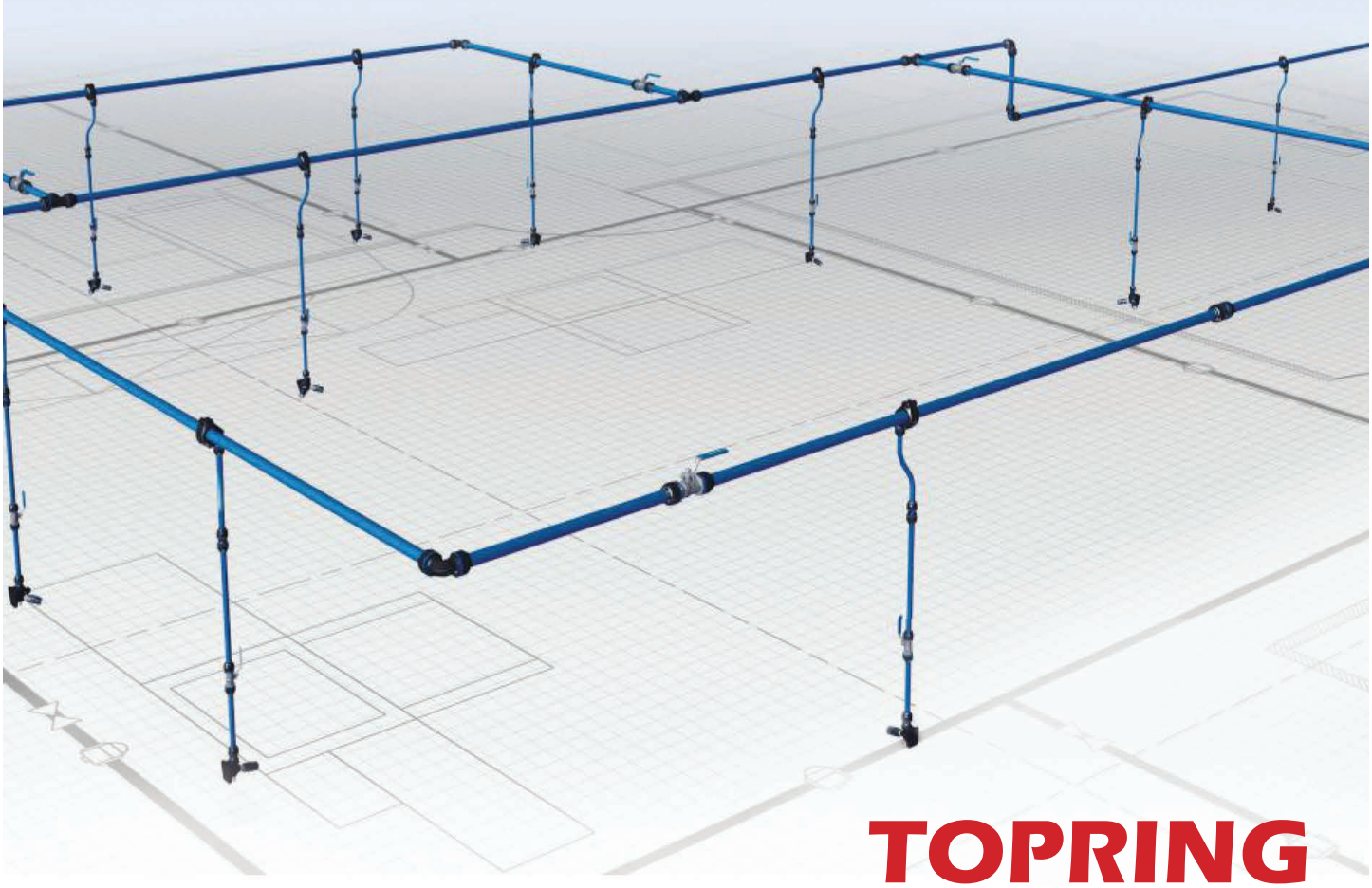
TOPRING PPS

100% ALUMINIUM SOLUTION

DESIGN GUIDE

FOR COMPRESSED AIR PIPING SYSTEMS

SERIES 8



TOPRING

Compressed air solutions

96.607 **TOPRING** September 2020

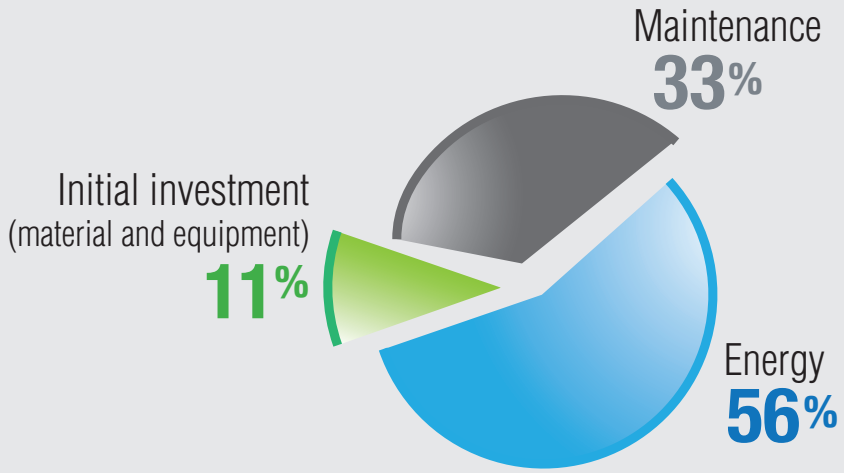
COMPRESSED AIR HAS A COST

Compressed air is a significant source of energy that is used by many different industries. A properly planned compressed air system is energy-efficient and reduces the cost of producing and distributing compressed air. The chart below shows the distribution of costs for a compressed air system.

Because energy and maintenance costs can represent up to 90% of total costs, the compressed air system must be leaktight, durable, and built with high-quality materials.

Electricity costs will be 1% higher for every additional 2 PSI maintained in the system.

Breakdown of costs associated to compressed air system over 10 years



Compressed air accounts for about 10% of industrial electricity consumption, which can represent tens of thousands of dollars every year

Source: approximate costs, Hydro-Québec

The **TOPRING PPS** piping system delivers an efficient, durable compressed air system. Its 100% aluminium design makes it corrosion-resistant and leaktight.

This design guide details the elements to consider when building a compressed air system with the **TOPRING PPS** piping system.

To find out more about the benefits of this series, refer to the **TOPRING PPS** catalogue on **TOPRING**.com.



SYSTEM PLANNING

1. Estimating air requirements by application

Every compressed air system project is unique because user needs vary widely and can be met through a number of configuration options. The first step is to identify the types of applications involved in the project. Consider:

1. The number of pneumatic tools and equipment to be used
2. The total air volume required (SCFM)
3. The air quality required
4. The operating conditions
5. The choice of compressor

TECH TIP

The volume of air produced by the compressor will affect the choice of pipe diameters for the main system. Typically, a compressor produces about 4 SCFM per HP when air is produced at 100 PSIG.

2. Determining the layout of the plant and workstations

A plant layout showing the location of workstations is needed to determine the system's length in linear feet. In addition, the following information must be known:

1. The structure of the building
2. Whether it's a ceiling- or wall-mounted installation
   - If the system is installed on the ceiling, what is its height?
   - If the system is mounted on the walls, are there any obstacles to bypass or avoid (e.g., beams)?
3. The location of the compressor room: is it in an open or closed space? On the main floor or on a mezzanine?
4. The number of stories in the building
5. The location of workstations: are they close to walls, or in the middle of the space?
6. Is a future expansion planned? If so, at least 25% to 50% extra capacity should be added.

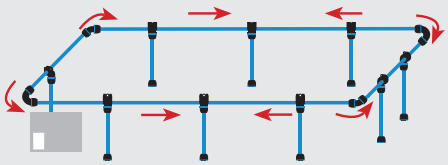
CAUTION

The piping system should never support loads other than its own weight, or be exposed to movement other than the normal expansion of its components. When planning the layout of a workstation, flexible hoses should be connected through sturdily attached hose reels or manifolds to isolate piping from tool weight and movement.

3. Configuring the system

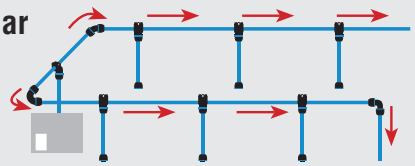
Depending on the workstation layout, there are two options for the optimal configuration of a compressed air system:

Closed loop (recommended)



- Compressed air flows through several lines simultaneously
- Pressure and airflow are balanced throughout the system
- Drops are powered by multiple sources
- Air supply is more efficient, which allows for the installation of pipes with smaller diameters (reducing costs)
- This type of system is easy to modify
- This type of system reduces pressure loss

Linear



A linear system is an option when a closed loop configuration is impossible.
To power the air in both directions, the compressor must be located in the center of the system (from the compressor to the farthest point of use).

For more information on the advantages of a closed loop configuration, see the "Menuiseries Belisle" case study on **TOPRING**.com.

4. Establishing pipe diameter sizing

The following information is needed to determine the pipe diameter for the main system and service outlets:

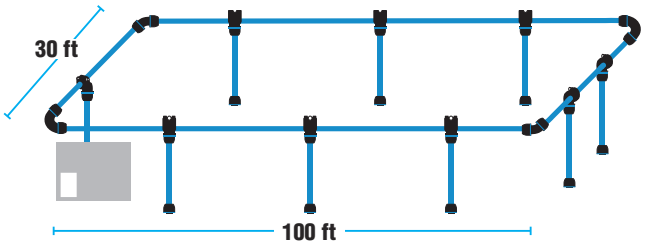
- The total airflow (SCFM) required by pneumatic tools and equipment
- The maximum length between the compressor and application
- The total length of the main line (linear feet)

Example of 5-step calculation for pipe diameter sizing

Step 1 Calculate the linear feet for the main line

Example:
Closed loop system with 9 drops in a plant measuring 100 ft x 30 ft

Total length of the line in linear feet
2 x 100 ft and 2 x 30 ft **= 260 ft**



Step 2 Calculate the total airflow required in SCFM

The pipe diameter must be big enough to transport sufficient air at the required pressure to all points of use. The required number of SCFM is indicated by the manufacturer of the pneumatic tools or equipment. As a reference, see table **A** on page 10.

Base on our example:

Six 3/8" reversible drills:	23,8 SCFM	x 6	=	**142,8 SCFM**
Three 10 mm belt sanders:	18,9 SCFM	x 3	=	**56,7 SCFM**
Three 1/2" impact guns:	28,6 SCFM	x 3	=	**85,8 SCFM**
		Total required airflow	=	**285,3 SCFM**
		Total with extra 25 %*	=	**356,6 SCFM**

* It is preferable to add 25% to 50% extra to accommodate future needs.

Step 3 Establish the diameter of the main line

Based on the data in Table **A** on page 10 (closed loop system) and our example, for an air pressure demand of **356,6 SCFM** and a main line measuring **260 linear feet** in length, a diameter of **40 mm** is necessary.

TOTAL LENGTH OF NETWORK (FT)

REQUIRED SCFM	100'	150'	200'	250'	300'	400'	500'	600'
200	32	32	32	32	32	40	40	40
300	32	32	40	40	40	40	40	50
400	40	40	40	40	40	50	50	50
500	40	40	40	50	50	50	50	50
750	50	50	50	50	63	63	63	63
1000	50	50	63	63	63	63	63	63
1500	63	63	63	63	80	80	80	80

Step 4 Calculate the equivalent lengths (fittings)

System fittings must be considered when calculating the total length of the line in linear feet. Each change in direction and each coupler will cause an additional pressure drop equal to an addition to the total length (see Table B on page 11).

For our example with 9 take-off drops, four 90° union elbows and a predetermined diameter of 40 mm, linear feet must be added as follo ws to the initial length:

Nine take-off drops:	9,84 ft x 9	=	**88,56 ft**
Four 90° union elbows:	7,87 ft x 4	=	**31,48 ft**
Equivalent total length		=	**120,04 ft**
+ Main line		=	**260,00 ft**
New total length in linear ft		=	**380,04 ft**

Based on Table **A** on page 10, the pipe diameter for the main line will go from 40 mm to 50 mm for a length of 400 linear feet and a consumption of 356,6 SCFM.

TOTAL LENGTH OF NETWORK (FT)

REQUIRED SCFM	100'	150'	200'	250'	300'	400'	500'	600'
200	32	32	32	32	32	40	40	40
300	32	32	40	40	40	40	40	50
400	40	40	40	40	40	50	50	50
500	40	40	40	50	50	50	50	50
750	50	50	50	50	63	63	63	63
1000	50	50	63	63	63	63	63	63
1500	63	63	63	63	80	80	80	80

Step 5 Determine the diameter for each drop

Using the data in Table **C** on page 11, SCFM is calculated based on the number of tools per drop. Next, Table **A** on page 10 shows the pipe diameter based on the total SCFM.

Example: Drop #1

Two 3/8" reversible drills:	23,8 SCFM x 2 = **47,6 SCFM required**
Rounded up to 60 SCFM	
The pipe diameter sizing for this drop would then be 20 mm	

TOTAL LENGTH OF NETWORK (FT)

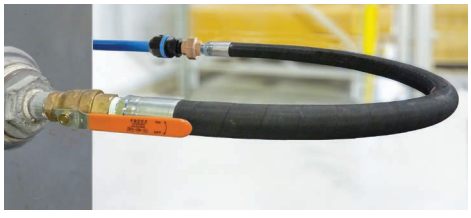
REQUIRED SCFM	100'	150'	200'	250'	300'
20	16	16	16	16	16
30	16	16	16	20	20
40	16	20	20	20	20
60	20	20	20	25	25
80	20	25	25	25	25

5. Installing anti-vibration hoses

CAUTION

An anti-vibration hose must always be installed between the compressor and the beginning of the piping system to protect the system from vibration and expansion forces.

These anti-vibration hoses are available with or without a Canadian Registration Number (CRN). Theymare available in steel reinforced rubber and stainless steel.



Anti-vibration hoses are also used for changes in direction and to bypass obstacles (see Adding expansion loops or expansion connectors under Point 6).

6. Planning for thermal variations in the system

Explanation of thermal expansion and contraction

Comparison of the linear expansion coefficients for materials frequently used in compressed air systems

Steel	1.3 x 10^{-5} m/m-°C
Copper	1.7 x 10^{-5} m/m-°C
TOPRING PPS 100% aluminium	**2.3 x 10^{-5} m/m-°C**
AIR LINE PA (polyamide)	1.2 x 10^{-4} m/m-°C
ABS	1.5 x 10^{-4} m/m-°C
PVDF	1.5 x 10^{-4} m/m-°C
PP	1.7 x 10^{-4} m/m-°C
PE	1.1 x 10^{-4} m/m-°C

The linear expansion coefficient (d) is 0.23 mm/m °C, or 0.23 millimeter per meter, per degree Celsius.

System design must factor in the phenomenon of expansion, which is calculated with the formula:
DL = d x L x DT

Example with an aluminium pipe:

Installation temperature: +10 °C

Pipe length: 20 m

Service temperature: 35 °C

Linear expansion coefficient: 0.024 mm/m

Calculation:

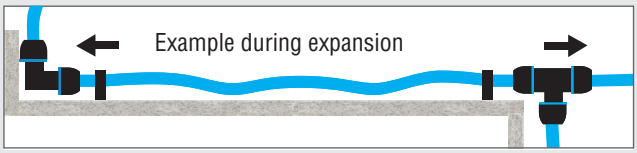
DT = 35 – 1 0 = 25 °C

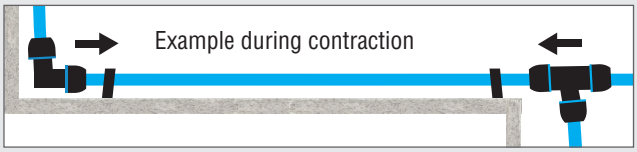
DL = 0,024 x 20 x 25 = 12 mm

LEGENDE	DESCRIPTION
d	Linear expansion coefficient
L	Length of the pipe
DT	Temperature difference inmdegrees Celsius
DL	Difference in length (expansion or contraction)

Effects of expansion or contraction if the expansion coefficient is not considered:

- Strain of pipes between two fixed points
- Compression of clamps or equipment with risk of strain, sag or rupture





Solutions to counter the effects of thermal variations

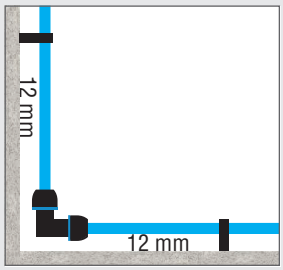
Leave space between pipe and wall

To prevent the effects of expansion/contraction and make sure there is enough room, space should be left between the pipes and walls at the time of installation.

Example using the calculation above:

DL = 0.024 mm/m coefficient for an aluminium pipe x 20 m x 25 °C = **12 mm**

Since the difference in length (DL) is 12 mm, the space between pipe and wall must be at least 12 mm.



Solutions to counter the effects of thermal variations

Adding expansion loops or expansion connectors

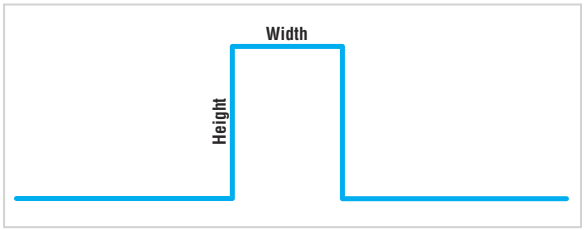
Aluminium compressed air pipes are subjected to temperature variations and expansion movements.
Each straight section of 50 meters must contain an elastic element to absorb expansion, without causing undue stress to the piping.

For systems with a pipe diameter of 20 to 80 mm (3/4 to 3 in)

Expansion loops are a good way to absorb expansion.
The diagram and table below indicate the recommended dimensions for the loops.

Dimensions of the expansion loops

Tube diameter		Height		Width	
mm	in	m	ft	m	ft
20 to 25	3/4 to 1	1.2	4	0.6	2
32 to 40	1-1/4 to 1-1/2	1.5	5	0.9	3
50	2	1.8	6	0.9	3
63 to 80	2-1/2 to 3	2.1	7	1.2	4



⚠ CAUTION

Dimensions for reference only. TOPRING assumes no responsibility for the design of any particular piping system. It is the responsibility of the project designer to ensure compliance with the applicable standards. These dimensions are only valid for an expansion loop intended to absorb the expansion of a straight section of up to 50 meters in length, in aluminium piping subject to a temperature variation relative to the building of up to 60 degrees Celsius.

For systems with a pipe diameter of 16 to 50 mm (1/2 to 2 in)



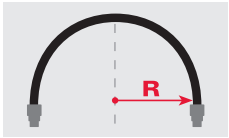
Series 8 anti-vibration hoses can also absorb expansion movements.
Available in 24 and 48-inch lengths, with or without a Canadian Registration Number (CRN).

Minimum bending radius for rubber hose diameter

Inside diameter Pipe / Connector		Minimum bending radius R	
mm	in	mm	in
16	1/2	178	7
20	3/4	241	9-1/2
25	1	305	12
32	1-1/4	419	16-1/2
40	1-1/2	500	19-11/16
50	2	635	25

Minimum bending radius for rubber hose diameter (CRN approved) CRN CANADIAN REGISTRATION NUMBER

Inside diameter Pipe / Connector		Minimum bending radius R	
mm	in	mm	in
16	1/2	89	3-1/2
20	3/4	121	4-3/4
25	1	152	6
32	1-1/4	210	8-1/4
40	1-1/2	254	10
50	2	318	12-1/2



TECH TIP

The anti-vibration hose must not be overly bent (too squared or not rounded enough). This hose is used to change direction and bypass obstacles.
It is installed at the compressor to neutralize vibrations (see Point 5).

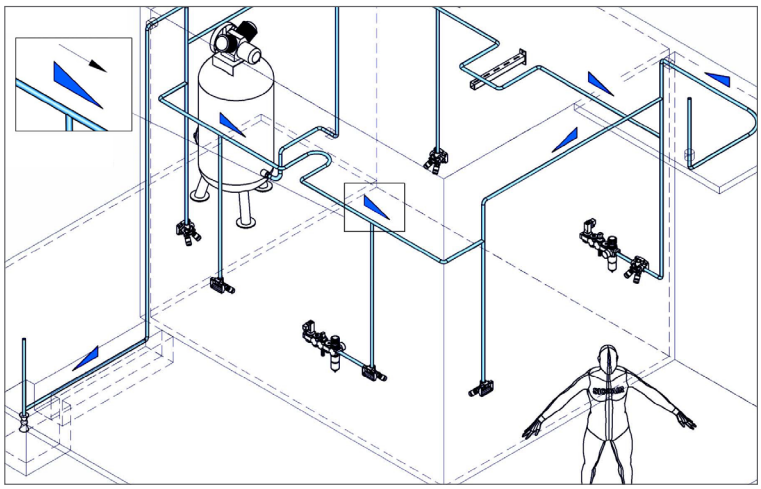
For systems with a pipe diameter of 63 to 80 mm (2-1/2 to 3 in)

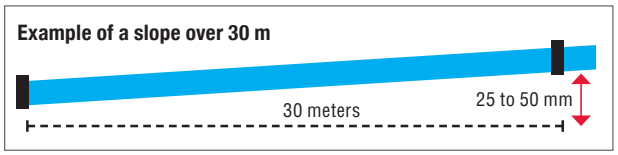
Expansion loops may be replaced by expansion connectors for quick and easy installation.



7. Determining the slopes

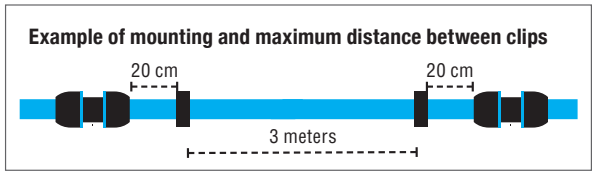
All horizontal pipes must have a slope of about 25 to 50 mm per 30 m to drain condensate. Downward slopes must lead to condensate drains installed as low as possible at the base of manifolds (not illustrated in the diagram shown here).



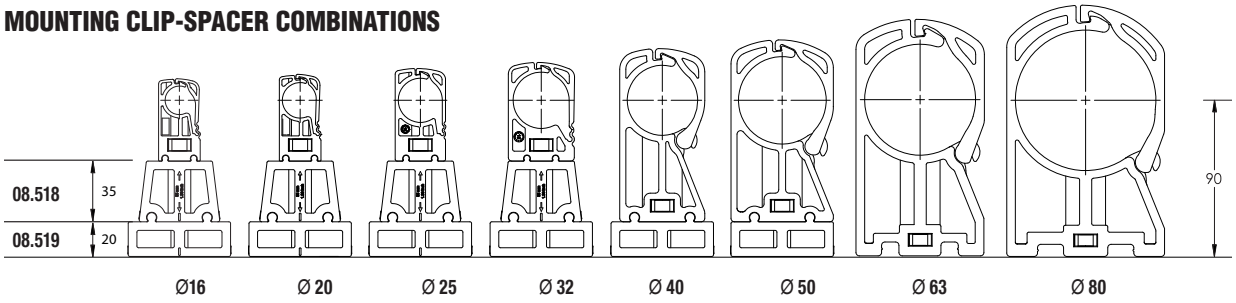


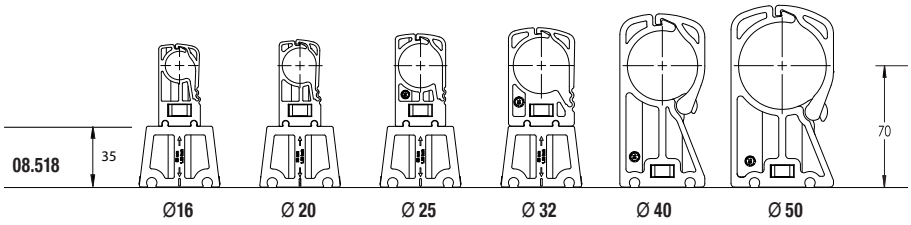
8. Adding mounting clips

The maximum distance between each mounting clip must be 3 m, regardless of pipe diameter. Mounting clips should be installed 20 cm from a fitting (upstream or downstream) to prevent pipes from bending.

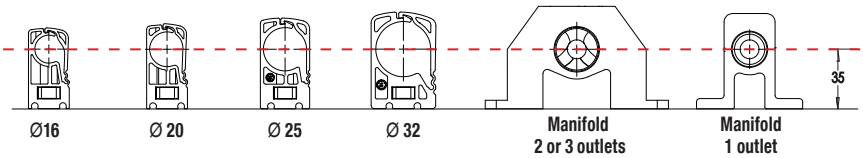


MOUNTING CLIP-SPACER COMBINATIONS





MOUNTING CLIP AND MANIFOLD COMBINATIONS FOR ALIGNMENT WITH DROP LEGS



SPACER FOR MOUNTING CLIP



08.518
Thickness 35 mm



08.519
Thickness 20 mm

SPACER FOR MANIFOLD



47.596
For 1 outlet manifold



47.598
For 2 or 3 outlets manifold

TECH TIP

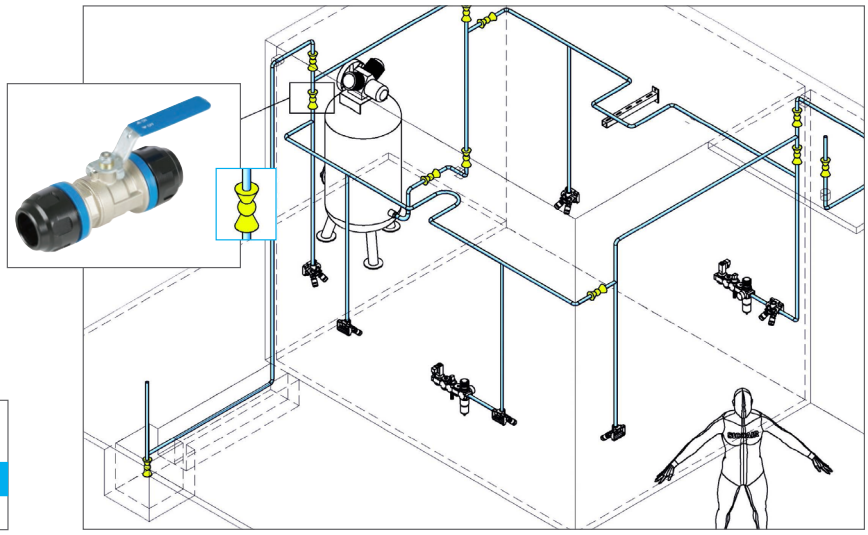
A deviation pipe can be used to correct the alignment between the main line and drop legs.

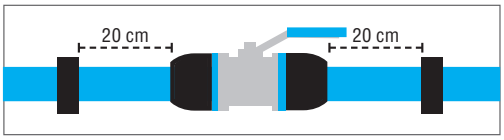


9. Planning maintenance

Ball valves should be installed in order to facilitate maintenance and isolate the system into sections.

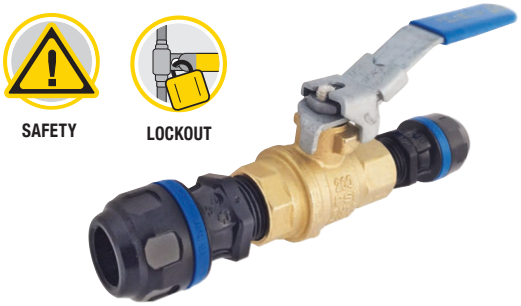
For a drop, a mounting bracket should be installed on both sides of the ball valve to prevent pipe distortion and vibration at the application.





SAFETY SOLUTION

Since maintenance operations must be carried out on a depressurized system, **TOPRING** offers ball valves with a safety exhaust that can be locked out.





BUYER AND/OR USER LIABILITY

Anyone who purchases and/or uses a TOPRING product and/or system (hereinafter “TOPRING Product(s)”) must carefully read the user instructions for that TOPRING Product and, where the product relates to compressed air, must be familiar with the associated health and safety risks prior to use.

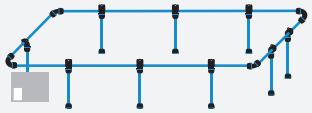
By purchasing and using a TOPRING Product, the buyer and/or user acknowledges that he or she understands and accepts his or her sole liability for installation, identification, maintenance, and use of the TOPRING Product as well as for configuration of any system that uses a TOPRING Product. Subject to the limits of public policy as expressed in the law, the buyer and/or user assumes the risk and liability that may arise from loss, damage, or injury caused by improper installation, identification, maintenance, and/or use of a TOPRING Product, or by misconfiguration of any system using a TOPRING Product, and holds harmless TOPRING and its subsidiaries and affiliated corporations (hereinafter “TOPRING”). The buyer and/or user must consider, among other factors, current regulations, the user instructions for the TOPRING Product, safety measures, the specifics of the premises or location, and the activities or operations conducted there.

By purchasing a TOPRING Product, and subject to the limits of public policy expressed in the law, the buyer and/or user hereby acknowledges and agrees that TOPRING cannot be held liable for any damages whatsoever (including damages caused by loss of profits, business interruption, loss of information, or any other loss) arising from improper installation, identification, maintenance, and/or user of a TOPRING Product, misconfiguration of a system that uses a TOPRING Product, or the impossibility of such a configuration, installation, identification, maintenance, and/or use.

The buyer and/or user of a TOPRING Product is responsible for informing any persons concerned of the risks, warnings and safety measures for TOPRING Products, including but not limited to employees using one or more TOPRING Products.

Table A
Tube diameters according to length and required SCFM

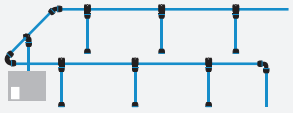
Closed loop network



TOTAL LENGTH OF THE NETWORK (FEET)

TOTAL FLOW REQUIRED SCFM	FEET / SCFM	100'	150'	200'	250'	300'	400'	500'	600'	700'	800'	900'	1000'	1250'	1500'	2000'
	5	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	10	16	16	16	16	16	16	16	16	16	16	16	16	16	16	20
	15	16	16	16	16	16	16	16	16	16	20	20	20	20	20	20
	20	16	16	16	16	16	16	20	20	20	20	20	20	20	20	25
	30	16	16	16	20	20	20	20	20	20	20	25	25	25	25	25
	40	16	20	20	20	20	20	25	25	25	25	25	25	25	25	32
	60	20	20	20	25	25	25	25	25	25	25	32	32	32	32	32
	80	20	25	25	25	25	25	32	32	32	32	32	32	32	32	40
	100	25	25	25	25	25	32	32	32	32	32	32	32	40	40	40
	125	25	25	25	32	32	32	32	32	32	32	40	40	40	40	40
	150	25	32	32	32	32	32	32	40	40	40	40	40	40	40	50
	200	32	32	32	32	32	40	40	40	40	40	40	40	50	50	50
	300	32	32	40	40	40	40	40	50	50	50	50	50	50	50	63
	400	40	40	40	40	40	50	50	50	50	50	50	63	63	63	63
	500	40	40	40	50	50	50	50	50	63	63	63	63	63	63	63
	750	50	50	50	50	63	63	63	63	63	63	63	63	80	80	80
	1000	50	50	63	63	63	63	63	63	80	80	80	80	80	80	80
	1500	63	63	63	63	80	80	80	80	80	80	80				

Linear network (dead end)



TOTAL LENGTH OF THE NETWORK (FEET)

TOTAL FLOW REQUIRED SCFM	FEET / SCFM	25'	50'	75'	100'	150'	200'	250'	300'	400'	500'	600'	700'	800'	900'	1000'
	5	16	16	16	16	16	16	16	16	16	16	16	16	16	20	20
	10	16	16	16	16	16	16	20	20	20	20	20	20	20	25	25
	15	16	16	16	16	20	20	20	20	25	25	25	25	25	25	25
	20	16	16	20	20	20	20	25	25	25	25	25	25	25	32	32
	30	16	20	20	20	25	25	25	25	32	32	32	32	32	32	32
	40	20	20	25	25	25	25	32	32	32	32	32	32	32	40	40
	60	20	25	25	25	32	32	32	32	32	40	40	40	40	40	40
	80	25	25	32	32	32	32	40	40	40	40	40	40	40	50	50
	100	25	32	32	32	32	40	40	40	40	40	50	50	50	50	50
	125	25	32	32	32	40	40	40	40	50	50	50	50	50	50	50
	150	32	32	32	40	40	40	40	50	50	50	50	50	63	63	63
	200	32	40	40	40	50	50	50	50	50	63	63	63	63	63	63
	300	40	40	50	50	50	50	63	63	63	63	63	63	80	80	80
	400	40	50	50	50	63	63	63	63	63	80	80	80	80	80	80
	500	40	50	50	63	63	63	63	80	80	80	80	80	80	80	
	750	50	63	63	63	80	80	80	80	80						
	1000	63	63	63	80	80	80	80								
	1500	63	80	80	80											

REFERENCE TABLES

Table B
Equivalent lengths of **TOPRING PPS** connections



Pipe O.D.		Union 	90° elbow union 	45° elbow union 	T reducer female thread 	T reducer 	Union reducer 	Connector male thread 	Drop coupling 
16 mm	1/2 po	0.33	2.30	/	0.33	/	/	0.33	/
20 mm	3/4 po	0.66	3.94	3.28	0.66	4.26	/	0.66	/
25 mm	1 po	0.66	4.92	3.94	0.99	5.90	1.64	0.66	5.90
32 mm	1 1/4 po	0.99	6.56	4.26	0.99	7.87	1.97	0.99	7.87
40 mm	1 1/2 po	0.99	7.87	5.25	1.31	9.84	2.30	0.99	9.84
50 mm	2 po	1.31	9.84	6.56	1.31	13.12	3.28	1,31	13.12
63 mm	2 1/2 po	1.64	11.48	8.20	1.64	14.76	4.92	1.64	14.76
80 mm	3 po	2.30	15.74	/	2.30	18.04	6.56	2.30	18.04

Feet measurements / @116 PSI / 33 ft/s / 10 m/s.

Table C
SCFM required by type of tool







SANDERS	FLOW SCFM
Sander	9.6
4-1/2" angle grinder	18.4
10mm belt sander	18.9
7" angle sander	29.6
NAILERS/STAPLERS	
18 gauge nailer/stapler	0.02 SCF/cycle
22-18 gauge stapler	0.03 SCF/cycle
Finishing nailer	0.03 SCF/cycle
Roofing nailer	0.05 SCF/cycle
Framing nailer	0.09 SCF/cycle
IMPACT TOOLS	
Miniature 1/4" ratchet	12.5
1/4" impact gun	14.0
3/8" ratchet	19.2
Zip gun	21.9
1/2" impact gun	28.6
3/4" impact gun	34.7
1" impact gun	87.5







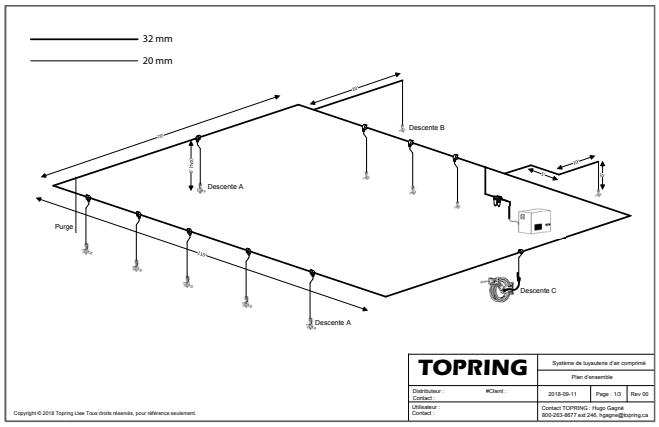
POLISHING TOOLS	FLOW SCFM
Orbital polisher	16.6
Oscillating sander	23.0
DRILLS	
3/8" air drill	17.3
3/8" reversible air drill	23.8
1/2" reversible air drill	26.4
OTHER TOOLS	
Riveter	0.08 SCF/cycle
Grease gun	0.8 SCF/cycle
Caulking gun	0.1
HVLP paint gun	9.5
Screw driver	9.6
Gravity fed sand blaster	12.0

Note: Airflow (SCFM) may vary among tool brands.
Check against the manufacturer's data.

TOPRING can help you plan, design, and select the right compressed air piping system.

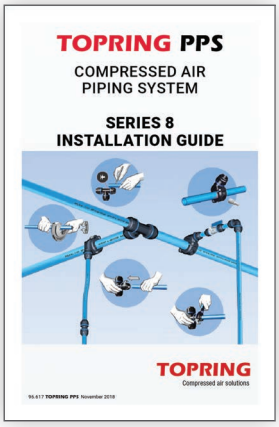
GENERAL LAYOUT

Visualize your compressed air installation with a Visio drawing provided upon request.



INSTALLATION SUPPORT

Download the **TOPRING PPS** piping system installation guide on **TOPRING**.com.



The technical information explains each installation step, making assembly of system components easy to understand.

TECHNICAL SUPPORT

For technical support with a specific project, contact us at 1 800 263-8677 or visit the “Piping Systems” section of **TOPRING**.com to consult or download installation guides or videos, white papers, and practical tools.



This design guide is also available in French: code 96.606

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T 450 375-1828 **/** 1 800 263-8677 **/** **F** 450 375-1408

solutions@**TOPRING**.ca / www.**TOPRING**.com