Why do steam traps fail? What can you do about it?

Properly functioning steam traps open to release condensate and automatically close when steam is present. Failed traps waste fuel, reduce efficiency, increase production costs and compromise the overall integrity of the steam and condensate systems. Traps should be tested on a regular basis – or the neglect may be quite costly.

Failed steam traps negatively impact the entire steam system: They …

- Waste energy
- Adversely affect production
- Increase maintenance costs
- Create safety issues

Steam energy conservation is important to our national interest; examine the government figures below:

- More than 45 percent of all the fuel burned by U.S. manufacturers is consumed to raise steam. Steam is used to heat raw materials and treat semi-finished products. It is also a power source for equipment, as well as for building heat and electricity generation. But steam is not free. It costs approximately $18 billion annually to feed the boilers generating steam.
- Many manufacturing facilities can recapture energy through the installation of more efficient steam equipment and processes. A typical industrial facility can realize steam savings of 20 percent by improving their steam system. If steam system improvement were adopted industry-wide, the benefits would be $4 billion in fuel cost reduction and 32 million metric tons of emission reductions.

Source: U.S. Department of Energy. Energy Efficiency and Renewable Energy.

OK, so just why do steam traps fail?
Obviously, anything mechanical will malfunction; steam traps are no exception to the rule. Proper maintenance improves longevity and helps reduce maintenance costs.

There are three general conditions which adversely affect traps:

- Dirt is by far the leading cause of failure, resulting in either a leaking or plugged trap.
- Pressure surges (due to sudden steam valve openings, improper piping or trap misapplications) result in water hammer and subsequent damage to the internal steam trap components.
- Over-sizing IB traps can lose their prime; TD traps can experience rapid cycling.

A 600 psi rated steam trap is being ultrasonically tested

How do we keep problems to a minimum and keep energy costs in check? One simple way is to look for warning signs. Let's review the most evident signs that should signal a distress call from your steam system.

- The once-lazy plume from your condensate stacks is now an out-of-control freight train. The steam that is standing at attention from your stack, like a soldier standing at attention, is costing you dearly.

- Condensate back pressures that have slowly been rising have been causing your electric condensate pump to self-destruct. High-temperature condensate cannot be handled by conventional electric pumps. Temperatures over 212 degrees Fahrenheit cause conventional electric condensate return pumps to cavitate. Motors burn out and mechanical seals begin to leak when steam is present.

- Pressure reducing valves (PRVs) or control valves fail to maintain set pressures. Fully or partially plugged traps prevent condensate from being eliminated from the steam space. Undrained condensate at PRV stations will back up into the steam line and will wiredraw the heads and seats of the reducing valves. Wiredrawing is when high-velocity water in the steam system cuts (scores) the surfaces of heads and seats. Even small microscopic cuts will prevent the proper operation of these valves.

- A production capability has been reduced. Open or closed traps that have failed will negatively impact production. Plugged traps will back condensate up into the process and dramatically reduce system efficiency. Blowing and leaking traps are costly to production due to the added and unnecessary energy consumption.

- Pipe wall thickness of the condensate system has become an issue. Fully open or partially opened steam traps that are not repaired in a timely manner will deteriorate the condensate return piping. Some of the early warning signs begin with steam leaks.

- The cost to maintain heat exchanger bundles, humidifiers, HVAC coils and other equipment has dramatically increased. Failed traps will prevent proper operation of sensitive equipment. When steam traps fail in a closed position, over time, the stagnant condensate will turn to carbonic acid (CO3). Carbonic acid will deteriorate all the metal with which it comes in contact. Beyond increased energy consumption, failed open traps also will cause control and efficiency issues.

- Water hammer can develop in neglected or mismanaged steam and condensate systems. Water hammer literally sounds like someone is hitting a pipe with a hammer. In some cases, water hammer can occur when a portion of the steam condenses into water within steam piping. Left undrained, condensate will spill into the steam system and begin to accumulate. Eventually, a wave of water will be created. This slug of water can be carried at high velocity until it reaches an obstruction like a closed valve, a lower elevation or a sudden change of direction. A trap that is blowing steam can also cause water hammer. Blowing traps create back-pressure in the condensate system piping. If condensate piping is already undersized, the problem will be compounded by the additional pressures found by the faulty traps. Undrained condensate can back up into the steam distribution piping. From the standpoint of plant safety, it is essential to test and maintain the steam trap population. Type "steam water hammer accidents and fatalities" into a search engine. The results should be convincing enough to create an immediate action plan.

After an ultrasonic test found the trap to be blowing, the downstream condensate line was shut and the test valve was opened to verify test results. The system pressure was 270 psi. At the cost of $10 per thousand pounds of steam produced, the energy loss for this single blowing trap is $21,000.

The action plan

- Perform a regularly scheduled steam trap survey.
- Identify system design issues.
- Perform an insulation audit. Areas where insulation has been removed and never replaced will significantly add to your overall steam production costs.
- Using ultrasound detection equipment, test bypass valves if they exist in your steam system. They may be leaking through when they ought to be shut.
- Turn off seasonally operated equipment such as unit heaters.
- Periodically test control valves or shut off valves in the HVAC system with a hand-held IR temperature instrument and an ultrasonic leak detector. If they are even partially leaking through, they are adding to overall energy costs.
- Audit the system and unused inventory equipment. Remove defunct systems.
- Whenever possible and practical, use a computerized system to control and monitor processes.

Purchase proper test equipment

Even if outside technical professionals are contracted to test the steam system, from time to time, a problem will occur. Time is money. Having the proper equipment and just one trained employee can avoid costly downtime. The two basic pieces of equipment to own are an infrared thermometer and an airborne ultrasonic instrument. Such equipment is readily available in all price ranges. A thermometer with simple features is fine; however, an ultrasonic listening device should be selected more carefully and must have clear signal quality.

This is similar to purchasing an audio system for your home and comparing one set of speakers with another set. When listening to a quality speaker system, the nuances of what was actually recorded open

your ears to a new level of listening. The same is true of listening to a steam trap. With a fine instrument, you can even hear the snap-crackle-pop of steam passing across the head and seat of a wiredrawn inverted bucket trap. After all, “hearing is believing.”

Before you begin
Before you spend your hard-earned money, consider some of the following characteristics of the ultrasound instrument:

- How is the sound quality heard through the headphones (external speakers will be hard to use in most steam environments)?
- Does it lack in versatility?
- Will it include the ability to change frequencies and test modules?
- Is it heavy and/or awkward to handle when up on a ladder?
- Does it have an extended warranty period?
- Is there proper technical support via phone or in the field?
- Can batteries be easily charged and replaced?
- Are trial rentals available?

Purchasing an ultrasound device should take intelligent consideration. The instrument must be capable of providing you a clear and discernable signal quality. Labor hours and equipment costs depend on it.

Why use ultrasound to test traps?
Of all the inspection methods, ultrasound is the most recommended and reliable. Ultrasound is a shortwave, high-frequency signal that does not travel far from its source. By listening to the ultrasonic components of a working steam trap, a user can isolate the signal and easily identify operational sounds. Ultrasonic testers translate high-frequency emissions generated from the mechanical and fluid flows of traps into the audible range where they are heard through headphones and seen as intensity levels on a meter. Some units have frequency tuning to filter out additional signals and to tune in to the sounds of steam and condensate. Testing steam traps with ultrasound provides results in real time. It isolates the area being tested by eliminating confusing background noises. A user can quickly adjust to recognizing differences among various steam traps.

The ultrasonic detector may be the easiest to use, most flexible and most accurate of the sound testing methods. However, the ultrasonic instrument cannot tell if a trap is cold or blocked. Therefore, first use a temperature indicator instrument to be certain that the system is operating. Then use the ultrasound instrument to determine if the trap is partially blocked or if back pressure exists at the traps outlet.

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