# Compressed Air System Design

In order to operate an effective and efficient compressed air system, a number of factors should be considered when designing the compressed air distribution network and planning the installation.

**Designing the compressed air distribution network**

In selecting the most appropriate compressed air distribution method it is first worth considering the location and output of each compressor in the network as well as the location and requirement of each point of use. With that information in mind, there are three main compressed air distribution layouts;

1) **Compressed air branch line**

   In a compressed air branch line configuration, also referred to as a single line or dead end line, compressed air is distributed via pipes that 'branch' out from the main compressed airline, with air flowing from one direction. Only a relatively short length of pipe is required for branch lines but they must have sufficient capacity to meet the whole system's demand for compressed air.

   Pros

   - Usually suitable for small compressed air users

   Cons

   - The diameter of airline pipe in a branch line needs to be significantly larger than it would be for a compressed air ring main or distribution network.
   - This distribution method creates an increased distance from the main compressed air supply. The connection lines to points of use will therefore have to be larger than for a compressed air ring main.
   - Individual sections of the network cannot be isolated for shut-down. This means that the entire compressed air system needs to be shut down for purposes such as cleaning or to expand the system.

2) **Compressed air ring main**

   A ring main layout is often considered best practice. In this configuration, compressed air can flow from two directions.

   Pros

   - Connection pipe length and volume can be halved (compared to branch line systems) if all the points of use have the same compressed air demand.
   - Connection lines are very short.
   - The compressed air system can operate as normal while areas of the compressed airline can be isolated and shut down for e.g. cleaning or system expansion.



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Cons

- More complex to install

3) **Compressed air distribution network**

A compressed air distribution network is very similar to a ring main system however it includes additional cross and longitudinal connections.

Pros

- Highly suited to large facilities
- Does not require excessively large pipe diameters
- Allows for sections of the distribution network to be shut-down as required

Cons

- The most complex network to install

The most energy efficient compressed air distribution network will be the one where all points of use are supplied with adequate levels of compressed air at the pressure required.

If the pressure drops, the efficiency of the compressed air system will be reduced. Equally if the pressure is too high, the energy consumption of the compressed air system will increase as will the chances of air leaks.

There are subsequently a number of factors which should be considered when designing a compressed air network;

- what distance must the air be transported and can this be reduced?
- what length and diameter of piping is required? Higher pressure drops are usually indicative of longer pipes or those with a smaller diameter.
- Can friction be kept to a minimum? Friction creates pressure drops. Consider increasing the pipe size and remove all avoidable valves and elbows.

**Planning the compressed air system installation**

For optimum reliability and efficiency there are a number of factors that should be considered when planning a compressed air system installation.



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1. Climate
   It is advisable to maintain a moderate temperature in the compressor house.

   Sub-zero temperatures can lead to the creation and distribution of moist compressed air. This will not only lead to poor air quality at point of use, but if a frost occurs, the condensation in the airline would freeze leading to a complete shut-down of the compressor station.
   The performance of lubricants within the compressed air system will also be affected if the temperature falls below +5°C, leading to system failures.

   Equally letting the compressor room get too hot can be problematic, particularly during the warmer months when 100% of the electrical energy that is used to power the compressor is converted into heat. It is important in this situation to take measures to safeguard the compressor house from exceeding the ambient temperature. Failing to do so may lead to electrical components and motors overheating as well as the compressed air dryers overloading. The result is similar – poor air quality at point of use due to the build-up of condensation.

   Inadequate ventilation in a compressor house can also lead to an accumulation of heat which would cause the compressed air system to shut-down.

2. Accessibility
   In designing the installation of a compressed air system it is worth bearing in mind how accessible all service areas of the equipment will be to ensure ease of maintenance.

3. Cleanliness
   It is important to protect compressed air equipment from dust exposure.

   The compressor intake filters will clog up if dust exposure is not limited. This will reduce compressor performance as well as increase maintenance requirements.
   In addition, clogged intake filters can negatively affect air cooling resulting in overheating. And, overheating can lead to costly downtimes where condensate accumulates and decreases the power of the compressed air dryer. Ultimately this will degrade air quality. A bag filter which cleans the intake air may be the solution for those applications where dust exposure is unavoidable.



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