



## SUMITOMO RECOMMENDED PROCEDURE

**SRP SP-F04-004**

**FutureFLEX®**

### TUBE OBSTRUCTION TESTING PROCEDURE

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## 1.0 General

1.1 This procedure describes the steps necessary to perform an end-to-end obstruction test on individual FutureFLEX tube spans. Test results are satisfactory when a 5mm OD plastic bead (or a 5mm OD metal ball bearing [BB]) is successfully blown through the 6mm ID of a tube span.

1.2 The Obstruction Test verifies the tube cable has not sustained an unusual level of loading. If not detected, an obstruction or restriction in a tube can result in the inability to successfully install a fiber bundle. All obstruction problems must be corrected before a fiber bundle installation is attempted.

1.3. Obstruction testing can be broken down into four (4) logical events.

1.4 Test Event #1 - It is recommended that Obstruction Testing be performed on all tubes in 2- and 4-tube cables and only on the odd numbered tubes in the outer ring of 7-, and 19-tube cables while the tube cable is still on the reel. This will ensure the tube cable reel has been shipped and stored correctly and that no damage has occurred to the tubes before the cable installation effort.

1.5 Test Event #2 - It is recommended that Obstruction Testing be performed on all tubes in 2- and 4-tube cables and only on the odd numbered tubes in the outer ring of 7- and 19-tube cables immediately after each tube cable segment has been installed / pulled in. This will ensure the tube cable was not damaged during the installation effort. Early detection of problems will make any necessary repairs easier to accomplish.

1.6 Test Event #3 - **It is mandatory that an Obstruction Test shall be performed on all tubes upon completion of the initial tube cable installation** (final tube route set, all clamps and fittings installed, all tube span connections made, etc.). This ensures the entire tube cable installation was performed properly.

1.7 Test Event #4 - It is strongly recommended to perform an Obstruction Test on an individual tube span just before a fiber bundle is installed in it. This ensures the tube span has not been damaged or altered since the last successful test.

1.8 Obstruction testing can be performed with various pressure sources; Nitrogen Cylinder, Compressed Air Cylinder, or Air Compressor.

1.9 Perform the Obstruction Test on all tubes in conjunction with the Tube Pressure Test (see Sumitomo Recommended Procedure SRP SP-F04-003). Perform the Pressure Test first, correct any leakage problems, and then perform the Obstruction Test.

1.10 Two personnel are required to perform this procedure.

## 2.0 Safety Precautions

2.1 Obstruction Test Safety – This procedure uses high-pressure gas to propel a hard plastic bead (or metal BB) through a tube span. Because the object will exit the tube at high velocity, it must be stopped safely. All personnel at the exit end of the tube span should remain alert and wear protective safety equipment.

2.1.1 Safety glasses should be worn during this test procedure.

2.1.2 Safely stop the bead when it exits a tube span by using a suitable Catch Device such as a plastic bottle, rag, heavy leather glove, or other tough, breathable material attached over the exit end of the tube.

***CAUTION: Never aim the end of the tube being tested toward other personnel.***

2.2 Pressurized Nitrogen – The use of inert (nonflammable) pressurized nitrogen (N<sub>2</sub>) gas presents several safety concerns.

2.2.1 N<sub>2</sub> is a simple asphyxiate. If large amounts of nitrogen are released into a confined area, the nitrogen can displace the amount of oxygen in air

necessary to support life. This can result in a loss of balance, dizziness, rapid reduction in the ability to perform movements, reduced consciousness of surroundings, as well as other symptoms that are included in the MSDS (Material Safety Data Sheet) available upon request from the Gas Supplier. It is recommended that pressurized nitrogen only be released into a well-ventilated area.

2.2.2 When using pressurized nitrogen, there are no risks related to fire, reactivity, or other special hazards. Nitrogen is not listed as a carcinogen by NTP, IARC, or OSHA.

2.3 Compressed Air – The use of nonflammable pressurized compressed air (Atmospheric Air), either from a cylinder / bottle or air compressor, presents no safety concerns.

2.3.1 Air is nontoxic and necessary to support life. There are no ventilation concerns.

2.3.2 Compressed Air at high pressures does present an unusual fire and explosive hazard in that it will accelerate the burning of materials to a greater rate than they would burn at normal atmospheric pressure.

2.3.3 When using pressurized air, there are no risks related to fire, reactivity, or other special hazards. Air is not listed as a carcinogen by NTP, IARC, or OSHA. An MSDS (Material Safety Data Sheet) is available upon request from the Gas Supplier.

2.4 Pressurized Gas Cylinders / Bottles – Transporting and handling pressurized gas cylinders presents several safety concerns.

2.4.1 Any pressurized gas cylinder is dangerous if damaged. Gas bottles must be properly capped when being transported and stored. Gas bottles must be secured in a stable pressure bottle dolly or chained to structure when uncapped for use.

2.4.2 A full size 300 cubic foot volume gas bottle weighs approximately 160 lbs. Two personnel should accomplish any manual lifting or moving of a bottle. Exercise care and use proper lifting techniques.

### 3.0 Reference Documents

3.1 Sumitomo Recommended Procedure, *FutureFLEX Blowing Equipment Set-up Procedure*, SRP SP-F04-001.

3.2. Sumitomo Recommended Procedure, *FutureFLEX Fiber Bundle Installation Procedure*, SRP SP-F04-002.

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

### 4.0 Equipment / Tools Required

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

- 4.1 Nitrogen Cylinder (Installer provided)
- Dry Industrial Grade Nitrogen; preferred pressure source
  - Inert (nonflammable) gas
  - Dry or with no more than 4 ppm moisture content (H<sub>2</sub>O)
  - Oil / contaminant free output
  - 300 cu. ft. (approx.) volume bottle size recommended
  - 2000-to-2500 psi (approx.) pressure charge

4.2 One Pressure Regulator with male quick-release 8mm Tubing Adapter (BEREG01 Two-Stage or BEREG02 Single-Stage).

**Note:** *If a Blowing Head Equipment Kit (BE200RM, BE200RS, or BE200RY) is available, use the Pressure Regulator with 8mm Tubing Adapter supplied with the Kit to perform Obstruction Testing. However, if not available, the Pressure Regulator with 8mm Tubing Adapter should be purchased separately in order to support testing requirements.*

4.3 Tube Test Kit (BEPT001) includes the following items:

- One Bypass Switch (BEPTSW)
- One 0-200 psi range Hand-Held Pressure Gauge (BEPTGA)
- One hundred (100) 5mm plastic beads (BEBB01)

**Note:** Tube Test Kit (BEPT001) is not part of Blowing Head Equipment Kit (BE200RM, BE200RS, or BE200RY) and must be purchased separately.

**Note:** Chrome steel ball bearings (BBs) may be used as an alternative to the plastic beads supplied in Tube Test Kit (BEPT001). Ensure the ball bearings are 5mm OD. Smaller or larger diameter BBs are not acceptable.

4.4 Catch Device (Installer provided) or BB Catcher (BE08CTB).

4.5 Large Adjustable Wrench (Installer provided); at least 10" suggested.

4.6 Tubing Cutter (BETC001).

4.7 8mm tubing (any type) for miscellaneous connections (Installer provided); 10' - 20' suggested.

4.8 Cylinder Adapter (BEREGCA) (Installer provided); required if using Compressed Air Cylinders as pressure source.

4.9 Alternate Pressure Source – Although bottled nitrogen is the preferred pressure source because of its cleanliness, general convenience, inexpensive cost, and ease of portability, compressed air from either a Compressed Air Cylinder or an Air Compressor can be used as an alternate pressure source.

4.10 Compressed Air Cylinder (Installer provided)

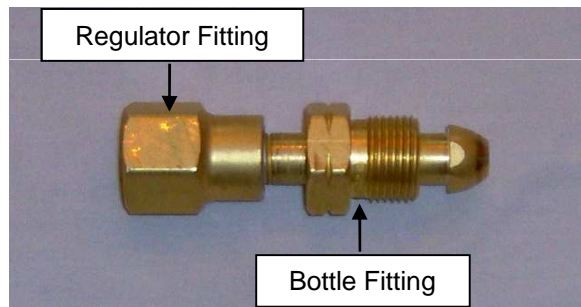
- "Dry Grade" Compressed Air
- Nonflammable gas (atmospheric air)
- Dry or with no more than 10 ppm moisture content (H<sub>2</sub>O)
- Oil / contaminant free
- 300 cu. ft. (approx.) volume bottle size recommended
- 2000-to-2500 psi (approx.) pressure charge

**Note:** Different types or "grades" of Compressed Air are available. The "purer" grades with such names as Zero Grade, Vehicle Emission Grade, Scientific Grade, and Accurate Grade undergo additional refining processes so

they contain fewer impurities (hydrocarbons) and have less moisture content. It is not necessary to use these "purer" grades of air for testing operations.

**Note:** Performance-wise, Compressed Air supplied in a Cylinder performs the same as Nitrogen. There are no differences in the blowability of fiber bundle nor testing of tubes.

**Important Note:** Compressed Air Cylinders are supplied with a Female left-hand thread Bottle fitting (CGA-590). Pressure Regulators BEREG01 or BEREG02 supplied in the Blowing Head Equipment Kit have a Male right-hand thread Nut (CGA-580). A CGA-590 Industrial Air Cylinder-to-CGA-580 Nitrogen Regulator Cylinder Adapter is therefore required to connect the Pressure Regulators to the Bottle fitting. One (1) Cylinder Adapter is required for each Pressure Regulator used. **See Fig. 1.**

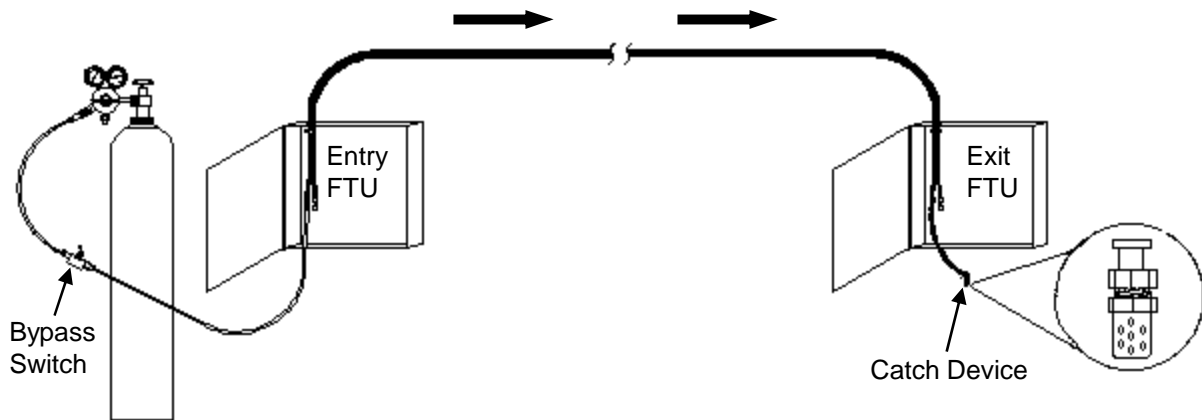


**Figure 1**

CGA-590 Industrial Air Cylinder-to-CGA-580 Nitrogen Regulator Cylinder Adapter

- 4.11 Air Compressor (Installer provided)
- Output dry or with no more than 10 ppm moisture content (H<sub>2</sub>O); often requires use of a Secondary Dryer
  - Output oil / contaminant free
  - Output flow rate (capacity) at least 12 scfm
  - Output pressure at least 200 psi

**Note:** If an Air Compressor is to be used, consider the following potential issues first. Power source / requirements? Physical size of Compressor? Portability? Distance Compressor must be set up from tube test point? Fittings necessary to connect Compressor output to a Pressure Regulator? Noise if use indoors?



**Figure 2**  
Obstruction Test Equipment Layout

## 5.0 Equipment Layout

5.1 See Fig. 2 for Obstruction Test Equipment layout.

## 6.0 Pressure Source Set-up

6.1 Begin Obstruction Test procedures with both Installers at entry point Fiber Termination Unit (FTU) location.

6.2 Ensure Gas Bottle is securely chained in place and remove valve cap.

6.3 Thread Pressure Regulator fitting onto bottle valve housing and tighten with large adjustable wrench.

**Note:** Do not use a serrated jaw tools (e.g.: pipe wrench, vise grips, channel locks, etc.) to tighten brass fitting of Pressure Regulator.

6.4 Open Bottle Supply Valve and check for leakage around fitting. If leakage is detected, close Bottle Supply Valve and see Sumitomo Recommended Procedure SRP SP-F04-001.

6.5 Close Bottle Supply Valve.

6.6 Install male quick-disconnect 8mm Tubing Adapter into female quick-disconnect fitting on Pressure Regulator. See Fig. 3.

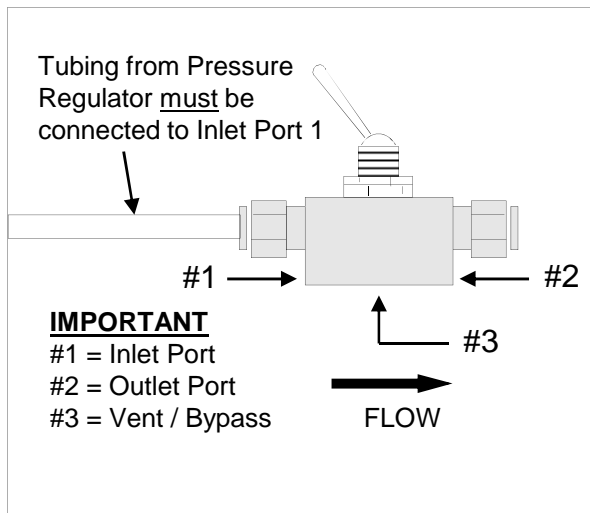


**Figure 3**  
8mm Tubing Adapter Installed to Pressure Regulator

## 7.0 Test Equipment Set-up

7.1 Locate numbers #1, #2, and #3 stamped on body on Bypass Switch (#1 and #2 are located under 8mm push-fit couplings and #3 is on bottom of valve). #1 is Inlet port. #2 is Outlet port. #3 port is "Bypass" or vent port. See Fig 4.

**CAUTION:** Inlet and Outlet tubing must be connected to correct push-fit couplings (#1 Inlet and #2 Outlet) or Bypass Switch will not function properly and can be damaged.



**Figure 4**  
Bypass Switch

**Note:** Inspect tubing ends before connecting to push-fit couplings. Use Tubing Cutter (BETC001) (Installer provided) to trim tubing ends with straight, clean cut for best seat and seal in push-fit couplings.

7.2 Push-fit Installer provided length of 8mm tubing between 8mm Tubing Adapter and #1 Inlet coupling on Bypass Switch. **See Fig. 5.**

**Note:** Bypass Switch is "OFF" when toggle switch / handle is positioned back towards #1 Inlet coupling or pressure source (Bleed Position). Bypass Switch is "ON" when toggle switch / handle is positioned forward towards #2 Outlet coupling or tube span (Pressurizing Position).

7.3 Ensure Bypass Switch is OFF and open Bottle Supply Valve. **See Fig. 5.**

7.4 Slowly adjust Pressure Regulator, increasing output pressure until Pressure Regulator's Output Gauge reads between 60-to-80 psi and stop.

**CAUTION:** Obstruction Test pressure should be 60 psi and no more than 80 psi maximum. Higher Obstruction Test pressures waste gas and can be very dangerous to operating personnel.

7.5 Once 60 psi is obtained on Pressure Regulator's Output Gauge, do not adjust Pressure Regulator Valve from its "pre-set" position. Maintaining a constant 60 psi pressure setting will ensure better test accuracy throughout remainder of Obstruction Test.

7.6 Close Bottle Supply Valve.

## 8.0 Obstruction Test Set-up

8.1 Installer #1 remains at entry point FTU location.

8.2 Installer #2 takes safety glasses and catch device to exit point FTU location.

8.3 Establish communications between Installers located at both ends of tube span.

8.4 Evaluate fiber bundle entry and exit point locations. Ensure they are well ventilated to disperse nitrogen gas released during Obstruction Test operations. If necessary, use jumper tubing to extend entry and exit point FTU tubes to ventilated area. If required, provide auxiliary means of ventilation.

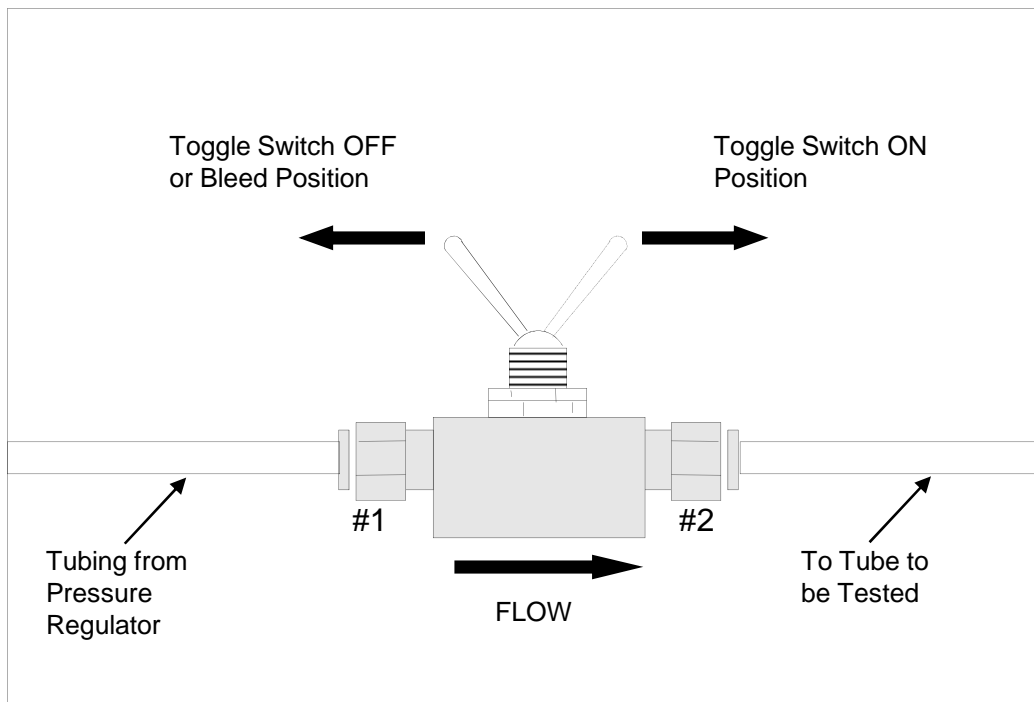
8.5 At entry and exit point FTUs, locate, identify, and verify correct tube span to be tested.

8.5.1 At entry point FTU, push-fit 8mm jumper tubing and a Tube Coupling between #2 Outlet on Bypass Switch and first tube to be tested. **See Fig. 5.**

8.5.2 When Installer #2 indicates ready, open Bottle Supply Valve and turn Bypass Switch ON to pressurize tube span.

8.5.3 At exit point FTU, verify pressure flows from correct tube; i.e.: do a "Continuity Check."

8.5.4 At entry point FTU, turn Bypass Switch OFF, close Bottle Supply Valve, and allow tube span to de-pressurize.



**Figure 5**  
Bypass Switch Positions

## 9.0 Obstruction Testing

9.1 At exit point FTU, ready catch device for first tube to be tested. If space is limited, push-fit 8mm jumper tubing and a Tube Coupling between first tube to be tested and catch device to extend tube span and catch device to a convenient working area.

9.2 At entry point FTU, ensure Bypass Switch is OFF and disconnect tubing from #2 Outlet on Bypass Switch.

9.3 Carefully insert a bead into outlet tubing and reconnect to Bypass Switch.

9.4 When Installer #2 indicates ready to receive bead, open Bottle Supply Valve. Turn Bypass Switch ON to propel bead through tube and start a time count.

**Note:** Depending on tube span length, on average, it takes a bead about 20-30 seconds to travel through a 1000' length of tubing.

9.5 **Important Point.** Time how long it takes the bead to exit tube span.

9.5.1 If the bead exits the tube span in a reasonable length of time, the test is successful.

9.5.2 If the bead is not received after a reasonable length of time, it is probably stuck. Turn Bypass Switch OFF, de-pressurize tube span, and see troubleshooting procedures in this SRP.

## 10.0 Obstruction Test Completion

10.1 When bead exits tube span, turn Bypass Switch OFF and de-pressurize tube span.

**Note:** Obstruction Test results must be recorded. See Addendum A (Obstruction Test Data Sheet) for a "suggested" format. Revise to suit specific needs.

10.2 When tube span has de-pressurized, disconnect catch device, retrieve bead, and repeat procedure for remaining tube spans.

**CAUTION:** When securing from Obstruction Testing operations, always de-pressurize / vent the Pressure Regulator by turning its valve counterclockwise until Output Pressure Gauge

reads zero. *This step is vital to prevent damaging the Regulator's internal diaphragm.*

10.3 When Obstruction Testing operations are concluded, close Bottle Supply Valve and open Pressure Regulator Valve to vent Regulator until its Output Pressure Gauge reads zero.

## 11.0 Troubleshooting Obstruction Problems

11.1 Troubleshooting obstruction problems first requires a stuck bead to be removed from the faulty tube span. Then the obstruction problem must be located and repairs made.

### 11.2 Removing a Stuck Bead

The stuck bead must be removed by applying pressure to the faulty tube span in the opposite direction from which the bead was installed. Relocate Bottle, Pressure Regulator, and Bypass Switch as required.

***CAUTION:*** *Do not attempt to push a stuck bead through the tube span with another bead or other object. One or both beads may become permanently lodged in the tube and that tube span may have to be abandoned.*

11.2.1 Relocate and connect catch device to original entry end of faulty tube span.

***CAUTION:*** *Maximum safe tube span operating pressure is 200 psi.*

11.2.2 Adjust Pressure Regulator Valve to supply 60 psi. Turn Bypass Switch ON and listen for bead to exit into catch device. If necessary, increase pressure to dislodge stuck bead.

11.2.3 Stay alert as stuck bead will be propelled from faulty tube span at very high velocity.

11.2.4 When bead exits, turn Bypass Switch OFF and de-pressurize tube span.

### 11.3 Isolating Tube Span into Segments

Once the stuck bead is removed from the faulty tube span, the cause of the obstruction must be found by isolating the tube span into shorter segments / sections.

11.3.1 For example, at a mid-point TDU, disconnect Tube Coupling in faulty span and connect catch device to new exit point of segment.

11.3.2 Perform normal obstruction testing steps using standard 60 - 80 psi test pressure.

11.3.3 If tube segment under test passes the bead, the obstruction problem is located in another part of the span.

11.3.4 Continue isolating the tube span into smaller segments, repeating the test until the obstructed segment is identified. Be sure to remove a stuck bead from any obstructed segment before proceeding with further troubleshooting efforts.

11.3.5 If having difficulty finding the exact location of an obstruction, try manually pushing a 2mm - 4mm OD nylon line into the faulty tube segment. When the nylon line stops moving, mark it. Remove the line and measure its length. Transfer this measurement to the tube span and inspect this area for possible damage.

### 11.4 Common Obstruction Locations

The most common locations for obstruction problems to occur are at Tube Coupling connections and in tube routing found in or near Tube Distribution and Fiber Termination Units (TDUs and FTUs). Additionally, if improper tube cable installation techniques were used, the obstruction could be anywhere along the tube cable route.

### 11.5 Common Causes for Obstructions

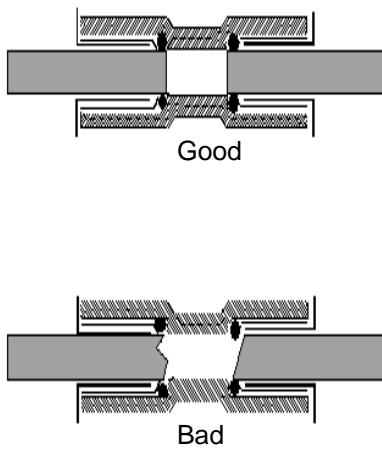
The most common causes for obstructions are listed below along with suggested repair techniques.

***CAUTION:*** *Always ensure tube span is de-pressurized before attempting to disconnect any Tube Coupling.*

#### 11.5.1 Tube End has a Slanted or Jagged Cut

Slanted or jagged cut end of tube extends into Tube Coupling pathway and blocks passage of bead. Trim end of tube using Tubing Cutter (BETC001) to obtain straight, clean cut. **See Fig 6.**





**Figure 6**  
Importance of Good, Straight Tubing  
Cuts for Best Seat and Seal Inside  
Tube Couplings

#### 11.5.2 Inside of Tube Coupling Blocked

Contamination (dirt) or shavings build-up inside Tube Coupling (resulting from numerous connect / disconnect cycles performed during troubleshooting) preventing good seat / seal with coupling O-rings. Clean out or replace Tube Coupling.

#### 11.5.3 Tube Coupling Installed in a Tube Bend

Locating a Tube Coupling in a curved tubing section introduces sharp bends into the tube path. Re-locate Tube Coupling to a straight tubing section.

#### 11.5.4 Bend Radius Too Tight

Tubes have been kinked because bend radius is / was too tight. Minimum bend radius of individual tubes during and after installation is 9". Minimum bend radius of tube cables under tension during installation is 20 times tube cable outside diameter. Minimum bend radius of tube cables not under tension (after installation) is 10 times tube cable outside diameter. Attempt to recover by changing tube / tube cable position or repair / replace damaged section.

#### 11.5.5 Clamps or Fittings on Individual Tubes or Tube Cables Too Tight

Tubes are compressed. Attempt to recover by loosening clamps or fittings to relieve compressive load or repair / replace damaged section.

#### 11.5.6 Other Damage to Individual Tubes

Damage caused by rough handling, tube being caught / pinched in an enclosure door / cover, and so forth. Attempt to recover or replace damaged section.

#### 11.5.7 Tubes Exiting End of Tube Cable Jacket / Sheath Are Not Relaxed

Unusual tube routing causes tubes to be compressed against tube cable jacket or central strength member. Tubes and strength members must be routed relatively straight when they exit a cable jacket. Change tube cable position and / or tube routing to relax the bending.

#### 11.5.8 Tube Cable Supports Too Far Apart

Outer layer tubes compressed because cables supports are too far apart. Supports should be provided every 5'-8' or less for indoor tube cable runs and every 8' or less for outdoor tube cable runs to properly support the weight of the tube cable. Install additional supports to relieve the compressive weight of the tube cable at the clamp or fitting.

11.6 After repairs have been made, always conduct another end-to-end Obstruction Test to verify bead passes through entire tube span.

**Note:** If Obstruction Test troubleshooting required numerous Tube Couplings to be disconnected / re-connected, it is also recommended that another Pressure Test be performed to re-verify the airtight integrity of the tube span. See Sumitomo Recommended Procedure SRP SP-F04-003.

## 12.0 Obstruction Testing On Reel

12.1 It is strongly recommended to perform this procedure upon initial receipt of tube cable reel, just before tube cable installation, or if tube cable condition is unknown or suspect.

12.2 Remove Heat Shrink End Caps or other sealing methods from both tube cable ends.

12.3 Remove about 3" – 6" of tube cable outer jacket to expose individual tubes.

12.4 Perform standard Obstruction Testing procedures as described in this SRP.

12.5 When complete, install Heat Shrink End Caps (below) or other appropriate sealing methods on both tube cable ends to prevent tube contamination during installation.

- DE04HS1 for 2- and 4-tube cables
- DE07HS1 for 7-tube cables
- DE19HS1 for all 19-tube cables except TC19TRX and -2 Armored tube cables
- DE19HS2 for TC19TRX and -2 Armored tube cables

### 13.0 Alternate Obstruction Test Method

13.1 The standard Obstruction Test procedure checks one tube span at a time. A “time-saving” method involves testing two tube spans at the same time. This method can be used provided the two spans under test run between the same end-to-end points.

13.2 The basic procedure to test two tube spans

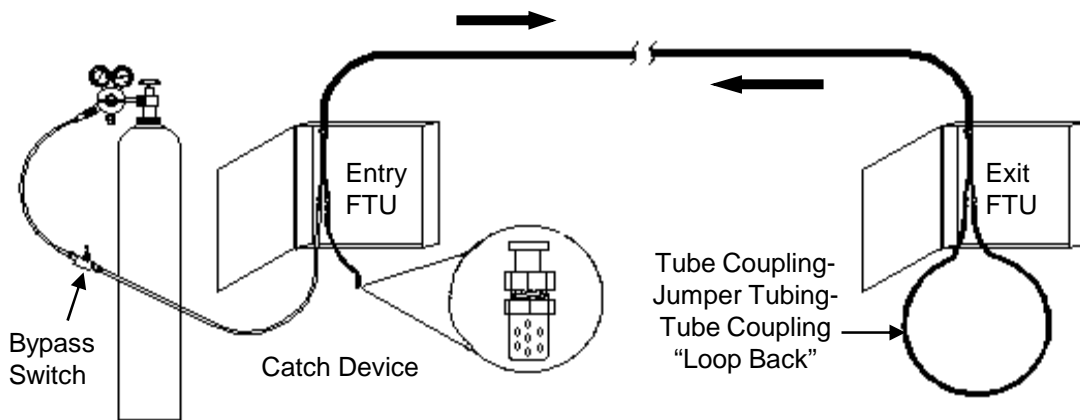
at the same time is identical to testing one tube span with the following exceptions. **See Fig. 7.**

13.2.1 At exit point FTU, use 8mm jumper tubing and Tube Couplings to connect two tube span ends together.

13.2.2 At entry point FTU, connect Bypass Switch to one tube span (serves as pressure supply leg) and catch device to other tube span (serves as pressure return leg).

13.2.3 Conduct Obstruction Test following normal test procedures.

**Note:** It is recommended to limit “multiple” tube testing to just two tube spans at the same time. In the event there are obstruction problems, troubleshooting efforts can quickly become more complex and time consuming when dealing with multiple tube spans.



**Figure 7**  
Alternate Obstruction Test Method



Document: SP-F04-004  
 Date Issued: 04/09  
 ADDENDUM A

**FUTUREFLEX®**

**TUBE OBSTRUCTION TEST DATA SHEET**

Test Date:	SEL Tube Cable Part Number (TCxxYYY):
Test Event:	Tube Cable Span or Segment ID Number
Test Personnel:	From: To:
End-User Rep:	<i>Note: Tube Cable Part Numbers and Span / Segment ID numbers <u>must</u> match As-Built Drawing documentation</i>

Ref Doc = Sumitomo Recommended Procedure SRP SP-F04-004  
 Test Criteria = 5mm OD Test Bead shot at 60 psi – 80 psi exits tube span

	Tube Cable Span or Segment ID Number	Tube Number (IN)	Tube Number (OUT)	Span length (Approx.)	Travel Time (Approx.)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
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