Section 12

Fittings, Accessories, and Helpful Engineering Information

Contents

- **Reduced assembly and maintenance time.**
- **Expanded pressure rating.**
- **Pre-applied thread sealant.**
- **Silicone free o-rings.**
- **Nickel plated brass bodies and collets.**
- **Maximum flows in a reduced size.**

Specifications

Fluid: Compressed air, nitrogen, inert and non-combustible gases compatible with materials of construction.

Working Pressure: 29.5" Hg vacuum to 260 psig (750 mm Hg to 18 bar)
Note: Flow Control working pressures: 5 to 150 psig (.3 to 10 bar)

Working Temperature: 0° to 175°F (-20° to 80°C)

Materials

Body, swivel fitting and collet: Nickel plated brass

O-ring: Silicone free Nitrile

Sealing washer (parallel male threads): Thermoplastic

Tubing: Nylon 11 or 12, Polyurethane (95 durometer or above) and LDPE (Low Density Polyethylene).

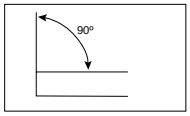
Thread Sealant: Precote 5 thread sealant is factory applied to the circumference of tapered male threads.

Tube O.D.'s and Tube Tolerances

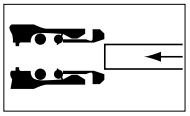
Tube O.D.	O.D. Tube Tolerances Nylon	Polyurethane
1/8" to 1/2" (3 mm to 14 mm)	+0.002" (+0.05 mm) -0.004" (-0.10 mm)	±0.004" (±0.10 mm)

LDPE –Tolerances specified in DIN 73378 or BS54-09/1:1976

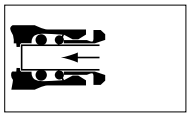
Method of Assembly



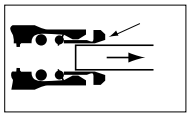
1. Ensure that the tube end is cut square and is free of burrs.



2. Push the tube through the collet into the fitting.

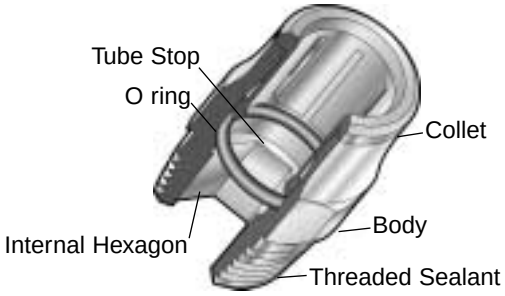


3. Continue pushing the tube (firmly) through the O-ring until it bottoms on the tube stop, then pull back



4. To disconnect, push the tube into the fitting until it bottoms on the tube stop. Then while holding down the collet, withdraw the tube.

Fitting Cutaway



Male Connector

Tube O.D.	NPTF or UNF Thread	Part Number
1/8"	10-32	12 425 0110
	1/16	12 425 0116
	1/8	12 425 0118
	1/4	12 425 0128
5/32"	10-32	12 425 0210
	1/8	12 425 0218
	1/4	12 425 0228
3/16"	1/8	12 425 0318
	1/4	12 425 0328
1/4"	10-32	12 425 0410
	1/8	12 425 0418
	1/4	12 425 0428
	3/8	12 425 0438
5/16"	1/8	12 425 0518
	1/4	12 425 0528
	3/8	12 425 0538
3/8"	1/8	12 425 0618
	1/4	12 425 0628
	3/8	12 425 0638
	1/2	12 425 0648
1/2"	1/4	12 425 0728
	3/8	12 425 0738
	1/2	12 425 0748

Swivel Male Elbow

Tube O.D.	NPTF or UNF Thread	Part Number
1/8"	10-32	12 447 0110
	1/8	12 447 0118
	1/4	12 447 0128
5/32"	10-32	12 447 0210
	1/8	12 447 0218
	1/4	12 447 0228
3/16"	1/8	12 447 0318
	1/4	12 447 0328
1/4"	10-32	12 447 0410
	1/8	12 447 0418
	1/4	12 447 0428
	3/8	12 447 0438
5/16"	1/8	12 447 0518
	1/4	12 447 0528
3/8"	1/8	12 447 0618
	1/4	12 447 0628
	3/8	12 447 0638
	1/2	12 447 0648
1/2"	1/4	12 447 0728
	3/8	12 447 0738
	1/2	12 447 0748

For additional sizes, configurations, metric products, and technical specifications request catalog Fittings APC-101.

Male Elbow

Tube O.D.	NPTF Thread	Part Number
1/8"	1/8	12 445 0118
5/32"	1/8	12 445 0218
	1/4	12 445 0228
3/16"	1/8	12 445 0318
	1/4	12 445 0328
1/4"	1/8	12 445 0418
	1/4	12 445 0428
	3/8	12 445 0438
5/16"	1/8	12 445 0518
	1/4	12 445 0528
3/8"	1/8	12 445 0618
	1/4	12 445 0628
	3/8	12 445 0638
	1/2	12 445 0648
1/2"	1/4	12 445 0728
	3/8	12 445 0738
	1/2	12 445 0748

Swivel Male Branch Tee

Tube O.D.	NPTF or UNF Thread	Part Number
1/8"	10-32 UNF	12 467 0110
	1/8	12 467 0118
	1/4	12 467 0128
5/32"	10-32 UNF	12 467 0210
	1/8	12 467 0218
	1/4	12 467 0228
1/4"	1/8	12 467 0418
	1/4	12 467 0428
	3/8	12 467 0438
5/16"	1/8	12 467 0518
	1/4	12 467 0528
3/8"	1/8	12 467 0618
	1/4	12 467 0628
	3/8	12 467 0638
	1/2	12 467 0648
1/2"	1/4	12 467 0728
	3/8	12 467 0738
	1/2	12 467 0748

Swivel Male Run Tee

Tube O.D.	NPTF or UNF Thread	Part Number
5/32"	10-32 UNF	12 468 0210
	1/8	12 468 0218
	1/4	12 468 0228
1/4"	1/8	12 468 0418
	1/4	12 468 0428
	3/8	12 468 0438
3/8"	1/8	12 468 0618
	1/4	12 468 0628
	3/8	12 468 0638
	1/2	12 468 0648
1/2"	1/4	12 468 0728
	3/8	12 468 0738
	1/2	12 468 0748

Female Connector

Tube O.D.	NPTF Thread	Part Number
5/32"	1/8	12 426 0218
	1/4	12 426 0228
1/4"	1/8	12 426 0418
	1/4	12 426 0428
3/8"	1/4	12 426 0628
	3/8	12 426 0638

Union

Tube O.D.	Part Number
1/8"	12 020 0100
5/32"	12 020 0200
1/4"	12 020 0400
5/16"	12 020 0500
3/8"	12 020 0600
1/2"	12 020 0700

Union Tee

Tube O.D.	Part Number
1/8"	12 060 0100
5/32"	12 060 0200
1/4"	12 060 0400
5/16"	12 060 0500
3/8"	12 060 0600
1/2"	12 060 0700

Union Elbow

Tube O.D.	Part Number
5/32"	12 040 0200
1/4"	12 040 0400
5/16"	12 040 0500
5/16"	12 040 0500
3/8"	12 040 0600
1/2"	12 040 0700

Plug*

Stem O.D.	Part Number
5/32"	11 004 0400
1/4"	94 050 904
5/16"	11 004 0800
3/8"	94 050 906
1/2"	94 050 907

*Material: Thermoplastic

Bulkhead Union

Tube O.D.	Part Number
1/8"	12 029 0100
5/32"	12 029 0200
3/16"	12 029 0300
1/4"	12 029 0400
5/16"	12 029 0500
3/8"	12 029 0600
1/2"	12 029 0700

For additional sizes, configurations, metric products, and technical specifications request catalog Fittings APC-101.

Parallel Union "Y" Connector*

Tube O.D. (2x)	Tube O.D (1x)	Part Number
5/32"	5/32"	12 082 0200
5/32"	1/4"	12 082 0402
1/4"	1/4"	12 082 0400

*Body Material: Thermoplastic

Tube End Reducer

Tube O.D.	Stem O.D.	Part Number
5/32"	1/4"	12 023 0402
	3/8"	12 023 0602
1/4"	3/8"	12 023 0604
	1/2"	12 023 0704
3/8"	1/2"	12 023 0706

Right Angle (Banjo) Flow Controls

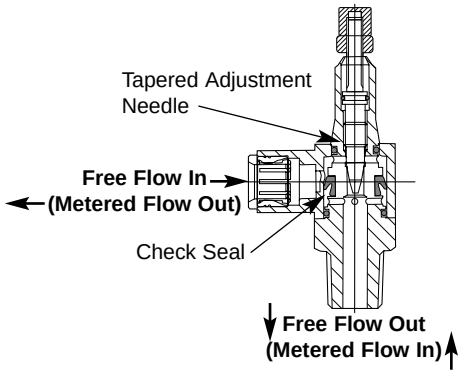
Operation:
Flow Controls are meter out type. Compressed air passes freely into the push-in fitting portion of the flow control, flowing past the check seal and entering the connected component. In reverse flow conditions, air passes back into the flow control and energizes the check seal. Air must now flow through the metered passage controlled by the tapered adjustment needle of the flow control, and finally exits through the push-in fitting end.

Specifications

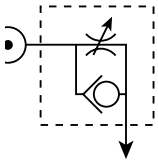
Fluid: Compressed air.
Working Pressure: 5 to 150 psig (.3 to 10 bar)
Temperature Range: 0° to 175°F (-20° to 80°C)

Materials of Construction:

Banjo bolt, body, collet: Nickel plated brass
Tapered adjusting needle: Brass
O-rings and check-seal: Silicone free Nitrile
Sealing washer: Thermoplastic (10-32 UNF)
Tubing: Nylon 11 or 12, 95 durometer polyurethane.
Thread Sealant: Applied to the full circumference of tapered male threads.



Pneumatic Symbol



VB0 Series

Tube O.D.	NPT or UNF Thread	Part Number
5/32"	10-32 UNF	12 VB0 0210
	1/8	12 VB0 0218
1/4"	1/8	12 VB0 0418
	1/4	12 VB0 0428
3/8"	1/4	12 VB0 0628
	3/8	12 VB0 0638
1/2"	3/8	12 VB0 0738
	1/2	12 VB0 0748

NPT Female	NPT Male	Part Number
1/8	1/8	12 VB0 1818
1/4	1/4	12 VB0 2828
3/8	3/8	12 VB0 3838
1/2	1/2	12 VB0 4848

For additional sizes, configurations, metric products, and technical specifications request catalog Fittings APC-101.

Check Valves - T50
In-line Push-in
5/32" - 1/2" O.D. tube

Technical Data

Fluid: Compressed air, nitrogen, inert and non-combustible gases compatible with materials of construction.

Operating Pressure:

26.8" Hg vacuum to 230 psi (-0.9 to 16 bar)

Operating Temperature:

0°* to 175°F (–20°* to 80°C)

* Consult our Technical Service for use below 35°F (2°C)

Model	O.D. Tube
T50Y0002	5⁄32"
T50Y0004	1⁄4"
T50Y0005	5⁄16"
T50Y0006	3⁄8"
T50Y0007	1⁄2"

ISO Symbol

Pressure Reducing Fitting - 124GB
In-line Push-in
5/32" - 1/2" O.D. tube
1/8 - 1/2 NPTF pipe

Technical Data

Fluid: Compressed air, nitrogen, inert and non-combustible gases compatible with materials of construction.

Operating Pressure:

Primary (inlet) pressure 0 to 150 psi (0 - 10 bar)
Maximum secondary (regulated) pressure 115 psi (8 bar)

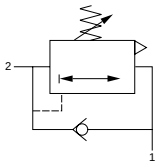
Operating Temperature:

0° to 175°F (-20° to +80°C)

Pressure Reducing Fitting: It is often necessary to provide a secondary reduced pressure to an actuator to control its operating force. A pressure reducing fitting provides this function, and can be manually adjusted to the required pressure level.

Part Number	O/D Tube	NPTF Thread
12 4GB 0218	5⁄32	1⁄8
12 4GB 0418	1⁄4	1⁄8
12 4GB 0428	1⁄4	1⁄4
12 4GB 0528	5⁄16	1⁄4
12 4GB 0538	5⁄16	3⁄8
12 4GB 0638	3⁄8	3⁄8
12 4GB 0748	1⁄2	1⁄2

ISO Symbol



Pilot Operated Check Valve - 124GA
In-line Push-in
1/4" - 1/2" O.D. tube
1/8 - 1/2 NPTF pipe

Technical Data

Fluid: Compressed air, nitrogen, inert and non-combustible gases compatible with materials of construction.

Operating Pressure:

15-150 psi (1 - 10 bar)

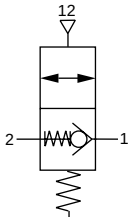
Operating Temperature:

0° to 175°F (-20° to +80°C)

Pilot Operated Check Valve: A blocking fitting which allows air flow in both directions if a pilot pressure is applied to port 12. When pressure to the pilot port is removed flow occurs in one direction only due to an integral control valve. When used in pairs, blocking fittings can control an actuator to give controlled operation in the event of an electrical problem, air failure, or tube breakage.

Product Number	O.D. Tube	NPTF Thread
12 4GA 0418	1⁄4"	1⁄8
12 4GA 0428	1⁄4"	1⁄4
12 4GA 0638	3/8"	3/8
12 4GA 0748	1⁄2"	1⁄2

ISO Symbol



For additional sizes, configurations, metric products, and technical specifications request catalog Fittings APC-101.

Pressure Reducing Fitting -124GD
In-line Push-in
5/32" O.D. tube
1/8 - 1/4 NPTF pipe

Product Number	Tube O/D	NPTF Thread
12 4GD 0218	5/32"	1/8
12 4GD 0228	5/32"	1/8

Technical Data

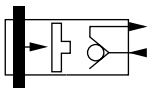
Fluid: Compressed air, nitrogen, inert and non-combustible gases compatible with materials of construction.

Operating Pressure:
Cylinder pressure (Pc) 145 psi (10 bar) max
Sensor supply pressure 43 to 145 psi (3 - 10 bar)
Sensor switch pressure 14.5 psi (1.0 bar) typical

Operating Temperature:
0° to 175°F (–20° to +80°C)

Pneumatic Sensor Fittings: Provides an air signal when a cylinder has reached the end of travel. Sensor fittings operate by detecting the drop in exhaust pressure at the end of a stroke. They effectively offer an all-pneumatic option to the electrical reed switch.

ISO Symbol



Tubing and Accessories

High Pressure Inch Tubing (Nylon 12)

Tubing				Maximum Working Pressure @ -40°F to 70°F (-40°C to 20°C)		Minimum Bend Radius		Part Number and Color				
OD (inch)	ID (inch)	OD (mm)	ID (mm)	psig	bar	inch	mm	Natural	Black	Blue	Green	Red
1/8	0.060			400	27.6	0.38	10	40 016 101	40 016 401	40 016 701	40 017 301	40 017 601
5/32	0.090	4	2.3	350	24.1	0.56	14	40 016 102	40 016 402	40 016 702	40 017 302	40 017 602
3/16	0.122			315	21.7	0.63	16	40 016 103	40 016 403	40 016 703	40 017 303	40 017 603
1/4	0.165			290	21.0	0.88	22	40 016 104	40 016 404	40 016 704	40 017 304	40 017 604
5/16	0.213	8	5.5	275	19.0	1.13	29	40 016 105	40 016 405	40 016 705	40 017 305	40 017 605
3/8	2.450			265	18.3	1.25	32	40 016 106	40 016 406			
1/2	0.370			210	14.5	1.50	38	40 016 107	40 016 407			

For other colors, lengths or packaging, please consult factory.

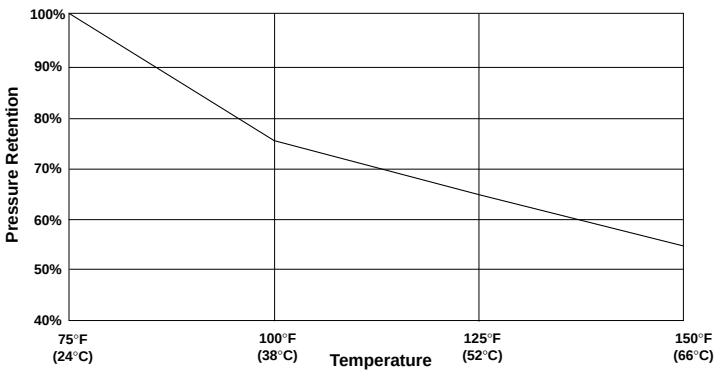
High Flow Inch Tubing (Nylon 11)

Tubing				Maximum Working Pressure @ -40°F to 70°F (-40°C to 20°C)		Minimum Bend Radius		Part Number and Color					
OD (inch)	ID (inch)	OD (mm)	ID (mm)	psig	bar	inch	mm	Natural	Black	Blue	Green	Red	Yellow
1/8	0.093			225	15.5	0.38	10	PB 0051 100	PB 0751 100	PB 0551 100	PB 0251 100	PB 0151 100	PB 0351 100
5/32	0.106	4	2.3	275	19.0	0.50	13	PB 0052 100	PB 0752 100	PB 0552 100	PB 0252 100	PB 0152 100	PB 0352 100
3/16	0.138			225	15.5	0.63	16	PB 0053 100	PB 0753 100	PB 0553 100	PB 0253 100	PB 0153 100	PB 0353 100
1/4	0.180			250	17.2	0.88	22	PB 0054 100	PB 0754 100	PB 0554 100	PB 0254 100	PB 0154 100	PB 0354 100
5/16	0.232	8	5.5	220	15.2	1.25	32	PB 0055 100	PB 0755 100	PB 0555 100	PB 0255 100	PB 0155 100	PB 0355 100
3/8	0.275			220	15.2	1.50	38	PB 0056 100	PB 0756 100	PB 0556 100	PB 0256 100	PB 0156 100	PB 0356 100
1/2	0.375			200	13.8	2.00	51	PB 0057 100	PB 0757 100	PB 0557 100	PB 0257 100	PB 0157 100	PB 0357 100

Notes
The working pressure for Nylon 11 tubing is calculated using a 4 to 1 safety factor.
* To determine working pressures at other temperatures, see chart.
Tubing is supplied in 100 ft. (30.5m) coils, packaged in poly bags.
For other colors, lengths or packaging, please consult factory.

For availability of “ghosted” part numbers consult factory.

Working Pressure at Elevated Temperature



Tube Cutter

Item	Product Number
Tube Cutter (5 pack)	M/3314
Replacement blade (5 pack)	M/32009

Check Valves

Port Size NPT	Model
1/8	C/520
1/4	C/521
3/8	C/532
1/2	C/522
3/4	C/523
1	C/524

In-line Flow Controls

Port Size NPT	Model
1/8	T1000A1800
1/4	T1000A2800
3/8	T1000A3800
1/2	T1000A4800

Quick Exhaust Valves

Port Size NPT	Model
1/8	T70A 1800
1/4	T70A 2800
3/8	T70A 3800
1/2	T70A 4800

Shuttle Valves

Port Size NPT	Model
1/8	T65A1800
1/4	T65A2800

Quietaire™ Pneumatic Silencers

Heavy-duty shell type

Port Size NPT	Part Number (male)	Part Number (female)
1/8	MB001A	MA001A
1/4	MB002A	MA002A
3/8	MB003A	MA003A
1/2	MB004A	MA004A
3/4	MB006A	MA006A
1	MB008A	MA008A

Standard-duty, sintered bronze

Port Size NPT	Part Number
10-32	MS000A
1/8	MS001A
1/4	MS002A
3/8	MS003A
1/2	MS004A
3/4	MS006A
1	MS008A

Standard-duty porous plastic

Port Size NPT	Part Number
10-32 UNF	M/S0
1/8	C/S1
1/4	C/S2
3/8	C/S3
1/2	C/S4
3/4	C/S6
1	C/S8

Breather vent sintered bronze

Port Size NPT	Part Number
1/8	MV001A
1/4	MV002A
3/8	MV003A
1/2	MV004A
3/4	MV006A
1	MV008A

Heavy duty speed control sintered bronze

Port Size NPT	Part Number
1/8	MM001A
1/4	MM002A
3/8	MM003A
1/2	MM004A

Standard-duty speed control porous plastic

Port Size NPT	Part Number
10-32 UNF	T20M0500
1/8	T20A1800
1/4	T20A2800
3/8	T20A3800
1/2	T20A4800

For additional sizes, configurations, metric products, and technical specifications request catalog Fittings APC-101.V

Determining Proper Air Valve Size

Most manufacturers catalogs give flow rating C_V for the valve, which was established using proposed National Fluid Power Association (NFPA) standard T3.21.3. The following tables and formulas will enable you to quickly size a valve properly. The traditional, often used, approach of using the valve size equivalent to the port in the cylinder can be very costly. Cylinder speed, not port size, should be the determining factor.

The following C_V calculations are based upon simplified formulas which yield results with acceptable accuracy under the following standard condition:

Air at a temperature of 68°F (20°C)

Absolute downstream or secondary pressure must be 53% of absolute inlet or primary pressure or greater. Below 53%, the air velocity may become sonic and the Cv formula does not apply. To calculate air flow to atmosphere, enter outlet pressure p_2 as 53% of absolute p_2. Pressure drop Δ P would be 47% of absolute inlet pressure. These valves have been calculated for a C_V = 1 in Table 3.

Nomenclature

B	Pressure drop factor	
C	Compression factor	
C_V	Flow factor	
D	Cylinder Diameter	(IN)
F	Cylinder Area	(SQ IN)
L	Cylinder Stroke	(IN)
p_1	Inlet or Primary Pressure	(PSIG)
p_2	Outlet or Secondary Pressure	(PSIG)
Δ P	Pressure differential (p_1 - p_2)	(PSID)
q	Air flow at actual condition	(CFM)
Q	Air flow of free air	(SCFM)
t	Time to complete one cylinder stroke	(SEC)
T	Absolute temperature at operating pressure Deg R = Deg F + 460	(R°)

Valve Sizing for Cylinder Actuation – (Method A)

$$C_V = \frac{\text{cylinder area (Sq In) (see Table 1) } \mathbf{F} \times \text{cylinder stroke (IN) } \mathbf{L} \times \text{Compression factor (see Table 2) } \mathbf{C}}{\text{Pressure drop factor } \mathbf{B} \times \text{time to complete cylinder stroke } \mathbf{t} \times \mathbf{29} \text{ (SEC)}}$$

Example:
Cylinder size 4" Dia. x 10" stroke. Time to extend: 2 seconds. Inlet pressure 90 psig. Allowable pressure drop 5 psid. Determine C_V.

Solution: Table 1 F = 12.57 sq in
Table 2 C = 7.1
B = 21.6

$$C_V = \frac{12.57 \times 10 \times 7.1}{21.6 \times 2 \times 29} = .7$$

Select a valve that has a C_V factor of .7 or higher. In most cases a 1/4" valve would be sufficient.

It is considered good engineering practice to limit the pressure drop Δ P to approximately 10% of primary pressure p_1. The smaller the allowable pressure drop, the larger the required valve will become.

After the minimum required C_V has been calculated, the proper size valve can be selected from the catalog.

Bore Size D (in)	Push Bore F (sq in)	Bore Size D (in)	Push Bore F (sq in)
3/4"	.44	4"	12.57
1"	.79	4-1/2"	15.90
1-1/8"	.99	5"	19.64
1-1/4"	1.23	6"	28.27
1-1/2"	1.77	7"	38.48
1-3/4"	2.41	8"	50.27
2"	3.14	10"	78.54
2-1/2"	4.91	12"	113.10
3-1/4"	8.30	14"	153.94

Table 1: Cylinder push bore area F for standard size cylinders

Inlet Pressure (psig)	Compression Factor C	Pressure Drop Factor B for various Pressure Drops Δ P				
		2 psig	5 psid	10 psid	15 psid	20 psid
10	1.7	6.5				
20	2.4	7.8	11.8			
30	3.0	8.9	13.6	18.0		
40	3.7	9.9	15.3	20.5	23.6	
50	4.4	10.8	16.7	22.6	26.4	29.0
60	5.1	11.7	18.1	24.6	29.0	32.0
70	5.8	12.5	19.3	26.5	31.3	34.8
80	6.4	13.2	20.5	28.2	33.5	37.4
90	7.1	13.9	21.6	29.8	35.5	39.9
100	7.8	14.5	22.7	31.3	37.4	42.1
110	8.5	15.2	23.7	32.8	39.3	44.3
120	9.2	15.8	24.7	34.2	41.0	46.4
130	9.8	16.4	25.6	35.5	42.7	48.4
140	10.5	16.9	26.5	36.8	44.3	50.3
150	11.2	17.5	27.4	38.1	45.9	52.1
160	11.9	18.0	28.2	39.3	47.4	53.9
170	12.6	18.5	29.0	40.5	48.9	55.6
180	13.2	19.0	29.8	41.6	50.3	57.2
190	13.9	19.5	30.6	42.7	51.7	58.9
200	14.6	20.0	31.4	43.8	53.0	60.4
210	15.3	20.4	32.1	44.9	54.3	62.0
220	16.0	20.9	32.8	45.9	55.6	63.5
230	16.7	21.3	33.5	46.9	56.8	64.9
240	17.3	21.8	34.2	47.9	58.1	66.3
250	18.0	22.2	34.9	48.9	59.3	67.7

Table 2: Compression Factor C and pressure drop Factor B.

Valve Sizing with C_V = 1 Table (Method B)
(For nomenclature see previous page)

This method can be used if the required air flow is known or has been calculated with the formulas as shown below:

1. $$Q = .0273 \frac{D^2L}{t} \times \frac{p_2 + 14.7}{14.7}$$ (SCFM)

Conversion of CFM to SCFM

2. $$Q = qx \frac{p_2 + 14.7}{14.7} \times \frac{528}{T}$$ (SCFM)

Flow factor Cv (standard conditions)

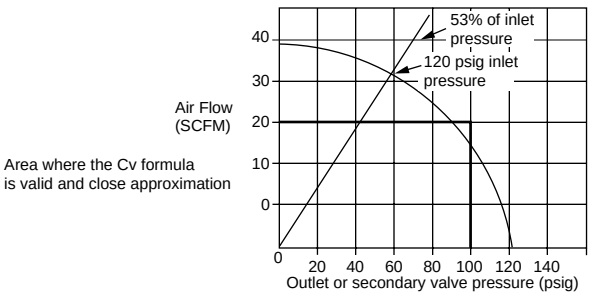
3. $$C_V = \frac{1.024 \times Q}{\sqrt{\Delta P \times (p_2 + 14.7)}}$$ Proposed NFPA Standard T3.21.3

Maximum pressure drop Δ p across the valve should be less than 10% of inlet pressure p_1.

Inlet Pressure (psig)	Air Flow Q (scfm) for various Pressure drops Δ P at Cv = 1					Air Flow Q (scfm) to atmosphere
	2 psid	5 psid	10 psid	15 psid	20 psid	
10	6.7					12.0
20	7.9	11.9				16.9
30	9.0	13.8	18.2			21.8
40	9.9	15.4	20.6	23.8		26.6
50	10.8	16.9	22.8	26.7	29.2	31.5
60	11.6	18.2	24.8	29.2	32.3	36.4
70	12.3	19.5	26.7	31.6	35.1	41.2
80	13.0	20.7	28.4	33.8	37.7	46.1
90	13.7	21.8	30.0	35.8	40.2	51.0
100	14.4	22.9	31.6	37.8	42.5	55.9
110	15.0	23.9	33.1	39.6	44.7	60.7
120	15.6	24.9	34.5	41.4	46.8	65.6
130	16.1	25.8	35.8	43.1	48.8	70.5
140	16.7	26.7	37.1	44.7	50.7	75.3
150	17.2	27.6	38.4	46.3	52.5	80.2
160	17.7	28.4	39.6	47.8	54.3	85.1
170	18.2	29.3	40.8	49.3	56.0	90.0
180	18.7	30.1	42.0	50.7	52.7	94.8
190	19.2	30.9	43.1	52.1	59.4	99.7
200	19.6	31.6	44.2	53.4	60.9	104.6
210	20.1	32.4	45.2	54.8	62.5	109.4
220	20.5	33.1	46.3	56.1	64.0	114.3
230	21.0	33.8	47.3	57.3	65.5	119.2
240	21.4	34.5	48.3	58.6	66.9	124.0
250	21.8	35.2	49.3	59.8	68.3	128.9

Table 3: Air Flow Q (scfm) for C_V = 1

Flow Curves: How to read them



Example 1: Find air flow Q (scfm) if C_V is known.
C_V (from valve catalog) = 1.8
Primary pressure p1 = 90 psig
Pressure drop across valve Δ P = 5 psid

Flow through valve from Table 3 for C_V = 1:21.8 scfm

$$Q = C_V \text{ of valve} \times \text{air flow at } C_V = 1 \text{ (scfm)}$$

$\underline{Q}$ = 1.8 x 21.8 = $\underline{39.2 \text{ scfm}}$

Example 2: Find Cv if air flow Q (scfm) is given.
Primary pressure p1 = 90 psig
Pressure drop Δ P = 10 psid
Air flow - Q = 60 scfm

Flow through valve from Table 3 for C_V = 1:30 scfm

$$C_V = \frac{\text{Air flow Q (scfm)}}{\text{Air flow at } C_V = 1 \text{ (scfm)}}$$

$$\underline{C_V} = \frac{60 \text{ scfm}}{30} = \underline{2.0}$$

A valve with a C_V of minimum 2 should be selected.

Example 3: Find C_V if air flow Q (scfm) to atmosphere is given (from catalog).
Primary pressure p_1 = 90 psig
Air flow to atmosphere Q = 100 scfm

Flow to atmosphere through valve from Table 3 for C_V = 1:51 scfm

$$C_V = \frac{\text{Air flow to atmosphere Q (scfm)}}{\text{Air flow to atmosphere at Cv = 1 (scfm)}}$$

$$C_V = \frac{100}{51} = \underline{2.0}$$

Flow given in catalog is equivalent to a valve with C_V = 2. This conversion is often necessary to size a valve properly since some manufacturers do not show the standard C_V to allow a comparison.

Example 4: Find C_V if cylinder size and stroke speed is known, using the formulas 1 and 3.
Primary pressure = 90 psig
Pressure drop across valve 5 psid
Cylinder size 4" dia. x 10" stroke
Time to complete stroke 2 sec.

$$Q = .0273 \frac{4^2 \times 10}{2} \times \frac{85 + 14.7}{14.7} = 14.81 \text{ scfm}$$

$$C_V = \frac{1.024 \times 14.81}{\sqrt{5 \times (85 + 14.7)}} = \underline{.7}$$

VOLUME

from/to	cm^3	liter	in^3	ft^3	fl oz	pt.	qt.	gal
cm^3	1	.001	0.06102	3.53 x 10-5	.03381	.00211	0.106	2.64 x -10
liter	1000	1	61.02	0.03532	33.81	2.113	10.057	.2642
in^3	16.39	0.01639	1	5379 x 10-4	.5541	.03463	0.01732	.00433
ft^3	2.83 x 104	28.32	1728	1	957.5	59.84	29.92	7.481
fl oz	29.57	0.02957	1.805	0.00104	1	.06250	.03125	.00781
pt	473.2	0.4732	28.88	0.01671	16	1	0.500	0.1250
qt	946.4	0.9463	57.75	0.03342	32	2	1	0.2500
gal (US)	3785	3.785	231	0.1337	128	8	4	1

PRESSURE

from/to	mm Hg	in Hg	in H_2O	ft H_2O	atm	lb/in^2	kg/cm^2
mm Hg	1	0.03937	0.5353	0.04460	.00132	0.01934	.00136
in Hg	25.40	1	13.60	1.133	.03342	0.4912	0.03453
in H_2O	1.868	0.07355	1	0.08333	0.00246	0.03613	0.00254
ft H_2O	22.42	0.8826	12	1	0.02950	0.4335	0.03048
atm	760	29392	406.8	33.9	1	14.70	1.033
lb/in^2	51.71	2.036	27.67	2.307	0.06805	1	0.07031
kg/cm^2	735.6	28.96	393.7	32.81	0.9678	14.22	1
bar	750.0	29.53	401.32	33.46	0.98592	14.504	1.01978

Length

from/to	cm	m	km	in	ft.	mile
cm	1	0.01	1 x 10-5	0.3937	0.03281	6.21 x 10-6
m	100	1	0.001	39.37	3.281	6.21 x 10-4
km	1 x 105	1000	1	3.94 x 104	3281	0.6214
in	2.540	0.02540	2.54 x 10-5	1	0.08333	1.58 x 10-5
ft	30.48	0.3048	3.05 x 10-4	12	1	1.89 x 10-4
mile	1.61 x 105	1609	1.609	6.34 x 104	5280	1

ENERGY

from/to	BTU	Cal	Joule	Hp. hr.	Kw hr.
BTU	1	252.0	1055	3.93 x 10-4	2.93 x 10-4
Cal	0.397	1	4.186	1.56 x 10-5	1.16 x 10-5
joule	9.48 x 10-4	0.2389	1	3.73 x 10-7	2.78 x 10-7
Hp hr	2545	6.41 x 105	2.68 x 106	1	0.7457
Kw hr	3413	8.60 x 105	3.60 x 106	1.341	1

AREA

from/to	cm^4	m^2	km^2	in^2	ft^2
cm^2	1	0.0001	1 x 10-10	0.1550	0.00108
m^2	1 x 104	1	1 x 10-5	1550	10.76
km^2	1 x 1010	1x 105	1	1.55 x 109	1.08 x 107
in^2	6.452	6.45 x 10-4	6.45 x 10-10	1	0.00694
ft^2	929.00	0.09290	9.29 x 10-8	144	1

TEMPERATURE CONVERSION

°C = 5/9 (°F - 32)
°F = 9/5 (°C + 32)
°K = °C + 273.2
°R = °F + 459.7

WEIGHT

from/to	gm	kg	oz	lb
gm	1	0.001	0.03527	0.00220
kg	1000	1	35.27	2.205
oz	28.35	0.02835	1	0.06250
lb	453.6	0.4536	16	1

TEMPERATURE COMPARISON

-100°C to +300°C

°C	°F	°C	°F
-100	-148	29	84.2
-90	-130	30	86.0
-80	-112	31	87.8
-70	-94	32	89.6
-60	-76	33	91.4
-50	-58	34	93.2
-40	-40	35	95.0
-35	-31	36	96.8
-30	-22	37	98.6
-25	-13	38	100.4
-20	-4	39	102.2
-15	5	40	104.0
-10	14	45	113
-5	23	50	122
0	32	55	131
1	33.8	60	140
2	35.6	65	149
3	37.4	70	158
4	39.2	75	167
5	41	80	176
6	42.8	85	185
7	44.6	90	194
8	46.4	95	203
9	48.2	100	212
10	50	110	230
11	51.8	120	248
12	53.6	130	266
13	55.4	140	284
14	57.2	150	302
15	59	160	320
16	60.8	170	338
17	62.6	180	356
18	64.4	190	374
19	66.2	200	392
20	68	210	410
21	69.8	220	428
22	71.6	230	446
23	73.4	240	464
24	75.2	250	482
25	77	260	500
26	78.8	270	518
27	80.6	280	531
28	82.4	290	554
		300	572

Warning

These products are intended for use in industrial compressed air systems only. Do not use these products where pressures and temperatures can exceed those listed under **Specifications**.

Before using these products with fluids other than those specified, for nonindustrial applications, life-support systems, or other applications not within published specifications, consult Norgren.

Through misuse, age, or malfunction, components used in fluid power systems can fail in various modes. The system designer is warned to consider the failure modes of all component parts used in fluid power systems and to provide adequate safeguards to prevent personal injury or damage to equipment in the event of such failure modes. **System designers must provide a warning to end users in the system instructional manual if protection against a failure mode cannot be adequately provided.**

System designers and end users are cautioned to review specific warnings found in instruction sheets packed and shipped with these products. System designers should also provide for all OSHA requirements including Title 29 CFR 1910.147 Lockout/Tagout.

It should be recognized that warnings are valid for any product, regardless of manufacturer, and are not restricted to products manufactured by Norgren. Norgren's reputation for product quality and performance is well established. We feel we have the additional obligation to provide information or warnings to customers to assist them in applying our products in a reasonable and safe manner.

Warranty

Items sold by Norgren are warranted to be free from defects in materials and workmanship for a period of two years from the date of manufacture, provided said items are used according to Norgren's recommended usages. Norgren's liability is limited to the repair of, refund of purchase price paid for, or replacement in kind of, at Norgren's sole option, any items proved defective, provided the allegedly defective items are returned to Norgren prepaid. The warranties expressed above are in lieu of and exclusive of all other warranties.

There are no other warranties, expressed or implied, except as stated herein. There are no implied warranties of merchantability or fitness for a particular purpose, which are specifically disclaimed. Norgren's liability for breach of warranty as herein stated is the exclusive remedy, and in no event shall Norgren be liable or responsible for incidental or consequential damages, even if the possibility of such incidental or consequential damages has been made known to Norgren.

Norgren reserves the right to discontinue manufacture of any product or change product materials, design, or specifications.