Product Data Sheet
Design and Installation Guide to Air Ring Mains

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Applications	
Air ring mains	✓

Introduction

The purpose of this document is to try and provide a practical guide for the assessment of the requirements and performance of compressed air ring main systems. Whilst every effort has been made to try and ensure that the data given here is correct John Guest Ltd would remind potential users of this data that it is their responsibility to ensure that any installation complies with Health and Safety requirements, trade / national / international laws and the recommendations of the British Compressed Air Society Guide.

Pipe sizing

Compressed air ring mains are the link between the compressor and the point of usage. Therefore correct sizing of the pipe work for the tasks envisaged is extremely important. Generating compressed air takes a surprising amount of energy and so pipe work losses due to friction or heating, which is unrecoverable waste energy, should be kept to a minimum. Due to heat, noise and vibration, John Guest Ltd. do not recommend the use of plastic pipes between the compressor and the air receiver. If there is no air receiver we recommend that the installer does not use plastic pipe or fittings within a minimum of one metre of the compressor and that they should ensure that the temperature of the compressed air and the local environment is below the maximum rating temperature of the system before any connection is made to plastic pipes or fittings. See also “Effects of temperature on a System” later in this guide. However a suitable connection will be required to join the compressor / air receiver to the system. Whilst it is accepted that the air in a system can run at a velocity of up to 15 metres per second it is generally found that the main supply ring should be run at a lower velocity of around 6 metres per second and the higher velocities (15 metres / second) only permitted in the final service lines. This will save energy and make the extraction of residue condensate and oil from the system easier. It should also be considered that a larger pipe size could act as a reservoir and will allow for the expansion of the system without re-plumbing at a later stage should this be required.
Regardless of the system pressure, it is generally thought that the pressure drop in the system should not exceed 0.3 Bar, and that a ring main is a better solution to smoothing out losses in a system as the air can arrive at an appliance from two directions.

Air flow rates

Air flow rates are expressed in Litres per Second or Cubic Feet per Minute and are related to air expanded back to 1 atmosphere (0 Bar Gauge). It should be born in mind that the velocity is calculated with the air in its compressed state.

All Dimensions in mm

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ECN 17164

Air flow rates (continued)

Example
Air travelling along a 20mm internal diameter pipe at a velocity of
6 metres / second and a pressure of 10 bar (gauge) has a compressed volume of
3.142 x 1 x 1 x 600 = 1885 cc / sec or 1.884 litres /second
(cross sectional area) x (Length travelled in 1 second)

But

This would be expressed as $P_1 V_1 = P_2 V_2$

Where P_1 = 11 (10 bar gauge)
V_1 = 1.884 Litres /sec
P_2 = 1 (0 bar gauge)
V_2 = 20.74 Litres /sec
And so in charts it would quote the volume as 20.74 litres per second.

From this data the following flow rates are derived

Air Flow at 6 Metres / second (1200 feet / minute) - Ring Main

John Guest Nylon 12 Tube (6mt per second)

JG Nylon 12 Pipe o/dia mm x i/dia mm — Air flow Litres / second at a velocity of 6 metres per second. Figures in brackets (.....) are in cubic feet per minute

System Pressure (bar gauge)	0.5	1.0	1.5	2.0	4.0	6.0	8.0	10.0	12.5	16.0	18.0
12 x 9	0.57	0.76	0.95	1.15	1.91	2.67	3.43	4.19	5.15	6.49	7.27
JG Rigid Nylon Pipe	(1.21)	(1.61)	(2.01)	(2.44)	(4.05)	(5.66)	(7.27)	(8.88)	(10.9)	(13.8)	(15.4)
PT. No. PA-RM1209											
15 x 12	1.02	1.36	1.70	2.04	3.39	4.75	6.10	7.46	9.16	11.54	12.9
JG Rigid Nylon Pipe	(2.16)	(2.88)	(3.60)	(4.32)	(7.19)	(9.97)	(12.9)	(15.8)	(19.4)	(24.5)	(27.3)
PT. No. PA-RM1512											
18 x 14	1.39	1.85	2.31	2.77	4.62	6.47	8.31	10.2	12.5	15.7	17.6
JG Rigid Nylon Pipe	(2.95)	(3.92)	(4.90)	(5.87)	(9.79)	(13.7)	(17.6)	(21.6)	(26.5)	(33.3)	(37.2)
PT. No. PA-RM1814											
22x 18	2.29	3.05	3.82	4.58	7.63	10.7	13.7	16.8	20.6	25.9	29.0
JG Rigid Nylon Pipe	(4.85)	(6.47)	(8.10)	(9.71)	(16.2)	(22.7)	(29.1)	(35.6)	(43.7)	(55.0)	(61.5)
PT. No. PA-RM2218											
28 x 23	3.74	4.99	6.23	7.48	12.5	17.5	22.4	27.4	33.7	42.4	47.4
JG Rigid Nylon Pipe	(7.93)	(10.6)	(13.2)	(15.9)	(26.5)	(37.1)	(47.5)	(58.1)	(71.4)	(89.8)	(100.4)
PT. No. PA-RM2823											

All Dimensions in mm

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John Guest Aluminium Tube – Ring Main (6 mt per second)

JG Aluminium Tube — Air flow Litres / second at a velocity of 6 metres per second
o/dia mm x i/dia mm — Figures in brackets (…..) are in cubic feet per minute

	System Pressure (Bar Gauge)										
	0.5	**1.0**	**1.5**	**2.0**	**4.0**	**6.0**	**8.0**	**10.0**	**12.5**	**16.0**	**18.0**
15 x 13	1.20	1.59	1.99	2.39	3.99	5.58	7.17	8.77	10.8	13.6	15.2
JG Al. Tube	(2.54)	(3.38)	(4.22)	(5.07)	(8.45)	(11.8)	(15.2)	(18.6)	(22.8)	(28.7)	(32.1)
PT. No.AL-RM1513-3M-20B											
18 x 16	1.81	2.41	3.02	3.62	6.03	8.45	10.9	13.3	16.3	20.5	22.9
JG Al. Tube	(3.84)	(5.12)	(6.39)	(7.67)	(12.8)	(17.9)	(23.0)	(28.1)	(34.5)	(43.5)	(48.6)
PT. No.AL-RM1816-3M20-B											
22 x 20	2.83	3.77	4.71	5.66	9.43	13.2	17.0	20.7	25.4	32.1	35.8
JG Al. Tube	(6.00)	(8.00)	(10.0)	(12.0)	(20.0)	(28.0)	(36.0)	(44.0)	(54.0)	(68.0)	(76.0)
PT. No.AL-RM2220-3M-20B											
28 x 26	4.78	6.37	7.97	9.56	15.9	22.3	28.7	35.1	43.00	54.2	60.5
JG Al. Tube	(10.1)	(13.5)	(16.9)	(20.3)	(33.8)	(47.3)	(60.8)	(72.3)	(91.2)	(115)	(128)
PT. No. AL-RM2826-3M-10B											

Air Flow at 15 Metres / second (3000 feet / minute)

John Guest Nylon 12 Tube – Outlets (15 mt per second)

JG Nylon 12 Tube — Air flow Litres / second at a velocity of 15 metres per second
o/dia mm x i/dia mm — Figures in brackets (…..) are in cubic feet per minute

System Pressure (Bar gauge)	**0.5**	**1.0**	**1.5**	**2.0**	**4.0**	**6.0**	**8.0**	**10.0**	**12.5**	**16.0**	**18.0**
12 x 9	1.43	1.90	2.38	2.88	4.78	6.68	8.58	10.5	12.9	16.2	18.2
JG Rigid Nylon Pipe	(3.03)	(4.03)	(5.05)	(6.11)	(10.1)	(14.2)	(18.2)	(22.3)	(27.4)	(34.4)	(38.5)
PT. No. PA-RM1209											
15 x 12	2.55	3.40	4.25	5.10	8.48	11.9	15.3	18.7	22.9	29.9	32.3
JG Rigid Nylon Pipe	(5.41)	(7.21)	(9.01)	(10.8)	(18.0)	(25.2)	(32.4)	(39.6)	(48.5)	(63.3)	(68.5)
PT. No. PA-RM1512											
18 x 14	3.48	4.63	5.78	6.93	11.6	16.2	20.8	25.5	31.3	39.3	43.9
JG Rigid Nylon Pipe	(7.38)	(9.82)	(12.3)	(14.7)	(24.6)	(34.3)	(44.1)	(54.1)	(65.7)	(83.3)	(93.1)
PT. No. PA-RM1814											
22 x 18	5.73	7.63	9.55	11.5	19.1	26.8	34.3	42.0	51.5	64.9	72.5
JG Rigid Nylon Pipe	(12.1)	(16.2)	(20.2)	(24.4)	(40.5)	(56.8)	(72.7)	(89.0)	(109)	(138)	(154)
PT. No. PA-RM2218											
28 x 23	9.35	12.5	15.6	18.7	31.3	43.8	56.0	68.5	84.3	106	109
JG Rigid Nylon Pipe	(19.8)	(26.5)	(33.1)	(39.6)	(66.4)	(92.9)	(119)	(145)	(179)	(225)	(251)
PT. No. PA-RM2823											

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John Guest Aluminium Tube – Outlets (15 mt per second)

JG Aluminium Tube o/dia mm x i/dia mm — Air flow Litres / second at a velocity of 15 metres per second. Figures in brackets (…..) are in cubic feet per minute

System Pressure (Bar gauge)	0.5	1.0	1.5	2.0	4.0	6.0	8.0	10.0	12.5	16.0	18.0
15 x 13	2.81	3.74	4.68	5.61	9.35	13.1	16.8	20.6	25.3	31.8	35.5
JG Al. Tube	(5.95)	(7.93)	(9.92)	(11.9)	(19.8)	(27.7)	(35.5)	(43.7)	(53.6)	(67.4)	(75.3)
PT. No.AL-RM1513-3M-20B											
18 x 16	2.99	3.98	4.98	5.97	9.96	13.9	17.9	21.9	26.9	33.8	37.8
JG Al. Tube	(9.12)	(12.1)	(15.2)	(18.2)	(30.3)	(42.4)	(54.7)	(66.8)	(82)	(103)	(116)
PT. No.AL-RM1816-3M-20B											
22 x 20	6.97	9.05	11.3	13.6	22.6	31.7	40.7	49.8	61.1	76.9	86
JG Al. Tube	(14.4)	(19.2)	(24)	(28.8)	(47.9)	(67.2)	(86.3)	(106)	(130)	(163)	(182)
PT. No. AL-RM2220-3M-20B											
28 x 26	11.6	15.4	19.3	23.2	38.6	54	69.5	84.9	104	131	147
JG Al. Tube	(24.6)	(32.6)	(40.9)	(49.2)	(81.8)	(115)	(147)	(180)	(220)	(278)	(312)
PT. No. AL-RM2826-3M-10B											

Note System pressures quoted above may not be suitable with certain temperatures and fittings. Please refer to the Installation Guide for Pressure / temperature limitations.

For conversion purposes only: 1 litre/sec = 2.12 cubic feet /minute

It should be remembered that in the ring main part of a circuit that the air can flow in 2 directions and so double the flow demonstrated above could be achieved for the same velocity.

All of these equations assume that there is no change of temperature.
If there is a change in temperature then a modified form of the equation above has to be used and this is

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Where T_1 is the temperature of the air in its pressurised state (°C + 273)
and T_2 is the temperature of the air in its uncompressed state (°C + 273)

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Pressure drop in a system

Air travelling along a pipe or through connecting fittings is subjected to friction and so encounters a pressure drop. These pressure losses are expressed in bar (per metre of pipe) and in the case of connectors they are expressed in equivalent metres of the same size pipe. In the case of complex connectors these equivalent lengths are only approximate but have been found by industry to be adequate for the design of systems.
Whilst the pressure drop can be anything up to the system pressure it is considered in the interests of good working practice and system efficiency to restrict the pressure drop to 0.3 bar.

John Guest has taken particular care in the design of their fittings to try and reduce losses; this has been achieved by the smooth transition of through bores.

Pressure drops not only occur in the pipes and fittings but in ancillary items such as filters, valves etc. The system loss must incorporate these losses as well as the pipe and fitting losses. It is the summation of all of these that make the system loss.

Pressure drop in pipes – John Guest Rigid Nylon 12

With dry, filtered air at 20°C

Air Velocity		John Guest Rigid Nylon Pipe size (o/d) 12mm	15mm	18mm	22mm	28mm
		(Pressure loss in bar per metre of pipe)				
2	Metres per second	0.00011	0.00008	0.00006	0.00005	0.00003
4	Metres per second	0.00046	0.00032	0.00026	0.00018	0.00013
6	Metres per second	0.00103	0.00071	0.00058	0.00042	0.00030
10	Metres per second	0.00288	0.00198	0.00162	0.00116	0.00084
15	Metres per second	0.00650	0.00445	0.00364	0.00262	0.00190

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Pressure drop in pipes – John Guest Aluminium pipe

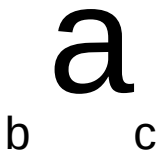
With dry, filtered air at 20°C

Air Velocity	John Guest Aluminium Pipe size (o/d) 15mm	18mm	22mm	28mm
	(Pressure loss in bar per metre of pipe)			
2 Metres per second	0.00007	0.00006	0.00004	0.00003
4 Metres per second	0.00029	0.00022	0.00016	0.00012
6 Metres per second	0.00066	0.00051	0.00037	0.00026
10 Metres per second	0.00185	0.00140	0.00104	0.00073
15 Metres per second	0.00418	0.00316	0.00234	0.00164

Pressure drop in fittings

These “equivalent lengths” apply to whatever local pipe is being used i.e. same size of fitting as the local pipe regardless of material of fittings

JG Connector Style	Pipe size (o/d) 12mm	15mm	18mm	22mm	28mm
	(Equivalent metres of Pipe)				
Straight	0	0	0	0	0
Elbow	3.0	2.0	1.6	1.24	1.18
Tee (in line of flow)	1.65	0.9	0.38	0.26	0.25
Tee (in branch of flow)	4.0	2.45	2.18	1.73	1.48
Tight 90° Bend in pipe	1.65	0.9	0.73	0.58	0.53
Water Trap Tee	4.0	2.45	2.18	1.73	1.48



Pressure ratings of fittings and pipe

Fittings

John Guest plastic fittings are quoted for use at the following maximum working pressures and temperatures. In addition the British compressed air society recommends that the burst pressure of the fittings should be 1.5 times the maximum working pressure. John Guest are able to confirm our compliance with these requirements. In practice all John Guest connectors used for Air ring main applications have burst pressures in excess of 25 bar and in many cases are far in excess of this figure. These ratings are regularly reviewed by the company quality audit procedure.

Fitting	Temperature °C	Max Working Pressure (Bar)	Min Burst Pressure (Bar)	Audit burst Pressure (Bar)
All fittings and sizes	minus 20°C (min)	10 Bar	15 Bar	> 25 Bar
All fittings and sizes	23°C	10 Bar	15 Bar	> 25 Bar
All fittings and sizes	70°C (max)	7 Bar	11 Bar	> 25 Bar

Nylon 12 Pipe

John Guest Nylon 12 Air Ring Main Pipe is suitable for use over the temperature range of minus 30°C to plus 100°C. It is quoted as being suitable at the following working pressures and temperature.

Size (O / Dia)	Max Working Pressure (Bar)							Min Burst Pressure
mm	-30°C to 20°C	30°C	40°C	50°C	60°C	70°C	80°C to 100°C	at Ambient temp (Bar)
12	20	16	12	10	9	8	6	30
15	25	20	15	13	11	10	8	37
18	28	22	17	14	14	11	9	42
22	22	18	13	11	10	9	7	33
28	20	16	12	10	9	8	6	30

Aluminium Pipe

John Guest Blue Powder Coated Aluminium Pipe is capable of being used over the temperature range minus 30°C to plus 100°C at the pressures quoted below. The British Compressed Air Society recommends that the minimum burst pressure should be 1.5 times the maximum working pressure but to allow for manufacturing variations in the wall thickness of the tube and the physical properties of the aluminium John Guest have calculated the working pressures as one third of the calculated burst pressures (Factor of safety 3).

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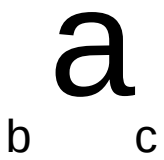
ECN 17164



Aluminium Pipe (continued)

Size (o/dia) mm	Maximum working pressure (bar)	Calculated Burst Pressure (bar)
15	44	132
18	36	110
22	30	90
28	23	70

Effects of temperature on a system

Heating of the compressed air in a system can happen due to the local environment, friction in the system or rapid changes in velocity. In a factory environment the local air temperature can be high and it should be borne in mind that as the local temperature increases the maximum working pressure should be decreased to sustain the life of the system. If the continuous temperature is going to be in excess of 50°C the pressure rating of the pipes and fittings will be approximately 70% of the rating at 20°C. If the heating of the system is local it will cause the air to expand and cause the pressure to rise if there is no flow. Rapid changes in section of the pipe work (from large to small in the direction of flow) can generate heat and may over time lead to the early failure of the system.

Installation Techniques

Nylon Pipes have different properties to steel pipes and so different techniques need to be employed for the installation of the system. For example nylon pipe expands considerably more than metallic pipe and so the method of constraining the pipe needs to be suitable for this expansion to take place. If the pipe is constrained at both ends it will buckle and generate side loads and stress in the tube. This can be alleviated by an expansion bend in the pipe work. Nylon pipe should be able to slide through mounting brackets. Nylon pipe is much lighter than that of steel pipe work and so the mountings do not need to be as robust. Using John Guest connectors means that the system can be easily modified to any new requirements, quickly and without significant specialist tools, such as threading equipment and pipe benders. Also using John Guest connectors means that no solvents or adhesives need to be employed in the installation. The expansion rate of nylon pipe is approximately 0.0001 metre per metre length per °C.

For recommendations on the supporting of pipe-work we would suggest that you refer to the John Guest Installation guide in the handbook.

All Dimensions in mm

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John Guest air ring main equipment is suitable to use above and below ground but we would strongly suggest that if it is installed below ground that it is installed in conduit so that the pipe can expand with temperature fluctuations and can easily be removed for service or maintenance. John Guest Ltd. would remind all persons involved with installation and service of compressed air systems that reference should be made to “Approved Code of Practice – Safety of Pressure Systems” available from HMSO in the United Kingdom. For installation in other countries, the appropriate Codes of Practice should apply.

Condensate and dirt in the system

It is always desirable to have clean dry air at the outlets of an air ring main system, as condensate and dirt will affect the performance and life of ancillary equipment. We would strongly recommend that a filter be fitted to the system to clean the air and that John Guest Water Trap tee’s be used to trap any residue condensate and this should be taken to a “drain off” facility to extract it from the system.

CE Marking

Due to the size of the fittings and pipes there is no requirement for the system parts to carry a CE marking. All components are however in conformance with “Sound Engineering Practice” requirements

ISSUE 2 25.05.05

ECN 17164

ECN
Data updated to include Aluminium tubes

ISSUE	DATE DRAWN	DATE ISS.	DRN. BY	ISS. BY	ECN	CHECKED	APPROVED
1	14.07.03		KRP	KRP		DAP	
2	25.05.05	06.06.05	KRP	KRP	17164		

DATA SHEET No.
DS-1103
TITLE
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