

# KUNKLE SAFETY AND RELIEF PRODUCTS

## DATA SUPPLEMENT

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### SIZING AND SELECTION

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#### 1. For Steam

- A. To obtain lb/h for sizing, divide BTU (max. firing rate) by 1000.  
To obtain kg/h for sizing, divided KW by 0.6461.

#### 2. For Liquid

- A. Liquid valves must be sized closely to actual flow; oversizing causes "chatter," undersizing causes high pressure.  
B. Liquid relief valves are normally capacity rated at 25% overpressure. Refer to Catalog capacity correction tables for 10% overpressure. ASME Section I and VIII and XIII-UV Liquid Valves are rated at 10% overpressure.

#### 3. For Air-Gas

- A. Valves for cold or cryogenic temperatures (below -20°F [-29°C]) must be made from bronze, brass, or stainless steel to avoid the brittleness found in other materials at these temperatures. Many valves are offered with cryogenic materials as an option/extra.

### SIZING – GAS FLOW CONVERSIONS

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If flow is expressed in actual volume, such as CFM (cubic feet per minute) or ACFM (actual CFM) as is often done for compressors, where the flow is described as displacement or swept volume, the flow may be converted to SCFM as follows (or from flow expressed in m<sup>3</sup>/h to Nm<sup>3</sup>/h).

Conversions from one volumetric flow rate to another or to weight flow (and vice versa) may only be done when the volumetric flow is expressed in the standard conditions shown above. If flows are expressed at temperature or pressure bases that differ from those listed above, they must first be converted to the standard base.

#### Inch-Pound Units

$$\text{scfm} = \left( \frac{\text{cfm}}{\text{acfm}} \right) \times \frac{14.7 + p}{14.7} \times \frac{520}{460 + t}$$

Where:

- p = gauge pressure of gas or vapor in psig  
t = temperature of gas or vapor in °F

#### Metric Units

$$\text{Nm}^3/\text{h} = \text{m}^3/\text{h} = \text{m}^3/\text{h} \times \frac{1.013 + p}{1.013} \times \frac{273}{273 + t}$$

Where:

- p = gauge pressure of gas or vapor in barg  
t = temperature of gas or vapor in °C

### CONVERSION FORMULAS

Degrees Fahrenheit (°F)	Degrees Celsius (°C)
F + 459.67 = R (Rankine)	C + 273.15 = K (Kelvin)
(F - 32) x 0.556 = C (Celsius)	(C x 1.8) + 32 = F (Fahrenheit)

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### SIZING

#### AIR AND GAS TEMPERATURE CORRECTION FACTORS

Temperature			Temperature			Temperature		
°F	[°C]	Tc	°F	[°C]	Tc	°F	[°C]	Tc
0	[-18]	1.062	140	[60]	.931	380	[193]	.787
10	[-12]	1.051	160	[71]	.916	400	[204]	.778
20	[-7]	1.041	180	[82]	.902	420	[216]	.769
30	[-1]	1.030	200	[93]	.888	440	[227]	.760
40	[4]	1.020	220	[104]	.874	460	[238]	.752
50	[10]	1.009	240	[116]	.862	480	[249]	.744
60	[16]	1.000	260	[127]	.849	500	[260]	.737
70	[21]	.991	280	[138]	.838	550	[288]	.718
80	[27]	.981	300	[149]	.828	600	[316]	.701
90	[32]	.972	320	[160]	.817	650	[343]	.685
100	[38]	.964	340	[171]	.806	700	[371]	.669
120	[49]	.947	360	[182]	.796	750	[399]	.656

#### NOTE

1. For temperatures other than 60°F [15.6°C] at valve inlet, multiply SCFM by Tc.

#### PHYSICAL PROPERTIES

Gas or Vapor	M Molecular Weight	k Specific Heat Ratio	C Gas Constant
Air	28.97	1.40	356
Ammonia, Anhydrous	17.03	1.31	348
Butane-n (Normal Butane)	58.12	1.09	326
Carbon Dioxide	44.01	1.29	346
Carbon Monoxide	28.01	1.40	356
Dowtherm A	165.00	1.05	321
Dowtherm E	147.00	1.00	315
Ethane	30.07	1.19	336
Ethylene (Ethene)	28.05	1.24	341
Helium	4.00	1.67	378
Hydrogen	2.02	1.41	357
Methane	16.04	1.31	348
Natural Gas (specific gravity = 0.60)	17.40	1.27	344
Nitrogen	28.01	1.40	356
Octane	114.23	1.05	321
Oxygen	32.00	1.40	356
Propane	44.10	1.13	330
Steam	18.02	1.31	348

# KUNKLE SAFETY AND RELIEF PRODUCTS

## DATA SUPPLEMENT

### SIZING

For capacities of super heated steam, multiply saturated steam capacity by correction factor below.

#### STEAM SUPER HEAT CORRECTION FACTOR, K<sup>s</sup> (continued on page 11)

Set Pressure		Saturated Steam Temp		Steam Temperature in, °F [°C]										
				340	360	380	400	420	440	460	480	500	520	540
psig	[barg]	°F	[°C]	[171]	[182]	[193]	[204]	[216]	[227]	[238]	[249]	[260]	[271]	[282]
15	[1.0]	250	[121.1]	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91
20	[1.4]	259	[126.1]	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91
40	[2.8]	287	[141.7]	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91
60	[4.1]	308	[153.4]	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91
80	[5.5]	324	[162.2]	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.91
100	[6.9]	338	[170.9]		1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92
120	[8.2]	350	[177.0]		1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92
140	[9.6]	361	[182.6]			1.00	1.00	0.99	0.98	0.96	0.95	0.94	0.93	0.92
160	[11.0]	371	[188.6]				1.00	0.99	0.98	0.97	0.95	0.94	0.93	0.92
180	[12.8]	380	[193.0]				1.00	0.99	0.98	0.97	0.96	0.95	0.93	0.92
200	[13.7]	388	[198.0]				1.00	0.99	0.99	0.97	0.96	0.95	0.93	0.92
220	[15.1]	395	[201.0]				1.00	1.00	0.99	0.98	0.96	0.95	0.94	0.93
240	[16.5]	403	[205.7]					1.00	0.99	0.98	0.97	0.95	0.94	0.93
260	[17.9]	409	[209.4]					1.00	0.99	0.98	0.97	0.96	0.94	0.93
280	[19.2]	416	[213.3]					1.00	1.00	0.99	0.97	0.96	0.95	0.93
300	[20.6]	422	[217.0]						1.00	0.99	0.98	0.96	0.95	0.93
350	[24.1]	436	[224.3]						1.00	1.00	0.99	0.97	0.96	0.94
400	[27.5]	448	[231.0]							1.00	0.99	0.98	0.96	0.95
450	[31.0]	460	[238.0]								1.00	0.99	0.97	0.96
500	[34.4]	470	[243.0]								1.00	0.99	0.98	0.96
550	[37.9]	480	[249.0]									1.00	0.99	0.97
600	[41.3]	489	[253.4]									1.00	0.99	0.98
650	[44.8]	497	[258.0]										1.00	0.99
700	[48.2]	506	[263.3]										1.00	0.99
750	[51.7]	513	[267.7]										1.00	1.00
800	[55.2]	520	[271.3]											1.00
850	[58.6]	527	[275.0]											1.00
900	[62.1]	533	[278.4]											1.00
950	[65.5]	540	[282.2]											
1000	[69.0]	546	[285.6]											

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#### STEAM SUPER HEAT CORRECTION FACTOR, K<sup>S</sup>

Set Pressure		Saturated Steam Temp		Steam Temperature in, °F [°C]										
				560	580	600	620	640	660	680	700	720	740	760
psig	[barg]	°F	[°C]	[293]	[304]	[316]	[327]	[338]	[349]	[360]	[371]	[382]	[393]	[404]
15	[1.0]	250	[121.1]	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.82
20	[1.4]	259	[126.1]	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.82
40	[2.8]	287	[141.7]	0.90	0.89	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.83	0.82
60	[4.1]	308	[153.4]	0.90	0.89	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.83	0.82
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