Steam Trap Inspection Procedure

I. Introduction

Steam trap design, installation, and function are paramount to an efficient steam system. The utilization of the BTU's released from steam are necessary in most processes. Various components have been added to steam systems. The most important development was the steam trap. These allow steam to remain in a system to deliver its BTU's and then, when it has cooled sufficiently to where it is no longer useful, it discharges the cooler "condensate". Other impurities such as gases that can negatively impact on the effective transfer of heat energy from steam are also removed.

Proper steam trap maintenance is essential to a steam system. Faulty steam traps not only waste energy, they can contribute to pipe erosion due to poor water quality and contaminants allowed to pass down stream. Faulty steam traps can negatively affect product quality.

Steam Traps should be inspected routinely. The frequency of inspection is often determined by application. As an example, steam systems used just for facility comfort (i.e. heating) are routinely inspected annually while systems that utilize steam as part of a manufacturing process might be inspected anywhere from biannually to quarterly, depending on the impact steam has on the process. Establishing a routine steam trap audit, is most recommended.

As part of any predictive maintenance routine, knowledge of the system is critical. For this reason, before inspection begins, a map or some diagram of the location of all the steam traps and valves in a facility should be available. All traps should be tagged and coded and referenced on the map/diagram. In addition, the trap inventory should include the trap type, size, manufacturer, and application.

To improve on inspection routines, it is recommended that some form of record keeping/data collection be employed to provide information about the steam system over time. (We recommend the DMS software that is available at no charge at http://www.uesystems.com/products/software) and as an App in the Android or Apple Store under "UE Systems, Inc. SteamTrap." There is other software available in the market that is specific to steam trap inspection as well. This is useful in spotting potential areas of recurrent problems, possible clues about misuse of traps, data about costs and savings incurred.

Once the record keeping has been put in order, various methods of inspection should be considered. The most common are visual inspection, acoustic stethoscopes, temperature and *ultrasonic testers*. Ultrasonic testers translate the high frequency emissions of a trap down into the audible range where they are heard through headphones and seen as intensity increments on a meter. Some units have frequency tuning to filter out additional signals and to tune into the sounds of steam and condensate while others have on-board recording and data logging so that users can record the sounds of steam traps and data log important test information.

II. Instrument Set-up

A. Analog

1. Ultraprobe 100

    a. Check/replace batteries
    b. Insert Contact Module
    c. Plug in headphones
    d. Place headphones over the ears
    e. Turn instrument on

2. Ultraprobe 2000

    a. Insert Contact Module
    b. Perform Sensitivity Validation
    c. Set frequency to *25Khz*
    d. Set Meter Response to Log
    e. Start at Sensitivity level 5
    f. Plug in headphones, and place over the ears

B. Digital

1. Ultraprobe 3000

    a. Be sure the memory is cleared from instrument
    b. Insert Contact Module
    c. Perform Sensitivity Validation
    d. Leave instrument in R for Real-Time mode (this is the default)
    e. Click to Sensitivity Mode
    f. Plug in headphones and place over the ears

2. Ultraprobe 9000

    a. Be sure the memory is cleared from instrument
    b. Insert Contact Module
    c. Perform Sensitivity Validation
    d. Leave instrument in R for Real-Time mode (this is the default)
    e. Set Frequency to *25 kHz*
    f. Click to Sensitivity Mode
    g. Check Battery level
    h. Plug in headphones and place over the ears

3. Ultraprobe 10,000
   a. If a DMS route has been established, download route to the CF or SD card.
   b. If it is not DMS route based ensure CF/SD card is clear.
   c. With the Ultraprobe turned off insert CF/SD card into the unit.
   d. With Ultraprobe turned off insert contact module into the front of the Ultraprobe. Align the four pins and push the module straight in DO NOT Twist. Ensure the stethoscope/contact module is completely pushed in.
   e. Plug in headphones and place over the ears.

NOTE: Select *"STM"* (Stethoscope Module) under *"Module type"* in the set-up Menu.

1. Turn on the Ultraprobe by pulling and holding the trigger in to keep ultraprobe on. **Note:** If the "Set Turn Off Mode" is set to "Trigger On/Off," release the trigger. Pulling the trigger again will shut the Ultraprobe off .Otherwise hold the trigger in to keep ultraprobe on.
2. Press the sensitivity knob two times and rotate knob to *"Setup Menu."*
3. Press the sensitivity knob to select *"Setup Menu."*.
4. Press the yellow Enter button to enter *"Setup Menu."*
5. Rotate the sensitivity knob until *"Application Select"* is highlighted in black.
6. Press the sensitivity knob to choose *"Application Select."*
7. Rotate the sensitivity knob to select *"Steam Disabled."* Disabled will be flashing.
8. Press the sensitivity knob to enable.
9. Once enabled, press the yellow *"Enter*" button to save/exit.
10. While in *"Setup Menu"* Rotate the sensitivity knob until *"Module Type Select"* is highlighted in black.
11. Press the sensitivity knob to choose *"Module Type Select."*
12. Rotate the sensitivity knob until the module that will be used for testing appears (STM).
13. Press sensitivity knob to select module.
14. Rotate sensitivity knob until *"Instrument Setup"* is highlighted in black.
15. Press sensitivity knob to choose *"Instrument Setup."*
16. If no route is loaded to ultraprobe, Rotate sensitivity knob until "*Manual*" appears.
17. Press sensitivity knob to choose "*Manual*."
18. IF, a route is loaded, rotate sensitivity knob to choose "Automatic."
19. Press sensitivity knob to choose "Automatic."

20. Press *“Enter”* to save/exit.
21. Press sensitivity knob until the "S" is flashing.
22. Rotate the sensitivity knob until "*S=35*.”
23. Press sensitivity knob until the "*kHz*" is flashing.
24. Rotate the sensitivity knob until it reads "*25 kHz*.”
25. The Ultraprobe is now ready to begin scanning.

4. Ultraprobe 15,000

a. If a DMS route has been established, download route to the SD card.

b. If it is not DMS route based, ensure SD card is clear.

c. With the Ultraprobe turned off insert SD card into the unit.

d. With Ultraprobe turned off insert scanning module into the front of the Ultraprobe. Align the four pins and push the module straight in DO NOT Twist. Ensure the scanning module is completely pushed in.

1. Turn on the Ultraprobe by depressing the power button.
2. Touch the *“Setup”* icon.
3. Touch Preferences to adjust general settings of Ultraprobe.
4. Enter 3 Alpha/Numeric Characters for the Inspector.
5. Highlight *“Module Type".*
6. Select the module that will be used for testing. *STM*
7. Tap the box with the STM to remove highlighted area.
8. Use down arrow to locate *"Instrument Setup.”*
9. Highlight *"Instrument Setup.”*
10. Choose *"Manual"* if no route will be loaded to the ultraprobe.
11. Choose “*Automatic*” if a pre-established steam route is to be loaded to the ultraprobe.

NOTE: *It is important to touch “OK” to save your settings.*

12. Once back on the “Setup” screen, touch the *"Application"* icon.
    1. Use down arrow to locate *“Steam.”*
    2. Choose *“Steam”* and touch *“OK.”*
    3. A message will appear *“Changing application will cause data to be clear, Continue?”* Choose *“Yes”* to save your setting and exit to the Setup page.
    4. Touch *“Exit”* to return to the Home page.
13. Touch *“dB Display”* icon located in the top left corner.
14. The main display is now visible
    a. Touch the *"S = ##”* to adjust sensitivity. A square rectangle will appear around the letter and number. This indicates that it is ready to be adjusted. It is a best practice to adjust sensitivity to its mid-range setting which is *“S=35”*. Use the “up” blue arrow in the middle right of your screen to accomplish this.

b. Touch *"kHz"* in the top right corner. Adjust this to read *"25 kHz."*

15. Plug in headphones and place over the ears
16. The Ultraprobe is now ready to begin data collection. Follow predetermined and/or loaded route.

NOTE: When obtaining decibel from new test point, sensitivity may need to be adjusted. Touch the *S=##* and tap the direction needed (up or down) based on the flashing arrow until a decibel (dB) appears on the screen.

III. Steam Trap Identification:

A. While there are a variety of traps available in the market place, for purposes of inspection, there are basically two main types: continuous flow and intermittent (on/off).

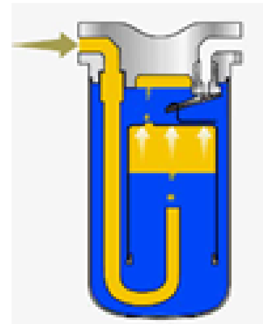
1. "On-Off" Traps
   On/off traps will have a basic hold-discharge-hold pattern. Typical of this type are:
   a. Inverted Buckets
   b. Thermodynamic
   c. Thermostatic (Bellows)
   d. Bi-Metallic

2. Continuous Flow Traps
   Continuous flow traps discharge condensate continuously. The most common are:
   a. Float and Thermostatic trap
   b. Fixed Orifice

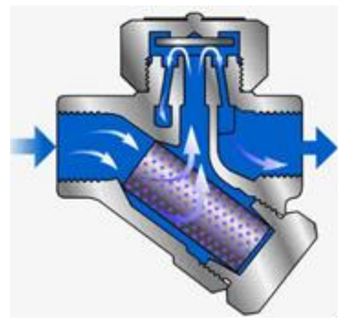
Each type of trap has its' own unique pattern that is described below. It is recommended that you listen to different types of traps to determine a "normal" operation in your particular situation before you proceed with your survey. Generally, when checking a trap ultrasonically, a continuous rushing sound will often be the key indicator of live steam passing through. Sound samples of different trap types can be heard on UE Systems web site: www.uesystems.com.

The most common method for testing a steam trap ultrasonically is to touch the trap on the downstream side at the discharge orifice. Adjust the sensitivity to the point where the trap sounds are heard. This is usually a setting in which the meter intensity indicator is at a mid-line position. Do not reduce the sensitivity too low or too high for in either setting, the trap sounds will be difficult to hear. If frequency tuning is available on your instrument, choose 25 kHz.

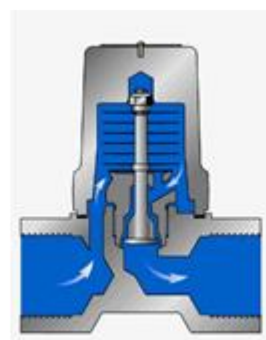
INVERTED BUCKET TRAPS (intermittent trap) normally fail in the open position because the trap loses its prime. This condition means a complete blow-through, not a partial loss. The trap will no longer operate intermittently. Aside from a continuous rushing sound, another clue for steam blow-through is the sound of the bucket clanging against the side of the trap. Leaking steam, not a total blow through, will have a continuous, but slight hissing sound. An early warning signal of potential leakage or blow-through in this type of trap will be the rattling sound of the linkage. This indicates linkage looseness that can lead to steam loss.



THERMODYNAMIC (DISC) TRAPS (intermittent trap) work on the difference in dynamic response to velocity change in flow of compressible and incompressible fluids. As steam enters, static pressure above the disc forces the disc against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disc lessens and the trap cycles. A good disc trap should cycle (hold-discharge-hold) 2 – 10 times per minute. It usually fails in the open position, allowing for a continuous blow-through of steam. While a trap operating in good condition will have a distinctive shut off between discharges, a leaking trap will never shut and will produce a slight hissing sound. Should the disc become worn, a condition referred to as "chattering" or "machine gunning" can occur. This produces a very rapid rattling sound that closely resembles the above descriptive terms. This condition allows steam to leak through and is a predictor of more severe problems to come.



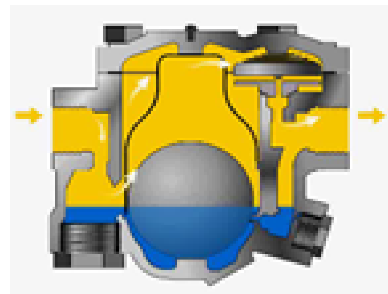
THERMOSTATIC TRAPS (intermittent trap) (Bellows and Bimetallic) operate on a difference in temperature between condensate and steam. They build up condensate so that the temperature of condensate drops down to a certain level below saturation temperature in order for the trap to open. By backing up condensate, the trap will tend to modulate open or closed depending on the load. These traps will have a hold-discharge-hold pattern. They can take a long time before discharging when there is little condensate build up. At times of high condensate, such as in start up they will stay open continuously (for that period in which the condensate is present). For this reason, it is best ***not*** to test these traps during start up. When closed, these traps will be silent; a slight hissing sound will indicate leakage. Blow-through will have a high amplitude rushing sound.



Should the bellows in a bellows trap become compressed by water hammer, the trap will not function properly. The occurrence of a leak will prevent the balanced pressure action of these traps. When either condition occurs, the trap will fail in its natural position either opened or closed. If the trap fails closed, condensate will back up and no sound will be heard. If the trap fails open, continuous rushing of live steam will be heard.

Bimetallic traps have plates that, when exposed to heat from steam will set and discharge as they cool in the presence of condensate. An improper set will prevent the plates from closing completely and allows steam to pass through. This will be heard as a constant rushing sound.

FLOAT AND THERMOSTATIC TRAPS (continuous flow)
contain two elements: a ball float and a thermostatic element (similar to that found in a thermostatic trap). When operating properly, the trap ball floats up and down on a bed of condensate, which keeps the discharge valve open. When listening to this condition, a modulating sound of the discharging condensate will be heard. This type of trap normally fails in the "closed" position. A pinhole leak produced in the ball float will cause the float to be weighted down or water hammer will collapse the ball float. Since the trap is totally closed, no sound will be heard, and the trap will be cold. In addition, check the thermostatic element in the float and thermostatic trap. If the trap is operating correctly, this element is usually quiet. Its main function is to remove air from the steam system at start up. If a rushing sound is heard, this will indicate steam blowing through the air vent since it will be in a state that will not differentiate between wither fluid. This indicates that the vent has failed in the open position and is wasting energy. Should the mechanical linkage become loose it will affect the operation of the discharge valve and can eventually lead to steam leakage. This will be heard as a clanging, rattling sound.



THINGS TO CONSIDER
Since ultrasonic testing of steam traps is a positive test, it provides results in a "real time" basis. The main advantage to ultrasonic testing is that it isolates the area being tested by eliminating confusing background noises. A user can quickly adjust to recognizing differences among various steam traps.

While performing a steam trap survey, it is important to note specific trap condition on a chart. As mentioned above, every trap should have a tag with a corresponding identification code. During the inspection procedure, trap condition should be noted. All poorly operating traps should be documented in a non-compliance report and a follow up procedure should be planned. Include a digital photograph of the trap in your report. The follow up procedure should include such items as trap number, condition and date of repair. As part of a quality assurance procedure, all repaired traps should be scheduled for re-test. A comprehensive report is recommended to describe the results of a steam trap survey. The report should include items such as the number of traps tested, the number found in good condition and the number of faulty traps. A cost analysis should be included as well. The cost analysis should indicate the gross amount of savings, the repair costs and the net savings for the survey.

Any steam system, no matter how diligent the operation, can leak; any trap can potentially waste steam. If performed properly, a routine, planned program of steam trap inspection and repair can continually pay for itself and contribute to a company's bottom line in terms of productivity, quality and energy savings.