Steam Injection

Pressurized Steam Humidifiers

Installation, Operation, and Maintenance Manual

DRISTEEM®
The humidification experts

ATTENTION INSTALLER

Read this manual before installing.
Leave manual with product owner.

DRI-STEEM technical support

800-328-4447

Where to find more information

On our Web site:

The following related documents can be viewed, printed, or ordered from our web site, **www.dristeem.com**

- Steam Injection catalog (which includes non-wetting distance graphs):
- *DRI-STEEM Design Guide* (includes steam loss tables and general humidification information)

In Dri-calc:

Dri-calc® is our humidification system sizing and selection software, which can be ordered at www.dristeem.com. Included in Dri-calc:

- A comprehensive library of installation guide documents, including:
  - Recommended placement within a duct or air handler
  - Recommended sensor placement

Or call us at 800-328-4447

While obtaining documents from our web site or from Dri-calc is the quickest way to review our literature, we also will mail to you any literature you need.

WARNING!

This product must be installed by qualified HVAC and electrical contractors and in compliance with local, state, and federal codes. Improper installation can cause property damage, severe personal injury, or death as a result of electric shock, burns, and/or fire.

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Introduction

Figure 2-1:
Single-tube
Steam Injection humidifier

DRI-STEEM® Steam Injection humidifier in its most elemental form — the Single-tube humidifier. Each Single-tube or Multiple-tube humidifier (including Maxi-bank™ and Mini-bank® humidifiers) has the same basic components: a stainless steel separator, a steam valve, and one or more jacketed dispersion tubes.

For ductless spaces, boiler steam can be dispersed by the fan of an Area-type model.

Standard and Clean-steem™ models suitable for a wide range of applications

DRI-STEEM's Steam Injection humidifiers use steam from an external source, such as an in-house boiler or a district steam system. They are adaptable to virtually any size application, and a wide variety of models accommodate a broad range of steam absorption requirements. All models are available in either standard or Clean-steem configuration.

Clean-steem humidifiers for controlled environments

Some humidification applications require steam that has no impurities. For these applications, boiler steam is often derived from deionized (DI) water and then dispersed into the air through one of our Clean-steem humidifiers.

Clean-steem humidifiers are typically used in environments with exacting temperature, air cleanliness, and humidity requirements such as hospitals, clean rooms, laboratories, and pharmaceutical plants.

Area-type™ for ductless spaces

Area-type Steam Injection humidifiers are designed for open spaces such as warehouses and manufacturing spaces that may not have a duct system. The steam discharged from the humidifier is quietly dispersed by a fan without introducing water droplets into the air.

Available models

Figure 3-1:
Steam Injection humidifier models

Single-tube humidifier

- Suitable for small capacity systems
- Long non-wetting distance
- Pre-assembled header/tube assembly

Mini-bank® humidifier

- Suitable for medium capacity systems
- Sized for small ducts
- Short to moderate non-wetting distance
- Pre-engineered and pre-assembled header/tube assembly, ready for mounting and hookup

Multiple-tube or Maxi-bank™ humidifier

- Suitable for large capacity systems
- Range of sizes to fit small ducts to large air handlers
- Short to moderate non-wetting distance
- Multiple-tube humidifier is field assembled (with interconnecting piping and header supplied by contractor)
- Maxi-bank humidifier is pre-assembled (except when either dimension is 98 inches or more) and includes interconnecting piping and header

Area-type humidifier

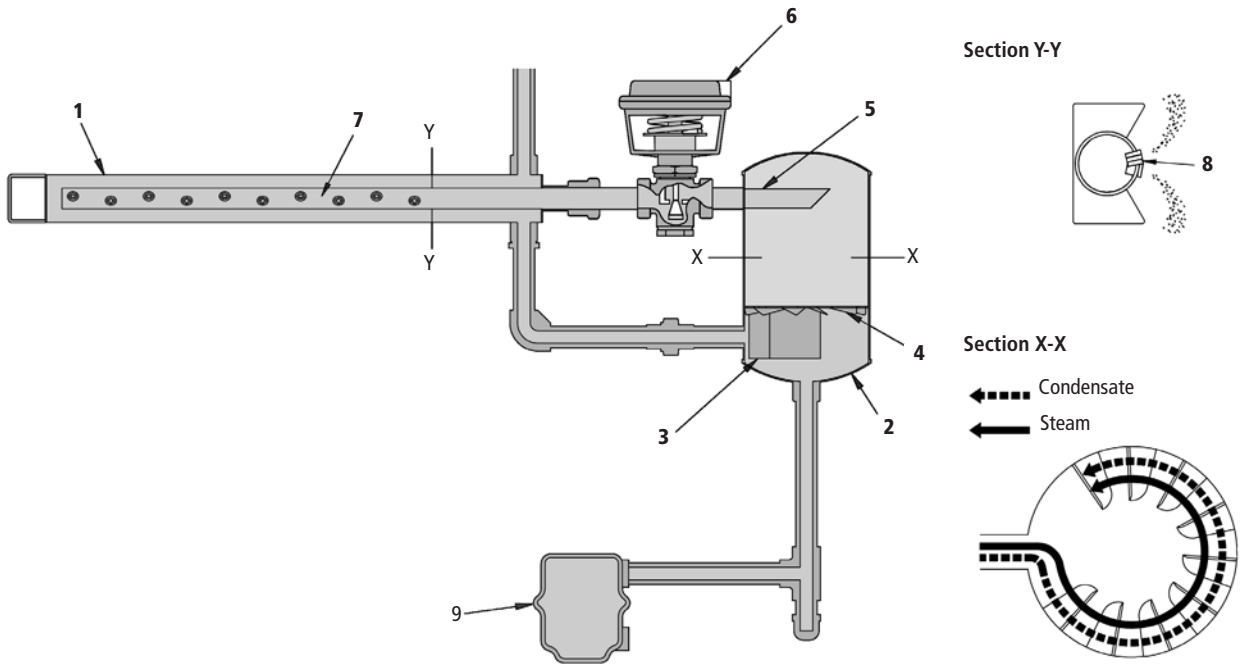
- Suitable for medium capacity systems
- Used in ductless spaces
- Application-dependent non-wetting distances

Choose standard or Clean-steem configurations

All Steam Injection models shown here can be purchased in either a standard or a Clean-steem configuration.

Basic components

Figure 4-1:
Steam Injection humidifier components



1. **Steam jacket**
   A chamber that jackets the inner dispersion tube with hot steam to eliminate condensation and dripping
2. **Steam separator**
   Removes entrained condensate and condensation slugs
3. **Deflector plate**
   Inside the steam separator, deflects water into a circular pattern and toward the drain
4. **Multi-baffle plate**
   Allows only steam to rise into the upper separator region
5. **Internal drying tube**
   Excludes any remaining moisture particles, allowing only dry steam to leave the separator
6. **Steam valve**
   Controls the steam amount allowed into the dispersion tube
7. **Dispersion tube**
   Provides uniform steam dispersion across the duct width
8. **Thermal-resin tubelet**
   Unique tubelets extend into the dispersion tube center so only the hottest, driest steam is discharged into the air. These tubelets also have an exceptional ability to trap noise generated by the valve.
9. **Steam trap**
   Allows only condensate to pass to the condensate return system

Please see the next page for a description of how these components operate together.

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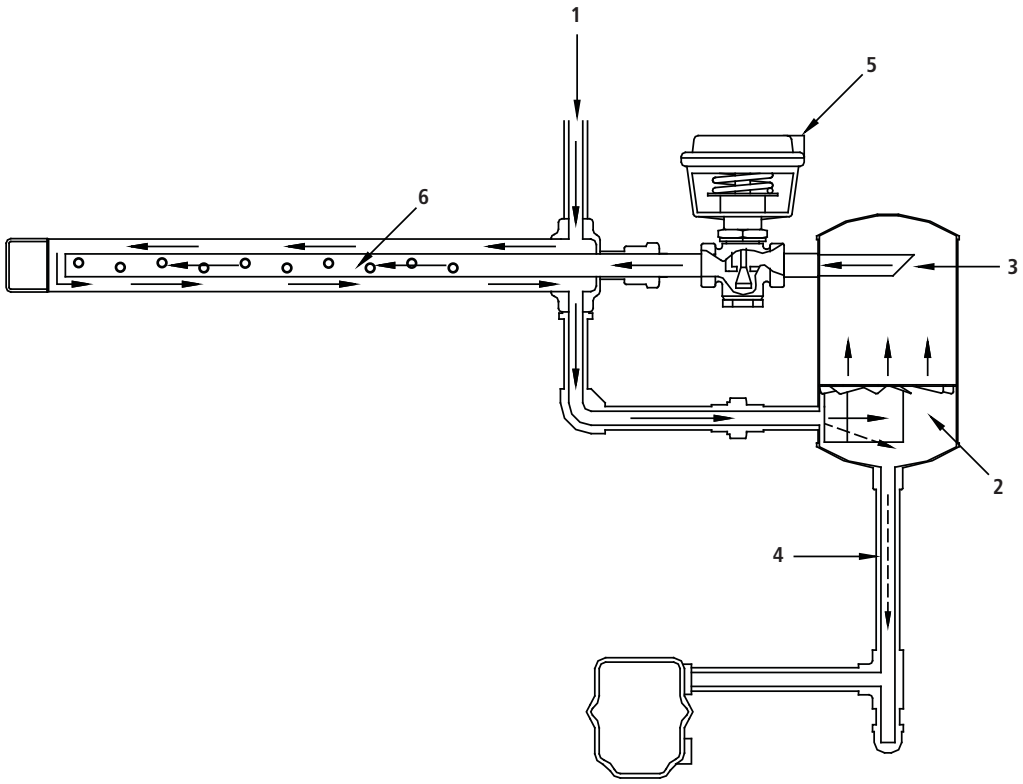
Principle of operation

Figure 5-1:
Steam Injection humidifier principle of operation



1. Boiler steam with entrained condensate enters the humidifier at line pressure and flows through a chamber (jacket) surrounding an inner dispersion tube. This steam jacketing preheats the dispersion tube so that when steam enters the dispersion tube (at Step 5 below) it does not condense as it would if the tube were cold, thereby eliminating condensation and dripping.
2. After flowing through the steam jacketing chamber, steam with entrained condensate slows from entering the larger space of the separator and from hitting the perimeter deflector plate, and begins to spin and separate.
3. Separated steam rises through the slots of the multi-baffle plate to the upper region of the separator and enters the internal drying tube that excludes any remaining moisture particles, allowing only dry steam to leave the separator.
4. Separated condensate drains from the separator to the steam trap.
5. The steam valve controls the amount of steam allowed into the preheated dispersion tube. The steam valve is typically controlled in one of three ways:
   - Control by another signal, such as a building management system
   - Humidity controller connected to the steam valve
   - DRI-STEEM's Vapor-logic® 3 microprocessor controller.
6. Steam is discharged uniformly through the tubelets into the airstream.

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Humidifier placement

Placing a steam injection humidifier in an AHU (see Figure 6-1)

- Location A is the best choice. Installing downstream of heating and cooling coils provides laminar flow through the dispersion unit; plus, the heated air provides an environment for best absorption. Use a multiple tube dispersion unit to ensure complete absorption of steam vapor before fan entry.
- Location B is the second-best choice. In change-over periods, the cooling coil will eliminate some moisture for humidification.
- Location C is the third-best choice. Air leaving a fan is usually very turbulent and may cause vapor to not absorb at the expected absorption distance. Allow for more absorption distance if installing downstream of a fan.
- Location D is the poorest choice. The cooler air at this location requires an increased absorption distance.

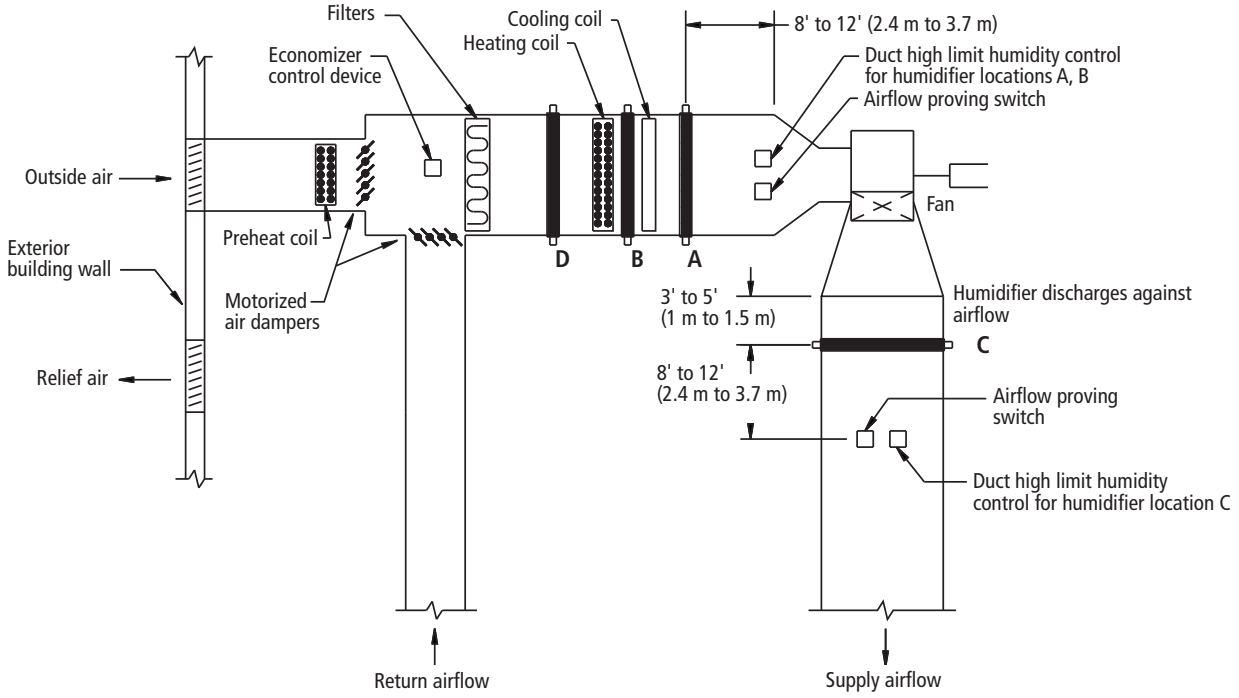
Use these examples as guidelines

Proper humidifier placement is crucial for successful system operation. Usually, there is no single correct placement for a humidifier. Much depends on system design and application. The following paragraphs and dispersion assembly placement examples are presented as guidelines for common situations.

First, check available absorption distance

Available absorption distance affects system choice. Dispersed steam must be absorbed into the airflow before it comes in contact with any duct elbows, fans, vanes, filters, or any object that can cause condensation and dripping.

Figure 6-1:
Placing a Steam Injection humidifier in an air handling unit (AHU)

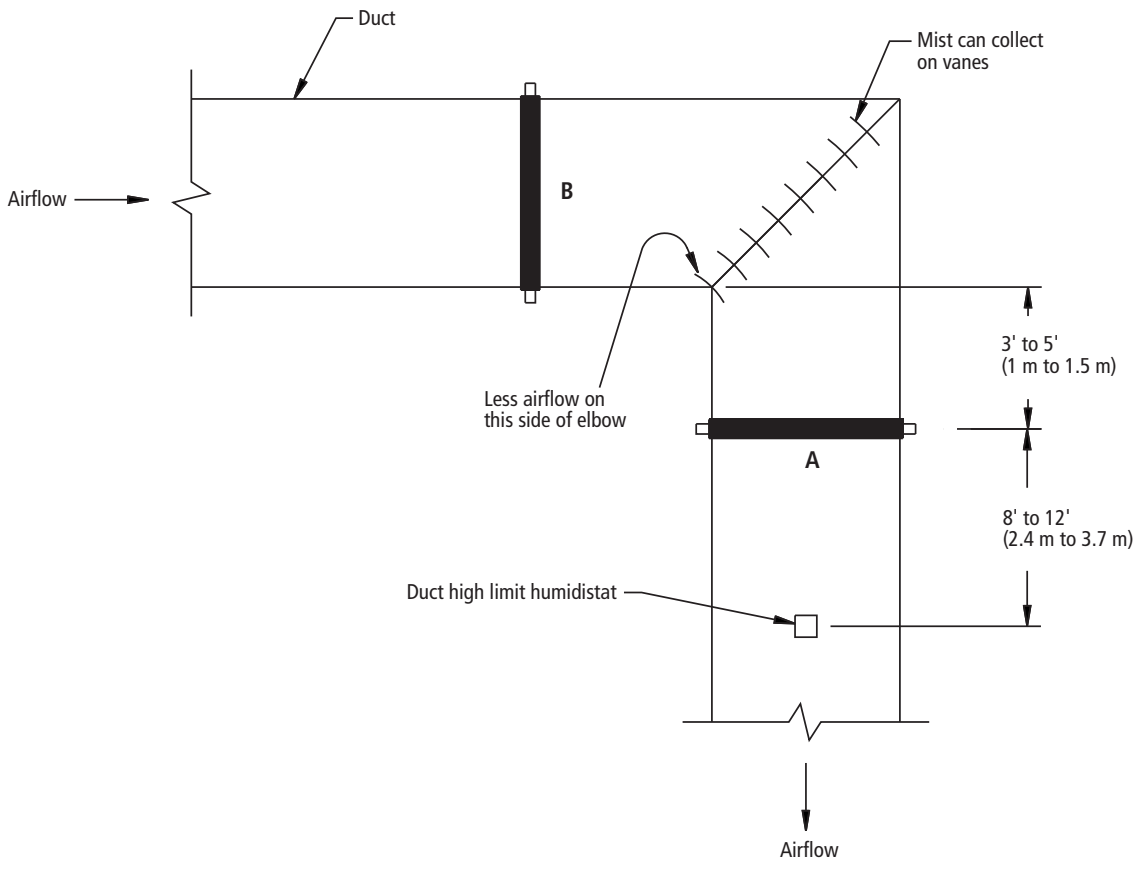


Humidifier placement

Placing a Steam Injection humidifier near an elbow (see Figure 7-1)

- Location A is the best choice. Better absorption occurs on the downstream side of an elbow than on the upstream side.
- Location B is the second-best choice. Installing upstream of an elbow can cause wetting at the turning vanes. In cases where it is structurally impossible to avoid Location B, use a multiple tube humidifier to ensure complete absorption. Also, since more air flows along the outside of a turn, better absorption occurs if the humidifier discharges proportionately more steam in that part of the airstream.
- At both locations, discharging steam against or perpendicular to the airstream gives slightly better mixing and absorption than discharging with the airstream.

Figure 7-1:
Placing a Steam Injection humidifier assembly near an elbow

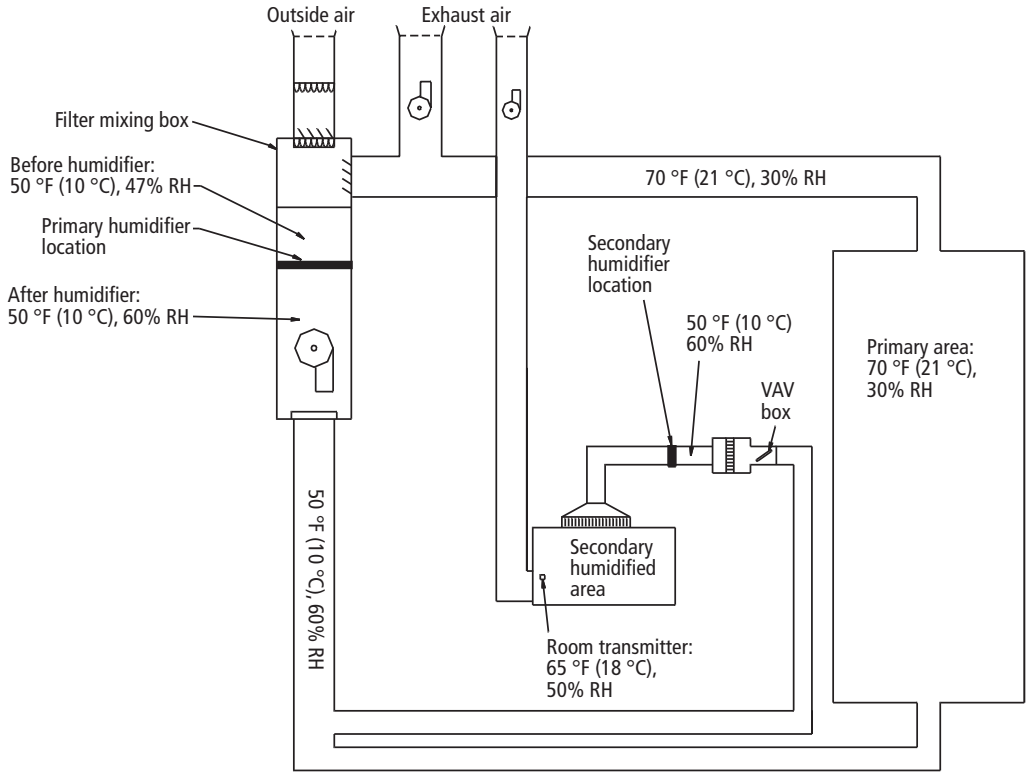


Humidifier placement

Placing a Steam Injection humidifier in a primary/secondary system (see Figure 8-1)

This type of system is commonly applied to facilities where most of the building requires one humidity level (typically to meet comfort requirements) and part of the building requires additional humidity. In Figure 8-1, the primary humidification system is within the main air handling unit. The secondary humidification system is located close to the point of steam discharge into the secondary area.

Figure 8-1:
Placing a Steam Injection humidifier in a primary/secondary system



Humidistat and sensor placement

Humidistat and sensor locations are critical (see Figure 9-1)

Humidistat and sensor location have a significant impact on humidifier performance. In most cases, we recommend that you do not interchange duct and room humidity devices. Room humidity devices are calibrated with zero or little airflow; whereas duct humidity devices require air passing across them. Recommended sensor locations:

A This is the ideal sensing location because this placement ensures the best uniform mix of dry and moist air with stable temperature control.

B This location is acceptable, but the room environment may affect controllability such as when the sensor is too close to air grilles, registers, or heat radiation from room lighting.

C This location is acceptable because it provides a good uniform mixture of dry and moist air, but if an extended time lag exists between moisture generation and sensing, make sure the control contractor extends the sampling time.

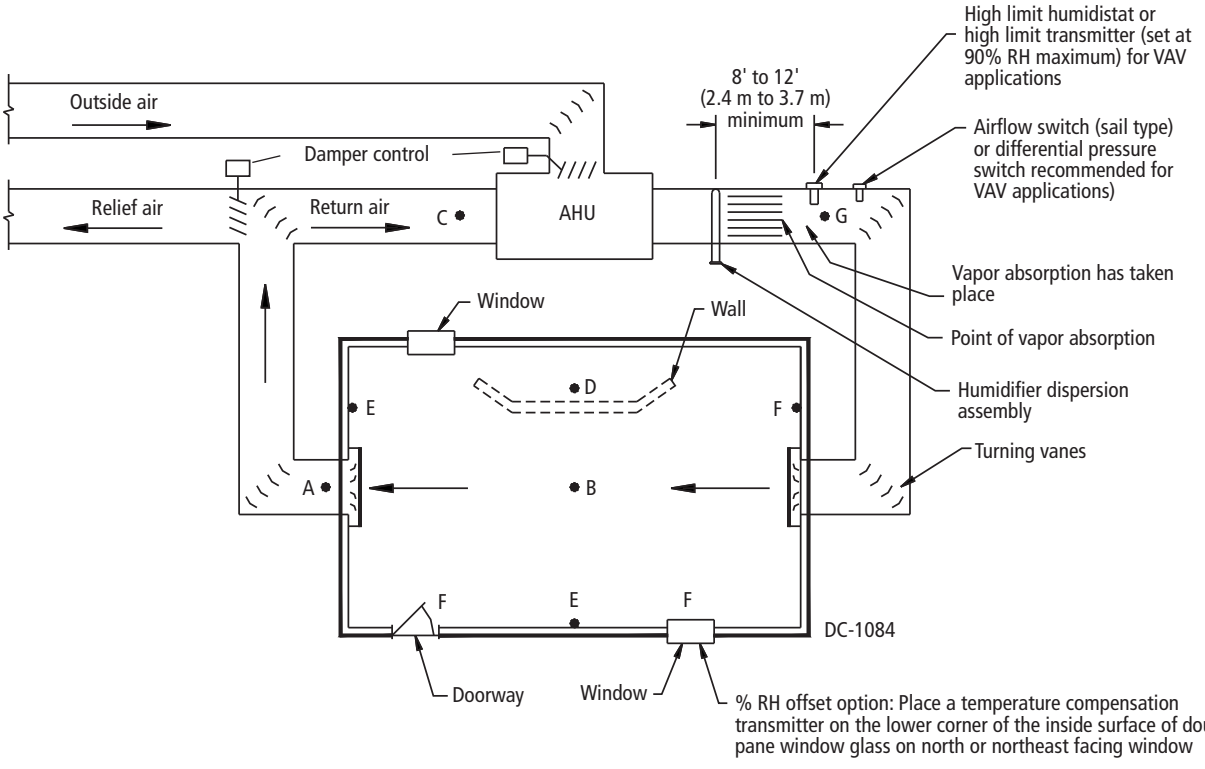
D This location behind a wall or partition is acceptable for sampling the entire room if the sensor is near an air exhaust return outlet. This location is also typical of sensor placement for sampling a critical area.

E These locations are not acceptable because they may not represent actual overall conditions in the space.

F These locations are not acceptable. Do not place sensors near windows, door passageways, or areas of stagnant airflow.

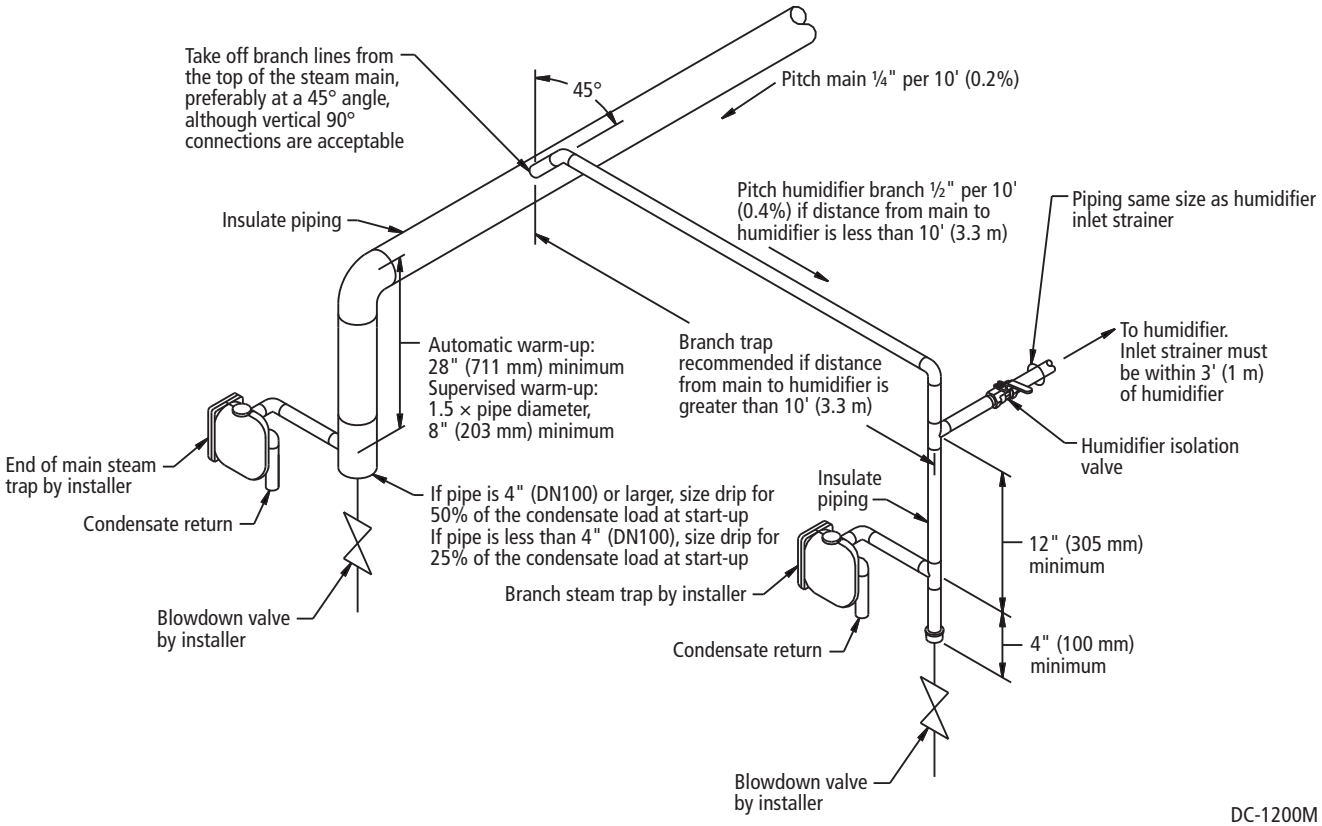
G This is the best location for a duct high limit humidistat or humidity sensor.

Figure 9-1:
Recommended sensor locations



Pressurized steam piping guidelines

Figure 10-1:
Field piping overview

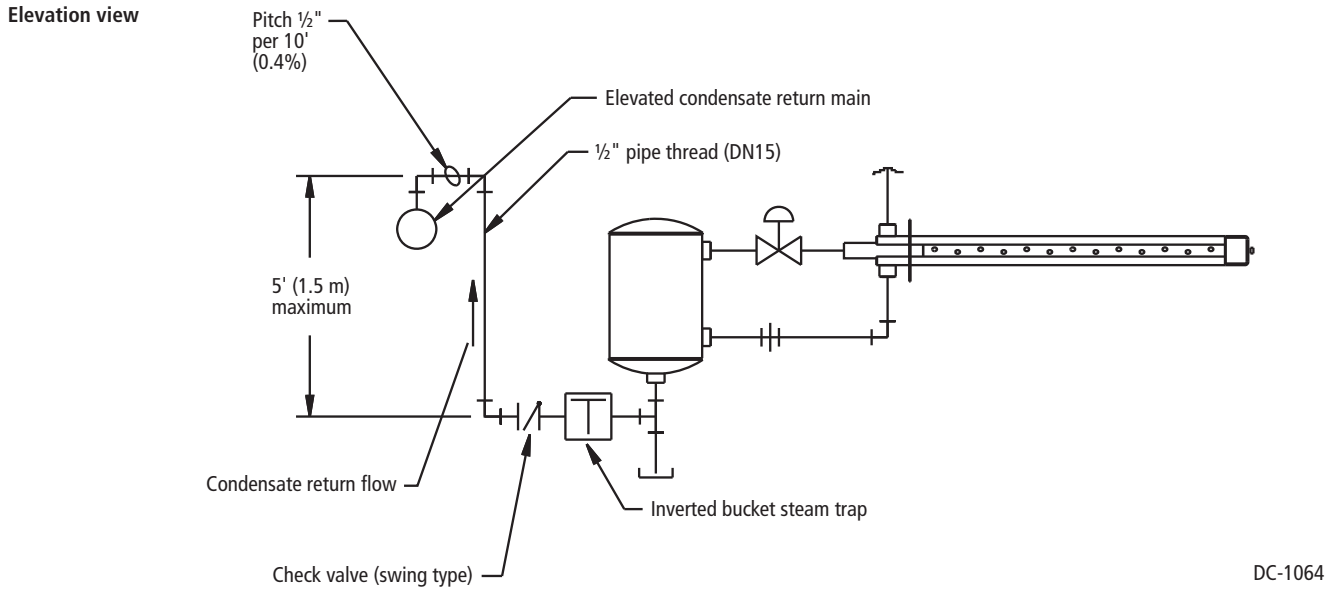


Piping notes:

- Size piping in accordance with ASHRAE recommendations.
- The humidifier's steam supply should be taken off the top of the steam main (not the side or bottom) to ensure the driest steam. The main should be dripped and trapped (in accordance with ASHRAE recommendations).
- The humidifier steam trap(s) must drain by gravity to the return main having little or no back pressure. If condensate cannot drain by gravity, then it must be elevated to the return main (see the next page for instructions).
- If steam pressure is less than or equal to 15 psi (103.4 kPa), use float and thermostatic (F&T) traps for the humidifier. If steam pressure is greater than 15 psi (103.4 kPa), use inverted bucket traps for the humidifier.
- If lifting condensate, use an inverted bucket trap. See drawings and instructions on the next page.
- Condensate from unavoidable heat loss in the distribution system must be removed promptly to eliminate water hammer and degradation of steam quality and heat transfer capability. Install drip legs at all low points and natural drainage points in the system, such as at the ends of mains and at the bottoms of risers, and ahead of pressure regulators, control valves, isolation valves, pipe bends and expansion joints. On straight horizontal runs with no natural drainage points, space drip legs at intervals not exceeding 300' (91 m) when the pipe is pitched down in the direction of the steam flow and at a maximum of 150' (46 m) when the pipe is pitched up, so that condensate flow is opposite of steam flow. These distances apply to systems where valves are opened manually to remove air and excess condensate that forms during warm-up conditions. Reduce these distances by about half in systems that are warmed up automatically.
- Insulate piping well to avoid unnecessary heat loss.
- Pitch return lines downward in the direction of the condensate flow at ½" per 10' (0.4%).

Pressurized steam piping guidelines

Figure 11-1:
Elevating condensate from a Steam Injection humidifier



Notes:

In certain installations, it is not possible to drain the humidifier steam trap by gravity. The condensate must be lifted. Generally, lifting condensate is not recommended, but it can be done successfully by observing the following rules:

- **Steam pressure.** Theoretically, one pound (6.9 kPa) of steam pressure will lift condensate about 2' (0.6 m). But in practice, because of pipe friction, pressure drop through a steam trap, and back pressure in a return line, we recommend that you consider the maximum lift to be 6" per pound (0.2 m per 6.9 kPa) of steam pressure at the trap. For example, a steam pressure of 5 psi (34.5 kPa) will provide a maximum lift of 2.5' (0.76 m). Lifts in excess of 5' (1.5 m) should not be attempted.
- **Steam trap.** When lifting condensate, use an inverted bucket type steam trap. Float and thermostatic (F&T) traps are more prone to water hammer damage with a flooded trap, which may occur when lifting condensate.
- **Pipe size.** The size of the vertical portion of the piping should be ½" pipe thread (DN15).
- **Check valve** (swing type). A low-pressure differential swing check-valve should be installed adjacent to the trap. This will prevent backflow of condensate into the humidifier during periods of little or no steam pressure. Failure to do so could result in the accumulated backflow discharging from the humidifier when steam pressure is resumed. Spring type check-valves are not recommended as they can reduce pressure available for condensate lifts.

Condensate lifting recommendations:

1. Condensate can be lifted for all steam jacket piping.
2. Condensate could be lifted for connection to separator but performance could vary based on variable pressure at the separator.
3. Condensate can not be lifted for connection on headers for Maxi-bank and Multiple tube.

Strainer sizes

Table 12-1:
Steam Injection humidifier strainer sizes

Entering steam pressure		NON-CLEAN-STEEM MODELS: Strainer size in inches (DN) based on steam output in lbs/hr and kg/h															
		½" (DN15)		¾" (DN20)		1" (DN25)		1½" (DN40)		2" (DN50)		2½" (DN65)		3" (DN80)		4" (DN100)	
psi	kPa	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h
2	14	30	14	65	29	85	39	200	91	300	136	500	227	640	290	950	431
5	34	50	23	100	45	145	66	330	150	500	227	810	367	1050	476	1600	726
10	69	65	29	120	54	190	86	450	204	760	345	1100	499	1635	742	2500	1134
15	103	75	34	140	64	230	104	540	245	900	408	1320	599	2060	934	3360	1524
20	138	85	39	160	73	260	118	625	284	1150	522	1550	703	2310	1048	4100	1860
25	172	95	43	180	82	300	136	720	327	1200	544	1750	794	2690	1220	4720	2141
30	207	110	50	200	91	340	154	790	358	1350	612	2000	907	3120	1415	5500	2495
35	241	120	54	220	100	360	163	860	390	1450	658	2200	998	3500	1588	6300	2858
40	276	130	59	245	111	400	181	960	435	1620	735	2350	1066	3700	1678	6550	2971
45	310	140	64	270	122	440	200	1035	469	1705	773	2430	1102	3850	1746	6840	3103
50	345	150	68	290	132	470	213	1100	499	1800	816	2500	1134	4000	1814	7100	3221

Entering steam pressure		CLEAN-STEEM MODELS: Strainer size in inches (DN) based on steam output in lbs/hr and kg/h															
		½" (DN15)		¾" (DN20)		1" (DN25)		1½" (DN40)		2" (DN50)		2½" (DN65)		3" (DN80)		4" (DN100)	
psi	kPa	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h
2	14	20	9	45	20	60	27	120	54	255	116	385	175	540	245	945	429
5	34	35	16	80	36	100	45	200	91	420	191	660	299	925	420	1620	735
10	69	50	23	120	54	160	73	315	143	650	295	1045	474	1465	665	2565	1163
15	103	65	29	155	70	210	95	420	191	870	395	1405	637	1970	894	3440	1560
20	138	80	36	190	86	260	118	515	234	1060	481	1750	794	2455	1114	4295	1948
25	172	95	43	210	95	310	141	620	281	1280	581	1990	903	2840	1288	5050	2291
30	207	110	50	230	104	360	163	730	331	1500	680	2225	1009	3205	1454	5700	2586
35	241	125	57	250	113	405	184	830	376	1625	737	2445	1109	3550	1610	6260	2840
40	276	135	61	270	122	450	204	935	424	1750	794	2665	1209	3850	1746	6820	3094
45	310	145	66	290	132	495	225	1020	463	1875	851	2850	1293	4100	1860	7300	3311
50	345	155	70	310	141	540	245	1110	503	2000	907	3075	1395	4450	2019	7900	3583

Notes:
- Capacity for non-Clean-steem model strainers is based on maximum 8,000 fpm (40.6 m/s) velocity through strainer.
- Capacity for Clean-steem model strainers is based on maximum 10,000 fpm (50.8 m/s) velocity through strainer.
- Strainer capacity limited to maximum pressure drop across strainer at 5% inlet steam pressure.
- Choose strainer size based on maximum flow through steam valve except for Multiple-tube/Maxi-bank humidifier with yoke assembly (multiple valves) where strainer size choice is based on combined maximum flow through all valves.

Supply and drain connections and dimensions

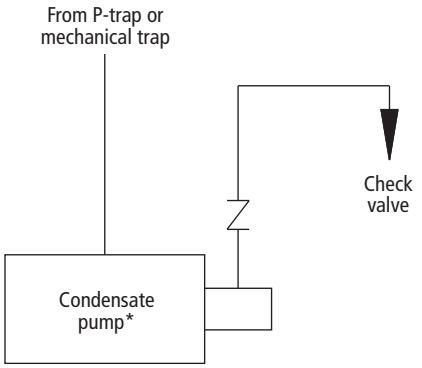
Table 13-1:
Condensate drain piping for Ultra-sorb and Steam Injection humidifiers

	Ultra-sorb XV† (Pressurized steam only)	Ultra-sorb LV & LH† (Pressurized steam option)		Steam Injection: Single-tube, Multiple-tube, Maxi-bank, Mini-bank humidifiers				Steam Injection: Area-type humidifier	
				Piping from separator or steam jackets		Piping from header***		Piping from separator	
	Standard	Standard	Clean-steem	Standard	Clean-steem	Standard	Clean-steem	Standard	Clean-steem
P-trap water seal	Optional for header overflow prevention in critical applications	Recommended method Drop: 8" Seal: 10"	Stainless steel Drop: 8" Seal: 10"	No	No	No	No	Drop: 8" Seal: 10"	NA
F&T trap	≤ 15 psi	Alternate method * Drop: 12" Drip: 4"	No	Use only if not lifting condensate and steam pressure is ≤ 15 psi Drop: 12" Drip: 4"	No	Drop: 12" Drip: 4"	No	No	NA
Inverted bucket trap	> 15 psi	No	No	Use only if lifting condensate or if steam pressure is > 15 psi Drop: 12" Drip: 4" **	No	No	No	No	NA
Stainless steel thermostatic trap	NA	No	≤ 60 lbs/hr of condensate: Drop: 12" Drip: 4" Cooling leg: 24" minimum	No	≤ 60 lbs/hr of condensate: Drop: 12" Drip: 4" Cooling leg: 24" minimum	No	≤ 60 lbs/hr of condensate: Drop: 12" Drip: 4" Cooling leg: 24" minimum	No	NA
Stainless steel F&T trap	NA	No	60 to 120 lbs/hr of condensate: Drop: 12" Drip: 4"	No	60 to 120 lbs/hr of condensate: Drop: 12" Drip: 4"	No	60 to 120 lbs/hr of condensate: Drop: 12" Drip: 4"	No	NA
Condensate to open drain	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
Condensate return by condensate pump	NA	Yes	Yes (stainless steel pump recommended)	Yes	Yes (stainless steel pump recommended)	Yes	Yes (stainless steel pump recommended)	Yes	NA
Condensate return to humidifier by gravity	NA	NA	NA	NA	NA	NA	NA	NA	NA
Condensate return to boiler via return line	Yes	No	No	Yes	Yes	No	No	No	NA

Notes:
* Provide 18" vertical clearance for future P-trap substitution if required.
** Trap may require priming after seasonal shutdown.
*** On small Maxi-bank headers (2″ or less in diameter), this trap may be omitted.
† See the applicable Ultra-sorb XV or Ultra-sorb LV & LH Installation, Operation, and Maintenance Manual for pressurized steam application information.

Supply and drain connections and dimensions

Figure 14-1:
Condensate pump



Note:
Use a condensate pump rated for your application. Pumps are rated by fluid temperature, head (pressure), and flow (gpm). Contact your local DRI-STEEM representative for pump selection.

Figure 14-2:
F&T trap or stainless steel thermostatic trap

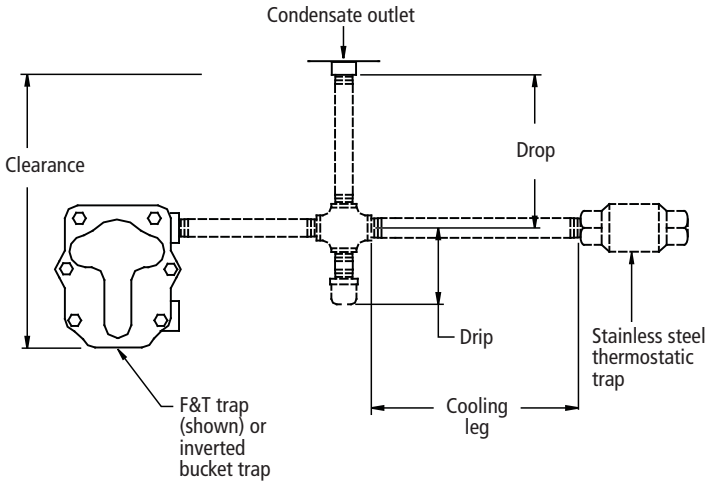
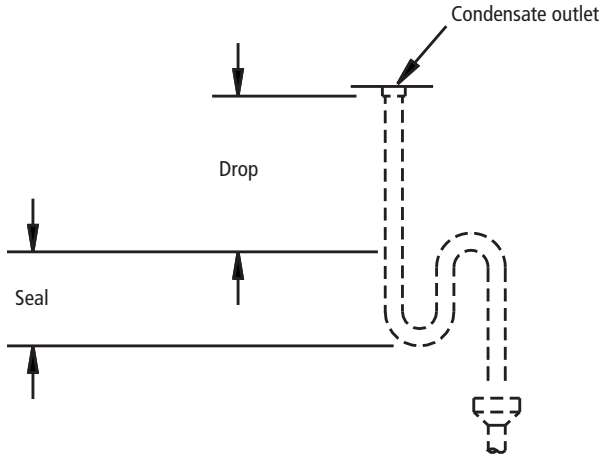
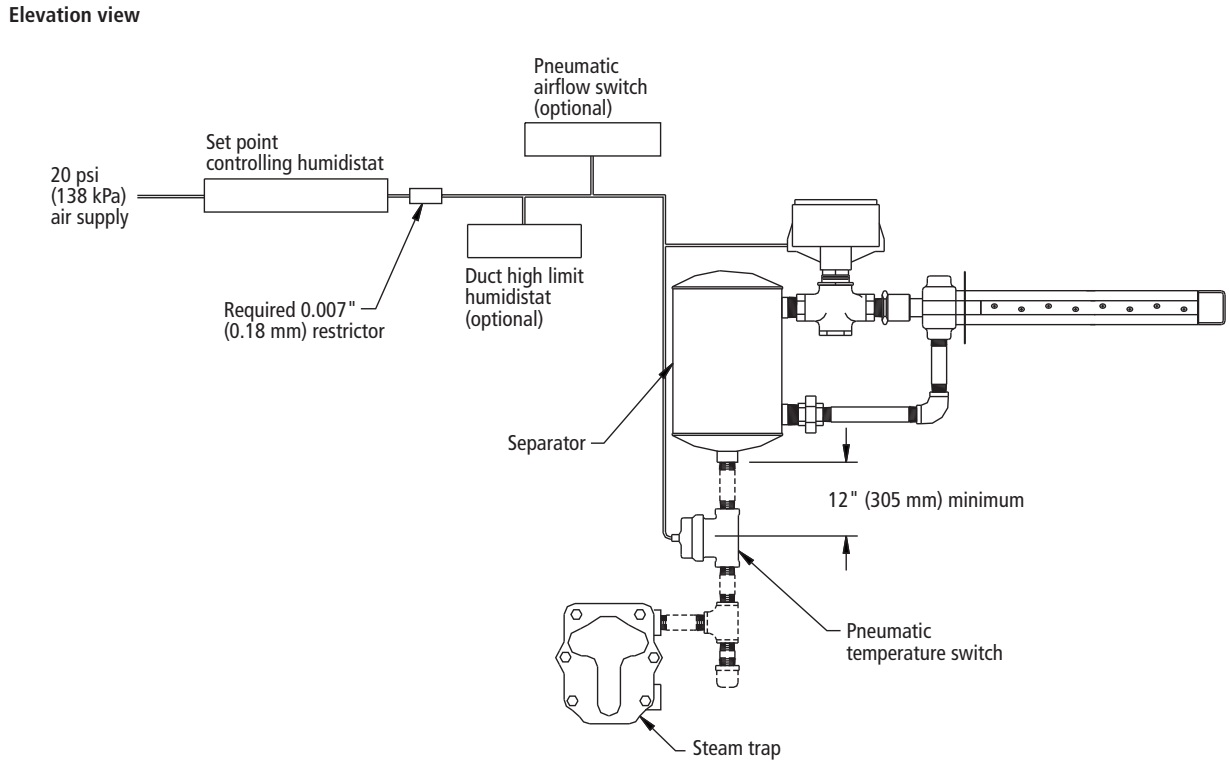


Figure 14-3:
P-trap water seal



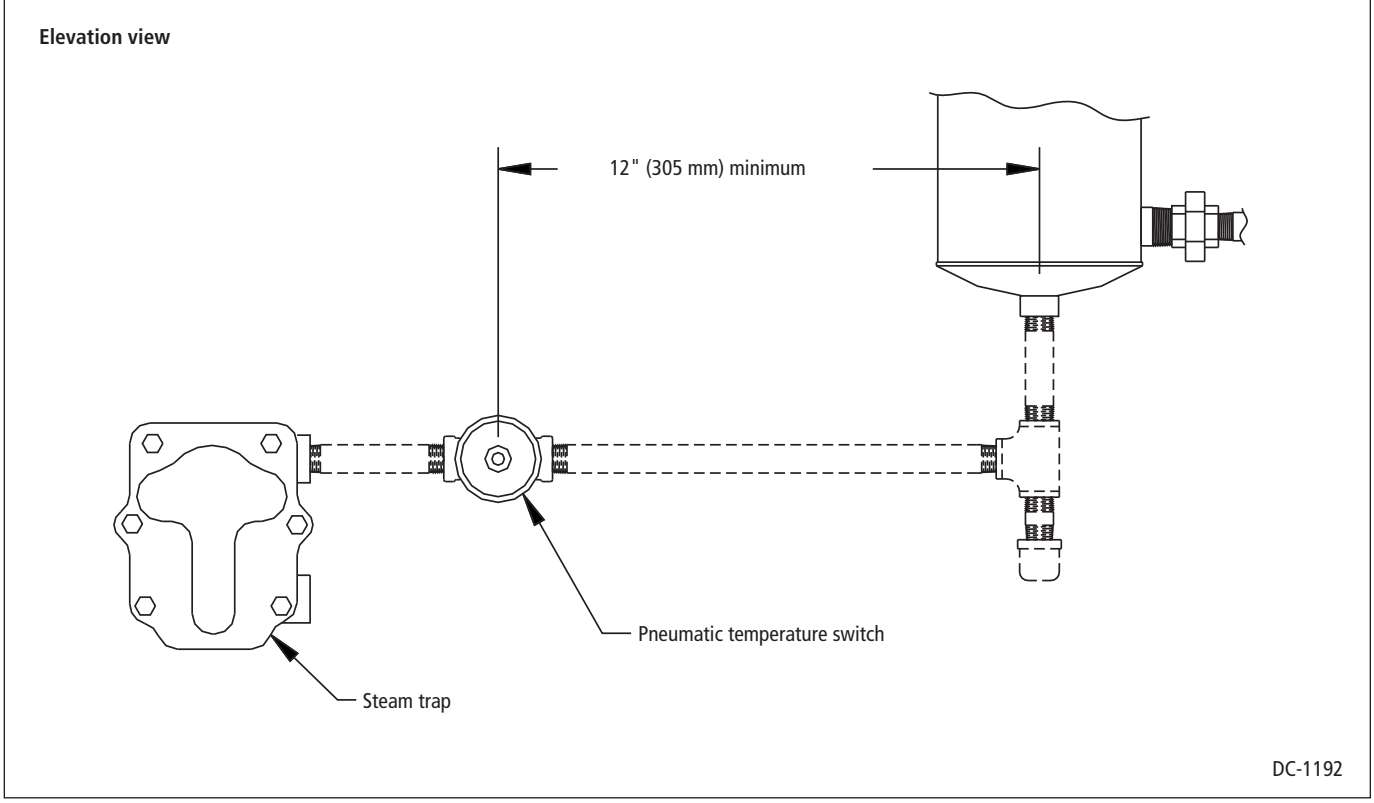
Temperature switches

Figure 15-1:
Pneumatic temperature switch standard location



Temperature switches

Figure 16-1:
Pneumatic temperature switch alternate location



Temperature switches

Pneumatic temperature switch notes:

- DRI-STEEM's pneumatic temperature switch, designed for use with a pneumatic control system, prevents condensate discharge from a steam injection humidifier during cold start or if the condensate return main becomes flooded. It accomplishes this by bleeding off the pneumatic signal from the controlling humidistat, preventing the pneumatic humidifier valve from opening until the steam trap has reached operating temperature.
- The pneumatic temperature switch has a self-contained air valve operated by a thermal disc that is normally open, bleeding off control air pressure. When steam comes in contact with the thermal disc, the fluid inside the disc expands, causing the air valve to close, thus allowing the pneumatic control system air pressure to build up and to actuate the steam control valve.
- Install the tee containing the pneumatic temperature switch in the condensate drainage pipe line between the separator and the inlet to the steam trap, as shown in the drawings on Pages 15 and 16.

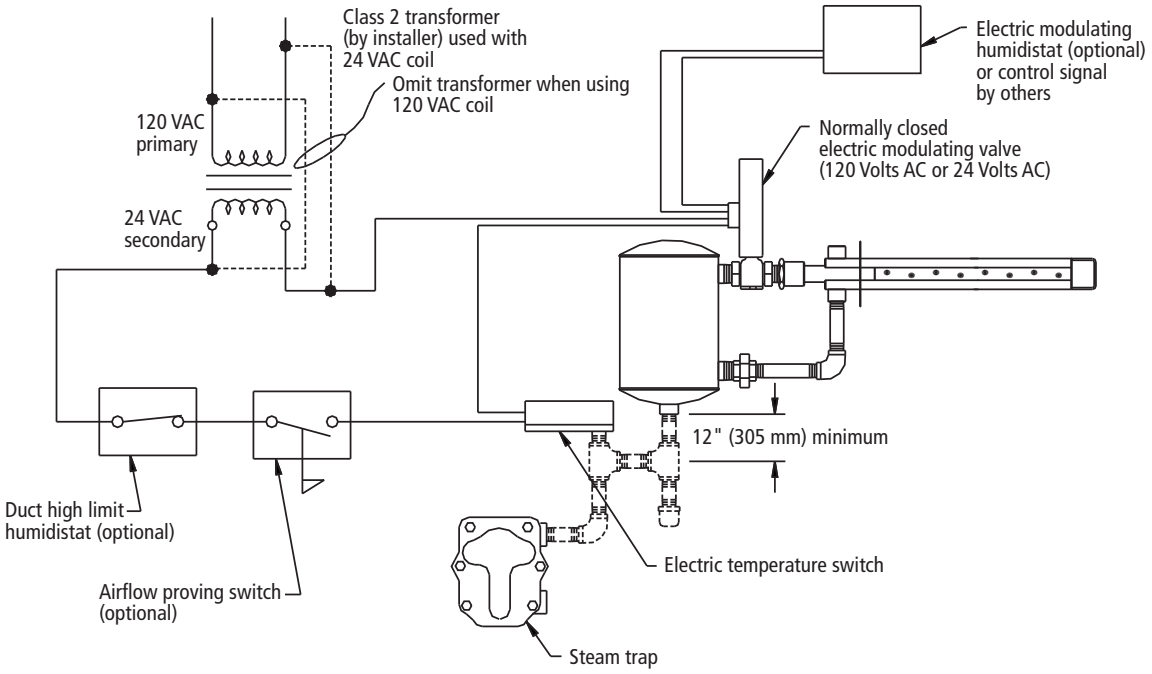
Electric temperature switches:

- The electric temperature switch prevents condensate discharge from a steam injection humidifier during a cold start or if the condensate return main becomes flooded. DRI-STEEM's electric temperature switch is a temperature-actuated make-break switch designed for use with electric humidity control systems. The temperature at which it switches is adjustable and should be set at 210 °F (99 °C).
- This switch prevents condensate discharge from a steam injection humidifier during a cold start or if the condensate return main becomes flooded.
- Install the sensing element of the device in the condensate return piping on the inlet side of the steam trap (see drawings), including a tee with a ½" pipe thread (DN15) opening to receive the sensing element. When steam surrounds the sensing element, the switch will “make,” allowing the humidifier valve to open.
- Install all wiring according to national and local electrical codes, and SIZE TRANSFORMER VA TO LOAD VA.
- When using the temperature switch with an electric modulating valve, use the special wiring instructions furnished with the valve.

Temperature switches

Figure 18-1:
Electric modulating temperature switch location

Elevation view



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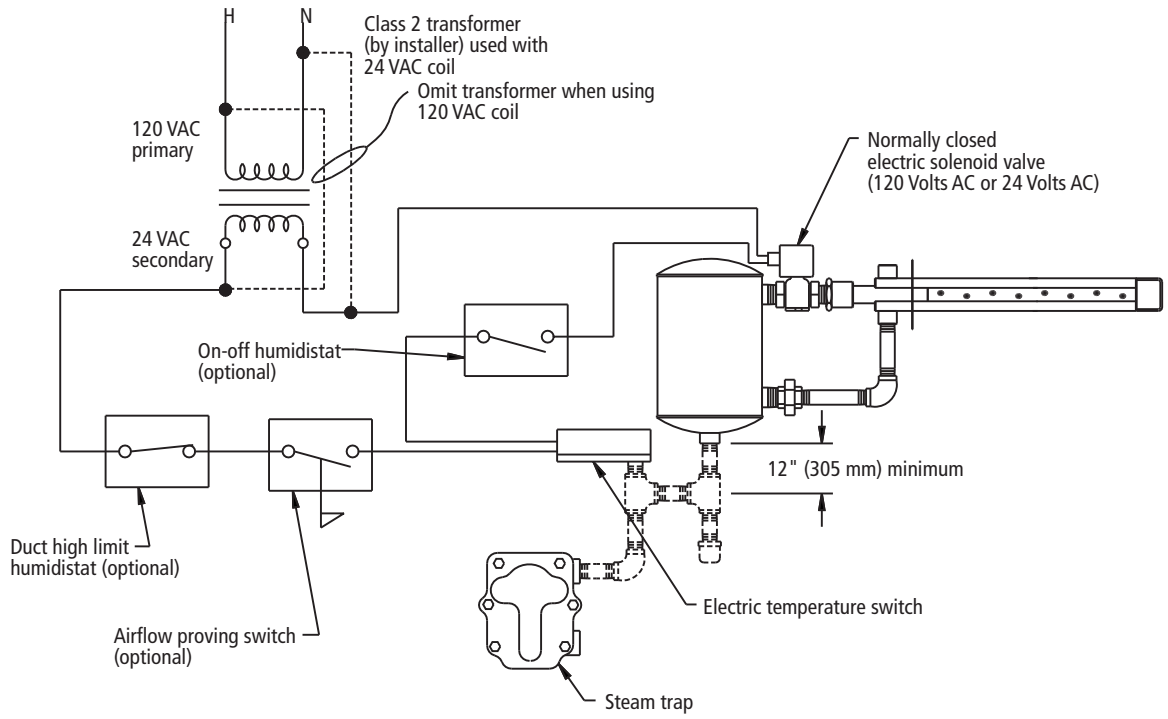
Temperature switches

Figure 19-1:
Electric on-off temperature switch location

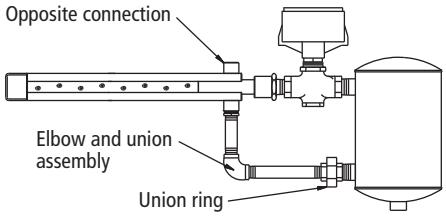
Elevation view



DC-1191

Configurations

Figure 20-1:
Changing from right-hand to left-hand configuration

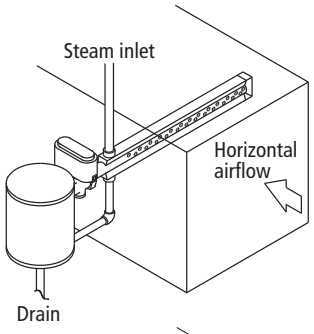


It may be necessary to change the steam discharge direction at the job site. To do so, follow these directions:

1. Non-threaded union ring.
2. Remove elbow and nipple assembly from dispersion tube and reinstall on opposite connection.
3. Rotate dispersion tube 180° with respect to separator.
4. Reconnect union halves and tighten union ring.
5. Humidifier now will discharge to opposite side.

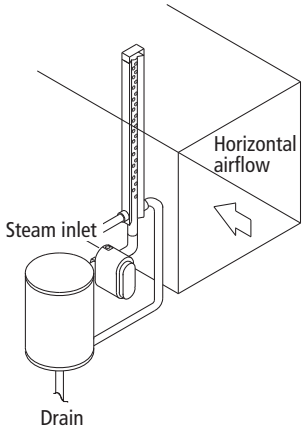
OM-8

Figure 20-2:
Single-tube humidifier installation configurations



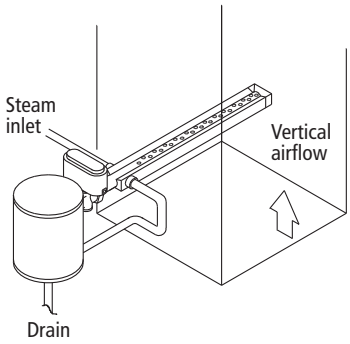
Standard configuration

Single-tube humidifiers are shipped this way unless ordered otherwise. See Page 24 for more information about this configuration. This is a right-hand configuration; to change to a left hand-configuration, see Figure 20-1.



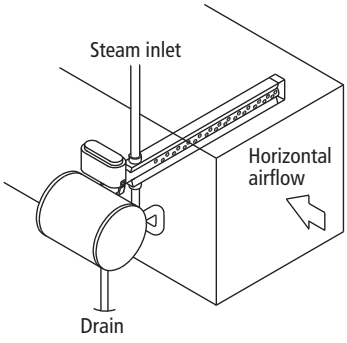
Vertical tube/horizontal airflow

Use this configuration when there is no access to side of duct or when duct is tall and narrow, to improve steam absorption. See Page 27 for more information about this configuration.



Horizontal tube/vertical airflow

Use this configuration in vertical airflow ducts. See Page 26 for more information about this configuration.



Horizontal separator

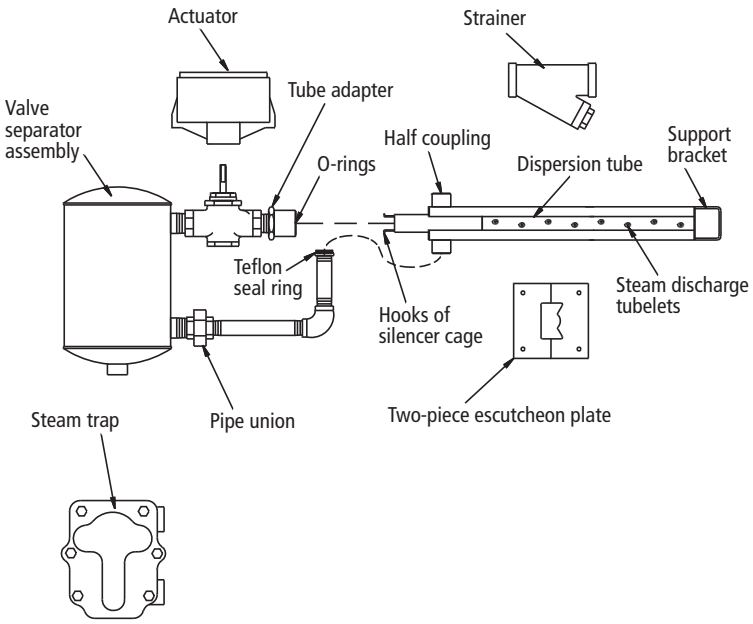
Use a horizontal separator configuration when space is tight, such as when installing above ceilings. Note this application requires a separator designed for horizontal installation. See Page 25 for more information about this configuration.

OM-380, 381, 382, 383

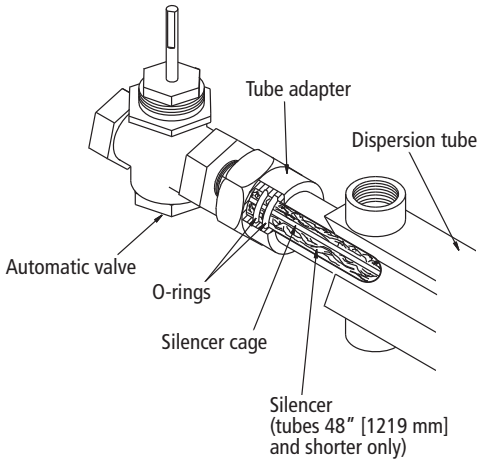
Assembly

Figure 21-1:
Single-tube humidifier field assembly

Single-tube humidifier



Detail: Tube adapter single dispersion tube



OM-7, OM-14

Single-tube humidifier field assembly

Small units are shipped assembled; the following applies to larger units that are disassembled for shipment.

1. Unpack shipment and verify receipt of all components with packing list. Report any shortages at once.
2. Match up dispersion tube with its proper valve-separator assembly (tubes and separators are match-tagged). Tubelets should point against the airflow for better steam-air mixing, except if tubes have fiberglass insulated-jacket option, then tubelets should discharge steam with the airflow to prevent condensation from forming on cool jackets. See the installation examples on the following pages before beginning assembly.
3. Unscrew pipe union, remove elbow and nipple portion, and install in half coupling of tube.
   Note: Before completing Step 3, determine which way (right or left) tubelets should point, and install in appropriate half coupling.
4. Install tube adapter in valve (use pipe dope) and tighten.
5. Lubricate O-rings and install inside tube adapter.
6. Insert tube adapter into dispersion tube. As this is being done, if unit has a silencer, squeeze hooks of silencer cage together and slide them into the tube adapter, allowing them to snap over rear edge of adapter. Complete inserting adapter into tube, being careful not to damage O-rings.
   Note: Unless special-ordered, silencers are furnished only with models 5-60 and 6-70 humidifiers with tubes equal to or shorter than 48" (1219 mm)
7. Tighten pipe union.
8. Thread Teflon seal ring into half coupling.
9. Torque Teflon seal ring to 15 ft-lbs (20.3 N-m).
   Note: Once tightened, do not attempt to re-tighten the Teflon seal, or the seal could be damaged.
10. Install the assembly in the duct. See "Installation" on the next page.

Installation

For more installation information

- See "Humidifier placement" on Pages 6-8 for information about choosing an installation location.
- See the "Pressurized steam piping guidelines" on Pages 10-11.
- See "Temperature switches" on Pages 15-19.
- See the humidifier piping drawings and notes on Pages 23-27.

WARNING!

Mount humidifier per the instructions in this manual and to a structurally stable surface. Improper humidifier mounting can cause the humidifier to fall resulting in severe personal injury or death.

WARNING!

DRI-STEEM strongly recommends installing a duct airflow proving switch and a duct high limit humidistat. These devices prevent the humidifier from making steam when there is no airflow in the duct or when the RH level in the duct is too high. Failure to install these devices can result in excessive moisture in the duct, which can cause bacteria and mold growth or dripping through the duct.

1. Insert a support bolt in one of the support bracket's three holes (upper, lower or end); cut holes in duct for inserting dispersion tube and support bolt.
2. Secure unit in duct with nut and support bolt. Mount two-piece escutcheon plate around tube and secure into duct with sheet metal screws. Where an airtight seal is required, use a suitable caulk around duct wall penetrations.
3. Install steam strainer and steam trap. Connect to steam and condensate return mains. See the drawings on the following pages and text below for detailed piping instructions.
4. Install control tubing (pneumatic) or wiring (electric) to valve actuator.
5. Install an airflow proving switch to prevent the valve from opening unless air is moving in duct. See "Humidifier placement" on Pages 6-8 for location recommendations.
6. Install a duct-mounted high-limit humidistat downstream from the humidifier. Set humidistat at 80-90% RH to prevent condensation forming in duct. Mount this humidistat far enough downstream to ensure that injected steam has been completely absorbed before the humidistat. See "Humidifier placement" on Pages 6-8 for location recommendations.
7. Install a temperature switch to prevent possible cold-start dripping when steam pressure to the humidifier is cycled. See "Temperature switches" on Pages 15-19 for more information.
8. Install the humidistat and/or sensors according to the recommendations on Page 9.

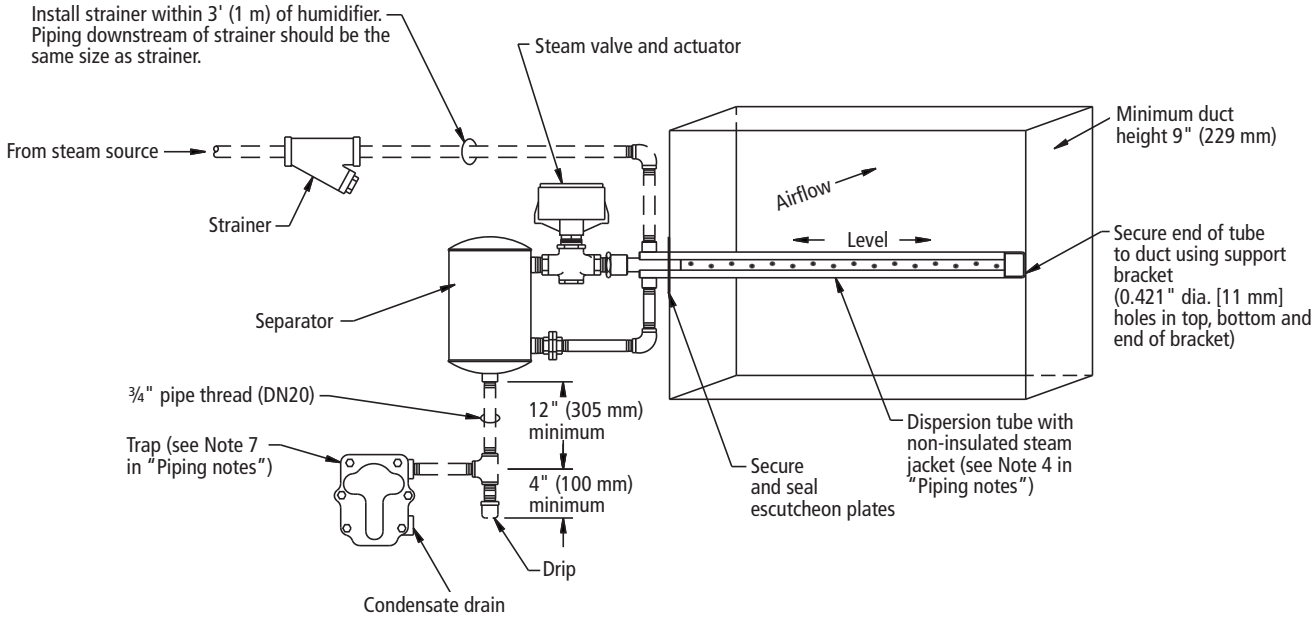
Piping notes

1. Refer to piping drawings on Pages 24-27.
2. To avoid metal fatigue, allow for thermal expansion of dispersion tube.
3. Dashed lines in drawings indicate provided by installer.
4. **When installing in a horizontal airflow**:
   Slightly better mixing, with less visible vapor travel, occurs when discharged steam blows against the airflow rather than with the airflow. Therefore, **when using non-insulated steam jackets in a horizontal airflow** (as shown in the piping drawings on Pages 24-27), position dispersion tubelets (steam orifices) so that they face into the airflow. If the dispersion tube has an insulated jacket, the discharged steam must blow with the airflow to avoid condensation that may occur when discharged steam contacts the cooler insulated jacket. Therefore, **when using insulated steam jackets in a horizontal airflow,** position dispersion tubelets so that they discharge steam with the airflow, and also add 24" (610 mm) to the non-wetting absorption distance.
5. **When installing in a vertical airflow:**
   Always position tubelets (steam orifices) pointing up when installing in a vertical airflow.
   Important: If steam jackets are insulated, install only in a vertical up flow application and add 24" (610 mm) to the non-wetting absorption distance. **Do not install insulated jackets in a vertical downflow application.**
6. For horizontal tube installations, center tube within duct height. For vertical tube installations, center tube within duct width.
7. If steam pressure is less than or equal to 15 psi (103.4 kPa), use a float and thermostatic (F&T) trap for the humidifier. If steam pressure is greater than 15 psi (103.4 kPa), use an inverted bucket trap for the humidifier. If lifting condensate, use an inverted bucket trap regardless of steam pressure.
8. See also the "Pressurized steam piping guidelines" on Pages 10-11.

Field piping

Figure 24-1:
Field piping overview: Horizontal dispersion tube installed in a horizontal airflow

Elevation view



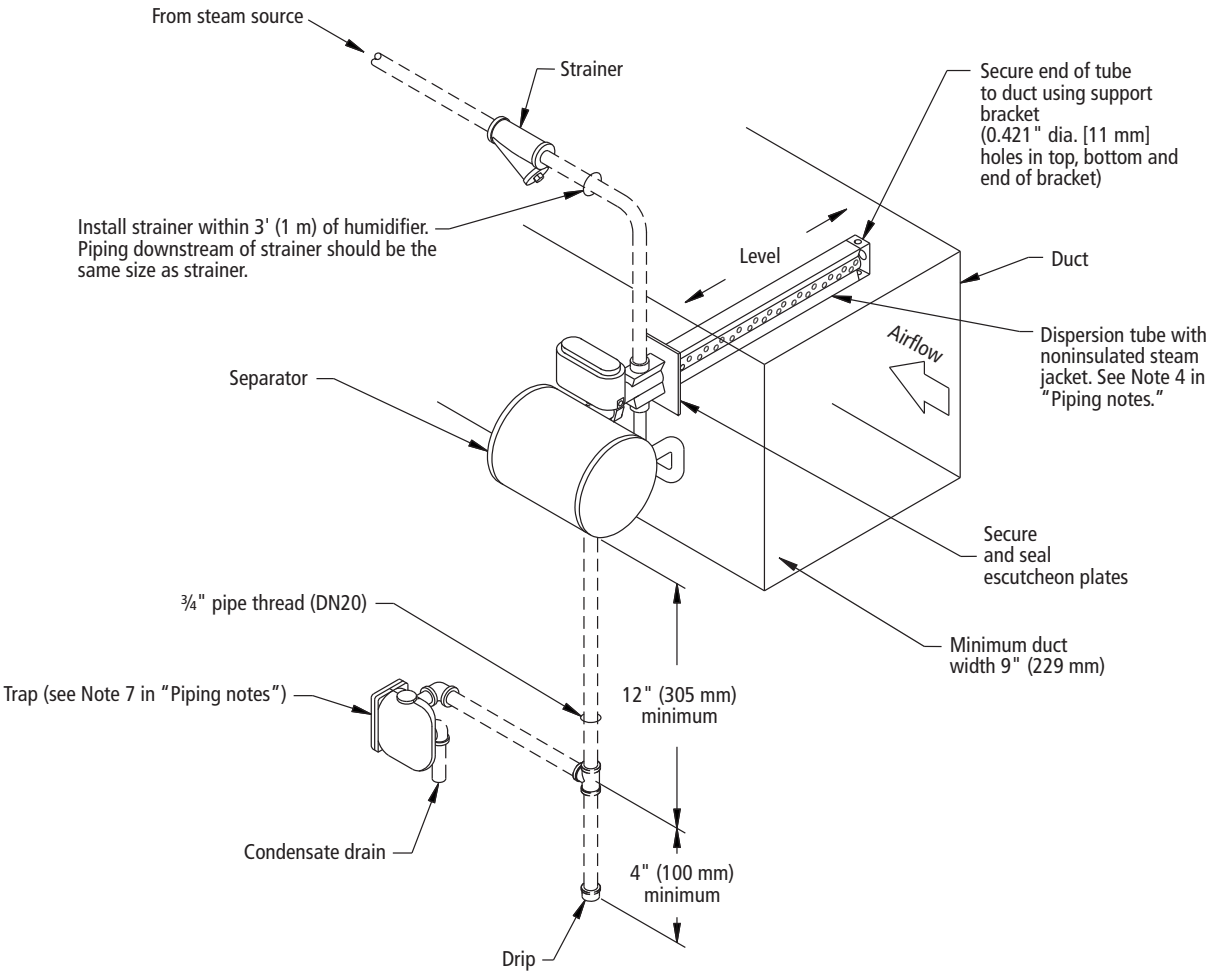
Note:
See "Piping notes" on Page 23.

DC-1065M

Field piping

Figure 25-1:
Field piping overview: Horizontal dispersion tube with a horizontal separator installed in a horizontal airflow

Elevation view



Note:
See "Piping notes" on Page 23.

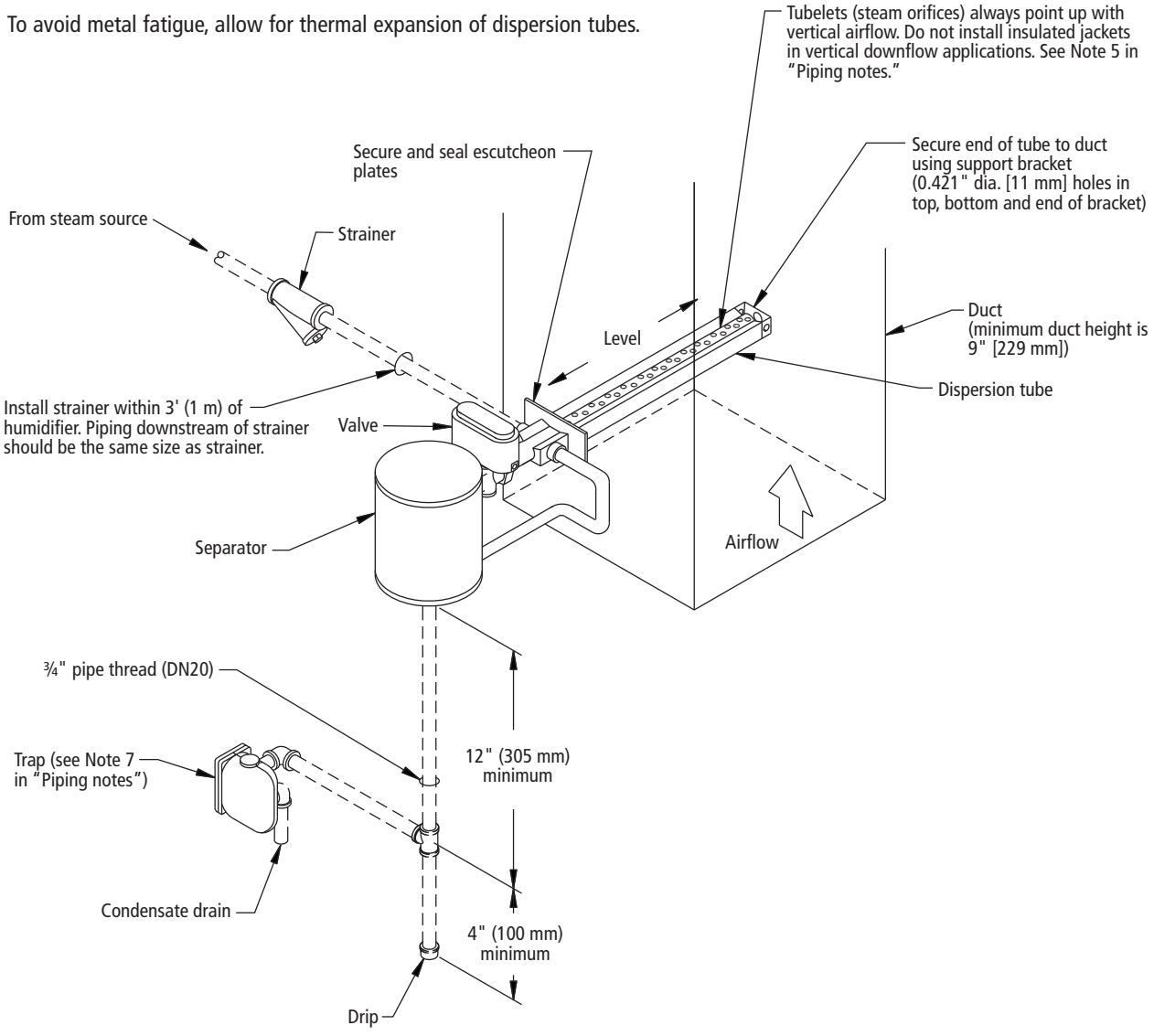
DC-1066M

Field piping

Figure 26-1:
Field piping overview: Horizontal dispersion tube installed in a vertical airflow

Elevation view

- To avoid metal fatigue, allow for thermal expansion of dispersion tubes.



Note:
See "Piping notes" on Page 23.

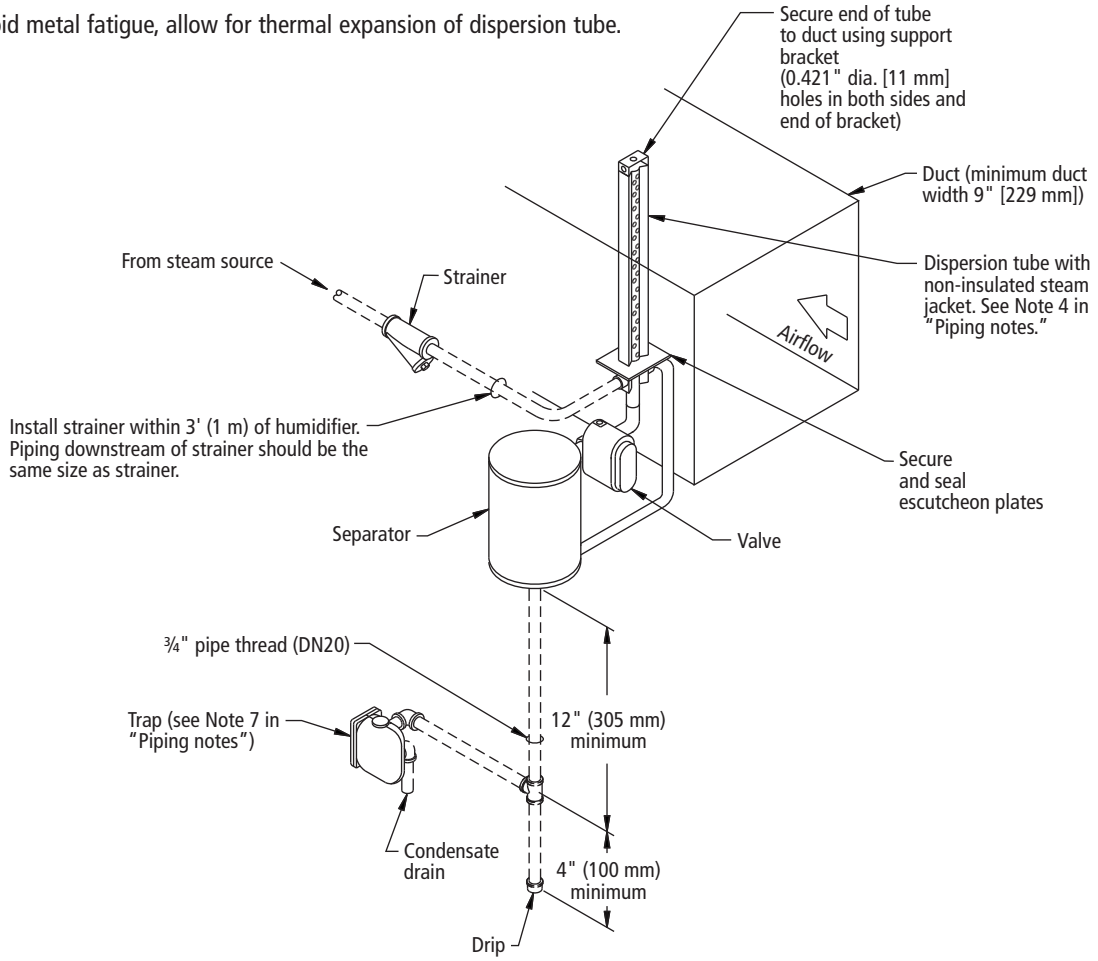
DC-1067

Field piping

Figure 27-1:
Field piping overview: Vertical dispersion tube installed in a horizontal airflow

Elevation view

- To avoid metal fatigue, allow for thermal expansion of dispersion tube.

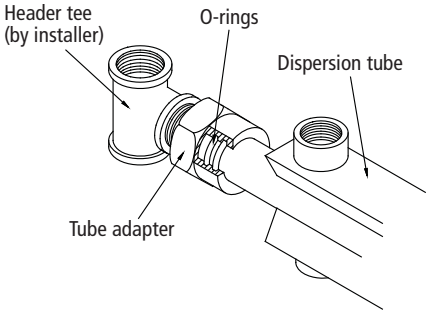


Note:
See "Piping notes" on Page 23.

DC-1068

Field assembly

Figure 28-1:
Tube adapter for Multiple-tube humidifiers



OM-15

Use the tube adapter to connect a non-threaded tube to a threaded pipe fitting.

Table 28-1:
Header sizing

Total capacity		Header size	
lbs/hr	kg/h	inches	DN
up to 280	up to 127	1.5*	38*
281 to 490	128 to 222	2	50
491 to 980	223 to 444	3	80
981 to 1743	445 to 790	4	100
1744 to 2752	791 to 1248	5	125
2753 to 3989	1249 to 1809	6	150

* Multiple-tube only

1. Unpack shipment and verify receipt of all components with packing list. Report any shortages at once.
2. Plan the tube bank. You will need to know the required spacing distance between tubes. If this information has not been provided, see note "For X" in Table 29-1 on Page 29. Arrange tubes so steam will discharge against the airflow, unless tubes are insulated (optional), in which case they should blow with the air to prevent condensation on metal jacket covering insulation.
3. Assemble the header based on the spacings determined in Step 2 above. If the header pipe size has not been specified, see Table 28-1. This table is based on a maximum steam velocity of 7,000 to 10,000 feet per minute (36 to 51 m/s), which will result in lower noise levels and produce uniform steam flow from all tubes. If noise level is not important or a uniform flow is not critical, a smaller header size may be used.
4. Install the tube adapter fittings in the header tees. (See Figure 28-1.) It usually works best to lay the header on the floor along with the tubes for the following steps 5, 6 and 7.
5. Install male pipe thread end of tube adapter into pipe fitting. Dope threads and tighten leak tight sealer.
6. O-rings are installed inside of tube adapter.
   Note: Use synthetic oil to lubricate O-rings before installing.
7. Insert tube adapter into dispersion tube. As this is being done, if unit has a silencer, squeeze hooks of silencer cage together and slide them into the tube adapter, allowing them to snap over rear edge of adapter. Complete inserting adapter into tube, being careful not to damage O-rings.
   Note: Unless special-ordered, silencers are furnished only with models 5-60 and 6-70 humidifiers having tubes equal to and shorter than 48" (1219 mm).
8. Slide tube into adapter being careful not to damage the O-rings.
9. Install the tubes in the adapter fittings, making sure the tubelets are pointing in the proper direction.
10. Cut to length, thread, and install the steam jacket piping.
11. Make the tube support strut using angle or channel iron, and bolt each tube end in place.

Installation

1. Insert a support bolt in one of the three holes (upper, lower or end) of the support brackets; cut holes in duct for inserting dispersion tube and support bolt.
2. Secure unit in duct with nuts and support bolts. Mount two-piece escutcheon plate around each tube and secure into duct with sheet metal screws. Where an airtight seal is required, use a suitable caulk around duct wall penetrations.
3. Install steam strainer and steam trap. Connect to steam and condensate return mains. See the drawings on the following pages and text on the next for detailed piping instructions.
4. Install control tubing (pneumatic) or wiring (electric) to valve actuator.
5. Install an airflow proving switch to prevent the valve from opening unless air is moving in duct. See "Humidifier placement" on Pages 6-8 for location recommendations.
6. Install a duct-mounted high-limit humidistat downstream from the humidifier. Set humidistat at 80-90% RH to prevent condensation forming in duct. Mount this humidistat far enough downstream to ensure that injected steam has been completely absorbed before the humidistat. See "Humidifier placement" on Pages 6-8 for location recommendations.
7. Install a temperature switch to prevent possible cold-start dripping when steam pressure to the humidifier is cycled. See "Temperature switches" on Pages 15-19 for more information.
8. Install the humidistat and/or sensors according to the recommendations on Page 9.

Table 29-1:
Minimum tube spacing distance, center to center (X)*

Dispersion tube model	Multiple dispersion tubes (standard)		Multiple dispersion tubes (Clean-steem™)	
	"X"		"X"	
	inches	mm	inches	mm
Series 60	6	152	8	203
Series 70	7	178	9	229
Series 80	9	229	12	305

Note:
* See Multiple-tube drawings on the following pages for X.

For more installation information

- See "Humidifier placement" on Pages 6-8 for information about choosing an installation location.
- See the "Pressurized steam piping guidelines" on Pages 10-11.
- See "Temperature switches" on Pages 15-19.
- See the Multiple-tube humidifier piping drawings and notes on Pages 30-35.

WARNING!

Mount humidifier per the instructions in this manual and to a structurally stable surface. Improper humidifier mounting can cause the humidifier to fall resulting in severe personal injury or death.

WARNING!

DRI-STEEM strongly recommends installing a duct airflow proving switch and a duct high limit humidistat. These devices prevent the humidifier from making steam when there is no airflow in the duct or when the RH level in the duct is too high. Failure to install these devices can result in excessive moisture in the duct, which can cause bacteria and mold growth or dripping through the duct.

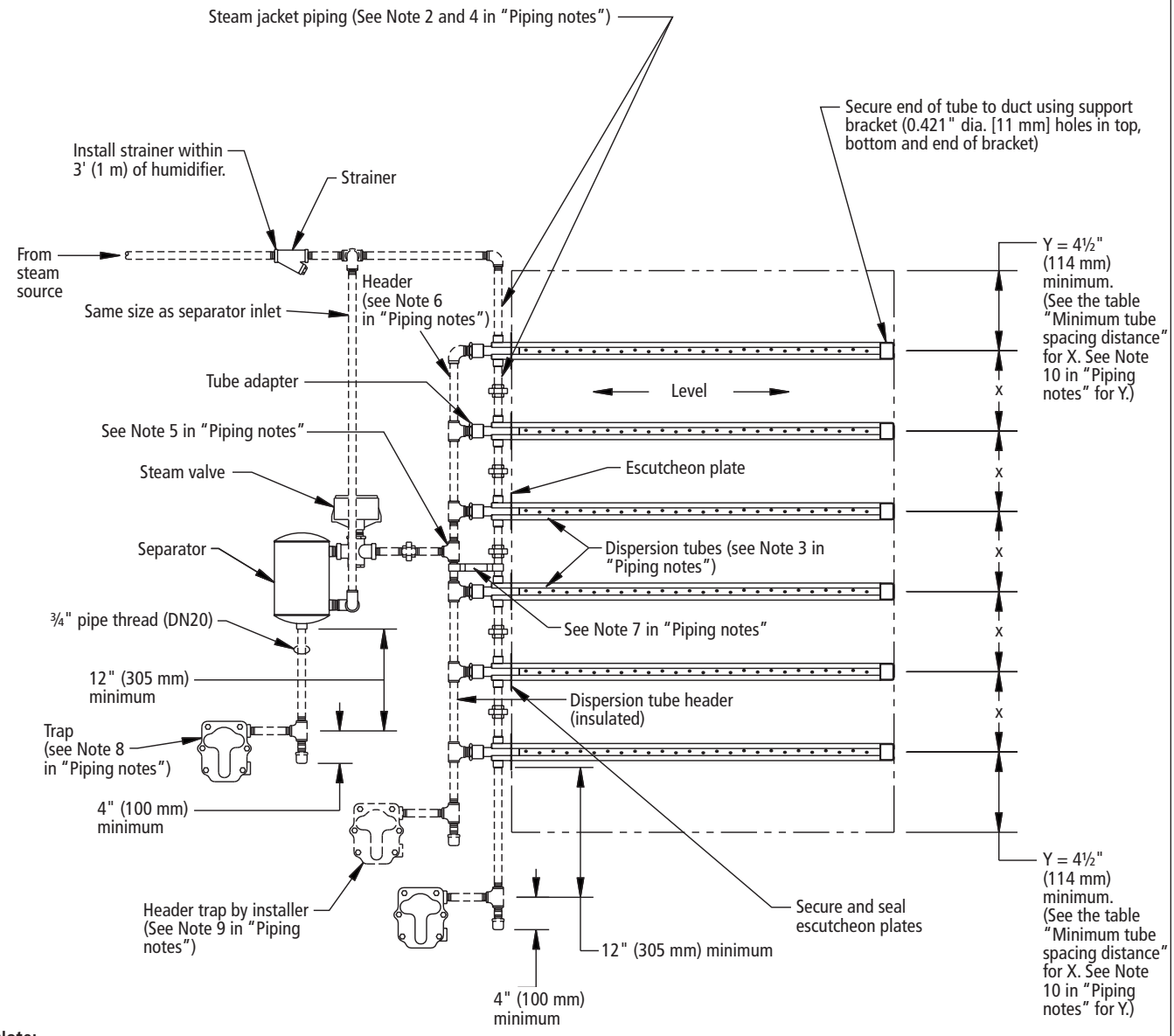
Piping notes

1. Refer to piping drawings on Pages 31-35.
2. Dashed lines on drawings indicate provided by installer.
3. Slightly better mixing, with less visible vapor travel, occurs when discharged steam blows against the airflow rather than with the airflow. Therefore, **when using non-insulated steam jackets in a horizontal airflow** (as shown in the drawings), position dispersion tubelets (steam orifices) so that they face into the airflow. If the dispersion tube has an insulated jacket, the discharged steam must blow with the airflow to avoid condensation that may occur when discharged steam contacts the cooler insulated jacket. Therefore, **when using insulated steam jackets in a horizontal airflow**, position dispersion tubelets so that they discharge steam with the airflow, and also add 24" (610 mm) to the non-wetting absorption distance.
4. Jacket piping size:
   - ½" pipe thread (DN15) for Series 60 tube(s)
   - ¾" pipe thread (DN20) for Series 70 tube(s)
   - 1½" pipe thread (DN40) for Series 80 tube(s)
5. To ensure uniform output from each tube, connect steam supply as near to the middle of the header as possible, but not in direct alignment with a dispersion tube.
6. See the header sizing table on Page 28.
7. After the unit is installed, secure steam jacket piping to the tube header.
8. If steam pressure is less than or equal to 15 psi (103.4 kPa), use float and thermostatic (F&T) traps for the humidifier. If steam pressure is greater than 15 psi (103.4 kPa), use inverted bucket traps for the humidifier. If lifting condensate, use an inverted bucket trap regardless of steam pressure.
9. The header trap is required to collect condensate from the header assembly, but because of the pressure drop across the valve, the steam pressure at the header trap is minimal; therefore, you cannot lift condensate by steam pressure from this trap.
10. X = distance between tubes, center to center
    Y = clearance at top and bottom = at least ½ X or 4½" (114 mm), whichever is greater, but not greater than X
    See the minimum tube spacing table on Page 29.
11. See also the "Pressurized steam piping guidelines" on Pages 10-11.
12. **When installing in a vertical airflow:**
    Always position tubelets (steam orifices) pointing up when installing in a vertical airflow.
    Important: If steam jackets are insulated, install only in a vertical up flow application and add 24" (610 mm) to the non-wetting absorption distance. Do no install insulated jackets in a vertical downflow application.

Field piping

Figure 31-1:
Field piping overview: Multiple dispersion tubes with total tube length less than or equal to 45' (13.7 m)

Elevation view



Note:
See "Piping notes" on Page 30.

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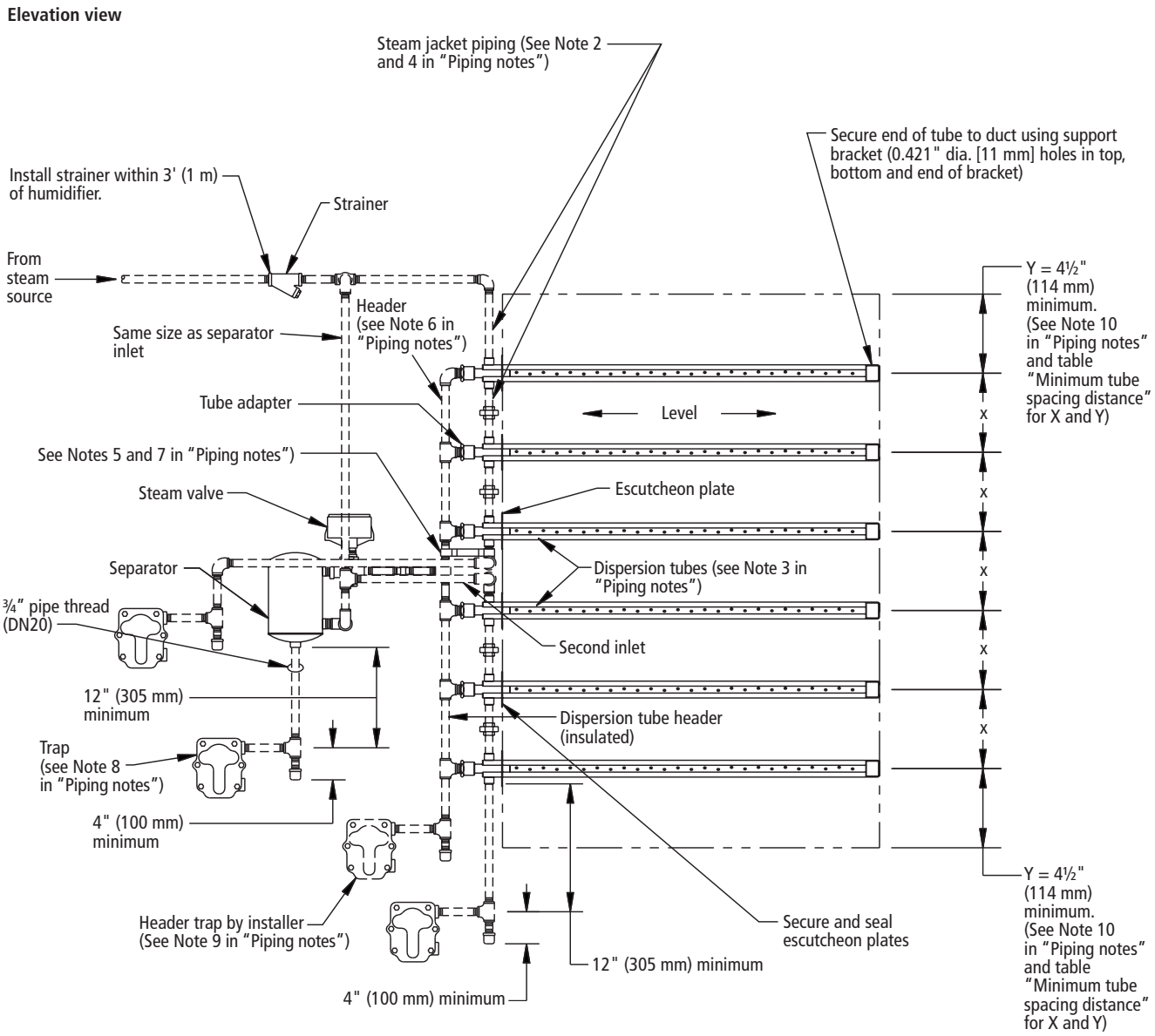
Field piping

Figure 32-1:
Field piping overview: Multiple dispersion tubes with total tube length greater than 45' (13.7 m)



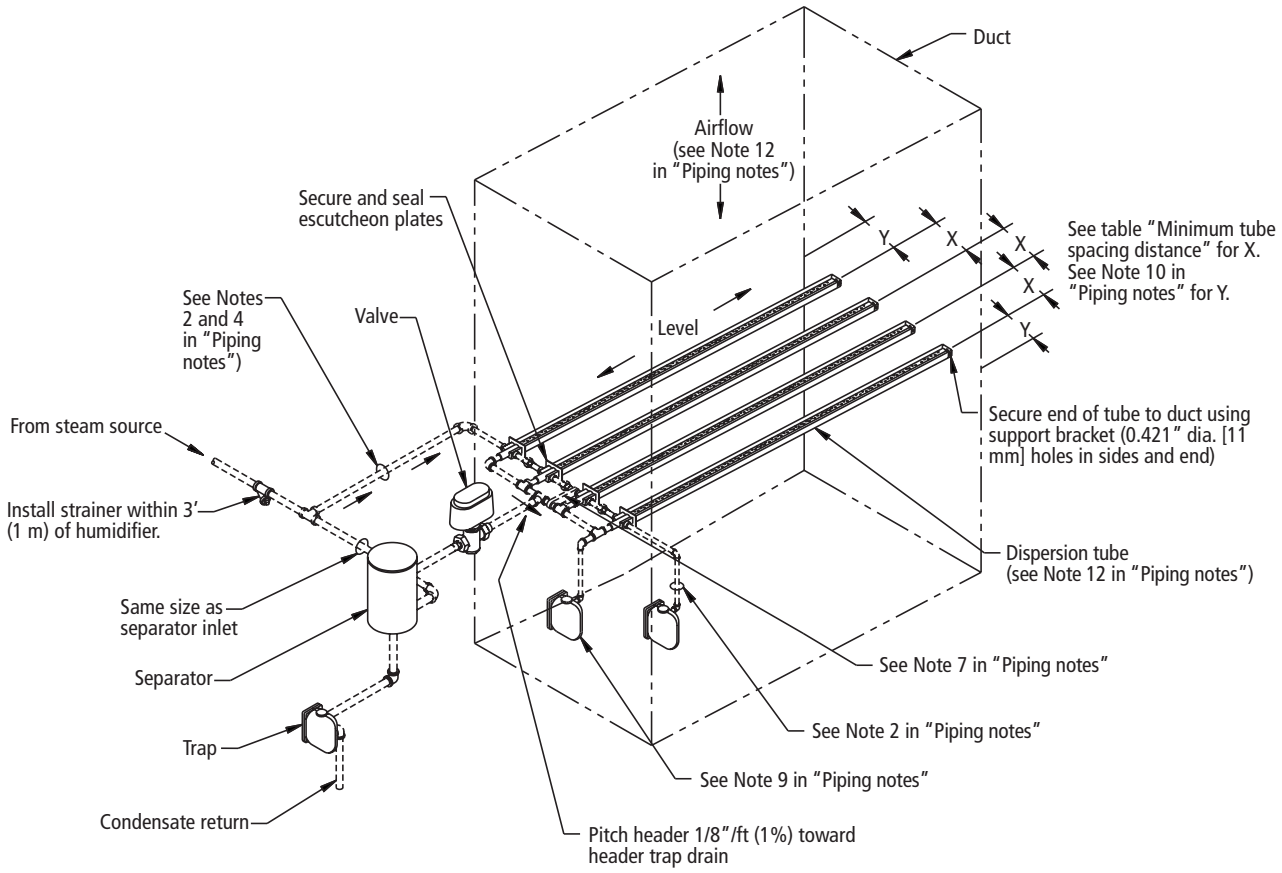
Note:
See "Piping notes" on Page 30.

DC-1071

Field piping

Figure 33-1:
Field piping overview: Multiple-tube humidifier installed in a duct vertical airflow

Elevation view

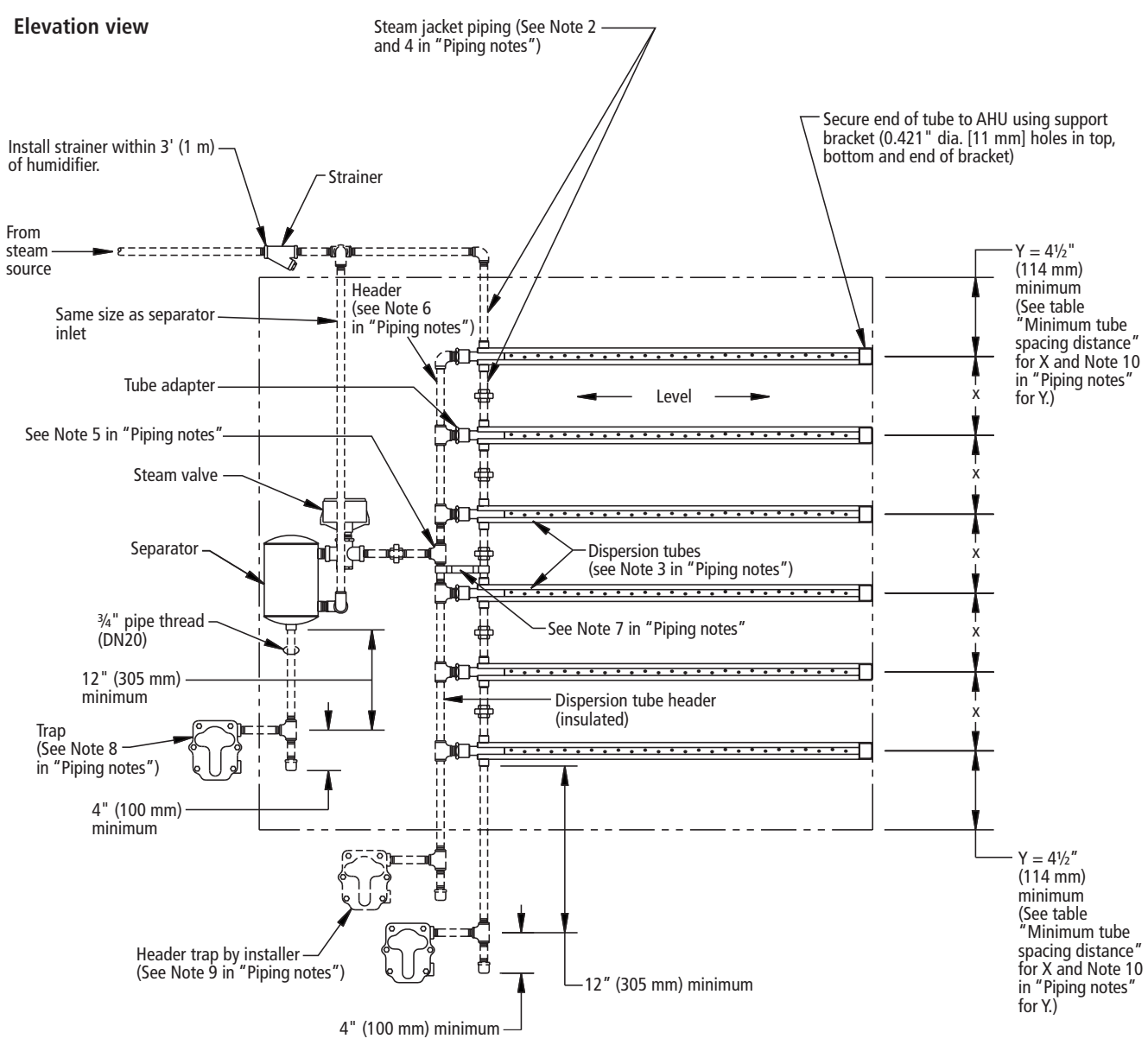


Note:
See "Piping notes" on Page 30.

DC-1074

Field piping

Figure 34-1:
Field piping overview: Multiple-tube humidifier with total tube length less than or equal to 45' (13.7 m) in AHU

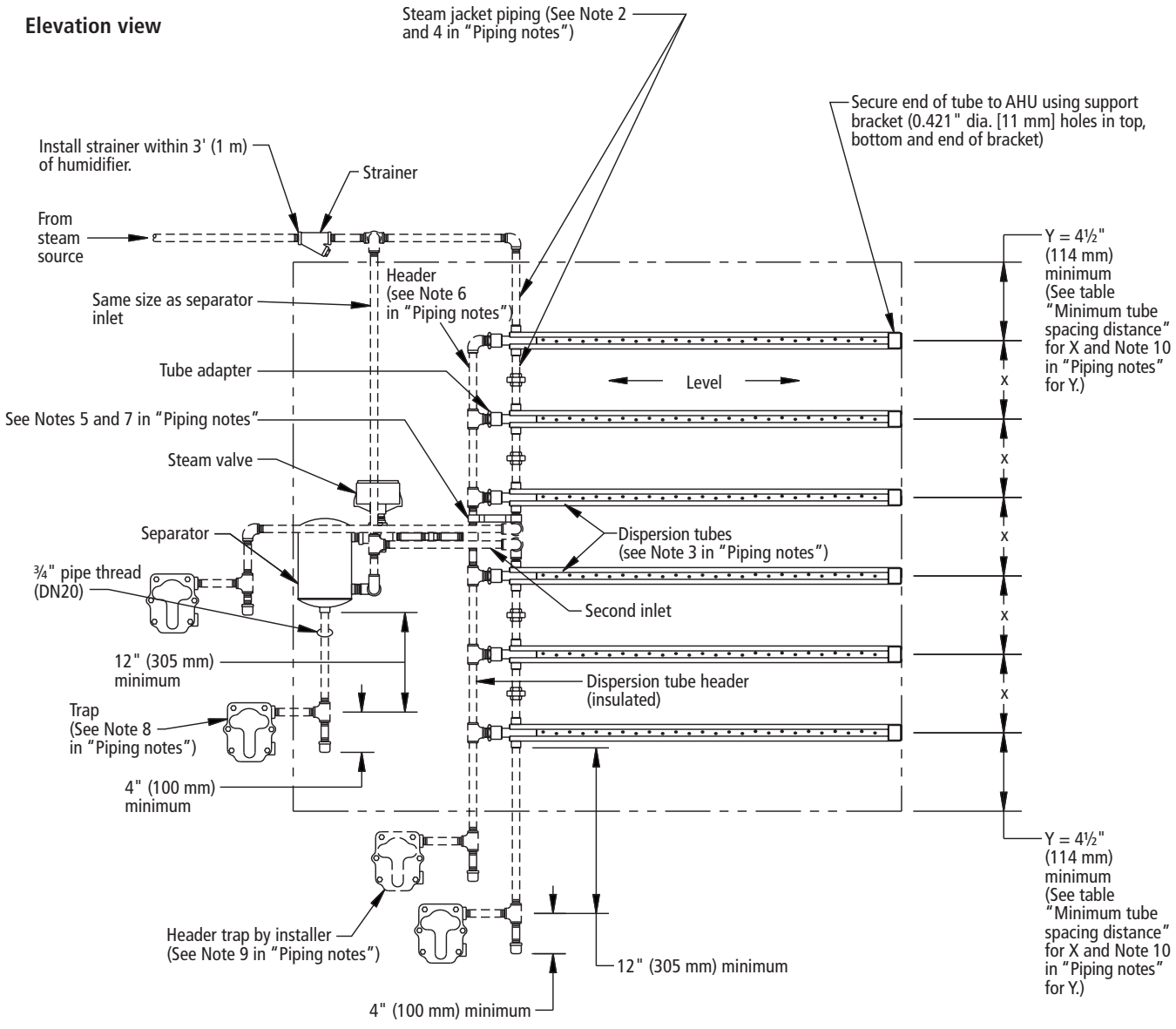


Note:
See "Piping notes" on Page 30.

DC-1204

Field piping

Figure 35-1:
Field piping overview: Multiple-tube humidifier with total tube length greater than 45' (13.7 m) in AHU



Note:
See "Piping notes" on Page 30.

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Installation

For more installation information

- See the "Product overview" section on Pages 2-15.
- See "Humidifier placement" on Pages 6-8 for information about choosing an installation location.
- See the "Pressurized steam piping guidelines" on Pages 10-11.
- See "Temperature switches" on Pages 15-19.
- See the Maxi-bank humidifier piping drawings and notes on Pages 38-44.

WARNING!

Mount humidifier per the instructions in this manual and to a structurally stable surface. Improper humidifier mounting can cause the humidifier to fall resulting in severe personal injury or death.

WARNING!

DRI-STEEM strongly recommends installing a duct airflow proving switch and a duct high limit humidistat. These devices prevent the humidifier from making steam when there is no airflow in the duct or when the RH level in the duct is too high. Failure to install these devices can result in excessive moisture in the duct, which can cause bacteria and mold growth or dripping through the duct.

Assembly and installation

The Maxi-bank humidifier's header piping and steam-jacket piping are provided by DRI-STEEM. The Maxi-bank is factory assembled and shipped intact, except for larger units that are broken down for shipment.

1. Unpack shipment and verify receipt of all Maxi-bank components with packing list. Report any shortages at once.
2. To simplify installation, we recommend that dispersion tubes be attached to the Maxi-bank header before dispersion tubes and header are installed in a duct or air handler.
3. Follow the pre-tagged component lettering and match up dispersion tubes (or tube sections) to their proper location on the Maxi-bank header.
4. Install each dispersion tube into its appropriate tube adapter on the header, being sure to lubricate O-rings in the tube adapters.
5. Proceed with the additional tubes. Bring the jacketed union halves together and secure unions by hand.
   Note: When the total length of dispersion tubes exceeds 45 feet (13.7 m), we recommend installing a second steam inlet to the dispersion tubes and a second jacket steam trap, as shown in Figure 41-1 and Figure 43-1.
6. When all the dispersion tubes are assembled, place the tube assembly into the duct or air handler, securing the assembly and tube ends to the duct or a fabricated structure. Install tubes level.
7. Position and secure header, then tighten interconnecting tube jacket unions. When installing into a duct, use the two-piece escutcheon plates around each tube and secure to duct with sheet metal screws. In duct applications where air tightness is required, seal around tube and bolts with suitable caulk.

More on next page ►

Installation

8. Locate and install separator/valve assembly to Maxi-bank mating union on header and tighten union.
9. Install strainer and necessary steam traps. Connect assembly to steam and condensate mains.
10. Install control tubing (pneumatic) or wiring (electric) to valve actuator.
11. Install an airflow proving switch to prevent the valve from opening unless air is moving in duct. See "Humidifier placement" on Pages 6-8 for location recommendations.
12. Install a duct-mounted high-limit humidistat downstream from the humidifier. Set humidistat at 80-90% RH to prevent condensation forming in the duct. Mount this humidistat far enough downstream to ensure that injected steam has been completely absorbed before the humidistat. See "Humidifier placement" on Pages 6-8 for location recommendations.
13. Install a temperature switch to prevent possible cold-start dripping when steam pressure to the humidifier is cycled. See "Temperature switches" on Pages 15-19 for more information.
14. Install the humidistat and/or sensors according to the recommendations on Page 9.
15. Pressure test system and secure fittings as necessary.

Piping notes

1. Refer to piping drawings on Pages 40-44.
2. Dashed lines in drawings indicate provided by installer.
3. Maxi-bank tube assemblies with total dispersion tube length equalling more than 45' (13.7 m) require a separate jacket inlet and separate jacket trap. Divide the tubes into equal groups.
4. **When installing in a horizontal airflow:**
   Slightly better mixing, with less visible vapor travel, occurs when discharged steam blows against the airflow rather than with the airflow. Therefore, **when using non-insulated steam jackets in a horizontal airflow** (as shown in the drawings on Pages 40-43), position dispersion tubelets (steam orifices) so that they face into the airflow. If the dispersion tube has an insulated jacket, the discharged steam must blow with the airflow to avoid condensation that may occur when discharged steam contacts the cooler insulated jacket. Therefore, **when using insulated steam jackets in a horizontal airflow**, position dispersion tubelets so that they discharge steam with the airflow, and also add 24" (610 mm) to the non-wetting absorption distance.
5. **When installing in a vertical airflow:**
   Always position tubelets (steam orifices) up with vertical airflow.
   Important: If steam jackets are insulated, install only in a vertical upflow application, and add 24" (610 mm) to the non-wetting absorption distance. **Do not install insulated jackets in a vertical downflow application.**

More on the next page ►

Table 38-1:
Minimum tube spacing distance, center to center (X)*

Dispersion tube model	Multiple dispersion tubes (standard)		Multiple dispersion tubes (Clean-steem™)	
	"X"		"X"	
	inches	mm	inches	mm
Series 60	6	152	8	203
Series 70	7	178	9	229
Series 80	9	229	12	305

Note:
* See Maxi-bank drawings on the following pages for X.

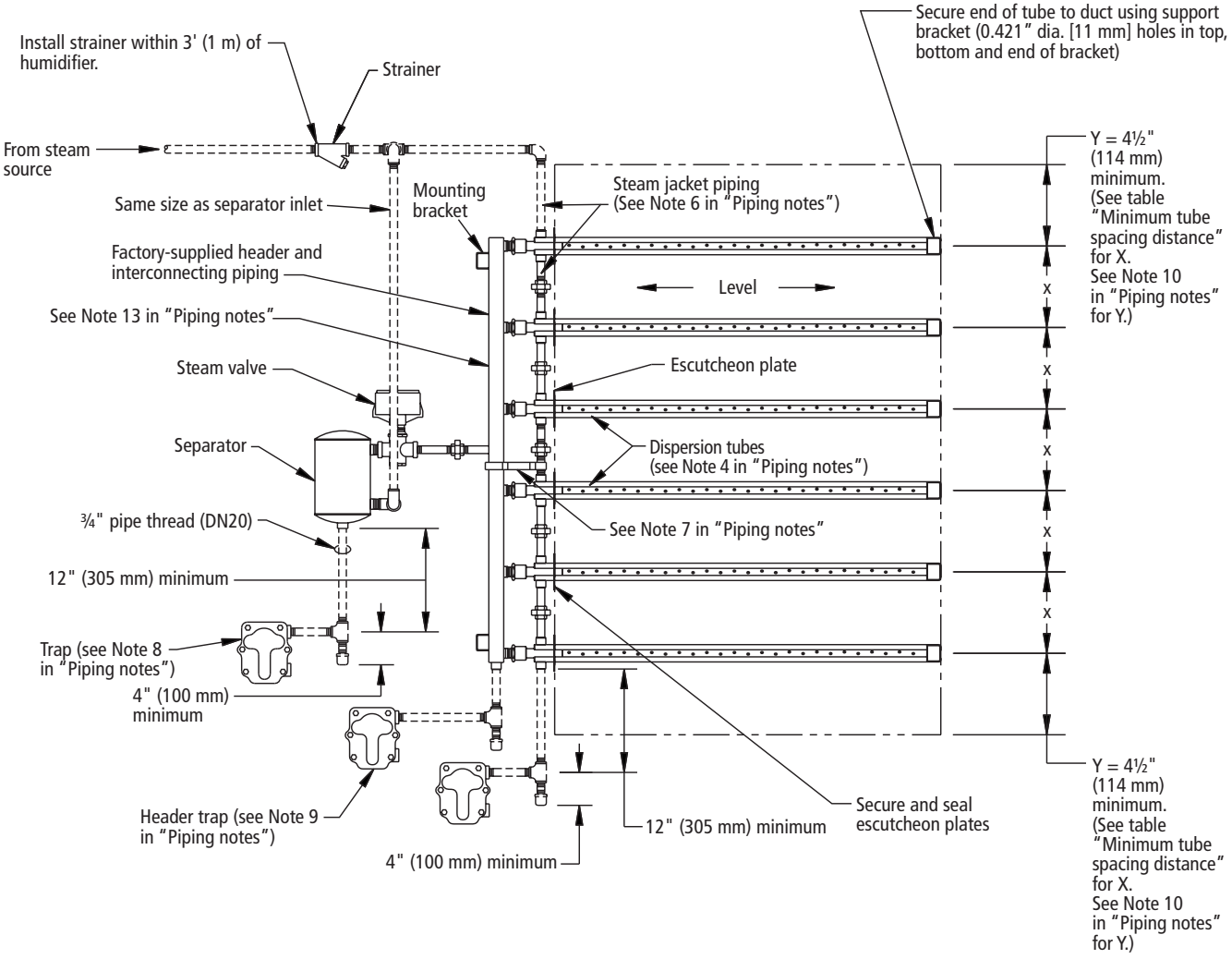
Piping notes

6. Jacket piping size:
   ½" pipe thread (DN15) for Series 60 tube(s)
   ¾" pipe thread (DN20) for Series 70 tube(s)
   1½" pipe thread (DN40) for Series 80 tube(s)
7. After the unit is installed, secure steam jacket piping to the tube header.
8. If steam pressure is less than or equal to 15 psi (103.4 kPa), use float and thermostatic (F&T) traps for the humidifier.
   If steam pressure is greater than 15 psi (103.4 kPa), use inverted bucket traps for the humidifier.
   If lifting condensate, use an inverted bucket trap regardless of steam pressure.
9. The header trap is required to collect condensate from the header assembly. Due to the pressure drop across the valve, the steam pressure at the header trap is minimal; therefore, you cannot lift condensate by steam pressure, or return condensate to a pressurized return, from this trap. On small headers (2" or less in diameter), this trap may be ommitted.
10. X = distance between tubes, center to center
    Y = clearance at top and bottom = at least ½ X or 4½" (114.3 mm), whichever is greater, but not greater than X
    See the "Minimum tube spacing distance" table on Page 38.
11. See "Pressurized steam piping guidelines" on Pages 10-11.
12. Drawings represent right-hand discharge.
13. Refer to "Header sizing" table on Page 28.

Field piping

Figure 40-1:
Field piping overview: Maxi-bank humidifier in a duct horizontal airflow, total tube length less than or equal to 45' (13.7 m)

Elevation view



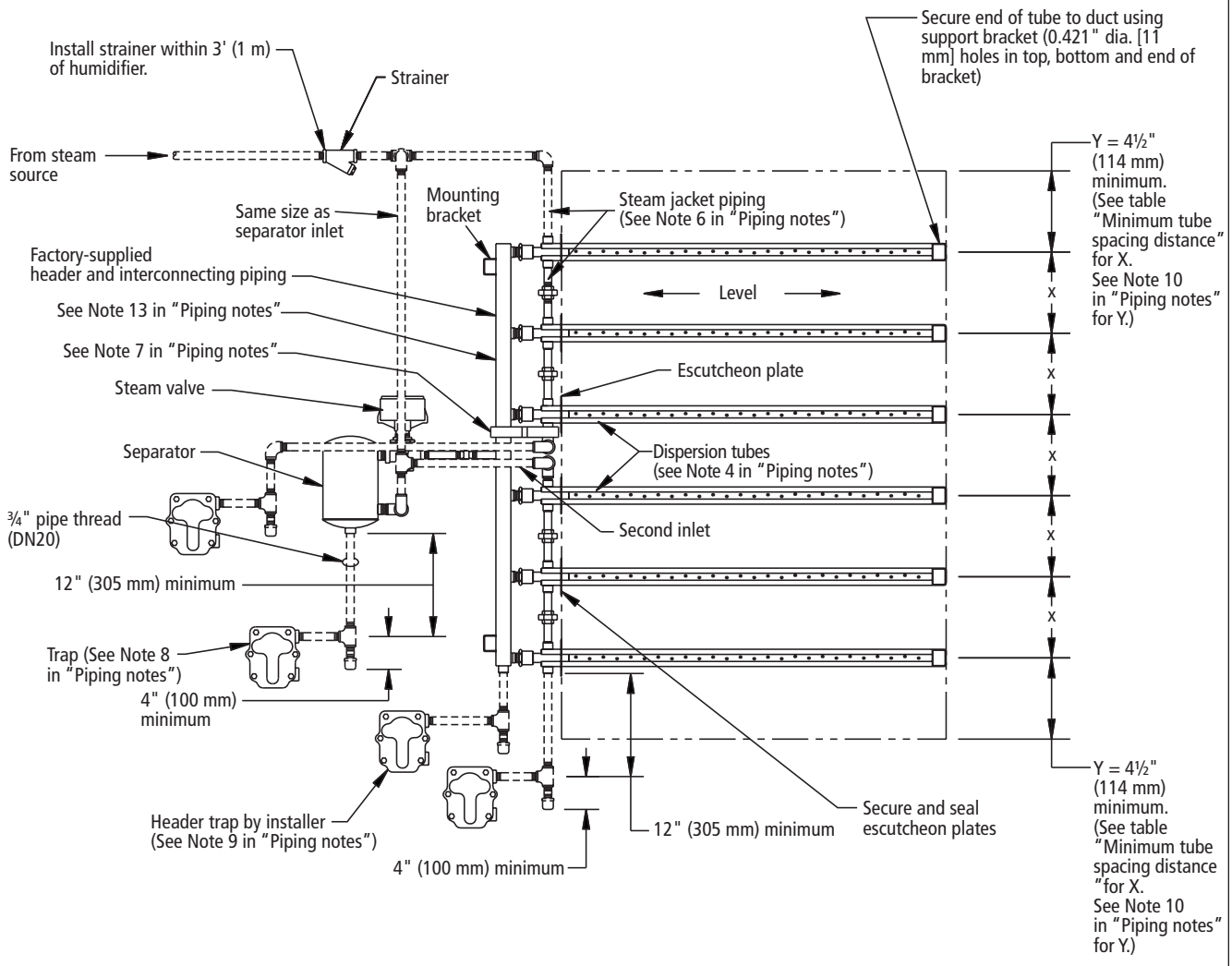
Note:
See "Piping notes" on Pages 38-39.

DC-1072

Field piping

Figure 41-1:
Field piping overview: Maxi-bank humidifier in a duct horizontal airflow, total tube length greater than 45' (13.7 m)

Elevation view



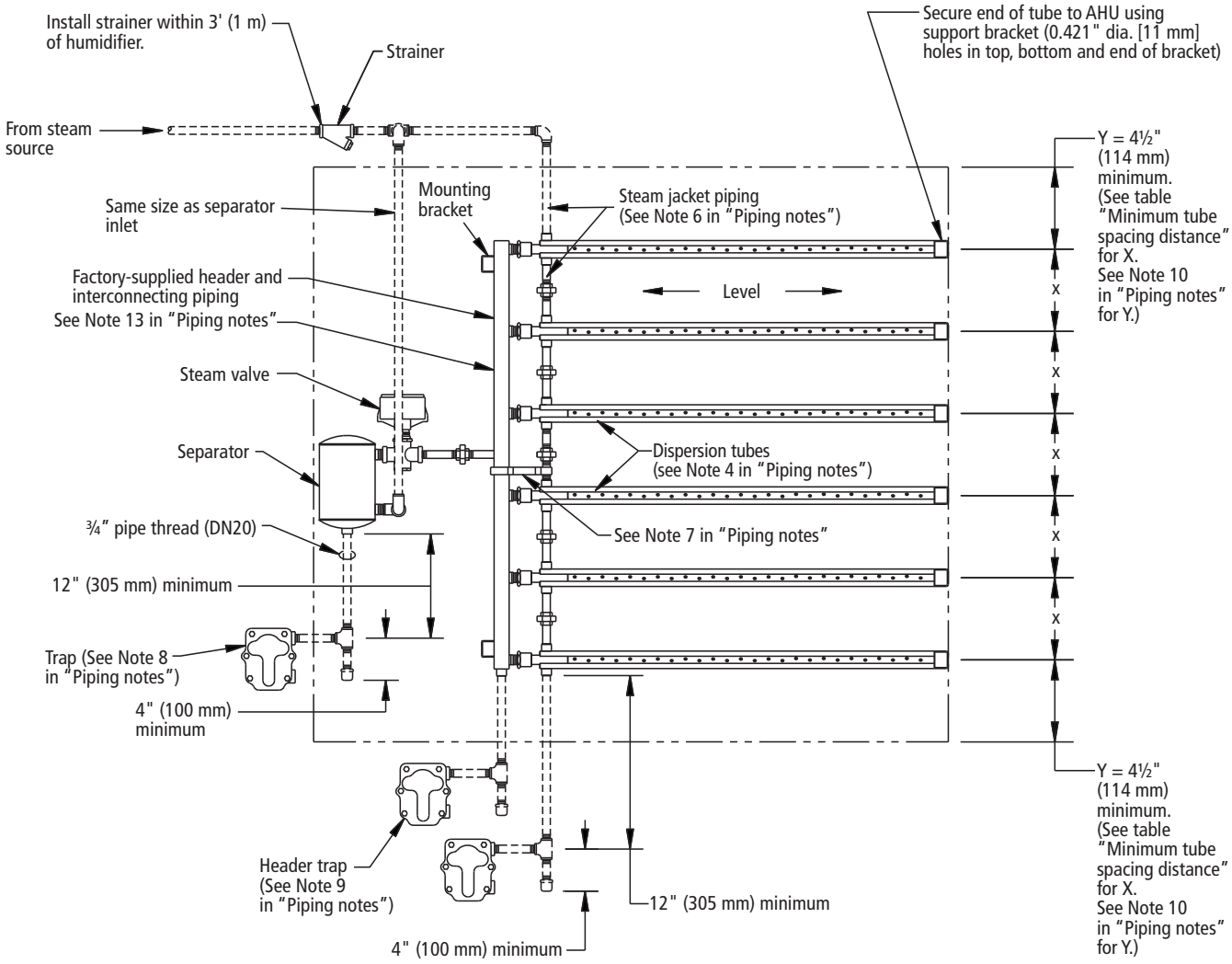
Note:
See "Piping notes" on Pages 38-39.

DC-1073

Field piping

Figure 42-1:
Field piping overview: Maxi-bank humidifier in an AHU horizontal airflow, total tube length less than or equal to 45' (13.7 m)

Elevation view

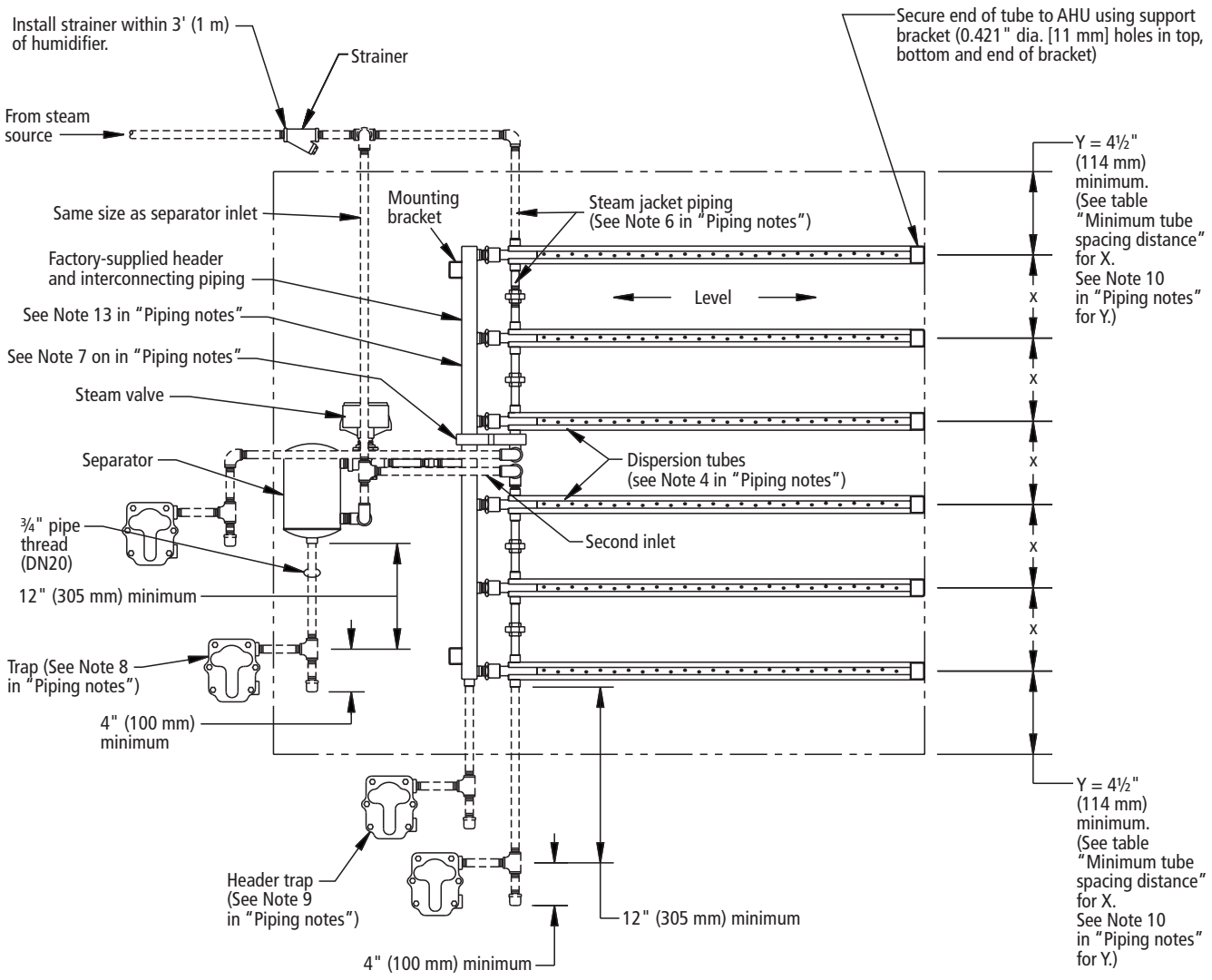


Note:
See "Piping notes" on Pages 38-39.

DC-1207

Field piping

Figure 43-1:
Field piping overview: Maxi-bank humidifier in an AHU horizontal airflow, total tube length greater than 45' (13.7 m)

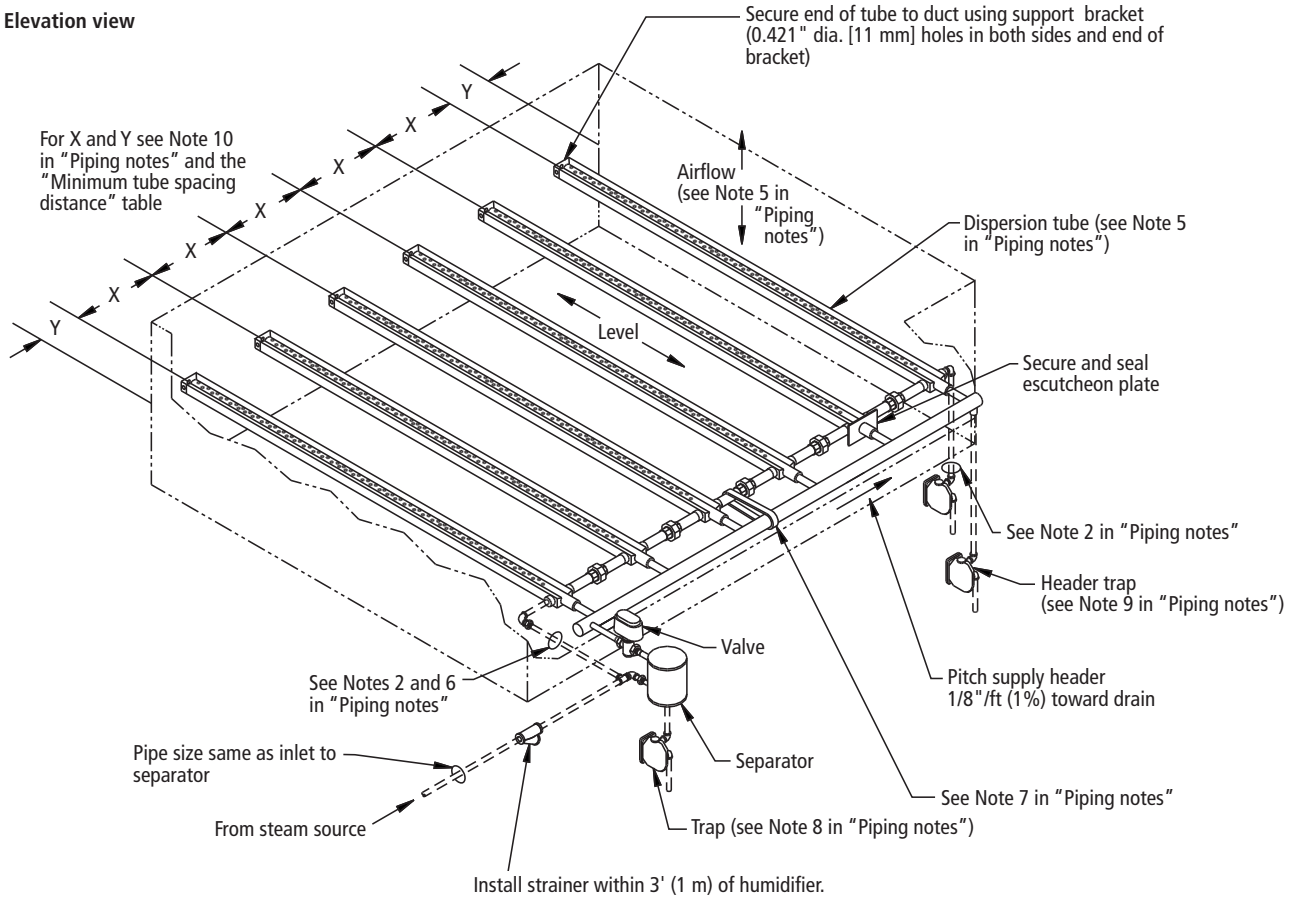


Note:
See "Piping notes" on Pages 38-39.

DC-1208

Field piping

Figure 44-1:
Field piping overview: Maxi-bank humidifier installed in a duct vertical airflow



Note:
See "Piping notes" on Pages 38-39.

DC-1075

Installation

Assembly and installation

The Mini-bank humidifier is a pre-engineered and pre-assembled header/tube assembly with tubes that are always 3" (76.2 mm) on center. The number of tubes depends upon the duct height. For best mixing, the tubes should span at least 90% (preferably 100%) of the duct width.

1. Unpack shipment and verify receipt of all components with packing list. Two F&T traps and one wye strainer are shipped loose for field installation. Report any shortages at once.
2. The Mini-bank can be configured to discharge steam against or with the airflow: Position the tube bank assembly at the desired orientation, slide the tube bank through the opening in the duct wall, join the tube bank assembly to the separator/valve assembly, and tighten the union.
3. Slightly better mixing with less "fog travel" results when the steam blows against the airflow. If the insulated jacket option has been supplied, the steam must blow with the airflow to avoid steam contacting and condensing on the metal jacket.
4. If a field change is necessary, loosen the union, and rotate the tube bank manifold, and tighten the union.
5. Install the Mini-bank humidifier in the duct, positioning the assembly so the tube bank is perpendicular to the top and bottom of the duct and level across the duct. Support the dispersion tube bank out-board end with a No. 10-32 bolt. To secure the Mini-bank escutcheon plate air tight, seal around the plate and fastener with suitable caulk.
6. Install the steam strainer, taking the steam supply to the Mini-bank humidifier off the top of steam main (instead of the side or bottom) to ensure the driest steam. The main should be dripped and trapped. See "Pressurized steam piping guidelines" on Pages 10-11.

More on the next page ►

For more installation information

- See "Humidifier placement" on Pages 6-8 for information about choosing an installation location.
- See the "Pressurized steam piping guidelines" on Pages 10-11.
- See "Temperature switches" on Pages 15-19.
- See the Mini-bank humidifier piping drawings and notes on Pages 46-47.

WARNING!

Mount humidifier per the instructions in this manual and to a structurally stable surface. Improper humidifier mounting can cause the humidifier to fall resulting in severe personal injury or death.

WARNING!

DRI-STEEM strongly recommends installing a duct airflow proving switch and a duct high limit humidistat. These devices prevent the humidifier from making steam when there is no airflow in the duct or when the RH level in the duct is too high. Failure to install these devices can result in excessive moisture in the duct, which can cause bacteria and mold growth or dripping through the duct.

Installation

7. Locate and install the steam traps as necessary. The Mini-bank humidifier steam traps should drain by gravity to return main having little or no back pressure. If condensate cannot drain by gravity, it must be elevated to return main (see Page 11).
8. Install control tubing (pneumatic) or wiring (electric) to valve actuator.
9. Install an airflow proving switch to prevent the valve from opening unless air is moving in duct. See "Humidifier placement" on Pages 6-8 for location recommendations.
10. Install a duct-mounted high-limit humidistat downstream from the humidifier. Set humidistat at 80-90% RH to prevent condensation forming in the duct. Mount this humidistat far enough downstream to ensure that injected steam has been completely absorbed before the humidistat. See "Humidifier placement" on Pages 6-8 for location recommendations.
11. Install a temperature switch to prevent possible cold-start dripping when steam pressure to the humidifier is cycled. See "Temperature switches" on Pages 15-19 for more information.
12. Install the humidistat and/or sensors according to the recommendations on Page 9.

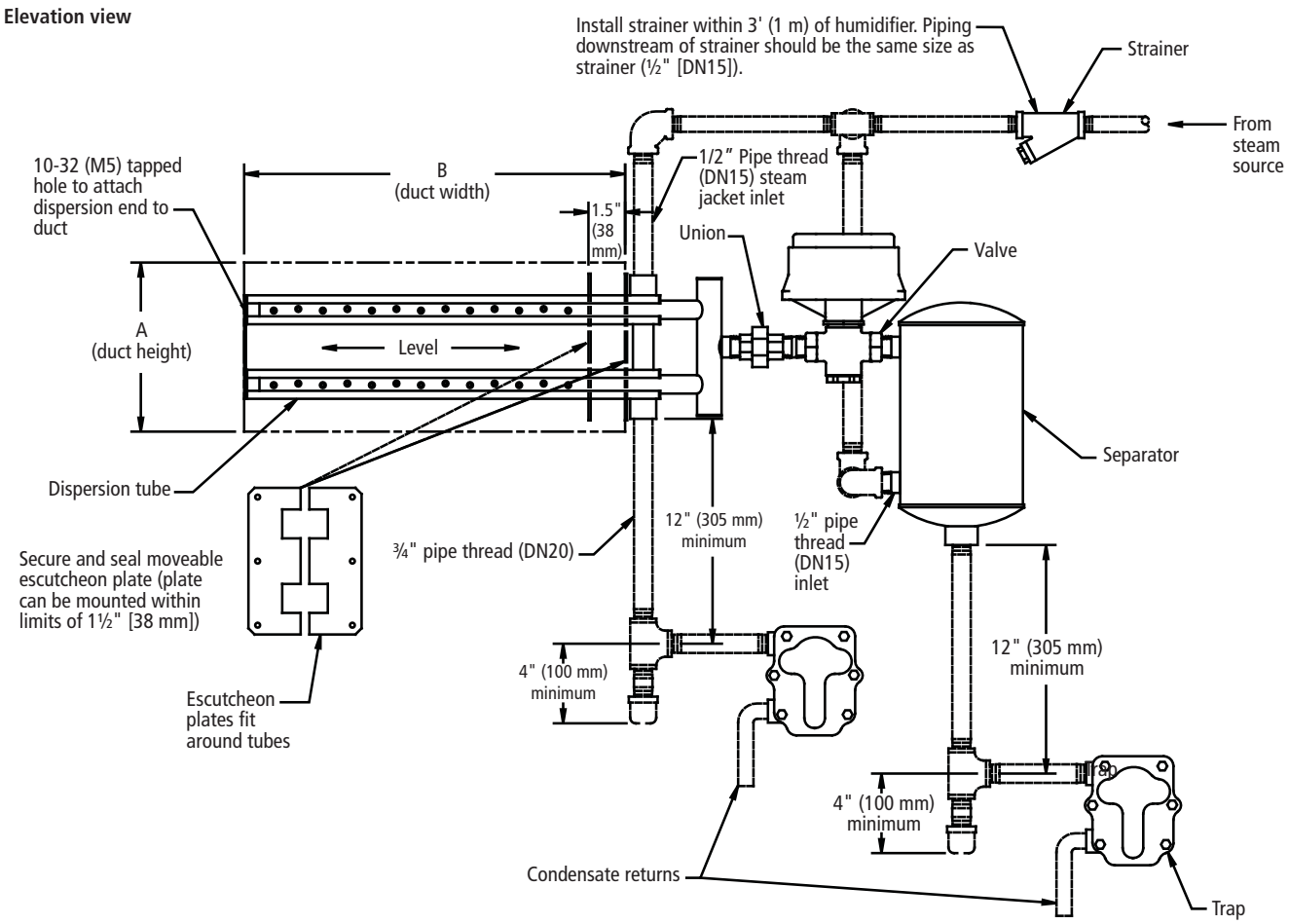
Table 46-1:
Mini-bank humidifier specifications

"A" duct height		Required number of tubes	"B" dispersion tube length	Shipping weights
inches	mm			
6-9	150-230	2	• From 6" to 36" in 2" increments (from 150 mm to 600 mm in 50 mm increments) • Additional lengths: 40" (1014 mm) 44" (1120 mm) 48" (1220 mm) • For ducts larger than 24" × 48" (610 mm × 1220 mm) use Multiple-tube unit	Tubes: 0.3 lbs per tube foot 0.4 kg per tube meter Remaining components (separator, valve, traps, etc.): 8.5 lbs (3.8 kg)
10-12	250-305	3		
13-15	330-380	4		
16-18	405-460	5		
19-21	480-535	6		
22-24	560-610	7		

Note:
See the following page for A and B.

Field piping

Figure 47-1:
Field piping overview: Mini-bank humidifier in a duct horizontal airflow



Notes:

1. To avoid metal fatigue, allow for thermal expansion of dispersion tubes.
2. Dashed lines indicate provided by installer.
3. Drawing represents a left-hand discharge.
4. Slightly better mixing, with less visible vapor travel, occurs when discharged steam blows against the airflow rather than with the airflow. Therefore, **when using non-insulated steam jackets in a horizontal airflow,** position dispersion tubelets (steam orifices) so that they face into the airflow.
   If the dispersion tube has an insulated jacket, the discharged steam must blow with the airflow to avoid condensation that may occur when discharged steam contacts the cooler insulated jacket. Therefore, **when using insulated steam jackets in a horizontal airflow,** position dispersion tubelets so that they discharge steam with the airflow, and also add 24" (610 mm) to the non-wetting absorption distance.
5. Center tube assembly within duct height.
6. If steam pressure is less than or equal to 15 psi (103.4 kPa), use float/thermostatic traps for the humidifier.
   If steam pressure is greater than 15 psi (103.4 kPa), use inverted bucket traps for the humidifier.
   If lifting condensate, use an inverted bucket trap regardless of steam pressure.
7. See the previous page for dimensions "A" and "B."
8. See "Pressurized steam piping guidelines" on Pages 10-11.

OM-7480

Installation

WARNING!

Mount humidifier per the instructions in this manual and to a structurally stable surface. Improper humidifier mounting can cause the humidifier to fall resulting in severe personal injury or death.

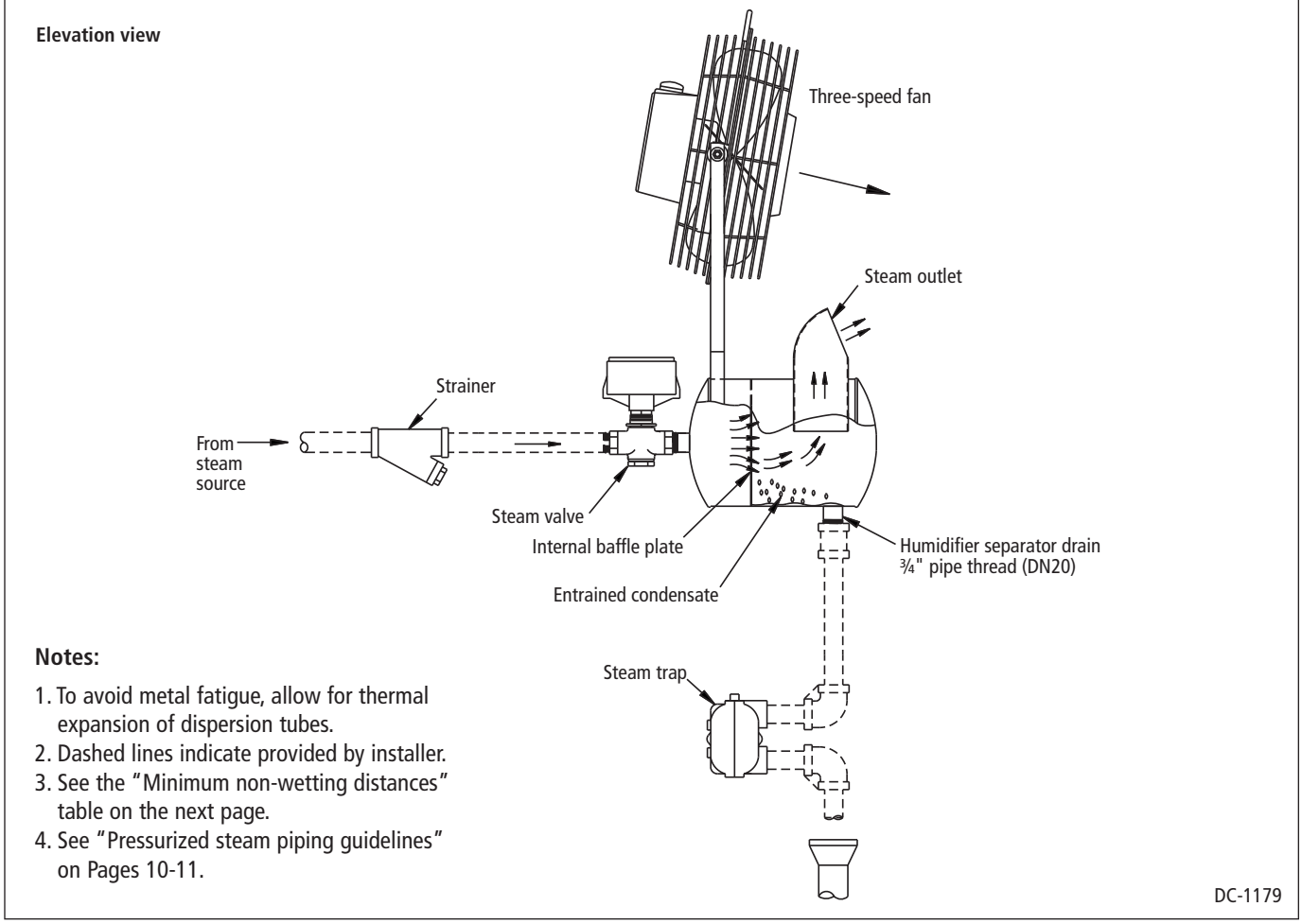
Assembly and installation

Area-type humidifiers are factory assembled and shipped as a complete unit, with steam trap and wye strainer shipped loose. Each humidifier requires a steam supply, condensate return, and either pneumatic or electrical supplies to operate the fan.

1. Select a location using the table "Minimum non-wetting distances for rise, spread, and throw."
2. Unpack shipment and verify receipt of all Area-type humidifier components with packing slip. Report any shortages at once.
3. Mount humidifier to supported steam and condensate piping as necessary.
4. Connect fan power as recommended for a minimum 60 lbs/hr (27.2 kg/h) of steam: 120v, 60 hz, below 1 amp (electric); and 2.5 cfm at 25 psi (1.2 litres/s at 172 kPa) (pneumatic). Both types of fans will provide 700 cfm (0.33 m^3/s) of air.
5. Connect the necessary control signal wiring (electric) or tubing (pneumatic) to steam valve operator.
   Note: Recommended maximum steam supply pressure is 15 psi (105 kPa). If pressure is greater than this, consult factory.
6. See field piping overview illustration on the next page.
7. See "Humidistat and sensor placement" on Page 9.

Field piping

Figure 49-1:
Field piping overview: Area-type humidifier



Notes:

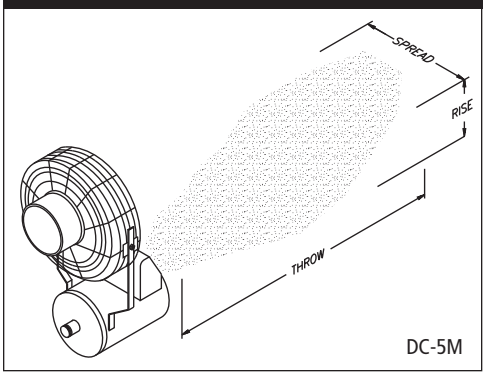
1. To avoid metal fatigue, allow for thermal expansion of dispersion tubes.
2. Dashed lines indicate provided by installer.
3. See the "Minimum non-wetting distances" table on the next page.
4. See "Pressurized steam piping guidelines" on Pages 10-11.

Table 49-1:
Dispersion fan specifications

	Electric fan	Pneumatic fan
Motor	120 V 50/60 Hz 0.75 A	100 psi 21 cfm 10,000 rpm max.
Blade diameter	12" (30.5 cm)	10" (24.5 cm)
Speeds	3	
Control	Rotary switch	
Operator setting		20 psi, 2 cfm

Rise, spread, and throw dimensions

Figure 50-1:
Area-type rise, spread, and throw



The table below lists the Area-type humidifier's minimum rise, spread and throw non-wetting dimensions. Surfaces cooler than ambient temperature, or objects located within this minimum dimension, may cause condensation and dripping.

Rise: Minimum non-wetting height above the steam chute
Spread: Minimum non-wetting width from the steam chute
Throw: Minimum non-wetting horizontal distance from the steam chute

The greater the space relative humidity, the higher and farther the discharged steam will carry and rise in the space until becoming absorbed.

Table 50-1:
Minimum non-wetting distances for rise, spread, and throw

Space temp.	Space RH		50 lbs/hr	20 kg/h	100 lbs/hr	45 kg/h	150 lbs/hr	65 kg/h	200 lbs/hr	90 kg/h	250 lbs/hr	110 kg/h	285 lbs/hr	130 kg/h
60 °F 16 °C	30%	Rise	1 ft.	0.5 m	4 ft.	1.5 m	6 ft.	2.0 m	7 ft.	2.5 m	8 ft.	2.5 m	9 ft.	3.0 m
		Spread	2 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	7 ft.	2.5 m	8 ft.	2.5 m	9 ft.	3.0 m
		Throw	6 ft.	2.0 m	10 ft.	3.0 m	12 ft.	4.0 m	13 ft.	4.0 m	15 ft.	5.0 m	17 ft.	5.5 m
	40%	Rise	1 ft.	0.5 m	4 ft.	1.5 m	6 ft.	2.0 m	8 ft.	2.5 m	9 ft.	3.0 m	10 ft.	3.0 m
		Spread	2 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	7 ft.	2.5 m	9 ft.	3.0 m	10 ft.	3.0 m
		Throw	6 ft.	2.0 m	10 ft.	3.0 m	12 ft.	4.0 m	14 ft.	4.5 m	16 ft.	5.0 m	18 ft.	5.5 m
	50%	Rise	1 ft.	0.5 m	4 ft.	1.5 m	6 ft.	2.0 m	8 ft.	2.5 m	9 ft.	3.0 m	10 ft.	3.0 m
		Spread	2.5 ft.	1.0 m	5 ft.	2.0 m	5 ft.	2.0 m	7 ft.	2.5 m	9 ft.	3.0 m	10 ft.	3.0 m
		Throw	6 ft.	2.0 m	10 ft.	3.0 m	12 ft.	4.0 m	14 ft.	4.5 m	16 ft.	5.0 m	18 ft.	5.5 m
70 °F 21 °C	30%	Rise	1 ft.	0.5 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Spread	1.5 ft.	0.5 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Throw	4 ft.	1.5 m	8 ft.	2.5 m	10 ft.	3.0 m	11 ft.	3.5 m	12 ft.	4.0 m	14 ft.	4.5 m
	40%	Rise	1 ft.	0.5 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Spread	2 ft.	1.0 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Throw	4 ft.	1.5 m	8 ft.	2.5 m	11 ft.	3.5 m	12 ft.	4.0 m	13 ft.	4.0 m	15 ft.	5.0 m
	50%	Rise	1 ft.	0.5 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Spread	2 ft.	1.0 m	3 ft.	1.0 m	4 ft.	1.5 m	5 ft.	2.0 m	6 ft.	2.0 m	7 ft.	2.5 m
		Throw	4 ft.	1.5 m	8 ft.	2.5 m	11 ft.	3.5 m	12 ft.	4.0 m	14 ft.	4.5 m	16 ft.	5.0 m

Humidifier start-up and shut-down

Humidifier start-up:

1. Open steam jacketing shut-off valve, if applicable.
2. Inspect steam valve for proper operation.
   Pneumatic: Inspect to ensure that: (1) the valve closes off steam tight, (2) the stem packing is not leaking steam, and (3) the diaphragm in the actuator is not leaking air.
   Electric: Inspect to be sure the valve operates freely, closes off steam tightly, and that the stem packing is not leaking.
3. Inspect steam traps and verify all are working properly. A blocked steam trap will be cold. A "blowing" steam trap will be hot and noisy, and the discharge pipe will be hot for a continuous distance up to 30 feet (9 meters). A properly operating steam trap will have about a two-degree temperature drop measured across the trap from inlet to discharge.
4. Verify airflow proving switch and high limit humidistat, if applicable, are working properly.

Humidifier shut-down:

1. Inspect steam valve for proper operation.
   Pneumatic: Inspect to ensure that: (1) the valve closes off steam tight, (2) the stem packing is not leaking steam, and (3) the diaphragm in the actuator is not leaking air.
   Electric: Inspect to be sure the valve operates freely, closes off steam tightly, and that the stem packing is not leaking.
2. Inspect steam traps and verify all are working properly. A blocked steam trap will be cold. A "blowing" steam trap will be hot and noisy, and the discharge pipe will be hot for a continuous distance up to 30 feet (9 meters). A properly operating steam trap will have about a two-degree temperature drop measured across the trap from inlet to discharge.
3. Close steam jacketing shut-off valve, if applicable.
4. Verify Teflon O-rings seal is functioning properly and not cracked or deformed.
5. Inspect silencer for cleanliness, if applicable.
6. Inspect the strainer for debris and clean if needed.

Eliminating excess heat from humidifier

Eliminating excess heat from pressurized steam-jacketed humidifiers

Figure 52-1:
Single humidifying steam path

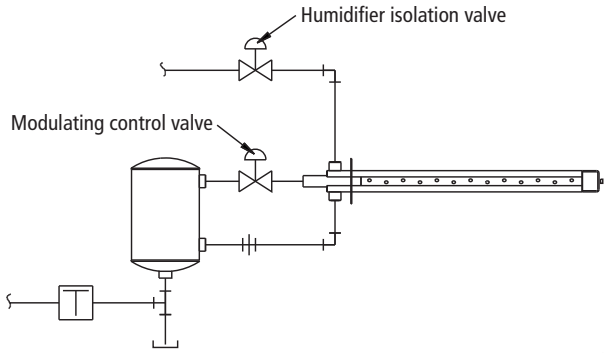
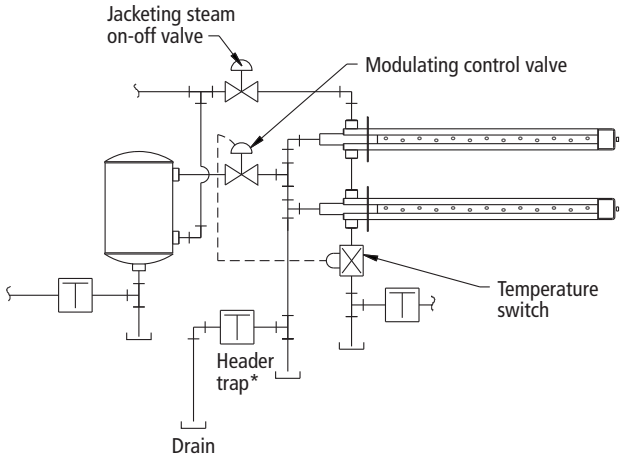


Figure 52-2:
Divided humidifying steam path



Note:
* Due to the pressure drop across the valve, the steam pressure at the header trap is minimal; therefore, you cannot lift condensate or return condensate to a pressurized return from this trap.

Eliminating excess heat from humidifier

See illustrations on the previous page.

In some applications with steam-jacketed humidifiers, the heat given off by the steam-heated tube (not the steams sensible heat) may be undesirable. While relatively insignificant in a single-tube unit (usually a rise of less than 2 °F [1 °C]), it can be much greater in a closely-spaced, multiple-tube installation. This can be dealt with in several ways:

1. Manually turn off the steam supply valve after the humidification season.
2. Insulate the tube exterior. (Note that this will enlarge the tube profile, causing additional resistance to airflow.)
3. Provide an automatic shut-off valve for the jacketing steam circuit in addition to the modulating control valve. This will eliminate heat gain during the "off" humidification periods only (see the two figures on the previous page). The jacketing steam valve should be a two-position type, with a minimum Cv of 5, and set to the full-open position prior to opening the modulating valve.

In the first figure (Figure 52-1), all steam (for jacketing and humidification) must pass through the jacket steam valve, and it must do so with very little or no pressure drop across the valve or maximum capacity will be reduced. More importantly, with just one supply source for jacket and humidification steam, the jacket steam temperature may drop below the temperature required to eliminate dripping. Therefore, the valve must be amply sized. This is not significant in a small capacity humidifier. In a large capacity humidifier, the required valve size may be quite expensive.

The second figure (Figure 52-2) shows a steam flow that has been divided into two paths: a humidifying steam path (which passes through the separator valve assembly), and a jacket steam path. When dividing the steam path, install a temperature switch as shown in the drawing to ensure that jacket steam is present before the control valve opens. Install a header trap, as shown, to collect condensation when the jacket steam is off.

Maintenance procedures

1. Strainer: Inspect the screen at least twice during the first year. If fouled, it should be inspected more frequently and cleaned as needed.
2. Steam trap: At least twice a year, verify that the steam trap is functioning properly. A blocked steam trap will be cold. An improperly operating steam trap with steam exiting the trap will be hot and noisy, and the discharge pipe from it will be hot for a continuous distance up to thirty feet (nine meters). A properly operating steam trap will have about a two degree temperature drop measured across the trap from inlet to discharge.
3. Valve (pneumatic): Inspect annually to ensure that:
   a. The valve closes off steam tight
   b. The stem packing is not leaking steam
   c. The diaphragm in the actuator is not leaking air.

   Valve (electric modulating): Inspect annually to ensure that
   a. The valve operates freely
   b. The valve closes off steam tightly
   c. The stem packing is not leaking.

   Valve (solenoid): Inspect annually to verify proper function with steam-tight shut-off.
4. Silencer: Inspect at least annually for cleanliness. Clean or replace as needed.
5. Teflon® seal rings: After one year of service, verify that rings are properly functioning. They require replacement if disturbed, since the Teflon can take a "set" and not return to its uncompressed shape.
6. O-rings (dispersion tube adapters): Replace after two or three years of service.
7. Separator: No maintenance required.
8. Dispersion tube: No maintenance required.

Troubleshooting

Table 55-1:
Steam Injection troubleshooting guide

Problem	Possible cause	Action
Humidifier discharges water in duct	• Steam main overloaded with water due to boiler discharging water with steam (priming) or improper steam main dripping	• Locate cause of priming and correct
	• Steam trap not draining properly	• Replace trap, repair, or clean as required • Reduce back pressure of condensate return line
	• Steam pressure is too low (below 2 psi [14 kPa])	• Verify that steam shutoff valves are fully open • Adjust pressure reducing valve • Adjust boiler pressure
	• Condensate is collecting in low, undripped points in steam main	• Install drips and steam traps as required
	• Steam jacketing of tube not up to proper temperature	• Excessive lifting of condensate. Reroute piping or raise steam pressure. • Short circuiting inside tube jacketing. Replace tube. • Improper steam trap location. Relocate and/or add additional trap. • Condensate return line pressure is too high. Re-pipe. • Dispersion tube is not level. Reposition.
	• Overloaded condensate return main	• Replace with larger piping, or pipe condensate to floor drain.
	• Inadequate steam trap capacity	• Replace steam trap orifices as necessary. • Replace with larger trap.
Humidifier leaks water	• Defective O-rings on tube adapter	• Replace O-rings
	• Steam leak in outer jacket of dispersion tube	• Repair leak, or replace tube. **Note:** Check installation to ensure tubes are not rigidly anchored in place. Tubes must be allowed to flex in response to thermal expansion.
Humidity exceeds setting of humidistat	• Automatic valve not fully closing	• Foreign matter is holding valve open. Clean valve; check line strainer. • Valve spring is broken. Replace spring. • Valve stem packing is adjusted too tightly. Loosen and/or replace packing. • Steam pressure exceeds close-off rating of valve spring. Replace actuator or valve spring with one that is compatible with the higher steam pressure. • Valve is installed backers. Remount. • Adjust valve linkage.
	• Control system is malfunctioning	• Incorrect control voltage. Verify and correct. • Incorrect control signal. Verify and correct. • Improper wiring. Verify and correct. • Incorrect humidity sensor. Verify and correct. • Humidity controller out of calibration. Calibrate.
	• Leak in steam piping inside duct	• Repair leak.

More on next page ►

Troubleshooting

Table 56-1:
Steam Injection troubleshooting guide

Problem	Possible cause	Action
Hunting: Humidity swings above and below desired set point	• Control system is malfunctioning.	• Faulty or inaccurate humidity controller. Calibrate or replace. • Poor location of control components. Relocate. • Incompatible control component(s). Change component(s).
	• Automatic valve is hunting.	• Humidifier is oversized. Change to a smaller valve. • Pressure-reducing valve is not accurately controlling steam pressure. Repair or replace. • Boiler pressure is swinging too widely. Adjust.
Space humidity will not rise to humidistat set point	• Excessive outside air volume	• Check fans, dampers, VAV, etc.
	• Steam pressure is too low.	• Manual steam valve is partially closed. Open. • Strainer screen is partially clogged. Clean. • Boiler pressure is too low. Adjust. • Pressure reducing valve is not accurately controlling steam pressure. Repair or replace. • Boiler pressure is swinging too widely. Adjust. • Check fans, dampers, VAV, etc. • Piped incorrectly. Re-pipe. • Steam piping is undersized.
	• Humidifier is undersized.	• Replace valve with larger capacity valve. • Replace with larger humidifier. • Add additional humidifier.
	• Automatic steam valve is not opening fully.	• Valve packing is adjusted too tightly. Loosen and/or replace packing. • Adjust valve linkage. • Check pilot positioner settings.
	• Control system is malfunctioning.	ELECTRIC: • Incorrect control circuit voltage. Change transformer. • Incorrect control signal. Replace component(s) to make all components compatible. • Improperly wired. Rewire. • Incorrect humidity sensor (Barber-Colman units only). Replace. • Humidity controller is out of calibration or is malfunctioning. Repair or replace. • Malfunctioning humidifier temperature switch is not allowing humidifier valve to open. Replace or readjust. PNEUMATIC: • Humidity controller is out of calibration or is malfunctioning. Repair or replace. • Obstructed air line. Clean. • Malfunctioning pneumatic temperature switch. Replace. • Air leak in actuator. Repair or replace. • Compressed air pressure is too low. Adjust.

More on next page ►

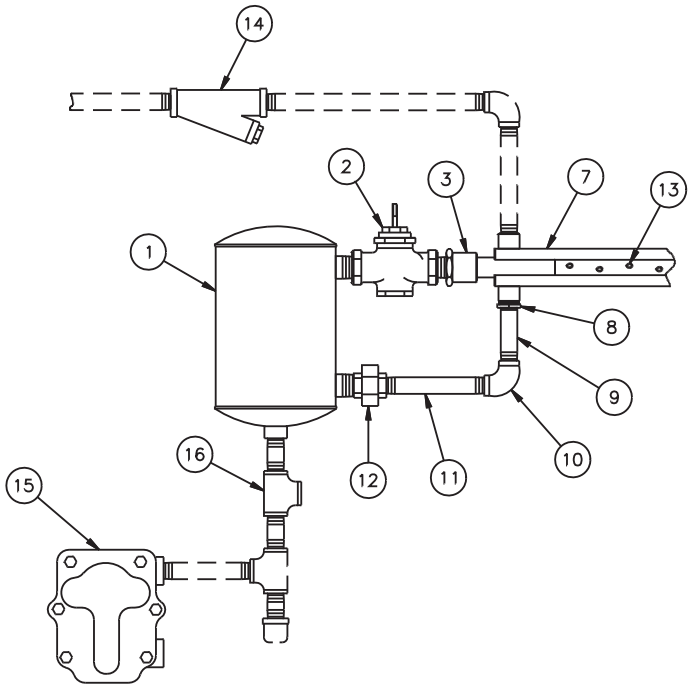
Troubleshooting

Table 57-1:
Steam Injection troubleshooting guide

Problem	Possible cause	Action
Space humidity will not rise to humidistat set point (continued)	• Foreign matter is preventing valve from opening.	• Clean or replace valve.
	• Excessive outside air volume.	• Reduce air volume.
Condensate in duct	• Humidifier is mounted too close to internal devices (dampers, turning vanes, etc.) in duct.	• Check fan, dampers, VAV, etc. • Move humidifier tubes to a point farther upstream of internal devices. • Add dispersion tubes for shorter absorption distance. consult DRI-STEEM to determine the total number of tubes required.
	• A non-insulated duct is passing through an unheated area (duct surface temperature is too low).	• Insulate ductwork.
	• Air cannot absorb steam quantity being discharged.	• Humidifier is operating when blower is off. Install airflow proving switch. • Valve is hunting. See previous page for instructions. • Air temperature in duct is too low for steam quantity being supplied. • Air cfm in duct is too low for steam quantity being supplied.
	• Steam pressure is too high, causing excess capacity.	• Reduce steam pressure.
Humidifier is noisy	• Tube silencer is missing. (Tube silencers are furnished on Size 60 tubes that are 48" [1219 mm] in length or less.)	• Install silencer.
	• Dispersion tube output is excessively high.	• Install additional tubes.

Single-tube, Multiple-tube, and Maxi-bank humidifiers

Figure 58-1:
Single-tube, Multiple-tube, and Maxi-bank humidifier replacement parts



Note:
See table on the next page for part numbers.

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Single-tube, Multiple-tube, and Maxi-bank humidifiers

Table 59-1:
Single-tube, Multiple-tube, and Maxi-bank humidifier replacement parts

No.	Description	Model	Part no.
1	Separator, 5, ½" vertical	½" valve 5-60	162520-001
	Separator, 6, ½" vertical	½" valve 6-60	162540-001
	Separator, 6, ¾" vertical	¾" valve 6-70	162540-002
	Separator, 7, ½" vertical	½" valve 7-70	162560-001
	Separator, 7, ¾" vertical	¾" valve 7-70	162560-002
	Separator, 7, 1" vertical	1" valve 7-70	162560-003
	Separator, 8, ¾" vertical	¾" valve 8-80	162570-001
	Separator, 8, 1" vertical	1" valve 8-80	162570-002
	Separator, 8, 1¼" vertical	1¼" valve 8-80	162570-003
	Separator, 8, 1½" vertical	1½" valve 8-80	162570-004
2	Valve (refer to specific order)		
3	Tube adapter, ½" NPT × 1"	½" valve 5-60, 6-70, 7-70	167080
	Tube adapter, ¾" NPT × 1"	¾" valve 6-70, 7-70	167085
	Tube adapter, ¾" NPT × 1½"	¾" valve 8-80	167090
	Tube adapter, 1" NPT × 1"	1" valve 7-70	167095
	Tube adapter, 1" NPT × 1½"	¾" valve 8-80	167100
	Tube adapter, 1¼" NPT × 1½"	1¼" valve 8-80	167077-125
	Tube adapter, 1½" NPT × 1½"	1½" valve 8-80	167105
4	60-70 O-rings #120 (not shown)	All 5-60, 6-70, 7-70	300400-007
	80 O-rings #128 (not shown)	All 8-80	300400-006
5*	SST silencer holder (not shown)	All 5-60, 6-70, 7-70	183100
6*	Med. gr. SST wool (not shown)	All 5-60, 6-70, 7-70	300210
7**	Model 60 tube	½" valve 5-60	161000
	Model 70 tube	All 6-70, 7-70	161500
	Model 80 tube	All 8-80	161750
8	Seal ring ½"-14 NPT	½" valve 5-60	306360-001
	Seal ring ¾"-14 NPT	All 6-70, 7-70	306360-002
	Seal Ring 1½"-11½" NPT	All 8-80	306360-003

Table 59-1:
Single-tube, Multiple-tube, and Maxi-bank humidifier replacement parts

No.	Description	Model	Part no.
9	Nipple-blk, ½" × 3½"	½" valve 5-60	201000-0069
	Nipple-blk, ¾" × 3"	All 6-70, 7-70	201200-005
	Nipple-blk, 1½" × 3½"	All 8-80	202200-003
10	Elbow-blk, ½" 90°	½" Valve 5-60	201000-010
	Elbow-blk, ¾" 90°	All 6-70, 7-70	201200-014
	Elbow-blk, 1½" 90°	All 8-80	202200-008
11	Nipple-blk, ½"	½" Valve 5-60	201000
	Nipple-blk, ¾"	All 6-70, 7-70	201200
	Nipple-blk, 1½"	All 8-80	202200
12	Union-blk, ½"	½" Valve 5-60	201000-015
	Union-blk, ¾"	All 6-70, 7-70	201000-020
	Union-blk, 1½"	All 8-80	201000-009
13	Tube insert, 60-70	All 5-60, 6-70, 7-70	310280
	Tube insert, 80	All 8-80	310290
14	Y-strainer, ½"	Specify size per job	300100-001
	Y-strainer, ¾"	Specify size per job	300100-002
	Y-strainer, 1"	Specify size per job	300100-003
	Y-strainer, 1½"	Specify size per job	300100-005
	Y-strainer, 2"	Specify size per job	300100-006
	Y-strainer, 2½"	Specify size per job	300100-007
15	Steam trap, F&T	Less than 15 psi	300000
	Bucket trap, inverted	Greater than 15 psi	300010
16	Temperature switch, electric		400260-001
	Temperature switch, pneumatic		307076

Notes:
* Only used in 60/70 tubes
** Specify size of orifice bore in insert and length of tube.

Area-type humidifier

Figure 60-1:
Area-type humidifier with electric fan

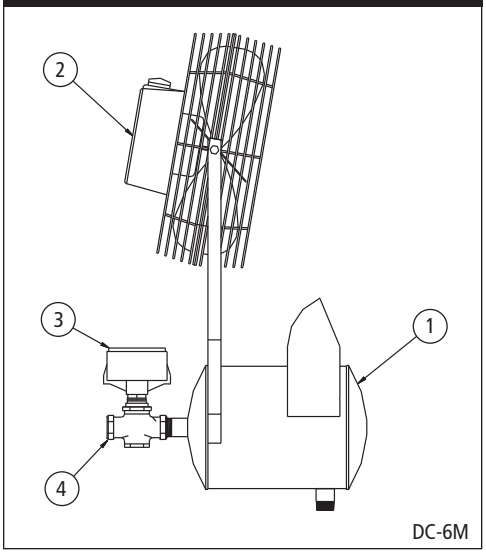


Table 60-1:
Area-type humidifier with electric fan replacement parts

No.	Description	Part no.
1	Separator (with ¾" NPT supply)	Consult factory
2	Fan, three-speed	400010
3	Valve operator, electric	500760
4	Valve, ½" NPT pneumatic with operator	510060
	Valve, ¾" NPT pneumatic with operator	510061
	Valve, 1" NPT pneumatic with operator	510063
	Valve, ½" NPT electric	510030
	Valve, ¾" NPT electric	510031
	Valve, 1" NPT electric	510032

Figure 60-2:
Area-type humidifier with pneumatic fan

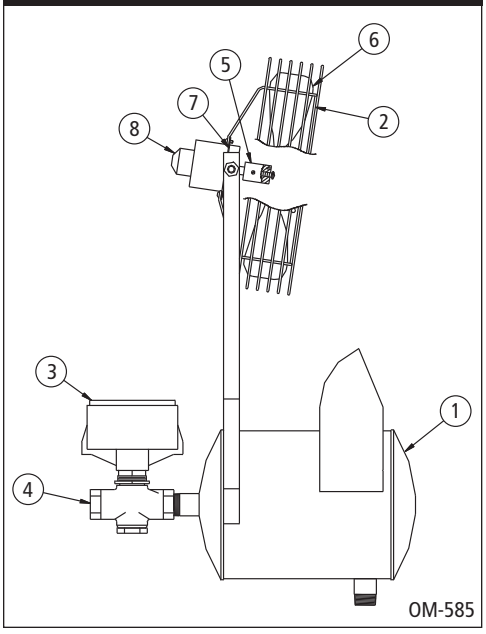


Table 60-2:
Area-type humidifier with pneumatic fan replacement parts

No.	Description	Part no.
1	Separator (with ¾" NPT supply)	Consult factory
2	Fan guard	306370
3	Valve operator, electric	500760
4	Valve, ½" NPT pneumatic with operator	510060
	Valve, ¾" NPT pneumatic with operator	510061
	Valve, 1" NPT pneumatic with operator	510063
	Valve, ½" NPT electric	510030
	Valve, ¾" NPT electric	510031
	Valve, 1" NPT electric	510032
5	Bracket, pneumatic fan blade	123660
6	Fan blade, aluminum	306380
7	Plate weld, fan mounting	164570
8	Fan motor, pneumatic	307030-001

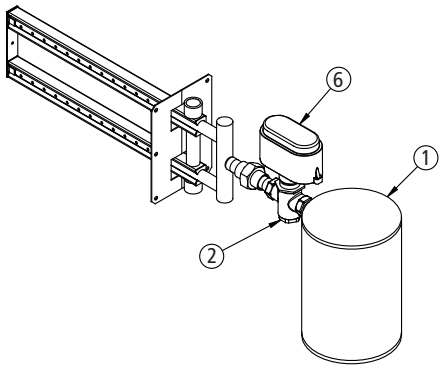
Mini-bank humidifer

Table 61-1:
Mini-bank humidifier replacement parts

No.	Description	Part no.
1	5" separator	162520
2	Valve, ½" pneumatic with operator	510060
	Valve, ½" electric	510030
3	Orifice, brass (not shown)*	203450
4	Trap, F&T (not shown)**	300000
5	Y-strainer, ½" (not shown)**	300100-001
6	Valve, operator, electric	500670

Notes:
* Varies with each order
** Shipped loose
For 18"– 23" tubelet size reduced for last one on either end
For 24"– 48" tubelet size reduced for last two on either end

Figure 61-1:
Mini-bank humidifier replacement parts



OM-7479

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For more than 40 years, DRI-STEEM has been leading the industry with creative and reliable humidification solutions. Our focus on quality is evident in the construction of our Steam Injection humidifiers, which feature cleanable stainless steel construction. DRI-STEEM also leads the industry with a Two-year Limited Warranty and optional extended warranty.

For more information

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Form No. DS-IOM-1110
Part No. 890000-401 Rev C

Two-year Limited Warranty

DRI-STEEM Corporation ("DRI-STEEM") warrants to the original user that its products will be free from defects in materials and workmanship for a period of two (2) years after installation or twenty-seven (27) months from the date DRI-STEEM ships such product, whichever date is the earlier.

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DRI-STEEM's Limited Warranty shall not be effective or actionable unless there is compliance with all installation and operating instructions furnished by DRI-STEEM, or if the products have been modified or altered without the written consent of DRI-STEEM, or if such products have been subject to accident, misuse, mishandling, tampering, negligence or improper maintenance. Any warranty claim must be submitted to DRI-STEEM in writing within the stated warranty period. Defective parts may be required to be returned to DRI-STEEM.

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DRI-STEEM SHALL NOT, UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, REVENUE OR BUSINESS) OR DAMAGE OR INJURY TO PERSONS OR PROPERTY IN ANY WAY RELATED TO THE MANUFACTURE OR THE USE OF ITS PRODUCTS. The exclusion applies regardless of whether such damages are sought based on breach of warranty, breach of contract, negligence, strict liability in tort, or any other legal theory, even if DRI-STEEM has notice of the possibility of such damages.

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The original user may extend the term of the DRI-STEEM Limited Warranty for a limited number of months past the initial applicable warranty period and term provided in the first paragraph of this Limited Warranty. All the terms and conditions of the Limited Warranty during the initial applicable warranty period and term shall apply during any extended term. An extended warranty term of an additional twelve (12) months or twenty four (24) months of coverage may be purchased. The extended warranty term may be purchased until eighteen (18) months after the product is shipped, after which time no extended warranties are available.

Any extension of the Limited Warranty under this program must be in writing, signed by DRI-STEEM, and paid for in full by the purchaser.

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