Refrigeration & Air Conditioning Technology
SIXTH EDITION

SECTION 3

BASIC AUTOMATIC CONTROLS

UNIT 14

Automatic Control Components and Applications

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UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Discuss space temperature control.
- Describe the mercury control bulb.
- Describe system overshoot and temperature swing.
- Describe the difference between low- and high-voltage controls.
- Name components of low- and high-voltage controls.
- Name two ways motors are protected from high temperature.

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UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Describe the difference between a diaphragm and a bellows control.
- State the uses of pressure-sensitive controls.
- Describe a high-pressure control.
- Describe a low-pressure control.
- Discuss the range and differential of a control.

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UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Describe pressure transducers.
- Describe a pressure relief valve.
- Describe the functions of mechanical and electromechanical controls.

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TEMPERATURE CONTROLS

- Cooling thermostats close on a rise in temperature
- Heating thermostats close on a temperature drop
- Can be used to protect motors from overheating
- Low voltage controls can protect high voltage devices
- Low voltage controls are smaller and switch electrical contacts faster then high voltage controls
- Residential systems often have low voltage controls

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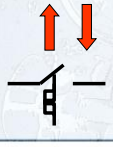
THE HEATING THERMOSTAT

CLOSES ON A DROP IN TEMPERATURE

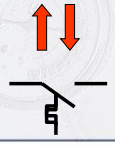
OPENS ON A RISE IN TEMPERATURE



THE COOLING THERMOSTAT

CLOSES ON A RISE IN TEMPERATURE

OPENS ON A DROP IN TEMPERATURE



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SPACE TEMPERATURE CONTROLS, LOW VOLTAGE

- Carry only small amounts of electric current
- Can use mercury or silver coated contacts
- Heat anticipator -used to reduce system overshoot
- Cold anticipator – anticipates system lag
- Temperature swing = System overshoot – Lag
- Thermostat subbase – provides mounting base for thermostat and means to make electrical connections

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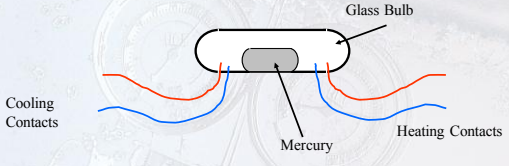
In the cooling mode, the cooling contacts are closed and the heating contacts are open



In the heating mode, the heating contacts are closed and the cooling contacts are open

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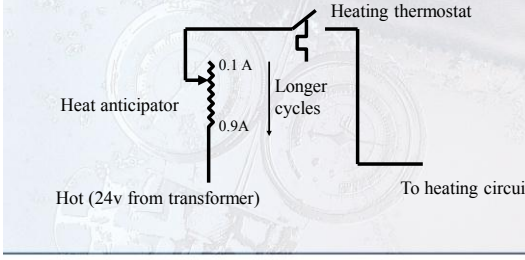
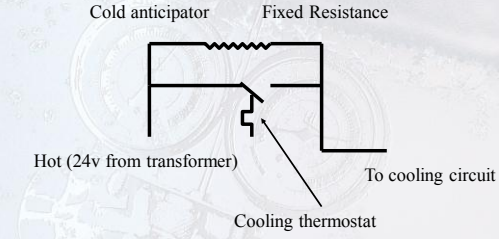
THE HEAT ANTICIPATOR



THE COLD ANTICIPATOR



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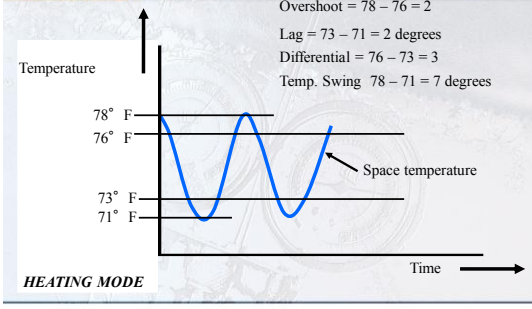

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SPACE TEMPERATURE CONTROLS, HIGH (LINE) VOLTAGE

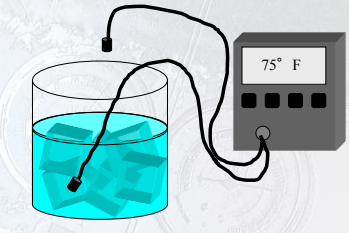
- Commonly found on self-contained equipment such as window air conditioners or refrigerators
- Heavy duty devices
- Not as sensitive as low-voltage controls
- Use bimetal, bellows or liquid-filled remote bulbs
- Often use mercury bulb or silver coated contacts
- Secured cover to prevent tampering

SENSING THE TEMPERATURE OF SOLIDS

- Sensing element is insulated for accuracy
- Sensing bulb should be secured to the solid
- Motor protection is accomplished with a thermistor or bimetal strip
- Thermistors are often embedded in the motor windings

SENSING THE TEMPERATURE OF FLUIDS

- Fluids include liquids and vapors
- Temperature measurement is often made by immersion
- Bulb can be insulated for accurate measurements
- On larger systems and piping arrangements, thermometers can be mounted in wells
- To measure air temperature, the thermometer probe can be placed directly in the air stream



The probe of the thermometer should be submerged in the liquid if possible

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PRESSURE-SENSING DEVICES

- Measure and/or control the pressure of refrigerants, air, gas, water and other fluids
- Often used to control electrical switching devices
- Can either open or close on a rise in pressure
- Can be used to sense a pressure differential
- Can be used as operational or safety devices
- Differential = Cut in pressure – Cut out pressure
- Some controls are adjustable, while others are not

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ELECTRONIC PRESSURE CONTROLS

- Contain small microprocessors and use pressure transducers
- Transducers convert the sensed pressure to an electronic signal
- Signal is processed by the microprocessor
- The processor then adjusts system operation according to the pressure-generated signals
- System changes may involve compressor or condenser fan motor cycling

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HIGH PRESSURE CONTROLS

- Normally closed device that opens on a rise in pressure
- Device is connected to the high pressure side of the system
- Used to disable a compressor if the head pressure exceeds safe limits
- Can be an automatic or manual reset device
- Can be factory set or field adjusted

LOW PRESSURE CONTROLS

- Normally closed device that opens on a drop in pressure
- Connected to the low pressure side of the system
- Can be used for temperature control or for low charge protection
- Usually an automatic reset device
- Can be automatic or manual reset devices

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The High Pressure Switch	The Low Pressure Switch
Closes on a drop in pressure	Closes on a rise in pressure
Opens on a rise in pressure	Opens on a drop in pressure

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OIL PRESSURE SAFETY CONTROLS

- Operates on a differential in pressure
- Net Oil Pressure = Oil pump pressure – Suction pressure
- Ensure that compressors operate with sufficient oil pressure
- Most compressors need at least 30 psig to operate correctly
- The control has a built in time delay
- The cutout time delay is normally about 90 seconds
- Can be a mechanical or electronic device
- Electronic controls use pressure transducers

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AIR PRESSURE CONTROLS

- Can verify airflow through duct systems
- Can be used to determine pressure differentials
- Can be used as an interlock between the system blower and electric heaters
- Can be used to initiate the defrost cycle on heat pump systems

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WATER PRESSURE REGULATORS

- Controls water pressure to main system components
- Often used on hydronic heating systems and systems using water-cooled condensers
- On hydronic systems, the valve opens on a drop in pressure to add water to the water circuit
- On water-cooled systems, the valve opens on a rise in head pressure to increase water flow through the condenser

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GAS PRESSURE SWITCHES AND REGULATORS

- Gas switches are often used as safety switches
- Gas switches are normally closed devices and will remain closed unless an unsafe condition exists
- Gas switches should never be jumped out
- Gas regulators reduce gas supply pressure to the working burner pressure
- Gas regulators can be adjusted

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MECHANICAL AND ELECTROMECHANICAL CONTROLS

- Mechanical controls operate independently from other controls
- A water-regulating valve is a mechanical control
- Electromechanical controls convert mechanical movement into some electrical activity
- A sail switch is an example of an electromechanical control

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MECHANICAL CONTROL MAINTENANCE

- Water regulating valves should be checked for leaks
- Corrosion, wet spots and rust indicate leaks
- Pressure relief valves can be tested by lifting the lever
- Check to make sure that the valve seats properly
- Be careful since the water can be very hot

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ELECTROMECHANICAL CONTROL MAINTENANCE

- Check for water leaks, if applicable
- Check transmission lines for leaks
- Ensure that controls are mounted securely
- Check for frayed or burned wires
- Check for excessive control vibration

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UNIT SUMMARY

- Space temperature is controlled by thermostats
- Thermostats can also be used to protect electrical components
- Heating thermostats close on a drop in temperature
- Cooling thermostats close on a rise in temperature
- Temperature swing = System Overshoot – System Lag
- Pressure controls open and close in response to sensed pressures
- Differential = Cut in pressure – Cut out pressure
- Mechanical controls operate independently of other controls
- Electromechanical controls result in some electrical activity