www.QuincyCompressor.com

701 North Dobson
Bay Minette, AL 36507
Phone 251.937.5900
Fax 251.937.7182

an EnPro Industries company

General Guidelines for the Sizing and Application of Point of Use Components

In compressed air systems, it is important to regulate all air users below the supply header pressure. The use of compressed air at supply pressure causes a pressure gradient from the point of use back to the point of supply. Unfortunately, in most facilities, no one currently specifies the installation of the point of use components such as filters, regulators, lubricators, hoses and fittings. These components, represent the highest-pressure drops in the system and control the impact each user has on the balance of the system. After installing filters, regulators, and lubricators, if the application doesn't perform acceptably, plant personnel will increase the pressure at the regulator. If the header pressure then affects the application, the system pressure will be elevated to solve the problem (at significant increases in system operating costs). A more appropriate solution is to install higher flow components with lower differential, at a relatively low cost; or resize the user to operate at lower pressures (a larger diameter cylinder). The methods described below are the simplest and least expensive means of increasing pressure at an individual application by resizing the point of use components which does not increase compressed air system operating costs.

Size for Rate of Flow and Pressure Differential

Size all applications for maximum rate of flow, not flow per cycle. As an example, the usage may be 5 cubic feet in 2 seconds per cycle once per minute. The flow per cycle is 5 cubic feet. The rate of flow is 5 cf X 60 sec ÷ 2 sec = 150 cfm rate of flow. The highest rate of flow, highest temperature and lowest supply pressure yields the highest-pressure differential. Size all of the components in the system between the compressors and the air users in this manner. The chart supplied in the example below will provide initial guidelines. A reasonable and cost effective standard would be a designed differential not to exceed 6 psid which allows for 4 psi of added differential as point of use filters foul. This will allow the lowest possible header pressures to minimize operating costs without increasing the costs of components substantially. Remember, the cost of the next size larger regulator, filter or lubricator is only a small one-time cost. The costs to operate the entire system 10 psi higher just for filter, lubricator and regulator differential can easily reach thousands of dollars annually.

Filters

Another critical factor is component quality. Filters vary greatly in their dirt holding ability called filter void. The void can vary from 30 to 80 % depending on the amount of binder and type of media used by the manufacturer. In essence, the manufacturer can controls filter life. Chose carefully your selection of filters and do not buy on price alone.

Lubricators

There are three basic types of lubricators. The venturi design has a restriction, which is an energy loss. The drip type lubricator also has a differential and is difficult to control. The wick type has no restriction, creates minimal differential, and has a finite control of lubricant flow. We recommend the wick type lubricator for most applications that require a lubricator to minimize pressure losses to 1-2 psid and to minimize lubricant consumption.

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Regulators
We recommend diaphragm regulators with precision pilots for most applications. This type of regulator has the lowest control differential requirements which can be specified at 3 psi. The precision pilot will provide the tightest control of application pressure, also at minimal pressure loss. Please note that these pressure loss recommendations are most important on applications which require pressures near the system header pressure.

General Recommendations
Push-lock fittings are in general use in many facilities and by many manufacturers or pneumatic driven equipment. Based on independent testing – 37 % of this type fitting leak at initial start-up. We recommend replacing push-lock fittings as they fail with a double backing ferrule fitting manufactured by Parker Hannifin or Swagelok. It does not make good business sense to make wholesale replacement of Push-lock fittings, but all new equipment and replacement equipment should use only the double backing ferrule design. Proper fittings are more inexpensive to purchase and install, but long term their performance has a significant impact on operating costs and leak rates.

Specify full flow, low leak design quick-disconnects over the general industrial or automotive 1/4" or 3/8" quick disconnect. The flow is more than 50% higher for the same fitting size which minimizes the pressure loss at the applications.

Teflon tape when used as a pipe thread sealant in compressed air systems can lead to a high level of leaks. We recommend an anaerobic self-curing compounds such as Loctite 567 as tube fitting thread sealant and Loctite 579 as compressed air pipe thread sealant. Primer N7649 is required with both products. Cleaning the threads prior to applying the sealant is a must for the sealant to work effectively. For answers to technical questions, call Loctite technical services at 1-800-562-8483.

Attaching flexible hoses to pipe nipples with clamps will cause air leaks. The end nipples have serrations on the OD of the nipple which cut the inside the hose when attached by any method that does not have the swaged ferrule over the outside. Make these connections using a swaged ferrule around the outside of the rubber hose that is longer than the nipple inside the hose. This eliminates premature failure of the flexible hose. When hose is used in compressed air service, follow the following recommendations:

- The hose should have the largest ID and shortest length possible.
- Where the hose ID becomes ergonomically unacceptable employ a larger lead hose and smaller whip hose at the application.
- Use full flow quick disconnects on only one end of the hose.

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Selection of Filters, Regulators, Lubricators, Hose, and Piping For Point of Use Applications

Nominal Standard Pipe in Inches

Initial PSIG	1/8	1/4	3/8	1/2	3/4	1	1.25	1.5	2	2.5	3
5	0.2	0.5	1.1	2	2.6	5.2	10.8	16	32	54	96
10	0.3	0.7	1.5	3	4.5	8.4	17.6	26	50	80	148
20	0.5	1.2	2.5	5	7.5	14	30	44	86	140	240
30	0.75	1.7	3.6	7	10.5	20	42	62	120	198	340
40	1	2.2	4.8	9.2	13.6	25	54	80	154	256	432
50	1.2	2.7	6	10.4	16.8	31	66	98	189	308	539
60	1.4	3.2	7.2	13.6	20	37	78	116	224	360	641
70	1.65	3.7	8.2	16.6	23	42	90	134	256	420	743
80	1.9	4.2	9.2	17.7	26	48	102	152	288	480	839
90	2.1	4.7	10.4	19.6	29	54	114	170	324	530	937
100	2.3	5.2	11.6	21.6	32	60	126	188	360	580	1040

The above table represents scfm flow at various pressures at various nominal pipe sizes. To establish a basis for calculating either different flows or other differentials or combinations, use the above flows at the nominal pipe size and pressure which will produce differentials for the following point of use items. The initial pressures minus the differential equals the highest final or application pressure which will remain stable. The above data assumes a point of use temperature of 70 oF. Please note that the table provided is for nominal values, for accurate results you must obtain similar data from the manufacturer of the point of use components in your facility.

1. Regulators - 4 psid
2. Lubricators - 2 psid
3. Filters - 2 psid
4. ANSI Sch 40 black pipe- 1/8" to 1/2" = 4 % of initial pressure / 100 ft.
5. ANSI Sch 40 black pipe- 3/4" to 3" = 2 % of initial pressure / 100 ft.
6. Hose approximates items #4 & #5 for similar hose ID and length.
7. For fittings and elbows correct your total psid by adding 20 % of delta.

The following example shows how to use the table:

The minimum initial pressure available in the overhead piping (P4) is 90 psig. We have agreed on a maximum differential of 10 psi in the installation of a rotary vane air tool which consumes 20 scfm at 80 psig. We are located 50 linear feet from the sub header to the point of use. We need pipe, fittings, a filter, regulator, lubricator, and a hose of 10' in length.

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50’ of Sch 40 black pipe 3/4” @ 80 psig @ 100’ = 2 psid @ 26 scfm
50’ = 1 psid
26 is to 1 as 20 is to X
X, the delta at service = **0.76 psid**

Filter 26 scfm @ 80 psig @ 2 psid @ 3/4”
26 is to 2 as 20 is to X
X, the delta at service = **1.54 psid**

Regulator 26 scfm @ 80 psig @ 4 psid @ 3/4”
26 is to 4 as 20 is to X
X, the delta at service = **3.07 psid**

Lubricator 26 scfm @ 80 psig @ 2 psid @ 3/4”
26 is to 2 as 20 is to X
X, the delta at service = **1.54 psid**

10’ braided hose 3/8” @ 80 psig @ 100’ = 2 psid @ 9.2 scfm
.1 times 2 psid = .2 psid
9.2 is to 0.2 as 20 is to X
X, the delta at service = **0.43 psid**

Total of deltas:	50’ of pipe	0.76
	Filter	1.54
	Regulator	3.07
	Lubricator	1.53
	10’ of hose	0.43
Total		**7.3 psid**

Correct delta P for fittings, disconnects, and elbows....... 7.3 x 1.2 = **8.8** psid
Total differential when at maximum flow at temperature with the above items of the P5 installation for the rotary vane air tool with 20 scfm @ 80 psig

Please note that the table provided is for nominal values, for accurate results you must obtain similar data from the manufacturer of the point of use components in your facility.