For more than 100 years, Armstrong has been providing utility system solutions and optimization for our global partners through products, education, training aids and service. Because we know our customers are always looking for ways to make their facilities more efficient, we offer total system solutions for steam, air and hot water.

In addition to energy- and cost-saving products, Armstrong provides comprehensive services. We offer turn-key installation, operation and maintenance services; steam and compressed air system audits; steam trap management; process drying optimization; condensate system improvement; insect heat treatment; and hot-water solutions for process, safety, sanitation and domestic applications—all of which can be customized to help improve your bottom line.

Customers have been turning to Armstrong for more than 100 years because of a continuing need to optimize the efficiency of their industrial, institutional and commercial facilities. It is our intelligence and experience that separate us from other companies.

We're proud of the tradition we've established at Armstrong—merging energy and environment while sharing our vast knowledge, so future generations can benefit from a healthier, cleaner world.

Armstrong offers the following utility system and service solutions:

- **Steam and Condensate Solutions –** Steam trapping and steam tracing equipment, testing and monitoring, strainers, air vents, liquid drainers, and condensate recovery equipment
- **Hot Water Solutions –** Hot water heaters, balancing valves, radiator products, mixing valves and hose stations
- **Heat Transfer Solutions –** Heating and cooling coils, unit heaters, and tank heaters
- **Humidification Solutions –** Conditioned steam humidifiers, gas fired humidifiers, electric steam humidifiers and fogging systems
- **Pressure/Temperature Control Solutions –** Pressure reducing valves and temperature regulators
- **Armstrong Service Solutions –** Armstrong Service offers complete utility system optimization services for industrial, institutional and commercial facilities worldwide. We provide steam system audits and utility system performance evaluations; long-term operation and maintenance to ensure best-in-class performance; turn-key sustaining engineering that includes installation and continuing engineering solutions; utility optimization, which allows us to identify energy-saving projects within your utility system; and utility monetization, whereby we purchase your utility assets to free up cash for use elsewhere in your organization.

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Say energy. Think environment. And vice versa.

Any company that is energy conscious is also environmentally conscious. Less energy consumed means less waste, fewer emissions and a healthier environment.

In short, bringing energy and environment together lowers the cost industry must pay for both. By helping companies manage energy, Armstrong products and services are also helping to protect the environment.

Armstrong has been sharing know-how since we invented the energy-efficient inverted bucket steam trap in 1911. In the years since, customers' savings have proven again and again that knowledge not shared is energy wasted.

Armstrong's developments and improvements in steam trap design and function have led to countless savings in energy, time and money. This section has grown out of our decades of sharing and expanding what we've learned. It deals with the operating principles of steam traps and outlines their specific applications to a wide variety of products and industries. You'll find it a useful complement to other Armstrong literature and the Armstrong Steam-A-ware™ software program for sizing and selecting steam traps, pressure reducing valves and water heaters, which can be requested through Armstrong's Web site, **armstrong**international.com.

This section also includes Recommendation Charts that summarize our findings on which type of trap will give optimum performance in a given situation and why.

IMPORTANT: This section is intended to summarize general principles of installation and operation of steam traps, as outlined above. Actual installation and operation of steam trapping equipment should be performed only by experienced personnel. Selection or installation should always be accompanied by competent technical assistance or advice. This data should never be used as a substitute for such technical advice or assistance. We encourage you to contact Armstrong or its local representative for further details.

Instructions for Using the Recommendation Charts

A quick reference Recommendation Chart appears throughout the "HOW TO TRAP" sections of this catalog, pages CG-19 to CG-45.

A feature code system (ranging from A to Q) supplies you with "at-a-glance" information.

The chart covers the type of steam traps and the major advantages that Armstrong feels are superior for each particular application.

For example, assume you are looking for information concerning the proper trap to use on a gravity drained jacketed kettle. You would:

1. Turn to the "How to Trap Jacketed Kettles" section, pages CG-37 to CG-38, and look in the lower right-hand corner of page CG-37. The Recommendation Chart located there is reprinted below for your convenience. (Each section has a Recommendation Chart.)
2. Find "Jacketed Kettles, Gravity Drain" in the first column under "Equipment Being Trapped" and read to the right for Armstrong's "1st Choice and Feature Code." In this case, the first choice is an IBLV and the feature code letters B, C, E, K, N are listed.
3. Now refer to Chart CG-2 below, titled "How Various Types of Steam Traps Meet Specific Operating Requirements" and read down the extreme left-hand column to each of the letters B, C, E, K, N. The letter "B," for example, refers to the trap's ability to provide energy-conserving operation.
4. Follow the line for "B" to the right until you reach the column that corresponds to our first choice, in this case the inverted bucket. Based on tests and actual operating conditions, the energy-conserving performance of the inverted bucket steam trap has been rated "Excellent." Follow this same procedure for the remaining letters.

Abbreviations

IB	Inverted Bucket Trap
IBLV	Inverted Bucket Large Vent
BM	Bimetallic Trap
F&T	Float and Thermostatic Trap
CD	Controlled Disc Trap
DC	Automatic Differential Condensate Controller
CV	Check Valve
T	Thermic Bucket
PRV	Pressure Reducing Valve

Chart CG-1. Recommendation Chart
(See chart below for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Jacketed Kettles Gravity Drain	IBLV B, C, E, K, N	F&T or Thermostatic
Jacketed Kettles Syphon Drain	DC B, C, E, G, H, K, N, P	IBLV

Chart CG-2. How Various Types of Steam Traps Meet Specific Operating Requirements

Feature Code	Characteristic	IB	BM	F&T	Disc	Thermostatic Wafer	DC	Orifice
A	Method of Operation	(1) Intermittent	(2) Intermittent	Continuous	Intermittent	(2) Intermittent	Continuous	Continuous
B	Energy Conservation (Time in Service)	Excellent	Excellent	Good	Poor	Fair	(3) Excellent	Poor
C	Resistance to Wear	Excellent	Excellent	Good	Poor	Fair	Excellent	Poor
D	Corrosion Resistance	Excellent	Excellent	Good	Excellent	Good	Excellent	Good
E	Resistance to Hydraulic Shock	Excellent	Excellent	Poor	Excellent	(4) Poor	Excellent	Good
F	Vents Air and CO2 at Steam Temperature	Yes	No	No	No	No	Yes	Poor
G	Ability to Vent Air at Very Low Pressure (1/4 psig)	Poor	(5) NR	Excellent	(5) NR	Good	Excellent	Poor
H	Ability to Handle Start-Up Air Loads	Fair	Excellent	Excellent	Poor	Excellent	Excellent	Poor
I	Operation Against Back Pressure	Excellent	Excellent	Excellent	Poor	Excellent	Excellent	Poor
J	Resistance to Damage From Freezing	(6) Good	Good	Poor	Good	Good	Good	Excellent
K	Ability to Purge System	Excellent	Good	Fair	Excellent	Good	Excellent	Poor
L	Performance on Very Light Loads	Excellent	Excellent	Excellent	Poor	Excellent	Excellent	Poor
M	Responsiveness to Slugs of Condensate	Immediate	Delayed	Immediate	Delayed	Delayed	Immediate	Poor
N	Ability to Handle Dirt	Excellent	Fair	Poor	Poor	Fair	Excellent	Poor
O	Comparative Physical Size (7)	Large	Small	Large	Small	Small	Large	Small
P	Ability to Handle"Flash Steam"	Fair	Poor	Poor	Poor	Poor	Excellent	Poor
Q	Mechanical Failure (Open or Closed)	Open	Open	Closed	(8) Open	(9)	Open	NA

(1) Drainage of condensate is continuous. Discharge is intermittent.
(2) Can be continuous on low load.
(3) Excellent when "secondary steam" is utilized.
(4) Bimetallic and wafer traps – good.
(5) Not recommended for low pressure operations.
(6) Cast iron traps not recommended.
(7) In welded stainless steel construction – medium.
(8) Can fail closed due to dirt.
(9) Can fail either open or closed, depending upon the design of the bellows.

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Steam Tables

What They Are...How to Use Them

The heat quantities and temperature/pressure relationships referred to in this section are taken from the Properties of Saturated Steam table.

Definitions of Terms Used

Saturated Steam is pure steam at the temperature that corresponds to the boiling temperature of water at the existing pressure.

Absolute and Gauge Pressures
Absolute pressure is pressure in pounds per square inch (psia) above a perfect vacuum. Gauge pressure is pressure in pounds per square inch above atmospheric pressure, which is 14.7 pounds per square inch absolute. Gauge pressure (psig) plus 14.7 equals absolute pressure. Or, absolute pressure minus 14.7 equals gauge pressure.

Pressure/Temperature Relationship (Columns 1, 2 and 3). For every pressure of pure steam there is a corresponding temperature. Example: The temperature of 250 psig pure steam is always 406°F.

Heat of Saturated Liquid (Column 4). This is the amount of heat required to raise the temperature of a pound of water from 32°F to the boiling point at the pressure and temperature shown. It is expressed in British thermal units (Btu).

Latent Heat or Heat of Vaporization (Column 5). The amount of heat (expressed in Btu) required to change a pound of boiling water to a pound of steam. This same amount of heat is released when a pound of steam is condensed back into a pound of water. This heat quantity is different for every pressure/temperature combination, as shown in the steam table.

Total Heat of Steam (Column 6). The sum of the Heat of the Liquid (Column 4) and Latent Heat (Column 5) in Btu. It is the total heat in steam above 32°F.

Specific Volume of Liquid (Column 7). The volume per unit of mass in cubic feet per pound.

Specific Volume of Steam (Column 8). The volume per unit of mass in cubic feet per pound.

How the Table Is Used

In addition to determining pressure/temperature relationships, you can compute the amount of steam that will be condensed by any heating unit of known Btu output. Conversely, the table can be used to determine Btu output if steam condensing rate is known. In the application portion of this section, there are several references to the use of the steam table.

Table CG-1. Properties of Saturated Steam
(Abstracted from Keenan and Keyes, THERMODYNAMIC PROPERTIES OF STEAM, by permission of John Wiley & Sons, Inc.)

	Col. 1 Gauge Pressure	Col. 2 Absolute Pressure (psia)	Col. 3 Steam Temp. (°F)	Col. 4 Heat of Sat. Liquid (Btu/lb)	Col. 5 Latent Heat (Btu/lb)	Col. 6 Total Heat of Steam (Btu/lb)	Col. 7 Specific Volume of Sat. Liquid (cu ft/lb)	Col. 8 Specific Volume of Sat. Steam (cu ft/lb)
Inches of Vacuum	29.743	0.08854	32.00	0.00	1075.8	1075.8	0.016022	3306.00
	29.515	0.2	53.14	21.21	1063.8	1085.0	0.016027	1526.00
	27.886	1.0	101.74	69.70	1036.3	1106.0	0.016136	333.60
	19.742	5.0	162.24	130.13	1001.0	1131.0	0.016407	73.52
	9.562	10.0	193.21	161.17	982.1	1143.3	0.016590	38.42
	7.536	11.0	197.75	165.73	979.3	1145.0	0.016620	35.14
	5.490	12.0	201.96	169.96	976.6	1146.6	0.016647	32.40
	3.454	13.0	205.88	173.91	974.2	1148.1	0.016674	30.06
	1.418	14.0	209.56	177.61	971.9	1149.5	0.016699	28.04
PSIG	0.0	14.696	212.00	180.07	970.3	1150.4	0.016715	26.80
	1.3	16.0	216.32	184.42	967.6	1152.0	0.016746	24.75
	2.3	17.0	219.44	187.56	965.5	1153.1	0.016768	23.39
	5.3	20.0	227.96	196.16	960.1	1156.3	0.016830	20.09
	10.3	25.0	240.07	208.42	952.1	1160.6	0.016922	16.30
	15.3	30.0	250.33	218.82	945.3	1164.1	0.017004	13.75
	20.3	35.0	259.28	227.91	939.2	1167.1	0.017078	11.90
	25.3	40.0	267.25	236.03	933.7	1169.7	0.017146	10.50
	30.3	45.0	274.44	243.36	928.6	1172.0	0.017209	9.40
	40.3	55.0	287.07	256.30	919.6	1175.9	0.017325	7.79
	50.3	65.0	297.97	267.50	911.6	1179.1	0.017429	6.66
	60.3	75.0	307.60	277.43	904.5	1181.9	0.017524	5.82
	70.3	85.0	316.25	286.39	897.8	1184.2	0.017613	5.17
	80.3	95.0	324.12	294.56	891.7	1186.2	0.017696	4.65
	90.3	105.0	331.36	302.10	886.0	1188.1	0.017775	4.23
	100.0	114.7	337.90	308.80	880.0	1188.8	0.017850	3.88
	110.3	125.0	344.33	315.68	875.4	1191.1	0.017922	3.59
	120.3	135.0	350.21	321.85	870.6	1192.4	0.017991	3.33
	125.3	140.0	353.02	324.82	868.2	1193.0	0.018024	3.22
	130.3	145.0	355.76	327.70	865.8	1193.5	0.018057	3.11
	140.3	155.0	360.50	333.24	861.3	1194.6	0.018121	2.92
	150.3	165.0	365.99	338.53	857.1	1195.6	0.018183	2.75
	160.3	175.0	370.75	343.57	852.8	1196.5	0.018244	2.60
	180.3	195.0	379.67	353.10	844.9	1198.0	0.018360	2.34
	200.3	215.0	387.89	361.91	837.4	1199.3	0.018470	2.13
	225.3	240.0	397.37	372.12	828.5	1200.6	0.018602	1.92
	250.3	265.0	406.11	381.60	820.1	1201.7	0.018728	1.74
		300.0	417.33	393.84	809.0	1202.8	0.018896	1.54
		400.0	444.59	424.00	780.5	1204.5	0.019340	1.16
		450.0	456.28	437.20	767.4	1204.6	0.019547	1.03
		500.0	467.01	449.40	755.0	1204.4	0.019748	0.93
		600.0	486.21	471.60	731.6	1203.2	0.02013	0.77
		900.0	531.98	526.60	668.8	1195.4	0.02123	0.50
		1200.0	567.22	571.70	611.7	1183.4	0.02232	0.36
		1500.0	596.23	611.60	556.3	1167.9	0.02346	0.28
		1700.0	613.15	636.30	519.6	1155.9	0.02428	0.24
		2000.0	635.82	671.70	463.4	1135.1	0.02565	0.19
		2500.0	668.13	730.60	360.5	1091.1	0.02860	0.13
		2700.0	679.55	756.20	312.1	1068.3	0.03027	0.11
		3206.2	705.40	902.70	0.0	902.7	0.05053	0.05

Flash Steam (Secondary)

What is flash steam? When hot condensate or boiler water, under pressure, is released to a lower pressure, part of it is re-evaporated, becoming what is known as flash steam.

Why is it important? This flash steam is important because it contains heat units that can be used for economical plant operation—and which are otherwise wasted.

How is it formed? When water is heated at atmospheric pressure, its temperature rises until it reaches 212°F, the highest temperature at which water can exist at this pressure. Additional heat does not raise the temperature, but converts the water to steam.

The heat absorbed by the water in raising its temperature to boiling point is called "sensible heat" or heat of saturated liquid. The heat required to convert water at boiling point to steam at the same temperature is called "latent heat." The unit of heat in common use is the Btu, which is the amount of heat required to raise the temperature of one pound of water 1°F at atmospheric pressure.

If water is heated under pressure, however, the boiling point is higher than 212°F, so the sensible heat required is greater. The higher the pressure, the higher the boiling temperature and the higher the heat content. If pressure is reduced, a certain amount of sensible heat is released. This excess heat will be absorbed in the form of latent heat, causing part of the water to "flash" into steam.

Condensate at steam temperature and under 100 psig pressure has a heat content of 308.8 Btu per pound. (See Column 4 in Steam Table.) If this condensate is discharged to atmospheric pressure (0 psig), its heat content instantly drops to 180 Btu per pound. The surplus of 128.8 Btu re-evaporates or flashes a portion of the condensate. The percentage that will flash to steam can be computed using the formula:

$$\textbf{\% flash steam} = \frac{SH - SL}{H} \times 100$$

SH = Sensible heat in the condensate at the higher pressure before discharge.

SL = Sensible heat in the condensate at the lower pressure to which discharge takes place.

H = Latent heat in the steam at the lower pressure to which the condensate has been discharged.

$$\textbf{\% flash steam} = \frac{308.8 - 180}{970.3} \times 100 = 13.3\%$$

Chart CG-3 shows the amount of secondary steam that will be formed when discharging condensate to different pressures.

Chart CG-3.
Percentage of flash steam formed when discharging condensate to reduced pressure.

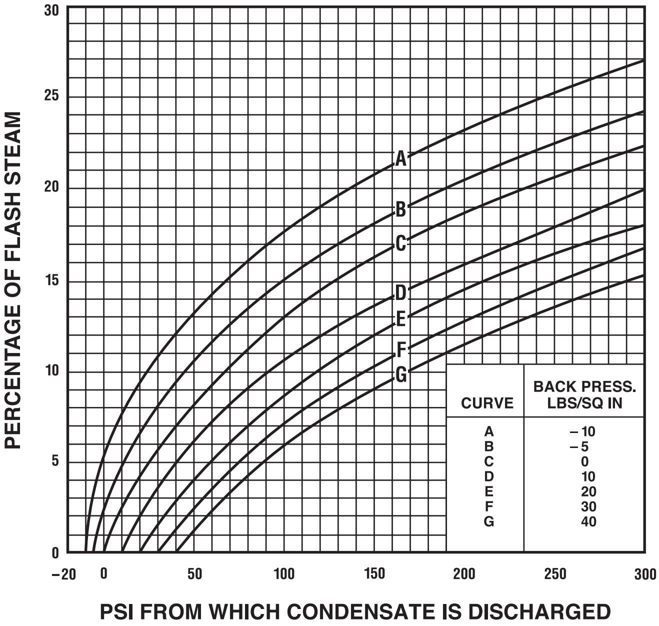
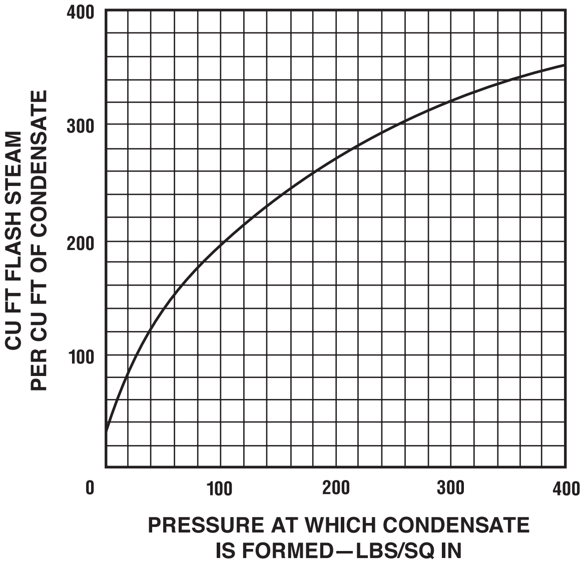


Chart CG-4.
Volume of flash steam formed when one cubic foot of condensate is discharged to atmospheric pressure.



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Steam...Basic Concepts

Steam is an invisible gas generated by adding heat energy to water in a boiler. Enough energy must be added to raise the temperature of the water to the boiling point. Then additional energy—without any further increase in temperature—changes the water to steam.

Steam is a very efficient and easily controlled heat transfer medium. It is most often used for transporting energy from a central location (the boiler) to any number of locations in the plant where it is used to heat air, water or process applications.

As noted, additional Btu are required to make boiling water change to steam. These Btu are not lost but stored in the steam ready to be released to heat air, cook tomatoes, press pants or dry a roll of paper.

The heat required to change boiling water into steam is called the heat of vaporization or latent heat. The quantity is different for every pressure/temperature combination, as shown in the steam tables.

Steam at Work... How the Heat of Steam Is Utilized

Heat flows from a higher temperature level to a lower temperature level in a process known as heat transfer. Starting in the combustion chamber of the boiler, heat flows through the boiler tubes to the water. When the higher pressure in the boiler pushes steam out, it heats the pipes of the distribution system. Heat flows from the steam through the walls of the pipes into the cooler surrounding air. This heat transfer changes some of the steam back into water. That's why distribution lines are usually insulated to minimize this wasteful and undesirable heat transfer.

When steam reaches the heat exchangers in the system, the story is different. Here the transfer of heat from the steam is desirable. Heat flows to the air in an air heater, to the water in a water heater or to food in a cooking kettle. Nothing should interfere with this heat transfer.

Condensate Drainage... Why It's Necessary

Condensate is the by-product of heat transfer in a steam system. It forms in the distribution system due to unavoidable radiation. It also forms in heating and process equipment as a result of desirable heat transfer from the steam to the substance heated. Once the steam has condensed and given up its valuable latent heat, the hot condensate must be removed immediately. Although the available heat in a pound of condensate is negligible as compared to a pound of steam, condensate is still valuable hot water and should be returned to the boiler.

Definitions

- **The Btu.** A Btu—British thermal unit—is the amount of heat energy required to raise the temperature of one pound of cold water by 1°F. Or, a Btu is the amount of heat energy given off by one pound of water in cooling, say, from 70°F to 69°F.
- **Temperature.** The degree of hotness with no implication of the amount of heat energy available.
- **Heat.** A measure of energy available with no implication of temperature. To illustrate, the one Btu that raises one pound of water from 39°F to 40°F could come from the surrounding air at a temperature of 70°F or from a flame at a temperature of 1 000°F.

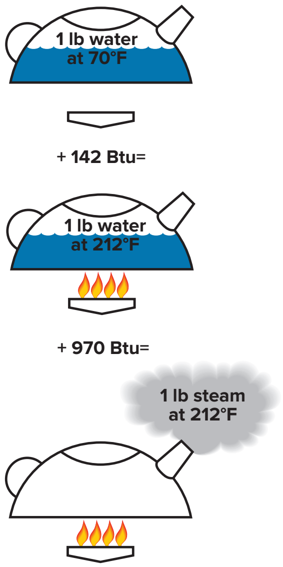


Figure CG-1. These drawings show how much heat is required to generate one pound of steam at atmospheric pressure. Note that it takes 1 Btu for every 1°F increase in temperature up to the boiling point, but that it takes more Btu to change water at 212°F to steam at 212°F.

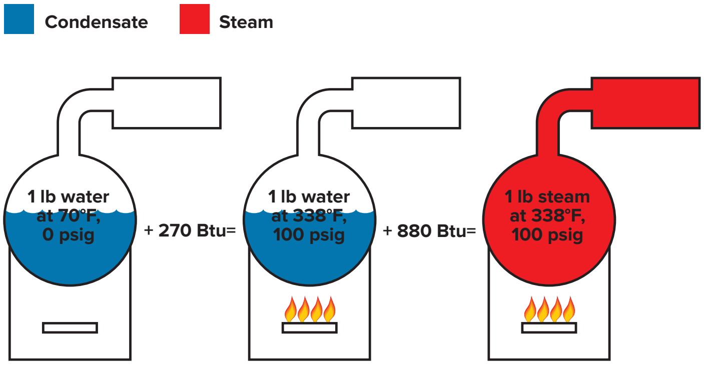


Figure CG-2. These drawings show how much heat is required to generate one pound of steam at 100 pounds per square inch pressure. Note the extra heat and higher temperature required to make water boil at 100 pounds pressure than at atmospheric pressure. Note, too, the lesser amount of heat required to change water to steam at the higher temperature.

The need to drain the distribution system. Condensate lying in the bottom of steam lines can be the cause of one kind of water hammer. Steam traveling at up to 100 miles per hour makes "waves" as it passes over this condensate (Fig. CG-4). If enough condensate forms, high-speed steam pushes it along, creating a dangerous slug that grows larger and larger as it picks up liquid in front of it. Anything that changes the direction—pipe fittings, regulating valves, tees, elbows, blind flanges—can be destroyed. In addition to damage from this "battering ram," high-velocity water may erode fittings by chipping away at metal surfaces.

The need to drain the heat transfer unit. When steam comes in contact with condensate cooled below the temperature of steam, it can produce another kind of water hammer known as thermal shock. Steam occupies a much greater volume than condensate, and when it collapses suddenly, it can send shock waves throughout the system. This form of water hammer can damage equipment, and it signals that condensate is not being drained from the system.

Obviously, condensate in the heat transfer unit takes up space and reduces the physical size and capacity of the equipment. Removing it quickly keeps the unit full of steam (Fig. CG-5). As steam condenses, it forms a film of water on the inside of the heat exchanger. Non-condensable gases do not change into liquid and flow away by gravity. Instead, they accumulate as a thin film on the surface of the heat exchanger—along with dirt and scale. All are potential barriers to heat transfer (Fig. CG-3).

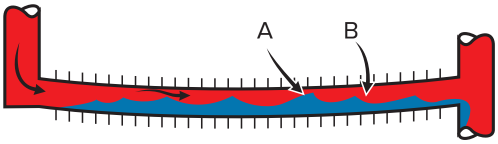


Figure CG-4. Condensate allowed to collect in pipes or tubes is blown into waves by steam passing over it until it blocks steam flow at point **A**. Condensate in area **B** causes a pressure differential that allows steam pressure to push the slug of condensate along like a battering ram.

The need to remove air and CO_2. Air is always present during equipment start-up and in the boiler feedwater. Feedwater may also contain dissolved carbonates, which release carbon dioxide gas. The steam velocity pushes the gases to the walls of the heat exchangers, where they may block heat transfer. This compounds the condensate drainage problem, because these gases must be removed along with the condensate.

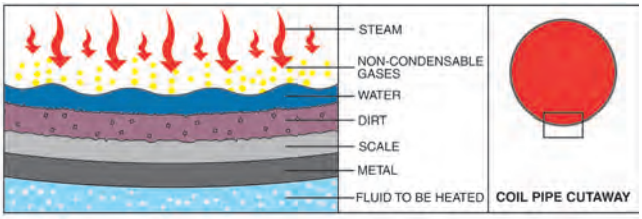


Figure CG-3. Potential barriers to heat transfer: steam heat and temperature must penetrate these potential barriers to do their work.

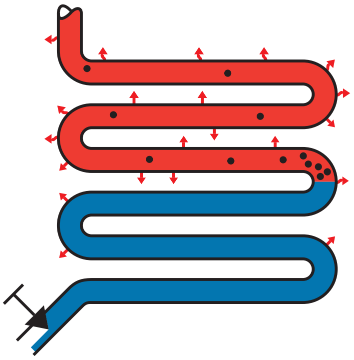


Figure CG-5. Coil half full of condensate can't work at full capacity.

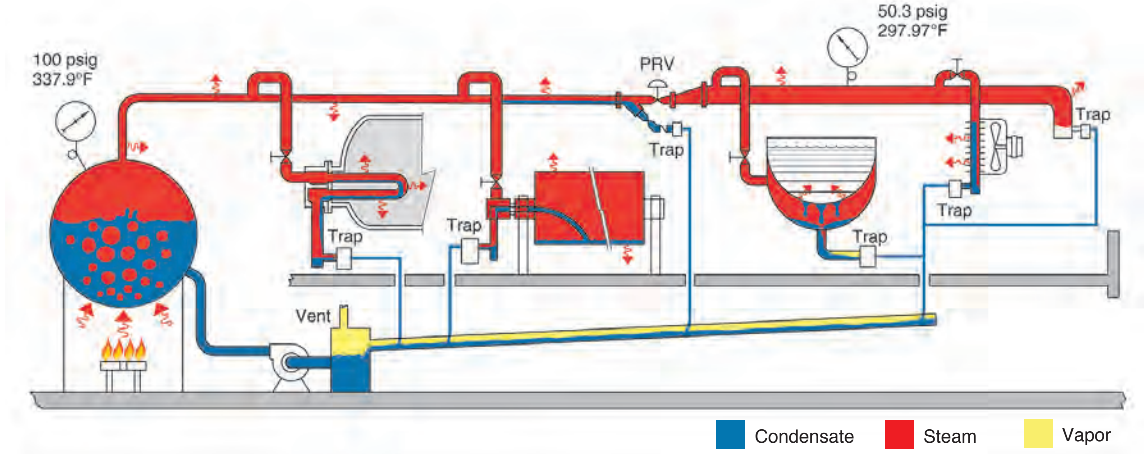


Figure CG-6. Note that heat radiation from the distribution system causes condensate to form and, therefore, requires steam traps at natural low points or ahead of control valves. In the heat exchangers, traps perform the vital function of removing the condensate before it becomes a barrier to heat transfer. Hot condensate is returned through the traps to the boiler for reuse.

Effect of Air on Steam Temperature

When air and other gases enter the steam system, they consume part of the volume that steam would otherwise occupy. The temperature of the air/steam mixture falls below that of pure steam. Figure CG-7 explains the effect of air in steam lines. Table CG-2 and Chart CG-5 show the various temperature reductions caused by air at various percentages and pressures.

Effect of Air on Heat Transfer

The normal flow of steam toward the heat exchanger surface carries air and other gases with it. Since they do not condense and drain by gravity, these non-condensable gases set up a barrier between the steam and the heat exchanger surface. The excellent insulating properties of air reduce heat transfer. In fact, under certain conditions as little as 1/2 of 1% by volume of air in steam can reduce heat transfer efficiency by 50% (Fig. CG-8).

Table CG-2. Temperature Reduction Caused by Air

Pressure (psig)	Temp. of Steam, No Air Present (°F)	Temp. of Steam Mixed With Various Percentages of Air (by Volume) (°F)		
		10%	**20%**	**30%**
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	**298.0**	**291.0**	**283.5**	**275.1**
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

When non-condensable gases (primarily air) continue to accumulate and are not removed, they may gradually fill the heat exchanger with gases and stop the flow of steam altogether. The unit is then "air bound."

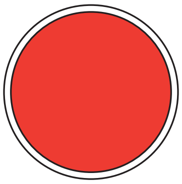
Corrosion

Two primary causes of scale and corrosion are carbon dioxide (CO_2) and oxygen. CO_2 enters the system as carbonates dissolved in feedwater and, when mixed with cooled condensate, creates carbonic acid. Extremely corrosive, carbonic acid can eat through piping and heat exchangers (Fig. CG-9). Oxygen enters the system as gas dissolved in the cold feedwater. It aggravates the action of carbonic acid, speeding corrosion and pitting iron and steel surfaces (Fig. CG-10).

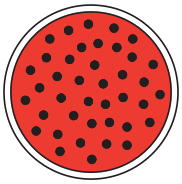
Eliminating the Undesirables

To summarize, traps must drain condensate because it can reduce heat transfer and cause water hammer. Traps should evacuate air and other non-condensable gases because they can reduce heat transfer by reducing steam temperature and insulating the system. They can also foster destructive corrosion. It's essential to remove condensate, air and CO_2 as quickly and completely as possible. A steam trap, which is simply an automatic valve that opens for condensate, air and CO_2 and closes for steam, does this job. For economic reasons, the steam trap should do its work for long periods with minimum attention.

Figure CG-7. Chamber containing air and steam delivers only the heat of the partial pressure of the steam, not the total pressure.



Steam chamber 100% steam
Total pressure 100 psia
Steam pressure 100 psia
Steam temperature 327.8°F



Steam chamber 90% steam and 10% air
Total pressure 100 psia
Steam pressure 90 psia
Steam temperature 320.3°F

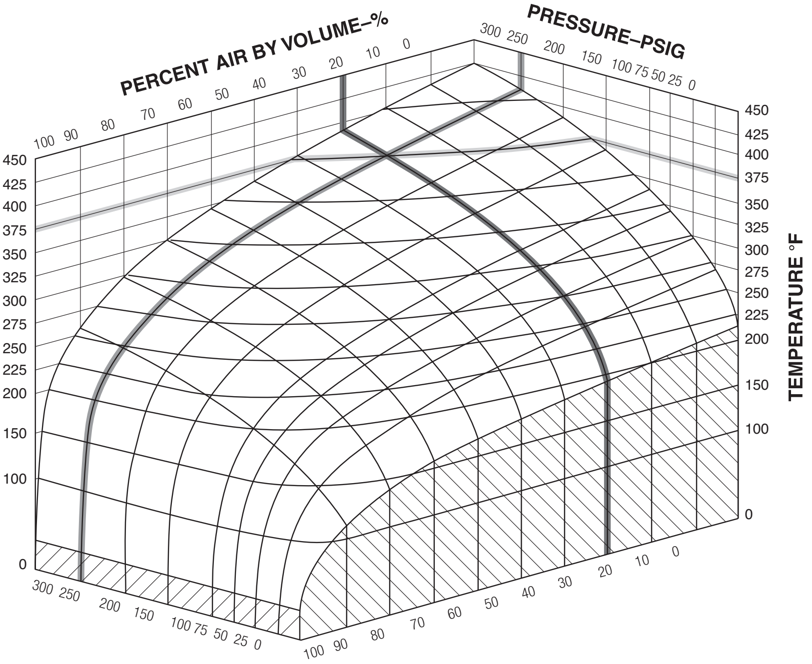


Chart CG-8. Air Steam Mixture

Temperature reduction caused by various percentages of air at differing pressures. This chart determines the percentage of air with known pressure and temperature by determining the point of intersection between pressure, temperature and percentage of air by volume. As an example, assume system pressure of 250 psig with a temperature at the heat exchanger of 375°F. From the chart, it is determined that there is 30% air by volume in the steam.+

What the Steam Trap Must Do

The job of the steam trap is to get condensate, air and CO_2 out of the system as quickly as they accumulate. In addition, for overall efficiency and economy, the trap must also provide:

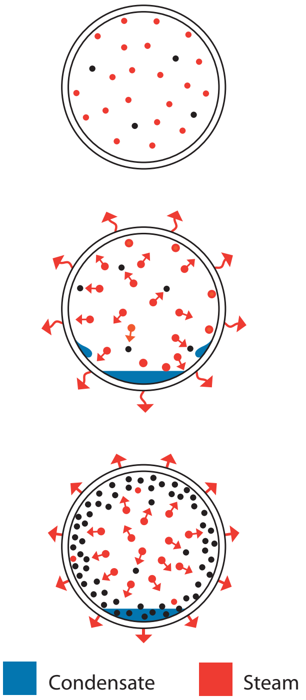
1. **Minimal steam loss.** Table CG-3 shows how costly unattended steam leaks can be.
2. **Long life and dependable service.** Rapid wear of parts quickly brings a trap to the point of undependability. An efficient trap saves money by minimizing trap testing, repair, cleaning, downtime and associated losses.
3. **Corrosion resistance.** Working trap parts should be corrosion-resistant in order to combat the damaging effects of acidic or oxygen-laden condensate.
4. **Air venting.** Air can be present in steam at any time and especially on start-up. Air must be vented for efficient heat transfer and to prevent system binding.
5. **CO_2 venting.** Venting CO_2 at steam temperature will prevent the formation of carbonic acid. Therefore, the steam trap must function at or near steam temperature since CO_2 dissolves in condensate that has cooled below steam temperature.
6. **Operation against back pressure.** Pressurized return lines can occur both by design and unintentionally. A steam trap should be able to operate against the actual back pressure in its return system.
7. **Freedom from dirt problems**. Dirt is an ever-present concern since traps are located at low points in the steam system. Condensate picks up dirt and scale in the piping, and solids may carry over from the boiler. Even particles passing through strainer screens are erosive and, therefore, the steam trap must be able to operate in the presence of dirt.

A trap delivering anything less than all these desirable operating/design features will reduce the efficiency of the system and increase costs. When a trap delivers all these features the system can achieve:

1. Fast heat-up of heat transfer equipment
2. Maximum equipment temperature for enhanced steam heat transfer
3. Maximum equipment capacity
4. Maximum fuel economy
5. Reduced labor per unit of output
6. Minimum maintenance and a long trouble-free service life

Sometimes an application may demand a trap without these design features, but in the vast majority of applications the trap which meets all the requirements will deliver the best results.

Figure CG-8. Steam condensing in a heat transfer unit moves air to the heat transfer surface, where it collects or “plates out” to form effective insulation.



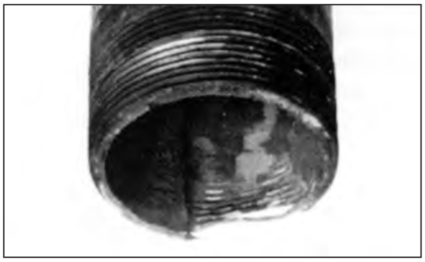


Figure CG-9. CO_2 gas combines with condensate allowed to cool below steam temperature to form carbonic acid, which corrodes pipes and heat transfer units. Note groove eaten away in the pipe illustrated.

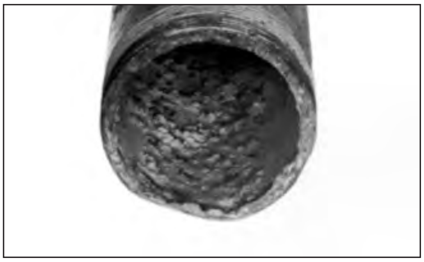


Figure CG-10. Oxygen in the system speeds corrosion (oxidation) of pipes, causing pitting such as shown here.

Figs. CG-9 and CG-10 courtesy of Dearborn Chemical Company.

Table CG-3. Cost of Various Sized Steam Leaks at 100 psi
(Assuming steam costs $10.00/1,000 lbs)

Size of Orifice		Lbs Steam Wasted Per Month	Total Cost Per Month (USD)	Total Cost Per Year (USD
1/2"	12, 7 mm	553,000	$5,530.00	$66,360.00
7/16"	11, 2 mm	423,500	4,235.00	50,820.00
3/8"	9, 5 mm	311,000	3,110.00	37,320.00
5/16"	7, 9 mm	216,000	2,160.00	25,920.00
1/4"	6, 4 mm	138,000	1,380.00	16,560.00
3/16"	4, 8 mm	78,000	780.00	9,360.00
1/8"	3, 2 mm	34,500	345.00	4,140.00

The steam loss values assume typical condensate load for drip trap applications.
Armstrong methodology for steam trap management and condensate return is sanctioned by the Clean Development
Mechanism of the United Nations Framework Convention on Climate Change.

The Inverted Bucket Steam Trap

The Armstrong inverted submerged bucket steam trap is a mechanical trap that operates on the difference in density between steam and water. See Fig. CG-11. Steam entering the inverted submerged bucket causes the bucket to float and close the discharge valve. Condensate entering the trap changes the bucket to a weight that sinks and opens the trap valve to discharge the condensate. Unlike other mechanical traps, the inverted bucket also vents air and carbon dioxide continuously at steam temperature.

This simple principle of condensate removal was introduced by Armstrong in 1911. Years of improvement in materials and manufacturing have made today's Armstrong inverted bucket traps virtually unmatched in operating efficiency, dependability and long life.

Long, Energy-Efficient Service Life

At the heart of the Armstrong inverted bucket trap is a unique leverage system that multiplies the force provided by the bucket to open the valve against pressure. There are no fixed pivots to wear or create friction. It is designed to open the discharge orifice for maximum capacity. Since the bucket is open at the bottom, it is resistant to damage from water hammer. Wearing points are heavily reinforced for long life.

An Armstrong inverted bucket trap can continue to conserve energy even in the presence of wear. Gradual wear slightly increases the diameter of the seat and alters the shape and diameter of the ball valve. But as this occurs, the ball merely seats itself deeper—preserving a tight seal.

Reliable Operation

The Armstrong inverted bucket trap owes much of its reliability to a design that makes it virtually free of dirt problems. Note that the valve and seat are at the top of the trap. The larger particles of dirt fall to the bottom, where they are pulverized under the up-and-down action of the bucket. Since the valve of an inverted bucket is either closed or fully open, there is free passage of dirt particles. In addition, the swift flow of condensate from under the bucket's edge creates a unique self-scrubbing action that sweeps dirt out of the trap. The inverted bucket has only two moving parts—the valve lever assembly and the bucket. That means no fixed points, no complicated linkages—nothing to stick, bind or clog.

Corrosion-Resistant Parts

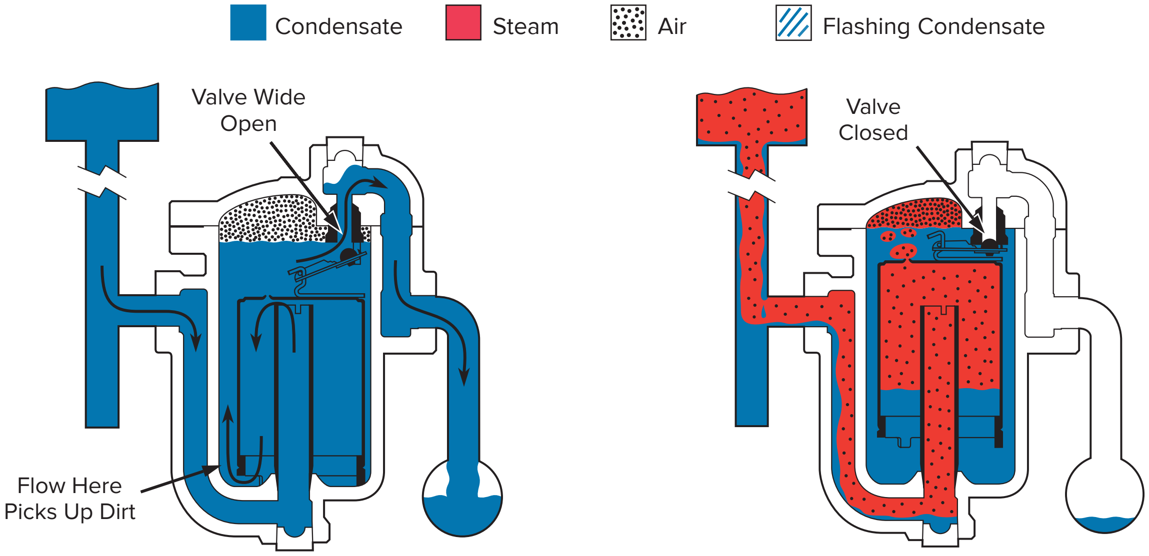
The valve and seat of Armstrong inverted bucket traps are high chrome stainless steel, ground and lapped. All other working parts are wear- and corrosion-resistant stainless steel.

Operation Against Back Pressure

High pressure in the discharge line simply reduces the differential across the valve. As back pressure approaches that of inlet pressure, discharge becomes continuous just as it does on the very low pressure differentials.

Back pressure has no adverse effect on inverted bucket trap operation other than capacity reduction caused by the low differential. There is simply less force required by the bucket to pull the valve open, cycling the trap.

Figure CG-11. Operation of the Inverted Bucket Steam Trap (at pressures close to maximum)



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.

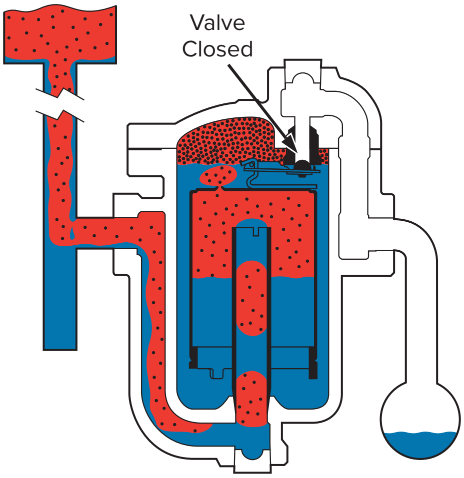
Types of Armstrong Inverted Bucket Traps Available to Meet Specific Requirements

The availability of inverted bucket traps in different body materials, piping configurations and other variables permits flexibility in applying the right trap to meet specific needs. See Table CG-4.

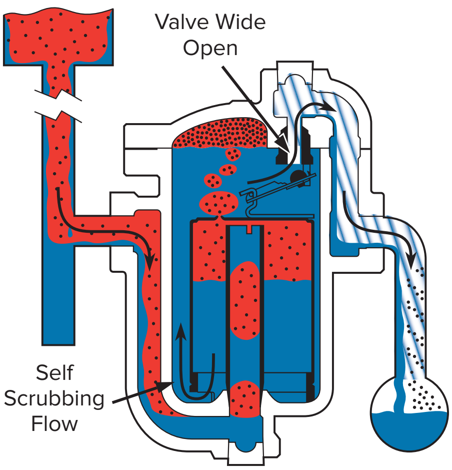
1. **All-Stainless Steel Traps.** Sealed, tamper-proof stainless steel bodies enable these traps to withstand freeze-ups without damage. They may be installed on tracer lines, outdoor drips and other services subject to freezing. For pressures to 650 psig and temperatures to 800°F.
2. **Cast Iron Traps.** Standard inverted bucket traps for general service at pressures to 250 psig and temperatures to 450°F. Offered with side connections, side connections with integral strainers and bottom inlet—top outlet connections.
3. **Forged Steel Traps.** Standard inverted bucket traps for high pressure, high temperature services (including superheated steam) to 2,700 psig at 1,050°F.
4. **Cast Stainless Steel Traps.** Standard inverted bucket traps for high capacity, corrosive service. Repairable. For pressures to 700 psig and temperatures to 506°F.

Table CG-4. Typical Design Parameters for Inverted Bucket Traps

Body and Cap Materials	Cast Iron	Stainless Steel	Forged Steel	Cast Steel	Cast Stainless Steel
Connections	1/2" thru 2-1/2"	3/8" thru 1"	1/2" thru 2"	1/2" thru 1"	1/2" thru 2"
Type Connections	Screwed	Screwed, Socketweld	Screwed, Socketweld or Flanged	Screwed, Socketweld or Flanged	Screwed, Socketweld or Flanged
Operating Pressure (psig)	0 thru 250	0 thru 650	0 thru 2,700	0 thru 600	0 thru 700
Capacity (lbs/hr)	To 20,000	To 4,400	To 20,000	To 4,400	To 20,000



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.

The Float and Thermostatic Steam Trap

The float and thermostatic trap is a mechanical trap that operates on both density and temperature principles. The float valve operates on the density principle: A lever connects the ball float to the valve and seat. Once condensate reaches a certain level in the trap the float rises, opening the orifice and draining condensate. A water seal formed by the condensate prevents live steam loss.

Since the discharge valve is under water, it is not capable of venting air and non-condensables. When the accumulation of air and non-condensable gases causes a significant temperature drop, a thermostatic air vent in the top of the trap discharges it. The thermostatic vent opens at a temperature a few degrees below saturation so it's able to handle a large volume of air—through an entirely separate orifice—but at a slightly reduced temperature.

Armstrong F&T traps provide high air-venting capacity, respond immediately to condensate and are suitable for both industrial and HVAC applications.

Reliable Operation on Modulating Steam Pressure

Modulating steam pressure means that the pressure in the heat exchange unit being drained can vary anywhere from the maximum steam supply pressure down to vacuum under certain conditions. Thus, under conditions of zero pressure, only the force of gravity is available to push condensate through a steam trap. Substantial amounts of air may also be liberated under these conditions of low steam pressure. The efficient operation of the F&T trap meets all of these specialized requirements.

High Back Pressure Operation

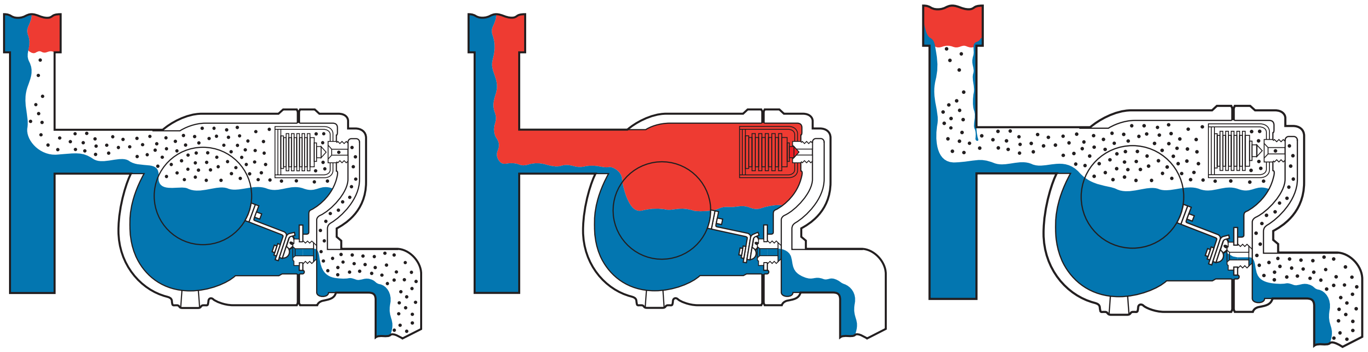
Back pressure has no adverse effect on float and thermostatic trap operation other than capacity reduction due to low differential. The trap will not fail to close and will not blow steam due to the high back pressure.

Table CG-5. Typical Design Parameters for Float and Thermostatic Traps

Body and Cap Materials	**Cast Iron**	**Cast Steel**
Connections	1/2" thru 3"	1/2" thru 3"
Type Connections	Screwed or Flanged	Screwed, Socketweld or Flanged
Operating Pressure (psig)	0 thru 250	0 thru 465
Capacity (lbs/hr)	To 208 000	To 280 000

Figure CG-12. Operation of the F&T Steam Trap

🟦 Condensate 🟥 Steam ▨ Air



1. On start-up, low system pressure forces air out through the thermostatic air vent. A high condensate load normally follows air venting and lifts the float, which opens the main valve. The remaining air continues to discharge through the open vent.

2. When steam reaches the trap, the thermostatic air vent closes in response to higher temperature. Condensate continues to flow through the main valve, which is positioned by the float to discharge condensate at the same rate that it flows to the trap.

3. As air accumulates in the trap, the temperature drops below that of saturated steam. The balanced pressure thermostatic air vent opens and discharges air.

NOTE: These operational schematics of the F&T trap do not represent actual trap configuration.

The Controlled Disc Steam Trap

The controlled disc steam trap is a time-delayed device that operates on the velocity principle. It contains only one moving part, the disc itself. Because it is very lightweight and compact, the CD trap meets the needs of many applications where space is limited. In addition to the disc trap's simplicity and small size, it also offers advantages such as resistance to hydraulic shock, the complete discharge of all condensate when open and intermittent operation for a steady purging action.

Operation of controlled disc traps depends on the changes in pressures in the chamber where the disc operates. The Armstrong CD trap will be open as long as cold condensate is flowing. When steam or flash steam reaches the inlet orifice, velocity of flow increases, pulling the disc toward the seat. Increasing pressure in the control chamber snaps the disc closed. The subsequent pressure reduction, necessary for the trap to open, is controlled by the heating chamber in the cap and a finite machined bleed groove in the disc. Once the system is up to temperature, the bleed groove controls the trap cycle rate.

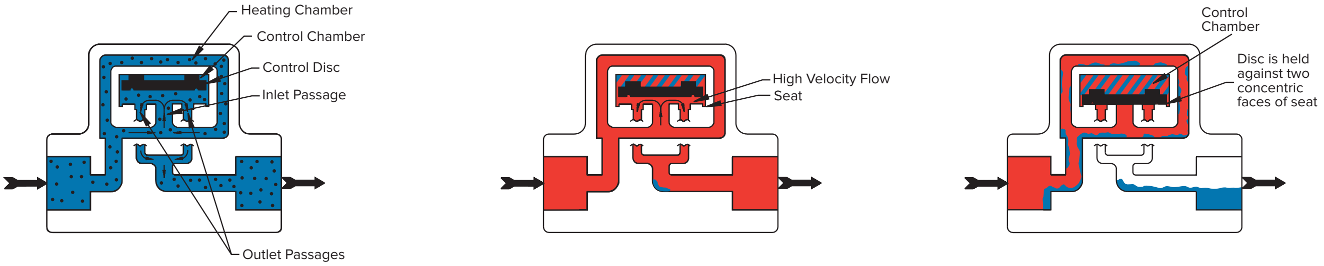
Unique Heating Chamber

The unique heating chamber in Armstrong's controlled disc traps surrounds the disc body and control chamber. A controlled bleed from the chamber to the trap outlet controls the cycle rate. That means that the trap design—not ambient conditions—controls the cycle rate. Without this controlling feature, rain, snow and cold ambient conditions would upset the cycle rate of the trap.

Table CG-6. Typical Design Parameters for Controlled Disc Traps	
Body and Cap Materials	Steel
Connections	3/8" thru 1"
Type Connections	Screwed, Socketweld or Flanged
Operating Pressure (psig)	10 thru 600
Capacity (lbs/hr)	To 2 850

Figure CG-13. Design and Operation of Controlled Disc Traps

🟦 Condensate 🟥 Steam ▨ Air ▨ Condensate and Steam Mixture



1. On start-up, condensate and air entering the trap pass through the heating chamber, around the control chamber and through the inlet orifice. This flow lifts the disc off the inlet orifice, and the condensate flows through to the outlet passages.

2. Steam enters through the inlet passage and flows under the control disc. The flow velocity across the face of the control disc increases, creating a low pressure that pulls the disc toward the seat.

3. The disc closes against two concentric faces of the seat, closing off the inlet passage and also trapping steam and condensate above the disc. There is a controlled bleeding of steam from the control chamber; flashing condensate helps maintain the pressure in the control chamber. When the pressure above the disc is reduced, the incoming pressure lifts the disc off the seat. If condensate is present, it will be discharged, and the cycle repeats.

The Bimetallic Steam Trap

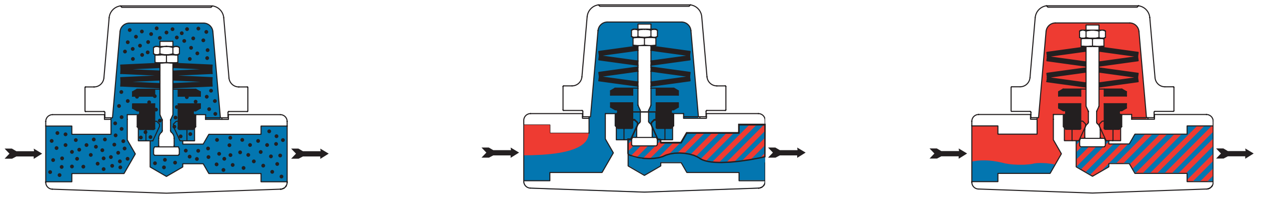
Bimetallic steam traps have the ability to handle large start-up loads. As the trap increases in temperature, its stacked nickel-chrome bimetallic elements start to expand, allowing for tight shutoff as steam reaches the trap, thus preventing steam loss. In addition to its light weight and compact size, it offers resistance to water hammer. Titanium valve and seat on high-pressure bimetallic traps ensure extremely long service life in the harsh environment of superheated steam systems.

Table CG-7. Typical Design Parameters for Bimetallic Traps

Body and Cap Materials	Carbon Steel	Stainless Steel
Connection Sizes	1/2”, 3/4”, 1”	
Type Connections	Screwed, Socketweld, Flanged	Screwed, NPT, BSPT, Socketweld, Buttweld, Flanged
Operating (psig)	0 - 250	200 - 900
Cold Water Capacity lb/hr	up to 11 000	

Figure CG-14. Design and Operation of Bimetallic Steam Traps

🟦 Condensate 🟥 Steam ▨ Air ▨ Flashing Steam



1. On start-up, the trap is cold, so the elements are flat and the valve is wide open, which results in air and condensate being easily removed from the system by working pressure.

2. With increasing temperature of the condensate, the bimetallic elements will start to expand and flex.

3. When set temperature is reached, the force of the elements is high enough to close the valve completely against the system pressure working on the valve.

The Thermostatic Steam Trap

Armstrong thermostatic steam traps are available with balanced pressure bellows or wafer-type elements and are constructed in a wide variety of materials, including stainless steel, carbon steel and bronze. These traps are used on applications with very light condensate loads.

Thermostatic Operation

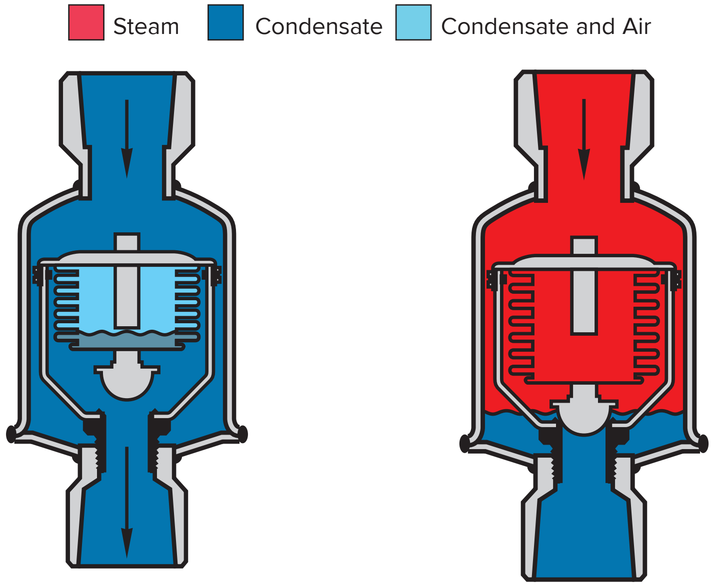
Thermostatic steam traps operate on the difference in temperature between steam and cooled condensate and air. Steam increases the pressure inside the thermostatic element, causing the trap to close. As condensate and non-condensable gases back up in the cooling leg, the temperature begins to drop, and the thermostatic element contracts and opens the valve. The amount of condensate backed up ahead of the trap depends on the load conditions, steam pressure and size of the piping. It is important to note that an accumulation of non-condensable gases can occur behind the condensate backup.

Table CG-8. Design Parameters for Thermostatic Traps

	Balanced Pressure Bellows		Balanced Pressure Wafer		
Body and Cap Materials	Stainless Steel	Bronze	Stainless Steel	Carbon Steel	Bronze
Connections	1/2", 3/4"	1/2", 3/4"	1/4" thru 1"	1/2", 3/4"	1/2", 3/4", 1"
Type Connections	Screwed, Socketweld	NPT Straight, Angle	Screwed, Socketweld	Screwed, Socketweld	NPT Straight, Angle
Operating Pressure (psig)	0 - 300	0 - 50	0 - 400	0 - 600	0 - 65
Capacity (lbs/hr)	To 3 450	To 1 600	To 70	To 85	To 960

NOTE: Thermostatic traps can also be used for venting air from a steam system. When air collects, the temperature drops and the thermostatic air vent automatically discharges the air at slightly below steam temperature throughout the entire operating pressure range.

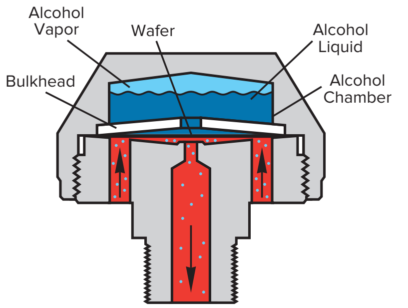
Figure CG-15. Operation of the Thermostatic Steam Trap



1. On start-up, condensate and air are pushed ahead of the steam directly through the trap. The thermostatic bellows element is fully contracted, and the valve remains wide open until steam approaches the trap.

2. As the temperature inside the trap increases, it quickly heats the charged bellows element, increasing the vapor pressure inside. When pressure inside the element becomes balanced with system pressure in the trap body, the spring effect of the bellows causes the element to expand, closing the valve. When temperature in the trap drops a few degrees below saturated steam temperature, imbalanced pressure contracts the bellows, opening the valve.

Figure CG-16.
Operation of Thermostatic Wafer



Balanced Pressure Thermostatic Wafer operation is very similar to balanced pressure bellows described in Fig. CG-15. The wafer is partially filled with a liquid. As the temperature inside the trap increases, it heats the charged wafer, increasing the vapor pressure inside. When the pressure inside the wafer exceeds the surrounding steam pressure, the wafer membrane is forced down on the valve seat, and the trap is closed. A temperature drop caused by condensate or non-condensable gases cools and reduces the pressure inside the wafer, allowing the wafer to uncover the seat.

The Automatic Differential Condensate Controller

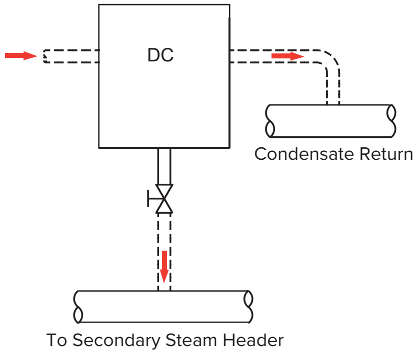
Armstrong automatic differential condensate controllers (DC) are designed to function on applications where condensate must be lifted from a drain point or in gravity drainage applications where increased velocity will aid in drainage.

Lifting condensate from the drain point—often referred to as syphon drainage—reduces the pressure of condensate, causing a portion of it to flash into steam. Since ordinary steam traps are unable to distinguish flash steam and live steam, they close and impede drainage.

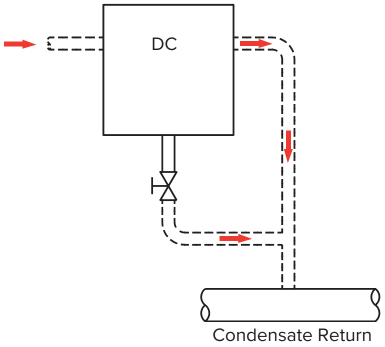
Increased velocity with gravity drainage will aid in drawing the condensate and air to the DC. An internal steam by-pass controlled by a manual metering valve causes this increased velocity. Therefore, the condensate controller automatically vents the by-pass or secondary steam. This is then collected for use in other heat exchangers or discharged to the condensate return line.

Capacity considerations for draining equipment vary greatly according to the application. However, a single condensate controller provides sufficient capacity for most applications.

Figure CG-17.



For the most efficient use of steam energy, Armstrong recommends this piping arrangement when secondary steam is collected and reused in heat transfer equipment.



Piping arrangement when flash steam and non-condensables are to be removed and discharged directly to the condensate return line.

Condensate Controller Operation

Condensate, air and steam (live and flash) enter through the controller inlet. At this point flash steam and air are automatically separated from the condensate. Then they divert into the integral by-pass at a controlled rate, forming secondary steam (See Fig. CG-18).

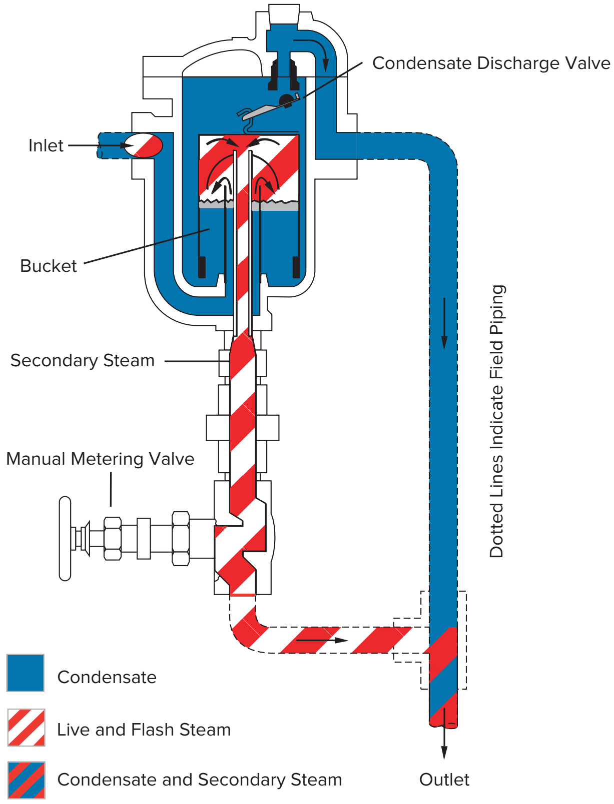
The valve is adjustable so it matches the amount of flash present under full capacity operation or to meet the velocity requirements of the system. The condensate discharges through a separate orifice controlled by the inverted bucket.

Because of the dual orifice design, there is a preset controlled pressure differential for the secondary steam system, while maximum pressure differential is available to discharge the condensate.

Table CG-9. Typical Design Parameters for the Automatic Differential Condensate Controller

Body and Cap Materials	**Cast Iron**	**Steel**
Connections	1/2" thru 2"	1" thru 2"
Type Connections	Screwed	Screwed
Operating Pressure (psig)	0 thru 250	0 thru 650
Capacity (lbs/hr)	To 20 000	To 20 000

Figure CG-18. Condensate Controller Operation



Armstrong® Steam Trap Selection

To obtain the full benefits from the traps described in the preceding section, it is essential to select traps of the correct size and pressure for a given job and to install and maintain them properly. One of the purposes of this section is to supply the information to make that possible. Actual installation and operation of steam trapping equipment should be performed only by experienced personnel. Selection or installation should always be accompanied by competent technical assistance or advice. This section should never be used as a substitute for such technical advice or assistance. We encourage you to contact Armstrong or its local representative for further details.

Basic Considerations

Unit trapping is the use of a separate steam trap on each steam-condensing unit including, whenever possible, each separate chest or coil of a single machine. The discussion under the Short Circuiting heading explains the "why" of unit trapping versus group trapping.

Rely on experience. Select traps with the aid of experience–either yours, the know-how of your Armstrong Representative or what others have learned in trapping similar equipment.

Do-it-yourself sizing. Do-it-yourself sizing is simple with the aid of Steam-A-ware™, Armstrong's sizing and selection software program, which can be downloaded at: **armstrong**international.com.

Even without this computer program, you can easily size steam traps when you know or can calculate:

1. Condensate loads in lbs/hr
2. The safety factor to use
3. Pressure differential
4. Maximum allowable pressure

1. **Condensate load.** Each "How To" portion of this section contains formulas and useful information on steam condensing rates and proper sizing procedures.
2. **Safety factor or experience factor to use.** Users have found that they must generally use a safety factor in sizing steam traps. For example, a coil condensing 500 lbs/hr might require a trap that could handle up to 1 500 lbs/hr for best overall performance. This 3:1 safety factor takes care of varying condensate rates, occasional drops in pressure differential and system design factors.

Safety factors will vary from a low of 1.5:1 to a high of 10:1. The safety factors in this book are based on years of user experience.

Configuration affects safety factor. More important than ordinary load and pressure changes is the design of the steam-heated unit itself. Refer to Figs. CG-21, CG-22 and CG-23 showing three condensing units each producing 500 pounds of condensate per hour, but with safety factors of 2:1, 3:1 and 8:1.

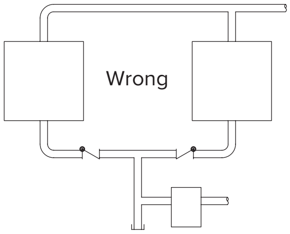


Figure CG-19. Two steam-consuming units drained by a single trap, referred to as group trapping, may result in short circuiting.

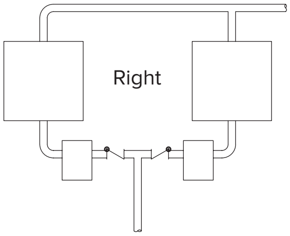


Figure CG-20. Short circuiting is impossible when each unit is drained by its own trap. Higher efficiency is assured.

Short Circuiting

If a single trap connects more than one drain point, condensate and air from one or more of the units may fail to reach the trap. Any difference in condensing rates will result in a difference in the steam pressure drop. A pressure drop difference too small to register on a pressure gauge is enough to let steam from the higher pressure unit block the flow of air or condensate from the lower pressure unit. The net result is reduced heating, output and fuel waste (see Figs. CG-19 and CG-20).

Identical Condensing Rates, Identical Pressures With Differing Safety Factors

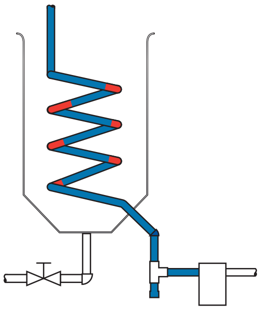


Figure CG-21. Continuous coil, constant pressure gravity flow to trap. 500 lbs/hr of condensate from a single copper coil at 30 psig. Gravity drainage to trap. Volume of steam space very small. 2:1 safety factor.

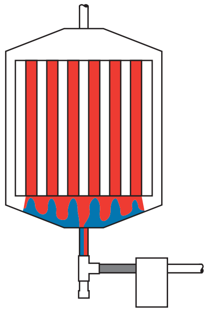


Figure CG-22. Multiple pipes, modulated pressure gravity flow to trap. 500 lbs/hr of condensate from unit heater at 80 psig. Multiple tubes create minor short-circuiting hazard. Use 3:1 safety factor at 40 psig.

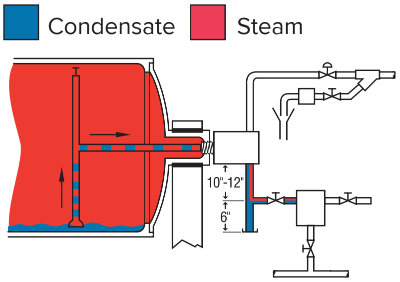


Figure CG-23. Large cylinder, syphon drained. 500 lbs/hr from a 4' diameter, 10' long cylinder dryer with 115 cu ft of space at 30 psig. The safety factor is 3:1 with a DC and 8:1 with an IB.

Economical steam trap/orifice selection. While an adequate safety factor is needed for best performance, too large a factor causes problems. In addition to higher costs for the trap and its installation, a needlessly oversized trap wears out more quickly. And in the event of a trap failure, an oversized trap loses more steam, which can cause water hammer and high back pressure in the return system.

3. **Pressure differential.** Maximum differential is the difference between boiler or steam main pressure or the downstream pressure of a PRV and return line pressure. See Fig. CG-24. The trap must be able to open against this pressure differential.

NOTE: Because of flashing condensate in the return lines, don't assume a decrease in pressure differential due to static head when elevating.

Operating differential. When the plant is operating at capacity, the steam pressure at the trap inlet may be lower than steam main pressure. And the pressure in the condensate return header may go above atmospheric.

If the operating differential is at least 80% of the maximum differential, it is safe to use maximum differential in selecting traps.

Modulated control of the steam supply causes wide changes in pressure differential. The pressure in the unit drained may fall to atmospheric or even lower (vacuum). This does not prevent condensate drainage if the installation practices in this handbook are followed.

IMPORTANT: Be sure to read the discussion to the right, which deals with less common but important reductions in pressure differential.

4. **Maximum allowable pressure.** The trap must be able to withstand the maximum allowable pressure of the system or design pressure. It may not have to operate at this pressure, but it must be able to contain it. As an example, the maximum inlet pressure is 350 psig and the return line pressure is 150 psig. This results in a differential pressure of 200 psi; however, the trap must be able to withstand 350 psig maximum allowable pressure. See Fig. CG-24.

Factors Affecting Pressure Differential

Except for failures of pressure control valves, differential pressure usually varies on the low side of the normal or design value. Variations in either the inlet or discharge pressure can cause this.

Inlet pressure can be reduced below its normal value by:

1. A modulating control valve or temperature regulator.
2. "Syphon drainage." Every 2' of lift between the drainage point and the trap reduces the inlet pressure (and the differential) by one psi. See Fig. CG-25.

Discharge pressure can be increased above its normal value by:

1. Pipe friction.
2. Other traps discharging into a return system of limited capacity.
3. Elevating condensate. Every 2' of lift increases the discharge pressure (and the differential) by one psi when the discharge is only condensate. However, with flash present, the extra back pressure could be reduced to zero. See Fig. CG-26, noting the external check valve.

🟦 Condensate 🟥 Steam

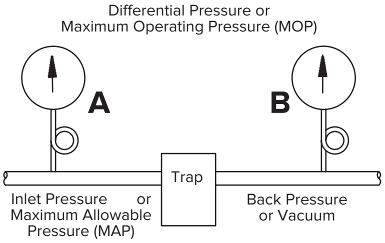


Figure CG-24. "A" minus "B" is Pressure Differential: If "B" is back pressure, subtract it from "A". If "B" is vacuum, add it to "A".

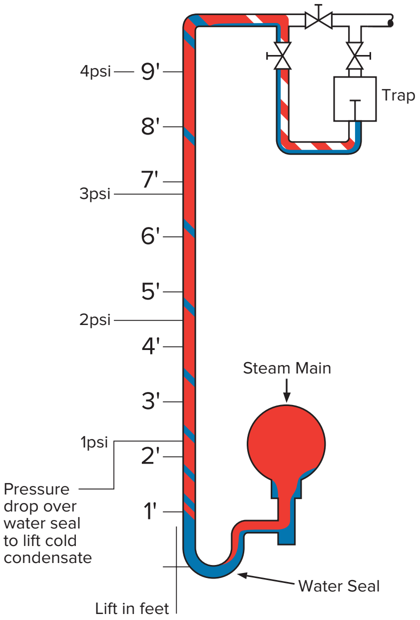


Figure CG-25. Condensate from gravity drain point is lifted to trap by a syphon. Every 2' of lift reduces pressure differential by 1 psi. Note seal at low point and the trap's internal check valve to prevent backflow.

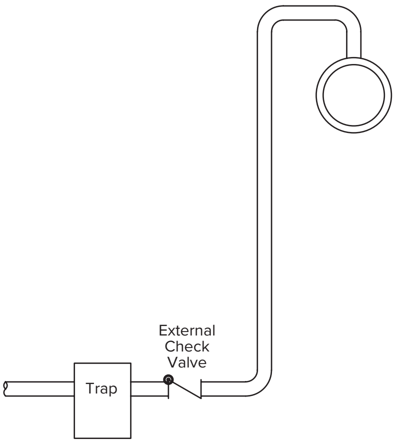


Figure CG-26. When trap valve opens, steam pressure will elevate condensate. Every 2' of lift reduces pressure differential by 1 psi.

How to Trap Steam Distribution Systems

Steam distribution systems link boilers and the equipment actually using steam, transporting it to any location in the plant where its heat energy is needed.

The three primary components of steam distribution systems are boiler headers, steam mains and branch lines. Each fulfills certain requirements of the system and, together with steam separators and steam traps, contributes to efficient steam use.

Drip legs. Common to all steam distribution systems is the need for drip legs at various intervals (Fig. CG-27). These are provided to:

1. Let condensate escape by gravity from the fast-moving steam.
2. Store the condensate until the pressure differential can discharge it through the steam trap.

Figure CG-27. Drip Leg Sizing

The properly sized drip leg will capture condensate. Too small a drip leg can actually cause a venturi "piccolo" effect where pressure drop pulls condensate out of the trap. See Table CG-13 on page CG-19.

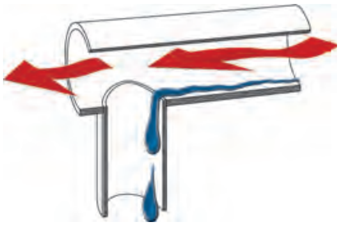


Chart CG-6. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Boiler Header	IBLV M, E, L, N, B, Q	*F&T

*On superheated steam never use an F&T type trap.
Always use an IB with internal check valve and burnished valve and seat.

Chart CG-7. Recommendation Chart

Equipment Being Trapped	1st Choice, Feature Code and Alternate Choice(s)	0 - 30 psig	Above 30 psig
Steam Mains and Branch Lines Non-freezing Conditions	B, M, N, L, F, E, C, D, Q	*IB	*IB
	Alternate Choice	F&T	**F&T
Steam Mains and Branch Lines Freezing Conditions	B, C, D, E, F, L, M, N, Q, J	*IB	*IB
	Alternate Choice	Thermostatic or CD	

*Provide internal check valve when pressures fluctuate.
**Use IBLV above F&T pressure/temperature limitations.
NOTE: On superheated steam, use an IB with internal check valve and burnished valve and seat.

Boiler Headers

A boiler header is a specialized type of steam main that can receive steam from one or more boilers. It is most often a horizontal line which is fed from the top and in turn feeds the steam mains. It is important to trap the boiler header properly to assure that any carryover (boiler water and solids) is removed before distribution into the system.

Steam traps that serve the header must be capable of discharging large slugs of carryover as soon as they are present. Resistance to hydraulic shock is also a consideration in the selection of traps.

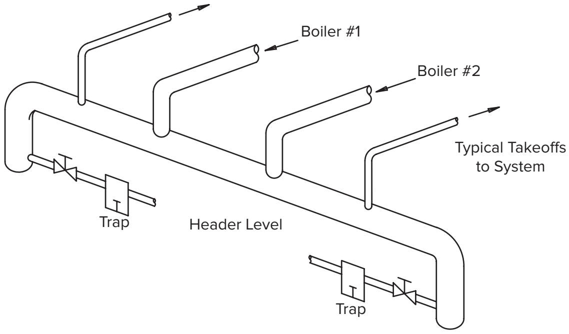
Trap selection and safety factor for boiler headers (saturated steam only). A 1.5:1 safety factor is recommended for virtually all boiler header applications. The required trap capacity can be obtained by using the following formula: Required Trap Capacity = Safety Factor x Load Connected to Boiler(s) x Anticipated Carryover (typically 10%).

EXAMPLE: What size steam trap will be required on a connected load of 50,000 lbs/hr with an anticipated carryover of 10%? Using the formula:
Required Trap Capacity = 1.5 x 50 000 x 0.10 = 7 500 lbs/hr.

The ability to respond immediately to slugs of condensate, excellent resistance to hydraulic shock, dirt-handling ability and efficient operation on very light loads are features that make the inverted bucket the most suitable steam trap for this application.

Installation. If steam flow through the header is in one direction only, a single steam trap is sufficient at the downstream end. With a midpoint feed to the header (Fig. CG-28), or a similar two-directional steam flow arrangement, each end of the boiler header should be trapped.

Figure CG-28. Boiler Headers



Drip leg same as the header diameter up to 4."
Above 4", 1/2 header size, but never less than 4."

Steam Mains

One of the most common uses of steam traps is the trapping of steam mains. These lines need to be kept free of air and condensate in order to keep steam-using equipment operating properly. Inadequate trapping on steam mains often leads to water hammer and slugs of condensate that can damage control valves and other equipment.

There are two methods used for the warm-up of steam mains—supervised and automatic. Supervised warm-up is widely used for initial heating of large-diameter and/or long mains. The suggested method is for drip valves to be opened wide for free blow to the atmosphere before steam is admitted to the main. These drip valves are not closed until all or most of the warm-up condensate has been discharged. Then the traps take over the job of removing condensate that may form under operating conditions. Warm-up of principal piping in a power plant will follow much the same procedure.

Automatic warm-up is when the boiler is fired, allowing the mains and some or all equipment to come up to pressure and temperature without manual help or supervision.

CAUTION: Regardless of warm-up method, allow sufficient time during the warm-up cycle to minimize thermal stress and prevent any damage to the system.

Trap selection and safety factor for steam mains (saturated steam only). Select trap to discharge condensate produced by radiation losses at running load. Sizing for start-up loads results in oversized traps, which may wear prematurely. Size drip legs to collect condensate during low-pressure, warm-up conditions. (See Table CG-13 on page CG-21.) Condensate loads of insulated pipe can be found in Table CG-10. All figures in the table assume the insulation to be 75% effective. For pressures or pipe sizes not included in the table, use the following formula:

$$C = \frac{A \times U \times (T_1 - T_2)E}{H}$$

Where:

C = Condensate in lbs/hr-foot

A = External area of pipe in square feet (Table CG-10, Col. 2)

U = Btu/sq ft/degree temperature difference/hr from Chart CG-7 (page CG-19)

T_1 = Steam temperature in °F

T_2 = Air temperature in °F

E = 1 minus efficiency of insulation (Example: 75% efficient insulation: 1 - .75 = .25 or E = .25)

H = Latent heat of steam (See Steam Table on page CG-5)

Table CG-10. Condensation in Insulated Pipes Carrying in Quiet Air at 70°F (Insulation assumed to be 75% efficient.)

Pressure, psig		15	30	60	125	180	250	450	600	900
Pipe Size (in)	sq ft Per Lineal ft	Pounds of Condensate Per Hour Per Lineal Foot								
1	.344	.05	.06	.07	.10	.12	.14	.186	.221	.289
1-1/4	.434	.06	.07	.09	.12	.14	.17	.231	.273	.359
1-1/2	**.497**	**.07**	**.08**	**.10**	**.14**	**.16**	**.19**	**.261**	**.310**	**.406**
2	.622	.08	.10	.13	.17	.20	.23	.320	.379	.498
2-1/2	.753	.10	.12	.15	.20	.24	.28	.384	.454	.596
3	**.916**	**.12**	**.14**	**.18**	**.24**	**.28**	**.33**	**.460**	**.546**	**.714**
3-1/2	1.047	.13	.16	.20	.27	.32	.38	.520	.617	.807
4	1.178	.15	.18	.22	.30	.36	.43	.578	.686	.897
5	**1.456**	**.18**	**.22**	**.27**	**.37**	**.44**	**.51**	**.698**	**.826**	**1.078**
6	1.735	.20	.25	.32	.44	.51	.59	.809	.959	1.253
8	2.260	.27	.32	.41	.55	.66	.76	1.051	1.244	1.628
10	**2.810**	**.32**	**.39**	**.51**	**.68**	**.80**	**.94**	**1.301**	**1.542**	**2.019**
12	3.340	.38	.46	.58	.80	.92	1.11	1.539	1.821	2.393
14	3.670	.42	.51	.65	.87	1.03	1.21	1.688	1.999	2.624
16	**4.200**	**.47**	**.57**	**.74**	**.99**	**1.19**	**1.38**	**1.927**	**2.281**	**2.997**
18	4.710	.53	.64	.85	1.11	1.31	1.53	2.151	2.550	3.351
20	5.250	.58	.71	.91	1.23	1.45	1.70	2.387	2.830	3.725
24	**6.280**	**.68**	**.84**	**1.09**	**1.45**	**1.71**	**2.03**	**2.833**	**3.364**	**4.434**

Table CG-11. The Warming-Up Load from 70°F, Schedule 40 Pipe

Pressure, psig		2	15	30	60	125	180	250
Pipe Size (in)	wt of Pipe Per ft (lbs)	Pounds of Condensate Per Lineal Foot						
1	1.69	.030	.037	.043	.051	.063	.071	.079
1-1/4	2.27	.040	.050	.057	.068	.085	.095	.106
1-1/2	**2.72**	**.048**	**.059**	**.069**	**.082**	**.101**	**.114**	**.127**
2	3.65	.065	.080	.092	.110	.136	.153	.171
2-1/2	5.79	.104	.126	.146	.174	.215	.262	.271
3	**7.57**	**.133**	**.165**	**.190**	**.227**	**.282**	**.316**	**.354**
3-1/2	9.11	.162	.198	.229	.273	.339	.381	.426
4	10.79	.190	.234	.271	.323	.400	.451	.505
5	**14.62**	**.258**	**.352**	**.406**	**.439**	**.544**	**.612**	**.684**
6	18.97	.335	.413	.476	.569	.705	.795	.882
8	28.55	.504	.320	.720	.860	1.060	1.190	1.340
10	**40.48**	**.714**	**.880**	**1.020**	**1.210**	**1.500**	**1.690**	**1.890**
12	53.60	.945	1.170	1.350	1.610	2.000	2.240	2.510
14	63.00	1.110	1.370	1.580	1.890	2.340	2.640	2.940
16	**83.00**	**1.460**	**1.810**	**2.080**	**2.490**	**3.080**	**3.470**	**3.880**
18	105.00	1.850	2.280	2.630	3.150	3.900	4.400	4.900
20	123.00	2.170	2.680	3.080	3.690	4.570	5.150	5.750
24	**171.00**	**3.020**	**3.720**	**4.290**	**5.130**	**6.350**	**7.150**	**8.000**

Table CG-12. Pipe Weights Per Foot in Pounds

Pipe Size (in)	Schedule 40	Schedule 80	Schedule 160	XX Strong
1	1.69	2.17	2.85	3.66
1-1/4	2.27	3.00	3.76	5.21
1-1/2	**2.72**	**3.63**	**4.86**	**6.41**
2	3.65	5.02	7.45	9.03
2-1/2	5.79	7.66	10.01	13.69
3	**7.57**	**10.25**	**14.32**	**18.58**
3-1/2	9.11	12.51	-	22.85
4	10.79	14.98	22.60	27.54
5	**14.62**	**20.78**	**32.96**	**38.55**
6	18.97	28.57	45.30	53.16
8	28.55	43.39	74.70	72.42
10	**40.48**	**54.74**	**116.00**	**-**
12	53.60	88.60	161.00	-
14	63.00	107.00	190.00	-
16	**83.00**	**137.00**	**245.00**	**-**
18	105.00	171.00	309.00	-
20	123.00	209.00	379.00	-
24	**171.00**	**297.00**	**542.00**	**-**

How to Trap Steam Distribution Systems

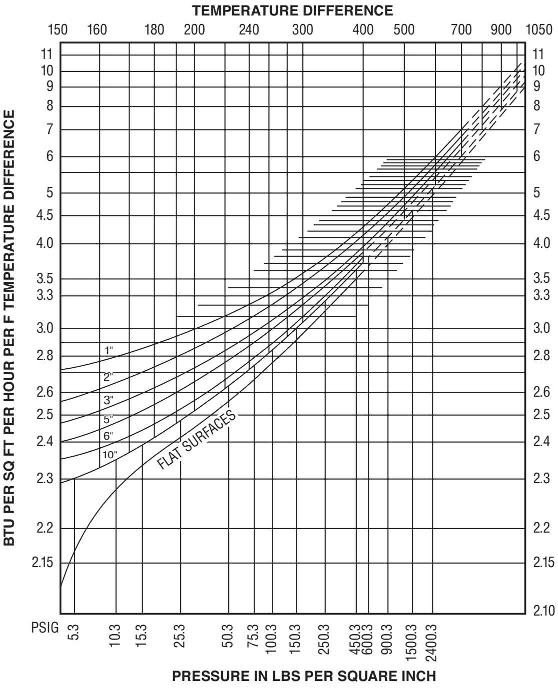
For traps installed between the boiler and the end of the steam main, apply a 2:1 safety factor. Apply a 3:1 safety factor for traps installed at the end of the main or ahead of reducing and shutoff valves that are closed part of the time.

The inverted bucket trap is recommended because it can handle dirt and slugs of condensate and resists hydraulic shock. In addition, should an inverted bucket fail, it usually does so in the open position.

Installation. Both methods of warm-up use drip legs and traps at all low spots or natural drainage points such as:

Ahead of risers
End of mains
Ahead of expansion joints or bends
Ahead of valves or regulators

Chart CG-7. Btu Heat Loss Curves



Install drip legs and drain traps even where there are no natural drainage points (See Figs. CG-29, CG-30 and CG-31). These should normally be installed at intervals of about 300' and never longer than 500'.

On a supervised warm-up, make drip leg length at least 1-1/2 times the diameter of the main, but never less than 10". Make drip legs on automatic warm-ups a minimum of 28" in length. For both methods, it is a good practice to use a drip leg the same diameter as the main up to 4" pipe size and at least 1/2 of the diameter of the main above that, but never less than 4". See Table CG-13.

Table CG-13. Recommended Steam Main and Branch Line Drip Leg Sizing

M	D	H	
		Drip Leg Length Min. (in)	
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**
6	4	10	28
8	4	12	28
10	**6**	**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**

Chart CG-8. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Steam Separator	IBLV B, M, L, E, F, N, Q	*DC

*DC is 1st choice where steam quality is 90% or less.

Steam Mains

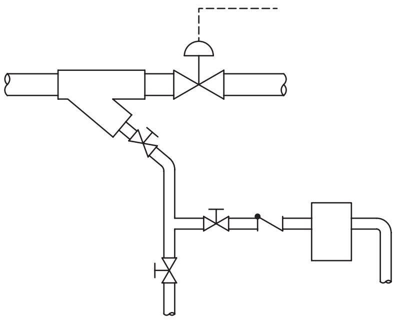


Figure CG-29.
Trap draining strainer ahead of PRV.

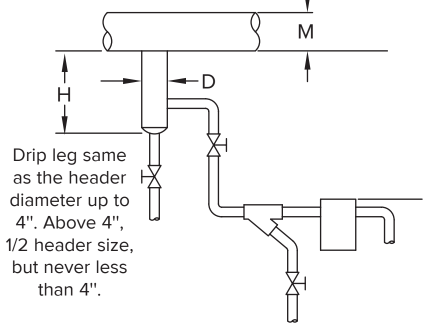


Figure CG-30.
Trap draining drip leg on main.

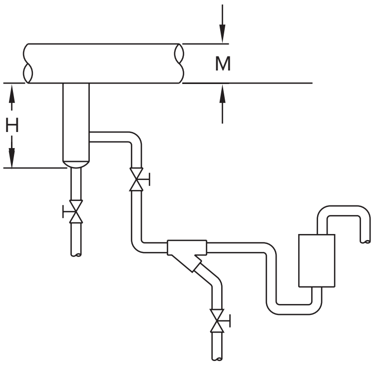


Figure CG-31.
Trap draining drip leg at riser. Distance "H" in inches ÷ 28 = psig static head for forcing water through the trap.

Branch Lines

Branch lines are take-offs from the steam mains supplying specific pieces of steam-using equipment. The entire system must be designed and hooked up to prevent accumulation of condensate at any point.

Trap selection and safety factor for branch lines. The formula for computing condensate load is the same as that used for steam mains. Branch lines also have a recommended safety factor of 3:1.

Installation. Recommended piping from the main to the control is shown in Fig. CG-32 for runouts under 10’ and Fig. CG-33 for runouts over 10’. See Fig. CG-34 for piping when control valve must be below the main.

Install a full pipe-size strainer ahead of each control valve as well as ahead of the PRV, if used. Provide blowdown valves, preferably with IB traps. A few days after starting the system, examine the strainer screens to see if cleaning is necessary.

Separators

Steam separators are designed to remove any condensate that forms within steam distribution systems. They are most often used ahead of equipment where especially dry steam is essential. They are also common on secondary steam lines, which by their very nature have a large percentage of entrained condensate.

Trap selection and safety factors for separators. Apply a 3:1 safety factor in all cases, even though different types of traps are recommended, depending on condensate and pressure levels.

Use the following formula to obtain the required trap capacity:

Required trap capacity in lbs/hr = safety factor x steam flow rate in lbs/hr x anticipated percent of condensate (typically 10% to 20%).

EXAMPLE: What size steam trap will be required on a flow rate of 10 000 lbs/hr? Using the formula:

Required trap capacity =
3 x 10 000 x 0.10 = 3 000 lbs/hr.

The inverted bucket trap with large vent is recommended for separators. When dirt and hydraulic shock are not significant problems, an F&T type trap is an acceptable alternative.

An automatic differential condensate controller may be preferred in many cases. It combines the best features of both of the above and is recommended for large condensate loads that exceed the separating capability of the separator.

Installation

Connect traps to the separator drain line 10” to 12” below the separator with the drain pipe running the full size of the drain connection down to the trap take-off (Fig. CG-35). The drain pipe and dirt pocket should be the same size as the drain connection.

Branch Lines

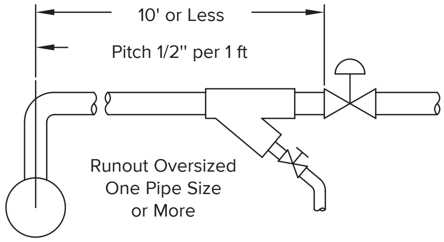


Figure CG-32. Piping for runout less than 10 ft. No trap required unless pitch back to supply header is less than 1/2'' per ft.

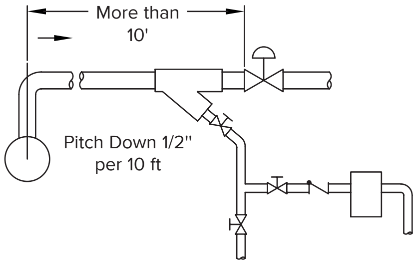


Figure CG-33. Piping for runout greater than 10'. Drip leg and trap required ahead of control valve. Strainer ahead of control valve can serve as drip leg if blowdown connection runs to an inverted bucket trap. This will also minimize the strainer cleaning problem. Trap should be equipped with an internal check valve or a swing check installed ahead of the trap.

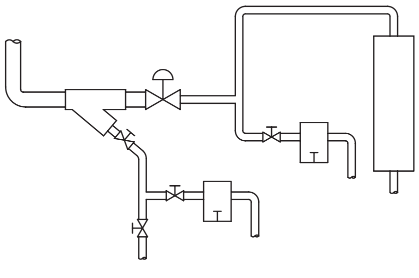


Figure CG-34. Regardless of the length of the runout, a drip leg and trap are required ahead of the control valve located below steam supply. If coil is above control valve, a trap should also be installed at downstream side of control valve.

Steam Separator

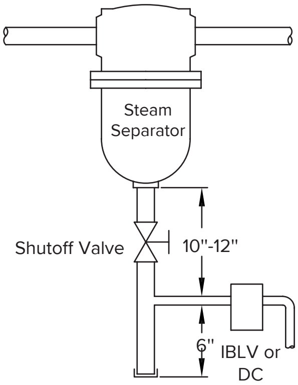


Figure CG-35. Drain downstream side of separator. Full-size drip leg and dirt pocket are required to ensure positive and fast flow of condensate to the trap.

How to Trap Steam Tracer Lines

Steam tracer lines are designed to maintain the fluid in a primary pipe at a certain uniform temperature. In most cases, these tracer lines are used outdoors, which makes ambient weather conditions a critical consideration.

The primary purpose of steam traps on tracer lines is to retain the steam until its latent heat is fully utilized and then discharge the condensate and non-condensable gases. As is true with any piece of heat transfer equipment, each tracer line should have its own trap. Even though multiple tracer lines may be installed on the same primary fluid line, unit trapping is required to prevent short circuiting. See page CG-15.

In selecting and sizing steam traps, it's important to consider their compatibility with the objectives of the system, as traps must:

1. Conserve energy by operating reliably over a long period of time.
2. Provide abrupt periodic discharge in order to purge the condensate and air from the line.
3. Operate under light load conditions.
4. Resist damage from freezing if the steam is shut off.

The cost of steam makes wasteful tracer lines an exorbitant overhead no industry can afford.

Trap Selection for Steam Tracer Lines.
The condensate load to be handled on a steam tracer line can be determined from the heat loss from the product pipe by using this formula:

$$Q = \frac{L \times U \times \Delta T \times E}{S \times H}$$

Where:

Q = Condensate load, lbs/hr

L = Length of product pipe between tracer line traps in ft

U = Heat transfer factor in Btu/sq ft/°F/hr (from Chart CG-7, page CG-21)

ΔT = Temperature differential in °F

E = 1 minus efficiency of insulation (example: 75% efficient insulation or 1 - .75 = .25 or E = .25)

S = Lineal feet of pipe line per sq ft of surface (from Table CG-29, page CG-55)

H = Latent heat of steam in Btu/lb (from Steam Table, page CG-5)

Typical Tracer Installation

Figure CG-36.

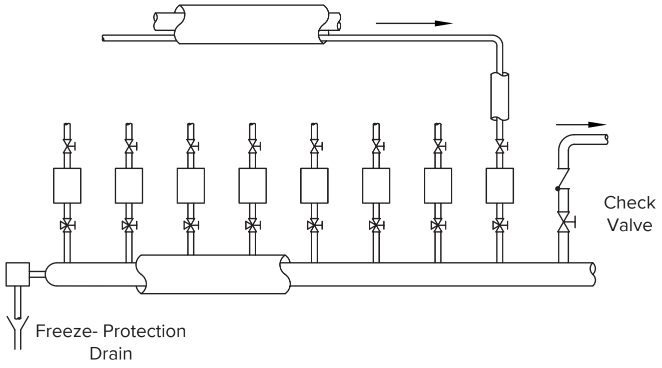


Figure CG-37.

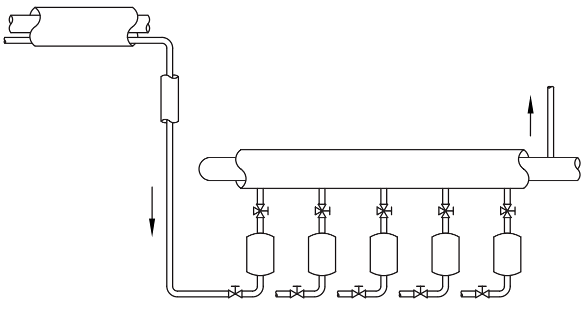


Chart CG-9. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Tracer Lines	*IB A, B, C, L, J, N, I, K	Thermostatic or CD

*Select a 5/64" steam trap orifice to conserve energy and avoid plugging with dirt and scale.

Table CG-14. Pipe Size Conversion Table (Divide lineal feet of pipe by factor given for size and type of pipe to get square feet of surface.)

Pipe Size (in)	Iron Pipe	Copper or Brass Pipe
1/2	4.55	7.63
3/4	3.64	5.09
1	**2.90**	**3.82**
1-1/4	2.30	3.05
1-1/2	2.01	2.55
2	**1.61**	**1.91**
2-1/2	1.33	1.52
3	1.09	1.27
4	**.848**	**.954**

How to Trap Steam Tracer Lines

EXAMPLE: Three tracer lines at 100 psig steam pressure are used on a 20” diameter, 100’ long insulated pipe to maintain a temperature of 190°F with an outdoor design temperature of -10°F. Assume further that the pipe insulation is 75% efficient. What is the condensate load?

Using the formula:

$$Q = \frac{100 \text{ ft} \times 2.44 \text{ Btu/sq ft -°F - hr} \times 200°\text{F} \times .25}{0.191 \text{ lin ft/sq ft} \times 880 \text{ Btu/lb}} = 72 \text{ lbs/hr}$$

Now divide by three in order to get the load per tracer line — 24 lbs/hr.

On most tracer line applications, the flow to the steam trap is surprisingly low; therefore, the smallest trap is normally adequate. Based on its ability to conserve energy by operating reliably over a long period of time, handle light loads, resist freezing and purge the system, an inverted bucket trap is recommended for tracer line service.

Safety factor. Use a 2:1 safety factor whether exposure to ambient weather conditions is involved or not. Do not oversize steam traps or tracer lines. Select a 5/64” steam trap orifice to conserve energy and avoid plugging with dirt and scale.

Installation

Install distribution or supply lines at a height above the product lines requiring steam tracing. For the efficient drainage of condensate and purging of non-condensables, pitch tracer lines for gravity drainage and trap all low spots. This will also help avoid tracer line freezing. (See Figs. CG-36, CG-37 and CG-38.)

To conserve energy, return condensate to the boiler. Use vacuum breakers immediately ahead of the traps to ensure drainage on shutdown on gravity drain systems. Freeze-protection drains on trap discharge headers are suggested where freezing conditions prevail.

Figure CG-38. Typical Tracer Installation

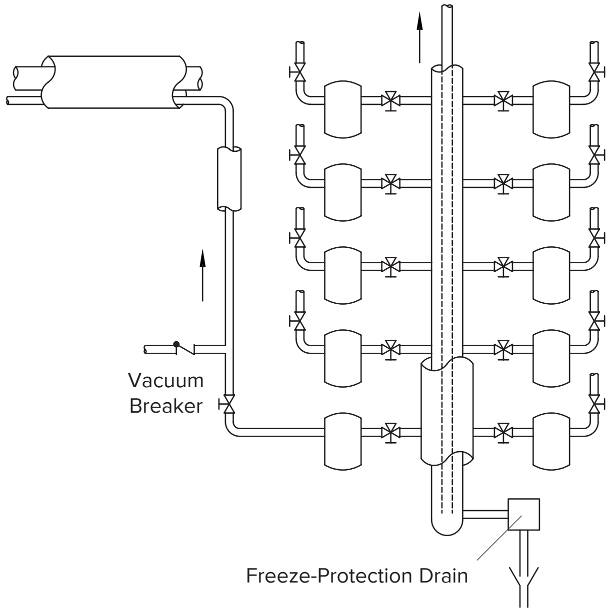
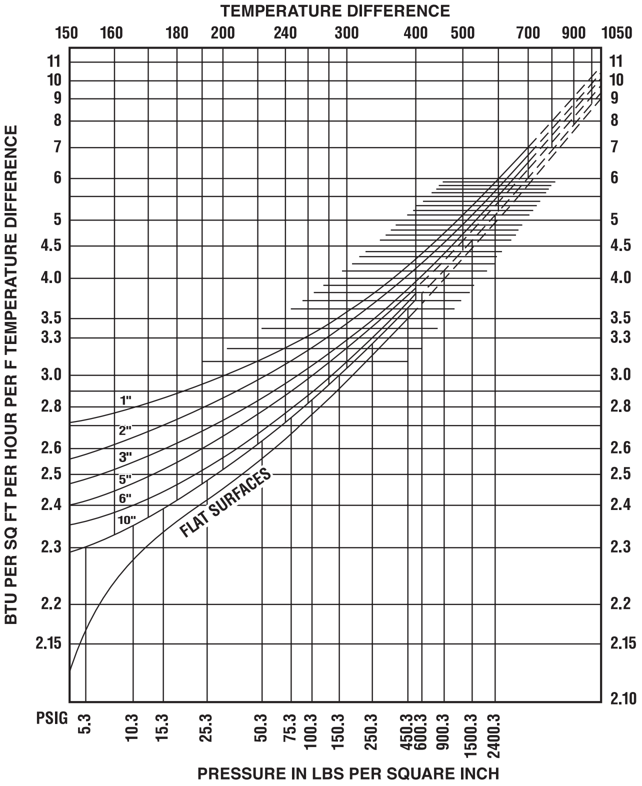


Chart CG-10. Btu Heat Loss Curves
Unit heat loss per sq ft of surface of uninsulated pipe of various diameters (also flat surface) in quiet air at 75°F for various saturated steam pressures or temperature differences.



How to Trap Superheated Steam Lines

At first glance, this may seem confusing due to the idea that superheated steam produces no condensate; therefore, the steam lines carrying superheated steam should not have any condensate in them. This is true once the system is up to temperature and pressure, but condensate removal is necessary up to this point. This section will explain what superheated steam is and the applications for its use.

The specific heat of any substance (using Btu standards) is the quantity of heat required to raise the temperature of 1 pound by 1 degree F. With this definition, the specific heat of water is 1, and the specific heat of superheated steam varies according to temperature and pressure. Specific heat decreases as the temperature rises but increases as the pressure goes up.

Superheated steam is customarily made by the addition of an extra set of coils inside the boiler or in the exhaust area of the boiler so as to use the "waste" heat from the boiler. Or, by the addition of a superheat chamber somewhere after the boiler, attached to the steam main. A schematic diagram of a steam generator with a superheated section of coil is shown below.

Properties of Superheated Steam

Superheated steam has several properties that make it unsuitable as a heat energy exchange medium yet ideal for work and mass transfer. Unlike saturated steam, the pressure and temperature of superheated steam are independent. As superheat is formed at the same pressure as the saturated steam, the temperature and volume increase.

In high heat release boilers with relatively small drums, separation of steam from water is extremely difficult. The combination of the small volume of water in the drums and rapid load swings produces severe shrink and swell conditions in the drum, which promotes water carryover.

This water can be removed with separators and traps in the steam outlets, but they are not 100% efficient. In applications where dry steam is a necessity, additional superheating coils are placed in the boiler furnace as convection passes. More heat is added to the steam to vaporize the water carryover, which adds a small amount of superheat to guarantee absolutely dry steam.

Because superheated steam can give up so little heat before it converts back to saturated steam, it is not a good heat-transfer medium. Some processes, such as power plants, require a dry heat in order to do work. Whatever the type of power unit, superheat helps reduce the amount of condensation when starting from cold. Superheat also increases the power output by delaying condensation during the expansion stages in the equipment. Having drier steam at the exhaust end will increase the life of turbine blades.

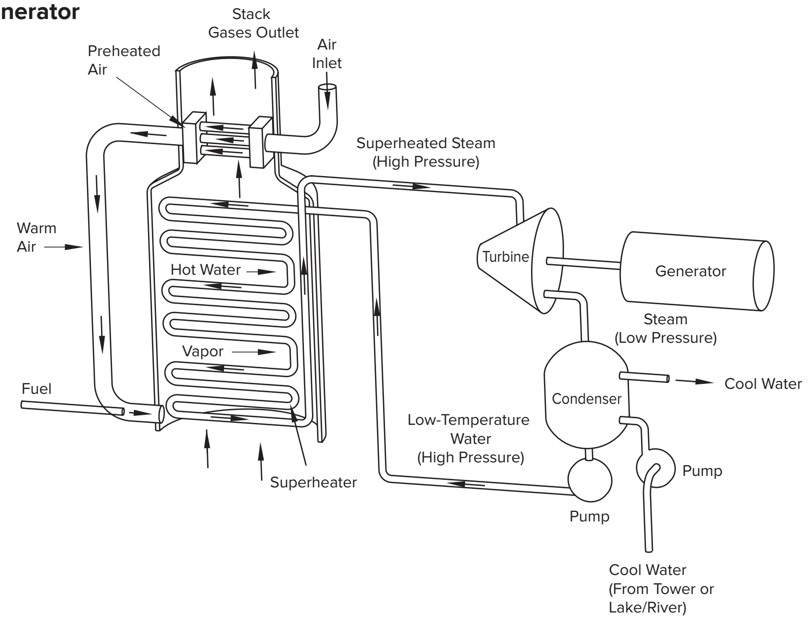
Superheated steam can lose heat without condensing whereas saturated steam cannot. Therefore, superheated steam can be transported through very long steam lines without losing sufficient heat to condense. This permits the delivery of dry steam throughout the entire steam system.

Why Trap Superheated Systems?

The primary reason for traps on superheat systems is the start-up load. It can be heavy because of the large size of the mains. On start-up, manual valves will most likely be used since time is available to open and to close the valves. This is known as supervised start-up. A second reason for steam traps is to handle emergencies such as superheater loss or by-pass, which might require operation on saturated steam. In these unscheduled events, there is no time available for manually opening valves; therefore, steam traps are a necessity.

These are the situations for which proper trap sizing is a must. Condensate must be removed as it forms in any steam system to keep efficiency high and to minimize damaging water hammer and erosion.

Figure CG-39. Steam Generator



How to Trap Superheated Steam Lines

Sizing Superheat Loads to Traps

The condensate load to a trap used on superheat will vary widely from severe start-up loads to virtually no load during operation. Consequently, this is a demanding application for any steam trap.

During start-up, very large lines are being filled with steam from cold conditions. At this time, only saturated steam at low pressure is in the lines until the line temperature can be increased. This is done slowly over a long period so the lines are not stressed. Large condensate flow combined with low pressure is the start-up condition that requires the use of large capacity traps. These oversized traps are then required to operate at very high pressures with very low capacity requirements during normal superheat operation.

Typical start-up loads can be roughly calculated as follows:

Using:

$$C = \frac{0.114\ Wp\ (t2\text{-}t1)}{H}$$

Where:

C = Amount of condensate in pounds

Wp = Total weight of pipe (from Table CG-12 on page CG-20)

H = Total heat of X pressure minus Sensible heat of Y Pressure (Latent heat of steam. For long warm-up times, use the total heat of saturated steam at the superheat steam supply pressure (X) minus the sensible heat of saturated steam at the average pressure (Y) during the warm-up time involved.)

0.114 = Specific heat of steel pipe in btu/lb °F

EXAMPLE:

Assuming a 100°F/hr (37°C/hr) heat-up

14’’ (35 cm) diameter Schedule 80 line

Supply superheated steam at 1 200 psig 1070°F (85 bar, 577°C)

Ambient temperature is 70°F (21°C)

200 feet (61 m) of run between traps

For the first two hours:

W = (200 ft) (107 lb/ft) = 21 400 lb (9727 kg)

t(2) - t(1) = 270 - 70 = 200°F (93°C)

H = 1 184.8 btu/lb - 196.27 btu/lb = 988.5 btu/lb = (474 kJ)

$$C = \frac{(0.114 \text{ btu/lb °F})\ (21\,400 \text{ lb})\ (200\text{°F})}{988.5 \text{ btu/lb}} = 493 \text{ lb } (224 \text{ kg})$$

For the second two hours:

The only thing that changes is the sensible heat of the saturated steam at average pressure during the time involved.

$$C = \frac{(0.114 \text{ btu/lb °F})\ (21\,400 \text{ lb})\ (200\text{°F})}{851.1 \text{ btu/lb}} = 573 \text{ lb } (260 \text{ kg})$$

Table CG-15. Time Period Table

Time Period	Average Pressure psig (barg)	Temperature at End of Time Period °F (°C)	14” Line Condensation Rate lb/hr (kg/hr)
1st 2 hours	5 (.35)	270 (132)	247 (112)
2nd 2 hours	140 (9.8)	470 (243)	286 (130)
3rd 2 hours	700 (49)	670 (354)	352 (160)
4th 2 hours	1 200 (85)	870 (465)	288 (131)
5th 2 hours	1 200 (85)	1 070 (577)	260 (118)

NOTE: For the average pressure of 1,200 psig (85 bar), assume H to be the latent heat of 1,200 psig (85 bar) steam plus superheat at temperature at the end of the period.

To ensure the condensate is removed efficiently, proper drip leg sizing and piping recommendations should also be followed when installing traps on superheat systems. The Table CG-13 on page CG-21 lists the proper drip leg size for given pipe sizes.

The question arises whether insulation should be used on the drip leg, piping leading to the trap, and the trap. The answer is no; unless it is mandatory for safety reasons, this section of the steam system should not be insulated. This ensures that some condensate is continuously being formed ahead of the trap and going to it, thus prolonging the trap’s life.

Types of Superheat Traps

Bimetallic

A bimetallic trap is set to not open until condensate has cooled to a temperature below saturation. For the existing pressure, it will remain closed whenever steam of any temperature is in the trap. As the steam temperature rises, the pull of the bimetallic element becomes greater, providing a greater sealing force on the valve. Superheated steam tends to seal the valve better. The bimetallic trap also has the ability to handle large start-up loads. For these reasons, this trap is a good choice for superheat.

During superheat operation, the condensate in the trap must cool to a temperature below the saturation temperature before the trap can open. Condensate may back up into the line and cause damage to the lines, valves and equipment if drip leg size and length before the trap are insufficient.

Inverted Bucket

A water seal prevents steam from getting to the valve, promoting no live steam loss and long life. The valve at the top makes it impervious to dirt and permits removal of air. Large start-up loads can be handled, and the trap can still accommodate small running loads. There are problems associated with its application on superheat, mostly associated with the necessity of maintaining its water seal or “prime.” Proper piping is necessary to maintain a prime in the IB.

For proper inverted bucket piping on superheat, refer to Figure CG-31 on page CG-21. When sizing a superheat trap, size for start-up load with no safety factor. Body materials should be selected on the basis of maximum pressure and temperature, including superheat.

How to Trap Space Heating Equipment

Space heating equipment such as unit heaters, air handling units, finned radiation and pipe coils is found in virtually all industries. This type of equipment is quite basic and should require very little routine maintenance. Consequently, the steam traps are usually neglected for long periods of time. One of the problems resulting from such neglect is residual condensate in the heating coil, which can cause damage due to freezing, corrosion and water hammer.

Trap Selection and Safety Factors

Different application requirements involving constant or variable steam pressure determine which type and size of trap should be used. There are two standard methods for sizing traps for coils.

1. **Constant Steam Pressure.**
   INVERTED BUCKET TRAPS AND F&T TRAPS—Use a 3:1 safety factor at operating pressure differentials.

2. **Modulating Steam Pressure.**
   F&T TRAPS AND INVERTED BUCKET TRAPS
   WITH THERMIC BUCKETS

- 0-15 psig steam—2:1 safety factor at 1/2 psi pressure differential
- 16-30 psig steam—2:1 at 2 psi pressure differential
- Above 30 psig steam—3:1 at 1/2 of maximum pressure differential across the trap.

INVERTED BUCKET TRAPS WITHOUT THERMIC BUCKETS
Above 30 psig steam pressure only—3:1 at 1/2 of maximum pressure differential across the trap.

Trap Selection for Unit Heaters and Air Handling Units

You may use three methods to compute the amount of condensate to be handled. Known operating conditions will determine which method to use.

1. **Btu method.** The standard rating for unit heaters and other air coils is Btu output with 2 psig steam pressure in the heater and entering air temperature of 60°F. To convert from standard to actual rating, use the conversion factors in Table CG-16 (page CG-29). Once the actual operating conditions are known, multiply the condensate load by the proper safety factor.

2. **CFM and air temperature rise method.** If you know only CFM capacity of fan and air temperature rise, find the actual Btu output by using this simple formula: Btu/hr = CFM x 1.08 x temperature rise in °F.

EXAMPLE: What size trap will drain a 3 500 CFM heater that produces an 80°F temperature rise? Steam pressure is constant at 60 psig.

Using the formula:
3 500 x 1.08 x 80 = 302 400 Btu/hr.
Now divide 302 400 Btu/hr by 904.5 Btu (from the Steam Tables) to obtain 334 lbs/hr and then multiply by the recommended safety factor 3. The application needs a trap with a 1 002 lbs/hr capacity.

Derive the 1.08 factor in the above formula as follows:
1 CFM x 60 = 60 CFH
60 CFH x .075 lbs of air/cu ft = 4.5 lbs of air/hr
4.5 x 0.24 Btu/lb -°F (specific heat of air) = 1.08 Btu/hr °F - CFM.

3. **Condensate method.**
   Once you determine Btu output:
   a. Divide Btu output by latent heat of steam at steam pressure used. See Column 2 of Table CG-16 (page CG-29) or the Steam Table (page CG-5). This will give the actual weight of steam condensed. For a close approximation, a rule of thumb could be applied in which the Btu output is simply divided by 1,000.
   b. Multiply the actual weight of steam condensing by the safety factor to get the continuous trap discharge capacity required.

Chart CG-11. Multipliers for Sizing Traps for Multiple Coils

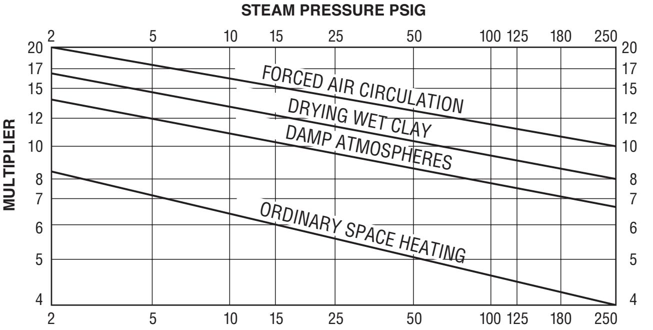


Chart CG-12. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Constant Pressure		1st Choice and Feature Code	Variable Pressure	
		0-30 psig	Above 30 psig		0-30 psig	Above 30 psig
Unit Heaters	B, C, E, K, N	IBLV	IBLV	B, C, G, H, L	F&T	*F&T
	Alternate Choice	F&T	*F&T	Alternate Choice	IBLV	IBLV
Air Handling Units	B, C, E, K, N, O	IBLV	IBLV	B, C, G, H, L	F&T	*F&T
	Alternate Choice	F&T	*F&T	Alternate Choice	IBT	IBLV
Finned Radiation & Pipe Coils	B, C, E, K, N	IBLV	IBLV	B, C, G, H, L	F&T	F&T
	Alternate Choice	Thermostatic	Thermostatic	Alternate Choice	IBLV	IBLV

*Use IBLV above F&T pressure/temperature limitations.

PLEASE NOTE: 1. Provide vacuum breaker wherever subatmospheric pressures occur.
2. Do not use F&T traps on superheated steam.

How to Trap Space Heating Equipment

Trap Selection for Pipe Coils and Finned Radiation

Pipe coils. Insofar as possible, trap each pipe individually to avoid short circuiting.

Single pipe coils. To size traps for single pipes or individually trapped pipes, find the condensing rate per linear foot in Table CG-18 (page CG-29). Multiply the condensing rate per linear foot by the length in feet to get the normal condensate load.

For quick heating, apply a trap selection safety factor of 3:1 and use an inverted bucket trap with a thermic vent bucket. Where quick heating is not required, use a trap selection safety factor of 2:1 and select a standard inverted bucket trap.

Multiple pipe coils. To size traps to drain coils consisting of multiple pipes, proceed as follows:

1. Multiply the lineal feet of pipe in the coil by the condensing rate given in Table CG-18. This gives normal condensate load.
2. From Chart CG-11 (page CG-27), find the multiplier for your service conditions.
3. Multiply normal condensate load by multiplier to get trap required continuous discharge capacity. **Note that the safety factor is included in the multiplier.**

Finned radiation. When Btu output is not known, condensing rates can be computed from Tables CG-17 and CG-19 (page CG-29) with sufficient accuracy for trap selection purposes. To enter Table CG-19, observe size of pipe, size of fins, number of fins and material. Determine condensing rate per foot under standard conditions from Table CG-19. Convert to actual conditions with Table CG-17.

Safety factor recommendations are to:

1. Overcome the short circuiting hazard created by the multiple tubes of the heater.
2. Ensure adequate trap capacity under severe operating conditions. In extremely cold weather the entering air temperature is likely to be lower than calculated, and the increased demand for steam in all parts of the plant may result in lower steam pressures and higher return line pressures—all of which cut trap capacity.
3. Ensure the removal of air and other non-condensables.

WARNING: For low-pressure heating, use a safety factor at the actual pressure differential, not necessarily the steam supply pressure, remembering that the trap must also be able to function at the maximum pressure differential it will experience.

Installation

In general, follow the recommendations of the specific manufacturer. Figs. CG-40, CG-41, CG-42 and CG-43 represent the consensus of space heating manufacturers.

NOTE: For explanation of safety drain trap, see Fig. CG-66 (page CG-49).

Figure CG-40. Trapping and Venting Air Heat Coil

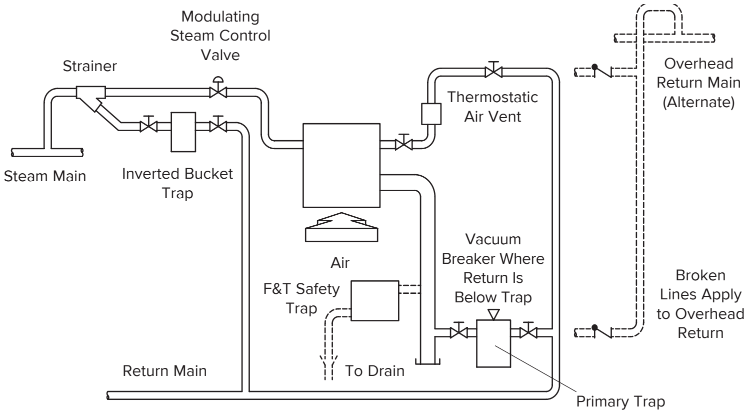


Figure CG-42. Generally approved method of piping and trapping high-pressure (above 15 psi) horizontal discharge heaters. Figs. CG-40 and CG-41 drip leg should be 10”-12” minimum.

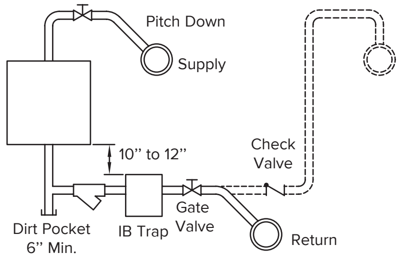


Figure CG-41. Trapping and Venting Air Heat Coil

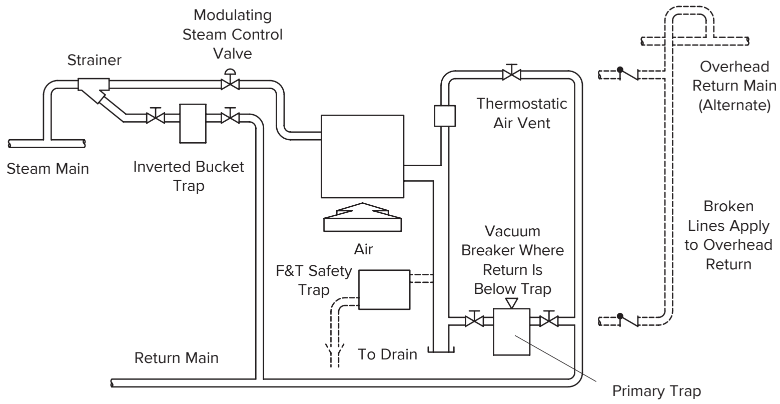


Figure CG-43. Generally approved method of piping and trapping low-pressure (under 15 psi) vertical discharge heaters.

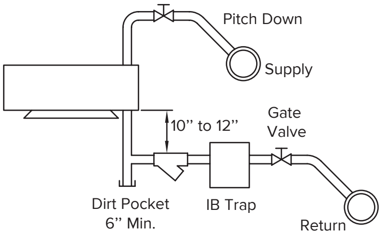


Table CG-16. A Table of Constants for determining the Btu output of a unit heater with conditions other than standard — standard being with 2 lbs steam pressure at 60°F entering air temperature. To apply, multiply the standard Btu capacity rating of heater by the indicated constant. (Reprinted from• ASHRAE Guide by special permission.)

Steam Pressure lbs Per sq in	Latent Heat of Steam	Entering Air Temperature °F											
		-10	0	10	20	30	40	50	60	70	80	90	100
2	966.3	—	—	—	—	—	1.155	1.078	1.000	0.926	0.853	0.782	0.713
5	960.7	1.640	1.550	1.456	1.370	1.289	1.206	1.127	1.050	0.974	0.901	0.829	0.760
10	**952.4**	**1.730**	**1.639**	**1.545**	**1.460**	**1.375**	**1.290**	**1.211**	**1.131**	**1.056**	**0.982**	**0.908**	**0.838**
15	945.5	1.799	1.708	1.614	1.525	1.441	1.335	1.275	1.194	1.117	1.043	0.970	0.897
20	939.3	1.861	1.769	1.675	1.584	1.498	1.416	1.333	1.251	1.174	1.097	1.024	0.952
30	**928.5**	**1.966**	**1.871**	**1.775**	**1.684**	**1.597**	**1.509**	**1.429**	**1.346**	**1.266**	**1.190**	**1.115**	**1.042**
40	919.3	2.058	1.959	1.862	1.771	1.683	1.596	1.511	1.430	1.349	1.270	1.194	1.119
50	911.2	2.134	2.035	1.936	1.845	1.755	1.666	1.582	1.498	1.416	1.338	1.262	1.187
60	**903.9**	**2.196**	**2.094**	**1.997**	**1.902**	**1.811**	**1.725**	**1.640**	**1.555**	**1.472**	**1.393**	**1.314**	**1.239**
70	897.3	2.256	2.157	2.057	1.961	1.872	1.782	1.696	1.610	1.527	1.447	1.368	1.293
75	893.8	2.283	2.183	2.085	1.990	1.896	1.808	1.721	1.635	1.552	1.472	1.392	1.316
80	**891.1**	**2.312**	**2.211**	**2.112**	**2.015**	**1.925**	**1.836**	**1.748**	**1.660**	**1.577**	**1.497**	**1.418**	**1.342**
90	885.4	2.361	2.258	2.159	2.063	1.968	1.880	1.792	1.705	1.621	1.541	1.461	1.383
100	880.0	2.409	2.307	2.204	2.108	2.015	1.927	1.836	1.749	1.663	1.581	1.502	1.424

Table CG-17. Finned Radiation Conversion Factors for steam pressures and air temperatures other than 65°F air and 215°F steam.

Steam Pressure (psig)	Steam Temp. (°F)	Entering Air Temperature °F						
		45	55	65	70	75	80	90
.9	215.0	1.22	1.11	1.00	.95	.90	.84	.75
5	227.1	1.34	1.22	1.11	1.05	1.00	.95	.81
10	**239.4**	**1.45**	**1.33**	**1.22**	**1.17**	**1.11**	**1.05**	**.91**
15	249.8	1.55	1.43	1.31	1.26	1.20	1.14	1.00
30	274.0	1.78	1.66	1.54	1.48	1.42	1.37	1.21
60	**307.3**	**2.10**	**2.00**	**1.87**	**1.81**	**1.75**	**1.69**	**1.51**
100	337.9	2.43	2.31	2.18	2.11	2.05	2.00	1.81
125	352.9	2.59	2.47	2.33	2.27	2.21	2.16	1.96
175	**377.4**	**2.86**	**2.74**	**2.60**	**2.54**	**2.47**	**2.41**	**2.21**

Table CG-18. Condensing Rates in Bare Pipe Carrying Saturated Steam

Steam Pressure (psig) Temp. Rise From 70°		Pounds of Condensate Per hr Per Lineal ft					
Pipe Size (in)	sq ft Per Lineal ft	15 180	30 204	60 237	125 283	180 310	250 336
1/2	.220	.13	.15	.19	.26	.30	.35
3/4	.275	.15	.19	.24	.33	.38	.45
1	**.344**	**.19**	**.23**	**.28**	**.39**	**.46**	**.54**
1-1/4	.434	.23	.28	.36	.49	.57	.67
1-1/2	.497	.26	.32	.41	.55	.65	.76
2	**.622**	**.33**	**.40**	**.50**	**.68**	**.80**	**.93**
2-1/2	.753	.39	.47	.59	.81	.95	1.11
3	.916	.46	.56	.70	.96	1.13	1.31
3-1/2	**1.047**	**.52**	**.63**	**.80**	**1.08**	**1.27**	**1.50**
4	1.178	.58	.70	.89	1.21	1.43	1.72

Table CG-19. Finned Radiation Condensing Rates with 65°F air and 215°F steam (for trap selection purposes only).

	Pipe Size (in)	Fin Size (in)	Fins Per Inch	No. of Pipes High on 6" Centers	Condensate lbs/hr Per Foot of Pipe
Steel Pipe, Steel Fins Painted Black	1-1/4	3-1/4	3 to 4	1	1.1
				2	2.0
				3	**2.6**
	1-1/4	4-1/4	3 to 4	1	1.6
				2	2.4
				3	**3.1**
	2	4-1/4	2 to 3	1	1.5
				2	2.4
				3	**3.1**
Copper Pipe Aluminum Fins Unpainted	1-1/4	3-1/4	4	1	1.6
				2	2.2
				3	**2.8**
	1-1/4	4-1/4	5	1	2.2
				2	3.0
				3	**3.6**

How To Trap Process Air Heaters

Process air heaters are used for drying paper, lumber, milk, starch and other products as well as preheating combustion air for boilers.

Common examples of this type of equipment are process dryers, tunnel dryers, and combustion air preheaters. Compared with air heaters for space heating, process air heaters operate at very high temperature, 500°F not being uncommon. These extremely high-temperature applications require high pressure (and occasionally superheated) steam.

Trap Selection and Safety Factor

Determine the condensate load for process air heaters with the following formula:

$$Q = \frac{F \times Cp \times d \times 60 \text{ min/hr} \times \Delta T}{H}$$

Where:

Q = Condensate load in lbs/hr
F = Cubic feet of air per minute
Cp = Specific heat of air in Btu/lb—°F (from Table CG-34, page CG-57)
d = Density of air—.075 lbs/cu ft
ΔT = Temperature rise in °F
H = Latent heat of steam in Btu/lb (Steam Table, page CG-5)

EXAMPLE: What would be the condensate load on a tunnel dryer coil handling 2 000 CFM of air and requiring a 100°F temperature rise? The steam pressure is 45 psig. Using the formula:

$$Q = \frac{2\ 000 \times .24 \times .075 \times 60 \times 100}{915}$$

$$Q = 236 \text{ lbs/hr}$$

Multiplying by a safety factor of 2—which is recommended for all constant pressure process air heaters—indicates that a trap with a capacity of 472 lbs/hr will be required. This is based on one coil. For higher air temperature rises, additional coils in series may be required.

Safety Factors

For constant steam pressure, use a safety factor of 2:1 at operating pressure differential. For modulating steam pressure, use a safety factor of 3:1 at 1/2 of maximum pressure differential across the trap.

Installation

Give piping for an entire piece of process air heating equipment—including all steam trap connections—adequate allowance for expansion due to the wide temperature variations. Mount traps 10”-12” below the coils with a dirt pocket of at least 6”. On both constant and modulated pressure heaters, install a vacuum breaker between the coil and the steam trap. Install an air vent on each coil to remove air and other non-condensables that can cause rapid corrosion.
See Fig. CG-44.

Consider a safety drain if condensate is elevated after the trap or if back pressure is present. See page CG-49 for piping diagram and explanation.

Figure CG-44. Process Air Heater

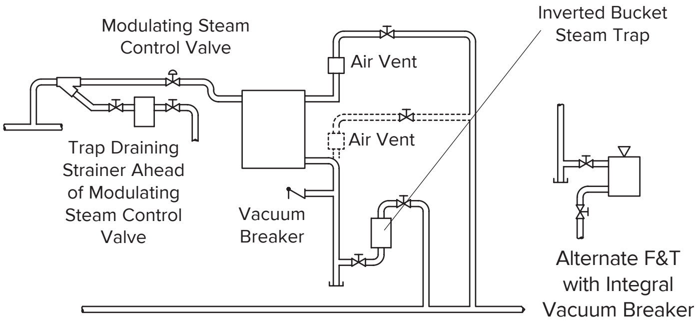


Chart CG-13. Recommendation Chart
(See Page CG-4 for “Feature Code” References.)

Equipment Being Trapped	1st Choice and Feature Code	Constant Pressure		1st Choice and Feature Code	Variable Pressure	
		0-30 psig	Above 30 psig		0-30 psig	Above 30 psig
Process Air Heaters	A, B, F, I, K, M	IB	IB	B, C, G, H, L	F&T	*F&T
	Alternate Choice	F&T	IBLV	Alternate Choice	IBLV	IBLV

*Use IBLV above F&T pressure temperature limitations.

PLEASE NOTE:
1. Provide vacuum breaker wherever subatmospheric pressures occur.
2. Do not use F&T traps on superheated steam.

Armstrong® How To Trap – Shell & Tube Heat Exchangers & Submerged Coils

Submerged coils are heat transfer elements that are immersed in the liquid to be heated, evaporated or concentrated. This type of coil is found in virtually every plant or institution that uses steam. Common examples are water heaters, reboilers, suction heaters, evaporators and vaporizers. These are used in heating water for process or domestic use, vaporizing industrial gases such as propane and oxygen, concentrating in-process fluids such as sugar, black liquor and petroleum, and heating fuel oil for easy transfer and atomization.

Different application requirements involving constant or variable steam pressure determine which type of trap should be used. Trap selection factors include the ability to handle air at low differential pressures, energy conservation and the removal of dirt and slugs of condensate. Three standard methods of sizing help determine the proper type and size traps for coils.

Safety Factor

1. **Constant Steam Pressure.** INVERTED BUCKET TRAPS OR F&T TRAPS—use a 2:1 safety factor at operating pressure differentials.
2. **Modulating Steam Pressure.** F&T TRAPS OR INVERTED BUCKET TRAPS.
   1. 0-15 psig steam—2:1 at 1/2 psi pressure differential.
   2. 16-30 psig steam—2:1 at 2 psi pressure differential.
   3. Above 30 psig steam—3:1 at 1/2 of maximum pressure differential across the trap.
3. **Constant or Modulating Steam Pressure with Syphon Drainage.** An automatic differential condensate controller with a safety factor of 3:1 should be used. An alternate is an IBLV with a 5:1 safety factor.

Apply the safety factor at full differential on constant steam pressure. Apply the safety factor at 1/2 maximum differential for modulating steam pressure.

Shell and Tube Heat Exchangers

One type of submerged coil is the shell and tube heat exchanger (Fig. CG-45). In these exchangers, numerous tubes are installed in a housing or shell with confined free area. This ensures positive contact with the tubes by any fluid flowing in the shell. Although the term submerged coil implies that steam is in the tubes and the tubes are submerged in the liquid being heated, the reverse can also be true, where steam is in the shell and a liquid is in the tubes.

Trap Selection for Shell and Tube Heat Exchangers

To determine the condensate load on shell and tube heaters, use the following formula when actual rating is known.* (If heating coil dimensions alone are known, use formula shown for embossed coils. Be sure to select applicable "U" factor):

$$Q = \frac{L \times \Delta T \times C \times 500 \times sg}{H}$$

Where:

Q = Condensate load in lbs/hr

L = Liquid flow in GPM

ΔT = Temperature rise in °F

C = Specific heat of liquid in Btu/lb-°F (Table CG-33, page CG-57)

500 = 60 min/hr x 8.33 lbs/gal

sg = Specific gravity of liquid (Table CG-33)

H = Latent heat of steam in Btu/lb (Steam Table, page CG-5)

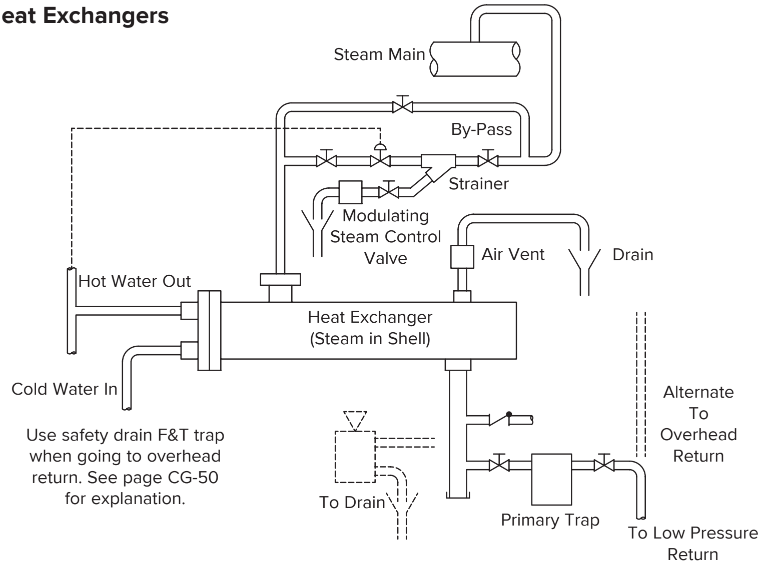
EXAMPLE: Assume a water flow rate of 50 GPM with an entering temperature of 40°F and a leaving temperature of 140°F. Steam pressure is 15 psig. Determine the condensate load.

Using the formula:

$$Q = \frac{50 \text{ GPM} \times 100°\text{F} \times 1 \text{ Btu/lb-°F} \times 500 \times 1.0 \text{ sg}}{945 \text{ Btu/lb}} =$$

*** Size steam traps for reboilers, vaporizers and evaporators (processes that create vapor) using the formula for EMBOSSED COILS on page CG-32.**

Figure CG-45. Shell And Tube Heat Exchangers
(Typical Piping Diagram)



Use safety drain F&T trap when going to overhead return. See page CG-50 for explanation.

Rule of Thumb for Computing Condensing Rate for Water Heaters: Raising the temperature of 100 gallons of water 1°F will condense one pound of steam.

Embossed Coils

Very often open tanks of water or chemicals are heated by means of embossed coils (Fig. CG-46). Upsetting grooves in the sheet metal of the two halves produce the spaces for the steam. When welded together, the halves form the passages for steam entry, heat transfer and condensate evacuation.

Trap Selection for Embossed Coils

Calculate the condensate load on embossed coils with the following formula:

Q = A x U x Dm

Where:

Q = Total heat transferred in Btu per hour
A = Area of outside surface of coil in sq ft
U = Overall rate of heat transfer in Btu per hr-sq ft-°F. See Tables CG-20 and CG-21.
Dm = Logarithmic mean temperature difference between steam and liquid (as between inlet and outlet of a heat exchanger) in °F

$$Dm = \frac{D1-D2}{Log_e \frac{(D1)}{(D2)}}$$

D1 = Greatest temperature difference
D2 = Least temperature difference

Logarithmic mean temperature difference can be determined with slightly less accuracy using the nomograph, Chart CG-16 (page CG-36).

U values are determined by tests under controlled conditions.

Tables CG-20 and CG-21 show the commonly accepted range for submerged embossed coils. For trap selection purposes, use a U value that is slightly greater than the conservative U value selected for estimating actual heat transfer.

EXAMPLE:

A = 20 sq ft of coil surface
U = 175 Btu/sq ft-hr-°F
Conditions:
Water in: 40°F
Water out: 150°F
Steam pressure: 125 psig or 353°F
D1 = 353 - 40, or 313
D2 = 353 - 150, or 203

Dividing by 4 to get within range of Chart CG-16 (page CG-36), we have:
D1 = 78.25
D2 = 50.75

Mean difference from chart is 63°F.
Multiplying by 4, the mean temperature difference for the original values is 252°F. Substituting in the equation:

Q = 20 x 175 x 252 = 882 000 Btu/hr

Btu transferred per hour.
Latent heat of steam at 125 psig = 867.6

$$\frac{882\ 000}{867.6} = 1\ 016 \text{ lbs condensate per hr}$$

To determine trap capacity required, multiply condensing rate by the recommended safety factor.

Table CG-20. Pipe Coil U Values in Btu/hr-sq ft-°F

Type of Service	Circulation	
	Natural	Forced
Steam to Water	50-200	150-1 200
1-1/2” Tube Heaters	180	450
3/4” Tube Heaters	200	500
Steam to Oil	10-30	50-150
Steam to Boiling Liquid	300-800	-
Steam to Boiling Oil	50-150	-

Table CG-21. Embossed Coil U Values in Btu/hr-sq ft-°F

Type of Service	Circulation	
	Natural	Forced
Steam to Watery Solutions	100-200	150-275
Steam to Light Oil	40-45	60-110
Steam to Medium Oil	20-40	50-100
Steam to Bunker C	15-30	40-80
Steam to Tar Asphalt	15-25	18-60
Steam to Molten Sulphur	25-35	35-45
Steam to Molten Paraffin	25-35	40-50
Steam to Molasses or Corn Syrup	20-40	70-90
Downtherm to Tar Asphalt	15-30	50-60

Figure CG-46. Thermostatic Controlled Embossed Coil, Syphon Drained

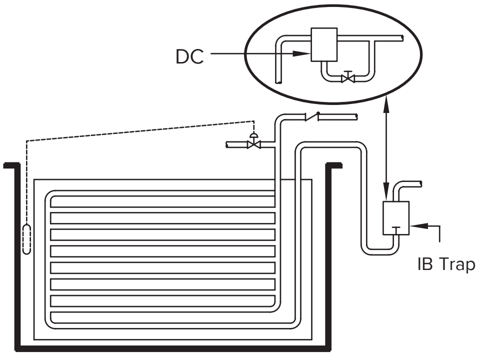
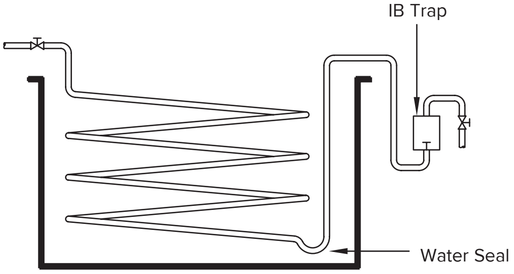


Figure CG-47. Continuous Coil, Syphon Drained



Pipe Coils

Pipe coils are heat transfer tubes immersed in vessels that are large in volume compared to the coils themselves (Fig. CG-47, page CG-32). This is their primary difference when compared to shell and tube heat exchangers. Like embossed coils, they may be drained by gravity or syphon drained, depending on the conditions prevailing at the installation site. Unlike embossed coils, most pipe coils are installed in closed vessels.

Trap Selection for Pipe Coils

Determine the condensate load for pipe coils by applying one of the formulas, depending on known data. If capacity is known, use the formula under shell and tube heat exchangers. When physical dimensions of coil are known, use the formula under embossed coils.

Installation

When gravity drainage is utilized on shell and tube heat exchangers, embossed coils and pipe coils, locate the steam trap below the heating coil. Under modulating pressure, use a vacuum breaker. This can be integral in F&T traps or mounted off the inlet piping on an inverted bucket trap. Place an ample drip leg ahead of the trap to act as a reservoir. This ensures coil drainage when there is a maximum condensate load and a minimum steam pressure differential.

Avoid lifting condensate from a shell and tube heat exchanger, embossed coil or pipe coil under modulated control. However, if it must be done, the following is suggested:

1. Do not attempt to elevate condensate more than 1' for every pound of normal pressure differential, either before or after the trap.
2. If condensate lift takes place after the steam trap, install a low-pressure safety drain. (See page CG-49).
3. If condensate lift takes place ahead of the steam trap (syphon lift), install an automatic differential condensate controller to efficiently vent all flash steam.

For Pounds of Steam Condensed Per sq ft Per Hour of Submerged Coil Surface, see Chart CG-17 (page CG-36).

Chart CG-14. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Constant Pressure		1st Choice and Feature Code	Variable Pressure	
		0-30 psig	Above 30 psig		0-30 psig	Above 30 psig
Shell and Tube Heat Exchangers	B, C, E, F G, I, K N, Q	IBLV	IBLV	B, C, G, H, I, L	F&T†	F&T†
	Alternate Choice	DC F&T	DC *F&T	Alternate Choice	DC IBT	DC IBLV
Embossed Coils and Pipe Coils Syphon Drain	B, C, E, F, G, H, I K, N, Q	DC	DC	B, C, G, H, I, L	DC	DC
	Alternate Choice	IBLV	IBLV	Alternate Choice	F&T†	*F&T†
Embossed Coild and Pipe Coils Gravity Drain	B, C, E, F, G, I, K N, Q	IBLV	IBLV	B, C, G, H, I, L	F&T†	*F&T†
	Alternate Choice	DC F&T	DC F&T	Alternate Choice	DC IBT	DC IBLV

*Use IBLV above pressure/temperature limitations.
†If dirt and large volumes of air must be handled, an inverted bucket trap with an external thermostatic air vent can be used effectively.

Please Note:
1. Provide vacuum breaker wherever subatmospheric pressures occur.
2. Provide a safety drain when elevating condensate on modulating service.

How to Trap Evaporators

Evaporators reduce the water content from a product through the use of heat. They are very common to many industries, especially paper, food, textiles, chemical and steel.

An evaporator is a shell and tube heat exchanger where the steam is normally in the shell and the product is in the tubes and in motion. Depending upon the type of product and the desired results, more than one stage or effect of evaporation may be required. The triple effect is the most common, although as many as five or six can be found on some applications.

Single Effect

While the product is being forced through the tubes of the evaporator, heat is added to remove a specific amount of moisture. After this is completed, both the product vapor and the concentrated product are forced into the separating chamber where the vapor is drawn off and may be used elsewhere. The concentrate is then pumped off to another part of the process (Fig. CG-48).

Multiple Effect

In using the multiple effect method, there is a conservation of heat as steam from the boiler is used in the first effect, and then vapor generated from the product is used as the heat source in the second effect. The vapor generated here is then used as the heat source in the third effect and finally heats water for some other process or preheats the incoming feed (Fig. CG-49).

There are many variables in the design of evaporators due to their wide application to many different products. The steam capabilities for evaporators can vary from approximately 1 000 lbs per hour to 100 000 lbs per hour, while steam pressures may vary from a high of 150 psig in the first effect to a low of 24'' mercury vacuum in the last effect.

Because evaporators are normally run continuously, there is a uniform load of condensate to be handled. It's important to remember that traps must be selected for the actual pressure differential for each effect.

The three major considerations when trapping evaporators are:

1. Large condensate loads.
2. Low pressure differentials in some effects.
3. The evacuation of air and contaminants.

Safety Factor

- When load is fairly constant and uniform, a 2:1 safety factor should be adequate when applied to an actual condensing load in excess of 50,000 lbs/hr.
- Below 50 000 lbs/hr, use a 3:1 safety factor.

For single and multiple effect evaporators, automatic differential condensate controllers are recommended. In addition to offering continuous operation, DC traps vent air and CO_2 at steam temperature, handle flash steam and respond immediately to slugs of condensate.

Figure CG-48. Single Effect Evaporator System

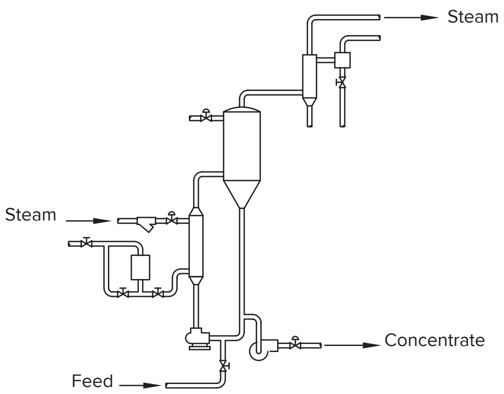


Figure CG-49. Triple Effect Evaporator System

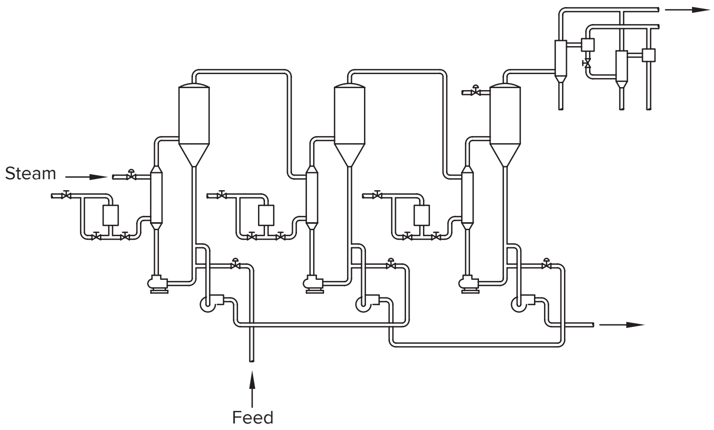


Chart CG-15. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice, Feature Code and Alternate Choice(s)	0-30 psig	Above 30 psig
Evaporator Single Effect	A, F, G, H, K, M, P	DC	DC
	Alternate Choices	IBLV F&T	IBLV F&T
Evaporator Multiple Effect	A, F, G, H, K, M, P	DC	DC
	Alternate Choices	IBLV F&T	IBLV F&T

How to Trap Evaporators

Installation

Because an evaporator is basically a shell and tube heat exchanger with the steam in the shell, there should be separate steam air vents on the heat exchanger. Place these vents at any area where there is a tendency for air to accumulate, such as in the quiet zone of the shell. Install a separate trap on each effect. While the condensate from the first effect may be returned to the boiler, condensate from each successive effect may not be returned to the boiler due to contamination from the product.

Trap Selection for Evaporators

When calculating the condensate load for evaporators, take care in selecting the U value (Btu/hr-sq ft-°F). As a general rule, the following U values can be used:

- 300 for natural circulation evaporators with low pressure steam (up to 25 psig)
- 500 on natural circulation with high pressure (up to 45 psig)
- 750 with forced circulation evaporators

Use the following formula to compute heat transfer for constant steam pressure continuous flow heat exchangers.

$$Q = A \times U \times Dm$$

Where:

Q = Total heat transferred in Btu per hour

A = Area of outside surface of coil in sq ft

U = Overall rate of heat transfer in Btu/hr-sq ft-°F (See Tables CG-20 and CG-21 on page CG-32)

Dm = Logarithmic mean temperature difference between steam and liquid (as between inlet and outlet of a heat exchanger) in °F

$$Dm = \frac{D1-D2}{\text{Log}_e \frac{(D1)}{(D2)}}$$

Where:

D1 = Greatest temperature difference

D2 = Least temperature difference

Logarithmic mean temperature difference can be estimated by using the nomograph, Chart CG-16 (page CG-36).

EXAMPLE:

A = Heat transfer tubes: eight 3/4” OD tubes 12’ long

$$\frac{8 \times 12'}{5.09 \text{ (from Table CG-24)}} = 20 \text{ sq ft of coil surface}$$

U = 500 Btu/hr-sq ft-°F

Conditions:
Water in: 40°F
Water out: 150°F

125 psig or 353°F steam pressure:
D1 = 353°F - 40°F, or 313°F
D2 = 353°F - 150°F, or 203°F

Dividing by 4 to get within range of Chart CG-16, we have:
D1 = 78.25°F
D2 = 50.75°F

Mean difference from chart is 63°F. Multiplying by 4, the mean temperature difference for the original value is 252°F. Substituting in the equation:

Q = 20 x 500 x 252 = 2 520 000 Btu/hr transferred per hour

Latent heat of steam at 125 psig = 867.6

$$\frac{2\ 520\ 000}{867.69} = 2\ 900 \text{ lbs condensate per hour}$$

To determine trap capacity required, multiply the condensing rate by the recommended safety factor.

How to Trap Evaporators

Table CG-22. Pipe Coil U Values in Btu/hr-sq ft-°F

Type of Service	Circulation	
	Natural	Forced
Steam to Water	50-200	150-200
1-1/2" Tube Heaters	180	450
3/4" Tube Heaters	200	500
Steam to Oil	10-30	50-150
Steam to Boiling Liquid	300-800	-
Steam to Boiling Oil	50-150	-

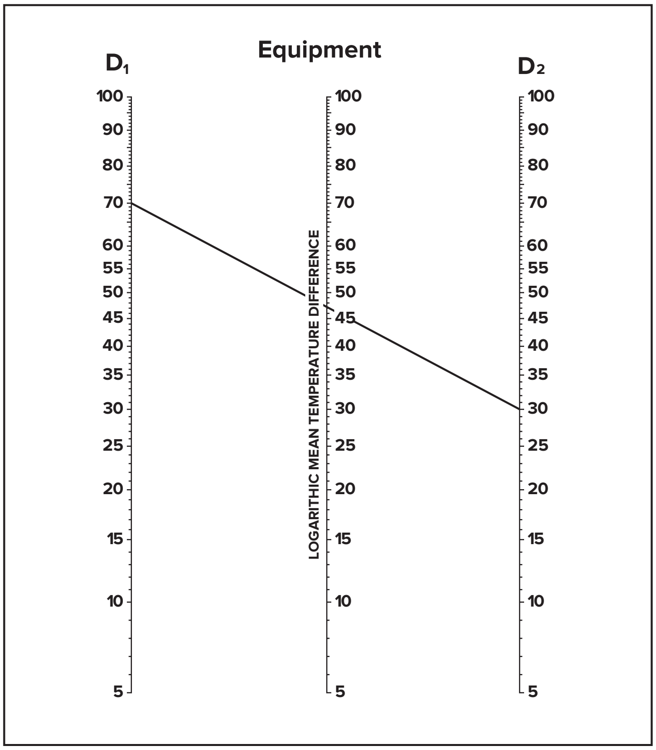
Table CG-24. Pipe Size Conversion Table. (Divide lineal feet of pipe by factor given for size and type of pipe to get square feet of surface)

Pipe Size (in)	Iron Pipe	Copper or Brass Pipe
1/2	4.55	7.63
3/4	3.64	5.09
1	**2.90**	**3.82**
1-1/4	2.30	3.05
1-1/2	2.01	2.55
2	**1.63**	**1.91**
2-1/2	1.33	1.52
3	1.09	1.27
4	**.848**	**.954**

Table CG-23. Embossed Coil U Values in Btu/hr-sq ft-°F

Type of Service	Circulation	
	Natural	Forced
Steam to Watery Solutions	100-200	150-275
Steam to Light Oil	40-45	60-110
Steam to Medium Oil	20-40	50-100
Steam to Bunker C	15-30	40-80
Steam to Tar Asphalt	15-25	18-60
Steam to Molten Sulphur	25-35	35-45
Steam to Molten Paraffin	25-35	40-50
Steam to Molasses or Corn Syrup	20-40	70-90
Downtherm to Tar Asphalt	15-30	50-60

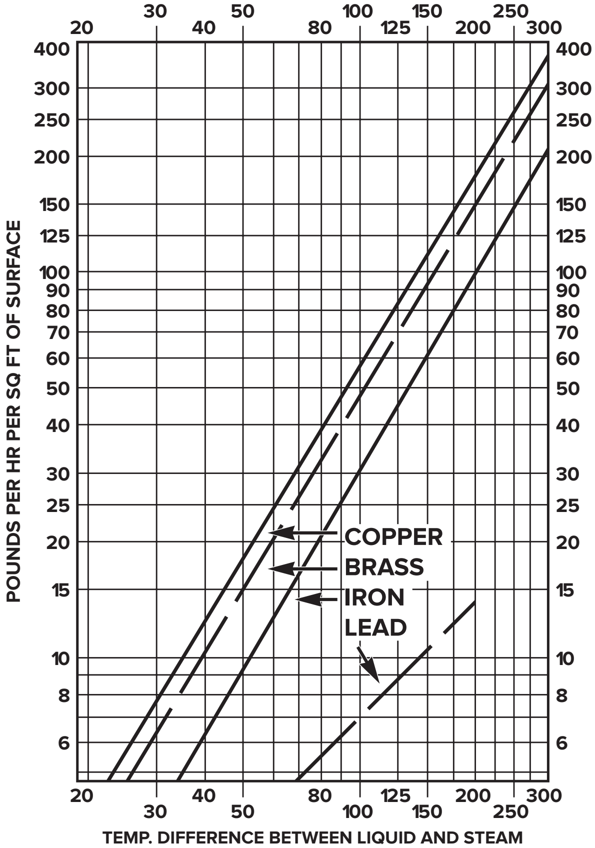
Chart CG-16. Mean Temperature Difference Chart for Heat Exchange Equipment



Connect greatest temperature difference on scale D_1 with least temperature difference on scale $\mathbf{D_2}$ to read logarithmic mean temperature difference on center scale.

Chart CG-17. Pounds of Steam Condensed Per sq ft Per Hour of Submerged Coil Surface

(See "Conditions" conversion factors below chart)



Condition Factors
(Divide chart figures by proper factor)

CONDITIONS	FACTOR
Will remain bright	1
Moderate scale	2
Liquid contains up to 25% solids	3-5
Thick viscous liquids	4-8

How to Trap Jacketed Kettles

Steam jacketed kettles are essentially steam jacketed cookers or concentrators. They are found in all parts of the world and in almost every kind of application: meat packing, paper and sugar making, rendering, fruit and vegetable processing and food preparation—to name a few.

There are basically two types of steam jacketed kettles—fixed gravity drain and tilting syphon drain. Each type requires a specialized method for trapping steam, although the major problems involved are common to both.

The most significant problem encountered is air trapped within the steam jacket, which adversely affects the temperature. Jacketed kettles usually perform batch operations, and maintaining a uniform or “cooking” temperature is critical. With an excessive amount of air, wide variations in temperature occur and may result in burnt product and/or slow production. To be more specific, under certain conditions as little as 1/2 of 1% by volume of air in steam can form an insulating film on the heat transfer surface and reduce efficiency as much as 50%. See pages CG-9 and CG-10.

A second basic concern in the use of steam jacketed kettles is the need for a steady, thorough removal of condensate. Accumulation of condensate in the jacket leads to unreliable temperature control, reduces the output of the kettle and causes water hammer.

Trap Selection for Jacketed Kettles

Table CG-25 gives the required trap capacities for various size kettles based on the following assumptions:
U = 175 Btu/hr-sq ft-°F
Safety factor of 3 included.

EXAMPLE: What would be the recommended trap capacity for a 34” gravity drained kettle at 40 psig steam? Reading directly from the chart, a trap with a capacity of 1 704 lbs/hr at the operating pressure is required.

For an alternative method of determining condensate, use the following formula:

$$Q = \frac{G \times sg \times Cp \times \Delta T \times 8.3}{H \times t}$$

Where:

Q = Condensate loads (lbs/hr)
G = Gallons of liquid to be heated
sg = Specific gravity of the liquid
Cp = Specific heat of the liquid
ΔT = Temperature rise of the liquid °F
8.3 = lbs/gal of water
H = Latent heat of the steam (Btu/lb)
t = Time in hours for product heating

EXAMPLE: Select a trap for a 250-gallon kettle using 25 psig steam to heat a product with a specific gravity of 0.98 and a specific heat of 0.95 Btu/lb-°F. Starting at room temperature of 70°F, the product will be heated to 180°F in 1/2 hour. (Assume 3:1 safety factor.) Using the formula:

$$Q = \frac{250 \text{ gal} \times 0.98 \times 0.95 \text{ Btu/lb-°F} \times 110\text{°F} \times 8.3 \text{ lbs/gal}}{933 \text{ Btu/lb} \times 0.5 \text{ hr}}$$

$$= \frac{212\,500}{466.5}$$

$$= 455 \text{ lbs/hr}$$

Now simply multiply by a safety factor of 3 to get 1,365 lbs/hr of condensate and select the proper type and capacity trap.

Based on the standard requirements and problems involved with fixed gravity drained kettles, the most efficient type trap to use is the inverted bucket.

The inverted bucket trap vents air and CO_2 at steam temperature and provides total efficiency against back pressure. The primary recommendation for tilting syphon drained kettles is the automatic differential condensate controller. In addition to providing the same features as the IB, the DC offers excellent air venting ability at very low pressure and excellent flash steam handling ability. If an IB trap is selected for syphon drained service, use a trap one size larger.

General Recommendations for Maximum Efficiency

Desirable Cooking Speed. Because the product cooked has such an important bearing on trap selection, a plant with many jacketed kettles should conduct experiments using different sizes of traps to determine the size giving best results.

Steam Supply. Use steam lines of ample size to supply steam to the kettles. Locate the inlet nozzle high up on the jacket for best results. It should be slotted so as to give steam flow around the entire jacket area.

Installation

Install traps close to the kettle. You can further increase the dependability and air-handling capability by installing a thermostatic air vent at high points in the jacket. See Figs. CG-50 and CG-51.

Never drain two or more kettles with a single trap. Group drainage will invariably result in short circuiting.

Chart CG-18. Recommendation Chart
(See Page CG-4 for “Feature Code” References.)

Equipment Being Trapped	1st Choice and Feature Code	Alernate Choices
Jacketed Kettles Gravity Drain	IBLV B, C, E, H, K, N	F&T or Thermostatic
Jacketed Kettles Syphon Drain	DC B, C, E, G, H, K, N, P	IBLV

How to Trap Jacketed Kettles

Figure CG-50. Fixed Gravity Drained Kettle

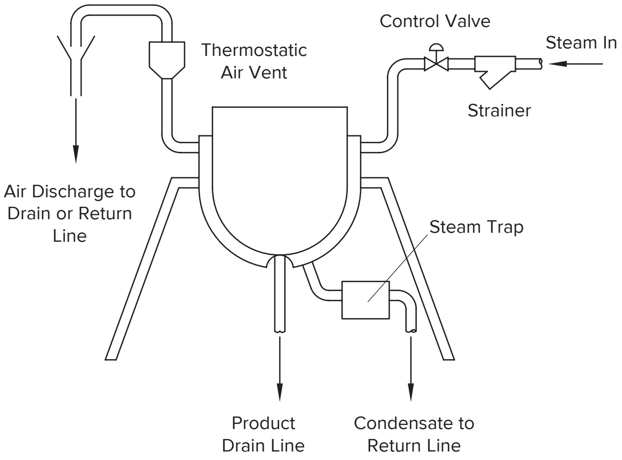


Figure CG-51. Tilting Syphon Drained Kettle

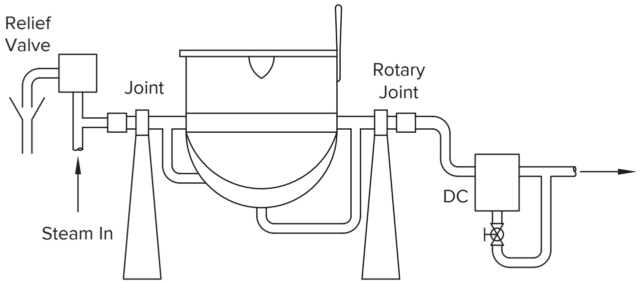


Table CG-25. Condensate Rates in lbs/hr for Jacketed Kettles—Hemispherical Condensing Surface
Safety factor 3:1 is included. Assume U = 175 Btu/hr-sq ft-°F, 50°F starting temperature.

Kettle Diameter (in)	Heat Transfer Surface (sq ft)	U.S. Gallons of Water in Hemisphere	U.S. Gals. Water per in. of Height Above Hemisphere	Steam Pressure								
				5 psig 227°F	10 psig 240°F	15 psig 250°F	25 psig 267°F	40 psig 287°F	60 psig 307°F	80 psig 324°F	100 psig 338°F	125 psig 353°F
18	3.50	7	1.10	339	366	387	426	474	522	564	603	642
19	3.90	8	1.20	378	408	432	477	528	582	630	669	714
20	**4.35**	**9**	**1.35**	**420**	**456**	**483**	**531**	**588**	**651**	**702**	**747**	**798**
22	5.30	12	1.65	513	555	588	648	717	792	855	912	972
24	6.30	16	1.95	609	660	699	768	852	942	1 017	1 083	1 155
26	**7.40**	**20**	**2.30**	**717**	**774**	**822**	**903**	**1 002**	**1 107**	**1 194**	**1 272**	**1 356**
28	8.50	25	2.65	822	891	942	1 038	1 149	1 269	1 371	1 461	1 557
30	9.80	31	3.05	948	1 026	1 089	1 197	1 326	1 464	1 581	1 686	1 797
32	**11.20**	**37**	**3.50**	**1 086**	**1 173**	**1 242**	**1 368**	**1 515**	**1 674**	**1 809**	**1 926**	**2 052**
34	12.60	45	3.95	1 221	1 320	1 398	1 539	1 704	1 881	1 944	2 166	2 310
36	14.10	53	4.40	1 365	1 476	1 566	1 722	1 908	2 106	2 277	2 424	2 586
38	**15.70**	**62**	**4.90**	**1 521**	**1 644**	**1 743**	**1 917**	**2 124**	**2 346**	**2 535**	**2 700**	**2 877**
40	17.40	73	5.45	1 686	1 821	1 932	2 124	2 355	2 601	2 808	2 991	3 189
42	19.20	84	6.00	1 860	2 010	2 130	2 343	2 598	2 868	3 099	3 300	3 519
44	**21.10**	**97**	**6.60**	**2 043**	**2 208**	**2 343**	**2 577**	**2 856**	**3 153**	**3 405**	**3 627**	**3 867**
46	23.00	110	7.20	2 229	2 409	2 553	2 808	3 111	3 435	3 711	3 954	4 215
48	25.30	123	7.85	2 451	2 649	2 808	3 087	3 423	3 780	4 083	4 350	4 638
54	**31.70**	**178**	**9.90**	**3 076**	**3 324**	**3 523**	**3 875**	**4 296**	**4 743**	**5 125**	**5 458**	**5 820**
60	39.20	245	12.30	3 798	4 104	4 350	4 785	5 304	5 856	6 327	6 738	7 185
72	56.40	423	17.70	5 469	5 910	6 264	6 890	7 638	8 433	9 111	9 703	10 346

How to Trap – Closed, Stationary Steam Chamber Equipment

Closed, stationary steam chamber equipment includes platen presses for the manufacture of plywood and other sheet products, steam jacketed molds for rubber and plastic parts, autoclaves for curing and sterilizing and retorts for cooking.

Product Confined in Steam Jacketed Press

Molded plastic and rubber products such as battery cases, toys, fittings and tires are formed and cured, and plywood is compressed and glue-cured in equipment of this type. Laundry flatwork ironers are a specialized form of press with a steam chamber on one side of the product only.

Trap Selection and Safety Factor

The condensate load for closed, stationary steam chamber equipment is determined by use of the following formula:

$$Q = A \times R \times S$$

Where:

Q = Condensate load in lbs/hr

A = Total area of platen in contact with product in sq ft

R = Condensing rate in lbs/sq ft-hr (For purposes of sizing steam traps, a 3 lbs/sq ft-hr condensing rate may be used)

S = Safety factor

EXAMPLE: What is the condensate load for a mid platen on a press with 2’ x 3’ platens, upper and lower? Using the formula:

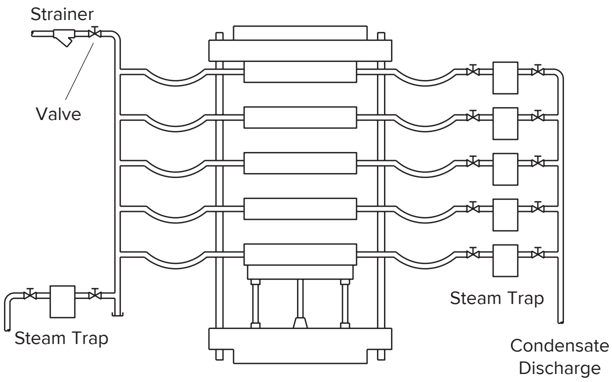
Q = 12 sq ft x 3 lbs/sq ft-hr x 3 = 108 lbs/hr

End platens would have half this load.

The safety factor recommended for all equipment of this type is 3:1.

The inverted bucket trap is the recommended first choice on steam jacketed chambers, dryers and ironers because it can purge the system, resist hydraulic shock and conserve energy. Disc and thermostatic type traps may be acceptable alternatives.

Figure CG-52. Product Confined In Steam Jacketed Press



Installation

Although the condensate load on each platen is small, individual trapping is essential to prevent short circuiting, Fig. CG-52. Individual trapping ensures maximum and uniform temperature for a given steam pressure by efficiently draining the condensate and purging the non-condensables.

Direct Steam Injection Into Product Chamber

This type of equipment combines steam with the product in order to cure, sterilize or cook. Common examples are autoclaves used in the production of rubber and plastic products, sterilizers for surgical dressings and gowns, and retorts for cooking food products already sealed in cans.

Trap Selection and Safety Factor

Calculate the condensate load using the following formula:

$$Q = \frac{W \times C \times \Delta T}{H \times t}$$

Where:

Q = Condensate load in lbs/hr

W = Weight of the material in lbs

C = Specific heat of the material in Btu/lb-°F (See page CG-57)

ΔT = Material temperature rise in °F

H = Latent heat of steam in Btu/lb (See Steam Tables on page CG-5)

t = Time in hours

EXAMPLE: What will be the condensate load on an autoclave containing 300 lbs of rubber product which must be raised to a temperature of 300°F from a starting temperature of 70°F? The autoclave operates at 60 psig steam pressure and the heat-up process takes 20 minutes. Using the formula:

$$Q = \frac{300 \text{ lbs} \times .42 \text{ Btu/lb-°F} \times 230\text{°F}}{904 \text{ Btu/lb} \times .33 \text{ hr}} = 96 \text{ lbs/hr}$$

Multiply by a recommended safety factor of 3:1 to get the required capacity—288 lbs/hr.

Since steam is in contact with the product, you can anticipate dirty condensate. In addition, the vessel is a large volume chamber that requires special consideration in the purging of condensate and non-condensables. For these reasons, an inverted bucket trap with an auxiliary thermostatic air vent installed at the top of the chamber is recommended.

Where no remote thermostatic air vent can be installed, incorporate the large volume air purging capabilities in the steam trap itself. An automatic differential condensate controller should be considered a possible first choice on large chambers. As an alternative, an F&T or thermostatic trap should be used and be preceded by a strainer, the latter receiving regular checks for free flow.

Installation

Because the steam and condensate is in contact with the product, the trap discharge should almost always be disposed of by some means other than return to the boiler. In virtually all cases this equipment is gravity drained to the trap. However, very often there is a condensate lift after the trap. Because steam pressure is usually constant, this does not present a problem. For thorough air removal and quicker warm-up, install a thermostatic air vent at a high point of the vessel. See Fig. CG-53.

Product in Chamber—Steam in Jacket

Autoclaves, retorts and sterilizers are also common examples of this equipment; however, the condensate is not contaminated from actual contact with the product and can be returned directly to the boiler. Steam traps with purging ability and large volume air venting are still necessary for efficient performance.

Trap Selection and Safety Factor

Size steam traps for "product in chamber–steam in jacket equipment" by using the same formula outlined for direct steam injection. The safety factor is also 3:1.

The inverted bucket trap is recommended because it conserves steam, purges the system and resists hydraulic shock.

Use the IB trap in combination with a thermostatic air vent at the top of the chamber for greater air-handling capability. As an alternative, an F&T or thermostatic trap could be used. On large chambers, where it's not possible to install the air vent, an automatic differential condensate controller should be considered a possible first choice.

Installation

With "product in chamber—steam in jacket equipment," the steam and condensate do not come in contact with the product and can be piped to the condensate return system. Where possible, install an auxiliary thermostatic air vent at a remote high point on the steam chamber. See Fig. CG-54.

Chart CG-19. Recommendation Chart (See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choices
Product Confined Steam Jacketed Press	IB A, B, E, K	CD and Thermostatic
Direct Steam Injection into Product Chamber	*IB A, B, E, H, K, N, Q	**DC
Product in Chamber–Steam in Jacket	*IB A, B, E, H, K	Thermostatic and F&T and **DC

*An auxiliary air vent is recommended.
**First choice on large volume vessels.

Figure CG-53. Direct Steam Injection Into Product Chamber

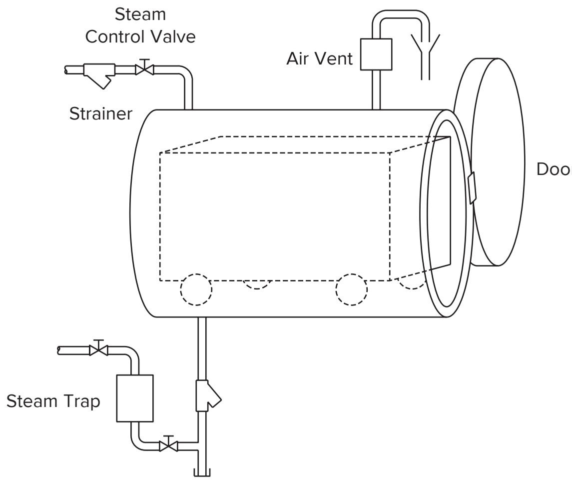
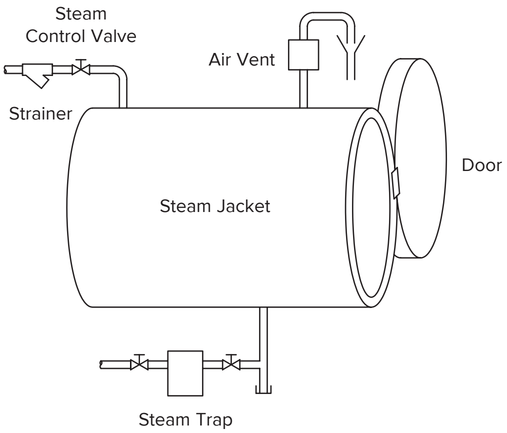


Figure CG-54. Product in Chamber—Steam in Jacket



How to Trap – Rotating Dryers Requiring Syphon Drainage

There are two classifications of rotating dryers which vary significantly in both function and method of operation. The first dries a product by bringing it into contact with the outside of a steam-filled cylinder. The second holds the product inside a rotating cylinder where steam-filled tubes are used to dry it through direct contact. In some applications a steam jacket surrounding the cylinder is also used.

Safety Factor
The safety factor for both kinds of dryers depends on the type of drainage device selected.

- If an automatic differential condensate controller (DC) is installed, use a safety factor of 3:1 based on the maximum load. This will allow sufficient capacity for handling flash steam, large slugs of condensate, pressure variations and the removal of non-condensables. The DC performs these functions on both constant and modulated pressure.
- If an inverted bucket trap with large vent is used, increase the safety factor in order to compensate for the large volume of non-condensable and flash steam that will be present. Under constant-pressure conditions, use a safety factor of 8:1. On modulated pressure increase it to 10:1.

Rotating Steam Filled Cylinder with Product Outside

These dryers are used extensively in the paper, textile, plastic and food industries, where common examples are dry cans, drum dryers, laundry ironers and paper machine dryers. Their speed of operation varies from 1 or 2 rpm to surface velocities as high as 5 000 rpm. Operating steam pressure ranges from subatmospheric to more than 200 psig. Diameters can vary from 6” or 8” to 14’ or more. In all cases syphon drainage is required and flash steam will accompany the condensate.

Trap Selection
Condensate loads can be determined by use of the following formula:

$$Q = 3.14D \times R \times W$$

Where:

Q = Condensate load in lbs/hr
D = Diameter of the dryer in ft
R = Rate of condensation in lbs/sq ft-hr
W = Width of dryer in ft

EXAMPLE: Determine the condensate load of a dryer 5 ft in diameter, 10 ft in width and with a condensing rate of 7 lbs/sq ft-hr. Using the formula:

Condensate load = 3.14(5) x 7 x 10 = 1 100 lbs/hr

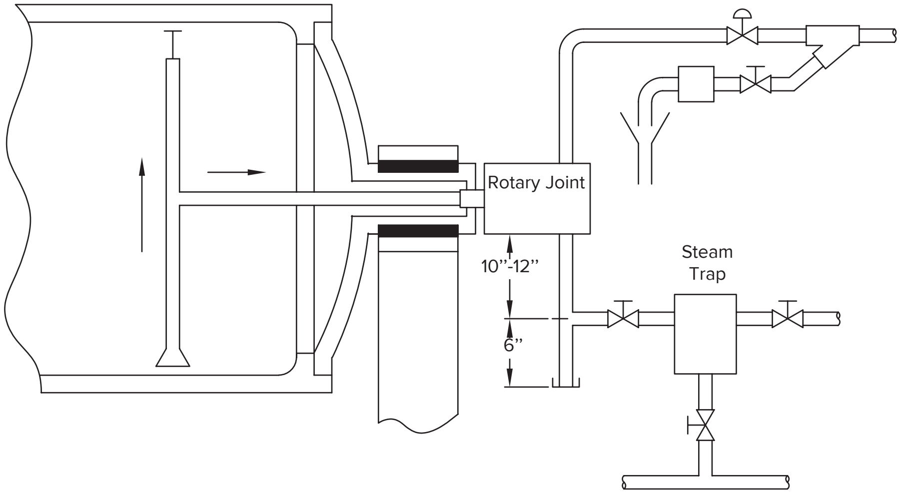
Based on its ability to handle flash steam, slugs of condensate and purge the system, a DC is the recommended first choice. An IBLV may be adequate if proper sizing procedures are followed.

Chart CG-20. Recommendation Chart
(See Page CG-4 for “Feature Code” References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Rotating Dryers	DC A, B, K, M, P, N	IBLV*

*On constant pressure use 8:1 safety factor, and on modulated pressure use 10:1.

Figure CG-55. Product Outside Dryer



A revolving cylinder drained with a syphon—an internal syphon surrounded by steam. Some condensate flashes back to steam due to the steam jacketed syphon pipe and syphon lifting during evacuation.

Product Inside a Rotating Steam Heated Dryer

This type of dryer finds wide application in meat packing as well as food processing industries. Common examples are grain dryers, rotary cookers and bean conditioners.

Their speed of rotation is relatively slow, usually limited to a few rpm, while steam pressure may range from 0-150 psig. These slower rotating speeds permit the condensate to accumulate in the bottom of the collection chamber in practically all cases. Again, syphon drainage is required and flash steam is generated during condensate removal.

Trap Selection

The condensate load generated by these dryers can be determined through use of the following formula:

$$Q = \frac{N \times L \times R}{P}$$

Where:

Q = Condensate in lbs/hr
N = Number of tubes
L = Length of tubes in ft
R = Condensing rate in lbs/sq ft-hr (typical 6-9 lbs/sq ft-hr)
P = Lineal ft of pipe per sq ft of surface (see Table CG-26)

EXAMPLE: What will be the condensate load on a rotary cooker containing 30 1-1/4” steel pipes 12’ in length with a condensing rate of 8 lbs/sq ft-hr?
Using the formula:

$$Q = \frac{30 \times 12 \times 8}{2.30} = 1\,252 \text{ lbs/hr}$$

A differential controller is recommended on these dryers for its purging and flash steam handling ability.

The IBLV again requires proper sizing for certain applications.

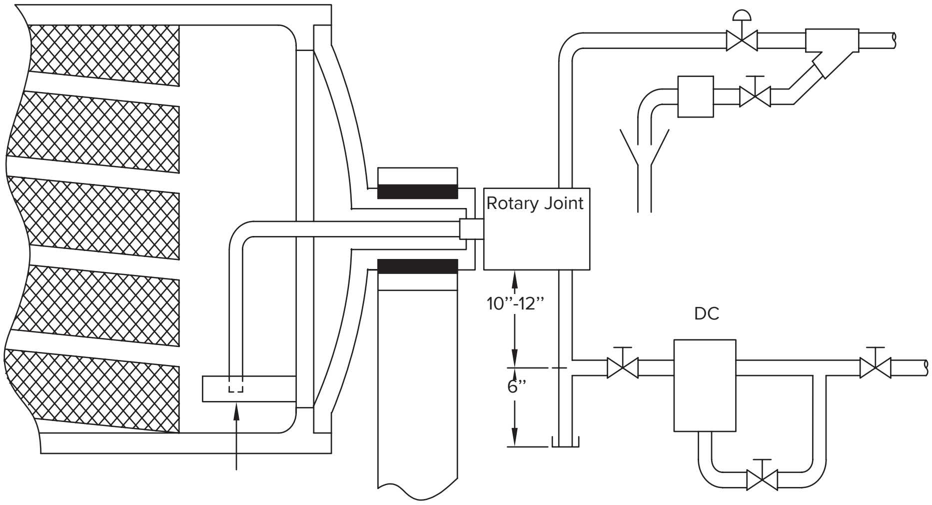
Installation

In all cases, condensate drainage is accomplished through a rotary joint, Figs. CG-55 and CG-56. The DC should then be located 10”-12” below the rotary joint with an extended 6” dirt pocket. These provide a reservoir for surges of condensate and also a pocket for entrained scale.

Table CG-26. Pipe Size Conversion Table (Divide lineal feet of pipe by factor given for size and type of pipe to get square feet of surface)

Pipe Size (in)	Iron Pipe	Copper or Brass Pipe
1/2	4.55	7.63
3/4	3.64	5.09
1	**2.90**	**3.82**
1-1/4	2.30	3.05
1-1/2	2.01	2.55
2	**1.61**	**1.91**
2-1/2	1.33	1.52
3	1.09	1.27
4	**.848**	**.954**

Figure CG-56. Product Inside Dryer



A revolving cylinder drained with a syphon—an internal syphon surrounded by steam. Some condensate flashes back to steam due to the steam jacketed syphon pipe and syphon lifting during evacuation.

How to Trap Flash Tanks

When hot condensate or boiler water, under pressure, is released to a lower pressure, part of it is re-evaporated, becoming what is known as flash steam. The heat content of flash is identical to that of live steam at the same pressure, although this valuable heat is wasted when allowed to escape through the vent in the receiver. With proper sizing and installation of a flash recovery system, the latent heat content of flash steam may be used for space heating; heating or preheating water, oil and other liquids; and low pressure process heating.

If exhaust steam is available it may be combined with the flash. In other cases, the flash will have to be supplemented by live make-up steam at reduced pressure. The actual amount of flash steam formed varies according to pressure conditions. The greater the difference between initial pressure and pressure on the discharge side, the greater the amount of flash that will be generated.

To determine the exact amount, as a percentage, of flash steam formed under certain conditions, refer to page CG-6 for complete information.

Trap Selection

The condensate load can be calculated using the following formula:

$$Q = L - \frac{L \times P}{100}$$

Where:

Q	=	Condensate load in lbs/hr (to be handled by steam trap)
L	=	Condensate flow into flash tank in lbs/hr
P	=	Percentage of flash

EXAMPLE: Determine the condensate load of a flash tank with 5,000 lbs/hr of 100 psig condensate entering the flash tank held at 10 psig. From page CG-6, the flash percentage is P = 10.5%. Using the formula:

$$Q = 5\ 000 - \frac{(5\ 000 \times 10.5)}{100} = 4\ 475 \text{ lbs/hr}$$

Due to the importance of energy conservation and operation against back pressure, the trap best suited for flash steam service is the inverted bucket type with large bucket vent. In addition, the IB operates intermittently while venting air and CO_2 at steam temperature.

In some cases, the float and thermostatic type trap is an acceptable alternative. One particular advantage of the F&T is its ability to handle heavy start-up air loads.

Chart CG-21. Recommendation Chart
(See Page CG-4 for "Feature Code" References.)

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Flash Tanks	IBLV B, E, M, L, I, A, F	F&T or *DC

*Recommended where condensate loads exceed the separating capability of the flash tank.

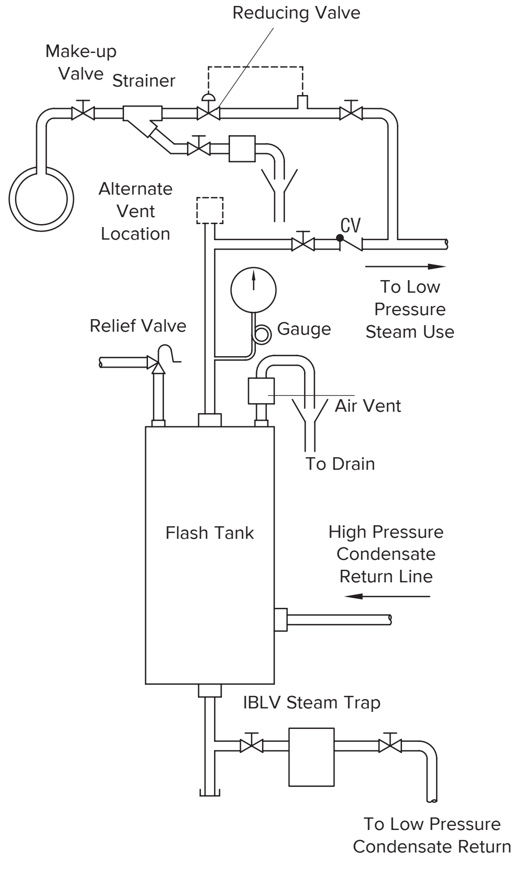
Refer to Chart CG-3 (page CG-6) for percentage of flash steam formed when discharging condensate to reduced pressure.

A third type of device that may be the preferred selection in many cases is the automatic differential condensate controller. It combines the best features of both the IB and F&T and is recommended for large condensate loads that exceed the separating capability of the flash tank.

Safety Factor

The increased amount of condensate at start-up and the varying loads during operation accompanied by low pressure differential dictates a safety factor of 3:1 for trapping flash tanks.

Figure CG-57. Typical Flash Tank Piping Sketch



Flash steam tank with live steam make-up, showing recommended fittings and connections. The check valves in the incoming lines prevent waste of flash when a line is not in use. The by-pass is used when flash steam cannot be used. Relief valves prevent pressure from building up and interfering with the operation of the high pressure steam traps. The reducing valve reduces the high pressure steam to the same pressure as the flash, so they can be combined for process work or heating.

How to Trap Flash Tanks

Installation

Condensate return lines contain both flash steam and condensate. To recover the flash steam, the return header runs to a flash tank, where the condensate is drained, and steam is then piped from the flash tank to points of use, Fig. CG-57. Since a flash tank causes back pressure on the steam traps discharging into the tank, these traps should be selected to ensure their capability to work against back pressure and have sufficient capacity at the available differential pressures.

Condensate lines should be pitched toward the flash tank, and where more than one line feeds into a flash tank, each line should be fitted with a swing check valve. Then, any line not in use will be isolated from the others and will not be fed in reverse with resultant wasted flash steam. If the trap is operating at low pressure, gravity drainage to the condensate receiver should be provided.

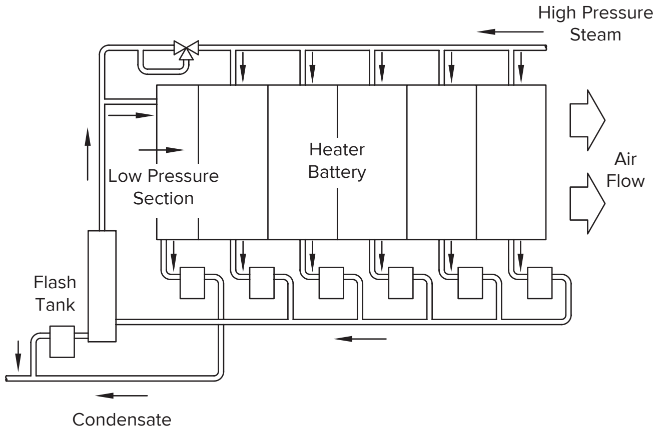
Generally, the location chosen for the flash tank should meet the requirement for maximum quantity of flash steam and minimum length of pipe.

Condensate lines, the flash tank, and the low pressure steam lines should be insulated to prevent waste of flash through radiation. The fitting of a spray nozzle on the inlet pipe inside the tank is not recommended. It may become choked, stop the flow of condensate, and produce a back pressure to the traps.

Low pressure equipment using flash steam should be individually trapped and discharged to a low pressure return. Large volumes of air need to be vented from the flash tank; therefore, a thermostatic air vent should be used to remove the air and keep it from passing through the low pressure system.

Figure CG-58. Flash Steam Recovery from an Air Heater Battery

Flash is taken from the flash tank and combined with live steam, the pressure of which is reduced to that of the flash by a reducing valve.



Flash Tank Dimensions

The flash tank can usually be conveniently constructed from a piece of large diameter piping with the bottom ends welded or bolted in position. The tank should be mounted vertically. A steam outlet is required at the top and a condensate outlet at the bottom. The condensate inlet connection should be 6''-8'' above the condensate outlet.

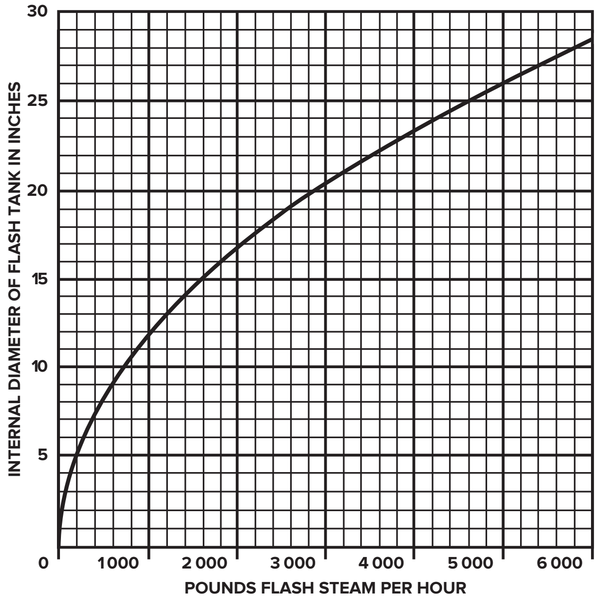
The important dimension is the inside diameter. This should be such that the upward velocity of flash to the outlet is low enough to ensure that the amount of water carried over with the flash is small. If the upward velocity is kept low, the height of the tank is not important, but good practice is to use a height of 2'-3'.

It has been found that a steam velocity of about 10' per second inside the flash tank will give good separation of steam and water. On this basis, proper inside diameters for various quantities of flash steam have been calculated; the results are plotted in Chart CG-22. This curve gives the smallest recommended internal diameters. If it is more convenient, a larger tank may be used.

Chart CG-22 does not take into consideration pressure—only weight. Although volume of steam and upward velocity are less at a higher pressure, because steam is denser, there is an increased tendency for priming. Thus it is recommended that, regardless of pressure, Chart CG-22 be used to find the internal diameter.

Chart CG-22.
Determination of Internal Diameter of Flash Tank to Handle a Given Quantity of Flash Steam

Find amount of available flash steam (in pounds per hour) on bottom scale, read up to curve and across to vertical scale, to get diameter in inches.



How to Trap Absorption Machines

An absorption refrigeration machine chills water for air conditioning or process use by evaporating a water solution, usually lithium bromide. Steam provides the energy for the concentration part of the cycle and, except for electric pumps, is the only energy input during the entire cycle.

A steam trap installed on a steam absorption machine should handle large condensate loads and purge air at low pressure, modulated conditions.

Trap Selection and Safety Factor

Determine the condensate load produced by a low pressure (normally 15 psig or less) single-stage steam absorption machine by multiplying its rating in tons of refrigeration by 20, the amount of steam in lbs/hr required to produce a ton of refrigeration. This represents consumption at the rated capacity of the machine.

EXAMPLE: How much condensate will a single-stage steam absorption machine with a rated capacity of 500 tons produce?

Multiply the 500-ton machine capacity rating x 20 lbs/hr to get the condensate load—10 000 lbs/hr.

A 2:1 safety factor should be applied to the full capacity condensate load, and the steam trap must be capable of draining this load, at a 1/2 psi differential. In other words, the machine in the example would require a trap capable of handling 20 000 lbs/hr of condensate at 1/2 psi, and the capability of functioning at the maximum pressure differential, usually 15 psi.

In comparison, two-stage absorption machines operate at a higher steam pressure of 150 psig. They have an advantage over single-stage units in that their energy consumption per ton of refrigeration is less (12.2 lbs steam/hr/ton of refrigeration at rated capacity).

EXAMPLE: How much condensate will a two-stage steam absorption machine with a rated capacity of 300 tons produce?

Multiply the 300-ton machine capacity rating x 10 lbs/hr to get the condensate load—3 000 lbs/hr.

Chart CG-23. Recommendation Chart
(See Page CG-4 for "Feature Code" References.

Equipment Being Trapped	1st Choice and Feature Code	Alternate Choice
Steam Aborption Machine	F&T A, B, G	*IB

NOTE: Vacuum breaker and standby system should be provided.
*With external thermostatic air vent.

On two-stage steam absorption machines, a 3:1 safety factor should be used. Therefore, the example requires a steam trap with a capacity of 9 000 lbs/hr. At pressures above 30 psig, the trap capacity must be achieved at 1/2 maximum pressure differential, which in the example is 75 psi. At pressures below 30 psig, trap capacity must be achieved at 2 psi differential pressure. However, the trap must still be capable of operating at a maximum inlet pressure of 150 psig.

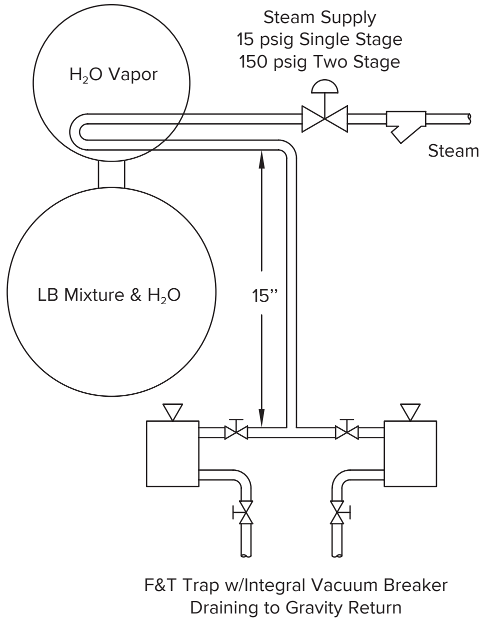
The F&T trap with an integral vacuum breaker is ideally suited for draining both single- and double-stage steam absorption machines. It provides an even, modulated condensate flow and energy-conserving operation. An inverted bucket trap with an external thermostatic air eliminator may also be acceptable.

Installation

Mount the steam trap below the steam coil of the absorption machine with a drip leg height of at least 15" (Fig. CG-59). This ensures a minimum differential pressure across the trap of 1/2 psi. Whichever trap is used, a standby trapping system is recommended for this service. In the event that a component in the drainage system needs maintenance, the absorption machine can operate on the standby system while the repairs are being made. This ensures continuous, uninterrupted service.

In some cases, very heavy condensate loads may require the use of two traps operating in parallel to handle the normal load.

Figure CG-59. Generally approved method of piping steam absorption machine with standby trapping system.



Trap Selection and Safety Factors

Armstrong®

This table provides recommendations for traps likely to be most effective in various applications. The recommended safety factors ensure proper operation under varying conditions. For more specific information on recommended traps and safety factors, contact your Armstrong Representative.

Table CG-27.

Application	1st Choice	2nd Choice	Safety Factor
Boiler Header	IBLV	F&T	1.5:1
(Superheat)	IBCV Burnished	Wafer	Start-Up Load
Steam Mains & Branch Lines (Non-Freezing)	IB (CV if pressure varies)	F&T	2:1, 3:1 if @ end of main, ahead of valve, or on branch
(Freezing)	IB	Thermostatic or Disc	Same as above
Steam Separator	IBLV	DC	3:1
Steam quality 90% or less	DC	—	
Tracer Lines	IB	Thermostatic or Disc	2:1
Unit Heaters and Air Handlers (Constant Pressure)	IBLV	F&T	3:1
(0-15 Variable Pressure)	F&T	IBLV	2:1 @ 1/2 psig Differential
(16-30 Variable Pressure)			2:1 @ 2 psig Differential
(>30 Variable Pressure)			3:1 @ 1/2 Max. Pressure Differential
Finned Radiation & Pipe Coils (Constant Pressure)	IB	Thermostatic	3:1 for quick heating 2:1 normally
(Variable Pressure)	F&T	IB	
Process Air Heaters (Constant Pressure)	IB	F&T	2:1
(Variable Pressure)	F&T	IBLV	3:1 @ 1/2 Max. Pressure Differential
Steam Absorption Machine (Chiller)	F&T	IB Ext. Air Vent	2:1 @ 1/2 psig Differential
Shell & Tube Heat Exchangers, Pipe & Embossed Coils (Constant Pressure)	IB	DC or F&T	2:1
(Variable Pressure)	F&T	DC or IBT (If >30 psig IBLV)	<15 psig 2:1 @ 1/2 psig 16-30 psig 2:1 @ 2 psig >30 psig 3:1 @ 1/2 Max. Pressure Differential
Evaporator Single Effect & Multiple Effect	DC	IBLV or F&T	2:1, If load 50 000 lbs/hr use 3:1
Jacketed Kettles (Gravity Drain)	IBLV	F&T or Thermostatic	3:1
(Syphon Drain)	DC	IBLV	
Rotating Dryers	DC	IBLV	3:1 for DC, 8:1 for IB variable pressure, 10:1 for IB variable pressure
Flash Tanks	IBLV	DC or F&T	3:1

IBLV = Inverted Bucket Large Vent
IBCV = Inverted Bucket Internal Check Valve
IBT = Inverted Bucket Thermic Vent
F&T = Float & Thermostatic
DC = Differential Condensate Controller

Use an IB with external air vent above the F&T pressure limitations or if the steam is dirty. All safety factors are at the operating pressure differential unless otherwise noted.

Installation and Testing of Armstrong Steam Traps

Before Installing

Run pipe to trap. Before installing the trap, clean the line by blowing down with steam or compressed air. (Clean any strainer screens after this blowdown.)

Trap Location ABCs

Accessible for inspection and repair.

Below drip point whenever possible.

Close to drip point.

Trap Hookups. For typical hookups, see Figs. CG-60 (below) through CG-71, pages CG-47 through CG-50.

Shutoff Valves ahead of traps are needed when traps drain steam mains, large water heaters, etc., where system cannot be shut down for trap maintenance. They are not needed for small steam-heated machines—a laundry press, for example. Shutoff valve in steam supply to machine is usually sufficient.

Shutoff Valves in trap discharge line are needed when trap has a by-pass. It is a good idea when there is high pressure in discharge header. See also Check Valves.

By-passes (Figs. CG-64 and CG-65) are discouraged, for if left open, they will defeat the function of the trap. If continuous service is absolutely required, use two traps in parallel, one as a primary, one as a standby.

Unions. If only one is used, it should be on discharge side of trap. With two unions, avoid horizontal or vertical in-line installations. The best practice is to install at right angles as in Figs. CG-60 and CG-64, or parallel as in Fig. CG-65.

Standard Connections. Servicing is simplified by keeping lengths of inlet and outlet nipples identical for traps of a given size and type. A spare trap with identical fittings and half unions can be kept in storeroom. In the event a trap needs repair, it is a simple matter to break the two unions, remove the trap, put in the spare and tighten the unions. Repairs can then be made in the shop and the repaired trap, with fittings and half unions, put back in stock.

Test Valves (Fig. CG-60) provide an excellent means of checking trap operation. Use a small plug valve. Provide a check valve or shutoff valve in the discharge line to isolate trap while testing.

Figure CG-60.
Typical IB Hookup

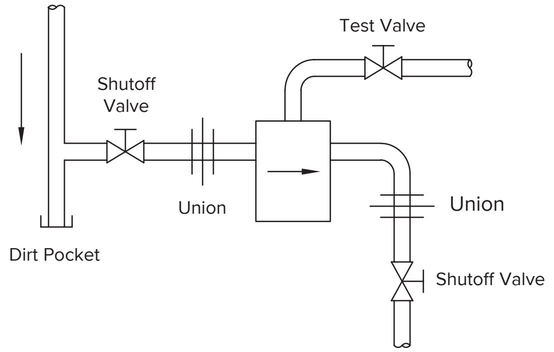


Figure CG-61.
Typical IB Bottom Inlet—Top Outlet Hookup

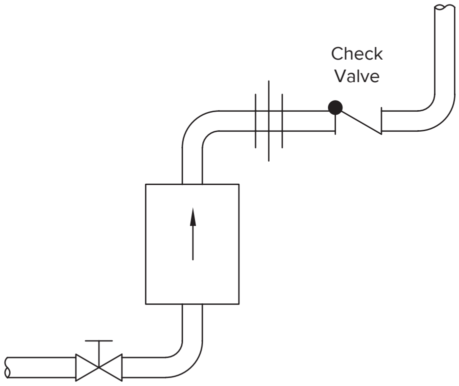


Figure CG-62.
Typical IB Bottom Inlet—Side Outlet Hookup

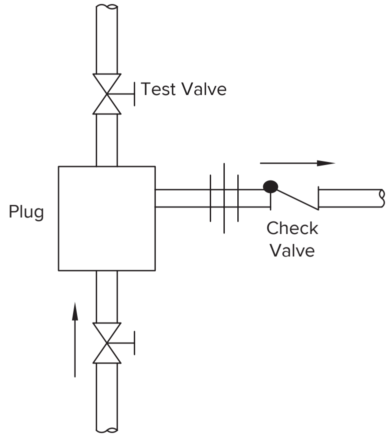
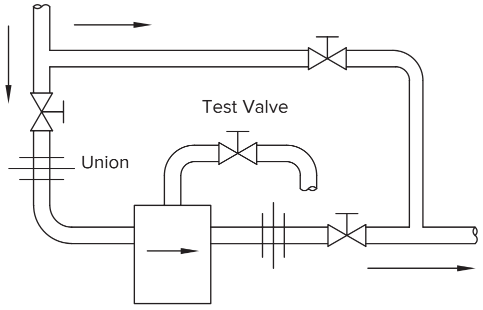


Figure CG-63.
Typical IB By-pass Hookup



Strainers. Install strainers ahead of traps if specified or when dirt conditions warrant their use. Some types of traps are more susceptible to dirt problems than others—see Recommendation Chart on page CG-4.

Some traps have built-in strainers. When a strainer blowdown valve is used, shut off steam supply valve before opening strainer blowdown valve. Condensate in trap body will flash back through strainer screen for thorough cleaning. Open steam valve slowly.

Dirt Pockets are excellent for stopping scale and core sand, and eliminating erosion that can occur in elbows when dirt pockets are not provided. Clean periodically.

Syphon Installations require a water seal and, with the exception of the DC, a check valve in or before the trap. Syphon pipe should be one size smaller than nominal size of trap used but not less than 1/2" pipe size.

Elevating Condensate. Do not oversize the vertical riser. In fact, one pipe size smaller than normal for the job will give excellent results.

Check Valves are frequently needed. They are a must if no discharge line shutoff valve is used. Fig. CG-63 shows three possible locations for external check valves—Armstrong inverted bucket traps are available with internal check valves, while disc traps act as their own check valve. Recommended locations are given in Fig. CG-63.

Discharge Line Check Valves prevent backflow and isolate trap when test valve is opened. Normally installed at location B, Fig. CG-63. When return line is elevated and trap is exposed to freezing conditions, install check valve at location A.

Inlet Line Check Valves prevent loss of seal if pressure should drop suddenly or if trap is above drip point in IB traps. Armstrong Stainless Steel Check Valve in trap body, location D, Fig. CG-63, is recommended. If swing check is used, install at location C.

Figure CG-64.
Possible Check Valve Locations

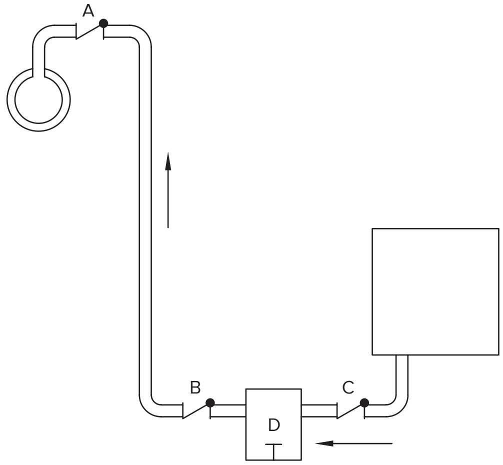


Figure CG-65.
Typical IB By-pass Hookup, Bottom Inlet—Top Outlet

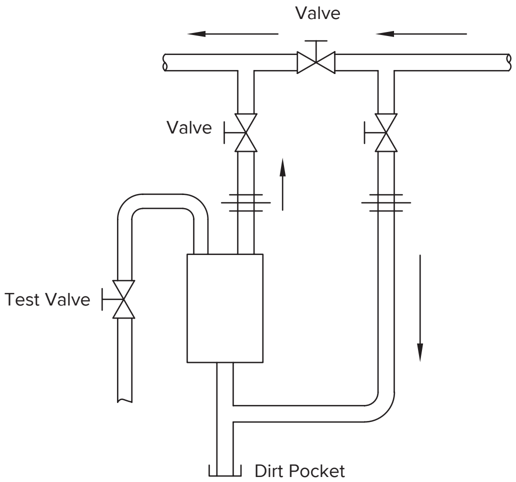
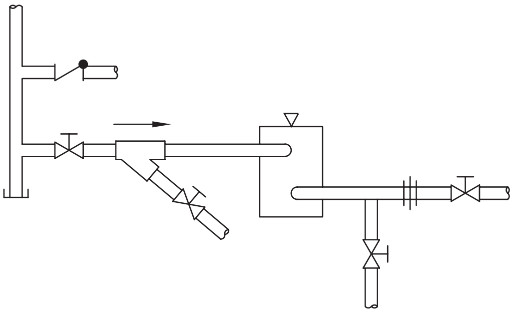


Figure CG-66.
Typical F&T Hookup



Protection Against Heat Exchanger Stall

Stall occurs when the inlet pressure will fall below the outlet pressure of a steam trap. In these situations, a condensate pump should be used to covercome the back pressure, return the condnesate adequately, and avoid stalling the heat exchanger. When a condensate pump is not practical, a **Safety Drain Trap** should be used whenever there is a likelihood that the inlet pressure will fall below the outlet pressure of a primary steam trap, especially in the presence of freezing air. One such application would be on a modulated pressure heating coil that must be drained with an elevated return line. In the event of insufficient drainage from the primary trap, condensate rises into the safety drain and is discharged before it can enter the heat exchanger. An F&T trap makes a good safety drain because of its ability to handle large amounts of air and its simplicity of operation. Safety drain trap should be same size (capacity) as primary trap.

The proper application of a safety drain is shown in Fig. CG-66. The inlet to the safety drain must be located on the heat exchanger drip leg, above the inlet to the primary trap. It must discharge to an open sewer. The drain plug of the safety drain is piped to the inlet of the primary trap. This prevents the discharge of condensate formed in the safety drain by body radiation when the primary trap is active. The safety drain has an integral vacuum breaker to maintain operation when pressure in the heat exchanger falls below atmospheric. The inlet of the vacuum breaker should be fitted with a gooseneck to prevent dirt from being sucked in when it operates. The vacuum breaker inlet should be provided with a riser equal in elevation to the bottom of the heat exchanger to prevent water leakage when the vacuum breaker is operating, but the drip leg and trap body are flooded.

Protection Against Freezing

A properly selected and installed trap will not freeze as long as steam is coming to the trap. If the steam supply should be shut off, the steam condenses, forming a vacuum in the heat exchanger or tracer line. This prevents free drainage of the condensate from the system before freezing can occur. Therefore, install a vacuum breaker between the equipment being drained and the trap. If there is not gravity drainage through the trap to the return line, the trap and discharge line should be drained manually or automatically by means of a freeze protection drain. Also, when multiple traps are installed in a trap station, insulating the traps can provide freeze protection.

Anti-Freeze Precautions.

1. Do not oversize trap.
2. Keep trap discharge lines very short.
3. Pitch trap discharge lines down for fast gravity discharge.
4. Insulate trap discharge lines and condensate return lines.
5. Where condensate return lines are exposed to ambient weather conditions, tracer lines should be considered.
6. If the return line is overhead, run vertical discharge line adjacent to drain line to top of return header and insulate drain line and trap discharge line together. See Fig. CG-67.

NOTE: A long horizontal discharge line invites trouble. Ice can form at the far end, eventually sealing off the pipe. This prevents the trap from operating. No more steam can enter the trap, and the water in the trap body freezes.

Figure CG-67. Typical Safety Drain Trap Hookup.

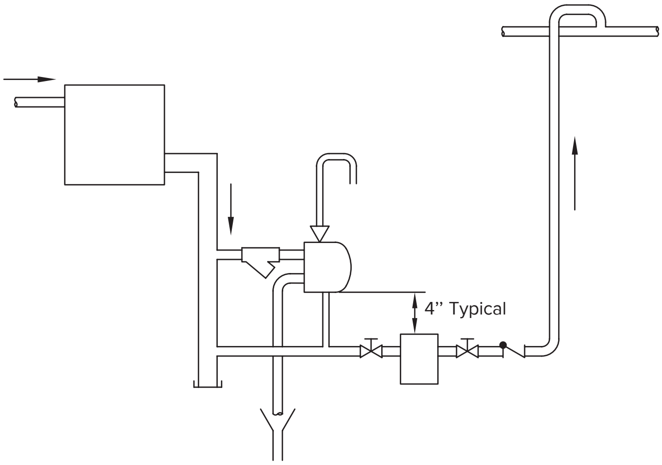


Figure CG-68.
Typical Condensate Pump Hookup.

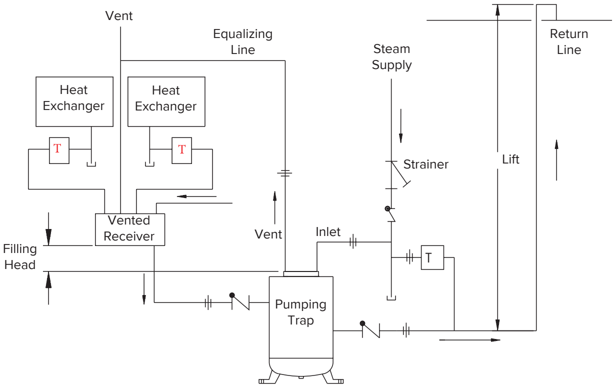
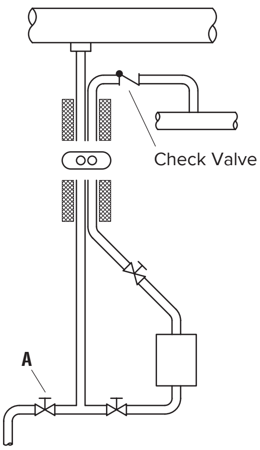


Figure CG-69.



Outdoor installation to permit ground level trap testing and maintenance when steam supply and return lines are high overhead. Drain line and trap discharge line are insulated together to prevent freezing. Note location of check valve in discharge line and blowdown valve **A** that drains the steam main when trap is opened for cleaning or repair.

Testing Armstrong Steam Traps

Testing Schedule.
For maximum trap life and steam economy, a regular schedule should be set up for trap testing and preventive maintenance. Trap size, operating pressure and importance determine how frequently traps should be checked.

Table CG-28. Suggested Yearly Trap Testing Frequency

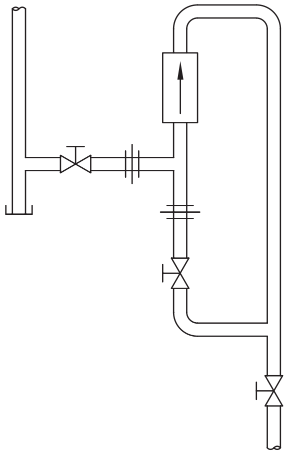
Operating Pressure (psig)	Application			
	Drip	Tracer	Coil	Process
0-100	1	1	2	3
101-250	2	2	2	3
251-450	2	2	3	4
451 and above	3	3	4	12

How to Test

The test valve method is best. Fig. CG-60 (page CG-47) shows correct hookup, with shutoff valve in return line to isolate trap from return header. Here is what to look for when test valve is opened:

1. **Condensate Discharge**—Inverted bucket and disc traps should have an intermittent condensate discharge. F&T traps should have a continuous condensate discharge, while thermostatic traps can be either continuous or intermittent, depending on the load. When an IB trap has an extremely small load it will have a continuous condensate discharge which causes a dribbling effect. This mode of operation is normal under this condition.
2. **Flash Steam**—Do not mistake this for a steam leak through the trap valve. Condensate under pressure holds more heat units-Btu-per pound than condensate at atmospheric pressure. When condensate is discharged, these extra heat units re-evaporate some of the condensate. See description of flash steam on page CG-6.
   How to Identify Flash: Trap users sometimes confuse flash steam with leaking steam. Here's how to tell the difference: If steam blows out continuously, in a "blue" stream, it's leaking steam. If steam "floats" out intermittently (each time the trap discharges) in a whitish cloud, it's flash steam.

Figure CG-69.
Typical DC Hookup



3. **Continuous Steam Blow**—Trouble. Refer to page CG-51.
4. **No Flow**—Possible trouble. Refer to page CG-51.

Listening Device Test. Use a listening device or hold one end of a steel rod against the trap cap and the other end against your ear. You should be able to hear the difference between the intermittent discharge of some traps and the continuous discharge of others. This correct operating condition can be distinguished from the higher velocity sound of a trap blowing through. Considerable experience is required for this method of testing, as other noises are telegraphed along the pipe lines.

Pyrometer Method of Testing. This method may not give accurate results, depending on the return line design and the diameter of the trap orifice. Also, when discharging into a common return, another trap may be blowing through, causing a high temperature at the outlet of the trap being tested. Better results can be obtained with a listening device. Request Armstrong Bulletin 310.

Figure CG-70.
Typical Disc Trap Hookup

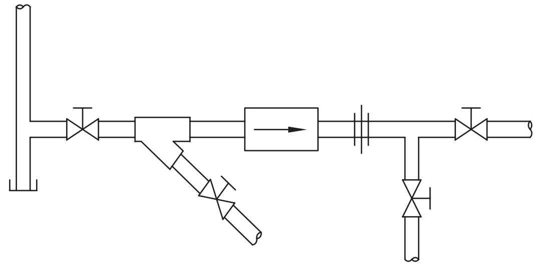
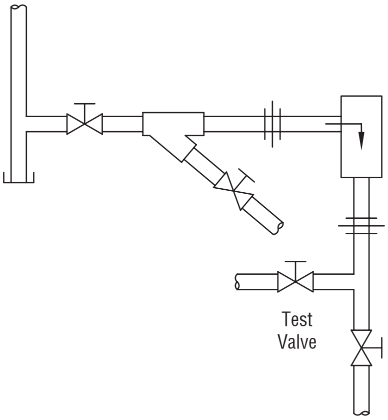


Figure CG-71.
Typical Thermostatic Hookup



Troubleshooting Armstrong Steam Traps

The following summary will prove helpful in locating and correcting nearly all steam trap troubles. Many of these are actually system problems rather than trap troubles.

More detailed troubleshooting literature is available for specific products and applications—consult factory.

Whenever a trap fails to operate and the reason is not readily apparent, the discharge from the trap should be observed. If the trap is installed with a test outlet, this will be a simple matter—otherwise, it will be necessary to break the discharge connection.

Cold Trap—No Discharge

If the trap fails to discharge condensate, then:

A. Pressure may be too high.
  1. Wrong pressure originally specified.
  2. Pressure raised without installing smaller orifice.
  3. PRV out of order.
  4. Pressure gauge in boiler reads low.
  5. Orifice enlarged by normal wear.
  6. High vacuum in return line increases pressure differential beyond which trap may operate.

B. No condensate or steam coming to trap.
  1. Stopped by plugged strainer ahead of trap.
  2. Broken valve in line to trap.
  3. Pipe line or elbows plugged.

C. Worn or defective mechanism.
Repair or replace as required.

D. Trap body filled with dirt.
Install strainer or remove dirt at source.

E. For IB, bucket vent filled with dirt. Prevent by:
  1. Installing strainer.
  2. Enlarging vent slightly.
  3. Using bucket vent scrubbing wire.

F. For F&T traps, if air vent is not functioning properly, trap will likely air bind.

G. For thermostatic traps, the bellows element may rupture from hydraulic shock, causing the trap to fail closed.

H. For disc traps, trap may be installed backward.

Hot Trap—No Discharge

A. No condensate coming to trap.
  1. Trap installed above leaky by-pass valve.
  2. Broken or damaged syphon pipe in syphon drained cylinder.
  3. Vacuum in water heater coils may prevent drainage. Install a vacuum breaker between the heat exchanger and the trap.

Steam Loss

If the trap blows live steam, the trouble may be due to any of the following causes:

A. Valve may fail to seat.
  1. Piece of scale lodged in orifice.
  2. Worn parts.

B. IB trap may lose its prime.
  1. If the trap is blowing live steam, close the inlet valve for a few minutes. Then gradually open. If the trap catches its prime, chances are the trap is all right.
  2. Prime loss is usually due to sudden or frequent drops in steam pressure. On such jobs, the installation of a check valve is called for—location D or C in Fig. CG-63 (page CG-48). If possible, locate trap well below drip point.

C. For F&T and thermostatic traps, thermostatic elements may fail to close.

Continuous Flow

If an IB or disc trap discharges continuously, or an F&T or thermostatic trap discharges at full capacity, check the following:

A. Trap too small.
  1. A larger trap, or additional traps, should be installed in parallel.
  2. High pressure traps may have been used for a low pressure job. Install right size of internal mechanism.

B. Abnormal water conditions. Boiler may foam or prime, throwing large quantities of water into steam lines.
A separator should be installed or else the feed water conditions should be remedied.

Sluggish Heating

When trap operates satisfactorily, but unit fails to heat properly:

A. One or more units may be short-circuiting. The remedy is to install a trap on each unit. See page CG-17.

B. Traps may be too small for job even though they may appear to be handling the condensate efficiently. Try next larger size trap.

C. Trap may have insufficient air-handling capacity, or the air may not be reaching trap. In either case, use auxiliary air vents.

Mysterious Trouble

If trap operates satisfactorily when discharging to atmosphere, but trouble is encountered when connected with return line, check the following:

A. Back pressure may reduce capacity of trap.
  1. Return line too small—trap hot.
  2. Other traps may be blowing steam—trap hot.
  3. Atmospheric vent in condensate receiver may be plugged—trap hot or cold.
  4. Obstruction in return line—trap hot.
  5. Excess vacuum in return line—trap cold.

Imaginary Troubles

If it appears that steam escapes every time trap discharges, remember: Hot condensate forms flash steam when released to lower pressure, but it usually condenses quickly in the return line. See Chart CG-4 on page CG-6.

Sizing Charts

Chart CG-25, page CG-53, is the basic chart for determining the flow rate and velocity of steam in Schedule 40 pipe for various values of pressure drop per 100 ft, based on 0 psig saturated steam. Using the multiplier chart (Chart CG-24), Chart CG-25 can be used at all saturation pressures between 0 and 200 psig (see Example).

These Charts are based on the Moody Friction Factor, which considers the Reynolds number and the roughness of the internal pipe surfaces.

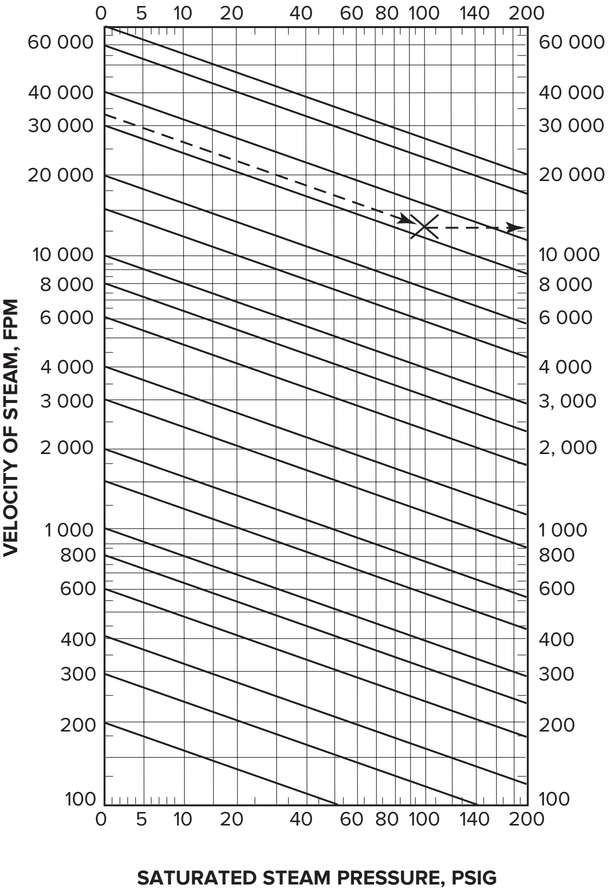
Notes: Based on Moody Friction Factor where flow of condensate does not inhibit the flow of steam. See Chart CG-24 for obtaining flow rates and velocities of all saturation pressures between 0 to 200 psig: see Example.

Pipe Sizing

Two principal factors determine pipe sizing in a steam system:

1. The initial pressure at the boiler and the allowable pressure drop of the total system. The total pressure drop in the system should not exceed 20% of the total maximum pressure at the boiler. This includes all drops—line loss, elbows, valves, etc. Remember, pressure drops are a loss of energy.
2. Steam velocity. Erosion and noise increase with velocity. Reasonable velocities for process steam are 6 000 to 12 000 fpm, but lower pressure heating systems normally have lower velocities. Another consideration is future expansion. Size your lines for the foreseeable future. If ever in doubt, you will have less trouble with oversized lines than with ones that are marginal.

Chart CG-24. Velocity Multiplier Chart for CG-25.



Use of Basic and Velocity Multiplier Charts

Example.
Given a flow rate of 6 700 lb/hr, an initial steam pressure of 100 psig, and a pressure drop of 11 psi/100 ft, find the size of Schedule 40 pipe required and the velocity of steam in the pipe.

Solution: The following steps are illustrated by the broken line on Chart CG-25 and Chart CG-24.

1. Enter Chart CG-25 at a flow rate of 6 700 lb/hr, and move vertically to the horizontal line at 100 psig.

2. Follow inclined multiplier line (upward and to the left) to horizontal 0 psig line. The equivalent mass flow at 0 psig is about 2 500 lb/hr.

3. Follow the 2 500 lb/hr line vertically until it intersects the horizontal line at 11 psi per 100 ft pressure drop. Nominal pipe size is 2-1/2 in. The equivalent steam velocity at 0 psig is about 32 700 fpm.

4. To find the steam velocity at 100 psig, locate the value of 32 700 fpm on the ordinate of the velocity multiplier chart (Chart CG-24) at 0 psig.

5. Move along the inclined multiplier line (downward and to the right) until it intersects the vertical 100 psig pressure line. The velocity as read from the right (or left) scale is about 13 000 fpm.

NOTE: Steps 1 through 5 would be rearranged or reversed if different data were given.

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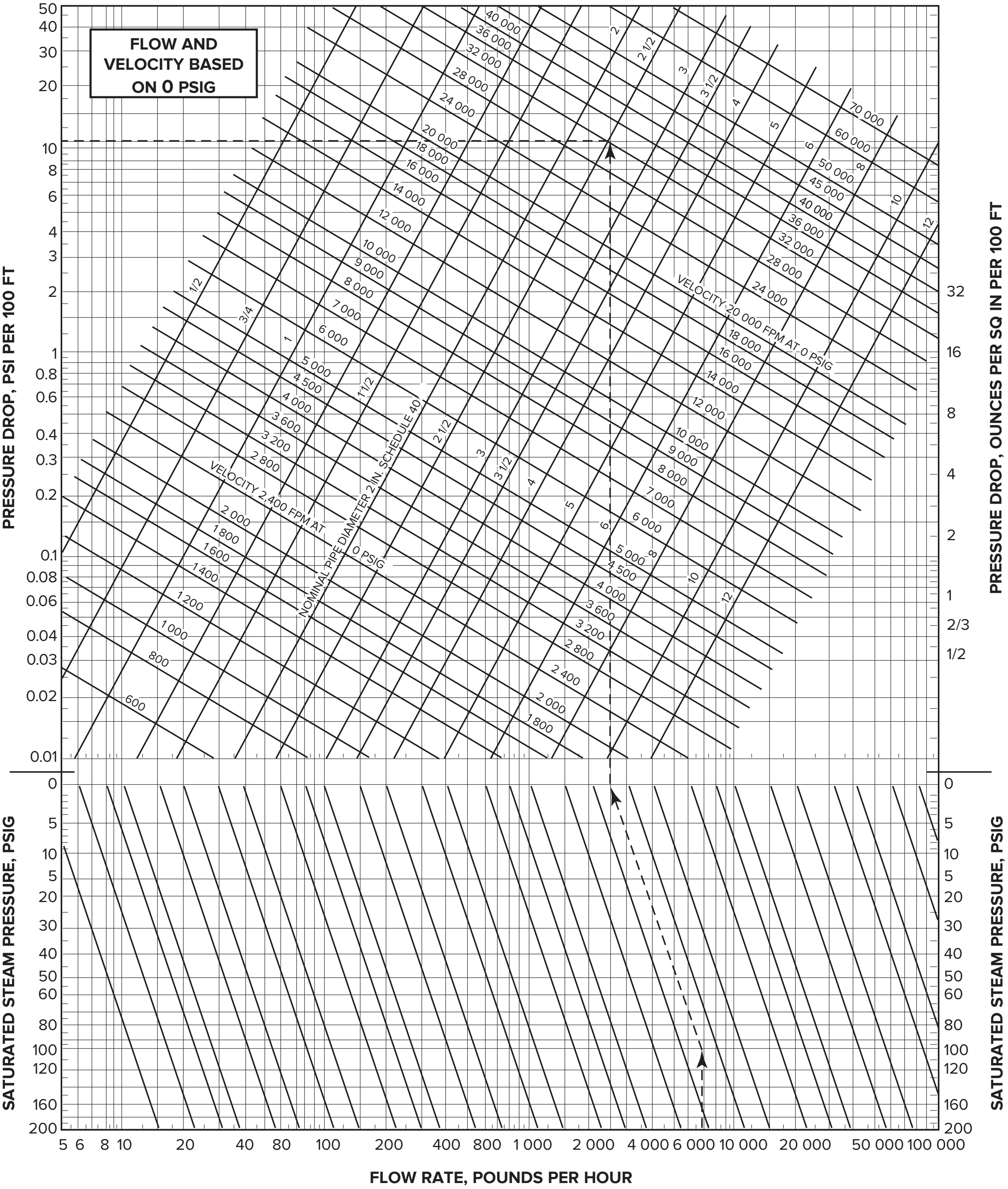
Chart CG-25. Flow Rate and Velocity of Steam in Schedule 40 Pipe at Saturation Pressure of 0 psig



How to Size Condensate Return Lines

The sizing of condensate return lines presents several problems that differ from those of sizing steam or water lines. The most significant of these is the handling of flash steam. Although a return line must handle both water and flash steam, the volume of flash steam is many times greater than the volume of condensate. For the values in Chart CG-26 the volume of flash steam is 96% to 99% of the total volume. Consequently, only flash steam is considered in Chart CG-26.

Condensate return lines should be sized to have a reasonable velocity at an acceptable pressure drop. Chart CG-26 is based on having a constant velocity of 7 000 feet per minute or below, using Schedule 40 pipe. Additional factors that should also be considered—depending on water conditions—are dirt, fouling, corrosion and erosion.

For a given supply pressure to the trap and a return line pressure, along with an assumed pressure drop per 100 feet of pipe (ΔP/L) and knowing the condensate flow rate, the proper pipe diameter can be selected from Chart CG-26.

How to Use Chart CG-26

Example 1: A condensate system has the steam supply at 30 psig. The return line is non-vented and at 0 psig. The return line is to have the capacity for returning 2 000 lbs/hr of condensate. What must be the size of the return line?

Solution: Since the system will be throttling the condensate from 30 psig to 0 psig, there will be flash steam (assuming no subcooling), and the system will be a dry-closed (not completely full of liquid and not vented to atmosphere) return. The data in Chart CG-26 can be used. A pressure of 1/4 psig per 100 feet is selected. In Chart CG-26 for a 30 psig supply and a 0 psig return for ΔP/L = 1/4, a pipe size for the return line of 2" is selected.

Example 2: A condensate return system has the steam supply at 100 psig and the return line is non-vented and at 0 psig. The return line is horizontal and must have a capacity of 2 500 lbs/hr. What size pipe is required?

Solution: Since the system will be throttling non-subcooled condensate from 100 psig to 0 psig, there will be flash steam, and the system will be a dry-closed return. Selecting a pressure drop of 1 psi per 100 feet yields from Chart CG-26 a non-recommended situation (a). Select a pressure drop of 1/4 psi per 100 feet and then a 2-1/2" pipe can be used for this system.

Chart CG-26. Flow Rate (lbs/hr) for Dry-Closed Returns

ΔP/L psi/100'	Supply Pressure = 5 psig			Supply Pressure = 15 psig			Supply Pressure = 30 psig			Supply Presssure = 50 psig		
	Return Pressure = 0 psig			Return Pressure = 0 psig			Return Pressure = 0 psig			Return Pressure = 0 psig		
D, in	1/16	1/4	1	1/16	1/4	1	1/16	1/4	1	1/16	1/4	1
1/2	240	520	1 100	95	210	450	60	130	274	42	92	200
3/4	510	1 120	2 400	210	450	950	130	280	590	91	200	420
1	**1 000**	**2 150**	**a**	**400**	**860**	**a**	**250**	**530**	**1 120**	**180**	**380**	**a**
1-1/4	2 100	4 500	a	840	1 800	a	520	1 110	a	370	800	a
1-1/2	3 170	6 780	a	1 270	2 720	a	780	1 670	a	560	1 200	a
2	**6 240**	**13 300**	**a**	**2 500**	**5 320**	**a**	**1 540**	**3 270**	**a**	**1 110**	**2 350**	**a**
2-1/2	10 000	21 300	a	4 030	8 520	a	2 480	5 250	a	1 780	3 780	a
3	18 000	a	a	7 200	a	a	4 440	9 360	a	3 190	a	a
4	**37 200**	**a**	**a**	**14 900**	**a**	**a**	**9 180**	**a**	**a**	**6 660**	**a**	**a**
6	110 500	a	a	44 300	a	a	27 300	a	a	19 600	a	a
8	228 600	a	a	91 700	a	a	56 400	a	a	40 500	a	a

Chart CG-26. Flow Rate (lbs/hr) for Dry-Closed Returns

ΔP/L psi/100'	Supply Pressure = 100 psig			Supply Pressure = 150 psig			Supply Pressure = 100 psig			Supply Presssure = 150 psig		
	Return Pressure = 0 psig			Return Pressure = 0 psig			Return Pressure = 15 psig			Return Pressure = 15 psig		
D, in	1/16	1/4	1	1/16	1/4	1	1/16	1/4	1	1/16	1/4	1
1/2	28	62	133	23	51	109	56	120	260	43	93	200
3/4	62	134	290	50	110	230	120	260	560	93	200	420
1	**120**	**260**	**a**	**100**	**210**	**a**	**240**	**500**	**a**	**180**	**390**	**800**
1-1/4	250	540	a	200	440	a	500	1 060	a	380	800	a
1-1/2	380	810	a	310	660	a	750	1 600	a	570	1 210	a
2	**750**	**1 590**	**a**	**610**	**1 300**	**a**	**1 470**	**3 100**	**a**	**1 120**	**2 350**	**a**
2-1/2	1 200	2 550	a	980	2 100	a	2 370	5 000	a	1 800	3 780	a
3	2 160	a	a	1 760	3 710	a	4 230	a	a	3 200	6 710	a
4	**4 460**	**a**	**a**	**3 640**	**7 630**	**a**	**8 730**	**a**	**a**	**6 620**	**a**	**a**
6	13 200	a	a	10 800	a	a	25 900	a	a	19 600	a	a
8	27 400	a	a	22 400	a	a	53 400	a	a	40 500	a	a

[a] For these sizes and pressure losses the velocity is above 7 000 fpm. Select another combination of size and pressure loss.

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Armstrong® Useful Engineering Tables

Table CG-29. Schedule 40 Pipe, Standard Dimensions

Size (in)	Diameters		Nominal Thickness (in)	Circumference		Transverse Areas			Length of Pipe Per sq ft		Length of Pipe Containing One Cubic Foot	Nominal Weight Per Foot		Number of Threads Per Inch of Screw
	External (in)	Approximate Internal (in)		External (in)	Internal (in)	External (sq in)	Internal (sq in)	Metal (sq in)	External Surface	Internal Surface		Plain Ends	Threaded and Coupled	
									Feet	Feet	Feet			
1/8	0.405	0.269	0.068	1.272	0.845	0.129	0.057	0.072	9.431	14.199	2533.775	0.244	0.245	27
1/4	0.540	0.364	0.088	1.696	1.114	0.229	0.104	0.125	7.073	10.493	1383.789	0.424	0.425	18
3/8	**0.675**	**0.493**	**0.091**	**2.121**	**1.549**	**0.358**	**0.191**	**0.167**	**5.658**	**7.747**	**754.360**	**0.567**	**0.568**	**18**
1/2	0.840	0.622	0.109	2.639	1.954	0.554	0.304	0.250	4.547	6.141	473.906	0.850	0.852	14
3/4	1.050	0.824	0.113	3.299	2.589	0.866	0.533	0.333	3.637	4.635	270.034	1.130	1.134	14
1	**1.315**	**1.049**	**0.133**	**4.131**	**3.296**	**1.358**	**0.864**	**0.494**	**2.904**	**3.641**	**166.618**	**1.678**	**1.684**	**11-1/2**
1-1/4	1.660	1.380	0.140	5.215	4.335	2.164	1.495	0.669	2.301	2.767	96.275	2.272	2.281	11-1/2
1-1/2	1.900	1.610	0.145	5.969	5.058	2.835	2.036	0.799	2.010	2.372	70.733	2.717	2.731	11-1/2
2	**2.375**	**2.067**	**0.154**	**7.461**	**6.494**	**4.430**	**3.355**	**1.075**	**1.608**	**1.847**	**42.913**	**3.652**	**3.678**	**11-1/2**
2-1/2	2.875	2.469	0.203	9.032	7.757	6.492	4.788	1.704	1.328	1.547	30.077	5.793	5.819	8
3	3.500	3.068	0.216	10.996	9.638	9.621	7.393	2.228	1.091	1.245	19.479	7.575	7.616	8
3-1/2	**4.000**	**3.548**	**0.226**	**12.566**	**11.146**	**12.566**	**9.886**	**2.680**	**0.954**	**1.076**	**14.565**	**9.109**	**9.202**	**8**
4	4.500	4.026	0.237	14.137	12.648	15.904	12.730	3.174	0.848	0.948	11.312	10.790	10.889	8
5	5.563	5.047	0.258	17.477	15.856	24.306	20.006	4.300	0.686	0.756	7.198	14.617	14.810	8
6	**6.625**	**6.065**	**0.280**	**20.813**	**19.054**	**34.472**	**28.891**	**5.581**	**0.576**	**0.629**	**4.984**	**18.974**	**19.185**	**8**
8	8.625	7.981	0.322	27.096	25.073	58.426	50.027	8.399	0.442	0.478	2.878	28.554	28.809	8
10	10.750	10.020	0.365	33.772	31.479	90.763	78.855	11.908	0.355	0.381	1.826	40.483	41.132	8
12	**12.750**	**11.938**	**0.406**	**40.055**	**37.699**	**127.640**	**111.900**	**15.740**	**0.299**	**0.318**	**1.288**	**53.600**	**—**	**—**
14	14.000	13.125	0.437	43.982	41.217	153.940	135.300	18.640	0.272	0.280	1.069	63.000	—	—
16	16.000	15.000	0.500	50.265	47.123	201.050	176.700	24.350	0.238	0.254	0.817	78.000	—	—
18	**18.000**	**16.874**	**0.563**	**56.548**	**52.998**	**254.850**	**224.000**	**30.850**	**0.212**	**0.226**	**0.643**	**105.000**	**—**	**—**
20	20.000	18.814	0.593	62.831	59.093	314.150	278.000	36.150	0.191	0.203	0.519	123.000	—	—
24	24.000	22.626	0.687	75.398	71.063	452.400	402.100	50.300	0.159	0.169	0.358	171.000	—	—

Table CG-30. Equivalent Length of Pipe to Be Added for Fittings–Schedule 40 Pipe

Pipe Size (in)	Length in Feet to Be Added Run				
	Standard Elbow	Side Outlet Tee	Gate Valve*	Globe Valve*	Angle Valve*
1/2	1.3	3	0.3	14	7
3/4	1.8	4	0.4	18	10
1	**2.2**	**5**	**0.5**	**23**	**12**
1-1/4	3.0	6	0.6	29	15
1-1/2	3.5	7	0.8	34	18
2	**4.3**	**8**	**1.0**	**46**	**22**
2-1/2	5.0	11	1.1	54	27
3	6.5	13	1.4	66	34
3-1/2	**8.0**	**15**	**1.6**	**80**	**40**
4	9.0	18	1.9	92	45
5	11.0	22	2.2	112	56
6	**13.0**	**27**	**2.8**	**136**	**67**
8	17.0	35	3.7	180	92
10	21.0	45	4.6	230	112
12	**27.0**	**53**	**5.5**	**270**	**132**

*Valve in full open position

Table CG-31. Thermal Expansion of Pipe

Temp (°F)	Elongation in Inches Per 100 ft From -20°F Up			
	Cast Iron Pipe	Steel Pipe	Wrought Iron Pipe	Copper Pipe
-20	0.000	0.000	0.000	0.000
0	0.127	0.145	0.152	0.204
20	**0.255**	**0.293**	**0.306**	**0.442**
40	0.390	0.430	0.465	0.655
60	0.518	0.593	0.620	0.888
80	**0.649**	**0.725**	**0.780**	**1.100**
100	0.787	0.898	0.939	1.338
120	0.926	1.055	1.110	1.570
140	**1.051**	**1.209**	**1.265**	**1.794**
160	1.200	1.368	1.427	2.008
180	1.345	1.528	1.597	2.255
200	**1.495**	**1.691**	**1.778**	**2.500**
240	1.780	2.020	2.110	2.960
280	2.085	2.350	2.465	3.422
320	**2.395**	**2.690**	**2.800**	**3.900**
360	2.700	3.029	3.175	4.380
400	3.008	3.375	3.521	4.870
500	**3.847**	**4.296**	**4.477**	**6.110**
600	4.725	5.247	5.455	7.388

From Piping Handbook, by Walker and Crocker, by special permission. Table CG-31 gives the expansion from -20°F to temperature in question. To obtain the amount of expansion between any two temperatures, take the difference between the figures in the table for those temperatures. For example, if cast iron pipe is installed at a temperature of 80°F and is operated at 240°F, the expansion would be 1.780 - 0.649 = 1.131 in.

Table CG-32. Diameters and Areas of Circles and Drill Sizes

Drill Size	Diameter	Area	Drill Size	Diameter	Area	Drill Size	Diameter	Area	Drill Size	Diameter	Area
3/64	.0469	.00173	27	.1440	.01629	C	.2420	.04600	27/64	.4219	.13920
55	.0520	.00212	26	.1470	.01697	D	.2460	.04753	7/16	.4375	.15033
54	**.0550**	**.00238**	**25**	**.1495**	**.01705**	**1/4**	**.2500**	**.04909**	**29/64**	**.4531**	**.16117**
53	.0595	.00278	24	.1520	.01815	E	.2500	.04909	15/32	.4688	.17257
1/16	.0625	.00307	23	.1540	.01863	F	.2570	.05187	31/64	.4844	.18398
52	**.0635**	**.00317**	**5/32**	**.1562**	**.01917**	**G**	**.2610**	**.05350**	**1/2**	**.5000**	**.19635**
51	.0670	.00353	22	.1570	.01936	17/64	.2656	.05515	33/64	.5156	.20831
50	.0700	.00385	21	.1590	.01986	H	.2660	.05557	17/32	.5312	.22166
49	**.0730**	**.00419**	**20**	**.1610**	**.02036**	**I**	**.2720**	**.05811**	**9/16**	**.5625**	**.24850**
48	.0760	.00454	19	.1660	.02164	J	.2770	.06026	19/32	.5937	.27688
5/64	.0781	.00479	18	.1695	.02256	K	.2810	.06202	5/8	.6250	.30680
47	**.0785**	**.00484**	**11/64**	**.1719**	**.02320**	**9/32**	**.2812**	**.06213**	**21/32**	**.6562**	**.33824**
46	.0810	.00515	17	.1730	.02351	L	.2900	.06605	11/16	.6875	.37122
45	.0820	.00528	16	.1770	.02461	M	.2950	.06835	23/32	.7187	.40574
44	**.0860**	**.00581**	**15**	**.1800**	**.02545**	**19/64**	**.2969**	**.06881**	**3/4**	**.7500**	**.44179**
43	.0890	.00622	14	.1820	.02602	N	.3020	.07163	25/32	.7812	.47937
42	.0935	.00687	13	.1850	.02688	5/16	.3125	.07670	13/16	.8125	.51849
3/32	**.0938**	**.00690**	**3/16**	**.1875**	**.02761**	**O**	**.3160**	**.07843**	**27/32**	**.8437**	**.55914**
41	.0960	.00724	12	.1890	.02806	P	.3230	.08194	7/8	.8750	.60132
40	.0980	.00754	11	.1910	.02865	21/64	.3281	.08449	29/32	.9062	.64504
39	**.0995**	**.00778**	**10**	**.1935**	**.02941**	**Q**	**.3320**	**.08657**	**15/16**	**.9375**	**.69029**
38	.1015	.00809	9	.1960	.03017	R	.3390	.09026	31/32	.9687	.73708
37	.1040	.00850	8	.1990	.03110	11/32	.3438	.09281	1	1.0000	.78540
36	**.1065**	**.00891**	**7**	**.2010**	**.03173**	**S**	**.3480**	**.09511**	**1-1/16**	**1.0625**	**.88664**
7/64	.1094	.00940	13/64	.2031	.03241	T	.3580	.10066	1-1/8	1.1250	.99402
35	.1100	.00950	6	.2040	.03268	23/64	.3594	.10122	1-3/16	1.1875	1.1075
34	**.1110**	**.00968**	**5**	**.2055**	**.03317**	**U**	**.3680**	**.10636**	**1-1/4**	**1.2500**	**1.2272**
33	.1130	.01003	4	.2090	.03431	3/8	.3750	.11045	1-5/16	1.3125	1.3530
32	.1160	.01039	3	.2130	.03563	V	.3770	.11163	1-3/8	1.3750	1.4849
31	**.1200**	**.01131**	**7/32**	**.2188**	**.03758**	**W**	**.3860**	**.11702**	**1-7/16**	**1.4375**	**1.6230**
1/8	.1250	.01227	2	.2210	.03836	25/64	.3906	.11946	1-1/2	1.5000	1.7671
30	.1285	.01242	1	.2280	.04083	X	.3970	.12379	1-5/8	1.6250	2.0739
29	**.1360**	**.01453**	**A**	**.2340**	**.04301**	**Y**	**.4040**	**.12819**	**1-3/4**	**1.7500**	**2.4053**
28	.1405	.01550	15/64	.2344	.04314	13/32	.4062	.12962	1-7/8	1.8750	2.7612
9/64	.1406	.01553	B	.2380	.04449	Z	.4130	.13396	2	2.0000	3.1416

Conversion Factors

Power

Multiply	By	To Get
Boiler hp	33 472	Btu/hr
Boiler hp	34.5	lbs H_2O evap. at 212°F
Horsepower	2 540	Btu/hr
Horsepower	550	ft-lbs/sec
Horsepower	33 000	ft-lbs/min
Horsepower	42.42	Btu/min
Horsepower	0.7457	Kilowatts
Kilowatts	3 415	Btu/hr
Kilowatts	56.92	Btu/min
Watts	44.26	ft-lbs/min
Watts	0.7378	ft-lbs/sec
Watts	0.05692	Btu/min
Tons refrig.	12 000	Btu/hr
Tons refrig.	200	Btu/min
Btu/hr	0.00002986	Boiler hp
lbs H_2O evap. at 212°F	0.0290	Boiler hp
Btu/hr	0.000393	Horsepower
ft-lbs/sec	0.00182	Horsepower
ft-lbs/min	0.0000303	Horsepower
Btu/min	0.0236	Horsepower
Kilowatts	1.341	Horsepower
Btu/hr	0.000293	Kilowatts
Btu/min	0.01757	Kilowatts
ft-lbs/min	0.02259	Watts
ft-lbs/sec	1.355	Watts
Btu/min	1.757	Watts
Btu/hr	0.0000833	Tons Refrig.
Btu/min	0.005	Tons Refrig.

Energy

Multiply	By	To Get
Btu	778	ft-lbs
Btu	0.000393	hp-hrs
Btu	0.000293	kw-hrs
Btu	0.0010307	{lbs H_2O evap.) at 212°F
Btu	0.293	Watt-hrs
ft-lbs	0.3765	Watt-hrs
latent heat} of ice	143.33	Btu/lb H_2O
lbs H_2O evap.} at 212°F	0.284	kw-hrs
lbs H_2O evap.} at 212°F	0.381	hp-hrs
ft-lbs	0.001287	Btu
hp-hrs	2 540	Btu
kw-hrs	3 415	Btu
lbs H_2O evap.} at 212°F	970.4	Btu
Watt-hrs	3.415	Btu
Watt-hrs	2 656	ft-lbs
Btu/lb H_2O	0.006977	{Latent heat of ice
kw-hrs	3.52	{lbs H_2O evap. at 212°F
hp-hrs	2.63	{lbs H_2O evap. at 212°F

Pressure

Multiply	By	To Get
atmospheres	29.92	{in Mercury (at 62°F)
atmospheres	406.8	{in H_2O (at 62°F)
atmospheres	33.90	{ft. H_2O (at 62°F)
atmospheres	14.70	lbs/in^2
atmospheres	1.058	ton/ft^2
in. H_2O} (at 62°F)	0.0737	{in. Mercury (at 62°F)
ft H_2O} (at 62°F)	0.881	{in. Mercury (at 62°F)
ft H_2O} (at 62°F)	0.4335	lbs/in^2
ft H_2O} (at 62°F)	62.37	lbs/ft^2
in. Mercury} (at 62°F)	70.73	lbs/ft^2
in. Mercury} (at 62°F)	0.4912	lbs/in^2
in. Mercury} (at 62°F)	0.03342	atmospheres
in. H_2O} (at 62°F)	0.002458	atmospheres
ft. H_2O} (at 62°F)	0.0295	atmospheres
lbs/in^2	0.0680	atmospheres
ton/ft^2	0.945	atmospheres
in. Mercury} (at 62°F)	13.57	{in. H_2O (at 62°F)
in. Mercury} (at 62°F)	1.131	{ft H_2O (at 62°F)
{ft H_2O lbs/in^2	2.309	(at 62°F)
{ft H_2O) lbs/ft^2	0.01603	(at 62°F)
{in. Mercury lbs/ft^2	0.014138	(at 62°F)
{in Mercury lbs/in^2	2.042	(at 62°F)
lbs/in^2	0.0689	Barg
lbs/in^2	0.0703	kg/cm^2

Velocity of Flow

Multiply	By	To Get
ft/min	0.01139	miles/hr
ft/min	0.01667	ft/sec
cu ft/min	0.1247	gal/sec
cu ft/sec	448.8	gal/min
miles/hr	88	ft/min
ft/sec	60	ft/min
gal/sec	8.02	cu ft/min
gal/min	0.002228	cu ft/sec

Temperature

°F = (°C x 1.8) + 32

°C = (°F - 32) ÷ 1.8

Weight

Multiply	By	To Get
lbs	7 000	grains
lbs H_2O (60°F)	0.01602	cu ft H_2O
lbs H_2O (60°F)	0.1198	gal H_2O
tons (long)	2 240	lbs
tons (short)	2 000	lbs
grains	0.000143	lbs
lbs H_2O cu ft H_2O	62.37	(60°F)
lbs H_2O gal H_2O	8.3453	(60°F)
lbs	0.000446	tons (long)
lbs	0.000500	tons (short)

Circular Measure

Multiply	By	To Get
Degrees	0.01745	Radians
Minutes	0.00029	Radians
Diameter	3.142	Circumference
Radians	57.3	Degrees
Radians	3 438	Minutes
Circumference	0.3183	Diameter

Volume

Multiply	By	To Get
Barrels (oil)	42	gal (oil)
cu ft	1 728	cu in
cu ft	7.48	gal
cu in	0.00433	gal
gal (oil)	0.0238	barrels (oil)
cu in	0.000579	cu ft
gal	0.1337	cu ft
gal	231	cu in

Heat Transmission

Multiply	By	To Get
Btu/in} /sq ft /hr/°F	0.0833	{Btu/ft /sq ft /hr/°F
Btu/ft} /sq ft /hr/°F	12	{Btu/in /sq ft /hr/°F

Fractions and Decimals

Multiply	By	To Get
Sixty-fourths	0.015625	Decimal
Thirty-seconds	0.03125	Decimal
Sixteenths	0.0625	Decimal
Eighths	0.125	Decimal
Fourths	0.250	Decimal
Halves	0.500	Decimal
Decimal	64	Sixty-fourths
Decimal	32	Thirty-seconds
Decimal	16	Sixteenths
Decimal	8	Eighths
Decimal	4	Fourths
Decimal	2	Halves

Gallons shown are U.S. standard.

Specific Heat—Specific Gravity

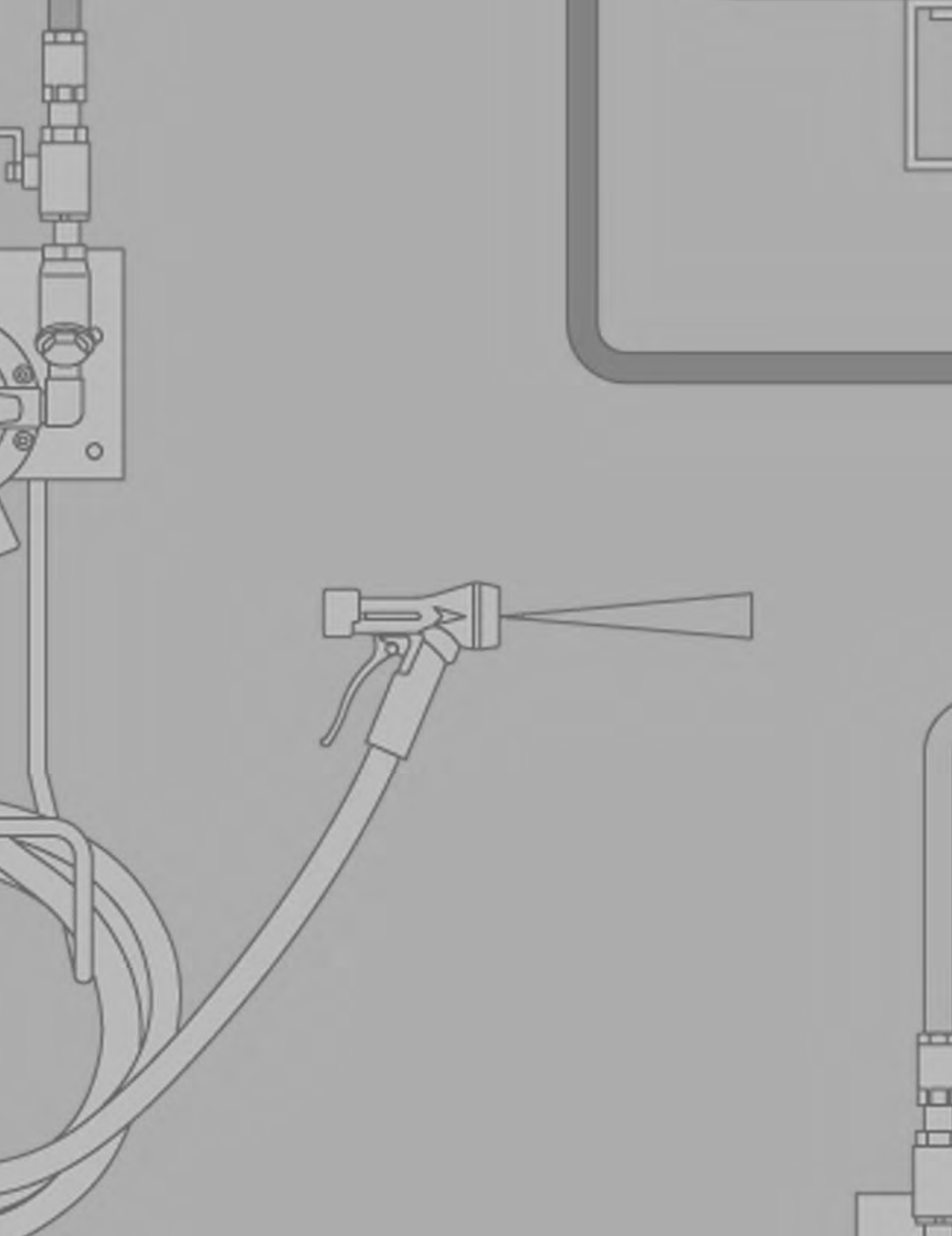
Table CG-33. Physical Properties of Liquids and Solids

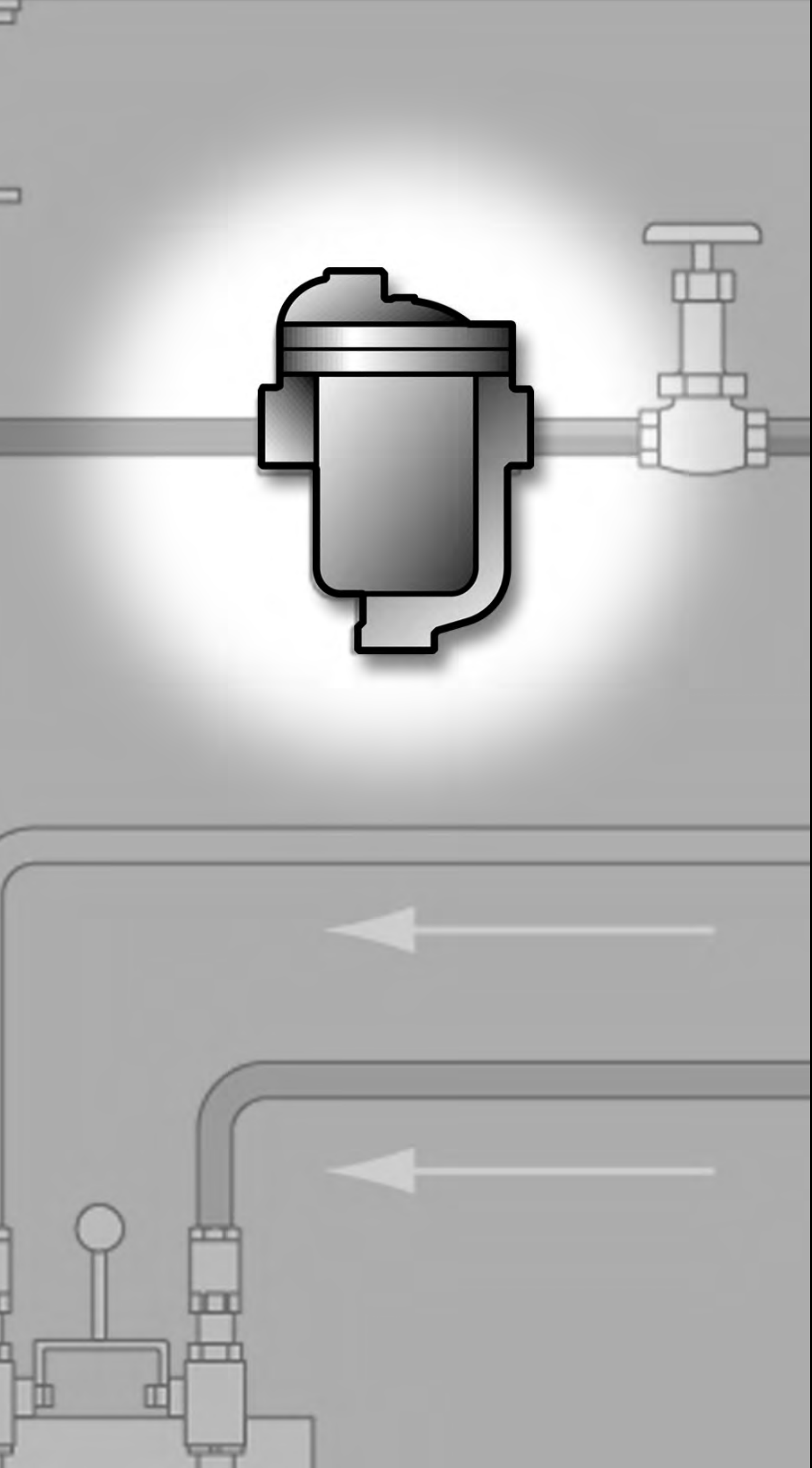
	Liquid (L) or Solid (S)	sp gr @ 60-70°F	sp ht @ 60°F Btu/lb-°F
Acetic acid 100%	L	1.05	0.48
Acetic acid 10%	L	1.01	0.96
Acetone, 100%	**L**	**0.78**	**0.514**
Alcohol, ethyl, 95%	L	0.81	0.60
Alcohol, methyl, 90%	L	0.82	0.65
Aluminum	**S**	**2.64**	**0.23**
Ammonia, 100%	L	0.61	1.10
Ammonia, 26%	L	0.90	1.00
Aroclor	**L**	**1.44**	**0.28**
Asbestos board	S	0.88	0.19
Asphalt	L	1.00	0.42
Asphalt, solid	**S**	**1.1-1.5**	**0.22-0.4**
Benzene	L	0.84	0.41
Brickwork & Masonry	S	1.6-2.0	0.22
Brine - calcium chloride, 25%	**L**	**1.23**	**0.689**
Brine - sodium chloride, 25%	L	1.19	0.786
Clay, dry	S	1.9-2.4	0.224
Coal	**S**	**1.2-1.8**	**0.26-0.37**
Coal tars	S	1.20	0.35@40
Coke, solid	S	1.0-1.4	0.265
Copper	**S**	**8.82**	**0.10**
Cork	S	0.25	0.48
Cotton, cloth	S	1.50	0.32
Cottonseed oil	**L**	**0.95**	**0.47**
Dowtherm A	L	0.99	0.63
Dowtherm C	L	1.10	0.35-0.65
Ethylene glycol	**L**	**1.11**	**0.58**
Fatty acid - palmitic	L	0.85	0.653
Fatty acid - stearic	L	0.84	0.550
Fish, fresh, average	**S**		**0.75-0.82**
Fruit, fresh, average	S		0.80-0.88
Gasoline	L	0.73	0.53
Glass, Pyrex	**S**	**2.25**	**0.20**
Glass, wool	S	0.072	0.157
Glue, 2 parts water 1 part dry glue	L	1.09	0.89
Glycerol, 100% (glycerin)	**L**	**1.26**	**0.58**
Honey	L		0.34
Hydrochloric acid, 31.5% (muriatic)	L	1.15	0.60
Hydrochloric acid, 10% (muriatic)	**L**	**1.05**	**0.75**
Ice	S	0.90	0.50
Ice Cream	S		0.70
Lard	**S**	**0.92**	**0.64**
Lead	S	11.34	0.031
Leather	S	0.86-1.02	0.36
Linseed oil	**L**	**0.93**	**0.44**
Magnesia, 85%	L	0.208	0.27
Maple syrup	L		0.48
Meat, fresh, average	**S**		**0.780**
Milk	L	1.03	0.90-0.93
Nickel	S	8.90	0.11
Nitric acid, 95%	**L**	**1.50**	**0.50**
Nitric acid, 60%	L	1.37	0.64
Nitric acid, 10%	L	1.05	0.90
No. 1 Fuel Oil (kerosene)	**L**	**0.81**	**0.47**
No. 2 Fuel Oil	L	0.86	0.44
No. 3 Fuel Oil	L	0.88	0.43
No. 4 Fuel Oil	**L**	**0.90**	**0.42**
No. 5 Fuel Oil	L	0.93	0.41
No. 6 Fuel Oil	L	0.95	0.40
API Mid-continent crude	L	.085	0.44
API gas oil	L	0.88	0.42
Paper	**S**	**1.7-1.15**	**0.45**
Paraffin	S	0.86-0.91	0.62
Paraffin, melted	L	0.90	0.69
Phenol (carbolic acid)	**L**	**1.07**	**0.56**
Phosphoric acid, 20%	L	1.11	0.85
Phosphoric acid, 10%	L	1.05	0.93
Phthalic anhydride	**L**	**1.53**	**0.232**
Rubber, vulcanized	S	1.10	0.415
SAE - SW (#8 machine lube oil)	L	0.88	
SAE - 20 (#20 machine lube oil)	**L**	**0.89**	
SAE - 30 (#30 machine lube oil)	L	0.89	
Sand	S	1.4-1.76	0.19
Sea water	**L**	**1.03**	**0.94**
Silk	S	1.25-1.35	0.33
Sodium hydroxide, 50% (caustic acid)	L	1.53	0.78
Sodium hydroxide, 30%	**L**	**1.33**	**0.84**
Soybean oil	L	0.92	0.24-0.33
Steel, mild @ 70	S	7.90	0.11
Steel, stainless, 300 series	**S**	**8.04**	**0.12**
Sucrose, 60% sugar syrup	L	1.29	0.74
Sucrose, 40% sugar syrup	L	1.18	0.66
Sugar, cane & beet	**S**	**1.66**	**0.30**
Sulfur	S	2.00	0.203
Sulfuric acid, 110% (fuming)	L		0.27
Sulfuric acid, 98%	**L**	**1.84**	**0.35**
Sulfuric acid, 60%	L	1.50	0.52
Sulfuric acid, 20%	L	1.14	0.84
Titanium (commercial)	**S**	**4.50**	**0.13**
Toluene	L	0.86	0.42
Trichloroethylene	L	1.62	0.215
Tetrachloride carbon	**L**	**1.58**	**0.21**
Turpentine, spirits of	L	0.86	0.42
Vegetables, fresh, average	S		0.73-0.94
Water	**L**	**1.00**	**1.00**
Wines, table, dessert, average	L	1.03	0.90
Woods, vary from	S	0.35-0.9	0.90
Wool	**S**	**1.32**	**0.325**
Zinc	S	7.05	0.095

Table CG-34. Physical Properties of Gases

	sp gr @ 60-70°F	spht@60°FBtu/lb-°F
Air	1.00	0.24
Ammonia	0.60	0.54
Benzene		**0.325**
Butane	2.00	0.455
Carbon dioxide	1.50	0.21
Carbon monoxide	**0.97**	**0.255**
Chlorine	2.50	0.118
Ethane	1.10	0.50
Ethylene	**0.97**	**0.45**
Freon - 12		0.16
Hydrogen	0.069	3.42
Hydrogen sulfide	**1.20**	**0.25**
Methane	0.55	0.60
Nitrogen	0.97	0.253
Oxygen	**1.10**	**0.225**
Propane	1.50	0.46
Sulfur dioxide		0.162
Water vapor (steam)	2.30	0.453

Notes





Steam Trapping and Steam Tracing Equipment

Armstrong

Armstrong®

Pay less money for energy—and more attention to the environment.

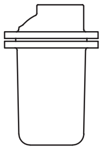
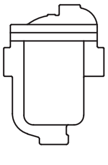
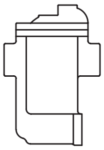
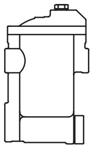
It's pretty obvious, really. An efficient steam trap wastes less energy, which means you burn less fuel and reduce emissions. The results are energy savings and a cleaner, healthier environment. By helping companies manage energy, Armstrong steam traps are also helping protect the world we all share.

As a steam trap wears, it loses efficiency and begins to waste energy. But Armstrong inverted bucket traps last years longer than other traps. They operate more efficiently longer because the inverted bucket is the most reliable steam trap operating principle known.

Clearly, the longer an efficient trap lasts, the more it reduces energy wasted, fuel burned and pollutants released into the air. It's an all-around positive situation that lets the environment win, too. Bringing energy down to earth in your facility could begin with a renewed focus on your steam system, especially your steam traps. Said another way: Zeroing in on your steam traps is an easy way to pay less money for energy—and more attention to the environment.

Companies around the world are beginning to realize that rather than being separate challenges, energy and the environment are and have always been a single mission. And that quality management in one area will surely impact the other.

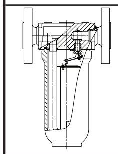
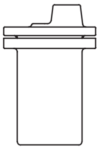
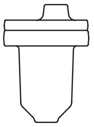
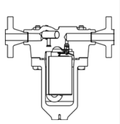
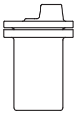
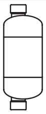
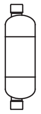
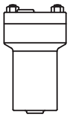
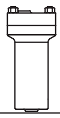
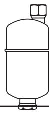
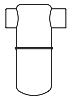
Armstrong Steam Trap ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size 1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	Located on Page
	**Series 200** Inverted Bucket Capacities to **20 000** lb/hr	↑	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**211**	250	●							74
							212	250	●	●						
							213	250	●	●	●					
							214	250			●	●				
							215	250			●	●	●			
							216	250					●	●		
	**Series 800** Inverted Bucket Capacities to **20 000 lb/hr**	→	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**800**	150	●	●						76
							811	250	●	●	●					
							812	250	●	●						
							813	250		●	●					
							814	250			●	●				
							815	250			●	●	●	●		78
							816	250						●	●	
	**Series 880** Inverted Bucket Capacities to **4 400** lb/hr	→	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**880**	150	●	●	●					80
							881	250	●	●	●					
							882	250	●	●						
							883	250		●	●	●				
	**Series 980** Inverted Bucket Capacities to **4 400** lb/hr	→	Screwed Socketweld Flanged †	600	650	ASTM A216 WCB Carbon Steel	**981**	600	●	●						82
							983	600		●	●					

† Operating pressure and temperature may be limited depending on the class of flange selected.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

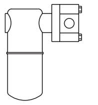
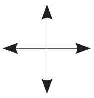
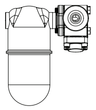
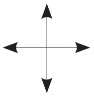
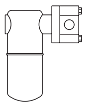
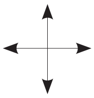
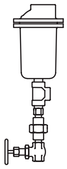
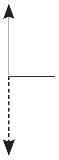
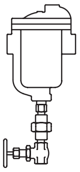
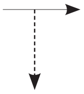
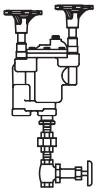
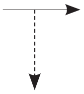
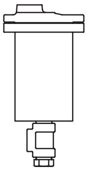
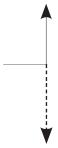
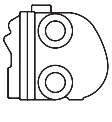
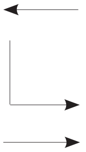
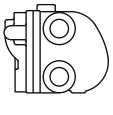
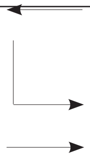
Armstrong Steam Trap ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size							Located on Page
									3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	
	**Series EM** Inverted Bucket Capacities to **1 058** lb/hr	→	Screwed Socketweld Flanged †	464	482	Forged Carbon Steel	**EM**	464		●	●					84
	**Series 300** Inverted Bucket Capacities to **20 000** lb/hr	↑	Screwed Socketweld Flanged †	★★ 700	★★ 700	ASTM A105 Forged Steel	**310**	400		●	●					86
				600			**312**	600		●	●	●				
				1 080			**313**	650		●	●	●				
				1 130			**314**	650				●	●			
				965			**315**	650				●	●	●		
				1 050			**316**	650						●	●	
	**Series 411G** Inverted Bucket Capacities to **1 300** lb/hr	↑	Screwed Socketweld Flanged †	★★ 1 000	★★ 700	ASTM A105 Forged Steel	**411G**	1 000		●	●					88
	**Series 521** Inverted Bucket Capacities to **1 300** lb/hr	→	Screwed NPT & BSPT Socketweld, Flanged †	1 000	700	ASTM A105 Forged Steel	**521**	1 000		●	●					90
	**Series 400** Inverted Bucket Capacities to **20 000** lb/hr	↑	Screwed Socketweld Flanged †	★★ 1 050	★★ 850	ASTM A182 F22 Forged Steel	**413**	1 000		●	●	●				92
				1 080			**415**	1 000				●	●	●		
				1 350			**416**	1 000						●	●	
	**Series 401-SH** Inverted Bucket Capacities to **770** lb/hr	↑	Screwed Socketweld Flanged †	1 000	800	Carbon Steel ASTM A106 Gr. B	**401-SH**	1 000		●	●					94
	**Series 501-SH** Inverted Bucket Capacities to **950** lb/hr	↑	Screwed Socketweld Flanged †	1 540	850	316L Stainless Steel ASTM A312	**501-SH**	1 540		●	●					94
	**Series 5000** Inverted Bucket Capacities to **5 150** lb/hr	↑	Socketweld Flanged †	★★ 1 730	★★ 900	ASTM A182 F22 Forged Steel	**5133G**	1 500		●	●	●				96
				★★ 2 070			**5155G**	1 800			●	●	●			
	**Series 6000** Inverted Bucket Capacities to **6 500** lb/hr	↑	Socketweld Flanged †	★★ 3 090	★★ 900	ASTM A182 F22 Forged Steel	**6155G**	2 700					●	●		98
	**Series 1000** Inverted Bucket Capacities to **4 400** lb/hr	↑	Screwed Socketweld	400	800	304L Stainless Steel	**1010**	150		●	●					102
				400	800		**1011**	400		●	●					
				650	600		**1022**	650			●					
				450	800		**1013**	450				●				
	**Series 1800** Inverted Bucket Capacities to **1 802** lb/hr	→	Screwed Socketweld	400	800	304L Stainless Steel	**1810**	200	●	●						104
							1811	400		●	●					
				650	600		**1822**	650		●	●	●				

★★See tables on pages 86, 89 and 91 for complete temperature/pressure rating information.

† Operating pressure and temperature may be limited depending on the class of flange selected.

Steam Trap ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig							Located on Page
									1/2”	3/4”	1”	1-1/4”	1-1/2”	2”	
	**Series 2000** Inverted Bucket Capacities to **1 300** lb/hr		Screwed Socketweld	400	800	304L Stainless Steel	**2010**	200	●	●	●				106
							2011	400	●	●	●				
				650	600		**2022**	650	●	●	●				
	**Series 4000** Inverted Bucket Capacities to **1 300** lb/hr		Screwed NPT Socketweld Flanged	400	800	ASTM-A 240 Grade 304L	**4010**	200	●	●	●				108
							4011	400	●	●	●				
				650	600		**4022**	650	●	●	●				
	**1811N and 2011N** Inverted Bucket non-metallic seat Capacities to **900** lb/hr		Screwed Socketweld	400	800	304L Stainless Steel	**1811N**	200	●	●					110
							2011N	200	●	●	●				
	**Series 20-DC** Automatic Differential Condensate Controllers Capacities to **20 000** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**21-DC**	250	●						112
							22-DC	250		●					
							23-DC	250			●				
							24-DC	250				●			
							25-DC	250					●		
							26-DC	250						●	
	**Series 80-DC** Automatic Differential Condensate Controllers Capacities to **20 000** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**81-DC**	250		●					114
							82-DC	250		●					
							83-DC	250			●				
							84-DC	250				●			
							85-DC	250						●	
							86-DC	250						●	
	**Series TVS 80-DC** Automatic Differential Condensate Controllers Capacities to **4 400** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**TVS 81-DC**								116
							TVS	250	●	●					
							82-DC	250	●	●					
							TVS	250		●	●				
							83-DC								
	**Series 30-DC** Automatic Differential Condensate Controllers Capacities to **20 000** lb/hr		Screwed	1 080	700	ASTM A105 Forged Steel	**33-DC**	650			●				118
				1 130			**34-DC**	650				●			
				1 015			**35-DC**	650					●		
				1 100			**36-DC**	650						●	
	**Series B & BI** F&T Capacities to **8 900** lb/hr		Screwed	125 175	353 377	ASTM A48 Class 30 Cast Iron	**B2, BI2**	30	●▲						122
							B3, BI3	30		●▲					
							B4, BI4	30			●▲				
							B5	30				●			
							B6	30					●		
							B8	30						●	
	**Series A & AI** F&T Capacities to **8 900** lb/hr		Screwed	175	377	ASTM A48 Class 30 Cast Iron	**AI2**	175	●						124
							A3, AI3	175	●▲	●					
							A4, AI4	175		●▲	●				
							A5	175			●	●			
							A6	175				●	●		
							A8	175					●	●	

▲Series AI and BI for in-line connection.

† Operating pressure and temperature may be limited depending on the class of flange selected.

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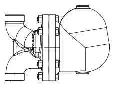
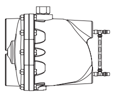
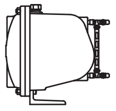
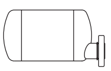
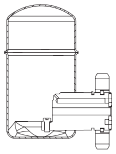
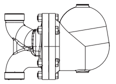
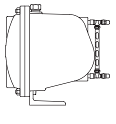
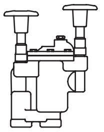
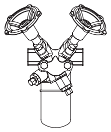
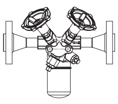
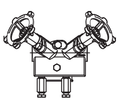
Steam Trap ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size 1/2”	3/4”	1”	1-1/4”	1-1/2”	2”	2-1/2”	3”	Located on Page
	**Series AIC** F&T Capacities to **60 000** lb/hr	↕ ↔	Screwed Flanged	580	572	ASTM A395 Ductile Iron	**AICV** **AICFH**	465					●	●			126
	**Series JD & KD** F&T Capacities to **142 000** lb/hr	← ↳	Screwed Flanged	300	650	ASTM A395 Ductile Iron	**15-JD**	15						●			128
							20-JD	20						●			
							30-JD	30						●			
							75-JD	75						●			
							125-JD	125						●			
							175-JD	175						●			
							250-JD	250						●			
							300-JD	300						●			
							30-KD	30						●			
							50-KD	50							●		
							300-KD	300							●	●	
	**Series L & M** F&T Capacities to **208 000** lb/hr	← ↳	Screwed Flanged † (screw on)	250	450	ASTM A48 Class 30 Cast Iron	**L8**	250						●			130
							L10	250							●		
							M12	250								●	
	**Series FT-4000** F&T Capacities to **1 080** lb/hr	↕ ↔	Screwed Socketweld	485	600	ASTM A240 Grade 304L	**FT-4075**	75	●	●	●						132
							FT-4150	150	●	●	●						
							FT-4225	225	●	●	●						
							FT-4300	300	●	●	●						
							FT-4465	465	●	●	●						
	**Series FF-4000** F&T Capacities to **1 050** lb/hr	↕ ↔	Screwed Socketweld	600	800	ASTM A240 Grade 304L	**FF-4250**	250	●	●							134
							FF-4450	450	●	●							
	**Series ICS** F&T Capacities to **60 000** lb/hr	↕ ↔	Screwed Socketweld Flanged †	580	572	Carbon Steel	**ICS**	465	●	●	●	●	●	●			136
	**Series LS & MS** F&T Capacities to **280 000** lb/hr	← ↳	Screwed Socketweld Flanged †	450	650	ASTM A216 WCB Carbon Steel	**LS8**	450						●			138
							LS10	450							●		
							MS-12	450								●	
	**TVS 800** Trap Valve Station Capacities to **4 400** lb/hr	→	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**TVS 811**	250	●	●							142
							TVS 812	250	●	●							
							TVS-813	250		●	●						
	**TVS 4000** Trap Valve Station	↕ ↔	Screwed Socketweld	650	600	ASTM A351 Gr. CF8M	**TVS 4000**	650	●	●							146
	**TVS 4000F** Trap Valve Station	↕ ↔	Flanged †	650	600	ASTM A351 Gr. CF8M	**TVS 4000F**	650		●	●						148
	**TVS 5000** Trap Valve Station	↕ ↔	Screwed Socketweld Flanged †	650	600	ASTM A350 LF2	**TVS 5000**	650	●	●							152

† Operating pressure and temperature may be limited depending on the class of flange selected.

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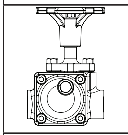
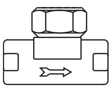
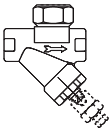
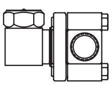
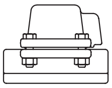
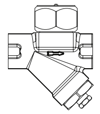
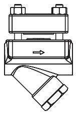
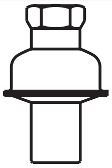
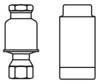
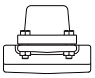
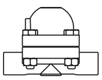
Steam Trap ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size								Located on Page
									1/4”	3/8”	1/2”	3/4”	1”	2”	2-1/2”	3”	
	**TVS 1100** Trap Valve Station	↔	Screwed Socketweld Flanged †	580	662	ASTM A105 Carbon Steel	**TVS 1100**	319			●	●					150
	**Series CD-33** Disc Capacities to **2 428** lb/hr	↔ ↕	Screwed	915	752	ASTM A743 Gr. CA40	**CD-33**	600			●	●	●				158
							CD-33L			●	●	●					
	**Series CD-33S** Disc w/Integral Strainer Capacities to **2 428** lb/hr						**CD-33S**				●	●	●				156
							CD-33SL				●	●					
	**Series CD-3300** Disc Capacities to **800** lb/hr	✥	Screwed Socketweld	720	750	Stainless Steel	**CD-3300**	450			●	●	●				159
	**Series CD-40** Controlled Disc Capacities to **2 850** lb/hr	↔ ↕	Screwed	600	500	Carbon Steel	**CD-41**	600		●	●						160
							CD-42	600				●					
							CD-43	600					●				
	**Series CD-60** Controlled Disc Capacities to **2 850** lb/hr	↔ ↕	Screwed Socketweld	600	750	Forged Carbon Steel	**CD-61**	600		●	●						160
							CD-62	600				●					
							CD-63	600					●				
	**Series CD-72SR** Controlled Disc Capacities to **3 900** lb/hr	↔ ↕	Screwed NPT BSPT Socketweld Flanged †	1 010	750	ASTM A105N/ A350 LF2 Cl.1	**CD-72S/ SL**	600			●	●	●				162
	**Series CD-82S** Controlled Disc Capacities to **750** lb/hr	↔ ↕	Screwed NPT BSPT Socketweld, Buttweld Flanged †	1 500	650	ASTM A182 F11 Cl.2	**CD-80S**	100			●	●					163
						ASTM A182 F22 Cl.3	**CD-82S**										
	**Series WMT** Thermostatic Wafer Cold Water Start-Up Capacities to **1 000** lb/hr		Screwed	250	400	304L Stainless Steel	**WMT-1**	250	●	●	●						
	**Series WT** Thermostatic Wafer Cold Water Start-Up Capacities to **1 600** lb/hr	↔ ↕	Screwed	400	650	304L Stainless Steel	**WT-1**	400			●	●					167
			Screwed Socketweld	600	750	C1018 Carbon Steel	**WT-3**	600			●	●					
		✥		400	650	304L Stainless Steel	**WT-2000**	400			●	●	●				
  	**Model SH** Thermostatic Wafer Cold Water Start-Up Capacities to **1 600** lb/hr	↔ ↕	Screwed NPT BSPT Socketweld Flanged †	580	662	ASTM A105	**SH-300**	319			●	●	●				169
			Screwed NPT BSPT Socketweld Buttweld Flanged †	900	900	Stainless Steel	**SH-900**	L=650* H=900*			●	●					
			Buttweld Flanged †										●				
			Socketweld Buttweld Flanged †	1 800	1 050	ASTM 217 Cer. C12A	**SH-1500**	1 800				●	●				

*L = low pressure *H = high pressure † Operating pressure and temperature may be limited depending on the class of flange selected.

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Steam Trap ID Charts

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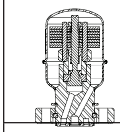
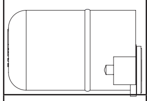
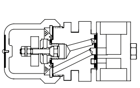
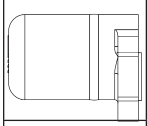
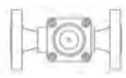
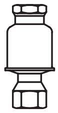
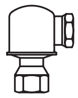
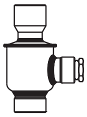
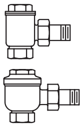
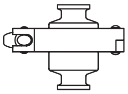
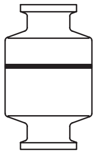
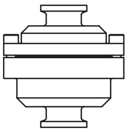
									1/2"	3/4"	1"	
	**Model SH-2000** Cold Water Start-Up Capacities to **4 800** lb/hr	↔↕	Screwed Socketweld	400	800	Stainless Steel	**SH-2000**	400	●	●	●	171
	**Model SH-2500** Cold Water Start-Up Capacities to **6 000** lb/hr	↔↕	Screwed Socketweld	650	600	ASTM A351 Gr. CF8M	**SH-2500**	650	●	●	●	172
	**Model AB-3000** Bimetallic Capacities to **4 000** lb/hr	↔↕	Screwed Socketweld Flanged †	319	650	ASTM - A240 304L	**AB-3000**	319	●	●	●	173
	**Model SH-4000** Cold Water Start-Up Capacities to **6 000** lb/hr	↔↕	Screwed Socketweld	1 245	900	Stainless Steel	**SH-4000**	1 245		●	●	174
	**Model TC-300** Cold Water Start-Up Capacities to **1 000** lb/hr	↔	Screwed Socketweld Flanged †	465	662	ASTM A15 Carbon Steel	**TC-300**	250	●	●	●	166
 	**Series TT** Thermostatic Bellows Capacities to **3 450** lb/hr	↔↕	Screwed	300	450	304L Stainless Steel	**TTF-1**	300	●	●		175
		↴					**TTF-1R**		●	●		
		↔↕	Screwed Socketweld				**TT-2000**		●	●	●	
	**TAVB** Thermostatic Bellows w/Integral Vacuum Breaker	↑	Straight-Thru Screwed	300	365	304L Stainless Steel	**TAVB-2** **TAVB-3**	150	●	●		177
	**Series** **TS-2/TS-3** Radiator Capacities to **1 600** lb/hr	↓	Threaded	50	300	Bronze	**TS-2**	50	●	●		178
		↴		65	315		**TS-3**	65	●	●	●	
	**Series TC** Thermostatic Clean Steam Clamped Capacities to **3 450** lb/hr	↓	Sanitary	120	350	Stainless Steel	**TC-C**	100	●	●	●	179
	**Series TC** Thermostatic Clean Steam Sealed Capacities to **3 775** lb/hr	↓	Sanitary	150	366	Stainless Steel	**TC-S**	120	●	●	●	
			Threaded						●	●		
			Tube End						●	●		
	**Series TC** Thermostatic Clean Steam Repairable Capacities to **3 775** lb/hr	↓	Sanitary	120	356	Stainless Steel	**TC-R**	100	●	●	●	
			Threaded						●	●		
			Tube End						●	●		

† Operating pressure and temperature may be limited depending on the class of flange selected.

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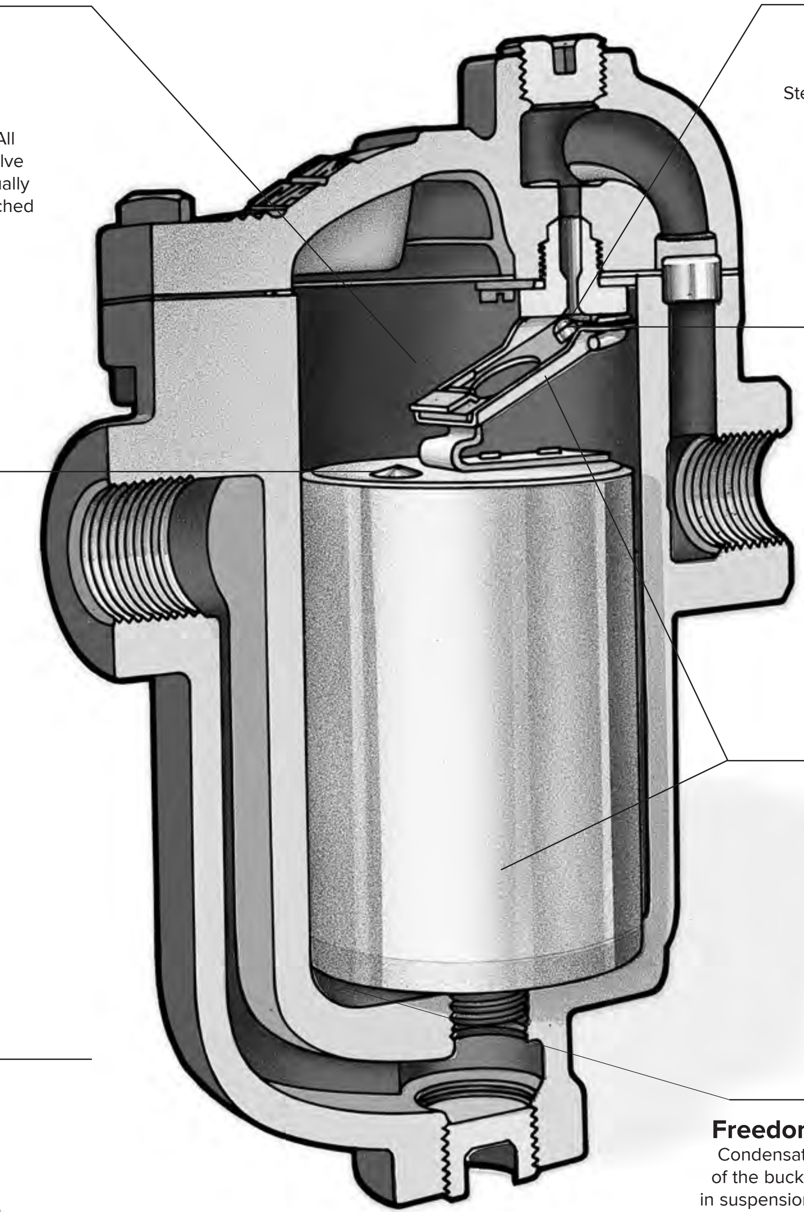
The Inverted Bucket Steam Trap

Energy Efficient Because It's So Reliable

The inverted bucket is the most reliable steam trap operating principle known. The heart of its simple design is a unique leverage system that multiplies the force provided by the bucket to open the valve against pressure. Since the bucket is open at the bottom, it resists damage from water hammer, and wear points are heavily reinforced for long life.

The inverted bucket has only two moving parts—the valve lever assembly and the bucket. That means no fixed points, no complicated linkages. Nothing to stick, bind or clog.



Wear and corrosion resistance

Free-floating guided lever valve mechanism is "frictionless," and all wear points are heavily reinforced. All working parts are stainless steel. Valve and seat are stainless steel, individually ground and lapped together in matched sets.

Continuous air and CO_2 venting

Vent in top of bucket provides continuous automatic air and CO_2 venting with no cooling lag or threat of air binding. Steam passing through vent is less than that required to compensate for radiation losses from the trap so it's not wasted.

Excellent operation against back pressure

Since trap operation is governed by the difference in density of steam and water, back pressure in the return line has no effect on the ability of the trap to open for condensate and close against steam.

Virtually no steam loss

Steam does not reach the water-sealed discharge valve.

Purging action

Snap opening of the valve creates a momentary pressure drop and turbulence in the unit drained. This breaks up films of condensate and air and speeds their flow to the trap.

Dependable operation

Simple, direct operation with nothing to stick, bind or clog. Only two moving parts—the valve lever and the bucket.

Freedom from dirt problems

Condensate flow under the bottom edge of the bucket keeps sediment and sludge in suspension until it is discharged with the condensate. Valve orifice opens wide and closes tightly. No buildup of dirt or close clearances to be affected by scale.

Resistance to damage from water hammer

Open bucket or float will not collapse as a result of water hammer.

Inverted Bucket Steam Trap

Conserves Energy Even in the Presence of Wear

Armstrong inverted bucket steam traps open and close based on the difference in density between condensate and steam—the inverted bucket principle. They open and close gently, minimizing wear. This simple fact means that inverted buckets are subject to less wear than some other types of traps.

In fact, as an Armstrong inverted bucket trap wears, its tight seal actually improves. The ball valve and seat of the Armstrong trap provide essentially line contact—resulting in a tight seal because the entire closing force is concentrated on one narrow seating ring.

An Armstrong inverted bucket trap continues to operate efficiently with use. Gradual wear slightly increases the diameter of the seat and alters the shape and diameter of the ball valve. But, as this occurs, a tight seal is still preserved—the ball merely seats itself deeper.

Corrosion-Resistant Parts

The stainless steel valve and seat of the Armstrong inverted bucket steam trap are individually ground and lapped together in matched sets. All other working parts are wear- and corrosion-resistant stainless steel.

Venting of Air and CO_2

The Armstrong inverted bucket provides continuous automatic air and CO_2 venting with no cooling lag or threat of air binding.

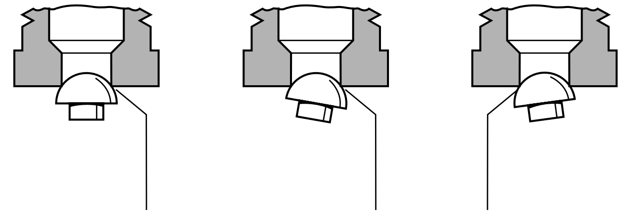
Operation Against Back Pressure

The Armstrong inverted bucket has excellent performance against back pressure. It has no adverse effect on inverted bucket operation other than to reduce its capacity by the low differential. The bucket simply requires less force to pull the valve open and cycle the trap.

Freedom From Dirt Problems

Armstrong designed its inverted bucket to be virtually free of dirt problems. The valve and seat are at the top of the trap, far away from the larger particles of dirt, which fall to the bottom. Here the up-and-down action of the bucket pulverizes them. Since the valve of an inverted bucket is either fully closed or open, dirt particles pass freely. And the swift flow of condensate from under the bucket's edge creates a unique self-scrubbing action that sweeps dirt out of the trap.

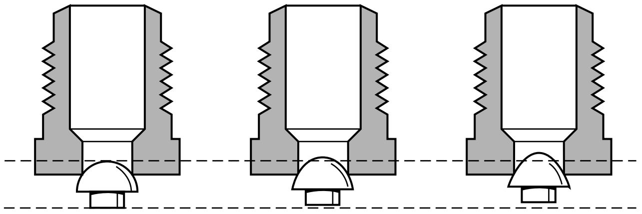
Armstrong IB Valve Seating/Ball Valve



Line Contact—
Single Seat

Infinite Number of Center Lines and
Seating Circumferences

IB Valve Wear Characteristics



Armstrong IB ball valve continues to seat itself deeper, providing a tight seal even in the presence of wear.

Armstrong® How to Use the IB Trap Summary Capacity Chart

This catalog should be utilized as a guide for the installation and operation of steam trapping equipment by experienced personnel. Selection or installation should always be accompanied by competent technical assistance or advice. Armstrong and its local representatives are available for consultation and technical assistance. We encourage you to contact your Armstrong Representative for complete details.

The summary capacity chart plots actual trap capacity vs. inlet pressure on a log-log grid. The trap capacities become **straight lines** on this grid. The **small numbers** along the pressure axis identify the subdivisions; for example, between the large 10 and 100, the numbers 2, 3, 5, and 7 represent 20, 30, 50 and 70 psig.

The summary chart combines many trap families into one chart by presenting only a portion of the capacity line for each orifice size. For charts that give capacity over a wide range of pressures, see the specific trap model pages.

Individual capacity charts for various traps are given throughout this catalog. Those charts show capacity lines for each orifice, with pressures usually from 1 psig up to the maximum rated pressure of that orifice.

To select an inverted bucket steam trap using the summary capacity chart, you must know the condensate load, safety factor, inlet pressure and outlet pressure. Remember, the object is to select a trap that can 1) operate at the maximum inlet pressure, and 2) handle the capacity at the minimum differential pressure. Consider the following typical problems.

Example 1. Constant pressure, condensing rate.
Given:
Maximum inlet pressure . . . . .70 psig
Normal operating differential pressure . . . . 60 psig
Required capacity = 300 lb/hr condensate load
times 3:1 safety factor, or . . . . 900 lb/hr

Enter the chart at the 60 psig line and go up to 900 lb/hr capacity. This is directly on the 5/32" orifice line for models 211, 811 and 881 (and other traps). Now follow this line to the right, to the vertical drop at 70 psig. This means the orifice will work, in these traps, up to a maximum differential of 70 psig. Assuming a cast iron trap is suitable, the 5/32" orifice in a Model 211, 811 or 881 trap will meet all the operating requirements.

Example 2. Constant condensing rate but with possible reduced inlet pressure.
Given:
Maximum inlet pressure . . . . .100 psig
Minimum inlet pressure. . . . . .40 psig
Required capacity = 400 lb/hr condensate load
times 3:1 safety factor, or .1 200 lb/hr

Consider the maximum operating pressure first. Enter the chart at the 100 psig line and find the first capacity line above 1 200 lb/hr. This is the 5/32" orifice in a Model 212, 812 or 882, and it has a capacity of 1 800 lb/hr at 100 psig. Now extend this straight line to the left until it intersects the 40 psig pressure line. At 40 psig, read a capacity of 1 300 lb/hr. (You could also refer to the individual capacity charts for Models 212, 812 or 882.) Assuming cast iron is suitable, this is the desired trap selection to meet the requirements of opening at the maximum pressure, and also having the needed capacity at the minimum pressure.

This example points out how the capacity is influenced by the trap size. Example 1 also used the same orifice size, but in a physically smaller trap. In the larger trap the same diameter orifice not only has a higher capacity, it will work at higher pressures.

Example 3. Constant condensing rate but high back pressure.
Given:
Inlet pressure . . . . .100 psig
Normal outlet (back) pressure . . . . 50 psig
Required capacity = 1 800 lb/hr condensate load
times 3:1 safety factor, or . . . . 5 400 lb/hr

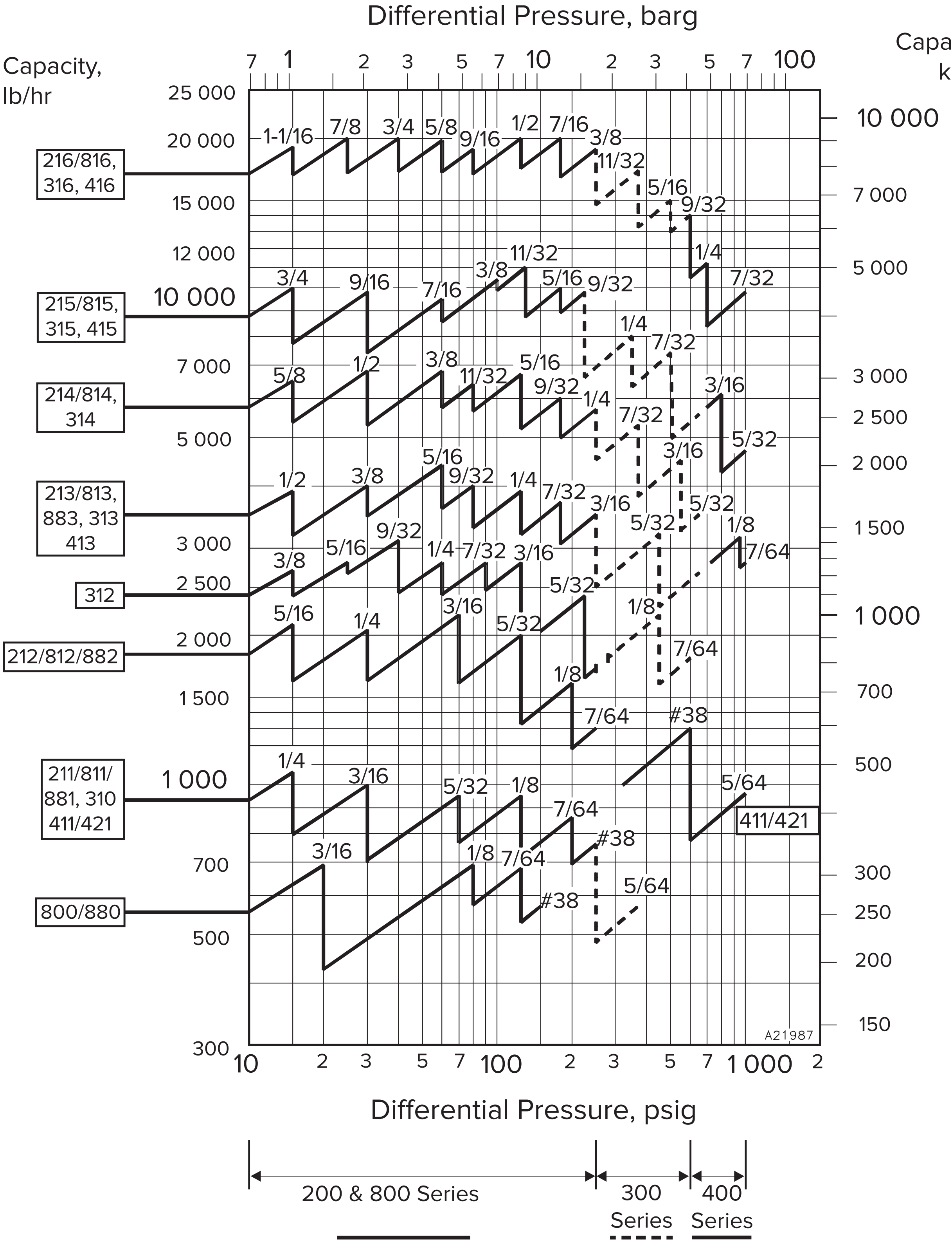
Traditional method:
Since the differential pressure is only 50 psig, enter the chart at 50 psig and go up to a capacity of 5 400 lb/hr. This is just under the capacity lines for Models 214 and 814. However, the 5/16" orifice is the largest orifice that will operate at 100 psig inlet pressure. (Remember that the back pressure may not always be there!) Extend the capacity line for the 5/16" orifice to the left, and read a capacity of 4 800 lb/hr at 50 psig. Since this is too low, go up to the 215/815 capacity lines and repeat the process. The selection will end up being a Model 215 or 815 with a 3/8" orifice.*

About this chart ...
The Armstrong capacity chart shows continuous discharge capacities of Armstrong traps under actual operating conditions, as determined by many hundreds of tests made over the years. In these tests, **hot condensate** was used, at or near the steam temperature corresponding to the test pressure. The choking effect of flash steam in the orifice and the back pressure created by this flash steam were therefore automatically taken into account. The test setups were similar to an actual installation hookup, so that pipe friction in both inlet and discharge lines was reflected in the results.

* This method is conservative. While it will always select a workable trap, it may select a larger trap than necessary. Consult Armstrong Application Engineering for further information about the effects of back pressure.

IB Trap Summary Capacity Chart

Summary Capacity Chart

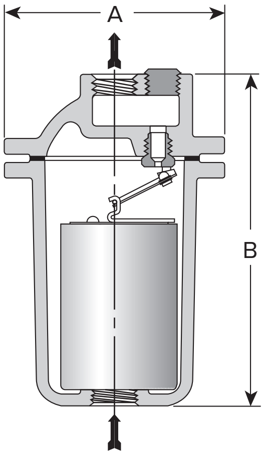


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

200 Series Inverted Bucket Steam Traps

Cast Iron for Vertical Installation

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)



Description

The most reliable steam trap known—the inverted bucket—provides efficient condensate drainage of virtually all types of steam-using equipment. Put the inverted bucket to work in a tough cast iron package, and you have the best of both worlds. Because they operate efficiently for longer periods of time, Armstrong cast iron inverted buckets add solid energy savings to lower replacement/labor costs.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, allowing no condensate backup. They are also resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	Model 211-216: 250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Test plug:	Carbon steel

Options

- Stainless steel internal check valve
- Thermic vent bucket
- Scrub wire

Specification

Inverted bucket steam trap, type ... in cast iron, with continuous air venting at steam temperature, free floating stainless steel mechanism, and discharge orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

For a fully detailed certified drawing, refer to CD #1001.

200 Series, Bottom Inlet, Top Outlet Traps

Add suffix “CV” to model number for internal check valve, “T” for thermic vent bucket.

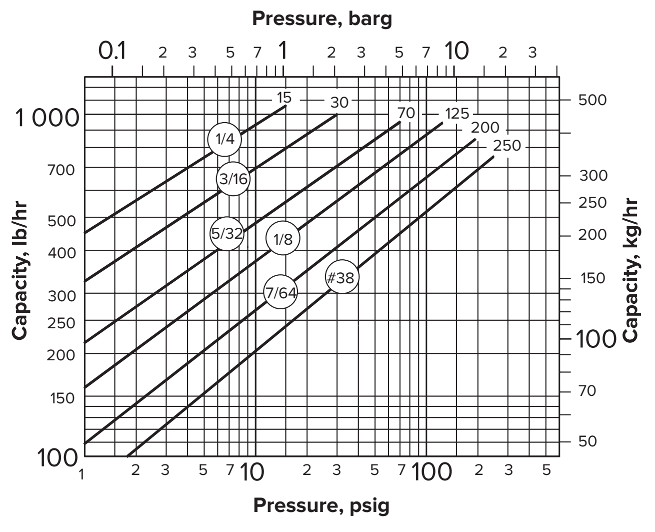
Model No.	211		212		213		214		215		216	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2	15	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1, 1-1/4	25, 32	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50
Test Plug	1/8	3	3/8	10	1/2	15	1/2	15	3/4	20	1	25
“A” (Flange Diameter)	4-1/4	108	5-1/4	133	6-3/8	162	7-1/2	190	8-1/2	216	10-3/16	259
“B” (Height)	6-7/16	164	8-5/8	218	11-1/2	292	12-3/8	314	14-3/16	360	18	457
Number of Bolts	6		8		6		8				12	
Weight lb (kg)	6 (2.7)		11-1/2 (5.2)		20-1/4 (9.2)		33 (15.0)		44-3/4 (20.3)		77-1/2 (35.2)	

200 Series Inverted Bucket Steam Traps

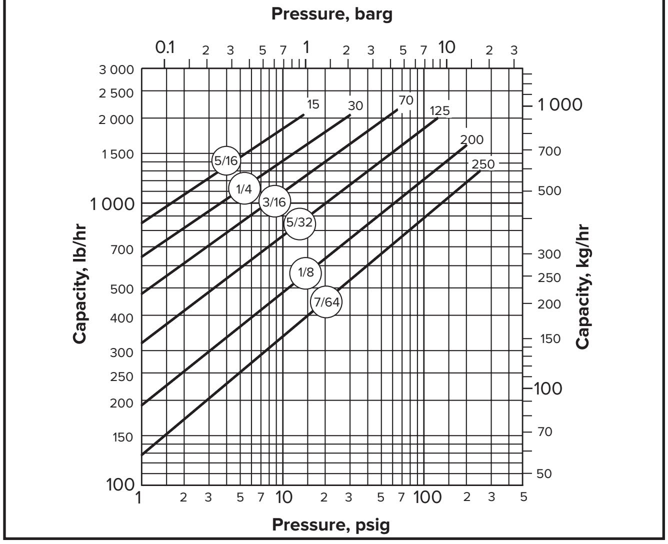
Cast Iron for Vertical Installation

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

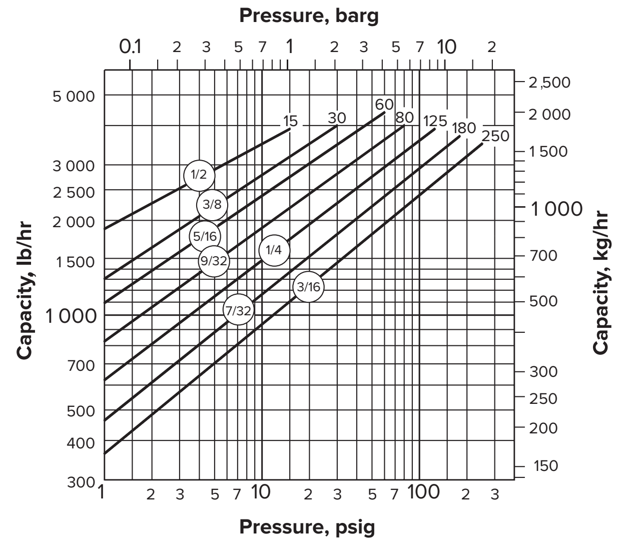
Model 211 Capacity



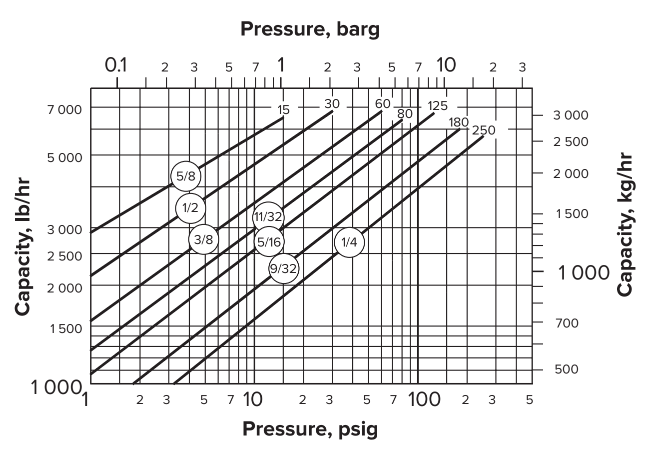
Model 212 Capacity



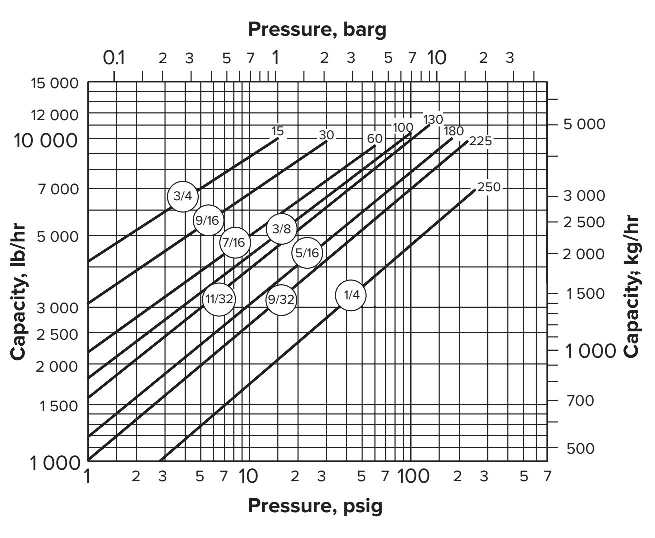
Model 213 Capacity



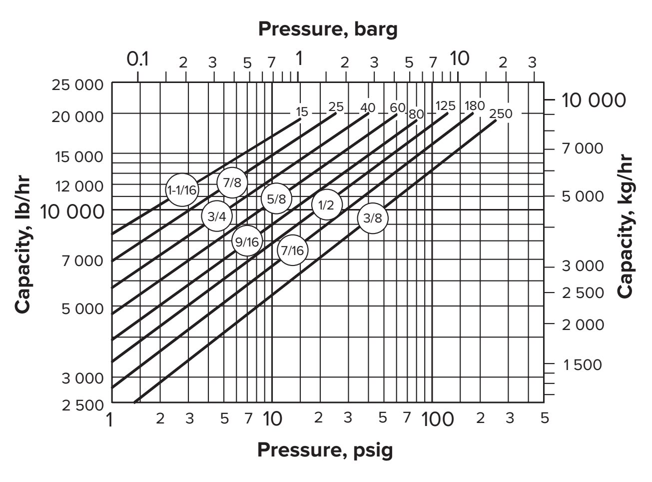
Model 214 Capacity



Model 215 Capacity



Model 216 Capacity

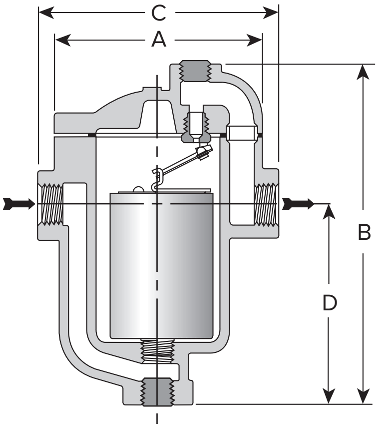


Armstrong®

800-813 Series Inverted Bucket Steam Trap

Cast Iron for Horizontal Installation

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)



Description

The most reliable steam trap known—the inverted bucket—provides efficient condensate drainage of virtually all types of steam-using equipment. Put the inverted bucket to work in a tough cast iron package, and you have the best of both worlds. Because they operate efficiently for longer periods of time, Armstrong cast iron inverted buckets add solid energy savings to lower replacement/labor costs. All Armstrong cast iron inverted bucket steam traps are repairable for even bigger maintenance savings.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, allowing no condensate backup. They are also resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	Model 800: 150 psig (10 barg)
	Model 811-813: 250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Test plug:	Carbon steel

Options

- Stainless steel internal check valve
- Thermic vent bucket
- Stainless steel pop drain
- Probe connection
- Thermo drain
- Scrub wire

Specification

Inverted bucket steam trap, type ... in cast iron, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

800-813 Series Side Inlet, Side Outlet Traps. Add suffix "CV" to model number for internal check valve, "T" for thermic vent bucket.

Model No.	800*		811		812		813	
	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4	15, 20	3/4, 1	20, 25
Test Plug	1/4	6	1/4	6	1/2	15	3/4	20
"A" (Flange Diameter)	3-3/4	95.2	3-3/4	95.2	5-5/8	143	7	178
"B" (Height)	5-7/16	138	6-7/8	175	9-1/16	230	11-3/4	298
"C" (Face-to-Face)	5	127	5	127	6-1/2	165	7-3/4	197
"D" (Bottom to C Inlet)	2-3/4	70	4-1/4	108	5-3/8	137	7-1/32	179
Number of Bolts	6							
Weight lb (kg)	5 (2.3)		6 (2.7)		15 (6.8)		27-1/2 (12.5)	

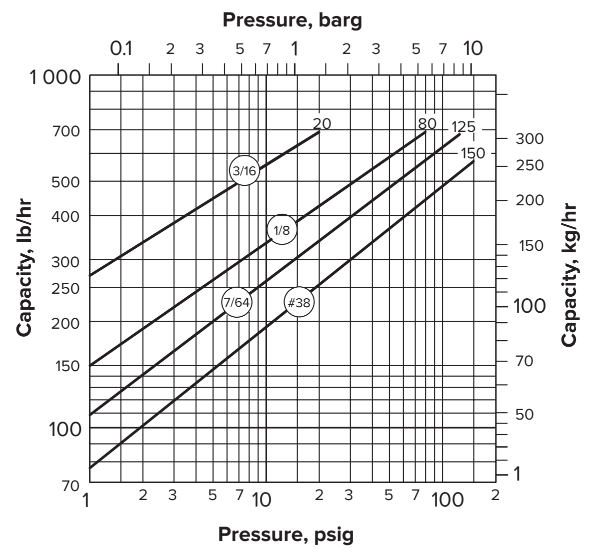
*Cannot be furnished with both thermic vent bucket and check valve.

800-813 Series Inverted Bucket Steam Trap

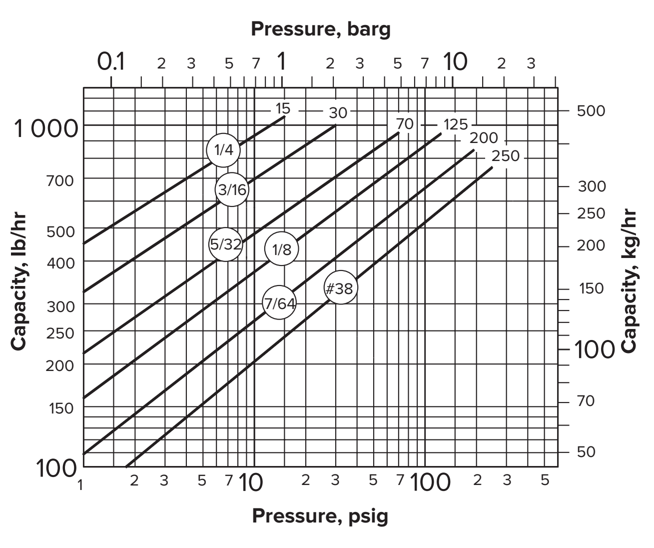
Cast Iron for Horizontal Installation

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

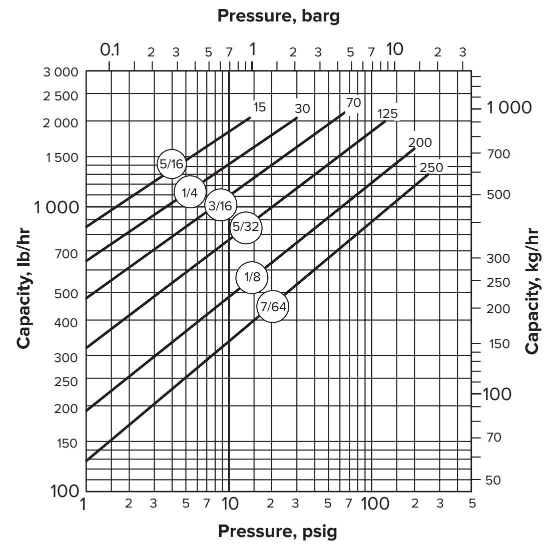
Model 800 Capacity



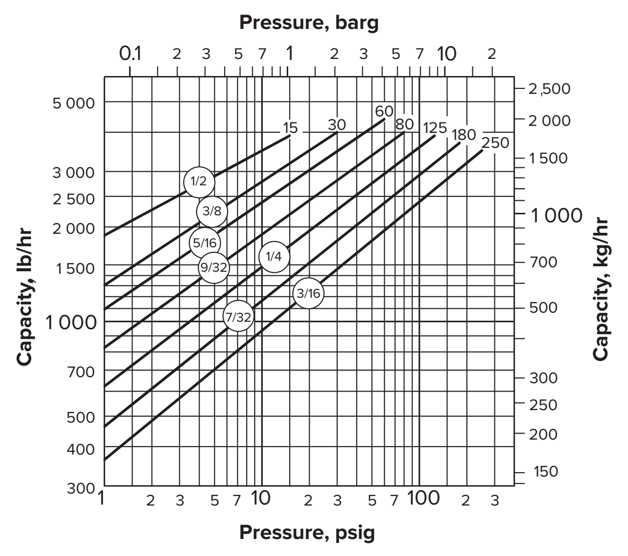
Model 811 Capacity



Model 812 Capacity



Model 813 Capacity

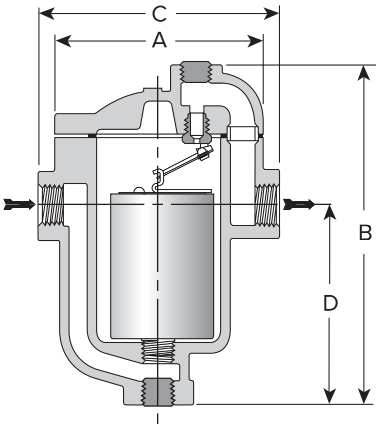


Armstrong®

814-816 Series Inverted Bucket Steam Trap

Cast Iron for Horizontal Installation

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)



Description

The most reliable steam trap known—the inverted bucket—provides efficient condensate drainage of virtually all types of steam-using equipment. Put the inverted bucket to work in a tough cast iron package, and you have the best of both worlds. Because they operate efficiently for longer periods of time, Armstrong cast iron inverted buckets add solid energy savings to lower replacement/labor costs. All Armstrong cast iron inverted bucket steam traps are repairable for even bigger maintenance savings.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, allowing no condensate backup. They are also resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	Model 814-816: 250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless Steel—17-4PH
Test plug:	Carbon steel

Options

- Stainless steel internal check valve
- Thermic vent bucket
- Stainless steel pop drain
- Probe connection
- Thermo drain
- Scrub wire

Specification

Inverted bucket steam trap, type ... in cast iron, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and discharge orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

814-816 Series Side Inlet, Side Outlet Traps. Add suffix "CV" to model number for internal check valve, "T" for thermic vent bucket.

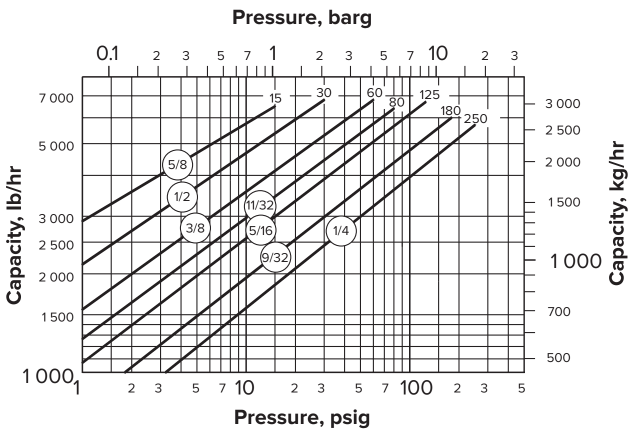
Model No.	814		815		816	
	in	mm	in	mm	in	mm
Pipe Connections	1, 1-1/4	25, 32	1, 1-1/4, 1-1/2, 2	25, 32, 40, 50	2, 2-1/2	50, 65
Test Plug	1	25	1-1/2	40	2	50
"A" (Flange Diameter)	8	203	9	229	11-1/2	292
"B" (Height)	13-5/8	346	16-1/4	413	21-5/16	541
"C" (Face-to-Face)	9	229	10-1/4	260	13	330
"D" (Bottom to ℄ Inlet)	7-13/16	198	8-1/16	205	11	279
Number of Bolts	8					
Weight lb (kg)	44 (20.0)		71 (32.2)		131 (59.4)	

814-816 Series Inverted Bucket Steam Trap

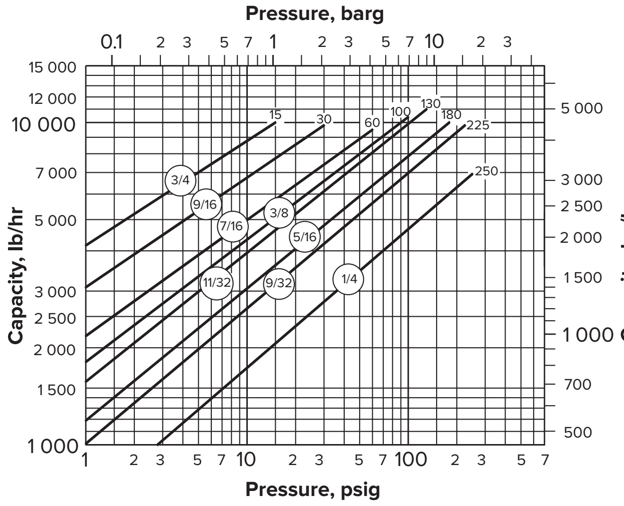
Cast Iron for Horizontal Installation

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

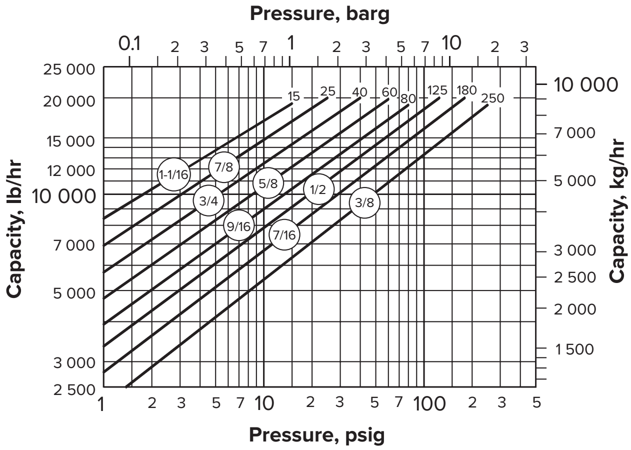
Model 814 Capacity



Model 815 Capacity



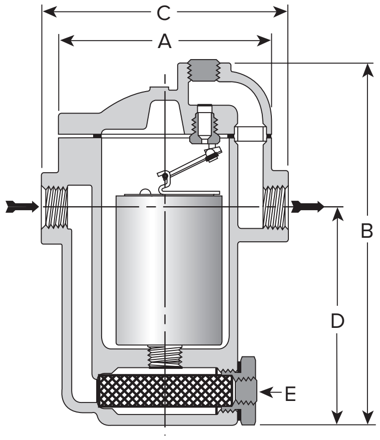
Model 816 Capacity



880 Series Inverted Bucket Steam Traps

Cast Iron for Horizontal Installation With Integral Strainer

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)



Description

The most reliable steam trap known—the inverted bucket—provides efficient condensate drainage of virtually all types of steam-using equipment. Put the inverted bucket to work in a tough cast iron package with an integral strainer, and you have the best of both worlds. Because they operate efficiently for longer periods of time, Armstrong cast iron inverted buckets add solid energy savings to lower replacement/labor costs. All Armstrong cast iron inverted bucket steam traps are repairable for even bigger maintenance savings.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, allowing no condensate backup. They are also resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	Model 880: 150 psig (10 barg) Model 881-883: 250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Test plug:	Carbon steel
Strainer:	Stainless steel—304

Options

- Stainless steel internal check valve
- Thermic vent bucket
- Scrub wire

Specification

Inverted bucket steam trap, type ... in cast iron with integral strainer, with continuous air venting at steam temperature, with free-floating stainless steel mechanism, and discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

880 Series Side Inlet, Side Outlet Traps With Integral Strainers. Add suffix "CV" to model number for internal check valve, "T" for thermic vent bucket.

Model No.	880*		881		882		883	
	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4	15, 20	3/4, 1, 1-1/4	20, 25, 32
Test Plug	1/4	6	1/4	6	1/2	15	3/4	20
"A" (Flange Diameter)	3-3/4	95.2	3-3/4	95.2	5-5/8	142.9	7	177.8
"B" (Height)	6-1/16	154	7-1/16	179	9-3/8	244	12-3/8	314
"C" (Face-to-Face)	5	127	5	127	6-1/2	165	7-7/8	200
"D" (Bottom to ℄ Inlet)	3-7/16	87.3	4-7/16	113	5-3/4	146	7-3/8	187
"E" (Blowdown Connection)	3/8	9	3/8	9	3/8	9	1/2	15
Number of Bolts	6							
Weight lb (kg)	5-1/2 (2.5)		6 (2.7)		15-1/2 (7.0)		31 (14.1)	

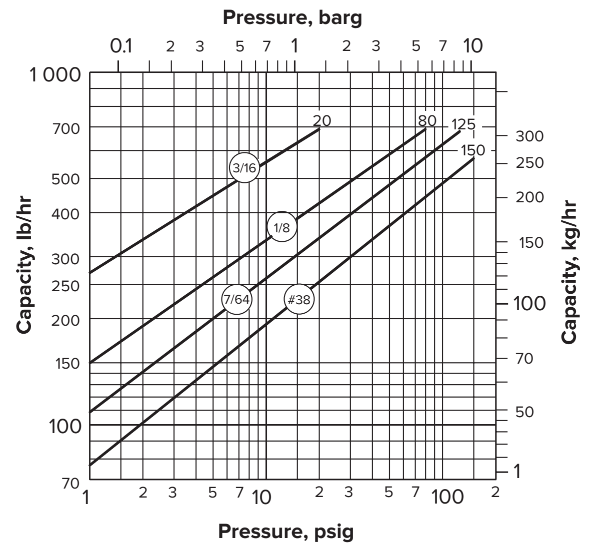
*Cannot be furnished with both thermic vent bucket and check valve.

880 Series Inverted Bucket Steam Traps

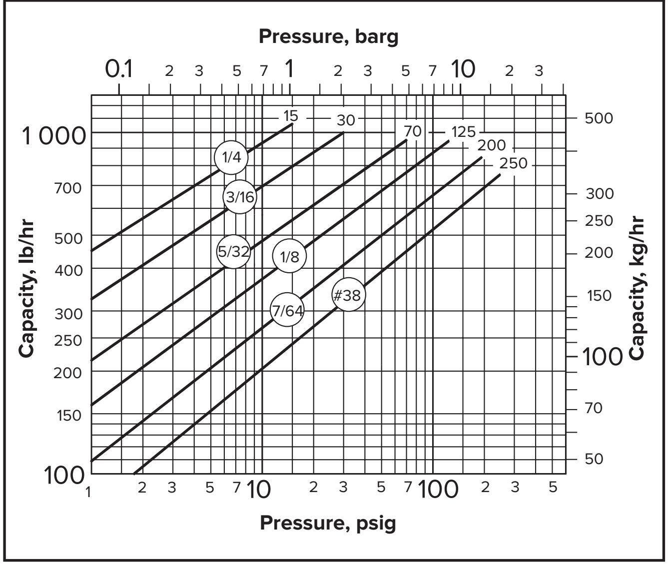
Cast Iron for Horizontal Installation With Integral Strainer

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

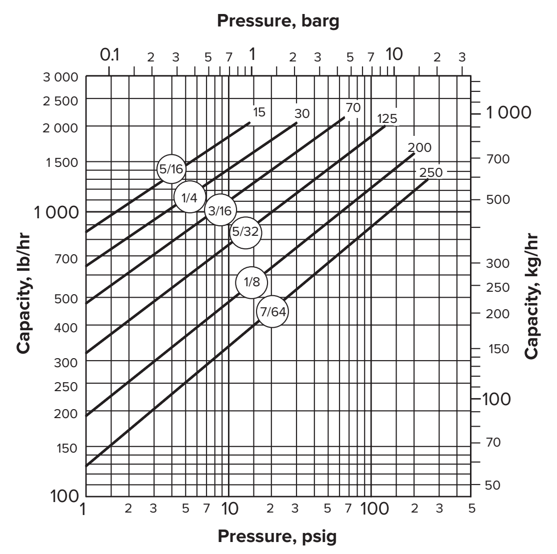
Model 880 Capacity



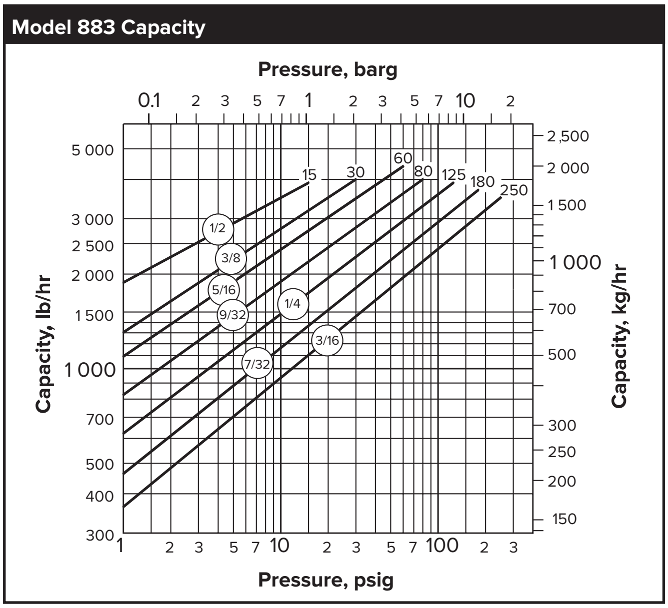
Model 881 Capacity



Model 882 Capacity



Model 883 Capacity

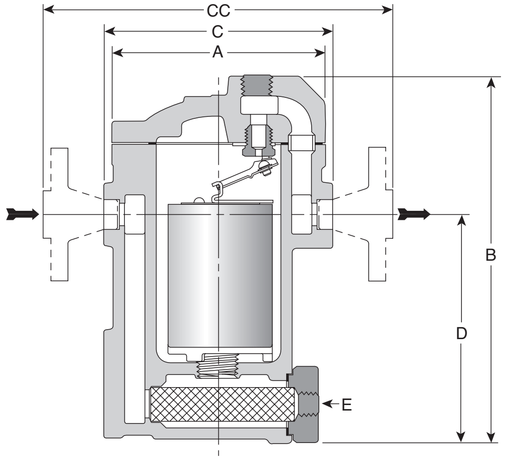


Armstrong®

980 Series Inverted Bucket Steam Traps

Cast Steel for Horizontal Installation With Integral Strainer

For Pressures to 600 psig (41 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)



Description

Armstrong offers two sizes of cast steel traps with in-line horizontal pipe connections and integral strainers with a choice of screwed, socketweld or flanged connections.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, allowing no condensate backup. They are also resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	600 psig @ 650°F (41 barg @ 343°C)
Maximum operating pressure:	600 psig (41 barg)

Connections

Screwed NPT and BSPT
Socketweld
Flanged

See page 187 for dimensional information for flanged and socketweld connections.

Materials

Body:	ASTM A216 WCB
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Strainer:	Stainless steel—304
Test plug:	Carbon steel

Options

- Stainless steel internal check valve
- Thermic vent bucket (983 only) maximum operating pressure 250 psig (17 barg)
- Scrub wire

Specification

Inverted bucket steam trap, type ... in cast steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, integral strainer, and discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

For a fully detailed certified drawing, refer to CD #1007.

980 Series Traps

Model No.	981		983	
Pipe Connections	in	mm	in	mm
	1/2, 3/4	15, 20	3/4, 1	20, 25
Test Plug	1/2	15	3/4	20
"A" (Flange Diameter)	4-1/2	114	7-1/4	184
"B" (Height)	8-5/8	219	12-5/16	313
"C" (Face-to-Face, Scr or SW)	5-3/8	137	7-3/4	197
"CC" (Face-to-Face, Class 600 ANSI Flanges*)				
1/2" (15 mm) connection	9-3/8	238	—	—
3/4" (20 mm) connection	9-1/2	241	11-3/4	298
1" (25 mm) connection	—	—	12-1/8	308
"D" (Bottom to ℄ Inlet)	4-13/16	122	7-9/16	192
"E" (Blowdown Connection)	3/8	9	3/4	20
Weight, Scr or SW lb (kg)	11-1/2 (5.2)		43 (19.5)	
Weight, 600 Class Flanges lb (kg) 1/2" connection	18 (8.2)		50 (22.7)	

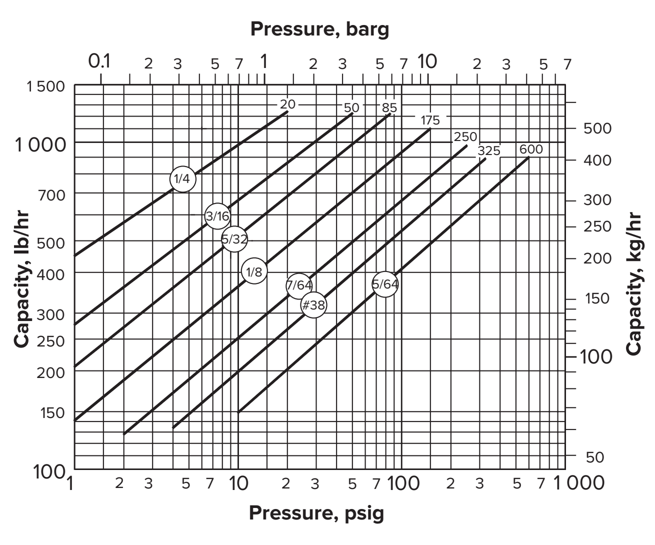
*Face-to-face, other flanges on request. Also available with ANSI raised face, flat face or ring joint flanges.

980 Series Inverted Bucket Steam Traps

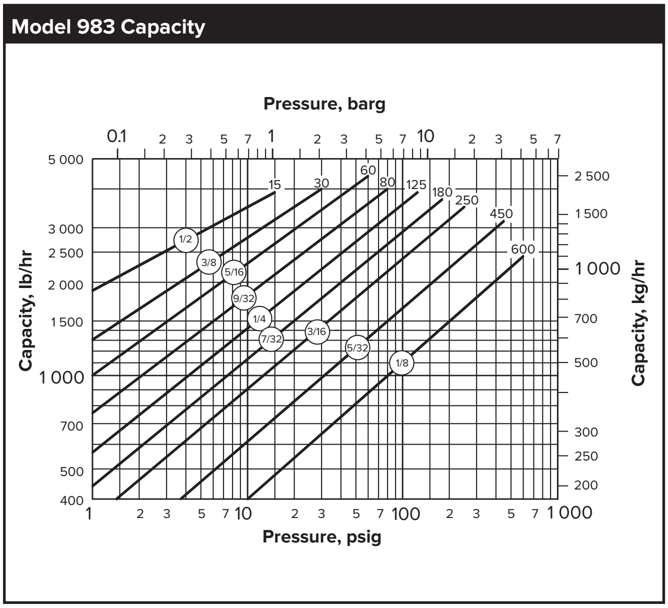
Cast Steel for Horizontal Installation With Integral Strainer

For Pressures to 600 psig (41 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

Model 981 Capacity



Model 983 Capacity



Armstrong®

EM Series Inverted Bucket Steam Traps

Forged Carbon Steel for Horizontal Installation

For Pressures to 454 psig (32 barg)...Capacities to 1 058 lb/hr (480 kg/hr)

Description

Armstrong's type EM forged steel inverted bucket steam trap combines the most reliable steam trap operating principle known in a body, which can be opened for Easy Maintenance.

High resistance to wear, corrosion and water hammer.

The free-floating guided lever valve mechanism is "frictionless" with all wear points heavily reinforced. All working parts are stainless steel; valve and seat are hardened chrome steel, individually ground and lapped.

Freedom from dirt problems. Condensate flow under bottom edge of bucket keeps sediment and "sludge" in suspension until discharged by full differential purging action. Valve orifice opens wide - closes tight. There is no buildup of dirt, no close clearances to be affected by scale. Under normal conditions of reasonably "clean steam", a strainer is not necessary. However, this is left to the user's discretion.

Air handling ability. Vent in bucket top provides continuous automatic air and CO2 venting with no cooling leg and prevents air binding. Wiggle wire ensures clean vent hole at all times. Any steam passing through vent is condensed and discharged as liquid.

No steam loss. Steam does not reach the water sealed valve.

Inverted bucket traps require no adjustment and no live steam to operate.

Maximum operating conditions

Maximum allowable pressure (vessel design):	464 psig @ 482°F (32 barg @ 250°C)
Maximum operating pressure:	464 psig (32 barg)
Maximum back pressure:	99% of inlet pressure

Connections

Screwed BSPT and NPT
Socketweld
Flanged DIN or ANSI (welded)

Materials

Body:	Forged carbon steel
Internals:	All stainless steel – 304
Valve and seat:	Stainless steel – 440F
Gasket:	Spiral wound graphite
Bolts:	24 CrMo5

Options

- Bucket vent scrubbing wire for heavy dirt/oil conditions
- For superheated steam we advise stellited valve and seat

How to order

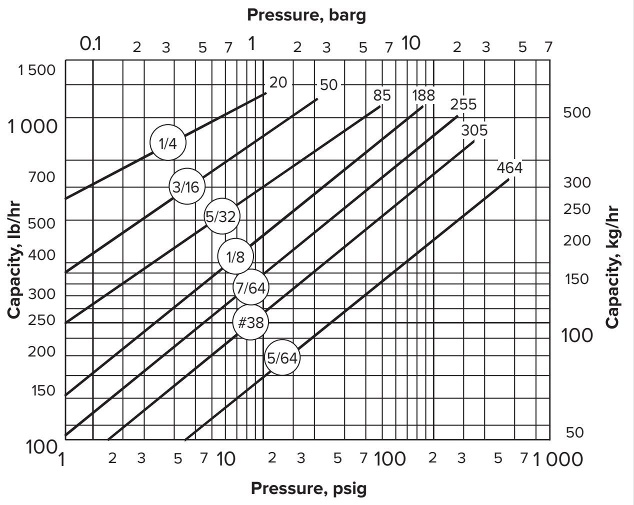
Specify:
- Size and type of pipe connection
- Max. working pressure that will be encountered or orifice size
- Max. condensate load
- Any options required

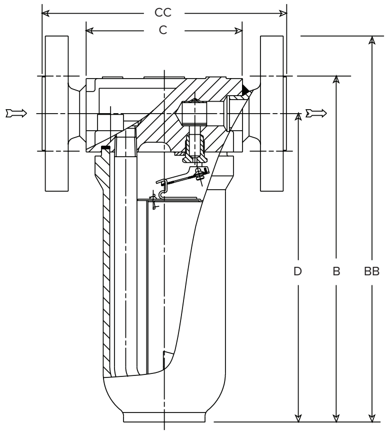
EM Series Inverted Bucket Steam Traps

Forged Carbon Steel for Horizontal Installation

For Pressures to 454 psig (32 barg)...Capacities to 1 058 lb/hr (480 kg/hr)

Model EM Capacity





Model EM Side Inlet, Side Outlet Trap (dimensions in mm)

Pipe Connections	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25
"C" Face-to-Face (screwed & SW)	3-5/8	92	3-5/8	92	—	–
"CC" Face-to-Face (flanged ANSI CL150)	6-3/4	171	7	178	7-1/4	184
"CC" Face-to-Face (flanged ANSI CL300)	7	178	7-3/8	187	7-3/4	197
"D" Bottom to C Inlet	7-7/16	189	7-7/16	189	7-7/16	189
"B" Height (screwed & SW)	8-1/4	210	8-1/4	210	—	–
"BB" Height (flanged*)	9-1/4	235	9-7/16	240	9-5/8	245
Weight, screwed, lb (kg)	6.8 (3.1)		6.8 (3.1)		—	
Weight, flanged, lb (kg)	12 (5.5)		15.7 (7.1)		18 (8.1)	

Armstrong®

300 Series Inverted Bucket Steam Trap

Forged Carbon Steel for Vertical Installation

For Pressures to 650 psig (45 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

Description

Armstrong offers its 300 Series forged carbon steel traps for vertical installation with a choice of screwed, socketweld or flanged connections.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating, and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket, which provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, allowing no condensate backup. They are also resistant to water hammer.

For Superheat Service:

1. Don't oversize the orifice; a restricted orifice may be advisable.
2. Specify an internal check valve.
3. Provide a drip leg of adequate diameter and length.
4. Provide a generous length (2'-3') of inlet piping, with the trap below the main.
5. Don't insulate the trap or the inlet piping.

Connections

Screwed NPT and BSPT
Socketweld
Flanged

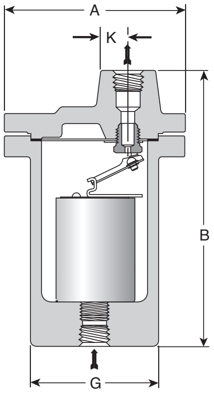
See page 187 for dimensional information for flanged and socketweld connections.

Materials

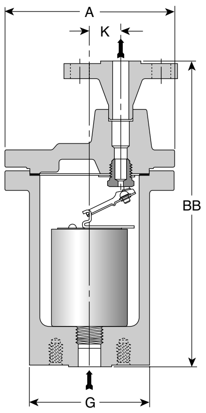
Body:	ASTM A105 Models 312, 313, 316 are also available with cast 316 stainless steel bodies and all stainless steel internals
Internals:	All stainless steel—304 (Models 314, 315 and 316 have cast iron bucket weights)
Valve and seat:	Stainless steel—17-4PH or Titanium

Options

- Stainless steel internal check valve
- Thermic vent bucket 250 psig (17 barg) maximum
- Scrub wire



Series 300 Trap



Series 300-FW Trap

Specification

Inverted bucket steam trap, type ... in forged carbon steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

Pressure-Temperature Rating for Forged Steel Traps

Model No.	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature							
			°F	°C	°F	°C	°F	°C	°F	°C
			-20/ +650	-28/ +343	700	371	750	399	800	427
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
310	400	27.5	770	48	770	48	730	50	600	41
312	600	41	600	41	600	41	560	38.5	500	34.5
313	650	45	1 080	74	1 080	74	970	67	780	54
314	650	45	1 130	78	1 120	77	990	68	810	56
315	650	45	1 015	70	965	66.5	860	59	690	47.5
316	650	45	1 100	76	1 050	72	940	65	760	52

NOTES: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used. Maximum allowable pressures shown in boldface will be marked on nameplate, unless otherwise requested. Traps with flanges may have different pressure-temperature ratings.

300 Series Bottom Inlet, Top Outlet Traps. Add suffix "CV" to trap number for internal check valve.

Model No. Screwed or SW **Model No. Flanged**	**310** **310-FW**		312 312-FW		313 313-FW		314 314-FW		315 315-FW		316 316-FW	
	in	mm	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
Pipe Connections	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4, 1	15, 20, 25	1, 1-1/4	25, 32	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50
"A" (Diameter)	4-5/8	117	6-3/4	171	8	203	8-5/8	219	9-3/4	248	11-7/8	302
"B" (Height, Screwed or SW)	7-15/16	202	10-3/16	259	11-1/2	292	13-11/16	348	15	381	17-1/8	435
"BB"	12-1/16*	306*	12-5/16	313	13-7/8	352	16-1/16	408	17-9/16	446	19-11/16	500
"G" (Body OD)	3-1/16	78	4-3/4	121	5-1/8	130	5-3/4	146	6-5/8	168	8-3/8	213
"K" (℄ Outlet to ℄ Inlet)	9/16	14.3	1-1/4	31.7	1-7/16	36.5	1-7/16	36.5	1-3/4	44.4	2-1/8	54.0
Number of Bolts	6				8				9		10	
Weight Scr. or SW lb (kg)	10 (4.5)		30 (13.6)		50 (22.7)		70 (31.8)		98 (44.5)		179 (81.2)	
Weight, Flanged lb (kg)	12 (5.4)		32 (14.5)		51 (23.1)		73 (33.1)		103 (46.7)		184 (83.5)	

*"BB" dimensions shown are for 3/4" conn., Class 600 flanged No. 310-FW. Consult factory for dimensions of models with other connection sizes and/or flanges.

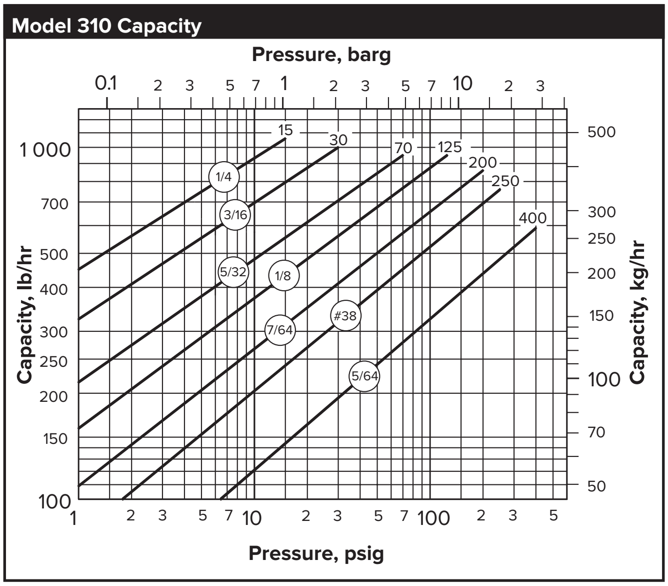
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

300 Series Inverted Bucket Steam Trap

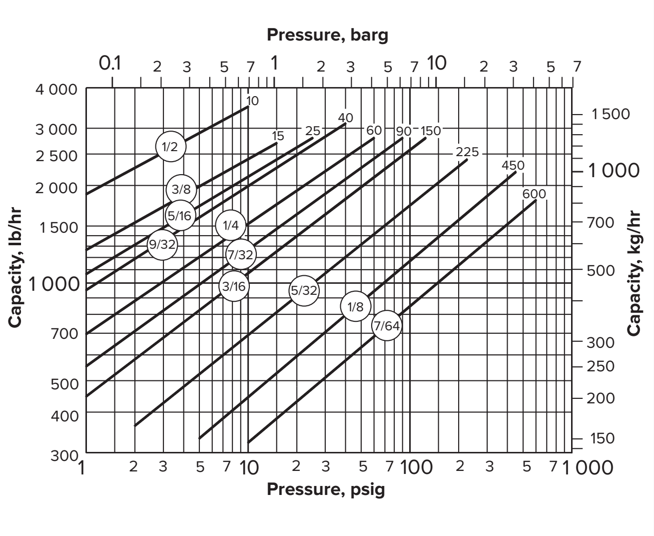
Forged Carbon Steel for Vertical Installation

For Pressures to 650 psig (45 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

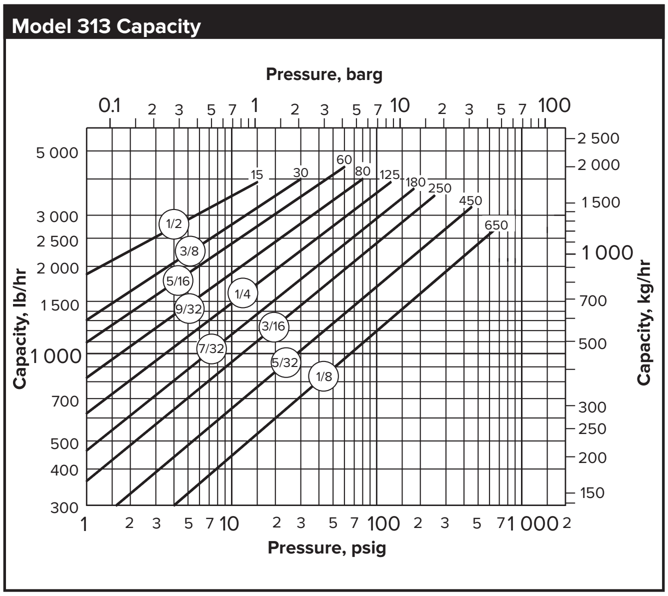
Model 310 Capacity



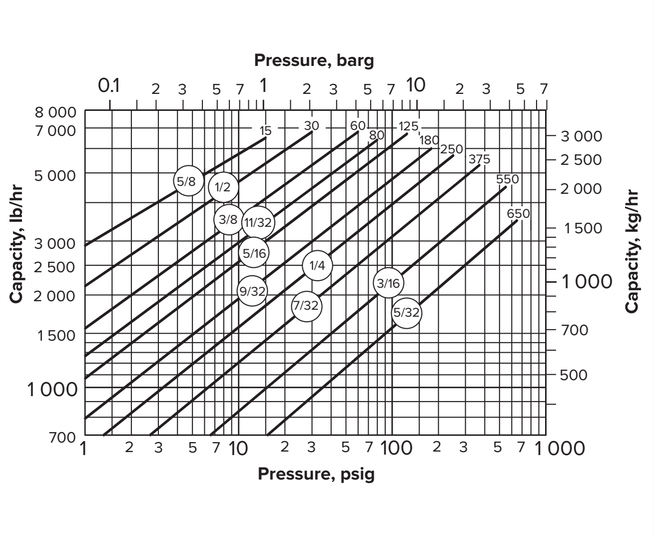
Model 312 Capacity



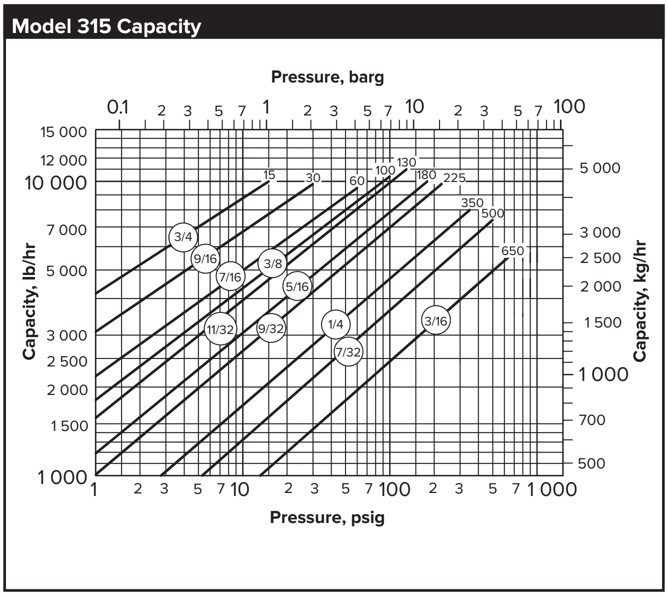
Model 313 Capacity



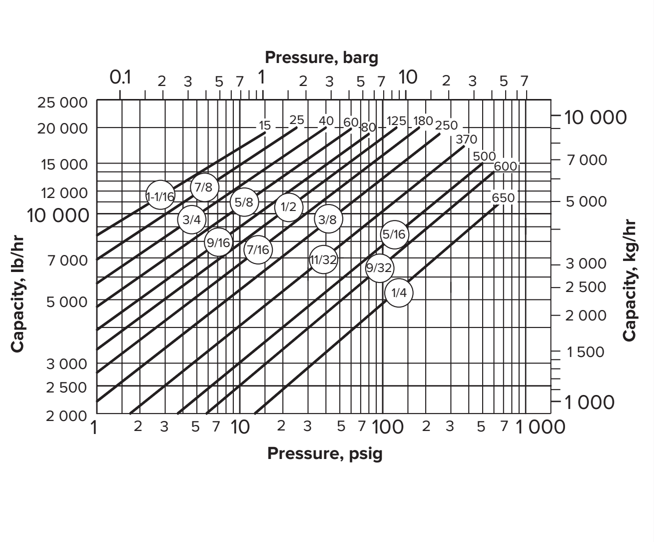
Model 314 Capacity



Model 315 Capacity



Model 316 Capacity

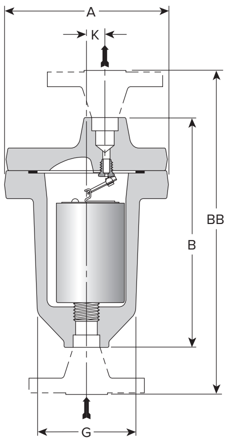


Armstrong®

411G Series Inverted Bucket Steam Traps

Forged Carbon Steel for Vertical and Horizontal Installation

For Pressures to 1 000 psig (69 barg)...Capacities to 1 300 lb/hr (590 kg/hr)



Model 411G Trap

Description

Armstrong Model 411G vertical installation offers smaller capacities at higher pressures.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket.

Inverted bucket traps drain continuously to prevent condensate backup. They are also resistant to water hammer.

411G Bottom Inlet, Top Outlet Traps
Add suffix “CV” to trap number for internal check valve.

Model No. Screwed or SW **Model No. Flanged**	**411G** **411G-FW**	
Pipe Connections	**in**	**mm**
	1/2, 3/4	15, 20
“A” (Diameter)	6-5/16	160
“B” (Height, Screwed or SW)	8-13/16	224
“G” (Body OD)	4-1/16	103
“K” (℄ Outlet to ℄ Inlet)	3/4	19.0
Number of Bolts	8	
Weight Scr. or SW lb (kg)	25 (11.3)	
Weight, Flanged lb (kg)	35 (15.9)	

Consult factory for “BB” dimensions.

Connections

Screwed NPT and BSPT
Socketweld
Flanged

See page 187 for dimensional information for flanged and socketweld connections.

Materials

Body:	ASTM A105
411G cap:	ASTM A105
Internals:	All stainless steel—304
Valve and seat:	Titanium

Options

Stainless steel internal check valve

Specifications

Inverted bucket steam trap, type ... in forged carbon steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, with the discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

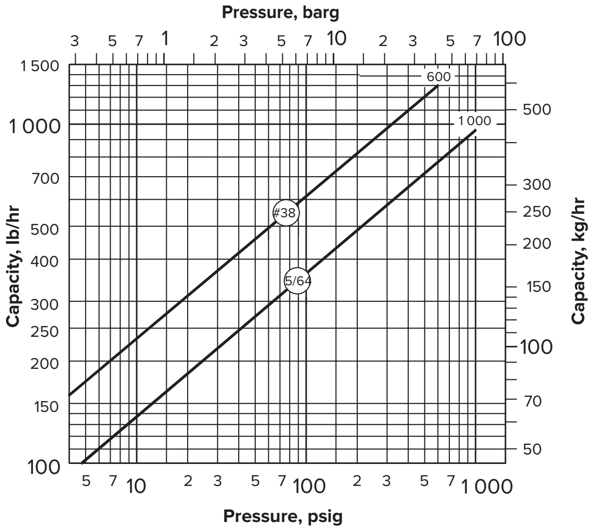
For a fully detailed certified drawing, refer to CD #1105.

411G Series Inverted Bucket Steam Traps

Forged Carbon Steel for Vertical and Horizontal Installation

For Pressures to 1 000 psig (69 barg)...Capacities to 1 300 lb/hr (590 kg/hr)

Model 411G Capacity



Pressure-Temperature Rating for Forged Steel Traps

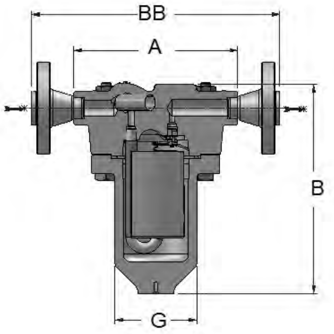
Model No.	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature							
			°F	°C	°F	°C	°F	°C	°F	°C
			-20/+650	-28/+343	700	371	750	399	800	427
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
411G	1 000	69	1 000	69	1 000	69	950	65.5	840	58

NOTE: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used. Maximum allowable pressures shown in boldface will be marked on nameplate, unless otherwise requested. Traps with flanges may have different pressure-temperature ratings.

521 Series Inverted Bucket Steam Traps

Forged Carbon Steel for Horizontal Installation

For Pressures to 1 000 psig (69 barg)...Capacities to 1 300 lb/hr (590 kg/hr)



Model 521 Trap

521 Side Inlet, Side Outlet Traps		
Model No. Screwed or SW Model No. Flanged	521 521-FW	
	in	mm
Pipe Connections	1/2, 3/4	15, 20
"A"	8	203
"B" (Height, Screwed or SW)	10-5/16	263
"G" (Body OD)	4	102
Number of Bolts	8	
Weight Scr. or SW lb (kg)	30 (13.4)	

Consult factory for "BB" dimensions.

Description

Armstrong Model 521 horizontal installation offers smaller capacities at higher pressures.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating and has no fixed pivots to create wear or friction, because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat. The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket. Inverted bucket traps drain continuously to prevent condensate backup. They are also resistant to water hammer. Model 521 adds the convenience and savings of in-line repairability and is designed to meet today's energy-management requirements efficiently and economically over a long, trouble-free service life. Model 521 also has an integral strainer to protect from dirt and scale

Connections

Screwed NPT and BSPT
Socketweld
Flanged

Materials

Body:	ASTM A105N
Cap:	ASTM A105N
Internals:	All stainless steel—304
Valve and seat:	Titanium
Strainer Screen	Stainless Steel
Bolt/Nut	ASTM A193 Gr B7 / ASTM A194 Gr 2H

Specifications

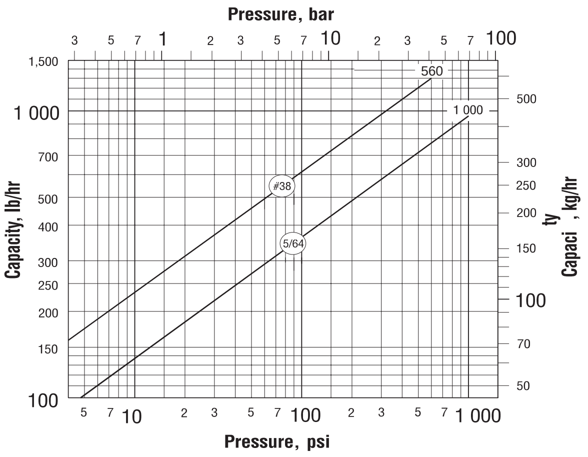
Inverted bucket steam trap with integral strainer, type ... in forged carbon steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, with the discharge orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

Model 521 Capacity



NOTE: #38 orifice in Model 521 is limited to 560 psig (39 barg).

Pressure-Temperature Rating for Forged Steel Traps

Model No.	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature							
			°F	°C	°F	°C	°F	°C	°F	°C
			-20/+650	-28/+343	700	371	750	399	800	427
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
521	1 000	69	1 000	69	1 000	69	950	65.5	840	58

NOTE: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used. Traps with flanges may have different pressure-temperature ratings.

Notes

400 Series Inverted Bucket Steam Trap

Forged Chrome-moly Steel for Vertical Installation

For Pressures to 1 000 psig (69 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

Description

Armstrong offers its 400 Series forged chrome-moly steel traps for vertical installation with a choice of screwed, socketweld or flanged connections.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket. This provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously to prevent condensate backup. They are also resistant to water hammer.

Operation on Superheat. A normally operating bucket trap is filled with saturated steam and condensate. Superheated steam can enter only as fast as the steam inside can condense. As a result, the temperature of the trap is at (or slightly below) saturated steam temperature, regardless of the degree of superheat.

Trap Selection. The pressure-containing parts of the steam trap should safely withstand the maximum pressure and temperature conditions of the system. For example, a trap is required for a 900 psig (62 barg) main at 900°F (482°C). The normal operating temperature of the trap will be about 532°F (278°C). A Model 415 trap should be selected, even though several smaller traps are capable of handling the working pressure.

For Superheat Service:

1. Don't oversize the orifice; a restricted orifice may be advisable.
2. Specify an internal check valve.
3. Provide a drip leg of adequate diameter and length.
4. Provide a generous length (2'-3') of inlet piping, with the trap below the main.
5. Don't insulate the trap or the inlet piping.

Connections

Screwed NPT and BSPT
Socketweld
Flanged

See page 187 for dimensional information for socketweld connections.

Materials

Body:	ASTM A182 F22 Class 3 Models 413 and 415 are available with cast 316 stainless steel bodies and all stainless steel internals
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH or Titanium

Options

Stainless steel internal check valve

Specification

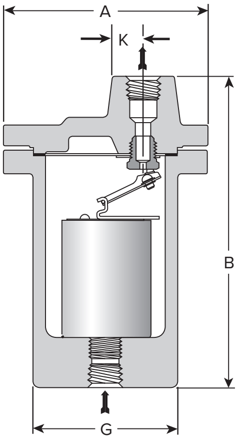
Inverted bucket steam trap, type ... in forged chrome-moly steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, with the discharge orifice at the top of the trap.

How to Order

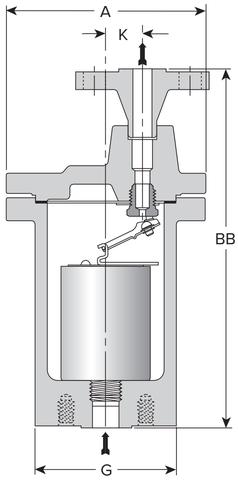
Specify:

- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

For a fully detailed certified drawing, refer to CD #1002.



Series 400 Trap



Series 400-FW Trap

400 Series, Bottom Inlet, Top Outlet Traps. Add suffix "CV" to trap number for internal check valve.

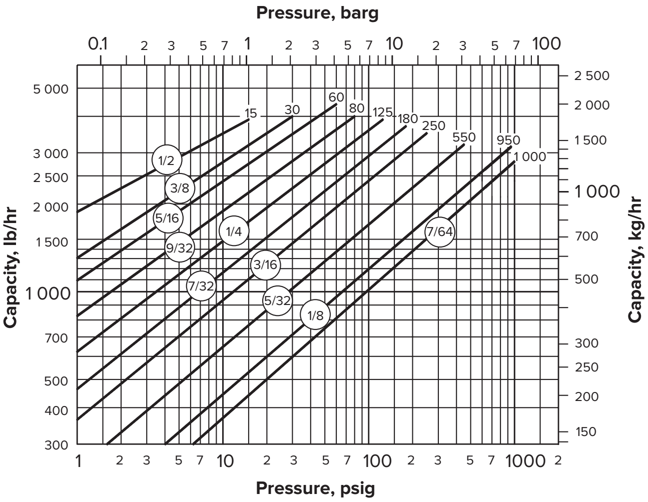
Model No. Screwed or SW Model No. Flanged	413 413-FW		415 415-FW		416 416-FW	
Pipe Connections	in	mm	in	mm	in	mm
	1/2, 3/4, 1	15, 20, 25	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50
"A" (Diameter)	8-5/8	219	10-3/4	273	12-1/2	317
"B" (Height, Screwed or SW)	12-3/16	310	14-15/16	379	17-5/8	448
"BB"	14-7/8	378	18-1/16	459	21-1/2	546
"G" (Body OD)	5-3/8	137	6-7/8	175	8-1/2	216
"K" (℄ Outlet to ℄ Inlet)	1-7/16	36.5	1-3/4	44.4	2-1/8	54.0
Number of Bolts	8		9		12	
Weight Scr. or SW lb (kg)	65 (29.5)		126 (57.2)		205 (93.0)	
Weight, Flanged lb (kg)	70 (31.8)		132 (59.9)		211 (95.7)	

400 Series Inverted Bucket Steam Trap

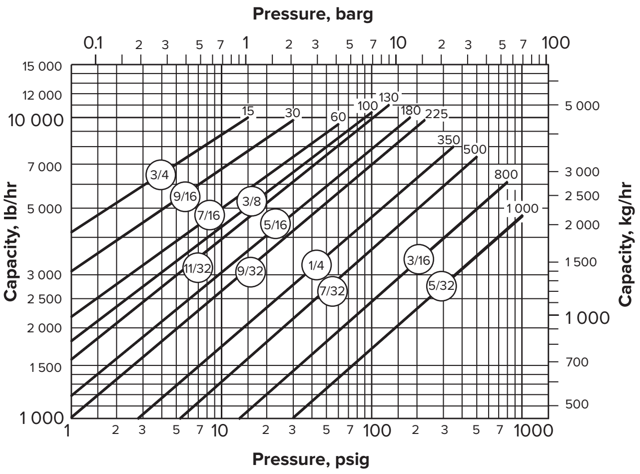
Forged Chrome-moly Steel for Vertical Installation

For Pressures to 1 000 psig (69 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

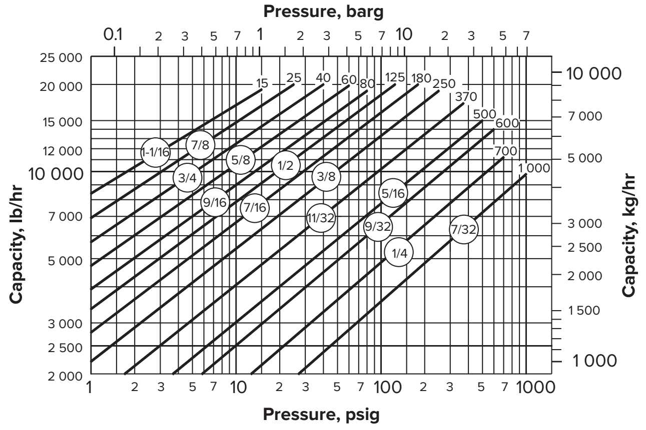
Model 413 Capacity



Model 415 Capacity



Model 416 Capacity



Pressure-Temperature Rating for Forged Steel Traps

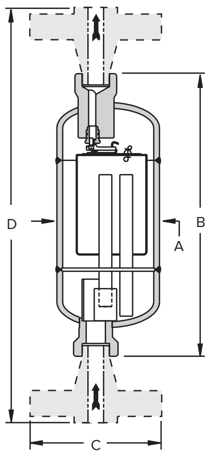
Model No	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature											
			°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
			-20/+650	**-28/+343**	**700**	**371**	**750**	**399**	**800**	**427**	**850**	**454**	**900**	**482**
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
413	1 000	69	1 200	83	1 200	83	1 200	83	1 200	83	1 050	72	780	54
415	1 000	69	1 100	76	1 100	76	1 100	76	1 100	76	1 080	74.5	965	66.5
416	1 000	69	1 700	117	1 700	117	1 700	117	1 660	114	1 350	93	990	68

NOTES: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used.
Maximum allowable pressures shown in boldface will be marked on nameplate, unless otherwise requested.
Traps with flanges may have different pressure-temperature ratings.

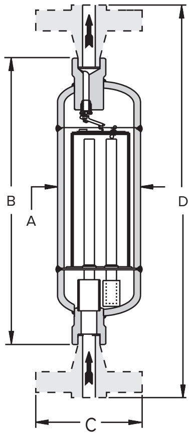
401-SH/501-SH Series Inverted Bucket Superheat Steam Trap

Carbon Steel or Stainless Steel for Vertical Installation

For Pressures to 1 540 psig (105 barg)...Capacities to 950 lb/hr (432 kg/hr)



Model 401-SH



Model 501-SH

Description

Armstrong's 401-SH/501-SH Series inverted bucket steam trap line is made for overcoming the difficult combination of superheat and high pressure/low load service.

To survive this most severe steam service, Armstrong created an inverted bucket trap with a unique accumulation chamber. The chamber collects sufficient condensate to ensure full discharge cycles. A cup in the chamber floats up and down on the steam inlet tube, sealing it off as the condensate level rises. At the same time as the chamber collects condensate, steam continues to flow under the bucket, making sure that the discharge valve closes tightly until the condensate rises into the trap body and the bucket falls down. The operation is on/off, no throttling or dribbling.

Furthermore, it combines all the advantages of an inverted bucket steam trap:

- High resistance to wear, corrosion and water hammer with no gaskets.
- A unique leverage system multiplies the force provided by the bucket, to open the valve against system pressure.
- The mechanism is located at the top. No dirt can collect on the orifice. Small particles of dirt will be held in suspension until discharged by the full differential purging action.
- The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small hole in the bucket.
- Inverted bucket traps require no adjustment. They do not allow condensate backup and are resistant to water hammer.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):
Model 401-SH: 1 000 psig @ 800°F (69 barg @ 427°C)
Model 501-SH: 1 540 psig @ 850°F (105 barg @ 454°C)

Maximum operating pressure:
Model 401-SH: 1 000 psig
Model 501-SH: 1 540 psig

Connections

Screwed NPT and BSPT (401-SH only)
Socketweld
Flanged

See page 187 for dimensional information for flanged and socketweld connections.

Materials

Body:	
Model 401-SH	Carbon steel ASTM A106 Gr. B Sch. 80 pipe
Model 501-SH	Stainless steel 316L ASTM A312 Sch. 80 pipe
Internals:	Stainless steel—304
Valve and seat:	Titanium
Connections:	
Model 401-SH	Stainless steel—304
Model 501-SH	Stainless steel—316L

Specification

Inverted bucket steam trap, type ... in carbon steel (stainless steel), with accumulation chamber, continuous air venting at steam temperature, stainless steel leverage system, with the discharge orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size

For a fully detailed certified drawing, refer to:
401-SH CD #1011
501-SH CD #1012

401-SH and 501-SH Series Steam Traps

Model	401-SH		501-SH			
	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4	15, 20	1/2	15	3/4	20
"A" Diameter (NPT, BSPT or SW)	4	100	4	100	4	100
"B" Height (NPT, BSPT or SW)	11	275	13-9/16	344	13-9/16	344
"C" Diameter (Flanged)*	4-5/8	117	4-3/4	121	5-1/8	130
"D" Height (Flanged)*	15-1/8	384	18-3/16	462	18-11/16	475
Weight NPT, BSPT or SW lb (kg)	12 (5.5)		15 (7)			
Weight Flanged lb (kg)	15 (6.7)		29 (13)			

*401-SH 600 lb RF shown. 501-SH 900/1500 lb RF shown.

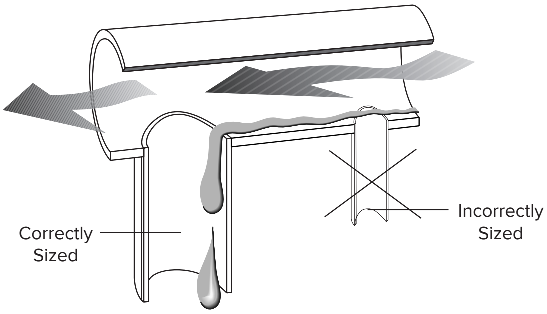
401-SH/501-SH Series Inverted Bucket Superheat Steam Trap

Carbon Steel or Stainless Steel for Vertical Installation

For Pressures to 1 540 psig (105 barg)...Capacities to 950 lb/hr (432 kg/hr)

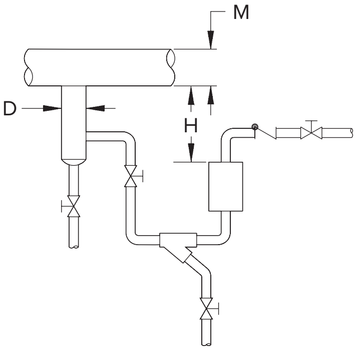
Installation Recommendations

What little condensate there is on superheat and high pressure/low load service usually forms in drip legs and in the traps themselves. Therefore proper piping and drip legs of adequate size and diameter are essential for the successful operation of the Armstrong superheat trap.



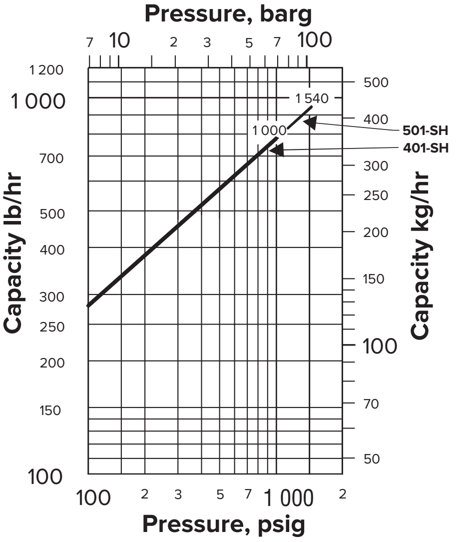
Drip Leg Sizing

The properly sized drip leg will capture condensate. Too small a drip leg can actually cause a venturi "piccolo" effect where pressure drop pulls condensate out of the drip leg and trap.



Trap Draining Drip Leg on Steam Main

Model 401/501 Capacity

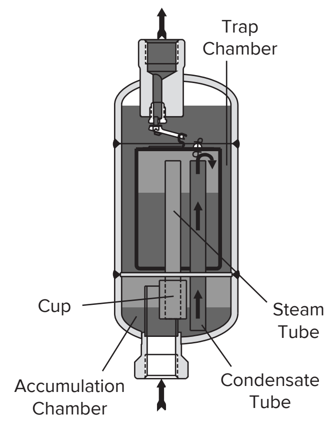


Recommended Steam Main and Branch Line Drip Leg Tracing

M		D		H Drip Leg Length Minimum			
Steam Main Size		Drip Leg Diameter		Supervised Warm-Up		Automatic Warm-Up	
in	mm	in	mm	in	mm	in	mm
1/2	15	1/2	15	10	250	28	710
3/4	20	3/4	20	10	250	28	710
1	25	1	25	10	250	28	710
2	50	2	50	10	250	28	710
3	75	3	75	10	250	28	710
4	100	4	100	10	250	28	710
6	150	4	100	10	250	28	710
8	200	4	100	12	300	28	710
10	250	6	150	15	380	28	710
12	300	6	150	18	450	28	710
14	350	8	200	21	530	28	710
16	400	8	200	24	600	28	710
18	450	10	250	27	685	28	710
20	500	10	250	30	760	30	760
24	600	12	300	36	910	36	910

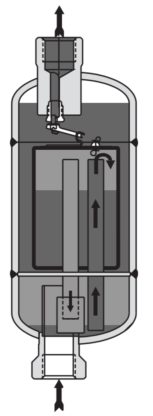
KEY

☐ Air ▨ Steam ■ Condensate



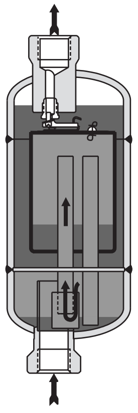
Cycling—Discharge Valve Wide Open

With the steam feed tube to the trap chamber sealed, condensate flows through the condensate feed tube (from accumulation chamber) into the trap chamber. This sinks the inverted bucket, which opens the discharge valve, cycling the trap.



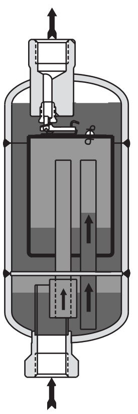
Cycle Ending

As the level of condensate in the accumulation chamber falls, the cup sealing the steam feed tube moves downward, opening a passage for steam to flow into trap chamber.



Trap Closed

As steam begins to flow through the accumulation chamber and up the steam feed tube under the inverted bucket in the trap chamber, the discharge valve closes tightly.



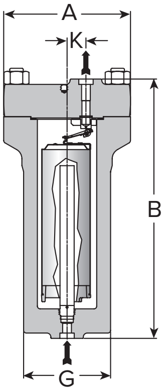
Cycle About to Repeat

As the level of condensate rises in the accumulation chamber, the cup floats up until it again seals the steam feed tube, and the cycle repeats.

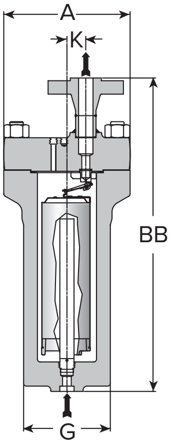
5000 Series Inverted Bucket Steam Trap

Forged Chrome-moly Steel for Vertical Installation

For Pressures to 1 800 psig (124 barg)...Capacities to 5 150 lb/hr (2 336 kg/hr)



Series 5133G-5155G Traps



Series 5133G-FW & 5155G-FW Traps

Description

Armstrong offers its 5000 Series forged chrome-moly steel traps for vertical installation with a choice of screwed, socketweld or flanged connections.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket. This provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, to prevent condensate backup. They are also resistant to water hammer.

Operation on Superheat. A normally operating bucket trap is filled with saturated steam and condensate. Superheated steam can enter only as fast as the steam inside can condense. As a result, the temperature of the trap is at (or slightly below) saturated steam temperature, regardless of the degree of superheat.

Trap Selection. The pressure-containing parts of the steam trap should safely withstand the maximum pressure and temperature conditions of the system. For example, a trap is required for a 1 000 psig (68 barg) main at 950°F (510°C). The normal operating temperature of the trap will be about 546°F (286°C). A Model 5133G trap should be selected, even though several smaller traps are capable of handling the working pressure.

For Superheat Service:

1. Don’t oversize the orifice; a restricted orifice may be advisable.
2. Specify an internal check valve.
3. Provide a drip leg of adequate diameter and length.
4. Provide a generous length (2'-3') of inlet piping, with the trap below the main.
5. Don’t insulate the trap or the inlet piping.

Connections

Screwed NPT and BSPT
Socketweld
Flanged

See page 187 for dimensional information for flanged and socketweld connections.

Materials

Body:	ASTM A182 F22 Class 3
Internals:	All stainless steel—304
Valve and seat:	Titanium

Options

- Stainless steel internal check valve

For a fully detailed certified drawing, refer to:
5133 CD #1069
5155 CD #1096

5000 Series Bottom Inlet, Top Outlet Traps
Add suffix “CV” to trap number for internal check valve.

Model No. Screwed or SW **Model No. Flanged**	**5133G** **5133G-FW**		**5155G** **5155G-FW**	
Pipe Connections	**in**	**mm**	**in**	**mm**
	1/2, 3/4, 1	15, 20, 25	3/4, 1, 1-1/4	20, 25, 32
“A” (Diameter)	8-1/2	216	10-3/8	264
“B” (Height, Screwed or SW)	14-1/4	362	16-7/32	412
“BB”	18-7/8*	479*	20-7/8*	530*
“G” (Body OD)	5-3/4	146	7-5/8	194
“K” (℄ Outlet to ℄ Inlet)	1-5/16	33.3	1-3/4	44.4
Number of Bolts	8		10	
Weight Scr. or SW lb (kg)	113 (44.5)		171 (77.6)	
Weight, Flanged lb (kg)	120 (47.6)		185 (83.9)	

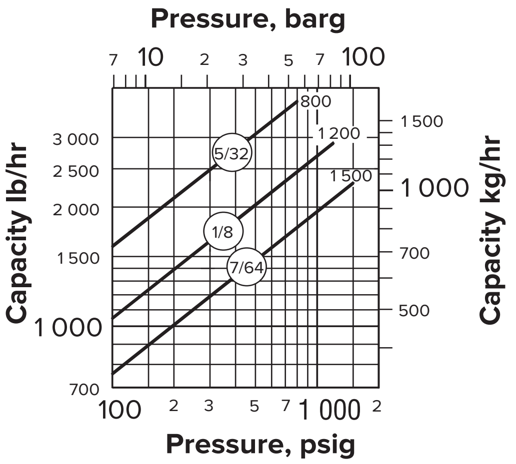
*“BB” dimensions shown are for 1" conn. Class 1500 flanged No. 5133G-FW and 1-1/4" conn. Class 1500 flanged No. 5155G-FW. Consult factory for dimensions of models with other connection sizes and/or flanges.

5000 Series Inverted Bucket Steam Trap

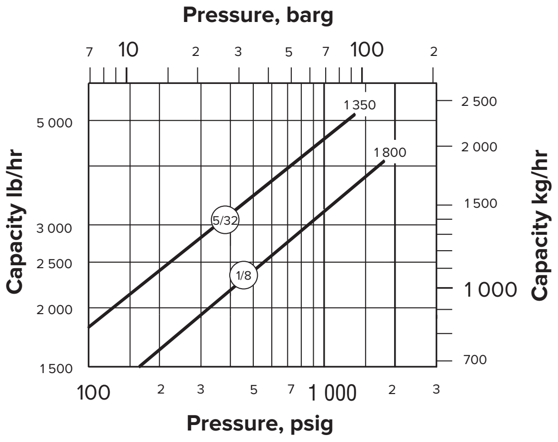
Forged Chrome-moly Steel for Vertical Installation

For Pressures to 1 800 psig (124 barg)...Capacities to 5 150 lb/hr (2 336 kg/hr)

Model 5133G Capacity



Model 5155G Capacity



Pressure-Temperature Rating for Forged Steel Traps

Model No.	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature															
			°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
			-20/+650	**-28/+343**	**700**	**371**	**750**	**399**	**800**	**427**	**850**	**454**	**900**	**482**	**950**	**510**	**1 000**	**538**
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
5133G	1 500	103	2 120	146	2 120	146	2 120	146	2 120	146	1 990	137	1 730	119	1 350	93	930	64
5155G	1 800	124	2 520	174	2 520	174	2 520	174	2 520	174	2 370	163	2 070	143	1 610	111	1 110	76.5

NOTES: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used.
Maximum allowable pressures shown in boldface will be marked on nameplate, unless otherwise requested. Traps with flanges may have different pressure-temperature ratings.

Options

Internal Check Valves are spring loaded stainless steel and screw into an extended inlet tube having a pipe coupling at the top to save fittings, labor and money. Internal check valves may result in slightly reduced capacities.

Screwed Connections are available in all sizes for pressures of 900 psig or less. Traps for pressures of 900 psig or higher are available with socketweld or flanged connections.

Specification

Inverted bucket steam trap, type ... in forged chrome-moly steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, with the discharge orifice at the top of the trap.

How to Order

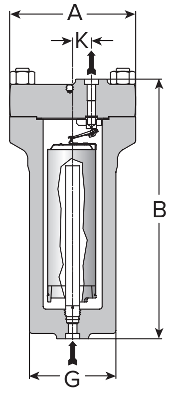
Specify:
- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

Armstrong®

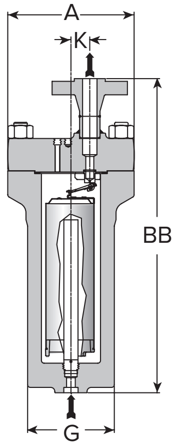
6000 Series Inverted Bucket Steam Trap

Forged Chrome-moly Steel for Vertical Installation

For Pressures to 2 700 psig (186 barg)...Capacities to 6 500 lb/hr (2 948 kg/hr)



Model 6155G Traps



Model 6155G-FW Traps

6000 Series Bottom Inlet, Top Outlet Traps
Add suffix "CV" to trap number for internal check valve.

Model No. Screwed or SW Model No. Flanged	6155G 6155G-FW	
Pipe Connections	in	mm
	1, 1-1/4	25, 32
"A" (Diameter)	11-3/4	298
"B" (Height, Screwed or SW)	24-1/8	613
"BB"	29-11/16*	724*
"G" (Body OD)	8-3/8	213
"K" (℄ Outlet to ℄ Inlet)	1-3/4	44.4
Number of Bolts	10	
Weight Scr. or SW lb (kg)	325 (147.4)	
Weight, Flanged lb (kg)	340 (154.2)	

*"BB" dimensions shown are for Class 2500 flanged No. 6155G-FW traps. Consult factory for dimensions of models with other connection sizes and/or flanges.

Description

Armstrong offers its 6000 Series forged chrome-moly steel traps for vertical installation with a choice of socketweld or flanged connections.

A unique leverage system multiplies the force provided by the bucket to open the valve against system pressure. The mechanism is free-floating and has no fixed pivots to create wear or friction.

Because the mechanism is located at the top of the trap, no dirt can collect on the orifice. Small particles of dirt are held in suspension until discharged by the full differential purging action when the bucket sinks, pulling the valve off the seat.

The discharge orifice is surrounded by a water seal, preventing live steam loss. Automatic air venting is provided by a small vent hole in the bucket. This provides continuous automatic air and CO_2 venting at steam temperature.

Inverted bucket traps drain continuously, although discharging intermittently, to prevent condensate backup. They are also resistant to water hammer.

Operation on Superheat. A normally operating bucket trap is filled with saturated steam and condensate. Superheated steam can enter only as fast as the steam inside can condense. As a result, the temperature of the trap is at (or slightly below) saturated steam temperature, regardless of the degree of superheat.

Trap Selection. The pressure-containing parts of the steam trap should safely withstand the maximum pressure and temperature conditions of the system. For example, a trap is required for a 1 500 psig (102 barg) main at 1 000°F (538°C). The normal operating temperature of the trap will be about 596°F (299°C). A Model 6155G trap should be selected, even though several smaller traps are capable of handling the working pressure.

For Superheat Service:

1. Don't oversize the orifice; a restricted orifice may be advisable.
2. Specify an internal check valve.
3. Provide a drip leg of adequate diameter and length.
4. Provide a generous length (2'-3') of inlet piping, with the trap below the main.
5. Don't insulate the trap or the inlet piping.

Connections

Socketweld
Flanged
See page 187 for dimensions information for flanged and socketweld connections.

Materials

Body:	ASTM A182 F22 Class 3
Internals:	All stainless steel—304
Valve and seat:	Titanium

Options

- Stainless steel internal check valve

Screwed connections are available in all sizes for pressures of 900 psig or less. Traps for pressures of 900 psig or higher are available with socketweld or flanged connections.

Specification

Inverted bucket steam trap, type ... 6155G in forged chrome-moly steel, with continuous air venting at steam temperature, free-floating stainless steel mechanism, with the discharge orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection. When flanges are required, specify type of flange in detail
- Maximum working pressure that will be encountered or orifice size
- Any options required

For a fully detailed certified drawing, refer to CD #1092.

6000 Series Inverted Bucket Steam Trap

Forged Chrome-moly Steel for Vertical Installation

For Pressures to 2 700 psig (186 barg)...Capacities to 6 500 lb/hr (2 948 kg/hr)

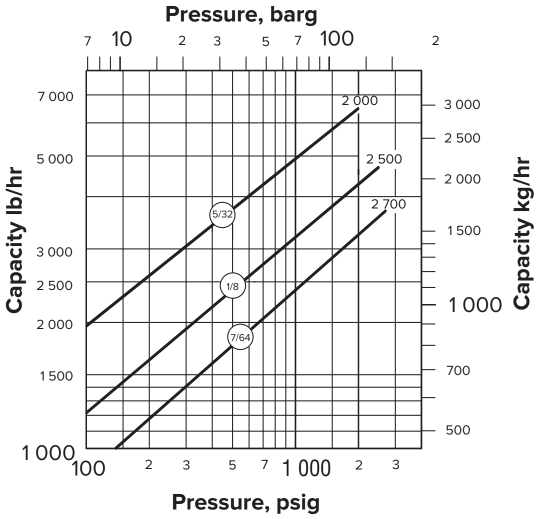
Pressure-Temperature Rating for Forged Steel Traps

Model No.	Max. Oper. Pressure, Sat. Steam		Maximum Allowable Pressure (Vessel Design) of Pressure-Containing Parts at Indicated Temperature													
			°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°F
			-20/+650	**-28/+343**	**700**	**371**	**750**	**399**	**800**	**427**	**850**	**454**	**900**	**482**	**950**	**510**
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
6155G	2 700	186	3 500	241	3 500	241	3 500	241	3 500	241	3 500	241	3 090	213	2 410	166

Model No.	°F	°C
	1 000	**538**
	psig	barg
6155G	1 650	114

NOTES: Maximum operating pressure to be marked on nameplate will be determined by actual orifice used.
Maximum allowable pressures shown in boldface will be marked on nameplate, unless otherwise requested. Traps with flanges may have different pressure-temperature ratings.

Model 6155G Capacity



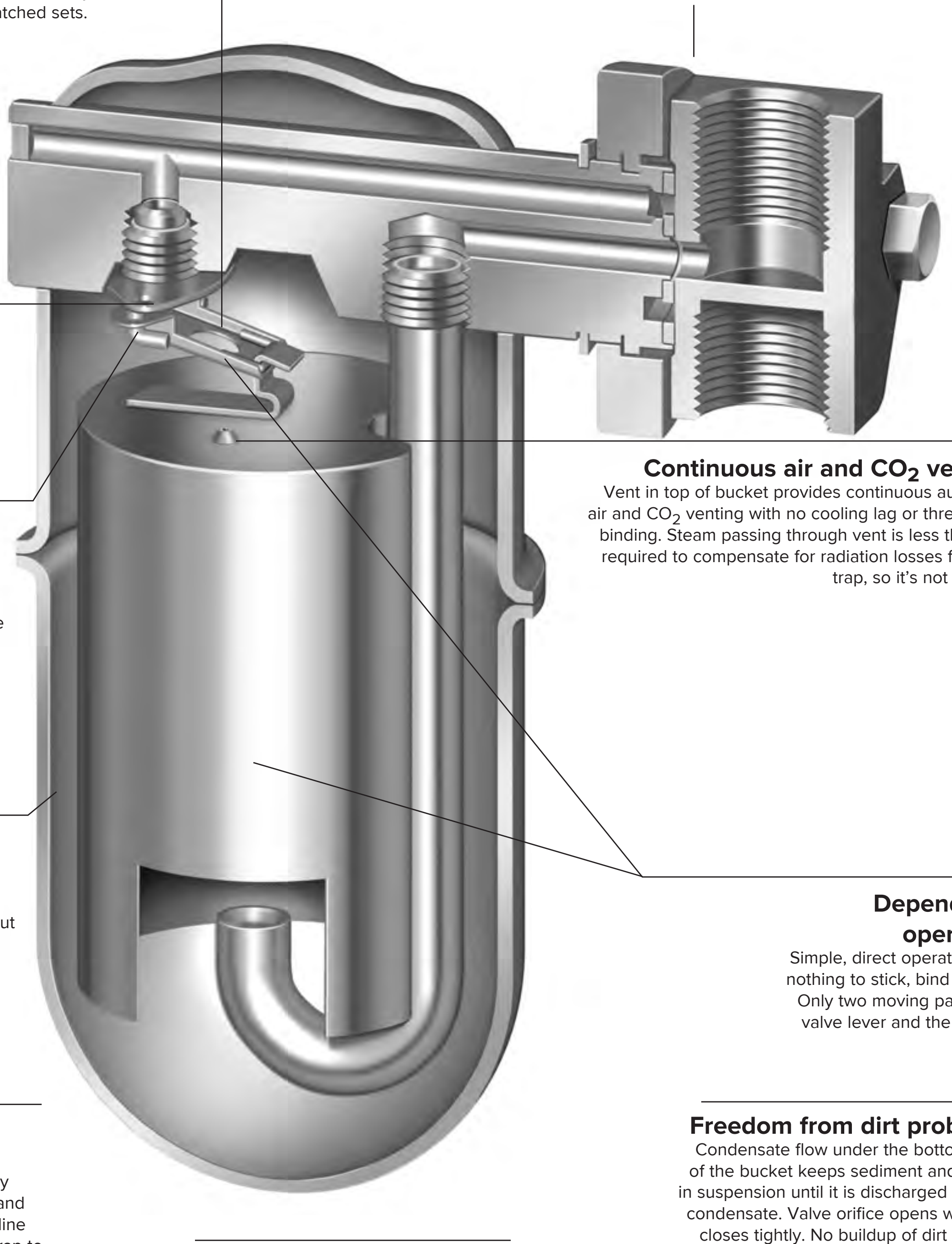
Options

Internal Check Valves are spring loaded stainless steel and screw into an extended inlet tube having a pipe coupling at the top to save fittings, labor and money. Internal check valves may result in slightly reduced capacities.

2000 Series Stainless Steel Traps

The Armstrong stainless steel traps—Series 1000, Series U-1000, Series 1800 and Series 2000—have high resistance to damage from freeze-ups. They also offer high resistance to wear and corrosion for longer service reliability, and they provide continuous air venting.

Armstrong stainless steel traps provide maximum ease and economy of installation, inspection or replacement. What's more, an Armstrong stainless steel trap is the ideal solution for trapping applications such as tracer lines, steam mains, and heating and processing applications.



Wear and corrosion resistance
Free-floating guided lever valve mechanism is "frictionless," and all wear points are heavily reinforced. All working parts are stainless steel. Valve and seat are stainless steel, individually ground and lapped together in matched sets.

360° universal 304 stainless steel connector
Provides quick, easy in-line renewability along with all the proven advantages of an inverted bucket operation. Also available with optional IS-2 integral strainer connector with 20 x 20 mesh stainless steel strainer.

Virtually no steam loss
Steam does not reach the water-sealed discharge valve.

Continuous air and CO_2 venting
Vent in top of bucket provides continuous automatic air and CO_2 venting with no cooling lag or threat of air binding. Steam passing through vent is less than that required to compensate for radiation losses from the trap, so it's not wasted.

Purging action
Snap opening of the valve creates a momentary pressure drop and turbulence in the unit drained. This breaks up films of condensate and air and speeds their flow to the trap.

Sealed, tamperproof 304-L stainless steel package
Able to withstand freeze-ups without damage.

Dependable operation
Simple, direct operation with nothing to stick, bind or clog. Only two moving parts—the valve lever and the bucket.

Excellent operation against back pressure
Since trap operation is governed by the difference in density of steam and water, back pressure in the return line has no effect on the ability of the trap to open for condensate and close against steam.

Freedom from dirt problems
Condensate flow under the bottom edge of the bucket keeps sediment and sludge in suspension until it is discharged with the condensate. Valve orifice opens wide and closes tightly. No buildup of dirt or close clearances to be affected by scale.

Resistance to damage from water hammer
Open bucket or float will not collapse as a result of water hammer.

2000 Series Stainless Steel Traps

For Pressures to 650 (45 barg) psig... Capacities to 1 300 lbs/hr (590 kg/hr)

With the Series 2000 360° universal connector, you can install inverted bucket efficiency and long service life in any piping configuration with little or no repiping. You get the reliability of the inverted bucket operating principle, plus all the benefits of all-stainless steel construction:

- A sealed, tamperproof package
- A compact, lightweight trap
- The ability to withstand freeze-ups without damage
- Exceptional corrosion resistance
- A three-year guarantee against defective materials or workmanship

Series 2000 steam traps combine savings in three important areas: energy, installation and replacement. The 360° universal connector provides quick, easy in-line renewability along with all the proven advantages of an inverted bucket operation. Choice of NPT or BSPT screwed connections, or socketweld connections.

Also available with IS-2 integral strainer connector.

Available with
Standard Connector

Material: 304 stainless steel

Available with
IS-2 Integral Strainer Connector
(shown with optional blowdown valve)

Material: 304 stainless steel

Available with
IS-4 Connector

Material: ASTM A351 Gr. CF8M

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

1000 Series Inverted Bucket Steam Trap

All Stainless Steel for Vertical Installation

For Pressures to 650 psig (45 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

Description

Armstrong 1000 Series stainless steel inverted bucket steam traps normally last three to four times longer than conventional traps used in identical services. Heat-treated stainless steel valves and seats are of the same design, material and workmanship as those used in traps for pressures up to 900 psig and temperatures to 900°F. More compact than cast iron or carbon steel equivalents, 1000 Series traps are ideal for trapping applications such as tracer lines, steam mains and heating/process applications.

The 1000 Series are guaranteed for three years.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

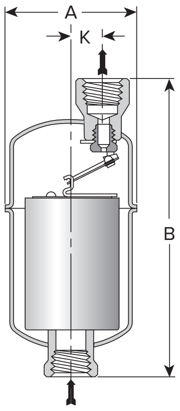
Model 1010, 1011:	400 psig @ 800°F (28 barg @ 427°C)
Model 1022:	650 psig @ 600°F (45 barg @ 316°C) 627 psig @ 700°F (43 barg @ 371°C) 604 psig @ 800°F (41.6 barg @ 427°C)
Model 1013:	450 psig @ 800°F (31 barg @ 427°C)

Maximum operating pressure:

Model 1010:	150 psig (10 barg)
Model 1011:	400 psig (28 barg)
Model 1022:	650 psig (45 barg)
Model 1013:	450 psig (31 barg)

Connections

Screwed NPT and BSPT
Socketweld



Model 1010 Trap

Materials

Body:	ASTM A240 Grade 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH or Titanium

Options

- Stainless steel internal check valve
- Thermic vent bucket 250 psig (17 barg) maximum; for Model 1022 15 psig (1 barg) maximum
- Wiggle wire
- 316 stainless steel valve and seat

Specification

Inverted bucket steam trap, type ... in all stainless steel, freeze resistant, without gaskets, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

1000 Series Traps

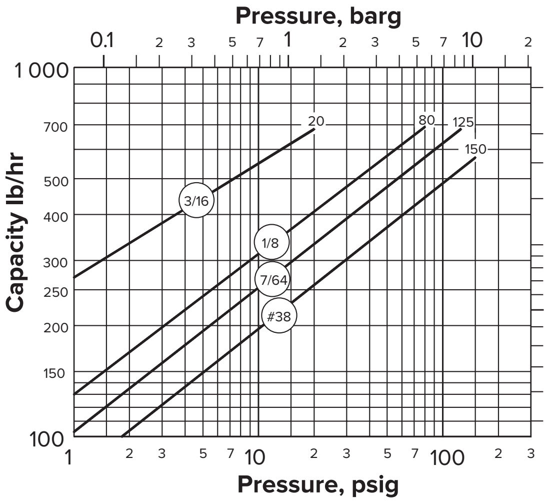
Model No.	1010		1011		1022		1013	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1/2, 3/4	15, 20	3/4	20	1	25
“A” (Diameter)	2-3/4	69.9	2-3/4	68.9	3-7/8	100	4-1/2	114
“B” (Height)	6-1/16	168	7-1/4	184	8-13/16	224	11-3/8	289
“K” (℄ Inlet to ℄ Outlet)	9/16	14.3	9/16	14.3	3/4	18	1-3/16	30.2
Weight lb (kg)	1-1/2 (0.7)		1-3/4 (0.8)		4 (2)		7-1/2 (3.4)	

1000 Series Inverted Bucket Steam Trap

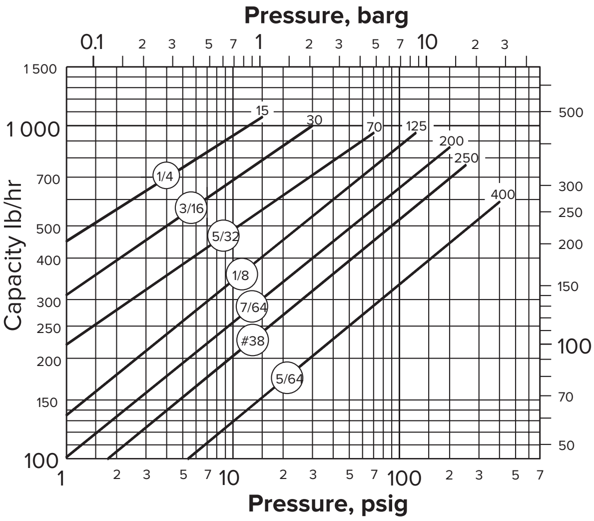
All Stainless Steel for Vertical Installation

For Pressures to 650 psig (45 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

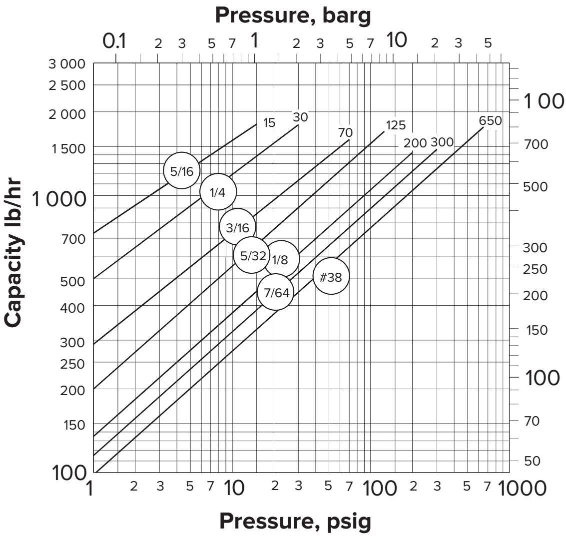
Model 1010 Capacity



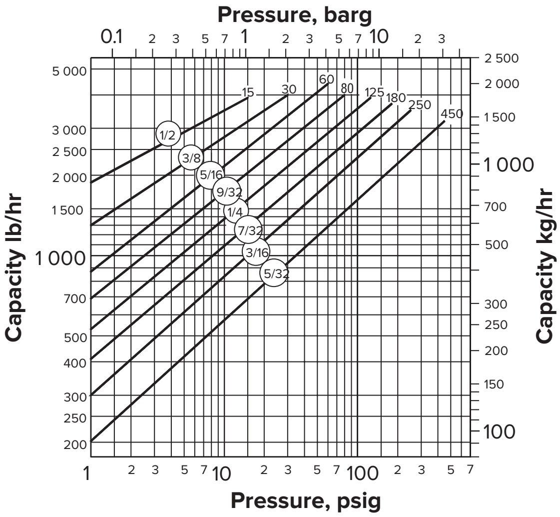
Model 1011 Capacity



Model 1022 Capacity



Model 1013 Capacity

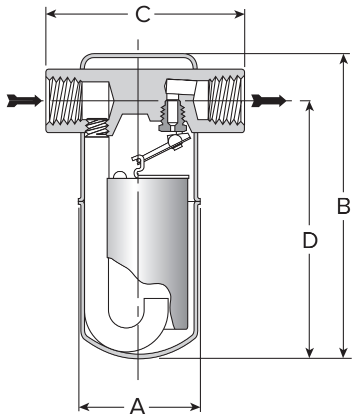


Armstrong®

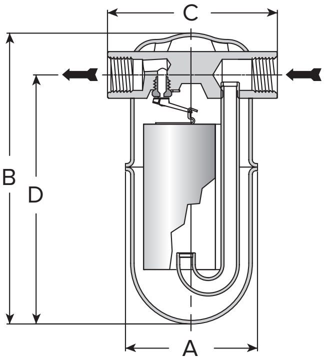
1800 Series Inverted Bucket Steam Trap

All Stainless Steel for Horizontal Installation

For Pressures to 650 psig (45 barg)...Capacities to 1 802 lb/hr (817 kg/hr)



Model 1811 Trap



Model 1822 Trap

Description

A quick and easy “in-line” replacement for other types of side inlet/side outlet traps, the Armstrong 1800 Series brings together all the benefits of energy-efficient inverted bucket operation. Side inlet/outlet all-welded construction means an inverted bucket trap that will operate efficiently on applications such as tracer lines, drips, heating, processing and similar applications.

With the 1800 Series you get freeze-resistant, all-stainless steel construction, with a three-year guarantee, plus all the benefits of inverted bucket operation:

Long, trouble-free service life
- Excellent purging action
- Continuous air venting
- Ease and flexibility of in-line installation

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model 1810, 1811:	400 psig @ 800°F (28 barg @ 427°C)
Model 1822:	650 psig @ 600°F (45 barg @ 315°C)
	627 psig @ 700°F (43 barg @ 371°C)
	604 psig @ 800°F (41.6 barg @ 427°C)

Maximum operating pressure:

Model 1810:	200 psig (14 barg)
Model 1811:	400 psig (28 barg)
Model 1822:	650 psig (45 barg)

Connections

Screwed NPT and BSPT
Socketweld
Flanged (consult factory)

Materials

Body:	ASTM A240 Grade 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH or Titanium

Options

- Insu-Pak™ insulation for Models 1810/1811
- Stainless steel pop drain for Models 1811/1822
- Probe connection for Models 1811/1822
- Restricted orifice
- Wiggle wire
- 316 stainless steel valve and seat

Specification

Inverted bucket steam trap, type ... in all stainless steel, freeze resistant, without gaskets, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and orifice at the top of the trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

1800 Series Traps

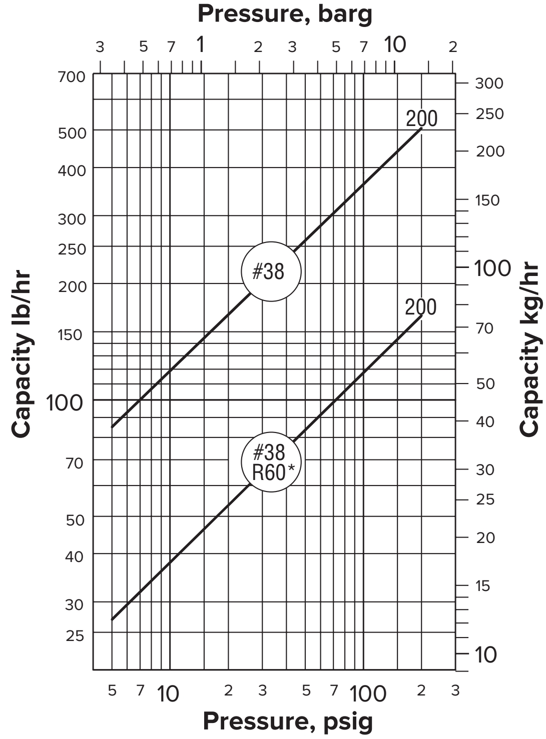
Model No.	1810		1811				1822			
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm
	3/8, 1/2	10, 15	1/2	15	3/4	20	1/2, 3/4	15, 20	1	25
“A” (Diameter)	2-11/16	68	2-11/16	68	2-11/16	68	3-7/8	99	3-7/8	99
“B” (Height)	5-5/16	135	6-5/16	160	6-9/16	167	8-1/2	218	8-1/2	218
“C” (Face to Face)	4-5/16	110	4-5/16	110	4-5/16	110	5	127	5	127
“D” (Bottom to ℄ Inlet)	4-7/16	113	5-7/16	138	5-9/16	141	7-3/8	187	7-1/8	181
Weight lb (kg)	1-3/4 (0.8)		2 (0.9)		2-3/8 (1.1)		7 (3)			

1800 Series Inverted Bucket Steam Trap

All Stainless Steel for Horizontal Installation

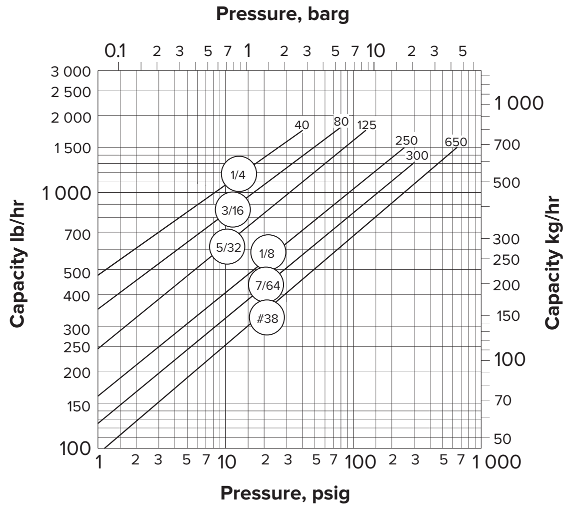
For Pressures to 650 psig (45 barg)...Capacities to 1 802 lb/hr (817 kg/hr)

Model 1810 Capacity

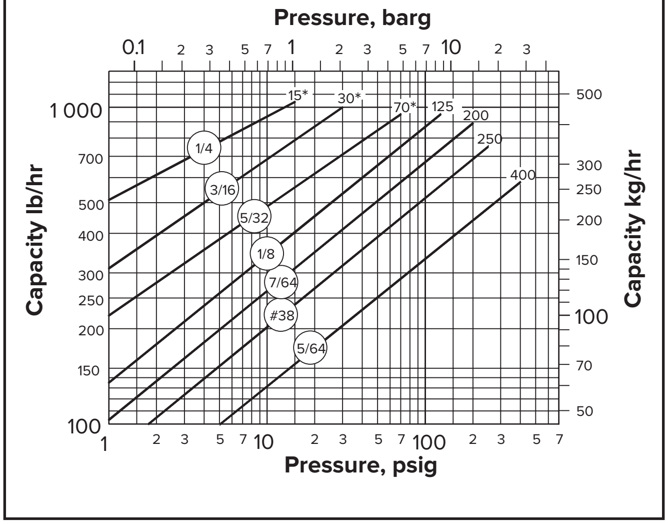


*NOTE: Because the orifice is located at the top, inverted bucket steam traps handle dirt and scale better than other types of traps. However, in applications where extremely dirty conditions exist, care should be exercised in the use of all types of restricted-orifice, reduced-capacity traps.

Model 1822 Capacity



Model 1811 Capacity

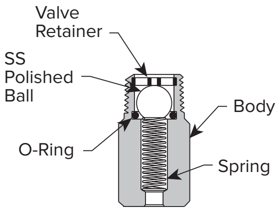


*Orifices available only with 3/4" connections.

Options

Pop Drain for Freeze Protection

In general, a properly selected and installed Armstrong trap will not freeze as long as steam is coming to the trap. If the steam supply is shut off, a pop drain should be used to automatically drain the trap. Stainless steel pop drain available for Models 1811 and 1822.



Maximum Operating Conditions

Pressure: 600 psig (41 barg)

Temperature: 350°F (177°C)

Insu-Pak™

Now you can insulate the in-line traps in your plant without complicating regular trap maintenance. Insu-Pak, a simple reusable insulation package, cuts the time and cost of in-field installation because it goes on in a snap. And it comes off just as easily. Insu-Pak can prevent trap freeze-up when used with a properly designed condensate manifold. Designed for use with Model 1810 and Model 1811 traps.

Probe connections are available for trap monitoring on Models 1811 and 1822.

2000 Series Inverted Bucket Steam Trap

All Stainless Steel With 360° Connector/IS-2/TVS-4000

For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr)

Description

With the 2000 Series' 360° universal connector, you can install inverted bucket efficiency and long service life in any piping configuration with little or no repiping. You get the reliability of the inverted bucket operating principle, plus all the benefits of all-stainless steel construction:

- A sealed, tamperproof package
- A compact, lightweight trap
- The ability to withstand freeze-ups without damage
- Exceptional corrosion resistance
- A three-year guarantee against defective materials, defective workmanship.

2000 Series steam traps combine savings in three important areas: energy, installation and replacement. The 360° universal connector provides quick, easy in-line replacement along with all the proven advantages of inverted bucket operation.

Also available with optional IS-2 integral strainer connector.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model 2010, 2011:	400 psig @ 800°F (28 barg @ 427°C)
Model 2022:	650 psig @ 600°F (45 barg @ 315°C)
	627 psig @ 700°F (43 barg @ 371°C)
	600 psig @ 800°F (41 barg @ 427°C)

Maximum operating pressure:

Model 2010:	200 psig (14 barg)
Model 2011:	400 psig (28 barg)
Model 2022:	650 psig (45 barg)

Connections

Screwed NPT and BSPT
Socketweld
Flanged (consult factory)

Materials

Body:	ASTM-A 240 Grade 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH or Titanium
Connector body (std & IS-2):	Stainless steel—304
Flange	ASTM A105 Zinc plated

Options

- Insu-Pak™ insulation for Models 2010/2011
- Stainless steel pop drain for Models 2011/2022
- Probe connection for Models 2011/2022
- Strainer blowdown valve for IS-2 connector
- Wiggle wire
- 316 stainless steel valve and seat

360° Connector Styles

- Standard connector
- IS-2 connector with integral strainer
- IS-2 connector with integral strainer with blowdown valve

Specification

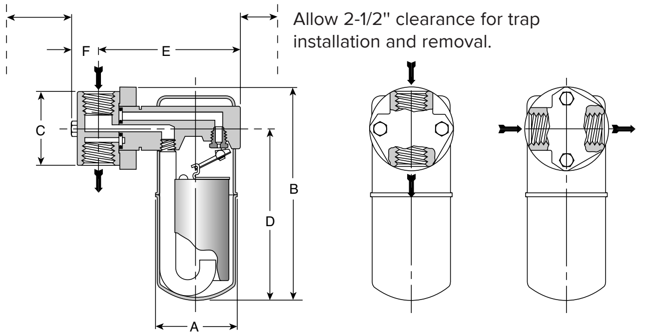
Inverted bucket steam trap, type ... in all stainless steel, freeze resistant, with 360° universal connector, having continuous air venting at steam temperature, free-floating stainless steel mechanism, and orifice at the top of the trap.

How to Order

Specify:

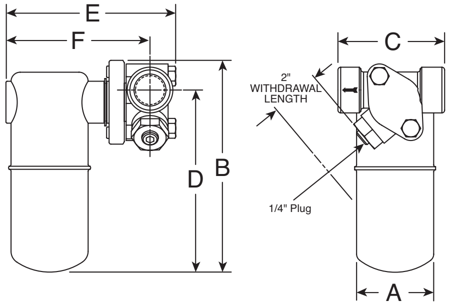
- Model number
- Size and type of pipe connection
- Type of 360° connector (with or without strainer)
- Maximum working pressure that will be encountered or orifice size
- Any options required

Allow 2-1/2" clearance for bolt installation and removal.



Allow 2-1/2" clearance for trap installation and removal.

Model 2011 Trap With Standard Connector



Series 2010-2022 With IS-2 Connector

Model No.	2010		2011		2022	
2000 Series Traps With Standard Connector						
	in	mm	in	mm	in	mm
Pipe Connections	3/8, 1/2, 3/4	10, 15, 20	3/8, 1/2, 3/4	10, 15, 20	3/8, 1/2, 3/4	10, 15, 20
"A" (Diameter)	2-11/16	68	2-11/16	68	3-7/8	98
"B" (Height)	6	152	6-15/16	176	8-11/16	221
"C" (Face to Face)	2-3/8	60	2-3/8	60	2-3/8	60
"D" (Bottom to ℄)	4-19/32	117	5-9/16	141	7-3/8	187
"E" (℄ to Outside)	4-9/16	115	4-9/16	115	5-3/4	146
"F" (℄ to Bolt)	1	25	1	25	1	25
Weight lb (kg)	4-1/4 (1.9)		4-1/2 (2.0)		7 (3)	

2000 Series Traps With IS-2 Integral Strainer Connector

Model No.	2010				2011				2022			
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1	25	1/2, 3/4	15, 20	1	25	1/2, 3/4	15, 20	1	25
"A" (Diameter)	2-11/16	68	2-11/16	68	2-11/16	68	2-11/16	68	3-7/8	98	3-7/8	98
"B" (Height)*	6	152	6	152	6-15/16	176	6-15/16	176	8-11/16	221	8-11/16	221
"C" (Face to Face)	3-1/2	89	4	102	3-1/2	89	4	102	3-1/2	89	4	102
"D" (Bottom to ℄)*	5	127	5	127	6	152	6	152	7-3/4	197	7-3/4	197
"E" (Outside to Bolt)	5-1/2	140	5-11/16	144	5-1/2	140	5-11/16	144	6-11/16	170	6-7/8	175
"F" (℄ to Outside)	4-5/8	117	4-13/16	122	4-5/8	117	4-13/16	122	5-13/16	148	6	152
Weight lb (kg)	4-3/4 (2.2)		5-1/4 (2.4)		5 (2.3)		5-1/2 (2.5)		7 (3)			

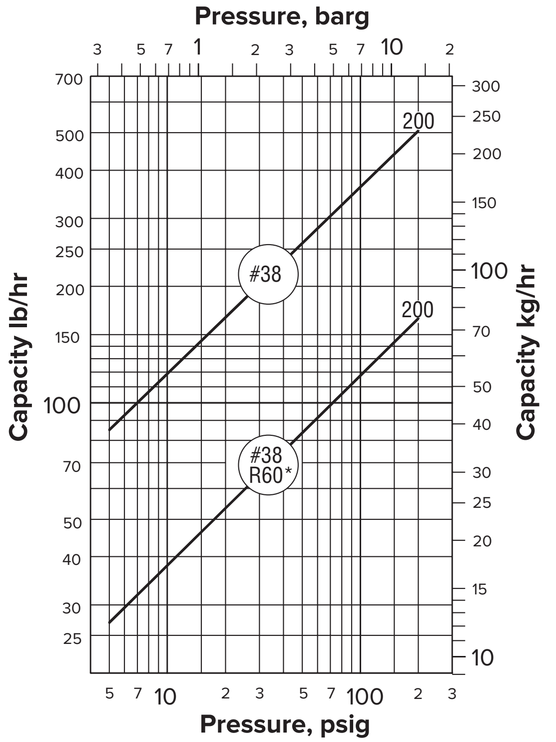
*Add 1/2" (15 mm) to "B" and "D" dimensions when optional probe connection is required.

2000 Series Inverted Bucket Steam Trap

All Stainless Steel With 360° Connector/IS-2/TVS-4000

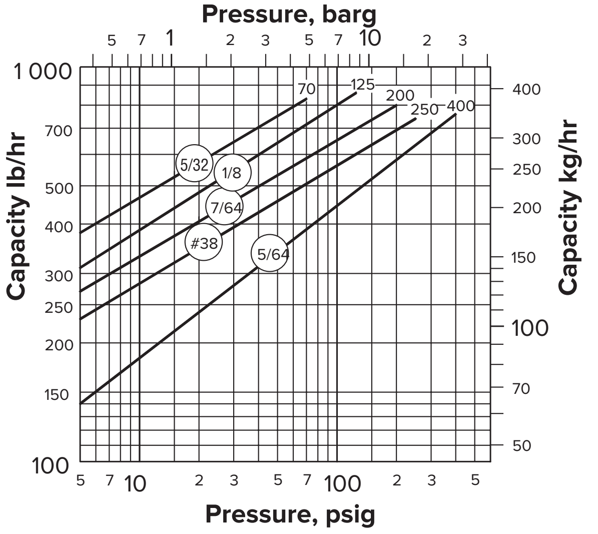
For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr)

Model 2010 Capacity

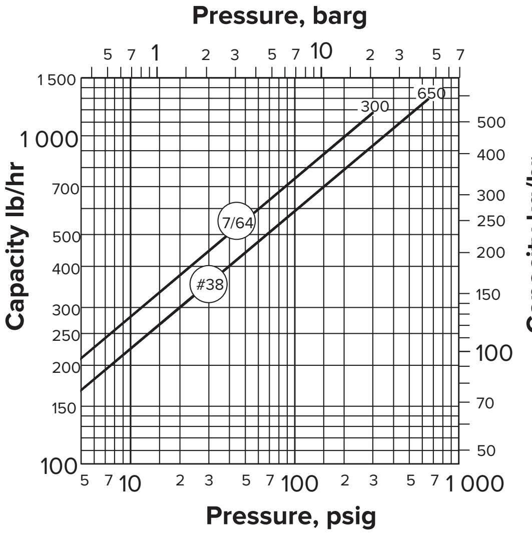


*NOTE: Because the orifice is located at the top, inverted bucket steam traps handle dirt and scale better than other types of traps. However, in applications where extremely dirty conditions exist, care should be exercised in the use of all types of restricted-orifice, reduced-capacity traps.

Model 2011 Capacity



Model 2022 Capacity



Connectors

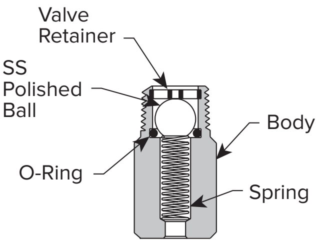
Besides the inverted bucket traps, the standard connector, IS-2 connector, and TVS-4000 connector with integral strainer can also be used on thermostatic, thermostatic wafer and disc traps.

CD-3300 Disc Trap With IS-2 Integral Strainer Connector

Options

Pop Drain for Freeze Protection

In general, a properly selected and installed Armstrong trap will not freeze as long as steam is coming to the trap. If the steam supply is shut off, a pop drain should be used to automatically drain the trap. Stainless steel pop drain available for Models 2011 and 2022.



Maximum Operating Conditions

Pressure:	600 psig (41 barg)
Temperature:	350°F (177°C)

Insu-Pak

Now you can insulate the in-line traps in your plant without complicating regular trap maintenance. Insu-Pak, a simple reusable insulation package, cuts the time and cost of in-field installation because it goes on in a snap. And it comes off just as easily. The Insu-Pak can prevent trap freeze-up when used with a properly designed condensate manifold. Designed for use with Model 2010 and Model 2011 traps.

Probe connections are available for trap monitoring for Models 2011 and 2022.

4000 Series Inverted Bucket Steam Trap

All Stainless Steel With IS-4 4-Bolt Connector

For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr)

Description

With the 4000 Series IS-4 connector, you can install 4-bolt compatible inverted bucket efficiency and long service life in any piping configuration with little or no repiping. You get the reliability of the inverted bucket operating principle, plus all the benefits of all-stainless steel construction:

- A sealed, tamperproof package
- A compact, lightweight trap
- The ability to withstand freeze-ups without damage
- Exceptional corrosion resistance
- A three-year guarantee against defective materials, defective workmanship.

4000 Series steam traps combine savings in three important areas: energy, installation and replacement. The 4-bolt connector provides quick, easy in-line replacement along with all the proven advantages of inverted bucket operation.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model IB4011:	400 psig @ 800°F (28 barg @ 427°C)
Model IB4022:	650 psig @ 600°F (45 barg @ 315°C) 627 psig @ 700°F (43 barg @ 371°C) 600 psig @ 800°F (41 barg @ 427°C)

Maximum operating pressure:

Model IB4011:	400 psig (28 barg)
Model IB4022:	650 psig (45 barg)

Connections

Screwed NPT
Socketweld
Flanged (consult factory)

Materials

Body:	ASTM-A 240 Grade 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH or Titanium
Connector body:	ASTM A351 Gr. CF8M

Options

- Stainless steel pop drain for Models 4011/4022
- Probe connection for Models 4011/4022
- Wiggle wire
- 316 stainless steel valve and seat

Connector Styles

- Standard with strainer
- With strainer blowdown valve
- With block/bleed valves

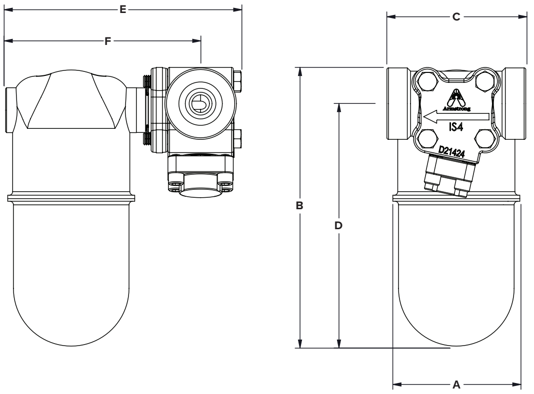
Specification

Inverted bucket steam trap, type ... in all stainless steel, freeze resistant, with 360° universal connector, having continuous air venting at steam temperature, free-floating stainless steel mechanism, and orifice at the top of the trap.

How to Order

Specify:

- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required



Model IB4022 Trap With IS-4 Connector

4000 Series Traps With Standard IS-4 Connector

Model No.	IB4011				IB4022			
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	3/4	20	1	25	3/4	20	1	25
"A" (Diameter)	2-11/16	68	2-11/16	68	3-7/8	98	3-7/8	98
"B" (Height)*	6-15/16	176	6-15/16	176	8-11/16	221	8-11/16	221
"C" (Face to Face)	4-1/4	108	4-1/4	108	4-1/4	108	4-1/4	108
"D" (Bottom to ℄)*	6	152	6	152	7-3/4	197	7-3/4	197
"E" (Outside to Bolt)	6-1/8	156	6-1/8	156	7-5/16	186	7-5/16	186
"F" (℄ to Outside)	4-15/16	125	4-15/16	125	6-1/8	156	6 -1/8	156
Weight lb (kg)	7-3/4 (3.5)				10-3/4 (4.9)			

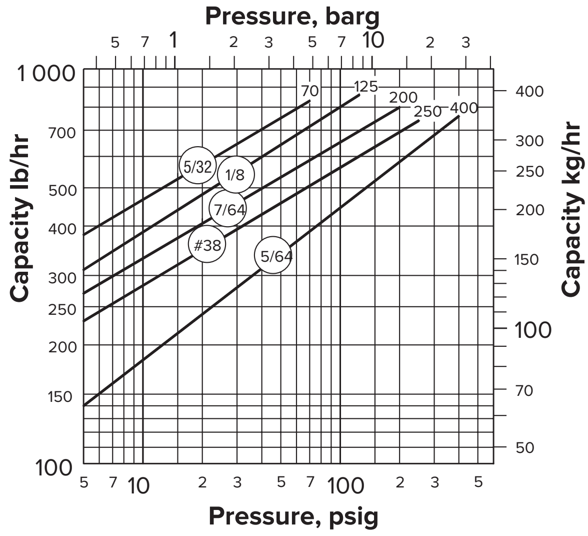
*Add 1/2" (15 mm) to "B" and "D" dimensions when optional probe connection is required.

4000 Series Inverted Bucket Steam Trap

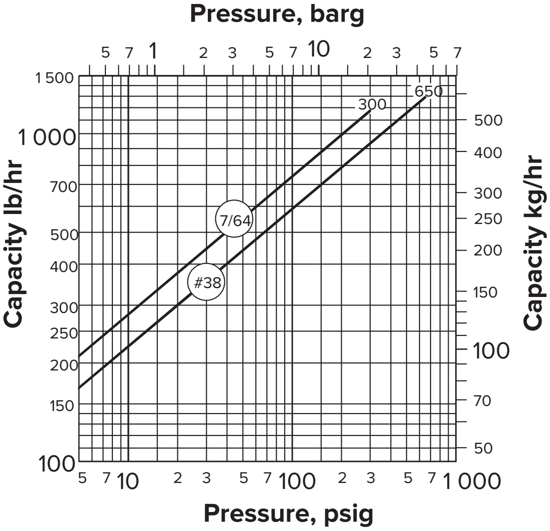
All Stainless Steel With IS-4 4-Bolt Connector

For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr)

Model IB4011 Capacity

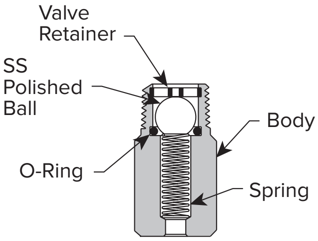


Model IB4022 Capacity



Options

Pop Drain for Freeze Protection
In general, a properly selected and installed Armstrong trap will not freeze as long as steam is coming to the trap. If the steam supply is shut off, a pop drain should be used to automatically drain the trap. Stainless steel pop drain available for Models 4011 and 4022.



Maximum Operating Conditions

Pressure:	600 psig (41 barg)
Temperature:	350°F (177°C)

Armstrong®

1811N and 2011N Inverted Bucket Steam Trap

All stainless steel, non-metallic seat for tracer service

For pressure to 200 psig (14 barg)... capabilities to 900 lbs/hr (410 kg/hr)

Description

With the 2000N Series' 360° universal connector or the in-line 1800N Series inverted bucket, copper oxide plugging problems can be eliminated. High pressure steam and condensate will dissolve copper tracing without proper amine treatment. The copper in solution precipitates out as copper oxide when it flashes through the steam trap orifice, depositing and eventually plugging the opening. The non-metallic seat eliminates the electrolytic attraction between the dissimilar metals. The copper oxide stays in suspension and flushes away with the condensate return. In addition, you get the reliability and energy efficiency of the inverted bucket design with the benefits of all-stainless steel construction.

- A sealed, tamperproof package
- A compact, lightweight trap
- Ability to withstand freeze-ups without mechanical failure
- Exceptional corrosion resistance
- A three-year guarantee against defective materials and workmanship

Maximum Operating Conditions

Maximum allowable pressure

Model 1811N	400 psig @ 800°F (28 barg @ 427°C)
Model 2011N	400 psig @ 800°F (28 barg @ 427°C)

Maximum operating pressure:

Model 1811N	200 psig @ 450°F (14 barg @ 232°C)
Model 2011N	200 psig @ 450°F (14 barg @ 232°C)

Materials

Body:	ASTM A240 Grade 304L
Internals:	All stainless steel
Valve:	Stainless steel—17-4PH
Seat:	Non-metallic

2011N 360° Universal, 2-bolt, Connector Styles

- Standard 2-bolt connector
- IS-2 connector including integral strainer with optional blowdown valve
- TVS 4000 Trap Valve Station

1811N Connections

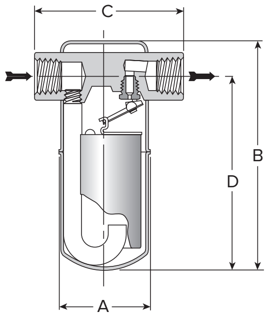
- 1/2" or 3/4", NPT or SW

Specification

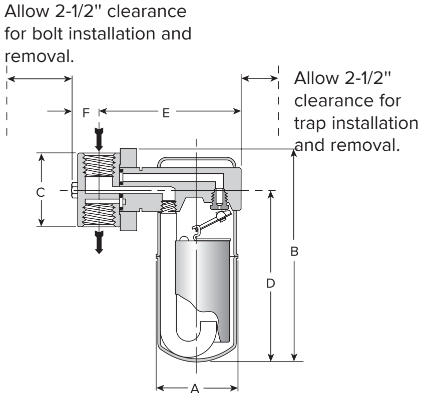
Inverted bucket steam trap. Stainless steel construction, stainless steel valve with non-metallic seats, freeze resistant, continuous air venting.

How to order

- Specify model
- Select connection size or type of connector
- Maximum working pressure or orifice size



Model 1811N Trap



Allow 2-1/2" clearance for bolt installation and removal.

Allow 2-1/2" clearance for trap installation and removal.

Model 2011N Trap With Standard Connector

1811N Dimensions and Weight

Model No.	1811N			
Pipe Connections	in	mm	in	mm
	1/2	15	3/4	20
"A" (Diameter)	2-11/16	68	2-11/16	68
"B" (Height)	6-5/16	160	6-9/16	167
"C" (Face to Face)	4-5/16	110	4-5/16	110
"D" (Bottom to ℄ Inlet)	5-7/16	138	5-9/16	141
Weight lb (kg)	2 (0.9)		2-3/8 (1.1)	

2011N Dimensions and Weight

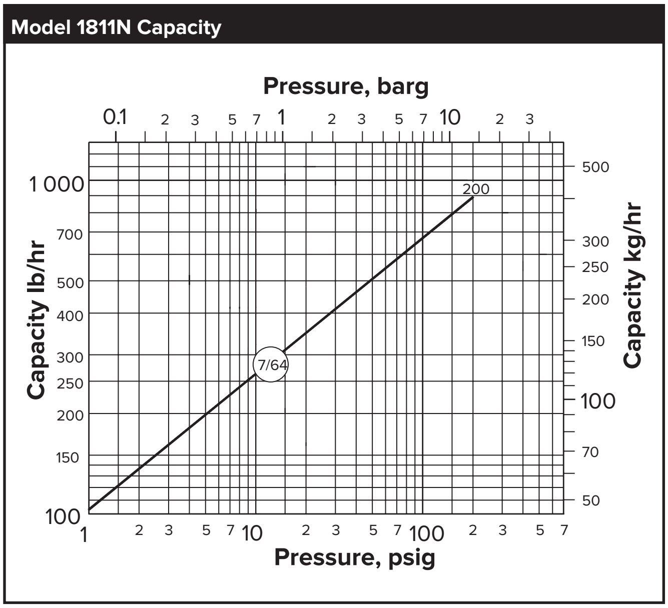
Model No.	2011	
Pipe Connections	in	mm
	3/8, 1/2, 3/4	10, 15, 20
"A" (Diameter)	2-11/16	68
"B" (Height)	6-15/16	176
"C" (Face to Face)	2-3/8	60
"D" (Bottom to ℄)	5-9/16	141
"E" (℄ to Outside)	4-9/16	115
"F" (℄ to Bolt)	1	25
Weight lb (kg)	4-1/2 (2.0)	

1811N and 2011N Inverted Bucket Steam Trap

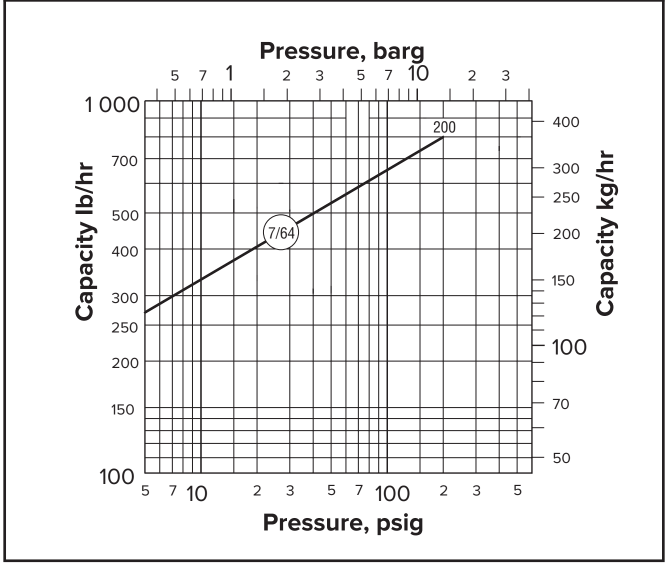
All stainless steel, non-metallic seat for tracer service

For pressure to 200 psig (14 barg)... capabilities to 900 lbs/hr (410 kg/hr)

Model 1811N Capacity

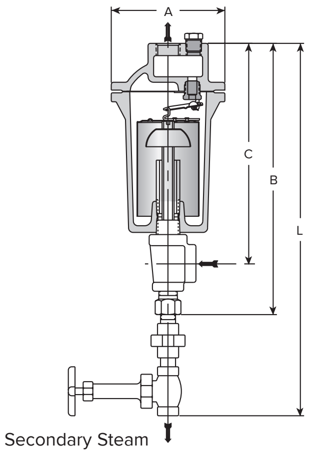


Model 2011N Capacity



20-DC Series Automatic Differential Condensate Controllers

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)



Description

Armstrong automatic differential condensate controllers (DC) are designed to function on applications where condensate must be lifted from a drain point or in gravity drainage applications where increased velocity will aid in condensate drainage.

When lifting from the drain point, often referred to as syphon drainage, the reduction in pressure that occurs when the condensate is elevated causes a portion of it to flash back into steam.

Ordinary steam traps, unable to differentiate between flash steam and live steam, close and impede drainage. Increased velocity with gravity drainage will aid in drawing the condensate and air to the DC. This increased velocity is caused by an internal steam by-pass, controlled by a manual metering valve, so the condensate controller will automatically vent the by-pass or secondary steam. This is then directed to the condensate return line or collected for use in other heat exchangers.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Fittings metering valve:	Metering valve—Bronze with stainless steel trim. Fittings 250# malleable iron

Specification

Automatic differential condensate controller, type ... in cast iron.

How to Order

- Specify model number
- Specify size and type of pipe connection
- Specify maximum working pressure that will be encountered or orifice size
- Specify any options required

For a fully detailed certified drawing, refer to CD #1008.

20-DC Series Differential Condensate Controllers

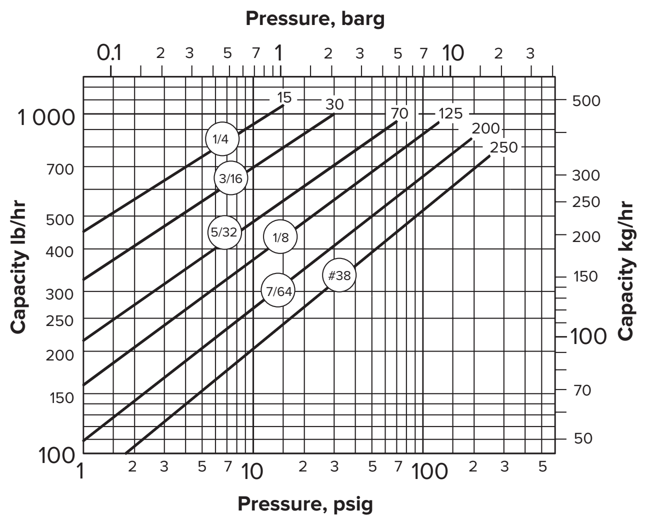
Model No.	21-DC		22-DC		23-DC		24-DC		25-DC		26-DC	
Inlet & Outlet Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/4	32	1-1/2	40	2	50
Secondary Steam Connection	3/8	10	1/2	15	1/2	15	3/4	20	1	25	1	25
"A" (Diameter)	4-1/4	108	5-1/4	133	6-3/8	162	7-1/2	190	8-1/2	216	10-3/16	259
"B" (Height)	9-3/4	248	12-1/4	311	15-1/2	394	18	457	20-1/4	514	23-1/2	597
"C"	7-3/4	197	9-1/2	241	12-3/4	324	15	381	16-3/4	425	19-3/4	502
"L"	14-7/8	378	18-1/8	460	21-3/8	543	23-7/8	606	26-3/4	679	31	787
Weight lb (kg)	7 (3.2)		14 (6.4)		24 (10.9)		38 (17.2)		53 (24.0)		86 (39.0)	

20-DC Series Automatic Differential Condensate Controllers

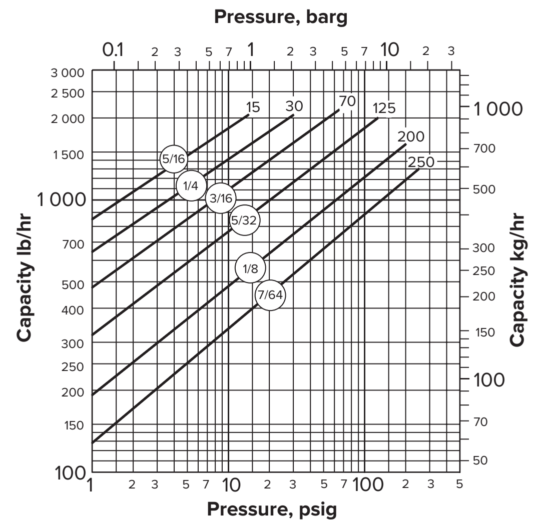
For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

Armstrong®

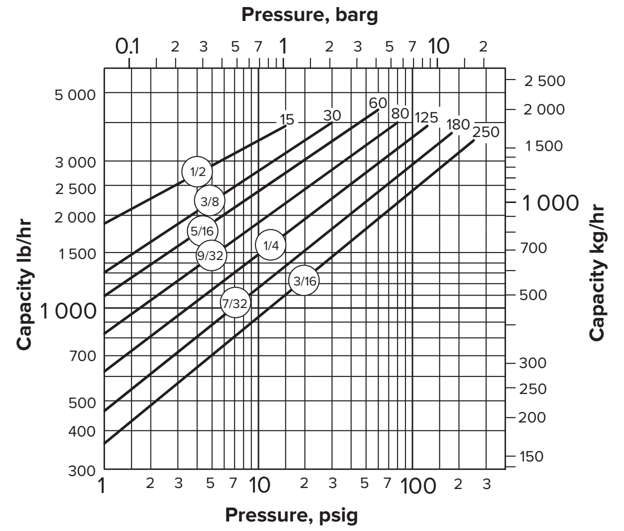
Model 21-DC Capacity



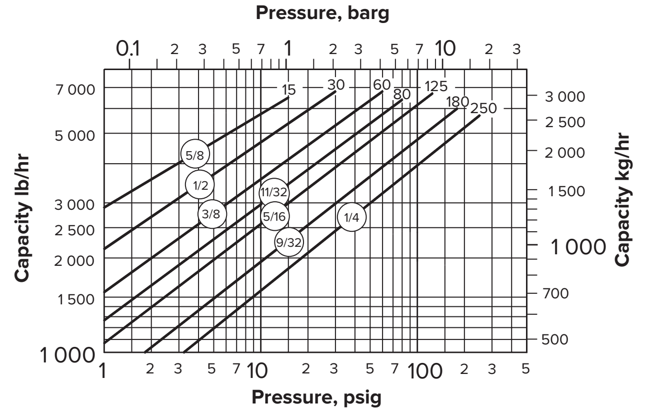
Model 22-DC Capacity



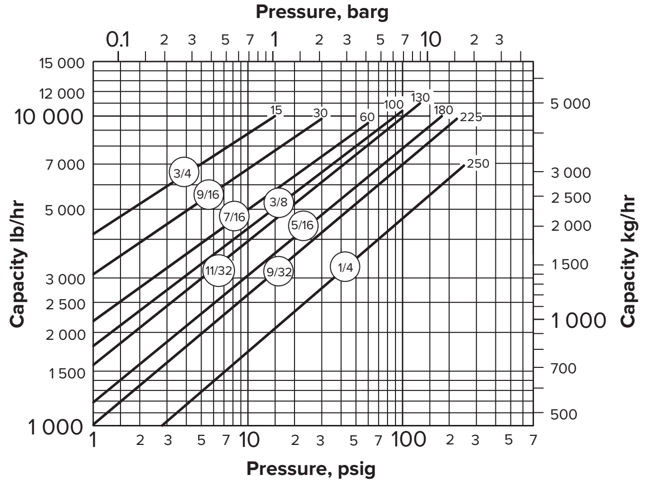
Model 23-DC Capacity



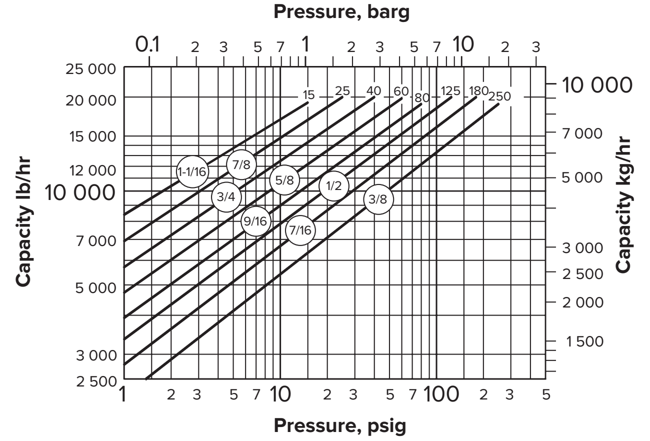
Model 24-DC Capacity



Model 25-DC Capacity



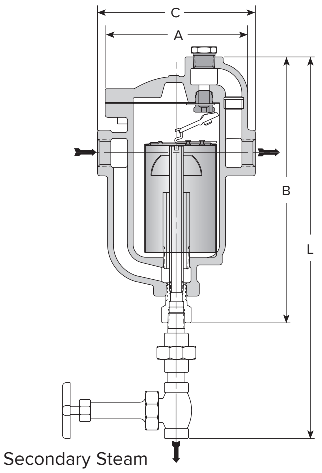
Model 26-DC Capacity



Armstrong®

80-DC Series Automatic Differential Condensate Controllers

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)



Description

Armstrong automatic differential condensate controllers (DC) are designed to function on applications where condensate must be lifted from a drain point or in gravity drainage applications where increased velocity will aid in condensate drainage.

When lifting from the drain point, often referred to as syphon drainage, the reduction in pressure that occurs when the condensate is elevated causes a portion of it to flash back into steam.

Ordinary steam traps, unable to differentiate between flash steam and live steam, close and impede drainage. Increased velocity with gravity drainage will aid in drawing the condensate and air to the DC. This increased velocity is caused by an internal steam by-pass, controlled by a manual metering valve, so the condensate controller will automatically vent the by-pass or secondary steam. This is then directed to the condensate return line or collected for use in other heat exchangers.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Fittings metering valve:	Metering valve—Bronze with stainless steel trim. Fittings 250# malleable iron.

Specification

Automatic differential condensate controller, type ... in cast iron.

How to Order

- Specify model number
- Specify size and type of pipe connection
- Specify maximum working pressure that will be encountered or orifice size
- Specify any options required

For a fully detailed certified drawing, refer to CD #1008.

80-DC Series Differential Condensate Controllers

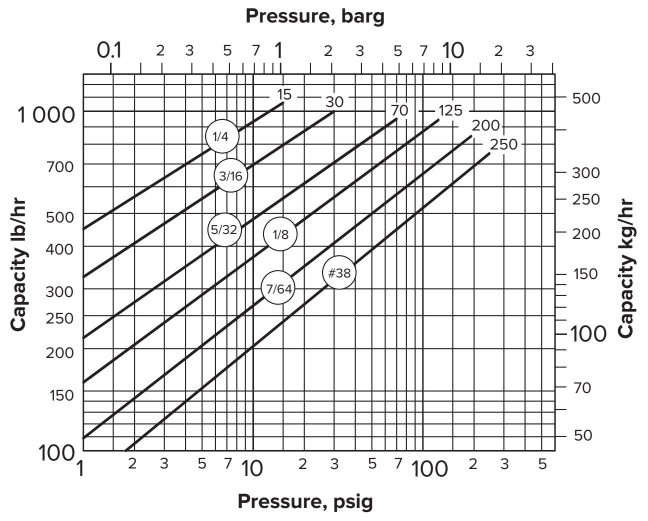
Model No.	81-DC		82-DC		83-DC		84-DC		85-DC		86-DC	
Inlet & Outlet Connections	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
	3/4	20	3/4	20	1	25	1-1/4	32	1-1/2, 2	50	2	50
Secondary Steam Conn.	3/8	10	1/2	15	1/2	15	3/4	20	1	25	1-1/2	40
"A" (Diameter)	3-3/4	95	5-5/8	143	7	178	8	203	9	229	11-1/2	292
"B" (Height)	8	203	10-1/2	267	13	330	15	381	17-1/2	445	23	584
"C"	5	127	16-5/8	422	7-3/4	197	9	229	10-1/4	260	13	330
"L"	13-1/4	337	17-1/2	445	18-3/4	476	21-3/4	552	24	610	32	813
Weight lb (kg)	7-1/2 (3.4)		17-1/2 (7.9)		30-1/2 (13.7)		47 (21.3)		75 (34)		139 (63)	

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

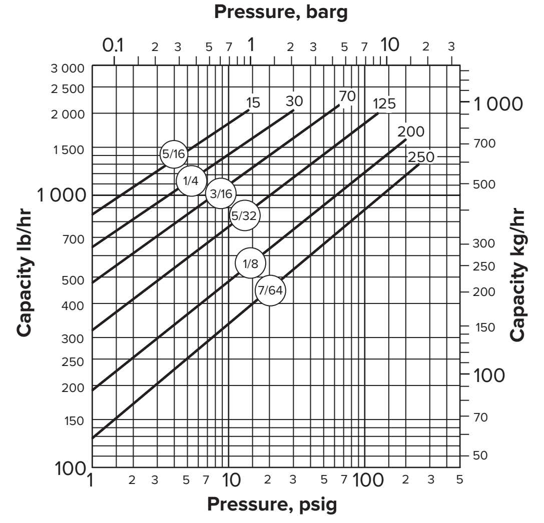
80-DC Series Automatic Differential Condensate Controllers

For Pressures to 250 psig (17 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

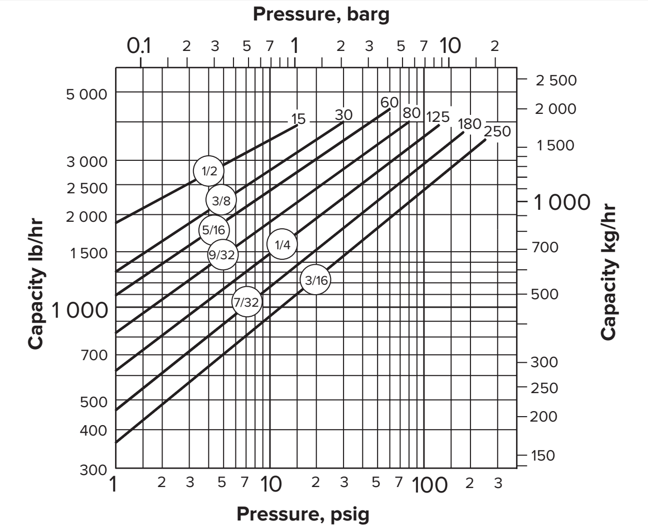
Model 81-DC Capacity



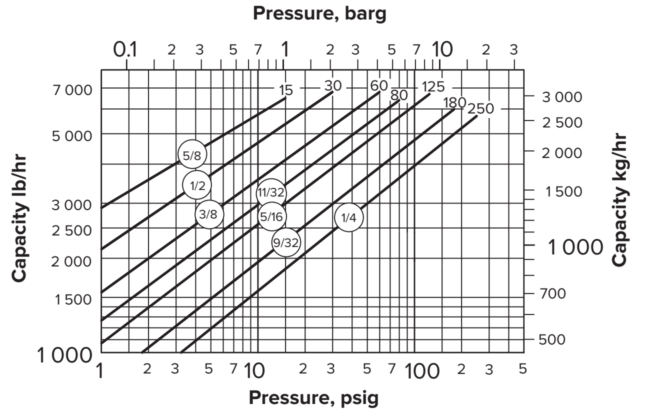
Model 82-DC Capacity



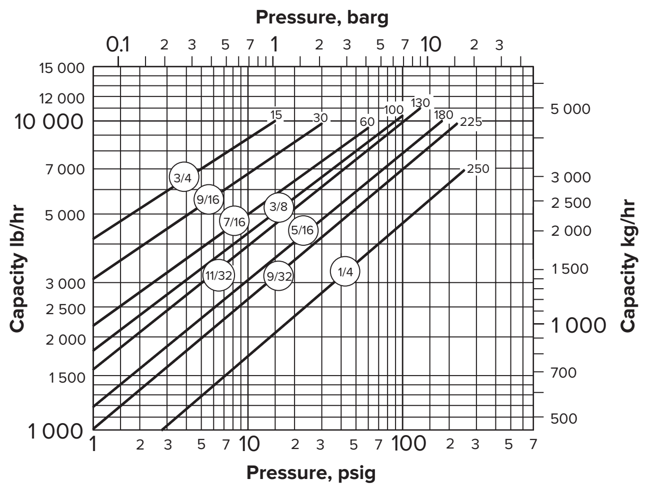
Model 83-DC Capacity



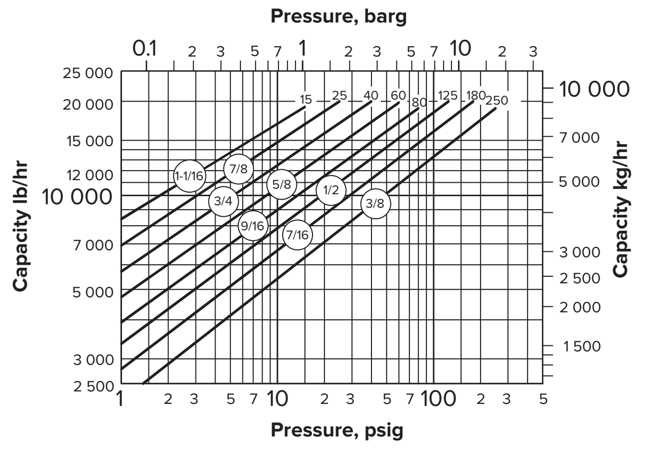
Model 84-DC Capacity



Model 85-DC Capacity

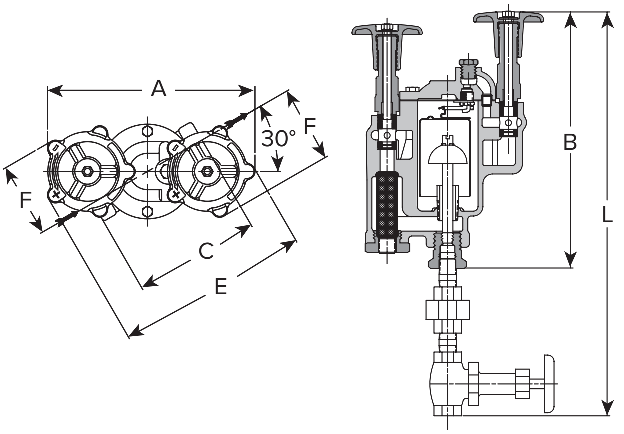


Model 86-DC Capacity

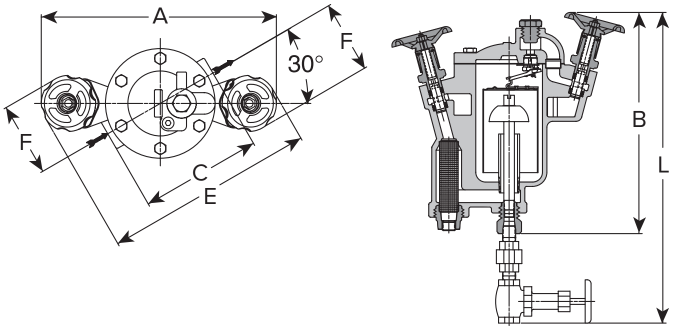


TVS 80-DC Series Automatic Differential Condensate Controllers

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)



TVS 81-DC



TVS 82-DC & TVS 83-DC

Description

Armstrong automatic differential condensate controllers (DC) are designed to function on applications where condensate must be lifted from a drain point or in gravity drainage applications where increased velocity will aid in condensate drainage.

When lifting from the drain point, often referred to as syphon drainage, the reduction in pressure that occurs when the condensate is elevated causes a portion of it to flash back into steam.

Ordinary steam traps, unable to differentiate between flash steam and live steam, close and impede drainage. Increased velocity with gravity drainage will aid in drawing the condensate and air to the DC. This increased velocity is caused by an internal steam by-pass, controlled by a manual metering valve, so the condensate controller will automatically vent the by-pass or secondary steam. This is then directed to the condensate return line or collected for use in other heat exchangers.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Fittings metering valve:	Metering valve—Bronze with stainless steel trim. Fittings 250# malleable iron.
Handwheel:	Ductile iron
TVS 80 Series Piston valve internals:	Stainless steel and graphite

Specification

Automatic differential condensate controller, type TVS in cast iron complete with integral piston valves on the inlet, and outlet with strainer.

How to Order

- Specify model number
- Specify size and type of pipe connection
- Specify maximum working pressure that will be encountered or orifice size
- Specify any options required

For a fully detailed certified drawing, refer to:

TVS 81-DC	**CD #1088**
TVS 82-DC and TVS 83-DC	**CD #1089**

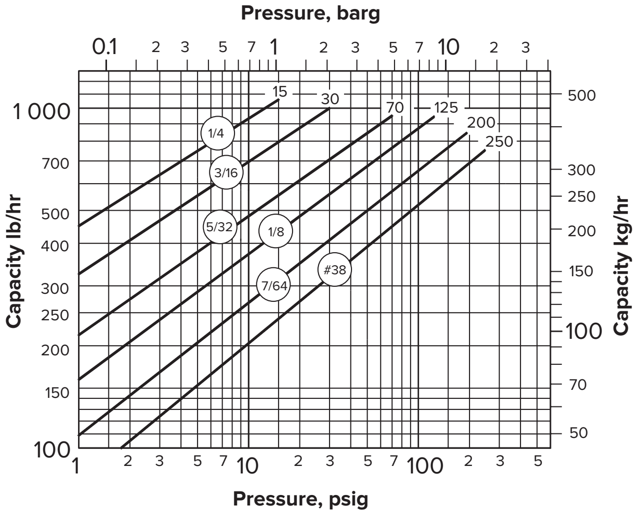
TVS 80-DC Series

Model No.	TVS 81-DC		TVS 82-DC		TVS 83-DC	
	in	mm	in	mm	in	mm
Inlet & Outlet Connections	1/2, 3/4	15, 20	1/2, 3/4	15, 20	3/4, 1	20, 25
Secondary Steam Connections	3/8	9	1/2	15	1/2	15
Test Plug	1/4	6	1/2	15	3/4	20
"A" Width Across Handwheels	8-1/4	210	13-3/4	349	15-1/8	384
"B" Outlet Valve Open	11	279	12-5/8	320	15-1/8	384
"C" Face to Face	5	127	6-1/2	165	7-3/4	197
"E"	7-5/8	194	13	330	14-3/8	365
"F"	3	76	4-1/2	114	4-7/8	124
"L"	16-3/4	425	18-3/8	467	20-3/4	527
Number of Bolts	6	6	6	6	6	6
Weight lb (kg)	13-1/2	6	27-1/2	12.5	50	23
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)					
Maximum Operating Pressure psig (barg)	250 (17)					

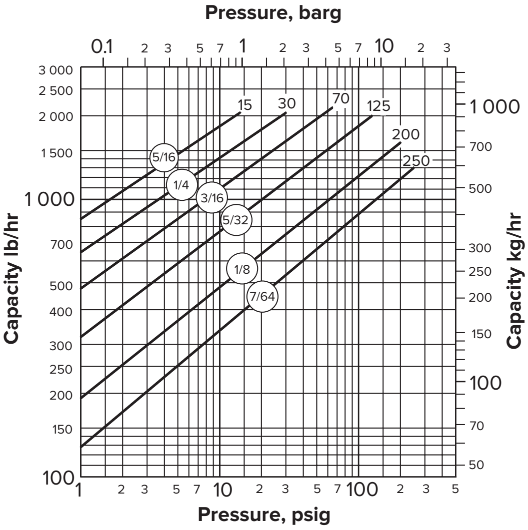
TVS 80-DC Series Automatic Differential Condensate Controllers

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

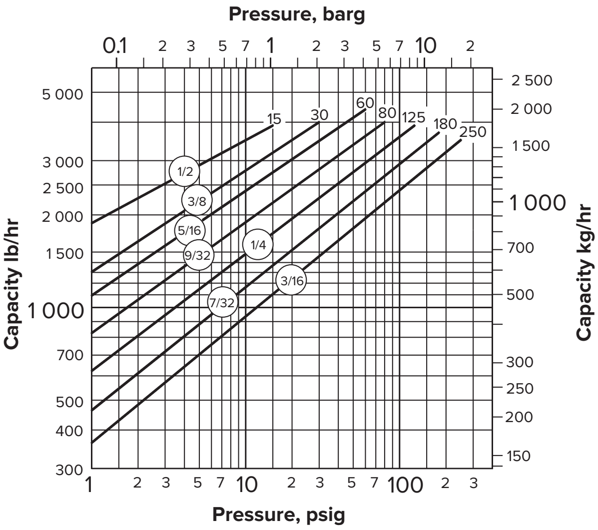
Model TVS 81-DC Capacity



Model TVS 82-DC Capacity



Model TVS 83-DC Capacity



Armstrong®

30-DC Series Automatic Differential Condensate Controllers

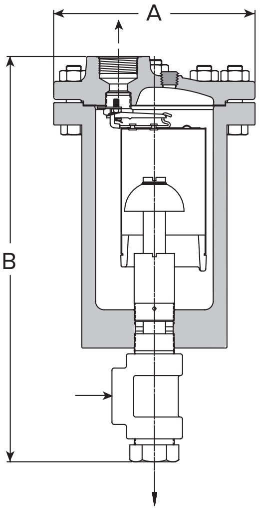
For Pressures to 650 psig (45 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

Description

Armstrong automatic differential condensate controllers (DC) are designed to function on applications where condensate must be lifted from a drain point or in gravity drainage applications where increased velocity will aid in condensate drainage.

When lifting from the drain point, often referred to as syphon drainage, the reduction in pressure that occurs when the condensate is elevated causes a portion of it to flash back into steam.

Ordinary steam traps, unable to differentiate between flash steam and live steam, close and impede drainage. Increased velocity with gravity drainage will aid in drawing the condensate and air to the DC. This increased velocity is caused by an internal steam by-pass, controlled by a manual metering valve, so the condensate controller will automatically vent the by-pass or secondary steam. This is then directed to the condensate return line or collected for use in other heat exchangers.



Connections

Screwed NPT and BSPT

Materials

Body:	ASTM A105
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Fittings:	3000# Carbon steel

Specification

Automatic differential condensate controller, type ... in carbon steel.

How to Order

- Specify model number
- Specify size and type of pipe connection
- Specify maximum working pressure that will be encountered or orifice size
- Specify any options required

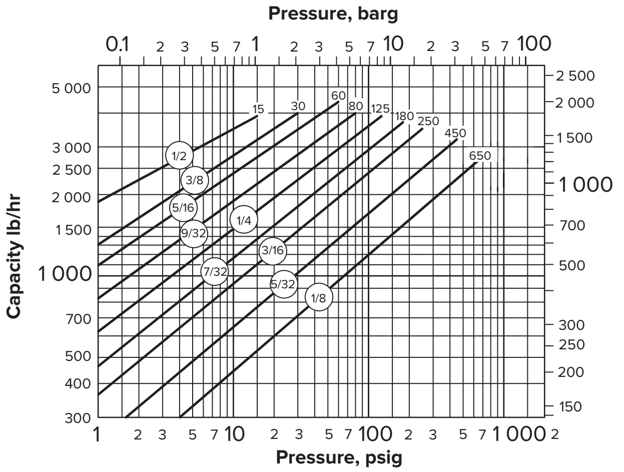
30-DC Series Differential Condensate Controllers

Model No.	33-DC		34-DC		35-DC		36-DC	
Inlet & Outlet Connections	in	mm	in	mm	in	mm	in	mm
	1	25	1-1/4	32	1-1/2	40	2	50
Secondary Steam Conn.	1/2	15	3/4	20	1	25	1	25
"A" (Diameter)	8	203	8-5/8	219	9-3/4	248	11-7/8	302
"B" (Height)	16-9/16	420	19-1/4	489	21-7/16	544	23-7/8	607
Weight lb (kg)	53 (24)		73 (33)		102 (46)		184 (83)	
Maximum Operating Pressure, Sat. Steam, psig (barg)	650 (44)							
Maximum Allowable Pressure (Vessel Design)	1 080 psig @ 650°F (74 barg @ 343°C)		1 130 psig @ 650°F (78 barg @ 343°C)		1 015 psig @ 650°F (70 barg @ 343°C)		1 100 psig @ 650°F (76 barg @ 343°C)	

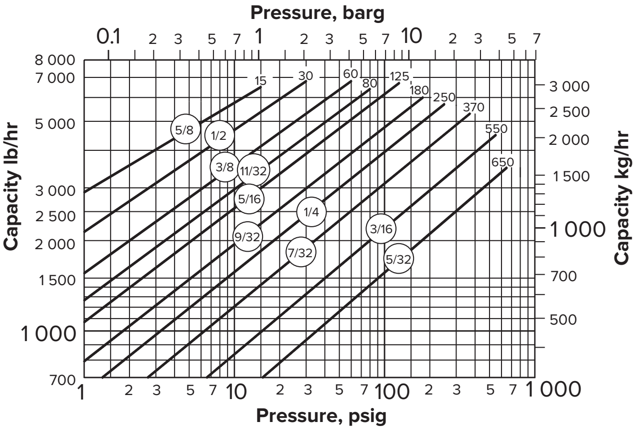
30-DC Series Automatic Differential Condensate Controllers

For Pressures to 650 psig (45 barg)...Capacities to 20 000 lb/hr (9 072 kg/hr)

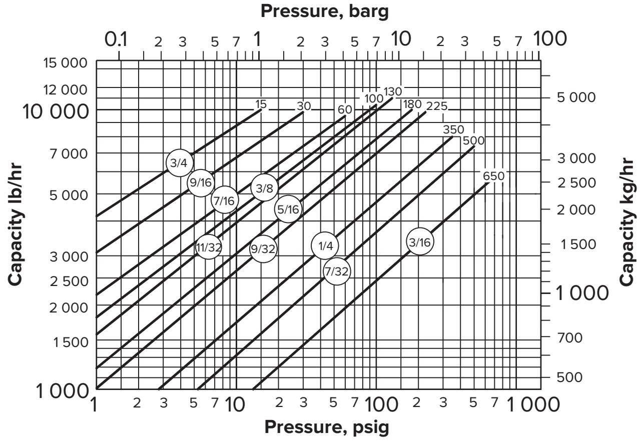
Model 33-DC Capacity



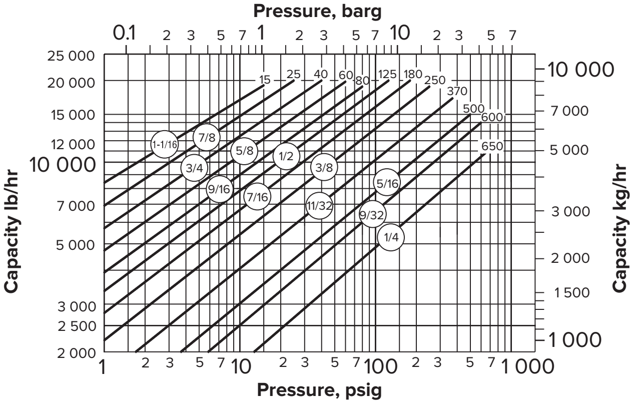
Model 34-DC Capacity



Model 35-DC Capacity



Model 36-DC Capacity

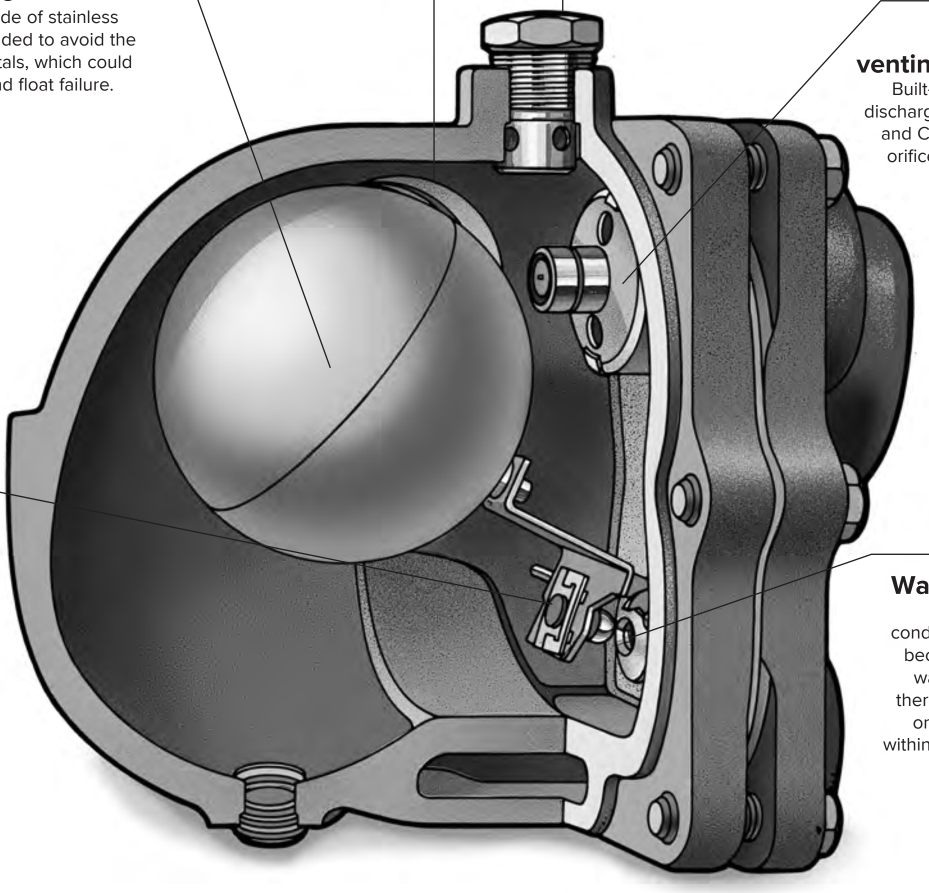


Armstrong® Float & Thermostatic Steam Trap

The More Your Steam Pressure Varies, the More You Need Armstrong F&T Traps

When steam pressure may vary from maximum steam supply pressure to vacuum, Armstrong F&Ts are your most energy-efficient choice. Our line of F&Ts brings Armstrong performance, dependability and long life to trapping services requiring continuous drainage with high air venting capacity. Thanks to separate orifices for condensate and air, they provide continuous condensate drainage and air venting—even under conditions of zero pressure.

All the benefits detailed below have been designed into Armstrong F&Ts through long experience in the manufacture of pressure float-type drain traps. They assure you of optimum operating efficiency for long periods with minimum trouble.



No water seal at inlet
Inlet high on body and condensate discharge valve in the bottom of the body prevent formation of a water seal that could block flow of air to vent under very low pressure conditions.

Optional integral vacuum breakers
Provide maximum protection against freezing and water hammer in condensing equipment under modulated control. They also eliminate another fitting being installed in the line.

Corrosion resistance
Entire float mechanism is made of stainless steel. The float is Heliarc welded to avoid the introduction of dissimilar metals, which could lead to galvanic corrosion and float failure.

High-capacity venting of air and C0$_2$
Built-in thermostatic air vent discharges large volumes of air and C0$_2$ through its separate orifice—even under very low pressure conditions.

Long life and dependable service
Valve is stainless steel in all sizes. Seat is heat treated in 1-1/2" pipe size and larger. Rugged float mechanism is built to resist wear, and the stainless steel float provides exceptionally high collapsing pressure and resistance to hydraulic shock.

Water sealed valve
Steam cannot reach condensate discharge valve because it is always under water. Balanced pressure thermostatic air vent closes on steam at any pressure within the operating range of the trap.

Operation against back pressure
Trap operation is governed solely by the condensate level in the trap. Back pressure in the return line will not render the trap inoperative as long as there is any pressure differential to force condensate through the discharge valve.

Continuous drainage
No pressure fluctuations due to intermittent condensate drainage. Condensate is discharged at very close to steam temperature. No priming needed.

Built as Tough as the Jobs They Do

Armstrong float and thermostatic traps are unique in their super heavy duty construction. Armstrong uses high quality ASTM A48 Class 30 cast iron or ASTM A216 WCB cast steel—normally found in pressure vessels rated to 250 psig or 465 psig. Internal mechanisms are made from stainless steel and are heavily reinforced. No brass cotter pins here. Valves and seats are stainless steel, hardened, ground and lapped to withstand the erosive forces of flashing condensate.

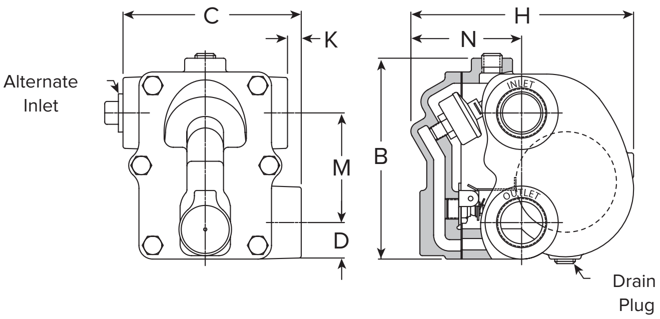
Why go to all this trouble on traps normally recommended for low-pressure, modulating service? The answer is in the word modulating. Modulating pressures mean widely varying loads, thermal cycling and high air and non-condensable gas loads. In other words, tough service. Inferior, lightweight construction is a mistake waiting to happen. Trap failures on modulating pressure may lead to water hammer, corrosion and even heat exchanger damage.

Armstrong's published capacities are based on actual measurements of traps handling hot, flashing condensate. Competitive F&Ts may utilize theoretical calculated capacities. Armstrong uses its own steam lab to give you actual capacity—especially important on high-capacity traps such as those in our ultra-capacity line. Not only does Armstrong offer super heavy duty construction for long life and reliability, but we also supply the data to back up performance. Here's a simple, easy-to-remember summary: The more your pressure varies, the more you need Armstrong F&Ts.

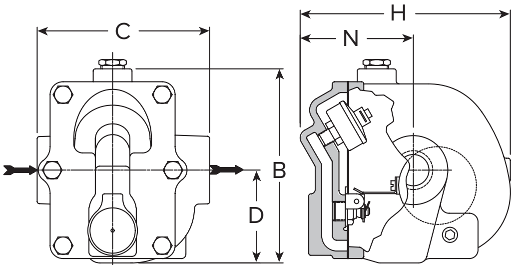
B and BI Series Float & Thermostatic Steam Trap

Cast Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures From Vacuum to 30 psig (2 barg)...Capacities to 8 900 lb/hr (4 037 kg/hr)



Model B Traps



Model BI Traps

Description

Armstrong B and BI Series F&T traps combine high standards of performance and long life with economy for heating service where continuous drainage with high air-venting capacity is required.

Because of the wide use of vacuum returns in systems of this type, the thermostatic air vent element is charged to give it the capability of compensated response to the pressure-temperature curve of steam at any pressure from less than 20" (500 mm) Hg vacuum to 30 psig (2 barg) gauge. B and BI Series F&T traps will vent air at slightly below steam temperature throughout this entire range of operation.

All B Series traps, except the 1/2" (15 mm) and 3/4" (20 mm), have inlet connections on both sides of the body to provide flexibility in piping. The BI Series F&T traps in sizes 1/2", 3/4" and 1" feature the convenience of in-line connections with the same internals as the B Series.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model B2-B3:	125 psig @ 353°F (8.5 barg @ 178°C)
Model B4-B8:	175 psig @ 377°F (12 barg @ 191°C)

Maximum operating pressure:

15B, BI:	15 psig (1 barg) saturated steam
30B, BI:	30 psig (2 barg) saturated steam

NOTE: Cast iron traps should not be used in systems where excessive hydraulic or thermal shock are present.

Connections

Screwed NPT and BSPT

Materials

Body and cap:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve:	Stainless steel—303 or 17-4PH
Seat:	Stainless steel—303 (ASTM A582) Stainless steel—17-4PH in 1-1/2" and 2"
Thermostatic air vent:	Stainless steel and bronze with phosphor bronze bellows, caged in stainless steel

Options

Integral vacuum breaker. Add suffix VB to model number.

CAUTION: Do not use a conventional vacuum breaker open to the atmosphere in any system that incorporates a mechanical return system that carries pressure less than atmospheric pressure. This includes all return systems designated as vacuum returns, variable vacuum returns or subatmospheric returns. If a vacuum breaker must be installed in such a system, it should be of the type that is loaded to open only when the vacuum reaches a calibrated level well in excess of the design characteristics of the system.

Specification

Float and thermostatic steam trap, type ... in cast iron, with thermostatic air vent.

How to Order

Pressure	Model	Connection Size	Option
15	B	2	VB
15 30	B = Standard Connection	*2 = 1/2" *3 = 3/4" 4 = 1" 5 = 1-1/4" 6 = 1-1/2" 8 = 2"	VB = Vacuum Breaker
	BI = In-line Connection	2 = 1/2" 3 = 3/4" 4 = 1"	

*No alternate inlet available.

B and BI Series Traps

Trap Series	B Model										BI Model	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1	25	1-1/4	32	1-1/2	40	2	50	1/2, 3/4, 1	15, 20, 25
"B" (Height)	4-7/8	124	5-1/2	140	5-1/2	140	7-7/16	189	9-5/8	244	5-5/8	143
"C" (Face to Face)	3-7/8	98	4-7/8	124	4-5/8	117	5-3/4	146	7-5/8	194	5	127
"D" (Bottom to ℄)	7/8	22.2	1	25.4	1-7/32	31.0	1-7/16	36.5	1-11/16	42.9	2-11/16	68
"H" (Width)	5-3/8	137	6	152	7-3/4	197	8-7/16	214	11-5/8	295	6-5/8	168
"K" (Connection Offset)	1/8	3.2	3/8	9.5	—	—	—	—	—	—	—	—
"M" (℄ to ℄)	2-3/4	69.8	3	76.2	3	76.2	4-3/16	106	6	152	—	—
"N" (Top to ℄)	2-9/16	65.1	3	76.2	3-3/8	85.7	3-3/4	95.2	5	127	3-9/32	83
Weight lb (kg)	6 (2.7)		8-1/2 (3.9)		11 (5.0)		19 (8.6)		40 (18.1)		9-3/4 (4.4)	

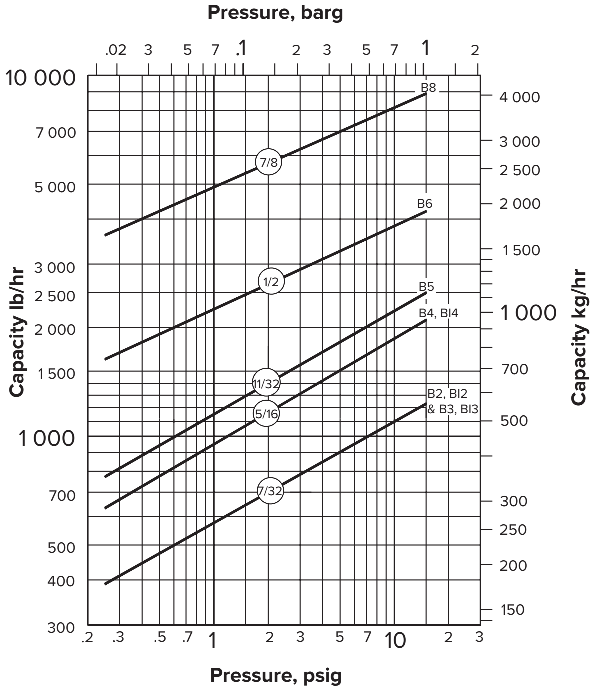
NOTE: Cast iron traps should not be used in systems where excessive hydraulic or thermal shock are present.

B and BI Series Float & Thermostatic Steam Trap

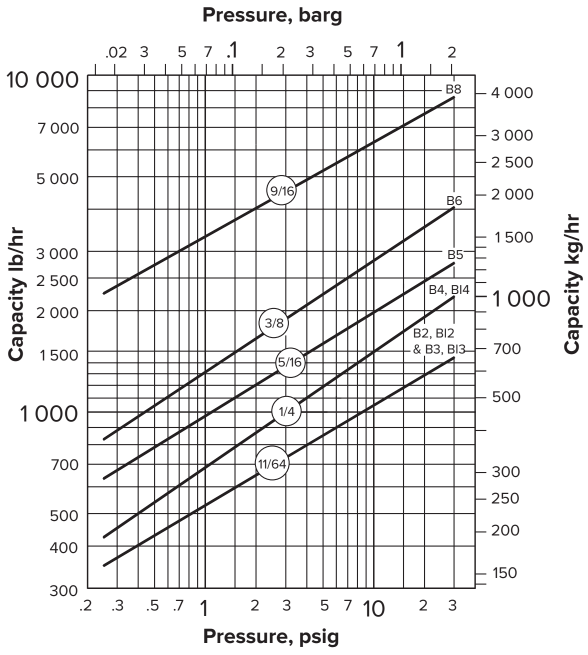
Cast Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures From Vacuum to 30 psig (2 barg)...Capacities to 8 900 lb/hr (4 037 kg/hr)

Model B & BI Series Capacity—15 psig



Model B & BI Series Capacity—30 psig

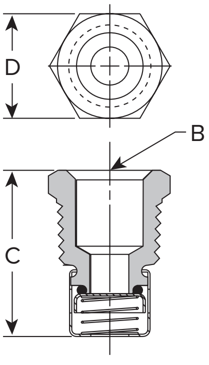


Options

Vacuum Breakers 3/8" (10 mm) and 1/2" (15 mm) NPT

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in condensing equipment under modulated control, vacuum breakers are recommended. Armstrong B and BI Series F&T traps are available with integral vacuum breakers. Maximum pressure is 150 psig (10 barg).



Vacuum Breakers

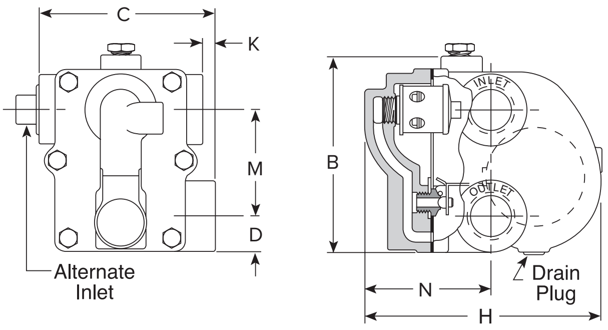
Size	in	mm	in	mm
	1/2 NPT	15 3/8	NPT	10
"B" Pipe Connections	3/8 NPT	10	1/4 NPT	6
"C" Height	1-1/4	32	1-3/32	28
"D" Width	7/8 Hex	22 Hex	11/16 Hex	17 Hex

Armstrong®

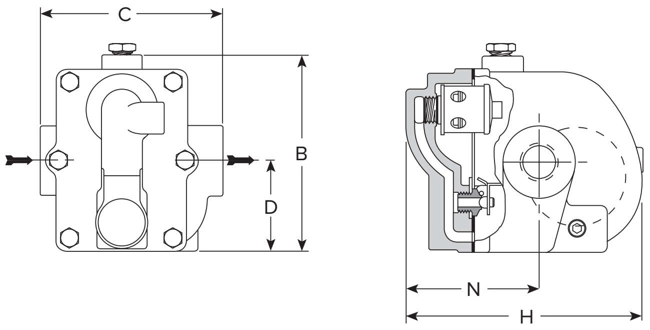
A & AI Series Float & Thermostatic Steam Trap

Cast Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures to 175 psig (12 barg)...Capacities to 8 600 lb/hr (3 900 kg/hr)



Model A Traps



Model AI Traps

Description

Armstrong A & AI Series F&T traps are for industrial service from 0 to 175 psig and feature a balanced pressure phosphor-bronze type bellows caged in stainless steel. Armstrong A & AI Series F&T traps are designed for service on heat exchange equipment where there is a need to vent air and non-condensable gases quickly.

The **AI Series F&T** traps feature the convenience of in-line connections with the same rugged internals found in the A Series.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):
175 psig @ 377°F (12 barg @ 191°C)

Maximum operating pressure:

Model 30-A, AI:	30 psig (2 barg) saturated steam
Model 75-A, AI:	75 psig (5 barg) saturated steam
Model 125-A, AI:	125 psig (8.5 barg) saturated steam
Model 175-A, AI:	175 psig (12 barg) saturated steam

NOTE: Cast iron traps should not be used in systems where excessive hydraulic or thermal shock are present.

Connections

Screwed NPT and BSPT

Materials

Body and cap:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve:	Stainless steel—17-4PH
Seat:	Stainless steel—303 (ASTM A582) Stainless steel—17-4PH in 1-1/2" and 2"
Thermostatic air vent:	Stainless steel and bronze with phosphor bronze bellows, caged in stainless steel

Options

Integral vacuum breaker. Add suffix VB to model number.

CAUTION: Do not use a conventional vacuum breaker open to the atmosphere in any system that incorporates a mechanical return system that carries pressure less than atmospheric pressure. This includes all return systems designated as vacuum returns, variable vacuum returns or subatmospheric returns. If a vacuum breaker must be installed in such a system, it should be of the type that is loaded to open only when the vacuum reaches a calibrated level well in excess of the design characteristics of the system.

Specification

Float and thermostatic steam trap, type ... in cast iron, with thermostatic air vent.

How to Order

Pressure	Model	Connection Size	Option
75	AI	2	VB
30 75 125 175	A = Standard Connection	3 = 3/4" 4 = 1" 5 = 1-1/4" 6 = 1-1/2" 8 = 2"	VB = Vacuum Breaker
	AI = In-line Connection	2 = 1/2" 3 = 3/4" 4 = 1"	

A & AI Series Traps

Trap Series	Model A										Model AI	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	3/4	20	1	25	1-1/4	32	1-1/2	40	2	50	1/2, 3/4, 1	15, 20, 25
"B" (Height)	5-1/8	130	5-1/8	130	5-13/16	148	7-7/16	189	9-3/4	248	5-1/2	140
"C" (Face to Face)	4-7/8	124	4-7/8	124	4-5/8	117	5-3/4	146	7-5/8	194	5	127
"D" (Bottom to ℄)	1	25.4	1	25.4	1-7/32	31.0	1-13/32	35.7	1-11/16	42.9	2-9/16	65.1
"H" (Width)	6-7/16	164	6-7/8	164	8-1/8	206	8-7/16	214	11-5/8	295	6-1/2	165
"K" (Connection Offset)	3/8	95.2	3/8	95.2	—	—	—	—	—	—	—	—
"M" (℄ to ℄)	3	76.2	3	76.2	3	76.2	4-3/16	106	6	152	—	—
"N" (Top to ℄)	3-3/8	85.7	3-3/8	85.7	3-3/4	95.2	3-3/4	95.2	5	127	3-11/16	93.7
Weight lb (kg)	9-1/2 (4.3)		8-1/4 (3.7)		11 (5.0)		18-3/4 (8.5)		40 (18.1)		9-3/4 (4.4)	

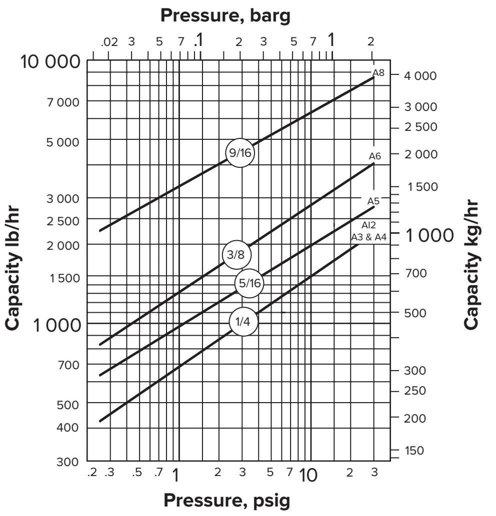
NOTE: Cast iron traps should not be used in systems where excessive hydraulic or thermal shock are present.

A & AI Series Float & Thermostatic Steam Trap

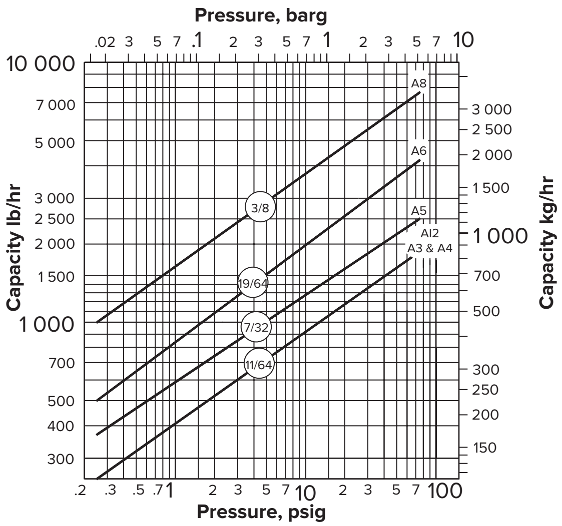
Cast Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures to 175 psig (12 barg)...Capacities to 8 600 lb/hr (3 900 kg/hr)

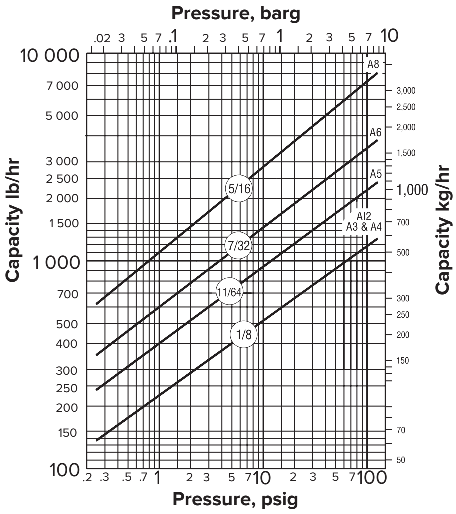
Model A & AI Series Capacity—30 psig



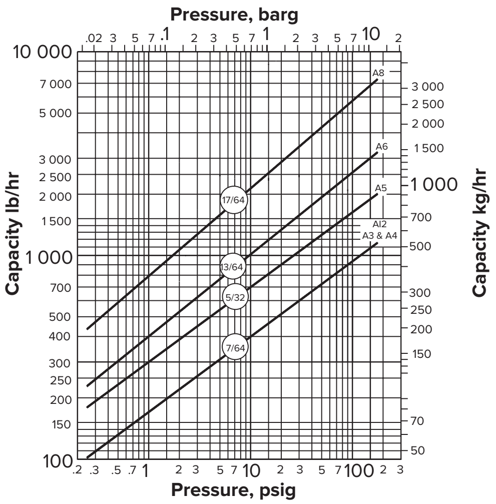
Model A & AI Series Capacity—75 psig



Model A & AI Series Capacity—125 psig



Model A & AI Series Capacity—175 psig

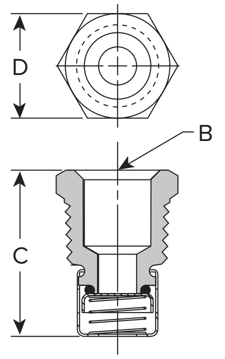


Options

Vacuum Breaker—3/8" (10 mm) and 1/2" (15 mm) NPT

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in condensing equipment under modulated control, vacuum breakers are recommended. Armstrong A and AI Series F&T Traps are available with integral vacuum breakers. Maximum service pressure is 150 psig (10 barg).



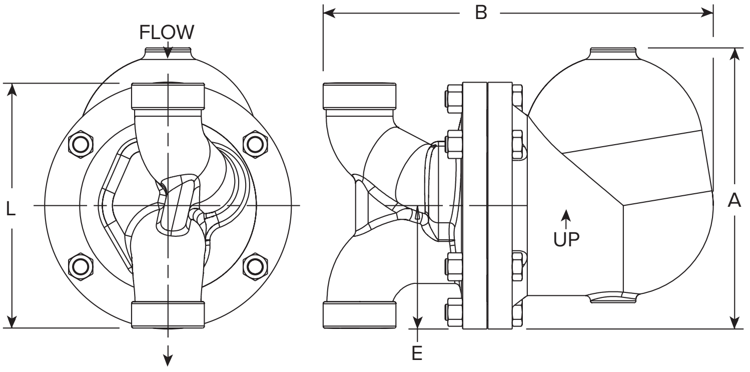
Vacuum Breaker

Size	in	mm	in	mm
	1/2 NPT	15	3/8 NPT	10
“B” Pipe Connections	3/8 NPT	10	1/4 NPT	6
“C” Height	1-1/4	32	1-3/32	28
“D” Width	7/8 Hex	22 Hex	11/16 Hex	17 Hex

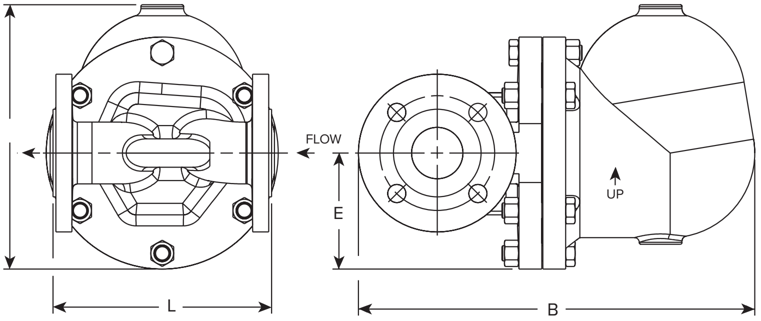
AIC Series Float & Thermostatic Steam Trap

Ductile Iron for Horizontal & Vertical Installation with Thermostatic Air Vent

For Pressures to 465 psig (32 barg)...Capacities to 60 075 lb/hr (27 250 kg/hr)



Model AICV



Model AICFH

Description

Armstrong AIC Series F&T traps are designed for industrial service up to 465 psig (32 barg). They feature all the benefits of Armstrong F&T traps, such as operation against back pressure, continuous drainage, high-capacity venting of air and CO_2, long life and dependable service and enjoys the convenience of in-line connections.

Armstrong AIC Series F&T traps are the perfect solution for applications where there is a need to vent air and non-condensable gases quickly under varying loads.

Maximum Operating Conditions

Maximum allowable pressure (vessel design)†:	580 psig @ 572°F 40 barg @ 300°C
Maximum Allowable Pressure:	580 psig (40 barg)
Maximum Allowable Temperature:	572°F (300°C)
Maximum Operating Pressure:	465 psig (32 barg)

† May be derated depending on flange rating and type.

Note: Caution should be used when Float and Thermostatic steam traps are applied in systems where freezing or excessive hydraulic shock can occur.

Connections

Screwed NPT and BSPT
Flanged ANSI and DIN

Materials

Body & Cap	Ductile Iron EN1563 EN-GJS-400-18U (ASTM A395)
Gasket	Graphite
Seat	Stainless Steel 17-4PH
Internals	Stainless Steel
Valve	Stainless Steel 17-4PH
Thermostatic Air Vent	Hastelloy Wafer

Options

Integral vacuum breaker (Maximum pressure is 150 psig (10 barg)). Add suffix VB to model number.

Flow Direction

Right to Left (Horizontal).
Top to Bottom (Vertical).

How to Order

Pressure	Model	Flow	Connection	Option
100	AIC	H	6	VB
100 200 465HP	AIC = Screwed Connection AICF = Flanged Connection	H = Horizontal V = Vertical	6 = 1-1/2" 8 = 2" 6 = DN40 8 = DN50	VB = Vacuum Breaker (limited to 150 psig/ 10 barg)

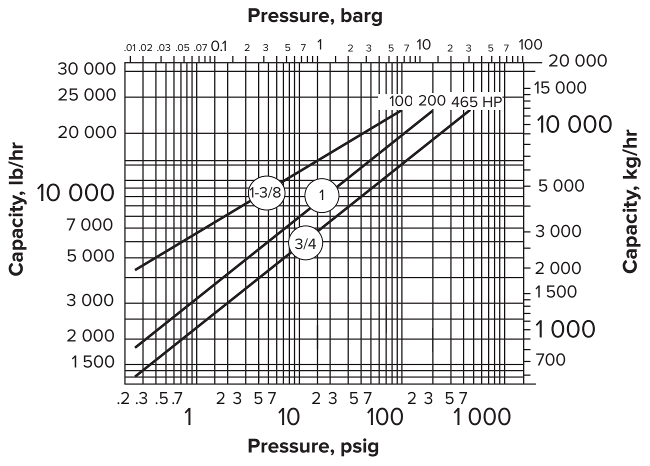
Available Connections and Face-To-Face Dimensions				
Pipe Connections	1 1/2" DN40		2" DN50	
	in	mm	in	mm
"A" Height	10-15/16	278	10-15/16	278
"B" (Length Screwed)	12-27/32	326	13-1/8	333
"B" (Length Flanged)	16-1/8	410	16-27/64	417
"L" (Face-to-face Screwed)	10-5/8	270	11-13/16	300
"L" (Face-to-face Flanged PN40 ANSI CL150)	9-1/16	230	9-1/16	230
"L" (Face-to-face Flanged ANSI CL300)	9-3/32	231	9-1/4	235
"E" (Bottom to ℄ of inlet)	4-13/16	122	4-13/16	122
Vacuum Breaker (optional)	1/2"	DN15	1/2"	DN15
Weight screwed lb (kg)	70-1/2 lb (32 kg)		70-1/2 lb (32 kg)	
Weight flanged lb (kg)	75 lb (34 kg)		75 lb (34 kg)	

AIC Series Float & Thermostatic Steam Trap

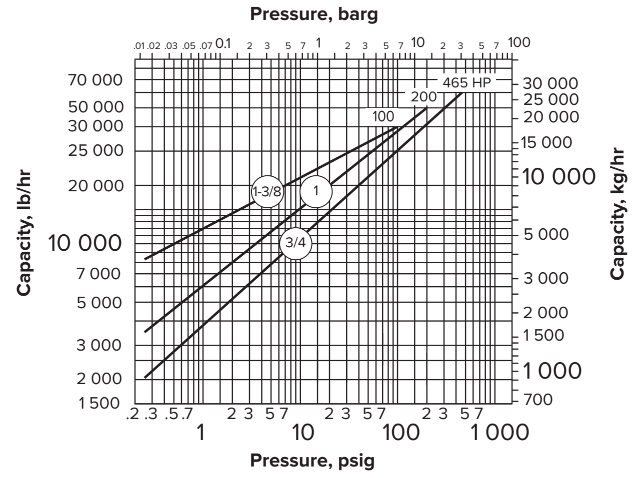
Ductile Iron for Horizontal & Vertical Installation with Thermostatic Air Vent

For Pressures to 465 psig (32 barg)...Capacities to 60 075 lb/hr (27 250 kg/hr)

Model AIC 1 1/2" Capacity



Model AIC 2" Capacity



Options

Vacuum Breaker 1/2" NPT (DN15)

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in condensing equipment under modulated control, vacuum breakers are recommended. Armstrong AIC Series F&T Traps are available with integral vacuum breakers. Maximum service pressure is 150 psig (10 barg).

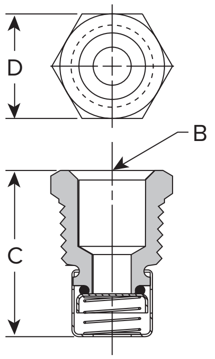
Vacuum Breaker

Size	in	mm	Max. allow. pres.
	1/2 NPT	DN15	150 psig (10 barg)
"B" Pipe Connections	3/8 NPT	DN10	
"C" Height	1-1/4	32	
"D" Width	7/8 Hex	22 Hex	

CAUTION: Do not use a conventional vacuum breaker open to the atmosphere in any system that incorporates a mechanical return system that carries pressure less than atmospheric pressure. This includes all return systems designated as vacuum returns, variable vacuum returns or subatmospheric returns. If a vacuum breaker must be installed in such a system, it should be of the type that is loaded to open only when the vacuum reaches a calibrated level well in excess of the design characteristics of the system.

Specification

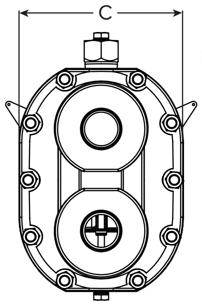
The steam trap shall be an Armstrong model AIC (AICF) float & thermostatic type. Cap and body shall be EN1563 EN-GJS-400-15U (ASTM A395) Ductile Iron. Inline connections shall be integral to the cap as well as the internal mechanism. The valve and seat mechanism and float shall be stainless steel and repairable without disturbing the piping. The thermostatic Air Vent shall be a balanced pressure Hastelloy wafer with chrome steel seat. Maximum allowable back pressure should be 99% of the inlet pressure.



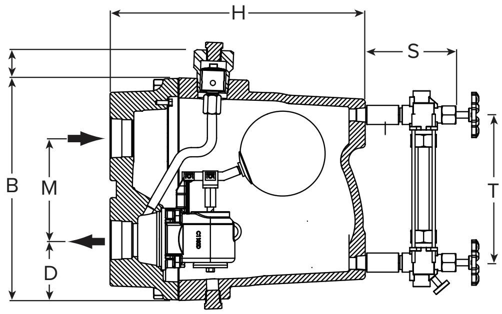
JD & KD Series Ultra-Capacity Float & Thermostatic Steam Trap

Ductile Iron for Horizontal Installation, With Thermostatic Air Vent

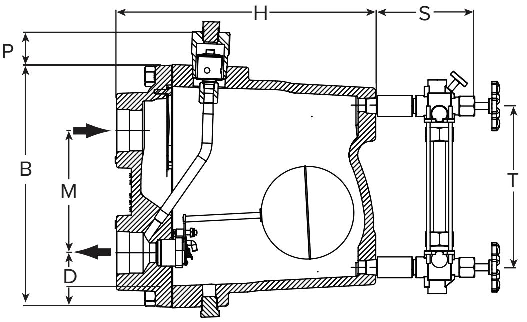
For Pressures to 300 psig (21 barg)...Capacities to 142 000 lb/hr (64 400 kg/hr)



Series JD & KD Cap



Series KD, F&T shown



Series JD, F&T shown

Description

The simple, yet rugged, ductile iron construction of the JD & KD Series Ultra-Capacity F&T steam traps offers long, trouble-free service. All floats, valves and seats, and lever mechanisms are constructed of stainless steel.

The integral thermostatic air vent is a balanced-pressure phosphor bronze bellows caged in stainless steel. It is designed especially for heavy-duty industrial applications where highly efficient, uninterrupted service is essential. This balanced-pressure-type air vent will respond to the pressure-temperature curve of steam at any pressure from zero to 300 psig (21 barg). Thus—up to 300 psig (21 barg)—air is vented at slightly below steam temperature.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model JD:	300 psig @ 650°F (21 barg @ 343°C)
Model KD:	300 psig @ 650°F (21 barg @ 343°C)

Maximum operating pressure:

Model 15-JD:	15 psig (1 barg) saturated steam
Model 20-JD:	20 psig (1.3 barg) saturated steam
Model 30-JD:	30 psig (2 barg) saturated steam
Model 75-JD:	75 psig (5.1 barg) saturated steam
Model 125-JD:	1 25 psig (8.6 barg) saturated steam
Model 175-JD:	175 psig (12 barg) saturated steam
Model 250-JD:	250 psig (17.2 barg) saturated steam
Model 300-JD:	300 psig (20.6 barg) saturated steam
Model 30-KD:	30 psig (2 barg) saturated steam
Model 50-KD:	50 psig (3.4 barg) saturated steam
Model 300-KD:	300 psig (20.6 barg) saturated steam

Maximum operating temperature bellows: 422°F (217°C)

Connections

Screwed NPT and BSPT
Flanged (screw on)

Materials

Body and cap:	ASTM A395 ductile iron
Internals:	All stainless steel
Valve(s) and seat(s):	Stainless steel
Drain plug:	Carbon steel
Thermostatic air vent:	Stainless steel and bronze with phosphor bronze bellows, caged in stainless steel

Options

- Integral vacuum breaker 150 psig (10 barg) maximum. Add suffix VB to model number
- No internal thermostatic air vent for liquid drainer service. Add suffix LD to model number
- Integral flash release for syphon drainage service. Add suffix CC to model number
- Flanged
- Armored gauge glass 310 psig @ 400°F (21 barg @ 204°C)

Specification

Float and thermostatic steam trap, type ... in ductile iron, with thermostatic air vent.

For a fully detailed certified drawing, refer to CD #1302.

How to Order

Pressure	Model	Connection Size	Option
75	**JD**	**8**	**VB**
15 20 30 75 125 175 250 300	JD	8 = 2"	VB = Vacuum Breaker LD = Liquid Drainer CC = Condensate Controller FLG = Specify type and class of flange GG = Gauge Glass
30	KD	8 = 2"	
50	KD	10 = 2-1/2"	
300	KD	10 = 2-1/2", 12 = 3"	

Special Configurations

Condensate controller with flash release for syphon drainage. The condensate controller (CC) configuration was developed especially to meet very large capacity needs in applications where condensate must be lifted from the drain point to the trap. Under such conditions—often referred to as syphon drainage—the reduction in pressure that occurs when the condensate is elevated causes a portion of the condensate to flash into steam. Ordinary traps, unable to differentiate between flash steam and live steam, close and impede drainage.

The JD & KD Series condensate controllers (CC) are equipped with a fixed, restricted orifice near the top of the body to bleed off the flash steam (and all air present). This permits the trap to function properly on flashing condensate.

Liquid drainer with back vent for exceptionally high-capacity drainage of liquid from gas under pressure. The liquid drainer (LD) configuration was developed to meet very large capacity needs in draining water and other liquids from air or other gases under pressure. To prevent air or gas binding, the access port in the top of the body serves as a back vent connection to the equipment being drained. For capacity data, consult Armstrong International or your Armstrong Representative.

JD and KD Series Traps

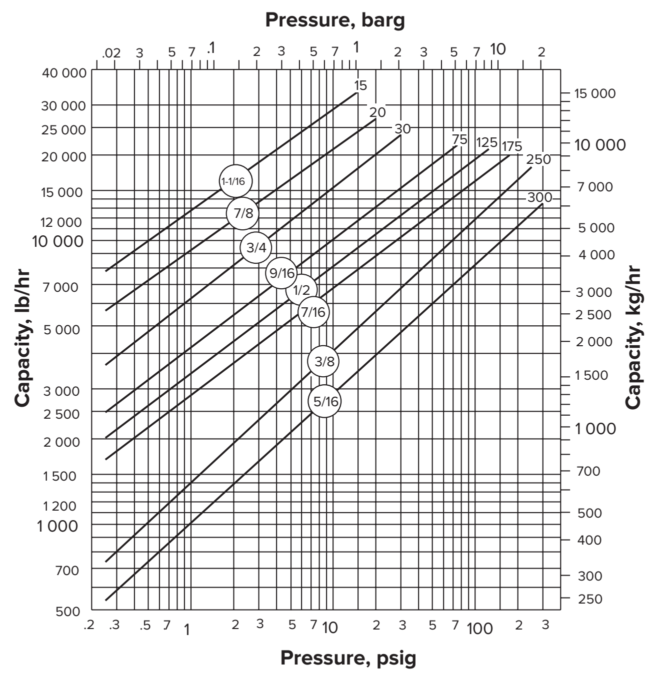
Trap Series	JD		KD	
Pipe Connection	in	mm	in	mm
	2	50	2, 2-1/2, 3	50, 65, 80
"B" (Height)	13-1/16	332	13-1/16	332
"C" (Width)	9-11/16	246	9-11/16	246
"D" (Bottom to ℄)	2-15/16	75	3-9/16	90
"H" (Length)	13-11/16	348	14-11/16	373
"M" (℄ to ℄)	6-5/8	168	6	152
"P" (Trap Top to Bellows Cap Top)	1-13/16	46	1-13/16	46
"S" (Gauge Glass width)	4-1/2	114	4-1/2	114
"T" (Gauge Glass height)	8-3/4	222	8-3/4	222
Weight lb (kg)	80 (39)		100 (45)	

JD & KD Series Ultra-Capacity Float & Thermostatic Steam Trap

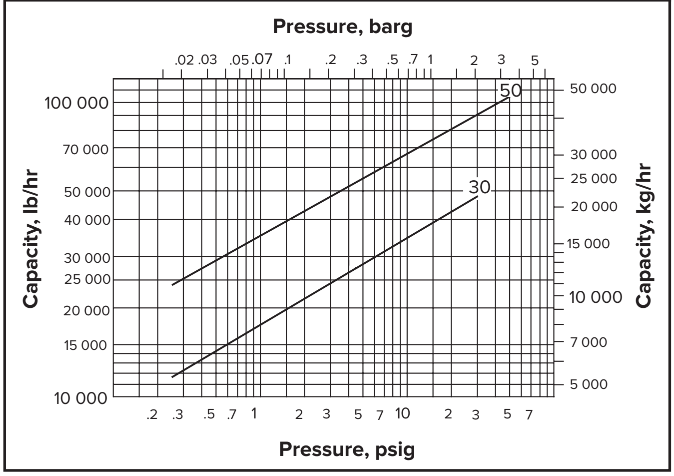
Ductile Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures to 300 psig (21 barg)...Capacities to 142 000 lb/hr (64 400 kg/hr)

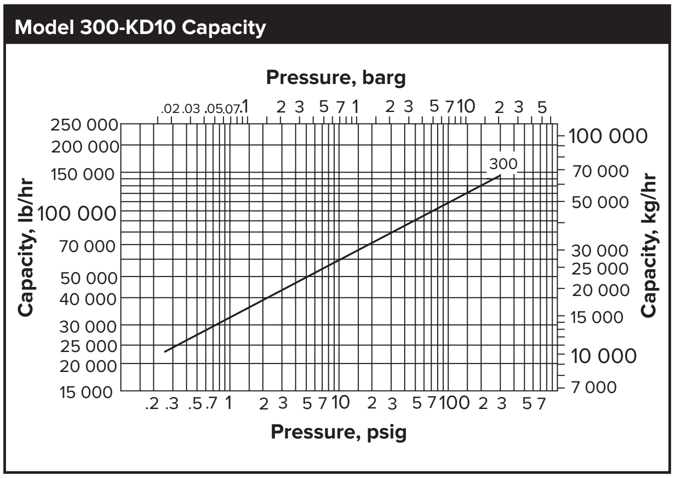
Model JD Series Capacity



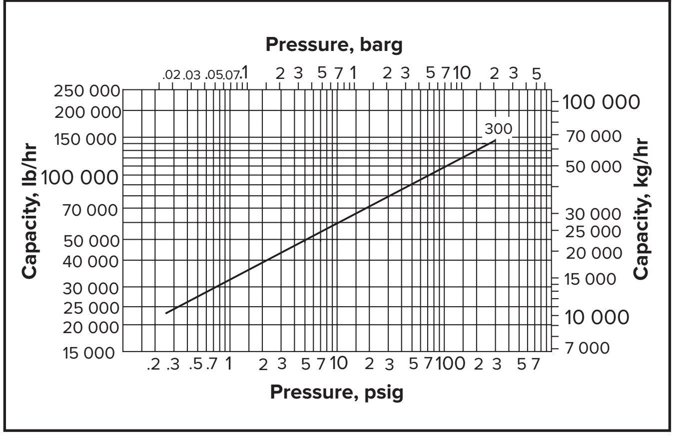
Model 30-KD8/50-KD10 Capacity



Model 300-KD10 Capacity



Model 300-KD12 Capacity



Options

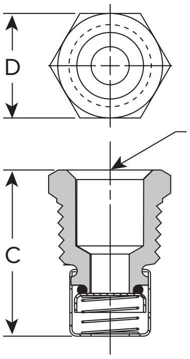
Vacuum Breaker—1/2" (15 mm) NPT

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in heating coils under modulated control, for example, vacuum breakers are recommended in conjunction with freeze protection devices.

Vacuum Breaker

Size	in	mm	Max. allow. pres.
	1/2 NPT	15	150 psig (10 barg)
"B" Pipe Connections	3/8 NPT	10	
"C" Height	1-1/4	32	
"D" Width	7/8 Hex	22 Hex	

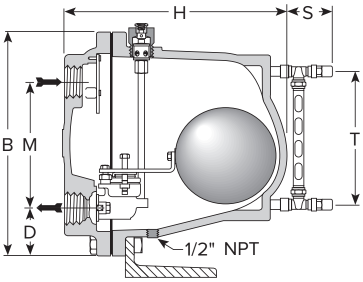


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

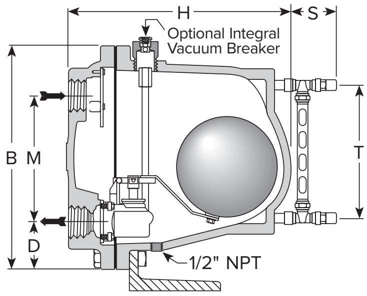
L & M Series Ultra-Capacity Float & Thermostatic Steam Trap

Cast Iron for Horizontal Installation, With Thermostatic Air Vent

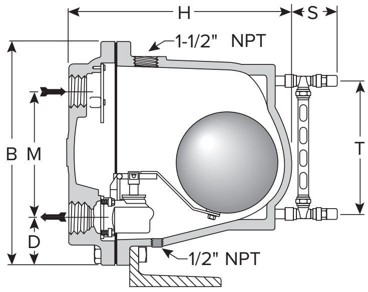
For Pressures to 250 psig (17 barg)...Capacities to 208 000 lb/hr (94 348 kg/hr)



Series L, F&T shown



Series M, CC shown



Series M, LD shown

Description

The simple yet rugged cast iron construction of the L & M Series Ultra-Capacity F&T steam traps offers long, trouble-free service. All floats, valves and seats, and lever mechanisms are constructed of stainless steel.

The integral thermostatic air vent is a balanced-pressure phosphor bronze bellows caged in stainless steel. It is designed especially for heavy-duty industrial applications where highly efficient, uninterrupted service is essential. This balanced pressure type air vent will respond to the pressure-temperature curve of steam at any pressure from zero to 250 psig (17 barg). Thus—up to 250 psig (17 barg)—air is vented at slightly below steam temperature.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model L:	250 psig @ 450°F (17 barg @ 232°C)
Model M:	250 psig @ 450°F (17 barg @ 232°C)

Maximum operating pressure:

Model 30-L:	30 psig (2 barg) saturated steam
Model 100-L:	100 psig (7 barg) saturated steam
Model 150-L:	150 psig (10 barg) saturated steam
Model 250-L:	250 psig (17 barg) saturated steam
Model 250-M:	250 psig (17 barg) saturated steam

Maximum operating temperature bellows: 422°F (217°C)

Connections

Screwed NPT and BSPT
Flanged (screw on)

Materials

Body and cap:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve(s) and seat(s):	Stainless steel
Drain plug:	Carbon steel
Thermostatic air vent:	Stainless steel and bronze with phosphor bronze bellows, caged in stainless steel

Options

- Integral vacuum breaker 150 psig (10 barg) maximum. Add suffix VB to model number
- No internal thermostatic air vent for liquid drainer service. Add suffix LD to model number
- Integral flash release for syphon drainage service. Add suffix CC to model number
- Armored gauge glass 310 psig @ 400°F (21 barg @ 204°C)
- L and M Series available with floor mounting bracket. Consult factory.

Specification

Float & thermostatic steam trap, type ... in cast iron, with thermostatic air vent.

For a fully detailed certified drawing, refer to CD #1010.

How to Order

Pressure	Model	Connection Size	Option
250	**M**	**12**	**GG**
30 100 150 250	L	8 = 2" 10 = 2-1/2"	VB = Vacuum Breaker LD = Liquid Drainer CC = Condensate Controller G/G = Gauge Glass FLG = Specify type and class of flange
250	M	12 = 3"	

Special Configurations

Condensate controller with flash release for syphon drainage and/or cascade service. The condensate controller (CC) configuration was developed especially to meet very large capacity needs in applications where condensate must be lifted from the drain point to the trap. Under such conditions—often referred to as syphon drainage—the reduction in pressure that occurs when condensate is elevated causes a portion of the condensate to flash into steam. Ordinary traps, unable to differentiate between flash steam and live steam, close and impede drainage.

The L & M Series condensate controllers (CC) are equipped with a fixed, restricted orifice near the top of the body to bleed off the flash steam (and all air present). This permits the trap to function properly on condensate.

Liquid drainer with back vent for exceptionally high capacity drainage of liquid from gas under pressure. The liquid drainer (LD) configuration was developed to meet very large capacity needs in draining water and other liquids from air or other gases under pressure. To prevent air or gas binding, the access port in the top of the body serves as a back vent connection to the equipment being drained. For capacity data, see pages 501 and 520 or consult your Armstrong Representative.

L and M Series Traps

Trap Series	L	M	L	M
Pipe Connection	in		mm	
	2, 2-1/2	3	50, 65	80
"B" (Height)	20-1/4		514	
"C" (Width)	14-3/4		375	
"D"(Bottom to ℄)	4-3/16		106	
"H" (Length)	19-3/4		502	
"M" (℄ to ℄)	11-5/16		287	
"S" (Gauge Glass Width)	3-3/4		95.2	
"T" (Gauge Glass Height)	12		305	
Weight lb (kg)	196 (88.9)			

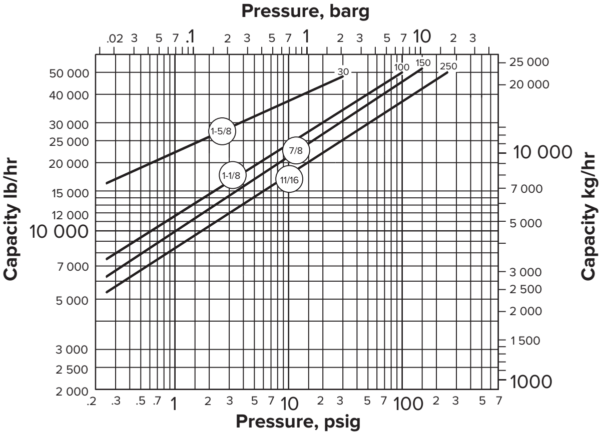
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

L & M Series Ultra-Capacity Float & Thermostatic Steam Trap

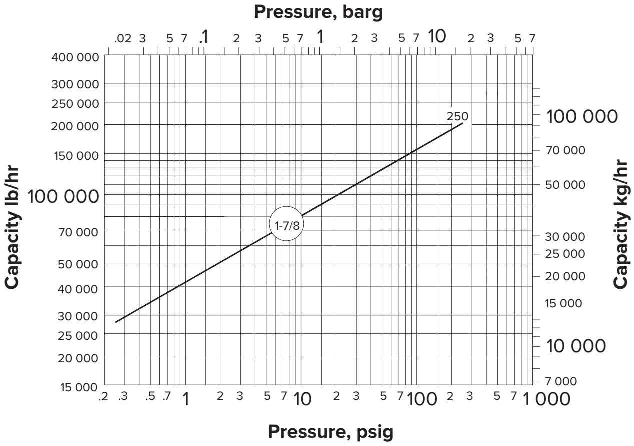
Cast Iron for Horizontal Installation, With Thermostatic Air Vent

For Pressures to 250 psig (17 barg)...Capacities to 208 000 lb/hr (94 348 kg/hr)

Model L Series Capacity



Model M Series Capacity



Installation Notes

Under conditions where the load may approach the maximum capacity of the trap, it is recommended that the size of the discharge line be increased one size as close to the trap cap as is practical. When L and M Series units are used in severe service conditions or at pressures exceeding 30 psig, use an anchoring bracket or other supportive measures to minimize stress on piping.

Ultra-Capacity L and M Series units MUST BE WARMED UP in the proper sequence and gradually. Recommended warm-up rate—not to exceed 100°F/8 minutes.

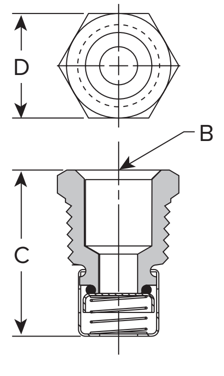
See your Armstrong Representative.

Vacuum Breaker—1/2" (15 mm) NPT
Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in heating coils under modulated control, for example, vacuum breakers are recommended in conjunction with freeze protection devices.

Vacuum Breaker

Size	in	mm	Max. allow. pres.
	1/2 NPT	15	150 psig (10 barg)
"B" Pipe Connections	3/8 NPT	10	
"C" Height	1-1/4	32	
"D" Width	7/8 Hex	22 Hex	



FT-4000 Series Float and Thermostatic Steam Trap

All Stainless Steel

For Pressures to 465 psig (32 barg)... Capacities to 1 080 lb/hr (490 kg/hr)

Description

With the FT-4000 Series, you can install a float and thermostatic trap in any piping configuration with little or no repiping. You get the reliability of the float and thermostatic operating principle, plus all the benefits of all-stainless steel construction.

- A sealed, tamperproof package
- A compact, lightweight trap
- Exceptional corrosion resistance
- A one-year guarantee against defective materials and workmanship

FT-4000 Series Float & Thermostatic steam traps combine savings in three important areas: energy, installation and replacement. Mounting the FT-4000 on universal connectors with integral strainers provides quick, easy in-line replacement with added protection from dirt and scale.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):
485 psig @ 600°F (33 barg @ 315°C)

Maximum operating pressure:

Model FT-4075:	75 psig (5 barg) saturated steam
Model FT-4150:	150 psig (10 barg) saturated steam
Model FT-4225:	225 psig (16 barg) saturated steam
Model FT-4300:	300 psig (21 barg) saturated steam
Model FT-4465:	465 psig (32 barg) saturated steam

Materials

Body:	ASTM A240 Grade 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel
Thermostatic air vent:	Wafer type-stainless steel with Hastelloy element
Flange	ASTM A105 Zinc plated

TVS 4000 Trap Valve Station With FT-4000 Float and Thermostatic Trap

Specification

Steam trap shall be float and thermostatic type having stainless steel construction, stainless steel valve, seat and float, for use on an IS-2 connector with integral strainer or TVS 4000 trap valve station. Integral thermostatic element shall be wafer type constructed of Hastelloy and stainless steel. Thermostatic element shall be capable of withstanding 45°F (25°C) of superheat and be resistant to water hammer damage.

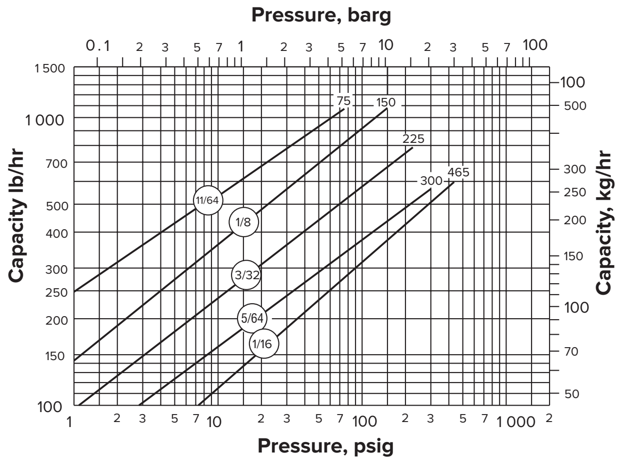
How to order

- Specify model number
- Select 360° connector style (IS-2 or TVS 4000)
- Specify maximum working pressure that will be encountered or orifice size
- Specify any options required

For a fully detailed certified drawing, refer to CD #1298 and CD #1299.

IS-2 Connector With FT-4000 Float and Thermostatic Trap

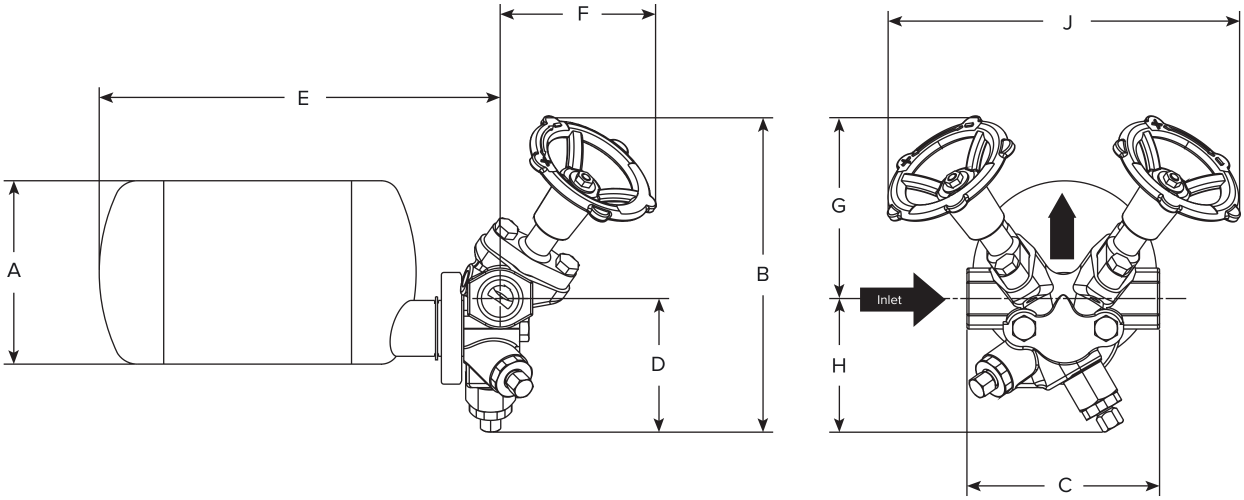
Model FT-4000 Series Capacity



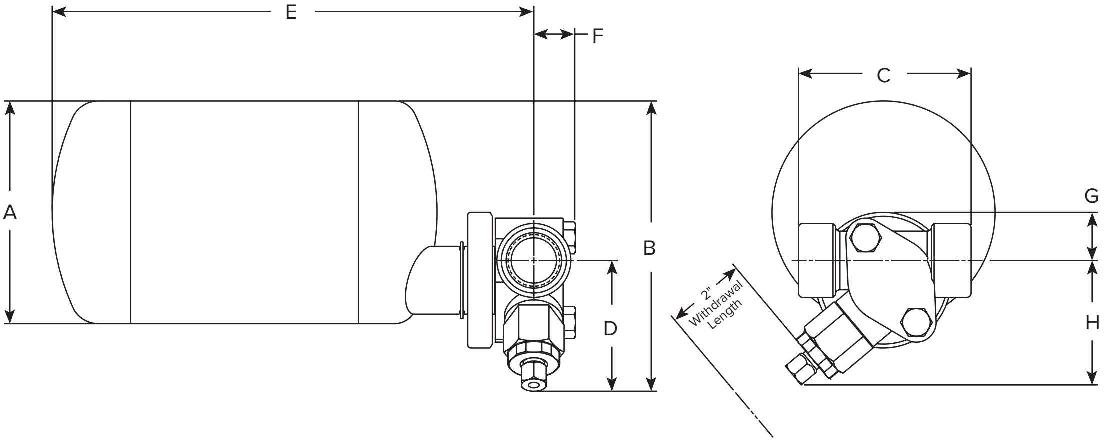
FT-4000 Series Float and Thermostatic Steam Trap

All Stainless Steel

For Pressures to 465 psig (32 barg)... Capacities to 1 080 lb/hr (490 kg/hr)



Series FT-4000 With TVS 4000 Trap Valve Station



Series FT-4000 With IS-2 Connector With Integral Strainer and Optional Blowdown Valve

FT-4000 Series Float and Thermostatic Steam Trap

Trap Series	FT-4000					
Model	IS-2 Connector With Integral Strainer				TVS 4000 Connector	
	in	mm	in	mm	in	mm
Pipe Connections	**1/2, 3/4**	**15, 20**	**1**	**25**	**1/2, 3/4**	**15, 20**
"A" Trap Diameter	4-1/2	114	4-1/2	114	4-1/2	114
"B" Total Height	5-7/8	149	5-7/8	149	7-7/8	198
"C" Face-to-Face	3-1/2	89	4	101	4-3/4	120
"D" Connection ℄ to Bottom	2-5/8	67	2-5/8	67	3-1/4	83
"E" Connection ℄ to Outside of Trap	10	255	10-1/4	259	9-7/8	250
"F" Connection ℄ to Front of Connector	7/8	22	7/8	22	3-7/8	98
"G" Connection ℄ to Top	1	25	1	25	4-1/2	114
"H" Connection ℄ to Bottom of Connector	2-1/2	64	2-1/2	64	3-1/4	83
"J" Width across Handwheels (valve open)	N/A				8-11/16	221
Test Port Connection	N/A				1/4 NPT	6
Maximum Operating Pressure (saturated steam)	465 psig (32 barg)					
Maximum Allowable Pressure (vessel design)	485 psig @ 600°F (33 barg @ 315°C)					
Trap Only Weight, lb (kg)	6-1/4 (2.8)					
Trap and Connector Weight, lb (kg)	8-3/4 (4)				12-3/4 (5.8)	

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

FF-4000 Series Float and Thermostatic Steam Trap with freely floating ball

All Stainless Steel

For Pressures to 250 psig (17 barg)... Capacities to 1 050 lb/hr (476 kg/hr)

Description

With the FF-4000 Series' 360° universal connector, you can install the float and thermostatic trap to fit any piping configuration. You get the reliability of the freely floating ball and thermostatic design plus all the benefits of all-stainless steel construction.

- A sealed, tamperproof package
- A compact, lightweight trap
- Exceptional corrosion resistance
- A three-year guarantee against defective materials and workmanship

FF-4000 Series Float and Thermostatic steam traps combine savings in three important areas: energy, installation and replacement. Mounting the FF-4000 on universal connectors provide quick and easy in-line replacement.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model FF-4250	270 psig @ 650°F (20.7 barg @ 343°C)
Model FF-4450	600 psig @ 800°F (41.4 barg @ 427°C)

Maximum operating pressure:

Model FF-4250	250 psig @ 650°F (17 barg @ 343°C)
Model FF-4450	450 psig @ 800°F (31 barg @ 427°C)

Materials

Body:	ASTM A240 Grade 304L
Internals:	All stainless steel-304
Ball seat:	Stainless Steel
Float:	Stainless Steel
Air Vent:	Bimetal

360° Universal Connector Styles

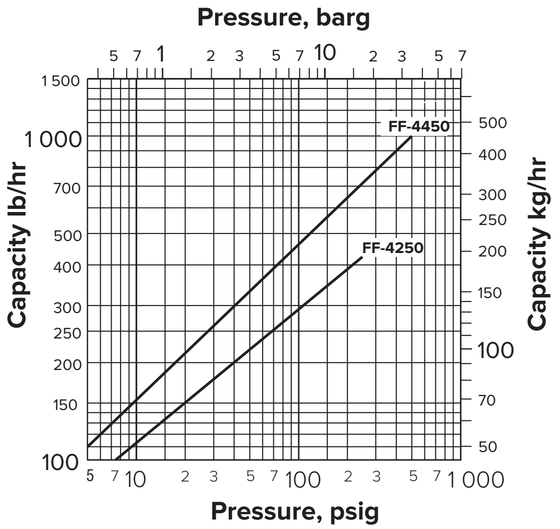
- Standard 2-bolt connector
- IS-2 connector with integral strainer and optional blowdown valve
- Trap Valve Station

How to order

- Specify model number
- Size and type of pipe connection, style of 360° universal connector.

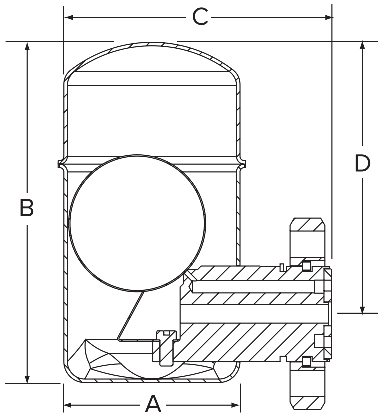
FF-4250 with TVS-4000

FF-4000 Series Capacities



FF-4000 Series

Model No.	FF-4250		FF-4450	
Pipe Connection	1/2, 3/4	15, 20	1/2, 3/4	15, 20
	in	mm	in	mm
"A" Diameter	2-11/16	68	3-7/8	98
"B" Height	4-7/8	124	6-3/16	157
"C" Outside to Flange"D"	3-7/8	98	4-15/16	125
"D" C Flange to Top	4	102	4-15/16	125
Trap Only Weight, lb (kg)	2 (0.9)		4 (1.8)	



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Notes

ICS Series Float & Thermostatic Steam Traps

Carbon Steel for Horizontal or Vertical Installation, With Thermostatic Air Vent

For Pressures to 465 psig (32 barg)... Capacities to 60 000 lb/hr (27 215 kg/hr)

Description

Armstrong ICS Series F&T traps are for industrial service from 0 to 465 psig (32 barg). The simple yet rugged construction of the ICS series carbon steel float and thermostatic trap is designed to assure long, trouble-free service.

Materials

Body:	ASTM A352 LCB
Internals:	All stainless steel
Valve(s) and Seat(s):	Stainless Steel
Thermostatic Air Vent:	Wafer type stainless steel with Hastelloy element

Connections

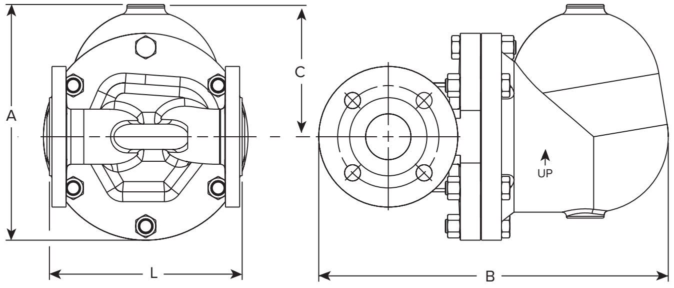
Flanged	ASME B16.5 Class 150 - 300
Socketweld	
NPT	

Options

Integral vacuum breaker. Add suffix VB to model number.
Condensate controller. Add suffix CC to model number.

Flow	in	mm	Flow Direction
Horizontal	1/2, 3/4, 1	15, 20, 25	Left-to-Right
Horizontal	1-1/2, 2	40, 50	Right-to-Left
Vertical	All	All	Down

Note: For vertical applications and dimensions, please consult factory.



Face-to-Face Dimensions - NPT and Socketweld

Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/2	40	2	50
"A" Height	7-11/16	196	7-11/16	196	8-5/16	211	11-5/16	288	11-5/16	288
"B" Length	10-15/16	278	11	279	12-3/8	314	14-3/4	374	14-15/16	380
"C" Cap ℄ to Top	4-15/16	126	4-15/16	126	5-3/16	131	6-9/16	166	6-9/16	166
"L" Face-to-Face	7-1/4	184	7	178	7-3/8	188	10-1/2	266	10-3/4	273
Weight lb (kg)	21 (10)		21 (10)		28 (13)		76 (35)		76 (35)	
Maximum Allowable Pressure (Vessel Design)	580 psig @ 650°F (40 barg @ 343°C)									
Maximum Operating Pressure	465 psig (32 barg)									

Face-to-Face Dimensions - ASME B 16.5 Class 150#

Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/2	40	2	50
"A" Height	7-11/16	196	7-11/16	196	8-5/16	211	11-5/16	288	11-5/16	288
"B" Length	11-7/8	301	12-1/16	306	13-9/16	344	15-11/16	399	16-3/16	412
"C" Cap ℄ to Top	4-15/16	126	4-15/16	126	5-3/16	131	6-9/16	166	6-9/16	166
"L" Face-to-Face	8	203	8-1/16	205	8-3/16	208	12-5/8	321	12-1/4	312
Weight lb (kg)	23 (11)		25 (11)		33 (15)		83 (38)		84 (38)	
Maximum Allowable Pressure (Vessel Design)	200 psig @ 400°F (13.6 barg @ 205°C)									
Maximum Operating Pressure	200 psig (13.6 barg)									

Face-to-Face Dimensions - ASME B 16.5 Class 300#

Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/2	40	2	50
"A" Height	7-11/16	196	7-11/16	196	8-5/16	211	11-5/16	288	11-5/16	288
"B" Length	11-15/16	304	12-5/16	314	13-13/16	352	16-5/16	414	16-1/2	419
"C" Cap ℄ to Top	4-15/16	126	4-15/16	126	5-3/16	131	6-9/16	166	6-9/16	166
"L" Face-to-Face	8-1/4	209	8-1/4	209	8-3/8	212	12-7/8	327	12-5/8	320
Weight lb (kg)	24 (11)		26 (12)		35 (16)		88 (40)		88(40)	
Maximum Allowable Pressure (Vessel Design)	585 psig @ 500°F (40.4 barg @ 260°C)									
Maximum Operating Pressure	465 psig (32 barg)									

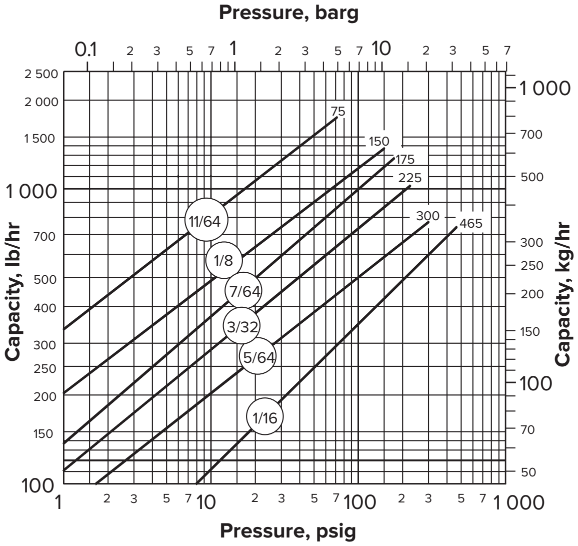
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

ICS Series Float & Thermostatic Steam Traps

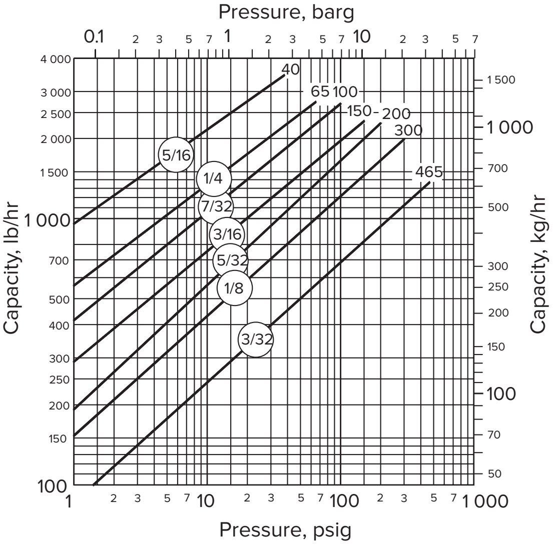
Carbon Steel for Horizontal or Vertical Installation, With Thermostatic Air Vent

For Pressures to 465 psig (32 barg)… Capacities to 60 000 lb/hr (27 215 kg/hr)

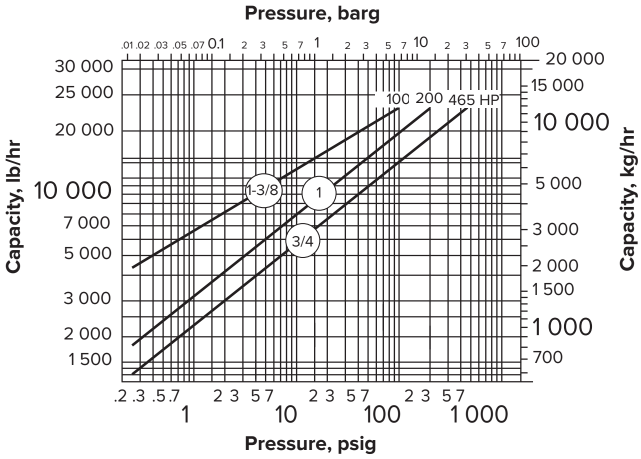
Model ICS Series Capacity 1/2" & 3/4"



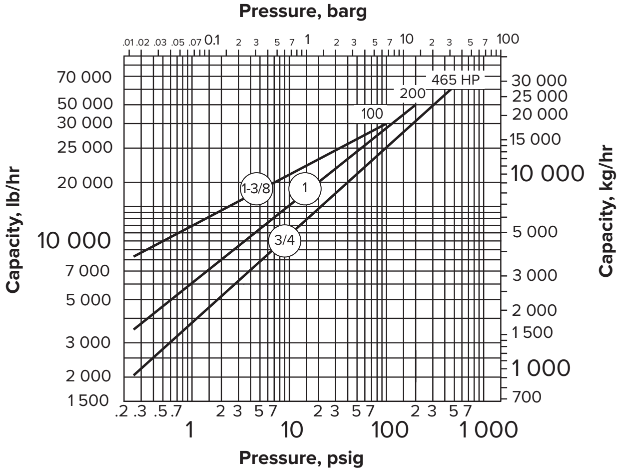
Model ICS Series Capacity 1"



Model ICS Series Capacity 1 1/2”

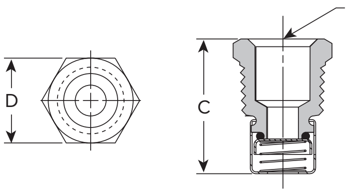


Model ICS Series Capacity 2”



Pressure	Model	Connection Size	Flow Direction	Connection Type
300	ICS	8	R**	NPT
(*)	ICS	2 = 1/2" 3 = 3/4" 4 = 1"	L= Left to Right V = Vertical	NPT SW 150RF 300RF
		6 = 1-1/2" 8 = 2"	R = Right to Left V = Vertical	

(*) Refer to capacity charts to determine orifice.
(**) Refer to previous page for flow information.



Options

Vacuum Breaker 1/2” NPT (DN15)

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in condensing equipment under modulated control, vacuum breakers are recommended. Armstrong ICS Series F&T Traps are available with integral vacuum breakers. Maximum service pressure is 150 psig (10 barg).

Vacuum Breaker

Size	in	mm	Max. allow. pres.
	1/2 NPT	DN15	150 psig at 366°F (10 barg at 184°C)
“B” Pipe Connections	3/8 NPT	DN10	
“C” Height	1-1/4	32	
“D” Width	7/8 Hex	22 Hex	

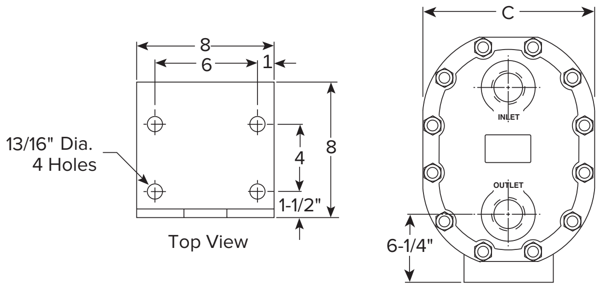
CAUTION: Do not use a conventional vacuum breaker open to the atmosphere in any system that incorporates a mechanical return system that carries pressure less than atmospheric pressure. This includes all return systems designated as vacuum returns, variable vacuum returns or subatmospheric returns. If a vacuum breaker must be installed in such a system, it should be of the type that is loaded to open only when the vacuum reaches a calibrated level well in excess of the design characteristics of the system.

Armstrong®

LS & MS Series Ultra-Capacity Float & Thermostatic Steam Trap

Cast Steel for Horizontal Installation, With Thermostatic Air Vent

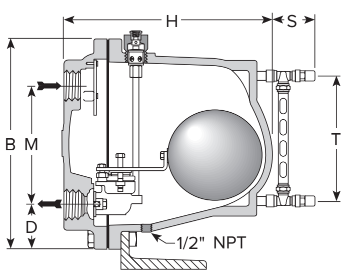
For Pressures to 450 psig (31 barg)...Capacities to 280 000 lb/hr (127 000 kg/hr)



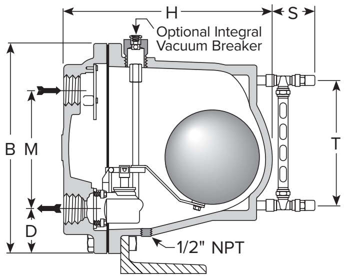
LS and MS Floor Mounting Bracket

LS & MS Series Traps		
Trap Series	LS & MS	
Pipe Connection	in	mm
	2, 2-1/2, 3*	50, 65, 80*
"B" (Height)	20	508
"C" (Width)	15-1/4	387
"D" (Bottom to ℄)	4-3/16	106
"H" (Length)	20-1/4	508
"M" (℄ to ℄)	11-5/16	287
"S" (Gauge Glass Width)	4-5/8	95.2
"T" (Gauge Glass Height)	12	305
Weight lb (kg)	290 (131.5)	

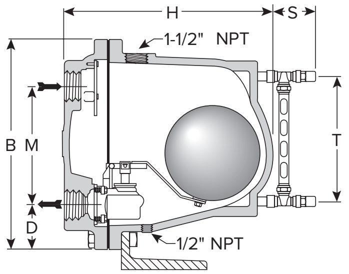
*MS Series 3" (80 mm) only.



Series LS, F&T shown



Series MS, CC shown



Series MS, LD shown

Description

The simple yet rugged cast steel construction of the LS & MS Series Ultra-Capacity F&T steam traps offers long, trouble-free service. All floats, valves and seats, and lever mechanisms are constructed of stainless steel.

The integral thermostatic air vent is a balanced-pressure phosphor bronze bellows caged in stainless steel. It is designed especially for heavy-duty industrial applications where highly efficient, uninterrupted service is essential. This balanced-pressure air vent will respond to the pressure-temperature curve of steam at any pressure from zero to 250 psig (17 barg). Thus—up to 250 psig (17 barg)—air is vented at slightly below steam temperature.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model LS:	450 psig @ 650°F (31 barg @ 343°C)
Model MS:	450 psig @ 650°F (31 barg @ 343°C)

Maximum operating pressure:

Model 30-LS:	30 psig (2 barg) saturated steam
Model 100-LS:	100 psig (7 barg) saturated steam
Model 150-LS:	150 psig (10 barg) saturated steam
Model 250-LS:	250 psig (17 barg) saturated steam
Model 250-MS:	250 psig (17 barg) saturated steam
Model 450-LS:	450 psig (31 barg) saturated steam
Model 450-MS:	450 psig (31 barg) saturated steam

Maximum operating temperature bellows: 422°F (217°C)
NOTE: For pressures above 250 psig (17 barg), the thermostatic vent should be removed and only a CC or LD version should be used.

Connections

- Screwed NPT and BSPT
- Socketweld
- Flanged (weld neck)

Materials

Body and cap:	ASTM A216 WCB
Internals:	All stainless steel—304
Valve(s) and seat(s):	Stainless steel
Drain plug:	Carbon steel
Thermostatic air vent:	Stainless steel and bronze with phosphor bronze bellows, caged in stainless steel

Options

- Integral vacuum breaker 150 psig (10 barg) maximum. Add suffix VB to model number.
- No internal thermostatic air vent for liquid drainer service. Add suffix LD to model number.
- Integral flash release for syphon drainage service. Add suffix CC to model number.
- Armored gauge glass 310 psig @ 400°F (21 barg @ 204°C)
- LS and MS Series available with floor mounting bracket. Consult factory.

Specification

Float and thermostatic steam trap, type ... in cast steel, with thermostatic air vent.

For a fully detailed certified drawing, refer to CD #1010.

How to Order

Pressure	Model	Connection Size	Option
100	LS	10	VB
30 100 150 250 450*	LS	8 = 2" 10 = 2-1/2"	VB = Vacuum Breaker LD = Liquid Drainer CC = Condensate Controller G/G = Gauge Glass FLG = Specify type and class of flange
250 450*	MS	12 = 3"	

* Orifice only available for CC and LD versions.

Special Configurations

Condensate controller with flash release for syphon drainage and/or cascade service. The condensate controller (CC) configuration was developed especially to meet very large capacity needs in applications where condensate must be lifted from the drain point to the trap. Under such conditions—often referred to as syphon drainage—the reduction in pressure that occurs when condensate is elevated causes a portion of the condensate to flash into steam. Ordinary traps, unable to differentiate between flash steam and live steam, close and impede drainage.

The LS & MS Series condensate controllers (CC) are equipped with a fixed, restricted orifice near the top of the body to bleed off the flash steam (and all air present). This permits the trap to function properly on condensate.

Liquid drainer with back vent for exceptionally high capacity drainage of liquid from gas under pressure. The liquid drainer (LD) configuration was developed to meet very large capacity needs in draining water and other liquids from air or other gases under pressure. To prevent air or gas binding, the access port in the top of the body serves as a back vent connection to the equipment being drained. For capacity data, see pages 501 and 520 or consult your Armstrong Representative.

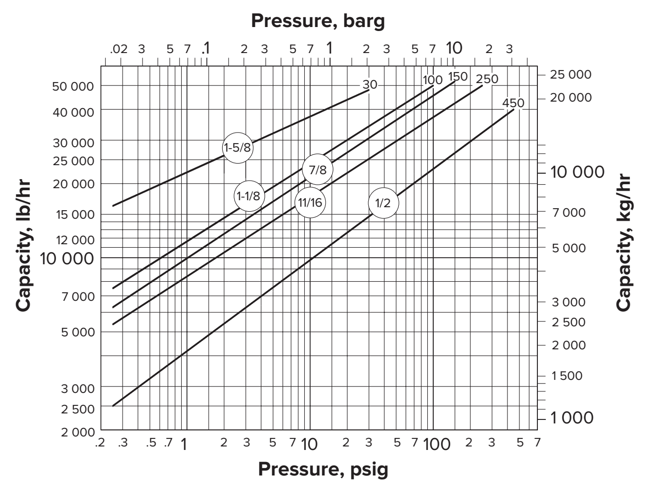
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

LS & MS Series Ultra-Capacity Float & Thermostatic Steam Trap

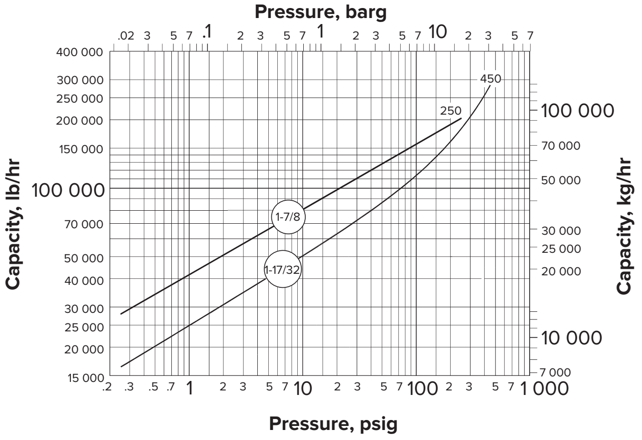
Cast Steel for Horizontal Installation, With Thermostatic Air Vent

For Pressures to 450 psig (31 barg)...Capacities to 280 000 lb/hr (127 000 kg/hr)

Model LS Series Capacity



Model MS Series Capacity



Installation Notes

Under conditions where the load may approach the maximum capacity of the trap, it is recommended that the size of the discharge line be increased one size as close to the trap cap as is practical.

When LS and MS Series units are used in severe service conditions or at pressures exceeding 30 psig, use an anchoring bracket or other supportive measures to minimize stress on piping.

Ultra-Capacity LS and MS Series units MUST BE WARMED UP in the proper sequence and gradually. Recommended warm-up rate not to exceed 100°F/8 minutes.

See your Armstrong Representative.

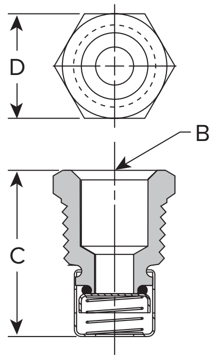
Vacuum Breaker—1/2" (15 mm) NPT

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in heating coils under modulated control, for example, vacuum breakers are recommended in conjunction with freeze protection devices.

Vacuum Breaker

Size	in	mm	Max. allow. pres.
	1/2 NPT	15	150 psig (10 barg)
“B” Pipe Connections	3/8 NPT	10	
“C” Height	1-1/4	32	
“D” Width	7/8 Hex	22 Hex	

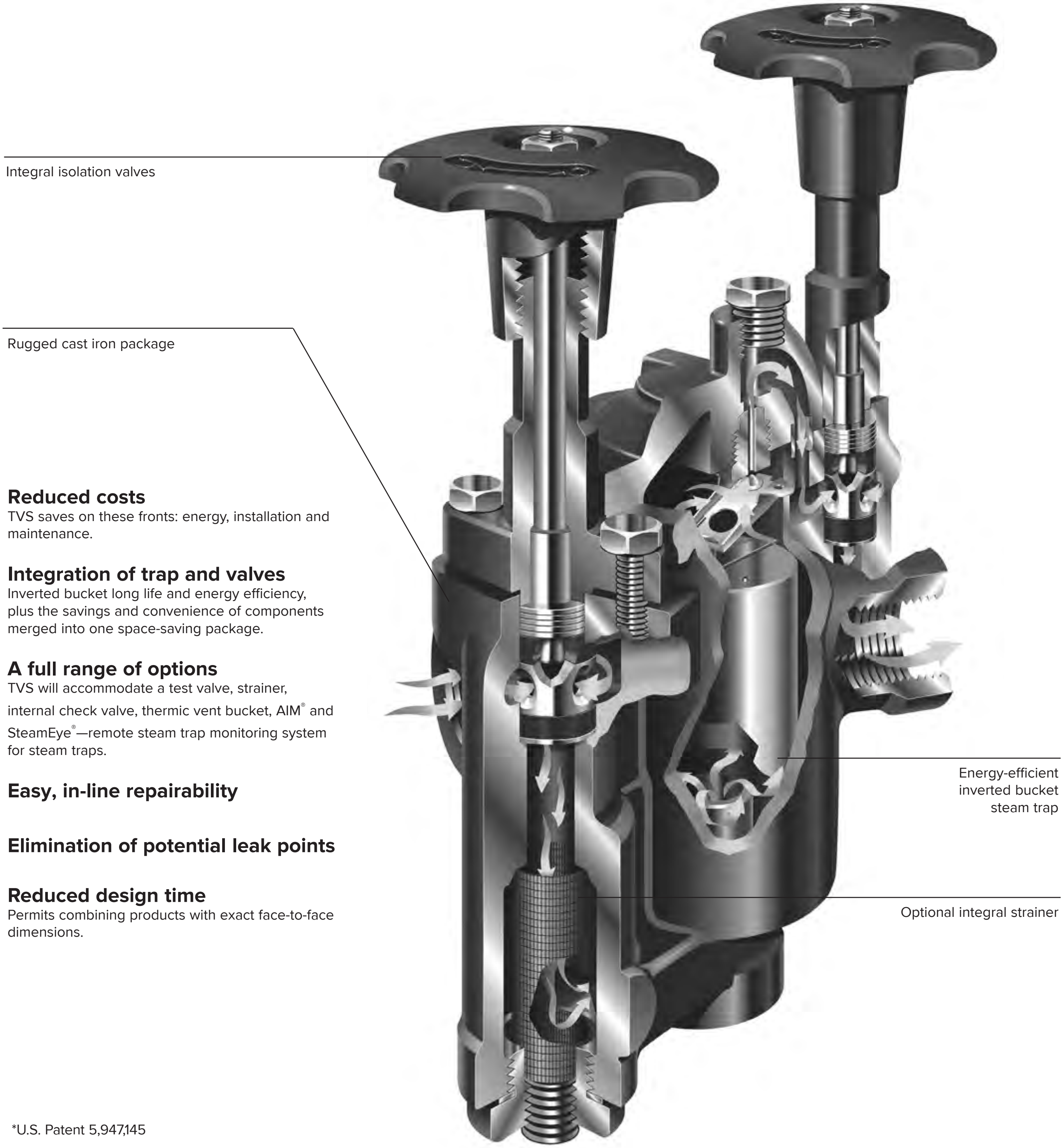


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong® TVS 800 Series Cast Iron Trap Valve Station

Put the principle of the inverted bucket to work in a tough cast iron package and you have the best of both worlds—energy efficiency and long-lasting reliability. Add the advantages of valves integrated into one compact trap/valve casting, and you extend the benefits into installation, trap testing and maintenance.

All the components are concentrated in a single, accessible package and can be dealt with in-line. And if you have existing Armstrong cast iron traps in-line, identical face-to-face dimensions will make retrofitting with the patented* Armstrong Trap Valve Station (TVS) a snap. You'll also reduce your inventory requirements. So you'll eliminate what you're paying just to keep parts on hand.



Reduced costs
TVS saves on these fronts: energy, installation and maintenance.

Integration of trap and valves
Inverted bucket long life and energy efficiency, plus the savings and convenience of components merged into one space-saving package.

A full range of options
TVS will accommodate a test valve, strainer, internal check valve, thermic vent bucket, AIM® and SteamEye®—remote steam trap monitoring system for steam traps.

Easy, in-line repairability

Elimination of potential leak points

Reduced design time
Permits combining products with exact face-to-face dimensions.

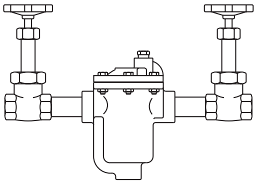
*U.S. Patent 5,947,145

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

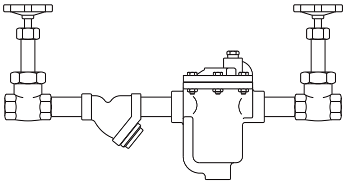
TVS 800 Series Cast Iron Trap Valve Station

TVS makes a long story...short.

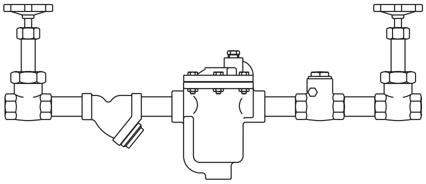
Typical Installation



Inverted bucket trap with two isolation valves



Inverted bucket trap with two isolation valves and strainer



Inverted bucket trap with two isolation valves, strainer and check valve

Trap Valve Station

The Innovation Is Integration

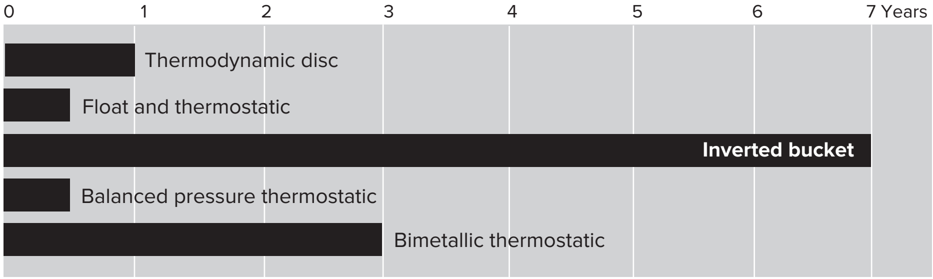
The Armstrong TVS makes what used to be long, complicated steam installation stories simple and compact. It shortens installations by integrating components—specifically an inverted bucket steam trap with two or more valves.

For example, here's an old description for a typical installation: valve-nipple-strainer-nipple-trap-nipple-valve. It's a long tale, even for this simple piping arrangement.

The Trap Valve Station rewrites this steam story: pipe-TVS-pipe. In other words, the TVS makes it all one, delivering the functions of multiple components in a dramatically smaller unit. It integrates two high-value products in a package of revolutionary versatility.

Look above to see how the Armstrong cast iron Trap Valve Station has rewritten these typical steam installations.

Average Service Life for Different Trap Types 200 psig (14 barg)

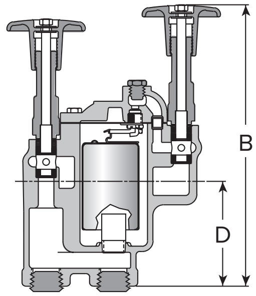


Above data from ICI Engineer January 1993 special issue with permission from ICI Engineering.

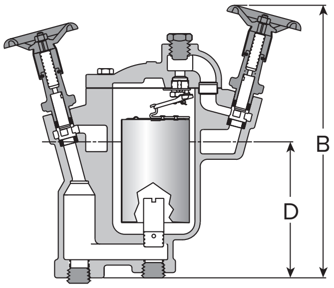
TVS 800 Series Trap Valve Station

Cast Iron for Horizontal Installation, With Integral Piston Valves

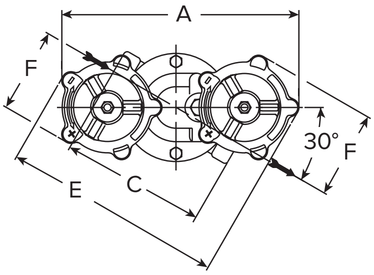
For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)



Model TVS 811



Series TVS 812/813



Series TVS 811/812/813 - Top View

Same principle. Different package. Now the energy-saving performance and reliability of the inverted bucket steam trap are available in a versatile new package.

You'll still enjoy all the familiar benefits. And the same efficient condensate drainage from virtually every kind of steam-using equipment. But what you'll find new are all the benefits of a piston valve integrated into the same space-saving package.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):	250 psig @ 450°F (17 barg @ 232°C)
Maximum operating pressure:	250 psig (17 barg)

Connections

Screwed NPT and BSPT

Materials

Cap and body:	ASTM A48 Class 30
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH
Handwheel:	Ductile iron
Internals:	Stainless steel
Valve sealing rings:	Graphite and stainless steel
Blowdown valve	Stainless steel

Options

- Stainless steel internal check valve
- Thermic vent bucket
- Stainless steel pop drain
- Integral strainer
- Scrub wire
- Probe connection
- Blowdown valve (TVS 811 and TVS 812 only)

Specification

Inverted bucket steam trap, type ... in cast iron, with continuous air venting at steam temperature, free-floating stainless steel mechanism, and discharge orifice at the top of the trap. Integral upstream and downstream shutoff piston style valves in same dimensional space as standard bucket trap.

How to Order

Specify:
- Model number
- Size and type of pipe connection
- Maximum working pressure that will be encountered or orifice size
- Any options required

For a fully detailed certified drawing, refer to:

TVS 811	**CD #1099**
TVS 812/813	**CD #1100**

TVS 800 Series Trap Valve Station

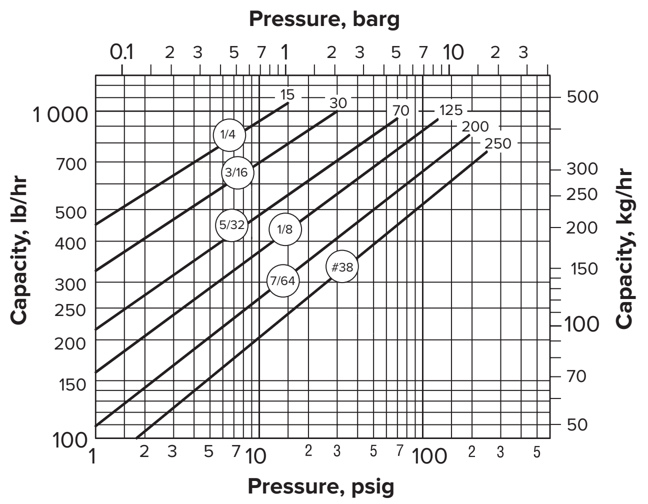
Model No.	TVS 811		TVS 812		TVS 813	
Pipe Connections	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1/2, 3/4	15, 20	3/4, 1	20, 25
Test Plug	1/4	6	1/2	15	3/4	20
"A" Width Across Handwheels	8-1/4	210	13-3/4	349	15-1/8	384
"B" Outlet Valve Open	10-1/4	260	11-3/4	298	14-1/4	362
"C" Face to Face	5	127	6-1/2	165	7-3/4	197
"D" Connection ℄ to Bottom	3-11/16	94	4-3/4	121	7-1/4	184
"E"	7-5/8	194	13	330	14-3/8	365
"F"	3	76	4-1/2	114	4-7/8	124
Number of Bolts	6	6	6	6	6	6
Weight lb (kg)	12 (5.4)		25 (11.3)		47 (24)	

TVS 800 Series Trap Valve Station

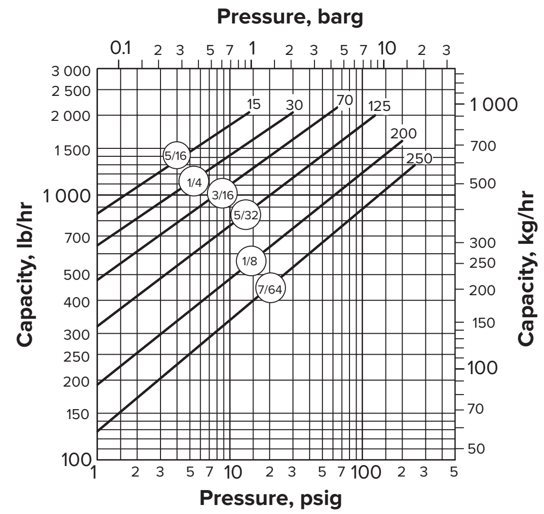
Cast Iron for Horizontal Installation, With Integral Piston Valves

For Pressures to 250 psig (17 barg)...Capacities to 4 400 lb/hr (2 000 kg/hr)

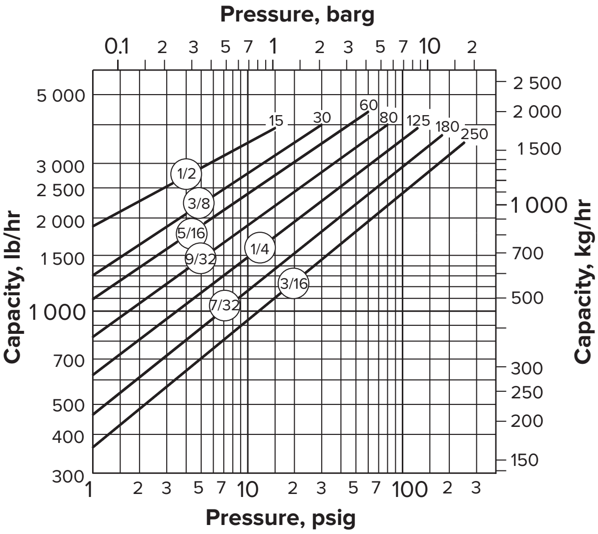
Model TVS 811 Capacity



Model TVS 812 Capacity



Model TVS 813 Capacity



Options

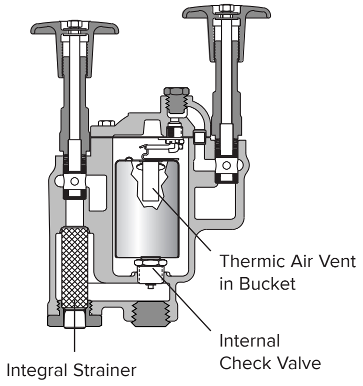
Internal Check Valves are spring-loaded stainless steel and screw directly into the trap inlet or into an extended inlet tube having a pipe coupling at the top to save fittings, labor and money.

Thermic Vent Buckets have a bimetal controlled auxiliary air vent for discharging large amounts of air on start-up.

Integral Strainer is made from 20 x 20 stainless steel screen.

Probe Connections are available for trap monitoring.

Blowdown Valve for clearing strainers of dirt and debris.

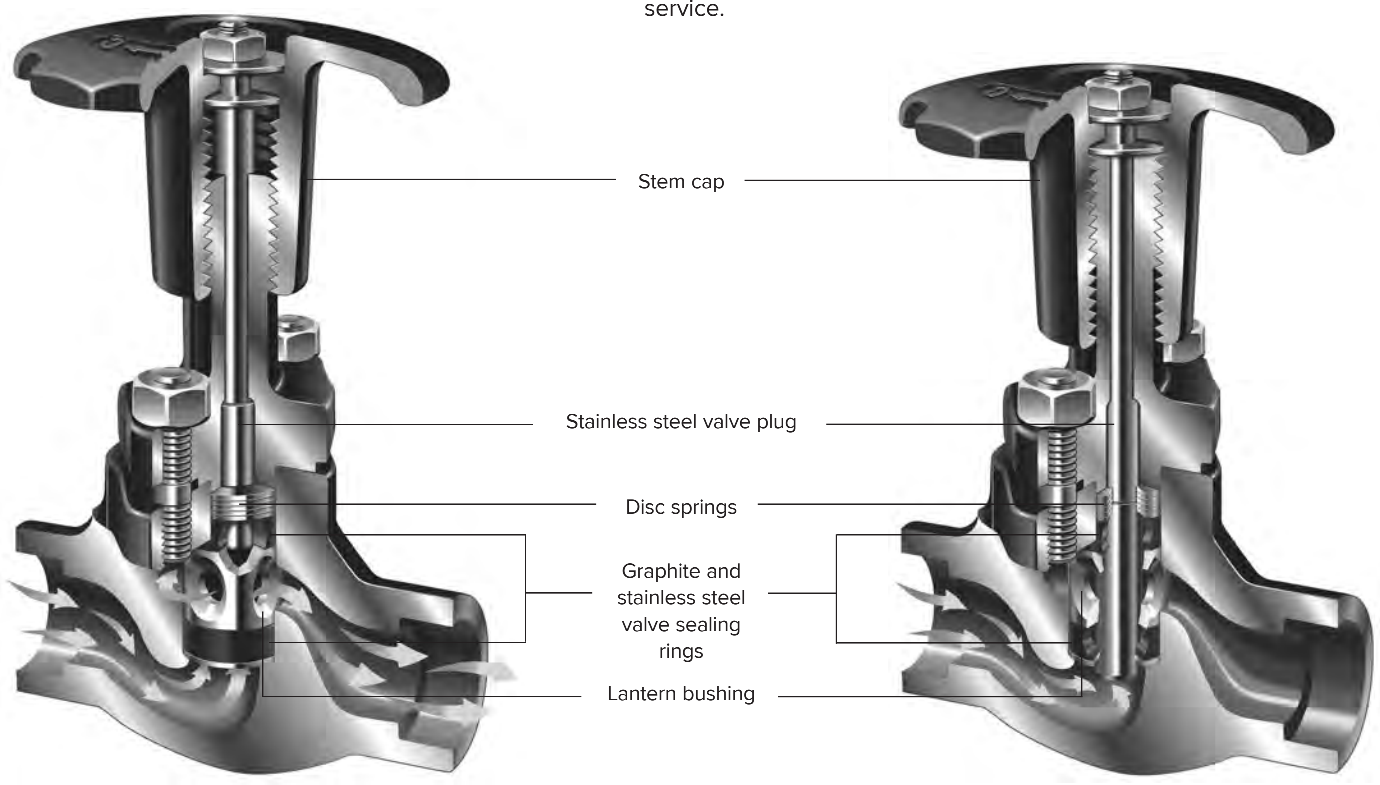


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

TVS 4000 Series Stainless Steel Trap Valve Station

The Piston Valve

Armstrong Steam Distribution Manifolds (MSD/SMSD) and TVS 4000 Trap Valve Stations incorporate advanced piston sealing technology for safer, longer lasting steam isolation service.



Open Position **Closed Position**

- **Dual sealing action.** The piston valve is a seatless valve that includes two graphite and stainless steel valve sealing rings that seal the stem and function as a seat. This combination provides long-term protection against leaks to the atmosphere and downstream piping.

- **Self-cleaning action.** Stainless steel piston slides without rotating between the two valve sealing rings, preventing dirt from damaging the surfaces.

- **Sealing integrity.** Flexible disc springs automatically provide leak tightness by exerting pressure, which keeps the upper and lower valve sealing rings compressed at all times. Sealing tightness is ensured by the compression of the sealing rings against the piston and valve body. This combination of disc springs and dual valve seal rings protects against expansion and contraction due to heating and cooling. This ensures dependable operation, even after years of service.

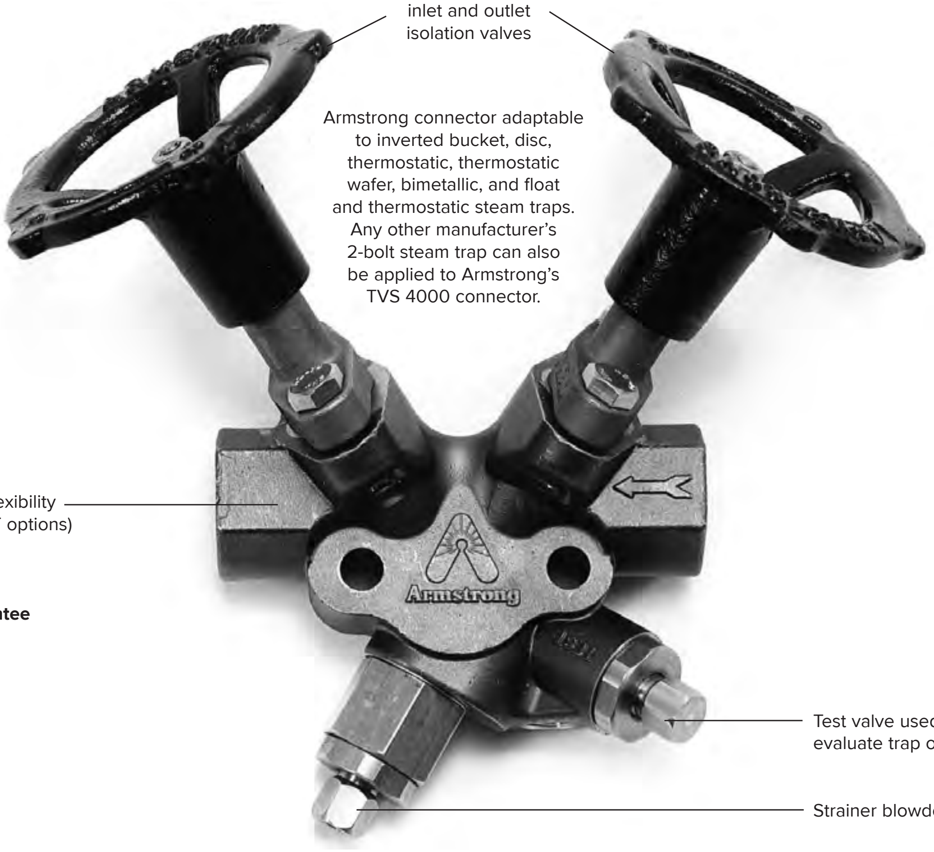
- **Protected valve stem.** The valve stem and sealing surfaces are completely protected from dirt and corrosion by the stem cap, whether in an open or closed position.

- **In-line repairability.** All sealing valve components may be easily replaced in-line.

- **Long-term operation.** Piston valve design ensures actuation even after many years without operation.

U.S. Patent 6,467,503

TVS 4000 Series Stainless Steel Trap Valve Station



Integral piston style inlet and outlet isolation valves

Armstrong connector adaptable to inverted bucket, disc, thermostatic, thermostatic wafer, bimetallic, and float and thermostatic steam traps. Any other manufacturer's 2-bolt steam trap can also be applied to Armstrong's TVS 4000 connector.

Connection flexibility (SW, NPT, BST options)

3-year guarantee

Test valve used to test and evaluate trap operation

Strainer blowdown valve

Description

Same principle. Different package with two piston-style isolation valves, test valve and integral stainless steel strainer with blowdown valve. What you'll find new are all the benefits of a piston valve integrated into the same space-saving package.

Maximum Operating Conditions

Maximum allowable pressure:
830 psig (57.2 barg) @ 800^{0}F (427^{0}C)

Materials—TVS 4000 Connector

Connector:	ASTM A351 Gr. CF8M
Strainer screen:	Stainless steel
Test valve:	Stainless steel
Blowdown valve:	Stainless steel

Isolation Valve Components

All wetted parts:	Stainless steel
Valve sealing rings:	Graphite and stainless steel
Handwheel:	Ductile iron

Weight

6-1/2 lb (2.9 kg)

Features

- **Reduced costs.** TVS saves on these fronts: reduced leak points, installation and maintenance time.
- **A full range of features.** TVS has test and strainer blowdown valves. When installed with Armstrong Model 2011 and 2022 steam traps, it will also accommodate the Armstrong pop drain as well as AIM® and SteamEye®—remote steam trap monitoring and testing devices.
- **Reduced design time.** Permits combining products with exact face-to-face dimensions.
- **Three-year guarantee.** The TVS 4000 is guaranteed for three years.
- **Easy, in-line repairability with maximum safety.** TVS allows isolation at point of service with upstream/downstream depressurization.
- **Installation versatility.** The connector design makes the TVS adaptable to any manufacturer's 2-bolt steam trap and piping configuration.
- **Simplified trap testing.** TVS enhances your capability to check trap operation and offers a built-in method to block and bleed traps.

How to Order

Model	Connection	Type of Connection Inlet/Outlet	Flow Direction	Trap Type
TVS 4000	1/2" 3/4"	NPT SW BSPT Flanged*	R = Right to Left L = Left to Right	Inverted Bucket Disc Thermostatic wafer Bimetallic Float and Thermostatic

*Consult factory.

U.S. Patent 6,467,503

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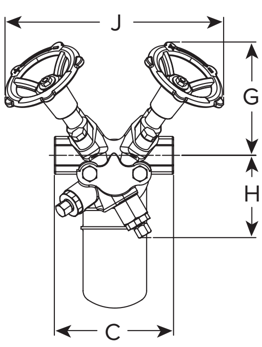
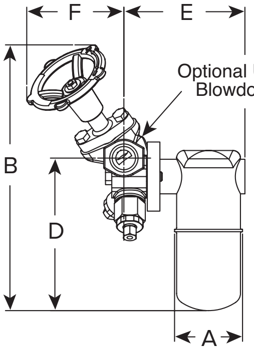
TVS 4000 Series Stainless Steel Trap Valve Station

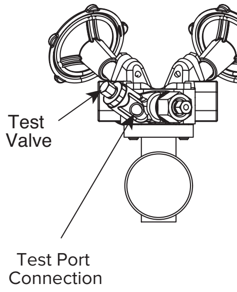
For Pressures to 830 psig (57.2 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)



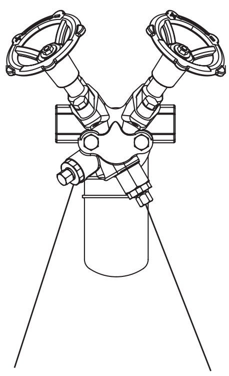
Model TVS 4000 With 2000 Series SS Trap
Front View



Model TVS 4000 With 2000 Series SS Trap
Side View



Model TVS 4000 With 2000 Series SS Trap
Bottom View



Test Valve
Used to test and evaluate trap operation

Strainer Blowdown Valve

Same principle. Different package with two piston-style isolation valves, test valve and integral stainless steel strainer with blowdown valve. Now the energy-saving performance and reliability of the inverted bucket steam trap are available in a versatile new package. You'll still enjoy all the familiar benefits. And the same efficient condensate drainage from virtually every kind of steam-using equipment. What you'll find new are all the benefits of a piston valve integrated into the same space-saving package.

Materials—TVS 4000 Connector

Connector:	ASTM A351 Gr. CF8M
Strainer screen:	Stainless steel
Screen retainer:	Stainless steel
Gasket:	Stainless steel
Retainer unit:	Stainless steel
Test valve:	Stainless steel
Blowdown valve:	Stainless steel

Isolation Valve Components

Handwheel:	Ductile iron
Nut:	Stainless steel
Stem, washers:	Stainless steel
Bonnet:	ASTM A351 Gr. CF8M
Bonnet, bolts:	DIN 933, Gr. A2 Class 70 per DIN 267
Valve plug:	Stainless steel
Disc springs:	Stainless steel
Valve sealing rings:	Graphite and stainless steel
Lantern bushing:	Stainless steel
Valve washers:	Stainless steel

Materials—Series 2000 Traps

Body:	ASTM A240 Gr. 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH

TVS 4000 Series With 2000 Series Inverted Bucket Steam Trap

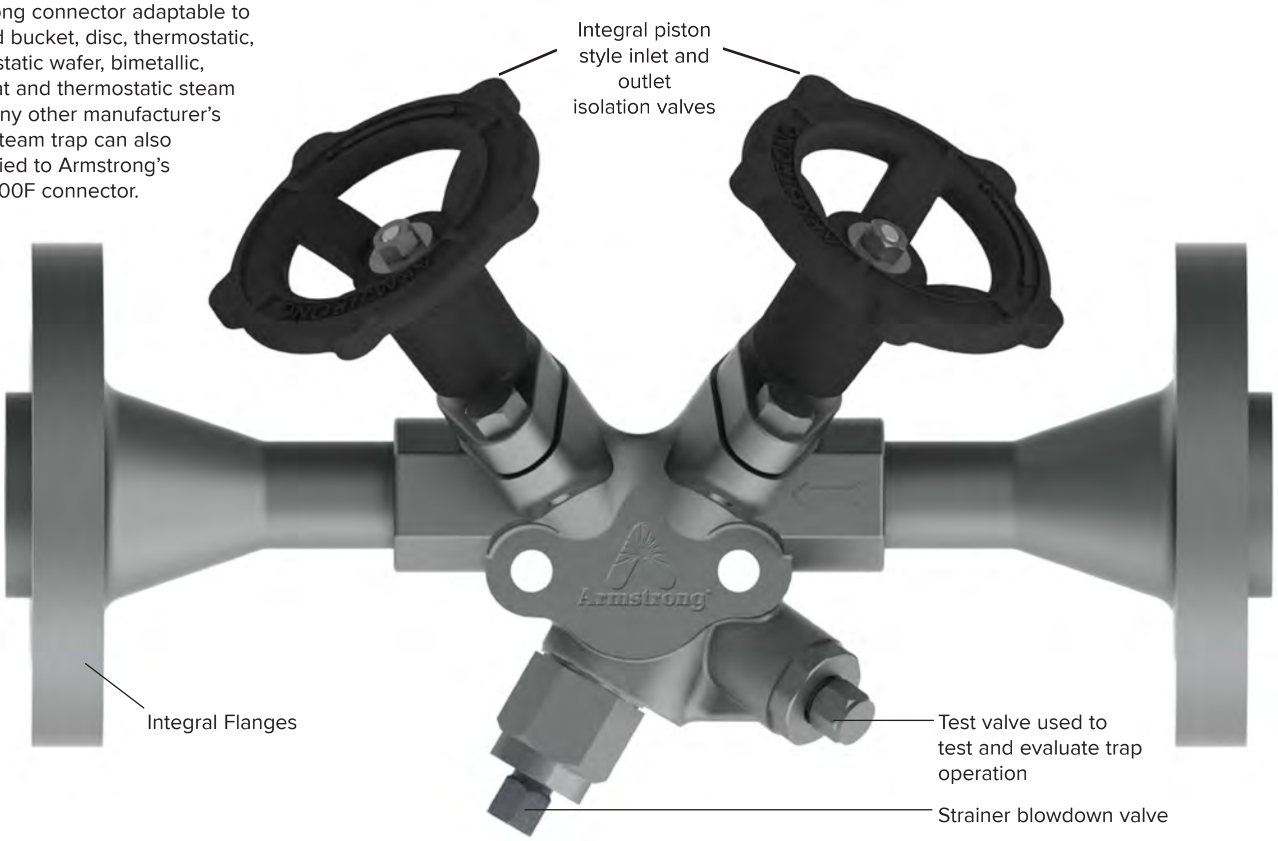
Model No.	2010		2011		2022	
Pipe Connections	in	mm	in	mm	in	mm
	3/8, 1/2, 3/4	10, 15, 20	1/2, 3/4	15, 20	1/2, 3/4	15, 20
"A" Trap Diameter	2-11/16	68	2-11/16	68	3-7/8	98
"B" Height (Valve Open)	8	203	10-1/2	268	12-1/2	318
"C" Face to Face	4-3/4	120	4-3/4	120	4-3/4	120
"D" Connection ℄ to Bottom	4-3/4	120	6	154	8	203
"E" Connection ℄ to Outside of Trap	4-1/2	114	4-13/16	122	5-7/8	149
"F" Connection ℄ to Front of Handwheel (Valve Open)	3-1/2	89	3-7/8	98	3-7/8	98
"G" Connection ℄ to Top of Handwheel (Valve Open)	3-1/4	83	4-1/2	114	4-1/2	114
"H" Connection ℄ to Bottom of Connector	1-7/8	47	3-1/4	83	3-1/4	83
"J" Width Across Handwheels (Valve Open)	9-1/4	235	8-3/4	222	8-3/4	222
Test Port Connection	1/4 NPT	6	1/4 NPT	6	1/4 NPT	6
Weight lb (kg)	9	4	9-1/2	4.3	12	5.4
Maximum Operating Pressure (Trap)	200 psig (14 barg)		400 psig (28 barg)		650 psig (45 barg)	
Maximum Operating Conditions (Connector)	830 psig (57.2 barg) @ 800°F (427°C) 1400 psig (96.5 barg) @ 100°F (38°C)					
Maximum Allowable Pressure (Trap)	400 psig (28 barg) @ 750°F (399°C)				650 psig @ 600°F (45 barg @ 315°C)	

U.S. Patent 6,467,503

TVS 4000F Series Stainless Steel Trap Valve Station

For Pressures to 830 psig (57.2 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)

Armstrong connector adaptable to inverted bucket, disc, thermostatic, thermostatic wafer, bimetallic, and float and thermostatic steam traps. Any other manufacturer's 2-bolt steam trap can also be applied to Armstrong's TVS 4000F connector.



Description

A complete package featuring two piston-style isolation valves, test valve and integral stainless steel strainer with blowdown valve. You'll realize all the benefits of a piston valve integrated into the same space-saving package.

Maximum Operating Conditions

Maximum allowable pressure:
830 psig (57.2 barg) @ 800°F (427°C)

Materials—TVS 4000F Connector

Connector	ASTM A351 Gr. CF8M
Strainer screen	Stainless steel
Test valve	Stainless steel
Blowdown valve	Stainless steel

Isolation Valve Components

All wetted parts	Stainless steel
Valve sealing rings	Graphite and stainless steel
Handwheel	Ductile iron

Weight

14 lb (6.4 kg)

Features

- **Reduced costs.** TVS saves on these fronts: reduced leak points, installation and maintenance time.
- **A full range of features.** TVS has test and strainer blowdown valves. When installed with Armstrong Model 2011 and 2022 steam traps, it will also accommodate the Armstrong pop drain as well as TrapAlert™ and SteamEye® —remote steam trap monitoring and testing devices.
- **Reduced design time.** Permits combining products with exact face-to-face dimensions.
- **Three-year guarantee.** The TVS 4000F is guaranteed for three years.
- **Easy, in-line repairability with maximum safety.** TVS allows isolation at point of service with upstream/downstream depressurization.
- **Installation versatility.** The connector design makes the TVS adaptable to any manufacturer's 2-bolt steam trap and piping configuration.
- **Simplified trap testing.** TVS enhances your capability to check trap operation and offers a built-in method to block and bleed traps.
- **Integral Flanges.** The body and connections are of one piece construction, free of welds and other potential leak paths.

How to Order

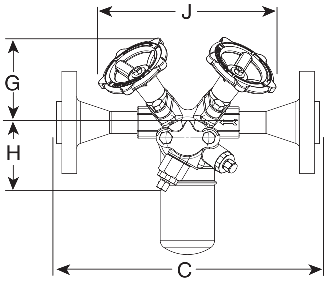
Model	Connection	Type of Connection Inlet/Outlet	Flow Direction	Trap Type
TVS 4000F	3/4"	Flanged ASME B16.5 Class 150, 300, 600	R = Right to Left L = Left to Right	Inverted Bucket • Disc • Thermostatic wafer Bimetallic • Float and Thermostatic
	1"	Flanged ASME B16.5 Class 150, 300		

U.S. Patent 6,467,503

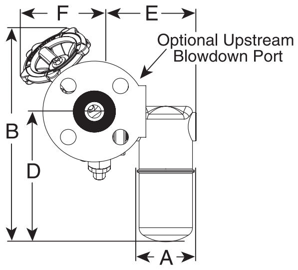
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

TVS 4000F Series Stainless Steel Trap Valve Station

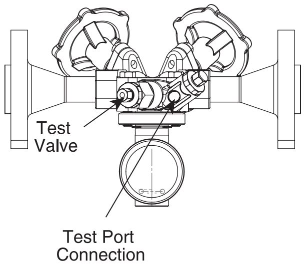
For Pressures to 830 psig (57.2 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)



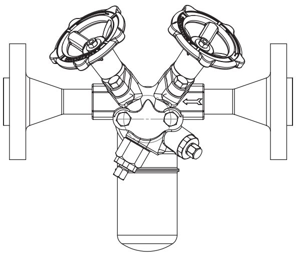
Model TVS 4000F
with
2000 Series SS Trap
Front View



Model TVS 4000F
with
2000 Series SS Trap
Side View



Model TVS 4000F
with
2000 Series SS Trap
Bottom View



Strainer
Blowdown
Valve

Same principle. Different package with two piston-style isolation valves, test valve and integral stainless steel strainer with blowdown valve. Now the energy-saving performance and reliability of the inverted bucket steam trap are available in a versatile new package. You'll still enjoy all the familiar benefits. And the same efficient condensate drainage from virtually every kind of steam-using equipment. What you'll find new are all the benefits of a piston valve integrated into the same space-saving package.

Materials—TVS 4000F Connector

Connector	ASTM A351 Gr. CF8M
Strainer screen	Stainless steel
Screen retainer	Stainless steel
Gasket	Stainless steel
Retainer unit	Stainless steel
Test valve	Stainless steel
Blowdown valve	Stainless steel

Isolation Valve Components

Handwheel	Ductile iron
Nut	Stainless steel
Stem, washers	Stainless steel
Bonnet	ASTM A351 Gr. CF8M
Bonnet, bolts	DIN 933, Gr. 8.8 per DIN 267
Valve plug	Stainless steel
Disc springs	Stainless steel
Valve sealing rings	Graphite and stainless steel
Lantern bushing	Stainless steel
Valve washers	Stainless steel

Materials—Series 2000 Traps

Body	ASTM A240 Gr. 304L
Internals	All stainless steel—304
Valve and seat	Stainless steel—17-4PH

TVS 4000 Series With 2000 Series Inverted Bucket Steam Trap

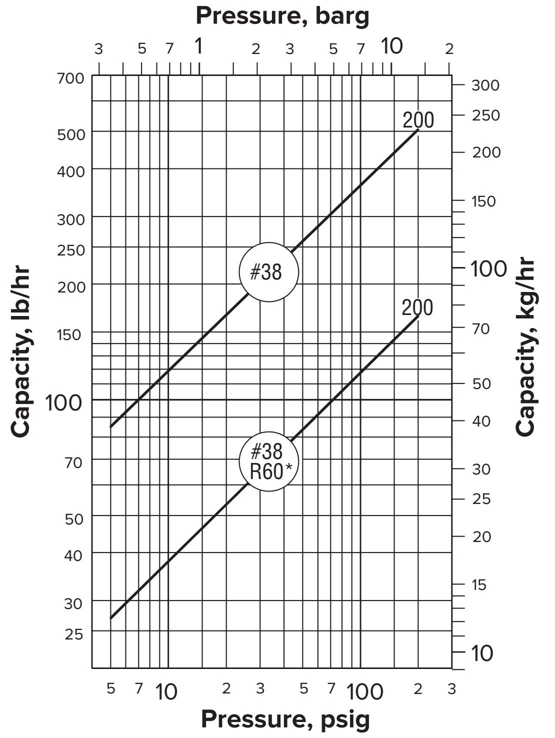
Model No.	2010		2011		2022	
Pipe Connections	in	mm	in	mm	in	mm
	3/4, 1	20, 25	3/4, 1	20, 25	3/4, 1	20, 25
"A" Trap Diameter	2-11/16	68	2-11/16	68	3-7/8	98
"B" Height (Valve Open)	8	203	10-1/2	268	12-1/2	318
"C" Face to Face	12	305	12	305	12	305
"D" Connection ℄ to Bottom	4-3/4	120	6	154	8	203
"E" Connection ℄ to Outside of Trap	4-1/2	114	4-13/16	122	5-7/8	149
"F" Connection ℄ to Front of Handwheel (Valve Open)	3-1/2	89	3-7/8	98	3-7/8	98
"G" Connection ℄ to Top of Handwheel (Valve Open)	3-1/4	83	4-1/2	114	4-1/2	114
"H" Connection ℄ to Bottom of Connector	1-7/8	47	3-1/4	83	3-1/4	83
"J" Width Across Handwheels (Valve Open)	9-1/4	235	8-3/4	222	8-3/4	222
Test Port Connection	1/4 NPT	6	1/4 NPT	6	1/4 NPT	6
Weight lb (kg)	16	7.3	16.5	7.5	19	8.6
Maximum Operating Pressure (Trap)	200 psig (14 barg)		400 psig (28 barg)		650 psig (45 barg)	
Maximum Operating Conditions (Connector)	830 psig (57.2 barg) @ 800^{0}F (427^{0}C) 1400 psig (96.5 barg) @ 100^{0}F (38^{0}C)					
Maximum Allowable Pressure (Trap)	400 psig (28 barg) @ 800°F (427°C)				650 psig @ 600°F (45 barg @ 315°C)	

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

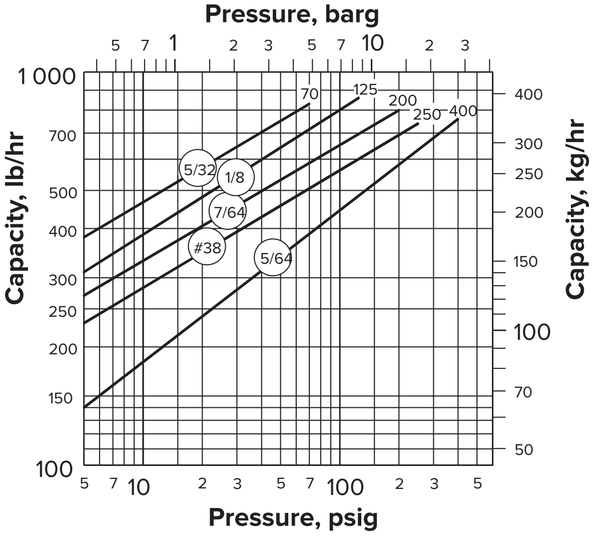
TVS 4000F Series Stainless Steel Trap Valve Station

For Pressures to 830 psig (57.2 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)

Model 2010 Capacity

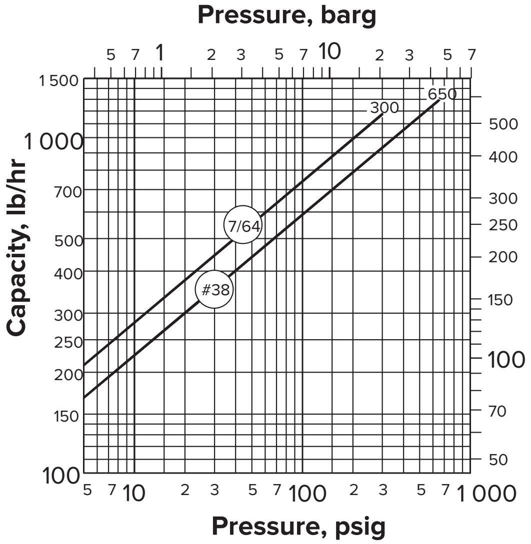


Model 2011 Capacity



*NOTE: Because the orifice is located at the top, inverted bucket steam traps handle dirt and scale better than other types of traps. However, in applications where extremely dirty conditions exist, care should be exercised in the use of all types of restricted-orifice, reduced-capacity traps.

Model 2022 Capacity



Options

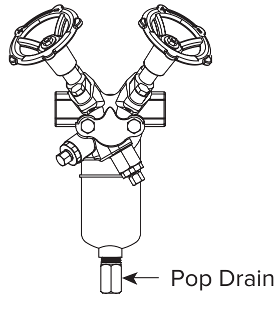
Insu-Pak™

Now you can insulate the in-line traps in your plant without complicating regular trap maintenance. Insu-Pak, a simple reusable insulation package, cuts the time and cost of in-field installation because it goes on in a snap. And it comes off just as easily. The Insu-Pak can prevent trap freeze-up when used with a properly designed condensate manifold. Designed for use with Model 2010 and Model 2011 traps.

Pop Drain

Simple but effective against freeze-up. Properly installed and maintained at low points in your system, the simple, pressure-actuated pop drain opens for condensate drainage at 5 psig (0.35 barg) for Models 2011 and 2022.

Probe Connections are available for trap monitoring on Models 2011 and 2022.



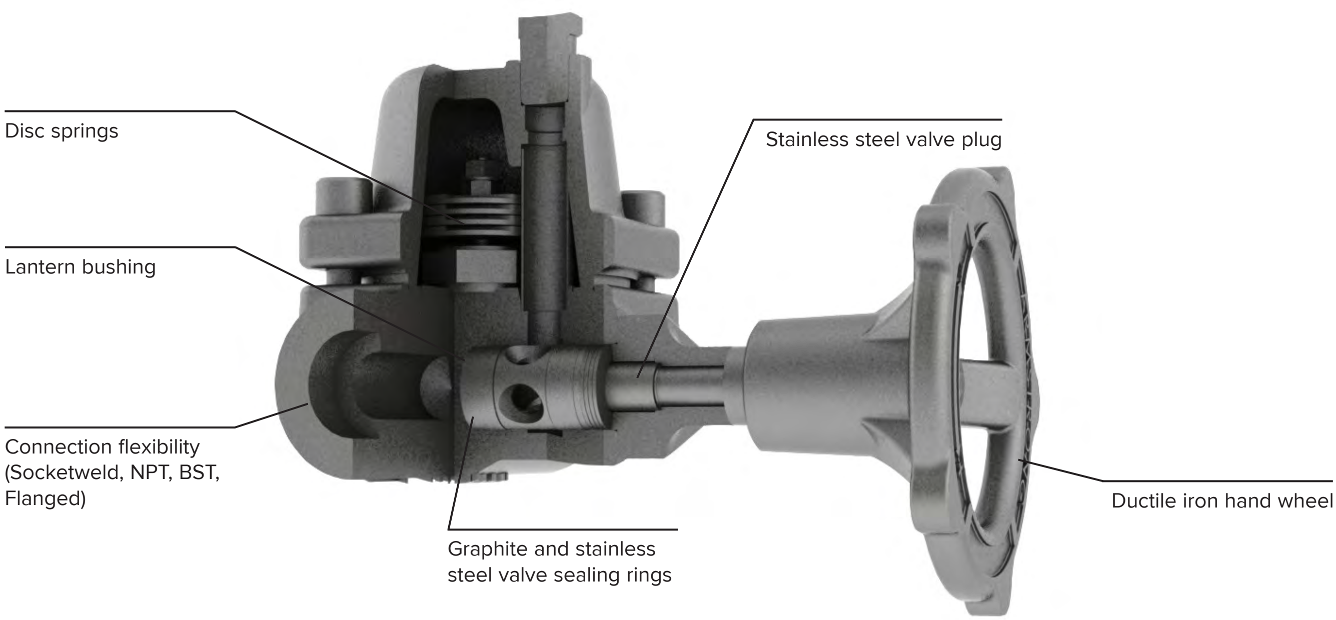
U.S. Patent 6,467,503

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

TVS 1100 Series Carbon Steel Trap Valve Station

For pressure to 319 psig/22 barg, and cold water capacities to 4 630 lb/hr/2 100 kg/hr

The Armstrong TVS 1100 Series bimetallic steam trap with integral isolation valve incorporates advanced piston sealing technology and a compact design for safer, longer lasting steam isolation service.



- **Single valve operation.** Eliminates the need for ancillary isolation valve, reducing the number of potential leak points, and providing a compact, space-saving design.
- **Dual sealing action.** The piston valve is a seatless valve that includes two graphite and stainless steel valve sealing rings that seal the stem and function as a seat. This combination provides long-term protection against leaks to the atmosphere and downstream piping.
- **Integral strainer.** Eliminates dirt and particulate from steam during operation.
- **Bimetallic air vent capsule.** Easily removes air and condensate during start-up.
- **Sealing Integrity.** Flexible disc springs automatically provide leak tightness by exerting pressure, which keeps the upper and lower valve sealing rings compressed at all times. Sealing tightness is ensured by the compression of the sealing rings against the piston and valve body.
- **In-line repairability.** All sealing valve components may be easily replaced in-line.
- **Long-term operation.** Piston valve design ensures actuation even after many years without operation.

TVS 1100 Features versus Conventional Designs		
	Armstrong TVS 1100 Series	Conventional Designs
Design	Compact	Bulky, Multiple Leak Points
Module Length	6.2" (160 mm)	15.7" (400 mm)
Module Height	4.01" (102 mm)	6.3" (160 mm)
No. of Leakage Points	2	4
Isolation Valve	Zero Leakage Piston Valve	Normal Globe/Ball Valve
Strainer	Standard Feature	Not available - which leads to element failure due to dirt
Mechanism	Bimetallic/Thermostatic/Thermodynamic	Thermostatic
Repairable	Yes	No

TVS 1100 Series Carbon Steel Trap Valve Station

For pressure to 319 psig/22 barg, and cold water capacities to 4 630 lb/hr/2 100 kg/hr

Description

The Armstrong TVS 1100 features an integral piston-style isolation valve, stainless steel strainer and bimetallic steam trap. The space-saving design of the TVS 1100 greatly reduces the number of potential leak points, cuts installation time and expense, and provides years of dependable steam isolation service.

Maximum Operating Conditions

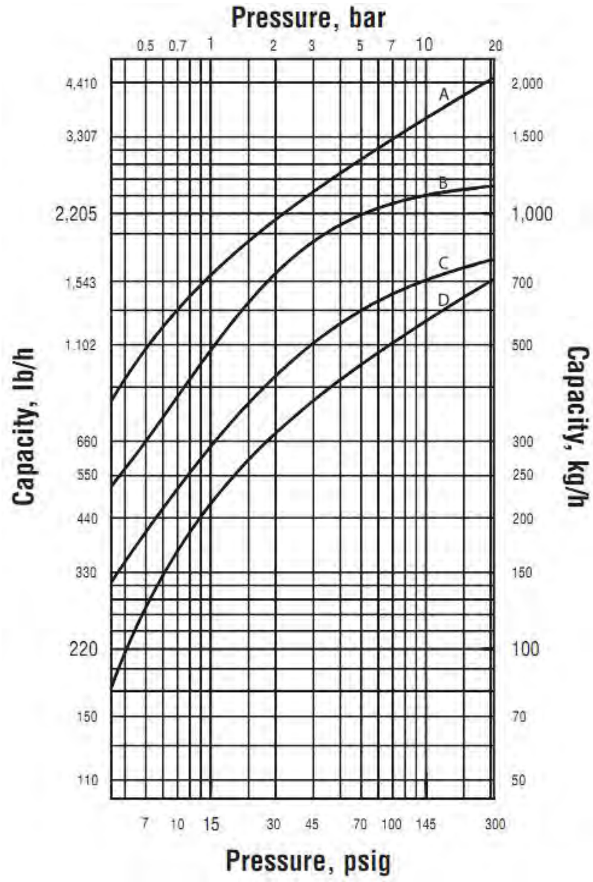
Maximum allowable pressure (Vessel design)
580 psig @ 662°F/40 barg @ 350°C
Maximum operating pressure 319 psig/22 barg
Maximum back pressure 99% of inlet pressure

Materials

Body and cap:	ASTM A105
Valve:	Stainless steel—17-4PH
Seat:	Stainless steel-304
Bimetallic elements:	Nickel-plated

Isolation Valve Components

Handwheel	Ductile Iron
Nut	Stainless steel
Stem, washers;	Stainless steel
Bonnet:	ASTM A350 Gr LF2
Bonnet, bolts:	Carbon steel
Valve plug:	Stainless steel
Disc spring:	Stainless steel
Valve sealing rings:	Graphite and stainless steel
Lantern bushing:	Stainless steel
Valve washers:	Stainless steel

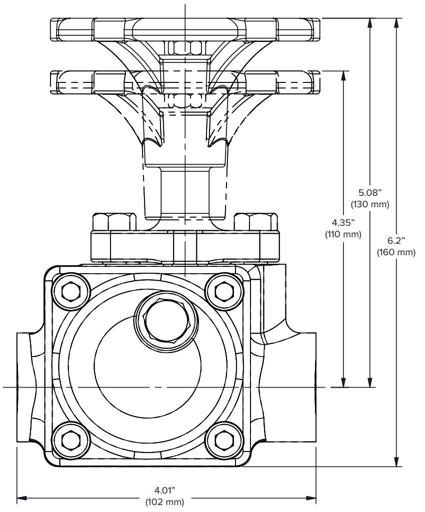


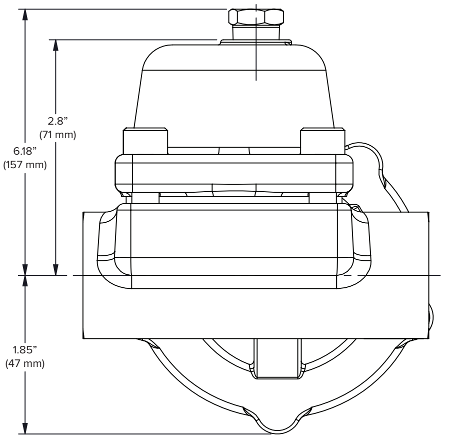
How to Order:

Model	Connection	Type of Connection Inlet/Outlet
TVS 1100	1/2" 3/4"	NPT SW BSPT Flanged*

*Consult factory.

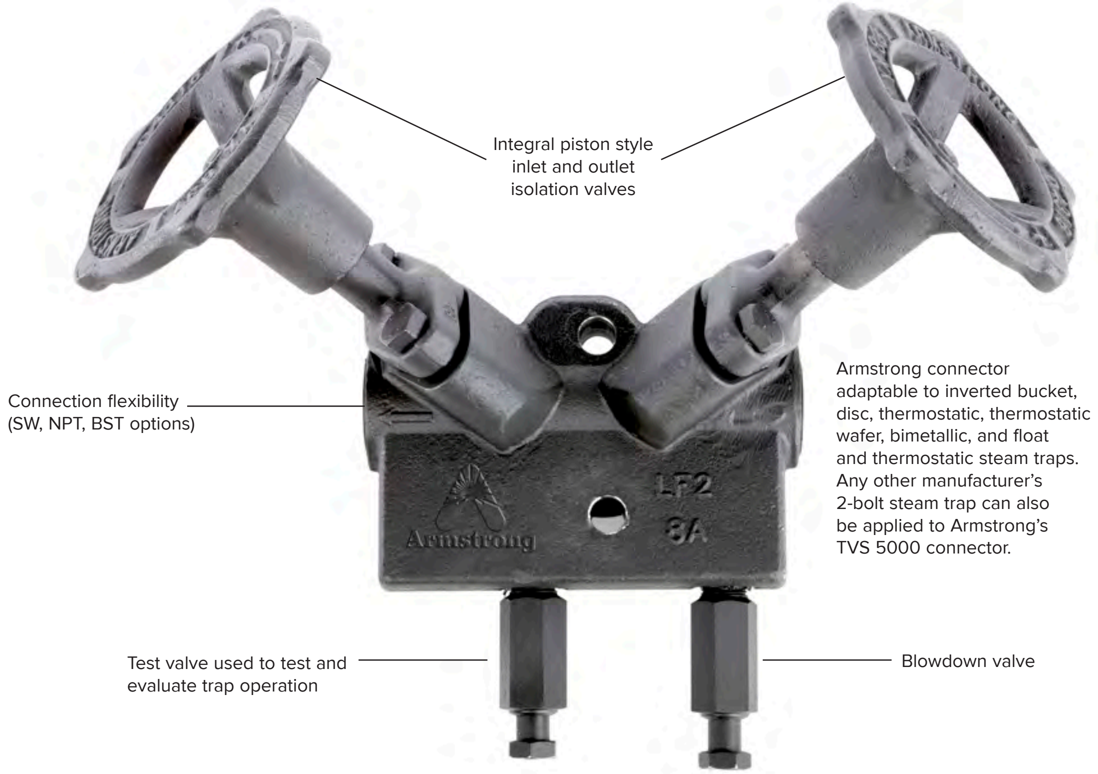
Dimensions:





Armstrong®

TVS 5000 Trap Valve Station



Description

Armstrong's TVS 5000 is designed as a one piece body equipped with a piston valve(s) combined with a removable steam trap mounted with a connecting flange.

Maximum Operating Conditions

Maximum allowable pressure:
650 psig @ 600°F (45 barg @ 315°C)

Materials—TVS 5000 Connector

Connector: ASTM A350 LF2
Test valve: ASTM A582 T303
Blowdown valve: ASTM A582 T303

Isolation Valve Components

Valve sealing rings: Graphite and stainless steel
Bonnet: ASTM A350 LF2
Bolts: DIN 933
Valve plug: ASTM A564
Lantern bushings: ASTM A582 T304
Valve washer: ASTM A582 T304
Disc springs: AISI T301
Nut: AISI T304
Handwheel: Ductile iron A536

Weight

11.71 lb (5.3 kg)

Features

- **Reduced costs.** TVS saves on these fronts: reduced leak points, installation and maintenance time.
- **Reduced design time.** Permits combining products with exact face-to-face dimensions.
- **Easy, in-line repairability with maximum safety.** TVS allows isolation at point of service with upstream/downstream depressurization.
- **Simplified trap testing.** TVS enhances your capability to check trap operation and offers a built-in method to block and bleed traps.

How to Order

Model	Connection	Type of Connection Inlet/Outlet	Flow Direction	Trap Type
TVS 5000	1/2" 3/4"	NPT SW BSPT Flanged*	R = Right to Left L = Left to Right	Inverted Bucket Disc Thermostatic wafer Bimetallic Float and Thermostatic

*Consult factory.

Notes

Universal Stainless Steel Connector

IS-2 Stainless Steel Connector with Integral Strainer Provides:

- A full line stainless steel strainer in the connector eliminates leak points and reduces installation time
- A strainer that is not discarded when the trap is replaced
- Easy strainer screen replacement
- Optional blowdown valve
- Accommodates Armstrong's inverted bucket, disc, thermostatic, thermostatic wafer, bimetallic, and float and thermostatic traps. Any manufacturer's 2-bolt steam trap can also be applied to Armstrong's IS-2 connector.

Maximum Operating Conditions

Maximum allowable pressure:
830 psig (57.2 barg) @ 800°F (427°C)
1400 psig (96.5 barg) @ 100°F (38°C)
Refer to Trap Specifications for further operating conditions.

Connector Styles

- IS-2 connector with integral strainer
- IS-2 connector with integral strainer with blowdown valve

Connection Sizes

- 1/2", 3/4", 1"

Connection Types

Screwed NPT and BSPT
Socketweld
Flanged (consult factory)

Materials

Connector Body:	All stainless steel—304
Strainer:	20 x 20 Mesh 304 stainless steel

Weight

2 lbs (0.91 kg)

How to Order IS-2 Connector with Integral Strainer

Specify:
- Connection style
- Connection size
- Connection type
- Inlet flow direction
  - Left to Right
  - Right to Left

Standard 360° Stainless Steel Connector Provides:

- A compact, lightweight assembly
- Standardization, reducing inventory
- A compact design, simplifying piping
- Accommodates Armstrong's inverted bucket, disc, thermostatic, thermostatic wafer and bimetallic steam traps. Any manufacturer's 2-bolt steam trap can also be applied to Armstrong's standard connector.

Maximum Operating Conditions

Maximum allowable pressure:
830 psig (57.2 barg) @ 800°F (427°C)
1400 psig (96.5 barg) @ 100°F (38°C)
Refer to Trap Specifications for further operating conditions.

Connector Styles

- Standard 360°

Connection Sizes

- 3/8", 1/2", 3/4"

Connection Types

Screwed NPT and BSPT
Socketweld
Flanged (consult factory)

Weight

1-1/2 lbs (0.70 kg)

How to Order Standard 360° Stainless Steel Connector

Specify:
- Connection size
- Connection type

Universal Stainless Steel Connector - IS-4

Description

With the IS-4 universal connector, you can install a 4-bolt compatible steam trap to fit most piping configurations and applications. The IS-4 combines the integrity of an all welded installation with the versatility of a quick change steam trap replacement.

The IS-4 works with Armstrong Intelligent Monitoring (AIM™) to bring intelligence to wireless technology by applying smart devices to monitor critical plant applications in real time.

- Class 900 design
- All stainless steel construction
- Integral strainer
- Exceptional corrosion resistance
- Recessed gasket surface
- Three-year guarantee against defects in materials and workmanship (connector only)

Maximum Operating Conditions

Maximum allowable pressure (connector design):

IS-4	1 245 psig @ 900°F (85.8 barg @ 482°C)
IS-4BD	1 100 psig @ 800°F (75.8 barg @ 426°C)

Materials and Weights

Body	ASTM A351 Gr. CF8M
Screen	Stainless steel
Screen retainer	ASTM A351 Gr. CF8M
Retainer bolts	ASTM A193 Gr. B16
Weights:	
IS-4	4.75 lbs (2.15 kg)
IS-4BD	9.9 lbs (4.5 kg)

4-Bolt Connector Steam Traps Available

- SH4000 Series
- IB4022
- IB4011

Specification

All stainless steel in-line universal connector with integral strainer able to accept steam traps compatible with the 4-bolt technology. Up to Class 900 service.

IS-4

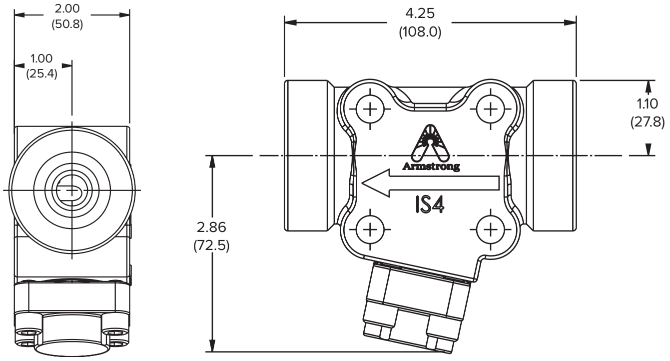
How to order

IS-4 **3FL** **900** **DBB** **DBB**

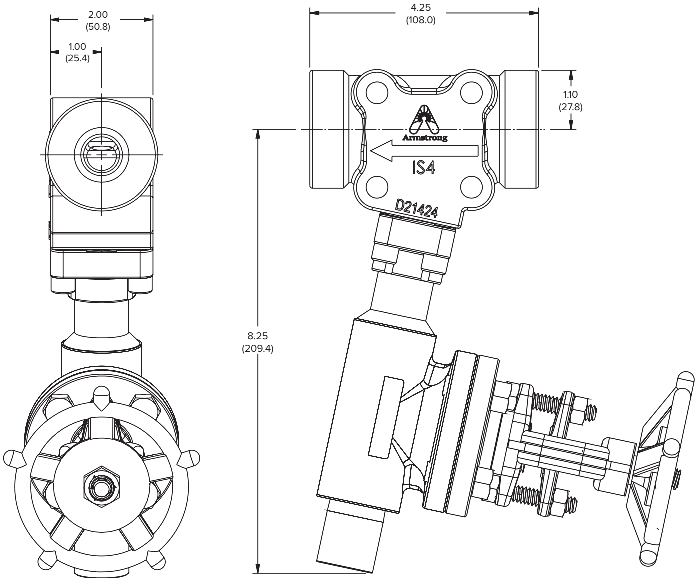
Model	Connection Size/Type	Flanges	Inlet Configuration	Outlet Configuration
IS-4 **or** **IS-4BD**	**3NPT**=3/4(20)NPTF **3SW**=3/4(20)Socketweld **3FL**=3/4(20)Flanged **4NPT**=1(25)NPTF **4SW**=1(25)Socketweld **4FL**=1(25)Flanged	Class 600 Class 900	None **SB**=Single Block **DBB**=Double Block & Bleed	None **SB**=Single Block **DBB**=Double Block & Bleed

Notes:

1. Right to left flow only available.
2. IS-4BD includes Class 800 forged steel gate valve for blowdown service.
3. Connection Size/Type based on the system condensate supply and return requirements.
4. All connections for SB or DBB will be socketweld.
5. Flanges available in Class 600 and 900.
6. For Block & Bleed dimensions: Consult Factory

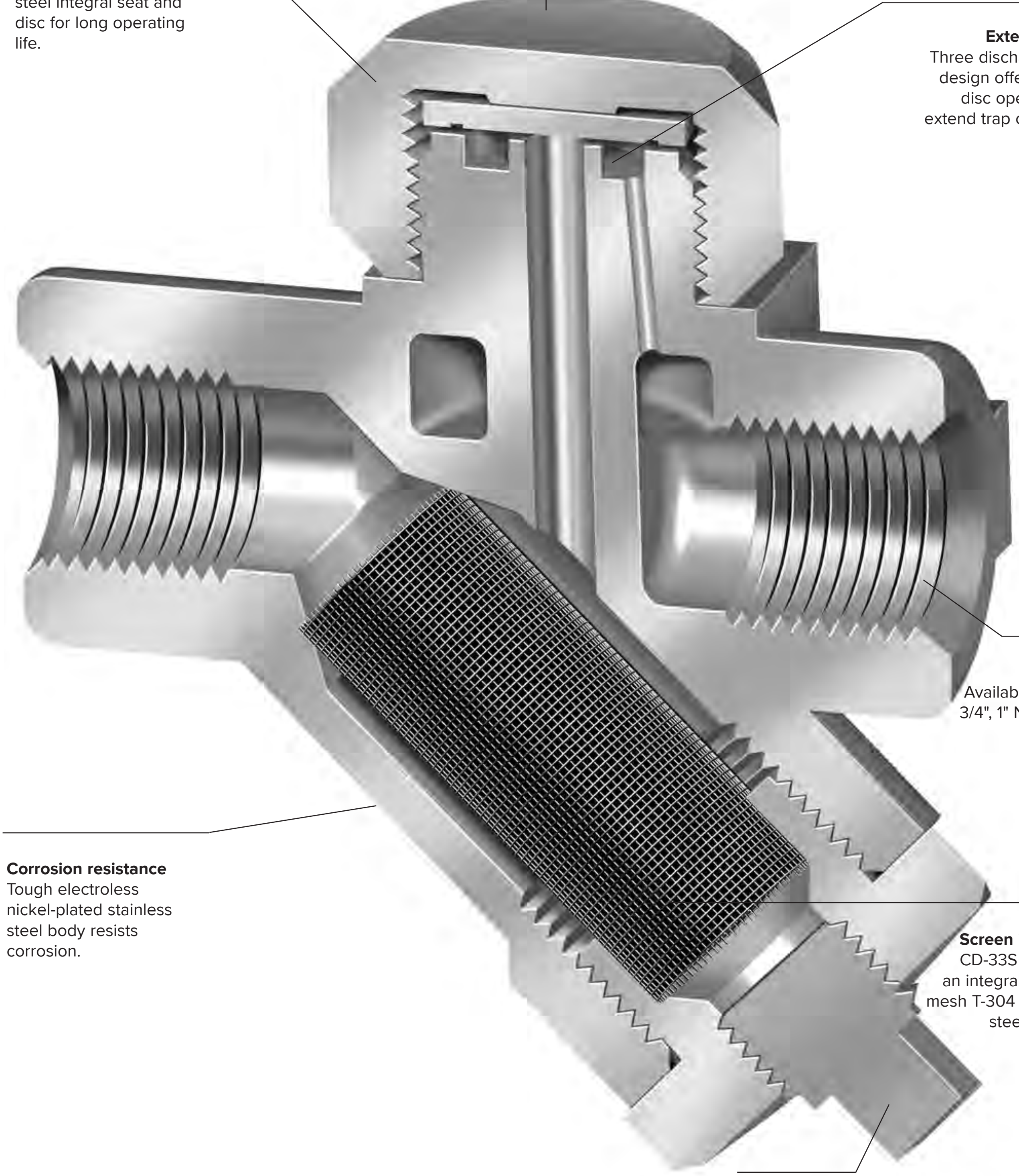


IS-4



IS-4BD

Armstrong® CD-33/CD-33S Disc Trap



Durable
Hardened stainless steel integral seat and disc for long operating life.

Adapts to outdoors
Optional rain guard insulating cap available to prevent excessive radiant heat loss in outside applications.

Extended life
Three discharge port design offers stable disc operation to extend trap operating life.

NPT
Available in 1/2", 3/4", 1" NPT only.

Corrosion resistance
Tough electroless nickel-plated stainless steel body resists corrosion.

Screen included
CD-33S includes an integral 30 x 30 mesh T-304 stainless steel screen.

Blowdown choice
Blowdown plug standard. Blowdown valve available as an option.

CD-33/CD-33S Disc Trap

The Armstrong CD-33 is a disc style trap designed to control the trap's cycle rate. By reducing the cycle rate, the Armstrong CD-33 will have a longer service life than typical disc traps. This enhanced performance will ensure that maintenance time is minimized and steam costs are greatly reduced.

The CD-33 is designed with three discharge ports, which offer stable disc operation to extend trap operating life. The capacities of the Armstrong CD-33 have been engineered specifically for the following applications: large steam main drips, process equipment, and HVAC heating equipment on constant pressure. The CD-33L (low capacity) trap is designed for the low capacity applications of steam main drips and steam tracing lines. By ensuring that the capacities are designed to suit the application, and are not oversized, the CD-33 Series will last longer than other disc traps with excessive capacity ratings.

Advantages

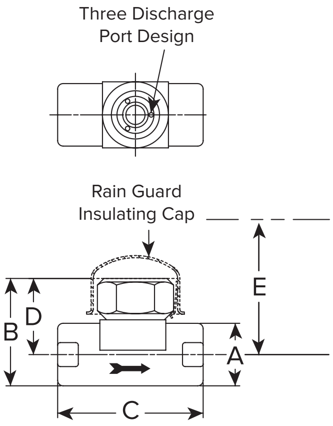
- Three discharge port design
- Minimal wear with controlled cycling
- Freeze-resistant
- Hardened seat and disc

Specification

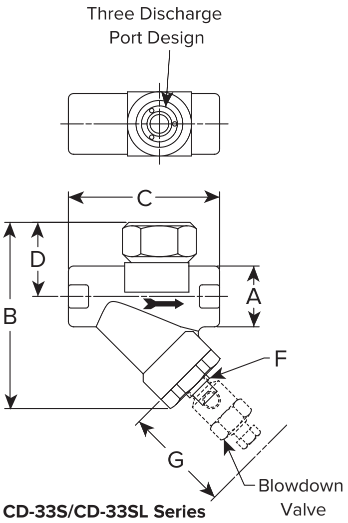
Steam trap shall be stainless steel thermodynamic type, integral seat design with hardened disc and seating surfaces, and electroless nickel plated finish. When required, trap shall be supplied with an integral Y strainer, integral blowdown valve or rain guard insulating cap. Maximum allowable pressure (vessel design) shall be 915 psig @ 752°F (63 barg @ 400°C). Maximum operating pressure shall be 600 psig @ 752°F (42 barg @ 400°C).

CD-33 Series Disc Trap

For Steam Service up to 600 psig (42 barg)...Capacities to 2 500 lb/hr (1 134 kg/hr)



CD-33/CD-33L Series



CD-33S/CD-33SL Series
With Integral Strainer

List of Materials	
Name of Part	Material
Body	ASTM A743 Gr. CA40
Cap	ASTM A743 Gr. CA40
Disc	ASTM A276 Gr. 420
Strainer Screen	30 x 30 Mesh T-304 Stainless Steel
Screen Retainer	ASTM A743 Gr. CA40
Blowdown Plug (CD-33S only)	Carbon Steel
Options	
Blowdown Valve	Stainless Steel
Rain Guard Insulating Cap (1/2", 3/4" Sizes Only)	Stainless Steel

The Armstrong CD-33 is a disc style trap designed to control the trap's cycle rate. By reducing the cycle rate, the Armstrong CD-33 will have a longer service life than typical disc traps. This enhanced performance will ensure that maintenance time is minimized and steam costs are greatly reduced.

The CD-33 is designed with three discharge ports, which offer stable disc operation to extend trap operating life. The capacities of the Armstrong CD-33 have been engineered specifically for the following applications: large steam main drips, process equipment, and HVAC heating equipment on constant pressure. The CD-33L trap is designed for the low capacity applications of steam main drips and steam tracing lines. By ensuring that the capacities are designed to suit the application, and are not oversized, the CD-33 Series will last longer than other disc traps with excessive capacity ratings.

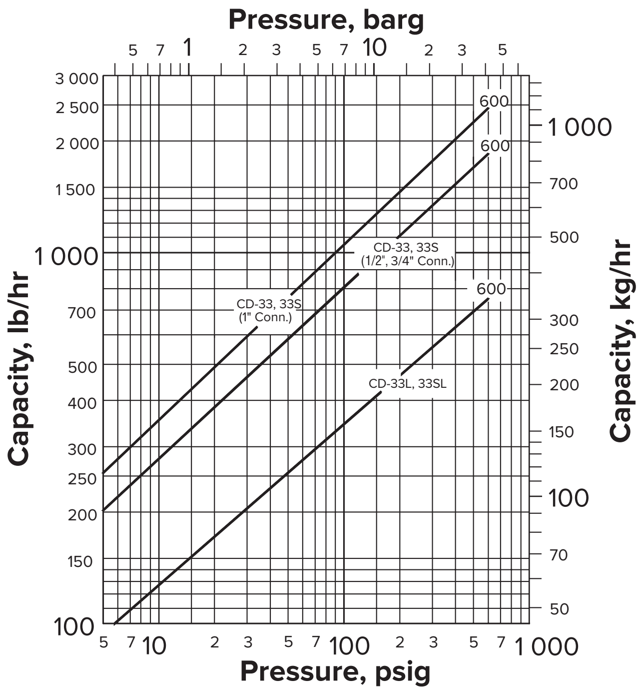
Advantages

- Three discharge port design
- Minimal wear with controlled cycling
- Freeze-resistant
- Hardened seat and disc

Specification

Steam trap shall be stainless steel thermodynamic type, integral seat design with hardened disc and seating surfaces, and electroless nickel plated finish. When required, trap shall be supplied with an integral Y strainer, integral blowdown valve or rain guard insulating cap. Maximum allowable pressure (vessel design) shall be 915 psig @ 752°F (63 barg @ 400°C). Maximum operating pressure shall be 600 psig @ 752°F (41 barg @ 400°C).

Model CD-33 Capacity



CD-33 Series Disc Trap

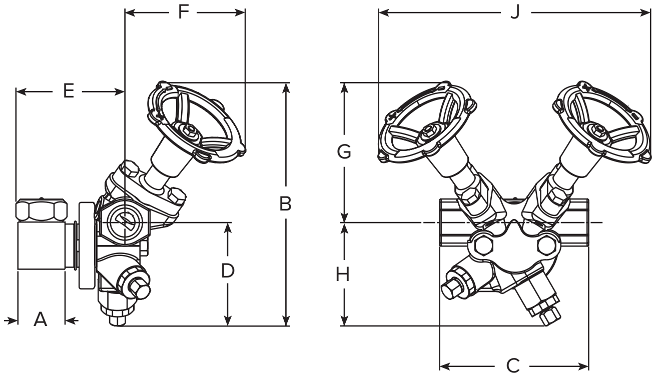
Model No.	CD-33				CD-33S (w/strainer)				CD-33L (low capacity)		CD-33SL (w/strainer) (low capacity)	
Pipe Connection Size	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1	25	1/2, 3/4	15, 20	1	25	3/8, 1/2, 3/4	10, 15, 20	1/2, 3/4	15, 20
"A"	1-7/16	37	1-3/4	44	1-7/16	37	1-3/4	44	1-7/16	36	1-7/16	36
"B" Height	2-1/2	63	3-1/8	79	4-1/4	108	4-3/4	121	2-1/2	63	4-1/4	108
"C" Length	3-5/16	84	3-15/16	100	3-1/2	89	4-1/8	105	3-5/16	84	3-1/2	89
"D" CL to Top of Cap	1-3/4	44	2-1/4	57	1-3/4	44	2-1/4	57	1-3/4	44	1-3/4	44
"E" Withdrawal Distance Rain Guard Insulating Cap	–	–	–	–	3	76	3	76	–	–	3	76
"F" Blowdown Connection Size	–	–	–	–	1/4 NPT	6	1/4 NPT	6	–	–	1/4 NPT	6
"G" Withdrawal Distance Blowdown Valve	–	–	–	–	3-1/2	89	3-1/2	89	–	–	3-1/2	89
Weight, lb (kg)	1.4 (0.64)		2.5 (1.1)		2.2 (1.0)		3.25 (1.5)		1.41 (0.64)		2.2 (1.0)	
Maximum Allowable Pressure (Vessel Design)	915 psig @ 752°F (63 barg @ 400°C)											
Minimum Operating Pressure, psig (barg)	3.5 psig (0.24 barg)											
Maximum Operating Pressure, psig (barg)	600 psig @ 486°F (41 barg @ 252°C)											

Maximum Back Pressure as Percent of Inlet Pressure, 80%

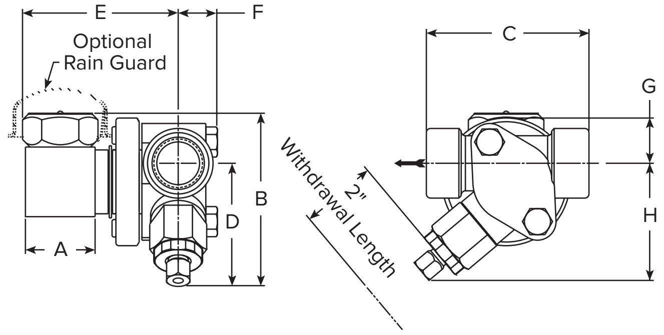
CD-3300 Series Disc Steam Traps

All Stainless With 360° Connector/IS-2/TVS-4000

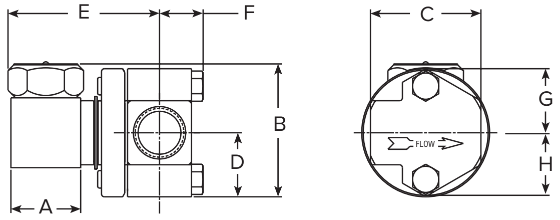
For Steam Pressures to 450 psig (31 barg)...Capacities to 800 lb/hr (363 kg/hr)



CD-3300 With TVS-4000 Trap Valve Station



CD-3300 With IS-2 Connector With Integral Strainer and Blowdown Valve



CD-3300 With Standard Connector

The Armstrong CD-3300 is a three discharge port design, which provides stable disc operation to extend operating life.

The CD-3300 is piped in-line by a 360° universal connector, which allows you to install the trap in virtually any piping configuration. Armstrong's unique standard connector or its IS-2 connector with integral strainer makes the CD-3300 easy to install, easy to renew. You save on labor time and cost because the connector simplifies piping and remains in-line.

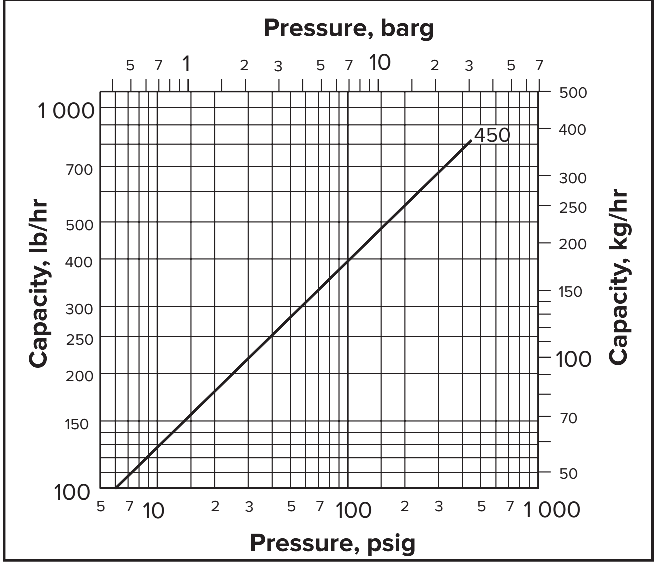
Materials

Trap cap:	ASTM A743 CA40
Trap disc:	ASTM A276 Gr. 420
Trap body:	ASTM A276 Gr. 420
Flange	ASTM A105 Zinc plated
Standard connector:	Stainless steel—304
IS-2 connector with integral strainer:	ASTM A351 Gr. CF8 20 x 20 mesh 304 SS Screen

Options

Rain guard insulating cap
Blowdown valve—IS-2 connector only

CD-3300 Series Capacity



CD-3300 Series Disc Traps

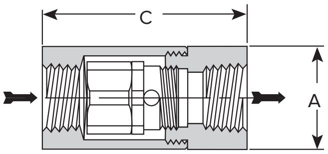
Model	CD-3300							
	Standard Connector		IS-2 Connector With Integral Strainer				TVS 4000 Connector	
	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4	15, 20	1/2, 3/4	15, 20	1	25	1/2, 3/4	15, 20
"A" Trap Diameter	1-1/2	38	1-1/2	38	1-1/2	38	1-1/2	38
"B" Total Height	2-7/8	73	3-3/4	94	3-3/4	94	7-13/16	198
"C" Face-to-Face	2-3/8	60	3-1/2	89	4	101	4-3/4	120
"D" Connection ℄ to Bottom	1-3/8	35	2-5/8	67	2-5/8	67	3-1/4	83
"E" Connection ℄ to Outside of Trap	3-3/8	86	3-3/8	86	3-9/16	90	3-9/16	90
"F" Connection ℄ to Front of Connector	13/16	20	7/8	22	7/8	22	3-7/8	98
"G" Connection ℄ to Top	1-3/8	46	1	25	1	25	4-1/2	114
"H" Connection ℄ to Bottom of Connector	1-3/8	46	2-1/2	64	2-1/2	64	3-1/4	83
"J" Width Across Handwheels (Valve Open)	—	—	—	—	—	—	8-11/16	221
Test Port Connection	—	—	—	—	—	—	1/4 NPT	6
Trap Only Weight, lb (kg)	2 (0.91)							
Trap and Connector Weight, lb (kg)	3.6	1.6	3.9	1.8	4.2	2	8-1/2	3.8
Maximum Operating Pressure	450 psig @ 456°F (31 barg @ 236°C)							
Maximum Allowable Pressure (Vessel Design)	720 psig @ 750°F (50 barg @ 400°C)							

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

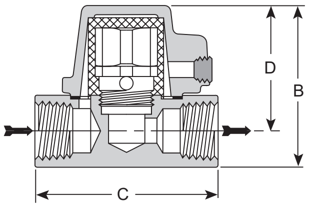
CD-40 and CD-60 Series Controlled Disc Steam Trap

Carbon Steel

For Pressures to 600 psig (41 barg)...Capacities to 2 850 lb/hr (1 295 kg/hr)



CD-40 Series Trap



CD-63 Model Shown

Description

Armstrong CD-40 and CD-60 Series controlled disc traps contain a replaceable capsule, making it possible to renew a worn trap by simply replacing the capsule. A heating chamber in the shell ensures consistent operation. This steam jacket provides a relatively constant temperature in the control chamber regardless of ambient conditions. Cycling rate is controlled and does not increase when the trap is exposed to cold winds, rain or snow. CD-40 Series traps are also available with optional integral .045 perforated stainless steel strainer screens. CD-60 Series traps contain integral strainers with ratios of open area to inside area of pipe that equal or exceed those of most separate "Y" type strainers.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model CD-40	600 psig @ 500°F (41 barg @ 260°C)
Model CD-60	600 psig @ 750°F (41 barg @ 399°C)

Maximum operating pressure: 600 psig (41 barg) at saturated steam temperature
Minimum operating pressure: 10 psig (0.7 barg)

Connections

Model CD-40 and CD-60	Screwed NPT and BSPT
Model CD-60	Socketweld

Materials Model CD-40

Body:	Carbon steel—C-1215
Control chamber:	Hardened 440 stainless steel
Disc:	Hardened 440 stainless steel
Capsule body:	Hardened 440 stainless steel
Strainer screen (option):	Stainless steel

Materials Model CD-60

Body:	ASTM A216 WCB
Cap:	ASTM A216 WCB
Control chamber:	Hardened 440 stainless steel
Disc:	Hardened 440 stainless steel
Capsule body:	Hardened 440 stainless steel
Strainer screen:	20 x 20 mesh stainless steel

Option

CD-40 Series integral strainer screen (.045 perforated stainless steel)

Specification

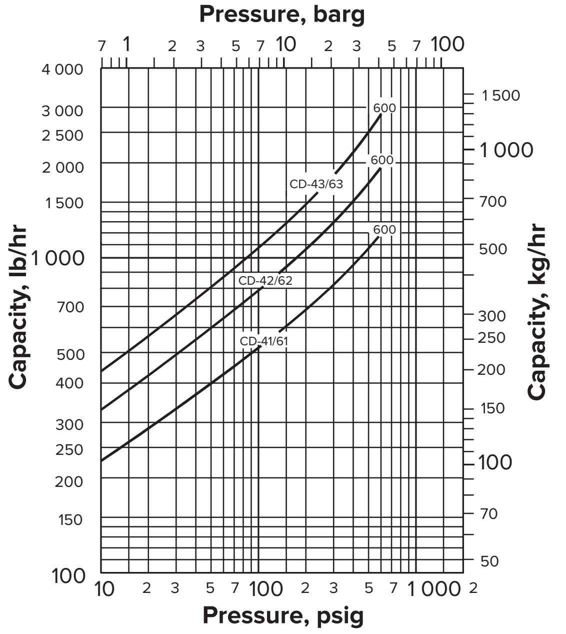
Controlled disc steam trap, type ... in carbon steel. CD-60 includes integral strainer. Maximum allowable pressure 600 psig.

How to Order

- Specify model number
- Specify size and type of pipe connection
- Specify any options required

For a fully detailed certified drawing, refer to CD #1020.

Models CD-41/61, 42/62 & 43/63 Capacity



Capacities given are continuous discharge capacities in pounds and kilograms of hot condensate per hour at pressure differential indicated with condensate temperatures approximately 25°F (14°C) below steam temperatures.

NOTE: CD traps can operate with minimum of 2 psig (.15 barg) inlet pressure and a maximum of 80% back pressure. However, for best results, inlet pressure should not drop below 10 psig (.70 barg) and back pressure should not exceed 50% of inlet pressure.

CD-40 and CD-60 Series Controlled Disc Traps

Model No.	CD-41*				CD-42*		CD-43*		CD-61				CD-62		CD-63	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	3/8	10	1/2	15	3/4	20	1	25	3/8	10	1/2	15	3/4	20	1	25
"A" (Diameter)	1-1/4	31.7	1-1/4	31.7	1-5/8	41.3	2-3/8	60.3	—	—	—	—	—	—	—	—
"B" (Height)	—	—	—	—	—	—	—	—	2-3/4	66.7	2-3/4	66.7	3-1/2	87.3	4-1/4	108
"C" (Length)	3	76.2	3-13/32	86.5	3-15/16	100.0	4-5/8	117.5	3-1/2	88.9	3-1/2	88.9	4-5/8	117	4-3/4	122
"D" (℄ to Top of Cap)	—	—	—	—	—	—	—	—	2-1/8	50.8	2-1/8	50.8	2-3/4	68.3	3-5/16	84.1
Weight lb (kg)	3/4 (0.3)		3/4 (0.3)		1-3/4 (0.8)		4-1/4 (1.9)		2-3/4 (1.2)		2-1/2 (1.1)		4-3/4 (2.2)		6-3/4 (3.1)	

*Optional integral strainer available.

CD72SR Series Disc Traps

For Steam Service up to 1010 psig (69.6 barg) and Capacities from 935 lb/hr (435 Kg/hr)

Armstrong CD72SR is a disc styled trap designed to control the trap's cycle rate. The reduced cycle rate provides Armstrong CD72SR trap with a longer service life than typical disc traps. This enhanced performance ensures minimum maintenance time and reduced steam costs.

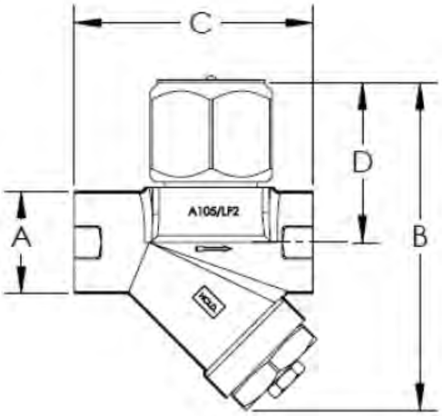
The capacity of Armstrong CD72SR has been engineered specifically for the following applications: large steam main drips, process equipments and HVAC heating equipments at constant pressure.

Advantages of CD72SR

- Minimum wear with controlled cycling
- Freeze-resistant
- Hardened Seat and disc
- Weldable
- In-line repairable

Connections

Screwed BSPT and NPT Socketweld
Flanged DIN or ANSI (Welded).
Consult factory for dimensions and weight



List of Materials	
Name of Part	Material
	CD72SR
Body	Dual certified Forged Corten Steel
Cap	ASTM A 105N / A350 LF2 Cl. 1
Disc & Seat	ASTM A 564 TYP630, H900
Strainer Screen	Stainless steel TYP304, 30 x 30 Mesh
Screen Retainer	Dual certified Forged Corten Steel ASTM A 105N / A350 LF2 Cl. 1
Blowdown Plug	ASTM A350 Gr. LF2 CL.1

Dimensions and Weights				
Model No.	CD72SR			
	1/2" and 3/4" (DN 15 DN20)		1" (DN25)	
	in	mm	in	mm
"A"	1.53	38.8	1.89	48.0
"B" Height	4.89	124.1	5.12	130.0
"C" Length	3.56	90.5	4.41	112.0
"D" ℄ to top of cap	2.38	60.5	2.58	65.6
Weight, lb (Kg)	3.31 (1.5)		4.59 (2.0)	
Max. allowable pressure (Vessel Design)	1010 psig @ 750°F (69.6 barg @ 399°C)			
MIn. operating pressure	3.5 psig (0.24 barg)			
Max. operating pressure	600 psig @ 486°F (41.4 barg @ 252°C)			

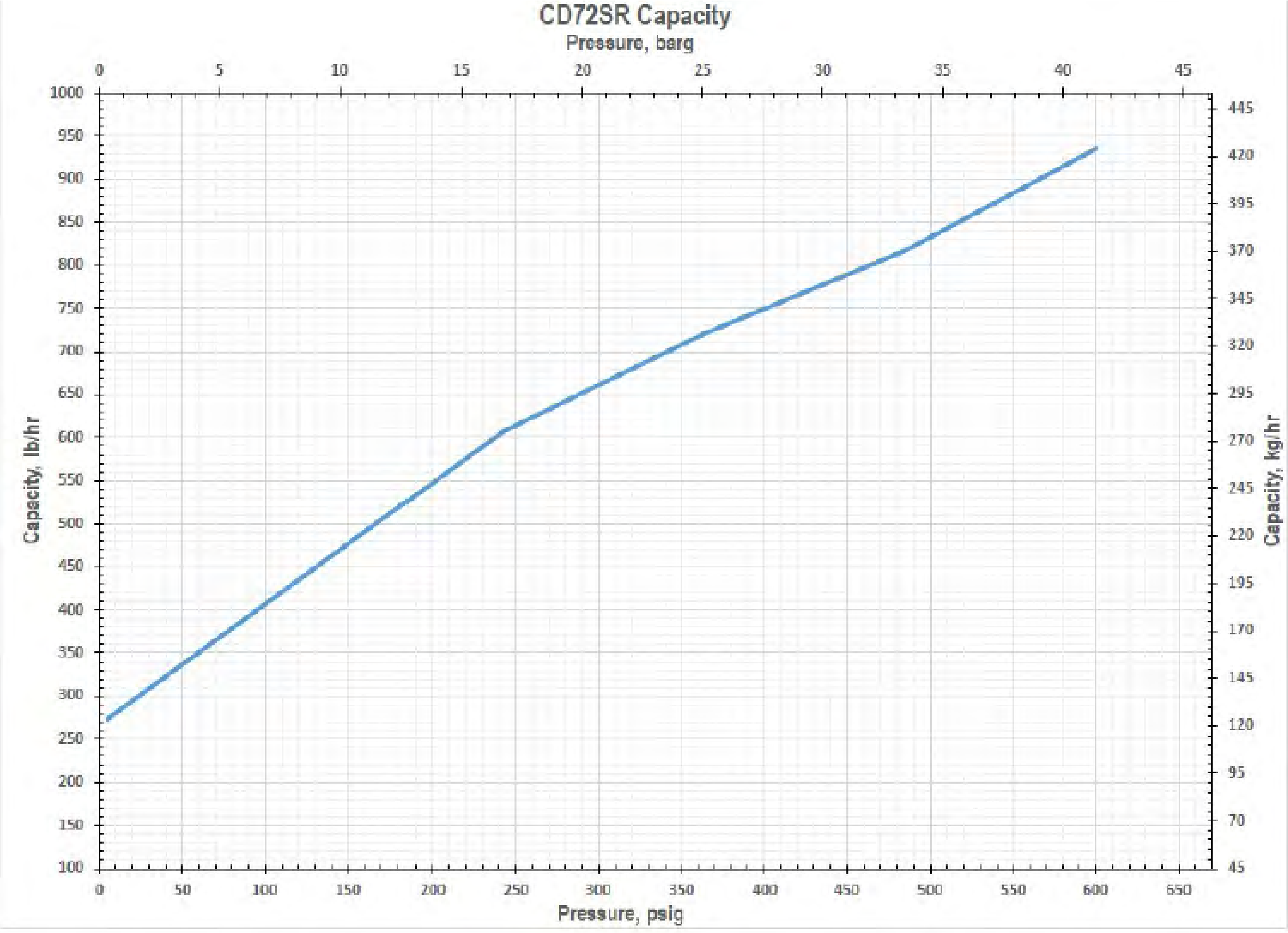
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

CD72SR Series Disc Traps

For Steam Service up to 1010 psig (69.6 barg) and Capacities from 935 lb/hr (435 Kg/hr)

CD72SR CAPACITY CHART

Capacities given are in continuous discharge capacities in pounds and kilograms of hot condensate per hour at pressure differential indicated with condensate temperatures approximately 25° F (14°C) below steam temperature.



OTHER FACE TO FACE DIMENSIONS ARE AVAILABLE ON REQUEST

CD72SR	1/2"(DN15)				3/4"(DN20)				1"(DN25)			
			INDIA - IBR				INDIA - IBR				INDIA - IBR	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
ANSI 150#	6.7	169	8.3	210	6.9	174	7.9	200	7.9	200	8.7	220
ANSI 300#	7.0	179	8.8	224	7.2	183	8.7	220	8.4	213	9.4	240
ANSI 600#	7.6	192	9.3	235	7.7	195	9.1	230	8.9	226	10	253
PN40	5.9	150	-	-	5.9	150	-	-	6.3	160	-	-

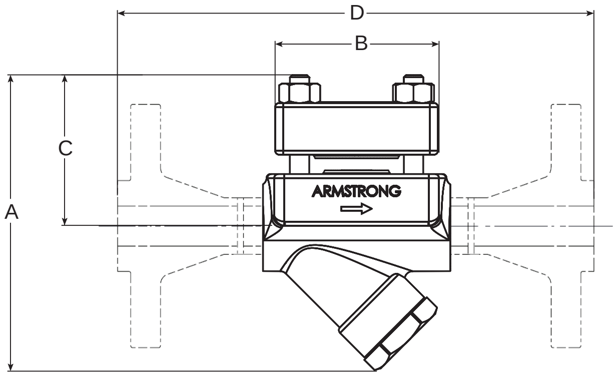
CD-80S Series Disc Trap

For steam service up to 1 000 psig (68.9 barg)...Capacities to 800 lb/hr (362 kg/hr)

Description

The Armstrong CD-80S series are durable disc style steam traps designed for medium to high-pressure use. Perfectly suited for drip trap applications, the CD-80S series was engineered to meet the demanding conditions found in Power and Petrochemical applications.

With an integral strainer and rugged construction, the CD-80S series offers a compact, reliable solution for high pressure applications with low condensate loads.



Advantages

- Compact
- Integral Strainer
- Freeze-resistant
- Replaceable seat and disc
- Weldable

Connections

- Screwed NPT and BSPT
- Socketweld and Buttweld
- Flanged Connections available

Series CD-80S List of Materials

Name of Part	Material	
	CD-80S	CD-82S
Body	ASTM A182 F11 Class 2	ASTM A182 F22 Class 3
Cap		
Screen Retainer		
Disc	ASTM A681 TYP D2	
Seat		
Bolts/Nuts	ASTM A193 Gr. B16 / ASTM A194 Gr. 7	
Strainer Screen	30 x 30 Mesh T-304 Stainless Steel	

Dimensions and Weights - NPT, BSPT and SW Connection

	in	mm
	1/2, 3/4	15, 20
"A" Height	5-11/16	144
"B" Length*	3-5/8	92
"C" CL to top of cap	2-31/32	75
Weight, lb (kg)*	7.75 (3.5)	
Minimum Operating Pressure	100 psig (6.9 barg)	
Maximum Operating Pressure	1 000 psig @ 546°F (68.9 barg @ 285°C)	
Maximum Allowable Pressure	1 500 psig @ 650°F (103.4 barg @ 343°C)	

Dimensions and Weights - ASME B 16.5 Class 150# Flanged Connection

	in	mm	in	mm
	1/2	15	3/4	20
"A" Height	5-11/16	144	5-11/16	144
"D" Face-to-Face	8-3/4	222	9-3/32	231
"C" CL to top of cap	2-31/32	75	2-31/32	75
Weight, lb (kg)*	11.75 (5.3)			
Minimum Operating Pressure	100 psig (6.9 barg)			
Maximum Operating Pressure	200 psig @ 400°F (13.7 barg @ 204°C)			
Maximum Allowable Pressure	200 psig @ 400°F (13.7 barg @ 204°C)			

Dimensions and Weights - ASME B 16.5 Class 600# Flanged Connection

	in	mm	in	mm
	1/2	15	3/4	20
"A" Height	5-11/16	144	5-11/16	144
"D" Face-to-Face	9-19/32	244	10-1/32	254
"C" CL to top of cap	2-31/32	75	2-31/32	75
Weight, lb (kg)*	13.75 (6.2)		15.75 (7.1)	
Minimum Operating Pressure	100 psig (6.9 barg)			
Maximum Operating Pressure	1 000 psig @ 546°F (68.9 barg @ 285°C)			
Maximum Allowable Pressure	1 210 psig @ 600°F (83.7 barg @ 316°C)			

Dimensions and Weights - BW Connection

	in	mm
	1/2, 3/4	15, 20
"A" Height	5-11/16	144
"B" Length*	4-23/32	120
"C" CL to top of cap	2-31/32	75
Weight, lb (kg)*	8.0 (3.6)	
Minimum Operating Pressure	100 psig (6.9 barg)	
Maximum Operating Pressure	1 000 psig @ 546°F (68.9 barg @ 285°C)	
Maximum Allowable Pressure	1 500 psig @ 650°F (103.4 barg @ 343°C)	

Dimensions and Weights - ASME B 16.5 Class 300# Flanged Connection

	in	mm	in	mm
	1/2	15	3/4	20
"A" Height	5-11/16	144	5-11/16	144
"D" Face-to-Face	9-3/32	231	9-1/2	241
"C" CL to top of cap	2-31/32	75	2-31/32	75
Weight, lb (kg)*	11.75 (5.3)		13.75 (6.2)	
Minimum Operating Pressure	100 psig (6.9 barg)			
Maximum Operating Pressure	665 psig @ 500°F (45.6 barg @ 260°C)			
Maximum Allowable Pressure	665 psig @ 500°F (45.6 barg @ 260°C)			

Dimensions and Weights - ASME B 16.5 Class 900# Flanged Connection

	in	mm	in	mm
	1/2	15	3/4	20
"A" Height	5-11/16	144	5-11/16	144
"D" Face-to-Face	10-1/4	260	10-31/32	279
"C" CL to top of cap	2-31/32	75	2-31/32	75
Weight, lb (kg)*	21.75 (9.9)			
Minimum Operating Pressure	100 psig (6.9 barg)			
Maximum Operating Pressure	1 000 psig @ 546°F (68.9 barg @ 285°C)			
Maximum Allowable Pressure	1 500 psig @ 650°F (103.4 barg @ 343°C)			

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

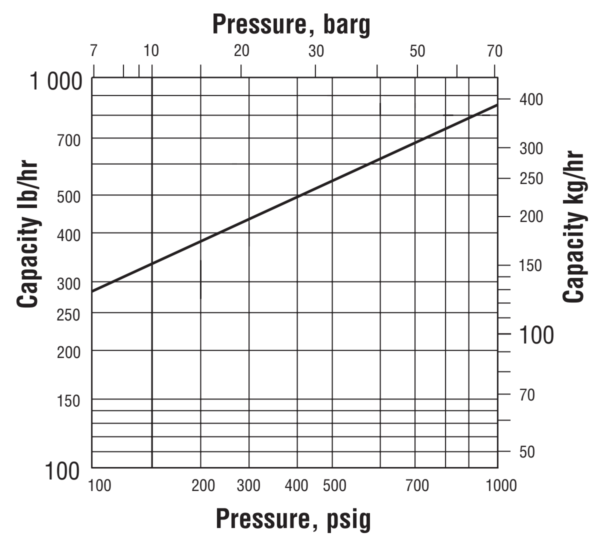
CD-80S Series Disc Trap

For steam service up to 1 000 psig (68.9 barg)...Capacities to 800 lb/hr (362 kg/hr)

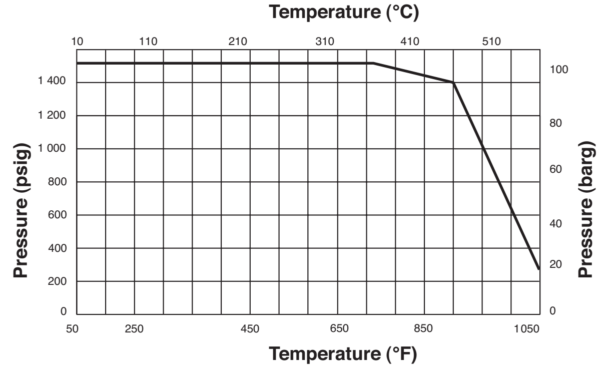
Specification

Steam trap shall be forged steel (ASTM A182 F11 or ASTM A182 F22) thermodynamic type. Trap shall be supplied with bolted cover and replaceable disc and seating surfaces. Trap shall be supplied with an integral Y strainer with stainless steel mesh. Maximum allowable pressure (vessel design) shall be 1 500 psig @ 650°F (103.4 barg @ 343°C). Maximum operating pressure shall be 1 000 psig @ 546°F (68.9 barg @ 285°C).

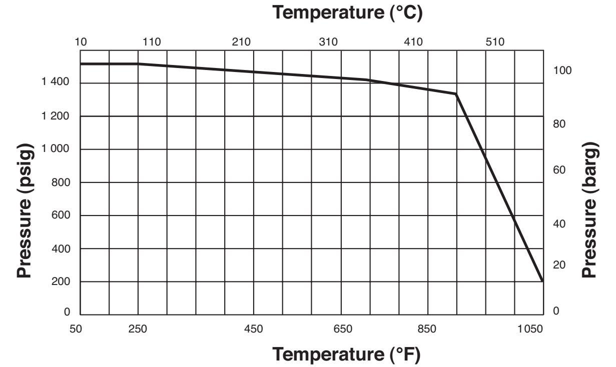
Series CD-80S Series Capacity



CD-80S Allowable Pressure/Temperature



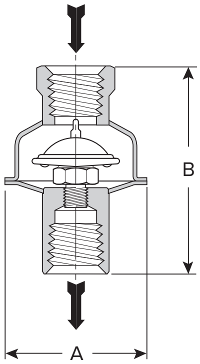
CD-82S Allowable Pressure/Temperature



Thermostatic Wafer Steam Trap

Stainless Steel

For Pressures to 250 psig (17 barg)...Cold Water Start-Up Capacities to 1 000 lb/hr (453 kg/hr)



Model WMT-1 Trap

WMT Thermostatic Wafer Steam Trap				
Model No.	WMT-1			
Pipe Connections	in	mm	in	mm
	1/4, 3/8	6, 10	1/2	15
"A" (Diameter)	2-1/4	57	2-1/4	57
"B" (Height)	3-5/16	84	3-5/16	84
Weight lb (kg)	1-1/4 (0.6)		1-1/4 (0.6)	

Model	WMT-1
Connections	Screwed NPT and BSPT
Material	
Cap and body	ASTM A240 Grade 304L
Capsule	All stainless steel—304
Maximum Operating Conditions	
Maximum allowable pressure (vessel design)	250 psig @ 400°F (17 barg @ 204°C)
Maximum operating pressure	250 psig (17 barg)

Description

The WMT thermostatic wafer traps are designed to last longer than other oversized, all-purpose thermostatic and thermodynamic steam traps.

A water seal prevents loss of steam through the orifice of the WMT Series.

Adjusts automatically to flow rates, including large start-up loads, at all pressures within its range.

Specification

Thermostatic wafer steam trap, type WMT stainless steel.

How to Order

- Specify model number
- Specify size and type of pipe connection. When flanges are required, specify type of flange in detail

For a fully detailed certified drawing, refer to CD #1017 (WMT-1).

Model WMT-Series Thermostatic Wafer Trap Capacity

Differential Pressure*		Cold Water Start-Up 70°F (21°C)		Hot Water Start-Up 212°F (100°C)		Operating Condensate 50°F (0°C) Below Saturation	
psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	**lb/hr	**kg/hr
5	0.35	120	54	100	45	10	4.5
10	0.70	150	68	170	77	13	5.9
20	1.4	320	145	250	113	18	8.2
30	2	390	177	300	136	20	9.1
40	3	420	191	350	159	24	10.9
50	3.5	490	222	400	181	26	11.8
75	5	570	259	480	218	30	13.6
100	7	650	295	580	263	35	15.9
150	10.5	700	318	700	318	40	18.1
200	14	900	408	800	363	46	20.9
250	17	1 000	454	950	431	50	22.7

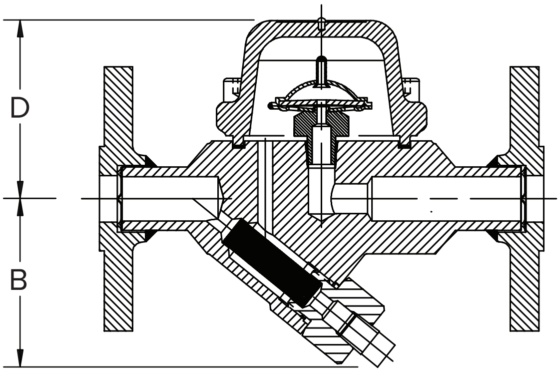
*Capacities based on differential pressure with no back pressure.

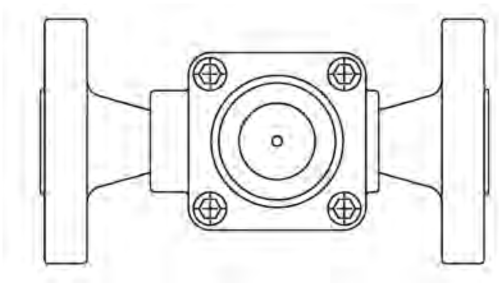
**Capacities will vary with the degree of subcooling. When greater capacities are required, the trap will automatically adjust to the load, up to the maximum (cold water) capacity shown, by increasing the amount of subcooling.

TC-300 Series Thermostatic Wafer Steam Trap

Carbon Steel

For Pressures to 250 psig (17 barg)...Cold Water Start-Up Capacities to 1 000 lb/hr (453 kg/hr)





Description

The TC-300 is sized precisely to handle the extremely low condensate load found in most instrument steam tracer lines. The TC-300 traps are designed to last longer than other oversized, all-purpose thermostatic and thermodynamic steam traps.

This steam trap adjusts automatically to flow rates, including large start-up loads, at all pressures within its range.

How to Order

Specify: Model Number, Size and type of pipe connection. When flanges are required, specify type of flange in detail.

TC-300 Series Thermostatic Wafer Steam Trap Capacity

Differential Pressure*		Cold Water Start-Up 70°F (21°C)		Hot Water Start-Up 212°F (100°C)		Operating Condensate 50°F (10°C) Below Saturation	
psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	**lb/hr	**kg/hr
5	0.35	120	54	100	45	10	4.5
10	0.70	150	68	170	77	13	5.9
20	1.4	320	145	250	113	18	8.2
30	2	390	177	300	136	20	9.1
40	3	420	191	350	159	24	10.9
50	3.5	490	222	400	181	26	11.8
75	5	570	259	480	218	30	13.6
100	7	650	295	580	263	35	15.9
150	10.5	700	318	700	318	40	18.1
200	14	900	408	800	363	46	20.9
250	17	1 000	454	950	431	50	22.7

* Capacities based on differential pressure with no back pressure.
** Capacities will vary with the degree of subcooling. When greater capacities are required, the trap will automatically adjust to the load, up to the maximum (cold water) capacity shown, by increasing the amount of subcooling.

TC-300 Trap

Pipe Connections	in	mm
	1/2, 3/4,1	15 – 20 – 25
"B" Height (Screwed & SW)	4-19/32	117
"A" Height (flanged PN40*)	4-19/32	117
"C" Face-to-Face (Screwed & SW)	3-1/2 – 3-1/2 – N/A	90 – 90 – N/A
"CC" Face-to-Face (Flanged PN40*)	5-29/32 – 5-29/32 – 6-19/64	150 – 150 – 160
"D" CL to Top	2-3/8	60
Weight in kg (Screwed & SW)	4-1/4	1,9
Weight in kg (Flanged PN40)	9-1/2 – 9-1/2 – 10	4,3 – 4,5 – 4,7

TC-300 Traps

Model	TC-300
Connections	Screwed BSPT and NPT Socketwelded Flanged DIN and ANSI
Material	
Cap and Body	ASTM-A-105
Capsule	All Stainless Steel – 304
Maximum Operating Conditions	
Maximum allowable pressure (vessel design)†	465 psig @ 662°F (32 barg @ 350 °C)
Maximum operating pressure	250 psig @ 400°F (17 barg @ 207 °C)

† May be derated depending on flange rating and type.

WT Series Thermostatic Wafer Steam Trap

Stainless Steel or Carbon Steel

For Pressures to 600 psig (41 barg)...Cold Water Start-Up Capacities to 1 600 lb/hr (726 kg/hr)

Description

Armstrong offers three thermostatic wafer steam traps. The WT-1 is ideal for low-capacity steam tracers and features an exclusive non-welded wafer design and internal strainer screen two to three times larger than that of other thermostatic traps in a sealed stainless steel body. Choice of NPT or BSPT screwed connections.

The WT-2000 does not have an internal strainer, but is equipped with a special 360° connector to expand piping options and simplify installation. Choice of NPT or BSPT screwed connections, or socketweld connections. Also available with optional IS-2 stainless steel connector with integral strainer.

Armstrong's WT-3 is a carbon steel thermostatic wafer trap for superheated drip service. It features an exclusive non-welded wafer design, which eliminates problems associated with weld stress. The WT-3 has no thin-walled enclosures such as bellows or welded diaphragms. It is also resistant to water hammer. Choice of NPT or BSPT screwed connections, or socketweld connections.

NOTE: Since the normal operation of all suppressed temperature-discharge (subcooling) steam traps is to back up condensate, they should not be used on drip legs for saturated steam service, heating or process equipment. Exercise care in the maintenance of any thermostatic wafer trap with a small discharge area susceptible to clogging.

Specification

Thermostatic wafer steam trap, type ... in stainless steel or carbon steel.

How to Order

Specify:
- Model number
- Size and type of pipe connection, or connector style
- Any options required

For a fully detailed certified drawing, refer to CD #1017.

Model WT Series Wafer Trap Capacity

Differential Pressure*		Cold Water Start-Up 70°F (21°C)		Hot Water Start-Up 212°F (100°C)		Operating Condensate 50°F (10°C) Below Saturation	
psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	**lb/hr	**kg/hr
5	0.35	120	54	100	45	10	4.5
10	0.70	150	68	170	77	13	5.9
20	1.4	320	145	250	113	18	8.2
30	2	390	177	300	136	20	9.1
40	3	420	191	350	159	24	10.9
50	3.5	490	222	400	181	26	11.8
75	5	570	259	480	218	30	13.6
100	7	650	295	580	263	35	15.9
150	10.5	700	318	700	318	40	18.1
200	14	900	408	800	363	46	20.9
250	17	1 000	454	950	431	50	22.7
300	21	1 050	476	1 025	465	56	25.4
350	24	1 150	522	1 200	544	63	28.6
400	28	1 300	590	1 250	567	70	31.8

*Capacities based on differential pressure with no back pressure.

**Capacities will vary with the degree of subcooling. When greater capacities are required, the trap will automatically adjust to the load, up to the maximum (cold water) capacity shown, by increasing the amount of subcooling.

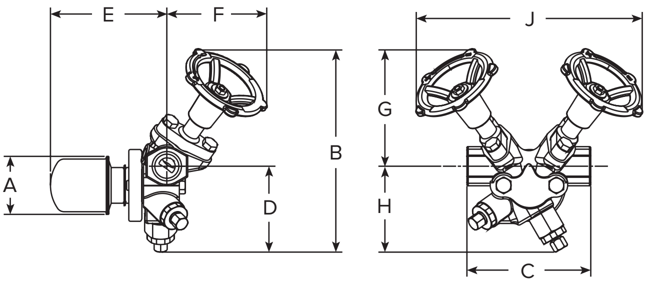
Model	WT-1 All Stainless Steel	WT-2000 Stainless Steel w/360° Connector	WT-3 Carbon Steel
Design		Welded	
Connections	Screwed (NPT and BSPT) Socketweld	Screwed (NPT and BSPT), Socketweld and Flanged	Screwed (NPT and BSPT) Socketweld
Material			
Body	ASTM A240—304L		Carbon steel C-1018
Cap			
Capsule wafer	Hastelloy		
Capsule body	Stainless steel—303		
Capsule cap			
Flange	—	ASTM A105 Zinc plated	—
Connector			
Standard	—	Stainless steel—304	—
IS-2 w/integral strainer	—	Stainless steel—304 w/20x20 mesh 304 SS screen	—
TVS 4000	—	ASTM A351 Gr. CF8M with screen, test valve and blowdown valve—stainless steel	—
Maximum Operating Conditions			
Maximum allowable pressure (vessel design)	400 psig @ 650°F (28 barg @ 343°C)		600 psig @ 750°F (41 barg @ 399°C)
Maximum operating pressure	400 psig (28 barg)		600 psig (41 barg)
Option WT-2000			
Blowdown Valve IS-2 Connector and TVS-4000 Only			

Armstrong®

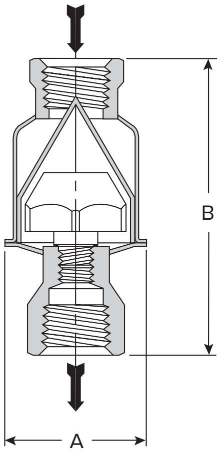
WT Series Thermostatic Wafer Steam Trap

Stainless Steel or Carbon Steel

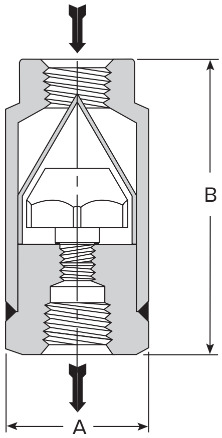
For Pressures to 600 psig (41 barg)...Cold Water Start-Up Capacities to 1 600 lb/hr (726 kg/hr)/hr (726 kg/hr)



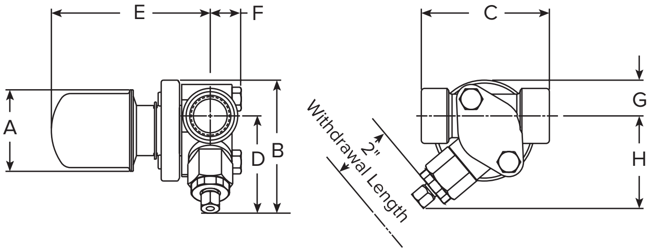
Series WT-2000 With TVS 4000 Trap Valve Station



Model WT-1 Trap



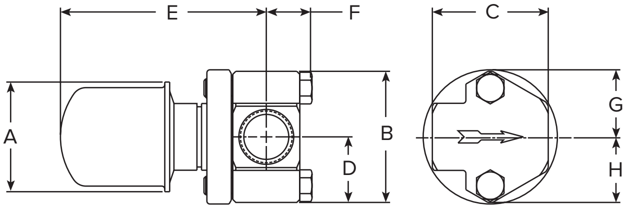
Model WT-3 Trap



Series WT-2000 With Integral Strainer and Blowdown Valve

Connectors

The WT-2000 can be connected to the standard connector, the IS-2 with integral strainer, or TVS 4000. WT-2000 can be used on thermostatic, thermostatic wafer and disc traps.



Series WT-2000 With Standard Connector

WT-1 Series Traps

Model No.	WT-1			
Pipe Connections	in	mm	in	mm
	1/2	15	3/4	20
"A" (Diameter)	2-1/4	57	2-1/4	57
"B" (Height)	4-1/2	114	4-11/16	119
Weight, lb (kg)	1 (0.5)		1-1/4 (0.6)	

WT-3 Series Traps

Model No.	WT-3	
Pipe Connections	in	mm
	1/2, 3/4	15, 20
"A" (Diameter)	2-1/4	57
"B" (Height)	4-5/8	118
Weight, lb (kg)	3 (1.4)	

WT-2000 Series Traps

Model No.	WT-2000							
	Standard Connector		IS-2 Connector With Integral Strainer				TVS 4000 Connector	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	3/8, 1/2, 3/4	10, 15, 20	1/2, 3/4	15, 20	1	25	1/2, 3/4	15, 20
"A" Trap Diameter	2-1/4	57	2-1/4	57	2-1/4	57	2-1/4	57
"B" Total Height	2-11/16	68	3-5/8	92	3-5/8	92	7-13/16	198
"C" Face-to-Face	2-3/8	60	3-1/2	89	4	101	4-3/4	120
"D" Connection ℄ to Bottom	1-3/8	46	2-5/8	67	2-5/8	67	3-1/4	83
"E" Connection ℄ to Outside of Trap	4-1/4	107	4-3/4	120	4-15/16	125	4-1/2	115
"F" Connection ℄ to Front of Connector	13/16	20	7/8	22	7/8	22	3-7/8	98
"G" Connection ℄ to Top	1-3/8	46	1	25	1	25	4-1/2	114
"H" Connection ℄ to Bottom of Connector	1-3/8	46	2-1/2	64	2-1/2	64	3-1/4	83
"J" Width Across Handwheels (valve open)	—	—	—	—	—	—	8-11/16	221
Test Port Connection	—	—	—	—	—	—	1/4 NPT	6
Trap Only Weight, lb (kg)	1-1/2 (0.70)							
Trap and Connector Weight, lb (kg)	3.2 (7)		3.4 (7.5)				8 (3.6)	

SH Series Superheat Traps

Bimetallic Steam Traps For Superheat Conditions

For Pressures to 1 800 psig (124 barg)...Cold Water Capacities to 6 500 lb/hr (2 950 kg/hr)

Description

Armstrong's SH Series Bimetallic Steam Traps for superheat or low load conditions are the ideal traps for applications where other trap styles are not suitable for long life.

The Armstrong SH Series bimetallic traps also have the ability to handle the large start-up loads associated with superheat applications. The unique bimetallic element allows for shut-off before superheat reaches the trap, thus preventing steam loss. The SH-900/1500 series utilizes titanium valves and seats to ensure extremely long service life in the harsh environment of superheated steam systems.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):

Model SH-300:	580 psig @ 662°F (40 barg @ 350°C)
Model SH-900L and H:	900 psig @ 900°F (62 barg @ 482°C)
Model SH-1500:	1 800 psig @ 1 050°F (124 barg @ 565°C)

Maximum operating pressure:

Model SH-300:	319 psig (22 barg)
Model SH-900L:	650 psig (45 barg)
Model SH-900H:	900 psig (62 barg)
Model SH-1500:	1 800 psig (124 barg)

Suggested minimum operating pressure:

Model SH-300:	Not applicable
Model SH-900L and H:	200 psig (14 barg)
Model SH-1500:	600 psig (41 barg)

Connections

Model SH-300:	Screwed BSPT and NPT, socketweld, flanged DIN or ANSI (welded)
Model SH-900:	Socketweld, flanged, buttweld, screwed, NPT, BSPT
Model SH-1500:	Socketweld, flanged, buttweld

Materials

Model SH-300

Body and cap:	ASTM A105 ASTM A350-LF2
Valve and seat:	Chrome Steel - 440C
Elements:	Nickel plated
Strainer:	Stainless steel screen

Model SH-900

Body and cap:	ASTM A351 Gr. CF8M
Valve and seat:	Titanium
Elements:	Ni-Cr and stainless steel
Strainer:	Stainless steel screen

Model SH-1500

Body and cap:	ASTM 217 Gr. C12A
Valve and seat:	Titanium
Elements:	Ni-Cr and stainless steel
Strainer:	Stainless steel screen

Specification

Steam trap shall be a bimetallic style. The trap shall be investment cast chrome-moly steel (Model SH-1500) with integral stainless steel strainer, in-line repairable. The mechanism shall consist of a stacked nickel-chrome bimetal operator, with titanium valve and seat. The steam trap shall be capable of operation on low load and superheat applications throughout its pressure/temperature range.

Bimetallic style steam traps in carbon steel (Model SH-300) or stainless steel (Model SH-900) with integral stainless steel strainer, in-line repairable. The mechanism shall consist of a stacked nickel-chrome bimetal operator (SH-300 nickel plated) with titanium valve and seat (SH-300 chrome steel valve and seat). The steam trap shall be capable of operation on low-load applications throughout its pressure/temperature range.

How to Order

- Specify model number
- Specify maximum operating pressure
- Specify size and type of pipe connection. When flanges are required, specify type of flange in detail

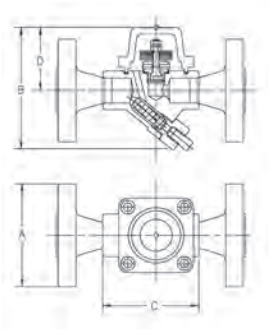
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

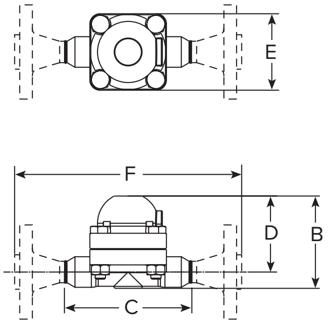
SH Series Superheat Traps

Bimetallic Steam Traps For Superheat Conditions

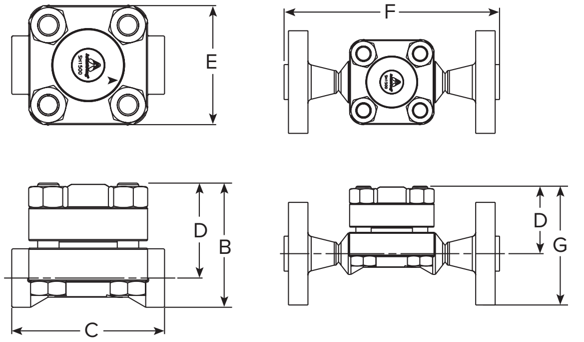
For Pressures to 1 800 psig (124 barg)...Cold Water Capacities to 6 500 lb/hr (2 950 kg/hr)



Model SH-300



Model SH-900



Model SH-1500

SH Series Dimensions and Weights

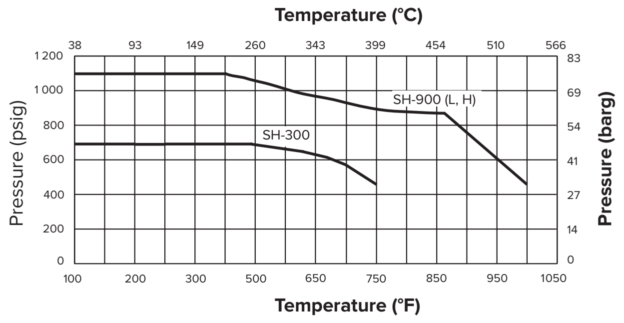
Model	SH-300		SH-900		SH-1500	
Pipe Connections	in	mm	in	mm	in	mm
	1/2, 3/4, 1***	15, 20, 25	1/2, 3/4, 1**	15, 20, 25	3/4, 1	20, 25
“B” Height	4-1/2	115	4-1/2	115	5	127
“C” Face-to-Face	3-1/2	90	6-1/4	158	6-1/4	158
“D” ℄ to Top	2-5/16	59	3-3/4	95	3-13/16	97
“E” Width	—	—	3-3/4	95	4-7/8	124
*“F”	—	—	11	279	12	305
*“G”	—	—	—	—	6-3/8	162
Weight, lb (kg)	4.1 (1.9)		10 (4.4)		15 (6.8)	

*“F” dimensions for SH-900 are for 3/4" connection, class 600 flanged. “F” and “G” dimensions for SH-1500 are for 3/4" connection, class 1500 flanged. Consult factory for dimensions of models with other connection sizes and/or flanges.

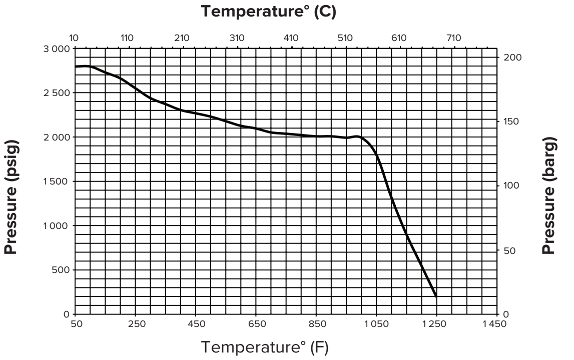
** SH-900 1" buttweld.

***SH-300 1" only available as flanged connections.

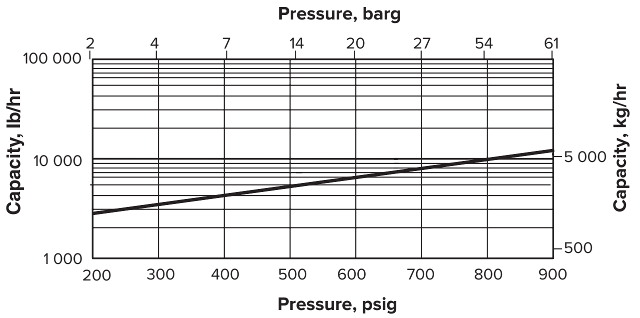
SH-300/SH-900 Allowable Pressure/Temperature



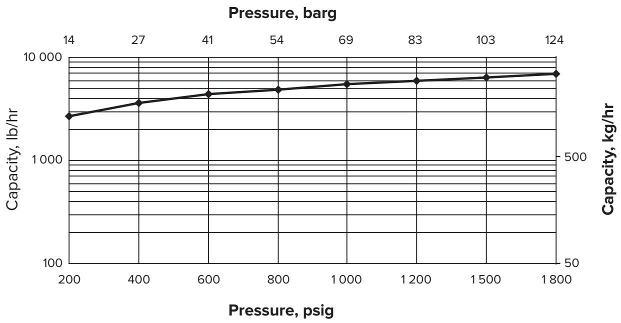
SH-1500 Allowable Pressure/Temperature



SH-900 Cold Water Capacity



SH-1500 Cold Water Capacity



SH-2000 Bimetallic Steam Traps

All Stainless Steel

For pressures to 400 psig (28 barg)...Cold Water Capacities to 4 800 lb/hr (2 175 kg/hr)

Description

SH Series Superheat Steam Traps operate by the effect that rising temperature has on the thermostatic bimetallic elements.

The effect of rising temperature on bimetallic elements operates the Armstrong SH-2000 bimetallic steam trap. It adjusts to changing conditions because the curving of the bimetallic elements, caused by increasing temperature, compensates for increasing pressure.

At start-up, the valve is wide open, which allows a large volume of non-condensables and cold condensate to be removed from the system. When the system reaches steam temperature, the elements become sufficiently hot to pull on the trap's valve stem, closing the valve.

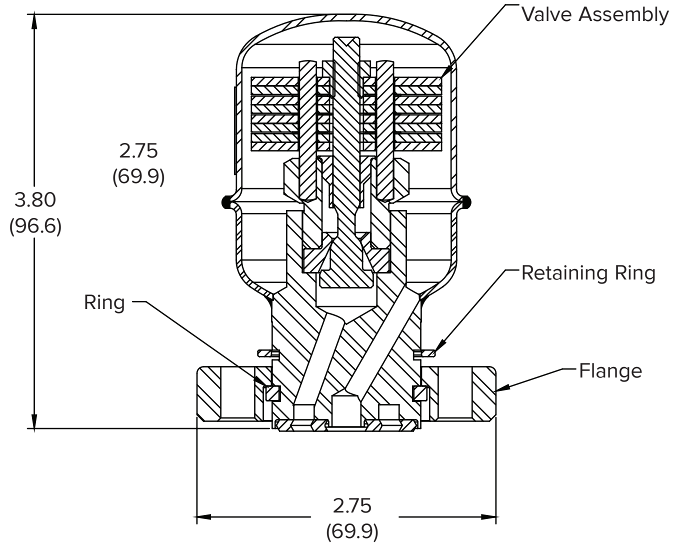
The valve remains closed until the bimetallic elements cool, thus allowing the valve to crack open, venting the condensate and non-condensables, and then close again when steam temperature is reached.

The Armstrong SH-2000 has a sealed, stainless steel body that is lightweight, compact and highly resistant to corrosion. It is adaptable to an Armstrong 360° Universal Connector or a Trap Valve Station (TVS). This makes it easy to install and replace, as the trap can be removed while the connector remains in-line. That means savings in labor cost and ultimate flexibility—because inverted bucket, thermostatic, thermostatic wafer, disc, and float and thermostatic steam traps can all be installed on the same connector.

Maximum Operating Conditions

Maximum allowable pressure (vessel design):
400 psig @ 800°F (28 barg @ 427°C)

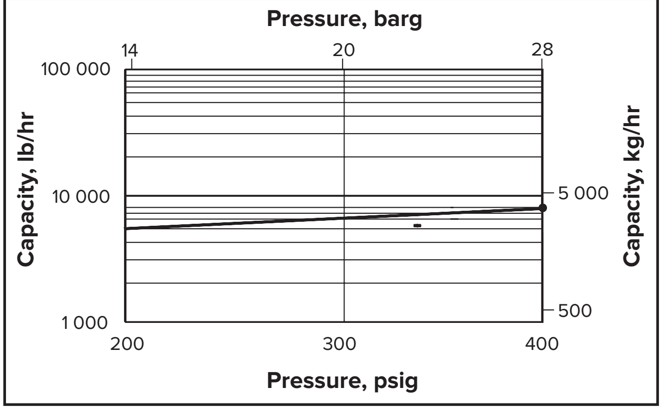
Maximum operating pressure: 400 psig (28 barg)
Suggested minimum operating pressure: 200 psig (14 barg)



Materials

Body:	Stainless Steel
Valve & Seat Elements:	Titanium, Ni-Cr and Stainless Steel
Ring:	Stainless Steel
Cap Assembly:	Stainless Steel
Flange:	ASTM A105 Zinc plated
Retainer Ring:	Carbon Steel
Spiral Wound Gasket:	Stainless Steel
Label:	Aluminum

SH-2000 Cold Water Capacity



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

SH-2500 Bimetallic Steam Trap

All Stainless Steel

For Pressures to 650 psig (45 barg)...Capacities to 6 000 lb/hr (2 722 kg/hr)

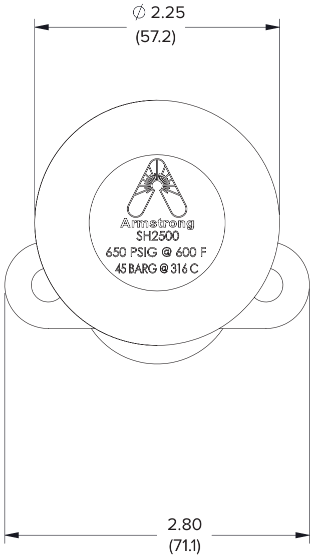
Description

Armstrong's SH-2500 Bimetallic Steam Trap is the ideal design for applications involving superheated steam.

During start-up, the bimetallic mechanism is fully open and allows large volumes of non-condensable gases and condensate to be removed from the system. As the system reaches saturated steam conditions, the mechanism begins to close preventing any live steam loss. The superheat during normal operating steam conditions keep the valve closed to ensure long service life.

In the event that operating conditions change and condensate forms at the steam trap inlet, the cooling effect allows the bimetallic mechanism to open and discharge any accumulation. The valve quickly closes once normal operating conditions return.

The SH-2500 consists of an investment cast, stainless steel body that is compact and highly resistant to harsh, corrosive environments. The integral mounting flange is compatible with the Armstrong IS-2, TVS-4000, std connector making for labor savings and easy steam trap replacement.



Maximum Operating Conditions

Maximum allowable pressure (vessel design):
650 psig @ 600°F (45 barg @ 316°C)

Maximum operating pressure:
SH-2500 650 psig @ 600°F (45 barg @ 316°C)

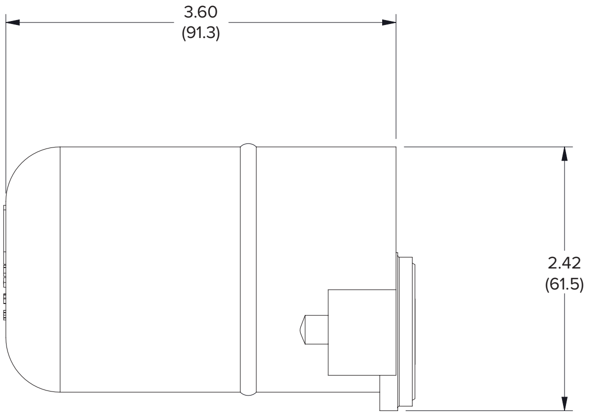
Suggested minimum operating pressure:
SH-2500 200 psig (14 barg)

Materials and Weight

Body:	ASTM A351 Gr. CF8M
Valve & Seat Elements:	Titanium Ni-Cr Stainless Steel
Spiral Wound Gasket:	Stainless Steel
Bolts:	ASTM A193 B7
Weight:	2.8 lbs (1.3 kg)

Specification

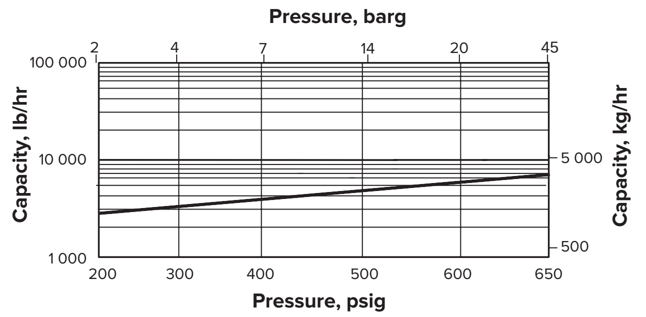
Steam traps shall be a bimetallic style designed for superheated steam applications. The steam trap body shall be tamperproof, investment cast stainless steel A351 Gr. CF8M. The mechanism shall consist of a stacked nickel-chrome bimetal operator with titanium valve and seat. The gaskets shall be captured stainless steel spiral wound. The steam trap shall be compatible with the 2-bolt universal connector technology.



How to Order

Specify model number
Maximum working pressure and temperature

SH-2500 Cold Water Capacity (Start Up)



Note: Cold water capacity for start-up loads only. When superheat present, there will be minimal condensate.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

AB-3000 Series Bimetallic Steam Traps

All Stainless Steel

For Pressures to 319 psig (22 barg)...Capacities to 4 630 lb/hr (2 100 kg/hr)

Description

Armstrong's AB-3000 Bimetallic Steam Trap operates by the effect that rising temperature has on bimetallic elements. It adjusts itself to changing conditions, as the increasing pressure on the valve is compensated by the curving of the bimetallic elements caused by the increasing temperature.

Armstrong's AB-3000 has a sealed, stainless steel body that is lightweight, compact and highly resistant to corrosion. The AB-3000 is repairable (body and cap can be unscrewed). It is piped through the Armstrong 360° Universal Connector or Trap Valve Station (TVS). This makes it easy to install and replace, as the trap can be removed while the connector remains in-line. The result is savings in labor cost and increasing in flexibility, as other trap types (Inverted Bucket, Thermostatic and Thermodynamic) can be installed on the same connector.

Maximum operating conditions

Maximum allowable pressure (vessel design):	406 psig @ 650°F (28 barg @ 343°C)
Maximum operating pressure:	319 psig (22 barg)
Maximum back pressure:	99% of inlet pressure

Connections

Screwed BSPT and NPT
Socketweld

Materials

Body:	ASTM - A240 304L
Standard connector:	Stainless steel – 304
Valve:	Chrome steel – 440F
Seat:	303 Stainless steel
Elements:	Nickel plated
Strainer:	304 Stainless steel

Specification

Bimetallic repairable steam trap, type AB-3000 in stainless steel, with integral strainer. Piped through 360° Universal Connector or Trap Valve Station (TVS). Maximum allowable back pressure 99% of inlet pressure.

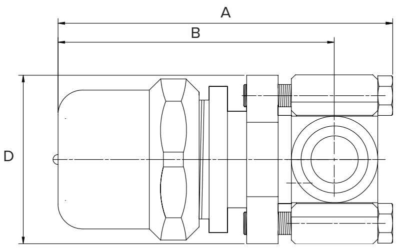
How to order

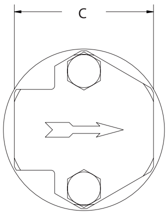
Specify:

- Size and type of pipe connection.
- Maximum working pressure that will be encountered
- Maximum condensate load

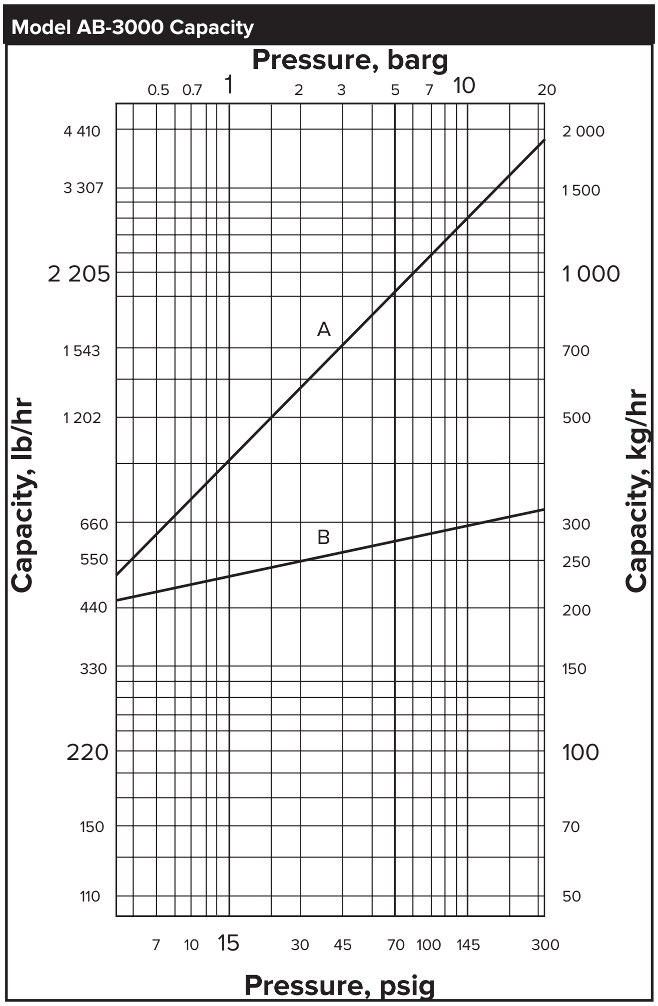
Model AB-3000 Trap

	in	mm
Pipe Connections	3/8, 1/2, 3/4, 1	10, 15, 20, 25
"A" Length w/ Connector	5-7/16	138
"B" ℄ to Top of Cap	4-1/2	115
"C" Face-to-Face (screwed & SW)	2-3/8, 2-3/8, N/A	60, 60, N/A
"D" Trap Diameter	2-3/16	70
Weight lb (kg) (screwed & SW)	4 (2)	





Model AB-3000 Capacity



A = Cold Water
B = Hot Condensate

SH-4000 Series Bimetallic Steam Traps

All Stainless Steel

For Pressures to 1 245 psig (86 barg)...Capacities to 6 000 lb/hr (2 722 kg/hr)

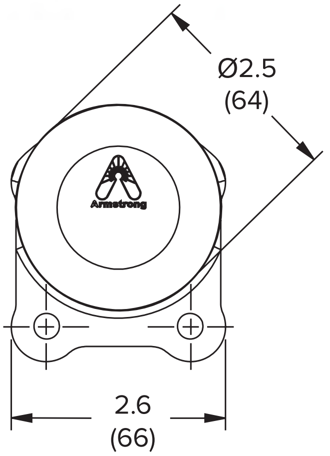
Description

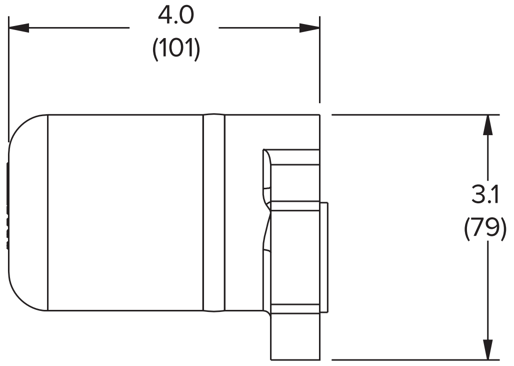
Armstrong's SH-4000 Series Bimetallic Steam Trap is the ideal design for applications involving superheated steam.

During start-up, the bimetallic mechanism is fully open and allows large volumes of non-condensable gases and condensate to be removed from the system. As the system reaches saturated steam conditions, the mechanism begins to close preventing any live steam loss. The superheat during normal operating steam conditions keep the valve closed to ensure long service life.

In the event that operating conditions change and condensate forms at the steam trap inlet, the cooling effect allows the bimetallic mechanism to open and discharge any accumulation. The valve quickly closes once normal operating conditions return.

The SH-4000 consists of an investment cast, stainless steel body that is compact and highly resistant to harsh, corrosive environments. The integral mounting flange is compatible with the Armstrong IS-4, 4-bolt, Class 900, connector making for labor savings and easy steam trap replacement.





Maximum Operating Conditions

Maximum allowable pressure (vessel design):
1 245 psig @ 900°F (86 barg @ 482°C)

Maximum operating pressure:

SH-4009L	650 psig @ 900°F (45 barg @ 482°C)
SH-4009H	900 psig @ 900°F (62 barg @ 482°C)
SH-4015	1 245 psig @ 900°F (86 barg @ 482°C)

Suggested minimum operating pressure:
SH-4009L and SH-4009H 200 psig (14 barg)
SH-4015 650 psig (45 barg)

Materials and Weight

Body:	ASTM A351 Gr. CF8M
Valve & Seat Elements:	Titanium Ni-Cr Stainless Steel
Spiral Wound Gasket:	Stainless Steel
Bolts:	ASTM A193 B7
Weight:	3.75 lbs (1.7 kg)

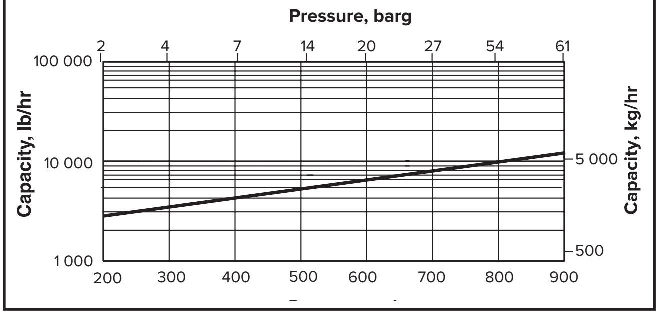
Specification

Steam traps shall be a bimetallic style designed for superheated steam applications. The steam trap body shall be tamperproof, investment cast stainless steel A351 Gr. CF8M. The mechanism shall consist of a stacked nickel-chrome bimetal operator with titanium valve and seat. The gaskets shall be captured stainless steel spiral wound. The steam trap shall be compatible with the 4-bolt universal connector technology.

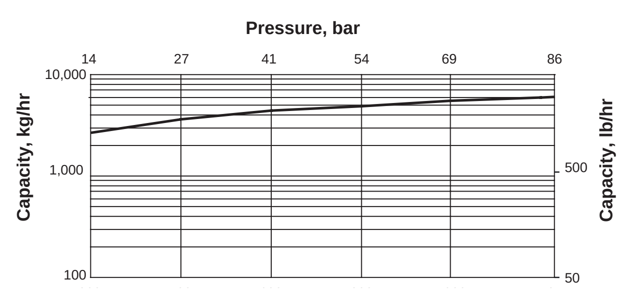
How to Order

Specify model number
Maximum working pressure and temperature

SH-4009L and SH-4009H Cold Water Capacity



SH-4015 Cold Water Capacity



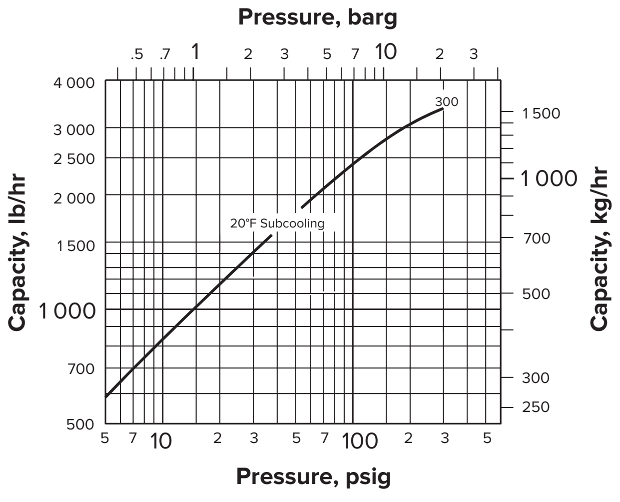
Note: Cold water capacity for start-up loads only. When superheat present, there will be minimal condensate.

TT Series Thermostatic Steam Traps

All Stainless Steel

For Pressures to 300 psig (20 barg)...Capacities to 3 450 lb/hr (1 568 kg/hr)

TTF Series Capacity

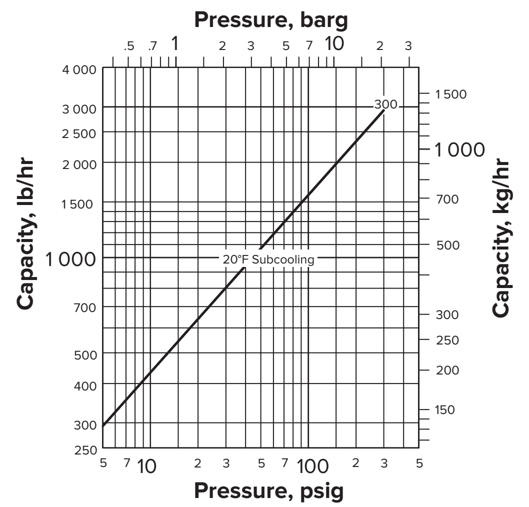


Description

The balanced pressure bellows thermostatic steam trap has a sealed, stainless-steel body that is lightweight, compact and highly resistant to corrosion. The cage, bellows, valve and seat are all assembled into a precisely calibrated operating unit that ensures positive opening and closing action at slightly below steam temperature. The unique, stainless-steel construction is smaller and much lighter than comparable cast iron, brass or steel traps. TTF-1 is available with straight-thru or right angle connections. TT-2000 with the 360° universal stainless steel connector comes with either a standard connector or the IS-2 connector with integral strainer.

NOTE: Also can be used as a thermostatic air vent (Reference TTF Series Thermostatic Air Vents page 464).

Model TT-2000 Capacity



Specification

Thermostatic steam trap, type … in stainless steel.

How to Order

Specify:

- Model number
- Size and type of pipe connection
- Connector type (TT-2000)

Connections

3/8", 1/2", 3/4" (10 mm, 15 mm, 20 mm)
1" (25 mm) IS-2 connector only
Socketweld

Materials

Body:	304L stainless steel
Bellows:	Stainless steel and bronze with phosphor-bronze bellows, caged in stainless steel
Flange	ASTM A105 Zinc plated
Connector:	304 stainless steel (TT-2000)

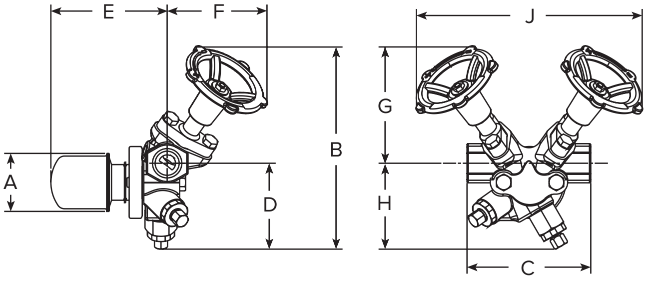
For a fully detailed certified drawing, refer to:
Standard Connector CD #1018 **IS-2 Connector CD #1117**

Model	TTF-1	TTF-1R	TT-2000
Design	Welded		
Connections	Screwed (NPT and BSPT)		Screwed (NPT and BSPT), Socketweld and Flanged
Material			
Body	ASTM A240 - 304L		
Valve	Bronze		
Seat	Stainless steel		
Thermostatic air vent	Standard stainless steel & bronze w/phosphor bronze bellows caged in stainless steel		
Optional: All stainless steel thermostatic air vent			
Connector			
Standard	—	—	Stainless steel - 304
IS-2 w/integral strainer	—	—	Stainless steel - 304 w/20x20 mesh 304 SS screen
TVS 4000	ASTM A351 Gr. CF8M with screen, test valve, and blowdown valve—stainless steel		
Maximum Operating Conditions			
Maximum allowable pressure (vessel design)	300 psig @ 450°F (20 barg @ 232°C)		
Maximum operating pressure	300 psig (20 barg)		
Maximum operating temperature bellows	422°F (217°C)		

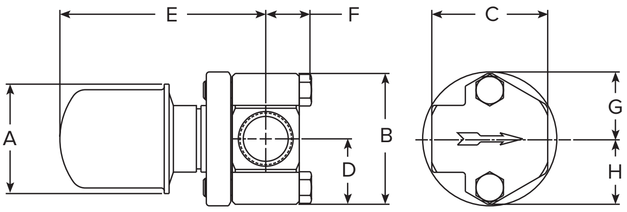
TT Series Thermostatic Steam Traps

All Stainless Steel

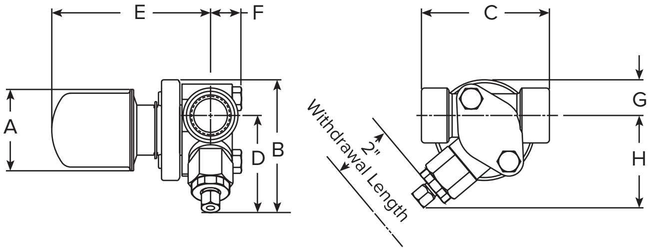
For Pressures to 300 psig (20 barg)...Capacities to 3 450 lb/hr (1 568 kg/hr)



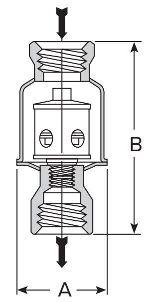
Series TT-2000 With TVS 4000 Trap Valve Station



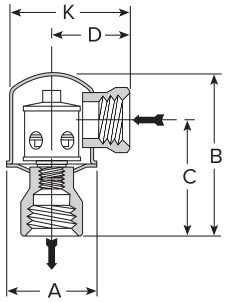
Series TT-2000 With Standard Connector



Series TT-2000 With Integral Strainer and Blowdown Valve



Series TTF-1 Trap



Series TTF-1R Trap

TT-2000 Series Steam Trap

Model No.	TT-2000							
	Standard Connector		IS-2 Connector With Integral Strainer				TVS 4000 Connector	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	3/8, 1/2, 3/4	10, 15, 20	1/2, 3/4	15, 20	1	25	1/2, 3/4 1	5, 20
“A” Trap Diameter	2-1/4	57	2-1/4	57	2-1/4	57	2-1/4	57
“B” Total Height	2-11/16	68	3-5/8	92	3-5/8	92	7-13/16	198
“C” Face-to-Face	2-3/8	60	3-1/2	89	4	101	4-3/4	120
“D” Connection ℄ to Bottom	1-3/8	46	2-5/8	67	2-5/8	67	3-1/4	83
“E” Connection ℄ to Outside of Trap	4-1/4	107	4-3/4	120	4-15/16	125	4-1/2	115
“F” Connection ℄ to Front of Connector	13/16	20	7/8	22	7/8	22	3-7/8	98
“G” Connection ℄ to Top	1-3/8	46	1	25	1	25	4-1/2	114
“H” Connection ℄ to Bottom of Connector	1-3/8	46	2-1/2	64	2-1/2	64	3-1/4	83
“J” Width Across Handwheels (valve open)	—	—	—	—	—	—	8-11/16	221
Test Port Connection	—	—	—	—	—	—	1/4 NPT	6
Trap Only Weight, lb (kg)	1-1/2 (0.70)							
Trap and Connector Weight, lb (kg)	3.2 (7)		3.4 (7.5)				8 (3.6)	

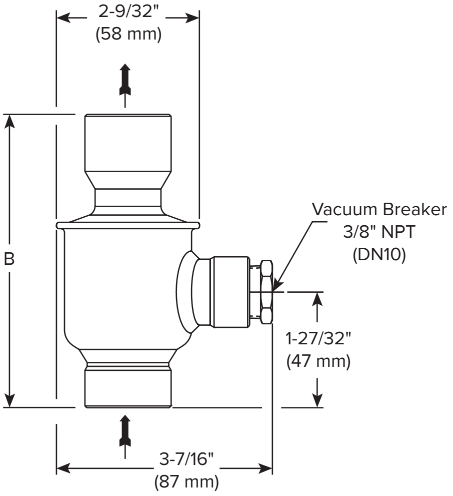
TTF-1 Series Steam Trap

Model No.	TTF-1 Straight-Thru Connection				TTF-1R Right-Angle Connection			
	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2	15	3/4	20	1/2	15	3/4	20
“A” Trap Diameter	2-1/4	57	2-1/4	57	2-1/4	57	2-1/4	57
“B” Total Height	4-1/2	114	4-11/16	119	3-3/4	97	3-15/16	100
“C” Face-to-Face	—	—	—	—	2-5/8	67	2-13/16	71
“D” Connection ℄ to Bottom	—	—	—	—	1-15/16	49	1-7/8	48
“K” Inlet to Outside of Trap	—	—	—	—	3-1/16	78	3	76
Trap Only Weight, lb (kg)	3/4 (0.4)		1 (0.5)		3/4 (0.4)		1 (0.5)	

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Stainless Steel Thermostatic Air Vent/Vacuum Breaker

For Pressures to 150 psig (10 barg)...Capacities to 55 scfm



TAVB-3 shown

The Armstrong TAVB is a combination thermostatic air vent/vacuum breaker that is ideally suited for steam-filled vessels with modulating controls. The TAVB will vent air and other non-condensables from vessels such as shell and tube heat exchangers, jacketed kettles and steam coils during their operation. It will also break the vacuum that forms during steam control modulation.

This balanced pressure air vent responds to the pressure-temperature curve of steam, and the soft-seated vacuum breaker responds to 2" H_2O of vacuum.

- Maximum allowable pressure: 300 psig (20 barg)
- Maximum allowable temperature: 365°F (185°C)
- Maximum working pressure: 150 psig (10 barg)
- All stainless steel welded construction
- NPT connections

Armstrong thermostatic air vents should be installed at the highest point on a steam chamber, with the air vent located above the chamber. This will minimize the possibility of any liquid carryover, and air can be vented to atmosphere without a drain line.

For a fully detailed certified drawing, refer to CD #1260.

Features

Physical Data

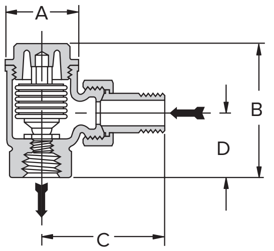
Model No.		TAVB-2		TAVB-3	
		in	mm	in	mm
Pipe Connections	Thermostatic Air Vent	1/2	15	3/4	20
	Vacuum Breaker	3/8	9.5	3/8	9.5
“A” (Diameter)		2-1/4	57	2-1/4	57
“B” (Height)		4-5/8	117	4-11/16	119
“C” (℄ Inlet to Face of Vacuum Breaker)		2-1/8	54	2-1/8	54
Weight lb (kg)		1 (0.45)		1-1/4 (0.57)	
Maximum Allowable Pressure (Vessel Design)		300 psig @ 365°F (20 barg @ 185°C)			
Maximum Operating Pressure		150 psig (10 barg)			
Discharge Orifice Size		3/16"			

List of Materials

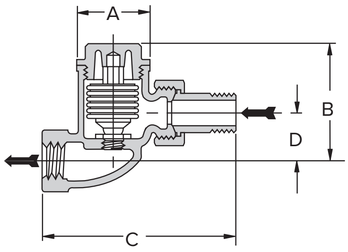
Name of Part	Material
Body	304-L Stainless steel
Connections	304 Stainless steel
Balanced Pressure Thermostatic Air Vent	Stainless steel and bronze with phosphor-bronze bellows, entire unit caged in stainless steel
Gasket	Copper clad non-asbestos
Vacuum Breaker Body	303 Stainless steel
Valve	Stainless steel
Spring	302 Stainless steel
“O” Ring	EPDM
Screen	Stainless steel

TS-2/TS-3 Radiator Traps

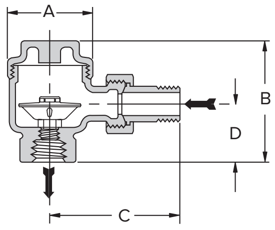
For Pressures to 65 psig (4.5 barg)...Capacities to 1 600 lb/hr (726 kg)



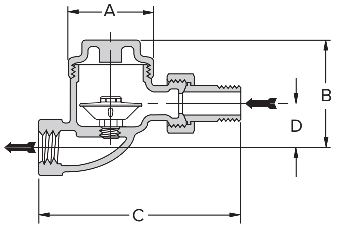
TS-2 Trap Angle Type



TS-2 Trap Straight Type



TS-3 Trap Angle Type



TS-3 Trap Straight Type

Armstrong Series TS radiator traps are offered in both angle and straight patterns. The TS-2 has a balanced pressure thermostatic element with a high quality multiple-convolution bellows. It's ideal for draining equipment such as steam radiators and convectors, small heat exchangers, unit heaters and steam air vents. The TS-2 comes with a strong, cast bronze body and a stainless seat. The valve and seat are renewable in-line.

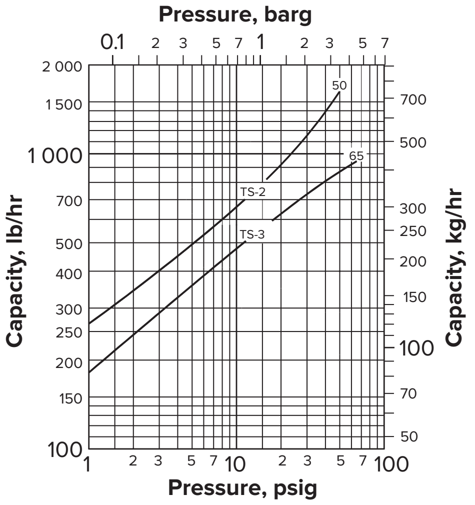
The TS-3 is a heavy duty, wafer type trap for the drainage of all types of steam radiators and convectors. Its wafer design is well suited to systems prone to water hammer, which may damage conventional bellows type units. The TS-3 is repairable in-line and has an all-stainless steel wafer element.

Materials

Cap:	Bronze, ASTM B62
Body:	Bronze, ASTM B62
Union nipple:	Brass, ASTM B584
Valve:	
Model TS-2:	Brass
Model TS-3:	Stainless steel
Valve seat:	Stainless steel
Element:	
Model TS-2:	Phosphor-bronze bellows
Model TS-3:	T-316 SS Wafer w/T-304 SS Housing

For a fully detailed certified drawing, refer to:
TS-2 CDY #1045
TS-3 CDY #1046

Model TS-2/TS-3 Capacity



TS Series Radiator Traps Physical Data

Model	TS-2								TS-3											
Pattern	Angle				Straight				Angle						Straight					
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1/2	15	3/4	20	1/2	15	3/4	20	1	25	1/2	15	3/4	20	1	25
"A" Diameter	1-5/8	41	1-5/8	41	1-5/8	41	1-5/8	41	2	50	2	50	2-3/8	86	2	50	2	50	2-3/8	86
"B" Height	2-15/16	75	3	76	2-11/16	68	2-7/8	73	2-7/8	73	3-5/8	92	3-7/8	98	2-5/8	61	3-3/8	86	3-1/2	89
"C"	2-9/16	65	2-7/8	73	4	102	4-1/2	114	3-1/8	79	3-1/2	89	4-1/8	105	4-7/8	124	5-1/4	133	6-1/2	165
"D"	1-3/8	35	1-5/8	41	1-1/8	28	1-5/16	33	1-3/8	35	1-5/8	41	2	50	1-1/8	28	1-3/8	35	1-5/8	41
Weight, lb (kg)	1-1/2 (0.68)		1-3/4 (0.79)		1-1/2 (0.68)		2 (0.91)		1-1/2 (0.68)		2 (0.91)		2-1/2 (1.1)		1-1/2 (0.68)		2-1/4 (1)		3 (1.4)	
Maximum Allowable Pressure (Vessel Design)	50 psig @ 300°F (3.4 barg @ 149°C)								65 psig @ 315°F (4.5 barg @ 157°C)											
Pressure, psig (barg)	50 (3.4)								65 (4.5)											
Vacuum Ratings	25" Mercury								10" Mercury											

TC Series Clean Steam Thermostatic Traps

For Clean Steam Systems

For Pressures to 120 psig (8 barg)...Capacities to 3 775 lb/hr (1 712 kg/hr)

Armstrong offers a complete range of T-316L stainless steel clean steam thermostatic traps to handle the special requirements of clean steam systems. Different body configurations allow for choice of piping and ease of cleaning.

The thermostatic design is free-draining and can operate close to steam temperature at any given pressure.

Features

- Constructed of 316L stainless steel for corrosion resistance
- Highly polished for cleanability
- Self-draining to minimize contamination
- Compact and lightweight
- Easy to install
- Provide easy disassembly for cleaning

Typical Applications

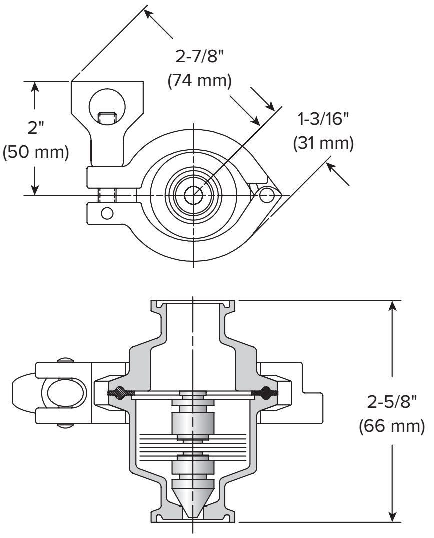
- Fermentors
- Sterilizers/autoclaves
- Process piping
- Block and bleed
- Bioreactors
- CIP/SIP systems
- Equipment sterilization
- Sterile barriers

How to Order:

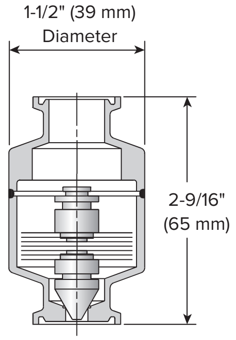
Specify:
- Model number
- Pipe connection size
- End connection type

Example:
TC-C, 1/2" sanitary end connections.

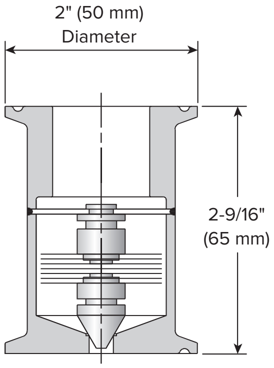
For a fully detailed certified drawing, refer to:
TC-C CD #1161
TC-R CD #1162
TC-S CD #1163



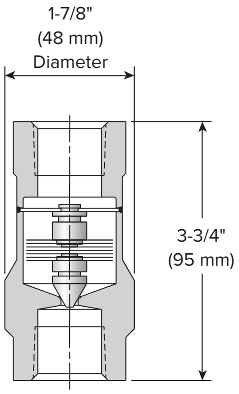
Model TC-C Clamp
With Sanitary Body Clamp
1/2" (15 mm), 3/4" (20 mm), 1" (25 mm)
Sanitary End Connections



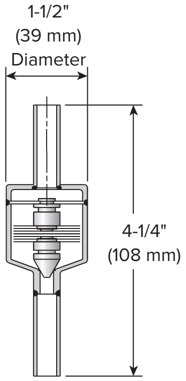
Model TC-S Sealed
1/2" (15 mm), 3/4" (20 mm)
Sanitary End Connections



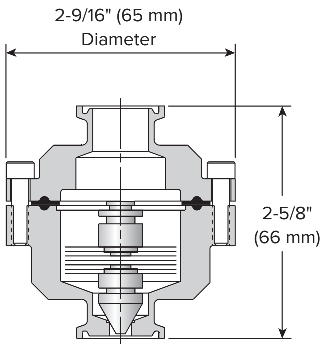
Model TC-S Sealed
1" (25 mm)
1-1/2" (40 mm)
Sanitary End Connections



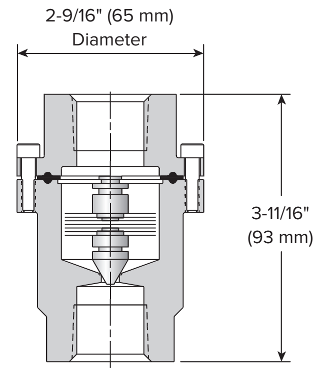
Model TC-S Sealed
1/2" (15 mm), 3/4" (20 mm)
Threaded End Connections



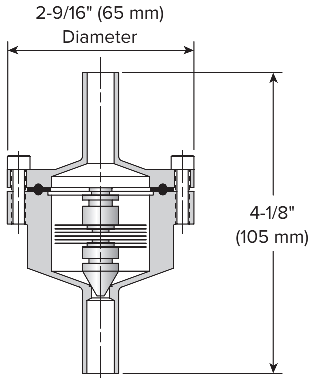
Model TC-S Sealed
1/2" (15 mm), 3/4" (20 mm)
Tube End Connections



Model TC-R Repairable
With Bolted Body and Cap
1/2" (15 mm), 3/4" (20 mm),
1" (25 mm), 1-1/2" (40 mm)
Sanitary End Connections



Model TC-R Repairable
With Bolted Body and Cap
1/2" (15 mm), 3/4" (20 mm)
Threaded End Connections



Model TC-R Repairable
With Bolted Body and Cap
1/2" (15 mm), 3/4" (20 mm)
Tube End Connections

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

TC Series Clean Steam Thermostatic Traps

For Clean Steam Systems

For Pressures to 120 psig (8 barg)...Capacities to 3 775 lb/hr (1 712 kg/hr)

Materials

Model	TC-C Clamp	TC-R Repairable	TC-S Sealed
Cap and body	ASTM A479 316L		
Bellows	316L Stainless Steel		
Body gasket	Viton®		—
Retainer	Stainless Steel		
Clamp	Stainless Steel	—	—
Screws	—	Stainless Steel	—
Finish	180 grit electro polish to 20 µin Ra or below inside, and 150 grit electro polish to 30 µin Ra or below on outside		Mechanical finish to 63 µin Ra interior and 32 µin Ra exterior

NOTE: µin = microinches

Physical Data

Model	TC-C Clamp	TC-R Repairable	TC-S Sealed
Maximum Allowable Pressure (Vessel Design)	120 psig (8.3 barg)		150 psig (10 barg)
Maximum Allowable Temperature	350°F (177°C)		366°F (186°C)
Maximum Operating Pressure	100 psig (7 barg)		120 psig (8.3 barg)
Weight lb (kg)	1-1/4 (0.57)	1-1/2 (0.68)	3/4 (0.34)

TC Series Clean Steam Trap Capacities

psig	barg	10°F (5.6°C) Subcool		20°F (11.2°C) Subcool	
		lb/hr	kg/hr	lb/hr	kg/hr
5	0.35	180	82	320	145
10	0.70	360	163	645	293
20	1.4	676	307	1 108	503
30	2.1	1 009	458	1 563	709
40	2.8	1 236	561	1 830	830
50	3.5	1 542	699	2 016	915
60	4.1	1 845	837	2 505	1 136
70	4.8	2 037	924	2 668	1 210
80	5.5	2 360	1 071	2 990	1 356
90	6.2	2 460	1 116	3 237	1 468
100	6.9	2 547	1 155	3 450	1 565
110	7.6	2 610	1 184	3 640	1 651
120	8.3	2 660	1 206	3 775	1 712

Armstrong Simplifies Your Tracing Line Systems

Designed to simplify and supply all the components (steam traps, manifolds, valves, etc.) necessary for your drip and tracer line applications, Armstrong's new Steam Distribution and Condensate Collection Manifolds bring all components together to reduce installation costs and provide a compact, easily accessible, centrally located assembly.

Armstrong's manifold series includes four different configurations, a Steam Distribution (MSD/SMSD), and a Condensate Collection Assembly (CCA/CCAF). As an option, the condensate manifolds can offer freeze protection.

In either case, you will save the expensive headaches of trying to fabricate in-house. What's more, your manifold will be backed by the famous Armstrong quality—and a standard three-year limited warranty.

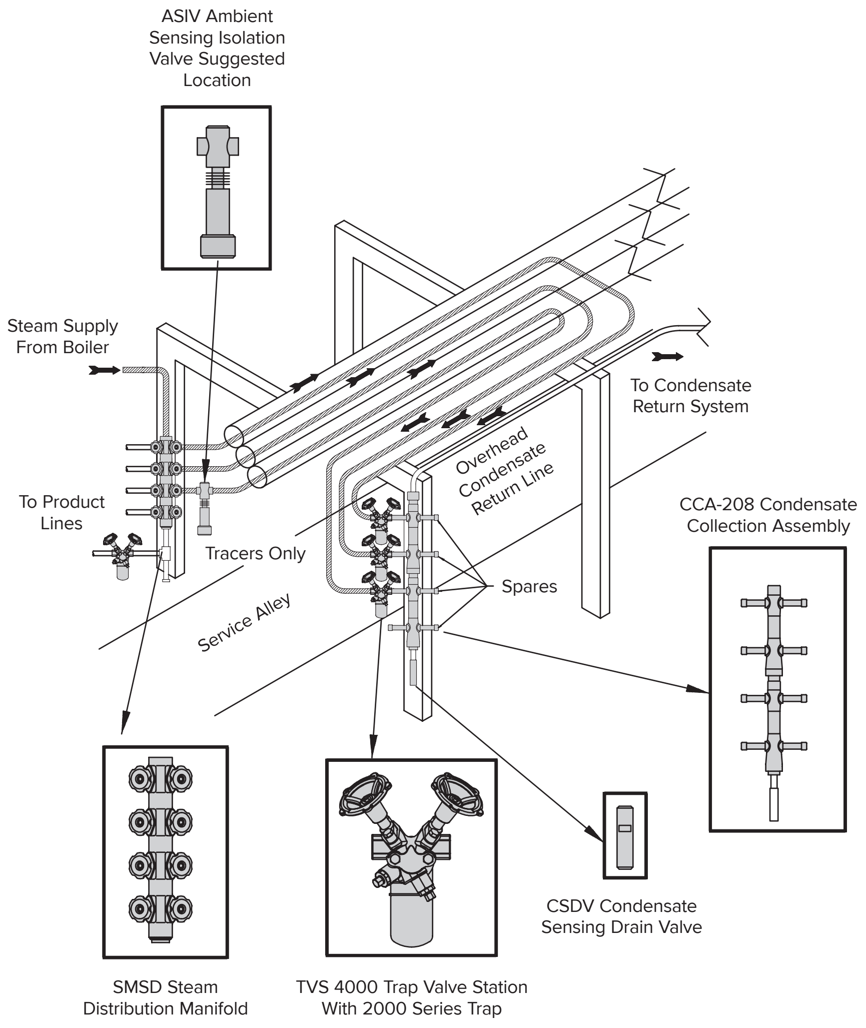
Steam Distribution Manifolds

As a Steam Distribution Assembly (MSD/SMSD), the manifold places all steam supply valves in one location. Standardizing components and centralizing their location simplifies installation, cutting costs from the beginning. You also save because routine maintenance is faster.

Condensate Collection Manifolds

To make industry's trapping and valving more efficient, Armstrong combines its stainless steel steam trap valve stations with manifolds into a package called the Condensate Collection Assembly (CCA). This prepackaged assembly offers many great benefits—cost savings in installation, design flexibility, and reduced purchasing time. CCAF would also include syphon tube freeze protection.

Whatever your condensate collection or steam distribution needs, Armstrong has the manifold for savings over the long term.



Shown are typical locations for Armstrong manifolds. The many manifolds in chemical/petrochemical plants consume valuable floor space and often block movement among the units. Operating costs are high, and installation requires expensive custom fabrication on site. Clearly, a prefabricated manifold permitting standardization of components offers substantial savings over conventional units. Shaded products are available from Armstrong. Call or consult your Armstrong Representative if additional product details are required.

The Proof Is in the Piston

Many of Armstrong's manifolds utilize the piston valve because of its years of excellent performance in steam systems all over the world. The proof of Armstrong's long service life for manifolds...is in the piston.

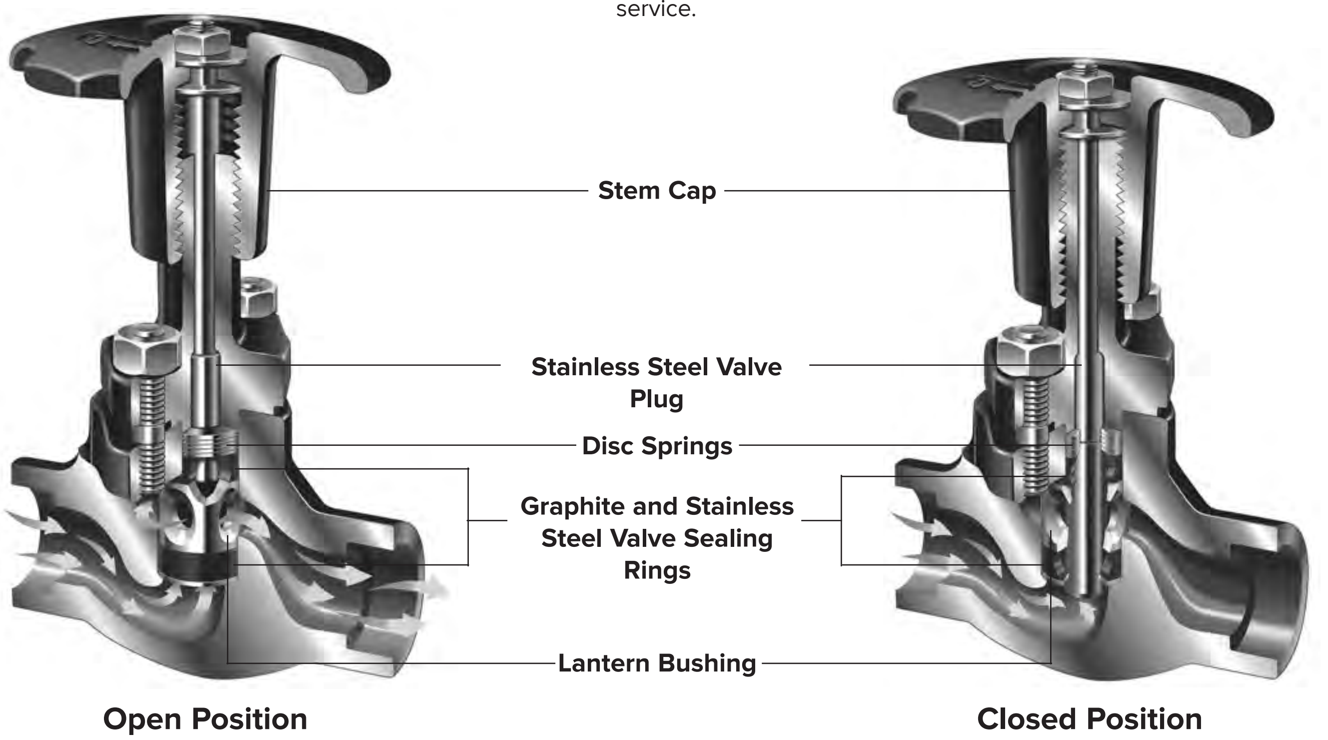
All types of valves—plug valves, gate valves, piston valves and even ball valves—have been summoned for duty in steam service. Due to its excellent sealing characteristics in steam service, and because it has no gland packing, the piston valve is frequently selected for steam systems.

People who have used it over the past 90 years can testify that leakage to atmosphere is extremely rare, even without any maintenance. The elastic contact between piston and valve sealing rings provides a perfect tightness, both in-line and to atmosphere.

Steam system valves, whatever their design, are used to isolate steam and condensate lines or when a faulty steam trap needs to be removed from the line. This means the valves stay in the open position for long periods and are nearly always in contact with the atmosphere. It is not surprising, therefore, that when the valves need to be closed, they can often prove difficult to operate. Our experience and the demands from end users for energy efficiency have led us to a sealing system designed especially for steam service.

The Piston Valve

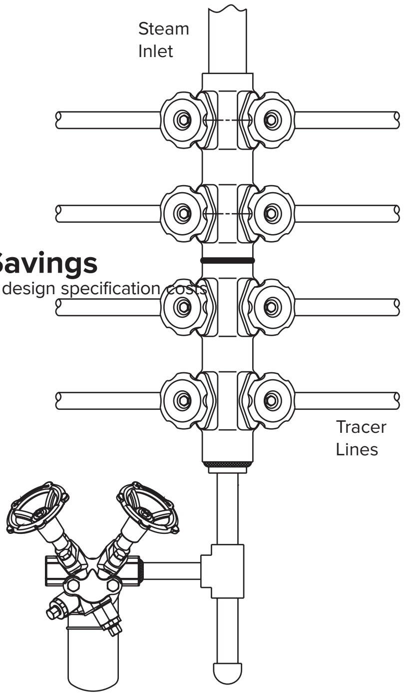
Armstrong Steam Distribution Manifolds (MSD/SMSD) and TVS 4000 Trap Valve Stations incorporate advanced piston sealing technology for safer, longer lasting steam isolation service.



- **Dual sealing action.** The piston valve is a seatless valve that includes two graphite and stainless steel valve sealing rings that seal the stem and function as a seat. This combination provides long-term protection against leaks to the atmosphere and downstream piping.
- **Self-cleaning action.** Stainless steel piston slides without rotating between the two valve sealing rings, preventing dirt from damaging the surfaces.
- **Sealing integrity.** Flexible disc springs automatically provide leak tightness by exerting pressure, which keeps the upper and lower valve sealing rings compressed at all times. Sealing tightness is ensured by the compression of the sealing rings against the piston and valve body. This combination of disc springs and dual valve seal rings protects against expansion and contraction due to heating and cooling. This ensures dependable operation, even after years of service.
- **Protected valve stem.** The valve stem and sealing surfaces are completely protected from dirt and corrosion by the stem cap, whether in an open or closed position.
- **In-line repairability.** All sealing valve components may be easily replaced in-line.
- **Long-term operation.** Piston valve design ensures actuation even after many years without operation.

Steam Distribution Manifold (MSD/SMSD)

As Steam Distribution Assemblies (MSD/SMSD), the manifolds place all steam supply valves in one location. Standardizing components and centralizing their location simplifies installation while providing cost savings. You also save because routine maintenance is faster. Insulation can also be provided...and can be a major savings in most installations.



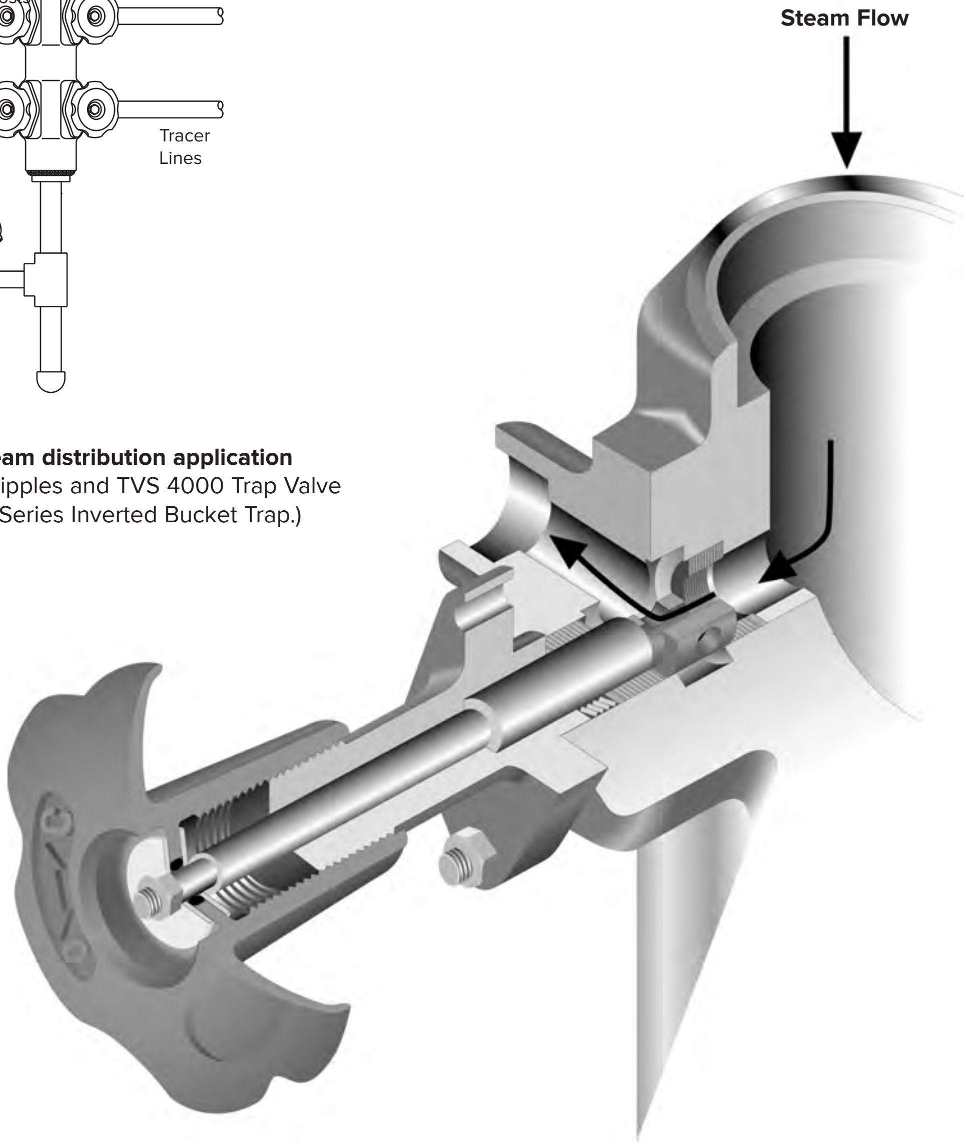
Typical SMSD steam distribution application (shown with optional nipples and TVS 4000 Trap Valve Station with 2000 Series Inverted Bucket Trap.)

Cost Savings

- Reduced design specification costs
- Prefabrication vs. field assembly for easy installation
- Reduced shipping and field handling costs
- Lower long-term maintenance and operating costs
- 3-year guarantee

Design Flexibility

- Dimensional consistency
- Space savings
- Insulation package available
  SMSD may also be used on systems utilizing glycol, Dowtherm and other heat transfer liquids.



Armstrong® Steam Distribution Manifold (MSD/SMSD)

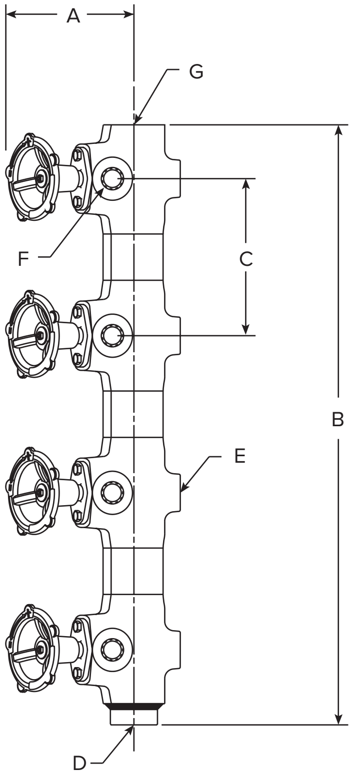
Physical Data

Model	MSD Series						SMSD Series					
	MSD-04		MSD-08		MSD-12		SMSD-04		SMSD-08		SMSD-12	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
“A” (Open Position)	8	203	8	203	8	203	8	203	8	203	8	203
“B” Height	11-1/2	292	24-1/4	615	37-1/8	943	10-1/4	260	19-3/4	501	29-1/4	743
“C” ℄ to ℄	6-3/8	162	6-3/8	162	6-3/8	162	4-3/4	120	4-3/4	120	4-3/4	120
“D” Blowdown Connection	3/4 SW	20	3/4 SW	20	3/4 SW	20	3/4 SW	20	3/4 SW	20	3/4 SW	20
“E” Number of Holes for Mounting (M14)	2	2	4	4	6	6	2	2	4	4	6	6
“G” Inlet	1-1/2 SW	40	1-1/2 SW	40	1-1/2 SW	40	1-1/2 SW	40	1-1/2 SW	40	1-1/2 SW	40
“F” Outlet*	1/2	15	1/2	15	1/2	15	1/2	15	1/2	15	1/2	15
Weight, lb (kg)	21 (10)		46 (21)		67 (30)		20 (9)		40 (18)		59 (27)	
Maximum Operating Pressure	464 psig (32 barg) @ 752°F (400°C)											

*3/4" (20 mm) available – contact factory.

List of Materials

Name	Material
Manifold Body	ASTM A105N/A-350 LF2 Forged Steel
Handwheel	Ductile iron
Bonnet	ASTM A351 Gr. CF8M
Spring Washer	Stainless steel
Bonnet, Bolts	DIN 933, Gr. 8.8 per DIN 267
Piston & Stem	Stainless steel—17-4PH
Valve Sealing Rings	Expanded graphite & stainless steel



Steam Distribution Manifold

Steam Distribution Manifold With TVS 4000, Inverted Bucket Drip Trap and Optional Stand

Pre-Assembled...Condensate Collection Assembly (CCA)

Armstrong combines its Trap Valve Stations (TVS) with manifolds into a package called the Condensate Collection Assembly (CCA). This prepackaged assembly offers many great benefits—cost savings in assembly, design flexibility and reduced purchasing and design time. The CCA with TVS 4000 Trap Valve Station and 2000 Series Inverted Bucket Traps is guaranteed for 3 years.

Cost Savings

This preassembled concept offers tremendous savings by reducing multiple component purchases that cause additional purchase order monitoring and shipping costs. Other savings include far less labor time required for field assembly.

This modular forged steel body design provides quick assembly/delivery, reducing overall project costs.

- Minimal welding vs complete manifold fabrication
- Eliminates multiple component purchases
- Reduced design specification costs
- Prefabrication vs. field assembly for easy installation
- Reduced shipping and field handling costs
- Lower long-term maintenance and operating costs
- 3-year guarantee

Design Flexibility

Armstrong can meet virtually any design parameter, including dimensional consistency, with your choice of socketweld or threaded connections. Armstrong inverted bucket, thermostatic, thermostatic wafer, bimetallic or disc steam traps can be provided or any other manufacturer's two-bolt steam trap can be used. If you require a specific piping arrangement, Armstrong can offer the flexibility to meet your specifications.

Materials

Manifold body:	ASTM A105N/A-350 LF2 Forged Steel

Removable Insulation Package

A removable insulation package is available for all steam and condensate manifolds.

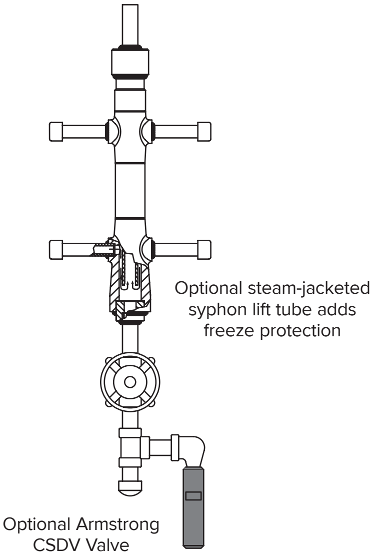
- Inexpensive
- Quick to install
- Removable for maintenance
- Reusable after maintenance
- Weatherproof
- Formed to cover all manifold elements
- Strong, durable cover
- Available to fit all manifold sizes

Freeze Protection Package (CCAF)–Optional

A manifold assembly for more efficient condensate return has another benefit—freeze protection. Armstrong's innovative manifold design actually serves as a heat station, heating one or more traps if the steam supply is interrupted or shut off to the traps. The protection is accomplished as long as one trap continues to discharge into the manifold. The manifold's internal syphon tube creates a water seal, which contains the flash steam from the discharge of the live trap. This allows radiant heat to protect shut-off traps from freezing.

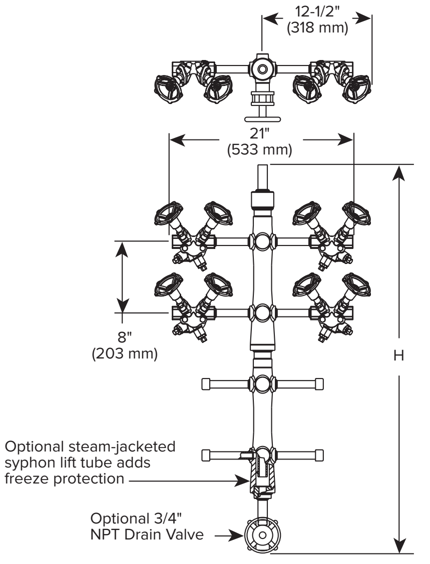
An optional freeze protection valve package senses condensate temperature. When this device opens, it drains condensate from the manifold assembly, thus providing further freeze protection.

CCAF 212 Condensate Collection Assembly
(Shown with TVS 4000 Trap Valve Station with 2000 Series Inverted Bucket all stainless steel steam traps with optional removable insulation package including nipples, drain valve and stand.)

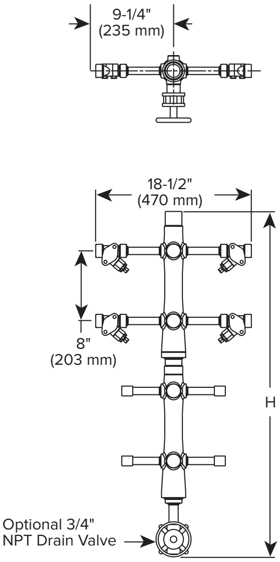


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong® Pre-Assembled...Condensate Collection Assembly (CCA)



CCAF Condensate Collection Assembly with TVS 4000 Trap Valve Station, Optional Freeze Protection and Drain Valve.
Available with Armstrong's inverted bucket, disc, thermostatic, thermostatic wafer or bimetallic steam traps. Any manufacturer's 2-bolt steam trap can also be applied to Armstrong's trap connectors.



CCA Condensate Collection Assembly With IS-2 Connectors with Strainer, Blowdown Valve and Optional Drain Valve
Available with Armstrong's inverted bucket, disc, thermostatic, thermostatic wafer or bimetallic steam traps. Any manufacturer's 2-bolt steam trap can also be applied to Armstrong's trap connectors.

Physical Data

Model	CCA-204		CCA-206		CCA-208		CCA-210		CCA-212	
"H"	in	mm	in	mm	in	mm	in	mm	in	mm
	23-1/8	587	31-1/8	790	39-1/8	994	47-1/8	1 197	55-1/8	1 400
Maximum Allowable Pressure	604 psig @ 800°F (42 barg @ 427°C)									

Physical Data

Model	CCAF-204		CCAF-206		CCAF-208		CCAF-210		CCAF-212	
"H"	in	mm	in	mm	in	mm	in	mm	in	mm
	27-5/16	694	35-5/16	897	43-5/16	1 100	51-5/16	1 303	59-5/16	1 506
Maximum Allowable Pressure	604 psig @ 800°F (42 barg @ 427°C)									

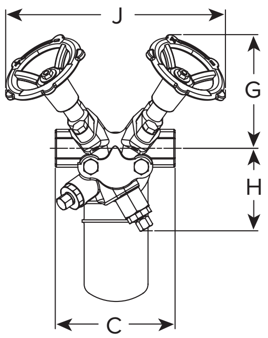
How to Order Manifold Packages

CCA	208	2NPT	6PE	3DVN	TVS 4000 SCH80
Manifold Model	Number of Take-offs Per Manifold	Connection Size Take-offs, NPS in (mm)	Connection Size Top, NPS in (mm)	Connection Bottom, NPS in (mm)	Trap Valve Station
MSD Steam Distribution Manifold	04 08 12	2NPT = 1/2 (15) NPTF^{1} 2SW = 1/2 (15) SW^{1} 3NPT = 3/4 (20) NPTF 3SW = 3/4 (20) Socketweld	6SW = 1-1/2 (40) SW^{1} 6FW150 = 1-1/2 (40) 150# RF Flange 6FW300 = 1-1/2 (40) 300# RF Flange 8FW150 = 2 (50) 150# RF Flange 8FW300 = 2 (50) 300# RF Flange	3SW = 3/4 (20) SW^{1} 3NPT = 3/4 (20) NPTF 3WD = 3/4 (20) Welded Dripleg^{2} 3TD = 3/4 (20) Threaded Dripleg^{2}	TVS 4000 IS2 with BD IS2 Standard None
SMSD Small Steam Distribution Manifold					
CCA Condensate Collection Assembly	204 206 208 210 212		6PE = 1-1/2 (40) Plain End^{1} 6FW150 = 1-1/2 (40) 150# RF Flange	3NPT = 3/4 (20) NPTM^{1} 3DVN = 3/4 (20) Drain Valve NPTM/ NPTM 3DVS = 3/4 (20) Drain Valve SW/ NPTM	
CCAF Condensate Collection Assembly Freeze Protection			3PE = 3/4 (20) Plain end^{1} 3NPT = 3/4 (20) NPTM 3FW150 = 3/4 (20) 150# Flange		

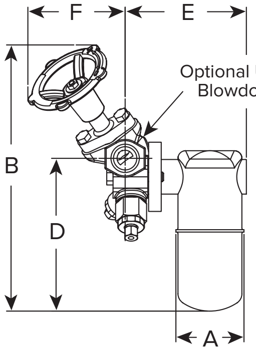
1. Armstrong stocks manifold cores (less nipples, drain valves and trap stations) in these connections.
2. Must pick this bottom connection to use trap station (TVS 4000 only choice) and trap on MSD and SMSD.
3. Nipples connecting manifold to trap station can be Schedule 80 (standard) or schedule 160 (optional).

TVS 4000 Series Stainless Steel Trap Valve Station

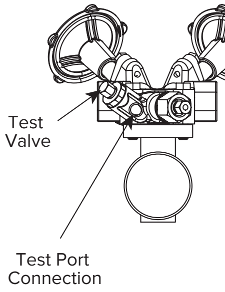
For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)



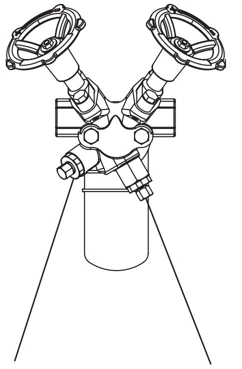
Model TVS 4000 With 2000 Series SS Trap
Front View



Model TVS 4000 With 2000 Series SS Trap
Side View



Model TVS 4000 With 2000 Series SS Trap
Bottom View



Test Valve
Used to test and evaluate trap operation

Strainer Blowdown Valve

Same principle. Different package with two piston-style isolation valves, test valve and integral stainless steel strainer with blowdown valve. Now the energy-saving performance and reliability of the inverted bucket steam trap are available in a versatile new package. You'll still enjoy all the familiar benefits. And the same efficient condensate drainage from virtually every kind of steam-using equipment. What you'll find new are all the benefits of a piston valve integrated into the same space-saving package.

Materials—TVS 4000 Connector

Connector:	ASTM A351 Gr. CF8M
Strainer screen:	Stainless steel
Screen retainer:	Stainless steel
Gasket:	Stainless steel
Retainer unit:	Stainless steel
Test valve:	Stainless steel
Blowdown valve:	Stainless steel

Isolation Valve Components

Handwheel:	Ductile iron
Nut:	Stainless steel
Stem, washers:	Stainless steel
Bonnet:	ASTM A351 Gr. CF8M
Bonnet, bolts:	DIN933, Gr. 8.8 per DIN267
Valve plug:	Stainless steel
Disc springs:	Stainless steel
Valve sealing rings:	Graphite and stainless steel
Lantern bushing:	Stainless steel
Valve washers:	Stainless steel

Materials—Series 2000 Traps

Body:	ASTM A240 Gr. 304L
Internals:	All stainless steel—304
Valve and seat:	Stainless steel—17-4PH

TVS 4000 Series With 2000 Series Inverted Bucket Steam Trap

Model No.	2010		2011		2022	
Pipe Connections	in	mm	in	mm	in	mm
	3/8, 1/2, 3/4	10, 15, 20	3/8, 1/2, 3/4	10, 15, 20	3/8, 1/2, 3/4	10, 15, 20
"A" Trap Diameter	2-11/16	68	2-11/16	68	3-7/8	98
"B" Height (Valve Open)	8	203	10-1/2	268	12-1/2	318
"C" Face to Face	4-3/4	120	4-3/4	120	4-3/4	120
"D" Connection ℄ to Bottom	4-3/4	120	6	154	8	203
"E" Connection ℄ to Outside of Trap	4-1/2	114	4-13/16	122	5-7/8	149
"F" Connection ℄ to Front of Handwheel (Valve Open)	3-1/2	89	3-7/8	98	3-7/8	98
"G" Connection ℄ to Top of Handwheel (Valve Open)	3-1/4	83	4-1/2	114	4-1/2	114
"H" Connection ℄ to Bottom of Connector	1-7/8	47	3-1/4	83	3-1/4	83
"J" Width Across Handwheels (Valve Open)	9-1/4	235	8-3/4	222	8-3/4	222
Test Port Connection	1/4 NPT	6	1/4 NPT	6	1/4 NPT	6
Weight, lb (kg)	9 (4)		9-1/2 (4.3)		12 (5.4)	
Maximum Operating Pressure (Trap)	200 psig (14 barg)		400 psig (28 barg)		650 psig (45 barg)	
Maximum Allowable Pressure (Trap)	400 psig (28 barg) @ 750°F (399°C)				650 psig @ 600°F (45 barg @ 315°C)	

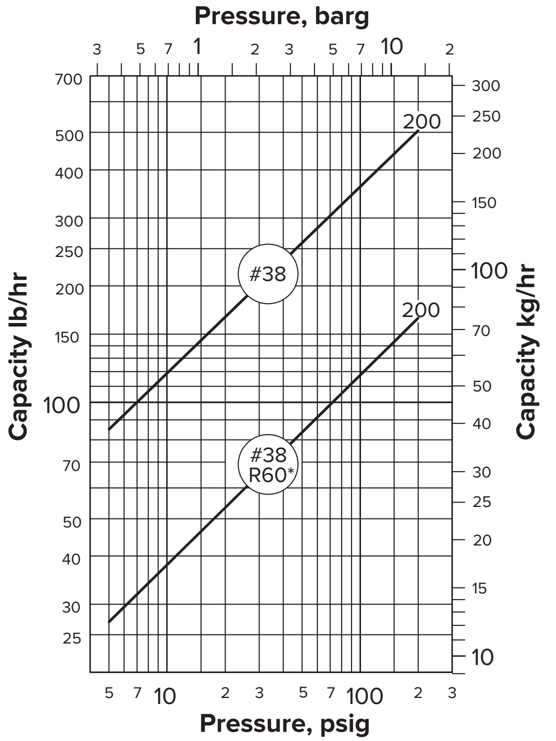
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong®

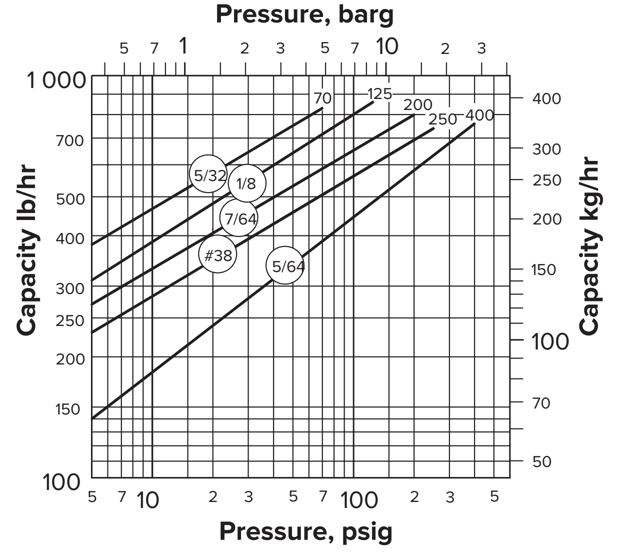
TVS 4000 Series Stainless Steel Trap Valve Station

For Pressures to 650 psig (45 barg)...Capacities to 1 300 lb/hr (590 kg/hr) (Using 2000 Series Inverted Bucket Steam Traps)

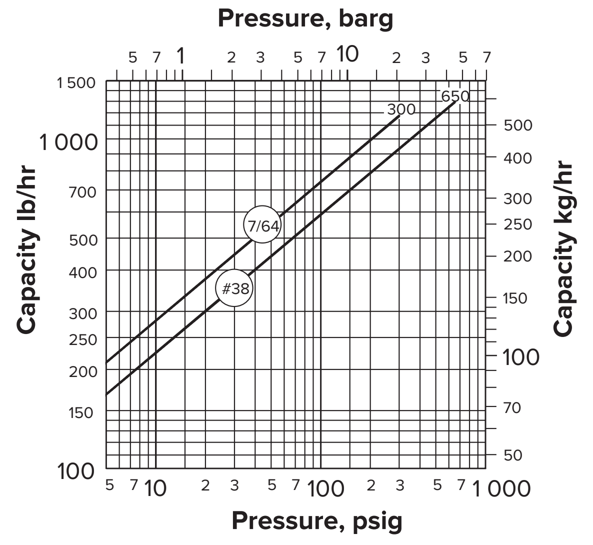
Model 2010 Capacity



Model 2011 Capacity



Model 2022 Capacity



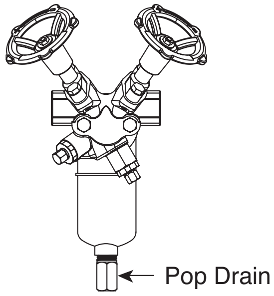
*NOTE: Because the orifice is located at the top, inverted bucket steam traps handle dirt and scale better than other types of traps. However, in applications where extremely dirty conditions exist, care should be exercised in the use of all types of restricted-orifice, reduced-capacity traps.

Options

Insu-Pak™
Now you can insulate the in-line traps in your plant without complicating regular trap maintenance. Insu-Pak, a simple reusable insulation package, cuts the time and cost of in-field installation because it goes on in a snap. And it comes off just as easily. The Insu-Pak can prevent trap freeze-up when used with a properly designed condensate manifold. Designed for use with Model 2010 and Model 2011 traps.

Pop Drain
Simple but effective against freeze-up. Properly installed and maintained at low points in your system, the simple, pressure-actuated pop drain opens for condensate drainage at 5 psig (0.35 barg) for Models 2011 and 2022.

Probe Connections are available for trap monitoring on Models 2011 and 2022.



How to Order

Model	Connection	Type of Connection Inlet/Outlet	Flow Direction	Trap Type
TVS 4000	1/2" 3/4"	NPT SW BSPT Flanged*	R = Right to Left L = Left to Right	Inverted Bucket Disc Thermostatic wafer Bimetallic Float and Thermostatic

*Consult factory.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

TVS 6000UD Forged Steel Trap Valve Station

Compact double isolation and bleed concept (Up and Downstream) with 360° Connector

For pressures up to 650 psig (45 barg)...Capacities to 1300 lb/hr (590 kg/h)
Using 2000 Series IB Steam Traps

3-year warranty

Patent Pending
US 62/945,958


Integral double piston style inlet and outlet isolation valves

Connection flexibility
(SW, BW, BSPT, NPT Flanges
EN or ANSI)

Bleed outlet

Connector block adaptable to inverted bucket, disc, thermostatic wafer, bimetallic, float and thermostatic steam traps

Bleed inlet

Test valve used to test and evaluate trap operation

Strainer and blowdown valve

Description

This original concept has been developed to meet new demanding requirements regarding safety when operating steam equipments such as steam traps, in various industrial environments. TVS 6000UD is a compact double isolation and bleed concept (up and downstream) with a 360° connector.

TVS 6000UD provides double isolation inlet and outlet piston valves, bleed of inlet/outlet valves, a test valve, a strainer and a blowdown valve at trap inlet all merged together in a single compact 2-bolts universal connector. The TVS 6000UD's design ensures increased safety while saving space, time and cost.

This TVS 6000UD is covered by a three-year-warranty. The TVS 6000UD can be fitted with steam traps of different technologies (thermodynamic, thermostatic, float and thermostatic or free float. Please refer to specific steam trap capacity charts).

Connections

Screwed BSPT and NPT
Socketweld and Buttweld
Flanged EN1092-1 PN40 or ASME B16.5

Materials – TVS 6000UD Connector

Connector:	ASTM A350 LF2
Test valve:	ASTM A582 T303 – Nitronic 60
Blowdown valve:	ASTM A582 T303 – Nitronic 60
Depressurising valve:	ASTM A582 T303 – Nitronic 60
Flanges:	P250GJ (other material on request)

Isolation Valve Components

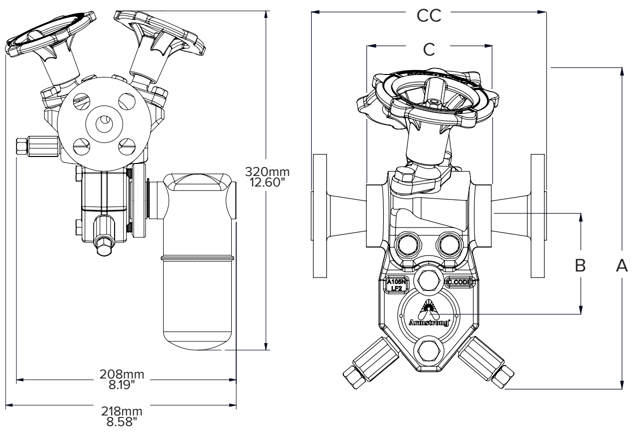
Valve Sealing Rings:	Graphite and Stainless Steel
Bonnet	ASTM A350 LF2
Bonnet Bolting	DIN933 8.8
Stem and washers	ASTM A564 17-4 H900
Lantern bushings :	ASTM A582 T304
Valve washer :	ASTM A582 T304
Disc springs :	AISI T301
Nut :	AISI T304
Handwheel :	Ductile Iron

Flow Direction

Left to Right (L/R)
Right to Left (R/L)

Table ST-189-1. TVS 6000UD Compact double isolation and bleed

	in	mm	in	mm	in	mm
Connection Size	1/2	15	3/4	20	1	25
"A" valve closed	9	230	9	230	9	230
"A" valve open	9 13/16	250	9 13/16	250	9 13/16	250
"B"	2 13/16	72	2 13/16	72	2 13/16	72
"C" Face-to-Face (screwed, SW & BW)	3 15/16	100	3 15/16	100	3 15/16	100
"CC" Face-to-Face (flanged EN1092-1 PN40)	5 7/8	150	5 7/8	150	6 1/4	160
"CC" Face-to-Face (flanged ASME B16.5 #150)	6 11/16	170	6 3/4	172	7	179
"CC" Face-to-Face (flanged ASME B16.5 #300)	7	179	7 1/8	182	7 1/2	192
Weight in lb (kg) (screwed, SW & BW)	11.4 (5.2)		11.4 (5.2)		11.4 (5.2)	
Weight in lb (kg) (flanged EN1092-1 PN40)	15.2 (6.9)		16.5 (7.5)		17.4 (7.9)	
Maximum Allowable Pressure †	45 barg @ 315 °C			653 psig @ 599 °F		
Maximum Hydrotest Temperature	599 °F / 315 °C					
Maximum Hydrotest Pressure	986 psig / 68 barg					



† May be derated depending on flange rating and type.

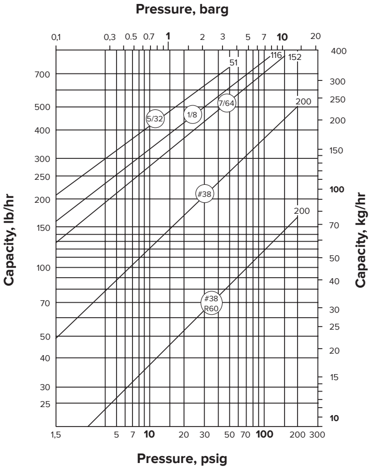
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

TVS 6000UD Forged Steel Trap Valve Station

Compact double isolation and bleed concept (Up and Downstream) with 360° Connector

For pressures up to 650 psig (45 barg)...Capacities to 1300 lb/hr (590 kg/h)
Using 2000 Series IB Steam Traps

Table ST-190-1. Model 2010 Capacity



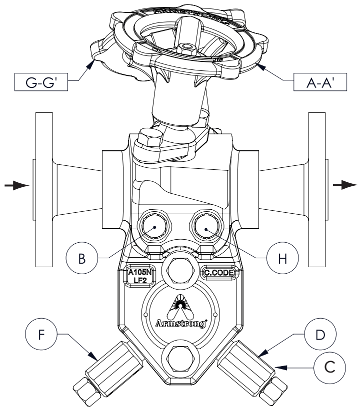
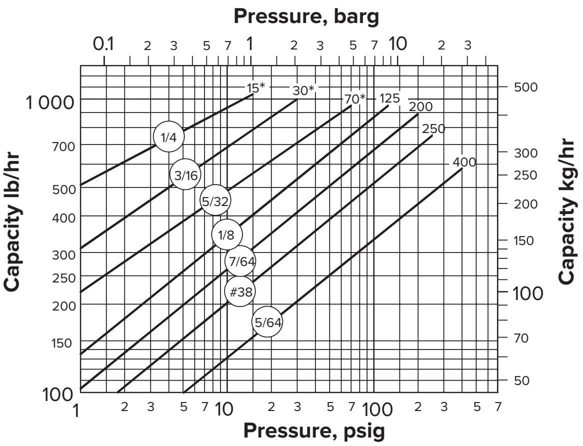
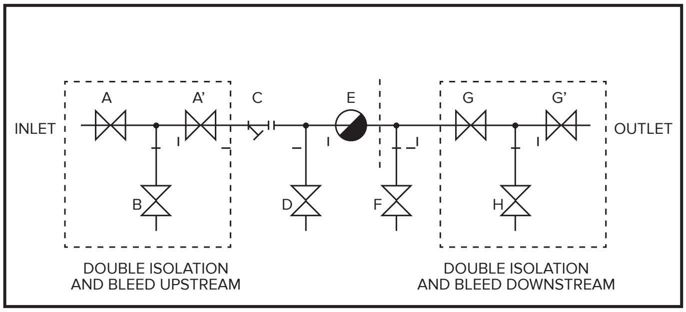


Table ST-190-2. Model 2011 Capacity



TVS 6000UD - L/R version



UPSTREAM

A : INLET FIRST ISOLATION VALVE
A' : INLET SECOND ISOLATION VALVE
B : BLEED INLET
C : STRAINER
D : DEPRESSURIZING VALVE
E : STEAM TRAP CONNECTION

DOWNSTREAM

F : TEST VALVE
G : OUTLET FIRST ISOLATION VALVE
G' : OUTLET SECOND ISOLATION VALVE
H : BLEED OUTLET

Table ST-190-3. Model 2022 Capacity

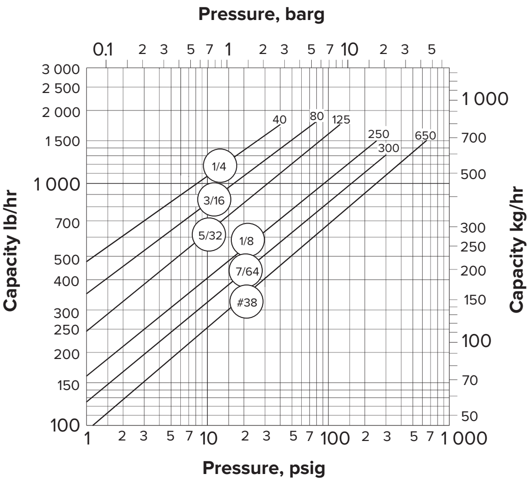


Table ST-190-4. How to Order

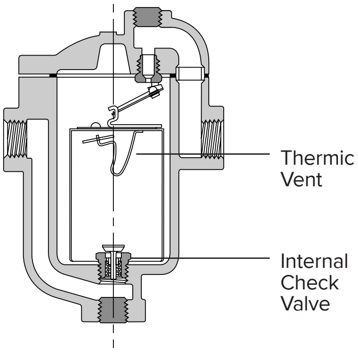
Model	Connection	Type of Connection	Flow Direction
TVS 6000UD	DN15 DN20 DN25	Flanges EN1092-1 & PN Class	L/R = Left to Right R/L = Right to Left
	1/2" 3/4" 1"	BSPT, NPT, SW, BW, Flanges ASME B16.5 & Class RF	

* Capacities to be reduced by 5% for pressure below 5 bar (tested with Armstrong steam traps).

Steam Trap Options

Thermic Vent Buckets

Whenever steam is turned on and off, air will accumulate in the piping and steam equipment. A trap equipped with a thermic bucket will discharge this air 50 to 100 times faster than a standard bucket, reducing warm-up time. Thermic vent buckets are suitable for pressures up to 130 psig (9 barg). A large vent hole in the bucket can also solve air venting problems upon start-up.

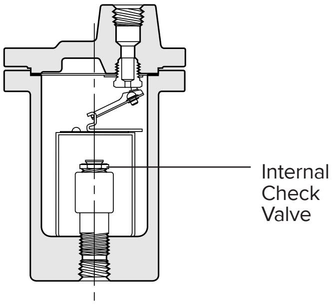


Internal Check Valves—1/2" (15 mm) Thru 2" (50 mm) NPT

Almost all Armstrong inverted bucket steam traps can be equipped with internal check valves. A check valve is needed between the trap and the equipment being drained in the following cases:

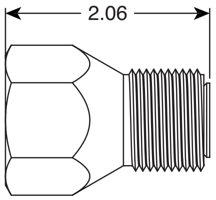
- When the trap is installed above the unit drained
- When sudden pressure drops may occur in the steam supply to the unit
- Whenever a back pressure exists in the condensate return line

Armstrong spring-loaded, stainless-steel internal check valves can be screwed directly into the trap inlet or into an extended inlet tube having a pipe coupling at the top.



"In-Line" Check Valve—1/2" (15 mm) and 3/4" (20 mm) NPT

On 1800 and 2000 Series stainless-steel traps, an internal check valve cannot be installed. Armstrong's CVI "in-line" check valve will solve the problem.

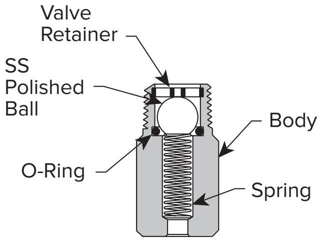


Pop Drain for Freeze Protection—1/2" (15 mm) NPT

In general, a properly selected and installed Armstrong trap will not freeze as long as steam is coming to the trap. If the steam supply is shut off, a pop drain should be used to automatically drain the trap.

Maximum Operating Conditions

Pressure:	600 psig (41 barg)
Temperature:	350°F (177°C)

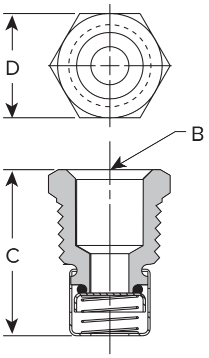


Steam Trap Options

Vacuum Breaker—3/8" (10 mm) and 1/2" (15 mm) NPT

Many times, condensate will be retained ahead of steam traps because of the presence of a vacuum. To break a vacuum, air must be introduced into the system by means of a vacuum breaker.

For maximum protection against freezing and water hammer in heating coils under modulated control, for example, vacuum breakers are recommended in conjunction with freeze protection devices.



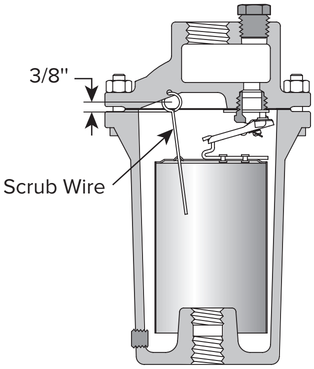
Vacuum Breaker

Size	in	mm	in	mm
	1/2 NPT	15	3/8 NPT	10
"B" Pipe Connections	3/8 NPT	10	1/4 NPT	6
"C" Height	1-1/4	32	1-3/32	28
"D" Width	7/8 Hex	22 Hex	11/16 Hex	17 Hex

Dirt Problems

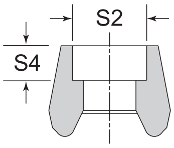
Whenever dirt plugs the bucket vent, Armstrong recommends the use of a scrubbing wire which, on each cycle, keeps the bucket vent hole open.

In normal conditions, the inverted bucket trap is not sensitive to dirt problems (because of its orifice at the top of the trap), unlike most other traps, which should be installed normally with a strainer (see Armstrong "Y" Type Strainers page 445).



Socketweld Dimensions

Pipe Size		S-2		S-4 Min.	
in	mm	in	mm	in	mm
1/2	15	0.855	22	3/8	10
3/4	20	1.065	27	1/2	13
1	25	1.330	34	1/2	13
1-1/4	32	1.675	43	1/2	13
1-1/2	40	1.915	49	1/2	13
2	50	2.406	61	5/8	16
2-1/2	65	2.906	74	5/8	16
3	80	3.535	90	5/8	16



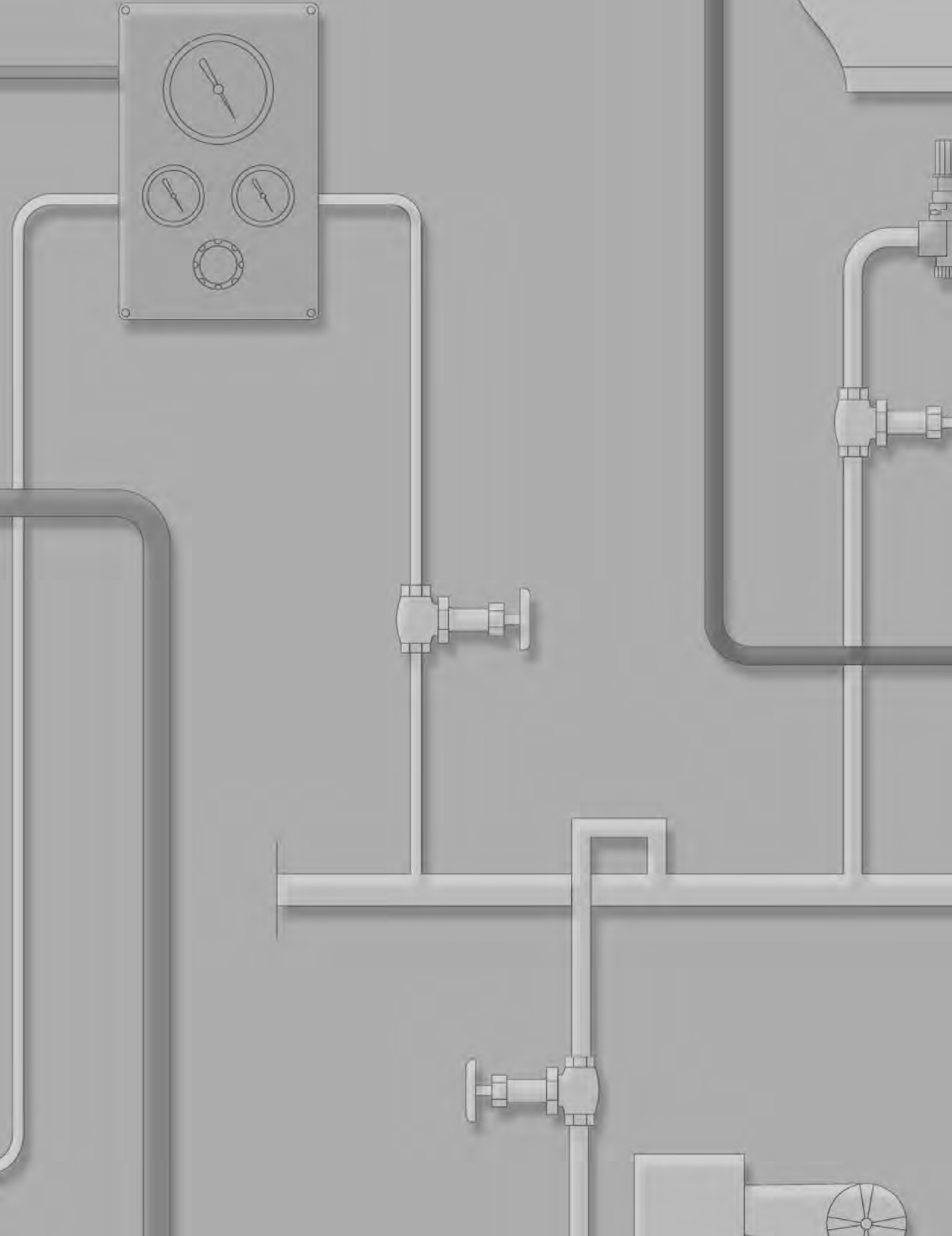
Socketweld Connection

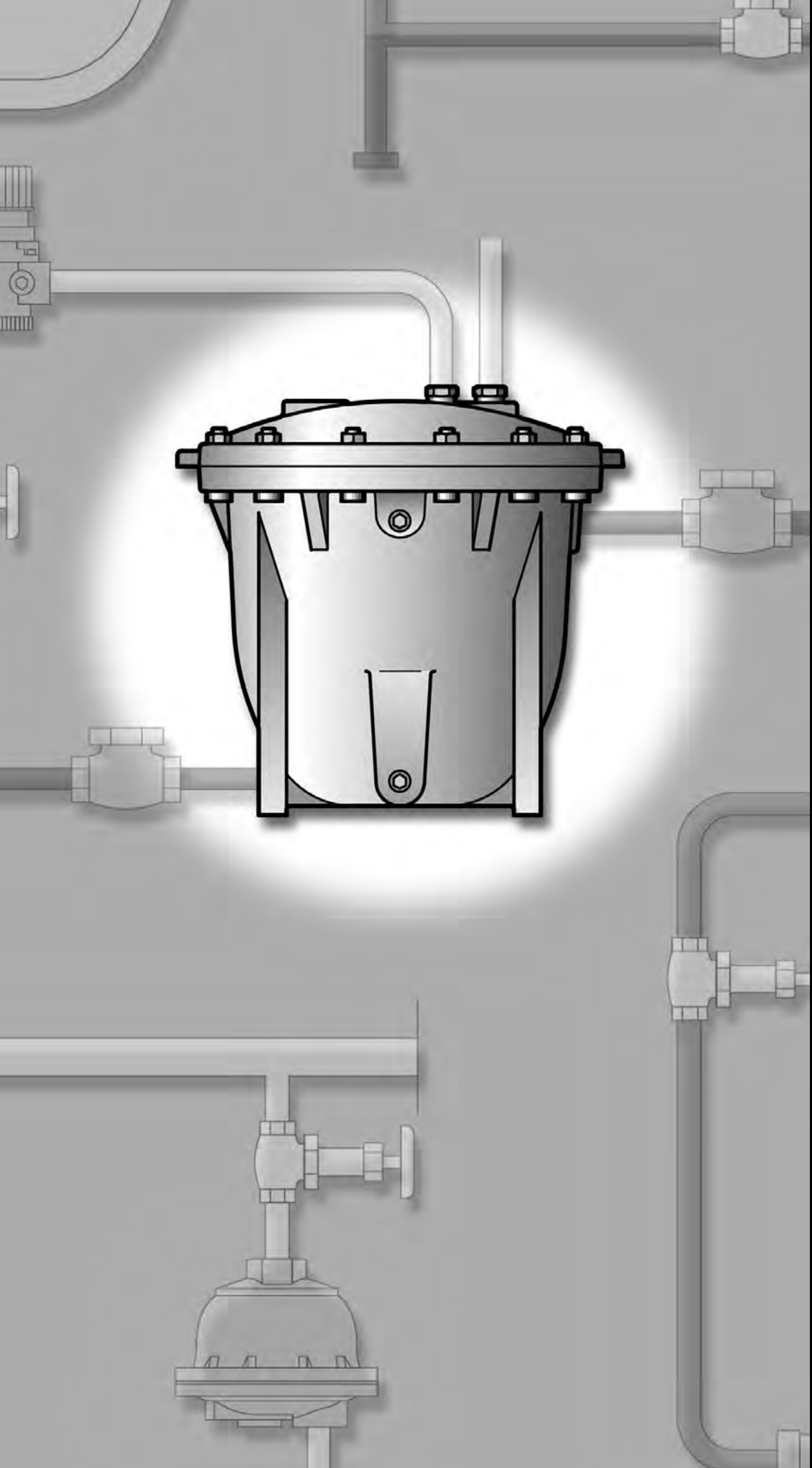
Flanged Connections

Flanged traps are furnished with the following ANSI B16.5 flanges as standard. Flange facings comply with ANSI B16.5.

Pressure Class Rating	Inlet Connection	Outlet Connection
150 and 300	1/16" Raised Face	1/16" Raised Face
600 and Higher	1/4" Raised Face	1/4" Raised Face

Other types of flanged connections (such as large male and female ring joint, large or small tongue and groove, etc.) can be furnished. Flange requirements for both inlet and outlet must be specified.





Condensate
Recovery
Equipment

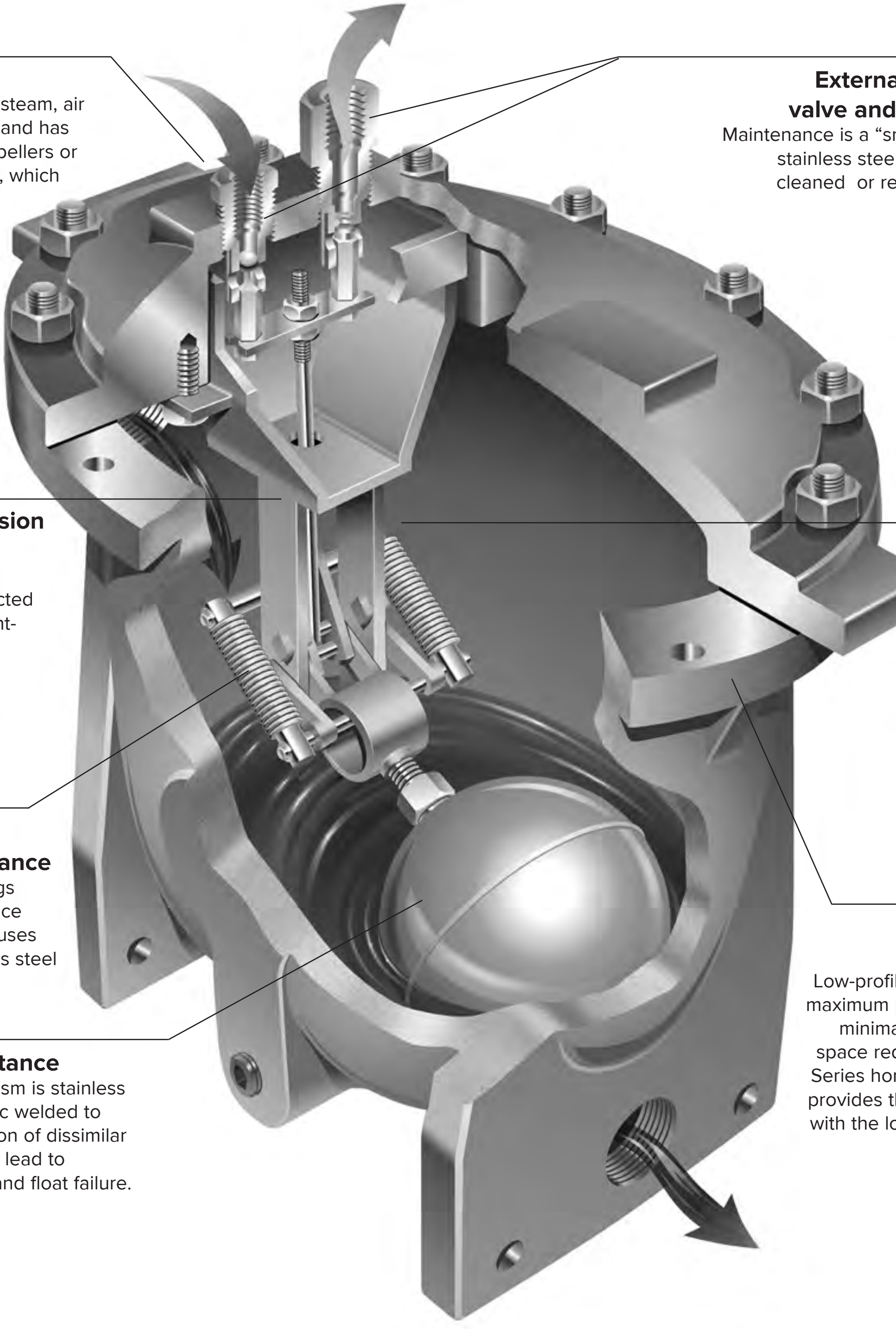
Armstrong

Armstrong®

Inside Advantages

Mechanical condensate pumps operate with a spring-assisted float mechanism, which means the springs themselves are a major wear point. Armstrong pumping traps have large-diameter Inconel X-750 springs, which provide superior corrosion resistance and longer service life than those in competitive models. For other inside advantages, see below.

Notice the difference in spring design from the industry standard spring set (left) and the Armstrong Inconel spring set.



Non-electric
Utilizes inexpensive steam, air or gas for operation and has no seals, motors, impellers or electric components, which frequently fail.

Externally replaceable valve and seat assembly
Maintenance is a "snap" with hardened stainless steel valves that can be cleaned or replaced without cap removal.

Wear and corrosion resistance
Mechanism frame assembly is constructed of rugged investment-cast stainless steel components.

Long life and dependable service
Simple float/spring operation and rugged all-stainless steel construction allow for long, trouble-free service life.

Stress chloride corrosion resistance
Inconel X-750 springs have higher resistance to the stress that causes lower-grade stainless steel springs to fail.

Compact, low-profile design
Low-profile design allows for maximum pump capacity with minimal fill head and floor space requirements. PT-300 Series horizontal tank design provides the highest capacity with the lowest profile on the market.

Corrosion resistance
Entire float mechanism is stainless steel. Float is Heliarc welded to avoid the introduction of dissimilar metals, which could lead to galvanic corrosion and float failure.

Effective Condensate Management = Energy Savings

The most basic part of energy management is utilizing all valuable Btu within the steam system. Depending on the pressure, condensate exiting a trap contains approximately 20% of the heat energy transferred at the boiler in the form of sensible heat. Effective recovery of condensate reduces three tangible costs of producing steam:

- Fuel/energy costs associated with producing steam
- Boiler water make-up and sewage treatment
- Boiler water chemical treatment

These savings can be calculated using the attached savings form. Returning condensate saves money, energy and the environment. Pour money and energy savings back into your plant—not down the drain.

Condensate Recovery Savings Analysis

Location ______________________ Bldg ______________________

Energy costs will vary from plant to plant and regions of the world. Values shown are conservative. Complete this form using your facilities' numbers to determine annual savings in your plant by returning condensate. If some costs are not known, use the figures below for conservative estimates.

A) Condensate Load ....= **8 000 lb/hr**

B) Annual Hours of Operation ....= **7 200 hrs per year**

C) Total Water and Sewage Cost ....= **$.005 per gal**
   c1) Untreated water and sewage ....= **$.002 per gal**
   c2) Water treatment chemicals ....= **$.003 per gal**

D) Make-Up Water Preheating Requirements = **140 Btu/lb**
   d1) Condensate Return Temperature ...= **200°F**
   d2) Make-Up Water Temperature.......= **60°F**

E) Steam Cost ....= **$ 5.00/1 000 lb**

F) Annual Water Savings...................................= **$ 34 532.00**

$$\frac{(A)8000 \times (B)7200 \times (C).005}{8.34 \text{ lb/gal}}$$

G) Savings for Preheating Make-Up Water....= **$ 40 320.00**

$$\frac{(A)8000 \times (B)7200 \times (D)140 \times (E)5.00}{{}^{*}1000 \times 1000}$$

H) Cost of Steam to Operate†
   Armstrong Pump Trap...................................= **$ 864.00**

$$\frac{3 \times (A)8000 \times (B)7200 \times (E)5.00}{1000 \times 1000}$$

I) Total Dollars Saved Annually (F + G - H) . = **$ 73 988.00**

J) Payback Period in Years ....= **.27 Years**

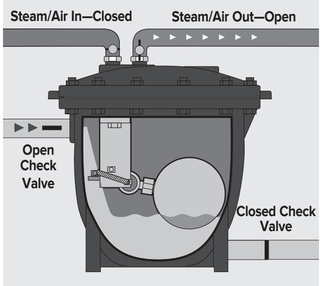
$$\frac{{}^{**}(\text{cost of equipment/installation}) \$20\ 000}{(I)\ 73\ 988}$$

* Btu/lb from direct steam injection

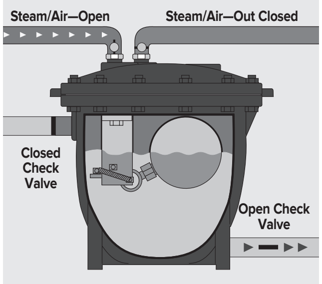
** Estimated equipment and installation cost

† Cost to operate in example assumes an "open" vented system. If pump trap is used in "closed loop" application, steam operation cost is negligible.

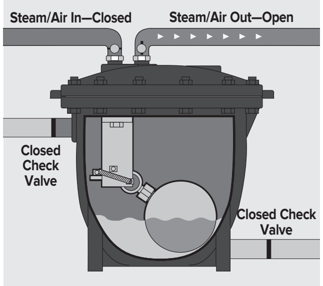
Pumping Trap Operation



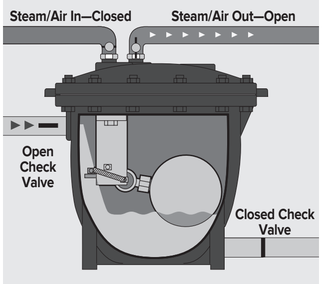
Filling
1. During filling, the steam, air or inert gas inlet and check valve on pumping trap outlet are closed. The vent and check valve on the inlet are open.



Begin Pumping
2. Float rises with level of condensate until it passes trip point, and then snap action reverses the internal valve positions shown in step one.



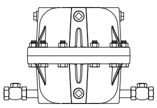
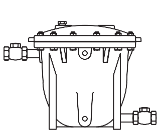
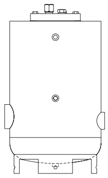
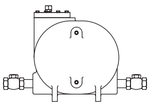
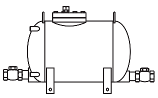
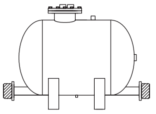
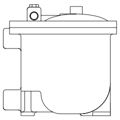
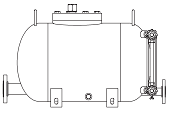
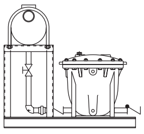
End Pumping
3. Float is lowered as level of condensate falls until snap action again reverses the internal valve positions.



Repeat Filling
4. Steam, air or inert gas inlet and trap outlet are again closed while vent and condensate inlet are open. Cycle begins anew.

Armstrong®

Pumping Trap ID Charts

Illustration	Type	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Mechanism Material	Model	Max. Oper. Press. psig	Capacity Range lb/hr	Connection Size				Located on Page
										1"	1-1/2"	2"	3" x 2"	
	**Series PT-100**	Screwed	150	450	ASTM A48 Class 30 Cast Iron	Stainless Steel with Inconel X-750 Spring	PT-104	100	1 800	●				199
	**Series PT-200**	Screwed	150	450	ASTM A48 Class 30 Cast Iron	Stainless Steel with Inconel X-750 Spring	PT-204	125	2 400	●				201
							PT-206		3 700		●			
	**Series PT-400**	**Screwed	150	*650	**Fabricated Steel 150 psig ASME Sec. VIII Design "U" Stamped	Stainless Steel with Inconel X-750 Spring	PT-404	125	3 600	●				203
							PT-406		5 500		●			
	Series PT-400LL	**150# ANSI Flanged					PT-408		7 400			●		214
							PT-412		12 200				●	
	**Series PT-3500**	Screwed	150	450	ASTM A48 Class 30 Cast Iron	Stainless Steel with Inconel X-750 Spring	PT-3508	125	9 900			●		205
							PT-3512		14 500				●	
	**Series PT-300**	Screwed	150	*650	**Fabricated Steel 150 psig ASME Sec. VIII Design "U" Stamped	Stainless Steel with Inconel X-750 Spring	PT-308	125	11 600			●		207
	Series PT-300LL	**150# ANSI Flanged **300# ANSI Flanged		550			PT-312		16 600				●	214
	**Series PT-500**	**150# ANSI Flanged	150	500	**Fabricated Steel 150 psig ASME Sec. VIII Design "U" Stamped	Stainless Steel with Inconel X-750 Spring	PT-516	150	80 000	4" x 4"				211
	**Double Duty® 4**	Screwed	72	320	Ductile Iron	Stainless Steel	Simplex Duplex	72	up to 350	1" x 1"				215
	**Double Duty® 6**	**150# ANSI Flanged	200	400	Carbon Steel	Stainless Steel with Inconel X-750 Spring	Simplex Duplex Triplex Quadplex	200	up to 4 800	1-1/2" x 1"				217
	Double Duty® 12								up to 19 900	3" x 3"				230
	**Series 100, 200, 300, 3500 Low Boy™ Packages**	For detailed information, regarding Armstrong pre-piped pump packages, please contact the factory or visit our website at armstronginternational.com												

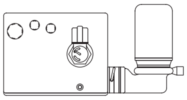
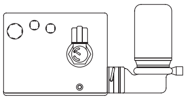
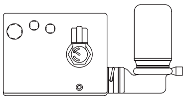
**Other connection type, receiver pressure vessel ratings and material type available upon request—consult factory.

*Standard mechanism: Maximim motive 125 psig; maximum allowable pressure 150 psig (vessel rating); maximum temperature 480°F (vessel rating).

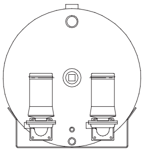
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Pumping Trap ID Charts

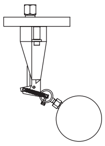
Electric Centrifugal Condensate Pump ID Chart

Illustration	Type	Sq. Ft. EDR	Pump Capacity GPM	Pump Disch. Press.	Motor HP	RPM	Disch. Size Inches	Inlet Size Inches	Receiver Cap. Gallons	Locate Page for Sizing
	**FHS Series** **FHC Series** **Simplex or Duplex**	8 000 thru 20 000	12 thru 30	Max. 20 psig	Simplex 1/3, 1/2, 3/4 Duplex 1/2 or 3/4	3 500 RPM Only Single Phase Only	3/4"	2" thru 3"	FHS Series 8 - 30 (Steel) FHC Series 15 - 36 (Cast Iron)	240
	**AFH-4100** **4200** **4300** **3500** **Simplex or Duplex**	2 000 thru 50 000	*3 thru 75	*20 thru 50	*1/3 thru 5	1 750 and 3 500 Single or Three Phase	3/4" thru 1-1/2"	2" thru 4"	AFH-4100/4300 8 - 120 (Steel/SS) AFH-4200 6 - 120 (Cast Iron)	243 thru 252
	**AFH-4400 Simplex or Duplex**	4 000 thru 60 000	6 thru 90	*10 thru 50	1/3 thru 1-1/2"	3500 RPM	3/4" thru 1-1/2"	2" thru 2-1/2"	12 - 100	253

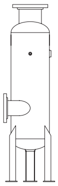
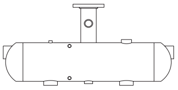
Boiler Feed Condensate Pump ID Chart

Illustration	Type	Boiler HP BHP	Pump Capacity GPM	Pump Disch. Press.	Motor HP	RPM	Disch. Size Inches	Inlet Size Inches	Receiver Cap. Gallons	Locate Page for Sizing
	**AFH-4100** **4200** **4300** ****3500** **5000**	15 to 700	*3 to 140	*20 to 50	1/3 to 7-1/2	1 750 and 3 500 Single or Three Phase	Consult Factory		30 to 714	243

Rescue Cap® Non-Electric Steam/Air Powered Pump Retrofit Assembly ID Chart

Illustration	Fits Competitors' Mechanical Pumps Listed Below							Page
	Spirax Sarco Models PPC & PPF PTC & PTF	Watson McDaniel Models PMPC & PMP	Spence & Nicholson Condensate Commanders	KADANT-Johnson Corporation	ITT Hoffman PCS	Yarway Series 65 Steel	Clark Reliance	227

Flash Tank ID Chart

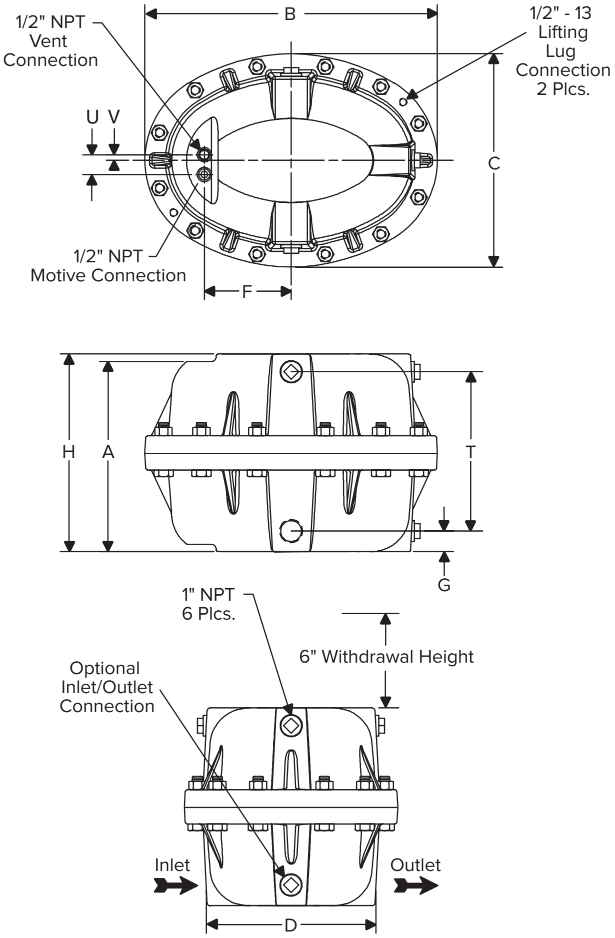
Illustration	Type	Connections	Size	Pressure Rating	Sparge Pipe	Body Material	Page
	**VAFT Vertical Flash Tanks**	NPT Flanged	6” 8” 12” 16”	***150 psig	N/A	Carbon Steel	259
	**HAFT Horizontal Flash Tanks**	NPT Flanged	4” thru 30”				250

*Other capacities, discharge pressures and HP available - consult factory.

**3500 Series has elevated tank as standard.

***Other pressure ratings available upon request.

PT-104 Series Mini Pump Trap



The patented Armstrong PT-104 Mini Pump Trap is the smallest non-electric solution that can move condensate or other liquids from lower to higher points and from lower to higher pressures. Condensate can be returned at temperatures well above the 200°F (93°C) limit of conventional electric centrifugal pumps without the headaches of leaking seals or cavitation problems. The PT-104 Mini Pump Trap is the small solution for a big problem.

Features

- Economical non-electric operation. Uses inexpensive steam, air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Cast iron durability. Rugged construction material means long service life.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.

For a fully detailed certified drawing, refer to CDF #1028.

PT-104 Mini Pump Trap Physical Data

Symbol	in	mm
"A"	12	305
"B"	18-1/2	470
"C"	13-1/2	343
"D"	10-3/4	272
"F"	5-1/2	140
"G"	1-5/16	33
"H"	12-1/2	317
"U"	1-1/4	32
"V"	3/8	9
"T"	10-1/16	256
Weight lb (kg)	140 (64)	
Bronze Check Valves lb (kg)	4 (2)	
Stainless Steel Check Valve lb (kg)		
Maximum Operating Pressure	100 psig (7 barg)	
Maximum Allowable Pressure (vessel design)	150 psig @ 450°F (10 barg @ 232°C)	

PT-104 Mini Pump Trap Connection Sizes

Connection	Type	in	mm
Inlet	NPT	1	25
Outlet		1	25
Vent		1/2	15
Motive Pressure		1/2	15
Optional Gauge Glass		1	25
Optional Cycle Counter/Pressure Gauge		1	25

PT-104 Mini Pump Trap Materials

Name of Part	Material
Body and Cap	Cast iron ASTM A48 Cl.30
Vent/Inlet Valves	Stainless steel
Mechanism Assembly	Stainless steel
Spring	Inconel X-750
Gasket	Graphoil
Bolts	SA 449
Nuts	ASTM A194 Gr.2H
Plug	Cast iron

PT-104 Series Mini Pump Trap

Options

Use of external check valves required for operation of pumping trap.

- Inlet Swing Check Valve
  - NPT Bronze ASTM B 62
  - Teflon® Disc
  - Class 150 (Minimum)
- Outlet
  - Stainless Steel Check Valve
  - Class 150 (Minimum)
- In-line Check Valves
  - Stainless Steel Non-Slam Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

Capacity Conversion Factors for Other Filling Heads

Filling Head				
in	**0**	**6**	**12**	*** 24 or greater**
mm	**0**	**150**	**305**	*** 620 or greater**
PT-104 Mini Pump Trap	0.7	1.0	1.2	* Consult factory

NOTE: Fill head measured from drain to top of cap. See figures on page 234.

PT-104 Mini Pump Trap Capacities

Motive Pressure		Total Lift or Back Pressure		Filling Head 6" (152 mm) Liquid Specific Gravity 0.9 - 1.0			
				Steam		Air	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	1 125	510	2 100	952
25	1.7			1 300	590	2 200	998
50	3.5			1 550	703	2 275	1 032
75	5.0			1 650	748	2 300	1 043
100	7.0			1 400	635	2 350	1 066
25	1.7	15	1.0	650	295	1 900	862
50	3.5			700	317	2 050	930
75	5.0			750	340	2 100	952
100	7.0			800	363	2 150	975
35	2.5	25	1.5	400	181	1 800	816
50	3.5			450	204	1 935	878
75	5.0			500	227	2 050	930
100	7.0			550	249	2 075	941
50	3.5	40	2.75	250	113	1 620	735
75	5.0			300	136	1 850	823
100	7.0			350	159	1 950	884

NOTE: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump case. See figures on page 234.

PT-200 Series Low Profile Cast Iron Pump Trap

3-Year No Fail Warranty
3-Year
No Fail
Pump Trap Mechanism

The Armstrong PT-200 Series Low Profile Pump Trap is a low maintenance, non-electric solution to move condensate or other liquids from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. Condensate can be returned well above the 200°F (93°C) limit of conventional electric condensate pumps without the headaches of leaking seals or cavitation problems.

Features

- Economical non-electric operation. Uses inexpensive steam, air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Cast iron durability. Rugged construction material means long service life.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.

Options

Use of external check valves required for operation of pumping trap.

- Inlet Swing Check Valve
  - NPT Bronze ASTM B 62
  - Teflon® Disc
  - Class 150 (Minimum)
- Outlet
  - Stainless Steel Check Valve
  - Class 150 (Minimum)
- In-line Check Valves
  - Stainless Steel Non-Slam Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

For a fully detailed certified drawing, refer to CDF #1000.

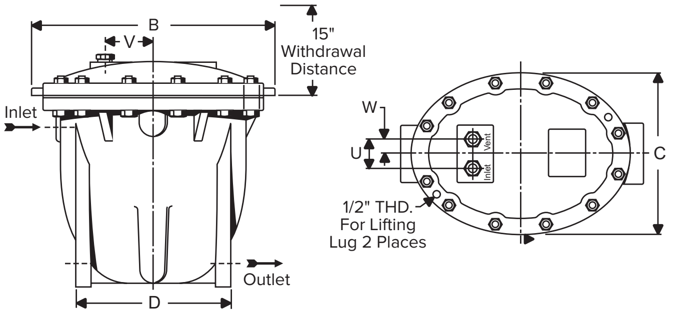
PT-200 Pumping Trap Materials

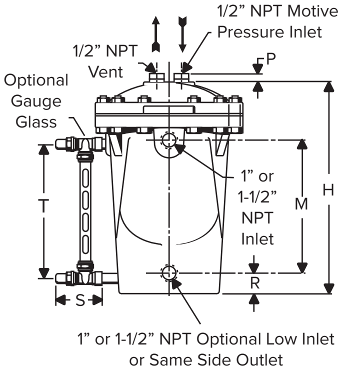
Name of Part	Series PT-200
Body and Cap	Cast iron ASTM A48 Cl. 30
Cap Gasket	Graphoil
Bolts	SA-449 Steel
Nuts	Alloy steel ASTM A194 Gr. 2H
Inlet Valve Assembly	Stainless steel
Vent Valve Assembly	Stainless steel
Valve Assembly Washers	Zinc plated steel
Plug	Steel
Mechanism Assembly	Stainless steel
Springs	Inconel X-750

PT-200 Pumping Trap Connection Sizes

Model	Cast Iron			
	PT-204		PT-206	
	in	mm	in	mm
Inlet Connection	1	25	1-1/2	40
Outlet Connection	1	25	1-1/2	40
Optional Low Inlet or Same Side Outlet Connection	1	25	1-1/2	40
Motive Pressure Connection	1/2	15	1/2	15
Vent Connection	1/2	15	1/2	15
Gauge Glass Connection	1/2	15	1/2	15

PT-200 Series Low Profile Cast Iron Pump Trap





PT-200 Pumping Trap Physical Data		
	PT-204 PT-206	
	in	mm
“B”	20-7/16	519
“C”	13-1/2	342
“D”	12-15/16	328
“H”	19	482
“M”	11-35/64	293
“P”	23/32	18
“R”	2-1/32	51
“S”	4-3/8	111
“T”	12	305
“U”	2-1/4	57
“V”	4-1/8	104
“W”	1-1/8	28
Weight lb (kg)	210 (96)	
Number of Body/Cap Bolts	12	
Check Valve Conn. in (mm)	1 (25)	1-1/2 (40)
Bronze Check Valves lb (kg)	4 (2)	9 (4)
Stainless Steel Check Valves lb (kg)	4 (2)	9 (4)

Maximum Allowable Pressure (Vessel Design) 150 psig @ 450°F (10 barg @ 232°C)
Maximum Operating Pressure 125 psig (9 barg)

PT-200 Capacity Conversion Factors for Other Fill Heads											
Fill Head		in	mm	in	mm	in	mm	in	mm	in	mm
		0	0	6	152	12	305	24	610	36	914
Model	PT-204	0.7		1		1.1		1.3		1.4	
	PT-206	0.7		1		1.1		1.3		1.4	

NOTE: Fill head is measured from drain point to top of cap. See figures on page 234.

PT-200 Pumping Trap Capacities											
Motive Pressure		Total Lift or Back Pressure		PT-204 (6" Fill Head) 1" x 1"				PT-206 (6" Fill Head) 1-1/2" x 1-1/2"			
				Steam Motive		Air Motive		Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	1 800	816	2 100	953	2 700	1 225	3 000	1 361
25	1.7			2 025	919	2 300	1 043	3 200	1 451	3 500	1 588
50	3.5			2 100	953	2 500	1 134	3 400	1 542	3 600	1 633
75	5			2 200	998	2 700	1 225	3 500	1 588	3 700	1 678
100	7			2 300	1 043	*	*	3 600	1 633	*	*
125	8.5			2 400	1 089	*	*	3 700	1 678	*	*
25	1.7	15	1	1 500	680	2 000	907	2 400	1 088	2 700	1 225
50	3.5			2 000	907	2 250	1 021	3 200	1 451	3 400	1 542
75	5			2 100	953	2 500	1 134	3 300	1 497	3 500	1 588
100	7			2 110	957	*	*	3 350	1 520	*	*
125	8.5			2 125	964	*	*	3 400	1 542	*	*
35	2.5	25	1.5	1 500	680	1 700	771	2 100	953	2 300	1 043
50	3.5			1 700	771	2 000	907	2 400	1 089	2 600	1 179
75	5			1 900	862	2 300	1 043	2 700	1 225	2 900	1 315
100	7			2 000	907	*	*	2 800	1 270	*	*
125	8.5			2 100	953	*	*	2 900	1 315	*	*
50	3.5	40	2.75	1 400	635	1 700	771	1 500	680	2 000	907
60	4			1 500	680	2 000	907	2 000	907	2 300	1 043
75	5			1 700	771	2 200	998	2 300	1 043	2 500	1 134
100	7			1 800	816	*	*	2 400	1 089	*	*
125	8.5			1 920	871	*	*	2 500	1 134	*	*
70	4.5	60	4	1 100	499	2 000	907	1 150	522	2 000	907
75	5			1 300	590	2 300	1 043	1 325	601	2 300	1 043
100	7			1 600	726	*	*	1 900	862	*	*
125	8.5			1 720	780	*	*	2 000	907	*	*

NOTES: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump cap. See figures on page 234. Although motive pressures are shown at high pressure differentials (difference between motive inlet pressure and total lift or back pressure), it is preferable to use a motive pressure of 10 - 15 psig (0.65 - 1.0 barg) above discharge (outlet) pressure. This ensures longevity of economical (bronze) check valves and reduces both venting time and temperature differential (on steam). If a higher differential is used, stainless steel check valves are recommended.
*Consult factory.

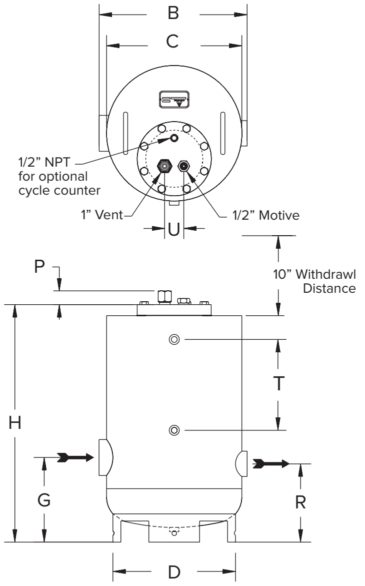
Armstrong® PT-400 Series Vertical Steel Pump Trap

3-Year No Fail Warranty
3-Year
No Fail
Pump Trap Mechanism

The Armstrong PT-400 Series Vertical Pump Trap is the low maintenance, non-electric solution to move condensate or other liquids from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. Condensate can be returned at temperatures well above the 200°F (93°C) limit of conventional electric condensate pumps without the headaches of leaking seals or cavitation problems.

Features

- Economical non-electric operation. Uses inexpensive steam, air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Durable construction. ASME code-stamped carbon steel body vessel.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.



Options

Use of external check valves required for operation of pumping trap.

- Inlet Swing Check Valve
  NPT Bronze ASTM B 62
  Teflon® Disc
  Class 150 (Minimum)
- Outlet
  Stainless Steel Check Valve
  Class 150 (Minimum)
- In-line Check Valves
  Stainless Steel Non-Slam Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

For a fully detailed certified drawing, refer to CDF #1004.

PT-400 Pumping Trap Physical Data

Model Number	PT-404, PT-406, PT-408 and PT-412			
	in		mm	
"B"	17-1/2		445	
"C"	16		406	
"D"	14-1/2		368	
"G"	10		254	
"H"	28		711	
"P"	1-5/8		41	
"R"	9-1/4		235	
"T"	12		305	
"U"	2-1/4		57	
Weight, lb (kg)	166 (75)			
Number of Body/Cap Bolts	8			
Model Number	**PT-404**	**PT-406**	**PT-408**	**PT-412**
Check Valve Conn., in (mm)	1 (25)	1-1/2 (40)	2 (50)	3 (75)
Bronze Check Valves, lb (kg)	4 (2)	9 (4)	16 (7)	29 (13)
Stainless Steel Check Valves, lb (kg)	4 (2)	9 (4)	15 (7)	38 (17)

PT-400 Series Vertical Steel Pump Trap

PT-400 Pumping Trap Connection Sizes

Model	Vertical Steel							
	PT-404		PT-406		PT-408		PT-412	
	in	mm	in	mm	in	mm	in	mm
Inlet Connection	1	25	1-1/2	40	2	50	3	80
Outlet Connection	1	25	1-1/2	40	2	50	2	50
Motive Pressure Connection	1/2	15	1/2	15	1/2	15	1/2	15
Vent Connection	1	25	1	25	1	25	1	25
Gauge Glass Connection	1/2	15	1/2	15	1/2	15	1/2	15

NOTES: Optional flanged connections available. Consult factory. Inlet/outlet socketweld connections available. Consult factory.

PT-400 Pumping Trap Capacities

Motive Pressure		Total Lift or Back Pressure		PT-404 (12" Fill Head) 1" x 1"				PT-406 (12" Fill Head) 1-1/2" x 1-1/2"				PT-408 (12" Fill Head) 2" x 2"				PT-412 (12" Fill Head) 3" x 2"			
				Steam Motive		Air Motive		Steam Motive		Air Motive		Steam Motive		Air Motive		Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	1 900	862	2 250	1 021	3 100	1 406	3 350	1 520	4 500	2 041	4 850	2 200	7 500	3 402	8 100	3 674
25	1.7			2 500	1 134	2 650	1 202	4 600	2 086	4 875	2 211	6 600	2 994	7 000	3 175	11 000	4 990	11 650	5 284
50	3.5			3 100	1 406	3 225	1 463	4 900	2 222	5 100	2 313	7 100	3 220	7 375	3 345	11 700	5 307	12 150	5 511
75	5			3 400	1 542	3 500	1 588	5 200	2 359	5 300	2 404	7 200	3 266	7 400	3 357	12 000	5 443	12 350	5 602
100	7			3 500	1 588	*	*	5 400	2 449	*	*	7 300	3 311	*	*	12 100	5 488	*	*
125	8.5			3 600	1 633	*	*	5 500	2 495	*	*	7 400	3 357	*	*	12 200	5 534	*	*
25	1.7	15	1	2 200	999	2 525	1 145	3 500	1 588	4 025	1 826	5 400	2 449	6 200	2 812	7 200	3 266	8 275	3 753
50	3.5			2 600	1 179	2 800	1 270	4 100	1 860	4 425	2 007	6 300	2 857	6 800	3 084	10 400	4 717	11 250	5 103
75	5			2 800	1 270	2 950	1 338	4 400	1 996	4 750	2 155	6 500	2 948	6 900	3 130	10 800	4 899	11 450	5 194
100	7			3 100	1 406	*	*	4 800	2 177	*	*	6 700	3 039	*	*	11 000	4 990	*	*
125	8.5			3 200	1 451	*	*	4 900	2 222	*	*	6 800	3 084	*	*	11 200	5 080	*	*
35	2.5	25	1.5	2 000	907	2 350	1 066	2 900	1 315	3 425	1 554	4 200	1 905	4 950	2 245	6 900	3 130	8 150	3 697
50	3.5			2 400	1 088	2 675	1 213	4 000	1 814	4 500	2 041	5 800	2 631	6 400	2 903	9 700	4 400	10 850	4 921
75	5			2 600	1 179	2 800	1 270	4 300	1 950	4 550	2 064	6 000	2 721	6 500	2 948	10 000	4 536	10 900	4 944
100	7			2 800	1 270	*	*	4 700	2 132	*	*	6 100	2 767	*	*	10 200	4 626	*	*
125	8.5			2 900	1 315	*	*	4 800	2 711	*	*	6 400	2 903	*	*	10 400	4 717	*	*
50	3.5	40	2.75	1 900	862	2 350	1 066	3 300	1 451	4 050	1 837	4 350	1 973	5 350	2 427	5 800	2 631	7 125	3 232
60	4			2 200	999	2 600	1 179	3 600	1 633	4 250	1 927	5 100	2 313	6 000	2 722	6 900	3 130	8 150	3 697
75	5			2 400	1 088	2 675	1 213	4 000	1 814	4 475	2 030	5 700	2 585	6 375	2 892	7 600	3 447	8 500	3 856
100	7			2 500	1 135	*	*	4 200	1 905	*	*	6 000	2 721	*	*	8 100	3 674	*	*
125	8.5			2 700	1 225	*	*	4 500	2 041	*	*	6 200	2 612	*	*	8 500	3 856	*	*
70	4.5	60	4	1 800	816	2 400	1 088	3 200	1 451	4 300	1 950	3 800	1 724	5 050	2 291	5 000	2 268	6 650	3 016
75	5			2 000	907	2 450	1 111	3 500	1 588	4 650	2 109	4 100	1 859	5 175	2 347	5 400	2 450	6 900	3 130
100	7			2 300	1 233	*	*	3 700	1 678	*	*	4 500	2 041	*	*	6 000	2 722	*	*
125	8.5			2 400	1 088	*	*	3 800	1 724	*	*	4 800	2 177	*	*	6 400	2 903	*	*

NOTES: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump cap. See figures on page 234. Although motive pressures are shown at high pressure differentials (difference between motive inlet pressure and total lift or back pressure), it is preferable to use a motive pressure of 10 - 15 psig (0.65 - 1 barg) above discharge (outlet) pressure. This ensures longevity of economical (bronze) check valves and reduces both venting time and temperature differential (on steam). If a higher differential is used, stainless steel check valves are recommended.
*Consult factory.

PT-400 Series Pumping Trap Materials

Name of Part	Series PT-400*
Body and Cap	Fabricated steel 150 psig ASME Sec. VIII design “U” stamped
Cap Gasket	Graphoil
Bolts	SA-449 steel
Nuts	None
Inlet Valve Assembly	Stainless steel
Vent Valve Assembly	Stainless steel
Valve Assembly Washers	Zinc-plated steel
Plug	Steel
Mechanism Assembly	Stainless steel
Springs	Inconel X-750

*Series PT-400 is available in all stainless steel. Consult factory.

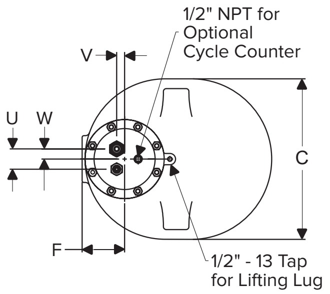
PT-400 Capacity Conversion Factors for Other Fill Heads

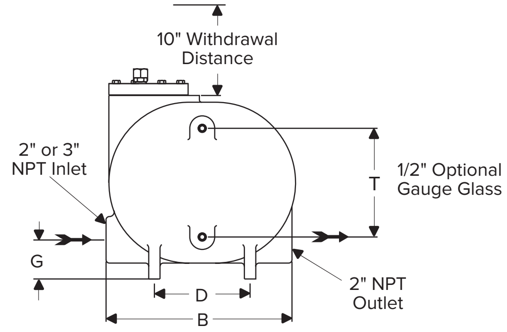
Fill Head		in	mm	in	mm	in	mm	in	mm	in	mm
		0	0	6	152	12	305	24	610	36	914
Model	PT-404	0.7		0.85		1.0		1.3		1.4	
	PT-406	0.7		0.85		1.0		1.2		1.35	
	PT-408	0.7		0.85		1.0		1.2		1.35	
	PT-412	0.7		0.85		1.0		1.08		1.2	

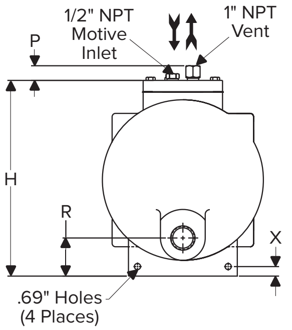
NOTES: Fill head is measured from drain point to top of cap. See figures on page 234.

PT-3500 Series Low Profile Pump Trap

3-Year No Fail Warranty
3-Year No Fail
Pump Trap Mechanism







The Armstrong PT-3500 Series Low Profile Pump Trap is the low maintenance, non-electric solution to move condensate or other liquids from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. Condensate can be returned at temperatures well above the 200°F (93°C) limit of conventional electric pumps without the headaches of leaking seals or cavitation problems.

Features

- Economical non-electric operation. Uses inexpensive steam, air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Cast iron durability. Rugged construction material means long service life.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.

Options

Use of external check valves required for operation of pumping trap.

- Inlet Swing Check Valve
  NPT Bronze ASTM B 62
  Teflon® Disc
  Class 150 (Minimum)
- Outlet
  Stainless Steel Check Valve
  Class 150 (Minimum)
- In-line Check Valves
  Stainless Steel Non-Slam Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

For a fully detailed certified drawing, refer to CDF #1041.

PT-3500 Series Pump Trap Physical Data

		PT-3508 and PT-3512	
		in	**mm**
"B"		20-1/4	514
"C"		17-3/4	451
"D"		10-9/16	268
"F"		4-3/4	120
"G"		4-5/16	110
"H"		21-11/16	550
"P"		1-5/8	41
"R"		4-5/16	110
"T"		12	305
"U"		2-1/4	27
"V"		7/8	22
"W"		1-1/4	32
"X"		1-1/16	27
Weight		**PT-3508**	**PT-3512**
Pump Trap Weight	**lb (kg)**	244 (111)	243 (110)
Bronze Check Valve		16 (7)	29 (13)
Stainless Check Valve		15 (7)	38 (17)

Maximum Operating Pressure: 125 psig (9 barg)
Maximum Allowable Pressure: Cast iron 150 psig @ 450°F (10 barg @ 232°C)

PT-3500 Series Low Profile Pump Trap

Condensate Reovery Equipment

PT-3500 Series Low Profile Pump Trap Capacities

Operating Inlet Pressure		Total Lift or Back Pressure		Filling Head 12" (305 mm) Liquid Specific Gravity 0.9 - 1.0							
				PT-3508 2" x 2"				PT-3512 3" x 2"			
				Steam		Air		Steam		Air	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	6 100	2 767	8 100	3 674	8 300	3 765	10 300	4 627
25	1.7			8 700	3 946	9 300	4 818	12 100	5 489	12 950	5 874
50	3.5			8 900	4 037	9 675	4 389	13 400	6 078	14 000	6 350
75	5			9 200	4 173	9 800	4 452	13 700	6 214	14 300	6 486
100	7			9 400	4 264	*	*	14 000	6 350	*	*
125	8.5			9 900	4 491	*	*	14 400	6 532	*	*
25	1.7	15	1	6 300	2 858	8 200	3 719	8 100	3 674	9 800	4 445
50	3.5			8 200	3 719	10 400	4 717	11 600	5 262	12 600	5 715
75	5			9 200	4 173	11 100	5 035	12 500	5 670	13 300	6 033
100	7			9 600	4 354	*	*	12 600	5 715	*	*
125	8.5			9 800	4 445	*	*	13 400	6 078	*	*
35	2.5	25	1.5	6 100	2 767	7 900	3 583	7 600	3 447	9 900	4 491
50	3.5			7 100	3 221	9 600	4 355	10 000	4 536	10 650	4 831
75	5			8 600	3 901	10 800	4 899	11 200	5 080	12 200	5 534
100	7			8 700	3 946	*	*	11 450	5 194	*	*
125	8.5			9 100	4 128	*	*	11 600	5 262	*	*
50	3.5	40	2.75	5 000	2 268	6 500	2 948	6 200	2 812	8 500	3 856
60	4			5 900	2 676	7 400	3 357	7 700	3 493	9 400	4 264
75	5			6 650	3 016	8 300	3 765	8 700	3 946	10 600	4 800
100	7			7 200	3 266	*	*	9 100	4 128	*	*
125	8.5			7 800	3 538	*	*	9 400	4 264	*	*
75	5	60	4	4 500	2 042	6 300	2 858	5 900	2 676	8 700	3 946
100	7			5 500	2 495	*	*	6 500	2 948	*	*
125	8.5			5 700	2 586	*	*	6 900	3 130	*	*

NOTES: Published capacities based on use of external check valves supplied by Armstrong. Although motive pressures are shown at high pressure differential (difference between motive inlet pressure and total lift or back pressure), it is preferable to use a motive pressure of 10 - 15 psig (0.65 - 1.0 barg) above discharge (outlet) pressure. This ensures longevity of economical (brass) check valves and reduces both venting time and temperature differential (on steam). Shading indicates sizing example shown on page 220.
*Consult factory.

PT-3500 Capacity Conversion Factors for Other Fill Heads

Fill Head		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
		0	0	6	152	12	305	18	457	24	610	36	914
Model	PT-3508	0.7		0.85		1.0		1.1		1.2		1.35	
	PT-3512	0.7		0.85		1.0		1.04		1.08		1.2	

NOTE: Fill head measured from drain point to top of cap. See figures on page 234.

PT-3500 Series Low Profile Pump Trap Materials

Name of Part	Material
Body	Cast iron - ASTM A48 class 30
Cap	Carbon steel SA-516-70
Cap Gasket	Graphoil
Inlet Valve Assembly	Stainless steel
Vent Valve Assembly	Stainless steel
Valve Assembly Washers	Zinc-plated steel
Plug	Steel
Mechanism Assembly and Float	Stainless steel
Springs	Inconel X-750

PT-3500 Series Low Profile Pump Trap Connection Sizes

Model Number	PT-3508		PT-3512	
	in	mm	in	mm
Inlet Connection	2	50	3	75
Outlet Connection	2	50	2	50
Motive Pressure Connection	1/2	15	1/2	15
Vent Connection	1	25	1	25
Gauge Glass Connection	1/2	15	1/2	15

Armstrong®

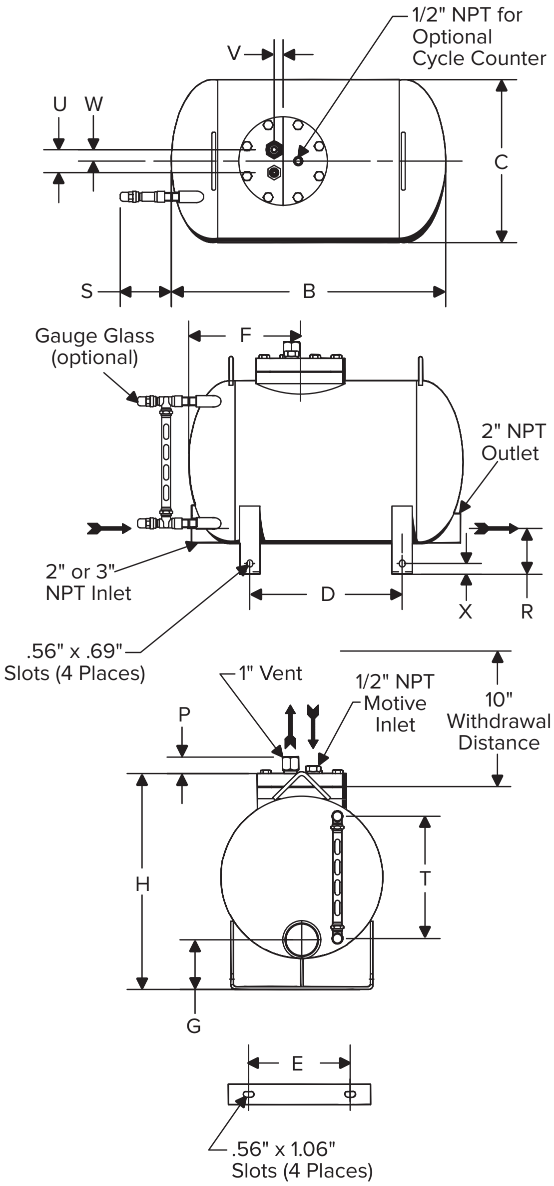
PT-300 Series Horizontal Steel, Low Profile Pump Trap

3-Year No Fail Warranty
3-Year
No Fail
Pump Trap Mechanism

The Armstrong PT-300 Series Horizontal, Low Profile Pump Trap is the low maintenance non-electric solution to move condensate or other liquids from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. Condensate can be returned at temperatures well above the 200°F (93°C) limit of conventional electric condensate pumps without the headaches of leaking seals or cavitation problems.

Features

- Economical non-electric operation. Uses inexpensive steam, air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Durable construction. ASME code-stamped carbon steel body vessel.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.



PT-300 Pumping Trap Physical Data

Model Number	PT-308 PT-312	
	in	mm
"B"	27	686
"C"	16	406
"D"	13	381
"E"	10	254
"F"	11	279
"G"	5-7/16	138
"H"	21-3/16	538
"P"	1-5/8	41
"R"	4-13/16	122
"S"	5-1/32	128
"T"	12	305
"U"	2-1/4	57
"V"	7/8	22
"W"	1-1/4	32
"X"	1-1/16	27
Face to Face	27-1/2*	698
Weight lb (kg)	154 (70)	
Number of Body/Cap Bolts	8	
Check Valve Conn. in (mm)	2 (50)	3 (75)
Bronze Check Valves lb (kg)	16 (7)	29 (13)
Stainless Steel Check Valves lb (kg)	15 (7)	38 (17)

Maximum Allowable Pressure (Vessel Design): 150 psig @ 650°F (10 barg @ 343°C)
Maximum Operating Pressure: 125 psig (9 barg)
*Tolerance +/- 1/2"

For a fully detailed certified drawing, refer to CDF #1001.

PT-300 Series Horizontal Steel, Low Profile Pump Trap

PT-300 Pumping Trap Materials

Name of Part	Series PT-300*
Body and Cap	Fabricated steel 150 psig ASME Sec. VIII design "U" stamped
Cap Gasket	Graphoil
Bolts	SA-449 steel
Nuts	None
Inlet Valve Assembly	Stainless steel
Vent Valve Assembly	Stainless steel
Valve Assembly Washers	Zinc plated steel
Plug	Steel
Mechanism Assembly	Stainless steel
Springs	Inconel X-750

NOTES: Optional flanged or socketweld connections available. Consult factory.
*Series PT-300 is available in all stainless steel. Consult factory.

PT-300 Pumping Trap Connection Sizes

Model	Horizontal Steel			
	PT-308		PT-312	
	in	mm	in	mm
Inlet Connection	2	50	3	80
Outlet Connection	2	50	2	50
Motive Pressure Connection	1/2	15	1/2	15
Vent Connection	1	25	1	25
Optional Gauge Glass Connection	1/2	15	1/2	15

PT-300 Pumping Trap Capacities

Motive Pressure		Total Lift or Back Pressure		PT-308 (12" Fill Head) 2" x 2"				PT-312 (12" Fill Head) 3" x 2"			
				Steam Motive		Air Motive		Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	6 900	3 130	9 200	4 173	9 000	4 082	12 300	5 579
25	1.7			10 200	4 622	10 900	4 944	13 200	5 987	14 200	6 441
50	3.5			10 600	4 808	11 100	5 035	15 100	6 849	15 800	7 167
75	5			10 800	4 898	11 300	5 126	15 300	6 940	16 100	7 303
100	7			11 200	5 080	*	*	15 500	7 031	*	*
125	8.5			11 600	5 261	*	*	16 600	7 530	*	*
25	1.7	15	1	7 000	3 175	10 100	4 581	9 000	4 082	11 200	5 080
50	3.5			9 600	4 354	10 900	4 944	12 800	5 806	13 800	6 260
75	5			10 750	4 876	11 100	5 035	14 200	6 441	15 000	6 804
100	7			10 900	4 944	*	*	14 300	6 486	*	*
125	8.5			11 300	5 125	*	*	15 100	6 849	*	*
35	2.5	25	1.5	7 100	3 221	9 200	4 173	8 100	3 674	11 500	5 216
50	3.5			8 300	3 765	10 200	4 627	10 200	4 627	12 750	5 783
75	5			10 100	4 581	11 000	4 989	12 500	5 670	13 500	6 123
100	7			10 200	4 627	*	*	12 700	5 761	*	*
125	8.5			10 300	4 672	*	*	13 000	5 897	*	*
50	3.5	40	2.75	5 700	2 585	7 600	3 447	6 600	2 994	9 800	4 445
60	4			6 600	2 994	8 800	3 992	8 400	3 810	10 500	4 763
75	5			7 600	3 447	10 100	4 581	9 800	4 445	12 700	5 761
100	7			8 400	3 810	*	*	10 100	4 581	*	*
125	8.5			9 400	4 264	*	*	10 300	4 672	*	*
70	4.5	60	4	4 500	2 041	7 000	3 175	6 000	2 722	10 200	4 627
75	5			4 700	2 132	7 100	3 221	6 400	2 903	10 400	4 717
100	7			6 400	2 903	*	*	7 100	3 221	*	*
125	8.5			6 600	2 994	*	*	7 400	3 357	*	*

NOTES: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump cap. See figures on page 234.Although motive pressures are shown at high pressure differentials (difference between motive inlet pressure and total lift or back pressure), it is preferable to use a motive pressure of 10 - 15 psig (0.65 - 1 barg) above discharge (outlet) pressure. This ensures longevity of economical (brass) check valves and reduces both venting time and temperature differential (on steam). If a higher differential is used, stainless steel check valves are recommended.
*Consult factory.

PT-300 Capacity Conversion Factors for Other Fill Heads

Fill Head		in	mm	in	mm	in	mm	in	mm	in	mm
		0	0	6	152	12	305	24	610	36	914
Model	PT-308	0.7		0.85		1.0		1.2		1.3	
	PT-312	0.7		0.85		1.0		1.08		1.2	

NOTES: Fill head is measured from drain point to top of cap. See figures on page 234.

Options

Use of external check valves required for operation of pumping trap.

- Inlet Swing Check Valve
  NPT Bronze ASTM B 62
  Teflon® Disc
  Class 150 (Minimum)
- Outlet
  Stainless Steel Check Valve
  Class 150 (Minimum)
- In-line Check Valves
  Stainless Steel Non-Slam Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

Sizing and Selection—
PT-100/200/300/3500/400/DD-4/DD-6/PT-6F Series

The Armstrong non-electric pump trap is sized based on actual condensate load (lb/hr or kg/hr) being pumped. The following steps are used to size the pump.

1. Determine the total condensate load to be pumped in lb/hr or kg/hr. See table on page 217 for conversion factors.
2. Determine the total back pressure the pump will operate against. Total back pressure is the sum of the following:
   - Vertical lift expressed in psig. See conversion formula below to convert lift to psig
   - Existing pressure in condensate return line or D.A. tank
   - Frictional loss from pipe, valves and fittings
3. Determine type of motive gas to be used (steam, air or other inert gas) and pressure available.

Example:

- Condensate load = 7 100 lb/hr (3 221 kg/hr).
- Total back pressure = 25 psig (1.5 barg)
  (25 foot vertical lift = 10.8 psig, 14 psig in condensate return line).
- Motive pressure is steam at 50 psig (3.5 barg).

Solution: Model PT-3508
Find 25 psig total lift or back pressure in column two of Low Profile Pump Trap Capacities table on page 217. Then find 50 psig motive pressure in column one. Move across the capacity table until you reach a model number with the correct capacity. A PT-3508 has been highlighted on page 217 for this example.

Either a closed reservoir pipe or a vented receiver is required for proper condensate storage during the pump-down cycle of the pumping trap.

For vented/open system receiver sizing:

- Determine the pressure from where the condensate is being discharged.
- Determine condensate load.

Reference Percentage of Flash Steam chart on page 221 to find the pressure that corresponds with the discharge condensate pressure. For this example, use 15 psig.

Follow 15 psig on the horizontal axis where it intersects the curve. Move left from the intersecting lines to the vertical axis for the percentage of flash steam that is created. For this example it will be 3% (see shaded area on Percentage of Flash Steam chart).

Multiply 3% by the condensate load. Using example above 7 100 lb/hr. 7 100 x .03 = 213 lb/hr flash steam.

Using the Vented Receiver Sizing table on page 221, find the amount of flash steam in column one. Follow the table across to determine the size of the vented receiver. (See shaded area on Inlet Reservoir Pipe Sizing table—page 221 for this example.)

For closed reservoir piping:
1. Determine condensate load (using example above 7 100 lb/hr).

Reference the inlet reservoir pipe sizing for closed systems on page 221. Find 7 100 lb/hr in column one. Move horizontally across to find proper pipe size. (Note length or diameter may be slightly enlarged when capacity falls between given condensate loads in column one.) Selection is shaded.

Metric Conversion Formulas

Convert lb/hr to kg/hr—By dividing by 2.2046 Example: 1 800 lb/hr ÷ 2 2046 = 816 kg/hr

Convert psig to barg—By dividing by 14.5 Example: 15 psig ÷ 14.5 = 1.03 barg

Convert psig to kg/cm²—By dividing by 14.22 Example: 15 psig ÷ 14.22 = 1.05 kg/cm²

Sizing and Selection— PT-100/200/300/3500/400/DD-4/DD-6/PT-6F Series

Inlet Reservoir Pipe Sizing for Closed Systems

Condensate Load		Reservoir Pipe Diameter											
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
lb/hr	kg/hr	2	50	3	75	4	100	6	150	8	200	10	250
up to		Length of Pipe											
		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
500	227	4	1.2	2-1/2	0.7	1-1/2	0.4						
1 000	453	4-1/2	1.4	2	0.6	1-1/2	0.4						
1 500	680	7	2.1	3	0.9	2	0.6						
2 000	907	9	2.7	4	1.2	2-1/2	0.7						
2 500	1 134	11	3.4	5	1.5	3	0.9	1-3/4	0.5				
3 000	1 360	13-1/2	4.1	6	1.8	3-1/2	1.1	2	0.6				
4 000	1 814	18	5.5	8-1/2	2.6	5	1.5	2-1/2	0.7				
5 000	2 268			10	3.0	6	1.8	3	0.9	1-1/2	0.4		
6 000	2 722			12	3.7	7	2.1	3-1/2	1.1	2	0.6		
7 000	3 175			14-1/2	4.4	8-1/2	2.6	4	1.2	2	0.6		
8 000	3 629			16-1/2	5.0	9-1/2	2.9	4-1/2	1.4	2-1/2	0.7	1-1/2	0.4
9 000	4 082					11	3.4	5	1.5	3	0.9	2	0.6
10 000	4 536					12	3.7	5-1/2	1.7	3	0.9	2	0.6
11 000	4 990					13	4.0	6	1.8	3-1/2	1.1	2	0.6
12 000	5 443					14	4.3	6-1/2	2.0	4	1.2	2-1/2	0.7

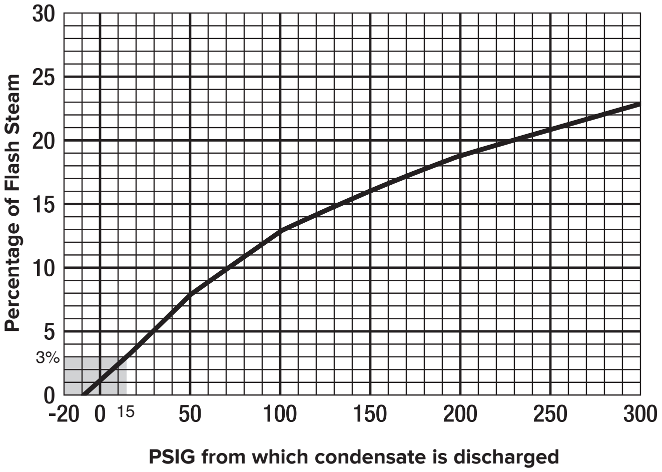
NOTE: When draining condensate from a single piece of equipment in a closed system, to achieve maximum energy efficiency a reservoir should be installed horizontally above and ahead of the pump trap. Sufficient reservoir volume is required above the filling head level to hold condensate during the pump trap discharge cycle. The chart above shows the minimum reservoir sizing, based on the condensate load, to prevent equipment flooding during the pump trap discharge cycle.

Vented Receiver Sizing for Open Systems

Flash Steam		Receiver Diameter		Receiver Length		Vent Line Diameter	
lb/hr	kg/hr	in	mm	in	mm	in	mm
up to				36	914		
75	34	4	102			1-1/2	40
150	68	6	152			2	50
300	136	9	229			2-1/2	65
500	227	10	254			3	75
900	408	12	300			4	100
1 200	544	16	405			6	150
2 000	907	20	508			8	200

NOTE: When draining from single or multiple pieces of equipment in an open system, a vented receiver should be installed horizontally above and ahead of the pump trap. In addition to sufficient holding volume of the condensate above the fill head of the pump trap to hold the condensate during the pump trap cycle, the receiver must also be sized to allow enough area for flash steam and condensate separation. An overflow could also be added when required. The minimum recommended water seal is 12" (300 mm). This table shows proper receiver tank sizing based on flash steam present. See the chart at right to calculate the percentage of flash steam at a given pressure drop.

Percentage of Flash Steam Formed When Discharging Condensate to Reduce Pressure



NOTE: Back pressure = 0 psig

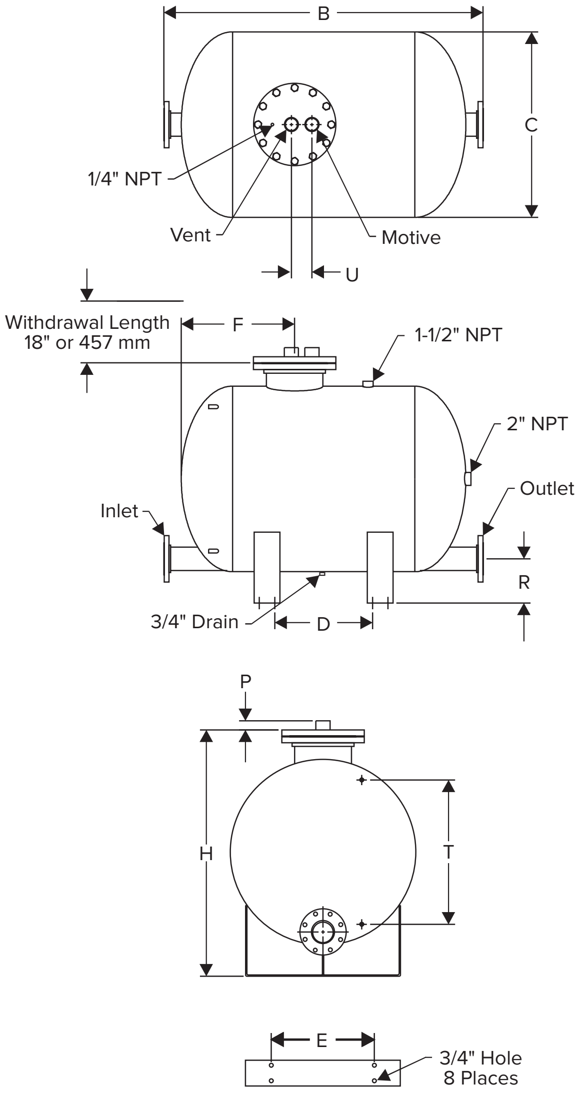
Armstrong® PT-516 High Capacity Pump Trap

Effective recovery and return of hot condensate are essential to overall plant efficiency while conserving energy. Large amounts of condensate provide the best opportunities to save energy.

The Armstrong PT-516 High Capacity Pump Trap is the low maintenance, non-electric solution to moving large amounts of condensate and other liquids from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. Condensate can be returned at temperatures well above the 200°F (93°C) limit of conventional electric pumps without the headaches of leaking seals or cavitation.

Features

- Economical non-electric operation. Uses inexpensive steam air or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe—explosion-proof.
- Durable construction. ASME code-stamped carbon steel body vessel.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.



For a fully detailed certified drawing, refer to FH1367.

PT-516 High Capacity Pump Trap Physical Data		
	in	mm
Inlet Connection	4 150# ANSI Flg.	100 150# ANSI Flg.
Outlet Connection	4 150# ANSI Flg.	100 150# ANSI Flg.
Motive Connection	2 NPT	50 NPT
Vent Connection	2 NPT	50 NPT
Gauge Glass Conn.	1/2 NPT	15 NPT
"B"	62	1 574
"C"	36	914
"D"	19-1/16	484
"E"	20	508
"F"	22	559
"H"	48	1 219
"P"	1-3/4	44
"R"	8-3/4	222
"T"	28	711
"U"	4	100
Weight	807	366
Number of Bolts	12	12

Maximum Operating Pressure on standard unit: 150 psig (10 barg).
For higher pressure, consult factory.
Maximum Allowable Pressure (standard vessel deisgn): 150 psig @ 500°F (10 barg @ 277°C).
300 psig (21 barg) vessel available upon request.

PT-516 Capacity Conversion Factors for Other Fill Heads												
Fill Head	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	0	0	6	152	12	305	16	406	24	610	36	914
PT-516	0.7		0.75		0.8		0.85		1.0		1.08	

PT-516 High Capacity Pump Trap

Typical Applications

- Low pressure heating systems
- Process heat exchanger or coils with modulating steam control
- Remote installations (tracing, tank farms or remote coils)
- Systems under vacuum
- Hazardous (explosion proof) areas
- Caustic environments
- Sumps or submersed areas

PT-516 High-Capacity Pump Trap Materials

Name of Part	Description
Cap, Body, Bolting	Fabricated steel 150 psig ASME Sec. VIII design "U" stamp coded
Cap Gasket	Stainless steel spiral wound
Inlet Valve Assembly	Stainless steel
Vent Valve Assembly	Stainless steel
Mechanism Assembly: Frame, Float and Spring	Stainless steel

NOTES: 300 psig ASME vessel available upon request. PT-516 available in all stainless steel. Consult factory.

Armstrong PT-516 Pump Trap Sizing and Selection

PT-516 Pump Trap Capacities

Motive Pressure		Total Lift or Back Pressure		4" x 4" Connections 24" Fill Head			
				Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr
15	1.0	5	0.34	28 962	13 137	57 619	26 136
25	1.7			37 162	16 857	61 911	28 083
35	2.5			42 563	19 307	64 738	29 365
50	3.5			48 288	21 903	67 735	30 725
60	4			51 214	23 231	69 267	31 420
70	4.5			53 688	24 138	70 562	32 007
75	5			54 796	24 855	71 142	32 270
100	7			59 414	26 950	73 559	33 366
125	8.5			62 995	28 575	*	*
150	10.34			65 922	29 902	*	*
25	1.7	15	1	36 720	16 656	50 783	23 035
35	2.5			40 611	18 421	54 293	24 627
50	3.5			45 196	20 501	58 013	26 315
60	4			47 740	21 655	59 915	27 177
70	4.5			50 005	22 682	61 523	27 907
75	5			51 054	23 159	62 243	28 233
100	7			55 675	25 254	65 243	29 594
125	8.5			59 552	27 013	*	*
150	10.34			62 923	28 542	*	*
35	2.5	25	1.5	29 212	13 251	46 238	20 973
50	3.5			33 413	15 156	50 962	23 116
60	4			35 672	16 181	53 376	24 211
70	4.5			37 646	17 076	55 418	25 138
75	5			38 548	17 485	56 313	25 544
100	7			42 454	19 257	60 141	27 280
125	8.5			45 649	20 706	*	*
150	10.34			*	*	*	*
50	3.5	40	2.75	26 210	11 889	41 244	18 708
60	4			27 353	12 407	44 028	19 971
70	4.5			28 319	12 846	46 382	21 039
75	5			28 752	13 042	47 435	21 517
100	7			30 555	13 860	51 828	24 022
125	8.5			31 954	14 494	*	*
150	10.34			33 097	15 013	*	*
70	4.5	60	4	25 973	11 781	32 026	14 527
75	5			26 373	11 963	33 514	15 202
100	7			28 042	12 720	40 951	18 575
125	8.5			29 336	13 307	*	*
150	10.34			30 394	13 787	*	*
100	7	80	5.5	23 892	10 837	34 893	15 827
125	8.5			24 231	10 991	*	*
150	10.34			24 570	11 145	*	*

NOTES: Published capacities above are based on actual steam testing using a minimum 200°F condensate. Published capacities are based on the use of external check valves supplied by Armstrong.
*Consult factory.

Options

External check valves required for use of pumping trap.

- Inlet/Outlet Check Valve
  CS/SS Wafer Style or All Stainless Steel Wafer Style
- Bronze Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

Reservoir Sizing — DD-12/PT-12F/PT-516 Series High Capacity

Either a closed reservoir pipe or a vented receiver is required for proper condensate storage during the pump-down cycle of the pumping trap. Refer to the tables for sizing.

For Closed Reservoir Piping

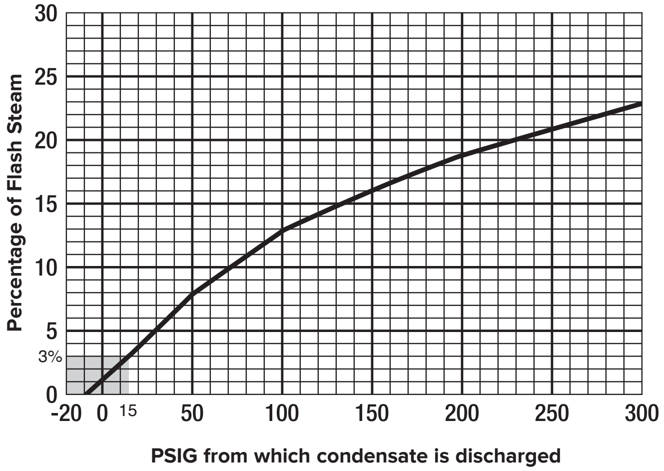
1. Determine condensate load.
   Example 30 000 lb/hr:
   - Reference the Inlet Reservoir Pipe table top right. Find the 30 000 lb/hr condensate load in column one. Move across the columns to find the proper pipe sizing.

For Vented Receiver Sizing

1. Determine the pressure from where the condensate is being discharged.
2. Determine condensate load.
   - Reference the chart below to find the pressure that corresponds with the discharge condensate pressure. For this example, use 15 psig.
   - Follow 15 psig to where it intersects the “0” psig curve. Move to the left from intersecting lines for the percentage of flash that will be created. For this example, it will be 3%.
   - Multiply the 3% by the condensate load. For this example, it is 30 000 lb/hr. Thus, 30 000 x .03 = 900 lb/hr of flash steam.

Using the Vented Receiver table bottom right, find the amount of flash steam in column one. Follow the table across to determine the sizing of the vented receiver.

Percentage of Flash Steam Formed When Discharging Condensate to Reduce Pressure



NOTE: Back pressure = 0 psig

Inlet Reservoir Pipe Sizing for Closed Systems

Condensate Load lb/hr	Reservoir Pipe Diameter (in)					
	8	10	12	16	20	24
up to	Length of Pipe (feet)					
10 000	6-1/2	6	5	3	2	
20 000	12	11-1/2	10	7	4	
30 000		12	10-1/2	9	6	4
40 000		17	14	12	8	6
50 000			16	13	9	6
60 000				15	11	8
70 000					15	10

NOTE: When BP/MP is less than 50%, the reservoir diameters above can be reduced by 1/2" (15 mm). When draining condensate from a single piece of equipment in a **closed system,** to achieve maximum energy efficiency (see Closed System figure on page 234) a reservoir should be installed horizontally above and ahead of the pump trap. Sufficient reservoir volume is required above the filling head level to hold condensate during the pump trap discharge cycle. The table above shows the minimum reservoir sizing, based on the condensate load, to prevent equipment flooding during the pump trap discharge cycle.

Vented Receiver for an Open System

Flash Steam lb/hr	Receiver Diameter (in)	Receiver Length (in)	Vent Line Diameter (in)
up to			
1 000	16	60	6
2 000	20	60	8
3 000	24	60	8
4 000	26	60	10
5 000	28	60	10
6 000	30	72	12
7 000	32	72	12
8 000	36	72	14

NOTE: When draining from single or multiple pieces of equipment in an open system, a vented receiver should be installed horizontally above and ahead of the pump trap (see Open System figure on page 234). In addition to sufficient holding volume of the condensate above the fill head of the pump trap to hold the condensate during the pump trap cycle, the receiver must also be sized to allow enough area for flash steam and condensate separation. An overflow could also be added when required. The minimum recommended water seal is 12" (305 mm). The table above shows proper receiver tank sizing based on flash steam present. See chart left to calculate the percentage (%) of flash steam at a given pressure drop.

PT-300LL/PT-400LL Light Liquid Pump Traps

Features

- Economical non-electric operation. Uses inexpensive steam or inert gas.
- Low-maintenance operation. No leaking seals, impeller or motor problems means lower maintenance. No NPSH issues.
- Lower installation costs. Single trade required for installation and maintenance.
- Peace of mind. Standard unit is intrinsically safe.
- Durable construction. ASME code-stamped carbon steel body vessel.
- Corrosion resistance. Internals are all stainless steel for corrosion resistance and long life.
- Heavy-duty springs. Springs are made from long-lasting Inconel X-750.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The pump can be used in flooded pits without fear of electrocution or circuit breaker defaults.
- Externally removable/replaceable seats. Seats can be replaced or cleaned without removing the mechanism assembly.
- Specific gravity range. Pumps can accommodate specific gravity down to 0.65.

PT-300LL Light Liquid Pump Trap

PT-400LL Light Liquid Pump Trap

Typical Applications

- Hydrocarbon knockout drum/separator
- Flare header drain
- Applications where the specific gravity of the liquid could be as low as 0.65
- Applications where hydrocarbons may be present

Technical Data

Back Pressure

- Maximum back pressure for the PT-300LL or PT-400LL is 60 psig (4.1 barg)

Motive Pressure

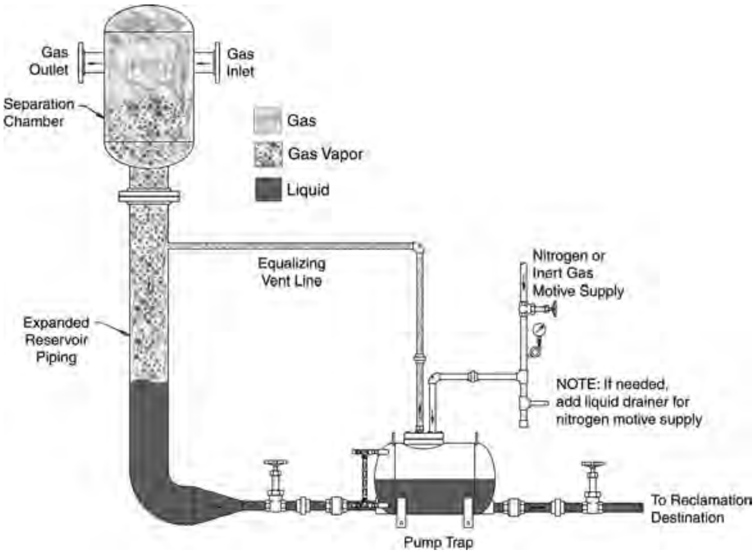
- **Maximum motive pressure (Nitrogen or Inert Gas) is 100 psig (6.9 barg)**

NOTE: To determine the lb/hr of liquid being pumped, use the following formula:

lb/hr of liquid = capacities x specific gravity of liquid

To size the Light Liquid Pumps, use the sizing charts on pages 215 and 219.

Consult Armstrong for engineered pre-piped receiver packages.



Hydrocarbon Knockout Drum Separator

Double Duty® 4

Steam Trap/Pump Combination

Description

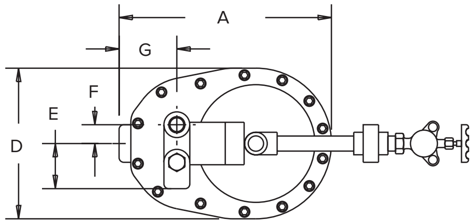
Armstrong's Double Duty® Series steam trap/pump combination offers a low profile solution to draining heat exchangers in various applications.

The Double Duty® 4 is a low profile pump that offers you the versatility of combining a pump within a steam trap to aide in condensate drainage from a heat exchanger under all operating conditions.

Double Duty® 4

Features

- Economical. non-electric operation
- Low-maintenance operation. No leaking seals, impeller or motor problems. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade installation.
- Peace of mind. Intrinsically safe.
- Ductile iron durability. Rugged construction material means long service life.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The trap/pump can be used in pits or sumps without fear of electrocution or circuit breaker defaults.



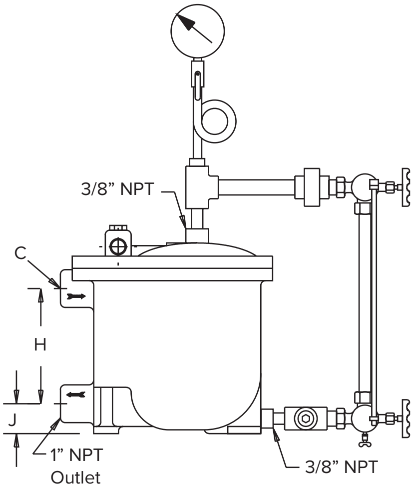
Maximum Operating Conditions

Maximum allowable pressure

DD-4	72 psig @ 320°F (5 barg @ 160°C)

Maximum operating pressure:

DD-4	72 psig @ 320°F (5 barg @ 160°C)

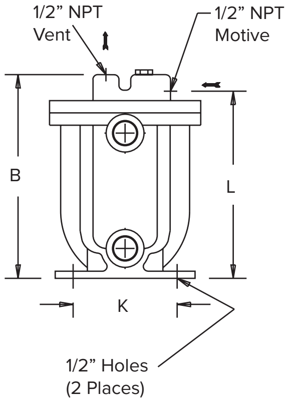


Materials

Body:	Ductile iron
Mechanism:	All stainless steel
Springs:	304 Stainless steel
Float:	All stainless steel

For a fully detailed certified drawing, refer to CD-2030.

Double Duty® 4 Physical Data		
	in	mm
"A"	11-3/16	284
"B"	10-13/16	274
"C"	1	25
"D"	8	203
"E"	2-7/16	61
"F"	1	25
"G"	3	76
"H"	6-1/8	155
"J"	1-5/8	41
"K"	5-1/2	140
"L"	9-15/16	251
Weight lb (kg)	37 (17)	



Double Duty® 4

Steam Trap/Pump Combination

Double Duty® 4 Pump Capacities

Motive		Back Pressure		Capacity	
psig	**barg**	**psig**	**barg**	**lb/hr**	**kg/hr**
15	1	5	0.34	220	100
25	1.7			300	136
50	3.5			348	158
70	4.5			350	159
25	1.7	15	1	220	100
50	3.5			345	156
70	4.5			348	158
35	2.5	25	1.5	220	100
50	3.5			325	147
70	4.5			348	158
50	3.5	40	2.75	220	100
60	4			300	136
70	4.5			335	152
70	4.5	60	4	220	100

NOTE: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump case.

Double Duty® 4 Trap Capacities

Differential Pressure		Capacity	
psig	**barg**	**lb/hr**	**kg/hr**
5	0.34	1 342	610
10	0.7	1 980	900
20	1.4	2 860	1 300
30	2.1	3 410	1 550
40	3	3 795	1 725
50	3.4	4 070	1 850
60	4.1	4 235	1 925
70	4.8	4 400	2 000

Capacity Conversion Factors for Other Filling Heads

Filling Head			
in	**0**	**2**	**6**
mm	**0**	**50**	**152**
Double Duty DD-4	.65	1.0	1.10

NOTE: Fill head measured from drain to top of cap.

Double Duty® 6

Steam Trap/Pump Combination

Description

Armstrong's Double Duty® Series steam trap/pump combination offers a low profile solution to draining heat exchangers in various applications.

The Double Duty® 6 is an ASME code stamped carbon steel vessel. The Double Duty® 6 offers you the versatility of combining a pump within a steam trap to aide in condensate drainage under all operating conditions.

Double Duty® 6

Features

- Economical. non-electric operation
- Low-maintenance operation. No leaking seals, impeller or motor problems. No NPSH issues.
- Space-saving size. Low-profile body fits in tight spaces while allowing minimal fill head.
- Lower installation costs. Single trade installation.
- Peace of mind. Intrinsically safe.
- ASME Carbon Steel durability. Rugged construction material means long service life.
- Efficiency. A closed loop means no motive or flash steam is lost. All valuable Btu's are captured and returned to the system.
- Safety. The trap/pump can be used in pits or sumps without fear of electrocution or circuit breaker defaults.

Maximum Operating Conditions

Maximum allowable pressure

DD-6 200 psig @ 400°F (14 barg @ 204°C)

Maximum operating pressure:

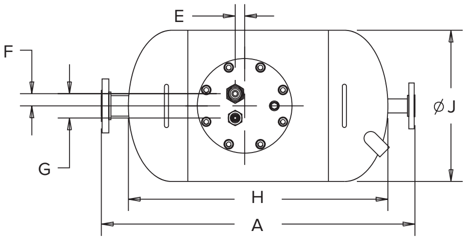
DD-6 200 psig @ 400°F (14 barg @ 204°C)

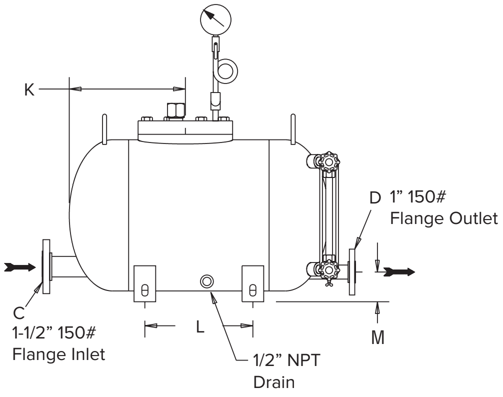
Materials

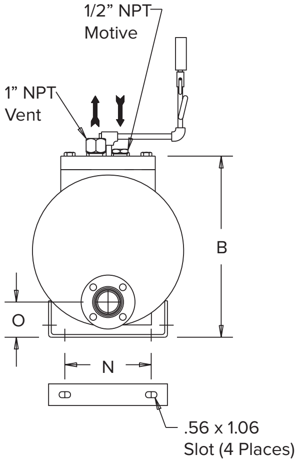
Body:	ASME Code Stamped Carbon Steel
Springs:	Inconel X-750
Internals:	All stainless steel

For a fully detailed certified drawing, refer to CD2035.

Double Duty® 6 Physical Data		
	in	mm
"A"	29	737
"B"	16-11/16	424
"C"	1-1/2	38
"D"	1	25
"E"	7/8	22
"F"	1-1/8	28
"G"	2-1/4	57
"H"	24	610
"J"	14	356
"K"	10-13/16	275
"L"	10	254
"M"	2-13/16	71
"N"	8	203
"O"	3-3/16	81
Weight lb (kg)	140 (64)	







Double Duty® 6

Steam Trap/Pump Combination

Double Duty® 6 Pump Capacities

Motive		Back Pressure		Capacity	
psig	barg	psig	barg	lb/hr	kg/hr
15	1	5	0.34	2 400	1 089
25	1.7			3 000	1 361
50	3.5			4 000	1 814
75	5			4 500	2 041
100	7			4 600	2 087
125	8.5			4 700	2 132
150	10.34			4 800	2 177
175	12			4 800	2 177
200	14			4 600	2 087
25	1.7	15	1	2 000	907
50	3.5			2 800	1 270
75	5			3 400	1 542
100	7			3 600	1 633
125	8.5			3 700	1 678
150	10.34			3 800	1 724
175	12			3 600	1 633
200	14			3 500	1 588
35	2.5	25	1.5	1 800	816
50	3.5			2 300	1 043
75	5			2 900	1 315
100	7			3 000	1 361
125	8.5			3 000	1 361
150	10.34			2 900	1 315
175	12			2 500	1 134
200	14			2 300	1 043
50	3.5	40	2.75	1 400	635
75	5			2 000	907
100	7			2 400	1 089
125	8.5			2 500	1 134
150	10.34			2 500	1 134
175	12			1 800	816
200	14			1 700	771
75	5	60	4	1 500	680
100	7			1 800	816
125	8.5			2 000	907
150	10.34			1 700	771
175	12			1 500	680
200	14			1 400	635

NOTE: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump case.

Double Duty® 6 Trap Capacities

Differential Pressure		Capacity	
psig	barg	lb/hr	kg/hr
2	0.14	9 500	4 309
5	0.34	12 400	5 625
10	0.7	15 000	6 804
25	1.5	20 400	9 253
50	3.5	22 500	10 206
75	5.2	22 500	10 206
100	6.9	22 500	10 206
150	10.3	22 500	10 206
200	13.8	22 500	10 206

Capacity Conversion Factors for Other Filling Heads

Filling Head				
in	**0**	**6**	**12**	*** 24 or greater**
mm	**0**	**150**	**305**	*** 620 or greater**
Double Duty DD-6	0.7	1.0	1.08	* Consult factory

NOTE: Fill head measured from drain to top of cap.

Double Duty® 12

Steam Trap/Pump Combination

Description

Armstrong's Double Duty-12 steam trap/pump combination offers a unique solution for draining condensate from heat exchangers and coils in various applications.

The Double Duty-12 is an ASME code stamped carbon steel vessel which offers you the versatility of combining a pump mechanism within a steam trap to assist in condensate drainage under all operating conditions.

Features

- ASME Section VIII "U" stamped vessel
- Inconel X-750 springs for long service life
- All stainless steel internals
- Easy access to the steam trap mechanism without removing cap assembly
- Externally removable vent and motive seats
- Separate pump and trap mechanisms

Maximum Operating Conditions

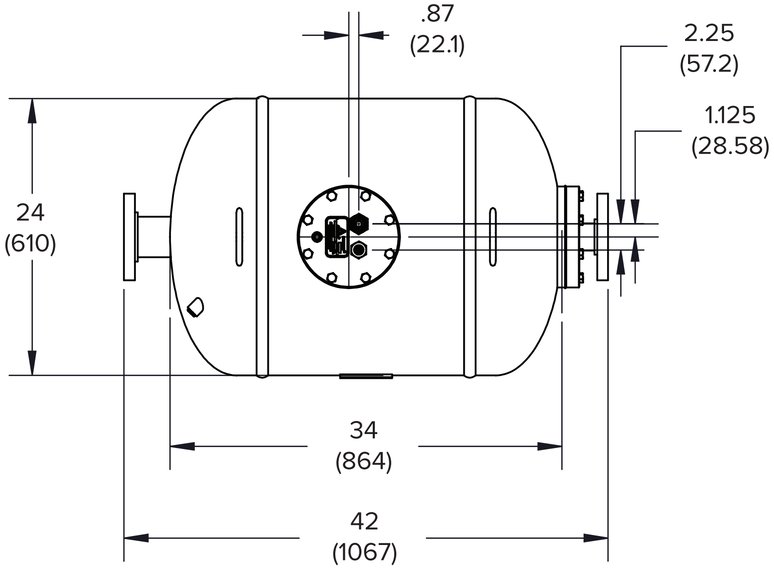
Maximum allowable pressure: 200 psig @ 400°F (14 barg @ 204°C)
Maximum operating pressure: 200 psig @ 400°F (14 barg @ 204°C)

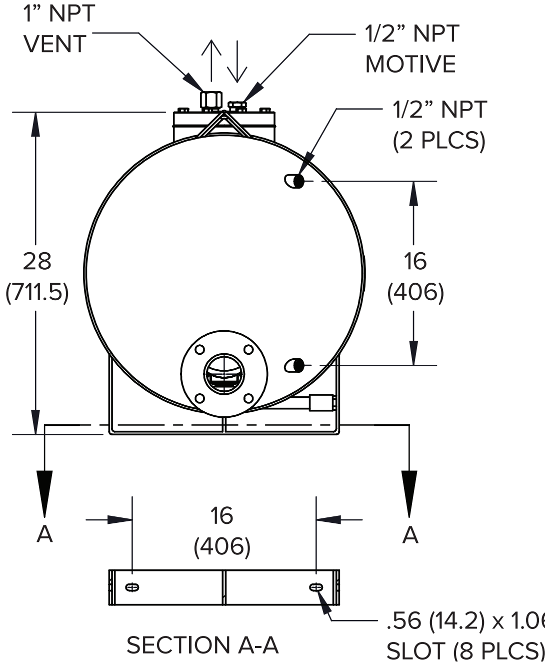
(Consult factory for different pressure/temperature ratings)

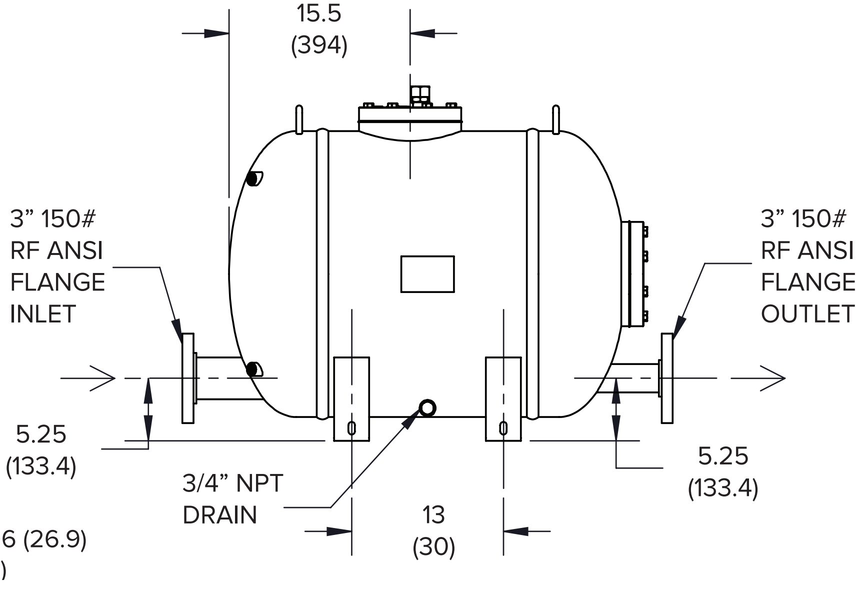
Materials

Body:	ASME code carbon steel
Springs:	Inconel X-750
Internals:	Stainless steel

For a fully detailed certified drawing, refer to CD-2472.







Double Duty® 12

Steam Trap/Pump Combination

Double Duty® 12 Pump Capacities

Motive		Back Pressure		Capacity	
psig	barg	psig	barg	lb/hr	kg/hr
15	1	5	0.34	9 800	4 445
25	1.7			12 900	5 581
50	3.5			16 500	7 484
75	5			18 200	8 255
100	7			18 900	8 573
125	8.5			19 300	8 754
150	10.34			19 800	8 981
175	12			19 900	9 026
200	14			19 900	9 026
25	1.7	15	1	8 500	3 856
50	3.5			12 900	5 851
75	5			14 800	6 713
100	7			16 000	7 257
125	8.5			16 400	7 439
150	10.34			17 200	7 802
175	12			17 300	7 847
200	14			17 300	7 847
35	2.5	25	1.5	7 200	3 266
50	3.5			10 300	4 672
75	5			12 300	5 579
100	7			13 700	6 214
125	8.5			13 700	6 214
150	10.34			14 700	6 668
175	12			14 800	6 713
200	14			15 000	6 804
50	3.5	40	2.75	6 700	3 039
75	5			9 500	4 309
100	7			10 600	4 808
125	8.5			10 900	4 944
150	10.34			11 300	5 126
175	12			11 300	5 126
200	14			11 400	5 171
75	5	60	4	6 900	3 130
100	7			8 300	3 765
125	8.5			8 300	3 765
150	10.34			8 400	3 810
175	12			8 400	3 810
200	14			8 600	3 901
100	7	80	5.5	6 400	2 903
125	8.5			6 400	2 903
150	10.34			7 200	3 266
175	12			7 200	3 266
200	14			7 300	3 311

NOTE: Published capacities are based on the use of external check valves supplied by Armstrong.

Capacity Conversion Factors for Other Filling Heads

Filling Head					
in	**0**	**6**	**12**	**24**	*** 24 or greater**
mm	**0**	**150**	**305**	**610**	*** 620 or greater**
Double Duty DD-12	.7	.85	1	1.08	* Consult Factory

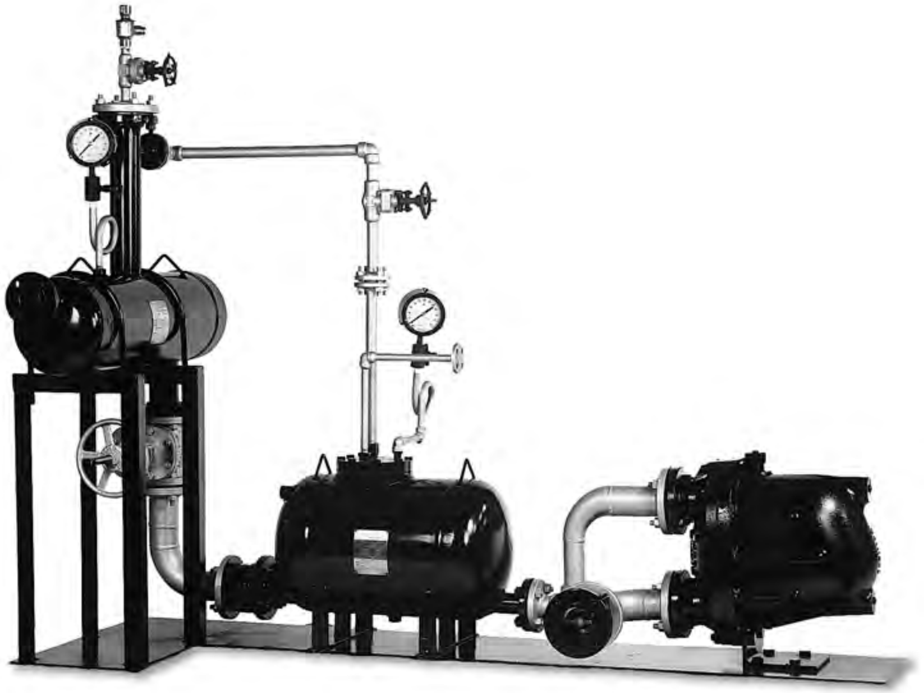
Double Duty® 12 Trap Capacities

Differential Pressure		Capactiy	
psig	barg	lb/hr	kg/hr
2	.14	21 500	9 752
5	.34	28 700	13 018
10	.7	35 900	16 284
25	1.5	52 100	23 632
50	3.5	59 600	27 034
75	5.2	72 000	32 659
100	6.9	81 000	36 741
150	10.3	93 000	42 184

NOTE: Fill head measured from drain to top of cap.
Weight in lb/kg: 348 (158)

Armstrong Packaged Solutions

Custom Fabrications



Armstrong can design and fabricate custom packages to fit your application needs.

ASME Packages

Armstrong can design and fabricate all ASME packages to meet your plant piping requirements.

Standard

Armstrong's standard simplex (shown), duplex, triplex or quadraplex packages are unparalleled in quality and craftsmanship.

Accessories

Pre-Piped PRV Station

PRV/Drip trap stations, pre-piped to single pumps or packages.

Horizontal ASME Reservoirs/Horizontal Flash Tanks

ASME stamped vessels designed for condensate collection or use as horizontal flash tanks. (Horizontal flash tanks with sparge tubes and drop legs are also available - consult factory)

Exhaust Heads

Eliminate water carryover in atmospheric vent pipe.

Digital Cycle Counters
- Open- or closed-loop designs
- Optional external dry contacts
- Intrinsically safe models available (consult factory)

Insulation Blankets
- Pumps
- Receivers (consult factory for models)

Options

Use of external check valves required for operation of pumping trap.

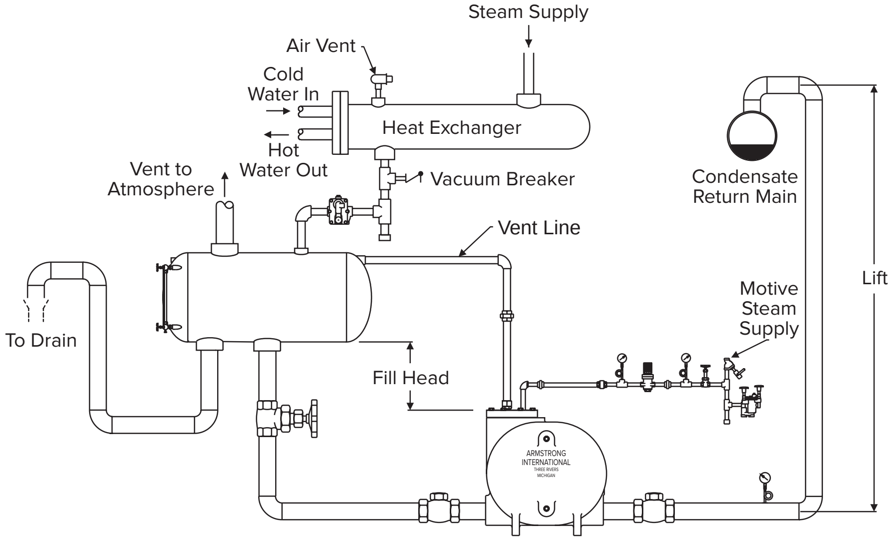
- Inlet Swing Check Valve
  NPT Bronze ASTM B 62
  Teflon® Disc
  Class 150 (Minimum)
- Outlet
  Stainless Steel Check Valve
  Class 150 (Minimum)
- In-line Check Valves
  Stainless Steel Non-Slam
  Check Valves
- Bronze Gauge Glass Assembly
- Steel Gauge Glass Assembly
- Removable Insulation Jacket
- Digital Cycle Counter

Check Valves
- Stainless steel in-line non-slam check valves
- Bronze/stainless steel (standard)
- Cast steel/stainless steel wafer-style (flanged pumps)
- Stainless steel/stainless steel wafer-style (flanged pumps)
- Bronze (standard)

Level Gauges
- Bronze glass gauge (standard)
- Carbon steel glass gauge
- Reflex gauge (HPI Service)—consult factory

Pump/Package Accessories

Low Boy™ packages enable you to utilize mechanical pump technology in limited height applications.

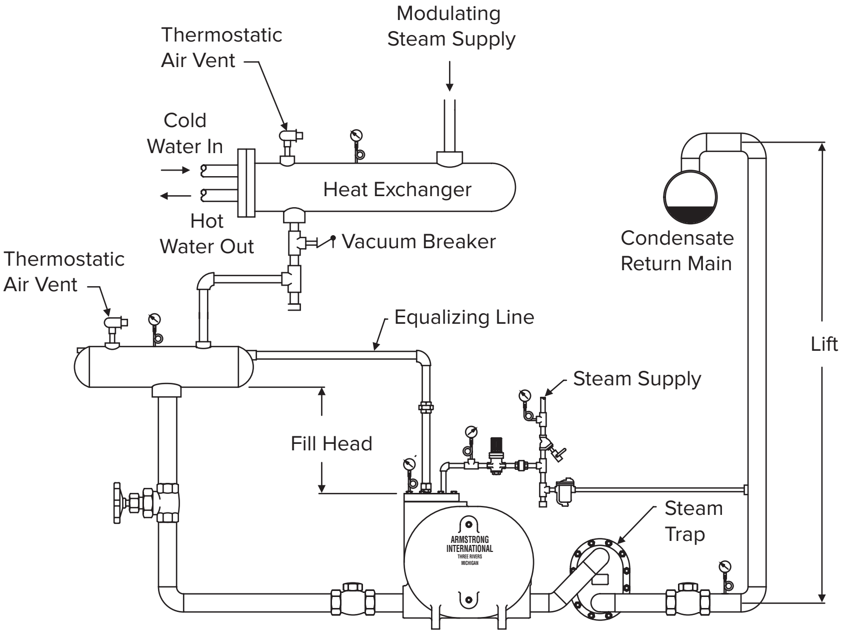


Multiple or single traps discharging to vented receiver.

OPEN SYSTEMS

For the majority of applications, a steam trap is recommended on each piece of heat exchange equipment. The steam trap, or traps, discharge to a vented receiver where flash steam will be vented to the atmosphere. The pump trap is located downstream and below the vented receiver, allowing for proper fill head height. See tables on page 221 and 224 for vented receiver and vent sizing for an open system.

Note 1: Drip trap may be discharged into the receiver, the return line or to the drain.



Draining steam coil or heat exchanger when steam pressure may exceed the return line pressure, a steam trap is required on the discharge side of the pump trap. Request installation and operation manual IB-100.

CLOSED SYSTEMS

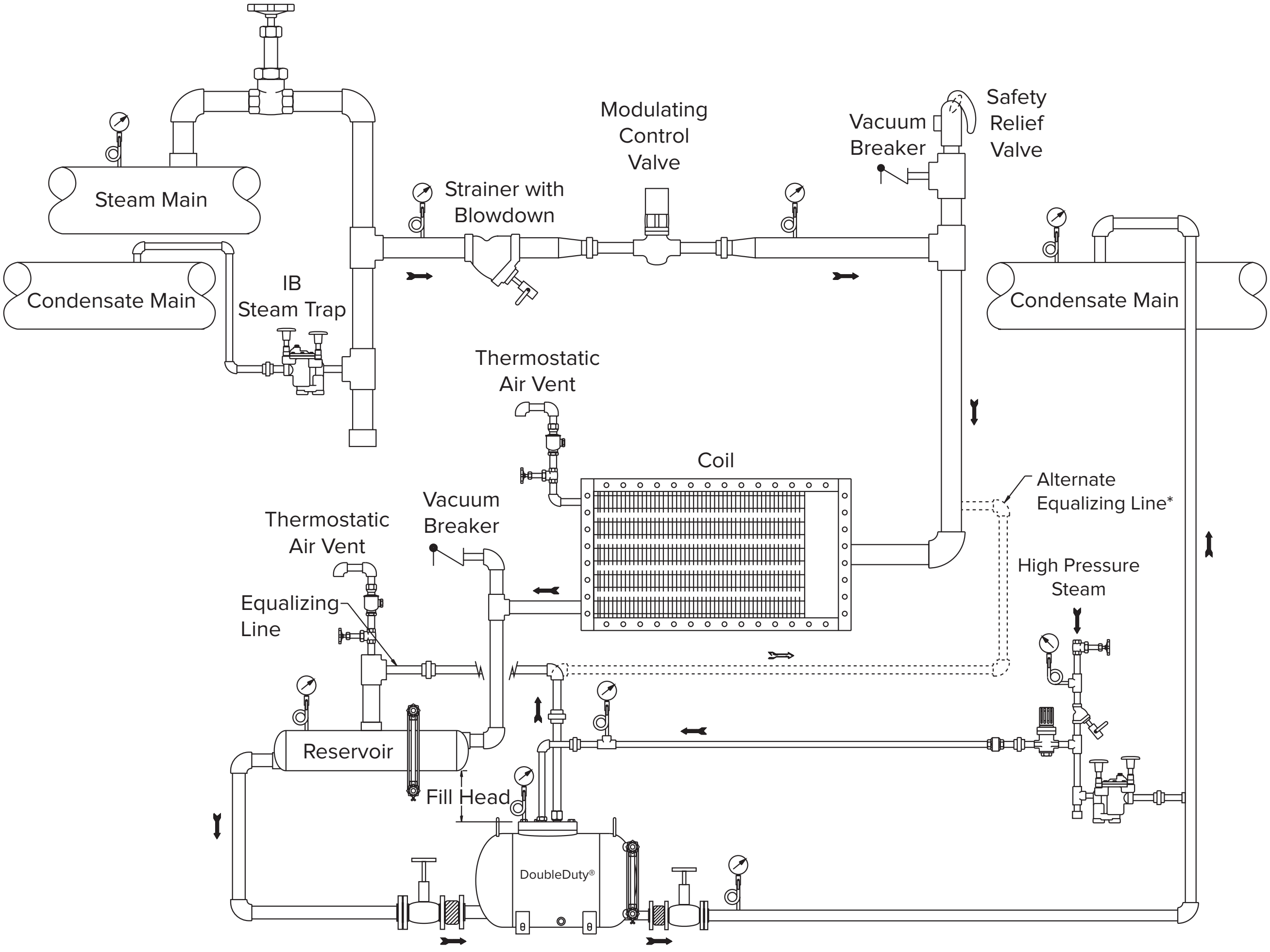
Applications exist where it is desirable to tie the vent line back into the heat exchange space, equalizing the pressure in the heat exchanger, reservoir/piping and the pump trap. This allows water to flow by gravity down to the pump where it can be returned. Valuable Btu's remain within the system due to no flash steam loss to the atmosphere through the vent. Closed system applications can also be used to drain liquid from the equipment under a vacuum. See installation and operation manual IB-100. See tables on pages 221 and 224 for reservoir pipe sizing.

Note 1: If steam motive is used, the drip trap may be discharged into the return line or to the drain.

Note 2: Vent piping from the pump trap can be connected to the inlet side of the equipment being drained if the pressure drop across the equipment is less than .5 psig (0.03 barg) and there is a minimum of 24" (609 mm) of fill head present.

Note 3: A vacuum breaker must be installed if the vent piping from the pump trap is connected to the receiver. If the equipment modulated down to a sub-atmospheric condition, the vacuum breaker will open to equalize the system and provide adequate drainage.

Double Duty® Typical Application



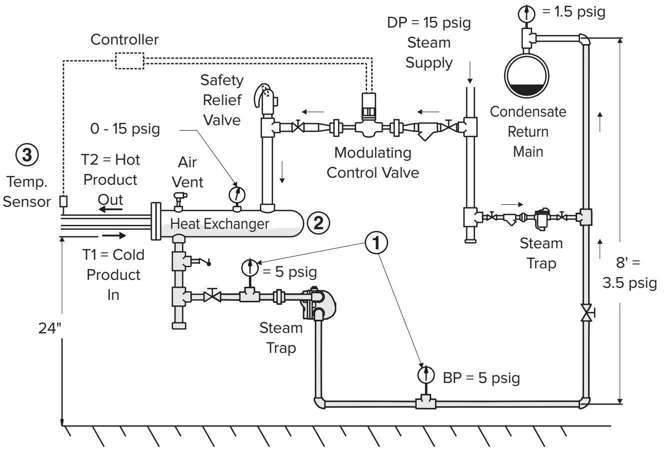
*Used only if pressure drop across coils is less than 1/2 psi.

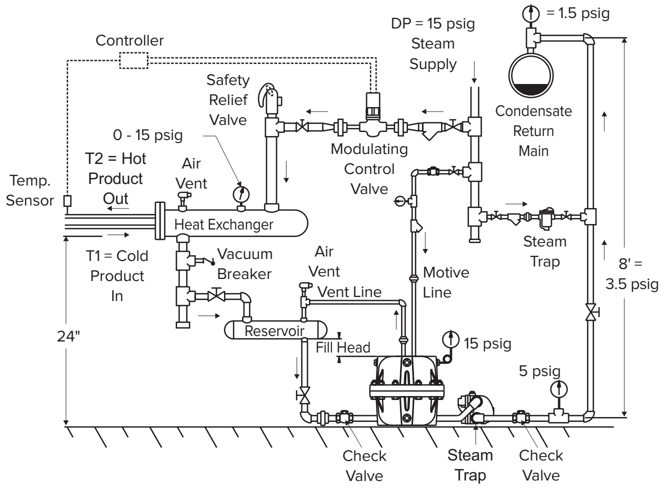
Common Applications for Condensate Armstrong Pump Traps

- Air Heating Coils
- Plate and Frame Heaters
- Jacketed Kettles
- Vacuum Space
- Flash Tanks
- Shell and Tube Heat Exchangers
- Absorption Chillers
- Low Pressure Applications

Any application using modulated control.

Condensate Drainage From Modulated Steam/Temperature Controlled Equipment





Problem: "Stall" Condition on Modulated Steam Control

Modulated steam controls are required to change steam pressure in the heat exchanger to control accurate product output temperature. Due to these varying steam pressure changes, a stall condition exists in all heat exchangers where condensate cannot flow through the steam trap due to insufficient pressure differential. Under the stall condition, partial or complete flooding will occur. Reference figure above noting the stall conditions and problems that can occur.

Problems

1. Stall condition—no condensate drainage due to insufficient pressure to move condensate through the steam trap
2. Heat exchange equipment floods causing equipment damage from:
   - Water hammer due to steam and condensate occupying the same space
   - Corrosion due to carbonic acid forming from sub-cooled condensate reabsorbing trapped carbon dioxide and non-condensable gases
3. Inaccurate temperature control

Stall Chart

Use of the stall chart on right will determine the point where flooding will occur.

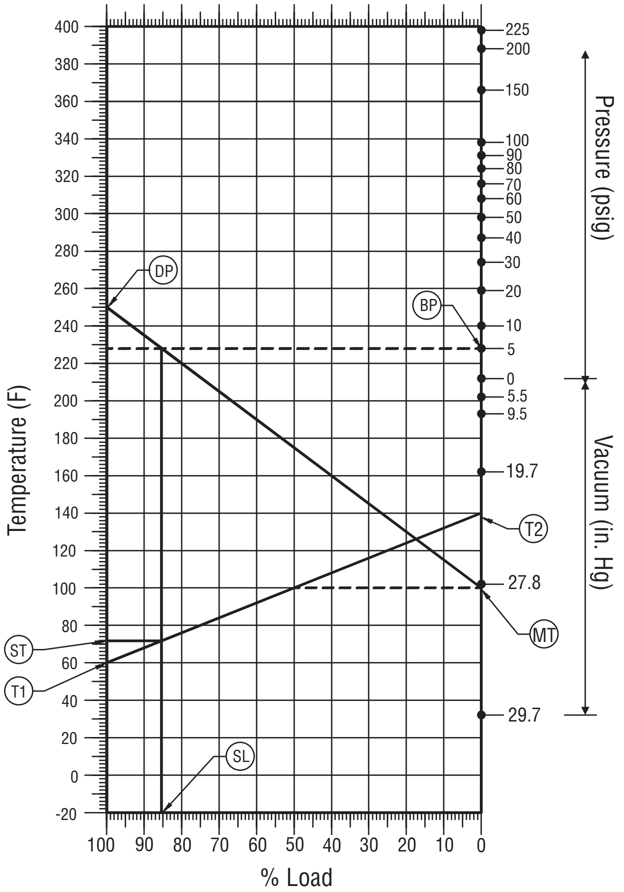
Application information required:	**Example**
DP = design pressure to heat exchanger 15 psig	
BP = back pressure	5 psig
T1 = incoming temperature	60°F
T2 = exit temperature	140°F
MT = mean temperature	100°F

Stall Information:	
SL = stall load %	85%
ST = stall load temperature	72°F

Armstrong Solution

The Armstrong pump trap and steam trap combination is the total solution to the stall condition by removing condensate under all system conditions. When the steam system pressure is sufficient to overcome the back pressure, the steam trap operates normally. When the system pressure falls to the stall condition, the pump trap operates and pumps condensate through the steam trap. Temperature control and condensate drainage are assured under all system conditions.

NOTE: The pump trap is sized for the stall conditions.
NOTE: Closed-loop solution shown. See page 234 for vented system arrangement.



Notes

Rescue Cap® Non-Electric Steam/Air Powered Pump Retrofit Assembly

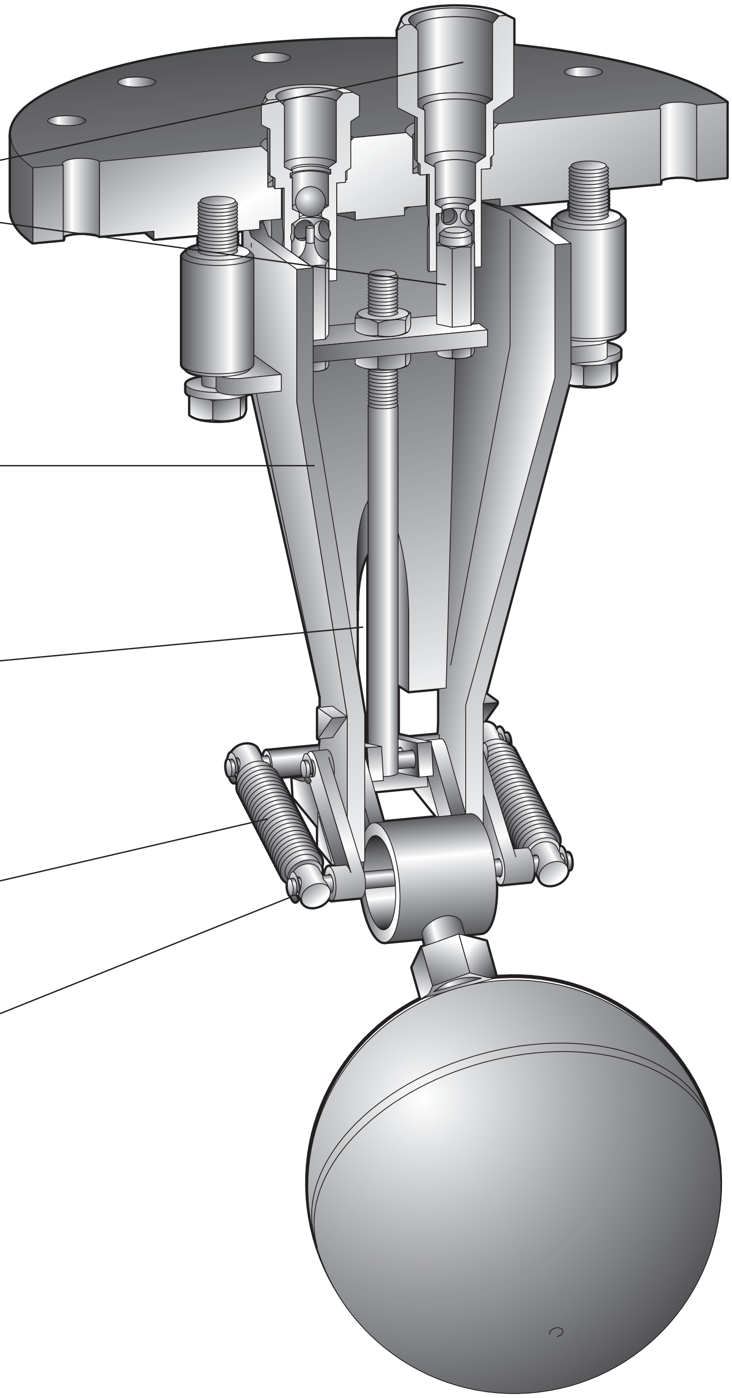
3-Year No Fail Warranty
3-Year
No Fail
Pump Trap Mechanism

Do you experience maintenance problems with non-electric steam/air powered pumps?

Are you dumping valuable condensate because of frequent maintenance?

Do you experience spring failures?

Do you have to remove the complete cap assembly to view, clean or replace the motive or vent valve?



Externally replaceable valve and seat assembly
Maintenance is a snap with stainless steel valves that can be cleaned or replaced without cap removal.

Wear and corrosion resistance
Mechanism frame assembly is constructed of rugged investment-cast stainless steel components.

Long life and dependable service
Simple float/spring operation and rugged all stainless steel construction allow for long, trouble-free service life.

Stress chloride corrosion resistance
Inconel X-750 springs have higher resistance to the stress that causes lower-grade stainless steel springs to fail.

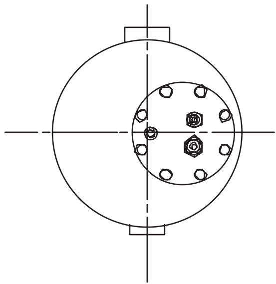
Bushings
Reduce friction and wear on pivot points

Rescue Cap® Non-Electric Steam/Air Powered Pump Retrofit Assembly

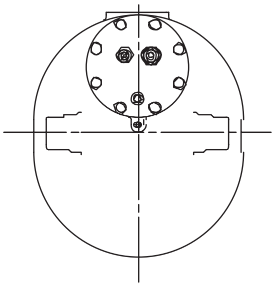
Armstrong's non-electric steam/air powered pump retrofit cap and mechanism assembly fits most competitive models. To ensure proper fit, please provide the following information:

- Manufacturer's name:____________________________
- Manufacturer's model number:______________________
- Number of bolt holes in cap: ______________________
- Bolt circle dimension "B":_________________________
- Inside diameter of vessel opening "A":_______________
- Bolt hole orientation (one hole or two holes):__________

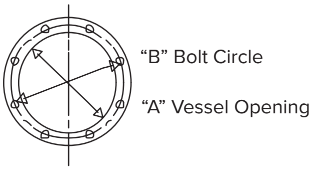
Two-hole Orientation

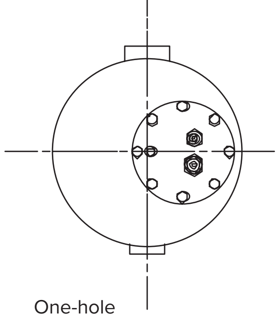


Two-hole Orientation

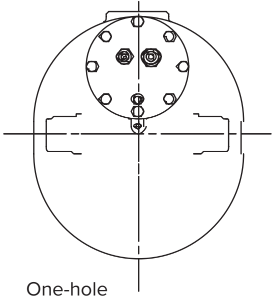


Two-hole Orientation

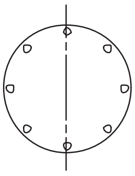




One-hole Orientation

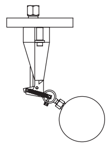


One-hole Orientation



One-hole Orientation

Rescue Cap® Non-Electric Steam/Air Powered Pump Retrofit Assembly

Illustration	Fits Competitors' Mechanical Pumps Listed Below					
	Spirax Sarco Models PTC & PTF PPC & PPF	Watson McDaniel Models PMPC & PMP	Spence & Nicholson Condensate Commanders	KADANT Johnson Corporation	ITT Hoffman PCS	Yarway Series 65 Steel	Clark Reliance

Armstrong® FHC / FHS Series Electric Condensate Pumps

Armstrong FHC (cast iron) and FHS (steel) electric condensate pumps are offered as packaged units, pre-assembled, wired and factory tested.

Features

- Heavy duty, ballbearing, close-coupled pump motors with stainless steel shaft. 3450 RPM for greater efficiency and more economical operation.
- Level controls with two-pole, drip proof case, stainless steel float and float rod, doublebreak silver-to-silver contacts. Float travel adjustment is easy, visible and accessible.
- Pump mounting design provides efficient operation and extended life by venting air and flushing seal area.
- Offers a wide range of pressures and GPM. Unique design for easy maintenance.
- Pumps made of durable cast iron for extended life; efficient design provides maximum capacity with minimum motor load.
- The ultimate in ceramic technology for extended life. The seal runs on the brass impeller hub with the motor shaft actually outside the pump body. Therefore, the shaft is not exposed to corrosion by condensate. Recommended for temperatures up to 250°F (120°C).

For control panel information and optional items, please refer to page 258.

Please visit our web site, **armstrong**internationl.com, for detail information regarding dimensions and weights.

For a fully detailed certified drawing, refer to:

FHC-112	CDF1092	FHS-4028G	CD2243
FHC-122	CDF1093	FHS-112	CDF1089
FHC-212	CD2244	FHS-122	CD2241
FHC-222	CDF1095	FHS-212	CD2242
		FHS-222	CDF1091
		FHS-230	CDF1091

Specifications - FHC Cast Iron Receiver Condensate Pumps

Model No.		Pump GPM	Standard Motor Voltage*	Maximum Pump Discharge, psig	Pump Discharge Nozzle Size	Pump HP	Receiver Size Gallons	sq ft EDR
Simplex	Duplex							
FHC-112	FHC-212	12	115V/1Ph 3500 RPM	20	3/4”	1/3	15	8 000
FHC-122	FHC-222	22				1/2	24	15 000

Specifications - FHS Carbon Steel Receiver Condensate Pumps

Model No.		Pump GPM	Standard Motor Voltage*	Maximum Pump Discharge, psig	Pump Discharge Nozzle Size	Pump HP	Receiver Size Gallons	sq ft EDR
Simplex	Duplex							
FHS-4028G	—	12	115V/1Ph 3500 RPM	20	3/4”	1/3	8	8 000
FHS-112	FHS-212						15	
FHS-122	FHS-222	22				1/2	30	15 000
—	FHS-230	30				3/4		20 000

*Can be field wired to 230V/1Ph/60Hz

Additional units for larger capacities and higher pressures available upon request.

Pumps have cast iron bodies.

Sizing Condensate Pumps

Step 1—Determine the condensing rate of the system:

Where: C = Condensing Rate in lb/hr
F_1 = Conversion to GPM = 500
F_2 = Conversion to EDR = .0005

Formula: $C \div F_1 = GPM$
$GPM \div F_2 =$ sq. ft. EDR

Example: 2000 lb/hr ÷ 500 = 4 GPM
4 GPM ÷ 0.0005 = 8 000 sq. ft. EDR

Step 2—Apply a 3:1 safety factor by multiplying by 3

Example: 4 GPM x safety factor of 3 = 12 GPM
Select a pump with a 12 GPM rating with a sq. ft. EDR of 8 000

Step 3—Determine system back pressure

The total back pressure is determined by vertical lift, system pressure on the discharge side of the pump, plus frictional loss through pipe, valves and fittings.

Vertical lift, 2.31 ft. = 1 psig + system pressure (psig) + frictional loss (psig) = total system back pressure.

Select a pump that has a maximum discharge pressure greater than the total system back pressure calculated for the system.

Special Notes:

- Floor mounted condensate receivers have a maximum operating temperature rating of 200°F. Higher temperature applications will require that the receiver be elevated to achieve proper net positive suction head (NPSH).
- Duplex units are typically sized for system redundancy, using a mechanical alternator for less wear on each pump.
- For systems that require vacuum pumps, control panels, high performance motors and special condensate receivers, consult the factory for engineering and pricing assistance.
- Condensate receivers are typically sized for one to three minutes of storage capacity.
- The condensate receiver that is mounted to the pump must always remain vented to the atmosphere.

NPSH is critical to the proper operation of an electric condensate pump. NPSH is the measure of how close the suction passage of the pump is to boiling. NPSH can be calculated by the following formula: $NPSH = H_s + H_p - H_v - H_f$

Where:
H_s = static head of the liquid at the pump suction
H_v = vapor pressure of the liquid at the pump suction

H_p = absolute pressure above the static head of the liquid
H_f = friction loss in the suction piping

Sizing for Electric Condensate Package

Date: ______________________ **Representative:** ______________________

Salesperson: ______________________ **Application:** ______________________

Customer: ______________________ **Customer Location:** ______________________

Pump GPM required* (with 3:1 safety factor) ______________________

Determine pump discharge:

Friction loss of pipe ______________________

Vertical lift ______________________

If pumping into a pressurized line (add pressure of line) ______________

Add 5 psig safety factor ______________________

Total psig ______________________

Standard packages rated to pump up to 200°F condensate

Temperature of condensate ______________________

Motor voltage and phase ______________________

Material of receiver: ☐ Steel ☐ Cast Iron ☐ Stainless Steel

Motor enclosure: ☐ ODP ☐ TEFC* ☐ Explosion Proof*

Is a control panel needed: ☐ Yes ☐ No

NEMA rating: ☐ NEMA 12 ☐ NEMA 4*

Type of alternator on a duplex: ☐ Mechanical ☐ Electric

Condensate Return Schedule

Model Number ______________________

Capacity __________ GPM at ____________ PSIG

__________ HP __________ RPM

Receiver __________ gallons

Current __________ phase, 60 cycles, __________ volts

Options included on package:

____

____

____

*It is acceptable to use a 2:1 safety factor if the actual loads are known. If actual load is unknown, use standard 3:1 safety factor.

Series 4100 Condensate and Boiler Feed

- Heavy gauge 3/16” steel receivers for long service life
- 3450 rpm motors for maximum efficiency with minimum horsepower
- Simplex/duplex
- Wide range of options available
- Standard Units: 3 gpm - 75 gpm
- Consult factory for additional sizes

Series 4200 Condensate and Boiler Feed

- Heavy duty cast iron receivers for long service life
- 3450 rpm motors for maximum efficiency with minimum horsepower
- Simplex/duplex
- Wide range of options available
- Standard Units: 3 gpm - 75 gpm
- Consult factory for additional sizes

Series 4300 Condensate and Boiler Feed

- Heavy gauge 3/16” stainless steel receivers for long service life
- 3450 rpm motors for maximum efficiency with minimum horsepower
- Simplex/duplex
- Wide range of options available
- Standard Units: 3 gpm - 75 gpm
- Consult factory for additional sizes

Series 5000 Boiler Feed

- Heavy gauge 3/16” carbon steel cylindrical receivers (stainless steel available)
- 3450 rpm motors for maximum efficiency with minimum horsepower
- Simplex/duplex (other)
- Wide range of options available
- Standard Units: 25 gpm - 100 gpm
- Consult factory for additional sizes

Series 3500 Condensate and Boiler Feed

- Heavy gauge 3/16” carbon steel cylindrical receivers (stainless steel available)
- 3450 rpm motors for maximum efficiency with minimum horsepower
- Simplex/duplex
- Wide range of options available
- Standard Units: 3 gpm - 140 gpm
- Consult factory for additional sizes

Carbon Steel Receiver Electric Pump Packages

AFH-4100 Series

Cap Sq. Ft. EDR	Discharge Pressure PSIG	Pump Cap. G.P.M.	HP 3500 R.P.M.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
8 000	20	12	1/3	8	AFH-4028-G	—	90	—	3/4"	2"
2 000	20	3		15	AFH-4122-G	AFH-4122-GDA	125	185		
4 000		6			AFH-4124-G	AFH-4124-GDA				
6 000		9			AFH-4126-G	AFH-4126-GDA				
8 000		12			AFH-4128-G	AFH-4128-GDA				
10 000		15	1/2	30	AFH-41210-G	AFH-41210-GDA	190	240		2-1/2"
15 000		22.5			AFH-41215-G	AFH-41215-GDA				
20 000		30	3/4		AFH-41220-G	AFH-41220-GDA	200	250		
25 000		37.5		45	AFH-41225-J	AFH-41225-JDA	285	350	1-1/2"	2-1/2"
30 000		45	1		AFH-41230-J	AFH-41230-JDA				
40 000		60	1-1/2	60	AFH-41240-J	AFH-41240-JDA	335	405		
50 000		75	2	95	AFH-41250-J	AFH-41250-JDA	385	460		
2 000	30	3	1/2	15	AFH-4132-J	AFH-4132-JDA	180	250		2"
4 000		6			AFH-4134-J	AFH-4134-JDA				
6 000		9			AFH-4136-J	AFH-4136-JDA				
8 000		12			AFH-4138-J	AFH-4138-JDA				
10 000		15	3/4		AFH-41310-J	AFH-41310-JDA	185	255		
15 000		22.5	1	30	AFH-41315-J	AFH-41315-JDA	230	300		2-1/2"
20 000		30			AFH-41320-J	AFH-41320-JDA				
25 000		37.5		45	AFH-41325-J	AFH-41325-JDA	285	350		
30 000		45	1-1/2		AFH-41330-J	AFH-41330-JDA	290	355		
40 000		60	2	60	AFH-41340-J	AFH-41340-JDA	340	410		
50 000		75	3	95	AFH-41350-J	AFH-41350-JDA	395	470		
2 000	40	3	1	15	AFH-4142-J	AFH-4142-JDA	190	270		2"
4 000		6			AFH-4144-J	AFH-4144-JDA				
6 000		9			AFH-4146-J	AFH-4146-JDA				
8 000		12			AFH-4148-J	AFH-4148-JDA				
10 000		15			AFH-41410-J	AFH-41410-JDA				
15 000		22.5	1-1/2	30	AFH41415-J	AFH-41415-JDA	240	310		2-1/2"
20 000		30			AFH-41420-J	AFH-41420-JDA				
25 000		37.5		45	AFH-41425-J	AFH-41425-JDA	290	355		
30 000		45	2		AFH-41430-J	AFH-41430-JDA	295	360		
40 000		60		60	AFH-41440-J	AFH-41440-JDA	340	410		
50 000		75	3	95	AFH-41450-J	AFH-41450-JDA	395	470		
2 000	50	3	2	15	AFH-4152-J	AFH-4152-JDA	195	275		2"
4 000		6			AFH-4154-J	AFH-4154-JDA				
6 000		9			AFH-4156-J	4156-JDA				
8 000		12			AFH-4158-J	4158-JDA				
10 000		15			AFH-41510-J	41510-JDA				
15 000		22.5		30	AFH-41515-J	41515-JDA	245	320		2-1/2"
20 000		30	3		AFH-41520-J	41520-JDA	255	330		
25 000		37.5		45	AFH-41525-J	41525-JDA	305	385		
30 000		45			AFH-41530-J	41530-JDA				
40 000		60	5	60	AFH-41540-J	41540-JDA	370	500		
50 000		75		95	AFH-41550-J	41550-JDA	430	560		

Note: When ordering units, specify sq. ft. capacity, discharge pressure, G.P.M. model number and motor voltage. Higher G.P.M. and discharge pressure available upon request.
2 ft NPSH units available for 200°F - 212°F condensate.
Models with higher capacities or discharge pressures available upon request.
Contact Armstrong or your local Armstrong representative for submittal drawings and specifications.
Pumps have cast iron bodies.

Cast Iron Receiver Electric Pump Packages

Armstrong®

AFH-4200 Series

Cap Sq. Ft. EDR	Discharge Pressure PSIG	Pump Cap. G.P.M.	HP 3500 R.P.M.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size Inches	Inlet Size Inches
2 000	20	3	1/3	6	AFH-4222-G	—	150	—	3/4"	2"
4 000		6			AFH-4224-G	—		—		
6 000		9		15	AFH-4226-G	AFH-4226-GDA	260	295		
8 000		12			AFH-4228-G	AFH-4228-GDA				
10 000		15	1/2		AFH-42210-G	AFH-42210-GDA				
15 000		22.5		24	AFH-42215-G	AFH-42215-GDA	300	335		
20 000		30	3/4	36	AFH-42220-G	AFH-42220-GDA	410	445		3"
25 000		37.5			AFH-42225-J	AFH-42225-JDA	350	420	1-1/2"	
30 000		45	1		AFH-42230-J	AFH-42230-JDA	355	430		
40 000		60	1-1/2	50	AFH-42240-J	AFH-42240-JDA	420	500		
50 000		75	2		AFH-42250-J	AFH-42250-JDA	425	510		
2 000	30	3	1/2	6	AFH-4232-J	—	165	—		2"
4 000		6			AFH-4234-J	—				
6 000		9		15	AFH-4236-J	AFH-4236-JDA	295	360		
8 000		12			AFH-4238-J	AFH-4238-JDA				
10 000		15	3/4		AFH-42310-J	AFH-42310-JDA	300	365		
15 000		22.5	1	24	AFH-42315-J	AFH-42315-JDA	305	380		
20 000		30		36	AFH-42320-J	AFH-42320-JDA	355	430		3"
25 000		37.5			AFH-42325-J	AFH-42325-JDA				
30 000		45	1-1/2		AFH-42330-J	AFH-42330-JDA	360	440		
40 000		60	2	50	AFH-42340-J	AFH-42340-JDA	425	510		
50 000		75	3		AFH-42350-J	AFH-42350-JDA	435	525		
2 000	40	3	1	6	AFH-4242-J	—	170	—		2"
4 000		6			AFH-4244-J	—				
6 000		9		15	AFH-4246-J	AFH-4246-JDA	295	360		
8 000		12			AFH-4248-J	AFH-4248-JDA				
10 000		15			AFH-42410-J	AFH-42410-JDA				
15 000		22.5	1-1/2	24	AFH-42415-J	AFH-42415-JDA	310	390		
20 000		30		36	AFH-42420-J	AFH-42420-JDA	360	440		3"
25 000		37.5			AFH-42425-J	AFH-42425-JDA				
30 000		45	2		AFH-42430-J	AFH-42430-JDA	365	450		
40 000		60		50	AFH-42440-J	AFH-42440-JDA	425	510		
50 000		75	3		AFH-42450-J	AFH-42450-JDA	435	525		
2 000	50	3	2	6	AFH-4252-J	—	175	—		2"
4 000		6			AFH-4254-J	—				
6 000		9		15	AFH-4256-J	AFH-4256-JDA	315	395		
8 000		12			AFH-4258-J	AFH-4258-JDA				
10 000		15			AFH-42510-J	AFH-42510-JDA				
15 000		22.5		24	AFH-42515-J	AFH-42515-JDA	330	415		
20 000		30	3	36	AFH-42520-J	AFH-42520-JDA	370	460		3"
25 000		37.5			AFH-42525-J	AFH-42525-JDA				
30 000		45			AFH-42530-J	AFH-42530-JDA				
40 000		60	5	50	AFH-42540-J	AFH-42540-JDA	445	535		
50 000		75			AFH-42550-J	AFH-42550-JDA				

Note: When ordering units, specify sq. ft. capacity, discharge pressure, G.P.M. model number and motor voltage. Higher G.P.M. and discharge pressure available upon request.
2 ft NPSH units available for 200°F - 212°F condensate.
Models with higher capacities or discharge pressures available upon request.
Contact Armstrong or your local Armstrong representative for submittal drawings and specifications.
Pumps have cast iron bodies.

Stainless Steel Receiver Electric Pump Packages

AFH-4300 Series Stainless Steel Electric Condensate Pump Packages

Cap Sq. Ft. EDR	Discharge Pressure PSIG	Pump Cap. G.P.M.	HP 3500 R.P.M.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size Inches	Inlet Size Inches
8 000	20	12	1/3	8	AFH-4028-GS	—	90	—	3/4"	2"
2 000		3		15	AFH-4322-G	AFH-4322-GDA	125	185		
4 000		6			AFH-4324-G	AFH-4324-GDA				
6 000		9			AFH-4326-G	AFH-4326-GDA				
8 000		12			AFH-4328-G	AFH-4328-GDA				
10 000		15	1/2	30	AFH-43210-G	AFH-43210-GDA	190	240		2-1/2"
15 000		22.5			AFH-43215-G	AFH-43215-GDA				
20 000		30	3/4		AFH-43220-G	AFH-43220-GDA	200	250		
25 000		37.5		45	AFH-43225-J	AFH-43225-JDA	285	350	1-1/2"	
30 000		45	1		AFH-43230-J	AFH-43230-JDA				
40 000		60	1-1/2	60	AFH-43240-J	AFH-43240-JDA	335	405		
50 000		75	2	95	AFH-43250-J	AFH-43250-JDA	385	460		
2 000	30	3	1/2	15	AFH-4332-J	AFH-4332-JDA	180	250		2"
4 000		6			AFH-4334-J	AFH-4334-JDA				
6 000		9			AFH-4336-J	AFH-4336-JDA				
8 000		12			AFH-4338-J	AFH-4338-JDA				
10 000		15	3/4		AFH-43310-J	AFH-43310-JDA	185	255		
15 000		22.5	1	30	AFH-43315-J	AFH-43315-JDA	230	300		2-1/2"
20 000		30			AFH-43320-J	AFH-43320-JDA				
25 000		37.5		45	AFH-43325-J	AFH-43325-JDA	285	350		
30 000		45	1-1/2		AFH-43330-J	AFH-43330-JDA	290	355		
40 000		60	2	60	AFH-43340-J	AFH-43340-JDA	340	410		
50 000		75	3	95	AFH-43350-J	AFH-43350-JDA	395	470		
2 000	40	3	1	15	AFH-4342-J	AFH-4342-JDA	190	270		2"
4 000		6			AFH-4344-J	AFH-4344-JDA				
6 000		9			AFH-4346-J	AFH-4346-JDA				
8 000		12			AFH-4348-J	AFH-4348-JDA				
10 000		15			AFH-43410-J	AFH-43410-JDA				
15 000		22.5	1-1/2	30	AFH43415-J	AFH-43415-JDA	240	310		2-1/2"
20 000		30			AFH-43420-J	AFH-43420-JDA				
25 000		37.5		45	AFH-43425-J	AFH-43425-JDA	290	355		
30 000		45	2		AFH-43430-J	AFH-43430-JDA	295	360		
40 000		60		60	AFH-43440-J	AFH-43440-JDA	340	410		
50 000		75	3	95	AFH-43450-J	AFH-43450-JDA	395	470		
2 000	50	3	2	15	AFH-4352-J	AFH-4352-JDA	195	275		2"
4 000		6			AFH-4354-J	AFH-4354-JDA				
6 000		9			AFH-4356-J	4356-JDA				
8 000		12			AFH-4358-J	4358-JDA				
10 000		15			AFH-43510-J	43510-JDA				
15 000		22.5		30	AFH-43515-J	43515-JDA	245	320		2-1/2"
20 000		30	3		AFH-43520-J	43520-JDA	255	330		
25 000		37.5		45	AFH-43525-J	43525-JDA	305	385		
30 000		45			AFH-43530-J	43530-JDA				
40 000		60	5	60	AFH-43540-J	43540-JDA	370	500		
50 000		75		95	AFH-43550-J	43550-JDA	430	560		

Note: When ordering units, specify sq. ft. capacity, discharge pressure, G.P.M. model number and motor voltage. Higher G.P.M. and discharge pressure available upon request.
2 ft NPSH units available for 200°F - 212°F condensate.
Models with higher capacities or discharge pressures available upon request.
Contact Armstrong or your local Armstrong representative for submittal drawings and specifications.
Pumps have cast iron bodies.

Sizing for Boiler Feed Package

This sheet MUST be sent in with every order.

Date: ______________________________ **Representative:** ______________________________

Salesperson: ______________________________ **Application:** ______________________________

Customer: ______________________________ **Customer Location:** ______________________________

Number of boilers the pump is feeding ____________ (need a minimum of one dedicated pump per boiler)

Capacity of each boiler (BHP): ______________________________

BTU/HR / 33 475 = BHP

GPM / 0.069 = BHP

LBS/HR / 34.5 = BHP

Determine pump discharge: ______________________________

Operating pressure of boiler

Friction loss of pipe between pump and boiler (psig)

Lift from pump to boiler (psig) ____________________(2.31' lift = 1 psig)

Add 5 psig safety factor______________________________

Total (psig)______________________________

Standard packages rated to pump up to 200°F condensate

Temperature of condensate ______________________________

Motor voltage and phase ______________________________

Material of receiver: ☐Steel ☐Cast Iron ☐Stainless Steel

Motor enclosure: ☐ODP ☐TEFC*

Is a control panel needed: ☐Yes ☐No

NEMA rating: ☐NEMA 12 ☐NEMA 4*

Is there a need for pre-heat tube to heat the feed water in the tank? ☐Yes ☐No

If so, up to what temperature? ______________________________

What is the maximum inlet pressure of the make-up water to the tank? _________

Need to use a solenoid maek-up water valve if over 45 psig.

Boiler Feed Schedule

Model Number ______________________________

Capacity __________ GPM at ____________ PSIG

__________ HP __________ RPM

Receiver __________ gallons

Current __________ phase, 60 cycles, __________ volts

Options included on package:

____

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Carbon Steel Receiver Boiler Feed Packages

AFH-4100 Series Steel Boiler Feed Packages

Boiler H.P.	Discharge Pressure PSIG	Pump Cap. G.P.M.	Motor H.P.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
15	20	3	1/3	30	AFH-4122-GF	AFH-4122-GDF	200	240	2-1/2”	3/4”
	30		1/2		AFH-4132-JF	AFH-4132-JDF	260	300		1-1/2”
	40		1		AFH-4142-JF	AFH-4142-JDF	265	310		
	50		2		AFH-4152-JF	AFH-4152-JDF	275	330		
30	20	6	1/3		AFH-4124-GF	AFH-4124-GDF	200	240		3/4”
	30		1/2		AFH-4134-JF	AFH-4134-JDF	260	300		1-1/2”
	40		1		AFH-4144-JF	AFH-4144-JDF	265	310		
	50		2		AFH-4154-JF	AFH-4154-JDF	275	330		
45	20	9	1/3	45	AFH-4126-GF	AFH-4126-GDF	240	280		3/4”
	30		1/2		AFH-4136-JF	AFH-4136-JDF	300	340		1-1/2”
	40		1		AFH-4146-JF	AFH-4146-JDF	305	350		
	50		2		AFH-4156-JF	AFH-4156-JDF	315	370		
60	20	12	1/3	60	AFH-4128-GF	AFH-4128-GDF	275	335		3/4”
	30		1/2		AFH-4138-JF	AFH-4138-JDF	335	395		1-1/2”
	40		1		AFH-4148-JF	AFH-4148-JDF	340	405		
	50		2		AFH-4158-JF	AFH-4158-JDF	350	425		
75	20	15	1/2	95	AFH-41210-GF	AFH-41210-GDF	360	420		3/4”
	30		3/4		AFH-41310-JF	AFH-41310-JDF	420	480		1-1/2”
	40		1		AFH-41410-JF	AFH-41410-JDF	425	490		
	50		2		AFH-41510-JF	AFH-41510-JDF	435	510		
100	20	20	1/2		AFH-41215-GF	AFH-41215-GDF	360	420		3/4”
	30		1		AFH-41315-JF	AFH-41315-JDF	420	480		1-1/2”
	40		1-1/2		AFH-41415-JF	AFH-41415-JDF	425	490		
	50		2		AFH-41515-JF	AFH-41515-JDF	435	510		
150	20	30	3/4	120	AFH-41220-GF	AFH-41220-GDF	415	475		3/4”
	30		1		AFH-41320-JF	AFH-41320-JDF	475	535		1-1/2”
	40		1-1/2		AFH-41420-JF	AFH-41420-JDF	480	545		
	50		3		AFH-41520-JF	AFH-41520-JDF	490	565		

Note: All boiler feed units supplied with Armstrong make-up water valve (rated to 45 psig maximum inlet pressure) and gauge glass; solenoid make-up valve available.
Models with higher capacities or discharge pressures available upon request.
Pumps have cast iron bodies.

Cast Iron Receiver Boiler Feed Packages

AFH-4200 Series Cast Iron Boiler Feed Packages

Boiler H.P.	Discharge Pressure PSIG	Pump Cap. G.P.M.	Motor H.P.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
15	20	3	1/3	36	AFH-4222-GF	AFH-4222-GDF	465	500	3"	3/4"
	30		1/2		AFH-4232-JF	AFH-4232-JDF	505	580		1-1/2"
	40		1		AFH-4242-JF	AFH-4242-JDF	510	590		
	50		2		AFH-4252-JF	AFH-4252-JDF	520	600		
30	20	6	1/3		AFH-4224-GF	AFH-4224-GDF	465	500		3/4"
	30		1/2		AFH-4234-JF	AFH-4234-JDF	505	580		1-1/2"
	40		1		AFH-4244-JF	AFH-4244-JDF	510	590		
	50		2		AFH-4254-JF	AFH-4254-JDF	520	600		
45	20	9	1/3	50	AFH-4226-GF	AFH-4226-GDF	575	610		3/4"
	30		1/2		AFH-4236-JF	AFH-4236-JDF	615	690		1-1/2"
	40		1		AFH-4246-JF	AFH-4246-JDF	620	700		
	50		2		AFH-4256-JF	AFH-4256-JDF	625	710		
60	20	12	1/3		AFH-4228-GF	AFH-4228-GDF	575	610		3/4"
	30		1/2		AFH-4238-JF	AFH-4238-JDF	615	690		1-1/2"
	40		1		AFH-4248-JF	AFH-4248-JDF	620	700		
	50		2		AFH-4258-JF	AFH-4258-JDF	625	710		
75	20	15	1/2	75	AFH-42210-GF	AFH-42210-GDF	785	820	4"	3/4"
	30		3/4		AFH-42310-JF	AFH-42310-JDF	825	900		1-1/2"
	40		1		AFH-42410-JF	AFH-42410-JDF	830	910		
	50		2		AFH-42510-JF	AFH-42510-JDF	835	920		
100	20	20	1/2	120	AFH-42215-GF	AFH-42215-GDF	1 043	1 078		3/4"
	30		1		AFH-42315-JF	AFH-42315-JDF	1 085	1 160		1-1/2"
	40		1-1/2		AFH-42415-JF	AFH-42415-JDF	1 095	1 180		
	50		2		AFH-42515-JF	AFH-42515-JDF	1 100	1 200		
150	20	30	3/4		AFH-42220-GF	AFH-42220-GDF	1 043	1 078		3/4"
	30		1		AFH-42320-JF	AFH-42320-JDF	1 085	1 160		1-1/2"
	40		1-1/2		AFH-42420-JF	AFH-42420-JDF	1 095	1 180		
	50		3		AFH-42520-JF	AFH-42520-JDF	1 110	1 220		

Note: All boiler feed units supplied with Armstrong make-up water valve (rated to 45 psig maximum inlet pressure) and gauge glass; solenoid make-up valve available.
Models with higher capacities or discharge pressures available upon request.
Pumps have cast iron bodies.

Stainless Steel Receiver Boiler Feed Packages

AFH-4300 Series Stainless Steel Receiver Boiler Feed Packages

Boiler H.P.	Discharge Pressure PSIG	Pump Cap. G.P.M.	Motor H.P.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
15	20	3	1/3	30	AFH-4322-GF	AFH-4322-GDF	200	240	2-1/2"	3/4"
	30		1/2		AFH-4332-JF	AFH-4332-JDF	260	300		1-1/2"
	40		1		AFH-4342-JF	AFH-4342-JDF	265	310		
	50		2		AFH-4352-JF	AFH-4352-JDF	275	330		
30	20	6	1/3		AFH-4224-GF	AFH-4224-GDF	200	240		3/4"
	30		1/2		AFH-4334-JF	AFH-4334-JDF	260	300		1-1/2"
	40		1		AFH-4344-JF	AFH-4344-JDF	265	310		
	50		2		AFH-4354-JF	AFH-4354-JDF	275	330		
45	20	9	1/3	45	AFH-4326-GF	AFH-4326-GDF	240	280		3/4"
	30		1/2		AFH-4336-JF	AFH-4336-JDF	300	340		1-1/2"
	40		1		AFH-4346-JF	AFH-4346-JDF	305	350		
	50		2		AFH-4356-JF	AFH-4356-JDF	315	370		
60	20	12	1/3	60	AFH-4328-GF	AFH-4328-GDF	275	335		3/4"
	30		1/2		AFH-4338-JF	AFH-4338-JDF	335	395		1-1/2"
	40		1		AFH-4348-JF	AFH-4348-JDF	340	405		
	50		2		AFH-4358-JF	AFH-4358-JDF	350	425		
75	20	15	1/2	95	AFH-43210-GF	AFH-43210-GDF	360	420		3/4"
	30		3/4		AFH-43310-JF	AFH-43310-JDF	420	480		1-1/2"
	40		1		AFH-43410-JF	AFH-43410-JDF	425	490		
	50		2		AFH-43510-JF	AFH-43510-JDF	435	510		
100	20	20	1/2		AFH-43215-GF	AFH-43215-GDF	360	420		3/4"
	30		1		AFH-43315-JF	AFH-43315-JDF	420	480		1-1/2"
	40		1-1/2		AFH-43415-JF	AFH-43415-JDF	425	490		
	50		2		AFH-43515-JF	AFH-43515-JDF	435	510		
150	20	30	3/4	120	AFH-43220-GF	AFH-43220-GDF	415	475		3/4"
	30		1		AFH-43320-JF	AFH-43320-JDF	475	535		1-1/2"
	40		1-1/2		AFH-43420-JF	AFH-43420-JDF	480	545		
	50		3		AFH-43520-JF	AFH-43520-JDF	490	565		

Note: All boiler feed units supplied with Armstrong make-up water valve (rated to 45 psig maximum inlet pressure) and gauge glass; solenoid make-up valve available.
Models with higher capacities or discharge pressures available upon request.
Pumps have cast iron bodies.

Cylindrical Carbon Steel Receiver Boiler Feed Packages

AFH-5000 Series Cylindrical Carbon Steel Receiver Boiler Feed Packages

Boiler H.P.	Discharge Pressure PSIG	Pump Cap. G.P.M.	Motor H.P.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
150	20	25	3/4	125	AFH-502150-JF	AFH-502150-JDF	570	665	3”	1-1/2”
	30		1		AFH-503150-JF	AFH-503150-JDF	590	685		
	40		1-1/2		AFH-504150-JF	AFH-504150-JDF	600	695		
	50		2		AFH-505150-JF	AFH-505150-JDF	615	710		
200	20	30	3/4	146	AFH-502200-JF	AFH-502200-JDF	635	690		
	30		1		AFH-503200-JF	AFH-503200-JDF	640	730		
	40		1-1/2		AFH-504200-JF	AFH-504200-JDF	650	750		
	50		2		AFH-505200-JF	AFH-505200-JDF	670	770		
250	20	35	3/4	175	AFH-502250-JF	AFH-502250-JDF	800	870		
	30		1		AFH-503250-JF	AFH-503250-JDF	805	875		
	40		1-1/2		AFH-504250-JF	AFH-504250-JDF	815	885		
	50		2		AFH-505250-JF	AFH-505250-JDF	840	910		
300	20	45	1	210	AFH-502300-JF	AFH-502300-JDF	830	920		
	30		1-1/2		AFH-503300-JF	AFH-503300-JDF	835	930		
	40				AFH-504300-JF	AFH-504300-JDF	840	940		
	50		2		AFH-505300-JF	AFH-505300-JDF	860	980		
400	20	55	1-1/2	250	AFH-502400-JF	AFH-502400-JDF	900	995		
	30				AFH-503400-JF	AFH-503400-JDF	905	1 005		
	40		2		AFH-504400-JF	AFH-504400-JDF	920	1 020		
	50		5		AFH-505400-JF	AFH-505400-JDF	930	1 030		
500	20	70	2	326	AFH-502500-JF	AFH-502500-JDF	975	1 070	4”	
	30				AFH-503500-JF	AFH-503500-JDF	980	1 075		
	40		3		AFH-504500-JF	AFH-504500-JDF	990	1 085		
	50		5		AFH-505500-JF	AFH-505500-JDF	1 045	1 140		
600	20	85	2	395	AFH-502600-JF	AFH-502600-JDF	1 070	1 170		
	30		3		AFH-503600-JF	AFH-503600-JDF	1 070	1 170		
	40		5		AFH-504600-JF	AFH-504600-JDF	1 090	1 190		
	50				AFH-505600-JF	AFH-505600-JDF	1 090	1 190		
700	20	100	2	470	AFH-502700-JF	AFH-502700-JDF	1 235	1 335		
	30		5		AFH-503700-JF	AFH-503700-JDF	1 245	1 345		
	40				AFH-504700-JF	AFH-504700-JDF	1 245	1 345		
	50				AFH-505700-JF	AFH-505700-JDF	1 295	1 395		

Note: All boiler feed units supplied with Armstrong make-up water valve (rated to 45 psig maximum inlet pressure) and gauge glass; solenoid make-up valve available.
Models with higher capacities or discharge pressures available upon request.
Pumps have cast iron bodies.

Cylindrical Elevated Carbon Steel Receiver Boiler Feed Packages

AFH-3500 Series Cylindrical Elevated Carbon Steel Receiver Boiler Feed Packages

Boiler H.P.	Discharge Pressure PSIG	Pump Cap. G.P.M.	Motor H.P.	Rec. Cap Gal.	Unit Model No. Simplex	Unit Model No. Duplex	Weight (lb) Simplex	Weight (lb) Duplex	Disch. Size In.	Inlet Size In.
15	20	3	1/2	33	AFH-35215-GF	AFH-35215-GDF	265	325	3/4	4
	30				AFH-35315-JF	AFH-35315-JDF	285	365	1-1/2	
	40		1		AFH-35415-JF	AFH-35415-JDF	290	375		
	50		2		AFH-35515-JF	AFH-35515-JDF	310	415		
30	20	6	1/2		AFH-35230-GF	AFH-35230-GDF	265	325	3/4	
	30				AFH-35330-JF	AFH-35330-JDF	285	365	1-1/2	
	40		1		AFH-35430-JF	AFH-35430-JDF	290	375		
	50		2		AFH-35530-JF	AFH-35530-JDF	310	415		
45	20	9	1/2	49	AFH-35245-GF	AFH-35245-GDF	350	410	3/4	5
	30				AFH-35345-JF	AFH-35345-JDF	370	450	1-1/2	
	40		1		AFH-35445-JF	AFH-35445-JDF	375	460		
	50		2		AFH-35545-JF	AFH-35545-JDF	395	500		
60	20	12	1/2	65	AFH-35260-GF	AFH-35260-GDF	390	450	3/4	
	30				AFH-35360-JF	AFH-35360-JDF	410	490	1-1/2	
	40		1		AFH-35460-JF	AFH-35460-JDF	415	500		
	50		2		AFH-35560-JF	AFH-35560-JDF	435	540		
75	20	15	1/2	95	AFH-35275-GF	AFH-35275-GDF	440	500	3/4	6
	30		3/4		AFH-35375-JF	AFH-35375-JDF	460	540	1-1/2	
	40		1		AFH-35475-JF	AFH-35475-JDF	465	550		
	50		2		AFH-35575-JF	AFH-35575-JDF	485	590		
100	20	20	1/2		AFH-352100-GF	AFH-352100-GDF	615	675	3/4	
	30		3/4		AFH-353100-JF	AFH-353100-JDF	635	715	1-1/2	
	40		1-1/2		AFH-354100-JF	AFH-354100-JDF	645	735		
	50		2		AFH-355100-JF	AFH-355100-JDF	660	765		
150	20	30	3/4	146	AFH-352150-GF	AFH-352150-GDF	720	790	3/4	
	30		1		AFH-353150-JF	AFH-353150-JDF	740	830	1-1/2	
	40		1-1/2		AFH-354150-JF	AFH-354150-JDF	750	850		
	50		3		AFH-355150-JF	AFH-355150-JDF	770	890		
200	20	40	1	210	AFH-352200-JF	AFH-352200-JDF	930	1 020		
	30		1-1/2		AFH-353200-JF	AFH-353200-JDF	935	1 030		
	40		2		AFH-354200-JF	AFH-354200-JDF	940	1 040		
	50		3		AFH-355200-JF	AFH-355200-JDF	960	1 080		
500	20	100	2	470	AFH-352500-JF	AFH-352500-JDF	1 335	1 450		
	30		3		AFH-353500-JF	AFH-353500-JDF	1 340	1 460		
	40				AFH-354500-JF	AFH-354500-JDF	1 340	1 460		
	50		5		AFH-355500-JF	AFH-355500-JDF	1 390	1 560		
600	20	120	2	595	AFH-352600-JF	AFH-352600-JDF	1 440	1 555		
	30		3		AFH-353600-JF	AFH-353600-JDF	1 445	1 565		
	40		5		AFH-354600-JF	AFH-354600-JDF	1 495	1 665		
	50				AFH-355600-JF	AFH-355600-JDF	1 495	1 665		
700	20	140	3	714	AFH-352700-JF	AFH-352700-JDF	1 555	1 675		
	30		5		AFH-353700-JF	AFH-353700-JDF	1 605	1 775		
	40				AFH-354700-JF	AFH-354700-JDF	1 605	1 775		
	50		7-1/2		AFH-355700-JF	AFH-355700-JDF	1 615	1 795		

Note: All boiler feed units supplied with Armstrong make-up water valve (rated to 45 psig maximum inlet pressure) and gauge glass; solenoid make-up valve available.
Models with higher capacities or discharge pressures available upon request..
Pumps have cast iron bodies.

AFH 4400 Series
Stainless Steel Condensate Return Units

High Quality Stainless Steel Exceptional Value, Extraordinary Quality

Armstrong Stainless Steel Condensate Return Units offer the best materials available for long life. Tanks have a 20-year warranty against failure due to corrosion and are made from 304 SS with internal ribbing where needed for excellent strength. Available in six standard sizes; 12, 25, 45, 70, and 100 gallon capacities (with custom sizes available) in simplex or duplex pump configuration. Compact dimensions and light weight make it a simple task to replace your old cast iron unit. System accessories are of the highest quality.

These pumps are made of investment cast 316 stainless steel. The single stage impeller is of semi-open design allowing for occasional pumping of small solids without clogging. Pump is permanently aligned to the electric motor, never requiring alignment at the job site. Pumps are furnished with 250°F mechanical seals, and are equipped with a seal cavity bleed line to keep the seal lubricated and minimize the probability of premature seal failure. Pump discharge openings are NPT.

Standard motors are: three phase- 208/230/460 V TEFC, Single phase -115/208/230 V ODP. Other voltages are available on request. Other motors available are explosion proof, wash down duty, premium efficiency, and any other motor available with a 56C frame.

Motor/pump controls available for simplex, duplex, triplex, and quadplex, in single phase or three phase with a limitless array of available options for any requirement. NEMA 1 is standard enclosure. All other enclosures are available.

AFH 4400 Series
Stainless Steel Condensate Return Units

EDR (SQ. FT.)	PSIG	GPM	MOTOR HP	TANK SIZE	SIMPLEX MODEL NUMBER THREE PHASE	SIMPLEX MODEL NUMBER SINGLE PHASE	DUPLEX MODEL NUMBER THREE PHASE	DUPLEX MODEL NUMBER SINGLE PHASE
4000	10	6	1/3	12	AFH-44S3106	AFH-44S1106	AFH-44D3106	AFH-44D1106
	20		1/3		AFH-44S3206	AFH-44S1206	AFH-44D3206	AFH-44D1206
	25		1/2		AFH-44S3256	AFH-44S1256	AFH-44D3256	AFH-44D1256
	30		3/4		AFH-44S3306	AFH-44S1306	AFH-44D3306	AFH-44D1306
	40		1		AFH-44S3406	AFH-44S1406	AFH-44D3406	AFH-44D1406
	50		1-1/2		AFH-44S3506	AFH-44S1506	AFH-44D3506	AFH-44D1506
6000	10	9	1/3		AFH-44S3109	AFH-44S1109	AFH-44D3109	AFH-44D1109
	20		1/3		AFH-44S3209	AFH-44S1209	AFH-44D3209	AFH-44D1209
	25		1/2		AFH-44S3259	AFH-44S1259	AFH-44D3259	AFH-44D1259
	30		1		AFH-44S3309	AFH-44S1309	AFH-44D3309	AFH-44D1309
	40		1-1/2		AFH-44S3409	AFH-44S1409	AFH-44D3409	AFH-44D1409
	50		1-1/2		AFH-44S3509	AFH-44S1509	AFH-44D3509	AFH-44D1509
10000	10	15	1/3	25	AFH-44S31015	AFH-44S11015	AFH-44D31015	AFH-44D11015
	20		1/2		AFH-44S32015	AFH-44S12015	AFH-44D32015	AFH-44D12015
	25		1/2		AFH-44S32515	AFH-44S12515	AFH-44D32515	AFH-44D12515
	30		1		AFH-44S33015	AFH-44S13015	AFH-44D33015	AFH-44D13015
	40		1-1/2		AFH-44S34015	AFH-44S14015	AFH-44D34015	AFH-44D14015
	50		2		AFH-44S35015	AFH-44S15015	AFH-44D35015	AFH-44D15015
15000	10	22.5	1/3		AFH-44S31022	AFH-44S11022	AFH-44D31022	AFH-44D11022
	20		1/2		AFH-44S32022	AFH-44S12022	AFH-44D32022	AFH-44D12022
	25		1		AFH-44S32522	AFH-44S12522	AFH-44D32522	AFH-44D12522
	30		1-1/2		AFH-44S33022	AFH-44S13022	AFH-44D33022	AFH-44D13022
	40		2		AFH-44S34022	AFH-44S14022	AFH-44D34022	AFH-44D14022
	50		3		AFH-44S35022	---	AFH-44D35022	---
20000	10	30	1/3	45	AFH-44S31030	AFH-44S11030	AFH-44D31030	AFH-44D11030
	20		3/4		AFH-44S32030	AFH-44S12030	AFH-44D32030	AFH-44D12030
	25		1		AFH-44S32530	AFH-44S12530	AFH-44D32530	AFH-44D12530
	30		1-1/2		AFH-44S33030	AFH-44S13030	AFH-44D33030	AFH-44D13030
	40		2		AFH-44S34030	AFH-44S14030	AFH-44D34030	AFH-44D14030
25000	10	37.5	1/2		AFH-44S31037	AFH-44S11037	AFH-44D31037	AFH-44D11037
	20		3/4		AFH-44S32037	AFH-44S12037	AFH-44D32037	AFH-44D12037
	25		1-1/2		AFH-44S32537	AFH-44S12537	AFH-44D32537	AFH-44D12537
	30		1-1/2		AFH-44S33037	AFH-44S13037	AFH-44D33037	AFH-44D13037
	40		3		AFH-44S34037	---	AFH-44D34037	---
30000	10	45	1/2		AFH-44S31045	AFH-44S11045	AFH-44D31045	AFH-44D11045
	20		3/4		AFH-44S32045	AFH-44S12045	AFH-44D32045	AFH-44D12045
	25		1-1/2		AFH-44S32545	AFH-44S12545	AFH-44D32545	AFH-44D12545
	30		2		AFH-44S33045	AFH-44S13045	AFH-44D33045	AFH-44D113045
	40		3		AFH-44S34045	---	AFH-44D34045	---
40000	10	60	3/4	70	AFH-44S31060	AFH-44S11060	AFH-44D31060	AFH-44D11060
	20		1		AFH-44S32060	AFH-44S12060	AFH-44D32060	AFH-44D12060
	25		2		AFH-44S32560	AFH-44S12560	AFH-44D32560	AFH-44D12560
	30		2		AFH-44S33060	AFH-44S13060	AFH-44D33060	AFH-44D13060
50000	10	70	3/4		AFH-44S31070	AFH-44S11070	AFH-44D31070	AFH-44D11070
	20		1		AFH-44S32070	AFH-44S12070	AFH-44D32070	AFH-44D12070
	25		2		AFH-44S32570	AFH-44S12570	AFH-44D32570	AFH-44D12570
60000	15	90	1	100	AFH-44S31590	AFH-44S11590	AFH-44D31590	AFH-44D11590

Standard unit includes:

Stainless steel tank complete with flange mounted stainless steel pump close coupled to motor of HP shown 115/208-230V/1/60 ODP or 208/230/460v/3/60 3450 RPM TEFC. Simplex unit has NEMA 1 float switch and duplex has NEMA 1 mechanical alternator. Sight Glass is standard.

Additional motor options are: Washdown duty and explosion proof.

Additional Accessories: Thermometer, Electrical enclosures, Isolation valves.

AFH 4400 Series Stainless Steel Condensate Return Unit Accessories (210°F)

All Stainless Steel Electric Condensate Pumps (Simplex) 210°F Capable

AFH-4400 Series All Stainless Steel Electric Pump Packages good to 210° max water temp						
EDR (Sq. Ft.)	PSIG	GPM	Motor HP	Tank Size	Simplex Model Number Three Phase	Simplex Model Number Single Phase
4 000	20	6	1/2	12	AFH-44S32FT206	AFH-44S12FT206
	25		1/2		AFH-44S32FT256	AFH-44S12FT256
	30		3/4		AFH-44S32FT306	AFH-44S12FT306
6 000	20	9	1/2	12	AFH-44S32FT209	AFH-44S12FT209
	25		3/4		AFH-44S32FT259	AFH-44S12FT259
	30		3/4		AFH-44S32FT309	AFH-44S12FT309
10 000	20	15	3/4	25	AFH-44S32FT2015	AFH-44S12FT2015
	25		1/2		AFH-44S32FT2515	AFH-44S12FT2515
	30		----------		----------	----------
15 000	20	22.5	1/2	25	AFH-44S32FT2022	AFH-44S12FT2022
	25		1/2		AFH-44S32FT2522	AFH-44S12FT2522
	30		----------		----------	----------

*Use standard Simplex/Duplex drawings.

All Stainless Steel Electric Condensate Pumps (Duplex) 210°F Capable

AFH-4400 Series All Stainless Steel Electric Pump Packages good to 210° max water temp						
EDR (Sq. Ft.)	PSIG	GPM	Motor HP	Tank Size	Duplex Model Number Three Phase	Duplex Model Number Single Phase
4 000	20	6	1/2	12	AFH-44D32FT206	AFH-44D12FT206
	25		1/2		AFH-44D32FT256	AFH-44D12FT256
	30		3/4		AFH-44D32FT306	AFH-44D12FT306
6 000	20	9	1/2	12	AFH-44D32FT209	AFH-44D12FT209
	25		3/4		AFH-44D32FT259	AFH-44D12FT259
	30		3/4		AFH-44D32FT309	AFH-44D12FT309
10 000	20	15	3/4	25	AFH-44D32FT2015	AFH-44D12FT2015
	25		1/2		AFH-44D32FT2515	AFH-44D12FT2515
	30		----------		----------	----------
15 000	20	22.5	1/2	25	AFH-44D32FT2022	AFH-44D12FT2022
	25		1/2		AFH-44D32FT2522	AFH-44D12FT2522
	30		----------		----------	----------

*Use standard Simplex/Duplex drawings.

AFH 4400 Series Stainless Steel Condensate Return Unit Accessories (212°F)

All Stainless Steel Electric Condensate Pumps (Simplex) 212°F Capable

AFH-4400 Series All Stainless Steel Electric Pump Packages good to 212° max water temp

EDR (Sq. Ft.)	PSIG	GPM	Motor HP	Tank Size	Simplex Model Number Three Phase	Simplex Model Number Single Phase
4 000	20	6	1/2	12	AFH-44S32FTE206	AFH-44S12FTE206
	25		1/2		AFH-44S32FTE256	AFH-44S12FTE256
	30		3/4		AFH-44S32FTE306	AFH-44S12FTE306
6 000	20	9	1/2	12	AFH-44S32FTE209	AFH-44S12FTE209
	25		3/4		AFH-44S32FTE259	AFH-44S12FTE259
	30		3/4		AFH-44S32FTE309	AFH-44S12FTE309
10 000	20	15	3/4	25	AFH-44S32FTE2015	AFH-44S12FTE2015
	25		1/2		AFH-44S32FTE2515	AFH-44S12FTE2515
	30		----------		----------	----------
15 000	20	22.5	1/2	25	AFH-44S32FTE2022	AFH-44S12FTE2022
	25		1/2		AFH-44S32FTE2522	AFH-44S12FTE2522
	30		----------		----------	----------

*Use standard Simplex/Duplex drawings.

All Stainless Steel Electric Condensate Pumps (Duplex) 212°F Capable

AFH-4400 Series All Stainless Steel Electric Pump Packages good to 212° max water temp

EDR (Sq. Ft.)	PSIG	GPM	Motor HP	Tank Size	Duplex Model Number Three Phase	Duplex Model Number Single Phase
4 000	20	6	1/2	12	AFH-44D32FTE206	AFH-44D12FTE206
	25		1/2		AFH-44D32FTE256	AFH-44D12FTE256
	30		3/4		AFH-44D32FTE306	AFH-44D12FTE306
6 000	20	9	1/2	12	AFH-44D32FTE209	AFH-44D12FTE209
	25		3/4		AFH-44D32FTE259	AFH-44D12FTE259
	30		3/4		AFH-44D32FTE309	AFH-44D12FTE309
10 000	20	15	3/4	25	AFH-44D32FTE2015	AFH-44D12FTE2015
	25		1/2		AFH-44D32FTE2515	AFH-44D12FTE2515
	30		----------		----------	----------
15 000	20	22.5	1/2	25	AFH-44D32FTE2022	AFH-44D12FTE2022
	25		1/2		AFH-44D32FTE2522	AFH-44D12FTE2522
	30		----------		----------	----------

*Use 212°F Elevated Receiver drawing.

AFH 4400 Series
Stainless Steel Condensate Return Unit Accessories

Sight Gauge Assembly

SS bottom fixture with shut-off valve, SS top fixture, 2- heavy duty SS glass guards, and tempered glass tube.

Stainless Steel Butterfly Isolation Valves (Optional)

Butterfly Isolation Valves between pump and receiver are available. These valves are of great value when removing one pump of a duplex system without having to shut the system down.

Float Switches

Float Switches are heavy duty 2 pole with stainless steel rod and float. Duplex alternating float switch includes high level lag pump on feature.

Nema 1 standard, Nema 4 and Nema 7/9 are available.

Pressure Gauges (Optional) Not Shown

2 1/2” Liquid Filled SS Casing

Thermometer (Optional)

2 1/2” Diameter face, Bi-metal, 4” stem, Range 32 - 250°F.

4100/4200/4300/3500/5000 Series
Electric and Boiler Feed Control Panel and Accessories

Features

- Motor circuit protector (MCP)
- HOA selector switch
- External reset
- Control circuit transformer
- Pilot light (pump running)
- Removable mounting plate and thermal strip in a single NEMA 12 enclosure
- Mounted and wired with single-point power connection
- CE
- CSA
- UL listed component

Options

- UL certification
- CUL certification
- Pilot light
- Test push button
- Electric alternator
- Low water cutoff
- Manual transfer switch (boiler feed only)
- High-level alarm horn and light with silencing switch
- Low-level alarm horn and light with silencing switch
- Remote mounting deduction
- Simplex, triplex, quadruplex pumps
- Explosion proof
- NEMA 4, 4X

Special Options

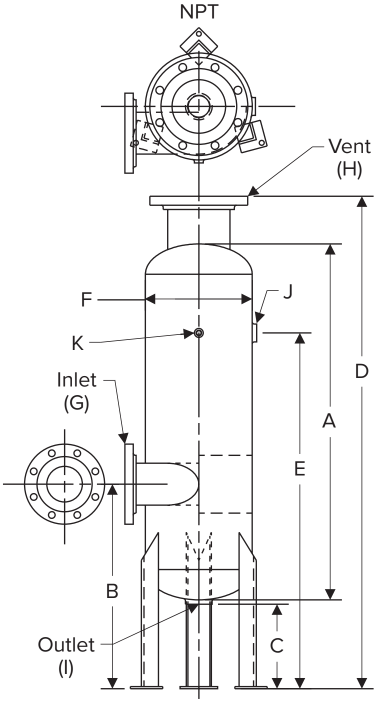
- Mechanical and electrical alternators
- Thermometer
- Isolation valves
- Special motor construction
  - TEFC
  - Explosion proof
- 1750 RPM motors
- Larger pumping capacities
- Higher discharge pressures
- 2’ NPSH Rating
- Water level gauge
- Discharge pressure gauges
- Inlet strainer

Control Panel

Water Level Gauge
(optional on most models)

Isolation Valve
(optional on most models)

Vertical Flash Tanks (VAFT)



Features

- ASME coded and stamped vessels
- Standard pressure rating 150 psig (other pressure ratings available upon request)
- Standard models are designed and sized to cover a wide range of applications and loads
- Flash vessels are designed to provide low velocity flash steam with no water carryover
- Quick payback for flash recovery investment
- Special tanks available upon request

For a fully detailed certified drawing, refer to CDF #1023.

Physical Data—Standard Design Model VAFT

Model No.	AFT-6		AFT-8		AFT-12		AFT-16	
	in	mm	in	mm	in	mm	in	mm
A	36	914	36	914	40	1 016	48	1 219
B	21	533	21	533	23	584	26	660
C	9-1/2	241	9-1/2	241	9-1/2	241	9-1/2	241
D	51	1 295	52	1 321	55-3/8	1 407	63-1/2	1 613
E	36	914	36	914	40	1 016	48	1 219
F	6	150	8	203	12	305	16	406
G	2	50	3	80	4	102	6	150
H	2-1/2	65	4	102	6	150	6	150
I	1-1/2	40	1-1/2	40	2	50	2	50
J	3/4	20	1	25	1-1/2	40	2	50
K	1/2	15	1/2	15	1/2	15	1/2	15

NOTE: Connections “G” and “H” are 150 lb. flanges. All others are NPT. All flash tanks are ASME coded for 150 psig (10 barg). Special sizes available upon request.

Capacities—Standard Design Model VAFT

Model No.	Maximum Condensate Load		Maximum Flash Load	
	lb/hr	kg/hr	lb/hr	kg/hr
AFT-6	2 000	907	325	147
AFT-8	5 000	2 268	900	408
AFT-12	10 000	4 536	2 000	907
AFT-16	20 000	9 072	2 000	907

Flash Steam Savings Analysis

Part I: Determining the amount of flash steam produced

A. Condensate Load A = ________ lb/hr.

B. Annual hours of operation B = ________ hrs/yr.

C. Steam Cost C = ________ $/1 000 lbs.

D. Flash steam percentage from chart (on page 264) D = ________ %

E. Flash steam produced:

D x A = flash steam produced E = ________ lb/hr.

Part II: Determining dollar value of the flash steam

F. Annual flash steam savings:

$$F = \frac{E \times B \times C}{1\,000}$$ F = ________ $/yr.

Series VAFT-BDV Boiler Blowdown Vessels

All Stainless Steel

For pressures to 150 psig (10 barg) / Capacities to 20 000 lb/hr (9 072 kg/hr)

Description

The Armstrong VAFT-BDV blowdown vessel is designed to efficiently separate surface blowdown water and flash steam. Built according to ASME Section VIII standards, the design is compact, requiring a small footprint in which to operate. For blowdown loads up to 20 000 lb/hr (9 072 kb/hr), Armstrong has a model to fit your needs.

- ASME-coded and stamped vessels
- 3/8” Carbon steel construction
- Stainless Steel Strike Plate
- Standard pressure rating 150 psig (10 barg) (Other pressure
- ratings available.)
- Vessels are designed to provide low velocity flash steam with no water carryover.

Standard Models:

VAFT-1238BDV (12”)
VAFT-1638BDV (16”)

Optional Equipment:

- 3/4” Commercial or Industrial Aftercooler Assembly
- 1” Commercial or Industrial Aftercooler Assembly
- Pressure Guage
- Safety Relief Valve

Blowdown Vessel

Model	Condensate Load/ Flash Load lb/hr	Diameter(in)	Inlet Size (in)	Discharge Size (in)	Material	Weight (lb)
VAFT1238BDV	max 10 000/max 2 000	12	4	3	CS 150F 3/8” Nominal Thickness	Consult Factory
VAFT1638BDV	max 20 000/max 3 000	16	6	3	CS 150F 3/8” Nominal Thickness	

Horizontal Flash Tanks (HAFT)

Features

- ASME coded and stamped vessels
- Standard pressure rating 150 psig (other pressure ratings available upon request)
- Standard models are designed and sized to cover a wide range of applications and loads
- Flash vessels are designed to provide low velocity flash steam with no water carryover
- Quick payback for flash recovery investment
- Special tanks available upon request
- HAFT-Series horizontal flash tanks for low flash load applications.

For a fully detailed certified drawing, refer to CDF #1038.

Flash Steam Savings Analysis

Part I: Determining the amount of flash steam produced

A. Condensate Load A = ________ lb/hr.

B. Annual hours of operation B = ________ hrs/yr.

C. Steam Cost C = ________ $/1 000 lbs.

D. Flash steam percentage from chart (on page 264) D = ________ %

E. Flash steam produced:

D x A = flash steam produced E = ________ lb/hr.

Part II: Determining dollar value of the flash steam

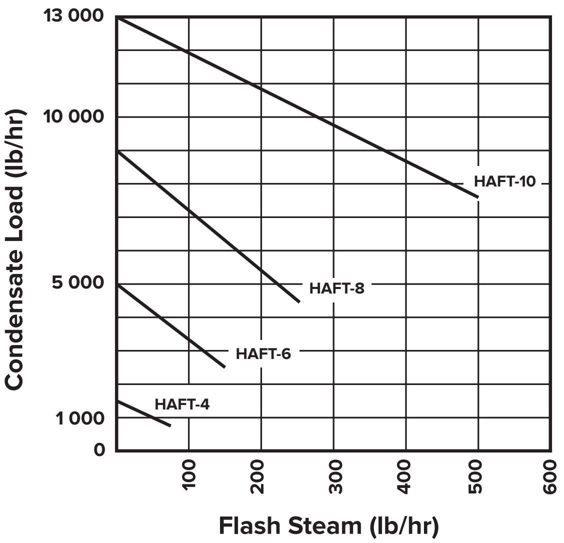
F. Annual flash steam savings:

$$F = \frac{E \times B \times C}{1\,000}$$ F = ________ $/yr.

NOTES

1. Models are ASME SEC. VIII "U" stamped for 150 psig
2. All connections are FNPT.

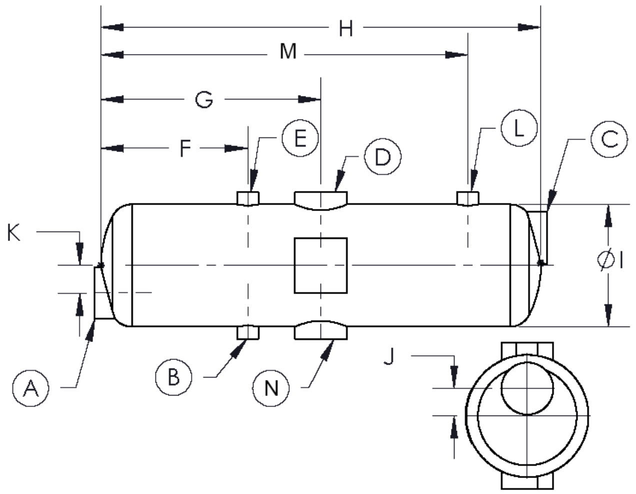
HAFT Series Sizing



Physical Data — Standard Design Model (HAFT)

Model No.	HAFT-10		HAFT-8		HAFT-6		HAFT-4	
	in	mm	in	mm	in	mm	in	mm
A	3	76	2	50	1-1/2	38	1-1/2	38
B	1	25	1	25	1	25	1	25
C	3	76	2	50	1-1/2	38	1-1/2	38
D	3	76	2-1/2	64	2	50	1-1/2	38
E	1	25	1	25	1	25	1	25
F	12	305	12	305	12	305	8	203
G	18	457	18	457	18	457	12	305
H	36	914	36	914	36	914	24	610
I	10	254	8	203	6	152	4	102
J	2-1/4	57	1-3/4	44	1-1/4	32	1	25
K	2-1/4	57	1-3/4	44	1-1/4	32	1	25
L	1	25	1	25	1	25	1	25
M	30	762	30	762	30	762	18	457
N	3	76	2	50	2	50	1-1/2	38

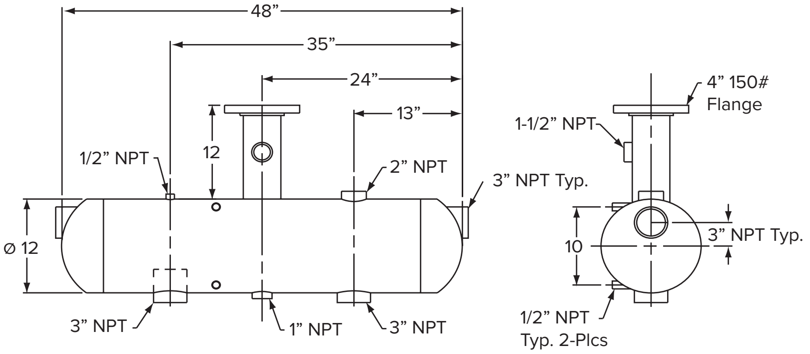
Note: All flash tanks are ASME coded for 150 psig (10 barg). Special sizes and connections available upon request.

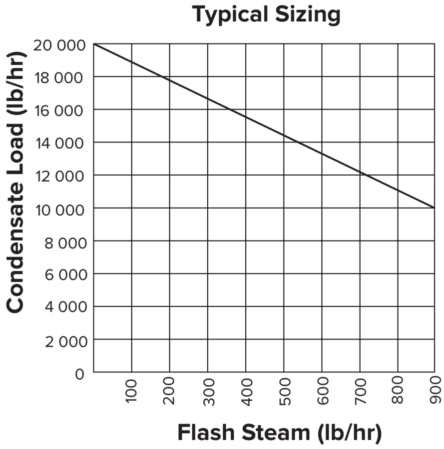


Capacities — Standard Design Model (HAFT)

Model No.	Maximum Condensate Load	
	lb/hr	kg/hr
HAFT-10	13 000	5 897
HAFT-8	9 000	4 082
HAFT-6	5 000	2 268
HAFT-4	1 500	680

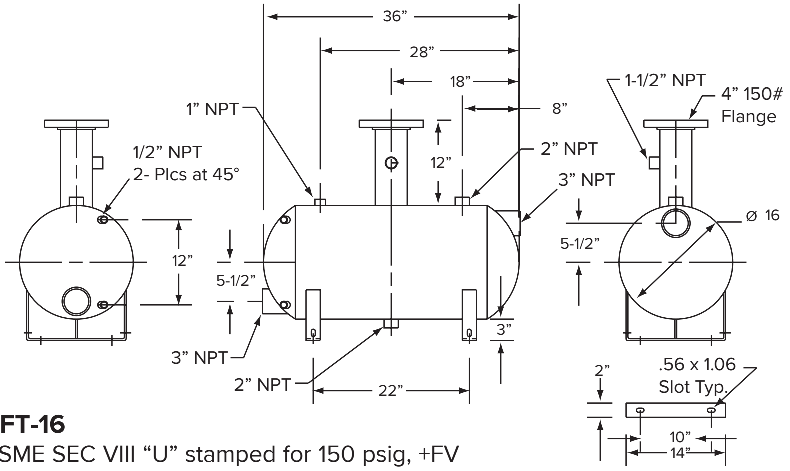
Horizontal Flash Tanks (HAFT)

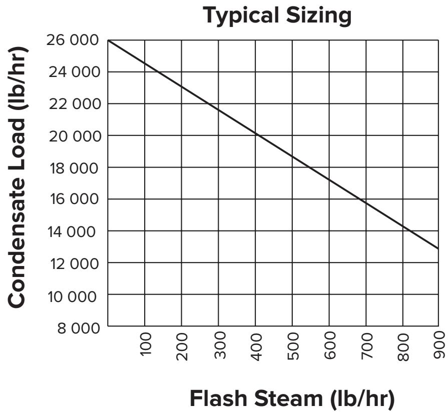




HAFT-12

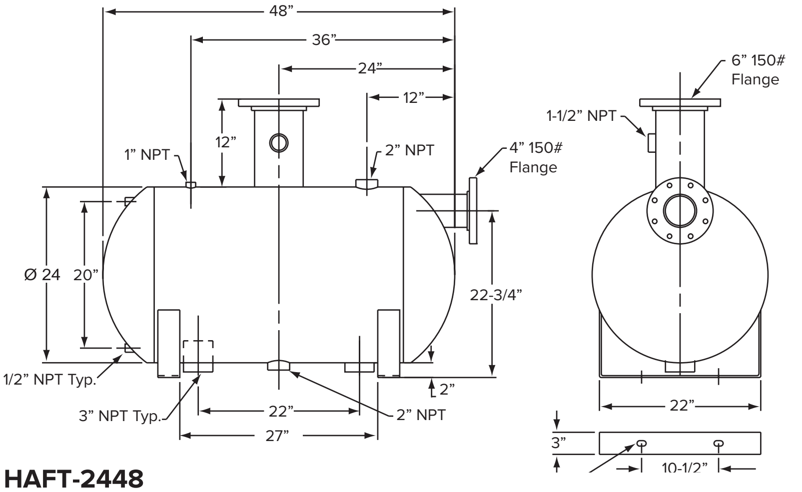
1. ASME SEC VIII "U" stamped for 150 psig, +FV
2. Temperature rating -20° to 550°F
3. Approximate volume: 22 gallons
4. Maximum flash load 900 lb/hr

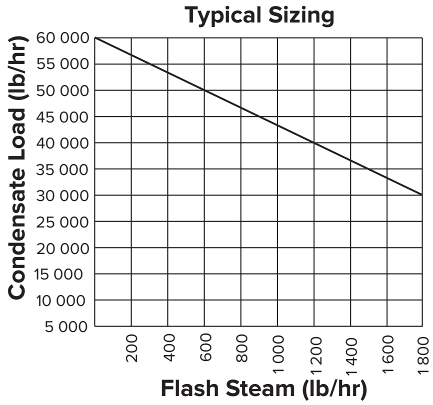




HAFT-16

1. ASME SEC VIII "U" stamped for 150 psig, +FV
2. Temperature rating -20° to 550°F
3. Approximate volume: 30 gallons
4. Maximum flash load 900 lb/hr

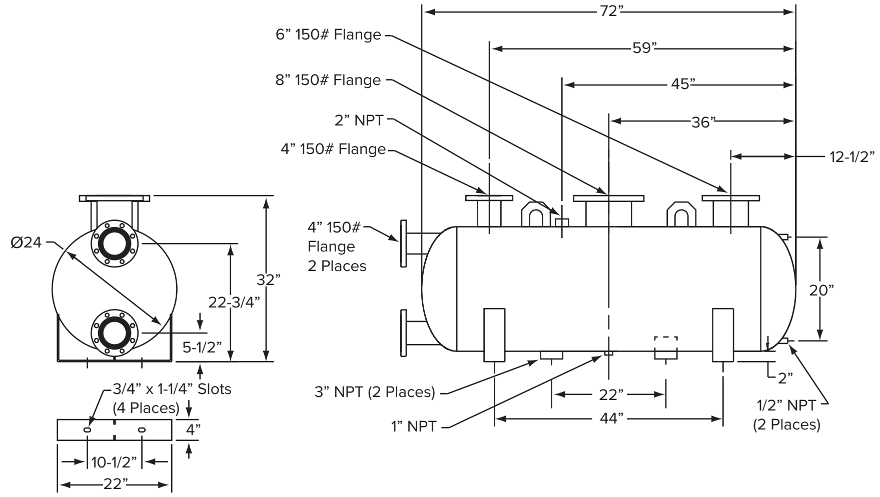


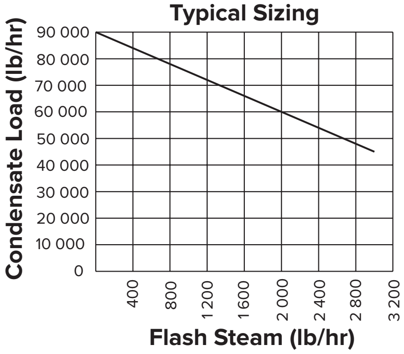


HAFT-2448

1. ASME SEC VIII "U" stamped for 150 psig, +FV
2. Temperature rating -20° to 550°F
3. Approximate volume: 85 gallons
4. Maximum flash load 1 800 lb/hr

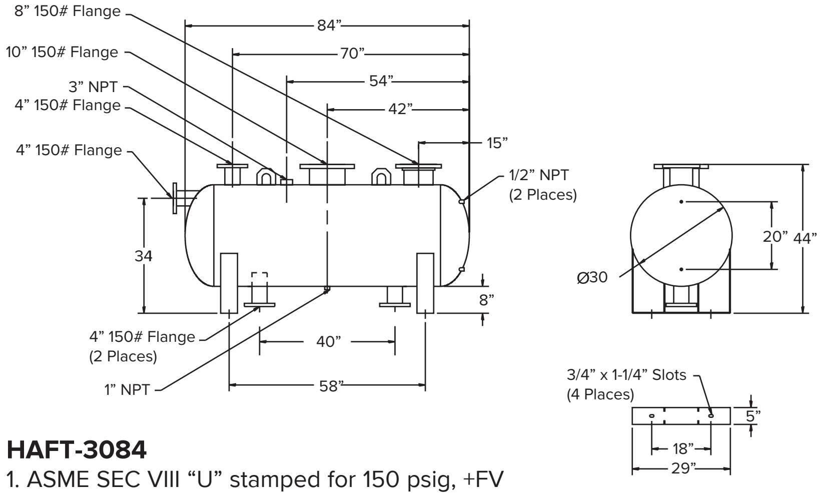
Horizontal Flash Tanks (HAFT)

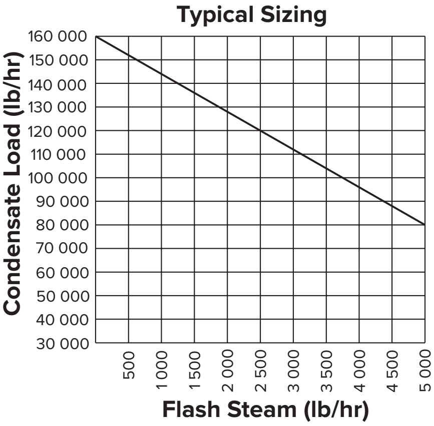




HAFT-2472

1. ASME SEC VIII “U” stamped for 150 psig, +FV
2. Temperature rating -20° to 550°F
3. Approximate volume: 130 gallons
4. Maximum flash load 3 000 lb/hr





HAFT-3084

1. ASME SEC VIII “U” stamped for 150 psig, +FV
2. Temperature rating -20° to 550°F
3. Approximate volume: 240 gallons
4. Maximum flash load 5 000 lb/hr

Flash Recovery Vessels

How much flash steam is available?

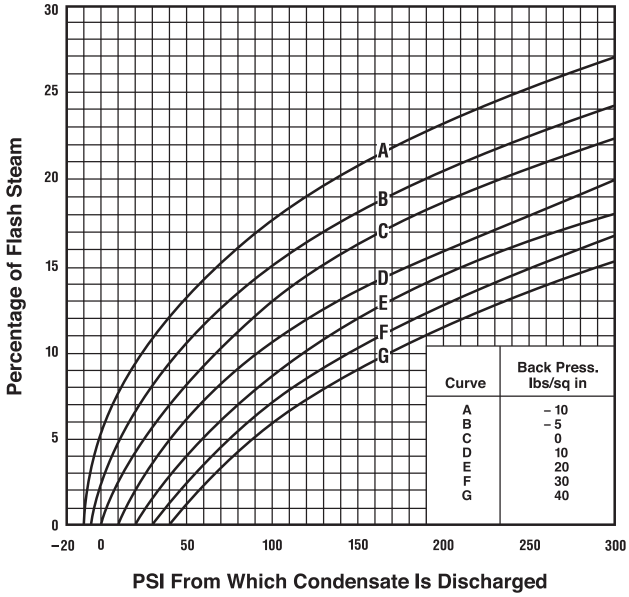
1. Follow horizontal axis right to primary discharge pressure.
2. Follow vertically up to secondary pressure curve.
3. Move left to “Percentage of flash steam.”

Example:
Condensate load = 10 000 lb/hr
Primary pressure = 100 psig
Secondary pressure = 10 psig

Percentage of flash = 10.6%
Secondary steam load = 1 060 lb/hr
(10 000 lb/hr x .1060 = 1 060 lb/hr)

Selection:
Model AFT-12

Percentage of Flash Steam Formed When Discharging Condensate to Reduced Pressure



Application Information

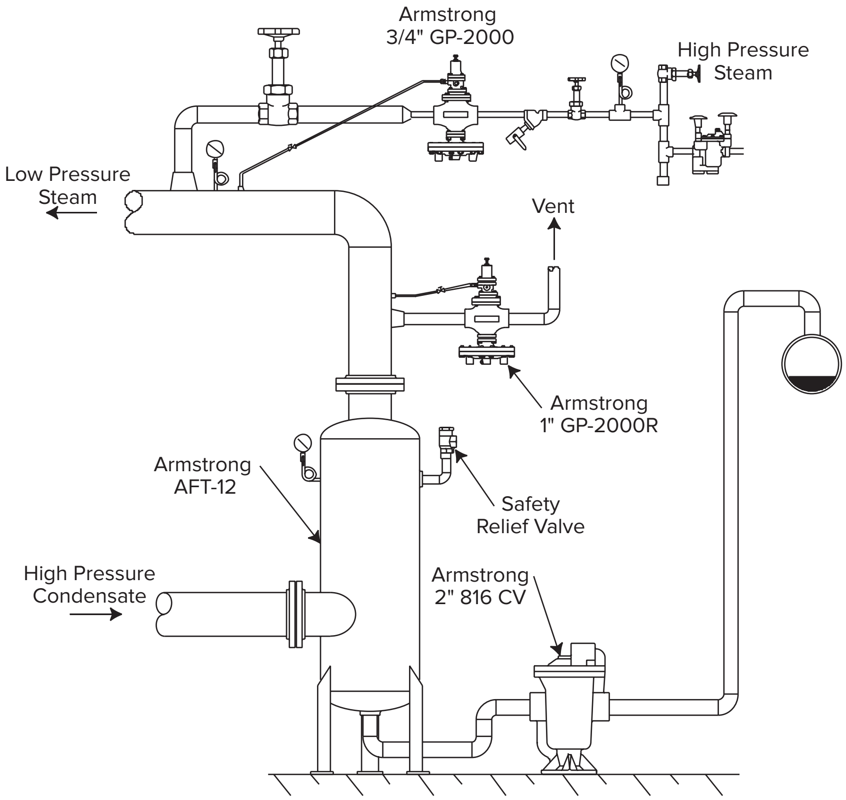
A. Condensate Load to Flash Tank **6 000** lb/hr
B. Pressure of Incoming Condensate **100** psig
C. Flash Tank Pressure **20** psig
D. Flash Percentage **9.5%**
E. Flash Amount = A x (D/100) = **570** lb/hr
F. Low Pressure Steam Required **2 500** lb/hr
G. High Pressure Steam **200** psig
H. Back Pressure **5** psig

Flash tank will accommodate (A) **6 000** lb/hr of condensate at (B) **100** psig, resulting in (E) **570** lb/hr of flash steam at (C) **20** psig. The flash tank shall be Armstrong Model AFT-12.

The back pressure regulator shall pass (E) **570** lb/hr of steam from (C) 20 psig to atmosphere. The back pressure regulator shall be Armstrong Model **1" GP-2000R.**

The pressure reducing valve shall pass (F) **2 500** lb/hr of steam from (G) **200** psig to (C) **20** psig. Pressure reducing valve shall be **3/4" GP-2000.**

The steam trap shall be an inverted bucket type with large vent and internal check valve. The steam trap will be sized using a 3:1 safety factor. The steam trap shall pass 3 x (A - E) **16 290** lb/hr at a (C - H) **15** psig differential. The steam trap shall be an Armstrong Model 2" 816 CV.



Notes

PT-12F

High Capacity Pump Trap

Description

Armstrong's PT-12F pump trap offers a non-electric solution to move condensate from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. The PT-12F is an ASME code-stamped carbon steel vessel, capable of returning condensate at temperatures well above the 200°F (93°C) limit of conventional electric pumps.

Features

- Low-maintenance, non-electric operation. No leaking seals, impeller or motor problems. No NPSH issues.
- Externally removable vent and motive seats
- ASME Section VIII "U" stamped vessel
- Lower installation costs. Single trade installation.
- ASME Carbon Steel durability, Inconel X-750 springs and all
- stainless steel internals for long service life
- Safety. The pump can be used in pits or sumps without fear of electrocution or circuit breaker defaults.

Maximum Operating Conditions

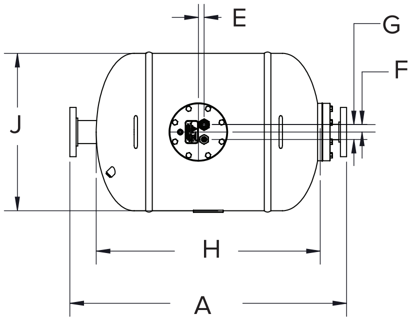
Maximum allowable pressure:
200 psig @ 400°F (14 bar @ 204°C)

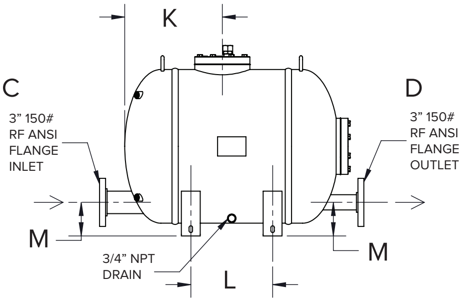
Maximum operating pressure:
200 psig @ 400°F (14 bar @ 204°C)
(Consult factory for different pressure/temperature ratings and materials)

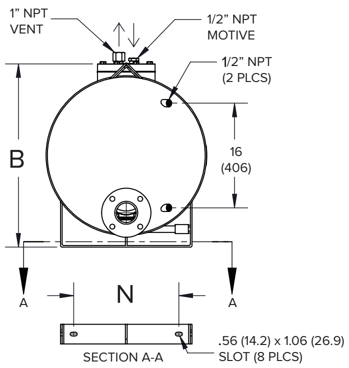
Materials

Body:	Carbon Steel
Springs:	Inconel X-750
Internals:	Stainless Steel

For a fully detailed certified drawing, refer to CD2914.







PT-12F Physical Data		
	in	mm
"A"	42	1067
"B"	28	711.5
"C"	3	80
"D"	3	80
"E"	7/8	22
"F"	1-1/8	28
"G"	2-1/4	57
"H"	34	864
"J"	24	610
"K"	15-1/2	394
"L"	13	330
"M"	5-1/4	133
"N"	16	406
Weight lb (kg)	348 (158)	

PT-12F Pump Capacities

Motive		Back Pressure		Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr
15	1	5	0.34	9 800	4 445	15 800	7 166
25	1.7			12 900	5 581	17 800	8 073
50	3.5			16 500	7 484	18 800	8 526
75	5			18 200	8 255	19 500	8 844
100	7			18 900	8 573	-	-
125	8.5			19 300	8 754	-	-
150	10.34			19 800	8 981	-	-
175	12			19 900	9 026	-	-
200	14			19 900	9 026	-	-
25	1.7	15	1	8 500	3 856	14 000	6 349
50	3.5			12 900	5 851	17 500	7 937
75	5			14 800	6 713	18 300	8 299
100	7			16 000	7 257	-	-
125	8.5			16 400	7 439	-	-
150	10.34			17 200	7 802	-	-
175	12			17 300	7 847	-	-
200	14			17 300	7 847	-	-
35	2.5	25	1.5	7 200	3 266	12 700	5 760
50	3.5			10 300	4 672	15 600	7 075
75	5			12 300	5 579	16 800	7 619
100	7			13 700	6 214	-	-
125	8.5			13 700	6 214	-	-
150	10.34			14 700	6 668	-	-
175	12			14 800	6 713	-	-
200	14			15 000	6 804	-	-
50	3.5	40	2.75	6 700	3 039	12 100	5 488
75	5			9 500	4 309	14 700	6 667
100	7			10 600	4 808	-	-
125	8.5			10 900	4 944	-	-
150	10.34			11 300	5 126	-	-
175	12			11 300	5 126	-	-
200	14			11 400	5 171	-	-
75	5	60	4	6 900	3 130	10 900	4 943
100	7			8 300	3 765	-	-
125	8.5			8 300	3 765	-	-
150	10.34			8 400	3 810	-	-
175	12			8 400	3 810	-	-
200	14			8 600	3 901	-	-
100	7	80	5.5	6 400	2 903	9 600	4 354
125	8.5			6 400	2 903	-	-
150	10.34			7 200	3 266	-	-
175	12			7 200	3 266	-	-
200	14			7 300	3 311	-	-

NOTE: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump case.

Capacity Conversion Factors for Other Filling Heads

	Filling Head				
in	**0**	**6**	**12**	**24**	*** 24 or greater**
mm	**0**	**150**	**305**	**610**	*** 620 or greater**
Capacity Multiplier	0.7	.85	1.0	1.08	* Consult factory

NOTE: Fill head measured from drain to top of cap.

PT-6F

Low Profile Pump Trap

Description

Armstrong's PT-6F pump trap offers a low profile non-electric solution to move condensate from low points, low pressures or vacuum spaces to an area of higher elevation or pressure. The PT-6F is an ASME code-stamped carbon steel vessel, and will return condensate at temperatures well above the 200°F (93°C) limit of conventional electric pumps.

PT-6F

Features

- Low-maintenance, non-electric operation. No leaking seals, impeller or motor problems. No NPSH issues.
- Externally removable vent and motive seats
- ASME Section VIII "U" stamped vessel
- Space-saving size, low-profile body fits in tight spaces
- ASME Carbon Steel durability, Inconel X-750 springs and all stainless steel internals for long service life
- Lower installation costs. Single trade installation F
- Safety. The pump can be used in pits or sumps without fear of electrocution or circuit breaker defaults.

Maximum Operating Conditions

Maximum allowable pressure:
200 psig @ 400°F (14 bar @ 204°C)

Maximum operating pressure:
200 psig @ 400°F (14 bar @ 204°C)

Materials

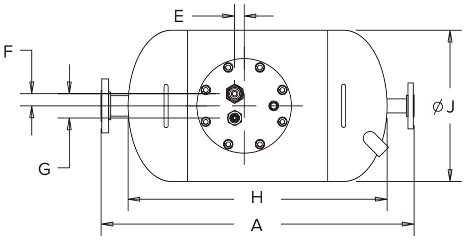
Body:	Carbon Steel
Springs:	Inconel X-750
Internals:	Stainless Steel

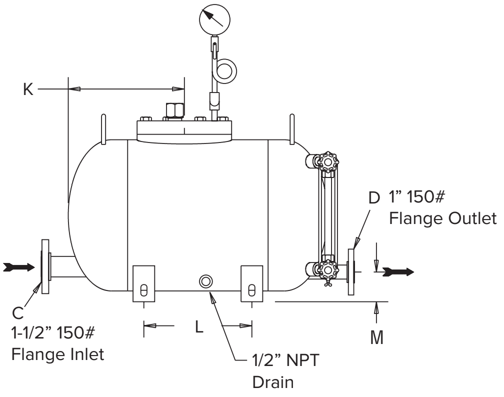
(Consult factory for different pressure/temperature ratings and materials)

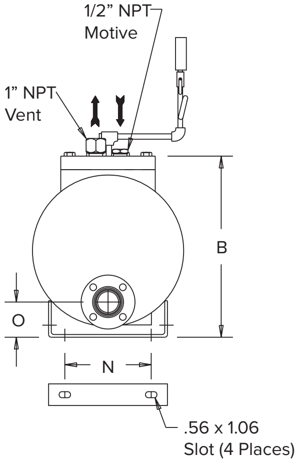
For a fully detailed certified drawing, refer to CD2913.

PT-6F Physical Data

	in	mm
"A"	29	737
"B"	16-11/16	424
"C"	1-1/2	38
"D"	1	25
"E"	7/8	22
"F"	1-1/8	28
"G"	2-1/4	57
"H"	24	610
"J"	14	356
"K"	10-13/16	275
"L"	10	254
"M"	2-13/16	71
"N"	8	203
"O"	3-3/16	81
Weight lb (kg)	140 (64)	







PT-6F

Low Profile Pump Trap

PT-6F Pump Capacities

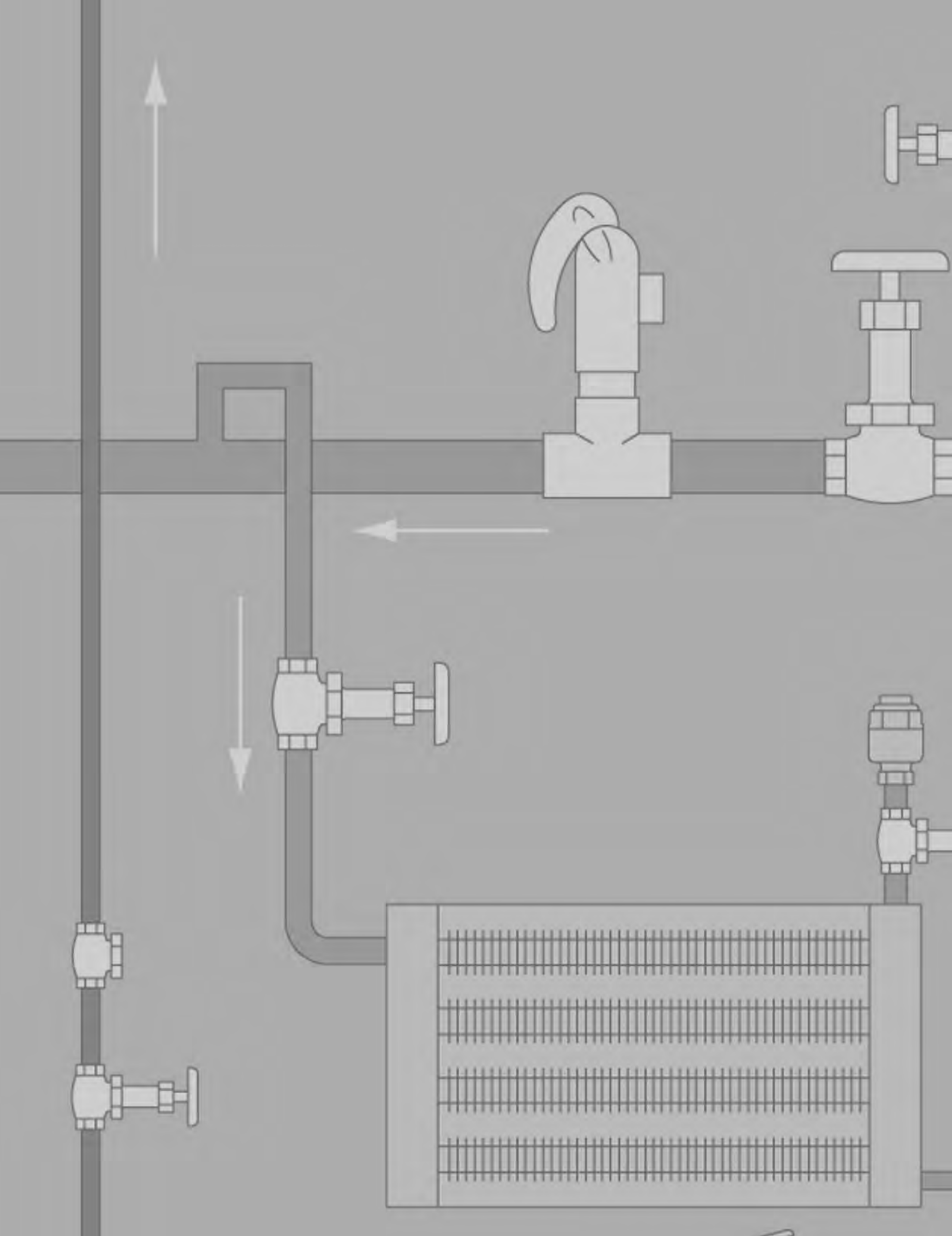
Motive		Back Pressure		Steam Motive		Air Motive	
psig	barg	psig	barg	lb/hr	kg/hr	lb/hr	kg/hr
15	1	5	0.34	2 400	1 089	3 600	1 632
25	1.7			3 000	1 361	4 500	2 040
50	3.5			4 000	1 814	5 500	2 494
75	5			4 500	2 041	6 000	2 721
100	7			4 600	2 087	-	-
125	8.5			4 700	2 132	-	-
150	10.34			4 800	2 177	-	-
175	12			4 800	2 177	-	-
200	14			4 600	2 087	-	-
25	1.7	15	1	2 000	907	4 000	1 814
50	3.5			2 800	1 270	4 500	2 045
75	5			3 400	1 542	5 000	2 267
100	7			3 600	1 633	-	-
125	8.5			3 700	1 678	-	-
150	10.34			3 800	1 724	-	-
175	12			3 600	1 633	-	-
200	14			3 500	1 588	-	-
35	2.5	25	1.5	1 800	816	3 500	1 587
50	3.5			2 300	1 043	4 500	2 040
75	5			2 900	1 315	4 800	2 176
100	7			3 000	1 361	-	-
125	8.5			3 000	1 361	-	-
150	10.34			2 900	1 315	-	-
175	12			2 500	1 134	-	-
200	14			2 300	1 043	-	-
50	3.5	40	2.75	1 400	635	3 500	1 587
75	5			2 000	907	4 400	1 995
100	7			2 400	1 089	-	-
125	8.5			2 500	1 134	-	-
150	10.34			2 500	1 134	-	-
175	12			1 800	816	-	-
200	14			1 700	771	-	-
75	5	60	4	1 500	680	3 300	1 496
100	7			1 800	816	-	-
125	8.5			2 000	907	-	-
150	10.34			1 700	771	-	-
175	12			1 500	680	-	-
200	14			1 400	635	-	-

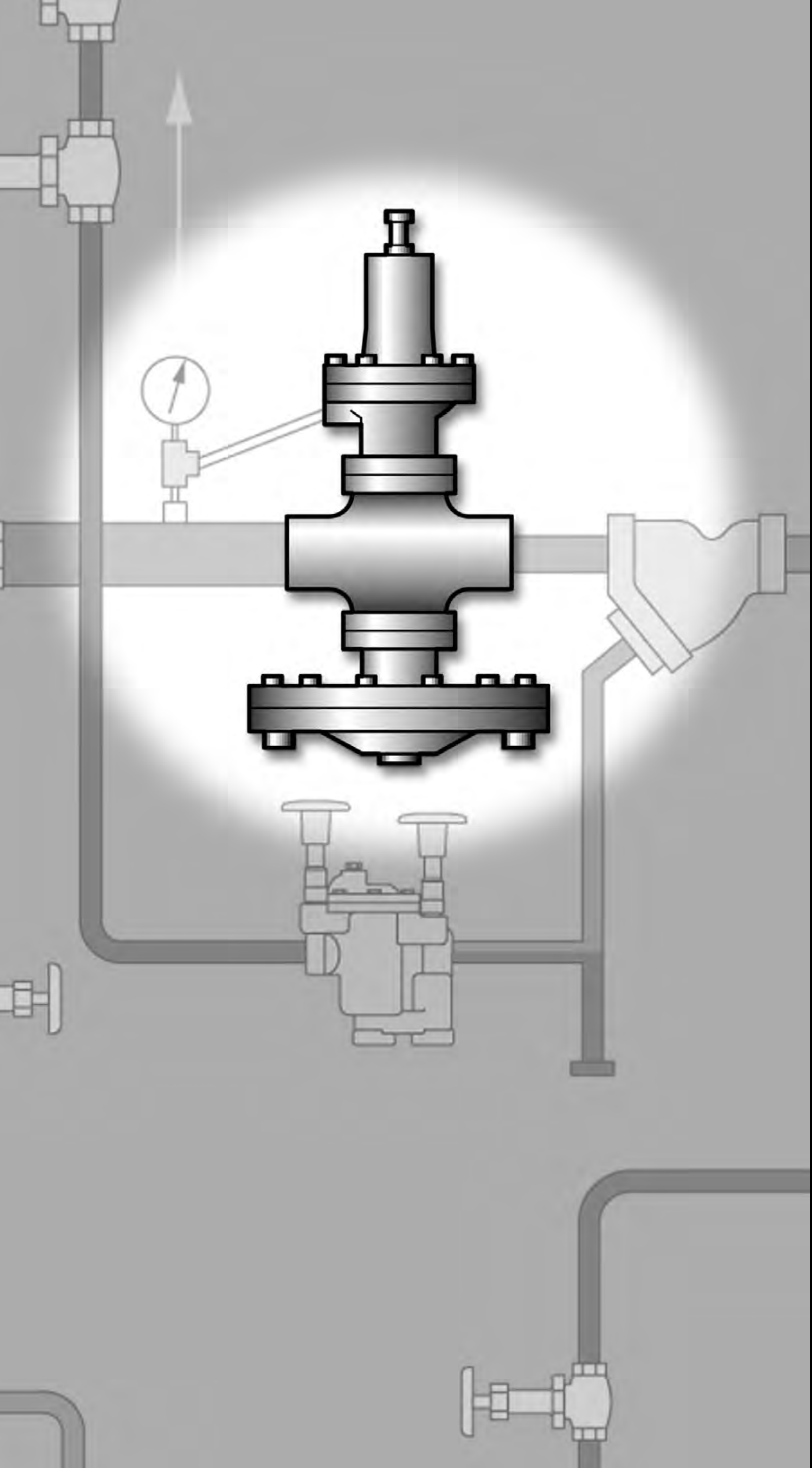
NOTE: Published capacities are based on the use of external check valves supplied by Armstrong. Fill head measured from drain point to top of pump case.

Capacity Conversion Factors for Other Filling Heads

Filling Head					
in	**0**	**6**	**12**	**24**	*** 24 or greater**
mm	**0**	**150**	**305**	**610**	*** 620 or greater**
Capacity Multiplier	0.7	.85	1.0	1.08	* Consult factory

NOTE: Fill head measured from drain to top of cap.





Pressure
and Temperature
Controls

Armstrong

Armstrong®

Pressure Reducing Valves

Armstrong pressure reducing valves (PRVs) and temperature regulators help you manage steam, air and liquid systems safely and efficiently. And assure uninterrupted productivity—by maintaining constant pressure or temperature for process control. In short, Armstrong products make using resources safe and productive...as well as environmentally sound.

For decades, Armstrong has devoted itself to learning—and sharing—all it can about energy conservation as it relates to steam equipment. As part of our product/service network, PRVs and temperature regulators represent expanded options for a reliable Armstrong solution.

PRV Types

Steam, liquids and gases usually flow at high pressures to the points of final use. At these points, a pressure reducing valve lowers the pressure for safety and efficiency and to match the requirements of the application. There are three types of pressure reducing valves.

Direct Acting. The simplest of PRVs, the direct acting type operates with either a flat diaphragm or convoluted bellows. Since it is self-contained, it does not need an external sensing line downstream to operate. It is the smallest and most economical of the three types and designed for low to moderate flows. Accuracy of direct acting PRVs is typically +/-10% of the downstream set point.

Internally Piloted Piston-Operated. This type of PRV incorporates two valves—a pilot and main valve—in one unit. The pilot valve has a design similar to the direct acting valve. The discharge from the pilot valve acts on top of a piston, which opens the main valve. This design makes use of inlet pressure in opening a larger main valve than could otherwise be opened directly. As a result, there is a greater capacity per line size and greater accuracy (+/-5%) than with the direct acting valve. As with direct acting valves the pressure is sensed internally, eliminating the need for an external sensing line.

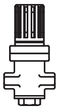
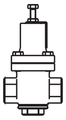
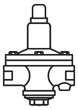
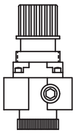
Externally Piloted. In this type, double diaphragms replace the piston operator of the internally piloted design. This increased diaphragm area can open a larger main valve, allowing a greater capacity per line size than the internally piloted valve. In addition, the diaphragms are more sensitive to pressure changes, and that means accuracy of +/-1%. This greater accuracy is due to the location, external of the valve, of the sensing line where there is less turbulence. This valve also offers the flexibility to use different types of pilot valves (i.e., pressure, temperature, air loaded, solenoid or combinations).

Selector Guide

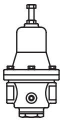
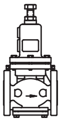
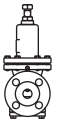
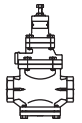
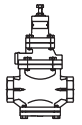
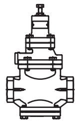
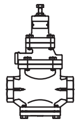
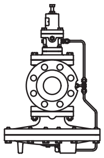
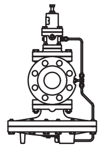
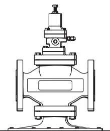
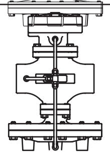
Pressure Reducing Valve Selection								
If Fluid Is	If Inlet Pressure Is		If Outlet Pressure Is		If Maximum Capacity Is Less Than		Look for Model	Find on Page
	psig	barg	psig	barg	lb/hr	kg/hr		
Steam	15 to 150	1 to 10	3 to 60	.21 to 4	425	193	GD-6N	282
	5 to 15	.3 to 1	2 to 12	.14 to .8	5 643	2 565	GP-2000L	291
	15 to 250	1 to 17	7 to 200	.48 to 13.8	18 024	8 175	GP-1000	291
	15 to 300	1 to 20	1.5 to 200	.10 to 14	134 534	61 024	GP-2000 Series	296
	15 to 300	1 to 20	3 to 140	.21 to 9.6	1 038	471	GD-30S/GD-45	278/280
	15 to 250	1 to 17	3 to 140	.21 to 9.6	3 471	1 575	GD-30	278
	15 to 425	1 to 30	1.5 to 248	.10 to 17	25 706	11 660	GP-2000CS	296
	15 to 150	1 to 10	5 to 125	.34 to 8.6	4 505	2 048	GP-1000 SS/AS	291
If Fluid Is	If Inlet Pressure Is		If Outlet Pressure Is		If Maximum Capacity Is Less Than		Look for Model	Find on Page
	psig	barg	psig	barg	gpm	l/min		
Water and Non-corrosive Liquids	20 to 230	1.4 to 16	7 to 80	.48 to 5.5	141	534	GD-24	285
	15 to 150	1 to 10	3 to 60	.21 to 4.1	18	68	GD-6	282
	15 to 150	1 to 10	7 to 100	.48 to 6.9	1 323	5 007	GD-200	286
	15 to 300	1 to 20	7 to 130	.48 to 9.0	1 323	5 007	GD-200H	286
If Fluid Is	If Inlet Pressure Is		If Outlet Pressure Is		If Maximum Capacity Is Less Than		Look for Model	Find on Page
	psig	barg	psig	barg	scfm	m3/min		
Air and Non-Corrosive Gases	15 to 150	1 to 10	5 to 125	.34 to 8.6	413	702	GD-10F	283
	15 to 300	1 to 20	5 to 125	.34 to 8.6	8 329	14 153	GD-10	283
	15 to 150	1 to 10	3 to 60	.21 to 4.1	153	260	GD-6	282
	15 to 150	1 to 10	7 to 125	.48 to 8.6	6 488	11 024	GP-1000A	291
	15 to 150	1 to 10	7 to 100	.48 to 6.9	20 614	35 028	GD-200	286
	15 to 300	1 to 20	7 to 130	.48 to 9.0	20 614	35 028	GD-200H	286
	15 to 300	1 to 20	3 to 140	.21 to 9.6	374	764	GD-45	274
	15 to 250	1 to 17	3 to 150	.21 to 9.6	1 249	2 122	GD-30	272

NOTE: GD models are direct acting; GP models are pilot controlled.

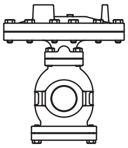
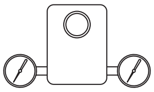
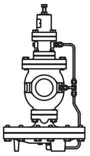
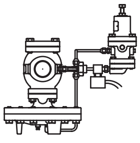
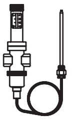
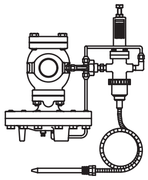
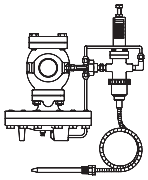
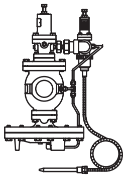
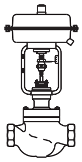
Pressure and Temperature Control ID Charts

Illustration	Type	Fluid	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size	Located on Page
	**GD-30** Direct Acting Valves	Steam, Air, Non-Corrosive Gases	NPT	250	410	Cast Bronze ASTM B584	GD-30	250	1/2", 3/4", 1", 1-1/2", 2"	278
				300	430	Stainless Steel AISI 316	GD-30S	300	1/2", 3/4", 1"	
	**GD-45** Direct Acting Valves	Steam, Air, Non-Corrosive Gases	NPT	300	450	Ductile Iron ASTM A536	GD-45	300	1/2", 3/4", 1"	280
	**GD-6** Direct Acting Valves	Steam	NPT	150	450	Cast Iron ASTM A278	GD-6N	150	3/8", 1/2", 3/4", 1"	282
		Liquid, Gas			175		GD-6			
	**GD-10** Direct Acting Valves	Air, Non-Corrosive Gases	NPT	300	175	Zinc and Aluminum	GD-10	300	1/4", 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	283
				250			GD-10F	250	1/4", 3/8", 1/2", 3/4"	
							AF-10		1/4", 3/8", 1/2", 3/4", 1"	

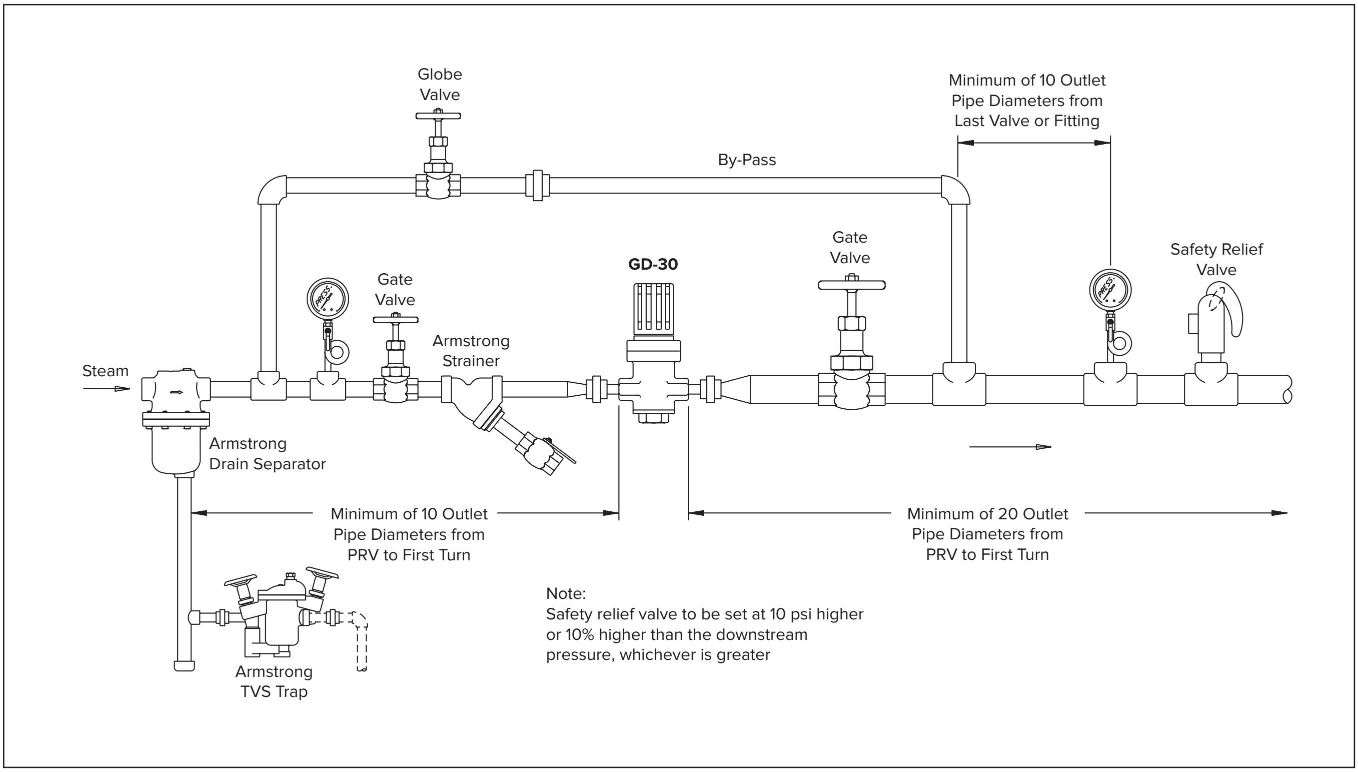
Armstrong® Pressure and Temperature Control ID Charts

Illustration	Type	Fluid	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size	Located on Page
	**GD-24** Direct Acting Valves	Water	NPT	230	175 210 (Viton)	Cast Bronze ASTM B584	GD-24	230	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	285
	**GD-200** Direct Acting Valves	Air, Water, Non-Corrosive and Non-Viscous Liquids	Flanged ANSI 150#	150	175 210 (Viton)	Ductile Iron ASTM A536	GD-200	150	2", 2-1/2", 3", 4", 5", 6"	286
			Flanged ANSI 300#	300			GD-200H	300		
	**GD-20R** Direct Acting Valves	Water, Non-Corrosive Gases	Flanged ANSI 150#	150	175	Ductile Iron ASTM A536	GD-20R	150	1/2", 3/4", 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", 4", 5", 6"	288
	**GP-1000** Internal Pilot Piston Operated	Steam	NPT	250	450	Ductile Iron ASTM A536	GP-1000	250	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	291
			Flanged ANSI 150#	150				150	2", 2-1/2", 3", 4"	
	**GP-1000 A** Internal Pilot Piston Operated	Air, Non-Corrosive Gases	NPT	150	175	Ductile Iron ASTM A536	GP-1000A	150	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	291
			Flanged ANSI 150#						2", 2-1/2", 3", 4"	
	**GP-1000 SS** Internal Pilot Piston Operated	Steam	NPT	150	450	Stainless Steel AISI 304	GP-1000SS	150	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	291
	**GP-1000 AS** Internal Pilot Piston Operated	Steam	NPT	150	450	Stainless Steel AISI 304	GP-1000AS	150	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	291
	**GP-2000** External Pilot Diaphragm Operated	Steam	NPT	300	450	Ductile Iron ASTM A536	GP-2000 Integral or Remote Pilot	300	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	296
			Flanged ANSI 150#	185				185	2", 2-1/2", 3", 4", 6"	
			Flanged ANSI 300#	300				300		
	**GP-2000 L** External Pilot Diaphragm Operated (low pressure)	Steam	NPT	150	450	Ductile Iron ASTM A536	GP-2000 L	15	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	297
			Flanged ANSI 150#						2", 2-1/2", 3", 4", 6"	
	**GP-2000CS** External Pilot Diaphragm Operated	Steam	NPT	450	600	Carbon Steel Grade WCB	GP-2000CS	450	1/2", 3/4", 1", 1-1/4", 1-1/2", 2" 2", 2-1/2", 3", 4"	298
			Flanged ANSI 150#	140				140		
			Flanged ANSI 300#	450				450		
	**GP-2000K-1, GP-2000K-3, GP-2000K-6** External Pilot Diaphragm Operated	Steam	NPT	300	450	Ductile Iron ASTM A536	GP-2000K-1	300	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	299
			Flanged ANSI 150#	185			GP-2000K-3	185	2", 2-1/2", 3", 4", 6"	
			NPT	300			GP-2000K-6	300		

Pressure and Temperature Control ID Charts

Illustration	Type	Fluid	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size	Located on Page
	**GD-2000K** Direct Acting Diaphragm Operated	Steam	NPT	300	450	Ductile Iron ASTM A536	GD-2000K	300	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	300
			Flanged ANSI 150#	185				185	2", 2-1/2", 3", 4"	
			Flanged ANSI 300#	300				300		
	**OBK-2000** Pneumatic Temperature Pilot	Air	NPT	250 (Process) 25 (Air)	400	Brass	OBK-2000	250 (Process) 25 (Air)	1/2" Process 1/8" Air	303
	**GP-2000R** External Pilot Diaphragm Operated	Steam	NPT	200	450	Ductile Iron ASTM A536	GP-2000R	200	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	304
			Flanged ANSI 150#	185				185	2", 2-1/2", 3", 4", 6"	
			Flanged ANSI 300#	200				200		
	**GP-2000 On/Off** External Pilot Solenoid Operated Valve	Steam	NPT	150	366	Ductile Iron ASTM A536	GP-2000	150	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	307
			Flanged ANSI 150#						2", 2-1/2", 3", 4", 6"	
			Flanged ANSI 300#							
	**OB-30/31** Direct Acting Temperature Regulators	Water, Steam and Non-Corrosive Liquids	NPT	150	366	Bronze ASTM B584	OB-30 (Heating)	150	1/2", 3/4", 1"	310
				250			OB-31 (Cooling)	250		
	**OB-2000** Piloted Diaphragm Operated Temperature Regulator	Steam	NPT	300	450	Pilot Bronze ASTM B584 Valve Ductile Iron A536	OB-2000	300	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	312
			Flanged ANSI 150#	185				185	2", 2-1/2", 3", 4", 6"	
			Flanged ANSI 300#	300				300		
	**OB-2000 L** Piloted Diaphragm Operated Temperature Regulator (low pressure)	Steam	NPT	150	450	Pilot Bronze ASTM B584 Valve Ductile Iron A536	OB-2000 L	15	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	314
			Flanged ANSI 150#						2", 2-1/2", 3", 4"	
	**OB-2000PT** Pressure/ Temperature Piloted Diaphragm Operated Temperature Regulator	Steam	NPT	300	450	Temp. Pilot Bronze ASTM B584 Valve and Pressure Pilot Ductile Iron A536	OB-2000PT	300	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	316
			Flanged ANSI 150#	185				185	2", 2-1/2", 3", 4", 6"	
			Flanged ANSI 300#	300				300		
	**Control Valve** Pnuematic Actuated Control Valve	Steam, Liquid	NPT	300	450	Carbon Steel A216 Gr. WCB	CV1500 (1/2" - 4" Sizes)	300	1/2", 3/4", 1", 1-1/2", 2”, 2-1/2”, 3, 4, 6, 8	320
			Flanged ANSI 150#	185				185		
			Flanged ANSI 300#	300			CV1100 (6" & 8" Sizes)	300		

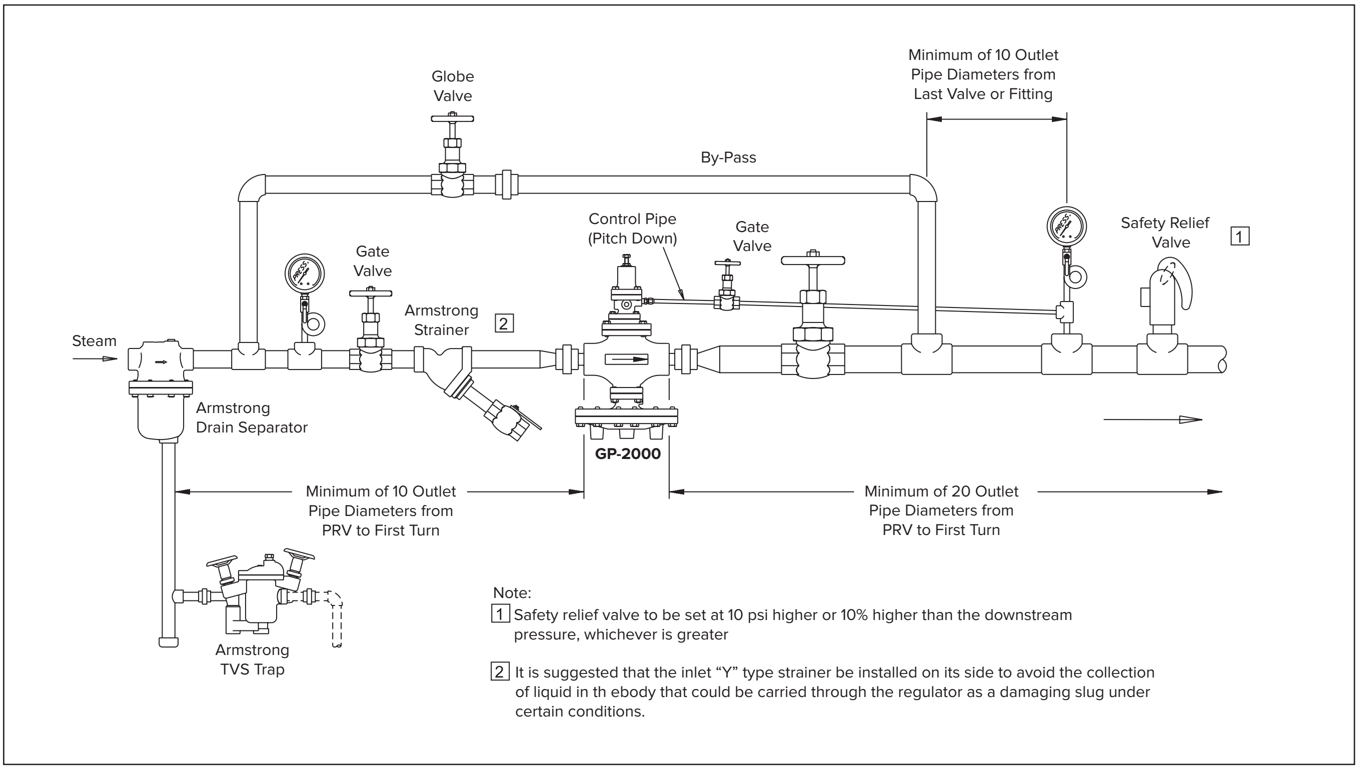
Direct Acting Single Stage Reduction



Note:
Safety relief valve to be set at 10 psi higher or 10% higher than the downstream pressure, whichever is greater

Typical Direct Acting PRV Installation

External Pressure Pilot Single Stage Reduction



Note:

1 Safety relief valve to be set at 10 psi higher or 10% higher than the downstream pressure, whichever is greater

2 It is suggested that the inlet "Y" type strainer be installed on its side to avoid the collection of liquid in th ebody that could be carried through the regulator as a damaging slug under certain conditions.

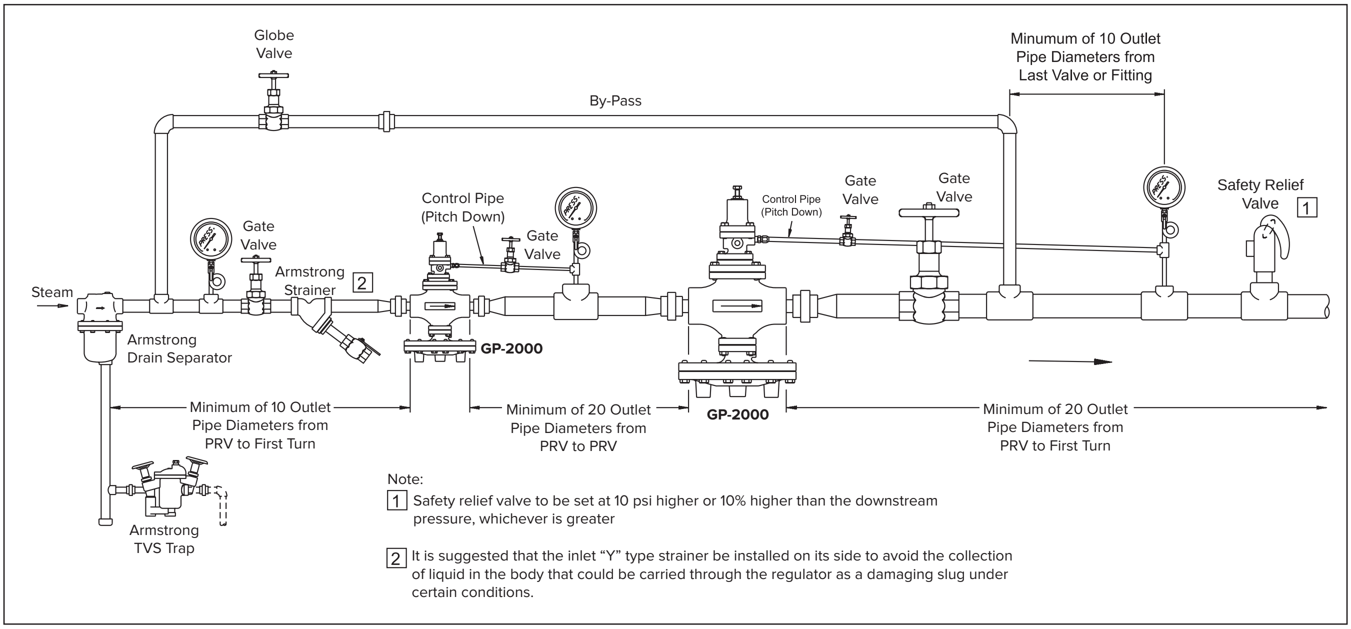
Typical External Pressure Pilot PRV Installation

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Application Data—Pressure Reducing Valves

External Pressure Pilot Two Stage Reduction

This piping application is used when the pressure turndown ratio is greater than that of a single valve. Pressure reduction is accomplished by using two valves in series to reduce the pressure in stages. Depending on the volume of fluid required and pressure reduction, the second stage valve typically will be larger in size than the first stage valve. Unless a specific intermediate pressure of the fluid is required, this intermediate pressure is typically selected so as to keep the pressure turndown ratios of both valves as similar as possible. This will help equalize and maximize the service life of both valves.



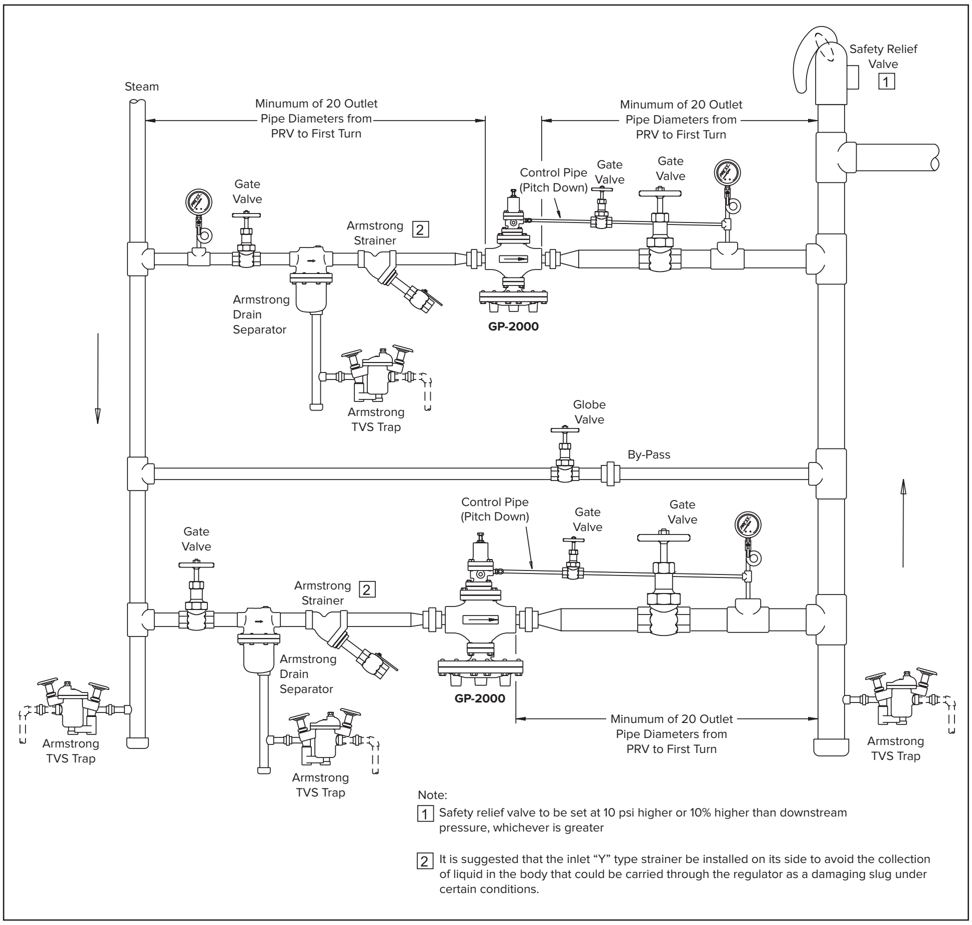
Note:

1 Safety relief valve to be set at 10 psi higher or 10% higher than the downstream pressure, whichever is greater

2 It is suggested that the inlet “Y” type strainer be installed on its side to avoid the collection of liquid in the body that could be carried through the regulator as a damaging slug under certain conditions.

External Pressure Pilot One-Third to Two-Thirds Reduction Station◆◆

This piping application is used when the flow rangeability is greater than that of a single valve. Better control is achieved by piping two valves in parallel and sizing one to handle 1/3 the maximum load and the other 2/3 the maximum load. These two valves are staged by offsetting their pressure set points by 2-3 psig. The smaller valve is usually the lead valve and would have a pressure set point at the desired pressure. The larger valve is usually the lag valve and would have a pressure set point of 2-3 psig below the lead valve. This offset of set points will stage the valves so that the lag valve will remain closed until the lead valve can no longer pass the required flow and is wide open. This lack of flow will cause the set pressure to drop slightly until the lag valve opens and regulates at the higher demands of flow.



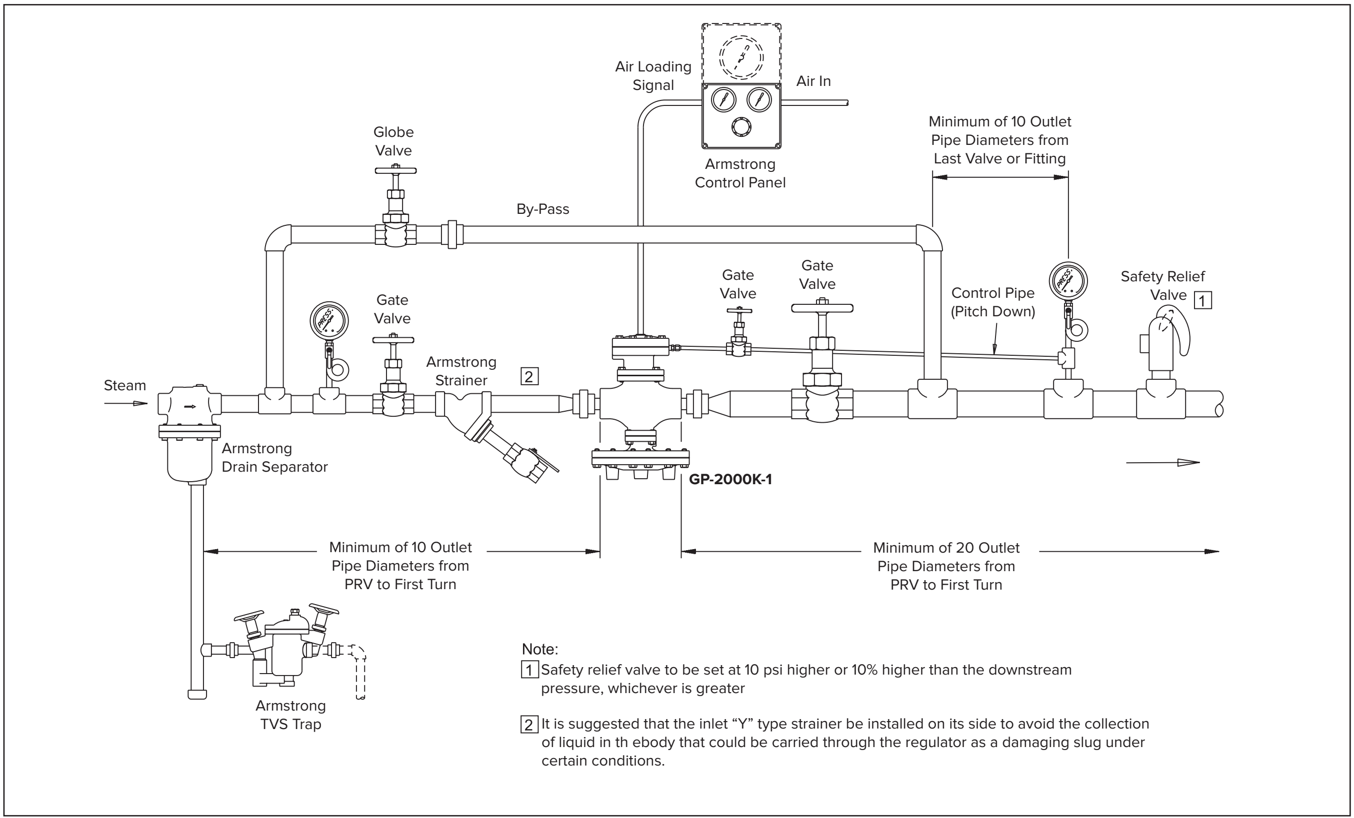
Note:

1 Safety relief valve to be set at 10 psi higher or 10% higher than downstream pressure, whichever is greater

2 It is suggested that the inlet “Y” type strainer be installed on its side to avoid the collection of liquid in the body that could be carried through the regulator as a damaging slug under certain conditions.

Application Data—Pressure Reducing Valves

Air Loaded External Pilot Single Stage Reduction



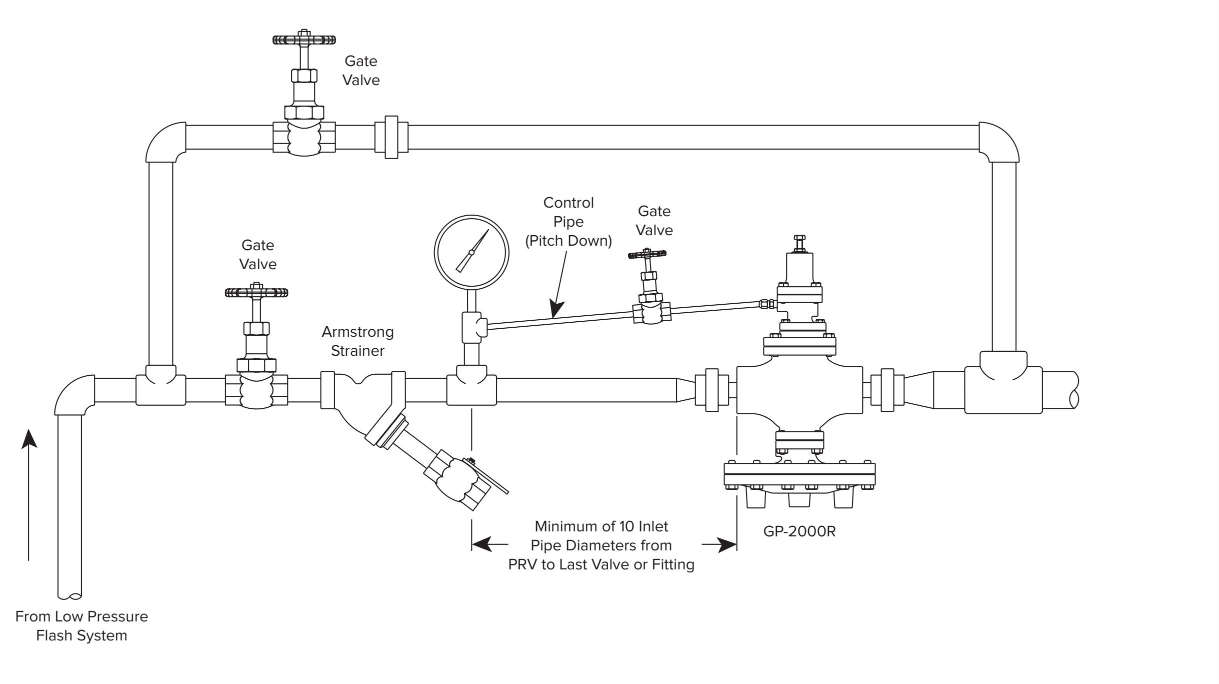
Note:

1 Safety relief valve to be set at 10 psi higher or 10% higher than the downstream pressure, whichever is greater

2 It is suggested that the inlet "Y" type strainer be installed on its side to avoid the collection of liquid in th ebody that could be carried through the regulator as a damaging slug under certain conditions.

Typical Air Loaded External Pilot Reduction Station. Complete with remote located air loading control panel.

External Back Pressure Pilot Installation



Typical External Pilot Back Pressure Installation. Used to maintain a constant upstream pressure in the piping system.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Sizing Data

Selection Formulas

C_V Value and Calculations

1. For Steam:

$$\text{When } P_2 > \frac{P_1}{2} \quad C_v = \frac{W}{2.1\sqrt{\Delta P\,(P_1 + P_2)}}$$

$$\text{*When } P_2 \leq \frac{P_1}{2} \quad C_v = \frac{W}{1.71\,(P_1)}$$

2. For Gas:

$$\text{When } P_2 > \frac{P_1}{2} \quad C_v = \frac{Q\sqrt{G\,(T+460)}}{963\sqrt{\Delta P\,(P_1 + P_2)}}$$

$$\text{When } P_2 \leq \frac{P_1}{2} \quad C_v = \frac{Q}{36.39\,(P_1)}$$

3. For Liquid:

$$C_v = \frac{(GPM)\sqrt{G}}{\sqrt{\Delta P}}$$

Formula Key

W = Maximum flow capacity of steam, lbs/hr

P_1 = Inlet pressure, psia (psig + 14.7)

P_2 = Outlet pressure, psia (psig + 14.7)

ΔP = Pressure drop ($P_1 - P_2$) psig

Q = Maximum flow capacity of gas SCFH

G = Specific gravity

T = Fluid temperature °F

GPM = Maximum flow capacity of liquid GPM

C_v = Valve flow coefficient

* Formula applies only to piloted valves. With direct acting valves, at critical flow or sonic flow, capacities diminish with greater differential pressure.

Ordering Information

C_v Values for Each Product

Model	Connection Size																									
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/4	8	3/8	10	1/2	15	3/4	20	1	25	1-1/4	32	1-1/2	40	2	50	2-1/2	65	3	80	4	100	5	125	6	150
GD-10	1.4		1.4		1.4		2.6		5.8		5.8		5.8		43		—		—		—		—		—	
GD-10F	1.4		1.4		1.4		2.6		5.8		—		—		—		—		—		—		—		—	
GD-6/6N	—		.35		.5		1.0		1.5		—		—		—		—		—		—		—		—	
GD-200/200H	—		—		—		—		—		—		—		16		28		36		68		75		108	
GD-20R	—		—		1.5		2.7		4		8		11		14		23		32		48		75		108	
GD-24	—		—		1.5		1.9		3		4		7		10		—		—		—		—		—	
GD-30/GD-45	—		—		1.3		1.5		2.5		—		5.6*		8.5*		—		—		—		—		—	
GP-2000 Series	—		—		5		7.2		10.9		14.3		18.8		32		60		78		120		—		250	
GP-1000	—		—		1		2.3		4		6.5		9		16		25		36		64		—		—	
OB-30/OB-31	—		—		3.7		4.6		5.8		—		—		—		—		—		—		—		—	
OB-2000/OB-2000PT	—		—		5		7.2		10.9		14.3		18.8		32		60		78		120		—		—	

NOTE: 50% reduced ports are available for all 2000 Series valves. Capacities and Cv are reduced by 1/2. GD-6/6N and GD-30/45 capacities cannot be determined with a formula—consult capacity tables. Reference note under formula key above.

*GD-30 only.

When ordering please specify:

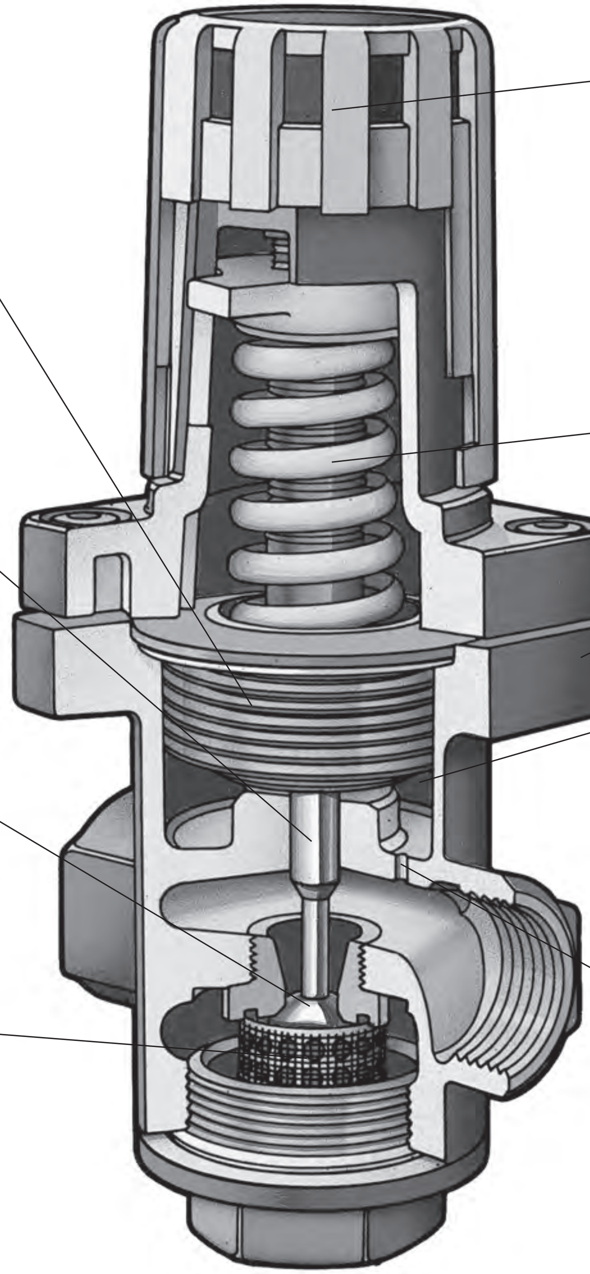
1. Model number
2. Connection size and type
3. Quantity
4. Service fluid
5. Specific gravity (if other than steam, air, water)
6. Fluid temperature
7. Maximum inlet pressure
8. Desired delivered pressure (reduced pressure)
9. Flow rate
10. Special conditions (if any)

Notes

Direct Acting

For Steam, Air and Non-Corrosive Gas Service

The simplest of pressure reducing valves, the direct acting type operates with either a flat diaphragm or convoluted bellows. Since it is self-contained, it does not need an external sensing line downstream to operate. It is the smallest and most economical of the three types and is designed for low to moderate flows. Accuracy of direct acting PRVs is typically +/-10%.



Plastic cap doesn't absorb heat so it won't burn an operator's hands. Permits changing of set pressure without tools. Simply lift cap and turn to desired setting.

Convoluted phosphor bronze bellows allows smaller body size than conventional direct-acting diaphragm PRVs.

Interchangeable range spring is easily changed to different pressure by removing four (4) cap screws.

Stainless steel stem and bronze body minimize the sticking common with conventional valves.

Bronze body for corrosion resistance.

Downstream pressure sensed outside the bellows vs. inside, which assures bellows integrity and longer bellows life.

Hardened stainless steel valve and seat with spring return to assure tight shutoff.

Integral sensing port to eliminate piping of external sensing line.

Integral mesh strainer eliminates fouling due to dirt.

For Steam, Air and Non-Corrosive Gases

The GD-30 is a compact, high performance direct acting valve. Economical to buy and use, it's ideal for those low to moderate flow applications where accuracy of +/-10% is acceptable. The GD-30 is well suited for laundry and dry cleaning equipment, hospital equipment, tire molds, humidifiers, small heaters and applications in food processing. It provides tight shutoff for dead-end service on steam. Turndown ratio is 10:1 and ANSI Class IV Shutoff.

For a fully detailed certified drawing, refer to:
GD-30 (bronze only) **CDY #1038**
GD-30S (stainless steel) **CDY #1089**

GD-30/30S Specifications

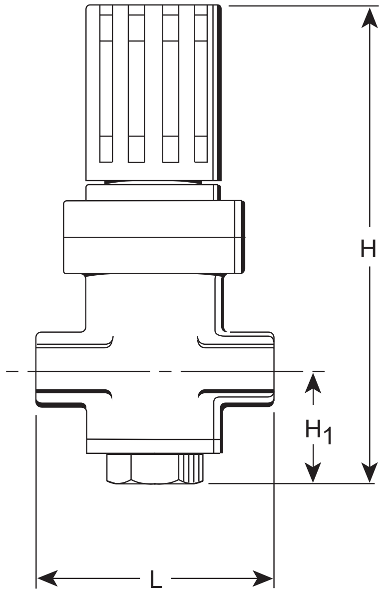
Model Number	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Spring Color	Minimum Differential psig (barg)	Application	Maximum Temp. °F (°C)	Materials		
							Body	Valve/Seat	Bellows
GD-30	15 - 250 (1 - 17)	3 - 15 (.21 - 1.0) 7 - 60 (0.5 - 4.0) 50 - 140 (3.4 - 9.6)	Yellow Blue Green	7 (.48)	Steam, Air, Non-Corrosive Gases	410 (210)	Cast Bronze ASTM B584	Stainless Steel AISI 440/304	Phosphor Bronze ASTM B103*
GD-30S	15 - 300 (1 - 20)				Steam, Air, Non-Corrosive Gases	430 (220)	Stainless Steel AISI 316		Stainless Steel AISI 316L

*Stainless steel optional

GD-30/30S Dimensions and Weights

Symbol	Connection Size									
	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	**15**	**3/4**	**20**	**1**	**25**	**1-1/2***	**40**	**2***	**50**
L	3-1/8	80	3-3/8	85	3-3/4	95	5-1/2	140	5-7/8	150
H_1	2	47	2	47	2	47	3	77	3	77
H	7-1/2	191	7-1/2	191	7-1/2	191	12-1/8	307 1	2-1/8	307
Weight lb (kg)	4-1/4 (1.9)		4-1/4 (1.9)		4-1/2 (2.0)		21-3/8 (9.7)		22 (10)	
C_v	1.3		1.5		2.5		5.6		8.5	

NOTE: GD-30 capacities cannot be determined with a formula—consult capacity tables. Reference note under formula key on page 275.
*GD-30S available in 1/2", 3/4", and 1" only.



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

GD-30/30S

GD-30 Capacities—Steam

	lb/hr							kg/hr						
	Inlet	Outlet	Connection Size					Inlet	Outlet	Connection Size				
			in							mm				
	psig		1/2	3/4	1	1-1/2	2	barg		15	20	25	40	50
	C_v Factor		1.3	1.5	2.5	5.6	8.5	C_v Factor		1.3	1.5	2.5	5.6	8.5
	15	7	49	56	92	198	297	1.0	.5	22	25	42	90	135
	20	13	53	61	105	216	331	1.4	.9	24	28	48	98	150
		7	42	55	63	180	264		.5	19	25	35	82	120
	30	23	62	71	112	242	408	2.0	1.6	28	32	51	110	185
		15	53	60	101	209	309		1.0	24	27	46	95	140
		3	33	40	60	139	216		.2	15	18	27	63	98
	40	32	99	121	187	407	617	2.8	2.2	45	55	85	185	280
		20	79	97	159	330	517		1.4	36	44	72	150	235
		4	40	55	77	159	264		.3	18	25	35	72	120
	50	40	130	143	242	539	837	3.4	2.8	59	65	110	245	380
		20	99	115	187	407	628		1.4	45	52	85	185	285
		5	48	62	88	193	297		.3	22	28	40	88	135
	60	48	137	154	265	584	899	4.0	3.3	62	70	120	265	408
		40	150	165	289	617	969		2.8	68	75	131	280	440
		18	90	104	170	374	584		1.2	41	47	77	170	265
		6	55	73	99	220	331		.4	25	33	45	100	150
	80	64	176	205	342	738	1 168	5.5	4.4	80	93	155	335	530
		54	187	225	353	782	1 201		3.7	85	102	160	355	545
		23	121	137	220	489	749		1.6	55	62	100	222	340
		8	60	77	108	231	363		.5	27	35	49	105	165
	100	80	203	242	397	863	1 355	6.9	5.5	92	110	180	392	615
		66	225	262	437	958	1 465		4.5	102	119	198	435	665
		40	198	231	375	837	1 278		2.8	90	105	170	380	580
		10	68	79	132	297	473		.7	31	36	60	135	215
	120	96	231	276	452	991	1 520	8.3	6.6	105	125	205	450	690
		70	276	311	518	1 168	1 818		4.8	125	141	235	530	825
		45	240	267	450	980	1 509		3.1	109	121	204	445	685
		12	110	121	198	462	705		.8	50	55	90	210	320
	150	120	287	333	551	1 212	1 862	10.3	8.3	130	151	250	550	845
		85	364	421	705	1 531	2 369		5.9	165	191	320	695	1 075
		55	298	353	595	1 278	2 005		3.8	135	160	270	580	910
		15	132	165	254	562	848		1.0	60	75	115	255	385
	180	140	408	485	794	1 719	2 677	12.4	9.7	185	220	360	780	1 215
		115	430	507	860	1 829	2 832		8.0	195	230	390	830	1 285
		70	386	430	739	1 619	2 501		4.8	175	195	335	735	1 135
		18	165	187	309	683	1 035		1.2	75	85	140	310	470
	200	140	461	518	871	1 983	3 063	13.8	9.7	209	235	395	900	1 390
		115	474	540	904	2 005	3 085		8.0	215	245	410	910	1 400
		80	430	496	827	1 818	2 810		5.5	195	225	375	825	1 275
		20	209	242	386	848	1 300		1.4	95	110	175	385	590
	225	140	485	573	948	2 060	3 195	15.5	9.7	220	260	430	935	1 450
		115	496	584	961	2 071	3 207		8.0	225	265	436	940	1 455
		85	463	540	904	1 983	3 063		5.9	210	245	410	900	1 390
		23	254	298	496	1 079	1 675		1.6	115	135	225	490	760
	250	140	525	606	1 014	2 226	3 438	17.2	9.7	238	275	460	1 010	1 560
		120	551	584	1 038	2 248	3 471		8.3	250	265	471	1 020	1 575
		70	463	529	893	1 939	2 997		4.8	210	240	405	880	1 360
		25	276	320	529	1 146	1 796		1.7	125	145	240	520	815
GD-30S Only	275	140	529	613	1 023	–	–	18.9	9.7	240	278	464	–	–
		120	529	613	1 023	–	–		8.3	240	278	464	–	–
		70	470	542	902	–	–		4.8	213	246	409	–	–
		28	295	344	562	–	–		1.9	134	156	255	–	–
	300	140	529	613	1 023	–	–	20.0	9.7	240	278	464	–	–
		100	529	613	1 023	–	–		6.9	240	278	464	–	–
		70	478	551	926	–	–		4.8	217	250	420	–	–
		30	309	359	595	–	–		2.7	140	163	270	–	–

NOTE: For air capacities scfm, multiply steam capacities (lb/hr) by 0.36. For air capacities m3/hr, multiply steam capacities (kg/hr) by 1.35. Maximum pressure reduction ratio 10:1.

Armstrong® GD-45

For Steam, Air and Non-Corrosive Gas Service

The GD-45 is a compact, high-performance, direct-acting valve. Inexpensive to buy and use, it is ideal for those moderate flow applications that do not justify the higher cost of pilot-controlled valves.

The GD-45 is well-suited for laundry and dry-cleaning equipment, hospital equipment, tire molds, humidifiers, small heaters, and applications in food processing. It provides tight, quick, easy installation.

Quick, easy installation

- Lightweight and compact
- Piping supports the valve of ductile iron for greater durability and higher inlet pressure
- Screwed connections
- No external sensing lines or parts needed
- Maximum turndown ratio 10:1
- ANSI Class IV shutoff

Simple selection

- 1/2", 3/4" and 1"
- Match pipe size normally
- Three pressure range springs (for best control when ranges overlap, use smaller range spring)

Long life/easy maintenance

- Highly resilient phosphor-bronze bellows
- Hardened stainless-steel working parts
- Integral strainer (removable for cleaning) for protection from wear or dirt
- Teflon gaskets used at all joints for improved leakage prevention

For a fully detailed certified drawing, refer to CDY #1090.

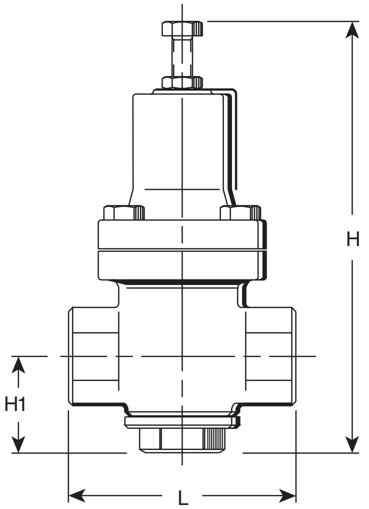
GD-45 Specifications

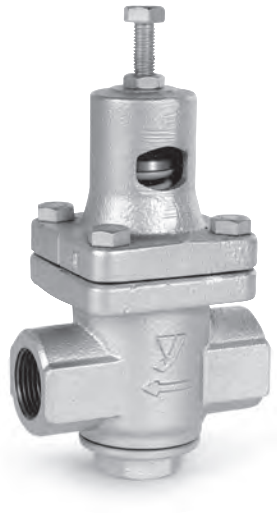
Service	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Minimum Differential psig (barg)	Maximum Temperature °F (°C)	Materials		
					Body	Valve/Seat	Bellows
Steam, Air Non-Corrosive Gases	15 - 300 (1 - 20)	3 - 15 (.21 - 1.0) Yellow	7 (.48)	450 (232)	ASTM A536 Ductile Iron	Hardened Stainless Steel AISI 420	Phosphor Bronze ASTM B103
		7 - 60 (0.5 - 4.0) Blue					
		50 - 140 (3.4 - 9.6) Green					

GD-45 Dimensions and Weights

Symbol	Connection Size					
	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25
L	4-3/8	111	4-3/8	111	4-3/8	111
H_1	1-7/8	47	1-7/8	47	1-7/8	47
H	8-1/2	216	8-1/2	216	8-1/2	216
Wt, lb (kg)	7 (3.2)					
Cv	1.3		1.5		2.5	

NOTE: GD-45 capacities cannot be determined with a formula—consult capacity tables. Reference note under formula key on page 275.





GD-45

GD-45 Capacities—Steam

lb/hr					kg/hr				
Inlet	Outlet	Connection Size			Inlet	Outlet	Connection Size		
		in					mm		
psig		1/2	3/4	1	barg		15	20	25
C_v Factor		1.3	1.5	2.5	C_v Factor		1.3	1.5	2.5
15	7	49	56	92	1.0	.5	22	25	42
20	13	53	61	105	1.4	.9	24	28	48
	7	42	55	63		.5	19	25	35
30	23	62	71	112	2.0	1.6	28	32	51
	15	53	60	101		1.0	24	27	46
	3	33	40	60		.2	15	18	27
40	32	99	121	187	2.8	2.2	45	55	85
	20	79	97	159		1.4	36	44	72
	4	40	55	77		.3	18	25	35
50	40	130	143	242	3.4	2.8	59	65	110
	20	99	115	187		1.4	45	52	85
	5	48	62	88		.3	22	28	40
60	48	137	154	265	4.0	3.3	62	70	120
	40	150	165	289		2.8	68	75	131
	18	90	104	170		1.2	41	47	77
	6	55	73	99		.4	25	33	45
80	64	176	205	342	5.5	4.4	80	93	155
	54	187	225	353		3.7	85	102	160
	23	121	137	220		1.6	55	62	100
	8	60	77	108		.5	27	35	49
100	80	203	242	397	6.9	5.5	92	110	180
	66	225	262	437		4.5	102	119	198
	40	198	231	375		2.8	90	105	170
	10	68	79	132		.7	31	36	60
120	96	231	276	452	8.3	6.6	105	125	205
	70	276	311	518		4.8	125	141	235
	45	240	267	450		3.1	109	121	204
	12	110	121	198		.8	50	55	90
150	120	287	333	551	10.3	8.3	130	151	250
	85	364	421	705		5.9	165	191	320
	55	298	353	595		3.8	135	160	270
	15	132	165	254		1.0	60	75	115
180	140	408	485	794	12.4	9.7	185	220	360
	115	430	507	860		8.0	195	230	390
	70	386	430	739		4.8	175	195	335
	18	165	187	309		1.2	75	85	140
200	140	461	518	871	13.8	9.7	209	235	395
	115	474	540	904		8.0	215	245	410
	80	430	496	827		5.5	195	225	375
	20	209	242	386		1.4	95	110	175
225	140	485	573	948	15.5	9.7	220	260	430
	115	496	584	961		8.0	225	265	436
	85	463	540	904		5.9	210	245	410
	23	254	298	496		1.6	115	135	225
250	140	525	606	1 014	17.2	9.7	238	275	460
	120	551	584	1 038		8.3	250	265	471
	70	463	529	893		4.8	210	240	405
	25	276	320	529		1.7	125	145	240
300	140	528	616	1 023	20	9.7	240	280	465
	120	551	627	1 038		8.3	250	285	477
	70	484	550	913		4.8	220	250	415
	30	319	352	583		2.0	145	160	265

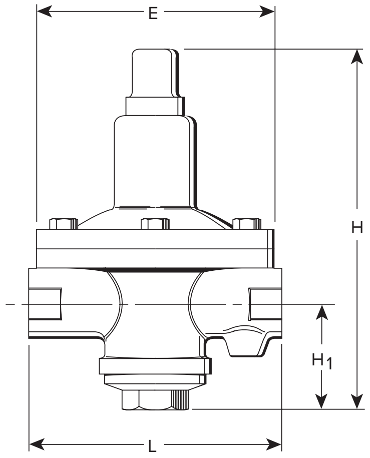
NOTE: For air capacities scfm, multiply steam capacities (lb/hr) by 0.36. For air capacities m3/hr, multiply steam capacities (kg/hr) by 1.35.
Maximum pressure reduction ratio 10:1.

Armstrong® GD-6N (Steam), GD-6 (Liquid, Gas)

For Steam, Air and Water

The GD-6N and GD-6 are compact, direct acting diaphragm valves ideal for low-flow applications, including laundry/dry cleaning equipment, hospital equipment, tire/plastic molds and food processing. Lightweight and compact, the valves require no external sensing lines or additional parts. External adjusting screw with locking nut and cover make for quick, easy setting and adjustment. Tight shutoff for dead-end service. Removable stainless steel diaphragm, hardened stainless steel working parts (6N), integral removable strainer (6N) and in-line renewable valve and seat. Available in 3/8", 1/2", 3/4" and 1" sizes with a choice of two set pressure spring ranges.

For a fully detailed certified drawing, refer to CDY #1040.



GD-6N/GD-6 Specifications

Model	Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Spring Color	Minimum Differential psig (barg)	Maximum Temperature °F (°C)	Materials			
							Body	Main Valve	Valve Seat	Diaphragm
GD-6N	Steam	15 - 150 (1 - 10)	3 - 15 (.21 - 1.0) and 15 - 60 (1 - 4)	Yellow Stripe	7 (.48)	450 (232)	Cast Iron ASTM A278	Stainless Steel AISI 304	Stainless Steel AISI 420	Stainless Steel AISI 304
GD-6	Liquid Gas			Yellow/Blue Stripe		175 (79)		Brass (w/Disc) ASTM B16	Bronze ASTM B584	

GD-6N Capacities—Steam

lb/hr							kg/hr					
Inlet	Outlet	Connection Size in					Inlet	Outlet	Connection Size mm			
psig		3/8	1/2	3/4	1		barg		10	15	20	25
15	3 - 8	18	25	51	76		1.0	.2 - .6	8.2	11.3	23.1	34.5
20	13	12	17	34	51		1.4	.9	5.4	7.7	15.4	23.1
	3 - 10	21	30	59	89			.2 - .7	9.5	13.6	26.8	40.4
25	18	14	20	41	61		1.7	1.2	6.4	9.1	18.6	27.7
	15	19	28	55	83			1.0	8.6	12.7	24.9	37.6
	3 - 12	24	34	68	102			.2 - .8	10.9	15.4	30.8	46.3
30	23	16	23	47	71		2.1	1.6	7.3	10.4	21.3	32.2
	20	21	30	59	89			1.4	9.5	13.6	26.8	40.4
	3 - 15	27	38	76	115			.2 - 1	12.2	17.2	34.5	52.2
40	32	21	30	60	90		2.8	2.2	9.5	13.6	27.2	40.8
	25	28	40	79	119			1.7	12.7	18.1	35.8	54.0
	4 - 20	33	47	94	140			.3 - 1.4	15.0	21.3	42.6	63.5
50	40	25	36	73	109		3.4	2.8	11.3	16.3	33.1	49.4
	32	33	47	94	141			2.2	15.0	21.3	42.6	64.0
	5 - 25	39	55	111	166			.3 - 1.7	17.7	24.9	50.3	75.3
60	48	30	43	55	128		4.1	3.3	13.6	19.5	24.9	58.1
	40	37	53	107	160			2.8	16.8	24.0	48.5	72.6
	6 - 30	45	64	128	192			.4 - 2.1	20.4	29.0	58.1	87.1
75	60	37	52	104	156		5.2	4.1	16.8	23.6	47.2	70.8
	48	47	67	135	202			3.3	21.3	30.4	61.2	91.6
	7 - 37	54	77	153	230			.5 - 2.6	24.5	34.9	69.4	104.3
100	65	61	87	173	260		6.9	4.5	27.7	39.5	78.5	117.9
	10 - 50	69	98	196	294			.7 - 3.4	31.3	44.5	88.9	133.4
125	13 - 60	84	119	239	358		8.6	.9 - 4.1	38.1	54.0	108.4	162.4
150	15 - 60	99	142	283	425		10.3	1 - 4.1	44.9	64.4	128.4	192.8

NOTE: For air capacities scfm, multiply steam capacities (lb/hr) by 0.36.
For air capacities m3/hr, multiply steam capacities (kg/hr) by 1.35.
Maximum pressure reduction ratio 10:1.

ANSI Class IV Shutoff.

GD-6N/GD-6 Dimensions and Weights

Symbol	Connection Size							
	in	mm	in	mm	in	mm	in	mm
	3/8	10	1/2	15	3/4	20	1	25
L	6-1/2	165	6-1/2	165	7-1/4	185	7-1/4	185
H	9-1/2	237	9-1/2	237	10-1/4	261	10-1/4	261
H_1	2-1/4	57	2-1/4	57	3	76	3	76
E	6-1/8	155	6-1/8	155	7	175	7	175
Wt lb (kg)	12 (5.5)		12 (5.5)		18 (8.2)		18 (8.2)	
C_v	.35		.5		1.0		1.5	

GD-6 Capacities—Water

gpm						l/min				
ΔP	Connection Size in					ΔP	Connection Size mm			
psig	3/8	1/2	3/4	1		barg	10	15	20	25
5	.8	1.1	2.2	3.4		.35	3.0	4.2	8.3	12.9
10	1.1	1.6	3.2	4.7		.7	4.2	6.0	12.1	17.8
15	1.4	1.9	3.9	5.8		1.0	5.3	7.2	14.8	22.0
25	1.8	2.5	5.0	7.5		1.7	6.8	9.5	18.9	28.4
50	2.5	3.5	7.1	10.6		3.5	9.5	13.2	26.9	40.1
75	3.0	4.3	8.7	13.0		5.2	11.4	16.3	32.9	49.2
100	3.5	5.0	10.0	15.0		6.9	13.2	18.9	37.9	56.8
125	3.9	5.6	11.2	16.8		8.6	14.8	21.2	42.4	63.6
147	4.2	6.1	12.1	18.2		10.0	15.9	23.1	45.8	68.9

GD-10, GD-10F, AF-10

For Air and Non-Corrosive Gases

The GD-10/10F is a lightweight direct acting diaphragm valve used primarily for pneumatic tool air supply and non-hazardous gas regulation. Screwed connections make it easy to support in position without external sensing lines or other parts. Zinc or aluminum bodies eliminate rust and scale. Plug, seat and diaphragm are renewable in-line, and you can make quick adjustments externally with locking handle. Quarter-inch pressure gauge connection is standard, and all units are capable of tight shutoff for dead-end service. GD-10 available in sizes 1/4" - 2." Highly efficient Model AF-10 air filters with zinc or aluminum bodies are used to remove liquids and solid particles from compressed air. The AF-10 is available in sizes 1/4" - 1."

For a fully detailed certified drawing, refer to list below.

GD-10 CDY #1003
GD-10F CDY #1002
AF-10 CDY #1004

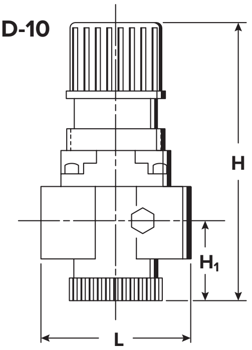
GD-10/GD-10F/AF-10 Specifications

Model	Application	Inlet Pres. psig (barg)	Reduced Pressure psig (barg)	Min. Differ. psig (barg)	Max. Temp. °F (°C)	Materials				
						Body in (mm)	Bowl	Main Valve in (mm)	Valve Plug in (mm)	Diaphragm
GD-10	Air and Other Non-Corrosive Gases	15 - 300 (1 - 20)	5 - 125 (.34 - 8.6)	7 (.48)	175 (79)	Zinc 1/4, 3/8, 1/2, 3/4 (6, 9, 15, 20) Aluminum 1 - 2 (25 - 50)	—	Zinc 1/4, 3/8, 1/2, 3/4 (6, 9, 15, 20) Aluminum 1 - 2 (25 - 50)	Brass 1/4, 3/8, 1/2, 3/4 (6, 9, 15, 20) Nylon 1 - 2 (25 - 50)	Nitrile
GD-10F		15 - 250 (1 - 17)	5 - 125 (.34 - 8.6)	7 (.48)		Zinc			Brass	Nitrile
AF-10		0 - 250 (0 - 17)	—	—		Zinc 1/4, 3/8, 1/2, 3/4 (6, 9, 15, 20) Aluminum 1 (25)		—	—	—

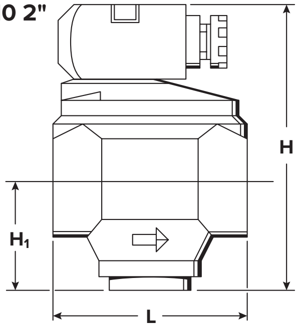
GD-10 Dimensions and Weights

Symbol	Connection Size											
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/4	**8**	**3/8**	**10**	**1/2**	**15**	**3/4**	**20**	**1, 1-1/4, 1-1/2**	**25, 32, 40**	**2**	**50**
L	2-5/8	67	2-5/8	67	2-5/8	67	3-1/2	98	4-1/4	108	6	152
H	5-3/8	136	5-3/8	136	5-3/8	136	5-7/8	149	7-1/8	181	9-3/4	248
H_1	1-1/2	38	1-1/2	38	1-1/2	38	1-1/2	38	2-3/8	60	3-9/16	90
Wt, lb (kg)	1-1/2 (.7)		1-1/2 (.7)		1-1/2 (.7)		2 (.9)		3 (1.4)		10 (4.5)	
C_v	1.4						2.6		5.8		43	

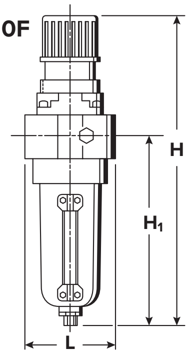
GD-10



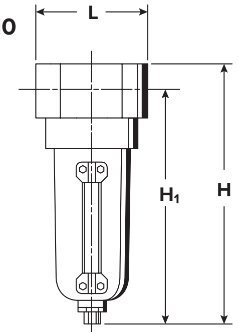
GD-10 2"



GD-10F



AF-10



Armstrong® GD-10, GD-10F, AF-10

GD-10/GD-10F Capacities—Air

scfm						m^3/hr					
Inlet	Outlet	Connection Size				Inlet	Outlet	Connection Size			
		in						mm			
psig		1/4, 3/8, 1/2	3/4	1*, 1-1/4, 1-1/2	2**	barg		8, 10, 15	20	25*, 32, 40	50**
15	8	19	35	78	580	1.0	0.6	32	60	133	985
30	23	24	44	98	727	2.0	1.6	40	75	167	1 235
	15	33	61	136	1 011		1.0	56	104	232	1 718
	5 - 7	38	70	157	1 166		.34 - 48	64	120	267	1 981
40	33	26	49	109	810	2.8	2.3	45	83	186	1 377
	20	42	77	173	1 280		1.4	71	131	293	2 174
	5 - 12	46	86	192	1 427		.34 - .83	79	147	327	2 424
50	40	34	63	141	1 046	3.4	2.8	58	107	240	1 777
	30	46	86	191	1 416		2.1	78	145	324	2 405
	5 - 17	55	102	228	1 687		.34 - 1.17	93	173	387	2 867
75	60	49	91	203	1 503	5.2	4.1	83	154	344	2 553
	45	66	123	273	2 026		3.1	112	208	464	3 442
	7 - 30	76	141	316	2 339		.48 - 2.1	129	240	536	3 975
100	80	64	118	264	1 958	6.9	5.5	108	201	449	3 327
	60	86	159	355	2 634		4.1	146	271	604	4 475
	10 - 42	97	181	403	2 991		.69 - 2.9	165	307	686	5 082
125	100	79	146	326	2 413	8.6	6.9	134	248	553	4 101
	75	106	196	437	3 241		5.2	179	333	743	5 507
	13 - 55	119	220	491	3 643		.89 - 3.8	202	374	835	6 190
150	120	93	173	387	2 868	10.3	8.3	159	295	657	4 873
	85	129	240	535	3 967		5.9	219	408	909	6 741
	15 - 67	140	260	579	4 295		1.03 - 4.6	238	441	984	7 298
175	125	126	235	524	3 884	12.1	8.6	215	399	890	6 599
	100	149	276	617	4 573		6.9	253	470	1 048	7 769
	18 - 80	161	299	667	4 947		1.24 - 5.5	274	508	1 134	8 405
200	125	161	298	666	4 934	13.8	8.6	273	507	1 131	8 383
	20 - 92	182	339	755	5 599		1.38 - 6.3	310	575	1 283	9 513
250†	25 - 125	225	417	931	6 903	17.2†	1.7 - 8.6	382	709	1 582	11 729
300	30 - 125	267	496	1 107	8 207	20.0	2.1 - 8.6	454	843	1 881	13 944
350**	35 - 125	—	—	—	9 511	24.1**	2.4 - 8.6	—	—	—	16 159
425**	43 - 125	—	—	—	11 467	29.3**	3.0 - 8.6	—	—	—	19 482

* GD-10F not available above 3/4" (20 mm).

** 2" (50 mm) GD-10 valve maximum inlet pressure is 425 psig (30 barg).

† GD-10F has a maximum inlet pressure of 250 psig (17 barg).

GD-10F Dimensions and Weights

Symbol	Connection Size							
	in	mm	in	mm	in	mm	in	mm
	1/4	8	3/8	10	1/2	15	3/4	20
L	2-3/4	70	2-3/4	70	2-3/4	70	3-7/8	98
H	9-3/8	238	9-3/8	238	9-3/8	238	10-7/8	276
H$_1$	5-3/4	146	5-3/4	146	5-3/4	146	6-3/8	162
Wt, lb (kg)	2-1/2 (1.2)		2-1/2 (1.2)		4-1/2 (2.0)		4-1/2 (2.0)	
C$_V$	1.4						2.6	

AF-10 Dimensions and Weights

Symbol	Connection Size									
	in	mm	in	mm	in	mm	in	mm	in	mm
	1/4	8	3/8	10	1/2	15	3/4	20	1	25
L	2-3/4	70	2-3/4	70	2-3/4	70	3-7/8	98	4-3/4	121
H	6-3/8	162	6-3/8	162	6-3/8	162	7	178	11-3/8	289
H$_1$	5-3/4	146	5-3/4	146	5-3/4	146	6-3/8	162	10	254
Wt, lb (kg)	2 (.9)								3 (1.4)	

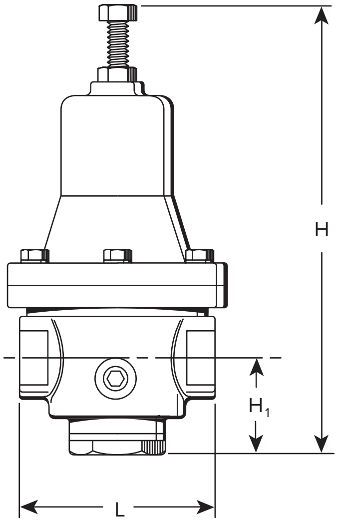
GD-24

For Non-Potable Water Service Only

An industrial-grade valve for non-potable water systems, the GD-24 is lightweight, compact and economical. Comes with screwed connections and will mount in any position. Requires no external sensing lines. Bronze body and high temperature diaphragm suitable for hot or cold process water service. Valve, seat and diaphragm are renewable in line. External adjusting screw with lock. Six sizes, 1/2" through 2". ANSI Class IV shutoff.

Illegal for potable water service per SDWA section 1417 (As Amended).

For a fully detailed certified drawing, refer to CDY #1023.



GD-24 Specifications

Application	Maximum Pressure psig (barg)	Reduced Pressure Range psig (barg)	Minimum Differential psig (barg)	Maximum Temperature °F (°C)	Materials			
					Body	Main Valve	Valve Seat	Diaphragm
Hot or Cold Water	20 - 230 (1.3 - 16)	7 - 80 (.48 - 5.5)	7 (.48)	175* (79)	Cast Bronze ASTM 584		Stainless Steel AISI 304	NBR**

*With Viton® diaphragm maximum temperature is 210°F (99°C).
**Viton optional.

GD-24 Capacities—Water

gpm							l/min						
ΔP	Connection Size						ΔP	Connection Size					
	in							mm					
DP (psig)	1/2	3/4	1	1-1/4	1-1/2	2	DP (barg)	15	20	25	32	40	50
7	4	5	8	11	19	26	0.5	15	20	30	40	70	100
10	5	6	9	13	22	32	0.7	18	24	36	48	84	120
15	6	8	12	15	27	39	1.0	22	29	44	59	103	147
25	8*	10	15	20	35	50	1.7	30*	38	57	76	132	189
50	11	14*	21	28	49	71	3.4	40	53*	80	107	187	268
75	13	17	26*	35	61*	87	5.2	49	66	98*	131	231*	328
100	15	20	30	40*	70	100*	6.9	57	76	114	151*	265	378*
125	17	22	34	45	78	112	8.6	63	85	127	169	296	423
150	18	24	37	49	86	122	10.3	70	93	139	185	325	464
175	20	26	40	53	93	132	12.0	75	100	150	200	351	501
200	21	28	42	57	99	141	13.8	80	107	161	214	375	535

*At flows greater than this, velocities will exceed 10 ft/sec and pipe erosion could occur.
NOTE: Maximum pressure reduction ratio 10:1.

GD-24 Dimensions and Weights

Symbol	Connection Size											
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/4	32	1-1/2	40	2	50
L	3-1/4	83	3-1/2	89	4	102	4-3/4	121	6	152	7-1/4	184
H_1	1-3/4	45	2	51	2-1/2	64	3-1/4	83	3-1/2	89	4-1/2	115
H	7-3/4	197	8-1/2	216	9-5/8	245	11-1/4	286	13-1/2	343	16	407
Wt, lb (kg)	4	(1.8)	5-1/4	(2.4)	7-1/4	(3.3)	10-3/8	(4.7)	18	(8.2)	31-1/2	(14.3)
C_v	1.5		2		3		4		7		10	

GD-200/200H

For Air, Water, Non-Corrosive and Non-Viscous Liquids

The GD-200/200H offers high capacity and highly accurate control with a large, cupped diaphragm for a long stroke. Compact and rugged, the GD-200's composition valve and stainless steel seat mean high performance over a long service life. Well suited to non-viscous liquid pressure reduction, the valve is widely applied in domestic water applications, construction equipment, irrigation, tank car loading and industrial or commercial air conditioning. Upstream variations do not affect balanced pressure valve, and composition disc assures tight shutoff. Turndown ratio is 10:1, and sizes range from 2" through 6". ANSI Class IV Shutoff.

GD-200/200H Specifications

Model Number	Pressure			Spring Color	Application	Max. Temp. °F (°C)	Min. Diff. psig (barg)	Materials				
	Inlet psig (barg)	Reduced psig (barg)						Body	Main Valve	Valve Seat	Diaphragm	Connection
		2" - 3" (50 - 80 mm)	4" - 6" (100 - 150 mm)									
GD-200	150 (10)	7 - 36 (.48 - 2.5) 37 - 100 (2.5 - 6.9)	7 - 36 (.48 - 2.5) 37 - 72 (2.5 - 5.0)	Yellow	Liquid Gas	175 (79)**	7 (.48)	Ductile Iron ASTM A536	NBR	Stainless Steel AISI 304	NBR***	ANSI 150 lb. Flg.
GD-200H	300 (20)	*72 - 130 (4.9 - 8.8)	*72 - 108 (4.9 - 7.3)	Black								ANSI 300 lb. Flg.

*This spring range for GD-200H only.
**With Viton® diaphragm maximum temperature is 210°F (99°C).
***Viton optional.

GD-200/200H Capacities—Air

scfm							
Inlet	Outlet	Connection Size					
		in					
psig		2	2-1/2	3	4	5	6
15	8	216	377	485	917	1 011	1 456
20	13	235	412	530	1 000	1 103	1 589
	7	305	534	686	1 296	1 429	2 058
25	18	254	444	570	1 077	1 188	1 711
	7	374	655	842	1 591	1 755	2 527
30	23	270	473	609	1 149	1 268	1 826
	7	440	770	990	1 870	2 063	2 970
40	32	321	561	722	1 363	1 503	2 165
	20	476	833	1 071	2 024	2 232	3 214
	7 - 12	531	929	1 194	2 256	2 488	3 583
50	40	389	681	875	1 654	1 824	2 626
	30	527	922	1 185	2 239	2 469	3 555
	7 - 17	628	1 099	1 413	2 668	2 943	4 238
60	48	457	800	1 029	1 943	2 143	3 086
	35	628	1 099	1 413	2 669	2 944	4 239
	7 - 22	725	1 269	1 631	3 081	3 398	4 893
75	60	559	979	1 258	2 377	2 621	3 775
	45	754	1 319	1 696	3 204	3 534	5 089
	7 - 30	870	1 523	1 959	3 699	4 080	5 876
100	80	729	1 275	1 640	—	—	—
	60	980	1 715	2 205	4 166	4 594	6 616
	10 - 42	1 113	1948	2 504	4 730	5 217	7 513
125	100	898	1 572	2 021	—	—	—
	70	1 206	2 111	2 714	5 317	5 864	8 444
	13 - 55	1 356	2 372	3 050	5 762	6 355	9 151
150	100	1 331	2 329	2 995	—	—	—
	80	1 517	2 655	3 414	—	—	—
	15 - 67	1 598	2 797	3 596	6 793	7 492	10 788
180	100	1 772	3 100	3 986	—	—	—
	90	1 848	3 235	4 159	—	—	—
	18 - 80	1 889	3 306	4 251	8 030	8 856	12 753
200	100	2 044	3 577	4 598	—	—	—
	20 - 92	2 083	3 646	4 688	8 855	9 766	14 063
250	25 - 100	2 569	4 495	5 779	10 917	12 041	17 338
300	25 - 100	3 054	5 344	6 871	12 979	14 315	20 613

m3/hr							
Inlet	Outlet	Connection Size					
		mm					
barg		50	65	80	100	125	150
1.03	0.55	366	641	824	1 557	1 718	2 473
1.38	0.90	400	700	900	1 699	1 874	2 699
	0.48	518	907	1 166	2 202	2 428	3 497
1.72	1.24	431	754	969	1 831	2 019	2 907
	0.48	636	1 113	1 431	2 703	2 981	4 293
2.07	1.59	459	804	1 034	1 953	2 154	3 102
	0.48	748	1 308	1 682	3 178	3 505	5 047
2.76	2.21	545	954	1 226	2 316	2 554	3 678
	1.38	459	804	1 034	1 953	2 154	3 102
	.48 - .83	902	1 578	2 029	3 833	4 227	6 087
3.45	2.76	661	1 157	1 487	2 810	3 099	4 462
	2.07	809	1 416	1 820	3 438	3 792	5 461
	.48 - 1.17	1 067	1 867	2 400	4 534	5 000	7 200
4.14	3.31	777	1 360	1 748	3 302	3 642	5 244
	2.41	895	1 566	2 014	3 803	4 195	6 041
	.48 - 1.5	1 232	2 155	2 771	5 234	5 773	8 313
5.17	4.14	950	1 663	2 138	4 038	4 453	6 413
	3.10	1 067	1 867	2 401	4 535	5 001	7 202
	.48 - 2.1	1 479	2 588	3 328	6 285	6 932	9 983
6.89	5.52	1 238	2 167	2 786	—	—	—
	4.14	1 281	2 241	2 882	5 444	6 004	8 646
	.69 - 2.9	1 891	3 309	4 255	8 037	8 864	12 765
8.62	6.89	1 526	2 670	3 433	—	—	—
	5.17	1 665	2 914	3 747	7 077	7 806	11 241
	.89 - 3.8	2 303	4 031	5 182	9 789	10 796	15 547
10.34	6.89	2 261	3 957	5 088	—	—	—
	5.52	2 049	3 586	4 610	—	—	—
	1.03 - 4.6	2 715	4 752	6 110	11 541	12 729	18 329
12.41	6.89	3 010	5 268	6 773	—	—	—
	6.21	2 578	4 512	5 801	—	—	—
	1.24 - 5.5	3 210	5 618	7 223	13 643	15 047	21 668
13.79	6.89	3 472	6 077	7 813	—	—	—
	1.38 - 6.3	3 540	6 195	7 965	15 044	16 593	23 894
17.24	1.72 - 6.9	4 364	7 637	9 819	18 548	20 457	29 458
20.00	1.72 - 6.9	5 188	9 080	11 674	22 051	24 321	35 022

GD-200H Only

NOTE: Maximum pressure reduction ratio 10:1.

NOTES: Available in sizes below 2" upon request. Differential valve (GD-21) available upon request.

GD-200/200H

GD-200/200H Capacities—Water

gpm								l/min						
ΔP	Connection Size							ΔP	Connection Size					
	in								mm					
DP (psig)	2	2-1/2	3	4	5	6		DP (barg)	50	65	80	100	125	150
7	42	74	95	180	198	286		0.5	160	280	361	681	751	1 082
10	51	89	114	215	237	342		0.7	192	335	431	814	898	1 293
15	62	108	139	263	290	418		1.0	235	411	528	997	1 100	1 583
20	72	125	161	304	335	483		1.4	271	474	609	1 151	1 270	1 828
25	80	140*	180	340	375	540		1.7	303	530*	681	1 287	1 420	2 044
35	95*	166	213*	402*	444	639		2.4	360*	627	806*	1 520*	1 680	2 419
50	113	198	255	481	530*	764		3.4	428	749	964	1 820	2 006*	2 891
75	139	242	312	589	650	900*		5.2	525	918	1 180	2 229	2 459	3 407*
100	160	280	360	680	750	1 080		6.9	606	1 060	1 363	2 574	2 839	4 088
125	179	313	402	760	839	1 207		8.6	677	1 185	1 524	2 878	3 174	4 571
150	196	343	441	833	919	1 323		10.0	742	1 298	1 669	3 153	3 477	5 007

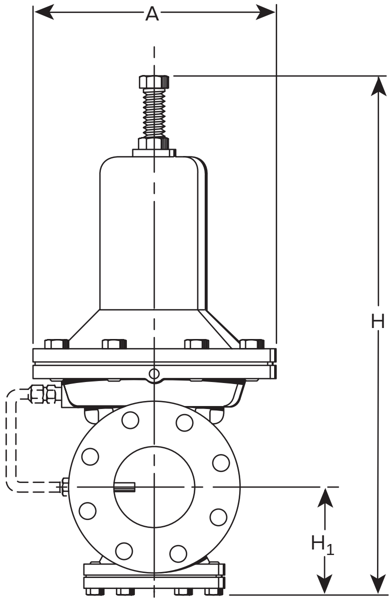
*At flows greater than this, velocities will exceed 10 ft/sec and pipe erosion could occur.
NOTE: Minimum flow is 1.3 gpm (4.9 l/min).

GD-200/200H Dimensions and Weights

Size		GD-200 Face-to-Face		GD-200H Face-to-Face		A		H		H_1		C_V	Weight	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm		lb	kg
2	50	7-5/8	195	7-7/8	200	6	152	16-1/4	415	3-1/8	81	16	43	19.2
2-1/2	65	10-5/8	270	10-7/8	277	7	178	21-1/2	550	4-1/16	105	28	88	40.0
3	80	10-5/8	270	11-1/8	283	7-1/2	191	22-9/16	577	4-9/16	120	36	97	43.7
4	100	12-1/8	308	12-3/4	342	9	229	25-1/6	637	5-1/4	135	68	154	70.0
5	125	15	380	15-7/8	403	10	254	33	839	6-1/2	169	75	317	144.0
6	150	15-3/4	400	16-5/8	422	11	280	35-9/16	908	7-1/2	194	108	381	173.0

For a fully detailed certified drawing, refer to:

GD-200	**CD #2106**
GD-200H	**CD #2107**



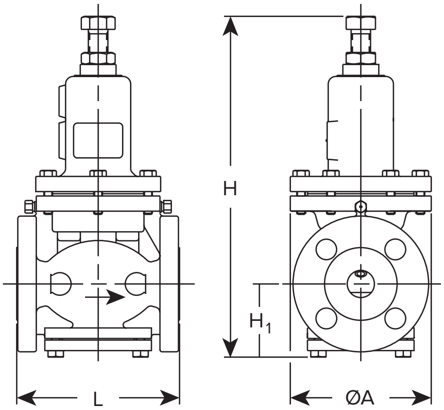
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

GD-20R

For Water, Non-Corrosive and Non-Viscous Liquids

The GD-20R offers high capacity and highly accurate control with a large, cupped diaphragm for a long stroke. Compact and rugged, the GD-20R's composition valve and stainless steel seat mean high performance over a long service life. It is mainly used in heating and cooling equipment, and automatically regulates the pressure according to load fluctuations. It can be used in by-pass systems to prevent pump shutoff and to maintain a constant fluid pressure in the line. Turndown ratio is 10:1, and sizes range from 1/2" through 6".

For a fully detailed certified drawing, refer to CDY #1100.



GD-20R Capacities—Water

gpm									
ΔP	**Connection Size**								
DP (psig)	**1/2**	**3/4**	**1**	**1-1/4**	**1-1/2**	**2**	**2-1/2**	**3**	**4**
7	4	7	11	22	29	37	61	86	127
10	5	9	13	27	35	44	73	103	152
15	6	10	15	33	43	54	89	126	186
25	8*	14*	20	43*	55*	70	115	163	240
50	11	19	28*	60	78	99*	163*	230*	339
75	13	23	35	74	95	121	199	281	416*
100	15	27	40	85	110	140	230	325	480

l/min									
ΔP	**Connection Size**								
DP (barg)	**15**	**20**	**25**	**32**	**40**	**50**	**65**	**80**	**100**
0.5	15	27	40	85	110	140	230	325	481
0.7	18	32	48	102	132	168	275	389	575
1.0	22	40	59	125	161	205	337	476	704
1.7	30*	53*	76	162*	208*	265	435	615	908
3.4	40	72	106*	228	294	374*	617*	870*	1 285
5.2	49	89	131	279	361	459	754	1 065	1 575*
6.9	57	102	151	322	416	530	871	1 230	1 817

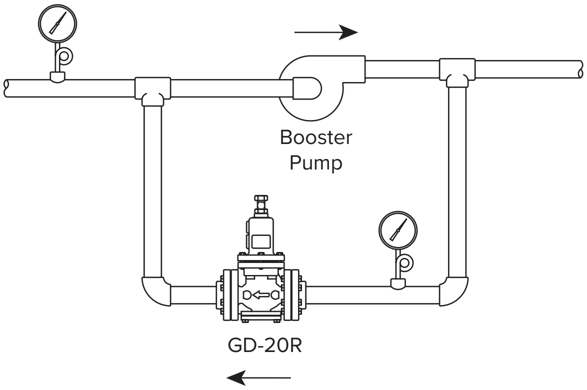
*At flows greater than this, velocities will exceed 10 ft/sec and pipe erosion could occur.

GD-20R Dimensions and Weights

Symbol	**Connection Size**																					
	in	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
	1/2	**15**	**3/4**	**20**	**1**	**25**	**1-1/4**	**32**	**1-1/2**	**40**	**2**	**50**	**2-1/2**	**65**	**3**	**80**	**4**	**100**	**5**	**125**	**6**	**150**
L	5-11/16	145	5-15/16	150	5-15/16	150	7-11/16	195	7-11/16	195	7-11/16	195	10-5/8	270	10-5/8	270	12-1/8	308	15-1/8	384	15-15/16	404
H	11-5/8	296	11-5/8	296	12-1/2	317	15-9/16	395	15-9/16	395	16-5/16	415	21-7/8	555	22-15/16	582	25-3/8	645	33-7/16	849	36-1/8	918
H_1	2-1/4	57	2-1/4	57	2-5/8	67	3	76	3	76	3-3/16	81	4-5/16	110	4-15/16	125	5-5/8	143	7-1/16	179	8-1/16	204
Wt., lb (kg)	18 (8)		18 (8)		22 (10)		37 (17)		37 (17)		42 (19)		88 (40)		96 (44)		156 (71)		320 (145)		386 (175)	
C_V	1.5		2.7		4		8		11		14		23		32		48		75		108	

GD-20R Specifications

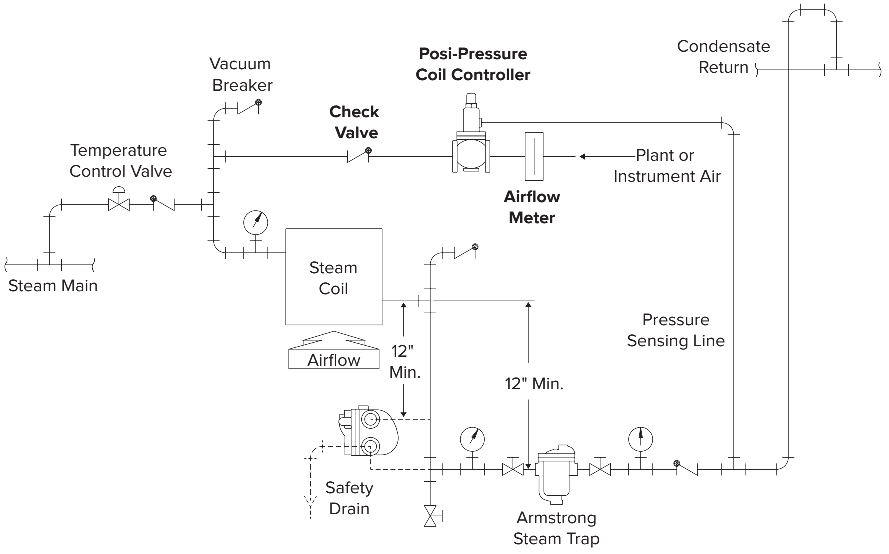
Pressure	**Set Pressure**		**Spring Color**	**Application**	**Max. Temp. °F (°C)**	**Min. Diff. psig (barg)**	**Materials**			
Inlet psig (barg)	**1/2" - 3" (15 - 80 mm)**	**4" - 6" (100 - 150 mm)**					**Main Valve**	**Valve Seat**	**Diaphragm**	**Connection**
150 (10)	7 - 36 (.48 - 2.5) 37 - 100 (2.5 - 6.9)	7 - 36 (.48 - 2.5) 37 - 72 (2.5 - 5.0)	Yellow Black	Liquid	175 (79)	7 (.48)	NBR	Stainless Steel AISI 304	NBR	ANSI 150 lb. Flanged



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong Posi-Pressure Control System

A Revolutionary Way to Provide Positive Condensate Drainage for Heat Exchange Equipment



Posi-Pressure Control System Suggested Installation

Posi-Pressure Control System Kit, consisting of controller, check valve, airflow meter

Forget About Flooded Heat Exchangers

The major cause of flooded heat exchangers is a lack of sufficient pressure differential across the steam trap under modulated steam conditions. With Armstrong's Posi-Pressure Control System, there is always a minimum preset differential pressure between the heat exchanger and the condensate return system. Even if the pressure in the condensate return changes, the Posi-Pressure Controller automatically adjusts to maintain the preset differential.

Forget About Water Hammer

When heat exchangers flood, steam and cold condensate frequently come in contact with each other. When this happens, the steam rapidly condenses, causing water hammer. This water hammer condition can cause damage to heat exchangers, piping and fittings. By eliminating heat exchanger flooding, the Posi-Pressure Control System will solve the problem.

Forget About Frozen Steam Coils

Most steam coils freeze because they are flooded with condensate. Costly—bulky—and high maintenance face and by-pass coil systems were created to solve this problem by maintaining a positive differential steam pressure. Now, with Armstrong's Posi-Pressure Control System, simple and inexpensive modulated control systems can do the same job. However, we must caution that proper steam coil design, steam trapping and venting practices are also required for freeze protection. If assistance is needed, Armstrong's Representatives are trained to analyze your total steam system and offer you solutions to your problems.

How Does the Posi-Pressure Control System Work?

A normal steam system may modulate into a vacuum to control temperature. A vacuum breaker is often installed to prevent this condition. Once the vacuum breaker opens, temperature control is accomplished by mixing the air with the steam. The steam/air mixture results in a lower temperature. However, even a vacuum breaker will not work if condensate has to be elevated to an overhead return, or if the return system is pressurized.

The Posi-Pressure Control System acts as a vacuum breaker. Instead of introducing air at atmospheric pressure, the controller injects air at an elevated pressure into the heat exchanger. The user presets the level of elevated air pressure at the time of installation. Rather than a specific pressure, the controller maintains a specific differential pressure across the steam trap. Even if a steam trap fails or other causes change the condensate return pressure, the controller will sense this difference and maintain the preset differential.

How Much Air Will Be Used?

The Posi-Pressure Control System uses very little air. The amount depends upon the size of the steam trap selected. Air usage can vary from as little as 10 SCFH to 90 SCFH or more on large systems. To put this in perspective, a 27 SCFH parcel of air amounts to a 3-foot cube in one hour! Once the initial air is introduced, only the leakage through the large vent bucket in the steam trap must be added. This air volume is so low that it is practically undetectable in a deaerator.

Are There Any Other Advantages?

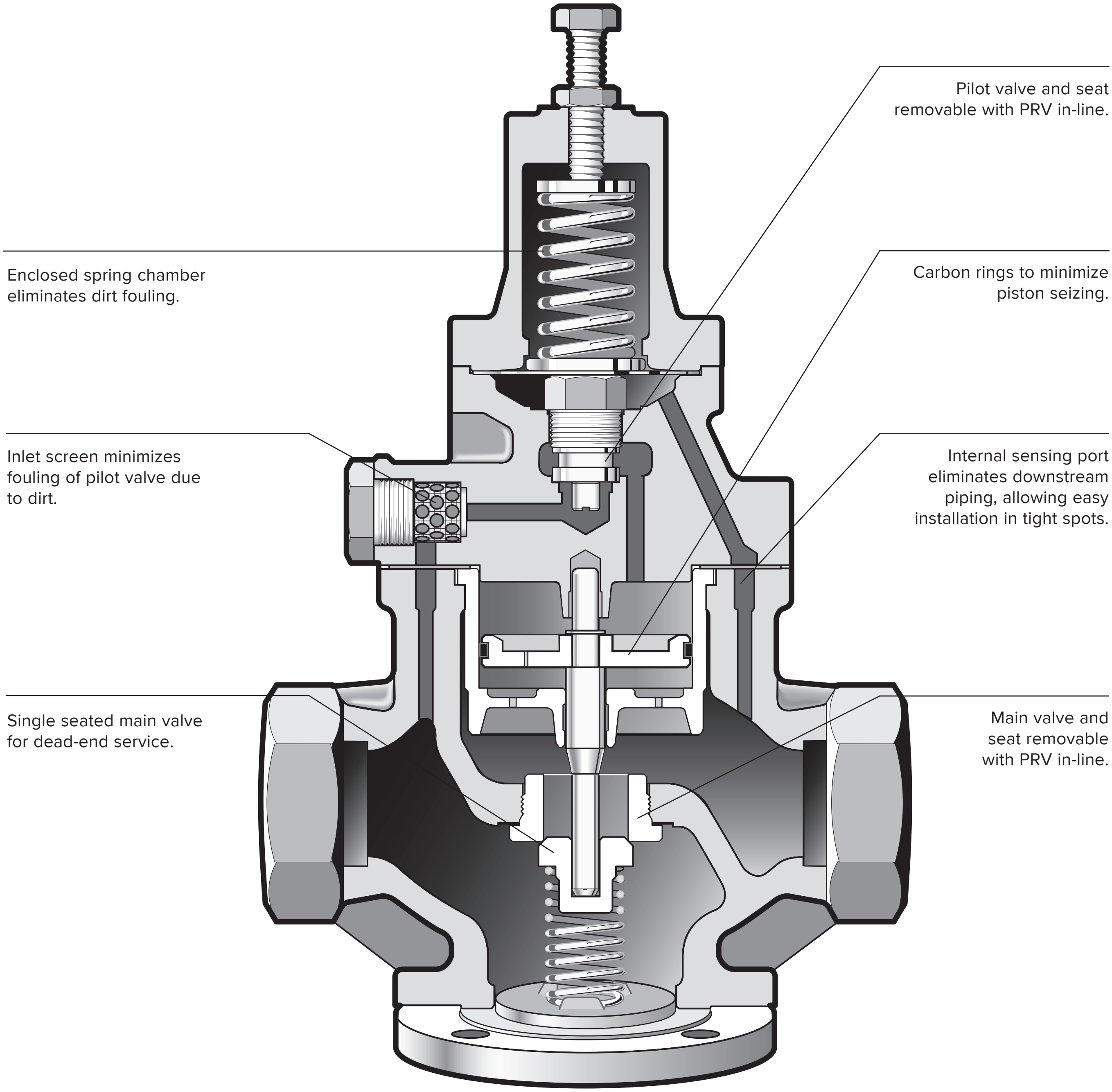
Yes! It is generally recommended that float and thermostatic traps be used on modulated steam systems because they drain better when there is no motive pressure other than the static head of condensate. With a positive pressure always being maintained by the Posi-Pressure Control System, an inverted bucket steam trap with its inherent longer life expectancy can, and must, be used. Since air is injected at a positive pressure, carbon dioxide (the real cause of corrosion) is diluted and swept clear of the heat exchanger.

For a fully detailed certified drawing, refer to CDY #1041.

Internally Piloted

For Steam, Air and Non-Corrosive Gas Service

This type of PRV incorporates two valves—a pilot and main valve—in one unit. The pilot valve has a design similar to the direct acting valve. The discharge pressure from the pilot valve is transmitted on top of a piston which opens the main valve. This design makes use of inlet pressure in opening a larger main valve than could otherwise be opened directly. As a result, there is a greater capacity per line size and greater accuracy (±5%) than with the direct acting valve.



GP-1000

For Steam, Air and Non-Corrosive Gas

The GP-1000 Series valves are pilot-controlled for accurate regulation of pressure under wide-ranging flow. Internal pilot design eliminates external components and piping.

Internally piloted GP Series valves are capable of larger capacity and greater accuracy than direct acting valves.

Completely supported by piping, lightweight GP Series valves install easily with NPT or flanged connections. A stainless steel diaphragm, hardened stainless steel working parts and integral removable strainer team up to provide high performance over a long, trouble-free service life. Valves are equipped with a single seated main valve, piston valve rings for longer life and an external adjusting screw with locking nut. All working parts are renewable in-line. ANSI Class IV Shutoff.

For a fully detailed certified drawing, refer to list below.

GP-1000 NPT	**CD #2104**
GP-1000 Flanged	**CD #2105**
GP-1000 SS/AS	**CDY #1081**

GP-1000

Model Number	Pressure		Spring Color	Application	Maximum Temp. °F (°C)	Minimum Diff. psig (barg)	Body	Main Valve/ Valve Seat	Pilot Valve/ Seat	Piston/Cylinder	Diaphragm
	Inlet psig (barg)	Reduced psig (barg)									
NPT GP-1000	15 - 250 (1 - 17)	7 - 125 (.48 - 8.6)	Black	Steam	450 (232)	7 (.48)	Ductile Iron ASTM A536	Stainless Steel AISI 420	Stainless Steel AISI 403/420	Stainless Steel AISI 420/Stainless Steel AISI 403	Stainless Steel AISI 301
		125 - 200 (8.6 - 13.8)	Green								
150 ANSI GP-1000	15 - 150 (1 - 10)	7 - 125 (.48 - 8.6)	Black							Bronze/Bronze ASTM C36000	
NPT GP-1000A	15 - 150 (1 - 10)	7 - 125 (.48 - 8.6)		Air & Gas	175 (80)			Stainless Steel AISI 420/ Brass w/NBR			
150 ANSI GP-1000A	15 - 150 (1 - 10)	7 - 125 (.48 - 8.6)									
GP-1000SS* GP-1000AS*	15 - 150 (1 - 10)	7 - 125 (.48 - 8.6)		Steam	450 (232)		Stainless Steel AISI 304	Stainless Steel AISI 420	Stainless Steel AISI 403/420	Stainless Steel AISI 420/Stainless Steel AISI 403	

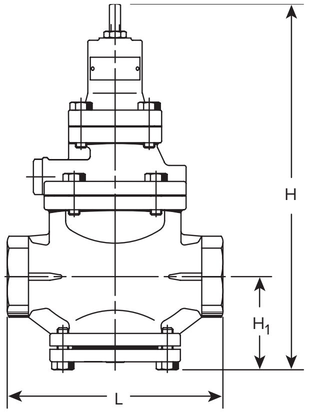
NOTES: Sizes 2" (50 mm) and below are NPT connections. Sizes 2" (50 mm) and larger are flanged connections.
Turndown ratio for GP-1000 20:1.
*GP-1000SS/GP-1000AS are available in 1/2" - 2" only and are flanged with NPT companion flanges.

GP-1000, GP-1000A, GP-1000SS, GP-1000AS Dimensions and Weights

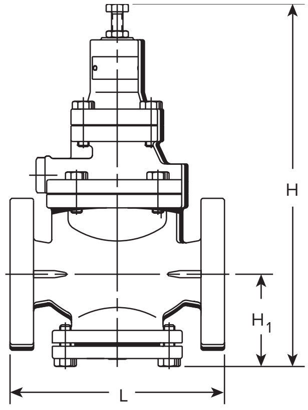
Symbol	Connection Size																	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	**15**	**3/4**	**20**	**1**	**25**	**1-1/4**	**32**	**1-1/2**	**40**	**2***	**50**	**2-1/2**	**65**	**3**	**80**	**4**	**100**
L	5-7/8	150	6-1/8	155	6-5/16	160	7-1/2	190	7-1/2	190	8-11/16	220	9-5/8	245	11-3/8	290	13	330
H	11-1/4	285	11-1/4	285	11-7/8	300	12-3/4	323	12-3/4	323	13-5/8	347	14	357	15-7/8	404	17-3/4	450
H_1	2-1/2	64	2-1/2	64	2-5/8	67	3-1/4	82	3-1/4	82	3-11/16	93	4	100	4-13/16	122	5-9/16	144
Wt, lb (kg)	15-1/2 (7)		15-1/2 (7)		19 (8.5)		25-1/2 (12)		27-1/2 (12.5)		40 (18)		66 (30)		77 (35)		116 (53)	
C_V	1		2.3		4		6.5		9		16		25		36		64	

NOTES: GP-1000 is 1/2"-2" (20-50 mm) NPT, 2"- 4" (50-100 mm) ANSI 150 lb flanged.
* "L" Dimension for 2" 150# flange is 8-11/16" (220 mm).

GP-1000



GP-1000 NPT 1/2" - 2"



GP-1000 150 FL 2" - 4"

Capacities for Steam, Air and Non-Corrosive Gas

GP-1000 Capacities—Steam

lb/hr										
Inlet	Outlet	Connection Size								
		in								
psig		1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
C_V Factor		1	2.3	4	6.5	9	16	25	36	64
15	8	40	93	161	261	362	644	1 005	1 448	2 574
	7	43	98	170	277	383	681	1 264	1 533	2 725
20	13	44	101	176	285	395	702	1 097	1 580	2 809
	7	60	130	227	369	511	909	1 421	2 047	3 639
30	23	50	116	202	328	454	807	1 261	1 816	3 228
	7	76	176	306	497	688	1 223	1 911	2 752	4 892
40	33	56	129	225	365	506	900	1 406	2 024	3 598
	25	79	182	316	514	711	1 264	1 976	2 845	5 057
	5 - 12	94	215	374	608	842	1 497	2 338	3 367	5 986
50	42	65	151	262	425	589	1 047	1 636	2 356	4 188
	30	98	226	393	638	884	1 572	2 456	3 536	6 287
	7 - 17	111	254	443	719	996	1 770	2 766	3 983	7 081
75	63	94	216	376	612	847	1 506	2 353	3 388	6 024
	45	141	323	562	914	1 265	2 249	3 515	5 061	8 998
	7 - 30	153	353	614	997	1 380	2 454	3 835	5 522	9 817
100	85	119	274	476	774	1 072	1 905	2 977	4 287	7 622
	70	162	374	650	1 056	1 462	2 599	4 061	5 847	10 395
	7 - 42	196	451	785	1 275	1 765	3 138	4 903	7 061	12 553
125	106	148	340	591	960	1 329	2 363	3 693	5 318	9 454
	100	167	385	670	1 089	1 507	2 680	4 187	6 029	10 718
	75	225	517	900	1 462	2 024	3 598	5 623	8 097	14 394
	7 - 55	239	549	956	1 553	2 150	3 822	5 972	8 600	15 289
150	125	183	421	733	1 191	1 649	2 931	4 580	6 595	11 724
	100	248	571	993	1 613	2 234	3 971	6 205	8 936	15 885
	80	283	651	1 132	1 839	2 547	4 528	7 074	10 187	18 111
	8 - 67	282	648	1 127	1 831	2 535	4 506	7 041	10 139	18 025
175	148	205	471	819	1 331	1 844	3 277	—	—	—
	125	270	620	1 078	1 752	2 426	4 312	—	—	—
	100	317	730	1 269	2 062	2 856	5 077	—	—	—
	9 - 80	324	746	1 298	2 109	2 919	5 190	—	—	—
200	170	230	529	919	1 494	2 069	3 678	—	—	—
	150	289	665	1 157	1 880	2 603	4 628	—	—	—
	125	342	787	1 369	2 225	3 081	5 478	—	—	—
	10 - 92	367	844	1 469	2 386	3 304	5 874	—	—	—
225	191	258	594	1 034	1 680	2 326	4 135	—	—	—
	175	308	708	1 231	2 000	2 769	4 923	—	—	—
	150	366	841	1 463	2 377	3 292	5 852	—	—	—
	12 - 105	410	943	1 640	2 664	3 689	6 558	—	—	—
250	200	325	748	1 301	2 113	2 926	5 202	—	—	—
	175	388	892	1 551	2 520	3 489	6 203	—	—	—
	150	435	1 001	1 741	2 829	3 916	6 963	—	—	—
	13 - 117	453	1 041	1 811	2 942	4 074	7 242	—	—	—

NOTE: For air capacities scfm, multiply steam capacities lb/hr by 0.36.

GP-1000

Capacities for Steam, Air and Non-Corrosive Gas

GP-1000 Capacities—Steam

kg/hr

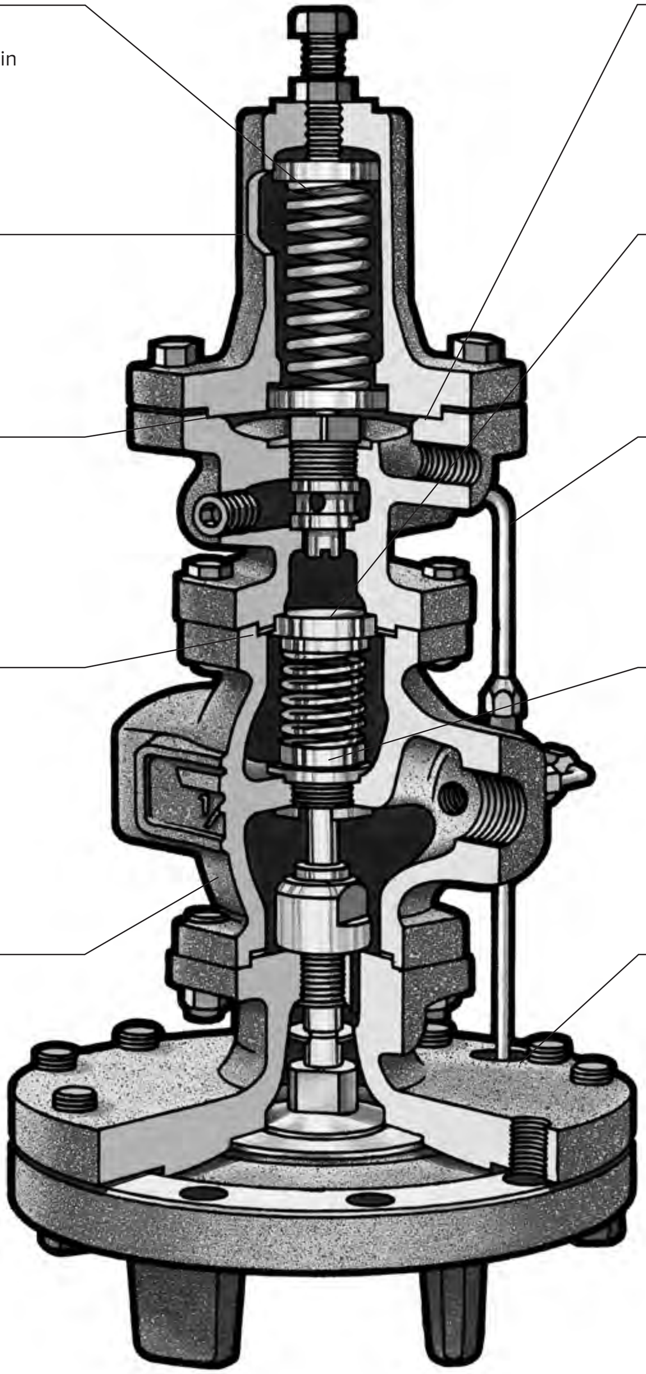
Inlet	Outlet	Connection Size								
		mm								
barg		15	20	25	32	40	50	65	80	100
C_V Factor		1	2.3	4	6.5	9	16	25	36	64
1.03	0.55	18	42	73	119	164	292	456	657	1 168
	0.48	20	44	77	126	174	309	483	695	1 236
1.38	0.90	20	46	80	129	179	319	498	717	1 274
	0.48	25	59	103	167	232	412	644	928	1 650
2.07	1.59	23	53	92	149	206	366	572	824	1 464
	.48	35	80	139	225	312	555	867	1 248	2 219
2.76	2.28	26	59	102	166	230	408	638	918	1 632
	1.72	36	82	143	233	323	574	896	1 290	2 294
	.48 - .83	42	98	170	276	382	679	1 061	1 527	2 715
3.45	2.90	30	68	119	193	267	475	742	1 069	1 900
	2.07	45	102	178	290	401	713	1 114	1 604	2 852
	.48 - 1.17	50	115	201	326	452	803	1 255	1 807	3 212
5.17	4.34	43	98	171	278	384	683	1 067	1 537	2 732
	3.10	64	147	255	415	574	1 020	1 594	2 296	4 081
	.48 - 2.1	70	160	278	452	626	1 113	1 739	2 505	4 453
6.89	5.86	54	124	216	351	486	864	1 350	1 945	3 457
	4.83	74	169	295	479	663	1 179	1 842	2 652	4 715
	.48 - 2.9	89	205	356	578	801	1 423	2 224	3 203	5 694
8.62	7.31	67	154	268	436	603	1 072	1 675	2 412	4 288
	6.89	76	175	304	494	684	1 215	1 899	2 735	4 862
	5.17	102	235	408	663	918	1 632	2 550	3 673	6 529
	.48 - 3.7	108	249	433	704	975	1 734	2 709	3 901	6 935
10.00	8.62	83	191	332	540	748	1 330	2 077	2 991	5 318
	6.89	113	259	450	732	1 013	1 801	2 815	4 053	7 206
	5.52	128	295	513	834	1 155	2 054	3 209	4 621	8 215
	.55 - 4.6	128	294	511	830	1 150	2 044	3 194	4 599	8 176
12.07	10.20	93	214	372	604	836	1 487	—	—	—
	8.62	122	281	489	795	1 100	1 956	—	—	—
	6.89	144	331	576	936	1 295	2 303	—	—	—
	.62 - 5.5	147	338	589	956	1 324	2 354	—	—	—
13.79	11.72	104	240	417	678	938	1 668	—	—	—
	10.34	131	302	525	853	1 181	2 099	—	—	—
	8.62	155	357	621	1 009	1 398	2 485	—	—	—
	.68 - 6.3	167	383	666	1 082	1 499	2 665	—	—	—
15.51	13.17	117	270	469	762	1 055	1 876	—	—	—
	12.07	140	321	558	907	1 256	2 233	—	—	—
	10.34	166	382	664	1 078	1 493	2 654	—	—	—
	.82 - 7.24	186	428	744	1 209	1 673	2 975	—	—	—
17.24	13.79	147	339	590	959	1 327	2 360	—	—	—
	12.07	176	404	703	1 143	1 583	2 814	—	—	—
	10.34	197	454	790	1 283	1 776	3 158	—	—	—
	.89 - 8.06	205	472	821	1 335	1 848	3 285	—	—	—

For air capacities m^3/hr, multiply steam capacities kg/hr by 1.35.

Notes

For Steam Service

This type is similar to the internally piloted piston-operated valve in that a pilot and main valve are utilized. However, double diaphragms replace the piston. This increased diaphragm area can open a larger main valve, allowing a greater capacity per line size than the internally piloted piston-operated valve. In addition, the diaphragms are more sensitive to pressure changes, which results in accuracy of ±1%. This greater accuracy is due to the positioning of the sensing line downstream, where there is less turbulence. This valve also offers the flexibility to use different types of pilot valves (i.e., pressure, temperature, air loaded, solenoid or combination).



Interchangeable springs—regardless of valve size—means more flexibility in applications.

Enclosed spring chamber eliminates dirt fouling.

Dual stainless steel diaphragms provide corrosion resistance.

All cast mating parts are male and female to reduce the chance of leaks at gasket surfaces and assure proper alignment.

Ductile iron body provides a wider range of applications than cast iron and offers a less costly option to cast steel.

Available in both integral and remote mounted pilot.

Integral strainer protects the pilot valve from failure due to dirt.

Easily removable copper tubing permits troubleshooting while valve is in-line.

Easy access to main valve for quick inspection or maintenance by removing main valve spring and screen and lifting valve from stem. No special tools needed.

Design eliminates copper tubing from passing around the bottom diaphragm housing, minimizing chance of damage during shipping or installation.

For Steam Service

The GP-2000 is a high performance, externally piloted reducing valve for large capacity requirements. Typical use is on intermittent service, including applications such as heat exchangers, steam coils, rotating dryers, process equipment and heating systems. With a 20:1 rangeability and high C_V, the GP-2000 is reliable and accurate (+/-1% of pressure set point from 5% to 100% of flow) over a long, trouble-free service life. Hardened stainless steel working parts are renewable in-line. Single seated for dead-end service. Available with both NPT (1/2" - 2") and flanged connections in 1/2" - 6" sizes. ANSI Class IV Shutoff.

For a fully detailed certified drawing, refer to:

GP-2000	**CDY #1008**
GP-2000 Flanged	**CDY #1007**

GP-2000 Specifications

Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Spring Color	Maximum Temperature °F (°C)	Minimum Differential psig (barg)	Materials				
						Body	Main Valve/Seat	Pilot Valve/Seat	Diaphragm	Color
Steam	NPT 15 - 300 (1 - 20)	*1.5 - 3 (.10 - .21)	Yellow	450 (232)	7 (.48)	Ductile Iron ASTM A536	Stainless Steel AISI 420		Stainless Steel AISI 301	Dark Gray
	15 - 185 (1 - 13) 150 lb. Flanged	3 - 21 (.21 - 1.4)	Yellow							
	15 - 300 (1 - 20) 300 lb. Flanged	15 - 200 (1 - 13.8)	Green							

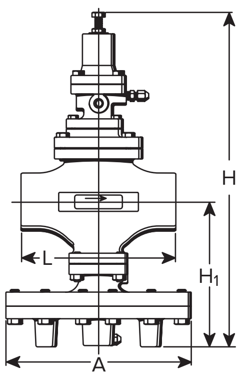
*NOTE: When using this spring range, remove one (1) pilot diaphragm. Capacities are reduced by 1/2 of capacity chart when this spring is being used.

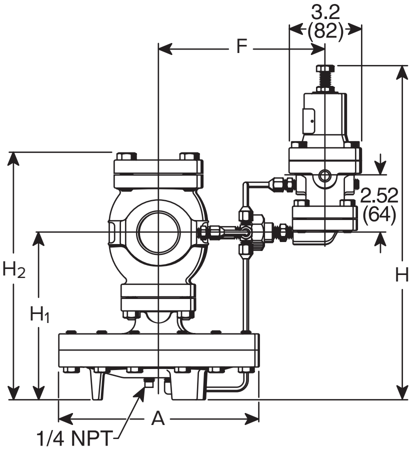
GP-2000 Dimensions and Weights

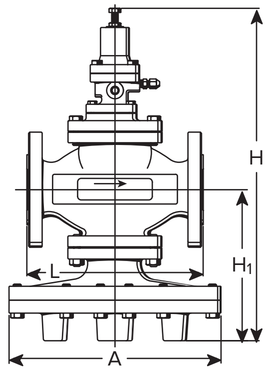
Size		Face-to-Face "L"						A		F		H Integral		H Remote		H_1		H_2		Weight						C_V*
		NPT		150#		300#														NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170	9-5/8	244	34	14	36	15	42	19	5.0
3/4	20	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170	9-5/8	244	34	14	36	15	42	19	7.2
1	25	6-5/16	160	5-3/4	147	–	–	8-15/16	226	7-1/16	179	15-15/16	404	14-7/16	367	6-15/16	175	10	254	44	19	48	20	54	23	10.9
1-1/4	32	7-1/8	180	6-1/2	166	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192	11-1/8	283	51	22	53	22	59	25	14.3
1-1/2	40	7-1/8	180	7-7/16	189	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192	11-1/8	283	51	22	55	23	61	26	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	10-15/16	276	7-11/16	195	19-5/8	498	16	406	8-1/2	216	12-5/8	321	75	33	81	36	84	36	32
2-1/2	65	–	–	10-15/16	278	11-1/2	292	13-13/16	352	8-5/16	211	21-3/4	552	17-5/16	440	9-13/16	251	14-3/4	375	–	–	142	65	150	65	60
3	80	–	–	11-3/4	298	12-7/16	315	13-13/16	352	8-3/4	222	22-5/8	575	17-15/16	456	10-7/16	264	15-3/4	400	–	–	155	69	166	72	78
4	100	–	–	13-1/2	343	14-1/8	359	15-13/16	401	9-7/16	239	25-15/16	658	20-1/8	511	12-5/8	321	19-1/4	489	–	–	247	112	264	119	120
6	150	–	–	18-1/8	460	19	483	19-3/4	502	–	–	31-3/4	806	–	–	16-1/4	414	26-1/2	673	–	–	507	230	553	252	250

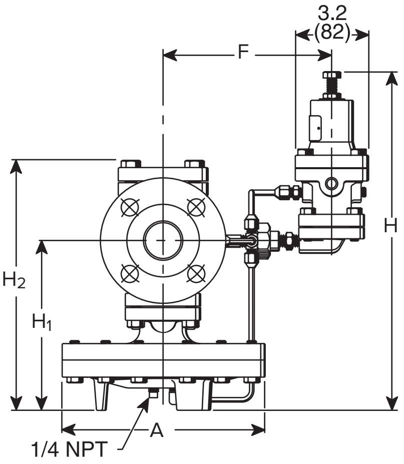
*50% reduced port available for sizes 1/2" - 4". The C_V value should be divided by 2 to get reduced port C_V.

For capacities see page 305.









GP-2000L

For Steam Service

The GP-2000L is a high performance, externally piloted reducing valve for large capacity and low inlet pressure requirements. The GP-2000L is reliable and accurate (+/-1% of pressure set point from 5% to 100% of flow) over a long, trouble-free service life. Hardened stainless steel working parts are renewable in-line. Single seated for dead-end service. Available with both NPT (1/2" - 2") and flanged connections in 1/2" - 4" sizes. ANSI Class IV Shutoff.

GP-2000L Specifications

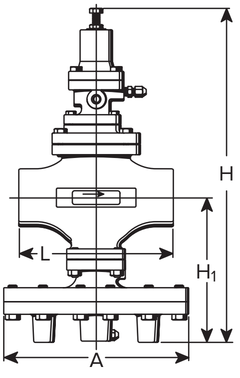
Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Spring Color	Maximum Temperature °F (C)	Minimum Differential psig (barg)	Materials				
						Body	Main Valve/ Seat	Pilot Valve/ Seat	Diaphragm	Color
Steam	5 - 15 (.3 - 1)	2 - 12 (.13 - .8)	Yellow	450 (232)	3 (.21)	Ductile Iron ASTM A536	Stainless Steel AISI 420		Stainless Steel AISI 301	Dark Gray

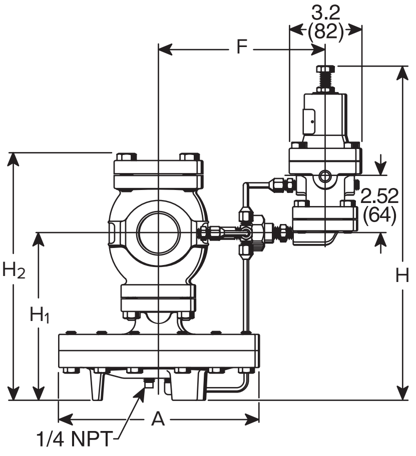
GP-2000L Dimensions and Weights

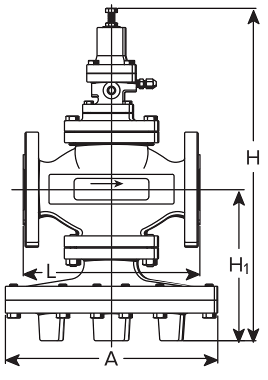
Size		Face-to-Face "L"						A		F		H Integral		H Remote		H_1		H_2		Weight						C_V*
		NPT		150#		300#														NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170	9-5/8	244	34	14	36	15	42	19	5.0
3/4	20	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170	9-5/8	244	34	14	36	15	42	19	7.2
1	25	6-5/16	160	5-3/4	147	–	–	8-15/16	226	7-1/16	179	15-15/16	404	14-7/16	367	6-15/16	175	10	254	44	19	48	20	54	23	10.9
1-1/4	32	7-1/8	180	6-1/2	166	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192	11-1/8	283	51	22	53	22	59	25	14.3
1-1/2	40	7-1/8	180	7-7/16	189	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192	11-1/8	283	51	22	55	23	61	26	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	10-15/16	276	7-11/16	195	19-5/8	498	16	406	8-1/2	216	12-5/8	321	75	33	81	36	84	36	32
2-1/2	65	–	–	10-15/16	278	11-1/2	292	13-13/16	352	8-5/16	211	21-3/4	552	17-5/16	440	9-13/16	251	14-3/4	375	–	–	142	65	150	65	60
3	80	–	–	11-3/4	298	12-7/16	315	13-13/16	352	8-3/4	222	22-5/8	575	17-15/16	456	10-7/16	264	15-3/4	400	–	–	155	69	166	72	78
4	100	–	–	13-1/2	343	14-1/8	359	15-13/16	401	9-7/16	239	25-15/16	658	20-1/8	511	12-5/8	321	19-1/4	489	–	–	247	112	264	119	120

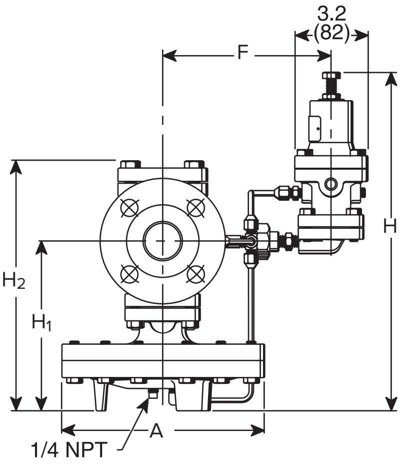
*50% reduced port available for sizes 1/2" - 4". The C_V value should be divided by 2 to get reduced port C_V.

For capacities see page 315.









Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Armstrong® GP-2000CS Carbon Steel Body

For Steam Service

The GP-2000CS is a high performance, externally piloted reducing valve for large capacity requirements. Typical use is on intermittent service, including applications such as heat exchangers, steam coils, rotating dryers, process equipment and heating systems. With a 20:1 rangeability and high C_V, the GP-2000CS is reliable and accurate (+/-1% of pressure set point from 5% to 100% of flow) over a long, trouble-free service life. Stellited stainless steel working parts are renewable in-line. Single seated for dead-end service. Available with both NPT (1/2" - 2") and flanged connections in 2" - 4" sizes.

For a fully detailed certified drawing, refer to:

GP-2000	**CDY #1008**
GP-2000 Flanged	**CDY #1007**

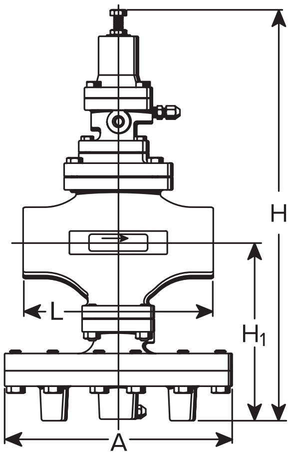
GP-2000GP-2000CS Specifications

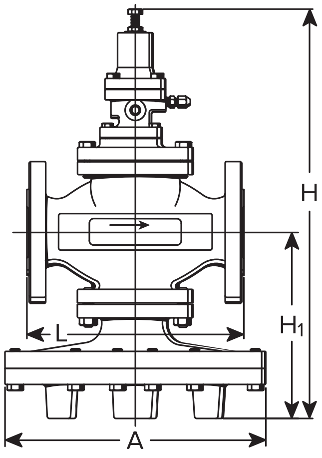
Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Spring Color	Maximum Temperature °F (°C)	Minimum Differential psig (barg)	Materials				
						Body	Main Valve/Seat	Pilot Valve/Seat	Diaphragm	Color
Steam	NPT 15 - 450 (1 - 31)	3 - 21 (.21 - 1.4)	Yellow	600°F (315°C)	7 (.48)	Carbon Steel WCB ASTM216 A216M-08	Stainless Steel 304 Stainless Steel Stellite	420 Stainless Steel	Stainless Steel AISI 301	Silver
	150 lb Flanged 15 - 140 (1 - 9.6)	15 - 200 (1 - 13.6)	Green							
	300 lb Flanged 15 - 450 (1 - 31)	190 - 300 (13.1 - 20.6)	Brown							

GP-2000CS Dimensions and Weights

Size		L						A		F		H Integral		H_1		H_2		Weight						C_V
		NPT		150#		300#												NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	6-3/4	170	9-5/8	244	35	16	–	–	–	–	5.0
3/4	20	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	6-3/4	170	9-5/8	244	35	16	–	–	–	–	7.2
1	25	6-5/16	160	–	–	–	–	8-15/16	226	7-1/16	179	15-15/16	404	6-15/16	175	10	254	49	22	–	–	–	–	10.9
1-1/4	32	7-1/8	180	–	–	–	–	8-15/16	226	7-7/16	188	17-1/8	434	7-5/8	192	11-1/8	283	53	24	–	–	–	–	14.3
1-1/2	40	7-1/8	180	–	–	–	–	8-15/16	226	7-7/16	188	17-1/8	434	7-5/8	192	11-1/8	283	53	24	–	–	–	–	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	10-15/16	276	7-11/16	195	19-5/8	498	8-1/2	216	12-5/8	321	62	37	88	40	92	42	32
2-1/2	65	–	–	10-15/16	278	11-1/2	292	13-13/16	352	8-5/16	211	21-3/4	552	9-13/16	251	14-3/4	375	–	–	159	72	168	76	60
3	80	–	–	11-3/4	298	12-7/16	315	13-13/16	352	8-3/4	222	22-5/8	575	10-7/16	264	15-3/4	400	–	–	174	79	185	84	78
4	100	–	–	13-1/2	343	14-1/8	359	15-13/16	401	9-7/16	239	25-15/16	658	12-5/8	321	19-1/4	489	–	–	276	125	293	133	120

For capacities see page 305.





GP-2000K-1/GP-2000K-3/GP-2000K-6

Air Loaded Valves for Steam

A high performance externally air piloted pressure reducing valve, the GP-2000K-1/GP-2000K-3/GP-2000K-6 is an ideal choice when set point changes are frequent and access to the PRV is difficult. The valve comes totally assembled and requires no field installation except downstream sensing line and air line connection. High Cv, 20:1 turndown ratio and accurate control ±1% of pressure set point from 5% to 100% of flow. A rugged ductile iron body, hardened stainless steel working parts, double stainless steel diaphragms and in-line repairability add up to reliability on the job. Single seated for dead-end service.

For a fully detailed certified drawing, refer to:

GP-2000K	**CDY #1014**
GP-2000K Flanged	**CDY #1015**

GP-2000K-1, GP-2000K-3, GP-2000K-6 Weights

Size		Weight, lb (kg)†						C_V
		NPT		150#		300#		
in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	34	16	36	15	42	19	5.0
3/4	20	34	16	36	15	42	19	7.2
1	25	44	20	48	20	54	23	10.9
1-1/4	32	51	23	53	22	59	25	14.3
1-1/2	40	51	23	55	23	61	26	18.8
2	50	75	34	81	36	84	36	32
2-1/2	65	—	—	142	65	150	65	60
3	80	—	—	155	69	166	72	78
4	100	—	—	247	112	264	119	120
6	150	—	—	507	230	553	252	250

*50% reduced port available for sizes 1/2" - 4". The CV value should be divided by 2 to get reduced port CV.

† For GP-2000K-3 and GP-2000K-6 weights, add 7-1/4 lb. (3.3 kg).

GP-2000K-1, GP-2000K-3, GP-2000K-6 Specifications

Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Max. Temp. °F (°C)	Minimum Differential psig (barg)	Materials				
					Body	Main Valve/ Seat	Pilot Valve/ Seat	Diaphragm	Color
Steam	NPT 15 - 300 (1 - 20)	K-1 7 - 125 (.48 - 8.6) K-3 30 - 200 (2 - 13.8) K-6 45 - 200 (3.1 - 13.8)	450 (232)	7 (.48)	Ductile Iron ASTM A536	Stainless Steel AISI 420		Stainless Steel AISI 301	Dark Gray
	150 lb Flanged 15 - 185 (1 - 13)								
	300 lb Flanged 15 - 300 (1 - 20)								

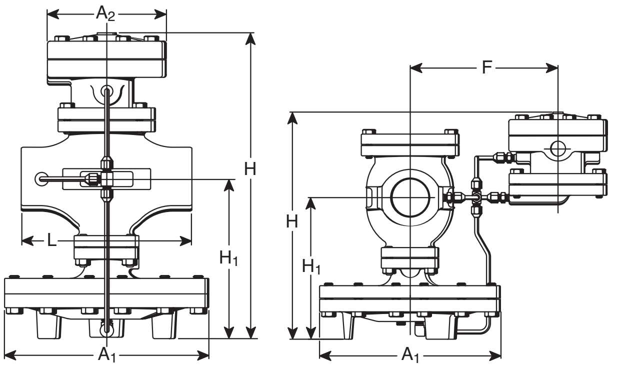
GP-2000K-1, GP-2000K-3, GP-2000K-6 Dimensions

Size		Face-to-Face "L"						A_1		F		H Integral		H Remote		H_1		**A_2	
		NPT		150#		300#													
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
1/2	15	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	175	13-3/16	335	11-13/16	300	6-3/4	170	3-1/4	82
3/4	20	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	175	13-3/16	335	11-13/16	300	6-3/4	170	3-1/4	82
1	25	6-5/16	160	5-3/4	147	–	–	8-15/16	226	7-1/16	179	13-7/16	341	12	305	6-15/16	175	3-1/4	82
1-1/4	32	7-1/8	180	6-1/2	166	–	–	8-15/16	226	7-7/16	188	14-5/8	371	12-11/16	322	7-5/8	192	3-1/4	82
1-1/2	40	7-1/8	180	7-7/16	189	–	–	8-15/16	226	7-7/16	188	14-5/8	371	12-11/16	322	7-5/8	192	3-1/4	82
2	50	9-1/8	230	8-9/16	217	9-1/8	232	10-15/16	276	7-11/16	195	17-1/8	435	13-1/4	337	8-1/2	216	3-1/4	82
2-1/2	65	–	–	10-15/16	278	11-1/2	292	13-13/16	352	8-5/16	211	19-1/4	489	15-3/8	391	9-13/16	251	3-1/4	82
3	80	–	–	11-3/4	298	12-7/16	316	13-13/16	352	8-3/4	222	20-1/8	512	16-3/8	416	10-7/16	264	3-1/4	82
4	100	–	–	13-1/2	343	14-1/8	359	15-13/16	401	9-7/16	239	23-7/16	595	19-7/8	505	12-5/8	321	3-1/4	82
6	150	–	–	18-1/8	460	19	483	19-3/4	502	–	–	29-3/8	746	–	–	27-1/4	692	3-1/4	82

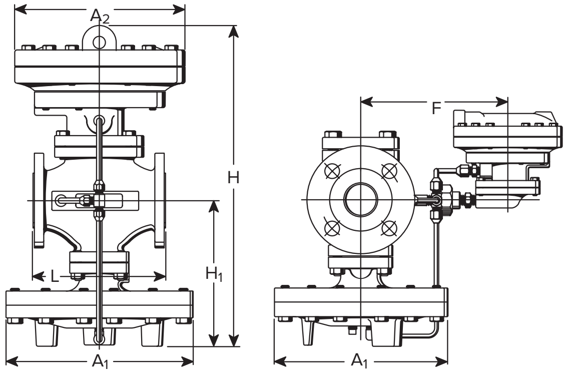
*For GP-2000K-3 and GP-2000K-6 add 1-1/4" (18 mm) to "H" dimension.

**For GP-2000K-3 and GP-2000K-6, A2 dimension = 6-13/16" (172 mm).

For capacities see page 305.
For air loading chart see page 301.



GP-2000K-1



GP-2000K-3 & GP-2000K-6

GD-2000K

Air Loaded Valves for Steam

The GD-2000K is an ideal choice when set point changes are frequent, access to the valve is difficult and steam quality is poor. The GD-2000K comes with either NPT or flanged connections for quick, easy installation. It also comes with a durable ductile iron body and features double stainless steel diaphragms and hardened stainless working parts, renewable in-line. High Cv and 10:1 turndown ratio. Single seated for dead-end service.

For a fully detailed certified drawing, refer to:

GD-2000K NPT	**CDY #1020**
GD-2000K Flanged	**CDY #1021**

GD-2000K Specifications

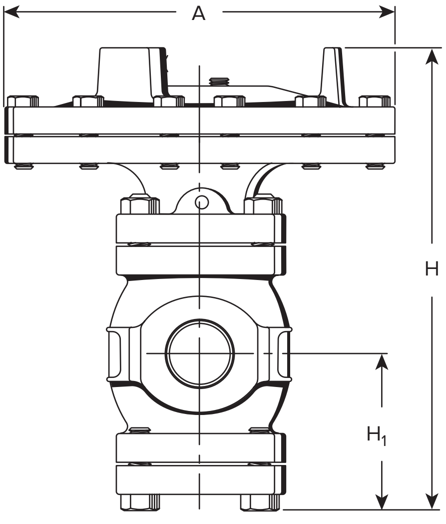
Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Maximum Temperature °F (°C)	Minimum Differential psig (barg)	Materials			
					Body	Main Valve/Seat	Diaphragm	Color
Steam	NPT 15 - 300 (1 - 20)	7 - 200 (.48 - 13.8)	450 (232)	7 (.48)	Ductile Iron ASTM A536	Stainless Steel AISI 420	Stainless Steel AISI 301	Dark Gray
	150 lb Flanged 15 - 185 (1 - 13)							
	300 lb Flanged 15 - 300 (1 - 20)							

GD-2000K Dimensions and Weights

Size		Face-to-Face						H_1		H		A		Weight						C_V*
		NPT		150#		300#								NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	—	—	—	—	2-7/8	74	9-5/8	244	7-15/16	200	27	13	—	—	—	—	5.0
3/4	20	5-15/16	150	—	—	—	—	2-7/8	74	9-5/8	244	7-15/16	200	27	13	—	—	—	—	7.2
1	25	6-5/16	160	—	—	—	—	3-1/16	76	10	251	8-15/16	226	35	17	—	—	—	—	10.9
1-1/4	32	7-1/8	180	—	—	—	—	3-1/2	90	11-1/8	282	8-15/16	226	43	20	—	—	—	—	14.3
1-1/2	40	7-1/8	180	—	—	—	—	3-1/2	90	11-1/8	282	8-15/16	226	43	20	—	—	—	—	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	4-1/2	114	12-5/8	319	10-15/16	276	66	31	72	34	73	34	32.0
2-1/2	65	—	—	10-15/16	278	11-1/2	292	4-3/4	122	14-3/4	373	13-13/16	352	—	—	135	62	136	62	60.0
3	80	—	—	11-3/4	298	12-7/16	315	5-1/2	140	15-3/4	399	13-13/16	352	—	—	146	67	152	69	78.0
4	100	—	—	13-1/2	343	14-1/8	359	6-1/2	167	19-1/4	488	15-13/16	401	—	—	230	105	240	109	120.0

*50% reduced port available for sizes 1/2" - 4". The Cv value should be divided by 2 to get reduced port Cv.

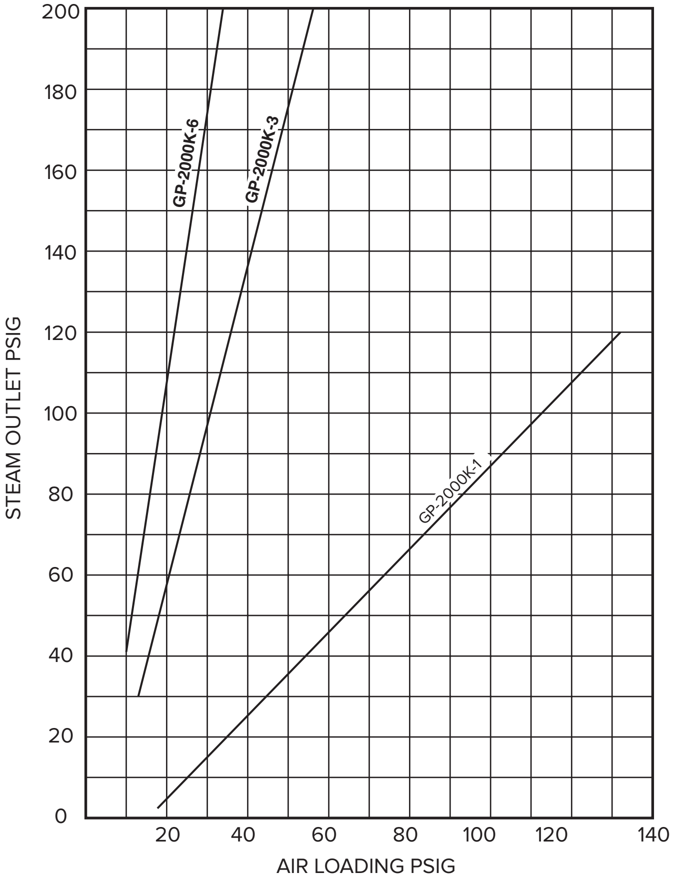
For capacities see page 305.
For air loading chart see page 301.



GD-2000K

Air Loading Charts

GP-2000K-1,3,6



How to Use the Air Loading Charts (GP-2000K-1,3,6)

- Enter the graph at the steam outlet pressure from the value on the vertical axis.
- Move horizontally to the right until the air loading lines are intersected.
- Then read vertically below the point of intersection for the air loading pressure required.

Selection Example (GD-2000K)

Using 1-1/2" GD-2000K

Steam Inlet Pressure P_1	200 psig
Steam Outlet Pressure P_2	75 psig
Differential Pressure ΔP	125 psig

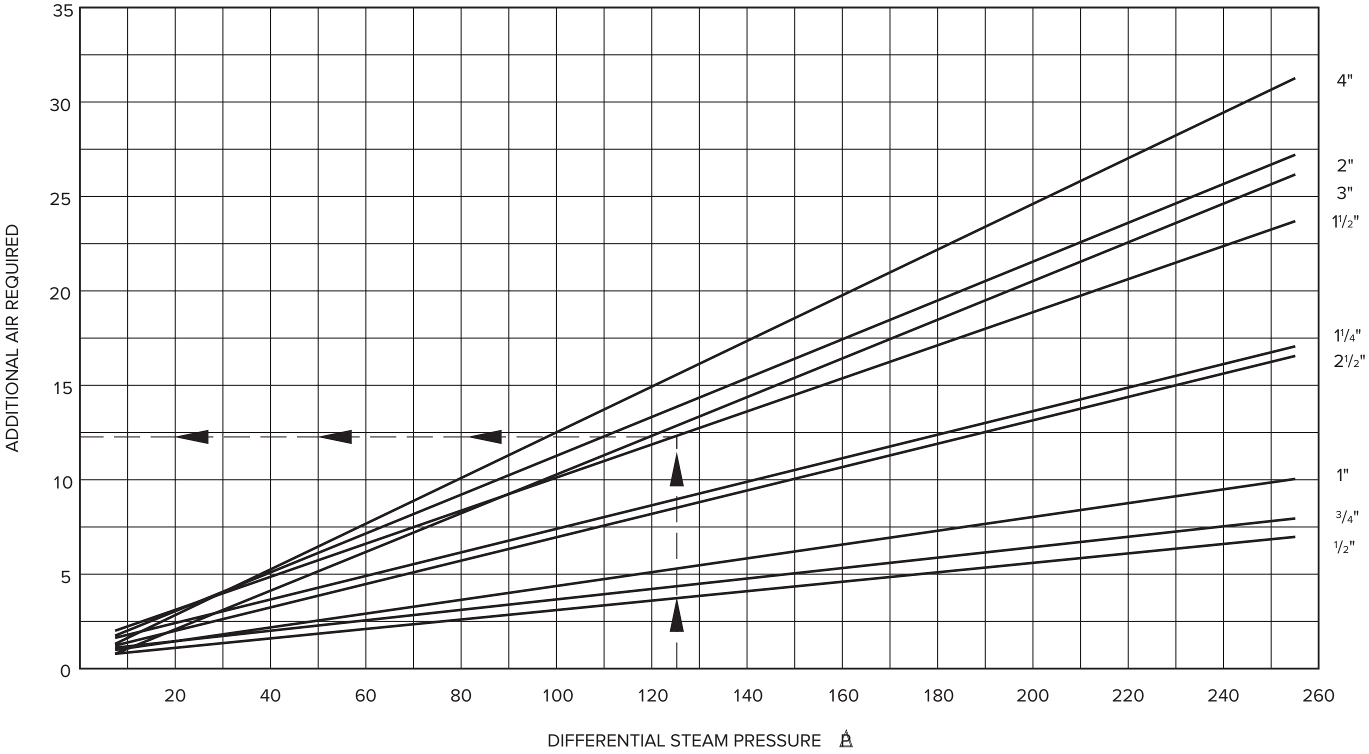
Read horizontally across the bottom of the chart to the 125 psig ΔP line.

Read vertically up to the diagonal line that corresponds to a 1-1/2" GD-2000K.

Read horizontally to the left for additional air signal required.

Outlet Pressure P_2	75 psig
Additional Air ΔP Air	12 psig
Total Air Pressure Required	87 psig

GD-2000K

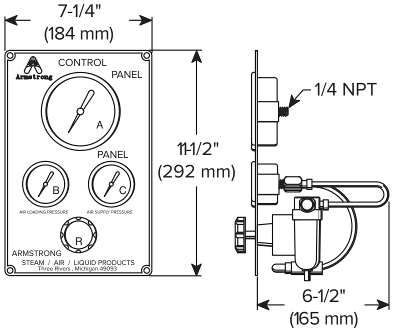


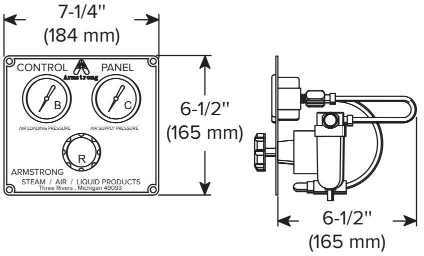
Control Panels & Air Loaders

Armstrong Control Panels and Air Loaders are designed to provide the necessary air loading signal to control any air-operated pressure reducing valve. While designed specifically to control Armstrong pressure reducing valves such as the GP-2000K-1, 3 & 6, GD-2000K and GP-1000, these panels can remotely control other air-loaded valves. Panel is of rigid lightweight anodized aluminum for easy handling and installation. Control panel comes fully assembled with gauges suited to applications. Panel mate regulator and panel mate filter are standard on panels and are also available separately.

"A" Panel

"Y" Panel

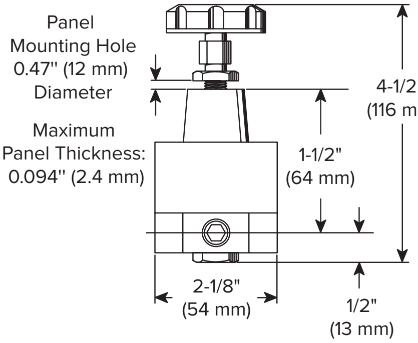




For a fully detailed certified drawing, refer to:
"A" Panel CDY #1028
"Y" Panel CDY #1029

Materials of Construction—Panel Mate—Filter		
Name of Part	Panel Mate	Filter
Body	Zinc	
Bottom plug	Brass	–
Pilot diaphragm	Nitrile	–
Main diaphragm	Nitrile	–
Pilot valve	Stainless steel	–
Main valve	Polycarbonate	–
Main valve seat	Teflon	–
Bowl	–	Zinc
Element	–	Porous polypropylene
Elastomers	Nitrile, neoprene and polyurethane	Nitrile and neoprene

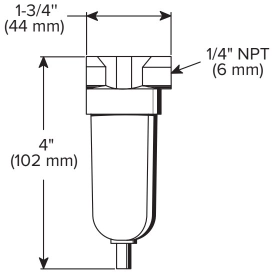
NOTE: Panel material is anodized aluminum.



Panel Mate Regulator

Specifications—Control Panel

Standard Pressure Gauge Ranges		
Gauge	**"A" Panel**	**"Y" Panel**
"A" psig (barg)	0 - 100 (0 - 7)	–
"B" psig (barg)	0 - 100 (0-7)	
"C" psig (barg)	0 - 200 (0-14)	
Optional: Gauge "A" Ranges psig (barg)	0 - 30, 0-200, 0-300 (0-2, 0-14, 0-20)	–
Optional: Gauge "B" and "C" Ranges psig (barg)	0-30, 0-100, 0-200, 0-300 (0-2, 0-7, 0-14, 0-20)	
Max. Inlet Air Pressure psig (barg)	200 (14)	
Max. Outlet Air Pressure psig (barg)	150 (10)	



Panel Mate Filter

Specifications—Panel Mate—Regulator and Filter

	*Regulator		Filter	
	psig	**barg**	**psig**	**barg**
Inlet pressure maximum	200	14	250	17
Outlet pressure maximum	150	10	–	–
Temperature maximum, °F (°C)	160 (71)		175 (79)	

*NOTE: Use a panel mate filter upstream of regulator to prevent fouling.

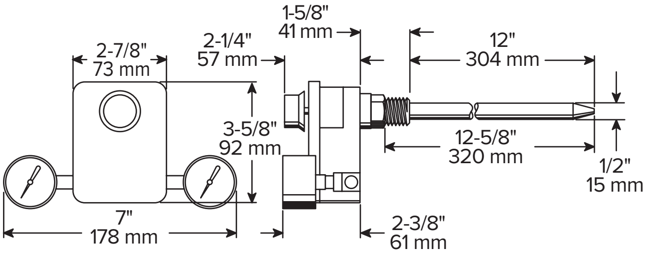
OBK-2000

Pneumatic Temperature Pilot

A compact pneumatic temperature pilot with broad temperature ranges, the OBK-2000 can be remotely located away from the regulator valve, an advantage not available with a conventional capillary system.

Typical applications include instantaneous or storage tank water heaters, air make-up units and manufacturing process operations such as parts washing, die casting and plastic molding.

Capable of reverse-acting (heating) or direct-acting (cooling) operation, the OBK-2000 features a simple design with fewer moving parts for trouble-free operation. Other features include supply and control pressure gauges, a rugged cast brass housing, and precise and rapid response to temperature changes. Brass and stainless steel wells are available.



OBK-2000

OBK-2000 Materials

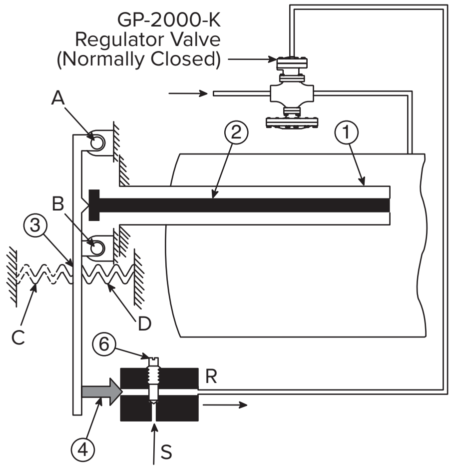
Name of Part	Material
Body	Brass
O-rings	Silicone Rubber/Buna "N"
Valve	Phos. Bronze
Valve Seat	Phos. Bronze

NOTE: Thermal wells available. 304 stainless steel or brass are standard materials. Other materials available upon request.

Reverse-Acting Operation—For Heating

During operation, a temperature change in the medium being controlled creates a change in the length of the sensitivity tube. An increase in temperature lengthens the sensitivity tube (1) and moves the invar rod (2) from the lever (3). The lever pivots at point B and is moved so the exhaust valve (4) is opened by the spring at (D). This lever action decreases the supply air at point (S) in the control line at point (R) and closes the regulator valve. A decrease in temperature shortens the sensitivity tube at point (1) and moves the invar rod against the lever point (3). The lever at this point moves against the spring at point (D) to close the exhaust valve at point (4). This lever action increases the pressure in the control line at point (R) and opens the valve.

The sensitivity adjustment screw at point (6) regulates the rate of flow of the supply air to the controller to a change in temperature. Turning the screw clockwise increases the sensitivity by reducing the flow and increasing the response time. Turning the screw counterclockwise decreases the sensitivity by increasing flow and reducing the response time. Valve closes on air failure, making it fail-safe.



Positions A and C show pivot point A and spring C when controller is direct acting.

OBK-2000 Specifications

Dial adjustment range—°F (°C)	Standard—50 to 350 (10 to 177)
Maximum supply pressure (air) @ room temperature—psig (barg)	25 (2)
Air consumption (maximum)—SCIM (cm/s)	800 (218 - 3)
Maximum operating pressure—psig (barg)	250 (17)
Maximum operating temperature—°F (°C)	400 (204)
Temperature response—°F (°C)	0.5 (0.3)
Mounting—in (mm)	1/2 (15)
Air connections —in (mm)	1/8 (3)
Shipping weight—lb (kg)	4 (1.8)
Sensitivity (adjustable)—psig (barg)	1/4 to 2-1/4 (0.02 to 0.16)
Maximum pressure on wells	
Stainless steel—psig (barg)	1 125 (79)
Brass—psig (barg)	525 (36)

For Steam Back Pressure Regulation

The GP-2000R is a high performance externally piloted throttling back pressure valve for large capacity applications. Typical applications would include those systems utilizing flash steam for low pressure heating or processes. The GP-2000R valves will function to maintain a constant upstream pressure. This valve is not a safety valve and should not be used for that purpose.

For a fully detailed certified drawing, refer to:
GP-2000R Threaded CDY #1018
GP-2000R Flanged CDY #1019

GP-2000R Specifications

Application	Inlet Pressure psig (barg)	Relieving Pressure psig (barg)	Spring Color	Maximum Temperature °F (°C)	Minimum Differential psig (barg)	Materials				
						Body	Main Valve/ Seat	Pilot Valve/ Seat	Diaphragm	Color
Steam	NPT 3 - 200 (.21 - 13.8)	3 - 21 (.21 - 1.4)	Yellow	450 (232)	3 (.21)*	Ductile Iron ASTM A536	Stainless Steel AISI 420		Stainless Steel AISI 301	Dark Gray
	150 lb Flanged 3 - 185 (.21 - 13)	14 - 157 (1.0 - 11.0)	Green							
	300 lb Flanged 3 - 200 (.21 - 13.8)	143 - 200 (10 - 13.8)	Brown							

*If used for a 3-15 psig set point, outlet pressure must be 0 psig.

GP-2000R Dimensions

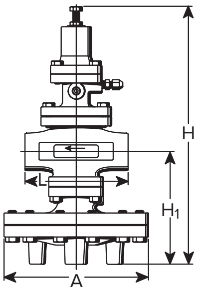
Size		Face-to-Face "L"						A		F		H Integral		H Remote		H_1	
		NPT		150#		300#											
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
1/2	15	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170
3/4	20	5-15/16	150	–	–	–	–	7-15/16	200	6-7/8	176	15-3/4	398	14-1/4	362	6-3/4	170
1	25	6-5/16	160	5-3/4	147	–	–	8-15/16	226	7-1/16	179	15-15/16	404	14-7/16	367	6-15/16	175
1-1/4	32	7-1/8	180	6-1/2	166	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192
1-1/2	40	7-1/8	180	7-7/16	189	–	–	8-15/16	226	7-7/16	188	17-1/8	434	15-1/8	384	7-5/8	192
2	50	9-1/8	230	8-9/16	217	9-1/8	232	10-15/16	276	7-11/16	195	19-5/8	498	16	406	8-1/2	216
2-1/2	65	–	–	10-15/16	278	11-1/2	292	13-13/16	352	8-5/16	211	21-3/4	552	17-5/16	440	9-13/16	251
3	80	–	–	11-3/4	298	12-7/16	316	13-13/16	352	8-3/4	222	22-5/8	575	17-15/16	456	10-7/16	264
4	100	–	–	13-1/2	343	14-1/8	359	15-13/16	401	9-7/16	239	25-15/16	658	20-1/8	511	12-5/8	321
6	150	–	–	18-1/8	460	19	483	19-3/4	502	—	—	31-3/4	806	—	—	26-1/2	673

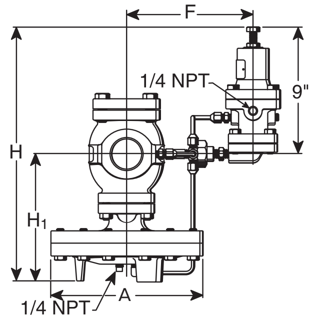
For capacities see page 305.

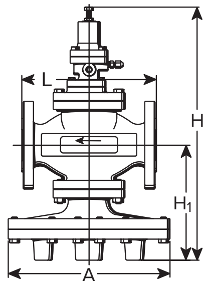
GP-2000R Weights

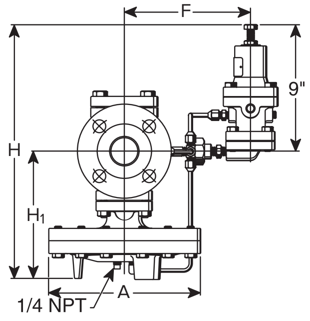
Size		Weight						C_V*
		NPT		150#		300#		
in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	34	14	36	15	42	19	5
3/4	20	34	14	36	15	42	19	7.2
1	25	44	19	48	20	54	23	10.9
1-1/4	32	51	22	53	22	59	25	14.3
1-1/2	40	51	22	55	23	61	26	18.8
2	50	75	33	81	36	84	38	32
2-1/2	65	–	–	142	65	150	68	60
3	80	–	–	155	69	166	75	78
4	100	–	–	247	112	264	120	120
6	150	–	–	509	231	555	253	250

*50% reduced port available for sizes 1/2" - 4".
The C_V value should be divided by 2 to get reduced port C_V.









GP-2000, 2000K-1, 3 & 6, GD-2000K, GP-2000R, GP-2000CS

Capacities for Steam

GP-2000, GP-2000K-1, GP-2000K-3, GP-2000K-6, GD-2000K, GP-2000R, GP-2000CS Capacities—Steam lb/hr

Inlet	Outlet	lb/hr Connection Size in									
psig		1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6
C_V Factor		5	7.2	10.9	14.3	18.8	32	60	78	120	250
15	8	201	290	438	575	756	1 287	2 413	3 137	4 826	10 055
	3	250	361	546	716	942	1 603	3 005	3 907	6 010	12 521
20	13	219	316	478	628	825	1 404	2 633	3 423	5 267	10 972
	3	313	451	683	896	1 178	2 006	3 761	4 889	7 521	15 669
25	18	236	340	515	676	889	1 513	2 837	3 688	5 673	11 819
	3 - 5	339	489	740	971	1 276	2 172	4 073	5 295	8 146	16 972
30	23	252	363	550	721	948	1 614	3 026	3 934	6 052	12 609
	3 - 7	382	550	833	1 093	1 437	2 446	4 586	5 962	9 172	19 109
40	33	281	405	613	804	1 057	1 799	3 373	4 385	6 747	14 056
	25	395	569	861	1 130	1 486	2 529	4 741	6 164	9 483	19 756
	3 - 12	468	673	1 020	1 338	1 758	2 993	5 612	7 296	11 224	23 384
50	42	327	471	713	936	1 230	2 094	3 927	5 105	7 853	16 361
	30	491	707	1 071	1 405	1 847	3 143	5 894	7 662	11 788	24 557
	3 - 17	553	797	1 206	1 582	2 080	3 540	6 638	8 630	13 276	27 659
60	51	373	537	814	1 067	1 403	2 389	4 479	5 823	8 958	18 662
	45	471	679	1 028	1 348	1 773	3 017	5 657	7 355	11 315	23 572
	35	586	843	1 277	1 675	2 202	3 748	7 027	9 135	14 053	29 278
	3 - 22	639	920	1 392	1 827	2 401	4 088	7 664	9 963	15 328	31 934
75	63	471	678	1 026	1 346	1 769	3 012	5 647	7 341	11 295	23 530
	55	593	854	1 292	1 696	2 229	3 794	7 114	9 249	14 229	29 643
	45	703	1 012	1 532	2 010	2 643	4 499	8 435	10 966	16 871	35 148
	4 - 30	767	1 104	1 672	2 193	2 884	4 908	9 203	11 964	18 406	38 347
100	85	595	857	1 298	1 703	2 239	3 811	7 145	9 289	14 291	29 773
	75	751	1 081	1 636	2 147	2 822	4 804	9 007	11 709	18 014	37 529
	60	914	1 316	1 992	2 614	3 436	5 849	10 967	14 257	21 934	45 696
	5 - 42	981	1 412	2 138	2 805	3 687	6 276	11 768	15 299	23 536	49 034
125	106	739	1 064	1 610	2 112	2 777	4 727	8 863	11 522	17 725	36 928
	100	837	1 206	1 825	2 395	3 149	5 359	10 048	13 063	20 097	41 869
	75	1 125	1 619	2 451	3 216	4 228	7 197	13 494	17 543	26 989	56 226
	7 - 55	1 194	1 720	2 604	3 416	4 491	7 644	14 333	18 633	28 666	59 722
150	127	881	1 269	1 922	2 521	3 314	5 641	10 577	13 751	21 155	44 072
	100	1 241	1 787	2 705	3 549	4 666	7 943	14 893	19 360	29 785	62 052
	8 - 67	1 408	2 028	3 070	4 027	5 295	9 012	16 898	21 968	33 796	70 409
175	148	1 024	1 475	2 233	2 929	3 851	6 555	12 291	15 978	24 581	51 211
	125	1 348	1 940	2 938	3 854	5 067	8 624	16 170	21 021	32 341	67 376
	100	1 587	2 285	3 459	4 537	5 965	10 154	19 038	24 750	38 076	79 325
	9 - 80	1 622	2 336	3 536	4 639	6 098	10 380	19 463	25 302	38 926	81 097
200	170	1 149	1 655	2 506	3 287	4 322	7 356	13 792	17 930	27 585	57 468
	150	1 446	2 083	3 153	4 136	5 438	9 256	17 354	22 560	34 708	72 309
	125	1 712	2 465	3 732	4 896	6 437	10 956	20 542	26 705	41 085	85 593
	10 - 92	1 836	2 643	4 002	5 250	6 902	11 748	22 028	28 637	44 056	91 784
225	191	1 292	1 861	2 817	3 695	4 858	8 270	15 505	20 157	31 011	64 606
	175	1 539	2 215	3 354	4 400	5 785	9 847	18 462	24 001	36 925	76 926
	150	1 829	2 633	3 986	5 230	6 876	11 703	21 944	28 527	43 887	91 431
	12 - 105	2 049	2 951	4 468	5 861	7 706	13 116	24 593	31 971	49 186	102 472
250	200	1 626	2 341	3 544	4 649	6 112	10 404	19 508	25 360	39 015	81 282
	175	1 938	2 791	4 226	5 544	7 288	12 406	23 261	30 239	46 521	96 919
	150	2 176	3 133	4 743	6 223	8 181	13 925	26 110	33 943	52 219	108 790
	13 - 117	2 263	3 259	4 934	6 473	8 510	14 484	27 158	35 306	54 316	113 159
275	200	2 042	2 941	4 452	5 841	7 679	13 070	24 507	31 859	49 014	102 112
	175	2 299	3 311	5 012	6 575	8 644	14 714	27 588	35 864	55 176	114 950
	14 - 130	2 477	3 567	5 400	7 084	9 313	15 852	29 723	38 640	59 446	123 847
300	200	2 416	3 479	5 267	6 910	9 084	15 462	28 991	37 688	57 982	120 796
	175	2 637	3 797	5 748	7 540	9 913	16 874	31 638	41 130	63 277	131 826
	15 - 142	2 691	3 875	5 866	7 695	10 117	17 220	32 288	41 975	64 576	134 534
350	248	2 656	3 825	5 791	7 597	9 987	17 000	31 864	41 423	63 728	—
	225	2 886	4 156	6 292	8 254	10 852	18 471	34 629	45 017	69 258	—
	200	3 095	4 457	6 748	8 853	11 639	19 811	37 135	48 276	74 270	—
	18 - 160	3 118	4 490	6 798	8 918	11 724	19 956	39 890	51 856	79 779	—
425	248	3 702	5 331	8 071	10 588	13 921	23 695	44 415	57 740	88 830	—
	225	3 870	5 574	8 438	11 070	14 553	24 771	46 439	60 370	92 877	—
	22 - 195	4 000	5 578	8 719	11 439	15 038	25 595	48 096	62 525	96 192	—

GP-2000CS Only

NOTE: Maximum pressure reduction 20:1, except for GD-2000K 10:1. Minimum pressure reduction is 85% of inlet pressure.
For 50% reduced port capacities, divide the capacity by 2.
50% reduced port available for sizes 1/2” - 4”.

Capacities for Steam continued

GP-2000, GP-2000K-1, GP-2000K-3, GP-2000K-6, GD-2000K, GP-2000R, GP-2000CS Capacities—Steam (kg/hr)

kg/hr											
Inlet	Outlet	Connection Size									
		mm									
barg		15	20	25	32	40	50	65	80	100	150
C_V Factor		5	7.2	10.9	14.3	18.8	32	60	78	120	250
1.03	0.55	91	131	199	261	343	584	1 095	1 423	2 189	4 561
	0.21	114	164	248	325	427	727	1 363	1 772	2 726	5 679
1.38	0.90	100	143	217	285	374	637	1 194	1 553	2 389	4 977
	0.21	142	205	310	407	534	910	1 706	2 218	3 412	7 108
1.72	1.24	107	154	234	307	403	686	1 287	1 673	2 573	5 361
	.21 - .34	154	222	336	440	579	985	1 848	2 402	3 695	7 698
2.07	1.59	114	165	249	327	430	732	1 373	1 784	2 745	5 719
	.21 - .48	173	250	378	496	652	1 109	2 080	2 704	4 161	8 668
2.76	2.28	128	184	278	365	479	816	1 530	1 989	3 060	6 376
	1.72	114	165	249	327	430	732	1 373	1 784	2 745	5 719
	.21 - .83	173	250	378	496	652	1 109	2 080	2 704	4 161	8 668
3.45	2.90	128	184	278	365	479	816	1 530	1 989	3 060	6 376
	2.07	179	258	391	513	674	1 147	2 151	2 796	4 301	8 961
	.21 - 1.17	212	305	462	607	798	1 358	2 546	3 309	5 091	10 607
4.14	3.52	148	214	324	425	558	950	1 781	2 315	3 562	7 421
	3.10	148	214	324	425	558	950	1 781	2 315	3 562	7 421
	2.41	223	321	486	637	838	1 426	2 673	3 475	5 347	11 139
	.21 - 1.5	251	361	547	718	943	1 606	3 011	3 914	6 022	12 546
5.17	4.34	213	307	465	611	803	1 366	2 562	3 330	5 123	10 673
	3.79	269	387	586	769	1 011	1 721	3 227	4 195	6 454	13 446
	3.10	319	459	695	912	1 199	2 041	3 826	4 974	7 653	15 943
	.27 - 2.1	348	501	758	995	1 308	2 226	4 175	5 427	8 349	17 394
6.89	5.86	270	389	589	772	1 016	1 729	3 241	4 213	6 482	13 505
	5.17	340	490	742	974	1 280	2 179	4 086	5 311	8 171	17 023
	4.14	415	597	904	1 186	1 559	2 653	4 975	6 467	9 949	20 728
	.34 - 2.9	445	641	970	1 272	1 673	2 847	5 338	6 939	10 676	22 242
8.62	7.31	335	482	730	958	1 260	2 144	4 020	5 226	8 040	16 750
	6.89	380	547	828	1 086	1 428	2 431	4 558	5 925	9 116	18 991
	5.17	510	735	1 112	1 459	1 918	3 265	6 121	7 957	12 242	25 504
	.48 - 3.7	542	780	1 181	1 550	2 037	3 467	6 502	8 452	13 003	27 090
10.34	8.76	400	576	872	1 143	1 503	2 559	4 798	6 237	9 596	19 991
	6.89	563	811	1 227	1 610	2 117	3 603	6 755	8 782	13 510	28 147
	.55 - 4.6	639	920	1 392	1 827	2 402	4 088	7 665	9 964	15 330	31 937
12.07	10.20	465	669	1 013	1 329	1 747	2 973	5 575	7 247	11 150	23 229
	8.62	611	880	1 332	1 748	2 298	3 912	7 335	9 535	14 670	30 562
	6.89	720	1 036	1 569	2 058	2 706	4 606	8 636	11 226	17 271	35 982
	.62 - 5.5	736	1 059	1 604	2 104	2 766	4 709	8 828	11 477	17 657	36 785
13.79	11.72	521	751	1 137	1 491	1 960	3 337	6 256	8 133	12 512	26 067
	10.34	656	945	1 430	1 876	2 466	4 198	7 872	10 233	15 744	32 799
	8.62	776	1 118	1 693	2 221	2 920	4 970	9 318	12 113	18 636	38 825
	.68 - 6.3	833	1 199	1 815	2 381	3 131	5 329	9 992	12 990	19 984	41 633
15.51	13.17	586	844	1 278	1 676	2 204	3 751	7 033	9 143	14 066	29 305
	12.07	698	1 005	1 521	1 996	2 624	4 466	8 374	10 887	16 749	34 894
	10.34	829	1 194	1 808	2 372	3 119	5 309	9 954	12 940	19 907	41 473
	.82 - 7.24	930	1 339	2 027	2 659	3 495	5 950	11 155	14 502	22 311	46 481
17.24	13.79	737	1 062	1 607	2 109	2 773	4 719	8 849	11 503	17 697	36 869
	12.07	879	1 266	1 917	2 515	3 306	5 627	10 551	13 716	21 102	43 962
	10.34	987	1 421	2 152	2 823	3 711	6 316	11 843	15 396	23 687	49 347
	.89 - 8.06	1 027	1 478	2 238	2 936	3 860	6 570	12 319	16 015	24 638	51 329
18.96	13.79	926	1 334	2 019	2 649	3 483	5 929	11 116	14 451	22 233	46 318
	12.07	1 043	1 502	2 273	2 982	3 921	6 674	12 514	16 268	25 028	52 141
	.96 - 8.96	1 124	1 618	2 449	3 213	4 224	7 191	13 482	17 527	26 965	56 177
20.00	13.79	1 096	1 578	2 389	3 134	4 120	7 013	13 150	17 095	26 300	54 793
	12.07	1 196	1 722	2 607	3 420	4 497	7 654	14 351	18 656	28 702	59 796
	1.03 - 9.79	1 220	1 758	2 661	3 491	4 589	7 811	14 646	19 040	29 292	61 024
24.13	17.10	1 205	1 735	2 627	3 446	4 530	7 711	14 453	18 789	28 907	—
	15.51	1 309	1 885	2 854	3 744	4 922	8 379	14 668	20 419	31 415	—
	13.79	1 404	2 022	3 061	4 016	5 279	8 986	16 844	21 898	33 689	—
	1.24 - 11.02	1 414	2 037	3 083	4 045	5 318	9 052	18 094	23 521	36 187	—
29.30	17.10	1 679	2 418	3 661	4 803	6 314	10 748	20 146	26 190	40 293	—
	15.51	1 756	2 528	3 827	5 021	6 601	11 236	21 064	27 383	42 129	—
	1.52 - 13.4	1 814	2 530	3 955	5 189	6 821	11 610	21 816	28 361	43 632	—

GP-2000CS Only

NOTE: Maximum pressure reduction 20:1, except for GD-2000K 10:1. Minimum pressure reduction is 85% of inlet pressure.
For 50% reduced port capacities, divide the capacity by 2.
50% reduced port available for sizes 15 - 100 mm.

GP-2000 On/Off—For Steam Service

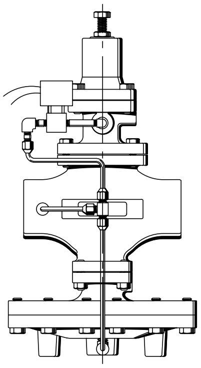
External Pilot Solenoid Operated Valves

The GP-2000 On/Off option allows for remote shutoff of pressure reducing valves. Automatic shutoff during power failures and shutoff based on set points of pressure, temperature or liquid levels of process fluids. This option is available as an accessory item or may be factory installed on any of the GP-2000 Series valves. The GP-2000 On/Off is designed for a maximum pressure of 150 psig and a maximum temperature of 366°F NEMA IV standard, coil: class H 110V standard. Available with normally open or normally closed solenoids.

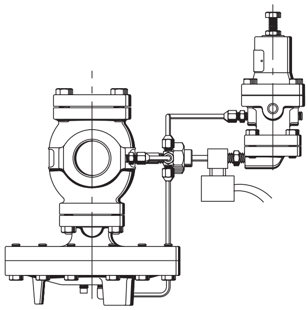
Non-Electric Gradient Monitoring Option

(Between Water and Steam Pressure)

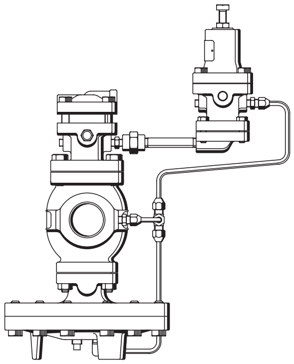
The GP-2000W1P provides a safe and dependable shutdown of steam when the water pressure falls or drops rapidly on a constant pressure, steam-to-water exchanger. Unlike a solenoid option that shuts the steam down when the water pressure drops below a pre-set point, the GP-2000W1P always maintains a constant steam pressure until water pressure drops to within 3 psig above the steam pressure. Lower water pressure will cause the steam pressure to fall, thereby maintaining a minimum 3 psig difference. This will allow the exchanger to produce hot water even when water pressure is low, and ensures that steam pressure will stay functional as long as water pressure is above 15 psig.



GP-2000, GP-2000CS, GP-2000R
with On/Off



GP-2000 Remote Mount
with On/Off



GP-2000W1P

Noise Treatment

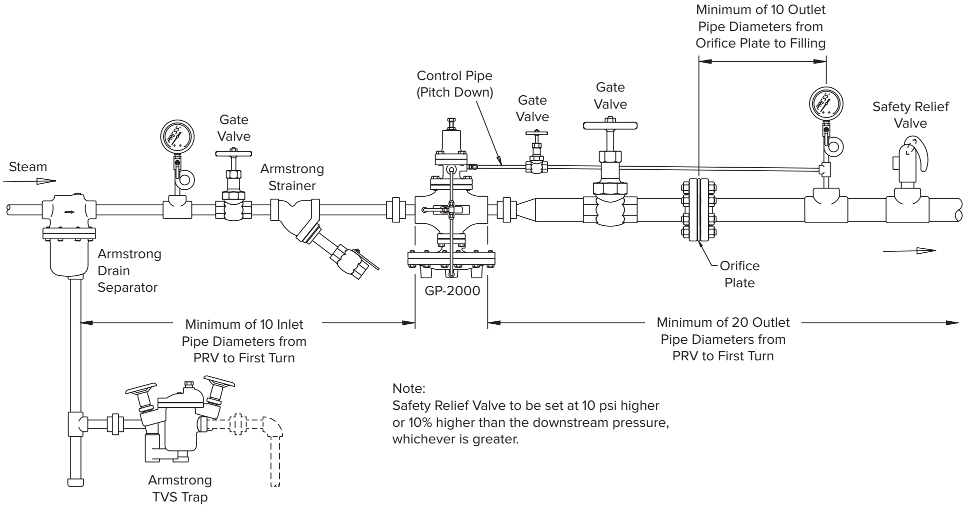
OSHA has established limits on the length of time any employee may be exposed to various sound levels. A sound level of 85 Dba or less is the acceptable standard for noise levels through a PRV in most applications. Certain facilities may require much less. Please consult Armstrong PRV Sizing Software or contact the local Armstrong factory representative for Dba levels for each application.

For Dba levels above 85 you can offer a 2" thick insulation cover for thermal conductivity and noise attenuation, a muffling orifice plate to reduce the noise through the PRV, or a combination of both.

A muffling orifice plate consists of a 1/4" thick stainless steel plate installed between mating ANSI flanges. The orifice plate is installed in the enlarged piping downstream of the pressure regulator. Each orifice plate is engineered for specific applications to maximize noise reduction without reducing regulator capacity.

Orifice plates for GP-2000 only.

Insulation Cover



Note:
Safety Relief Valve to be set at 10 psi higher or 10% higher than the downstream pressure, whichever is greater.

Muffling Orifice Plate

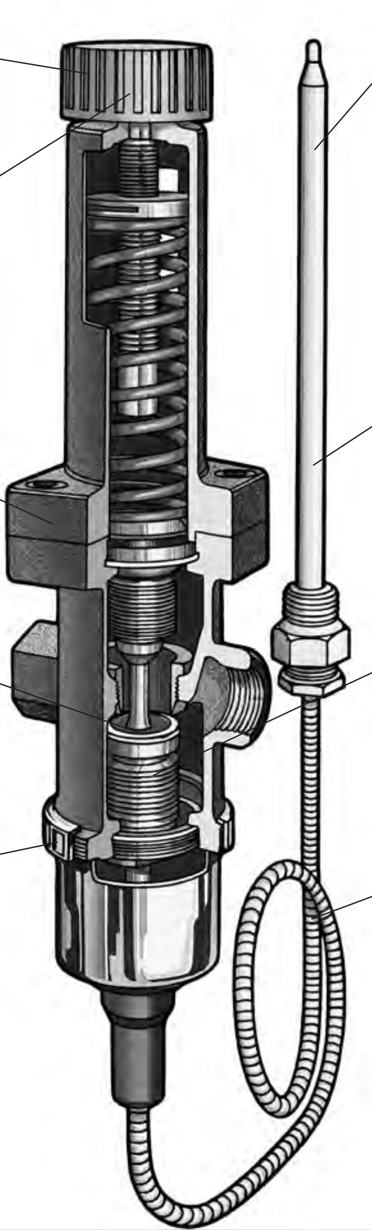
Notes

Temperature Regulators

For Steam, Water and Non-Corrosive Liquid Service

Armstrong self-actuated temperature regulators are compact, high performance units that are simple in design and operation—and suitable for a wide variety of applications.

Features including flexible mounting positions of the sensor, interchangeable capillaries and varied temperature ranges make installation, adjustment and maintenance quick and easy.



Color coded handles (red for heating and blue for cooling) make for easy identification in the field.

Easy no-tools temperature adjustment with a simple turn of the handle.

Cast bronze body permits liquid service to 250 psig and steam service to 150 psig.

Main valve seat materials are stainless steel and Teflon® for high durability and positive sealing.

Quick installation and removal of sensor from main body means easy temperature range changes.

Sensor temperature endurance—+72°F of the maximum value of the temperature regulation range. Gas-charged capillary eliminates chance of capillary charge mixing with process in case of breakage. Sensor can be mounted in any position.

Sensors are standard for both heating and cooling for all sizes (1/2"-1"). Standard capillary units for heating or cooling are accurate to within ±7°F.

A single valve with bellows and balancing mechanism ensures stable regulation. Not affected by pressure fluctuation.

Braided stainless steel capillary protects against crimping.

Temperature Regulator Valve Selection

If the Service Is	If Inlet Pressure is psig (barg)	Type of Control	Temperature Ratings °F (°C)	Temperature Accuracy °F (°C)	If Maximum Capacity Is Less Than	Look for Model	Find on Page
Heating	5 to 150 (.34 to 10)	Self Contained Direct Acting	From 32 to 302 (0 to 150) 5 Ranges	±7 (±3) From set point	1 745 (792)	OB-30	304
	5 to 15 (.34 to 1)	Self Contained Pilot Operated	From 18 to 361 (-7 to 183) 6 Ranges	±2 (±1) From set point	5 643 (2 565)	OB-2000L	308
	10 to 300 (.69 to 20				58 032 (26 323)	OB-2000	306
						OB-2000PT	310
Cooling	5 to 250 (.34 to 17)	Self Contained Reverse Acting	From 32 to 302 (0 to 150) 5 Ranges	±7 (±3) From set point	70 gpm (308 m3/hr)	OB-31	304

OB-30/31

For Steam, Air and Non-Corrosive Liquids

The Armstrong OB-30/31 is a direct acting temperature regulator that requires no external source for operation. Simple and compact, the unit is suitable for a wide variety of heating/cooling applications. Installing, adjusting or maintaining the OB-30/31 is quick and easy because interchangeable capillaries mount in any position and disconnect by simply loosening the union nut. No stem packing so there's no leakage. Single composition seat for tight shutoff. The OB-30/31 comes in 1/2", 3/4" or 1" sizes and is available with a choice of five temperature ranges and three capillary lengths.

For a fully detailed certified drawing, refer to CDY #1036.

OB-30/31 Specifications

Model	Application	Service	Max. Inlet Pressure psig (barg)	Maximum Diff. psig (barg)	Temperature Ranges °F (°C)	Max. Temp. °F (°C)	Temperature Accuracy °F (°C)	Capillary Lengths feet (meters)
OB-30	Heating	Steam, Water	Steam 150 (10)	140 (9.6)	32 - 95 (0 - 35) 77 - 158 (25 - 70) 104 - 212 (40 - 100) 140 - 266 (60 - 130) 158 - 302 (70 - 150)	366 (185)	±7 (±3) From Set Point	*6-1/2 (2) 9-1/2 (3) 16-1/2 (5)
OB-31	Cooling	Water, Non-Corrosive Liquids	Liquid 250 (17)					

*Standard length.

NOTES: Capillary can withstand a maximum of 72°F (40°C) above rated range. If desired set temperature is in temperature range overlap, select lower range.

OB-30/31 Materials

Body Material	Seat Type & Material	Valve Material	Capillary Material	Bulb Material	Thermal Well Material
Bronze ASTM B584	Single Seat 304 Stainless Steel	Teflon	304 Stainless Steel Armor Shielded Capillary	Copper-Nickel Plated	*304 Stainless Steel or Brass

*Other materials available upon request.

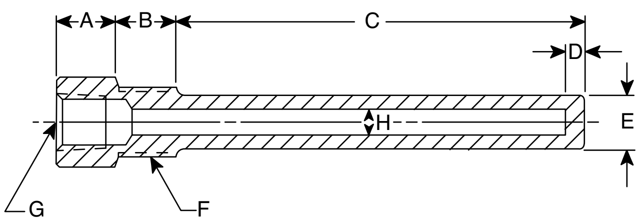
OB-30/31 Dimensions and Weights

Size		L		H_1		H		T		K		R		Weight		C_V
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	
1/2	15	3	80	5-1/8	130	12-1/2	315	3/8	10	8	200	1/2	15	6	2.8	3.7
3/4	20	3-1/8	85	5-1/8	130	12-1/2	315	3/8	10	8	200	1/2	15	6	2.8	4.6
1	25	3-1/2	95	5-1/8	130	12-1/2	315	3/8	10	8	200	1/2	15	6-1/2	3.0	5.8

Thermal Well Dimensions

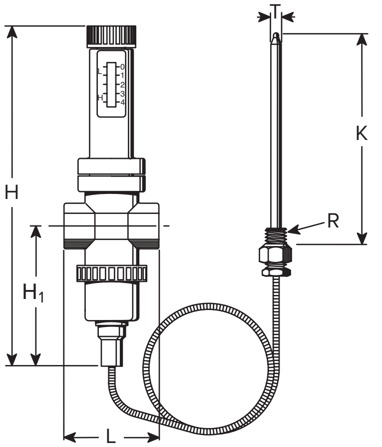
Model	A		B		C		D		E		F		G		H	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
OB-30/31	3/4	20	1	25	7-1/2	204	1/4	7	.765	20	3/4	20	1/2	15	.380	10
OB-2000/2000PT	1	25	3/4	20	7-3/4	197	1/4	7	.89	23	1	25	3/4	20	.630	16
OBK-2000	1	25	3/4	20	12-1/2	318	1/4	7	.765	20	3/4	20	1/2	15	.515	13

OB-30/31, OBK-2000 and OB-2000/2000PT Thermal Well



Standard Material: 304 stainless steel or brass. Other materials available upon request.

NOTE: When inserting sensor into thermal well, for best results, it is recommended that heat transfer medium be applied to sensor before installation.



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

OB-30 Capacities—Steam

lb/hr					kg/hr				
Inlet	Outlet	Connection Size			Inlet	Outlet	Connection Size		
		in					mm		
psig		1/2	3/4	1	barg		15	20	25
C_V Factors		3.7	4.6	5.8	C_V Factors		3.7	4.6	5.8
5	3	67	83	105	.35	.20	30	38	48
	2	81	100	127		.14	37	45	58
	0	101	126	159		0	46	57	72
10	8	75	94	118	.7	.55	34	43	54
	6	104	130	164		.41	47	59	75
	4	125	155	196		.28	57	70	89
	0	154	191	241		0	70	87	110
15	12	101	125	158	1.0	.83	46	57	72
	9	139	172	218		.62	63	78	99
	6	165	205	259		.41	75	93	118
	0-5	200	249	314		0-.35	91	113	143
20	15	139	173	218	1.38	1.0	63	79	99
	10	181	235	296		.7	82	107	135
	5	221	275	347		.35	100	125	158
	0-2	234	290	367		0-.14	106	132	167
25	20	149	186	234	1.72	1.38	68	85	106
	15	204	254	320		1.0	93	115	145
	10	241	300	378		.7	110	136	172
	0-5	268	333	420		0-.35	122	151	191
30	25	159	198	250	2.0	1.72	72	90	114
	15	258	322	406		1.0	117	146	185
	0-7	302	375	473		0-.48	137	170	215
40	30	244	304	384	2.76	2.0	111	138	175
	20	328	408	515		1.38	149	185	234
	0-12	369	459	579		0-.83	168	209	263
50	40	268	333	420	3.45	2.76	122	151	191
	30	383	451	569		2.0	174	205	259
	0-17	437	543	685		0-1.2	199	247	311
60	50	290	360	454	4.0	3.45	132	164	206
	40	395	491	619		2.76	180	223	281
	0-22	504	627	791		0-1.5	229	285	360
70	60	310	385	486	4.83	4.0	141	175	221
	50	328	424	665		3.45	149	193	302
	40	502	624	787		2.76	228	284	358
	0-27	572	711	897		0-1.9	260	323	408
80	70	329	409	616	5.52	4.83	150	186	280
	60	452	562	708		4.0	205	255	322
	50	537	668	842		3.45	244	304	383
	0-32	640	795	1 003		0-2.2	291	361	456
90	80	346	431	543	6.0	5.52	157	196	247
	70	478	694	749		4.83	217	315	340
	60	570	708	893		4.0	259	322	406
	50	639	795	1 002		3.45	290	361	455
	0-37	707	879	1 109		0-2.6	321	400	504
100	90	363	452	570	6.9	6.0	165	205	259
	80	502	625	788		5.52	228	284	358
	70	600	747	942		4.83	273	340	428
	60	676	840	1 060		4.0	307	382	482
	0-42	776	963	1 215		0-2.9	353	438	552
125	110	489	608	767	8.62	7.59	222	276	349
	100	619	770	971		6.9	281	350	441
	80	798	992	1 250		5.52	363	451	568
	70	863	1 073	1 353		4.83	392	488	615
	0-55	944	1 174	1 480		0-3.8	429	534	673
150	130	611	759	958	10.0	8.97	278	345	435
	120	736	915	1 154		8.28	335	416	525
	100	918	1 141	1 439		6.9	417	519	654
	0-63	1 113	1 384	1 745		0-4.3	506	629	793

NOTE: Where it is not possible to calculate pressure drop, 35% - 40% of gauge supply pressure can be used as a reasonable approximation.

Temperature Regulator Selection Example

Parameters:

Fluid .... Steam
Maximum inlet pressure .... 100 psig
Outlet pressure .... 90 psig
Maximum flow rate .... 500 lbs/hr
Temperature required .... 150°F
Distance from regulator to sensing point .... 5'

To Locate Proper Model:

Enter inlet column at .... 100 psig
Move to outlet pressure of .... 90 psig
Locate capacity of 570 lbs/hr under connection size .... 1"
Find capillary temperature range .... 77-158°F
Select capillary length .... 6-1/2'

Application Will Require:

OB-30, 1" with 77-158°F Temp. Range, Capillary Length 6-1/2'

OB-30/31 Capacities—Water

gpm				l/min			
Δ P	Connection Size			Δ P	Connection Size		
	in				mm		
psig	1/2	3/4	1	barg	15	20	25
5	8.1	10.1	12.3	.35	30	38	47
10	11.9	14.3	18.5	.70	45	55	70
15	14.3	17.6	22.0	1.00	55	67	83
20	16.7	20.7	26.4	1.40	63	78	100
25	18.5	22.0	28.2	1.80	70	83	107
30	20.3	25.6	31.7	2.00	77	97	120
50	26.4	33.5	41.4	3.50	100	127	157
75	32.6	39.6	49.3	5.20	123	150	187
100	37.9	46.2	57.2	7.00	143	175	217
125	42.2	52.0	65.6	8.70	160	197	248
150	46.3	57.25	70.5	10.00	175	217	267

Capillary Temperature Ranges

Temperature Ranges °F (°C)
32 - 95 (0 - 35)
77 - 158 (25 - 70)
104 - 212 (40 - 100)
140 - 266 (60 - 130)
158 - 302 (70 - 150)

NOTE: If desired set temperature is in temperature range overlap, select lower range.

For Steam

Armstrong's OB-2000 is a high performance externally piloted temperature regulator for large capacity applications such as heat exchangers, steam coils, steam dryers, plating tanks and parts washers. It is self-actuated and requires no external energy source. Capillary units mount in any position and can be easily disconnected and interchanged, offering easy installation and maximum application flexibility. Available in sizes 1/2" through 6" with six temperature ranges and three capillary lengths.

For a fully detailed certified drawing, refer to CDY #1013.

OB-2000L Specifications

Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Temperature Ranges °F (°C)	Temperature Accuracy °F (°C)	Capillary Lengths feet (meters)
Steam	NPT 10 - 300 (.69 - 20) 150 lb Flanged 10 - 185 (.69 - 13 300 lb Flanged 10 - 300 (.69 - 20)	7 (.48)	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	±2 (±1) From Set Point	*6-1/2 (2) 9-1/2 (3) 16-1/2 (5)

*Standard length.

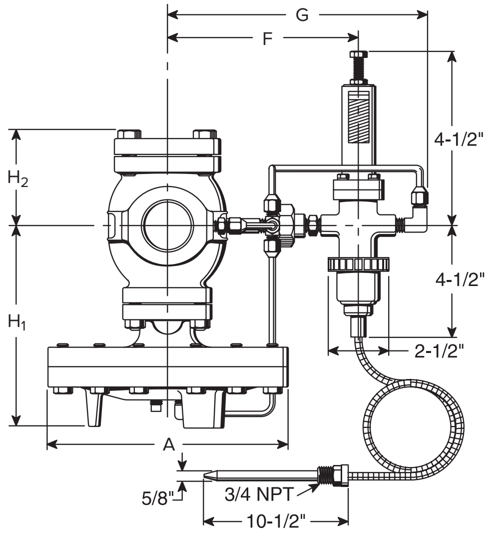
Note: If desired set temperature is in temperature range overlap, select lower range.

OB-2000 Dimensions and Weights

Size		Face-to-Face						H_1		H_2		A		F		G		Weight						C_V
		NPT		150#		300#												NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	–	–	6-3/4	170	2-15/16	74	7-15/16	200	6-5/8	169	8-3/4	222	31	15	33	15	39	18	5.0
3/4	20	5-15/16	150	–	–	–	–	6-3/4	170	2-15/16	74	7-15/16	200	6-5/8	169	8-3/4	222	31	15	33	15	39	18	7.2
1	25	6-15/16	160	5-3/4	147	–	–	6-15/16	175	3-1/16	76	8-15/16	226	6-7/8	174	8-7/8	226	39	19	41	20	47	21	10.9
1-1/4	32	7-1/8	180	6-1/2	166	–	–	7-5/8	192	3-9/16	90	8-5/16	226	7-1/8	182	9-1/4	235	47	22	49	23	54	24	14.3
1-1/2	40	7-1/8	180	7-7/16	189	–	–	7-5/8	192	3-9/16	90	8-15/16	226	7-1/8	182	9-1/4	235	47	22	49	23	54	24	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	8-1/2	216	4-1/16	103	10-15/16	276	7-7/16	189	9-1/2	242	71	33	77	36	78	36	32
2-1/2	65	–	–	10-15/16	278	11-1/2	292	9-13/16	251	4-7/8	122	13-13/16	352	8-1/8	206	10-1/8	259	–	–	138	63	140	64	60
3	80	–	–	11-3/4	298	12-7/16	315	10-7/16	264	5-3/8	135	13-13/16	352	8-9/16	217	10-5/8	270	–	–	149	69	155	71	78
4	100	–	–	13-1/2	343	14-1/8	359	12-5/8	321	6-9/16	167	15-13/16	401	9-1/4	234	11-1/4	287	–	–	234	107	243	110	120

NOTE: For 6" (150 mm) consult factory.

*50% reduced port available for sizes 1/2" - 4". The C_V value should be divided by 2 to get reduced port C_V.



OB-2000

For Steam

OB-2000 Sensor and Accessory Specifications

Capillary Material	Capillary Temperature Ranges °F (°C)	Bulb Material	Bulb Connection	Thermal Well Material	Thermal Well Connection
Copper Capillary Tube With 304 Stainless Steel Armor Shield	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	Nickel Plated Copper Bulb	3/4" (20 mm) NPT	Brass* 304 Stainless Steel*	1" (25 mm) NPT

*Standard. Other material available upon request. See page 310 for dimensions of well.
NOTE: Capillary can withstand a maximum of 36°F (20°C) above rated range.
NOTE: If desired set temperature is in temperature range overlap, select lower range.

OB-2000 Materials

OB-2000	Body Material	Seat Type & Material	Valve Material	Connection	Maximum Temperature °F (°C)
Main Valve	Ductile Iron ASTM A536	Single Seat Stainless Steel AISI 420	Stainless Steel AISI 420	NPT 150 lb Flanged 300 lb Flanged	450 (232)
Temperature Pilot Valve	Bronze ASTM B584			1/4" (6 mm) NPT	

Valve Sizing

Proper valve selection requires the following information
• Steam capacity required for application
• Supply pressure of steam
• Allowable pressure drop across valve*

*Where it is not possible to calculate pressure drop, 35% - 40% of gauge supply pressure can be used as a reasonable approximation.

Temperature Regulator Selection Example

Parameters:

Fluid	Steam
Maximum inlet pressure	100 psig
Outlet pressure	75 psig
Maximum flow rate	1 500 lbs/hr
Temperature required	180°F
Distance from regulator to sensing point	5'

To Locate Proper Model (refer to chart on page 317):

Enter inlet column at	100 psig
Move to outlet pressure of	75 psig
Locate capacity of 1 500 lbs/hr under	1" connection size
Find capillary temp. range	131-201°F
Select capillary length	6-1/2'

Application Will Require:

OB-2000, 1" with 131-201°F Temp. Range, Capillary Length 6-1/2'

OB-2000L

For Steam

Armstrong's OB-2000L is a high performance externally piloted temperature regulator for large capacity and low pressure applications. It is self-actuated and requires no external energy source. Capillary units mount in any position and can be easily disconnected and interchanged, offering easy installation and maximum application flexibility.

Available in sizes 1/2" through 4" with six temperature ranges and three capillary lengths.

For a fully detailed certified drawing, refer to CDY #2232.

OB-2000L Specifications

Application	Inlet Pressure psig (barg)	Reduced Pressure psig (barg)	Temperature Ranges °F (°C)	Temperature Accuracy °F (°C)	Capillary Lengths feet (meters)
Steam	5 - 15 (.3 - 1)	3 (.21)	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	±2 (±1) From Set Point	*6-1/2 (2) 9-1/2 (3) 16-1/2 (5)

*Standard length.

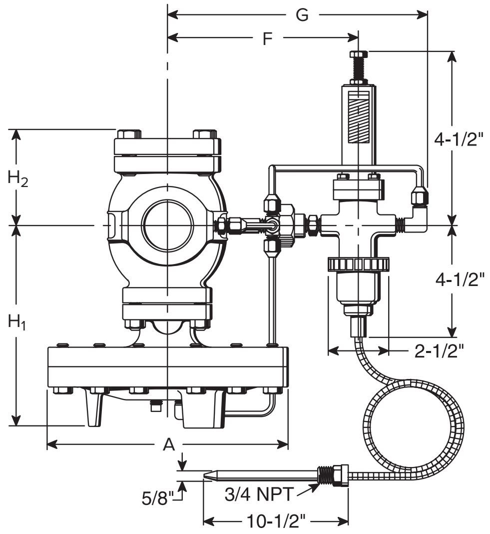
Note: If desired set temperature is in temperature range overlap, select lower range.

OB-2000L Dimensions and Weights

Size		Face-to-Face "L"				H_1		H_2		A		F		G		Weight				C_V
		NPT		150#												NPT		150#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	6-3/4	170	2-15/16	74	7-15/16	200	6-5/8	169	8-3/4	222	31	15	33	15	6.5
3/4	20	5-15/16	150	–	–	6-3/4	170	2-15/16	74	7-15/16	200	6-5/8	169	8-3/4	222	31	15	33	15	9
1	25	6-5/16	160	5-3/4	147	6-15/16	175	3-1/16	76	8-15/16	226	6-7/8	174	8-7/8	226	39	19	41	20	12
1-1/4	32	7-1/8	180	6-1/2	166	7-5/8	192	3-9/16	90	8-15/16	226	7-1/8	182	9-1/4	235	47	22	49	23	19
1-1/2	40	7-1/8	180	7-7/16	189	7-5/8	192	3-9/16	90	8-15/16	226	7-1/8	182	9-1/4	235	47	22	49	23	22
2	50	9-1/8	230	8-9/16	217	8-1/2	216	4-1/16	103	10-15/16	276	7-7/16	189	9-1/2	242	71	33	77	36	38
2-1/2	65	–	–	10-15/16	278	9-13/16	251	4-7/8	122	13-13/16	352	8-1/8	206	10-1/8	259	–	–	138	63	66
3	80	–	–	11-3/4	298	10-7/16	264	5-3/8	135	13-13/16	352	8-9/16	217	10-5/8	270	–	–	149	69	78
4	100	–	–	13-1/2	343	12-5/8	321	6-9/16	167	15-13/16	401	9-1/4	234	11-1/4	287	–	–	234	107	116

*50% reduced port available for sizes 1/2" - 4". The C_V value should be divided by 2 to get reduced port C_V.

For capacities see page 315.



OB-2000L

For Steam

OB-2000L Sensor and Accessory Specifications

Capillary Material	Capillary Temperature Ranges °F (°C)	Bulb Material	Bulb Connection	Thermal Well Material	Thermal Well Connection
Copper Capillary Tube With 304 Stainless Steel Armor Shield	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	Nickel Plated Copper Bulb	3/4" (20 mm) NPT	Brass* 304 Stainless Steel*	1" (25 mm) NPT

*Standard. Other material available upon request. See page 310 for dimensions of well.
NOTE: Capillary can withstand a maximum of 36°F (20°C) above rated range.
NOTE: If desired set temperature is in temperature range overlap, select lower range.

OB-2000L Materials

OB-2000	Body Material	Seat Type & Material	Valve Material	Connection	Maximum Temperature °F (°C)
Main Valve	Ductile Iron ASTM A536	Single Seat Stainless Steel AISI 420	Stainless Steel AISI 420	NPT 150 lb Flanged 300 lb Flanged	450 (232)
Temperature Pilot Valve	Bronze ASTM B584			1/4" (6 mm) NPT	

GP-2000L, OB-2000L

Capacities for Steam Service

GP-2000L and OB-2000L Steam Capacities

lb/hr											kg/hr										
Inlet	Outlet	Connection Size									Inlet	Outlet	Connection Size								
		in											mm								
psig		1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	barg		15	20	25	32	40	50	65	80	100
5	2	218	277	316	495	594	1 100	1 782	1 881	3 135	0.34	0.14	99	126	143	225	269	499	808	853	1 422
10	7	161	223	297	471	545	942	1 635	1 933	2 874	0.69	0.48	73	101	135	214	247	427	742	877	1 304
	3	356	435	475	812	920	1 518	2 574	2 772	4 598		0.21	161	197	215	368	417	689	1 168	1 257	2 086
15	12	178	246	328	519	601	1 038	1 803	2 131	3 169	1.03	0.83	81	112	149	235	273	471	818	966	1 437
	8	261	362	483	764	885	1 528	2 654	3 137	4 665		0.55	119	164	219	347	401	693	1 204	1 423	2 116
	3	416	482	594	970	1 168	1 694	3 069	3 366	5 643		0.21	189	219	269	440	530	768	1 392	1 527	2 560

Note: For reduced port capacity, please divide capacity by 2.

Armstrong® OB-2000PT

For Steam Service

The OB-2000PT is a diaphragm-operated externally piloted pressure/temperature combination regulator. It is used in applications where maximum pressure should be limited and the temperature of the heated medium is controlled using a single seated main valve. Temperature pilot and capillary unit disconnect, making repairs or temperature range changes quick and easy. Available in sizes 1/2" through 6" and with a choice of four spring ranges, six temperature ranges and three capillary lengths.

For a fully detailed certified drawing, refer to CDY #1006.

OB-2000PT Specifications

Application	Inlet Pressure psig (barg)	Minimum Differ. Pressure psig (barg)	Reduced Pressure & Spring Color psig (barg)	Temperature Ranges °F (°C)	Temperature Accuracy °F (°C)	Capillary Lengths feet (meters)
Steam	NPT 15 - 300 (1 - 20)	7 (.48)	1.5 - 3 (.10 - .21) Yellow 3 - 21 (.21 - 1.4) Yellow 15 - 200 (1.0 - 13.8) Green	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	±2 (±1) From Set Point	6-1/2 (2)* 9-1/2 (3) 16-1/2 (5)
	150 lb Flanged 15 - 185 (1 - 13)					
	300 lb Flanged 15 - 300 (1 - 20)					

*Standard length.

OB-2000PT Sensor and Accessory Specifications

Capillary Material	Capillary Temperature Ranges °F (°C)	Bulb Material	Bulb Connection	Thermal Well Material	Thermal Well Connection
Copper Capillary Tube With 304 Stainless Steel Armor Shield	18 - 59 (-8 - 15) 50 - 97 (10 - 36) 86 - 144 (30 - 62) 131 - 201 (55 - 94) 176 - 260 (80 - 127) 239 - 361 (115 - 183)	Nickel Plated Copper Bulb	3/4" (20 mm) NPT	Brass* 304 Stainless Steel*	1" (25 mm) NPT

*Standard. Other material available upon request. See page 310 for dimensions of well.
NOTES: Capillary can withstand a maximum of 36°F (20°C) above rated range. If desired set temperature is in temperature range overlap, select lower range.

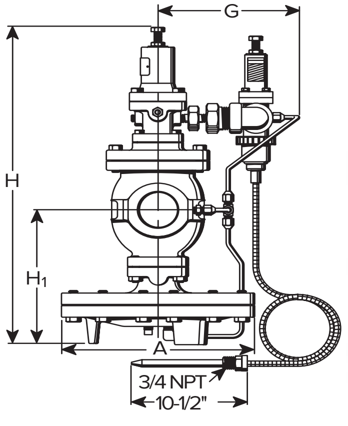
OB-2000PT Dimensions and Weights

Size		Face-to-Face						H		H_1		A		G		Weights						C_V
		NPT		150#		300#										NPT		150#		300#		
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg	
1/2	15	5-15/16	150	–	–	–	–	15-3/4	398	6-3/4	170	7-15/16	200	6-1/2	166	47	22	49	23	55	25	5.0
3/4	20	5-15/16	150	–	–	–	–	15-3/4	398	6-3/4	170	7-15/16	200	6-1/2	166	47	22	49	23	55	25	7.2
1	25	6-15/16	160	5-3/4	147	–	–	15-15/16	404	6-15/16	175	8-15/16	226	7	178	57	26	59	28	64	29	10.9
1-1/4	32	7-1/8	180	6-1/2	166	–	–	17-1/8	434	7-5/8	192	8-15/16	226	7-1/4	185	67	31	69	31	74	34	14.3
1-1/2	40	7-1/8	180	7-7/16	189	–	–	17-1/8	434	7-5/8	192	8-15/16	226	7-1/4	185	67	31	69	31	75	34	18.8
2	50	9-1/8	230	8-9/16	217	9-1/8	232	19-5/8	498	8-1/2	216	10-15/16	276	6-1/2	166	89	41	94	43	100	46	32
2-1/2	65	–	–	10-15/16	278	11-1/2	292	21-3/4	552	9-13/16	251	13-13/16	352	6-1/2	166	–	–	158	72	167	76	60
3	80	–	–	11-3/4	298	12-7/16	315	22-5/8	575	10-7/16	264	13-13/16	352	6-1/2	166	–	–	171	78	183	83	78
4	100	–	–	13-1/2	343	14-1/8	359	25-15/16	658	12-5/8	321	15-13/16	401	6-1/2	166	–	–	263	120	281	128	120

Note: For 6" (150 mm) consult factory.

OB-2000PT Materials

OB-2000PT	Body Material	Valve & Seat Material	Maximum Temperature °F (°C)
Main Valve	Ductile Iron ASTM A536	Stainless Steel AISI 420	450 (232)
Temperature Pilot Valve	Bronze ASTM B584		
Pressure Pilot	Ductile Iron ASTM A536		



OB-2000, OB-2000PT

Capacities for Steam Service

OB-2000, OB-2000PT Capacities—Steam

lb/hr											
Inlet	Outlet	Connection Size in									
psig		1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6
C_V Factor		5	7.2	10.9	14.3	18.8	32	60	78	120	250
10*	0 - 3	211	304	460	604	794	1 352	2 534	3 294	5 068	10 559
15	8	201	290	438	575	756	1 287	2 413	3 137	4 826	10 055
	0 - 3	250	361	546	716	942	1 603	3 005	3 907	6 010	12 521
20	13	219	316	478	628	825	1 404	2 633	3 423	5 267	10 972
	0 - 3	313	451	683	896	1 178	2 006	3 761	4 889	7 521	15 669
25	18	236	340	515	676	889	1 513	2 837	3 688	5 673	11 819
	0 - 5	339	489	740	971	1 276	2 172	4 073	5 295	8 146	16 972
30	23	252	363	550	721	948	1 614	3 026	3 934	6 052	12 609
	0 - 7	382	550	833	1 093	1 437	2 446	4 586	5 962	9 172	19 109
40	33	281	405	613	804	1 057	1 799	3 373	4 385	6 747	14 056
	25	395	569	861	1 130	1 486	2 529	4 741	6 164	9 483	19 756
	0 - 12	468	673	1 020	1 338	1 758	2 993	5 612	7 296	11 224	23 384
50	42	327	471	713	936	1 230	2 094	3 927	5 105	7 853	16 361
	30	491	707	1 071	1 405	1 847	3 143	5 894	7 662	11 788	24 557
	0 - 17	553	797	1 206	1 582	2 080	3 540	6 638	8 630	13 276	27 659
60	51	373	537	814	1 067	1 403	2 389	4 479	5 823	8 958	18 662
	45	471	679	1 028	1 348	1 773	3 017	5 657	7 355	11 315	23 572
	35	586	843	1 277	1 675	2 202	3 748	7 027	9 135	14 053	29 278
	0 - 22	639	920	1 392	1 827	2 401	4 088	7 664	9 963	15 328	31 934
75	63	471	678	1 026	1 346	1 769	3 012	5 647	7 341	11 295	23 530
	55	593	854	1 292	1 696	2 229	3 794	7 114	9 249	14 229	29 643
	45	703	1 012	1 532	2 010	2 643	4 499	8 435	10 966	16 871	35 148
	0 - 30	767	1 104	1 672	2 193	2 884	4 908	9 203	11 964	18 406	38 347
100	85	595	857	1 298	1 703	2 239	3 811	7 145	9 289	14 291	29 773
	75	751	1 081	1 636	2 147	2 822	4 804	9 007	11 709	18 014	37 529
	60	914	1 316	1 992	2 614	3 436	5 849	10 967	14 257	21 934	45 696
	0 - 42	981	1 412	2 138	2 805	3 687	6 276	11 768	15 299	23 536	49 034
125	106	739	1 064	1 610	2 112	2 777	4 727	8 863	11 522	17 725	36 928
	100	837	1 206	1 825	2 395	3 149	5 359	10 048	13 063	20 097	41 869
	75	1 125	1 619	2 451	3 216	4 228	7 197	13 494	17 543	26 989	56 226
	0 - 55	1 194	1 720	2 604	3 416	4 491	7 644	14 333	18 633	28 666	59 722
150	127	881	1 269	1 922	2 521	3 314	5 641	10 577	13 751	21 155	44 072
	100	1 241	1 787	2 705	3 549	4 666	7 943	14 893	19 360	29 785	62 052
	0 - 67	1 408	2 028	3 070	4 027	5 295	9 012	16 898	21 968	33 796	70 409
175	148	1 024	1 475	2 233	2 929	3 851	6 555	12 291	15 978	24 581	51 211
	125	1 348	1 940	2 938	3 854	5 067	8 624	16 170	21 021	32 341	67 376
	100	1 587	2 285	3 459	4 537	5 965	10 154	19 038	24 750	38 076	79 325
	0 - 80	1 622	2 336	3 536	4 639	6 098	10 380	19 463	25 302	38 926	81 097
200	170	1 149	1 655	2 506	3 287	4 322	7 356	13 792	17 930	27 585	57 468
	150	1 446	2 083	3 153	4 136	5 438	9 256	17 354	22 560	34 708	72 309
	125	1 712	2 465	3 732	4 896	6 437	10 956	20 542	26 705	41 085	85 593
	0 - 92	1 836	2 643	4 002	5 250	6 902	11 748	22 028	28 637	44 056	91 784
225	191	1 292	1 861	2 817	3 695	4 858	8 270	15 505	20 157	31 011	64 606
	175	1 539	2 215	3 354	4 400	5 785	9 847	18 462	24 001	36 925	76 926
	150	1 829	2 633	3 986	5 230	6 876	11 703	21 944	28 527	43 887	91 431
	0 - 105	2 049	2 951	4 468	5 861	7 706	13 116	24 593	31 971	49 186	102 472
250	200	1 626	2 341	3 544	4 649	6 112	10 404	19 508	25 360	39 015	81 282
	175	1 938	2 791	4 226	5 544	7 288	12 406	23 261	30 239	46 521	96 919
	150	2 176	3 133	4 743	6 223	8 181	13 925	26 110	33 943	52 219	108 790
	0 - 117	2 263	3 259	4 934	6 473	8 510	14 484	27 158	35 306	54 316	113 159
275	200	2 042	2 941	4 452	5 841	7 679	13 070	24 507	31 859	49 014	102 112
	175	2 299	3 311	5 012	6 575	8 644	14 714	27 588	35 864	55 176	114 950
	0 - 130	2 477	3 567	5 400	7 084	9 313	15 852	29 723	38 640	59 446	123 847
300	200	2 416	3 479	5 267	6 910	9 084	15 462	28 991	37 688	57 982	120 796
	175	2 637	3 797	5 748	7 540	9 913	16 874	31 638	41 130	63 277	131 826
	0 - 142	2 691	3 875	5 866	7 695	10 117	17 220	32 288	41 975	64 576	134 534

*Minimum inlet pressure for OB-2000PT is 15 psig (1 barg) because of the pressure pilot.

OB-2000, OB-2000PT

Capacities for Steam Service

OB-2000, OB-2000PT Capacities—Steam

Inlet	Outlet	kg/hr									
		Connection Size									
		mm									
barg		15	20	25	32	40	50	65	80	100	150
C_V Factor		5	7.2	10.9	14.3	18.8	32	60	78	120	250
0.69*	0 - .21	96	138	209	274	360	613	1 150	1 494	2 299	4 790
1.03	0.55	91	131	199	261	343	584	1 095	1 423	2 189	4 561
	0 - .21	114	164	248	325	427	727	1 363	1 772	2 726	5 679
1.38	0.90	100	143	217	285	374	637	1 194	1 553	2 389	4 977
	0 - .21	142	205	310	407	534	910	1 706	2 218	3 412	7 108
1.72	1.24	107	154	234	307	403	686	1 287	1 673	2 573	5 361
	0 - .34	154	222	336	440	579	985	1 848	2 402	3 695	7 698
2.07	1.59	114	165	249	327	430	732	1 373	1 784	2 745	5 719
	0 - .48	173	250	378	496	652	1 109	2 080	2 704	4 161	8 668
2.76	2.28	128	184	278	365	479	816	1 530	1 989	3 060	6 376
	1.72	114	165	249	327	430	732	1 373	1 784	2 745	5 719
	0 - .83	173	250	378	496	652	1 109	2 080	2 704	4 161	8 668
3.45	2.90	128	184	278	365	479	816	1 530	1 989	3 060	6 376
	2.07	179	258	391	513	674	1 147	2 151	2 796	4 301	8 961
	0 - 1.17	212	305	462	607	798	1 358	2 546	3 309	5 091	10 607
4.14	3.52	148	214	324	425	558	950	1 781	2 315	3 562	7 421
	3.10	148	214	324	425	558	950	1 781	2 315	3 562	7 421
	2.41	223	321	486	637	838	1 426	2 673	3 475	5 347	11 139
	0 - 1.5	251	361	547	718	943	1 606	3 011	3 914	6 022	12 546
5.17	4.34	213	307	465	611	803	1 366	2 562	3 330	5 123	10 673
	3.79	269	387	586	769	1 011	1 721	3 227	4 195	6 454	13 446
	3.10	319	459	695	912	1 199	2 041	3 826	4 974	7 653	15 943
	0 - 2.1	348	501	758	995	1 308	2 226	4 175	5 427	8 349	17 394
6.89	5.86	270	389	589	772	1 016	1 729	3 241	4 213	6 482	13 505
	5.17	340	490	742	974	1 280	2 179	4 086	5 311	8 171	17 023
	4.14	415	597	904	1 186	1 559	2 653	4 975	6 467	9 949	20 728
	0 - 2.9	445	641	970	1 272	1 673	2 847	5 338	6 939	10 676	22 242
8.62	7.31	335	482	730	958	1 260	2 144	4 020	5 226	8 040	16 750
	6.89	380	547	828	1 086	1 428	2 431	4 558	5 925	9 116	18 991
	5.17	510	735	1 112	1 459	1 918	3 265	6 121	7 957	12 242	25 504
	0 - 3.7	542	780	1 181	1 550	2 037	3 467	6 502	8 452	13 003	27 090
10.34	8.76	400	576	872	1 143	1 503	2 559	4 798	6 237	9 596	19 991
	6.89	563	811	1 227	1 610	2 117	3 603	6 755	8 782	13 510	28 147
	0 - 4.6	639	920	1 392	1 827	2 402	4 088	7 665	9 964	15 330	31 937
12.07	10.20	465	669	1 013	1 329	1 747	2 973	5 575	7 247	11 150	23 229
	8.62	611	880	1 332	1 748	2 298	3 912	7 335	9 535	14 670	30 562
	6.89	720	1 036	1 569	2 058	2 706	4 606	8 636	11 226	17 271	35 982
	0 - 5.5	736	1 059	1 604	2 104	2 766	4 709	8 828	11 477	17 657	36 785
13.79	11.72	521	751	1 137	1 491	1 960	3 337	6 256	8 133	12 512	26 067
	10.34	656	945	1 430	1 876	2 466	4 198	7 872	10 233	15 744	32 799
	8.62	776	1 118	1 693	2 221	2 920	4 970	9 318	12 113	18 636	38 825
	0 - 6.3	833	1 199	1 815	2 381	3 131	5 329	9 992	12 990	19 984	41 633
15.51	13.17	586	844	1 278	1 676	2 204	3 751	7 033	9 143	14 066	29 305
	12.07	698	1 005	1 521	1 996	2 624	4 466	8 374	10 887	16 749	34 894
	10.34	829	1 194	1 808	2 372	3 119	5 309	9 954	12 940	19 907	41 473
	0 - 7.24	930	1 339	2 027	2 659	3 495	5 950	11 155	14 502	22 311	46 481
17.24	13.79	737	1 062	1 607	2 109	2 773	4 719	8 849	11 503	17 697	36 869
	12.07	879	1 266	1 917	2 515	3 306	5 627	10 551	13 716	21 102	43 962
	10.34	987	1 421	2 152	2 823	3 711	6 316	11 843	15 396	23 687	49 347
	0 - 8.06	1 027	1 478	2 238	2 936	3 860	6 570	12 319	16 015	24 638	51 329
18.96	13.79	926	1 334	2 019	2 649	3 483	5 929	11 116	14 451	22 233	46 318
	12.07	1 043	1 502	2 273	2 982	3 921	6 674	12 514	16 268	25 028	52 141
	0 - 8.96	1 124	1 618	2 449	3 213	4 224	7 191	13 482	17 527	26 965	56 177
20.00	13.79	1 096	1 578	2 389	3 134	4 120	7 013	13 150	17 095	26 300	54 793
	12.07	1 196	1 722	2 607	3 420	4 497	7 654	14 351	18 656	28 702	59 796
	0 - 9.79	1 220	1 758	2 661	3 491	4 589	7 811	14 646	19 040	29 292	61 024

*Minimum inlet pressure for OB-2000PT is 15 psig (1 barg) because of the pressure pilot.

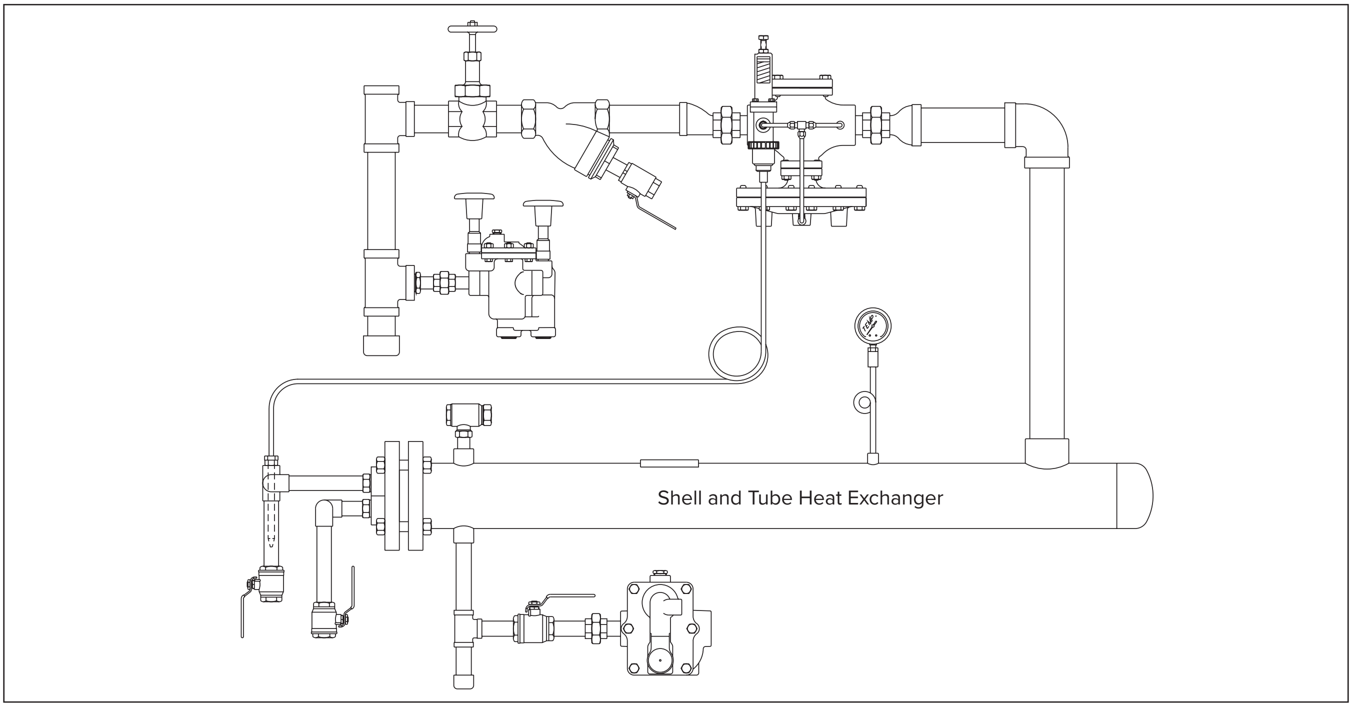
OB-30, OB-2000, OB-2000PT

For Steam Service

Points to Remember When Installing

- Drain condensate at inlet of pressure/temperature regulator with inverted bucket steam trap.
- Protect temperature regulating valve from dirt and scale by installing strainer with 100 mesh screen at inlet of valve.
- Install shutoff valves on either side of the regulating valve along with a by-pass line for maintenance purposes.
- Install vacuum breaker after the outlet of equipment and before the steam trap.
- Install sensor so it is fully immersed in the fluid being heated.
- If temperature well is used, apply heat transfer medium to sensor before insertion into well.
- Place thermometer into system in close proximity to temperature sensor for accurate valve adjustment.
- If possible, do not elevate condensate after steam trap.
- Determine pressure setting before temperature setting (OB-2000PT only).

Typical Installation—OB-30, OB-2000



Load Calculations

Heating oil with steam

$$\text{lb/hr steam} = \frac{\text{GPM}}{4} \times \Delta T \times 1.1$$

Heating water with steam

$$\text{lb/hr steam} = \frac{\text{GPM}}{2} \times \Delta T \times 1.1$$

Heating air with steam

$$\text{lb/hr steam} = \frac{\text{CFM}}{900} \times \Delta T \times 1.1$$

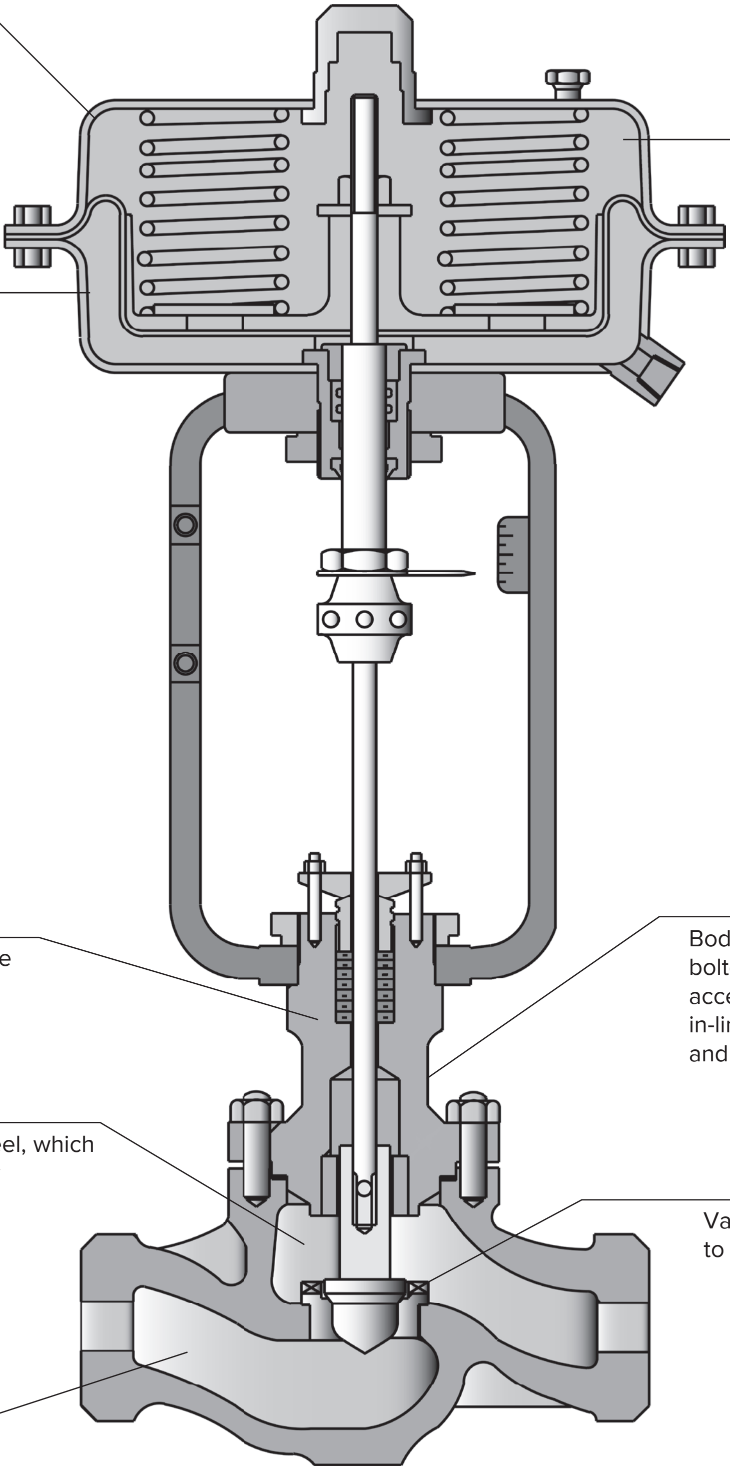
Jacketed kettles or tanks

$$\text{lb/hr steam} = \frac{\text{Gal} \times \text{SG} \times \text{Cp} \times \Delta T \times 8.3}{\text{Lat} \times \text{T}}$$

Where:

GPM = Gallons per minute
ΔT = Temperature rise (°F)
CFM = Cubic feet per minute
Cp = Specific heat of liquids (Btu/lb-°F)
T = Time (hours)
Lat = Latent heat of steam (Btu/lb)
Gal = Gallons of liquid to be heated
SG = Specific gravity
1.1 = Safety factor

Python® - 1100 Series Control Valves



Actuators are light weight and compact

Reverse and direct acting multi-spring actuators

Reinforced rolling diaphragm provides constant effective area throughout the stroke cycle allowing for the most accurate control

Low friction package available in teflon or graphoil

Body with top entry trim and bolted bonnet facilitates easy access to all internal parts for in-line inspections, maintenance and trim replacement

All trim parts are stainless steel, which means long life and reliability

Variety of trim options available to satisfy vast application range including reduced port trims, enabling nearest accurate selection for precise control requirements

Carbon steel body construction

Python® - 1100 Series Control Valves

When accurate control is desired from your steam or water applications the Armstrong Python® 1100 Series Control Valve will squeeze every bit of performance out of your system and deliver precise control. With a wide range of materials, sizes, trim, and other features, you are sure to find the Python® can accurately control your system. The Python® 1100 Series Control Valve is constructed and equipped with state of the art materials and is designed to meet the most stringent budget.

Python® Series 1100
Control Valve

Product Features

- Series 1100 valves are Globe two-way single seated body design valves, which satisfy the majority of control applications for HVAC, industrial and commercial markets.
- Body with top entry trim and bolted bonnet facilitates easy access to all internal parts for in-line inspection, maintenance and trim replacement.
- Stream line flow path provides large flow capacity.
- Variety of trim options are available to satisfy a vast application range including reduced port trims enabling nearest accurate selection for precise control requirements.
- Trims with top bush guided plugs are available with simple construction for stable operation, assuring high rangeability and turndown ratios.
- Micro trims available for control of minute flow rates.
- Trims with large guide plugs are available for full pressure balancing effect providing an economical choice for high pressure applications.
- All parts are renewable in-line.
- Carbon steel or stainless steel body construction.
- Reverse and direct acting multi-spring actuators.
- Available in 1/2” - 2” NPT and 1/2” - 8” ANSI flange design.
- Rated for class IV shut-off.

Python® Series 1100
Control Valve with Positioner

Accessories

- Pneumatic Valve Positioner
- Electro-Pneumatic (E/P) Valve Positioner
- Digital Valve Positioners
- Pressure/Temperature Controllers
- Air Filter Regulator

Python® - 1100 Series Control Valves

Control Valves - 1100 Series List of Materials

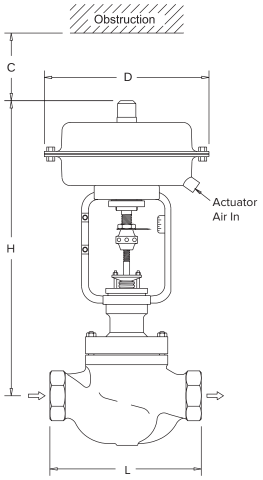
Valve Body*	Carbon Steel A216 Gr. WCB
Bonnet*	
Valve/Valve Seat	Stainless Steel AISI 431
Valve Stem	Stainless Steel 316
Gland Packing	V-Teflon - option 1 (366°F Max.) Grafoil - option 2
Yoke	S.G. Iron
Actuator Spring	Chrome Vanadium/Spring Steel
Actuator Diaphragm	Nitrile Reinforced with Nylon Fiber

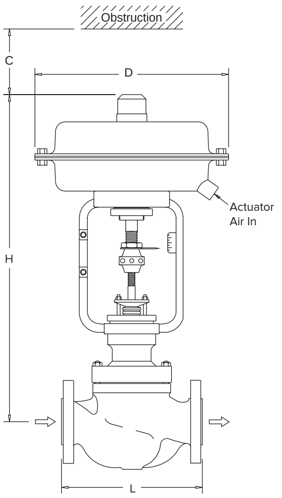
*Stainless steel available.

Control Valves - 1100 Series Specifications

Flow		Equal Percentage
Leakage		ANSI Class IV
Rangeability		50:1
Travel	1/2” to 1”	11/16” (18 mm)
	1-1/2” to 2”	1-1/8” (28 mm)
	2-1/2” to 4”	1-1/2” (38 mm)
	6” to 8”	2-1/4” (58 mm)
Maximum Temperature		450°F (232°C)*
Maximum Pressure		300 psig (20 barg)*

*Higher pressure and temperature valves available.





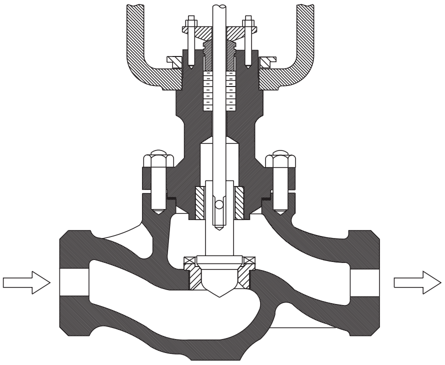
Control Valves - 1100 Series Dimensions and Weights

Size		Face-to-Face “L”						“C”		“D”		“H”		Weight					
in	mm	NPT		150#		300#								NPT		150#		300#	
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg
1/2	15	6-1/2	165	7	178	—	—	4	102	9-7/16	240	18-1/2	470	31	14	34	15	—	—
3/4	20	6-1/2	165	7-1/8	181	—	—	4	102	9-7/16	240	18-1/2	470	31	14	34	15	—	—
1	25	7-3/4	197	7-1/4	184	7-3/4	197	4	102	9-7/16	240	18-1/2	470	33	15	36	16	40	18
1-1/2	40	9-1/4	25	8-3/4	222	9-1/4	235	5	127	11-7/16	290	20-9/32	515	51	23	55	25	60	27
2	50	10-1/2	267	10	254	10-1/2	267	5	127	11-7/16	290	20-9/32	515	60	27	65	30	71	32
2-1/2	65	—	—	10-7/8	276	11-1/2	292	6	127	15	380	25-3/16	640	—	—	120	54	135	61
3	80	—	—	11-3/4	299	12-1/2	318	6	152	15	380	25-3/16	640	—	—	135	61	154	70
4	100	—	—	13-7/8	353	14-1/2	368	6	152	15	380	26-3/8	670	—	—	176	80	220	100
6	150	—	—	17-3/4	451	18-5/8	473	7	175	17-5/8	448	43-1/2	1105	—	—	330	150	396	180
8	200	—	—	21-3/8	543	22-3/8	568	7	175	17-5/8	448	45-1/4	1150	—	—	551	250	650	295

Note: Additional sizes up to 20” available upon request.

Contour Top Guided

The Contour Top Guided trims are the preferred choice for a variety of control applications due to their simple construction. Heavy top guided trim provides maximum support to impart complete stability. The plug shank is guided at the lowest portion of the bonnet minimizing the effect of side thrust on the valve plug and eliminating trim vibration.



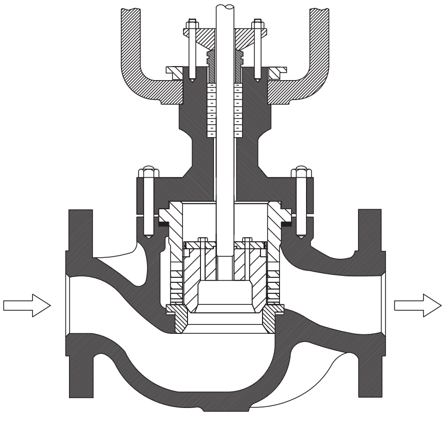
Contoured Top Guided Trim (Unbalanced)

Multi-Hole Cage Guided - Pressure Balanced

The large guide trims with pressure balancing effect enable the valve to handle higher ΔP shut off without employing high power actuators. The flow characteristic is achieved through plug contour. Equalizing holes are opened in the plug which effectively cancel out the unbalanced force impressed on the top and bottom of the valve plug.

Pressure balance sealing is attained; 1) At seating surface 2) Through pressure balance seal rings which are fitted on the plug seal applying pressure along the inner wall of the large guide having a ground, honed and chrome plated surface.

This multi-hole trim also helps with noise attenuation.



Multi-Hole Cage Guided
Pressure Balanced Trims

Contoured Top Guided Cv Values

Valve Size		Trim Size		C_V
in	mm	in	mm	
*1/2, *3/4, 1	*15, *20, 25	1	25	13
		3/4	20	9
		1/2	15	5
		5/16	8	3
		1/4	6	2
		1/8	3	1
1-1/2	40	1-1/2	40	30
		1-1/4	32	20
		1	25	13
2	50	2	50	50
		1-1/2	40	30
		1-1/4	32	20
2-1/2	65	2-1/2	65	80
		2	50	50
		1-1/2	40	30
3	80	3	80	110
		2-1/2	65	80
		2	50	50
4	100	4	100	200
		3	80	110
		2-1/2	65	80
6	150	6	150	400
		5	125	300
		4	100	200
8	200	8	200	640
		6	150	400
		5	125	300

Note: Additional sizes up to 20” available upon request.
* The trim size must be less than or equal to the valve size.

Multi-Hole Cage Guided Cv Values

Valve Size		Trim Size		C_V
in	mm	in	mm	
1-1/2	40	1-1/2	40	24
		1-1/4	32	16
		1	25	10
2	50	2	50	40
		1-1/2	40	24
		1-1/4	32	16
2-1/2	65	2-1/2	65	64
		2	50	40
		1-1/2	40	24
3	80	3	80	90
		2-1/2	65	64
		2	50	40
4	100	4	100	160
		3	80	90
		2-1/2	65	64
6	150	6	150	320
		5	125	240
		4	100	160
8	200	8	200	510
		6	150	320
		5	125	240

Note: Additional sizes up to 20” available upon request.

Python® - 1100 Series Control Valve

Multi-Spring Actuators: Series M

The "M" Series control valve actuators are diaphragm actuators with pre-compressed multi-spring construction. They are compact (fewer parts), easy to maintain and quickly reversible. The actuators are suitable for regulating and on/off applications. Various models are available covering small to larger thrust requirements.

The increasing air pressure supply moves the diaphragm and actuator stem opposing the spring force. With decreasing air pressure supply, the spring force moves the diaphragm in the opposite direction and back to the normal position. To get various loading capacities the number of springs are altered.

Specifications

- Maximum Diaphragm Pressure:
  - 50 psig (3.5 barg) for Model M and Mp
- Actuator travel:
  - 11/16”, 1-1/8”, 1-1/2”, 2-1/4”
  - (18, 28, 38, 58 mm)
- Diaphragm:
  - Nitrile reinforced with Nylon fiber
- Operating Temperature Range:
  - -40° to 176°F (-40° to 80°C)
- Connections:
  - 1/4” NPT (F) for Models 00 and 11
  - 3/8” NPT (F) for Models 22 and 33
- Permissible Linearity and Hysterisis:
  - ±5% of Signal Pressure Range

Features:

- Utility - Applicable for regulating and on-off applications
- High Power - Variety of models provide choice for low and high thrust requirements
- Construction - Due to multi-spring arrangement the actuators are lightweight and compact
- Reversible - The actuators are field reversible without demanding addition or deletion of parts
- Long Service Life - Rigid construction and durable components provide a long lasting service life
- Minimum Maintenance - The actuators are virtually maintenance free
- Accuracy - Rolling diaphragm construction provides constant effective area throughout the stroke

Direct Acting Actuators (Fail Open)

The actuator stem moves downward with increasing diaphragm pressure. When this pressure is reduced the opposing spring force moves the actuator stem upward. On air failure, the actuator stem is pulled to the extreme upward position by spring force.

This actuator is suitable for the following:
Fail Open - For valves with plugs that push down to close
Fail Close - For valves with plugs that push down to open

Reverse Acting Actuators (Fail Close)

The actuator stem moves upward with increasing diaphragm pressure. When this pressure is reduced the opposing spring force moves the actuator stem downward. On air failure, the actuator stem is pushed to extreme downward position by spring force.

This actuator is suitable for the following:
Fail Close - For valves with plugs that push down to close
Fail Open - For valves with plugs that push down to open

Air Volume Required Per Stroke.

Model Number	Cubic Feet/Stroke
M-00, Mp-00	0.012
M-11, Mp-11	0.035
M-22, Mp-22	0.082
M-33, Mp-33	0.185

Contoured Top Guided Shut Off Pressure

Model No.	Air Supply Pres. to Diaph.	Spring Setting Range		Diaph. Area	Maximum Differential Pressure (PSIG) ΔP / Shut Off Pressure												
		Direct Acting Actuator	Reverse Acting Actuator		Trim Size												
	PSIG	PSIG	PSIG	inch^2	1/8”	1/4” - 5/16”	1/2”	3/4”	1”	1-1/4”	1-1/2”	2”	2-1/2”	3”	4”	6”	8”
M-00	20	3 - 15	3 - 15	30	300	300	206	134	94	—	—	—	—	—	—	—	—
	23		6 - 18		300	300	300	300	222	—	—	—	—	—	—	—	—
	34	6 - 30	6 - 30		300	300	300	300	222	—	—	—	—	—	—	—	—
	37		9 - 32		300	300	300	300	300	—	—	—	—	—	—	—	—
	40		12 - 35		300	300	300	300	300	—	—	—	—	—	—	—	—
M-11	20	3 - 15	3 - 15	55	—	—	—	—	—	121	78	43	—	—	—	—	—
	23		6 - 18		—	—	—	—	—	269	178	102	—	—	—	—	—
	34	6 - 30	6 - 30		—	—	—	—	—	269	178	102	—	—	—	—	—
	37		9 - 32		—	—	—	—	—	300	279	162	—	—	—	—	—
	40		12 - 35		—	—	—	—	—	300	300	222	—	—	—	—	—
M-22	20	3 - 15	3 - 15	95	—	—	—	—	—	—	—	—	51	35	16	—	—
	23		6 - 18		—	—	—	—	—	—	—	—	114	80	38	—	—
	34	6 - 30	6 - 30		—	—	—	—	—	—	—	—	114	80	38	—	—
	37		9 - 32		—	—	—	—	—	—	—	—	178	125	62	—	—
	40		12 - 35		—	—	—	—	—	—	—	—	240	172	85	—	—
M-33	20	3 - 15	3 - 15	140	—	—	—	—	—	—	—	—	—	—	—	10	5
	23		6 - 18		—	—	—	—	—	—	—	—	—	—	—	27	14
	34	6 - 30	6 - 30		—	—	—	—	—	—	—	—	—	—	—	27	14
	37		9 - 32		—	—	—	—	—	—	—	—	—	—	—	42	25
	40		12 - 35		—	—	—	—	—	—	—	—	—	—	—	60	32

Do not exceed 50 PSIG air pressure to the actuator.

Multi-Hole Cage Guided Shut Off Pressure

Model No.	Air Supply Pres. to Diaph.	Spring Setting Range		Diaph. Area	Maximum Differential Pressure (PSIG) ΔP / Shut Off Pressure						
		Direct Acting Actuator	Reverse Acting Actuator		Trim Size						
	PSIG	PSIG	PSIG	inch^2	1-1/2”	2”	2-1/2”	3”	4”	6”	8”
M-11	20	3 - 15	3 - 15	55	257	150	—	—	—	—	—
	23		6 - 18		300	300	—	—	—	—	—
	34	6 - 30	6 - 30		300	300	—	—	—	—	—
	37		9 - 32		300	300	—	—	—	—	—
	40		12 - 35		300	300	—	—	—	—	—
M-22	20	3 - 15	3 - 15	95	—	—	298	190	97	—	—
	23		6 - 18		—	—	300	300	300	—	—
	34	6 - 30	6 - 30		—	—	300	300	300	—	—
	37		9 - 32		—	—	300	300	300	—	—
	40		12 - 35		—	—	300	300	300	—	—
M-33	20	3 - 15	3 - 15	140	—	—	—	—	—	133	21
	23		6 - 18		—	—	—	—	—	300	258
	34	6 - 30	6 - 30		—	—	—	—	—	300	258
	37		9 - 32		—	—	—	—	—	300	300
	40		12 - 35		—	—	—	—	—	300	300

Do not exceed 50 PSIG air pressure to the actuator.

Armstrong® Python® - Electric Actuators

When accurate control of your steam or water application is desired and air is not available, the Python® AEL Electric Control Valve will deliver precise control. The electric version of the popular 1100 series control valve is built to out perform and deliver accurate control. The AEL Series Electric Control Valve is constructed and equipped with state of the art industrial materials combined with the standard 1100 series main valve.

Python® Series 1100
AEL Electric Actuator

Product Features:

- Power: 24v AC (120v AC or 240v AC available)
- Terminal board connection
- Pillar mechanical connection
- Auto/Manual control
- Control signal 4-20 ma, 0-10 volts
- Protection class IP 67
- High thrust capabilities
- Electronic position control
- Metal internal gears
- Compact design
- Mounts to the standard 1100 Series valve body
- Actuators available from 1/2'' to 4''

List of Materials

Valve Body*	Carbon Steel A216 GR. WCB
Bonnet*	
Valve/Valve Seat	Stainless Steel AISI 410
Valve Stem	Stainless Steel 316
	V-Teflon- Option 1 (366°F max)
Gland Packing	Grafoil-Option 2
Yoke	S.G. Iron
Actuator Housing	Aluminum

*Stainless steel available.

Technical Data

Flow		Equal Percentage
Leakage		ANSI Class IV
Rangeability		50:1
Travel	1/2'' to 1''	11/16'' (18mm)
	1-1/4'' to 2''	1-1/8'' (28mm)
	2-1/2'' to 4''	1-1/2'' (38mm)
	6'' to 8''	2-1/4'' (58mm)
Maximum Temperature		450°F (232°C)
Maximum Pressure		300 psig (20 barg)
Voltage		24v Power Supply

Dimensions and Weights

Size		Face-to-Face "L"						"C"		"D"		"H"		Weight					
in	mm	NPT		150#		300#								NPT		150#		300#	
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg
1/2	15	6-1/2	165	7	178	—	—	7-7/8	200	5	127	14-9/16	370	22	10	34	15	—	—
3/4	20	6-1/2	165	7-1/8	181	—	—	7-7/8	200	5	127	14-9/16	370	22	10	34	15	—	—
1	25	7-3/4	197	7-1/4	184	—	—	7-7/8	200	5	127	24-15/16	633	24	11	36	16	—	—
1-1/4	32	9-1/4	235	8-3/4	222	—	—	6-5/16	160	7-1/4	183	26-1/8	664	39	18	55	25	—	—
1-1/2	40	9-1/4	235	8-3/4	222	—	—	6-5/16	160	7-1/4	183	26-1/8	664	39	18	55	25	—	—
2	50	10-1/2	267	10	254	10-1/2	267	6-5/16	160	7-1/4	183	26-11/16	678	48	22	65	30	71	32
2-1/2	65	—	—	10-7/8	276	11-1/2	292	6-5/16	160	7-1/4	183	26-5/16	668	—	—	120	54	135	61
3	80	—	—	11-3/4	299	12-1/2	318	6-5/16	160	7-1/4	183	28-1/2	724	—	—	135	61	150	68
4	100	—	—	13-7/8	353	14-1/2	368	6-5/16	160	7-1/4	183	31-5/8	803	—	—	176	80	210	95
6	150	—	—	17-3/4	451	18-5/8	473	6-5/16	160	7-1/4	183	34-1/4	870	—	—	322	146	380	172
8	200	—	—	21-3/8	543	22-3/8	568	—	—	—	—	—	—	—	—	540	245	630	286

*Refer to images on page 321.

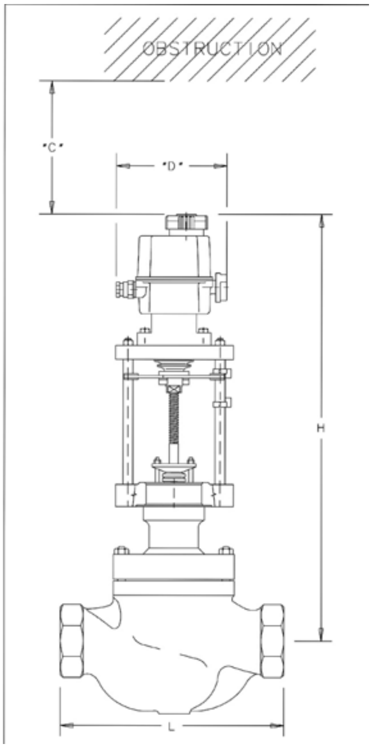
Python® - Electric Actuators

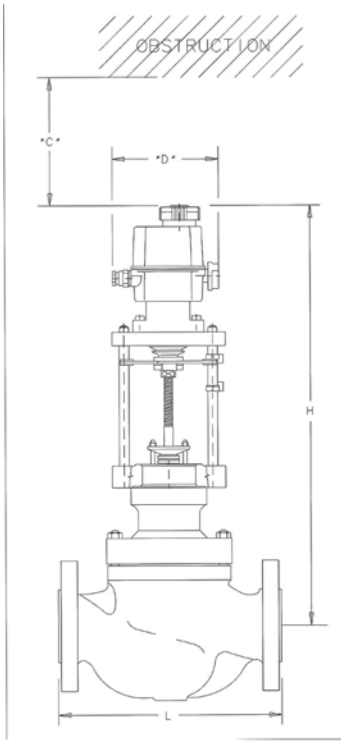
Top Guided

Size of Valve		NPT				150# Flg				
IN	MM	Switch-off thrust (N)	Speed (mm/min)	Modulating Model	ON/OFF Model	Switch-off thrust (N)	Speed (mm/ min)	Modulating Model	ON/OFF Model	Stroke
1/2''	15	1 900	28	AEL1430	AEL1490	1 900	28	AEL1430	AEL1490	18mm
3/4''	20	1 900	28	AEL1430	AEL1490	1 900	28	AEL1430	AEL1490	18mm
1''	25	1 900	28	AEL1430	AEL1490	1 900	28	AEL1430	AEL1490	18mm
1-1/4''	32	3 600	48	AEL1438	AEL1498	1 900	48	AEL1438	AEL1498	28mm
1-1/2''	40	4 600	48	AEL1438	AEL1498	3 600	48	AEL1438	AEL1498	28mm
2''	50	7 200	48	AEL1438	AEL1431	4 600	48	AEL1438	AEL1498	28mm
2-1/2''	65	—	—	—	—	4 600	48	AEL1438	AEL1498	—
3''	80	—	—	—	—	4 600	48	AEL1438	AEL1498	—
4''	100	—	—	—	—	4 600	48	AEL1438	AEL1498	—

Multi-Hole

Size of Valve		150# Flg				300# Flg				
IN	MM	Switch-off thrust (N)	Speed (mm/min)	Modulating Model	ON/OFF Model	Switch-off thrust (N)	Speed (mm/ min)	Modulating Model	ON/OFF Model	Stroke
1-1/2''	40	1 900	48	AEL1438	AEL1498	1 900	48	AEL1438	AEL1498	28mm
2''	50	1 900	48	AEL1438	AEL1498	1 900	48	AEL1438	AEL1498	28mm
2-1/2''	65	3 600	48	AEL1438	AEL1498	3 600	48	AEL1438	AEL1498	38mm
3''	80	3 600	48	AEL1438	AEL1498	3 600	48	AEL1438	AEL1498	38mm
4''	100	3 600	48	AEL1438	AEL1498	3 600	48	AEL1438	AEL1498	38mm
6''	150	4 600	48	AEL1431	AEL1491	5 800	48	AEL1438	AEL1431	58mm





Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Python® - 1100 Series Control Valve

Capacities for Saturated Steam Service

Contoured Top Guided Trim

		lb/hr												
Inlet	**Outlet**	**Trim Size and C_V in**												
(psig)		**1/8**	**1/4**	**5/16**	**1/2**	**3/4**	**1**	**1-1/4**	**1-1/2**	**2**	**2-1/2**	**3**	**4**	**6**
C_V Factor		**1.0**	**2.0**	**3.0**	**5.0**	**9.0**	**13.0**	**20.0**	**30.0**	**50.0**	**80.0**	**110.0**	**200.0**	**400.0**
5	3	18	36	54	91	163	236	363	545	908	1 453	1 998	3 632	7 265
	0 - 2	32	64	97	161	290	418	643	965	1 609	2 574	3 539	6 434	12 868
10	5	31	63	94	156	282	407	626	939	1 564	2 503	3 442	6 258	12 516
	0 - 4	40	81	121	202	363	524	807	1 210	2 017	3 227	4 437	8 067	16 134
15	10	35	69	104	173	312	450	693	1 039	1 732	2 771	3 810	6 927	13 854
	0 - 6	49	97	146	243	437	631	970	1 455	2 425	3 880	5 335	9 700	19 400
20	15	38	75	113	188	339	490	754	1 130	1 884	3 015	4 145	7 537	15 073
	0 - 8	57	113	170	283	510	737	1 133	1 700	2 833	4 533	6 233	11 333	22 666
30	20	59	118	178	296	533	769	1 183	1 775	2 959	4 734	6 509	11 835	23 670
	0 - 12	73	146	219	365	657	949	1 460	2 190	3 650	5 840	8 029	14 599	29 198
40	30	66	132	199	331	596	861	1 324	1 986	3 310	5 297	7 283	13 242	26 483
	25	79	158	237	395	711	1 027	1 580	2 371	3 951	6 322	8 692	15 805	31 609
	0 - 16	89	179	268	447	804	1 161	1 787	2 680	4 466	7 146	9 826	17 865	35 730
50	40	73	145	218	363	653	943	1 451	2 177	3 628	5 805	7 982	14 513	29 026
	30	98	196	295	491	884	1 277	1 965	2 947	4 911	7 858	10 805	19 646	39 292
	0 - 20	106	211	317	528	951	1 374	2 113	3 170	5 283	8 452	11 622	21 131	42 262
60	50	78	157	235	392	706	1 019	1 568	2 352	3 920	6 272	8 625	15 681	31 362
	35	117	234	351	586	1 054	1 522	2 342	3 513	5 856	9 369	12 882	23 422	46 845
	0 - 24	122	244	366	610	1 098	1 586	2 440	3 660	6 099	9 759	13 418	24 397	48 794
75	65	86	173	259	432	778	1 124	1 729	2 593	4 322	6 915	9 508	17 286	34 573
	50	130	261	391	652	1 174	1 696	2 609	3 914	6 524	10 438	14 352	26 094	52 188
	0 - 30	146	293	439	732	1 318	1 904	2 930	4 394	7 324	11 718	16 113	29 296	58 592
100	75	150	300	450	751	1 351	1 952	3 002	4 504	7 506	12 009	16 513	30 023	60 047
	60	183	366	548	914	1 645	2 376	3 656	5 484	9 139	14 623	20 106	36 557	73 114
	0 - 40	187	375	562	937	1 686	2 435	3 746	5 619	9 365	14 984	20 604	37 461	74 922
125	100	167	335	502	837	1 507	2 177	3 349	5 024	8 374	13 398	18 422	33 495	66 990
	75	225	450	675	1 125	2 024	2 924	4 498	6 747	11 245	17 992	24 740	44 981	89 962
	0 - 50	228	456	684	1 141	2 053	2 966	4 563	6 844	11 407	18 250	25 094	45 626	91 252
150	125	183	366	550	916	1 649	2 382	3 664	5 496	9 160	14 656	20 151	36 639	73 278
	100	248	496	745	1 241	2 234	3 227	4 964	7 446	12 410	19 857	27 303	49 642	99 284
	0 - 60	269	538	807	1 345	2 421	3 496	5 379	8 069	13 448	21 516	29 585	53 791	107 582
175	150	198	395	593	988	1 779	2 570	3 953	5 930	9 883	15 813	21 743	39 534	79 067
	110	300	600	901	1 501	2 702	3 903	6 004	9 006	15 010	24 016	33 022	60 041	120 082
	0 - 70	310	620	929	1 549	2 788	4 027	6 196	9 293	15 489	24 782	34 076	61 956	123 912
200	150	289	578	868	1 446	2 603	3 760	5 785	8 677	14 462	23 139	31 816	57 847	115 695
	125	342	685	1 027	1 712	3 081	4 451	6 847	10 271	17 119	27 390	37 661	68 474	136 948
	0 - 80	351	701	1 052	1 753	3 155	4 558	7 012	10 518	17 530	28 048	38 567	70 121	140 242
250	200	325	650	975	1 626	2 926	4 227	6 503	9 754	16 256	26 010	35 764	65 025	130 051
	150	413	827	1 240	2 067	3 721	5 374	8 268	12 402	20 670	33 072	45 474	82 681	165 361
	0 - 100	432	865	1 297	2 161	3 890	5 619	8 645	12 968	21 613	34 580	47 548	86 451	172 902
300	250	357	715	1 072	1 787	3 217	4 647	7 149	10 723	17 872	28 595	39 318	71 486	142 973
	200	483	966	1 450	2 416	4 349	6 281	9 664	14 495	24 159	38 655	53 150	96 637	193 273
	0 - 120	514	1 028	1 542	2 570	4 625	6 681	10 278	15 417	25 695	41 112	56 530	102 781	205 562

*Capacities based on maximum Cv. It is recommended to operate the valve between 15-85% of the valve opening. See chart on page 333.

Python® - 1100 Series Control Valve

Capacities for Saturated Steam Service

Contoured Top Guided Trim														
		kg/hr												
Inlet	Outlet	Trim Size and C_V mm												
(barg)		3	6	8	15	20	25	32	40	50	65	80	100	150
C_V Factor		1.0	2.0	3.0	5.0	9.0	13.0	20.0	30.0	50.0	80.0	110.0	200.0	400.0
0.34	0.21	8	16	25	41	74	107	165	247	412	659	906	1 648	3 295
	0 - 0.14	15	29	44	73	131	190	292	438	730	1 167	1 605	2 918	5 837
0.69	0.34	14	28	43	71	128	185	284	426	710	1 135	1 561	2 839	5 677
	0 - 0.28	18	37	55	91	165	238	366	549	915	1 464	2 013	3 659	7 318
1.03	0.69	16	31	47	79	141	204	314	471	785	1 257	1 728	3 142	6 284
	0 - 0.41	22	44	66	110	198	286	440	660	1 100	1 760	2 420	4 400	8 800
1.38	1.03	17	34	51	85	154	222	342	513	855	1 367	1 880	3 419	6 837
	0 - 0.55	26	51	77	129	231	334	514	771	1 285	2 056	2 827	5 141	10 281
2.07	1.38	27	54	81	134	242	349	537	805	1 342	2 147	2 953	5 368	10 736
	0 - 0.83	33	66	99	166	298	430	662	993	1 656	2 649	3 642	6 622	13 244
2.76	2.07	30	60	90	150	270	390	601	901	1 502	2 403	3 304	6 006	12 013
	1.72	36	72	108	179	323	466	717	1 075	1 792	2 868	3 943	7 169	14 338
	0 - 1.10	41	81	122	203	365	527	810	1 216	2 026	3 241	4 457	8 104	16 207
3.45	2.76	33	66	99	165	296	428	658	987	1 646	2 633	3 621	6 583	13 166
	2.07	45	89	134	223	401	579	891	1 337	2 228	3 565	4 901	8 911	17 823
	0 - 1.38	48	96	144	240	431	623	958	1 438	2 396	3 834	5 272	9 585	19 170
4.14	3.45	36	71	107	178	320	462	711	1 067	1 778	2 845	3 912	7 113	14 226
	2.41	53	106	159	266	478	691	1 062	1 594	2 656	4 250	5 843	10 624	21 249
	0 - 1.65	55	111	166	277	498	719	1 107	1 660	2 767	4 427	6 087	11 066	22 133
5.17	4.48	39	78	118	196	353	510	784	1 176	1 960	3 136	4 313	7 841	15 682
	3.45	59	118	178	296	533	769	1 184	1 775	2 959	4 734	6 510	11 836	23 672
	0 - 2.07	66	133	199	332	598	864	1 329	1 993	3 322	5 315	7 309	13 289	26 577
6.89	5.17	68	136	204	340	613	885	1 362	2 043	3 405	5 447	7 490	13 619	27 237
	4.14	83	166	249	415	746	1 078	1 658	2 487	4 146	6 633	9 120	16 582	33 164
	0 - 2.76	85	170	255	425	765	1 104	1 699	2 549	4 248	6 797	9 346	16 992	33 984
8.62	6.89	76	152	228	380	684	988	1 519	2 279	3 798	6 077	8 356	15 193	30 386
	5.17	102	204	306	510	918	1 326	2 040	3 061	5 101	8 161	11 222	20 403	40 807
	0 - 3.45	103	207	310	517	931	1 345	2 070	3 104	5 174	8 278	11 383	20 696	41 392
10.34	8.62	83	166	249	415	748	1 080	1 662	2 493	4 155	6 648	9 141	16 619	33 239
	6.89	113	225	338	563	1 013	1 464	2 252	3 378	5 629	9 007	12 385	22 517	45 035
	0 - 4.14	122	244	366	610	1 098	1 586	2 440	3 660	6 100	9 760	13 420	24 399	48 799
12.07	10.34	90	179	269	448	807	1 166	1 793	2 690	4 483	7 173	9 863	17 932	35 865
	7.58	136	272	409	681	1 226	1 770	2 723	4 085	6 809	10 894	14 979	27 234	54 469
	0 - 4.83	141	281	422	703	1 265	1 827	2 810	4 215	7 026	11 241	15 457	28 103	56 206
13.79	10.34	131	262	394	656	1 181	1 706	2 624	3 936	6 560	10 496	14 432	26 239	52 479
	8.62	155	311	466	776	1 398	2 019	3 106	4 659	7 765	12 424	17 083	31 060	62 119
	0 - 5.52	159	318	477	795	1 431	2 067	3 181	4 771	7 952	12 723	17 494	31 807	63 613
17.24	13.79	147	295	442	737	1 327	1 917	2 950	4 424	7 374	11 798	16 222	29 495	58 991
	10.34	188	375	563	938	1 688	2 438	3 750	5 626	9 376	15 001	20 627	37 504	75 007
	0 - 10.3	196	392	588	980	1 765	2 549	3 921	5 882	9 803	15 686	21 568	39 214	78 428
20.00	17.24	162	324	486	811	1 459	2 108	3 243	4 864	8 107	12 970	17 834	32 426	64 852
	13.79	219	438	658	1 096	1 973	2 849	4 383	6 575	10 959	17 534	24 109	43 834	87 668
	0 - 8.28	233	466	699	1 166	2 098	3 030	4 662	6 993	11 655	18 648	25 642	46 621	93 242

*Capacities based on maximum Cv. It is recommended to operate the valve between 15-85% of the valve opening. See chart on page 333.

Capacities for Saturated Steam Service

Multi-Hole Cage Guided Trim

lb/hr

Inlet	Outlet	Trim Size and C_v							
		in							
(psig)		1	1-1/4	1-1/2	2	2-1/2	3	4	6
C_v Factor		10.0	16.0	24.0	40.0	64.0	90.0	160.0	320.0
100	75	1 501	2 402	3 603	6 005	9 607	13 511	24 019	48 037
	60	1 828	2 925	4 387	7 311	11 698	16 451	29 246	58 491
	0 - 40	1 873	2 997	4 495	7 492	11 988	16 857	29 969	59 938
125	100	1 675	2 680	4 019	6 699	10 718	15 073	26 796	53 592
	75	2 249	3 598	5 398	8 996	14 394	20 242	35 985	71 970
	0 - 50	2 281	3 650	5 475	9 125	14 600	20 532	36 501	73 002
150	125	1 832	2 931	4 397	7 328	11 724	16 487	29 311	58 622
	100	2 482	3 971	5 957	9 928	15 885	22 339	39 713	79 427
	0 - 60	2 690	4 303	6 455	10 758	17 213	24 206	43 033	86 066
175	150	1 977	3 163	4 744	7 907	12 651	17 790	31 627	63 254
	110	3 002	4 803	7 205	12 008	19 213	27 018	48 033	96 065
	0 - 70	3 098	4 956	7 435	12 391	19 826	27 880	49 565	99 130
200	150	2 892	4 628	6 942	11 569	18 511	26 031	46 278	92 556
	125	3 424	5 478	8 217	13 695	21 912	30 813	54 779	109 559
	0 - 80	3 506	5 610	8 415	14 024	22 439	31 554	56 097	112 194
250	200	3 251	5 202	7 803	13 005	20 808	29 261	52 020	104 041
	150	4 134	6 614	9 922	16 536	26 458	37 206	66 145	132 289
	0 - 100	4 323	6 916	10 374	17 290	27 664	38 903	69 161	138 322
300	250	3 574	5 719	8 578	14 297	22 876	32 169	57 189	114 378
	200	4 832	7 731	11 596	19 327	30 924	43 486	77 309	154 618
	0 - 120	5 139	8 222	12 334	20 556	32 890	46 251	82 225	164 450

*Capacities based on maximum C_V. It is recommended to operate the valve between 15-85% of the valve opening. See chart on page 333.

Multi-Hole Cage Guided Trim

kg/hr

Inlet	Outlet	Trim Size and C_v							
		mm							
(barg)		25	32	40	50	65	80	100	150
C_v Factor		10.0	16.0	24.0	40.0	64.0	90.0	160.0	320.0
6.89	5.17	681	1 089	1 634	2 724	4 358	6 128	10 895	21 790
	4.14	829	1 327	1 990	3 316	5 306	7 462	13 266	26 531
	0 - 2.76	850	1 359	2 039	3 398	5 438	7 646	13 594	27 188
8.62	6.89	760	1 215	1 823	3 039	4 862	6 837	12 155	24 309
	5.17	1 020	1 632	2 448	4 081	6 529	9 182	16 323	32 645
	0 - 3.45	1 035	1 656	2 483	4 139	6 623	9 313	16 557	33 113
10.34	8.62	831	1 330	1 994	3 324	5 318	7 479	13 295	26 591
	6.89	1 126	1 801	2 702	4 503	7 206	10 133	18 014	36 028
	0 - 4.14	1 220	1 952	2 928	4 880	7 808	10 980	19 520	39 039
12.07	10.34	897	1 435	2 152	3 586	5 738	8 070	14 346	28 692
	7.58	1 362	2 179	3 268	5 447	8 715	12 255	21 788	43 575
	0 - 4.83	1 405	2 248	3 372	5 621	8 993	12 646	22 482	44 965
13.79	10.34	1 312	2 099	3 149	5 248	8 397	11 808	20 991	41 983
	8.62	1 553	2 485	3 727	6 212	9 939	13 977	24 848	49 695
	0 - 5.52	1 590	2 545	3 817	6 361	10 178	14 313	25 445	50 891
17.24	13.79	1 475	2 360	3 539	5 899	9 439	13 273	23 596	47 193
	10.34	1 875	3 000	4 500	7 501	12 001	16 877	30 003	60 006
	0 - 10.3	1 961	3 137	4 706	7 843	12 548	17 646	31 371	62 742
20.00	17.24	1 621	2 594	3 891	6 485	10 376	14 592	25 941	51 882
	13.79	2 192	3 507	5 260	8 767	14 027	19 725	35 067	70 134
	0 - 8.28	2 331	3 730	5 595	9 324	14 919	20 980	37 297	74 594

*Capacities based on maximum C_V. It is recommended to operate the valve between 15-85% of the valve opening. See chart on page 333.

Valve Sizing

To determine the size of valve you need, calculate the required Cv value for your application. Once you have calculated the required Cv, refer to the valve Cv charts on page 323 to determine the size and trim of valve. Globe style control valves have the best control in the midrange of the valve's capacity. It is best to pick a valve so the calculated Cv is between 15% and 85% of the valve opening, see page 332. See the formulas below for steam and water applications. Consult factory for other types of fluids.

For Saturated Steam Service

Subcritical Flow
When $\Delta P < 0.81(P_1/2)$

$$Cv = \frac{W}{2.1\sqrt{\Delta P(P_{1A}+P_{2A})}}$$

Critical Flow
When $\Delta P >= 0.81(P_1/2)$

$$Cv = \frac{W}{1.633\ (P_{1A})}$$

For Liquid Service

$$Cv = \frac{(GPM)\ \sqrt{G}}{\sqrt{\Delta P}}$$

C_v = Valve flow coefficient
W = Maximum flow capacity of steam, lbs/hr
P_{1A} = Inlet Pressure, psia (psig + 14.7)
P_{2A} = Outlet Pressure, psia (psig + 14.7)
ΔP = Pressure drop (P_1 - P_2) psig
GPM = Maximum flow capacity of Liquid, GPM
G = Specific Gravity

Actuator Sizing

To determine the required actuator, you need to determine the differential pressure (shut off pressure). The shut off pressure for a pressure reduction application is the pressure difference between P_1 and P_2. The shut off pressure for a temperature control application is the P_1 pressure.

Once you have calculated your shut off pressure, select the actuator model and spring setting range that exceeds your calculated shutoff pressure with the trim size previously selected. Select reverse acting for air to open (fail close) applications or direct acting for air to close (fail open) applications.

Make sure the required air pressure is available for the spring range selected.

Sizing Example 1:

Fluid: Saturated Steam
P_1 = 140 psig
P_2 = 20 psig
Flow: 13 000 lbs/hr
Actuator: Air to open (Fail Close)

Solution:
Valve Selection: Select the correct formula needed to calculate Cv. We need to use the critical flow formula since $\Delta P > .81(P_1/2)$.

$$C_v = \frac{13\ 000}{1.633(140 + 14.7)} = 52$$

Refer to the C_v charts on Page 4. Select a 2-1/2" Multi-hole cage guided with 2-1/2" Trim. Top bush guided would work as well, but multi-hole cage was chosen to help with noise attenuation.

Actuator Selection: Determine your shutoff pressure (ΔP).

$\Delta P = 140 - 20 = 120$ psig

Refer to chart 6-2 (multi-hole cage guided) and go to the 2-1/2" trim size column. Follow the column until you get to a pressure greater than 120 psig, then follow the row horizontally to determine you need a Model M-22 with the 3-15 psig spring range.

Complete valve selection is 1100 series, 2-1/2" 150# Flange with 2-1/2" Multi-hole cage trim and M-22 actuator with 3-15 psig spring range.

Sizing Example 2:

Fluid: Saturated Steam
Application: Temperature Control
P_1: 125 psig
Flow: 1 750 lbs/hr
Actuator: Air to open (Fail Close)

Solution:
Since this is a temperature control application and we do not know the P_2 pressure, we will size the valve with a 30% pressure drop. We need to use the subcritical flow formula.

$$C_v = \frac{1750}{2.1\sqrt{(37)((125+14.7)+(88+14.7))}} = 8.8$$

Refer to the Cv charts on Page 4. Select a 1" Contoured top guided with full port trim. The 1" is chosen over the 3/4" because the valve will control best between 15% - 85% of maximum valve capacity. The 3/4" valve would be operating at 98% of valve capacity.

Actuator Selection:

For temperature control applications, the shut off pressure is the P_1 pressure. Refer to chart 6-1 (Contoured Top Guided) and go to the 1" trim size column. Follow the column until you get to a pressure greater than 125 psig, then follow the row horizontally to determine you need a Model M-00 with a 6 - 18 psig spring range.

Complete valve selection is 1100 series 1" NPT with 1" contoured top guided trim and M-00 actuator with 6 - 18 psig spring range.

Determine the percentage of 'valve open' at any calculated C_v

You must first solve for a required C_v with one of the formulas on page 331. Using sizing example 2, we calculated a C_v of 8.8 and we chose a 1" contoured top guided valve with a full 1" trim with a maximum C_v of 13.

Step 1: Locate selected valve trim size in the far right-hand column. The maximum C_v for this trim can be found by moving two columns to the left.

Step 2: Locate the calculated C_v (flow coefficient) on the far left side.

Step 3: Follow calculated C_v to the right until it intersects with the curve associated with the trim size found in step 1.

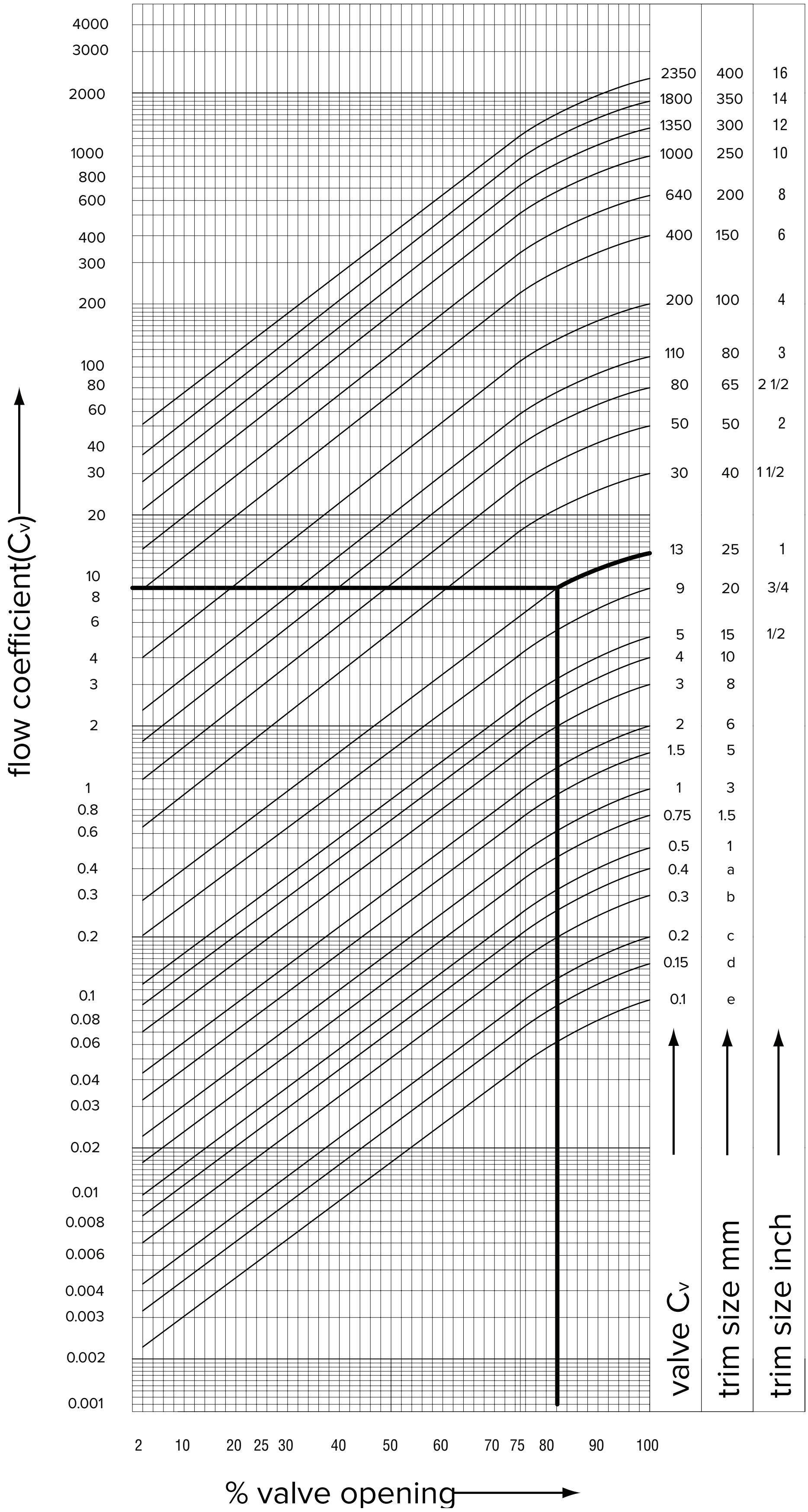
Step 4: From the point of intersection, travel vertically to the bottom of the chart.

This point indicates the percentage of valve open, at the calculated C_v. In this case the valve will operate at 83% of the valves maximum capacity.

The valve has the greatest control between 15 and 85% of the valve opening.

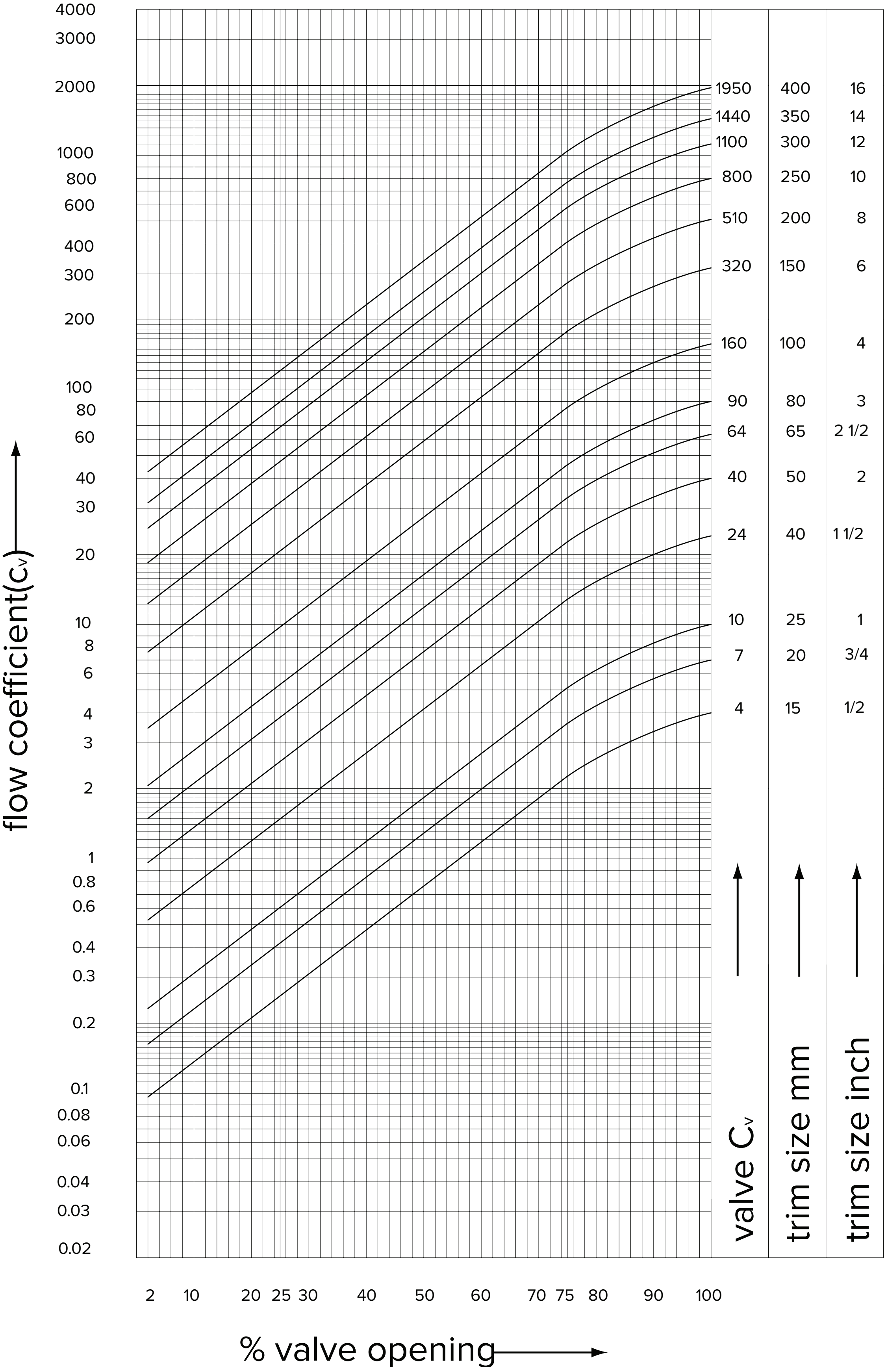
Python® - 1100 Series Control Valve

Trim: Contoured Top Bush Guided

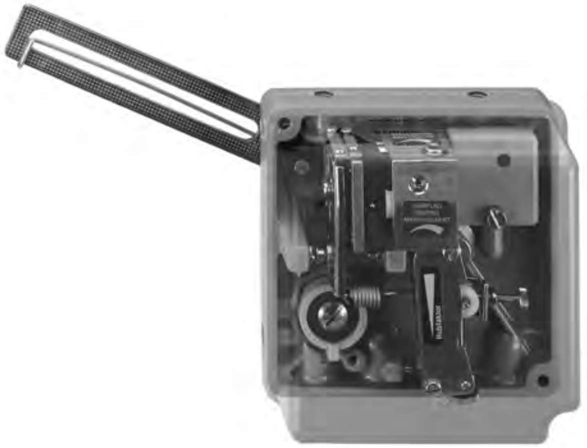


Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Trim: Multi-Hole Cage Guided



SRP981 Pneumatic Positioner



The SRP981 positioner is designed to control pneumatic valve actuators with pneumatic control signals. It is used to reduce the adverse effects of valve friction, for higher thrust and shorter positioning time. It offers an easy adjustment by two mechanical screws.

Input:

Signal range:	3 to 15 psig (0.2 to 1 barg) split range down to Δw 3 psig (0.2 barg)

Response characteristic:

Amplification: adjustable
Sensitivity: <0.1% F.S.
Non-linearity (terminal based adjustment): <1.0% F.S.
Hysteresis: <0.3% F.S.
Supply air dependency: <0.3% / 1.5 psig (0.1 barg)
Temperature effect: <0.5% / 10 K
Mechanical vibration: 10-60 Hz up to 0.14 mm
60 - 500 Hz up to 2 g
<0.25% of travel span

Supply:

Supply air pressure: 20 to 50 psig (1.4 to 3.5 barg)
Supply air: free of oil, dust and water according to IEC 654-2

Connection:

Pneumatic: Female threads G 1/8 according to ISO 228

Materials:

Base Plate:	Aluminum (Alloy No. 230) finished with DD varnish

Features

- Independent adjustment of stroke range and zero
- Adjustable amplification and damping
- Split range up to 4-fold possible
- Input signal from 3-15 psig (0.2-1 barg)
- Supply pressure up to 50 psig (3.5 barg)
- Low vibration effect in all directions
- Ambient temperature -40 to 176°F (-40 to 80°C)
- Protection class IP54 or IP65
- Explosion protection:
  II 2 G EEx c (constructive safety) + accessories in
  II 2 G EEx i according to ATEX
- Additional inputs/outputs (optional)
  - Position feedback 4 to 20 mA
  - Built-in independent inductive limit switches (2-/3 wire) or micro switches
- Accessories
  - Booster relay to minimize stroke time
  - Gauge manifold
- Gauges (optional)
  - External gauge manifolds
  - Integrated gauges
  - Indicating ranges:
    Input: 0 to 23 psig (0 to 1.6 barg)
    Output: 0 to 150 psig (0 to 10 barg)

SRI990 Analog Positioner

The analog positioner SRI990 with analog input 4 to 20 mA is designed to control pneumatic valve actuators. The modular structure of this product line enables conversion from an analog to an "intelligent" positioner with HART, Fieldbus or FoxCom.

It offers an easy adjustment by means of switches and potentiometers.

Input
Two wire system
Reverse polarity protection: Built-in standard feature
Signal range: 4 to 20 mA
Characteristic of setpoint: linear
Operating range: 3 to 21.5 mA
Voltage: DC 6 to 36 V (unloaded circuit)
Load: 300 Ohms, 6 V at 20 mA

Supply
Supply air pressure: 20 to 50 psig (1.4 to 3.5 barg)
Supply air: according to IEC 654-2

Response characteristics
Sensitivity: <0.2% of travel span
Non-linearity: <±0.8% of travel span
Hysteresis: <0.5% of travel span
Temperature effect: <±0.5% / 10 K
Supply air dependence: <0.3% / 15 psig (1 barg)
Mechanical vibration:
  10-60 Hz up to 0.14 mm,
  60-500 Hz up to 2 g: <0.25% of travel span

Features

- Ambient temperature -40 to 176°F (-40 to 80°C)
- Additional inputs/outputs (optional):
  - Position feedback 4 to 20 mA
  - Built-in independent inductive limit switches (2-/3 wire) or micro switches
- Accessories
  - Booster relay to minimize stroke time
  - Gauge manifold
- Configuration by means of switches and potentiometers
- Load 300 Ohms
- Low air consumption
- Supply air pressure up to 50 psig
- Single acting or double acting
- Mechanical travel indicator
- Reverse polarity protection and interlock diode
- Switch for pneumatic test
- Protection class IP 65 with ATEX and NEMA 4X with FM and CSA
- Explosion protection:
  - II 2 G EEx i/II 2 G EEx n (intrinsic safety) according to ATEX
  - Intrinsic safety according to FM and CSA
- Stainless steel housing for offshore or food and beverage applications

SRD991 Intelligent Positioner with HART, PROFIBUS PA, FOUNDATION Fieldbus H1 or FoxCom for EEx ia Intrinsically Safe Applications

The microprocessor controlled positioner SRD991 is designed to control pneumatic valve actuators and can be operated locally or by means of control systems (e.g. the Foxboro I/A Series System). The advanced diagnostic can be partially shown on the local LCD of the positioner or fully on a PC or a DCS workstation with a DTM based software (VALcare or Valve Monitor).

The positioner is available with different communication protocols. This includes versions with analog setpoint (4 to 20 mA) and superimposed HART- or FoxCom signal; digital with FoxCom protocol, or fieldbus communication according to PROFIBUS-PA and FOUNDATION fieldbus H1 according to IEC 1158-2 based on FISCO.

The SRD991 also has the capability to control a Partial Stroke Test(PST) that offers operators a tool to identify the trouble-proof function of ESD (Emergency Shut Down) valves.

Features

Version “Intelligent”

- Autostart with self calibrationg
- Self diagnostic, status and diagnostic messages

Version “Intelligent with Communication”

- Communication HART, FOUNDATION Fieldbus H1, PROFIBUS-PA or FoxCom
- Configuration by means of local keys, Hand Held Terminal, PC or I/A Series system or with an infrared interface by means of IRCOM

Version “Intelligent without Communication”

- Input signal 4-20 mA

Applicable to all SRD991 Models:

- Supply air pressure up to 50 psig (3.4 barg)
- Single or double acting
- Protection class IP 65, NEMA 4X
- Explosion protection:
  - II 2 G EEx i / II 2 G EEx n (intrinsic safety) according to ATEX
  - Intrinsic safety according to FM and CSA
- Ambient temperature –40 to 176°F (–40 to 80°C)
- Display and Local User Interface:
  - Multilingual Full-Text Graphic LCD or LEDs
  - Status- and Diagnostic-Messages displayed on LCD
  - Easy configuration by means of 3 push buttons
- Mechanical travel indicator
- Suitable for safety applications up to SIL3
- Partial Stroke Test (PST) for Emergency Shut Down applications
- Infrared Interface for wireless communication
- Stainless steel housing for offshore or food and beverage applications

- Additional Inputs/outputs (optional):
  - 2 binary outputs (limits)
  - Position feedback 4 to 20 mA, 1 Alarm output
  - 2 binary inputs
  - Built-in independent inductive limit switches (2- 3-wire) or micro switches
  - Sensors for supply air pressure and output pressure
  - Binary Inputs/Outputs dedicated to SIS logic solvers
- Accessories
  - Booster relay to minimize stroke time
  - Gauge Manifold

43AP Pressure Controller

- 4 to 400% proportional band
- 3-15 psig signal output
- 316 stainless steel spiral pressure element
- Enclosure meets IEC IP53 NEMA Type 3

43AP Temperature Controller

- 4 to 400% proportional band
- 15 Ft. capillary
- 316 stainless steel well with 6” insertion length
- Enclosure meets IEC IP53 NEMA Type 3

Features

- Wide selection of measuring elements
- Wide choice of control modes
- Broad range of integral (reset) and derivative adjustments
- Power failures do not influence process driven indication
- Weatherproof construction
- Versatile mounting
- Internal bumpless automatic-manual transfer station

These instruments indicate and control pressure, temperature, vacuum and differential pressure. They provide process industries with a highly dependable and versatile group of instruments.

Accuracy:

Input to pointer: ±0.5% of span for qualified elements.
Input to output: Depends on measuring element used.

Repeatability:

0.2% of span

Deadband:

0.1% of span

Ambient Temperature Effect:

Maximum control point shift at midspan per 100°F (55°C) change within normal operating conditions is 1% of input span.

Supply Pressure Effect:

Maximum control point shift at midspan per 1 psig (7 kPa) change within normal operating conditions is 0.2% of input span.

Foxboro/Eckardt Controllers

The 718C Series expands the capability of standard 1/8 DIN controllers with advanced features:

- Modbus serial communication to I/A Series for Windows NT, where data collection capabilities and remote operation are needed.
- Adaptive Auto-Tune for quick start ups
- Anti-Windup for keeping your batch process under control

The NEMA 4X faceplates allow these units to be used in applications where washdowns and dust conditions exist.

The Soft Start function prevents thermal shock.

Designed specifically for equipment manufacturers who need communications to data aquisition equipment, the light and compact (1/8 DIN size) is able to perform in the most demanding applications with easy yet reliable control.

The 718C Series start-up is as simple as:

- wiring the instrument
- configuring set points and alarm thresholds
- initiating the autotune function

Engineers, technicians and operators, skilled or unskilled in process control theory, can obtain perfect process control.

Foxboro 718C Electric Controller

- For digital control with universal input and local set point. Installed in a fiberglass enclosure with a thermal strip and auto tune instructions.
- One (1) mA output, 3 relays, 2 digital inputs and auxillary power supply for transmitters.
- No communication
- 24 Vdc, 110 AC, 240 AC power supply

Piston Valves

Description

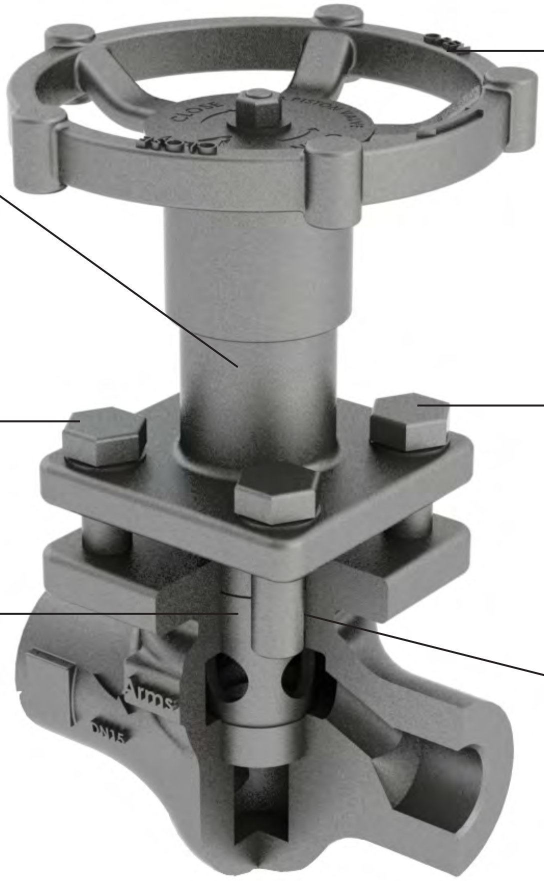
Armstrong Piston Valves are full port forged steel isolation valves with a maximum operating pressure of 136 Barg/1 973 psig and a maximum operating temperature of 427°C/800°F. The burnished piston and metal reinforced graphite rings provide leak-proof shut off and allow Armstrong Piston Valves to be operated at higher temperatures, while also extending operating life.

Armstrong Piston Valves are available in Socket Weld, BSPT, and NPT end connections. Flanged ends can be supplied upon request.

Armstrong Piston Valves are ideal for saturated and superheated steam, and hot water applications.

Armstrong Piston Valves Feature:

- Leak-proof isolation
- Sizes from 15mm/1/2" NB to 40mm/1-1/2" NB
- Choice of socket weld, screwed or flanged end connections
- Compatible with API, ASME, IBR, and DIN standards
- Resistant to cavitation
- All sealing valve components may be easily replaced in-line
- Long-term operation. Piston valve design ensures actuation even after many years without operation
- Fire-proof performance



Ductile Iron hand wheel designed for easy operation.

Piston stem is fully enclosed to prevent dirt and corrosion.

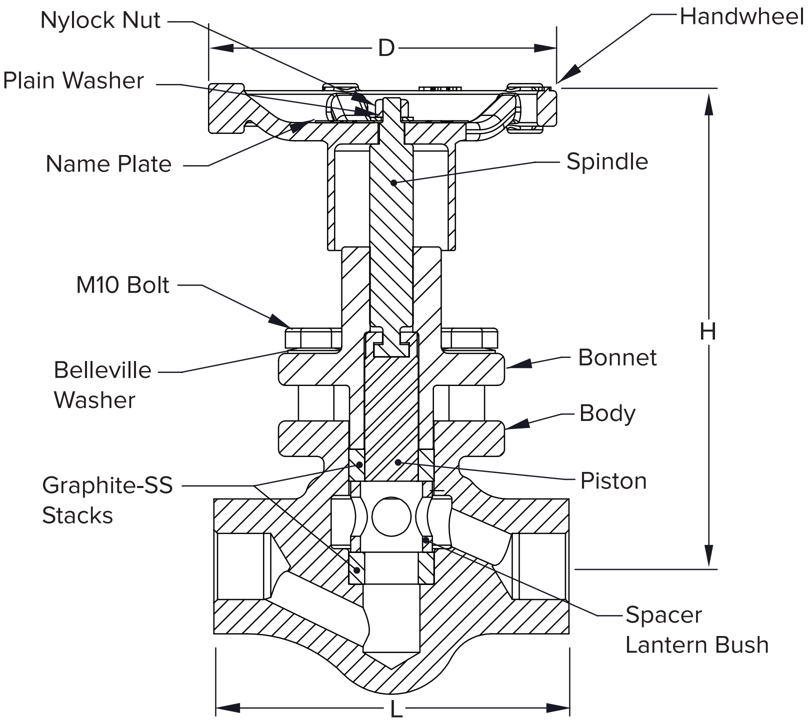
ASTM A19 GR B7 bolts for high temperature operation.

Four-bolt mechanism with Belleville washers to ensure spring action even in high temperature applications.

Precision burnished stainless steel pistons provide long-term operation, and ensures actuation even after many years without operation. The piston slides without rotating between the two valve sealing rings, preventing dirt from damaging the surfaces.

Flexible graphite reinforced ring stacks that withstand high temperatures and feature superior mechanical bonding.

Piston Valves



Forged Piston Valves ANSI Class 800 (API602 & ASME B16.34)

NB/DN	Body Material	L		H		D		Minimum Thread	Bolting Type	Approximate Weight	
		mm	in	mm	in	mm	in			kg	lbs
15	A105/LF2	100	3.9	134	5.3	93	3.7	14	4B - SE/SW	1.9	4.2
20	A105/LF2	120	4.7	138.5	5.5	93	3.7	14	4B - SE/SW	3.4	7.5
25	A105/LF2	135	5.3	183	7.2	112	4.4	18	4B - SE/SW	4.8	10.6
40	A105/LF2	185	7.3	226	8.9	112	4.4	19	4B - SE/SW	11.5	25.4

Design Features Forged Steel Piston Valves Class 800 (Sizes 15, 20, 25, 40NB)

End Connections *	Maximum Pressure at Temperature				Maximum Temperature at Operating Pressure				Hydro Test Pressure at Ambient Temperature
	barg	°C	psig	°F	°C	barg	°F	psig	
Socketweld ends	136.20	≤38	1 975.41	100	427	75.84	801	1 099.97	204.30

* Other end connections may have restricted pressure and temperature ratings due to applicable standards.

Design features of Armstrong Piston Valves:

Material of Construction - Body

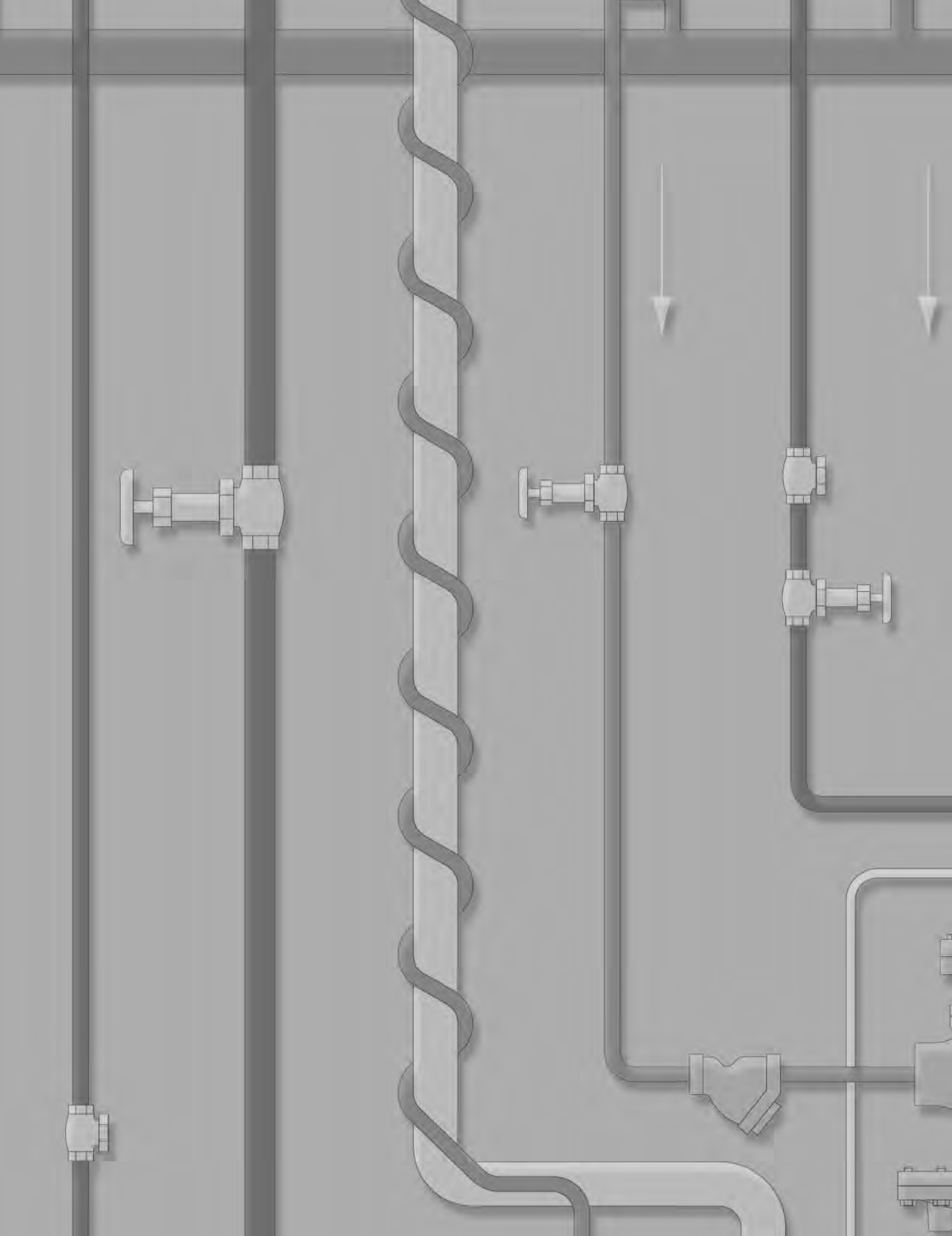
- Forged Steel (ASTM A105, ASTM A350 LF2)

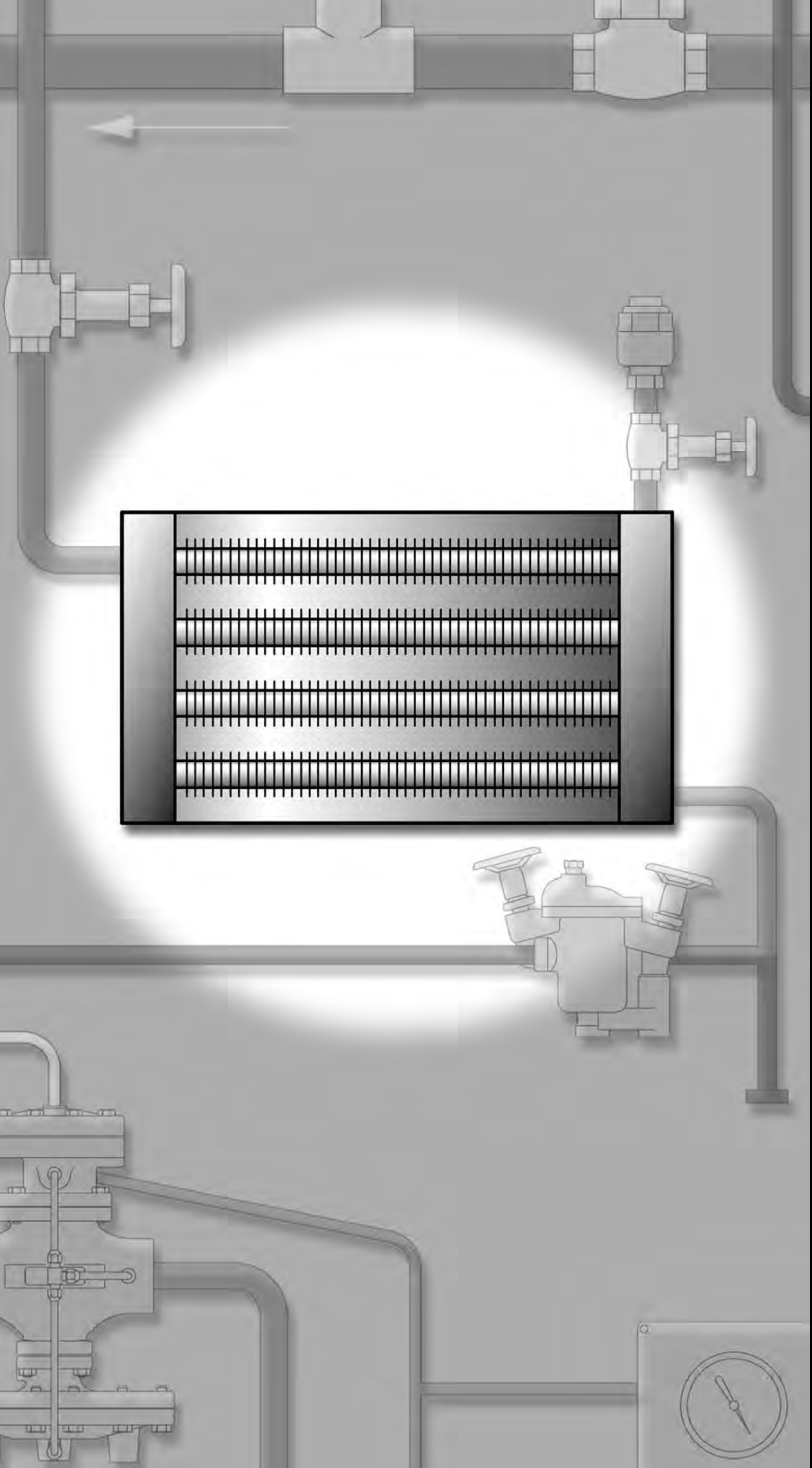
Material of Construction – Graphite Ring Stack

- Flexible Graphite and SS 316

Design Standards

- ASME (B16.34, B16.10, B16.5)
- API (600, 602)
- IBR 1950
- DIN (3202, 10226-1)
- Inspection and testing (API 598)
- Leak test (ANSI/FCI 70-2)
- Fire test (API SPEC 6FA : 1999)





Heating and Cooling Coils

Armstrong

Armstrong®

Why Leaky Coils Are a Losing Proposition

Leaky coils can be the beginning of the end for efficient heat transfer. Although coils may fail for a variety of reasons, mechanical failure and corrosion are the culprits in the majority of cases. When coils corrode, unwanted moisture and contaminants may foul the air stream or exhaust gases. And a steam leak from a badly corroded coil simply blows precious energy off into the atmosphere.

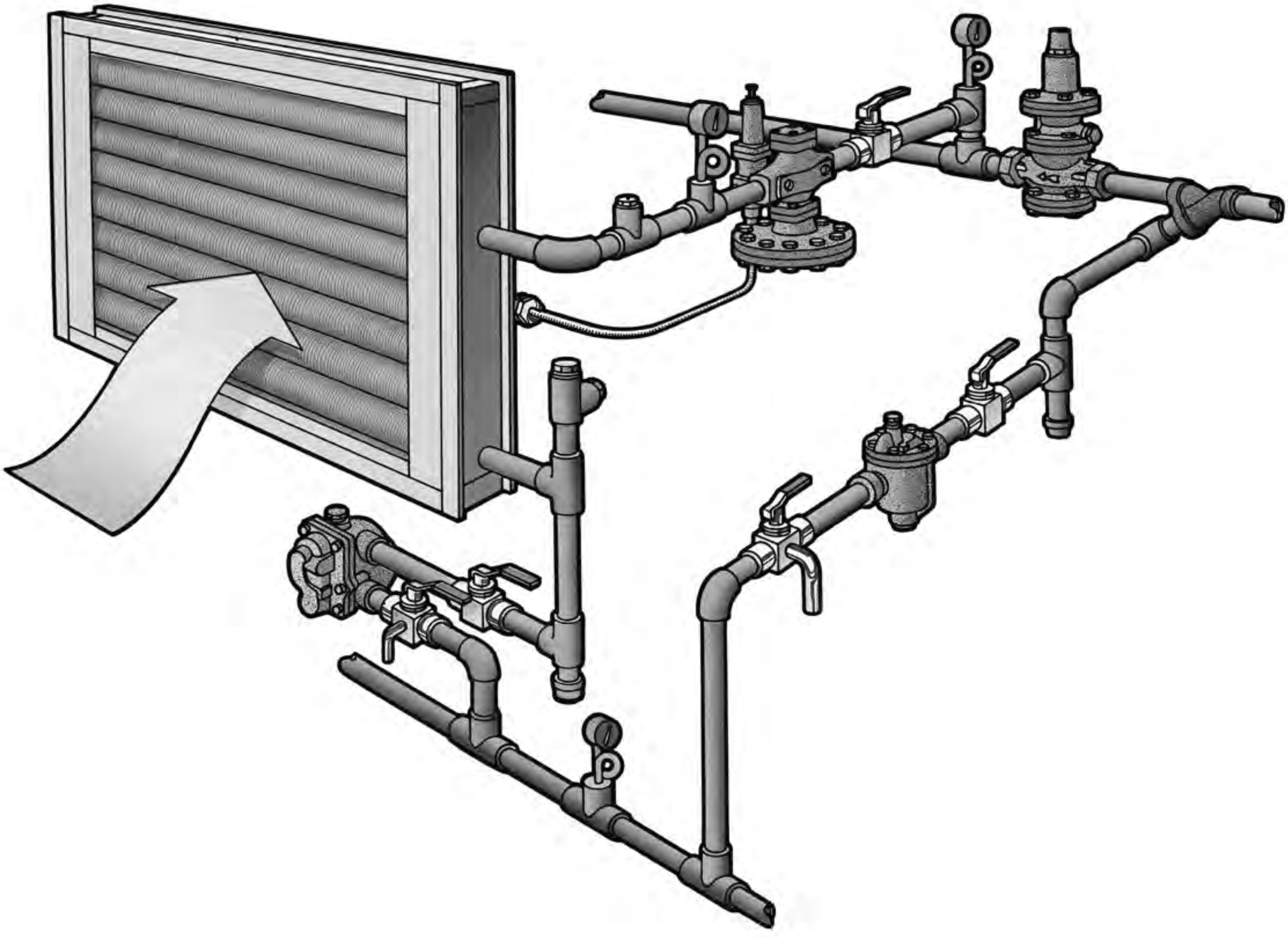
External corrosion. Contaminants in the airstream cause external corrosion. Dirt buildup intensifies corrosive action by trapping contaminants in concentrated pockets. And it's accelerated when dirt becomes strong airborne mist. Factors such as inappropriate fin pitch, fabricating techniques and material selection may also fuel external corrosion.

Internal corrosion. Retention of contaminated condensate or inadequate venting of non-condensable gases are major causes of internal corrosion. When CO_2 gas dissolves in condensate that has cooled below steam temperature, it forms highly corrosive carbonic acid. Likewise, oxygen left to stagnate in the system fosters corrosive action by pitting iron and steel surfaces. Joining pipes/tubes in headers of dissimilar materials may spawn galvanic action. Internal stresses due to improper welding may also hasten corrosion damage.

Armstrong to the Rescue

Armstrong's help in coil selection and design is one of the best defenses against external corrosion. We offer a wide selection of fin pitches to help combat dirt buildup. What's more, sturdy fins lend extra strength to withstand high-pressure cleaning without damage or distortion. As a defense against non-environmental factors, Armstrong fabricates coils in a full range of metals and alloys. You may also specify special coatings to increase external corrosion resistance.

Proper trapping and venting—a specialty of your Armstrong Representative—is where defense against internal corrosion



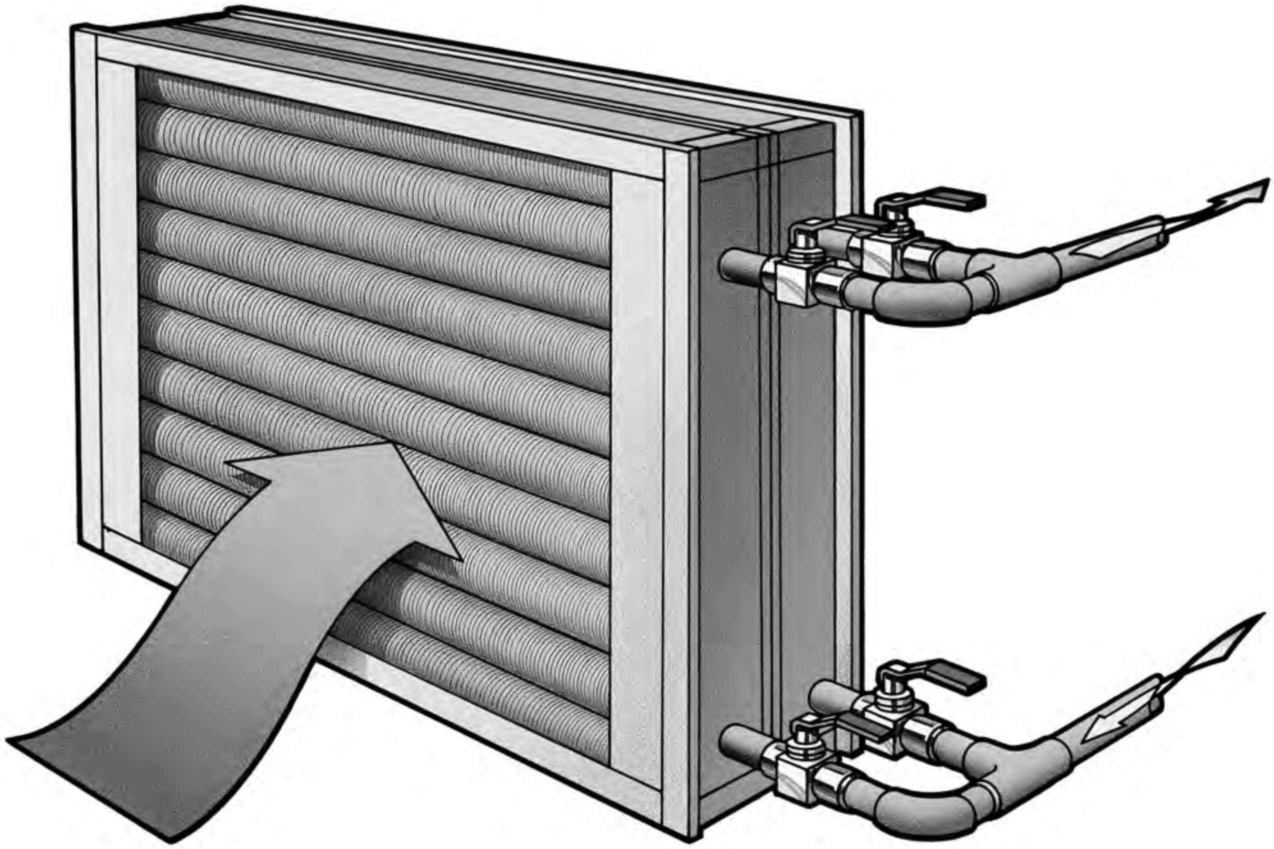
begins. Armstrong reps are steam specialists with more than 75 years of experience in properly sizing, locating and piping steam traps, strainers, vents and related equipment. That's why only Armstrong gives you quality steam coils—plus the installation and trapping help you need to make them work in your total system.

A System to Make Yours More Efficient

Today, the Armstrong "system" merges coil-building experience, practical knowledge and technical know-how from years of trapping coil installations. The result: coils that survive the rigors of high pressures, high temperatures and corrosive conditions.

For example, Armstrong fabricates standard steel heating coils from 1" OD 12 ga ERW Tube (.109" wall) helically wound with 0.024" thick steel fins at varying fin pitches. Each coil is tested during construction, and the completed unit is again tested hydrostatically to not less than 1.3 times the design pressure with a standard testing pressure at 450 psig for steel or stainless steel cores.

It's this simple: It takes one system to improve another. Exactly how the Armstrong system of product and service carefully matches coils to your specs and applications is the subject of the following pages.



Material Selection for Tubes, Headers and Connections

The choice of tube material depends upon several important factors:

- The corrosive quality of the steam or liquid medium
- The ability to pipe, trap and vent steam coils effectively
- The size and service requirements of the installation
- The external corrosion to which the coils are likely to be subjected

Generally speaking, the heat transfer characteristics of the tube material are of little consequence. The table on the next page illustrates the relative effect of tube materials on overall heat transfer. Because the fin area constitutes the vast majority of the heat transfer surface, it is the most important factor determining heat transfer effectiveness. Therefore, the choice of tube materials should be based on service requirements, not heat transfer efficiency.

Internal corrosion. The base material found in the 6000 Series coils is steel. The minimum wall thickness is .109" for steam coils and liquid coils, which affords both strength and corrosion resistance. All Armstrong coils are of monometallic design, which means that all wetted parts are made of the same materials. This precludes the likelihood of galvanic corrosion often experienced in coils made of dissimilar materials. For most applications, steel will provide very satisfactory service. In order to do this, however, steam coils must be carefully piped, trapped and vented to ensure good condensate and non-condensable gas evacuation.

The cross section of the coil on the right shows how internal corrosion caused by improper piping, trapping and venting may destroy coils from the inside out.

There are many cases where the steam cannot be conditioned enough to be non-corrosive or it is not possible to pipe, trap and vent the coils properly. For those areas, Armstrong recommends stainless steel wetted parts. Choosing which of these is most appropriate depends on the degree and type of problem as well as the steam pressure involved.

External corrosion. In the case of external corrosion, factors concerning the corrosiveness of the airstream enter into the decision. The choice of steel or stainless steel for the wetted parts depends on the compatibility of those materials with the contaminants in the airstream. In addition to the base materials available, Armstrong also offers hot dipped galvanizing, epoxy dip or baked phenolic coatings. These are frequently used when only external corrosion is a consideration.

Service requirements. These may be as important as the above considerations. Coil failures manifest themselves in many forms, but the most prevalent is failure of the tube-to-header joints. This failure occurs as a result of coil design defects, insufficient material at the tube-to-header joints or because of the method of connecting the tubes to the headers.

Armstrong 6000 Series coils are designed to accommodate the service requirements of the particular installation. They are built with enough material at the tube-to-header joints to make them strong. When differential expansion between tubes in steam coils is likely to over-stress the joints, centifeed type coils are recommended. Finally, Armstrong coils are always of welded construction, providing the best method of connecting the two parts together.

Computer-controlled equipment like this simplifies the process of drilling coil headers.

Tube Materials

The best combination of coil materials is the one that delivers maximum heat transfer and service life. Tubes, regardless of material, contribute little to heat transfer in extended-surface coils. It is the fins, fully exposed to the airstream, that provide the greatest contribution to heat transfer. Therefore, choose tube material on the basis of application.

Relative Heat Transfer Capacities of Identical Coils Using Different Tube Materials

Tube Material	Relative HT Capacity
Copper	1.00
Aluminum	1.00
Steel	.98
Stainless Steel	.95

Material Selection for Fins

The heat transfer coil is essentially a tube on which fins are spirally wound or similarly attached. The fins produce an extended surface to improve heat transfer to or from air or other gases passing over the fins. The effective heat transfer of a coil is based on fin pitch (number of fins per inch), fin height, fin material and method of attachment.

Copper fins offer the best heat transfer, but aluminum fins provide the best overall value. Compared to aluminum fins, steel fins reduce heat transfer. Compared to aluminum and steel, stainless steel fins reduce heat transfer significantly. Fins may be of aluminum, copper, steel, or stainless steel, depending on contaminants, operating conditions and economic considerations.

The selection of fin materials should be based upon several considerations:
- The heat transfer characteristic desired
- The compatibility of the material with the air stream
- The amount and type of particulate matter in the air stream
- The frequency and aggressiveness of coil cleaning

The table below illustrates the heat transfer effectiveness of various fin materials with Armstrong coils. Note that these relative heat transfer capacities are for a specific set of conditions. The factors will vary with different conditions.

The fin/tube combinations available are listed on page 349.

Relative Heat Transfer Capacities of Armstrong Coils With Tubes and Fins of Various Materials*

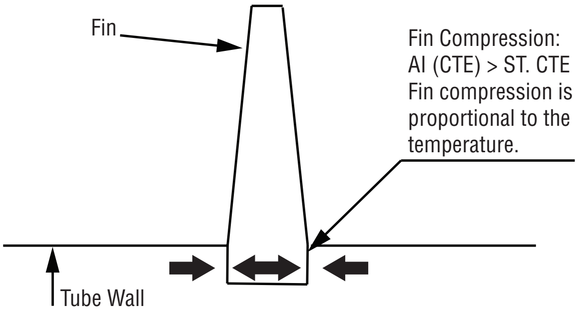
Tube Material	Fin Material	Relative HT Capacity
Steel	Copper Keyfin	1.05
Steel	Aluminum Keyfin	1.00
Stainless Steel	Aluminum Keyfin	.94
Steel	Steel L Fin	.92
Stainless Steel	Stainless Steel L Fin	.58

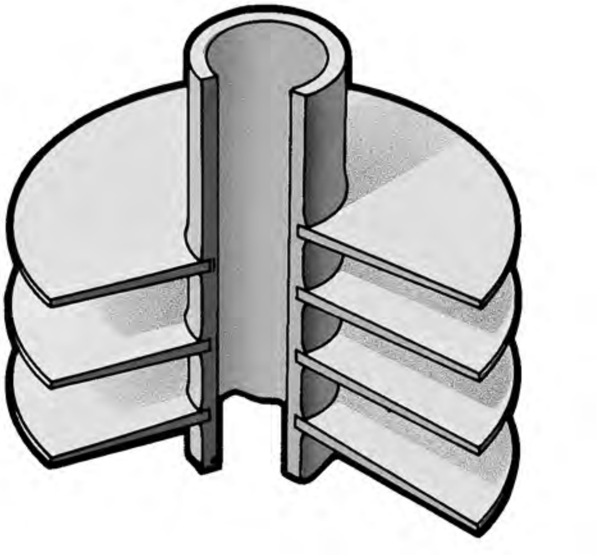
*At 800 ft/min velocity, 7 fins/inch and 300°F steam temperature. Will vary at other conditions.

Fin Types

Keyfin

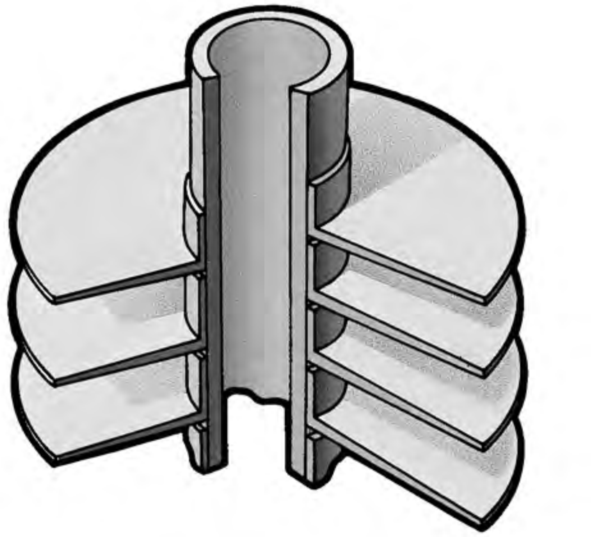
The keyfin is the standard design for Armstrong's most popular coils. Keyfin coils are manufactured by forming a helical groove in the tube surface, winding the fin into the groove and peening the displaced metal from the groove against the fin. This means a tight fit between the fin and the tube, providing for efficient operation over wide temperature ranges. Keyfin is the superior design for dissimilar fin and tube materials.





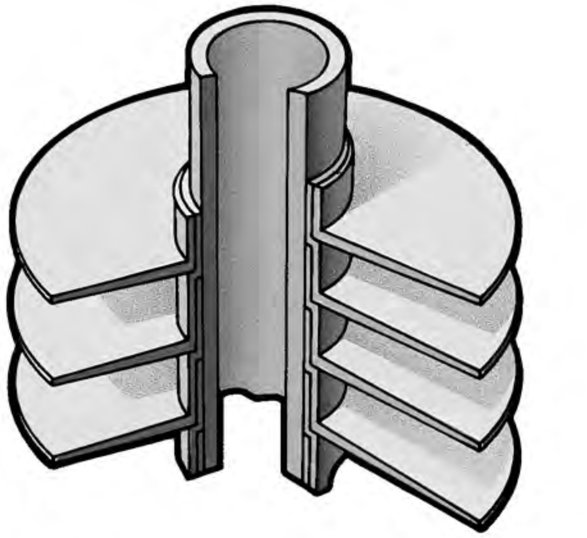
L Fin

The L fin has a "foot" at its base and is tension wound on knurled tube material. The L-shaped base provides a large contact area between the tube and the fin, ensuring effective, long-lasting heat transfer. The L fin is recommended when tubes and fins are of the same material.



Overlap L Fin

The overlap L fin is simply an L fin with an extended base. Each fin overlaps the foot of the previous fin, completely covering the tube surface. The overlap technique makes it possible to create a completely aluminumized coil for applications where exposed steel would be vulnerable to corrosion.



Why Settle for What's "Available" When You Can Specify Exactly What You Need?

Armstrong manufactures heavy-duty industrial coils in a wide range of sizes and materials to meet virtually any application demand. Dimensionally duplicated to fit your exact requirements, Armstrong coils are what you need. Whether it's off the shelf or off the wall. Other materials will be considered upon request.

Construction Features		
Tubes/Pipes		
Carbon Steel Tubes	Standard Optional	12 ga A-214 ERW 10 ga A-214 ERW 12 ga A-179 seamless 10 ga A-179 seamless
Carbon Steel Pipes	Optional	Sch 80 seamless; A-106 Gr 'B'
Stainless Steel Tubes	Standard Optional	14 ga (1" OD) 12 ga (1-1/2" OD) A-249 type 304L 14 ga (1" OD) 12 ga (1-1/2" OD) A-249 type 316L
Fins		
Steel	Standard	0.024" thick on 3/4" NPS pipes 0.024" thick on 1" OD tubes 0.036" thick on 1-1/2" OD tubes & 1" NPS & larger pipe
Aluminum	Standard Optional	0.020" thick on all tube sizes 0.016" thick on 1" OD 0.030" heavy keyfin 1" & 1-1/2" OD steel and stainless steel tube
Stainless Steel		0.020" thick type 304 & 316 on all sizes
Copper		0.016" thick on all sizes
Connections		
Steel		Sch 80 (screwed), Sch 40 (flanged)
Stainless Steel		Sch 40 (screwed), Sch 10 (flanged)
Headers		
All coils have headers of the same material as tubing and are of welded construction.		
Casing		
Galvanized Steel	Standard	Minimum 12 ga galvanized for depth 7-1/2" and over Minimum 14 ga galvanized for depth under 7-1/2"
Stainless Steel	Optional	14 ga type 304 & 316 for all depths
Aluminum	Optional	12 ga for all depths
Other gauge material available on request. All casings have drilled flanges for duct mounting unless specified otherwise.		
Design Pressure		
Standard design pressure for steel coils is 300 psig @ 650°F, stainless steel coils 300 psig @ 500°F. Hot oil coil: 250 psig @ 750°F. Higher pressure and/or temperature construction is available on request. -20°F MDMT, lower MDMT available on request.		
Testing		
All coils are tested hydrostatically to at least 1.3 times the working pressure with a standard testing pressure at 450 psig on steel & stainless steel steam coils.		
Options		
Steel tube with steel fin coils can be supplied hot dip galvanized. Steel/steel and steel/aluminum coils can be supplied with baked phenolic or epoxy coatings. Coils are available with ASME Section VIII, Division I, "U" stamps or CRN approval.		

Model Number Selection Series 6000 Coils

MODEL NUMBER

S H 2 – A 09 – Q 08 – 30 x 72 x 6 –

TYPE OF COIL

L = Liquid
S = Standard
C = Centifeed
T = Tandem, Opposite-End Conns
P = Tandem, Same-End Conns

PIPE/TUBE/AIRFLOW ORIENTATION

H = Horiz. Tubes/Horiz. Air
V = Vert. Tubes/Horiz. Air
D = Horiz. Tubes/Vert. Down Air
U = Horiz. Tubes/Vert. Up Air

ROWS DEEP IN DIRECTION OF AIRFLOW

FIN TYPE AND METALLURGY

A = Aluminum Keyfin (.020")
B = Aluminum Heavy Keyfin (.030")
D = Aluminum G Fin (.020")
E = Aluminum Overlap L Fin (.020")
F = Copper Keyfin (.016")
G = Steel L Fin (.024") on 3/4" NPS Pipe and 1" OD Tube (.036") on 1-1/2" OD Tube and 1" Pipe
H = Steel G Fin (.024")
J = 304 Stainless Steel L Fin (.020")
K = 316 Stainless Steel L Fin (.020")
U = Aluminum Keyfin (0.016")

FINS PER INCH (FPI)

PIPE/TUBE TYPE AND METALLURGY

N = Sch 40 Seamless Steel Pipe (SA-106 Gr B)
P = Sch 80 Seamless Steel Pipe (A-106 Gr B)
Q = 12 ga Steel Tube (A-214 ERW)
R = 10 ga Steel Tube (A-214 ERW)
S = 12 ga Steel Tube (A-179 SMLS)
T = 10 ga Steel Tube (A-179 SMLS)
U = Sch 10 304L SS Pipe (A-312)
V = Sch 10 316L SS Pipe (CA-312)
W = 14 ga 304L SS Tube (A-249)
X = 12 ga 304L SS Tube (A-249)
Y = 14 ga 316L SS Tube (A-249)
Z = 12 ga 316L SS Tube (A-249)

PIPE NOMINAL BORE SIZE OR TUBE OD IN ONE-EIGHTHS OF AN INCH

CASING WIDTH (INCHES)

CASING LENGTH (INCHES)

CASING DEPTH (INCHES)

LIQUID COILS=NUMBER OF PASSES TH & PH TANDEM STEAM COILS= (L) OR (R) HAND OF COIL*

SPECIFY:

Number, Size and Type of Connections

Also call out non-standard items such as:
Header Inside or Outside of Casing
Special Casing Flange Width and Drilling
Airtight Casing
Mounting Plate (removable type)
Coatings, etc.
Number of Inlets
Connection Location
Fluid Circuiting (for Liquid Coil)

---

*Hand of coil is determined by the position of either the condensate connection or the leaving liquid connection when facing the coil with the airflow to your back.

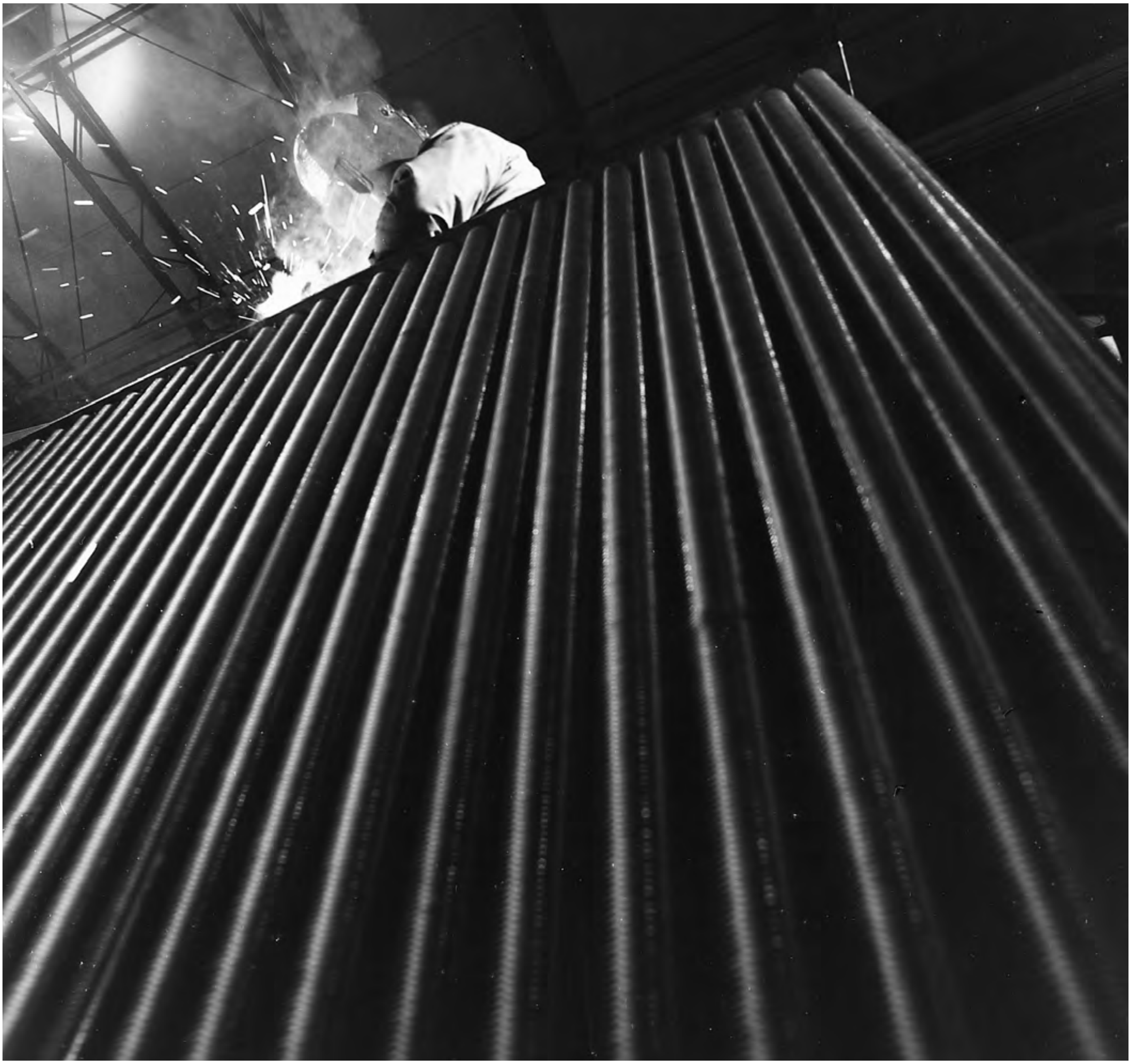
Steam Coils

For air heating coils, steam is the preferred medium for heat transfer throughout much of industry. It affords advantages over liquids because it is easy and inexpensive to move from the boiler to the point of use and because it gives up so much energy at a constant temperature when it condenses. Process control is easily and quickly accomplished with essentially no lag time as is experienced with liquids.

The selection of coil construction and materials is a multi-step process that must take a number of factors into consideration. Armstrong's line of heavy-duty steam coils is designed and manufactured to provide the long life and efficient heat transfer that pays dividends over a long period of time.

Selection of Steam Coil Circuitry

The following pages show the four types of coil circuits offered by Armstrong and discuss the application parameters of each. The return bend type circuit is not covered because Armstrong feels that one of the four listed circuits is a better choice for most applications.



Armstrong can build coils to a wide variety of material and performance specifications and dimensionally duplicate replacement coils to fit your exact requirements.

Armstrong® Series 6000 Steam Coil Types

Standard Coils (Type S)

This type of coil is used for most applications where entering air temperatures are above 35°F and steam is at constant pressure. It is used extensively in high-temperature process applications and for "reheat" in HVAC systems. It is not, however, recommended where even outlet air temperatures are required immediately after the coil, such as in multi-zone heating systems, or where a modulating steam control valve is used to control temperature.

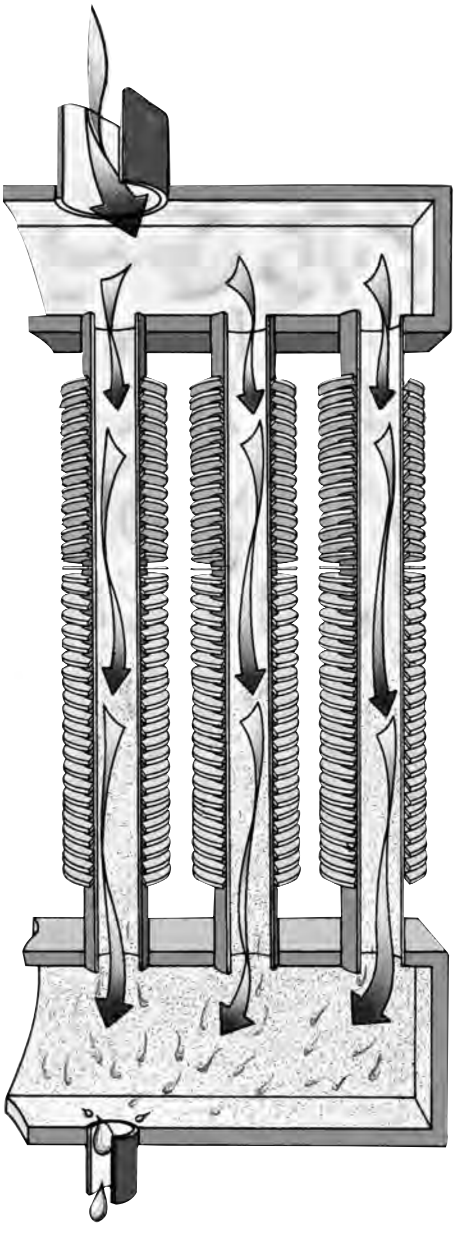
Centifeed Coils (Type C)

The single-row centifeed coil can be used where air is below freezing and/or modulating control is used. Recommended where:

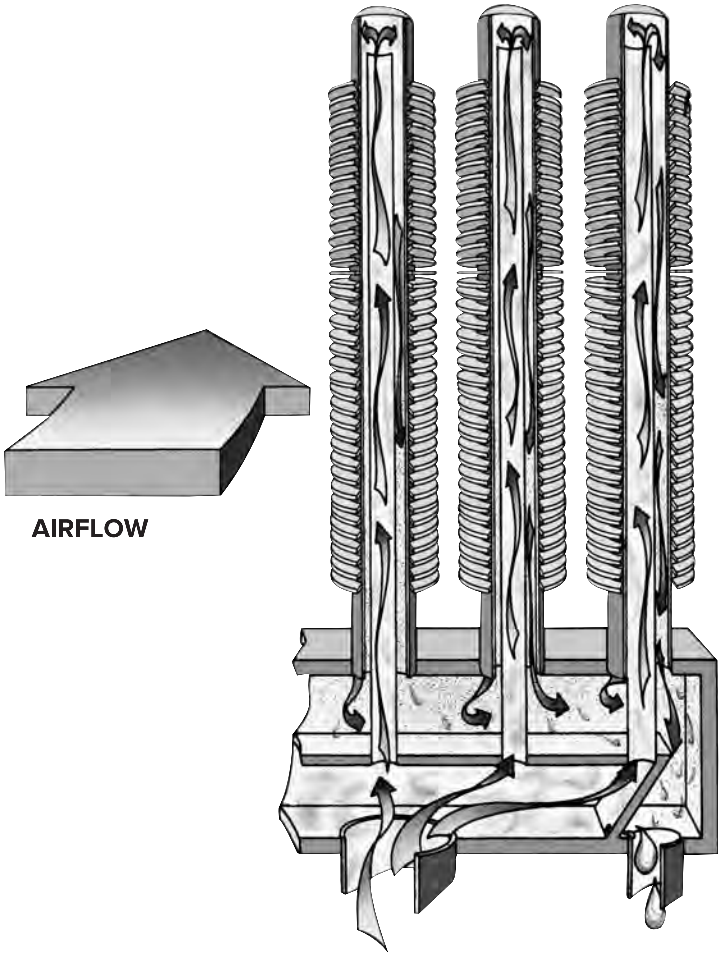
- **A** A single row delivers the required performance
- **B** A modulating steam control valve is used
- **C** Even outlet air temperatures are required over the whole coil face
- **D** Stainless steel tubes are used

Two-row centifeed coils are available where (B) and (C) are required, but tandem type coils are a better choice with freezing air temperatures.

A centifeed coil is one plain tube—called the inner steam distribution tube—inserted inside an outer finned tube. The center tube is fed with steam, which travels up this distribution tube and is then discharged into the outer tube. It then travels back between the outside wall of the distribution tube and the inside wall of the finned tube to the condensate header. The inner tube acts as a steam tracer to keep the finned tube warm along its total length.



Type S coils are available with opposite-end connections only.



Type C coils are available with same-end connections only.

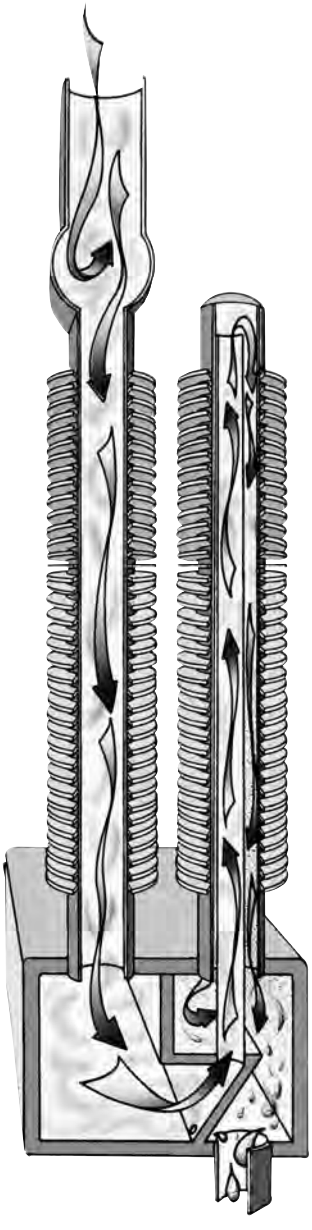
Tandem Coils (Types T and P)

Freezing applications requiring more than one row to achieve the desired final air temperature demand this type of coil.

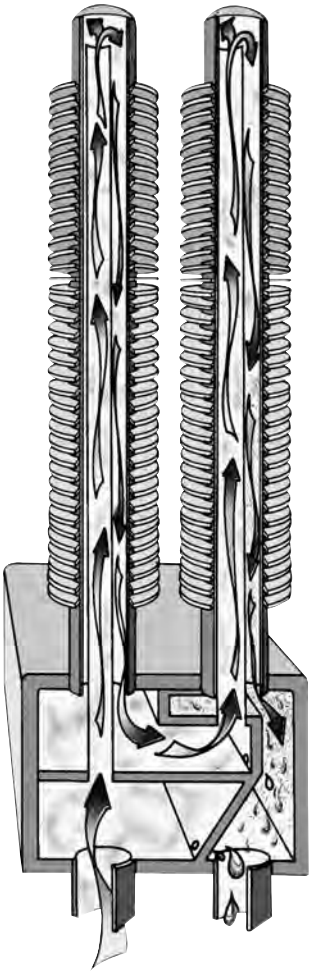
The coil is designed so that the total amount of steam to be condensed by the whole coil is fed into the first row in the direction of airflow. This purges non-condensable gases and droplets of condensate from that part of the coil exposed to the coldest air. Channeling the steam from the header to the other rows in series has the same purging effect. This design ensures that air passing over the last row is at least 35°F.

The coldest part of the coil will always have steam in sufficient quantity to overcome unequal distribution and "backfeeding" due to differing steam loads and pressure drops in adjacent tubes. This eliminates freezing problems caused by condensate holdup.

The "series" feed characteristic of the tandem coil, as opposed to the "parallel" feed of the two-row centifeed coil, makes it the ideal choice for multi-row coils in freezing applications. If you want a stainless steel tube tandem, specify a P type.



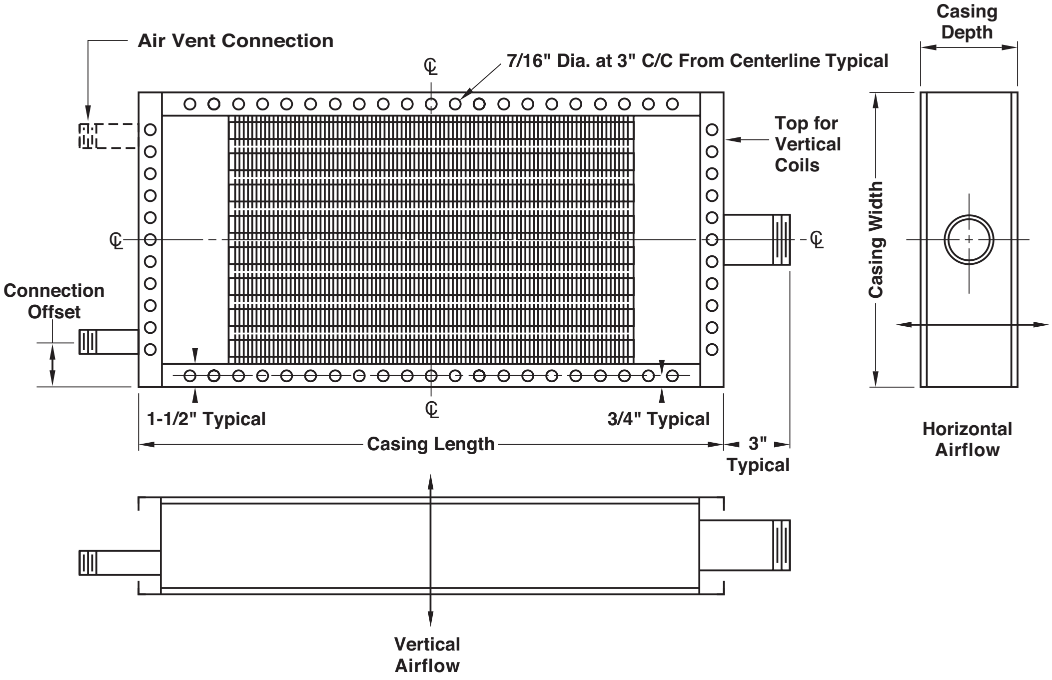
Type T coils have opposite-end connections.



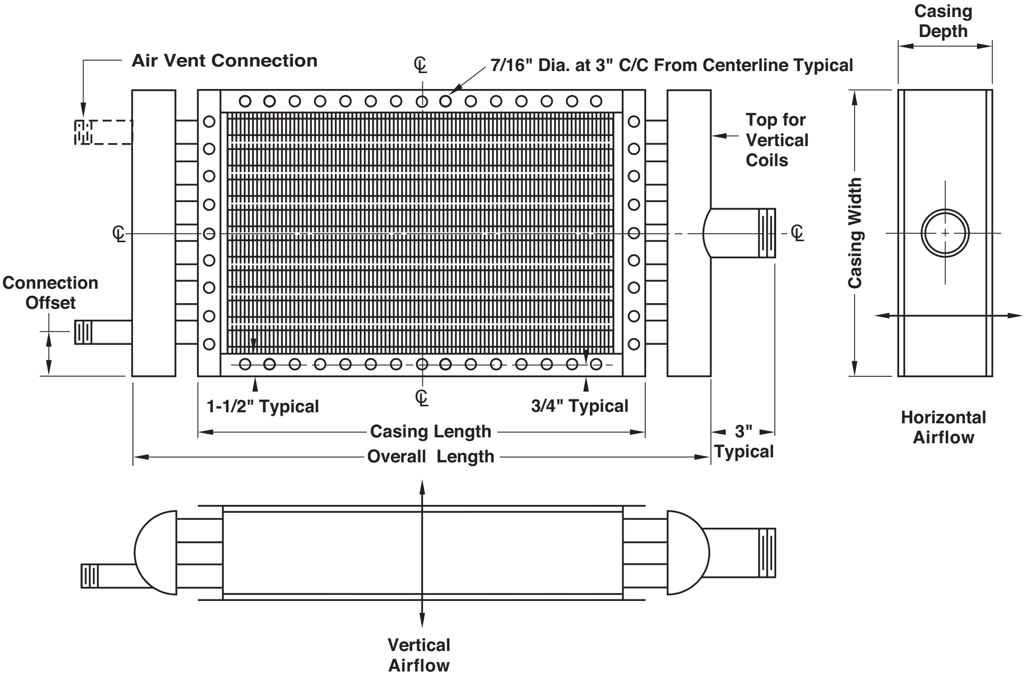
Type P units have same-end connections.

Steam Coil Typical Arrangements

- **Standard Coils (Type S)**
- **Tandem Coils (Type T)**
- **For Vertical or Horizontal Airflow**
- **With Headers Inside the Casing**



- **Standard Coils (Type S)**
- **Tandem Coils (Type T)**
- **For Vertical or Horizontal Airflow**
- **With Headers Outside the Casing**



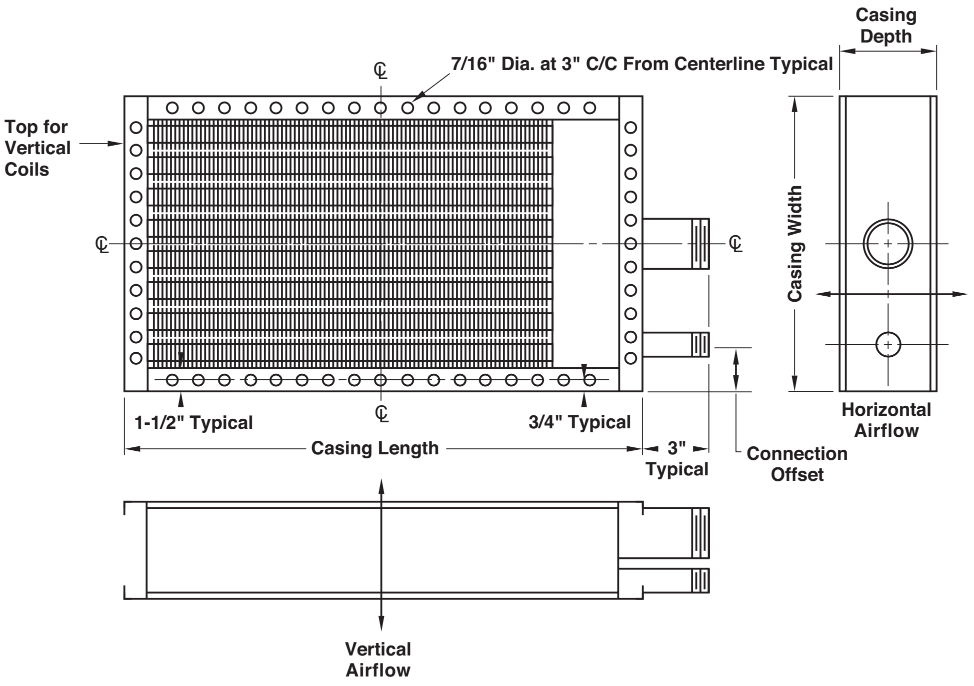
NOTES:

Always specify airflow directions and tube orientation when ordering coils.
Specify all dimensions for replacement coils, especially those varying from typicals above.
If coils are to be Tandem type, specify coil hand by facing the coil with airflow at your back and pointing to the condensate connection.

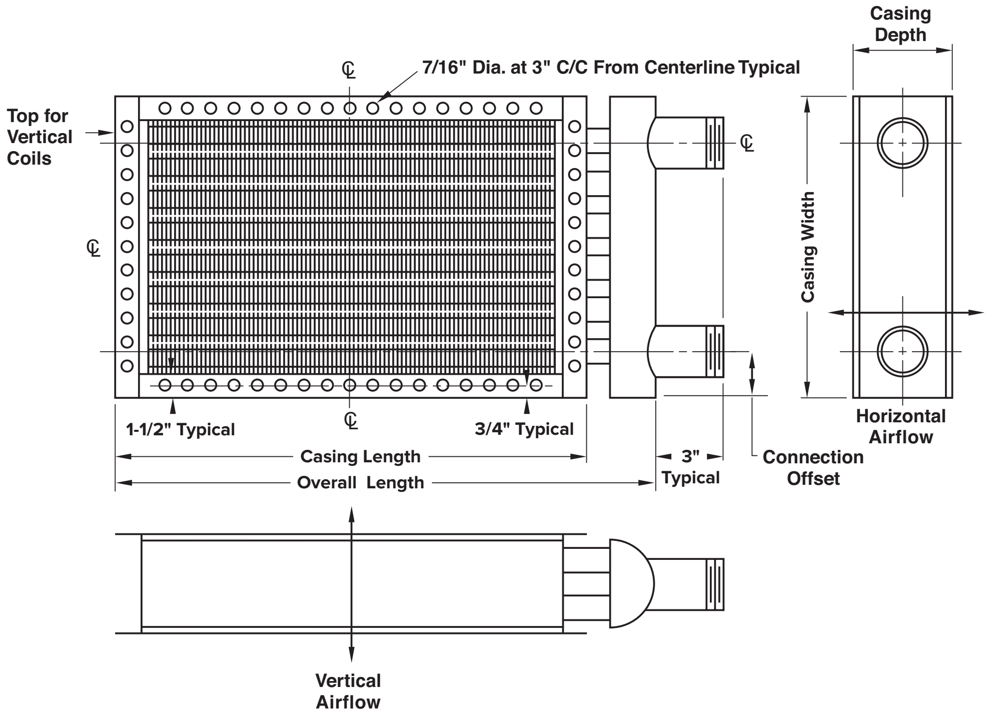
Minimum tandem casing depth is 7-1/2", contact factory for details.

Steam Coil Typical Arrangements

- **Centifeed Coils (Type C)**
- **Centifeed Tandem Coils (Type P)**
- **For Vertical or Horizontal Airflow**
- **With Headers Inside the Casing**



- **Centifeed Coils (Type C)**
- **Centifeed Tandem Coils (Type P)**
- **For Vertical or Horizontal Airflow**
- **With Headers Outside the Casing**

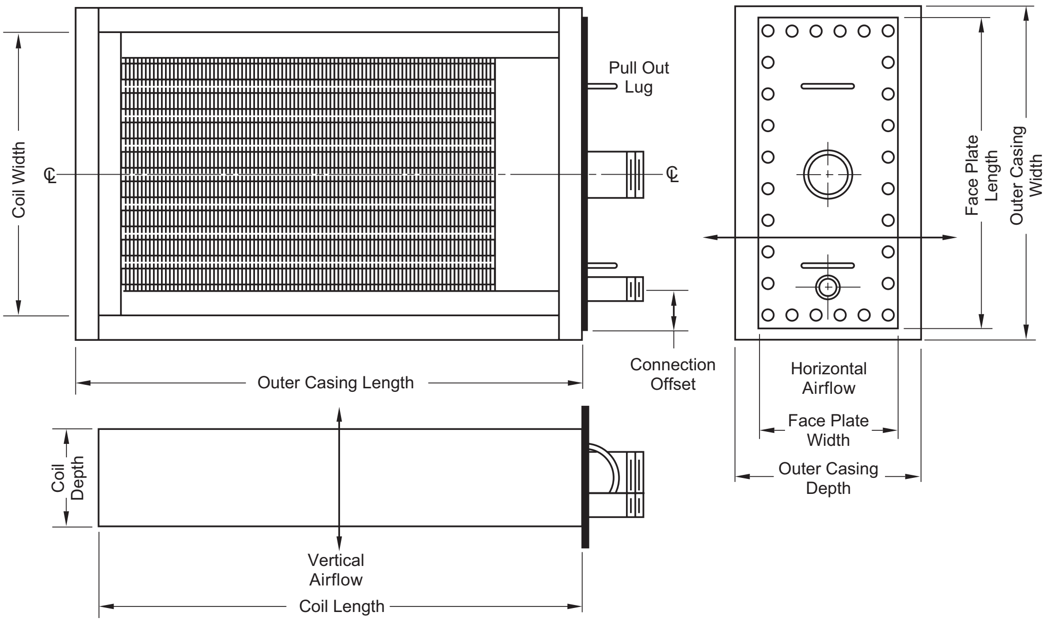


NOTES:

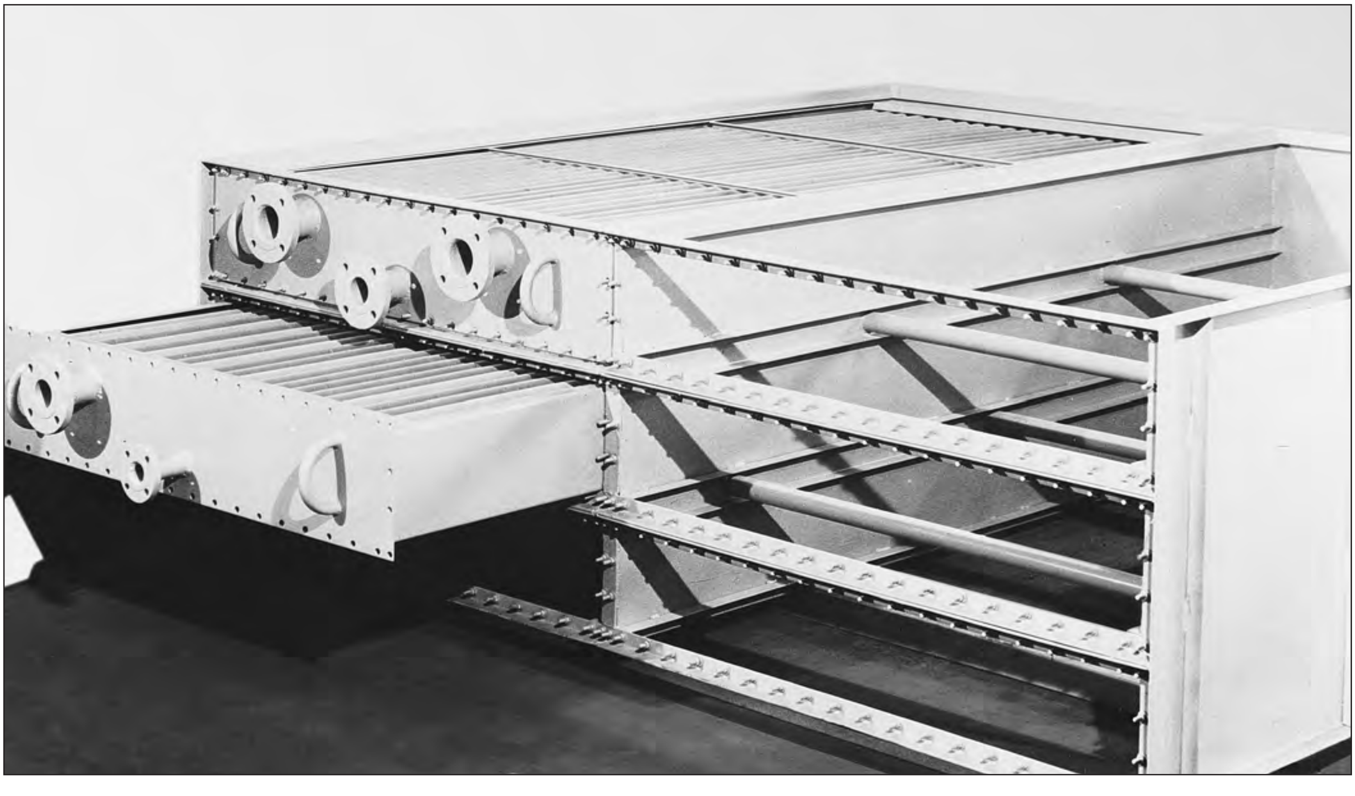
Always specify airflow directions and tube orientation when ordering coils.
Specify all dimensions for replacement coils, especially those varying from typicals above.
If coils are to be Tandem type, specify coil hand by facing the coil with airflow at your back and pointing to the condensate connection.

Armstrong® Steam Coil Typical Arrangements

- **Removable Coils**
- **Centifeed Coils (Type C)**
- **Centifeed Tandem Coils (Type P)**
- **For Vertical or Horizontal Airflow**
- **With Headers Inside the Casing**

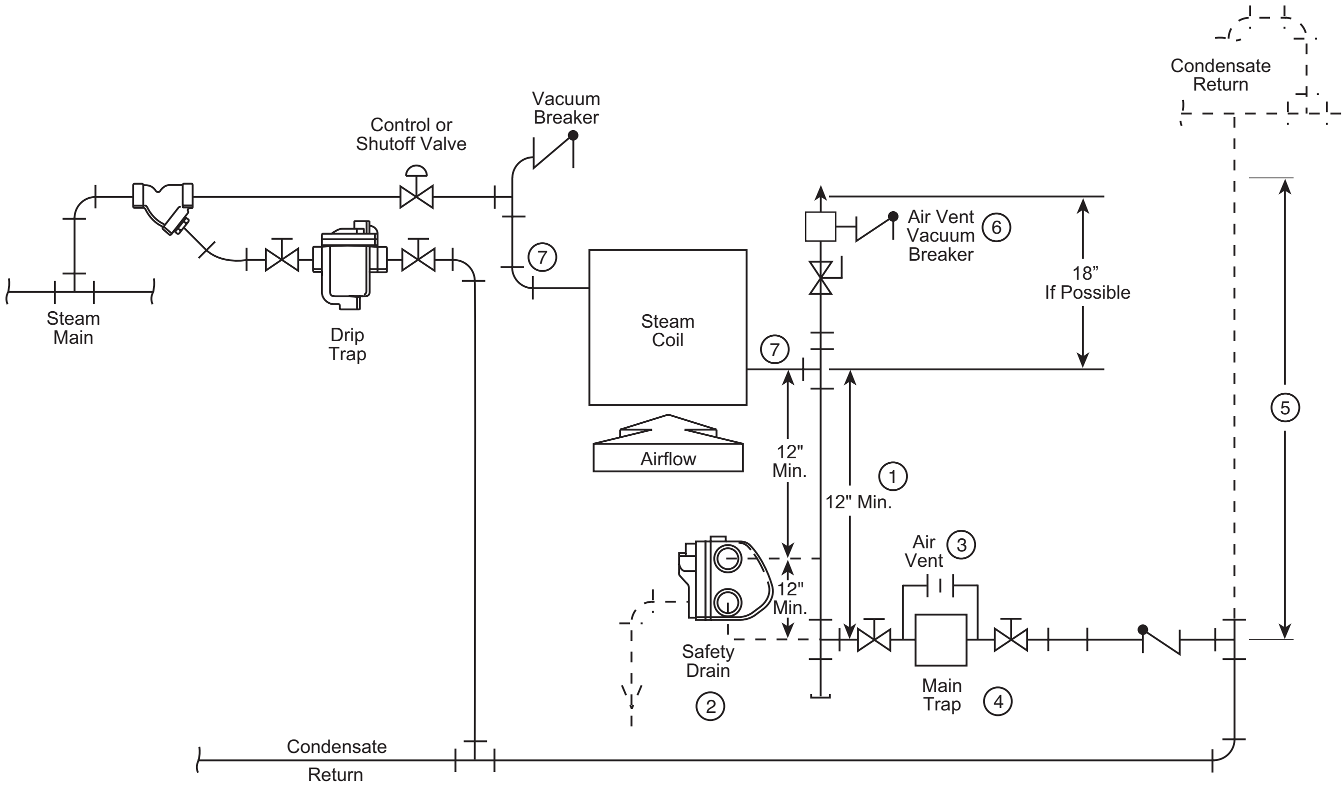


NOTES: Always specify airflow directions and tube orientation when ordering coils.
Specify all dimensions for replacement coils, especially those varying from typicals above.
If coils are to be Tandem type, specify coil hand by facing the coil with airflow at your back and pointing to the condensate connection.
Removable coils can be designed for removal from either connection end or end opposite connections.



Removable coils with outer casing (removable from connections end configuration shown above).

Recommended Piping Practices for Steam Heating Coils



1. 24" minimum if safety drain is used.
2. Safety drain is used if steam supply is modulated and the condensate system is pressurized or overhead. Armstrong’s pumping traps or Posi-Pressure Control system provides additional protection or may substitute for the safety drain, especially if condensate conservation is desired.
3. Air venting must be provided on all steam coils except those using low-pressure Posi-Pressure Control systems. The air vent may either be an orifice bleed or a thermostatically operated element, with the orifice bleed being the preferred choice. The air vent or orifice bleed should be piped so that it cannot be valved out independently of the trap.
4. The main trap may be either an inverted bucket or a float & thermostatic type depending upon the service conditions. See the chart below for recommendations. Inverted bucket type steam trap required with Posi-Pressure Control system.
5. Overhead condensate return system.
6. Required only on a modulated system.
7. Provide a flexible connection or swing joint at the coil inlet and outlet connections to isolate the coil from vibration, piping stresses and differential expansion within the coil.

NOTE: See Bulletin AH-825 for detailed operation and maintenance procedures. Recommended practice valid for all steam coils (Duralite, Series 6000 and Duramix.)

Armstrong Steam Trap Selection Guide

Equipment	Selections	Constant Pressure		Modulated Pressure	
		0 - 30 psig	Above 30 psig	0 - 30 psig	Above 30 psig
Unit Heaters	1st Choice	IBLV	IBLV	F&T	F&T
	2nd Choice	F&T	F&T	IBLV	IBLV
Air Handlers	1st Choice	IBLV	IBLV	F&T	F&T
	2nd Choice	F&T	F&T	IBLV	IBLV
		0 - 250 psig	Above 250 psig	0 - 30 psig	Above 30 psig
Process Coils	1st Choice	IBLV	IBLV	F&T	F&T
	2nd Choice	F&T	IBLV	IBLV	IBLV
Duramix	1st Choice	IBLV	IBLV	Not Recommended	

Steam Coil Sizing

Not for Retrofit

Date: ______________________________ **Representative:** ______________________________

Salesperson: ______________________________ **Application:** ______________________________

Customer: ______________________________ **Customer Location:** ______________________________

Performance Requirements

Air Flow Quantity ___________ ☐SCFM ☐ACFM ☐lb/hr (check one)

Altitude _________________ feet above sea level

Humidity Ratio ___________ lb. moisture/lb. dry air (process applications only)

Design Entering Temperature _______ °F

Design Leaving Temperature________ °F

Steam Pressure at the coil(s) ___________ ☐psig ☐psia

Steam Pressure ☐Modulated ☐Constant

Maximum Air Pressure Drop______ in wg

Special Requirements Not Covered Above ____

____

System and Coil Configuration Requirements

Air Flow Direction: ☐Horizontal ☐Vertical UP ☐Vertical DOWN (check one)

Fan Location: ☐Before Coils ☐After Coils (check one)

Coil Tube Orientation: ☐Horizontal ☐Vertical ☐Optional (check one)

Type of Coil: ☐Standard ☐Centifeed ☐Tandem ☐Centifeed-Tandem ☐Optional

Connection Type: ☐MPT ☐FPT ☐Flanged

Connection Location: ☐Opposite End ☐Same End ☐Optional

Tube Material: ☐Steel ☐304L Stainless ☐316L Stainless (check one)

Fin Material: ☐0.020” Aluminum Keyfin ☐0.030” Aluminum Keyfin

☐0.016” Copper Keyfin ☐Steel/L-Fin ☐Stainless Steel/L-Fin

Coils to be: ☐Duct Mounted ☐Removable with Outer Case ☐Core Only(check one)

Special Requirements Not Covered Above ____

____

Steam Coil Sizing

Replacement for Existing Coils

Armstrong®

Date: ______________________________ **Representative:** ________________________

Salesperson: __________________________ **Application:** ___________________________

Customer: ____________________________ **Customer Location:** _____________________

Performance Requirements

Air Flow Quantity __________ ☐SCFM ☐ACFM ☐lb/hr (check one)

Altitude _______________ feet above sea level

Humidity Ratio __________ lb. moisture/lb. dry air (process applications only)

Design Entering Temperature ______ °F

Design Leaving Temperature _______ °F

Steam Pressure at the coil(s) __________ ☐psig ☐psia

Steam Pressure ☐Modulated ☐Constant

Maximum Air Pressure Drop_____ in wg

Special Requirements Not Covered Above ____

____

System and Coil Configuration (Existing Installation)

Air Flow Direction: ☐Horizontal ☐Vertical UP ☐Vertical DOWN (check one)

Fan Location: ☐Before Coils ☐After Coils (check one)

Coil Tube Orientation: ☐Horizontal ☐Vertical ☐Optional (check one)

Type of Coil: ☐Standard ☐Centifeed ☐Tandem ☐Centifeed-Tandem ☐Optional

Connection Type: ☐MPT ☐FPT ☐Flanged Inlet:______ inches Outlet:______ inches

Connection Location: ☐Opposite End ☐Same End ☐Optional

Tube Material: _________________________

Fin Material: _______ ; Fin Thickness: ___ in; Fins/in _____ (count spaces)

Fin Type: ☐Plate ☐Spiral Wound ☐Extruded ☐Welded

Number of Rows of Tubes in Each Coil: ☐One ☐Two ☐Three ☐Other

Number of Coils of Parallel ______; Number of Coils in Deep in Airstream _______

Coils to be: ☐Duct Mounted ☐Removable with Outer Case ☐Core Only(check one)

Special Requirements Not Covered Above ____

____

Coil Requirements (Replacement Coil)

Type of Coil: ☐Standard ☐Centifeed ☐Tandem ☐Centifeed-Tandem ☐Optional

Connection Location: ☐Opposite End ☐Same End ☐Optional

Tube Material: ☐Steel ☐304L Stainless ☐316L Stainless (chek one)

Fin Material: ☐0.020” Aluminum Keyfin ☐0.030” Aluminum Keyfin
☐0.016” Copper Keyfin ☐Steel/L-Fin ☐Stainless Steel/L-Fin

Special Requirements Not Covered Above ____

____

Installation, Operation and Maintenance Instructions

In steam coils, successful operation and a long, trouble-free service life depend on:

1. The manner of installation, including the design of coil mounting and piping—with particular emphasis on trapping and air venting.
2. Operating conditions that are within design parameters.
3. The method of operation.
4. The thoroughness and frequency of cleaning required.

Following these simple guidelines will help you achieve maximum coil performance.

Receipt and Storage

1. Upon receipt, inspect coils and notify carrier immediately of an damage sustained in transit.
2. If coils are not installed immediately, store under cover in a heated area free of potential damage from personnel and/or equipment.

Installation

1. **Support coils and piping individually** to prevent undue strains on the steam and condensate connections. Use swing joints or flexible connections for freedom of movement.
2. Steam and condensate pipes should be the same size as coil connections. Maintain connection size from the coil back to the steam main and from the coil to the steam trap takeoff.
3. **Install a drip trap** prior to the coils (and before a control valve if there is one) to prevent the introduction of condensate.
4. **Install strainers** with blowdown valves before all control valves and traps.
5. To avoid hunting and maintain control, use only modified linear or equal percentage (vee-port) valves when a modulating control valve regulates the steam supply. Consult Armstrong for proper applications.
6. **Never oversize control valves. Bigger is NOT better.**
7. **Install a vacuum breaker** in the steam piping prior to the coil to prevent retention of condensate during shutdown. Also install a vacuum breaker on the downstream side of the coil when steam pressure is to be modulated. If you use check valves as vacuum breakers, they should be 15-degree swing checks.
8. Provide venting of non-condensable gases individually on each coil to ensure maximum heat transfer and minimum internal corrosion. In order of effectiveness, venting can be with a fixed orifice bleed, independent thermostatic vent or by using a float and thermostatic steam trap.
9. Trap all coils individually. Locate trap as close to coil as possible. Otherwise, inadequate drainage may damage the coil and/or interfere with effective heat transfer.
10. Use only traps such as the inverted bucket or float and thermostatic which drain continuously. When steam to the coils is modulated, a float and thermostatic trap is preferred. See the previous page for selection guidelines.
11. **Install a dirt pocket** prior to the steam trap. You may also install a gate valve at the bottom of the dirt pocket to facilitate drainage during shutdown periods.
12. Use the same size trap on all coils when they are in parallel across the duct opening. Coils mounted in series (one behind the other in the direction of the airflow) typically have lower condensing rates at the downstream end of the system. Size traps to handle the maximum calculated load for individual coils. Avoid oversizing. Consult your Armstrong Representative if you need assistance.
13. Modulating control valves are best used with gravity flow vented condensate return systems. If the condensate return system is overhead or pressurized, the use of pumps, Armstrong pumping traps or the Armstrong Posi-Pressure Coil Controller System is highly recommended. If this is not possible a safety drain as illustrated on page 357 should be installed.
14. **Install filters** at the coil inlet if possible. Simple filter systems permit easy cleaning or replacement and ensure efficient operation.
15. Refer to the previous page for an illustration of piping practices for steam heating coils.
16. Provide uniform air velocity and uniform air temperature at the face of the coil. This is very important for good coil performance.

Operation

Once coils are installed properly, their performance and service life depend on a few simple guidelines for maintenance and operation.

1. To prevent plugging of tubes, clean the piping system and blow down all strainers prior to initial startup.
2. On startup, feed steam to the coils slowly to avoid thermal shock loadings.
3. Make sure the steam has been on for a minimum of 15 minutes prior to starting fans or opening dampers.
4. Make sure operating pressures are kept within design limits.
5. During initial startup, tighten all bolted connections once the system stabilizes at operating temperature.
6. To provide maximum freeze protection, maintain a minimum steam pressure of 5 psig to coils exposed to air temperature below 40°F (5°C). If this is impossible, consult your Armstrong Representative.
7. Drain during shutdown to prevent internal corrosion.

Maintenance

1. If filters are installed, clean regularly to maintain adequate airflow across the coils and to keep fan loadings at design.
2. If filters are not used, inspect and clean coils periodically. Clogged filters and plugged coils have the same result.

Liquid Coils

Although steam may be the preferred heating medium for coils, liquids such as water, glycol solutions and high temperature heat transfer fluids are coming into wide use. Some of the reasons for the popularity of water and glycol systems are:

- Heat recovery systems are becoming more popular, and hot water or glycol solutions are ideal for that duty
- Hot water may be readily available from such sources as condensate systems or other processes, and it makes sense to use the available heat from those sources
- Users have a preference for liquids over steam

The use of high temperature heat transfer fluids has a number of practical advantages over water and steam when process air has to be heated to high temperatures. These fluids can operate in the 500°F to 750°F range at or near atmospheric pressure as opposed to steam, which would have to be over 1 500 psig in order to achieve a saturation temperature of 600°F. Systems capable of operating at high pressures are expensive to construct and maintain. Corrosion caused by steam and water and the need for water treatment to minimize scale formation result in high maintenance costs. The absence of any need for supervisory staff to be on constant duty is a further advantage of the high temperature heat transfer fluid system.

To meet the needs of industry for heavy duty liquid coils, Armstrong has introduced a line of standardized sizes in seven widths from 16-3/4" to 57-3/4" in 21 lengths from 24" to 144". These are available with fin pitches from 5 to 11 FPI and in 2 or 3 rows. Many circuiting options are available.

As with all Armstrong coils, liquid coils are built to withstand the rigors of tough industrial applications in contrast to the commercial grade coils frequently misapplied in industrial environments.

In addition to the standardized line, custom coils in sizes to fit existing installations and in materials to fit particular applications are also available.

Materials of Construction	
Tubes	1" OD 12 ga (.109" wall thickness) A-214 ERW carbon steel tubes (seamless tubes optional), 10 ga tube also available.
Fins	.020" or .030" thick aluminum keyfin (imbedded).
Headers	Schedule 40 steel or fabricated.
Connections	Water and glycol solutions: • Schedule 80 steel screwed MPT (flanges optional) — same end High temperature heat transfer fluids: • Seamless Schedule 40 steel with 300 lb raised face weld neck flanges—same end
Assembly	All wetted parts are welded into a monometallic structure, affording the greatest strength and corrosion resistance.
Design	250 psig at 750°F. Hydrostatically standard testing pressure at 450 psig.
Casing	Minimum 14 ga galvanized steel primed after manufacture.
Coatings	Special coatings such as baked phenolic or epoxy powder are available as options. These coatings are suitable for temperatures up to 400°F.

Armstrong®

Liquid Coil Sizing

Not for Retrofit

Date: ______________________________ **Representative:** ________________________

Salesperson: __________________________ **Application:** __________________________

Customer: ____________________________ **Customer Location:** ____________________

Performance Requirements

Air Flow Quantity __________ ☐SCFM ☐ACFM ☐lb/hr (check one)

Altitude ______________ feet above sea level

Humidity Ratio __________ lb. moisture/lb. dry air (process applications only)

Design Entering Temperature ______ °F

Design Leaving Temperature ______ °F

Liquid Type ____________________

Entering Liquid Temperature _______ °F

Leaving Liquid Temperature_______ °F (or liquid flow rate _______ gpm)

Liquid Characteristics at Average Liquid Temperature:____________________

Specific Gravity: __________________________

Specific Heat:____________________________

Viscocity: ______________ ☐cp ☐lb/ft-hr (check one)

Thermal Conductivity _______________________

Special Requirements Not Covered Above ______________________________________

____

____

System and Coil Configuration Requirements

Air Flow Direction: ☐Horizontal ☐Vertical UP ☐Vertical DOWN (check one)

Fan Location: ☐Before Coils ☐After Coils (check one)

Coil Tube Orientation: ☐Horizontal ☐Vertical ☐Optional (check one)

Tube Material: ☐Steel ☐304L Stainless ☐316L Stainless (chek one)

Fin Material: ☐0.020” Aluminum Keyfin ☐0.030” Aluminum Keyfin
☐0.016” Copper Keyfin ☐Steel ☐Stainless Steel

Coils to be: ☐Duct Mounted ☐Removable with Outer Case (check one)

Special Requirements Not Covered Above ______________________________________

____

____

Liquid Coil Sizing

Replacement for Existing Coils

Armstrong®

Date: ______________________________ **Representative:** ______________________________

Salesperson: ______________________________ **Application:** ______________________________

Customer: ______________________________ **Customer Location:** ______________________________

Performance Requirements

Air Flow Quantity __________ ☐SCFM ☐ACFM ☐lb/hr (check one)

Altitude _______________ feet above sea level

Humidity Ratio __________ lb. moisture/lb. dry air (process applications only)

Design Entering Temperature ______ °F

Design Leaving Temperature _______ °F

Liquid Type ____________________

Entering Liquid Temperature _______ °F

Leaving Liquid Temperature________ °F (or liquid flow rate ________ gpm)

Liquid Characteristics at Average Liquid Temperature:_____________________

Specific Gravity: ___________________________

Specific Heat:______________________________

Viscocity: ______________ ☐cp ☐lb/ft-hr (check one)

Thermal Conductivity _______________________

Special Requirements Not Covered Above ____

____

System and Coil Configuration (Existing Installation)

Air Flow Direction: ☐Horizontal ☐Vertical UP ☐Vertical DOWN (check one)

Fan Location: ☐Before Coils ☐After Coils (check one)

Coil Tube Orientation: ☐Horizontal ☐Vertical ☐Optional (check one)

Fluid Circuit:____

Connection Type: ☐MPT ☐FPT ☐Flanged Inlet:______ inches Outlet:______ inches

Connection Location: ☐Same End ☐Optional Connection Size: ___________ inches

Tube Material: _________________________

Fin Material: _______ ; Fin Thickness: ___ in; Fins/in _____ (count spaces)

Fin Type: ☐Plate ☐Spiral Wound ☐Extruded ☐Welded

Number of Rows of Tubes in Each Coil: ☐One ☐Two ☐Three ☐Other

Number of Coils of Parallel ______; Number of Coils in Deep in Airstream _______

Coils to be: ☐Duct Mounted ☐Removable with Outer Case ☐Core Only(check one)

Special Requirements Not Covered Above ____

____

Coil Requirements (Replacement Coil)

Type of Coil: ☐Standard ☐Centifeed ☐Tandem ☐Centifeed-Tandem ☐Optional

Connection Location: ☐Opposite End ☐Same End ☐Optional

Tube Material: ☐Steel ☐304L Stainless ☐316L Stainless (chek one)

Fin Material: ☐0.020" Aluminum Keyfin ☐0.030" Aluminum Keyfin

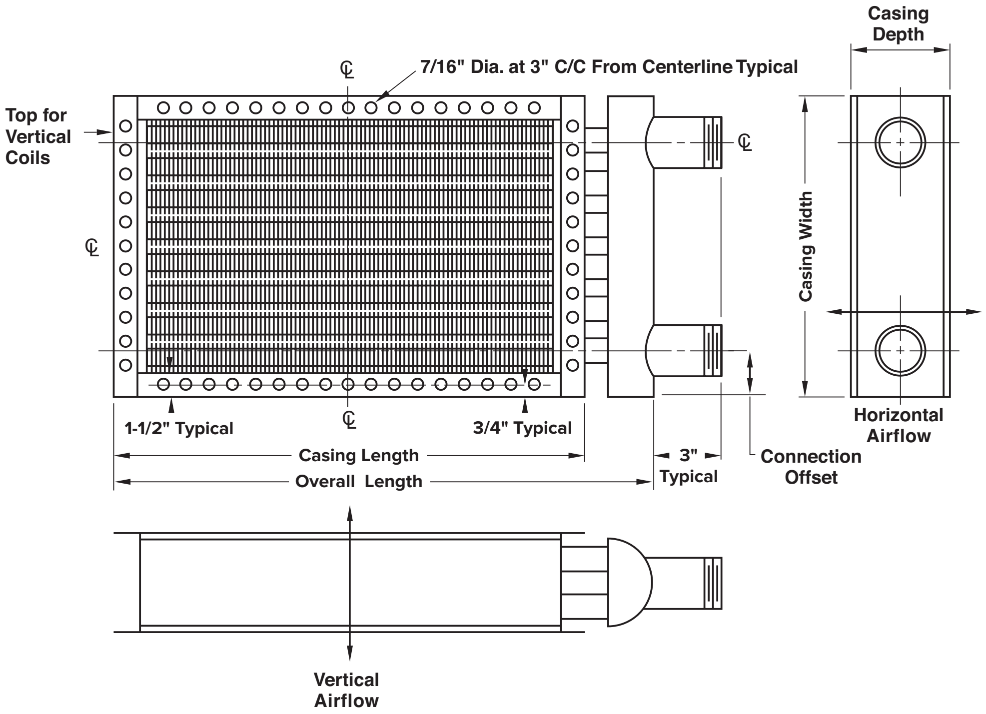
☐0.016" Copper Keyfin ☐Steel/L-Fin ☐Stainless Steel/L-Fin

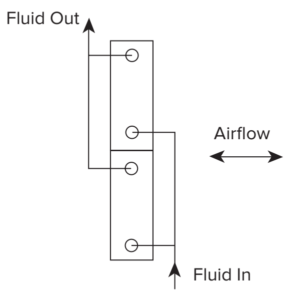
Special Requirements Not Covered Above ____

____

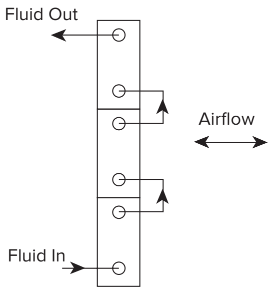
Liquid Coil Sizing

Not for Retrofit

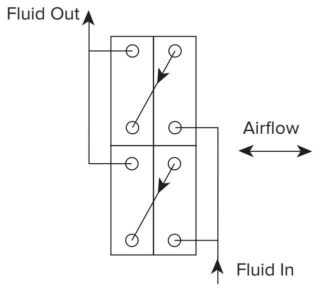




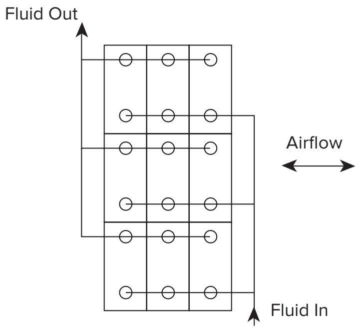
Airflow: 2 in Parallel
Fluid Flow: 2 in Parallel



Airflow: 3 in Parallel
Fluid Flow: 3 in Series



Airflow: 2 in Parallel x 2 in Series
Fluid Flow: 2 in Parallel x 2 in Series



Airflow: 3 in Parallel x 3 in Series
Fluid Flow: 9 in Parallel

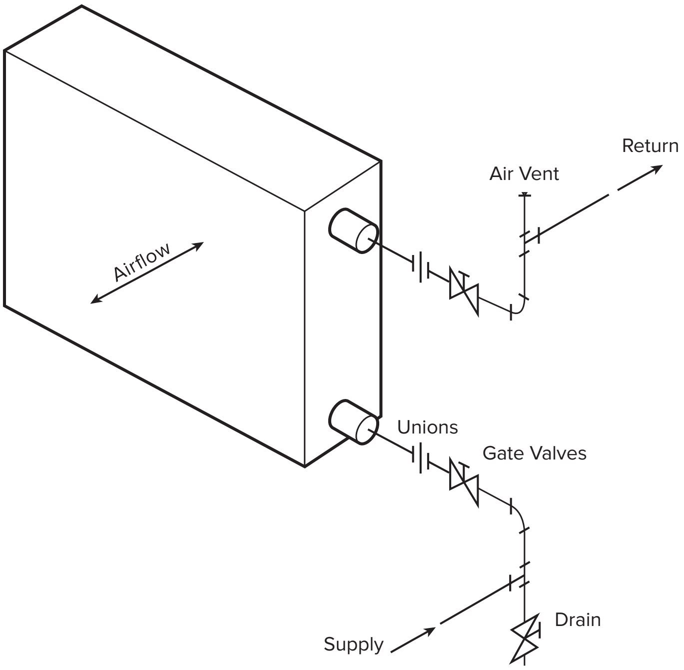
Casing Width: ____________________

Casing Length: __________________

Casing Depth: ___________________

Note: Casing width is always measured along the header.
Casing length is always measured along the tube length
Hole sizes and placement are Armstrong standards. Please not variances.

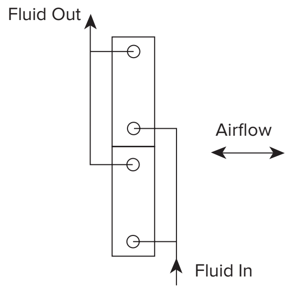
Piping Diagram for Water and Ethylene Glycol



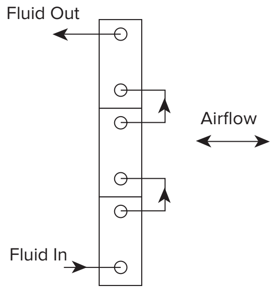
1. Install coils level to assure complete drainage.
2. Supply water to the bottom connection and return through the top connection.
3. Carefully vent coils, either individually or through an air manifold.
4. Armstrong recommends that coil isolation valves be fitted to take out coils without disturbing the whole system.
5. Ensure that water supply to coils is as clean as possible to avoid potential blockage and excessive fouling. Settling tanks and strainers can be used for this purpose.
6. Do not support piping from the coils. Install adequate hangers and expansion joints to prevent undue stresses.
7. Armstrong recommends the use of low pressure air or flushing with ethylene glycol to prevent freeze damage when draining.
8. Do not use throttling controls in hot water heating service if there is a possibility of below-freezing air passing through the coil. Use an air by-pass system at full water flow rate for control.

NOTE: Keep finned tube surface clean and free of all foreign matter in order to maintain the design heat transfer and pressure drop ratings. Install filters upstream of the coils to keep actual coil maintenance to a minimum.

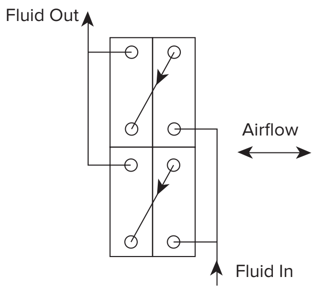
Examples of Multi-Coil Arrangements



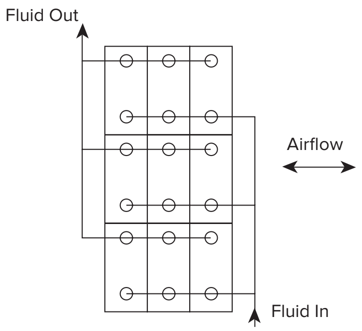
Airflow: 2 in Parallel
Fluid Flow: 2 in Parallel



Airflow: 3 in Parallel
Fluid Flow: 3 in Series



Airflow: 2 in Parallel x 2 in Series
Fluid Flow: 2 in Parallel x 2 in Series



Airflow: 3 in Parallel x 3 in Series
Fluid Flow: 9 in Parallel

How to Specify Armstrong Series 6000 Steam Coils

Heavy-duty construction/fabrication is why Armstrong Series 6000 coils last longer, saving maintenance and frequent replacement costs.

Think about it. Less expensive coils are also less durable and are commonly misapplied in heavy industrial service. As a result, they actually become more expensive when measured by down time, maintenance and replacement over a period of time. It's really a very simple fact: Higher initial costs are justified when they secure a lower life cycle cost.

The sample specifications below will help you in detailing coil construction for your heavy-duty application. These samples cover the most popular of the various material combinations. For assistance with other options, consult your Armstrong Representative.

Steel Tube/Aluminum Keyfins

- Tubes—minimum 12 ga carbon steel
- Fins—minimum 0.020" thick aluminum (imbedded type)
- Headers—minimum Sch 40 carbon steel pipe
- Connections—minimum Sch 80 carbon steel pipe
- Casings—minimum 14 ga galvanized steel
- Tubes, headers and connections shall be welded together to form monometallic joints.

Steel Tube/Steel Fins

- Tubes—minimum 12 ga carbon steel
- Fins—minimum 0.024" thick carbon steel ("L" fin)
- Headers—minimum Sch 40 carbon steel pipe
- Connections—minimum Sch 80 carbon steel pipe
- Casings—minimum 14 ga galvanized steel
- Tubes, headers and connections shall be welded together to form monometallic joints.

Stainless Steel Tube/Aluminum Fins

- Tubes—minimum 14 ga 304L stainless steel
- Fins—minimum 0.020" thick aluminum (imbedded type)
- Headers—minimum Sch 10 304L stainless steel pipe
- Connections—minimum Sch 40 304L stainless steel pipe
  Casings—minimum 14 ga galvanized steel
- Tubes, headers and connections shall be welded together to form monometallic joints.

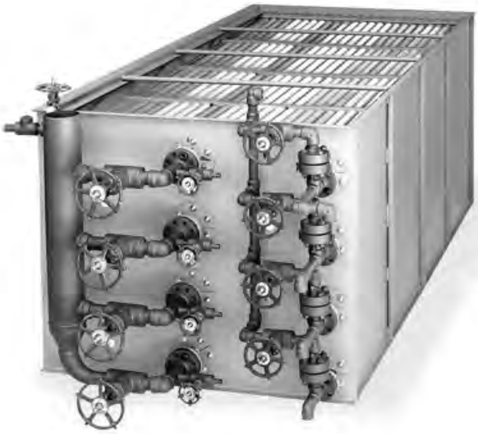
NOTE: 0.030" thick aluminum keyfin is an available option for imbedded type only.

Typical Coil Applications

Armstrong can manufacture coils in any configuration necessary to meet your requirements.

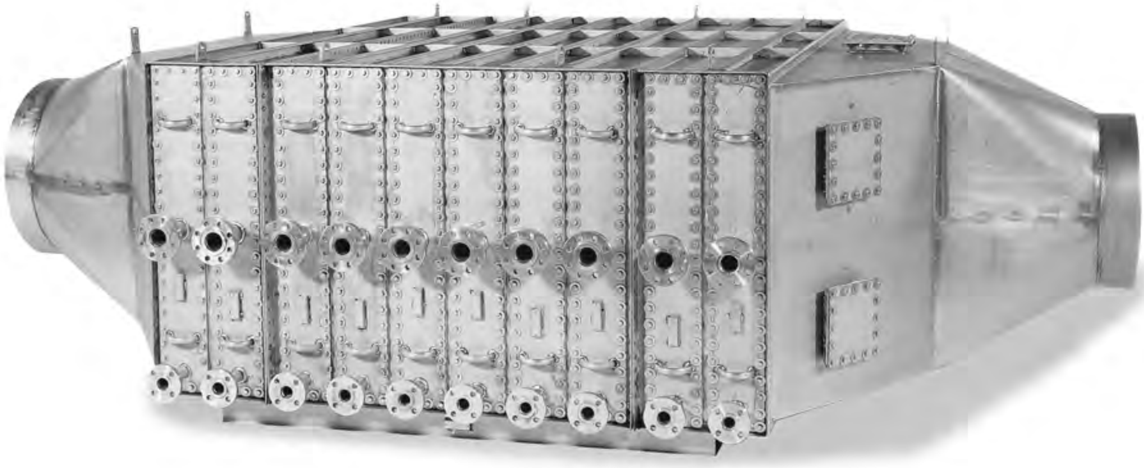
- Pulp dryer coils
- Veneer dryer coils
- Pocket ventilation coils
- Smokehouse coils
- Yankee hood drying coils
- Pasteurizer coils
- Air makeup coils for comfort heating
- Char coolers
- Carpet dryer coils
- Boiler air preheater coils
- Grain dryer coils
- Boiler feedwater runaround systems
- Starch dryer coils
- Textile dryer coils
- Dry kiln coils
- Paint spray booth coils
- Drying ovens
- Steam condenser coils
- Unit heaters for comfort heating
- Door heaters
- Tank heating coils
- Unit coolers and condensers
- Fluid Bed Dryers
- Direct Contact Fluid Bed Dryers

Coil Packages Engineered to Your Specifications

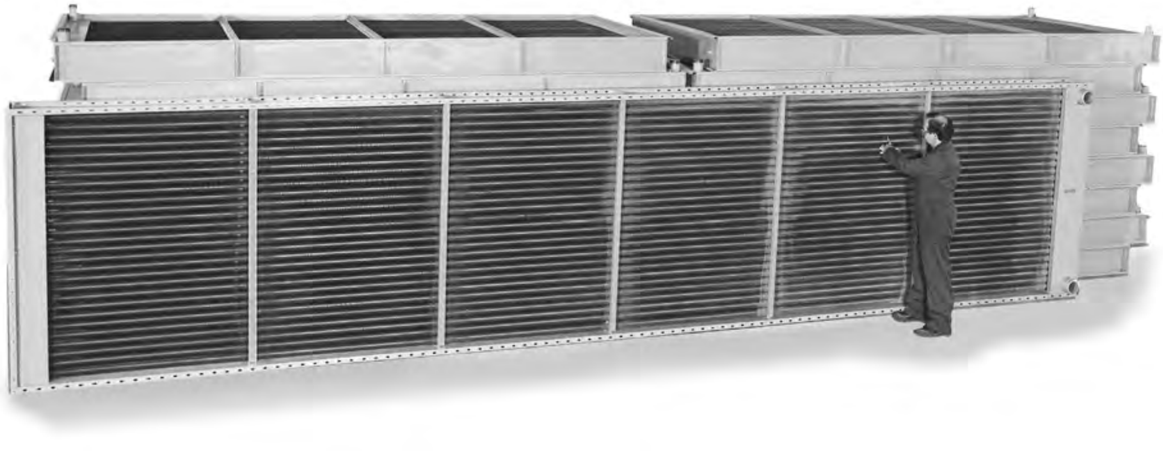


Blast air coolers and heaters.

Air heaters using high pressure steam.



Stainless steel boiler air preheaters used in the pulp and paper industry.



Air heaters using thermal oils.

Quality Construction

"Designed to Perform & Built to Last"

Armstrong Preheat Coils outlast thin-finned and thin-walled lightweights because of superior engineering and robust construction. Thicker tube walls and fins provide greater resistance to coil damage and wear from high pressures, temperatures and corrosive conditions.

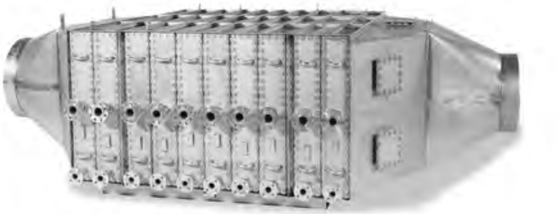
Armstrong's Typical Heavy Duty Air Heater Specifications:

- Fins - Keyfin - Embedded, Spiral Wound Aluminum or Copper
- Fin Thickness - Minimum 0.020" thickness or optional 0.030" Heavy Keyfin
- Tubes - 1" OD x 12 Ga Carbon Steel or 14 Ga St.Stl. (1-1/2" OD Available)
- Inner Tubes - 1/2" - 7/8" OD Carbon or St. Steel (no perforations or holes)
- Headers - Heavy Wall (Carbon Steel or St.Steel) Fabricated
- Tube/Header Joints - All Welded - Multi-Pass Full Penetration
- Tube Sheets - NC Machined, and Chamfered Tube Holes - Heavy Gauge
- Mono-Metallic Construction on all wetted parts reducing potential for galvanic corrosion
- Coil Casings - Min 14ga or 12 Ga Galvanized Steel or St. Steel
- Outer Casings - Drawer Type Construction with Airtight Outer Casings for ease of coil removal or replacement
- Cleanout/Inspection/Access Spacer Sections - Available on request
- Inlet/Outlet Transitions - Per Specification
- Pre-Piped Options - On Application
- Extended Warranties - Available on Application
- Design and Construction in Accordance with ASME SECTION VIII Div. 1. (All Armstrong 6000 Series Coils are built to this standard whether or not ASME is required - unlike other manufacturers).
- U Stamp Available on request
- Special Materials and Coatings available on request
- Manufacturing done in Armstrong factories, not subcontracted. Armstrong controls all QA/QC in-house.

Whether you need a standard replacement coil or custom-built unit, you'll get the same built-in quality.

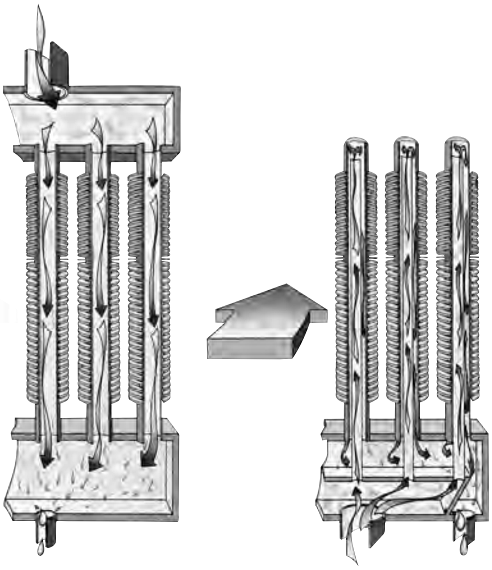
During construction each section of the coil is checked for compliance with detailed, written QA/QC procedures available for your review. And, finally the complete coil is tested hydrostatically to ASME standards.

Armstrong offers total steam expertise and manufacturing capability that can help you identify and solve coil problems. In addition, Armstrong's steam system package approach is a blueprint for blending superior products, knowledge and judgment into plans for effective energy management and pinpointing Heat Rate improvements.

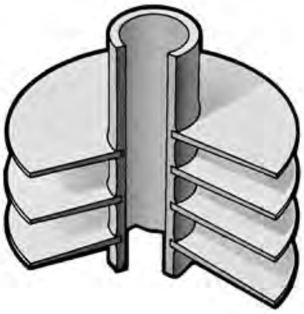


Full Systems with Transitions

Drawer Type Air Preheat Coils



Specialized Coil Designs



"KEYFIN" (embedded) Fin Tube

System Solutions for Boiler Air Preheating

Solutions Through Experience.

For power and large industrial plants, producing electricity, generating steam, energy efficiency, air preheating and protection of important heat transfer equipment and systems, go hand in hand. Coordinating design and performance of various system components requires a review of the entire energy usage loop from turbine extraction, through air preheating, to condensate collection, return, and re-use of available flash energy and hot condensate.

Combustion and boiler air preheating is no longer just a simple need to heat air to prevent dew point issues on tubular or regenerative air pre-heater surfaces. The advent of SCR's, SNCR's, WET/DRY SCRUBBERS – FGD'S, BAGHOUSE UPGRADES, AND STACK GAS REHEATING, have positioned the steam or fluid coil air pre-heater as a key component to the overall combustion efficiency and equipment life extension planning.

For more than a century, Armstrong has been synonymous with steam system innovation and solutions. Armstrong understands efficient generation and effective use of steam throughout the power/utility, large industrial boiler operations, from Coal/Fossil fired, through Biomass, Hog Fuels, Black Liquor Recovery (B.L.R.B.) and Fluid Bed designs to packaged fire tube boiler requirements.

Combustion air preheating heat source options we work with include, extraction or auxiliary steam source, thermal oils, glycol or hot water (from d/a etc.).

Armstrong leads the industry in rugged, robust coil designs that extend life of equipment and reduce downtime and lost energy production hours. With reduced staffing in most facilities, you can relax and focus on your base operations and be assured that the systems we provide will deliver years of continuous, optimized performance.

ARMSTRONG IS ALSO THE ONLY GLOBAL MANUFACTURER WITH THE ABILITY TO SUPPLY KEY SYSTEM COMPONENTS INCLUDING STEAM SUPPLY CONTROL VALVES, HEAVY DUTY COILS, CONDENSATE TRAPPING, VENTING COLLECTION AND RETURN SYSTEMS FROM THE SAME CORPORATE SOURCING! THIS MAKES ARMSTRONG YOUR ONE-STOP SOLUTION SOURCE!

Armstrong partners are air preheat and coil system specialists.

Combine our combustion air preheat coil-building know-how with the expertise of a decades-old steam specialist and what do you get? Preheat coils specifically designed for the rigors of power plant applications.

Armstrong: The power to improve on every energy front.

Why add Armstrong to your energy team? Our applications expertise in the key areas of combustion air preheating and efficient use of extraction steam and flash recovery is well documented. Our steam trapping and condensate recovery/handling knowledge in both saturated and superheated steam applications extends over 100 years. Even your HVAC, plant heating/cooling and hot water requirements are within the scope of the products and services from Armstrong.

Armstrong is a problem solver.

At Armstrong, we consider the entire system. We don't simply duplicate the coils within it. Flexibility—in material, engineering and construction—is the key to Armstrong's problem-solving. We carefully match coil characteristics to specific applications, on a case-by-case basis.

You can depend on Armstrong for custom engineering and quality construction.

Coil problem: Armstrong solution. We can manufacture coils in a range of sizes and in a variety of metals and alloys, including steel, stainless steel, copper, copper-alloy and other metals. A blend of custom engineering and quality construction results in an extended life cycle for your combustion air or process system coil/service package with a focus on heat rate improvement for power generation applications.

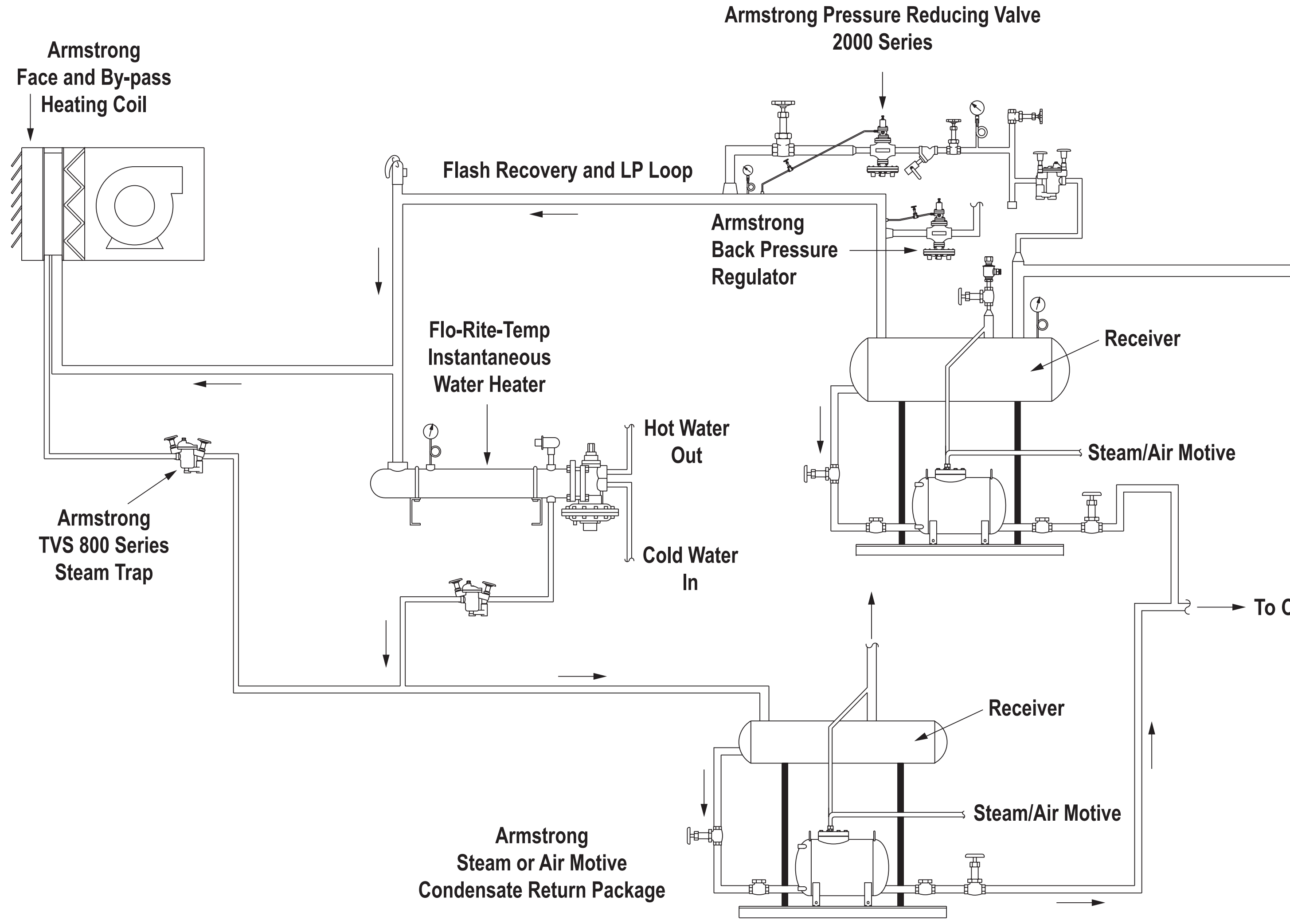
Armstrong has a complete range of service options.

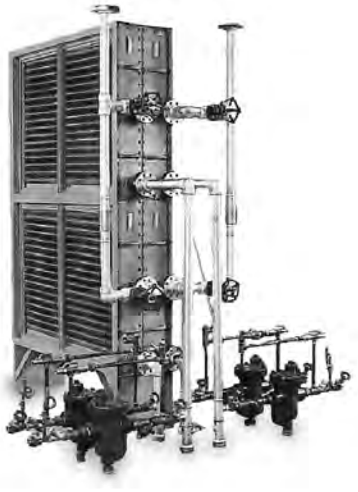
Specialists from Armstrong can visit your location for walkthroughs and follow up with comprehensive system assessments. While there may be more than one course of action for you, we will recommend and—if you choose—implement the one(s) that will deliver the greatest benefit.

Although the cost of fossil fuels fluctuates, Armstrong can help you use it more efficiently. Our experience and total coil air preheating system capability can be the beginning of your transition from necessary parasitic load preheating to maximizing your combustion air preheating system's effect on improving overall system efficiency and reliability.

CONTACT US TODAY!

System Solutions for Boiler Air Preheating

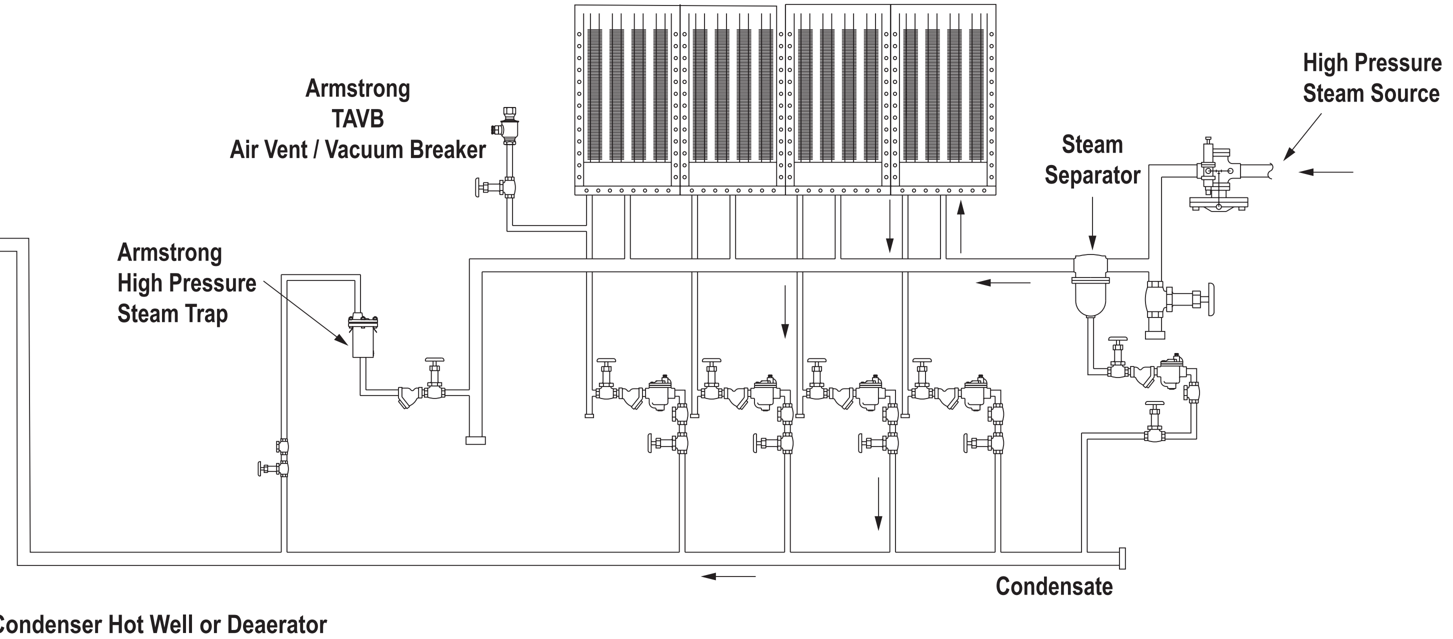


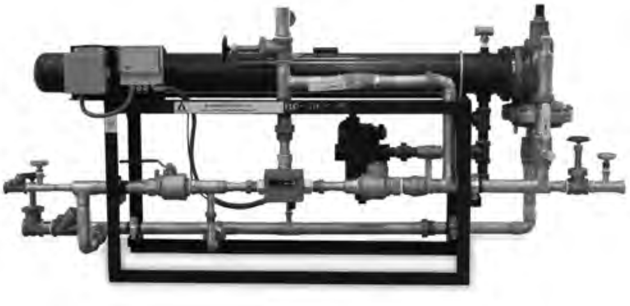


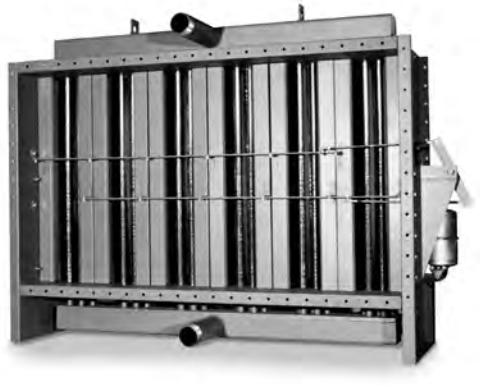
Pre-piped/Package Air Preheater Coil System

Heavy Duty Steam and Fluid Unit Heaters & Door Heaters

System Solutions for Boiler Air Preheating







Flo-Rite-Temp Instantaneous Water Heater

Condensate Recovery Systems

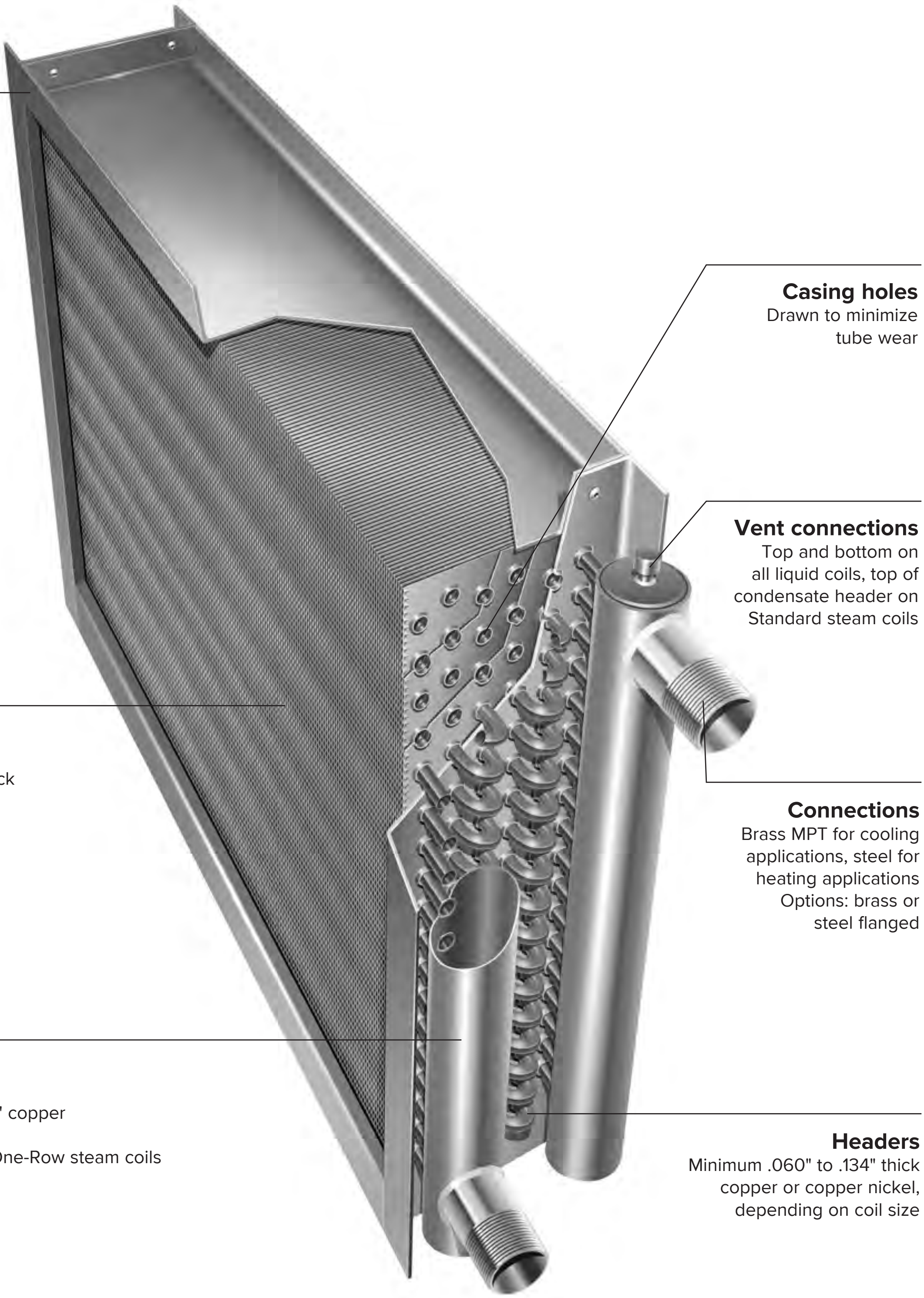
Heavy Duty Face & Bypass Steam Coil Pre-Heating Systems

If you are NOT following Best Practices, you may not be getting the Most out of your Air Preheating System!

Armstrong Duralite™ Plate Fin Coils

Armstrong is a full-line coil supplier with application knowledge and experience you'll find nowhere else in the industry. For nearly half a century, our heavy-duty industrial coils have been serving the process needs of heavy industry.

Building on that tradition of quality and dependability, our plate fin coils meet the diverse needs of the HVAC and light industrial markets.



Casings
14 or 16 Ga galvanized steel, depending on size and material
Options: aluminum or stainless steel

Casing holes
Drawn to minimize tube wear

Vent connections
Top and bottom on all liquid coils, top of condensate header on Standard steam coils

Fins
V-waffle, HTE or flat: 6 to 14 FPI
Aluminum: .008", .010", .012" thick
Copper: .006", .009" thick

Connections
Brass MPT for cooling applications, steel for heating applications
Options: brass or steel flanged

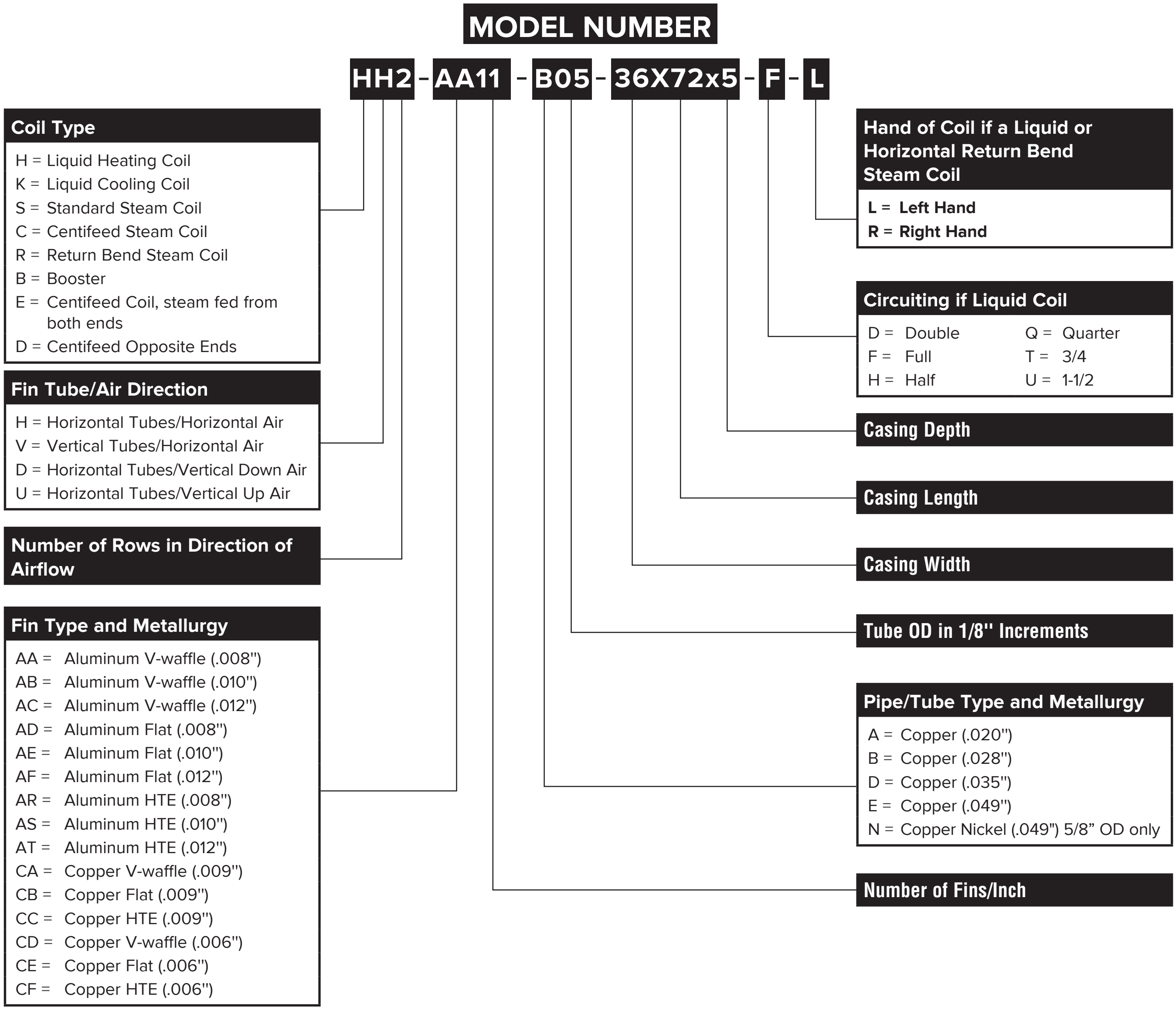
Tubes
5/8" OD x .028" thick copper
Options: .020" or .035" or .049" copper

1" OD x .032" thick copper on One-Row steam coils
Option: .049" thick copper

5/8" OD x 0.049" copper nickel

Headers
Minimum .060" to .134" thick copper or copper nickel, depending on coil size

Plate Fin Coil Model Numbers



MODEL NUMBER

HH2 - AA11 - B05 - 36X72x5 - F - L

Coil Type

H = Liquid Heating Coil
K = Liquid Cooling Coil
S = Standard Steam Coil
C = Centifeed Steam Coil
R = Return Bend Steam Coil
B = Booster
E = Centifeed Coil, steam fed from both ends
D = Centifeed Opposite Ends

Fin Tube/Air Direction

H = Horizontal Tubes/Horizontal Air
V = Vertical Tubes/Horizontal Air
D = Horizontal Tubes/Vertical Down Air
U = Horizontal Tubes/Vertical Up Air

Number of Rows in Direction of Airflow

Fin Type and Metallurgy

AA = Aluminum V-waffle (.008")
AB = Aluminum V-waffle (.010")
AC = Aluminum V-waffle (.012")
AD = Aluminum Flat (.008")
AE = Aluminum Flat (.010")
AF = Aluminum Flat (.012")
AR = Aluminum HTE (.008")
AS = Aluminum HTE (.010")
AT = Aluminum HTE (.012")
CA = Copper V-waffle (.009")
CB = Copper Flat (.009")
CC = Copper HTE (.009")
CD = Copper V-waffle (.006")
CE = Copper Flat (.006")
CF = Copper HTE (.006")

Hand of Coil if a Liquid or Horizontal Return Bend Steam Coil

L = Left Hand
R = Right Hand

Circuiting if Liquid Coil

D = Double	Q = Quarter
F = Full	T = 3/4
H = Half	U = 1-1/2

Casing Depth

Casing Length

Casing Width

Tube OD in 1/8" Increments

Pipe/Tube Type and Metallurgy

A = Copper (.020")
B = Copper (.028")
D = Copper (.035")
E = Copper (.049")
N = Copper Nickel (.049") 5/8" OD only

Number of Fins/Inch

How to Identify the Circuiting of a Return Bend Coil

1. Identify the inlet header and count the number of tubes fed from it.
2. Count the number of tubes in the face of the coil.
3. Divide the number of tubes fed from the header by the number of tubes in the face.
4. The result is the identification of the coil's circuit.

How to Identify the Hand of a Return Bend Coil

1. Face the coil with the airflow at your back (or imagine this).
2. Point to the outlet connection (it will be at the top of a liquid coil and should be closest to you). On a return bend steam coil, it will be the condensate return connection and should be farthest from you. If the reverse of the above exists, the coil may be installed incorrectly.
3. The connection on your right indicates a right-hand coil.
4. The connection on your left indicates a left-hand coil.

Coil-A-ware™ Sizing Program

Armstrong coils, both heavy duty and plate fin, are available on a Windows*-based computer program that is extremely user friendly. To obtain a copy through your Armstrong Representative, visit our Web site at armstronginternational.com and supply the requested information. Your local representative will personally deliver it to you. Updates will be available and downloadable from the Web site.

*Windows is a registered trademark of Microsoft.

How To Order Armstrong Duralite™ Plate Fin Steam Coils

Armstrong Duralite™ Plate Fin Steam Coils are available in Centifeed (Steam Distributing Tube Type), Standard (Opposite End Connections) and Two-Row Return Bend Construction.

Centifeed, Standard and Return Bend coils are made of 5/8" OD tubes as a standard.

One-Row coils are available optionally with 1" OD tubes.

Depending upon steam flow, long Centifeed coils may require steam to be fed from both ends to eliminate cold tube ends and subsequent freezing potential.

To ensure that a replacement coil will fit in the same location, and that it will perform the same as the coil it replaces, the dimensions and other data requested below must be obtained prior to sizing and pricing.

Dimensions

W	L	D	O	S*	C*

*Not required if Armstrong Standard Dimensions are acceptable.

Performance Information

Airflow rate: ____________________

☐ Fan CFM ☐ SCFM ☐ lb/hr

Fan location: ☐ before coil(s) ☐ after coil(s)

Steam pressure: ____________ psig

Entering air temperature: ____________° F

Leaving air temperature: ____________° F

Altitude: ________ ft. above MSL

Coil Information

Coil type (specify): ____________________

Fin type: ☐ flat ☐ V-waffle ☐ HTE

Fin material: ____________

Fin thickness: ____________in.

Fins per inch: ____________

Tube material: ____________

Tube OD: ____________ in.

Tube wall: ____________in.

Steam connection size: ____________in.

Condensate connection size: ____________in.

Casing material: ____________

Number of tubes in coil face: ____________

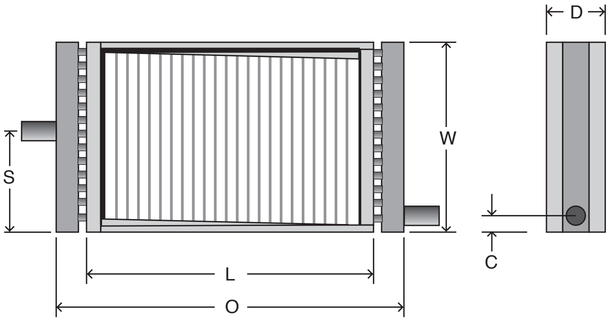
Number of tubes fed by each header: ____________

Number of rows of tubes in direction of airflow: ____________

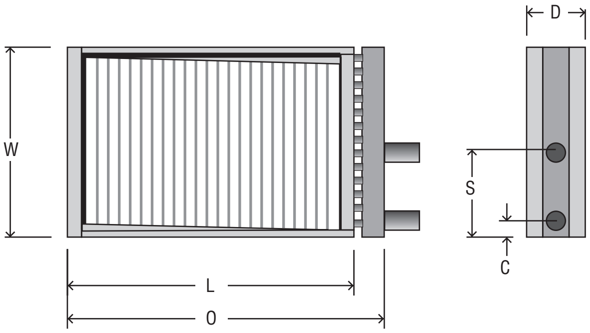
Hand of coil if Return Bend: ☐ left ☐ right

Special features: ____________________

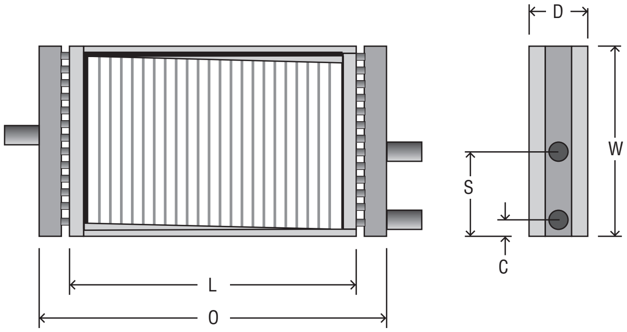
____



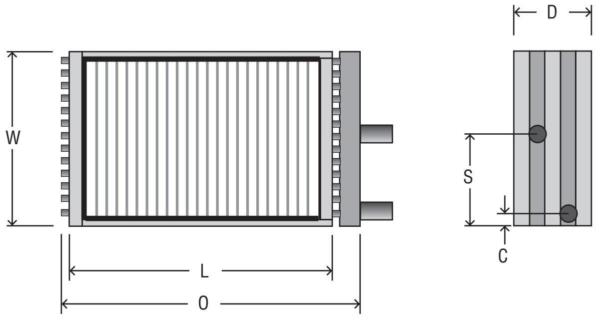
Standard Steam Coils



Centifeed Steam Coils



Centifeed Steam Coils Fed From Both Ends



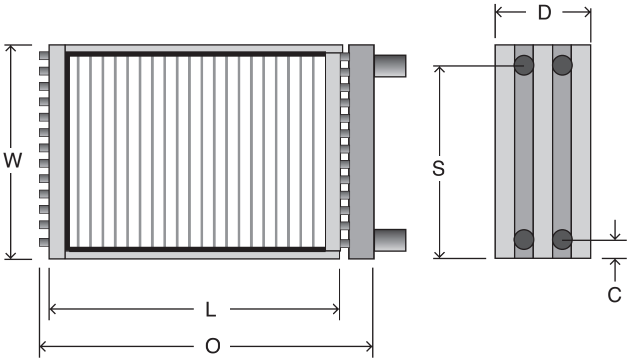
Return Bend Steam Coils

How To Order Armstrong Duralite™ Plate Fin Liquid Coils

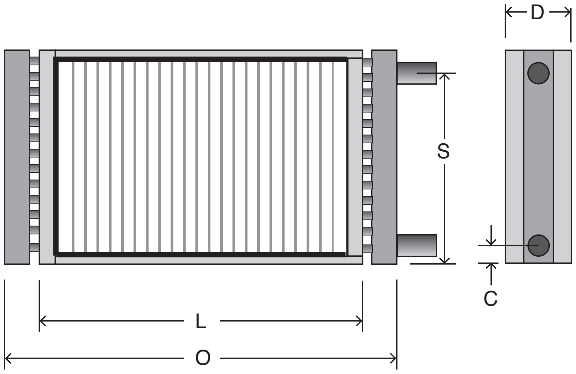
Armstrong Duralite™ Plate Fin Heating Coils are available in Return Header design in one- or two-row configurations and Return Bend design in two or more rows. Liquid coils are made of 5/8'' OD copper tube.

Cooling coils can be built from 2 to 12 rows and with double, full or 1/2 circuits. Custom circuits are also available.

To ensure that a replacement coil will fit in the same location, and that it will perform the same as the coil it replaces, the dimensions and other data requested below must be obtained prior to sizing and pricing.



Return Bend Heating & Cooling Coils



Return Header Heating Coils

Dimensions

W	L	D	O	S*	C*

*Not required if Armstrong Standard Dimensions are acceptable.

Performance Information

Airflow rate: ________________________________

☐ Fan CFM ☐ SCFM ☐ lb/hr

Fan location: ☐ before coil(s) ☐ after coil(s)

Entering air temperature: ____________________° F

Wet bulb or RH (if cooling): ______________________

Leaving air temperature: ____________________° F

Heating or cooling medium: ______________________

Entering liquid temperature: ____________________° F

Leaving liquid temperature: ____________________° F

or liquid flow rate: __________________ GPM

Altitude: __________ ft. above MSL

Coil Information

Coil type (specify): ______________________

Fin type: ☐ flat ☐ V-waffle ☐ HTE

Fin material: ______________________

Fin thickness: ____________________ in.

Fins per inch: ______________________

Tube material: ______________________

Tube OD: ____________________ in.

Tube wall: ____________________ in.

Inlet connection size: ____________________ in.

Outlet connection size: ____________________ in.

Casing material: ______________________

Number of tubes in coil face: ______________________

Number of tubes fed by each header: _____________________

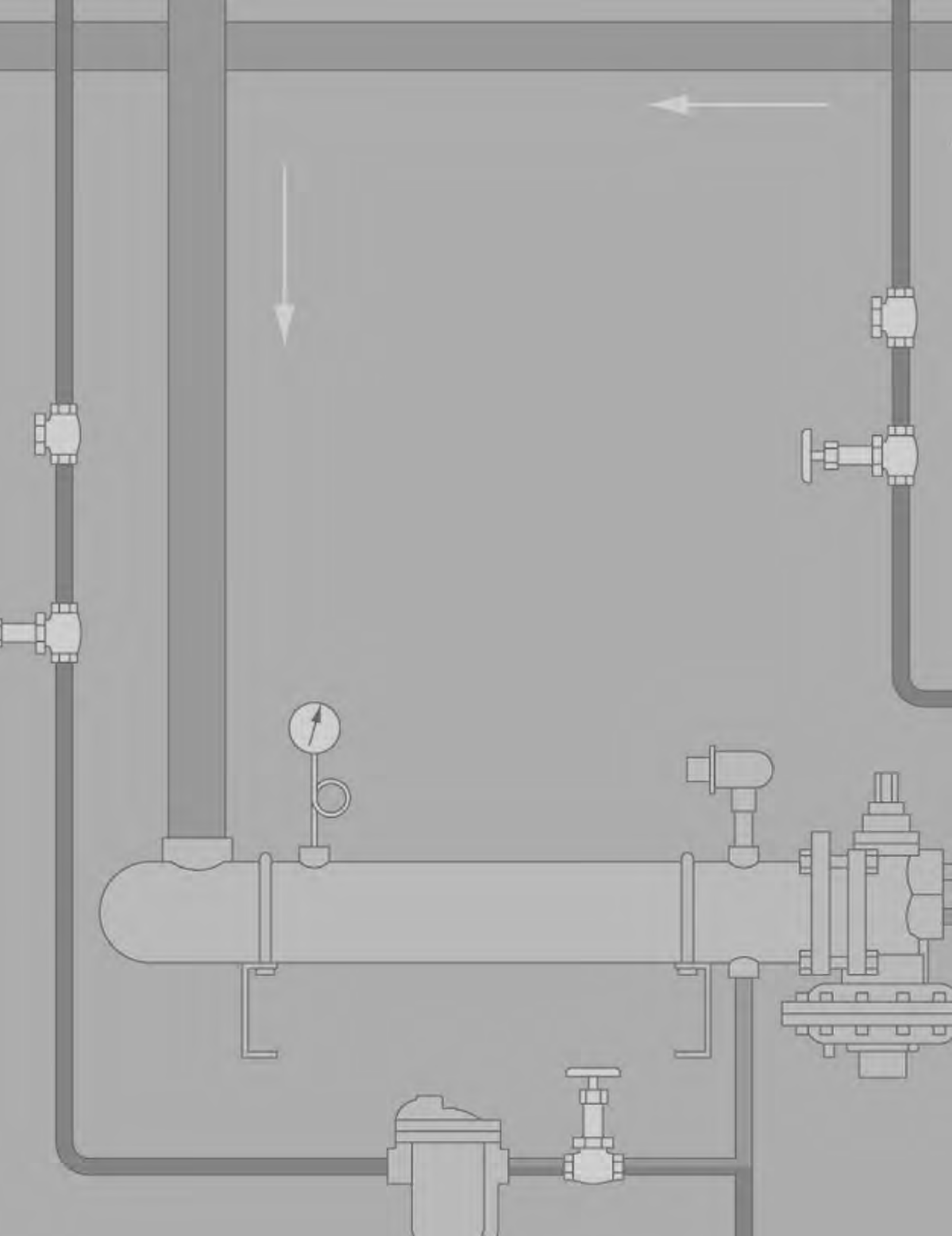
Number of rows of tubes in direction of airflow: ______________________

Hand of coil if Return Bend: ☐ left ☐ right

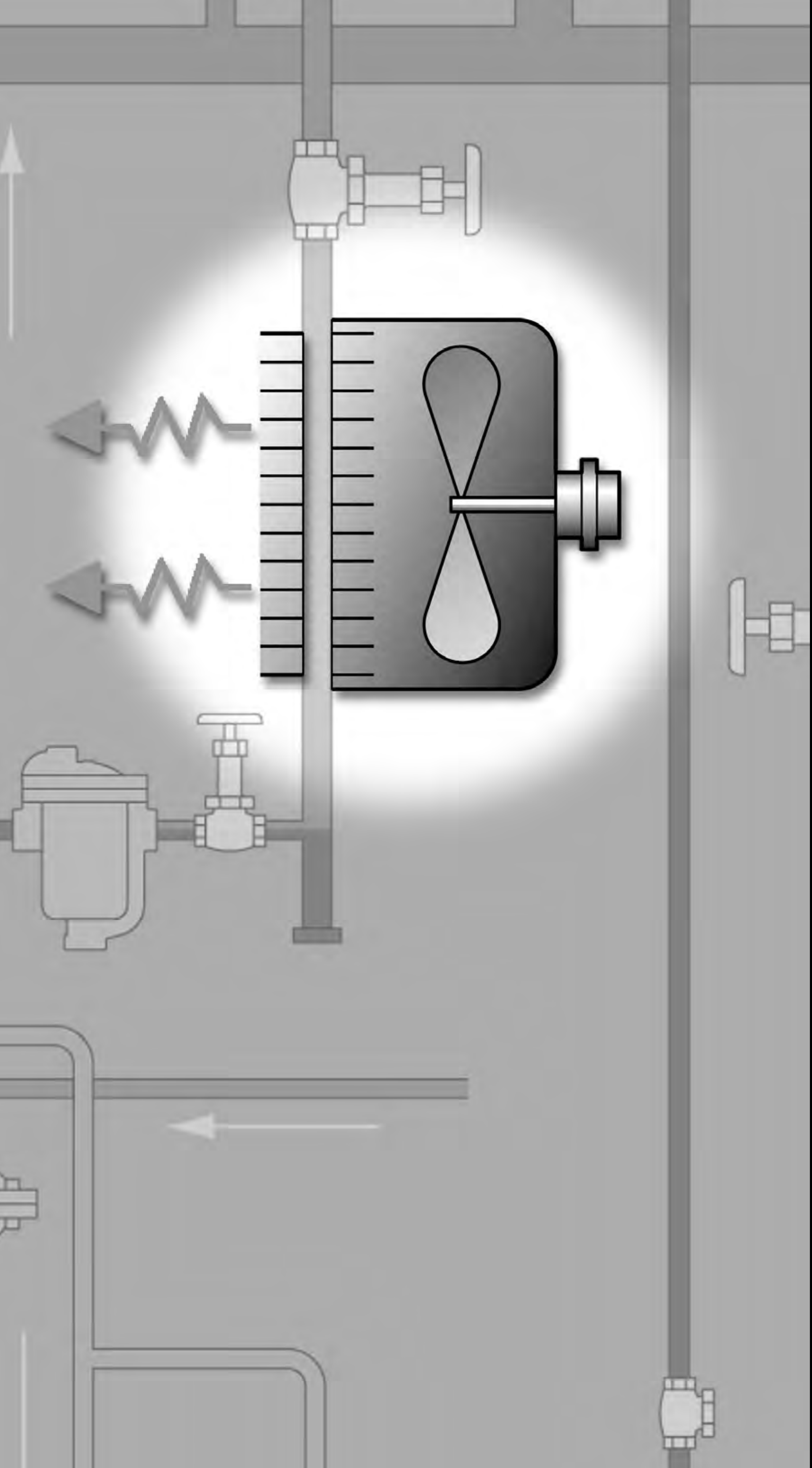
Special features: ________________________________

____

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.



Unit Heaters



Armstrong

Armstrong®

Longer Life in the Harshest Environments

When it comes to long life under tough industrial conditions, Armstrong is all you need to know about unit heaters. Even in the most severe environments, where coil leaks and corrosion are costly problems, Armstrong coils maintain high efficiency and output.

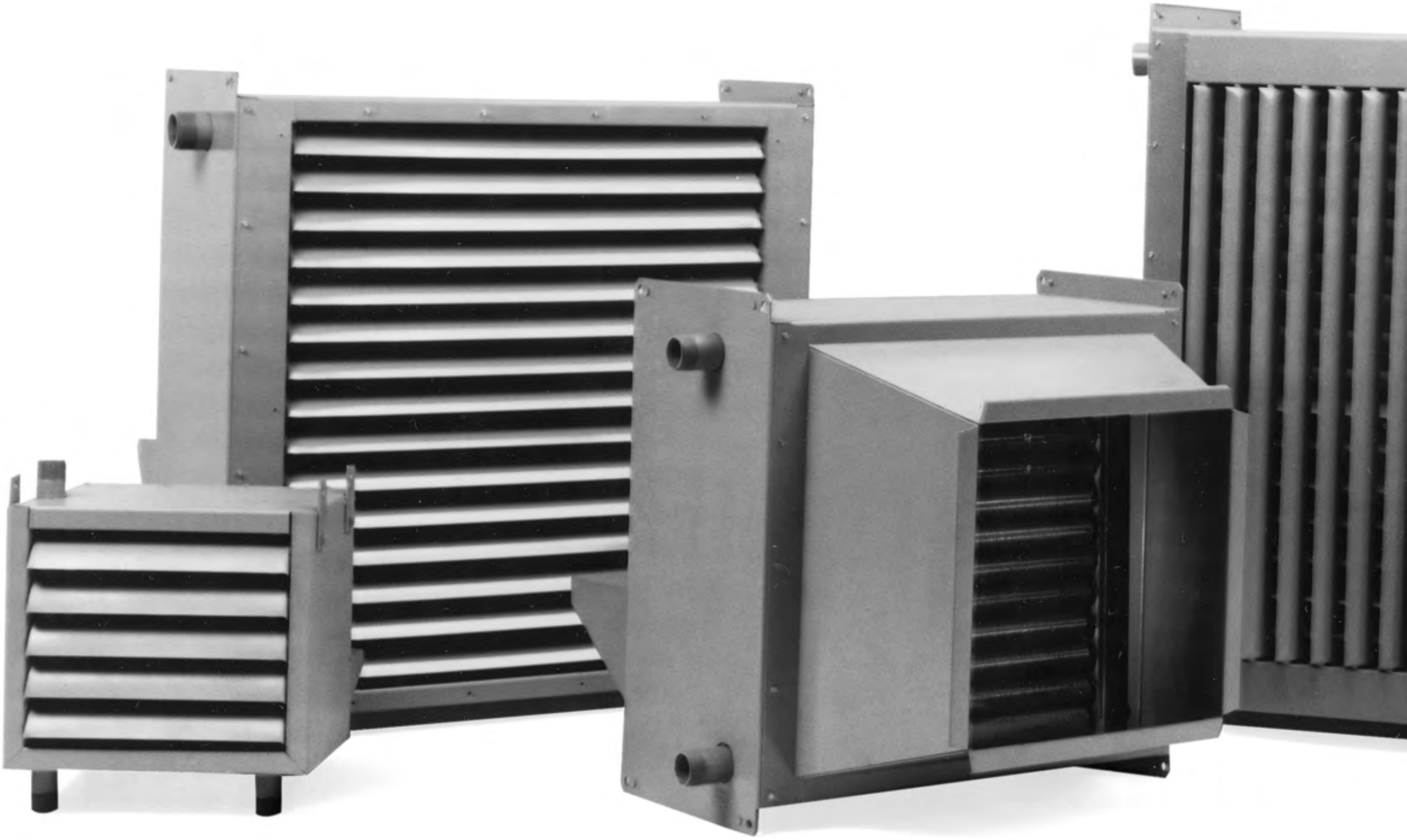
Armstrong: Why and How

The ability to maintain heat transfer efficiency and resist corrosion—both internally and externally—is why Armstrong unit heaters are uniquely dependable. *How* we construct them is your assurance of lasting performance, even in severe operating environments.

Consider these measurable benefits at work in your facility:

- **Heavy gauge enclosures:** Fabricated from 14-gauge steel for protection and durability.
- **Corrosion-resistant heating cores:** Cores are fabricated in a full range of materials, including steel, stainless steel, copper and others. Special coatings may be applied to increase resistance to external corrosion. Cores feature all-welded construction for durability and ease of repair. Cores can be steam or liquid compatible and can be used for steam, hot water or glycol heating mediums.
- **Standard NEMA frame TEFC ball bearing motors:** Supplied on all sizes, these heavy-duty motors are totally enclosed to lock out dirt for smooth performance. Quick access to the motor permits easy replacement.
- Thick fins and tubes: Constructed of high-strength, corrosion-resistant materials. Fins are available in a wide variety of thicknesses and pitches to withstand high pressure cleaning without damage or distortion.
- **Customizing to your needs:** Fans range in size from 10" to 48", and the wide selection of component materials means long, trouble-free service life.

Lightweight coils don't stand a chance in harsh environments. Armstrong coils survive because they're built as tough as your meanest application.

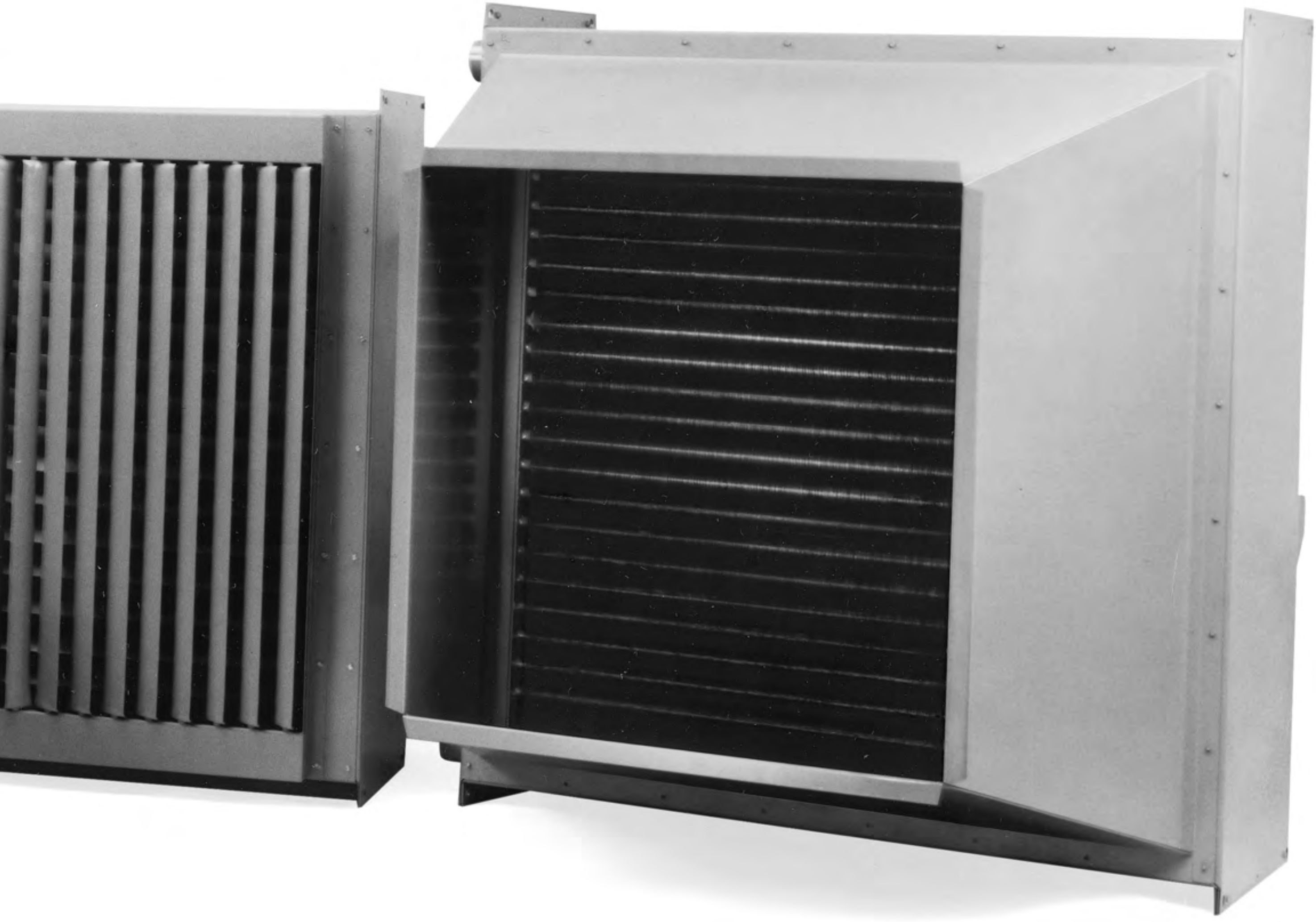


Your Steam Specialist

The first step toward ensuring trouble-free operation is proper unit selection. Your Armstrong Representative will help you select the right unit heater or door heater for any given application.

Our expertise as a manufacturer of unit heaters and door heaters is backed by over 70 years' experience in steam trapping, venting and condensate removal. To you, that means a superior product and an Armstrong Representative who understands how to make it work in your steam system.

If you're losing heat transfer due to deteriorating coils, contact your Armstrong Representative for a complete application analysis. You'll receive top-quality, reliable products from experts who know how to maximize your steam system efficiency.

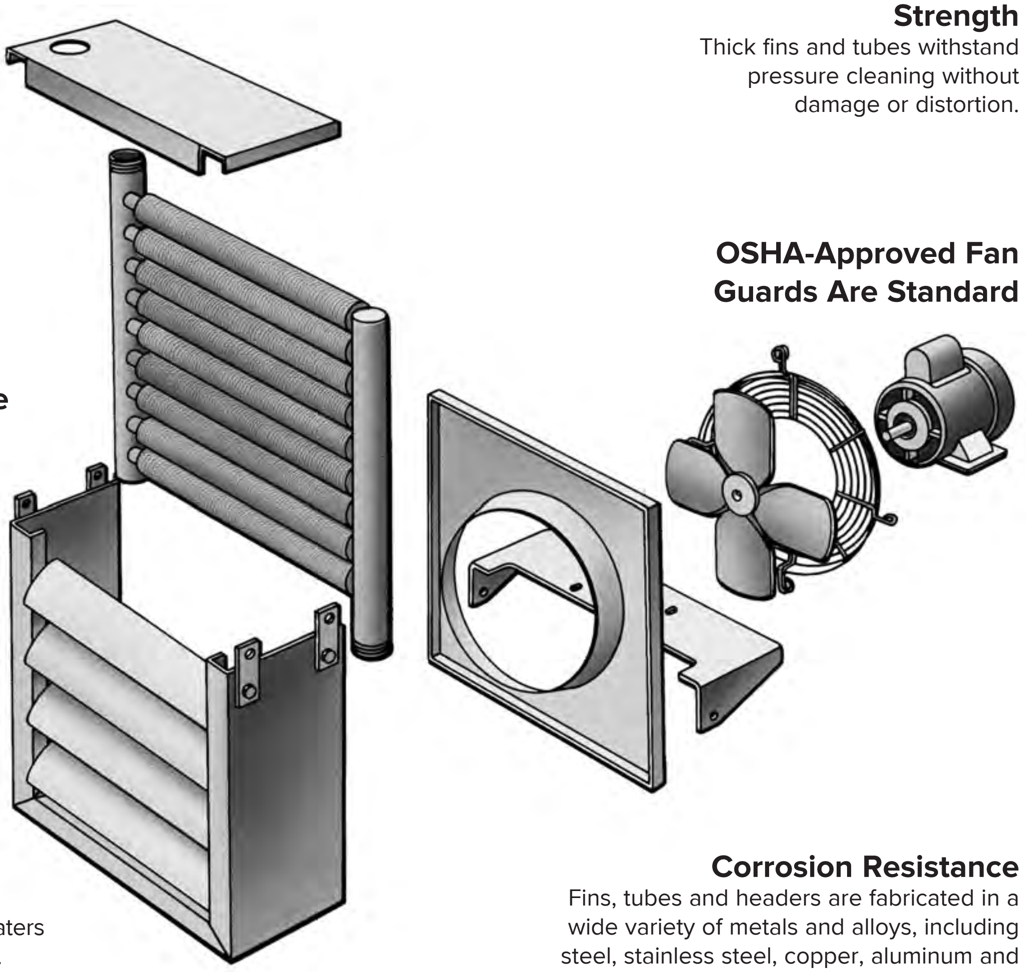


Compare the Benefits You Can't See

Many of the best reasons to insist on Armstrong unit heaters and door heaters are ones you never even see. Components like motors, bearings, tubes, enclosures and fins are built heavy-duty to ensure lasting performance.

Armstrong's options for fin material, pitch, height and type, for example, help explain why our heating cores last longer and perform with greater efficiency. These factors all have a bearing on heat transfer. Knowing how to balance these and other factors is the key to a cost-effective solution. That knowledge is perhaps the most important of Armstrong's many hidden benefits.

10"–20" Size



Sturdy Enclosures

Heavy-duty enclosures of 14-gauge steel provide a rigid structure. Aluminum, stainless steel and specially coated enclosures are also available as options.

Standard NEMA Frame TEFC Ball Bearing Motors

Supplied on all sizes, this rugged motor is built to last in tough industrial environments. If replacement is ever needed, motors are readily available from industrial supply dealers, and are easy to install.

Application Versatility

Because of their heavy-duty construction Armstrong unit heaters are used in many applications. These include product coolers, lube oil coolers, flash steam condensers, hot oil heaters and many others.

Cost-Reducing Strength

Thick fins and tubes withstand pressure cleaning without damage or distortion.

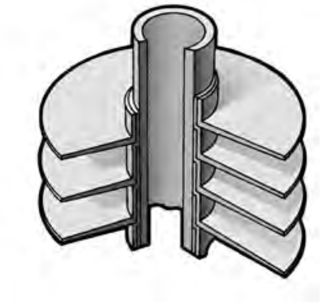
OSHA-Approved Fan Guards Are Standard

Corrosion Resistance

Fins, tubes and headers are fabricated in a wide variety of metals and alloys, including steel, stainless steel, copper, aluminum and others. Tubes and headers are of the same material to enhance strength and reduce the chance of leakage due to galvanic corrosion.

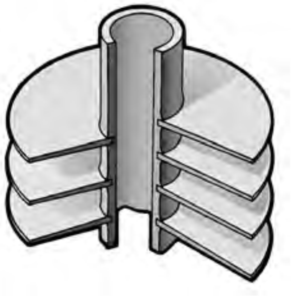
The L fin has a foot at its base and is tension wound on knurled tube material. The L-shaped base provides a large contact area between the tube and the fin, ensuring effective, long-lasting heat transfer. The L fin is recommended when tubes and fins are of the same material.

L Fin



The keyfin is manufactured by forming a helical groove in the tube surface, winding the fin into the groove and peening the displaced metal from the groove against the fin. This means a tight fit between the fin and the tube. The keyfin is the superior design for dissimilar tube and fin material.

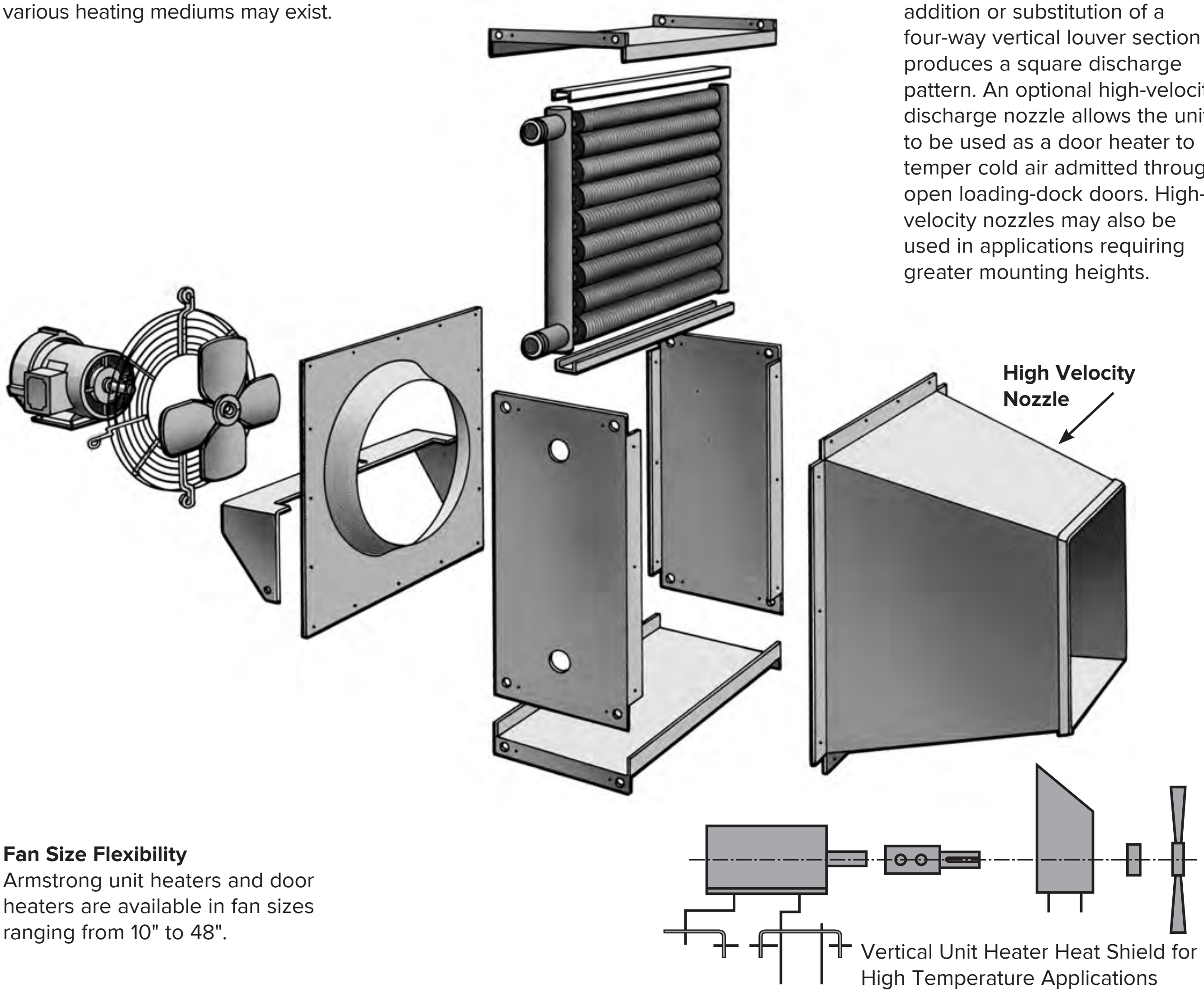
Keyfin



Steam or Liquid Compatible
Cores are available for steam or liquid, allowing units to be applied in different plant areas where various heating mediums may exist.

24"–48" Size

Mounting Flexibility
Basic units may be used in either horizontal or two-way vertical discharge configurations. The addition or substitution of a four-way vertical louver section produces a square discharge pattern. An optional high-velocity discharge nozzle allows the unit to be used as a door heater to temper cold air admitted through open loading-dock doors. High-velocity nozzles may also be used in applications requiring greater mounting heights.



Fan Size Flexibility
Armstrong unit heaters and door heaters are available in fan sizes ranging from 10" to 48".

Vertical Unit Heater Heat Shield for High Temperature Applications

Special purpose motor: 3b (see page 383)

Model Number Selection

MODEL NUMBER

A Q – 182 – HS – T 58

HOTBREATH TYPE

D = Dual (2 Fans)
See note 4 below.
F = Fixed
See note 5 below.
= Standard
(not dual or fixed)

FIN TYPE

A = Aluminum Keyfin
B = Heavy Aluminum Keyfin
F = Copper Keyfin
G = Steel L Fin
J = 304 Stainless L Fin
K = 316 Stainless L Fin
P = Aluminum Platefin

NO. FINS/INCH (SEE NOTE 1)

TUBE MATERIAL

Q = 12 Ga. Steel Tube
R = 10 Ga. Steel Tube
W = 14 Ga. 304L SS Tube
(see note 3)
Y = 14 Ga. 316L Tube
(see note 3)

MODEL SIZE

Fan Diameter (in)
No. Rows of Tubes in Core

MOTOR ELECTRICAL CHARACTERISTICS (SEE NOTE 2)

*12 = 115-203/160
20 = 208/1/60
21 = 208/3/60
23 = 230-460/3/60
58 = 575/3/60

*Consult factory for single phase motor above 1hp. Additional charge could apply.

MOTOR TYPE

T = Totally Enclosed
Fab Cooled
X = Explosion Proof
M = Severe Duty
(3-phase motors only)
H = High Ambient Air
Temperature
(See note 7 below)

CORES

S = Steam Core
L = Liquid Core

DISCHARGE TYPE

H = 2 Way Louver
(Usually Hor. Discharge)
V = 4 Way Louver
(Usually Vert. Discharge)
N = High Velocity Nozzle
(Std. on Door Heaters)

OTHER OPTIONS

HS = Heat Shield
(See note 6 below)

Notes:

1. If the number of fins/inch is standard, the numbers between fin type and tube material will be missing.

2. If dual or triple voltage motors are supplied, the voltage shown on the model number will be the lowest specified. It is the responsibility of the installer to ensure that the motor is wired correctly in accordance with the motor manufacturer's instructions to preclude damage.

3. May be substituted with Sch. 10 SS pipe.

4. Add prefix 'D' for dual units (2 fans on wider core). For standard unit with one fan, the Hotbreath type will be missing.

5. F Models includes larger motors, cleanout lip, ports for sensors.

6. Required for vertical airflow or if heating medium temperature is above 300°F.

7. Required for ambient air above 104°F and only available with 3-phases motors.

Material Specifications

Unit Heater Core Material Specifications

1" OD Tubes		Fins				Headers		Connections	
Material	**Min. Wall Thickness**	**Material**	**Type**	**FPI**	**Minimum Thickness**	**Material**	**Minimum Thickness**	**Material**	**Minimum Thickness**
Standard Materials									
Steel	.109"	Steel	L-Foot	11	.024"	Steel	.145"	Steel	.133"
Steel	.109"	Aluminum	Keyfin	11	.020"	Steel	.145"	Steel	.133"
Steel	.109"	Aluminum	Keyfin	13	.016"	Steel	.145"	Steel	.133"
Special Order Materials									
Steel	.109"	Copper	Keyfin	12	.016"	Steel	.145"	Steel	.133"
Stainless	.083"	Steel	L-Foot	11	.024"	Stainless	.109"	Stainless	.109"
Stainless	.083"	Stainless	L-Foot	10	.020"	Stainless	.109"	Stainless	.109"
Stainless	.083"	Aluminum	Keyfin	11	.020"	Stainless	.109"	Stainless	.109"
Stainless	.083"	Copper	Keyfin	11	.016"	Stainless	.109"	Stainless	.109"

NOTE: Stainless tubes available in either 304L or 316L.

Options:
- Special coatings such as powder coat epoxy, baked phenolic or hot dip galvanizing.
- Thicker tube walls.

Design Pressures and Testing Specifications

Core design pressure is 350 psig @ saturated steam temperature. (650°F for carbon steel and 500°F for stainless steel). Standard testing pressure at 525 psig. Higher pressure ratings are available upon request.

Enclosures

Enclosures, louvers and high-velocity nozzles are fabricated from 14 ga galvanized steel, finished in gray enamel. Available material options include stainless steel or aluminum. Epoxy coatings and other protective finishes are available.

Fans

Fans are of stamped aluminum with steel hubs and spiders on unit sizes 30" and smaller. Cast aluminum fans are furnished on unit sizes 36" and larger.

Fan guards are OSHA-approved and constructed of bright zinc plated steel wire.

Motor Specifications

Standard Motors

Construction:

TEFC, NEMA frame, rigid mount, continuous duty,
NEMA B design, Class B insulation, 1.0 service factor, sealed ball bearings and steel frame.

Electrical Characteristics:

Single Phase (standard through 3/4 HP—optional extra cost 1-1/2 HP) 115, 208 & 230 volts. Three Phase (all sizes)—208, 230, 460 & 575 volts.

Special Purpose Motors

1. Explosion-proof motors are available in all horsepowers and voltages. They are suitable for Class I Group D and Class II Groups F & G service.

2. Environmentally Protected. Known as “Mill & Chemical,” “Severe” and “Hostile” duty motors.

    a. Three phase 1/2 & 3/4 HP. Available with 1.15 service factor, Class F insulation, steel frame, cast iron end bells and conduit box, phosphatized or stainless steel shaft, shaft flingers and stainless steel nameplate.

    b. Three phase integral HP. Available with 1.15 service factor, Class F insulation, cast iron frame, end bells, fan cover and conduit box, stainless steel shaft, shaft flingers and stainless steel nameplate, epoxy coated. (Explosion proof motor S.F. = 1.0).

3. High Temperature Applications

    a. For horizontal discharge applications where high ambient temperatures are encountered (typically 140°F–150°F, 165°F maximum), motor HP or insulation class must be increased. Consult factory.

    b. For vertical units with on/off fan operation:

Heating Medium Temperature
300°F–375°F
Class F Insulation & Heat Shield

For explosion proof motor, consult factory.
375°F & Over
Class H Insulation & Heat Shield

4. Washdown duty motors also available.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Selecting Unit Heaters

A multi-step process is required to select the proper size, type and number of unit heaters to adequately heat a particular building. The process consists of the following steps:

1. Estimate the building heat loss.
2. Preliminarily select the number and type(s) of heaters to properly cover the area to be heated.
3. Select specific models and calculate the actual performance of equipment selected using actual heating medium conditions and inlet air temperatures.
4. Calculate actual throws, spreads and mounting heights and check to see that they will allow for complete coverage of the area to be heated.
5. If necessary, adjust selection and repeat steps 2 through 4.

Estimating Heat Loss

The ASHRAE Handbook of Fundamentals should be consulted to determine heat losses, taking into account specific building features. However, for an approximation of the heat loss from a typical modern industrial building, the following formula may be used.

With heated area size and outside design temperatures given:

A. Calculate the volume of the building in cubic feet:

Volume (cu ft) = floor length (ft) x floor width (ft) x average ceiling height (ft)

B. Calculate the area of walls and roofs that are exposed to outside temperature:

Exposed area (EA) = wall length (ft) x average ceiling height (ft) + floor area (sq ft)

C. Total heat load (MBH) =

$$\left(\frac{V}{25} + \frac{EA}{4}\right) \times \frac{\Delta T}{1000}$$

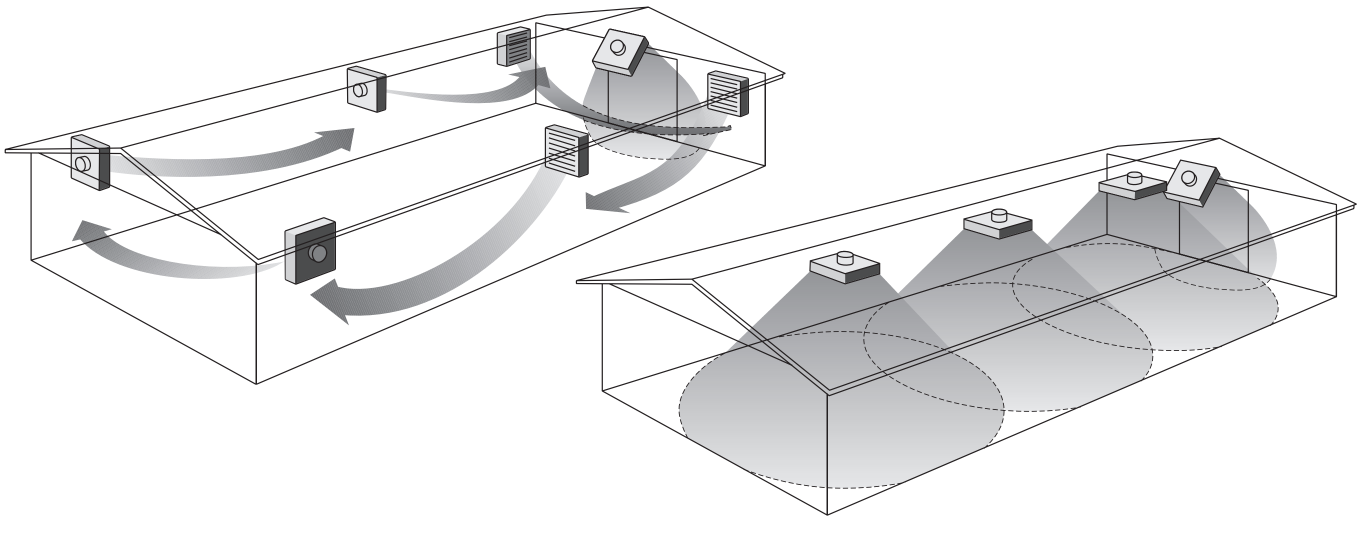
Where
V = Building Volume (cu-ft)
EA = Exposed Wall & Roof Area (ft^2)
ΔT = Inside Design Temperature (F) – Outside Design Temperature (F)

Selection of Number, Type(s) and Location of Unit Heaters

With the total heat loss calculated, the next step is to determine the number, type(s) and location of unit heaters. First, look at the layout of the building. From that, determine the general arrangement of the unit heaters. Some typical layouts are shown below, but any given arrangement should be tailored to the particular building. Some general rules to consider follow:

1. Horizontal unit heaters are used as a means to heat outside walls and should be directed to discharge toward or along walls to provide a wiping effect. Horizontal discharge units are generally sufficient to adequately heat most buildings except those with very large central floor areas or very high ceilings.

Typical Arrangements



Horizontal unit heaters provide a sweeping effect over outside walls and are sufficient to heat most buildings except those with large central floor areas.

Four-way vertical discharge units are used to heat large central areas and buildings with high ceilings or buildings with large heat loss through the ceiling.

2. Vertical unit heaters are used when a direct downward discharge to heat large central areas is needed. They may also be used if the mounting heights and throws allow for wiping of the walls with their discharge air. The discharge may be arranged for two-way airflow or four-way airflow with the addition or substitution of a four-way discharge section. A rectangular building might only need two-way discharge, whereas a square building would be better covered with a four-way arrangement.

   Vertical units are also used in buildings with high ceilings or where roof heat losses are exceptionally high. Hot air from the roof area is drawn into the units and directed down to floor level, minimizing temperature gradients and reducing fuel consumption.

   If fitted with a high-velocity discharge nozzle, units can be used at higher than normal mounting heights.

3. Door heaters simply use a high-velocity discharge nozzle to increase the air velocity to reach those areas that are hard to heat. These heaters can provide blankets of warm air to heat large open-loading doorways or busy entryways. They are also ideal for heating wide open plant areas. If door heater fans are activated only when doors are open, their Btu output should not be considered as part of the heat loss makeup. See page 386 for door heater selection guidelines.

4. Units should be directed toward the areas of greatest heat loss. Outside doorways and exposed windows require more careful consideration.

5. Unit heater airstreams should be minimally obstructed to allow for greatest heat distribution.

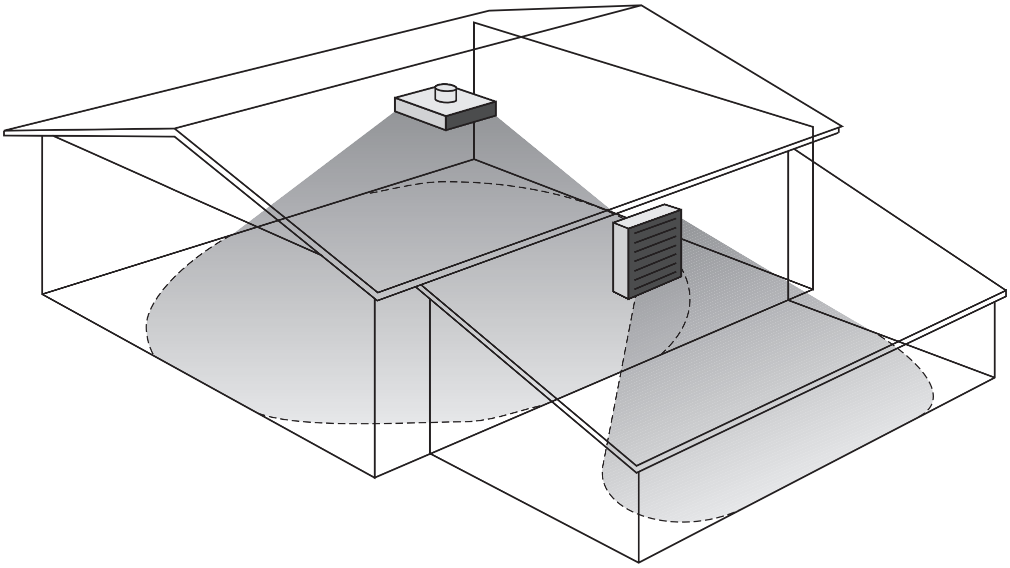
6. Unit heaters should be located to blow into open spaces such as aisles and along exterior walls rather than directly at personnel.

7. The mounting heights and throws specified on page 392 and corrected for outlet air temperature should be followed. Improper mounting height distance will result in poor heat distribution and reduced comfort.

Once the general layout has been determined, you can begin selecting the type of model required. First, select any door heaters that may be required. Then, select any vertical unit heaters. If the vertical unit heaters are to be directed toward center floor areas and used in conjunction with horizontal units, calculate the percentage of the total area it is intended to cover and divide that by 2. That will give you the percentage of the total heat that is required from the vertical units.

Lastly, select the horizontal units. The remaining heat load to be provided is divided by the number of units desired. Here your choice may be between a number of smaller units or fewer larger units. Notice that as the units increase in size and heating capacity their throw also increases. Generally, fewer larger units will result in the most economical installation as long as full coverage is provided.

After completing this preliminary selection process, you can calculate the actual throws, spreads and mounting heights to ensure the area will be adequately heated. If you find that the required coverage cannot be met with your initial selections, recalculate coverage by adjusting unit size or number of units.



High-velocity vertical unit heaters and door heaters are used to reach hard-to-heat areas or to provide blankets of warm air to large open areas such as loading dock doors.

Armstrong® Door Heaters

Door heaters are identical in design to unit heaters with the addition of a high-velocity nozzle. This nozzle helps direct airflow precisely to heat the door area required.

Door Heater Model Size Selection Chart

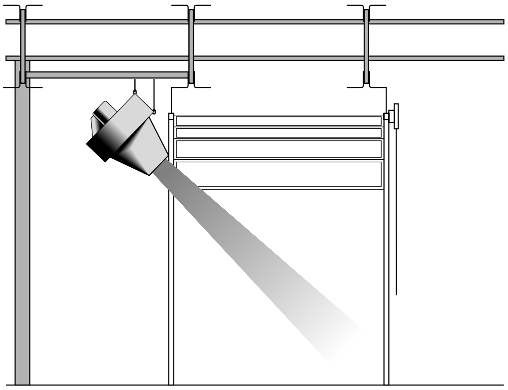
Door Size Width x Height (ft)	Outside Design Temperature							
	-40°F	-30°F	-20°F	-10°F	0°F	10°F	20°F	30°F
6 x 8	30	24	24	20	18	18	16	14
8 x 8	36	30	30	24	20	20	18	16
8 x 10	42	36	30	30	24	20	20	18
10 x 12	48	48	42	36	30	30	24	20
12 x 14	Two 42	Two 36	48	42	36	36	30	30
14 x 16	Two 48	Two 42	Two 36	48	42	42	36	30
16 x 18	Two 48	Two 48	Two 42	Two 36	48	48	42	36
18 x 20	Three 48	Three 42	Two 48	Two 42	Two 42	48	48	42
20 x 22	Three 48	Three 48	Three 42	Two 48	Two 42	Two 36	48	48
22 x 24	Four 48	Four 48	Three 48	Three 42	Two 48	Two 42	Two 36	48
24 x 26	Four 48	Four 48	Three 48	Three 48	Two 48	Two 42	Two 42	Two 36

How to Use This Model Size Chart:

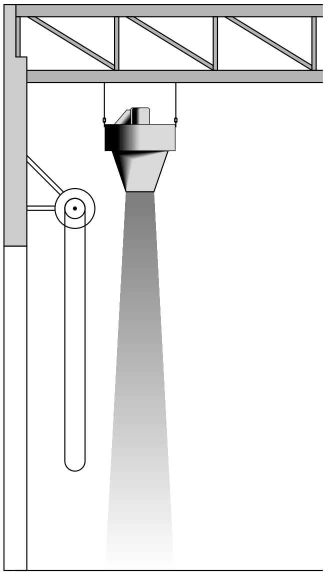
This chart gives the recommended size of door heaters. Select either a single- or double-row heating core from the appropriate performance chart (pages 386 to 392) to give a final air temperature within the 100°F to 130°F range.

- For roll-up or sliding doors, mount unit(s) to discharge vertically with the bottom of the discharge directly above the top of the door. For overhead doors, mount unit(s) back into the building at a distance to give sufficient clearance from the door in the open position. Aim the discharge toward the bottom of the door.
- For doors facing prevailing winds, select one size larger.
- If negative pressure exists in the building, consult factory. Additional capacity could be required.

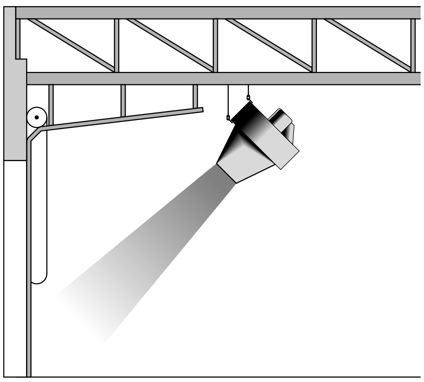
Typical Door Heater Arrangements



Side-mounted 45° discharge for low ceiling applications.



Vertical discharge for roll-up or sliding doors.



Front-mounted 45° discharge for overhead doors.

Performance Data With 2 psig① Steam, 60°F Entering Air Temperature

	Model Size	Common Data			Steel Tube / Aluminum Fin 11 FPI			Steel Tube / Steel Fin Stainless Tube / Steel Fin 11 FPI			Stainless Tube / Stainless Fin 10 FPI		
		Motor		CFM ②	MBH ③	Leaving Air (°F)	Cond. (lb/hr)	MBH ③	Leaving Air (°F)	Cond. (lb/hr)	MBH ③	Leaving Air (°F)	Cond. (lb/hr)
		HP	RPM										
Standard Models	101	1/3	1 725	810	36	102	38	29	93	30	17	80	18
	121	1/3	1 725	1 350	53	97	55	42	89	44	25	77	26
	141	1/3	1 725	2 590	80	89	83	64	83	66	37	73	39
	161	1/2	1 725	3 330	102	88	105	87	84	90	51	74	53
	181	3/4	1 725	4 420	128	87	133	109	83	113	64	73	66
	201	3/4	1 725	5 430	156	87	161	131	82	136	77	73	79
	241	1-1/2	1 125	7 020	205	87	212	179	84	185	105	74	108
	301	2	1 125	10 660	322	88	333	276	84	286	162	74	168
	361	2	1 125	13 440	406	88	420	351	84	363	206	74	213
	421	3	870	16 530	536	90	555	444	85	459	261	75	270
	481	3	870	22 110	692	89	716	593	85	614	349	75	361
High Outlet Air Temperature Models	102	1/3	1 725	700	55	133	57	45	119	47	28	98	29
	122	1/3	1 725	1 320	88	122	91	71	110	74	44	91	45
	142	1/3	1 725	1 980	122	117	126	100	107	103	61	88	63
	162	1/2	1 725	2 910	166	113	171	143	106	148	87	88	90
	182	3/4	1 725	3 900	212	110	219	182	103	189	110	86	114
	202	3/4	1 725	4 560	253	111	262	217	104	224	131	87	136
	242	1-1/2	1 125	6 000	343	113	355	304	107	315	186	89	192
	302	2	1 125	9 400	548	114	567	477	107	494	291	89	301
	362	2	1 125	12 160	722	115	747	622	107	643	380	89	393
	422	3	870	15 160	950	118	983	802	109	830	492	90	509
	482	3	870	20 040	1 234	117	1 277	1 063	109	1 100	652	90	675

NOTES:

① Steam pressure as supplied to unit heater. Valve and line losses must be subtracted from steam main pressure.

② Standard CFM measured at 70°F with density of .075 lb/cu ft.

③ Heat load in thousands of Btu/hr.

NOTE:
Leaving air temperature and MBH from table above must be corrected for steam pressures other than 2 psig and entering air temperatures other than 60°F.

Table below lists the correction factors. To determine correction factors falling between those shown, use the next lowest steam pressure and the next highest air temperature shown.

MBH (corrected) = MBH (above) x Correction Factor
LAT (corrected) = EAT + (MBH [corrected] x 926/CFM)
Condensate Load = MBH (corrected) x 1 000/Latent Heat of Steam

Correction Factors Based on 2 psig① Steam, 60°F Entering Air

Steam① Pressure (psig)	Temperature of Entering Air (°F)												Saturated Steam Temp. (°F)	Steam Latent Heat (Btu/lb)
	-10	0	10	20	30	40	50	60	70	80	90	100		
2	—	—	—	—	—	1.16	1.08	1.00	0.93	0.85	0.78	0.71	219	966
5	1.64	1.55	1.46	1.37	1.29	1.21	1.13	1.05	0.97	0.90	0.83	0.76	227	960
10	1.73	1.64	1.55	1.46	1.38	1.29	1.21	1.13	1.06	0.98	0.91	0.84	239	953
15	1.80	1.71	1.61	1.53	1.44	1.34	1.28	1.19	1.12	1.04	0.97	0.90	250	945
20	1.86	1.77	1.68	1.58	1.50	1.42	1.33	1.25	1.17	1.10	1.02	0.95	259	939
30	1.97	1.87	1.78	1.68	1.60	1.51	1.43	1.35	1.27	1.19	1.12	1.04	274	929
40	2.06	1.96	1.86	1.77	1.68	1.60	1.51	1.43	1.35	1.27	1.19	1.12	286	920
50	2.13	2.04	1.94	1.85	1.76	1.67	1.58	1.50	1.42	1.34	1.26	1.19	298	912
60	2.20	2.09	2.00	1.90	1.81	1.73	1.64	1.56	1.47	1.39	1.31	1.24	307	906
70	2.26	2.16	2.06	1.96	1.87	1.78	1.70	1.61	1.53	1.45	1.37	1.29	316	898
75	2.28	2.18	2.09	1.99	1.90	1.81	1.72	1.64	1.55	1.47	1.40	1.32	320	895
80	2.31	2.21	2.11	2.02	1.93	1.84	1.75	1.66	1.58	1.50	1.42	1.34	324	891
90	2.36	2.26	2.16	2.06	1.97	1.88	1.79	1.71	1.62	1.54	1.46	1.38	331	886
100	2.41	2.31	2.20	2.11	2.02	1.93	1.84	1.75	1.66	1.58	1.50	1.42	338	880
125	2.51	2.41	2.31	2.21	2.11	2.02	1.93	1.84	1.76	1.68	1.59	1.51	353	868
150	2.60	2.50	2.40	2.30	2.20	2.11	2.02	1.93	1.84	1.76	1.67	1.59	366	857
200	2.75	2.65	2.55	2.45	2.35	2.25	2.16	2.07	1.98	1.89	1.81	1.72	388	837
250	2.87	2.77	2.67	2.57	2.46	2.36	2.27	2.18	2.09	2.01	1.92	1.81	408	820

Performance Data With 200°F① Water, 60°F Entering Air Temperature

	Model Size	Common Data			Steel Tube / Aluminum Fin 11 FPI					Steel Tube / Steel Fin Stainless Tube / Steel Fin 11 FPI					Stainless Tube / Stainless Fin 10 FPI				
		Motor		CFM ②															
		HP	RPM		Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)	Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)	Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)
Standard Models	102	1/3	1 725	700	10	45	119	8.9	2.01	10	33	104	6.7	1.02	10	25	93	5.0	.54
					20	39	112	3.9	.39	20	29	99	2.9	.20	20	22	89	2.2	.10
					30	34	106	2.3	.13	30	25	93	1.7	.07	30	19	86	1.3	.04
	122	1/3		1 320	10	62	103	12.4	4.01	10	52	96	10.4	1.87	10	38	87	7.6	.95
					20	55	99	5.5	.79	20	46	92	4.6	.37	20	34	84	3.4	.19
					30	49	94	3.2	.27	30	40	88	2.7	.13	30	30	81	2.0	.07
	142	1/3		1 980	10	90	102	18.0	1.95	10	76	96	15.2	.94	10	55	86	11.0	.46
					20	78	97	7.8	.37	20	66	91	6.6	.18	20	48	82	4.8	.09
					30	67	92	4.5	.12	30	57	87	3.8	.06	30	42	79	2.8	.03
	162	1/2		2 910	10	119	98	23.9	2.77	10	97	91	19.3	1.24	10	70	82	14.0	.62
					20	105	94	10.5	.54	20	85	87	8.5	.24	20	61	80	6.1	.12
					30	92	89	6.1	.18	30	75	84	5.0	.08	30	54	77	3.6	.04
	182	3/4		3 900	10	156	97	31.2	3.89	10	132	91	26.5	1.77	10	94	82	18.9	.85
					20	137	93	13.7	.75	20	116	88	11.6	.34	20	83	80	8.3	.17
					30	121	89	8.1	.26	30	102	84	6.8	.12	30	74	78	4.9	.06
	202	3/4		4 560	10	190	99	38.0	4.88	10	161	93	32.2	2.25	10	115	83	23.1	1.08
					20	170	95	17.0	.97	20	144	89	14.4	.45	20	103	81	10.3	.22
					30	150	91	10.0	.34	30	127	86	8.4	.15	30	91	79	6.1	.08
	242	1-1/2	1 125	6 000	10	284	104	56.8	8.39	10	237	97	47.4	3.87	10	169	86	33.7	1.82
					20	258	100	25.8	1.73	20	214	93	21.4	.79	20	153	84	15.3	.37
					30	232	96	15.5	.62	30	196	90	13.1	.29	30	137	81	9.2	.13
	302	2		9 400	15	437	103	58.2	4.10	10	380	97	75.9	6.36	10	267	86	53.4	2.94
					20	416	101	41.6	2.79	20	345	94	34.5	1.31	20	245	84	24.5	.62
					30	381	98	25.4	1.04	30	315	91	21.0	.49	30	222	82	14.8	.23
	362	2		12 160	15	575	104	76.7	5.84	10	491	97	98.2	9.20	10	352	87	70.4	4.41
					20	552	102	55.2	4.19	20	452	95	45.3	1.96	20	324	85	32.4	.94
					30	506	99	33.7	1.56	30	419	92	27.9	.74	30	297	83	19.8	.35
	422	3	870	15 160	10	748	106	149.7	3.05	10	612	97	122.5	1.43	10	452	88	90.4	.70
					20	675	101	67.5	.62	20	552	94	55.2	.29	20	406	85	40.6	.14
					30	603	97	40.2	.22	30	490	90	32.6	.10	30	364	82	24.2	.05
	482	3		20 040	10	989	106	197.8	4.36	10	820	98	164.1	1.97	10	547	88	119.5	.98
					20	892	101	89.2	.89	20	745	94	74.5	.41	20	539	85	53.9	.20
					30	801	97	53.4	.32	30	667	91	44.4	.14	30	487	83	32.5	.07
Low Outlet Air Temperature Models	101	1/3	1 725	810	10	28	92	5.6	3.80	10	21	84	4.2	2.09	10	16	78	3.1	.86
					20	25	88	2.5	.74	20	19	82	1.9	.43	20	14	76	1.4	.17
					30	22	85	1.5	.26	30	17	79	1.1	.15	30	12	74	.8	.06
	121	1/3		1 350	10	41	88	8.2	6.20	10	32	82	6.3	3.54	10	23	76	4.6	1.4
					20	36	85	3.7	1.24	20	29	80	2.9	.73	20	20	74	2.0	.28
					30	32	82	2.2	.44	30	25	77	1.7	.25	30	18	73	1.2	.10
	141	1/3		2 590	10	60	81	12.0	3.13	10	47	77	9.5	1.85	10	33	72	6.6	.68
					20	52	79	5.2	.58	20	41	75	4.1	.35	20	29	70	2.9	.13
					30	45	76	3.0	.20	30	36	73	2.4	.12	30	25	69	1.7	.04
	161	1/2		3 330	10	76	81	15.3	4.15	10	63	78	12.7	2.19	10	45	73	9.0	.84
					20	67	79	6.7	.80	20	57	76	5.7	.44	20	40	71	4.0	.16
					30	58	76	3.9	.27	30	49	74	3.3	.15	30	35	70	2.3	.06
	181	3/4		4 420	10	97	80	19.5	5.62	10	81	77	16.1	3.03	10	57	72	11.4	1.15
					20	86	78	8.6	1.09	20	73	75	7.3	.61	20	50	71	5.0	.22
					30	75	76	5.0	.37	30	64	74	4.3	.21	30	45	69	3.0	.08
	201	3/4		5 430	10	119	80	23.8	7.14	10	98	77	19.6	3.85	10	69	72	13.7	1.44
					20	106	78	10.6	1.40	20	88	75	8.8	.78	20	62	71	6.2	.29
					30	94	76	6.3	.49	30	79	74	5.3	.28	30	55	69	3.7	.10
	241	1-1/2	1 125	7 020	15	160	81	21.4	4.47	10	136	78	27.1	4.76	10	95	73	19.0	2.16
					20	153	80	15.3	2.28	20	123	76	12.3	.97	20	86	71	8.6	.45
					30	137	78	9.1	.80	30	111	75	7.4	.36	30	78	70	5.2	.16
	301	2		10 660	15	249	82	33.2	6.66	10	208	78	41.7	7.22	10	149	73	29.7	3.41
					20	236	81	23.6	3.37	20	190	77	19.0	1.50	20	137	72	13.7	.74
					30	215	79	14.4	1.25	30	173	75	11.5	.55	30	124	71	8.3	.27
	361	2		13 440	15	327	83	43.6	9.87	10	269	79	53.7	10.43	10	190	73	38.0	4.88
					20	312	82	31.2	5.07	20	247	77	24.7	2.20	20	177	72	17.7	1.06
					30	285	80	19.0	1.87	30	226	76	15.1	.82	30	161	71	10.7	.39
	421	3	870	16 530	10	425	84	85.0	3.74	10	337	79	67.5	1.66	10	234	73	46.8	.74
					20	380	81	38.0	.75	20	300	77	30.0	.33	20	211	72	21.1	.15
					30	336	79	22.4	.26	30	266	75	17.7	.11	30	186	70	12.4	.05
	481	3		22 110	10	559	83	111.8	5.33	10	451	79	90.3	2.30	10	315	73	63.0	1.03
					20	502	81	50.2	1.07	20	406	77	40.6	.46	20	284	72	28.4	.21
					30	451	79	30.1	.39	30	365	75	24.4	.17	30	253	71	16.9	.07

Unit Heaters

NOTES:

① Water temperature at the unit heater.
② Standard CFM measured at 70°F with density of .075 lb/cu ft.
③ Heat load in thousands of Btu/hr.

NOTE:
Leaving air temperature and MBH from table on previous page must be corrected for water temperatures other than 200°F and entering air temperatures other than 60°F. Liquid flow rates and pressure drops are not corrected.

Table below lists the correction factors. To determine correction factors falling between those shown, use the next lowest water temperature and the next highest entering air temperature shown.

MBH (corrected) = MBH (from page 390) x Correction Factor

LAT (corrected) = EAT + (MBH (corrected) x 926/CFM)

Water ΔT = MBH (corrected) x 2.00/USGPM

Correction Factors Based on 200°F① Entering Water, 60°F① Entering Air

Entering Water Temp. (°F)	Temperature of Entering Air (°F)										
	0	10	20	30	40	50	60	70	80	90	100
160	1.23	1.14	1.05	0.96	0.88	0.80	0.72	0.63	0.57	0.48	0.41
170	1.31	1.21	1.12	1.04	0.95	0.87	0.79	0.70	0.63	0.55	0.48
180	1.38	1.29	1.20	1.11	1.02	0.94	0.86	0.77	0.70	0.62	0.55
190	1.46	1.36	1.27	1.18	1.10	1.01	0.93	0.85	0.77	0.69	0.62
200	1.54	1.44	1.35	1.26	1.17	1.09	1.00	0.92	0.84	0.76	0.68
210	1.61	1.52	1.42	1.33	1.25	1.16	1.07	0.99	0.91	0.83	0.75
220	1.69	1.59	1.50	1.41	1.32	1.23	1.14	1.06	0.98	0.90	0.82
230	1.77	1.67	1.57	1.48	1.39	1.30	1.22	1.13	1.05	0.97	0.89
240	1.84	1.75	1.65	1.55	1.47	1.37	1.29	1.20	1.12	1.04	0.96
250	1.92	1.82	1.72	1.63	1.54	1.45	1.36	1.27	1.19	1.11	1.03

Performance Data With 300°F① Water, 60°F Entering Air Temperature

	Model Size	Common Data			Steel Tube / Aluminum Fin 11 FPI					Steel Tube / Steel Fin Stainless Tube / Steel Fin 11 FPI					Stainless Tube / Stainless Fin 10 FPI				
		Motor HP	Motor RPM	CFM ②	Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)	Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)	Water Temp. Drop	MBH ③	Leaving Air (°F)	USGPM	Pressure Drop (ft wg)
Standard Models	102	1/3	1 725	700	40	69	151	3.4	.30	40	51	127	2.5	.15	40	38	111	1.9	.08
					60	64	145	2.1	.16	60	45	119	1.5	.05	60	34	106	1.2	.03
					80	60	140	1.5	.06	80	40	113	1.0	.02	80	30	99	.7	.01
	122	1/3		1 320	40	96	128	4.8	.61	40	79	116	4.0	.25	40	59	101	2.9	.14
					60	86	120	2.9	.21	60	71	110	2.4	.10	60	53	97	1.8	.05
					80	75	113	1.9	.09	80	62	104	1.6	.04	80	47	93	1.2	.02
	142	1/3		1 980	40	137	124	6.8	.28	40	116	114	5.8	.14	40	84	99	4.2	.07
					60	120	116	4.0	.10	60	101	107	3.4	.05	60	74	95	2.5	.02
					80	103	108	2.6	.04	80	86	100	2.1	.02	80	63	90	4.6	.01
	162	1/2		2 910	40	185	119	9.2	.41	30	148	107	7.4	.18	40	108	94	5.4	.09
					60	162	112	5.4	.14	60	131	102	4.4	.06	60	94	90	3.1	.03
					80	140	105	3.5	.06	80	114	96	2.8	.03	80	82	86	2.1	.01
	182	3/4		3 900	40	240	117	12.0	.58	40	203	108	10.2	.26	40	146	95	7.3	.13
					60	213	111	7.1	.20	60	179	103	6.0	.09	60	129	91	4.3	.04
					80	185	104	4.6	.09	80	158	97	3.9	.04	80	113	87	2.8	.02
	202	3/4		4 560	40	296	120	14.8	.74	40	251	111	12.5	.34	40	178	96	8.9	.16
					60	264	114	8.8	.26	60	224	106	7.5	.12	60	161	93	5.4	.06
					80	233	107	5.8	.11	80	197	100	4.9	.05	80	141	89	3.5	.03
	242	1-1/2	1 125	6 000	40	444	129	22.2	1.00	40	373	118	18.6	.60	40	264	101	13.2	.28
					60	405	123	13.5	.37	60	336	112	11.2	.22	60	238	97	7.9	.10
					80	363	116	9.1	.17	80	301	107	7.5	.10	80	214	93	5.4	.05
	302	2		9 400	40	721	131	36.0	1.57	40	596	119	29.8	.98	40	421	102	21.1	.46
					60	660	125	22.0	.59	60	543	114	18.1	.36	60	383	98	12.8	.17
					80	599	119	15.0	.27	80	493	109	12.3	.17	80	348	94	8.7	.08
	362	2		12 160	40	950	132	47.5	2.24	40	781	120	39.1	1.46	40	557	102	27.8	.69
					60	873	127	29.1	.84	60	714	114	23.8	.54	60	511	99	17.0	.26
					80	799	121	20.0	.40	80	654	110	16.4	.25	80	465	95	11.6	.12
	422	3	870	15 160	40	1 167	131	58.4	.32	40	956	118	47.8	.22	40	704	103	35.2	.11
					60	1 048	124	34.9	.12	60	856	112	28.5	.08	60	632	99	21.1	.04
					80	933	117	23.3	.05	80	763	107	19.1	.03	80	560	94	14.0	.02
	482	3		20 040	40	1 543	131	77.2	.45	40	1 294	120	64.7	.31	40	939	103	47.0	.15
					60	1 392	124	46.4	.16	60	1 158	114	38.6	.11	60	848	99	28.3	.05
					80	1 255	118	31.4	.07	80	1 045	108	26.1	.05	80	753	95	18.8	.02
Low Outlet Air Temperature Models	101	1/3	1 725	810	40	43	109	2.1	.56	40	33	98	1.7	.32	40	24	88	1.2	.13
					60	38	104	1.3	.20	60	30	94	1.0	.11	60	21	85	.7	.05
					80	34	98	.8	.09	80	26	90	.7	.05	80	19	82	.5	.02
	121	1/3		1 350	40	63	103	3.2	.93	40	49	94	2.5	.53	40	35	84	1.8	.21
					60	57	99	1.9	.33	60	45	91	1.5	.20	60	32	82	1.1	.08
					80	50	95	1.3	.15	80	39	87	1.0	.08	80	28	79	.7	.03
	141	1/3		2 590	40	91	93	4.6	.45	40	71	86	3.6	.26	40	50	78	2.5	.10
					60	80	89	2.7	.15	60	63	83	2.1	.09	60	44	76	1.5	.03
					80	69	85	1.7	.06	80	55	80	1.4	.04	80	38	74	1.0	.01
	161	1/2		3 330	40	117	93	5.8	.61	30	98	87	4.9	.33	40	69	79	3.5	.13
					60	103	89	3.4	.21	60	87	84	2.9	.12	60	61	77	2.0	.04
					80	89	85	2.2	.09	80	77	81	1.9	.05	80	54	75	1.4	.02
	181	3/4		4 420	40	150	91	7.5	.83	40	126	86	6.3	.46	40	87	78	4.4	.17
					60	133	88	4.4	.29	60	112	83	3.7	.16	60	78	76	2.6	.06
					80	117	84	2.9	.18	80	99	81	2.5	.07	80	69	74	1.7	.03
	201	3/4		5 430	40	185	92	9.2	1.07	40	153	86	7.6	.58	40	107	78	5.4	.22
					60	164	88	5.5	.38	60	138	84	4.6	.21	60	96	76	3.2	.08
					80	144	85	3.6	.16	80	122	81	3.1	.09	80	84	74	2.1	.03
	241	1-1/2	1 125	7 020	40	263	95	13.2	1.68	40	214	88	10.7	.74	40	149	80	7.4	.33
					60	239	92	8.0	.62	60	192	85	6.4	.26	60	135	78	4.5	.12
					80	212	88	5.3	.27	80	173	83	4.3	.12	80	121	76	3.0	.05
	301	2		10 660	40	408	96	20.4	2.53	40	329	89	16.7	1.13	40	234	80	11.7	.54
					60	372	92	12.4	.93	60	298	86	9.9	.41	60	213	79	7.1	.20
					80	334	89	8.4	.42	80	269	83	6.7	.19	80	192	77	4.8	.09
	361	2		13 440	40	537	97	26.9	3.75	40	425	89	21.3	1.64	40	302	81	15.1	.77
					60	494	94	16.5	1.41	60	389	87	13.0	.61	60	276	79	9.2	.29
					80	447	91	11.2	.65	80	356	85	8.9	.29	80	250	77	6.2	.13
	421	3	870	16 530	40	661	97	33.0	.57	40	528	90	26.4	.25	40	362	80	18.1	.11
					60	586	93	19.5	.20	60	466	86	15.5	.09	60	323	78	10.8	.04
					80	520	89	13.0	.09	80	411	83	10.3	.04	80	286	76	7.1	.02
	481	3		22 110	30	876	97	43.8	.82	40	700	89	35.0	.35	40	492	81	24.6	.16
					60	783	93	26.1	.29	60	630	86	21.0	.12	60	442	79	14.7	.06
					80	693	89	17.3	.13	80	564	84	14.1	.06	80	392	76	9.8	.02

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

NOTES:

① Water temperature at the unit heater.
② Standard CFM measured at 70°F with density of .075 lb/cu ft.
③ Heat load in thousands of Btu/hr.

NOTE:
Leaving air temperature and MBH from table on previous page must be corrected for water temperatures other than 300°F and entering air temperatures other than 60°F. Liquid flow rates and pressure drops are not corrected.

Table below lists the correction factors. To determine correction factors falling between those shown, use the next lowest water temperature and the next highest entering air temperature shown.

MBH (corrected) = MBH (from page 390) x Correction Factor

LAT (corrected) = EAT + (MBH [corrected] x 926/CFM)

Water ΔT = MBH (corrected) x 2.08/USGPM

Correction Factors Based on 300°F① Entering Water, 60°F Entering Air

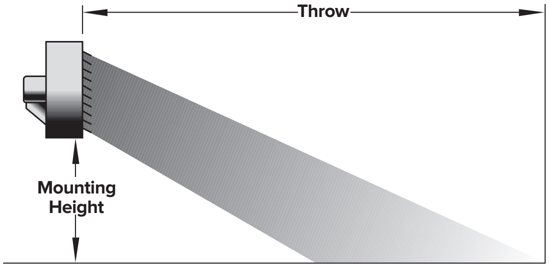
Entering Water Temp. (°F)	Temperature of Entering Air (°F)										
	0	10	20	30	40	50	60	70	80	90	100
260	1.15	1.10	1.04	0.99	0.94	0.88	0.83	0.78	0.73	0.69	0.64
270	1.19	1.14	1.08	1.03	0.98	0.93	0.88	0.82	0.78	0.73	0.68
280	1.23	1.18	1.13	1.08	1.02	0.97	0.92	0.87	0.82	0.77	0.72
290	1.27	1.22	1.17	1.12	1.07	1.01	0.96	0.91	0.86	0.81	0.76
300	1.31	1.26	1.21	1.16	1.11	1.05	1.00	0.95	0.90	0.85	0.80
310	1.35	1.30	1.25	1.21	1.15	1.10	1.04	0.99	0.94	0.89	0.84
320	1.41	1.36	1.30	1.26	1.19	1.14	1.09	1.03	0.98	0.93	0.88
330	1.45	1.40	1.34	1.30	1.23	1.18	1.13	1.07	1.02	0.97	0.92
340	1.49	1.44	1.39	1.34	1.27	1.22	1.17	1.11	1.06	1.01	0.95
350	1.54	1.48	1.43	1.38	1.33	1.26	1.21	1.15	1.10	1.05	1.00
360	1.58	1.52	1.47	1.42	1.36	1.30	1.25	1.20	1.14	1.09	1.04
370	1.62	1.57	1.51	1.46	1.40	1.35	1.29	1.24	1.18	1.13	1.08
380	1.66	1.61	1.55	1.50	1.44	1.39	1.33	1.28	1.22	1.17	1.12
390	1.71	1.65	1.60	1.54	1.49	1.43	1.37	1.32	1.27	1.21	1.16
400	1.74	1.69	1.63	1.57	1.53	1.47	1.42	1.36	1.31	1.25	1.20

Armstrong® Mounting Heights, Throws and Spreads

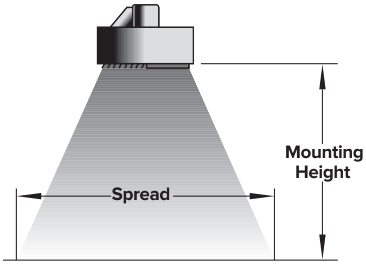
The mounting heights, throws and spreads listed below are based on an air temperature rise (ΔT) of 40°F. To arrive at these values for temperature rises other than 40°F, first determine the actual temperature rise from the appropriate performance data page. Then multiply the values from table below by the correction factors shown.

NOTES:

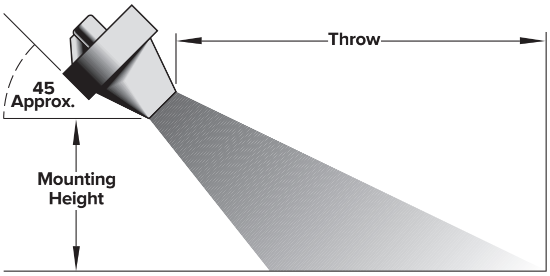
1. Minimum mounting height is 7 feet.
2. Mounting height is measured from bottom of unit to floor.
3. Values in the table were determined with louvers at 45°.
4. If four-way discharge louvers are used for horizontal applications, multiply throws by 0.8.
5. Values given are based upon average conditions and could be severely affected by such factors as obstructions, cross drafts, etc.



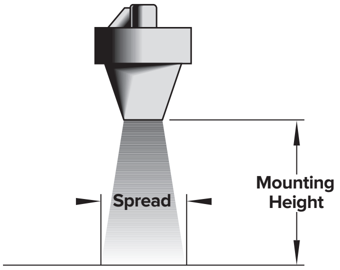
Horizontal Discharge––Standard Louvers



Vertical Discharge––Four-Way Louvers



Horizontal Discharge––High-Velocity Nozzle



Vertical Discharge––High-Velocity Nozzle

Discharge Temperature Correction Factors

Actual ΔT	Correction
10	1.18
20	1.12
30	1.06
40	1.00
50	0.94
60	0.88
70	0.82
80	0.76
90	0.70
100	0.64
110	0.58
120	0.51
130	0.45
140	0.39
150	0.33

Unit Heater Mounting Heights, Throws and Spreads

Model Size	Horizontal Louvered			Vertical Louvered			Horizontal High Velocity			Vertical High Velocity		
	Outlet Velocity FPM	Max. Mounting Height (ft)	Throw (ft)	Outlet Velocity FPM	Max. Mounting Height (ft)	Spread (ft)	Outlet Velocity FPM	Max. Mounting Height (ft)	Throw (ft)	Outlet Velocity FPM	Max. Mounting Height (ft)	Spread (ft)
101	600	10	30	660	10	25	2 310	12	40	2 310	17	15
121	750	12	44	820	13	38	2 050	14	58	2 050	22	20
141	1 090	14	53	1 200	16	48	2 620	17	72	2 620	27	25
161	1 110	15	66	1 220	17	52	2 290	18	88	2 290	29	27
181	1 200	16	72	1 320	18	55	2 270	19	94	2 270	31	29
201	1 220	17	76	1 340	18	56	2 380	20	101	2 380	31	29
241	1 360	18	82	1 500	19	59	2 340	22	109	2 340	32	30
301	1 340	20	84	1 500	20	62	2 270	24	112	2 270	34	32
361	1 220	21	88	1 340	21	65	2 210	25	122	2 210	36	34
421	1 110	21	118	1 230	21	66	2 180	25	158	2 180	36	34
481	1 140	22	118	1 270	22	70	2 210	26	160	2 210	37	35
102	550	9	22	600	9	24	2 000	11	30	2 000	15	13
122	730	12	37	800	13	38	2 000	14	49	2 000	22	20
142	840	13	45	920	15	46	2 000	16	62	2 000	26	24
162	970	15	56	1 060	17	51	2 000	18	75	2 000	29	27
182	1 050	16	66	1 160	18	55	2 000	19	86	2 000	31	29
202	1 030	16	69	1 130	18	56	2 000	19	92	2 000	31	29
242	1 170	17	73	1 280	19	59	2 000	20	97	2 000	32	30
302	1 180	19	74	1 320	20	62	2 000	23	98	2 000	34	32
362	1 100	20	78	1 210	20	62	2 000	24	110	2 000	34	32
422	1 020	21	110	1 130	21	66	2 000	25	145	2 000	36	34
482	1 040	22	110	1 150	22	70	2 000	26	147	2 000	37	35

Dimensions and Weights

Sound Data

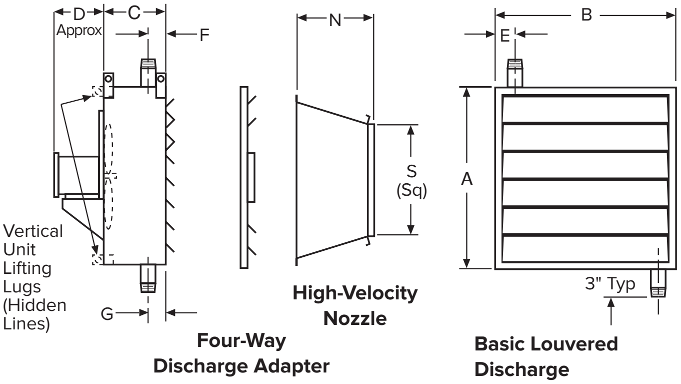
Since unit heaters use fans and motors to move air, sound is a natural result. The sound rating of a particular unit may limit its use in a given application. The following sound rating table is presented to allow you to select a unit based upon an acceptable sound level.

Sound Data

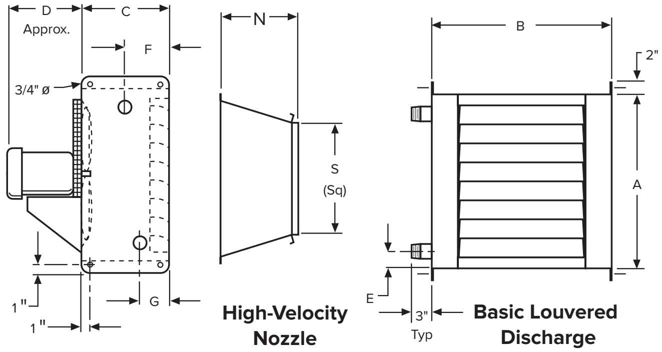
Unit Heater Size	dBA Sound * Pressure Level at 3 Feet from Unit
101 102	63 63
121 122	63 63
141 142	66 65
161 162	74 73
181 182	77 76
201 202	81 81
241 242	82 82
301 302	84 83
361 362	85 85
421 422	84 83
481 482	85 85

* Per fan.

10"–20" Units



24"–48" Units



NOTE: Connections are MPT

(Four-way louver section *replaces* basic louver section)

Dimensions and Weights

Model Size	Dimensions (in)										Basic Unit With Horizontal or Vertical Louvers Weights by Core Type (lb)			Additional Weight for High-Velocity Discharge Nozzle (lb)
	A	B	C	D	E	F	G	Conn. MPT	N	S	ST/AL	ST/ST	SS/SS	
101 102	15	17-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	10	7	95 135	105 155	95 145	11
121 122	17-1/4	19-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	10-3/4	9-3/4	105 150	120 180	110 165	14
141 142	19-1/2	21-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	11-1/2	11-3/4	120 175	140 210	125 190	16
161 162	22	23-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	12-1/4	14-1/4	135 195	165 240	145 220	19
181 182	24-1/4	25-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	13	16-3/4	150 220	185 280	160 250	22
201 202	26-1/2	27-3/4	12	9	1-3/8	4-1/2	4-1/4	1-1/2	13-3/4	18	170 245	210 315	180 285	24
241 242	32	34-1/4	18	12	2-7/16	6-3/4	4-1/4	2	14-1/2	20-3/4	290 360	350 470	320 420	17
301 302	39-1/4	40-1/4	18	12-1/2	1-13/16	6-3/4	4-1/4	2	18-13/16	26	360 460	460 650	410 550	31
361 362	45-1/4	46-1/4	18	12-1/2	2-5/8	6-1/2	4-1/2	2-1/2	22-7/8	29-1/2	440 550	560 800	500 680	47
421 422	52-1/4	52-1/4	22	15	2-5/8	6-1/4	4-3/4	3	29-3/8	33	680 830	850 1 150	770 1 010	35
481 482	59-1/4	58-1/4	22	15	2-3/8	6-1/4	4-3/4	3	31-1/4	38	800 990	1 030 1 430	920 1 240	47

* Dual units have two fans and two motors and, therefore, have twice the width and weight.

Installation Guidelines

Below are some abbreviated installation guidelines. Consult Armstrong for more detailed installation, operation and maintenance instructions.

General Piping Guidelines

1. Provide adequate support from the building structure to eliminate piping stresses.
2. Allow movement of the piping to provide for expansion and contraction. Use swing joints where possible.
3. Adequately support all piping. Do not use unit heater for this purpose.

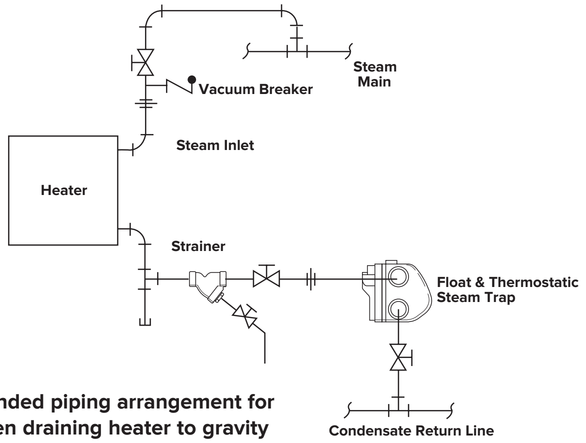
Steam Piping

1. Slope steam piping under 10' long toward the steam main. If steam pipe is longer than 10', slope toward the unit and install a drip trap before the unit.
2. All steam and condensate lines must be of the proper size to carry the calculated loads.
3. Only continuously draining traps such as inverted bucket or float and thermostatic types should be used. If an inverted bucket trap is used, an air vent should be installed downstream of the unit and before the trap.
4. Maintain the unit heater outlet size to the trap takeoff.
5. If condensate is to be lifted or if the return system is pressurized, use a check valve after the steam trap and provide a gate valve on the strainer to drain the heater in the off season.

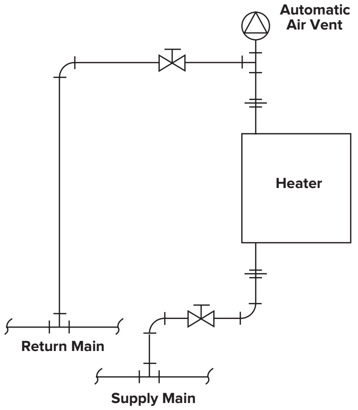
Liquid Piping

1. Supply return mains must be sloped for adequate venting.
2. Provide air vents at all high points.
3. Circulating pumps must be of adequate size to provide the required liquid flow and to overcome the system pressure drops.

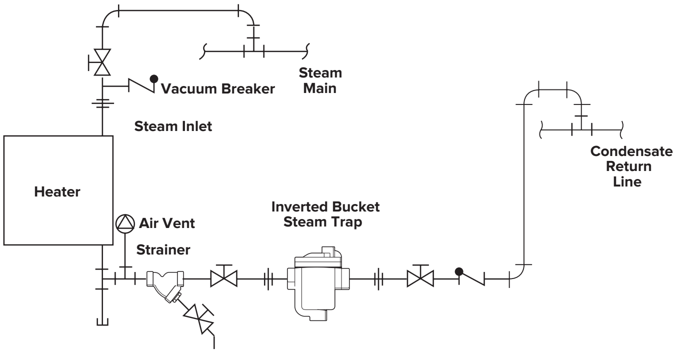
Typical Piping Arrangements



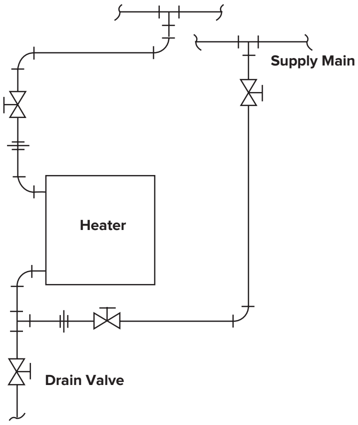
Recommended piping arrangement for steam when draining heater to gravity return.



Recommended piping arrangement for liquids to lower mains.



Recommended piping arrangement for steam when draining heater to overhead return.



Recommended piping arrangement for liquids to overhead mains.

Sample Specifications

Unit heaters supplied shall be manufactured with the methods and materials specified as follows:

General

Enclosures and Louvers—Shall be of minimum 14 ga galvanized steel and finished in gray enamel. (Epoxy coatings and other protective finishes are available.) Fans shall have aluminum alloy blades with steel hubs. (Epoxy coatings and other protective finishes are available.)

Motors—Shall be heavy-duty industrial type TEFC, ball bearing, standard NEMA frame motors. Electrical supply shall be _______ phase _______ volts 60 Hz. (Explosion-proof and other motor types available.)

Fan Guards—Shall be provided with each unit and be OSHA approved.

Core Type Specific

Steel tube/steel fin:

Tubes—Shall be 1" OD 12 ga steel tube. Minimum wall thickness shall be .109".

Fins—Shall be helically wound L-footed and of minimum .024" thick steel.

Headers—Shall be of carbon steel not less than .145" thick.

Connections—Shall be of Schedule 80 carbon steel pipe.

Assembly—Shall be welded to form a monometallic, internally wetted surface. Standard testing pressure at 525 psig. Pressure parts all welded.

Steel tube/aluminum fin:

Tubes—Shall be of 1" OD 12 ga steel tube. Minimum wall thickness shall be .109".

Fins—Shall be helically wound embedded type and of minimum .020" thick aluminum.

Headers—Shall be of carbon steel not less than .145" thick.

Connections—Shall be of Schedule 80 carbon steel pipe.

Assembly—Shall be welded to form a monometallic, internally wetted surface. Standard testing pressure at 525 psig.

Stainless steel tube/stainless steel fin:

Tubes—Shall be 304 L (or 316 L) 1" OD 14 ga stainless steel tube. Minimum wall thickness shall be .083".

Fins—Shall be helically wound L-footed and of minimum .020" thick 304 (or 316) stainless steel.

Headers—Shall be of the same stainless steel as the tubes not less than .109" thick.

Connections—Shall be of Schedule 40 stainless steel pipe.

Assembly—Shall be welded to form a monometallic, internally wetted surface. Standard testing pressure at 525 psig.

Stainless steel tube/steel fin:

Tubes—Shall be 304 L (or 316 L) 1" OD 14 ga stainless steel tube. Minimum wall thickness shall be .083".

Fins—Shall be helically wound L-footed and of minimum .024" thick steel.

Headers—Shall be of the same stainless steel as the tubes not less than .109" thick.

Connections—Shall be of Schedule 40 stainless steel pipe.

Assembly—Shall be welded to form a monometallic, internally wetted surface. Standard testing pressure at 525 psig.

Rotabreath High Mounted Series

Product Features

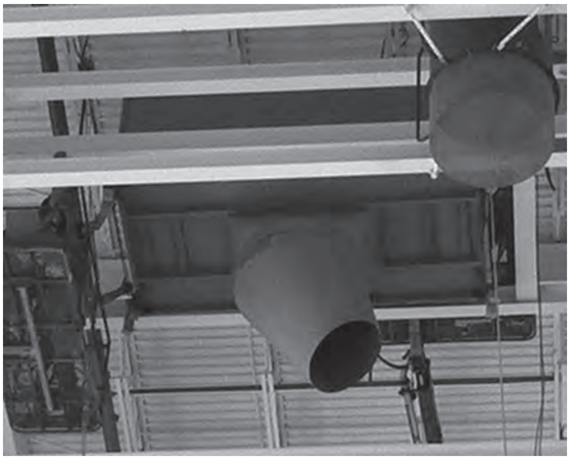
- Designed for steam, water or glycol
- 500 MBH (146 kW) to 1500 MBH (440 kW)
- One or two fans
- Rotating of fixed discharge
- High velocity nozzle
- Custom designs available

Product Benefits

- Less piping, wiring and controls
- Ideal in a low temp heat recovery loop (single point)
- Ease of maintenance
- Redued installation/shutdown time
- Simple installation, fewer units to install
- One unit averages 300 feet diameter of coverage
- Reduced temperature stratification

Typical Applications:

- Ideal for open space (ex. Aircraft Hangars)
- Used for high mounting (high ceiling) applications
- Ideal for low glycol temperatures
- Heat recovery application (single source)



Available in:

- Heavy Duty Series 6000
- Plate Fin Duralite

Hot Breath™/Hot Bin™ Portable Heaters

Armstrong offers their Heavy Duty Industrial Unit Heaters mounted on a Heavy Duty custom Service Cart with Pre-Piped Assemblies. This design offers the customer portable, on demand, spot heat treatment to any area or equipment within their facility.

Applications

- Integrated Pest Management – Heat Treatment for insect control. Dry Controlled Heat up for Structural (CAQ) and Targeted (Bin/Silo) areas (BAQ)
- Critical Area Heating during general plant shutdowns
- Temporary Comfort Heat
- Freeze Protection
- Construction Site work for Concrete Curing with controlled, low humidity, clean air

Purchase or Rent

- Purchase, Rental or Rent-To-Own Options

TEFC or Exp. Proof: (Industrial Rated)

- CAQ in Standard TEFC or Exp. Proof /FC options
- CAQ 115/230/1/60 1 HP (de-rated) with Prop Fan
- BAQ in Standard Exp. Proof options
- BAQ 230/460/3/60 3 HP with Centrifugal Fan

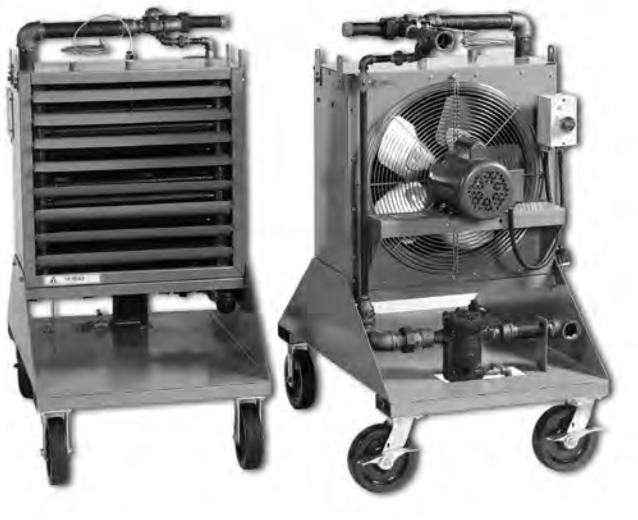
Pre-Assembled and Piped Package

Standard (150 PSIG Max. Steam Service Rating)

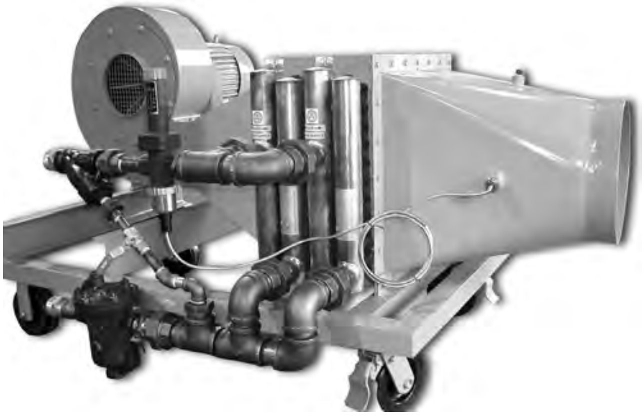
- Units designed to fit through 36" Doorways
- Armstrong Heavy Duty Full Size Y-Strainer w/Blow down
- Armstrong Adjustable Temp. Control Valve w/Capillary
- Armstrong Heavy Duty Industrial Finned Heating Coil
- Armstrong Inverted Bucket Steam Trap with Drain
- Heavy Duty Casing Material
- Industrial Prop Fan (CAQ) or Centrifugal Fan (BAQ) with OSHA Guard
- Steam & Condensate Piping interconnected
- Inlet/Outlet Dixon “BOSS” Steam / Condensate Fittings
- Heavy Duty Steel Cart, welded and bolted
- Heavy Duty Industrial Caster/Wheels with (2) Locks
- Heavy Duty Wood Shipping Containers (Rental Units supplied with Re-Usable Shipping Containers)
- 2 Way Adjustable Discharge Louvers (CAQ)
- 12” Discharge Nozzle with 25Ft Hi-Temp Flex Duct & Clamps (BAQ)
- Dixon “Boss” Clamps / Fittings for Field Connections
- Heavy Duty, Steam Rated (250dgF) Hose (2 – 50ft)
- Heavy Duty Electric Cable. Plugs and Disconnect Pre-Wired on Single Phase (only).(Exp. Proof Shipped Loose)

Options

- Custom Options are available for Purchased Units to meet specific customer demands.



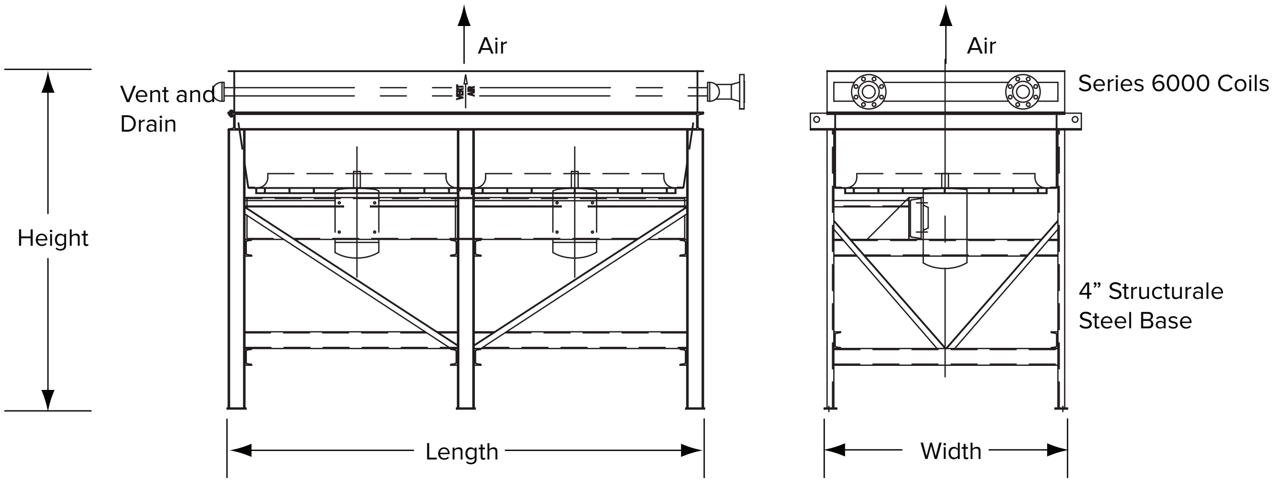
CAQ-202-HS-T12
(380 MBH - 50 psig @ 60°F EAT)



BAQ-300-HS-X23 Custom Packaged System

HI-Temp Steam Rated Hose and Quick Connectors

Armstrong® Steam Condenser and Liquid Cooler



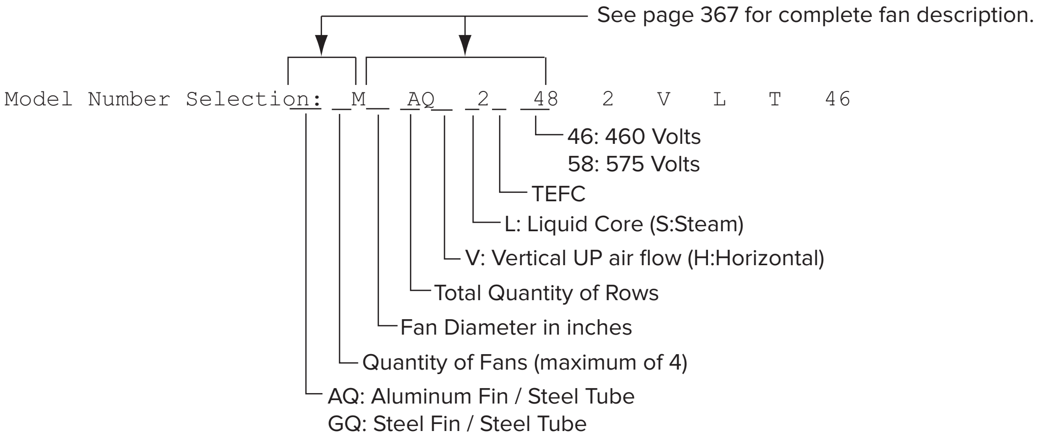
Available Options

- TEMA and API 661 design available
- ASME Section VIII Div. 1 available on pressure parts - consult factory
- TEMA and API 661 design available
- Epoxy coating available
- Hail Guard
- Removable Covers
- Removable Coils - contact factory

Dimensions

Unit Dimensions			Length						Height	
			Quantity of Fans							
Fan Size	Width		2		3		4			
	in	mm	in	mm	in	mm	in	mm	in	mm
36”	49-1/4	1 251	96-1/2	2 451	142-3/4	3 626	189	4 801	46	1 168
42”	56-1/4	1 429	108-1/2	2 756	160-3/4	4 083	213	5 410	54	1 372
48”	63-1/4	1 607	120-1/2	3 061	178-3/4	4 540	237	6 020	60	1 524

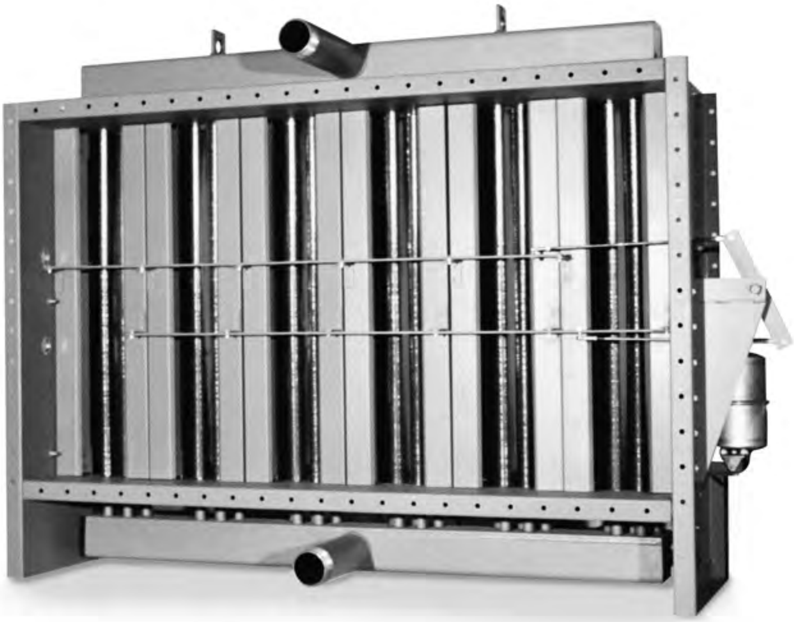
Note: Custom and larger dimensions available. Consult factory.



For sound pressure level, contact factory.

Duramix™ Face and By-pass Heating Coil

Armstrong®



The Armstrong Duramix™ heating coil controls air temperature while operating at full steam pressure. Once set, the desired leaving air temperature is maintained by Duramix™ regardless of variations in the entering air temperature. The Armstrong Duramix™ heating coil is simple, yet very effective, and it is easy to install and maintain.

How Does It Work?

Special dampers, operated by a pneumatic or electric actuator connected to a temperature sensor, adjust the leaving air temperature by channeling the appropriate amount of entering air across the heating coils and diverting the remaining air through by-pass channels. As entering air temperature gets closer to or farther from the set point, the dampers are closed or opened accordingly.

Typical Applications

- HVAC air preheat systems
- Make-up air systems
- Combustion air preheat systems

Advantages

- Maximum freeze protection
- Accurate temperature control
- Even leaving air temperature

Why Choose Armstrong Duramix™?

The Armstrong Duramix™ heating coil combines the advantages of a face and by-pass system with the quality, heavy-duty construction inherent in all Armstrong coils. From an all-welded, monometallic coil to corrosion-resistant linkages to a tough casing assembly, the Armstrong Duramix™ coil is built to provide long-lasting, trouble-free service.

Materials

- Heavy-Duty Tubes: 12 ga steel (type Q)
  10 ga steel (type R)
  14 ga 304L stainless steel (type W)
  14 ga 316L stainless steel (type Y)
- Heavy-Duty Fins: 0.020" thick aluminum (type A)
  0.030" thick aluminum (type B)
  0.024" thick steel (type G)
  0.020" thick 316L stainless steel (type K)
  0.016" thick copper (type F)
- Monometallic Coil Design: Prevents galvanic corrosion
- Welded Tube-to-Header Joints: Prevent leaks
- All Stainless Steel Damper Linkage Assembly: Prevents dampers from “freezing up” due to corrosion
- 12 ga steel casing provides a strong, durable frame Optional: 12 ga 304L stainless steel
- 16 Ga. Louvers

Design Limit

150 psig @ 400°F (10 barg @ 204°C)

Custom-built Duramix face and by-pass heating coils are also available. Please consult factory.

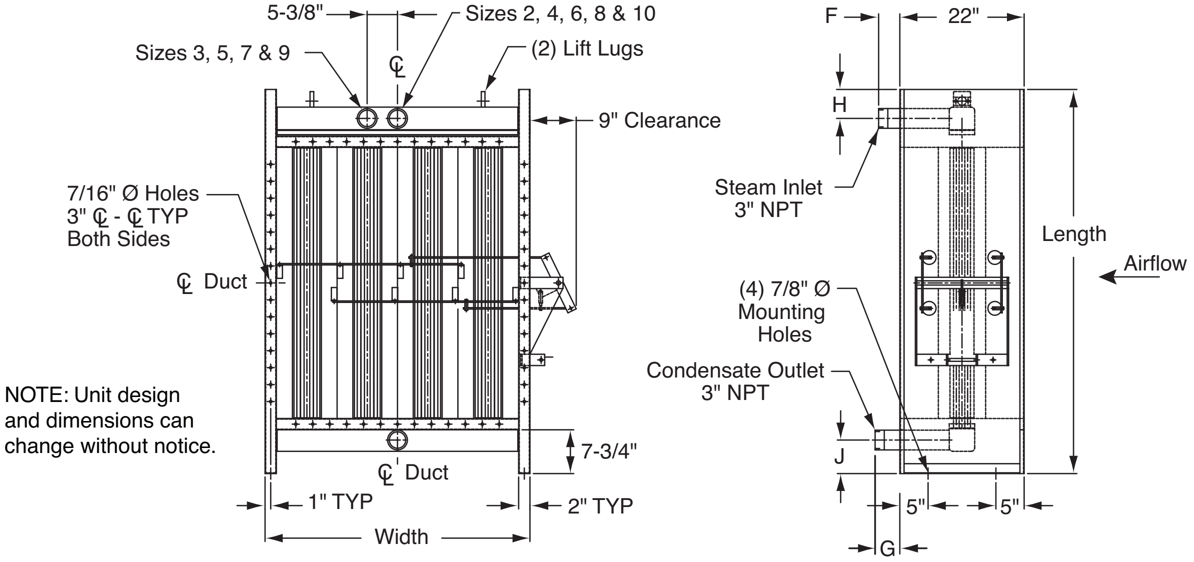
Coil Type

- Available also in centifeed, tandem and centifeed tandem, consult factory.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Duramix™ Sizing and Selection

All sizes are for vertical tubes and horizontal airflow only.
For help in selecting the right size for either a new or retrofit application, please call us.
Left hand Duramix shown below.



NOTE: Unit design and dimensions can change without notice.

1-Row Units

Size	No. of Tube Bundles				2		3		4		5		6		7		8		9		10		11		12	
	Casing Width (in)				25-3/8		36-1/8		46-7/8		57-5/8		68-1/4		79		89-3/4		100-1/2		111-1/8		121-7/8		132-5/8	
	F (in)				3-3/4		3-3/4		3-3/4		3-3/4		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8	
	Casing Length	G (in)	H (in)	J (in)	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT
					ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb
A	44"	4-3/8	5-1/8	5-15/16	2.27	268	3.41	331	4.54	390	5.68	458	6.81	540	7.95	607	9.09	706								
B	56"				3.41	308	5.11	374	6.81	448	8.52	526	10.22	614	11.92	693	13.63	788								
C	68"				4.54	339	6.81	420	9.09	501	11.36	587	13.63	681	15.90	769	18.17	867	20.44	930	22.71	1 013	25.09	1 096	27.37	1 179
D	80"						8.52	460	11.36	546	14.20	647	17.03	753	19.87	844	22.71	958	25.55	1 037	28.39	1 130	31.37	1 230	34.22	1 330
E	93-11/16"								14.76	627	18.45	738	22.15	849	25.84	961	29.53	1 084	33.22	1 183	36.91	1 284	40.77	1 385	44.48	1 487
F	116"										22.81	825	27.38	940	31.94	1 070	36.50	1 195	41.06	1 320	45.63	1 430	50.19	1 540	54.75	1 667

2-Row Units

Size	No. of Tube Bundles				2		3		4		5		6		7		8		9		10		11		12	
	Casing Width (in)				25-3/8		36-1/8		46-7/8		57-5/8		68-1/4		79		89-3/4		100-1/2		111-1/8		121-7/8		132-5/8	
	F (in)				3-1/4		3-1/4		3-1/4		3-1/4		5-1/4		5-1/4		5-1/4		5-1/4		5-1/4		2-1/8		2-1/8	
	Casing Length	G (in)	H (in)	J (in)	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT
					ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb
A	44"	3-1/4	3-3/8	3-1/8	2.27	308	3.41	382	4.54	456	5.68	538	6.81	578	7.95	756	9.09	735								
B	56"				3.41	351	5.11	431	6.81	520	8.52	613	10.22	719	11.92	839	13.63	977								
C	68"				4.54	383	6.81	482	9.09	580	11.36	682	13.63	795	15.90	905	18.17	1 016	20.44	1 126	22.71	1 237	25.09	1 348	27.37	1 459
D	80"						8.52	528	11.36	632	14.20	752	17.03	877	19.87	1 048	22.71	1 193	25.55	1 318	28.39	1 420	31.37	1 522	34.22	1 624
E	98"								14.76	723	18.45	856	22.15	1 044	25.84	1 196	29.53	1 337	33.22	1 472	36.91	1 598	40.77	1 724	44.48	1 850
F	116"										22.81	960	27.38	1 211	31.94	1 344	36.50	1 481	41.06	1 626	45.63	1 873	50.19	1 926	54.75	2 076

Consult factory for additional size options.

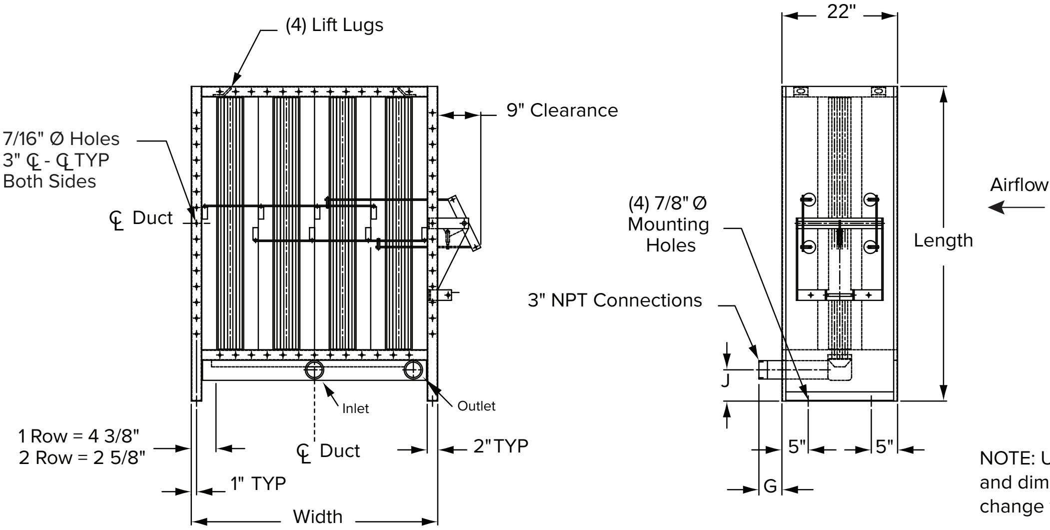
Design Limits: 150 psig @ 400F

```
Model Number Selection: BV1 - 2A A A11LH/RH08 - T
```

Left Hand / Right Hand (LH Shown Above)
Thermostat (T), Pneumatic (P), Electric (E), Actuator (A—If Supplied)
Tube Type, Gauge/Schedule, OD - See page 342
Fin Type, Fins per Inch - See page 342
No. of Tube Bundles, Casing Width / Casing Length
By-pass, Vertical, No. of Rows

Centifeed Duramix™ Sizing and Selection

All sizes are for vertical tubes and horizontal airflow only.
For help in selecting the right size for either a new or retrofit application, please call us.
Left hand Centifeed Duramix shown below.



NOTE: Unit design and dimensions can change without notice.

1-Row Units

Size	No. of Tube Bundles				2		3		4		5		6		7		8		9		10		11		12	
	Casing Width (in)				25-3/8		36-1/8		46-7/8		57-5/8		68-1/4		79		89-3/4		100-1/2		111-1/8		121-7/8		132-5/8	
	F (in)				3-3/4		3-3/4		3-3/4		3-3/4		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8		2-1/8	
	Casing Length	G (in)	H (in)	J (in)	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT
					ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb
A	36"	4-3/8	5-1/8	5-15/16	2.27	268	3.41	331	4.54	390	5.68	458	6.81	540	7.95	607	9.09	706								
B	48"				3.41	308	5.11	374	6.81	448	8.52	526	10.22	614	11.92	693	13.63	788								
C	60"				4.54	339	6.81	420	9.09	501	11.36	587	13.63	681	15.90	769	18.17	867	20.44	930	22.71	1 013	25.09	1 096	27.37	1 179
D	72"						8.52	460	11.36	546	14.20	647	17.03	753	19.87	844	22.71	958	25.55	1 037	28.39	1 130	31.37	1 230	34.22	1 330
E	90"								14.76	627	18.45	738	22.15	849	25.84	961	29.53	1 084	33.22	1 183	36.91	1 284	40.77	1 385	44.48	1 487
F	108"										22.81	825	27.38	940	31.94	1 070	36.50	1 195	41.06	1 320	45.63	1 430	50.19	1 540	54.75	1 667

2-Row Units

Size	No. of Tube Bundles				2		3		4		5		6		7		8		9		10		11		12	
	Casing Width (in)				25-3/8		36-1/8		46-7/8		57-5/8		68-1/4		79		89-3/4		100-1/2		111-1/8		121-7/8		132-5/8	
	F (in)				3-1/4		3-1/4		3-1/4		3-1/4		5-1/4		5-1/4		5-1/4		5-1/4		5-1/4		2-1/8		2-1/8	
	Casing Length	G (in)	H (in)	J (in)	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT	FA	WT
					ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb	ft^2	lb
A	36"	3-1/4	3-3/8	3-1/8	2.27	308	3.41	382	4.54	456	5.68	538	6.81	578	7.95	756	9.09	735								
B	48"				3.41	351	5.11	431	6.81	520	8.52	613	10.22	719	11.92	839	13.63	977								
C	60"				4.54	383	6.81	482	9.09	580	11.36	682	13.63	795	15.90	905	18.17	1 016	20.44	1 126	22.71	1 237	25.09	1 348	27.37	1 459
D	72"						8.52	528	11.36	632	14.20	752	17.03	877	19.87	1 048	22.71	1 193	25.55	1 318	28.39	1 420	31.37	1 522	34.22	1 624
E	90"								14.76	723	18.45	856	22.15	1 044	25.84	1 196	29.53	1 337	33.22	1 472	36.91	1 598	40.77	1 724	44.48	1 850
F	108"										22.81	960	27.38	1 211	31.94	1 344	36.50	1 481	41.06	1 626	45.63	1 873	50.19	1 926	54.75	2 076

Consult factory for additional size options.

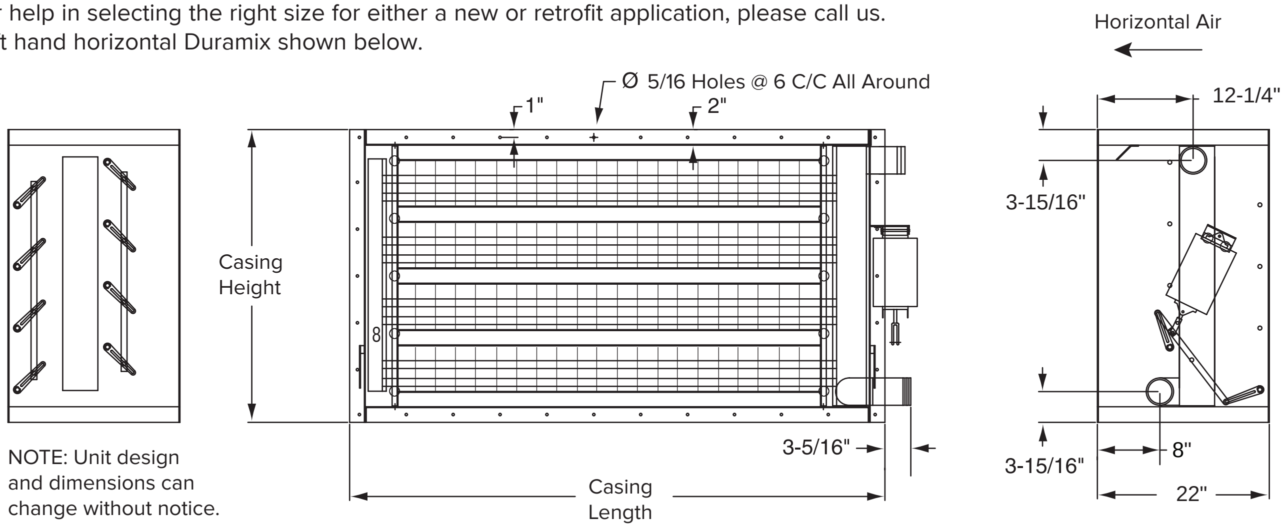
Design Limits: 150 psig @ 400°F

Model Number Selection: CBV1 - 4C - A11 - Q08 - TA - LH/RH

- LH/RH: Left Hand / Right Hand (LH Shown Above)
- TA: Thermostat (T), Pneumatic (P), Electric (E), Actuator (A - If Supplied)
- Q08: Tube Type, Gauge/Schedule, OD - See page C-7
- A11: Fin Type, Fins per Inch - See page C-7
- 4C: No. of Tube Bundles, Casing Width / Casing Length
- CBV1: Centifeed By-pass, Vertical, No. of Rows

Horizontal Duramix™ Sizing and Selection

All sizes are for horizontal tubes and horizontal airflow only.
For help in selecting the right size for either a new or retrofit application, please call us.
Left hand horizontal Duramix shown below.



NOTE: Unit design and dimensions can change without notice.

Size		A		B		C		D	
Casing Length (in)		**26-1/2**		**32-1/2**		**38-1/2**		**44-1/2**	
Size	**Casing Height (in)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**
2	20-3/4	0.96	239	1.43	262	1.91	285	2.38	308
3	29-1/8	1.43	263	2.15	345	2.86	380	3.57	414
4	37-1/2	1.68	287	2.52	429	3.35	475	4.19	521
5	45-7/8	—	—	3.58	512	4.76	570	5.95	627
6	54-1/4	—	—	—	—	5.72	664	7.14	733
7	62-5/8	—	—	—	—	—	—	8.33	840
8	71	—	—	—	—	—	—	9.53	946

Reference weight only using steel tube 12 Ga. A-214 and aluminum keyfin 0.020" thick.

Size		E		F		G		H	
Casing Length (in)		**50-1/2**		**56-1/2**		**62-1/2**		**68-1/2**	
Size	**Casing Height (in)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**	**Face Area Ft.^{2}**	**Weight (lb)**
2	20-3/4	2.86	331	3.33	354	3.81	377	4.28	400
3	29-1/8	4.28	449	5.00	483	5.71	517	6.42	552
4	37-1/2	5.71	566	6.66	612	7.61	658	8.56	704
5	45-7/8	7.14	684	8.33	742	9.52	799	10.71	856
6	54-1/4	8.57	802	10.00	871	11.42	940	12.85	1 008
7	62-5/8	10.00	920	11.66	1 000	13.32	1 080	14.99	1 161
8	71	11.43	1 038	13.33	1 129	15.23	1 221	17.13	1 313

Reference weight only using steel tube 12 Ga. A-214 and aluminum keyfin 0.020" thick.

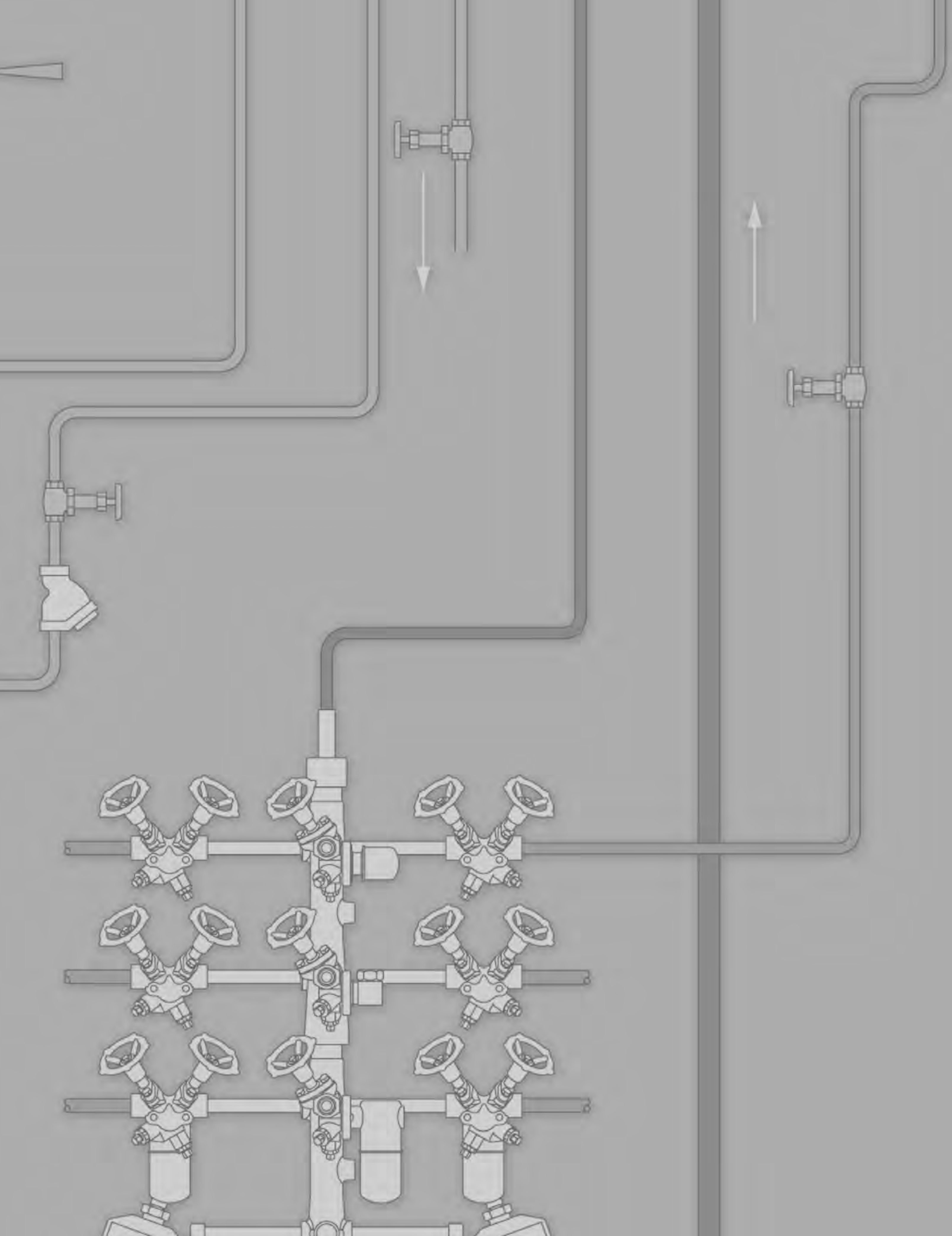
Design Limits: 150 psig @ 400°F

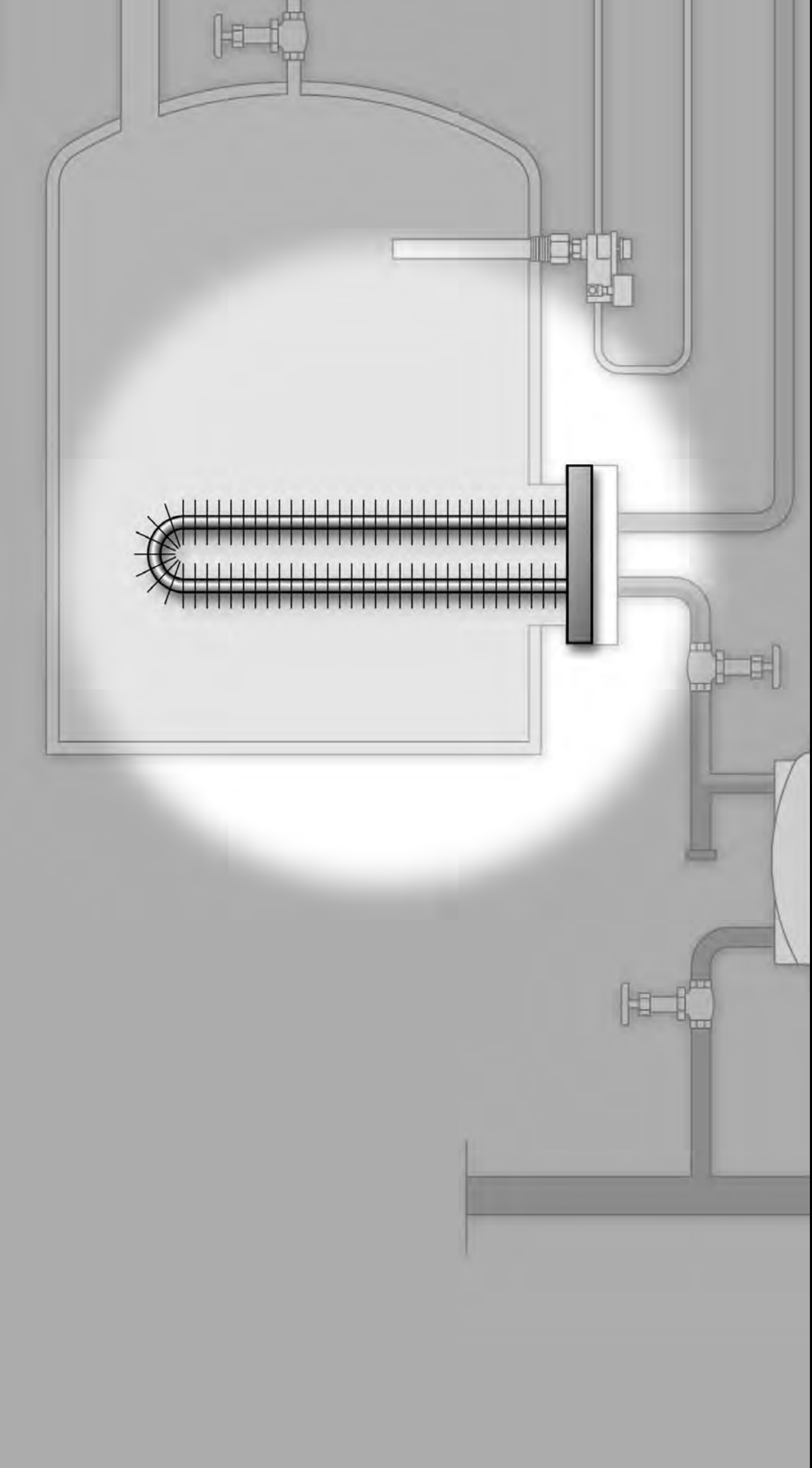
`Model Number Selection: BH2 - 4H - A11 - Q08 - HA - L`

Hand of Coil
Actuator Model (if required)
Tube Type, OD
Fin Type, Fin per Inch
Tube Bundles, Casing Width/Casing Length
By-pass, Horizontal, # Rows. BHC: Centifeed Model

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Notes



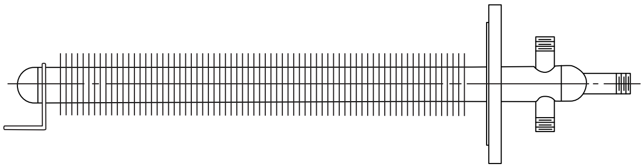


Tank Heaters

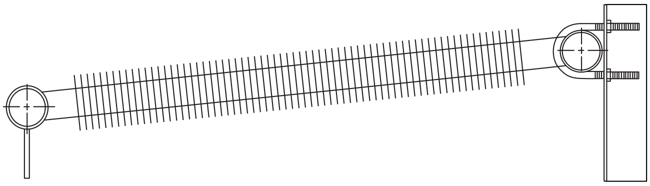
Armstrong

Armstrong®

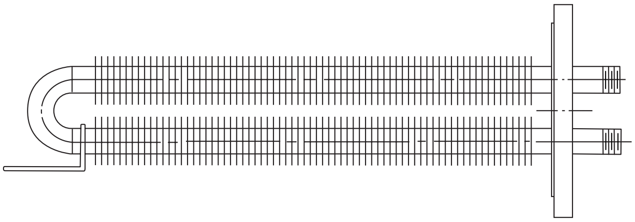
Features/Benefits of Armstrong Tank Heaters



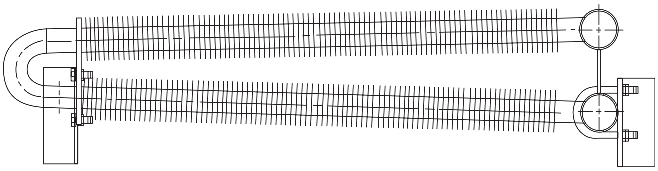
Flange Mounted Bayonet Type FBC and FBS



Base Mounted Direct Type BD



Flange Mounted Hairpin Type FHC and FHS



Base Mounted Hairpin Type BHC and BHS

Application Flexibility

Four types of tank heaters are offered in several materials and sizes to suit your specific requirements. Several heaters are custom built, consult factory.

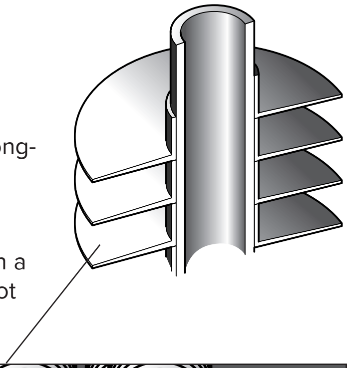
Space Savings

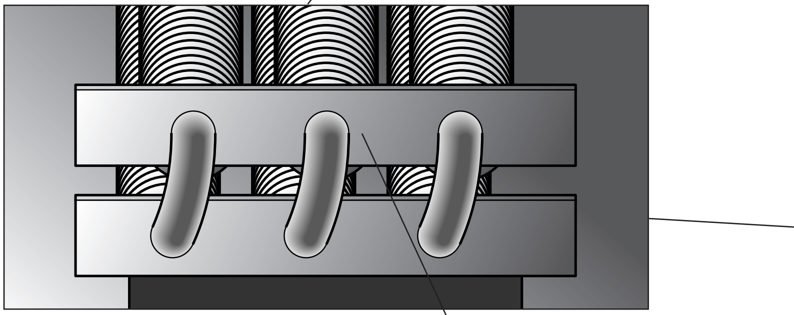
Flange mounted heaters are installed on various standard manhole sizes. You save internal space because only the heating element itself is inside. Steam and condensate connections are outside of the tank.

Heat Transfer Efficiency

Stiff, helically wound L fin design for an efficient and long-lasting heat transfer surface.

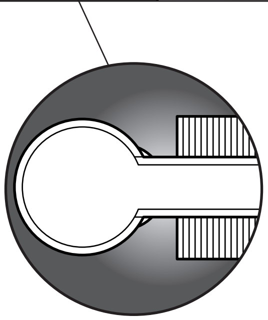
Vertical fin surface provides uniform heating of liquid with a minimum of coking due to hot spots.





Durability Over Long Life

Pipes and headers are of heavy construction (minimum Sch. 40 pipe for steel). Greater thickness means a stronger, more corrosion-resistant design that lasts longer.

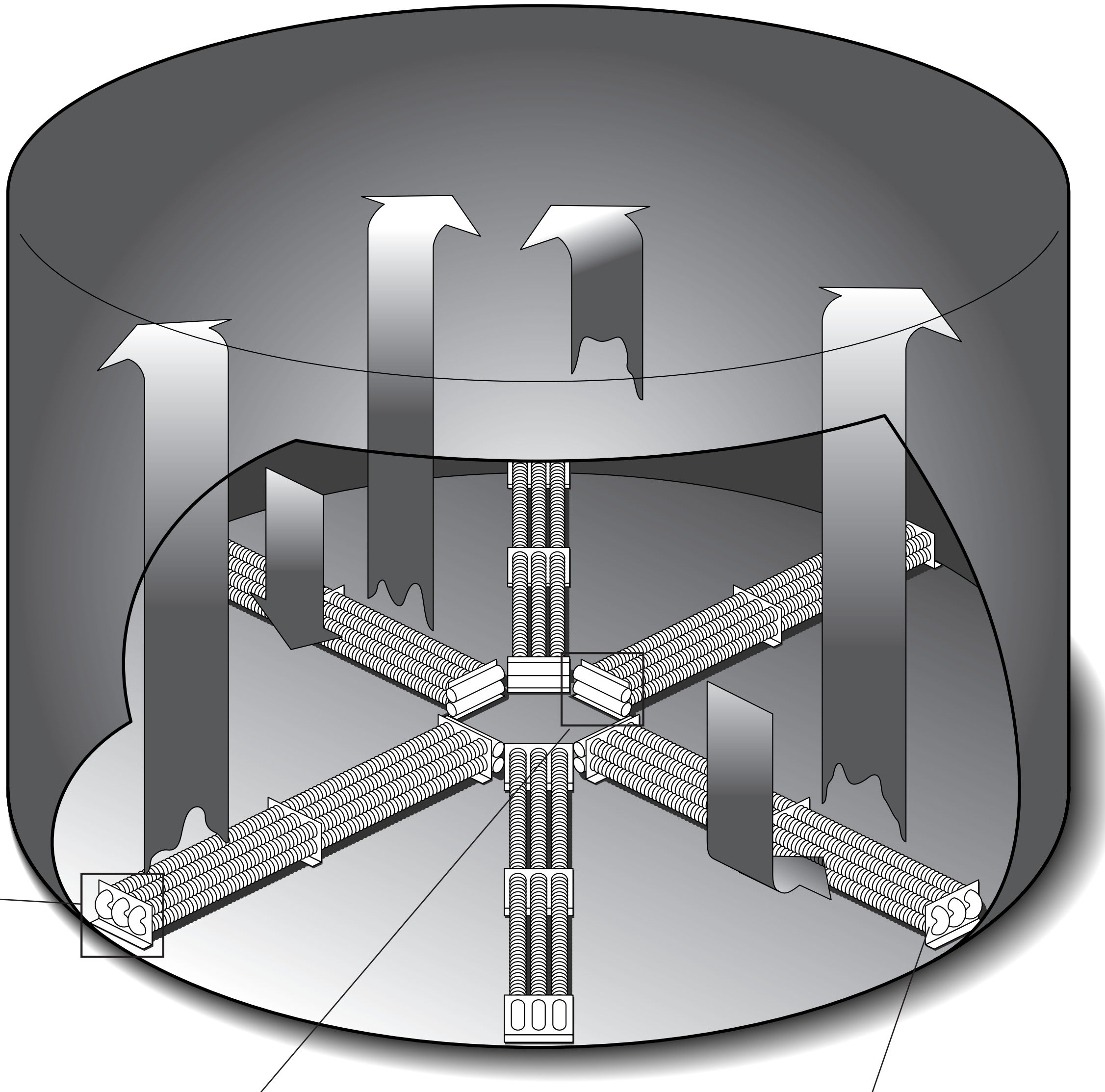


Corrosion Resistance

Pipes, headers and connections are welded together for a tough, single material joint. Eliminating dissimilar materials precludes galvanic corrosion, thereby lengthening service life.

Several heaters are custom built - consult factory.

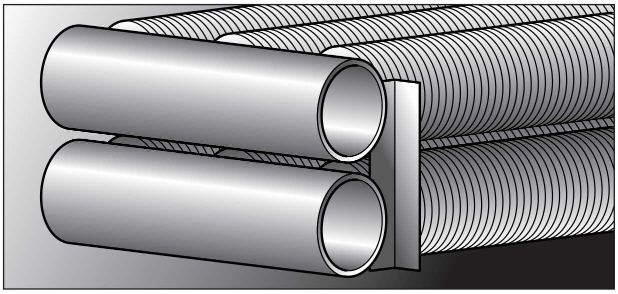
Typical Tank Heater Arrangement



Base Mounted Hairpin Types BHC and BHS Shown

Fast, Direct Connection

Heaters are ready for connection to the steam and condensate systems as supplied. Numerous types of connections are available.



Base mounted heaters come with supports to allow for a proper distance between the tank bottom and the heating surface. This also helps to minimize the need for internal welding. Longer units are provided with mid-support members to further minimize inside welding and ensure rigid footing.

Minimum Installation Welding

Armstrong base-mounted tank heaters are installed and removed easily through manholes, eliminating the need for time-consuming welding inside the tank.

Tougher on the Job

Armstrong tank heaters are built to withstand the rigorous demands encountered in industrial installations. The heavy-duty features of our units were developed in response to a need for tank heaters that could provide efficient heat transfer without sacrificing structural integrity. These features include heavy-wall pipes and headers, thick L footed fins and all welded construction. In addition, the mono-metallic construction of our units precludes galvanic corrosion, and the finned surface is rigid enough to withstand high-pressure cleaning.

Experience gained over 80 years backs every Armstrong tank heater. As a steam system specialist, your Armstrong Representative can provide assistance with everything from the boiler to the condensate return system.

Quality products from Armstrong, plus the practical knowledge to integrate them into your total steam system, ensure an efficient and trouble-free installation.

Efficient Heat Transfer

Finned pipe tank heaters are easier than bare pipe units to install, remove and repair. They are also more compact and provide superior efficiency in product heating. Finned pipe tank heaters provide up to 10 times as much heat transfer as an equivalent length of bare pipe, resulting in lower film or "skin" temperatures. This reduces coking of the product on the heat transfer surface and discoloration of heat-sensitive products. This buildup of deposits on the heater requires that more frequent cleanings be carried out to maintain maximum efficiency and original heat transfer design conditions.

This helically wound finned pipe is best suited for horizontal units, with the fins being in the vertical plane. This increases the natural convection currents, which increases heat transfer and continuously wipes the coil surface to maintain cleanliness.

Options to Match Your Applications

Armstrong tank heaters are available in four standard configurations:

- Flange Mounted Hairpin—Types FHC and FHS
- Flange Mounted Bayonet—Types FBC and FBS
- Base Mounted Hairpin—Types BHC and BHS
- Base Mounted Direct—Type BD

These four configurations offer a range of choices to suit most area coverage and thermal performance requirements. Each type includes a number of length, width and fin pitch options. All units are available in seamless carbon steel pipe construction. The hairpin and bayonet types are available in stainless steel**. Liquid heated units and custom designs are also available.**

Critical to the heating and maintenance of temperatures for a broad variety of products, Armstrong tank heaters are widely used in breweries, chemical and food processing plants, oil refineries, paper mills, tank storage farms, and in shipping and other industries.

BH **FB**

From left to right, Base Mounted Hairpin, Flange Mounted Bayonet, Flange Mounted Hairpin and Base Mounted Direct.

Model Number Selection

MODEL NUMBER

BH S – 6 – 4 FPI – 20

TYPE OF TANK HEATER

FH = Flange Mounted Hairpin
FB = Flange Mounted Bayonet
BH = Base Mounted Hairpin
BD = Base Mounted Direct

MATERIALS OF CONSTRUCTION

C = Carbon Steel
S = 304L or 316L
Stainless Steel

*Inconel construction also available, consult factory.

NOMINAL LENGTH

"L" Feet

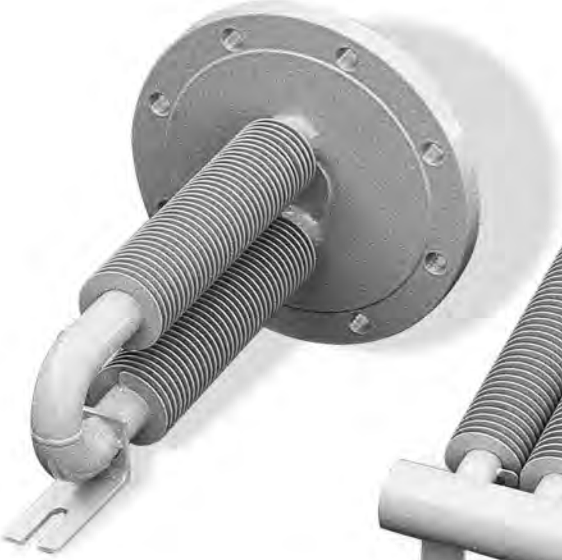
FINS PER INCH

UNIT NUMBER

Number of Finned Pipes
For Types
FHC, FHS, BHC, BHS, BD

or

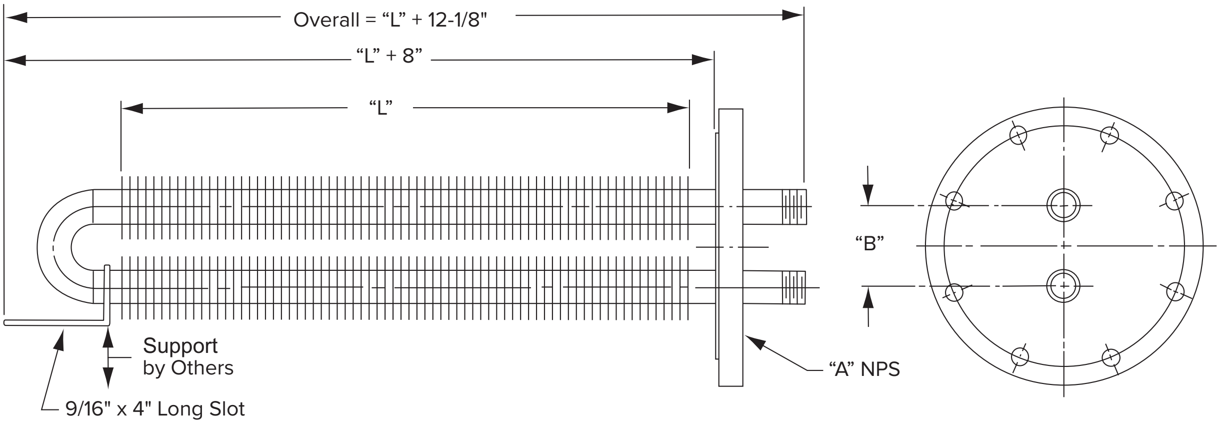
Pipe Size
For Types FBC, FBS



FH

BD

Flange Mounted Hairpin Type FHC and FHS



Standard Sizes

FHC Carbon Steel Units

Type	A Flange Size (in)	B (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
				3 FPI	4 FPI	5 FPI	3 FPI	4 FPI	5 FPI
FHC-2	8	3-3/4	2	11.6	14.9	18.1	71	74	77
			3	17.4	22.3	27.2	81	86	90
			4	23.2	29.8	36.3	91	97	103
			5	29.0	37.2	45.4	102	109	116
			6	34.8	44.6	54.4	112	120	129
			7	40.6	52.1	63.5	122	132	142
			8	46.4	59.5	72.6	132	144	155
			9	52.3	67.0	81.6	142	155	168
			10	58.1	74.4	90.7	153	167	181
FHC-4	10	5-5/16	2	21.8	27.9	34.0	124	130	135
			3	33.4	42.8	52.2	144	153	161
			4	45.0	57.7	70.3	165	176	187
			5	56.6	72.5	88.5	185	200	213
			6	68.2	87.4	106.6	206	223	239
			7	79.8	102.3	124.7	226	246	265
			8	91.4	117.2	142.9	246	269	291
			9	103.1	132.1	161.0	267	292	317
			10	114.7	146.9	179.2	287	316	343

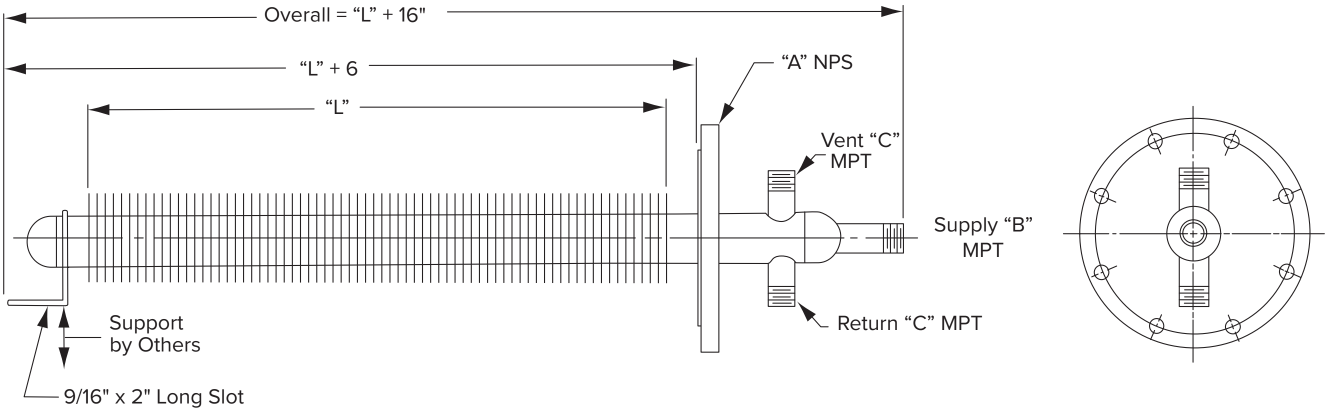
Materials of Construction
Pipes: 1-1/4" NPS Sch. 80 Seamless Steel (1.66" OD x 0.191" Wall)
Fins: 0.036" Thick Helically Wound Steel "L" Foot
Return Bends: A-234 Long Radius Forged Steel Sch. 80
Mounting Flange: A-105 Forged Steel, 150 lb Raised Face
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig

FHS Stainless Steel Units

Type	A Flange Size (in)	B (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
				3 FPI	4 FPI	5 FPI	3 FPI	4 FPI	5 FPI
FHS-2	8	3-3/4	2	8.8	11.1	13.4	60	61	62
			3	13.1	16.6	20.1	65	67	69
			4	17.5	22.2	26.9	71	73	75
			5	21.9	27.7	33.6	76	79	82
			6	26.3	33.3	40.3	82	85	88
			7	30.6	38.8	47.0	87	91	95
			8	35.0	44.4	53.7	92	97	101
			9	39.4	49.9	60.4	98	103	108
			10	43.8	55.5	67.2	103	109	114
FHS-4	10	5-5/16	2	17.5	22.2	26.9	100	102	105
			3	26.3	33.3	40.3	111	114	118
			4	35.0	44.4	53.7	122	126	131
			5	43.8	55.5	67.2	132	138	144
			6	52.5	66.6	80.6	143	150	157
			7	61.3	77.7	94.0	154	162	170
			8	70.0	88.8	107.5	165	174	183
			9	78.8	99.9	120.9	176	186	196
			10	87.6	111.0	134.3	186	198	209

Materials of Construction
Pipes: 1-1/4" NPS Sch. 10, 304L SS (1.66" OD x 0.109" Wall)
Fins: 0.020" Thick Helically Wound 304 SS "L" Foot
Return Bends: A-403 Long Radius 304L SS Sch. 10
Mounting Flange: A-182 304L SS, 150 lb Raised Face
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig
NOTE: Type 316L SS Construction is available.

Flange Mounted Bayonet Type FBC and FBS



Standard Sizes

FBC Carbon Steel Units

Type	A Flange Size (in)	B (in)	C (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
					3 FPI	4 FPI	5 FPI	3 FPI	4 PFI	5 FPI
FBC-125	4	3/4	3/4	2	5.8	7.4	9.1	33	34	35
				3	8.7	11.2	13.6	39	41	42
				4	11.6	14.9	18.1	45	47	50
				5	14.5	18.6	22.7	51	54	57
				6	17.4	22.3	27.2	57	60	64
				7	20.3	26.0	31.8	63	67	72
				8	23.2	29.8	36.3	69	74	79
				9	26.1	33.5	40.8	75	80	86
				10	29.0	37.2	45.4	81	87	93
FBC-200	6	1	1	2	7.9	10.1	12.3	50	52	54
				3	11.8	15.1	18.4	59	62	65
				4	15.7	20.2	24.6	67	71	75
				5	19.7	25.2	30.7	76	81	86
				6	23.6	30.2	36.9	85	91	96
				7	27.6	35.3	43.0	94	101	107
				8	31.5	40.3	49.2	102	110	118
				9	35.4	45.4	55.3	111	120	128
				10	39.4	50.4	61.5	120	130	139
FBC-250	6	1-1/4	1	2	9.2	11.8	14.3	60	62	65
				3	13.8	17.7	21.5	72	75	79
				4	18.4	23.5	28.7	84	89	94
				5	23.0	29.4	35.8	97	102	108
				6	27.6	35.3	43.0	109	115	123
				7	32.2	41.2	50.2	121	129	137
				8	36.8	47.1	57.4	133	142	151
				9	41.4	53.0	64.5	145	155	166
				10	46.0	58.9	71.7	158	168	180

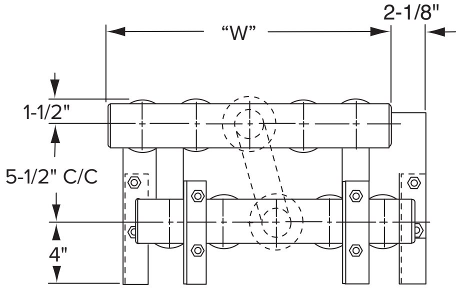
Materials of Construction
FBC-125 Pipes: 1-1/4" NPS Sch. 40 Seamless Steel (1.66" OD x 0.140" Wall)
FBC-200 Pipes: 2" NPS Sch. 40 Seamless Steel (2.375" OD x 0.154" Wall)
FBC-250 Pipes: 2-1/2" NPS Sch. 40 Seamless Steel (2.875" OD x 0.203" Wall)
Fins: 0.036" Thick Helically Wound Steel “L” Foot
Inner Distributing Pipe: Sch. 80A-53F Steel
End Caps: A-234 Forged Steel Sch. 40
Mounting Flange: A-105 Forged Steel, 150 lb Raised Face
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig
NOTE: Sch. 80 Construction is available.

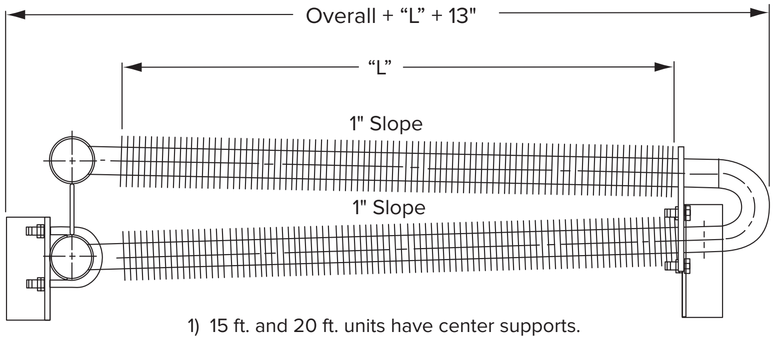
FBS Stainless Steel Units

Type	A Flange Size (in)	B (in)	C (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
					3 FPI	4 FPI	5 FPI	3 FPI	4 PFI	5 FPI
FBS-125	4	3/4	3/4	2	4.4	5.5	6.7	27	28	29
				3	6.6	8.3	10.1	31	32	33
				4	8.8	11.1	13.4	34	36	37
				5	10.9	13.9	16.8	38	39	41
				6	13.1	16.6	20.1	41	43	45
				7	15.3	19.4	23.5	45	47	50
				8	17.5	22.2	26.9	48	51	54
				9	19.7	25.0	30.2	52	55	58
				10	21.9	27.7	33.6	55	58	62
FBS-200	6	1	1	2	6.0	7.5	9.1	41	42	43
				3	8.9	11.3	13.6	46	48	49
				4	11.9	15.0	18.2	51	53	55
				5	14.9	18.8	22.7	57	59	61
				6	17.9	22.6	27.3	62	64	67
				7	20.8	26.3	31.8	67	70	73
				8	23.8	30.1	36.4	72	76	79
				9	26.8	33.8	40.9	77	81	85
				10	29.8	37.6	45.5	83	87	91
FBS-250	6	1-1/4	1	2	6.9	8.7	10.5	46	47	48
				3	10.4	13.0	15.7	53	54	56
				4	13.8	17.4	21.0	59	61	63
				5	17.3	21.7	26.2	66	69	71
				6	20.7	26.1	31.5	73	76	78
				7	24.2	30.4	36.7	80	83	86
				8	27.6	34.8	42.0	86	90	94
				9	31.1	39.1	47.2	93	97	101
				10	34.5	43.5	52.5	100	105	109

Materials of Construction
FBS-125 Pipes: 1-1/4" NPS Sch. 10, 304L SS (1.66" OD x 0.109" Wall)
FBS-200 Pipes: 2" NPS Sch. 10, 304L SS (2.375" OD x 0.109" Wall)
FBS-250 Pipes: 2-1/2" NPS Sch. 10, 304L SS (2.875" OD x 0.120" Wall)
Fins: 0.020" Thick Helically Wound 304 SS “L” Foot
Inner Distributing Pipe: Sch. 10, 304L SS
End Caps: A-403, 304L SS, Sch. 10
Mounting Flange: A-182, 304L SS, 150 lb Raised Face
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig
NOTE: Type 316L SS Construction is available.

Base Mounted Hairpin Type BHC and BHS





1) 15 ft. and 20 ft. units have center supports.
2) Header ends are beveled for on-site butt welding.

Standard Sizes

BHC Carbon Steel Units

Type	Minimum Manhole Size (in)	W (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
				3 FPI	4 FPI	5 FPI	3 FPI	4 FPI	5 FPI
BHC-4	16	7-1/8	5	59	76	93	108	123	138
			10	118	152	186	198	228	258
			15	178	228	278	293	338	383
			20	237	304	371	384	444	503
BHC-6	18	10-1/4	5	89	114	139	158	180	203
			10	178	228	278	294	339	383
			15	266	342	418	435	502	569
			20	355	456	557	570	660	749
BHC-8	22	13-3/8	5	118	152	186	208	238	268
			10	237	304	371	389	449	508
			15	355	456	557	576	666	755
			20	473	608	742	757	877	995
BHC-10	24	16-1/2	5	148	190	232	258	295	332
			10	296	380	464	484	559	633
			15	444	570	696	717	830	941
			20	592	760	928	943	1 093	1 241

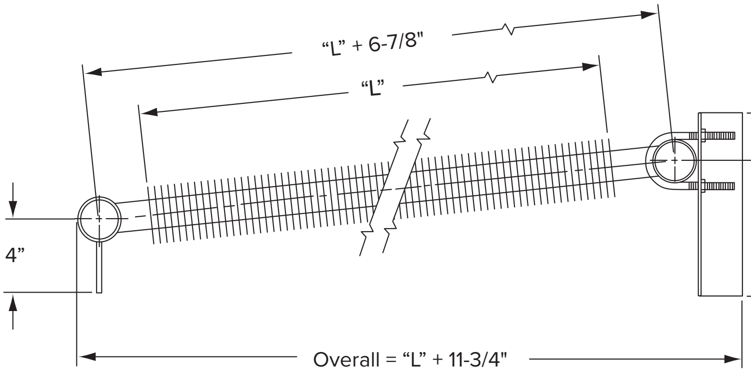
Materials of Construction
Pipes: 1-1/4" NPS Sch. 40 Seamless Steel (1.66" OD x 0.140" Wall)
Fins: 0.036" Thick Helically Wound Steel "L" Foot
Headers: 2" NPS Sch. 40 Seamless Steel (2.375" OD x 0.154" Wall)
Return Bends: A-234 Long Radius Forged Steel Sch. 40
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig
NOTE: Sch. 80 Construction is available.

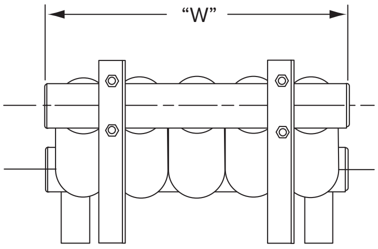
BHS Stainless Steel Units

Type	Minimum Manhole Size (in)	W (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
				3 FPI	4 FPI	5 FPI	3 FPI	4 FPI	5 FPI
BHS-4	16	7-1/8	5	44	55	67	70	76	81
			10	88	111	134	124	135	147
			15	131	166	201	182	199	217
			20	175	222	269	236	256	282
BHS-6	18	10-1/4	5	66	83	101	101	110	119
			10	131	166	201	182	199	217
			15	197	250	302	268	294	320
			20	263	333	403	349	384	418
BHS-10	24	16-1/2	5	88	111	134	133	144	156
			10	175	222	269	240	264	287
			15	263	333	403	354	389	424
			20	350	444	537	462	508	555
BHS-8	22	13-3/8	5	109	139	168	164	179	193
			10	219	277	336	299	328	357
			15	328	416	504	440	484	527
			20	438	555	672	575	633	691

Materials of Construction
Pipes: 1-1/4" NPS Sch. 10, 304L SS (1.66" OD x 0.109" Wall)
Fins: 0.020" Thick Helically Wound 304 SS "L" Foot
Headers: 2" NPS Sch. 40, 304L SS (2.375" OD x 0.154" Wall)
Return Bends: A-403 Long Radius 304L SS Sch. 10
Mechanical Design: 450 psig, 650°F, Standard Testing Pressure 675 psig
NOTE: Type 316L SS Construction is available.

Base Mounted Direct Type BD





1) 15 ft and 20 ft units have center supports.
2) Header ends are beveled for on-site butt welding.

Standard Sizes

BD Carbon Steel Units

Type	Minimum Manhole Size (in)	W (in)	Nominal Length L (ft)	Surface Area (sq ft)			Weight (lb)		
				3 FPI	4 FPI	5 FPI	3 FPI	4 FPI	5 FPI
BD-2	14	7-1/8	5	30	38	47	60	68	75
			10	59	76	93	104	121	135
			15	89	114	140	156	179	201
			20	118	152	186	201	231	261
BD-3	16	10-1/4	5	45	57	70	86	97	109
			10	89	114	139	154	177	199
			15	134	171	209	227	261	294
			20	178	228	278	295	340	384
BD-4	20	13-3/8	5	59	76	93	112	127	142
			10	118	152	186	203	233	262
			15	177	228	279	298	343	388
			20	237	304	371	389	449	508
BD-5	22	16-1/2	5	74	95	116	138	157	175
			10	148	190	232	251	288	325
			15	222	285	348	369	425	481
			20	296	380	464	482	557	631

Materials of Construction
Pipes: 1-1/4" NPS Sch. 40 Seamless Steel (1.66" OD x 0.140" Wall)
Fins: 0.036" Thick Helically Wound Steel "L" Foot
Headers: 2" NPS Sch. 40 Seamless Steel (2.375" OD x 0.154" Wall)
Mechanical Design: 450 psig, 650°F, Standard Testing Prsesure 675 psig
NOTE: Sch. 80 Construction is available.
These units are available only in Carbon Steel.

Tank Heater Selection Work Sheet

Tank Information

Tank Reference Number ____________________
Tank Type ____________________
Tank Material ____________________
Dimensions ____________________ feet
Insulated? ________ If yes, how thick? ________ inches
Open Top? ____________________
Tank Level (% full) or Fluid Volume ____________________
Design Ambient Air Temperature ____________________ °F
Design Wind Velocity (if outside and not insulated) ________ mph

Steam Information

Steam Pressure ________ psig
Saturated? ________ If not, what temperature? ________ °F

Fluid Information

Type of Fluid ____________________
Properties (not required for water) ____________________
1. Specific Gravity ______ at ____________________ °F
   or Density ________ lb/cu ft at ____________________ °F
   or Density ________ lb/US gal at ____________________ °F
2. Specific Heat ________ Btu/lb/°F at ____________________ °F
3. Viscosity (at least one value required, preferably two)
   units ____________
   ____________ at ____________________ °F
   ____________ at ____________________ °F

Heating Requirements

A. Through Load ________________ USGPM at ______ °F ________ not applicable
B. Heat-Up Load from ______ °F to ______ °F in ________ hours ______ not applicable
C. Maintenance Load to Hold ________ °F
D. Total Heat Load (if known) ________ Btu/hr

Tank Heater Requirements

1. Materials of Construction
   A. Carbon Steel ____________________
   B. Type 304L Stainless Steel ____________________
   C. Type 316L Stainless Steel ____________________

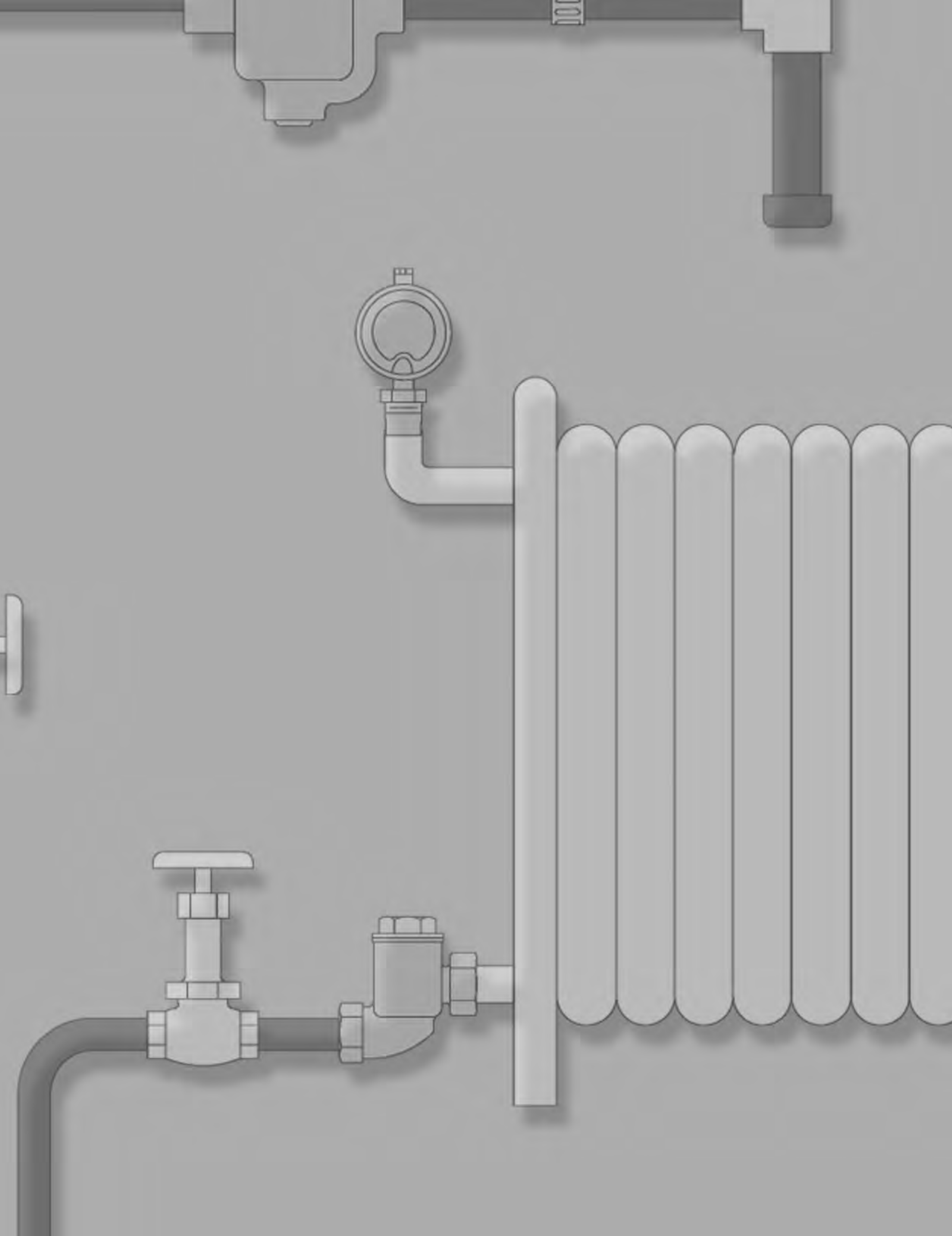
2. Type of Unit
   A. Flange Mounted ______________ (preference? Hairpin ________ Bayonet________)
   B. Base Mounted ______________ (preference? Hairpin ________ Direct________)
   If flange mounted, is std. flange size OK? ________If not, specify size ____________

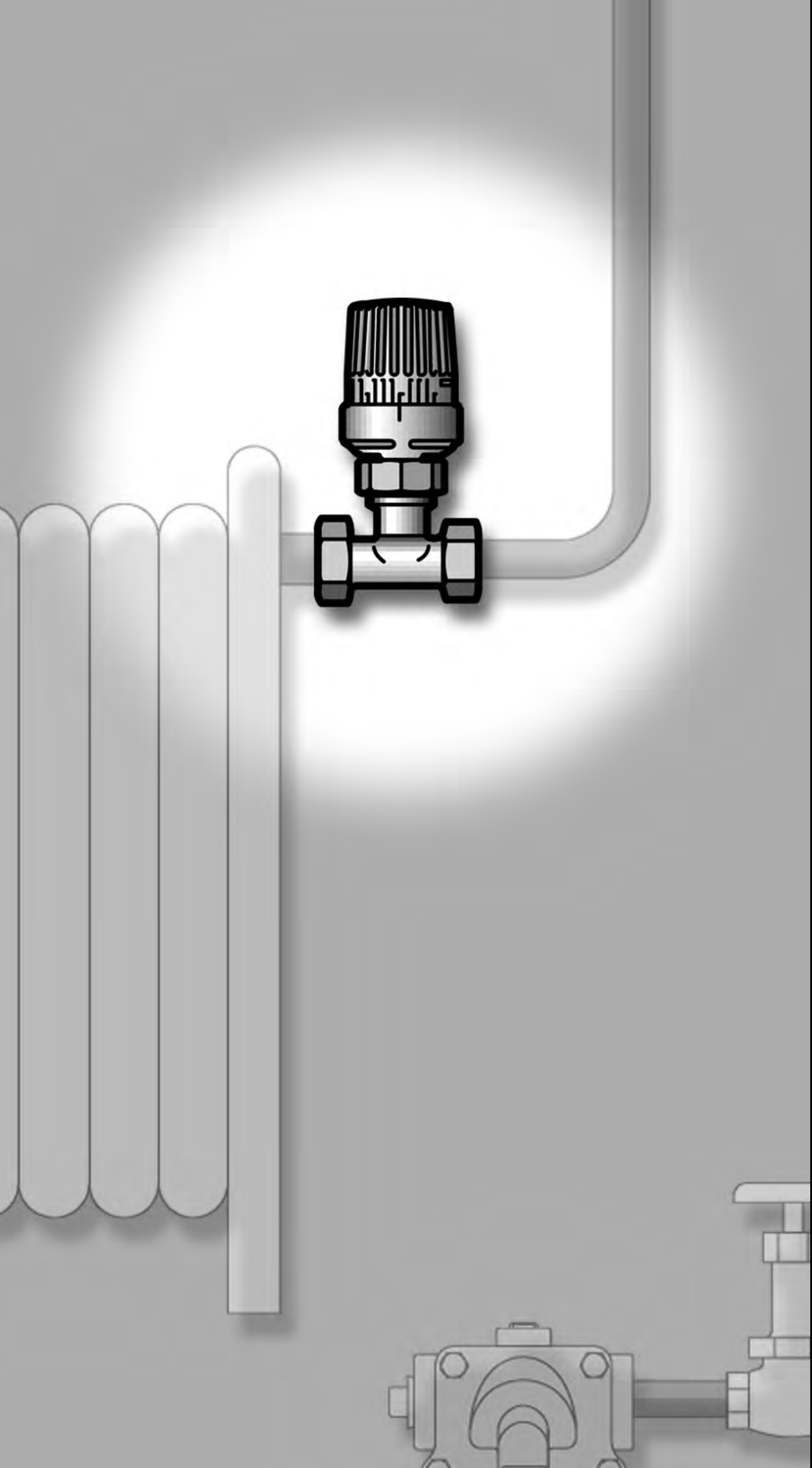
3. Maximum tank opening to insert heater into the tank: ________inches.

Other Information

____
____
____

Notes





Radiator Products

Armstrong

Armstrong®

Radiator ID Chart

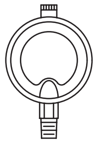
Illustration	Type	Body Pattern	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size				Located on Page
									1/8"	1/4"	1/2"	3/4"	
	**SV-12** Steam Radiator System Air Vents	Straight Angle (1/8" only)	NPT	15	250	Nickel Plated Brass	SV-12	15	●	●	●	●	422
	**AV-11, AV-13** Hydronic System Air Vents	Straight	NPT	200 Hydronic	210	Brass	AV-11	50	●				423
				350 Hydronic			AV-13	150			● Female	● Male	

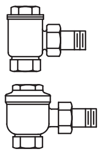
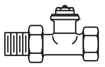
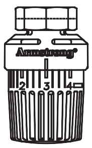
Illustration	Type	Body Pattern	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size			Located on Page
									1/2"	3/4"	1"	
	**Series TS-2/TS-3** Radiator Trap Capacities to 1 600 lb/hr	Straight Angle	Threaded	50	300	Bronze	TS-2	50	●	●		424
				65	315		TS-3	65	●	●	●	

Illustration	Type	Body Pattern	Conn. Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size				Located on Page
									1/2"	3/4"	1"	1-1/4"	
	**RV-4** Radiator Valves	Straight Angle Reverse Angle	NPT Solder (1/2 & 3/4)	15 Steam 150 Water	250	Nickel Plated Brass	RV-4	15 Steam 150 Water	●	●	●	●	420
	**LV-4, WV-4, MV-3, LV-4W, EV-4** Radiator Operators Remote Sensors Available	—	—	—	250	Plastic (Luron)	LV-4 WV-4 MV-3 LV-4W EV-4	—	Used with above RV-4				421

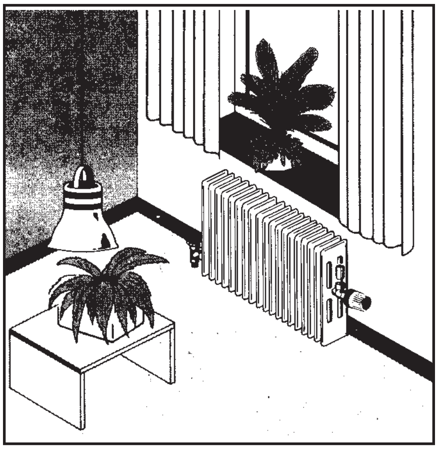
Radiator Products

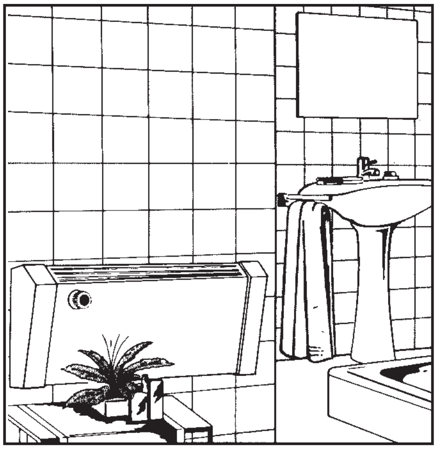
Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Typical Radiator Valve Applications


LV-4 with RV-4 reversed angle body, on free standing two-pipe steam radiator.

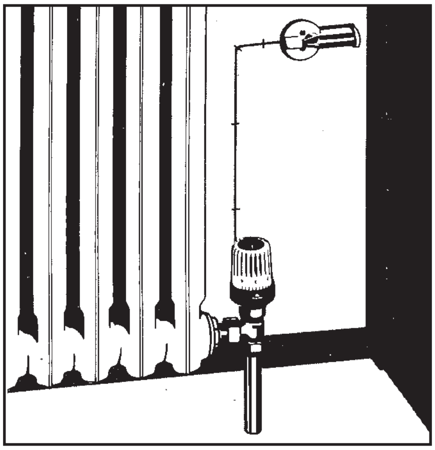

LV-4 with RV-4 reversed angle body on forced hot water radiator.

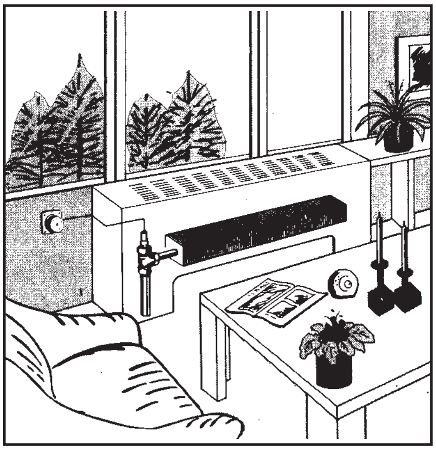

LV-4 with RV-4 one-pipe steam body on free standing radiator.

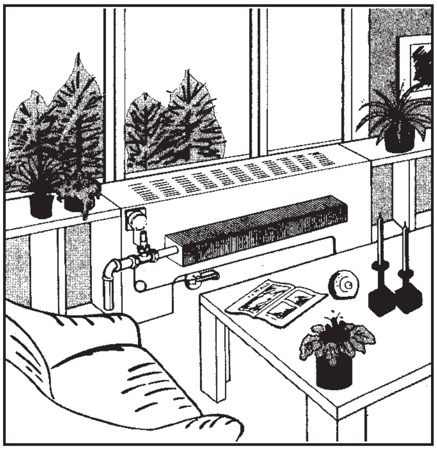

Convector with accessible thermostat. A LV-4 is shown, and in some cases a remote sensor is available.


LV-4 with remote sensor. Valve is covered by a curtain; remote sensor has been mounted away from the curtain.

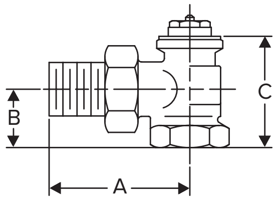

LV-4 with remote sensor. The sill creates a heat pocket; in this case a thermostat with remote sensor is necessay.


LV-4 remote sensor with RV-4 angle body. Vertically installed thermostats require a remote sensor.

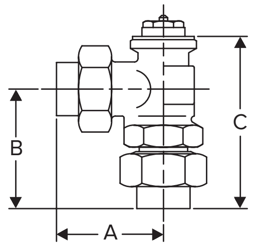

LV-4W with a RV-4 angle body. An inaccessible radiator valve requiring a remote control and adjuster unit.


LV-4W remote sensor with RV-4 straight body to insulate sensor from heat influence or cover, remote sensor is necessary.

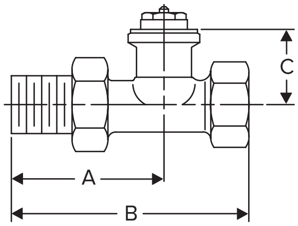
RV-4 Thermostatic Radiator Valves



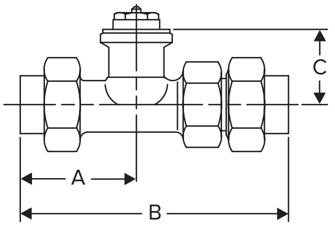
RV-4 Angle



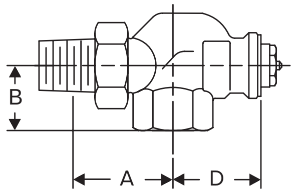
RV-4 Angle Solder



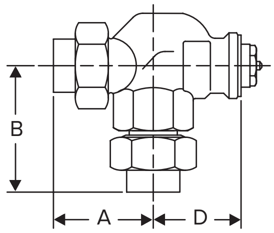
RV-4 Straight



RV-4 Straight Solder



RV-4 Reversed Angle



RV-4 Reversed Angle Solder

For Hot Water and Low Pressure Steam

Armstrong's thermostatic radiator valves are offered in straight, angle and reversed angle patterns. Thermostatic operators provide accurate and automatic control of space temperature. They are ideal for hot water and low pressure steam heated convectors, radiators, thermostatically controlled hydronic or low pressure heat exchangers. Five styles of thermostatic operators are available with liquid, liquid remote or low density wax sensors.

For a fully detailed certified drawing, refer to:

RV-4 Angle	**CDY #1049**
RV-4 Straight	**CDY #1050**
RV-4 Reversed Angle	**CDY #1051**

Physical Data—Valve Bodies

Pattern	Angle								Straight								Reversed Angle					
Pipe Conn. FPT x MPT	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/4	32	1/2	15	3/4	20	1	25	1-1/4	32	1/2	15	3/4	20	1	25
"A"	2-5/16	59	2-5/8	66	2-15/16	59	3-7/16	65	2-15/16	59	2-1/2	64	3-1/8	73	3-9/16	90	2-3/8	60	2-5/8	66	3	76
"B"	1	25	1-1/8	28	1-5/16	33	1-9/16	39	3-3/4	95	4-3/16	106	4-15/16	78	6	150	1-1/16	27	1-3/4	44	1-5/16	33
"C"	1-15/16	49	2-1/16	52	2-3/8	60	2-3/4	70	1-1/8	28	1-1/8	28	1-1/8	28	1-3/8	35	–	–	–	–	–	–
"D"	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1-9/16	40	1-3/8	35	1-1/2	38
Weight, lb (kg)	3/4 (0.34)				1-1/2 (0.68)		1-3/4 (0.79)		3/4 (0.34)		1 (0.45)		1-1/2 (0.68)		1-3/4 (0.79)		1 (0.45)		1-1/4 (0.56)		1-1/2 (0.68)	

Physical Data—Solder Valve Bodies

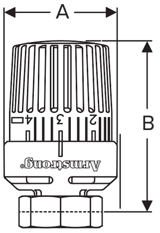
Pattern	Angle				Straight				Reversed Angle			
Pipe Connection Solder	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1/2	15	3/4	20	1/2	15	3/4	20
"A"	1-7/8	47	2-1/4	57	1-7/8	47	2-5/32	55	1-3/4	44	2-1/4	57
"B"	2-5/32	55	2-1/2	64	4-7/16	113	5-1/4	133	2-3/16	56	3-1/8	79
"C"	3	76	3-1/2	89	1-1/4	32	1-5/32	29	-	-	-	-
"D"	-	-	-	-	-	-	-	-	1-1/2	38	1-1/2	38
Weight, lb (kg)	3/4 (0.34)		1(0.45)		3/4 (0.34)		1 (0.45)		1-1/4 (0.56)		1-1/3 (0.60)	

Pressure/Temperatures

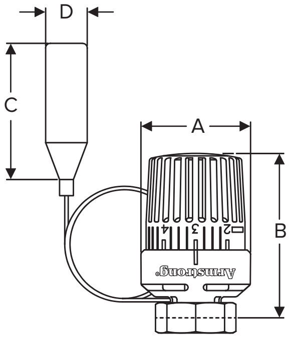
Model	"A" Insert (Standard On All Valves)	"S" Insert (Provides Longer Life on Steam Service)
Maximum Steam, psig (barg)	15 (1)	
Maximum Temp. °F (°C)	250 (121)	
Max. Diff.—Water, psig (barg)	15 (1)	
Max. Static Pressure, psig (barg)	150 (10)	

NOTE: Normally closed insert available.

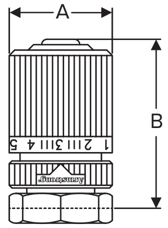
Thermostatic Operators



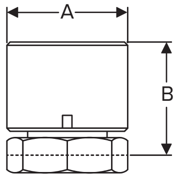
LV-4 Operator Liquid Sensor



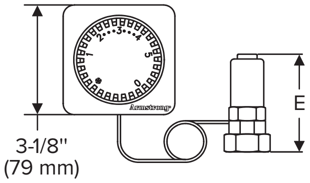
LV-4 Operator Remote Sensor



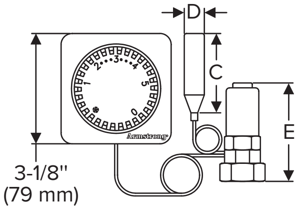
WV-4 Operator
Low Density Wax Sensor



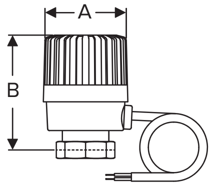
MV-3
Operator*



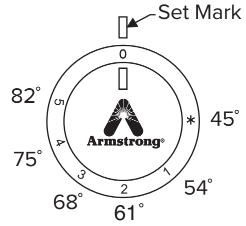
LV-4W Operator (Wall Mount)



LV-4W w/Remote Sensor



EV-4 Electric Operator
24 VAC N.C. or N.O.



Thermostatic Radiator Valve In-Service Repair Tool for Valve Repair Without Interrupting Operation

Failures of thermostatic radiator valves are frequently caused by solid matter suspended in the heating medium, such as weld or solder beads, dirt particles, etc. This results in the loss of the shut-off function of the valve through damage to the sealing surface of the valve and seat.

The use of an Armstrong In-Service Repair Tool provides a quick and easy way to remove the valve insert from an Armstrong radiator valve. Valve repair can then be accomplished without draining the heating system or interrupting its operation.

The LV-4 can be easily adjusted to a comfortable temperature. The temperature to scale relationship is shown to the left. The lowest setting provides freeze protection at approximately 45°F with a high setting of 82°F. Temperature settings on all LV-4 Operators may be limited or locked.

For a fully detailed certified drawing, refer to:

LV-4 Operator Liquid Sensor	**CDY #1053**
LV-4 Operator Remote Sensor	**CDY #1054**
MV-3 Operator	**CDY #1058**
LV-4W Operator (Wall Mount)	**CDY #1055**
LV-4W w/Remote Sensor	**CDY #1056**
EV-4 Electric Operator	**CDY #1057**
WV-4 Operator Low Density Wax Sensor	**CDY #1062**

Specifications—Valve Bodies and Operators

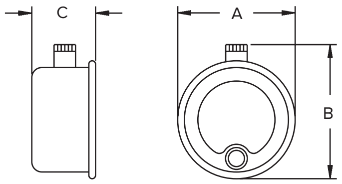
Name of Part	Material	
Valve Body	Brass (nickel plated)	
Main Valve	“A” insert - Brass	“S” insert chrome nickel plated
Main Valve Seat	“A” insert - EPDM	
Operator Body	Luron	
O-rings	EPDM	

Physical Data—Thermostatic Operators

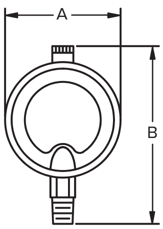
Type	LV-4 Operator w/Liquid Sensor		LV-4 Operator w/Liquid Remote Sensor		WV-4 Operator w/ Low Density Wax Sensor		MV-3 Operator*		LV-4W Operator (Wall Mount)		LV-4W Operator w/Remote Sensor		EV-4 Electric Operator	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
“A”	2-1/8	54	2-1/8	54	1-7/16	37	1-1/2	38	–	–	–	–	2	50
“B”	3-5/16	84	3-5/16	84	2-9/16	65	1-1/2	38	–	–	–	–	2-3/4	70
“C”	–	–	2-7/8	73	–	–	–	–	–	–	2-7/8	28	–	–
“D”	–	–	3/4	20	–	–	–	–	–	–	3/4	20	–	–
“E”	–	–	–	–	–	–	–	–	3	76	3	76	–	–
Remote Operator	–	–	–	–	–	–	–	–	3-1/8 x 3-1/8	79 x 79	3-1/8 x 3-1/8	79 x 79	–	–
Capillary Length, ft (m)	–		6-1/2 or 16-1/2 (2 or 5)		–		–		–		6-1/2 or 16-1/2 (2 or 5)		–	
Weight, lb (kg)	1/3 (0.15)		1/2 or 3/4 (0.23 or 0.34)		1/4 (0.11)		1/8 (0.05)		3/4 (0.34)		1 or 1-1/4 (0.45 or 0.57)		3/4 (0.34)	

*For on-off service—not thermostatic.

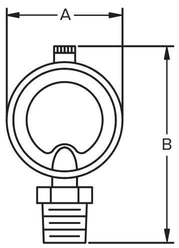
Armstrong® SV-12 Steam Radiator Air Vent



SV-12 Angle Air Vent



SV-12 Straight Air Vent



SV-12 Straight Main Air Vent

For Steam Service

A vent port size for every room location with the largest size for the coldest rooms and the smallest size for the "too hot" rooms. SV-12 air vents are easy to install on any steam radiator.

For a fully detailed certified drawing, refer to CDY #1042.

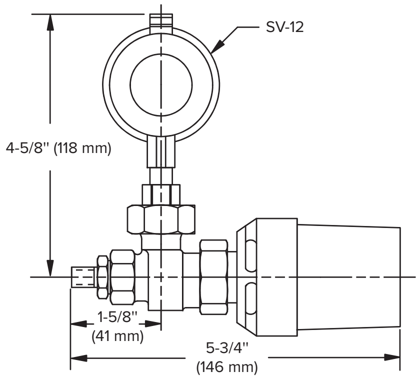
Materials

Name of Part	Material
Body	Nickel plated brass
Float	Polypropylene
Valve Seat	Brass
Bimetal Thermostatic Element	Stainless steel

Physical Data

Pattern	Angle Connection		Straight Connection		Straight Main Connection	
Pipe Connection Size	in	mm	in	mm	in	mm
	1/8	3	1/8, 1/4	3, 6	1/2, 3/4	15, 20
"A"	2-3/16	56	2-3/16	56	2-3/16	56
"B"	2-5/16	59	3-1/4	83	3-1/2	89
"C"	1-3/16	30	1-3/16	30	1-3/16	30
Max. Operating Pressure, psig (barg)	15 (1)					
Vent Port Designation and Port Size	4 = .040" 6 = .0935" 5 = .070" C = .1285" D = .1850" Each air vent is provided with all five of the above vent ports				1 = .1850" Only one vent port will be provided	

RV-4 One Pipe Steam Radiator Valve



RV-4 One Pipe Steam Radiator Valve

Specifications

Name of Part	Material	
Valve Body	Brass (nickel plated)	
Main Valve	"A" insert - Brass	"S" insert chrome nickel plated
Main Valve Seat	"A" insert - EPDM	
Operator Body	Luron	
O-rings	EPDM	

Pressure/Temperatures

Model	"A" Insert (Standard On All Valves)	"S" Insert (Provides Longer Life on Steam Service)
Maximum Steam, psig (barg)	15 (1)	
Maximum Temp. °F (°C)	250 (121)	
Max. Diff.—Water, psig (barg)	15 (1)	
Max. Static Pressure, psig (barg)	150 (10)	

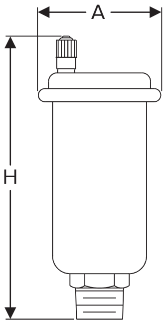
NOTE: Normally closed insert available.

For Steam Service

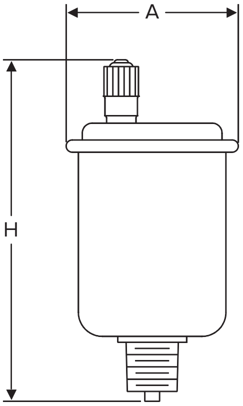
The Armstrong RV-4 One Pipe Radiator Valve is a state-of-the-art thermostatic radiator valve for low pressure steam service. The valve provides accurate and automatic control of space temperature in individual rooms through automatic air venting.

For a fully detailed certified drawing, refer to CDY #1052.

AV-11/AV-13 Air Vent



AV-11



AV-13

For Hot or Cold Water and Non-viscous Liquids

Air vent models AV-11 and AV-13 are compact float-type valves for the removal of air and other gases from hydronic heating and cooling systems, liquid chilling operations and other light liquid services.

For a fully detailed certified drawing, refer to:
AV-11 CDY #1047
AV-13 CDY #1048

Specifications

Model	Application	Working Pressure		Maximum Temperature		Connection	Hydraulic Test Body	
		psig	barg	°F	°C		psig	barg
AV-11	Hot or Cold Water	1 - 50	0.06 - 3.4	210	99	NPT Screwed	200	14
AV-13		1 - 150	0.06 - 10.3				350	24

Capacities

AV-11				AV-13			
ΔP		Capacities		ΔP		Capacities	
psig	barg	cfm	m³/hr	psig	barg	cfm	m³/hr
3.5	0.24	0.5	0.84	16	1.1	1	1.7
10	0.69	1.0	1.7	48	3.3	2	3.4
24	1.7	1.5	2.5	84	5.8	3	5.1
35	2.4	1.9	3.2	120	8.3	4	6.8
50	3.4	2.0	3.4	150	10	4.9	8.3

Physical Data

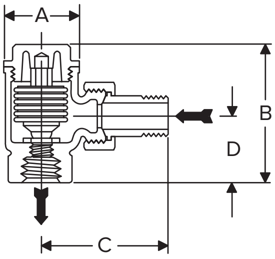
Model	AV-11		AV-13	
	in	mm	in	mm
Connection Size	1/8 v	3	1/2 Female 3/4 Male	15 Female 20 Male
"A"	1-3/4	44	2-1/8	54
"H"	3-3/8	86	4-5/8	118
Weight, lb (kg)	1/4 (0.11)		1/2 (0.23)	

Materials

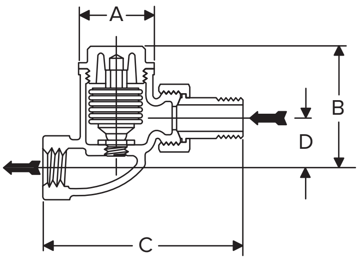
Valve	Float	Disc
Brass	Polypropylene	Nitrile

TS-2/TS-3 Radiator Traps

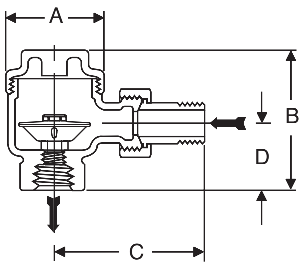
For Pressures to 65 psig (4.5 barg)...Capacities to 1 600 lb/hr (726/kg)



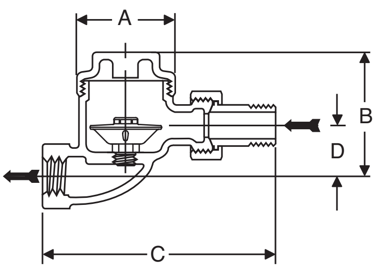
TS-2
Trap Angle Type



TS-2
Trap Straight Type



TS-3
Trap Angle Type



TS-3
Trap Straight Type

Armstrong Series TS radiator traps are offered in both angle and straight patterns. The TS-2 has a balanced pressure thermostatic element with a high quality multiple-convolution bellows. It's ideal for draining equipment such as steam radiators and convectors, small heat exchangers, unit heaters and steam air vents. The TS-2 comes with a strong cast bronze body and a stainless seat. The valve and seat are renewable in-line. The TS-3 is a heavy duty wafer type trap for the drainage of all types of steam radiators and convectors. Its wafer design is well suited to systems prone to water hammer, which may damage conventional bellows type units. The TS-3 is repairable in-line and has an all-stainless steel wafer element.

For a fully detailed certified drawing, refer to:
TS-2 CDY #1045
TS-3 CDY #1046

Physical Data

Model	TS-2								TS-3											
Pattern	Angle				Straight				Angle						Straight					
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1/2	15	3/4	20	1/2	15	3/4	20	1	25	1/2	15	3/4	20	1	25
"A" Diameter	1-5/8	41	1-5/8	41	1-5/8	41	1-5/8	41	2	50	2	50	2-3/8	86	2	50	2	50	2-3/8	86
"B" Height	2-15/16	75	3	76	2-11/16	68	2-7/8	73	2-7/8	73	3-5/8	92	3-7/8	98	2-5/8	61	3-3/8	86	3-1/2	89
"C"	2-9/16	65	2-7/8	73	4	102	4-1/2	114	3-1/8	79	3-1/2	89	4-1/8	105	4-7/8	124	5-1/4	133	6-1/2	165
"D"	1-3/8	35	1-5/8	41	1-1/8	28	1-5/16	33	1-3/8	35	1-5/8	41	2	50	1-1/8	28	1-3/8	35	1-5/8	41
Weight, lb (kg)	1-1/2 (0.68)		1-3/4 (0.79)		1-1/2 (0.68)		2 (0.91)		1-1/2 (0.68)		2 (0.91)		2-1/2 (1.1)		1-1/2 (0.68)		2-1/4 (1)		3 (1.4)	
Maximum Allowable Pressure (Vessel Design)	50 psig @ 300°F (3.4 barg @ 149°C)								65 psig @ 315°F (4.5 barg @ 157°C)											
Pressure, psi (barg)	50 (3.4)								65 (4.5)											
Vacuum Ratings	25" Mercury								10" Mercury											

Materials

Name of Part	TS-2	TS-3
Cap	Bronze, ASTM B-62	
Body	Bronze, ASTM B-62	
Union Nipple	Brass, ASTM B-584	
Valve	Brass	Stainless Steel
Valve Seat	Stainless steel	Stainless steel
Element	Phosphor-bronze bellows	T-316 SS Wafer with T-304 SS housing

Capacities

Orifice Size, in		5/16		1/8	
Differential Pressure		Model No.			
		TS-2		TS-3	
psig	barg	lb/hr	kg/hr	lb/hr	kg/hr
1	0.07	275	125	160	73
3	0.21	395	179	280	127
5	0.34	475	215	360	162
10	0.69	630	286	515	233
20	1.4	1 000	454	625	283
30	2.0	1 200	544	720	327
45	3.1	1 475	669	825	374
50	3.4	1 600	726	870	395
65	4.5	–	–	960	435

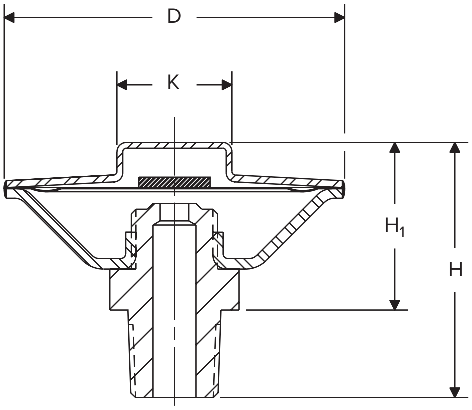
Capacities given are continuous discharge capacities in lb/hr (kg/hr) of hot condensate at pressure differential indicated.

T-Wafer Radiator Trap Replacement Capsule

For Steam Service

The T-Wafer capsule is a compact, easy to install, welded wafer element. The capsule is designed so that it can be easily adapted to almost any of the popular radiator traps currently in use.

For a fully detailed certified drawing, refer to CDY #1077.



T-Wafer Capsule

Specifications and Materials					
Application	**Max. Oper. psig (barg)**	**Max. Oper. Temp. °F (°C)**	**Materials**		
			Body	**Seat**	**Wafer**
Steam	65 (4)	312 (156)	T-304 SS	T-316 SS	T-316 SS

Physical Data							
L		***H**		**H_1**		**K**	
in	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
1-1/2	38	1-3/16	30	3/4	20	1/2 Hex	15

*When using adapter extension or using extra tall adapter, add 1/2" (15 mm).

For a complete listing of popular models adaptable to the T-Wafer, contact your Armstrong Representative.

Specify the following when ordering T-Wafers
Trap Manufacturer — Trap Model Number — Trap Connection Size — Trap Pattern (on some models)

Armstrong®

T-Wafer Radiator Trap Replacement Capsule

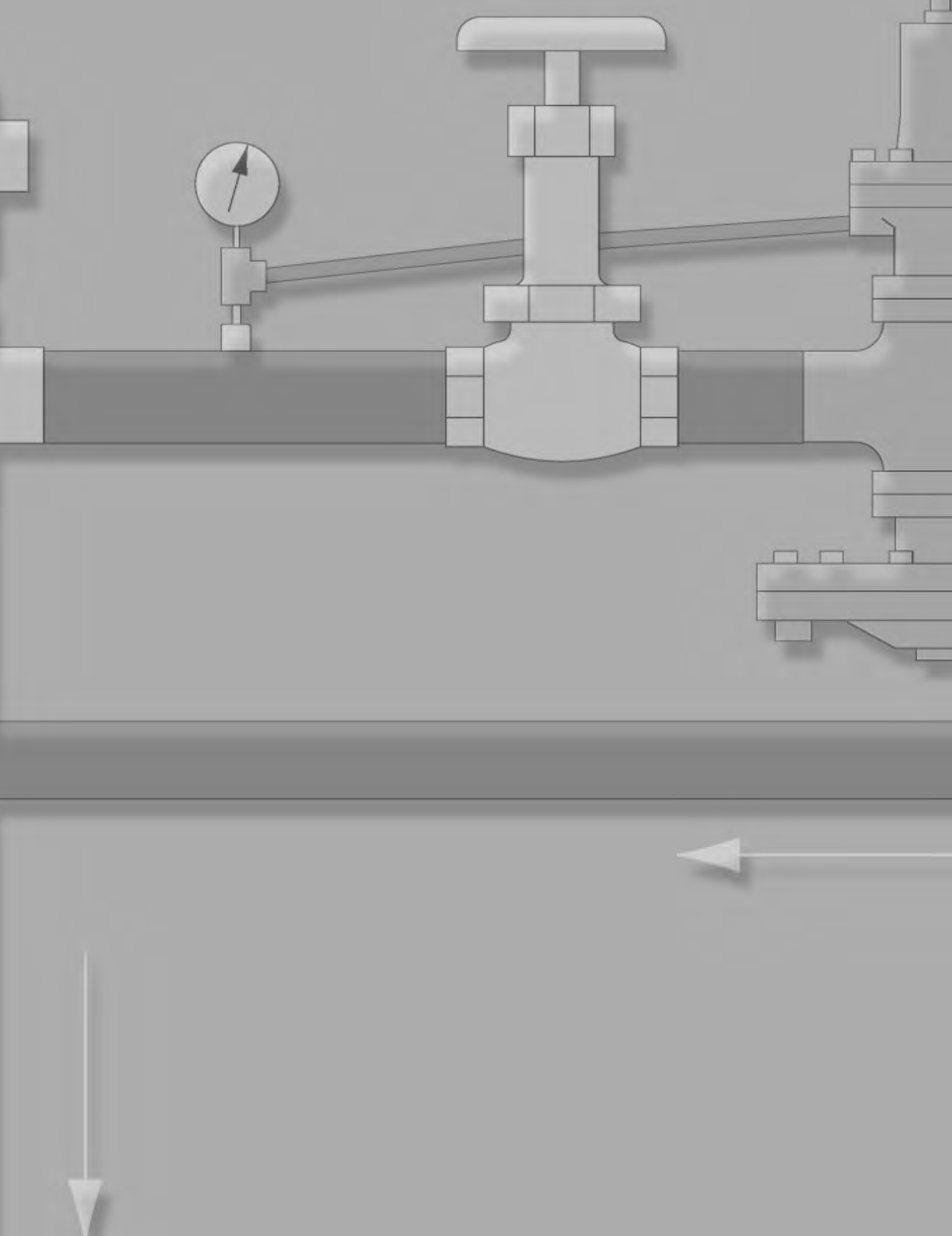
Popular Models Adaptable to the T-Wafer

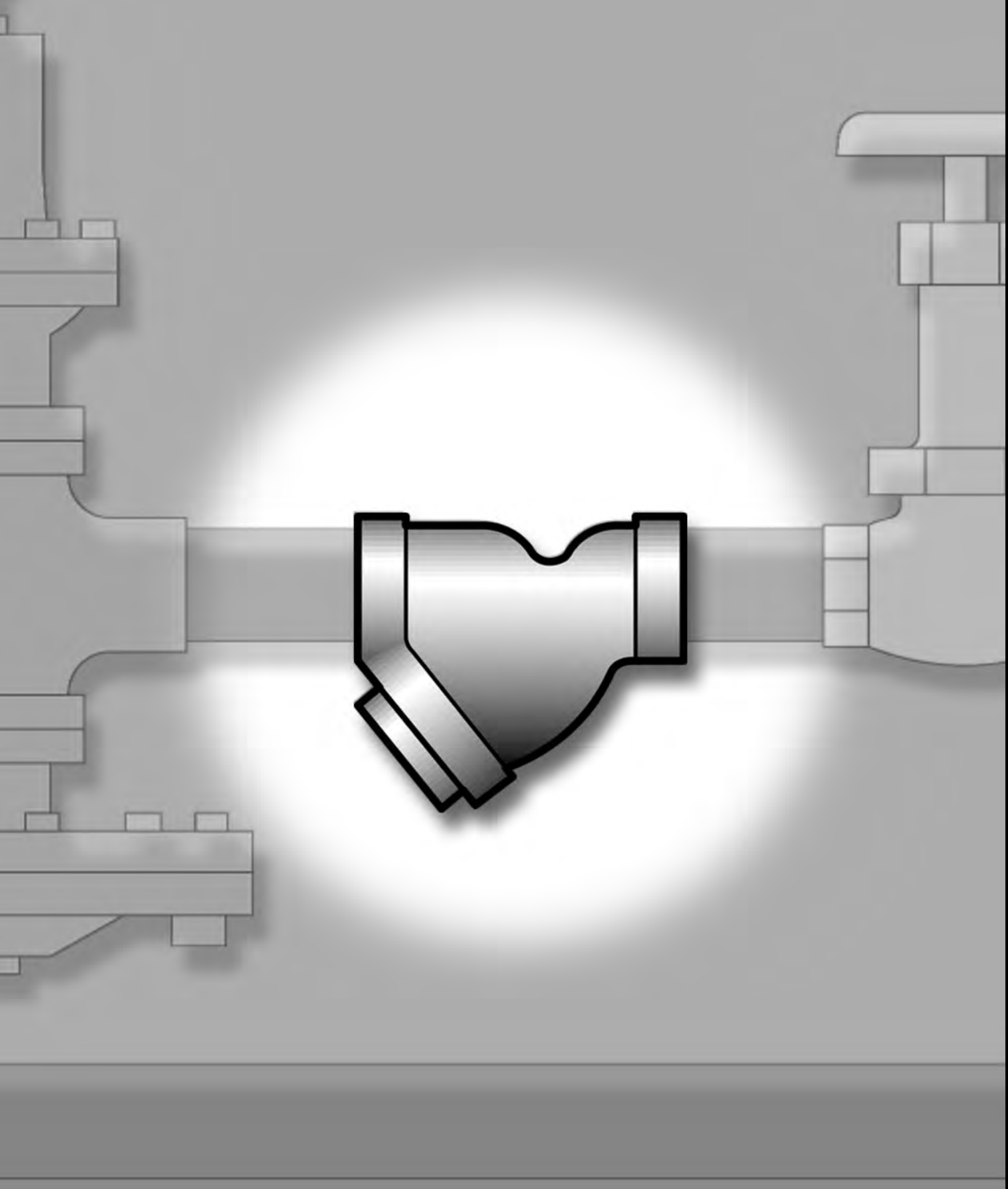
Trap Manufacturer	Trap Model	Trap Connection	Armstrong Part No.	Notes
Barnes & Jones	122	1/2"	B7413	Integral Seat
	3045			
	6	3/4"	B7418	
	134		B7437	
Dunham Bush	TH2A		B7412	Removable Seat
	1E	1/2"	B7430	
	1E		B7415	Integral Seat
	2E	3/4"	B7414	
	V1B	1/2"	B7415	
Hoffman	17C		B7416	Removable Seat
	8		B7432	
	8C	3/4"	B7416	
	9		B7432	
Illinois	1G	1/2"	B7409	
	3G	3/4"	B7431	
Marsh	2-7		B7411	
	1	1/2"	B7409	
	2		B7427	
	1N			
Monash-Younker	30		B7409	
	34		B7417	
Sarco	E	1/2" & 3/4"	B7409	
	H			
	H	1"	B7428	
	S65	1/2" & 3/4"	B7409	Trap Rated @ 65 psi
Trane	B1	1/2"		Removable Seat/Non-vertical
	B1		B7424	Integral Seat/Vertical Config.
	B1		B7423	Removable Seat/Vertical Config.
	B1		B7426	Integral Seat/Non-vertical
	B2		B7415	Integral Seat
	B3	3/4"	B7412	Removable Seat
	B3		B7436	Integral Seat
Warren Webster	02H & 02V	1/2"	B7411	Removable Seat
	12H5		B7419	
	22H5			
	502		B7411	
	502V-1			
	503	3/4"		
	512, 512H & 512G	1/2"	B7419	
	513	3/4"		
	522H	1/2"		
	522HB			
	524HB			
	533	3/4"		
	5993		B7411	
	702	1/2"		
	702V-1			
	703	3/4"		
	712	1/2"		
	712HB		B7419	
	713	3/4"	B7411	
	713HB		B7419	
	722HB	1/2"		
	724AH & 724HB	1"		
	734			
	780	3/8"	B7411	High Press. Heavy Load Trap
	781	1/2"	B7428	Removable Seat
	782			
	783	3/4"		
	784	1"		
	902	1/2"	B7425	
	902V		B7411	
	733H	3/4"	B7419	Heavy Load Trap

NOTE: This is not a complete listing of adaptable traps—For a complete listing, contact your Armstrong Representative. When ordering, please specify: 1. Trap Manufacturer 2. Trap Model Number 3. Trap Connection Size 4. Trap Pattern (on some models)

NOTES

Radiator Products





Strainers

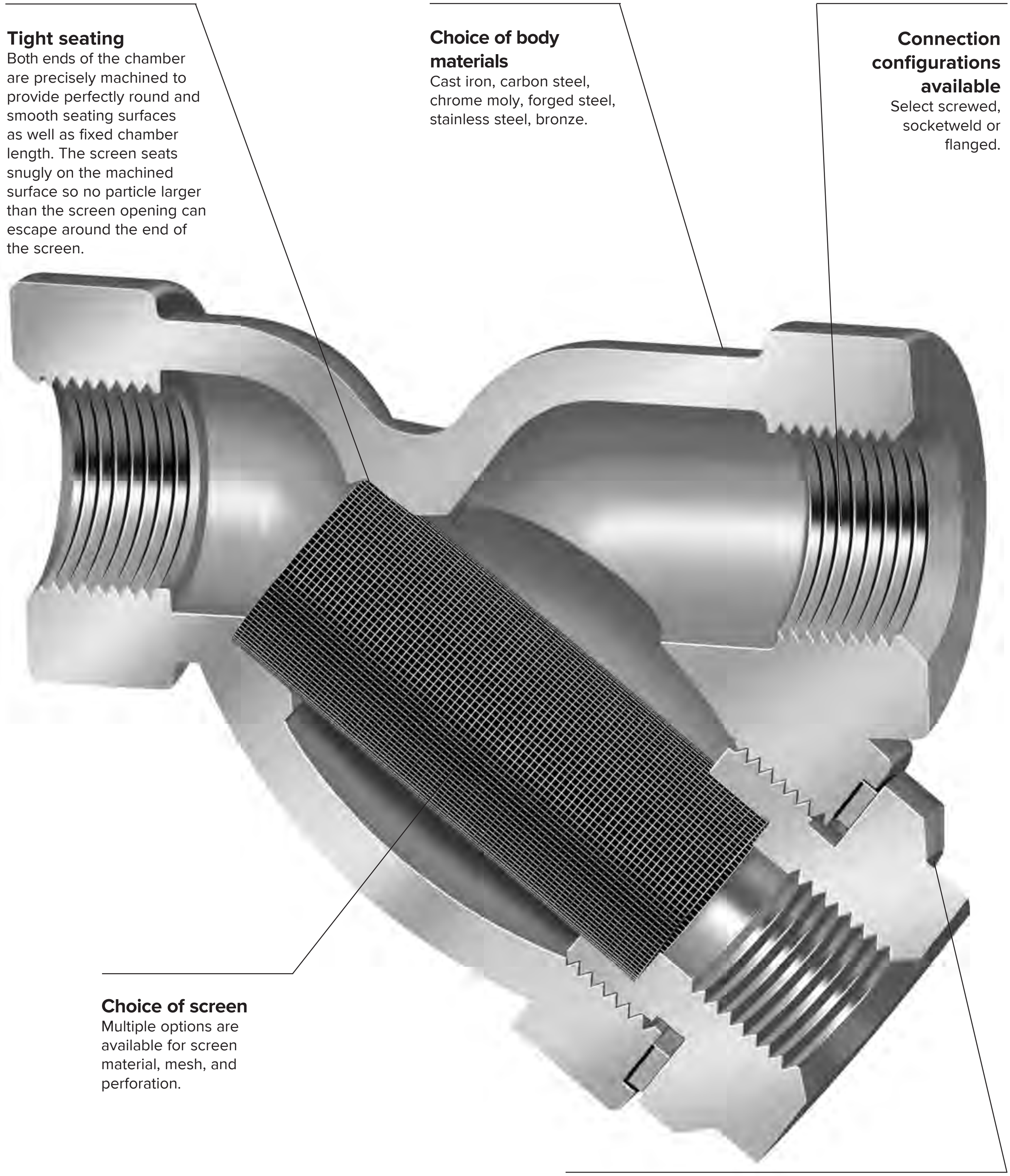
Armstrong

Armstrong®

Tight seating
Both ends of the chamber are precisely machined to provide perfectly round and smooth seating surfaces as well as fixed chamber length. The screen seats snugly on the machined surface so no particle larger than the screen opening can escape around the end of the screen.

Choice of body materials
Cast iron, carbon steel, chrome moly, forged steel, stainless steel, bronze.

Connection configurations available
Select screwed, socketweld or flanged.



Choice of screen
Multiple options are available for screen material, mesh, and perforation.

Easy-in, easy-out screwed screen retainers
Straight threads mean less torque is required to obtain a tight seal with proper gasket compression, and less torque is required to remove the retainer. The danger of "freezing in" is considerably less than with hard-to-break tapered pipe threads.

Armstrong Y-Type Strainers

Design Advantages

No-Leak, No-Crush Screen Chambers are assured by precise machining of both ends of the chamber to provide perfectly round and smooth seating surfaces as well as fixed chamber length. The screen seats snugly on the machined surface so no particle larger than the screen opening can escape around the end of the screen.

Easy-In, Easy-Out Screwed Screen Retainers have straight threads. Less torque is required to obtain a tight seal with proper gasket compression. Less torque is required to remove the retainer. The danger of "freezing in" is considerably less than with hard-to-break tapered pipe threads.

Off-Center Blowdown Connections for 2-1/2" and 3" size strainers. The off-center drain permits nearly complete removal of liquid and dirt when blowing down the strainer. And less liquid spills when removing the screen retainer.

How To Order

MODEL NUMBER

☐ A ☐ FL 125

CONNECTION SIZE (inches)

BODY MATERIAL

CA = Cast Iron ASTM A48 Cl. 30 (Screwed 1/2", 3/4", 1", 1-1/4", 1-1/2", 2")
A = Cast Iron ASTM A48 Cl. 30 (Screwed 2-1/2", 3" & Flanged 2"-6")
B & YCS-B = Cast Carbon Steel ASTM A216 Gr. WCB
C = Cast Chrome Moly Steel ASTM A217 Gr. WC6
D = Forged Steel ASTM A182 Gr. F22
E & YSS-E = Cast 316 Stainless Steel ASTM A351 Gr. CF8M
F = Cast Bronze ASTM B62

SCREEN MATERIAL

Please refer to table at top of page 435 for applicable screen code.

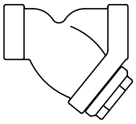
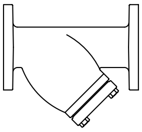
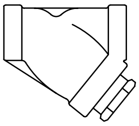
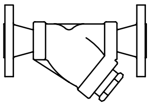
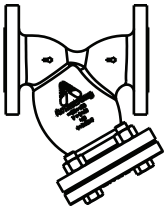
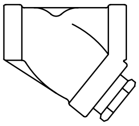
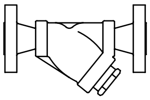
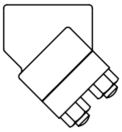
CONNECTION CONFIGURATION

SC = Screwed
FL = Flanged
SW = Socketweld

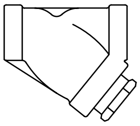
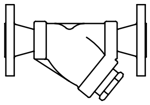
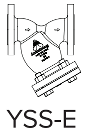
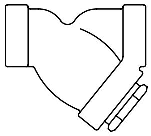
FLANGE CLASS

125
250
150
300
600
1500

Strainers ID Charts

Illustration	Model	Connection Size	Connection Type	Body Material	Pressure Temperature Ratings		Located on Page
					Steam Non-shock	Cold Non-shock	
	CA	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	Screwed	Cast Iron ASTM-A48 Class 30	250 psig @ 406°F	400 psig @ 150°F	436
	A	2-1/2", 3"					436
	A	2"	125 Flanged		125 psig @ 353°F	175 psig @ 150°F	437
	A	2-1/2" - 6"					437
	A	2"	250 Flanged		250 psig @ 400°F	400 psig @ 150°F	437
	A	2-1/2" - 6"					437
	B	1/2", 3/4", 1"	Screwed & Socketweld 900 lb	Cast Carbon Steel ASTM-A216 Gr. WCB	1 635 psig @ 609°F	2 220 psig @ 100°F	438
	B	1-1/4", 1-1/2", 2", 3"	Screwed & Socketweld 600 lb		1 135 psig @ 562°F	1 480 psig @ 100°F	438
	B	1/2", 3/4", 1"	Class 150 Flanged		205 psig @ 390°F	285 psig @ 100°F	439
	B	1-1/4", 1-1/2"					439
B	YCS-B	2" - 12"					440
	B	1/2", 3/4", 1"	Class 300 Flanged		605 psig @ 490°F	740 psig @ 100°F	439
	B	1-1/4", 1-1/2"					439
	YCS-B	2" - 12"					440
	B	1/2", 3/4", 1"	Class 600 Flanged		1 135 psig @ 562°F	1 480 psig @ 100°F	439
YCS-B	B	1-1/4", 1-1/2"					439
	YCS-B	2" - 12"					440
	C	1/2", 3/4", 1"	Screwed & Socketweld 1 500 lb	Cast Chrome Moly Steel ASTM-A217 Gr. WC6	2 090 psig @ 643°F	3 000 psig @ 100°F	441
	C	1-1/4", 1-1/2", 2"			2 515 psig @ 670°F	3 600 psig @100°F	441
	C	1/2", 3/4", 1"	Class 1 500 Flanged		2 090 psig @ 643°F	3 000 psig @ 100°F	442
	C	1-1/4", 1-1/2", 2"			2 515 psig @ 670°F	3 600 psig @ 100°F	441
	D	1/2", 3/4", 1", 1-1/4", 1-1/2", 2"	Socketweld 2 500 lb	Forged Steel ASTM-A182 Gr. F22	2 500 psig @ 1 025°F	6 000 psig @ 100°F	442

Strainers ID Charts

Illustration	Model	Connection Size	Connection Type	Body Material	Pressure Temperature Ratings		Located on Page
					Steam Non-shock	Cold Non-shock	
	E	1/2", 3/4", 1"	Screwed & Socketweld 1 500 lb	Cast Stainless Steel ASTM-A351 Gr. CF8M	2 090 psig @ 643°F	3 000 psig @ 100°F	443
	E	1-1/4", 1-1/2", 2", 3"	Screwed & Socketweld 600 lb		935 psig @ 538°F	1 140 psig @ 100°F	443
 E  YSS-E	E	1/2", 3/4", 1"	Class 150 Flanged		200 psig @ 386°F	275 psig @ 100°F	444
	E	1-1/2"					444
	YSS-E	2" - 12"					445
	E	1/2", 3/4", 1"	Class 300 Flanged		495 psig @ 467°F	720 psig @ 100°F	444
	E	1-1/2"					444
	YSS-E	2" - 12"					445
	E	1/2", 3/4", 1"	Class 600 Flanged		935 psig @ 540°F	1 440 psig @ 100°F	444
	E	1-1/2"					444
	YSS-E	2" - 12"					445
	F	1/2", 3/4", 1", 1-1/4"	Screwed 300 lb	Cast Bronze ASTM-B62	300 psig @ 422°F	500 psig @ 150°F	446
	F	1-1/2", 2"					446

Notes

Screen Data

Screen Material Availability and Particle Retention Size

Screen Specification		Particle Retention, Inches	Back-Up Screen Required	Materials			
				304 SS	Monel	Brass	316 SS
Perforated	1/64"	0.016	3" - 10"	Code 10	Code 18	—	—
	1/32"	0.031	None	Code 11	Code 19	—	Code 31
	.045 (3/64")	0.045	None	Code 1	Code 3	Code 4	Code 7
	1/16"	0.062	None	Code 12	—	—	Code 32
	1/8"	0.125	None	Code 8	Code 21	Code 28	Code 33
	3/16"	0.188	None	Code 13	Code 22	—	Code 34
	1/4"	0.25	None	Code 14	Code 23	—	Code 35
Mesh	20 x 20	0.034	6" - 10"*	Code 15	Code 5**	—	—
	24 x 110	0.0056	5" - 10"	—	Code 24	—	Code 2
	40 x 40	0.015	1-1/2" - 10"	Code 16	Code 6	—	Code 37
	100 x 100	0.0055	All sizes	Code 9	Code 25	—	Code 38
	150 x 150	0.0041	All sizes	Code 40	—	—	—
	200 x 200	0.0029	All sizes	Code 17	—	—	Code 39

*Except 6" - 125 lb cast iron

**On Code 5—2-1/2" thru 10" require back-up screens

Shade indicates only available screen choices for CA Series Strainers.

(1) A back-up screen is required for all YCS-B and YSS-E strainers with mesh screens. No back ups are used on perforated screens for the YCS-B and YSS-E.

(2) 24 x 110 mesh screen not available for YCS-B and YSS-E Strainers.

Ratio of Open Area of Screen to Inside Area of Pipe

Strainer Size	Total Screen Area, sq in	Inside Area of Pipe, sq in	Ratio—Perforated Screens							Ratio—Wire Mesh Screens				
			1/64"	1/32"	.045"	1/16"	1/8"	3/16"	1/4"	24 x 110	20 x 20	40 x 40	100 x 100	200 x 200
1/2"	7.2	0.30	5.2	5	6.4(5)	5.2	6.9(5.4)	8.8	10	4.8(3.8)	6.6	5.2(4.1)	2.2(1.8)	2.5
3/4"	7.2	0.53	4	3.9	5	4	5.4	6.9	7.8	3.8	5.3	4.1	1.8	2
1"	11	0.86	3.8	3.7	4.7	3.8	5.1	6.5	7.4	3.7	5.2	4	1.7	1.9
1-1/4"	15.9	1.49	3.2	3	3.9	3.2	4.2	5.4	6.1	3.2	4.4	3.4	1.5	1.6
1-1/2"	23.6	2.03	3.4	3.3	4.3	3.4	4.6	5.9	6.7	3.5	4.8	2.8	1.6	1.8
2"	34.4	3.35	3	2.9	3.8	3	4.1	5.2	5.9	3.2	4.4	2.6	1.5	1.6
2-1/2"	54.4	4.78	3.4	3.3	4.2	3.4	4.5	5.8	6.6	3.3	3.5†	2.7	1.7	1.9
3" 125#	74	7.39	1.7	2.9	3.7	3	4	5.1	5.8	2.9	3.1†	2.3	1.5	1.7
3" 250#	87	7.39	2	3.4	4.3	3.5	4.7	6	6.8	3.5	3.8†	2.8	1.8	2
4" 125#	123	12.7	1.7	2.8	3.5	2.9	3.8	4.9	5.6	2.8	3†	2.3	1.5	1.6
4" 250#	145	12.7	2	3.3	4.2	3.4	4.5	5.8	6.6	3.4	3.7†	2.1	1.8	2
6" 125#	272	28.9	1.6	2.7	3.4	2.8	3.1	4.8	5.4	1.6	3	1.8	1.5	1.6
6" 250#	317	28.9	1.9	3.1	4	3.2	4.3	5.5	6.3	1.9	2.7	2.1	1.7	1.9
Percentage Open Area			30%*	29%	37%	30%	40%	51%	58%	33%*	46%*	36%*	—	—

NOTES: Cast steel, stainless steel and bronze strainers have the same ratios as 250 lb cast iron. This table does not apply to the YCS-B, Forged Steel F22, and YSS-E strainers (pages 440, 442, and 445).

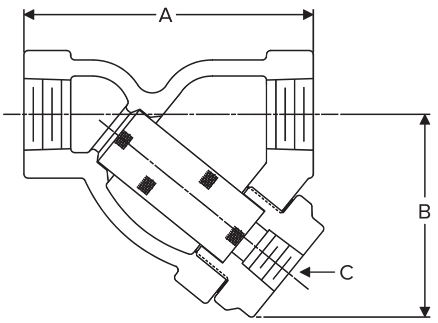
Numbers in parentheses apply to CA cast iron series only. A back-up screen is required for all YCS-B and YSS-E strainers with mesh screens.

*For unbacked screens.

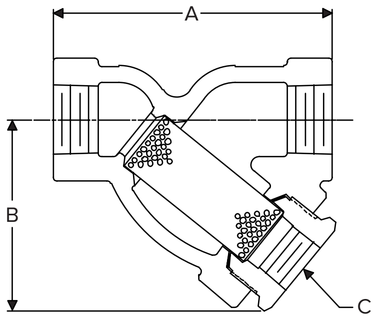
†Back-up required, Monel only.

Shade indicates that back-up screens are required.

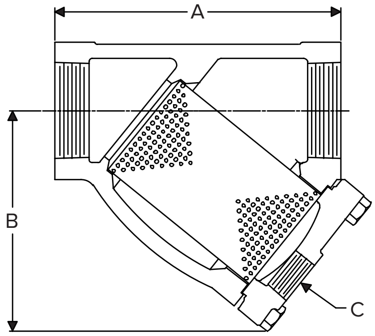
Cast Iron
250 lb Screwed 1/2" - 3"



CA1SC 1/2", 3/4", 1", 1-1/2", 2"



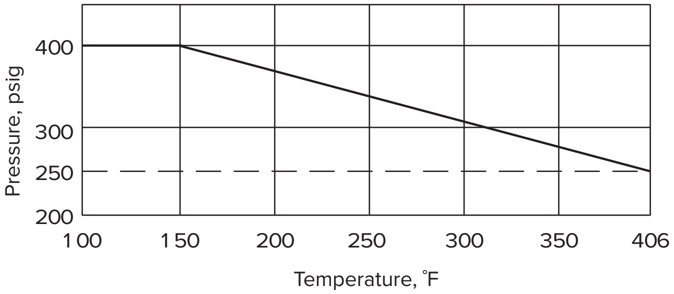
CA1SC 1-1/4"



A1SC 2-1/2", 3"

For a fully detailed certified drawing, refer to:
CA1SC 1/2", 3/4", 1", 1-1/4", 1-1/2", 2" CD #1111
A1SC 2-1/2", 3" CD #1043

Pressure/Temperature Rating

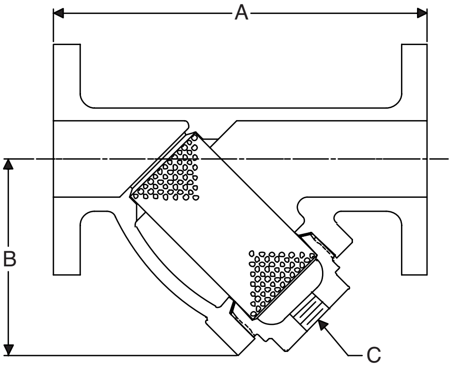


Materials: 250 lb Screwed 1/2" - 3" (15 - 80 mm)						
Connections Size		Body	Standard Screen	Screen Retainer	Gasket	Bolting
in	mm					
1/2, 3/4	15, 20	ASTM A48 Class 30 Cast Iron	304 SS .045" perforated†	ASTM A48 Class 30 Cast Iron	Spiral Wound	N/A
1, 1-1/2, 2	25, 40, 50					
1-1/4	32				Soft Steel	
2-1/2, 3	65, 80		304 SS .045" perforated†		Non-asbestos	Cap Screws ASTM A193 Gr. B7

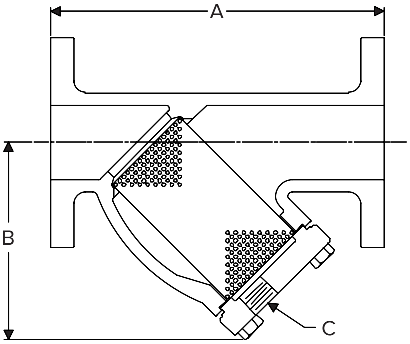
†NOTE: Other screen materials available. See page 435.

Physical Data: 250 lb Screwed 1/2" - 3" (15 - 80 mm)																
Size		Ordering Code, Standard Screen	Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Connections
					A		B		C		Saturated Steam		150°F (66°C) non-shock			
in	mm		lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	CA1SC	3	1.4	4-1/4	108	3	76	3/8	9.5	250	17	400	28	Threaded	ANSI B1.20.1 Screwed
3/4	20								1/2	15						
1	25		4-1/2	2	5	127	3-3/4	95								
1-1/4	32		7	3	5-1/2	140	3-7/8	98								
1-1/2	40		10	4.5	6-5/16	160	4-7/16	113								
2	50		15	6.8	7-1/2	191	5-7/16	138								
2-1/2	65	A1SC	24-1/2	11	8-1/2	216	6-7/16	164	3/4	20					Bolted	
3	80		45-1/2	21	10-1/2	267	8	203	1-1/4	32						

Cast Iron
Class 125 Flanged 2"- 6" and Class 250 Flanged 2" - 6"



2" Class 125 or 250 Flanged



2-1/2" - 6" Class 125 Flanged, 2-1/2" - 6" Class 250 Flanged

For a fully detailed certified drawing, refer to list below:

2" Class 125 or 250 Flanged	**CD #1044**
2-1/2" - 6" Class 125 Flanged	**CD #1045**
2-1/2" - 6" Class 250 Flanged	**CD #1046**

Materials: Class 125 Flanged 2" - 6" (50 - 150 mm) and Class 250 Flanged 2" - 6" (50 - 150 mm)

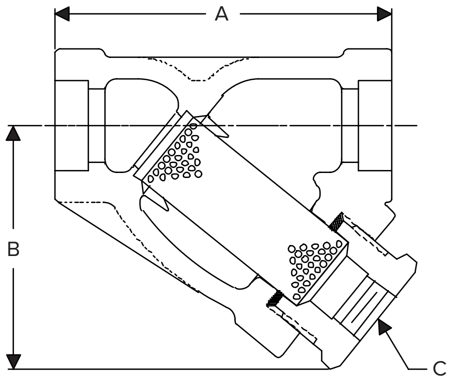
Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
2	50	ASTM A48 Class 30 Cast Iron		Soft Steel	N/A	304 SS .045" perforated†
2-1/2, 3, 4, 6	65, 80, 100, 150			Non-asbestos	Cap Screws ASTM A193	

†NOTE: Other screen materials available. See page 435.

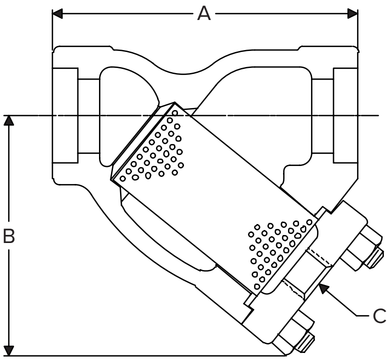
Physical Data: Class 125 Flanged 2" - 6" (50 - 150 mm) and Class 250 Flanged 2" - 6" (50 - 150 mm)

Size		Ordering Code, Standard Screen	Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Conn.
					A		B		C		Saturated Steam		150°F (66°C) non-shock			
in	mm		lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
2	50	A1FL125	22	10	9-3/4	248	5-1/8	130	1/2	15	125	8.6	175	12	Threaded	Class 125 ANSI B16.1 Flat Faced
2-1/2	65		36	16	11-1/16	281	6-7/16	164	3/4	20					Bolted	
3	80		49	22	12-1/4	311	7-1/4	184	1-1/4	32						
4	100		83	38	14-7/8	378	9-1/2	241	1-1/4	32						
6	150		187	85	20-7/16	519	13-7/8	353	1-1/2	40						
2	50	A1FL250	25	11	10-1/4	260	5-1/8	130	1/2	15	250	17	400	28	Threaded	Class 250 ANSI B16.1 1/16" RF
2-1/2	65		42	19	11-11/16	297	6-7/16	164	3/4	20					Bolted	
3	80		70	32	14-1/8	283	8-1/2	216	1-1/4	32						
4	100		125	57	17-1/8	435	10-3/4	273	1-1/4	32						
6	150		294	133	23-1/2	597	15-3/4	400	1-1/2	40						

Cast Carbon Steel (WCB)
600 lb and 900 lb Screwed or Socketweld 1/2" - 3"



900 lb—B1SC/B1SW 1/2", 3/4", 1"

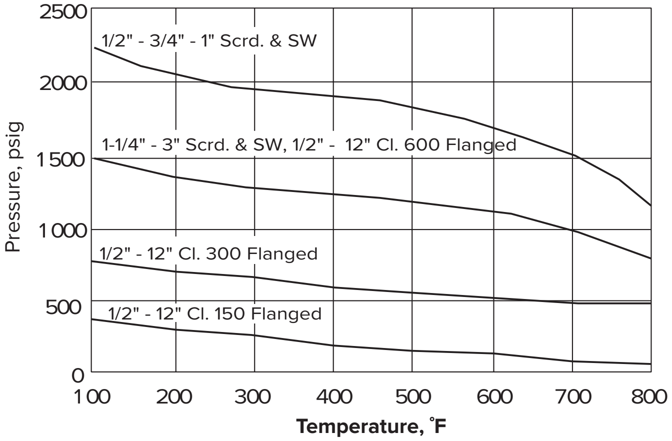


600 lb—B1SC/B1SW 1-1/4", 1-1/2", 2", 3"

For a fully detailed certified drawing, refer to:

900 lb—B1SC/B1SW 1/2", 3/4", 1"	**CD #1047**
600 lb—B1SC/B1SW 1-1/4", 1-1/2", 2", 3"	**CD #1048**

Pressure/Temperature Rating



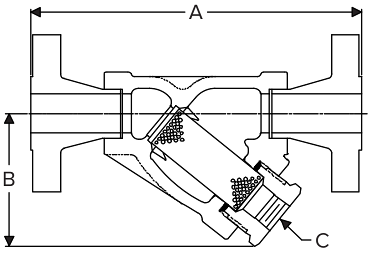
Materials: 600 lb and 900 lb Screwed or Socketweld 1/2" - 3" (15 - 80 mm)						
Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4	15, 20	ASTM A216 Gr. WCB	ASTM A108 Gr. 1045	Soft Steel	N/A	304 SS .045" perforated†
1	25		ASTM A108 Gr. 1040			
1-1/4, 1-1/2, 2	32, 40, 50		ASTM A216 Gr. WCB	304 SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B7 Nuts ASTM A194 Gr. 2H	
3	80			Non-asbestos	Cap Screws ASTM A193 Gr. B7	

†NOTE: Other screen materials available. See page 435.

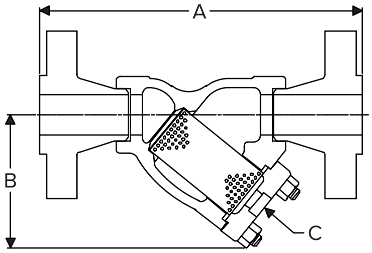
Physical Data: 600 lb and 900 lb Screwed or Socketweld 1/2" - 3" (15 - 80 mm)																	
Size		Ordering Code Standard Screen		Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Connections
						A		B		C		Saturated Steam		100°F (38°C) non-shock			
in	mm	Scr'd	SW	lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	B1SC	B1SW	2-1/2	1	3-3/4	95	2-11/16	68	3/8	9.5	1 635	113	2 220	153	Threaded	ANSI B1.20.1 Screwed ANSI B16.11 Socketweld
3/4	20			3-1/2	1.6	4-3/16	106	2-15/16	75	1/2	15						
1	25			6	2.7	5	127	3-1/2	89								
1-1/4	32			9	4	5-1/2	140	4-3/16	106			1 135	78	1 480	102	Bolted	
1-1/2	40			11	5	6-5/16	160	4-13/16	122								
2	50			19	9	7-3/4	197	5-5/8	143								
3	80			46	21	11-3/8	289	8-3/16	208	1-1/4	32						

Cast Carbon Steel (WCB)

Class 150, 300 Flanged, and 600 Flanged 1/2" - 1-1/2"



B1FL 1/2", 3/4", 1"



B1FL 1-1/4", 1-1/2"

For a fully detailed certified drawing, refer to:
B1FL 1/2", 3/4", 1" CD #1050 **B1FL 1-1/4", 1-1/2" CD #1051**

Materials: Class 150, 300, and 600 Flanged 1/2" - 1-1/2" (15 - 40 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4	15, 20	ASTM A216 Gr. WCB	ASTM A108 Gr. 1045	Soft Steel	N/A	304 SS .045" perforated†
1	25					
1-1/4, 1-1/2	32, 40		ASTM A216 Gr. WCB	304 SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B7 Nuts ASTM A194 Gr. 2H	

†NOTE: Other screen materials available. See page 435.

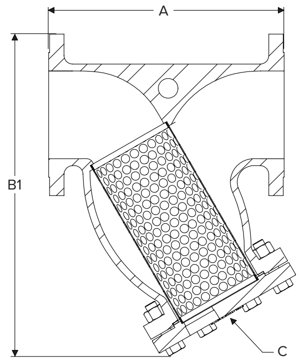
Physical Data: Class 150, 300, and 600 Flanged 1/2" - 1-1/2" (15 - 40 mm)

Size		Ordering Code, Standard Screen	Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Flanges
					A		B		C		Saturated Steam		100°F (38°C) non-shock			
in	mm		lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	B1FL 150	5	2.3	6-7/8	175	2-11/16	68	3/8	9.5	205	14	285	20	Threaded	Class 150 ANSI B16.5 1/16" RF
3/4	20		10	4.5	7-3/8	187	2-15/16	75	1/2	15						
1	25		10-1/2	4.8	8-1/2	216	3-1/2	89								
1-1/4	32		15	7	9	229	4-3/16	106							Bolted	
1-1/2	40		20	9	10-1/4	260	4-13/16	122								
1/2	15	B1FL 300	6-1/2	3	7-1/4	184	2-11/16	68	3/8	9.5	605	42	740	51	Threaded	Class 300 ANSI B16.5 1/16" RF
3/4	20		12	5	7-3/4	197	2-15/16	75	1/2	15						
1	25		13-1/2	6	8-7/8	226	3-1/2	89								
1-1/4	32		17-1/2	8	9-5/8	244	4-3/16	106							Bolted	
1-1/2	40		26	12	10-3/4	273	4-13/16	122								
1/2	15	B1FL 600	11	5	7-11/16	195	2-11/16	68	3/8	9.5	1 135	78	1 480	102	Threaded	Class 600 ANSI B16.5 1/4" RF
3/4	20		12	5.4	8-1/4	210	2-15/16	75	1/2	15						
1	25		13-1/2	6	9-3/8	238	3-1/2	89								
1-1/4	32		18-1/2	8.5	10-1/4	260	4-3/16	106							Bolted	
1-1/2	40		28	13	11-5/16	287	4-13/16	122								

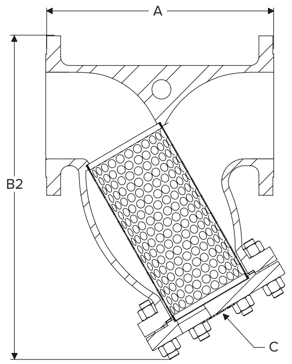
NOTE: For pressure/temperature ratings, see page 438.

Cast Carbon Steel (WCB)

Class 150, 300 Flanged, and 600 Flanged 2" - 12"



YCS-B 2"-12" (Bolts)



YCS-B 2"-12" (Studs)

Materials: Class 150, 300, and 600 Flanged 2" - 12" (50 - 300 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting (B_1) / Studs (B_2)	Standard Screen
in	mm					
2 - 12	50 - 300	ASTM A216 Gr. WCB	ASTM A105N	304 SS Spiral Wound Graphite	Bolts / Studs ASTM A193 Gr. B7 Nuts ASTM A194 2H Zinc Plated	304 SS .045" perforated†

†NOTE: Other screen materials available. See page 435.

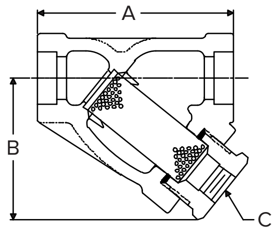
Physical Data: Class 150, 300, and 600 Flanged 2" - 12" (50 - 300 mm)

Size		Weight		Dimensions								Maximum Pressure				Screen Retainer Type	Flanges
				A		B_1 (bolts)		B_2 (studs)		C		Saturated Steam		100°F (38°C) non-shock			
in	mm	lb	kg	in	mm	in	mm	in	mm	in	mm	psig	barg	psig	barg		
2	50	40	18	8	203	8-3/32	205	8-19/32	218	1/2	15	205	14	285	20	Bolted	Class 150 ANSI B16.5 1/16" RF
3	80	55	25	9-1/2	241	9-19/32	245	9-29/32	252	1	25						
4	100	104	47	11-1/2	292	11-19/32	294	11-15/16	303	1-1/2	40						
6	150	173	78	16	406	16-13/32	417	17	432	2	50						
8	200	299	135	19-1/2	495	20-13/16	529	21-1/4	540								
10	250	458	208	24-1/2	622	24-19/32	625	25-1/8	638								
12	300	767	348	27-1/2	699	29	736	29-19/32	752								
2	50	45	21	10-1/2	267	8-7/32	207	8-1/2	216	1/2	15	605	42	740	51	Bolted	Class 300 ANSI B16.5 1/16" RF
3	80	77	35	12-1/2	318	10-3/32	256	10-13/32	264	1	25						
4	100	135	61	14	356	11-13/16	300	12-7/32	310	1-1/2	40						
6	150	254	115	17-1/2	445	16-23/32	424	17-1/8	435	2	50						
8	200	446	202	22	559	21-13/32	543	21-7/8	555								
10	250	650	295	24-1/2	622	25-7/32	639	25-10/16	651								
12	300	981	445	28	711	29-13/16	757	30-11/32	771								
2	50	64	29	11-1/2	292	9-3/32	230	9-13/32	239	1/2	15	1 135	78	1 480	102	Bolted	Class 600 ANSI B16.5 1/4" RF
3	80	106	48	14	356	11-7/32	284	11-23/32	298	1	25						
4	100	211	96	17	432	13-1/2	342	14	356	1-1/2	40						
6	150	453	205	22	559	19-7/32	487	19-23/32	501	2	50						
8	200	721	327	26	660	23	585	24-1/4	603								
10	250	1 227	556	31	787	27-13/16	707	28-15/32	723								
12	300	1 663	754	33	838	32-29/32	835	33-10/16	854								

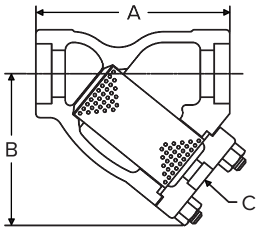
NOTE: For pressure/temperature ratings, see page 438.

Cast Chrome Moly Steel (WC6)

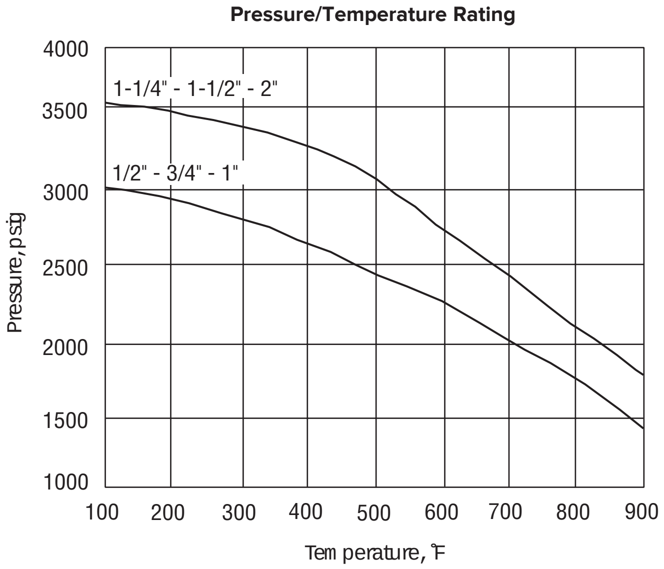
1 500 lb Screwed, Socketweld and Cl. 1 500 Flanged 1/2"- 2"

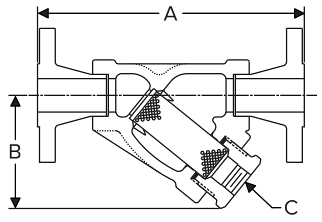


C1SC/C1SW 1/2", 3/4", 1"

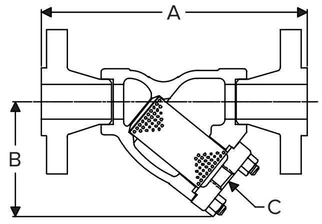


C1SC/C1SW 1-1/4", 1-1/2", 2"





C1FL 1/2", 3/4", 1"



C1FL 1-1/4", 1-1/2", 2"

For a fully detailed certified drawing, refer to list below:

C1SC/C1SW 1/2", 3/4", 1"	**CD #1055**
C1SC/C1SW 1-1/4", 1-1/2", 2"	**CD #1056**
C1FL 1/2", 3/4", 1"	**CD #1057**
C1FL 1-1/4", 1-1/2", 2"	**CD #1058**

Materials: 1 500 lb Screwed, Socketweld and Cl. 1 500 lb Flanged 1/2" - 2" (15 - 50 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4, 1	15, 20, 25	ASTM A217 Gr. WC6	ASTM A276	Soft Steel	N/A	304 SS .045" perforated†
1-1/4, 1-1/2, 2	32, 40, 50		ASTM A217 Gr. WC6	316L SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B16 Nuts ASTM A194 Gr. 2H	

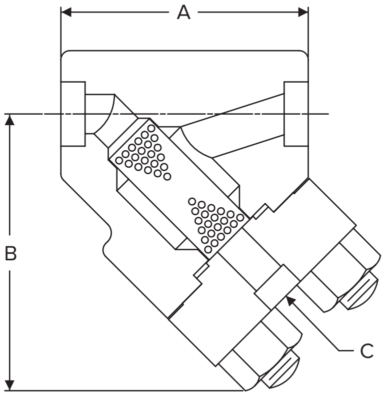
†NOTE: Other screen materials available. See page 435.

Physical Data: 1 500 lb Screwed, Socketweld and Cl. 1 500 lb Flanged 1/2" - 2" (15 - 50 mm)

Size		Ordering Code Standard Screen		Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Connections
						A		B		C		Saturated Steam		100°F (38°C) non-shock			
in	mm	Scr'd	SW	lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	C1SC	C1SW	2-1/2	1.1	3-3/4	95	2-11/16	68	3/8	9.5	2 090	144	3 000	207	Threaded	ANSI B1.20.1 Screwed ANSI B16.11 Socketweld
3/4	20	C1SC	C1SW	3-1/2	1.6	4-3/16	106	2-15/16	75	1/2	15						
1	25	C1SC	C1SW	5-1/2	2.5	5	127	3-1/2	89	1/2	15						
1-1/4	32	C1SC	C1SW*	17	8	6-3/4	171	6	152	3/4	20	2 515	173	3 600	248	Bolted	
1-1/2	40	C1SC	C1SW*	17	8	6-3/4	171	6	152	3/4	20						
2	50	C1SC	C1SW*	25	11	8-1/4	210	7-7/16	189	1	25						
1/2	15	C1FL1500		12	5	8-1/4	210	2-11/16	68	3/8	9.5	2 090	144	3 000	207	Threaded	Class 1500 ANSI B16.5 1/4" RF
3/4	20	C1FL1500		15-1/2	7	9-3/8	238	2-15/16	75	1/2	15						
1	25	C1FL1500		22-1/2	10	10-1/4	260	3-1/2	89	1/2	15						
1-1/4	32	C1FL1500*		37	17	12-1/8	308	6	152	3/4	20	2 515	173	3 600	248	Bolted	
1-1/2	40	C1FL1500*		45	20	12-7/8	327	6	152	3/4	20						
2	50	C1FL1500*		78	35	15-5/8	397	7-7/16	189	1	25						

*Socketweld Blowdown Connections.

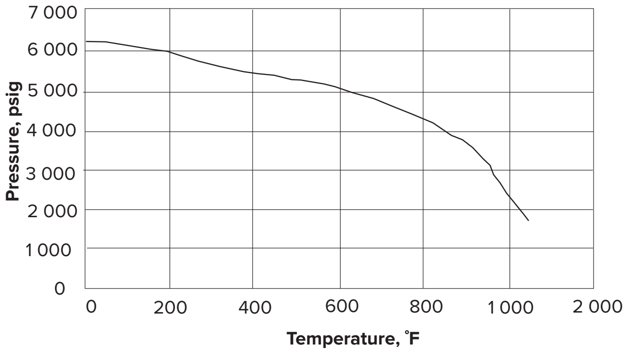
Forged Steel (F22)
2 500 lb Socketweld 1/2" - 2"



D1SW 1/2" - 2"

For a fully detailed certified drawing, refer to CD #1059.

Pressure/Temperature Rating



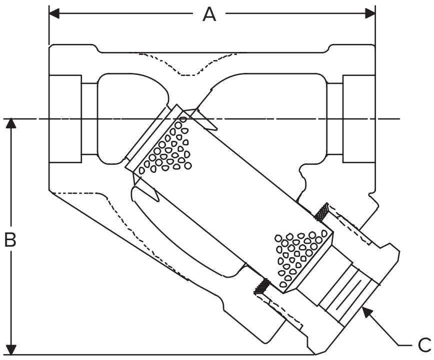
Materials: 2 500 lb Socketweld 1/2" - 2" (15 - 50 mm)						
Connection Size		**Body**	**Screen Retainer**	**Gasket**	**Bolting**	**Standard Screen**
in	**mm**					
1/2, 3/4, 1, 1-1/4, 1-1/2, 2	15, 20, 25, 32, 40, 50	ASTM A182 Gr. F22	ASTM A182 Gr. F22	347 SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B16 Nuts ASTM A194 Gr. 2H	304 SS .045" perforated†

†NOTE: Other screen materials available. See page 435.

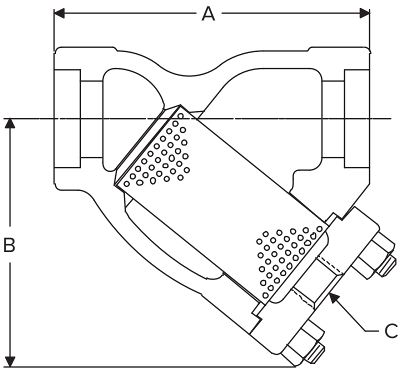
Physical Data: 2 500 lb Socketweld 1/2" - 2" (15 - 50 mm)																
Size		**Ordering Code, Standard Screen**	**Weight**		**Dimensions**						**Maximum Pressure**				**Screen Retainer Type**	**Connections**
					A		**B**		**C***		**Saturated Steam**		**100°F (38°C) non-shock**			
in	**mm**		**lb**	**kg**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**psig**	**barg**	**psig**	**barg**		
1/2	15	D1SW	26	12	5-1/8	130	5-5/8	143	1/2	15	2 500	172	6 000	414	Bolted	ANSI B16.11 Socketweld
3/4	20															
1	25															
1-1/4	32		56	25	6-5/8	168	7-3/8	187								
1-1/2	40															
2	50															

*Socketweld blowdown connections for 1/2" (15 mm) pipe.

Cast Stainless Steel (CF8M)
1 500 lb and 600 lb Screwed, Socketweld 1/2" - 3"

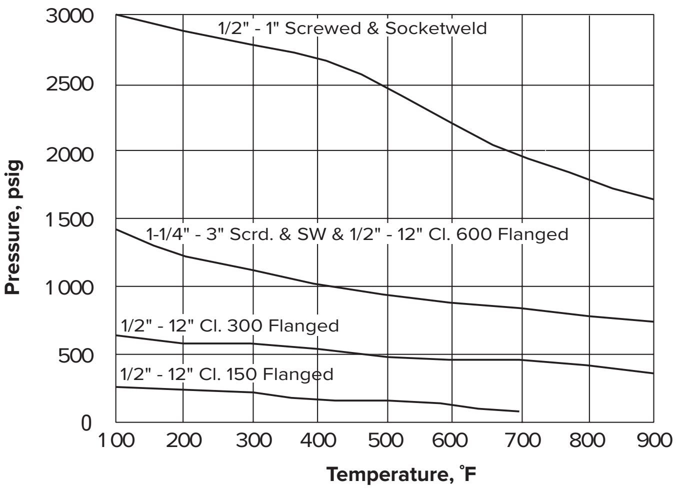


1500 Lb. E7SC/E7SW 1/2", 3/4", 1"



600 Lb. E7SC/E7SW 1-1/4", 1-1/2", 2", 3"

Pressure/Temperature Rating



For a fully detailed certified drawing, refer to:
E7SC/E7SW 1/2", 3/4", 1" CD #1060
E7SC/E7SW 1-1/4", 1-1/2", 2", 3" CD #1061

Materials: 1 500 lb and 600 lb Screwed or Socketweld 1/2" - 3" (15 - 80 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4, 1	15, 20, 25	ASTM A351 Gr. CF8M	ASTM A276	316 SS Flat	N/A	316 SS .045" perforated†
1-1/4, 1-1/2, 2	32, 40, 50		ASTM A351 Gr. CF8M	304 SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B7 Nuts ASTM A194 Gr. 2H	
3	80			Non-asbestos	Cap Screws ASTM A193 Gr. B7	

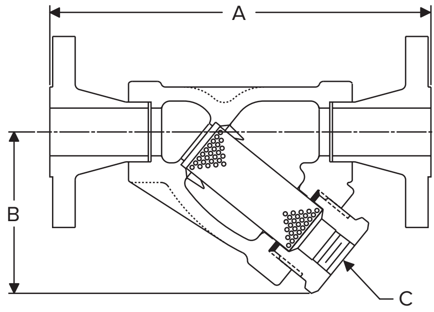
†NOTE: Other screen materials available. See page 435.

Physical Data: 1 500 lb and 600 lb Screwed or Socketweld 1/2" - 3" (15 - 80 mm)

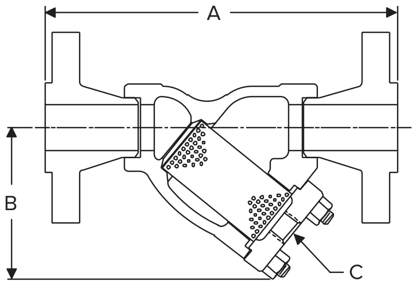
Size		Ordering Code Standard Screen		Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Connections
						A		B		C		Saturated Steam		100°F (38°C) non-shock			
in	mm	Scr'd	SW	lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	1500# E7SC	1500# E7SW	2-1/2	1.1	3-3/4	95	2-11/16	68	3/8	9.5	2 090	144	3 000	207	Threaded	ANSI B1.20.1 Screwed ANSI B16.11 Socketweld
3/4	20			3-1/2	1.6	4-3/16	106	2-15/16	75	1/2	15						
1	25			6	3	5	127	3-1/2	89								
1-1/4	32	600# E7SC	600# E7SW	9	4	5-1/2	140	4-3/16	106			935	64	1 440	99	Bolted	
1-1/2	40			11	5	6-5/16	160	4-13/16	122								
2	50			19	9	7-3/4	197	5-5/8	143								
3	80			50	23	11-3/8	289	8-3/16	208	1-1/4	32						

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Cast Stainless Steel (CF8M)
Cl. 150, 300, and 600 Flanged 1/2" - 1-1/2"



E7FL 1/2", 3/4", 1"



E7FL 1-1/2"

For a fully detailed certified drawing, refer to list below:

E7FL 1/2", 3/4", 1"	**CD #1071**
E7FL 1-1/2"	**CD #1063**

Materials: Class 150, 300, and 600 Flanged 1/2" - 1-1/2" (15 - 40 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4, 1	15, 20, 25	ASTM A351 Gr. CF8M	ASTM A276	316 SS Flat	N/A	316 SS .045" perforated†
1-1/2	40		ASTM A351 Gr. CF8M	304 SS Spiral Wound Non-asbestos	Studs ASTM A193 Gr. B7 Nuts ASTM A194 Gr. 2H	

†NOTE: Other screen materials available. See page 435.

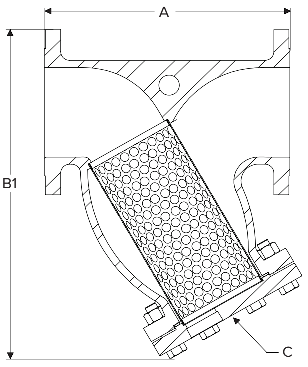
Physical Data: Class 150, 300, and 600 Flanged 1/2" - 1-1/2" (15 - 40 mm)

Size		Ordering Code, Standard Screen	Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Flanges
					A		B		C		Saturated Steam		100°F (38°C) non-shock			
in	mm		lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	E7FL 150	5	2.3	6-7/8	175	2-11/16	68	3/8	9.5	200	14	275	19	Threaded	ANSI B16.5 1/16" RF
3/4	20		10	4.5	7-3/8	187	2-15/16	75	1/2	15						
1	25		11	5	8-3/8	213	3-1/2	89								
1-1/2	40		20	9	10-1/8	257	4-13/16	122							Bolted	
1/2	15	E7FL 300	6-1/2	3	7-1/4	184	2-11/16	68	3/8	9.5	495	34	720	50	Threaded	ANSI B16.5 1/16" RF
3/4	20		9-1/2	4.3	7-3/4	197	2-15/16	75	1/2	15						
1	25		13-1/2	6	8-7/8	226	3-1/2	89								
1-1/2	40		22	10	10-3/4	273	4-13/16	122							Bolted	
1/2	15	E7FL 600	8-1/2	4	7-11/16	195	2-11/16	68	3/8	9.5	935	64	1 440	99	Threaded	ANSI B16.5 1/4" RF
3/4	20		9-1/2	4.3	8-1/4	210	2-15/16	75	1/2	15						
1	25		13-1/2	6	9-3/8	238	3-1/2	89								
1-1/2	40		27	12	11-5/16	287	4-13/16	122							Bolted	

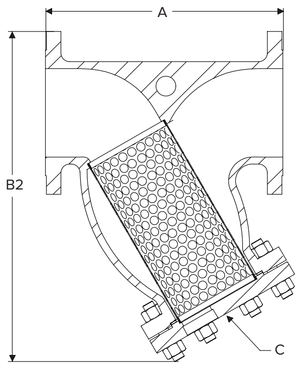
NOTE: For pressure/temperature ratings, see page 443.

Cast Stainless Steel (CF8M)

Class 150, 300 Flanged, and 600 Flanged 2" - 12"



YSS-E 2"-12" (Bolts)



YSS-E 2"-12" (Studs)

Materials: Class 150, 300, and 600 Flanged 2" - 12" (50 - 300 mm)

Connection Size		Body	Screen Retainer	Gasket	Bolting (B$_1$) / Studs (B$_2$)	Standard Screen
in	mm					
2 - 12	50 - 300	ASTM A351 Gr. CF8M	ASTM A182 Gr. F316	304 SS Spiral Wound Graphite	Bolts ASTM A193 Gr. B7 Zinc Plated Nuts ASTM A194 2H Zinc Plated	316 SS .045" perforated†
					Studs ASTM A193 B8M Nuts ASTM A194 8M	

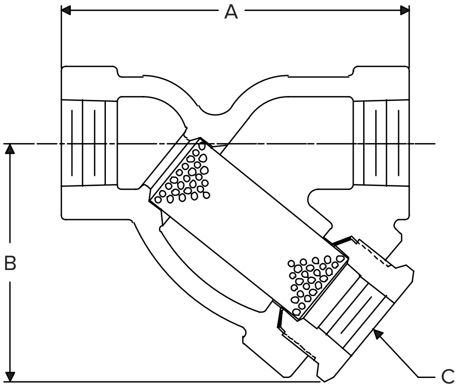
†NOTE: Other screen materials available. See page 435.

Physical Data: Class 150, 300, and 600 Flanged 2 " - 12" (50 - 300 mm)

Size		Weight		Dimensions								Maximum Pressure				Screen Retainer Type	Flanges
				A		B$_1$ (bolts)		B$_2$ (studs)		C		Saturated Steam		100°F (38°C) non-shock			
in	mm	lb	kg	in	mm	in	mm	in	mm	in	mm	psig	barg	psig	barg		
2	50	40	18	8	203	8-3/32	205	8-19/32	218	1/2	15	200	14	275	19	Bolted	Class 150 ANSI B16.5 1/16" RF
3	80	55	25	9-1/2	241	9-19/32	245	9-29/32	252	1	25						
4	100	104	47	11-1/2	292	11-19/32	294	11-15/16	303	1-1/2	40						
6	150	173	78	16	406	16-13/32	417	17	432	2	50						
8	200	299	135	19-1/2	495	20-13/16	529	21-1/4	540								
10	250	458	208	24-1/2	622	24-19/32	625	25-1/8	638								
12	300	767	348	27-1/2	699	29	736	29-19/32	752								
2	50	45	21	10-1/2	267	8-7/32	207	8-1/2	216	1/2	15	495	34	720	50	Bolted	Class 300 ANSI B16.5 1/16" RF
3	80	77	35	12-1/2	318	10-3/32	256	10-13/32	264	1	25						
4	100	135	61	14	356	11-13/16	300	12-7/32	310	1-1/2	40						
6	150	254	115	17-1/2	445	16-23/32	424	17-1/8	435	2	50						
8	200	446	202	22	559	21-13/32	543	21-7/8	555								
10	250	650	295	24-1/2	622	25-7/32	639	25-10/16	651								
12	300	981	445	28	711	29-13/16	757	30-11/32	771								
2	50	64	29	11-1/2	292	9-3/32	230	9-13/32	239	1/2	15	935	64	1 440	99	Bolted	Class 600 ANSI B16.5 1/4" RF
3	80	106	48	14	356	11-7/32	284	11-23/32	298	1	25						
4	100	211	96	17	432	13-1/2	342	14	356	1-1/2	40						
6	150	453	205	22	559	19-7/32	487	19-23/32	501	2	50						
8	200	721	327	26	660	23	585	24-1/4	603								
10	250	1 227	556	31	787	27-13/16	707	28-15/32	723								
12	300	1 663	754	33	838	32-29/32	835	33-10/16	854								

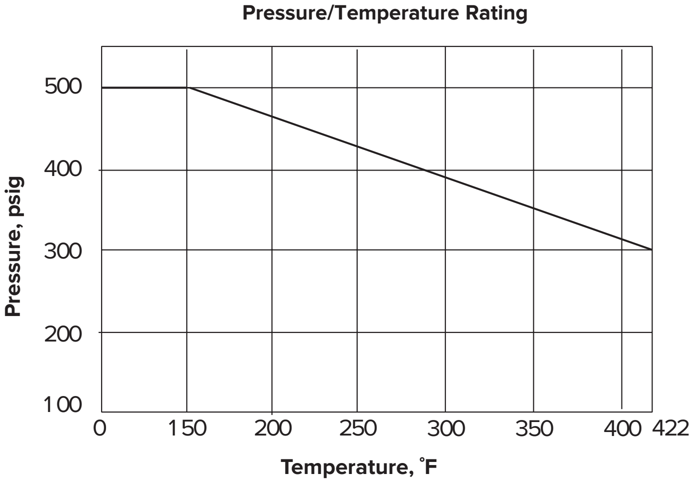
NOTE: For pressure/temperature ratings, see page 443.

Cast Bronze
300 lb Screwed 1/2" - 2"



F4SC 1/2"- 2"

For a fully detailed certified drawing, refer to CD #1064.



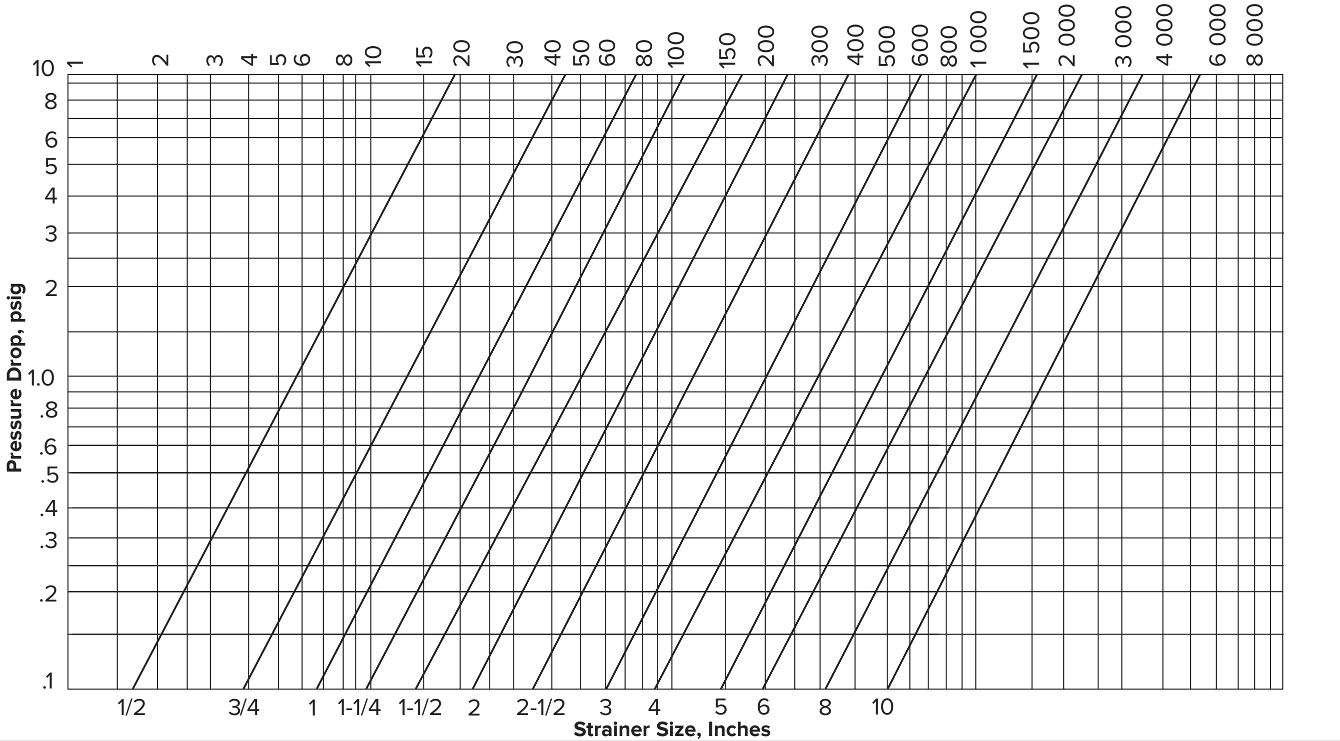
Materials: 300 lb Screwed 1/2" - 2" (15 - 50 mm)						
Connection Size		Body	Screen Retainer	Gasket	Bolting	Standard Screen
in	mm					
1/2, 3/4, 1, 1-1/4, 1-1/2, 2	15, 20, 25, 32, 40, 50	ASTM B62	Brass C	Copper	N/A	Brass .045" perforated†

†NOTE: Other screen materials available. See page 435.

Physical Data: 300 lb Screwed 1/2" - 2" (15 - 50 mm)															
Size		Ordering Code, Standard Screen	Weight		Dimensions						Maximum Pressure				Screen Retainer Type	Connections
					A		B		C		Saturated Steam		150°F (66°C) non-shock			
in	mm		lb	kg	in	mm	in	mm	in	mm	psig	barg	psig	barg		
1/2	15	F4SC	1-1/2	0.68	3-1/2	89	2-1/2	64	3/8	9.5	300	21	500	34	Threaded	ANSI B1.20.1 Screwed
3/4	20		2	0.91	4	102	2-7/8	73	1/2	15						
1	25		3-1/2	1.6	4-3/4	121	3-5/16	84								
1-1/4	32		5	2.3	5-1/4	133	4	102								
1-1/2	40		7-1/2	3.4	6	152	4-3/8	111								
2	50		12	5.4	7	178	5-1/2	140								

Water Flow Capacities

Water Flow Capacities in U.S. Gallons Per Minute (gpm)



Armstrong Y-Type Strainers—Master Selection Table

Master Selection Table

Material	Connections	Sizes		Pressure - Temperature Ratings		Pressure - Temperature Ratings	
		in	mm	Standard		Metric	
				Steam, Non-Shock	Cold, Non-Shock	Steam, Non-Shock	Cold, Non-Shock
Cast Iron ASTM A48 Class 30	Screwed - 250 lb	1/2 - 3	15 - 80	250 psig @ 406°F	400 psig @ 150°F	17 barg @ 208°C	28 barg @ 66°C
	Class 125 Flanged	2 - 6	50 - 150	125 psig @ 353°F	175 psig @ 150°F	8.6 barg @ 178°C	12 barg @ 66°C
	Class 250 Flanged	2 - 6	50 - 150	250 psig @ 406°F	400 psig @ 150°F	17 barg @ 208°C	28 barg @ 66°C
Cast Carbon Steel ASTM A216 Gr. WCB	Screwed & Socketweld - 900 lb	1/2 - 1	15 - 25	1 635 psig @ 609°F	2 200 psig @ 100°F	113 barg @ 321°C	153 barg @ 38°C
	Screwed & Socketweld - 600 lb	1-1/4 - 3	32 - 80	1 135 psig @ 562°F	1 480 psig @ 100°F	78 barg @ 294°C	102 barg @ 38°C
	Class 150 Flanged	1/2 - 12	15 - 150	205 psig @ 390°F	285 psig @ 100°F	14 barg @ 199°C	20 barg @ 38°C
	Class 300 Flanged	1/2 - 12	15 - 150	605 psig @ 490°F	740 psig @ 100°F	42 barg @ 254°C	51 barg @ 38°C
	Class 600 Flanged	1/2 - 12	15 - 100	1 135 psig @ 562°F	1 480 psig @ 100°F	78 barg @ 294°C	102 barg @ 38°C
Cast Chrome Moly Steel ASTM A217 Gr. WC6	Screwed & Socketweld - 1 500 lb	1/2 - 1	15 - 25	2 090 psig @ 643°F	3 000 psig @ 100°F	144 barg @ 339°C	207 barg @ 38°C
	Screwed & Socketweld - 1 500 lb	1-1/4 - 2	32 - 50	2 515 psig @ 670°F	3 600 psig @ 100°F	173 barg @ 354°C	248 barg @ 38°C
	Class 1 500 Flanged	1/2 - 1	15 - 25	2 090 psig @ 643°F	3 000 psig @ 100°F	144 barg @ 339°C	207 barg @ 38°C
	Class 1 500 Flanged	1-1/4 - 2	32 - 50	2 515 psig @ 670°F	3 600 psig @ 100°F	173 barg @ 354°C	248 barg @ 38°C
Forged Steel ASTM A182 Gr. F22	Socketweld - 2 500 lb	1/2 - 2	15 - 50	2 500 psig @ 1 025°F	6 000 psig @ 100°F	172 barg @ 552°C	414 barg @ 38°C
Cast SS ASTM A351 Gr. CF8M	Screwed & Socketweld - 1 500 lb	1/2 - 1	15 - 25	2 090 psig @ 643°F	3 000 psig @ 100°F	144 barg @ 339°C	207 barg @ 38°C
	Screwed & Socketweld - 600 lb	1-1/4 - 3	32 - 80	935 psig @ 538°F	1 400 psig @ 100°F	64 barg @ 281°C	97 barg @ 38°C
	Class 150 Flanged	1/2 - 12	15 - 150	200 psig @ 388°F	275 psig @ 100°F	14 barg @ 198°C	19 barg @ 38°C
	Class 300 Flanged	1/2 - 12	15 - 150	495 psig @ 467°F	720 psig @ 100°F	34 barg @ 242°C	50 barg @ 38°C
	Class 600 Flanged	1/2 - 12	15 - 100	935 psig @ 540°F	1 440 psig @ 100°F	64 barg @ 282°C	99 barg @ 38°C
Cast Bronze ASTM B62	Screwed - 300 lb	1/2 - 2	15 - 50	300 psig @ 422°F	500 psig @ 150°F	21 barg @ 217°C	34 barg @ 66°C

Y-Type Strainers - Forged/Cast

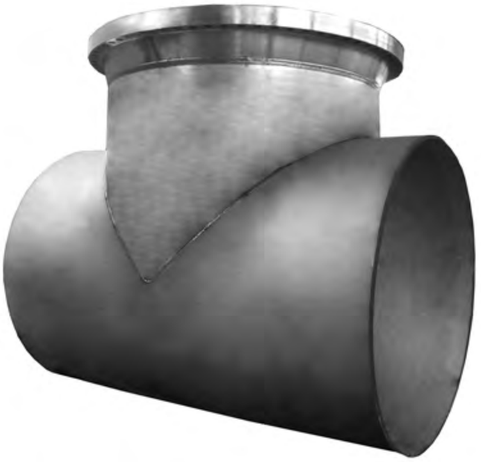
*Class 150 lbs. up to 24”
*Class 300 lbs. up to 24”
*Class 600 lbs. up to 24”
*Class 900 lbs. up to 16”
*Class 2 500 to 4 500 lbs. up to 8”

* Larger sizes are available upon request.

Basket Strainers

Simplex or duplex type up to 96” body and 72” connections.

Sizes and classes per customer requirements.



T-Type Strainers - Carbon Steel/Stainless Steel

*Class 150 lbs. 2” to 24”
*Class 300 lbs. 2” to 24”
*Class 600 lbs. 2” to 24”
*Class 900 lbs. 2” to 24”
*Class 1 500 lbs. 2” to 24”
*Class 2 500 lbs. 2” to 24”

* Larger sizes are available upon request.

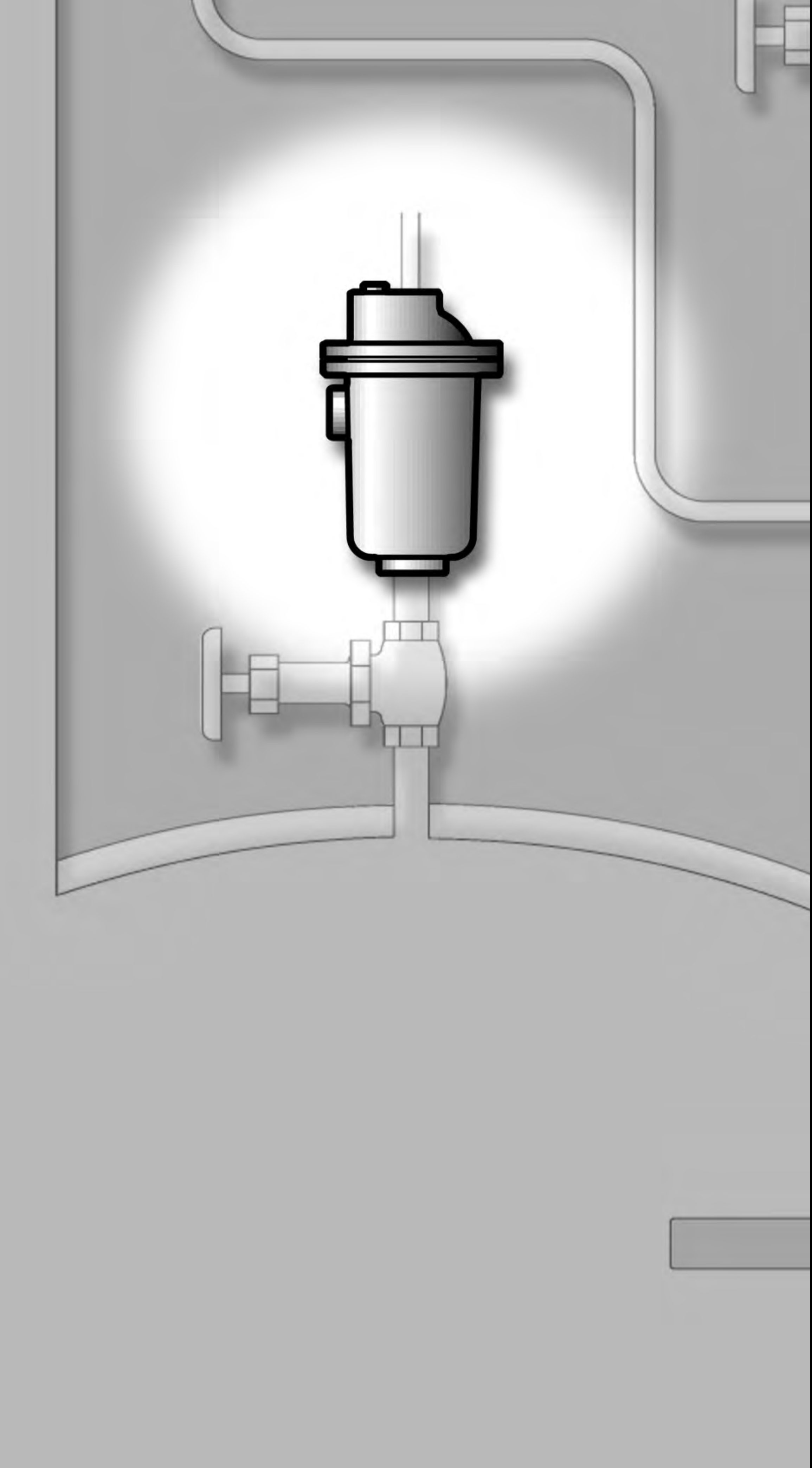
Strainers are designed bolted bonnet as standard, however, pressure seal design is available for class 600 lbs. and over upon request.

Conical Strainers

*Up to class 2 500 lbs. 2” up to 72”

* Larger sizes are available upon request.

Notes



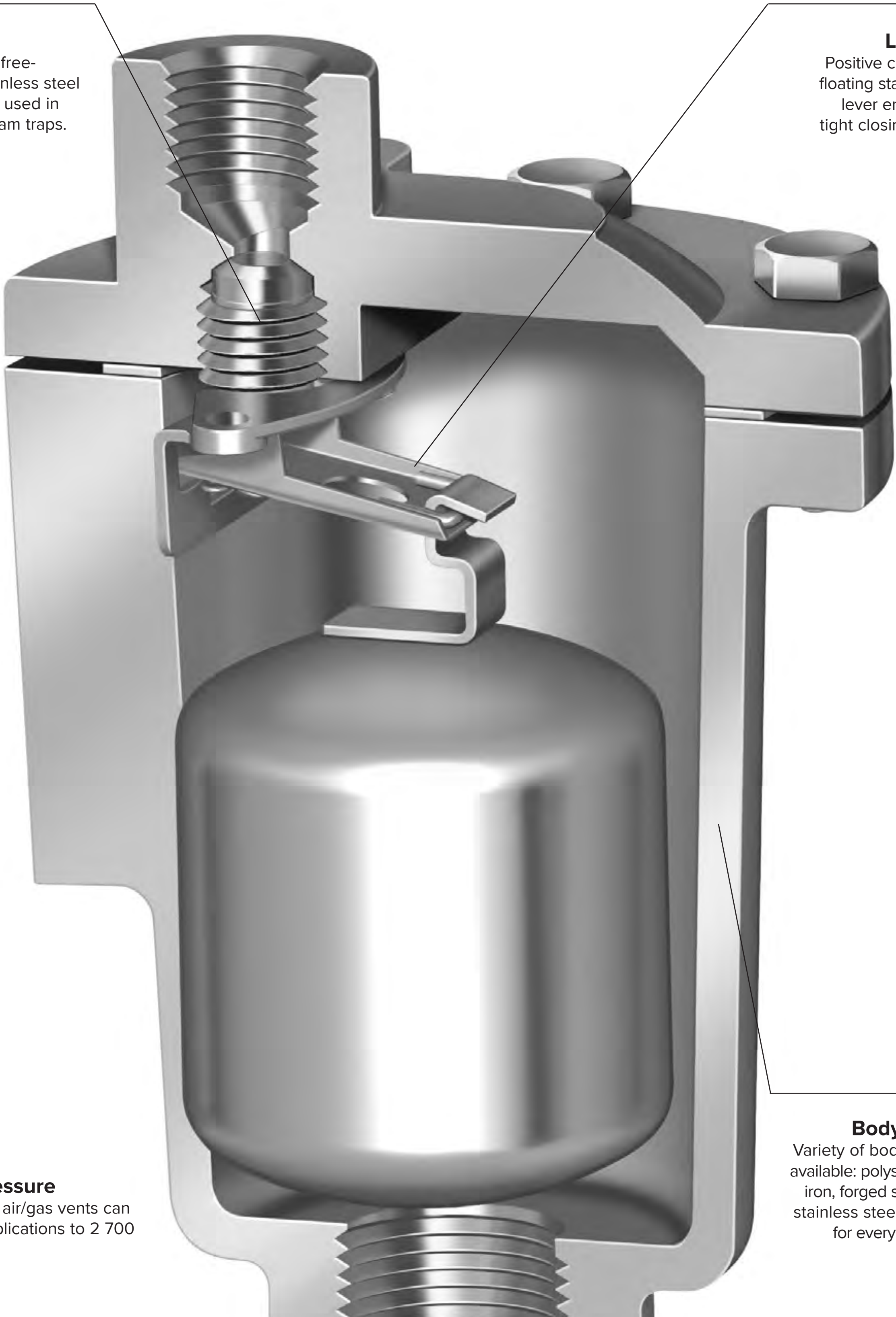
Air Vents

Armstrong

Armstrong®

Proven
Same proven, free-floating all stainless steel mechanism as used in Armstrong steam traps.

Leak-tight
Positive closing, free-floating stainless steel lever ensures leak-tight closing under all conditions.



High pressure
Armstrong air/gas vents can handle applications to 2 700 psig.

Body options
Variety of body materials available: polysulfone, cast iron, forged steel and all stainless steel. A material for every application.

Selecting The Armstrong Air/Gas Vent

With the desired CFM capacity known, find the orifice size required from the table on this page. Then find the vent or vents with the correct orifice size on pages 457, 459, 461 or 469 that will operate at the required pressure with a liquid of the specific gravity being handled.

Example—Find a model number that will vent 52 cfm of air (including safety factor of 1.5 - 2.0) from a liquid with a specific gravity of 0.93 at 250 psig. Using the table below, follow the 250 psig line across to the number 60.9. Orifice size is 5/32". Now go to pages 457, 459, 461 or 469 checking the 5/32" orifice lines to locate a vent for 250 psig or higher with 0.90 gravity liquid.

NOTE: Since specific gravity falls between 0.95 and 0.90, use 0.90 gravity data. The model 3-AV on page 456 is the one to use.

For Venting During Filling Only

If a vent is required only for getting rid of air when a system is started up, such as when starting up a deep well pump or filling an empty pipe, tank or other vessel, ability of the vent to open at operating pressure can be ignored. In these cases, a model number with a large orifice for fast venting may be selected, **but the vent will not open after air is expelled and the system reaches operating pressure.**

$$V = \frac{W}{d} = \frac{2.05\ C\ A\ P_2 \times 60}{d} \sqrt{\frac{\left(\frac{P_1}{P_2}\right)^{.283}\left[\left(\frac{P_1}{P_2}\right)^{.283} - 1\right]}{T}}$$

Where:

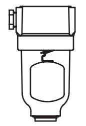
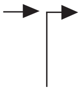
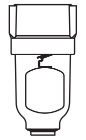
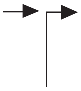
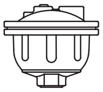
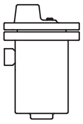
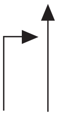
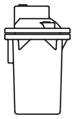
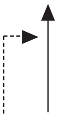
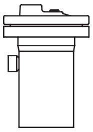
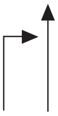
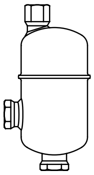
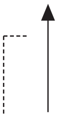
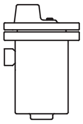
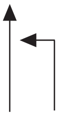
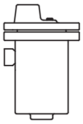
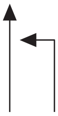
V = Volume flow rate, ft^3/min
W = Mass flow rate, lb/min
d = Density, 0.07494 lb/ft^3 at standard conditions
C = Flow coefficient = 0.65
A = Orifice area, in^2
P1 = Upstream pressure, psia
P2 = Pressure at throat orifice or downstream pressure = greater of 0.53 P1 or 14.7 psia
T = Upstream temperature = 530°R

Ref: Baumeister & Marks, Standard Handbook for Mechanical Engineers, 7th edition.

Discharge of Air Through an Orifice in Standard Cubic Feet per Minute at a Standard Atmospheric Pressure of 14.7 psia and 70°F

pressure psig	Orifice Diameter, inches																					
	1/16	5/64	3/32	#38	7/64	1/8	9/64	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1-1/16
5	0.64	1.00	1.44	1.54	1.96	2.56	3.24	4.00	5.76	7.84	10.2	13.0	16.0	19.4	23.0	31.4	41.0	51.9	64.0	92.2	125	185
6	0.70	1.09	1.57	1.69	2.14	2.80	3.54	4.37	6.30	8.57	11.2	14.2	17.5	21.2	25.2	34.3	44.8	56.7	70.0	101	137	202
7	0.75	1.18	1.70	1.82	2.31	3.02	3.82	4.71	6.78	9.23	12.1	15.3	18.8	22.8	27.1	36.9	48.2	61.1	75.4	109	148	218
9	0.85	1.33	1.91	2.05	2.61	3.40	4.31	5.32	7.66	10.4	13.6	17.2	21.3	25.7	30.6	41.7	54.4	68.9	85.1	122	167	246
12	0.98	1.52	2.19	2.35	2.99	3.90	4.94	6.10	8.78	11.9	15.6	19.8	24.4	29.5	35.1	47.8	62.4	79.0	97.5	140	191	282
15	1.09	1.70	2.44	2.62	3.33	4.34	5.50	6.79	9.78	13.3	17.4	22.0	27.2	32.9	39.1	53.2	69.5	88.0	109	156	213	314
20	1.27	1.98	2.86	3.06	3.89	5.08	6.42	7.93	11.4	15.5	20.3	25.7	31.7	38.4	45.7	62.2	81.2	103	127	183	249	367
25	1.45	2.27	3.27	3.50	4.45	5.81	7.35	9.07	13.1	17.8	23.2	29.4	36.3	43.9	52.3	71.1	92.9	118	145	209	285	420
30	1.63	2.55	3.68	3.94	5.01	6.54	8.28	10.2	14.7	20.0	26.2	33.1	40.9	49.5	58.9	80.1	105	132	163	235	320	472
35	1.82	2.84	4.09	4.38	5.57	7.27	9.20	11.4	16.4	22.3	29.1	36.8	45.4	55.0	65.4	89.1	116	147	182	262	356	525
40	2.00	3.13	4.50	4.82	6.13	8.00	10.1	12.5	18.0	24.5	32.0	40.5	50.0	60.5	72.0	98.0	128	162	200	288	392	578
45	2.18	3.41	4.91	5.26	6.69	8.73	11.1	13.6	19.6	26.7	34.9	44.2	54.6	66.0	78.6	107	140	177	218	314	428	631
50	2.37	3.70	5.32	5.70	7.25	9.46	12.0	14.8	21.3	29.0	37.9	47.9	59.2	71.6	85.2	116	151	192	237	341	464	684
60	2.73	4.27	6.15	6.58	8.37	10.9	13.8	17.1	24.6	33.5	43.7	55.3	68.3	82.6	98.3	134	175	221	273	393	535	790
70	3.10	4.84	6.97	7.46	9.49	12.4	15.7	19.4	27.9	37.9	49.6	62.7	77.4	93.7	112	152	198	251	310	446	607	895
80	3.46	5.41	7.79	8.34	10.6	13.9	17.5	21.6	31.2	42.4	55.4	70.1	86.6	105	125	170	222	281	346	499	679	1 001
90	3.83	5.98	8.62	9.2	11.7	15.3	19.4	23.9	34.5	46.9	61.3	77.5	95.7	116	138	188	245	310	383	551	750	1 107
100	4.19	6.55	9.44	10.1	12.8	16.8	21.2	26.2	37.8	51.4	67.1	84.9	105	127	151	206	268	340	419	604	822	1 212
110	4.56	7.13	10.3	11.0	14.0	18.2	23.1	28.5	41.0	55.9	73.0	92.4	114	138	164	223	292	369	456	657	894	1 318
125	5.11	7.98	11.5	12.3	15.6	20.4	25.9	31.9	46.0	62.6	81.7	103	128	155	184	250	327	414	511	736	1 001	1 477
150	6.02	9.41	13.6	14.5	18.4	24.1	30.5	37.6	54.2	73.8	96.4	122	151	182	217	295	385	488	602	867	1 181	1 741
200	7.85	12.3	17.7	18.9	24.0	31.4	39.8	49.1	70.7	96.2	126	159	196	238	283	385	503	636	785	1 131	1 539	2 269
250	9.68	15.1	21.8	23.3	29.6	38.7	49.0	60.5	87.1	119	155	196	242	293	348	474	620	784	968	1 394	1 897	2 798
300	11.5	18.0	25.9	27.7	35.2	46.0	58.3	71.9	104	141	184	233	288	348	414	564	737	932	1 151	1 657	2 256	3 326
400	15.2	23.7	34.1	36.5	46.4	60.7	76.8	94.8	136	186	243	307	379	459	546	743	971	1 228	1 517	2 184	2 973	4 383
500	18.8	29.4	42.4	45.3	57.6	75.3	95.3	118	169	231	301	381	471	569	678	922	1 205	1 525	1 882	2 711	3 689	5 440
600	22.5	35.1	50.6	54.1	68.8	89.9	114	141	202	275	360	455	562	680	809	1 102	1 439	1 821	2 248	3 237	4 406	6 497
750	28.0	43.7	62.9	67.4	85.6	112	142	175	252	343	447	566	699	846	1 007	1 370	1 790	2 265	2 797	4 027	5 481	8 082
1 000	37.1	58.0	83.5	89.4	114	148	188	232	334	455	594	751	928	1 123	1 336	1 818	2 375	3 006	3 711	5 344	7 273	10 725

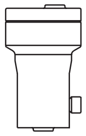
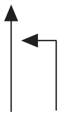
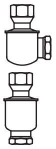
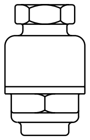
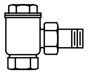
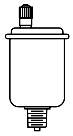
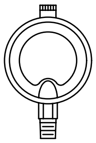
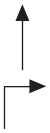
Armstrong® Air Vent ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size							Located on Page
									1/8"	1/4"	1/2"	3/4"	1"	1-1/2"	2"	
	**Series 1-AVC** See-Thru Free Floating Lever Air/Gas Vents		Screwed	150	150	Nylon Cap Polycarbonate Body	1-AVC	150			●	★★ ●				454
	**Series 1-AVCW** See-Thru Free Floating Lever Air Vents for Ozone Applications		Screwed	150	150	PBT Cap (Polybutylene Terephthalate) Polycarbonate Body	1-AVCW	150			▲	★★ ●				455
	**Series 21-AR** Fixed Pivot Ball Float Air/Gas Vents		Screwed	250	450	ASTM A48 Class 30 Cast Iron	21-AR	250			●	●				459
	**Series 21-312** Fixed Pivot Ball Float Air/Gas Vents		Screwed Socketweld Flanged †††	600 or 500	100 or 750	ASTM A105 Forged Steel	21-312AR	68			●	●				459
							21-312VAR	600			●	●				
	**Series 1, 2, 3, 6** Free Floating Lever Air/Gas Vents		Screwed	300	200	ASTM A48 Class 30 Cast Iron	1-AV†	300			★ ●	★ ●				456
				250	450		2-AV	250			●	●				
							3-AV	250				●	●			
							6-AV	250						●	●	
	**Series 30** Free Floating Lever Air/Gas Vents		Screwed Socketweld Flanged †††	600 or 500	100 or 750	ASTM A105 Forged Steel	32-AV	600			●	●				458
				1 000 or 600	100 or 750		33-AV	900			●	●	●			
				1 000 or 600	100 or 750		36-AV	1 000						●	●	
	**Series 10** Free Floating Lever Air/Gas Vents		Screwed Socketweld (22 and 13 only)	500 or 440	100 or 500	304-L Stainless Steel	11-AV ††	400			●	★★ ●				460
				555 or 475	100 or 500		22-AV	555				●				
				570 or 490	100 or 500		13-AV	570					●			
	**Series HLAR** High Leverage Air/Gas Vents		Screwed Socketweld Flanged †††	100 or 600	100 or 750	ASTM A105 Forged Steel	2313 HLAR	1 000			●	●	●			462
							2315 HLAR						●	1-1/4 ● 1-1/2 ●		
							2316 HLAR							●	●	
	**Series HLAR** High Leverage Air/Gas Vents		Screwed Socketweld Flanged †††	1 500 or 900	100 or 850	ASTM A182 Gr. F22 Forged Steel	2413 HLAR	1 500			●	●	●			462
				1 800 or 900	100 or 900		2415 HLAR	1 800					●	1-1/4 ● 1-1/2 ●		
							2416 HLAR	1 500						●	●	

★ 1/4" outlet connection ★★ 1/2" outlet connection † Side connection available ▲ Alternate inlet 1/2"

†† Side connection not available ††† Flange selection may limit pressure and temperature rating.

Air Vent ID Charts

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size							Located on Page
									1/8"	1/4"	1/2"	3/4"	1"	1-1/2"	2"	
	**Series HLAR** High Leverage Air/Gas Vents		Screwed Socketweld Flanged †††	2 120 or 1 700	100 or 900	ASTM A182 Gr. F22 Forged Steel	25133G-HLAR	2 125			●	●	●			462
				2 520 or 2 000	100 or 900		25155G-HLAR	2 500				●	●	1-1/4 ●		
				3 700 or 3 000	100 or 900		26155G-HLAR	2 700					●	1-1/4 ●		
	**Series TTF** Thermostatic Air Vents		Straight-Thru Right Angle	300	450	304-L Stainless Steel	TTF-1 TTF-1R	300			●	●				464
	**Series TV-2** Thermostatic Air Vents		Screwed	125	350	ASTM B62 Cast Bronze	TV-2	125			●					465
	**Series TS-2** Thermostatic Air Vents		Threaded	50	300	ASTM B62 Bronze	TS-2	50			●	●				466
	**AV-11, AV-13** Air Vents		Screwed	50 150	210	Brass	AV-11 AV-13	50 150	●		●	●				467
	**SV-12** Steam Radiator Air Vent		Threaded	15	250	Nickel Plated Brass	SV-12	15	●	●	●	●				468

★ 1/4" outlet connection ★★ 1/2" outlet connection † Side connection available ▲ Alternate inlet 1/2"
†† Side connection not available ††† Flange selection may limit pressure and temperature rating.

1-AVC See-Thru Air Vent

For Pressures to 150 psig (10 barg) or Specific Gravity Down to 0.80

A See-Thru Body—So You'll Know When It's Working
Now, you can literally see what you've been missing—the early warning signs of a system problem. Since you'll know the operating condition of the air vent, you won't have to waste time and money scheduling maintenance that isn't needed. In other words, you will be able to react to a condition before it becomes a problem.

A simple ball float mechanism requiring no electricity to operate, the new Armstrong 1-AVC discharges automatically only when air/gas are present. That means no liquid loss as with manual venting.

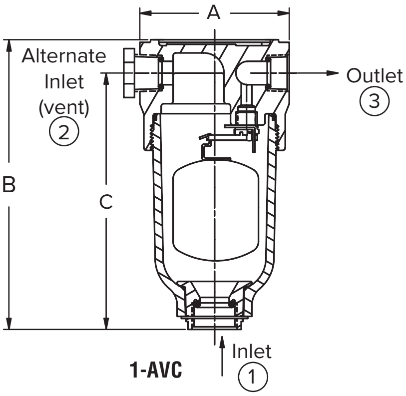
An Inside Look
See-thru body means you can observe changing conditions as they occur. See a problem in the making—instead of having to deal with it after the fact.

Efficient Operation
Simple ball float mechanism discharges only when air is present so it doesn't waste liquid.

Positive Seating
Free-floating valve mechanism assures positive seating so it prevents liquid loss. There are no fixed pivots to wear or create friction, and wear points are heavily reinforced for long life.

Reduced Maintenance
Stainless steel internals mean corrosion resistance and reduced maintenance.

Corrosion Resistance
Long-lasting polysulfone body and reinforced nylon cap resist corrosion and provide long, trouble-free service life.



How to Order

Inlet ①	Alternate Inlet ②	Outlet ③
3/4"	1/2"	1/2"
1/2" or 3/4"	1/2" or 3/4"	1/2"

NOTE: The Armstrong 1-AVC should not be used in an environment where there are high levels of ketones or chlorinated or aromatic hydrocarbons.

For a fully detailed certified drawing, contact Armstrong.

List of Materials

Name of Part	Material
Cap	Reinforced Nylon*
Body	polysulfone
O-Rings (Body Cap and Fitting)	Nitrile Elastomer Compound
Float Lever and Screws	Stainless Steel
Valve & Seat	Stainless Steel
Fitting & Pipe Plug	Reinforced Nylon
Retainer Ring	Zinc Plated Steel

*UV sensitive.

Physical Data

	in	mm
Inlet Connection	1/2, 3/4	15, 20
Outlet Connection	1/2	15
"A" Face-to-Face	3-1/2	89
"B" Height	6-3/4	171
"C" Bottom to ℄	6	552
Maximum Allowable Pressure (Vessel Design)	150 psig @ 150°F (10 barg @ 65°C)	
Maximum Operating Pressure	150 psig (10 barg)	
Specific Gravity Range	1.00 to 0.80	
Weight, lb (kg)	1 (.45)	

Model 1-AVC Capacity

Differential Pressure		Orifice Size	scfm	m³/hr
psig	barg			
15	1.0	1/8"	4.3	7.3
30	2.0		6.5	11.0
50	3.5		9.5	16.1
75	5.0		13.1	22.2
100	7.0		16.9	28.7
125	8.5		20.5	34.8
150	10.5		24.2	41.3

NOTE: Discharge of air through an orifice in scfm (standard cubic feet of free air per minute) at a standard atmospheric pressure of 14.7 psig (1 barg) and 70°F (21°C).

1-AVCW See-Thru Air Vent for Ozone Applications

For Pressures to 150 psig (10 barg) or Specific Gravity Down to 0.80

What Is Ozone?

Ozone is a gas that forms naturally during thunderstorms when lightning converts normal oxygen molecules (O_2) into ozone (O_3). The fresh, sweet smell in the air after a storm is the smell of ozone. The unstable ozone molecule reacts rapidly with most substances and is an extremely strong natural oxidant.

How Is Commercial Ozone Produced?

Ozone can be formed by exposing air to ultraviolet light; however, the most common method of generating ozone is by passing air through an electrical discharge. Because ozone has strong oxidizing properties, its production requires corrosion-resistant equipment.

How Is Ozone Used in Water Filtration and Purification?

Because ozone is such an effective oxidant, it kills viruses, bacteria, mold, mildew, fungus and germs. Passing ozone through water achieves high purification rates without any chemical residue. Oxygen is the only by-product.

Typical Customer Applications:

- Purifying standing ground water in Third World countries.
- Conditioning water for poultry and livestock.
- Purifying water in the bottled water industry.
- Filtering and purifying water for process applications.

A See-Thru Body Shows You It's Working

Now, you can literally see what you've been missing. The Armstrong 1-AVCW See-Thru Air Vent lets you easily check its operating condition. You won't have to waste time and money scheduling maintenance that isn't needed, and you can quickly react to a condition before it becomes a problem.

Efficient Operation

Simple ball-float mechanism doesn't need electricity to operate. The air vent automatically discharges only when air or gas is present. No liquid is lost, as with manual venting.

Positive Seating

Free-floating valve mechanism ensures positive seating and prevents liquid loss. There are no fixed pivots to wear or create friction. Wear points are heavily reinforced for long life.

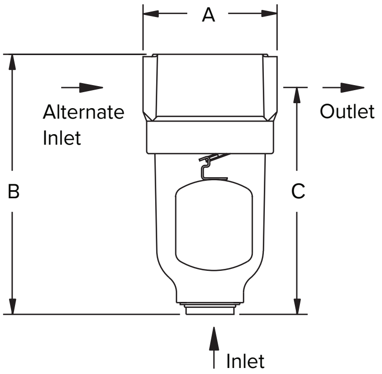
Corrosion Resistance

Long-lasting CPVC cap and polysulfone body provides trouble-free operation. T316 stainless steel internal parts resist corrosion and reduce maintenance.

Compare–and Save the Difference

Seeing really is believing–especially when you compare the Armstrong 1-AVCW See-Thru Air Vent with manual venting. Measure the time and money you can save with a more efficient, easier-to-maintain system. For more information or technical assistance, contact your local Armstrong Representative.

NOTE: The Armstrong 1-AVCW should not be used in an environment where there are high levels of ketones or chlorinated or aromatic hydrocarbons.



1-AVCW

List of Materials

Name of Part	Material
Cap	CPVC
Body	Polysulfone
O-Rings (Body Cap and Fitting)	Aflas
Float Lever and Screws	T316 Stainless Steel
Valve & Seat	T316 Stainless Steel
Fitting	CPVC
Retainer Ring	Zinc Plated Steel

Physical Data

	in	mm
Inlet Connection (In Body)	3/4	20
Inlet Connection (Alternate)	1/2	15
Outlet Connection	1/2	15
"A" Face-to-Face	3-1/2	89
"B" Height	6-13/16	172
"C" Bottom to ℄	6	152
Maximum Allowable Pressure (Vessel Design)	150 psig @ 150°F (10 barg @ 66°C)	
Maximum Operating Pressure	150 psig (10 barg)	
Specific Gravity Range	1.00 to 0.80	
Weight, lb (kg)	1 (.5)	

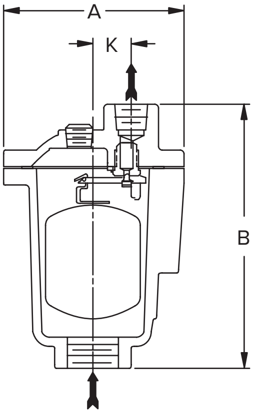
Model 1-AVCW Capacity

Differential Pressure		Orifice Size	scfm	m³/hr
psig	barg			
15	1.0	1/8"	4.3	7.3
30	2.0		6.5	11.0
50	3.5		9.5	16.1
75	5.0		13.1	22.2
100	7.0		16.9	28.7
125	8.5		20.5	34.8
150	10.5		24.2	41.3

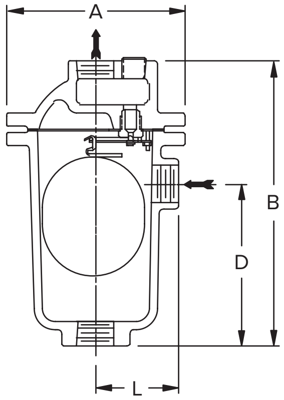
NOTE: Discharge of air through an orifice in scfm (standard cubic feet of free air per minute) at a standard atmospheric pressure of 14.7 psig (1 barg) and 70°F (21°C).

Free Floating Lever Air/Gas Vents—Cast Iron

For Pressures to 300 psig (21 barg) or Specific Gravity Down to 0.40



Model 1-AV



Model 2-AV, 3-AV and 6-AV

Armstrong free floating lever Air/Gas Vents use the same bodies, caps, lever mechanisms, valves and seats of Armstrong inverted bucket steam traps that have been proven in years of service.

Elliptical floats and high leverage make it possible to open large orifices to provide adequate capacity for vent size and weight. The hemispherical valve, seat and leverage are identical in design, materials and workmanship to those for saturated steam service up to 1 000 psig, with the exception of the addition of a guidepost to assure a positive, leaktight valve closing under all conditions.

1-AV—A cast iron air vent that uses a positive-closing free floating lever to ensure leaktight closing under all conditions. This vent is good for low capacity air/gas venting up to 300 psig.

For a fully detailed certified drawing, refer to CD #1070.

2-AV, 3-AV and 6-AV—Cast iron vents using the same proven free floating lever mechanisms used in Armstrong steam traps. For applications where high air/gas venting capacity is required up to 250 psig.

For a fully detailed certified drawing, refer to CD #1034.

Physical Data

Model No.	Cast Iron							
	1-AV**		2-AV		3-AV		6-AV	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2*, 3/4*	15, 20	1/2, 3/4	15, 20	3/4, 1	20, 25	1-1/2, 2	40, 50
"A"	3-3/4	89	5-1/4	133	6-3/8	162	10-3/16	259
"B"	5-1/2	140	8-3/4	222	11-1/2	292	18	457
"D"	-	-	5-1/8	130	7	188	9-3/8	238
"K"	13/16	21	-	-	-	-	-	-
"L"	-	-	2-7/16	62	2-7/8	73	4-5/8	-
Weight, lb (kg)	4 (1.8)		12 (5.5)		21 (9.5)		78 (35.5)	
Max. Allowable Pressure (Vessel Design)	300 psig @ 200°F (21 barg @ 93°C) 250 psig @ 450°F (17 barg @ 232°C)		250 psig @ 450°F (17 barg @ 232°C)					

*Outlet connection 1/4" (7 mm). **1-AV available with side connection if specified on order. On models 2-AV, 3-AV and 6-AV, pipe size of side connections is same as that of inlet and outlet connections. Some floats are oil filled. Consult factory for details.

List of Materials

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket	Bolts	Nuts
1-AV	Stainless Steel			ASTM A48 Class 30 Cast Iron	Non-asbestos	ASTM A193 Gr. B7	ASTM A563 Gr. A
2-AV						SAE Gr. 2	
3-AV							
6-AV							

Free Floating Lever Air/Gas Vents—Cast Iron

For Pressures to 300 psig (21 barg) or Specific Gravity Down to 0.40

1-AV Maximum Operating Pressures

Minimum Specific Gravity	**0.80**	
Orifice Size (in)	Maximum Operating Pressure	
	psig	barg
1/8	146	10
7/64	173	12
#38	219	15
5/64	300	21

Maximum Operating Pressures of free floating lever vents with weighted floats for different orifice sizes, and the specific gravities on which they can be used.

2-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60		0.55		0.50	
Float wt., oz (g)	7.7 (217)		7.3 (206)		6.9 (195)		6.5 (184)		6.1 (174)		5.7 (163)		5.4 (152)		5.0 (141)		4.6 (130)		4.2 (119)		3.8 (109)	
Orifice Size (in)	Maximum Operating Pressure																					
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
5/16	27	1.8	25	1.8	24	1.7	23	1.6	22	1.5	20	1.4	19	1.3	18	1.2	16	1.1	15	1.0	14	0.9
1/4	44	3.0	42	2.9	40	2.7	38	2.6	35	2.4	33	2.3	31	2.1	29	2.0	27	1.8	24	1.7	22	1.5
3/16	97	6.7	92	6.4	88	6.0	83	5.7	78	5.4	73	5.0	68	4.7	64	4.4	59	4.1	54	3.7	49	3.4
5/32	167	12	159	11	151	10.4	142	9.8	134	9.3	126	8.7	118	8.1	110	7.6	101	7.0	93	6.4	85	5.8
1/8	250	17	250	17	250	17	244	17	230	16	216	15	202	14	187	13	173	12	159	11	145	10.0
7/64	250	17	250	17	250	17	250	17	250	17	250	17	250	17	240	17	222	15	204	14	186	13
#38	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	231	16
5/64	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17

3-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60	
Float wt., oz (g)	14.9 (423)		14.2 (402)		13.4 (381)		12.7 (360)		12.0 (339)		11.2 (318)		10.5 (296)		9.7 (275)		9.0 (254)	
Orifice Size (in)	Maximum Operating Pressure																	
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1/2	21	1.5	20	1.4	19	1.3	18	1.3	17	1.2	16	1.1	15	1.0	14	1.0	13	0.9
3/8	45	3.1	43	3.0	41	2.8	38	2.7	36	2.5	34	2.3	32	2.2	30	2.0	27	1.9
5/16	72	5.0	69	4.7	65	4.5	61	4.2	58	4.0	54	3.8	51	3.5	47	3.3	44	3.0
9/32	96	6.6	91	6.3	87	6.0	82	5.6	77	5.3	72	5.0	68	4.7	63	4.3	58	4.0
1/4	144	9.9	137	9.4	130	8.9	123	8.5	116	8.0	109	7.5	102	7.0	94	6.5	87	6.0
7/32	206	14	196	13	186	13	176	12	165	11	155	10.7	145	10.0	135	9.3	125	8.6
3/16	250	17	250	17	250	17	250	17	249	17	234	16	218	15	203	14	188	13
5/32	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17

6-AV Maximum Operating Pressures

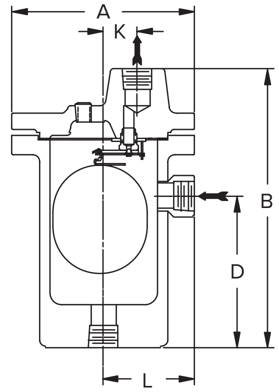
Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60		0.55		0.50		0.45		0.40	
Float wt., oz (g)	73.5 (2 084)		69.8 (1 979)		66.2 (1 875)		62.5 (1 771)		58.8 (1 667)		55. 1 (1 563)		51.5 (1 459)		47.8 (1 354)		44.1 (1 250)		40.4 (1 146)		36.8 (1 042)		33.1 (938)		29.4 (833)	
Orifice Size (in)	Maximum Operating Pressure																									
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1-1/16	22	1.5	21	1.5	20	1.4	19	1.3	18	1.2	17	1.2	16	1.1	14	1.0	13	0.9	12	0.8	11	0.8	10	0.70	9	0.62
7/8	35	2.4	33	2.3	31	2.2	30	2.0	28	1.9	26	1.8	24	1.7	23	1.6	21	1.5	19	1.3	18	1.2	16	1.1	14	1
3/4	50	3.5	48	3.3	45	3.1	43	3.0	40	2.8	38	2.6	35	2.4	33	2.3	30	2.1	28	1.9	25	1.8	23	1.6	20	1.4
5/8	77	5.3	73	5.0	69	4.8	66	4.5	62	4.3	58	4.0	54	3.7	50	3.5	46	3.2	43	2.9	39	2.7	35	2.4	31	2.2
9/16	102	7.0	97	6.7	92	6.3	87	6.0	82	5.6	77	5.3	72	4.9	67	4.6	62	4.2	57	3.9	51	3.6	46	3.2	41	3.9
1/2	148	10.2	140	9.7	133	9.2	126	8.7	119	8.2	111	7.7	104	7.2	97	6.7	89	6.2	82	5.6	75	5.1	67	4.6	60	4.1
7/16	210	14	200	14	189	13	179	12	168	12	158	11	148	10.2	137	9.5	127	8.7	116	8.0	106	7.3	96	6.6	85	5.9
3/8	250	17	250	17	250	17	250	17	250	17	249	17	233	16	216	15	200	14	184	13	167	12	151	10.4	134	9.3
11/32	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	245	17	223	15	201	14	179	12
5/16	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	230	16
9/32	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17
1/4	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17

*If specific gravity falls between those shown, use next lowest: e.g., if actual gravity is 0.73, use 0.70 specific gravity data.

Armstrong®

Free Floating Lever Air/Gas Vents—Forged Steel

For Pressures to 1 000 psig (69 barg) or Specific Gravity Down to 0.40



Model 32-AV, 33-AV and 36-AV

32-AV, 33-AV and 36-AV—Forged steel vents using the same proven free floating lever mechanisms used in Armstrong steam traps.

For applications where high air/gas venting capacity is required up to 1 000 psig. Available with screwed, socketweld or flanged connections.

For a fully detailed certified drawing, refer to CD #1035.

List of Materials

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket	Bolting
32-AV	Stainless Steel			ASTM A105 Forged Steel	Non-asbestos	Bolts ASTM A193 Gr. B7 Nuts ASTM A194 Gr. 2H
33-AV						
36-AV						

Physical Data

Model No.	Forged Steel					
	32-AV†		33-AV†		36-AV†	
Pipe Connections	1/2, 3/4, 1	15, 20, 25	3/4, 1	20, 25	1-1/2, 2	40, 50
“A”	6-3/4	171	8	203	11-7/8	301
“B”	10-3/16	259	11-9/16	294	17-1/8	435
“D”	5-9/16	141	6-1/16	154	9	229
“K”	1-1/4	32	1-7/16	37	2-1/8	54
“L”	3-3/8	86	3-7/8	98	6-1/16	154
Approx. Wt. lb (kg)	31 (14)		49 (22)		163 (74)	
Max. Allow. Pressure (Vessel Design)	600 psig @ 100°F (41 barg @ 38°C) 500 psig @ 750°F (34 barg @ 399°C)		1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 399°C)			

†Available in Type 316 SS. Consult factory. Pipe size of side connections if provided is same as that of inlet and outlet connections. Some floats are oil filled. Consult factory for details.

Free Floating Lever Air/Gas Vents—Forged Steel

For Pressures to 1 000 psig (69 barg) or Specific Gravity Down to 0.40

High-Temperature Service

Maximum allowable working pressures of floats decrease at temperatures above 100°F. Allow for approximately:

- 10% decrease at 200°F
- 15% decrease at 300°F
- 20% decrease at 400°F

The float is not always the limiting factor, however. Consult with Armstrong Application Engineering if you have a high-temperature application that also requires maximum operating pressures.

Sour Gas Service

Forged steel and stainless steel traps can be modified to resist hydrogen sulfide stress corrosion. These modifications involve annealing the float, which will reduce the maximum working pressure of the float to about half of its normal value. Consult Armstrong Application Engineering for allowable working pressures.

Maximum Operating Pressures of free floating lever vents with weighted floats for different orifice sizes, and the specific gravities on which they can be used.

32-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65	
Float wt., oz (g)	11.8 (335)		11.2 (318)		10.6 (301)		10.0 (285)		9.4 (268)		8.9 (251)		8.3 (234)		7.7 (218)	
Orifice Size (in)	Maximum Operating Pressure															
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
5/16	41	2.8	39	2.7	37	2.6	35	2.4	33	2.3	31	2.1	29	2.0	27	1.9
1/4	68	4.7	64	4.4	61	4.2	58	4.0	54	3.7	51	3.5	47	3.3	44	3.0
3/16	149	10.3	142	9.8	134	9.3	127	8.8	120	8.2	112	7.7	105	7.2	97	6.7
5/32	257	18	244	17	231	16	219	15	206	14	193	13	180	12	168	12
1/8	439	30	417	29	396	27	374	26	352	24	330	23	309	21	287	20
7/64	562	39	534	37	506	35	478	33	450	31	423	29	395	27	367	25
#38	600	41	600	41	600	41	595	41	561	39	526	36	491	34	457	31
5/64	600	41	600	41	600	41	600	41	600	41	600	41	600	41	600	41

33-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60	
Float wt., oz (g)	14.9 (423)		14.2 (402)		13.4 (381)		12.7 (360)		12.0 (339)		11.2 (318)		10.5 (296)		9.7 (275)		9.0 (254)	
Orifice Size (in)	Maximum Operating Pressure																	
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1/2	21	1.5	20	1.4	19	1.3	18	1.3	17	1.2	16	1.1	15	1.0	14	1.0	13	0.9
3/8	45	3.1	43	3.0	41	2.8	38	2.7	36	2.5	34	2.3	32	2.2	30	2.0	27	1.9
5/16	72	5.0	69	4.7	65	4.5	61	4.2	58	4.0	54	3.8	51	3.5	47	3.3	44	3.0
9/32	96	6.6	91	6.3	87	6.0	82	5.6	77	5.3	72	5.0	68	4.7	63	4.3	58	4.0
1/4	144	9.9	137	9.4	130	8.9	123	8.5	116	8.0	109	7.5	102	7.0	94	6.5	87	6.0
7/32	206	14	196	13	186	13	176	12	165	11	155	10.7	145	10.0	135	9.3	125	8.6
3/16	309	21	294	20	279	19	264	18	249	17	234	16	218	15	203	14	188	13
5/32	484	33	460	32	437	30	413	28	389	27	365	25	342	24	318	22	294	20
1/8	900	62	900	62	883	61	835	58	787	54	739	51	691	48	643	44	595	41
7/64	900	62	900	62	900	62	900	62	900	62	900	62	883	61	822	57	760	52

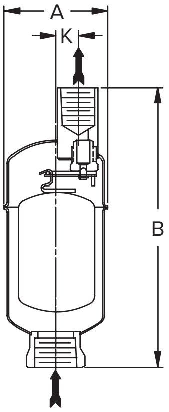
36-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60		0.55		0.50		0.45		0.40	
Float wt., oz (g)	73.5 (2 084)		69.8 (1 979)		66.2 (1 875)		62.5 (1 771)		58.8 (1 667)		55.1 (1 563)		51.5 (1 459)		47.8 (1 354)		44.1 (1 250)		40.4 (1 146)		36.8 (1 042)		33.1 (938)		29.4 (833)	
Orifice Size (in)	Maximum Operating Pressure																									
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1-1/16	22	1.5	21	1.5	20	1.4	19	1.3	18	1.2	17	1.2	16	1.1	14	1.0	13	0.9	12	0.8	11	0.8	10	0.70	9	0.62
7/8	35	2.4	33	2.3	31	2.2	30	2.0	28	1.9	26	1.8	24	1.7	23	1.6	21	1.5	19	1.3	18	1.2	16	1.1	14	1
3/4	50	3.5	48	3.3	45	3.1	43	3.0	40	2.8	38	2.6	35	2.4	33	2.3	30	2.1	28	1.9	25	1.8	23	1.6	20	1.4
5/8	77	5.3	73	5.0	69	4.8	66	4.5	62	4.3	58	4.0	54	3.7	50	3.5	46	3.2	43	2.9	39	2.7	35	2.4	31	2.2
9/16	102	7.0	97	6.7	92	6.3	87	6.0	82	5.6	77	5.3	72	4.9	67	4.6	62	4.2	57	3.9	51	3.6	46	3.2	41	3.9
1/2	148	10.2	140	9.7	133	9.2	126	8.7	119	8.2	111	7.7	104	7.2	97	6.7	89	6.2	82	5.6	75	5.1	67	4.6	60	4.1
7/16	210	14	200	14	189	13	179	12	168	12	158	11	148	10.2	137	9.5	127	8.7	116	8.0	106	7.3	96	6.6	85	5.9
3/8	331	23	315	22	299	21	282	19	266	18	249	17	233	16	216	15	200	14	184	13	167	12	151	10.4	134	9.3
11/32	441	30	419	29	398	27	376	26	354	24	332	23	310	21	288	20	266	18	245	17	223	15	201	14	179	12
5/16	567	39	539	37	511	35	483	33	455	31	427	29	399	27	371	26	342	24	250	17	250	17	250	17	230	16
9/32	743	51	706	49	669	46	633	44	596	41	559	39	522	36	485	33	449	31	250	17	250	17	250	17	250	17
1/4	1 000	69	1 000	69	979	67	925	64	871	60	817	56	763	53	710	49	656	45	250	17	250	17	250	17	250	17
7/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	926	64	250	17	250	17	250	17	250	17
3/16	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	250	17	250	17	250	17	250	17

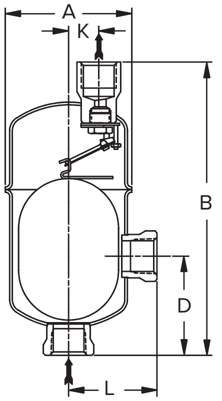
*If specific gravity falls between those shown, use next lowest: e.g., if actual gravity is 0.73, use 0.70 specific gravity data.

Free Floating Lever Air/Gas Vents—All Stainless Steel

For Pressures to 600 psig (41 barg) or Specific Gravity Down to 0.50



Model 11-AV



Model 22-AV and 13-AV

The Armstrong stainless steel free floating lever air vents have been developed to provide positive venting of air/gases under pressure.

The body and cap and all working parts of the No. 11-AV, 22-AV and 13-AV are made of high strength, corrosion resistant stainless steel. Body and caps are welded together to form a permanently sealed, tamperproof unit with no gaskets. Elliptical floats and high leverage provide up to 115 SCFM capacity for these compact air/gas vents. Lever action is guided to assure proper seating of the valve under all operating conditions.

11-AV, 22-AV and 13-AV—All stainless steel construction where exposure to either internal or external corrosion is a problem. These air/gas vents have the same proven free floating mechanisms used in other Armstrong steam traps. Pressures to 600 psig @ 100°F (41 barg @ 38°C).

For a fully detailed certified drawing, refer to list below:
11-AV CD #1066
13-AV and 22-AV CD #1086

Physical Data

Model No.	11-AV		22-AV		13-AV	
Pipe Connections	1/2, 3/4**	15, 20**	3/4	20	1	25
"A"	2-3/4	70	3-7/8	99	4-1/2	114
"B"	7-1/4	184	8-13/16	224	11-3/8	289
"D"	–	–	3-3/8	86	6-1/8	156
"K"	9/16	14	7/8	22	1-3/16	30
"L"	–	–	2-5/8	67	3-1/4	83
Weight, lb (kg)			5 (2.3)		7-1/2 (3.4)	
Max. Allow. Pressure (Vessel Design)	500 psig @ 100°F (34 barg @ 38°C) 440 psig @ 500°F (30 barg @ 260°C)		600 psig @ 100°F (41 barg @ 38°C) 475 psig @ 500°F (33 barg @ 260°C)		570 psig @ 100°F (39 barg @ 38°C) 490 psig @ 500°F (34 barg @ 260°C)	

** 1/2" (15 mm) outlet.

List of Materials

Model No.	Valve & Seat*	Leverage System*	Float*	Body & Cap*
11-AV	Hardened chrome steel—17-4PH	303/304 Stainless Steel	304 Stainless Steel	Sealed Stainless Steel 304-L
22-AV				
13-AV				

*Type 316 SS valve and seat available. Consult factory.

*11-LD available in all-316SS. Consult factory.

Free Floating Lever Air/Gas Vents—All Stainless Steel

For Pressures to 600 psig (41 barg) or Specific Gravity Down to 0.50

Maximum Operating Pressures of free floating lever vents with weighted floats for different orifice sizes, and the specific gravities on which they can be used.

11-AV Maximum Operating Pressures

Minimum Specific Gravity	0.75		0.50	
Float wt., oz (g)	2.90 (82) Standard		2.08 (59) Special	
Orifice Size (in)	Maximum Operating Pressure			
	psig	barg	psig	barg
1/8	178	12	118	8
#38	267	18	177	12
5/64	400	28	311	21

22-AV Maximum Operating Pressure

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60		0.55		0.50	
Float wt., oz (g)	10.0 (282)		9.5 (268)		9.0 (254)		8.5 (240)		8.0 (226)		7.5 (212)		5.4 (152)		5.0 (141)		4.6 (130)		4.2 (119)		3.8 (109)	
Orifice Size (in)	Maximum Operating Pressure																					
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
5/16	35	2.4	33	2.3	31	2.2	30	2.0	28	1.9	26	1.8	19	1.3	18	1.2	16	1.1	15	1.0	14	0.9
1/4	57	3.9	54	3.7	51	3.5	49	3.4	46	3.2	43	3.0	31	2.1	29	2.0	27	1.8	24	1.7	22	1.5
3/16	126	8.7	120	8.2	113	7.8	107	7.4	101	7.0	95	6.5	68	4.7	64	4.4	59	4.1	54	3.7	49	3.4
5/32	217	14.9	206	14.2	195	13.5	185	12.7	174	12.0	163	11.2	118	8.1	110	7.6	101	7.0	93	6.4	85	5.8
1/8	371	25.6	352	24.3	334	23.0	316	21.8	297	20.5	279	19.2	202	13.9	187	12.9	173	12.0	159	11.0	145	10.0
7/64	474	32.7	451	31.1	427	29.5	404	27.9	380	26.2	357	24.6	258	17.8	240	16.5	222	15.3	204	14.0	186	12.8
#38	590	40.7	561	38.7	532	36.7	503	34.7	473	32.7	444	30.6	321	22.1	298	20.6	276	19.0	253	17.5	231	15.9
5/64	600	41.4	600	41.4	600	41.4	600	41.4	600	41.4	600	41.4	473	32.6	440	30.3	407	28.1	374	25.8	341	23.5

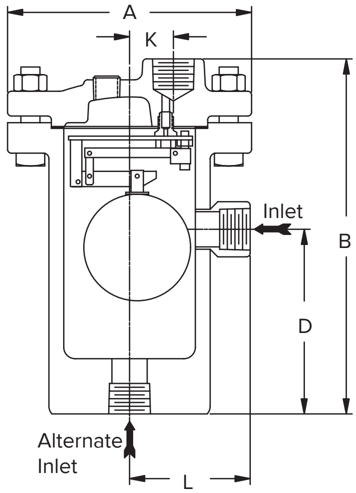
13-AV Maximum Operating Pressures

Specific Gravity*	1.00		0.95		0.90		0.85		0.80		0.75		0.70		0.65		0.60	
Float wt., oz (g)	14.9 (423)		14.2 (402)		13.4 (381)		12.7 (360)		12.0 (339)		11.2 (318)		10.5 (296)		9.7 (275)		9.0 (254)	
Orifice Size (in)	Maximum Operating Pressure																	
	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1/2	21	1.5	20	1.4	19	1.3	18	1.3	17	1.2	16	1.1	15	1.0	14	1.0	13	0.9
3/8	45	3.1	43	3.0	41	2.8	38	2.7	36	2.5	34	2.3	32	2.2	30	2.0	27	1.9
5/16	72	5.0	69	4.7	65	4.5	61	4.2	58	4.0	54	3.8	51	3.5	47	3.3	44	3.0
9/32	96	6.6	91	6.3	87	6.0	82	5.6	77	5.3	72	5.0	68	4.7	63	4.3	58	4.0
1/4	144	9.9	137	9.4	130	8.9	123	8.5	116	8.0	109	7.5	102	7.0	94	6.5	87	6.0
7/32	206	14	196	13	186	13	176	12	165	11	155	10.7	145	10.0	135	9.3	125	8.6
3/16	309	21	294	20	279	19	264	18	249	17	234	16	218	15	203	14	188	13
5/32	484	33	460	32	437	30	413	28	389	27	365	25	342	24	318	22	294	20
1/8	570	39	570	39	570	39	570	39	570	39	570	39	570	39	570	39	570	39
7/64	570	39	570	39	570	39	570	39	570	39	570	39	570	39	570	39	570	39

*If specific gravity falls between those shown, use next lowest: e.g., if actual gravity is 0.73, use 0.70 specific gravity data.

High Leverage Ball Float Type Air Relief Traps

For Low Flows at Pressures to 2 700 (186 barg) or Specific Gravity Down to 0.49



The Armstrong High Leverage Series of Air Relief traps were developed especially for venting gases from low specific gravity fluids at high pressures. They use standard Armstrong forged steel bodies with very high leverage air relief mechanisms. Available with screwed, socketweld or flanged connections.

NOTE: Models 2313-HLAR, 2316-HLAR, 2413-HLAR and 2415-HLAR are also available with cast T-316 stainless steel body and all-stainless steel internals. Consult factory.

Sour Gas Service

Forged steel and stainless steel traps can be modified to resist hydrogen sulfide stress corrosion. These modifications involve annealing the float, which will reduce the maximum working pressure of the float to about half its normal value. Consult Armstrong Application Engineering for allowable working pressures.

Physical Data—High Leverage Ball Float Type Air Relief Traps

Model No.	2313-HLAR†		2315-HLAR		2316-HLAR		2413-HLAR†		2415-HLAR		2416-HLAR		25133G-HLAR		25155G-HLAR		26155G-HLAR	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4, 1	15, 20, 25	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50	1/2, 3/4, 1	15, 20, 25	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50	1/2, 3/4, 1	15, 20, 25	3/4, 1, 1-1/4	20, 25, 32	1, 1-1/4	25, 32
“A”	8	203	9-3/4	248	11-7/8	302	8-5/8	219	10-3/4	273	12-1/2	318	8-1/2	216	10-3/8	263	11-3/4	298
“B”	11-9/16	294	15-1/16	383	17-1/8	435	11-7/8	302	15	381	17-3/4	451	14-1/4	362	16-7/32	412	24-1/8	613
“D”	6-1/16	154	7-13/16	198	9	229	5-3/8	137	7-1/4	184	9	229	3	75	4	102	5	127
“G”	5-1/8	130	6-7/8	175	8-3/8	213	5-3/8	137	6-7/8	175	8-5/8	219	5-3/4	146	7-3/8	187	8-3/8	213
“K”	1-7/16	37	1-3/4	44	2-1/8	54	1-7/16	37	1-3/4	44	2-1/8	54	1-5/16	33	1-3/4	44	1-3/4	44
“L”	3-7/8	98	4-11/16	119	5-3/4	146	4	102	4-13/16	122	5-13/16	148	–	–	–	–	–	–
Weight, lbs (kg)	46 (21)		98 (44)		160 (73)		69 (31)		130 (59)		210 (95)		113 (51)		171 (78)		325 (147)	
Maximum Allowable Pressure (Vessel Design)	1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 400°C)						1 500 psig @ 100°F (103 barg @ 38°C) 900 psig @ 850°F (62 barg @ 454°C)		1 800 psig @ 100°F (125 barg @ 38°C) 900 psig @ 900°F (62 barg @ 482°C)				2 120 psig @ 100°F (146 barg @ 38°C) 1 700 psig @ 900°F (117 barg @ 482°C)		2 520 psig @ 100°F (174 barg @ 38°C) 2 000 psig @ 900°F (138 barg @ 482°C)		3 700 psig @ 100°F (255 barg @ 38°C) 3 000 psig @ 900°F (207 barg @ 482°C)	

†Available with cast 316 stainless steel body and all stainless steel internals. Consult factory.

List of Materials

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
2313-HLAR 2315-HLAR 2316-HLAR	Stainless Steel			ASTM A105 Forged Steel	Compressed Asbestos-free
2413-HLAR 2415-HLAR 2416-HLAR				ASTM A182 Grade F22 Forged Steel	
25133G-HLAR 25155G-HLAR 26155G-HLAR					Spiral Wound Stainless Steel non-asbestos

2315-HLAR Maximum Operating Pressures

Specific Gravity	1.00 – 0.61		0.60 – 0.51	
Float Weight, oz (g)	9.0 (255)		7.1 (201)	
Orifice	Maximum Operating Pressure			
	psig	barg	psig	barg
3/16	825	56	600	41
5/32	1 000	69		
1/8				
3/32				

Maximum Operating Pressures of free floating lever vents with weighted floats for different orifice sizes, and the specific gravities on which they can be used.

2313-HLAR Maximum Operating Pressures

Specific Gravity	1.00 - 0.69		0.68 - 0.54	
Float Weight, oz (g)	6.75 (191)		4.75 (135)	
Orifice size (in)	Maximum Operating Pressure			
	psig	barg	psig	barg
1/8	1 000	69	475	33
7/64				
3/32				
5/64				
1/16				

2316-HLAR Maximum Operating Pressures

Specific Gravity	1.00 – 0.70		0.69 – 0.55	
Float Weight, oz (g)	22 (624)		15.5 (439)	
Orifice	Maximum Operating Pressure			
	psig	barg	psig	barg
7/32	1 000	69	475	33
3/16				
5/32				
1/8				
3/32				

High Leverage Ball Float Type Air Relief Traps

For Low Flows at Pressures to 2 700 (186 barg) or Specific Gravity Down to 0.49

Maximum Operating Pressures of free floating lever vents with weighted floats for different orifice sizes, and the specific gravities on which they can be used.

2413-HLAR Maximum Operating Pressures

Specific Gravity	1.00 – 0.90		0.89 – 0.69		0.68 – 0.54	
Float Weight, oz (g)	9.375 (266)		6.75 (191)		4.75 (135)	
Orifice size (in)	Maximum Operating Pressure					
	psig	barg	psig	barg	psig	barg
1/8	1 500	103	1 000	69	475	33
7/64						
3/32						
5/64						
1/16						

2415-HLAR Maximum Operating Pressures

Specific Gravity	1.00 – 0.85		0.84 – 0.61		0.60 – 0.51	
Float weight, oz (g)	13.75 (390)		9.0 (255)		7.1 (201)	
Orifice	Maximum Operating Pressure					
	psig	barg	psig	barg	psig	barg
3/16	1 200	83	825	56	600	41
5/32	1 725	119	1 150	80		
1/8	1 800	124	1 200	83		
3/32						

2416-HLAR Maximum Operating Pressures

Specific Gravity	1.00 – 0.70		0.69 – 0.55	
Float Weight, oz (g)	22 (624)		15.5 (439)	
Orifice	Maximum Operating Pressure			
	psig	barg	psig	barg
7/32	1 400	96	475	33
3/16				
5/32				
1/8				
3/32				

25133G HLAR Maximum Operating Pressures

Specific gravity	1.00 – 0.98		0.97 – 0.90		0.89 – 0.69		0.68 – 0.54	
Float weight, oz (g)	10.5 (298)		9.375 (266)		6.75 (191)		4.75 (135)	
Orifice	Maximum Operating Pressure							
	psig	barg	psig	barg	psig	barg	psig	barg
7/64	2 125	146	1 500	103	1 000	69	475	33
3/32								
5/64								
1/16								

25155G HLAR Maximum Operating Pressures

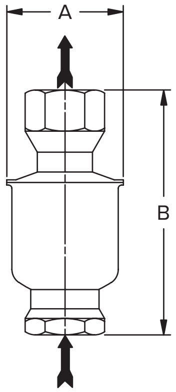
Specific gravity	1.00 – 0.95		0.94 – 0.86		0.85 – 0.63		0.62 – 0.52	
Float weight, oz (g)	15.4 (437)		13.75 (390)		9.25 (262)		7.1 (201)	
Orifice	Maximum Operating Pressure							
	psig	barg	psig	barg	psig	barg	psig	barg
3/16	1 350	93	1 200	83	825	58	600	41
5/32	1 925	132	1 725	119	1 200	82		
1/8	2 500	172	2 000	138	1 200	83		
3/32								

26155G HLAR Maximum Operating Pressures

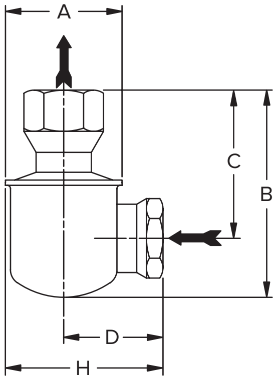
Specific gravity	1.00 – 0.95		0.94 – 0.86		0.85 – 0.63		0.62 – 0.52	
Float weight, oz (g)	15.4 (437)		13.75 (390)		9.25 (262)		7.1 (201)	
Orifice	Maximum Operating Pressure							
	psig	barg	psig	barg	psig	barg	psig	barg
3/16	1 350	93	1 200	83	825	58	600	41
5/32	1 925	132	1 725	119	1 200	82		
1/8	2 700	186	2 000	138	1 200	83		
3/32								

Armstrong Stainless Steel Thermostatic Air Vents

For Pressures to 300 psig (20 barg)...Capacities to 104 scfm



TTF-1
Straight-Thru



TTF-1R
Right Angle

Armstrong offers Thermostatic Air Vents for positive venting of air and other non-condensable gases from steam in chamber type heat transfer equipment. Typical applications include jacketed kettles, retorts, vulcanizers, jacketed sterilizers or other contained equipment where air could accumulate in remote areas of the steam chamber and reduce heat transfer capacity. These vents are balanced pressure air vents that respond to the pressure-temperature curve of steam. Air is automatically vented at slightly below steam temperature throughout the entire operating pressure range.

Features

- Suitable for pressures from 0 - 300 psig
- All 304-L stainless steel bodies—sealed, tamper-proof
- Balanced pressure thermostatic element vents air at slightly below steam temperature over the entire pressure range—no adjustments required
- Dependable, proven phosphor-bronze bellows caged in stainless steel with bronze valve and stainless steel seat
- Available in straight-thru or right-angle connections

Armstrong thermostatic air vents should be installed at the highest point on a steam chamber, with the air vent located above the chamber. This will minimize the possibility of any liquid carryover, and air can be vented at atmosphere without a drain line.

For a fully detailed certified drawing, refer to CD #1018.

List of Materials

Name of Part	Material
Body	304-L Stainless steel
Connections	304 Stainless steel
Balanced Pressure Thermostatic Air Vent	Stainless steel and bronze with phosphor-bronze bellows, entire unit caged in stainless steel
Gasket	Copper clad non-asbestos

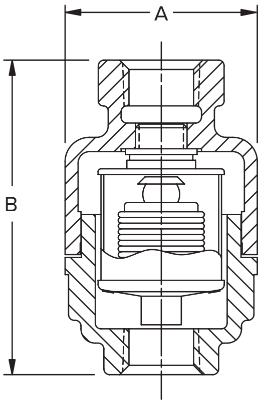
Optional: All stainless steel thermostatic air vent.

Physical Data

Model No.	Straight-Thru Connections TTF-1				Right-Angle Connections TTF-1R			
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1/2	15	3/4	20
"A" Diameter	2-1/4	57	2-1/4	57	2-1/4	57	2-1/4	57
"B" Height	4-1/2	114	4-11/16	119	3-3/4	95	3-15/16	100
"C" ℄ inlet to face of outlet	–		–		2-5/8	67	2-13/16	71
"D" ℄ outlet to face of inlet	–		–		1-15/16	49	1-7/8	48
"H"	–		–		3-1/16	78	3	76
Weight, lb (kg)	3/4 (0.4)		1 (0.5)		3/4 (0.4)		1 (0.5)	
Maximum Allowable Pressure (Vessel Design)	300 psig @ 450°F (20 barg @ 232°C)							
Maximum Operating Pressure, psig (barg)	300 (20)							
Discharge Orifice Size	3/16"							

TV-2 Thermostatic Air Vent

For Pressures to 125 psig (9 barg)...Capacities to 46 scfm



TV-2
Thermostatic Air Vent

Armstrong offers the Model TV-2 Balanced Pressure Thermostatic Air Vent for positive venting of air from chamber type heat transfer equipment with no loss of steam. Typical applications include jacketed kettles, retorts, vulcanizers, jacketed sterilizers or other contained equipment where air could accumulate at the top of the steam chamber and reduce heat transfer capacity.

The Model TV-2 is a balanced-pressure thermostatic air vent that responds to the pressure-temperature curve of steam at any pressure from light vacuum to maximum operating pressure. Air is automatically vented at slightly below steam temperature throughout the entire operating pressure range.

The thermostatic element is a charged multi-convolution phosphor bronze bellows caged in stainless steel. Valve and seat are also stainless steel designed to meet the most rigid cycling specifications known for this type of service.

Features

- Stainless steel hemispherical valve and seat
- Thermostatic element comprises a multi-convolution phosphor bronze bellows caged in stainless steel
- Thermostatic element is charged with water to provide positive opening of the valve at slightly below steam temperature and positive closing in the presence of steam throughout the operating pressure range
- ASTM B62 cast bronze body

Armstrong Model TV-2 Thermostatic Air Vents should be installed at the highest points of steam chambers with inlet connections to the vents higher than the highest points of the chambers. Thus installed there is a minimum hazard of any liquid carryover and air can be vented to atmosphere with no drain line necessary.

For a fully detailed certified drawing, refer to CD #1032.

TV-2 Physical Data

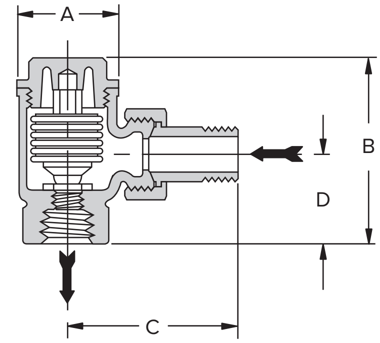
Pipe Connections	in	mm
	1/2	15
"A" (Diameter)	2-3/16	56
"B" (Height)	3-1/2	89
Weight, lb (kg)	1-1/2 (0.8)	
Maximum Operating Pressure	125 psig (9 barg)	
Temperature Maximum, °F (°C)	350°F (177°C)	

TV-2 Materials

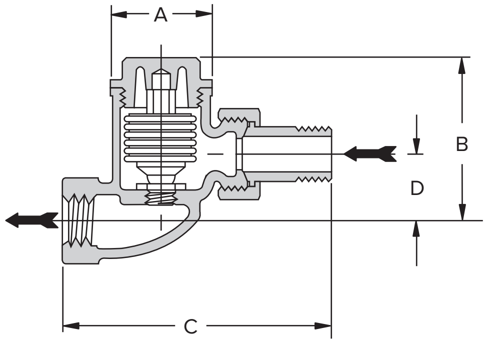
Name of Part	Material
Body & Cap	Cast bronze ASTM B62
Gasket	Compressed non-asbestos
Thermostatic Unit	
Bellows	Phosphor bronze
Cage and Cover	Stainless steel
Thermostatic Unit Gasket	Copper clad

TS-2 Thermostatic Air Vent

For Pressures to 50 psig (3.4 barg)...Capacities to 25.9 scfm



TS-2 Air Vent Angle Type



TS-2 Air Vent Straight Type

Armstrong TS thermostatic air vent is offered in both angle and straight patterns. The TS-2 has a balanced pressure thermostatic element with a high quality multiple-convolution bellows. It's ideal for venting air from equipment such as steam radiators and convectors, small heat exchangers, and unit heaters. The TS-2 comes with a strong, cast bronze body and a stainless steel seat. The valve and seat are renewable in-line.

Materials

Cap:	Bronze, ASTM B62
Body:	Bronze, ASTM B62
Union Nipple:	Brass, ASTM B584
Valve:	Brass
Valve Seat:	Stainless steel
Element:	Phosphor-bronze bellows

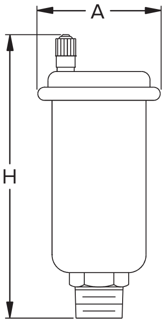
For a fully detailed certified drawing, refer to CDY #1045.

Physical Data

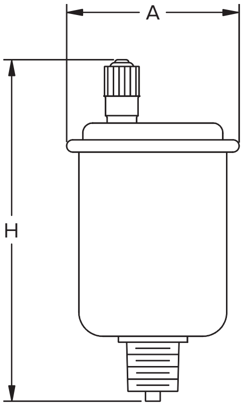
Model	TS-2							
Pattern	Angle				Straight			
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1/2	15	3/4	20
"A" Diameter	1-5/8	41	1-5/8	41	1-5/8	41	1-5/8	41
"B" Height	2-15/16	75	3	76	2-11/16	68	2-7/8	73
"C"	2-9/16	65	2-7/8	73	4	102	4-1/2	114
"D"	1-3/8	35	1-5/8	41	1-1/8	28	1-5/16	33
Weight, lb (kg)	1-1/2 (0.68)		1-3/4 (0.79)		1-1/2 (0.68)		2 (0.91)	

AV-11/AV-13 Air Vents

For Pressures to 150 psig (10 barg)



AV-11



AV-13

For Hot or Cold Water and Non-Viscous Liquids

Air vent models AV-11 and AV-13 are compact float-type valves for the removal of air and other gases from hydronic heating and cooling systems, liquid chilling operations and other light liquid services.

Physical Data

Model	AV-11		AV-13			
Connection Size	in	mm	in	mm	in	mm
	1/8	3	1/2 Female	15 Female	3/4 Male	20 Male
"A"	1-3/4	44	2-1/8	54	2-1/8	54
"H"	3-3/8	86	4-5/8	118	4-5/8	118
Weight, lb (kg)	1/4 (0.11)		1/2 (0.23)			

Capacities

AV-11				AV-13			
ΔP		Capacities		ΔP		Capacities	
psig	barg	cfm	m³/hr	psig	barg	cfm	m³/hr
3.5	0.24	0.5	0.84	16	1.1	1	1.7
10	0.69	1.0	1.7	48	3.3	2	3.4
24	1.7	1.5	2.5	84	5.8	3	5.1
35	2.4	1.9	3.2	120	8.3	4	6.8
50	3.4	2.0	3.4	150	10	4.9	8.3

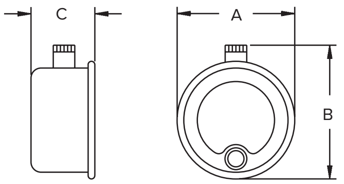
Specifications

Model	Application	Working Pressure		Maximum Temperature		Connection	Hydraulic Test Body	
		psig	barg	°F	°C		psig	barg
AV-11	Hot or Cold Water	1 - 50	0.06 - 3.4	210	99	NPT Screwed	200	14
AV-13		1 - 150	0.06 - 10.3				350	24

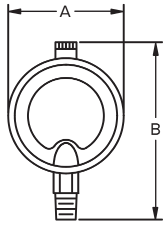
Materials

Valve	Float	Disc
Brass	Polypropylene	Nitrile

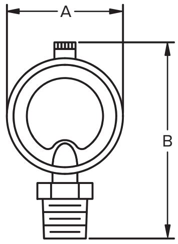
Armstrong® SV-12 Steam Radiator Air Vent



SV-12 Angle Air Vent



SV-12 Straight Air Vent



SV-12 Straight Main Air Vent

For Steam Service

A vent port size for every room location with the largest size for the coldest rooms and the smallest size for the "too hot" rooms. SV-12 air vents are easy to install on any steam radiator.

For a fully detailed certified drawing, refer to CDY #1042.

Materials

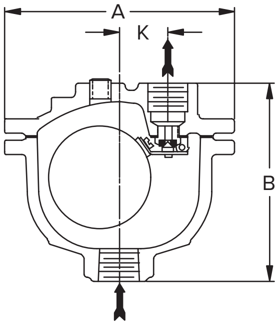
Name of Part	Material
Body	Nickel plated brass
Float	Polypropylene
Valve Seat	Brass
Bimetal Thermostatic Element	Stainless steel

Physical Data

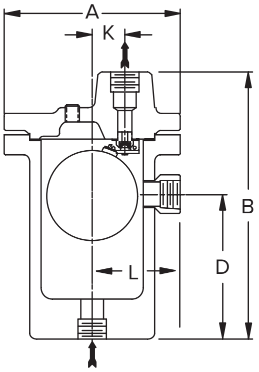
Pattern	Angle Connection		Straight Connection		Straight Main Connection	
Pipe Connection Size	in	mm	in	mm	in	mm
	1/8	3	1/8, 1/4	3, 6	1/2, 3/4	15, 20
"A"	2-3/16	56	2-3/16	56	2-3/16	56
"B"	2-5/16	59	3-1/4	83	3-1/2	89
"C"	1-3/16	30	1-3/16	30	1-3/16	30
Max. Operating Pressure, psig (barg)	15 (1)					
Vent Port Designation and Port Size	4 = .040" 6 = .0935" 5 = .070" C = .1285" D = .1850" Each air vent is provided with all five of the above vent ports				1 = .1850" Only one vent port will be provided	

Fixed Pivot Ball Float Air/Gas Vents

For Pressures to 600 psig (41 barg) or Specific Gravity Down to 0.83



Model 21-AR



Model 21-312 AR/VAR

Physical Data

Model No.	Cast Iron		Forged Steel	
	21-AR		21-312 AR/VAR	
Pipe Connections	in	mm	in	mm
	1/2, 3/4	15, 20	1/2, 3/4	15, 20
"A"	6-3/16	157	6-3/4	171
"B"	5-1/4	133	10-1/4	260
"D"	-	-	5-9/16	141
"K"	1-5/16	33	1-1/4	32
"L"	-	-	3-5/16	84
Approximate Weight, lb (kg)	8 (4)		30 (14)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F** (17 barg @ 232°C**)		600 psig @ 100°F (41 barg @ 38°C) 500 psig @ 750°F** (34 barg @ 399° C**)	

**Viton valve seat insert limited to 400°F (204°C).

21-AR—A small, high-quality economical air vent. It employs a single lever with a fixed pivot and viton seat, ensuring a tight shut-off.

For a fully detailed certified drawing, refer to CD #1037.

21-312 AR/VAR —Forged steel version of the Model 21 with a larger float and higher leverage. Available with screwed, socketweld or flanged connections.

For a fully detailed certified drawing, refer to CD #1106.

21-AR Maximum Operating Pressures

Minimum Specific Gravity	0.49		0.84	
Float Weight, oz (g)	2.25 (64)		4.12 (118)	
Orifice (in)	Maximum Operating Pressure			
	psig	barg	psig	barg
7/32	17	1.2	-	-
3/16	23	1.6	-	-
5/32	33	2.3	-	-
9/64	41	2.8	-	-
1/8	52	3.6	-	-
3/32	92	6.4	-	-
5/64	133	9.2	-	-
1/16	208	14	-	-
1/16	-	-	250	17

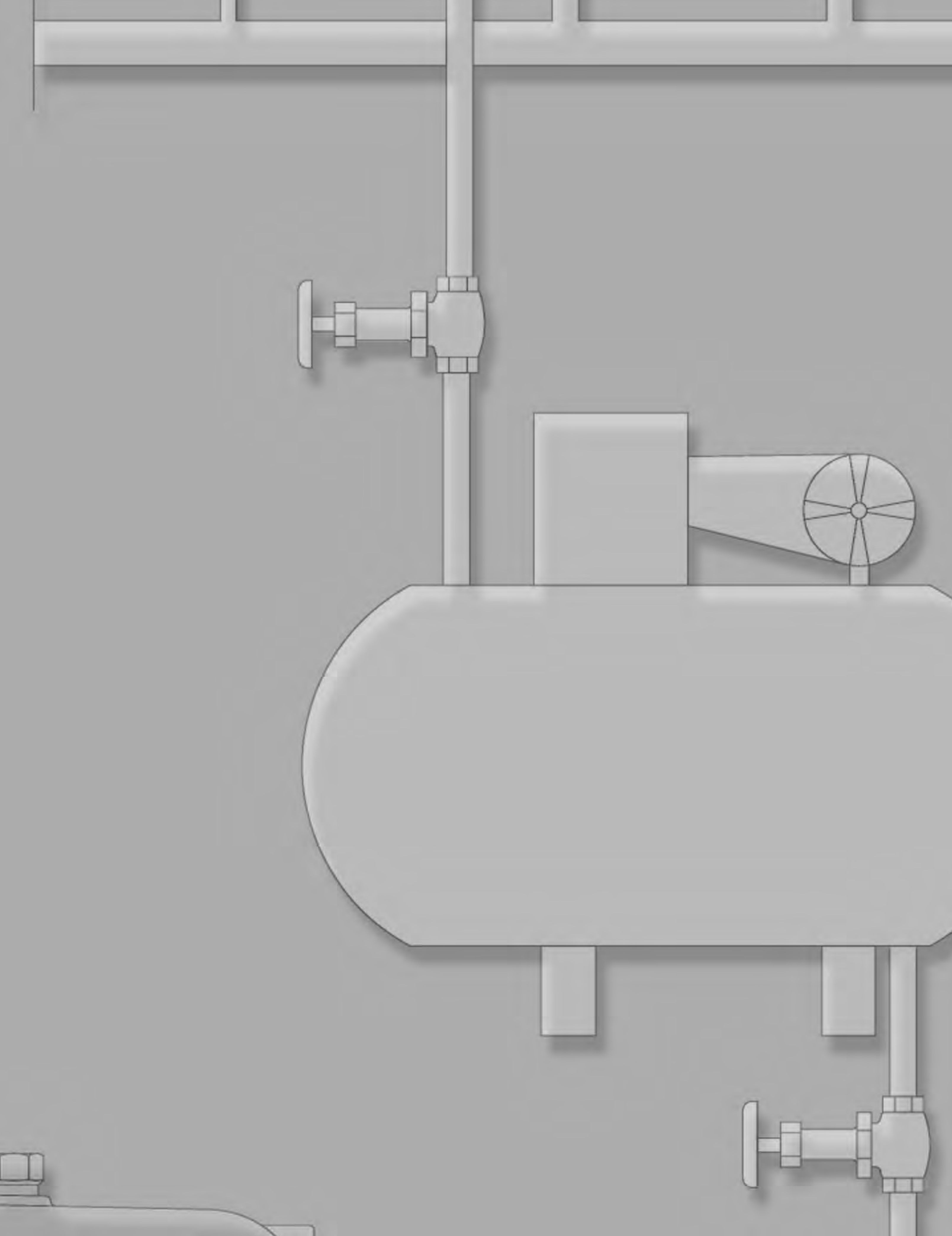
21-312 AR/VAR Maximum Operating Pressures

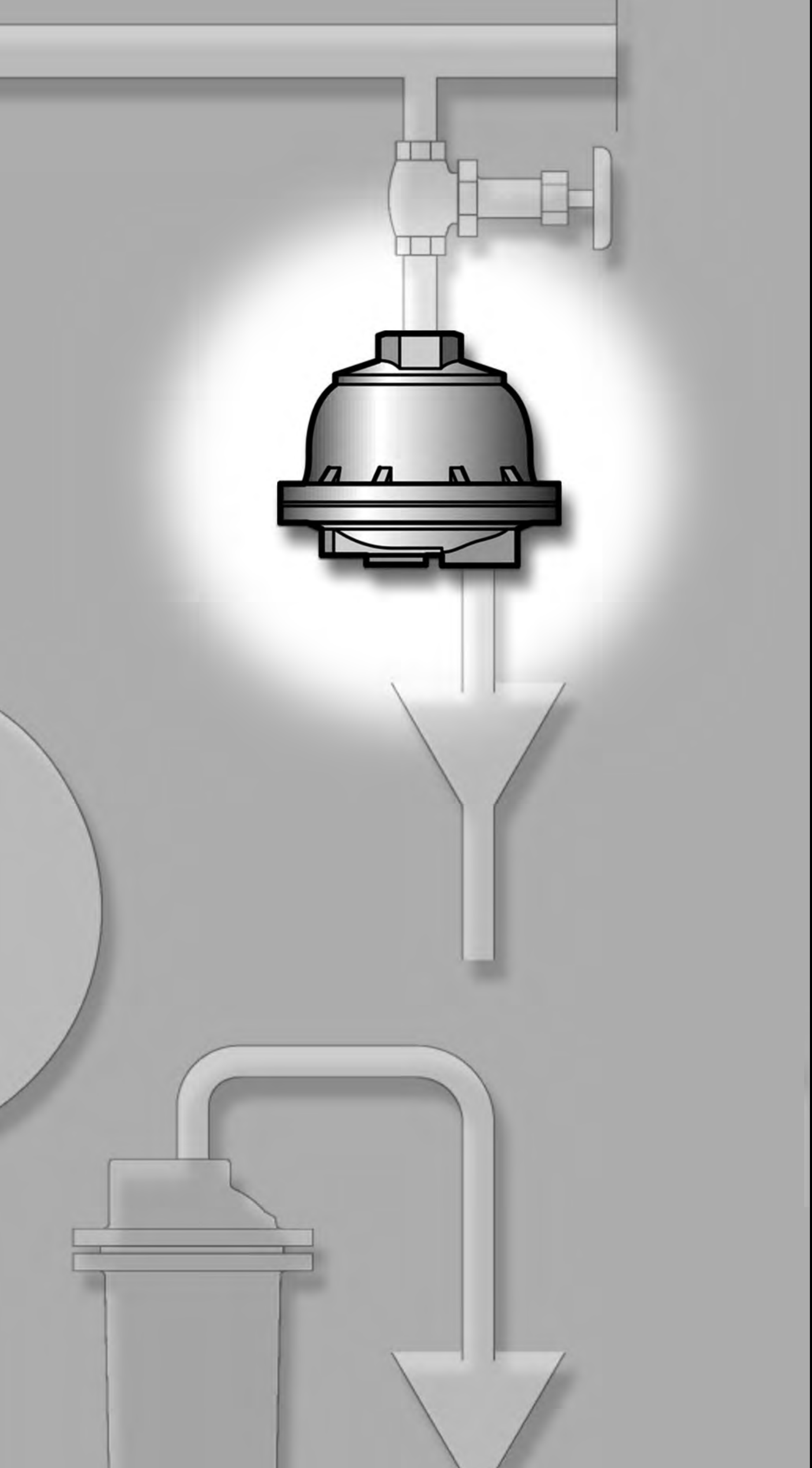
Model	**Minimum Specific Gravity**	0.83	
	Float Weight, oz (g)	5 (143)	
	Orifice (in)	Maximum Operating Pressure	
		psig	barg
21-312AR	1/4	22	1.5
	7/32	28	1.9
	3/16	38	2.7
	5/32	55	3.8
	9/64	68	4.7
21-312VAR	1/8	173	12
	3/32	308	21
	5/64	443	31
	1/16	600	41

List of Materials

Model No.	Valve	Seat	Leverage System	Float	Body & Cap	Gasket	Bolting
21-AR	Stainless Steel	Stainless Steel with *Viton Insert	Stainless Steel	Stainless Steel	ASTM A48 Class 30 Cast Iron	Non-Asbestos	Bolts SAE Gr. 2 Nuts ASTM A563 Gr. A
21-312 AR 21-312 VAR					ASTM A105 Forged Steel		Bolts and Nuts ASTM B633 Type 1

NOTE: Above vents available in T-316 SS bodies and caps and all SS internals. Aluminum body and cap available for Model 21-AR only.
*Other seat insert materials available. Consult factory.





Liquid Drainers

Armstrong

Armstrong®

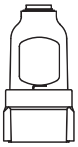
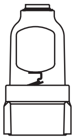
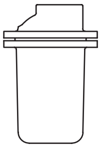
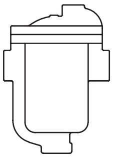
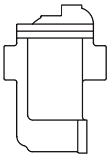
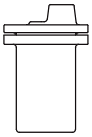
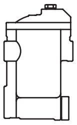
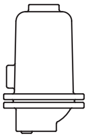
32-LD Forged Steel Free Floating Lever Drain Trap

1-LD Cast Iron Free Floating Lever Drain Trap

11-LD Stainless Steel Free Floating Lever Drain Trap

Liquid Drainers ID Charts

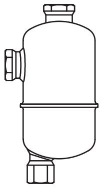
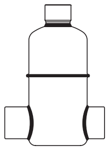
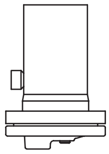
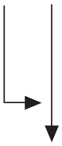
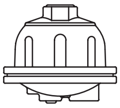
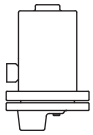
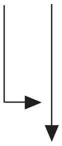
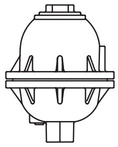
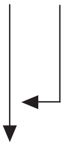
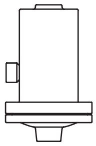
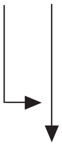
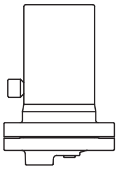
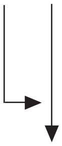
Armstrong Liquid Drainers

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size 1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	Located on Page
	**Series 1-LDC** See-Thru Free Floating Lever Drain Traps Capacities to **1 500** lb/hr	↓ →	Screwed	150	150	Nylon Cap Polycarbonate Body	**1-LDC**	150	●	★★ ●					502
	**Series 1-LDCW** See-Thru Free Floating Lever Drain Traps for Ozone Applications	↓ →	Screwed	150	150	PBT Cap (Polybutylene Terephthalate) Polycarbonate Body	**1-LDCW**		▲	★★ ●					505
	**Series 200 BVSW** Inverted Bucket Drain Traps Capacities to **7 000** lb/hr	↑	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**211**	250	●						506
							212		●	●					
							213		●	●	●				
	**Series 800 BVSW** Inverted Bucket Drain Traps Capacities to **7 000** lb/hr	→	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**800**	150	●	●					506
							811	250	●	●	●				
							812	250	●	●					
							813	250		●	●				
	**Series 880 BVSW** Inverted Bucket Drain Traps Capacities to **7 000** lb/hr	→	Screwed	250	450	ASTM A48 Class 30 Cast Iron	**880**	150	●	●					506
							881	250	●	●	●				
							882	250	●	●					
							883	250		●	●				
	**Series 300 BVSW** Inverted Bucket Drain Traps Capacities to **7 000** lb/hr	↑	Screwed Socketweld Flanged†	600	650	ASTM A105 Forged Steel	**312**	600	●	●	●				
				1 080	650		**313**		●	●	●				
	**Series 900 BVSW** Inverted Bucket Drain Traps Capacities to **7 000** lb/hr	→	Screwed Socketweld Flanged†	600	650	ASTM A216 WCB Cast Steel	**981**	300	●	●					
							983	600		●	●				
	**Series 1, 2, 3, 6** Free Floating Lever Drain Traps Capacities to **49 000** lb/hr	↓→ ↓	Screwed	300	200	ASTM A48 Class 30 Cast Iron	**1-LD**	300	★ ●						509
				250	450		**2-LD**	250	●	●					
							3-LD			●	●				
							6-LD						●	●	

★ 1/4" outlet connection
★★ 1/2" outlet connection
† Flange selection may limit pressure and temperature rating.
†† Side connection not available.

Liquid Drainers ID Charts

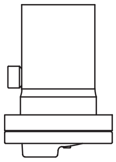
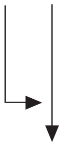
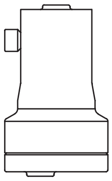
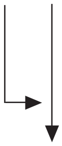
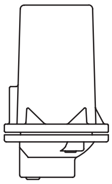
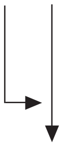
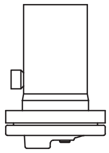
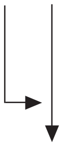
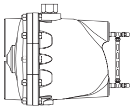
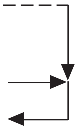
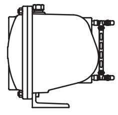
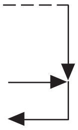
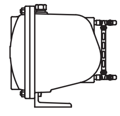
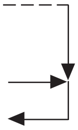
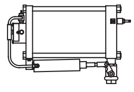
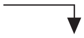
Armstrong Liquid Drainers

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size						Located on Page
									1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	
	**Series 11, 22, 13** Free Floating Lever Drain Traps Capacities to **9 500** lb/hr		Screwed Socketweld	500 or 440	100 or 500	304-L Stainless Steel	**11-LD**[††]	400	●	★★ ●					510
			Screwed Socketweld (22 and 13 Series Only)	600 or 475	100 or 500		**22-LD**	533		●					
				570 or 490	100 or 500		**13-LD**	570			●				
	**180-LD/181-LD** Free Floating Lever Drain Traps Capacities to **1 100** lb/hr		Screwed Socketweld	500 or 440	100 or 500	304L Stainless Steel	**180-LD**	229	●						512
							181-LD	350		●					
	**Series 30** Free Floating Lever Drain Traps Capacities to **42 000** lb/hr		Screwed Socketweld Flanged[†]	600 or 500	100 or 750	ASTM A105 Forged Steel	**32-LD**	600	●	●	●				511
				1 000 or 600	100 or 750		**33-LD**	900	●	●	●				
				1 000 or 600	100 or 750		**36-LD**	1 000					●	●	
	**Series 21** Fixed Pivot Drain Trap Capacities to **2 700** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**21**	250	●	●					514
	**Series 21-312** Fixed Pivot Drain Traps Capacities to **3 900** lb/hr		Screwed Socketweld Flanged[†]	600 or 500	100 or 750	ASTM A105 Forged Steel	**21-312**	74	●	●	●				
							21-312V	600	●	●	●				
	**Series 71-A** Snap Action Drain Trap Capacities to **1 950** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**71-A**	250		●	●				
	**Series 71-315** Snap Action Drain Trap Capacities to **1 950** lb/hr		Screwed Socketweld Flanged[†]	1 000 or 600	100 or 750	ASTM A105 Forged Steel	**71-315**	1 000		●	●	●			
	**Series 2300** High Leverage Spring-Loaded Float Type Drain Trap Capacities to **14 500** lb/hr		Screwed Socketweld Flanged[†]	1 000 or 600	100 or 750	ASTM A105 Forged Steel	**2313-HLS**	1 000	●	●	●				516
							2315-HLS				●	●	●		
							2316-HLS						●	●	

[†] Flange selection may limit pressure and temperature rating.

Liquid Drainers ID Charts

Armstrong Liquid Drainers

Illustration	Type	Flow Direction	Connection Type	Max. Allow. Press. psig	TMA °F	Body Material	Model	Max. Oper. Press. psig	Connection Size 1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	Located on Page
	**Series 2400** High Leverage Spring-Loaded Float Type Drain Traps Capacities to **16 250** lb/hr		Screwed Socketweld Flanged†	1 500 or 900	100 or 850	ASTM A182 Gr. F22 Forged Steel	**2413-HLS**	1 500	●	●	●						516
				1 800 or 900	100 or 900		**2415-HLS**	1 800			●	●	●				516
							2416-HLS	1 800					●	●			
	**Series 2500/2600** High Leverage Spring-Loaded Float Type Drain Traps Capacities to **11 000** lb/hr		Screwed Socketweld Flanged†	2 120 or 1 700	100 or 900	ASTM A182 Gr. F22 Forged Steel	**25133G HLS**	2 120		●	●	●					516
				2 520 or 2 000	100 or 900		**25155G HLS**	2 520			●	●	●				
				3 700 or 3 000	100 or 900		**26155G HLS**	3 700				●	●				
	**Series 2, 3, 6** Free Floating Lever Dual Gravity Drain Traps Capacities to **40 000** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**2-DG**	190	●	●							518
							3-DG	250		●	●						
							6-DG	250					●	●			
	**Series 30** Free Floating Lever Dual Gravity Drain Traps Capacities to **40 000** lb/hr		Screwed Socketweld Flanged†	600 or 500	100 or 750	ASTM A105 Forged Steel	**32-DG**	325	●	●	●						
				1 000 or 600	100 or 750		**33-DG**	700		●	●						
				1 000 or 600	100 or 750		**36-DG**	1 000					●	●			
	**Series JD&KD** Ultra-Capacity Drain Traps Capacities to **302 000** lb/hr		Screwed	300	650	ASTM A395 Ductile Iron	**JD8**	300*						●			520
							KD8							●			
							KD10								●		
							KD12									●	
	**Series L&M** Ultra-Capacity Drain Traps Capacities to **700 000** lb/hr		Screwed	250	450	ASTM A48 Class 30 Cast Iron	**L8**	250*						●			
							L10								●		
							M12									●	
	**Series LS&MS** Ultra-Capacity Drain Traps Capacities to **700 000** lb/hr		Screwed Socketweld Flanged†	450	650	ASTM A216 WCB Cast Steel	**LS8**	450*						●			
							LS10								●		
							MS12									●	
	**ADP-1** Pneumatically Operated Liquid Drainer Capacities to 1.5 lb liquid per cycle		Screwed	180	150	Aluminum ASTM B221 6061-T6511	**ADP-1**	180		●							524

*For different specific gravities, see table LD-33 on page LD-49.

†Flange selection may limit pressure and temperature rating.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Bringing Energy Down to Earth

Say energy. Think environment. And vice versa.

Any company that is energy conscious is also environmentally conscious. Less energy consumed means less waste, fewer emissions and a healthier environment.

In short, bringing energy and environment together lowers the cost industry must pay for both. By helping companies manage energy, Armstrong products and services are also helping to protect the environment.

Armstrong has been sharing know-how since we invented the energy-efficient inverted bucket steam trap in 1911. In the years since, customers' savings have proven again and again that knowledge not shared is energy wasted.

Armstrong's developments and improvements in drain trap design and function have led to countless savings in energy, time and money. This section has grown out of our decades of sharing and expanding what we've learned. It deals with the operating principles of drain traps and outlines their specific applications to a wide variety of products and industries.

This section also includes Recommendation Charts that summarize our findings on which type of drain trap will give optimum performance in a given situation and why.

Terminology

Drain traps, as described in this section, have many other names in industry. A drain trap is an automatic loss prevention valve that opens to discharge liquids and closes to prevent air or gas loss. In industry, drain traps are also known as:

- Compressed air drains
- Condensate drainers
- Air traps
- Water traps
- Dump valves
- Float traps
- Liquid drainers
- Compressed air traps

This section should be utilized as a guide for the installation and operation of drain trapping equipment by experienced personnel. Selection or installation should always be accompanied by competent technical assistance or advice. We encourage you to contact Armstrong or its local representative for complete details.

Instructions for Using the Recommendation Charts

Quick reference Recommendation Charts appear throughout the “HOW TO DRAIN” pages of this section, pages LD-17 to LD-28.

A feature code system (ranging from A to N) supplies you with “at-a-glance” information.

The chart covers the type of drain traps and the major advantages that Armstrong feels are superior for each particular application.

For example, assume you are looking for information concerning the proper trap to use on an aftercooler. You would:

1. Turn to the **“How to Drain Aftercoolers”** section, pages LD-21 and LD-22, and look in the lower left-hand corner of page LD-21. (Each application has a Recommendation Chart.) The Recommendation Chart LD-7 from page LD-21 is reprinted below as Chart LD-1 for your convenience.
2. Find **“Aftercooler”** in the first column under **“Equipment Being Drained”** and read to the right for Armstrong’s **“1st Choice and Feature Code”.** In this case, the first choice is an IB and the feature code letters F, G, J, K, M are listed.
3. Now refer to the chart below, titled **“How Various Types of Drain Traps Meet Specific Operating Requirements”** and read down the extreme left-hand column to each of the letters F, G, J, K, M. The letter “F,” for example, refers to the trap’s ability to handle oil/water mix.
4. Follow the line for “F” to the right until you reach the column that corresponds to our first choice, in this case the inverted bucket. Based on tests, actual operating conditions, and the fact that the discharge is at the top, the inverted bucket trap handles oil/water mixtures extremely well. Follow this same procedure for the remaining letters.

Chart LD-1. Recommendation Chart
(See below for “Feature Code” references.)

Equipment Being Drained	Air		Gas	
	1st Choice and Feature Code	Alternate Choice	1st Choice and Feature Code	Alternate Choice
Aftercooler	IB F, G, J, K, M	FF	*FF B, E, J	FP
Intercooler				

*Since IBs vent gas to operate, an FF is suggested because gas venting may not be desirable.

Chart LD-2. How Various Types of Drain Traps Meet Specific Operating Requirements

Feature Code	Characteristic	IB	FF	FP	FS	D	TV	MV
A	Method of Operation (Intermittent-Continuous)	I	C	C	I	I	I	C
B	Energy Conservation in Operation	Good	Excellent	Excellent	Excellent	Fair	Poor	Excellent
C	Energy Conservation Over Time	Good	Excellent	Excellent	Excellent	Poor	Fair	Poor (5)
D	Resistance to Wear Fair	Excellent	Excellent	Fair	Good	Poor	Good	Excellent
E	Corrosion Resistance	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
F	Ability to Handle Oil/Water Mix	Excellent	Fair	Fair	Fair	Good	Excellent	Excellent
G	Ability to Prevent Sludge Buildup	Excellent	Poor	Poor	Fair	Good	Good	Excellent
H	Resistance to Damage from Freezing (1)	Good (2)	Poor	Poor	Poor	Good	Fair	Good
I	Performance to Very Light Loads	Good	Excellent	Excellent	Excellent	Poor	Poor	Poor
J	Responsiveness to Slugs of Liquid (3)	Good	Excellent	Excellent	Excellent	Poor	Poor	Poor
K	Ability to Handle Dirt	Excellent	Fair	Fair	Excellent	Poor	Excellent	Good
L	Comparative Physical Size	Large	Large	Large	Large	Small	Small	Small
M	Mechanical Failure (Open-Closed)	Open	Closed	Closed	Closed	Open	(4)	(4)
N	Noise Level of Discharge (Loud-Quiet)	Quiet	Quiet	Quiet	Quiet	Loud	Loud	(4)

IB = Inverted Bucket
FF = Float-Free Linkage
FP = Float-Fixed Pivot Linkage
FS = Float-Snap Acting Linkage
D = Disc
TV = Timed Solenoid Valve
MV = Manual Valve

(1) Cast iron not recommended.
(2) Sealed stainless steel = good.
(3) Float traps should be back vented = excellent.
(4) Can be either.
(5) Usually end up “cracked open.”

Compressed Air/Gases—Basic Concepts

Moisture is always present in compressed air, and oil can be present at some points in a compressed air system. For the efficient operation and long life of gaskets, hoses and air tools, this excess moisture and the oil must be removed from the system.

The removal of moisture and oil from a system involves more than just traps. To maintain high efficiency and avoid costly problems, a compressed air system also requires:

1. Aftercoolers to bring the compressed air down to ambient or room temperature.
2. Separators to knock down suspended droplets of water or fog. Separators are installed downstream from aftercoolers or in air lines near point of use, or both.
3. Drain traps to discharge the liquid from the system with a minimum loss of air.

Table LD-1. Weight of Water Per Cubic Foot of Air at Various Temperatures

Temp. °F	Percentage of Saturation									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	Grains	Grains	Grains	Grains	Grains	Grains	Grains	Grains	Grains	Grains
-10	.028	.057	.086	.114	.142	.171	.200	.228	.256	.285
0	**.048**	**.096**	**.144**	**.192**	**.240**	**.289**	**.337**	**.385**	**.433**	**.481**
10	.078	.155	.233	.310	.388	.466	.543	.621	.698	.776
20	.124	.247	.370	.494	.618	.741	.864	.988	1.112	1.235
30	**.194**	**.387**	**.580**	**.774**	**.968**	**1.161**	**1.354**	**1.548**	**1.742**	**1.935**
32	.211	.422	.634	.845	1.056	1.268	1.479	1.690	1.902	2.113
35	.237	.473	.710	.946	1.183	1.420	1.656	1.893	2.129	2.366
40	**.285**	**.570**	**.855**	**1.140**	**1.424**	**1.709**	**1.994**	**2.279**	**2.564**	**2.849**
45	.341	.683	1.024	1.366	1.707	2.048	2.390	2.731	3.073	3.414
50	.408	.815	1.223	1.630	2.038	2.446	2.853	3.261	3.668	4.076
55	**.485**	**.970**	**1.455**	**1.940**	**2.424**	**2.909**	**3.394**	**3.879**	**4.364**	**4.849**
60	.574	1.149	1.724	2.298	2.872	3.447	4.022	4.596	5.170	5.745
62	.614	1.228	1.843	2.457	3.071	3.685	4.299	4.914	5.528	6.142
64	**.656**	**1.313**	**1.969**	**2.625**	**3.282**	**3.938**	**4.594**	**5.250**	**5.907**	**6.563**
66	.701	1.402	2.103	2.804	3.504	4.205	4.906	5.607	6.308	7.009
68	.748	1.496	2.244	2.992	3.740	4.488	5.236	5.984	6.732	7.480
70	**.798**	**1.596**	**2.394**	**3.192**	**3.990**	**4.788**	**5.586**	**6.384**	**7.182**	**7.980**
72	.851	1.702	2.552	3.403	4.254	5.105	5.956	6.806	7.657	8.508
74	.907	1.813	2.720	3.626	4.533	5.440	6.346	7.253	8.159	9.066
76	**.966**	**1.931**	**2.896**	**3.862**	**4.828**	**5.793**	**6.758**	**7.724**	**8.690**	**9.655**
78	1.028	2.055	3.083	4.111	5.138	6.166	7.194	8.222	9.249	10.277
80	1.093	2.187	3.280	4.374	5.467	6.560	7.654	8.747	9.841	10.934
82	**1.163**	**2.325**	**3.488**	**4.650**	**5.813**	**6.976**	**8.138**	**9.301**	**10.463**	**11.625**
84	1.236	2.471	3.707	4.942	6.178	7.414	8.649	9.885	11.120	12.326
86	1.313	2.625	3.938	5.251	6.564	7.877	9.189	10.502	11.814	13.137
88	**1.394**	**2.787**	**4.181**	**5.575**	**6.968**	**8.362**	**9.756**	**11.150**	**12.543**	**13.997**
90	1.479	2.958	4.437	5.916	7.395	8.874	10.353	11.832	13.311	14.780
92	1.569	3.138	4.707	6.276	7.844	9.413	10.982	12.551	14.120	15.639
94	**1.663**	**3.327**	**4.990**	**6.654**	**8.317**	**9.980**	**11.644**	**13.307**	**14.971**	**16.624**
96	1.763	3.525	5.288	7.050	8.813	10.576	12.338	14.101	15.863	17.676
98	1.867	3.734	5.601	7.468	9.336	11.203	13.070	14.937	16.804	18.661
100	**1.977**	**3.953**	**5.930**	**7.906**	**9.883**	**11.860**	**13.836**	**15.813**	**17.789**	**19.766**

Based on atmospheric pressure of 14.7 psia.

Compressed Air/Gases—Basic Concepts

Water carried with air into tools or machines where air is being used will wash away lubricating oil. This causes excess wear to motors and bearings and results in high maintenance expense. Without adequate lubrication, the tools and machines run sluggishly and their efficiency is lowered. This effect is particularly pronounced in the case of pneumatic hammers, drills, hoists and sand rammers, where the wearing surfaces are limited in size and the excessive wear creates air leakage.

Where air is used for paint spraying, enameling, food agitation and similar processes, the presence of water and/or oil cannot be tolerated, nor can particles of grit or scale.

In instrument air systems, water will tend to cling to small orifices and collect dirt, causing erratic operation or failure of sensitive devices.

Pipeline Troubles

When water accumulates at low points in the pipeline, the air-carrying capacity of the line is reduced. Eventually, airflow over the pool of water will begin to carry the water along at high velocity. This produces "water hammer" along the line, and may even carry over a slug of water into a tool. In cold weather, accumulations of water may freeze and burst pipelines.

Air's Capacity to Hold Moisture

At atmospheric pressure (14.7 psia), 8 cu ft of air with an RH of 50% and a temperature of 70°F will contain 32 grains of moisture vapor.

When the pressure is doubled (without increasing the temperature) the volume is cut in half (4 cu ft), but there are still 32 grains of moisture. This means the relative humidity is now 100%—all the moisture in vapor form that it can handle.

Increasing the pressure to 100 psig (114.7 psia), the volume of air is further reduced to approximately 1 cu ft. This 1 cu ft of compressed air still at 70°F can hold a maximum eight grains of moisture.

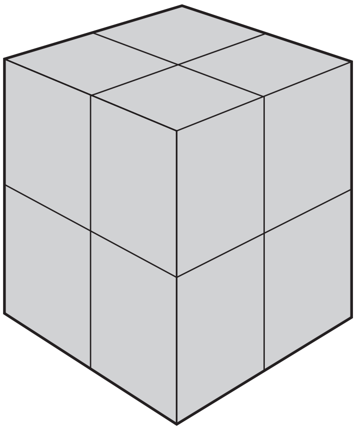


Figure LD-1.
Pressure: 0 psig (14.7 psia)
Temp: 70°F
Air = 8 CF
Moisture = 32 Grains
Max Possible = 64 Grains

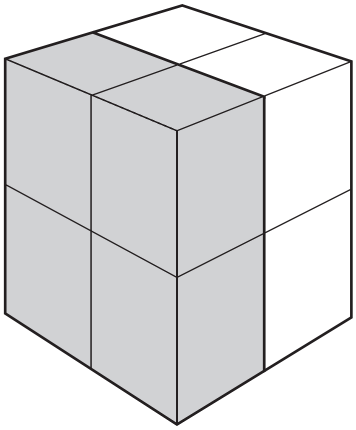


Figure LD-2.
Pressure: 15 psig (29.7 psia)
Temp: 70°F
Air = 4 CF
Moisture = 32 Grains
Max Possible = 32 Grains

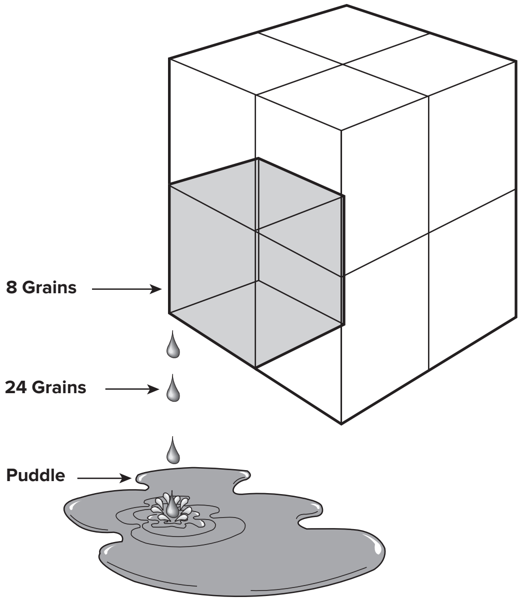


Figure LD-3.
Pressure: 100 psig (114.7 psia)
Temp: 70°F
Air = 1 CF
Moisture = 32 Grains
Max Possible = 8 Grains
24 Grains
of Liquid

Drainage Problems and How to Avoid Them

Oil. A critical drainage problem exists at points where oil may be present in the compressed air (principally at intercoolers, aftercoolers and receivers).

Two facts create this problem:
1. Oil is lighter than water and will float on top of water.
2. Compressor oil when cooled tends to become thick and viscous.

The beaker simulates any drain trap that has its discharge valve at the bottom, Fig. LD-4. Like the beaker, the trap will fill with heavy oil that may be thick and viscous.

Compare with Fig. LD-5, which shows an identical beaker except that the discharge valve is at the same level as the oil. Oil will escape until the oil level is so thin that for every 19 drops of water and one of oil that enter the beaker, exactly 19 drops of water and one drop of oil will leave. The beaker always will be filled with water.

The conclusion is obvious. When there is an oil-water mixture to be drained from an air separator or receiver, use a trap with the discharge valve at the top.

Dirt and Grit. While scale and sediment is seldom a problem between the compressor and receiver, it is encountered in the air distribution system, particularly when the piping is old. In this situation, scale will be carried to a drain trap along with the water. If the drain trap is not designed to handle dirt and grit, the trap may fail to drain water and oil, or the trap valve may not close.

Air Loss. Often in compressed air systems, the solution to one problem may also cause another problem. For example, a common method of draining unwanted moisture is to crack open a valve; however, this also creates a leak. The immediate problem is solved, but the "solution" has an obvious, and usually underestimated, cost of continual air loss.

How much air is lost depends on orifice size and line pressure (see Table LD-2). The overall result is a decrease in line pressure, the loss of up to a third of the system's compressed air, and the cost of compressing it.

Leak control involves:
- Looking for leaks during shut-down with an ultrasonic leak detector
- Determining total leakage by observing how fast pressure drops with the compressor off, both before and after a leak survey
- Fixing leaks at joints, valves and similar points
- Replacing cracked-open valves with drain traps
- Checking the system regularly

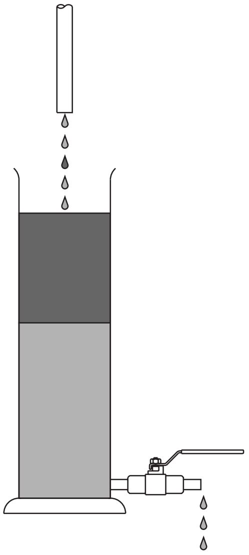


Figure LD-4.
If a beaker collecting oil and water is drained from the bottom at the same rate that oil and water enter, it will eventually fill entirely with oil because oil floats on water.

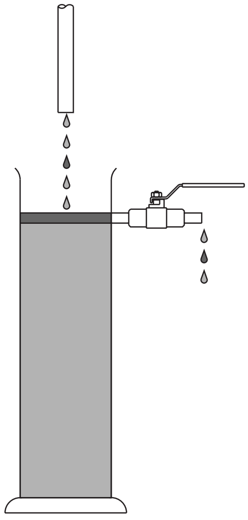
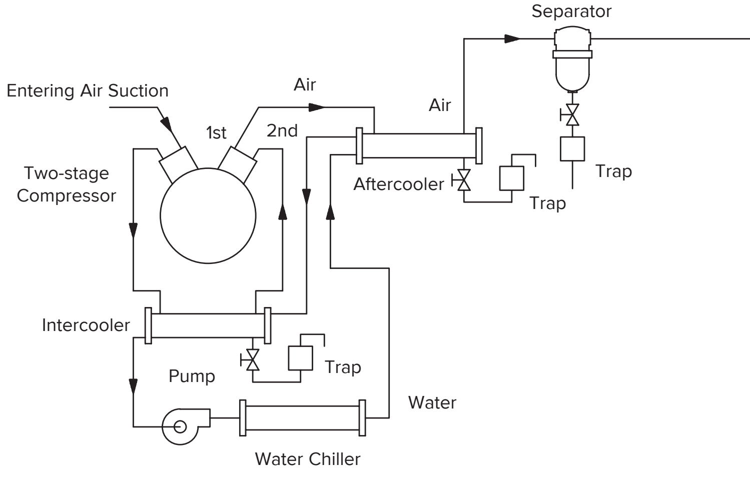


Figure LD-5.
If a beaker collecting oil and water is drained from the top at the same rate that oil and water enter, it soon will be entirely filled with water because the oil floats on the water.

Figure LD-6. Drain Trap Locations in a Compressed Air System
The use of drain traps is an effective way to remove water that collects in many places in a compressed air system. Each trap location must be considered individually.



Compressed Air/Gases—Basic Concepts

Drainage Methods

Manual. Liquid may be discharged continuously through cracked-open valves, or periodically by opening manually operated drain valves.

Open drains are a continuous waste of air or gas—and the energy to produce it. A valve manually opened will be left open until air blows freely. Frequently, however, the operator will delay or forget to close the valve, and precious air or gas is lost.

Automatic. Automatic drainage equipment that is adequate for the system is seldom included in the original system. However, subsequent installation of automatic drain traps will significantly reduce energy and maintenance costs.

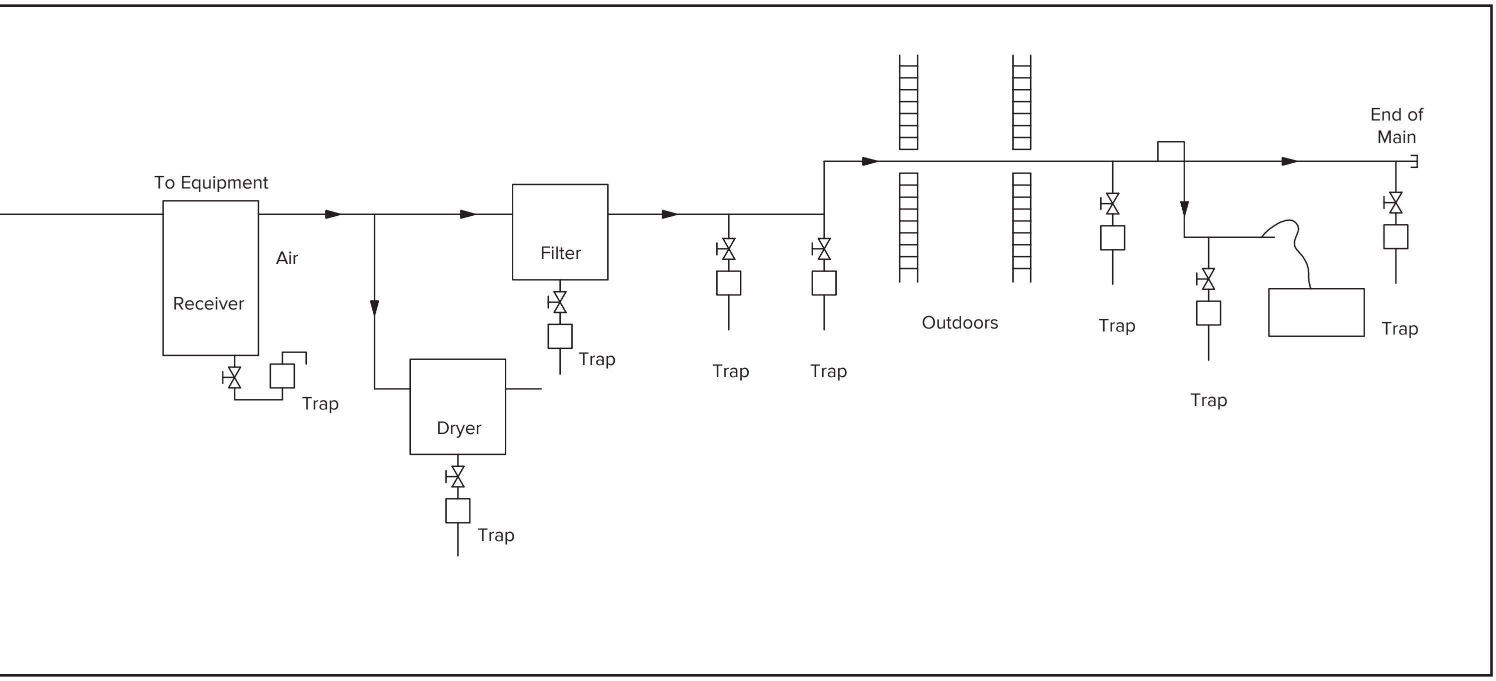
Drain Traps. Water collected in separators and drip legs must be removed continuously without wasting costly air or gas. In instances where drain traps are not part of the system design, manual drain valves are usually opened periodically or left cracked open to drain constantly. In either case, the valves are opened far enough that some air and gas are lost along with the liquid. To eliminate this problem, a drain trap should be installed at appropriate points to remove liquid continuously and automatically without wasting air or gas.

The job of the drain trap is to get liquid and oil out of the compressed air/gas system. In addition, for overall efficiency and economy, the trap must provide:

- Operation that is relatively trouble-free with minimal need for adjustment or maintenance
- Reliable operation even though dirt, grit and oil are present in the line
- Long operating life
- Minimal air loss
- Ease of repair

Table LD-2. Cost of Various Size Air Leaks at 90 psig

Orifice Diameter (in)	Leakage Rate (scfm)	Total Cost Per Month	Cost Total Per Year
3/8	138.00	$1 207.50	$14 490
1/4	61.00	533.75	6 405
1/8	**15.40**	**134.75**	**1 617**
7/64	11.80	103.25	1 239
5/64	6.00	52.50	630
1/16	**3.84**	**33.60**	**403**



For Heavy Oil/Water Service

BVSW inverted bucket drain traps are designed for systems with heavy oil or water services.

An inverted bucket is used because the discharge valve is at the top, so oil is discharged first and the trap body is almost completely filled with water at all times.

BVSW stands for Bucket Vent Scrubbing Wire. This 1/16" dia. wire swings freely from the trap cap and extends through the bucket vent. Its function is to prevent reduction of vent size by buildup of solids or heavy oil in the vent itself. The up-and-down motion of the bucket relative to the vent scrubbing wire keeps the vent clean and full size.

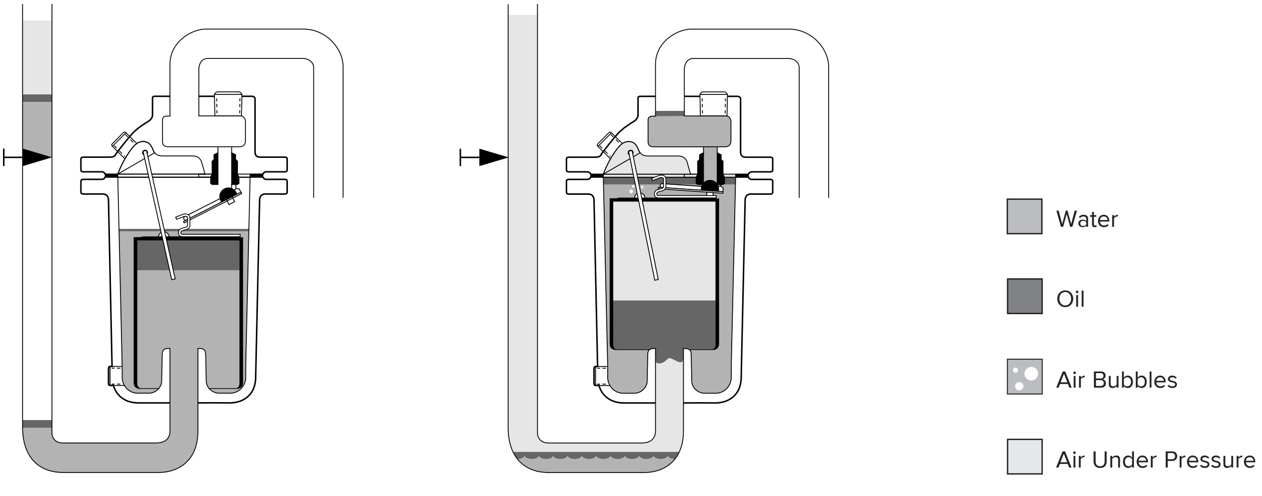
Operation of Inverted Bucket Drain Traps

1. Since there is seldom sufficient accumulation of water to float the bucket and close the valve, the trap must be primed on initial start-up or after draining for cleaning. Step 1 shows "after operating" primed condition with oil in the top of bucket and a very thin layer of oil on top of water in the trap body.

2. When valve in line to trap is opened, air enters bucket, displacing liquid. When bucket is two-thirds full of air, it becomes buoyant and floats. This closes the discharge valve. As bucket rises, the vent scrubbing wire removes oil and any dirt from bucket vent.

   Both liquid and air in trap are at full line pressure, so no more liquid or air can enter trap until some liquid or air escapes through the discharge valve. Static head forces air through bucket vent. The air rises to top of trap and displaces water that enters bucket at bottom to replace air that passes through vent. Just as soon as bucket is less than two-thirds full of air, it loses buoyancy and starts to pull on valve lever as shown in Step 3.

Figure LD-7. Operation of the BVSW Inverted Bucket Drain Trap

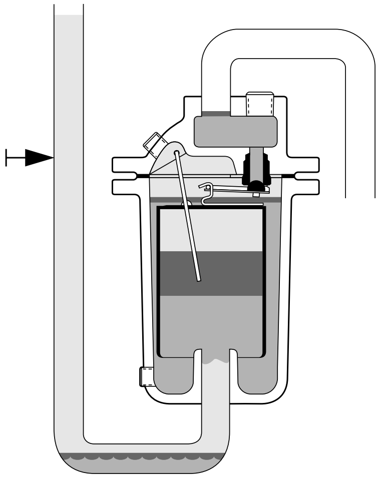


1. Trap primed, air off, bucket down, trap valve open.
2. Trap in service, bucket floating. Air passes through bucket vent and collects at top of trap.

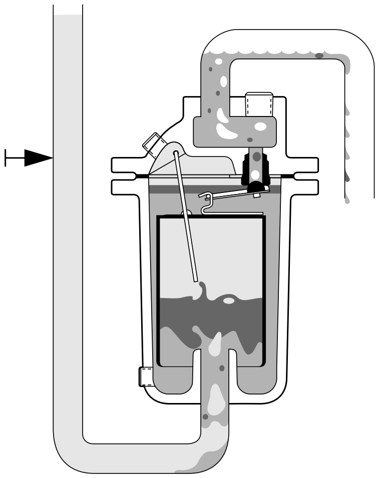
3. Note that liquid level at top of trap has dropped and the liquid level in the bucket has risen. The volume of water displaced by air exactly equals the volume of water that entered the bucket. During this valve-closed part of the operating cycle—Steps 2 and 3—water and oil are collecting in the horizontal line ahead of the trap. When the bucket is about two-thirds full of liquid, it exerts enough pull on lever to crack open the discharge valve.

4. Two things happen simultaneously. a) The accumulated air at top of trap is discharged immediately, followed by oil and any water that enters the trap while the valve is cracked. b) Pressure in trap body is lowered slightly, allowing accumulated liquid in horizontal line to enter the trap. Air displaces liquid from the bucket until it floats and closes the discharge valve, restoring the condition shown in Step 2.

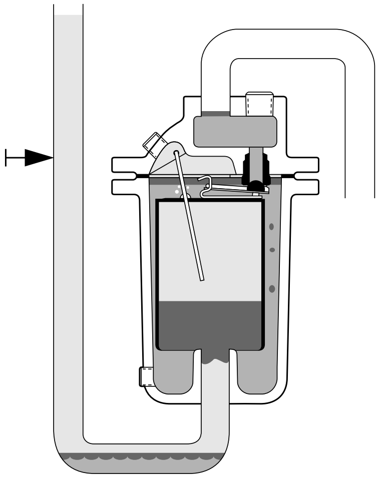
5. When full buoyancy is restored, the trap bucket is two-thirds full of air. Oil that has entered while trap was open flows under bottom of bucket and rises to top of water in trap body. The trap normally discharges small quantities of air several times per minute.



3. Water enters bucket to replace air passing through bucket vent. This increases weight of bucket until…



4. …pull on lever cracks valve. Air at top of trap escapes, followed by oil and water. Liquid in pipe ahead of trap enters bucket followed by air.



5. Air displaces liquid and excess oil from bucket, restoring condition shown in Step 2.

Closed Float

Hollow, thin-wall metal floats are attached through linkages to valves at the trap bottom, and a seat with an appropriately sized orifice is inserted at the trap outlet. Floats are selected to provide adequate buoyancy to open the valve against the pressure difference. Discharge usually is to atmosphere, so the pressure drop is equal to the system air pressure. The float and linkage are made of stainless steel, and the valve and seat are hardened stainless steel for wear resistance and long life. The body is cast iron, stainless steel, or cast or forged steel depending on gas pressure. Bodies may be made of stainless steel to resist corrosive gas mixtures.

Entering liquid drops to the bottom of the body. As liquid level rises, the ball is floated upward, thereby causing the valve to open sufficiently that outlet flow balances inlet flow. Subsequent change of incoming flow raises or lowers water level further opening or throttling the valve. Thus discharge is proportionally modulated to drain liquid completely and continuously. However, gas flow may be constant or it may abruptly change depending on system demand characteristics. Liquid formation may be sporadic, or the nature of flow generation may cause surges. At times, flow will be very low, requiring operation to throttle the flow or even tight shut-off. Tightness of closure, gas leakage and trap cost will depend on the design of linkage and valve.

Free Floating Lever

The discharge from the No. 1-LD is continuous. The opening of the valve is just wide enough to remove the liquid as fast as it comes to the trap. Thus, at times, the valve is barely cracked from its seat.

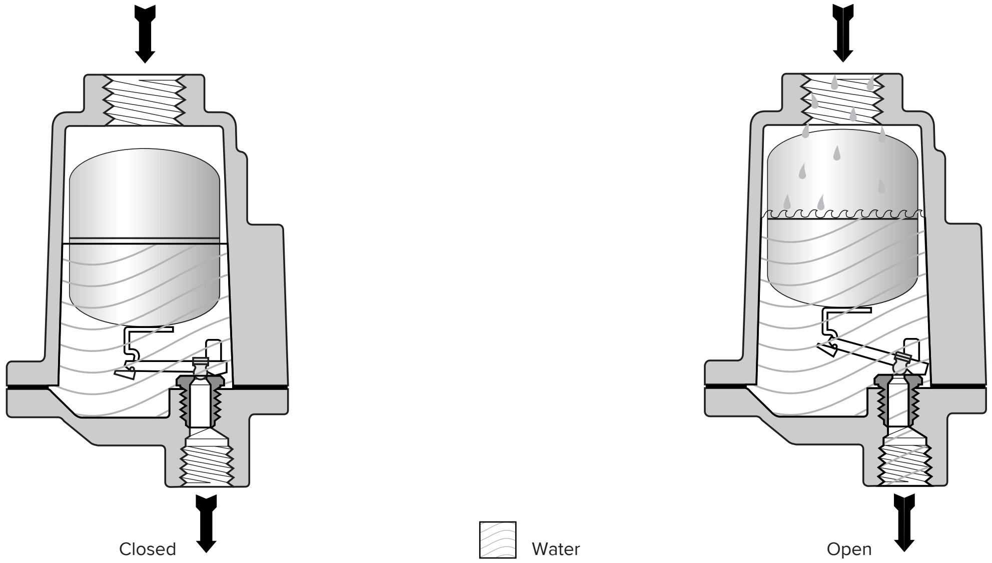
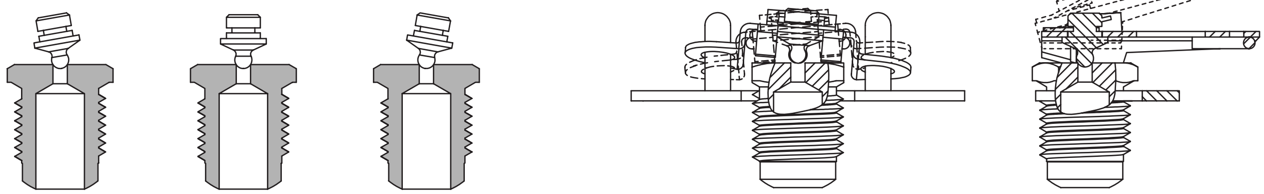


Figure LD-8. Operation of the No. 1-LD Free Floating Lever Drain Trap
As water begins to fill the body of the trap, the float rises, opening the discharge valve. Motion of the free floating valve lever is guided to provide precise closure.

Free Floating Linkage Valve

A hemispherical ball-shaped valve is attached to linkage which is suspended freely on two guide pins. There is no fixed pivot or rigid guides; therefore, the attachment is loose. There are no critical alignments, and the lever and valve may move in all directions. Consequently, the lever may move the valve to the seat in any alignment. As the valve approaches the seat, the pressure pushes the round valve into the square edge orifice of the seat, effecting a line seal to attain bubble-tight closure.

Figure LD-9. Free Floating Linkage



Fixed Pivot Conical Valve

A conically shaped valve is attached to a fixed pivot leverage system. The fixed pivot does not allow the valve to move freely to conform to the seat for tight closure. Thus, it may not seal tightly, and some loss of air or gas may be expected.

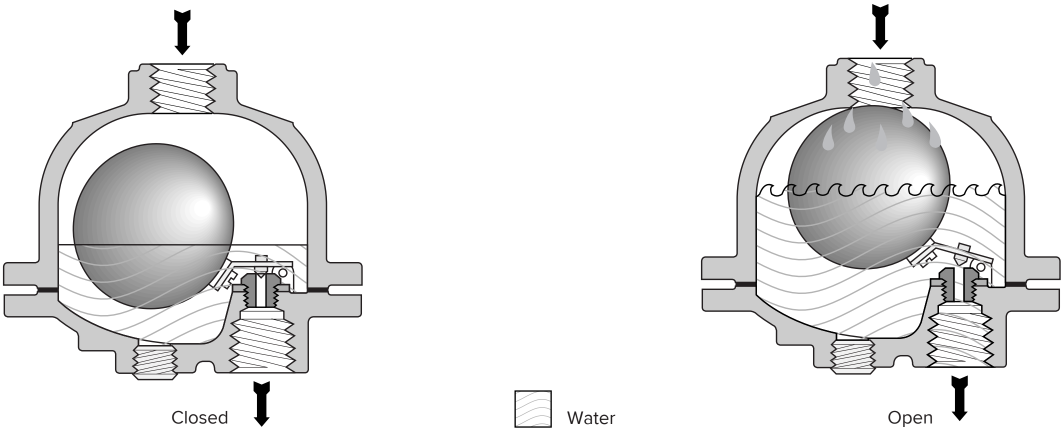


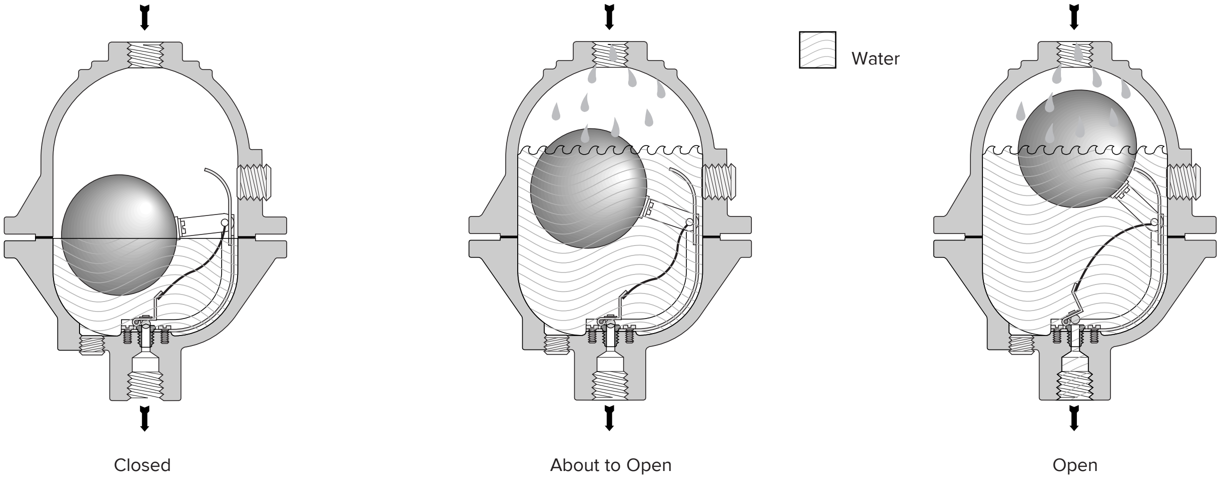
Figure LD-10. Operation of No. 21 Fixed Pivot Drain Trap
As the water level rises, the ball float cracks the valve to drain liquid at the same rate that it reaches the trap. Changes in the rate of flow to the trap adjust the float level and the degree of opening of the valve.

Snap Action Valve

Because of the sporadic liquid flow, much of the time the valve in a standard float-type drainer is only slightly opened. If there is fine dirt or grit in the liquid, particles may accumulate and clog the partially open valve, or they may lodge between the valve and seat, preventing closure. To overcome this, a special toggle-spring operated valve is used.

A flat spring attached to the leverage system holds the valve closed until liquid level is high enough for the buoyancy to exceed the spring force. Then the valve is snapped open, and the accumulated dirt and grit can be flushed through the wide open valve. When the body is nearly empty, buoyancy is reduced enough to permit the spring to snap the valve closed.

Figure LD-11. Operation of No. 71-A Snap Action Drain Trap



Filling Cycle. Trap valve has just closed. Spring bowed to right. Float rides high in water because no force is exerted on spring. As water enters, float rises, storing energy in spring. This increases submergence of float.

Float now is more than half submerged and spring has assumed a "handlebar mustache" shape. Energy stored in spring is due to increased displacement of water. A very slight rise in water level causes spring to snap to the left...

...Instantly the valve opens wide. This releases energy from spring and float again rides high in water. As water level drops, weight of float bends spring to right, causing snap closing of valve before all the water has been discharged.

Drain Trap Selection

To obtain the full benefits from the traps described in the preceding section, it is necessary that the correct size and pressure of drain trap be selected for each job, and that it be properly installed and maintained.

Rely on Experience. Most drain traps are selected on the basis of experience. This may be:

- Your personal experience
- The experience of your Armstrong Representative or distributor
- The experience of thousands of others in draining identical equipment

Do-It-Yourself Sizing is required at times. Fortunately, drain trap sizing is simple when you know or can figure:

1. Liquid loads in lbs/hr.
2. Pressure differential.
3. Maximum allowable pressure.

1. Liquid Load. Each "How To" section of this handbook contains formulas and useful information on proper sizing procedures and safety factors.

2. Pressure Differential. Maximum differential is the difference between main pressure, or the downstream pressure of a PRV, and return line pressure. See Fig. LD-12. The drain trap must be able to open against this pressure differential.

Operating differential. When the plant is operating at capacity, the pressure at the trap inlet may be lower than main pressure. And the pressure in the return header may go above atmospheric.

If the operating differential is at least 80% of the maximum differential, it is safe to use maximum differential in selecting traps.

IMPORTANT: Be sure to read the discussion on page LD-16, which deals with less common, but important, reductions in pressure differential.

3. Maximum Allowable Pressure. The trap must be able to withstand the maximum allowable pressure of the system, or design pressure. It may not have to operate at this pressure, but it must be able to contain it. As an example, the maximum inlet pressure is 150 psig and the return line pressure is 15 psig. This results in a differential pressure of 135 psig; however, the trap must be able to withstand 150 psig maximum allowable pressure. See Fig. LD-12.

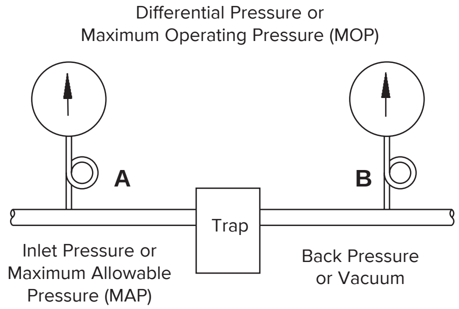


Figure LD-12. "A" minus "B" is Pressure Differential: If "B" is back pressure, subtract it from "A." If "B" is vacuum, add it to "A."

Factors Affecting Pressure Differential

Pressure Differential in Detail

Inlet pressure can be:

1. Air main pressure.
2. Reduced pressure controlled by a pressure reducing valve station.

Discharge can be:

1. Atmospheric.
2. Below atmospheric—under vacuum. Add vacuum to inlet pressure to get pressure differential. 2" Hg vacuum = approximately 1 psig of pressure below atmospheric.
3. Above atmospheric due to:
   a. Pipe friction
   b. Elevating liquid

Every 2' lift reduces pressure differential by approximately 1 psig, when the discharge is only liquid.

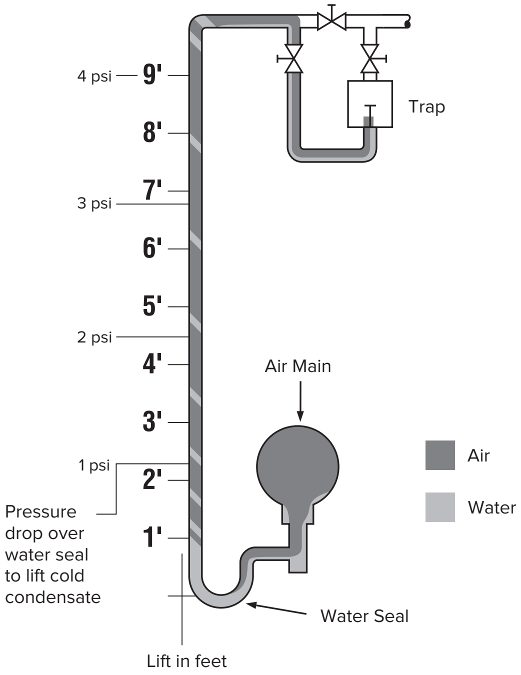


Figure LD-13. Liquid from gravity drain point is lifted to trap by a syphon. Every 2' of lift reduces pressure differential by approximately 1 psig. Note seal at low point and the trap's internal check valve to prevent back flow.

Special Considerations

Drain traps are available for services other than those found on standard compressed air systems.

High Pressure

Spring-loaded mechanisms allow float type drain traps to operate on pressures above 3 000 psig.

Fluids Other Than Water

Different fluids, such as oils and liquid, can be compensated for with specially weighted floats or lower operating pressure ratings. Fluids with specific gravities down to 0.4 will work with float type drain traps.

Materials of Construction

Service requirements for stainless steel or other corrosion-resistant materials can be met by float and inverted bucket type drain traps.

NACE Sour Gas Service

Special materials and construction are required for hydrogen sulfide service.

High Capacity for Large Flow Rates

Ultra-capacity type drain traps allow float type drain traps to be used on service requiring capacities up to 700 000 lbs/hr.

Dual Gravity

Float type drain traps can be modified to drain a heavier fluid from a lighter fluid.

How to Drain Air Distribution Systems

Air distribution systems make up the vital link between compressors and the vast amount of air-utilizing equipment. They represent the method by which air is actually transported to all parts of the plant to perform specific functions.

The three primary components of air distribution systems are air mains, air branch lines, and air distribution manifolds. They each fill certain requirements of the system, and together with separators and traps, contribute to efficient air utilization. Common to all air distribution systems is the need for drip legs at various intervals. These drip legs are provided to:

1. Let liquid escape by gravity from the fast-moving air.
2. Store the liquid until the pressure differential can discharge it through the drain trap.
3. Serve as dirt pockets for the inevitable dirt and grit that will accumulate in the distribution system.

Air mains are one of the most common applications for drain traps. These lines need to be kept free of liquid to keep the supplied equipment operating properly. Inadequately trapped air mains often result in water hammer and slugs of liquid, which can damage control valves and other equipment. There is also a freeze potential wherever water is allowed to accumulate. In areas where air is moving slowly, the accumulation of water can effectively reduce the pipe size, thereby increasing the pressure drop and wasting energy.

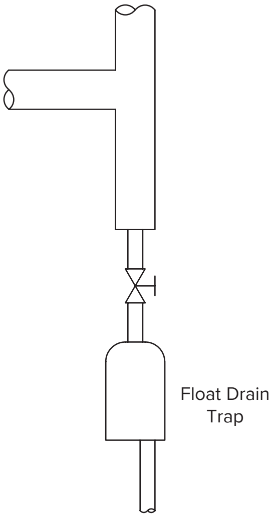


Figure LD-14.
Drain trap installed straight under a low point.

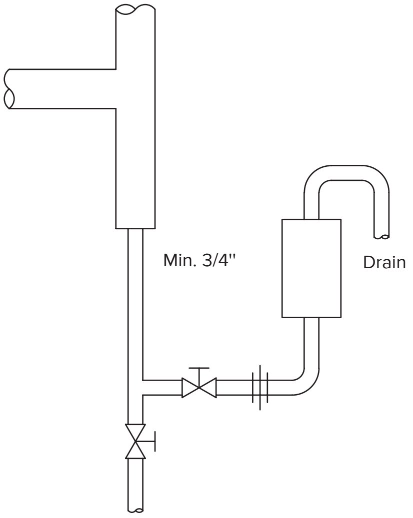


Figure LD-15.
Series 200 or 300 inverted bucket drain traps installed on compressed air line contaminated by oil.

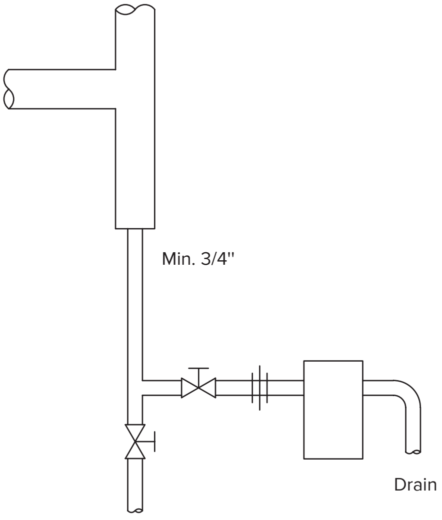


Figure LD-16.
Series 800 or 900 inverted bucket drain traps installed on compressed air line contaminated by oil.

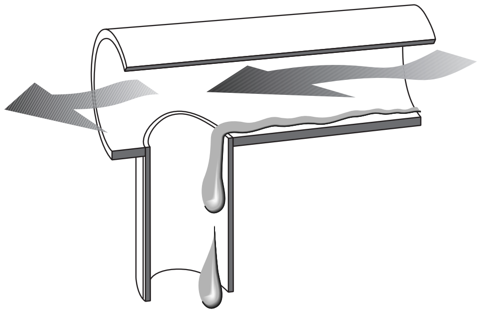


Figure LD-17. Drip leg length should be at least 1-1/2 times the diameter of the main and never less than 10". Drip leg diameter should be the same size as the main, up to 4" pipe size and at least 1/2 of the diameter of the main above that, but never less than 4".

Chart LD-3. Recommendation Chart
(See chart on page LD-6 for "Feature Code" references.)

Equipment Being Drained	1st Choice and Feature Code	Alternate Choice and Feature Code
Air Mains	FF B, C, D, J, M	FP*

*IB is a good alternative where heavy oil carryover is likely.

Selection of Drain Traps and Safety Factor for Air Mains

Traps should be selected to discharge a volume of liquid normally produced when the system is up and running. Liquid loads can be estimated if actual CFM or air volume flow is not known. If cold temperatures are possible, the dew point at supply pressure must be known. Once this maximum is determined, the safety factor used to size the trap will be only 10% of the total potential liquid load. Ten percent of the total is used because most of the liquid has been removed in the aftercooler and receiver. The drain trap must handle only the small remaining amount of 10% of the total possible load.

If actual airflow rate is not known, it can be estimated using Chart LD-4, titled “Pressure Drop in Compressed Air Pipe.” Using an assumed pressure drop of 1/4 (.25) psig per 100 ft, and 100 psig gauge pressure of air through a 4" line, it can be seen that approximately 1 000 cu ft of free air per minute are flowing through the line. Taking this figure to the chart titled “Water Condensed From Compressed Air,” Chart LD-6 on page LD-20, it can be seen that if 80°F, 90% RH air is delivered at 100 psig, then 1.2 lbs of water will be condensed per minute at 1 000 CFM. This number will be multiplied by 60 to convert from minutes to hours, which equals 72 lbs/hr. For this air main then, take 10% of this figure, or 7.2 lbs/hr, to be the flow rate to the drainer.

Rule of Thumb for Calculating Compressor Liquid Loads

$$\frac{\text{CFM x 20 gr/cu ft x 60 min/hr}}{\text{7 000 gr/\#}} = \text{\#/hr}$$

1. Assuming worst condition:
   100°F @ 100% RH
   For other conditions, see page LD-7
2. Using air main safety factor of: Load x 10%

Installation of Drain Traps on Air Mains

Drip Legs. All air mains should utilize drip legs and traps at all low spots or natural drainage points, such as ahead of risers, end of mains, ahead of expansion joints or bends, and ahead of valves and regulators (see installation Fig. LD-17).

Where there are no natural drainage points, drip legs and drain traps should still be provided. These should normally be installed at intervals of about 500 ft.

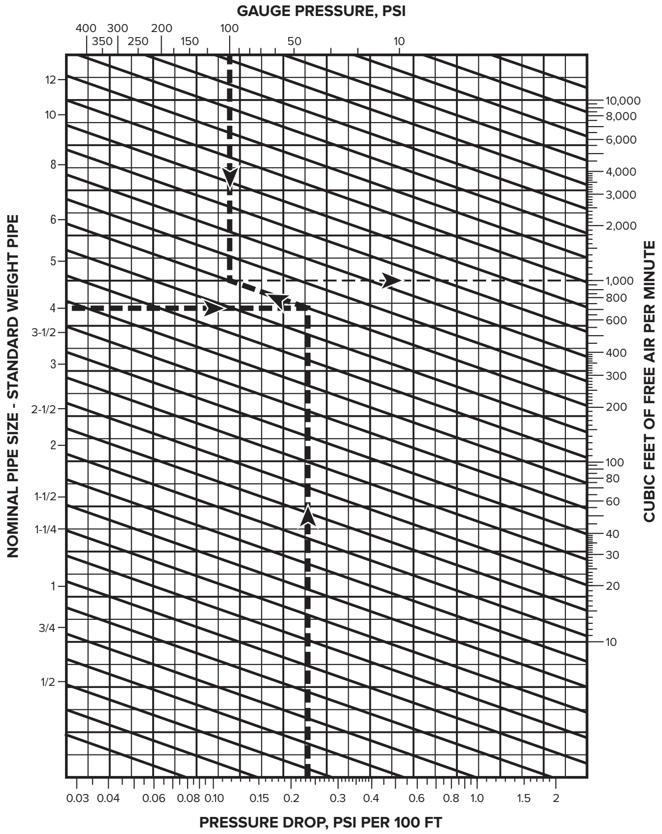


Chart LD-4. Pressure Drop in Compressed Air Pipe
Chart gives pressure drop in compressed air piping in pounds per square inch per 100 ft of pipe. Initial pressure, flow and size of pipe must be known or assumed.

How to Drain Air Distribution Systems

Branch Lines

Branch lines are takeoffs of the air main supplying specific areas of air-utilizing equipment. Branch lines must always be taken from the top of the air main. The entire system must be designed and hooked up to prevent accumulation of liquid at any point. If a specific process area requires it, an air dryer will be installed on the branch line.

Trap Selection and Safety Factor for Branches

The formula for computing liquid load in branch lines is the same as that used for air mains. Branch lines also have a recommended safety factor of 10% of total air load. Drip legs must be installed ahead of risers and at the end of branch lines, especially when branch line runouts exceed 50 ft. There are usually several branches off the air main, and in many cases they experience a high liquid load when they run against cold outside walls. This cooling causes more moisture to condense in the branch line than would be seen in the air main.

Distribution Manifolds

A distribution manifold is a terminal for a branch line from which several air users are taken off. They are particularly common in manufacturing facilities for pneumatic tool hookups or takeoffs to cylinder actuators. Like branch lines, it is common for distribution manifolds to be installed against cool walls where low temperatures cause condensation and the accumulation of liquid.

Distribution manifolds are often equipped with filters and regulators. Regulators may also be found at the termination before the air-using device.

Since the air distribution manifold is usually one pipe size larger than the branch line, it is common for air velocity to drop when coming from the branch line. With this decrease in velocity, often combined with lower ambient temperatures, it is common for a liquid to accumulate in the distribution manifold. For this reason, the use of filter-drainer combinations or separate drain traps is recommended. Trapping the liquid in the distribution manifold is important to protect the regulators on air-using equipment and orifices in air-using instruments.

This is a location where manual valves are commonly misused due to their accessibility. To drain the liquid and keep it from fouling an instrument or pneumatic tool, manual valves will often be cracked to atmosphere. When they are left this way, the result is a large air loss due to the unrestricted free blow of air to atmosphere.

Trap Selection and Safety Factor for Distribution Manifolds

Normally the smallest drain trap is practical for distribution manifolds up to manifold diameters of 2". Above 2", the distribution manifold should be considered a branch, and then the sizing procedure from the Air Main section would apply.

Chart LD-5. Recommendation Chart
(See chart on page LD-6 for "Feature Code" references.)

Equipment Being Drained	1st Choice and Feature Code	Alternate Choice
Branch Lines	FF B, C, D, J, M	FP*
Distribution Manifolds	FF B, C, D, I, M	FP

*IB is a good alternative where heavy oil carryover is likely.

How to Drain Air Distribution Systems

Installation

The ABCs of trap installation must be followed: "A" for accessible, "B" for below the point being drained, and "C" for close to the point being drained. If the discharge point for this drain trap is some distance away from the drain point, the discharge line from the trap should be run out—not the inlet to the trap.

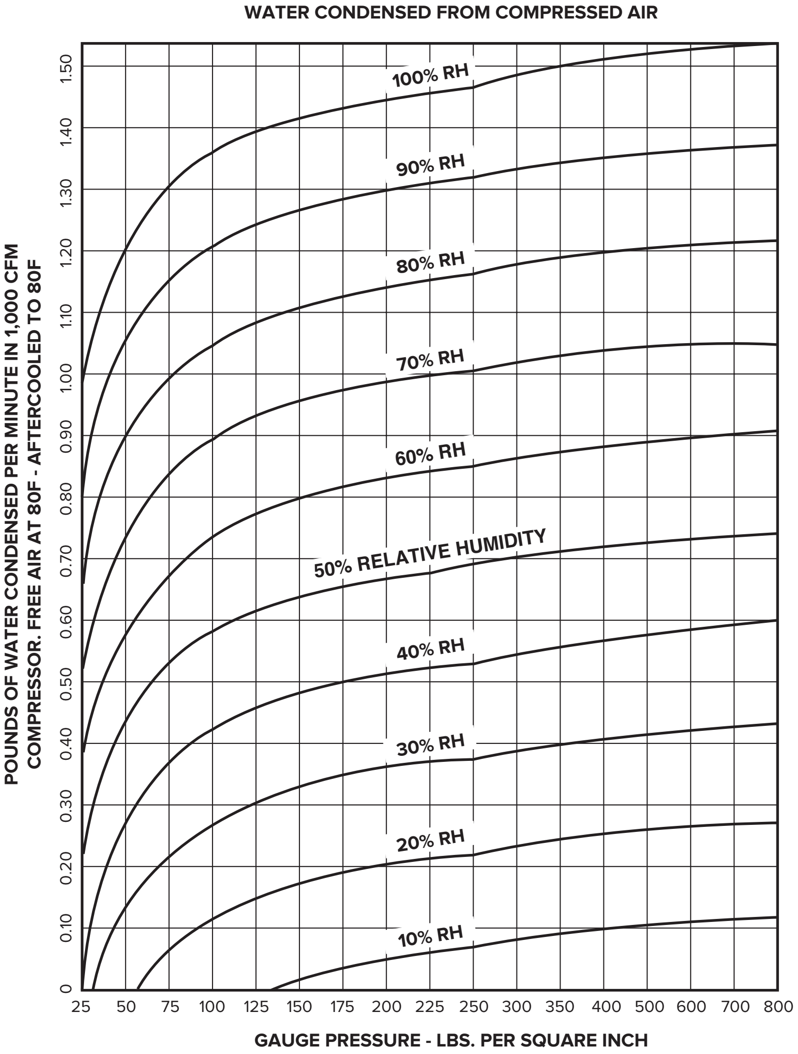
When installing traps on the drain connection of filters, particular care should be taken to the connection size. Normally outlet connections on filters are 1/4" in size or less. This connection size is normally not large enough to allow anything but slugs of liquid to flow into the trap housing. If a float trap is utilized, it should be either back vented or the connection size must be increased to 3/4" minimum. For additional installation recommendations, see pages LD-51 and LD-52.

Table LD-3. Correction Factors

For lbs water condensed at temperatures other than 80°F, find wt condensed at 80°F and multiply by factors shown.

°F	Factor	°F	Factor	°F	Factor	°F	Factor
10	.070	50	.373	100	1.81	140	5.15
20	.112	60	.525	110	2.39	150	6.52
30	.176	70	.729	120	3.12	160	8.19
40	.259	90	1.35	130	4.02	170	10.2

Chart LD-6. Water Condensed From Compressed Air



NOTE: Amount of water condensed is in direct ratio to compressor rating. For example, for 500 CFM compressor, multiply determined amount of condensate by 0.50; for 200 CFM compressor, multiply amount of condensate by 0.20.

How to Drain Intercoolers, Aftercoolers, and Aftercooler Separator Combinations

Aftercooler

An aftercooler serves as the primary means of moisture removal on industrial air systems. It increases the efficiency of air distribution by reducing pressure drop created when air flows through the system. It does this by using cooling water to reduce the specific volume of the air which, in turn, allows the air to flow through the system with less pressure drop. Aftercoolers are found on most industrial compressors over 10 hp in size. In addition to removing the heat of compression, aftercoolers also remove approximately two-thirds of the liquid found in the air, and help in the removal and knock-down of oil carryover from the compressor.

Intercooler

Compressor intercoolers are designed to increase the efficiency of compression by reducing the temperature and specific volume of air between stages of compression. This allows the compressor to do more work at a lower temperature than would normally occur. Because some condensing will occur in the intercooler, a drain trap is required to protect compressor parts.

If liquid were to carry over from the intercooler, it could also carry dirt or scale into the compressor and/or also cause corrosion within the compressor, both of which are undesirable for efficient compressor operation. If slugs of liquid were to pass from the intercooler into the compressor, it would make the compressor operation erratic. Efficient trapping is required at this point to deliver dry air to the next stage of the compressor.

An intercooler is typically a shell and tube heat exchanger. Liquid condensate flow out of the heat exchanger is usually irregular, causing slugs to accumulate and pass into the drain trap. Because of this, a drip leg is required on the intercooler, and full size outlet piping from the intercooler must be used into a dirt pocket. The drip leg allows the slug of condensate to be handled by the drain trap and handles some small backup while the drain trap is discharging the liquid.

The intercooler may also experience oil carryover if the compressor is not of the oil-less or sealed type. As air enters the intercooler, it carries a mist or tiny droplets of oil along with it. Because the air is at a relatively high temperature, this oil is fairly thin. Then, as the intercooler cools the air and oil, the oil may thicken. The drain trap must be able to discharge this oil before it thickens and negatively affects the drain trap and intercooler operation. Trap selection is very important in this type of application where a water and oil mix must be handled by the trap and the oil must be discharged first.

Since the aftercooler removes approximately two-thirds of the total moisture load, traps here will normally be much larger than those found on the rest of the system.

Trap Selection and Safety Factor

Intercooler

Select the proper trap for:

1. Entering water temperature into the intercooler.
2. Airflow rate through the intercooler.
3. Intermediate pressure at which the intercooler is operated.

Use Chart LD-6 on page LD-20, “Water Condensed From Compressed Air,” to determine the pounds of water condensed per minute in 1 000 CFM. Then multiply by 60 to convert minutes to hours and use a safety factor of 2:1.

Chart LD-7. Recommendation Chart
(See chart on page LD-6 for “Feature Code” references.)

Equipment Being Drained	Air		Gas	
	1st Choice and Feature Code	Alternate Choice	1st Choice and Feature Code	Alternate Choice
Aftercooler	IB F, G, J, K, M	FF	*FF B, E, J	FP
Intercooler				

*Since IBs vent gas to operate, an FF is suggested because gas venting may not be desirable.

How to Drain Intercoolers, Aftercoolers, and Aftercooler Separator Combinations

When selecting the type of trap, consider the failure mode and the ability of the trap to respond to slugs of liquid. In most cases, an “open” failure mode will be desirable as it is vital to protect the compressor from slugs of liquid. A quick response to slugs is important so there is no delay between the time the liquid accumulates and the trap discharges the liquid.

Aftercooler

When the aftercooler condensing rate is not known, there are two typical methods for calculating condensate load. The first method is to calculate total airflow through the system. Then using Chart LD-6 on page LD-20, titled “Water Condensed From Compressed Air,” determine pounds of water condensed per minute in 1 000 CFM. Multiply this by 60 to convert minutes to hours for required trap capacity in pounds per hour (the entering maximum incoming summertime temperature and relative humidity must be known to use this chart). This load is then multiplied by 2 to determine required trap capacity.

The second method of calculating trap capacity is to look at maximum allowable flow rate through the aftercooler. Use the “Water Condensed From Compressed Air” chart on page LD-20 in the same manner as described in Method 1. Although this method will normally yield a larger trap size, it allows for the addition of another compressor or the interconnection of several compressors to the system in the event of unplanned by-passes.

In the second method, it’s important to estimate the average water temperature within the aftercooler as closely as possible. Not all air actually comes in contact with the water tubes; therefore, the air is not uniformly cooled to the water temperature. If actual leaving air temperature is known, this is by far the most accurate figure to use. A properly sized aftercooler will normally cool compressed air down to within 15°F of entering air temperature.

Installation

When installing drain traps on aftercoolers or aftercooler separator combinations, the “ABCs” of trap installation should be followed:

Accessible for maintenance and repair.
Below the point being drained.
Close to the drip point as possible.

Be sure to follow manufacturer’s instructions on trap installation. Most aftercoolers are equipped with a separate separator. However, if a separator is not furnished, the aftercooler must be trapped individually. In the case of the aftercooler/separator combination, only the separator normally requires a trap. See Fig. LD-18 or LD-19. But again, it is important to follow manufacturer’s instructions. For additional installation recommendations, see pages LD-51 and LD-52.

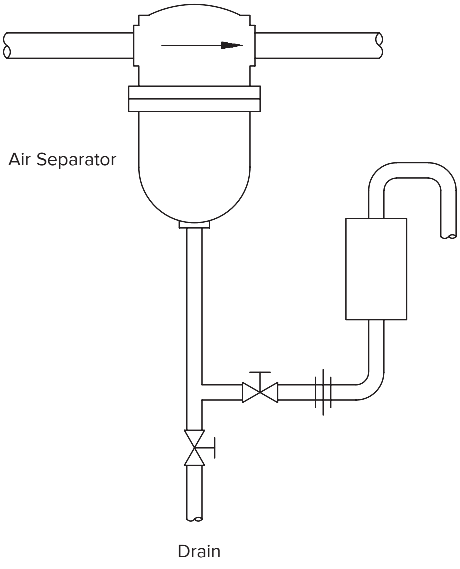


Figure LD-18. Installation of a 200 Series inverted bucket drain trap on compressed air contaminated by oil.

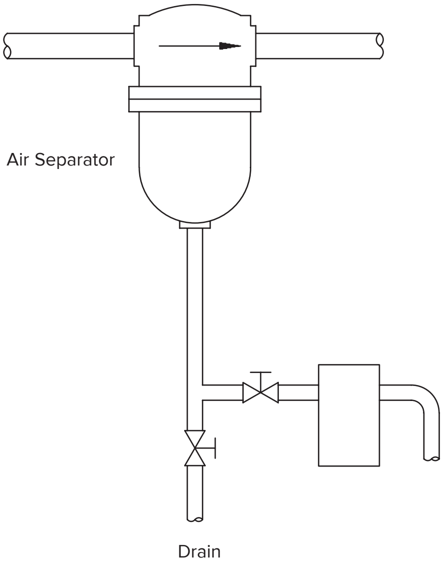


Figure LD-19. 800 Series inverted bucket drain trap installed on compressed air contaminated by oil.

How to Drain Separators, Separator Filter Combinations

Separators serve an important function within the compressed air system. Separators may also be known as knockout pots, knockout drums or demisters. Their function is to remove liquid that may be moving at a high speed from the flowing air, and they normally perform this function in a two-step process.

1. Separators increase the flow area and volume of the gas, thereby reducing its velocity. Air within the system may flow at velocities exceeding 100 mph. At this velocity any liquid will be entrained as droplets and will not be flowing along the bottom of the pipe. To remove these liquid droplets, it is necessary to reduce the velocity of the gas; otherwise, the droplets accumulate and again become entrained with the flowing gas.

2. The second step is to change direction and impinge the liquid. As the velocity of the gas is reduced, the velocity of the fast-moving droplets can be reduced even further by causing the air to take either 90-degree turns or to centrifugally flow within a chamber. Both of these methods serve to “sling” the droplets up against baffles, plates or the wall of the separator.

Because the droplets have a relatively high mass and are incompressible, their velocity will drop dramatically. At this point, gravity will take over, causing the drops to accumulate and flow into the bottom of the separator. Liquid will often fall in sheets down the wall of the separator and collect at the outlet piping in slugs. The immediate drainage of the slugs is important since the separator is normally a final opportunity to protect an air-using device downstream.

If liquid is allowed to accumulate for any amount of time, it may undermine the entire purpose and function of the separator. Therefore, if the separator does not do its job efficiently, it can actually become a reservoir that accumulates condensate and forms slugs to be transmitted down the air line and into the device being protected. In this case, the use of a separator may be worse than no protection at all.

Locations

Separators are normally located on the leaving side of aftercoolers and before the compressed air receiver. They are often integral with filters located before sensitive air-using equipment or as part of the filter on a distribution manifold. In this case there may be a combination filter, oiler, regulator and separator drainage point for liquids to accumulate.

Trap Selection and Safety Factor

If the separator is part of an aftercooler combination installed between the compressor and the receiver, you should refer to the section on Aftercoolers and Aftercooler Separators for trap selection.

Trap selection is fairly critical, especially on equipment with **larger than** 1" air lines feeding it, since slug formation can wash scale into the air-using equipment and become a serious dirt problem. Therefore, on larger than 1" separators, the flow should be calculated by totaling the air consumption of the devices downstream and using Chart LD-6, “Water Condensed From Compressed Air,” on page LD-20. Use the full water load expected and the safety factor of 3:1 to figure trap capacity.

Chart LD-8. Recommendation Chart
(See chart on page LD-6 for “Feature Code” references.)

Equipment Being Drained	1st Choice and Feature Code	Alternate Choice
Separator Line Size > 1"	FF* J, B, C, E	IB
Separator Inlet Pipe < 1"		FP*

*IB is a good alternative when heavy oil carryover is likely.

How to Drain Separators, Separator Filter Combinations

To determine proper trap capacity for separators with a pipe size of **less than** 1", the flow can be estimated by using Chart LD-6, "Water Condensed From Compressed Air," on page LD-20, and then calculating 20% of full load.

The safety factor for both selection procedures is 3:1 since separators must respond to surges of liquid from the inlet. In this case, the trap must handle far more liquid than would be experienced under normal operation.

Installation

When installing ball float type traps on separators 1" and above, it's important to back vent the trap (refer to the section on how to hook up ball floats for the purpose and function of back vent lines, page LD-51). All other types of drainers should be coupled as closely as possible to the drain leg. The drain leg should be the same size as the drain connection on the separator and extend 6" below the separator with another 6" allowed for a dirt pocket. The trap is then tee'd off this line (see Figs. LD-20 and LD-21). This piping is crucial because, as noted above, if the separator does not receive full drainage, it can be worse than no separator at all. For this reason, the "ABCs" are critical:

Accessible for inspection and maintenance.
Below the equipment being drained.
Close to the drain point.

The line size leading from the drip leg to the inlet of the unit should be kept the same size as the trap inlet for good drainage into the trap. Again, when slugs are being handled it's important that the trap begin draining immediately. Back vents on float type traps should be a minimum of 1/2" in pipe size with 3/4" preferred. Any valves used in this back-vent piping should be full ported to allow free gas flow out of and liquid flow into the drain trap. For additional installation recommendations, see pages LD-50 to LD-52.

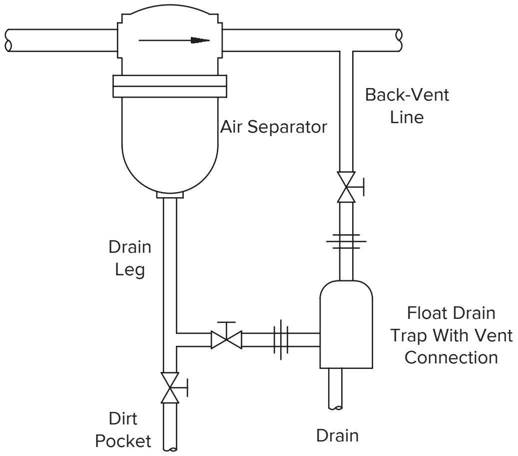


Figure LD-20. Installation of a drain trap with equalizing line downstream of the separator in order to assure a quick and regular flow to the drainer. Note side inlet connection from separator.

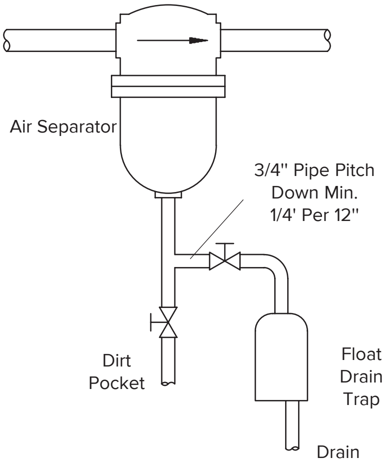


Figure LD-21. Installation of a drain trap on side of separator.

How to Drain Receivers

Receivers perform the vital function of storing air for the system. The receiver dampens pressure fluctuations in the system and provides a very short storage time in the event of compressor failure. It also functions as a liquid knockout drum to prevent entrained liquid (which may carry over) from entering the compressed air dryer or the air mains. The receiver should be sized to provide enough storage time for an orderly shutdown, particularly in the case of instrumentation air systems. Receiver volume is what provides the amount of air required for storage periods.

The receiver should be located close to the compressor. Fallout of liquid is normal due to low velocity within the receiver. Velocity is at the lowest point it will reach in any other part of the operating system. The air has a high dwell time within the receiver and is more likely to cool to ambient. This cooling of the air is what causes moisture to condense.

The receiver is equipped with a drain port at the bottom to allow liquids to flow to drain traps. In many cases, because receivers are so large and located adjacent to the compressor, they are installed close to the floor. When this happens, the drain point is relatively inaccessible, making trap piping difficult and gravity flow into the trap often impossible. To avoid this, the receiver should be located on a small concrete pad, which will facilitate efficient drain trap installation and operation.

For several reasons, it's good to keep the receiver drained. When receiver volume is lost, the dampening of the compressed air pressure is reduced and the storage time between compressor failure and system shutdown is greatly reduced. Corrosion within the receiver can also take place when liquid is allowed to accumulate.

Manual valves are commonly used to drain receivers since they are typically installed close to the floor. The resulting loss of receiver volume is seldom noticed in the day-to-day operation of the system. However, with any manual system, the valve can be forgotten and not opened. Then, when the weather changes from a relatively dry, low moisture load to a warm, high moisture load, the receiver will lose volume and the dampening effect and accumulator effect are decreased. The compressor can short cycle under these conditions, increasing the wear and tear on the compressor. In addition, the only reminder to open the manual valve is when carryover occurs. In this case, an air dryer can be damaged, liquid can be introduced into the air mains and surge through the system, causing scale to be washed into the system, water hammer and/or freeze damage.

Trap Selection and Safety Factor

To select the proper trap for the receiver, it is necessary to calculate total system load using Chart LD-6, "Water Condensed From Compressed Air," on page LD-20. Once this total potential load is known, it will be multiplied by the following factors: With an aftercooler, multiply the load by 50%, with an aftercooler separator combination, multiply the total load by 40%, and if no aftercooler is present, multiply the total load by 70%. Once this load is known, a safety factor of 2:1 is applied.

Table LD-4. Total System Load Multipliers

Calculate Total System Load with	Aftercooler	Aftercooler Separator	None
Multiply by	50%	40%	70%

Chart LD-9. Recommendation Chart
(See chart on page LD-6 for "Feature Code" references.)

Equipment Being Drained	**1st Choice and Feature Code**	**Alternate Choice**
Receivers	FS* C, E, I, J, K	IB D

*FF for over 120 lbs/hr load.

How to Drain Receivers

Installation

When a float type drain trap is used with a receiver, the level will run at about the inlet connection on the trap. Therefore, it is important to locate the trap as close to the floor as feasible and with no dips in the piping. See Figs. LD-22 thru LD-25. If there is a piping dip with a float type unit and the vent connection is not back vented, the unit will fail to operate. In the case of a back-vented unit, the dip in the piping will be flooded at all times. An inverted bucket trap can be installed above floor level since it will operate above the drain point. An internal check valve, tube and coupling should be installed to prevent the liquid seal from flowing backward on system shutdown. A snap action type float unit should be used when any amount of grit is expected in the system. In this case, the spring life can be extended by moving the drain trap slightly upward to allow liquid to accumulate both within the receiver and within the trap body between trap cycles. For additional installation recommendations, see pages LD-50 to LD-52.

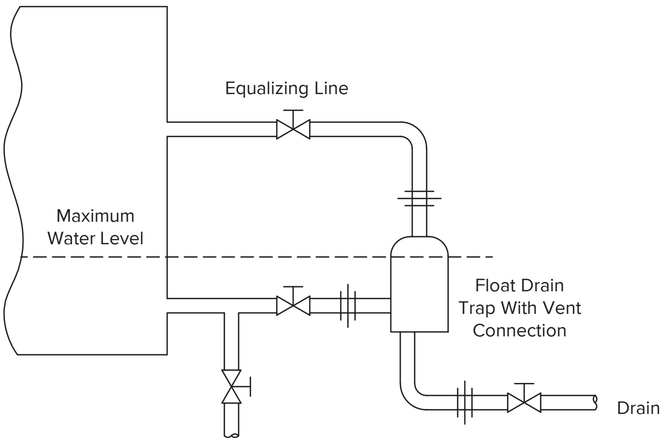


Figure LD-22.
Drain trap installed at side of a receiver, close to floor. Water will rise to broken line before drain trap opens.

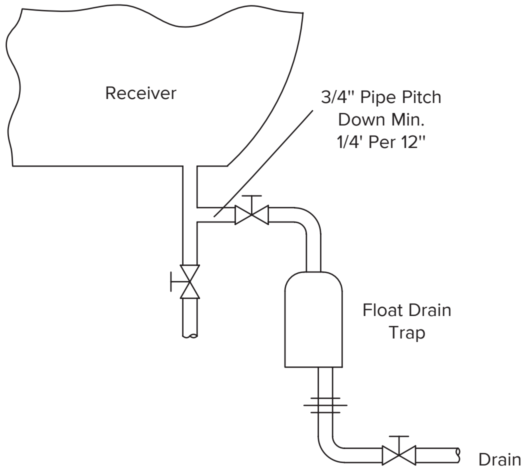


Figure LD-23.
Install the drain trap on side to get better access or compensate for lack of space under the receiver (particularly for drain trap used under compressors).

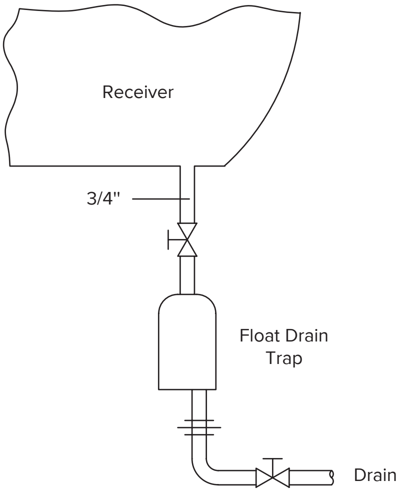


Figure LD-24.
Installation **not recommended** because of the dirt problem that can occur with a drain trap installed straight under the receiver.

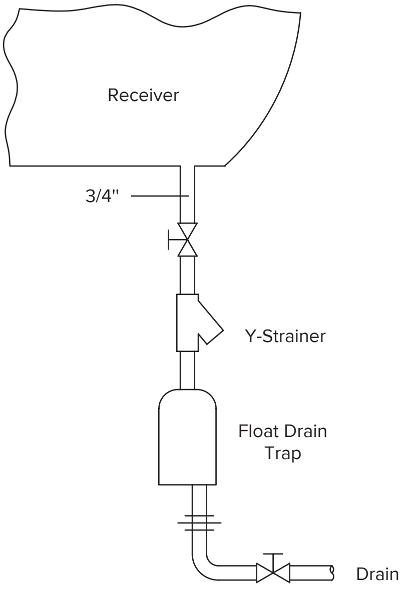


Figure LD-25.
Same installation but with a strainer protecting the drain trap.

Liquid Drainers

How to Drain Dryers

The function of dryers is to eliminate liquid in applications where freezing or any moisture accumulation can cause serious problems with the air-consuming equipment. Dryers should always be installed on instrument quality air systems.

Two basic dryer types are dessicant and refrigerated. In the dessicant type, the dessicant chemical absorbs the liquid by chemically bonding with the water molecules. Dessicant dryers can achieve very low dew points and are often installed with a pre-dryer of the refrigerant type. Refrigerant dryers work the same as aftercoolers by circulating cold fluid, causing the moisture to condense. However, their ability to reach low dew points is limited by the temperature at which frost will form on the heat exchanger tubing (greatly reducing heat transfer).

This leads to a discussion of air dew point. Dew point is the temperature at which moisture will condense out from the air due to its relative humidity increasing above 100%; see Chart LD-11. When this happens, the moisture condenses out and can be drained to a drain trap. Dew point is also important when considering air that has left the dryer, because if the air is ever exposed to temperatures below its dew point, moisture will form. Therefore, when applying air dryers, it is important to consider two features of compressed air usage that will impact dryer selection.

1. When air is compressed, the dew point is increased. Also, the dew point under pressurized conditions must be known. For example, even though a -40°F dew point is achieved at atmospheric conditions, this becomes a dew point of about 10°F once the air has been compressed to 100 psig. In outdoor systems, when the temperature drops below 10°F, condensing and freezing of that moisture will result.
2. When compressed air is expanded through instruments or air tools, its volume increases, pressure decreases and a temperature drop is usually experienced. If the temperature drops below the dew point of the air, undesirable moisture forms in the equipment. The air would never be subjected to that temperature under any conditions other than when expanding.

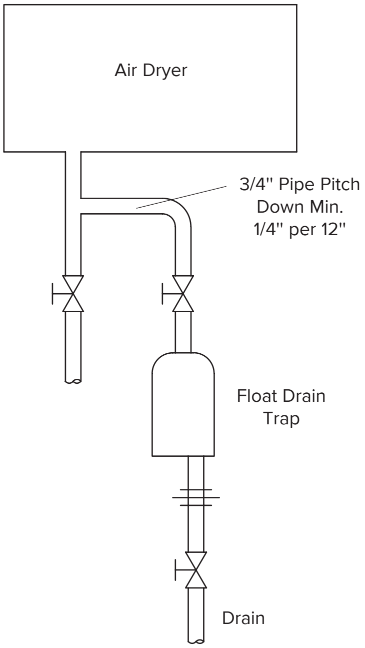


Figure LD-26.
Drain trap installation with dirt leg for purging the dirt.

Chart LD-10. Recommendation Chart
(See chart on page LD-6 for "Feature Code" references.)

Equipment Being Drained	1st Choice and Feature Code	Alternate Choice
Dryers	FF B, C, J, N	IB FP

How to Drain Dryers

Drain traps are usually required on refrigerated type dryers only. Here the refrigerant chills air and creates moisture that the drain trap can discharge. In the case of the dessicant type air dryer, the chemical grabs the moisture and bonds chemically with the water molecules, and no liquid accumulates. These bonded water molecules are then usually driven off in a regeneration cycle the dryer must periodically undergo.

Trap Selection and Safety Factor

In most cases, the dryer manufacturer will rate the dryer for a given moisture removal rate. The safety factor should still be applied to this load, however. If the manufacturer's ratings are not known, then it's necessary to calculate the moisture content of the air at aftercooler conditions and the moisture content at ambient conditions. Using the lower moisture content between these two, compare that figure to the moisture content at the dew point of the air leaving the dryer. The difference in these moisture contents is then multiplied by the airflow through the dryer to determine the moisture load. The safety factor applied to the load is 2:1 since liquid should be drained immediately from the dryer and the liquid tends to flow into the drain trap in slugs.

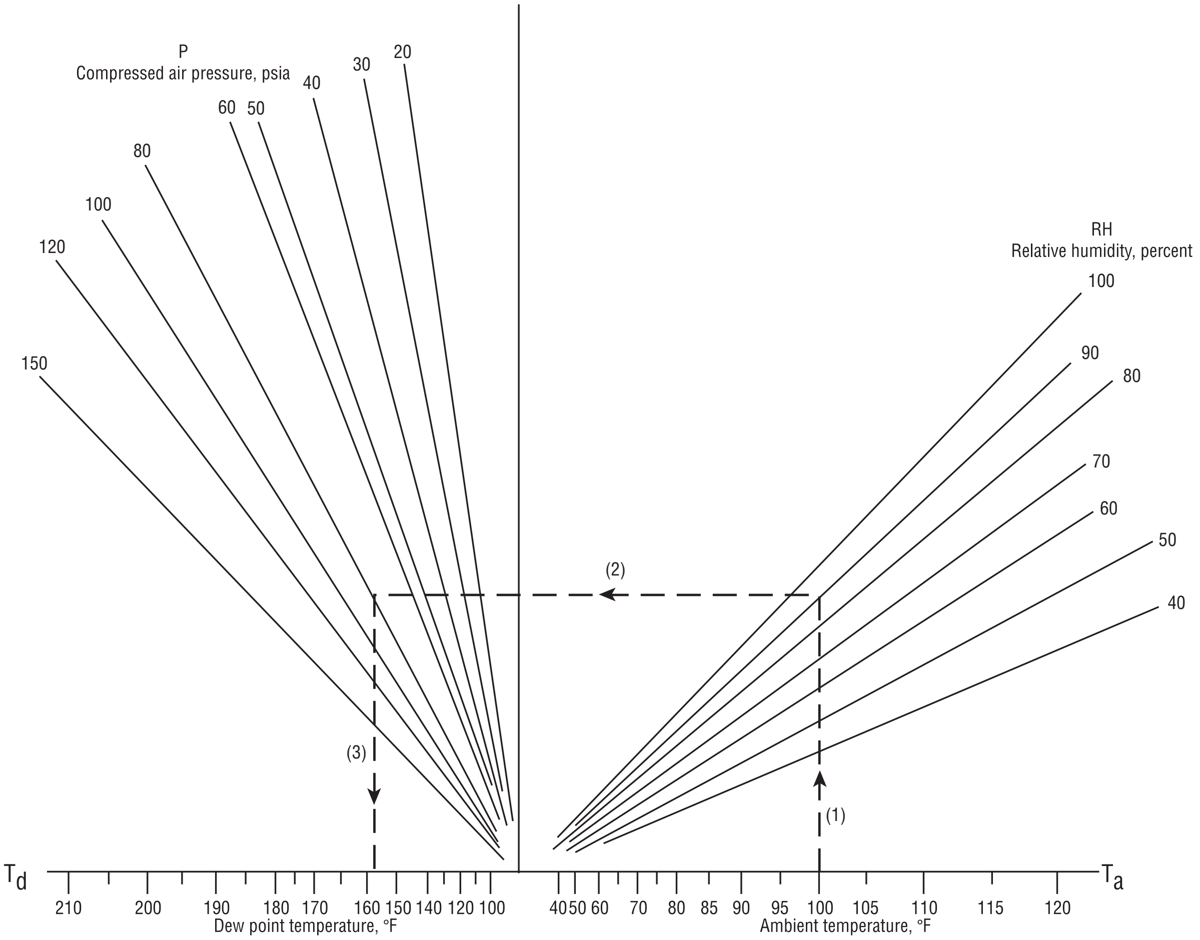
Installation

The dryer should come with a drain port of a given pipe size sufficient to handle the liquid coming out of the dryer. In this pipe size, a drain leg should be piped up 6" below the dryer with another 6" below that as a dirt pocket. Teeing off this line and into the trap with the same inlet size as the trap will allow for gravity drainage into the trap. Again, the ABCs of trap installation should be followed:

Accessible.
Below the point being drained.
Close to the drain leg as possible.

If the trap is too close to the floor to allow the use of a ball float trap, an inverted bucket trap should be considered. For additional installation recommendations, see pages LD-50 to LD-52.

Chart LD-11. Estimated Dew Point of Compressed Air



Nomograph estimates dew point of compressed air.

How to Select and Size Armstrong Drain Traps

For Draining Liquids From Gases Under Pressure

Armstrong liquid drain traps are offered in a wide variety of sizes and types to meet the most specific requirements. The most widely used models and sizes utilize bodies, caps and some operating parts that are mass produced for Armstrong steam traps. The proven capabilities of these components, along with volume production economies, enable us to offer you exceptionally high quality at attractive prices. You can choose the smallest and least costly model that will meet your requirements with confidence.

Selection Procedure for Draining Liquid From Gas

1. Multiply the actual peak liquid load (lbs/hr) by a safety factor of at least 1-1/2 or 2. See paragraph headed “Safety Factors.”

2. From Orifice Capacity Chart LD-12, find the orifice size that will deliver the required cold water capacity at the maximum operating pressure. If a light liquid is to be drained, convert light liquid capacity in lbs per hour to water capacity using factors in Table LD-5. Then find orifice size from Chart LD-12.

3. From the Orifice Size Operating Pressure tables on the product model pages, find the drain trap(s) capable of opening the required orifice size at a specific pressure (and specific gravity if other than cold water–specific gravity 1.0).

NOTE: If specific gravity falls between those shown in the tables, use next lower. Example: If specific gravity is 0.73, use 0.70 gravity data.

Safety Factors

Safety factor is the ratio between actual continuous discharge capacity of the drain trap and the amount of liquid to be discharged during any given period. Chart LD-12 shows the maximum continuous rate of cold water discharge of the drain trap. However, you must provide capacity for peak loads and, possibly, lower-than-normal pressures. A safety factor of 1-1/2 or 2 is generally adequate if applied to the peak load and the minimum pressure at which it occurs. If the load discharge to the trap is sporadic, a higher safety factor may be required. Contact your Armstrong Representative for details.

Selection Examples

EXAMPLE No. 1: Find a drain trap to drain 1 000 lbs of water per hour from air at 500 psig pressure differential.

Multiply 1 000 lbs/hr by 2 (if not already done) to provide a safety factor; thus, a 2 000 lbs/hr continuous discharge capacity is required. In Capacity Chart LD-12, the 2 000 lb capacity line intersects the 500 psig pressure line directly below the No. 38 drill orifice curve. This orifice is available in the No. 1-LD or No. 11-LD drain trap, but for much lower pressures. Moving to the 32-LD, a #38 orifice is good to 489 psig. This is the trap/orifice combination to use.

Table LD-14, page LD-37, shows the No. 32-LD drain trap with #38 orifice will operate at pressures up to 489 psig and, therefore, is suitable for the job. Further checking shows the No. 2313 HLS drain trap with a 7/64" orifice could also handle the job, but it is designed particularly for low gravity liquids and is more costly than the No. 32-LD, so the No. 32-LD is a better choice.

EXAMPLE No. 2: Find a drain trap to drain 6 400 lbs/hr (safety factor included) of .80 specific gravity liquid from gas at 400 psig pressure differential.

Since Capacity Chart LD-12 is based on water capacity, the known light liquid capacity requirement must be converted to its equivalent water capacity with the factor given in Table LD-5: 6 400 x 1.12 = 7 168 = water capacity required for using Chart LD-12.

Chart LD-12 shows that 7 168 lbs/hr and 400 psig calls for a 7/32" orifice. Entering the .80 specific gravity column of Table LD-14, page LD-37, shows that a No. 36-LD forged steel drain trap will open a 7/32" orifice at pressures up to 707 psig. As a matter of fact, this drain trap will open a 1/4" orifice at 501 psig and would be the one to use.

NOTE: While drain traps are sized on the basis of pressure differential, steel must be used whenever gauge pressure in the drain trap exceeds 250 psig.

Where Not to Use

Float type drain traps are not recommended where heavy oil, sludge or considerable dirt are encountered in lines. Dirt can prevent the valve from seating tightly, and cold oil can prevent float traps from opening. Where these conditions exist, Armstrong inverted bucket BVSW traps should be used.

How to Order Drain Traps

Specify:
- Drain trap size by number
- Orifice size
- Pipe connections—size and type
- Maximum operating pressure

If the correct drain trap cannot be determined, tell us capacity required, maximum pressure, and SPECIFIC GRAVITY of liquid.

Table LD-5. Conversion Factors to Find Cold Water Capacity Equivalents for Light Liquids

Specific Gravity	Multiply Light Liquid Capacity in Pounds Per Hour by:
.95	1.03
.90	1.06
.85	1.09
.80	1.12
.75	1.16
.70	1.20
.65	1.24
.60	1.29
.55	1.35
.50	1.42
.45	1.49
.40	1.58

How to Select and Size Armstrong Drain Traps

For Draining Water From a Light Liquid

Armstrong dual gravity drain traps for draining water from a light liquid are described on pages LD-47 and LD-48. All models shown are identical to corresponding models of traps used to drain liquid from a gas except that float weights are modified to make them suitable for draining water from a light liquid.

Dual gravity drain trap* selection requires that you know the peak heavy liquid load, maximum operating pressure, and specific gravity of the light liquid. With this information you can determine the orifice size required from Chart LD-12 and find the specific drain trap that will meet your conditions from the pressure tables on the dual gravity pages.

Selection Procedure for Draining Water from a Light Liquid

1. Assume a required safety factor of 2:1. Multiply the peak load in pounds per hour by 2. (See paragraph on "Safety Factors.")
2. From Capacity Chart LD-12, find the intersection of actual load times safety factor and the minimum operating pressure differential. Follow the pressure line immediately above this point to intersect the next higher orifice capacity curve. Then follow this curve downward and to the left to get the orifice size.
3. Inspect the tables on pages LD-47 and LD-48 to find the smallest trap that can open the predetermined orifice size at the maximum operating pressure differential. Do not oversize dual gravity drain traps. Oversizing will cause excessive fluctuation of the interface between the two liquids.

NOTE: While drain traps are sized on the basis of operating pressure differential, forged steel must be used when total pressure in the drain trap exceeds 250 psig.

How to Order Dual Gravity Drain Traps

Specify:

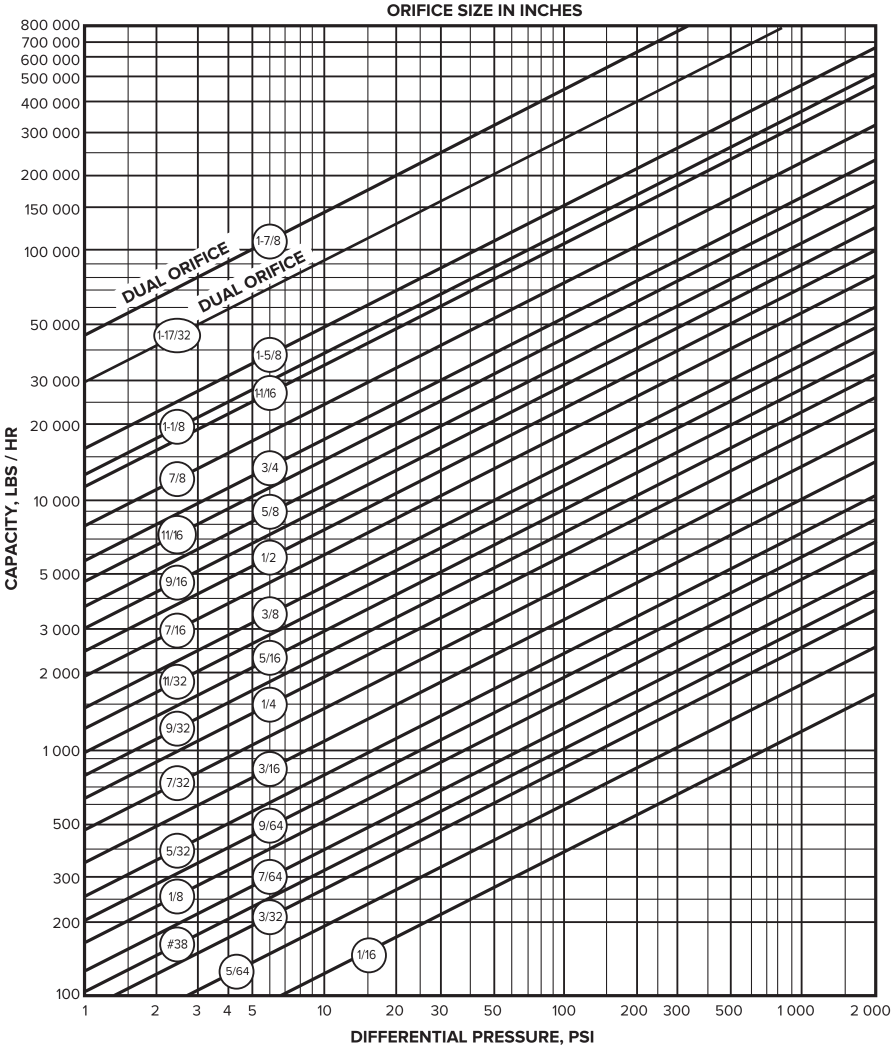
- Drain trap size by number
- Orifice size
- Pipe connections—size and type
- Specific gravity of light liquid
- Weight of water discharge per hour
- Maximum operating pressure

If you are not sure of the drain trap size to use, then specify:

- Specific gravity of light liquid
- Capacity in pounds of water per hour with safety factor included
- Working pressure—maximum and minimum

Chart LD-12.
Calculated Cold Water Capacity of Armstrong Drain Trap Orifices at Various Pressures

Actual capacity also depends on trap configuration, piping and flow to trap. It is important to allow for safety factors and fluid density variations due to temperature.



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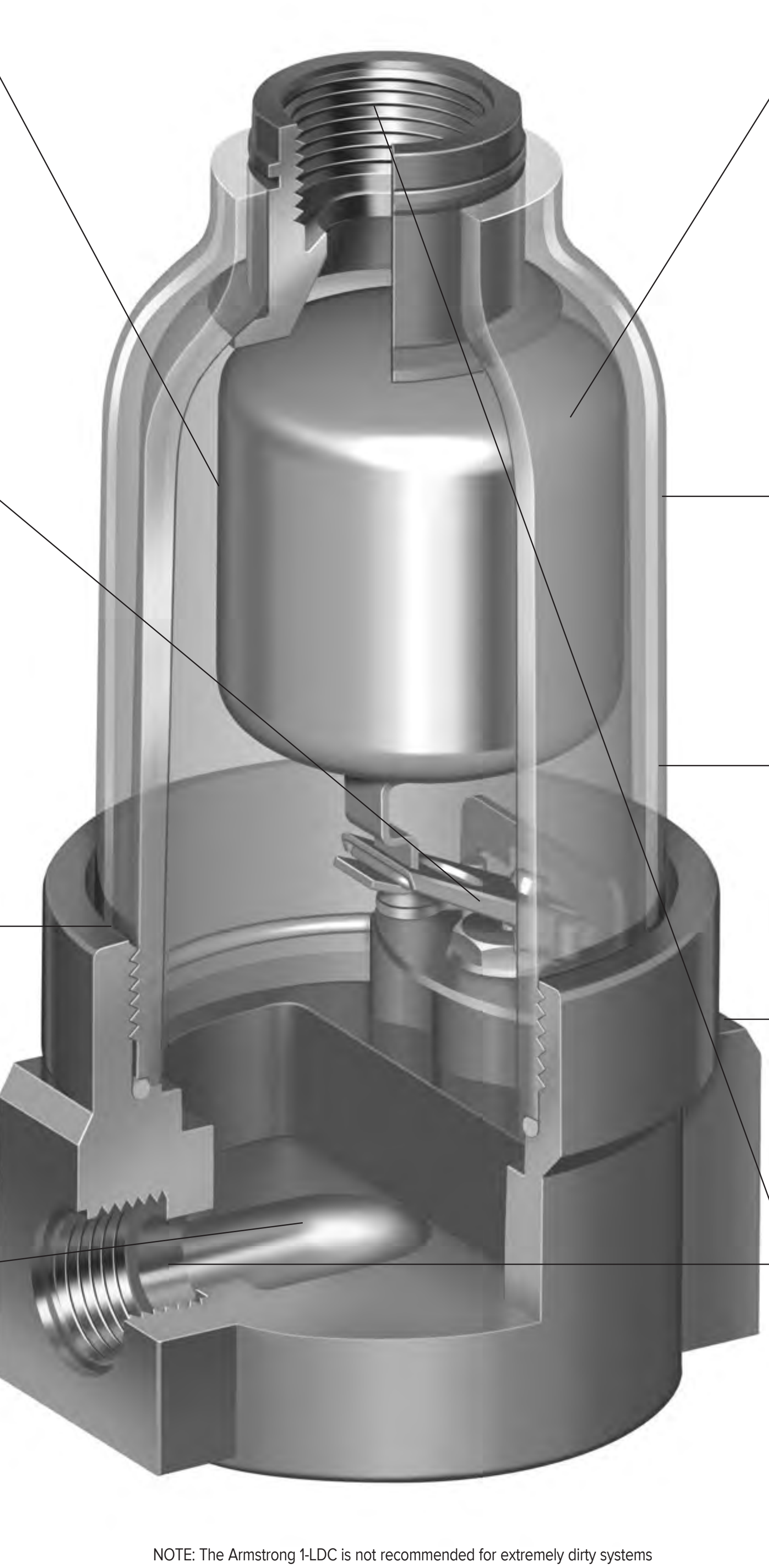
* Floats for dual gravity drain traps are weighted with quenching oil which, in the unlikely possibility of float failure, may be dispersed through the system. If this is a hazard, consult the Armstrong Application Engineering Department.

1-LDC—A See-Thru Body So You'll Know When It's Working

Benefits You Can See



Reduced maintenance
Stainless steel internals mean corrosion resistance and reduced maintenance.

Efficient operation
Simple ball float mechanism discharges only when liquid is present so it doesn't waste air.

Positive seating
Free-floating valve mechanism assures positive seating so it prevents air loss. There are no fixed pivots to wear or create friction, and wear points are heavily reinforced for long life.

An inside look
See-thru body means you can observe changing conditions as they occur. See a problem in the making—instead of having to deal with it after the fact.

In-line repairability
In-line connections and an O-ring seal make for quick, easy repairs without dismantling piping. Just unscrew and remove the body for maintenance.

Corrosion resistance
Long-lasting polysulfone body and reinforced nylon cap weigh less than 20% of cast iron liquid drain traps. Rugged polysulfone resists corrosion and provides long, trouble-free service life.

Reduced need for cleaning
Recessed dirt pocket gives dirt a place to accumulate away from the valve seat. Valve seat is 1-1/4" above the dirt pocket. Compared to other ball float drain traps, the Armstrong 1-LDC reduces dirt fouling and needs less frequent cleaning.

Simplified installation
Optional horizontal or vertical inlet with horizontal outlet eliminates the need for extra fittings. Makes installation in existing systems easier. Vertical inlet is 3/4" to accommodate air venting. Requires no electricity.

NOTE: The Armstrong 1-LDC is not recommended for extremely dirty systems or those with heavy oil carryover. The drain trap should not be used in an environment where there are high levels of ketones or chlorinated or aromatic hydrocarbons.

1-LDC—A See-Thru Body So You'll Know When It's Working

Now, you can literally see what you've been missing—the early warning signs of a drain trap or system problem. Since you'll know the operating condition of a drain trap, you won't waste time and money scheduling maintenance that isn't needed. In other words, you will be able to react to a condition before it becomes a problem.

A simple ball float mechanism requiring no electricity to operate, the new Armstrong 1-LDC discharges automatically only when liquid is present. That means no air loss as with timed devices, which open even when liquid is not present.

Moisture in a compressed air system causes a variety of problems— everything from dirt fouling and potential corrosion to water hammer. Getting the water out—automatically, reliably—builds greater efficiency into your system. In short, pay attention to your compressed air system, and you'll probably pay less to compress air.

Compare...and Save the Difference

Seeing really is believing—especially when you compare the Armstrong see-thru drain trap with cast iron units. Measure the differences in the time and money you can save with a more efficient, easier-to-maintain compressed air system. For more information or technical assistance, contact your local Armstrong Representative.

1-LDC See-Thru Liquid Drainer

For Loads to 1 500 lb/hr (690 kg/hr)...Pressures to 150 psig (10 barg)

Now, you can literally see what you've been missing—the early warning signs of a drain trap or system problem. Since you'll know the operating condition of a drain trap, you won't waste time and money scheduling maintenance that isn't needed. In other words, you'll be able to react to a condition before it becomes a problem.

A free floating mechanism needs no electricity to operate, the 1-LDC discharges automatically only when liquid is present. That means no air loss as with timed devices that open even when liquid is not present. Moisture in a compressed air system causes problems. Getting the water out—automatically, reliably—builds greater efficiency into your system.

For a fully detailed certified drawing, contact Armstrong.

List of Materials

Table LD-6.

Name of Part	Material
Cap and Fitting	Reinforced Nylon*
Body	Polysulfone
O-Rings (Cap, Body and Fitting)	Nitrile Elastomer Compound
Float, Lever and Screws	Stainless Steel
Valve & Seat	
Retainer Ring	Zinc-Plated Steel

*UV sensitive

Maximum Operation Pressures and Capacities

Table LD-7.

Specific Gravity	1.0				0.95			
Orifice Size	Maximum Operating Pressure		Capacity		Maximum Operating Pressure		Capacity	
	psig	barg	lb/hr	kg/hr	psig	barg	lb/hr	kg/hr
1/8	121	8.3	1 500	690	109	7.6	1 400	640
#38	150	10.0	1 100	510	150	10.0	1 100	490

Capacities given are continuous discharge capacities in lb/hr or kg/hr of liquid at pressure differential indicated.

Physical Data

Table LD-8.

	in	mm
Inlet Connections	1/2, 3/4	15, 20
Outlet Connection	1/2	15
Alternate Inlet or Vent Connection	1/2, 3/4	15, 20
"A"	3-1/2	89
"B"	6-7/8	175
"C"	6-3/32	155
Weight lbs (kg)	1 (0.45)	
Maximum Allowable Pressure (Vessel Design)	150 psig @ 150°F (10 barg @ 65°C)	
Maximum Operating Pressure psig (barg)	150 (10)	

How to Order

Body Inlet ①	Cap Inlet ②	Cap Outlet ③
3/4"	1/2"	1/2"
1/2" or 3/4"	1/2" or 3/4"	1/2"

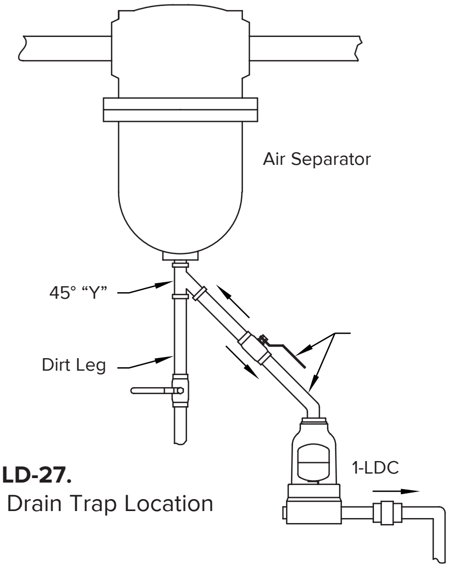
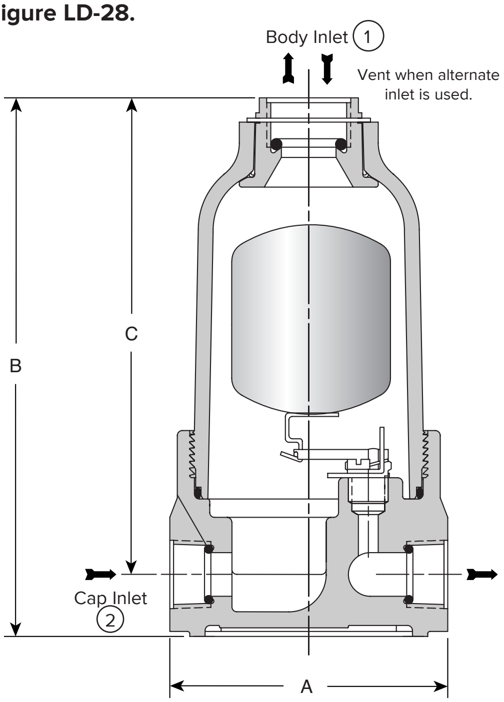


Figure LD-27.
Typical Drain Trap Location

Drain traps dispose of water that collects in many places in a compressed air system. Each drain trap arrangement must be considered individually.

Figure LD-28.



1-LDCW See-Thru Air Liquid Drainer for Ozone Applications

For Pressures to 150 psig (10 barg) or Specific Gravity 1.0

What Is Ozone?

Ozone is a gas that forms naturally during thunderstorms when lightning converts normal oxygen molecules (O^2) into ozone (O^3). The fresh, sweet smell in the air after a storm is the smell of ozone. The unstable ozone molecule reacts rapidly with most substances and is an extremely strong natural oxidant.

How Is Commercial Ozone Produced?

Ozone can be formed by exposing air to ultraviolet light; however, the most common method of generating ozone is by passing air through an electrical discharge. Because ozone has strong oxidizing properties, its production requires corrosion-resistant equipment.

How Is Ozone Used in Water Filtration and Purification?

Because ozone is such an effective oxidant, it kills viruses, bacteria, mold, mildew, fungus and germs. Passing ozone through water achieves high purification rates without any chemical residue. Oxygen is the only by-product.

Typical Customer Applications:

- Purifying standing ground water in Third World countries.
- Conditioning water for poultry and livestock.
- Purifying water in the bottled water industry.
- Filtering and purifying water for process applications.

A See-Thru Body Shows You It's Working

Now, you can literally see what you've been missing. The Armstrong 1-LDCW See-Thru Liquid Drainer lets you easily check its operating condition. You won't have to waste time and money scheduling maintenance that isn't needed, and you can quickly react to a condition before it becomes a problem.

Efficient Operation

Simple ball-float mechanism doesn't need electricity to operate. The liquid drainer automatically discharges liquid when it is present. No air or gas is lost, as with manual draining.

Positive Seating

Free-floating valve mechanism ensures positive seating and prevents liquid loss. There are no fixed pivots to wear or create friction. Wear points are heavily reinforced for long life.

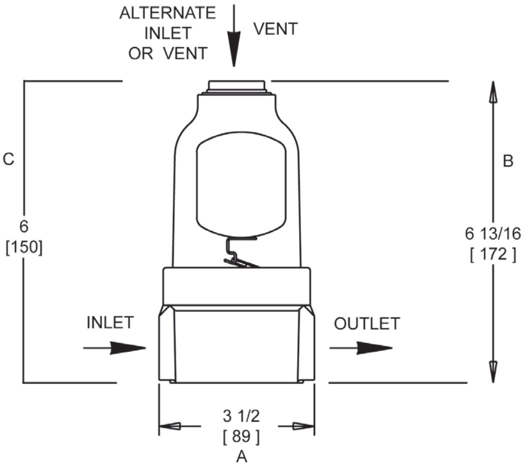
Corrosion Resistance

Long-lasting CPVC cap and polysulfone body provides trouble-free operation. T316 stainless steel internal parts resist corrosion and reduce maintenance.

Compare–and Save the Difference

Seeing really is believing–especially when you compare the Armstrong 1-LDCW See-Thru Air Liquid Drainer with manual drainage. Measure the time and money you can save with a more efficient, easier-to-maintain system. For more information or technical assistance, contact your local Armstrong Representative.

NOTE: The Armstrong 1-LDCW should not be used in an environment where there are high levels of ketones or chlorinated or aromatic hydrocarbons.



1-LDCW

List of Materials

Name of Part	Material
Cap	CPVC
Body	Polysulfone
O-Rings (Body Cap and Fitting)	Aflas
Float Lever and Screws	T316 Stainless Steel
Valve & Seat	T316 Stainless Steel
Fitting	CPVC
Retainer Ring	Zinc Plated Steel

Physical Data

	in	mm
Inlet Connection (In Body)	3/4	20
Inlet Connection (Alternate)	1/2	15
Outlet Connection	1/2	15
"A" Face-to-Face	3-1/2	89
"B" Height	6-13/16	172
"C" Bottom to C	6	152
Maximum Allowable Pressure (Vessel Design)	150 psig @ 150°F (10 barg @ 66°F)	
Maximum Operating Pressure	150 psig (10 barg)	
Specific Gravity Range	1.00 to 0.80	
Weight, lb (kg)	1 (.5)	

Armstrong®

Inverted Bucket Drain Traps (BVSW Model)

For Loads to 7 000 lb/hr (3 175 kg/hr)...Pressures to 650 psig (45 barg)

Armstrong inverted bucket drain traps are designed for systems where heavy oil and dirt may be encountered. The enlarged bucket vent equipped with a scrub wire (BVSW) keeps the drain trap operating under dirty conditions.

List of Materials

Table LD-9.

BVSW Model No.	Body & Cap	Valve & Seat	Bucket & Leverage System	Gasket
800, 811, 812, 813, 880, 881, 882, 883, 211, 212, 213	Cast Iron ASTM A48 Class 30	Stainless Steel		Compressed Asbestos-free
312, 313	Forged Steel ASTM A105			
981, 983	Cast Steel ASTM A216 Grade WCB			

Physical Data

Table LD-10. Orifices, Maximum Operating Pressure (See Chart LD-12, page LD-30, for cold water capacities at various pressures.)

Model No. / Orifice Size	800 BVSW 880 BVSW		811 BVSW 881 BVSW 211 BVSW		812 BVSW 882 BVSW 212 BVSW		312 BVSW*		813 BVSW 883 BVSW 213 BVSW 313 BVSW* 983 BVSW*		981 BVSW*	
in	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1/4	—	—	—	—	—	—	—	—	125	8.5	—	—
7/32	—	—	—	—	—	—	—	—	180	12.5	—	—
3/16	—	—	—	—	—	—	—	—	250	17	50	3.5
5/32	—	—	—	—	125	8.5	—	—	450	31	85	6
1/8	80	5.5	125	8.5	200	14	—	—	600	41	170	11
7/64	125	8.5	200	14	250	17	600	41	—	—	250	17
#38	150	10.5	250	17	—	—	—	—	—	—	330	22.5

NOTE: Larger capacity models available. Consult your local Armstrong Representative or the Armstrong factory.
* Use steel traps for pressures above 250 psig (17 barg).

Table LD-11. Armstrong 800 Series Drain Traps

Model No.	800 BVSW		811 BVSW		812 BVSW		813 BVSW	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4	15, 20	3/4, 1	20, 25
Test Plug	1/4	6	1/4	6	1/2	15	3/4	20
“A”	3-3/4	95	3-3/4	95	5-5/8	143	7	178
“B”	5-7/16	138	6-7/8	175	9-1/16	230	11-3/4	298
“C”	5	127	5	127	6-1/2	165	7-3/4	197
“D”	2-3/4	70	4-1/4	108	5-3/8	137	7-1/32	179
Number of Bolts	6		6		6		6	
Weight lbs (kg)	5 (2.3)		6 (2.7)		15 (6.8)		27-1/2 (13)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)							
Max. Operating Pressure psig (barg)	150 (10.5)		250 (17)					

NOTE: Larger capacity models available. Consult your local Armstrong Representative or the Armstrong factory.

Inverted Bucket Drain Traps (BVSW Model)

For Loads to 7 000 lb/hr (3 175 kg/hr)...Pressures to 650 psig (45 barg)

Physical Data

Table LD-12. Armstrong 880-980 Series Drain Traps With Integral Strainers (See pages LD-29 and LD-30 for capacity.)

Model No.	Cast Iron								Cast Steel			
	880 BVSW		881 BVSW		882 BVSW		883 BVSW		981 BVSW		983 BVSW	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4	15, 20	3/4, 1, 1-1/4	20, 25, 32	1/2, 3/4	15, 20	3/4, 1	20, 25
Test Plug	1/4	6	1/4	6	1/2	15	3/4	20	1/2	15	3/4	20
"A"	3-3/4	95	3-3/4	95	5-5/8	143	7	178	4-1/2	114	7-1/4	184
"B"	6-1/16	154	7-1/16	179	9-3/8	244	12-3/8	314	8-5/8	219	12-15/32	313
"C"	5	127	5	127	6-1/2	165	7-7/8	200	5-3/8	137	7-3/4	197
"D"	3-7/16	87.3	4-7/16	113	5-3/4	146	7-3/8	187	4-13/16	122	7-9/16	192
Number of Bolts	6		6		6		6		6		6	
Weight lbs (kg)	5-1/2 (2.5)		6 (2.7)		15-1/2 (7)		31 (14)		11-1/2 (5)		43 (20)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)								600 psig @ 650°F (41 barg @ 343°C)			
Max. Oper. Pressure psig (barg)	150 (10.5)		250 (17)						330 (22.5)		600 (41)	

NOTE: Larger capacity models available. Consult your local Armstrong Representative or the Armstrong factory.

Table LD-13. Armstrong 200-300 Series Drain Traps (See pages LD-29 and LD-30 for capacity.)

Model No.	Cast Iron						Forged Steel			
	211 BVSW		212 BVSW		213 BVSW		312 BVSW		313 BVSW	
Pipe Connections	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1/2, 3/4, 1	15, 20, 25	1/2, 3/4, 1	15, 20, 25
Test Plug	1/8	3	3/8	10	1/2	15	—	—	—	—
"A"	4-1/4	108	5-1/4	133	6-3/8	162	6-3/4	171	8	203
"B"	6-3/8	162	8-3/4	222	10-3/4	273	10-3/16	259	11-1/2	292
"G"	—	—	—	—	—	—	4-3/4	121	5-1/8	130
"K" (℄ Outlet to ℄ Inlet)	—	—	—	—	—	—	1-1/4	31.7	1-7/16	36.5
Number of Bolts	6		8		6		6		8	
Weight lbs (kg)	6 (2.7)		11-1/2 (5.2)		20-1/4 (9.2)		30 (14)		50 (23)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)						600 psig @ 650°F (41 barg @ 343°C)		1 080 psig @ 650°F (75 barg @ 343°C)	
Max. Oper. Pressure psig (barg)	250 (17)						600 (41)		650 (45)	

NOTE: Larger capacity models available. Consult your local Armstrong Representative or the Armstrong factory.

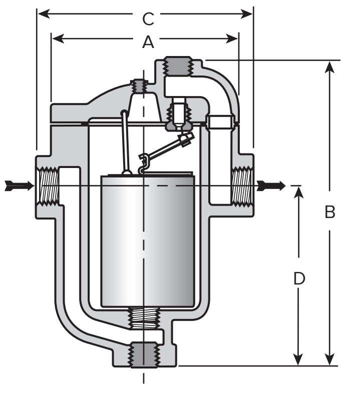


Figure LD-29.
Series 800

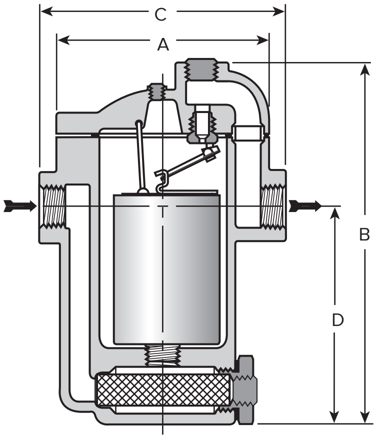


Figure LD-30.
Series 880 & 980

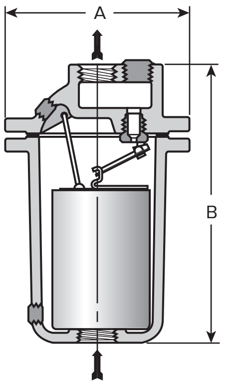


Figure LD-31.
Series 200

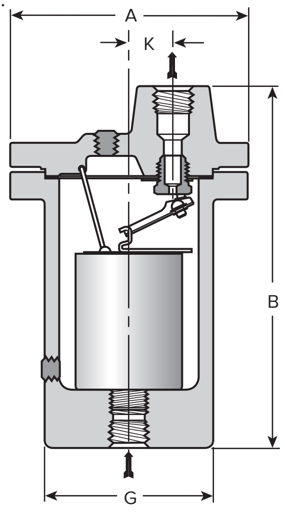


Figure LD-32.
Series 300

Free Floating Lever Drain Traps

For Loads to 50 000 lb/hr (22 679 kg/hr)...Pressures to 1 000 psig (69 barg)

Table LD-14. Maximum Operating Pressures for Handling Different Specific Gravity Liquids With Orifices Available in Guided Free Floating Lever Drain Traps. (See pages LD-29 and LD-30.)

Model No.	Sp. Grav	1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50	
	Orifice	Maximum Operating Pressure psig (barg)																					
	in	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1-LD	1/8	121	8.3	109	7.6	98	6.8	87	6.0	75	5.2	64	4.4	52	3.6	41	2.8	29	2.0	18	1.2	6	0.4
	7/64	143	9.9	130	9.0	116	8.0	103	7.1	89	6.1	75	5.2	62	4.3	48	3.3	35	2.4	21	1.4	7	0.5
	#38	182	12.5	164	11	147	10.2	130	9.0	113	7.8	95	6.6	78	5.4	61	4.2	44	3.0	26	1.8	9	0.6
	5/64	300	20.7	289	19.9	259	17.8	228	15.7	198	13.7	168	11.6	137	9.5	107	7.4	77	5.3	47	3.2	16	1.1
11-LD	1/8	176	12.1	161	11.1	146	10.1	130	9.0	115	7.9	100	6.9	85	5.8	69	4.8	54	3.7	39	2.7	24	1.6
	7/64	209	14	191	13	173	12	155	10.7	137	9.4	119	8.2	100	6.9	82	5.7	64	4.4	46	3.2	28	1.9
	#38	264	18	242	17	219	15	196	14	173	12	150	10.4	127	8.8	104	7.2	81	5.6	59	4.0	36	2.5
	5/64	400	28	400	28	384	27	344	24	304	21	264	18	224	15	183	13	143	9.9	103	7.1	63	4.3
2-LD to 250 psig (17 barg) 22-LD to 533 psig (37 barg)	5/16	22	1.5	20	1.4	18	1.3	17	1.1	15	1.0	13	0.9	11	0.8	10	0.7	8	0.5	6	0.4	4	0.3
	1/4	36	2.5	33	2.3	30	2.1	27	1.9	24	1.7	22	1.5	19	1.3	16	1.1	13	0.9	10	0.7	7	0.5
	3/16	79	5.5	73	5.0	67	4.6	60	4.2	54	3.7	47	3.3	41	2.8	35	2.4	28	2.0	22	1.5	16	1.1
	5/32	137	9.4	126	8.7	115	7.9	104	7.2	93	6.4	82	5.6	71	4.9	60	4.1	49	3.4	38	2.6	27	1.8
	1/8	234	16.1	215	14.8	196	13.5	178	12.2	159	10.9	140	9.6	121	8.4	102	7.1	83	5.8	65	4.5	46	3.2
	7/64	299	20.6	275	19	251	17.3	227	15.7	203	14	179	12	155	10.7	131	9.0	107	7.4	83	5.7	59	4.0
	#38	372	25.7	342	23.6	313	21.6	283	19.5	253	17.4	223	15	193	13	163	11.2	133	9.2	103	7.1	73	5.0
	5/64	533	37	475	33	461	32	417	29	372	26	328	23	284	20	240	17	196	14	152	10.5	108	7.4
32-LD	5/16	29	2.0	26	1.8	23	1.6	21	1.4	18	1.2	15	1.0	12	0.9	10	0.7	7	0.5	4	0.3	2	0.1
	1/4	47	3.3	43	3.0	38	2.6	34	2.3	29	2.0	25	1.7	20	1.4	16	1.1	12	0.8	7	0.5	3	0.2
	3/16	104	7.2	94	6.5	85	5.8	75	5.2	65	4.5	55	3.8	45	3.1	35	2.4	25	1.8	16	1.1	6	0.4
	5/32	180	12	163	11	146	10	129	8.9	112	7.7	95	6.5	78	5.4	61	4.2	44	3.0	27	1.9	10	0.7
	1/8	307	21	278	19	249	17	220	15	191	13	162	11	133	9	104	7.2	75	5.2	46	3.2	17	1.2
	7/64	393	27	356	25	319	22	282	19	245	17	207	14	170	12	133	9	96	6.6	59	4.1	22	1.5
	#38	489	34	443	31	397	27	351	24	304	21	258	18	212	15	166	11	120	8	73	5.1	27	1.9
	5/64	600	41	600	41	585	40	517	36	449	31	381	26	313	22	244	17	176	12	108	7	40	2.8
3-LD to 250 psig (17 barg) (Cast Iron) 13-LD to 570 psig (39 barg) (Stainless) 33-LD to 900 psig (62 barg) (Steel)	1/2	16	1.1	14	1.0	13	0.9	12	0.8	10	0.7	9	0.6	7	0.5	6	0.4	5	0.3	3	0.2	2	0.1
	3/8	33	2.3	31	2.1	28	1.9	25	1.7	22	1.5	19	1.3	16	1.1	13	0.9	10	0.7	7	0.5	4	0.3
	5/16	54	3.7	49	3.4	44	3.0	39	2.7	35	2.4	30	2.1	25	1.7	20	1.4	16	1.1	11	0.8	6	0.4
	9/32	71	4.9	65	4.5	59	4.0	52	3.6	46	3.2	40	2.7	34	2.3	27	1.9	21	1.4	15	1.0	8	0.6
	1/4	107	7.4	97	6.7	88	6.1	79	5.4	69	4.8	60	4.1	50	3.5	41	2.8	32	2.2	22	1.5	13	0.9
	7/32	153	10.5	139	9.6	126	8.7	112	7.7	99	6.8	85	5.9	72	5.0	59	4.0	45	3.1	32	2.2	18	1.2
	3/16	230	16	209	14	189	13	169	12	149	10.3	129	8.9	108	7.5	88	6.1	68	4.7	48	3.3	27	1.9
	5/32	359	25	327	23	296	20	264	18	233	16	201	14	169	12	138	9.5	106	7.3	74	5.1	43	2.9
	1/8	726	50	662	46	598	41	534	37	470	32	406	28	342	24	278	19	214	15	150	10.3	86	5.9
	7/64	900	62	847	58	765	53	683	47	601	41	519	36	437	30	356	25	274	19	192	13	110	7.6
6-LD Cast Iron	1-1/16	21	1.4	19	1.3	18	1.2	16	1.1	15	1.0	13	0.9	12	0.8	10	0.7	9	0.6	7	0.5	6	0.4
	7/8	32	2.2	30	2.1	28	1.9	26	1.8	23	1.6	21	1.4	19	1.3	16	1.1	14	1.0	12	0.8	9	0.6
	3/4	47	3.2	44	3.0	40	2.8	37	2.5	34	2.3	30	2.1	27	1.9	24	1.6	20	1.4	17	1.2	14	0.9
	5/8	72	4.9	67	4.6	61	4.2	56	3.9	51	3.5	46	3.2	41	2.8	36	2.5	31	2.1	26	1.8	21	1.4
	9/16	95	6.5	88	6.1	81	5.6	75	5.2	68	4.7	61	4.2	55	3.8	48	3.3	41	2.8	34	2.4	28	1.9
	1/2	138	9.5	128	8.8	118	8.1	108	7.5	99	6.8	89	6.1	79	5.4	69	4.8	59	4.1	50	3.4	40	2.8
	7/16	196	13	182	13	168	12	154	11	140	10	126	8.7	112	7.7	98	6.8	85	5.8	71	4.9	57	3.9
	3/8	250	17	250	17	250	17	243	17	221	15	199	14	177	12	155	11	133	9.0	111	7.7	90	6.2
	11/32	250	17	250	17	250	17	250	17	250	17	250	17	236	16	207	14	178	12	148	10	119	8.2
	5/16	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	228	16	191	13	153	11
	9/32	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	201	14
	1/4	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17
	7/32	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17
	3/16	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17	250	17
36-LD Forged Steel	1-1/16	16	1.1	15	1.01	13	0.91	12	0.81	10	0.71	9	0.6	7	0.5	6	0.4	4	0.3	3	0.2	1	0.1
	7/8	25	1.7	23	1.6	21	1.4	18	1.3	16	1.1	14	0.95	11	0.79	9	0.63	7	0.47	5	0.31	2	0.16
	3/4	36	2.5	33	2.3	30	2.1	27	1.8	23	1.6	20	1.4	17	1.1	13	0.91	10	0.68	7	0.45	3	0.22
	5/8	56	3.9	51	3.5	46	3.1	41	2.8	35	2.4	30	2.1	25	1.7	20	1.4	15	1.05	10	0.69	5	0.34
	9/16	74	5.1	67	4.6	60	4.2	54	3.7	47	3.2	40	2.8	34	2.3	27	1.8	20	1.4	13	0.92	7	0.46
	1/2	107	7.4	97	6.7	88	6.0	78	5.4	68	4.7	58	4.0	49	3.4	39	2.7	29	2.0	19	1.3	10	0.66
	7/16	152	10.5	138	9.6	125	8.6	111	7.6	97	6.7	83	5.7	69	4.8	55	3.8	41	2.9	27	1.9	14	0.94
	3/8	240	17	218	15	197	14	175	12	153	10.5	131	9.0	109	7.5	87	6.0	65	4.5	43	3.0	21	1.5
	11/32	320	22	291	20	262	18	233	16	203	14	174	12	145	10	116	8.0	87	6.0	58	4.0	29	2.0
	5/16	411	28	374	26	336	23	299	21	262	18	224	15	187	13	149	10.3	112	7.7	74	5.1	37	2.5
	9/32	539	37	490	34	441	30	392	27	343	24	293	20	244	17	195	13	146	10.1	97	6.7	48	3.3
	1/4	788	54	716	49	644	44	573	39	501	35	429	30	357	25	286	20	214	15	142	9.8	70	4.9
	7/32	1 000	69	1 000	69	910	63	808	56	707	49	606	42	505	35	403	28	302	21	201	14	99	6.9
	3/16	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	992	68	826	57	660	46	494	34	328	23	163	11.2
Specific Gravity		1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50	

NOTE: If specific gravity falls between those shown in the chart, use the next lower gravity. For example, if specific gravity is 0.73, use 0.70 gravity data.

High Temperature Service

Maximum allowable working pressures of floats decrease at temperatures above 100°F (37.8°C). Allow for approximately:

- 10% decrease at 200°F (93.3°C)
- 15% decrease at 300°F (148.9°C)
- 20% decrease at 400°F (204.4°C)

The float is not always the limiting factor, however. Consult with Armstrong Application Engineering if you have a high-temperature application that also requires maximum operating pressures.

Free Floating Lever Drain Traps

For Loads to 49 000 lb/hr (22 226 kg/hr)...Pressures to 300 psig (21 barg)

Armstrong's cast iron, free floating lever drain traps use the same bodies, caps, lever mechanisms, valves and seats of Armstrong inverted bucket steam traps that have been proven in years of service. Elliptical floats and high leverage make it possible to open large orifices to provide adequate capacity for drain trap size and weight.

List of Materials

Table LD-15.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
1-LD 2-LD 3-LD 6-LD	Stainless Steel			Cast Iron ASTM A48 Class 30	Compressed Asbestos-free

For information on special materials, consult the Armstrong Application Engineering Department.

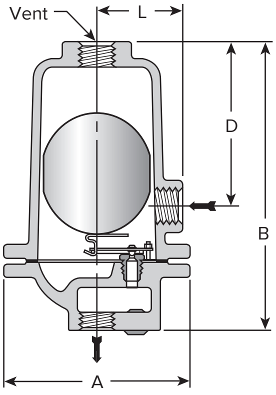


Figure LD-33.
No. 2-LD, 3-LD and 6-LD cast iron guided lever drain traps. No. 1-LD has standard top inlet and optional side connection.

The hemispherical valve, seat and leverage of the 1-LD, 2-LD, 3-LD and 6-LD cast iron traps are identical in design, materials and workmanship to those for saturated steam service up to 300 psig (21 barg) with the exception of the addition of a guidepost to assure a positive, leaktight valve closing under all conditions.

For a fully detailed certified drawing, refer to:
1-LD CD #1070
2-LD, 3-LD, 6-LD CD #1034

Physical Data

Table LD-16. Armstrong Guided Lever Liquid Drain Traps

Model No.	Cast Iron							
	1-LD		2-LD		3-LD		6-LD	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2*	15*	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1-1/2, 2	40, 50
“A”	3-3/4	95	5-1/4	133	6-3/8	162	10-3/16	259
“B”	5-1/2	140	8-3/4	222	11-1/2	292	18	457
“D”	2-7/8	73	5-1/8	130	7	188	9-3/8	238
“K” (℄ Outlet to ℄ Inlet)	13/16	21	—	—	—	—	—	—
“L”	1-7/8	48	2-7/16	62	2-7/8	73	4-5/8	117
Approx. Wt. lb (kg)	4 (2)		12 (5.5)		21 (9.5)		78 (35.5)	
Max. Allow. Pressure (Vessel Design)	300 psig @ 200°F† (21 barg @ 93°C)		250 psig @ 450°F (17 barg @ 232°C)					

NOTE: Vessel design pressure may exceed float collapse pressure in some cases.
Pipe size of vent connection is same as that of inlet and outlet connections.
†For pressures not exceeding 250 psig (17 barg), a maximum temperature of 450°F (232°C) is allowed.
*1/4" (6 mm) outlet.

Free Floating Lever Drain Traps

For Loads to 9 500 lb/hr (4 309 kg/hr)...Pressures to 570 psig (39 barg)

Armstrong's stainless steel, free floating lever drain traps use the same bodies, caps, lever mechanisms, valves and seats of Armstrong inverted bucket steam traps that have been proven in years of service. Elliptical floats and high leverage make it possible to open large orifices to provide adequate capacity for drain trap size and weight.

The hemispherical valve, seat and leverage of the 11-LD, 22-LD and 13-LD stainless steel traps are identical in design, materials and workmanship to those for saturated steam service up to 570 psig (39 barg) with the exception of the addition of a guidepost to assure a positive, leaktight valve closing under all conditions.

For a fully detailed certified drawing, refer to list below:
11-LD CD #1066
13-LD and 22-LD CD #1086

List of Materials

Table LD-17.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
11-LD 22-LD 13-LD	Stainless Steel*			Sealed Stainless Steel, 304L*	—

*11-LD available in all-316SS. Consult factory.

For information on special materials, consult the Armstrong Application Engineering Department.

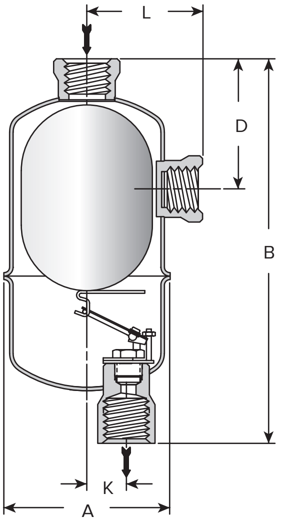


Figure LD-34.
No. 22-LD and 13-LD stainless steel guided lever liquid drain trap with sealed, tamperproof construction.

Physical Data

Table LD-18. Armstrong Guided Lever Liquid Drain Traps

Model No.	Stainless Steel					
	11-LD**		22-LD		13-LD	
Pipe Connections	in	mm	in	mm	in	mm
	3/4*	20*	3/4	20	1	25
"A"	2-3/4	70	3-15/16	100	4-1/2	114
"B"	7-1/4	184	8-13/16	224	11-3/8	289
"D"	—	—	3	76	6-1/8	156
"K"	9/16	14	7/8	22	1-3/16	30
"L"	—	—	2-5/8	67	3-9/32	83
Approx. Wt. lbs (kg)	1-3/4 (0.79)		3-1/4 (1.5)		7-1/2 (3.4)	
Max. Allowable Pressure (Vessel Design)	500 psig @ 100°F (35 barg @ 38°C) 440 psig @ 500°F (30 barg @ 260°C)		600 psig @ 100°F (41 barg @ 38°C) 475 psig @ 500°F (33 barg @ 260°C)		570 psig @ 100°F (39 barg @ 38°C) 490 psig @ 500°F (34 barg @ 260°C)	

Note: Vessel design pressure may exceed float collapse pressure in some cases.
Pipe size of vent connection is same as that of inlet and outlet connections.
*1/2" (15 mm) outlet. **No side connection.

Free Floating Lever Drain Traps

For Loads to 42 000 lb/hr (19 050 kg/hr)...Pressures to 1 000 psig (69 barg)

Armstrong's forged steel, free floating lever drain traps use the same bodies, caps, lever mechanisms, valves and seats of Armstrong inverted bucket steam traps that have been proven in years of service. Elliptical floats and high leverage make it possible to open large orifices to provide adequate capacity for drain trap size and weight.

The hemispherical valve, seat and leverage of the 32-LD, 33-LD and 36-LD forged steel traps are identical in design, materials and workmanship to those for saturated steam service up to 1 000 psig (69 barg) with the exception of the addition of a guidepost to assure a positive, leaktight valve closing under all conditions.

For a fully detailed certified drawing, refer to CD #1035.

List of Materials

Table LD-21.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
32-LD 33-LD 36-LD	Stainless Steel			Forged Steel ASTM A105	Compressed Asbestos-free

For information on special materials, consult the Armstrong Application Engineering Department.

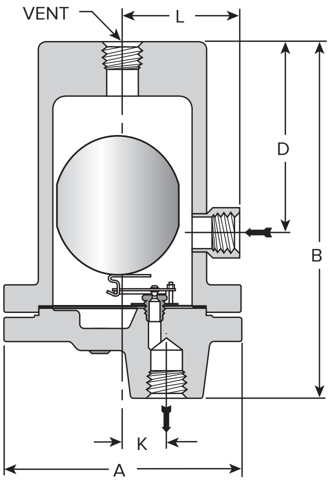


Figure LD-37.
No. 32-LD, 33-LD and 36-LD forged steel guided lever drain trap. Socketweld or flanged connections are also available.

Physical Data

Table LD-22. Armstrong Guided Lever Liquid Drain Traps

Model No.	Forged Steel					
	32-LD†		33-LD†		36-LD†	
Pipe Connections	in	mm	in	mm	in	mm
	1/2, 3/4, 1	15, 20, 25	1/2, 3/4, 1	15, 20, 25	1-1/2, 2	40, 50
"A"	6-3/4	171	8	203	11-7/8	302
"B"	10-3/16	259	11-9/16	294	17-1/8	435
"D"	5-9/16	141	6-1/16	154	9	229
"K"	1-1/4	32	1-7/16	37	2-1/8	54
"L"	3-3/8	86	3-9/16	90	6-1/16	154
Approx. Wt. lbs (kg)	31 (14)		49 (22)		163 (74)	
Max. Allowable Pressure (Vessel Design)	600 psig @ 100°F (41 barg @ 38°C) 500 psig @ 750°F (35 barg @ 400°C)		1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 400°C)			

Note: Vessel design pressure may exceed float collapse pressure in some cases.
Pipe size of vent connection is same as that of inlet and outlet connections.
†Available in Type 316 stainless steel. Consult factory.

Armstrong®

180 Series Free Floating Lever Drain Traps

All Stainless Steel for Horizontal Installation

For pressures to 400 psig (28 barg) . . . Capacities to 2 000 lb/hr (907 kg/hr)

Armstrong's stainless steel, free floating lever drain traps use the same bodies, caps, lever mechanisms, valves and seats as Armstrong inverted bucket steam traps that have been proven in years of service. Elliptical floats and high leverage make it possible to open large orifices to provide adequate capacity for drain trap size and weight.

The hemispherical valve, seat and leverage of the 180-LD and 181-LD stainless steel traps are identical in design, materials and workmanship to those for saturated steam service up to 570 psig (39 barg), except that the 180 Series traps have a guidepost to ensure a positive, leak-tight valve closing under all conditions. The 180 Series is designed for situations where mounting a drainer close to the floor is critical. A back vent connection is required.

For a fully detailed certified drawing, refer to list below:
180-LD CD #1276

List of Materials

Table LD-19.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap
180-LD 181-LD	Stainless Steel			Sealed Stainless Steel 304L

Physical Data

Table LD-20. Armstrong 180 Series Free Floating Lever Drain Traps

Model No.	180-LD		181-LD	
Pipe Connections	in	mm	in	mm
	1/2	15	3/4	20
"A" (Diameter)	2-11/16	68	2-11/16	68
"B" (Height)	6	152	7-1/4	184
"C" (Face to Face)	4-5/16	110	4-5/16	110
"D" (Bottom to C Inlet)	5-1/8	130	6-9/32	160
"P"	1/2	15	3/4	20
Weight, lb (kg)	1-3/4 (0.8)		2-3/8 (1.1)	
Max. Allowable Pressure (Vessel Design)	500 psig @ 100°F (35 barg @ 38°C) 440 psig @ 500°F (30 barg @ 260°C)			

Note: Vessel design pressure may exceed float collapse pressure in some cases. Pipe size of vent is same as that of inlet and oulet connections.

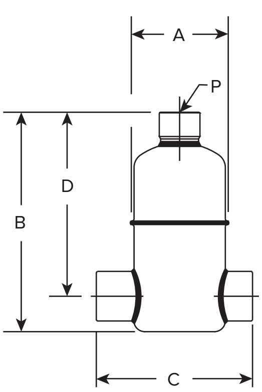


Figure LD-35.
Model 180-LD

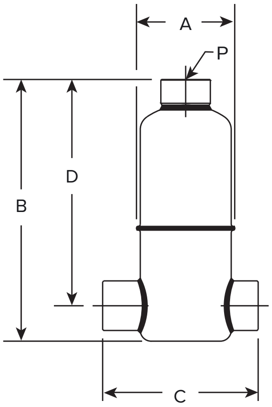


Figure LD-36.
Model 181-LD

Chart LD-13. Model 180-LD Capacity

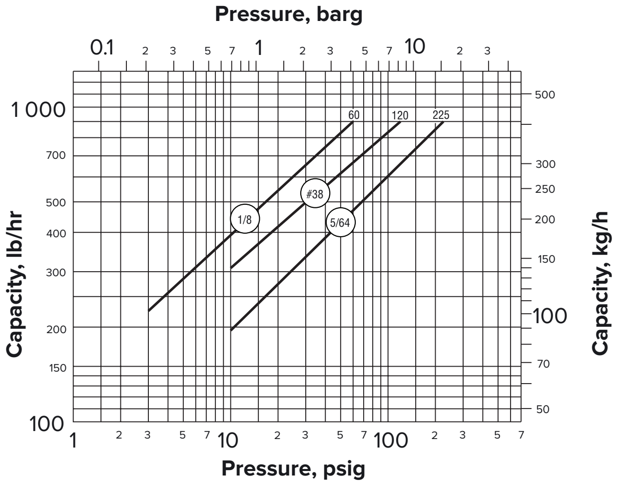
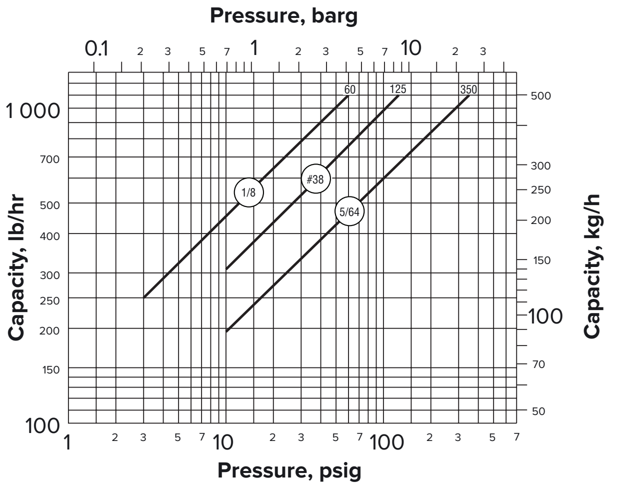


Chart LD-14. Model 181-LD Capacity



Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Notes

Liquid Drainers

Fixed Pivot and Snap Action Drain Traps

For Loads to 3 900 lb/hr (1 769 kg/hr)...Pressures to 1 000 psig (69 barg)

Continuous Flow or On-Off Float Type Drain Traps

Armstrong's line of fixed lever and snap action drain traps includes two basic models available in cast iron and forged steel. The floats are light enough to handle light liquids.

No. 21—A small, high-quality, economical drain trap for use on drainage jobs where dirt and oil are not encountered. It employs a single lever with a fixed pivot.

No. 21-312—Forged steel version of the No. 21 with larger float and higher leverage.

No. 71-A—Wide open, tight-shut drain trap for use where fine dirt and grit may be present or where liquid load is light. A flat spring in the leverage system holds the valve closed until the trap body is nearly full of water. Then it snaps open, washing dirt through. When the trap body is nearly empty, the spring snaps the valve shut.

No. 71-315—Forged steel version of No. 71-A.

CAUTION: Ball float drain traps are not recommended where heavy oil, sludge or considerable dirt are encountered in lines. Under these circumstances use Armstrong inverted bucket BVSW traps.

Table LD-23. Maximum Operating Pressures for Handling Different Specific Gravity With Orifices Available in Fixed Lever and Snap Action Drain Traps (See pages LD-29 and LD-30.)

Model No.		Sp. Grav.	1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50	
		Orifice size (in)	Maximum Operating Pressure psig (barg) at 100°F (38°C)																					
		psig	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
21		1/4	22	1.5	20	1.4	18	1.3	16	1.1	15	1.0	13	0.9	11	0.8	10	0.7	8	0.5	6	0.4	4	0.3
		7/32	28	1.9	26	1.8	24	1.6	21	1.5	19	1.0	17	1.2	15	1.0	12	0.9	10	0.7	8	0.6	6	0.4
		3/16	38	2.6	35	2.4	32	2.2	29	2.0	26	1.8	23	1.6	20	1.4	17	1.2	14	1.0	11	0.7	8	0.5
		5/32	54	3.8	50	3.5	46	3.2	41	2.9	37	2.6	33	2.3	29	2.0	24	1.7	20	1.4	16	1.1	11	0.8
		9/64	67	4.6	62	4.2	56	3.9	51	3.5	46	3.1	40	2.8	35	2.4	30	2.1	24	1.7	19	1.3	14	1.0
		1/8	84	5.8	78	5.4	71	4.9	64	4.4	58	4.0	51	3.5	44	3.0	37	2.6	31	2.1	24	1.7	17	1.2
		3/32	148	10.2	136	9.4	124	8.6	112	7.7	101	6.9	89	6.1	77	5.3	66	4.5	54	3.7	42	2.9	30	2.1
		5/64	210	14	193	13	176	12	160	11	143	9.9	126	8.7	110	7.6	93	6.4	77	5.3	60	4.1	43	3.0
		1/16	250	17	250	17	250	17	245	17	220	15	194	13	168	12	143	9.9	117	8.1	92	6.3	66	4.6
21-312*	3-3/8 oz (96 g) Float	1/4	42	2.9	39	2.7	36	2.5	33	2.3	30	2.1	28	1.9	25	1.7	22	1.5	19	1.3	16	1.1	13	0.9
		7/32	54	3.8	51	3.5	47	3.2	43	3.0	40	2.7	36	2.5	32	2.2	28	2.0	25	1.7	21	1.5	17	1.2
		3/16	74	5.1	69	4.7	64	4.4	59	4.0	54	3.7	49	3.4	44	3.0	39	2.7	34	2.3	28	2.0	23	1.6
		5/32	200	14	197	14	182	13	168	12	153	10.6	139	9.6	125	8.6	110	7.6	96	6.6	82	5.6	67	4.6
	4-1/2 oz (128 g) Float	9/64	229	16	211	15	200	14	200	14	189	13	171	12	153	10.6	136	9.4	118	8.1	100	6.9	83	5.7
		1/8	288	20	266	18	243	17	221	15	200	14	200	14	193	13	171	12	148	10.2	126	8.7	104	7.2
		3/32	500	34	465	32	426	29	387	27	348	24	309	21	270	19	231	16	200	14	200	14	182	13
	6 oz (170 g) Float	5/64	589	41	533	37	500	34	500	34	495	34	440	30	384	27	329	23	274	19	218	15	200	14
		1/16	600	41	600	41	600	41	600	41	563	39	500	34	500	34	500	34	420	29	335	23	250	17
71-A & 71-315 **		1/4	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	10	0.7	—	—	—	—	—	—
		3/16	20	1.4	20	1.4	20	1.4	20	1.4	20	1.4	20	1.4	20	1.4	20	1.4	—	—	—	—	—	—
		1/8	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9	—	—	—	—	—	—
		7/64	200	14	200	14	200	14	200	14	200	14	200	14	200	14	200	14	—	—	—	—	—	—
71-A		5/64	250	17	250	17	250	17	250	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—
71-315		5/64	500	35	500	35	500	35	500	35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		1/16	1 000	69	1 000	69	1 000	69	1 000	69	—	—	—	—	—	—	—	—	—	—	—	—	—	—

NOTE: If actual specific gravity falls between those shown in above table, use next lower. For example, if actual gravity is 0.73, use 0.70 gravity data.

*5/32" orifice (and smaller) utilizes higher leverage mechanism designated 21-312V.

**Use 6 1/4 oz. float for 0.85 - 1.0 S.G. Use 3 3/8 oz. float for 0.65 - 0.80 S.G.

Fixed Pivot and Snap Action Drain Traps

For Loads to 3 900 lb/hr (1 769 kg/hr)...Pressures to 1 000 psig (69 barg)

Physical Data

Table LD-24. Armstrong Fixed Lever and Snap Action Drain Traps

Model No.	Cast Iron				Forged Steel			
	21†		71-A*		21-312†		71-315*	
Pipe Connections	in	mm	in	mm	in	mm	in	mm
	1/2, 3/4	15, 20	3/4, 1	20, 25	1/2, 3/4, 1	15, 20, 25	3/4, 1, 1-1/4, 1-1/2	20, 25, 32, 40
"A"	6-3/16	157	8-1/2	216	6-3/4	171	9-3/4	248
"B"	5-1/4	133	10-3/4	273	10-3/16	259	15-5/8	397
"D"	—	—	4-1/4	108	5-9/16	141	7-13/16	198
"K"	1-5/16	33	—	—	1-1/4	32	—	—
"L"	—	—	3-1/2	89	3-5/16	84	4-5/8	117
Weight, lbs (kg)	8 (4)		29 (13)		30 (14)		92 (42)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)				600 psig @ 100°F (41 barg @ 38°C) 500 psig @ 750°F (34 barg @ 400°C)		1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 400°C)	

† Cast 316 stainless steel body and cap with all stainless steel internals available. Aluminum body and cap available for Model 21 only. Consult factory.

*Snap action drain traps should not be used where load exceeds 120 lb/hr (54 kg/hr). Use on greater loads shortens spring life.

List of Materials

Table LD-25.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
21	Stainless Steel			Cast Iron ASTM A48 Class 30	Compressed Asbestos-free
71-A					
21-312 71-315				Forged Steel* ASTM A105	

*No. 71-315 cap is cast steel.

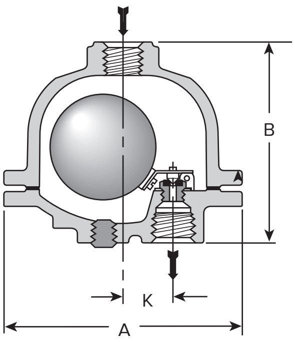


Figure LD-38.
No. 21 cast iron fixed lever drain trap.

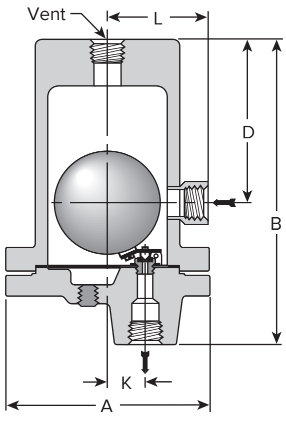


Figure LD-39.
No. 21-312 forged steel fixed lever drain trap.

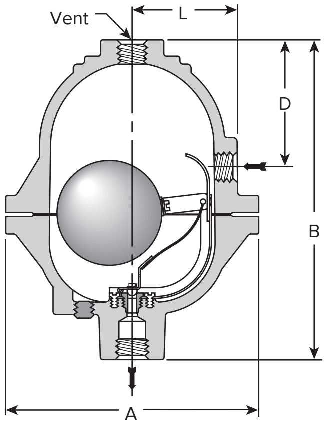


Figure LD-40.
No. 71-A cast iron snap action drain trap.

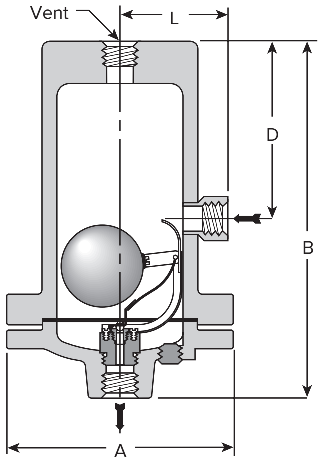


Figure LD-41.
No. 71-315 forged steel snap action drain trap.

For a fully detailed certified drawing, refer to list below:

No. 21	**CD #1037**	**No. 71-A**	**CD #1038**
No. 21-312	**CD #1106**	**No. 71-315**	**CD #1107**

High Leverage Spring-Loaded Ball Float Type Drain Traps

For Low Flows at Pressures to 3 700 psig (255 barg) and Specific Gravity Down to 0.40

The Armstrong High Leverage Series of liquid drain traps was developed especially for draining low specific gravity fluids from gases at high pressures. They use standard Armstrong forged steel bodies with very high leverage systems and spring assist.

NOTE: Models 2313-HLS, 2316-HLS, 2413-HLS and 2415-HLS are also available with cast T-316 stainless steel body and all-stainless steel internals. Consult factory.

Because of design considerations in this drain trap, it is essential that a safety factor of at least 2 be applied to the peak liquid load for sizing purposes.

Do not use HLS drain traps on steam service.

Sour Gas Service
Forged steel and stainless steel traps can be modified to resist hydrogen sulfide stress corrosion. These modifications involve annealing the float, which will reduce the maximum working pressure of the float to about half its normal value. Consult Armstrong Application Engineering for allowable working pressures.

Table LD-26. Reference Data

Model No.	Float Diameter	Unbalanced Float Weight
2313-HLS 2413-HLS 25133G-HLS	3-1/2" (89 mm)	4 oz (113 g)
2315-HLS 2415-HLS 25155G-HLS 26155G-HLS	4" (102 mm)	4-1/2 oz (128 g)
2316-HLS 2416-HLS	5" (127 mm)	6 oz (170 g)

Table LD-27. Maximum Operating Pressures for Handling Different Specific Gravity Liquids With Orifices Available in High Leverage Drain Traps (See pages LD-29 and LD-30.)

Model No.	Sp. Grav.	1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50		.45		.40	
	Orifice	Maximum Operating Pressure psig (barg) at 100°F (38°C)																									
	in	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
2313-HLS	1/16	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	630	43
	5/64	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	940	65	670	47	410	29
	3/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	850	58	660	46	480	33	290	20
	7/64	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	910	63	770	53	630	44	490	34	360	25	220	15
	1/8	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	920	63	810	56	700	48	600	41	490	34	380	26	280	19	170	11.7
2315-HLS	3/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	960	66
	1/8	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	900	62	730	50	550	38
	5/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	930	64	810	56	700	48	590	40	470	33	360	25
	3/16	1 000	69	1 000	69	1 000	69	970	67	890	61	810	56	730	50	650	45	570	39	490	34	410	28	330	23	250	17
2316-HLS	3/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69
	1/8	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69
	5/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69
	3/16	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	830	57
	7/32	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	1 000	69	880	61	750	52	620	43
2413-HLS	1/16	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 420	98	1 020	71	630	43
	5/64	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 460	101	1 200	83	940	65	670	47	410	29
	3/32	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 500	103	1 400	97	1 220	84	1 030	71	850	58	660	46	480	33	290	20
	7/64	1 500	103	1 500	103	1 500	103	1 460	101	1 320	91	1 180	82	1 050	72	910	63	770	53	630	44	490	34	360	25	220	15
2415-HLS	3/32	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 560	108	1 260	87	960	66
	1/8	1 800	124	1 800	124	1 800	124	1 800	124	1 800	124	1 780	122	1 600	110	1 430	98	1 250	86	1 080	74	900	62	730	50	550	38
	5/32	1 720	119	1 610	111	1 490	103	1 380	95	1 270	87	1 150	80	1 040	72	930	64	810	56	700	48	590	40	470	33	360	25
	3/16	1 210	83	1 130	78	1 050	72	970	67	890	61	810	56	730	50	650	45	570	39	490	34	410	28	330	23	250	17
2416-HLS	3/32	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110
	1/8	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110
	5/32	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 480	102	1 220	84
	3/16	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 580	109	1 400	97	1 220	84	1 040	72	860	59
	7/32	1 600	110	1 600	110	1 600	110	1 600	110	1 600	110	1 570	108	1 440	99	1 300	90	1 170	81	1 040	71	900	62	770	53	640	44
25133G-HLS	1/16	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	1 820	125	1 420	98	1 020	71	630	43
	5/64	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	2 120	146	1 980	137	1 720	119	1 460	101	1 200	83	940	65	670	47	410	29
	3/32	2 120	146	2 120	146	2 120	146	1 960	135	1 770	122	1 590	110	1 400	97	1 220	84	1 030	71	850	58	660	46	480	33	290	20
	7/64	1 870	129	1 740	120	1 600	110	1 460	101	1 320	91	1 180	82	1 050	72	910	63	770	53	630	44	490	34	360	25	220	15
25155G-HLS	5/64	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 210	152	1 780	123	1 350	93
	3/32	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 520	174	2 470	170	2 170	150	1 870	129	1 560	108	1 260	87	960	66
	1/8	2 520	174	2 470	171	2 300	159	2 130	147	1 950	135	1 780	122	1 600	110	1 430	98	1 250	86	1 080	74	900	62	730	50	550	38
	5/32	1 720	119	1 610	111	1 490	103	1 380	95	1 270	87	1 150	80	1 040	72	930	64	810	56	700	48	590	40	470	33	360	25
	3/16	1 210	83	1 130	78	1 050	72	970	67	890	61	810	56	730	50	650	45	570	39	490	34	410	28	330	23	250	17
26155G-HLS	5/64	3 700	255	3 700	255	3 700	255	3 700	255	3 700	255	3 700	255	3 700	255	3 490	241	3 060	211	2 630	182	2 210	152	1 780	123	1 350	93
	3/32	3 700	255	3 700	255	3 700	255	3 680	254	3 380	233	3 080	212	2 770	191	2 470	170	2 170	150	1 870	129	1 560	108	1 260	87	960	66
	1/8	2 650	183	2 470	171	2 300	159	2 130	147	1 950	135	1 780	122	1 600	110	1 430	98	1 250	86	1 080	74	900	62	730	50	550	38
	5/32	1 720	119	1 610	111	1 490	103	1 380	95	1 270	87	1 150	80	1 040	72	930	64	810	56	700	48	590	40	470	33	360	25
	3/16	1 210	83	1 130	78	1 050	72	970	67	890	61	810	56	730	50	650	45	570	39	490	34	410	28	330	23	250	17
Specific Gravity		1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50		.45		.40	

NOTE: If actual specific gravity falls between those shown in above table, use next lower. For example, if actual gravity is 0.73, use 0.70 data.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

High Leverage Spring-Loaded Ball Float Type Drain Traps

For Low Flows at Pressures to 3 700 psig (255 barg) and Specific Gravity Down to 0.40

List of Materials

Table LD-28.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
2313-HLS 2315-HLS 2316-HLS	Stainless Steel			ASTM A105 Forged Steel	Compressed Asbestos-free
2413-HLS 2415-HLS 2416-HLS 25133G-HLS 25155G-HLS 26155G-HLS				ASTM A182 Grade F22 Forged Steel	

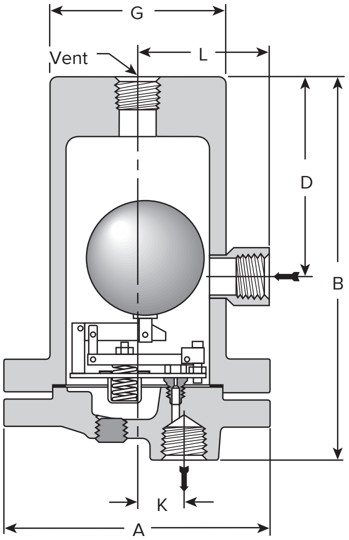


Figure LD-42.
High leverage ball float drain trap.

For a fully detailed certified drawing, refer to CD #1074.

Physical Data

Table LD-29. High Leverage Spring-Loaded Ball Float Type Drain Traps

Model No.	2313-HLS†		2315-HLS		2316-HLS		2413-HLS†		2415-HLS†		2416-HLS		25133G-HLS		25155G-HLS		26155G-HLS	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4, 1	15, 20, 25	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50	1/2, 3/4, 1	15, 20, 25	1, 1-1/4, 1-1/2	25, 32, 40	1-1/2, 2	40, 50	1/2, 3/4, 1	15, 20, 25	3/4, 1, 1-1/4	20, 25, 32	1, 1-1/4, 1-1/2	25, 32, 40
“A”	8	203	9-3/4	248	11-7/8	302	8-5/8	219	10-3/4	273	12-1/2	318	8-1/2	216	10-3/8	263	11-3/4	298
“B”	11-9/16	294	15-1/16	383	17-1/8	435	11-7/8	3 002	15	381	17-3/4	451	14-1/4	362	16-7/32	412	24-1/8	613
“D”	6-1/16	154	7-13/16	198	9	229	5-3/8	137	7-1/4	184	9	229	3	75	4	102	5	127
“G”	5-1/8	130	6-7/8	175	8-3/8	213	5-3/8	137	6-7/8	175	8-5/8	219	5-3/4	146	7-3/8	187	8-3/8	213
“K”	1-7/16	37	1-3/4	44	2-1/8	54	1-7/16	37	1-3/4	44	2-1/8	54	1-5/16	33	1-3/4	44	1-3/4	44
“L”	3-7/8	98	4-11/16	119	5-3/4	146	4	102	4-13/16	122	5-13/16	148	—	—	—	—	—	—
Weight, lbs (kg)	46 (21)		98 (44)		160 (73)		69 (31)		130 (59)		210 (95)		113 (51)		171 (78)		325 (147)	
Maximum Allowable Pressure (Vessel Design)	1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 400°C)						1 500 psig @ 100°F (103 barg @ 38°C) 900 psig @ 850°F (62 barg @ 454°C)		1 800 psig @ 100°F (125 barg @ 38°C) 900 psig @ 900°F (62 barg @ 482°C)				2 120 psig @ 100°F (146 barg @ 38°C) 1 700 psig @ 900°F (117 barg @ 482°C)		2 520 psig @ 100°F (174 barg @ 38°C) 2 000 psig @ 900°F (138 barg @ 482°C)		3 700 psig @ 100°F (255 barg @ 38°C) 3 000 psig @ 900°F (207 barg @ 482°C)	

Note: Available with screwed, socketweld or flanged connections.
† Available with cast 316 stainless steel body and all stainless steel internals. Consult factory.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Free Floating Lever Dual Gravity Drain Traps

For Pressures to 1 000 psig (69 barg)

Armstrong free floating lever dual gravity drain traps are identical to the units described on pages LD-38 and LD-40 except float weights are modified to make them suitable for draining water from a light liquid. If you wish to use them for draining any liquid with specific gravity other than 1.00, consult the Armstrong Application Engineering Department.

Floats for dual gravity drain traps are weighted with quenching oil which, in the unlikely possibility of float failure, may be dispersed through the system. If this is a hazard, consult the Armstrong Application Engineering Department.

NOTE: Armstrong can design dual gravity traps for venting light liquids from above heavier liquids. Consult the Armstrong Application Engineering Department.

Viscosity Considerations for Dual Gravity Traps
The operation of dual gravity traps depends upon a float that will sink in the light liquid and float in the heavy liquid. When the specific gravities of the two liquids are very close, the available operating forces are, therefore, also very small. Viscous fluids may impair the ability of the trap to respond to changing liquid levels.

Consult Armstrong's Application Engineering Department if your application involves fluids more viscous than 70 cs, which is approximately the viscosity of a light machine oil.

Table LD-30. Maximum Operating Pressures for Draining Water From Different Specific Gravity Liquids With Orifices Available in Dual Gravity Drain Traps (See pages LD-29 and LD-30.)

Model No.	Sp. Grav.	.50		.55		.60		.65		.70		.75		.80		.85			
	Float Wt, oz	**6.0**		**6.5**		**7.0**		**7.5**		**8.0**		**8.5**		**9.1**		**9.6**			
	Float Wt, g	**170**		**184**		**199**		**213**		**228**		**242**		**257**		**271**			
	Orifice (in)	Maximum Operating Pressure																	
		psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg		
2-DG	5/16	15	1.0	12	0.9	10	0.7	9	0.6	7	0.5	5	0.35	—	—	—	—		
	1/4	25	1.6	20	1.4	18	1.2	15	1.0	12	0.8	9	0.6	6	0.4	—	—		
	3/16	**50**	**3.6**	**45**	**3.0**	**40**	**2.6**	**30**	**2.2**	**25**	**1.8**	**20**	**1.4**	**12**	**0.9**	**7**	**0.45**		
	5/32	90	6.0	75	5.5	65	4.6	55	3.8	45	3.0	35	2.4	22	1.6	12	0.8		
	1/8	150	10	130	9.0	110	8.0	90	6.5	75	5.0	55	4.0	40	2.6	20	1.4		
	7/64	**190**	**13**	**170**	**12**	**150**	**10**	**120**	**8.5**	**100**	**6.5**	**75**	**5.0**	**50**	**3.4**	**25**	**1.8**		
32-DG	**Sp. Grav.**	**.50**		**.55**		**.60**		**.65**		**.70**		**.75**		**.80**		**.85**			
	Float Wt, oz	**8.8**		**9.6**		**10.3**		**11.1**		**11.9**		**12.7**		**13.5**		**14.3**			
	Float Wt, g	**248**		**271**		**293**		**315**		**338**		**360**		**382**		**405**			
	Orifice (in)	Maximum Operating Pressure																	
	5/16	25	1.6	20	1.4	18	1.2	15	1.0	12	0.9	10	0.7	7	0.5	—	—		
	1/4	40	2.6	35	2.4	30	2.0	25	1.8	22	1.4	18	1.2	12	0.8	8	0.5		
	3/16	**90**	**6.0**	**75**	**5.0**	**65**	**4.6**	**55**	**3.8**	**45**	**3.2**	**35**	**2.6**	**25**	**1.8**	**18**	**1.2**		
	5/32	150	10	130	9.0	110	8.0	100	6.5	80	5.5	65	4.4	45	3.2	30	2.0		
	1/8	250	17	225	15	200	13	170	11	140	9.5	110	7.5	80	5.5	50	3.4		
	7/64	**325**	**22**	**275**	**20**	**250**	**17**	**225**	**15**	**180**	**12**	**140**	**9.5**	**100**	**7.0**	**65**	**4.4**		
3-DG to 250 psig* (17 barg) Cast Iron	**Sp. Grav.**	**.50**		**.55**		**.60**		**.65**		**.70**		**.75**		**.80**		**.85**		**.90**	
	Float Wt, oz	**11.2**		**12.2**		**13.2**		**14.2**		**15.2**		**16.1**		**17.1**		**18.1**		**19.1**	
	Float Wt, g	**317**		**345**		**373**		**401**		**430**		**458**		**486**		**514**		**542**	
	Orifice (in)	Maximum Operating Pressure																	
	1/2	12	0.8	10	0.7	9	0.6	8	0.5	6	0.45	5	0.35	—	—	—	—	—	—
	3/8	25	1.8	22	1.6	20	1.4	15	1.2	12	0.9	10	0.7	7	0.5	—	—	—	—
	5/16	**40**	**2.8**	**35**	**2.4**	**30**	**2.2**	**25**	**1.8**	**22**	**1.4**	**15**	**1.2**	**12**	**0.8**	**7**	**0.5**	**—**	**—**
	9/32	55	3.6	45	3.2	40	2.8	35	2.4	30	2.0	22	1.6	15	1.0	9	0.6	—	—
	1/4	80	5.5	70	4.8	60	4.2	50	3.6	40	3.0	35	2.2	25	1.6	15	1.0	—	—
33-DG for all pressures	**7/32**	**110**	**8.0**	**100**	**7.0**	**90**	**6.0**	**75**	**5.0**	**60**	**4.2**	**45**	**3.2**	**35**	**2.4**	**20**	**1.4**	**7**	**0.45**
	3/16	170	12	150	10	130	9.0	110	7.5	90	6.5	70	4.8	50	3.4	30	2.0	10	0.7
	5/32	275	19	225	16	200	14	170	12	140	10	110	7.5	80	5.5	45	3.2	15	1.0
	1/8	**550**	**38**	**475**	**34**	**425**	**28**	**350**	**24**	**300**	**20**	**225**	**15**	**160**	**11**	**100**	**6.5**	**30**	**2.2**
	7/64	700	48	600	42	525	36	450	32	375	26	275	20	200	14	120	8.5	40	2.8
6-DG to 250 psig* (17 barg) Cast Iron	**Sp. Grav.**	**.50**		**.55**		**.60**		**.65**		**.70**		**.75**		**.80**		**.85**		**.90**	
	Float Wt, oz	**52**		**57**		**62**		**67**		**72**		**77**		**82**		**87**		**92**	
	Float Wt, g	**1 483**		**1 622**		**1 760**		**1 899**		**2 038**		**2 177**		**2 316**		**2 455**		**2 594**	
	Orifice (in)	Maximum Operating Pressure																	
	1-1/16	12	0.9	12	0.8	10	0.7	9	0.6	8	0.5	6	0.4	—	—	—	—	—	—
	7/8	22	1.4	18	1.2	18	1.2	15	1.0	12	0.8	10	0.7	7	0.5	5	0.35	—	—
	3/4	**30**	**2.2**	**25**	**1.8**	**25**	**1.6**	**20**	**1.4**	**18**	**1.2**	**15**	**1.0**	**10**	**0.7**	**7**	**0.5**	**—**	**—**
	5/8	45	3.2	40	2.8	35	2.6	30	2.2	25	1.8	22	1.4	15	1.2	12	0.8	6	0.4
	9/16	60	4.2	55	3.8	50	3.4	40	2.8	35	2.4	30	2.0	22	1.4	15	1.0	8	0.5
	1/2	**90**	**6.0**	**80**	**5.5**	**70**	**4.8**	**60**	**4.2**	**50**	**3.4**	**40**	**2.8**	**30**	**2.2**	**22**	**1.4**	**12**	**0.8**
36-DG to 1 000 psig (69 barg) Steel	7/16	130	9.0	110	8.0	100	7.0	90	6.0	70	5.0	60	4.0	45	3.0	30	2.0	15	1.2
	3/8	200	14	180	12	160	11	140	9.5	110	8.0	90	6.5	70	4.8	50	3.2	25	1.8
	11/32	**275**	**18**	**250**	**16**	**200**	**14**	**180**	**12**	**150**	**10**	**120**	**8.5**	**90**	**6.5**	**65**	**4.4**	**35**	**2.4**
	5/16	350	24	300	22	275	19	225	16	190	13	160	11	120	8.0	80	5.5	45	3.0
	9/32	450	32	400	28	350	24	300	20	250	18	200	14	160	11	110	7.5	60	4.0
	1/4	650	46	575	40	525	36	450	30	375	26	300	20	225	16	160	11	80	6.0
	7/32	950	65	850	55	750	50	650	44	525	36	425	30	325	22	225	15	120	8.5
	3/16	1 000	69	1 000	69	1 000	69	1 000	69	850	60	700	48	525	36	350	24	200	14

NOTE: If actual specific gravity falls between those shown in the above table, use the next higher gravity. For example, if actual gravity is 0.73, use 0.75 gravity data.
*For vessel pressures above 250 psig (17 barg), always use steel drain traps.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Free Floating Lever Dual Gravity Drain Traps

For Pressures to 1 000 psig (69 barg)

List of Materials

Table LD-31.

Model No.	Valve & Seat	Leverage System	Float	Body & Cap	Gasket
2-DG 3-DG 6-DG	Stainless Steel			Cast Iron ASTM A48 Class 30	Compressed Asbestos-free
32-DG 33-DG 36-DG				Forged Steel ASTM A105	

For information on special materials, consult the Armstrong Application Engineering Department.

For a fully detailed certified drawing, refer to:
No. 2-DG, 3-DG, 6-DG CD #1034
No. 32-DG, 33-DG, 36-DG CD #1035

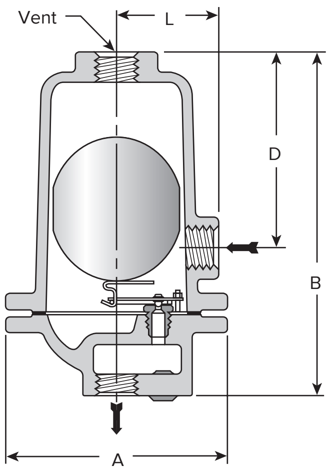


Figure LD-43.
No. 2-DG, 3-DG and 6-DG cast iron dual gravity drain traps.

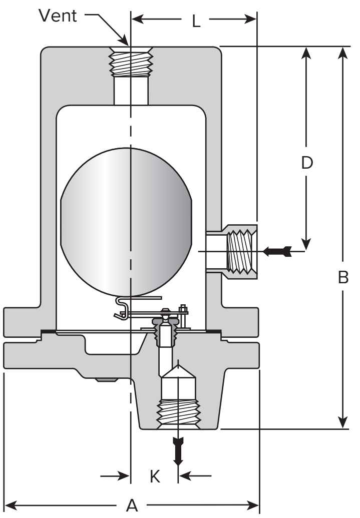


Figure LD-44.
No. 32-DG, 33-DG and 36-DG Forged steel dual gravity drain traps. Socketweld or flanged connections are also available.

Physical Data

Table LD-32. Armstrong Free Floating Lever Dual Gravity Drain Traps

Model No.	Cast Iron						Forged Steel					
	2-DG		3-DG		6-DG		32-DG*		33-DG*		36-DG*	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Pipe Connections	1/2, 3/4	15, 20	1/2, 3/4, 1	15, 20, 25	1-1/2, 2	40, 50	1/2, 3/4, 1	15, 20, 25	1/2, 3/4, 1	15, 20, 25	1-1/2, 2	40, 50
"A"	5-1/4	133	6-3/8	161	10-3/16	259	6-3/4	171	8	203	11-7/8	302
"B"	8-3/4	222	11-1/2	292	18	457	10-3/16	259	11-9/16	297	17-1/8	435
"D"	5-1/8	103	7	188	9-3/8	238	5-9/16	141	6-1/16	154	9	229
"K"	—	—	—	—	—	—	1-1/4	32	1-7/16	37	2-1/8	54
"L"	2-7/16	62	2-7/8	73	4-5/8	117	3-3/8	86	3-7/8	98	6-1/16	154
Approx. Wt. lbs (kg)	12 (5.5)		21 (9.5)		78 (35.5)		31 (14)		49 (22)		163 (74)	
Maximum Allowable Pressure (Vessel Design)	250 psig @ 450°F (17 barg @ 232°C)						600 psig @ 100°F (41 barg @ 38°C) 500 psig @ 750°F (35 barg @ 400°C)		1 000 psig @ 100°F (69 barg @ 38°C) 600 psig @ 750°F (41 barg @ 400°C)			

* Available in Type 316 stainless steel. Consult factory.

Designs, materials, weights and performance ratings are approximate and subject to change without notice. Visit armstronginternational.com for up-to-date information.

Ultra-Capacity Drain Traps

Capacities to 700 000 lb/hr (317 520 kg/hr)... Pressures to 450 psig (31 barg)

Armstrong ultra-capacity ball float drain traps are designed to meet exceptionally large capacity needs in draining water and other liquids from air or other gases under pressure.

Options. L and M Series drain traps are available with armored gauge glass with a maximum allowable pressure of 250 psig @ 425°F (17 barg @ 218°C). When ordering, be sure to specify “Liquid Drainer” or “LD.” Example, LS-series LD, 2'' (50 mm) NPT, 7/8'' orifice.

For a fully detailed certified drawing, refer to:
L and M Series, CD #1010 **JD and KD Series, CD #1302**

Table LD-33. Maximum Operating Pressures for Handling Different Specific Gravity Liquids With Orifices Available in Ultra-Capacity Drain Traps

Model No.	Specific Gravity	1.00		.95		.90		.85		.80		.75		.70		.65		.60		.55		.50	
	Orifice Size	Maximum Operating Pressure																					
	in	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
JD	1-1/16	16	1.0	15	1.0	13	0.89	12	0.82	11	0.75	10	0.69	9	0.62	7	0.48	6	0.41	5	0.34	4	0.28
	3/4	35	2.4	32	2.2	30	2.0	27	1.8	24	1.6	22	1.5	19	1.3	16	1.0	14	0.97	11	0.75	9	0.62
	9/16	87	6.0	81	5.5	75	5.0	68	4.6	61	4.2	55	3.8	48	3.3	41	2.8	35	2.4	28	1.8	22	1.5
	1/2	146	10	135	9.0	125	8.5	113	8.0	102	7.0	91	6.2	81	5.5	69	4.8	59	4.0	47	3.2	37	2.6
	7/16	175	12	175	12	175	12	175	12	158	11	141	10	125	8.5	107	7.3	91	6.2	73	5.0	57	3.9
	3/8	250	17	232	16	214	15	195	13	177	12.2	159	10.9	140	9.7	122	8.4	103	7.1	85	5.9	67	4.6
	5/16	300	20.6	300	20.6	300	20.6	300	20.6	300	20.6	300	20.6	300	20.6	300	20.6	300	20.6	279	19.2	219	15.0
30KD	1-7/8 dual orifice	30	2	30	2	30	2	30	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50KD		50	3.5	50	3.5	50	3.5	50	3.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
300KD		300	21	300	21	300	21	300	21	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L to 250 psig (17 barg)	1-5/8	35	2.4	32	2.2	30	2.0	27	1.8	25	1.6	23	1.6	20	1.4	18	1.2	15	1.0	13	0.89	10	0.69
	1-1/8	116	8.0	108	7.4	100	7.0	92	6.3	84	5.8	76	5.2	68	4.7	60	4.1	52	3.6	44	3.0	36	2.5
	7/8	174	12	162	11	150	10.5	138	9.5	126	8.6	114	7.9	102	7.0	90	6.2	78	5.4	65	4.5	53	3.7
LS For all Pressures	11/16	*315	*22	*294	*20	*272	*19	250	17	228	16	206	14	184	13	162	11	141	9.7	119	8.2	97	6.7
	1/2	*450	*31	*450	*31	*450	*31	*450	*31	*450	*31	*400	*28	*354	*24	*298	*21	248	17	197	14	147	10
M to 250 psig (17 barg)	1-7/8 dual orifice	250	17	250	17	250	17	250	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MS For all Pressures	1-17/32 dual orifice	*450	*31	*450	*31	*450	*31	*450	*31	*450	*31	—	—	—	—	—	—	—	—	—	—	—	—

*These pressures applicable only to LS and MS models.

List of Materials

Table LD-34.

Name of Part		Material	
		Series JD, KD, L & M	Series LS & MS
Cap & Body	JD, KD	ASTM A395 Ductile Iron	ASTM A216 Grade WCB
	L, M	ASTM A48 Class 31	
Cap Extension*	L, LS	304 Stainless Steel, ASTM A351 Grade CF8	
	KD, M, MS	17-4 Ph, ASTM A747 Grade CB7Cu-1	
Cap Bolting		ASTM A193 Grade B 7**	ASTM A193 Grade B 7
Cap Gaskets		Flexible Graphite	
Float Mechanism		Stainless Steel	

* JD Series does not have cap extension.
**JD and KD Series - ASTM A307 Grade B.

Physical Data

Table LD-36. Ultra-Capacity Drain Traps

Trap Series	JD & KD		L & M		LS & MS	
	in	mm	in	mm	in	mm
“B”	13-1/16	332	20-1/4	514	20	508
“C”	9-5/8	244	14-3/4	375	15-1/4	387
“H”	13-7/8	352	19-3/4	502	20	508
“M”	6-1/2	165	11-5/16	287	11-5/16	287
“D”	3	76	4-3/16	106	4-3/16	106
“S”	—	—	3-3/4	95	3-3/4	95
“T”	—	—	12	305	12	305
Weight lbs (kg)	100 (45)		196 (89)		290 (132)	
Max. Allow. Pressure (Vessel Design)	300 psig @ 650°F (21 barg @ 343°C)		250 psig @ 450°F (17 barg @ 232°C)		450 psig @ 650°F (31 barg @ 338°C)	

JD, KD, L and M Series also may be used for steam service as float and thermostatic traps and as condensate controllers. Steam service capacities for all configurations are given in the Steam Trapping section of this catalog.

Connections Available

Table LD-35.

Model	Size		NPT	BSPT	SW	FLG
	in	mm				
JD	2	50	X	X	—	*
KD	2, 2-1/2, 3	50, 65, 80	X	X	—	*
L	2, 2-1/2	50, 65	X	X	—	X
M	3	80	X	X	—	X
LS	2, 2-1/2	50, 65	X	X	X	X
MS	3	80	X	X	X	X

*Flanged connections available. Consult factory.

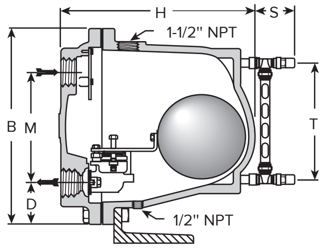


Figure LD-45.
L and LS Series

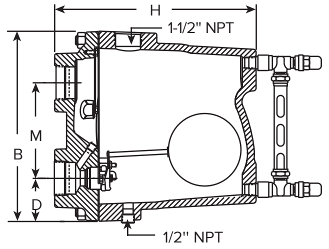


Figure LD-46.
JD and KD Series

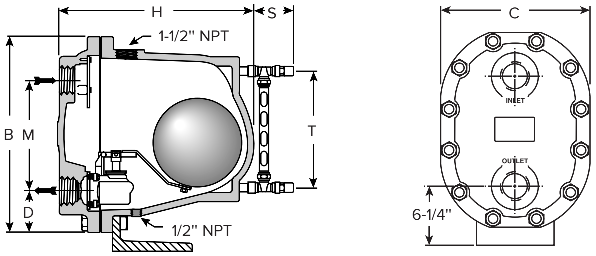


Figure LD-47.
M and MS Series

Installation and Maintenance of Drain Traps

For Draining Liquid From Gas...for Draining Water From Light Liquid

Installation Procedures

Pipe Fitting. Adhere to good piping practice. Clean pipes carefully after cutting and threading before hooking up traps. Before connecting traps to system, blow down at full pressure to clear the pipes of dirt, pipe cuttings and other foreign objects.

Strainers are necessary if there is a chance scale and sediment can be carried to the trap.

Blowdown Valves may prove useful.

Shutoff Valves & Unions should be provided so the drain trap can be examined and/or serviced without shutting down the unit drained.

Operation. Maximum operating pressure is stamped on the trap. Do not exceed this pressure.

A. Ball float drain traps must be located below the drain point.

B. Make inlet piping as short as possible with a minimum of elbows and other restrictions.

C. Back venting usually required on ball float drain traps.

1. Pressure vessels should be vented back to any convenient point above the liquid level. Use a full-ported valve in the back-vent line. On larger traps (6 and 36-LD and larger) use a minimum of 3/4" (20 mm) nominal pipe for back venting—1" (25 mm) or larger preferred for heavy loads. Remember, the pressure in the unit drained and in the drain trap are the same—only the difference in liquid levels produces flow.

2. Separators and drip points should be vented to the downstream side of the unit.

3. On very light loads, venting is not necessary, but use at least a 3/4" (20 mm) connection between the vessel and the trap. Make sure inlet line is vertical or pitched to trap.

4. Float type drain traps do not require priming.

Typical installations of drain traps are shown in drawings in “Installation and Maintenance of Drain Traps” section.

Drain Trap Testing and Troubleshooting

Testing Schedule

A regular schedule should be set up for testing and preventive maintenance. Size and operating pressure determine how frequently drain traps should be checked. Units on normal industrial applications should be checked as follows:

High Pressure Drain Traps—250 psig (17 barg) and up. Test daily to weekly.

Medium Pressure Drain Traps—60 to 250 psig (4 to 17 barg). Test weekly to monthly.

Low Pressure Drain Traps—1 to 60 psig (0.07 to 4 barg). Test monthly to annually. Large traps on high capacity jobs can be tested more frequently to good advantage.

Drain Traps on gas and other critical applications should be checked at the same time valves and other line equipment are inspected. Your own experience will determine the required testing schedule.

Troubleshooting

A. Drain trap does not discharge.

1. Insufficient liquid coming to drain trap to permit discharge. Continue operation.

2. Drain trap filled with dirt or sludge. Remove cap and mechanism; clean thoroughly. Install strainer in inlet side of drain trap.

3. Differential pressure across drain trap too high. Check inlet and outlet pressure. If the difference exceeds the maximum operating pressure stamped on the drain trap, the valve will remain closed. Reduce differential pressure if possible, or install properly sized mechanism in drain trap if possible.

4. Worn valve seat. As the seat becomes worn, the seating surface area enlarges, lowering the trap’s maximum operating pressure. Replace with new parts.

5. Inlet or outlet line valves closed. Open valves.

6. Strainer clogged. Clean strainer screen.

7. Float defective or collapsed. Replace float.

B. Drain trap discharges continuously.

1. If drain trap discharges full stream of liquid continuously and vessel fills full of liquid—
   a. Drain trap too small for job. Replace with correct size.
   b. Abnormal amounts of liquid coming to drain trap. Remedy cause or replace with drain trap that has a larger capacity and will handle peak loads.

C. Drain trap blows through.

1. Dirt or scale on valve or seat. Remove cap, clean drain trap, as well as valve and seat.

2. Worn valve, or seat that is wire-drawn. Remove cap, replace mechanism.

3. IB trap may lose its prime.
   a. Close the inlet valve for a few minutes. Then gradually open. If the drain trap catches its prime, the chances are that the trap is all right.
   b. Frequent loss of prime may require an internal check valve or, if trap is old, valve and seat may be worn.

In the event of any unusual maintenance or operational difficulty, consult your Armstrong Representative, or the Armstrong International Application Engineering Department.

Installation and Maintenance of Drain Traps

For Draining Liquid From Gas...for Draining Water From Light Liquid

Installation of Armstrong drain traps for the most satisfactory operation requires that a few simple rules be observed:

Clean Piping. First install piping and valve ahead of trap, then blow down at full air pressure to remove loose dirt. Last of all, screw the trap into position.

Location. Compressed drain traps should be located below and close to the unit being drained (See Figs. LD-48 and LD-50), or as directed by the equipment manufacturer. When headroom is inadequate, inverted bucket drain traps can be installed above the unit drained, but they must be equipped with a check valve in the inlet line (See Fig. LD-49). They should be accessible for maintenance.

Priming. Prime bodies of inverted bucket drain traps before turning on the air. Ball float traps do not require priming.

Back Venting (Ball Float Traps Only). Ordinarily a drain trap has little water to handle, and a single line to the *top of the trap* is sufficient. However, if a ball float trap must be installed at some distance from the drip point, or if there are large quantities of water to be discharged, back venting is good insurance for positive and fast flow of water to the drain (See Fig. LD-52). Be sure there are no pockets in the vent line in which water could collect and prevent venting (See Fig. LD-54). If high water level is objectionable, raise the receiver, or dig a pit so top of trap can be at the same level as the bottom of the drain line (See Fig. LD-53). Otherwise, use an inverted bucket trap that can be installed above the drip point (See Fig. LD-49).

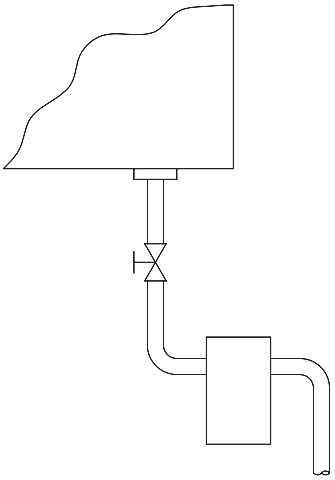


Figure LD-48.
Standard hookup for inverted bucket drain trap BVSW. **Be sure to fill trap body with water before opening the valve.**

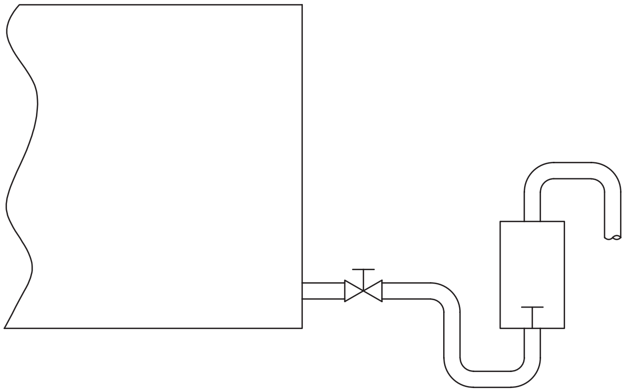


Figure LD-49.
The inverted bucket trap draining an air receiver where space limitations prevent installation below the receiver. Note trap should either have internal check valve or a swing check to prevent prime loss when air pressure drops.

Installation and Maintenance of Drain Traps

For Draining Liquid From Gas...for Draining Water From Light Liquid

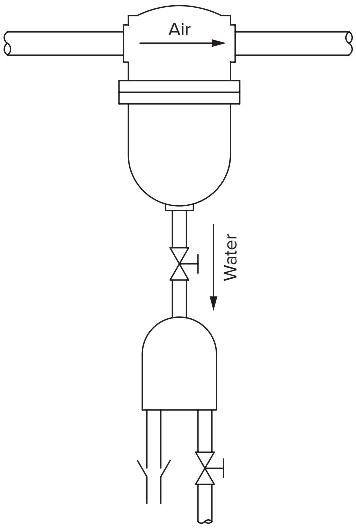


Figure LD-50.
Drain trap installed below an air line separator. Keep the pipe as short as possible.

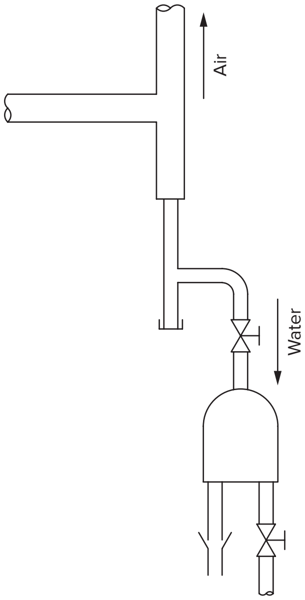


Figure LD-51.
Drain trap draining air line drip pocket. Be sure to use a gate valve and blow down the assembly before installing trap.

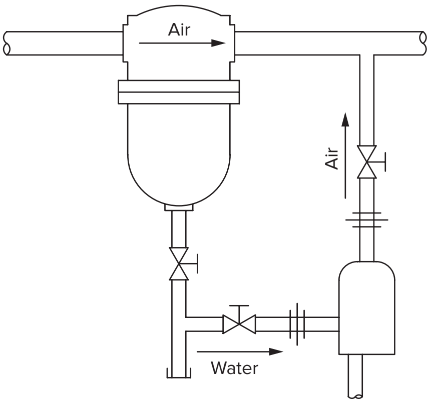


Figure LD-52.
Drain trap with vent line to downstream side of air separator to assure positive and fast flow of water to the trap. Note side inlet connection from separator.

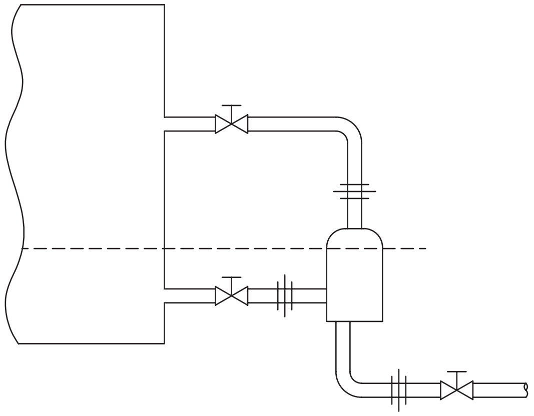


Figure LD-53.
Drain trap installed at side of receiver, close to floor. Water will rise to broken line before trap opens.

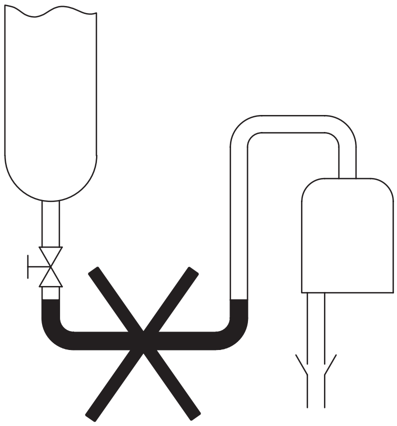


Figure LD-54.
Do not install a ball float trap above the drip point or put a loop or pocket in the line to the trap. The water seal prevents air from leaving trap body and allowing liquid to enter.

Liquid Drainers

Armstrong® ADP-1 Pneumatically Operated Liquid Drainer

Armstrong's pneumatically operated liquid drainer with press-to-test actuator for compressed air wastes no air, and it provides automatic operation in a see-thru vessel. This liquid drainer is ideal for draining oil/water separators. Its low profile makes it easy to mount on base-mounted compressors, remote cooler packs, refrigerated air dryers and filters.

Features:

- Convenient press-to-test actuator
- Large 100-oz. see-thru reservoir
- Fully pneumatic
- No wasted air
- Extremely low profile
- Ideal for oil/water separators
- Non-clogging ball valve
- No strainers to clean
- Automatic operation
- Vent valve provided
- Easy to retrofit

Options:

- Legs
- Mechanical cycle counter
- Heater

For a fully detailed certified drawing, refer to CD #1271.

List of Materials

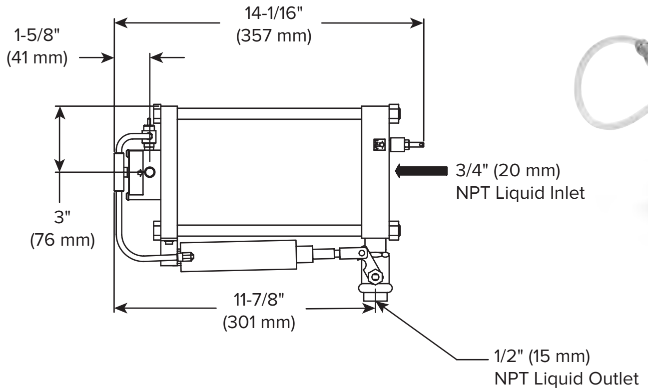
Table LD-37.

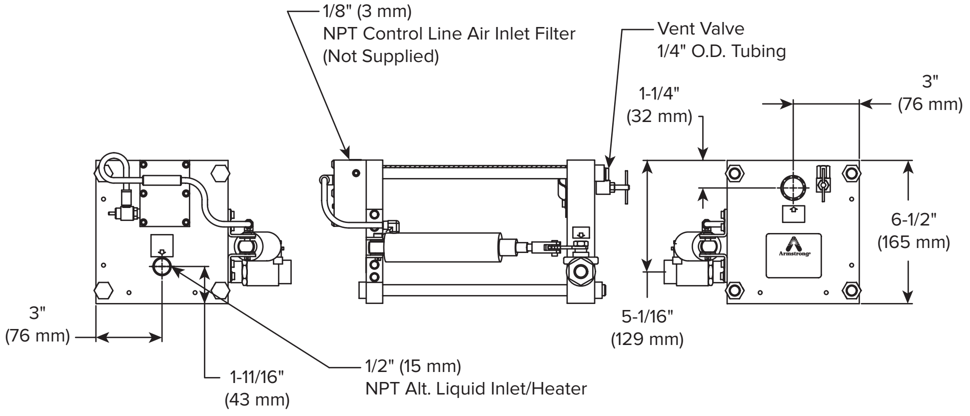
Name of Part	Material
Inlet and Outlet Heads	Aluminum ASTM B221 6061-T6511
Float and Leverage System	Stainless Steel
Reservoir	Fiberglass
Outlet Ball Valve	Bronze with Stainless Steel Ball and Stem
Air Cylinder	Stainless Steel
Optional Floor/Wall Mounts	Stainless Steel

Physical Data

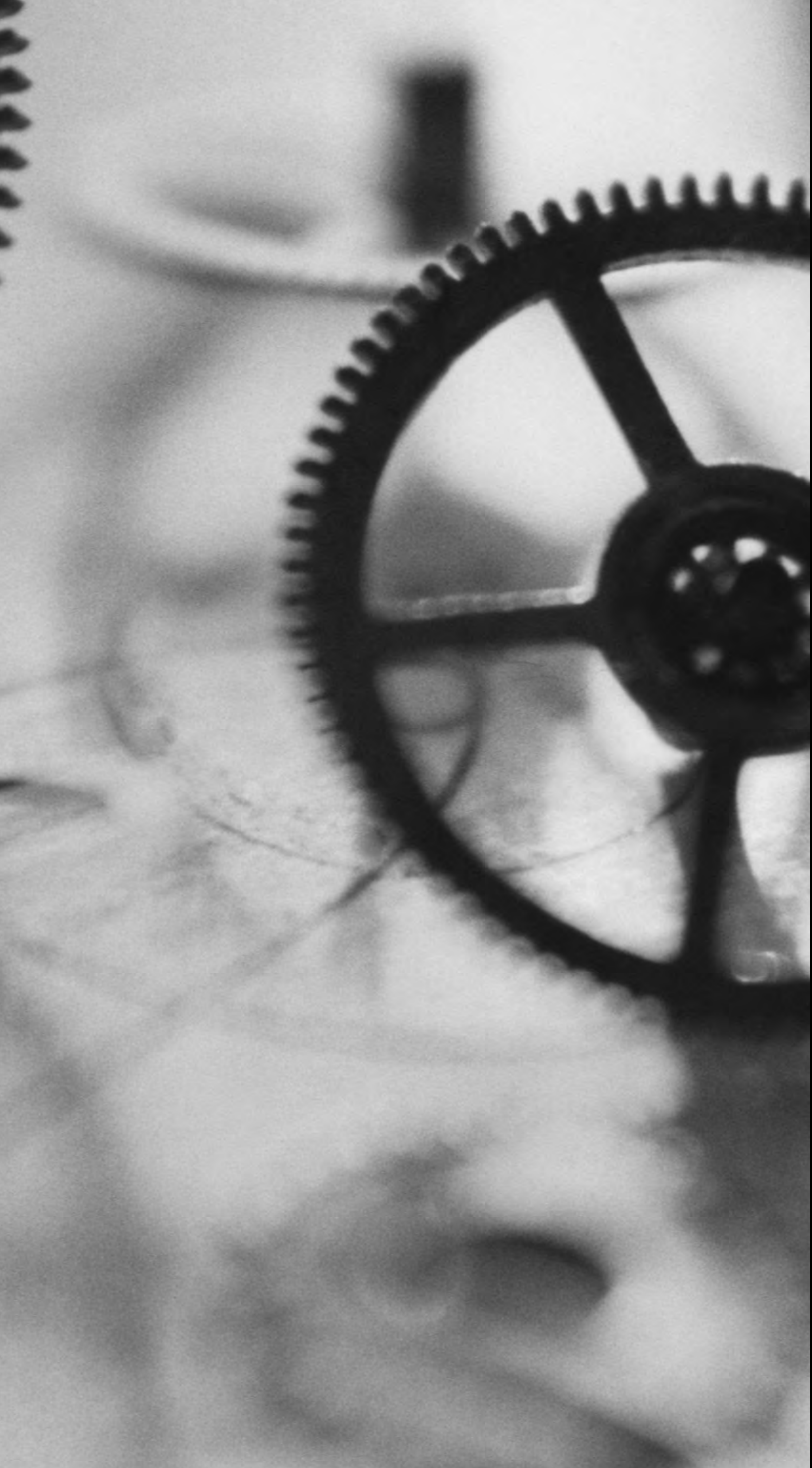
Table LD-38. Armstrong ADP-1 Pneumatically Operated Liquid Drainer

Specifications	in	mm
Liquid Outlet	1/2	15
Liquid Inlet	3/4	20
Alternate Liquid Inlet/Heater	1/2	15
Control Air Inlet	1/8	3
Vent Valve Connection	1/4" OD Tubing	
Weight, lb (kg)	14 (6.4)	
Maximum Operating Pressure	180 psig (12 barg)	
Maximum Operating Temperature	150°F (66°C)	
Capacity	1.5 lb liquid per cycle	
Maximum Control Air Pressure	80 - 120 psig (6 - 8.3 barg)	





Notes



Ancillary Products

Armstrong

Armstrong®

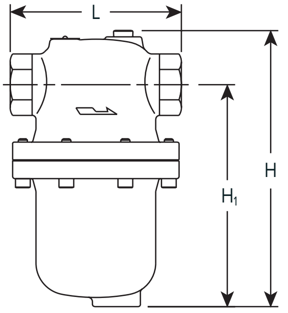
Armstrong®

DS Series Drain Separators

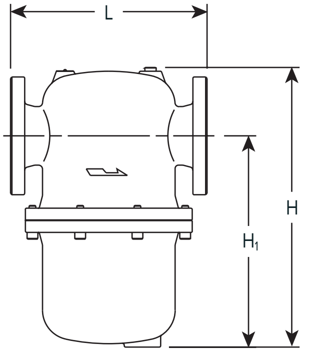
Condensate in steam and air piping reduce thermal efficiency, cause water hammer, corrode equipment such as valves and pipes, and cause other problems.

Armstrong drain separators separate condensate efficiently by using the centrifugal force of steam or air created by introducing it into a specifically shaped path. Because of the simple structure of the drain separators, pressure loss is minimized, enabling clean, dry steam or air to be fed to equipment.

With correct sizing and proper drainage, the separators are designed to eliminate 98% of all entrained liquids and particles that are 10 microns and larger in size.



DS-1 / DS-3 / DS-4



DS-2 / DS-3 / DS-4

Features

- A cyclone structure maximizes liquid separation efficiency
- Pressure loss is extremely low
- No moving parts means no breakdowns

Operating Principle

When steam or air flow enters the drain separator, centrifugal force is generated in the fluid because of the device's internal structural design. The fluid drains along the wall because of the difference in specific gravity with steam or air, eventually striking the baffle. The baffle guides the fluid to the drain outlet and to the trap, which drains it. As a result, both small dirt particles and condensate are separated and removed from the system through the bottom drain.

For fully certified drawings refer to:

DS-1 / DS-2	**CDY1102**
DS-3	**CD2126**
DS-4	**CD2127**

DS Series Specifications

Model	Application	Maximum Pressure psig (barg)	Maximum Temp. °F (°C)	Materials	
				Body	Nozzle
DS-1	Steam Air	NPT 300 (20)	430 (221)	Ductile Iron ASTM A536	Cast Iron ASTM A48
DS-2		150 lb. Flanged 185 (13)			
		300 lb. Flanged 300 (20)			
DS-3 DS-4		NPT 300 (20)	650 (343)	SS304 (DS-3) Carbon Steel (DS-4)	
		150 lb. Flanged 150 (10)	450 (232)		
		300 lb. Flanged 500 (34)	650 (343)		

DS Series Dimension and Weights

Model	Size		Face-to-Face "L"						H		H¹		Drain		Weight					
			NPT		150#		300#								NPT		150#		300#	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	kg	lb	kg	lb	kg
DS-1	1/2	15	5-15/16	150	—	—	—	—	9-9/16	243	7-5/8	193	3/4	20	16	7.3	—	—	—	—
	3/4	20	5-15/16	150	—	—	—	—	9-9/16	243	7-5/8	193	3/4	20	16	7.3	—	—	—	—
	1	25	5-15/16	150	—	—	—	—	9-9/16	243	7-5/8	193	3/4	20	16	7.3	—	—	—	—
	1-1/4	32	7-1/2	190	—	—	—	—	11-1/8	243	8-3/8	213	1	25	28	12.7	—	—	—	—
	1-1/2	40	7-1/2	190	—	—	—	—	11-1/8	243	8-3/8	213	1	25	28	12.7	—	—	—	—
	2	50	8-5/8	219	—	—	—	—	13-15/32	243	10-1/4	260	1	25	45	20.5	—	—	—	—
DS-2	2-1/2	65	—	—	11-1/2	292	11-15/16	303	16-15/32	418	12-3/8	314	1	25	—	—	45	20.5	77	35
	3	80	—	—	13-1/2	343	14-1/64	356	19	484	14-1/2	361	1-1/4	32	—	—	77	35	99	45
	4	100	—	—	15-13/16	402	16-7/16	418	23-3/8	594	17-1/2	445	1-1/4	32	—	—	99	45	143	65
DS-3 DS-4	1/2	15	5-1/2	140	9	229	9	229	16	356	9	229	1	25	28	12.7	30	13.6	32	14.5
	3/4	20	5-1/2	140	9	229	9	229	16	356	9	229	1	25	28	12.7	30	13.6	32	14.5
	1	25	6-3/8	162	10-1/2	267	10-1/2	267	16	356	10-1/2	267	1	25	30	13.6	33	15	35	15.9
	1-1/4	32	6-3/8	162	10-1/2	267	10-1/2	267	16	356	10-1/2	267	1	25	32	14.5	35	15.9	37	16.8
	1-1/2	40	7-5/8	194	11-1/2	292	11-1/2	292	19	483	12-1/2	318	1	25	46	20.9	50	22.7	56	25.4
	2	50	7-7/8	200	11-1/2	292	11-1/2	292	19	483	12-1/2	318	1	25	51	23.1	55	24.9	59	26.8
	2-1/2	65	—	—	16	406	16	406	22	559	15	381	1	25	—	—	100	45.4	110	49.9
	3	80	—	—	18	457	18	457	26	660	18	457	1	25	—	—	140	63.5	150	68
	4	100	—	—	20	508	20	508	31	787	22	559	1-1/2	40	—	—	195	88.4	220	99.8
	6	150	—	—	24	610	24	610	41	1 041	30	762	1-1/2	40	—	—	350	159	380	172
	8	200	—	—	28	711	28	711	50	1 270	37	940	2	50	—	—	475	215	610	278
	10	250	—	—	34	864	34	864	70	1 778	55	1 397	2	50	—	—	780	354	1 180	535
	12	300	—	—	38	965	38	965	75	1 905	58	1 473	2-1/2	65	—	—	940	426	1 510	685

DS Series Drain Separators

Capacities for Steam Service

DS-1/DS-2 Series Steam Capacities (lb/hr)

Size	5 psig	10 psig	25 psig	50 psig	100 psig	150 psig	200 psig	250 psig	300 psig
1/2”	34	43	69	113	200	287	374	461	548
3/4”	60	75	121	198	351	503	656	809	962
1”	98	122	197	320	568	816	1 063	1 311	1 559
1-1/4”	169	212	340	555	983	1 412	1 840	2 269	2 698
1-1/2”	230	288	463	755	1 338	1 922	2 505	3 088	3 672
2”	379	475	763	1 244	2 206	3 167	4 129	5 090	6 052
2-1/2”	541	678	1 089	1 775	3 147	4 519	5 891	7 263	8 635
3”	835	1 046	1 682	2 741	4 860	6 978	9 096	11 215	13 333
4”	1 437	1 802	2 896	4 720	8 368	12 016	15 664	19 312	22 960

DS-1/DS-2 Series Steam Capacities (kg/hr)

Size	0.34 barg	0.69 barg	1.7 barg	3.4 barg	6.9 barg	10.3 barg	13.8 barg	17.2 barg	20.7 barg
1/2”	16	20	31	51	91	130	170	209	249
3/4”	27	34	55	90	159	228	298	367	436
1”	44	55	89	145	258	370	482	595	707
1-1/4”	77	96	154	252	446	640	835	1 029	1 224
1-1/2”	104	131	210	342	607	872	1 136	1 401	1 665
2”	172	215	346	564	1 001	1 437	1 873	2 309	2 745
2-1/2”	245	307	494	805	1 428	2 050	2 672	3 294	3 917
3”	379	475	763	1 243	2 204	3 165	4 126	5 087	6 048
4”	652	817	1 314	2 141	3 796	5 450	7 105	8 760	10 414

DS-3/DS-4 Series Steam Capacities (lb/hr)

Size	5 psig	10 psig	25 psig	50 psig	100 psig	150 psig	200 psig	250 psig	300 psig
1"	190	225	295	390	550	675	780	860	1 000
1-1/4"	320	345	460	620	860	1 050	1 125	1 140	1 160
1-1/2"	460	500	680	880	1 225	1 550	1 800	2 000	2 250
2"	790	910	1 050	1 550	2 200	2 700	3 150	3 700	4 000
2-1/2"	1 075	1 120	1 585	2 400	3 400	4 300	5 000	5 375	6 400
3"	1 950	2 300	2 950	3 750	5 250	6 600	7 600	9 000	10 000
4"	3 250	3 800	4 975	6 100	9 000	11 100	13 000	11 500	11 650
5"	4 975	5 850	7 650	9 250	11 400	11 700	12 000	23 000	25 000
6"	7 700	8 990	10 100	10 450	21 500	26 500	31 000	36 000	39 000
8"	10 750	11 450	12 000	23 750	34 000	43 000	51 000	58 000	66 000
10"	20 000	22 500	29 500	37 000	54 500	68 000	78 000	90 000	100 000
12"	29 500	34 000	44 000	54 000	81 000	100 000	105 000	112 000	114 000

DS-3/DS-4 Series Steam Capacities (kg/hr)

Size	0.34 barg	0.69 barg	1.7 barg	3.4 barg	6.9 barg	10.3 barg	13.8 barg	17.2 barg	20.7 barg
1"	86	102	134	177	249	306	354	390	454
1-1/4"	145	156	209	281	390	476	510	517	526
1-1/2"	209	227	308	399	556	703	816	907	1 021
2"	358	413	476	703	998	1 225	1 429	1 678	1 814
2-1/2"	488	508	719	1 089	1 542	1 950	2 268	2 438	2 903
3"	885	1 043	1 338	1 701	2 381	2 994	3 447	4 082	4 536
4"	1 474	1 724	2 257	2 767	4 082	5 035	5 897	5 216	5 284
5"	2 257	2 654	3 470	4 196	5 171	5 307	5 443	10 433	11 340
6"	3 943	4 078	4 581	4 740	9 752	12 020	14 061	16 329	17 690
8"	4 876	5 194	5 443	10 773	15 422	19 504	23 133	26 308	29 937
10"	9 072	10 206	13 381	16 783	24 721	30 844	35 380	40 823	45 359
12"	13 381	15 422	19 958	24 494	36 741	45 359	47 627	50 802	51 710

Stainless Steel Sump Ejector

Armstrong Condensate Management Group offers a stainless steel sump ejector for use in draining unwanted water from steam pits, steam tunnels or enclosed spaces. The stainless steel sump ejector uses a snap-acting Inconel X-750 spring-assisted mechanism, which engages a steam motive valve, turning the pump on or off as the float rises and falls. The all stainless steel design will ensure long life in the rather harsh environment of a steam pit.

The stainless steel sump ejector is designed to eliminate maintenance headaches and safety issues surrounding steam pits, tunnels and enclosed spaces.

Features

- All stainless steel construction and design guard against corrosion
- True steam-on, steam-off operation
- Heavy duty Inconel X-750 springs provide a long, trouble-free service life
- The small, compact and unique cast stainless steel design is unlike anything on the market today

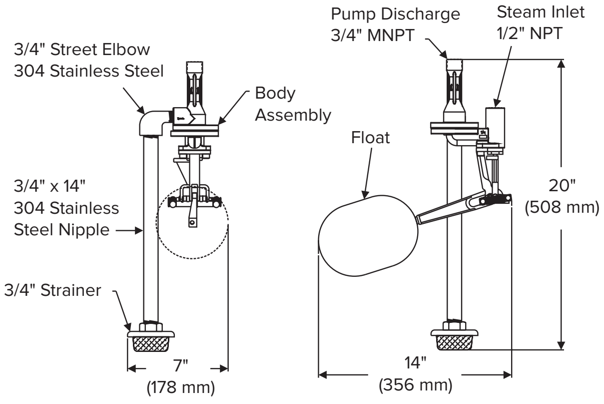
For a fully detailed certified drawing, refer to list below.

3/4"	CDF #1052
1-1/2"	CDF #1065

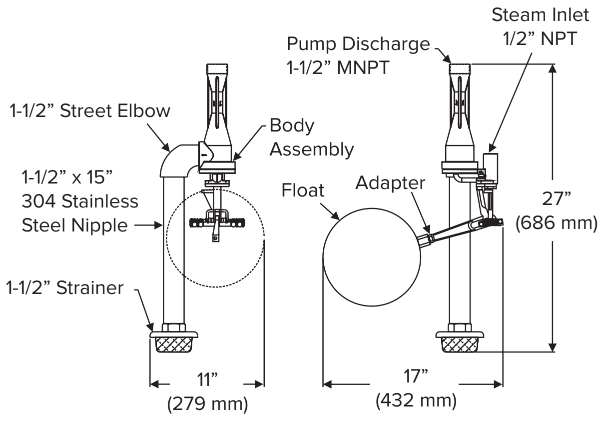
Stainless Steel Sump Ejector Materials

Name of Part	Material
Mechanism	ASTM A351 CF8M
Springs	Inconel X-750
Spring Ends	304 Stainless Steel
Clevis Pins	304 Stainless Steel
Body	ASTM A351 CF8M
Nozzle	308 Stainless Steel
Seal Retainer	308 Stainless Steel
Motive Ball	440-C Stainless Steel
Motive Valve	316 Stainless Steel
Rod Seal	PTFE
Seal Spring	Hastelloy C-276
Rod Wiper	Nitrile
O-Ring	EPDM
Bolts	18-8 Stainless Steel
Strainer Body	Glass Filled Nylon
Strainer Mesh	Stainless Steel
Fittings	304 Stainless Steel
Pipe	304 Stainless Steel

Stainless Steel Sump Ejector



3/4" Model



1-1/2" Model

3/4" Stainless Steel Sump Ejector Capacities in gallons per minute (gpm)

Discharge Head (ft)	Water Temperature 60°F						Water Temperature 100°F						Water Temperature 140°F				
	Motive Steam Pressure (psig)						Motive Steam Pressure (psig)						Motive Steam Pressure (psig)				
	40	60	80	100	120	150	40	60	80	100	120	150	60	80	100	120	150
0	6.0	9.3	11.6	12.2	12.8	12.9	6.0	9.0	9.2	8.6	8.0	8.0	5.5	5.3	5.4	5.5	5.5
5	4.0	7.3	9.9	11.1	11.9	12.4	3.0	7.1	8.2	8.1	7.8	7.8	4.5	4.5	5.3	5.4	5.4
10	2.0	5.2	8.3	10.0	11.0	11.9	—	5.2	7.2	7.7	7.6	7.6	3.5	3.5	5.2	5.2	5.2
15	—	3.2	6.6	8.9	10.0	11.5	—	3.3	6.2	7.2	7.3	7.4	—	—	5.1	5.1	5.1
20	—	—	5.0	7.8	9.2	11.0	—	—	5.2	6.7	7.1	7.3	—	—	5.0	4.9	4.9
25	—	—	—	6.7	8.3	10.5	—	—	—	6.2	6.8	7.1	—	—	4.9	4.8	4.8
30	—	—	—	5.6	7.4	10.0	—	—	—	5.7	6.6	6.9	—	—	4.8	4.6	4.6
35	—	—	—	—	6.5	9.5	—	—	—	—	6.4	6.7	—	—	—	4.5	4.5
40	—	—	—	—	5.6	9.1	—	—	—	—	6.1	6.6	—	—	—	4.3	4.3
45	—	—	—	—	—	8.6	—	—	—	—	—	6.4	—	—	—	—	4.2
50	—	—	—	—	—	8.1	—	—	—	—	—	6.2	—	—	—	—	4.0

Note: Maximum operating pressure is 175 psig (12 barg). No increase in capacity with motive pressure over 150 psig (10 barg).

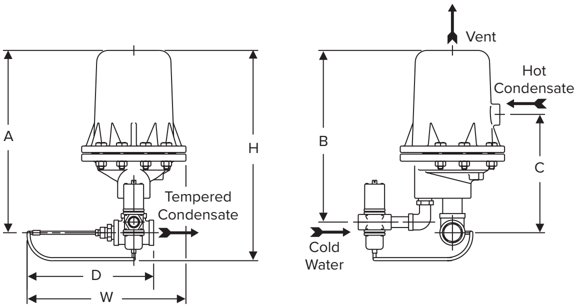
1-1/2" Stainless Steel Sump Ejector Capacities in gallons per minute (gpm)

Discharge Head (ft)	Water Temperature 60°F						Water Temperature 100°F						Water Temperature 140°F					
	Motive Steam Pressure (psig)						Motive Steam Pressure (psig)						Motive Steam Pressure (psig)					
	60	80	100	120	150	175	60	80	100	120	150	175	60	80	100	120	150	175
5	23.0	34.0	42.2	48.4	56.8	55.8	23.2	34.1	42.2	49.9	55.3	56.0	26.3	36.1	46.3	46.2	41.1	41.0
10	—	28.4	38.0	43.2	51.0	51.2	—	28.9	37.2	44.5	52.1	54.8	—	28.9	38.2	43.5	41.1	40.9
15	—	—	35.0	37.9	46.5	50.4	—	—	31.3	39.3	48.9	53.1	—	—	30.7	38.1	41.1	40.9
20	—	—	26.1	33.5	44.4	49.5	—	—	—	35.0	44.7	51.4	—	—	23.6	33.4	41.2	40.8
25	—	—	—	29.0	39.5	48.0	—	—	—	30.9	40.3	47.2	—	—	—	—	41.4	40.5
30	—	—	—	—	35.2	43.5	—	—	—	—	36.5	43.9	—	—	—	—	—	—
35	—	—	—	—	31.1	38.8	—	—	—	—	32.3	39.1	—	—	—	—	—	—
40	—	—	—	—	—	34.3	—	—	—	—	—	35.7	—	—	—	—	—	—

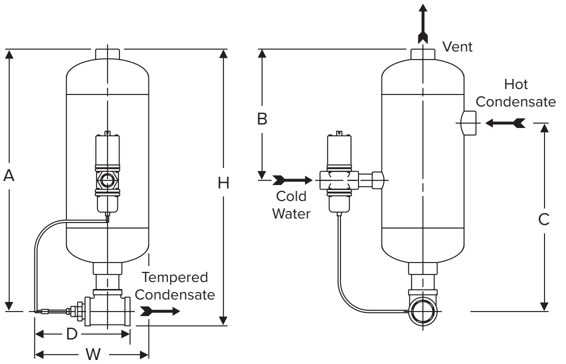
Armstrong®

CC Series Condensate Coolers

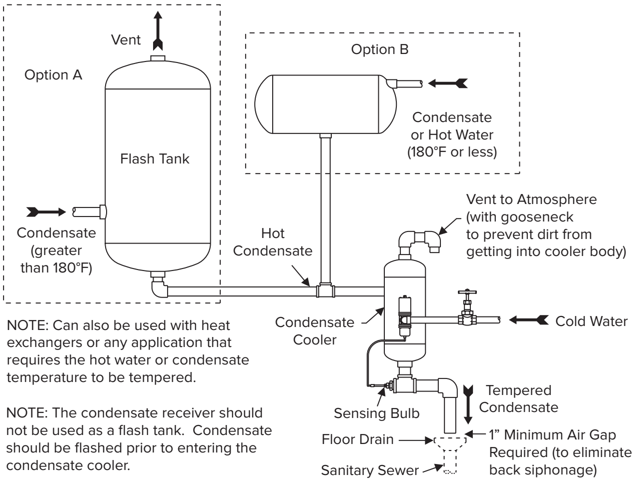
Drain Tempering Service



Model CC-5 and CC-12



Model CC-25 and CC-40



NOTE: Can also be used with heat exchangers or any application that requires the hot water or condensate temperature to be tempered.

NOTE: The condensate receiver should not be used as a flash tank. Condensate should be flashed prior to entering the condensate cooler.

Typical Installation

Description

Armstrong's Condensate Cooler is a device that mixes hot condensate or hot water with a cold water supply to reduce the temperature to acceptable discharge drain temperatures as required by city and state codes. It is a pre-assembled package that is suitable for any plumbing system. When hot condensate or hot water is drained into the condensate cooler body, the tempering valve opens and allows cold water to enter the chamber and mix with hotter liquid, cooling it to a preset temperature level of 135°F (57°C) or to a desired field set temperature.

Capacities (Total of condensate and cooling water combined)

CC-5	5 gpm (19 lpm)
CC-12	12 gpm (45 lpm)
CC-25	25 gpm (95 lpm)
CC-40	40 gpm (151 lpm)

To determine condensate load, use the following formula:

$$\frac{(B - C)}{(H - C)} \times \text{ Model = gallons of hot liquid or condensate}$$

Where: B = Set point of tempering valve (preset to 135°F)
C = Cold water temperature
H = Hot water temperature or condensate temperature

Example:

$$\frac{(135 - 50)}{(180 - 50)} \times 5 \text{ (CC-5)} = 3.25^{*}$$

3.25 gal x 8.33 lbs per gallon x 60 = 1 624 lbs per hour

* In the example, Model CC-5 (5 gpm) can handle 3.25 gpm of 180°F liquid. If cold water temperature or discharge temperature changes, the capacity will change.

Tempered Condensate Range

Factory preset 135°F (57°C)
Field adjustable range 115 to 180°F (46 to 82°C)
Maximum cold water pressure 150 psig (10 barg)

Materials

Body:	
CC-5 and CC-12	ASTM A48 cast iron
CC-25 and CC-40	Carbon steel
Pipe and Fittings:	Malleable iron
Body (Controller):	Brass
Sensing Bulb:	Bronze

For a fully detailed certified drawing, refer to:

CC-5 CDY #1000	**CC-25 CDY #1091**
CC-12 CDY #1073	**CC-40 CDY #10923**

Physical Data

Model	CC-5		CC-12		CC-25		CC-40	
Pipe Connection	in	mm	in	mm	in	mm	in	mm
Vent	3/4	20	1-1/2	40	1-1/2	40	2	50
Hot Condensate Inlet	3/4	20	1-1/2	40	1-1/2	40	2	50
Tempered Condensate Outlet	1-1/4	32	1-1/2	40	2	50	2-1/2	65
Cold Water Inlet	3/8	10	3/4	20	1	25	1	25
"H"	13	330	23	584	29	737	32-13/16	833
"W"	12-1/2	318	14-3/16	361	13	330	14-1/2	368
"A"	10-13/16	275	20-5/16	516	27-1/2	698	31	787
"B"	9-1/2	241	19-3/16	487	13-13/16	351	15-5/16	389
"C"	6-1/2	165	11-7/8	302	19-13/16	503	21-9/16	548
"D"	11	279	11	279	11	279	12	305
Weight, lb (kg)	15 (6.8)		77 (35)		81 (37)		93 (42)	

Armstrong MS-6 Noiseless Heater

The use of hot water is indispensable in food processing, cleaning, and plating operations. Although the simplest and most efficient way to provide the water is by direct steam sparging, such a format often results in vibration and noise caused by steam blowing into the water tank. These problems can be greatly reduced by mounting an MS-6 noiseless heater at the end of the pipe.

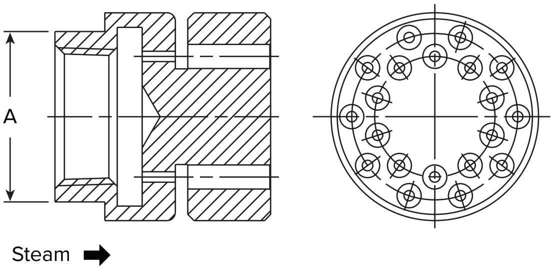
Features

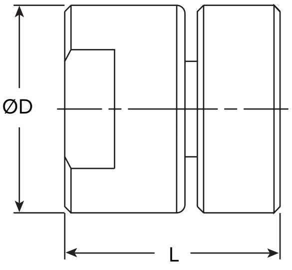
- Stainless steel construction for greater durability
- Mounting is simple and economical
- Maintenance free

Formula for Calculating Steam Load
to Heat Water in Tank

$$\text{lbs/hr} = \frac{\text{Gal} \times \Delta T \times 8.3}{\text{Lat} \times T}$$

Gal = Gallons of water to be heated
ΔT = Temperature rise °F
Lat = Latent heat of steam (Btu/lb)
T = Time in hours





Specifications	
Fluid	Steam
Pressure Range	7 - 100 psig (0.5 - 7 barg)
Silencing Limit Temperature	190°F (90°C)
Material	304 Stainless Steel
Connection	NPT

Dimensions and Weights

Connection Size	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
	1/2	15	3/4	20	1	25	1-1/4	32	1-1/2	40	2	50
"L"	1-15/16	49	1-15/16	49	2-1/16	52	2-3/16	55	2-5/16	59	2-9/16	65
"D"	1-3/8	35	1-1/4	45	2	50	2-3/8	60	2-3/4	70	4-1/8	105
"A"	1-3/16	30	1-7/16	36	1-5/8	41	2	50	2-3/8	60	3-9/16	90
Weight, lb (kg)	0.55 (0.25)		0.88 (0.40)		1.15 (0.52)		1.70 (0.77)		2.54 (1.15)		6.59 (2.99)	

Capacities - Steam, lb/hr (kg/hr)

Inlet, psig (barg)	Connection Size											
	1/2"		3/4"		1"		1-1/4"		1-1/2		2	
	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
7 (0.50)	54	25	129	58	157	71	190	86	291	132	362	164
10 (0.70)	65	30	147	67	179	81	222	101	323	147	413	187
15 (1.00)	84	38	177	80	214	97	276	125	376	171	498	226
20 (1.38)	103	46	208	94	250	113	330	150	430	195	582	264
30 (2.00)	140	63	269	122	321	146	439	199	536	243	751	341
40 (2.76)	177	80	330	149	392	178	547	248	643	292	921	418
50 (3.45)	214	97	390	177	463	210	655	297	749	340	1 090	494
60 (4.14)	251	114	451	205	534	242	764	346	856	388	1 259	571
70 (4.83)	289	131	512	232	605	275	872	395	963	437	1 428	648
80 (5.52)	326	148	573	260	676	307	980	445	1 069	485	1 597	725
90 (6.20)	363	165	634	288	748	339	1 088	494	1 176	533	1 767	801
100 (6.90)	400	181	695	315	819	371	1 197	543	1 282	582	1 936	878

Armstrong Exhaust Head - AEH Series

Description

Armstrong's AEH series carbon steel exhaust heads should be used when there is a risk of water carryover up an atmospheric vent pipe. The internal knock-out plate and stainless steel mesh screening effectively contains water carry-over and discharges it through the bottom drain leaving dry flash steam to vent through the top of the vessel.

Connections

Flanged	ASME B16.5 CL 150
Drain	FNPT

How To Order

Exhaust heads are typically sized to match existing vent line connections. Choose the Armstrong model below which best fits your application.

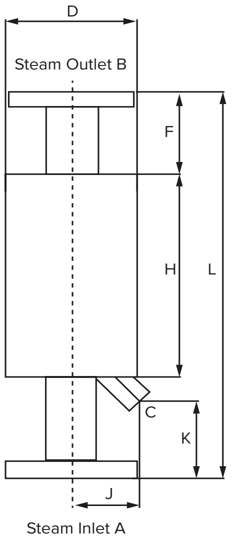
(**Note:** 1. Excessive carryover could be caused by leaking steam traps or undersized vents. 2. Not for use on Safety Relief Valves.)

Materials

Part Name	AEH Series
Body	Carbon Steel
Baffle Plate	Carbon Steel
Screens	304 Stainless Steel
Flange	Carbon Steel
Connection Pipe	Carbon Steel

Dimensions

Model	Connection Size			D	H	L	F	K	J
	Steam Inlet A In (mm)	Steam Outlet B In (mm)	Drain C In (mm)	In (mm)	In (mm)	In (mm)	In (mm)	In (mm)	In (mm)
AEH20592-2	2 (50)	2 (50)	3/4 (19)	6-1/4 (159)	9-13/16 (250)	18-1/2 (470)	4 (100)	3-5/8 (92)	3-1/4 (82)
AEH20592-3	3 (80)	3 (80)	3/4 (19)	8-5/8 (219)	11-13/16 (300)	21-5/8 (550)		4-13/16 (122)	4-1/8 (105)
AEH20592-4	4 (100)	4 (100)	1 (25)	10-3/4 (273)	13-3/4 (350)	24-13/16 (630)		5-11/16 (145)	5-3/16 (132)
AEH20592-6	6 (150)	6 (150)	1-1/2 (38)	12-13/16 (325	15-3/4 (400)	27-9/16 (700)		6-1/2 (165)	6-1/4 (158)
AEH20592-8	8 (200)	8 (200)	2 (50)	16-3/4 (426)	17-3/4 (450)	30-11/16 (780)		7-3/8 (188)	8 (204)
AEH20592-10	10 (250)	10 (250)	2 (50)	20 (508)	19-11/16 (500)	33-7/16 (850)		8-3/16 (208)	9-3/8 (238)



Notes

Ancillary Products