



Cleaning & Inspection Training

Your source for Optical Interconnect Solutions
Design • Test • Manufacture

2020 JUNE



WHERE DOES THE CONTAMINATION COME FROM?

Equipment Cooling Fans



Opening Packaging Materials



Our Shoes



HVAC Systems



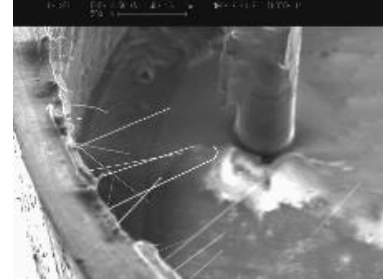
Atmospheric Humidity



Plant Pollen



Circuit Board Tin Whiskers



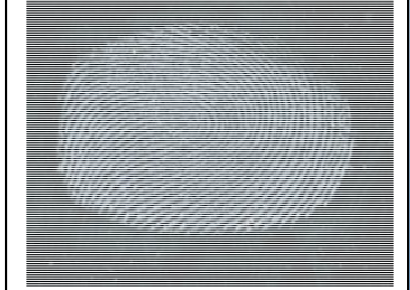
Lint From Our Clothing



Construction

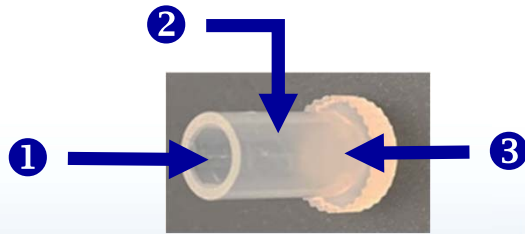


Finger Prints



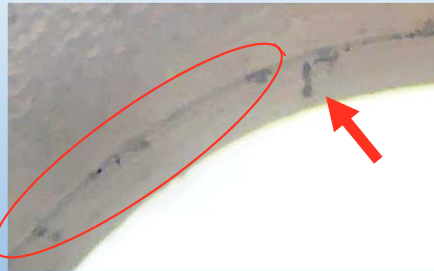


PROTECTIVE ENDCAPS ARE A COMMON SOURCE OF CONTAMINATION

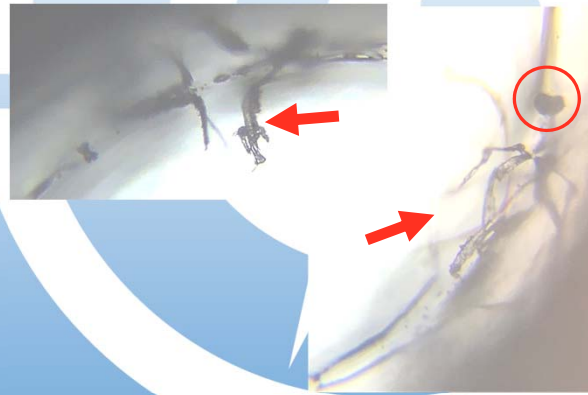


- The role of the protective endcaps on an assembly are to protect the ferrule endface from bumps that can cause scratches
- Sometimes the endcaps are a source of endface contamination.

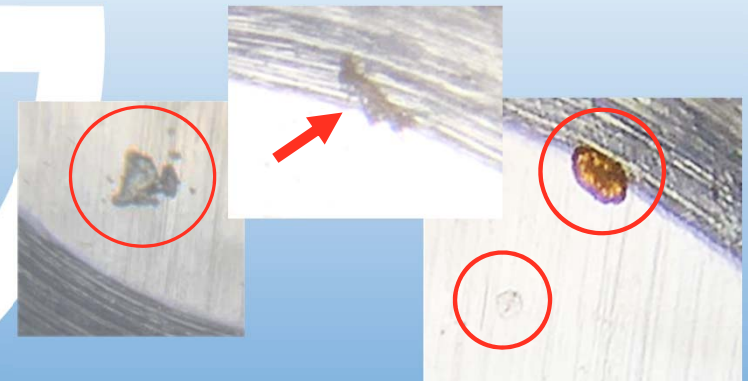
① UPPER INNER WALLS



② MIDDLE INNER WALL

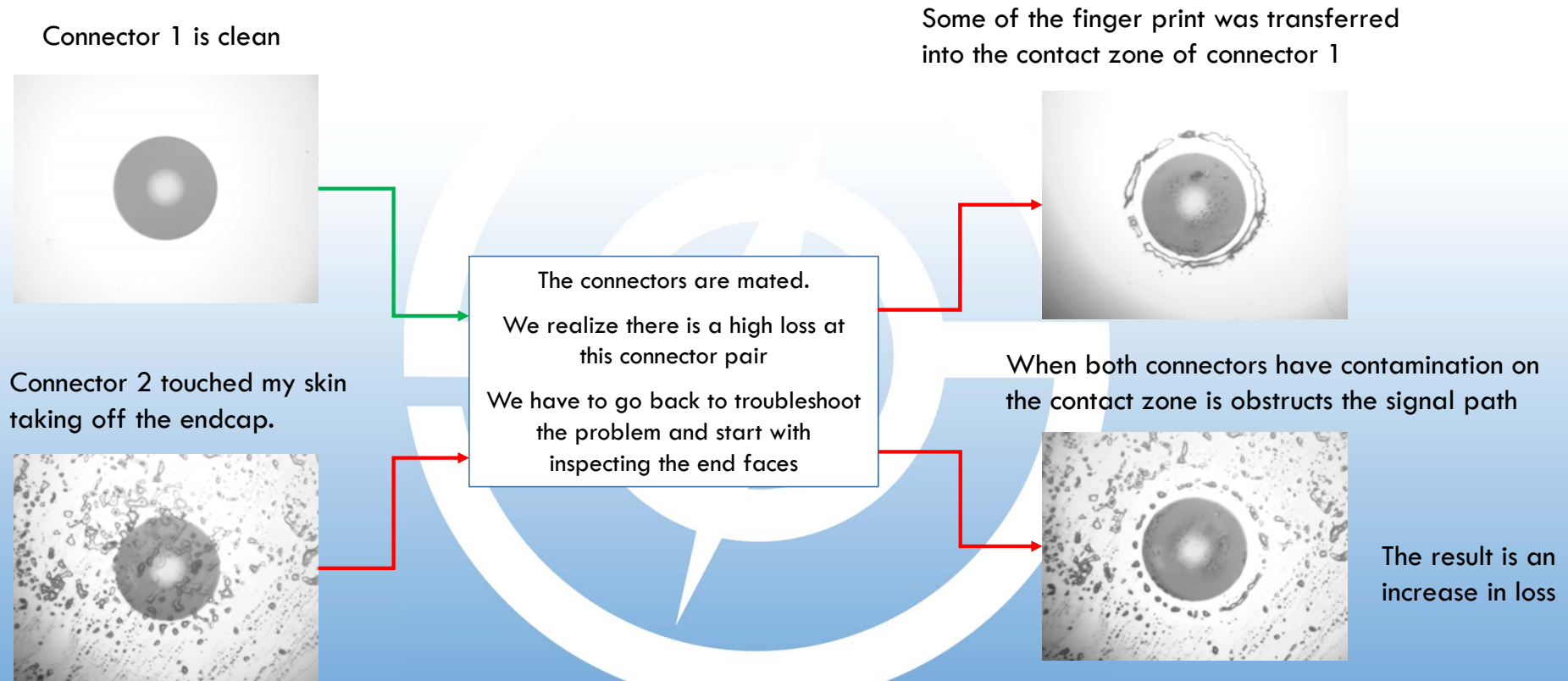


③ BOTTOM & BOTTOM INNER WALL



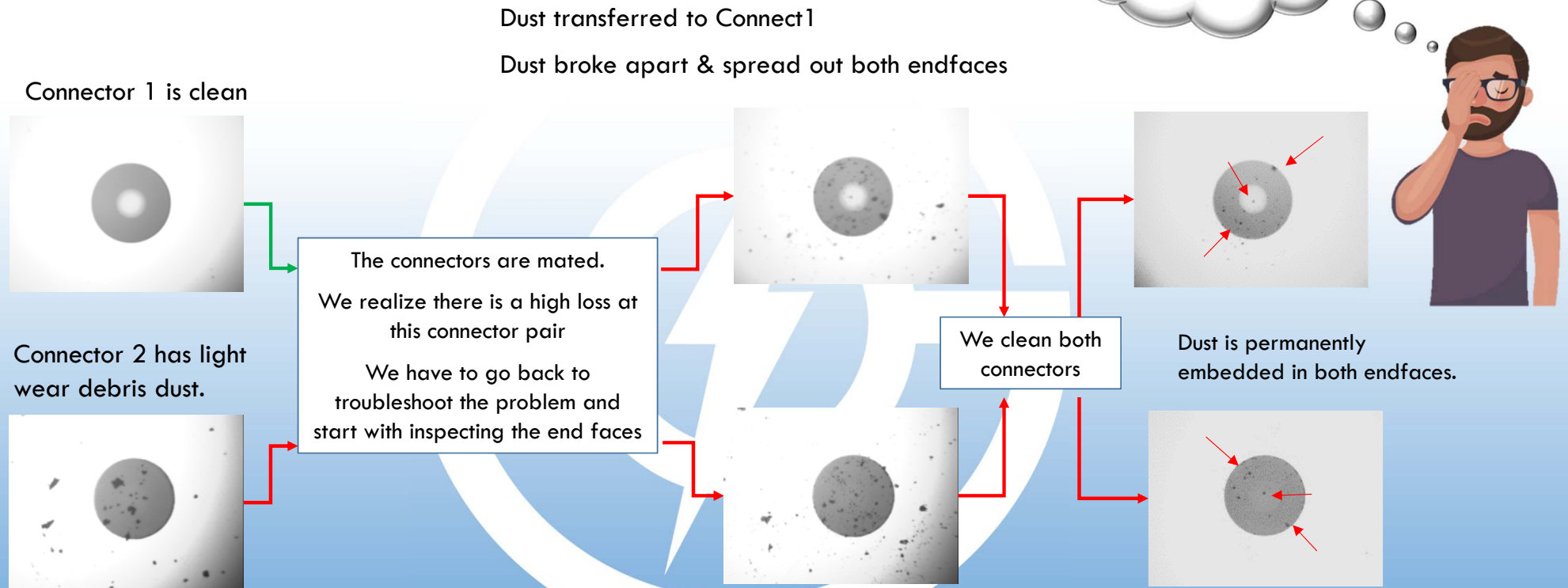


OTHER CONNECTORS CAN BE A SOURCE OF CONTAMINATION





HOW CONTAMINATION RUINS CONNECTORS





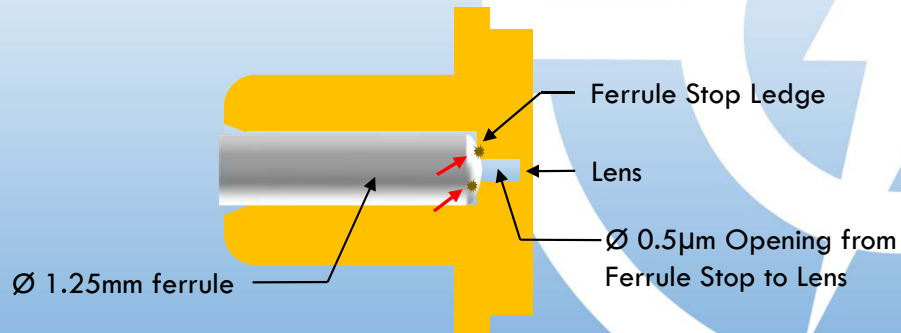
CONTAMINATION WILL DESTROY YOUR OPTICAL TRANSCEIVERS



Optical Sub Assembly

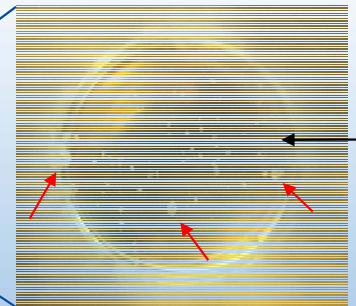
- Image on left is a LC in a SFP transceiver with the cover removed.
- When a ferrule with some dust on the endface enters the port of a transceiver, the dust is transferred on the sub assembly.

Ferrule In Transceiver Port Cutaway View



Ferrule Stop Ledge

Lens

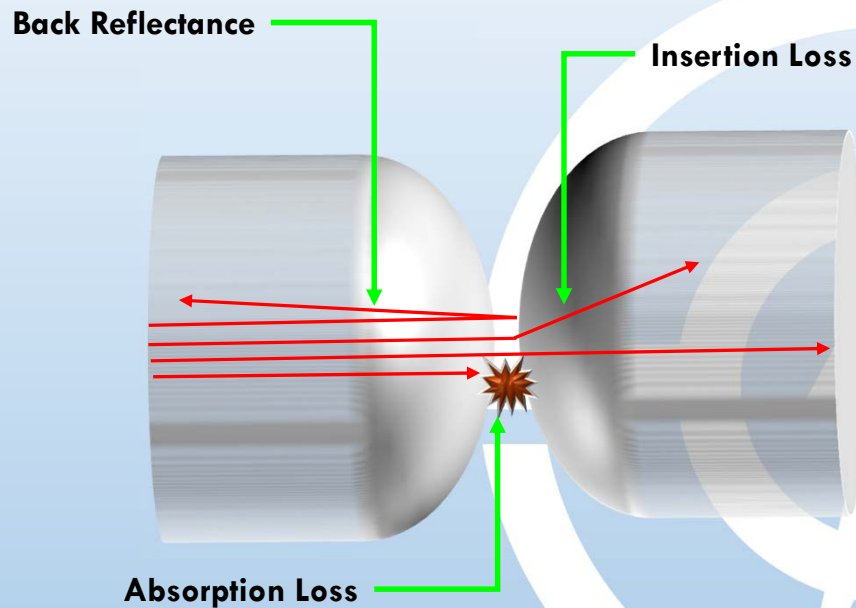


Lens

- Dust on the lens will migrate along the surface of the lens into the spot zone and disrupting the transmission of the signal.
- When contamination get onto the lens, the 0.5µm opening makes it impossible to clean and running the transceiver.



CONTAMINATION WILL DESTROY YOUR OPTICAL TRANSCEIVERS



BAD NEWS!!!

- Contamination, scratches, embedded dust on the surface of a ferrule endface causes signal loss.
- It is the most common issue installers will experience working with fiber optic connectors.

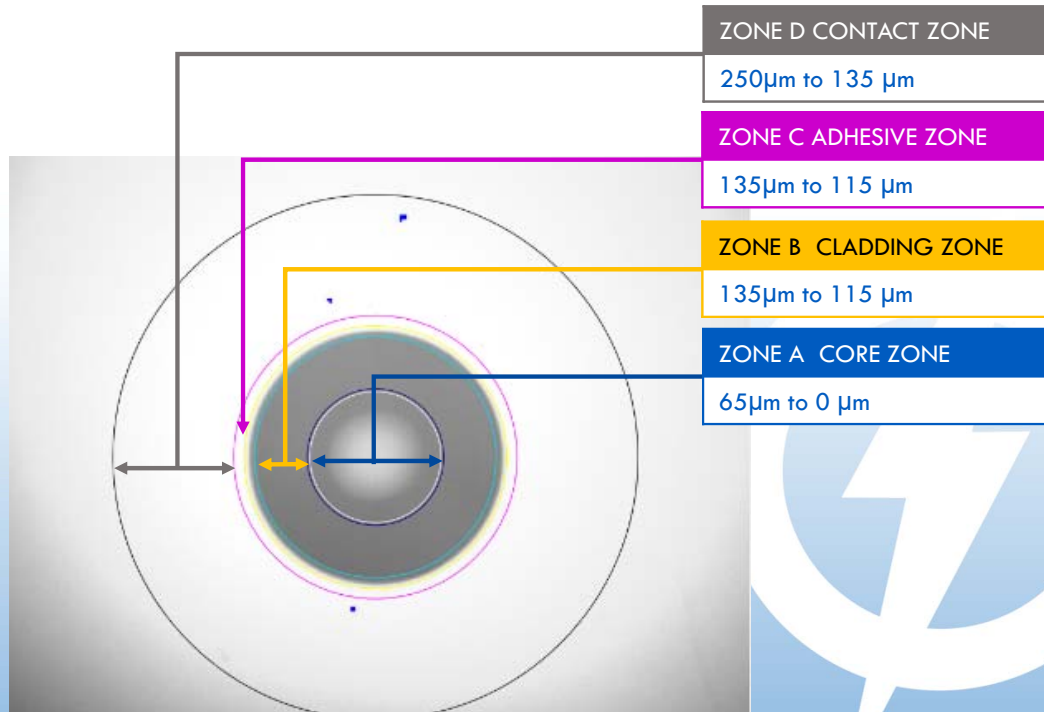


GOOD NEWS!!!

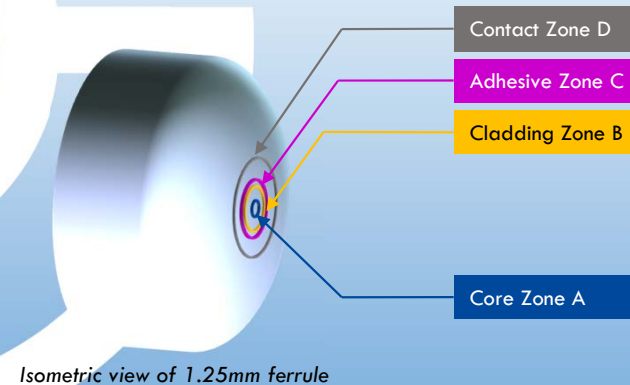
Endface contamination is the simplest and least expensive challenge to overcome on a fiber optic network installation.



IEC 61300-3-35 FOUR MEASUREMENT ZONES FOR SINGLE FIBER

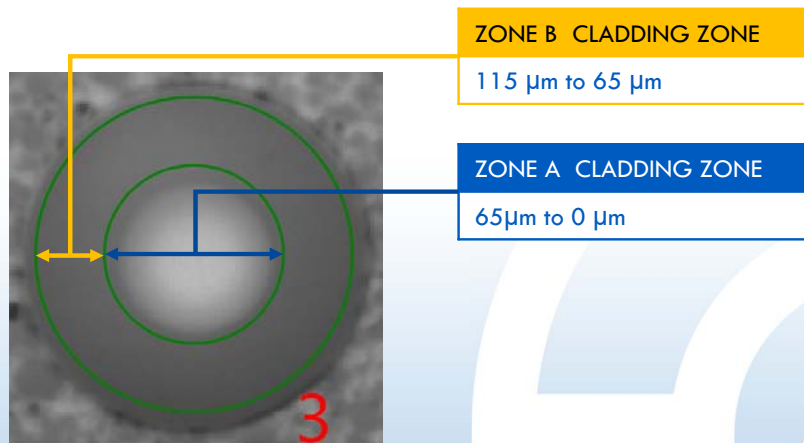


- IEC 61300-3-35 industry standard for assessing surface quality of a ferrule endface.
- Includes pass-fail criteria for determining if a surface defect will impact the signal loss.
- Most endface defects that cause high loss are caused by contamination and easily avoided.



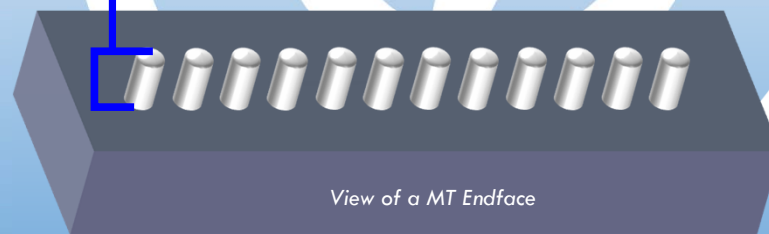


IEC 61300-3-35 TWO MEASUREMENT ZONES FOR MT MULTI FIBER

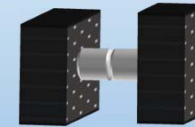


- MT ferrules only have 2 zones because the individual fibers protrude up from the ferrule plane
- Contamination on the fiber or in between the fibers interfere the alignment of the two fibers causing high losses

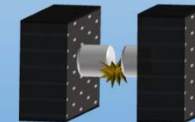
You need uniformity on the fiber protrusion height to minimize loss



FIBERS TOUCHING ☒

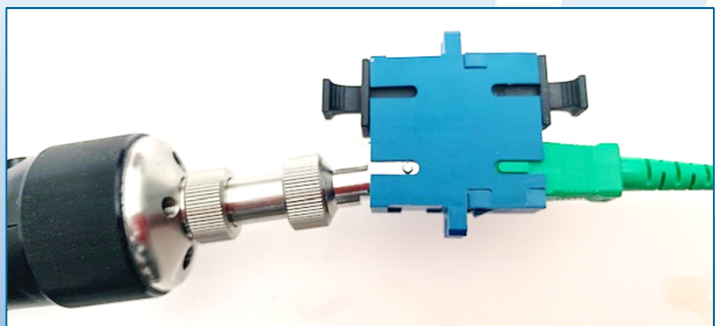


FIBERS NOT TOUCHING ☐





SPEED THE N PROCESS BUY USING THE IN ADAPTER INSPECTION TIPS



Using a connector adapter with the In Adapter Inspection Tip will take:

- **2 seconds per end** to inspect a LC endface
- **< 20 seconds per end** to inspect a 12 fiber MT endface.

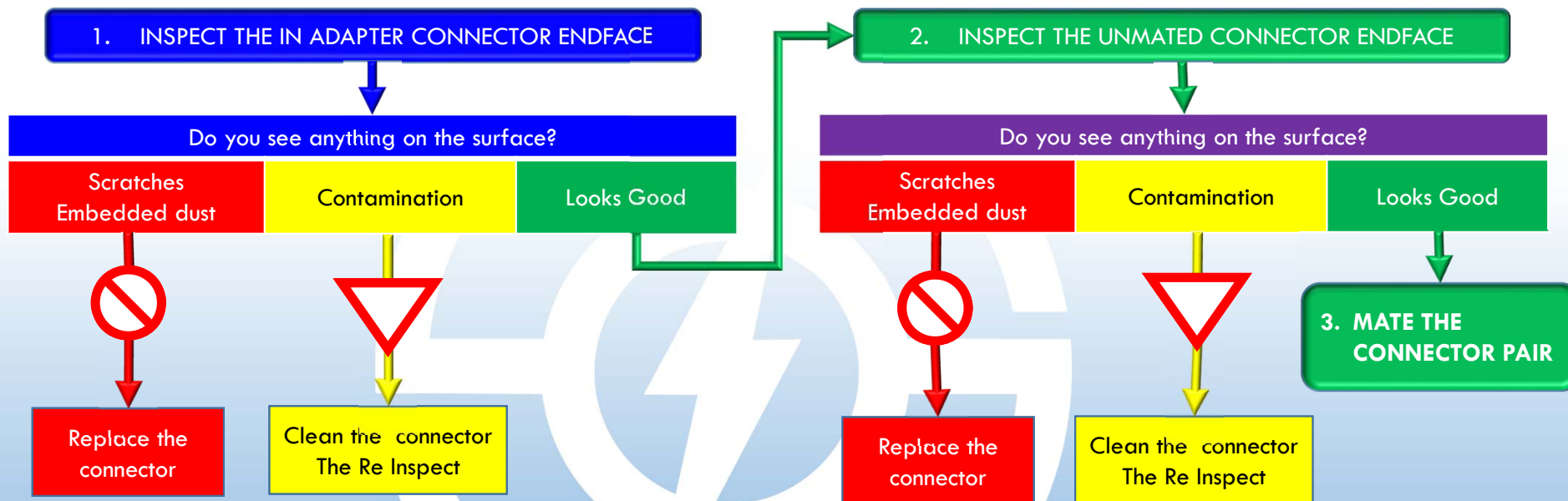


ADVANTAGES OF USING THE IN ADAPTER INSPECTION TIPS:

- **SAVE TIME** by not switching between inspection tips for checking endfaces in patch panels and the unmated cable assemblies.
- Using the same inspection tip and an adapter for inspecting cable assemblies **ELIMINATE NEED FOR CONTINUAL MANUAL FOCUS ADJUSTMENTS**.
- If working with **ANGLE POLISHED CONNECTORS**, the alignment of the inspection scope's camera angle and the angle of the ferrule endface are in alignment



PROACTIVE PROCESS FOR ELIMINATING PROBLEMS IN THE BEGINNING

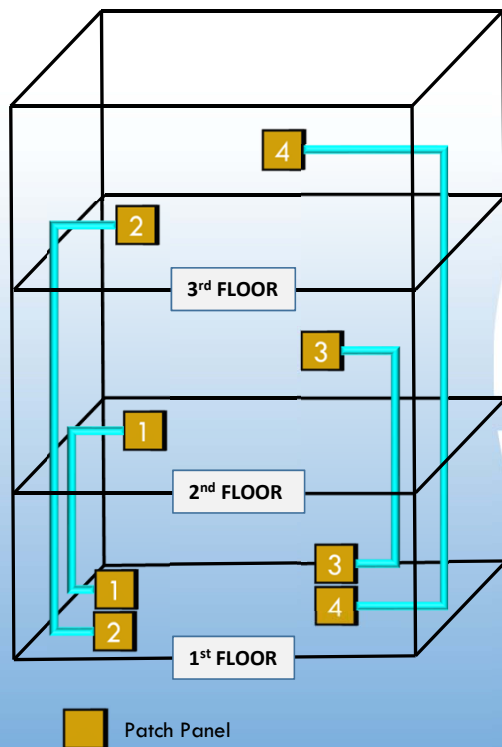


TIPS FOR SAVING YOU TIME AND MONEY:

- **NEVER** assume an endface is clean. We have seen what happens when dust gets in between a mated connector pair.
- Get in the habit of checking both endfaces of a connector pair just before you mate the connector pair.



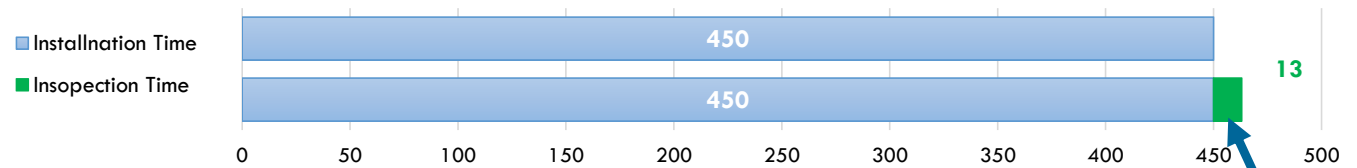
CASE STUDY: INSTALLATION OF FOUR 24 FIBER ASSEMBLIES IN A BUILDING



INSTALLATION NOTES:

- It will take **7.5 hours** to pull, secure & label the 4 trunk assemblies
- The trunk assemblies are using LC Duplex connectors
- There are **384 endfaces** that should be inspected
 - $24 \text{ fibers in a trunk} \times 2 \text{ ends} = 48$
 - $48 \text{ endfaces going into 48 ports} = 96$
 - $96 \text{ endfaces per link} \times 4 \text{ trunks} = 384 \text{ endfaces TOTAL}$
- If the trunk uses LC duplex ends, it would take **< 13 mins** to do a full **100% inspection**

Comparison of Installation Times in Minutes

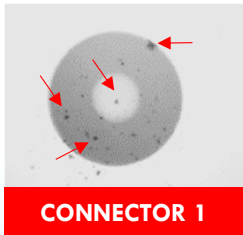


Doing 100% inspection only increased the labor 2.8%

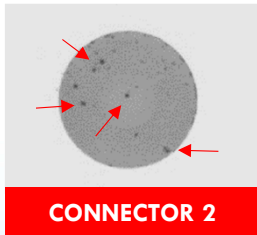


WHAT WILL HAPPEN IF WE INSPECT ONLY IF THERE IS PROBLEM?

REVIEW OF DAMAGE CAUSED BY CONTAMINATION



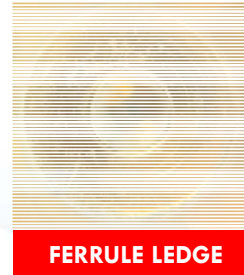
CONNECTOR 1



CONNECTOR 2



We saw how dust trapped between a connector pair embeds ruining both endfaces.



FERRULE LEDGE



Ø 0.5µm Lens



We saw how dusts transfers on the transceiver the lens. When dust gets onto the lens surface, there is no way to remove it.

POTENTIAL REWORK EXPENSES

Replacement & Prep for a field installable anaerobic connector:	15 mins/end
Replacement & Prep for a field installable hot melt, heat or UV cure connector:	20 mins/end
Replacement & Prep for a fusion splicing a jumper:	20 mins/end

+ **Additional times waiting for rework parts**

+ **Additional expenses buying the rework parts + the labor to fix the damage**

CONCLUSIONS:

1. You will be replacing assemblies & transceivers permanently damaged by mating contaminated connectors.
2. Any perceived time or cost saving benefits skipping inspection are gone with the first repair.
3. If you really think you are short on time to inspect a connector, where will you find the time to for reworking problems?



WHAT WILL HAPPEN IF WE JUST CLEAN AND SKIP INSPECTION?

Case Study 2: We are installing ten 60 fiber cable assemblies

- 2400 endfaces for this installation project. ((60 fibers x 10 assemblies) x 4 ends)
- We are going to use a cleaner that gives 500 engagements and costs \$50
- Our techs are going to engage the cleaner 2X per endface since we are skipping inspection

Project Cleaning Costs

- 500 cleanings per cleaner / 2 engagements per endface = 250 cleanings per cleaning tool
- 2400 endface / 250 cleanings = 9.6 so we will need 10 cleaners **\$500 Total**



What if we found that some of the connector were fine and really did not need to be cleaned?

What happens if the cleaner missed something and failed to properly clean the endface?

Do all the cleaners perform the same? If there was a better cleaner, could I reduce the cleaning expense?



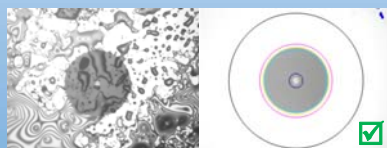
IMPORTANCE OF SELECTING THE RIGHT PROCESS & PRODUCTS

IF INSPECTION FOUND 1 OUT 12 ENDFACES NEEDED CLEANING, IT WOULD HAVE REDUCED CLEANING EXPENSES BY **90%**.

Fiber 1	Fiber 2	Fiber 3	Fiber 4	Fiber 5	Fiber 6	Fiber 7	Fiber 8	Fiber 9	Fiber 10	Fiber 11	Fiber 12
✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓

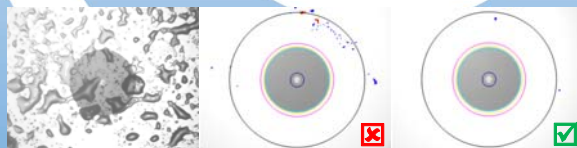
QUALITY AND CLEANING PERFORMANCE VARIES BETWEEN CLEANERS. A HIGHER QUALITY CLEANER WILL CLEAN AN ENDFACE CLEANING WITH 1X ENGAGEMENT THAT ANOTHER LESSER QUALITY CLEANER WILL NEED 3X TO 4X ENGAGEMENTS TO CLEAN.

Senko's SMART CLEANER CS-LC



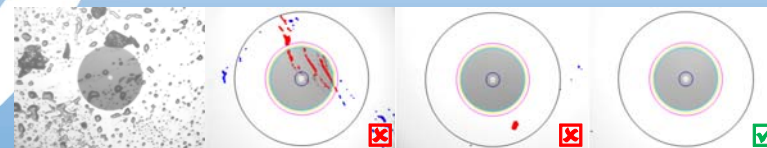
1 Engagement

Leading Competitor A



1 Engagement 2 Engagements

Knock Off of Leading Competitor A



1 Engagement 2 Engagements 3 Engagements

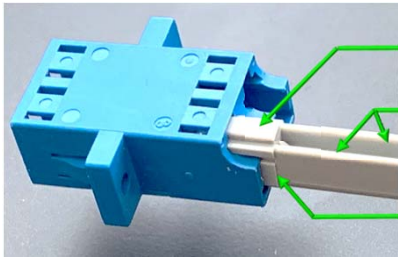


FEATURES TO LOOK FOR WHEN SELECTING A CLEANING TOOL

CHECK THE FIT OF THE CLEANER INTO THE ADAPTER PORT

You want the cleaner's tip to be very stable in the adapter port.

Senko SMART CLEANER CS-LC

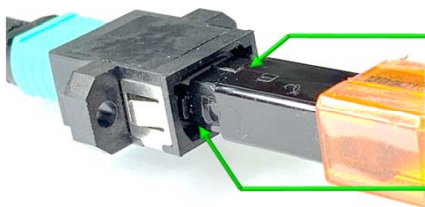


Key fills the notch in the port

Double spine for greater strength

Port Alignment Grooves

Senko SMART CLEANER MPO



Key fills the notch in the port

Port Alignment Grooves

EXAMINE THE FEATURES OF THE CLEANING TIP AND BARREL

The cleaning tip quality is important because this is what is making contact and wiping the ferrule surface.

Senko SMART CLEANER CS-LC



- Multiple features for stabilizing the cleaning tip
- Molded material are seamless with smooth lines
- Cleaning tip design provides precise control of the cleaning strand and minimize wear stresses

Knock Off of Leading Competitor LC Cleaner



- Depending on hole in tip for alignment
- Orange peel surface + surface flashing degrades and contaminates strand
- Soft plastic material of the cleaning wears rapidly shortening the life of cleaner



LESSON LEARNED THAT WILL HELP YOU REDUCE INSTALLATION COSTS

1. A combination of inspection + cleaning will prevent signal loss caused by contamination and enable us to reduce our installation expenses.
2. Mating connectors with verifying the surface quality and cleanliness is risky and frequently results in permanent damage the ferrule of both ends of the connector pair.
3. The amount of time it takes to inspect a ferrule endface is 2 seconds and verifying the hundreds of endfaces is going to take less time than reworking a single contamination based problem.
4. Quality of cleaners in the market varies so surest way to get the job done right the first time is use good quality product and good processes.



THANK YOU FOR YOUR TIME!

Questions?

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