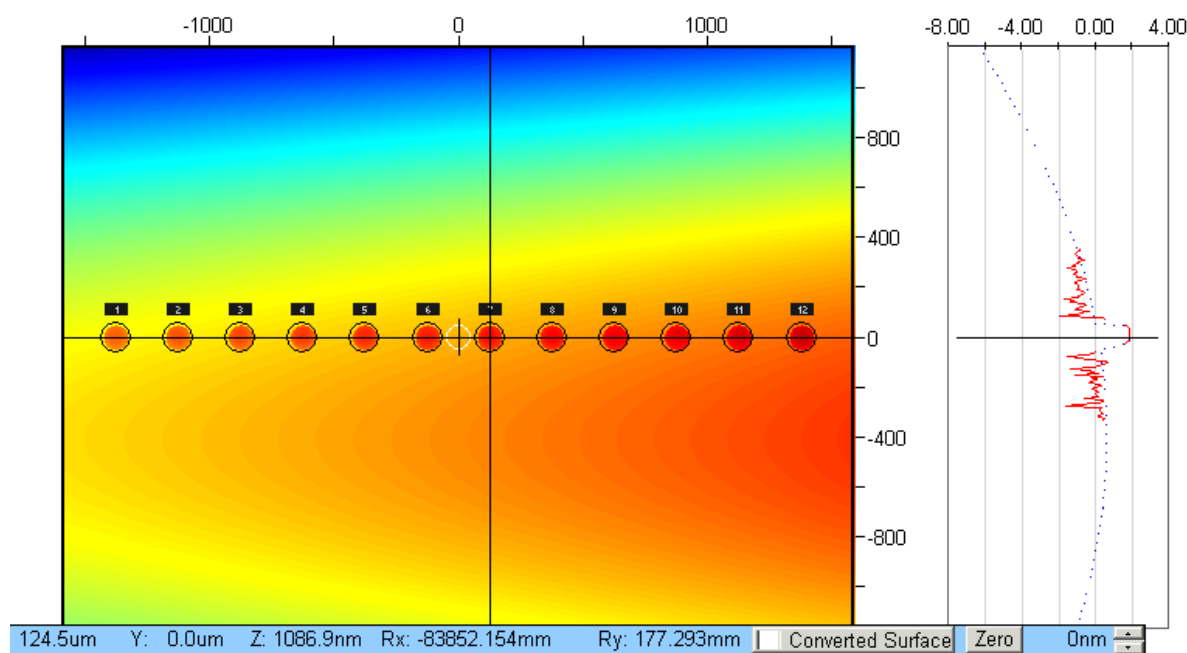
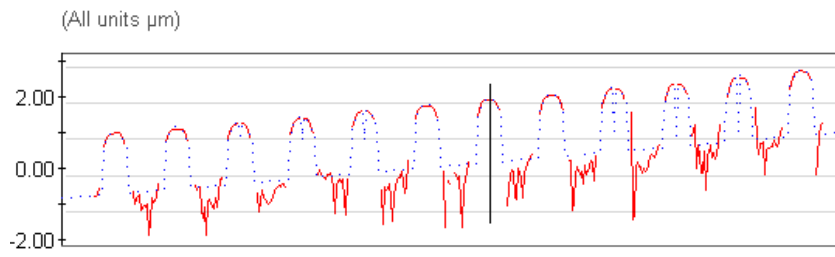
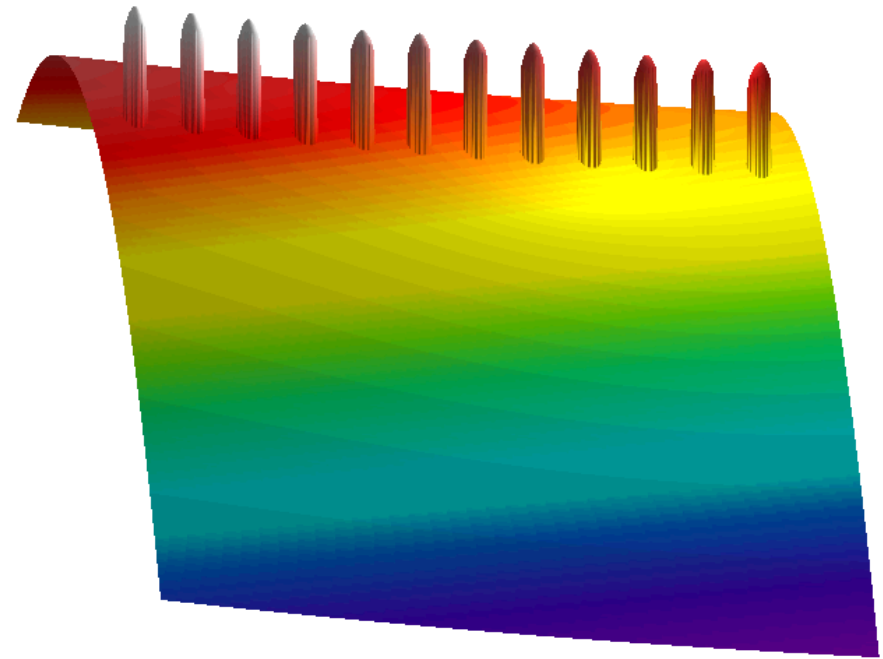


Figure 3 – Alignment pin geometry



FOUR FIBERS SHOWN FOR SIMPLICITY

Endface shape



Images
courtesy of
DORC



End Face Shape

PMS 11.01.316(48) -- SN:2367344 -- Untitled -- (HF: C:\Dorc\Results\Zx1_090611_1319.csv)

File Measurement Mode Type View Tools Help Dorc

MT Results: -- 3M AMT -- (Default [ALL])

GL 258.5

Fibers

Max-Min	805
Differential	-527
Coplanarity	Total
Minus	-283
536	

Fiber Line Y-Angle

X-Angle	0.089	N/A	
Min	Max	Aver.	
Height	179	984	705

Adjacent Differential

-269	161	130
------	-----	-----

Core Dip

41	193	72
----	-----	----

Roughness (Ra)

7	17	13
---	----	----

Roughness (Rq)

9	26	18
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Tilt X

-0.070	0.203	0.046
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Tilt Y

-0.289	-0.153	-0.245
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Ferrule

Curvature

Long (X)	4788
Short (Y)	63

Tilt

Long (X)	0.098
Short (Y)	7.966

Roughness

Rq (nm)	111
Ra (nm)	94

Dome Height (nm)

890

DataFill (%)

28

Show Guide Pin(s) Info

Fiber	Height	Adj Diff	Core Dip	Rq	Ra	Tilt X	Tilt Y
1	823	N/A	54	25	17	-0.027	-0.266
2	984	161	22	26	15	-0.070	-0.198
3	749	-234	49	26	17	0.045	-0.203
4	717	-33	58	17	11	-0.005	-0.275
5	676	64	19	13	10	0.030	-0.276
6	795	117	45	19	13	0.048	-0.226
7	311	116	45	23	13	0.076	-0.272
8	692	-45	41	23	16	0.107	-0.249
9	760	-132	37	14	10	-0.031	-0.258
10	622	-136	36	20	15	0.058	-0.289
11	353	-269	55	20	15	0.203	-0.153
12	179	130	72	13	11	0.112	-0.269

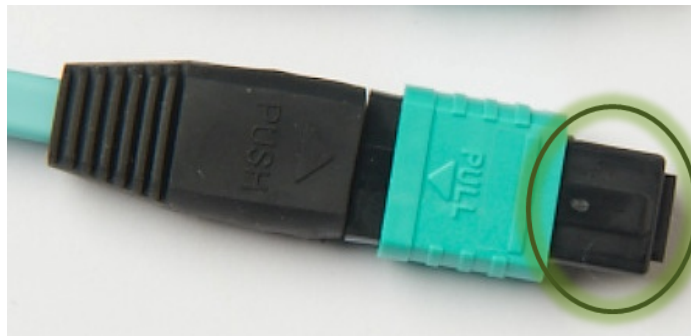
Angled MT | ini:38, ids:23 | 12:1-ALL:D | High Res. | HF: 1 | 25.0* | TD

MEASURE VIDEO INSPECT MOVIE 2D MESH HI-RES HISTORY QC SAVE *.JPG SAVE *.MTA Zx-1 CONTROL SETUP DELETE FROM HISTORY SCREEN RESULTS



Polarisation

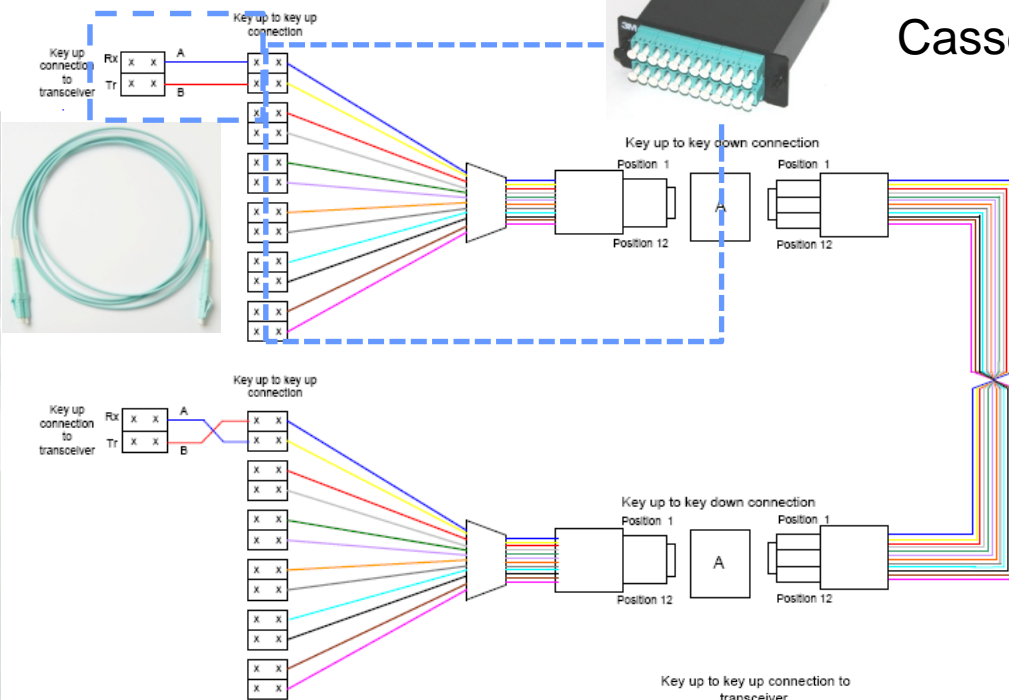
- Multifibre connectors must be arranged so that the transmitter is connected to the receiver for each fibre.
- Standardised in TIA 568 C series using three methods (A, B, C)
- Standardised in ISO/IEC 14763-2 using 1 method (nominally A)
- Position of key on MPO is critical



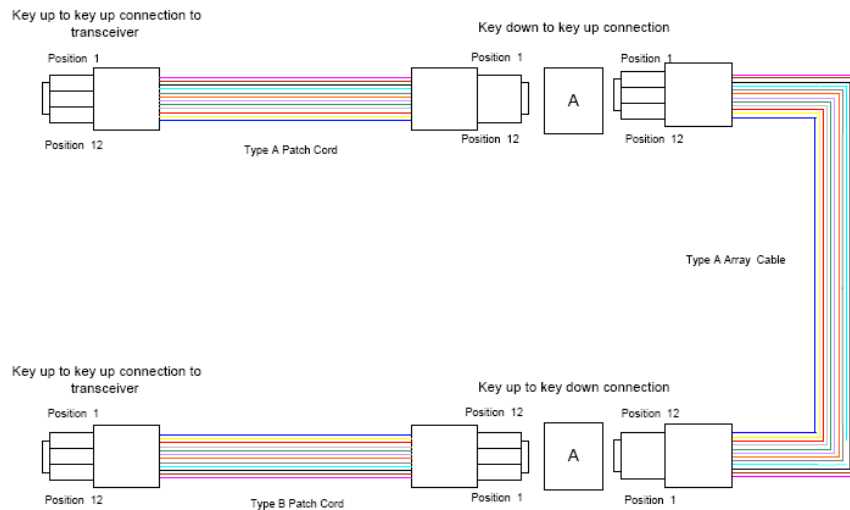
Polarity - Type A



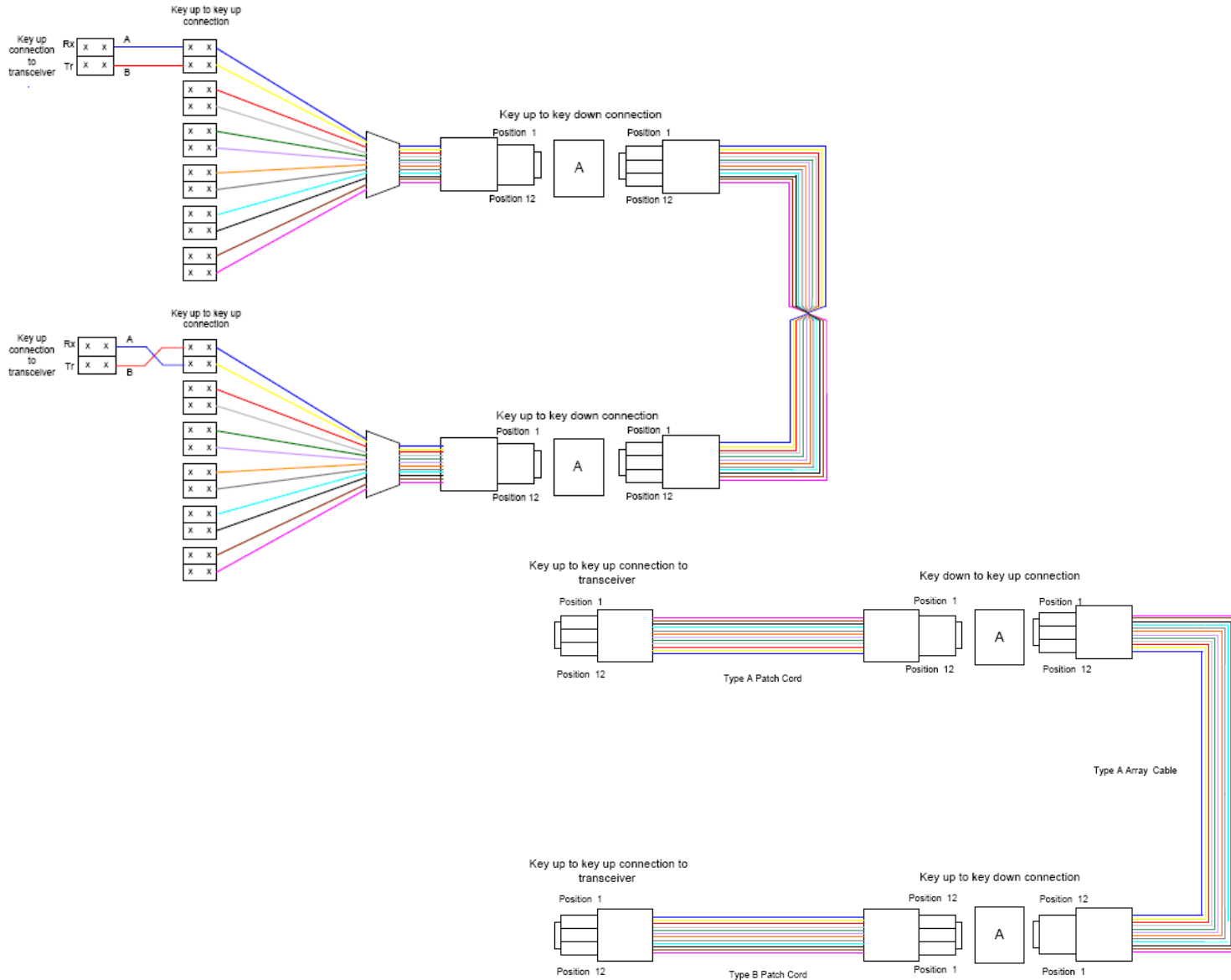
Cassette



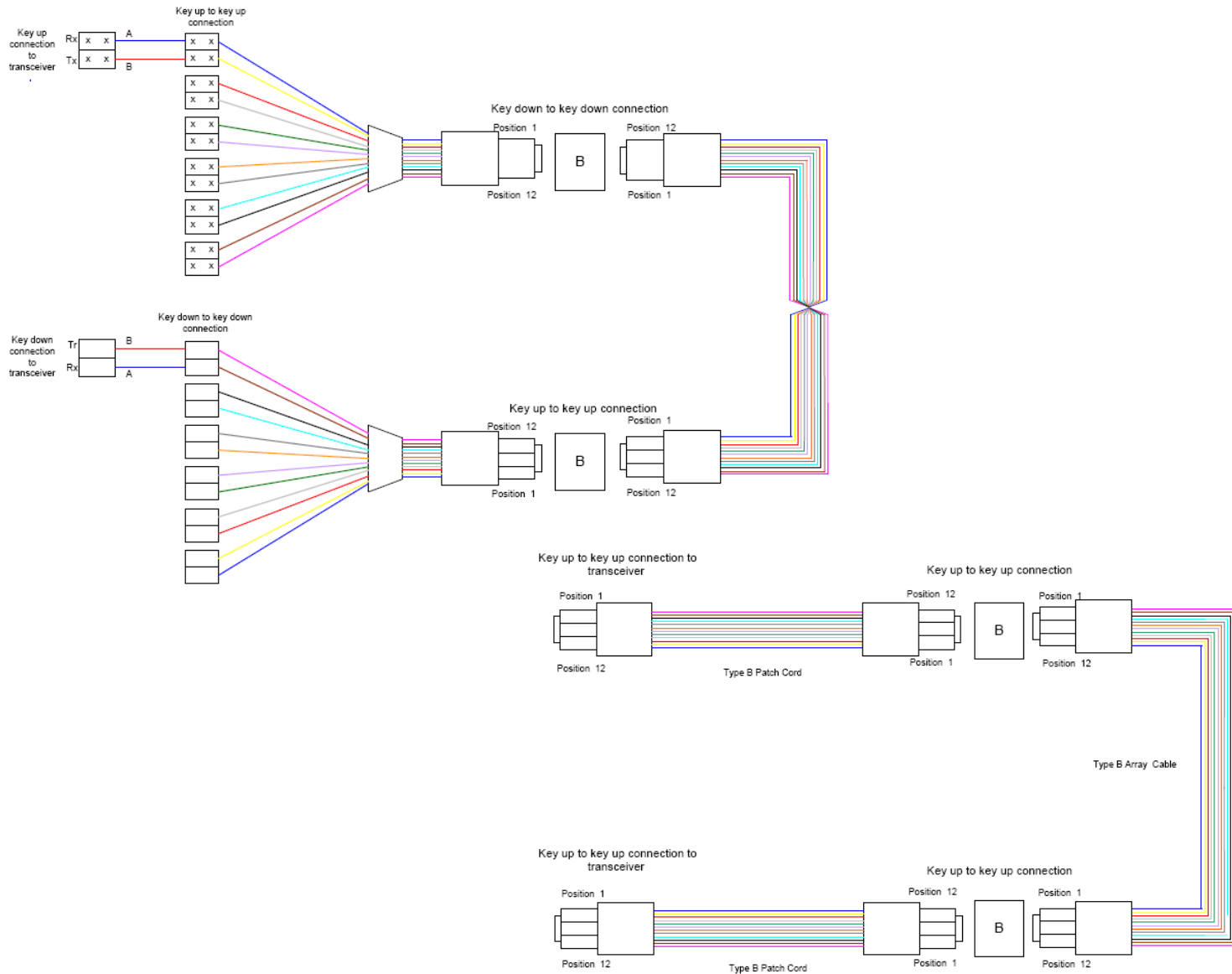
← Backplane /trunk cable



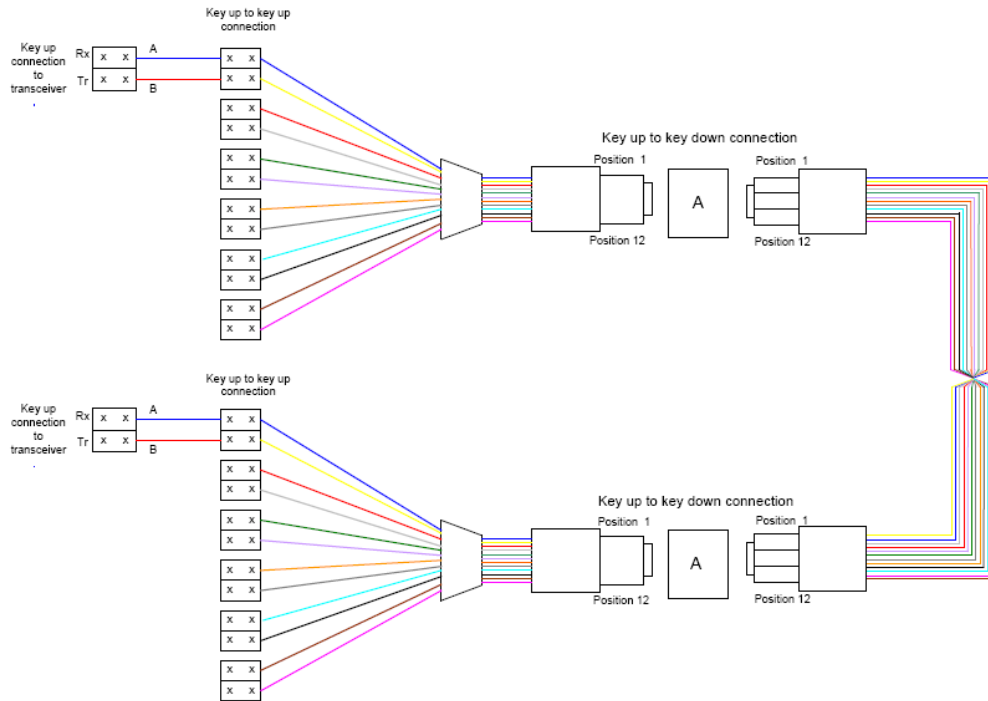
Polarity - Type A



Polarity - Type B



Polarity - Type C



Installing and Testing the System

- Standard installation rules apply with regard to
 - *Pulling tension*
 - *Minimum bend radius*
 - *Bundling and securing*
 - *Pathways*
- Pay attention to polarity
- All end faces (including the MPO) should be inspected and, if necessary, cleaned before assembling into a link
- Links should be 100% tested (all fibres, all links)

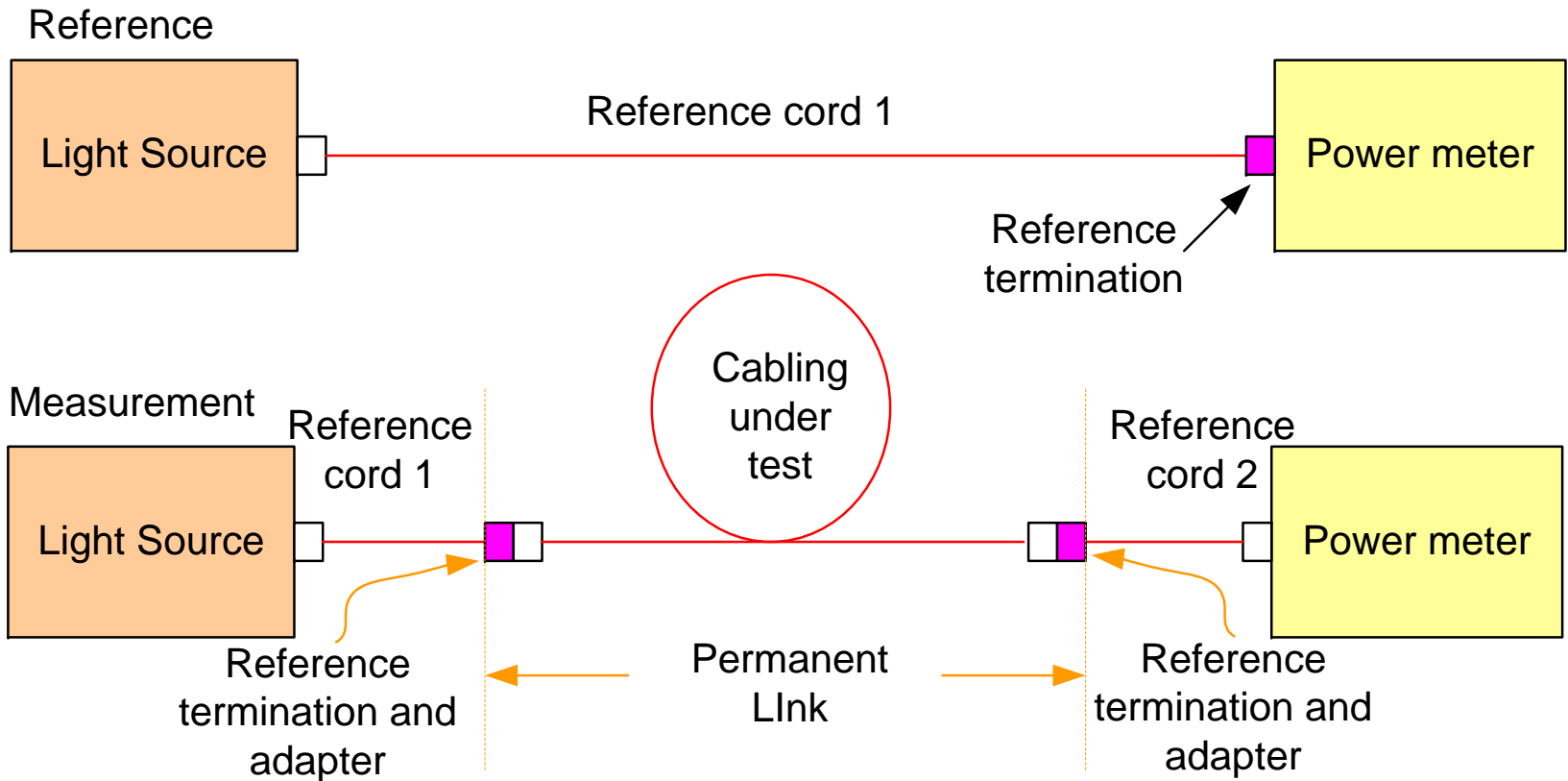




Testing

- Quality of the test reference lead is of prime importance
 - *Standards not yet clear on one definition of reference test lead*
 - *Definition from IEC 61280-4-1(multimode): "connector/plug with tightened tolerances terminated onto an optical fibre with tightened tolerances such that the expected loss of a connection formed by mating two such assemblies is less than or equal to 0,1 dB"*
- For multimode, it seems possible to use singlemode plugs on a multimode cable and use singlemode adapters.
 - *No reference plugs for MPO*
- Each installation should have defined acceptance criteria
 - *Permanent link or channel?*

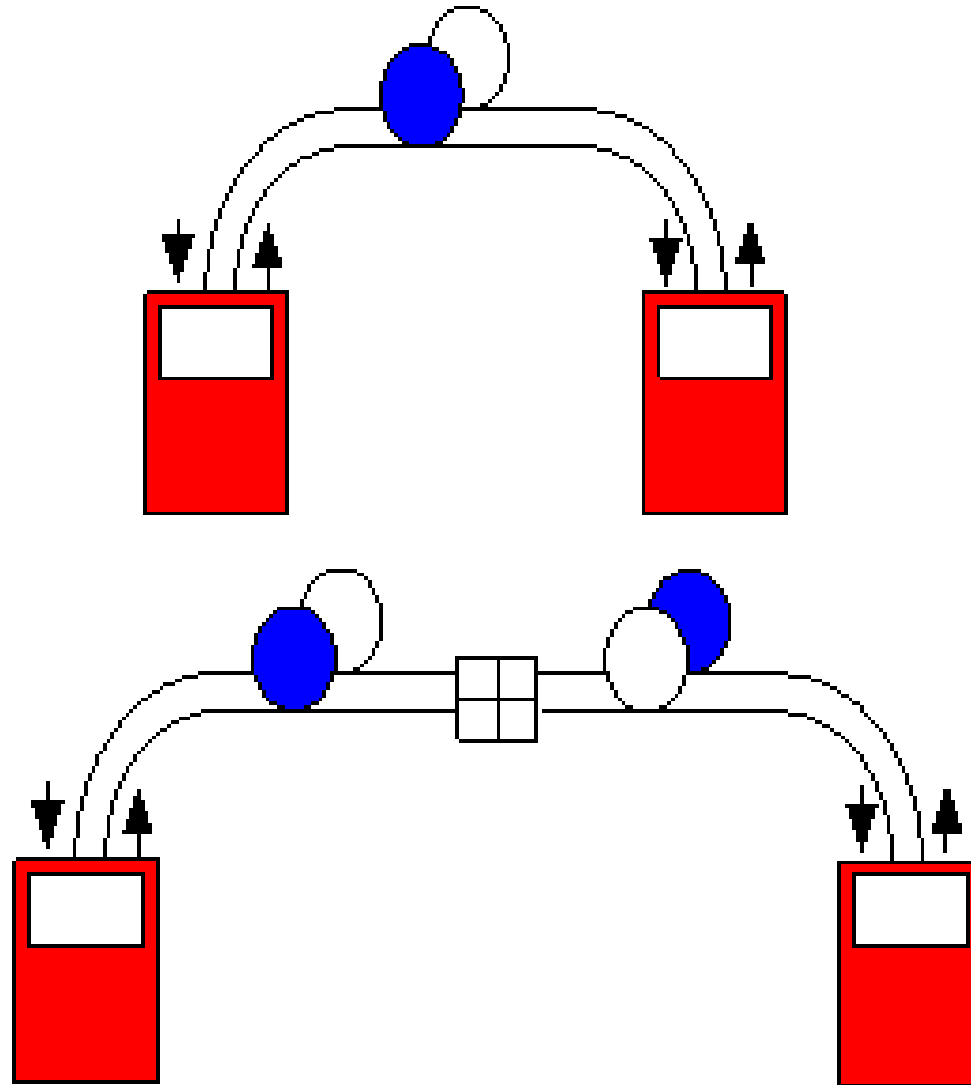
One Cord Method



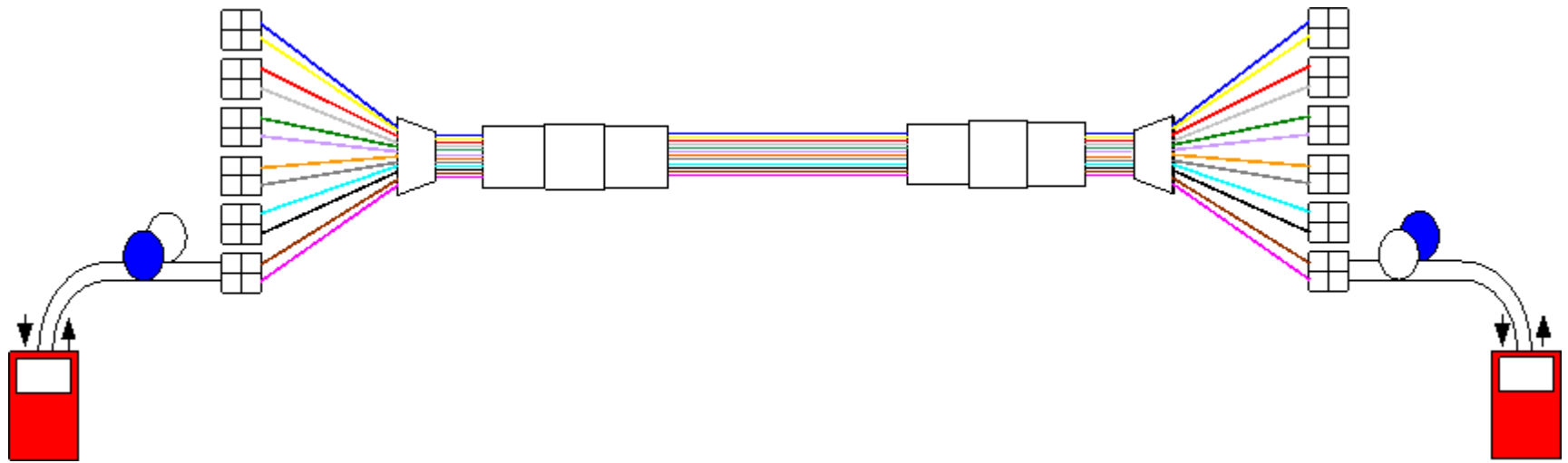
Standard method where there is the same three part connector at each end of the link and on the LSPM

Testing – Taking a Reference and Test Set Up

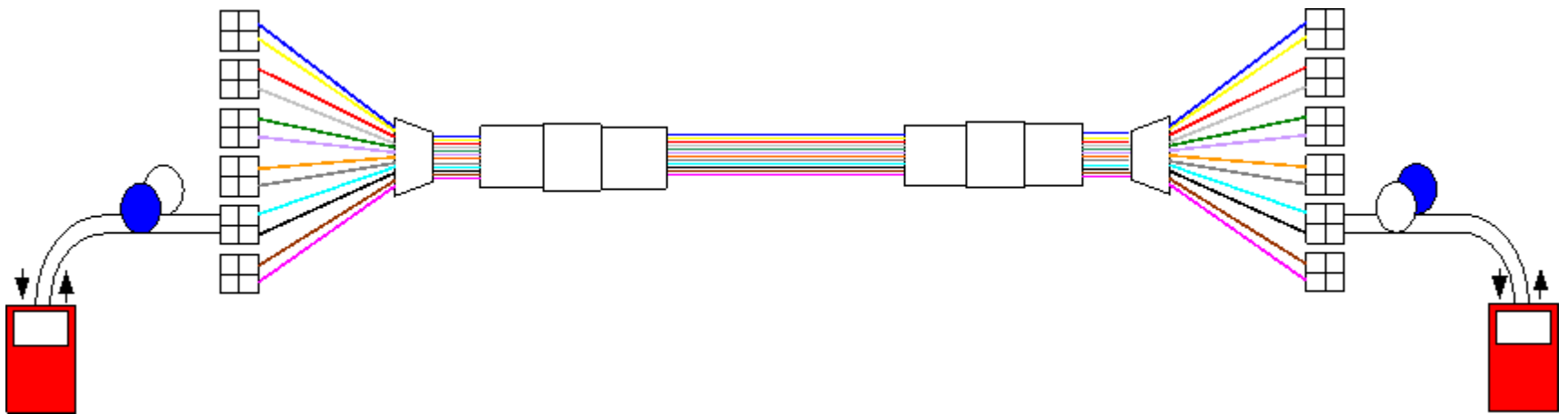
- Launch conditioner
- Fibre loop



Test –First Pair



Test - Second Pair (etc.)

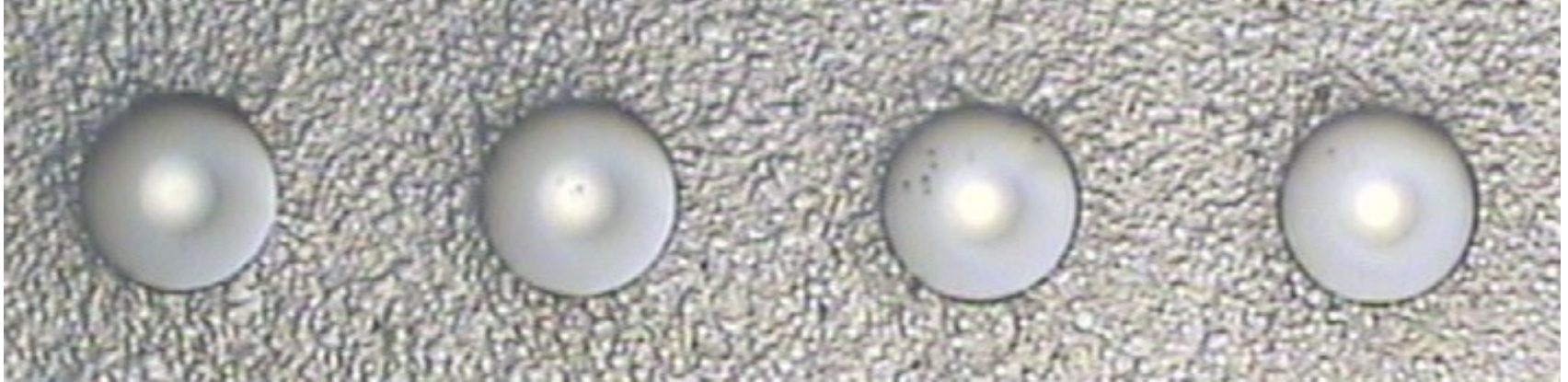


Inspection and Cleaning

- Never assemble a connector without inspection and if necessary cleaning the endface.

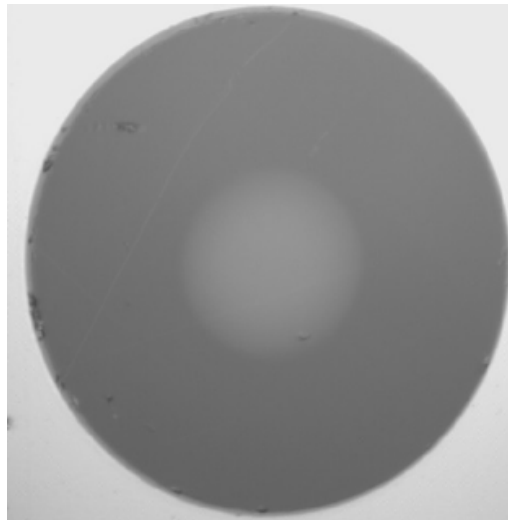


Inspection and Cleaning (2)



Inspection and Cleaning

	Multimode	
Location	Core	Cladding
Number of scratches (width)	No Limit $\leq 3 \mu\text{m}$ 0 $> 3 \mu\text{m}$	No Limit $\leq 5 \mu\text{m}$ 0 $> 5 \mu\text{m}$
Number of pits/chips/defects (diameter)	4 $\leq 5 \mu\text{m}$ 0 $> 5 \mu\text{m}$	No limit $< 2 \mu\text{m}$ 5 from 2 to $5 \mu\text{m}$ None $> 5 \mu\text{m}$



Summary



- Specification of parallel optics systems should be standards based
- Interoperability between different systems is not guaranteed, depending on polarity choices.
- Care should be taken in specification and test over insertion loss requirements.
- All systems should be 100% tested
- Inspection equipment is available to kept connections clean and undamaged