

## HYGIENIC DIRECT STEAM INJECTION HUMIDIFIERS DSHS

### DESCRIPTION

The presence of chemicals used in water treatment of plant steam boilers which produce steam used in humidification systems can have toxic effects on human health. Regulations have come into force in some countries so that only clean steam is used for humidification purposes and, to meet such requirements.

The ADCAPure DSHS series of hygienic direct steam injection humidifiers are designed to ensure highly efficient and moisture free clean steam injection in air ducts and AHU for humidification purposes. These units are completely manufactured in 316L stainless steel, and are available as plug and play packaged solutions or alternatively as individual components to be incorporated into humidification systems. Each humidifier is manufactured as a bespoke solution to meet flow requirements and duct design with single or multiple injection tubes.

### MAIN FEATURES

Quiet and efficient.  
Hygienic design in 316L stainless steel.  
Bespoke injection tubes to meet flow requirements and duct design.  
Fully jacketed injection tubes providing moisture free steam injection.

### STANDARD SURFACE FINISH

Internal wetted parts:  $\leq 0,51$  micron Ra – SF1.  
External: Satin bead blast finish – 1,6 micron Ra.  
Other surface conditions see IS PV20.00 E – Technical information.

OPTIONS: Fully assembled in a plug and play package.

USE: Saturated steam.

AVAILABLE MODELS: DSHS10 and DSHS25.

INJECTION TUBE SIZES: 3/4" and 1".

CONNECTIONS: ASME BPE clamp ferrules.  
Others on request.

PACKAGING: Assembling and packaging in a clean room certified according to ISO 14644-1.  
The product is end capped and sealed with recyclable thermo-shrinkable plastic film, to avoid contamination.

INSTALLATION: Horizontal or vertical (pointing upwards) installation in horizontal air ducts.  
Horizontal installation in vertical air ducts. See IMI – Installation and maintenance instructions.



**Single tube humidifier**



**Injection tube**



**S10HV  
centrifugal separator**

## OPERATION

Clean steam moves in the supply line passing, if necessary, through an ADCAPure pressure reducing valve to reduce it to humidification pressure (generally around 1 to 2 barg). Steam then passes through an ADCAPure S10HV centrifugal humidity separator which removes most of its moisture content. The separator special design dries the steam which is injected and also the steam which feeds the injection tube heating chamber keeping heating temperatures stable. As steam leaves the humidity separator and passes through the jacketed injection tubes it is kept at a constant temperature, preventing condensation to be carried over with the steam.

Condensate collects on the bottom of the separator and is removed from the system via a ADCAPure TSS6 thermostatic steam trap. Condensate which forms inside the injection tube heating chamber is removed by means of one or multiple steam traps depending on the case.

An ADCAPure hygienic control valve equipped with a fail-safe electric or pneumatic actuator provides accurate modulation of flow and, thus, precise humidity control.

## ABSORPTION DISTANCE

Absorption distance is the dimension from the injection tube outlet to the downstream point where steam has been fully absorbed by the air passing through and is no longer visible as mist. The absorption distance serves as base for the calculation of the minimum distances to any obstacle (e.g. branches, filters, ventilators) installed downstream. If such obstacles would otherwise be located at a shorter distance, unabsorbed steam would hit those parts and condense, causing dripping which often results in microbial growth and, consequently, odors and an overall unhealthy air.

Absorption distance is mainly affected by:

- Air temperature: absorption distance decreases with increase in inlet air temperature.
- Inlet relative humidity: absorption distance decreases with increase in inlet relative humidity.
- Required relative humidity: absorption distance increases with increase in required relative humidity.
- Mixing homogeneity: absorption distance decreases with increase in mixing homogeneity.

## SINGLE VS MULTI-TUBE HUMIDIFIERS

A single-tube humidifier is the most economically viable solution if a single injection tube respects the humidification load and the higher absorption distance (generally associated with single-tube humidifiers) is lower than the distance to any obstacle downstream – Consult Table 1 and Table 2.

If on the other hand, the available distance is insufficient to accommodate the necessary absorption distance of a single-tube solution or when duct height is significant then a multi-tube humidifier should be selected. This solution will shorten the necessary absorption distance by up to 4 times as the increase in injection points will decrease flow velocity and also promote an homogenous and efficient mixing – Consult Table 3 and Table 4.

**TABLE 1 – INJECTION TUBE STEAM CAPACITY – SINGLE-TUBE (kg/h)**

MODEL	C * (mm)	STEAM PRESSURE TO HUMIDIFIER SUPPLY CONNECTION (barg)															
		0,25	0,5	0,75	1	1,25	1,5	1,75	2	2,25	2,5	2,75	3	3,25	3,5	3,75	4
DSHS10	180 – 450	17	24	30	35	38	41	45	49	51	53	56	60	61	63	67	70
	451 – 650	21	31	38	43	46	50	55	61	64	67	71	75	77	79	83	87
	651 – 1000	32	46	55	64	70	76	83	90	94	99	105	111	114	117	123	128
	≥ 1001	43	63	74	86	94	103	112	121	127	133	141	149	153	157	165	173
DSHS25	330 – 600	72	103	126	145	159	173	188	204	214	226	237	251	257	266	279	291
	601 – 900	78	114	138	158	172	187	204	221	232	248	261	274	280	288	303	319
	901 – 1250	95	139	168	192	212	232	253	273	286	301	316	332	339	349	368	386
	≥ 1251	114	166	200	230	252	275	299	324	341	359	377	397	–	–	–	–

\* Tube insertion length (see dimensions table).

**TABLE 2 – MAXIMUM RECOMMENDED DUCT HEIGHT FOR SINGLE-TUBE HUMIDIFIER**

INJECTION TUBE	DSHS10	DSHS25
DUCT HEIGHT	Up to 900 mm	Up to 1100 mm

## HOW TO SIZE

### Example 1 – Single-tube humidifier

Installation position: Inside a horizontal air duct with 2000 mm of available downstream distance without obstacles.  
 Duct size (H x W): 500 x 800 mm  
 Maximum humidification load: 100 kg/h @ 1 barg

Step 1: Select the injection tube model

A single-tube humidifier is appropriate for the required absorption distance (see Note).

According to Table 1 a single DSHS25 injection tube respects the maximum humidification load as it ensures 158 kg/h for an insertion length between 601 and 900 mm.

Step 2: Select the humidity separator

The humidity separator should be of the same size as the pipeline upstream which has previously been sized accordingly, e.g. by pressure drop or velocity, not exceeding 25 m/s (recommended).  
 For the current example, with a maximum humidification load of 100 kg/h @ 1 barg, the recommended pipe size is 11/4" and so the appropriate humidity separator is a 11/4" ADCAPure S10HV.

Step 3: Select the control valve and actuator

After calculating the required Kv for the application one can find the valve Kvs on the respective ADCAPure control valve datasheet. For the current example, the selection could be e.g. a 11/2" ADCAPure V926H with a 25 mm seat and Kvs of 10 m<sup>3</sup>/h to suit the application. The valve can be fitted with an ADCATrol ELF series electric fail-safe spring return actuator or a reverse action ADCATrol PA series pneumatic actuator.

Step 4: Steam traps, pressure reducing station and ancillaries

A suitable trapping set must be installed on the drain connection of the humidity separator and heating chamber. A pressure reducing station may be required in some situations to reduce system pressure to the desired value and different valves and ancillaries may also be necessary. Consult the manufacturer for further information.

**TABLE 3 – INJECTION TUBE STEAM CAPACITY – MULTI-TUBE (kg/h)**

MODEL	C * (mm)	STEAM PRESSURE TO HUMIDIFIER SUPPLY CONNECTION (barg)															
		0,25	0,5	0,75	1	1,25	1,5	1,75	2	2,25	2,5	2,75	3	3,25	3,5	3,75	4
DSHS10	180 – 1000	43	62	74	86	94	102	112	121	126	133	141	149	153	157	166	172
	≥ 1001	58	85	99	116	126	139	151	163	171	179	190	201	206	211	222	233
DSHS25	330 – 1250	128	187	226	259	286	313	341	368	386	406	426	448	457	471	496	521
	≥ 1251	153	224	270	310	340	371	403	437	460	484	508	535	562	589	617	645

\* Tube insertion length (see dimensions table).

**TABLE 4 – MINIMUM RECOMMENDED NUMBER OF INJECTION TUBES FOR MULTI-TUBE HUMIDIFIER**

DUCT HEIGHT	Up to 1500 mm	1501 – 2000 mm	2001 – 2500 mm	above 2501 mm
Nº OF TUBES	2	3	4	5 or more

## Example 2 – Multi-tube humidifier

Installation position: Inside a AHU with 500 mm downstream distance to fan entry  
 AHU size (H x W): 1600 x 1600 mm  
 Maximum humidification load: 180 kg/h @ 1,5 barg

### Step 1: Select the injection tube model and quantity

A multi-tube humidifier is recommended in order to ensure complete steam absorption before reaching the fan entry (see Note).

According to table Table 4 a total of three injection tubes are recommended for a AHU height of 1600 mm. Their nominal size can then be selected according to Table 3. In this case, a set of three DSHS25 will ensure 371 kg/h for an insertion length  $\geq 1251$  mm.

### Step 2: Select the humidity separator

The humidity separator should be of the same size as the pipeline upstream which has previously been sized accordingly, e.g. by pressure drop or velocity, not exceeding 25 m/s (recommended).

For the current example, with a maximum humidification load of 180 kg/h @ 1.5 barg, the recommended pipe size is 11/2" and so the appropriate humidity separator is a 11/2" ADCAPure S10HV.

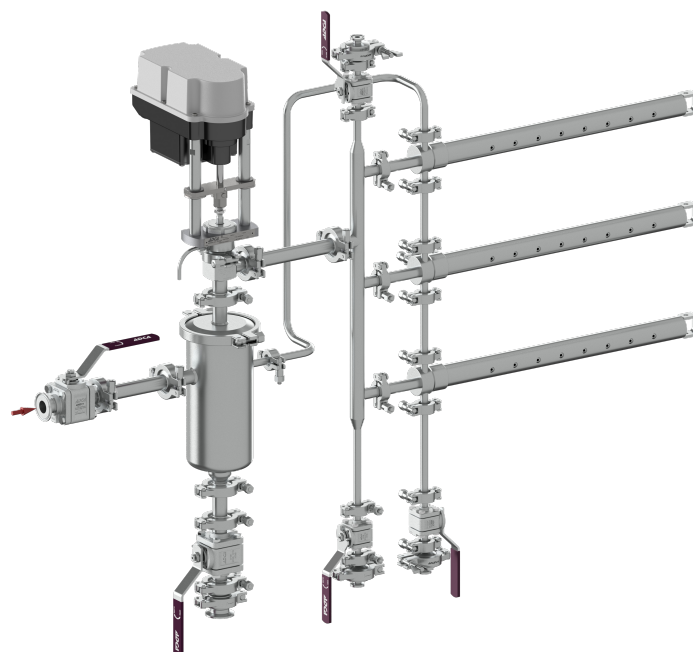
### Step 3: Select the control valve and actuator

After calculating the required Kv for the application one can find the valve Kvs on the respective ADCAPure control valve datasheet. For the current example, the selection could be e.g. a 11/2" ADCAPure V926H with a Kvs of 16 m<sup>3</sup>/h to suit the application. The valve can be fitted with an ADCATrol ELF series electric fail-safe spring return actuator or a reverse action ADCATrol PA series pneumatic actuator.

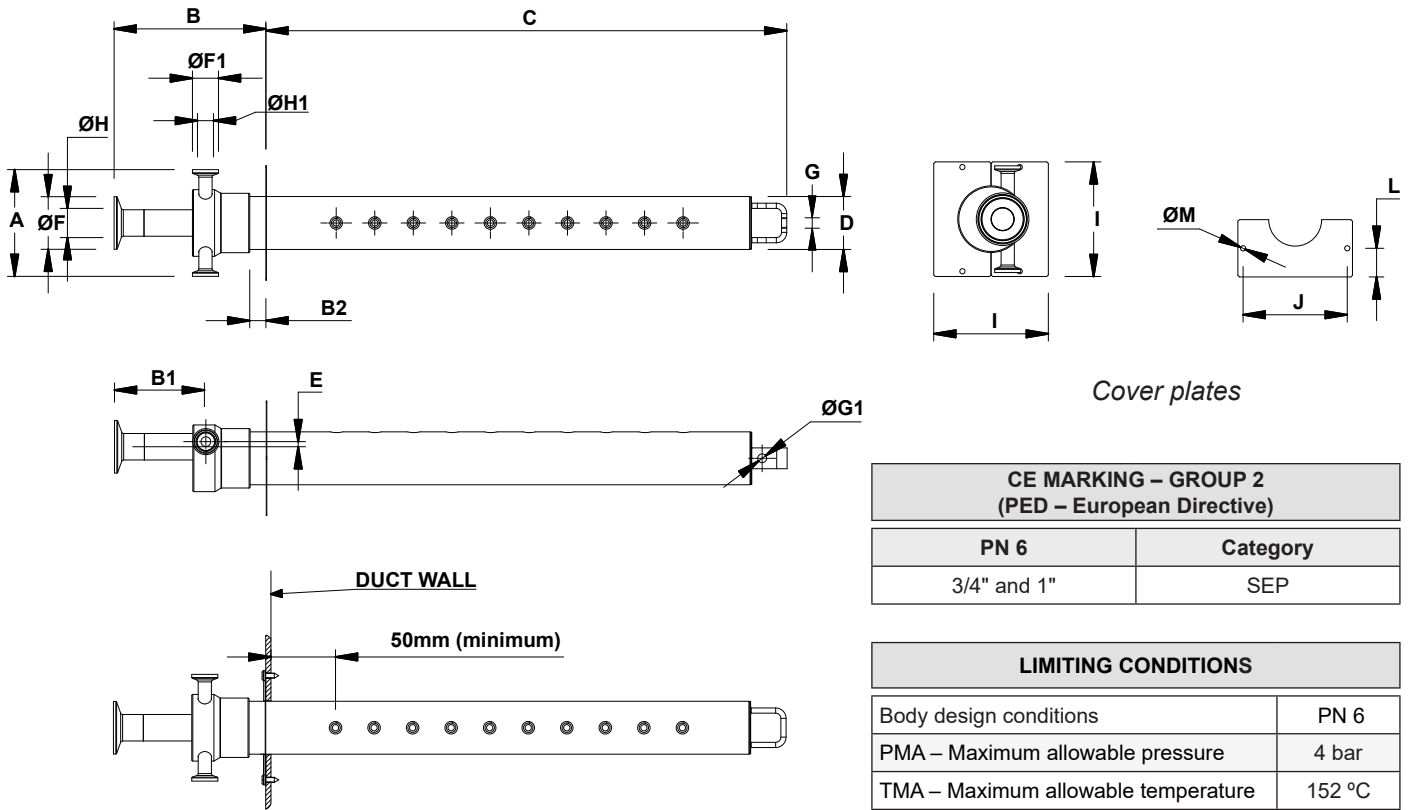
### Step 4: Steam traps, pressure reducing station and ancillaries

A suitable trapping set must be installed on the drain connection of the humidity separator and one or multiple steam traps must also be installed to drain the heating chambers and manifold if any. A pressure reducing station may be required in some situations to reduce system pressure to the desired value and different valves and ancillaries may also be necessary. Consult the manufacturer for further information.

Note: For information on ADCAPure DSHS absorption distances consult the manufacturer. Required information: Inlet air temperature (°C), inlet relative humidity (%), outlet relative humidity (%), injection steam pressure (barg), maximum humidification load (kg/h), duct/AHU dimensions (H x W in mm).



INJECTION TUBES

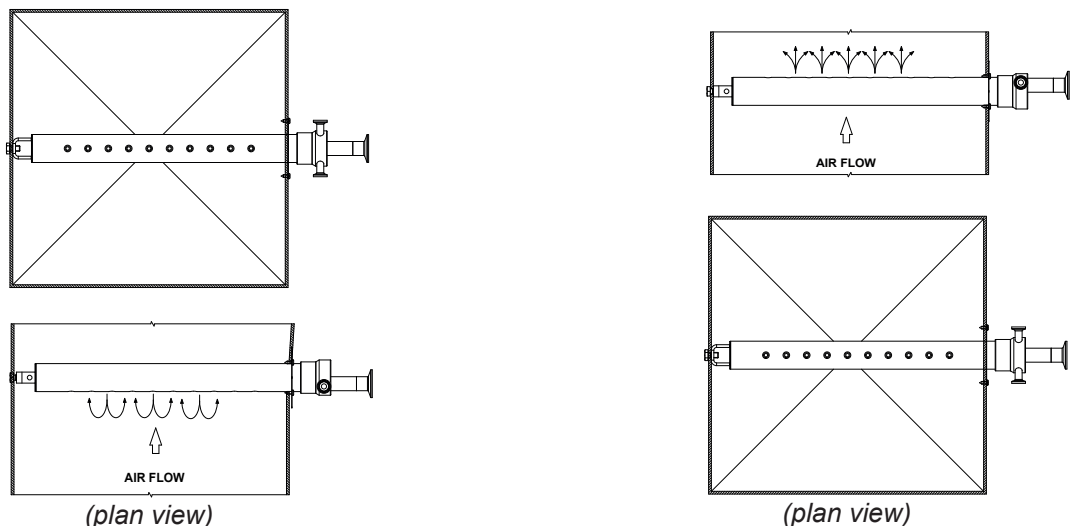


DIMENSIONS (mm)																		
MODEL	A	B	B1	B2 *	C ** Min. - Max.	D	E	ØF	ØF1	G	ØG1	ØH	ØH1	I	J	L	ØM	WGT. (kg)
DSHS10	91	147,5	85	20	180 - 3100	38	3,1	25	25	M10	8,5	15,75	9,4	100	90	25	5	***
DSHS25	102,5	145,7	87,7	15,5	330 - 3100	50	4,9	50,5	25	M10	8,5	22,1	9,4	110	100	25,5	5	

\* When thermal insulation is present, this dimension must be increased accordingly.  
 \*\* Tube insertion length to be defined according to customer requirements (e.g. duct width).  
 \*\*\* To be confirmed after exact length is defined.

STEAM EMISSION DIRECTION

Steam injection should be against the air flow. On vertical air flow applications, the steam should be injected upwards, regardless of the air flow direction.



Horizontal duct

Vertical duct



ORDERING CODES DSHS										
<b>Model</b>	<b>DHS</b>	<b>10</b>	<b>XXXX</b>	<b>XX</b>	<b>A</b>	<b>X</b>	<b>X</b>	<b>A</b>	<b>15</b>	
DSHS Hygienic injection tube	DHS									
<b>Type</b>										
10		10								
25		25								
<b>Insertion length (mm)</b>										
Specify dimension "C"			XXXX							
<b>Options</b>										
None				XX						
"B2" increased by 30 mm to accommodate thermal insulation thickness				I3						
<b>Pipe connection (d1)</b>										
Clamp ferrule ASME BPE					D					
<b>Surface finish a)</b>										
Standard surface finish						X				
Mirror mechanical polished external surfaces (SF1)						P				
Electropolished internal wetted parts (SF5)						E				
<b>Special features</b>										
None							X			
<b>Pipe connection (d2)</b>										
Clamp ferrule ASME BPE								D		
<b>Size (d1 x d2)</b>										
3/4" x 3/4"									20	
1" x 1"									25	
<b>Specials / Extras</b>										
Full description or additional codes have to be added in case of non-standard combination										E

a) Consult IS PV20.00 (Technical information) for further details and other surface finish options.