

Module 11 - Fibre Testing

- ≡ Fibre Attenuation Standards
- ≡ Preparation
- ≡ Stages of Testing
- ≡ Tier 1: Optical Loss Test Set (OLTS)
- ≡ Loss Reading Setup
- ≡ Fibre Loss Measurement
- ≡ Encircled Flux (Part 1)
- ≡ Uncertainty
- ≡ Encircled Flux (Part 2)
- ≡ Tier 2 Testing with OTDR
- ≡ SmartLoop Testing

Excel Warranty Testing Requirements

Fibre Attenuation Standards

- Fibre cable, connectors and splices are all subject to maximum loss
- Fibre cable is based on a loss per km (therefore a calculation will be required), whilst connector losses are always quoted as a mated pair
- Whilst you can set the loss budget within the tester manually, most testers have an automated process
- Do not use Typical Values when testing.

Wavelength	Singlemode	Multimode
850nm	N/A	3.5dB/Km
1300nm	N/A	1.0dB/Km
1310nm	0.35dB/Km	N/A
1550nm	0.2dB/Km	N/A
1625nm	0.15dB/Km	N/A

Wavelength	Singlemode	Multimode
Splices	Mechanical or Fusion Splice Losses 0.1dB Max. Video 0.3dB Max. Voice/Data	
Connectors	0.75dB Max OM4 0.5dB Max	

 One useful tool is a free download from the Fibre Optic Association, called FOA-Losscalc, which will calculate the loss budget for you. Download from [iTunes](#).

Preparation

Following these small steps could save a great deal of wasted time:

- 1 Ensure you inspect and clean all test reference cords you intend to use
- 2 Charge the batteries of test equipment before going to site, as there may not be any power available
- 3 Collect all documentation required
- 4 Ensure you have a cleaning kit suitable for the connectors and adapters
Are you testing 1.25mm ferrules or 2.5mm?

Stages of Testing

- Continuity testing using a White Light Source tests for broken fibre within the link
 - White Light (Torch) travels hundreds of metres in multimode fibre and tens of metres in singlemode fibre
 - Continuity tests using an LED red light source at 620-670 nm can transmit over several kilometres
- Visible Laser light source at 620–670 nm can find breaks, cracks and over bends/kinks
- Check for continuity before doing measurement tests
- Visible light does not guarantee quality of the joints or connectors



The Fluke Versiv with fibre heads has this white light source built in. Ensure whatever leads you use are clean.

Tier 1: Optical Loss Test Set (OLTS)

Sometimes known as Power Source and Light Meter

Testing Specifications

Testing the installed cable plant for link loss and verifying the cabling length and polarity

- Polarity for some backbone simplex applications may not need to be verified
- Must be capable of recording/storing results for warranty purposes
- Light source should be LED for multimode fibre or LASER for singlemode
- Power meter to measure actual link loss in dB or actual received power level in dBm
- Multimode tested at both 850 and 1300nm
- Singlemode tested at 1310 and 1550nm (1625nm is typically used in the Telecoms space and not common in the Enterprise space)
- Test both directions
 - *Bi-Directional testing is critical as reflections can occur in both directions. The Fluke Versiv will guide you through the process for this*
- Light source simulates transmitter

Loss Reading Setup

- 1 Ensure that all test leads are serviceable
- 2 Connectors and fibre match system on test
- 3 Test set is within calibration date
- 4 Test set covers fibre spec Singlemode / Multimode and Wavelengths
- 5 Reference zeroed at test wavelength

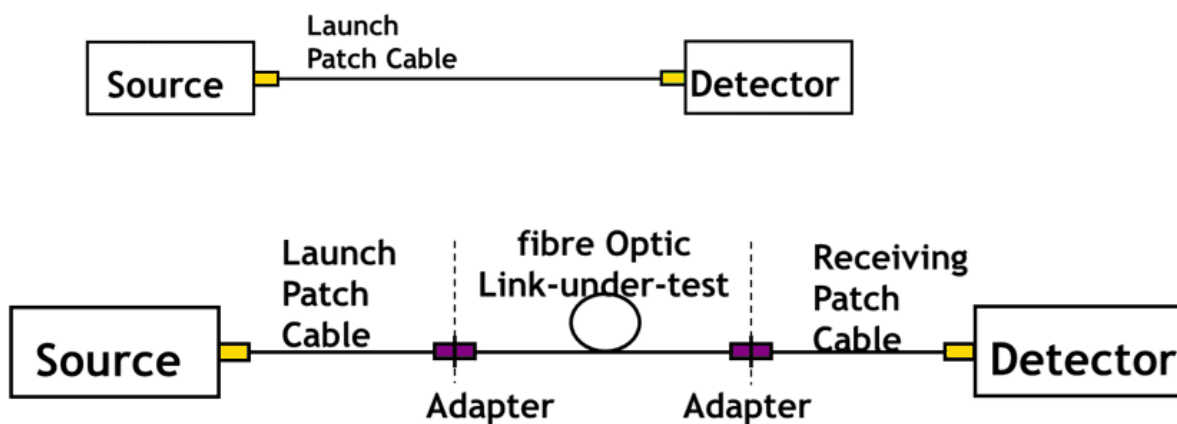
 No apologies will be made about repeated references to cleanliness, it is the biggest fault found. There have been numerous occasions when Excel Support Engineers have been called to site regarding 'failing' fibre links only to find the problem was end face contamination.

Fibre Loss Measurement

Test Method “2”

“Original specification for premises cabling
but only when cabling connectors match
test instrument connectors!”

Set the reference level:



Measurement loss - Link plus two connections

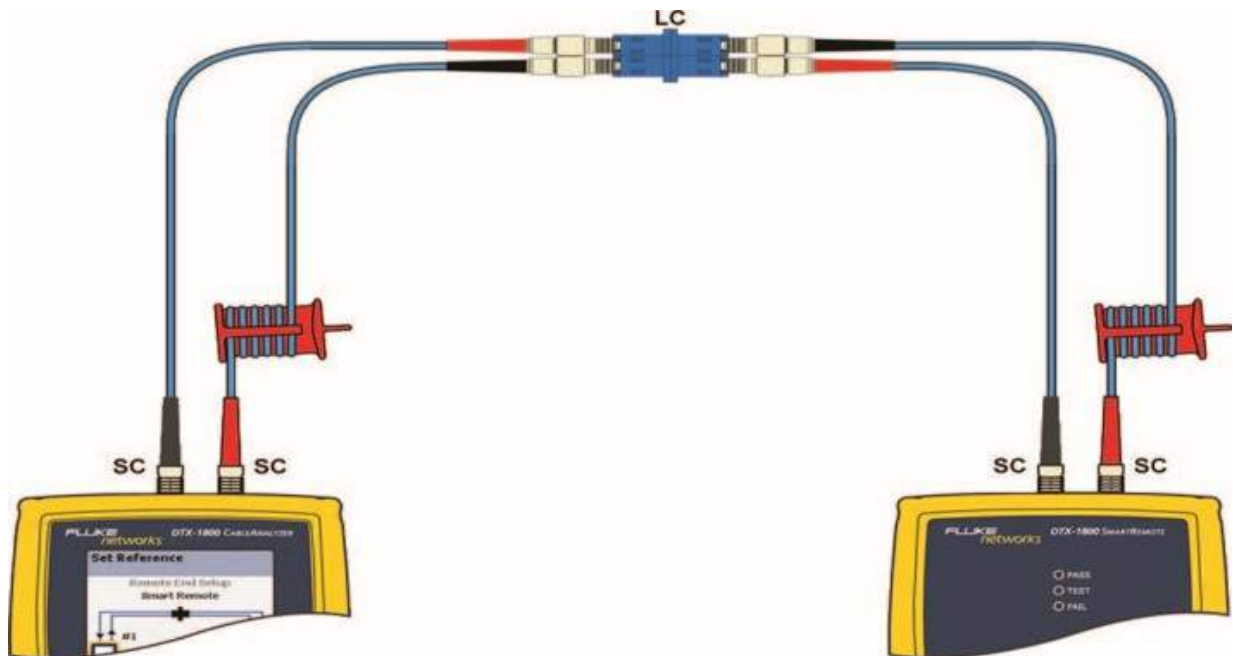
 Test Method 2 is also known as the 'One Jumper Reference Method'

Advantages

Disadvantages

Advantages	Disadvantages
Correctly measures link loss (fibre + 2 adapters)	Doesn't work with connectors other than the type on the tester
Recommended by ISO/IEC 14763-3	Requires frequent disconnecting of the patch cord at the detector (invites trouble from dirt or damage to the detector)
	For dual-fibre measurements, it's very likely that users will disconnect the patch cord at the source

Do not use Modified Method 2

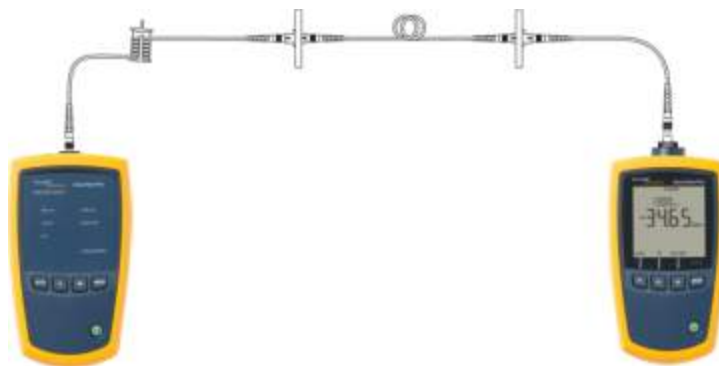


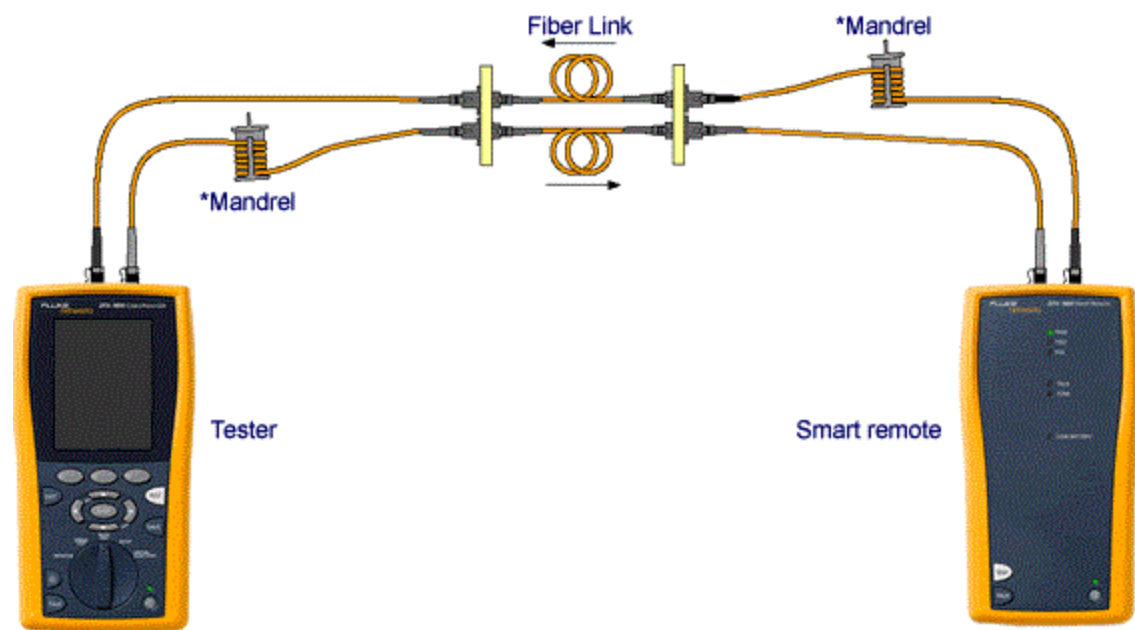
- When setting a reference using a bulkhead adapter as shown, measurement uncertainty starts with whatever the loss is in that bulkhead adapter
- There is no way to know that loss
- Measurement uncertainty could be as high as 1.5 dB
- ISO/IEC TR 14763-3 specifies “Method 2 – one jumper reference” for testing the fibre link
- A mismatch of the connector type between the OLTS and the link used to require a modified method, however this has been overcome with specific Test Reference Cords
- Using the wrong method can result in a significant measurement error

Encircled Flux (Part 1)

- Any measurement has a level of uncertainty
 - a. Method
 - b. Number of connectors
 - c. Light source

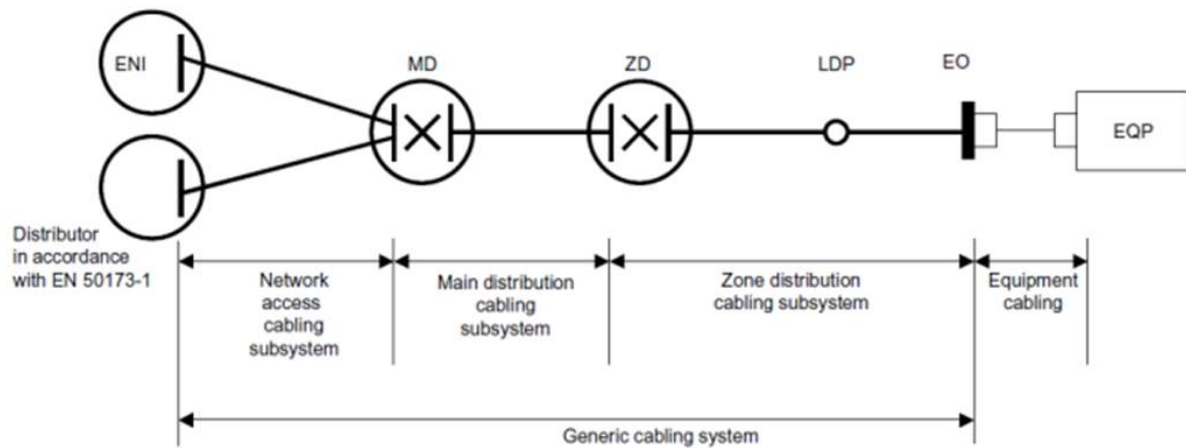
Power Source and Light Meter





Optical Loss Test Set

Uncertainty



- The uncertainty is increased by more connectors in the link
- Zoned Data Centres are an example

Mandrels

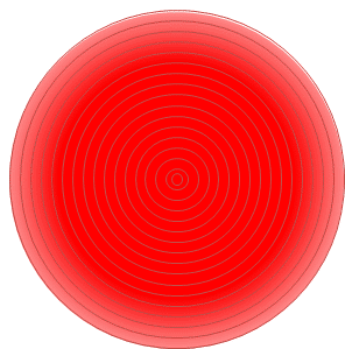
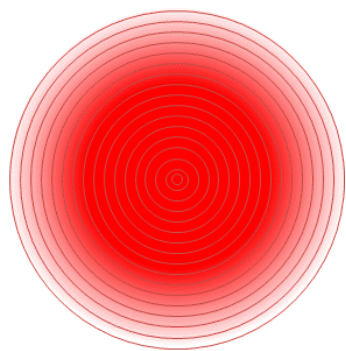
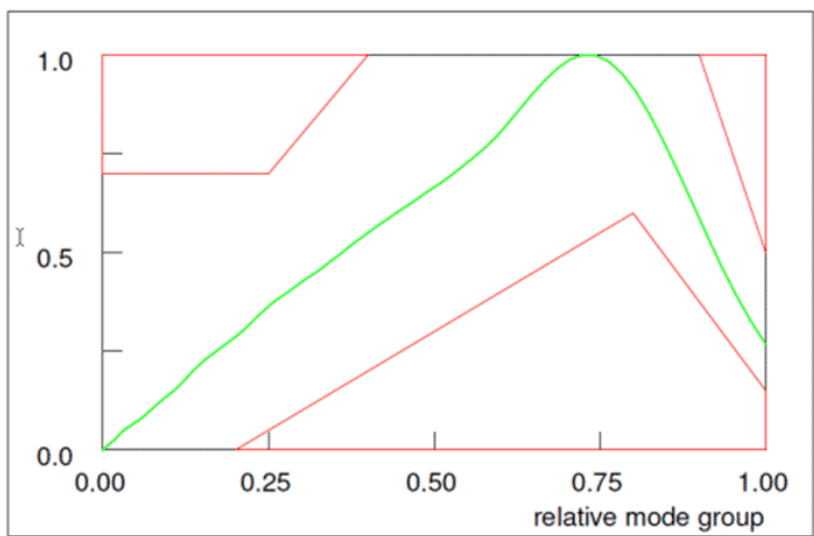


- When measuring multimode we used to use Fibre Mandrels
- Fibre mandrels improve measurement consistency and loss measurement repeatability; yielding fewer false failures
- The mandrels act as mode filters
- They remove high-order modes from the optical signal to achieve Equilibrium Modal Distribution (EMD) when testing with LED sources that overfill the fibre
- Mandrels have been used to meet the launch conditions specified in EN 50173 & IEC 14763-3

 Even the use of mandrels left a level of uncertainty

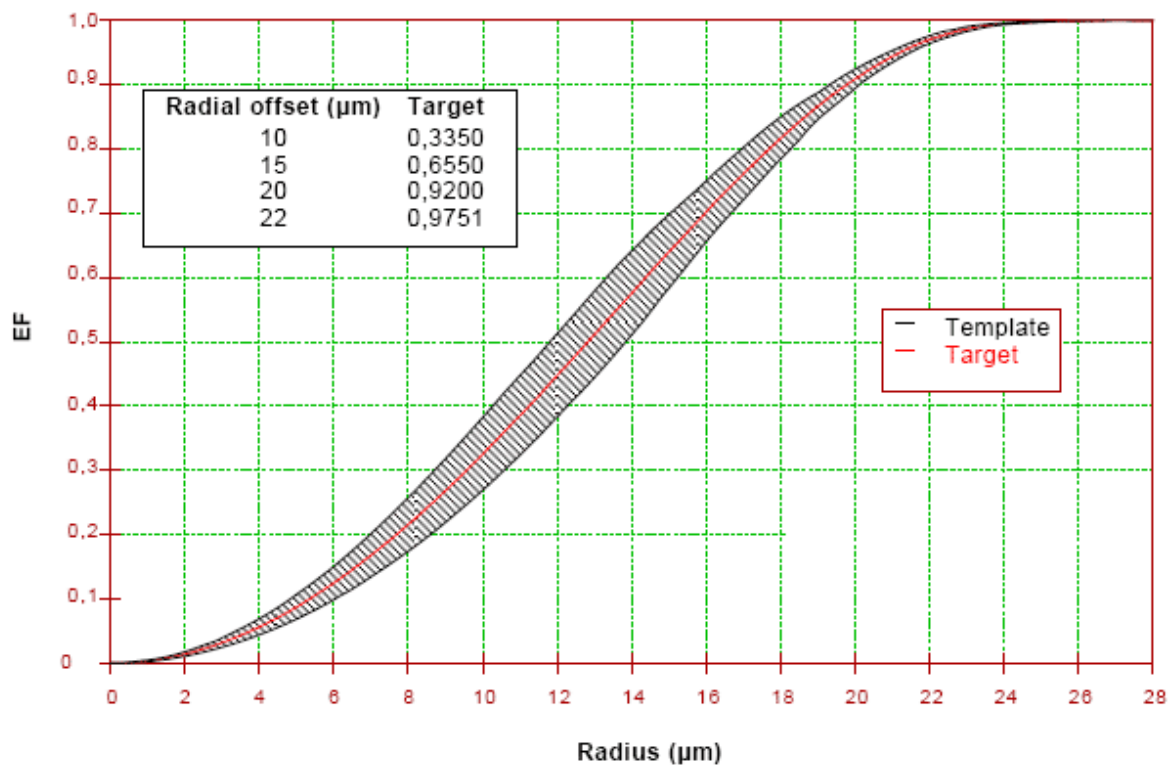
Light Source

- Traditional source gave erratic mode fill
- Increase in uncertainty



Encircled Flux (Part 2)

- By tightening the tolerances Encircled Flux has led to:
 - More consistency
 - More accuracy
- ISO/IEC 14763-3: Part 3- Testing of Optical Fibre Cabling, recommends Encircled Flux is used for testing multimode
- EN50173 -1 and EN50346 (the standards for testing structured cabling) stipulate that the method used for testing fibre is indicated within ISO/IEC 14763-3



Encircled Flux TRCs (Test Reference Cords)



- The lozenge contains a short link of fibre with a specific kink in it
- On the outside there are two sealed apertures, which contain two screws
- These are used to 'Tune' the TRCs in a laboratory to ensure they meet the tight tolerances required

Tier 2 Testing with OTDR

Testing Specification

- Tier 2: Tier 1 plus an OTDR trace
- Testing for anomalies and assuring uniformity of cable attenuation and connector insertion loss
- The higher level of testing providing quantitative measures of the installed condition and performance of the cabling system and its components
- Evidence that cable is installed without degrading events e.g. bends, bad connections, bad splices
- OTDR provides the optimum information for troubleshooting each event is very accurately recorded giving both location and type of fault that needs to be fixed
- Sometimes a consultant may request an OTDR Trace is carried on a drum of fibre cable before it is installed, to validate its specification and quality.

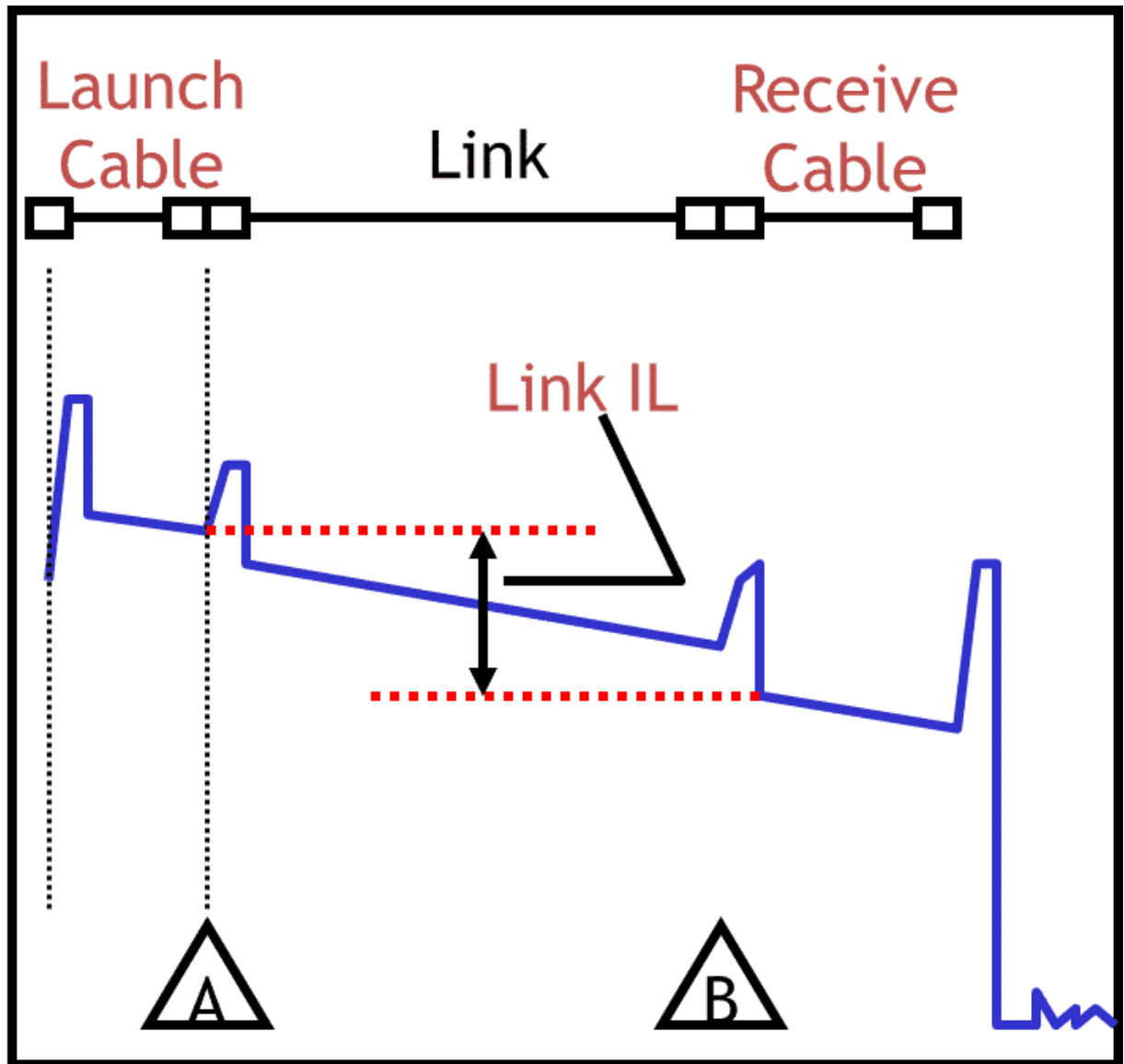
OTDR

Optical Time Domain Reflectometer



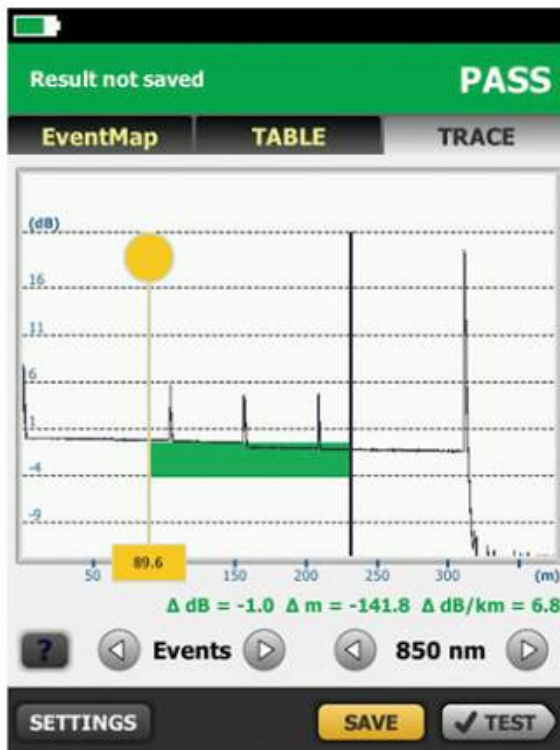
- An Optical Time Domain Reflectometer (OTDR) is used in fibre optics to measure the time and intensity of the light reflected on an optical fibre by measuring Backscatter
- It is used as a troubleshooting device to find faults, splices, and bends in fibre optic cables, with an eye toward identifying light loss
- An OTDR can detect such light loss and pinpoint trouble areas, making repairs easy

Reading a Trace

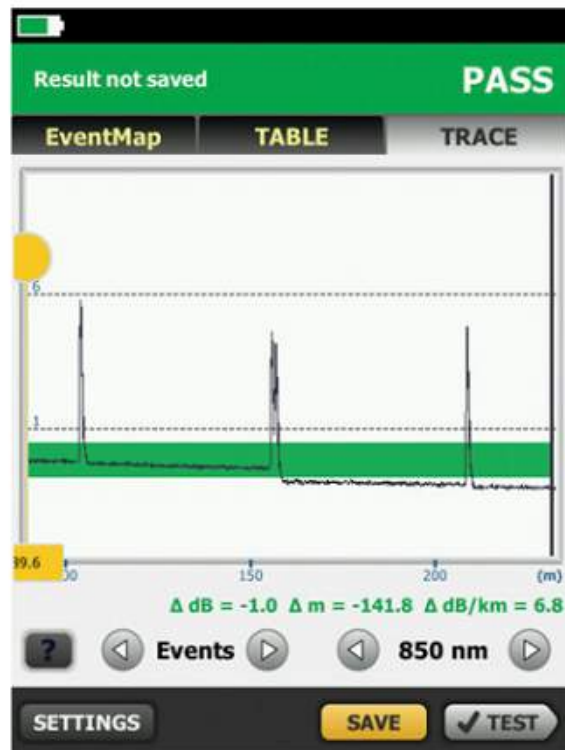


- You must always use both a Launch and a Receive or Tail cables wherever possible
 - It may not be possible to use a receive cable when testing a drum of cable
- Each spike on the graph is an event, this may be:
 - Connection

- Splice
- Kink or bend in fibre
- You will then be able to move the cursor to the event to investigate it further
- With Versiv you can also use the EventMap function to interrogate the results

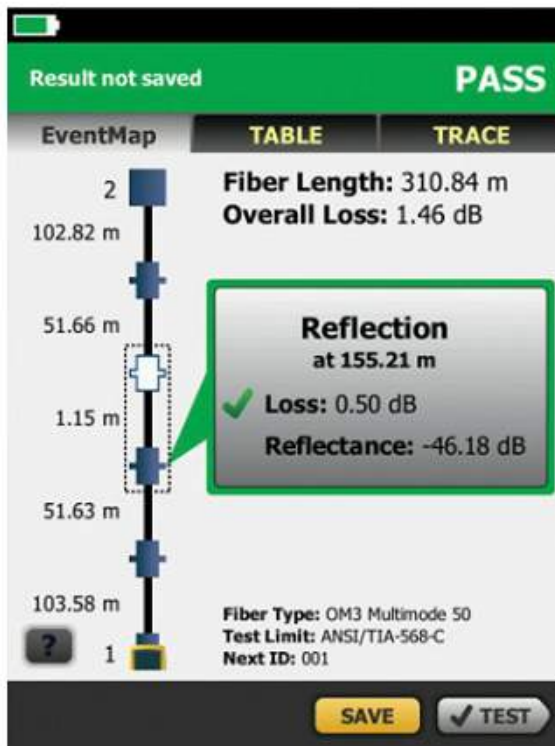


View traces

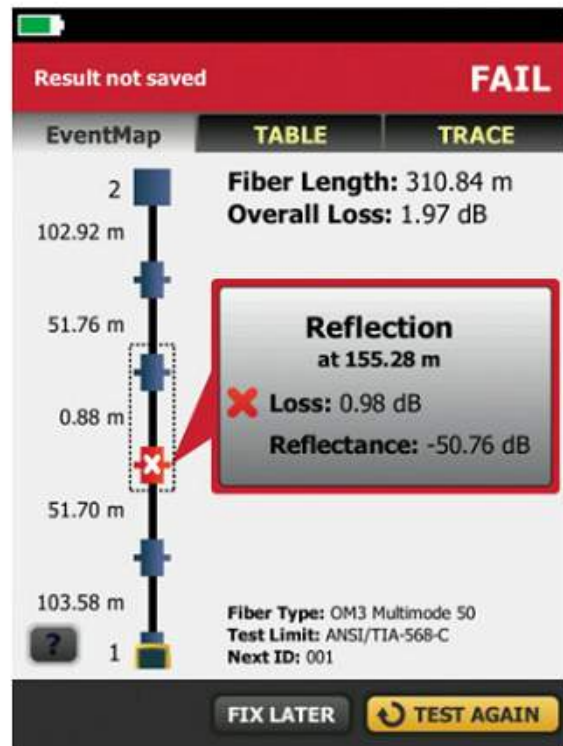


Pinch and zoom in for trace detail

We have used Fluke as the example. Other vendors have similar tools to interrogate the results. When reviewing the information remember to subtract the length of the launch lead from the distance. i.e. in the image above the actual distance from the first connection is 51.70m.



Graphical EventMap view – PASS



Eventmap – FAIL. See Help icon for on screen corrective action.

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Common Problems

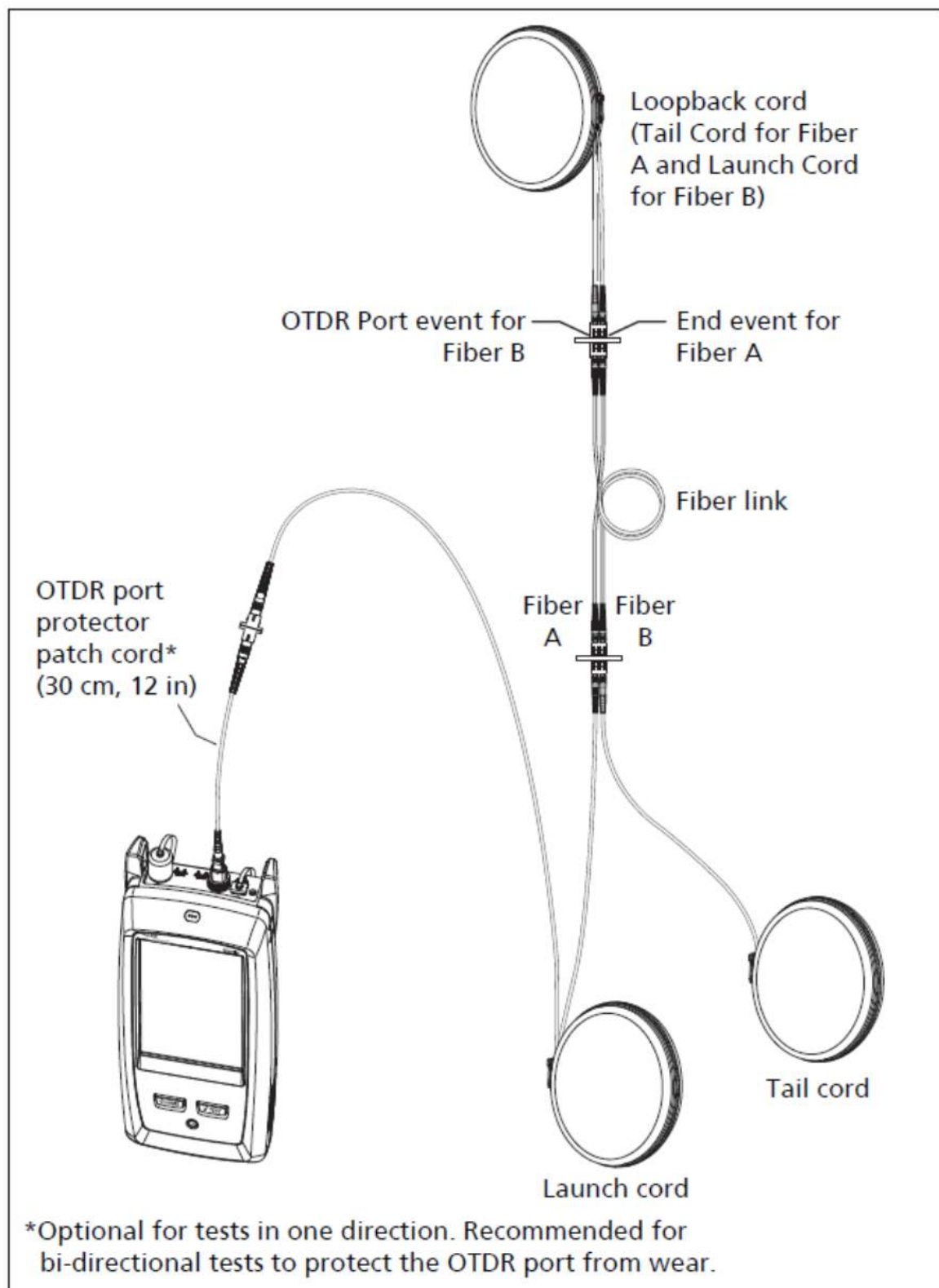
1. Not ideal for measuring short links
2. Bi-Directional Testing is difficult
 - o You have to take the only OTDR itself to the remote end
 - o The launch and tail cords must remain in place, which time consuming and expensive
3. Do not:
 - a. Connect fibre directly to the OTDR

- b. Look into the launch lead – Laser used is Hazardous to eyesight
- c. Use OTDR in hazardous areas
- d. Connect OTDR into a live system – can damage both OTDR and or the system

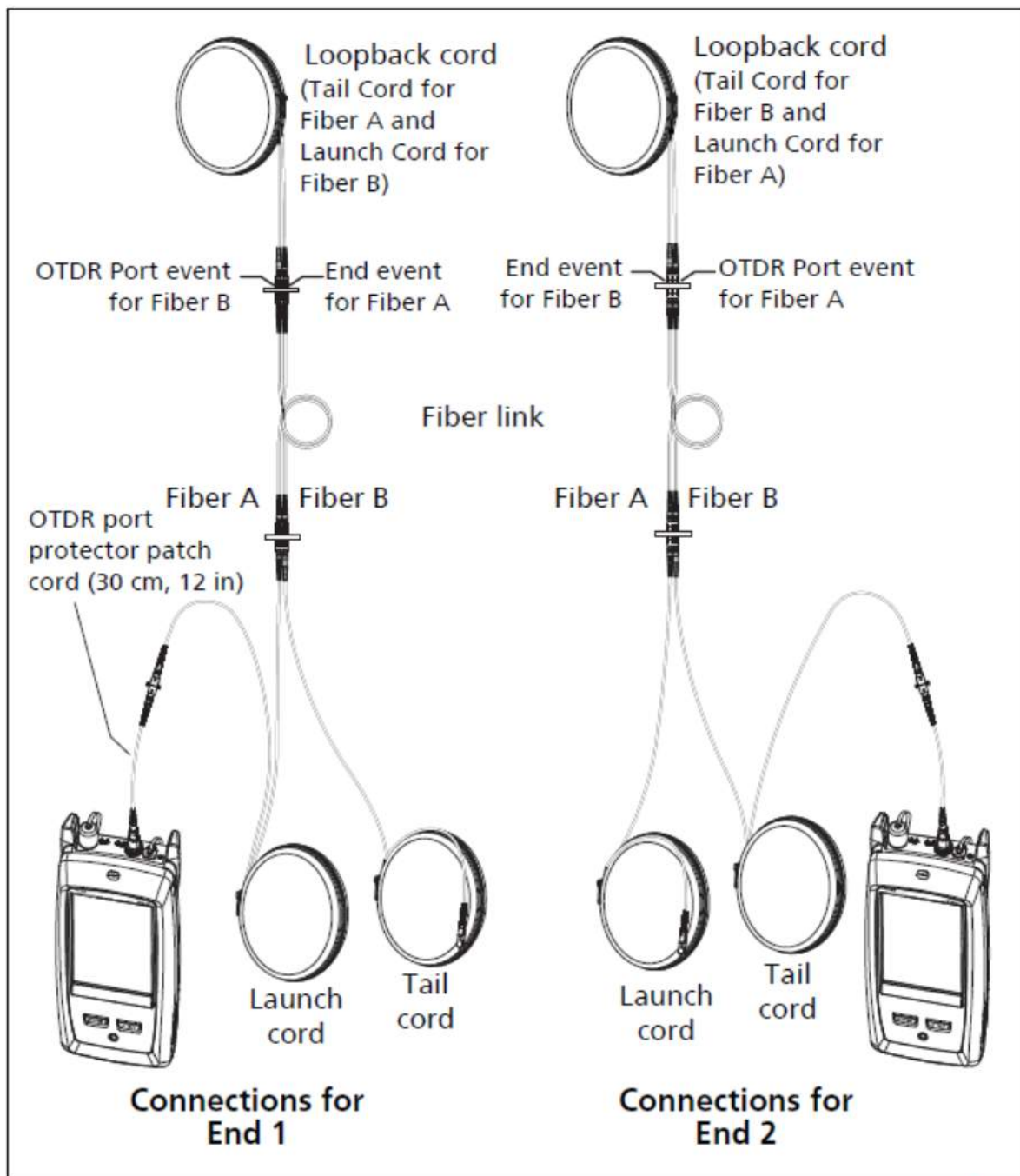
For the reasons mentioned it has not been the ideal way of testing fibre in the Enterprise or Data Centre environments. Instead, it is mainly used for Telecoms and FTTx installations.

SmartLoop Testing

- Until recently Bi-Directional Testing using an OTDR was difficult.
- Fluke have introduced SmartLoop to Overcome this.
- Initially intended to test duplex links in the Data Centre with multiple connections
- The process requires 3 launch leads of the same fibre type as that under test
- The connectors must be the correct type for each connection you will make.
- If necessary, you can connect two launch cords together to make a loopback cord that has the same connectors on both ends.
- As can be seen from the following image, the Loopback cord acts as the Tail Lead for Fibre A and Launch Lead for Fibre B.



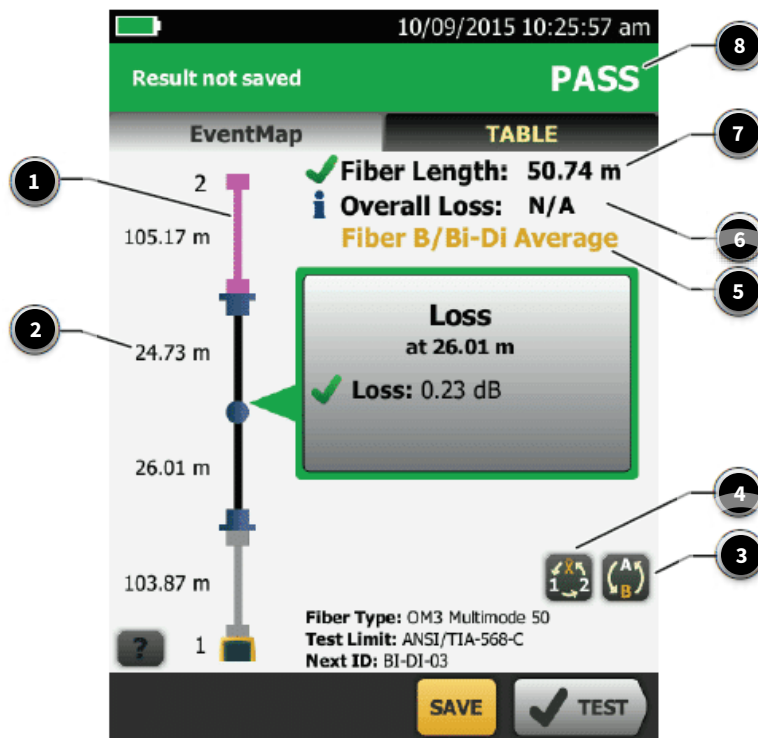
- Halfway through the test, the tester tells you to connect the tail lead to the OTDR port
- Make the connections for End 2 as shown in image below, then tap DONE
- The tester automatically calculates bi-directional averages of loss measurements

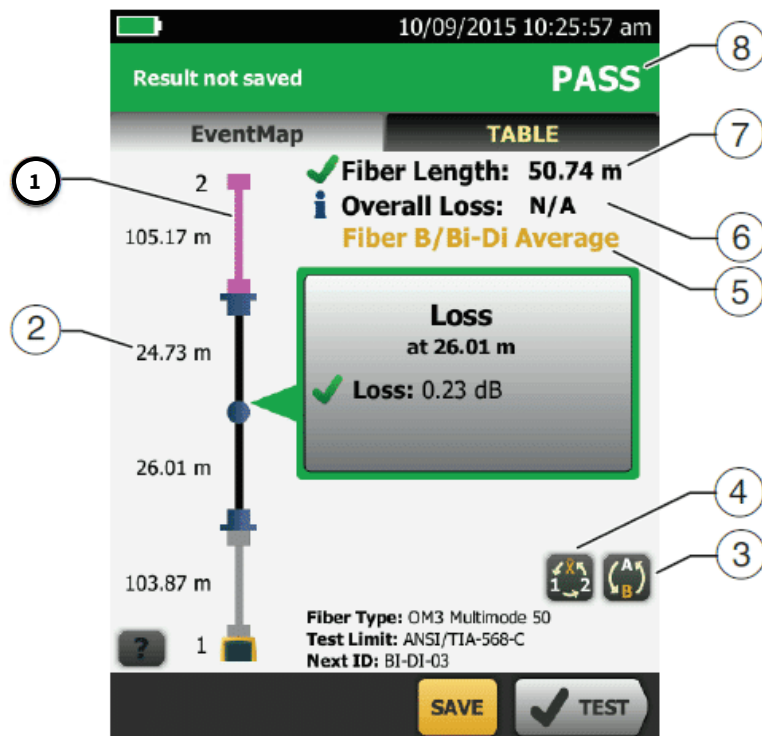


Switch the launch and tail connections at the end of the short patch cord not the patch panel. If you switch the connectors at the patch panel, you will possibly get less accurate results for those connections during the second half of the test.

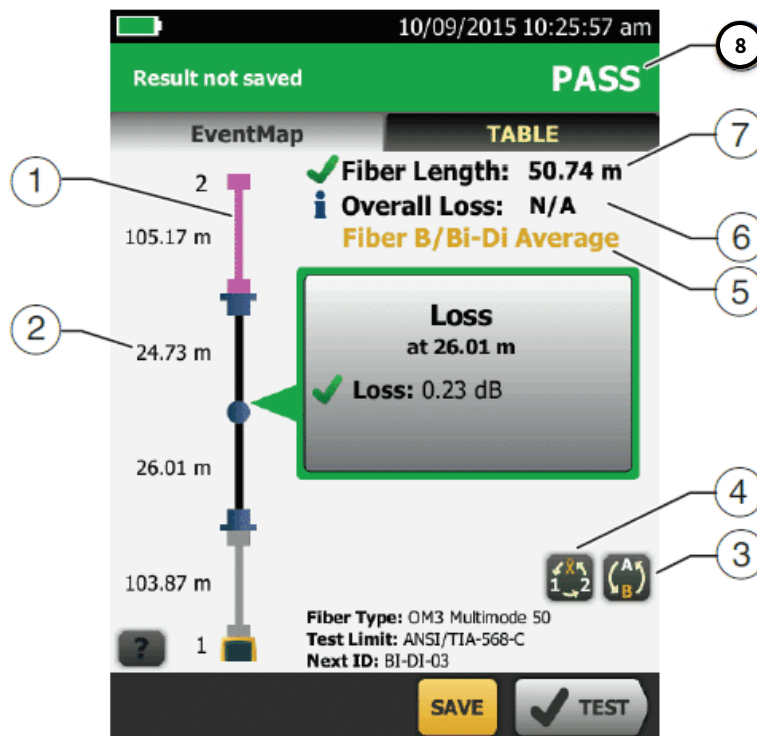
SmartLoop Results

Once you have saved the results you are able to see a summary of the results from ends 1 and 2 on fibres A and B. You will also be able to see the EventMap for a result.



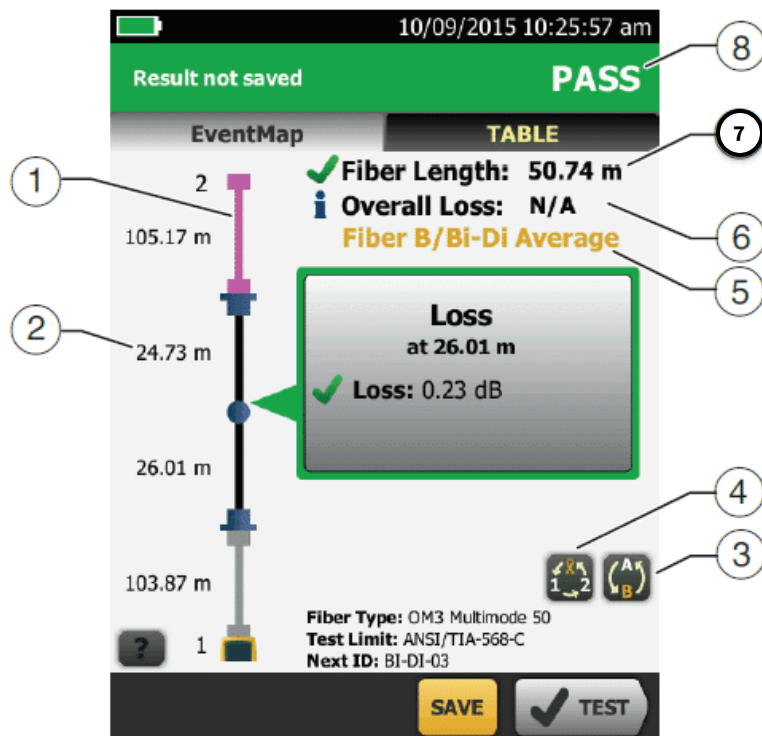


The purple fibre is the loopback cord

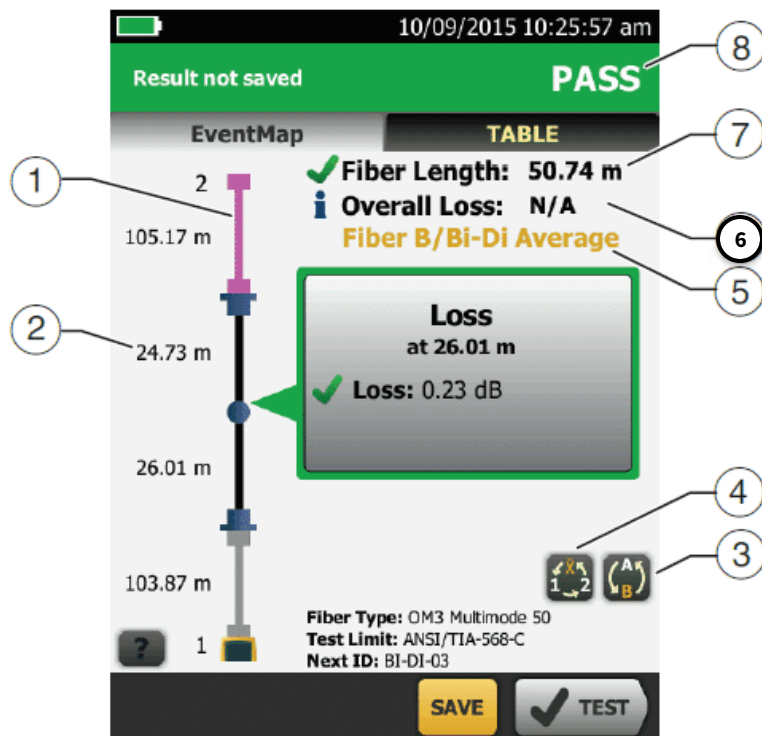


PASS/FAIL: The overall result for the fibres

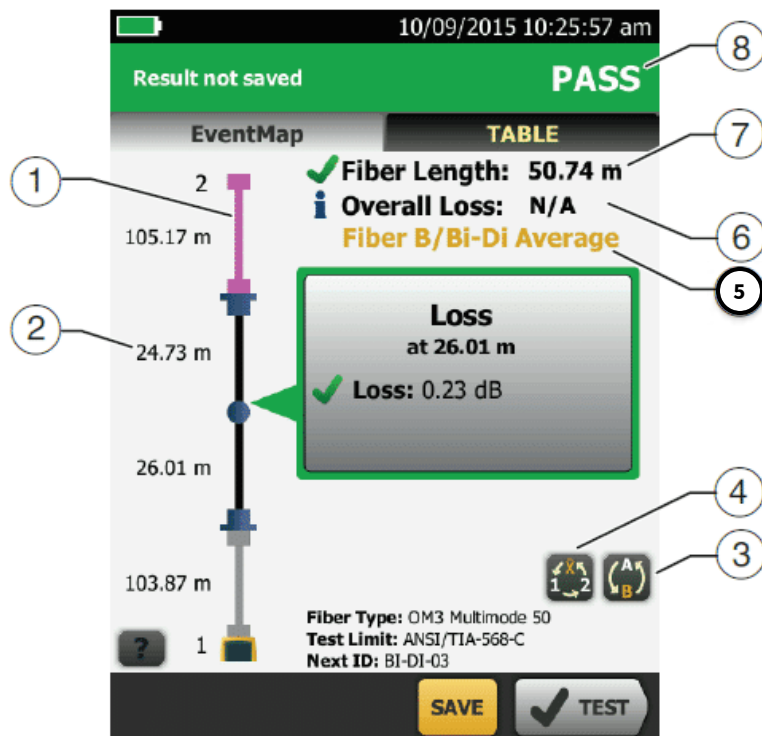
- PASS: The averaged results passed. It is possible for one or both directions to have FAIL results, while the overall result is PASS.
- FAIL: The averaged results failed.



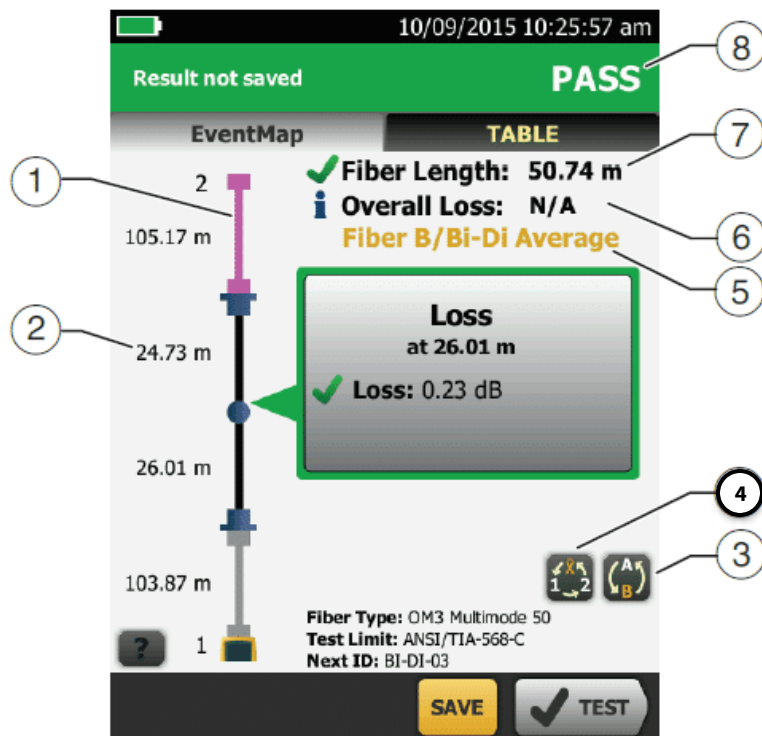
Fibre Length: The longest length of the two directions



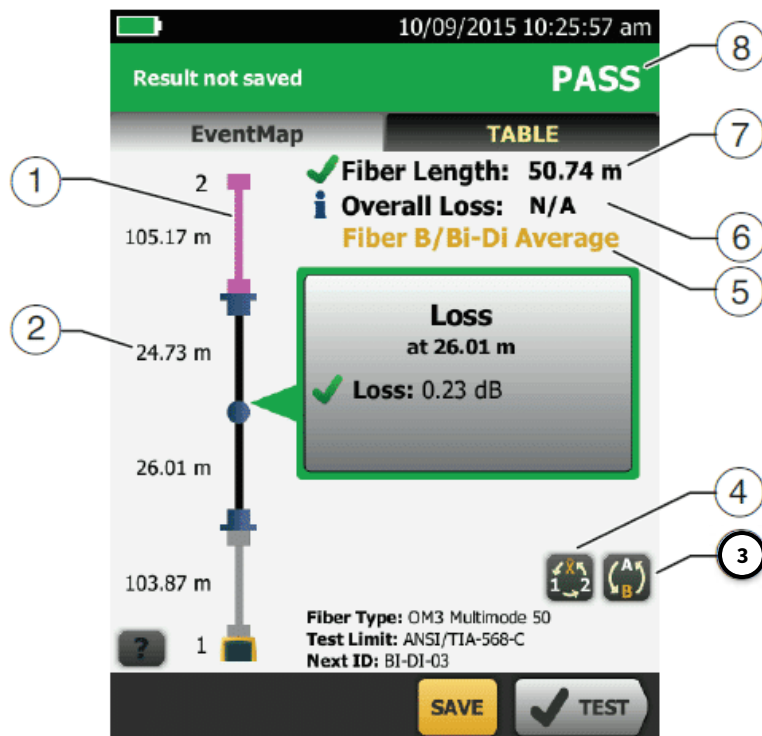
Overall Loss: The average loss of the two directions



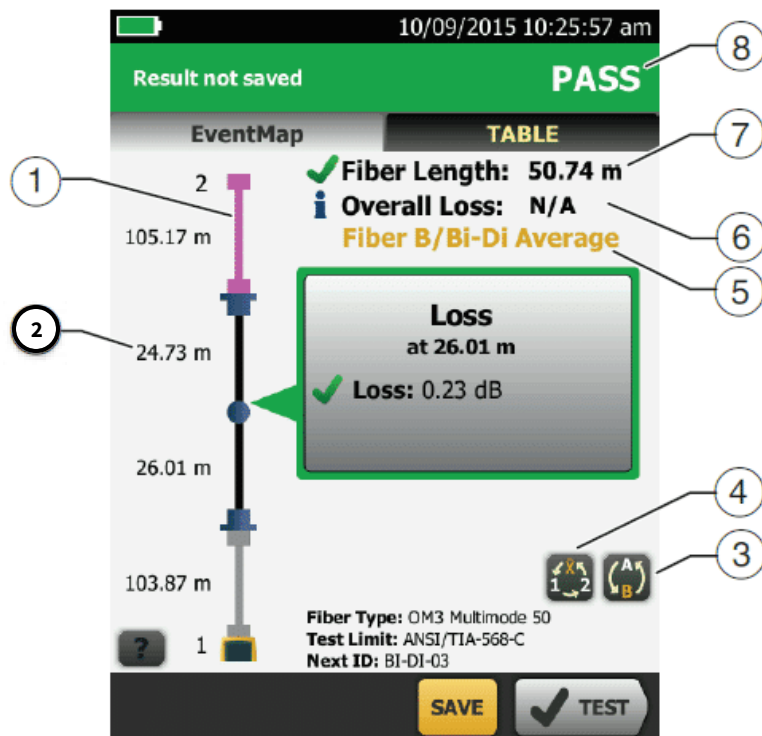
This line shows which results are on the display. Use the selection buttons (4 and 5) to see other results



This button shows with bi-directional SmartLoop results and bi-directional OTDR results from single fibres. Tap this button to see results from each direction (End 1 or End 2) or the averaged results (X)



Tap this button to see the results for the other fibre (A or B). Touch for 3 seconds to see a summary of the results from ends 1 and 2 on fibres A and B. To see the EventMap for a result in the list, tap the result



The longest segment length of the two directions

Excel Warranty Testing Requirements

- 1 TIER 1 Testing, OLTS
- 2 Both directions and both wavelengths
- 3 Results recorded on the test equipment
- 4 Forwarded electronically in testers native format
- 5 Tester within calibration
- 6 Any exceptions to this must come from Excel Technical Support