Armstrong

APPLICATION GUIDELINES

STEAM MAIN DRAINAGE

1) Steam Main Drip Leg Dimensions
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1) Steam Main Drip Leg Dimensions

In order to trap your steam mains, some important piping dimensions should be considered when designing the system. Drip legs are the key to successful, water hammer free, system start-up.

Drip Legs:

a) Let condensate escape by gravity from the fast moving steam. The properly sized drip leg acts as a separator by providing an increase in flow area, which slows the steam flow down allowing the condensate to drop out. This is important during operation as well as start up. During operation steam velocities can approach 150 miles per hour. Condensate that is carried along at this velocity will not be drained easily unless the velocity is reduced. Therefore, drip leg diameter must be large enough to create the separpator effect by reducing velocity.

   Once the system is up to pressure the large drip leg keeps the condensate from being sucked out of the drip leg. This can happen when high velocity steam moves across the opening of a too small drip leg causing a "piccolo effect". The high velocity gas experiences a pressure drop, which will cause condensate to be sucked out of a small pipe. A large drip leg does not experience this pressure drop and is therefore able to collect and discharge condensate.

b) Store the condensate until the pressure differential is great enough for the steam trap to discharge it.

   On start up cold piping causes steam to collapse and pressure to drop. This causes a very high condensate load for the trap to handle, but with virtually no pressure for the trap to use in discharging the condensate. This is compounded when the condensate line is **located** above the steam line. So, rather **than** flood the steam main, a large drip leg gives the water a place to accumulate until the pressure is sufficient for the trap to handle the accumulation.

GENERAL:

The selection of drip leg sizes to drain steam mains depends on the warmup method that will be used:

Figure 1 -- Steam Mains

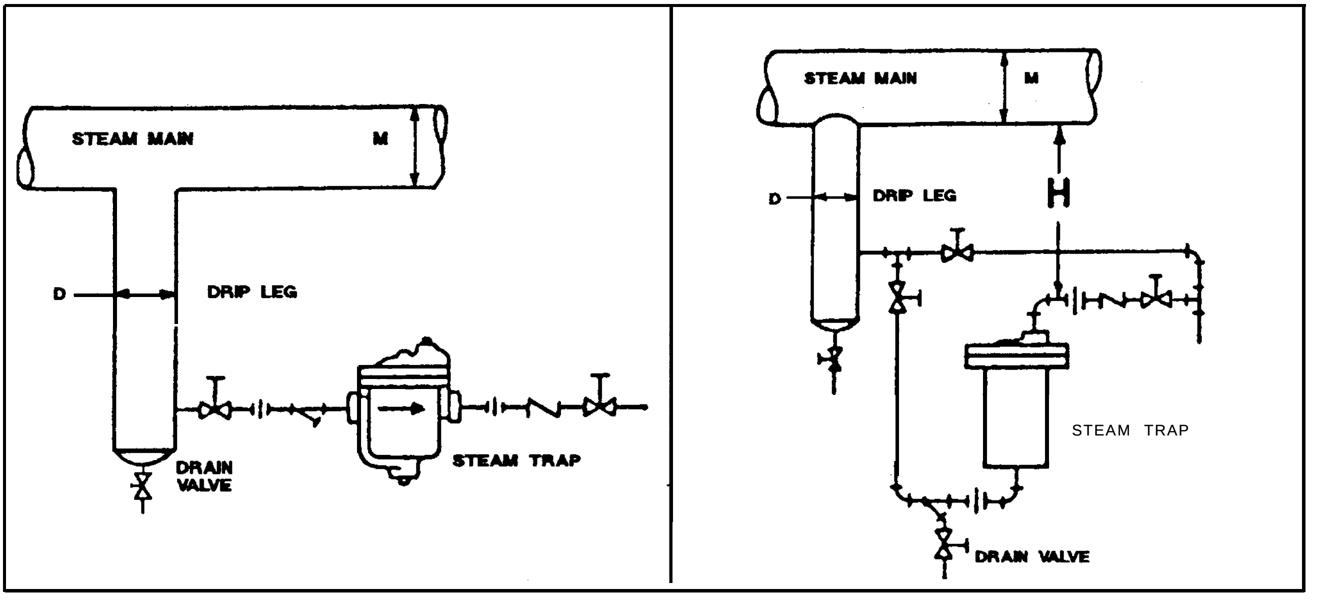

Table 1 -Recommended Drip Leg Sizing

M	D	Drip Leg Length (Inches)	
Steam Main Size (in)	Drip Leg Diameter (in)	Supervised Warm-Up	Automatic Warm-Up
1/2	1/2	10	28
3/4	3/4	10	28
1	1	10	28
2	2	10	28
3	3	10	28
4	4	10	28
5	4	10	28
6	4	10	28
8	4	12	28
10	5	15	28
12	6	18	28
14	8	21	28
16	8	24	28
18	10	27	28
20	10	30	30
24	12	36	36

NOTES:

1. Drain valve is required for supervised start-up only. Drain valve needs heat tracing or insulation on outdoor installation where freezing is possible.

2. Steam traps are shown in two piping set-ups: side-in, side-out or bottom-in, top-out. On supervised start-up, the H dimension is to the top of the trap or the top ofthedrain piping, whichever is higher. Eithertrap type can be used.

3. Drip leg piping should always follow the “D” dimension. The take-off to the trap can be the same connection as the trap. We are constantly asked for a 3” trap to drain a 3” line. A 3” trap is grossly oversized, and a 3/4” trap will work better, because it is sized for the load.

4. Static pressure head “H” must always be positive on automatic warm up.

2) Types of Warm-Up:

a) Supervised Warm-Up: is widely used for initial heating of large diameter (above 8 inch) or long (more than 1000 feet) mains. Such mains may be warmed up only once in a lifetime. The drain valves for free flow to the atmosphere are opened wide before steam is admitted to the main. These dripvalves are not closed until after all or most of the warm-up condensate has been discharged. Then the trap is opened and can take over the job.

A supervised warm-up will not need such a long drip leg, because only operating load condensate will be removed automatically by traps, and the condensate load will stay about the same. (Warm-up of principal piping in a power plant will follow the same procedure).

b) Automatic Warm-Up: In this case, the boiler is fired, letting the mains and some or all equipment come up to pressure and temperature without manual help. This kind of warmup is used more for occasional steam use or steam system shutdown every night, weekend, or seasonally. In this case, you will need a bigger drip leg because the condensate load handled by the trap will be much greater, due to the start-up load.

At start-up a high condensate load occurs at low pressure. Once up to temperature there will be less condensate at high pressure. In this type of warm-up, the steam trap will discharge all the condensate, because there are no manual drain valves.

3) Spacing of Drip Legs:

Drip legs and drain traps should be provided at intervals no longer than 500 feet because steam main condensate should be drained while it is a “heavy dew” rather than a dangerous slug.

4) Low Pressure Drainage-Sing Traps for Automatic Warm-up:

A static head dimension is used only on automatic warm-up because we have two pressure conditions. Start up-low pressure and operating high pressure.

During start-up the trap is discharging condensate because of the static head dimension. Condensate can be discharged during the warm-up only because the static head pushes condensate through the trap.

Generally, a trap that can handle the line's running load can also handle the start-up load as long as the line is heated no faster than 200°F per hour. The trap's capacity is actually quite high at cold start-up conditions because:

1. Cold condensate does not flash when discharged. The flashing causes flow to be choked off when being discharged from the orifice.

2. Cold water is more dense than hot (by more than 10%) so more pounds per hour are able to pass through the fixed orifice in the trap.

To check trap capacity you must know:

1. The total warming up load (see Handbook M101 , Table 17-2: Warming Up Load).

2. The time period over which warm-up takes place.

3. The static head dimension "H".

Divide the head dimension by 28 (H÷28) to get psi. Then divide the warming up load by the start-up time (in hours) to get lbs. per hour. Table 2 lists orifice capacities at these very low pressures. If your pressure is not listed, do not interpolate. Capacities can be approximated using this equation:

$$C_1 = C_2 \times \frac{\sqrt{P_1}}{\sqrt{P_2}}$$

where:

C_1 = Unknown capacity (#/hr) at actual pressure (P_1)
P_1 = actual pressure in psi
P_2 = pressure from chart
C_2 = capacity from chart

Table 2 Orifice Capacities at Low Pressures.
Use only for sizing traps for automatic warm-up.

Pressure psig	0.5	1.0	2.0
Orifice	Pounds per hour		
5/64"	37	52	71
No. 38	49	69	121
7/64"	73	103	140
1/8"	94	134	182
5/32"	148	209	284
3/16"	214	302	410
7/32"	291	411	559
1/4"	379	535	728
9/32"	482	680	925
5/16"	595	841	1145
11/32"	715	1010	1370
3/8"	851	1205	1640
7/16"	1160	1640	2230
1/2"	1515	2140	2910
9/16"	1875	2650	3600
5/8"	2375	3350	4550
3/4"	3100	4160	5400
7/8"	4225	5700	7250
1 1/16"	6240	8400	10700

5) Trap Types

We recommend the use of inverted bucket steam traps because this kind of trap works on the density principle thereby discharging condensate as soon as it reaches the trap.

Another advantage of inverted bucket traps is that they fail open, so, in case of trap failure, the main won't flood.