

Steam-to-Steam Humidifiers

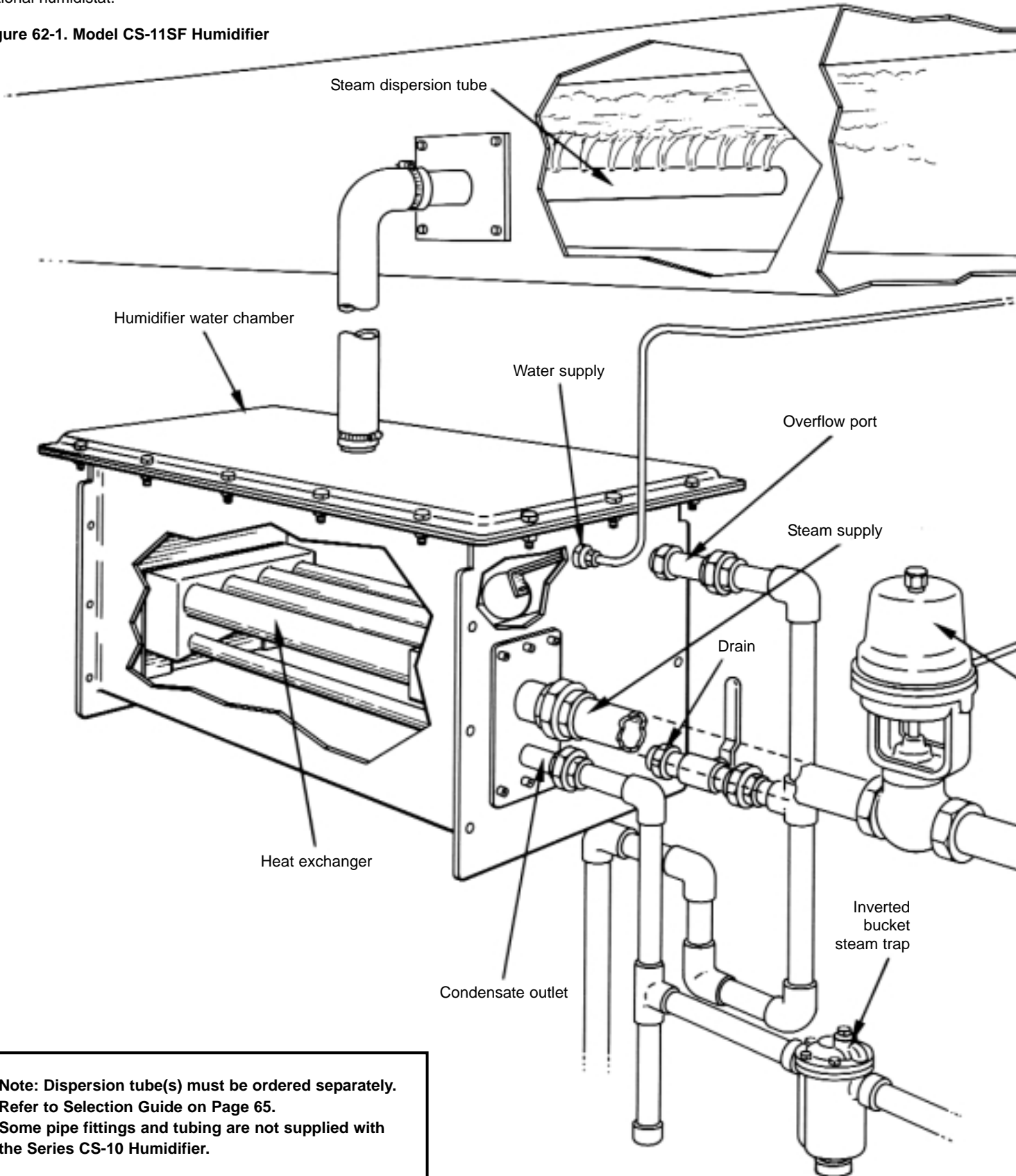
clean rooms
electronics
pharmaceutical

Armstrong



Consists of the humidifier, control valve, inverted bucket steam trap, strainer, dispersion tube(s), control panel (if available) and optional humidistat.

Figure 62-1. Model CS-11SF Humidifier



Steam-to-Steam Humidifiers

Note: Dispersion tube(s) must be ordered separately. Refer to Selection Guide on Page 65. Some pipe fittings and tubing are not supplied with the Series CS-10 Humidifier.

Ionic Beds

The use of Ionic Beds in the CS-10 Series will reduce the amount of maintenance, and improve the overall performance of the unit. With the beds in the tank, the scale will build up on the media and reduce the amount of scale on the heat exchanger. This provides a longer heat exchanger life, and a more efficient heat transfer. Ionic beds are not available in all models. See Page 65.

Heavy Duty Construction

of the humidifier chamber, heat exchanger, float mechanism, and duct dispersion tube make the unit rugged and corrosion resistant.

In-line Strainer

with no-crush screen removes most of steam particulate matter.

ACV Series Control Valve

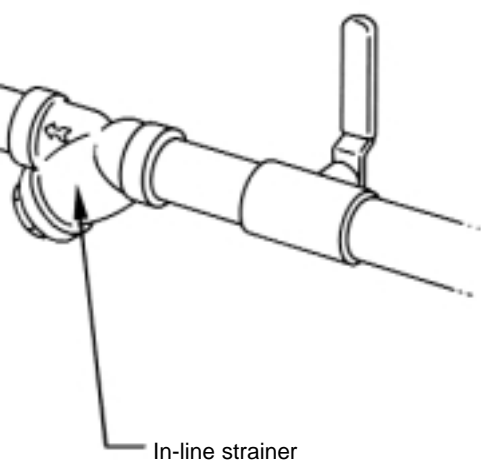
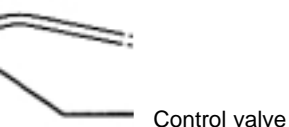
controls the steam flow to the heat exchanger. This valve uses Armstrong's 19 mm stroke, parabolic plug valve design with years of proven field performance. The valve is available for pneumatic, electric or electronic control signals. See Page 70.

Reliable Cast Iron Inverted Bucket Steam Trap

provides dependable drainage because it has only two moving parts and not fixed pivots or complicated linkage to stick, bind or clog.

Safety Features

protect against damage in event of failure. The control valve is designed to fail closed, and the humidifier's water chamber overflow port will protect the unit from overfilling in case of level control failure.



Simplified Cleaning

is facilitated by a removable lid that provides easy access to the heat exchanger for removal of accumulated solids. Optional Teflon coated or phenolic coated heat exchangers are available to further aid cleanability.

Electronic Control Panel

includes an electronic level control module and terminals for incoming control wiring. Field proven conductance actuated level control probes are used for reliable control of the humidifier's fill and drain valves.

Maintenance

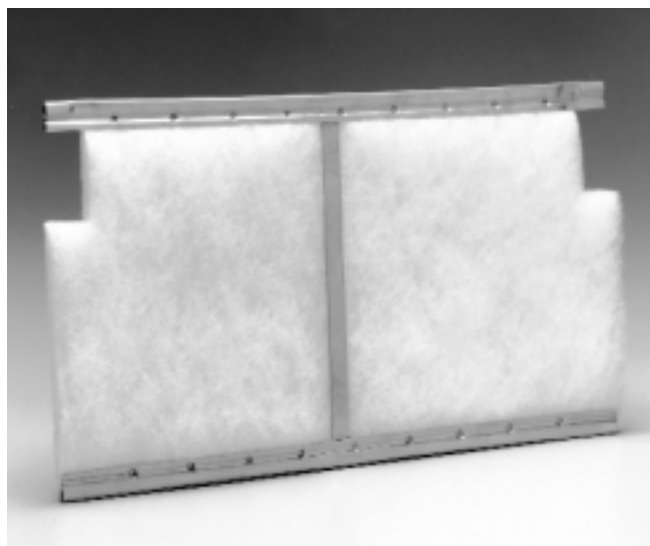
of the Series CS-10, to assure efficient operation of the unit, is important. The production of steam from ordinary tap water will result in solids remaining in the chamber, particularly in models without ionic beds. Periodic cleaning of the chamber and heat exchanger will be necessary. Use of softened or purified water will lessen or eliminate need for cleaning.

If maintenance is a concern, Armstrong offers other solutions. Series 9000 and 1000 Humidifiers are the most reliable, carefree direct-injection humidifiers available. They can be supplied with steam from a central boiler or if boiler water treatment carryover is a concern, can be supplied from a separate dedicated boiler using untreated tap water or an unfired steam boiler.

EHU and HumidiClean Electric Humidifiers are self-generating units, which produce humidifying steam from ordinary tap water.

Figure 63-1. Ionic Beds

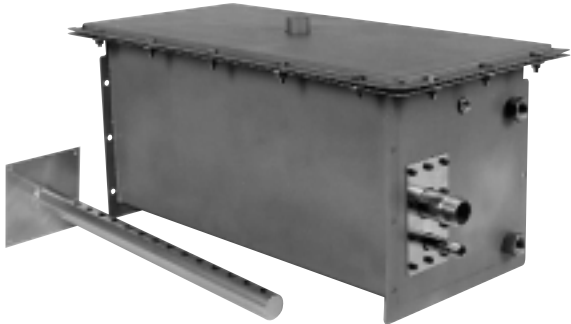
Ionic beds are used in Models CS-13CB, CS-14CB, CS-14SB, CS-15CB and CS-15SB.





Series CS-10 Humidifiers

For Chemical-Free Steam Humidification with Revolutionary Ionic Bed Technology



If you have a concern . . . We Have a Solution

For those who are concerned about the effects of water-treatment chemicals in the discharge of humidifying steam, Armstrong offers the Series CS-10 Humidifier.

Clean, Economical Steam From Untreated Water

The Series CS-10 is a steam-to-steam device which uses existing boiler steam to produce clean steam from untreated water. Because the Series CS-10 uses steam from a central boiler as its heat source, the humidifying steam can be produced more economically than from electricity.

The Series CS-10 consists of a heat exchanger submersed in a tank of water. The heat of the steam supplied to the heat exchanger raises the temperature of the tank water to the boiling point, converting the water to steam which is then injected into an air handling system. The result gives all the benefits of steam humidification without the concern for boiler water treatment carryover.

Armstrong, with 60 plus years of experience since inventing the first steam humidifier, has a model to meet every need... to fit every circumstance. The Series CS-10 will meet the needs of facilities requiring the proven benefits of direct-injected steam humidification without the concern for potentially harmful airborne contaminants.

It may be just the solution for your sensitive environment!

Steam Humidification

Many benefits are derived from humidifying work spaces. Proper levels of relative humidity are vital to the preservation of hygroscopic materials such as paper, wood and textiles; to the prevention of electrostatic discharge; to the comfort of workers.

Steam is the recommended medium for humidification. "If the system requires humidification, the humidification process should be limited to the direct injection of steam" (National Research Council, 1987).

When steam for direct-injection humidification is taken from a central boiler it may contain vaporized amines, used to protect boiler and steam system components from corrosion. Testing has shown that carefully administered boiler treatment programs maintain levels of amine in humidified air well within guidelines suggested by OSHA, the ACGIH, and the FDA. There remain some concerns, however, about the effects of volatile, neutralizing amines in steam systems supplying humidifiers. It must be pointed out that the concerns are about the amines themselves, not steam humidification.

Steam-to-Steam Humidifiers

Capacities and Physical Data



Table 65-1. Continuous Discharge Capacities in kg of Steam Per Hour

Inlet Steam Pressure (barg)	Range							
	CS-11S	CS-12S	CS-13S	CS-13C	CS-14S	CS-14C	CS-15S	CS-15C
0,15	0,9	1,8	2,3	–	–	–	–	–
0,35	4,5	13,5	22,7	22,7	34,0	45,4	52,2	90,7
0,70	13,5	36,3	45,4	79,4	61,2	127,0	122,0	254,0
0,90	15,0	47,6	54,4	95,3	95,3	159,0	191,0	318,0
1,00	15,9	54,4	81,6	109,0	118,0	181,0	236,0	363,0

Capacities based on steam pressure entering control valve.

Table 65-2. List of Materials

Series No.	CS-10S	CS-10SB	CS-10SF	CS-10DI	CS-10C	CS-10CB	CS-10CF
Chamber and Lid	T304 SS						
Heat Exchanger	T304 SS (T316 Optional)				Electroless Nickel Plated Copper		
Chamber Gasket	SI (Silicone)						
Control Panel (Not Shown)	NEMA 4		NONE		NEMA 4		NONE
Ionic Bed Material*	Proprietary						
Float Mechanism Less Valve	N/A		T304 SS		N/A		T304 SS
Float Mechanism Valve Only	N/A		EPDM		N/A		EPDM
Level Control Electrodes	18-8 SS & Teflon		N/A		18-8 SS & Teflon		N/A
Dispersion Tube	T304 SS						
Hose Cuff	EPDM						
Gasket Inlet / Outlet	NBR (Buna - N)						
Chamber Cap Screws & Nuts	18-8 SS						
Inverted Bucket Steam Trap	ASTM A48 CL. 30 w/ 18-8 SS						
Control Valve	To Be Specified						
Strainer	ASTM A48 CL. 30 w/ T304 SS Screen						

* Ionic beds are used in Models CS-13CB, CS-14CB, CS-14SB, CS-15CB and CS-15SB.

Table 65-3. Selecting Proper Steam Dispersion Tube

Steam Dispersion Tube Model No.		Steam Dispersion Tube Length in mm	Duct Width in mm		Weight in kg
CS-11	CS-12, CS-13, CS-14, CS-15		Min	Max.	
D-1	DL-1	30	28	41	1,4
D-1,5	DL-1,5	46	43	56	1,4
D-2	DL-2	61	58	86	2,0
D-3	DL-3	91	89	117	3,0
D-4	DL-4	122	119	147	3,6
D-5	DL-5	152	150	178	4,0
D-6	DL-6	183	180	208	4,5
D-7	DL-7	213	211	239	5,0
D-8	DL-8	244	241	269	5,5
D-9	DL-9	274	272	300	6,0
D-10	DL-10	305	302	330	6,4

Notes:

Models CS-12 and CS-13 require a minimum of two DL dispersion tubes each.

Model CS-14 requires a minimum of two dispersion tubes for capacities **less than** 82 kg/h. **Greater than** 82 kg/h requires four dispersion tubes (minimum) or Armstrong HumidiPack.

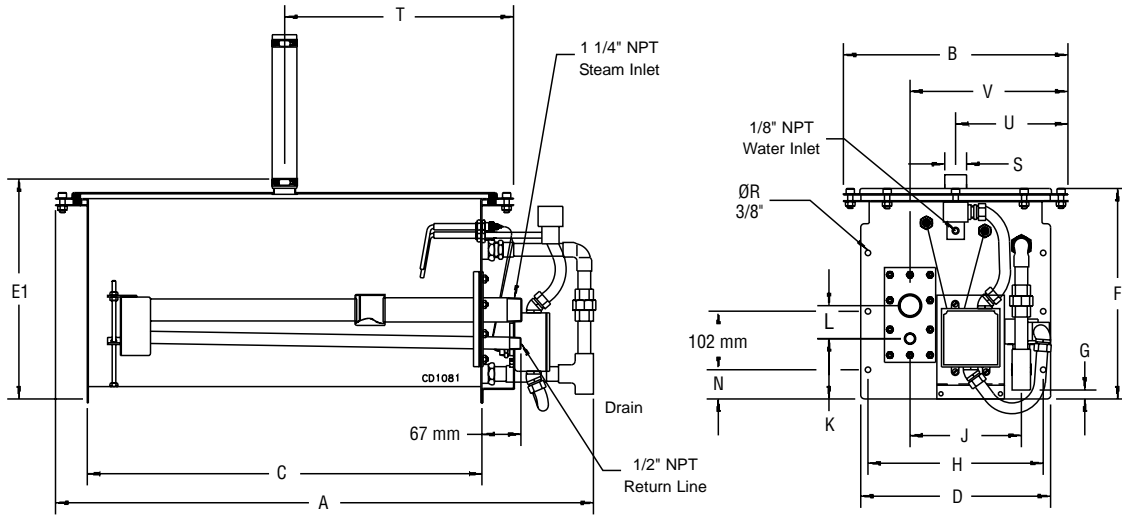
Model CS-15 may be used with four dispersion tubes (minimum) for capacities **less than** 164 kg/h. For capacities **greater than** 164 kg/h, an Armstrong HumidiPack is suggested.

Model Codes:

- S** = Stainless Steel Heat Exchanger
- C** = Nickel Plated Heat Exchanger
- B** = Unit is using Ionic Bed
- F** = Float Level Control (instead of Conductance Probe)
- DI** = Stainless Steel Heat Exchanger with P403 Coating and Float Level Control

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

Figure 66-1. Model CS-11



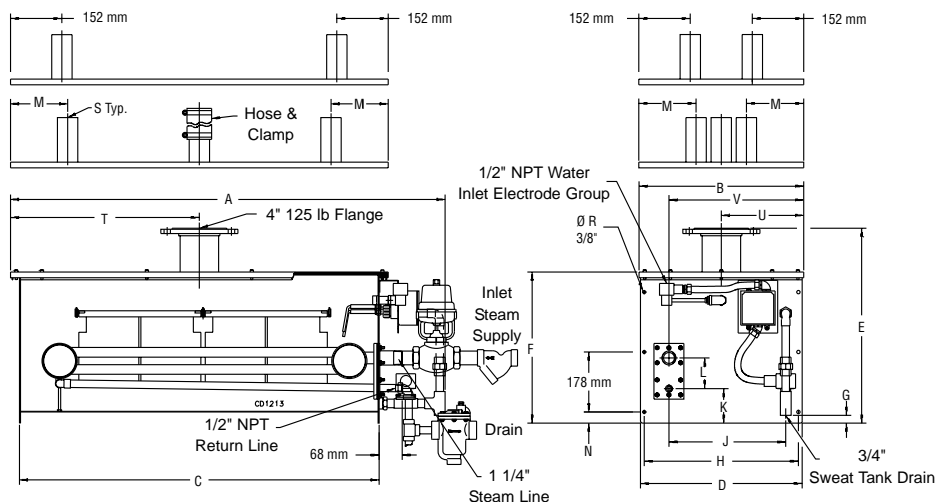
Steam-to-Steam Humidifiers

Table 66-1. Dimensions in mm						
Item	Description	CS-11	CS-12	CS-13	CS-14	CS-15
A	Length (overall)	933	1 289	1 289	1 156	1 156
B	Width (overall)	391	489	489	559	1 060
C	Length from Bottom of Tank	686	1 067	1 067	972	972
D	Tank Width	330	479	479	584	1 092
E	Tank Bottom to Steam Outlet (4" Flange)	-	578	578	797	797
E1	Tank Bottom to Steam Outlet	383	578	578	805	805
F	Tank Bottom to Top of Lid	365	445	364	675	675
G	Drain to Tank Bottom	16	24	24	-	-
H	Width ϕ Tank Flange Holes	305	457	457	559	1 060
J	ϕ of Drain to ϕ Condensate Outlet	194	346	346	219	219
K	ϕ Return Line to Tank Bottom	105	77	77	137	137
L	ϕ Return Line to ϕ Steam Inlet	57	91	91	237	237
M	ϕ Steam Outlet to Edge of Lid	-	170	170	140	140
N	Tank Bottom to 1st Flange Hole	51	33	33	178	178
R	No. of Tank Flange Holes (Both Ends)	12 holes				
S	Diameter of Steam Outlet	38	4" Raised Face Flange			
			60	60	60	60
T	ϕ Steam Outlet to End of Lid	398	560	560	511	511
U	ϕ Steam Outlet to Edge of Lid	195	244	244	279	279
V	ϕ Return Line to Tank Flange	275	400	400	183	183
Maximum Operating - kg		83	181	188	417	680
Shipping Weight - kg		39	73	73	180	354

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Figure 67-1. Model CS-12/13

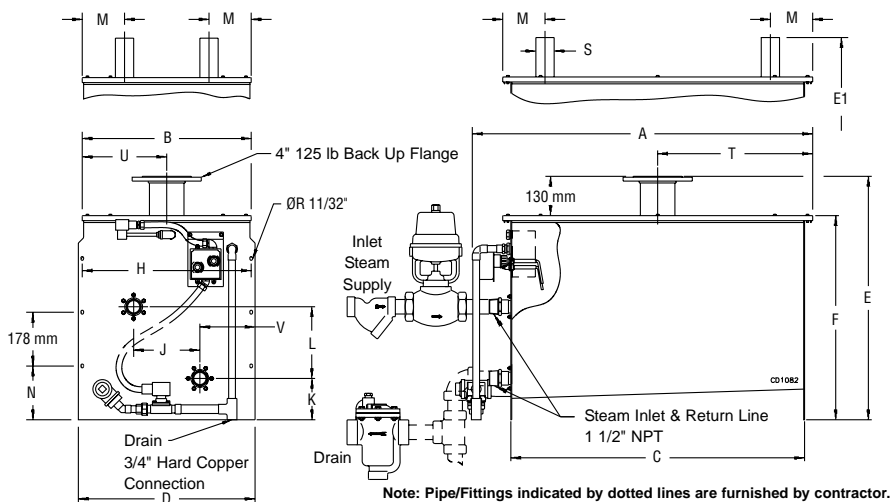
**Alternate Lids:
CS-12/13 with 2 or 3 Steam Outlets**



**Model CS-12/13 Shown with Single
4" Flanged Steam Outlet**

Figure 67-2. Model CS-14

**Alternate Lids:
CS-14 with 2 or 4 Steam Outlets**

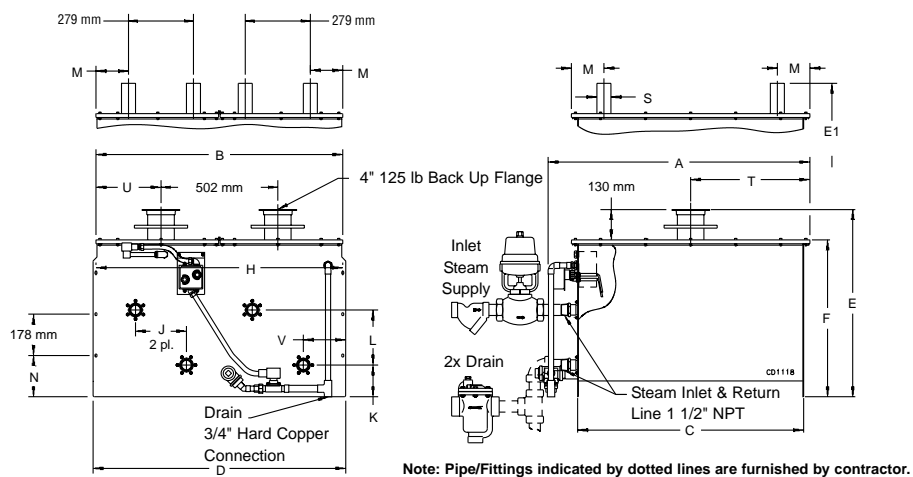


**Model CS-14 Shown with Single
4" Flanged Steam Outlet**

Note: Pipe/Fittings indicated by dotted lines are furnished by contractor.

Figure 67-3. Model CS-15

**Alternate Lid:
CS-15 with 4 Steam Outlets**



**Model CS-15 Shown with Two
4" Flanged Steam Outlets**

Note: Pipe/Fittings indicated by dotted lines are furnished by contractor.

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Series CS-10 Options and How to Order

List of Options

- Control Humidistat
- High Limit Humidistat
- Air Proving Switch
- Teflon Coated Heat Exchanger (Stainless Steel Heat Exchangers only)
- Phenolic Coated Heat Exchanger for DI Water
- 3 m Flexible Rubber Hose (CS-11 only)
- Insulation
- Support Legs
- DN 100 Steam Header with four 2" connections for additional separation and simplified transition to multiple dispersion tubes
- Lid Options
 - CS-13 (2) 2" connections
 - (3) 2" connections (suggested for greater than 82 kg/h units)
 - (1) 4" flanged connection
 - CS-14 (1) 4" flanged connection
 - (4) 2" connections
 - (2) 2" connections (less than 82 kg/h only)
 - CS-15 (2) 4" flanged connections
 - (4) 2" connections (less than 164 kg/h only)

How to Order

1. Determine model from Table 68-1 below based on capacity and control options:
2. Size of humidifier: **11, 12, 13, 14 or 15** (for capacities see Table 65-1).
Example of complete model: **CS-11SF**
3. Specify control valve operator type: (Mode of control).
Example: For a pneumatic valve on **Model CS-11: ACV-02-AM**
4. Length of dispersion tube(s) (See Table 65-3, Page 65)
5. Specify steam pressure and capacity required.
6. Specify control voltage to control panel (if applicable)
7. For electric valves only: Specify control valve supply voltage and desired input signal.

Figure 68-1. Series CS-10 Dispersion Tube and Series CS-10 Dispersion Tube with Drain Tube

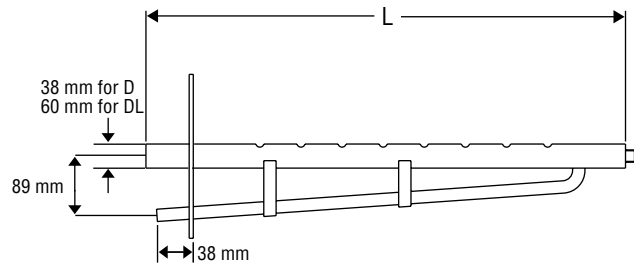


Table 68-1. Model Determination Table				
Model No.	Coil Material	Level Control	Drain Valve	Control Panel
CF-11SF	Stainless Steel	Float	Optional	N/A
CF-12SF				
CF-13SF				
CF-11S				
CF-12S				
CF-13S				
CF-14S				
CF-15S	Electroless Nickel Plated Copper	Conductance Probe	Standard	Basic
CF-13C				
CF-14C				
CF-15C				
CF-13CB				
CF-14CB				
CF-15CB				
CF-12SB	Stainless Steel			Advanced
CF-13SB				
CF-14SB				
CF-15SB				
CF-11DI	Stainless Steel with P403 Coating	Float	N/A	N/A
CF-12DI				
CF-13DI				
CF-14DI				
CF-15DI				

Table 68-2. Series CS-10 Control Valve Selection	
Humidifier Model No.	Control Valve Model No.
CS-11	ACV-02
CS-12	ACV-03
CS-13	ACV-03
	ACV-04
CS-14	ACV-06
CS-15	HWELL-2

Table 68-3. Series CS-10 Standard Operator Types Available	
Pneumatic Modulating	
AM = Armstrong C-1801 (ACV-02 & -03 only)	
HAM = Honeywell MP953D and F	
Electric Modulating	
HEM = Honeywell ML7425A 2-10 Vdc	
BLEM = Belimo AF24SR	
BNVEM = Belimo NVF24 (ACV-02, -03 & -04 only)	

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

Control Valve Characteristics

CS-10 Series Steam-to-Steam humidifiers are supplied with the Armstrong Series ACV Control Valve for applications when central steam or steam under pressure is available. The valve utilizes our parabolic plug design offering immediate response and precise modulation of flow throughout the 19 mm valve stroke. The parabolic plug also offers high rangeabilities.

Accuracy by Design – Not by Accident

The secret of accurate control is making sure a valve's control characteristics match the application. When they do, the valve controls accurately (without hunting) and performs reliably. When there's no match, the valve simply cannot do what the application demands.

Armstrong uses a modified parabolic plug to handle exceptionally low output. The modification of true linear characteristics provides more precise control when capacity requirements are very low and the valve is just cracked off the

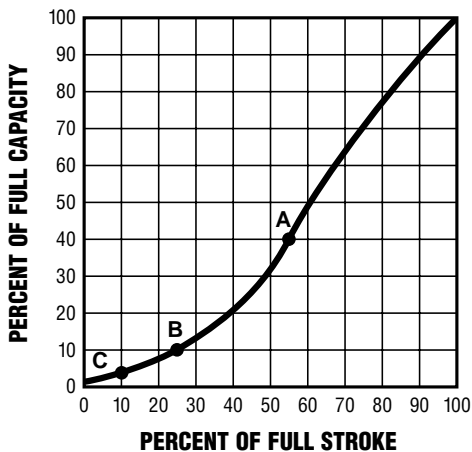
seat. Notice in Figure 70-1 that at point A on the curve more than half the valve stroke is devoted to 40% of the unit's capacity. At point B, 1/4 of the stroke is devoted to only 10% of capacity. At point C, 10% of the stroke covers less than 5% of the unit's capacity.

How low can the unit control? Table 72-1, Page 72 tabulates this function, called rangeability. Rangeability is the ratio between the maximum controllable flow and the minimum controllable flow through the valve. The higher the rangeability of a valve, the more accurately it can control flow when low output is required. If rangeability is too low, the valve will "hunt" excessively when low output is required.

To calculate minimum flow, simply multiply Cv by the percentages shown in the table. For example, a 5/16" orifice in an ACV-02 has a Cv of 2,5. The lowest output that can be controlled is 2% of maximum flow.

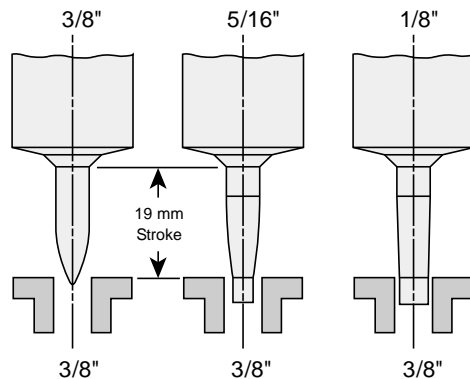
Steam-to-Steam Humidifiers

Figure 70-1. Modified Linear Curve



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

Figure 70-2. Parabolic Plug Type Valves



Parabolic plug valve configuration permits accurate modulation of flow over the complete stroke of the valve.

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Control Valve Physical Data

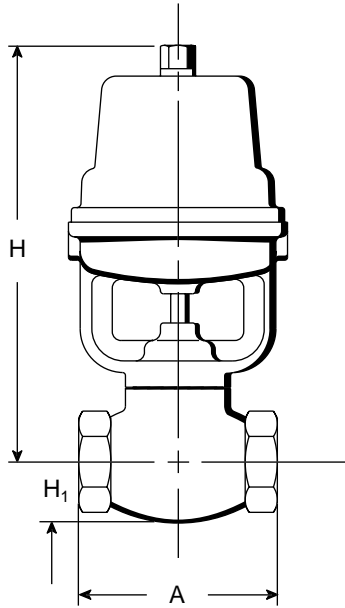


Table 71-1. Specifications						Dimensions and Weights		
Model Number	Pipe Size in mm	Body Material	Trim Material	Vessel Design Limitation	Minimum Δ P	A in mm	H ₁ in mm	Weight in kg
Control Valve								
ACV-02	1/2"	Cast Iron	300 Series Stainless Steel	17 bar @ 204°C	0,14 bar	105	29	4,4
ACV-03	3/4"					108	33	4,8
ACV-04	1"					140	48	5,3
ACV-06	1 1/2"					203	62	10,0
ECV-02	1/2"	T-316 Stainless Steel		27,5 bar @ 204°C		105	29	3,9
ECV-03	3/4"					108	33	4,3

Table 71-2. Physical Data "H" Dimensions in mm							
Model Number	Armstrong C-1801	Honeywell MP953D	Honeywell MP953F	Sauter AV42 P10	Honeywell ML7425A	Belimo AF24SR	Belimo NVF24-MFT-US E
ACV/ECV-02	216	178	302	361	313	386	295
ACV/ECV-03	225	187	311	370	322	395	305
ACV-04	-	203	324	386	338	411	318
ACV-06	-	229	352	415	367	440	346

How to Order

Body Material

A = Cast Iron
E = T-316 Stainless Steel

Product Line

CV = Control Valve

Connection Size

02 = 1/2"
03 = 3/4"
04 = 1"
06 = 1 1/2"

Standard Operator Types

Pneumatic Modulating

AM = Armstrong C-1801
HAM = Honeywell MP953D and F
SRAM = Sauter AV42 P10

Electric Modulating

HEM = Honeywell ML7425A
BELEM = Belimo AF24SR
BNVEM = Belimo NVF24-MFT-US-E

Steam-to-Steam Humidifiers

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Control Valve Capacity Calculations

Steam-to-Steam Humidifiers

Table 72-1. Control Valve Rangeability (Normally Closed Valves)											
Control Valve Model	Valve	Rangeability		Standard Operators							
		Equivalent Diameter in Inches	Ratio of Flow Max:Min	Flow Coefficient CV	Armstrong C-1801	Sauter AV42 P10	Honeywell MP953D	Honeywell MP953F	Belimo NVF24	Honeywell ML7425A	Belimo AF24SR
	Maximum Operating Pressure in barg										
CV-06	1 1/2"	63:1	27,0	N/A	8,6	1,7	10,3	N/A	4,1	6,8	
	1 1/4"	69:1	21,0								
	1 1/8"	61:1	19,5			2,1					
	1"	53:1	18,0								
	7/8"	44:1	16,0								
3/4"	33:1	13,0									
CV-04	1"	53:1	13,0	N/A	8,6	4,8	10,3	4,1	10,3	10,3	
	3/4"	33:1	10,5								
	5/8"	25:1	8,5								
	9/16"	105:1	7,0								
	1/2"	97:1	6,0								
7/16"	75:1	5,0									
CV-03	3/4"	118:1	7,5	5,5	8,6	5,5	10,3	4,1	10,3	10,3	
	5/8"	123:1	6,5								
	9/16"	105:1	6,0								
	1/2"	97:1	5,5	10,3		8,6					10,3
	7/16"	75:1	4,0								
CV-02	1/2"	97:1	4,0	10,3	8,6	10,3	10,3	4,1	10,3	10,3	
	7/16"	75:1	3,5								
	3/8"	70:1	3,0								
	5/16"	49:1	2,5								
	1/4"	31:1	1,7								
	3/16"	18:1	0,9								
	1/8"	37:1	0,45								
1/16"	10:1	0,09									

Table 72-2. Selection Formulas	
For Steam	Formula Key
<p>For Water: $Q = \frac{0,86 \times C_v \times \sqrt{\Delta P}}{\sqrt{G}}$</p> <p>For Steam: When $P_2 > \frac{P_1}{2}$ $W = 20 \times C_v \times \sqrt{\Delta P \times P_2}$</p> <p>When $P_2 < \frac{P_1}{2}$ $W = 10 \times C_v \times P_1$</p>	<p>C_v = Valve flow coefficient G = Specific gravity in kg/dm³ Q = Maximum flow capacity of liquid in Nm³/h P_1 = Inlet pressure in bar(a) P_2 = Outlet pressure in bar(a) ΔP = Pressure drop ($P_1 - P_2$) in bar W = Maximum flow capacity of steam in kg/h</p>

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