READ AND SAVE THESE INSTRUCTIONS

INSTALLATION, OPERATION AND MAINTENANCE

DRI-STEEM®

STEAM INJECTION HUMIDIFIERS
FOR APPLICATIONS WITH A STEAM BOILER

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DRI-STEEM®

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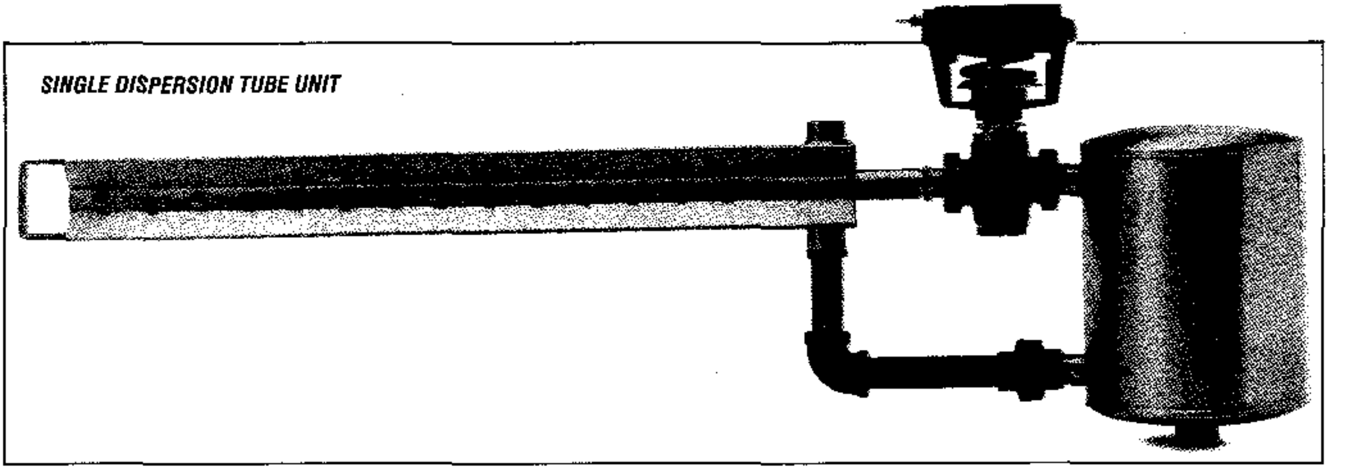
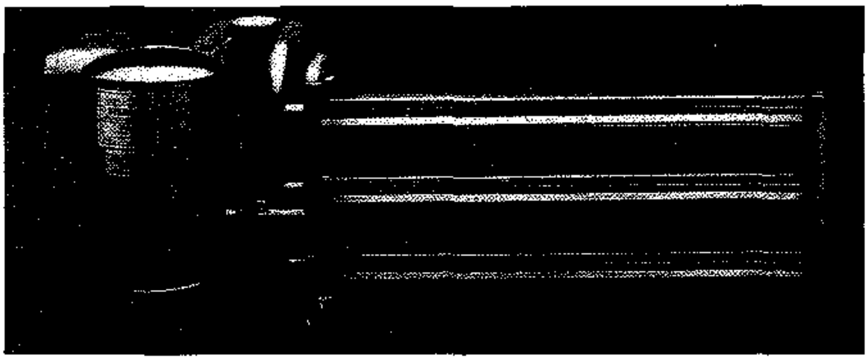
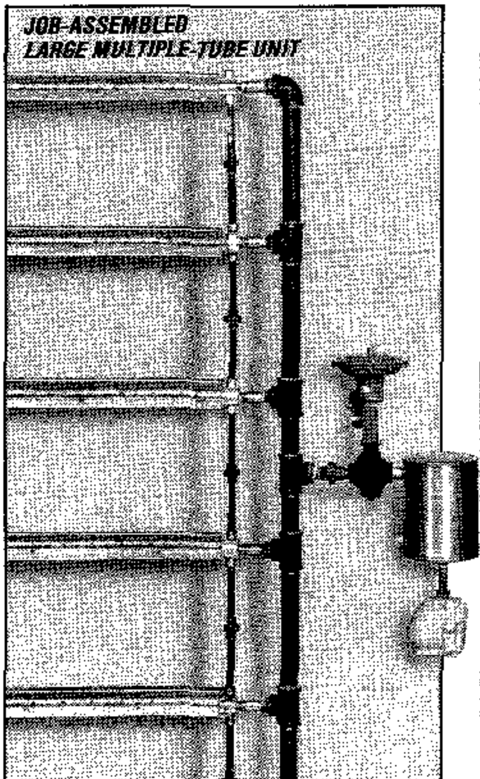
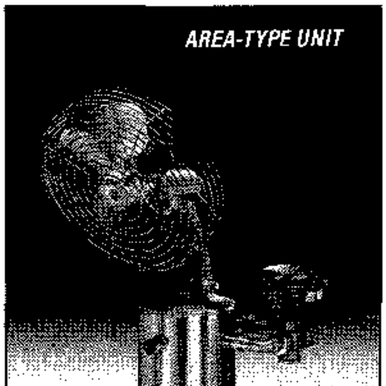


SINGLE DISPERSION TUBE UNIT

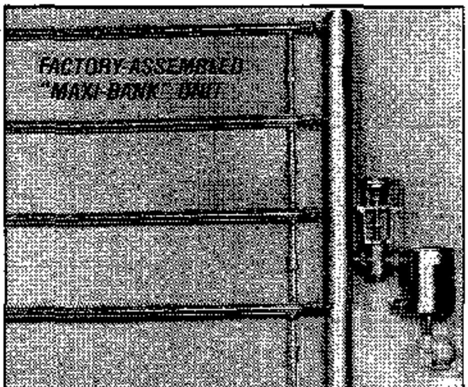




JOB-ASSEMBLED LARGE MULTIPLE-TUBE UNIT



AREA-TYPE UNIT



FACTORY-ASSEMBLED "MAXI-BANK" UNIT

ABSORPTION:
WHY IT'S IMPORTANT

Some steam injection humidifier designs fail to adequately mix the steam with the air stream. Poor mixing means poor (or slow) absorption of the steam into the air, and unabsorbed steam collects on fans, dampers and turning vanes in ducts. This results in wet ducts, leaking ducts and wet floors, even algae and bacteria growth in severe conditions.

STEAM "CHANGES STATE" AS IT BECOMES ABSORBED

The illustration on this page shows the typical steam absorption process in a moving air stream. As the steam *emerges from the humidifier's dis-*charge inserts it is invisible. Within an inch or two it changes into a white fog of tiny water droplets. This fog moves downstream, expands to fill the duct, and then gradually disappears.

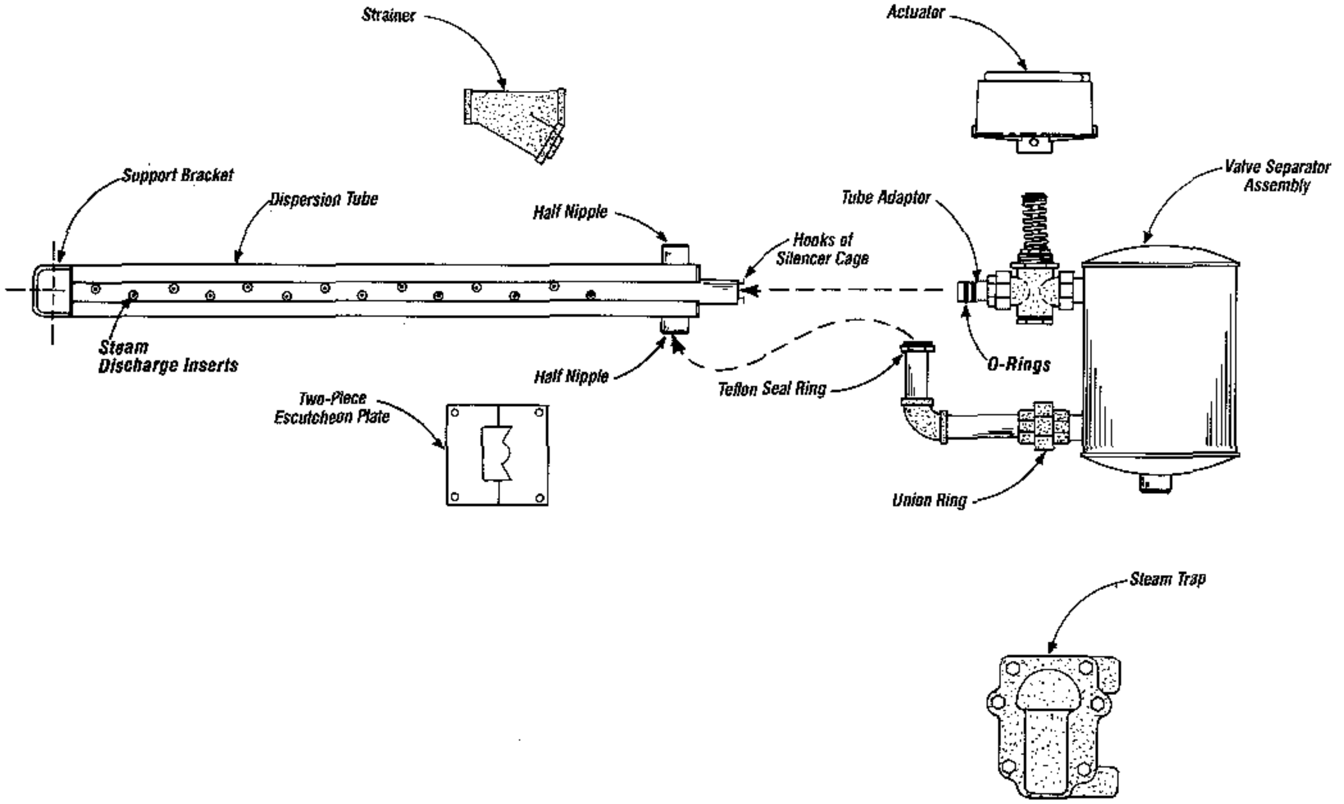
During this process, the steam goes through two 'changes of state'. The first is when the steam becomes visible (changes into fog) and the second is when the fog disappears. The second change of state should occur as quickly as possible, before anything in the duct gets wet.

When the steam is turned into fog, it is because the envelope of comparatively cool air that receives the steam becomes 'supersaturated', causing excess moisture to condense, forming the visible white fog. As it condenses, 970 Btu's of heat per pound of steam are released into the mixture of steam and air. As the fog moves downstream and fans out, it gradually re-absorbs this heat and re-evaporates, changing back into invisible vapor.

The air travel distance required for the two changes of state to occur is called the ABSORPTION DISTANCE or "fog travel distance".

(NOTE: The temperature of the steam/air mixture can rise as much as 30°F between the two changes of state—a point to remember when choosing a thermostat location in a duct.)

FIELD ASSEMBLY
SINGLE-TUBE HUMIDIFIER

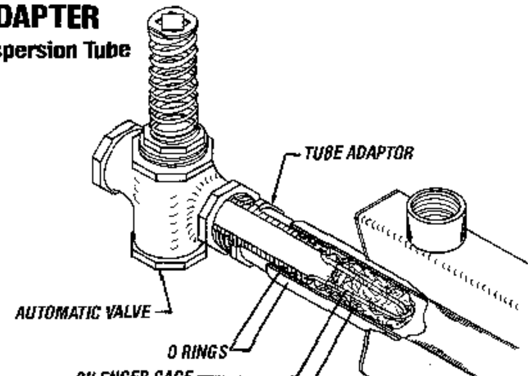


NOTE: Small units are shipped assembled—the following applies to larger units which are disassembled for shipment.

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).
3. Unscrew union ring, remove elbow and nipple portion and install in half nipple of tube. Note: Before completing step 3, determine which way (right or left) steam holes should point and install in appropriate half nipple. (Refer to pg. 5)
4. Insert tube adaptor into dispersion tube (lubricate O-rings). As this is being done squeeze hooks of silencer cage (see Note "a".) together and start them into tube adaptor allowing them to snap into machined groove inside adaptor—then complete pushing adaptor into tube, being careful to avoid damaging O-rings.
5. Bring union halves together, tighten union ring, snug up teflon seal ring (not too tight) and unit is ready to be installed in duct.
6. Install a support bolt in one of the three holes (upper, lower or end) of support bracket, cut holes in duct for insertion of dispersion tube and for support bolt.
7. Secure unit in duct with nut and support bolt. Mount 2-piece escutcheon plate around tube and secure with sheet metal screws into duct. Where total air tightness is required seal around tube and bolt with suitable caulking.
8. Install steam strainer and steam trap. Connect to steam and condensate return mains. See page 11 for piping notes.
9. Install control tubing (pneumatic) or wiring (electric) to valve actuator. Note: An air flow proving device (to prevent valve from opening unless air is moving in duct) should be installed.

NOTE A: Silencers are furnished only with model 5-60 and 6-70 humidifiers having tubes 4 feet long and shorter (all others do not have silencers unless specially ordered).

TUBE ADAPTER
Single Dispersion Tube



Installation of Tube Adapter

1. Install tube adaptor in valve, use pipe dope and tighten leak-tight.
2. Install O-rings in external grooves of tube adaptor. NOTE: Lubricate O-rings before installing.
3. Insert silencer cage into adaptor and allow hooks to snap into internal groove.
4. Slide tube over silencer, tube adaptor, and O-rings being careful not to damage O-rings.

CONFIGURATIONS

SINGLE TUBE HUMIDIFIERS (4 Variations)

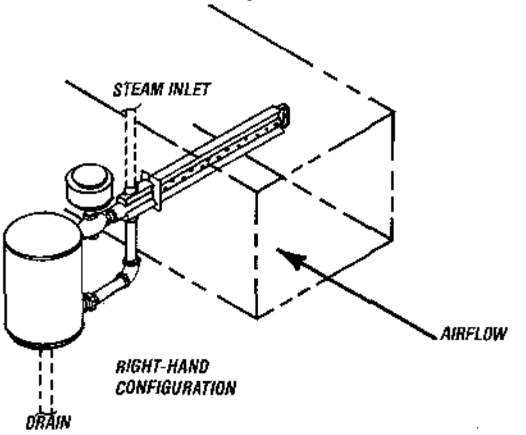


Fig. 1: Horizontal tube and horizontal steam discharge. This arrangement comprises majority of uses. If not ordered otherwise, this is how units are shipped. Unit shown in Fig. #1 is right-hand. (To change, refer to changing from right to left on the bottom of this page.)

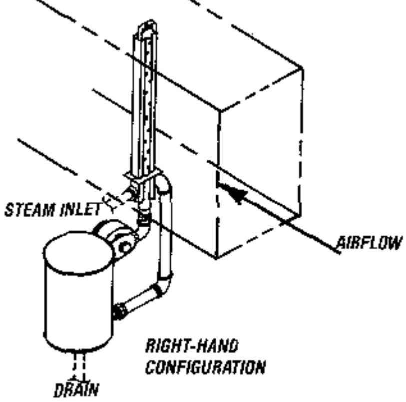


Fig. 2: Vertical tube. Used when there is no access to side of duct. Absorption of the steam will be improved if duct is tall and narrow rather than shallow and wide.

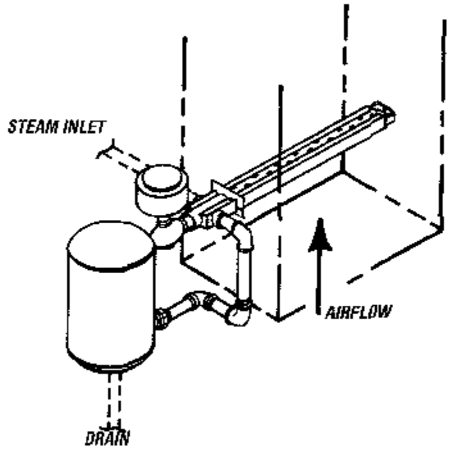


Fig. 3: Vertical discharge. Used in vertical ducts. To eliminate cold start dripping, inserts should always point up regardless of air flow direction (up or down).

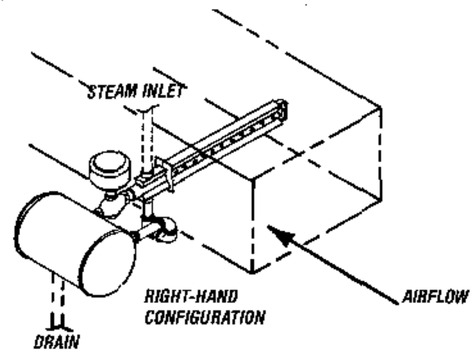
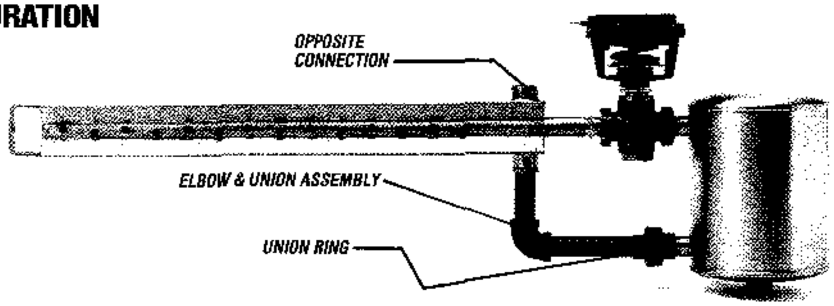


Fig. 4: Horizontal separator. Used where height is at a premium (above ceilings etc.). Turning the separator on its side saves about 4 inches of height.

NOTE: All of the above variations are done by simply substituting pipe nipples of different lengths and in some cases, adding ells and nipples (except for Fig. 4).

NOTE: STEAM SHOULD DISCHARGE AGAINST THE AIR FLOW, EXCEPT WHEN INSULATED. INSULATED TUBES SHOULD DISCHARGE WITH THE AIR STREAM TO PREVENT POSSIBLE CONDENSATION ON THE METAL JACKET COVERING THE INSULATION.

CHANGING FROM RIGHT-HAND TO LEFT-HAND CONFIGURATION

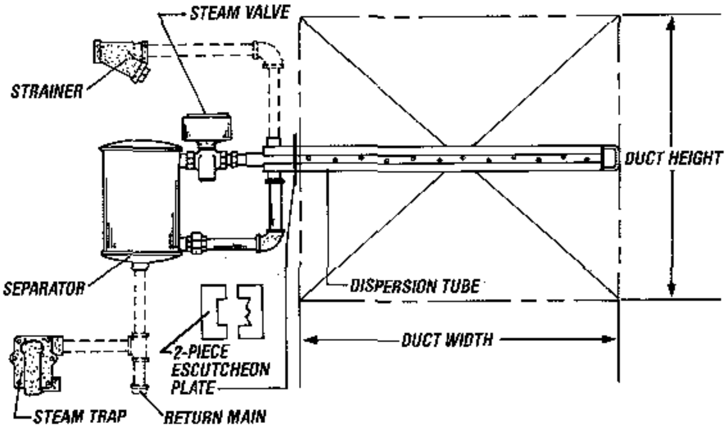


For various reasons it may be necessary to change the steam discharge direction to the opposite side of that for which the humidifier was ordered. Simply follow these directions:

1. Unthread union ring.
2. Remove elbow and nipple assembly from dispersion tube and re-install on opposite connection.
3. Rotate dispersion tube 180° in respect to separator.
4. Re-connect union halves and tighten union ring.
5. Humidifier now will discharge to opposite side.

PIPING & INSTALLATION

SINGLE TUBE HUMIDIFIER



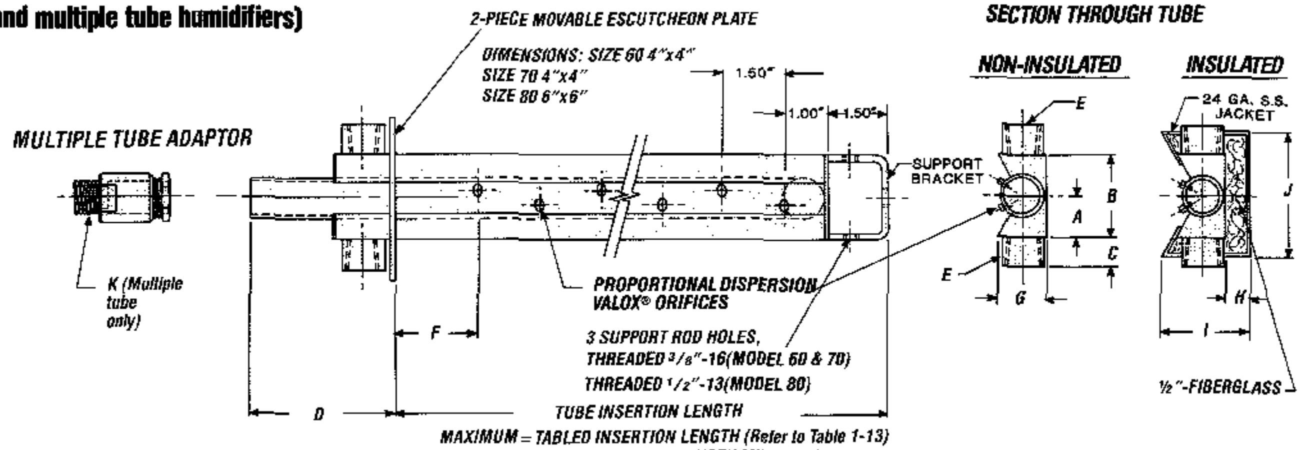
1. Humidifier steam supply should be taken off the top of the steam main (instead of side or bottom) to ensure driest steam. Main should be dripped and trapped.
2. *Humidifier steam trap must drain by gravity to return main having* little or no back pressure. If condensate cannot drain by gravity (must be elevated to return main) see page 14.
4. Air flow proving switch is recommended to prevent valve from opening unless air is moving in duct.
5. High limit (duct mounted) humidistat 15 feet or more downstream and set at 80-90% is recommended when duct air is below 70°F to prevent condensation in duct.
6. Steam VALOX® inserts should point towards air stream for better steam-air mixing except if tubes have insulated jacket option (steam could condense on cool jacket).
7. Temperature warm-up switch (to prevent possible cold start dripping) is recommended when steam pressure is to be dropped to zero periodically. See page 7 for instructions.

NOTE: All dotted line piping by contractor.

MECHANICAL SPECIFICATIONS

DISPERSION TUBE

(Single and multiple tube humidifiers)



MAXIMUM = TABLED INSERTION LENGTH (Refer to Table 1-13)
MINIMUM = TABLED INSERTION LENGTH MINUS 1¾"

TABLE 1-13: Dispersion Tube Dimensions In Inches/mm.

Tube No.	A	B	C	D	E	*F	**G	H	I	J	K	Tube Shipping Weight Wt/Ft of Tube Lbs.	(Kg)	Standard Dispersion Tube Lengths In Inches (cm) (For Lengths Other Than Shown Consult Factory) 6 (15)	12 (30)	18 (46)	24 (61)	30 (76)	36 (91)	48 (122)	60 (152)	72 (183)	84 (213)	96 (244)	108 (274)	120 (305)	132 (335)	144 (366)
60	15/16" (23.8)	1⅞" (47.6)	13/16" (20.6)	3¾" (95.2)	½" (12.7)	2" (50.8)	1⅛" (28.6)	½" (12.7)	1 15/16" (49.2)	2⅞" (73.03)	¾" (19.1)	1.5	.68	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
70	1⅜" (34.9)	2¾" (69.8)	13/16" (20.6)	4" (102)	¾" (19.1)	2" (50.8)	1⅞" (47.6)	½" (12.7)	2⅝" (66.7)	3¾" (95.2)	¾" (19.1)	2	.9			X	X	X	X	X	X	X	X	X	X	X	X	X
80	1½" (38.1)	3" (76.2)	1 1/16" (27.0)	5½" (140)	1½" (38.1)	2" (50.8)	2⅝" (66.7)	½" (12.7)	3⅜" (985.7)	4" (101.7)	1¼" (31.8)	3	1.4						X	X	X	X	X	X	X	X	X	X

*1½" (38mm) on 6" tube

**1" (25mm) on 6" tube

SEPARATOR

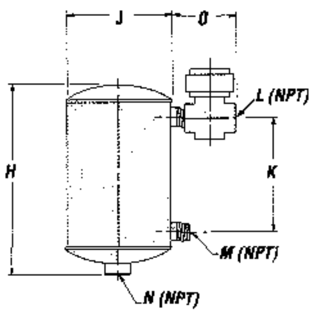


TABLE 3-13: Separator Dimensions In Inches (cm).

Separator Size	L	M	N	O	P		R*	Shipping Wt.** Lbs.	Kg.
5	9½ (24.1)	5 (12.7)	5¼ (13.3)	Varies	½	¾	4½ (11.4)	19	8.6
6	9¾(24.8)	6 (15.2)	5½ (14.0)	with	¾	¾	6 (15.2)	21	9.5
7	10½(26.7)	7 (17.8)	6 (15.2)	valve	¾	¾	7 (17.8)	26	11.8
8	11¾(29.8)	8 (20.3)	7 (17.8)	size per	1½	¾	8 (20.3)	43	19.5
9	13¼(33.7)	9 (22.9)	7 (17.8)	hum. load	2	¾	9 (22.9)	52	23.5

*Standard pneumatic control valve

**Includes control valve, drain traps and strainer

TEMPERATURE SWITCHES

PNEUMATIC SWITCH

PURPOSE:

This device is a self contained, temperature actuated, normally open, air valve that closes when the capillary tube senses a temperature of approximately 220°F. It is designed to be used with pneumatic humidity control systems. It prevents the humidifier valve from opening until the unit is hot enough to prevent dripping and also will shut down the humidifier in the event of a flood of condensate caused by a steam system malfunction such as a priming boiler, flooded return main etc.

Installation of the No. 1 PTS is as follows:

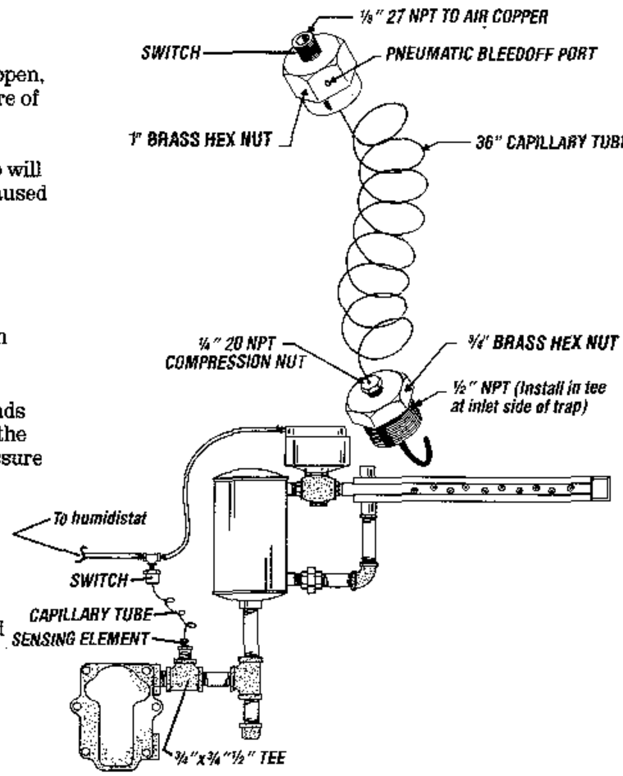
The sensing element of the device is to be installed in the return piping, on the inlet side of the steam trap.

When steam surrounds the sensing element, the liquid fill expands and transmits pressure to a bellows in the switch. Expansion of the bellows closes the bleed off port in the switch and allows air pressure to build up in the air tubing controlling the valve.

1. Provide a tee to receive the ½" NPT brass fitting as shown.

2. Crimping of the capillary tube will ruin the device..

3. Mount the switch in the air line between the humidifier valve and the humidistat.



TYPICAL PIPING LAYOUT

ELECTRICAL SWITCH

PURPOSE:

This device is a temperature actuated make-break switch. The temperature at which it switches is adjustable and should be set at 220° F. It is designed to be used with electric humidity control systems.

The purpose of this device is to prevent the humidifier valve from opening until the humidifier has heated up to operating temperature. It also will shut down the humidifier in the event of a flood of condensate caused by a steam system malfunction such as a priming boiler, flooded return main etc.

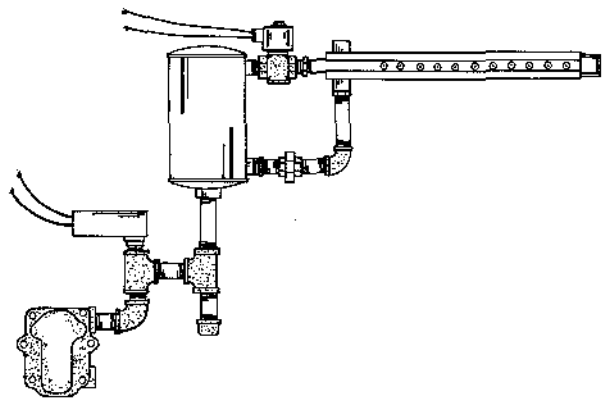
INSTALLATION

The sensing element of the device is to be installed in the return piping on the inlet side of the steam trap. When steam surrounds the sensing element the switch will "make" allowing the humidifier valve to open.

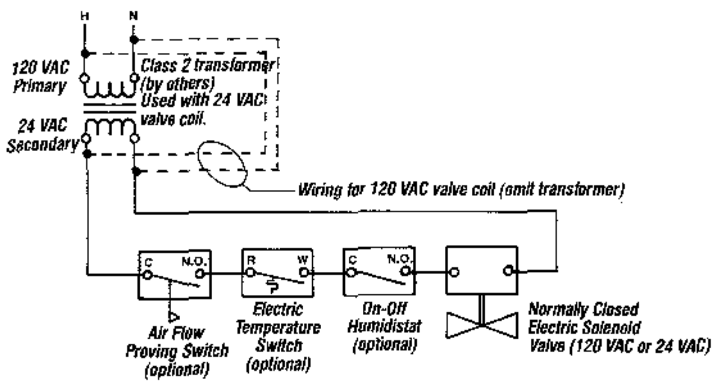
Provide a tee having a ½" NPT opening to receive the sensing element.

NOTE: All wiring per national and local electrical codes. (SIZE TRANSFORMER VA TO LOAD VA)

NOTE: When temperature switch is used with ELECTRIC MODULATING valve a special wiring diagram will be furnished with the valve shipped. Use this diagram for wiring instructions.



TYPICAL WIRING DIAGRAM with ELECTRIC SOLENOID VALVE



MULTIPLE-TUBE HUMIDIFIERS

FIELD ASSEMBLY OF LARGE MULTIPLE-TUBE UNIT

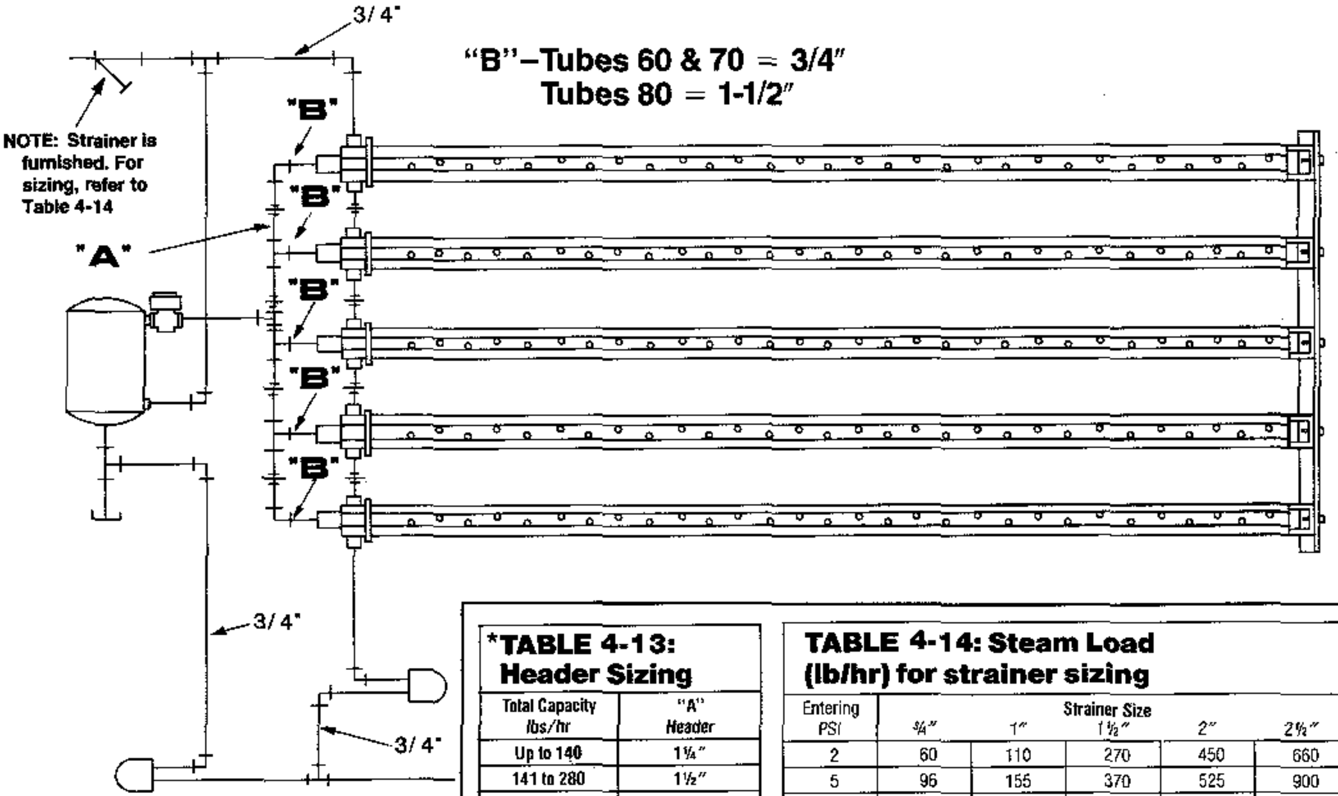


***TABLE 4-13: Header Sizing**

Total Capacity lbs/hr	"A" Header
Up to 140	1¼"
141 to 280	1½"
281 to 490	2"
491 to 700	2½"
701 to 980	3"
981 to 1323	3½"
1324 to 1743	4"
1744 to 2752	5"
2753 to 3989	6"

*Based on velocity of approximately 5000 fpm for minimum noise and equal flow rate in all tubes.

TABLE 4-14: Steam Load (lb/hr) for strainer sizing

Entering PSI	Strainer Size ¾"	1"	1½"	2"	2½"
2	60	110	270	450	660
5	96	155	370	525	900
10	120	190	450	760	1100
15	137	230	540	900	1320
20	160	260	625	1150	1550
25	180	300	720	1200	1750
30	200	340	790	1350	2000
35	220	360	860	1450	2200
40	245	400	960	1620	2350
50	290	470	1100	1800	2500

Example: Capacity = 680 lbs/hr 24 PSI steam pressure.
Selection: Valve C_V = 14.0 or more, supply and header = 1½" pipe size.

Explanation: This appears undersized but it is acceptable in pipe sizing to deviate from the table up to 20%. Valve C_V should always be equal to or greater than that called for in the table.

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, the following procedure is *usually* done. Assume you have five tubes to be installed in a 90" high airstream. Divide the 90" by 5 (tubes) = 18", provide a half space 18/2 = 9" at the top and bottom and four spaces between tubes of 18" each. See sketch above. Arrange tubes so steam will blow *against* the air unless tubes are factory insulated (option) in which case they should blow *with* the air to prevent possible condensation on metal jacket covering insulation.

3. Assemble the header based on the spacings determined in step 2. If the header pipe size has not been specified you may use Table 4-13 for this purpose. Table 4-13 is based on a maximum steam velocity of 7 to 10,000 feet per minute which is conservative and will produce low noise levels and uniform steam flow from tube to tube. If noise level is not important or if *uniformity of flow is not critical, smaller header piping* which will result in higher velocities may be used.

4. Install the tube adaptor fittings in the header. (See illustration on the top of page 9.) It usually works best to lay the header on the floor along with the tubes for steps 5, 6 and 7.

5. Install the tubes in the adapter fittings making sure the steam inserts are pointing in the proper direction.

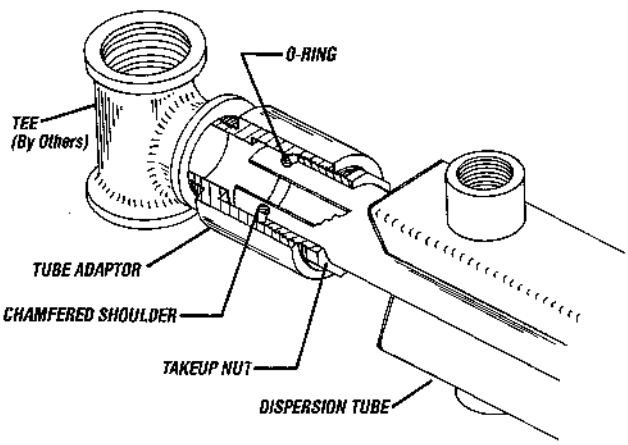
6. Cut to length, thread and install the steam jacket piping.

7. Make the tube support strut using angle or channel iron and bolt each tube end in place.

8. Mount the tube bank in the duct or air handler and complete the steam and condensate piping.

TUBE ADAPTER FOR LARGE MULTIPLE DISPERSION TUBE UNITS

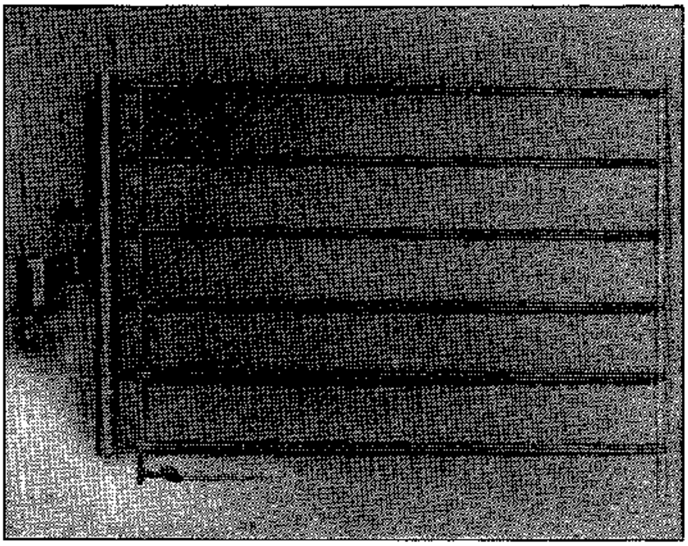
(Used to connect unthreaded tube to threaded pipe fitting.)



INSTALLATION INSTRUCTIONS:

1. Install male pipe thread end of tube adaptor into pipe fitting. Dope threads and tighten leak tight.
2. Install O-ring inside of tube adaptor. The O-ring should be pushed in so it rests against the chamfered shoulder.
3. Install take-up-nut until nut is positioned against the O-ring.
4. Slide tube into adaptor take up nut and through the O-ring being careful not to cut the O-ring when inserting tube.
5. Tighten take-up-nut until tube will not turn. This will seal tubes to adaptor. NOTE: Excessive tightening may damage O-ring.

PRE-ASSEMBLED, LARGE MULTIPLE-TUBE UNIT (MAXI-BANK)



These tube banks are factory assembled and shipped intact except for the very largest which are partially disassembled, match tagged and include a re-assembly drawing with the shipment. The valve-separator assembly, steam traps and strainer are shipped loose. Header piping and all interconnecting piping are furnished. Header pipe is constructed of steel unless stainless steel is special ordered. (Photo above shows stainless steel header.)

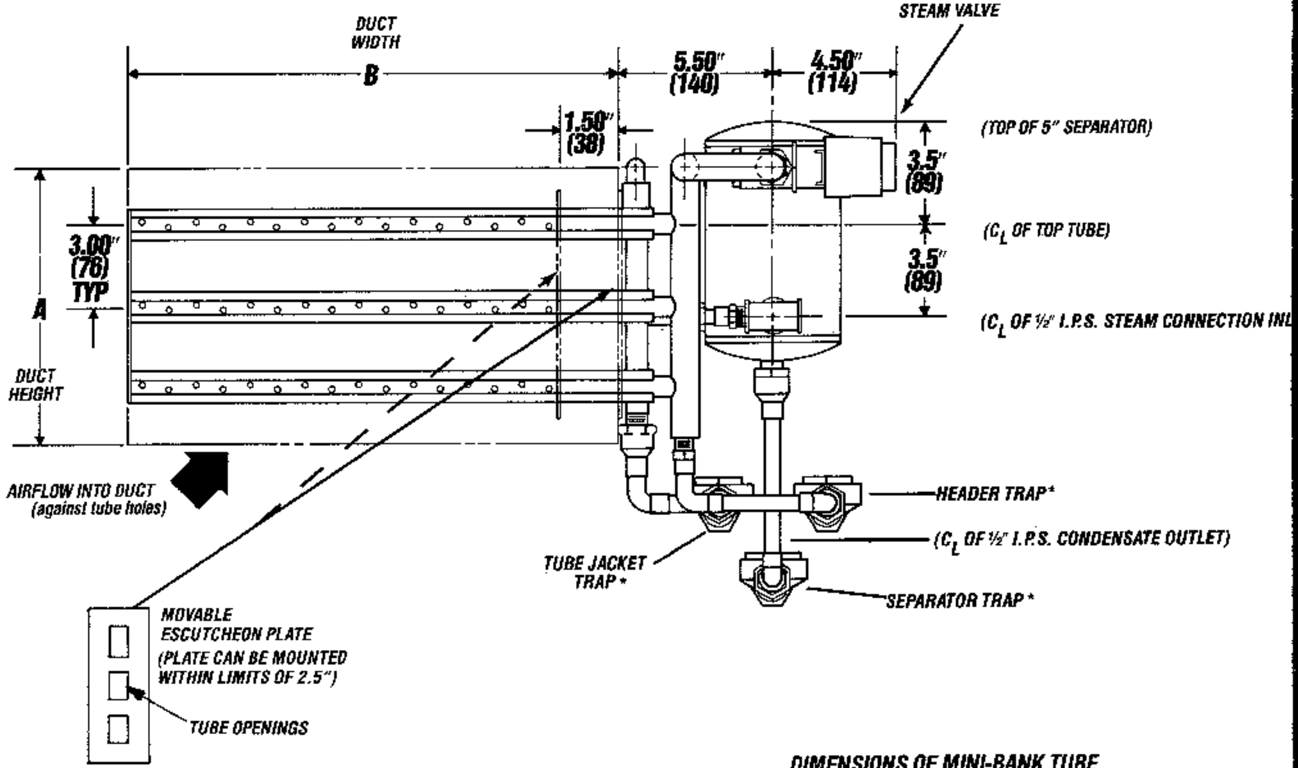
'MINI-BANK' MULTIPLE-TUBE UNIT

The Mini-Bank is shipped as a unit. The tubes are always 3″ on center and as the duct heights vary, more or fewer tubes are needed. It discharges to the right only (viewed from the separator end) unless ordered otherwise. It cannot be altered (right hand to left hand) in the field.

Slightly better mixing with less "fog travel" results when the steam blows *against* the air rather than *with* it. If, however, the factory-applied, insulated jacket option has been supplied, the steam should blow with the air to avoid steam contacting the cool metal jacket and condensing.

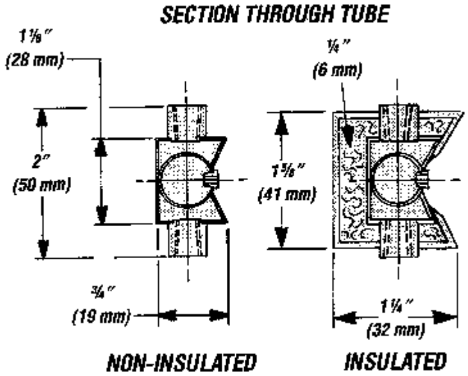
For best mixing the tubes should span at least 90%, preferably 100% of the duct width.

If any of the inserts at the tube ends are causing steam to impinge on the duct wall and condense, these holes should be plugged. Undrilled orifice blanks can be ordered from the factory for this purpose. The orifices are merely pressed in and can easily be replaced.



* NOTE:
In certain installations of steam humidifiers, for structural reasons, it is not possible to drain the humidifier steam traps by gravity. The condensate must be lifted. When this condition exists (MINI-BANK only) it is necessary to remove the steam trap connected to the bottom end of the header pipe: Failure to do this can allow condensate to back up through the header and out the dispersion tube inserts. Remove the trap and close off both openings. This may result in a small amount of moisture discharge into the air stream. It will be very minor! The remaining two traps need no changing. Refer to page 14 for more information on raising condensate.

DIMENSIONS OF MINI-BANK TUBE SECTION THROUGH TUBE



SYSTEM DESIGN

HIGH LIMIT HUMIDISTATS

In a simple heating and ventilating system, *the humidifier is controlled by* a space humidstat which modulates the normally closed humidifier valve to maintain the desired humidity level.

Secondary or "high limit" duct mounted humidity controllers are recommended in any of the following circumstances:

(a) Whenever duct humidity is held at a point approaching saturation in the duct in order to satisfy the space; in hospital work this is quite common. Usually the operating rooms require cooling the year around. The air temperature in the duct will be comparatively low (approximately 55° F) and the desired operating room relative humidity comparatively high (usually 50% to 55% RH) at 72° F. This requires a relative humidity within the duct that approaches saturation.

(b) Whenever on-off control is used instead of modulating control. Usually, the humidifiers are sized for the maximum expected load conditions. As the outside temperature moderates, the relative humidity of the incoming air rises. A point could be reached where saturation could occur in the duct.

(c) Whenever the steam pressure is expected to fluctuate widely (more than 3psig).

High limit humidistat should be mounted a minimum of 5 feet past your specific total absorption distance. Your specific absorption distance should be stated in your mechanical plan and specifications, if not available refer to the Absorption Distance tables in the DRI-STEEM catalog to determine your specific absorption distance. *If none of the above are* available consult the DRI-STEEM factory.

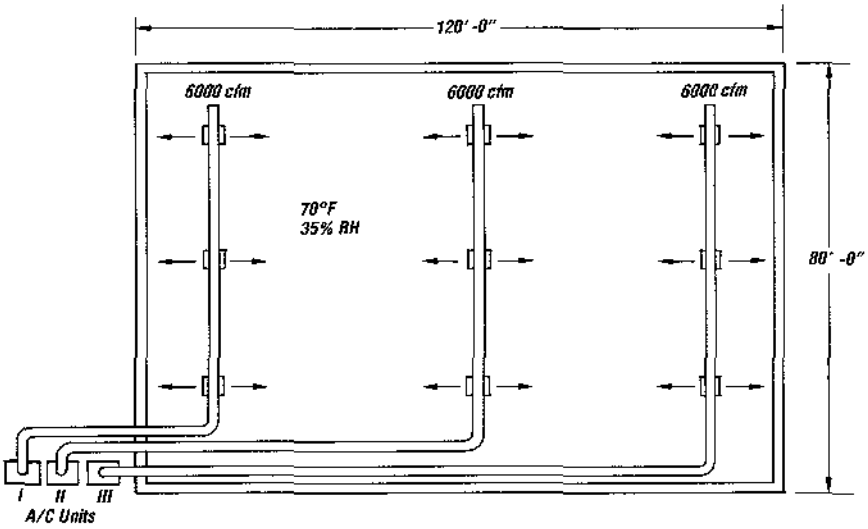
TAKING ADVANTAGE OF VAPOR MIGRATION

Design of humidification systems can often be simplified, and installed cost significantly reduced, when this property of water vapor is put to work.

Water vapor is a gas and behaves under the laws of low pressure gases. As such, when water vapor is introduced into a room or space, the area in the immediate vicinity of the point(s) of introduction undergoes an increase in vapor pressure. The water vapor then, because of this higher pressure, migrates to all parts of the space which are at a lower vapor pressure, whether or not air movement is taking place. The rate of migration or *speed of movement is proportional to the* difference in vapor pressure.

Following is an example, based on Drawing 1-18, to demonstrate the use of this principle:

DRAWING 1-18



An assembly area is served by three air conditioners, each supplying 6000 cfm of air at 55°F. The space is to be humidified to 35% RH at 70°F. The total load is calculated to be 54 lbs per hour.

Since this is an open area with no dividing partitions, water vapor can freely migrate within the space.

In this case, it appears that it would be *less expensive to install one* large humidifier than three smaller humidifiers.

AC Unit "II" would be the best location for this humidifier, since its air discharge is most centrally located within the space.

PRIMARY-SECONDARY vs. SINGLE STAGE HUMIDIFICATION

The primary/secondary technique of humidification is frequently employed in hospital surgery suites and by the use of steam humidifiers.

It consists of a primary humidifier, usually located at the main air handling unit, plus one or more secondary or "booster" humidifiers, each serving a separate zone.

The primary humidifier is usually sized to humidify the total air stream to a 70° F room equivalent level of about 30% (this would be 50% in the duct if the duct temperature were 55° F). It is usually controlled by a duct mounted humidistat.

Each of the secondary humidifiers is sized to bring the humidity level of the zone it serves up to the ultimate desired room level, usually 50% at 70°F (this would be 85% in the duct if the duct air, again, were at 55°F).

This humidifier is usually controlled by a wall humidistat mounted within the zone or space it serves.

There are two advantages derived by using this method.

The first is quite obvious. It provides individual zone control.

The second may not be as obvious. It *permits more precise control of the* quantity emitted by the "booster" humidifier and alleviates the problem of "visible steam discharge" into the surgery room. In two-stage humidification, the "booster" humidifier "sees" air at a fairly constant humidity level. Such being the case, the valve is not required to modulate the steam quantity over as wide a capacity range as in the one-step system. In a one-step system, the humidifier "sees" air *ranging from near zero relative humidity* in winter to fully humidified in summer. So the "booster" humidifier is required to adjust for wide swings in steam quantity requirements.

It must be remembered that in either the one or two-stage method, assuming zone humidifiers are used, the load is comparatively small and will dictate the use of small capacity valves which will have low turn down ratios. This design technique, therefore, does compensate for the inherent deficiency in the modulating capability (turn down ratio) of small capacity steam valves.

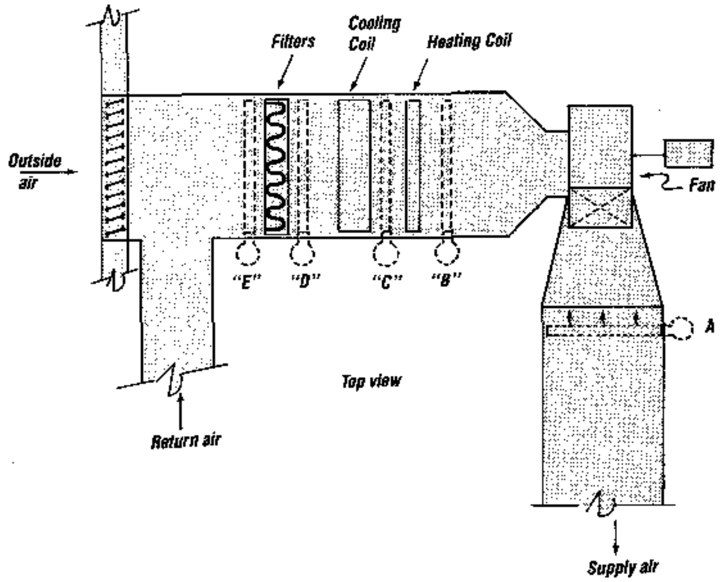
PLACEMENT OF THE HUMIDIFIER WITHIN A SYSTEM

Usually, there is no *single* right or wrong placement for a humidifier. Much depends on the system design, its uses and its applications.

However, the following are presented as practical alternatives to some of the most common situations.

Example 1: Placement in an Air Handling Unit

DRAWING 1-20



Location "A" is the first choice, assuming there is sufficient straight duct distance downstream of the humidifier for absorption to take place. If nearby downstream inner-duct objects (dampers, turning vanes, etc.) are present, the use of a "rapid absorption" design should be considered, or another location selected.

Location"B" may be the next choice, assuming that steam absorption can be completed prior to entering the fan, otherwise the fan may be damaged. Furthermore, wetted areas are potential producers of algae and/or bacteria. If the required duct relative humidity design is high, due to coolness of the air, closely-spaced multiple tubes may be required to accomplish rapid absorption, in order to protect the fan. With certain humidifier designs, it is possible to complete absorption within a steam travel distance of 24 inches.

Location "C" is a possibliity. However, when and if the heating coil is cold, it will condense some of the humidifying vapor. In the absence of a drain pan or waterproof floor, this may not be acceptable. If the coil is *always* heated during the humidifying season, it offers more absorption distance to protect the fan and would be a better location than "B".

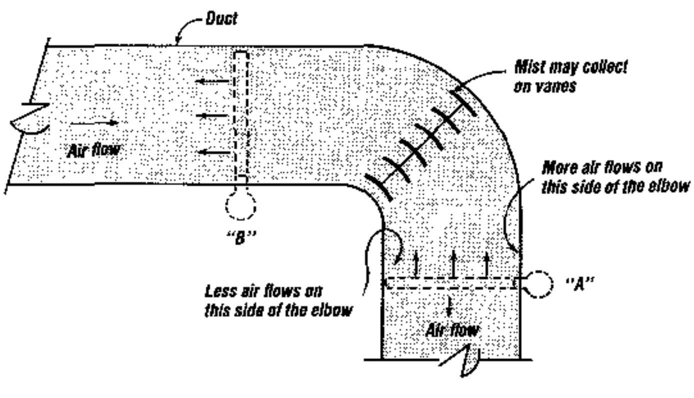
Location "D" is a poorer location than "C" because the cooling coil will act as a moisture eliminator. Cooling coils have drain pans below them so water accumulation is not a danger.

However, the condensed vapor represents a waste. Sometimes, even more important, is the fact that condensed water vapor can be very corrosive. There are cases on record where cooling coils have been destroyed, over time, with condensed humidification vapor felt to be the cause.

Location "E" would be an extremely poor choice because the filters would become saturated and/or covered with ice.

Example 2: Placement in an Elbow

DRAWING 2-20



Because of possible wetting of turning vanes, the downstream side of an elbow (location "A") is a better choice than "B". In cases where it is structurally impossible to avoid location "B", a "rapid absorption" design may be required at "B". Discharging *against* the air stream gives slightly better mixing than discharging *with* the air stream.

Since more air flows along the "outside" of a turn, better absorption will result if the humidifier discharges proportionately more steam in that part of the air stream.

Example 3: Placement in a Dual Duct System

In numerous cases, dual duct systems have been designed with a single humidifier installed in the hot deck. The results have not been successful. Those zones having a low heat loss are supplied predominantly with non-humidified, cool air and become short of moisture.

In this type of system, the hot and cold deck air *temperatures usually* are constant, and temperature control in each zone is accomplished at the zone mixing box in the space, by varying the ratio of hot vs. cold air.

As the heating-cooling load within the building changes, the ratio of the volumes of hot and cold air in the two decks swings along with it. Neither single location, hot deck or cold deck, will be satisfactory at all times for the addition of humidity.

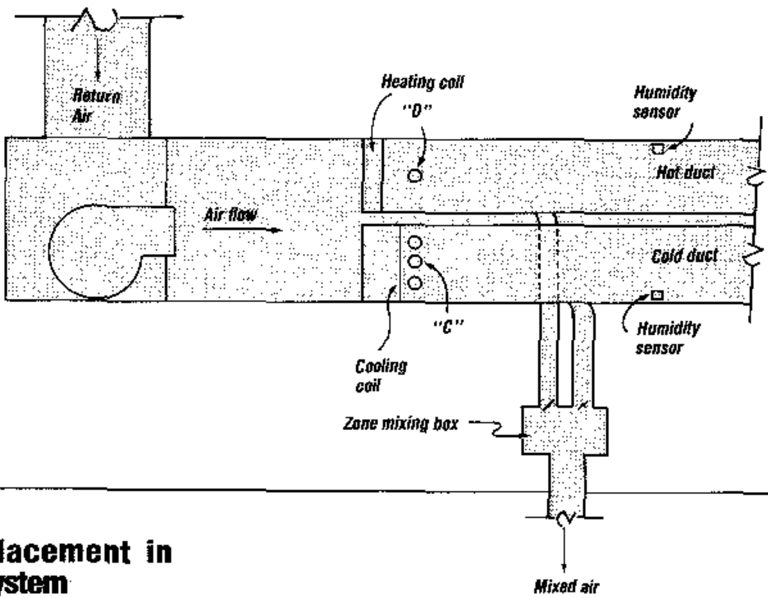
It is usually neccessary, therefore, to treat each of the two decks separately, i.e., each with its own humidifier and sensing device (humidistat).

Usually each of the two humidifiers is selected for the total building humidification load. In other words, if the total load is 400 pounds per hour, *each* humidifier would have a capacity of 400 pounds per hour. This is done to assure adequate humidifier capacity at times of 100% hot deck air and vice versa. Special attention should be given to the steam absorption distance, particularly in the cold deck.

The downstream humidistat in each duct must be set for the room or space *duct equivalent* relative humidity. For example, in a system where the cold duct temperature is a constant 55°F, and the desired space conditions are 72°F and 45% RH, the duct humidistat must be set to control at 80% RH.

The humidistat must be far enough downstream to escape the moisture "cloud" in order to control accurately.

DRAWING 1-21



Example 4: Placement in a Multi-Zone System

For reasons of economy, the usual *objective when humidifying a multiple* zone system is that of using a single humidifier rather than one for each zone. Application of a humidifier to this equipment is sometimes difficult because the system is so compact. It can usually be done, however, with satisfactory results.

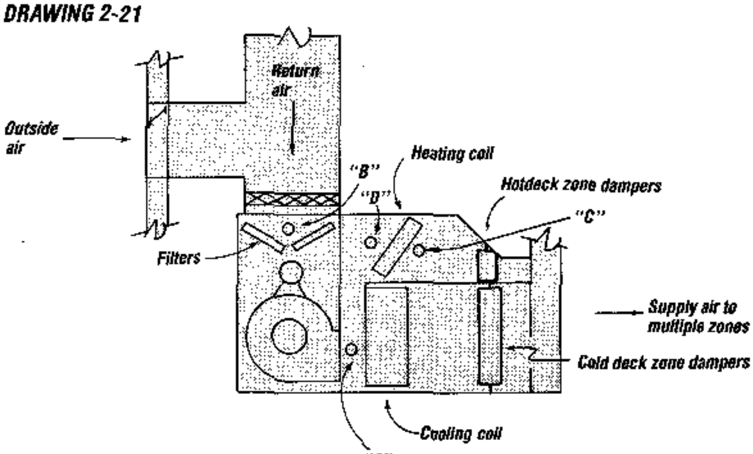
Location "A" is generally the best. It affords the maximum absorption distance ahead of the zone dampers. Some loss of vapor may occur due to *condensation* on the cooling coil, but since there is a drain pan below the coil, no damage will occur. In cases where the *duct* relative humidity exceeds 50%, multiple steam tubes should be used to shorten the absorption distance.

Location "C" is in a warmer location, but is a shorter distance to the dampers than "A". The same is true for location "D".

Location "B" is *not acceptable because* it will cause wetting of the filters and the fan.

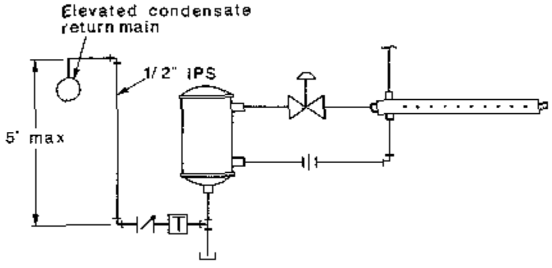
In some applications, the air quantity of one of the zones will be larger and may be sufficient to absorb all of the humidity required for all of the zones. This is easily checked by the use of Table 1-16, Page 16. If such is the case, that particular zone may be a more desirable location for adding humidity than within the air handling unit itself. While it is true that a differential in relative humidity between zones will exist for a period of time after start-up, it will eventually equalize as the system is operated.

DRAWING 2-21



ELEVATING THE CONDENSATE FROM A STEAM HUMIDIFIER

In certain installations of steam humidifiers, for structural reasons, it is not possible to drain the humidifier steam trap by gravity. The condensate must be lifted. Generally, this is not recommended because of possible water hammer, improper drainage when steam pressure is low, etc. But, when absolutely necessary, it can usually be done successfully by observing several rules.



Steam Pressure

Theoretically, one pound of pressure will raise water about 2 feet. In practice, because of pipe friction, pressure drop through a steam trap, back pressure in a return line, etc., a maximum lift of 1/2 foot per pound of steam pressure at the trap is recommended. For example, a steam pressure of 5 psi will provide a maximum lift of 2 1/2 feet. Lifts in excess of 5 feet should not be attempted.

Steam Trap

The trap used should be of a type that is full open or closed as it operates, such as the inverted bucket or disk types. Float and thermostatic traps, where the degree of valve opening in the trap varies with the flow rate, impose an excessive pressure drop at low flow rates and may not do the job.

Pipe size

The size of the vertical portion of the piping usually should not be larger than 1/2" IPS.

Check Valve (Swing Type)

A low pressure differential swing check valve should be provided, adjacent to the trap, to 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 pressure is resumed. (See Drawing 1-22.)

ELIMINATING EXCESS HEAT FROM STEAM-JACKETED HUMIDIFIERS

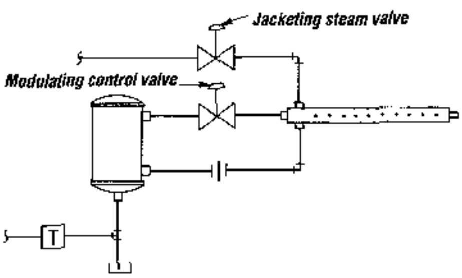
In certain applications of steam jacketed humidifiers, the heat given off by the steam heated tube (not the sensible heat of the steam) may be undesirable. While relatively insignificant in a single tube unit (usually less than 2°F), it can be several times that amount in a closely-spaced, multiple-tube installation.

This can be dealt with in several ways:

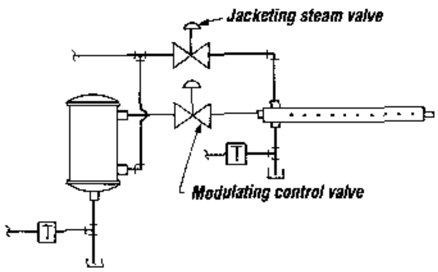
1. Manually valving off the steam supply during non-humidifying periods
2. Insulating the tube exterior. This will enlarge the tube profile, thus causing additional resistance to air flow
3. Providing an automatic shut-off valve for the jacketing circuit, in addition to the modulating control valve. This, of course, eliminates the heat gain during the "off" humidification periods only. (See Drawing 2-22.)

There are two methods of handling automatic jacketing steam valves. The basis for the decision between the two is one of valve cost — the larger the valve, the greater its cost.

DRAWING 2-22



DRAWING 3-22



In Drawing 2-22, all of the steam (for jacketing *and* humidification) must pass through the jacketing steam valve, and it must do so with very little or no pressure drop across the jacket valve. Otherwise, the maximum capacity will be reduced. Perhaps even more serious, the temperature of the jacketing steam may drop below that required to eliminate dripping.

Therefore, the valve must be amply sized. This is not particularly significant in a small capacity humidifier. However, in a large capacity humidifier, the required large size of the valve will cause it to be very expensive.

Drawing 3-22 shows a steam flow which has been divided into two paths; one, a humidifying steam path (which passes through the separator), and the other, a jacketing steam path.

To assure air removal and the presence of jacketing steam, it is necessary to provide a second steam trap which serves the jacketing circuit. However, the jacketing valve need only be of 1/2" IPS to pass sufficient jacket steam.

In either case, but particularly as illustrated in Drawing 2-22, the jacketing valve should be two positional in operation and should be required to go to the full-open position prior to beginning the opening of the modulating valve.

POSSIBLE MALFUNCTIONS AND PROBABLE CAUSES

I. HUMIDIFIER DISCHARGES WATER
- A. Steam main filled with water due to priming boiler or malfunctioning end-of-main drip trap
- B. Steam pressure too low (below 2 psi)
- C. Dispersion tube not level
- D. Steam trap not functioning properly
  1. Steam trap clogged with foreign matter
  2. Overloaded or flooded return main
  3. Back pressure too high in return main
  4. Manual steam shut-off valve not fully open (causes steam pressure loss)

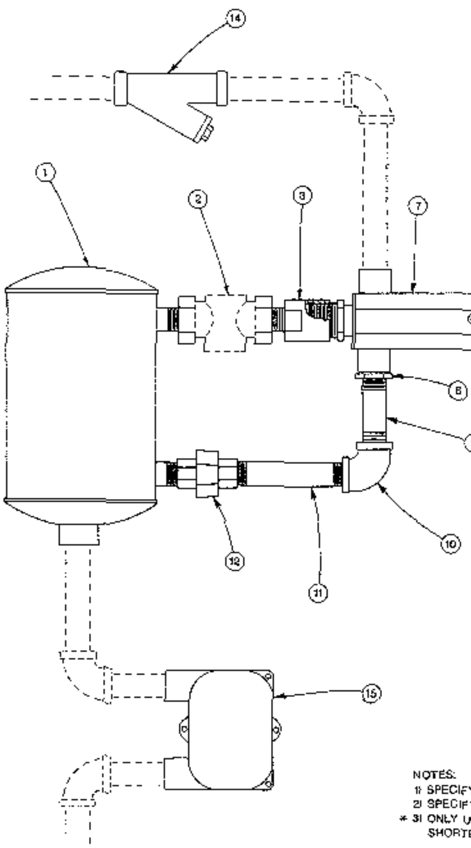
II. HUMIDITY EXCEEDS DESIRED LEVEL
- A. Leak in outer jacket or dispersion tube
- B. Automatic valve not closing fully
  1. Foreign matter holding valve open
  2. Valve spring broken
  3. Humidity controller out of calibration
  4. Malfunction in control system
  5. Valve packing adjusted too tightly (valve sticks)

III. HUMIDITY SWINGS ABOVE AND BELOW DESIRED CONTROL POINT
- A. Faulty or inaccurate humidity controller
- B. Humidity controller mounted in poor sensing location
- C. Automatic valve is "hunting" because:
  1. Humidifier is oversized
  2. Pressure reducing valve is not controlling accurately
  3. Boiler pressure is swinging too widely
  4. Valve is sticking

IV. HUMIDITY IS TOO LOW
- A. Steam pressure is too low
- B. Strainer screen is partially clogged
- C. Manual steam shut-off value is partially closed
- D. Humidity controller is out of calibration
- E. Humidifier is undersized
- F. Automatic valve is not opening fully
  1. Valve packing is adjusted too tightly
  2. Air leak in diaphragm of pneumatic valve operator

V. CONDENSATION IN DUCT
- A. Air temperature in duct is too low (cool air won't absorb *as much as warm air)*
- B. Humidifier is mounted too close to internal devices in duct (coil, turning vanes, etc.) Steam must "disappear" before contacting these devices.
- C. Non-insulated duct passing through unheated area
- D. Humidifier valve not interlocked with blower controls
- E. Valve is "hunting" (see III)
- F. Too much steam for the amount of air

DRI-STEEM STEAM INJECTION PARTS LIST



NOTES:
1) SPECIFY SIZE OF ORIFICE BORE IN INSERT
2) SPECIFY LENGTH OF TUBE
* 3) ONLY USED IN 60/70 TUBES FOUR FEET OR SHORTER

NO.	DESCRIPTION	QTY.	PART NO.	MODEL
15	INVERTED BUCKET TRAP	0-1	300010	15 PSI OR GREATER
15	F&T STEAM TRAP	0-1	300000	LESS THAN 15 PSI
14	Y-STRAINER- 2-1/2"	0-1	300100-007	(SPECIFY SIZE PER JOB)
14	Y-STRAINER- 2"	0-1	300100-006	
14	Y-STRAINER- 1-1/2"	0-1	300100-005	
14	Y-STRAINER- 1"	0-1	300100-003	
14	Y-STRAINER- 3/4"	0-1	300100-002	
14	Y-STRAINER- 1/2"	0-1	300100-001	
13	80 TUBE INSERT	0-1	310290	(ALL)8-80
13	60-70 TUBE INSERT	0-1	310280	(ALL)5-60,6-70,7-70
12	1-1/2" UNION-BLK	0-1	202200-009	(ALL)8-80
12	3/4" UNION-BLK	0-1	201200-020	(ALL)6-70,7-70
12	1/2" UNION-BLK	0-1	201000-015	(1/2"VALVE)5-60
11	1-1/2" NIPPLE-BLK	0-1	202200	(ALL)8-80
11	3/4" NIPPLE-BLK	0-1	201200	(ALL)6-70,7-70
11	1/2" NIPPLE-BLK	0-1	201000	(1/2"VALVE)5-60
10	1-1/2" 90° ELBOW-BLK	0-1	202200-006	(ALL)8-80
10	3/4" 90° ELBOW-BLK	0-1	201200-014	(ALL)6-70,7-70
10	1/2" 90° ELBOW-BLK	0-1	201000-010	(1/2"VALVE)5-60
9	1-1/2" x 3-1/2" NIPPLE-BLK	0-1	202200-003	(ALL)8-80
9	3/4" x 3" NIPPLE-BLK	0-1	201200-005	(ALL)6-70,7-70
9	1/2" x 3-1/2" NIPPLE-BLK	0-1	201000-006	(1/2"VALVE)5-60
8	1-1/2" - 11-1/2 NPT SEAL RING	0-1	306360-003	(ALL) 8-80
8	3/4"-14NPT SEAL RING	0-1	306360-002	(ALL)6-70,7-70
8	1/2"-14NPT SEAL RING	0-1	306360-001	(1/2" VALVE)5-60
7	MODEL 80 TUBE	0-1	161750	(ALL)8-80
7	MODEL 70 TUBE	0-1	161500	(ALL)6-70,7-70
7	MODEL 60 TUBE	0-1	161000	(1/2"VALVE)5-60
* 6	*MED. GR. SST WOOL (NOT SHOWN)*	0-1	300210	(ALL)5-60,6-70,7-70
* 5	SST-SILENCER HOLDER (NOT SHOWN)	0-1	300200	(ALL) 5-60,6-70,7-70
4	80 O-RING #026 (NOT SHOWN)	0-2	300400-002	(ALL)8-80
4	60-70 O-RING #018.MG (NOT SHOWN)	0-2	300400-001	(ALL)5-60,6-70,7-70
3	1-1/2"NPT x 1-1/2" TUBE ADAPTER	0-1	203680-007	(1-1/2"VALVE)8-80
3	1-1/4"NPT x 1-1/2" TUBE ADAPTER	0-1	203680-006	(1-1/4"VALVE)8-80
3	1"NPT x 1-1/2" TUBE ADAPTER	0-1	203680-005	(1"VALVE)8-80
3	1"NPT x 1" TUBE ADAPTER	0-1	203680-003	(1"VALVE)7-70
3	3/4"NPT x 1-1/2" TUBE ADAPTER	0-1	203680-004	(3/4"VALVE)8-80
3	3/4"NPT x 1" TUBE ADAPTER	0-1	203680-002	(3/4"VALVE)6-70,7-70
3	1/2"NPT x 1" TUBE ADAPTER	0-1	203680-001	(1/2"VALVE)5-60,6-70,7-70
2	VALVE (REFER TO SPECIFIC ORDER)	1		ALL
1	*8" - 1-1/2" VERTICAL SEPARATOR*	*0-1*	*162570-004*	*(1-1/2"VALVE)8-80*
1	8" - 1-1/4" VERTICAL SEPARATOR	0-1	162570-003	(1-1/4"VALVE)8-80
1	8" - 1" VERTICAL SEPARATOR	0-1	162570-002	(1"VALVE)8-80
1	8" - 3/4" VERTICAL SEPARATOR	0-1	162570-001	(3/4"VALVE)8-80
1	7" - 1" VERTICAL SEPARATOR	0-1	162560-003	(1"VALVE)7-70
1	7" - 3/4" VERTICAL SEPARATOR	0-1	162560-002	(3/4"VALVE)7-70
1	7" - 1/2" VERTICAL SEPARATOR	0-1	162560-001	(1/2"VALVE)7-70
1	6" - 3/4" VERTICAL SEPARATOR	0-1	162540-002	(3/4"VALVE)6-70
1	6" - 1/2" VERTICAL SEPARATOR	0-1	162540-001	(1/2"VALVE)6-70
1	5" - 1/2" VERTICAL SEPARATOR	0-1	162520-001	(1/2" VALVE)5-60

MAINTENANCE RECORD AND NOTES

DATE	

INSTALLATION DATE ______________________________ **INSTALLER** ______________________________

MAINTENANCE NOTES:

1. STRAINER—When the system is new the screen should be inspected at least twice during the first year. If found fouled, more frequent inspection and cleaning should be provided.

2. STEAM TRAP—At least twice a year verify that the steam trap is functioning properly. A blocked steam trap will be cold. A "blowing" steam trap will be hot and noisy and the discharge pipe from it will be hot a continuous distance up to thirty feet. A properly operating steam trap will be hot and make noise at intervals and the discharge pipe from it will be progressively cooler beginning at the trap.

3. VALVE (Pneumatic)—Should be inspected annually to be sure 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.

   VALVE (Electric Modulating)—Should be inspected annually to be sure that the valve operates freely, closes off steam tight and that the stem packing is not leaking.

   VALVE—(Solenoid Type)—Inspect annually to verify proper functioning with steam tight shut off.

4. SILENCER—Should be inspected at least annually for cleanliness. Clean or replace as needed.

5. TEFLON SEAL RINGS—After one year of service they may require replacement whenever disturbed because the teflon sometimes takes a "set."

6. "O" RINGS—(Dispersion Tube Adapters)—Replace after two or three years or service.

7. SEPARATOR—No maintenance required.

8. DISPERSION TUBE—No maintenance required.

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