SUMITOMO RECOMMENDED PROCEDURE

SRP: SP-F04-016

FutureFLEX® AIR-BLOWN FIBER® SOLUTIONS

TUBE CABLE SPLICE KIT INSTALLATION PROCEDURE

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SEL is a Member of the Sumitomo Electric Industries, Ltd. Group

1.0 General

1.1 This Procedure describes the standard techniques for installing Tube Cable Splice Kits on FutureFLEX dielectric (non-metallic/armored) Tube Cables.

1.2 Tube Cable Splice Kits provide a permanent, in-line Tube Cable splice with a waterproof protective barrier by collapsing a rubber Shrink Sleeve around the coupled Tubes and Tube Cable jacket ends.

1.3 Once installed, a Tube Cable Splice Kit is not re-enterable compared to a TDU enclosure or Splice Case.

1.3.1 Before the Tube Cable splice is waterproofed / closed, the Tube span must be Pressure and Obstruction tested in accordance with Sumitomo Recommended Procedures **SRP: SP-F04-003** and **SRP: SP-F04-004.**

1.3.2 After the Tube Cable splice is waterproofed / closed, re-entry is only possible by cutting the rubber Shrink Sleeve from around the bare Tubes. This action introduces the strong possibility of damaging the Tubes.

1.4 Tube Cable Splice Kits are primarily used in outdoor applications wherever two (2) Tube Cables of the same Tube count must be coupled / spliced together. Typical installation locations are inside Maintenance Holes, Vaults, Hand Holes, and similar.

1.5 Tube Cable Splice Kits are not indoor fire-rated. However, they can be used in a Building Entrance Facility area (within the first 50' of building entry) to splice an outside plant Tube Cable to an indoor rated Tube Cable (with the same Tube count) provided a re-enterable enclosure is not required by project specifications at that location. Once installed, the Tube Cable Splice Kit will provide an effective protective barrier around the outdoor-to-indoor Tube Cable Splice.

1.6 Tube Cables joined with a Tube Cable Splice Kit should Not be pulled. The Splice Kit does not provide any tensile strength to the splice point and severe Tube damage could result.

2.0 Safety Precautions

2.1 The use of personnel safety equipment is strongly recommended while cutting and stripping Tube Cable ends. This includes the use of cut-resistant Kevlar gloves and eye wear.

3.0 Reference Documents

3.1 Sumitomo Recommended Procedure, *FutureFLEX Tube Pressure Testing Procedure,* **SRP: SP-F04-003.**

3.2 Sumitomo Recommended Procedure, *FutureFLEX Tube Obstruction Testing Procedure,* **SRP: SP-F04-004.**

3.3 Sumitomo Recommended Procedure, *FutureFLEX Tube Cable Installation Procedures,* **SRP: SP-F04-008.**

3.4 Sumitomo Recommended Procedure, *FutureFLEX Tube Cable Splicing Procedures,* **SRP: SP-F04-031.**

4.0 Equipment / Tools Required

The following equipment, tools, and materials are required to complete this procedure:

4.1. Tube Cable Splice Kits:

- **DE00SPL** for 2 and 4-Tube Cables
  - ✓ 1-1/2" Expanded Diameter, 15-1/4" Length
- **DE01SPL** for 7 and 12-Tube Cables
  - ✓ 3" Expanded Diameter, 26" Length
- **DE02SPL** for 19-Tube Cables
  - ✓ 4" Expanded Diameter, 33" Length
- **DE03SPL** for 24-Tube Cables
  - ✓ 5" Expanded Diameter, 36" Length

Note: *Splice Kits include Tube Couplings, water-blocking tape, mastic tape, and a rubber Shrink Sleeve. The rubber Shrink Sleeve is also known as a "Cold Shrink Boot" because no heating is required to Shrink or collapse the Sleeve around the splice point.*

- ✓ Vinyl Electricians Tape
- ✓ Felt Tip Pen / Marker
- ✓ Tape Measure
- ✓ Protective Gloves (Kevlar)
- ✓ Utility Knife with Hook Blade
- ✓ Tube Cable Cutter (**SEL: BETL03 / BETL64**)
- ✓ Single Tube Cutter (**SEL: BETC001**)

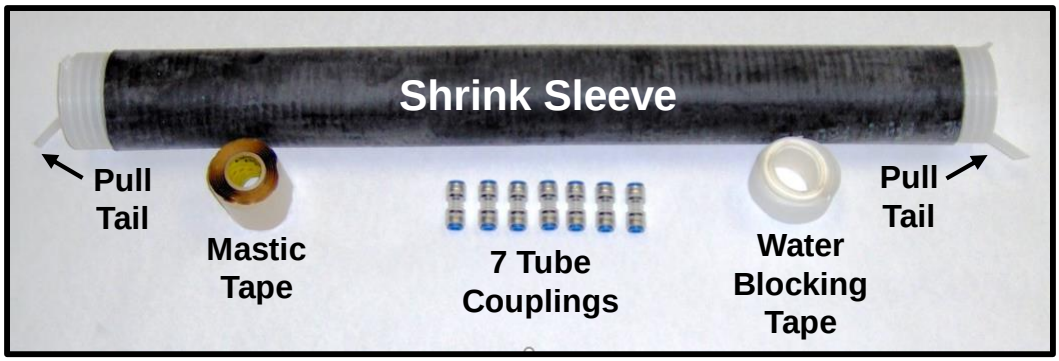


Figure 1
SEL P/N: DE01SPL Tube Cable Splice Kit - *(For 7 & 12 Tube Cables)*

5.0 Equipment Layout

5.1 See Fig. 1 for a typical Tube Cable Splice Kit layout and kit component details.

DE00SPL Tube Cable Splice Kit
- For Dielectric 2 & 4-Tube Cables:
  TC02TOX & TC02MSOS only
  TC04TOD & TC04MSOS only
- Shrink Sleeve 1-1/2" open dia. x 15-1/4" L
- (2 or 4) Tube Couplings (DE08MC2)
- Water Blocking Tape
- Mastic Tape

DE01SPL Tube Cable Splice Kit
- For Dielectric 7 & 12 Tube Cables:
  TC07TOX & TC07MSOS only
  TC12TOX & TC12MSOS only
- Shrink Sleeve 3" open dia. x 26" L
- (7 or 12) Tube Couplings (DE08MC2)
- Water Blocking Tape
- Mastic Tape

DE02SPL Tube Cable Splice Kit
- For Dielectric 19-Tube Cables:
  TC19TOX & TC19MSOS only
- Shrink Sleeve 4" open dia. x 33" L
- (19) Tube Couplings (DE08MC2)
- Water Blocking Tape
- Mastic Tape

DE03SPL Tube Cable Splice Kit
- For Dielectric 24 Tube Cables:
  TC24TOX only
- Shrink Sleeve 5" open dia. x 36" L
- (24) Tube Couplings (DE08MC2)
- Water Blocking Tape
- Mastic Tape

6.0 Preparing the Tube Cables

6.1 Key Step**.** Before installing a Tube Cable Splice Kit, verify that both Tube Cable ends will mate properly so that their Tubes will not be crossed / twisted when coupled. See Sumitomo Recommended Procedure **SRP: SP-F04-008** and. **See Fig. 1a**

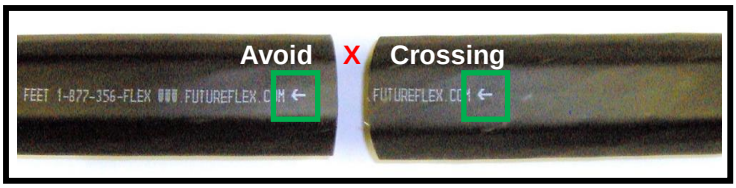


Figure 1a

Tube Cable Arrows Shall point in the Same Direction at an inline splice point. (Maintains Proper Tube Orientation/Polarity)

6.2 Determine final installed location of Shrink Sleeve. Shrink Sleeves should be installed in a straight section of the Tube Cable route; not in a bend, curve or angle of any type.

6.3 Position Both Tube Cables and Shrink Sleeve side-by-side and hold in place. Ensure Tube Cables overlap each other.

6.4 Mark Both Tube Cable jackets to coincide with left and right ends of Shrink Sleeve. **See Fig. 2.**

6.5 Use Tube Cable Cutter **(SEL: BETL03)** and cut each Tube Cable to length at its First Mark.

6.6 To achieve an effective watertight seal, Shrink Sleeves must overlap Tube Cable jacket ends.

IMPORTANT NOTE: All provided Measurements are Approximate Measurements Only. The following illustrations and procedural steps clearly demonstrate proper installation for a 7-Tube Cable.
** **Remember: Measure Twice and Cut Once** **

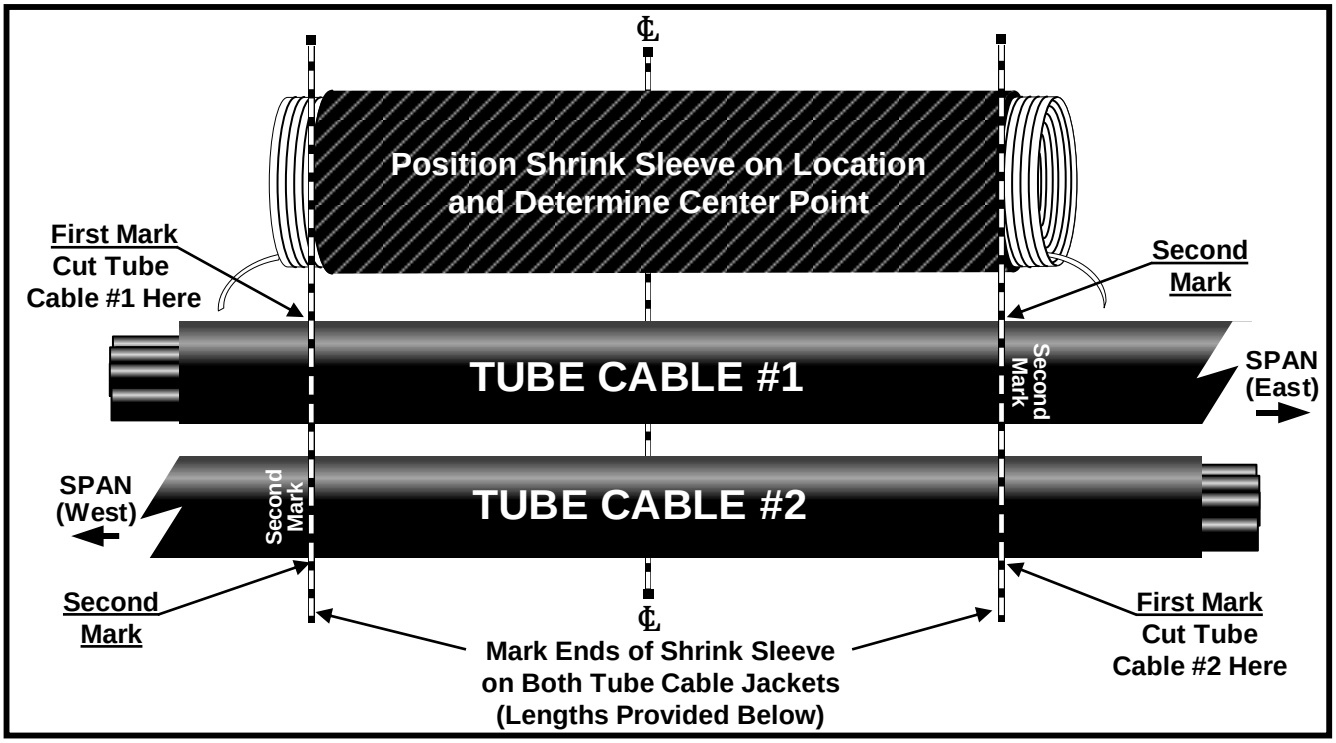


Figure 2 - Preparing Tube Cables

Dimensional Details: Approximate – Shrink Sleeve Dimensions:
- For **2 & 4** -Tube Cables = 1-1/2" D x 15-1/4" L
- For **7 & 12** -Tube Cables = 3" D x 26" L
- For **19** - Tube Cables = 4" D x 33" L
- For **24** - Tube Cables = 5" D x 36" L

SEL: BETL003
(Tube Cable Cutter)

6.6.1 For 2 & 4-Tube Cables, measure approximately 2" forward from Second Mark and make a Third Mark on each Tube Cable jacket. **See Fig. 3.**

6.6.2 For 7 & 12-Tube Cables, measure approximately 6" forward from Second Mark and make a Third Mark on each Tube Cable jacket. **Refer to Fig. 3.**

6.6.3 For 19 & 24-Tube Cables, measure approximately 5" forward from Second Mark and make a Third Mark on each Tube Cable jacket. **Refer to Fig. 3.**

6.7 Use a Hook Blade Knife to lightly score each Tube Cable jacket at its Third Mark. Pull the ripcord and strip the jacket away to expose the individual Tubes.

7.0 Cutting the Tubes

Note: *See Section 11 when splicing a 4-tube Tube Cable with a Center Filler Member.*

IMPORTANT NOTE: Once installed, Shrink Sleeves collapse very tightly over the coupled splices. If the provided Tube Coupling pattern is not accomplished the Tube Couplings may compress into adjacent bare Tubes and damage (pinch/collapse) them. This procedure follows the Unique Tube Coupling "Stagger-Arrangement" method.

TIP: Layout and measure everything prior to making your first cut.

7.1 On the first Tube Cable, locate Tube #1. Measure approximately 4" in from stripped end of Tube Cable jacket and mark Tube #1. Use Tube Cutter **(SEL: BETC001)** to cut Tube #1 at this mark. **See Fig. 4.**

7.2 Locate Tube #2. Measure approximately 1" from the previous cut Tube (Tube #1) and mark Tube #2. Use Tubing Cutter **(SEL: BETC001)** to cut Tube #2 at this mark. **Refer to Fig. 4.**

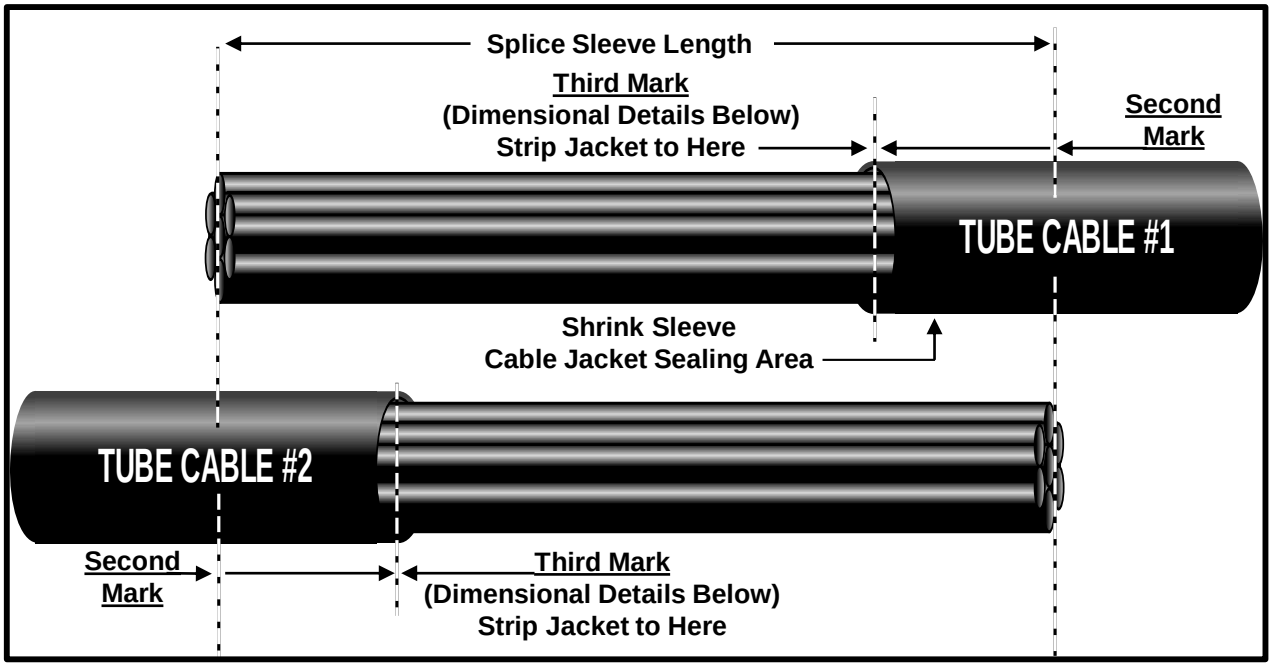


Figure 3
Stripping Tube Cables to Proper Length

Dimensional Details: Approximate - Second-to-Third Mark Dimensions:
- For **2 & 4** -Tube Cables = 2" Each End Approx.
- For **7 & 12** -Tube Cables = 6" Each End Approx.
- For **19 & 24** -Tube Cables = 5" Each End Approx.

7.3 Repeat above step for remaining Tubes #3 through #7.

Important Step. The Tubes of the first Tube Cable should be cut as described in ascending numerical sequence in order to correctly stagger individual Tube Couplings.

7.4 On second Tube Cable, locate Tube #7. Measure approximately 4" in from stripped end of Tube Cable jacket and mark Tube #7. Use Tube Cutter **(SEL: BETC001)** to cut Tube #7 at this mark. **Refer to Fig. 4.**

7.5 Locate Tube #6. Measure approximately 1" from the previous cut Tube (Tube #7) and mark Tube #6. Use Tubing Cutter **(SEL: BETC001)** to cut Tube #6 at this mark. **Refer to Fig. 4.**

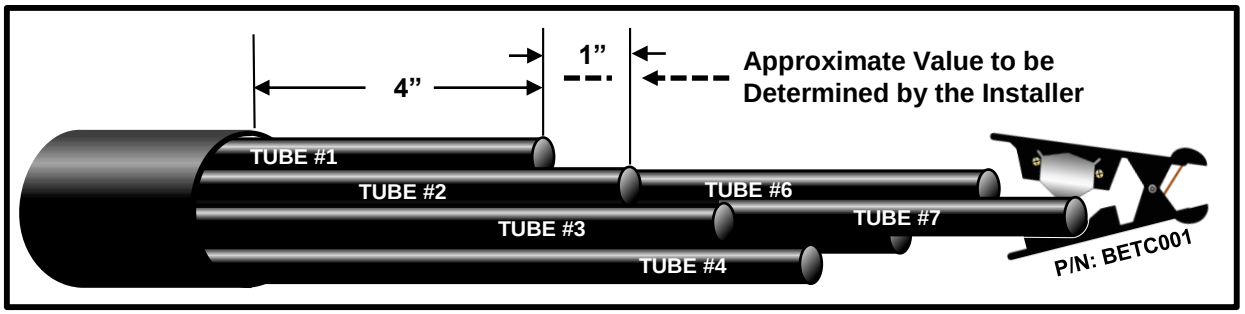


Figure 4
Correct Technique for Cutting Tubes
First Tube Cable = Cut Tubes in Ascending Order from Tube #1 to Tube #7
Second Tube Cable = Cut Tubes in Descending Order from Tube #7 to Tube #1

7.6 Repeat above step for remaining Tubes #5 through #1.

7.7 Important Step. The Tubes of the second Tube Cable must be cut as described in descending numerical sequence in order to correctly stagger individual Tube Couplings.

Note: *For a 19-Tube Cable splice, cut Tubes of first Tube Cable starting with Tube #1 and, in ascending numerical sequence, end with Tube #19. Cut Tubes of second Tube Cable starting with Tube #19 and, in descending numerical sequence, end with Tube #1.*

Tip: *Make a "Measuring Aid" to help measure your required dimension. Wrap tape around the end of a scrap piece of tubing and trim to an approximate "Installer Determined" length to create an easy to use and accurate measuring aid.* ***See Fig. 5.***

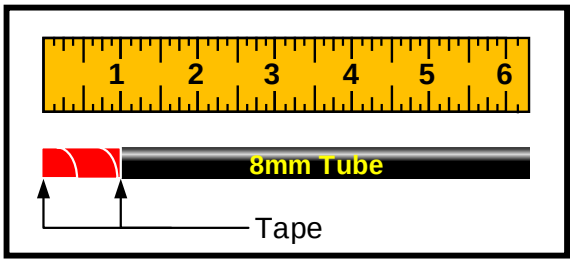


Figure 5 - "Measuring Aid"

8.0 Installing the Tube Couplings

8.1 Slide Shrink Sleeve over one Tube Cable end and past exposed Tubes. Be sure that one pull tail of the Sleeve's plastic core inner wrapping is exposed at each end of the Sleeve. **See Fig. 6.**

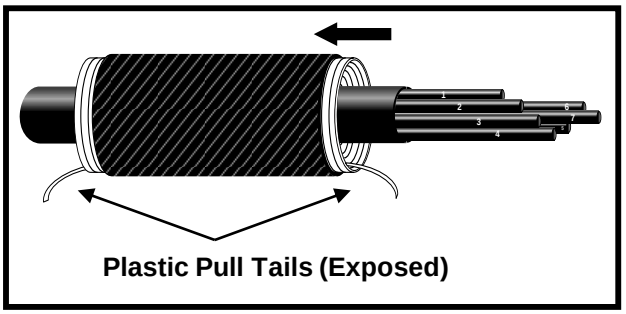


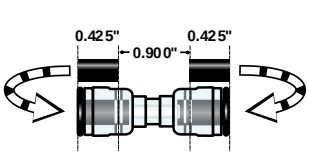
Figure 6
Shrink Sleeve Installed Over Tube Cable
(Before Tube Cables are Coupled)

Note: *Shrink Sleeves for 7, 12, 19 and 24-Tube Cables have two (2) pull tails. Shrink Sleeves for 2 & 4-Tube Cables have only one (1) pull tail.*

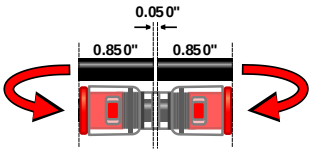
8.2 Select either Tube Cable and install a Tube Coupling on each Tube. Be sure each Tube is pushed all the way into its coupling and fully and firmly seated. **See Fig. 7.**

8.3 Connect Tube Cable ends together by first coupling the Tube with highest number to its mate. Then continue coupling Tubes in descending numerical sequence. Be sure each Tube is pushed all the way into its coupling and fully and firmly seated. **See Fig. 8.**

Note: Always use the same style couplers for all couplings of tubes. *(Affects Measurements)*



Tube Coupler **DE08MC2**
Old Style Accepts (0.425")



Tube Coupler **DE08MC2**
New Style Accepts (0.850")

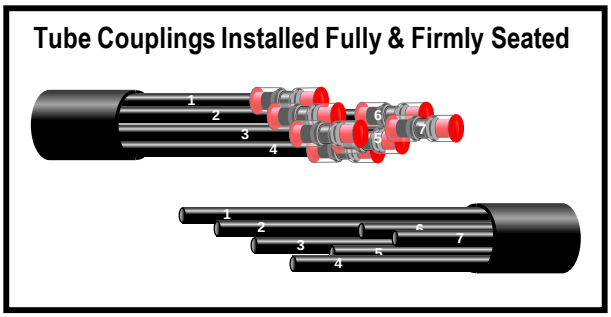


Figure 7
All Couplers Installed on One Tube Cable

8.4 Tube Coupling stagger arrangement places plastic shoulder of one Tube Coupling against the plastic shoulder of an adjacent Tube Coupling. This arrangement is necessary to prevent a Tube Coupling from being pressed into and possibly compressing / kinking an adjacent bare Tube when Shrink Sleeve is collapsed.

8.5 Important Step. Once all the Tubes are coupled together, each Tube in the span must be tested before Shrink Sleeve is collapsed. While the Tube Couplings are still exposed and accessible, perform Pressure Test and Obstruction Test Procedures per Sumitomo Recommended Procedures **SRP: SP-F04-003** and **SRP: SP-F04-004.**

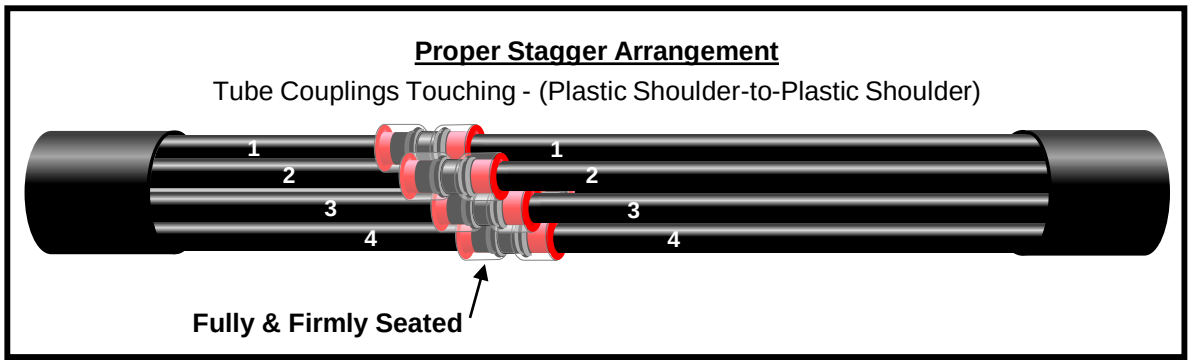


Figure 8
All Tubes Coupled in Proper Stagger Arrangement

9.0 Sealing the Splice

9.1 After Tube testing is complete and any/all problems corrected, the exposed splice must be waterproofed before the Shrink Sleeve is collapsed.

9.2 Use the water blocking tape provided in the Tube Cable Splice Kit and apply a helically-wrapped layer over the splice area. Start and end water blocking tape wrap just inside jacket ends. Overlap adjoining wraps by 30%-50%. **See Fig. 9.**

9.3 Use Vinyl Electricians Tape (Installer provided) and apply a helically-wrapped layer over the water-blocking tape. This secures both ends of the water blocking tape to the cable and keeps it from tearing when the Shrink Sleeve is collapsed. Overlap adjoining wraps by 30%-50%. **Refer to Fig. 9.**

9.4 Clean and dry any foreign material from both Tube Cable jacket ends. Clean all areas where the Shrink Sleeve will come in contact with the jacket.

9.5 Use the mastic tape provided in the Tube Cable Splice Kit to wrap two (2) layers around each Tube Cable jacket end. Apply mastic tape about 1/4" in from end of jacket. Be sure to apply mastic tape with adhesive side directly on the cable jacket and wrap it tightly to minimize or eliminate any air voids. **Refer to Fig. 9.**

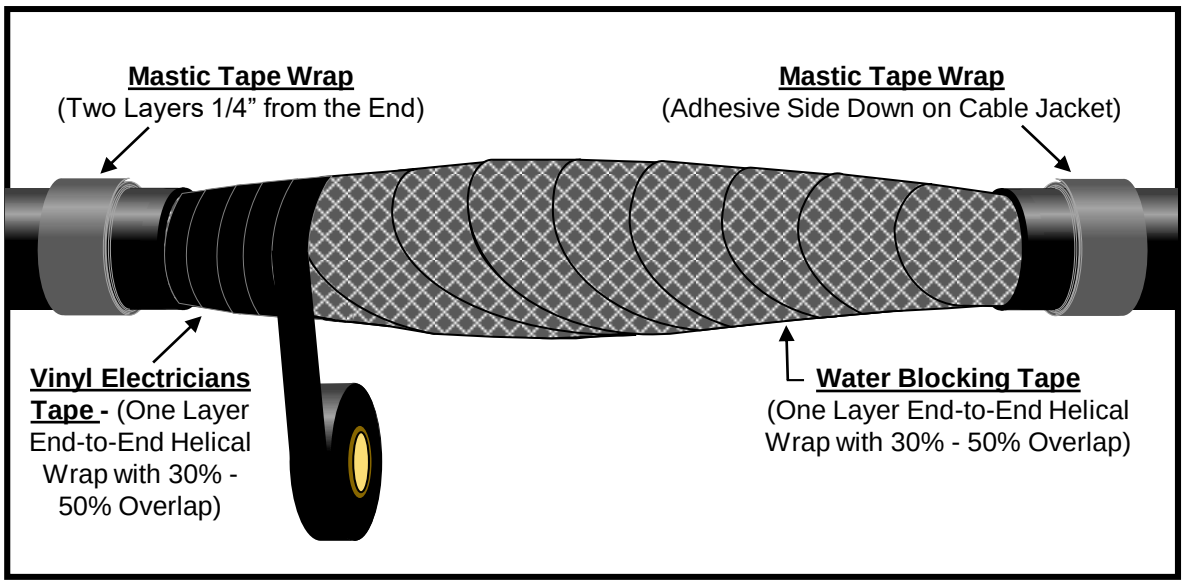


Figure 9
Waterproofing the Splice

10.0 Collapsing the Shrink Sleeve

Note: *Shrink Sleeves for 7, 12, 19, and 24-Tube Cables have two (2) pull tails. They must be pulled one at a time (Not Together). The Shrink Sleeve will collapse from the center outward, one half or side at a time.*

Note: *Shrink Sleeves for 2 & 4-Tube Cables only have one (1) pull tail. When pulled, the Sleeve collapses from one end only.*

10.1 Center the Shrink Sleeve over the coupled splice area. Confirm that one pull tail of the Sleeve's plastic core inner wrapping is accessible at each end of the Sleeve. **See Fig. 10.**

10.2 Hold Shrink Sleeve in place and grasp one pull tail. Gently Pull and the Sleeve will begin collapsing onto the center of the splice area. Unwind the pull tail as progress is made.

10.2.1 Key Step. As the Shrink Sleeve begins to collapse, it must be pulled to guide the collapsing rubber from the splice center outward.

10.2.2 If the Sleeve is not pulled, the collapsing rubber will tend to build layers on top of itself instead of collapsing along the splice.

10.3 Repeat the process with the opposite pull tail for the other half of the Shrink Sleeve. *(Except for 2 & 4 Tube Cables).*

10.4 Center the Shrink Sleeve over the coupled splice area. Confirm that the pull tail of the Sleeve's plastic core inner wrapping is accessible.

10.5 Hold the Shrink Sleeve in place and grasp the pull tail. Gently pull and the Sleeve will begin collapsing onto the end of splice area. Unwind the pull tail as progress is made.

10.5.1 Key Step. As the Shrink Sleeve starts to collapse, it must be pulled to guide the collapsing rubber.

10.5.2 If the Sleeve is not pulled, the collapsing rubber will tend to build layers on top of itself instead of collapsing along the splice.

10.6 This completes the **Tube Cable Splice Kit Installation Procedure.**

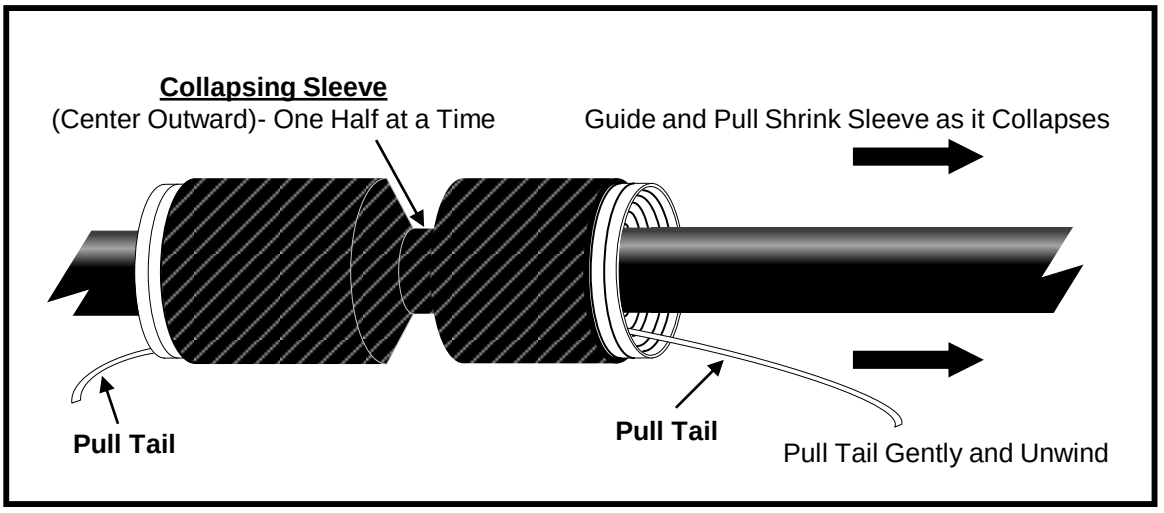


Figure 10
Collapsing Shrink Sleeve for 2 & 4 - 7 & 12 - 19 and 24 Tube - Tube Cables

11.0 Special Technique for Central Filler Members

11.1 For Tube Cables containing a Central Filler Member, an extra step is required when installing a Tube Cable Splice Kit.

Note: *Currently only* ***SEL P/N: TC04TOD*** *and* ***TC04MSOS*** *Tube Cable designs contain an HDPE central filler member.*

11.2 Center members may be cut off but must be re-joined to prevent movement that could damage Tubes or Couplings inside the splice.

11.2 Cut each Center Member so that there will be approximately 4" of overlap between them when the Tubes are coupled.

11.3 Use Vinyl Electricians Tape to thoroughly wrap the pair of center members together. **See Fig. 11.**

CAUTION: *Tube Cables joined with a Tube Cable Splice Kit should never be pulled. This also applies to Tube Cables with Center Filler Members. The Center Members are NOT strength members, they are a filler used to keep the tubes properly aligned.*

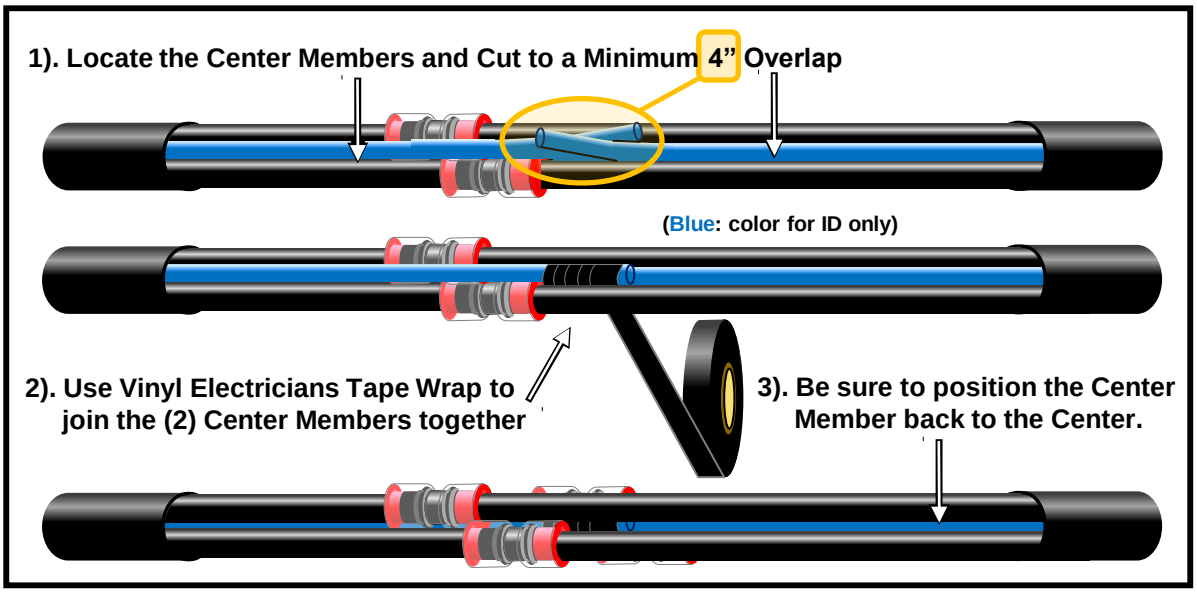


Figure 11
Re-Coupling of the Center Filler Member

12.0 Tube Cable Splice Kits for Armored Tube Cable Types *(Not Recommended)*

12.1 The use of a Tube Cable Splice Kit to provide a Permanent, In-Line Splice with a Waterproof Protective Barrier around an Armored Tube Cable is Not Recommended.

12.2 The Armored Elements must be Bonded with the Appropriate Shield/Bullet Connector Assemblies and Bonding (Strap) Hardware.

12.3 If you choose to proceed, **Caution** should be exercised so that No Outward Protrusions i.e., (Bonding Hardware) is allowed to penetrate the Shrink Sleeve. You must also Remove all Sharp Edges from the Armoring and apply a Tape Wrap afterwards.

Note: **SEL** shall only approve the Splicing of Armored Tube Cables when the Splice is Housed Inside of an SEL Approved Enclosure or Splice Case.

Note: **SEL** does **Not** guarantee a Waterproof Seal when our Splice Kits are used on Armored Cables.

12.4 In-Line Splices of Armored Tube Cable types are *Best Accomplished* inside Properly Rated Outdoor Enclosures such as a NEMA-4, 4X, 6, or 6P Enclosure or inside a Splice Case. Suitable Enclosures are Equipped or can be Accessorized to Efficiently Handle the previously mentioned concerns.