

Breaking Through the Myths to Reality

A Future-Proof View of Fiber Optic Inspection and Cleaning

Dear Viewer: As presented at BICSI® in February-2018, this seminar has video and animations that are not available as a .pdf file. If you would like the original version, please contact BICSI or the author.

Edward J. Forrest, Jr.
RMS(RaceMarketingServices)

Bringing Ideas
Together



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Caution: This Presentation
is going to be controversial!

**IT IS BASED ON 2,500 YEARS OF
SCIENCE AND PRODUCT DEVELOPMENT**



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Fact OR **FICTION**
of
Fiber Optic Cleaning and Inspection

**This seminar may contradict current trends
and what you've been taught.**

**Let's separate Facts from Fiction
and
Myth from Scientific Reality**



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Fact OR FICTION

of
Fiber Optic Cleaning and Inspection

- A Fiber Optic Connector is a Two-Dimensional Structure
- **99.9% “Reagent Grade” Isopropanol is an effective fiber optic cleaner**
- Cleaning is not important... anything is better than nothing!
- **There are OTHER WAYS BESIDES VIDEO INSPECTION to determine if the connector is “clean”**
- **Debris on the surface of a fiber optic connector surface is two-dimensional “diameter”.**
- “Automatic Detection” is “good enough”. “Pass-Fail” is easy to understand
- Existing standards, such as IEC 61300-3-35, are “Best Practice”



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Fact OR FICTION

WHAT IS THE “AUTHORITY” ?

PRECISION CLEANING AND INSPECTION ISN'T “NEW”.

- **‘Wafer Fabs’ for electronic components** (LEDs, CPU, RF...)
- **High-density printed circuit boards** (Pick & Place)
- **Metal Cleaning** (Aerospace, Nuclear, Gas & Oil)
- **Implantable medical devices** (Cochlear, Cardiac, Prosthetic)

A well-established performance history of precision cleaning and inspection on which our Industry can base itself...and has not.



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Please
join me:

In Search of: Best Practice

[Best practice - Wikipedia](https://en.wikipedia.org/wiki/Best_practice)

https://en.wikipedia.org/wiki/Best_practice

“A **best practice*** is a method or technique ... that produces results ... superior to those achieved by other means....”

*Merriam-Webster Dictionary, Cambridge Dictionary, Investopedia®, Business-Dictionary®, Technopedia®

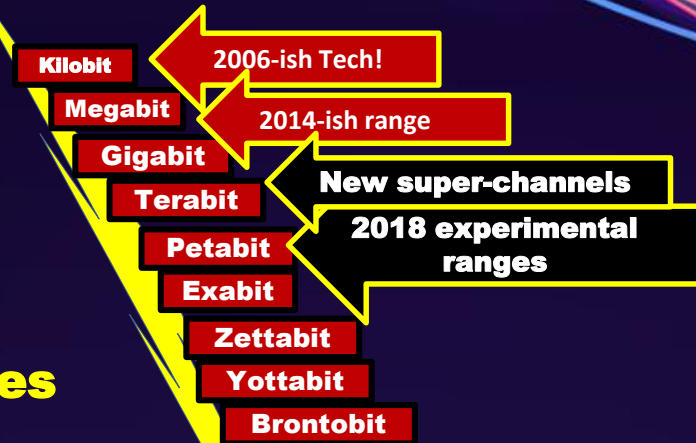


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What Does It Mean? “Future-Proof”*

1. **Processes** that anticipate future developments.
2. **Actions** taken to minimize negative consequences.
3. **Change old perceptions into new realities**

* adjective: British. Oxford® Dictionary. Technipedia®, Cambridge® Dictionary, Wikipedia®



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What Does It Mean? **“Future-Proof”***

“Do all aspects of Fiber Optic Network Design, Installation and Training Development?”

advance at

The Speed of Light?



“MAYBE...”
Is that good enough?



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* adjective: British. Oxford® Dictionary. Technipedia®, Cambridge® Dictionary, Wikipedia®

Buzz Words?

**Future
Proof**

**Best
Practice**

Or: The Way Forward



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Myth or Reality?

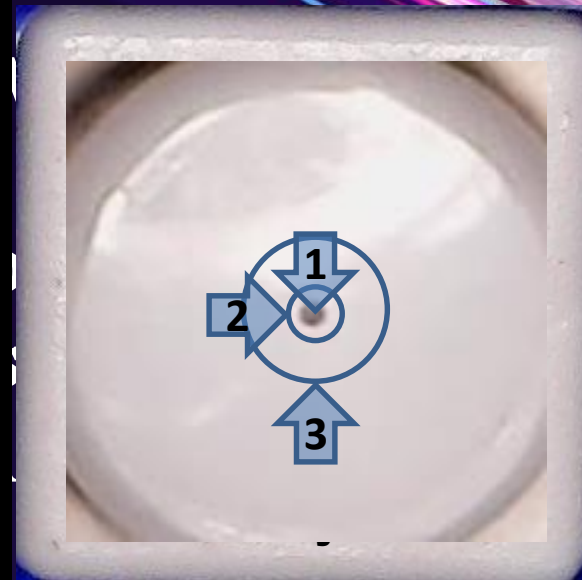
What is the “end face”?

Is the IEC 61300-3-35 definition of a two-dimensional surface adequate and accurate?

“Zone-1” ... is the “fiber/core”

“Zone-2” ... is the reflective cladding

“Zone-3” ... is the contact surface



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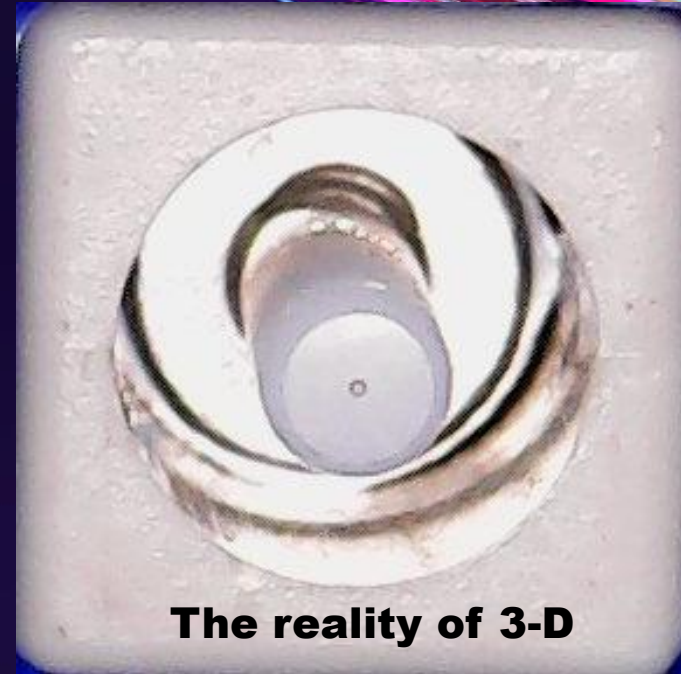


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Myth or Reality?

THE “MYTH” OF TWO-DIMENSIONS

- 1.) **Connectors are two-dimensions**
- 2.) **Contamination is two-dimensions**
- 3.) **Contamination is limited to a limited “end face” surface area diameter**



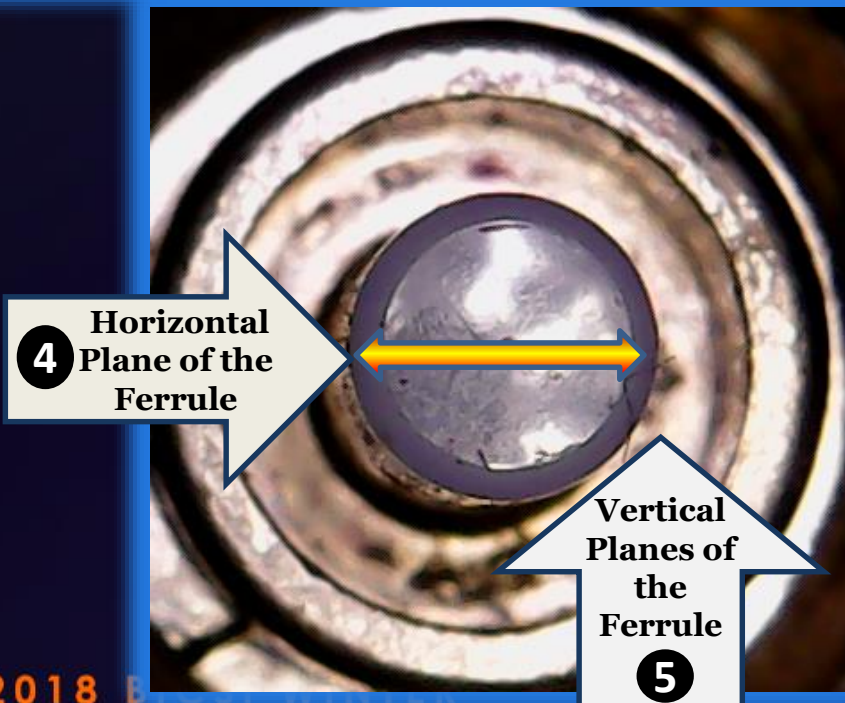
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Myth
or
Reality?

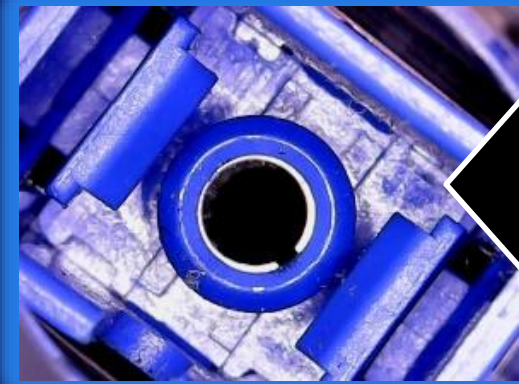
The fiber optic end face and associated components are 3-D structures!



4 Horizontal Plane of the Ferrule

Vertical Planes of the Ferrule
5

Add Zone-4 and Zone-5 to your understanding of any fiber optic surface



Includes these surfaces also!



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Images © RMS-1



Myth Happens



**Sometimes, it's “impossible” grasp the vast
and infinite nature of our
universe of installations!**

***We want “it” to be ‘easy’...
... “it” can also be accurate and effective.***



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Myth Happens



“it”

Sometimes, it's “i
and in
univer

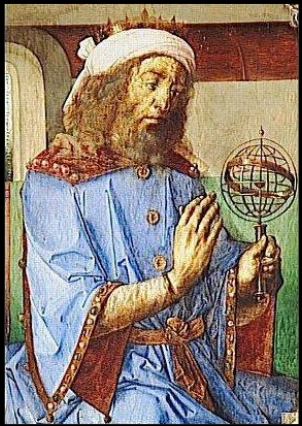
- Accurate and adequate design parameters
- Installation methods and procedures
- Effective “best practice” training

We
... “it” can also be a



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Who are they ... and what do they have to do with cleaning and inspection fiber optics?



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A brief lesson in the History of Physics and Geometry!

Early 1900's

Planck's Quantum Theory of Physics revolutionized our understanding of Atomic and Subatomic structures; Einstein's Theory of Relativity revolutionized our understanding of space and time.

Planck's work on sub-atomic structures defined them as 3-D ... and tied Euclidean mathematical science to physics!



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...about the year 1590, two Dutch spectacle makers, Zaccharias Janssen and his father Hans started experimenting ... put several lenses in a tube and made an significant discovery.

**THEY HAD JUST INVENTED THE
COMPOUND MICROSCOPE...
PRECURSOR TO
CONTEMPORARY VIDEO INSPECTION**



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**THESE HISTORICAL THEORIES AND PRACTICAL REALITIES
ARE ESSENTIAL TO PRECISION INSPECTION AND
PRECISION CLEANING FIBER OPTICS!**

- 1. Existing precision cleaning and inspection standards are based on “Euclidian 2-D geometry”.**
- 2. Ptolemy, Descartes, Planck, Einstein and Chis Columbus taught us ...
*about what we know as you are sitting there today
in the here & now!***

WE EXIST IN 3-DIMENSIONS!



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IT'S TRUE:



We are inspecting and cleaning fiber optic connections based on 2nd Century (BC) Euclidean Geometry and Microscopes invented in the 16th Century!

It's time to ... “GO 21st CENTURY” ... with our thinking about these things!!!



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Myth or Reality?

THE “MYTH” OF TWO-DIMENSIONS

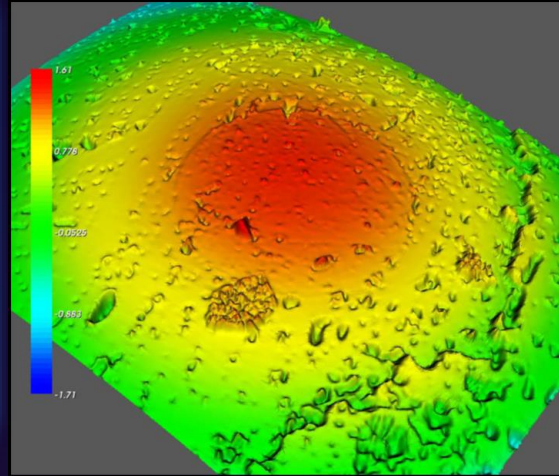
CONNECTORS ARE NOT
TWO-DIMENSIONAL STRUCTURES



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IEC 61300-3-35 Measures Debris & Contamination in “Diameter of 2-D”

Set the Record Straight!
Contamination,
in any or all
forms,
is NOT
two-dimensions.



The “red” on this
interferometer
scale is (max)
1.67 microns in
*width and
height.*



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Who has the ‘need to know’?

AN INDUSTRY-WIDE UPDATE IS IN PROCESS

No matter the application or connection type ... when deploying fiber optics ... there is an end face and associated connector geometry that must be cleaned and inspected ... properly.

Future generations will benefit from what you do now
Design-Install-Train-Manufacture

®



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“WE” ARE STILL EVOLVING.

- Copper continues to grow even in the face of replacement by fiber optics.
- **Fiber Optics is challenged by wireless, DOCSIS 3.1, and who knows what 5G will mean to all of us!**
- You as a network designer, technician or trainer are challenged by: newer, faster, better.

®



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**You are NOT sitting there in
two-dimensions!**

**Connectors and Contamination
are NOT two dimensions as well!**

A “Homer Simpson® Moment?”



The Myths of Test and Inspection:

*Before you clean, how do you know what debris you are cleaning?
After you clean...how do you know...the surface actually clean?*

SET THE RECORD STRAIGHT: WHAT DO I USE?

- **Fiber Identifier**
 - **Visual Fault Locator**
- **Db loss test set (power meter & light source)**
 - **OTDR?**
- **Direct view microscope or loupe? A magnifying glass?**
 - **Video Scope?**

**The “real question”:
What do they do?**



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What do they do?

Fiber Identifier: A Live Fiber Trace and Toner enables the technician to identify available fibers without the disruption of existing subscriber services.

The Fiber Identifier will not indicate a clean surface



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What do they do?

Visual Fault Locator: A visual fault locator *uses a high power visible laser designed to locate and identify faults and breaks in fiber optic cables, patch panels and other cable splice areas.* They are typically effective up to 7km.

- ***This instrument will not indicate a clean/soiled fiber***



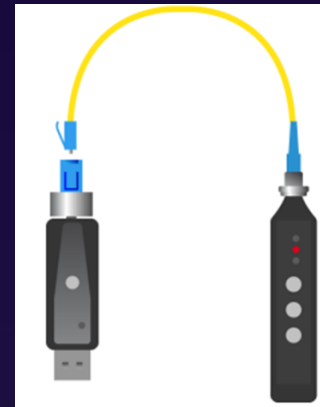
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What do they do?

Db loss test set (power meter & light source):

Provides insertion loss measurements...*how much light is lost on a fiber 'run'*

- ***Will not indicate clean/soiled fiber***



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What do they do?

OTDR? Provides a graph of a fiber optic cable typically reporting:

- Distance to faults and connectors/loss per km
- Length of the fiber run
- Verify splice loss
- Reflectance and Insertion Loss

These measurements can indicate a soiled fiber.

The OTDR is a “beautiful thing” ... may be too much for “inspection” alone.



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A Fiber Optic Video Scope is

**“Best Practice” means to assure fiber optic surfaces
are precision clean...**

Which one works best?



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Consider : “The 4 Classes of Inspection”



Class-1: Probe and Monitor



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Consider : “The 4 Classes of Inspection”

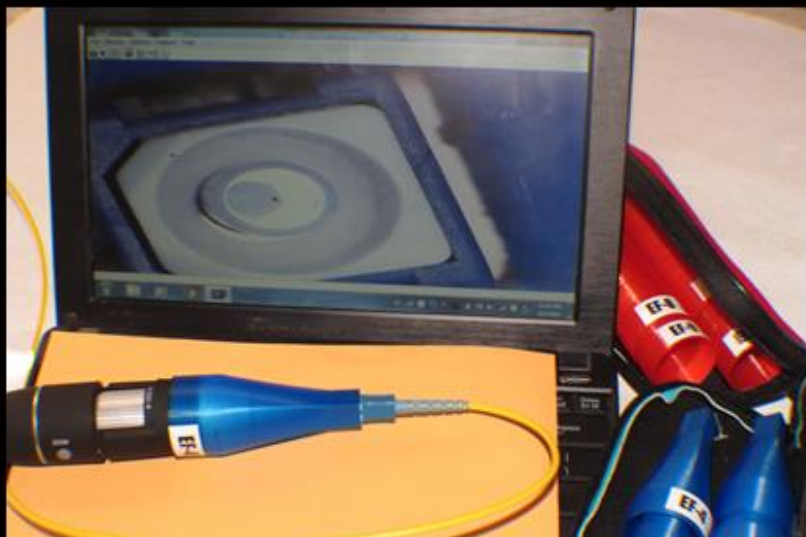


Class-2: Wireless/AutoDetect



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Consider : “The 4 Classes of Inspection”



**Class-3: Views 3-D Nature of
any connector & debris**



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What do they do?

Class-4:



Direct view microscope or loupe

- Descended from the 16th Century, the “direct view” microscope, *should never be used on an active fiber.*
 - “Far too often”: Direct View microscopes are used *improperly and unsafely where video inspection is compulsory*
 - My personal feeling: “*Never Trust a Claim these are filtered*”.
- Ideal: QC jumpers...



Which Works Best?

“It depends...” on your applications specific needs.

Don't be “sold” ... listen to all the ‘technology reasons’ a specific manufacturer has designed into their instrument.



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Myth or Reality?

Mini Conclusion

The “myth” of two-dimensions is embedded in fiber optic cleaning and inspection training and standards.

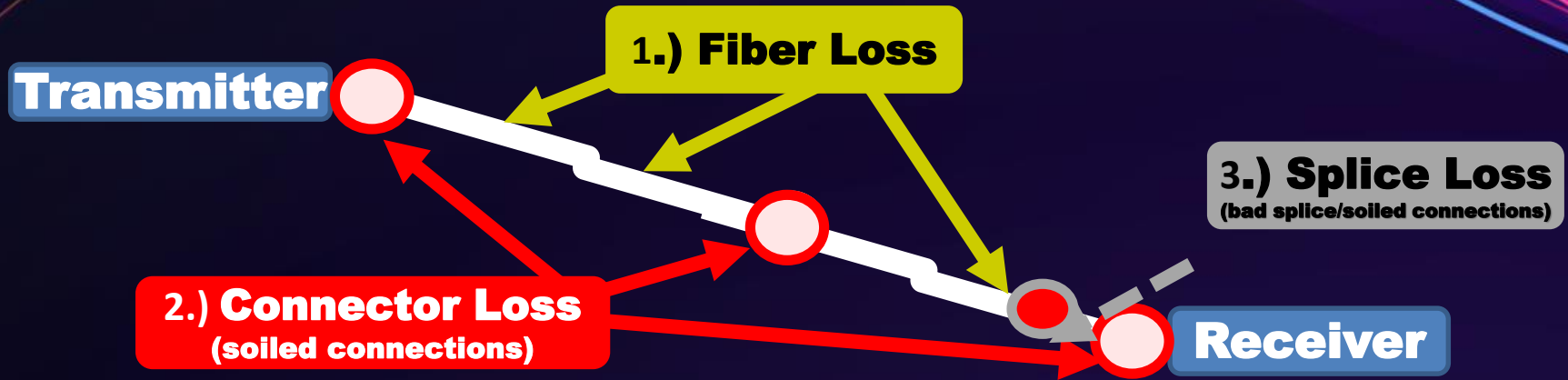
Does it really matter?

“The Answer” to that question is also why you are here!



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Insertion Loss is a 'design sum' total of three components. It's an essential calculation in every fiber optic installation.



AN IMPROPERLY CLEANED CONNECTION CONTRIBUTES TO:

- a.) Insertion loss
- b.) Inaccurate testing based on flawed criteria
- c.) *Time lost in testing ... also part of a 'lo\$\$ budget'* (Courtesy: FOA)



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There are many “opportunities” for insertion loss
“transmitter-to- receiver”.

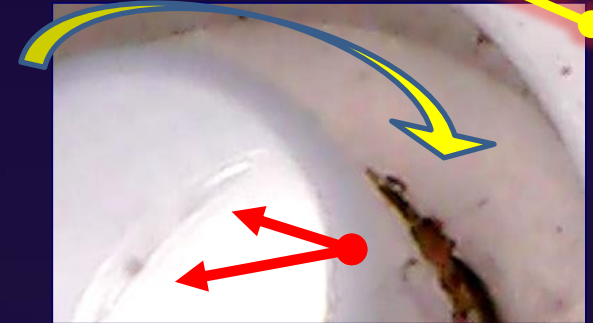
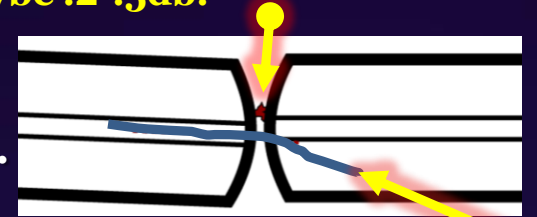
In this session we’ll review some you know...
...and...introduce you to others you may not!



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Understanding all fiber optic surfaces is critical to successful deployment

- ✓ **Reflectance**: “Reflected Power” can be caused by a soiled or improperly cleaned connector. Acceptable loss on single-mode is ... maybe .2-.5db.
- ✓ **Misalignment**: Debris on the end face can add to the loss budget by a misaligned fiber... and...unseen debris.
- ✓ **Damage**: “Scratch-through-the-core is obvious”...
Equal/greater concern is debris on “unseen surfaces”.



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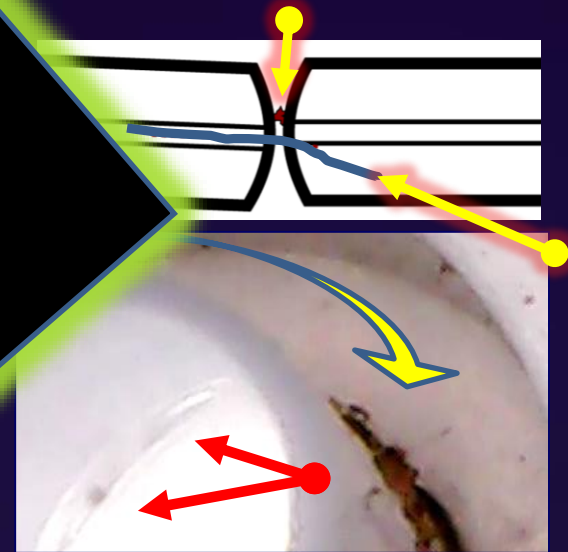
Cleaning (all) fiber optic surfaces is critical to successful deployments

As Speeds and Capacities increase ...

...as well, so should your awareness

Three Dimensional Nature of:

- a.) the connector
- b.) contamination type
- c.) its location



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Understanding all fiber optic surfaces is
critical to successful deployment

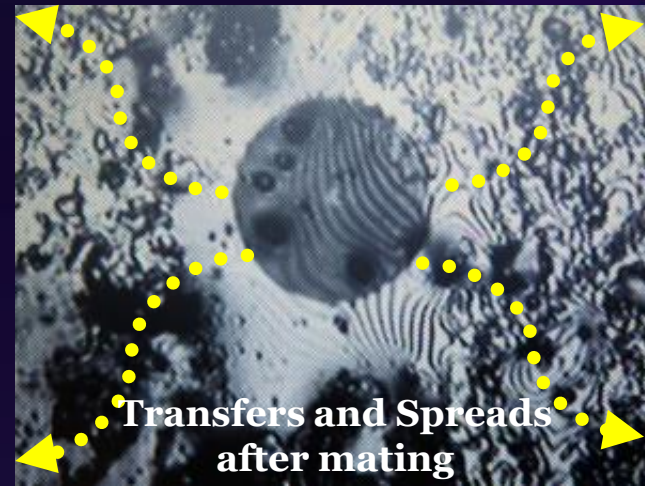
All of which impacts Insertion Loss

on “unseen surfaces”.

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What is “Primary” and “Secondary” Contamination©

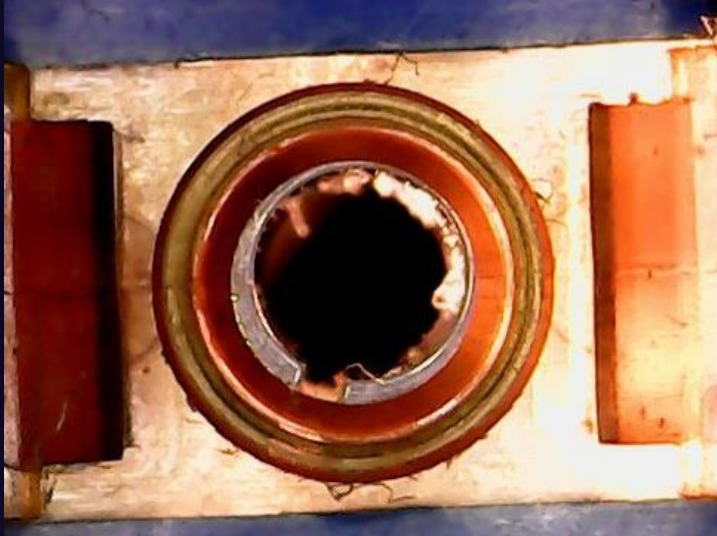


“Primary Contamination” is debris as defined by existing standards such as IEC 61300-3-35 rev-2. It’s seen through traditional inspection devices



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What is “Primary” and “Secondary” Contamination[©]



“Secondary Contamination” may be present on connector sectors outside the ‘field-of-view’ of an end face as defined by existing standards, or, other sectors of a connector.

Debris on the surface of this alignment sleeve can be ‘pushed’ from the ‘jumper side’ to the ‘backplane’ side.

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What is “Primary” and “Secondary” Contamination[©]

Notice: Inspection Ends **Here.**

In reality, contamination does not end at this point on the connector surface.

Popular inspection devices only view a limited two-dimensional surface.



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What is Primary and Secondary (Cross) Contamination©?

- “Primary contamination” is soil deposited on the end face surface by touch, environment, or other activity. *It is standardized by several organizations.*
- “Secondary (cross) contamination” is debris of any type *outside the limits of most existing inspection and not often characterized by existing standards.*
- Awareness of “Primary and Secondary (cross) contamination” provides a more complete understanding of connector, debris, and best practices for fiber optic design, installation and training. *It is a higher standard.*



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**“PRIMARY” AND “SECONDARY” CONTAMINATION:
EQUAL OPPORTUNITY PROBLEMS!
(To a successful deployment)**

- We all have been taught to clean (and inspect) The End Face: *that’s a good start.*
- Now for the first time, we see proof there is more to consider than “only the end face”.
- ***This means that if you have cleaned multiple times with no positive result ... you may be cleaning the wrong sector of the connector.***



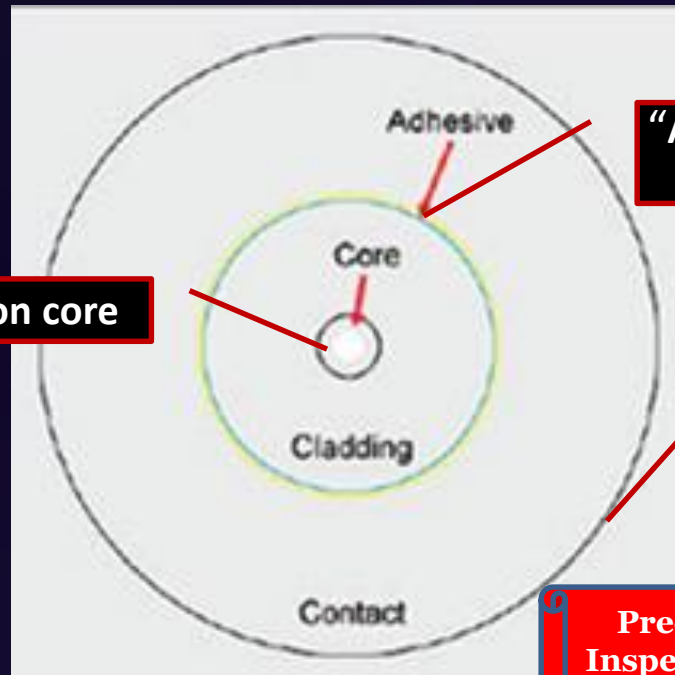
**“What is the “3-D”
nature of a connector?”**

“ISN'T ‘2-D’ GOOD ENOUGH?”



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This is the 'standard IEC 61300-3-35 view' of an end face



9 (50/62.5) micron core

"Adhesive" Zone and Cladding
@ 125 microns

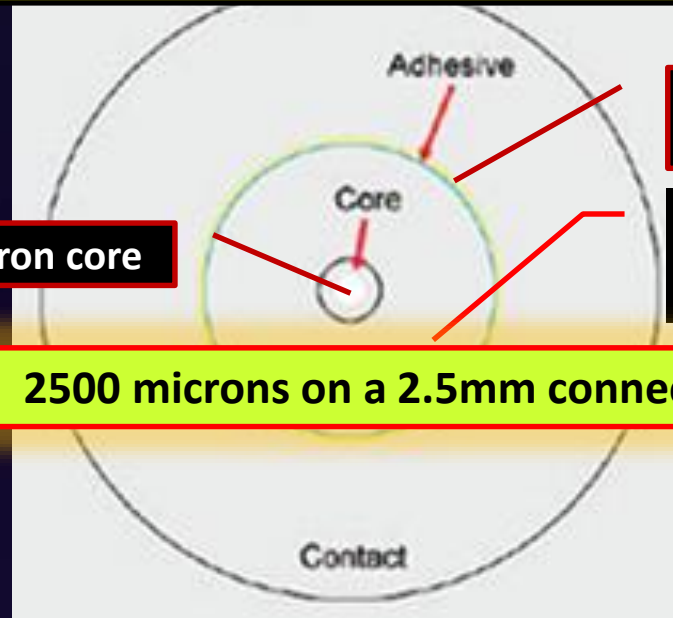
Contact Zone @ 250-300
microns

Precision Cleaning and
Inspection is not limited to
single mode installations



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The remaining field-of-view is not seen with existing two-dimensional fiber optic video inspection



9 (50/62.5) micron core

“Adhesive” Zone and Cladding @ 125 microns

Contact Zone @ 250-300 microns

2500 microns on a 2.5mm connector

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Precision Cleaning and
Inspection is not limited to
single mode installations

This short video demonstrates the complete “field-of-view” of a “FC” connector.

There is limited debris on the actual “end face”, while the remainder of the connector is heavily contaminated ... which can cause “Secondary (Cross) Contamination”

Every fiber optic connector type should be characterized in this way.



Image Captured on RMS-1. Please inquire if you want a copy.



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**THIS PRESENTATION IS BASED ON ESTABLISHED SCIENCE
THAT MAY SEEM (A LITTLE) FOREIGN TO YOU.**

→ Over the last 30+ years we have been
'taught & marketed' many stories.

Why?

→ Today, you are receiving new information that
updates the last 30+ years ...

→ As we move from "theoretical" to "practical", this science
and continual update is important to the future times
of fiber optic deployments of all types.



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That's why you are here!

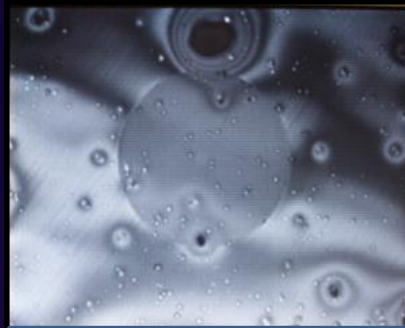
Let's talk some trash!



Dry Debris tends to stay in place



Fluids move and can transfer



Some contamination is unknown.

Existing standards define debris, soils and contamination...

- 1.) In two dimensional "diameter".**
- 2.) In relation of "distance" contamination-to-core.**
- 3.) No consideration of 'connector geometry' Alignment Sleeve, Adapter, etc.**



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There is “Science” to:

- **The various types of contamination**
- **How to remove contamination**



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What is 'dry' debris?

Actually: "How is this leaf present on this car surface?"

1.) If it's laying there, it *might* be 'blown away!

2.) If it's **surface tension hydrogen bonded**: attached by a mono-molecular 'adhesive' layer.

Can be difficult to remove

1. https://en.wikipedia.org/wiki/Surface_tension
2. https://www.researchgate.net/post/Surface_tension_and_hydrogen_bonding2https://
3. www.youtube.com/watch?v=hZvC5BKE8Sc



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What is 'dry' debris?



**HOW IS “DUST” PRESENT ON THIS
“END FACE” ...ACTUALLY?**

- 1.) It's laying there!
- 2.) It's embedded in the micro polishes of the surface
- 3.) It's attached by a static-field attraction
- 4.) It's 'surface bonded'.



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What is 'dry' debris?

While the vehicle surface and the end face are not the same ... there are common sciences of physics and contamination removal that apply to both.

THIS IS “THE SCIENCE OF CLEANING”

(Understanding the nature of debris helps you do your best work)

If you are interested in learning more, please let me know ... “What do you want to understand”.

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What is the difference between something that is “dry” and something that is a “fluid”?

- ✓ A “dry contaminate” tends to stay in place. **It may not be easy to remove.**
- ✓ A “fluidic contaminate”, by nature, moves and transfers. *It can flow to other sectors of the connector ‘geometry’.*

THESE “SCIENCES OF CONTAMINATION” HAVE BEEN STUDIED FOR THOUSANDS OF YEARS.

Myth or Reality?



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Another type of contamination is “damage”



Scratch/Damage

Some “scratches” are inevitable and acceptable.

● Others, such as this, can trap contamination and make removal difficult. *At these microscopic levels, a scratch can be a ‘reservoir’ for debris.*

This understanding directs us to the significance of the interaction between inspection, location of debris, and, removal procedures.



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The 3rd Type of Debris

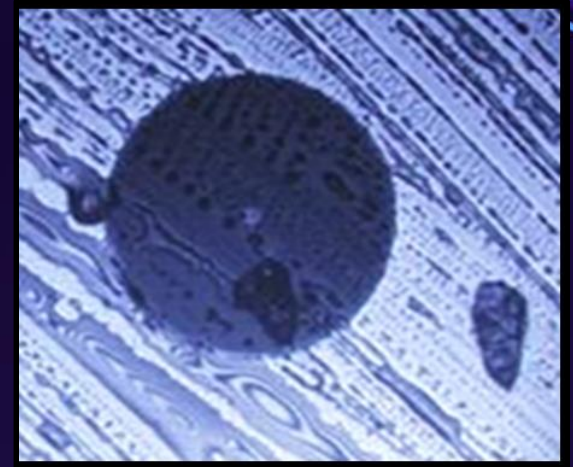
“Dry Types and Fluidic[©] Types” in “**Combination**”



Hand Lotion and Dust



Jet fuel and Sand



Finger Oil and Dry Skin



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THESE ARE ONLY A FEW OF THE (INFINITE) TYPES OF (POTENTIAL) DEBRIS THAT CAN INFLUENCE INSERTION LOSS

- **“The Problem” is that existing standards are based on ‘easy to remove debris’ ... not real world types likely you encounter.**
- **Existing standards only consider a small sector of the overall connector surface ... another ‘concern’.**
- **Cleaning tools are commercialized on ‘easy-to-remove (minimum) requirements’ not “best practice/future proof” (real world/worst case) possibilities!**



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CRITICAL TAKEAWAY:

Contamination is part of our universe!

- **Fiber optic deployments are rarely made in pristine conditions.**

Create an installation plan noting the environment:

- Dry, Humid, Dry & Hot...**
- Anticipate debris: dust, mud...**
- Previous problems and how they were resolved**

*Inspection and cleaning processes become 2nd Nature.
The fundamental techniques are the same...no matter the connector type*



Clean & Good to Go?

How do we know?



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HOW DO TO KNOW IF A CONNECTION IS 'CLEAN' AND 'GOOD TO GO'?

By Standards

IEC 61300-3-35

- **TIA 455-240**
- **Telcordia GR 2923-CORE**
- **SAE AIR-6021**

By Testing

- **OTDR**
- **Power Meter**
- **Visual Fault Locator**
- **Direct or Video Inspection**



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CAN STANDARDS BE OBSOLETE AND TESTING INADEQUATE?

IEC 61300-3-35

- **TIA 455-2**
- **Telcordia**
- **SAE AIR-155**

Yes

**Meter
Fault Locator
or Video
Section**



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**For Fiber Optic Sciences, ‘the 5-10 year update cycle of standards’
do not keep pace with development of the technologies**

Yes

“Myth Happens” when it comes to selecting test gear, the best way is to “See” fiber optic surfaces and contamination”!

This means: invest in video inspection and/or understand better cleaning methods and procedures

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Anatomy of a Standard

Look outside our industry to understand the concepts

SAE J 429 Bolt Standard: likely each is aware of it!

Grade	Size Range	Tensile Strength min PSI	Minimum elongation %-	Material Hardness	Grade	Possible Application
1	¼" -1 ½"	36,000	18%	B7 to B100**	1	Toy Assembly
2	¼" -1 ½"	57,000*	18%	B80 to B100**	2	Light weight lawn mower assemblies
5	¼" -1 ½"	92,000*	14%	C19 to C30	5	Medium weight assembly such as riding lawn mower
8	¼" -1 ½"	130,000-	12%	C33 to C39	8	Heavy Duty assembly: bridges, vehicle suspension

SAE J-429 IS 'APPLICATIONS SPECIFIC'.

It was first published in 1983 and updated in 1999. Not much changes with “nuts and bolts” standards like this one! (The 1999 Update added “washers”!)

Fiber Optic Standards are considered (inadequately) the same way



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- **Rapidly Evolving Technologies** (such as fiber optics) do not wait five or ten years to ‘re-standardize’!

As it is now: Rapidly Evolving Technologies evolve based on Proprietary know-how, Trial-and-Error, White Papers, Instructions, Word-of-Mouth Training -versus- Formal Training
(sessions such as this).

- **FIBER OPTIC STANDARDS CAN BE INTERNET BASED, BLOGGED AND VETTED BY SME FOR ANNUAL UPDATE.**
 - For many years, I have advocated that BICSI® lead-the-way and establish the concept of a **Rapidly Evolving Standard**©



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THIS IS ALSO A GOOD TIME TO REMIND YOU OF TWO IMPORTANT FACTORS:

1. Precision Cleaning a Fiber Optic Surface is “Applications Specific”

- The type of debris, location of the job, tools you select all play a critical role.
 - *The process is not ‘one-size-fits-all’.*
- When I clean, test and evaluate: I seek 1st Time Cleaning

2. End Face and Connector cleaning is NOT the same as Fusion Splice Prep

- The Products may be different
- The Techniques may be different
- Fusion splice prep cleans jacket residues and the SIDE of the FIBER...
not the end face



Eliminate Standards?

ABSOLUTELY NOT!

Think in other ways:

- 1. Understand that existing standards are ‘minimum requirements’ and may not be: ‘Best Practice’.**
- 2. Create your own: ‘BEST PRACTICE STANDARD’**
- 3. Make it part of a Work Order or Network Design**
- 4. Update cleaning and inspection procedures using the model: **“Worst Case Leads to Best Practice”.****

**Mini
Conclusions**

***“Worst Case” leads to a
“Best Practice Standard” you can
implement...this afternoon!***

**Fiber Optic deployments are in clean(er) data centers,
Along a rail road right-of-way, Deep in an arid military theatre,
During a rain-storm, in a bucket-truck, in Kansas...
FTTh in Ohio ... an MDU in The Bronx ... FTTP in Tampa!**



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**ABSOLUTELY NOT...
REDEFINE THEM**

Eliminate Standards?

- **Obtain support from the cleaning tool producer or manufacturer's representative.**
 - Your 'distributor' is a critical *supply source* ... but may not be the best resource for this information.
 - Give me a call...



Connector Types... Debris Types... Standards...

WHAT DOES IT ALL MEAN?

“Location ... Location ... Location!”



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A Higher Standard to “Future-Proof” your success

inspection

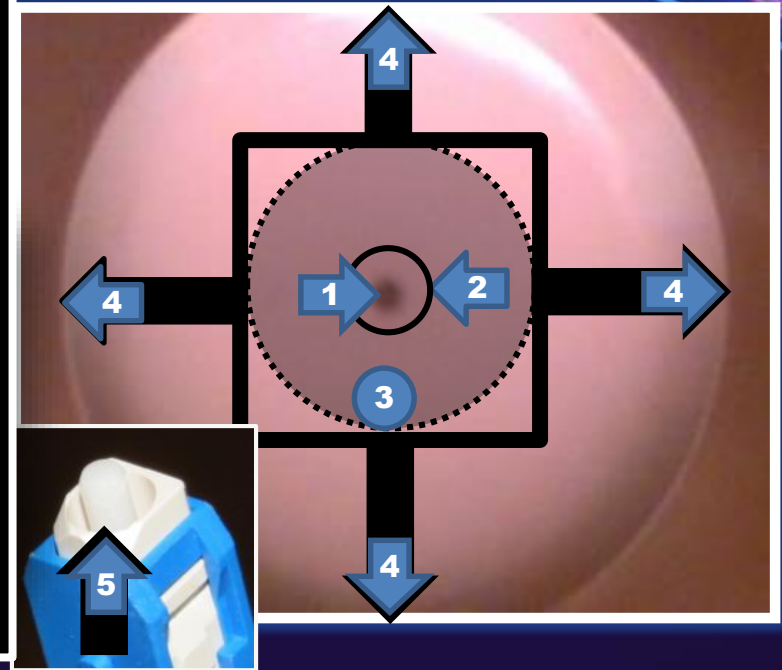


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THE FIVE ZONE THREE DIMENSIONAL VIEW

The “Field of View” *within the black box* is the typical limited view of a 400x video scope.

- **The greater the magnification** the better the resolution (ability to define contamination) but
- **The greater the magnification,** the less you see of the complete connector surface.



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THE FIVE ZONE THREE DIMENSIONAL VIEW

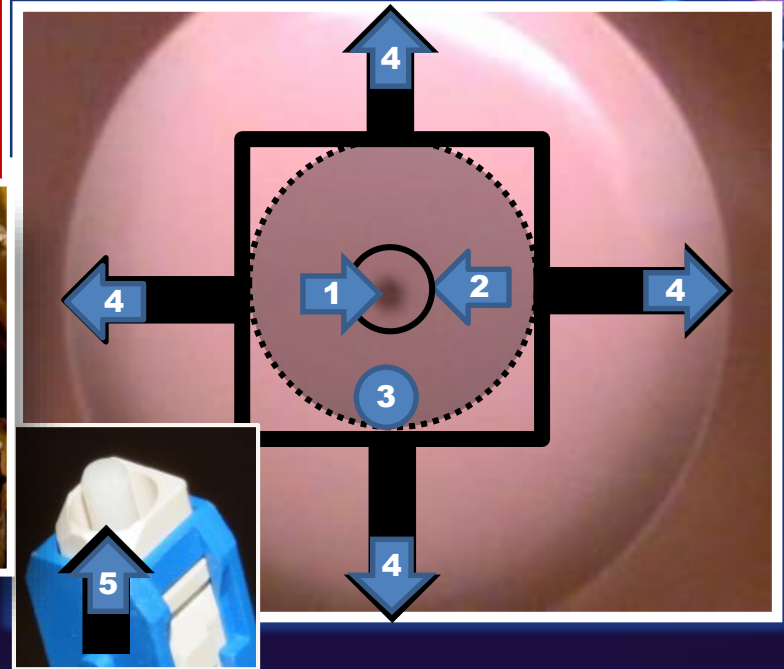
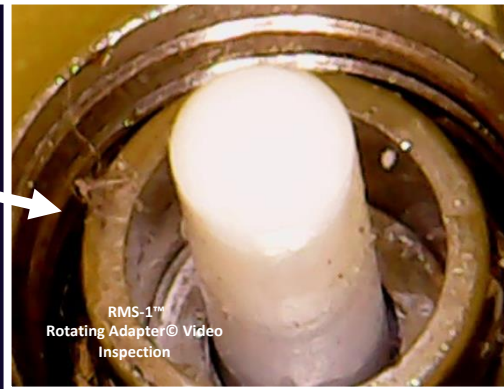
To properly precision clean and inspect...

“Look Outside the Box”

- Consider total ‘connector geometry’

Why?

“Debris exists in places you can’t see”



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Precision Inspection: The Concept of “Field of View”



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video.



RMS-1
Rotating Adapter © Video
Inspection
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This is about half-way!

Please, take a short break. Jot down your thoughts, notes or, challenges and send Ed an email.

edforrest@fiberopticprecisioncleaning.com



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Welcome Back!

Questions **or** Challenges ?



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Myth or Reality?

What is Precision Cleaning and Precision Inspection ?



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The Three Dimensions of Cleaning Anything

INCLUDING ALL FIBER OPTIC CONNECTIONS

1st What: soil am I cleaning?

2nd Where: is the soil located?

3rd How: what will remove the soil?



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Daily we consider these things
...it's part of a 2,500 year, innate experience that
directly relates to:

**Precision Cleaning and Inspection of
any fiber optic surface!**



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As part of this 'INNATE 2,500 YEAR CLEANING EXPERIENCE' there is an advantage:

We can see what we are cleaning...

This is not always the case when inspecting fiber optic surfaces...



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The reality is:
...you may not see
what **“needs to be
cleaned”** on a fiber
optic surface.



Be Aware and
Be Prepared

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These are the cleaning methods available in 2018.

1. DRY CLEANING
2. **WET-TO-DRY CLEANING**
3. HYBRID/COMBINATION PROCESS
4. **BLIND-CLEANING**® “leap-of-faith”

AUDIENCE PARTICIPATION:

A little help, please?

Which one do you use?

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____

Surprisingly? My survey conducted over a four year period reports about 60% of all connections are “blind cleaned”



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Myth or Reality?

The Myths of Cleaning



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Which do you use?

Fiber Optic Cleaning Products: 1998-2018

Cassettes



Dispensed Solvents



Cleaning Platforms



Probe Tools



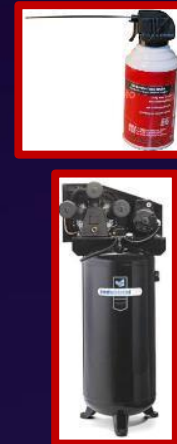
Optical Lens Wipers, Tissues and Precision Wipes



Swab Tools... "Sticks"!



Compressed Gas Dusters and Compressed Shop Air



Mechanical Cleaners



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How do you clean?



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Dry Cleaning Process

Using tools, swabs, and wiping materials

Advantage: “The Convenience of Tools”

Disadvantages:

- 1.) The “dry cleaning process” dry debris; may not remove it.
- 2.) The “dry clean process” can create a static field: attracts additional debris
- 3.) “Dry Cleaning” works best on debris that is “wet”.

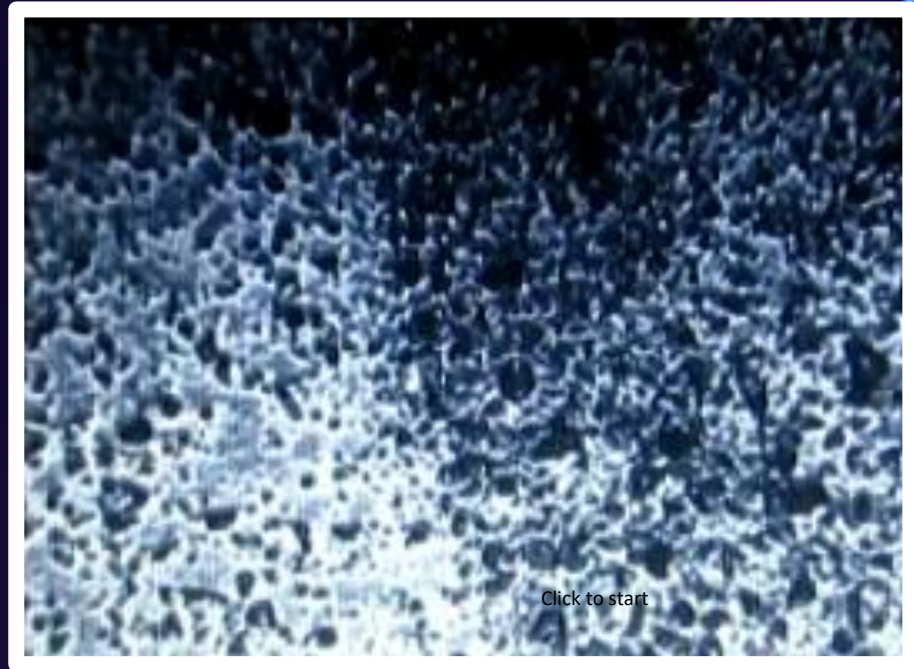


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Dry Cleaning Process

Using tools, swabs, and wiping materials

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this informative
video.



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*Remember the 'last' coffee you spilled on your desk?
There was a small river headed to your lap and keyboard!!!
How did you stop it ?*

- You used a dry wiper: *Dry Cleaning is a “mopping action” that absorbs something “wet”.*
 - Best Practice for *Dry Cleaning* with a probe tool, swab, cassette or cleaning platform: use the procedure when (if) you identify the debris as a fluid.

If you are *not* inspecting the surface...every time...how do you know?

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So, (following existing training/standards),
the instruction is:

*“Since dry-cleaning didn’t work...
use the wet-to-dry method...”*

“DO YOU AGREE?”

THAT’S THE INSTRUCTION ... CORRECT?



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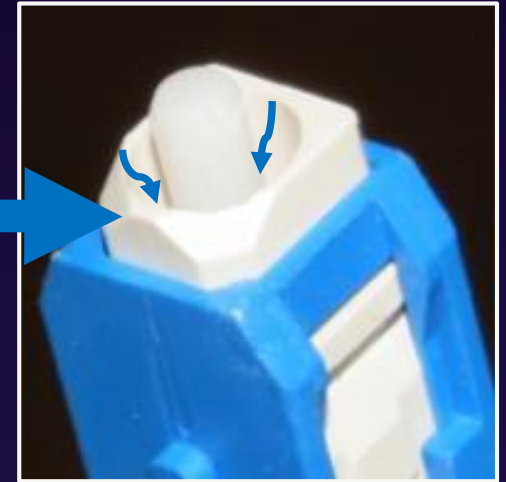
WHAT'S IN A WORD?

“Wet-to-Dry-Cleaning”



Everything
in
Moderation!

(There are micro-surfaces)



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“Wet-to-Dry” Cleaning

- “What’s in a Word?”
 - “WHERE’S THE BEEF?”



“Thanks” to
Wendy’s®!

*Hey Ed, what’s wrong with
saying “wet-to-dry cleaning”?*

DO THE WORDS MEAN
WHAT THEY SAY?

*Is there
a better way?*

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“Wet-to-Dry” Cleaning

The next demonstration is conducted using 99.9% IPA.

It has been repeated many thousands of times over the last 20 years.

The testing clearly proves that it is possible to “flood” the end face...check it out!



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video.

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**The ‘wet-to-dry’ process may, *or may not* ...
actually dry the surface.**

***Stop and think about it:* Using something
“wet” works best on debris that is “dry”.**

**This is the Science of Hydrology*: *the attraction and absorption
of dry matter by fluids...and fluids into dry matter.***

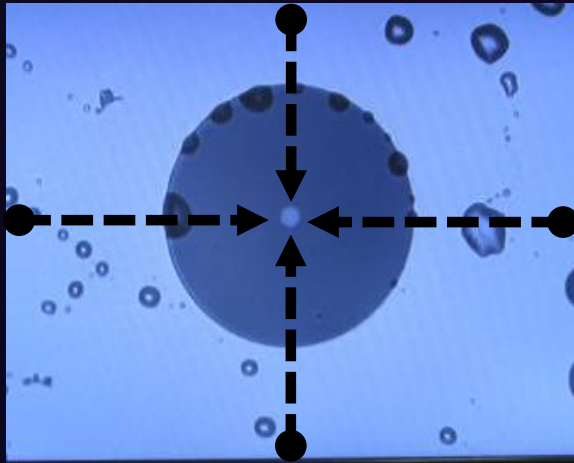
***Professor Tyson Ochsner: Oklahoma State University**



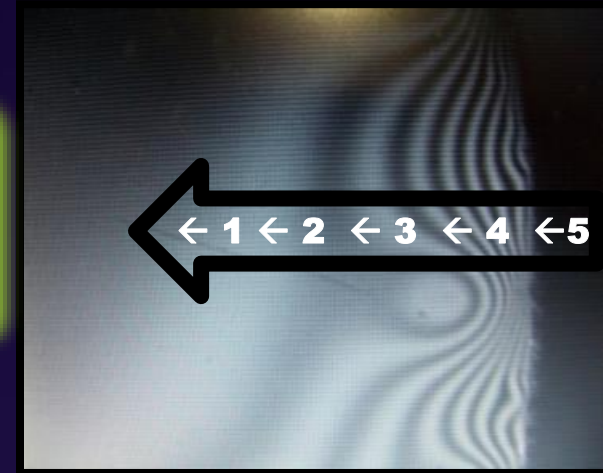
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‘Fluidic Contamination’ on the outer limits of the ‘field of view’, and embedded in Zone-5, can transfer and migrate.

If you are “blind-cleaning” you will never know!

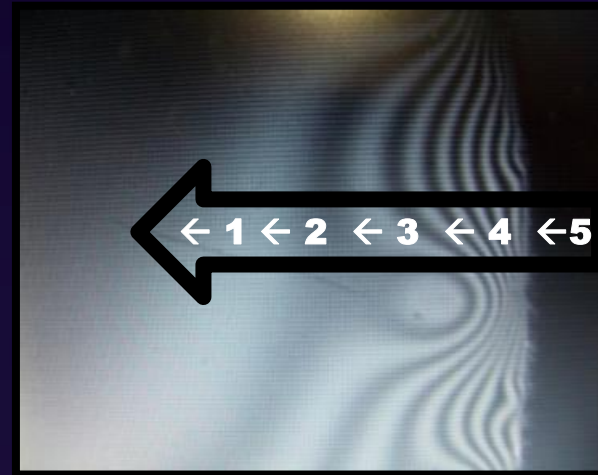
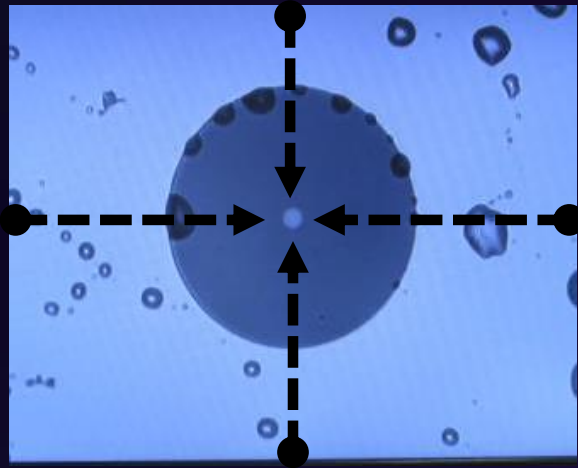


Fluid from Zones 4 & 5 heading to Zones 3-2-1



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***Don't let the term 'wet-to-dry'
convey a sense of "cleaning-over-confidence".***



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Food For Thought:

- Dry Cleaning works best for **'wet contamination'** ... *it's a mopping action*
- Wet-to-Dry Cleaning works best for **'dry debris'**.
- **What's the "Best Practice"?**
- What works on the widest range of debris?
- **Can a (different) 3rd PROCESS clean The 1st Time?**



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For me: “The instructions are *bass-ackwards!*”

(Unless you really want to clean 5-6 times and inspect each time to assure the job is done right the 1st time!)



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The 3rd Process

- **Recorded in Telcordia GR-2023-Core: 2011**
 - Identifies proper cleaning materials
- **Identifies a technique that under-uses high-performance fiber optic cleaners**
 - Integrates and identifies a drying technique
- **Applicable for all current cleaning tools and enhances their performance: *more often than not, this 3rd procedure makes the product you select perform better.***



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THE 3RD TECHNIQUE USES A SMALL AMOUNT OF HIGH PERFORMING FIBER OPTIC CLEANER.

This assures that the end face is not “flooded” with excessive cleaner that can be trapped in the recesses of the connector...including Zone-5

THERE IS AN INTEGRATED DRYING STEP...THIS MEANS DIFFERENT TECHNIQUES FOR VARIOUS TOOLS ... BUT “DRYING IS ESSENTIAL” AS AN INTEGRAL STEP TO *ACTUAL DEBRIS REMOVAL FROM THE END FACE.*

Yes, this may mean you “click it” more than once and you use two swabs instead of one!

- The technique is ‘Plan-B’ when video inspection is not available...or, you’ve cleaned it for 15 minutes and the “*darned thing still is not clean*”!

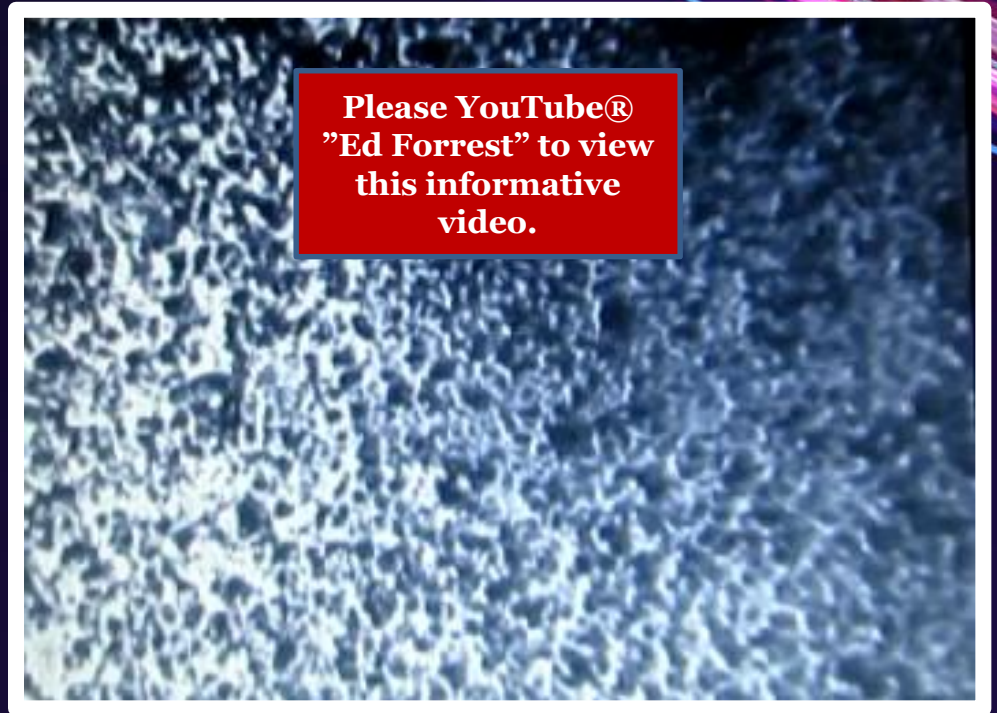


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**THE 3RD TECHNIQUE USES A
SMALL AMOUNT OF HIGH
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CLEANER.**

*This assures that the end
face is not “flooded” with
excessive cleaner that can
be trapped in the recesses
of the connector...including
Zone-5*



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Did you ever wonder?

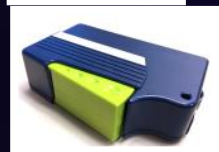
**“Why” are there so many
different cleaning products?**



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Fiber Optic Cleaning Product Confusion of Choice!

Cassettes



Dispensed Solvents



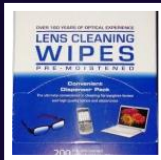
Cleaning Platforms



Probe Tools



Optical Lens Wipers, Tissues and Precision Wipes



Swab Tools... "Sticks"!



Compressed Gas Dusters and Compressed Air



Mechanical Cleaners



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➤ What if ... all of these products could work better?

IEC 61300-3-35 enables the technician to clean 'up to 5 times'

➤ What if ... *all* of these tools could work closer to **The 1st Time** ... every time!



➤ W

“WHAT IF”

A (slightly-different) **procedure**
served as a “safety net” in those
times when the only method and
procedure was to
“Blind Clean”?

ne!



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➤ WI

“WHAT IF”

that (slightly-different) procedure
was common to all tools and
eliminated confusion of choice?

➤ **What if: “Precision Cleaning
is
a Process Change”?**



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No more “mythology”!

*Precision cleaning is:
an applications specific
process change....*



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This is how it goes:

**Cleaning based on
“SCIENCES OF CLEANING”
not “product-of-the-month”.**

(Yes, the product you are using now ... can work better!)

The only thing I am “selling” is knowledge and experience!



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What is the “Proof”?

In December-2014 I conducted an updated series of tests comparing contemporary cleaning tools.

Debris and Contamination included:

- 1.) Vegetable Oil
- 2.) 10-30w SAE Engine Oil
- 3.) Arizona Road Dust
- 4.) Desert Dust from Afghanistan
- 5.) Jergens® hand lotion
- 6.) Vegetable Oil and Arizona Road Dust
- 7.) 10W-30 Engine Oil and Desert Dust
- 8.) Hand Lotion and Arizona Road Dust

1. IBC® Tool
2. ClePen Tool™
3. FerruleMate®
4. FerruleMate-2
5. Sticklers® 2.5mm Swabs tools
6. ITW Chemtronics® 2.5mm Swab Tools
7. QbE® Cleaning Platforms
8. Stickers® Clean Wipe Platform
9. HandiMate™ Platform

The goal was “First Time Cleaning”

Vendor-Neutral Testing

(This testing was inspired by a 2005 “Cisco Series” that also used “worst case debris” to establish “best practices”



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What is the “Proof”?

**Over 90% of the tools worked better...
cleaned The 1st Time**

**...with the simple process change
not included in the manufacturer's instructions.**

*The 2014 Lab Tests confirmed what I experienced when I visited
'you' (in my commercial-life) at your office, lab, or garage.*

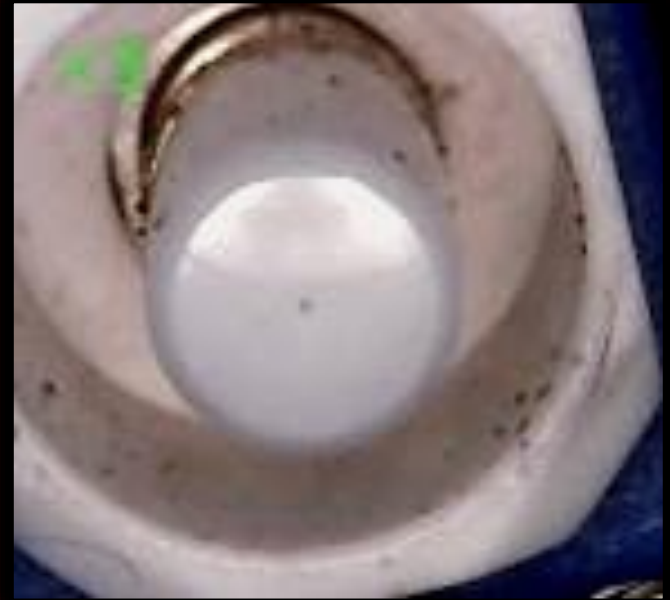


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What is the “Proof”?

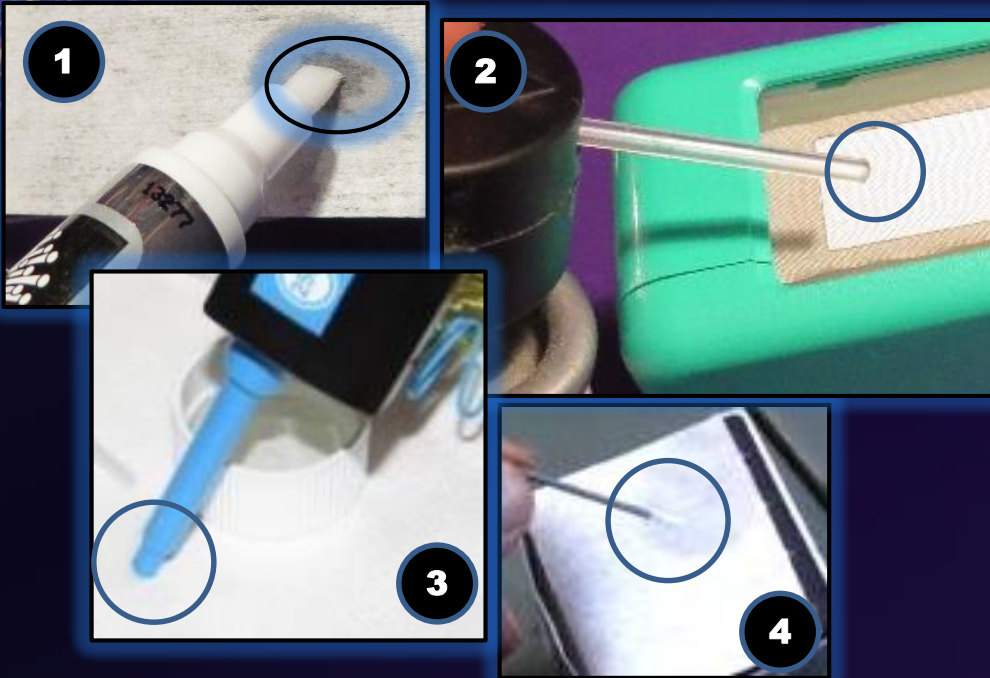
“Proof” also derived with development of a new inspection device that confirmed locations of debris on all fiber optic surface types.



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'Best Practice' Techniques



“HOW TO PROPERLY MOISTEN ANY FIBER OPTIC CLEANING TOOL”

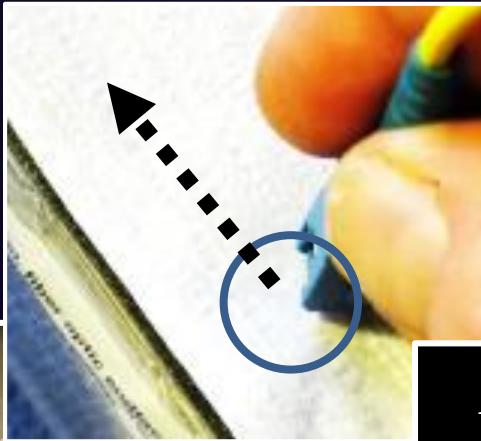
Always use a small amount of high performing fiber optic cleaner. No IPA!

- 1.) Moisten the cleaning platform surface
- 2.) Lightly moisten ‘reel cleaner’ tape
- 3.) Depress the probe tool to moisten the cleaning tip. ***Don't activate ... if it “clicks” the solvent won't be in the right place!!***
- 4.) Hold the Probe or Swab tip in the moist area for a count of 1-2-3-4-5.



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The fiber optic “precision cleaning motion” is a straight line action
Moves debris away from the initial point of contact.



Using the cleaning platform or reel cleaner

- 1.) The surface is lightly moistened ... 1/2” diameter of fiber optic cleaner is often enough!
- 2.) Clean from the back of the rack
-or-
Moisten the probe or swab tool tip

A “key benefit” of the large platform tools is the surface area enables you to “find the angle”.

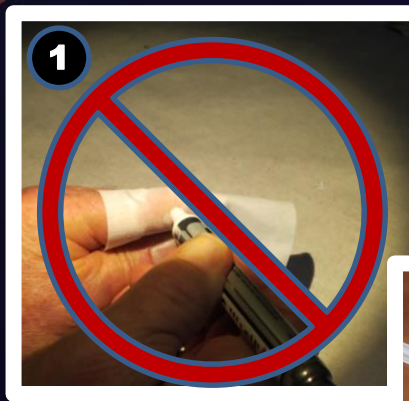
This assures the complete end face is clean.

Debris is moved away from the initial point of contact and not circled and redistributed



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Don't:



1.) **DON'T** place a wiper over your finger or in the palm of your hand. *Hand oils can transfer through the wiper to the end face.*

2.) **DON'T** clean on a hard surface. *A work table surface can 'grind-grit' and damage the end face.*

3.) **DON'T** "dunk"! Contemporary fiber optic grade cleaners are formulated to perform using **MINIMUM QUANTITIES**

It is possible to use too much...

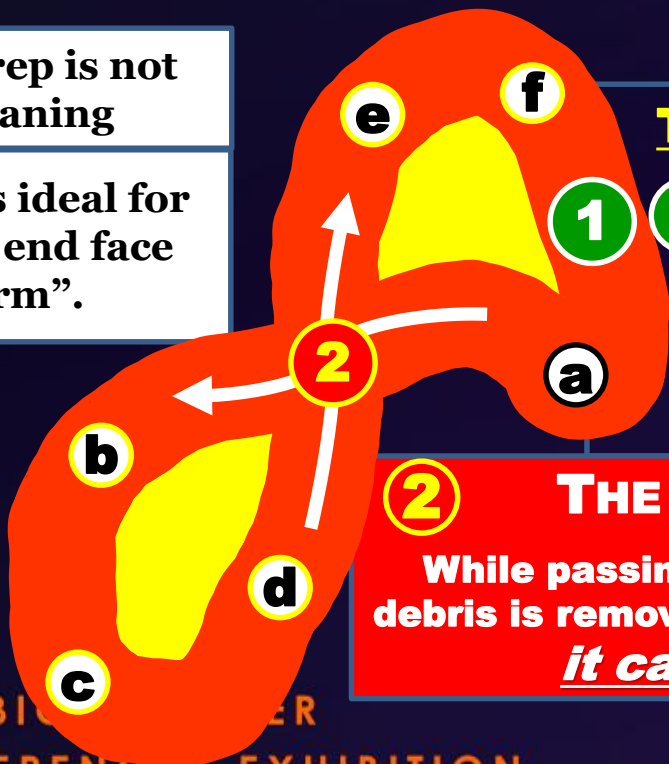


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The “Figure-8” Motion is a “Polishing Action”

Fusion Splice Prep is not
End Face Cleaning

The “Figure-8” is ideal for
“polishing” the end face
after “re-term”.



THE STARTING POINT OF THE MOTION.

- End face drawn a-to-b, c-to-d, e-to-f.
- The motion starts again.
- **THIS CAN CAUSE RECONTAMINATION.**

THE “CRITICAL JUNCTURE”

While passing the end face through the Figure-8 debris is removed and as the end face ‘crosses-over’ ***it can be re-contaminated.***

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Conclusion

Eliminate the Confusion!

What Works!

- ✓ **This group of products always used with precision fiber optic solvents is “Best-Practice”**

✓ **Which one?**

- ✓ **It is an ‘applications specific’ decision.**
- ✓ **Like a Straight-Blade/Philips/Torx decision ... contamination type and location reflects the final result.**

✓ **Ask your rep!**

- ✓ **Request Samples & Training**
- ✓ **Challenge the factory!**

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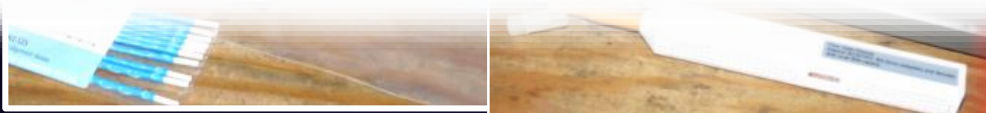
Conclusion

Eliminate the Confusion!

✓ This group of products

**Don't "dry clean" first ... always use a
small amount of fiber optic grade cleaner**

THE FIRST TIME...EVERY TIME!



- ✓ Ask your rep!
- ✓ Request Samples & Training
- ✓ Challenge the factory!



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The MYTHS of Cleaning Products

Tips on How to Select Effective Precision Cleaning Products



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The photographs in the following slides are from unbiased, vendor-neutral, formal laboratory testing. There are other studies, please inquire.

(Special “thanks” to Chemtronics® for permission to use the images)

1.) The term “precision hydrocarbon” is a generic label. Test, study, sample against your anticipated contamination. All are NOT the same.

Network Designers: include this term (or a brand name) in your “specs”. **Reach out to cleaning companies. Manufacturer’s Reps, Distributors and producers:** reach out to Designers, Trainers and End Users.

2.) The term “HFE-7100” is a trade name for a 3M© precision cleaner.

- There are new solvents entering the market. Personally, I think “aqueous cleaners” have promise.
- “HFE-7100” is formulated may be present in products you now use.
NOT ALL “HFE-7100” cleaners are the same.

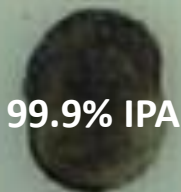


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The MYTHS of Cleaning Products

99.9% “Reagent Grade” Isopropanol is an effective fiber optic cleaning solvent

Grease



99.9% IPA

**3 second
Aerosol Spray**

**PRECISION
HYDROCARBON**



Animal Fat

99.9% IPA



**3 second
Aerosol Spray**

**PRECISION
HYDROCARBON**



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The MYTHS of Cleaning Products

99.9% “Reagent Grade” Isopropanol is an effective fiber optic cleaning solvent

Grease

**3M HFE-7100
Based Cleaner**

99.9% IPA

**3 second
Aerosol Spray**

Animal Fat

**3M HFE-7100
Based Cleaner**

99.9% IPA

**3 second
Aerosol Spray**



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WHY IS THIS SCIENTIFICALLY ACCURATE AND TRUE:

1. Isopropanol alcohol (IPA) is a ‘polar solvent’: it is effective cleaning ‘polar soils’ such as a finger print or ‘salts’.
2. **Precision Hydrocarbons, solvents based on 3M HFE-7100, DuPont® Vertrel® and some of the new Aqueous cleaners are designed to clean ‘Non-Polar’ soils such as pulling lubes, grease, hand lotions...the widest range you might imagine!**
3. The “other problem” with IPA is that is it “hygroscopic”...it attracts moisture to itself rapidly, degrading an already weak cleaning solvent. Proper storage is an issue leading to degradation of the already weak cleaning chemical.
 - ***If you can purchase 95-99.9% IPA in an aerosol container...it will stay fresher-longer. That said, it is still an ineffective and weak cleaner.***



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BY THE WAY:

1. **99.9% IPA is ‘acceptable’ for fusion splice prep ...
it’s end face cleaning that suffers.**

There are superior non-IPA cleaners for ‘fusion splice prep’ ... that don’t induce moisture into the splice.

1. Reduce your chemical inventory ... eliminate cross-application with the wrong cleaning solvents.
2. Use ones that follow:

“Worst Case Leads to Best Practice”

**What else do you need to know
about product selection?**

Other “Myths of Cleaning”



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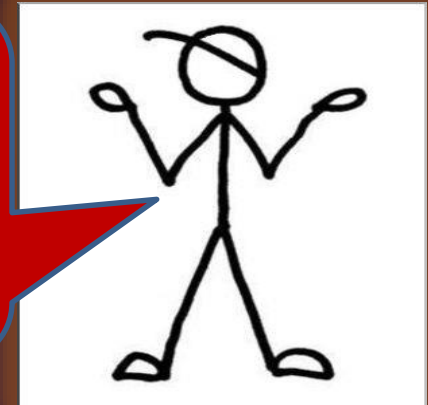
What wiping material is better-best?

- 1.) Clean room grade microfiber
- 2.) Hydro-entangled cellulose/polyester
- 3.) ~~100% paper and Low Lint Cotton~~



“What did he just say, Vern?”

“He just said use just about anything except paper and cotton!”



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Other “Myths of Cleaning”

“Lint-Free Wipers and Swab Tools”

Marketing Claims and Reality

Conduct a simple shear/tear test:



Hydroentangled cellulose/polyester is strong and far more ‘lint free’ than 100% cotton or 100% paper

Note the elongation in this wiping material before it pulled apart.

Perform this simple “pull & tear test” before you buy



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Other “Myths of Cleaning”

“Lint-Free Wipers and Swab Tools”

Marketing Claims and Reality

There is no such thing as “low lint” or “lint-free” cotton when it comes to precision cleaning.

This includes cleaning fusion splicers!



There are significant alternatives to “cotton”.

One is medical grade ‘foam’...and it’s a myth that foam is not acceptable!

Others include clean room microfibers. Some of the most popular are ‘sintered’ or ‘pull-truded’ polyester.

Get the straight story from your suppliers! Sample and test before sending out a crew.

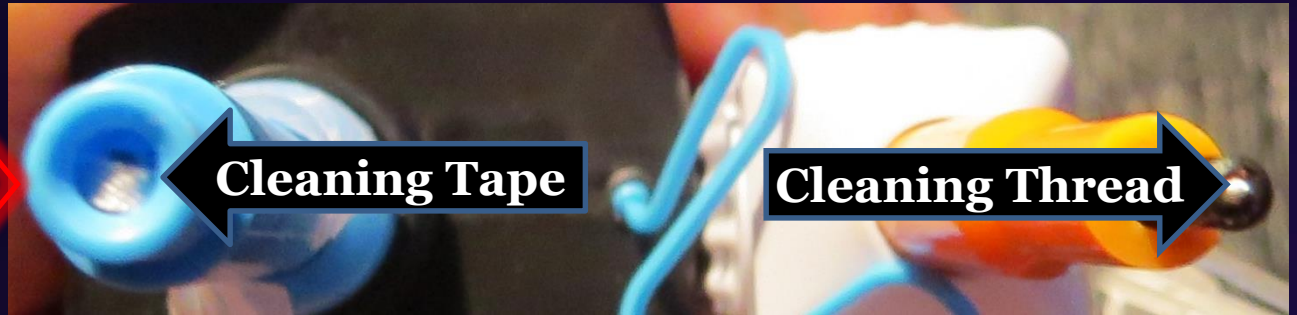
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Other “Myths of Cleaning”

“The convenience of Probe Tools”

Don't we all enjoy automation?

Both “probe tools” are marketed as 2.5mm devices



That's right...the white surface to the left in the blue surround and the white surface to the right in the black surround is the actual cleaning surface of these tools. Which one will clean more?



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Remember this picture?

Only a well-designed swab tool, lightly-moistened, will clean the alignment sleeve. ***Probe tools don't clean alignment sleeves.***

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Other “Myths of Cleaning”

“IPA and “Optical” Presaturated Wipers”

“Sure”, they are convenient!

“IPA is IPA”

Do not use for
end face
cleaning.



From \$6.12
/ 10 wipes

“The alcohol is ideal as a **general all-purpose cleaner** and is safe on plastics, PC Boards, connectors and contacts, fiber optics, semi-conductors, tape heads, office & medical equipment.”



If the wiper is used for an “optical lens surface”, it’s *not acceptable for fiber optics!*

Some actually have surfactants: soap!



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Other “Myths of Cleaning”

“Fiber Optic Grade Cleaners”

Marketing Claims and Reality

99.9% Regent
Grade IPA



Remember the “problem of storage”

This solvent attracts moisture into the ‘head room’ of the container.

Reduces cleaning ability!

Pens, Pumps,
Aerosols



Fiber Optic
Grade Precision
Cleaners



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Other “Myths of Cleaning”

ESTABLISH A “CHEMICAL AUDIT” PROGRAM

Why? Contemporary chemicals are “applications specific”

Example:

- You do not wash your hair with dish-washing soap
- **Some chemical formulations may NOT be appropriate for fiber optic applications**
i.e.: too strong and not ‘plastic safe’
not strong enough so they leave a “residue”



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Other “Myths of Cleaning”

Chemical Audit Chart

	Chemical Trade Name	Department	Application	Notes and Considerations
1.)	“FOC” Fiber Optic Cleaner	FTTh	End face Cleaning	May be used for fusion splice prep
2.)	“RGI” 99.9% Reagent Grade IPA	FTTh	Fusion Splice Prep	Do not use for end face cleaning
3.)	“GPD” General Purpose Degreaser	Maintenance	Brake cleaner	

Someone is thinking:
“This doesn’t happen.”
If it can...it will!



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Other “Myths of Cleaning”

“Canned Air”

It is not
“*breathable air*”
... it’s a gas.

Read the
label...some of
these are
“flammable gas”



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Other “Myths of Cleaning”

“Canned Air”

What it does not do:

- Remove an oily substance
- Break the static bond holding dust on the surface

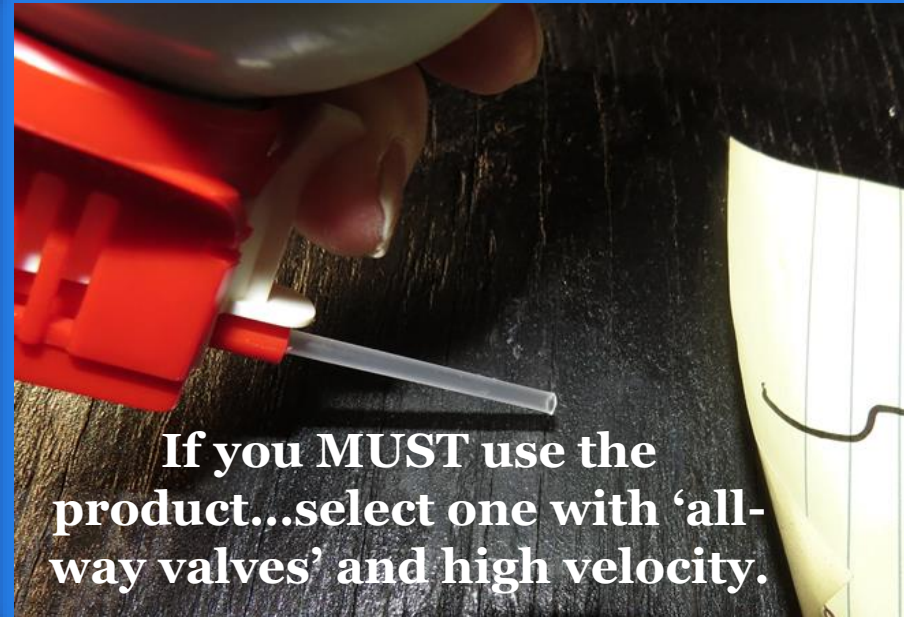
What it can do:

- Emit a damaging freeze mist
- **Dry water damaged connectors...a reason to have the container in your trailer!**



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Other “Myths of Cleaning”



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Conclusion

**“Proper” Product Selection
assures “Best Results”**



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Conclusion

Inspection and Cleaning ... of anything ... is a well-established 'SCIENTIFIC ROAD MAP' that began 5,000 years ago with the invention of soap!

THIS 'MAP' is not often followed as fiber optic sciences evolved over the last 30+ years.

That was our discussion today...



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Conclusion

Cleaning a connector surface
is not limited to the
'traditional end face'

*There is more
surface area to consider*

*'Soil points' cause primary
and/or secondary
cross-contamination*



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Conclusion

Why Waste Time?

Why ***“dry-clean first and then wet-to-dry clean if that doesn’t work...”***

Always use a small amount of fiber optic grade precision cleaner...*with all tools*

The First Time...Every Time



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Conclusion

“Best Process”
is
“Best Practice”!



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The End!

“Thank you for attending”

Questions, Challenges, or Comments?

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Please, email your contact information so I might update you from time to time.



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