The Two Minute Solutionizer

Storage part 1 - Backing up a base failure

One of the most undervalued components of the compressed air system is storage. A receiver that stores compressed air is like a capacitor in an electrical system, or a dam that will store water. The volume of storage impacts the rate of change in the system. The more storage or capacitance, the slower the rate of change in the compressed air system.

Storage plays an essential role in a compressed air system and will have a big impact on how efficient the system is. This two-minute Solutionizer will cover the back up of a base compressor failure.

Let us consider an installation that has two 75kW compressors. The intention is to operate one compressor as lead and the second compressor as lag or back-up. Compressed air is critical to the operation of the plant and loss of compressed air would result in plant shutdown and loss in productivity. As a Solutionizer you would probe the customer to determine how critical compressed air is to the plant and the cost of loss in productivity. The stand-by compressor would normally be stopped in auto-restart and would start as a result of falling pressure or a control signal.

Depending on the manufacturer, the size and the type of compressor there are several functions involved to enable the compressor to start and make pressure. Only the Nirvana can provide relatively instant pressure into the system as the Nirvana stops pressurised when it stops in auto-restart. This is not the case with conventional fixed speed or even competitors variable speed compressors. To start up a compressor from idle could take between 15 and 20 seconds. Once the compressor receives the load signal the compressor needs to go through the star/delta starting sequence. The compressor loads when the delta contact is energised. Internal pressure needs to build up before the minimum pressure valve opens. The amount of time in which this process occurs depends upon the star/delta time, size of the separator vessel within the compressor itself, plus the pressure drop in the system. Some manufacturers have ‘cold start permissive’, which do not allow the compressor to load until the oil is at a certain injection temperature. The duration of the start up time must be determined prior to selecting the correct receiver.

The largest base load compressor in our case is 75kW, 12.9 m^3/min (456-cfm), this represents 215 litres/second (7.6 cf/s). You must multiply the total time in seconds required to start the back up compressor to full load to determine the volume removed from the system whilst the back up compressor starts. If the start time is 18 seconds then the air lost is 18 seconds x 215 l/s = 3870 litres (18 sec x 7.6 cf/s = 136.8 cf). You must now determine the amount of control storage required to limit how much the pressure will drop before the back up compressor will match the lost capacity. Remember that the cold start permissive time begins from the load pressure of the back up compressor.

Use the following formula to determine the control storage capacity:

$$\text{Lost volume (litres)} \times \frac{\text{atmospheric pressure (bara)}}{\text{Allowable pressure drop (barg)}} = \text{control storage (litres)}$$

Example:

$$3870 \text{ litres} \times \frac{1.013}{0.5} = 7840.61 \text{ litres}$$

If you already have existing control storage, you must subtract this from the total existing storage amount to determine the volume required to handle the auto restart following failure of the base compressor, without production noticing the event. The key wording here is 'without the production noticing'.

Increasing the allowable pressure drop reduces the amount of storage needed. For example:

$$3870 \text{ litres} \times \frac{1.013}{0.7} = 5600 \text{ litres}$$

However, increasing the pressure results in a greater power requirement, and without an Intelliflow valve the higher pressure will result in increased air leaks and artificial demand.

If what you do today is the same as what you did yesterday and the day before the results will be the same. Don't resist change!

Next: Storage and compressor efficiency.