KUNKLE DATA SUPPLEMENT

SAFETY AND RELIEF PRODUCTS

Data Supplement for Kunkle Safety and Relief Products

VCTDS-00396-EN 22/05

CONTENTS

All valve dimensions are for reference only.

ASME CODES

The ASME (American Society of Mechanical Engineers) boiler and pressure vessel code requirements for overpressure protection as they relate to Kunkle products are as follows:

ASME Section I
This code applies to boilers where steam or other vapor is generated at a pressure greater than 15 psig [1.0 barg], high temperature water boilers intended for operation at pressures exceeding 160 psig [11.03 barg] and/or temperatures exceeding 250°F [121°C] and liquid phase thermal fluid heaters.

Boiler Pressure Accumulation
No more than 6% above the highest pressure at which any valve is set, or no more than 6% above MAWP.

Set Pressure
The set pressure of a one-valve installation cannot be higher than the MAWP. The set pressure of the second or other valves in a multiple valve installation can be up to 3% above the MAWP. The complete range of valve settings for multiple valve installations cannot be greater than 10% of the highest set pressure. For high temperature water boilers, this 10% range may be exceeded.

ASME Section IV and XIII - HV
This code applies to steam boilers operating at pressures not greater than 15 psig [1.0 barg] and hot water heating boilers operating at pressures not greater than 160 psig [11.03 barg] and/or temperatures not greater than 250°F [121°C].

Steam Boilers
Valve capacity must be selected to prevent the boiler pressure from rising more than 5 psig [0.35 barg] above the MAWP.

Hot Water Boilers
Safety valve must be set to relieve at a pressure not greater than the MAWP of the boiler. If more than one safety valve is used, the secondary valve(s) may be set up to 6 psig [0.41 barg] above the MAWP for boilers with MAWPs up to and including 60 psig [4.13 barg], and 5% for boilers with MAWPs greater than 60 psig [4.13 barg]. Capacity must be selected to prevent the pressure from rising more than 10% above the MAWP if one valve is used or 10% above the set pressure of the highest set valve if more than one valve is used.

Tanks/Heat Exchangers High Temperature Water-to-Water Heat Exchangers
Valve(s) must be set at a pressure not greater than the MAWP and with sufficient capacity to prevent the pressure from increasing more than 10% above the MAWP.

Steam to Hot Water Supply
Valve must be at least 1" [25 mm] diameter with set pressure not greater than MAWP of the tank.

High Temperature Water to Steam Heat Exchanger
Valve must be set at a pressure not greater than 15 psig [1.0 barg] and with sufficient capacity to prevent the pressure from rising more than 5 psig [0.35 barg] above the MAWP.

ASME Section VIII and XIII - UV
This code applies to unfired pressure vessels with an inside diameter larger than 6 inches [130 mm] and designed for use above 15 psig [1.0 barg]. Valve(s) must prevent the pressure from rising more than 10% or 3 psig [0.21 barg], whichever is greater, above the MAWP. For a single valve installation, the set pressure may not be greater than the MAWP. For multiple valve installations, the first valve cannot be set higher than the MAWP, but the other valves can be set up to 5% above the MAWP. The pressure rise for multiple valve installations can be 16% or 4 psig [0.27 barg], whichever is greater. When the vessel is exposed to an external heat source, such as fire, the pressure rise can be 21% above the MAWP.

NOTE
Information stated is for reference only. User should always refer to the current revision of the ASME BPVC.

ASME CODE REQUIREMENTS

National Board

Kunkle valves are manufactured at facilities that meet the manufacturing requirements of the ASME Sections I (V), IV and XIII (HV) and VIII and XIII (UV) codes for pressure relief valves. Valves that have the relief capacity certified by the National Board of Boiler and Pressure Vessel Inspectors bear the following code symbol stamp on the nameplate and the letters NB. Most Kunkle valves have NB certified capacities.

Code Stamps

'V' 

V — applies to all ASME Section I valves

'HV' 

HV — applies to all ASME Section IV and XIII-HV valves

'UV' 

UV — applies to all ASME Section VIII and XIII-UV valves

NOTE

Information stated above is based on latest Code at time of publication.

POWER BOILER - SECTION I - CODE 'V'

Set Pressure psig	[barg]	Set Pressure Tolerance	Minimum Blowdown[2]	Overpressure[1]
15 - 100	[1.03 - 6.90]		2 psig [0.14 barg] min.	
101+	[6.96+]		2%	
15 - 70	[1.03 - 4.83]	±2 psig [±0.14 barg]		
71 - 300	[4.90 - 20.69]	±3 %		
301 - 1000	[20.95 - 68.96]	±10 psig [±0.69 barg]		
1001 and up	[69.03 and up]	±1%		

NOTES

1. Overpressure would be 2 psig [0.14 barg] for pressures between 15 - 66 psig [1.03 - 4.55 barg]. Pressures above 66 psig [4.55 barg] would have an overpressure of 3%. Valves marked for liquid service have allowable overpressure of 10% or 3 psig (whicever is greater).
2. Maximum blowdown is 10% for "Special Application Section I" valves.

HEATING BOILER - SECTION IV - CODE 'HV'

	Set Pressure psig	[barg]	Set Pressure Tolerance	Blowdown	Overpressure
15 psig Steam	15	[1.0]	±2 psig [±0.14 barg]	2 - 4 psig [0.14 - 0.28 barg]	5 psig [0.34 barg]
Hot Water	15 - 60	[1.0 - 4.14]	±3 psig [±0.21 barg]	N/A	10%
Hot Water	61 - 160	[4.20 - 11.0]	±5%	N/A	10%

UNFIRED PRESSURE VESSEL - SECTION VIII - CODE 'UV'

Set Pressure psig	[barg]	Set Pressure Tolerance	Blowdown	Overpressure
15 - 30	[1.0 - 2.07 barg]	±2 psig [±0.14 barg]	N/A	3 psig [0.21 barg]
31 - 70	[2.14 - 4.83 barg]	±2 psig [±0.14 barg]	N/A	10%
71 and up	[4.90 barg and up]	±3%	N/A	10%

NON-CODE SET PRESSURE TOLERANCE

Set Pressure, psig [barg]	Set Pressure Tolerance, psig [barg]
Below 15 psig [1.0 barg] to 10 psig [0.69 barg]	+/- 2.0 psig [± 0.14 barg]
Below 10 psig [0.69 barg] to 5.0 psig [0.34 barg]	+/- 1.0 psig [± 0.07 barg]
Below 5.0 psig [0.34 barg]	+/- 0.5 psig [± 0.03 barg]
Below 0.0" Hg [0.0 mb] to 10" Hg [337 mb]	+/- 1.0" Hg [± 33.7 mb]
Below 10" Hg [337 mb] to 20" Hg [674 mb]	+/- 2.0" Hg [± 67.4 mb]
Below 20" Hg [674 mb]	+/- 4.0" Hg [± 134.8 mb]

SEAT TIGHTNESS PERFORMANCE STANDARDS

KUNKLE FACTORY STANDARD[1]

Code Section	Service	Performance Standard
I, VIII and Non-Code	Steam	No visible leakage for 15 seconds at 20% below nameplate set pressure or at 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.
VIII and Non-Code	Air/Gas	No audible leakage for 15 seconds at 20% below nameplate set pressure or at 5 psig [0.35 barg] below name plate set pressure, whichever is greater.
I, IV, VIII and Non-Code	Liquid	No visible leakage for 30 seconds at 20% below nameplate set pressure or at 5 psig [0.35 barg] below name plate set pressure, whichever is greater.
IV	Steam	No visible leakage for 30 seconds at 12 psig [0.83 barg].

1. For Kunkle Models 230/330/330S/333S see separate table below.

API-527 STANDARD

Model	Code Section	Service	Performance Standard
300, 600 900, 6000	I and VIII	Steam	API 527 - No visible leakage for 1 minute at 10% below nameplate set pressure or 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.
6000 (O-ring seat) 916/917 (soft seat) 918/919 (soft seat)	VIII	Air/Gas	API 527 - Bubble tight for 1 minute at 10% below nameplate set pressure or 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.
910/912 911/913	VIII	Air/Gas	API 527 - D and E orifice: 40 bubbles/min, F through J orifice: 20 bubbles/min at 10% below nameplate set pressure or 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.
916/917 (soft seat) 918/919 (soft seat)	VIII	Liquid	API 527 - No leakage for 1 minute at 10% below nameplate set pressure, or 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.
910/912 911/913 928/929	I and VIII	Liquid	API 527 - 10 cc/h for inlet sizes less than 1" or 10 cc/h/in of inlet valve size for inlet sizes 1" and larger at 10% below nameplate set pressure or 5 psig [0.35 barg] below nameplate set pressure, whichever is greater.

KUNKLE MODELS 230/330/330S/333S STANDARD SEAT TIGHTNESS

Code	Service	Performance Standard
VIII and Non-Code	Air/Gas	Bubble-tight for 10 seconds at 10% below nameplate set pressure

VALVE SELECTION GUIDE

(For specific minimum/maximum temperature/pressure ranges refer to individual product datasheets).

Model(s)	Material		Connections		Inlet Size Range		Min/Max[1] Press.		Min/Max Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
Steam (ASME Section I - Power Boilers)										
300, 600	CS	SS		X	1¼ - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/800	[-29/427]
920, 921, 927 (special use – 10% blowdown)	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	15/1400	[1.0/96.5]	-20/800	[-29/427]
6010, 6021, 6121, 6182 6186, 6221, 6283	Bronze	Brass	X		½ - 2½"	[12.7 - 63.5]	3/250	[0.69/17.2]	-60/406	[-51/208]
6030, 6130, 6230	Bronze	SS	X		½ - 2½"	[12.7 - 63.5]	3/300	[0.69/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1½ - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]
Steam (ASME Section VIII and XIII-UV - Unfired Steam Equipment)										
1 and 2	Bronze	Brass	X		½ - 1"	[12.7 - 25.4]	5/250	[0.34/17.2]	-60/406	[-51/208]
264, 265	CS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
300, 600	CS	SS		X	1¼ - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/750	[-29/399]
910	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911	SS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	3/250	[0.21/17.2]	-320/406	[-195/208]
913	Bronze	SS	X	O	½ - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/425	[-195/219]
6010, 6021, 6121, 6182, 6186, 6221, 6283	Bronze	Brass	X		½ - 2½"	[12.7 - 63.5]	3/250	[0.21/17.2]	-60/406	[-51/208]
6030, 6130, 6230	Bronze	SS	X		½ - 2½"	[12.7 - 63.5]	3/300	[0.21/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1½ - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]
Steam (ASME Section IV and XIII-HV - Low Pressure Steam Heating Boilers)										
930	Iron	Bronze	X		2 - 3"	[50.8 - 76.2]	15 only	[1.0]	250 only	[122]
6933, 6934	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	15 only	[1.0]	250 only	[122]
6935	Bronze	SS	X		½ - 2"	[12.7 - 50.8]	15 only	[1.0]	250 only	[122]
6254	Iron	SS	X	X	1½ - 6"	[38.1 - 152.4]	15 only	[1.0]	250 only	[122]
Steam (Non-code)[2]										
40R, 40RL	SS	SS	X		½ - ¾"	[12.7 - 19.05]	1/400	[0.07/27.6]	-60/850	[-51/454]

X = Standard O = Optional

NOTES

1. Set pressures less than 15 psig [1.0 barg] are non-code only.
2. See also ASME Section VIII and XIII-UV steam valves for non-code steam applications.

VALVE SELECTION GUIDE

(For specific minimum/maximum temperature/pressure ranges refer to individual product datasheets).

Model(s)	Material		Connections		Inlet Size Range		Min/Max[3] Press.		Min/Max[4] Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
Air/Gas (ASME Section VIII) and XIII-UV										
1 and 2	Brass	Brass	X		½ - 1"	[12.7 - 25.4]	5/250	[0.34/17.2]	-60/406	[-51/208]
30	Brass	Brass	X		¼"	[6.35]	60/4000	[4.1/275.8]	20/300	[-6.6/150]
189	Bronze	SS	X		½ - ¾"	[12.7 - 19.05]	1000/2500	[69/344.8]	-320/350	[-195/177]
264, 265	CS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
300, 600	CS	SS		X	1¼ - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/800	[-195/427]
330	Aluminum	SS	X[5]		¼ - ½"	[6.35 - 12.7]	1000/5500	[69/379.3]	-20/185	[-29/85]
330S, 333S	Aluminum	SS	X[5]		¼ - ½"	[6.35 - 12.7]	1000/7500	[69/517.1]	-20/185	[-29/85]
337	Iron	Bronze	X		2 - 3"	[50.8 - 76.2]	1/60	[0.07/4.14]	-20/406	[-29/208]
338	Aluminum	Brass	X		2"	[50.8]	5/30	[0.3/2.07]	-30/400	[-34/204]
363	Bronze	SS	X		½ - ¾"	[12.7 - 19.05]	50/1000	[3.4/69]	-320/350	[-195/177]
389	SS	SS	X		½ - ¾"	[12.7 - 19.05]	50/2500	[3.4/172.4]	-320/350	[-195/177]
541 (Buna disc), 542 (Viton® disc), 548 (SS disc)	Brass	Brass	X		¼ - ½"	[6.35 - 12.7]	3/400	[0.21/27.6]	-20/400	[-29/204]
541 (Buna disc), 542 (Viton® disc)	SS	SS	X		¼ - ½"	[6.35 - 12.7]	3/200	[0.21/13.8]	-20/300	[-29/149]
910, 916 (soft seat)[4]	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat)[4]	SS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat)[4]	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat)[4]	Bronze	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/425	[-195/219]
6010, 6121, 6182 6186, 6221, 6283[1]	Bronze	Brass	X		½ - 2½"	[12.7 - 63.5]	3/250	[0.21/17.2]	-60/406	[-51/208]
6030, 6130, 6320	Bronze	SS	X		½ - 2½"	[12.7 - 63.5]	3/300	[0.21/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1½ - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]
Air/Gas[2] (Non-code)										
230	Aluminum	SS	X[5]		¼ - ½"	[6.35 - 12.7]	300/1500	[20.7/103.4]	-20/185	[-29/85]
Air/Gas (Vacuum) in Hg [mm Hg]										
215V	Iron	Bronze	X		2 - 3"	[50.8 - 76.2]	2/29	[50/736]	-20/406	[-29/208]
910, 916 (soft seat)[4]	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	6/29	[152/736]	-20/800	[-29/427]
911, 917 (soft seat)[4]	SS	SS	X	O	½ - 2"	[12.7 - 50.8]	6/29	[152/736]	-320/800	[-195/427]
912, 918 (soft seat)[4]	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	6/29	[152/736]	-320/406	[-195/208]
913, 919 (soft seat)[4]	Bronze	SS	X	O	½ - 2"	[12.7 - 50.8]	6/29	[152/736]	-320/425	[-195/219]

X = Standard O = Optional

NOTES

1. Soft seat available on some models.
2. See also Section VIII air valves for non-code air/gas applications.
3. Set pressures less than 15 psig [1.0 barg] are non-code only.
4. Temperature limits of soft seats determine operating limits of valve.
5. SAE inlet thread available
6. Viton® and Teflon® are registered trademarks of the Chemours Company.

VALVE SELECTION GUIDE

(For specific minimum/maximum temperature/pressure ranges refer to individual product datasheets).

Model(s)	Material		Connections		Inlet Size Range		Min/Max[1] Press.		Min/Max[2] Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
Liquid (ASME Section I)										
928, 929	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	15/1400	[1.0/96.5]	-20/800	[-29/427]
Liquid (ASME Section IV and XIII-HV - Hot Water Boilers)										
537 (soft seat)	Iron/Bronze	Brass	X		¾ - 2"	[19.05 - 50.8]	15/160	[1.0/11]	-20/250	[-29/121]
Liquid (ASME Section VIII and XIII-UV)										
910, 916 (soft seat)[2]	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat)[2]	SS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat)[2]	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat)[2]	Bronze	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/425	[-195/219]
Liquid (Non-code)										
19, 20	Bronze	Bronze	X	O	½ - 3"	[12.7 - 76.2]	1/300	[0.07/20.7]	-60/406	[-51/208]
19M, 20M	Bronze	SS	X	O	2½ - 3"	[63.5 - 76.2]	1/500	[0.07/34.5]	-60/406	[-51/208]
71S	Iron	SS	X		½ - 2"	[12.7 - 50.8]	1/250	[0.07/17.2]	-20/406	[-29/208]
171, 171P	CS	SS	X		½ - 2"	[12.7 - 50.8]	1/400	[0.07/27.6]	-20/550	[-29/288]
171S	SS	SS	X		½ - 2"	[12.7 - 50.8]	1/400	[0.07/27.6]	-20/550	[-29/288]
91	Iron	Bronze	X	X	1½ - 6"	[38.1 - 152.4]	5/400	[0.34/27.6]	-20/406	[-29/208]
218,228	Iron	Bronze	X	X	3, 4, and 6"	[76.2 - 152.4]	60/200	[4.1/13.8]	-20/406	[-29/208]
140	SS	SS	X		⅜ - ½ "	[9.5 - 12.7]	10/300	[0.69/20.7]	-60/406	[-51/208]
264, 265	CS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		½ - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
910, 916 (soft seat)[2]	CS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat)[2]	SS	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat)[2]	Bronze	Brass	X		½ - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat)[2]	Bronze	SS	X	O	½ - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/425	[-195/219]
Liquid - Underwriters Laboratories (UL) For Oil Services										
200A	Bronze	Brass	X		¾ - 1½"	[19.05 - 38.1]	1/200	[0.07/13.8]	-60/406	[-51/208]
200H	Bronze	SS	X	O	¾ - 2"	[19.05 - 50.8]	1/200	[0.07/13.8]	-60/406	[-51/208]
Liquid - Underwriters Laboratories (UL) and Factory Mutual Research (FM) For Fire Pump Water Relief										
218, 228	Iron	Bronze	X	X	3, 4 and 6"	[76.2 - 152.4]	60/200	[4.1/13.8]	-20/406	[-29/208]
918 (soft seat)[2, 3]	Bronze	Brass	X		¾ - 1"	[19.05 - 25.4]	60/250	[4.1/17.2]	-20/406	[-29/208]
Other - Drip Pan Elbow										
299	Iron	N/A	X	X	2 - 8"	[50.80 - 203.2]	N/A	N/A	-20/406	[-29/208]

X = Standard O = Optional

NOTES

1. Set pressures below 15 psig [1.0 barg] are non-code only.
2. Temperature limits of soft seats determine operating limits of valve.
3. FM Approved only.

SIZING AND SELECTION

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

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^3/h to Nm^3/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

$$\text{scfm} = \left(\begin{matrix} \text{cfm} \\ \text{or} \\ \text{acfm} \end{matrix} \right) \text{x} \frac{14.7 + \text{p}}{14.7} \text{ x } \frac{520}{460 + \text{t}}$$

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

Metric Units

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

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)

SIZING

AIR AND GAS TEMPERATURE CORRECTION FACTORS

Temperature		Tc	Temperature		Tc	Temperature		Tc
°F	[°C]		°F	[°C]		°F	[°C]	
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

	M	k	C
Gas or Vapor	Molecular Weight	Specific Heat Ratio	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

SIZING

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

STEAM SUPER HEAT CORRECTION FACTOR, K^S (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]											

SIZING

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

STEAM SUPER HEAT CORRECTION FACTOR, K^S

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
80	[5.5]	324	[162.2]	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83	0.82
100	[6.9]	338	[170.9]	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.82
120	[8.2]	350	[177.0]	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.82
140	[9.6]	361	[182.6]	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.82
160	[11.0]	371	[188.6]	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.82
180	[12.8]	380	[193.0]	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.82
200	[13.7]	388	[198.0]	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.83
220	[15.1]	395	[201.0]	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
240	[16.5]	403	[205.7]	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
260	[17.9]	409	[209.4]	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84	0.83
280	[19.2]	416	[213.3]	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84	0.83
300	[20.6]	422	[217.0]	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83
350	[24.1]	436	[224.3]	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.83
400	[27.5]	448	[231.0]	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
450	[31.0]	460	[238.0]	0.94	0.93	0.92	0.91	0.89	0.88	0.87	0.86	0.86	0.85	0.84
500	[34.4]	470	[243.0]	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84
550	[37.9]	480	[249.0]	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84
600	[41.3]	489	[253.4]	0.96	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.84
650	[44.8]	497	[258.0]	0.97	0.95	0.94	0.92	0.91	0.90	0.89	0.87	0.86	0.86	0.85
700	[48.2]	506	[263.3]	0.97	0.96	0.94	0.93	0.91	0.90	0.89	0.88	0.87	0.86	0.85
750	[51.7]	513	[267.7]	0.98	0.96	0.95	0.93	0.92	0.90	0.89	0.88	0.87	0.86	0.85
800	[55.2]	520	[271.3]	0.99	0.97	0.95	0.94	0.92	0.91	0.90	0.88	0.87	0.86	0.85
850	[58.6]	527	[275.0]	0.99	0.98	0.96	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86
900	[62.1]	533	[278.4]	1.00	0.99	0.97	0.95	0.93	0.92	0.90	0.89	0.88	0.87	0.86
950	[65.5]	540	[282.2]	1.00	0.99	0.97	0.95	0.94	0.92	0.91	0.89	0.88	0.87	0.86
1000	[69.0]	546	[285.6]	1.00	0.99	0.98	0.96	0.94	0.93	0.91	0.90	0.89	0.87	0.86

GENERAL INFORMATION

Definition of units

GPM -Gallons per minute (liquid flow)
SCFM -Standard cubic feet per minute (air or gas flow)
#/h -Pounds per hour (steam flow)
Nm^3/h -Normal cubic meter per hour
BHP -Horsepower (energy)
K_v -Flow coefficient
F -° Fahrenheit (temperature)
C -° Centigrade (temperature)
Hg -Inches of mercury (pressure)
psig -Pounds per square inch, gauge (pressure)
psia -Pounds per square inch, absolute (pressure)
barg -(pressure) bar, gauge

DEFINITIONS AND COMMONLY USED TERMS

Blowdown
The difference in pressure between the opening pressure and reclose pressure. May be expressed in percent of set pressure or 'psig'.

Drag
Occurs when a valve does not close completely after popping and remains partly open until the pressure is further reduced.

Lift
The distance between the seat and disc seating surfaces when the valve is open.

MAWP
Maximum allowable working pressure. This data is found on the pressure vessel nameplate and is the maximum pressure at which the lowest set safety valve must be set (stamped).

Operating pressure
The gauge pressure at which a pressure vessel is maintained in normal operation.

Overpressure
The permitted increase in pressure developed after the valve has opened.

Pre-open/warn
An audible or visual discharge at a pressure slightly lower than the set pressure. Warns the operator that the valve is about to cycle.

Set pressure
The gauge pressure at which a safety valve visibly and audibly opens or a setting at which a relief valve discharges a 1" long, unbroken stream of liquid.

Safety and relief valves
The terms 'safety valve' and 'relief valve' are frequently used interchangeably. This is satisfactory to the extent that both safety and relief valves of the spring-loaded model are similar in external appearance and both serve the broad general purpose of limiting media (liquid and gaseous) pressures by discharging some of the pressurized liquid or gas. Some authorities restrict 'safety valves' to those installed on boilers, superheaters, and fired vessels - all others being classified as relief valves. We prefer, however, to briefly define them as follows:

- Safety valves are used with gases - which include air and steam. Their design always includes a huddling chamber which utilizes the expansion forces of these gases to effect quick opening (popping) and closing actions. The difference between the opening and closing pressures is termed 'blowdown' and for steam safety valves blowdown limitations are defined in the ASME Power Boiler Code.
- Relief valves are normally used for liquid service, although safety valves may also be used. Ordinarily, relief valves do not have an accentuated huddling chamber or a regulator ring for varying or adjusting blowdown. Therefore, they operate with more of a modulating action as pressure increases or decreases.

Safety relief valve pointers

1. ASME Codes require that valves for air, steam and water service over 140°F [60°C] have test levers.
2. Steam safety valves may be used for air service but not vice versa. Liquid valves should be used on liquid only.
3. Safety relief valves should be installed vertically with the drain holes open or piped to a convenient location.
4. The inlet to and outlet from a safety relief valve must be at least as large as the inlet and outlet connections of the pressure relief valve.

Maintenance

1. Develop a regular program of visual inspection, looking for clogged drains and discharge pipe, dirt build-up in and around the valve seat and broken or missing parts or seals.
2. Test the valve every six to 12 months (depending on plant's age and condition) preferably by raising the system pressure to the valve's set pressure or operating the hand lever. Always wear proper PPE (gloves, hearing protection, etc.) when performing lift lever test. Ensure all open discharge holes are facing away from you. Note: Minimum of 75% of set required before using lever to test.
3. Do not paint, oil, or otherwise cover any interior or working parts of any safety valve. They do not require any lubrication or protective coating to work properly.

When safety/relief valves require repair, service adjustments, or set pressure changes, work shall be accomplished by the manufacturer, or holders of 'VR' stamp.