SOLUTIONS

By Kelly Paffel, Inveno Engineering, LLC

(Above) The three test points for baseline information and testing areupstream of the steam trap, downstream of the steam trap and at the discharge side of the steam trap orifice. All images courtesy: Kelly Paffel

First of two parts

Testing steam trap stations by the temperature method

The relationship between steam pressure and temperature makes temperature measurement extremely helpful in understanding many different operating conditions of steam components in the steam and condensate system.

Infrared temperature measurement is a very quick and versatile tool for steam systems. Infrared testing equipment requires training to ensure success. All diagnostic tools have positive features and negative attributes. It is important to understand these attributes to ensure an accurate temperature measurement.

Temperature measurement devices must be an integral part of a steam trap station testing program. These devices are by no means the only piece of diagnostic equipment that should be used, but they can help provide valuable information that would otherwise not be available.

1. Temperature measurement can be an estimate of steam pressure

Plants can estimate steam and condensate pressures by using temperature testing devices to detect the temperature of the steam line inlet to the steam trap station and on the discharge line.

Knowing what steam and condensate pressures are present in the system will assist the steam trap station examiners, enabling them to quickly evaluate system dynamics that can affect the steam trap station's operation.

2. Determind whether the steam trap station is operational

A temperature measurement will allow the steam trap station examiners to determine whether the steam trap is operational or whether the steam trap station is below the expected temperature. If the latter, the plant should initiate root cause

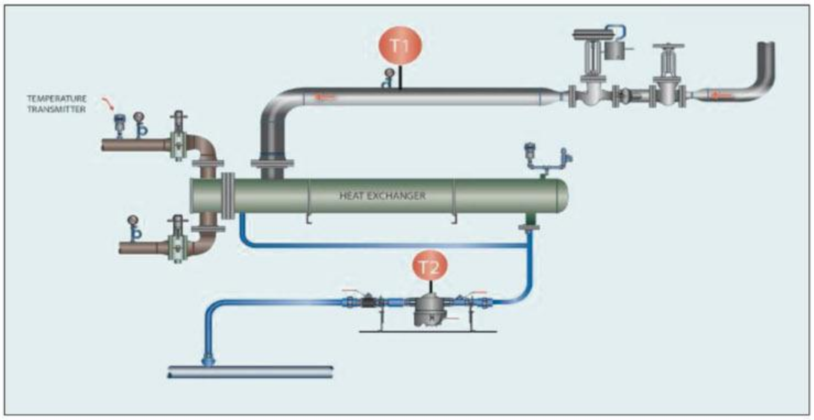

Figure 1: Ultrasound unit Measurements; Point A = the db reading (real time) and Point B = the kHz setting.

analysis to determine the source of the problem in the system.

For example, in Figure 2, the temperature on the steam line entering the process is 299°F; therefore, the steam trap body temperature should be at or close to the inlet temperature.

This is a true statement for 96% of the steam process applications. However, there are a few exceptions when the heat-transfer units have an extremely high condensing rate or when there is a pressure drop in the process.

Example 1: Equal temperatures

The inlet and outlet temperatures (process and steam trap) are at or near equal.

This means the steam trap is operational, and further testing can be accomplished.

Example 2: Low outlet temperature

In Figure 3, the steam trap body temperature is very low (210°F) compared to the inlet steam temperature to the process.

The steam trap temperature is low, and root cause analysis needs to be performed to find the reason, whether an undersized steam trap, a fouled strainer, high backpressure in the condensate line, or some other cause.

3. Test steam trap performance based on temperature

Although surface temperature measurement can be very useful in evaluating various potential conditions, using it alone for testing steam trap stations

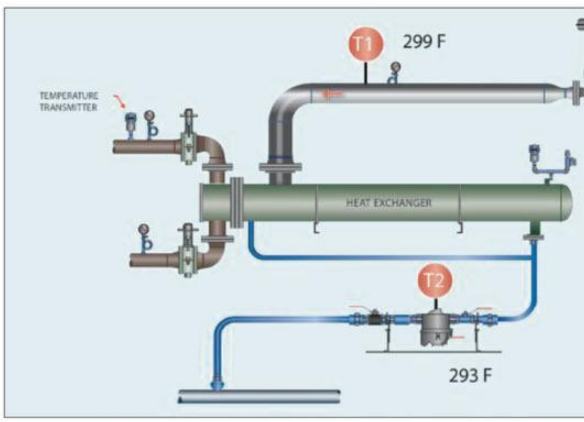

Figure 2: Ultrasound levels taken at test points No. 1 and No. 2 are equal or less than test point No. 3; the steam trap is operating properly.

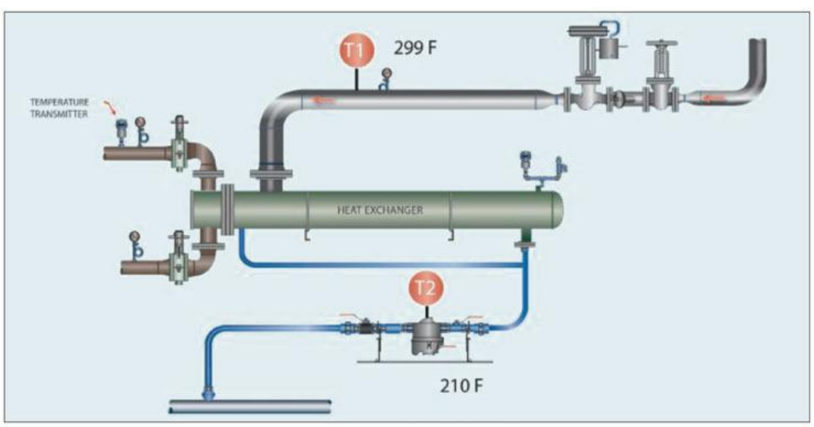

Figure 3: A float and thermostatic steam trap will have four test points: upstream of the steam trap, downstream of the steam trap, downstream of the steam trap discharge orifice, and downstream of the steam trap air vent orifice.

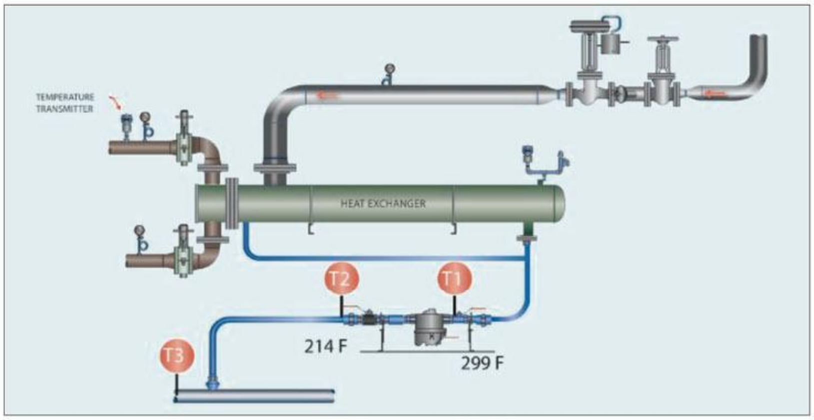

Figure 4: A failed steam trap that is indicated by a higher ultrasound reading at test point 3 than test point No. 1 and No. 2.

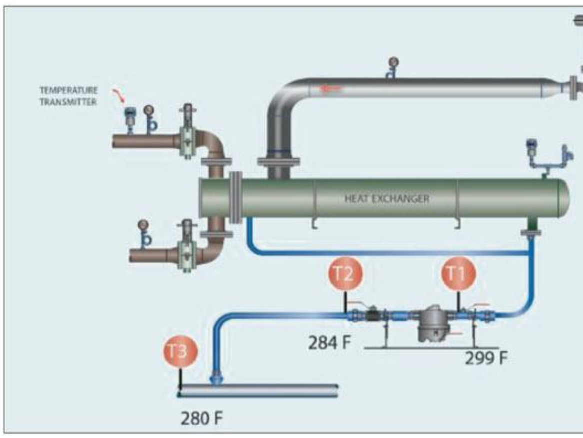

Figure 5: A steam trap leaking steam will have a slightly higher ultrasound reading at Test Point 3 than Test Point No. 1 and No. 2.

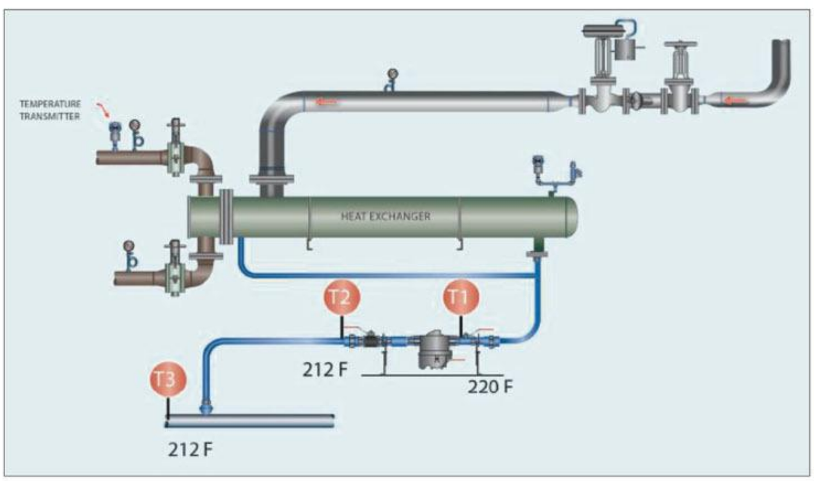

Figure 6: When testing with high-frequency ultrasound, all components of the steam station need to be checked. A high reading at test point No. 5 indicate the check valve is failed and not the steam trap.

will have a low accuracy for testing steam trap performance. A steam trap station examiner should be extremely knowledgeable of steam and condensate system dynamics.

Different sources state that if there is a high temperature differential across the steam trap station, then the steam trap is in good operational condition. If there is no or a very low temperature differential, then the steam trap has failed and is blowing or leaking steam into the condensate system. Temperature measurements must be part of the steam trap station standard operating procedures to ensure the steam trap station is operational.

Example 3: High temperature differential across the steam trap station

Figure 5 indicates a high temperature differential (inlet temperature is 299°F, and outlet temperature is 214°F). However, the steam trap has completely failed and is blowing steam into the condensate line. So why is there a high temperature differential?

If steam is blowing into a condensate line that has zero pressure, the steam temperature of the blowing or leaking steam trap must be 212°F, or the temperature of steam at zero pressure. In this case, when the steam passes from a high pressure to a lower pressure, "**Plants can estimate steam and condensate pressures by using temperature testing devices** to detect the temperature of the steam line inlet to the steam trap station and on the discharge line."

superheat will be generated, but the condensate passing the steam keeps the steam at saturated conditions.

Example 4: Steam trap station with a low temperature differential

Figure 6 shows a very low temperature differential (inlet temperature is 299°F, and outlet temperature is 284°F), which should indicate that the steam trap has failed and is blowing steam in the condensate line.

In this example, there is backpressure in the condensate return line, which is normal in most condensate lines due to design, undersizing, and elevations. The condensate line pressure will vary depending on the variables. With pressure in the condensate line, the condensate line temperature should be at or close to the saturated temperature at the condensate line pressure.

Example 5: Low-pressure systems

There will be a low temperature differential across the steam trap station based solely on the low steam pressures in the steam system and condensate line, as shown in Figure 6.

The steam trap could be failed or working properly; the condition of the steam trap is unknown because both conditions will have similar steam temperatures.

4. Measurement procedures

Temperature measurements need to be taken upstream and downstream of the steam trap station to determine the inlet steam pressure to the steam trap station and the condensate line backpressure.

To achieve a representative temperature, scan the exposed metal surfaces of the upstream and downstream piping/tubing around the steam trap station. Some installations may have several inches exposed, while other installations only may have pipeline components such as unions, valves, or fittings exposed. The steam trap station examiner must consider what is available for temperature scanning when incorporating the temperature reading in evaluating the steam trap station operation.

- Measure the inlet temperature of steam/condensate line to the inlet of the steam trap. A significantly lower temperature than the saturation temperature of the steam line pressure can indicate that there are issues with the steam trap, that flow is reduced due to plugged fittings or strainer screens, or even that the steam trap has been valved off.

- Measure the temperature to the inlet of the steam consumer (equipment) and compare it to the inlet of the steam trap. Generally, these temperatures should be close in measurement (±20°F/±11°C). Make sure to record the reading.

- Measure the outlet temperature in the condensate line downstream of the steam trap. There should be some decrease in the outlet temperature versus the inlet temperature. This measurement can also be used to determine the backpressure present in the condensate line. Again, make sure to record the reading.

Temperature measurement is an important part of steam trap station evaluation, but it is only one of the test methods that plants need to use correctly to assess steam trap station performance.

Kelly Paffel *is technical manager for Inveno Engineering LLC.*