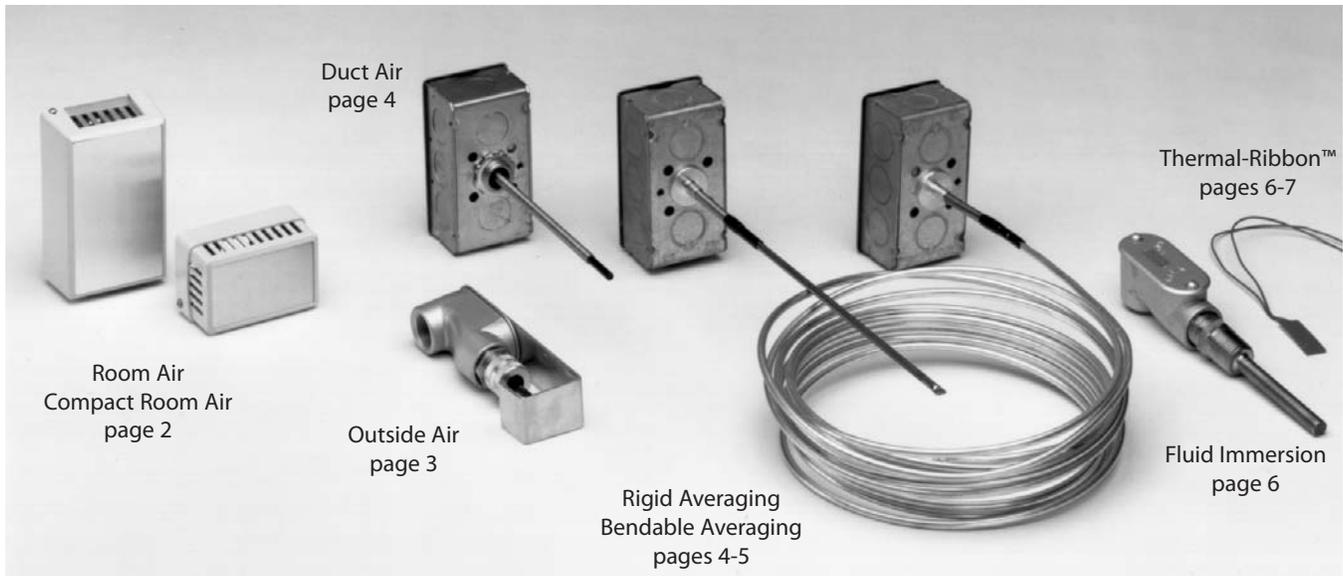


Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems



The accuracy of a building automation system depends on the readings taken at each temperature sensing point. Resistance thermometers and Temptran™ thermometers are highly accurate temperature sensing devices for HVAC/R systems. They provide input to instruments which control building temperatures. Special thermometers are made to sense the temperatures of room air, outside air, duct air and heat exchange fluids. This application aid gives guidelines on where and how to install resistance thermometers and Temptran thermometers for optimum accuracy.

Resistance thermometers

Resistance thermometers are called RTD's (resistance temperature detectors) or PRT's (platinum resistance thermometers). The electrical resistance of an RTD changes in a known and repeatable manner. As its temperature increases, so does its resistance. Minco's resistance thermometers contain wire elements, wound in configurations to best sense temperature changes in your application.

For more information on the principles and applications of resistance thermometers, request Minco Application Aid #18, *Resistance Thermometry*.

Temptran™ thermometers

A "Temptran™ thermometer" is a temperature sensing apparatus consisting of a resistance thermometer connected to a Temptran temperature transmitter. The Temptran itself is a two-wire temperature transmitter used to convert a resistance reading to a 4 to 20 mA current signal. Temptrons connect to the resistance thermometers by either a terminal block or wire leads.

The Temptran's output signal wires can run thousands of feet to control instruments with no loss of accuracy because the current signal is unaffected by leadwire resistance. Many standard instruments accept the Temptran's signal.

Temptran thermometers are individually calibrated with resistance thermometers at the factory and supplied in matched sets to improve total system accuracy. For lower cost, some Temptrons are factory calibrated to nominal resistance/temperature curves.

For specifications and ordering information of resistance thermometers and Temptran thermometers, request Minco Bulletin TS-102, *Temperature Sensors & Transmitters*.

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Air Thermometers

Room air thermometer

Installation Over Utility Box

1. Install a 2"x4" utility box about 5 feet above the floor.
2. Run the signal wires into the box.
3. Loosen the 2 cover screws with a 1/16" hex key wrench and remove the cover. Pull the signal wires through the baseplate. Install the baseplate over the utility box with the two screws provided. Be sure the "UP" arrow on the baseplate is pointing up.
4. See page 8 for electrical connection instructions.
5. Reinstall the cover on the baseplate and tighten the hex screws. Note that the cover fits only one way.

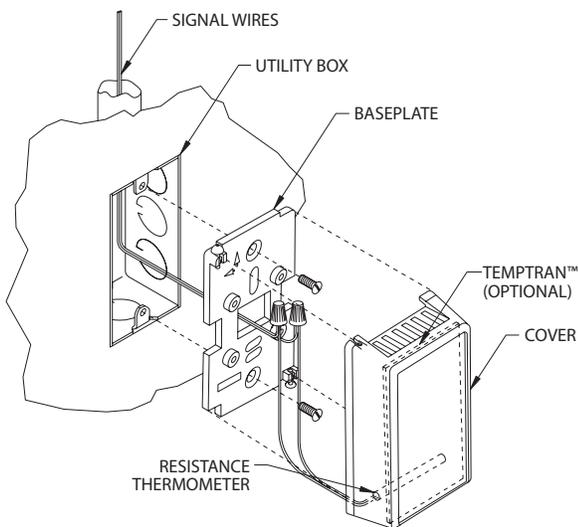
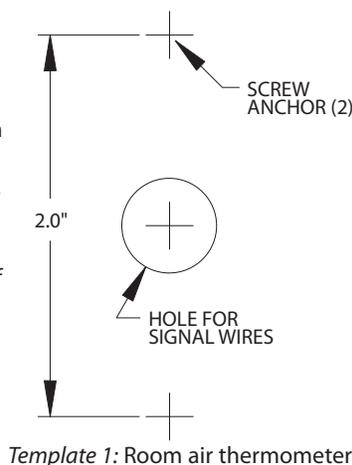


Figure 1: Room air thermometer with Temptran

Installation Directly On Drywall

1. Run the signal wires to the thermometer location (the thermometer should be 5 feet above the floor).
2. The thermometer may be mounted either horizontally or vertically if it contains a resistance thermometer only, but must be mounted vertically if it contains a circuit board Temptran. Use Template 1, right.



Template 1: Room air thermometer

3. Loosen the 2 cover screws with a 1/16" hex key wrench and remove the cover. Pull the signal wires through the baseplate and mount the baseplate to the wall. Be sure the "UP" arrow on the baseplate is pointing up, if mounting it vertically.
4. Connect the signal wires, either to the circuit board Temptran inside the cover, or directly to the resistance thermometer if there is no Temptran. See page 8 for electrical connection instructions.
5. Mount the baseplate on the drywall using screw anchors. Reinstall the cover on the baseplate and tighten the hex screws. The cover only fits one way.

Note to Wiremold users: If you are using Wiremold 500 raceway, check inside the thermometer cover for optional grooved knockouts. If the cover has knockouts, you may run the Wiremold into one of the slots on the sides of the baseplate. Then carefully match the cover with the baseplate (it only fits one way) and remove the proper knockout with a pliers.

Compact room air thermometer

Installation Over Utility Box With AC643 Adapter Plate

1. Install a 2"x 4" utility box. It should be about 5 feet above the floor.
2. Run the signal wires into the box.
3. Loosen the 2 cover screws with a 1/16" hex key wrench and remove the cover. Push the resistance thermometer wires through the baseplate.
4. Connect the resistance thermometer wires to the signal wires. See page 8 for electrical connection instructions.
5. Install the baseplate over the utility box with the 2 screws provided. Reinstall the cover on the baseplate and tighten the hex screws.

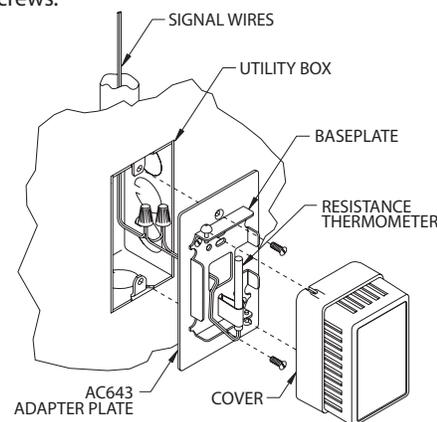


Figure 2: Compact room air thermometer

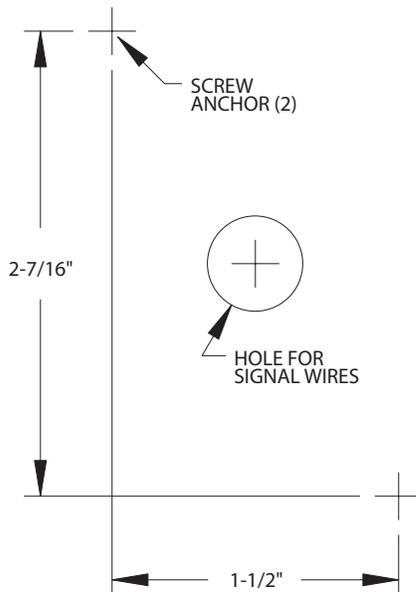
Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Air Thermometers

Compact room air thermometer (continued)

Installation Directly On Drywall

1. Run the signal wires to the thermometer location. The thermometer should be about 5 feet above the floor.
2. The thermometer may be mounted either horizontally or vertically. Use Template 2, below.
3. Loosen the 2 cover screws with a 1/16" hex key wrench and remove the cover. Pull the signal wires through the baseplate and mount the baseplate to the wall.
4. Connect the resistance thermometer wires to the signal wires. See page 8 for electrical connection instructions.
5. Mount the baseplate on the drywall using the screw anchors. Reinstall the cover on the baseplate and tighten the hex screws.



Template 2: Compact room air thermometer

Outside air thermometer

1. Mount the outside air thermometer where it will give a true reading. It should be out of the sun if possible, on the north side or corner of a building. If the sun will shine on the thermometer, mount it so the aluminum shield will keep sunlight off the RTD sensor. Locate the thermometer in free air where it will not pick up heat from exhaust air, building warmth, or roof warmth from sun exposure.

2. Run 1/2" conduit to thermometer location. The thermometer may be installed horizontally (Figure 3), or vertically with the RTD sensor pointing down. Thread the thermometer's connection head onto the conduit.
3. The outside air RTD sensor and Temptran thermometer may be factory calibrated and shipped as a matched set. If outdoor temperatures will exceed the Temptran's ambient rating, it should be mounted indoors. The distance between the Temptran and the RTD sensor should be as short as possible. Mount the Temptran in a utility box indoors using a #8 sheet metal screw through the utility box and into the Temptran's mounting hole. Run two extension wires between the RTD and Temptran.
4. Turn to page 8 for electrical connection instructions. Replace the connection head gasket and cover.

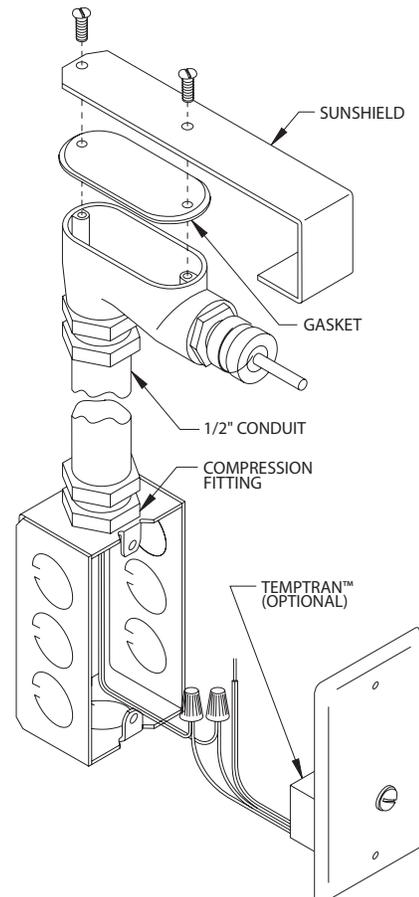


Figure 3: Outside air thermometer

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Duct Air Thermometers

Duct air thermometer installation

1. Cut a 1-1/8" diameter hole in the duct wall; use Template 3 on page 5.
2. Open the utility box cover and remove the foam gasket inside. Adhesive side first, slip it over the thermometer probe, remove the white paper backing, and press it on the utility box. One side of the gasket may be cut or slit for easier installation.
3. Insert the thermometer into the duct and screw the utility box to the duct wall with two #10 sheet metal screws. The sensing tip of the duct air thermometer should be close to the center of the duct.
4. See page 8 for electrical connection instructions.
5. Screw the cover back on the utility box.

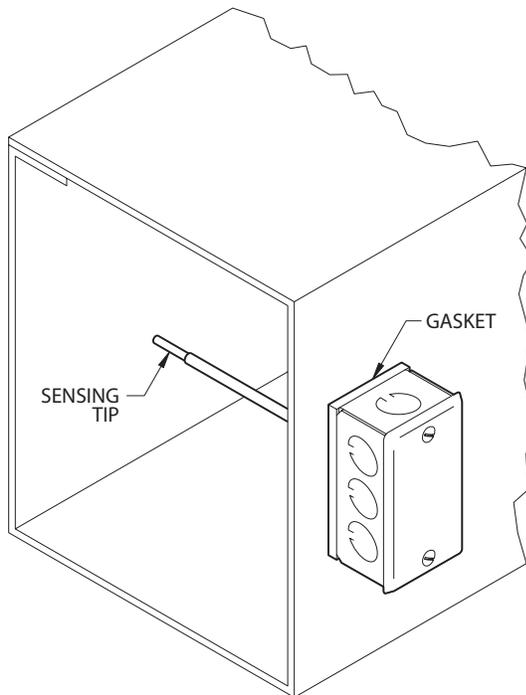


Figure 4: Duct air thermometer

Rigid averaging thermometer installation

1. The rigid averaging thermometer senses temperature along its entire length. Cut a 1-1/8" diameter hole in the duct wall. Using the template on page 5, drill two holes for the mounting screws with a #27 drill bit.
2. Open the utility box cover and remove the foam gasket inside. Adhesive side first, slip it over the thermometer probe, remove the white paper backing, and press it on the utility box. One side of the gasket may be cut or slit for easier installation.
3. Screw the utility box to the duct wall with two #10 sheet metal screws.
4. If the rigid probe is longer than 24", it should be supported near the tip so that it will not bend or vibrate.
5. See page 8 for electrical connection instructions.
6. Screw the cover back on the utility box.

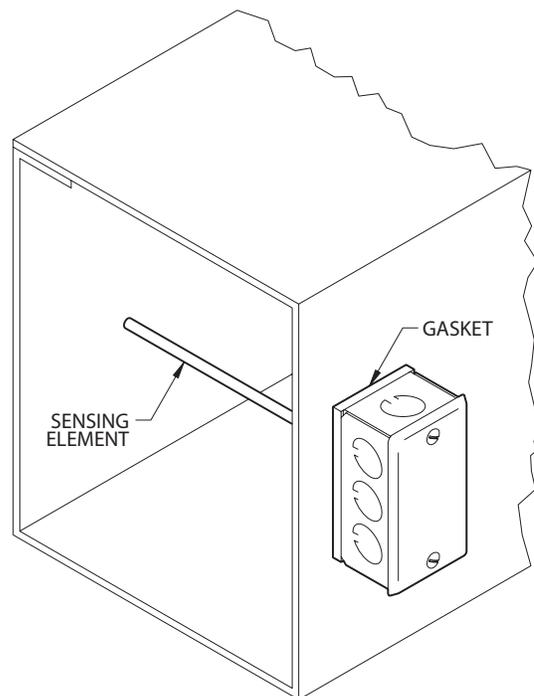


Figure 5: Rigid averaging thermometer

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Duct Air Thermometers

Bendable averaging thermometer installation

1. Area averaging thermometers sense temperature along their entire length. They are used where stratified hot and cold air layers might cause errors with single point sensors. Two suggested installations are shown below. You may design a different installation if you wish; just be sure the thermometer doesn't rattle and is evenly spaced across temperature zones.

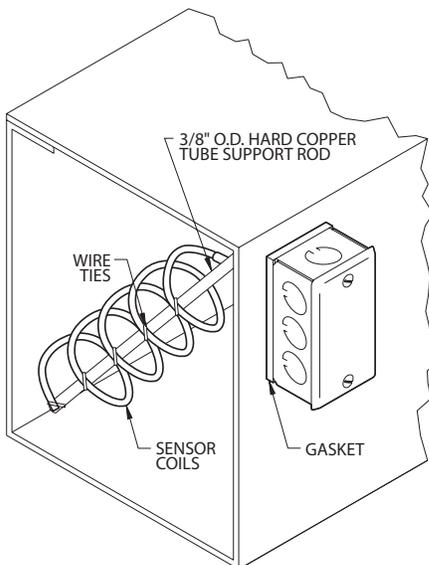


Figure 6: Bendable averaging thermometer, Installation A

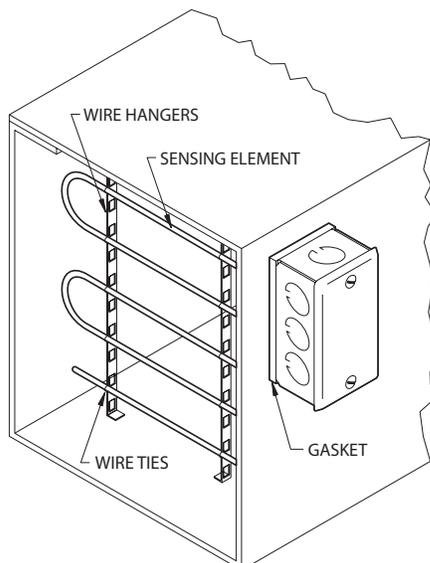
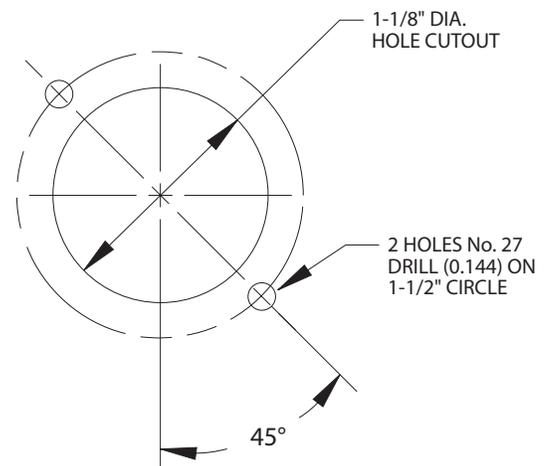


Figure 7: Bendable averaging thermometer, Installation B

2. Cut a 1-1/8" diameter hole in the duct wall; use Template 3, below.
3. Open the utility box cover and remove the foam gasket inside. Adhesive side first, slip it over the thermometer probe, remove the white paper backing, and press it on the utility box. One side of the gasket may be cut or slit for easier installation.
4. Installation A uses a 3/8" hard copper tube, or suitable equivalent, as a support rod for the thermometer. Cut the rod to size so its ends can be flattened and tightly set into the duct diagonally as shown in Figure 6. As an option, the support rod can be secured at each end with mounting flanges on the outside of the duct. Expand the coiled thermometer into a spiral and rotate the whole unit to screw the tubing through the hole and into the duct. Be sure to rotate the thermometer and utility box together. Screw the utility box to the duct wall with two #10 sheet metal screws. Attach the sensor coils to the copper support rod with wire ties.
5. Installation B uses two lengths of pipe hanger mounted inside the duct, parallel to the flow of air, to support the thermometer. Insert the thermometer through the hole in the duct, rotating the thermometer and utility box as a unit. Screw the utility box to the duct wall with two #10 screws. Carefully weave the thermometer back and forth horizontally in serpentine bends, with a minimum bend radius of 4 inches, and attach it to the pipe hangers with wire ties.
6. See page 8 for electrical connection instructions.
7. Screw the cover back on the utility box.



Template 3: Duct air thermometer

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Fluid Thermometers

Probe immersion thermometer installation in a pipe with a six inch diameter or larger

If the pipe's diameter is six inches or larger and fluid velocity is less than 10 feet per second, you can mount the thermometer perpendicular to the pipe. Use a welded fitting with a 1/2-14 NPT female thread.

See page 8 for instructions on the electrical connection instructions of Temptran thermometers.

Note: The Temptran's ambient temperature should be between 32 and 122°F. If the connection box will get hotter than 122°F, move the Temptran to a utility box in a cooler location and run extension leads between it and the RTD.

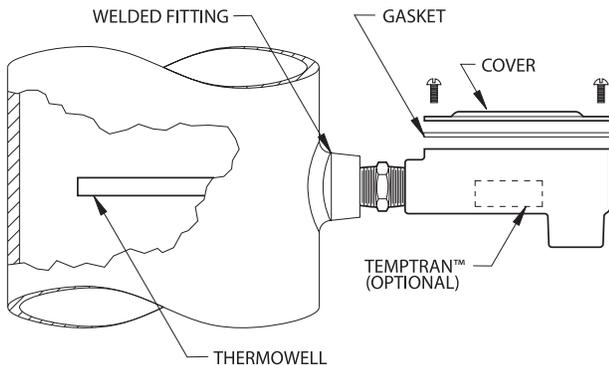


Figure 8: Fluid immersion thermometer in a large pipe

Probe immersion thermometer installation in a small pipe

The thermometer should be installed pointing down the pipe (as in the pipe tee shown below). Use a reducer bushing as shown to adapt from a larger pipe fitting to the 1/2" NPT male thread on the thermowell. Install using a 7/8" wrench on the thermowell's hex fitting.

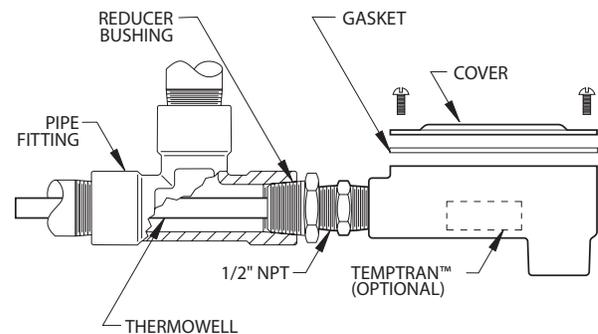


Figure 9: Fluid immersion thermometer in a small pipe

Thermal-Ribbon™ thermometer

Thermal-Ribbons are flexible resistance thermometers designed for surface-mounted sensing of fluids in pipes or tanks. They respond to temperature changes as quickly as immersed thermometers, but are less expensive to install. See Application Aid #16, Use Of Thermal-Ribbons For Pipe Fluid Temperature Sensing for full details.



When properly insulated, Thermal-Ribbon time response and accuracy are equal to immersed thermometers

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Fluid Thermometers

Thermal-Ribbon installation on pipe with #20 Stretch Tape

1. Minco #20 Stretch Tape is a self-adhering silicone rubber tape with two-way stretch for mounting Thermal-Ribbons to pipes or other cylinders.
2. Before mounting the Thermal-Ribbon, remove pipe insulation and clean all dust and oil from the mounting area.
3. Position the Thermal-Ribbon as shown, flat side down, with a bend in the leads for strain relief. Wrap the tape around the Thermal-Ribbon and pipe a minimum of 1-1/2 turns. Stretch the tape about 5% as you wrap it.
4. After wrapping, cut the tape and press the end in place. Be sure the tape is clean and the end is firmly adhered.
5. Run leadwires along the pipe for a short distance to prevent them from conducting heat away from the sensing element. Replace the pipe insulation. The Thermal-Ribbon must be insulated from surrounding air for proper temperature readings. The Thermal-Ribbon's leadwires can be connected to signal extension wires, directly to instrument inputs, or to Temptran inputs. See page 8 for information on electrical connection instructions.

Note: Shelf life of #20 Stretch Tape exceeds 6 months when stored at 77°F, and 50% relative humidity. Refrigeration may double shelf life.

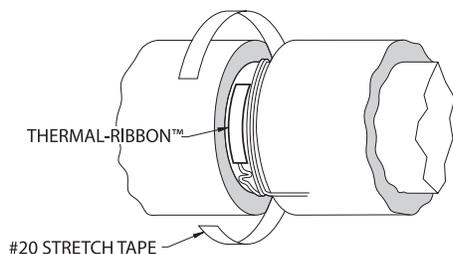


Figure 10: Thermal-Ribbon thermometer mounted on pipe

Thermal-Ribbon installation on pipe with #6 RTV Cement

1. Minco #6 RTV Cement is a room temperature vulcanizing cement, usable to 455°F, useful for mounting Thermal-Ribbons on pipes, tanks, or any smooth surface.
2. Before mounting the Thermal-Ribbon, remove insulation from the mounting surface and carefully clean all dust and oil from the area. For best results, grind or brush the pipe surface to expose bare metal.
3. Coat the flat mounting surface of the Thermal-Ribbon with cement. Keep the cement layer as thin as possible.

4. Position Thermal-Ribbon on the mounting surface, and apply uniform pressure to remove bubbles.
5. For best results, tape or lightly clamp the Thermal-Ribbon in place for at least 2 hours. Do not heat the pipe or mounting surface for 24 hours.
6. Secure the leadwires so they do not pull on the Thermal-Ribbon. Run them along the pipe for a short distance to prevent them from conducting heat away from the sensing element.
7. Replace or install insulation over the Thermal-Ribbon. The Thermal-Ribbon must be insulated from surrounding air for proper temperature readings.
8. See page 8 for electrical connection instructions.

Connection of Thermal-Ribbon to Temptran

1. Minco's AC766 Mounting Kit contains a utility box, 5 foot nylon strap, buckle, 4 wire nuts, and 6 feet of #20 Stretch Tape for Thermal-Ribbon mounting. The utility box, housing the Temptran and leadwire connections, straps directly over the insulation on the pipe near the Thermal-Ribbon. The Temptran may also be mounted in a nearby utility box or instrument cabinet. Mounting the Temptran near the resistance thermometer reduces leadwire resistance and associated error.
2. See page 8 for more information on electrical connection instructions.

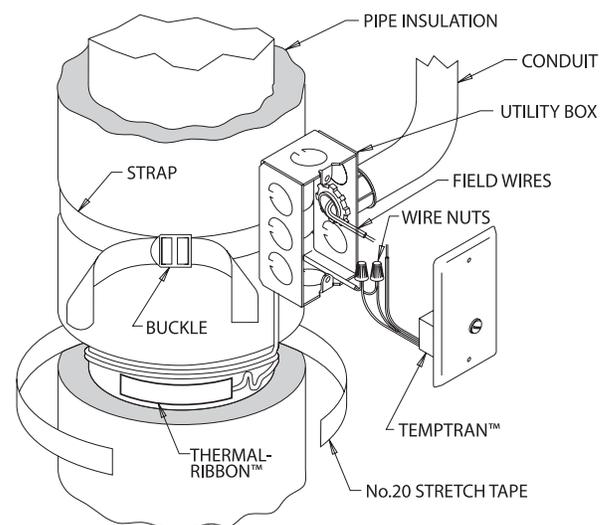


Figure 11: AC766 Mounting Kit for connection of Thermal-Ribbon thermometer and Temptrans, mounted on pipe

Installation Guidelines: Resistance Thermometers and Temptran™ Thermometers for Building Automation Systems

Electrical Connections

Resistance thermometer connections

Connect resistance thermometer leads to signal extension wires, Temptran input, or directly to instrument inputs. Use solder, wire nuts, crimp connectors, or terminal blocks. If the instrument requires a 3-wire input and you have a 2-wire resistance thermometer, simply connect one resistance thermometer lead to the two common extension wires or instrument inputs (Figure 12). If your instrument is designed for 4-wire input, attach extra extension leads to your 2 or 3-wire RTD (Figure 13). Attach the extension leads near the sensing element to reduce the effects of leadwire resistance.

For more information request Minco Application Aid #18, *Resistance Thermometry*.

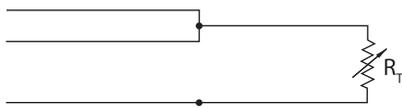


Figure 12: Extension leads for 2-wire RTD and 3-wire input

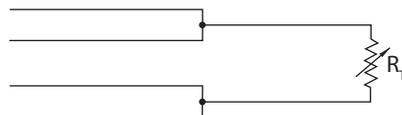


Figure 13: Extension leads for 2-wire RTD and 4-wire input

Temptran thermometer connections

1. **IMPORTANT:** Temptran transmitters Models TT150, TT151, and TT155 are factory calibrated. Keep these RTD's and Temptrons together in matched sets.
2. The Temptran converts the RTD's temperature reading to a 4 to 20 mA current signal. The two field wires, usually a twisted pair color-coded to identify polarity, carry both the current signal and the power to run the Temptran. The field wires connect to positions 1(+) and 2(–) on Temptrons with terminal blocks. Room air Temptran thermometers have no polarity — you may connect wires either way. If your Temptran has wire leads, use wire nuts, solder, or crimp connectors to connect the field wires to the red (+) and brown (–) leads.

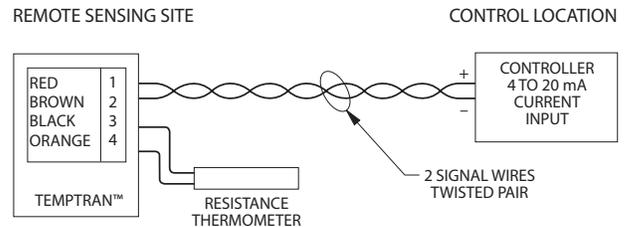


Figure 14: Typical hookup of a single current loop.

3. If the RTD and Temptran are mounted separately, resistance in extension leads between them will add to the RTD's readings. You should therefore use AWG #18 (or larger) wire for extension leads; and use solder, crimp connectors, or terminal blocks for all connections. RTD leads have no polarity to observe. Connect them to the Temptran's black and orange leads, or to positions 3 and 4 on the terminal block.

Recalibration of Temptran thermometers

Resistance thermometers do not need to be recalibrated; they are passive devices with negligible drift. Temptrons may need periodic recalibration. The procedure is straightforward:

1. Disconnect wires to the resistance thermometer and connect the Temptran to a resistance decade box, sometimes sold as an "RTD simulator."
2. Set switches on the decade box to correspond to the lower resistance of the RTD as it is listed on the Temptran label. Use a small screwdriver to adjust the output of the Temptran's zero pot to 4 mA DC.
3. The Temptran's span adjustment is made in the same manner. Set switches on the decade box to correspond with the RTD's upper resistance as it is listed on the label. Adjust the Temptran's current to 20 mA.
4. Repeat steps 2 and 3 and readjust as necessary to correct for interaction between the zero and span.
5. Disconnect the Temptran from the decade box and reconnect it to the resistance thermometer.