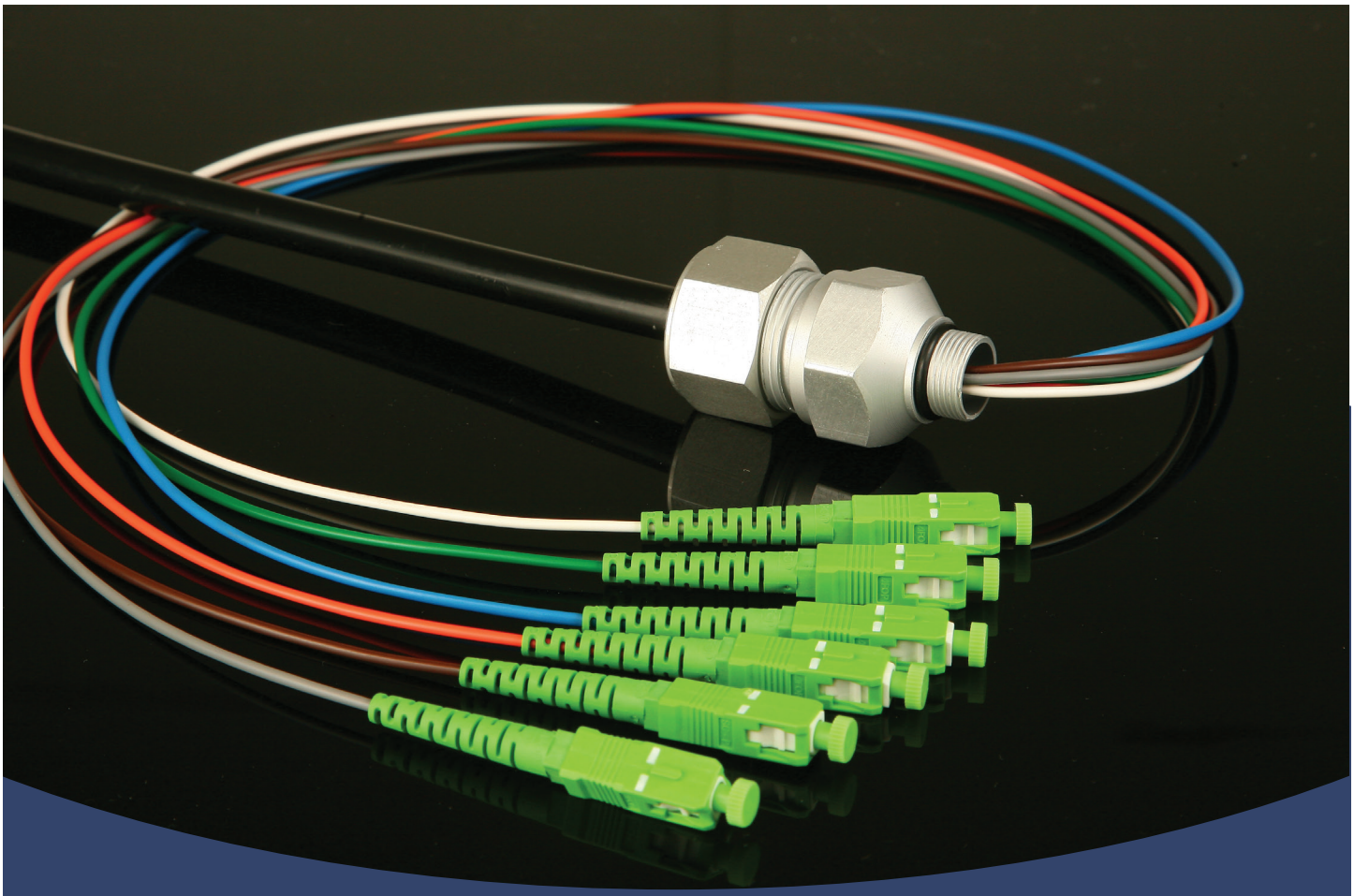

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HLC® Connector Studies - Electric Field Testing

Technical Paper

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HLC® Connector Studies – Electric Field Testing

ELECTRIC FIELD TESTING

This set of tests was inspired by the desire to improve connector cleaning processes in a measurable way. The testing methodology was inspired by the 3M handheld electrostatic field meter, which was designed to measure the charge value (volts, V) of the electric field on a given object or workspace. The field meter measures a space that is far too wide to examine the connector tip.

In fiber connector cleaning, it is widely accepted that solvent is a crucial part of the cleaning process, yet it is not as widely used in the field as we would have hoped. From the basics physics and electromagnetism, we know that triboelectric charges are generated between materials that come into frictive contact. When the connector comes into contact with the cleaning wipe and is dragged across it, a charge is created. Our experiments were designed to measure the electric field generated on the tip of the connector, specifically the ceramic endface, when the connector undergoes typical handing and cleaning practices.

We also sought to compare the HLC laser termination process with the industry standard termination process (UPC) and see if our laser processing, and the smoother surface that comes from it, has any effect on the amount of charge generated. During the HLC process, the endface is traversed with a CO2 laser, which affects the physical structure of the glass, and the result is a surface that is less porous. The two termination types were tested side by side using the same methods.

METHODS

The test setup required to measure the tip of the connector was complex in nature and required the support of an expert in electrostatic discharge. We worked with Dave Swenson of Affinity Static Consulting, a globally recognized expert in static control with over 35 years of service with 3M in the design and manufacture of ESD related products.

Dave helped us build a test setup that used a Monroe Electronics model 244 electrostatic volt meter with a 1017E miniature probe, designed for making measurements over small areas. The test setup allowed us to insert a connector through a grounded metal plane, and to position the probe within 3mm of the connector endface. At this distance, the probe measures the voltage across a 2mm x 2mm square area, roughly the size of the connector tip. All tests were done using a SC connector.

Once the connector was pushed through the grounded plane, we simulated some practical events and then measured the charge generated by the actions. Between measurements, we removed the electric field by applying a solvent to the endface and using an ionizing air fan to blow over all of the test surfaces. Once the field was removed, we completed another measurement.

In the initial testing we did with Affinity, we determined that the application of the solvent was crucial to the reduction of the electric field on the connector tip. As the relative humidity approached 100% with the application of the solvent to the endface, the charge of the field approached zero.

Photos of the core equipment used in static testing

Test Results:

Test 1: Dry Wipe – Side A

We started with a 4"x4" dry cleaning wipe from Chemtronics, very common in the industry. These types of wipes typically have two sides: Side A tends to feel a bit rougher to the touch, with side B being very soft. The wipe was backed with a rubber pad, and then dragged across the connector endface for 1 inch. This process was repeated 5 times between each measurement to simulate the process of Dry cleaning.

Measurements:	30 ea, UPC and HLC	
	HLC	UPC
Average (V):	95.73	106.53
Percent Diff:	11.28%	

Test 2: Dry Wipe – Side B

We followed the same procedure from Test 1, but with the softer Side B. This side is preferred by technicians in our experience and is said to clean better.

Measurements:	25 ea, UPC and HLC	
	HLC	UPC
Average (V):	347.68	390.88
Percent Diff:	12.43%	

Test 3: Mating into coupling adapter

In this test we simulated the connector being plugged into an adapter, whether it's in a panel or connecting to a test cord. Plugging into an adapter is something that occurs with a very high frequency in the field, especially with test cords. This process was repeated 10 times for each measurement.

Measurements:	25 ea, UPC and HLC	
	HLC	UPC
Average (V):	131.08	158.4
Percent Diff:	20.84%	

Test 4: Removing the Connector Cap

This test involved removing the cap of the fiber connector and placing it back onto the connector. This was done 5 times between each measurement.

Measurements:	25 ea, UPC and HLC	
	HLC	UPC
Average (V):	695.08	758.44
Percent Diff:	9.12%	

INITIAL CONCLUSIONS

Dry cleaning generates a charge on the endface that remains until it is dissipated. What we didn't expect was the difference between the different sides of the wipes. Side B, the softer of the two, generated nearly 3.5x the charge of Side A.

The mating of the connectors also generated a charge, slightly larger than the cleaning. The cap removal was the big surprise – a 7x higher charge than basic cleaning!

The HLC connector endface generated less charge on average than the UPC connectors in all of the four measurement categories.

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WHY IS THIS RELEVANT?

Fiber connector cleaning is the biggest challenge facing test equipment and cable manufacturers in our industry. Dirty connectors lead to higher loss measurements, higher service rates, damaged bulkhead connectors, reduced life of test cords, etc. The build-up of charge on the tip of the connector attracts dirt and makes connectors more difficult to clean, making it a major contributor to reducing connection quality. Most people tend to think of the solvents role in fiber cleaning as a type of cleaning agent, and it can serve that purpose in the event the connector comes into contact with oils, grease, etc. The real reason that solvents ease the connector cleaning process is by removing the electric field and allowing the contaminants that were being electrostatically attracted to the endface to have their bonds broken and be more easily removed.

The data generated shows that through basic fiber handling (cleaning, mating, cap removal), a charge can be generated, and it is cumulative, e.g. more cleaning on the wipe means more accumulated charge. Since these basic tasks work against our ability to clean, it is critical that we use a solvent ***often*** to neutralize that charge.

The HLC connector showed itself to be slightly more resistant to charge accumulation. The ~10% difference in charge accumulation is not a huge difference, but is an incremental improvement to the standard connection. It can serve as a small insurance policy against charge accumulation, but is by no means a substitution for proper wet/dry cleaning techniques.

Given that the test cords we build are constantly having their caps removed, being plugged into ports, and being cleaned (hopefully…), wet/dry cleaning is ***essential*** to success in fiber installations, and the HLC provides a better performance in high use applications.