Conditioned Steam Humidifiers

industrial processes
office buildings
printing
hospitals
warehouses

Armstrong

Armstrong®
Intelligent System Solutions™
STEAM • AIR • HOT WATER

When It Comes to Improving Humidification… It Starts with Steam

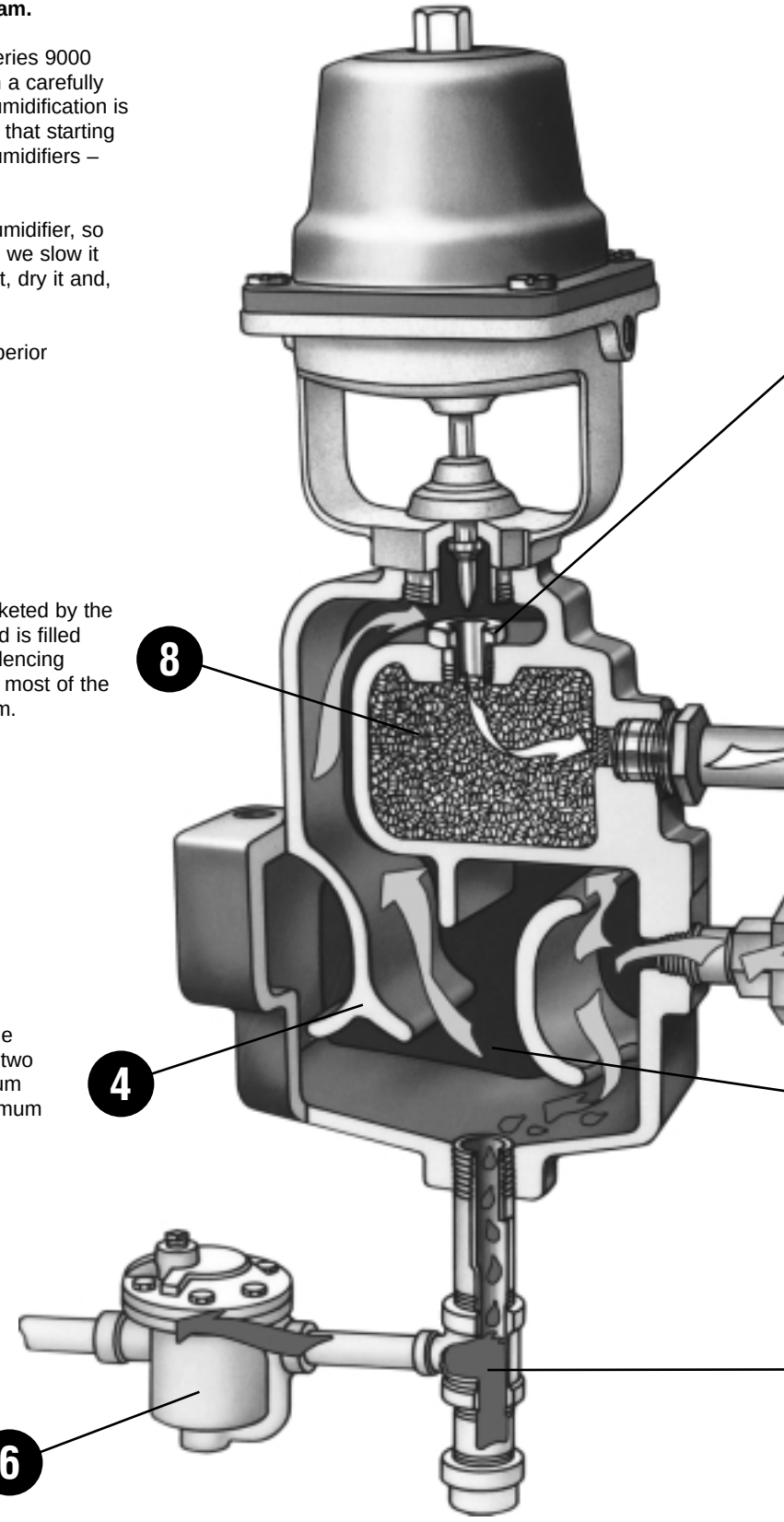
Why the Armstrong Series 9000 humidifier starts with steam

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

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

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

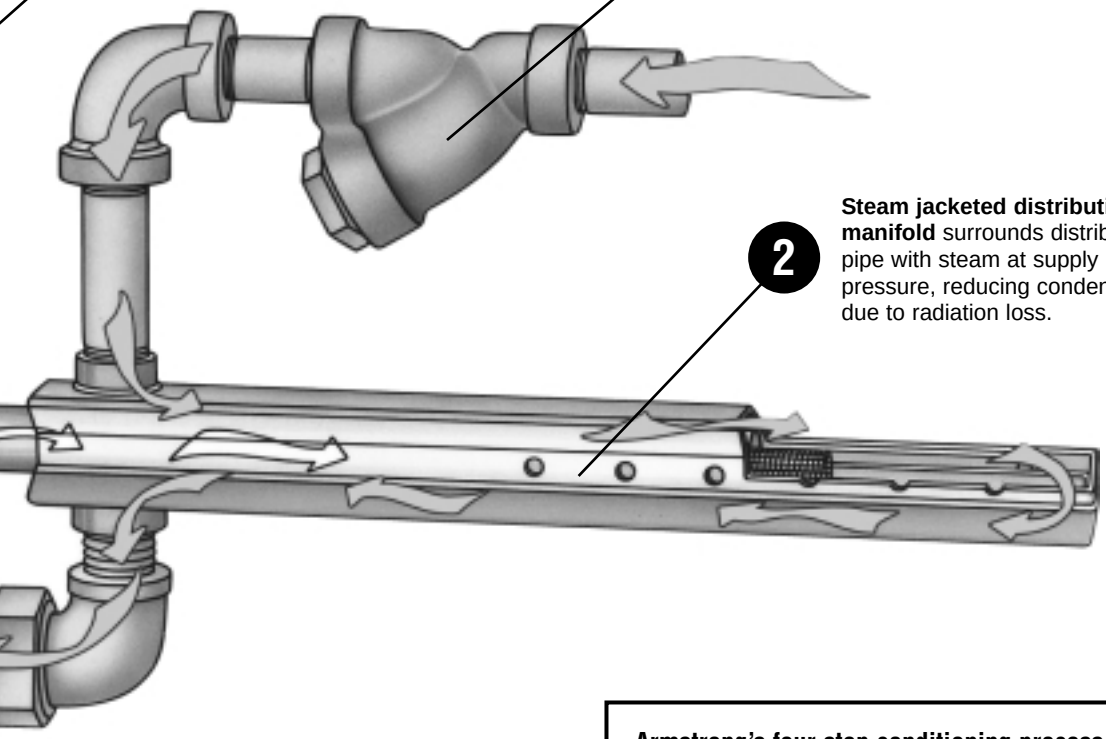
Conditioned steam. It's the cornerstone of the Series 9000's superior performance and control. Here's why.



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

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

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



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

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

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

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

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

Armstrong's four-step conditioning process

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

Precise Control and Uniform Distribution

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

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

Precise flow control can be achieved with a valve designed expressly for the purpose of adding steam to air. All Armstrong modulating humidifiers employ unique parabolic plug type valves. See Figure 44-1.

Armstrong uses an exclusive modified plug for the control valve to accomplish this. The modification of true linear characteristics provides more precise control when capacity requirements are very low and the valve is just cracked off the seat. Notice in Chart 44-1 that at point A on the curve more than half the valve stroke is devoted to 40% of the unit's capacity. At point B, one-quarter of the stroke is devoted to only 10% of capacity. At point C, 10% of the stroke covers less than 5% of the unit's capacity.

How low can the unit control? Table 44-1 tabulates this function, called rangeability. Rangeability is the ratio between the maximum controllable flow and the minimum controllable flow of steam through the valve. The higher the rangeability of a valve, the more accurately it can control steam flow at low outputs.

To calculate this minimum flow, simply multiply Continuous Discharge Capacity by the percentage shown in Table 44-1. **For example**, a 9/32" orifice at 1 bar can discharge 34 kg/h. The lowest output that can be controlled is 2.5% of 34 or 0,85 kg/h.

Table 44-1. Steam Humidifier Valve Rangeabilities

	Valve	Rangeability	
Humidifier Models	**Equivalent Diameter (In)**	**Ratio of Flow Max.:Min.**	**Minimum Flow % of Maximum**
Model No. 94	1 1/2"	63:1	1,6
	1 1/4"	69:1	1,4
	1 1/8"	61:1	1,6
	1"	53:1	1,9
	7/8"	44:1	2,3
	3/4"	33:1	3,0
	5/8"	25:1	4,0
Model No. 93	3/4"	118:1	0,8
	5/8"	123:1	0,8
	9/16"	105:1	0,9
	1/2"	97:1	1,0
	15/32"	85:1	1,2
	7/16"	75:1	1,3
	13/32"	64:1	1,6
Model No. 92	1/2"	97:1	1,0
	7/6"	75:1	1,3
Model No. 90, 91 or 92	3/8"	70:1	1,4
	11/32"	59:1	1,7
	5/16"	49:1	2,0
	9/32"	40:1	2,5
	1/4"	31:1	3,2
	7/32"	24:1	4,2
	3/16"	18:1	5,6
	5/32"	59:1	1,7
	1/8"	37:1	2,7
Model No. 90 or 91	7/64"	28:1	3,5
	3/32"	21:1	4,8
	5/64"	15:1	6,9
	1/16"	10:1	10,0

Figure 44-1. Parabolic Plug Metering Valve
Parabolic plug valve configuration permits accurate modulation of flow over the complete stroke of the valve.

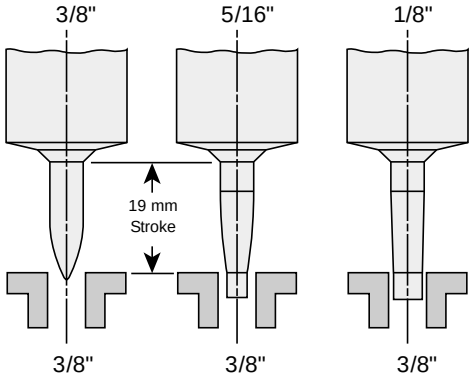
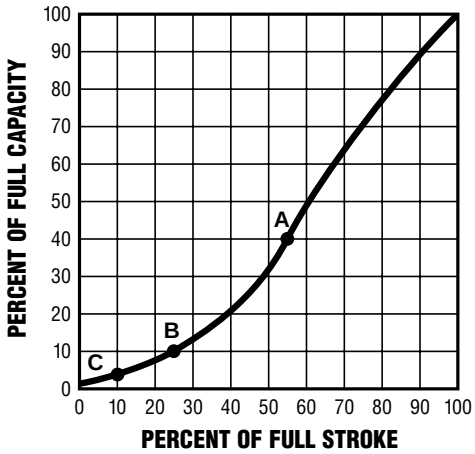


Chart 44-1.
Modified linear characteristic curve for valves used under modulating control. The modification of true linear characteristics provides more precise control when capacity requirements are very low and the valve is just cracked off the seat.



All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Humidifier operators

The operator for the valve is equally important to humidifier control, and several types are available to provide compatibility with the system in which they are installed. The operator must be able to position the valve in very nearly identical relationship to the seat on both opening and closing strokes. This is essential in order to provide consistent, accurate metering of steam discharged by the humidifier.

By their design, electric motor modulating actuators provide true linear positioning characteristics on both opening and closing cycles. Pneumatic operators may or may not be able to provide the precise positioning and holding characteristics essential to accurate control.

Rolling diaphragm type pneumatic operators are recommended, providing they meet the following criteria:

1. Large diaphragm area – 77 cm² or more – to provide ample lifting force. This permits the use of a spring heavy enough to stabilize both the hysteresis effect and the flow velocity effect on the positioning of the valve stem versus air pressure to the operator.

2. Diaphragm material that is highly resistant to wear or weakening from continuous cycling and high temperatures.

3. Operator stroke long enough, in conjunction with valve plug and seat design, to provide high rangeability ratios.

4. Easy serviceability.

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

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

Temperature switches are recommended.

Temperature switches prevent humidifier operation until start-up condensate is drained and the entire unit is up to steam temperature, thus eliminating the possibility of spitting on cold start-up.

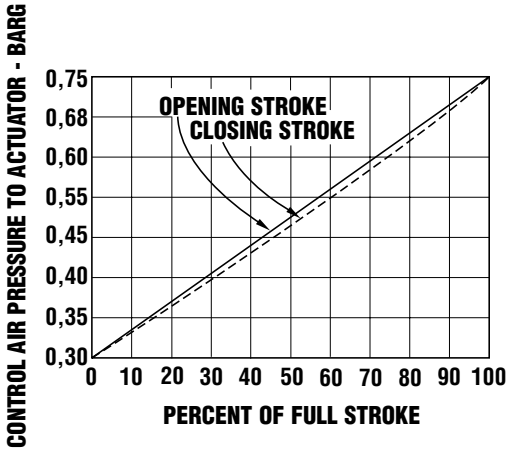
Either pneumatic or electric temperature switches are recommended in any system where the steam supply to the manifold jacket and humidifier body may be interrupted or turned off, such as summer cycles. Cold piping downstream of the on/off valves can generate spitting.

Table 45-1. Operator Spring Ranges for Pneumatically Controlled Humidifiers

Armstrong C-1801		Honeywell MP953D	
Operating Range	Adjustable Start points	Operating Range	Non-Adjustable Start points
0,34 bar	0,21 bar minimum	0,27 bar	0,21 bar
0,69 bar*	0,21 bar minimum	0,34 bar	0,55 bar
		0,48 bar*	0,27 bar

* Standard spring - furnished when no spring range is specified.

Chart 45-1.
Modified linear characteristic curve for valves used under modulating control. The modification of true linear characteristics provides more precise control when capacity requirements are very low and the valve is just cracked off the seat.



All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Installation of Armstrong Duct-Type Humidifiers for Air Handling Systems

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

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

Horizontal manifolds should be perfectly level with the discharge holes pointed upstream against the air flow. **Note:** If manifold is insulated, discharge holes must point downstream to prevent condensation on metal insulation cover. Manifolds over 30 cm in length should be supported.

Steam supply and condensate drain piping should be made in accordance with good piping practice. Trap discharge must be connected to a return line with pressure well below supply pressure to the humidifier. Please see Basic Application Principles in the Humidification Engineering section beginning on Page 24 of this catalogue.

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

Primary Methods of Installation

Figure 46-1. Method Number 1

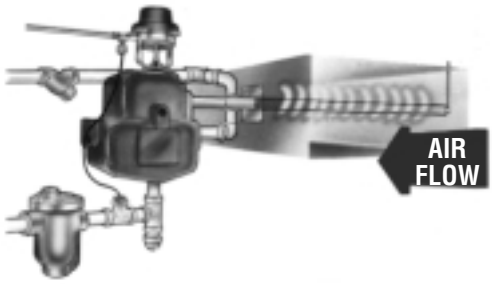


Figure 46-2. Method Number 2

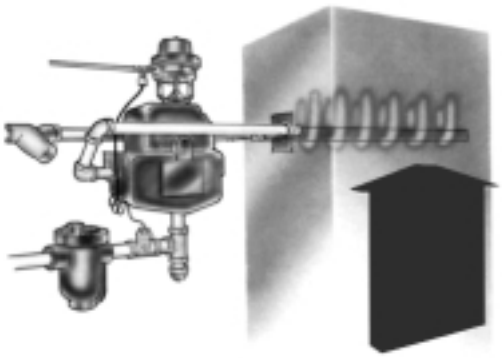
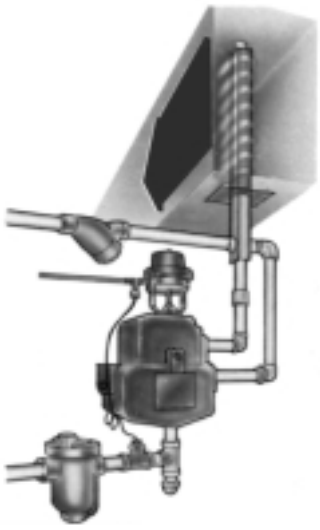


Figure 46-3. Method Number 3



Steam Supply Methods

Figure 47-1. Steam supply through manifold

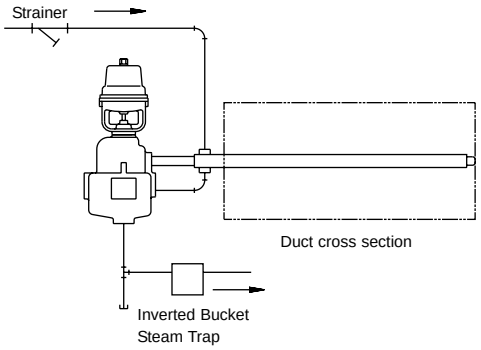


Figure 47-2. Steam supply direct to separator (Manifold trapped separately)

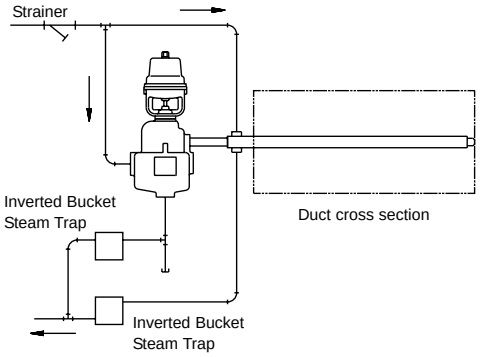
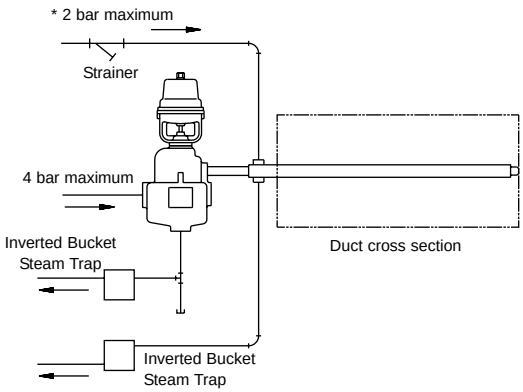


Figure 47-3. Steam supply direct to separator (Manifold trapped separately)



* 2 bar maximum for size 94 and 1400 manifolds.

How to Order

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

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

2. Size of humidifier for duct installation – 91, 92, 93, 94
3. Manifold length from Table 51-2, Page 51.
4. Specify steam pressure and capacity required in accordance with Tables on Pages 52 and 53.
5. For electrically operated models, state electrical characteristics (control signal, and power supply voltage).

Suggested Specification

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

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

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

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

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

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

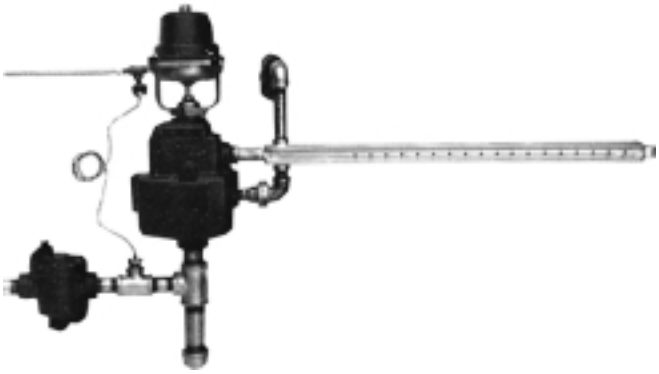
F. The distribution manifold shall provide uniform distribution over its entire length and be jacketed by steam to assure that vapor discharged is free of water droplets.

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

The Armstrong Series 9000 Humidifier

(physical data, dimensions and capacities)

Figure 48-1.



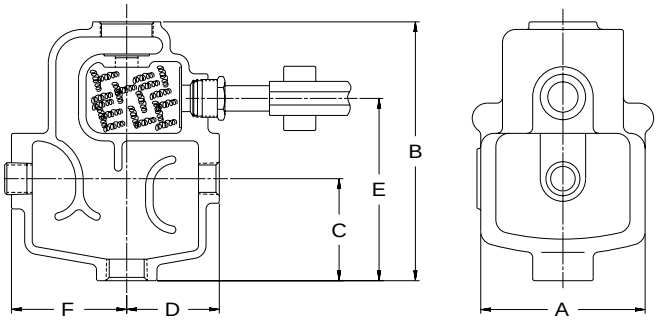


Table 48-1. Physical Data

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

* Add height and weight of operator for overall data. All dimensions are in millimeters.
†Weight includes drain trap, strainer, and fittings.
For Physical Data on Series 1000 Stainless Steel Humidifiers, see Page 50.

Table 48-2. List of Materials

Steam Chamber	Cast Iron	Manifold Fittings	Brass
Bonnet Assembly	Brass	Manifold Coupler	Brass
Valve & Stem	18-8 Stainless Steel	Nut	Brass
Valve Seat	18-8 Stainless Steel	Strainer	Cast Iron
Manifold	304 Stainless Steel	Steam Trap	Cast Iron

Armstrong Conditioned-Steam Humidifiers for air handling systems are manufactured to meet the needs of central station humidification or booster humidification. Operation and control may be pneumatic or electric. See Page 54.

Standard Package

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

Pneumatically Controlled (AM) Models:

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

Electric Motor Controlled (EM) Models:

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

Recommended Option

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

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Armstrong International SA • Parc Industriel des Hauts-Sarts (2e Avenue) • 4040 Herstal • Belgium
Tel.: +32 (0)4 240 90 90 • Fax: +32 (0)4 248 13 61
www.armstrong.be • marketing@armstrong.be

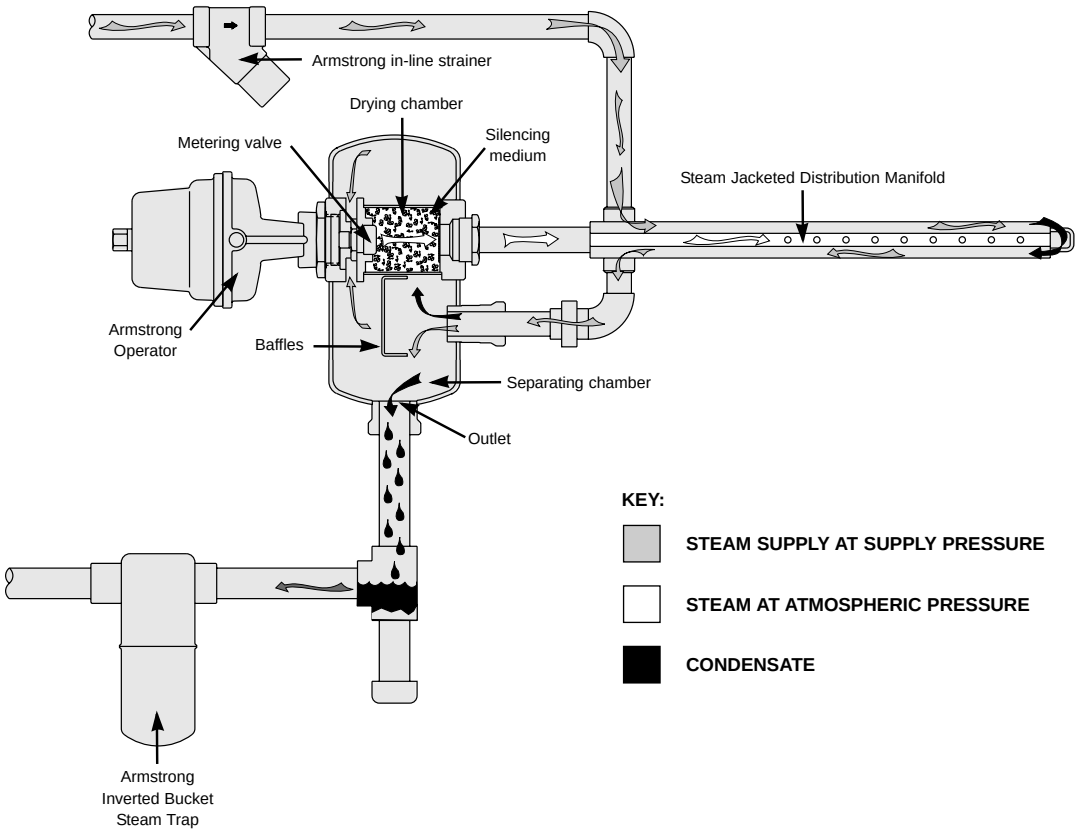
The Armstrong Series 1000 Stainless Steel Humidifier

Armstrong also offers a steam separator-type humidifier **for use in sensitive environments** where pure demineralized, deionized or distilled water is used to generate clean steam.

All wetted parts of **the humidifier package** are **stainless steel**, so the carry-over of impurities created by this highly corrosive water is minimized. Whenever carryover of impurities is a problem in steam discharge, the Armstrong Series 1000 solves it – with precisely controlled, trouble-free steam humidification.

- **Reduced corrosion threat.** Since Armstrong uses stainless steel for all wetted parts, the Series 1000 prevents problems caused by corrosion and subsequent carry-over of corrosion by-products.
- **No condensation through radiation.** The internal plug-type metering valve is an integral part of the steam separator and is completely steam jacketed to prevent condensation through radiation. What's more, the **steam jacketed** steam distribution manifold completely surrounds the distribution pipe with steam at supply pressure, further reducing condensation due to radiation loss.
- **Effective silencing.** Thanks to a drying chamber that is jacketed by the separating chamber and filled with a stainless steel silencing medium, most of the noise of escaping steam is absorbed.
- **Dry steam discharge.** Steam entering the drying chamber is at supply temperature and essentially atmospheric pressure, so any remaining mist is re-evaporated.
- **Maximum separation.** The interior baffle **conditions** the steam by forcing it to make two 180° turns, assuring optimum velocity reduction and maximum separation.
- **Dependable inverted bucket drainage.** With only two moving parts, the reliable, energy saving inverted bucket steam trap provides reliable drainage with a design that allows failure open – important on open-end service.

For Series 1000 humidifier capacities, see Pages 52 and 53.



The Armstrong Series 1000 Humidifier, continued…

(physical data, dimensions and capacities)

Humidifier Operators.
Pneumatic Modulating
Electric Modulating
Electronic Modulating

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

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

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

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

How To Order.
1. Mode of control:
   pneumatic modulating – AM
   electric modulating – EM
2. Size of humidifier for duct installation – 1100, 1200, 1300 or 1400.
3. Manifold length from Table 51-2.
4. Specify steam pressure and capacity required in accordance with appropriate table on Pages 52 and 53.
5. For electrically operated models, state electrical characteristics (control signal and power supply voltage).

Figure 50-1.

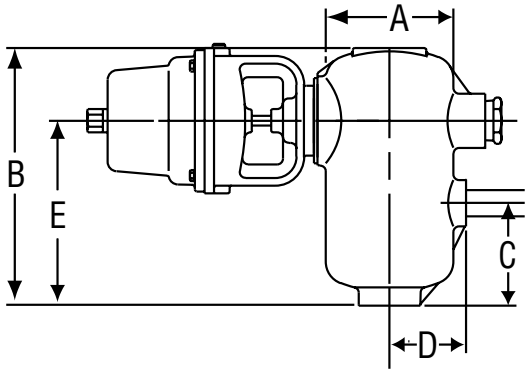


Table 50-1. List of Materials	
Steam Chamber	T-316 CF8M Stainless Steel (model 1100 only)
	T-304 Stainless Steel (models 1200, 1300 and 1400)
Bonnet & Assembly Valve & stem Valve Seat Manifold & Fittings	18-8 Stainless Steel
Operator	See Specifics
Strainer	ASTM 351 (T-316 SS)
Inverted Bucket Steam Trap	T-304 Stainless Steel

Table 50-2 and 50-3. Physical Data

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

* Add height and weight of operator for overall data. All dimensions are in millimeters.

† Weight includes drain trap, strainer, and fittings.

Notes: 1. For manifold lengths and duct widths with which they may be used, see Table 51-2, Page 51.
2. All wetted parts are 300 Series stainless steel.

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Armstrong International SA • Parc Industriel des Hauts-Sarts (2e Avenue) • 4040 Herstal • Belgium
Tel.: +32 (0)4 240 90 90 • Fax: +32 (0)4 248 13 61
www.armstrong.be • marketing@armstrong.be

Figure 51-1. Steam Distribution Manifold Data

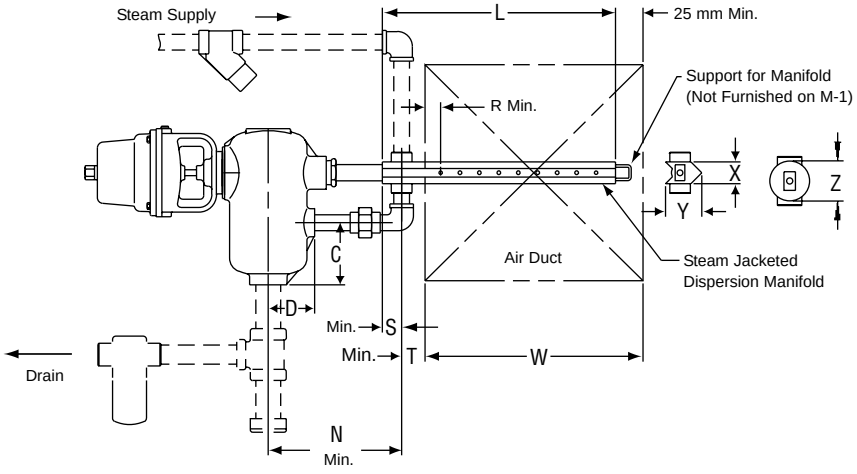


Table 51-1. Cross-Section Dimensions (in mm)

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

Table 51-2. Manifold Lengths and Duct Widths with which they may be used

91 thru 94 Size and 1000 Manifold Model No.		M-1	M-1,5	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12
L - Length (Meters)		0,30	0,45	0,61	0,91	1,22	1,52	1,83	2,13	2,44	2,74	3,05	3,35	3,66
W - Duct Width	(Minimum)	0,20	0,38	0,53	0,79	1,09	1,36	1,66	1,97	2,27	2,58	2,88	3,18	3,49
	(Maximum)	0,36	0,51	0,76	1,07	1,32	1,63	1,93	2,24	2,54	2,84	3,15	3,45	3,76
Approximate Shipping Weight (in kg)	91 Size	1,4	1,8	2,3	2,7	3,6	4,5	5,4	6,3	6,8	7,7	8,6	9,5	10,4
	92 Size and 1200	1,8	2,3	2,7	4,0	5,0	5,9	7,2	8,2	9,5	9,8	11,3	12,7	13,6
	93 Size and 1300	2,7	3,6	4,5	5,9	7,7	9,5	10,9	13,1	14,5	16,8	18,6	19,5	20,9
	94 Size and 1400	Consult Factory				10,9	13,6	15,4	18,1	20,4	23,1	24,9	27,2	29,0

Note: Insulated manifolds are available. Consult factory.

Table 51-3. Number of Manifolds to be Stacked for Duct Heights Exceeding 900 mm

Duct Height in mm	No. of Manifolds
900 - 1 500	2
1 500 - 2 000	3
2 000 - 2 500	4
2 500 - Up	5 or more

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

Table 51-4. Multiple Manifold Pipe Sizes and Adapter Numbers

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

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

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Capacities of Armstrong Humidifiers

Table 52-1. Sizes 91 and 1100, Continuous Discharge Capacities in kg of Steam Per Hour

Orifice Size (In.)	Steam Pressure in bar																		
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00	2,50	3,00	4,00
1/16"	0,6	0,7	0,8	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	2,0	2,5	2,9	3,5	3,8	4,5	5,6
5/64"	1,0	1,2	1,4	1,6	1,8	2,0	2,1	2,3	2,4	2,5	2,7	2,8	3,0	3,8	4,8	5,0	5,6	6,7	8,6
3/32"	1,4	1,7	1,9	2,3	2,6	2,8	3,0	3,3	3,5	3,7	3,9	4,0	4,3	5,4	6,0	6,5	7,8	9,6	11
7/64"	1,9	2,2	2,6	3,1	3,6	4,0	4,1	4,5	4,6	5,0	5,2	5,4	6,0	7,2	8,0	8,6	9,5	12	15
1/8"	2,5	3,1	3,3	4,0	4,5	5,0	5,5	5,9	6,3	6,3	6,8	7,2	8,0	10	11	13	14	16	20
5/32"	3,6	4,5	5,1	6,3	7,2	7,7	8,6	9,0	9,5	10	11	12	13	14	16	18	20	24	29
3/16"	5,5	6,8	7,7	10	11	12	12	13	14	15	16	17	18	22	24	27	29	35	42
7/32"	7,5	10	11	13	15	16	17	18	19	20	21	22	24	28	32	35	38	44	64
1/4"	10	13	14	17	19	21	22	24	25	27	28	29	31	37	41	46	52	61	77
9/32"	12	15	16	20	21	23	25	26	28	29	30	32	34	40	48	52	57	68	84
5/16"	15	17	19	23	25	27	29	31	33	35	37	39	42	48	56	61	67	90	114
11/32"	16	20	22	25	30	33	35	37	39	41	43	44	49	58	67	78	86	104	126
3/8"	19	23	25	30	32	35	37	42	44	48	50	52	57	68	77	86	96	115	143

Table 52-2. Sizes 92 and 1200, Continuous Discharge Capacities in kg of Steam Per Hour

Orifice Size (In.)	Steam Pressure in bar																		
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00	2,50	3,00	4,00
1/8"	2,2	3,2	3,6	4,0	4,5	5,0	5,5	6,0	6,8	7,0	8,0	9,0	10	11	12	13	14	16	20
5/32"	3,6	4,5	5,5	6,3	7,3	7,7	8,6	9,0	9,5	10	11	12	13	14	16	18	20	24	29
3/16"	5,4	6,8	8,2	9,5	10	11	12	13	14	15	16	17	18	21	24	27	29	35	42
7/32"	7,2	9,5	11	13	15	16	17	18	19	20	21	22	24	28	32	38	41	47	61
1/4"	10	11	15	17	19	21	22	24	25	27	28	29	31	37	41	46	52	61	77
9/32"	12	16	19	22	24	26	29	30	32	34	36	37	40	47	53	59	69	80	97
5/16"	15	20	23	27	30	32	35	37	39	42	44	45	49	57	65	72	85	96	118
11/32"	18	24	28	32	35	38	41	44	46	49	52	54	59	69	78	87	101	114	142
3/8"	24	27	29	35	38	42	45	47	52	54	56	58	63	74	83	93	103	122	151
7/16"	34	38	41	45	49	53	56	60	62	65	68	72	77	89	102	114	126	157	190
1/2"	40	43	45	47	51	55	60	64	68	72	76	79	88	104	121	136	151	181	220

Table 52-1. Sizes 93 and 1300, Continuous Discharge Capacities in kg of Steam Per Hour

Capacities when Steam Supply is Through the Manifold

Orifice Size (In.)	Steam Pressure in bar																		
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00	2,50	3,00	4,00
13/32"	32	38	45	50	55	60	63	67	69	73	77	78	84	96	112	122	135	161	200
7/16"	35	43	49	57	59	63	66	70	77	80	86	89	97	112	129	142	152	182	225
15/32"	38	55	59	66	68	71	76	82	88	92	96	102	108	128	145	161	175	203	248
1/2"	45	58	66	73	78	84	90	92	98	103	110	115	123	146	165	185	197	227	282
9/16"	47	62	72	84	89	94	102	108	117	121	123	128	141	163	185	207	234	279	342
5/8"	53	67	79	92	97	106	114	124	131	134	144	153	167	194	221	248	275	328	408
3/4"	58	79	92	105	116	130	140	153	164	170	173	186	208	249	289	338	385	452	576

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Table 53-2. Sizes 93 and 1300, Continuous Discharge Capacities in kg of Steam Per Hour

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

Orifice Size (In.)	Steam Pressure in bar																		
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00	2,50	3,00	4,00
13/32"	32	38	45	50	55	60	63	67	69	73	77	78	84	96	112	122	135	161	200
7/16"	35	43	49	57	59	63	66	70	77	80	86	89	97	112	130	142	152	182	225
15/32"	38	55	59	66	68	71	76	82	88	92	96	102	108	128	145	161	175	203	248
1/2"	45	58	66	73	78	84	90	92	98	103	110	115	123	146	165	185	197	227	282
9/16"	47	62	72	84	89	94	102	108	117	121	123	128	141	163	185	207	234	279	342
5/8"	57	73	83	95	102	112	119	129	139	142	152	162	173	209	232	261	291	343	443
3/4"	62	85	100	119	122	136	152	171	186	195	210	225	238	288	336	375	422	500	620

Table 53-3. Sizes 94 and 1400, Continuous Discharge Capacities in kg of Steam Per Hour

Capacities when Steam Supply is Through the Manifold

Orifice Size (In.)	Steam Pressure in bar															
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00
5/8"	62	76	86	97	102	114	121	131	142	148	159	169	188	217	245	275
3/4"	84	103	117	132	140	154	164	177	193	201	215	229	252	310	350	390
7/8"	110	135	153	171	184	202	215	232	251	264	282	300	344	396	452	503
1"	126	156	177	198	212	234	248	269	290	304	326	347	386	450	514	575
1 1/8"	145	180	204	230	245	269	286	310	339	351	376	400	422	507	591	666
1 1/4"	156	190	215	251	259	284	302	327	361	371	396	422	448	536	631	711
1 1/2"	177	222	253	282	303	334	354	384	417	435	465	496	523	633	729	824

Table 53-4. Sizes 94 and 1400, Continuous Discharge Capacities in kg of Steam Per Hour

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

Orifice Size (In.)	Steam Pressure in bar																		
	0,15	0,20	0,25	0,35	0,40	0,50	0,55	0,60	0,70	0,75	0,80	0,90	1,00	1,40	1,70	2,00	2,50	3.00	4,00
5/8"	62	76	86	97	102	114	121	131	142	148	159	169	188	217	245	275	303	357	461
3/4"	90	110	125	140	150	165	175	190	205	215	230	244	275	321	358	404	445	533	656
7/8"	114	140	159	178	191	210	222	241	260	273	292	311	358	412	461	520	576	697	847
1"	136	170	193	222	231	254	270	293	326	332	355	378	425	488	559	632	693	832	1 038
1 1/8"	168	210	238	267	286	314	333	362	378	410	438	467	505	605	698	769	859	1 026	1 280
1 1/4"	187	235	267	300	320	352	373	405	435	459	490	523	551	674	784	883	979	1 182	1 454
1 1/2"	245	299	340	381	408	449	476	517	547	585	626	667	699	843	961	1 096	1 201	1 448	1 823

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Operators Installed on Armstrong Humidifiers

Operator Types

Armstrong C-1801 pneumatic operator for humidifiers under modulating control. Adjustable start points and various air pressure ranges. (See Table 45-1, Page 45.)

Standard Honeywell MP953D pneumatic operator for humidifiers under modulating control. Operating spring ranges and start points are shown in Table 45-1, Page 45. Operational start point adjustment is available in the form of a pilot positioner where required.

Standard electric operator for humidifiers under modulating electrical control. Choice of Honeywell ML7425A operator (24V 60Hz), Belimo AF24SR (shown above, 24V 60 Hz standard), or Belimo NVF24 (24V 60Hz). Transformers for other voltages available for all electric operators.

Standard ASCO electric solenoid operator for humidifiers under on-off control. **Caution:** On-off operation of humidifiers in air handling systems is advisable only for very limited, specialized applications. Consult your Armstrong Representative.

Humidifier operators in stock

1. Pneumatic Modulating

Armstrong	C-1801
Honeywell	MP953D and F
Sauter	AV42 P10

2. Electric Modulating

Honeywell	ML7425A
Belimo	AF24SR
	NVF24

3. Solenoid

Asco	Class H Coil

Other humidifier operators that might be installed on Armstrong humidifiers*

1. Pneumatic Modulating

Barber-Colman	MK-4600 Series
Fisher Governor	513 R
	513 R with 3582 positioner
Honeywell	600
	Type 9
Johnson	PA 20/150
Samson	271/240
	271/350

2. Electric Modulating

Baelz	Type E11
Barber-Colman	MPR-5600, MPR-5700
	MP-5210
	MP-361, MP-461
Honeywell	M7285A
Johnson/Penn	M130XG-A
Siemens	SKD62 with ASK50
Satchwell	Type ALES-ALXS-ALZS
Sauter	AVN1H12F020
	AVN1H12F001

Note: Any operator with a reverse acting (lift to open) 19 mm stroke and spring return can usually be adapted. Consult factory for details.

* Request Armstrong Application Guideline APP-505 for details on control signal and power requirements.

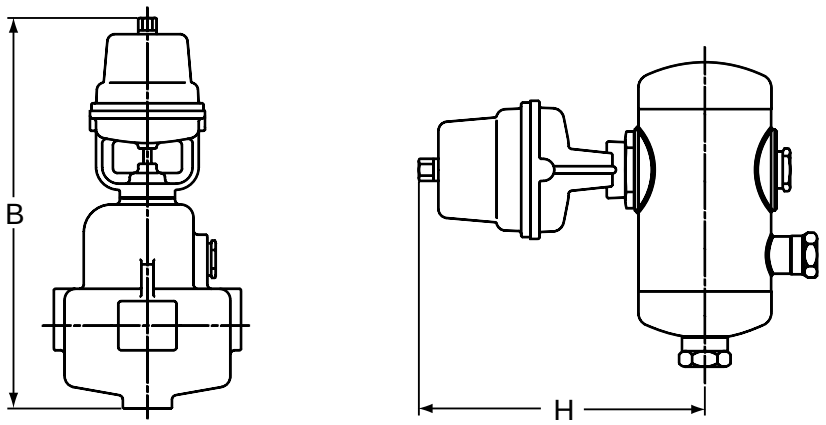


Table 55-1. Dimensions (in mm) and Weights with Operators Installed

	Pneumatic Modulating			Electric Modulating			Electric On-Off
Mode of Control	**Armstrong C-1801**	**Honeywell MP953D**	**Sauter AV42P10**	**Honeywell ML7425A**	**Belimo AF24SR**	**Belimo NVF24-MFT-US-E**	**ASCO**
"B" - 91 Size	406	368	549	501	560	481	276
92 Size	406	368	549	501	576	481	276
93 Size	495	454	633	585	665	565	368
94 Size	–	622	766	718	789	697	–
"H" - 1100 Size	238	203	384	336	407	370	111
1200 Size	243	208	388	340	413	375	116
1300 Size	273	235	415	367	440	402	143
1400 Size	–	287	468	420	492	–	–
Weight of Operator	3,5 kg	2,7 kg	2,3 kg	2,4 kg	5,9 kg	2 kg	0,3 kg

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Unit Humidifiers for Area Humidification

How electrically operated units work.

After passing through the Armstrong in-line strainer, steam enters the cast iron steam separating chamber. The use of cast iron as a separator is probably the single most important feature in the Armstrong humidifier design.

The preferred material of strength and durability, cast iron gives Series 9000 humidifiers flexibility in design without fabrication. In addition, castings mean better heat retention because of thicker walls. Which in turn means a lower rate of condensation.

Entering the main separating chamber, steam encounters a cupped baffle which reverses its flow and turns it back on itself. The outer walls of the casting form another cup, and the same thing happens again. These two 180° turns help condition the steam, reducing its volume and separating the condensate from the vapor. Condensate from supply and radiation and most of the particulates in the steam not removed by the strainer collect in the large drain leg and are discharged through the inverted bucket drain trap.

Steam from the separating chamber flows around and through the solenoid valve, which is actuated by a demand signal from the humidistat. (Solenoids can be exchanged for electric or pneumatic control if desired by choosing an operator and bonnet assembly.)

Next the steam flows into the drying chamber, which is jacketed by the separating chamber. The drying chamber is filled with a stainless steel silencing material, which almost completely absorbs the noise of escaping steam. Dispersion is through a jet nozzle or by a fan.

How air-operated units work.

Air-operated units operate in the same manner as electric units except that they utilize a pneumatic humidistat as humidity controller in the space and an air operator to open and close the steam valve.

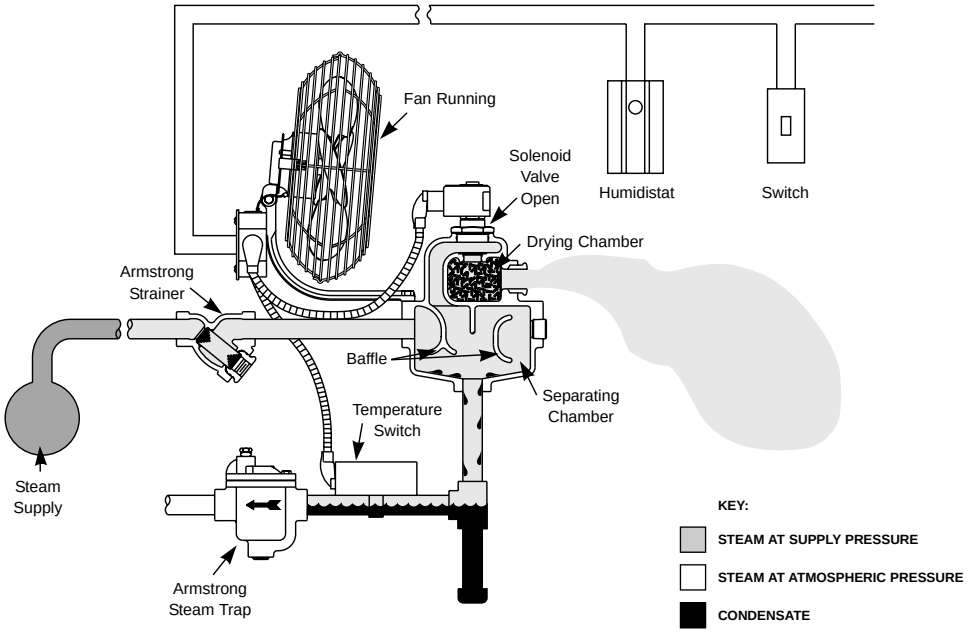
Explosion hazard humidification.

Sizing air-operated humidifiers for areas where an explosion hazard exists is done exactly as for other requirements except that they should be sized for the most severe conditions of makeup air, RH required and minimum steam pressure.

Table 56-1. Location of Unit Humidifiers for Direct Discharge into Atmosphere

Method of Steam Dispersion	Maximum Discharge Capacities in kg of Steam per Hour	Minimum Ceiling in meters	Ceiling Clearance in meters
Electric Fan FSA, AMEF Models	15	2,5	0,6
	35	3,1	0,9
	90	4,3	1,8
	135	4,9	2,5
Air Fan AMAF Models	15	3,1	0,9
	35	3,7	1,3
	90	4,9	2,5
	135	6,1	2,5
Jet VSA, AM Models	15	3,1	1,3
	35	3,7	1,8
	90	6,1	3,0
	135	6,1	3,0

Figure 56-1. How Armstrong Conditioned Steam Humidifiers Operate for Area Humidification



All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Armstrong International SA • Parc Industriel des Hauts-Sarts (2e Avenue) • 4040 Herstal • Belgium
Tel.: +32 (0)4 240 90 90 • Fax: +32 (0)4 248 13 61
www.armstrong.be • marketing@armstrong.be

Electrically-Operated "On-Off" Unit Humidifiers

(physical data, dimensions and capacities)

With Fan.
For direct discharge into atmosphere of area humidified at steam supply pressures from 0,15 to 4 bar. Solenoid valve turns steam on and off. Integral fan with oilless motor provides rapid, uniform distribution of moisture.

Without Fan.
For direct discharge into atmosphere of area humidified at steam supply pressures from 0,15 to 4 bar. Solenoid valve turns steam on and off. Generally used in parallel with unit heaters.

Figure 57-1. FSA humidifiers

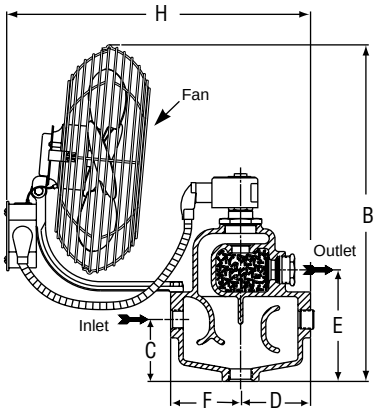


Figure 57-2. VSA humidifiers

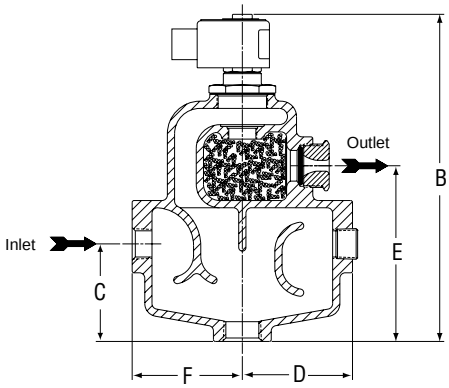


Table 57-1. Dimensions

Model N°	B	C	D	E	F	H
FSA-91	472	86	97	154	400	78
FSA-92	472	86	97	154	400	97
FSA-93	533	117	121	229	464	121

Table 57-2. Dimensions

Model N°	B	C	D	E	F
VSA-91	276	86	97	154	78
VSA-92	276	86	97	154	97
VSA-93	368	117	121	229	121

Table 57-3. Physical Data on Armstrong Electrically Operated On-Off Humidifiers

Model Number	FSA-91	VSA-91	FSA-92	VSA-92	FSA-93	VSA-93
*Coil (watts) 120V, 50/60 Hz	10	10	10	10	10	10
*Motor (watts) 120V, 50/60 Hz	6	–	6	–	6	–
Humidistat (amps at 220V)	2,2	2,2	2,2	2,2	2,2	2,2
Shipping Weight (kg)	13	10	15	12	31	28
Steam Inlet & Strainer	3/4"	3/4"	3/4"	3/4"	1 1/4"	1 1/4"
Drain Connection	1"	1"	1"	1"	1 1/4"	1 1/4"
Drain Trap No.	800	800	800	800	811	811

Table 57-4. Capacities, Armstrong Electrically Operated On-Off Humidifiers

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

		FSA-91, VSA-91, DSA-91						FSA-92, VSA-92, DSA-92						FSA-93, VSA-93, DSA-93			
Orifice Size		1/16"	3/32"	1/8"	5/32"	3/16"	7/32"	7/32"	1/4"	5/16"	3/8"	7/16"	1/2"	5/16"	3/8"	7/16"	1/2"
Steam Pressure in barg	0,15	0,7	1,4	2,5	3,7	5,7	7,5	7,3	10	15	24	34	40	20	23	35	45
	0,30	0,9	2,1	3,7	5,7	8,5	12	11	17	27	32	43	46	29	39	49	66
	0,40	1,1	2,5	4,4	6,9	10	14	16	21	32	38	49	51	36	48	59	78
	0,60	1,4	3,2	5,6	8,8	13	17	18	24	37	47	58	64	40	53	66	90
	0,70	1,5	3,5	6,2	9,7	15	19	19	25	40	52	62	68	44	59	77	98
	0,80	1,6	3,8	6,6	10	16	20	20	27	42	56	68	75	48	64	86	110
	1,00	1,9	4,2	8,2	12	17	23	22	29	45	63	72	–	53	73	97	123
	1,40	2,5	5,4	10,4	14	21	28	24	31	49	73	–	–	62	84	112	–
	1,70	3,1	6,0	11,6	16	24	31	26	39	62	–	–	–	70	96	130	–
	2,00	3,4	6,5	12,7	18	27	34	38	46	72	–	–	–	79	108	–	–
	2,50	3,8	7,8	13,6	20	29	–	41	52	85	–	–	–	86	119	–	–
	2,75	4,2	8,7	14,8	22	32	–	44	57	–	–	–	–	94	129	–	–
	3,50	5,0	10,4	18,0	27	39	–	54	69	–	–	–	–	109	–	–	–
	4,00	5,6	11,1	20,0	29	–	–	61	77	–	–	–	–	122	–	–	–

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Electrically-Operated "On-Off" Unit Humidifiers, continued...

(physical data, dimensions and capacities)

Standard Package.
The complete "package" includes the following:
1. Humidifier with solenoid valve.
2. Fan and motor for FSA Models.
3. Standard open contact humidistat.
4. "Y" type strainer.
5. Armstrong inverted bucket trap.
6. Temperature switch to prevent "spitting" during warm-up.

How To Order.
Specify model number, electrical characteristics, steam pressure, and orifice size.

Suggested Specification.
Steam humidifier for electric control: Humidifier shall be of the steam separator type with full separation ahead of the control valve and with internal drying chamber and steam jacketed outlet to assure discharge of dry steam only.

A. Humidifier shall receive steam at supply pressure.

B. Separating chamber shall be drained by an inverted bucket steam trap.

C. An integral stainless steel steam jacketed solenoid valve shall control flow of steam at supply pressure to the drying chamber. The drying chamber shall be filled with stainless steel silencing material. Vapor shall be discharged from the drying chamber through the steam-jacketed outlet at atmospheric pressure to provide relative humidity at the specified level.

D. A temperature switch shall be employed to prevent humidifier from operating before cold start-up condensate is drained.

Air-Operated Unit Humidifiers

(physical data, dimensions and capacities)

With Fan.
For direct discharge into area humidified at steam supply pressures from 0,15 to 4 bar. Integral air-open spring-close operator opens steam discharge valve on signal from pneumatic hygrostat. Integral air powered fan provides rapid, uniform distribution of moisture. Electric fans are also available.*

Without Fan.
For direct discharge into area humidified at steam supply pressures from 0,15 to 4 bar. Integral air-open spring-close operator opens steam discharge valve on signal from pneumatic hygrostat. Discharge velocity of steam is used for dispersion. Auxiliary air movement is desirable.

Figure 59-1. AMAF humidifiers with air powered fans

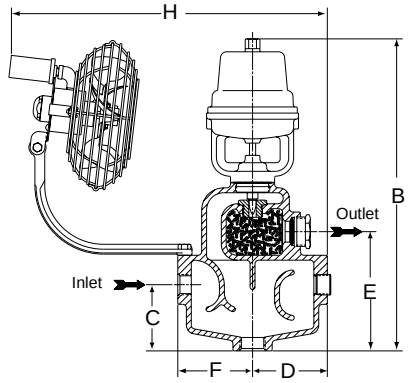


Figure 59-2. AM humidifiers

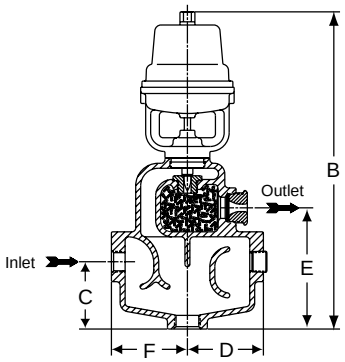


Table 59-1. Dimensions

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

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

Table 59-2. Dimensions

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

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

Table 59-3. Physical Data, Armstrong Air-operated Humidifiers

Model Number	FSA-91	VSA-91	FSA-92	VSA-92	FSA-93	VSA-93
Air Pressure Max. (bar)	1,4	1,4	1,4	1,4	1,4	1,4
Air Required for Fan @ 1,4 bar	–	3,4 m³/h	–	3,4 m³/h	–	3,4 m³/h
Drain Connection	1"	1"	1"	1"	1 1/4"	1 1/4"
Drain Trap No.	800	800	800	800	811	811
Shipping Weight (kg)	15	17	17	20	28	30
Steam Inlet & Strainer	3/4"	3/4"	3/4"	3/4"	1 1/4"	1 1/4"

Table 59-4. Capacities, Armstrong Air-operated Humidifiers

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

		AM-91A, AMAF-91A						AM-92A, AMAF-92A					AM-93A, AMAF-93A			
Orifice Size		1/16"	3/32"	5/32"	7/32"	9/32"	3/8"	3/16"	1/4"	5/16"	3/8"	1/2"	13/32"	15/32"	9/16"	3/4"
Steam Pressure in barg	0,15	0,7	1,4	3,7	7,5	12	19	5,4	10	15	22	36	32	38	47	62
	0,30	0,9	2,1	5,7	12	17	25	8,2	15	23	34	45	45	59	72	100
	0,40	1,1	2,5	6,9	14	21	31	10	19	29	42	56	55	68	89	122
	0,60	1,4	3,2	8,8	17	25	–	12	22	35	49	65	63	76	102	–
	0,70	1,5	3,5	9,7	19	28	–	14	25	39	55	73	69	88	117	–
	0,80	1,6	3,8	10	20	29	–	16	28	44	62	82	77	96	123	–
	1,00	1,9	4,2	12	23	33	–	18	31	49	70	94	84	108	141	–
	1,40	2,5	5,4	14	28	–	–	21	37	58	82	–	96	128	–	–
	1,70	3,1	6,0	16	31	–	–	23	41	65	–	–	112	–	–	–
	2,00	3,4	6,5	18	34	–	–	26	46	72	–	–	122	–	–	–
	2,50	3,8	7,8	20	–	–	–	28	49	–	–	–	135	–	–	–
	2,75	4,2	8,7	22	–	–	–	30	53	–	–	–	–	–	–	–
	3,50	5,0	10,4	27	–	–	–	34	61	–	–	–	–	–	–	–
	4,00	5,6	11,1	29	–	–	–	38	67	–	–	–	–	–	–	–

All dimensions and weights are approximate. Use certified print for exact dimensions. Design and materials are subject to change without notice.

Air-operated Unit Humidifiers, continued...

(physical data, dimensions and capacities)

Standard Package.
The complete "package" includes the following:
1. Humidifier with integral operator (when specified).
2. Fan and motor for AMAF and AMEF models.
3. "Y" type strainer.
4. Armstrong inverted bucket steam trap.

Options.
1. Temperature switch to prevent spitting during warm-up.
2. Pneumatic humidistat.
3. Filter, air regulator and gauge.

How To Order.
Specify model number steam pressure and orifice size. Specify electrical specifications for AMEF Models.

Suggested Specification.
Steam humidifier for pneumatic control: Humidifier shall be of the cast iron steam separator type with full separation ahead of the control valve and with internal drying chamber and steam jacketed outlet to assure discharge of dry steam only.

A. Humidifier shall receive steam at supply pressure.

B. Separating chamber shall be drained by an inverted bucket steam trap.

C. An integral stainless steel steam jacketed control valve shall control flow of steam at supply pressure to the drying chamber. The drying chamber shall be filled with stainless steel silencing material. Vapor shall be discharged from the drying chamber through the steam jacketed outlet at atmospheric pressure to provide relative humidity at the specified level.

D. A temperature switch shall be employed to prevent humidifier from operating before cold start-up condensate is drained.