



Fact Sheet

Air Distribution

Energy saving in air distribution

An optimum compressed air distribution is an energy pipeline like an electricity cable which transports compressed air energy with as few losses as possible, i. e. with the lowest reduction of the

- flow pressure (pressure drop due to narrow points in the pipeline)
- the air quantity (leaks) and
- the air quality (rust, welding scale, water etc.).

Pipeline system

In practice, compressed air tubes (main and distribution lines) are frequently selected without sufficient knowledge and without taking energetic issues into consideration with the result that in 80 of 100 firms (EU study), often 50 % and more of the compressed air energy are destroyed before they can reach the usage points.

The correct planning of a network has direct influence on the performance of the machines and the costs of producing compressed air. Select the correct diameter taking into account the flow rate required and the permissible pressure drop. The pressure drop from the air receiver in the compressor room to the final connection point should not exceed 0.1 bar. In an

optimally designed compressed air network, the pressure loss is split into:

- ≤ 0.03 bar for the main line
- ≤ 0.03 bar for the distribution
- ≤ 0.04 bar for the connection
- ≤ 0.3 bar for connection equipment

Just as the economic efficiency of the compressor is documented, the operating efficiency of air distribution should also be documented – missing documentation always means wasted energy.

Main line (ML):

Connects the generator system (compressor room) with the distribution system. The main line should be sized so as to allow reserves for future extensions.

Distribution line (DL):

This distributes the air within a consumption sector. It can be designed as a branch or ring line, or as a ring line with integrated branch lines.

Flow pressure at tool (P _e bar)	Air consumption %	Measure	
8.0	125	} throttle controller	waste of energy
7.0	111		
6.3 bar	100 %	optimum performance	
6.0	96	} increase pressure	disproportionate decrease in productivity
5.0	77		
4.0	61		
3.0	44		

Table 1: Annual energy costs due to leaks

Hole diameter mm	Air loss		Energy loss		Costs	
	at 6 bar l/s	at 12 bar l/s	at 6 bar kWh	at 12 bar kWh	at 6 bar €	at 12 bar €
1	1,1	2,0	0,4	1,1	300	900
3	9,7	18,0	3,5	9,7	2 800	7 800
5	26,9	50	9,7	27,0	7 800	21 700
10	107,8	200,1	38,8	108,1	31 100	86 500

(*) kW x 0.1 €/kWh x 8000 Bh/a

Table 2: Annual energy costs due to leaks

Nominal Diameter	DN 50	DN 65	DN 80	DN 100
Pressure drop [bar]	0,60	0,16	0,07	0,02
Investment [Euro]	5 200	6 800	8 000	10 200
Energy cost to compensate pressure drop [Euro/year]	3 433	933	415	109
Total cost over 10 years [Euro]	39 530	16 131	12 147	11 294

Table 3: Costs resulting from selection of too small diameters

Storage

Another influencing factor for the air quality and quantity is the storage of the compressed air. Compressed air storage straight after production also called "central storage" influence the air quality to the extent that the direct condensate is removed. Furthermore, storage makes it possible to meet requests for much larger quantities of air within a short time than the compressor could provide immediately. There is also the possibility – depending on the use involved – of "decentralised storage" directly at the point of use. Further information on storing compressed air can be found in the fact sheets Control and Treatment.

Costs

When comparing the investment costs, the material and assembly costs of the different pipe systems should be compared as there is no generally valid formula for the correct pipeline material. For this reason, priority should be given to the individual demand case with its respective technical requirement.

With the exception of stainless steel, the costs of various pipeline materials do not vary widely, the differences are so small that they can be negated in the annual amortisation amounts/depreciation amounts.

However, selecting the correct nominal width is decisive. Considerable consequential costs can arise if the diameter is too small. Whoever tries to save on acquisition costs here, has to pay for this in consequential costs (see Table 3).

Refurbishment of air distribution systems

Generally, a pipeline inspection should not be delayed for economic and ecological reasons. But such an inspection should also be conducted step for step and not in haste.

Large saving potentials in compressed air distribution can be determined based on a quick rough diagnosis as follows:

- air quality
- leaks
- pressure drops.

Does the **air quality** meet the requirements?

Alongside the type of treatment, this is mainly a question of whether the pipe system is corrosion-free. Does the air at the points of use still correspond to the values (produced) at the production outlet? Carbon deposits/water, rust or zinc dust (even if only in subsections) often make additional expensive maintenance work necessary at each extraction point as well as a centralised treatment.

Are there **leaks** in the system?

By recording the load at the compressors and comparing this with the existing extractions, the quantity of leaks can be determined. It is vital to consider both "opened" and "closed" points of use, since leaks at the connecting equipment and in the machines may falsify these measurements.

The impact on the tools of supercharging can also be regarded as "leaks". A tool which needs 6 bar, but is charged with 7 or 8 bar wastes considerable additional amounts of air.

How high is the **pressure drop**?

This can arise due to too small diameters. In networks which have grown over time, more and more points of use have been added to longer and longer main lines without these having been redimensioned in accordance with the requirements. Perhaps, only the compressor capacity has been increased. After the diagnosis has been made taking into account all three criteria, an economically sensible refurbishment can be determined. Either, certain parts or sectors should be refurbished or, if all the negative phenomena coincide, a new network may be the most economic solution from the cost/benefit aspect. Such refurbishments often cost much less than years of wasting energy – the payback periods are very short.

An economic concept can be designed by any specialist compressed air company!

Often, a meticulous observation using measurements of the complete system from production and treatment through distribution right up to the mechanisms of the machines is a time-consuming necessity, which, however, pays off lucratively for a company – regardless of the type and size – quickly and long-term.

The maintenance of the most expensive energy source which is also vital to production should be done as diligently as it really deserves!!!

The "Druckluft Schweiz" campaign (efficient compressed air in Switzerland) motivates and supports the operators of compressed air systems in Switzerland in implementing measures to increase the energy efficiency of compressed air supply. The campaign is led by the Fraunhofer Institute for Systems and Innovation Research and sponsored by the Swiss Federal Office of Energy and the "Electricity Saving Fund" of ewz, the electricity company of the city of Zurich. It is part of the "EnergieSchweiz" Programme. Co-sponsors are the following companies from the compressed air sector: Airtag, Atlas Copco, Donaldson, Dopag, Kaeser, Oetiker, Prematic, Servatechnik, Vektor.

Further information can be found at www.druckluft.ch

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