PNEUMATIC CONTROLS – PREVENTIVE MAINTENANCE
AND TROUBLESHOOTING
Johnson Controls, Inc.

INTRODUCTION
A pneumatic control system is more sophisticated and complex than many electrical control systems. To properly maintain and service a pneumatic control, it is important for the service technician to be familiar with all aspects of the system, from basics to the adjustment of the individual components.

This chapter covers maintenance, components, and adjusting instructions for a typical pneumatic control system.

MAINTENANCE
Preventive maintenance is required to ensure optimum system operation. Although the components of all control systems are of the highest quality available and should give many years of excellent service, it is essential that the following routine preventive maintenance procedures be followed.

INSTRUMENT AIR SYSTEM

AIR COMPRESSOR

Intake Air Filter
The air filter cartridge should be cleaned or replaced every 30 to 90 days, depending on the cleanliness of air entering the system. A greater frequency of cleaning and replacement may be required if an excessive amount of dust and dirt is present. A compressor may pump oil if the air intake filter is dirty. An air filter is shown in Figure 1.

OIL FILTER
The coalescent in-line oil filter shown in Figure 2 has an integral gage, which indicates pressure drop across the filter. A filter should be changed when the pressure drop across it is 20 psi, or output pressure drops to 50 psig, whichever occurs first.
**Oil Filter and Gage**

An automatic drain in the bottom of the filter has a float valve that raises when entrapped liquids reach a certain level. Liquids are then blown out the bottom of the drain. The automatic drain should be cleaned, whenever the filter cartridge is replaced, with a household detergent or a specific solvent made for this purpose. DO NOT use any solvents that may be harmful to polycarbonates.

**CAUTION:**

After cleaning or replacing a filter cartridge, air pressure should be returned gradually to the system. A high surge of air pressure can destroy the cartridge.

**BELT ADJUSTMENT**

Belt tension should be checked every 30 days. The belt should deflect approximately 1/4" with normal hand pressure. If the deflection is greater than nominal, the motor should be moved accordingly to adjust the tension. Be sure to keep the pulley sheaves aligned.

**OIL LEVEL**

Oil level must be checked at least once a week and changed every 90 days or 500 operating hours, whichever comes first. Contact the local manufacturer's branch for type of oil recommended.

**OIL PRESSURE**

Oil pressure on 1-hp compressors and larger should be maintained in the 7 to 15 psig range. Check for dirty lines or faulty pump if pressure is abnormal. On compressors smaller than 1 hp, check oil level only.

**MOISTURE IN AIR TANKS**

Moisture must be drained from air tanks weekly. When the outside air is cold and dry, there will be very little moisture. When it is hot and humid, water will collect very rapidly. Do not try to outguess the weather; check regularly.
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AIR DRYERS

Refrigerated Air Dryer
The refrigerated air dryer's automatic moisture removal trap must be checked regularly for float operation, and must be cleaned when a buildup of contaminants is noticed. The condenser is factory adjusted and sealed and should not be tampered with. The condenser coil should be cleaned with a vacuum cleaner twice a year.

DESICCANT DRYER

The desiccant dryer shown in Figure 5 is a maintenance-free system as long as it receives oil-free air. If the desiccant becomes oil contaminated to the point where it is not drying the air sufficiently, (when two-thirds of the indicator turns pink) the desiccant chamber must be replaced.

OUTPUT PRESSURE
Check reducing valve output pressure daily. Refer to your control drawing for pressures recommended.
Pressures should be maintained within ±½ psig at the output of the pressure-reducing assembly(s). The pressures in Figure 6 are standard.
COMPRESSOR RUN TIME

The size of the air compressor station has been selected to provide the necessary supply of compressed air for each control system. Periodically check the running time of the compressor under various operating conditions. Compressor running times above 60% are excessive. This can result from either air leaks in the system or inefficient air compressor operation. It is essential to find the cause of excessive air consumption and correct the problem, since the increased running time can do damage to the air compressor and also result in carry-over of moisture and oil to filters.

AIR SUPPLY SYSTEM EXPANSION

Before the control system is expanded to include additional pneumatic devices, the existing air supply system should be checked for sufficient capacity.

PNEUMATIC ACTUATORS

Actuators can give years of trouble-free service. The actuator diaphragm is generally the only part that ever needs replacement. When a valve or damper actuator will not stroke, check for a sticking valve stem or for a binding damper linkage. Another possibility for an actuator not operating is an air leak in the air line between the controller and actuator. A simple method of determining if there is such an air leak is to listen for air passing out of the controller at a high rate. (This condition will exist only if the controller is asking for a change in position.)
VALVES

Visually check control valves periodically for leaks and sticking stems. Loss of a valve's ability to close tightly will suggest inspection of valve seats and discs for wear and contaminant buildup. Valve disassembly and repair may require special tools. Contact your local manufacturer's representative for specific recommendations and instructions.

DAMPERS

Automatic control dampers must be checked periodically for tight closure, bent blades, and defective linkage. The damper shown in Figure 9 has oil-impregnated bearings that do not require lubrication, however, the linkage to the damper should be lubricated periodically to assure smooth operation. Frequency of lubrication will be determined by environment.

CONTROLLERS

Controllers of the type shown in Figure 10 are basically maintenance-free as long as they receive clean, dry air and are not abused. If the controller is contaminated with oil, the air supply system must be checked for proper operation and oil should be eliminated from pneumatic lines before the controller is serviced or replaced. Contact your local manufacturer's rep if it is determined that oil is present in the control air supply system.
HVAC SYSTEM

A control system cannot maintain proper conditions within a building unless the heating, ventilating, and air conditioning system is functioning as designed. It is therefore essential that the maintenance recommended by the manufacturer of such equipment be performed. By the same token, a control system cannot function properly if maintenance is not performed on it. In consideration of this requirement, a sample list of recommended maintenance tasks is offered below. It shows the major tasks considered essential for the continued efficient operation of a control system.

MAINTENANCE CHECKLIST

1. Air Compressor
   a. drain moisture from tank
   b. check air pressure switch settings
   c. check running time
   d. check oil pressure
   e. check oil level, fill
   f. change oil
   g. check pulley tightness, belt tension
   h. check belt condition, change as required
   i. check operation of check valve
   j. change or clean suction filter
2. Filter and Pressure Reduction
   a. check reducing valve pressure settings
   b. operate safety valve
   c. check oil filter cartridge, clean
   d. check automatic trap operation
   e. clean traps
   f. replace air filter element

3. Refrigerated Air Dryer
   a. check automatic traps, clean
   b. clean condenser tubes
   c. clean cover grills

4. HVAC and Fan System Controls
   a. review cycle and sequence of operation
   b. check controllers for calibration
   c. check operation of panel devices
   d. clean control panel
   e. check damper operation
   f. clean and lubricate damper linkage
   g. check operation sequence of damper actuators
   h. check operating range of pilots
   i. check operation and sequence of valves
   j. check operation of safety limits and minimum positioning devices
   k. clean all instruments, covers, gages, etc.

5. Room and Zone Controls
   a. check operation and calibration of controllers
   b. check operation and sequence of unit valves and/or dampers
   c. clean all instruments, gages, etc.
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TRANSMITTERS

Sensitivity

Never attempt to adjust the sensitivity. It is set at the factory and cannot be reset without the proper equipment. If the red seal between the fixed sensitivity slider and the slider plate is broken, the warranty is voided.

Troubleshooting

If the transmission or indication system appears to be operating improperly, check the following before changing the starting point of the transmitter.

1. Check for 20 psig supply air.
2. Check for matching operating ranges of transmitter and indicators.
3. Check indicator gages for accuracy at various pressures, such as 6, 9, and 12 psig, with a separate input and gage.
4. Check for transmission line problems. This can be done by placing an accurate indicating device and the transmitter measuring element side-by-side and comparing the reading of the indicating device to the reading at the other end of the transmission line. If the reading at the end of the transmission line is lower than that of the indicating device, check for a leak in the transmission line, or a plugged or partially plugged restrictor (.007 in.).

Adjusting

If the above checks have been made and the transmitter is still in error, proceed as follows:

1. Take an accurate reading at the element.
2. From the graphs (Figure 18), find the proper transmission pressure corresponding to the measured reading. Be sure to use the vertical scale of Operating Ranges, which corresponds to the range of the instrument being adjusted.
3. Turn the starting point adjusting screw until the transmission pressure corresponds to the reading at the element.

LOW LIMIT PROTECTION

The importance of taking every precaution against freeze-up of equipment cannot be over-emphasized. Regardless of the automatic low-limit devices furnished, the following procedures should generally be followed when there is any indication that the outside temperature will drop to the predetermined low-limit setting.

PUMPS

All hot water pumps and/or condensate or vacuum pumps should be operational.
BOILERS

Boilers and or converters should be allowed to cycle on a demand basis.

SUPPLY AND EXHAUST FANS

Supply fans should be allowed to operate on their normal occupied or unoccupied cycles. When on the unoccupied cycle, the outside air and exhaust dampers should be closed and the return air damper open.

LOW-LIMIT THERMOSTAT OPERATION

The low temperature limit protection device, located at the heating coil discharge, senses the lowest temperature along any portion of its sensing element. When one foot or more of any portion of the element senses a temperature as low as the thermostat set point, the instrument will open the circuit. Since the thermostat responds to a "spot" type condition, it is essential that stratification of air in the mixing chamber entering the coil be eliminated, if proper operation is to be expected.

Where repeated shut-downs occur as a result of this condition, a greater tendency exists for the operating personnel to override or bypass the low-limit protection device in order to keep the unit running. This is a dangerous practice and should be avoided. Further investigation as to the cause of shut-down should take place to determine the cause of the problem, followed by appropriate remedial action.

Low-limit protection devices should be checked prior to the arrival of cold weather. This can be done by turning the dial to a warmer setting until the low-limit protection device operates. The setting should equal the temperature of the entering air or water. Do not forget to turn the device back to the original setting called for on the control diagram.

SPECIAL PRECAUTIONS

In extremely cold weather, the following added precautions should be taken: Before air supply systems are started, check steam traps and steam pressure and/or water temperature at the air supply system. After supply systems are started, check operation of the control system thermostats and observe for correct functioning with respect to the temperatures being sensed.

OCCUPANT DISCOMFORT

The first evidence of trouble with the heating, ventilation, or cooling system is very often a complaint from an individual who is too hot, too cold, or is bothered with drafts. Go to the person complaining and personally check the complaint. Experience has shown that in the majority of cases, the problem behind the complaint is not a malfunction of the control system. To assist in determining this, the various factors, other than automatic control, that can create comfort problems are listed:

1. **Zone Control.**
   A person outside of the controlled zone may feel too hot or too cold. A zone control thermostat can only sense the temperature at its particular location. Temperatures in all other areas of the zone are dependent on proper balance of the heating/cooling distribution system.

2. **Sun Load.**
   Direct sunlight on the thermostat will cause overcooling of a zone while direct sunlight on the individual will cause overheating.
3. **Covering of Grills.**

   Frequently, occupants will cover part or all of a discharge grill causing improper heating or cooling. Whenever a grill is covered, the heating or cooling medium is not permitted to enter the space to correct for variances from the setpoint.

4. **Occupant Location.**

   If occupants are located adjacent to outside walls or windows, they may be subject to cold air leakage through the windows and/or radiant cooling from the walls.

5. **Insufficient Conditioned Air Supply.**

   This can be caused by poor air distribution, dirty filters in the air conditioning unit, or lack of proper return or exhaust air outlets.

6. **People and Equipment.**

   Overheating will result if more people or equipment occupy an area than was intended in the original design concept. This can occur when a meeting is held in an area not designed for this type of function.

7. **Heating and Cooling System.**

   A malfunction, or lack of capacity in extreme weather, of the primary or secondary mechanical heating or cooling equipment may result in insufficient heating or cooling.

8. **Psychological Adjustment.**

   Many complaints are purely psychological. Once a person understands the limitations of an HVAC system, he is more likely to accept prevailing conditions.

9. **Drafts.**

   In systems using air as a means of heating and cooling, there must be movement of air. To many people, even a slight air motion is uncomfortable. This can be a problem when an unbalanced system causes excessive drafts. Minor problems can sometimes be solved by relocation of work stations; however, it is always best to have a balanced system, i.e., proper size, spacing, and functioning of air distribution equipment (fans, diffusers, grills, registers, etc.).

10. **Wide Fluctuation of Air Temperature.**

    Wide fluctuation of air temperature in an area can be the result of varying load conditions or improperly adjusted controls.

11. **Stuffiness.**

    A stuffy or smoky atmosphere will normally result from improper ventilation, i.e., insufficient fresh air supply, air too humid, over population, or inadequate exhaust.
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TROUBLESHOOTING: DIAGNOSING THE PROBLEM

HVAC EQUIPMENT

Depending on whether the area is too cold or too warm, and the time of year, check the heating, ventilating, and air conditioning equipment. This can include any or all of the following:

1. Air Compressor and Pressure Reducing Station.
2. Boiler.
3. Refrigeration Compressor and/or Chilled Water System.
4. Pumps.

AUTOMATIC CONTROLS

If all the HVAC equipment checks out properly, the automatic control system should be checked as follows: (This analysis is based on a complaint resulting from improper temperatures.)

CONTROLLER

Check the set point of the controller for the correct setting. Check the output air pressure of the instrument controlling the temperature in the complaint area. By examining the control diagram, the proper output pressure for the actual temperature conditions existing at the thermostat can be determined. If, for example, an overheated condition occurs, the thermostat output pressure should be calling for the source of heating to be shut "OFF" and the source of cooling to be "ON". If this is the case, it is not the thermostat causing the problem. If thermostat output pressure is not as described above, the problem may be with the thermostat. Check the air supply pressure to thermostats for correct pressure level and for any air leaks. If the above are OK, move the dial of the thermostat slowly from one extreme to the other to see if the output pressure will vary over the entire range of supply pressure. If the pressure does vary, then it is probable that the thermostat is only out of adjustment and should be readjusted to the correct temperature setting.

If there is no change in output pressure by moving the dial, there is a malfunction in the thermostat. If only a partial change in pressure results, it can be the result of either:

1. malfunction in the thermostat
2. leak in the control pressure line
3. leak in equipment being controlled

CONTROLLED DEVICES

Check the automatic valve, damper actuator, etc., to see if they are in the proper position as called for by the thermostat. If they are not, this may be the source of trouble.