MEASURE 1.10.3 Use the most efficient type of steam trap for each application.

RATINGS

New Facilities	Retrofit	O&M
A	B	

Steam traps are vital components of a steam system. If they do not perform properly, they can be a source of major energy and water loss. Normal wear of traps is a major cause of steam leakage. Steam traps can fail in a way that effectively creates a hole in the steam system. Using the wrong type of trap can cause improper operation of the steam-using equipment, damage piping, and destroy the trap itself. Loss of steam through a trap is almost invisible, because the steam disappears into the condensate system.

Make sure that each steam trap is individually matched to its application in terms of type and size. About half a dozen different types of steam traps are in common use today. The variety of types results from differences in application requirements and differences in cost. Trap types differ in reliability and time-between-overhaul. Some types of steam traps have higher average leakage than others. The cost of the trap should be a lesser factor in selecting one type of trap over another, because the trap cost is dwarfed by the cost of wasted steam.

In existing systems, you may find traps that are not the best type for the application. Proper trap application requires a certain amount of specialized knowledge, so traps may have been installed without considering all the relevant factors. Also, facility operators tend to favor trap types that are cheap and compact.

This Measure gives you an introduction to steam trap selection, with an emphasis on selecting traps that have the lowest average leakage over the life of the plant. Supplement this with manufacturers' literature for the specific types of traps that apply to your facility.

SUMMARY

Inappropriate types of steam traps waste steam. Select trap sizes using manufacturers' procedures.

SELECTION SCORECARD

Savings Potential .... $ $

Rate of Return, New Facilities % % % %

Rate of Return, Retrofit .... % % % %

Reliability .... ✓ ✓ ✓ ✓

Ease of Retrofit .... ☺ ☺ ☺

Once you understand trap selection, survey all the steam traps in your facility to determine whether each is the appropriate type and capacity for its application.

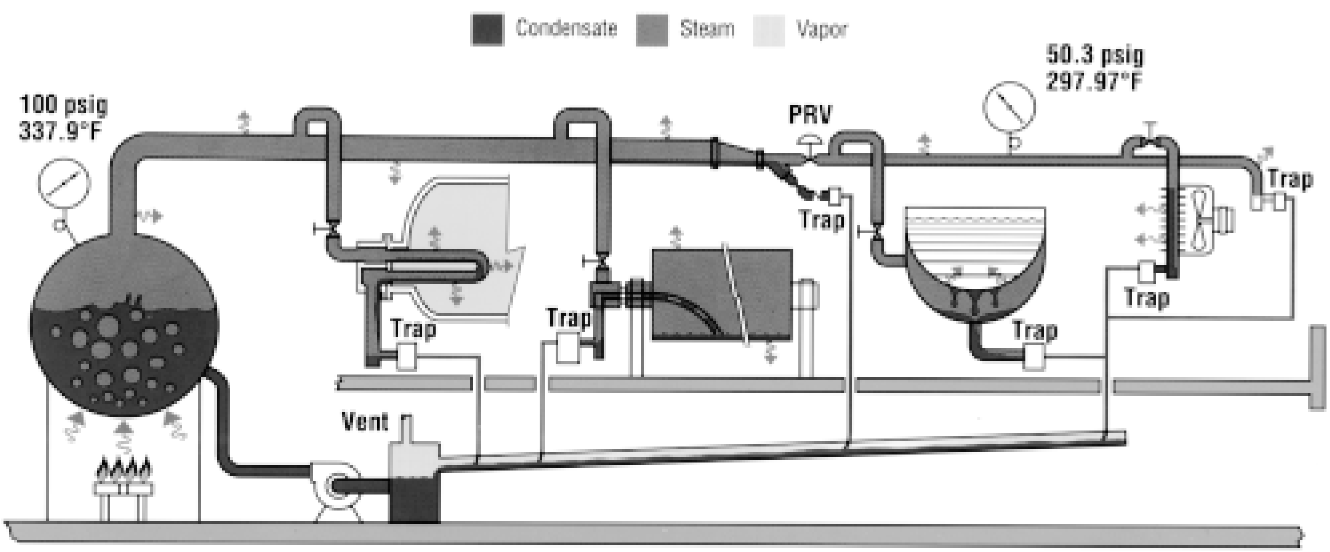
Finally, replace all inappropriate traps with the proper types and capacities.

This Measure deals with selecting steam traps and replacing inappropriate or less efficient types. See Measures 1.10.4 ff for trap maintenance.

The Two Applications of Steam Traps

Steam traps are devices that block the passage of steam while allowing liquid condensate to pass. Traps are used in two general applications, which are illustrated in Figure 1:

- ***on the outlets of steam-using equipment***, to keep steam confined inside the equipment until it has



Armstrong International, Inc.

Fig. 1 The two functions of steam traps One is to keep steam inside heating equipment until it has condensed and given up its latent heat. The other is to drain condensed water from steam lines before it damages the system.

given up its heat, i.e., to keep the steam from blowing straight through the equipment

- ***on steam lines***, to remove condensate that forms in the pipe. Condensate forms because of heat loss from the pipe. If allowed to accumulate, slugs of condensate propelled by steam pressure may accumulate enough kinetic energy to destroy valves, piping, and equipment. Traps used to drain steam lines are called "drip traps."

In many steam systems, the traps also serve as an important means of removing air and other non-condensible gases from the system. If these gases are not removed, they may block the flow of steam. For example, in a steam coil with many circuits, air that accumulates in the coil causes most of the steam to be routed through a few of the circuits, rendering the rest of the coil useless. Also, non-condensible gases are the source of corrosion in steam pipe and equipment. Oxygen corrodes steel directly, while carbon dioxide forms carbonic acid, which causes acid corrosion.

To minimize these problems, most applications require steam traps to have the ability to remove, or "vent," non-condensible gases (i.e., gases other than steam). Traps need a large venting capacity to clear air out of the steam system after a period of shutdown. Traps need a smaller venting capacity to vent the system continuously while it is in operation, to remove gases that are carried in the steam.

Steam traps usually vent non-condensible gases into the condensate system. The location of the traps may not allow complete venting of the system. Parts of a steam system may trap air by letting it become stagnant, so it is not carried along by steam flow. Separate air vents are installed in these parts of the system. These vents typically discharge air directly to the atmosphere, rather than to the condensate system.

How Steam Trap Leakage Wastes Energy

Most of the useful energy of steam is in the form of latent heat, which is the heat required to turn liquid water into steam inside the boiler. For a steam system to operate efficiently, all the steam must condense inside the steam-using equipment, so that the latent heat is transferred to the heating application. If steam leaks through a trap, most of the energy of the leaked steam is wasted.

Little or none of this energy is recovered on the way back through the condensate system. Steam that leaks through a trap into the condensate system is condensed by conductive heat loss through the pipes of the condensate system. In an atmospheric or vacuum condensate system, any steam leakage that is not condensed in the pipes is blown out of the condensate system vents, which are typically located at the condensate receiver.

Causes of Steam Trap Leakage

A large part of this Measure deals with the leakage characteristics of different types of steam traps. Before getting into the individual types, it is worth noting that all steam traps may leak for these reasons:

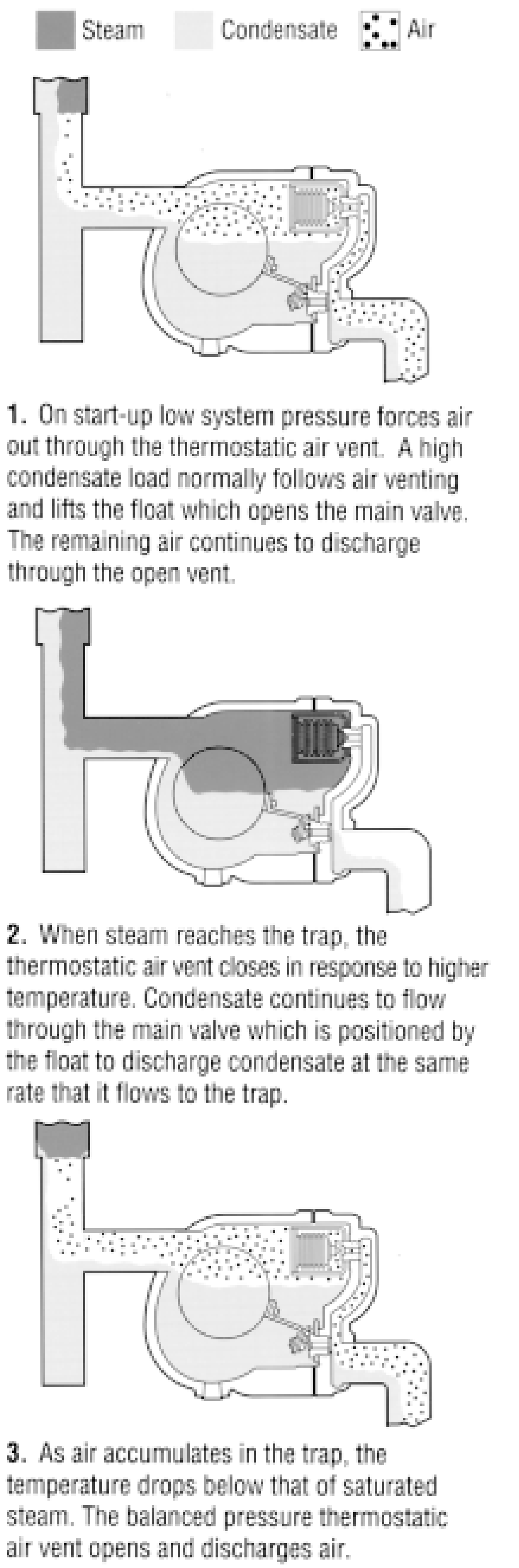
- ***inherent leakage of the trap design.*** In principle, all types of traps, except orifice traps, are capable of blocking steam completely. However, all traps will leak eventually. Field experience suggests that some trap types tend to operate longer before developing leakage. Also, some types of traps will leak if they are not installed in a certain way, whereas the method of installation does not cause leakage in other types.
- ***sticking in an open or partially open position.*** All types of traps are subject to complete failure as a result of fouling, corrosion, or mechanical failure. Failure in the open position is the equivalent of having a hole in the system the size of the trap's internal discharge passages. Failure in the closed position causes steam equipment to cease operating because it cannot discharge condensate. Failure of drip traps in the closed position is dangerous because slugs of condensate remain in steam lines. Some traps tend to fail in an open position, while others tend to fail in a closed position. This tendency may also be influenced by the characteristics of the steam system.
- ***wear and fouling of sealing surfaces.*** All types of steam traps (except orifice traps) block the flow of steam by metal-to-metal contact of sealing surfaces. Even if a trap continues to close properly, it will eventually develop leakage because of steam abrasion, fouling, and hammering of the sealing surfaces. Once leakage begins, it typically progresses rapidly. Some types and models of traps develop this type of leakage more quickly than others.

Steam loss also depends on the size of traps. Larger traps can waste more steam, and they cost more to replace. Survey all your traps, large and small, to make sure that each is appropriate for its application.

Steam Trap Types and Leakage Characteristics

The following is an introduction to the types of steam traps that are presently in common use, with emphasis on their steam leakage characteristics. The trap types are covered in approximate order of condensate draining capacity.

This comparison of efficiency characteristics requires broad generalizations. Information on trap leakage provided by manufacturers is sketchy and may lack credibility. One problem is that all types of traps can leak seriously under certain conditions, so any comparison depends on assumptions about the application. The major trap manufacturers tend to be



Armstrong International, Inc.

Fig. 2 How float-and-thermostatic (F&T) traps work

cautious about pointing the finger at certain trap types, probably because they make a variety of types themselves.

■ Float-and-Thermostatic (F&T) Traps

F&T traps are used for draining steam equipment and as drip traps. They are one of the most popular types, and they are used in a wide range of sizes. Figure 2 shows how they work.

As the name implies, a float-and-thermostatic trap is a combination of two separate devices, a float trap and a thermostatic vent. The float trap is the essence of simplicity. It consists of a chamber with a discharge valve at the bottom. The discharge valve is actuated by a float and lever. When the chamber is dry, the weight of the float keeps the valve closed. When the chamber fills with condensate, buoyancy lifts the float and opens the discharge valve. The float is usually spherical in shape to resist the pressure of the steam.

Float traps are efficient in separating condensate from steam because the trap directly senses the presence of condensate through its great buoyancy. Furthermore, the float ball can be made as large as needed to provide a strong operating force for the condensate valve. Steam cannot leak through the trap because the discharge is located under water.

A simple float trap cannot vent air. It would eventually fill with air and keep the valve from opening ("air bind"). To prevent this, virtually all float traps include a separate thermostatic valve near the top of the trap. This gives them the name "float-and-thermostatic." The thermostatic valve remains open until the trap heats up. F&T traps are able to vent large amounts of the air from the system, which is an important feature.

In F&T traps, the thermostatic element can become a source of steam leakage. Fortunately, the thermostatic

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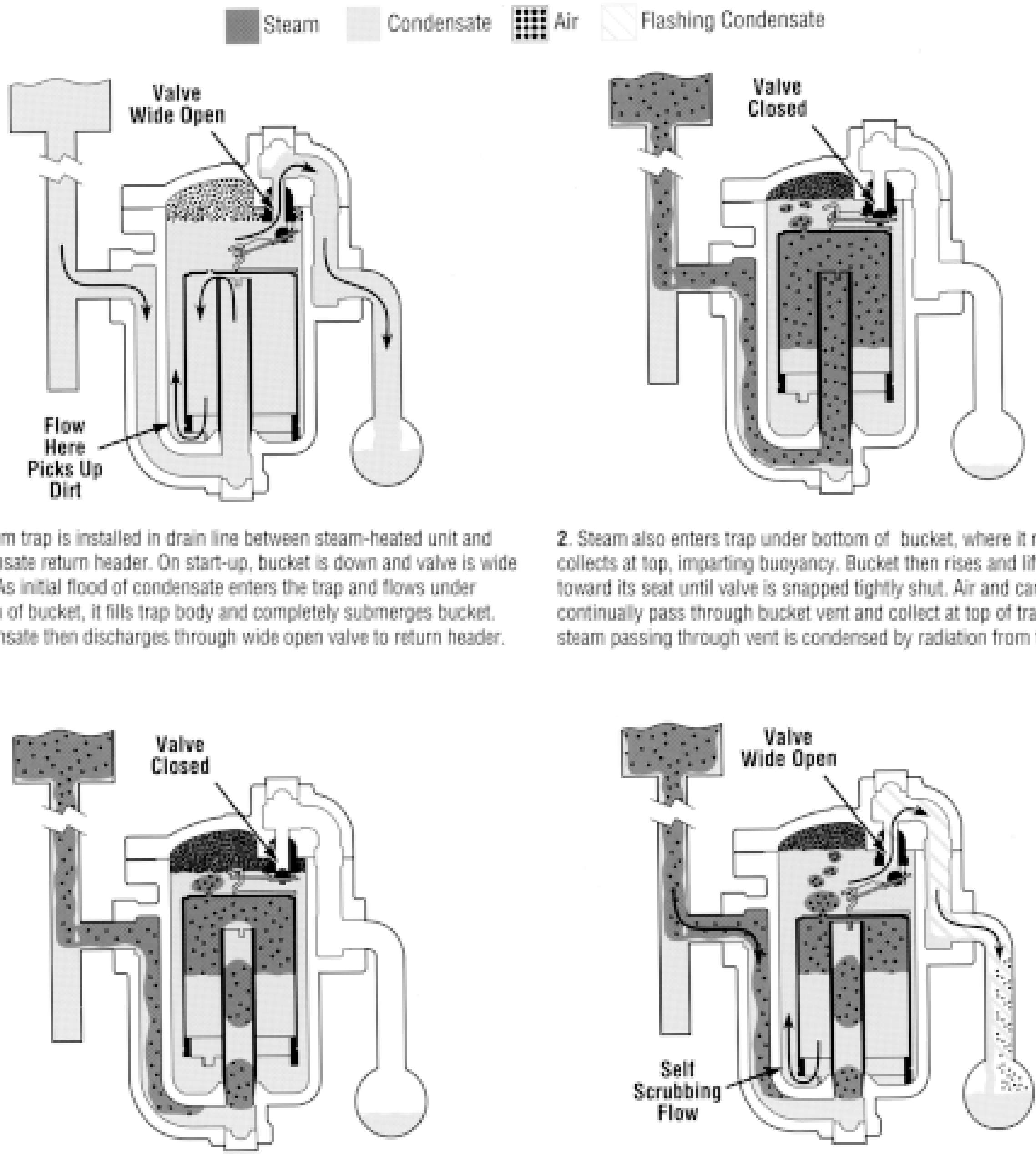
Fig. 3 Typical F&T traps The chubby shape provides space for the float ball to swing up and down. The thermostatic element is on the upper left.

element in an F&T trap wears out more slowly than the element in a thermostatic trap. This is because it remains closed most of the time, opening only when a volume of air accumulates inside the trap.

Float traps are vulnerable to dirt. The discharge valve is located near the bottom of the trap, where large dirt particles may accumulate. Also, float traps can operate steadily in a partially open position, which allows debris to become lodged between the plug and seat of the discharge valve. The protection against dirt is to buy a trap that has an integral strainer, or to install a strainer ahead of the trap.

You can recognize F&T traps from their large, rounded shape, which accommodates the spherical float ball inside. Figure 3 shows typical units.



1. Steam trap is installed in drain line between steam-heated unit and condensate return header. On start-up, bucket is down and valve is wide open. As initial flood of condensate enters the trap and flows under bottom of bucket, it fills trap body and completely submerges bucket. Condensate then discharges through wide open valve to return header.

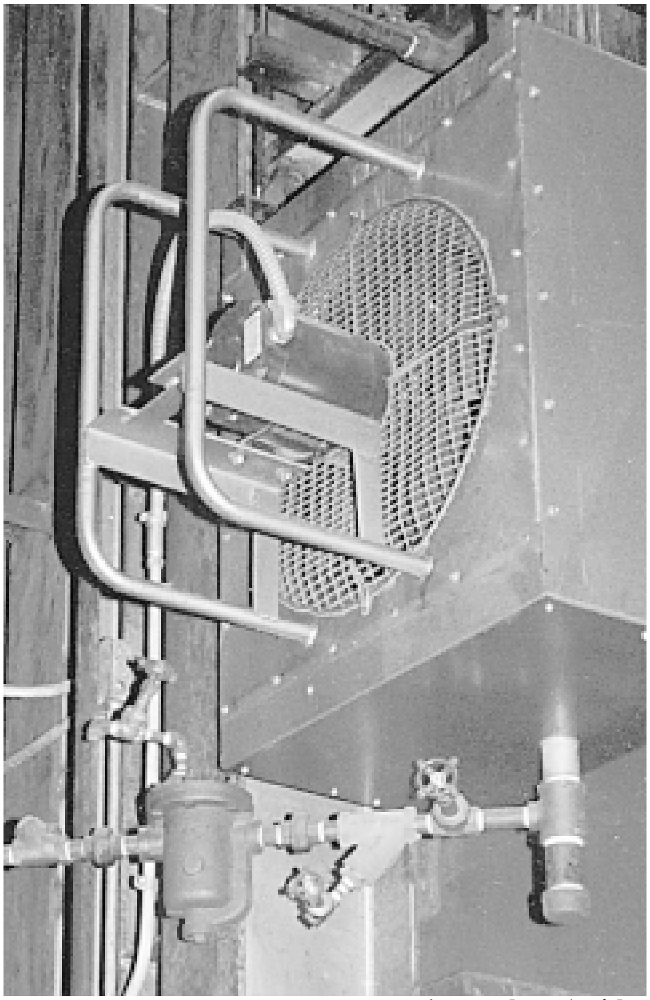
2. Steam also enters trap under bottom of bucket, where it rises and collects at top, imparting buoyancy. Bucket then rises and lifts valve toward its seat until valve is snapped tightly shut. Air and carbon dioxide continually pass through bucket vent and collect at top of trap. Any steam passing through vent is condensed by radiation from trap.

3. As the entering condensate starts to fill the bucket, the bucket begins to exert a pull on the lever. As the condensate continues to rise, more force is exerted until there is enough to open the valve against the differential pressure.

4. As the valve starts to open, the pressure force across the valve is reduced. The bucket then sinks rapidly and fully opens the valve. Accumulated air is discharged first, followed by condensate. The flow under the bottom of the bucket picks up dirt and sweeps it out of the trap. Discharge continues until more steam floats the bucket, and the cycle repeats.

Armstrong Inernational, Inc.

Fig. 4 How inverted bucket traps work



Armstrong International, Inc.

Fig. 5 A small inverted bucket trap draining a steam-fired space heater

Inverted Bucket Traps

Inverted bucket traps are used for draining steam equipment and as drip traps. They are used in a wide range of sizes. Figure 4 shows how they work.

An inverted bucket trap is built around a floating bucket that has its open side facing downward. Steam entering the trap is fed into the bucket, causing it to float to the top of the surrounding pool of condensate and close the discharge valve. When only condensate enters the trap, the steam in the bucket condenses and the bucket sinks, opening the discharge valve. Thus, condensate drains in cycles.

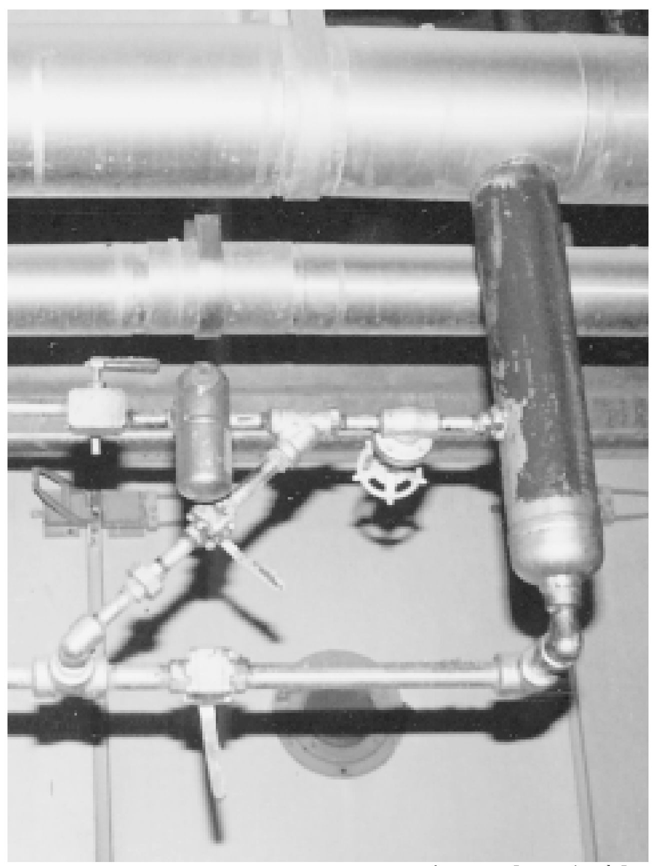
Inverted bucket traps allow little steam leakage when they are operating properly because the buoyancy of the bucket provides strong closure of the discharge valve. As with float traps, inverted bucket traps are relatively reliable because the bucket can be made as large as needed to provide a strong operating force for the condensate valve.

The top of the bucket has a small vent hole. This allows non-condensible gases to escape from the bucket and be discharged. The vent hole also allows a small quantity of steam to escape from the bucket into the main body of the trap, where it condenses. The presence of the vent hole also allows the trap to open more quickly when condensate enters it. In normal operation, loss of steam through the vent is limited by the rate at which steam condenses in the trap, which is small.

Inverted bucket traps are resistant to dirt because the discharge valve is located at the top of the trap, away from dirt that settles in the bottom of the trap body. The discharge valve opens abruptly and fully, so dirt carried in the condensate does not become lodged in the valve seat.

Inverted bucket traps are most likely to fail in the open position. They fail in the open position if they run dry, because then the bucket cannot float. (This problem is most likely to occur if the steam is superheated.) They may also fail from misalignment of the internal mechanical linkage. When they fail in the open position, the size of the discharge orifice is the only factor that limits steam loss.

You can recognize inverted bucket traps from their cylindrical shape, which conforms to the shape of the bucket inside. Figures 5 and 6 show two different models.



Armstrong International, Inc.

Fig. 6 A stainless steel inverted bucket trap installed as a drip trap Note the test valve installed on the discharge (left) side of the trap.

Thermostatic Traps

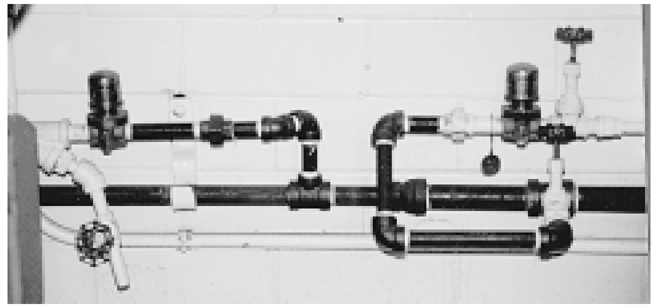
Thermostatic traps are used for draining steam equipment and as drip traps. They are most common in smaller capacities. Figure 7 shows typical units, which are characterized by small physical size.

Thermostatic traps operate by sensing the difference between the temperature of live steam and the temperature of condensate or non-condensible gases that cool inside the trap. Their operating principle is simple: steam cannot cool below its condensation temperature, but condensate and non-condensible gases can cool. When a thermostatic element inside the trap senses a temperature lower than steam temperature, it assumes that it is surrounded by water and opens the discharge valve.

Presently, there are two main categories of thermostatic traps:

- ***bimetallic traps,*** which consist of a valve that is moved by a simple bimetallic element that is located on the steam side of the valve. This type has a fixed operating temperature, so it cannot respond to changes in the pressure and temperature of the steam.

  Bimetallic traps are compact because they require space only for the small thermostatic element. The housing may have any shape.

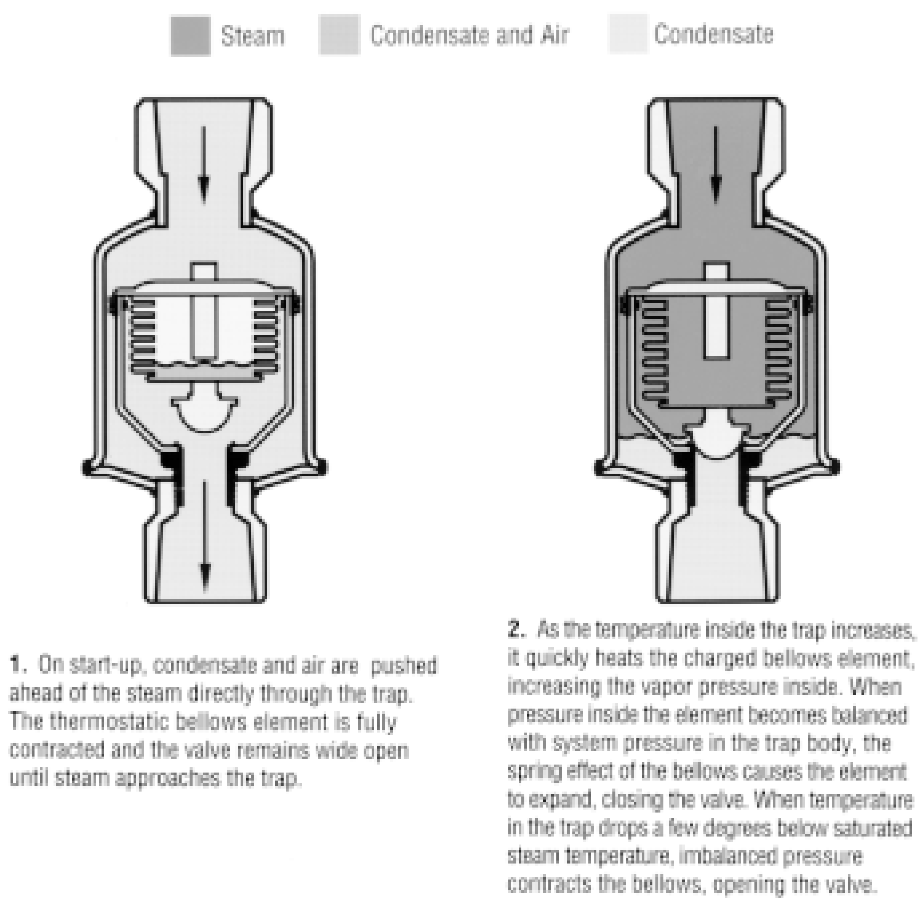


Armstrong International, Inc.

Fig. 7 A pair of thermostatic wafer steam traps The main attraction of these is their small size and low cost.

- ***bellows traps*** close a discharge valve using the pressure of a boiling fluid contained inside a bellows. The fluid in the bellows is selected to boil at a temperature lower than steam temperature, so the bellows wants to expand when steam is present. The pressure inside the bellows is partially balanced by the steam pressure, so the opening temperature of the bellows trap can adapt to changes in steam pressure. Figure 8 shows how a bellows trap works.

  This type of trap should not be exposed to superheated steam, because the pressure inside the bellows may exceed the steam pressure enough to burst the bellows.



Armstrong International, Inc.

Fig. 8 How a thermostatic bellows trap works

Bellows traps are small. Some have a cylindrical housing that conforms to a cylindrical bellows. Others have a compact housing that surrounds capsules of different shape, one of which resembles a large button.

Thermostatic traps are prone to leakage because they open and close relatively slowly. This provides time for erosion by high velocity steam and water while the sealing surfaces are barely separated. The partially open discharge valve may trap dirt, preventing tight closure.

The piping layout of thermostatic traps may be critical. The trap does not open until the condensate cools somewhat. If the condensate does not cool quickly enough, condensate may back up into the steam equipment or steam line. Therefore, install thermostatic traps so that they are surrounded by air that is substantially cooler than steam temperature. With low-pressure steam, the trap may have to be installed at a certain distance from the equipment or steam lines. Do not insulate the trap or the pipe that leads to it.

A standard thermostatic steam trap may be used as an air vent. You can recognize this application from the fact that the trap is installed at a high point on the steam equipment or pipe, rather than at a low point.

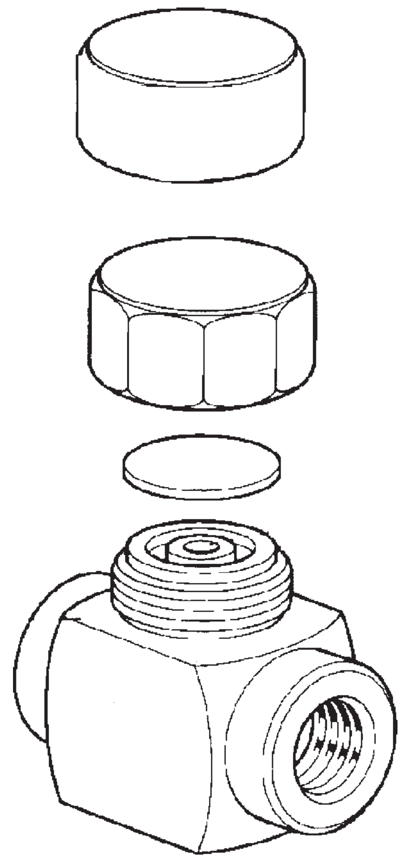
■ Disc Traps

Disc traps are used primarily as drip traps and for low steam loads, such as steam tracing lines. They are used in smaller capacities. (Disc traps are sometimes called "thermodynamic" traps. This may be a derivation of the name Thermo-Dynamic, which is a trade mark of Sarco Spirax, the original producer of disc traps.)

A disc trap consists of a flat disc resting on a circular seat that is smaller than the disc. The disc is enclosed in a chamber above the seat, where it moves freely. Figure 9 shows how simple these traps are in construction. Figure 10 shows how they work.

Condensate or steam enters the trap through the center of the seat, flows over the seat, and discharges through ports located under the perimeter of the disc. The disc is confined in a small chamber, into which it fits loosely so that steam can leak into the space above the disc. When condensate is present, it lifts the disc and exits. When steam enters the trap, Bernoulli effect reduces the pressure between the disc and seat. (Perhaps, this type of trap should be called "aerodynamic" rather than "thermodynamic.") Steam at full steam pressure leaks into the space above the disc, aiding the Bernoulli effect, and the trap snaps shut. Once the trap is shut, the disc is held down by the steam pressure above the disc.

The main advantage of disc traps is their small size in relation to their condensate capacity. You can usually identify them from the disc chamber, which is a small cylindrical housing that forms the top of the trap. Some disc traps are installed in-line, and these may be barely



Spirax Sarco, Inc.

Fig. 9 Disc trap The thin disc sits freely on the seat. Steam and condensate rise through the center hole, turn around under the disc, and bleed off through the surrounding space. The cap over the disc forms a chamber in which the disc is enclosed. At the top is an insulating cover, which improves trap performance.

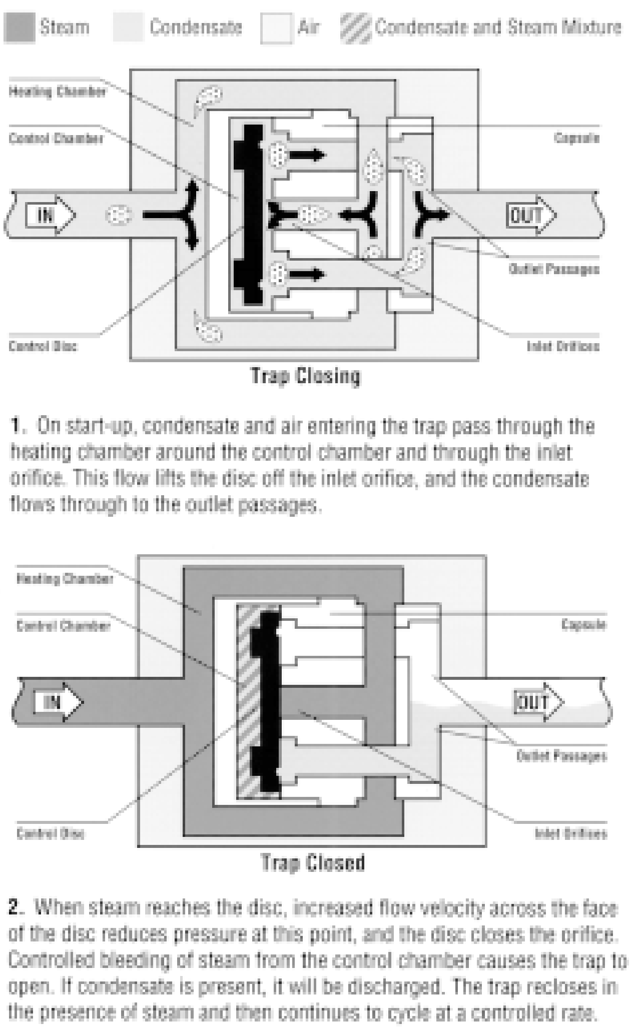
larger than the steam pipe itself. Figure 11 shows an installed unit.

The reliability of disc traps is a controversial issue. One leading trap manufacturer (who manufactures all the major types) asserts that disc traps are as reliable as other trap types. Other parties assert that leakage increases after a relatively short time because the sealing surfaces become deformed from hammering and steam abrasion. Also, the large contact area of the sealing surface makes disc traps vulnerable to leakage caused by fouling. Increasing leakage at the sealing surface allows the steam above the disc to vent quickly to the outlet, causing the trap to cycle more and more rapidly. Some manufacturers admit to this weakness, and they design their models for quick replacement of the disc and seat.

Even the way that disc traps operate is controversial. All agree that disc traps operate in a cyclic manner. Many parties say that disc traps cycle open periodically even when there is no condensate in the trap. This occurs because the steam above the disc condenses, eliminating the pressure that holds the disc closed. A puff of steam is lost with each operating cycle. However, one major manufacturer denies that their traps open in the absence of condensate. This manufacturer states that live steam never reaches the trap, but that the trap is closed by the flashing of condensate that is near steam temperature. This manufacturer insists that a water seal should be created ahead of the trap.

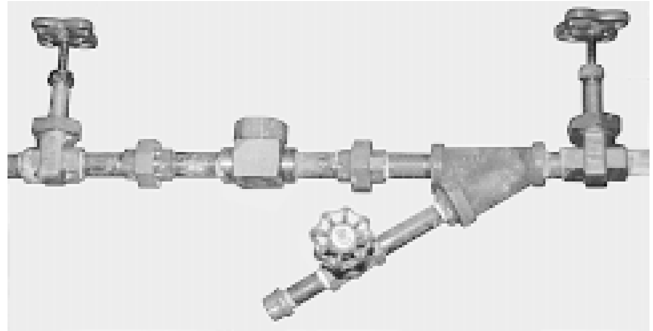
All seem to agree that trap cycling increases if heat loss through the trap body causes the steam above the disc to condense. For this reason, some manufacturers offer insulating caps for the disc cover. Other manufacturers offer more expensive models that surround the disc chamber with an outer chamber that is filled with inlet steam.

The design of the seat is also controversial. Some manufacturers assert that the operation of disc traps depends on a controlled rate of leakage between the disc and seat to ensure that the trap will open. They create this small leak with a tiny groove or a carefully roughened surface. However, one leading manufacturer uses sealing surfaces with no deliberate leakage. All agree that hardness of the sealing surfaces is important to resist deformation.



Armstrong International, Inc.

Fig. 10 How a disc trap works



WESINC

Fig. 11 Disc trap installed This type is very small, as you can see in comparison with the valves and strainer.

The most common failure mode of disc traps is increasingly rapid cycling that is caused by fouling or deformation of the sealing surfaces. When this occurs, steam is lost in puffs. The rate of steam leakage is limited by the interrupted flow and by the small size of the passages. If the steam plant or the application is shut down periodically, the trap might also stick shut or fully open.

Try to install disc traps so that the disc lies on its seat horizontally, equalizing the forces on the disc. Disc traps are sometimes installed with the disc vertical, but this hastens deterioration.

■ Orifice Traps

Orifice traps are used almost exclusively as drip traps. They are made only in smaller sizes.

An orifice trap, as its name implies, consists of nothing more than a small hole. A screen typically is installed upstream of the hole to prevent clogging. This type was introduced formally in the 1970's. The fixed orifice is essentially an adaptation of the practice of draining condensate manually by slightly opening a drain valve.

Orifice traps can be considered a controlled leak, whose principal merit is that the volume of the leak is known in advance. They are limited to use as drip traps, and they must be sized closely to match the expected condensation rate. They are not practical for steam-using equipment, which has large and variable steam consumption.

The housing of an orifice trap is very compact, typically only slightly larger than the pipe diameter. A sloppy insulation job may hide the device entirely.

The *ASHRAE Handbook* explains the operation of orifice "traps" as follows: "... an orifice of any size has much greater capacity for condensate than it does for steam because of the significant differences in their densities and because flashing condensate tends to choke the orifice ..." This explanation is not persuasive, because steam flows much more easily than water, in terms of volume. It is true that condensate chokes an orifice. However, a continuously open orifice is passing dry steam most of the time in a drip trap application, especially if the steam has any superheat. The *ASHRAE Handbook* goes on to say that "the steam loss is usually comparable to that of most cycling-type traps," but does not state which types.

Orifice traps are vulnerable to dirt because the orifices are quite small. The orifice must be protected by a screen that has a smaller mesh than the orifice size, and such a screen easily becomes clogged.

■ Other Types of Steam Traps

Various other types of traps have emerged over the years. Some, such as piston traps and open bucket traps, have become obsolete because of poor reliability, complexity, or large size. Other types of traps are limited to specialized applications, such as a variant of the inverted bucket trap designed to lift condensate. Consider replacing obsolete or inappropriate traps, rather than repairing them.

Other Selection Characteristics

From the standpoint of efficiency, ability to block steam flow is the main consideration in selecting traps. In addition, you need to consider other characteristics, especially these:

- ***reliability.*** Most steam is wasted by trap failure, rather than by inherent leakiness of certain types of traps. Different trap types vary in susceptibility to the three failure modes discussed previously.

  All traps can be expected to fail, but the average time between failures may vary widely among different types of traps. Many people feel that F&T traps and inverted bucket traps have the longest intervals between failure. Thermostatic traps probably have shorter intervals between maintenance because of their gradual closing characteristics. The reliability of disc traps is controversial, as discussed previously. Orifice traps are very vulnerable to clogging.

  All traps, except orifice traps, will eventually fail by leaking steam, but they may also stick fully open or fully closed. The latter modes are more likely in systems that shut down periodically, because this allows the mechanism to corrode into position. Inverted bucket traps tend to fail in the open position, because this is their shut-down position. Float traps tend to fail in the closed position, which is their shut-down position. A float trap can also fail by corrosion of the float ball, which closes the valve. Thermostatic traps can fail by failure of the thermostatic element. Orifice traps, of course, can fail only to a closed state by clogging.

  If an F&T trap fails in the closed position, its thermostatic element will cause it to behave like a thermostatic trap. This may reduce its capacity considerably, but will make the failure difficult to diagnose.

  No trap is reliable unless it is properly matched to its application. For example, float traps are vulnerable to water hammer, freezing, and dirt, whereas inverted bucket traps are resistant to these problems.

- ***capacity range.*** Float, bucket, and thermostatic traps block steam efficiently from zero condensate flow up to their maximum rated capacity. Disc traps adapt to different drainage rates, but they are limited to small capacities because of the way they operate. Orifice "traps" continuously leak steam when condensate is not present, so they must be sized accurately for the maximum expected condensate flow rate.

- ***system pressure.*** Inverted bucket traps are available for any pressure. Float traps are limited in pressure by the possibility of crushing the float. Bellows-type or encapsulated thermostatic traps are limited in pressure by the possibility of crushing the thermostatic element. Orifice and disc traps are limited in pressure by the erosion that occurs when high-pressure steam passes through narrow passages.

  Some disc traps require a minimum pressure drop between the steam side and the condensate side to operate properly, typically 10 PSI or more. In addition, disc traps are vulnerable to back pressure because proper operation requires steam to be able to exit from the trap at high velocity.

- ***venting a cold system at start-up.*** Thermostatic traps provide rapid venting of cold systems. Thermostatic elements are included in F&T traps for cold system venting.

  Inverted bucket traps do not vent air rapidly because the smallness of the vent hole in the bucket limits the flow of gases through the trap. To compensate for this, a thermostatic elements can be fitted to the bucket that increases the size of the vent hole when the bucket is cold. This added complication reduces the reliability of the trap, all other things being equal.

  Disc traps vent a cold system very slowly because the trap is closed by air in the same way as by live steam.

  Orifice traps are poor for venting a cold system because of the typically small size of the orifice.

  You can vent a cold system by using separate air vents, which gives you greater latitude in selecting trap types.

- ***venting a warmed-up system.*** F&T traps, inverted bucket traps, and orifice traps all do a good job of venting non-condensible gases from a system that is operating at normal temperature.

  If a thermostatic trap is kept flooded by condensate, air never has a chance to reach the thermostatic element, so the trap cannot vent a warmed-up system. This limitation is characteristic of most thermostatic traps because the thermostatic element must be set to close at some temperature lower than the steam temperature.

Disc traps vent an operating system slowly for the same reason that they vent a cold system poorly, namely, that non-condensible gases cause the trap to close rather than to open. Venting becomes impossible if the trap is installed with a water seal ahead of it to reduce cycling, as one manufacturer suggests.

- ***vulnerability to freezing.*** Inverted bucket traps and float traps remain partially filled with water when they are idle, which invites freezing damage. Of the two, float traps are more vulnerable because they contain a float ball and a thermostatic element (in F&T traps) that are easily crushed by ice expansion.

  Bimetallic thermostatic traps, disc traps, and orifice traps are less likely to be harmed by freezing.

  Installation practice is a major factor in avoiding freeze damage, both for traps and for other steam equipment. The basic principle is to completely drain the portions of the system that may be exposed to freezing temperatures. Competent steamfitters have a variety of techniques for accomplishing this. Major trap manufacturers publish guidance in avoiding freezing in steam systems.

- ***operation with superheated steam.*** Superheated steam can be a problem for several trap types when they are used in drip legs. If superheated steam reaches an inverted bucket trap, the steam will rush through and keep the trap dry, causing the trap to remain in the open position. Superheated steam may cause a disc trap to chatter and pass steam. Superheated steam may burst the expanding element of a bellows trap. Superheated steam may increase the loss through orifice traps.

  In principle, you could use any of these types with superheated steam, provided that you install them so that liquid condensate always forms ahead of the trap. However, this is a bad gamble, especially if the trap can be damaged by contact with superheated steam. Under some circumstances, the condensate may not form as you hope.

- ***vulnerability to water hammer.*** A slug of condensate propelled by high steam pressure has enough energy to crush trap components, especially thermostatic elements and float balls. Float traps and bellows-type thermostatic traps are sensitive to water hammer. Other common types resist damage much better.

- ***size.*** Float traps and bucket traps are bulky, whereas other common types are small.

- ***cost.*** Float traps and bucket traps are more expensive than other common types.

Other characteristics may be significant, and putting all the selection factors into perspective requires experience. Several steam trap manufacturers publish detailed selection guides. Experienced manufacturers' representatives can offer valuable advice. Recognize that vendors are biased toward the types that they offer, especially if they are proprietary, and toward more expensive models.

Sizing and Surge Capacity

Do not select traps with excess flow capacity. The capacity of the trap determines the size of the valve orifice (or internal passages, in the case of a disc trap). If the trap fails in the open position, the orifice size determines the rate of steam loss.

Select trap sizes using the instructions in the manufacturers' catalogs. Calculate sizing from the maximum condensate load, the pressure differential across the trap, and the nature of the application (which dictates extra capacity as a safety factor). Typically, F&T traps and inverted bucket traps are offered in a range of body sizes, which are combined with a range of orifice sizes to satisfy the full range of capacity requirements.

Consider the surge capacity inside the body of the trap. Surges of condensate must be kept from backing up into steam equipment or into steam lines. Float traps and bucket traps have a significant amount of surge capacity. You can also gain surge capacity by increasing the volume in the pipe that leads to the trap.

Strainers

As we have seen, dirt is a potential problem with steam traps. It can keep the valve from closing completely (all types, except orifice traps) and it can clog the trap passages (especially orifice and disc traps). The general solution to these problems is to install a strainer ahead of the trap. Figure 11 shows a strainer that is properly installed.

The strainer itself is an item that requires periodic inspection and cleaning. Unless the steam system has a particular dirt problem, inspection is needed only at long intervals. This leads people to forget about them. Make sure that your maintenance schedule includes such multi-year inspections. Figure 12 shows a strainer that has likely been forgotten.

To simplify the installation, you can get traps with integral strainers in most types and sizes. However, these do not eliminate the need to clean out the strainers periodically.

Piping Details

Proper operation of a steam trap depends on the way it is installed. As we have seen, installation practice is important for freeze protection, and it may be a factor in providing adequate surge capacity. Piping the trap to

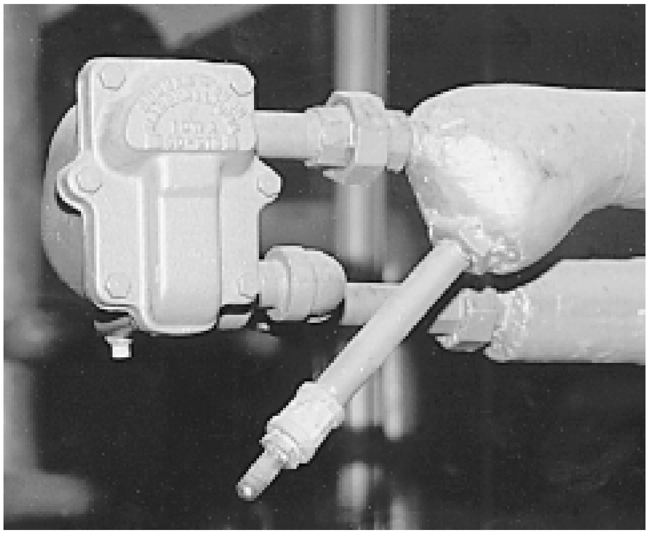


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Fig. 12 A strainer that needs cleaning The strainer installed for this F&T trap is completely hidden by insulation. Still, it could be used if it had a blowdown valve, which it lacks. The crude plug in the blowdown pipe has probably never been removed.

maintain a water column ahead of the trap may be necessary for satisfactory operation and longevity of thermostatic and disc traps. Refer to the manufacturer's literature for more details.

Avoid Sharing Traps

Do not use a single trap to serve more than one item of equipment. Condensate drainage is sensitive to discharge pressure, so if two units discharge to a common line, the discharge from the higher pressure unit can block the flow of condensate to the other unit. This problem is especially severe with modulating equipment. Sharing traps makes it difficult to diagnose problems in traps or the equipment they serve.

ECONOMICS

SAVINGS POTENTIAL: *Varies widely. For traps serving equipment, the wrong types of traps may waste 1 to 30 percent of the steam flow to the equipment. For drip traps, an orifice trap or a malfunctioning trap of any type may drain much more steam than condensate.*

COST: *F&T traps and inverted bucket traps typically cost from $100 to $500 each, in sizes where less efficient types of traps might be used.*

PAYBACK PERIOD: *Several months to several years.*

TRAPS & TRICKS

SELECTING THE TRAPS: *Start by educating yourself about steam traps. Know where to use each type of trap, and how to size traps. Take one of the courses offered by major trap manufacturers. Buy your traps from reputable manufacturers.*

INSTALLATION: *Trap installation requires special practices for each type of trap and application. Do your homework.*