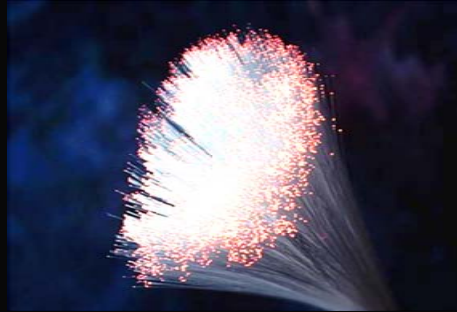


## FIBER OPTIC TERMINATION



### FIBER OPTIC CABLE COURSE

This course covers the following:

Multi Mode Fiber Optics with SMA connectors.

Safety procedures,

The history of fiber optics,

Product specifications,

Tooling requirements,

Termination of SMA type 905 connectors,

Testing of cables,

Installation rules.

**Note:** This course does not supersede Original Equipment Manufacturers (OEM) data or your companies engineering standards or policies.

This course is for training purposes only!

## FIBER OPTIC SAFETY PRECAUTIONS



### FIBER OPTIC SAFETY PRECAUTIONS

When terminating fiber there are a few safety rules to observe:

Always wear safety glasses when working with fiber optic cable.

Use caution and do not touch the end of the fiber.

The fiber can puncture the skin and break off.

Fiber shards are extremely difficult to remove from the skin.

Do not eat or drink in the vicinity of fiber optic cable terminating.

Stray shards could contaminate the food and be ingested.

Always dispose of glass shards in a proper disposal container.

When working with fiber optics, any employees performing any termination activities should always wear safety glasses.

Unless the technician is absolutely sure there is not a light source at the other end, they should never look directly into the end of the cable.

A power meter can be used to make certain the fiber is dark.

While working with fiber optics, the technician needs a well-lit work area..

Technicians should wear aprons to keep fiber particles off their clothing.

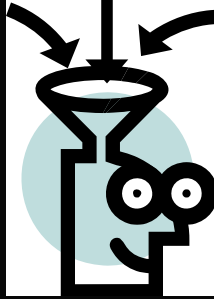
Workers should also read all MSDS material before handling chemicals.

When completing a fiber optic task, all cut fiber pieces should be disposed of properly along with any used chemicals and containers.

All work area's should be cleaned when the task is completed.

Following these fiber optic safety precautions can keep the technicians safe and an improved work environment for all employees.

## FIBER OPTICS COURSE OBJECTIVES



### **FIBER OPTICS COURSE OBJECTIVES**

The objective of this Fiber Optics course is to provide the technician with the knowledge and skills to install, terminate and test fiber optics systems in the certain aircraft with emphasis placed on consistent, safe and efficient maintenance practices.

## WHAT IS FIBER OPTICS?



### WHAT IS FIBER OPTICS?

Fiber optics is the term used to describe the principle and processes of transmitting data with light.

People have been communicating with light for a long time, flashing lights used to communicate between ships at sea, the lights in the tower of the Old North Church in Boston during the American Revolution, and the train Conductor's lamp are some examples.

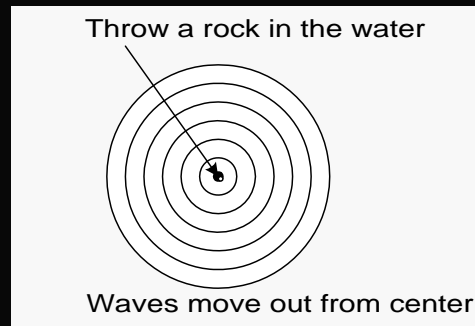
Fiber optics is based on the principle of total internal reflection discovered in the 1841 by Professor Colladon of the University of Geneva. He discovered that light in a stream of water will reflect internally and will follow the contour of the stream.

Fiber optics uses this principle to use cable to direct the light stream from one place to another. The invention and perfection of laser technology in the 1960's allowed the development of fiber optics as a means of transmitting data. Early attempts were hindered by high transmission losses in the fiber, and research showed that these losses were due to imperfections in the glass fibers.

Improvements in manufacturing have reduced losses from over 1000 dB/km to 2 dB/km, making possible the first commercial installation in 1975.

As in electricity, fiber optic cable is a conductor, but that is pretty much where the similarities stop. Fiber optic cable offers clear transmission with no electromagnetic interference. It is not electrically conductive, has no electrical grounding, and offers no electrical shock hazards. Temperature has little affect on it. A major attraction is its ability to carry data. It can carry data at high speeds over long distances yet at a size and weight at a fraction of electrical conductors.

## PRINCIPLES



### PRINCIPLES OF FIBER OPTICS

To understand the principles of fiber optics it is necessary to discuss the properties of light. Light moves in waves just like water.

Smoke signals, Flashing lights in the dark, some of the most basic of visual communications, yet still effective over a long distance. Expanding this concept, passing light through a glass medium has been around for a long time but the term "Fiber Optics" wasn't coined until the 1950s. The first laser followed in the 1960s and thus began the technology evolution that led to the Fiber Optic systems in aviation we know today.

As in electricity fiber optic cable is a conductor but that is pretty much where the similarities stop. Fiber optic cable offers clear transmission with no electromagnetic interference. It is not electrically conductive, has no electrical grounding, and offers no electrical shock hazards.

Temperature has little affect on it. A major attraction is its ability to carry information. It can carry information at high speeds over long distances yet at a size and weight at a fraction of electrical conductors.

## MULTIMODE STEP-INDEX FIBER



### MULTIMODE STEP-INDEX FIBER

Fibers come in four main configurations, each suited ideally to a different usage:

The fiber used in this course is,

Multimode step-index – 850 bandwidth

The differences among them relate mainly to the range of wavelengths at which the light will be transmitted/received and the total amount of information that needs to be transmitted at any one time (referred to as "**bandwidth**"). As analogies to further describe the differences, using one of these fiber configurations instead of another is like using a single extension cord versus using a power strip or using a 110-volt cord instead of a 220-volt cord.

Multimode step-index fibers carry light in a uniform refractive index core. The cladding serves as a type of full-length mirror, reflecting the light in straight paths at predetermined angles back to the other interior wall of the core and so on down the length of the fiber. Each mode of light is launched at one end and travels through to the other end at a unique angle, allowing for the receiver to sort the modes and decode them based on their angle of receipt. Fibers have increasing use in the components that make up coherent telecommunication systems. Fiber uses a layering construction in concentric circles for both optical and mechanical advantages. A "**core**" of silica glass, sometimes treated (or "**doped**") with another element to change its refractive index, is completely surrounded by a "**cladding**," which acts as a guide to the light waves, preventing light from leaking out of the core and keeping it traveling in the proper direction down the length of the fiber to its destination.

Surrounding the cladding is another layer, called a "**coating**." This layer is purely mechanical in nature, serving different functions such as providing protection. The term "coating" usually refers to protective layers (polymer or carbon) that are applied during the fiber drawing process, before the fiber contacts any surface.

### COATINGS

In a typical optical fiber, 75 percent of the materials used are coatings and/or buffers.

Coatings applied directly to the glass provide physical and environmental protection.

Buffers are applied over the coating(s) and provide additional mechanical protection such as crush resistance.

Many telecommunications applications use conventional dual urethane acrylate coatings to minimize microbending and aid in strippability. Specialty applications may use one or a combination of urethane acrylate,

HCS (Hard Clad Silica), (A200T)

PYROCOAT polyimide,

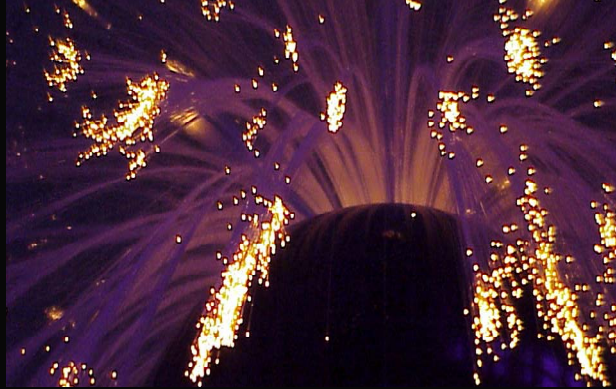
Silicone, carbon, and

Custom-designed coatings.

HCS coating is available in both fluoroacrylate (low refractive index) and hydrocarbon acrylate (high refractive index) versions. HCS is also available in a non-optical version for coating applications. Tefzel ETFE, PFA, silicone, and nylon buffers are applied over coatings during fiber draw, while an even larger variety of buffers are extruded after the draw process.

Aramid Yarn Braid is used protect optical fibers from mechanical damage and environmental degradation. The cable structure isolates the fibers from stresses that occur during installation or operation. The cable design and materials used are influenced by the application's environmental and mechanical requirements, temperature extremes, ultraviolet light (sun light), radiation, moisture, chemicals, flame and smoke generation, flexing and abrasion.

## WHY FIBER OPTICS?



### WHY FIBER OPTICS?

- **Noise Immunity.** Optical fibers are not affected by electromagnetic interference (EMI) or radio frequency interference (RFI). Also, fiber optics is the only medium that can transmit through a harsh radiation environment.

**EMP Resistance.** While not totally immune, optic fibers are highly resistant to Electromagnetic Pulse.

**Small Size and Low Weight.** A 3/8 inch (12 pair) fiber cable can carry as many voice channels as a 3 inch diameter copper (900 twisted pair) cable.

This fiber cable weighs 176 pounds per kilometer, the 3 inch copper over 16,000 lbs/km.

**No Short Circuits.** Glass fiber carries no electrical current and cannot short-out and damage equipment.

This alone makes it perfect for use in explosive environments.

## THE DISADVANTAGES OF FIBER OPTICS



### THE DISADVANTAGES OF FIBER OPTICS

The cost. The components and test equipment required for fiber optic installation are expensive when compared to copper wire.

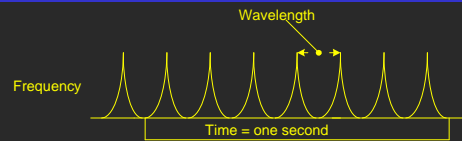
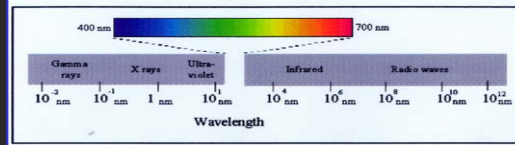
Skilled Personnel Required. Special skills and tools are required to repair and maintain fiber optic systems.

Fiber optic cable cannot carry electrical power.

A converter is required to change the electrical signal to an optical signal. This also adds a level of complexity and cost.

# PROPERTIES OF LIGHT

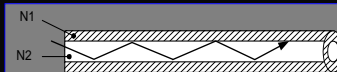
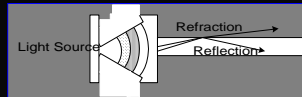
- The electromagnetic spectrum includes all forms of radiation, one of which is **visible light** -- the radiation to which our eyes are sensitive.
- Gamma-rays, X-rays, ultraviolet, infrared and radio waves are also forms of radiation. We divide the spectrum up according to the **wavelength** of the radiation.



## PROPERTIES OF LIGHT

All light is part of the electromagnetic spectrum and has a specific wavelength. The wavelengths are measured in nanometers (a nanometer is one-billionth of a meter). Visible light makes up only a narrow portion of the entire spectrum, 400 nm to 700 nm.

## PROPERTIES OF LIGHT



### PROPERTIES OF LIGHT

Refraction is the bending of a light beam as it passes through two dissimilar materials.

Reflection is the change in direction of the light beam.

Light in fiber optic cable is reflected inward by surrounding the core of the cable with a cladding of a lower refractive index.

is expressed in Hertz.

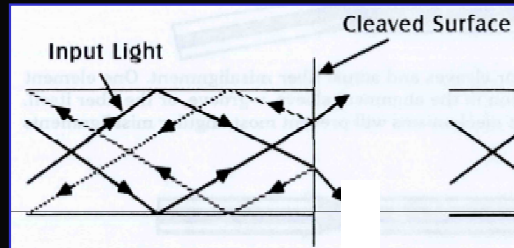
In a vacuum light travels at 300,000,000 meters per second or 300 Mega Hertz. Each color of the electromagnetic spectrum represents a specific wavelength. Fiber optics use wavelengths that extend beyond the visible range.

These infrared wavelengths (800 and 1550nm) are used because of their efficient propagation through glass fibers.

Propagation is the passing of light waves through a medium such as air or glass.

Each wavelength of light travels at a different speed through a medium. This makes each wavelength refract differently.

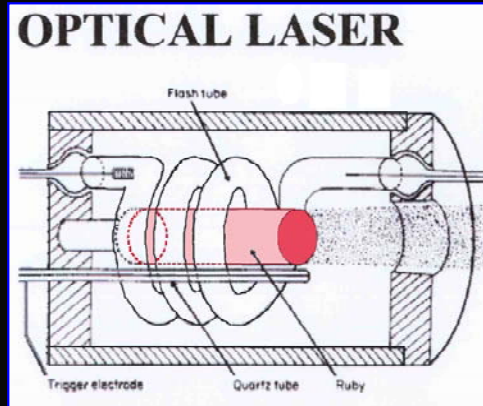
## PROPERTIES OF LIGHT



### PROPERTIES OF LIGHT

Fresnel Reflection- The change in direction of a light beam so that the light returns to its source. This effect causes much of the attenuation associated with connectors.

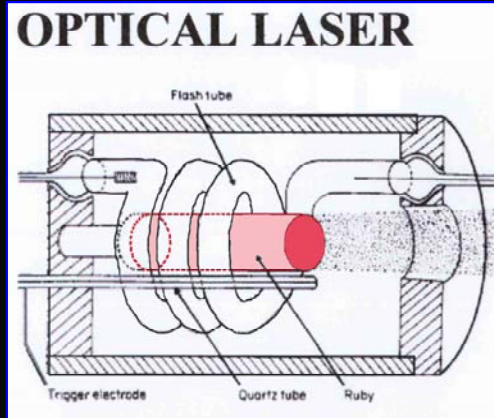
# Lasers



## Lasers

The word “laser” is actually an acronym for Light Amplification by the Stimulated Emission of Radiation. When the lamp flashes light is introduced into the ruby whose ends are polished and coated to make them reflective. One end is made less reflective than the other which allows the light to escape.

## LASERS CLASSIFICATION



## LASERS CLASSIFICATION

Lasers are generally classified and controlled according to the following criteria:

**CLASS I.** Low power lasers and laser systems that cannot emit radiation levels greater than the Maximum Permissible Exposure (MPE). Class I lasers and laser systems are incapable of causing eye damage and are therefore exempt from any control measures.

**CLASS II.** Visible, low power lasers or laser systems that are incapable of causing eye damage unless they are viewed directly for an extended period (greater than 1000 seconds).

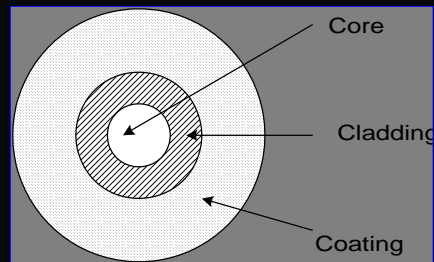
**CLASS III.** Medium power lasers and laser systems capable of causing eye damage with short duration (less than .25 seconds) exposures to the direct or reflected beam. This includes Class IIIa and IIIb lasers.

**CLASS IIIa.** Lasers that normally would not produce a hazard if viewed only momentarily with the unaided eye. They may present a hazard if viewed using collecting optics.

**CLASS IIIb.** Lasers that can produce a hazard if viewed directly.

**CLASS IV.** High power lasers capable of causing severe eye damage with short duration (.25 seconds) exposures to the direct or reflected beam. Class IV lasers are also capable of causing severe skin damage and igniting flammable and combustible materials.

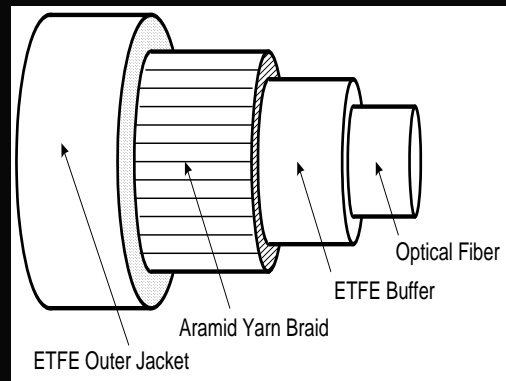
## PROPERTIES OF FIBER



### PROPERTIES OF FIBER

All fiber optic cables have 3 main components; the core, the cladding, and the coating. The core is the primary conductor of light, the cladding helps create the internal reflection and in some cases conducts a portion of the signal, and the coating that protects the core and cladding.

## PROPERTIES OF FIBER



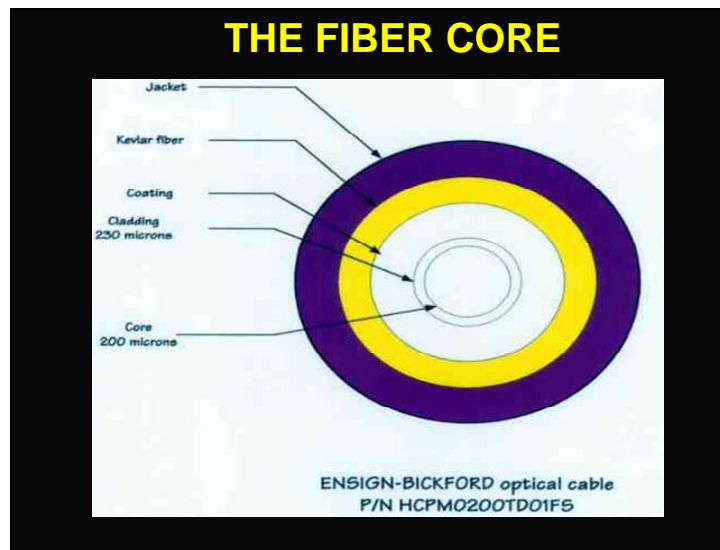
### PROPERTIES OF FIBER

The basic fiber referred to in fiber optics consist of a center **core** surrounded by a reflective **cladding** and protected by a special **coating**.

What a technician is more familiar with is a fiber cable, which consists of the basic fiber plus added layers of protection.

There are three fundamental types of fiber, step index multimode, graded index multimode, and single mode. Light travels differently in each type. This is dependent on the index of refraction for each specific cable.

In fiber optics, the index of refraction of fiber can be changed by controlling the composition of the core during the manufacturing process.



**THE FIBER CORE** p/n HCPM0200TDO1FS or similar

First, the illustration shown is a drawing of the fiber used in aircraft to connect the components of the HF radio system.

It is 200/230 multimode cable with Kevlar fiber braid between the coating and the outer jacket. The cable we use in the HF system is a plastic cable. It has a core diameter of 200um (micron) and cladding of 230um. The buffer is 500um. This type cable has a high tensile strength. The large core reduces misalignment sensitivity and allows for better coupling efficiency. Its temperature range is -65c to 125c. It is resistant to Jet fuel, solvents and oils.

## PROPERTIES OF FIBER

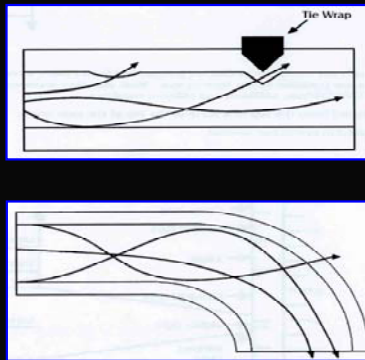


### PROPERTIES OF FIBER

There are essentially two types of transmission methods and fibers that match them.

- **Single Mode.** This method is used for long runs with lots of data transfer. The fiber has only one data path and typically has a core diameter of 9 microns. Single mode systems require a laser as a light source and operate at either 1310 nm or 1550 nm wavelengths.
- **Multimode.** As the name implies multimode fibers have hundreds of light paths, each carrying the same data. Multimode systems utilize Light Emitting Diodes as a light source and operate at either 850 nm or 1300 nm.

## PROPERTIES OF FIBER



### PROPERTIES OF FIBER

Micro-bending losses are caused by deviations in the core that occur when pressure is put on the fiber in a small area by items like tie wraps.

Micro bending loss occurs when the bend radius decreases to the point where light rays begin to pass through the cladding boundary. As the radius decreases the attenuation caused will increase. The total outside diameter is 1.8 mm. Maximum pull tension is 100 lbs. **Minimum bend radius is 10mm**

## TOOLING REQUIREMENTS



### TOOLING REQUIREMENTS

TK-6 HCS Termination kit - DTO3732-23 SMA TK-6 Termination Kit

RIFOCS 160L visual fault finder or Equivalent

557B Receiver & 257A-F20 transmitter - These are available at Greenlee Tempo.

ASM - 90 - is the adapter for the transmitter.

1087 - is the adapter for the receiver.

Hand Held Microscope up to 400x - Noyes 400X Ferrule Microscope request with Universal SMA Adapter.

Two jumpers with Male SMA 905 connectors on each end. P/N CM 230-1-8

1 SMA/SMA female coupler.

Note: Crimper and Cleaver may require QC certifications before use.

## TERMINATING FIBER



### TERMINATING FIBER

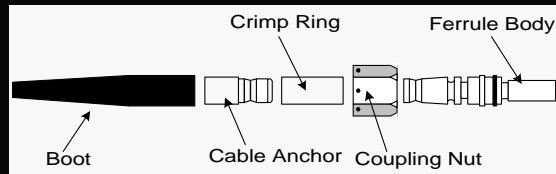
Installing a connector on fiber, while similar in some ways to putting a connector on copper wire, does require more care and an emphasis on cleanliness. As a matter of fact, cleanliness is a important part of terminating fiber optic cable.

This is a thirteen step process, plus cleaning, testing and capping.

The following sections will review each of the steps of installing a connector. **Connector, P/N CM 230-1-8**

## THE CONNECTOR

CM230-1-8 connector



### THE CONNECTOR

Installation of this connector requires the **TK-6 termination kit**. It contains all of the tools required to install the **CM 230-1-8 connector** shown above.

This connector is used in the Installation process of the military type connectors used for termination of the fiber optics cabling of the HF Radio systems.

The next slides will demonstrate the following:

Stripping.

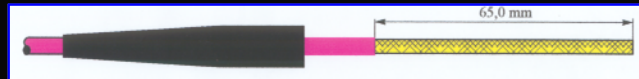
The cable anchor shown is the first part to crimp onto the cable.

Crimp ring involves two crimps 1<sup>st</sup> crimp is onto the cable anchor, second crimp is to hold the ferrule body and nut.

The Boot slides over the crimped area when finished.

Cap goes on cleaned cleaved end.

## STRIPPING THE CABLE



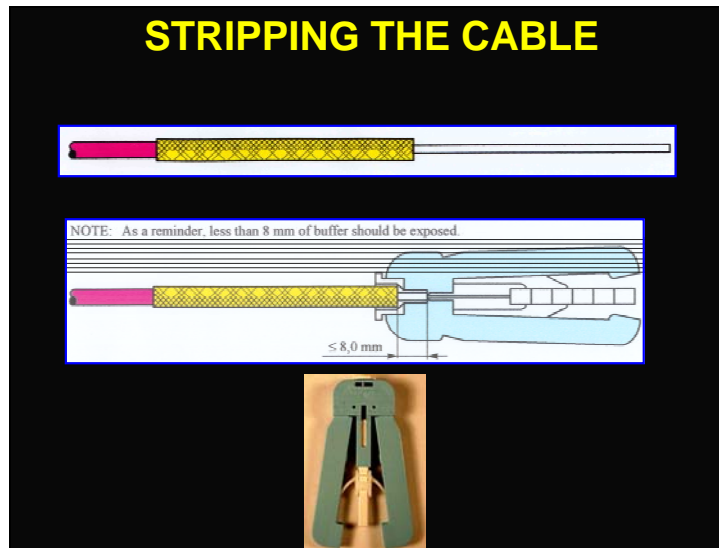
### STRIPPING THE CABLE

**This tool is part of the termination kit.**

**STEP ONE.** Slide the strain relief boot over the cable.

**STEP TWO.** Remove approximately 2.5 inches of the outer jacket using the tool provided in the kit. Use the 1.0 opening on stripper.

## STRIPPING THE CABLE



### STRIPPING THE CABLE

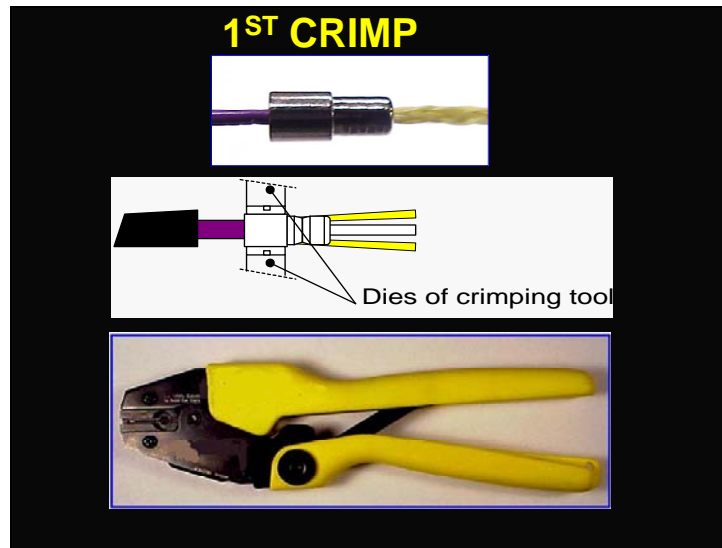
**This tool is part of the termination kit.**

**STEP THREE.** Fold the Kevlar sheath braid back over the outer sheath, exposing the coating.

**STEP FOUR.** Insert the fiber through the hole at the end of the MICRO-STRIP stripping tool until the cable butts into the brass fitting. (Removes the ETFE buffer coating) Squeeze the handles to cut the coating and pull straight for a short distance.

Release the handles and remove the tool. Use your fingers to remove the coating from the fiber.

What will remain is the Optic fiber, about the diameter of a human hair. **Note:** Be very careful handling the cable at this stage.

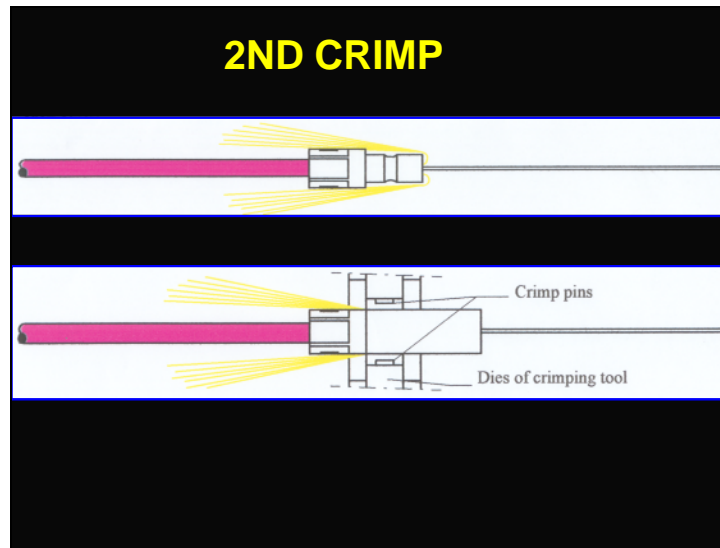


### **1ST CRIMP**

**This tool is part of the termination kit.**

**STEP FIVE.** Fold the Kevlar fiber braid back over the fiber and slide the crimping support sleeve over the braid so that it seats on the outer jacket.

**STEP SIX.** Crimp the support sleeve to the outer jacket as shown below.



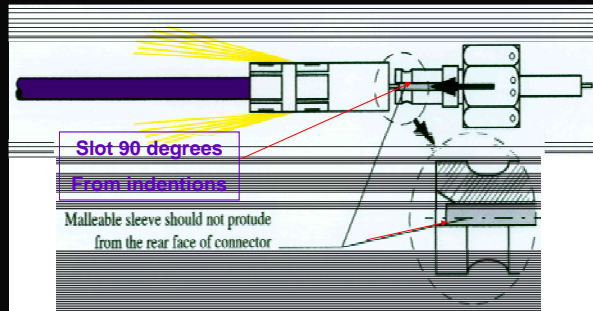
## 2ND CRIMP

**STEP SEVEN.** Divide the braid into approximately equal halves and fold them back over the support sleeve

**STEP EIGHT.** Slide the ferrule over the support sleeve until it rests firmly on the bottom portion of the sleeve and traps the braid. Crimp the rear portion of the ferrule.

**CAUTION:** Apply tension to the braid during this step and ensure that the braid is under the crimp pins. Ensure that the marks left by the crimp pins are aligned.

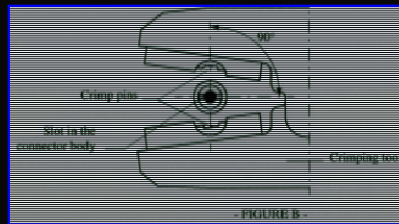
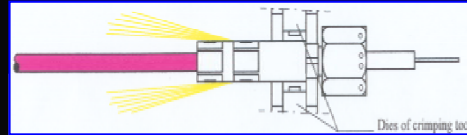
## POSITIONING FOR THE FINAL CRIMP



### FINAL CRIMP

**STEP NINE.** Slide the connector body assembly over the fiber until the shoulder is butted against the ferrule. Take care not to move the malleable sleeve it must be recessed from the rear of the connector. **Note:** Ensure that the slot in the connector body is at a 90-degree angle to the crimp pins and that the crimp indentation marks are aligned. **Failure to do this will result in fiber damage.**

## FINAL CRIMP

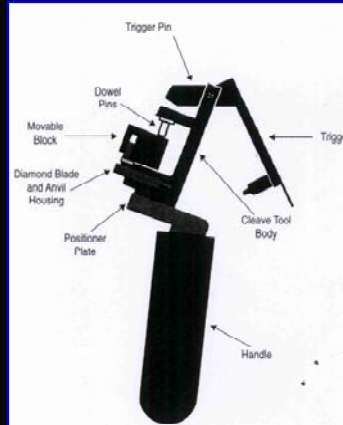


### FINAL CRIMP

**STEP TEN.** Crimp the front portion of the ferrule to the connector body. Ensure that the slots in the connector body are 90 degrees from the crimp pins. Failure to do this may result in breakage of the fiber.

Crimp the front portion of the ferrule to the connector body. During this operation position the connector body by aligning the forward edge of the ferrule with the edge of the crimping dies. Also ensure that the slot in the connector body is at a 90-degree angle to the crimp pins and that the crimp indentation marks are aligned. Failure to do this will result in fiber damage.

## CLEAVE TOOL OPERATION



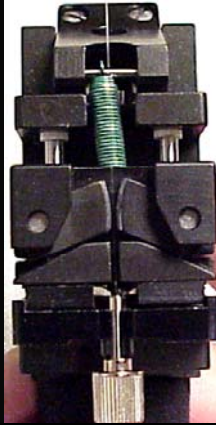
### CLEAVE TOOL OPERATION

**This tool is part of the termination kit.**

**STEP ELEVEN.** Cleave the fiber in the following manner. Insert the connector into the cleaving tool until it stops making sure that the fiber is positioned evenly between the fiber clamps. Slowly press the trigger. Release the trigger and remove the connector from the tool.

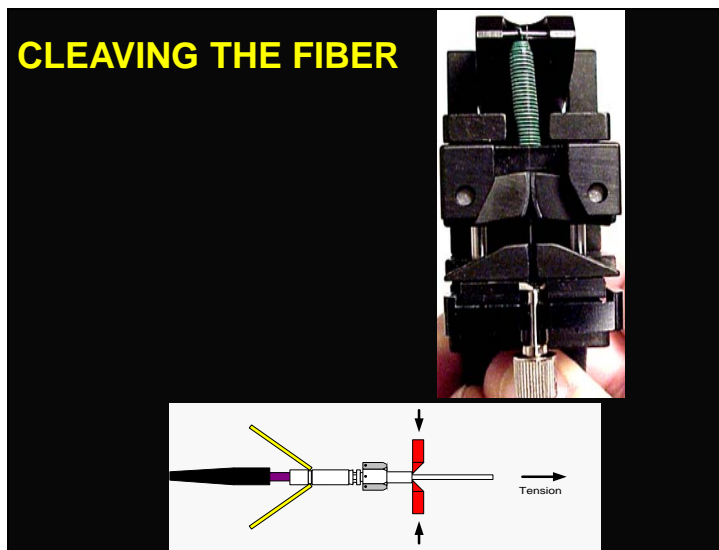
**NOTE:** After cleaving the fiber recover the fiber shard from the cleaving tool and dispose of in a closed container

## CLEAVING THE FIBER



### **CLEAVING THE FIBER**

**STEP TWELVE.** Carefully insert the connector into the cleaving tool making sure that the fiber is correctly positioned between the two fiber clamps and that the connector face is in close proximity to the cleaving blade.



## **CLEAVING THE FIBER**

**Do not hold the connector.** Cleave Process. Cleave the fiber using the CT2 cleaving tool equipped with the green spring. After inserting the connector into the cleaving tool making sure that the fiber is correctly positioned between the two fiber clamps and that the connector face is in close proximity to the cleaving blade. Allow it to center itself then slowly press the trigger. Release the trigger and remove the connector from the tool. Using scissors cut off exposed Kevlar. Slide the rear sleeve completely over the assembly as shown.

## **NOTE**

**Recover the cut piece of fiber before releasing the trigger of the cleave tool and place in a container for disposal.**

## **INSPECTION OF CLEAVED END**



### **INSPECTION OF CLEAVED END USING THE INSPECTION SCOPE**

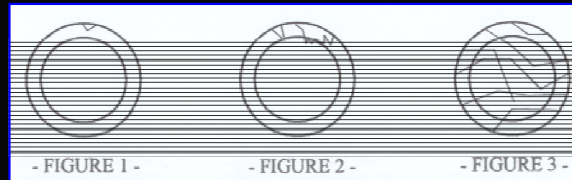
Cleaved surfaces are not always smooth and require inspection.

Shown is a Hand Held Microscope up to 400x - Noyes 400X Ferrule Microscope request with Universal SMA Adapter

Since very few of us have the visual acuity to check the condition of a 200x 400 micron fiber with the naked eye, we will employ the inspection scope.

The condition of the cleaved end of the fiber is critical to correct terminations and transmission of data. The 200X400 Inspection Scope magnifies the terminated end of the fiber 400 times, allowing a visual check of the condition of the cleave.

## WHAT YOU WILL SEE USING THE SCOPE



### WHAT YOU WILL SEE USING THE SCOPE

The figures shown are examples of the appearance of the end face of the fiber as viewed through the inspection scope.

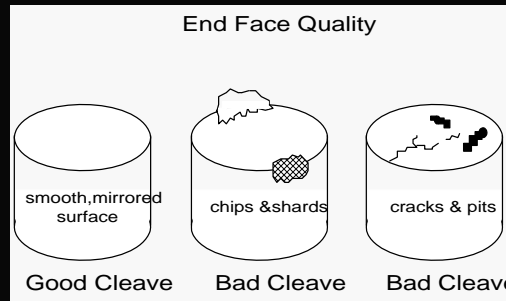
**FIGURE 1.** This fiber shows no perceptible impact from the diamond cleaving tool and is an example of excellent cleaving.

**FIGURE 2.** This fiber shows important impact from the diamond and some splintering. This would be acceptable as long as the splinters are restricted to the cladding.

**FIGURE 3.** This fiber shows significant impact from the diamond and splinters across the entire face of the cleave.

This is unacceptable cleaving. Cut the connector off and start over.

## INSPECTION OF CLEAVED END



### INSPECTION OF CLEAVED END

Cleaved surfaces are not always smooth and require inspection.

## CLEANING and CAPPING

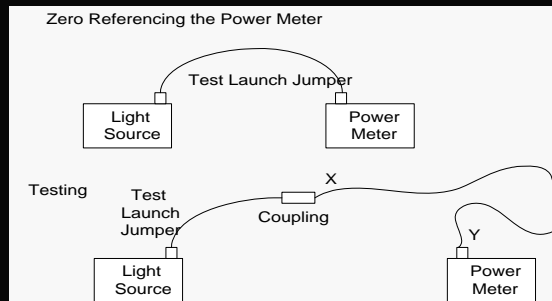


### **CLEANING and CAPPING**

STEP TWELVE. Clean the face of the connector with an alcohol pad and place the protective cap on the connector tip.

STEP THIRTEEN. Slide the strain relief boot in place over the connector

## INSPECTION AND TESTING



### INSPECTION AND TESTING

There are several methods available for testing fiber optic cable for continuity, attenuation, and proper cleaving. This section will familiarize you with these methods and prepare you to perform them.

#### SAFETY NOTE

Fiber optics light sources operate at wavelengths above the visible spectrum. The eye's normal blink response will not react to these infrared light sources and eye damage will result.

#### TERMS

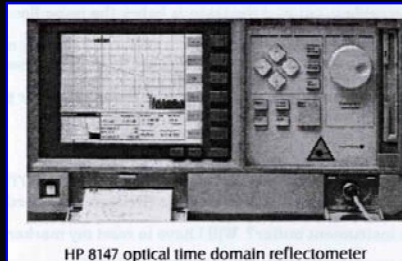
Attenuation. Loss in optic fiber, reflection, similar to resistance in copper wire.

dB or Decibel. The unit of measure of attenuation in optic fiber.

dBm or Decibel per milliwatt. The unit of measure of light power in optic fiber.

# TEST EQUIPMENT

## OPTICAL TIME DOMAIN REFLECTOMETER



HP 8147 optical time domain reflectometer

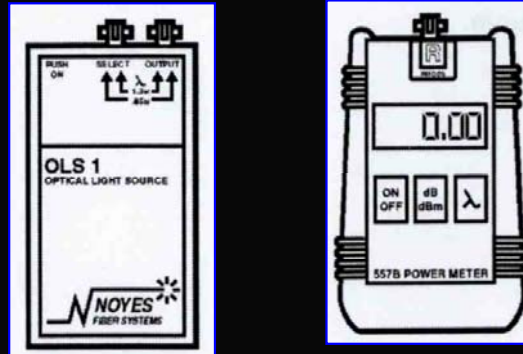
## TEST EQUIPMENT

The most common tool for troubleshooting fiber is the Optical Time Domain Reflectometer or OTDR. The OTDR shoots a light signal down the fiber and measures the backscatter to determine if there are problems and where the problems are.

All OTDR's have what is known as a "dead zone", this is an area where the instrument cannot measure. It occurs at the point where the fiber is connected to the OTDR and is dependent upon laser pulse width, reflection of the front panel connection and bandwidth of the receiver.

Another dead zone occurs after the OTDR detects a reflection (attenuation). As this distance is commonly 10 meters or more (about 40 feet) the OTDR is not suitable for use in aircraft.

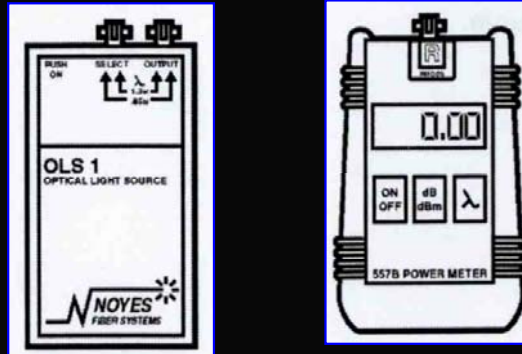
## OPTICAL LOSS TEST SET



### OPTICAL LOSS TEST SET

These test sets are required for providing accurate end-to-end loss measurements of a fiber optic system. The OLTS consists of two units, the light source and the power meter. They must be selected for the type system (**multimode** or single mode) and type of light . Typically, multimode systems operate at 850 or 1300 nanometers and use an LED (light emitting diode) as a light source. Single mode systems operate at 1310 or 1550 nm and use a laser as the light source.

## OPTICAL LOSS TEST SET



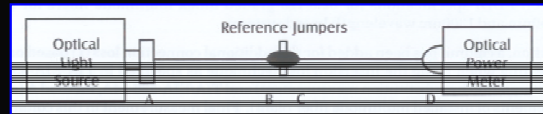
### OPTICAL LOSS TEST SET

These test sets are required for providing accurate end-to-end loss measurements of a fiber optic system. The OLTS consists of two units, the light source and the power meter. Testing the HF system fiber runs requires a special jumper called a launch cable. First the power meter must be zeroed. With the launch cable. Then it is connected to the fiber cable to be measured.

They must be selected for the type system (multimode or single mode) and type of light .

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## TESTING



### TESTING

Insertion Loss Testing for cables with connectors.

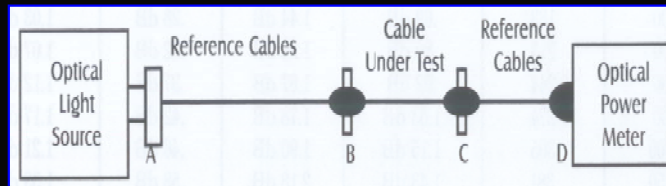
Turn on the light source and let it stabilize for 5 minutes.

Clean the connectors on the reference cable and the cable to be tested.

Attach the reference cable from the light source to the power meter. Using the male SMA/SMA adaptor connect both test cables together.

Set the power meter to the correct wavelength 850nm, and set the meter to read dB, then press the set reference button and hold it until "**HELD**" is displayed. The source and meter are now referenced to each other and the launch cable.

## FIBER CABLE TESTING



### FIBER CABLE TESTING

Insert cable to be tested between reference jumper and power meter.

Record cable loss in dB and final power measurement in dBm.

Repeat the test in the opposite direction (swap light source and power meter).

3.5db is acceptable loss, greater loss will require troubleshooting and repair of the cable.

#### NOTE:

When tightening cable connectors, tighten only finger tight. Do not use wrenches!!

If connectors are to be safety wired use only COPPER safety wire and twist it by hand. Safety wire pliers will over-torque the connector.

#### Note:

Total loss should **not exceed 3.5dB**.

#### CAUTION

Once the power meter and light source have been set to zero reference the light source must not be turned off until the testing is complete. Turning the light source off and on again changes the reference value and will result in incorrect test values.

## THE NUMBERS



### THE NUMBERS

In the optical loss test, the cable should not exceed **0 – 3.5 dB**

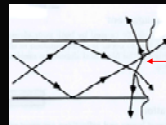
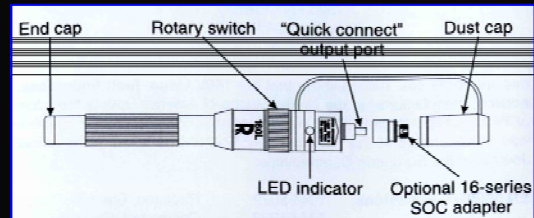
## CLEAN and CAP



### **Clean and cap**

Clean the face of the connector with a Alcohol Pad Place the protective cap on the connector tip.

## VISUAL FAULT FINDER



Reflection at broken fiber

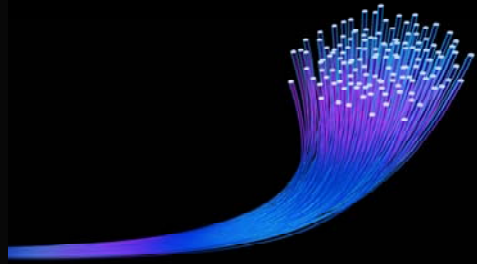
### VISUAL FAULT FINDER

This is a trouble shooting tool for locating breaks or high attenuations areas. (cable crushed, too tight a bend radius ex.)

The **RIFOCS 160L visual fault finder** is a pocket sized 635nm Class IIIa laser with 1.0mw maximum output. It will provide up to 48 hours of continuous operation and can locate breaks and bending losses in optical fibers up to 3km (1.8 miles) in length.

When connected to the fiber under test this tool will cause the jacket to “**glow**” reddish color at a break in the fiber or at a point where the fiber is bent too tightly or over clamped.

## INSTALLATION RULES



### INSTALLATION RULES

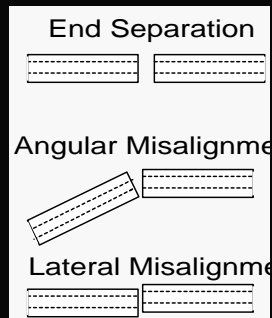
Fibers and their buffers are not the only structural elements of cables. Many but not all fiber optic cables include other components to provide strength and rigidity.

Cable is pulled never pushed. When pulling cable it may require many extra hands. Enlist help at each turn. Installation tension must be respected.

Never step on, kink or mishandle cable as it will break. If the outside of the cable breaks chances are the fibers in it will also break. Failures of properly installed cables is extremely rare. Almost all fiber optic cable failures are due to physical abuse. Fiber tends to break at weak points, at the connectors and/or radius's.

Fiber optic cable can be run with the electrical bundle or by itself with spaced clamping. The OEM or your company's manufacturing engineers will define the location and how the cable will be attached to the aircraft. Fiber should be routed inside a polymer type tubing before being clamped. Tie wraps can very easily crush the cable.

## Connection Factors



### CONNECTION FACTORS:

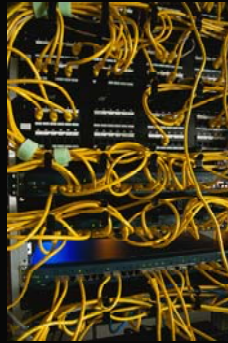
Optical connectors are used to disconnect and reconnect fiber optic cables with a minimum of loss. Connector loss is the major cause of all fiber faults. Cleanliness is very important but also other factors influence loss.

End separation – loose connections or a break

Angular Misalignment – To tight of bend radius Never bend fiber more the 40 mm radius.

Lateral Misalignment – Crushed or clamped to tight

## INSTALLATION RULES



### INSTALLATION RULES

Fiber must be protected from stretching forces. Most cable damage occurs from sudden force.

(Impact)

Environmental exposure. Avoid routing through high temperature areas.

Bend radius must be respected. Never bend fiber more than 40 mm.

Always respect the fiber and it will have high reliability.

Broken cable can not be spliced, if the break is close to the end of the connector, cut connector off and terminate. If the outside coating is damaged only with the optic fiber not broken, spiral wrap with electrical tape if your QC inspector allows.