Armstrong

CONDITIONED STEAM HUMIDIFIERS

HUMIDIFICATION USING ADIABATIC PROCESS WITH COLD WATER

Pressure Fog®

Pressure Fog® is Armstrong's energy efficient high pressure humidification solution. It produces a rich fog to provide humidity and evaporative cooling without the need for and air compressor, keeping energy costs low. Pressure Fog® is a system that is perfect for applications requiring high humidification output with minimal energy consumption.

Evapack®

Armstrong EVAPACK® Series converts ordinary drinkable water to water vapor using an adiabatic process. Dry air passes through a corrugated bank of wetted cells media made from inorganic wet fibers. EVAPACK® series uses the sensible air heat to evaporate the water. The air is cooled and humidified.

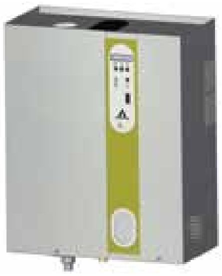
HUMIDIFICATION USING ISOTHERMAL PROCESS WITH STEAM

HUMIDICLEAN™ Series

HC-6000 Humidifier with Ionic Bed Technology™. The HumidiClean™ electric humidifier includes disposable inserts made of a fibrous medium. Called ionic beds, these devices attract solids from the boiling water, preventing the solids from plating out on the heating elements or on the tank walls. Tank cleaning is minimized, and effective service life is extended.

Series EHU Electric Steam Humidifier

No other electric humidifier does a better job of stabilizing and simplifying humidity control. Only Armstrong offers full modulation and a patented self-regulating maximum output feature. When you install an Armstrong Series EHU you get accurate, automatically adjusted humidity control that's virtually hands-free.



Series ERS Electric Steam Humidifier

ERS humidifiers is probably the most easy to use resistive steam humidifier existing. Maintenance is reduce to a very simple and quick operation thanks to the pivoting tank technology.

STEAM HUMIDIFICATION

Series 9000 Humidifier

The Series 9000 direct steam injection humidifier provides precisely controlled, trouble-free steam humidification. These units distribute steam and give you precise control to accurately maintain the required level of relative humidity. Available in a range of selections to meet various capacity requirements, Series 9000 units offer uniform vapor distribution and rapid, complete absorption. They maintain quiet operation and require minimal maintenance.

Series 1000 All Stainless Steel Humidifier

A steam separator type humidifier for use in sensitive environments where pure, demineralized, deionized or distilled water is used to generate clean steam. Designed for applications where all steam and condensate piping is stainless steel, the Armstrong Series 1000 delivers precisely controlled, trouble-free steam humidification. Stainless steel construction prevents problems caused by corrosion and subsequent carry-over of corrosion by-products.

Steam-To-Steam Humidifier

Steam-to-steam devices in the CS Series use boiler steam to produce chemical free steam from untreated water. Easy to install and simple to clean, Armstrong steam-to-steam humidifiers have all the benefits of steam humidification without the concern of boiler treatment carry-over.

Ionic Bed Technology™

This steam-to-steam device has all the benefits of Armstrong steam-to-steam humidifiers – easy to install, simple to clean – plus the innovative Ionic Bed Technology™ at the heart of all HumidiClean humidifiers.

Armstrong International at a glance

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 hotwater 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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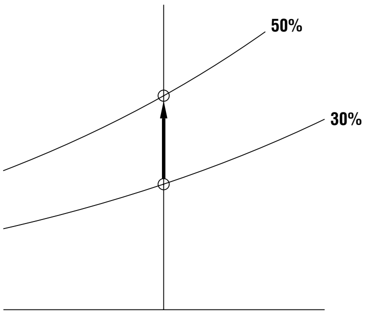
Steam Humidification (Isothermal)

Unlike other humidification methods, steam humidifiers have a minimal effect on dry-bulb (DB) temperatures. The steam humidifier discharges ready-made water vapor. This water vapor does not require any additional heat as it mixes with the air and increases relative humidity. Steam is pure water vapor existing at 100°C. This high temperature creates a perception that steam, when discharged into the air, will actually increase air temperature. This is a common misconception. In truth, as the humidifier discharges steam into the air, a steam/air mixture is established. In this mixture steam temperature will rapidly decrease to essentially the air temperature.



The psychrometric chart helps illustrate that steam humidification is a constant DB process. Starting from a point on any DB temperature line, steam humidification will cause movement straight up along the constant DB line. The example illustrates that 21°C DB is constant as we increase RH from 30% - 50%. This is true because steam contains the necessary heat (enthalpy) to add moisture without increasing or decreasing DB temperature. Actual results utilizing high pressure steam or large RH increases (more than 50%) increase DB by 0.5° to 1°C. As a result, no additional heating or air conditioning load occurs.

Direct Steam Injection Humidifiers

The most common form of steam humidifier is the direct steam injection type. From a maintenance point of view, direct steam humidification systems require very little upkeep. The steam supply itself acts as a cleaning agent to keep system components free of mineral deposits that can clog many forms of water spray and evaporative pan systems. Response to control and pinpoint control of output are two other advantages of the direct steam humidification method. Since steam is ready-made water vapor, it needs only to be mixed with air to satisfy the demands of the system. In addition, direct steam humidifiers can meter output by means of a modulating control valve. As the system responds to control, it can position the valve anywhere from closed to fully open. As a result, direct steam humidifiers can respond more quickly and precisely to fluctuating demand.

The high temperatures inherent in steam humidification make it virtually a sterile medium. Assuming boiler makeup water is of satisfactory quality and there is no condensation, dripping or spitting in the ducts, no bacteria or odors will be disseminated with steam humidification.

Corrosion is rarely a concern with a properly installed steam system. Scale and sediment – whether formed in the unit or entrained in the supply steam – are drained from the humidifier through the steam trap.

Steam-to-Steam Humidifiers

Steam-to-steam humidifiers use a heat exchanger and the heat of treated steam to create a secondary steam for humidification from untreated water. The secondary steam is typically at atmospheric pressure, placing increased importance on equipment location.

Maintenance of steam-to-steam humidifiers is dependent on water quality. Impurities such as calcium, magnesium and iron can deposit as scale, requiring frequent cleaning. Response to control is slower than with direct steam because of the time required to boil the water.

Direct Steam Humidification

Figure 4-1. Jacketed Steam Humidifier

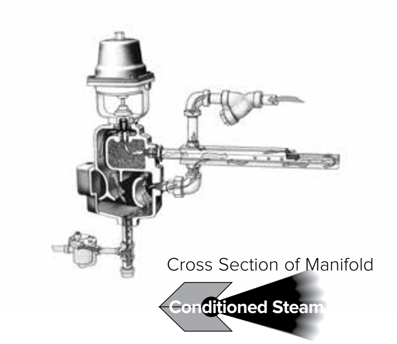
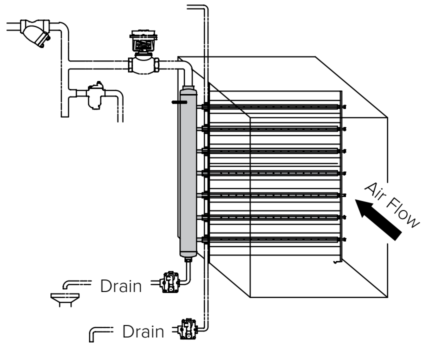
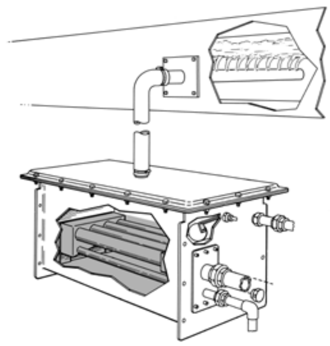


Figure 4-2. Panel Type



Steam-to-Steam Humidification

Figure 4-3.



Electric Steam Humidifiers (Electrode)

Electric steam humidifiers are used when a source of steam is not available. Electricity and water create steam at atmospheric pressure. Electrode-type units pass electrical current through water to provide proportional output. Use with pure demineralized, deionized or distilled water alone will generally not provide sufficient conductivity for electrode units.

Water quality affects the operation and maintenance of electrode-type humidifiers. Use with hard water requires more frequent cleaning, and pure softened water can shorten electrode life. Microprocessor-based diagnostics assist with troubleshooting.

Electrode units are easily adaptable to different control signals and offer full modulated output. However, the need to boil the water means control will not compare with direct-injection units.

Electric Steam Humidifiers (Resistance)

This type of electric humidifiers typically use immersed resistance heating elements to boil water. Since current does not pass through water, conductivity is not a concern.

Gas-Fired Steam Humidifiers

In gas-fired steam humidifiers, natural gas or propane are combined with combustion air and supplied to a gas burner. The heat of combustion is transferred to water through a heat exchanger, creating atmospheric steam for humidification. Combustion gasses must be vented per applicable codes. Fuel gas composition, combustion air quality and proper venting can affect operation. Water quality also can impact the operation and maintenance of gas-fired humidifiers. Ionic bed-type gas-fired humidifiers use ionic bed inserts containing fibrous media to attract solids from water as its temperature rises, minimizing the buildup of solids inside the humidifier. Therefore, water quality does not affect operation, and maintenance typically consists of simply replacing the ionic bed inserts. Ionic bed gas-fired humidifiers are adaptable to various control signals and offer modulated output. However, control of room RH is affected by the need to boil water and limitations inherent in gas valve and blower technology.

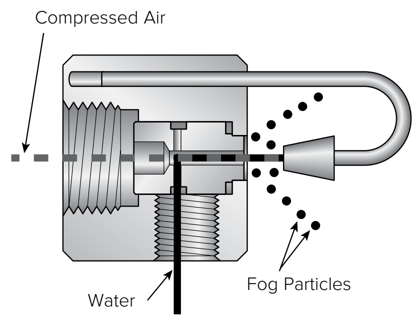
Fogging Systems (Adiabatic)

Fogging systems use compressed air to atomize water and create a stream of microscopic water particles, which appears as fog. In order to become vapor, water requires approximately 2 300 kJ per kilogram. The water particles quickly change from liquid to gas as they absorb heat from the surrounding air, or air stream. Properly designed fogging systems include sufficient heat in the air to allow the water to vaporize, avoiding "plating out" of water on surfaces, which might lead to control or sanitation problems. Fogging systems contain virtually none of the heat of vaporization required to increase RH to desired conditions. For this reason, fogging systems humidification is a virtually constant enthalpy process. As the psychrometric example illustrates, DB temperature changes as RH increases from 30% to 50%. This evaporative cooling can provide energy benefits for systems with high internal heat loads.

Unlike many adiabatic humidifiers, properly designed fogging systems are able to modulate both compressed air and water pressures to provide modulated output. Although time and distance (in an air handling system) are required for evaporation, response to control is immediate. High evaporation efficiency guarantees maximum system performance.

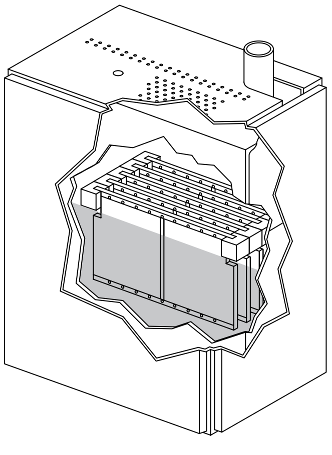
A water analysis is suggested prior to applying fogging systems when reverse osmosis (RO) or deionized (DI) water is not available.

Figure 5-1. Fogger Head



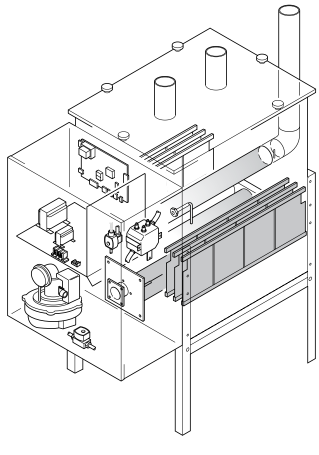
Electric Resistance Steam Humidification with Ionic Beds

Figure 5-2.



Gas-Fired with Ionic Beds

Figure 5-3.



Cost Comparisons

To fairly evaluate the costs of selecting a humidification system, you should include installation, operating and maintenance costs as well as initial costs. Total humidification costs are typically far less than heating or cooling system costs.

Initial costs, of course, vary with the size of the units. Priced on a capacity basis, larger capacity units are the most economical, regardless of the type of humidifier, i.e.: one humidifier capable of delivering 500 kilograms of humidification per hour costs less than two 250 kg/h units of the same type.

Direct steam humidifiers will provide the highest capacity per first cost Euro; fogging systems and gas-fired humidifiers are the least economical (first cost), assuming capacity needs of 45 kg/h or more.

Installation costs for the various types cannot be accurately formulated because the proximity of water, steam and electricity to humidifiers varies greatly among installations. Operating costs are low for direct steam and slightly higher for steam-to-steam. Fogging system and gas-fired (ionic bed) operating costs are also low. Energy costs are higher for electric humidifiers.

Direct steam humidifiers have the lowest maintenance costs, followed by fogging systems. Ionic bed electric and gas-fired humidifiers are designed specifically to minimize maintenance while adapting to various water qualities. Maintenance costs for other types can vary widely, depending on water quality and applications.

These are the principal considerations in selecting a humidification system. Table 7-1, Page 7 summarizes the capabilities of each humidifier type.

Figure 6-1.

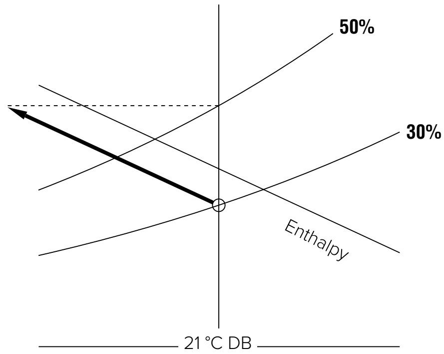
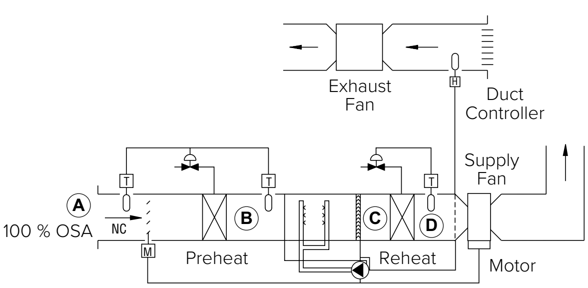


Table 6-1. System 3

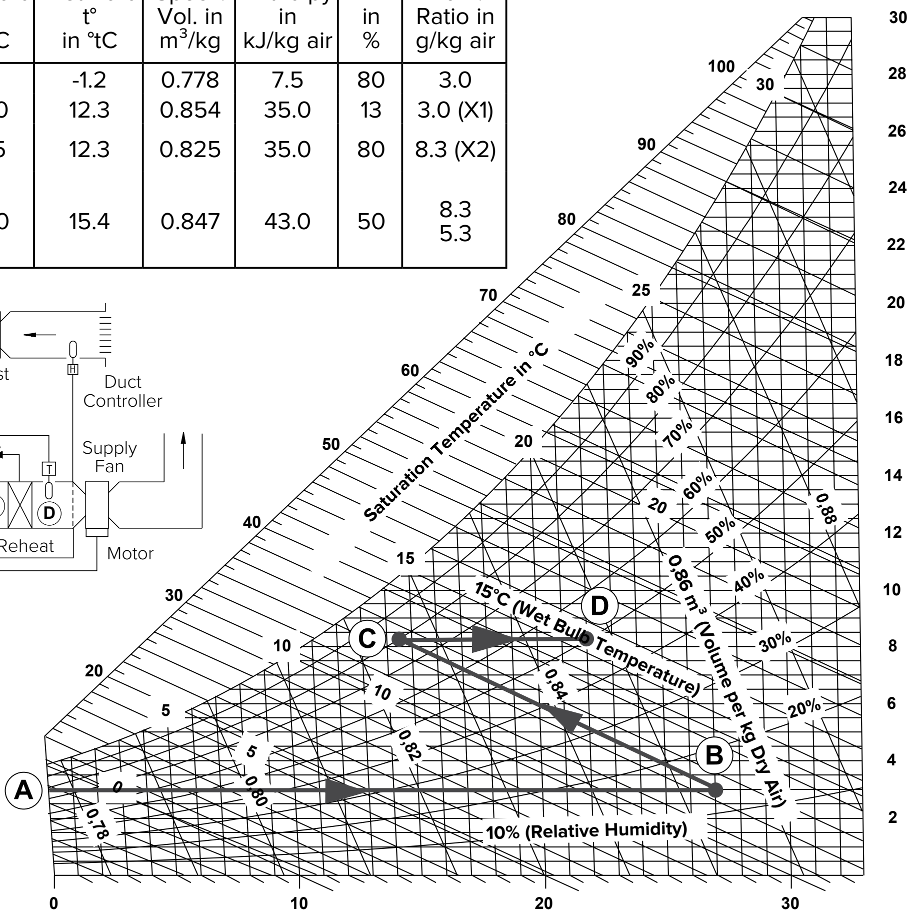
	Dry Bulb t° in °C	Wet Bulb t° in °tC	Specif. Vol. in m^3/kg	Enthalpy in kJ/kg air	RH in %	Hum. Ratio in g/kg air
A Outside conditions	0	-1.2	0.778	7.5	80	3.0
B Preheat	27.0	12.3	0.854	35.0	13	3.0 (X1)
C Humidification with unheated recycled water*	14.5	12.3	0.825	35.0	80	8.3 (X2)
D Reheat ΔX (X2-X1)	22.0	15.4	0.847	43.0	50	8.3 5.3

* assumed to be 80% efficient



Glossary of Symbols

- EA.............. Exhaust Air
- E-P relay.. Electric-Pneumatic relay
- H................ Humidity controller
- M............... Damper motor
- MA............ Mixed air
- NC............ Normally closed
- NO............ Normally open
- OSA.......... Outside Air
- RA............. Return Air
- T................ Temperature Controller



Recommended Applications

Steam: Recommended for virtually all commercial, institutional and industrial applications. Where steam is not available, small capacity needs up to 90 kg/h can be met best using ionic bed type, self-contained steam generating units. Above this capacity range, central system steam humidifiers are most effective and economical. Steam should be specified with caution where humidification is used in small, confined areas to add large amounts of moisture to hygroscopic materials. We recommend that you consult your Armstrong Representative regarding applications where these conditions exist.

Fogging Systems: Properly designed compressed air/water fogging systems used with a reverse osmosis (RO) or deionized (DI) water source will avoid problems associated with sanitation, growth of algae or bacteria, odor, or scale. The potential energy benefit associated with fogging systems should be examined for any application requiring over 230 kg/h where steam is not available, or where evaporative cooling is beneficial, such as air side economizers or facilities with high internal heat loads.

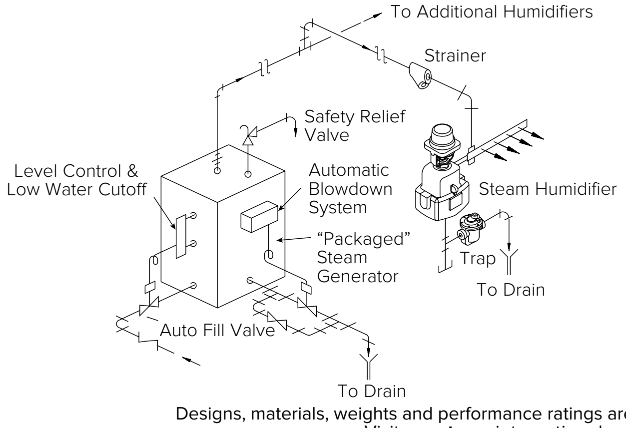
Summary: The evidence supports the conclusion that steam is the best natural medium for humidification. It provides ready-made vapor produced in the most efficient evaporator possible, the boiler. There is no mineral dust deposited, and because there is no liquid moisture present, steam creates no sanitation problems, will not support the growth of algae or bacteria, has no odor and creates no corrosion or residual mineral scale.

With these advantages in mind, engineers specify steam boilers and generators solely for humidification when the building to be humidified does not have a steam supply. The minimum humidification load where this becomes economically feasible falls in the range of 90 kg/h. Steam generator capacity is generally specified 50% greater than maximum humidification load, depending on the amount of piping and number of humidifiers and distribution manifolds that must be heated. Typical piping for boiler-humidifier installations is shown in Figure 7-1.

Table 7-1. Comparison of Humidification Methods

	Direct Steam	Steam-to-Steam	Electrode or Resistance Electric Steam	Ionic Bed Electric Steam	Ionic Bed Gas-Fired Steam	Fogging Systems
Effect on temperature	Virtually no change					Substantial temperature drop
Unit capacity per unit size	Small to very large	Small	Small to medium	Small to medium	Small to medium	Small to very large
Vapor quality	Excellent	Good	Good	Good	Good	Average
Response to control	Immediate	Slow	Fair	Fair	Fair	Immediate
Control of output	Good to excellent	Below average	Average	Average	Below average	Good to excellent
Sanitation/corrosion	Sterile medium; corrosion free	Bacteria can be present	Programmed to not promote bacteria	Programmed to not promote bacteria	Programmed to not promote bacteria	Designed to not promote bacteria
Maintenance frequency	Annual	Monthly	Monthly to quarterly	Quarterly to semi-annually	Quarterly	Annual
Maintenance difficulty	Low	Medium	Medium	Low	Medium	Low
Costs: price per unit of capacity	Low	High	Medium	Medium	High	Medium
Installation	Varies with availability of steam, water, gas, electricity, etc.					
Operating	Low	Low	Medium	Medium	Low	Low
Maintenance	Low	High	Medium	Low to medium	Low to medium	Low

Figure 7-1. Typical Piping for Boiler-Humidifier Installation



Design Guidelines

Boiler-Humidifier Combinations

1. Boiler gross output capacity should be at least 1.5 times the total humidification load.
2. Water softeners should be used on boiler feedwater.
3. Condensate return system is not necessary (unless required by circumstances).
4. Boiler pressure should be at 1 barg or less.
5. An automatic blowdown system is desirable.
6. All steam supply piping should be insulated.
7. No limit to size or number of humidifiers from one boiler.

Electric Or Gas-Fired Steam Humidifiers

When steam is not available, self-contained electric or gas-fired humidifiers can meet low-capacity requirements. The primary consideration in selecting this type of humidifier is its ability to work with wide ranges in water quality. Ionic bed electric or gas-fired humidifiers are frequently selected for this capability.

Direct Injection Steam Humidifiers

An evaluation of three performance characteristics is essential to understand the advantages steam holds over other humidification media:

- Conditioning
- Control
- Distribution

The humidifier must condition the steam so that it's completely dry and free of significant particulate matter. Response to control signals must be immediate, and modulation of output must be precise. Distribution of steam into the air must be as uniform as possible. Inadequate performance in any of these areas means the humidifier will not meet the basic humidification requirements.

Direct injection steam humidifiers are available in three basic types: specially designed steam panels, steam cups and the steam separator.

Specially designed steam panel systems incorporate advanced engineering in addressing unique applications where vapor trail is of prime concern.

The steam separator is a more sophisticated device which, when properly designed, meets essential performance criteria.

Figure 8-1. Steam Panel Humidifier

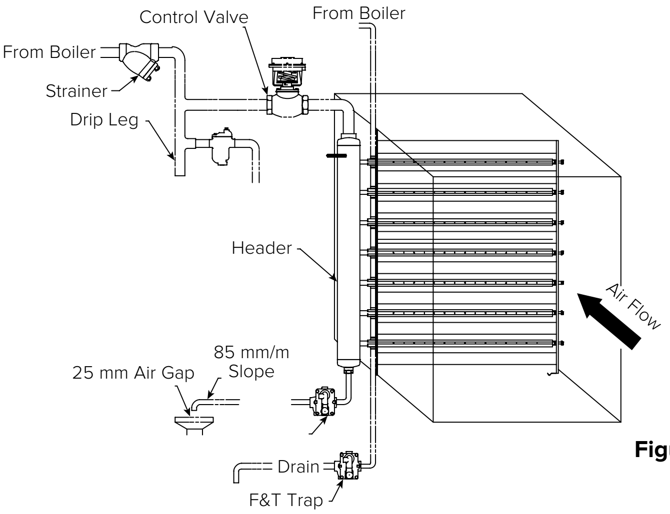
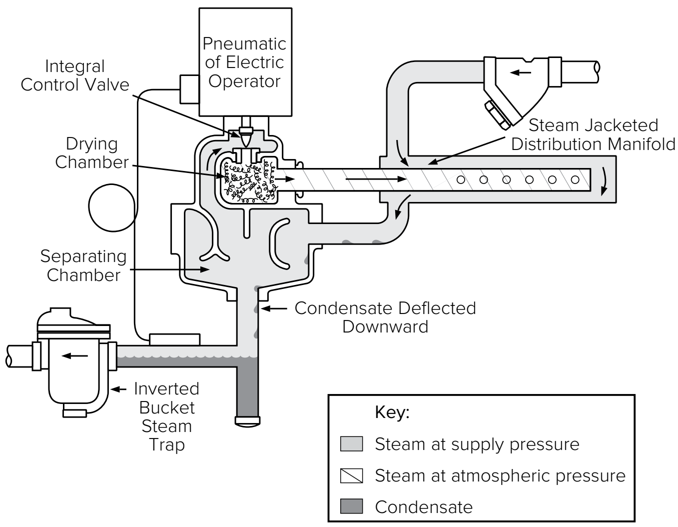


Figure 8-2. Steam Separator Type Humidifier



Steam Conditioning

As steam moves through supply lines, scale and sediment may be entrained in the flow – a Y-type strainer is required to remove larger solid particles. Similarly, the condensation that occurs in the supply lines permits water droplets or even slugs of condensate to be carried into the humidifier.

Several steps within the humidifier are required to positively prevent the discharge of liquid moisture and finer particulate matter along with the humidifying steam.

The separating chamber in the humidifier body should provide the volume required for optimum velocity reduction and maximum separation of steam from condensate. Properly separated, the condensate carries a substantial portion of the significant micronic particulates with it to be discharged through the drain trap.

Steam from the separating chamber can still carry liquid mist which must be removed. Humidifiers equipped with an inner drying chamber that is jacketed by the steam in the separating chamber can effectively re-evaporate any remaining water droplets before steam is discharged. Similarly, the control valve should be integral with the humidifier. Both the humidifier and the distribution pipe should be jacketed by steam at supply pressure and temperature to prevent condensation as steam is discharged.

Only proper design of the humidifier for conditioning of steam can assure the essential levels of sanitation and a clean atmosphere. These guidelines contribute to better comfort conditions and ensure that the humidifier meets the vital physical requirements of the system.

Control of Output

In most applications, humidifiers consistently operate at a fraction of maximum output.

Humidifier control must provide immediate response and precise modulation in order to accurately maintain the required relative humidity. Faulty control can make it difficult to provide the desired humidity level, and can lead to overloading the ducts with moisture and the creation of wet spots.

Two design factors affect the accuracy of humidifier control that can be achieved – the metering valve and the actuator that positions the valve.

Precise flow control can be achieved with a valve designed expressly for the purpose of adding steam to air. Parabolic plug type valves have been established as best for this service. They permit a longer stroke than comparable industrial valves, and the plug normally extends into the orifice even with the valve in "full open" position. This facilitates full and accurate modulation of flow over the complete stroke of the valve.

Chart 9-1. Desirable modified linear characteristic curve for valves used under modulating control. The modification of true linear characteristics provides more precise control when capacity requirements are very low and the valve is just cracked off the seat.

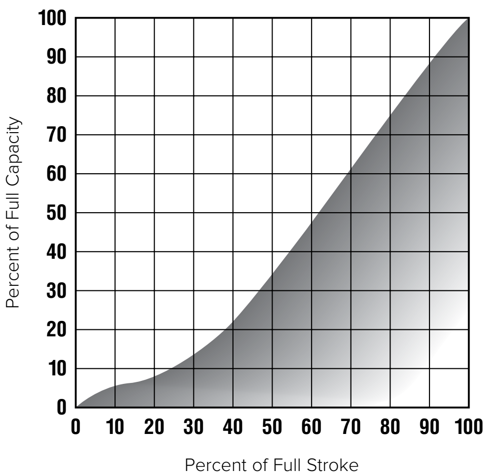
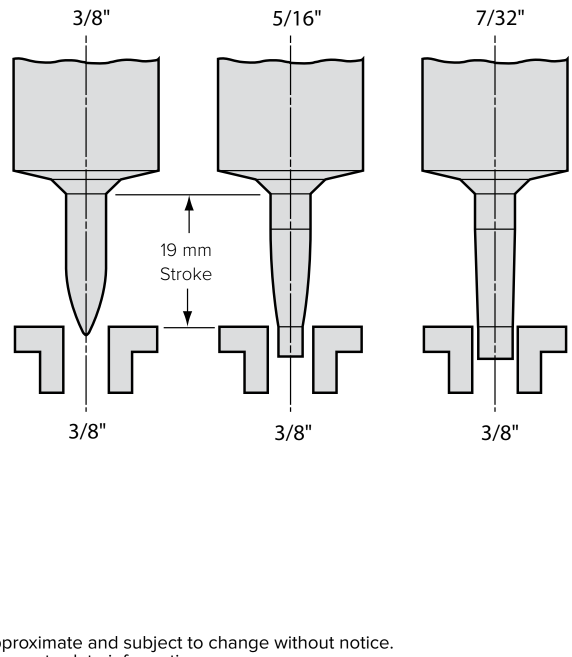


Figure 9-1. Parabolic Plug Metering Valve



Considerations in Selecting Steam Humidifiers, continued...

The Control Valve

The parabolic plug design also provides exceptionally high rangeability. Rangeability is the ratio between the maximum controllable flow and the minimum controllable flow of steam through the valve. The higher the rangeability of a valve, the more accurately it can control steam flow. Rangeabilities of the parabolic plug valves used in Armstrong Series 9000 Humidifiers shown in Table 10-1 are typical of the ratios that can be achieved with this type of valve.

The actuator is another important component in humidity control. Several types are available to provide compatibility with various system types. The actuator must be able to position the valve in very nearly identical relationship to the seat on both opening and closing strokes. This is essential to provide consistent, accurate metering of steam discharged by the humidifier.

By their design, electric motor modulating actuators provide true linear positioning characteristics on both opening and closing cycles. Pneumatic actuators may or may not be able to provide the precise positioning and holding characteristics essential to accurate control. Rolling diaphragm type pneumatic actuators are recommended, providing they meet the following criteria:

1. Large diaphragm area – 72 cm^2 or more – to provide ample lifting force. This permits the use of a spring heavy enough to stabilize both the hysteresis effect and the flow velocity effect on the positioning of the valve stem versus air pressure to the actuator.

2. Diaphragm material highly resistant to wear or weakening from continuous cycling.

3. Actuator stroke long enough (in conjunction with valve plug and seat design) to provide high rangeability ratios.

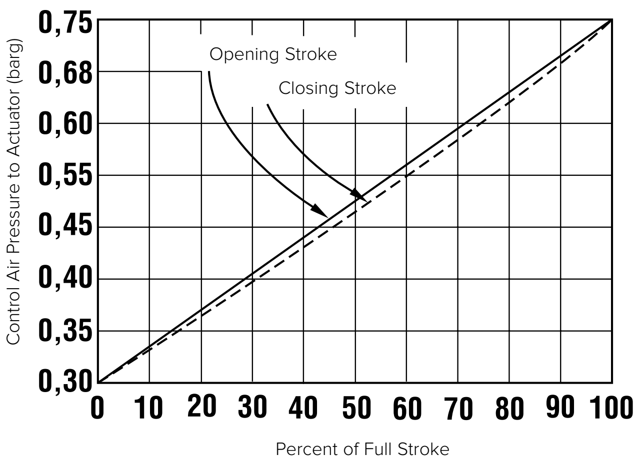
All modulating actuators, whether electric or pneumatic, should incorporate a spring return. This is necessary to ensure closing the valve if there is an interruption of power or control air to the unit.

For industrial in-plant operation and for very limited duct applications, a solenoid actuator may be used to provide simple on-off operation. This type of actuator should not be specified for duct applications without a detailed analysis of the system.

Table 10-1. Steam Humidifier Valve Rengeabilities

Valve Size	Rangeability	
Equivalent Diameter	Ratio of Flow Max:Min	Minimum Flow as % of Maximum
1 1/2"	63:1	1.6
1 1/4"	69:1	1.4
1 1/8"	61:1	1.6
1"	53:1	1.9
7/8"	44:1	2.3
3/4"	33:1	3.0
5/8"	123:1	0.8
9/16"	105:1	0.9
1/2"	97:1	1.0
15/32"	85:1	1.2
7/16"	75:1	1.3
13/32"	64:1	1.6
3/8"	70:1	1.4
11/32"	59:1	1.7
5/16"	49:1	2.0
9/32"	40:1	2.5
1/4"	31:1	3.2
7/32"	24:1	4.2
3/16"	18:1	5.6
5/32"	59:1	1.7
1/8"	37:1	2.7
7/64"	28:1	3.5
3/32"	21:1	4.8
5/64"	15:1	6.9
1/16"	10:1	10.0

Chart 10-1. Desirable Operating Characteristic for Pneumatic Actuators.
Position of valve is very nearly identical on both opening and closing strokes at any given air pressure to the actuator.



Distribution of Steam

The third essential factor in proper humidifier design is distribution. Steam must be discharged as uniformly as possible into the air to permit the fastest possible absorption without creating damp spots or saturated zones.

In normal ducts, a single distribution manifold installed across the long dimension will provide good distribution of steam. In large ducts or plenum chambers, it may be necessary to broaden the pattern of vapor discharge to achieve the required distribution, thus requiring multiple manifolds from single or multiple humidifiers.

Humidification for industrial areas without central air handling systems is customarily achieved with unit humidifiers discharging steam directly into the atmosphere. Proper mixing of steam and air can be accomplished in two ways. A dispersing fan may be mounted on the humidifier or a unit heater can be positioned to absorb and distribute the water vapor.

Figure 11-1. Unit Humidifier for Direct Discharge into Area

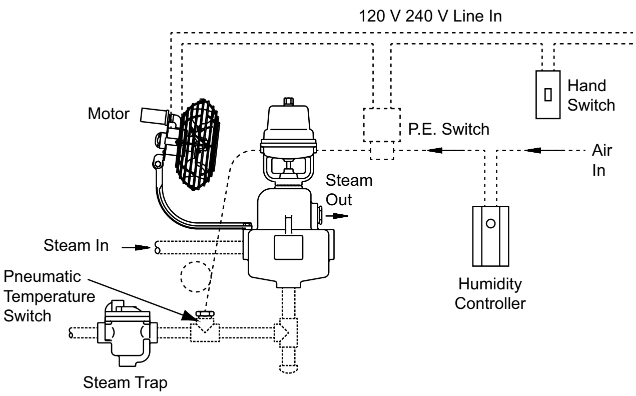


Figure 11-2. Single Distribution Manifold in a Normal Duct

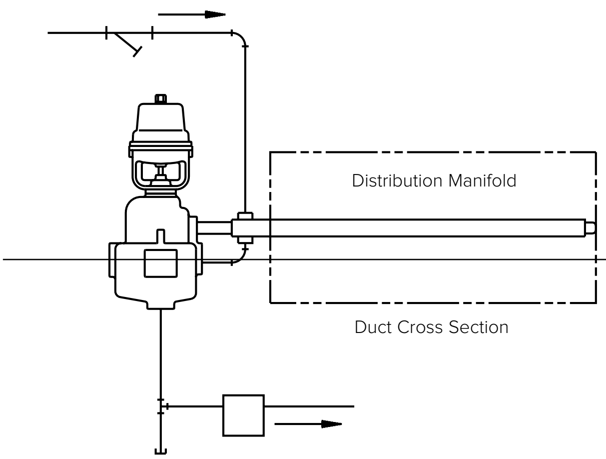
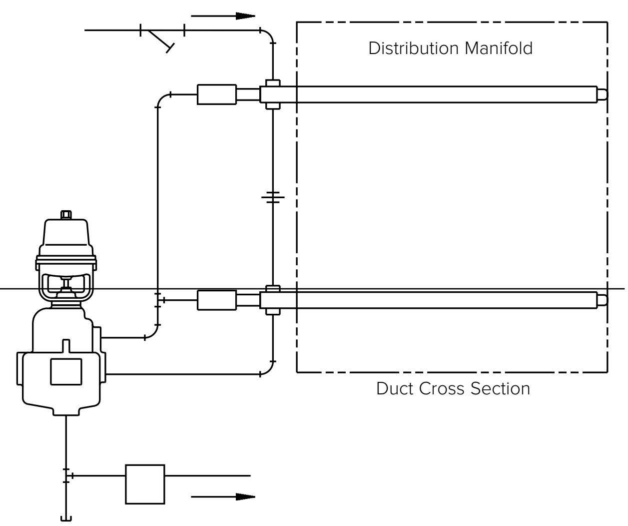


Figure 11-3. Multiple Distribution Manifolds in a Large Duct or Housing

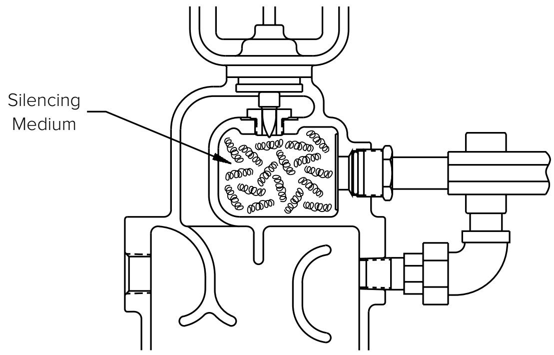


Note: See page 14 for multiple manifold hook-ups.

Operating Noise

In addition to these crucial performance characteristics, operating noise is a consideration in selecting steam humidifiers for areas where quiet operation is essential or desirable, i.e., hospitals, office buildings, schools, etc.

Figure 11-4. The noise of escaping steam is generated at the control valve. Muffling materials around the valve are necessary to minimize this noise.



Basic Application Principles

Several basic principles must be considered in the application of steam humidification equipment to insure proper system operation.

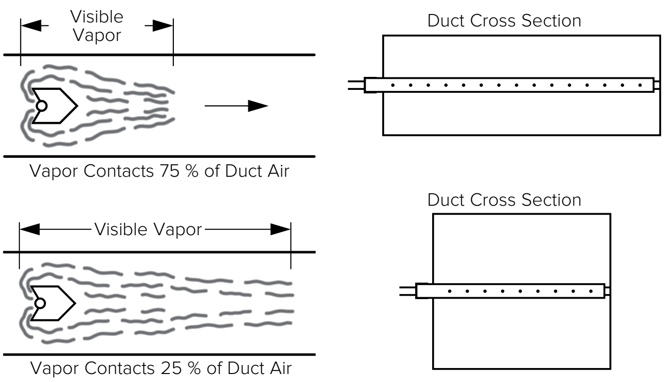
Vapor dissipation in air ducts is one of these considerations. In the steam humidification process, pure water vapor at 100°C is mixed with air at a lower temperature. The mixing of hot steam with cooler air results in heat transfer. Any time heat is transferred from steam condensation takes place. This condensation is referred to as visible vapor. When steam is discharged from a manifold in an air duct, it quickly changes from an invisible gas into visible water particles, and then dissipates to become invisible again.

Visible vapor indicates an area of super-saturation, where the invisible steam gas is condensing into water particles. When condensation occurs, the steam gas releases its latent heat of vaporization (about 2 320 kJ/kg of vapor) to duct air. Then, as the vapor completely mixes with the duct air, the latent heat previously given off is reabsorbed, converting the visible vapor back into invisible gas with essentially no change in DB temperature. (See Figure 12-2).

Clearly, the vapor dissipation in air ducts is very important to proper location of temperature or humidity controllers. Any controller located in or near the visible vapor pattern will produce inaccurate results because of pockets of saturated air. Under typical duct conditions, all controllers should be located at least 300 to 360 cm downstream of a manifold. However, the following system characteristics will affect the visible vapor pattern, and therefore should be considered in controller location:

1. Aspect Ratio of Duct. The ratio of duct height to width is a factor that influences the visible vapor pattern. Figure 12-1 shows two ducts with equal cross section areas, but with different aspect ratios. Air velocities, temperatures, RH and vapor output from the manifolds are all identical. However, in the taller duct the manifold is shorter and its vapor output comes in contact with a much smaller percentage of duct air, causing a longer visible vapor pattern.

Figure 12-1. Single Distribution Manifold in a Normal Duct



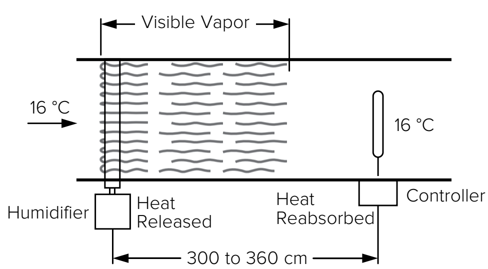
2. Duct Air Temperature. The temperature of the air flow in the duct also affects the length of the visible vapor pattern. Warmer air produces shorter vapor pattern, as shown in Figure 13-2, Page 13. All other conditions are the same.

3. Insulated Manifolds. While it is true that steam humidification is an isothermal process, several kJ of energy will be transferred into the air stream when using steam jacketed manifolds. Typically, this will result in less than 1°C temperature gain. The use of insulated steam jacketed manifolds will reduce this heat transfer for air temperature critical applications.

When insulated manifolds cannot be avoided, considerations need to be taken during the installation of these manifolds. A typical installation of a steam jacketed manifold requires the steam to be injected into the air stream. When insulated manifolds are used, they need to be installed with the steam being injected with the air stream. This is done to ensure moisture will not accumulate on the cool insulation jacket surfaces. However, when the manifolds are installed in this fashion, the added turbulence caused by the air flow travelling around the standard steam jacketed manifold is lost, resulting in a longer visible vapor trail. Figure 13-1 shows the proper installation, and effects on the visible vapor trail.

4. Duct Air Velocity. As the duct air velocity increases, the length of the visible vapor pattern increases. Figure 13-4 shows two sections of air ducts with air velocities of 1.27 m/s and 10 m/s respectively. Other conditions are the same: temperature, duct air humidity, duct dimensions and the amount of steam released from the identical manifolds. The length of the visible vapor pattern is approximately proportional to the velocity of the air in the duct.

Figure 12-2. Typical dry-bulb (sensible) temperature variations within a duct near the humidifier manifold. As the latent heat of vaporization is released, the temperature increases (in or near the visible vapor the temperature may rise by 1° to 2°C). However, as the visible vapor mixes and re-evaporates in the air flow, the heat of vaporization is reabsorbed and the duct air temperature returns to its former level.



5. Number of Manifolds in Duct.

In a large duct section requiring the discharge capacity of two humidifiers, better vapor distribution is achieved by using two manifolds full across the duct and vertically spaced to divide the duct section into thirds. The same effect is achieved by using multiple distribution manifolds from a single humidifier that has adequate capacity to meet the requirements. When a quantity of vapor is distributed among multiple manifolds, the amount released through each manifold is smaller, and more of the duct air comes into contact with the vapor. This effect is shown in Figure 13-5.

6. Duct Air RH. Relative humidity in the duct also affects the visible vapor. The higher the relative humidity downstream of the humidifier discharge, the longer the visible vapor trail. The closer duct conditions are to saturation, the longer the vapor trails are likely to be. Fortunately, duct air RH may be controlled with a duct high-limit humidistat, as shown in Figure 1.

Since the use of multiple manifolds reduces the length of visible vapor, their use should be considered whenever any of the following conditions exist at the humidifier location:

A. Duct air temperature is below 13°C or relative humidity is above 80%.

B. Duct air velocity exceeds 4 m/s.

C. “Final” or “high efficiency” filters are located within 300 cm downstream from humidifier.

D. Height of duct section exceeds 900 mm.

E. Visible vapor impinges upon coils, fans, dampers, filters (not final), turning vanes, etc. located downstream from humidifier.

Figure 14-1 allows you to determine the number of manifolds necessary to reach the required mixing length. For example:

- Air temperature: 13°C
- RH: 80%
- Air velocity: 2 m/s
- Required mixing length: 1 meter
- Steam load: 300 kg/h
- AHU dimensions: 2 750 mm x 2 750 mm

The chart shows that 0.3 meters of manifold should discharge maximum 7.2 kg/h of steam if 1 meter mixing length is required. This means that in order to keep the mixing length at 1 meter, the total dispersion length should be at least: (300 : 7.2) . 0.3 = 12.5 meters

Considering the AHU sizes, the biggest manifold that can be installed in it will have 2.7 meters length. In that case, the number of manifold will be: 12.5 : 2.7 = 4.6 = 5 manifolds.

This calculations allowed us to determine that in the example given above 5 manifolds having 2.7 meters length are necessary in order to discharge 300 kg of steam and mix it with the air within 1 meter after the humidifier location.

Figure 13-1. Standard Jacketed Manifold

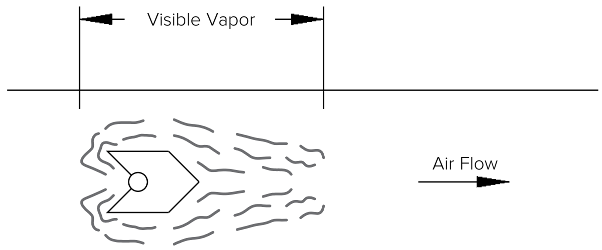


Figure 13-2. Insulated Jacketed Manifold

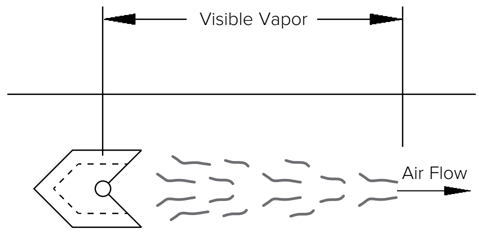


Figure 13-3

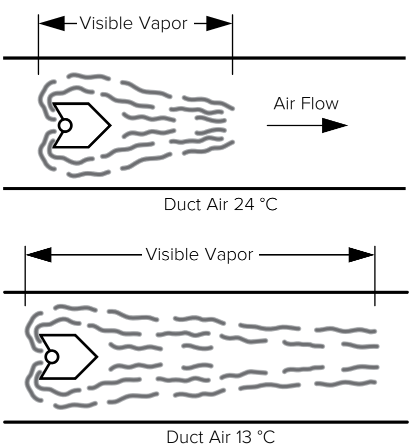


Figure 13-4

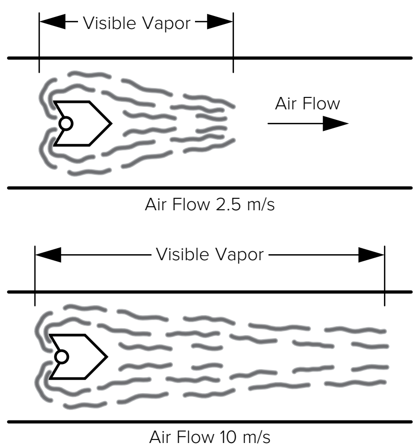


Figure 13-5

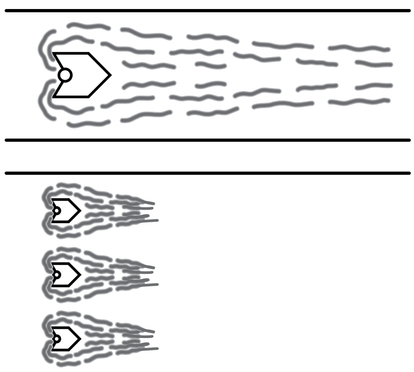


Table 14-1 and Figure 14-2 show a typical number of manifolds and typical spacing between them when duct height exceeds 900 mm.

Consult your Armstrong Representative or order Armstrong Humid-A-ware Humidification Sizing and Selection software at www.armstrong.be for specific recommendations regarding your needs.

The piping arrangement for humidifiers with multiple manifolds varies with the location of the manifolds.

When all manifolds are located above the humidifier inlet, manifold piping should be as shown in Figure 14-3.

When one or more manifolds are located below the humidifier inlet, the manifolds should be trapped separately, as shown in Figure 14-4.

Smaller manifolds, when possible to use, reduce the cost of multiple manifold installations. Care must be taken that the humidifier capacity does not exceed the combined capacity of the multiple manifolds. Piping arrangement is shown in Figure 15-3, Page 15.

7. Humidifier Manifold too Close to High Efficiency Filter. Many air handling systems require the use of high efficiency filters (also called "absolute" or "final" filters). These filters remove up to 99.97% of all particles 0.3 micron in diameter, and up to 100% of larger particles. The significance of these filtering qualities is shown in Table -2, where particle sizes of common substances are compared.

Figure 14-2.

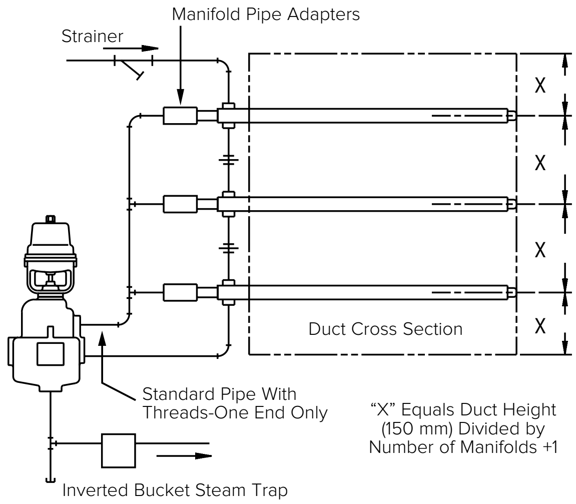


Figure 14-1.

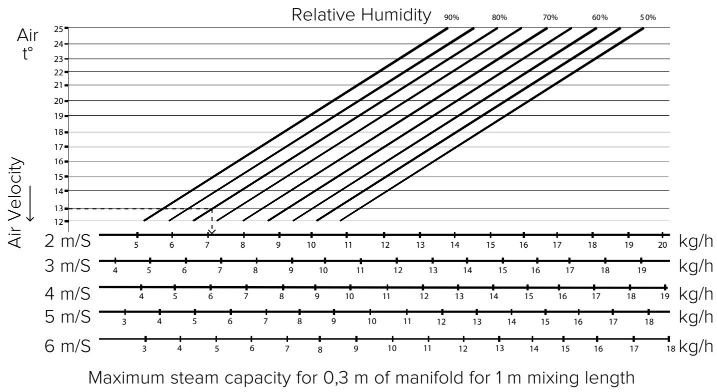


Table 14-1. Typical Number of Manifolds for Various Duct Heights	
Duct height at humidifier location in mm	No. of manifolds to be installed from one or more humidifiers
900 to 1 500	2
1 500 to 2 000	3
2 000 to 2 500	4
2 500 & Over	5 or more

Table 14-2. Typical Particle Sizes of Common Substances	
Material	Particle Size in Microns
Particles visible to human eye	10 or more
Human hair	100
Dust	1 to 100
Pollen	20 to 50
Fog (visible steam vapor)	2 to 40
Mist (water spray)	40 to 500
Industrial fumes	0.1 to 1
Bacteria	0.3 to 10
Gas molecules (steam gas)	0.0006

Figure 14-3.

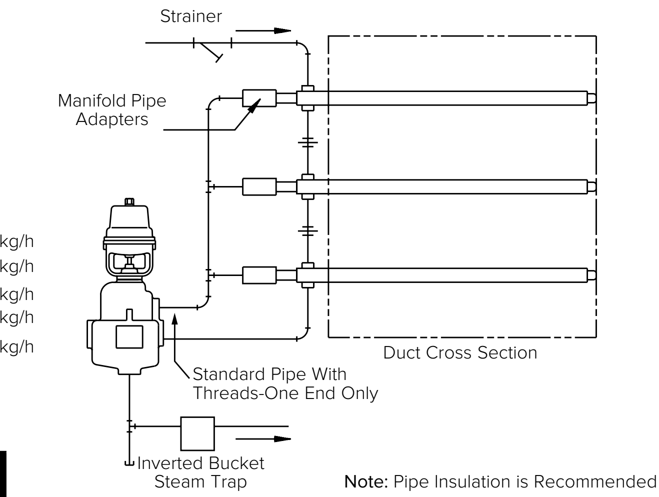
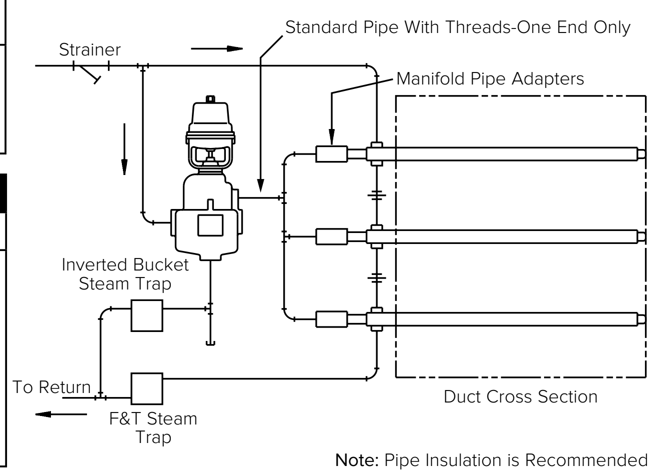


Figure 14-4



Since water particles present in visible vapor range from 2 to 40 microns, these particles are trapped by high efficiency filters. Some types of filters absorb moisture and expand, reducing air flow through the filter material. As a result, the static pressure in the duct rises from normal (about 25 mm water column) to as high as 1 000 mm WC. When the filter absorbs moisture, it also releases the latent heat of condensed steam into the duct air.

When a humidifier manifold is located too close to an absolute filter, the filter collects water vapor, preventing the moisture from reaching the space to be humidified. Placing the humidifier manifold farther upstream allows the water vapor to change into steam gas, which will pass unhindered through an absolute filter.

Under most circumstances, the water vapor will dissipate properly if the humidifier manifold is located at least 300 cm ahead of the final filter. However, if the duct air temperature is low, air velocity is high or the duct is tall, multiple manifolds may be installed to speed the mixing of steam with the duct air. For additional protection, install a duct high-limit controller just ahead of the final filter to limit the maximum humidity to approximately 90%. (See Figure 15-2)

Specially Designed Steam Panel Systems

For applications with particularly limited downstream absorption distances, custom engineered systems may be considered. The system includes a separator/header and multiple dispersion tube assembly packaged with a control valve, strainer, steam supply drip trap and one or two header drain traps. Each system is customized to provide uniform distribution and shortened mixing length distance downstream. (See Figure 15-4.)

How Steam Panel Systems Shorten Mixing Length Distance

Conditioned steam enters each of the dispersion tubes and flows through steam nozzles that extend from the center of each tube, before discharging through orifices into the airstream.

Airflow first encounters baffle tubes (See Figure 15-1) which influence its flow pattern and increase its velocity. Air traveling around each set of baffle tubes encounters opposing flow of high velocity steam exiting the orifices. The result is more uniform distribution and faster absorption of moisture into the air, resulting in a shorter mixing length distance requirement than experienced with traditional manifolds or dispersion tubes.

Specially Designed Steam Panel Systems

Figure 15-1.

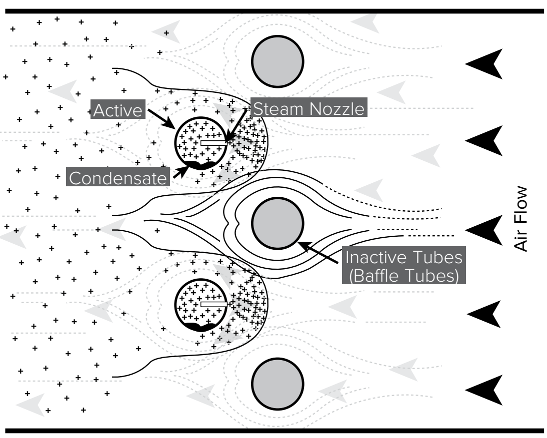


Figure 15-2.

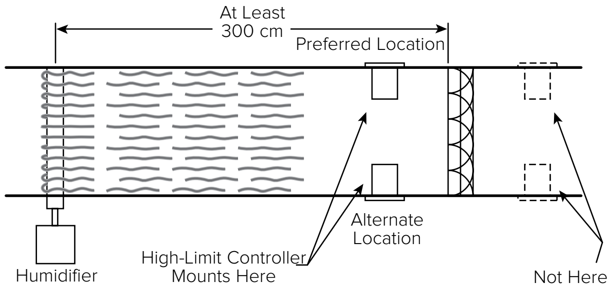


Figure 15-3.

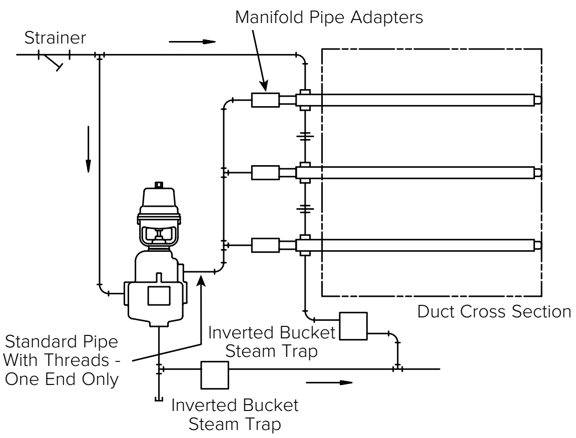
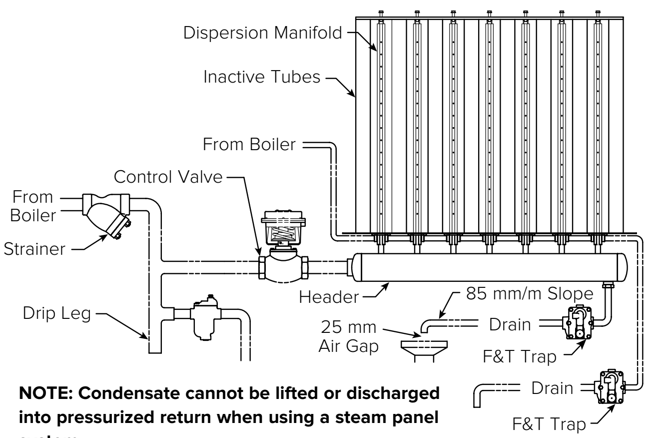


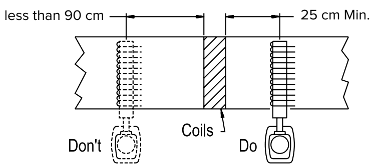
Figure 15-4. Steam Panel System



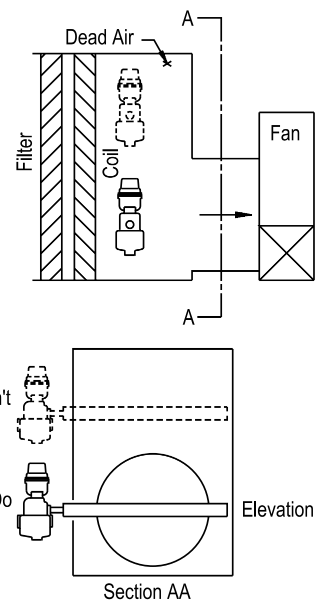
NOTE: Condensate cannot be lifted or discharged into pressurized return when using a steam panel system.

Armstrong® Installation Do's and Don'ts

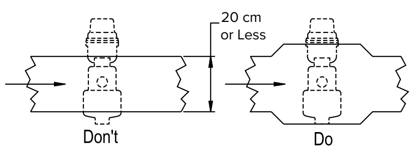
In discussing the systems, we mentioned a few location "do's and don'ts." Let's review these precautions that may help to keep you out of trouble. For example, whenever possible, install the distribution manifold downstream from coils. If you have more than three feet of distance available between the manifold and the coil on the upstream side, the manifold can be installed at this location (greater than three feet for higher velocity systems).



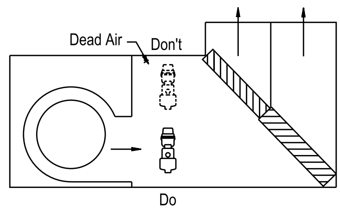
When it is necessary to place the humidifier in the coil section ahead of the fan, locate the manifold in the most active airflow and as far upstream from the fan inlet as possible.



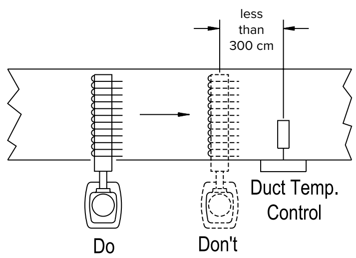
Don't risk restriction of the airflow in ducts 20 cm or less in depth. Use an expanded section as shown.



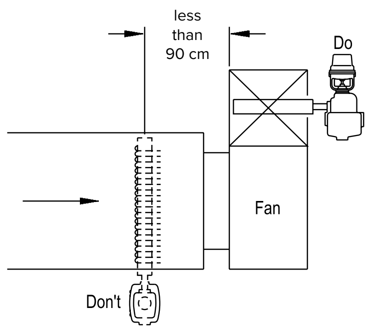
When it is necessary to place the humidifier discharge into a packaged multi-zone air handling system, install the distribution manifold into the center of the active air flow and as close to the fan discharge as possible.



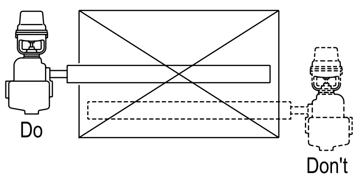
Do not install a distribution manifold closer than 10 feet upstream from a temperature controller or you may get false signals.



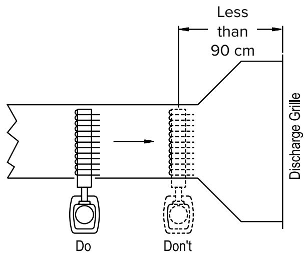
The distribution manifold should never be placed within three feet of an air fan intake. The best location is at the fan discharge.



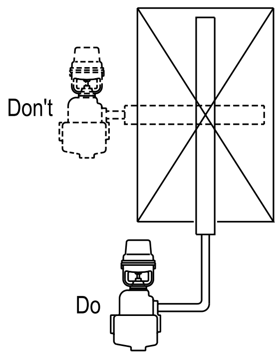
Whenever possible, install the distribution manifold into the center of the duct.



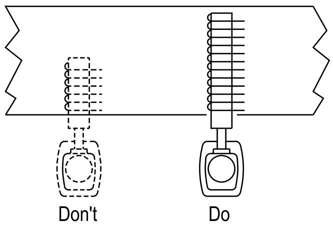
Always install distribution manifolds as far upstream from discharge air grilles as possible—never less than three feet upstream.



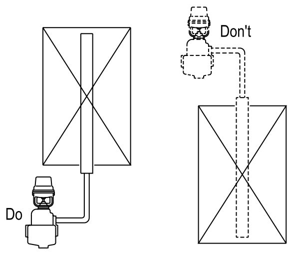
Always size and install the distribution manifold to span the widest dimension of the duct section.



Always select the stream distribution manifold length that will span the maximum width of the duct.



The manifold should never be installed vertically downward from the humidifier. This presents a condensate drainage problem in the jacket of the manifold. Vertical upward installation is permissible.



Armstrong Humidifiers for air handling systems may be installed in fan housings, plenums or ducts.

Normal manifold installation is with the manifold extending horizontally. When required, the manifold may extend vertically upward. It must not extend vertically downward.

Horizontal manifolds should be perfectly level with the discharge holes pointed upstream against the air flow. Note: If manifold is insulated, discharge holes must point downstream to prevent condensation on metal insulation cover. Manifolds over 1 foot in length should be supported.

Steam supply and condensate drain piping should be made in accordance with good piping practice. Trap discharge must be connected to a return line with pressure well below supply pressure to the humidifier. Please see Basic Application Principles in the Humidification Engineering section beginning on Page 12 of this catalog.

Warning: Steam humidifiers (or other products) should be installed in locations that allow routine inspection and accessibility for maintenance operations. Armstrong recommends that steam humidifiers not be placed in locations where unusual instances of malfunction of the humidifiers or the systems might cause damage to non-repairable, unreplaceable, or priceless property.

Primary Methods of Installation

Figure 17-1. Method Number 1

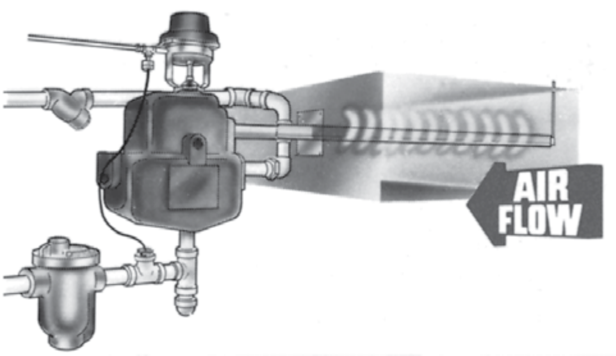


Figure 17-2. Method Number 2

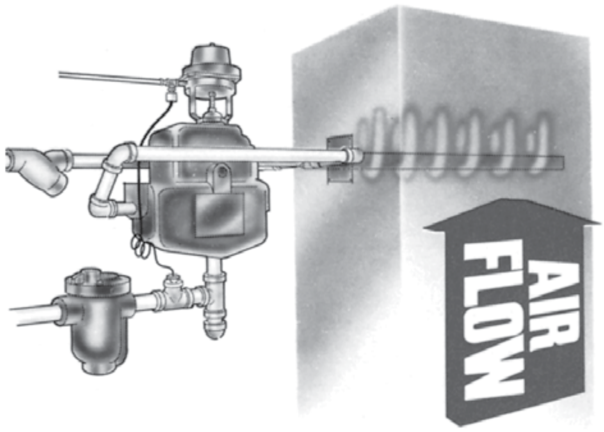
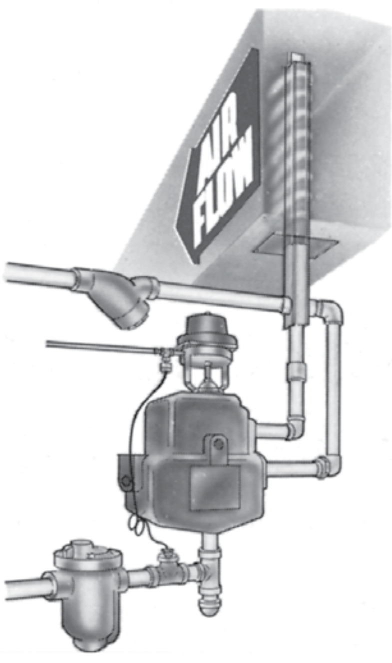


Figure 17-3. Method Number 3



When It Comes to Improving Humidification... It Starts with Steam

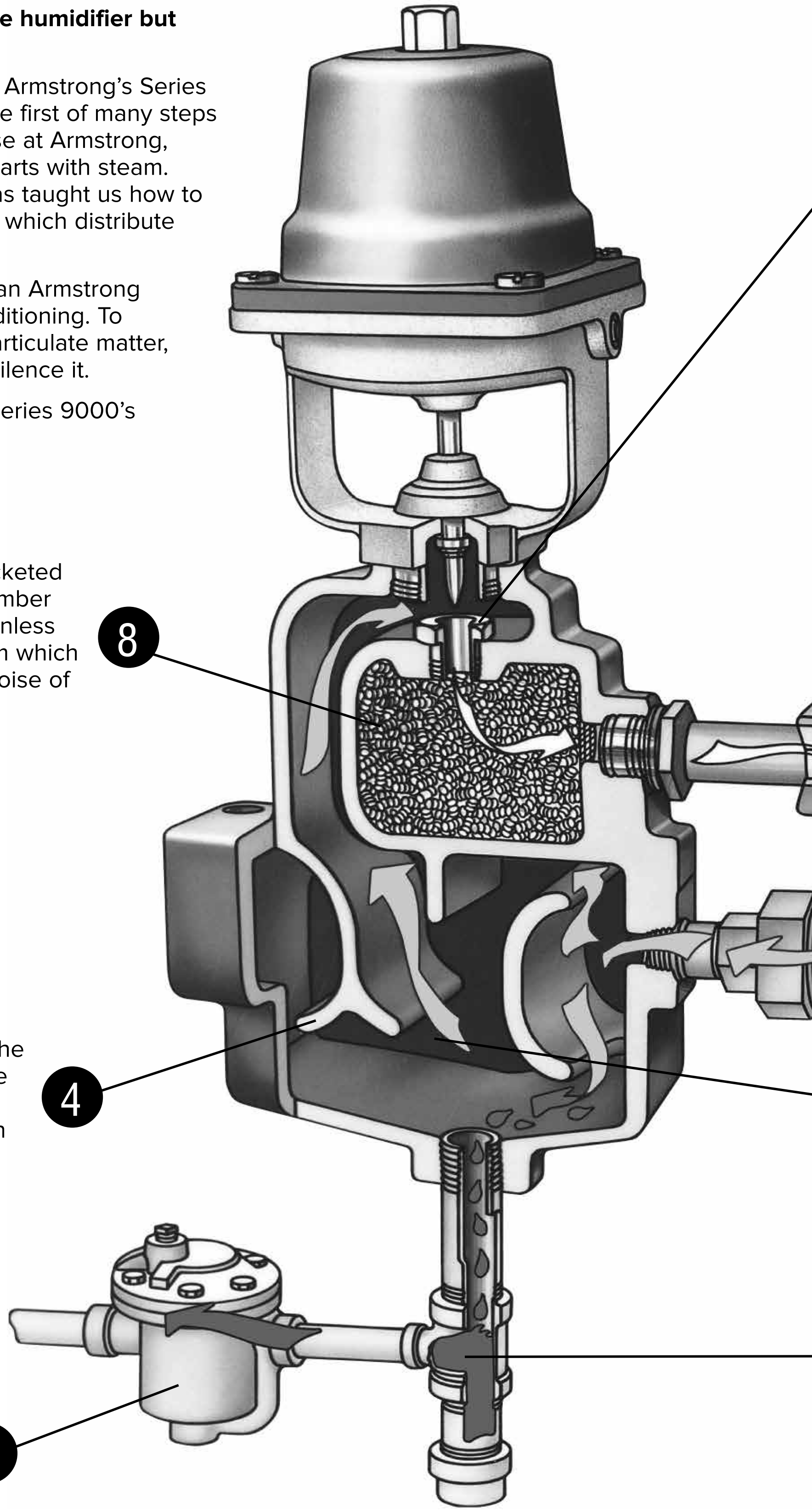
Why the Armstrong Series 9000 humidifier starts with steam

Armstrong's improvements in steam humidification are so fundamentally different they begin not with the humidifier but with the steam.

Unlike other units which simply disperse steam, Armstrong's Series 9000 humidifiers work with it, subjecting it to the first of many steps in a carefully engineered process. Why? Because at Armstrong, improving humidification is extremely basic. It starts with steam. And what we've learned at that starting point has taught us how to improve the design of hardware – humidifiers – which distribute steam.

There's no name for what happens to steam in an Armstrong humidifier, so we've created one. We call it conditioning. To condition steam, we slow it down, remove its particulate matter, separate condensate from it, dry it and, finally, silence it.

Conditioned steam. It's the cornerstone of the Series 9000's superior performance and control. Here's why.



8 **Drying chamber** is jacketed by the separating chamber and is filled with a stainless steel silencing medium which absorbs most of the noise of escaping steam.

4 **Interior baffles** condition the steam by forcing it to make two 180° turns, providing optimum velocity reduction and maximum separation.

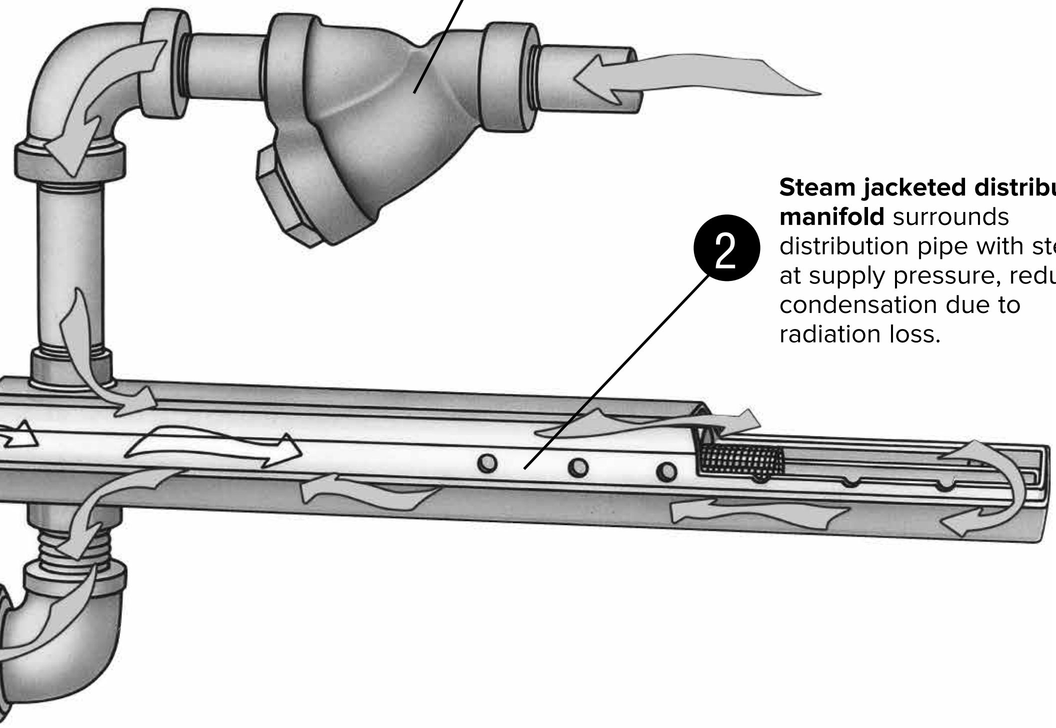
6 **Reliable cast iron inverted bucket steam trap** provides dependable draining because it has only two moving parts – and no fixed pivots or complicated linkage to stick, bind or clog.

Features

- Full jacketed manifold.
- Runs up to 4 bars and 1823 kg/h.
- Fast response time and excellent rangeability (up to 123/1).
- Quiter than other systems.
- Dry steam released.

7 **Internal metering valve** is an integral part of the steam separator and is completely steam jacketed, further preventing condensation through radiation.

1 **Armstrong in-line strainer** with no-crush screen removes most of steam particulate matter.



2 **Steam jacketed distribution manifold** surrounds distribution pipe with steam at supply pressure, reducing condensation due to radiation loss.

3 **Strong cast iron separator** dampens noise and effects of vibration. Its thick walls mean better heat retention and therefore less condensation.

5 **Large drain leg** collects condensate and discharges through the drain trap.

Armstrong's four-step conditioning process

- Straining. The first step in steam conditioning, straining removes most of the steam's dirt and scale particles.
- Separating. In the cast iron separating chamber, a cupped baffle reverses the flow, forcing the steam back on itself. The outer walls of the chamber form another cup, and the same thing happens again. These two 180° turns reduce the velocity and separate the condensate from the vapor. The center baffle, positioned directly over the large drain connection, knocks down and further guides condensate out the drain.
- Drying. Steam entering the dying chamber is at supply temperature and essentially atmospheric pressure, so there is no condensation. Any remaining mist is re-evaporated before it leaves the humidifier.
- Silencing. The drying chamber is filled with a stainless steel silencing material which absorbs almost completely the noise of escaping steam as it is generated at the control valve.

Steam Supply Methods

Figure 20-1. Single manifold installation

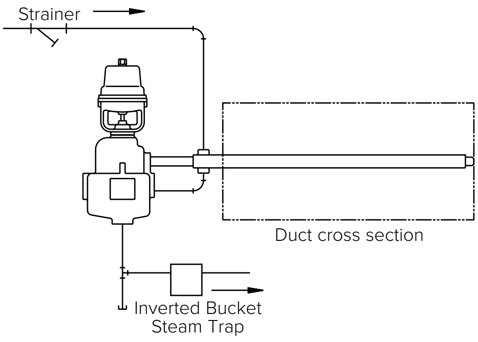


Figure 20-2. Multiple manifold installation

Note:For manifold lengths inferior to 6 m.

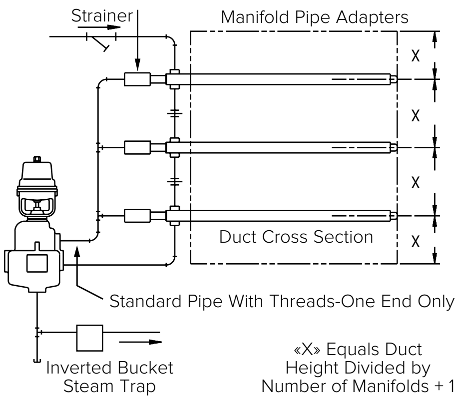
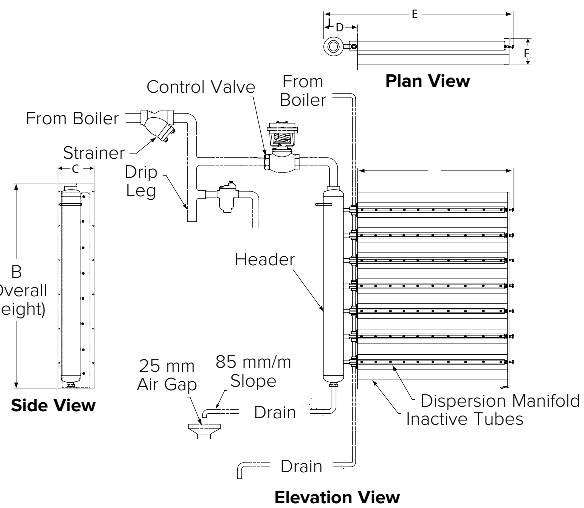


Figure 20-3. Installation with Humidipack



How to Order

1. Mode of control pneumatic modulating – AM, electric modulating – EM

   For industrial in-plant operation and for certain very limited duct applications, a solenoid actuator may be used to provide simple on-off operation. This type of actuator should not be specified for duct applications without a detailed analysis of the system – DSA.
2. Size of humidifier for duct installation – 91, 92, 93, 94
3. Manifold length from Table 7-2, Page 7.
4. Specify steam pressure and capacity required in accordance with Tables on Pages 8 and 9.
5. For electrically operated models, state electrical characteristics (control signal, and power supply voltage).

Suggested Specification

Steam Humidifiers for pneumatic or electric modulating control: Humidifier shall be the steam separator type providing full separation ahead of an integral steam jacketed control valve which discharges through an internal steam jacketed drying chamber, a silencing chamber and a steam jacketed distribution manifold.

A. Humidifier shall receive steam at supply pressure and discharge at atmospheric pressure. It shall be furnished with inlet strainer and external inverted bucket steam trap.

B. Separating chamber shall be of a volume and design that will disengage and remove all water droplets and all particulate matter larger than 3 microns when humidifier is operating at maximum capacity.

C. The stainless steel metering valve shall be integral within the body of the humidifier, and shall be jacketed by steam at supply pressure and temperature to prevent condensation.

D. The stainless steel metering valve shall be a parabolic plug with a 19 mm stroke, providing the high rangeabilities required to achieve full and accurate modulation of steam flow over the entire stroke of the valve.

E. The internal drying chamber shall receive steam at essentially atmospheric pressure and be jacketed by steam at supply pressure and utilize a stainless steel silencing medium.

F. The distribution manifold shall provide uniform distribution over its entire length and be jacketed by steam to assure that vapor discharged is free of water droplets.

G. Humidifier shall be equipped with an interlocked temperature switch to prevent the humidifier from operating before start-up condensate is drained.

The Armstrong Series 9000 Humidifier (physical data, dimensions and capacities)

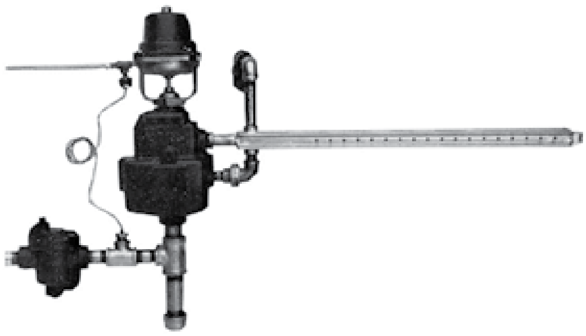


Figure 21-1 .

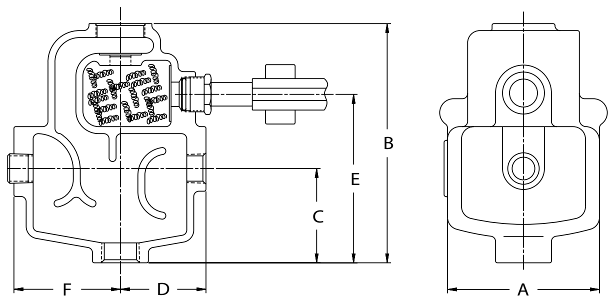


Table 21-1. Physical Data											
Humidifier Model Number	Dimensions in mm						Connection Sizes			Drain Trap Model	Weight in kg † (less operator and manifold)
	A	B*	C	D	E	F	Inlet	Drain	Trap		
91	115	218	86	78	154	97	1/2"	1"	3/4"	800	11
92	141	218	86	97	154	97	3/4"	1"	3/4"	800	14
93	171	302	117	121	229	121	1 1/4"	1 1/4"	3/4"	811	24
94	276	435	175	203	321	203	2"	2"	3/4"	812	66

Shade indicates products that are CE Marked according to the PED (97/23/EC). All the other sizes comply with the Article 3.3 of the same directive.
* Add height and weight of operator for overall data. All dimensions are in millimeters.
† Weight includes drain trap, strainer, and fittings.
For Physical Data on Series 1000 Stainless Steel Humidifiers, see Page 22.

Table 21-2. List of Materials			
Steam Chamber	Cast Iron	Manifold Fittings	Brass
Bonnet Assembly	Brass	Manifold Coupler	Brass
Valve & Stem	18-8 Stainless Steel	Nut	Brass
Valve Seat	18-8 Stainless Steel	Strainer	Cast Iron
Manifold	304 Stainless Steel	Steam Trap	Cast Iron

Armstrong Conditioned-Steam Humidifiers for air handling systems are manufactured to meet the needs of central station humidification or booster humidification. Operation and control may be pneumatic or electric.

Standard Package

All Armstrong Conditioned-Steam Humidifiers are supplied in standard "packages" which include the following:

Pneumatically Controlled (AM) Models:

1. Humidifier with integral operator (when specified).
2. Distribution manifold of length specified.
3. "Y" type strainer.
4. Armstrong inverted bucket trap.

Electric Motor Controlled (EM) Models:

1. Humidifier with integral operator (when specified).
2. Distribution manifold specified.
3. "Y" type strainer.
4. Armstrong inverted bucket trap.

Recommended Option

A pneumatic or an electric temperature switch is offered as an optional extra and is recommended in any system where the steam supply to the manifold jacket and humidifier body may be interrupted or turned off.

The Armstrong Series 1000 Humidifier, (physical data, dimensions and capacities)

Humidifier Operators.

Pneumatic Modulating
Electric Modulating
Electronic Modulating

Standard Package.

All Armstrong conditioned-steam humidifiers are supplied in standard “packages” which include the following.

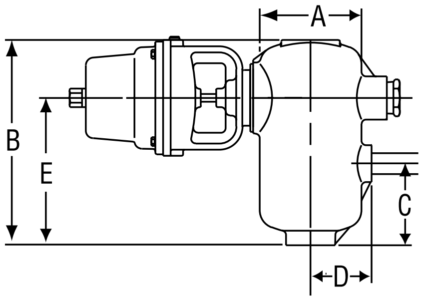
Pneumatically controlled (AM) models:

1. Humidifier with integral operator (when specified).
2. Distribution manifold of length specified.
3. “Y” type strainer.
4. Armstrong inverted bucket trap.

Electric motor controlled (EM) models:

1. Humidifier with integral operator (when specified).
2. Distribution manifold of length specified.
3. “Y” type strainer.
4. Armstrong inverted bucket trap.

Figure 22-1.



Recommended option: A pneumatic or an electric temperature switch is offered as an optional extra and is recommended in any system where the steam supply to the manifold jacket and humidifier body may be interrupted or turned off.

How To Order.

1. Mode of control:
   pneumatic modulating – AM
   electric modulating – EM
2. Size of humidifier for duct installation – 1100, 1200, 1300 or 1400.
3. Manifold length from Table 7-2.
4. Specify steam pressure and capacity required in accordance with appropriate table on Pages 8 and 9.
5. For electrically operated models, state electrical characteristics (control signal and power supply voltage).

Table 22-1. List of Materials	
Steam Chamber	T-316 CF8M Stainless Steel (model 1100 only)
	T-304 Stainless Steel (models 1200, 1300 and 1400)
Bonnet & Assembly Valve & stem Valve Seat Manifold & Fittings	18-8 Stainless Steel
Operator	See Specifics
Strainer	ASTM 351 (T-316 SS)
Inverted Bucket Steam Trap	T-304 Stainless Steel

Table 22-2 and 22-3. Physical Data

Humidifier Model Number	Dimensions in mm					Connection Sizes			Drain Trap Model	Weight in kg † (less operator and manifold)
	A*	B	C	D	E	Inlet	Drain	Trap		
1100	105	211	84	63	153	1/2"	1"	3/4"	1811	14
1200	114	262	101	97	170	3/4"	1"	3/4"	1811	14
1300	168	417	152	141	262	1 1/4"	1 1/4"	3/4"	1811	15
1400	273	613	227	236	373	2"	2"	3/4"	1812	36

Model 1400: PMA is limited to 1.85 barg. All sizes comply with the article 3.3 of the PED (97/23/EC).
* Add height and weight of operator for overall data. All dimensions are in millimeters.
† Weight includes drain trap. strainer, and fittings.

Notes:
1. For manifold lengths and duct widths with which they may be used, see Table 23-2, Page 23.
2. All wetted parts are 300 Series stainless steel.

Key:
Steam supply at supply pressure
Steam at atmospheric pressure
Condensate

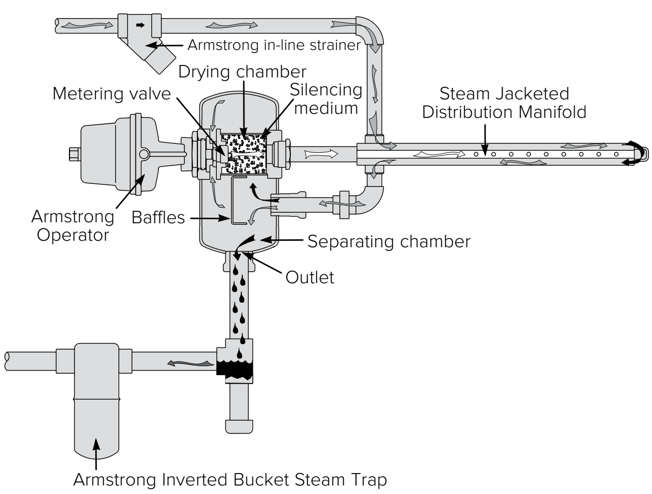


Figure 23-1. Steam Distribution Manifold Data

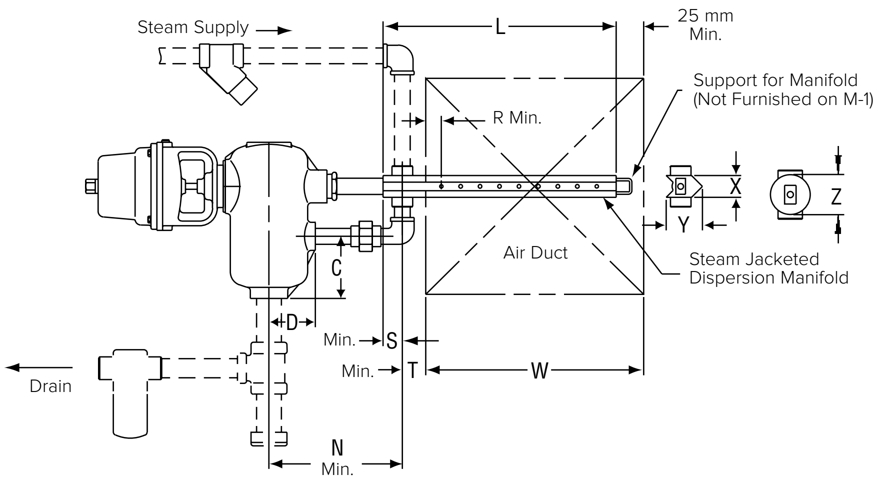


Table 23-1. Cross-Section Dimensions (in mm)								
Model	N	R	S	T	X	Y	Z	Steam Supply
91	145	51	25	25	32	48	46	1/2"
1100	217	51	25	25	32	48	46	1/2"
92 & 1200	218	51	25	25	44	67	52	3/4"
93 & 1300	230	51	41	41	54	79	–	1 1/4"
94 & 1400	343	51	41	41	83	108	–	2"

Table 23-2. Manifold Lengths and Duct Widths with which they may be used

91 thru 94 Size and 1000 Manifold Model No.		M-1	M-1.5	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12
L - Length (Meters)		0.30	0.45	0.61	0.91	1.22	1.52	1.83	2.13	2.44	2.74	3.05	3.35	3.66
W - Duct Width	(Minimum)	0.20	0.38	0.53	0.79	1.09	1.36	1.66	1.97	2.27	2.58	2.88	3.18	3.49
	(Maximum)	0.36	0.51	0.76	1.07	1.32	1.63	1.93	2.24	2.54	2.84	3.15	3.45	3.76
Approximate Shipping Weight (in kg)	91 Size	1.4	1.8	2.3	2.7	3.6	4.5	5.4	6.3	6.8	7.7	8.6	9.5	10.4
	92 Size and 1200	1.8	2.3	2.7	4.0	5.0	5.9	7.2	8.2	9.5	9.8	11.3	12.7	13.6
	93 Size and 1300	2.7	3.6	4.5	5.9	7.7	9.5	10.9	13.1	14.5	16.8	18.6	19.5	20.9
	94 Size and 1400	Consult Factory				10.9	13.6	15.4	18.1	20.4	23.1	24.9	27.2	29.0

All sizes comply with the article 3.3 of the PED (97/23/EC).
Note: Insulated manifolds are available. Consult factory.

Table 23-3. Number of Manifolds to be Stacked for Duct Heights Exceeding 900 mm	
Duct Height in mm	No. of Manifolds
900 - 1 500	2
1 500 - 2 000	3
2 000 - 2 500	4
2 500 - Up	5 or more

If you have specific vapor trail considerations, please contact the Armstrong HVAC Application Engineering Department.

Table 23-4. Multiple Manifold Pipe Sizes and Adapter Numbers		
Humidifier Size	Manifold Pipe Adapter No.	Pipe Connection Size
91	A-4967-B	1/2"
92	A-4967	3/4"
93	A-4967-L	1"*
94	A-5002	2"
1100	A-4967-5	1/2"
1200	A-4967-P	3/4"
1300	A-4967-R	1"*
1400	A-5002-C	2"

* Manifold tube is 1". Jacket connections are 1 1/4".

Capacities of Armstrong Humidifiers

Table 24-1. Sizes 91 and 1100, Continuous Discharge Capacities in kg of Steam Per Hour																			
Orifice Size (In.)	Steam Pressure in barg																		
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00	2.50	3.00	4.00
1/16"	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.5	2.9	3.5	3.8	4.5	5.6
5/64"	1.0	1.2	1.4	1.6	1.8	2.0	2.1	2.3	2.4	2.5	2.7	2.8	3.0	3.8	4.8	5.0	5.6	6.7	8.6
3/32"	1.4	1.7	1.9	2.3	2.6	2.8	3.0	3.3	3.5	3.7	3.9	4.0	4.3	5.4	6.0	6.5	7.8	9.6	11
7/64"	1.9	2.2	2.6	3.1	3.6	4.0	4.1	4.5	4.6	5.0	5.2	5.4	6.0	7.2	8.0	8.6	9.5	12	15
1/8"	2.5	3.1	3.3	4.0	4.5	5.0	5.5	5.9	6.3	6.3	6.8	7.2	8.0	10	11	13	14	16	20
5/32"	3.6	4.5	5.1	6.3	7.2	7.7	8.6	9.0	9.5	10	11	12	13	14	16	18	20	24	29
3/16"	5.5	6.8	7.7	10	11	12	12	13	14	15	16	17	18	22	24	27	29	35	42
7/32"	7.5	10	11	13	15	16	17	18	19	20	21	22	24	28	32	35	38	44	64
1/4"	10	13	14	17	19	21	22	24	25	27	28	29	31	37	41	46	52	61	77
9/32"	12	15	16	20	21	23	25	26	28	29	30	32	34	40	48	52	57	68	84
5/16"	15	17	19	23	25	27	29	31	33	35	37	39	42	48	56	61	67	90	114
11/32"	16	20	22	25	30	33	35	37	39	41	43	44	49	58	67	78	86	104	126
3/8"	19	23	25	30	32	35	37	42	44	48	50	52	57	68	77	86	96	115	143

Table 24-2. Sizes 92 and 1200, Continuous Discharge Capacities in kg of Steam Per Hour																			
Orifice Size (In.)	Steam Pressure in barg																		
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00	2.50	3.00	4.00
1/8"	2.2	3.2	3.6	4.0	4.5	5.0	5.5	6.0	6.8	7.0	8.0	9.0	10	11	12	13	14	16	20
5/32"	3.6	4.5	5.5	6.3	7.3	7.7	8.6	9.0	9.5	10	11	12	13	14	16	18	20	24	29
3/16"	5.4	6.8	8.2	9.5	10	11	12	13	14	15	16	17	18	21	24	27	29	35	42
7/32"	7.2	9.5	11	13	15	16	17	18	19	20	21	22	24	28	32	38	41	47	61
1/4"	10	11	15	17	19	21	22	24	25	27	28	29	31	37	41	46	52	61	77
9/32"	12	16	19	22	24	26	29	30	32	34	36	37	40	47	53	59	69	80	97
5/16"	15	20	23	27	30	32	35	37	39	42	44	45	49	57	65	72	85	96	118
11/32"	18	24	28	32	35	38	41	44	46	49	52	54	59	69	78	87	101	114	142
3/8"	24	27	29	35	38	42	45	47	52	54	56	58	63	74	83	93	103	122	151
7/16"	34	38	41	45	49	53	56	60	62	65	68	72	77	89	102	114	126	157	190
1/2"	40	43	45	47	51	55	60	64	68	72	76	79	88	104	121	136	151	181	220

Table 24-3. Sizes 93 and 1300, Continuous Discharge Capacities in kg of Steam Per Hour																			
Capacities when Steam Supply is Through the Manifold																			
Orifice Size (In.)	Steam Pressure in barg																		
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00	2.50	3.00	4.00
13/32"	32	38	45	50	55	60	63	67	69	73	77	78	84	96	112	122	135	161	200
7/16"	35	43	49	57	59	63	66	70	77	80	86	89	97	112	129	142	152	182	225
15/32"	38	55	59	66	68	71	76	82	88	92	96	102	108	128	145	161	175	203	248
1/2"	45	58	66	73	78	84	90	92	98	103	110	115	123	146	165	185	197	227	282
9/16"	47	62	72	84	89	94	102	108	117	121	123	128	141	163	185	207	234	279	342
5/8"	53	67	79	92	97	106	114	124	131	134	144	153	167	194	221	248	275	328	408
3/4"	58	79	92	105	116	130	140	153	164	170	173	186	208	249	289	338	385	452	576

Table 25-1. Sizes 93 and 1300, Continuous Discharge Capacities in kg of Steam Per Hour

Capacities when Steam Supply is Direct to Separator. (Manifold Trapped Separately)

Orifice Size (In.)	Steam Pressure in barg																		
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00	2.50	3.00	4.00
13/32"	32	38	45	50	55	60	63	67	69	73	77	78	84	96	112	122	135	161	200
7/16"	35	43	49	57	59	63	66	70	77	80	86	89	97	112	130	142	152	182	225
15/32"	38	55	59	66	68	71	76	82	88	92	96	102	108	128	145	161	175	203	248
1/2"	45	58	66	73	78	84	90	92	98	103	110	115	123	146	165	185	197	227	282
9/16"	47	62	72	84	89	94	102	108	117	121	123	128	141	163	185	207	234	279	342
5/8"	57	73	83	95	102	112	119	129	139	142	152	162	173	209	232	261	291	343	443
3/4"	62	85	100	119	122	136	152	171	186	195	210	225	238	288	336	375	422	500	620

Table 25-2. Sizes 94 and 1400, Continuous Discharge Capacities in kg of Steam Per Hour

Capacities when Steam Supply is Through the Manifold

Orifice Size (In.)	Steam Pressure in barg															
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00
5/8"	62	76	86	97	102	114	121	131	142	148	159	169	188	217	245	275
3/4"	84	103	117	132	140	154	164	177	193	201	215	229	252	310	350	390
7/8"	110	135	153	171	184	202	215	232	251	264	282	300	344	396	452	503
1"	126	156	177	198	212	234	248	269	290	304	326	347	386	450	514	575
1 1/8"	145	180	204	230	245	269	286	310	339	351	376	400	422	507	591	666
1 1/4"	156	190	215	251	259	284	302	327	361	371	396	422	448	536	631	711
1 1/2"	177	222	253	282	303	334	354	384	417	435	465	496	523	633	729	824

Table 25-3. Sizes 94 and 1400*, Continuous Discharge Capacities in kg of Steam Per Hour

Capacities when Steam Supply is Direct to Separator. (Manifold Trapped Separately)

Orifice Size (In.)	Steam Pressure in barg																		
	0.15	0.20	0.25	0.35	0.40	0.50	0.55	0.60	0.70	0.75	0.80	0.90	1.00	1.40	1.70	2.00	2.50	3.00	4.00
5/8"	62	76	86	97	102	114	121	131	142	148	159	169	188	217	245	275	303	357	461
3/4"	90	110	125	140	150	165	175	190	205	215	230	244	275	321	358	404	445	533	656
7/8"	114	140	159	178	191	210	222	241	260	273	292	311	358	412	461	520	576	697	847
1"	136	170	193	222	231	254	270	293	326	332	355	378	425	488	559	632	693	832	1 038
1 1/8"	168	210	238	267	286	314	333	362	378	410	438	467	505	605	698	769	859	1 026	1 280
1 1/4"	187	235	267	300	320	352	373	405	435	459	490	523	551	674	784	883	979	1 182	1 454
1 1/2"	245	299	340	381	408	449	476	517	547	585	626	667	699	843	961	1 096	1 201	1 448	1 823

*** Model 1400: PMA is limited to 1.85 barg.**

Shaded capacities are valid for model 94 only.

Note: Steam Pressure used to jacket 94 size manifold must not exceed 2 barg. Steam pressure can go to 4 barg if multiple 93 size manifolds are used. (See Figure 26-3,).

Air-Operated Unit Humidifiers (physical data, dimensions and capacities)

With Fan.

For direct discharge into area humidified at steam supply pressures from 0.15 to 4 barg. Integral air-open spring-close operator opens steam discharge valve on signal from pneumatic hygrostat. Integral air powered fan provides rapid, uniform distribution of moisture. Electric fans are also available.*

Without Fan.

For direct discharge into area humidified at steam supply pressures from 0.15 to 4 barg. Integral air-open spring-close operator opens steam discharge valve on signal from pneumatic hygrostat. Discharge velocity of steam is used for dispersion. Auxiliary air movement is desirable.

Figure 26-1. AMAF humidifiers with air powered fans

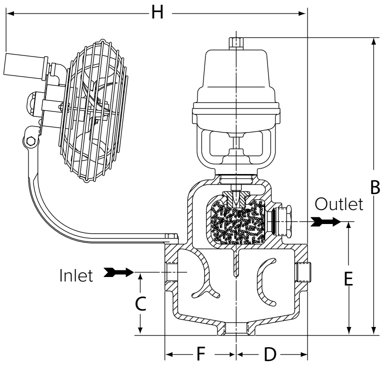


Figure 26-2. AM humidifiers

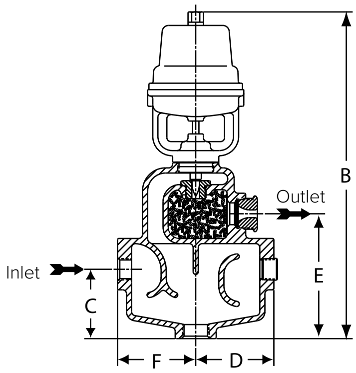


Table 26-1. Dimensions

Model N°	B	C	D	E	F	H
AMAF-91A	406	86	97	154	78	370
AMAF-92A	406	86	97	154	97	389
AMAF-93	486	117	121	229	121	451

* AMEF models have same dimensions except "H".
For Sizes 91 & 92, H = 400 mm; for Size 93, H = 464 mm.

Table 26-2. Dimensions

Model N°	B	C	D	E	F
AM-91A	406	86	97	154	78
AM-92A	406	86	97	154	97
AM-93A	486	117	121	229	121

All AM sizes are available with electric fans identical to those furnished with FSA models. These humidifiers are designated as AMEF models.

Table 26-3. Physical Data, Armstrong Air-operated Humidifiers

Model Number	FSA-91	VSA-91	FSA-92	VSA-92	FSA-93	VSA-93
Air Pressure Max. (barg)	1.4	1.4	1.4	1.4	1.4	1.4
Air Required for Fan @ 1.4 barg	–	3.4 m^3/h	–	3.4 m^3/h	–	3.4 m^3/h
Drain Connection	1"	1"	1"	1"	1 1/4"	1 1/4"
Drain Trap No.	800	800	800	800	811	811
Shipping Weight (kg)	15	17	17	20	28	30
Steam Inlet & Strainer	3/4"	3/4"	3/4"	3/4"	1 1/4"	1 1/4"

Table 26-4. Capacities, Armstrong Air-operated Humidifiers

Continuous discharge capacities in kg of steam per hour at steam pressure indicated at the humidifier.

Orifice Size	AM-91A, AMAF-91A						AM-92A, AMAF-92A					AM-93A, AMAF-93A			
Steam Pressure in barg	1/16"	3/32"	5/32"	7/32"	9/32"	3/8"	3/16"	1/4"	5/16"	3/8"	1/2"	13/32"	15/32"	9/16"	3/4"
0.15	0.7	1.4	3.7	7.5	12	19	5.4	10	15	22	36	32	38	47	62
0.30	0.9	2.1	5.7	12	17	25	8.2	15	23	34	45	45	59	72	100
0.40	1.1	2.5	6.9	14	21	31	10	19	29	42	56	55	68	89	122
0.60	1.4	3.2	8.8	17	25	–	12	22	35	49	65	63	76	102	–
0.70	1.5	3.5	9.7	19	28	–	14	25	39	55	73	69	88	117	–
0.80	1.6	3.8	10	20	29	–	16	28	44	62	82	77	96	123	–
1.00	1.9	4.2	12	23	33	–	18	31	49	70	94	84	108	141	–
1.40	2.5	5.4	14	28	–	–	21	37	58	82	–	96	128	–	–
1.70	3.1	6.0	16	31	–	–	23	41	65	–	–	112	–	–	–
2.00	3.4	6.5	18	34	–	–	26	46	72	–	–	122	–	–	–
2.50	3.8	7.8	20	–	–	–	28	49	–	–	–	135	–	–	–
2.75	4.2	8.7	22	–	–	–	30	53	–	–	–	–	–	–	–
3.50	5.0	10.4	27	–	–	–	34	61	–	–	–	–	–	–	–
4.00	5.6	11.1	29	–	–	–	38	67	–	–	–	–	–	–	–

Conditioned-Steam Showers

Armstrong Steam Showers are designed to create a stratum of high humidity in close proximity to a fast moving sheet, film or product. The objective may be to prevent accumulation of troublesome static electricity, or the shower may be used to prevent loss of moisture from the sheet or film.

If the sheet or film is hot, as it very likely may be, it tends to give up its moisture very quickly. The properly sized and installed steam shower, by creating a laminar zone of high humidity adjacent to the sheet or film, prevents this loss to maintain the desired moisture content.

In virtually all applications, however, it is essential that the steam be discharged in a "dry" state – that is, with no water droplets or liquid spray. The unique design of Armstrong Steam Showers assures this.

Separator-control units are identical in design and operation to equivalent humidifier models. The distribution manifolds have been especially modified to operate under slight pressure to meet the specific requirements of steam shower service.

Electrically controlled and pneumatically controlled models are offered in two sizes.

Figure 27-1. Armstrong Steam Shower Manifold

Standard Package

The complete "package" includes the following:

1. Steam shower with integral operator.
2. Distribution manifold.
3. "Y" type strainer.
4. Armstrong inverted bucket steam trap.
5. Temperature switch to prevent humidifier from operating before cold startup condensate is drained. (Cannot be incorporated on manually controlled steam showers.)

Note: Steam humidifiers (or other products) should be installed in locations that allow routine inspection and accessibility for maintenance operations. Armstrong recommends that steam humidifiers not be placed in locations where unusual instances of malfunction of the humidifiers or the systems might cause damage to non-repairable, unreplaceable, or priceless property.

Selection and Installation Notes

1. Armstrong Steam Showers are suitable for pressures up to 4 bar. Lower steam pressures (0.15 to 0.7 bar) are recommended for normal installations.
2. 91 size units are adequate for most showers up to 1.8 m span. 92 size showers should be used for longer spans or where larger volumes of steam are desired at very low pressures. For information on even larger models, consult factory.
3. Most commonly, the dispersion manifold is installed 150 to 200 mm from the object of the shower – no more than 300 mm.
4. A pressure-reducing valve should be installed in the steam supply to control the maximum volume of steam to the shower.
5. Dimensions are the same as for corresponding humidifier models.

Table 27-1. Physical Data and Capacities, Steam Shower Bodies and Operators

	On-Off Electrically Controlled†		Modulating Pneumatically Controlled	
Model No.	DSA-91-SM*	DSA-92-SM*	AM-91-SM*	AM-92-SM*
Shipping Weight in kg (less manifold)	11	18	12	19
Inlet & Strainer Size	1/2"	3/4"	1/2"	3/4"
Drain Connection Size	1"	1"	1"	1"
Drain Trap Model	800	800	800	800
Trap Connection Size	3/4"	3/4"	3/4"	3/4"

* Full nomenclature includes length of manifold in feet as a suffix to the Model No.
† Specify voltage required. Various voltages available – consult factory.
Note: For larger sizes and capacities, consult factory.
On request: Also available Manually Controlled (MC) and Electrical Modulating (XEM) units. For more information, consult factory.

Table 27-2. Manifold Lengths and Weights, Armstrong Steam Showers

Manifold Model No.		SM-1	SM-1.5	SM-2	SM-3	SM-4	SM-5	SM-6	SM-7	SM-8	SM-9	SM-10	SM-11	SM-12
L - Length (Meters)		0.30	0.45	0.61	0.91	1.22	1.52	1.83	2.13	2.44	2.74	3.05	3.35	3.66
Shipping Weight in kg	91 Size	1	2	2	3	4	5	5	–	––	–	–	–	–
	92 Size	3	3	4	5	6	7	8	9	10	11	12	13	14

ExpressPack® Multi-Tube Steam Dispersion Panel

ExpressPack® is a multi-tube steam dispersion panel that accepts atmospheric source steam and discharges it into a duct or air handling unit.

Packaged with Armstrong Steam Generating Humidifiers

ExpressPack® is designed to accept steam from Armstrong HumidiClean™ or Series EHU-700 (electric), Gas Fired HumidiClean™, or Series CS-10 steam-to-steam humidifiers.

Shortened Non-Wetting (Absorption) Distance

ExpressPack® uses a series of unique dispersion tubes spaced to provide a shorter non-wetting distance than conventional individual tubes. Each tube includes two rows of diametrically opposed nozzles.

Economical and Energy Wise

Dispersion tube spacing is selected to optimize performance while minimizing excessive condensation. ExpressPack® **components are typically shipped loose for field assembly, minimizing initial cost.**

Optional ceramic coating is available, which further minimizes condensation loss/duct heat gain.

Dry and Uniform Steam Discharge

The ExpressPack® panel disperses a dry and uniform discharge of steam. Stainless steel steam headers and dispersion tubes are sized to match application requirements for proper separation and coverage of the face area. The discharge nozzles extend inside the dispersion tube to insure steam is discharged rather than condensate to avoid spitting. Nozzle sizing and spacing also assists in providing a uniform discharge of steam across the face area. Each header includes a large 1" NPT drain connection to assure proper condensate drainage.

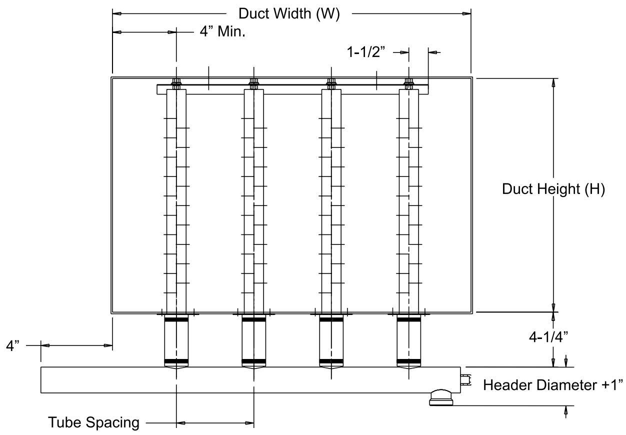
Application and Installation

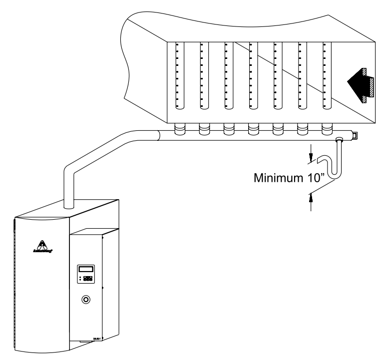
Used primarily in horizontal air flow applications, ExpressPack® is ideally oriented with a horizontal header and vertical dispersion tubes. ExpressPack® may be located in an air handler or duct. For duct applications, the panel's best location is near a joint in order to make installation practical. Care must be taken to minimize the distance of steam line run to ExpressPack® from the steam generating humidifier. With nozzle steam discharge perpendicular to air flow, ExpressPack® adapts well to high air flow velocity applications.

Simplified Selection

(refer to table with instruction and example for header and tube sizing and tube spacing)

ExpressPack®





ExpressPack Vertical Installation with HC-6000

Table 28-1. Capacities and Connections

Header Size	Maximum Capacity	Standard Inlet Conn.	Optional Connection	Drain Connection
2"	113.4 kg/hr	2" Pipe Stub	2" NPT	1" Drain
4"	362.9 kg/hr	4" Flange	4" Pipe Stub	1" Drain

Table 28-2. Dispersion Tube Capacities

Tube Size	Max. Capacity per Tube
1-1/2"	15.9 kg/hr
2"	31.8 kg/hr

Table 28-3. List of Materials

Part	Material
Header	T304 Stainless Steel
Dispersion Tubes	T304 Stainless Steel
Hose Cuffs	EPDM w/ Fabric Reinforcement
Outboard Support Plate	T304 Stainless Steel ASTM A240
Cover Plate	T304 Stainless Steel ASTM A240
Bolts, Nuts and Washers	Zinc Plated Carbon Steel

HumidiPack®

The Armstrong HumidiPack® is a pre-fabricated steam humidifier system that is ready for insertion into the duct. The HumidiPack consists of a separator/ header and multiple tube dispersion assembly when supplied for use with Armstrong steam generators. A steam supply control valve, strainer, steam trap, and a header drain trap are added when HumidiPack is used on pressurized steam. The HumidiPack accepts steam, separates entrained moisture from it, and admits it into a duct or air handler air stream via the dispersion assembly in a manner which substantially reduces mixing length distance when compared to traditional humidifiers.

HumidiPack® CF

The Armstrong HumidiPack® CF is a Grid with no steam jacketing but with internal piping to help steam and condensate flow. Only used with pressurized steam and with a vertical header which can be installed inside or outside. Maximum dimension is 1820 mm for header and 3650 for tubes.

HumidiPackPlus®

HumidiPackPlus® combines the mixing length distance shortening performance of HumidiPack with the additional feature of steam jacketed "active" tubes which allows a condensate recovery. It can be installed horizontally or vertically.

Simplified Installation

The HumidiPack and HumidiPackPlus dispersion assemblies slide neatly into ductwork or air handling units. This frequently reduces the time and labor required for field installations. Units with horizontal tubes and vertical headers offer all piping on one side of the ductwork or air handler to simplify piping.

Stainless Steel Construction

HumidiPack and HumidiPackPlus rugged designs offer stainless steel construction of wetted parts including the header/separator and dispersion assembly for a long trouble-free operating life. Tube to header joints consist of welded stainless steel rather than assembled plastic adapters with o-rings, minimizing service requirements.

Compatible With Many Steam Sources

HumidiPack may be used with Armstrong Steam-to-Steam, gas and electric steam generating humidifiers, also with some systems including packaged boilers or central steam supply to 4 barg. HumidiPackPlus may be used with packaged boilers or central steam supply to 4 barg.

Application Flexibility

Many sizes and configurations of HumidiPack and HumidiPackPlus are available to meet new installation or retrofit needs.

Figure 29-1. Horizontal HumidiPack Plus

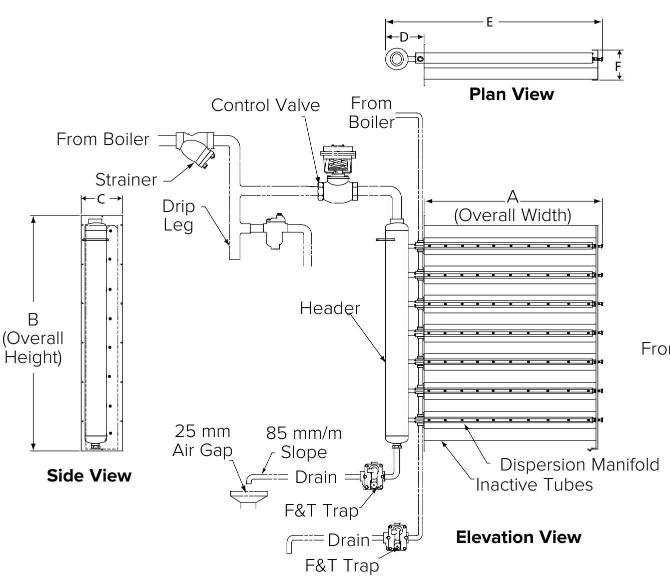
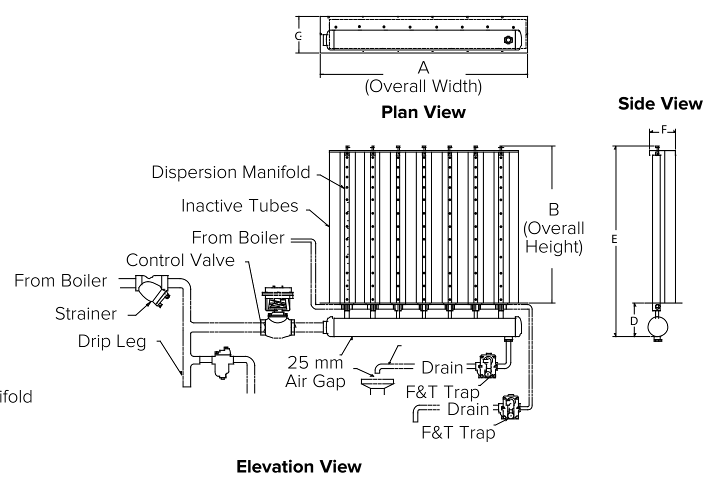
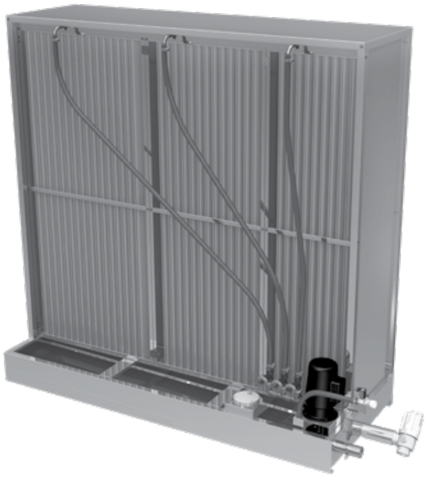


Figure 29-2. Vertical HumidiPack Plus





EVAPACK®

Simple, natural and efficient process

Armstrong EVAPACK® Series converts ordinary tap water to water vapor using an adiabatic process . Dry air passes through a corrugated bank of wetted cells media made from non-organic wet fibers. EVAPACK® series uses the sensible air heat to evaporate the water. The air is cooled and humidified.

Plug and Humidify - Easy and fast installation

The EVAPACK® humidifier water connections are on the side. Installation is quick, simple, and easy.

Compact design with a maximum footprint of 600 mm.

EVAPACK® works with different type of water: potable water, reverse osmosis or soft water.

Draining and over flow connections: 40 mm.

Different model configuration available

Armstrong EVAPACK® Series is available in Direct Water (DW) or Recirculated Water configuration.

Low and easy maintenance

The EVAPACK® humidifier cassettes are accessible by the side or by the front for big sizes. This reduces the requested replacement space. The cassette maintenance is made in seconds.

EVAPACK® humidifier water pump, water level detector, manual gate valves are on the service side, easily accessible for a simplified maintenance.

Easy cleaning

All EVAPACK® elements are easy to disassemble, to clean and to reassemble.

Customized Design

EVAPACK® humidifier is available for air handling units or ducts applications.

Dimensions are customized according to your applications.

Tailor made sizing.

From approximately 0.36 m^2 to 9.00 m^2 in one piece assembly. Multiple EVAPACK® humidifiers can be combined for larger sections.

Efficient

Low energy consumption

EVAPACK® humidifiers use the heat present in the air for humidifying and cooling.

Optimized water contact surface

EVAPACK® has been designed to get the highest air/water contact surface. Up to 12% more than traditional evaporative pads.

High efficiency and low pressure drop

EVAPACK® has been designed to maximize the efficiency and minimize pressure drop.

EVAPACK® Typical Configurations

Figure 30-1. Heating + Humidification

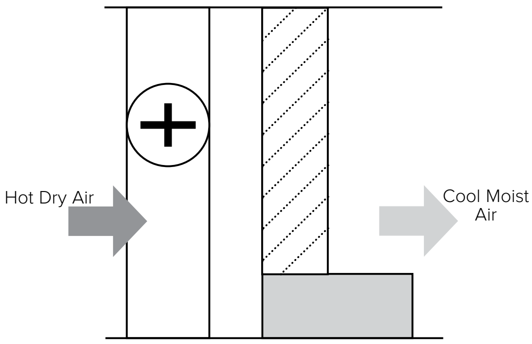
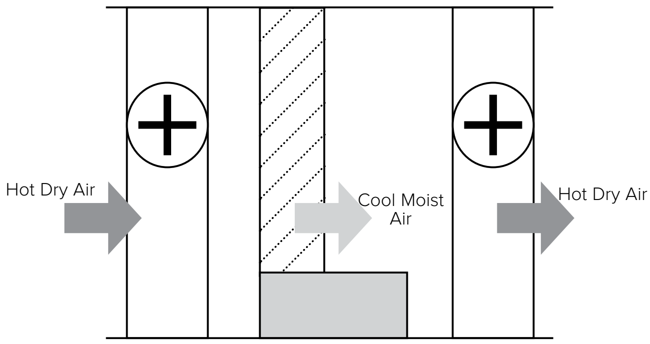


Figure 30-2. Pre-heating + Humidification + Post Heating



GAS HUMIDIFICATION

Gas-Fired HumidiClean™ with Ionic Bed Technology™

Operating costs are reduced with the GFH Series Gas-Fired HumidiClean humidifier from Armstrong. HumidiClean's innovative Ionic Bed Technology reduces operating costs even more by reducing the labor and downtime associated with cleaning humidifiers. The GFH Series uses natural gas or propane for economical operation. And the HumidiClean is designed for ease of use; it's adaptable to various water qualities, and service life cycle and tank drainage are field-adjustable. The GFH Series is CSA-certified and CGA-approved.

SPECIALIZED STEAM DISPERSION METHODS

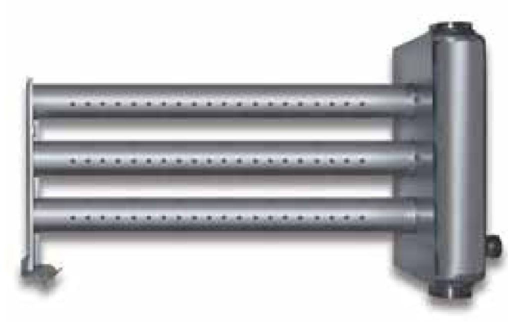
EHF Fan Package

The EHF Fan Package is used when the atmospheric steam can not be delivered in to the duct / AHU. This unit is mounted in the space that is to be humidified and fed by one of Armstrong's many atmospheric steam generators.

Steam Jacketed Dispersion Tube (SJDT)

The Armstrong SJDT is an all stainless steel dispersion tube with the unique ability to accept steam from atmospheric steam-generating humidifiers. The SJDT uses a portion of the steam to "jacket" the entire length of the tube, keeping the dispersion tube hot, even during periods of low demand. This "jacketing" effect improves the quality of steam discharge and reduces the chance for spitting or dripping in your air handling system. The SJDT will accept steam from:

- EHU
- Gas-Fired
- Steam-to-Steam
- HumidiClean



HumidiPack®, HumidiPackPlus® and HumidiPack CF®

A prefabricated steam humidifier system, the Armstrong HumidiPack® comes ready for insertion into the duct. For use on pressurized steam, the system includes a steam control valve, strainer, steam trap and header drain trap.

The HumidiPack accepts steam, separates entrained moisture from it and admits it into a duct or air handler airstream via the dispersion tube. HumidiPackPlus® combines a shortened non-wetting distance with steam-jacketed "active" tubes.

The result is a dry, uniform discharge of steam for nearly any application with a steam source from a pressurized central supply.

HUMID-A-WARE™ SOFTWARE

Humid-A-ware™ Software

For detailed information on customizing humidification schedules and calculating non-wetting distances and humidification loads, refer to Armstrong's Humid-A-Ware™ humidification sizing and selection software. It can be downloaded from Armstrong's web site: www.**armstrong**international.com

Humid-A-ware™
Humidification Sizing and Selection Software

ARMSTRONG UNIVERSITY

For nearly 100 years in the steam business, Armstrong has been devoted to building stronger bonds through the sharing of information and ideas. That's why Knowledge Not Shared Is Energy Wasted® is our motto, promise and pledge to you. And it's why we founded Armstrong University®. Use this site for quick research on steam, answers to steam system questions and comprehensive online steam system education:

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