REV	SHT	NAVSEA DRAWING NO.	ESWBS
-	1	8346972	408

APPLICATION	
NEXT ASSY	USED ON

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
-	RELEASED AS REVISION -	04/23/09	Robert A Throm

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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362-5101

FURCATION UNIT, TUBE, BLOWN OPTICAL FIBER, SPECIFIC METHOD PERTAINING TO POLYACRYLAMIDE CRYSTAL INSTALLATION

SIZE	CAGE	ESWBS	DRAWING NO.	REV
A	53711	408	8346972	-

SCALE: NONE	UCI	WT GRP	SHEET 1 of 17

MIL-STD 2042-2B (SH)

METHOD 2F1

FURCATION ASSEMBLY INSTALLATION

The following procedures are in accordance with MIL-STD-2042-2B (SH) METHOD 2F1, BOF Furcation Unit Installation

1. SCOPE

1.1 Scope. This method describes the procedure for installing the individual BOF fibers, or fibers within BOF bundles, into a furcation unit.

2. REQUIRED EQUIPMENT AND MATERIALS.

2.1 The equipment and materials in the tables located in the applicable sections of this method are to be used to perform these procedures.

3. PROCEDURES

3.1 Safety summary. The following safety procedures shall be observed:

a. Observe warnings and cautions on equipment and materials.
b. Safety glasses shall be worn at all times when handling bare fibers or dispensing adhesive.
c. Do not touch the ends of the fiber as they may be razor sharp. Wash your hands after handling bare fiber.
d. Do not stare into the end of a fiber until verifying that the fiber is not connected to a laser light source or LED.

3.2 Method 1. Furcation assembly and polyacrylamide installation using clear tubing.

3.2.1 The equipment and materials in the following Table 1 are recommended to perform this procedure and must be used to remain compliant with MIL-STD-2042-2B (SH) METHOD 2F1.

Table 1 Equipment and materials.

Description	Quantity
Furcation Assembly (AA59729)	1 (provided)
Safety glasses	1
Tapered tube plug AA59730-TTP-2 (6 fiber bundle, 2 to 6 individual fibers) Or; Tapered tube plug AA59730-TTP-3 (12 or 18 fiber bundle, 8 to 12 individual fibers)	1
Adhesive and sealant tape (Raychem SFTS-1 or equal)	As required
Ruler	1
Utility knife	1

Description	Quantity
Tube cutter	1
Bundle jacket stripper (18 gauge for 6-fiber bundles)	1
Bundle jacket stripper (12 gauge for 18-fiber bundles)	1
Clear jacket stripper (20 gauge for 6-fiber bundles)	1
Scissors	1
Fiber, BOF single fibers or fibers from a BOF bundle	As required
Tee Tube coupler (AA59731-T-8 or AA59731-T-8E) or Straight Tube coupler (AA59731-U-8 or AA59731-U-8E)	1
Pressure valve assembly	As required
Polyacrylamide Crystals	0.5 grams (provided)
Clear BOF tubing (8.0 mm OD)	1 – 3" piece Any length may be substituted
Wipes (NAVSEA DWG 6872811-18 or equal)	As required
Colored tubing or tape	As required

NOTE: Previously used BOF tube couplers may not adequately seal to BOF tubes. When installing BOF cabling, it is recommended to use new BOF tube couplers.

3.2.2 Tube and Fiber preparation.

NOTE: Before mating BOF tubes to BOF tube couplers, clean the end of each BOF tube with a wipe dampened with alcohol and blow dry as necessary.

NOTE: Refer to the connection chart or approved drawing to determine where straight or tee couplers are to be used.

Step 1 – Insert the individual fibers or bundled fiber into the tube coupler. Slide the tube coupler over the fibers/bundle to the BOF tube. Slide the tube coupler onto the BOF tube and seat it firmly (Figure 1).

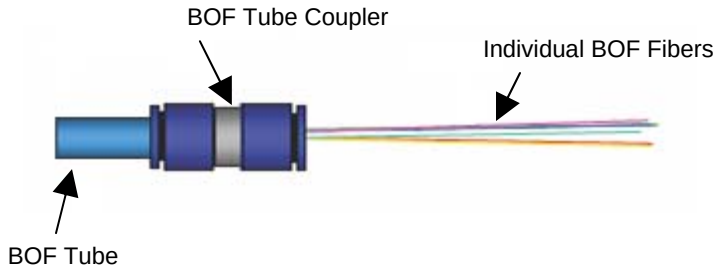

Figure 1

Step 2 - Using the scissors, trim back the individual fibers or fiber bundle that exits the tube coupler to approximately 66cm (26.0 inches) longer than the Loose Tube Furcation Cable (LTFC) length – (typically the length of the Loose Tube Furcation Assembly plus 2 feet is more than sufficient for most applications).

NOTE: The required length of the BOF fiber or fiber bundle and the loose tube furcation cables extending from the furcation assembly depends upon the equipment and fiber routing. This length may be determined by measuring the distance required to route the fiber from the end of the BOF tube to the furthermost connection point in the equipment plus approximately 130 mm (5 inches). The 26 inches mentioned above is in addition to this length

Step 3 – For tubes containing BOF bundles only:

NOTE: For eighteen fiber bundles, fibers of the same color are contained in each 6-fiber subunit. The sixth fiber color in each of the three 6-fiber subunits identifies the particular subunit. During the installation of the furcation unit, it is advantageous to know the 6-fiber subunit that each fiber comes from. One method to uniquely mark the fibers of each 6-fiber subunit is to make the fibers of each subunit a slightly different length.

a. Optional step for 18-fiber bundles: Using the scissors, cut off approximately 100mm (4 inches) of the fibers from one 6-fiber subunit. Then cut off approximately 200mm (8 inches) of the fibers from a different 6-fiber subunit.

b. Mark the bundle jacket approximately 25mm (1 inch) from the tube coupler.

NOTE: Do not pull slack fiber bundle out of the BOF tube while breaking out the bundled fibers. If slack fiber bundle is accidentally pulled out of the BOF tube, re-establish the bundle to its original position (using the 25mm mark on the bundle jacket as an index) and continue the procedure.

c. Using the bundle jacket stripper, remove the exposed bundle jacket in approximately 160 mm (6 inch) lengths back to the mark (Figure 2).

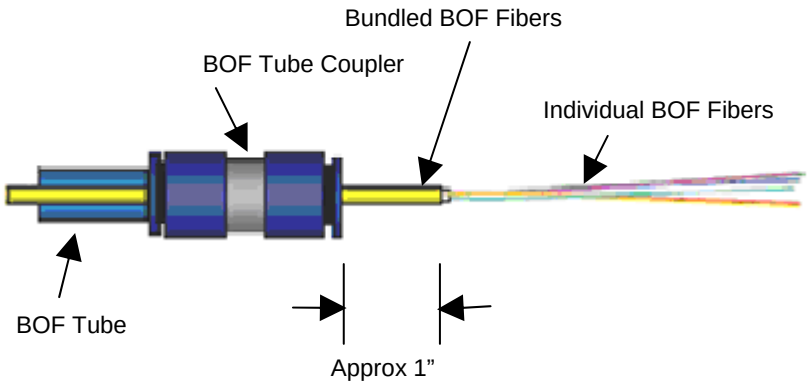

Figure 2

NOTE: Once a short length of the bundle jacket has been removed, the remaining length can be torn off the bundle by hand.

d. Using the clear jacket stripper, remove approximately 80 mm (3 inches) of the clear inner jacket from the end of each 6-fiber subunit.

NOTE: If wire stripper does not bite into the inner jacket, position the wire stripper at a 30 to 40 degree angle to increase its bite.

e. Find the ripcord from among the six fibers. Ensure that it is not crossed with any of the fibers. While holding the group of fibers in one hand, pull the ripcord along the bundle with the other hand. Pull the ripcord until it reaches the mark on the bundle jacket.

NOTE: The ripcord and fibers spiral along the bundle length. Take care to follow the spiral when pulling the ripcord.

f. Starting at the end of the fiber bundle subunit, carefully pull the group of fibers from the clear inner jacket.

g. Using the scissors carefully cut away the ripcord and the clear inner jacket.

h. Place the taper plug in the clear tubing and, if necessary, trim the flange to the diameter of the tube using scissors or other appropriate cutting tool. Remove tapered plug from clear tubing.

i. Check both ends of the clear tube to verify they are perpendicular to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

Step 4 - Insert the individual fibers into the short piece of clear BOF tube provided. Slide the clear BOF tube over the fibers to within approximately 50mm (2 inches) of the tube coupler (Figure 3).

NOTE: Any length of clear tubing can be used to adjust the location of push-fit connectors within equipment, boxes or cable harnesses. It is necessary to bend the tubing up without kinking the tubing such that polyacrylamide crystals can be poured down into the clear tube.

NOTE: The installer is cautioned to ensure that both ends of the tube are cut perpendicularly to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

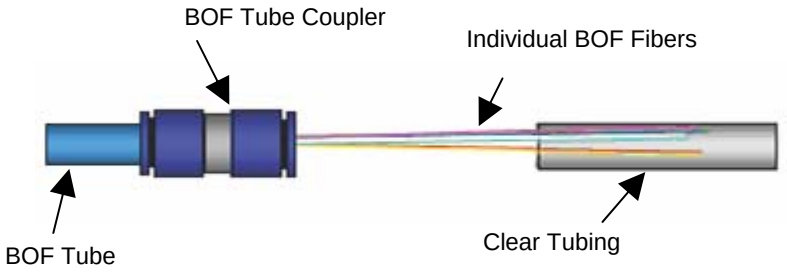

Figure 3

Step 5 - For BOF bundles only:

a. Place the provided tapered tube plug around the exposed bundle jacket approximately 19mm (0.75 inch) from the BOF tube coupler (Figure 4).

NOTE: The tapered tube plug should be oriented with the tapered tube end of the plug towards the short piece of clear BOF tube.

b. The flange on the tapered tube plug should be even with the outer diameter of the clear BOF tube. If necessary, using scissors or other appropriate cutting tool, trim the flange.

c. Push the short piece of BOF tube over the tapered plug until the plug is fully inserted into the tube.

NOTE: Do not pull slack fiber bundle out of the BOF tube while assembling the plug to the bundle jacket and the clear BOF tube. If slack fiber bundle is accidentally pulled out of the BOF tube, re-establish the bundle to its original position and continue the procedure.

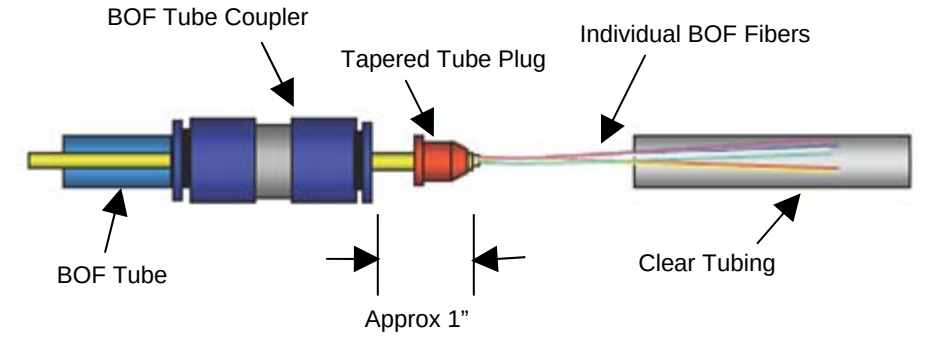

Figure 4

Step 6 - For tubes containing individual BOF fibers only:

a. Work a small amount of sealant tape around the optical fibers approximately 12 mm (0.5 inch) from the end of the BOF tube.

b. Place the tapered tube plug around the optical fibers and sealant tape (Figure 5).

NOTE: The tapered tube plug should be oriented with the tapered tube end of the plug towards the short piece of clear BOF tube.

c. The flange on the tapered tube plug should be even with the outer diameter of the clear BOF tube. If necessary, using scissors or other appropriate cutting tool, trim the flange.

NOTE: The installer is cautioned to ensure that both ends of the tube are cut perpendicularly to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

d. Push the short piece of clear BOF tube over the tapered plug until the plug is fully inserted into the tube.

NOTE: Do not pull slack fiber out of the BOF tube while assembling the plug to the individual BOF fibers and the clear BOF tube. If slack fiber bundle is accidentally pulled out of the BOF tube, re-establish the bundle to its original position and continue the procedure.

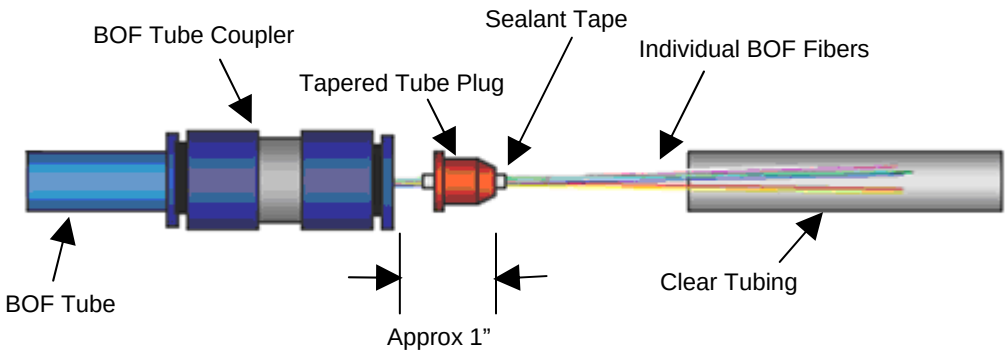

Figure 5

Step 7 – Slide the short piece of clear BOF tube with the tapered tube plug into the tube coupler and seat firmly (Figure 6). Apply a light load of approximately 22 N (5 lbs) between the tube and the coupler to ensure the tube is fully engaged onto the coupler.

NOTE: The optical fibers should now be fixed in the tapered tube plug in the BOF Tube and should not move into or out during the furcation unit installation or fiber termination process.

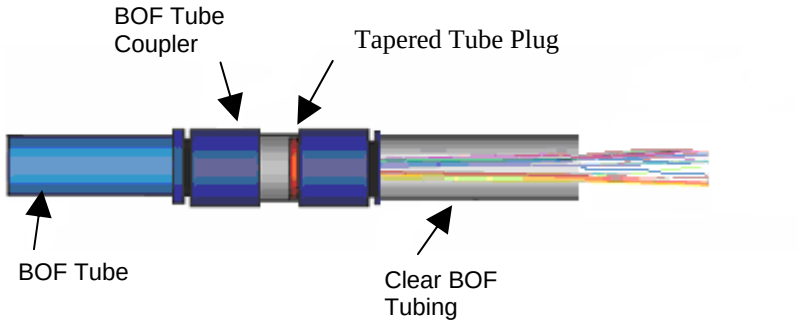

Figure 6

3.2.3 Furcation

Step 1 – Insert each individual fiber into one of the loose tube buffer tubes within the furcation unit (Figure 7). Feed each fiber through the furcation unit until all of the fibers are protruding from the ends of the individual loose tube furcation cables. Once started into the buffer tubes, with care it is frequently possible to slide all of the fiber strands into the buffer tubes simultaneously. This significantly expedites the installation process.

Step 2 - Clip the tip of the container containing the water swellable polyacrylamide crystals and, tipping the clear BOF tubing up, pour the contents (0.5 grams) into the clear BOF tubing around the fibers.

NOTE: If difficulty is encountered in tipping the tubing up, then a longer clear tube should be used to prevent kinking.

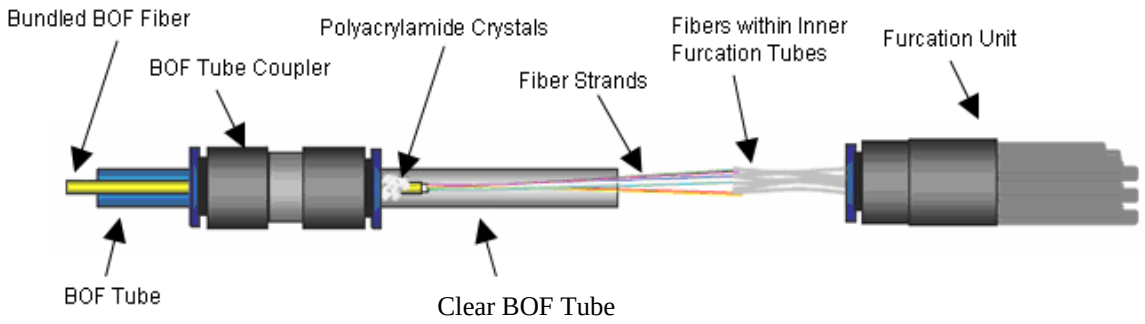

Figure 7

Step 3 – While continuing to hold the tubing up to keep the crystals at the far end, carefully insert the furcation assembly tube coupler onto the clear BOF tube and seat firmly (Figure 8). Ensure that no fibers are kinked within the tube as it is inserted into the tube coupler. Apply a light axial load of approximately 22 N (5 lbs) between the BOF tube and the furcation unit to verify coupler engagement.

NOTE: Do not rotate the furcation unit with respect to the BOF tube cable. Rotation of the furcation unit may cause increased optical loss or fiber breakage.

NOTE: Furcation units utilized should have a furcation cable for each of the fibers in the BOF tube. If the number of fibers in the BOF tube exceeds the number of furcation cables by design, the additional fibers shall be cut off after the required fibers are installed through their furcation cables.

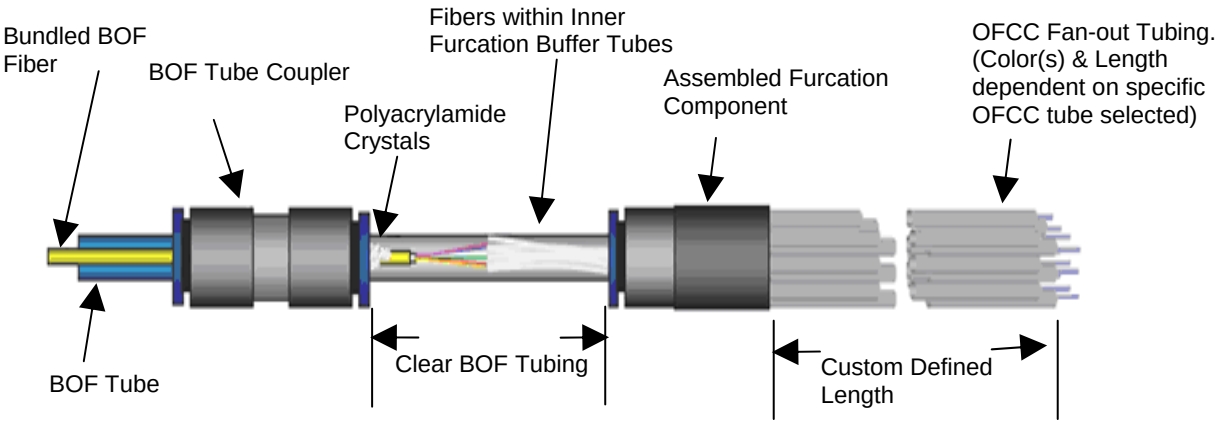

Figure 8

Step 4 - Utilizing a labeling methodology in accordance with local requirements, label each loose tube furcation cable to identify the fiber within that furcation cable. If marking the color of the fiber within each furcation cable, colored heat shrink tubing or tape may be used. Refer to table 2 for fiber color coding.

Step 5 – End seal any furcation cables that will not be terminated in accordance with Method 1E1 of MILSTD-2042-2B(SH)

3.3 Method 2. Furcation assembly and polyacrylamide installation using t-tube coupler.

Procedure for installation with clear piece of 8 mm tubing using Polyacrylamide crystals

3.3.1 The equipment and materials in the following Table 1 are recommended to perform this procedure and must be used to remain compliant with MIL-STD-2042-2B (SH) METHOD 2F1.

Table 1 Equipment and materials.

Description	Quantity
Furcation Assembly (AA59729)	1 (provided)
Safety glasses	1
Tapered tube plug AA59730-TTP-2 (6 fiber bundle, 2 to 6 individual fibers) Or; Tapered tube plug AA59730-TTP-3 (12 or 18 fiber bundle, 8 to 12 individual fibers)	2
Adhesive and sealant tape (Raychem SFTS-1 or equal)	As required
Ruler	1
Utility knife	1
Tube cutter	1
Bundle jacket stripper (18 gauge for 6-fiber bundles)	As required
Bundle jacket stripper (12 gauge for 18-fiber bundles)	As required
Clear jacket stripper (20 gauge for 6-fiber bundles)	As required
Scissors	1
Fiber, BOF single fibers or fibers from a BOF bundle	As required
Straight Tube coupler (AA59731-U-8 or AA59731-U-8E)	As required
Tee Tube coupler (AA59731-T-8 or AA59731-T-8E)	1
Polyacrylamide Crystals	0.5 grams (provided)
Clear BOF tubing (8.0 mm OD)	2 - 3” pieces
Wipes (NAVSEA DWG 6872811-18 or equal)	As required
Colored tubing or tape	As required

NOTE: Previously used BOF tube couplers may not adequately seal to BOF tubes. When installing BOF cabling, it is recommended to use new BOF tube couplers.

3.3.2 Tube and Fiber preparation.

NOTE: Before mating BOF tubes to BOF tube couplers, clean the end of each BOF tube with a wipe dampened with alcohol and blow dry as necessary.

Step 1 – Insert the individual fibers or bundled fiber into the tube coupler. Slide the tube coupler over the fibers/bundle to the BOF tube. Slide the tube coupler onto the BOF tube and seat it firmly (Figure 1).

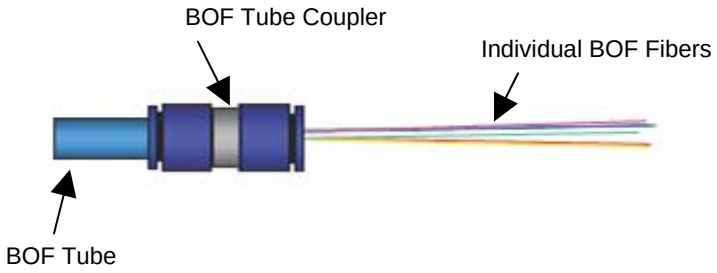

Figure 1

Step 2 - Using the scissors, trim back the individual fibers or fiber bundle that exits the tube coupler to approximately 66cm (26.0 inches) longer than the Loose Tube Furcation Cable (LTFC) length – (typically the length of the Loose Tube Furcation Assembly plus 2 feet is more than sufficient for most applications).

NOTE: The required length of the BOF fiber or fiber bundle and the loose tube furcation cables extending from the furcation assembly depends upon the equipment and fiber routing. This length may be determined by measuring the distance required to route the fiber from the end of the BOF tube to the furthermost connection point in the equipment plus approximately 130 mm (5 inches). The 26 inches mentioned above is in addition to this length

Step 3 – For tubes containing BOF bundles only:

NOTE: For eighteen fiber bundles, fibers of the same color are contained in each 6-fiber subunit. The sixth fiber color in each of the three 6-fiber subunits identifies the particular subunit. During the installation of the furcation unit, it is advantageous to know the 6-fiber subunit that each fiber comes from. One method to uniquely mark the fibers of each 6-fiber subunit is to make the fibers of each subunit a slightly different length.

a. Optional step for 18-fiber bundles: Using the scissors, cut off approximately 100mm (4 inches) of the fibers from one 6-fiber subunit. Then cut off approximately 200mm (8 inches) of the fibers from a different 6-fiber subunit.

b. Mark the bundle jacket approximately 25mm (1 inch) from the tube coupler.

NOTE: Do not pull slack fiber bundle out of the BOF tube while breaking out the bundled fibers. If slack fiber bundle is accidentally pulled out of the BOF tube, re-establish the bundle to its original position (using the 25mm mark on the bundle jacket as an index) and continue the procedure.

c. Using the bundle jacket stripper, remove the exposed bundle jacket in approximately 160 mm (6 inch) lengths back to the mark (Figure 2).

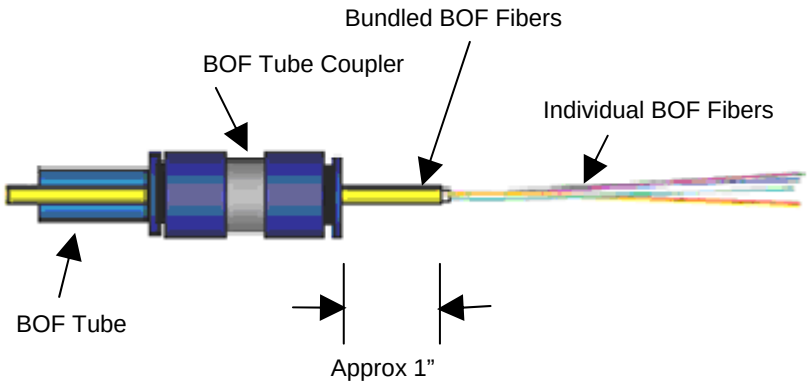

Figure 2

NOTE: Once a short length of the bundle jacket has been removed, the remaining length can be torn off the bundle by hand.

d. Using the clear jacket stripper, remove approximately 80 mm (3 inches) of the clear inner jacket from the end of each 6-fiber subunit.

NOTE: If wire stripper does not bite into the inner jacket, position the wire stripper at a 30 to 40 degree angle to increase its bite.

e. Find the ripcord from among the six fibers. Ensure that it is not crossed with any of the fibers. While holding the group of fibers in one hand, pull the ripcord along the bundle with the other hand. Pull the ripcord until it reaches the mark on the bundle jacket.

NOTE: The ripcord and fibers spiral along the bundle length. Take care to follow the spiral when pulling the ripcord.

f. Starting at the end of the fiber bundle subunit, carefully pull the group of fibers from the clear inner jacket.

g. Using the scissors carefully cut away the ripcord and the clear inner jacket

h. Place the taper plug in the clear tubing and, if necessary, trim the flange to the diameter of the tube using scissors or other appropriate cutting tool. Remove tapered plug from clear tubing.

i. Check both ends of the clear tube to verify they are perpendicular to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

Step 4 - Insert the individual fibers into the short piece of clear BOF tube provided. Slide the clear BOF tube over the fibers to within approximately 50mm (2 inches) of the tube coupler (Figure 3).

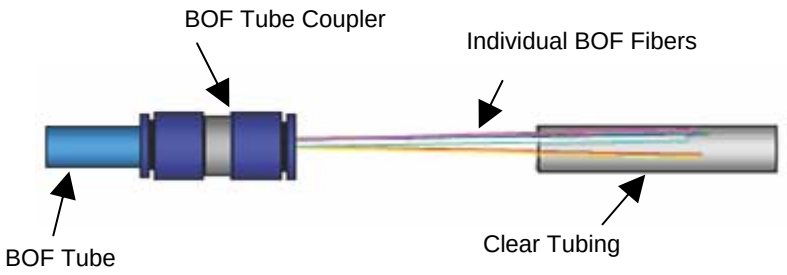

Figure 3

Step 5 - For BOF bundles only:

a. Place the provided tapered tube plug around the exposed bundle jacket approximately 19mm (0.75 inch) from the BOF tube coupler (Figure 4).

NOTE: The tapered tube plug should be oriented with the tapered tube end of the plug towards the short piece of clear BOF tube.

b. The flange on the tapered tube plug should be even with the outer diameter of the clear BOF tube. If necessary, using scissors or other appropriate cutting tool, trim the flange.

c. Push the short piece of clear BOF tube over the tapered plug until the plug is fully inserted into the tube.

NOTE: Do not pull slack fiber bundle out of the BOF tube while assembling the plug to the bundle jacket and the clear BOF tube. If slack fiber bundle is accidentally pulled out of the BOF tube, re-establish the bundle to its original position and continue the procedure.

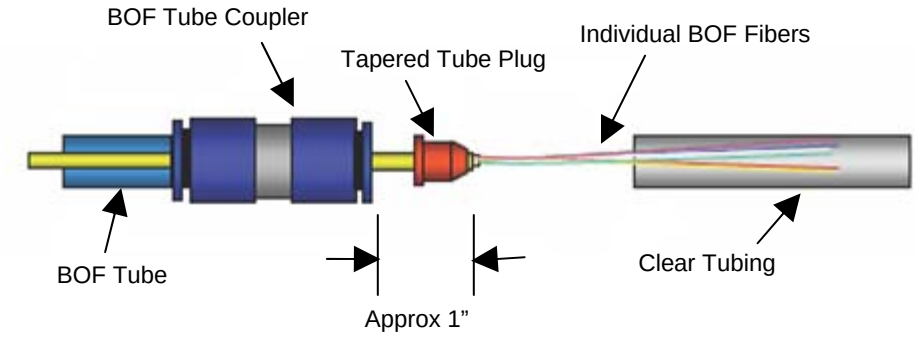

Figure 4

Step 6 - For tubes containing individual BOF fibers only:

a. Work a small amount of sealant tape around the optical fibers approximately 12 mm (0.5 inch) from the end of the BOF tube coupler.

b. Place the tapered tube plug around the optical fibers and sealant tape (Figure 5).

NOTE: The tapered tube plug should be oriented with the tapered tube end of the plug towards the short piece of clear BOF tube.

c. The flange on the tapered tube plug should be even with the outer diameter of the clear BOF tube. If necessary, using scissors or other appropriate cutting tool, trim the flange.

NOTE: The installer is cautioned to ensure that both ends of the tube are cut perpendicularly to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

d. Push the short piece of clear BOF tube over the tapered plug until the plug is fully inserted into the tube.

NOTE: Do not pull slack fiber out of the BOF tube while assembling the plug to the individual BOF fibers and the clear BOF tube. If slack fiber is accidentally pulled out of the BOF tube, re-establish the fiber to its original position and continue the procedure.

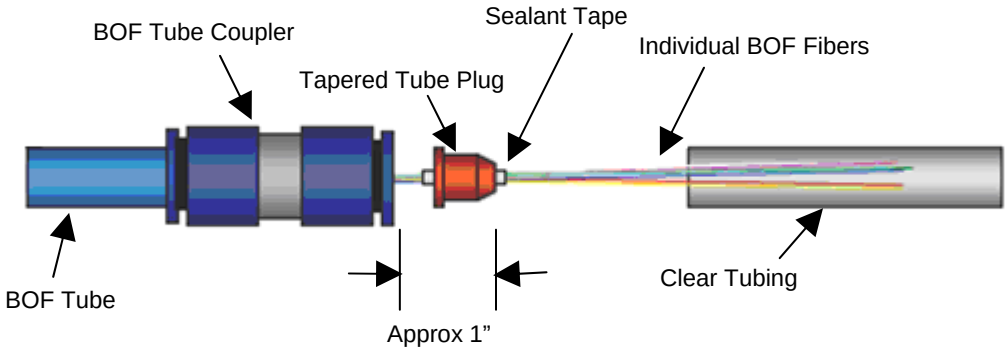

Figure 5

Step 7 – Slide the short piece of clear BOF tube with the tapered tube plug into the tube coupler and seat firmly (Figure 6). Apply a light load of approximately 22 N (5 lbs) between the tube and the coupler to ensure the tube is fully engaged onto the coupler.

NOTE: The optical fibers should now be fixed in the tapered tube plug in the BOF Tube and should not move into or out during the furcation unit installation or fiber termination process.

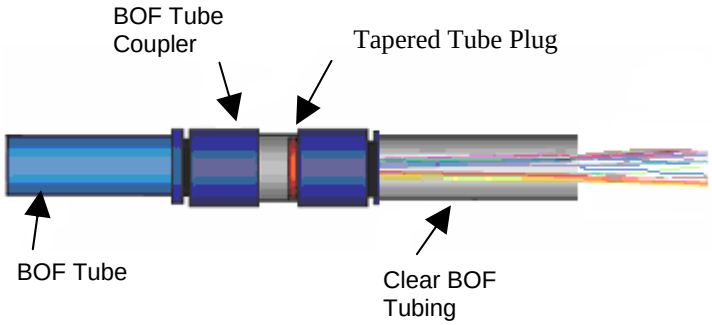

Figure 6

Step 8 – Insert the individual fibers into the tee tube coupler, slide to the short piece of clear BOF tube and seat firmly (Figure 7). Apply a light load of approximately 22 N (5 lbs) between the coupler and the tube to ensure the coupler is fully engaged onto the tube.

NOTE: The tee tube coupler should have 8 mm through openings on all entry points.

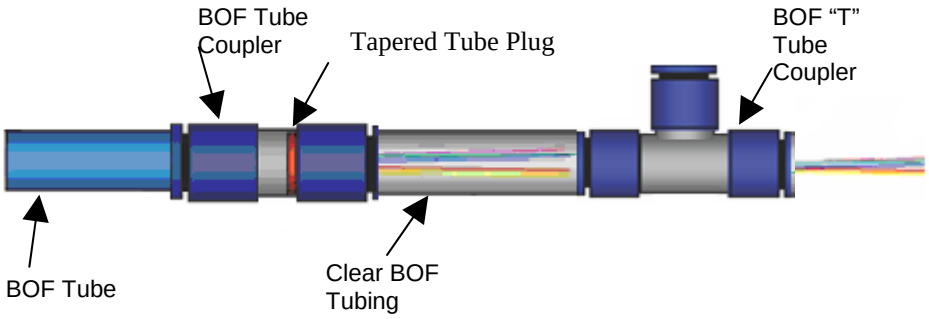

Figure 7

NOTE: The installer is cautioned to ensure that both ends of the tube are cut perpendicularly to the tube length. Clean the ends of the BOF tube with a wipe dampened with alcohol and blow dry as necessary.

Step 9 - Insert the individual fibers into the second short piece of clear BOF tube provided and seat firmly into the tee tube coupler. Apply a light load of approximately 22 N (5 lbs) between the tube and the coupler to ensure the tube is fully engaged onto the coupler.

Step 10 - Place the tapered tube plug around the optical fibers.

NOTE: The tapered tube plug should be oriented with the tapered tube end of the plug towards the short piece of clear BOF tube.

a. Using scissors or other appropriate cutting tool, trim the flange on the tapered tube plug even with the outer diameter of the clear BOF tube, if necessary.

b. Push the tapered plug into the short piece of BOF tube until the plug is fully inserted into the tube.

NOTE: Avoid excessive slack or bends in the fibers between the two tapered tube plugs. Excessive slack or bending of the fibers may cause increased optical loss or fiber breakage.

Step 11 – Insert the individual fibers into the tube coupler. Slide the tube coupler over the fibers to the short piece of clear BOF tube. Slide the tube coupler onto the clear BOF tube and firmly seat the tube within the tube coupler. (Figure 8). Apply a light load of approximately 22 N (5 lbs) between the coupler and the tube to ensure the coupler is fully engaged onto the tube.

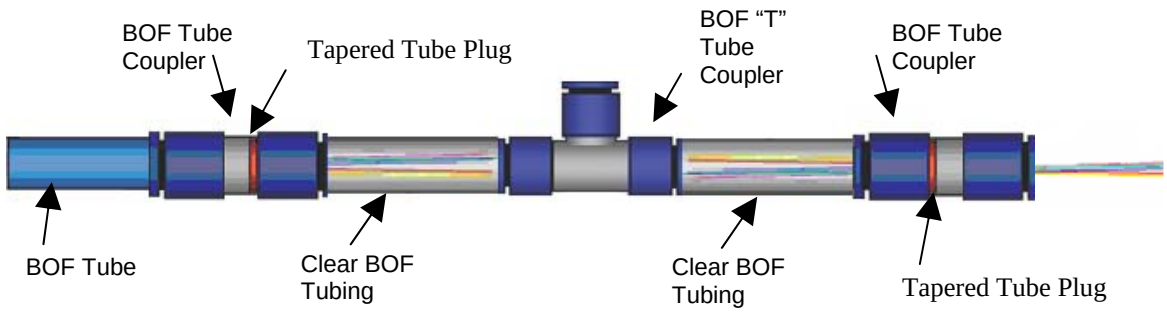

Figure 8

Step 12 – Proceed to Step 1 of 3.3.3.

3.3.3 Furcation

Step 1 – Remove the 3" tube that is attached to the coupler on the furcation unit.

a. Insert the individual fibers into the 3" tube. Slide the short tube into the BOF coupler and seat firmly.

Step 2 – Insert each individual fiber into one of the loose tube furcation tubes within the furcation unit (Figure 9). Feed each fiber through the furcation unit until all of the fibers are protruding from the ends of the individual loose tube furcation cables.

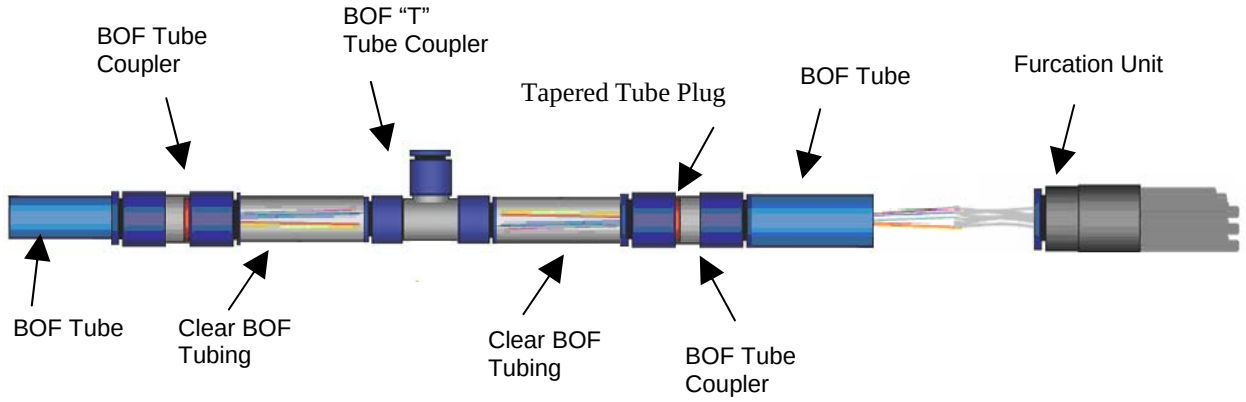

Figure 9

Step 3 – Carefully insert the furcation assembly tube coupler onto the BOF tube and seat firmly (Figure 10). Ensure that no fibers are kinked within the tube as it is inserted into the tube coupler. Apply a light axial load of approximately 22 N (5 lbs) between the BOF tube and the furcation unit to verify coupler engagement.

NOTE: Do not rotate the furcation unit with respect to the BOF tube cable. Rotation of the furcation unit may cause increased optical loss or fiber breakage.

NOTE: Furcation units utilized should have a furcation cable for each of the fibers in the BOF tube. If the number of fibers in the BOF tube exceeds the number of furcation cables by design, the additional fibers may be cut off after the required fibers are installed through their furcation cables.

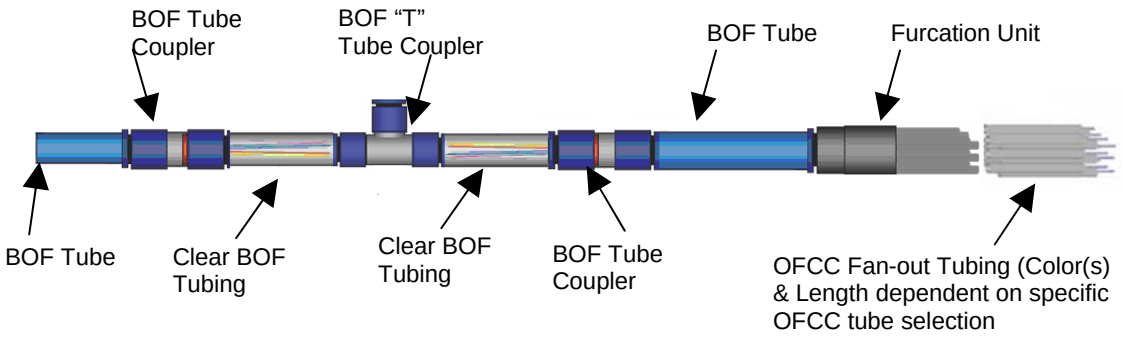

Figure 10

NOTE: Ensure that assembly of all couplers from the fiber optic cable plant to the furcation unit are securely seated. This is accomplished by applying a light axial load of approximately 22 N (5

lbs) to the series of couplers between the cable plant BOF tube and the furcation unit to verify overall coupler engagement.

Step 4 - Utilizing a labeling methodology in accordance with local requirements, label each loose tube furcation cable to identify the fiber within that furcation cable. If marking the color of the fiber within each furcation cable, colored heat shrink tubing or tape may be used. Refer to table 2 for fiber color coding.

Step 5 – End seal any furcation cables that will not be terminated in accordance with Method 1E1 of MIL-STD-2042-2B (SH)

3.3.4 Polyacrylamide Crystal Insertion

Step 1 – Remove plug from tee tube coupler and set aside.

Step 2 – Insert a spare tube into the tee coupler opening.

a. Insert polyacrylamide crystals into spare tube and visually fill clear BOF tube around the fibers to mid point. (approx. 0.5 grams). (Figure 11)

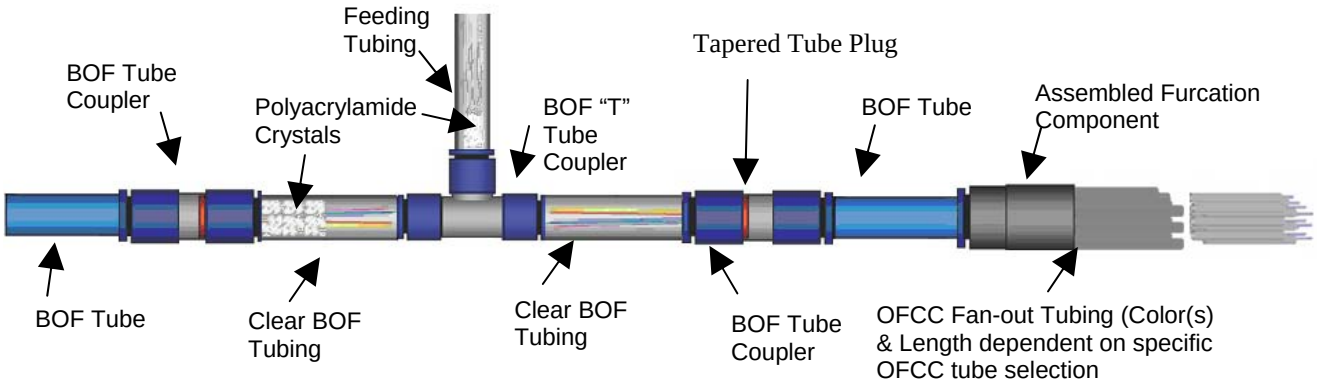

Figure 11

NOTE: If crystals do not free fall, finger tap on tee tube coupler as necessary.

b. Remove spare BOF filling tube and replace plug into the BOF tee coupler. (Figure 12)

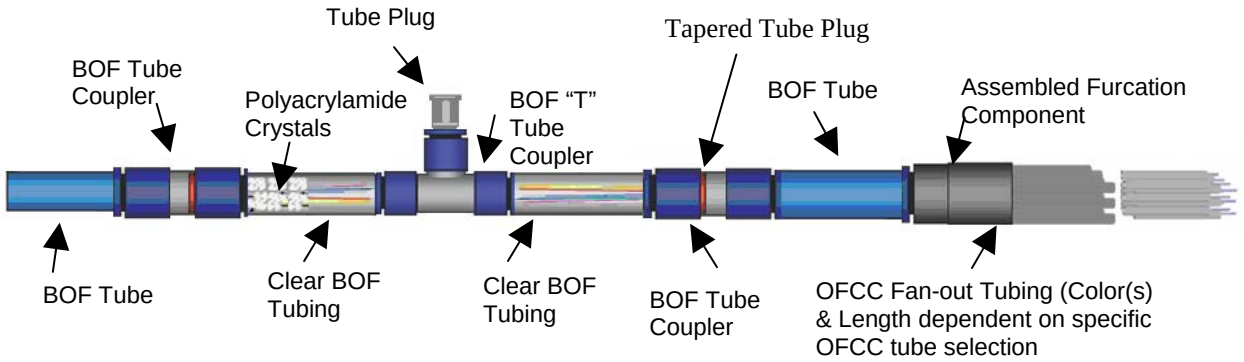

Figure 12

Table 2. Fiber Color Coding

Fiber Number	General Cable Fiber Color	Sumitomo Electric Light Fiber Color		
		12-Fiber Bundle	18-Fiber Bundle*	
			Subunit Color	Fiber Color
1	Blue	Blue	Red	Blue
2	Orange	Orange		Orange
3	Green	Green		Green
4	Brown	Brown		Brown
5	Slate	Slate		Slate
6	White	White		Red
7	Red	Red	Violet	Blue
8	Black	Black		Orange
9	Yellow	Yellow		Green
10	Violet	Violet		Brown
11	Pink	Pink		Slate
12	Aqua	Aqua		Violet
13	n/a	n/a	Yellow	Blue
14	n/a	n/a		Orange
15	n/a	n/a		Green
16	n/a	n/a		Brown
17	n/a	n/a		Slate
18	n/a	n/a		Yellow

* Note: The subunits of the 18-fiber bundles do not have color-coded subunit jackets. The subunit is identified by the presence of red, violet or yellow fiber within the subunit.