

These instructions provide the user with information for the installation of Swagelok® single-jacketed tubing, multijacketed tubing, insulated tubing, and pre-insulated trace tubing bundles. For additional information, see the Swagelok Multijacketed Tubing, Jacketed Tubing and Insulated Tubing catalog, MS-02-188 and Swagelok Pre-Insulated Tubing Bundles catalog, MS-02-316.



Caution

All installations must be done in accordance with applicable local codes.

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General Information

Keep all exposed ends of the tubing and insulation sealed at all times during storage, handling, and installation. Temporary methods may use a combination of water resistant plastic tape, caps, or bags. Permanent installations should use one of the methods described in these instructions.



Caution

Never allow insulation to get wet.

Determining Required Length

1. Determine the length of tubing required.
2. Measure along the path of installation. Measure tight or square into corners. Add sufficient length in order to make connections at each end.

Uncoiling and Straightening

There are four methods for uncoiling and straightening tubing depending on the type of tubing product and available equipment. Refer to the table to select the appropriate method of for your application.

| Method Number | Uncoiling Method | Straightening Method | Type of Tubing |
|---------------|---|--------------------------|---|
| 1 | By hand | Unroll on floor | Small coil of single-jacketed or multijacketed tubing |
| 2 | By hand | Use second smaller spool | Spool of single-jacketed or multijacketed tubing |
| 3 | By hand | Five-roll straightener | Coil of single tubing |
| 4 | Spool stand | Five-roll straightener | Spool of single tubing |
| 5 | Combination spool stand/ bundle straightener | | Spool of single-jacketed or multijacketed tubing |



Method 1: Unroll the coil on the floor or other flat surface. Straighten by hand and remove any bows.



Method 2: Use a second smaller spool to straighten the product as it is taken off of the larger shipping spool.



Method 3: Use the Swagelok five-roll tube straightener to straighten bare and jacketed tubing in sizes from 1/8 in. to 1/2 in.

See Swagelok instruction, MS-CRD-0147, for more details



Method 4: Mount spool on spool stand with five-roll straightener attachment.



1. Use a ramp to lift spool into place.



2. Adjust straightener position.



3. Adjust straightener to straighten tube.



4. Pull tube to create straight section of required length.

Method 5: Mount spool on combination spool stand/
bundle straightener.



1. Install support spindle through center hole in spool and install collars.



5. Rotate roller assembly towards operator.



2. Use ramp to load spool and fit spindle into C-bracket on stand. Install safety pins through holes in C-bracket to secure spool in stand.



6. With a steady motion, pull tubing through roller assembly.



3. Pull tubing from bottom of spool.



7. Continue to pull tubing through rollers to desired length.



4. Thread tubing between rollers.

Cutting

After tubing has been straightened and pulled to desired length, cut tubing with appropriate tool (hack saw or band saw).

Special Installation Instruction for Multijacketed Tubing

When the installation requires the multijacketed tubing to change elevation, that is to be bent into a different plane (horizontal to vertical or vertical to horizontal), follow the steps below for best results.



1. Twist bundle 90° to bend on flat side.



3. Twist bundle back 90° in the opposite direction as in step 1.



2. Make the bend with the flat side of the multijacketed tubing bundle following the radius of the tubing tray.

4. When working with more than one multijacketed bundle, overlap the twisted bundles through the elevation transition.

Bundle Bending

Bend the tubing using a bundle bending tool (Fig. 1) or a mandrel such as a small spool (Fig. 2) with a radius of at least 8 in. (203 mm). If the bundle is oval in shape, make the bend with the wide side of the bundle against the tool or mandrel (Fig. 3).

Note: A bundle bending tool with a 12 in. (305 mm) radius must be used when the bundle has any of these characteristics:

- The bundle contains two or more 3/4-in. (18 mm) OD tubes.
- The smallest bundle dimension is <1.75 in. (44.4mm)
- The bundle contains a tube 1 in. (25.4 mm) OD

When using a bundle bending tool:

1. Place the hook around the bundle towards the end of the bundle that you need to move during the bend (Fig. 3).
2. Rotate the handle towards the stationary end of the bundle until the desired bend is achieved. If a bend greater than 90° is required, reposition the bending tool and make additional bends.

Bundle Bending Tool Ordering Information

| Bundled Tubing Bend Radius | Swagelok Bundle Bending Tool Ordering Number |
|----------------------------|--|
| 8 in. (203 mm) | MS-BBT |
| 12 in. (305 mm) | MS-BBT-12 |



Fig. 1



Fig. 2



Fig. 3



Fig. 4

Bundle Bending, continued

For multi-jacket tubing only:

To make a lateral bend (Fig. 4):

1. Make the initial bend (Fig. 5).
2. Twist the bundle (90° maximum), and make the other bend (Fig. 6).



Fig. 5



Fig. 6

Single-Jacketed Tube Bending



1. Calculate bending as normal. See *Swagelok Tube Fitter's Manual*, MS-13-03.



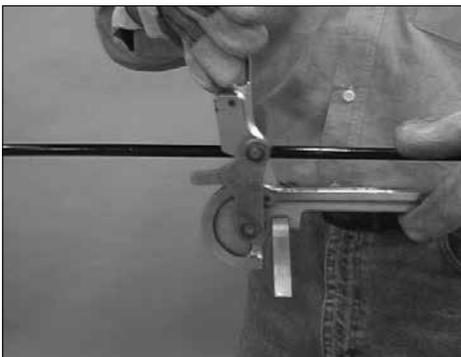
4. Make sure that shoe of bender is sliding over jacket.



2. Liberally lubricate jacket before bending with silicone spray or light oil to prevent tearing of the jacket.



5. Bend tubing to required angle.



3. Use tube bender one size larger than tube OD to accommodate jacket thickness.

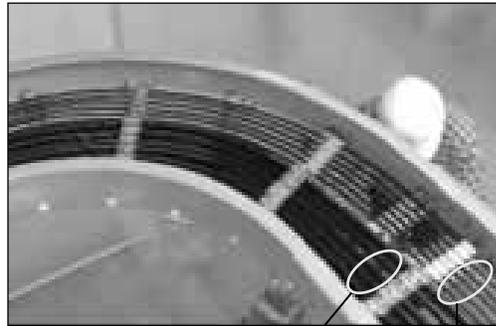


6. After bend is complete, inspect the condition of the bend to make sure jacket is intact.

Installation and Support

- To permanently install the tubing, remove temporary end seals and install the heat-shrink boot. See **Heat-Shrink End Seal Boot Installation**, page 11.
- Route tubing along existing structures, such as columns, beams, tubing struts, or tubing trays to provide support.
- Support jacketed tubing as you would bare tubing, except use the appropriately sized mounting clips. See Swagelok *Multijacketed Tubing, Jacketed Tubing, and Insulated Tubing* catalog, MS-02-188, for mounting clip ordering numbers.
- Support tubing every 6 ft (1.8 m) for horizontal runs, and every 15 ft (4.6 m) for vertical runs. For offshore applications in cable tray or ladder rack support, distance should be a maximum of every 36 in. or 1 meter for both horizontal and vertical runs.
- Supports and hangers must have a large surface area and be designed so they cannot be overtightened to crush the jacketed tubing.
- Do not use U-bolts as supports.
- Tubing may be strapped into an angle iron for support. Place the tubing in an angle iron that is 1/2 in. (12.7 mm) larger than the widest dimension of the bundle, and secure it with metal or plastic straps.

Refer to Swagelok *Stainless Steel Seamless Tubing and Tube Support Systems* catalog, MS-01-181, for additional information.



Tubing Tray

Multijacketed tubing

Single-jacketed tubing



Cushioned clamp tube supports



Multijacketed tubing mounting clips

Preparing Multijacketed Tubing for Breakout



Use a utility knife with a hook blade for best results.



1. Cut outer jacket of multijacketed tubing to desired length. Do not cut into the tubing jacket on the individual tubes.



2. Slice outer jacket axially and remove.



3. Cut and remove the foam wrap.



4. Cut and remove the polyester film wrap.



5. Score the aluminum stiffening plate with a knife and break off or cut with tin snips to remove.



6. Apply silicone sealant to the cut seam where the outer jacket was removed.

Preparing Multijacketed Tubing for Breakout, cont'd



7. Apply silicone sealant between individual tubes, on both sides, to ensure a good seal is created.



8. Center the heat shrink sleeve over the cut seam where outer jacket was removed.



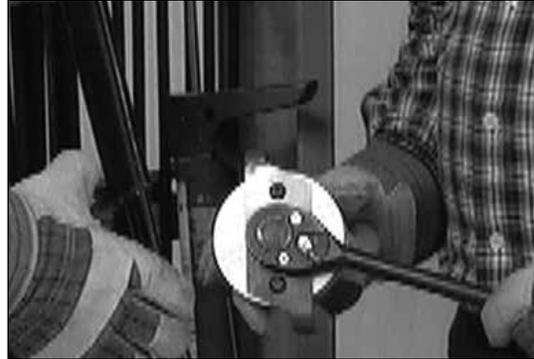
9. Use a heat gun to shrink the sleeve over the tubing. Move the heat source back and forth over the sleeve applying heat evenly.

Breakout Tool for Multijacketed Tubing

The breakout tool is used to separate individually jacketed tubes.

- Use 1/2 in. square drive ratchet to apply torque to make a 2 in. (50 mm) bend radius in 1/4 , 3/8, and 1/2 in. (6, 10, and 12 mm) tubes.

Follow the steps below for best results.



1. Slide tool bracket between tubes so that desired tube is between tool bracket and bending shoe.



2. Use groove in bending shoe which best fits the tubing. Holding tubing securely, use 1/2 in. square drive ratchet to rotate shoe and bend tubing to desired angle.



3. After initial breakout, use Swagelok tube bender of the next larger size to accommodate jacket thickness.

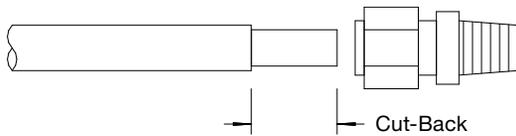
Cutting Jacketed Tubing



1. Mark jacket where tube should be cut.



2. Measure jacket cut-back according to chart.

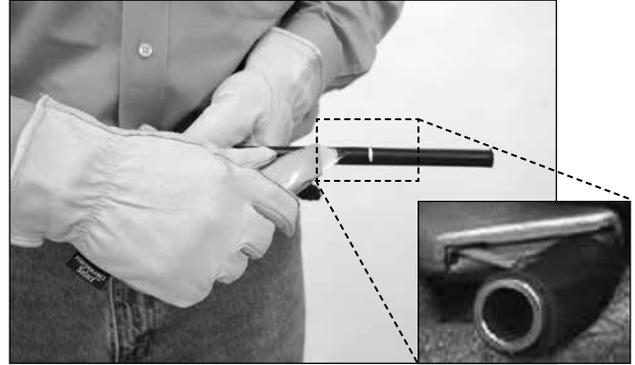


Jacket Cut-Back Chart

| Tube Dia. in. | Minimum Cut-Back in. | Tube Dia. mm. | Minimum Cut-Back mm |
|------------------|----------------------------|------------------|---------------------------|
| 1/4 | 13/16 | 8 | 22 |
| 3/8 | 15/16 | 10 | 25 |
| 1/2 | 1 3/16 | 12 | 29 |



3. Roll knife over jacket to cut. DO NOT draw it across tube.



4. Hold knife blade flat against the surface of the tube to cut jacket away from tube. A small hook blade can be used to cut jacket without danger of scratching the tubing.



5. Pull the jacket back to expose tube.



6. Mark the location of the cut on the tube.
7. Cut the tube with a Swagelok tube cutter or appropriate tool, then deburr the end of the tube.

Heat-Shrink Adhesive-Lined Sleeve Installation



1. Slide the sleeve over the tube before making the connection. Sleeve contains heat-activated adhesive on the inside surface.



4. Use a heat gun to shrink the sleeve over the tube and fitting. Keep the heat moving so you do not scorch or burn the sleeve or jacket.



2. Install the fitting.



5. Start applying heat at the center of the sleeve and move out to the end. Repeat pattern to seal other end.



3. Heat shrink sleeves are 5 in. (125 mm) long. Mark the tube to center the sleeve over the fitting. The sleeve should overlap the jacket on the tube by a minimum of 1 in. (25 mm).



6. When complete the sleeve should be uniform and there should be a small line of adhesive visible between the heat shrink sleeve and the jacket.

Heat-Shrink End-Seal Boot Installation for Insulated and Pre-Insulated Tubing

1. Cut back the insulation and jacket, leaving sufficient length of tubing exposed in order to make the necessary connections.
2. Slip the heat-shrink boot over the end of the tubing. Do not nick or cut the boot.



3. Use a heat gun to shrink the boot over the tubing. Move the heat source back and forth over the boot, applying heat evenly. Once the boot has assumed the shape of the tubing, stop applying heat. Further heating will not make the boot shrink any more tightly.

Note: If the boot does not assume the shape of the tubing, pinch the boot with pliers while hot and hold until cool to reduce the leg diameter.



Warning

Do not overheat tubing when applying a heat-shrink boot to a product with plastic tubing. Excessive heat could damage the tubing.

Self-Bonding Silicone Sealing Tape

- Self-bonding tape is applied after the fitting is installed. Among other applications it can be used to protect and seal unions, tees, crosses, jacket ends, and small valves.
- Self-bonding silicone tape is applied in layers with a minimum of 50 % overlap. Each fitting or installation should have a minimum of four (4) layers for full protection.
- Simulated installation on a bulkhead union is used for illustration.



1. For the first layer, use a length of 8 to 10 in. (200 to 250 mm). **DO NOT REMOVE THE BACKING LAYER!**
2. Pull back about 2 in. (50 mm) of backing and stretch the silicone tape 2 to 3 times the normal length.
3. Start the tape on the jacket a minimum of 1 in. (25 mm) from the end of the jacket and wrap it around the tube and fitting keeping it stretched 2 to 3 times its normal length. Overlap each layer by at least 50 %.



4. When applying the tape, keep the backing in place as long as possible. If the tape comes in contact with itself it will bond immediately.



5. A second layer should be applied in the opposite direction of wrapping.
6. For the finishing layer, cut a length of 6 to 8 in. (150 to 200 mm) long.
7. Stretch this layer 25 to 50 % and apply it in the opposite direction of the previous layer.
8. Inspect tape for any gaps or voids and flatten them with your hand. If this is not successful, apply an additional layer of tape.

Pre-Insulated Tubing Bundles

This section contains additional instructions for pre-insulated tubing bundles.

Determining Required Length

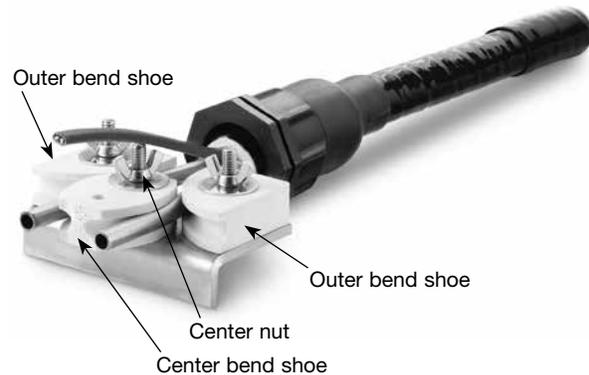
1. Determine the length of tubing required.
2. Allow at least 12 in. (305 mm) of straight tubing before connecting to fittings.
3. For steam-traced tubing bundles, add enough length to connect the tracer to the supply connection and to the return system.
4. For electric-traced tubing bundles, add enough length to connect the power supply. Include 6 in. (152 mm) for inside the junction box. Include enough length of tracer to heat any other desired devices at the end of the bundle.

Tracer Connections

Electric tracer kits must be connected and terminated using approved power connection and termination kits.

Center Line Tool for Pre-insulated Tubing Bundles

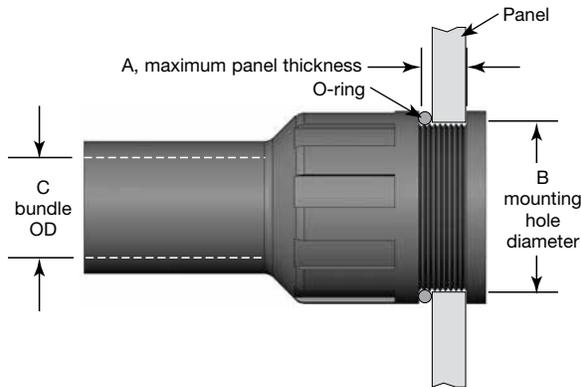
1. Cut the jacket and insulation, and remove to expose process and tracer tubes.
2. Insert the tube bundle through the seal boot.
3. Unscrew center nut and remove center bend shoe.
4. Insert tube bundle.
5. Gently bend tubes against the outside shoes.
6. Install center bend shoe and tighten center nut.
7. Bend tubes against center shoe until tubes are parallel.
8. Repeat step 3, and remove tubing bundle from tool.
9. Seal bundle ends. See **Heat-Shrink End Seal Boot Installation for Insulated and Pre-Insulated Tubing**, page 11, or **Heat-Shrink Entry Seal Boot Installation for Pre-Insulated Tubing Bundles**, page 13.



Heat-Shrink Entry-Seal Boot Installation Kit for Pre-Insulated Tubing Bundles

Kit Contents

- Threaded connector
- O-ring
- Shrinkable boot



| Ordering Number | Dimensions, in. (mm) | | |
|-----------------|----------------------|-------------|-----------------------------|
| | A | B | C |
| MS-HSS-4-KIT | 0.50 (12.7) | 2.00 (50.8) | 0.75 to 1.60 (19.0 to 40.6) |
| MS-HSS-4S-KIT | 1.00 (25.4) | 2.38 (60.5) | 0.75 to 2.10 (19.0 to 53.3) |
| MS-HSS-5-KIT | | 3.50 (88.9) | 1.43 to 2.75 (36.3 to 69.8) |
| MS-HSS-6X-KIT | | 4.50 (114) | 1.50 to 3.50 (38.1 to 88.9) |

1. Place the threaded connector end into the pre-cut hole in an enclosure so the flanged end is on the inside of the enclosure.
2. Place the O-ring over the threaded end and position against outside of enclosure.
3. Screw the shrinkable boot onto the connector, and tighten using a spanner wrench.
4. Insert the insulated tubing into the shrinkable boot opening and make the necessary connections in the enclosure.
5. Use a heat gun to shrink the boot over the tubing. Move the heat source back and forth over the boot, applying heat evenly. Once the boot has assumed the shape of the tubing, discontinue heat application. Further heating will not make the boot shrink tighter.

Note: If the boot does not assume the shape of the tubing, pinch the boot with pliers while hot and hold until cool to reduce the leg diameter.



Warning

Do not overheat tubing when applying a heat-shrink boot to a product with plastic tubing. Excessive heat could damage the tubing.

Silicone Sealant Installation for Pre-Insulated Tubing Bundles



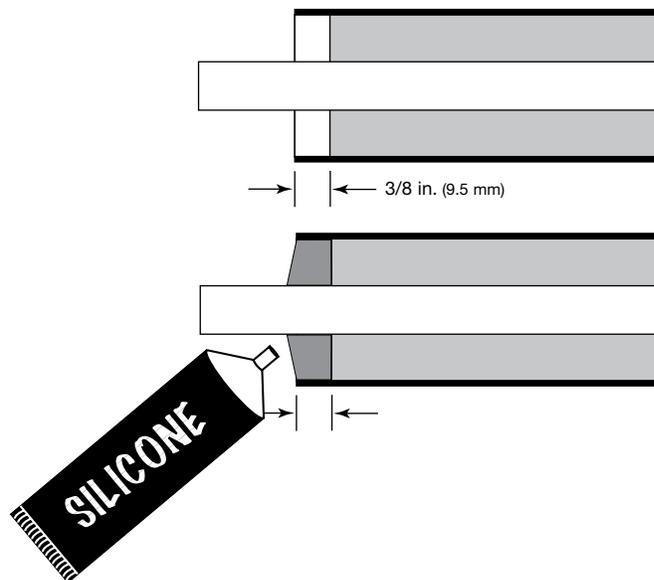
Caution
Seal insulation ends to prevent contamination of the insulation.

1. Cut the jacket square and remove insulation, leaving the desired length of tubing exposed.
2. Bend the process tubing to the desired position.
3. Cut and remove the insulation back under the jacket about 3/8 in. (9.5 mm).



Do not push back the insulation. It must be removed as indicated.

4. Fill the cavity end with silicone sealant, making sure that all exposed insulation is sealed.



Jacket Patch Kit Installation for Pre-insulated Tubing Bundles

Kit Contents

- Thermal insulation
- Self-sealing black rubber patch
- Fiberglass tape

To install the jacket patch kit at a splice:

1. Cut the jacket square and remove insulation, leaving desired length of tubing exposed on both pieces (Fig. 1).
2. Use a Swagelok tube fitting to connect the tubes (Fig. 2).
3. Wrap the area with thermal insulation until it is built up to the outside diameter of the jacket (Fig. 3). Use the fiberglass tape to hold the insulation in place.
4. Cut the self-sealing black rubber patch so that it extends over the pre-existing tubing bundle jackets by 1 in. (25 mm) on each side (Fig. 4).
5. Remove the protective wax paper backing, and wrap the patch around the area to be patched. Leave the clear protective layer in place and facing out.
6. Overlap the edges of the patch by at least 1/2 in. (12 mm) and press the patch into place (Fig. 4).
7. Use the fiberglass tape to hold the patch in place and prevent separation of the seams until it cures.

To install the jacket patch kit at a tubing end:

1. Wrap insulation around the tubes and fittings until the diameter is built up to equal the outside diameter of the jacket (Fig. 5).
2. Cut the patch material to extend over the jacket by 1 in. (25 mm) and beyond the insulation on the individual tubes by 3/8 in. (10 mm) (Fig. 6).
3. Remove the protective wax paper backing, and wrap the patch around the area to be patched. Leave the clear protective layer in place and facing out.
4. Overlap the edges of the patch by at least 1/2 in. (12 mm), and press the patch into place.
5. Use the fiberglass tape to hold the patch in place and prevent separation of the seams.
6. Fill the cavity end with a sealant, such as silicone sealant, making sure that all exposed insulation is protected (Fig. 7).

Fig. 1



Fig. 2

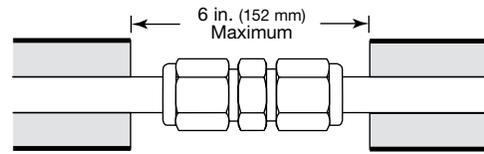


Fig. 3

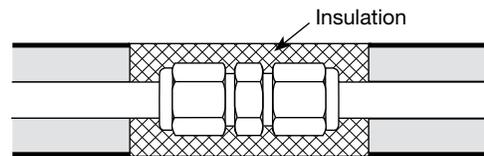


Fig. 4

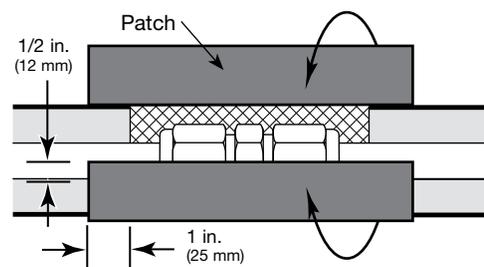


Fig. 5

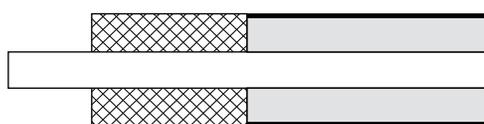


Fig. 6

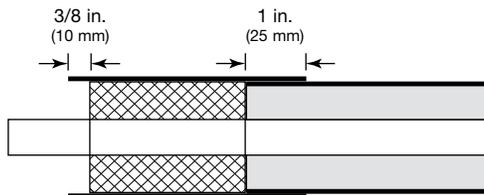
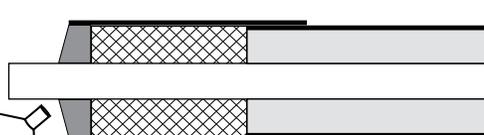


Fig. 7



Power Connection Installation for Pre-insulated Tubing Bundles

Kit Contents

- Junction box and cover
- Mounting bracket
- 2 mounting straps
- Connection kit

To mount bundle:

1. Cut the jacket and insulation to expose the process and tracer tubes to the length required to connect to the power location.
2. Seal the end of the bundle with a heat-shrink end seal boot or entry seal boot. See **Heat-Shrink End-Seal Boot Installation for Insulated and Pre-Insulated Tubing**, page 11, or **Heat-Shrink Entry-Seal Boot Installation for Pre-Insulated Tubing Bundles**, page 13.
3. Cut the process tubing to length and make connections.
4. See the manufacturer's instructions for installing the connection kit.



⚠ Caution

Electric Traced Systems

Consult installation instructions received with the kit. You may be required to make connections and terminations at a particular point on the tracer. If so, these points will need to be located prior to cutting the bundle to its final length. Failure to properly install the electric tracer can lead to excessive heating, tracer failure, and damage to the tubing bundle.

Temperature Sensor Installation for Pre-Insulated Tubing Bundles

The purpose of this instruction is to provide general guidance in the installation of a temperature sensing thermostat, an RTD, or thermocouple. Each thermostat is different and specific instructions may vary; see any additional instructions received with the specific product.

⚠ Caution

The sensor should be in contact with the process tubes only and not the tracer. Contact with the tracer could cause a false reading.

1. Determine a suitable mounting location for the thermostat housing, and route the capillary along the bundle.

⚠ Caution

Do not place near heater or near process connection in an enclosure. Doing so will cause the thermostat to register an inaccurate temperature.

2. Measure the sensor length and add an additional 2 in. (50 mm). This will be your slit length.
3. Slit the bundle lengthwise as determined in step 2, ensuring that the slit goes through the insulation and polyester film, opposite the tracer, where the sensor will be placed.
4. Insert the sensor into the bundle. The sensor should touch the process tubes only.

5. Once the sensor is in place, hold the slit area together and place fiberglass tape every 1 1/2 in. (38 mm) over the slit area.
6. Secure the capillary to the bundle with the fiberglass tape at least 2 in. (50 mm) from the end of the slit.
7. Apply a bead of silicone sealant along each side of the capillary.
8. Using a jacket patch kit, wrap the bundle with the rubber patch where the slit was made previously. See **Heat-Shrink Entry-Seal Boot Installation Kit for Pre-Insulated Tubing Bundles**, page 13, steps 4 to 7.

Note: The rubber patch should extend 2 in. (50 mm) past the slit on each side.

Similar techniques can be used to install other sensing devices. See any additional instructions provided by the device manufacturer.

