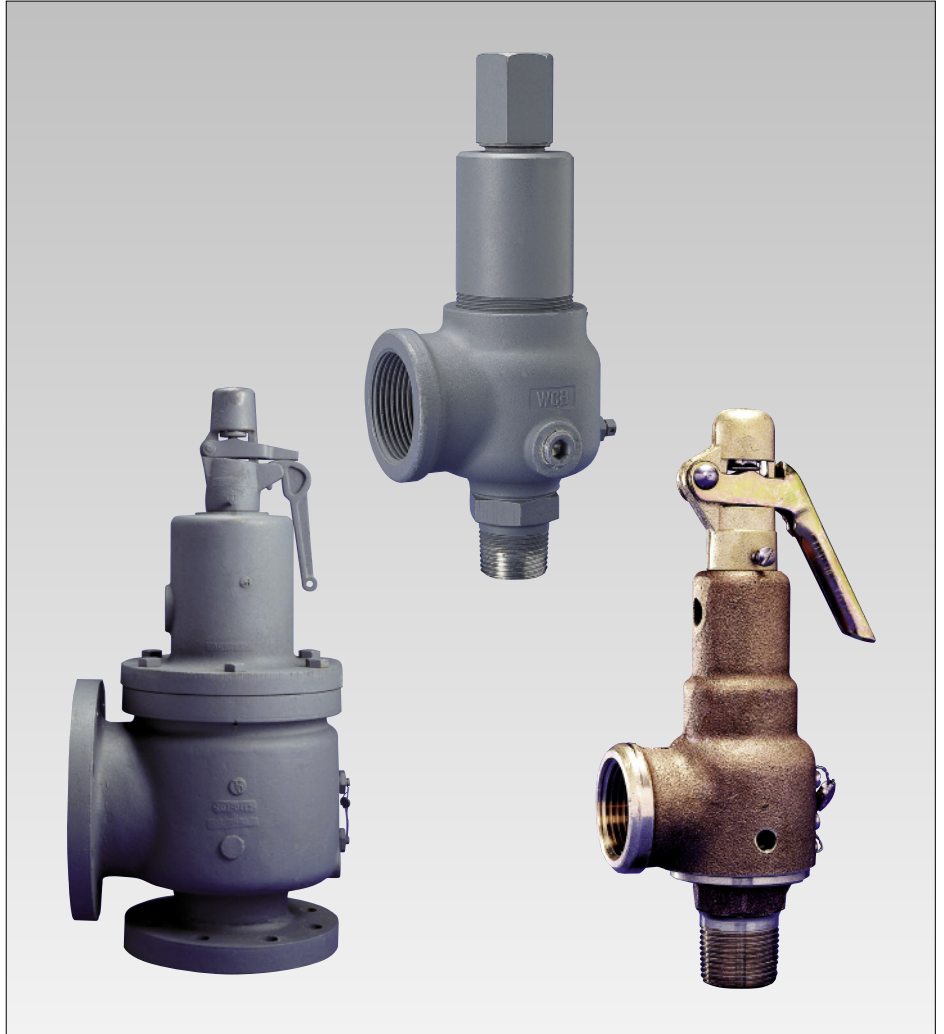


# KUNKLE

## Data Supplement for Safety and Relief Products



## Contents

ASME Codes . . . . .	2-3
Seat Tightness Performance Standards . . . . .	4
Valve Selection Guide . . . . .	5-7
Sizing and Selection . . . . .	8-11
General Information . . . . .	12
Kunkle Industries, Inc. Terms and Conditions of Sales . . . . .	13-15

**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] and high temperature water boilers intended for operation at pressures exceeding 160 psig [11.03 barg] and/or temperatures exceeding 250°F [121°C].

### 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

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

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 above is based on latest Code at time of publication.

## ASME Code Requirements

### National Board

Kunkle valves are manufactured at facilities that meet the manufacturing requirements of the ASME Sections I, IV, and VIII 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”  - applies to all ASME Section I valves

“HV”  - applies to all ASME Section IV valves

“UV”  - applies to all ASME Section VIII 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	Blowdown	Overpressure
15 - 66	[1.03 - 4.55]		2 - 4 psig [0.14 - 0.28 barg]	
67 - 100	[4.62 - 6.90]		2 psi [0.14 barg] - 6%	
101 - 250	[6.96 - 17.24]		2% - 6%	See Note below <sup>1</sup>
251 - 374	[17.31 - 25.79]		2% - 15 psig [1.03 barg]	
375 - 1000	[25.86 - 68.96]		2% - 4%	
15 - 69	[1.03 - 4.75]	±2 psig [±0.14 barg]		
70 - 300	[4.83 - 20.69]	±3 %		
301 - 1000	[20.95 - 68.96]	±10 psig [±0.69 barg]		
1001 and up	[69.03 and up]	±1%		

### Note

1. Overpressure would be 2 psig [0.14 barg] for pressures between 15 - 70 psig [1.03 - 4.83 barg]. Pressures above 70 psig [4.83 barg] would have an overpressure of 3%.

### 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

Code Section	Service	Performance Standard
I and VIII	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	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.
IV and VIII	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].

### 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 <sup>1</sup>	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 <sup>1</sup>	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	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.

### Note

- API 527 is not available on air service for:
  - Plain lever "J" orifice (Model 900 and Model 6000)
  - Plain lever (Model 900) above 444 psig [30.6 barg] set pressure.

## Valve Selection Guide

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

### Steam (ASME Section I - Power Boilers)

Model(s)	Material		Connections		Inlet Size Range		Min/Max <sup>1</sup> Press.		Min/Max Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
300, 600	CS	SS		X	1 1/4 - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/800	[-29/427]
920, 921, 927 (special use – 10% blowdown)	CS	SS	X		1/2 - 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		1/2 - 2 1/2"	[12.7 - 63.5]	3/250	[0.69/17.2]	-60/406	[-51/208]
6030, 6130, 6230	Bronze	SS	X		1/2 - 2 1/2"	[12.7 - 63.5]	3/300	[0.69/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1 1/2 - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]

### Steam (ASME Section VIII - Unfired Steam Equipment)

1 and 2	Bronze	Brass	X		1/2 - 1"	[12.7 - 25.4]	5/250	[0.34/17.2]	-60/406	[-51/208]
264, 265	CS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
300, 600	CS	SS		X	1 1/4 - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/750	[-29/399]
910	CS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911	SS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912	Bronze	Brass	X		1/2 - 2"	[12.7 - 50.8]	3/250	[0.21/17.2]	-320/406	[-195/208]
913	Bronze	SS	X		1/2 - 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		1/2 - 2 1/2"	[12.7 - 63.5]	3/250	[0.21/17.2]	-60/406	[-51/208]
6030, 6130, 6230	Bronze	SS	X		1/2 - 2 1/2"	[12.7 - 63.5]	3/300	[0.21/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1 1/2 - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]

### Steam (ASME Section IV - 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		1/2 - 2"	[12.7 - 50.8]	15 only	[1.0]	250 only	[122]
6935	Bronze	SS	X		1/2 - 2"	[12.7 - 50.8]	15 only	[1.0]	250 only	[122]
6254	Iron	SS	X	X	1 1/2 - 6"	[38.1 - 152.4]	15 only	[1.0]	250 only	[122]

### Steam (Non-code)<sup>2</sup>

40R, 40RL	SS	SS	X		1/2 - 3/4"	[12.7 - 19.05]	1/400	[0.07/27.6]	-60/850	[-51/454]
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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 steam valves for non-code steam applications.

## Valve Selection Guide

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

### Air/Gas (ASME Section VIII)

Model(s)	Material		Connections		Inlet Size Range		Min/Max <sup>3</sup> Press.		Min/Max <sup>4</sup> Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
1 and 2	Brass	Brass	X		1/2 - 1"	[12.7 - 25.4]	5/250	[0.34/17.2]	-60/406	[-51/208]
30	Brass	Brass	X		1/4"	[6.35]	60/4000	[4.1/275.8]	20/300	[-6.6/150]
189	Bronze	SS	X		1/2 - 3/4"	[12.7 - 19.05]	1000/2500	[69/344.8]	-320/350	[-195/177]
264, 265	CS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
300, 600	CS	SS		X	1 1/4 - 6"	[31.75 - 152.4]	15/1000	[1.0/69]	-20/800	[-195/427]
330 (Kynar <sup>®</sup> seat)	Aluminum	SS	X		1/4"	[6.35]	1000/5500	[69/379.3]	-20/185	[-29/85]
330S, 333S (Kynar <sup>®</sup> seat)	Aluminum	SS			1/4"	[6.35]	2000/6500	[138/448.3]	-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		1/2 - 3/4"	[12.7 - 19.05]	50/1000	[3.4/69]	-320/350	[-195/177]
389	SS	SS	X		1/2 - 3/4"	[12.7 - 19.05]	50/2500	[3.4/172.4]	-320/350	[-195/177]
541 (Buna disc), 542 (Viton <sup>®</sup> disc), 548 (SS disc)	Brass	Brass	X		1/4 - 1/2"	[6.35 - 12.7]	3/400	[0.21/27.6]	-20/400	[-29/204]
910, 916 (soft seat) <sup>4</sup>	CS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat) <sup>4</sup>	SS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat) <sup>4</sup>	Bronze	Brass	X		1/2 - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat) <sup>4</sup>	Bronze	SS	X		1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/425	[-195/219]
6010, 6121, 6182 6186, 6221, 6283 <sup>1</sup>	Bronze	Brass	X		1/2 - 2 1/2"	[12.7 - 63.5]	3/250	[0.21/17.2]	-60/406	[-51/208]
6030, 6130, 6320	Bronze	SS	X		1/2 - 2 1/2"	[12.7 - 63.5]	3/300	[0.21/20.7]	-60/425	[-51/219]
6252	Iron	SS	X	X	1 1/2 - 6"	[38.1 - 152.4]	10/250	[0.69/17.2]	-20/406	[-29/208]

### Air/Gas<sup>2</sup> (Non-code)

230 (Kynar <sup>®</sup> seat)	Aluminum	SS	X		1/4"	[6.35]	300/1500	[20.7/103.4]	-20/185	[-29/85]
803 (Kynar <sup>®</sup> seat)	Aluminum	SS	X		1/4"	[6.35]	1000/6000	[69/413.8]	-20/185	[-29/85]
818 (Teflon <sup>®</sup> seat)	CS	SS/Brass	X		2"	[50.8]	120/150	[8.3/10.3]	-20/300	[-29/150]

### 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) <sup>4</sup>	CS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	6/29	[152/736]	-20/800	[-29/427]
911, 917 (soft seat) <sup>4</sup>	SS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	6/29	[152/736]	-320/800	[-195/427]
912, 918 (soft seat) <sup>4</sup>	Bronze	Brass	X		1/2 - 2"	[12.7 - 50.8]	6/29	[152/736]	-320/406	[-195/208]
913, 919 (soft seat) <sup>4</sup>	Bronze	SS	X		1/2 - 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.

## Valve Selection Guide

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

### Liquid (ASME Section IV - Hot Water Boilers)

Model(s)	Material		Connections		Inlet Size Range		Min/Max <sup>1</sup> Press.		Min/Max <sup>2</sup> Temp.	
	Body	Trim	NPT	FLGD	in	[mm]	psig	[barg]	°F	[°C]
537 (soft seat)	Iron/Bronze	Brass	X		3/4 - 2"	[19.05 - 50.8]	15/160	[1.0/11]	-20/250	[-29/121]

### Liquid (ASME Section VIII)

910, 916 (soft seat) <sup>2</sup>	CS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat) <sup>2</sup>	SS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat) <sup>2</sup>	Bronze	Brass	X		1/2 - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat) <sup>2</sup>	Bronze	SS	X		1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/425	[-195/219]

### Liquid (Non-code)

19, 20	Bronze	Bronze	X	O	1/2 - 3"	[12.7 - 76.2]	1/300	[0.07/20.7]	-60/406	[-51/208]
19M, 20M	Bronze	SS	X	O	2 1/2 - 3"	[63.5 - 76.2]	1/500	[0.07/34.5]	-60/406	[-51/208]
71S	Iron	SS	X		1/2 - 2"	[12.7 - 50.8]	1/250	[0.07/17.2]	-20/406	[-29/208]
171, 171P	CS	SS	X		1/2 - 2"	[12.7 - 50.8]	1/400	[0.07/27.6]	-20/550	[-29/288]
171S	SS	SS	X		1/2 - 2"	[12.7 - 50.8]	1/400	[0.07/27.6]	-20/550	[-29/288]
91	Iron	Bronze	X	X	1 1/2 - 6"	[38.1 - 152.4]	5/400	[0.34/27.6]	-20/406	[-29/208]
218,228	Iron	Bronze	X		3, 4, and 6"	[76.2 - 152.4]	60/200	[4.1/13.8]	-20/406	[-29/208]
140	SS	SS	X		3/8 - 1/2 "	[9.5 - 12.7]	10/300	[0.69/20.7]	-60/406	[-51/208]
264, 265	CS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
266, 267	SS	SS	X		1/2 - 1"	[12.7 - 25.4]	4/3300	[0.28/227.6]	-20/750	[-29/399]
910, 916 (soft seat) <sup>2</sup>	CS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-20/800	[-29/427]
911, 917 (soft seat) <sup>2</sup>	SS	SS	X	O	1/2 - 2"	[12.7 - 50.8]	3/1400	[0.21/96.5]	-320/800	[-195/427]
912, 918 (soft seat) <sup>2</sup>	Bronze	Brass	X		1/2 - 2"	[12.7 - 50.8]	3/300	[0.21/20.7]	-320/406	[-195/208]
913, 919 (soft seat) <sup>2</sup>	Bronze	SS	X		1/2 - 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		3/4 - 1 1/2"	[19.05 - 38.1]	1/200	[0.07/13.8]	-60/406	[-51/208]
200H	Bronze	SS	X	O	3/4 - 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) <sup>2, 3</sup>	Bronze	Brass	X		3/4 - 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]
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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 VIII 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<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

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

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)



## Sizing

### Air and Gas Temperature Correction Factors

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

### Note

- 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

**Sizing**

**Steam Super Heat Correction Factor,  $K_S$  (continued on page 11)**

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

Set Pressure psig [barg]	Saturated Steam Temp °F [°C]	Steam Temperature in, °F [°C]												
		340 [171]	360 [182]	380 [193]	400 [204]	420 [216]	440 [227]	460 [238]	480 [249]	500 [260]	520 [271]	540 [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	0.96
550	[37.9]	480	[249.0]										1.00	0.97
600	[41.3]	489	[253.4]											0.98
650	[44.8]	497	[258.0]											1.00
700	[48.2]	506	[263.3]											1.00
750	[51.7]	513	[267.7]											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]											1.00
1000	[69.0]	546	[285.6]											1.00

## Sizing

### Steam Super Heat Correction Factor, $K_S$

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

Set Pressure psig [barg]		Saturated Steam Temp °F [°C]		Steam Temperature in, °F [°C]										
				560 [293]	580 [304]	600 [316]	620 [327]	640 [338]	660 [349]	680 [360]	700 [371]	720 [382]	740 [393]	760 [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 <sup>3</sup> /h	- Normal cubic meter per hour
BHP	- Horsepower (energy)
Kv	- 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. 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.

## Terms and Conditions of Sales

**1. Offer or Acceptance.** If this document constitutes an offer to sell by Seller (sometimes referred to as "Tyco Valves & Controls LP, Black Mountain (Kunkle)"), Seller's offer is expressly subject to Buyer's acceptance of all the terms and conditions contained herein and no other, unless otherwise mutually agreed to by both Seller and Buyer in a writing signed by both parties, and any response by Buyer which constitutes additional or different terms shall not operate as an acceptance if such acceptance would vary, delete or add to the terms and conditions contained herein. If this document constitutes an acceptance by Seller of Buyer's offer to buy the goods or services specified on the face hereof, such acceptance is expressly subject to all the terms and conditions contained herein and no others, unless otherwise mutually agreed to by both Seller and Buyer in a writing signed by both parties. Any of Buyer's proposed terms and conditions which are in addition to or different from those contained herein are hereby objected to and shall be of no effect. Buyer will in any event be deemed to have assented to all terms and conditions contained herein if any part of the goods sold hereunder are accepted.

**2. Shipping Dates.** The shipping dates, if any, set forth herein are approximate and are not guaranteed. Seller shall not be liable for any loss or damage for delay, non-delivery or other impairment of performance due to the actions or inactions of government, military authority, or Buyer, or by any reason of 'force major', which shall be deemed to mean all other causes whatsoever not reasonably within the control of Seller, including, but not limited to, acts of God, war, riot, sabotage, fires, floods, strikes, lockouts or other industrial disturbances, delays of carriers, and inability to secure materials, fuel labor, transportation or manufacturing facilities at Seller's expected prices. Any delay resulting from any such cause shall extend shipping dates correspondingly. Seller shall in no event be liable for any special, incidental or consequential damages arising from delay irrespective of the reason thereof, and receipt by Buyer shall constitute acceptance of delivery and waiver of any claims due to delay. Should delivery be delayed due to Buyer's actions or inactions, or should delivery be delayed at the request of Buyer, the selling price of the goods shall

automatically escalate at the rate of two percent [2%] per month for the duration of the delay or in an amount equal to Seller's increased cost, whichever is greater.

**3. Drawings.** If drawings are submitted herewith they are submitted only to show the general style, arrangement and approximate dimensions of the goods offered. No work is to be based on drawings unless the drawings are certified. Dimensional drawings certified by Seller will be furnished if agreed. In no event will manufacturing or proprietary drawings be supplied.

**4. Risk of Loss.** Buyer bears the risk of loss for damage to or destruction of the goods from and after the time same said goods are delivered either to the carrier for shipment to Buyer or to the Buyer, whichever occurs first, and regardless of whether or not Buyer may have the right to reject or revoke acceptance of said goods.

**5. Shipment.** If delivery specified is F.O.B. Seller's plant with freight allowed, Buyer shall pay to Seller, in addition to the purchase price, any and all transportation charges (including insurance).

**6. Taxes.** In addition to any prices specified herein, Buyer shall pay the gross amount of any present or future sales, use, excise, value-added, or other tax (whether federal, state, local or foreign) applicable to the price, sale, possession, or delivery of any goods or services furnished hereunder or to the use thereof by Buyer, or Buyer shall furnish Seller with a tax-exemption certificate acceptable to the levying taxing authority.

**7. Payments.** Buyer shall make payment in full for all goods ordered hereunder prior to shipment to Buyer, unless Buyer has entered into and agreed to Seller's Standard Credit Application and Agreement, in which event such Agreement is incorporated herein by reference and made a part hereof, unless and until such Agreement is terminated. The prices specified are in USA currency.

**8. Warranties; Remedies.** Tyco Valves & Controls LP, Black Mountain (Kunkle) warrants only that the goods delivered hereunder when paid for and properly installed, operated, and maintained shall be free from defects in material and workmanship under normal use and service for a period of twelve (12) months from the date of

installation by the first user of such goods or eighteen (18) months from date of shipment from the factory, whichever period shall be first completed. The warranty hereunder granted does not apply to products or components (such as electric or pneumatic mechanisms) manufactured by other companies or to any goods manufactured by Tyco Valves & Controls LP, Black Mountain (Kunkle) that have been subjected to misuse, improper installation, improper storage or protection prior to installation or use, negligence by Buyer or user, accident, corrosion, chemical attack or misapplication, or that have been modified or repaired by unauthorized persons. Tyco Valves & Controls LP, Black Mountain's (Kunkle) obligation and Buyer's remedy under this warranty are limited to: (a) correction, repair, or replacement, at Tyco Valves & Controls LP, Black Mountain's (Kunkle) option, of any defective unit of goods or (b) refund to Buyer of the purchase price allocable to the defective unit of goods if Tyco Valves & Controls LP, Black Mountain (Kunkle) is unable to repair, replace or correct such defect in a reasonable time. Tyco Valves & Controls LP, Black Mountain's (Kunkle) liability under this warranty is conditioned upon Buyer giving Tyco Valves & Controls LP, Black Mountain (Kunkle), immediate (but in any event within five (5) working days) written notice of any such defect. Any goods repaired or replaced of defective goods or parts shall, at Tyco Valves & Controls LP, Black Mountain's (Kunkle) option, occur at its plant in Houston, Texas and Tyco Valves & Controls LP, Black Mountain (Kunkle) shall reimburse Buyer all reasonable freight costs incurred in transporting defective goods or parts to and from Tyco Valves & Controls LP, Black Mountain's (Kunkle) plant in the event of a valid warranty claim. In the event Tyco Valves & Controls LP, Black Mountain (Kunkle) elects to provide replacement good or parts to buyer to repair defective goods, Buyer agrees to install said replacement parts or goods at its cost and, further, Tyco Valves & Controls LP, Black Mountain (Kunkle), shall in no event be liable for any labor or material costs of Buyer with respect to de-installing or repairing defective goods or installing replacement parts or goods. Tyco Valves & Controls LP, Black Mountain (Kunkle) shall have the option of requiring the return of the defective goods or parts thereof, transportation prepaid, to establish

## **Terms and Conditions of Sales** (continued)

the claim. Tyco Valves & Controls LP, Black Mountain (Kunkle) shall not be held liable for damages caused by delays in repair or replacement of any defective items. Certification by a separate writing as to compliance with specifications, blueprints, part numbers, quality test or otherwise will not create any warranty by or obligation of Tyco Valves & Controls LP, Black Mountain (Kunkle). The provisions in Tyco Valves & Controls LP, Black Mountain's (Kunkle) literature and specifications are descriptive only unless expressly stated as warranties. EXCEPT FOR THE LIMITED EXPRESS WARRANTY SET FORTH IN THIS SECTION, KUNKLE EXPRESSLY DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, ORAL AND WRITTEN, INCLUDING, WITHOUT LIMITATION, AND FITNESS FOR A PARTICULAR PURPOSE, WHETHER ARISING FROM STATUTE, COMMON LAW, CIVIL CODE, CUSTOM OR OTHERWISE. KUNKLE'S WARRANTY OBLIGATIONS AND BUYER'S REMEDIES FOR BREACH OF WARRANTY, EXCEPT AS TO TITLE, ARE SOLELY AND EXCLUSIVELY AS STATED IN THIS SECTION. No modification or addition to this document with respect to the foregoing warranty by Tyco Valves & Controls LP, Black Mountain (Kunkle) either before or after execution of this document, shall be made except in writing by the President or a Vice President of Tyco Valves & Controls LP, Black Mountain (Kunkle).

**9. Limitation of Liability.** In any event, the total liability of Tyco Valves & Controls LP, Black Mountain (Kunkle) arising from any cause of action or claim whatsoever, whether (a) in contract, (b) in tort, (including negligence, whether sole, joint, contributory, concurrent or antipollution law or regulation), (c) connected with any toxic or hazardous substance or constituent, (d) arising out of any representation or instruction, or under any warranty, (e) or otherwise, arising out of, connected with, or resulting from the design, manufacture, sale, resale, delivery, repair, replacement or use of any goods or the furnishing of any service shall in no event exceed the price allocable to and paid to Tyco Valves & Controls LP, Black Mountain (Kunkle) for the individual unit of goods or services or part thereof which gives rise to the cause of action or claim. In no event shall Tyco Valves & Controls LP, Black Mountain (Kunkle) or its affiliates be liable for any

special, indirect, incidental or consequential damages whenever occurring including, but not limited to, damages for loss of use of plant or property, damage to or destruction of equipment, downtime cost, cost of capital, economic loss, loss of good will, labor cost, loss of profits or revenues, or claims resulting from contracts between Buyer, its customers and/or suppliers, regardless of whether any of the foregoing arises from this document or Tyco Valves & Controls LP, Black Mountain (Kunkle) by any human being for personal injury or wrongful death. Tyco Valves & Controls LP, Black Mountain (Kunkle) and Buyer acknowledge and agree that the exclusions of remedies and limitations of liability and damages herein reflect a bargained-for allocation and limitation of risk, liability and damages. Tyco Valves & Controls LP, Black Mountain (Kunkle) will not defend, indemnify or hold harmless Buyer or others for any claim, expense or liability. This Section shall apply notwithstanding any other provision of this document.

### **10. Limitation of Liability to Third-Party**

**Purchases.** Prior to Buyer's transfer or sale of any goods sold pursuant hereto, or the transfer or sale of any interest in such goods, Buyer shall notify the Transferee of the full text of Sections 8 and 9 hereof in writing and shall provide Seller with written acknowledgment and acceptance by the transferee of the terms of Sections 8 and 9 hereof. Further, Buyer shall incorporate verbatim Sections 8 and 9 hereof in any contract between Buyer and any Transferee concerning any such transfer or sale. Buyer shall also include a written copy of Section 8 and 9 hereof with any goods covered hereby that are transferred or sold to a transferee. IF TRANSFER IS MADE CONTRARY TO THE PROVISIONS OF THIS SECTION 10, BUYER SHALL, IN ADDITION TO ANY OTHER LEGAL OR EQUITABLE RIGHTS OF SELLER, INDEMNIFY SELLER AGAINST ANY LIABILITIES, CLAIMS, COSTS, DAMAGES AND ATTORNEY'S FEES INCURRED BY SELLER IN EXCESS OF THOSE SET FORTH IN SECTIONS 8 AND 9 HEREOF. This Section 10 shall apply notwithstanding any other provisions of this document.

**11. Returns; Cancellations.** No goods may be returned except on prior written approval of Seller. Orders placed with and accepted by Seller may not be canceled except with

the written consent of Seller prior to shipment and Buyer's acceptance of Seller's cancellation charges which shall protect Seller against all costs and losses. Seller shall have the right to cancel the sale of any or all of the goods sold hereunder, without liability to Buyer except for the refund of monies already paid hereunder, the event manufacture or sale of the goods is or becomes technically or economically impractical.

**12. Product Modification.** Seller reserves the right to discontinue the manufacture of, or charge or modify the design and/or construction of goods sold pursuant to this document for the purpose of product improvement, without incurring any obligation to Buyer with respect thereto.

**13. Patents.** Seller agrees as its option, to defend at its safe cost and expense, and to pay any damages and cost awarded against Buyer, from any claim, suit or proceeding against Buyer to the extent such claim, suit or proceeding is based on an allegation that goods manufactured by Seller and delivered to Buyer hereunder infringe any United States letter patent, provided: (1) Seller is notified promptly in writing by Buyer of any such claim, suit or proceeding; (2) Seller is given information and assistance by Buyer as may be requested by Seller; and (3) Seller is given full authority (including authority to settle) by Buyer to conduct such defense as Seller deems appropriate. Seller's obligation under this Section does not apply to any goods the designs, instructions and/or specifications for which are partially or completely supplied by Buyer or to any claim, suit or proceeding in which the alleged infringement results from alteration of goods; use of goods for purposes other than those for which the goods were intended, or use of the goods in combination with products not manufactured by Seller. If in any suit covered by this Section, the use of goods is enjoined, Seller shall at its option and sole cost and expense either: (a) procure for Buyer the right to continue using the goods; (b) replace the goods with non-infringing goods; (c) modify the goods to be non-infringing; or (d) refund to Buyer or (d) refund to Buyer the purchase price of the goods and transportation costs related thereto. Seller shall have no liability with

## **Terms and Conditions of Sales** *(continued)*

respect to patent or trademark rights of countries foreign to the USA. The foregoing shall be Seller's sole and entire liability for patent infringement by the goods furnished pursuant hereto.

**14. Data.** Buyer agrees that all drawings, prints and other technical material (collectively 'Materials') which Seller provides to Buyer, whether prepared by Seller or by third parties under contract to Seller, contain data which embody trade secrets and confidential know-how of commercial value to Seller or to third parties under contract to Seller. Buyer agrees that Buyer and its agents and employees; (a) will keep confidential all such Materials; (b) will not disclose such Materials to any other person, corporate division or entity, except to employees of Buyer who need such Materials in order to perform Buyer's obligations hereunder; (c) will not use such Materials, except in connection with goods supplied hereunder; and (d) will not sell, lease, loan or permit any other person, corporate division or entity to use such Materials for any purpose, without Seller's prior written consent. Nothing herein shall restrict use of data or information available to the general public.

**15. Applicable Law: Section Headlines.**

**This document shall be deemed to have been executed and entered into the State of Texas, USA, and this document, and its formation, operation and performance, shall be governed, construed, performed and enforced in accordance with the substantive laws of the State of Texas, USA.**

The parties hereto agree that any civil action or lawsuit arising out of this document or the subject matter hereof shall be brought and maintained solely in state or federal courts located in Harris County, Texas, USA, and Buyer and Seller each hereby consents and submits to the personal jurisdiction of said courts. Any action or claim in any part arising out of or related to this document or the subject matter hereof, may be commenced or brought within one (1) year from the date the claim or action shall first arise or accrue, or be barred forever. The Section headings herein contained are for ease of reference only and shall not be construed to be part of this document.

**16. Merger.** Seller and Buyer agree that there are no understandings, agreements, representations or warranties between or by either of them, either oral or written, relative to the goods or services sold, pursuant hereto, including any made in or implied from past dealings, relative to the goods or services sold pursuant hereto, except those that are fully expressed herein. The provisions of this document supercede and control any previous understanding or agreement between the parties with respect to the subject matter hereof and this document is an expression of the complete and final understanding of the parties. Any representation, promise, course of dealing or trade usage not contained or referenced herein will not be binding on the parties hereto. Seller's branch managers or sales representatives, distributors, and dealers appointed by Seller are not authorized to make modifications, waivers or changes in or to these terms and conditions of sale. Buyer represents and agrees that it is Buyer's sole obligation and responsibility to determine the suitability of the goods for Buyer's use and application and any statements made by Seller's salespersons are opinion only and not representations or warranties of Seller and will not be relied on by the Buyer.

## **KUNKLE**

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