3M

Fiber Optic ST* and FC Connectors

Termination Procedures for Single-Mode and Multimode Field Mountable Connectors

Instructions

April 1995
Issue 1, 78-6900-1806-0

Contents

For further information contact:

Product Information and Pricing	Customer Service	800-426-8688
Training	Training Department	????

1.0 Warnings, Recommendations and Overview

1.1 Most fibers can be mechanically stripped without the aid of chemicals. If the fiber is not mechanically strippable, contact 3M's Training Department or the cable manufacturer for their recommendations.

1.2 After stripping, alcohol is used to clean the fibers and components before connecting them. Extreme care should be exercised when using this solvent. Avoid contact with skin, use adequate ventilation and be aware of its low flash point.

1.3 For safety reasons, no chemicals have been shipped with the Field Termination Kit. We have, however, included bottles for the alcohol and water.

1.4 The recommended cleaning solvent for connectors and tools is isopropyl alcohol (reagent grade, 99% or better). It may also be purchased from laboratory supply companies.

1.5 Please contact 3M™ Telecom Systems Division Training Department if you have any questions concerning chemicals or procedures.

1.6 Do not view fiber ends if they are laser illuminated. Eye damage may result. Illuminate fiber ends with white light only.

1.7 Alcohol may also be used to clean the lapping acetate and stripping tool when necessary. **Do not use acetone for cleaning.**

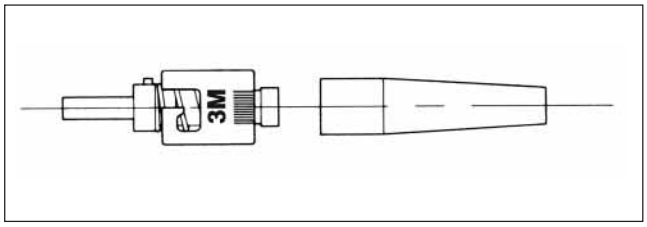
1.8 The connector termination procedures found in this manual are exactly the same for both the ST and FC/PC1 connectors. **Pictures should be considered generic to both** and color codes between multimode and single-mode will be noted.

1.9 The connectors described in this manual have pre radiused "PC" "domed" ferrule ends to ensure low attenuation and the best reflection performance. **All polishing should be done on the soft polishing pad only**, as described in this manual.

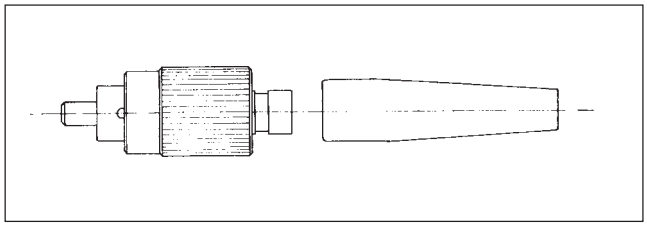
1.10 The ST and FC connectors with PC finishes are completely intermateable with flat finished connectors. PC to flat terminations actually provide improved performance over flat to flat terminations. PC to PC terminations as produced while using this manual, however, offer the best performance.

This manual is for terminating the following PC finished connectors with the 3M Universal ST*/FC Field Termination Kit.

	3M#	Identification
ST, Multimode		
Connector 125 µm	80-6104-4896-3	Black boot, Black backbone, Black C-ring
Connector 140 µm	80-6104-4898-9	Black boot, Black backbone, Copper C-ring
ST, Single-mode		
Connector 126 µm	80-6103-1827-3	Yellow boot, Silver backbone, Copper C-ring
Connector 127 µm	80-6104-4869-0	Yellow boot, Silver backbone, Silver C-ring
FC/PC1, Multimode		
Connector 125 µm	80-6104-5329-4	Black boot, Black backbone, Black C-ring
Connector 140 µm	80-6104-5330-2	Black boot, Black backbone, Copper C-ring
FC/PC1, Single-mode		
Connector 126 µm	80-6104-4237-0	Yellow boot, Silver backbone, Copper C-ring
Connector 127 µm	80-6104-4328-8	Yellow boot, Silver backbone, Silver C-ring



ST* Connectors (Single-mode and Multimode)



FC/PC1 Connectors (Single-mode and Multimode)

2.0 Jacketed Fiber Preparation

2.1 Assemble the curing stand as shown.

2.2 Prepare solvent containers as labeled.
a. Fill one bottle with alcohol.
b. Fill one bottle with water.

2.3 Using the serrated scissors, cut the cable about 1" (2.5 cm) longer than the required pigtail length.

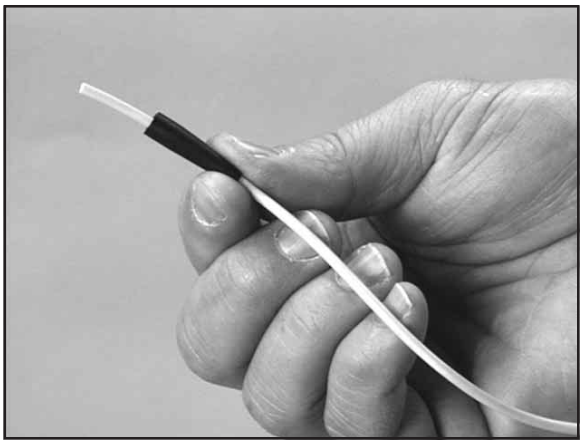
For cable assemblies, add 2" (5 cm).

2.4 Slip the strain relief boot onto the cable.

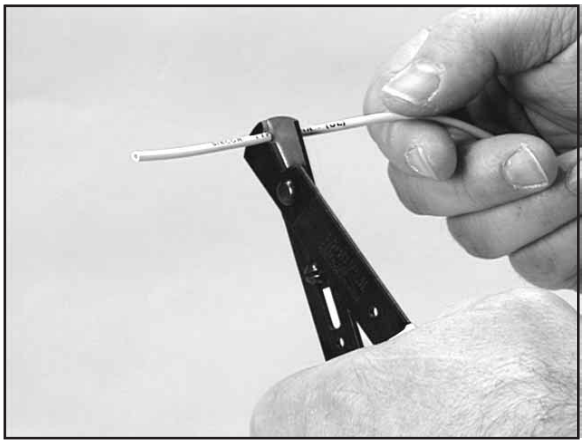
Note: ***Do not forget to do this step.***

The boot will not fit over a mounted connector assembly, so it is essential that it be slipped onto the cable at this time. Slip the small diameter of the boot onto the cable first.

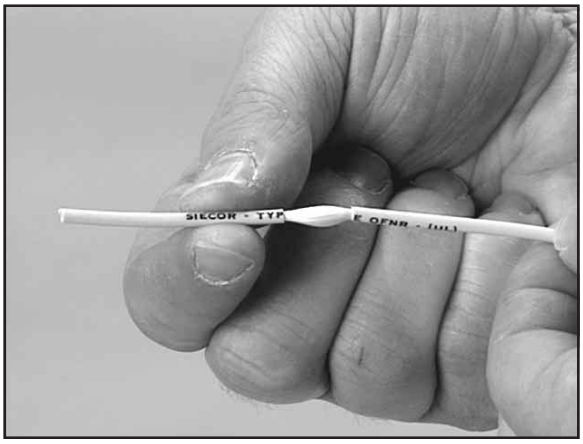
Note: ***Black boot = Multimode***
Yellow boot = Single-mode



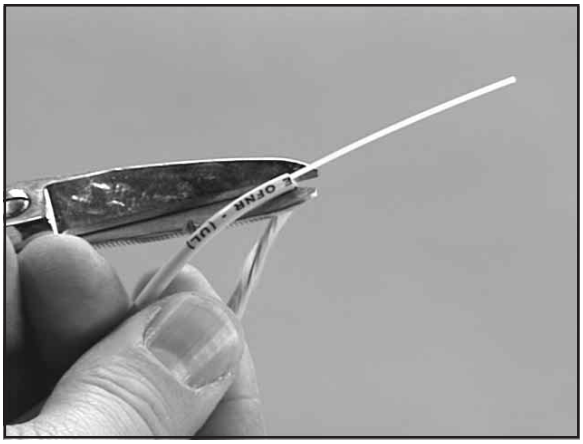
2.5 Cut and remove 3/4" (14 mm) to 7/8" (18 mm) of the cable's outer jacket. Close the yellow handled stripper on the cable until the outer jacket is cut.



Do not remove the outer jacket with the stripper, as it will soon dull the cutting edges. Use your fingers instead.



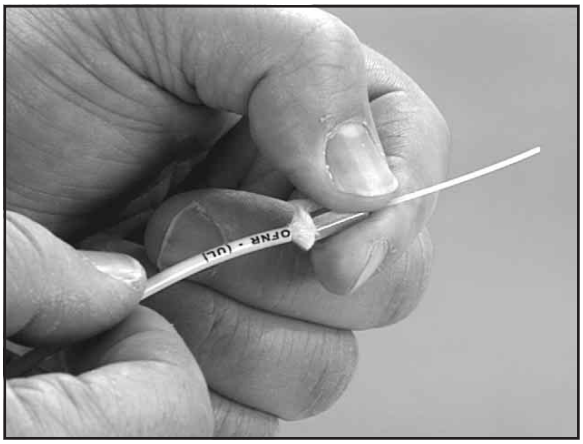
2.6 Cut and flare the strength members. Removing the outer jacket will expose the cable's strength members which are usually Kevlar™. Gather the Kevlar and pull it off to one side, giving it a slight twist. Using the serrated scissors, cut the Kevlar, leaving about 1/4" (6 mm) to 5/16" (8 mm) sticking out of the outer jacket.



Slip the smaller hole of the shorter stripping collar over the fiber and flare out all of the Kevlar evenly. Reverse the flaring collar and slide the larger hole over the fiber. Push down gently until the stripping collar folds the Kevlar back and seats.

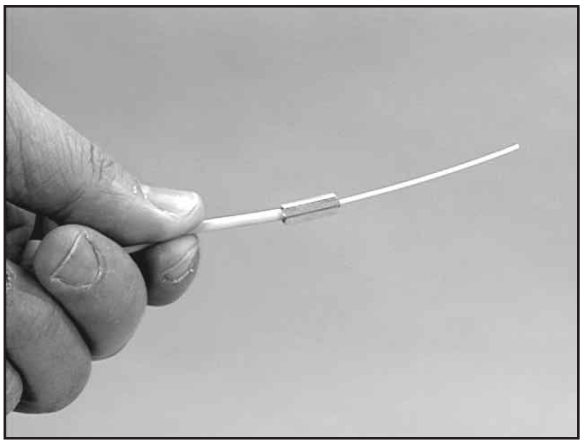
Note: ***For fiber that cannot be mechanically stripped, this collar can be used as a heat stripping guide.***

Call the 3M Training Department for information at 800-426-8688 for further information.

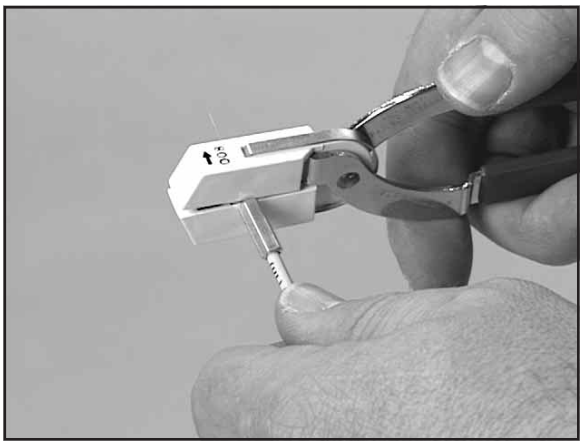


2.7 Before stripping, it is important to hold the cable in a configuration which will prevent the buffered fiber from being pulled out of the outer jacket.

Grasp the end of the outer jacket securely between your thumb and forefinger, over the middle finger, under the ring finger, and over the little finger. Squeezing with all fingers will clamp the buffered fiber in the outer jacket.

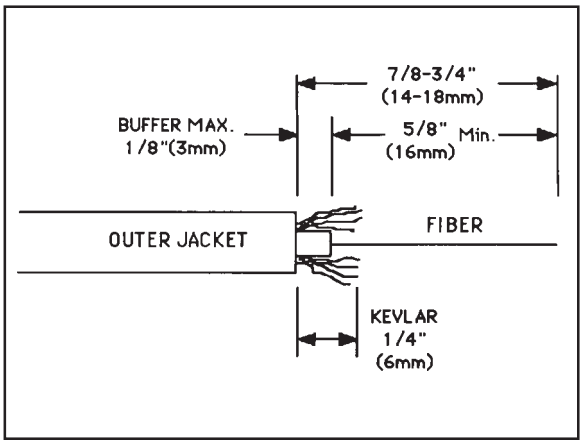


2.8 With the modified No-Nik® tool's arrow pointing in the direction of the stripping, remove 5/8" (16 mm) of the fiber's buffering two or three bites.



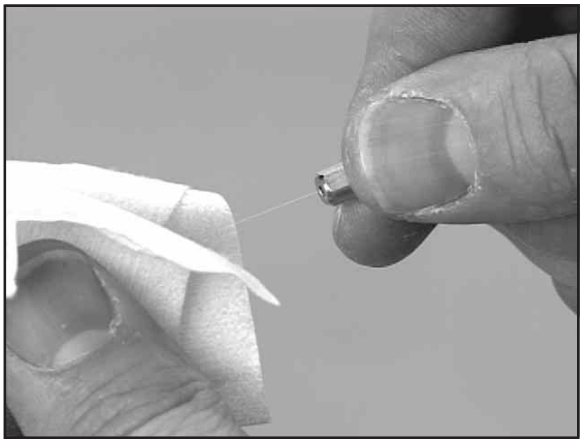
Be sure to remove the stripped material from the tool after each incremental cut. When stripping the last increment, the end of the stripping collar should gently rest against the fiber guide inside of the clearance hole of the modified No-Nik® tool.

The dimensions should match those shown.



The protruding buffer should be no longer than 1/8" (3 mm).

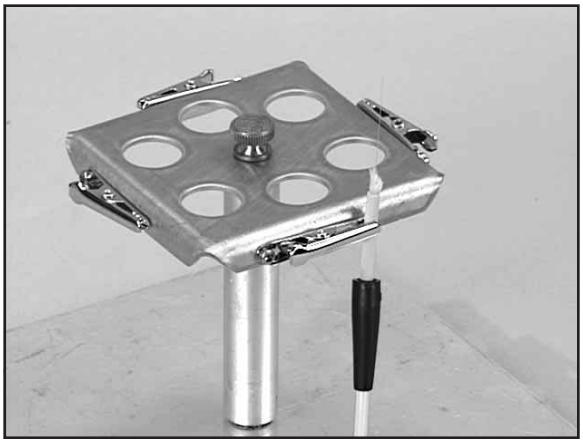
2.9 Moisten a clean lint-free cloth with alcohol from the bottle and wipe the fiber until it is clean.



Note: ***Carefully follow safety, health and environmental information given on container label or Material Safety Data Sheet for compound being used.***

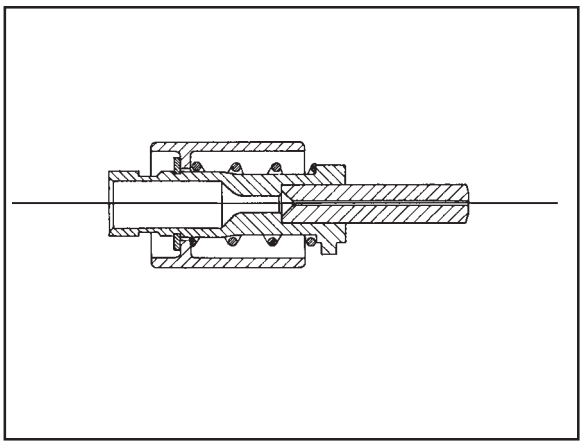
Do not allow solvent to soak the Kevlar®. Make sure there is absolutely no buffer residue or dirt on the fiber by holding it to a light and inspecting the fiber for a smooth shiny surface. Repeat process if necessary.

2.10 In order to protect the prepared fibers, clip the cable into the curing stand where the fiber end will not touch anything. When mounting more than one connector, prepare your fibers before mixing the epoxy.



3.0 Mounting

3.1 To inspect the connector, hold it up to a light to ensure that the capillary hole in the ceramic ferrule is clean. If the hole is obstructed, blow it clear or use a piece of stainless steel wire supplied with the kit to clear the ferrule.



The wire can also be used to remove a fiber broken during fitting, by inserting it into the front end of the ceramic ferrule and pushing the fiber out through the rear. Always blow the ceramic ferrule with compressed air after using a steel wire.

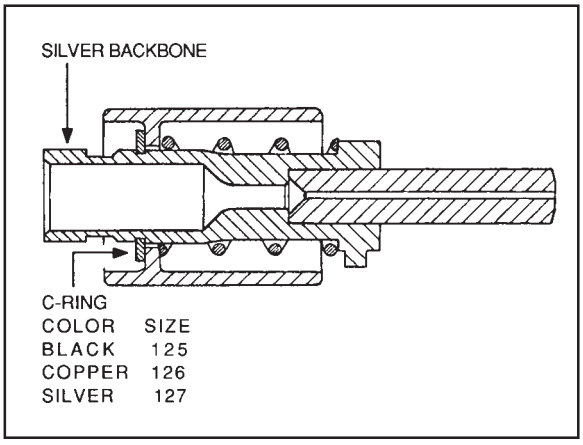
3.2 Select the correct ferrule size and dry fit the connector onto the fiber.

There are three ferrule capillary hole sizes available for mounting single-mode fiber. They are 125 µm, 126 µm, and 127 µm.

Note: Single-mode connectors are identified by a silver backbone.

For a typical single-mode fiber, select a 125 µm connector and dry fit the connector onto the fiber.

If the connector is too tight, then select a 126 µm connector and dry fit. If the 126 µm is too tight, use a 127 µm connector with a snug fit on the fiber in order to achieve the best performing cable assembly with the lowest losses.

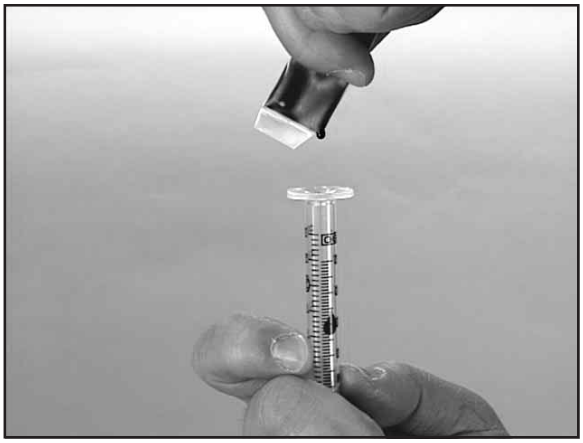


3.3 Remove the syringe plunger and place both parts on a clean convenient surface along with the dispensing tip. The epoxy supplied is Tra-con F113SC in premeasured 2 gram bi-packs. The working time is 45 minutes to 1 hour. It will cure in 20 minutes in our ovens at 87° C or overnight at 70° F. The shelf life is six months and the packages are dated. Each bi-pack will mount approximately 20 to 40 connectors.

Remove the separating bar and mix the two components by massaging the package and rubbing it back and forth over the smooth edge of a table. Make sure the epoxy is thoroughly mixed and is a uniform blue color.

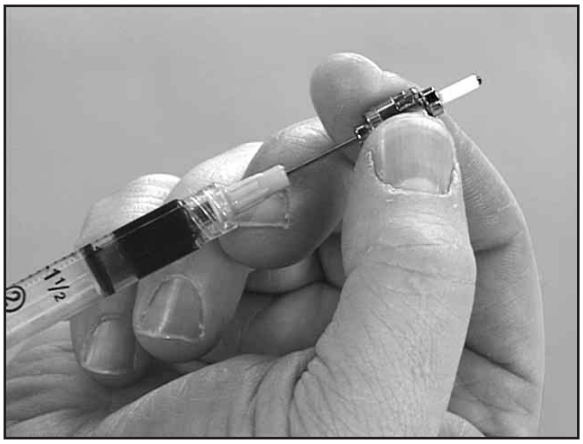
3.4 When the epoxy is thoroughly mixed, cut a small corner off the package and squeeze the contents into the syringe.

Insert the plunger and hold the syringe pointing upwards. After the epoxy settles on the plunger push it gently to expel any air.



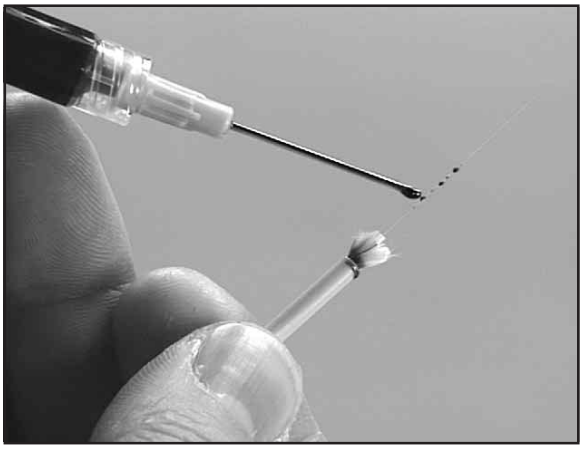
3.5 To attach the epoxy dispensing tip, push and twist-lock the dispensing tip onto the syringe body. Depress the plunger and eject the epoxy until there are no air pockets remaining.

3.6 Insert the syringe tip into the backbone of the connector until it bottoms out against the ceramic ferrule. Maintain pressure and slowly inject the epoxy until a bead appears on the end of the ceramic tip. Continue to inject epoxy until the bead covers about one third of the ceramic diameter end. Release the pressure on the plunger, wait five seconds and then remove the syringe. Also apply a thin coat of epoxy evenly around the inside wall of the backbone using the syringe.

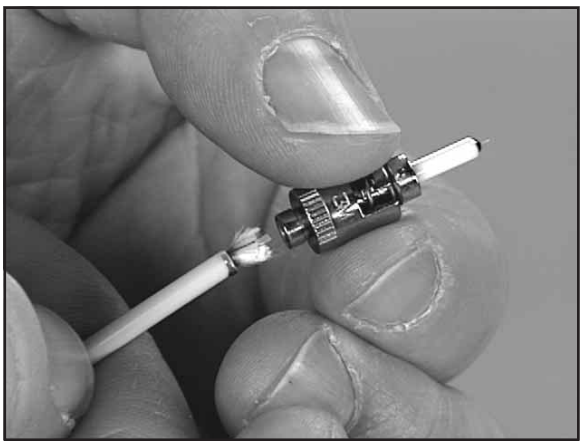


3.7 Coat the circumference of the outer jacket with a thin layer of epoxy, starting from the stripped edge of the jacket and extending 1/8" (3 mm) on the jacket.

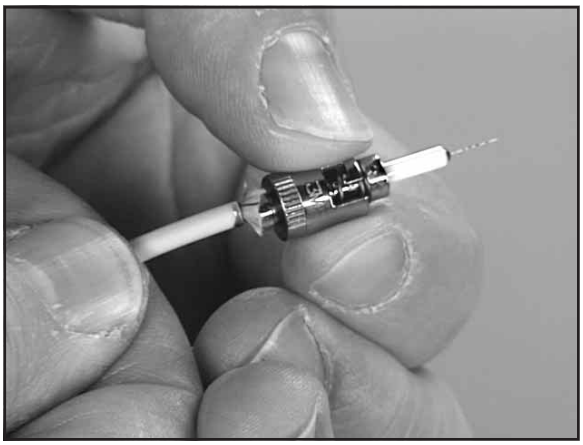
Also coat the exposed fiber with a thin layer of epoxy, starting at the edge of the buffer and extending 1/8" (3 mm) up the fiber.



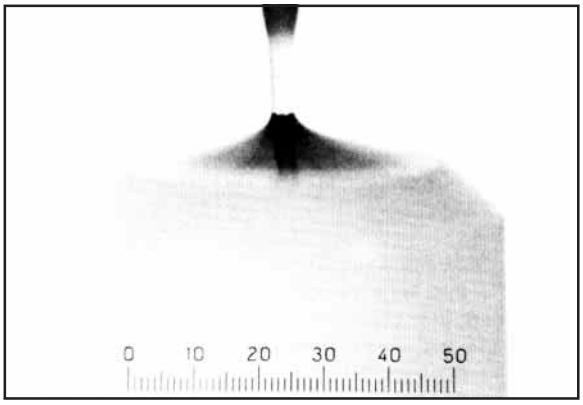
3.8 Hold the cable in one hand about 3/4" (2 cm) from the edge of the outer jacket and hold the connector in the other hand. Rest your hands on the table or against each other and carefully thread the connector (backbone first) straight into the fiber. Slightly rotate the connector between thumb and forefinger in order to ease the funneling of the fiber into its guide hole in the ferrule.



While rotating, maintain a continuous, light inward pressure to assist entry alignment. Slowly slide the connector onto the cable's outer jacket until it bottoms out. As this is done, the Kevlar® strands should flare out evenly and disappear into the backbone of the connector. Check for fiber breakage by slightly pulling back and pushing forward on the cable while watching for fiber movement.



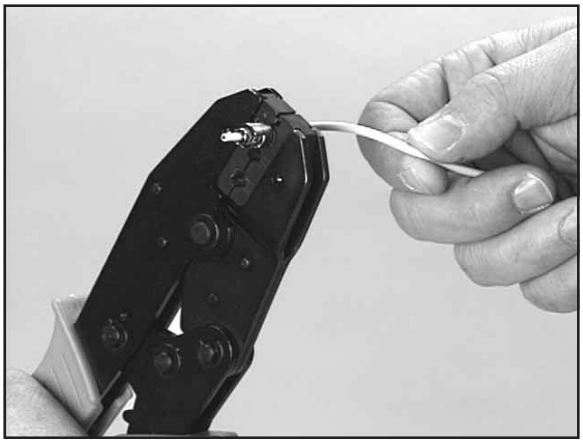
3.9 Looking at the tip of the ferrule, examine the epoxy surrounding the protruding fiber. The correct epoxy bead height should be between 2 to 4 fiber diameters (0.010" to 0.020") above the ceramic tip. If this is not the case, additional epoxy must be applied around the fiber base to build the bead to the proper height. A short piece of buffered fiber with about 1/4" (6 mm) of exposed fiber makes a good applicator.



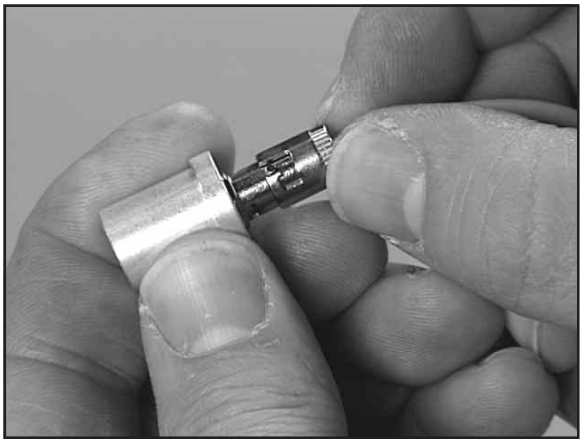
Note: ***If the fiber was stripped short, it may not be visible above epoxy bead. Holding the connector in one hand, use a slight inward pressure on the cable's outer jacket and inspect the epoxy bead, making sure that the fiber extends beyond the ferrule.***

Note: ***The outside diameter of the ceramic ferrule must be free of epoxy.***

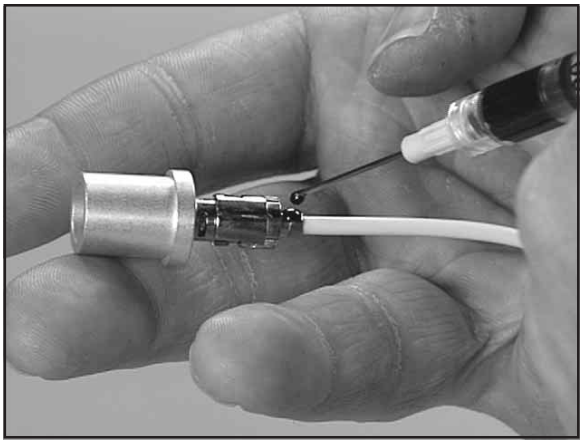
3.10 Wipe away any excess epoxy from the backbone and cable. Using the crimping tool, tightly crimp only the raised portion at the very end of the connector backbone onto the cable's outer jacket while maintaining an inward pressure on the cable. The crimp tool must be closed completely before it will release. Keep the crimp tool jaws free of hard epoxy.



3.11 When installing the load adapter onto the connector, be careful not to disturb the epoxy bead or break the fiber. Select the appropriate load adapter to match the connector type. (FC/PC connectors are threaded, ST connectors are bayonet.)



3.12 Apply a very thin layer of epoxy around the leading edge of the crimped area of the backbone. Slide the strain relief boot over the crimped area of the backbone and rotate it to evenly distribute the epoxy.



3.13 The procedure to cure the epoxy is as follows. Turn the oven on. When the oven is heated to the proper temperature the heater light will go off. Place the connector into one of the oven's ports. The full curing time for this epoxy is 20 minutes. After this period of time, remove the connector from the oven and place it in the curing stand to cool for at least 5 minutes.

Note: ***Epoxy will cure at room temperature in about 18 hours.***

Note: ***Allow the load adapter to cool to room temperature before scoring the fiber. This will ensure complete epoxy hardness.***

Note: ***Other epoxies are available. Contact 3M Telecom Systems Division Training for further information at 800-426-8688.***

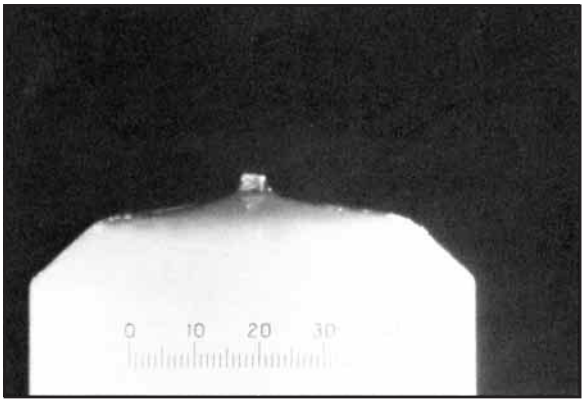
4.0 Scoring

4.1 Remove the load adapter and allow the connector to cool to room temperature before scoring.

4.2 Hold the connector in a vertical position with the fiber pointing upwards. Lightly score the fiber, using the scoring tool, just above the epoxy bead through which the fiber protrudes. **Do not score hard.** The fiber should be merely touched and not severed.

4.3 Using your fingers, carefully remove the fiber by pulling straight up from ferrule. If the fiber is too short, use the scoring tool to gently press against the fiber **from the scored side** until it breaks along the score mark.

4.4 Check the quality of the fiber end using the jeweler's loupe. The fiber should not protrude from the epoxy bead more than one fiber diameter. If the fiber is too long, be sure to polish it with extra caution. If the fiber is scored too short or broken beneath the epoxy bead, finishing should still be attempted.



5.0 Polishing, PC (Domed) Finish

5.1 To prepare the 5 µm polishing surface, clean the surface of the soft polishing pad with a lint free cloth dampened with isopropyl alcohol. Blow clean both sides of a sheet of 5 micron lapping acetate. Place the acetate shiny side down on to the soft pad.

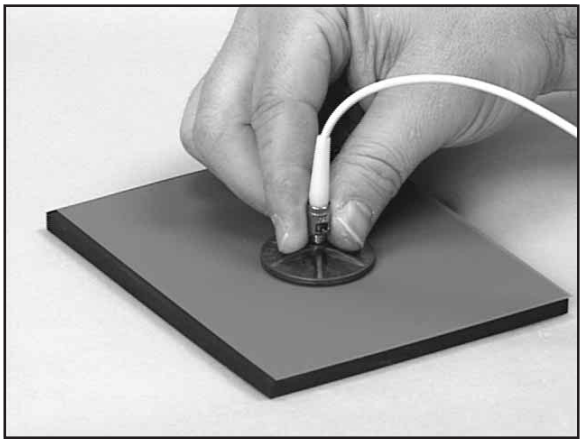
Note: ***Carefully follow safety, health and environmental information given on container label or Material Safety Data Sheet for compound being used.***

5.2 Wipe the polishing surface of the jig with a lint free cloth moistened with alcohol. Blow the entire jig clean with compressed air. Clean the connector with compressed air only, since wiping it may break fiber.

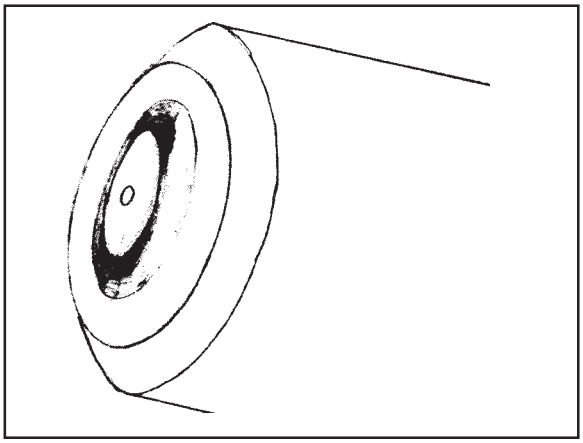
5.3 To perform the 5 µm finish, hold the polishing jig in your hand and insert the connector so that the ferrule end does not protrude past the bottom of the polishing jig. This is to ensure that the extended fiber from the ferrule will not be broken off below the epoxy level upon initial contact to the lapping film.

Note: ***If the connector does not fit easily into the jig, examine the sides of the ceramic ferrule for epoxy. Any excess epoxy can be removed with a razor blade.***

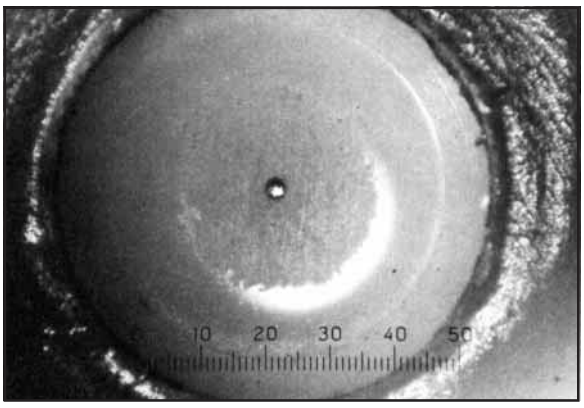
While holding both the connector and the polishing jig in one hand, slowly place the jig on the lapping film and begin to polish in a figure 8 motion without applying any pressure on the connector. Light scratch marks should begin to appear on the acetate surface.



Continue to polish until the fiber is flush with the epoxy bead (approximately six figure 8's). Once the fiber is supported by the epoxy bead, begin applying light pressure on connector while polishing in a figure 8 motion.



Continue to polish on the 5 µm acetate until a thin layer of light blue color epoxy remains on the ceramic tip. Stop when the thickness is about 0.001" (25 µm) and the outer edges of the epoxy layer start to break up and feather. This can be seen using the 7X jeweler's loupe.



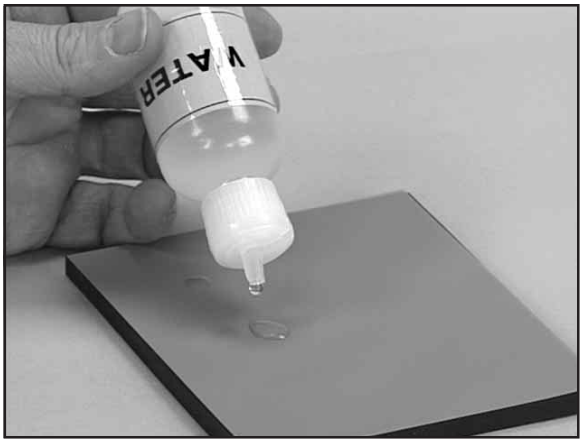
Note: ***If epoxy bead is too large, polishing time can be reduced by using a coarser grit of acetate, such as 3M™ 9 µm aluminum oxide before using the 5 µm.***

Note: ***The 5 µm lapping acetate can be cleaned with alcohol and blown dry for reuse. The sheet can be used to polish two to four connectors.***

5.4 Using an alcohol dampened lint free cloth clean the ferrule, the polishing jig, and the 5 µm lapping acetate. Blow all pieces dry with the compressed air.

Clean one sheet of 1 µm acetate and place it directly, shiny side down on the polishing pad.

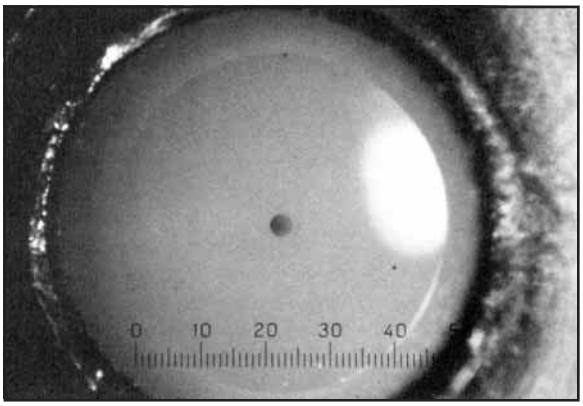
Place three to four drops of water on the 1 µm acetate.



5.5 To perform the 1 µm finish, insert the ferrule into the jig and lower it gently onto the moistened 1 µm acetate. Lightly polish until all the epoxy is removed (fifteen to twenty figure 8's). Inspect with the jeweler's loupe.

Do not overuse the 1 µm lapping acetate. Always attempt to polish on fresh areas of the acetate.

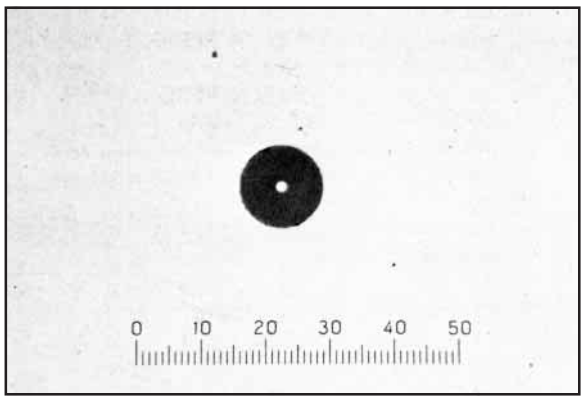
After the entire surface of the acetate has been used it can be clean with alcohol and reused to polish several more connectors and then discarded. If deep scratches appear on the fiber, discard the 1 µm acetate at that time.



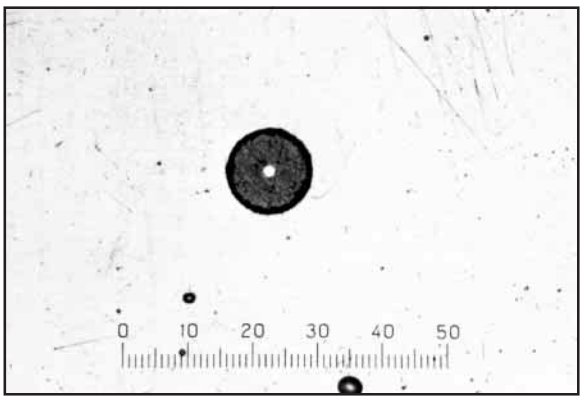
5.6 After polishing, remove the connector from the polishing jig, clean the ferrule and insert it into the fiber view scope.

The fiber should be free of epoxy and scratches and be flush with domed end of ceramic ferrule (see A).

If scratches or epoxy are present, repeat steps 5.4 and 5.5 with frequent inspections (see B).



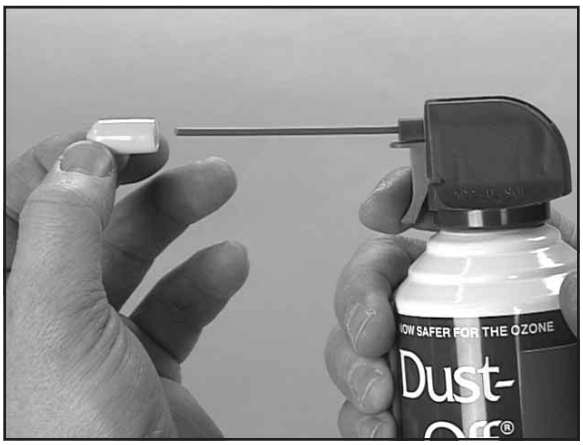
A



B

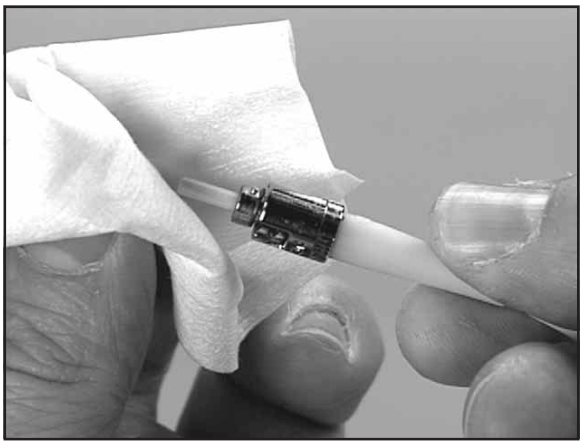
6.0 Final Cleaning

6.1 Blow the dust cap with compressed air.



Note: ***Carefully follow safety, health and environmental information given on container label or Material Safety Data Sheet for compound being used.***

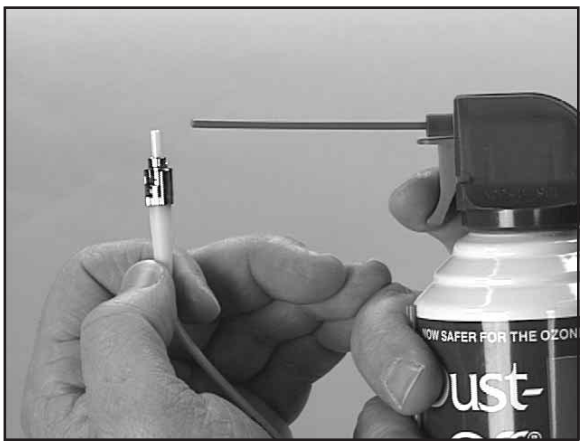
6.2 Wipe the ceramic ferrule with an alcohol dampened lint free cloth.



Note: ***Carefully follow safety, health and environmental information given on container label or Material Safety Data Sheet for compound being used.***

Be sure to wipe the entire length of the ferrule and the ferrule tip.

6.3 Blow the ferrule with compressed air.

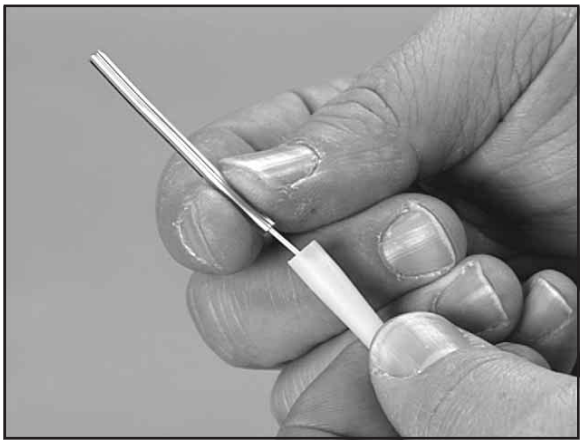


6.4 Immediately cover the ferrule with the dust cap.

7.0 Mounting Unjacketed / Buffered Fiber

7.1 Slip the strain relief boot onto the buffered fiber, small end first.

7.2 Slip the strain relief tube onto the buffered fiber.



7.3 Remove 5/8" (16 mm) to 11/16" (18 mm) of buffer using the No-Nik tool. Refer to steps 2.7 and 2.8.

7.4 Clean the fiber with alcohol.

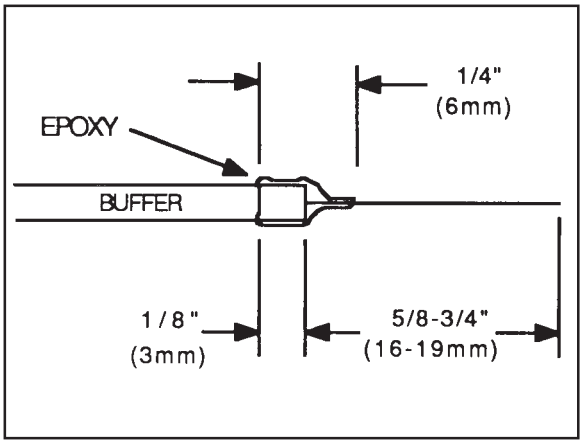
Note: ***Carefully follow safety, health and environmental information given on container label or Material Safety Data Sheet for compound being used.***

7.5 Continue with steps 3.1 through 3.6.

7.6 Apply epoxy to the connector backbone and fiber.

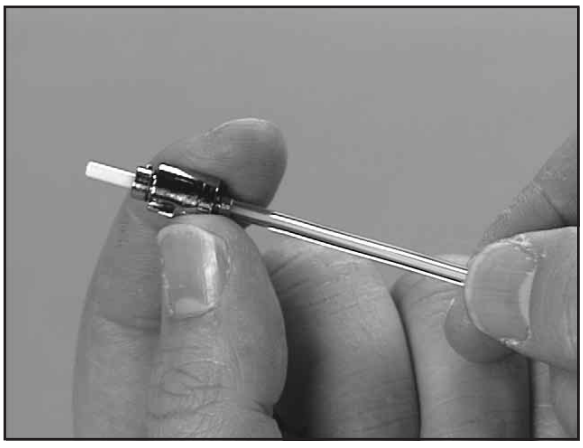
Note: ***Too much epoxy in the backbone may cause epoxy "wicking" up the strain relief tube.***

Apply a coating of epoxy on the buffer extending 1/8" (3 mm) down from the base of the bare fiber. Also coat the exposed fiber with a thin layer of epoxy, starting at the edge of the buffer and extending 1/8" (3 mm) up the fiber.



7.7 Hold the buffered fiber and the strain relief tube at the back of the tube as the connector is threaded onto the fiber. Refer to step 3.8.

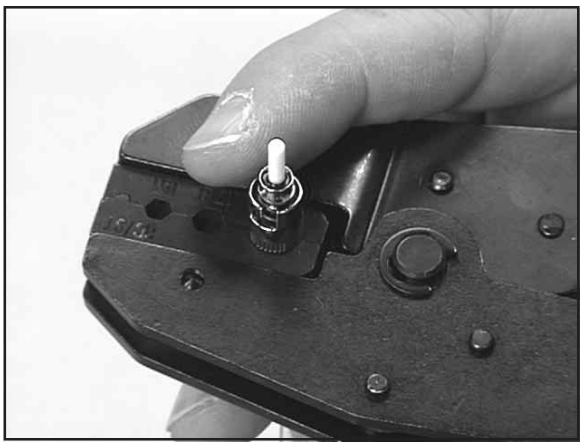
Ease the connector onto the strain relief tube and buffer until the strain relief tube bottoms out and the buffer seats at the base of the ceramic ferrule. Check the fiber for breakage. Refer to step 3.8.



7.8 Examine the epoxy bead.

7.9 Crimp the connector onto the strain relief tube. Refer to step 3.10.

Tightly crimp the connector backbone onto the strain relief tube while maintaining an inward pressure on the tube and the buffer.



7.10 Continue with steps 3.11 through 3.13.

Note: ***When placing the connector into the curing oven, hold the connector by the end of the strain relief boot until the load adapter seats in the bottom of the oven cavity. Do not hold the buffered portion of the fiber. Check to see that the buffered fiber is fully seated after it has been placed in the oven.***

7.11 Continue with the termination procedure for jacketed cable described in Sections 4, 5, and 6.

8.0 Connectorization

8.1 Identification methods.

ST* Connector Couplings – Available in single-mode and multimode.

Multimode couplings have black retaining ring inside the housing seen through two slots in the cylinder of the housing.

Single-mode couplings have yellow retaining ring inside the housing seen through two slots in the cylinder of the housing.

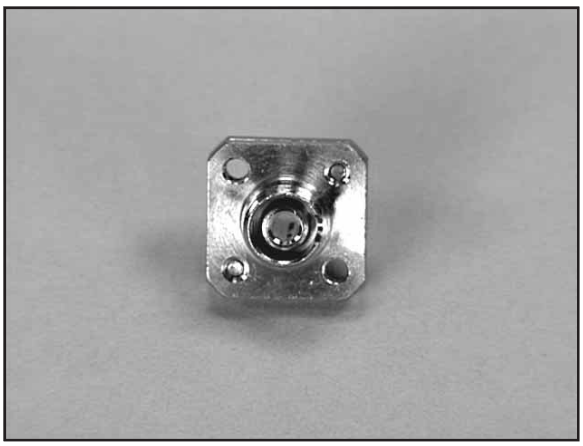
ST* Connector Couplings – Available in the two following types of housing:

Flanged design has two mounting screw holes for panel mounting. (see A)

Threaded design has the center portion of coupling threaded with a nut used to lock it in place. (see A) This type of coupling is usually mounted into a punched hole with flats.

A

FC/PC Couplings – Available with a flanged mounting. (see B)



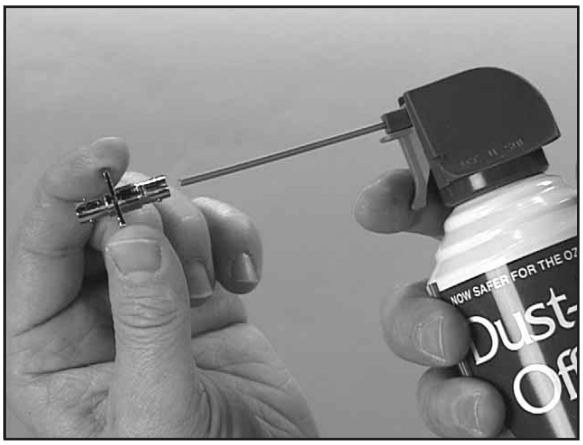
B

8.2 Connector Coupling Mating – Only one connection should be made at a time, and the dust cap should not be removed until prior to mating. It is always a good practice to clean all connectors and couplings before mating.

a. Clean the ceramic ferrule of connector with an alcohol dampened lint free cloth (see step 6.2) and immediately blow with compressed air (see step 6.3).

b. Insert an alcohol dampened pip cleaner into the coupling to remove any foreign particles.

Blow with compressed air.



c. Holding the connector by the boot, gently rotate until the key enters, then push the connector onto one end of the coupling. Lock the ST* connector housing in placed with a twisting motion.

d. When inserting the FC/PC connector, engage the key in the slot while holding the connector by the boot. Make sure that the key remains engaged while tightening the threaded nut.

e. Clean and mate the other connector into the coupling.

8.3 To disconnect, unscrew or unlatch the connectors and cover all parts with dust caps.

9.0 Universal ST* / FC Field Termination Kit

Description	Quantity	3M Stock Number
Kit with 110 V oven	1	80-6104-5313-8
Kit with 220 V oven	1	80-6104-5314-6
Kit Components		
Cleaning Wire	1	80-6104-4345-1
Scissors	1	80-6104-4754-4
Cable Stripper, Jacket	1	80-6104-4314-7
Modified No-Nik Stripper (.008)	1	80-6104-5332-8
Epoxy	10	80-6104-4902-9
Crimp Tool	1	80-6104-4319-6
Diamond Scriber	1	80-6104-4320-4
ST* Load Adapters	6	80-6104-4343-6
FC/PC Load Adapters	6	80-6104-5335-1
Termination Mounting Stand	1	80-6104-4334-5
Fiber View Scope (100X)** with ST/FC Adapter	1	80-6104-4344-4
Soft Polishing Pad	1	80-6104-5375-7
Aluminum Oxide Lapping Acetate 5µm	1 pkg	80-6104-4346-9
Aluminum Oxide Lapping Acetate 1µm	1 pkg	80-6104-4323-8
Carrying Case	1	80-6104-5351-8
ST*/FC Universal Polishing Jig	1	80-6104-5324-5
Squirt Bottle (alcohol)	1	80-6104-4329-5
Squirt Bottle (water)	1	80-6104-5334-4
Syringes	25	80-6104-4347-7
Dispensing Tips	25	80-6104-7441-8
Lint free cloth	1 pkg	80-6104-4324-6
Pipe cleaners, lint free (50/pkg)	1 pkg	80-6104-4349-3
Jeweler's loupe 7X	1	80-6104-4353-5
6" Pocket Rule	1	80-6104-5337-7
ST*/FC1 Stripping Collar	4	80-6104-4355-0
FC/PC2 Stripping Collar	4	80-6104-5333-6
ST*/FC1 Field Termination Manual	1	78-6900-1806-0
Box, Compartment, 4" x 8"	1	80-6104-5338-5
Curing Oven 110 V (for kit #05-00135)	1	80-6104-4351-9
Curing Oven 220 V (for kit #05-00137)	1	80-6104-4354-3

Note:** ***The Fiber View Scope #05-00249 provides convenient examination of the fiber end face without having to hold the connector in its polishing jig. (see step 5.6)

10.0 ST*/FC Consumable Kit

Description	Quantity	3M Stock Number
Kit	1	80-6103-1835-6
Kit Components		
.004 Cleaning Wires (12/vial)	1	80-6104-4345-1
Epoxy	10	80-6104-4902-9
Aluminum Oxide Lapping Acetate 5µm	1 pkg	80-6104-4346-9
Aluminum Oxide Lapping Acetate 1µm	1 pkg	80-6104-4323-8
Lint free cloth	1 pkg	80-6104-4324-6
Syringes	25	80-6104-4347-7
Dispensing Tips	25	80-6104-7441-8
Pipe cleaners, lint free (50/pkg)	1 pkg	80-6104-4349-3
ST*/FC1 Field Termination Manual	1	78-6900-1806-0

11.0 Part Numbers

Part Description		3M Stock Number
ST* Connector, Multimode		
	Connector 125 µm	80-6104-4896-3
	Connector 140 µm	80-6104-4898-9
	Coupling, flanged	80-6107-4713-3
	Coupling, threaded	80-6107-4712-5
ST* Connector, Single-mode		
	Connector 125 µm	80-6103-1826-5
	Connector 126 µm	80-6103-1827-3
	Connector 127 µm	80-6104-4869-0
	Coupling, flanged	80-6103-1831-5
	Coupling, threaded	80-6103-1830-7
FC/PC1, Multimode		
	Connector 125 µm	80-6104-5329-4
	Connector 140 µm	80-6104-5330-2
FC/PC1, Single-mode		
	Connector 125 µm	80-6104-4236-2
	Connector 126µm	80-6104-4237-0
	Connector 140 µm	80-6104-4238-8
	Coupling, flanged	80-6104-4239-6
Kits	Universal ST*/FC Field Termination Kit, 110 V oven	80-6104-5313-8
	Universal ST*/FC Field Termination Kit, 220 V oven	80-6104-5314-6
	ST*/FC Consumable Kit	80-6103-1835-6
Training	ST*/FC Video Tape VHS	
	NTSC mode (US)	80-6103-1876-0
	PAL mode (Europe)	80-6103-1877-8

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