



## BASIC NOTIONS IN COMPRESSED AIR



### WHAT DOES **PRESSURE** MEAN IN COMPRESSED AIR?

Compressed air **PRESSURE** is a way of measuring the potential energy stored in the compressed air system. Like voltage in electricity, pressure simply states what is available for work. Just as a wall plug still has voltage even if nothing is connected, so does a pressurized compressed air system have pressure even if nothing is being used.

Pressure is measured by calculating the force placed on the walls of the container in which the air is stored; this is usually stated in pounds per square inch, or PSI. Other measurements include BAR, for barometric pressure, ATM, for atmospheres, and kPa, or kiloPascals.



### WHAT DOES **AIR FLOW** MEAN IN COMPRESSED AIR?

Compressed air **FLOW** is a way of measuring the volume of air running through a compressed air system, application, component or tool, over a given time. Like current (amps) in electricity, flow indicates us the volume of air required to maintain sufficient force to perform work.

Flow is measured by taking the volume of air and dividing by a period of time. The most common unit of measurement is the cubic foot per minute, or CFM; liters per minute is another common measurement.





# UNITS AND CONVERSION TABLES

## CONVERSION FACTORS

From	Multiply by	=	From	Multiply by	=
<b>POWER</b>					
1 "horsepower" = hp	0.746	kiloWatts = kW	1 kiloWatts = kW	1.34	"horsepower" = hp
<b>VOLUME</b>					
1 inch <sup>3</sup> = in <sup>3</sup>	16.387	centimetre <sup>3</sup> = cm <sup>3</sup>	1 centimetre <sup>3</sup> = cm <sup>3</sup>	0.061	inch <sup>3</sup> = in <sup>3</sup>
1 feet <sup>3</sup> = ft <sup>3</sup>	0.0283	metre <sup>3</sup> = m <sup>3</sup>	1 metre <sup>3</sup> = m <sup>3</sup>	35.3	feet <sup>3</sup> = ft <sup>3</sup>
1 feet <sup>3</sup> = ft <sup>3</sup>	28.32	litre = l	1 litre = l	0.0353	feet <sup>3</sup> = ft <sup>3</sup>
1 gallon (U.S.)	3.785	litre = l	1 litre = l	0.264	gallon (U.S.)
1 gallon (U.S.)	0.1337	feet <sup>3</sup> = ft <sup>3</sup>	1 feet <sup>3</sup> = ft <sup>3</sup>	7.48	gallon (U.S.)
1 gallon (imperial)	4.546	litre = l	1 litre = l	0.22	gallon (imperial)
1 gallon (imperial)	0.1605	feet <sup>3</sup> = ft <sup>3</sup>	1 feet <sup>3</sup> = ft <sup>3</sup>	6.23	gallon (imperial)
1 metre <sup>3</sup> = m <sup>3</sup>	1000	litre = l	1 litre = l	0.001	metre <sup>3</sup> = m <sup>3</sup>
1 ounce (liquid) U.S. = oz	29.574	millilitre = ml	1 millilitre = ml	0.0338	ounce (liquid) U.S. = oz
1 ounce (liquid) imperial = oz	28.413	millilitre = ml	1 millilitre = ml	0.0352	ounce (liquid) imperial = oz
<b>LENGTH</b>					
1 inch = in	25.4	millimetre = mm	1 millimetre = mm	0.03937	inch = in
1 feet = ft	0.3048	metre = m	1 metre = m	3.281	feet = ft
<b>MASS</b>					
1 ounce = oz	28.35	gram = g	gram = g	0.03527	1 ounce = oz U.S.
1 pound = lb	453.592	gram = g	gram = g	0.002205	1 pound = lb
<b>TEMPERATURE</b>					
<b>Fahrenheit to Celsius</b>		<b>Celsius to Fahrenheit</b>			
$(^{\circ}\text{F} - 32) \times 5/9 = ^{\circ}\text{C}$		$(0^{\circ}\text{C} \times 9/5) + 32 = ^{\circ}\text{F}$			

## FLOW RATE CONVERSION

From \ To	litre/sec	litre/min	gallon/min	ft <sup>3</sup> /sec	ft <sup>3</sup> /min(SCFM)
litre/sec	1	60.0	15.8	0.0353	2.12
litre/min	0.0167	1	0.264	0.000589	0.0353
gallon/min	0.0631	3.789	1	0.00223	0.134
cu.ft/sec	28.3	1 700	449	1	60.0
cu.ft/min (SCFM)	0.472	28.3	7.48	0.0167	1

## PRESSURE CONVERSION

From \ To	mm Hg	in Hg	ft H <sub>2</sub> O	atm	Bar	lb/in <sup>2</sup> PSI	kg-f/cm <sup>2</sup>	kPa
mm Hg	1	0.0394	0.0446	0.00132	0.00133	0.0193	0.00136	0.133
in Hg	25.4	1	1.13	0.0334	0.0339	0.491	0.0345	3.39
ft H <sub>2</sub> O	22.4	0.883	1	0.0295	0.0299	0.434	0.0305	2.99
atm	760	29.9	33.9	1	1.01	14.7	1.03	101
Bar	750	29.5	33.5	0.987	1	14.5	1.02	100
lb/in <sup>2</sup> (PSI)	51.7	2.04	2.31	0.068	0.0689	1	0.0703	6.89
kg-f/cm <sup>2</sup>	736	29.0	32.8	0.968	0.981	14.2	1	98.1
kPa	7.50	0.295	0.335	0.00987	0.01	0.145	0.0102	1

Hg = Mercury

Example: 1 bar = 14.5 psi



## PRESSURE AND FLOW ARE DIFFERENT!

Pressure and flow are often confused, interchanged and misunderstood; while they are related, they are not the same thing. As an example, knowing what voltage is present in an electrical system is important, but it will not provide the information needed to gauge usage vs. available power. The current (amperage) available will be much more important; the same can be said of compressed air systems.

While it is important to note supply pressure, as much in terms of the compressor as in terms of what is required by the tools or applications, it is the volume of air available over time that will determine if the system can keep up with the tools. What is important to understand is that system flow capacity allows the system to replace air consumed at the tool in order to maintain adequate pressure for the tool to function properly. This can be demonstrated in how different types of tools function:



Rotating tools, such as screw drivers, impact guns or grinders, require flow to function well, since it is the volume of air running through a turbine or over a wheel that will drive the tool.



Pulse tools, such as nailers, staplers, etc., require a specific pressure to drive the fastener into the material; they will therefore be less affected by flow restrictions (as long as there is sufficient flow to replace the air used in the cycles).



## WHAT IS THE AIR CONSUMPTION FOR TYPICAL TOOLS?

Description	Continuous Air Consumption at 90 PSI	Description	Continuous Air Consumption at 90 PSI
18 Gauge Brad Nail Guns	0.02 SCF per cycle	Pull Type Air Nibbler	17.3 SCFM
22-18 Gauge Staplers	0.03 SCF per cycle	4" Angle Disc Grinder	18.4 SCFM
Finishing Nail Gun	0.03 SCF per cycle	Mini Belt Sander (10 mm)	18.9 SCFM
Coil Roofing Nail Gun	0.05 SCF per cycle	3/8" Ratchet	19.2 SCFM
Framing Nail Gun	0.09 SCF per cycle	D.A. Sander	19.2 SCFM
Riveter	0.08 SCF per cycle	Jitterbug Sander	19.2 SCFM
Grease Gun	0.8 SCF per cycle	Pistol Grip Shears	19.2 SCFM
Caulking Gun	0.1 SCFM*	Chisel/Hammer	21.9 SCFM
Engine Cleaner	6.1 SCFM	High Speed Sander	22.7 SCFM
Conventional Spray Gun	7.0 SCFM**	3/8" Reversible Drill	23.8 SCFM
HVLP Spray Gun	9.5 SCFM**	Abrasion Cut Off Tool	25.4 SCFM
Screwdriver	9.6 SCFM	Full Size Die Grinder	25.4 SCFM
Straight Line Sander	9.6 SCFM	1/2" Reversible Drill	26.4 SCFM
1/4" Mini Ratchet	12.5 SCFM	1/2" Impact Wrench	28.6 SCFM
1/4" Impact Driver	14.0 SCFM	7" Angle Sander	29.6 SCFM
Mini Die Grinder	16.5 SCFM	7" Vertical Polisher	31.0 SCFM
Random Orbital Sander	16.6 SCFM	3/4" Impact Wrench	34.7 SCFM
3/8" Angle Drill	17.3 SCFM	1" Impact Wrench	87.5 SCFM

\* at 20 PSI / \*\* at 40 PSI

Data based on a drop of 5 PSIG maximum



## HOW CHOOSING THE PROPER HOSE SIZE PER LENGTH AND FLOW (TOOL TYPE)?

- With most tools, the proper air hose size is at least one size larger than that of the air inlet pipe-thread
- Use of a smaller than recommended hose size will result in a serious reduction of tool performance



TOOL TYPE	FLOW SCFM	HOSE LENGTH					
		25'	35'	50'	75'	100'	150'
<b>NAILERS &amp; STAPLERS</b>							
18 gauge nailer/stapler	0.02 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
22-18 gauge stapler	0.03 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
Finishing nailer	0.03 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
Roofing nailer	0.05 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
Framing nailer	0.09 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
<b>IMPACT TOOLS</b>							
Miniature 1/4" ratchet	12.5	3/8	3/8	3/8	1/2	1/2	1/2
1/4" impact gun	14.0	3/8	3/8	3/8	1/2	1/2	1/2
3/8" ratchet	19.2	3/8	1/2	1/2	1/2	1/2	3/4
Zip gun	21.9	1/2	1/2	1/2	1/2	3/4	3/4
1/2" impact gun	28.6	1/2	1/2	1/2	3/4	3/4	3/4
3/4" impact gun	34.7	1/2	1/2	3/4	3/4	3/4	3/4
1" impact gun	87.5	3/4	3/4	3/4	1	1	1
<b>POLISHING TOOLS</b>							
Orbital polisher	16.6	3/8	3/8	1/2	1/2	1/2	1/2
Oscillating sander	23.0	1/2	1/2	1/2	1/2	3/4	3/4
<b>SANDERS</b>							
Sander	9.6	5/16	5/16	3/8	3/8	3/8	1/2
4-1/2" angle grinder	18.4	3/8	1/2	1/2	1/2	1/2	3/4
10mm belt sander	18.9	3/8	1/2	1/2	1/2	1/2	3/4
7" angle sander	29.6	1/2	1/2	1/2	3/4	3/4	3/4
<b>DRILLS</b>							
3/8" air drill	17.3	3/8	1/2	1/2	1/2	1/2	1/2
3/8" reversible air drill	23.8	1/2	1/2	1/2	1/2	3/4	3/4
1/2" reversible air drill	26.4	1/2	1/2	1/2	3/4	3/4	3/4
<b>OTHER TOOLS</b>							
Riveter	0.08 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
Grease gun	0.8 SCF/cycle	1/4	1/4	1/4	1/4	1/4	1/4
Caulking gun	0.1	1/4	1/4	1/4	1/4	1/4	1/4
HVLP paint gun	9.5	5/16	5/16	3/8	3/8	3/8	1/2
Screw driver	9.6	5/16	5/16	3/8	3/8	3/8	1/2
Gravity fed sand blaster	12.0	3/8	3/8	3/8	1/2	1/2	1/2

### NOTE:

- Continuous consumption at 100 PSIG
- Average consumption (actual consumption may vary)
- Data for straight PVC, rubber or polyurethane air hose new and exempt of contaminants (water, rust, dust)
- Information based on 5 PSIG pressure drop

Hose I.D.	SCFM available per length at 100 PSI					
	25'	35'	50'	75'	100'	150'
1/4	≤ 7	≤ 6	≤ 5	≤ 4	≤ 3	≤ 3
5/16	≤ 13	≤ 10	≤ 9	≤ 7	≤ 6	≤ 5
3/8	≤ 20	≤ 17	≤ 14	≤ 12	≤ 10	≤ 8
1/2	≤ 43	≤ 36	≤ 30	≤ 25	≤ 22	≤ 17
3/4	≤ 125	≤ 105	≤ 88	≤ 72	≤ 62	≤ 50
1	≤ 265	≤ 224	≤ 188	≤ 153	≤ 133	≤ 108