

**COPES-VULCAN**  
AN SPX BRAND

# VO-II & VO-76

## Variable Orifice Desuperheater



## Description and Principle of Operation

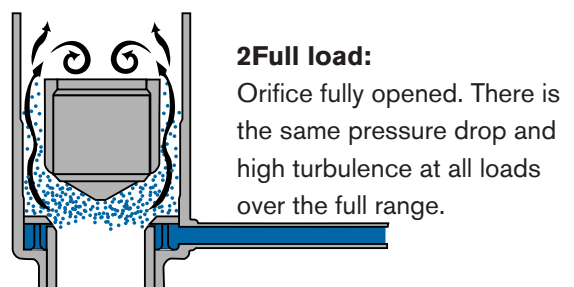
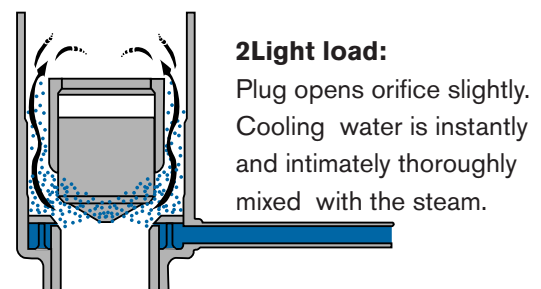
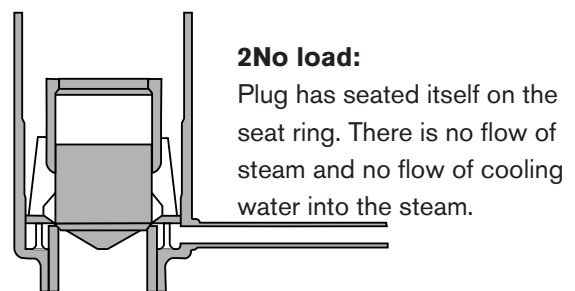
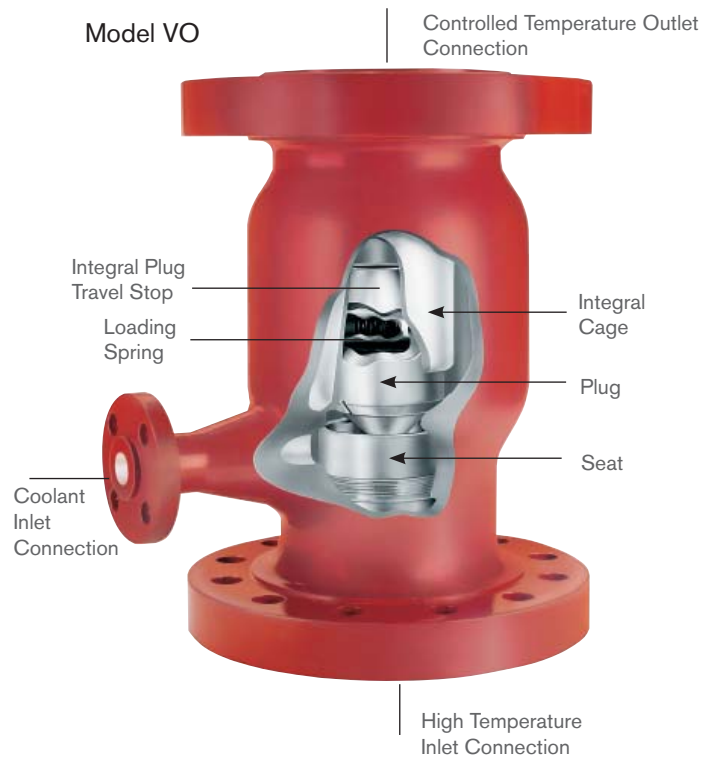
The Variable Orifice Desuperheater consists of a body which houses the desuperheater internals. The body incorporates a screwed-in seat over which a cage is located in such a manner that a coolant annulus is created around the seat. The coolant enters this annulus by means of a branch on the desuperheater body. The plug is free floating but incorporates a spring-loaded button which provides stability to the plug under light load conditions. Incorporated in the top of the cage is a plug stop to limit the amount of travel of the plug.

In service, incoming vapor acts on the underside of the plug, which is weighted in such a manner that a certain amount of the energy in the vapor is used to lift the plug. As more vapor flows through the desuperheater, the higher the plug is lifted, thus creating a variable orifice for the vapor flow. The energy used in lifting the plug creates a pressure drop across the seat which is quite constant regardless of the vapor flow. This pressure drop creates a relatively high velocity across the seat area, and it is at this point of low pressure constant velocity that the coolant is admitted into the vapor flow.

Coolant enters the annulus under the dictates of a control valve responsive to a temperature controller sensing the downstream vapor temperature. The coolant is admitted into the vapor flow through a peripheral gap between the underside of the cage and the top of the seat. Coolant is admitted all around the seat, thus ensuring that unequal cooling does not occur.

The coolant is picked up by the vapor flow as it discharges from the seat, and the low pressure zone that exists at this point is instrumental in atomizing the coolant into fine particles. In the turbulence which ensues as a result of the change in direction and velocity of the vapor, intimate mixing of the vapor and coolant takes place. Above the plug, as the vapor attempts to return to laminar flow, a vortex is created and any particles of coolant not completely absorbed by the vapor are drawn into this vortex where they suffer a further pressure reduction which again speeds up the atomizing process.

As virtually all of the desuperheating occurs within the desuperheater body itself, and as no coolant impinges on either the desuperheater or associated piping, no protective thermal liners are required.



## Variable Orifice Desuperheater

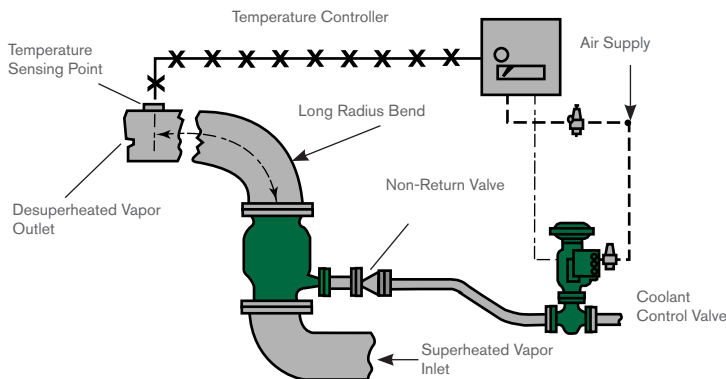
Copes-Vulcan's VO Variable Orifice Desuperheater is recognized industry wide as the most versatile desuperheater available. It is easily capable of meeting the most demanding needs for desuperheating in both the power and process industries.

The VO offers extremely fine control and exceptional turndown that is limited only by the rangeability of the coolant control valve itself.

With excellent mixing of vapor and coolant, control is possible throughout the entire operating range to within  $\pm 5^\circ\text{F}$  ( $\pm 2.5^\circ\text{C}$ ) of the set point which can be as close as  $10^\circ\text{F}$  ( $5^\circ\text{C}$ ) above saturation.

The coolant pressure which is required at the inlet to the VO need only be 5 psi (35 kPa) above the pressure of the vapor being desuperheated.

Because virtually all of the desuperheating occurs within the VO body itself, the temperature sensing element can be as close as 14—20' (4—6m) from the desuperheater outlet.



### Installation

The desuperheater is designed for installation in a vertical run of pipe with flow upwards. There are no requirements for straight pipe upstream or downstream of the unit, however, if a bend is located immediately at the outlet, it should be a long radius elbow.

### Model VO-II Design

The basic design of the pressure retaining part of the VO-II is in accordance with ANSI B16.5 (B.S.1560).

### Sizes

The VO-II is currently available in sizes 3" (80mm) through 20" (500mm).

### Materials of Construction

Carbon steel ASTM A216-WCB

Low alloy steel ASTM A217-WC6

Other castable materials available on request.

### Pressure Ratings

VO-II desuperheaters are available in ANSI pressure classes 150, 300, 600 and 900. For additional sizes, pressure classes, and configurations, refer to Model VO-76.

### End Connections

VO-II desuperheaters are normally supplied with flanged connections to ANSI (BS 1560) DIN (BS 4540) or BS10. For additional sizes, end connections, and configurations, refer to Model VO-76.

### Sizing/Selection

The VO-II and all Copes-Vulcan desuperheaters can be sized by Copes-Vulcan or an authorized Sales Representative using the SmartSize for Steam Conditioning Equipment computer sizing program to assure correct application.

Typical information required to size:

- Process steam flow rates
- Process steam pressure
- Process steam temperature (superheated)
- Desired process steam temperature(desuperheated)
- Available cooling water pressure
- Available cooling water temperature
- Process steam line size and schedule

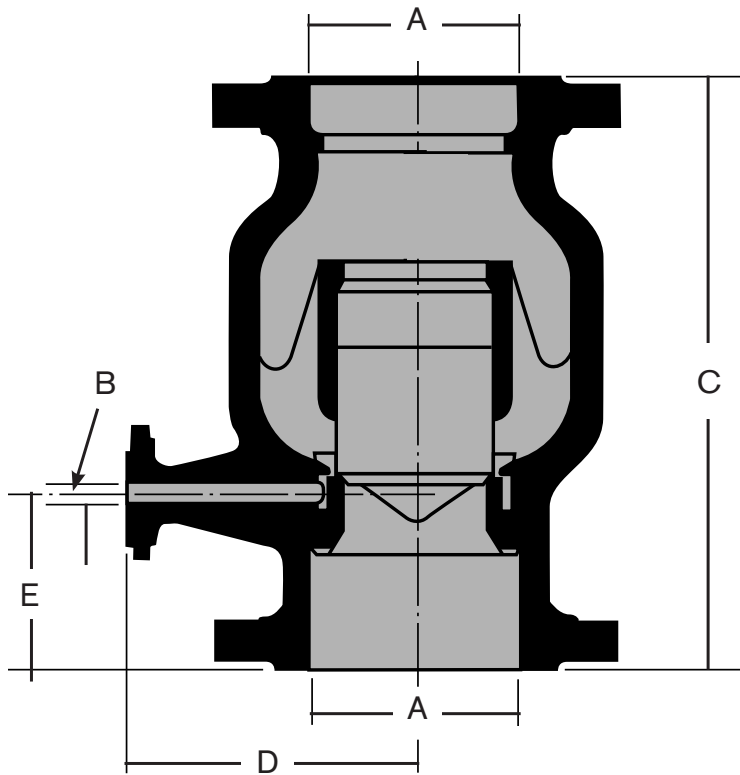
## VO-II Dimensions

150/900 Class Rating

Unit Size	Norm. Bore		150/300 Rating			600 Rating			900 Rating		
	A	B	C	D	E	C	D	E	C	D	E
3 80	3 80	1 25	13 330	7 178	5 127	13.75 349	7.25 184	5.38 137	14.25 362	7.63 194	5.63 143
4 100	4 100	1 25	14 356	7.5 191	5 127	15 381	7.75 197	5.5 140	15.5 394	8.13 206	5.75 146
6 150	6 150	1 25	18 457	9.63 244	6 152	19.25 489	9.88 251	6.63 168	20 508	10.25 260	7 178
8 200	8 200	1 25	22 559	10.75 273	6.5 165	23.75 603	11 279	7.38 187	24.25 616	11.38 289	7.63 194
10 250	10 250	1.5 40	27.75 705	12.75 324	7.75 197	29.5 749	13 330	8.63 219	30 762	13.38 340	8.88 225
12 300	12 300	1.5 40	34 864	15 381	8.75 222	35.75 908	15.25 387	9.63 244	36.75 933	15.63 397	10.13 257
14 350	14 350	1.5 40	39.5 1003	17 432	9 229	41.25 1048	17.25 438	9.88 251	42.5 1079	17.63 448	10.5 267
16 400	16 400	1.5 40	43 1092	20 508	10 254	44.5 1130	20.25 514	10.75 273	46 1168	20.63 524	11.5 292
18 450	18 450	1.5 40	50 1422	21 533	11 279	55.25 1480	21.25 540	12.13 303	59.75 1518	21.63 549	12.88 327
20 500	20 500	2 50	—	—	—	—	—	—	—	—	—

Inch

Millimeter



Packaging - Processing

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### Model VO-76

While virtually identical in operation and performance to the VO-II, the VO-76 is offered by Copes-Vulcan as an alternate when existing piping requires a custom fit, where pressure ratings exceed class 900, or where size requirements exceed those offered in the VO-II.

As "Arrangement #1," the VO-76 housing is supplied as a cast unit with integral inlet flange and butt weld outlet. "Arrangement #2" welds a reducer to the above description. The standard reducer results in a butt weld outlet the same nominal size as the flanged inlet, but non-standard sizes are also available.

As "Arrangement #3," a weld neck flange is added to the combination of housing and reducer. Again, the standard arrangement has the same size inlet and outlet flanges.

By using various sized reducers/expanders and/or flanges, an almost endless variation of dimensions and end connections can be achieved.

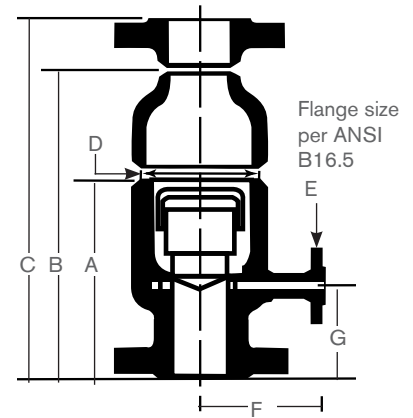
The VO-76 is also available with a housing fabricated from forged and wrought piping components when technical specifications and/or N.D.T. requirements preclude the use of castings. Again, reducers and flanges can be added as required, but unlike the cast VO-76, this applies to both inlet and outlet on the fabricated version of the VO-76.



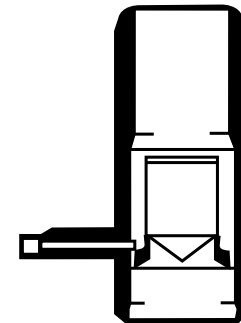
# VO-76 Dimensions

ANSI Pressure Classes 150-1500

Size	ANSI Class	A Housing	B Housing w/ Reducer	C Housing w/ Reducer & Outlet Flange	D Housing & Reducer I.D.	E Coolant Flange Size	F & G
2 50	150	<u>10.75</u> 273	<u>15.75</u> 400	<u>18.25</u> 464	5 127	.75 19	
	300	<u>10.75</u> 273	<u>15.75</u> 400	<u>18.5</u> 470			
	400	<u>10.75</u> 273	<u>15.75</u> 400	<u>18.88</u> 479			
	600	<u>10.75</u> 273	<u>15.75</u> 400	<u>18.88</u> 479			
	900	<u>11.5</u> 292	<u>16.5</u> 419	<u>20.75</u> 527			
	1500	<u>11.5</u> 292	<u>16.5</u> 419	<u>20.75</u> 527			
3 75	150	<u>10.75</u> 273	<u>16.25</u> 413	<u>19</u> 483	6 152	.75 19	
	300	<u>10.75</u> 273	<u>16.25</u> 413	<u>19.38</u> 492			
	400	<u>10.75</u> 273	<u>16.25</u> 413	<u>19.75</u> 502			
	600	<u>10.75</u> 273	<u>16.25</u> 413	<u>19.75</u> 502			
	900	<u>10.75</u> 273	<u>16.25</u> 413	<u>20.5</u> 521			
	1500	<u>12.38</u> 314	<u>17.88</u> 454	<u>22.75</u> 578			
	2500	<u>14</u> 356	<u>19.5</u> 495	<u>26.38</u> 670			
4 100	150	<u>14</u> 356	<u>21</u> 533	<u>24</u> 610	10 254	1 25.4	
	300	<u>14</u> 356	<u>21</u> 533	<u>24.38</u> 619			
	400	<u>14</u> 356	<u>21</u> 533	<u>24.75</u> 629			
	600	<u>14</u> 356	<u>21</u> 533	<u>25.25</u> 641			
	900	<u>14.5</u> 368	<u>21.5</u> 546	<u>26.25</u> 667			
	1500	<u>15.5</u> 394	<u>22.5</u> 571	<u>27.63</u> 702			
	6 150	150	<u>16.5</u> 419	<u>24.5</u> 622			
300		<u>16.5</u> 419	<u>24.5</u> 622	<u>28.38</u> 721			
400		<u>16.5</u> 419	<u>24.5</u> 622	<u>28.81</u> 732			
600		<u>16.5</u> 419	<u>24.5</u> 622	<u>29.38</u> 746			
900		<u>16.5</u> 419	<u>24.5</u> 622	<u>30.25</u> 768			
1500		<u>19.25</u> 489	<u>27.25</u> 692	<u>34.25</u> 870			
2500		<u>22.88</u> 581	<u>30.88</u> 784	<u>39.19</u> 995			
8 200		150	<u>20.25</u> 514	<u>29.38</u> 746	<u>33.38</u> 848	14 356	2 50.8
	300	<u>20.25</u> 514	<u>29.38</u> 746	<u>33.75</u> 857			
	400	<u>20.25</u> 514	<u>29.69</u> 754	<u>34.56</u> 878			
	600	<u>20.25</u> 514	<u>29.69</u> 754	<u>35.19</u> 894			
	900	<u>20.25</u> 514	<u>29.63</u> 752	<u>36.25</u> 921			
	1500	<u>23.25</u> 591	<u>33.38</u> 848	<u>42</u> 1069			



Typical Fabricated Arrangement



Please contact Copes-Vulcan for F and G dimensions.

A VO-76 typically will be one nominal size smaller than the equivalent VO-II. Both will have the same size plug and internal components.

Request available pressure/temperature ratings and dimensions.

Note: All dimensions are subject to change without notice.

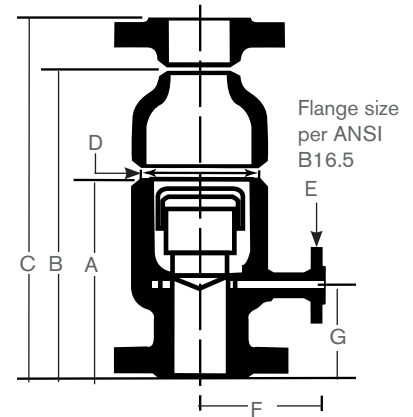
Request certified drawings.

Inch  
Millimeter

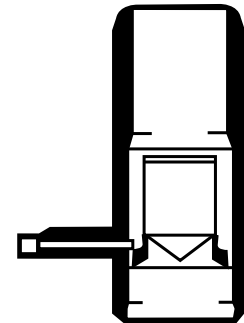
# VO-76 Dimensions (Cont.)

ANSI Pressure Classes 150-1500

Size	ANSI Class	A Housing	B Housing w/ Reducer	C Housing w/ Reducer & Outlet Flange	D Housing & Reducer I.D.	E Coolant Flange Size	F & G
10 250	150	25.25 641	35.19 894	39.19 995	16 406	2.5 63.5	
	300	25.25 641	35.19 894	39.81 1011			
	400	25.25 641	35.63 905	40.75 1035			
	600	25.25 641	35.63 905	41.88 1064			
12 300	150	29.88 759	42.19 1071	46.75 1187	20 508	3 76.2	
	300	29.88 759	42.19 1071	47.38 1203			
	400	29.88 759	42.69 1084	48.38 1229			
	600	29.88 759	42.69 1084	49.13 1248			
14 350	150	34.13 867	47.81 1214	52.81 1341	24 610	3 76.2	
	300	34.13 867	47.81 1214	53.44 1357			
	400	34.13 867	48.69 1237	55.56 1411			
	600	34.13 867	49.44 1256	56.19 1427			
16 400	150	37.63 956	52.94 1344	57.94 1472	26 660	3.5 88.9	
	300	37.63 956	53.25 1352	59 1499			
	400	37.63 956	53.5 1359	59.75 1518			
	600	37.63 956	53.5 1359	60.75 1543			
	900	38.13 968	55.25 1403	64 1626		4 101.6	
18 450	150	36.75 933	53.13 1349	58.63 1489	28 711	4 101.6	
	300	36.75 933	53.13 1349	59.38 1508			
	400	36.75 933	53.75 1365	60.5 1537			
	600	36.75 933	54.75 1391	62.25 1581			
20 500	150	38.13 968	54.63 1387	60.31 1532	30 762	4 101.6	
	300	38.13 968	55.38 1406	61.75 1568			
	400	38.13 968	56.13 1425	63 1600			
	600	38.13 968	54.69 1389	62.44 1586			
24 600	150	40.38 1026	59.88 1521	65.88 1673	36 914	3 76.2	
	300	41.63 1057	62.5 1587	69.13 1756			
	400	43.5 1105	65 1651	72.13 1832			
	600	44.75 1137	66.25 1683	74.5 1892			



Typical Fabricated Arrangement



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