DESIGN OF CONTROL SYSTEMS FOR HVAC APPLICATIONS

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ABSTRACT

The design and application of temperature control systems on a commercial building will bring the question to mind; Should the system be Pneumatic? Should it be Electronic? There is concern as to which system will be more appropriate to a certain project. With cost, maintenance, performance, dependability, and the cost of energy as a main concern of owners, the temperature control system has become an important part of efficient utilization of energy. Application of temperature control systems to heating, ventilating, and air conditioning systems has become an integral part of energy management. The first phase of the program will address the problem of selection of a type of system that will be cost and energy efficient, with a minimum maintenance program.

One area to be covered will be the technician and his ability to service the temperature control systems, in addition to information on the schools and technical training. The availability of trained and experienced service technicians creates a major problem for remote towns and communities.

Control systems are integrated to energy managment systems. Without proper maintenance the energy savings will not perform at their design level.

A sub-topic on up-to-date temperature control systems with retrofit needs will be included in the presentation.

The most important component of a pneumatic system is the compressed air supply system. The air compressor should be a standard brand name compressor, installed in a duplex system to provide a back-up system. A refrigerated air dryer is required to rid the system of moisture and oil. Also, an oil filter is required to prevent oil from entering the system from the lubrication of the air compressor. A moisture trap on the air compressor will automatically drain the condensate in the compressor tank. Most control manufacturers will provide information on air supply systems. Air pressure will vary from 15# to 25# depending on the brand and amount of use.

The receiver-controller, electronic or pnuematic, is the primary component in a temperature control system. We can use the human and run a biological analysis of temperature control. First we go back to the wood burning stove. We can feel the temperature with nerve ends on our skin which we will call a sensor. A signal is transmitted to our brain which we will call a receiver-controller. A decision is made to put wood in the stove, and a signal is sent to our hands and other motor functions which we will call actuators. The three parts of any system are the receiver-controller, the sensor, and the actuator. The receiver-controller is the brain or computer for a central loop. Some of the functions of the receiver-controller are as follows: (1) to reset the controlled temperature by outside air; (2) to reset controlled temperature to a load; (3) to reset a manual over-ride.

A sensor or transmitter is a sensing device that can sense and transmit temperature, humidity, and pressure in a pnuematic or electrical signal. A relay can change a signal into some other form of signal or power.

The construction material in a pneumatic control system consists of tubing, copper or polyethane, and support hardware such as hangers and clips.

In most electronic control systems the voltage is stepped down by a transformer or power supply to 24VAC or 20VDC. Electronic control systems using DC current should have a regulated power supply. Electronic receiver-controllers can have the same function as a pneumatic system. The electronic control system has made great progress with the advance of the electronic industry.

There is concern as to which system, pneumatic or electronic, will be more appropriate to a certain project. Unit cost, maintenance, performance, dependablility, and the cost of energy are main concerns of owners, and the temperature control system has become an important part of energy management. Cost is the major factor in the design of temperature control systems.

After a HVAC system has been applied to a project, the task of designing a control system for the HVAC system will begin. A list of questions are as follows: Does the system need modulating control? Will the system have a vent cycle or enthalpy control? What type of cooling, DX or chilled water? What form or heat transformer? What type of time control? These questions will be answered by the amount of money the owner is willing to spend. To keep the cost down and determine a type of system, the number of actuators (damper motors/valve motors) will project the cost advantage of electronic over pnuematic or conversely. Based on the price list of two out of five loading control companies, the "break even" point between electronic or pneumatic is twelve valve actuators. With thirteen valves of the modulating type, the control system will cost less using pnuematic. The other three control companies range from fifteen to twenty-six actuators.

This pricing is based on the cost of material only, with the price of an air compressor, dryer, and PRV being equal to the cost on electronic valve

actuator compared with the cost on pnuematic actuators. If a vent cycle or enthalpy with mixed air damper was designed for twelve units, the savings could be greater. The cost of installing poly tubing is somewhat less than conduit and wiring. The cost of installing copper tubing and the cost of wiring are about the same.

The ability of construction installers and service technicians in the temperature control industry needs to be improved. One reason is that most electronic technicians that have the ability to work on electronic control equipment, do not have the ability to be an air condition service technician, and most air condition service technicians lack the electronic skills. Pneumatic control systems also have the same deficiency pertaining to technical skills. As the control system becomes more advanced in design, the complexity increases. In most areas, the service technicians are not keeping up with the change in technology. The serviceman of the old school in air conditioning and heating is having a hard time with the new control systems.

Control companies have service and maintenance, but the air conditioning companies are hesitant to call on control for assistance because most control companies also do mechanical service. In the end, the owners have systems that are not performing properly.

Large school districts, hospitals, and large commercial complexes perform maintenance in-house. The trend for in-house maintenance is being carried over into temperature control systems. There is a great need for technical training for the in-house technician or maintenance man.

A reluctance for owners to have an energy management system installed is the ability of his in-house maintenance mechanic. The statement that is heard most often is "Make it simple". Being simple or complex is not the answer, but saving money in the form of energy and man hours should be one of the main functions of a control system. In the past the order of priorities of a control system was as follows: 1) comfort, 2) man hours, 3) energy, but the priority for today is 1) energy, 2) man hours, 3) comfort.

The advantages and disadvantages of a pnuematic control system pertaining to maintenance are noted. The advantages of maintaining a pneumatic system compared to an electric system are as follows:

1. Repair of parts cost less.
2. Change outs of actuators.
3. Trouble shooting.
4. Relocating components.

The main disadvantage of a pneumatic system is the maintenance of the compressed air system. The designer of a control system should always consult with the owner before selecting a type of system. In most cases the owner has a preference. New construction or a new system should be designed to the ability and technical training of the owner or its representative if possible, over designed systems with component controlling components will cause problems in the calibration of the system.

In my opinion, and observations of maintenance of temperature control systems, I would like to address the service and calibration of control systems. Control systems may be complex to the "run of the mill" maintenance man. Training of the service technician is one of the ojects that is a great concern to the owner. With service charges, out of town expenses, and travel time, the cost of temperature control may seem excessive. One of the best ways to reduce cost is to train the in-house service technicians.

The best type of training is the hands-on in the service man's own plant. This type of training may cost more and will be harder to control. The advantages are as follows:

1. Hands-on training on his equipment.
2. Training on control systems that are existing in his plant.
3. Failure of equipment that is common to his environment.

Classroom technical training or schools that are put on by the major control companies are the next best. To attend the company school, the owner should contact the manufacturer and apply for the next training session.

Service of electronic temperature control systems is separate and remote from air conditioning service on large systems. With computers and microprocessors controlling the temperature control systems, the serviceman will need to be basically a computer-electronic technician with a knowledge of HVAC systems. At this time, there is a shortage of this type of technician . The service of most electronic systems has become a change out system with little field repair. It seems to be easier for the owner and the temperature control company to have a change out because of the technical knowledge that is required for field repair. Also, most parts for control components are not a shelf item at the local electronic house. The replacement part cost compared to other electronic parts is higher because of the limited availability. Components of most instruments are not available because of the Unit Replacement Policy of the control companies.

In my observations of electronic control maintenance, I would like to address the upkeep and calibration of this type of system. I will not name the buildings or owners. A large school system that has four school campuses has an electronic temperature control system. In one school all of the temperature controls are disconnected and the roof top Multi-zone units are controlled by a toggle switch where the room zone thermostat once was. The units run 24 hours a day-7 days a week, if the units are not out on high-head or low pressure cut out. An ice-cream stick holds the compressor condenser fan relays in place. In another building, the hot deck on a double duct high pressure mixing box runs wild because the electronic hot water valve actuator has been disconnected. This type of situation is typical of the maintenance and calibration of electronic control systems when in-house maintenance is performed. In my area of service, about 75 percent of all control systems that use in-house maintenance are in bad shape.

Pneumatic control systems seem to fare better because of their familiarity in this region. About 50 percent of the pneumatic control systems are maintained to some degree of specification design.