C.E.M.S. FILE

Winterizing Pressure Transmitters

Winterizing

Ensuring that electronic pressure transmitters operate under all weather conditions requires consideration of three important variables: installation, protective measures, and cost. First, the transmitter must be located properly with respect to the process pipe. Second, once optimum installation is determined, consider the degree of temperature protection required. The type of installation and degree of protection should be considered together, and designed to complement one another. Third, the degree of weatherization needed should then be balanced against bottom line cost. Sometimes the best choice is no action at all. In any case, when evaluating weatherization options, first consider installation, then protective measures, then their costs.

WHY WINTERIZE TRANSMITTERS?

The most concise answer to the above question is winter, or more precisely, freeze damage. Failures can be caused by the freezing of water, or of solutions containing significant amounts of water. As water freezes, its density decreases. A volume of water will increase about ten percent as it changes to ice at atmospheric pressure. If the expansion is contained, the pressure exerted by the frozen fluid increases. The magnitude of this increase is large in comparison with each incremental decrease in temperature. Table 1 shows some common values for water at constant volume.

TABLE 1. Pressure Exerted by Frozen Fluid.

Temperature (°F)	Pressure (psia)
32	14.7
30	2,100
25	7,000
18.5	12,660
9.5	20,056
5.0	23,115
0.5	26,103

The table shows that the standard 2,000 psi overpressure rating for a Model 1151DP Transmitter is exceeded even at 30 °F. By the time 21 °F is reached, the nominal 10,000 psi burst-pressure on flanges has been surpassed. Even a little cold weather can cause pressure transmitter failures in the field. More important, this type of failure occurs with every type of pressure transmitter.

INSTALLATION ACCORDING TO SERVICE

When evaluating transmitters for freeze protection, the first consideration should be installation. Of course, the presence of water in the process indicates that some form of protection is required. Freeze damage can occur, however, when water is unintentionally present, for example, when moisture accumulates because of condensation. This moisture can freeze and damage the transmitter as well.

In any case, proper installation is necessary for good transmitter performance. In determining the best location, remember the following guidelines:

- Keep corrosive or hot process material out of contact with the transmitter.
- Prevent sediment from depositing in the impulse piping.
- Keep the liquid head balanced on both legs of the impulse piping.
- Keep the impulse piping as short as possible.
- Avoid ambient temperature gradients and fluctuations.

Liquid Service

For liquid flow measurement, mount transmitters below the process taps with the drain/vent valves facing downward. This allows the trapped gases to vent into the process line. See Figure 1a. Make the taps to the side of the line to avoid sediment deposits. While this installation is proper, it does nothing to prevent freeze damage. In liquid service, the choice of winterization method depends upon the freezing point of the process fluid at the operating pressures involved. Winterization requirements may be difficult to assess, especially if water accumulates in a non-aqueous process. In such cases, it may be better to protect regardless of the process fluid.

Gas Service

For gas flow measurement, install the transmitter above the process taps with the drain/vent valves facing upward. This provides automatic drainage and ensures that no liquid accumulates at the transmitter. See Figure 1b. Taps made on the top of the line eliminate the potential for low spots where moisture can accumulate. If this method is used, other protection may not be necessary.

Steam Service

For steam flow service, mount the transmitter below the process so that the impulse piping stays filled with condensate. See Figure 1a. Make taps to the side of the line. Note that this installation is similar to that for liquid service.

If it is impossible to mount the transmitter on its side as shown in Figure 1a and Figure 1b, it may be mounted upright, as in Figure 1c. This installation requires the addition of side drain/vent plugs. These plugs should be placed on top for liquid service to vent trapped gases, or on the bottom for gas service to drain unintentional moisture. Using side drain/vents increase the chance that a particular installation requires winterization.

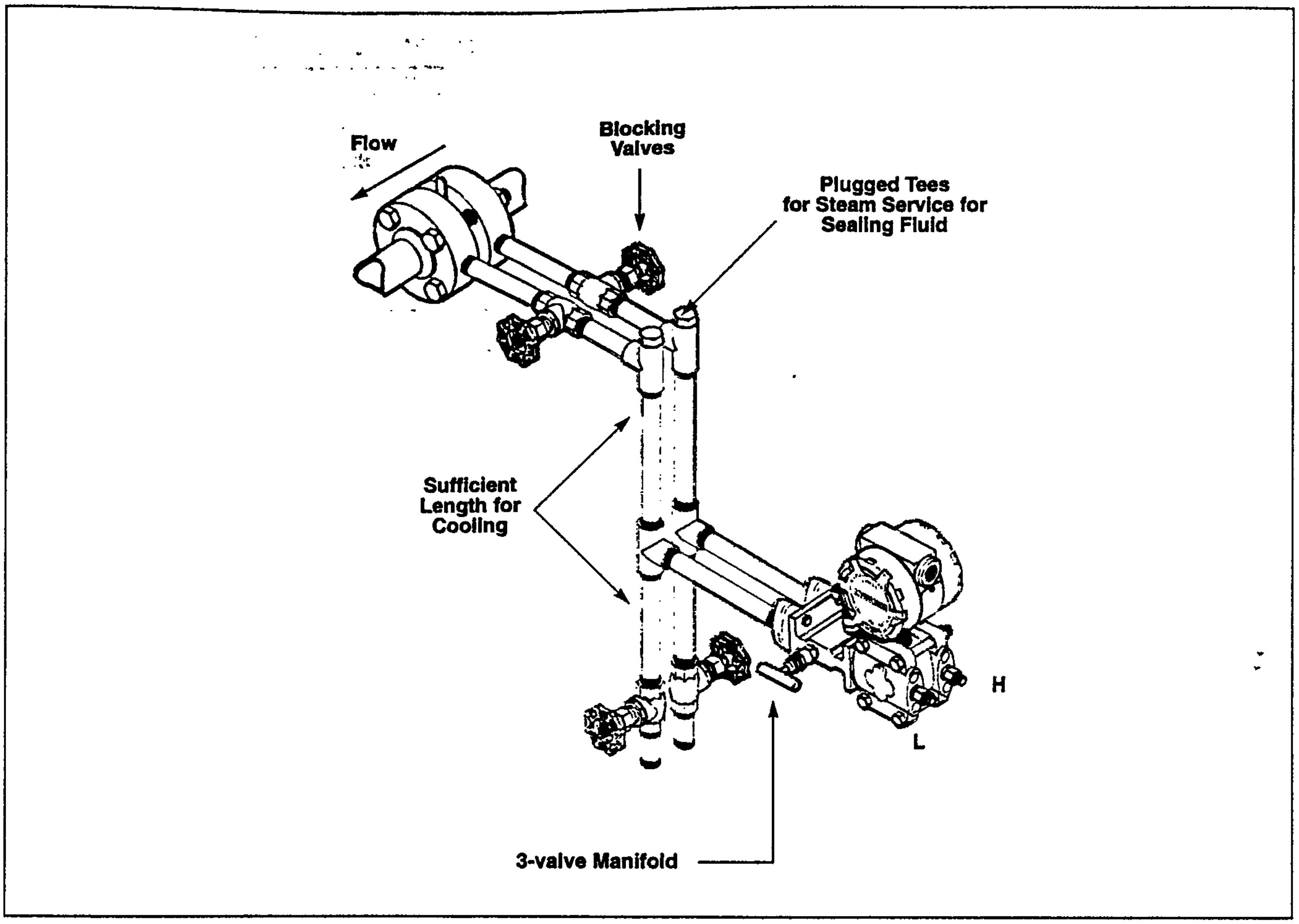

FIGURE 1a. Liquid or Steam Service.

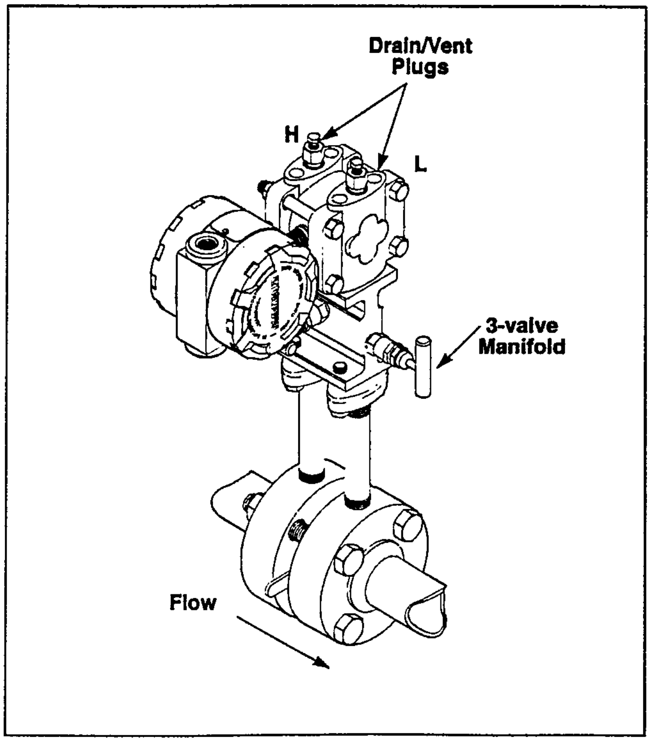

FIGURE 1b. Gas Service.

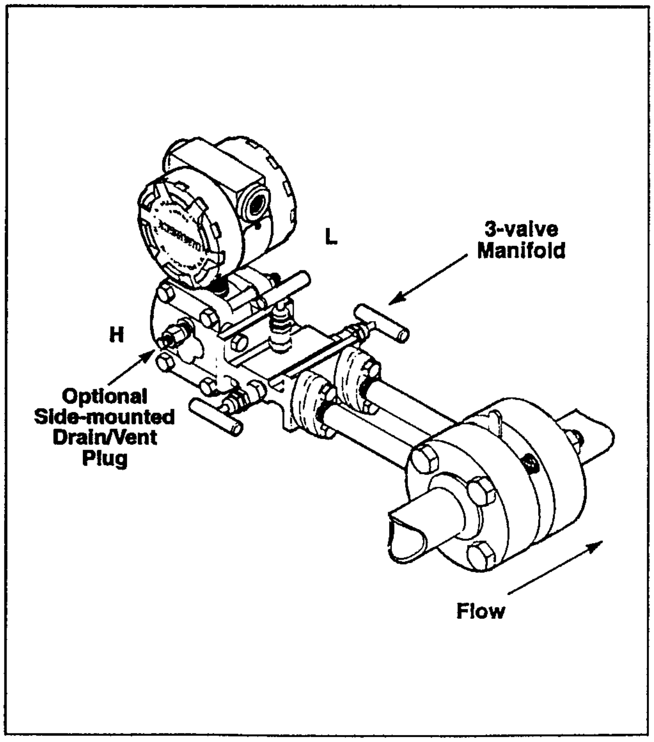

FIGURE 1c. Steam Service with Side Drain Vent.

PROTECTIVE MEASURES

Although winterizing a transmitter is relatively easy, protection should not end there. Impulse lines must also be protected from the point of measurement to the transmitter. Fortunately, this may be accomplished in several ways. Lines may be protected by tracing, insulation, or both. Tracing can take two forms, either electric or steam. Although steam is the safest because it cannot cause a spark, it is also the most difficult to implement. Steam tracers are likely to develop leaks, or worse, freeze and become blocked themselves.

Whatever protects impulse lines may also be used as a heat source at the transmitter. Usually, the transmitter is housed in an insulated, heated enclosure. Different sizes and shapes of these enclosures are available. Selection depends upon the size and the mounting configuration of the instrument.

Electric Resistance Tracers

Two types of electric tracing are available: resistance and self limiting. See Figure 2. In resistance tracing, heat is generated by electric current flowing through main conductors. The amount of heat generated depends on the size of the conductor, the length of the tracer, and the supply voltage. Since the size and length are specified at the time of purchase, resistance tracers must be custom made for each application. the heat output of this type of tracer is varied only by changing the supply voltage.

Self limiting tracers, on the other hand, generate heat by current flow between conductors rather than through them. This method offers several advantages in that it need not be specifically sized, but may be cut to a desired length. The heat output of a self-limiting tracer is inversely proportional to the ambient temperature. This saves energy by reducing heat output on warmer days. The trade-off to these advantages is that these tracers are extremely delicate and are easily damaged during installation.

Steam Tracing

Steam tracing is commonly used to protect process pipes, and may also be used for instrument tracing. This type of heat tracing does not normally consume large amounts of steam. When cleverly implemented, this type of installation can use locally available heat.

For example, an instrument may be close-coupled to the process as in Figure 3. Steam tracing in this case is provided by the process piping itself. Heat given off by hot processes may be sufficient to keep

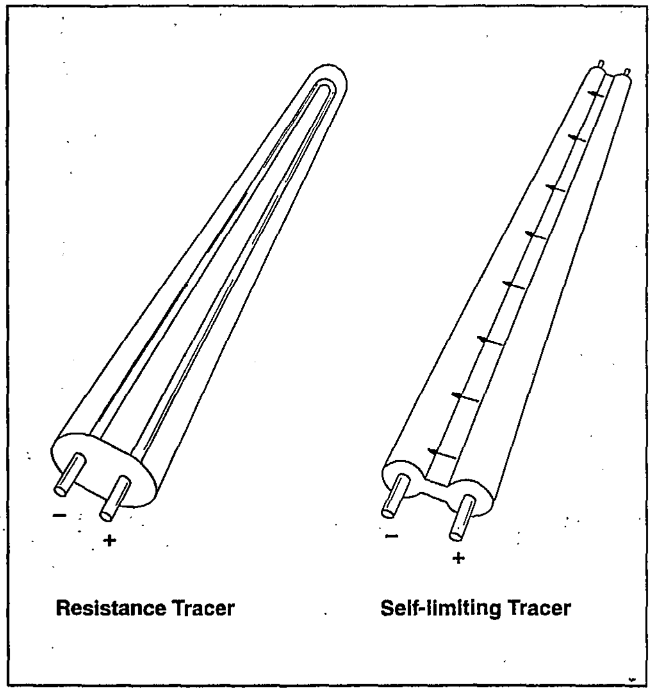

FIGURE 2. Electric Resistance Tracers.

an insulated box at a reasonable temperature during cold weather. The chief limitation is the need for sufficient room to mount and service the instrument. In addition, process and ambient conditions versus temperature capabilities of the instrument must be carefully compared. Another method of winterization is the use of steam studs in place of one or two of the standard flange bolts and nuts. See Figure 4. A steam stud is essentially a hollow bolt made of a corrosion-resistant, high strength material. Steam is passed through these studs to provide the necessary heat to the housing. Depending on the ambient conditions, an insulated box may also be required. However, no more than two steam studs should ever be used on each transmitter.

Heat pipes can also be used. They transfer energy to the transmitter from the process or other convenient source. See Figure 5. Heat pipes are sealed tubes with porous linings, containing compounds with suitable boiling points. Heat applied to any part of the pipe is transferred to colder areas by the process of boiling, vapor flow, and condensation.

Because the liquid is returned to the hot area by trickling along the porous lining, the instrument must be mounted above the heat source.

In addition, steam can be used in many other ways to protect transmitters and impulse lines. The best configuration depends on the individual requirements of each installation.

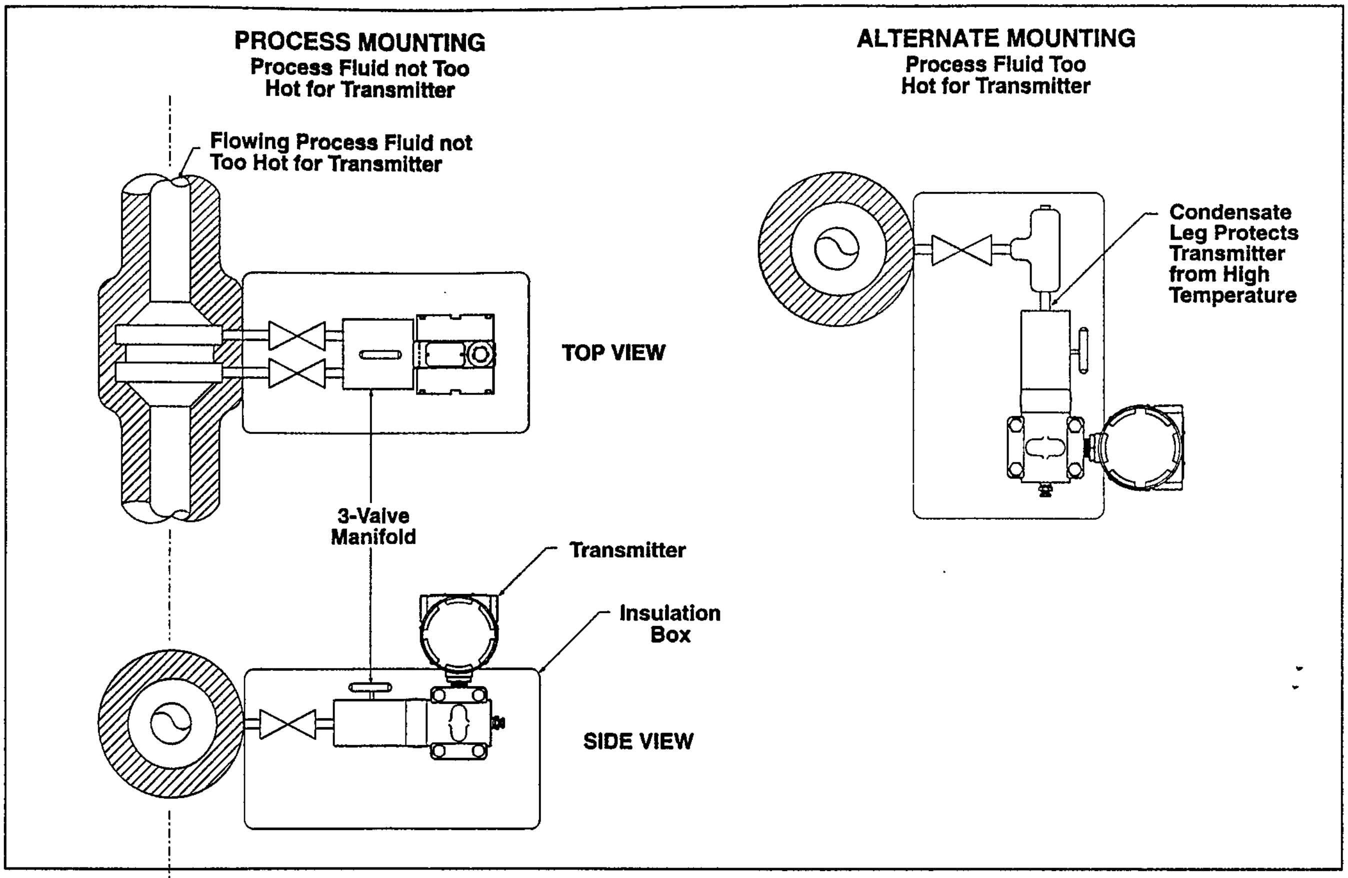

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FIGURE 3. Close Coupling.

Freeze-Proof Liquids

Instruments can often be winterized by filling impulse lines an transmitter chambers with freeze-proof liquids. Systems protected in this manner require fill fluids that meet design temperatures on both the high and low ends, and will not mix with the process fluid. Also, care must be taken to avoid inadvertent draining of lines.

A variation of this type of system employs diaphragm seals to isolate the freeze-proof liquid from the process fluid.

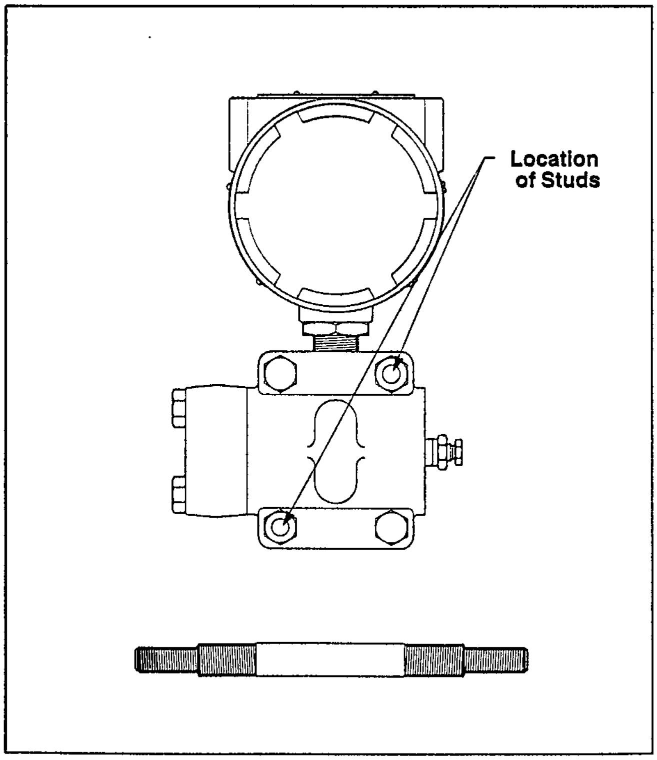

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FIGURE 4. Steam Studs.

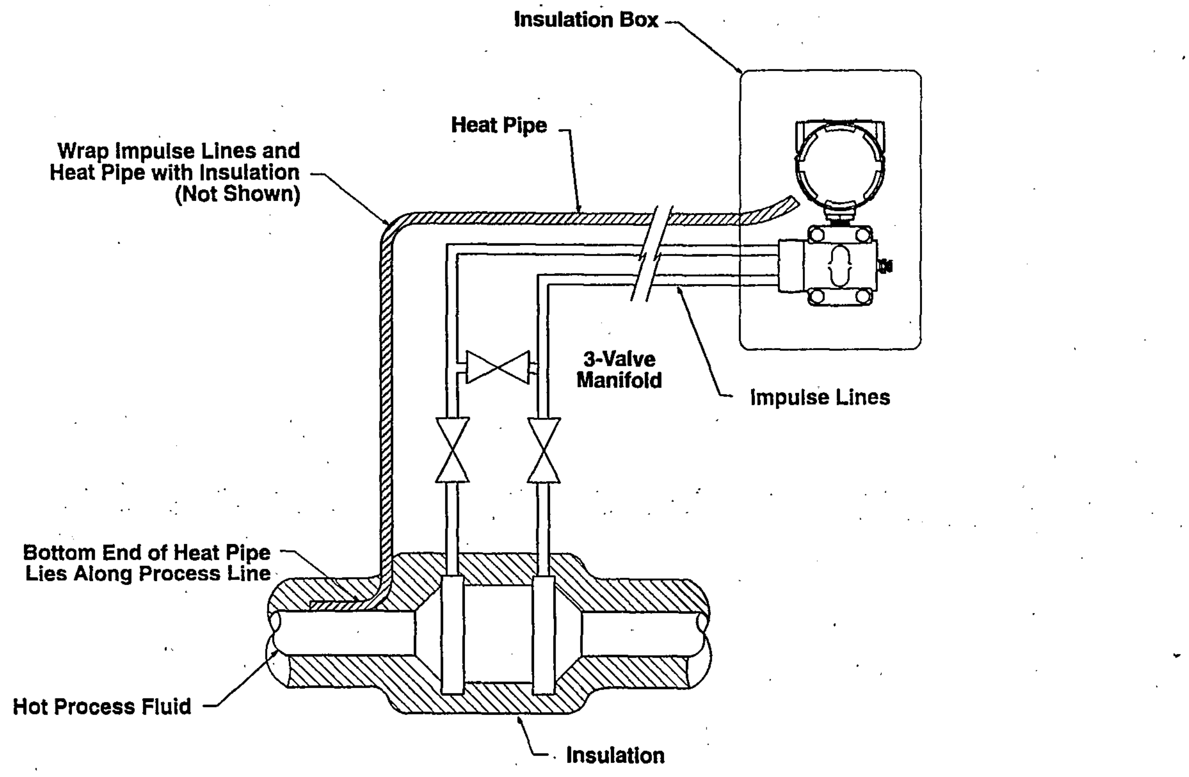

FIGURE 5. Heat Pipe Application.

TABLE 2. One-Hour Time Periods During Which Temperature is within Stated Ranges at Various Locations from October 28 through April 15.

Location	Temperature (°F)					
	30	30–32	33–34	35–39	40–44	45–49
Bismark, ND	2,707	377	252	601	551	554
Charleston, WV	753	381	254	643	628	642
Chicago, IL	1,542	560	373	768	600	583
Denver, CO	1,515	412	275	673	675	697
Memphis, TN	381	250	167	533	611	618
New Orleans, LA	20	30	20	140	295	437
Niagara Falls, NY	1,695	523	348	734	615	660
St. Louis, MO	1,053	395	264	647	589	557
Seattle, WA	193	277	184	833	1,264	1,486
Wilmington, DE	766	375	249	778	745	675

Cost

Obviously, numerous techniques can be used to winterize transmitters. The best method for a particular installation may not be immediately obvious. Factors to consider include initial expense, cost of the heating energy dissipated, reliability, maintenance needs, and effect on measurement accuracy.

These factors should also be weighed against the cost of doing nothing. Table 2 provides, by location, an estimate of the one-hour time periods during which temperature is within a stated range from October 28 to April 15. This table gives a good indication of whether or not winterization expense is justified.

If the expense appears justified, implementation of the protective measures is in order. Remember, in a single plant, the best protective action may differ from application to application. However, only by first reviewing the installation and then carefully considering each available option, can successful winterization be accomplished.