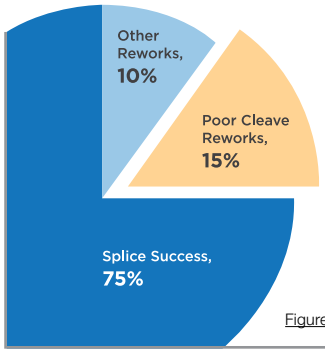
Eliminate the Most Common Splicing Errors with the Next Generation Splicing Solution

Recently, maximizing field operation efficiency has been gaining attention as an essential requirement to lower the cost of fiber installation in the field. Sumitomo Electric Lightwave has developed a new generation fusion splicing solution to meet this demand. In this document, we will introduce the new solution and how it will drastically help reduce costs.



MOST FREQUENT Problems

According to aggregated field data, the most frequently observed problem is poorly cleaved fibers. When faced with this problem, field operators are required to re-cleave, which happens about every 6 to 7 splices (15%).

Figure 1. According to SumiCloud™ splice data, approximately 15% of fiber preparations are rejected by the splicer because of poor cleaves.

Figure 2. Caution message for poor cleaves (example)

The following chart shows the timeline of a typical splice. If the fiber is cleaved properly and the splice is successful, 1 splice takes approximately 60 seconds. However, when a "rework" is required by the splicer, the cycle resets, and it takes approximately 80-100 seconds. This lost time accumulates quickly and reduces work efficiency in the field.

Figure 3. Time chart comparison between (a) a successful splice vs (b) rework due to poor cleaves (The time was measured using a single fiber core alignment splicer. Time for each process may vary depending on the skill of operators.)

DISAPPOINTING Result

As long as the operator follows the splicer's recommendations and continues to rework, the splicing quality will be maintained. However, thanks to human nature, it is not uncommon to see cases where the necessary rework is skipped. In this case, the splice is forcefully initiated with a poor quality cleave. According to our test results, if a poor cleave is forcefully spliced, 30% of splices result in losses of over 0.5 dB, and 70% of results are over 0.3dB. Such high losses, which would become apparent with an OTDR measurement, would require someone going back to the field to repair it; increasing time, costs, and in the worst case, resulting in the loss of a customer's trust.

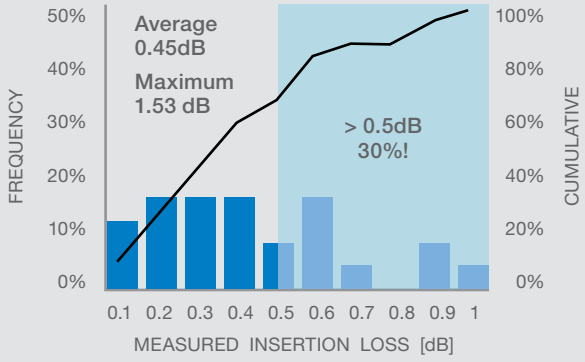


Figure 4. Insertion loss splice test result with poor cleaves (Normally the caution window appears on the screen so the splices are intentional operation.)

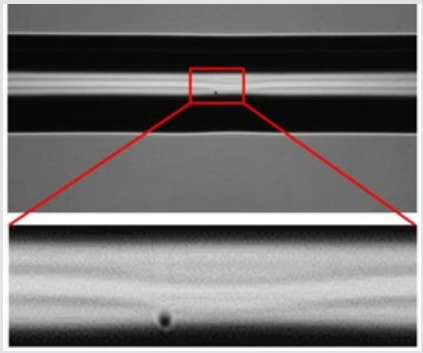


Figure 5. Example of a splice with poorly cleaved fibers.

HOW TO PREVENT the Problem

As described above, poor cleaves are associated with lower efficiency and higher insertion loss causing many problems. How can we prevent this?

First, why do poor cleaves occur? Even when using high quality cleavers, we have seen poor cleaves. In our observation, the following 3 key points are the major causes of these poor cleaves.

1 KNOWLEDGE & SKILL

The lack of knowledge or skill can result in poor cleaves, regardless of cleaver quality or deterioration levels. This type of error can be categorized as 'constant failures' in reliability engineering. To prevent this type of error, a certain level of expertise is needed, including the following: fiber cleaning, daily maintenance of tools, how to put the fiber correctly on the cleaver stage, etc. To accumulate this type of knowledge and skill, technical training is one of the most popular methods.

2 RANDOM CLEAVE ERROR

Dust, dirt, or other debris (fibers, coating, etc.) can disturb a cleave, even when the operator has all the necessary skills. This type of error can also occur regardless of cleaver quality or deterioration levels, making it a 'constant failure'. Periodical cleaning & maintenance is essential to prevent this type of error.

3 BLADE DETERIORATION

After thousands of fiber cleaves, the cleaver blade will gradually deteriorate and near its end of life. This is the so-called "wear and tear failure" and it should be distinguished from the 2 previously mentioned causes above, since rotating or replacement of a worn blade is required. It is not necessarily as a result of bad work practices.

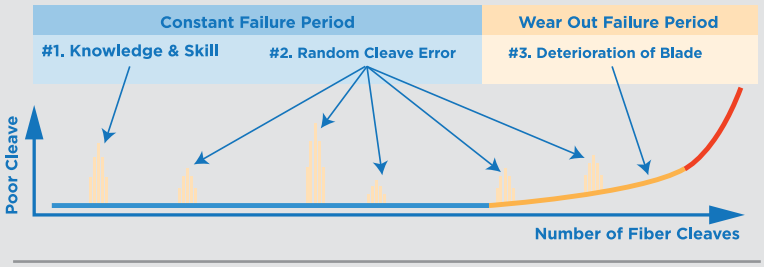


Figure 6. Schematic chart of cleaving experience in the field.

COUNTERMEASURES with New Technology

To solve these problems, we have developed 2 new technologies.

1. NanoTune™ enhances your splicing experience

NanoTune™ technology's main aim is to support the operators in the field. NanoTune™ reduces your time spent working and reduces splicing loss overall, by using the world's first AI splicing technology. Reworks, especially during fiber preparation, occasionally occur, even for the most skilled operators. NanoTune™ drastically reduces the need for these reworks, by enabling the operator to splice fibers that would have previously required rework. NanoTune™ realizes this by using state-of-the-art technology and our unique algorithms to accurately adjust parameters when splicing. NanoTune™ improves your field splice success rate to 90%, thus shortening your working time drastically.

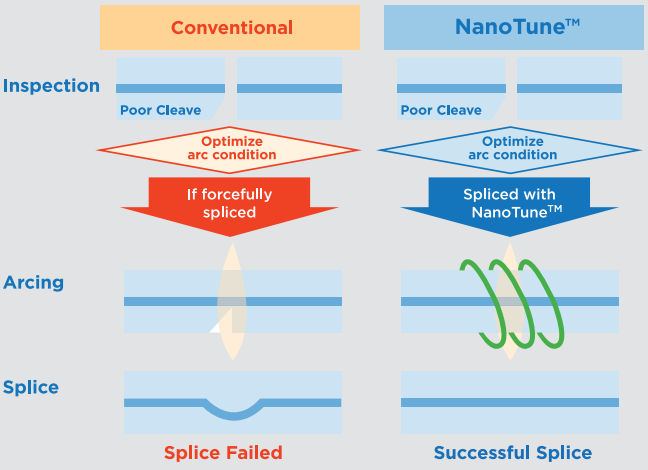


Figure 7. Process comparison between conventional splicers and a splicer with NanoTune™ Test results at right (Figure 8) show this insertion loss. Traditional splicers alert and request rework when a bad cleave is detected to maintain good splice performance. If the alert is ignored, bad cleaves often result in bad insertion loss (yellow). NanoTune™ has improved splicing capabilities of poor cleaves, enabling splicing of such fibers with low loss (blue) utilizing this state-of-art AI technology.

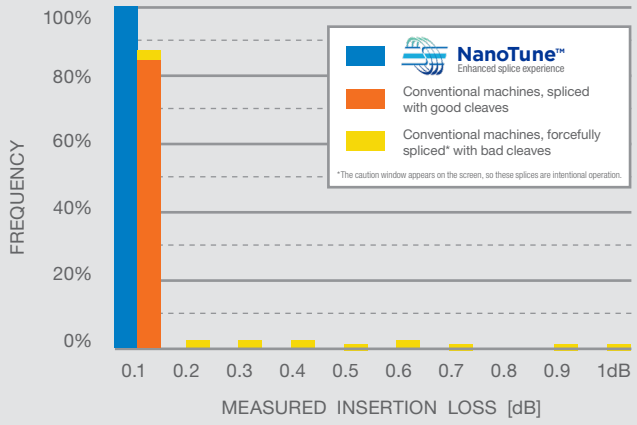


Figure 8. Splice test results with poor cleaves (14–40um crack).

THE 5 PRIMARY FEATURES to Realize NanoTune™

1. GLASS MELTING TECHNOLOGY
Mature glass melting techniques, cultivated as the pioneer in optical fiber manufacturing.

2. ACCUMULATED KNOWLEDGE
Field data collected by the use of SumiCloud™ forms a pool of big data that is used to simulate and analyze potential problems.

3. CUTTING EDGE AI TECHNOLOGY
State-of-the-art fiber end analysis technology, with AI based real-time 3D pattern recognition.

4. OPTIMIZED ALGORITHM
Splicing algorithm is optimized to instantly calculate the best possible splice based on 10 essential splice parameters.

5. PREDICTION OF CORE POSITION
Fiber core position prediction technology monitors fibers precisely up to the splice moment.

2. Preventive maintenance with SumiCloud™

SumiCloud™, Sumitomo's IoT technology, monitors key consumables and parts such as cleaver blades, electrodes, and batteries, among other essential components. It notifies users before a part is about to reach its end of life. This is done by collecting and analyzing data that act as early indicators for when deterioration starts to accelerate.

When accurately estimating deterioration of parts and components, it is essential to indicate the proper timing for blade maintenance (rotation or replacement), and distinguishing the difference between random failures, such as dirt on fibers, and actual failures that occur due to parts being worn out. Crude judgement criteria such as "3 consecutively poor cleaves", may result in misjudging the proper maintenance timing, and changing the blade before its end of life.

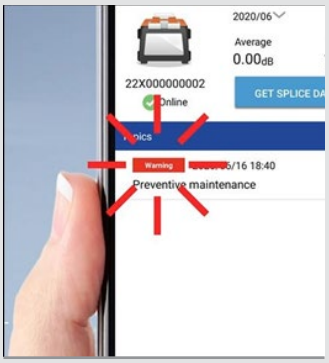


Figure 9. Intuitive user interface of the SumiCloud™ app.

The Preventive Maintenance suggestions by SumiCloud™ provide an intelligent analysis method which distinguishes the difference between "wear and tear failures" and random failures. The intuitive user interface of the SumiCloud™ app, available on Android and iOS, provides indication of when and instructions on how to maintain each part.

COST MERITS of Utilizing NanoTune™ & Preventive Maintenance

1. Improvement of work efficiency. NanoTune™ technology reduces the need for rework that would have been otherwise needed due to poor cleaves. This can increase the work efficiency from 75% to 90% or more. If we set up the labor cost of the field operator's cost as 50 USD, 15% efficiency increase corresponds 7.50 USD/hr.

2. Blade costs. NanoTune™ delivers a low loss splice even with poor cleaves, so it also lengthens the effective blade life 15% by requiring less re-cleaves. Thus, if we set up the blade cost as 100 USD, you save 15 USD per blade.

3. Keep customer confidence. It is priceless to keep your customers' satisfaction and confidence as the result of the quality of your installation work.

Figure 10. New High Definition Core Aligning fusion splicer, TYPE-Q102-CA+.

HOW TO ACCESS These Technologies

Sumitomo's new High Definition Core Aligning fusion splicer, TYPE-Q102-CA+ is now available with NanoTune™ and Preventive Maintenance features of SumiCloud™(*1).

(*1) Preventive Maintenance, along with other features requiring SumiCloud™, may not be available in some countries and regions. Please contact your local distributor for more information.

For more information about these features and to find out more about the TYPE-Q102-CA+, visit www.sumitomoelectriclightwave.com/product/q102-ca-core-alignment-fusion-splicer/