

# STEAM TRAP APPLICATIONS

## INTRODUCTION TO STEAM TRAPS

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### WHAT IS A STEAM TRAP AND WHAT DOES IT DO?

A steam trap is an automatic valve that allows condensate, air and other non-condensable gases to be discharged from the steam system while holding or trapping the steam in the system. Several different types of steam trap technologies exist to accomplish this extremely critical and necessary task.

### WHY ARE STEAM TRAPS REQUIRED?

For any steam system to operate properly the condensate, air and other non-condensable gases such as carbon dioxide must be removed from the steam system. This is the purpose of the steam trap.

#### CONDENSATE:

When steam releases its heat energy, the steam reverts back to water. This occurs in a heat exchanger making hot water, in a radiator heating a room, or in a steam pipe transferring steam. This water, technically referred to as *condensate*, must be removed from the system or the system would back up with water. The removal of condensate from the steam system is considered the primary function of the steam trap.

#### AIR:

Air exists in all steam pipes prior to system start-up when the system is cold. This air must be bled out of the piping system so that the steam can enter and eventually reach the designated process applications. If the air is not removed, the steam will effectively be blocked from entering the steam pipes by the residual air. In addition to blocking the steam, air acts as an insulator to heat transfer. Even after the system is filled with steam, small amounts of air can re-enter the system thru various paths such as boiler water make-up systems, vacuum breakers and air vents.

#### NON-CONDENSABLE GASES:

Gases other than air such as carbon dioxide exist inside steam systems. These non-condensable gases must also be separated from the steam and removed from the system for all processes to operate properly. In addition to inhibiting steam flow and proper heat transfer, carbon dioxide can be very corrosive to components in the system.

### STEAM TRAP GENERAL APPLICATION CATEGORIES:

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#### DRIP APPLICATIONS:

Drip applications are by far the most common application for steam traps. This application refers to removing the condensate that forms in steam lines when steam loses its heat energy due to radiation losses. Traps used in these applications are referred to as *drip traps*. Generally speaking, traps used for these applications require relatively small condensate capacities and don't normally need to discharge large amounts of air. (Air removal is the primary function of air vents and process traps located throughout the system.) The most common trap choices for drip applications are *thermodynamic* for steam pressures over 30 PSIG, and *float & thermostatic* for pressures up to 30 PSIG. Inverted bucket traps are also commonly used for drip trap applications due to their ability to handle large amounts of dirt and scale often found in this type of application.

#### PROCESS APPLICATIONS:

Process trap applications refer to removing condensate and air directly from a specific heat transfer process such as a heat exchanger that could be making hot water or a radiator heating a room. Traps used in these applications are referred to as *process traps*. Generally speaking, traps used for process applications require larger condensate handling capability and also need to be able to discharge large amounts of air. The most common trap choices for process applications are *float & thermostatic* traps and *thermostatic* traps. Both are known for their excellent condensate and air handling capabilities. In contrast, thermodynamic traps and inverted bucket traps, which have poor air handling ability, would normally make a poor choice for process applications.

#### TRACING APPLICATIONS:

Steam tracing refers to using steam to indirectly elevate the temperature of a product using jacketed pipes or tubing filled with steam. A typical application would be wrapping a pipeline containing high viscosity oil with tracing tubing. The steam inside the tubing heats the oil to lower its viscosity, allowing it to flow easily thru the pipeline. Similar to any steam applications, a steam trap must be used on the end of the steam tubing to discharge unwanted condensate. Steam traps used in these applications are referred to as *tracing traps*. The most common trap choice for tracing applications is the *thermostatic* type.

# STEAM TRAP APPLICATIONS

## INTRODUCTION TO STEAM TRAPS



The **Thermodynamic Disc Trap** is simple and compact and an excellent choice for a wide variety of drip applications. They excel in drip applications of pressures ranging from 30 psig to high pressure applications exceeding 3,000 psig, including superheated steam. The ½" TD600L is suitable for most drip applications, and offers reduced size discharge orifice holes which are preferable in terms of performance, longevity, and efficiency.



The design of modern **Thermostatic Bellows Traps** allows these traps to be used on a wide variety of applications, from general service drips to small-to-medium process heating applications with relatively constant loads. The welded stainless steel bellows is extremely rugged which prevents failure from waterhammer and corrosion, making these traps suitable for demanding industrial service. Also, because thermostatic traps subcool condensate, the condensate discharged generates less flash steam which may be advantageous in certain installations. For these reasons, Thermostatic Bellows Traps can be considered as a primary selection or as an alternative to other styles.



The **Float & Thermostatic Trap** is the primary choice of steam trap for process applications. They are excellent at discharging air from the system during start-up and offer a wide range of capacities to accommodate the vast majority of process heating applications. Their design allows them to immediately respond to changing condensate loads and pressures, which is a typical requirement of continuous heating process applications where control valves are used to modulate steam flow. Available F&T models range from designs for low pressure

heating to high-pressure and capacity industrial applications requiring cast steel or stainless steel.

# STEAM TRAP APPLICATIONS

## DRIP LEG DESIGN

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### PURPOSE:

Drip Legs are used for removing condensate from steam transmission and distribution lines. This helps ensure high quality steam for use in various plant applications and also will prevent damaging and dangerous waterhammer.

### OPERATION:

As steam travels at high velocity through piping, condensate forms as the result of piping heat losses and/or improper boiler control resulting in condensate carryover. Drip legs are therefore located at points where condensate may accumulate to allow for drainage by gravity down to a steam trap for proper discharge from the system. Since condensate drains by gravity, drip legs must be located on the bottom of piping and designed with diameters large enough to promote collection.

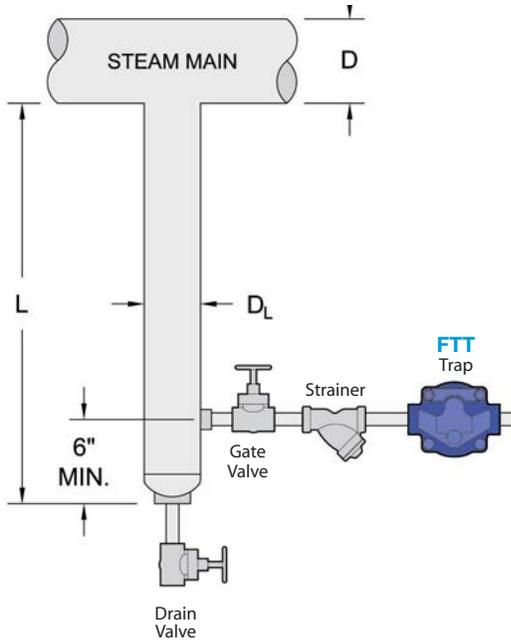
### INSTALLATION GUIDELINES: (see Figure 1)

- For drainage of steam transmission and distribution lines, drip legs should be located at bends in piping (direction changes), low points, end of line, and in straight run of piping every 200 feet.
- For protection of equipment such as regulators and control valves, drip legs should be installed directly ahead of the regulating or control valve line.
- Proper steam trap selection for drip applications is dependent upon application requirements, such as pressure, number of and distance between installed steam traps, ambient conditions, start-up requirements, etc. A commonly accepted practice is to use float & thermostatic (F&T) steam traps for low pressure steam systems up to 30 PSIG, and thermodynamic steam traps for steam pressures over 30 PSIG.
- Because condensate drainage from steam systems is dependent upon gravity, drip leg diameter is critical for optimum removal – larger is better. Collection leg diameter ( $D_L$ ) is recommended to be the same size as the steam main ( $D$ ), up to 4". For steam mains above 4", the collection leg diameter may be half the diameter of the main, but not less than 4". The length ( $L$ ) of the drip leg for systems with automatic start-up should be a minimum of 28" to provide approximately 1 PSI head pressure. The length ( $L$ ) of the drip leg for systems with supervised start-up should be  $1.5 \times D_L$ , but not less than 8".
- Consider low-cracking pressure (1/4 PSI opening pressure) check valves after steam traps when discharging into condensate return lines. Check valves eliminate the possibility of condensate backing up through the steam trap into the system.
- A drain valve is included at the bottom of the collection leg for manual discharge of condensate during supervised start-up. The drain valve should be located at least 6" below the steam trap line.
- An isolation valve and strainer should be installed before the steam trap. The isolation valve simplifies maintenance of the trap and the strainer protects the trap from any dirt, debris or scale in the line.

# STEAM TRAP APPLICATIONS

## DRIP LEG DESIGN

**Figure 1: Proper DRIP LEG Designs**

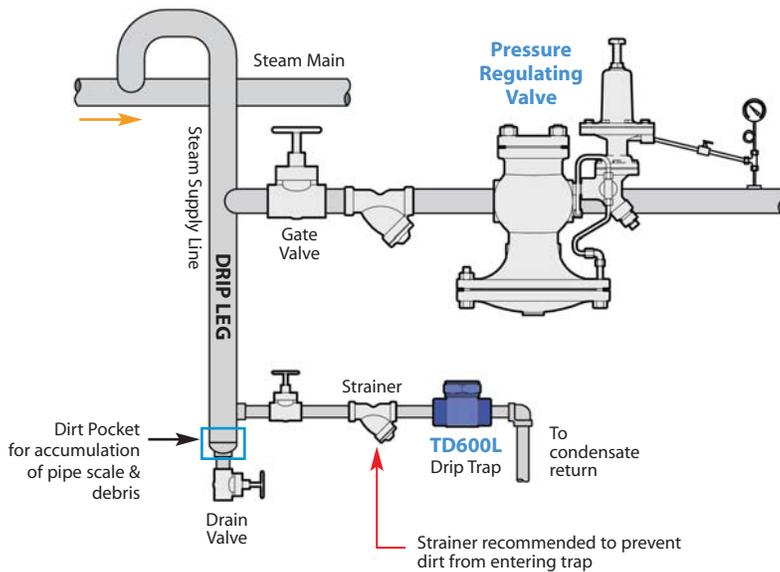


### DRIP LEG DESIGN CRITERIA:

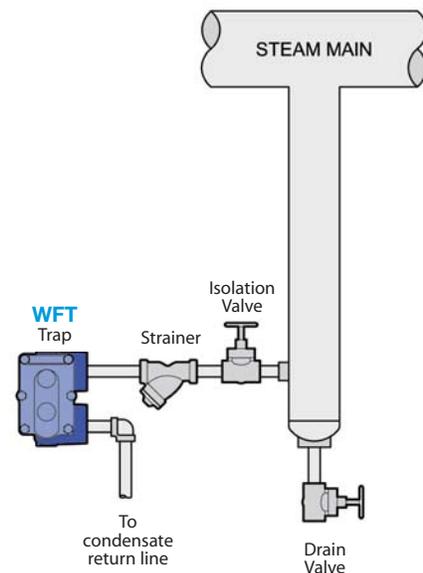
- 1) Locate prior to valves, bends in pipe (direction changes), low points, end of line and straight piping runs (max. 200 ft. apart).
- 2) Diameter:
  - Drip leg diameter ( $D_L$ ) to be equal to steam main diameter ( $D$ ) for steam main sizes up to 4"
  - Drip leg diameter ( $D_L$ ) may be half the steam main diameter ( $D$ ) for steam main sizes over 4", but not less than 4"
- 3) Length ( $L$ ):
  - For systems with automatic start-up,  $L$  to be 28" minimum (= 1 PSI minimum head pressure)
  - For systems with supervised start-up,  $L$  to be 1.5 x  $D_L$ , but not less than 8"

### DRIP LEG Before Regulator or Control Valve

Branch lines should always be taken off the top of the Steam Main pipe.



### DRIP LEG Draining Steam Main



# STEAM TRAP APPLICATIONS

## PROCESS TRAP GUIDELINES – Gravity Drainage

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### PURPOSE:

For removing condensate from below steam heat transfer equipment to ensure optimum heating under various load conditions.

### OPERATION:

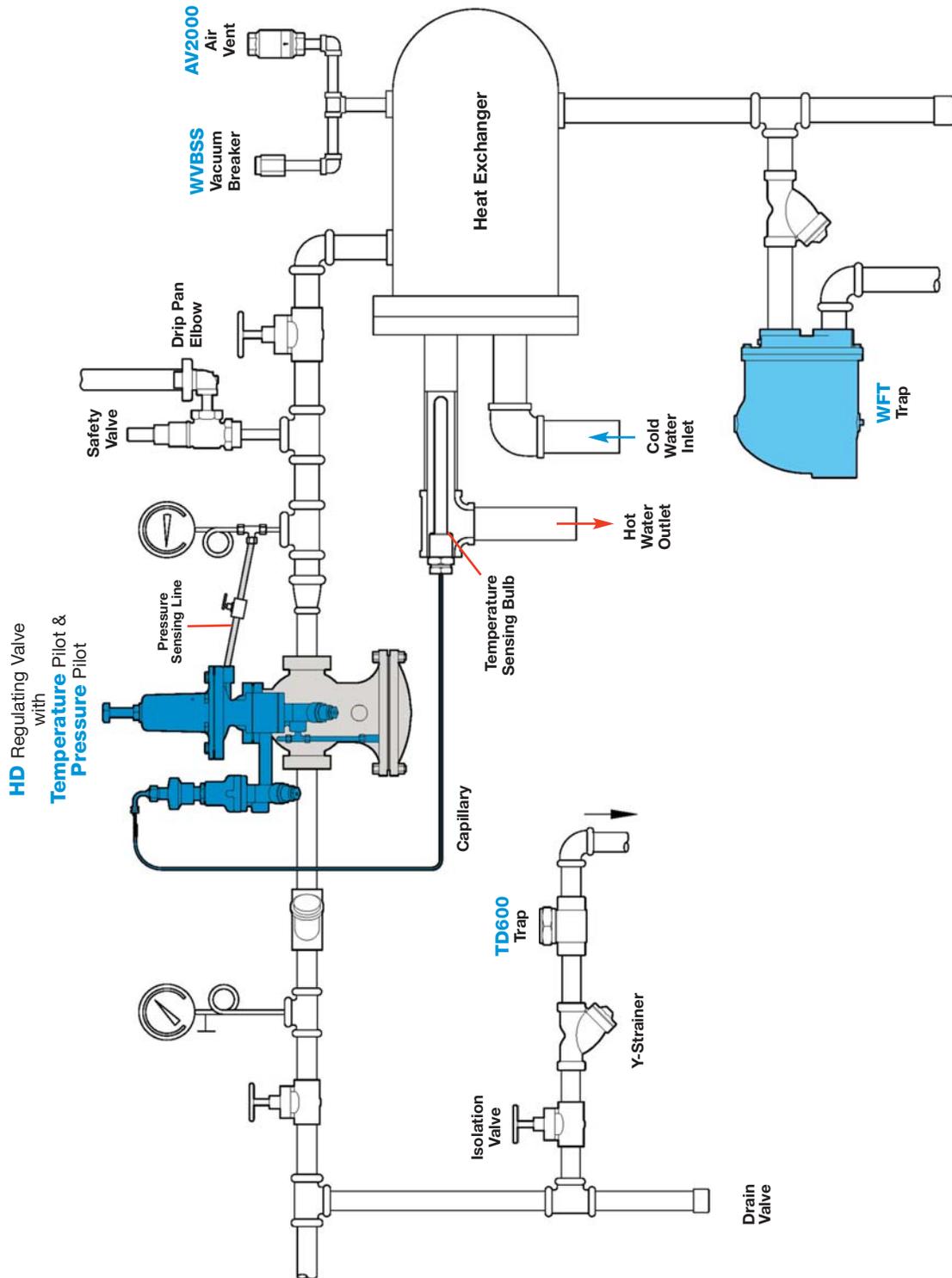
Steam used to heat product such as water in a heat exchanger condenses to liquid after passing through the heat exchanger and releasing its heating energy. To ensure optimum heating, this condensate is removed through an adequately sized drip leg and steam trap properly selected for the application and installed below the equipment. A Float and Thermostatic (F&T) steam trap is often an appropriate choice due to its modulating discharge and air venting capability.

### INSTALLATION GUIDELINES:

(see Figure 2)

- Selection and sizing of the process steam trap is critical to proper operation. A safety load factor (SLF) is applied to accommodate load variations, as well as high start-up requirements. Consult appropriate sections of this catalog or the factory for guidelines regarding proper process steam trap selection and sizing.
- The collecting leg to the process trap should be no smaller than the designed condensate outlet of the heat transfer equipment. Note that some steam trap technologies such as thermostatic require extended distance between the heat exchanger and steam trap to allow for back-up of subcooled condensate.
- The process trap should be located 2.3 feet (28”) below the condensate outlet of the heat exchanger to provide a minimum of 1 PSI head pressure.
- The drip leg and steam trap prior to the regulating valve protect the valve from condensate, as well as ensure the best quality steam for heat transfer. Note the take-off from the top of the steam main to avoid condensate that would collect on the bottom of the main piping.
- The vacuum breaker and auxiliary air vent located at the top of the heat exchanger vessel promotes proper drainage and optimum heat transfer. The vacuum breaker allows system equalization with atmospheric air to allow gravity condensate drainage when vacuum is formed from condensing steam. The air vent improves heat-up times and overall heat transfer by expelling accumulated air on start-up.
- Consider low-cracking pressure (1/4 PSI opening pressure) check valves after steam traps when discharging into condensate return lines. Check valves eliminate the possibility of condensate backing up through the steam trap into the system.
- An isolation valve and strainer should be installed before any steam trap. The isolation valve simplifies maintenance of the trap and the strainer protects the trap from any dirt, debris or scale in the line.

Figure 2:



Shell & Tube Heat Exchanger with Gravity Drainage of Condensate

# STEAM TRAP APPLICATIONS

## PROCESS TRAP GUIDELINES – Syphon Drainage

### PURPOSE:

For removing condensate from steam heat transfer equipment when the steam trap is to be installed *above* the point where condensate will collect.

### OPERATION:

When steam is used to heat liquid in a tank with a submerged coil or a rotary drum dryer, gravity drainage to the steam trap is not possible. For these applications, it is necessary to install the steam trap above the drain point of the equipment by creating a syphon lift to allow for proper condensate drainage.

### INSTALLATION GUIDELINES:

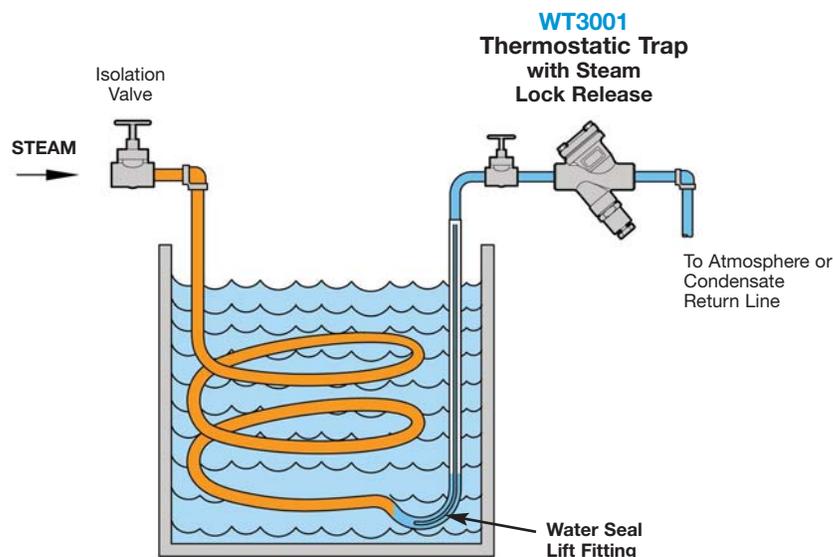
(see Figure 3)

- There are two critical requirements to ensure proper operation of syphon lift process drainage systems: A water seal lift fitting and a steam trap with a function to prevent steam lock (often referred to as Steam Lock Release or SLR).
- The lift fitting on a submerged coil provides a water seal to stop steam from pushing past the condensate and reaching the steam trap, preventing a vapor-lock condition of the trap.
- Steam Lock Release (SLR) is provided on the steam trap to ensure the syphon lift remains continuous by preventing steam from becoming trapped – or locked – between the cavity of the steam trap and incoming condensate. The SLR function allows any small portion of trapped steam to be automatically removed from the system, allowing continuous drainage.
- Consider low-cracking pressure (1/4 PSI opening pressure) check valves after steam traps when discharging into condensate return lines. Check valves eliminate the possibility of condensate backing up through the steam trap into the system.
- An isolation valve and strainer should be installed before any steam trap. The isolation valve simplifies maintenance of the trap and the strainer protects the trap from any dirt, debris or scale in the line.

### Figure 3: SUBMERGED COIL FOR HEATING LIQUID

#### Steam Lock Release Mechanism

must be used when trap is positioned above condensate level.



# STEAM TRAP APPLICATIONS

## PROCESS TRAP GUIDELINES – Syphon Drainage

### ROTATING STEAM DRYER

Commonly found in the Paper Making industry, a rotating piece of equipment offers a unique challenge of removing the condensate. Steam inside a rotating drum cylinder is used to heat product such as sheets of paper over the outside surface of the drum. The steam pressure pushes the condensate up through the pipe to the steam trap. Since the pipe that the condensate is traveling through is surrounded by steam, an issue can develop that will “**Steam Lock**” the trap causing the trap to stay closed, allowing the condensate to build up inside the rotating drum (Figure 4). By placing a **Steam Lock Release** feature on the Steam Trap, a small amount of steam will be constantly discharged through the trap. This allows condensate to reach the steam trap which causes it to open and function properly. This steam lock release feature is available on ALL F&T and Thermostatic traps and should be considered on this type of application.

**Figure 4: Rotating Steam Dryer Illustrating “Steam Lock”**

#### Steam Lock Release Option

must be used when trap is positioned above condensate level.

