Testing Single mode fiber when you can't access the remote end.

There are times when it may not be possible to access the far end of a single mode fiber link running between campus buildings or between sites. Many organizations often have dark fibers between data centers or operational sites, but they may not be open to allowing visitors on site to perform installation testing. How do you get around this apparent roadblock? With Fluke Networks Versiv® platform you can achieve effective testing to prove that links have been installed correctly and are operational plus generate your test results in one test report from Fluke Networks LinkWare® platform. All you need is a person based at the remote site who can assist with connection of test cords to facilitate the testing. While not perfect, the following method will allow you to perform Tier 1 (Basic) and Tier 2 (Extended) testing on an installed pair.

For this solution we will be using the Fluke Networks CertiFiber® Pro OLTS and the OptiFiber® Pro OTDR and an FI-1000 FiberInspector® camera.

Equipment required to carry out the testing:

Note: *For this testing approach to work correctly, it is critical that you get an inspected and clean Test Reference Cord and SmartLoop™ cord to the remote site **before** you attempt to try and test. Make sure you will have an assistant, at testing time, at the remote site.*

As with all fiber testing, inspection is a critical component to successful measurements. Without inspection, you may end up damaging the installed connectors. The CertiFiber Pro has a USB camera option for the inspection of end face connectors. Users are encouraged to take advantage of this.

Additionally, the CertiFiber Pro with the USB camera option can automatically grade a fiber end face to IEC 61300-3-35 Ed 2, in around one second. Various tips are available including 1.25mm and 2.5mm universal, plus LC and SC Bulkhead.

Before proceeding to test, ensure you have the correct test limit configured for your CertiFiber Pro. In this example, we shall use an ANSI/TIA-568.3-D standard as our test limit, you could also use the IEC 14763-3:2014 SMF limit but be aware this limit only supports SMF links to 5km. If you are using vendor specific limits, the test methodology described here is the same, but the acceptable connector and splice loss values may vary. Failing to use a 1-jumper reference for the OLTS testing portion of his procedure could result in negative loss results.

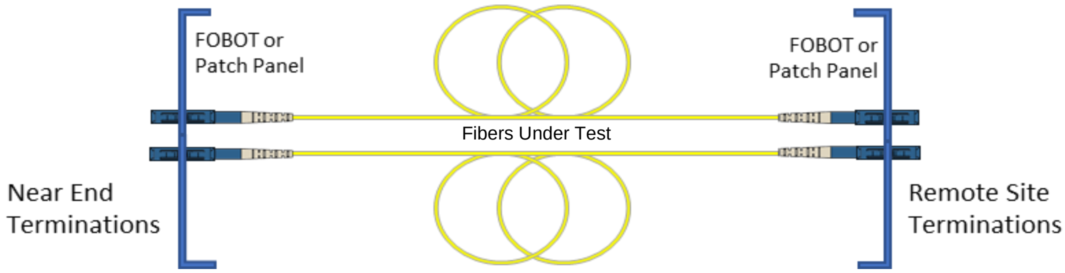

Figure 1. Representation of link to be tested.

Above is a representation of our links under test, there could be multiple embedded connectors and multiple splices that may need to be considered. Distances could be from hundreds of meters between building to tens of kilometres between sites. ANSI/TIA-568.3-D test limits can support measurement out to 40km. As mentioned earlier, ISO test standards currently only support measurement to 5km, but this is being reviewed with the intent to extend the range to 10km. For this example, our links to be tested go between buildings, each link is 130m long, each link has two connectors, one at each end and no splices, our fiber is OS2.

Tier 1 OLTS Testing

Test Reference Cords (TRCs) for OLTS testing

If the TRCs you are using are bad, your test results will be bad too. It represents the largest volume of calls for support. The procedure found here includes a method to verify your TRCs before and during testing. Fluke Networks TRCs use reference grade connectors (≤ 0.20 dB loss) in accordance with IEC 61280-4-2 and the ANSI/TIA-568.3-D standards. Note that standard grade cords are typically rated ≤ 0.50 dB loss and may fail the TRC verification check below.

The TRC kit available from Fluke Networks that is used in this testing example for OLTS testing is the model SRC-9-SCLC-KIT: Single mode TRC KIT 2 m (2 x SC/LC, 2 x LC/LC).

Configuring the CertiFiber Pro

To carry out our testing, we are going to create a new project on the CertiFiber Pro, clear the default test and cable IDs, use a setting for OS2 fiber, put the CertiFiber Pro into “Loopback” mode for Test Type and configure an ANSI/TIA-568.3-D test limit. We will use the mated connector count and splice count for the two fibers we are testing. We will also add a SM UPC inspection limit for evaluating our TRCs and connectors under test. Dirty connectors will degrade the loss values attained and can lead to a failing loss measurement.

With two mated connectors per link, our connector count will be four (4), our splice count will be zero (0). We are going to use a Single mode LC/LC TRC as our loopback connection at the far end.

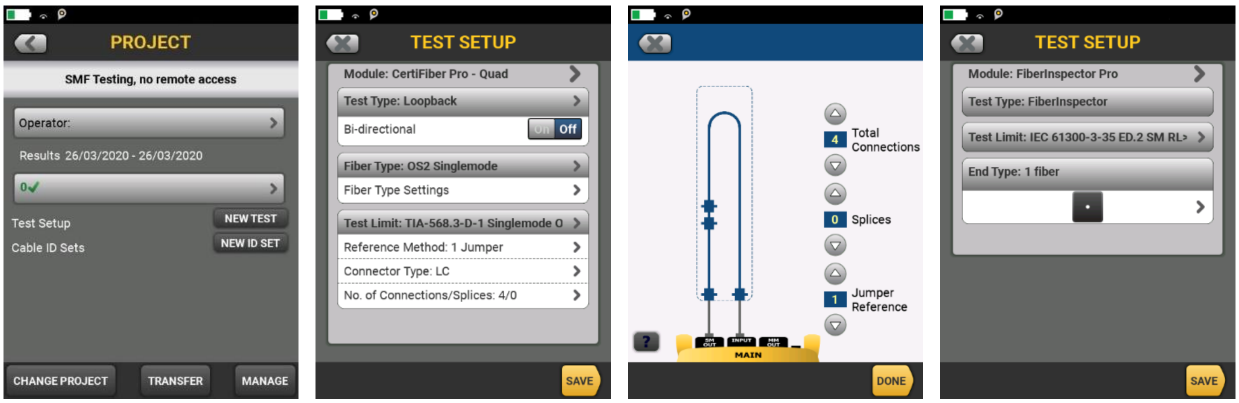

Figure 2. Create a blank New Project; create the initial OLTS test, configure connector and splice counts, add an Inspection test.

Configuring the OptiFiber Pro OTDR

As we will also be carrying out an OTDR test, we will go ahead and create the SmartLoop OTDR test at the same time. Being able to configure tests ahead of time is one of the key benefits of Fluke Networks ProjX™ system. We need to ensure Bi-directional is On, Macrobend detection is On and with the test limit, choose the same TIA test limit, with a 35dB Return Loss measurement included. This will help identify dirty connectors or poor cable installation practices.

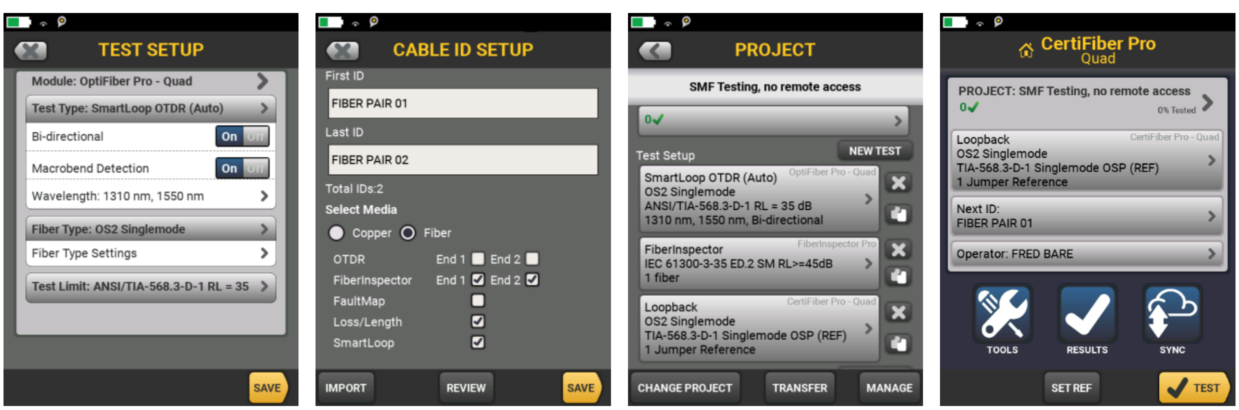

Figure 3. The required OTDR test, Cable ID entry and test requirements, completed project and Home Screen.

Carrying out the testing with the CertiFiber Pro OLTS

Once you have configured the tests in the CertiFiber Pro, you can then carry out testing. First step is to make sure everything is clean by using the Inspection Test we set up earlier. The process is inspect, clean if necessary, then re-inspect if cleaning was carried out.

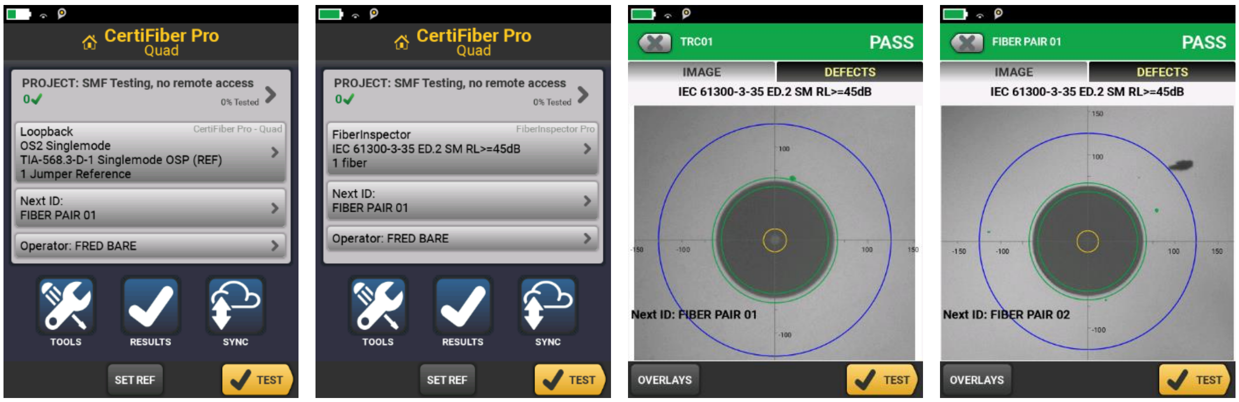

Figure 4. Select the Inspection test and inspect all TRCs and connections to the Fiber Under Test.

Once we have proven and recorded that all test cords and ports are clean, we can proceed to setting a reference, using the Reference Wizard, by touching the SET REF button.

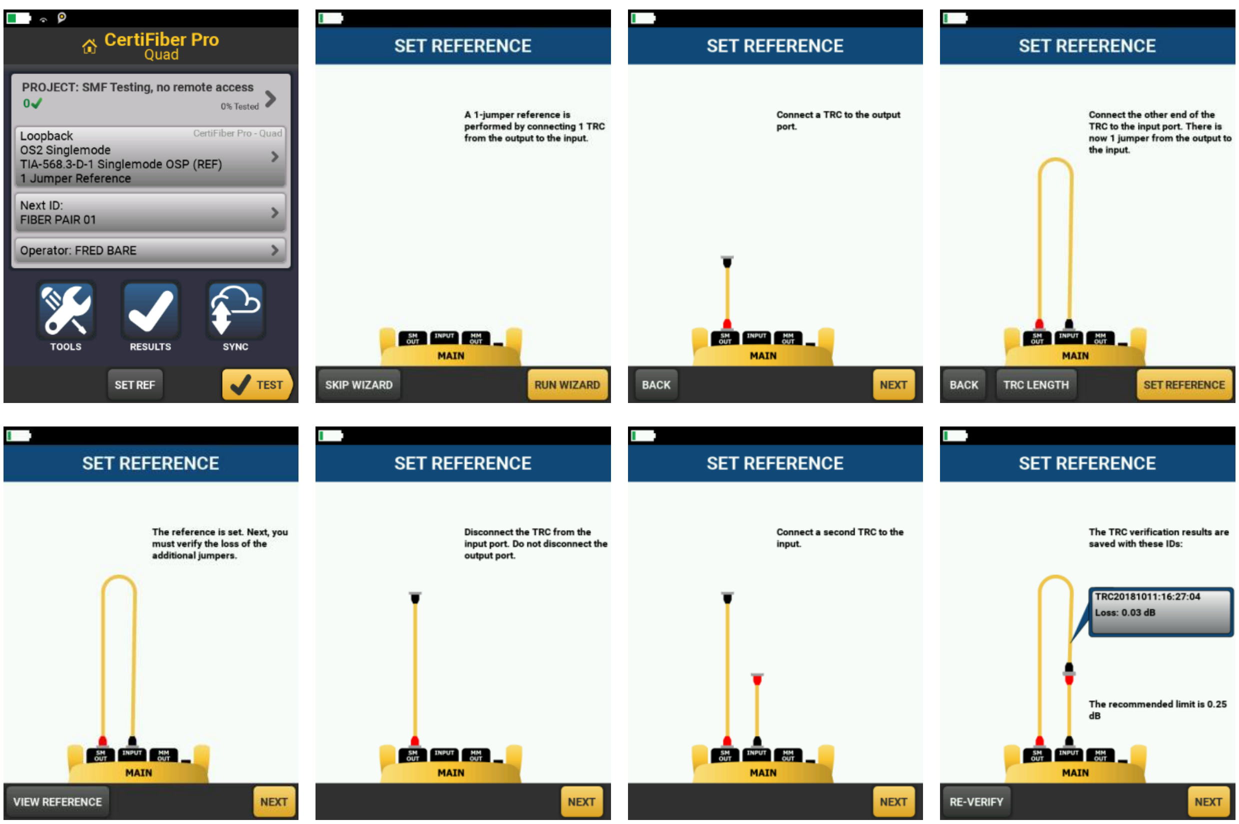

Figure 5. Carry out the Referencing procedure and the TRC validation process. This will ensure good measurement results. For Single mode TRCs, the loss should be less than 0.25dB.

Once the Reference Wizard has been completed, the last steps in the process are to disconnect the field end of the cords and to connect the fiber under test, then tap the HOME button. At this point, you will need somebody at the remote location to connect the TRC that will be used as a loopback. It is imperative that you send the cleaned TRC, SmartLoop Cord and appropriate QuickClean cleaners to the remote site **before** you attempt to start testing.

Your Test configuration for the OLTS will look like the diagram below.

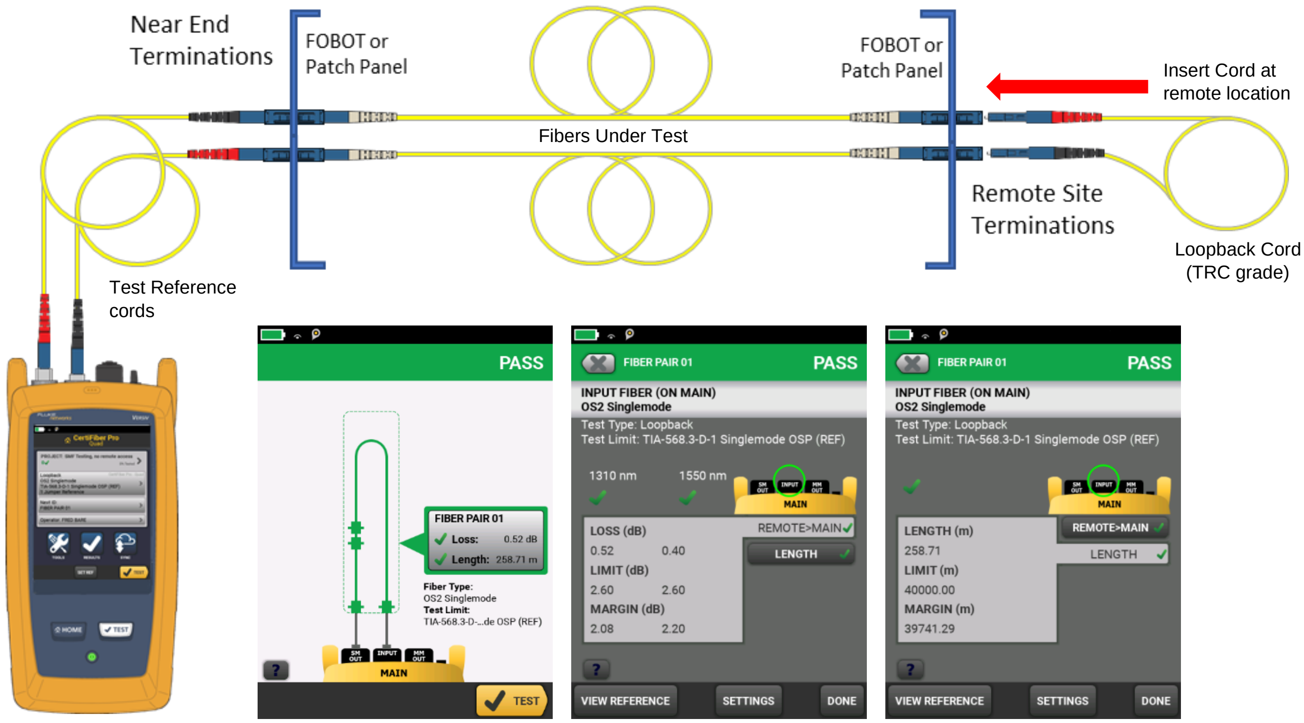

Figure 6. Test connection for the OLTS Loopback test, a TRC is used at the remote site as the loopback. A typical test result with Measured Loss, Budget Calculation for the link and length evaluation.

From our test results we can see we have low loss and hence good margin, this is a good indicator that both fibers are in good shape, however, it is possible that the pair passes because one of the links is exceptionally good and the other is marginal. For this reason, it's recommended that you take a little extra time to test the pair with an OTDR, which can not only catch this problem, but tell you what to fix if it's there. To carry out this testing we will use a SmartLoop OTDR test as our Tier 2 (Extended) test. This will allow us to evaluate the two fibers and the components used to construct both links.

Tier 2 OTDR Testing

Carrying out the testing with the OptiFiber Pro OTDR

In an earlier step we configured the SmartLoop OTDR test for the OptiFiber Pro, to perform this test, you need to remove the CertiFiber Pro module from the Main Unit and install the OptiFiber

Pro OTDR module in its place. As with the OLTS, the first step is to make sure everything is clean by using the Inspection Test we set up earlier. The process is inspect, clean if necessary, then re-inspect if cleaning was carried out. This time we are cleaning and inspecting our Launch, SmartLoop and Tail cords.

In the equipment required we have shown two Launch cords (used for the launch and tail cord) and two SmartLoop cords, you will need to send one of the SmartLoop cords to the remote site and use the second SmartLoop cord as part of your OTDR SmartLoop cord compensation process. All Fluke Networks SmartLoop cords are identical, this allows you to set compensation locally with one cord but have the actual SmartLoop cords located at the remote site(s).

From the HOME screen of the Main Unit, you need to change back to the Inspection test to check each connector of the launch, SmartLoop and tail cords. Once inspection is complete, you will then select the OTDR SmartLoop test and set your cord compensation accordingly.

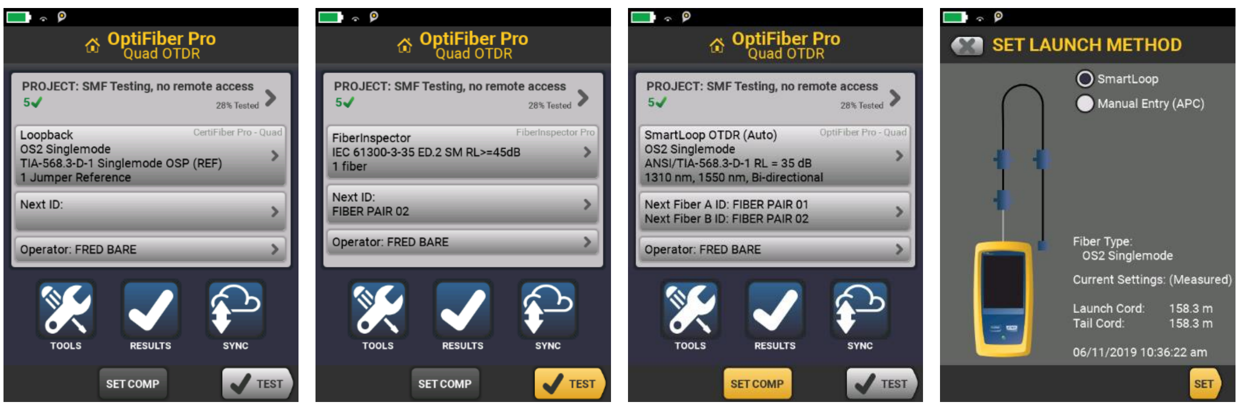

Figure 7. From the Home Screen after fitting the OTDR module, change to the FiberInspector test to check connectors on the cords, then select the SmartLoop OTDR test. Tap SET COMP and follow the instructions.

Follow the instructions for SET COMP (set compensation) given in the SET LAUNCH METHOD wizard. The compensation approach will allow the OTDR to remove the effects of the Launch, SmartLoop and Tail cords from the measurement you perform. This will allow you to measure both fibers bi-directionally (from both ends) and obtain an averaged result for each fibre.

Once the SET COMP is complete, check the trace and verify that the connections between the cords are less than 0.25dB loss. This will ensure the best measurement results.

If your connections are all good, save the SET COMP result, the OTDR will ask you to confirm the saving process. You can now use the Launch and Tail cords at your test location to connect to the link under test. Make sure your assistant at the remote end installs their SmartLoop cable across the same pair you are going to test. Your test connections should look as follows.

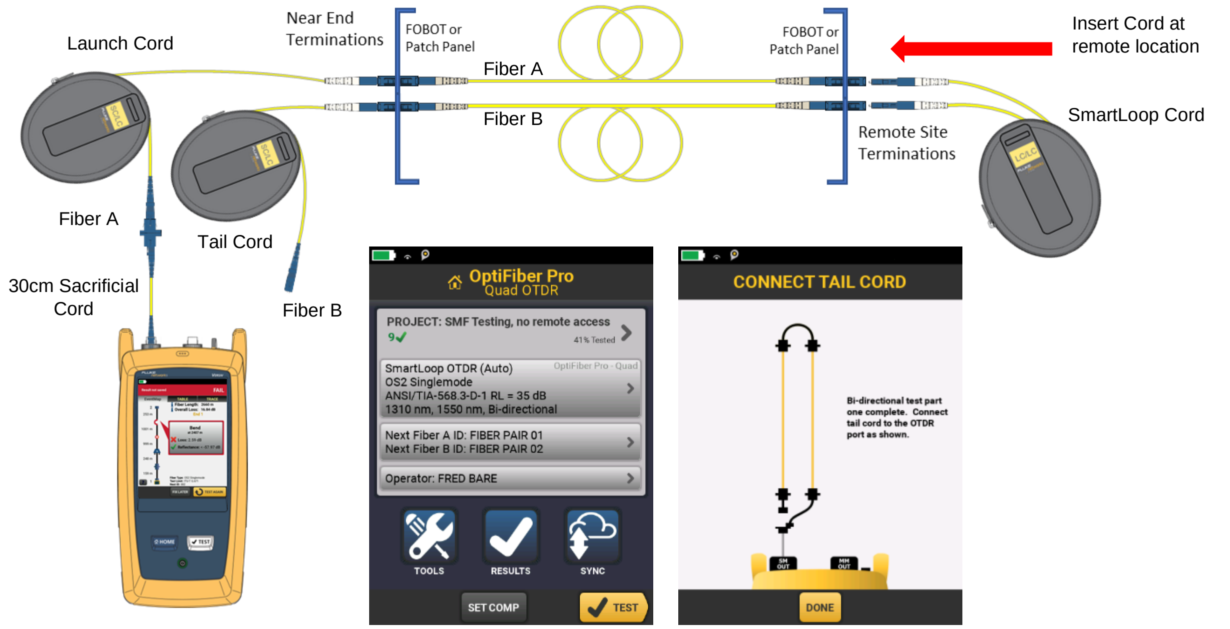

Figure 8. SmartLoop test configuration, Tap TEST to get going, halfway through you will need to swap the test cords.

Once you have established your test connections tap the TEST key and follow the instructions, halfway through the process you will need to change your OTDR sacrificial cord from Fiber A to Fiber B as per Figure 8. Tap DONE once you have swapped the fibers at the sacrificial cord.

When the test has finished SAVE the result. In this example, I will save the result as FIBER A and FIBER B, which are the two fibers that made up FIBER PAIR 01.

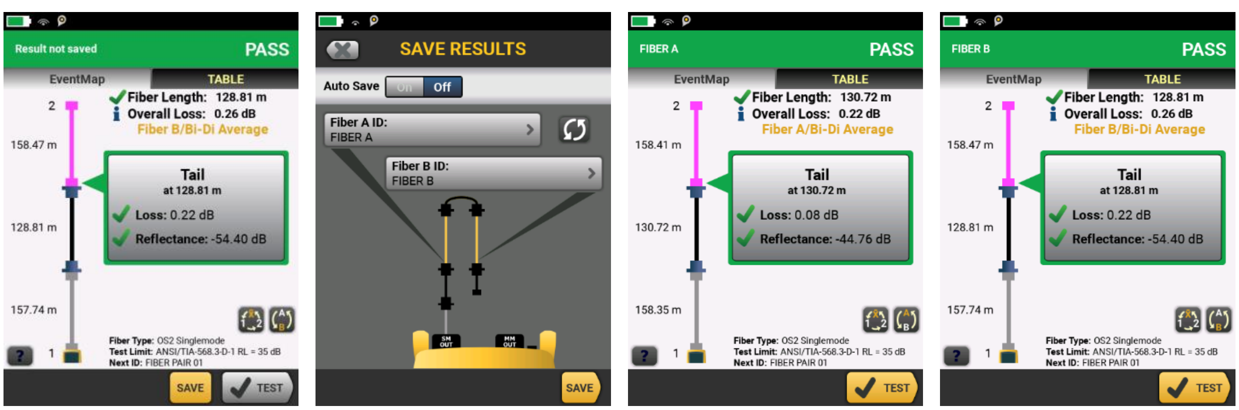

Figure 9. Once the bi-directional result is obtained, save each fiber as an individual fiber with their correct ID.

The results from the SmartLoop OTDR tests show that both fibers have similar losses. This confirms that the results from our OLTS loopback test are valid, losses in each fiber are low. If one of the fibers had an issue, we could then use our OTDR results to isolate the issue in the problem fiber. Our Tier 1 and Tier 2 tests are complete, and we have valid test results we can now document using Fluke Networks free LinkWare® solutions.

Documenting your results

Once you have downloaded your results into LinkWare PC (or uploaded them to LinkWare Live), you will be able to generate your documentation to show that the fibers were tested correctly and meet the requirements of the appropriate test standards. I will use LinkWare PC to give a documentation example.

I have downloaded the test results from our project into LinkWare PC.

	Cable ID	Date / Time:	Status	Length(m)	Headroom	Info	Test Limit
1	TRC20200326:16:37:01	26/03/2020 04:37:01 PM	N/A	2.5	0.20 (Loss Margin)		TRC Limit
2	TRC01	26/03/2020 02:36:06 PM	PASS	N/A	N/A (Loss Margin)		IEC 61300-3-35 ED.2 SM RL>=45dB
3	FIBER PAIR 01	26/03/2020 04:37:48 PM	PASS	258.7	2.08 (Loss Margin)		TIA-568.3-D-1 Singlemode OSP (REF)
4	FIBER A	30/03/2020 07:12:59 PM	PASS	130.7	N/A (Loss Margin)		ANSI/TIA-568.3-D-1 RL = 35 dB
5	FIBER B	30/03/2020 07:12:59 PM	PASS	128.8	N/A (Loss Margin)		ANSI/TIA-568.3-D-1 RL = 35 dB

Figure 10. Results as shown in LinkWare PC.

You need to check the TRC validation results as part of the reporting. This shows that the installer was using Test Reference Cords during testing and that the cords were in good shape. This gives a consultant or reviewer confidence in the validity of the testing. Here we can see in the highlighted result that our TRCs had less than 0.25dB loss and are acceptable to use. If you wish, you can also save the endface images for the TRCs to prove they were clean. At line 3 we can see our OLTS loopback results, and at lines 4 and 5 we can see our OTDR results. We can further expand out our OTDR results to check the bi-directional average for each fiber, which is the measurement that counts most.

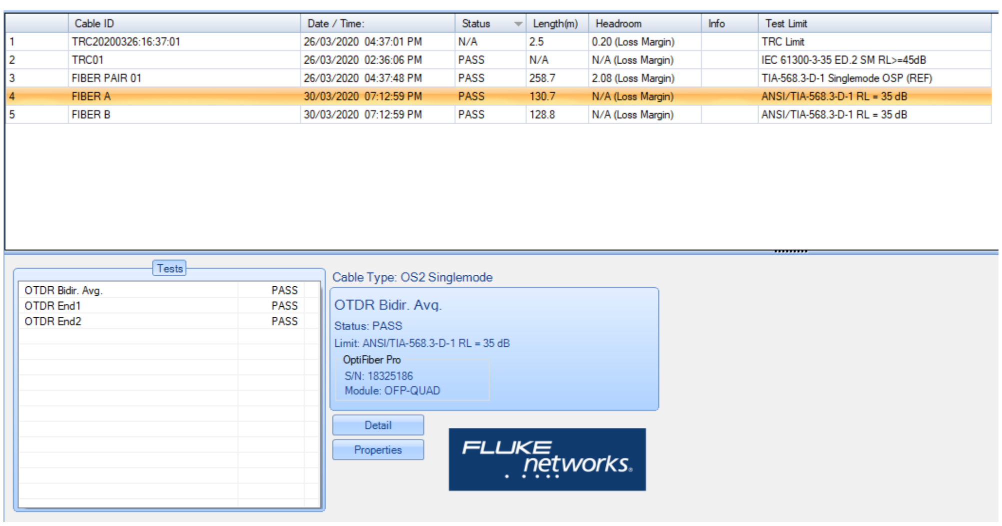

Figure 11. Our FIBER A OTDR result with the averaged result and the individual directional results.

Make sure you save your results first, then generate your test report for the end user. Using LinkWare PC, we can show and store all three tests in a single report, Inspection, OLTS and OTDR traces.

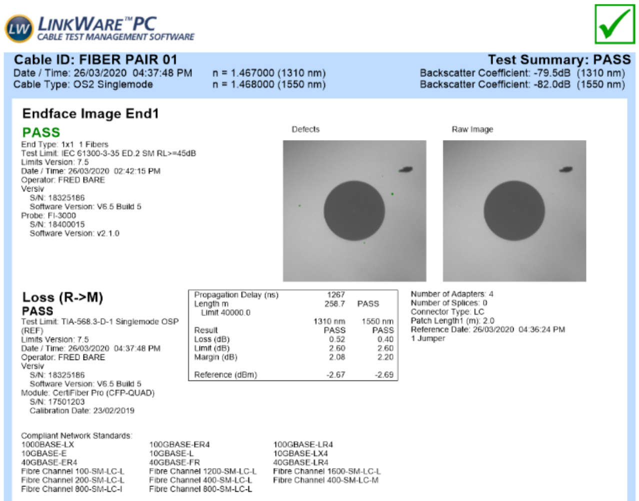

Figure 12. Optical Loss test report for the OLTS testing and Inspection.

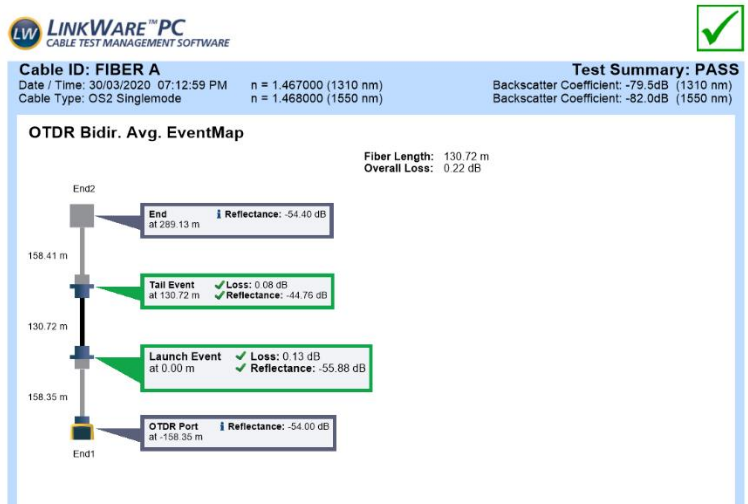

Figure 13. Summary Bi-directional OTDR test Report for FIBER A.

With OTDR testing the standards require a bi-directionally averaged result. The OptiFiber does this for you automatically when you utilise the SmartLoop OTDR feature.

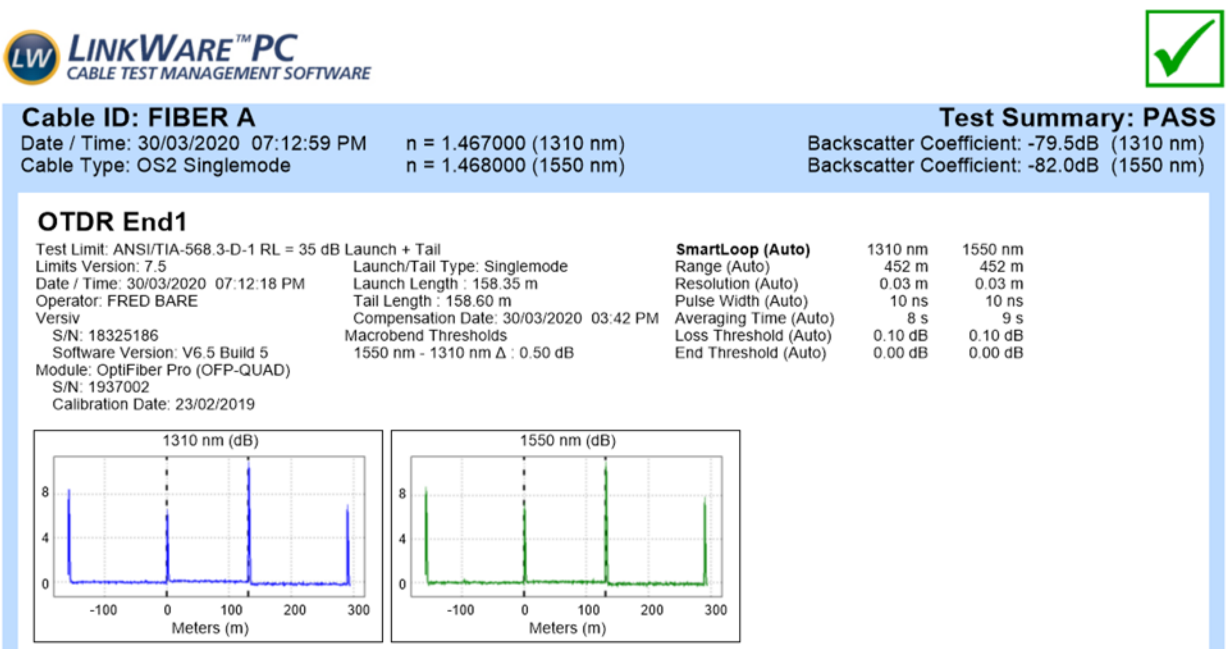

Figure 14. Traces captured from FIBER A at End1 that form part of the bi-directionally averaged result.