

***Advanced Management of
Compressed Air Systems
Pre-Workshop Assignment***

Pre-Workshop Assignment

In order to ensure that the Compressed Air Challenge Level II Training is most useful to you, it will be important for you to bring information about your plant's compressed air system to the workshop.

Please complete the five enclosed worksheets:

1. **Compressed Air System Block Diagram**, which asks you to draw a block diagram of your plant's compressed air system.
2. **Critical Pressure Applications**, which asks you to make simple line diagrams of two critical pressure applications in your plant.
3. **Pressure Measurements**, which asks you to measure pressure levels and fluctuations at various points in your plant.
4. **End-Use Requirements**, which asks you to look at the end-uses in your plant and identify their requirements.
5. **Getting Approval**, which inquires about experiences in getting approval to implement compressed air system improvements.

A compressed air systems terminology refresher has also been included. These terms will be used during the workshop. The better you understand them, the easier it will be for you to participate in the workshop exercises. A Handout to help you take the pressure measurements required by worksheet #3 has also been included.

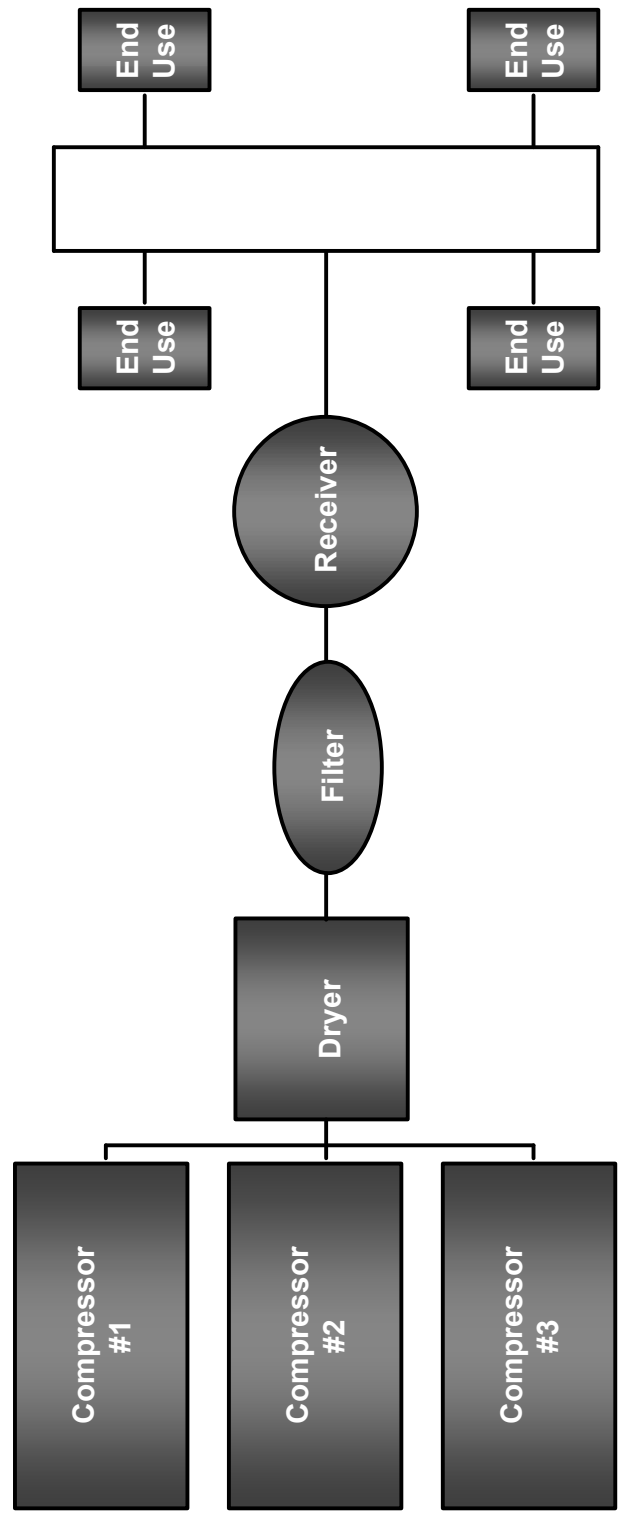
We will use all of this information during the workshop, so please be sure to bring the five completed worksheets to the workshop.

You will also need to bring a calculator.

Thank you.

Note: If your organization does not have a facility with a compressed air system, please try and complete the worksheets with data on another facility (e.g., if you are a compressed air system distributor, bring data on one of your customer's facilities).

Sample Block Diagram

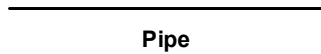
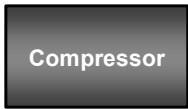


Compressed Air System Block Diagram

Directions: Please (1) review the Sample Block Diagram, and then (2) complete a block diagram of your plant's compressed air system using the shapes shown below. You may need to use a larger sheet of paper.

Name: _____ Date: _____

Plant: _____



Your System

Critical Pressure Applications

Directions: Make simple line drawings of two critical pressure applications in your plant. Critical pressure means applications that require a higher-than-typical pressure to operate. They may also be applications where operators are experiencing problems because of low pressure.

Pressure Measurements

Directions: Using a calibrated gauge or transducer, measure pressure fluctuations and record highs and lows. (Use data loggers for simultaneous readings, if available). Take pressure readings:

- 1. At the compressor discharge,*
- 2. After each dryer and filter,*
- 3. After the discharge from the air receiver,*
- 4. At the end of the header, and*
- 5. Before and after the FRL on end-uses requiring the highest pressure.*

Refer to the included Handout for information on pressure measurement tools and techniques.

Getting Approval

Directions: Answer the following questions in writing.

1. *Have you ever tried to get approval to implement an idea to improve your compressed air system?*

2. *How did you present it?*

3. *To whom?*

4. *What happened?*

5. *If management did not approve the project, what reasons did they provide for this decision?*

6. *What could you have done that might have resulted in positive outcome?*

Compressed Air System Terminology

The following terms will be used in the workshop. The better you understand them, the easier it will be for you to participate in the workshop exercises.

Absorption - The chemical process by which a hygroscopic desiccant, having a high affinity with water, melts and becomes a liquid by absorbing the condensed moisture. Deliquescent dryers rely on deliquescent chemicals to absorb moisture.

Adsorption - The process by which a desiccant with a highly porous surface attracts and removes the moisture from compressed air. The desiccant is capable of being regenerated. Desiccant dryers use desiccant substances to adsorb moisture.

Capacity - The amount of air flow delivered under specific conditions, usually expressed in cubic feet per minute (cfm).

Capacity, Actual - The actual volume flow rate of air or gas compressed and delivered from a compressor running at its rated operating conditions of speed, pressure, and temperature. Actual capacity is generally expressed in actual cubic feet per minute (acfm) at conditions prevailing at the compressor inlet. Also called Free Air Delivered (FAD).

Rated Capacity - Volume rate of air flow at rated pressure at a specific point.

Required Capacity - Cubic feet per minute (cfm) of air required at the inlet to the distribution system.

Cubic Feet Per Minute (cfm) - Volumetric air flow rate.

Cfm, Free Air (or Free Air Delivered {FAD}) - Cfm of air delivered to a certain point at a certain condition, converted back to ambient conditions. This term sometimes is used for the capacity of an air compressor. This is the same as acfm, being the delivered flow rate measured at prevailing ambient conditions.

Actual Cfm (acfm) - Flow rate of air at a certain point at a certain condition at that point. When used for the capacity of an air compressor, it is the delivered rate of flow, measured at prevailing ambient conditions of pressure, temperature and relative humidity.

Inlet Cfm - Cfm flowing through the compressor inlet filter or inlet valve under rated conditions. Also used to describe the rate of flow of a centrifugal type air compressor. Acfm and icfm should be the same for positive displacement type air compressors, but may not be the same in some designs of centrifugal air compressors. There may be air losses through shaft seals of each stage, so that the delivered rate of flow in acfm may be up to 5% less than the icfm entering the compressor.

Standard Cfm - Flow of free air measured and converted to a standard set of reference conditions. There may be confusion with this term since all standards are not the same. The Compressed Air Challenge and The Compressed Air & Gas Institute have adopted the International Standards Organization (ISO) definition of standard air as: 14.5 psia (1 bar); 68EF (20 C); dry (0% relative humidity).

Other standards include:

14.7 psia; 68EF; 36% relative humidity and 14.7 psia; 60EF; dry.

When the term scfm is used, the applicable standard should be stated.

Deliquescent - A material that absorbs water vapor from the air. Deliquescent materials cannot be regenerated by heating.

Desiccant - A material having a large proportion of surface pores, capable of attracting and removing water vapor from the air by adsorption. Desiccants can be regenerated with heat and/or compressed air.

Demand - Flow of air at specific conditions required at a point or by the overall facility.

Humidity, Relative - The relative humidity of a gas (or air) vapor mixture is the ratio of the partial pressure of the vapor to the vapor saturation pressure at the dry bulb temperature of the mixture.

Dew Point - The temperature at which moisture in the air will begin to condense if the air is cooled at constant pressure. At this point the relative humidity is 100%.

Pressure Dew Point - For a given pressure, the temperature at which water will begin to condense out of air.

Specific Humidity - The weight of water vapor in an air-vapor mixture per pound of dry air.

Power – The rate at which work is done.

Brake Horsepower (bhp) - Horsepower delivered to the output shaft of a motor or engine, or the horsepower required at the compressor shaft to perform work.

Load Factor - Ratio of average compressor load to the maximum rated compressor load over a given period of time.

Full-Load - Air compressor operation at full speed with a fully open inlet and discharge delivering maximum air flow.

Specific Power - A measure of air compressor efficiency, usually in the form of bhp/100 acfm.

Total Package Input Power - The total electrical power input to a compressor, including drive motor, cooling fan, motors, controls, etc.

Pressure - Force per unit area, measured in pounds per square inch (psi).

Gauge Pressure - The pressure determined by most instruments and gauges, usually expressed in psig. Barometric pressure must be considered to obtain true or absolute pressure.

Pressure Drop - Loss of pressure in a compressed air system or component due to friction or restriction.

Pressure Range - Difference between minimum and maximum pressures for an air compressor. Also called cut in-cut out or load-no load pressure range.

Rated Pressure - The operating pressure at which compressor performance is measured.

Receiver - A vessel or tank used for storage of gas under pressure. In a large compressed air system there may be primary and secondary receivers.

Surge - A phenomenon in centrifugal compressors where a reduced flow rate results in a flow reversal and unstable operation.