

thermostat is a refinement frequently added to residential control systems. Though opinions vary regarding the amount of fuel that can be saved by automatic night set-back, tests made both in the warm air heating research residence and the I=B=R research home at the University of Illinois indicate that, on thermostatically controlled systems, a possible fuel saving of from 7 to 10 percent may be obtained by reducing the house temperature 6 to 10 F from about 10:00 p.m. to 5:30 a.m.

It is often desirable to divide the house into two or more zones for greater accuracy of control and comfort. Each zone may then be maintained individually at the desired temperature level. The division into zones should be based upon exposure or occupancy; the most common division is usually found to be (1) the living section such as living room, dining room, den; (2) the sleeping section; (3) the service section such as kitchen, pantry, servants' quarters; and (4) the recreational areas.

Further discussion of zone control will be found in the following section on Zone Control and Zone Control Systems.

Year-round residential air conditioning systems which provide for heating in winter and cooling in summer should be given the same consideration in selecting the control system as required for commercial air conditioning systems. See Chapter 29. The basic principles are the same and the final results must provide for the comfort of the occupants. A reduction in investment for automatic controls may result in wasteful operation of the system and discomfort for the occupants.

Special thermostats have been designed to take care of the year-round residential air conditioning systems. These thermostats offer manual, semi-automatic, and automatic changeover from heating to cooling as selected by the unit manufacturer. Generally speaking, the heating unit is controlled by timed two-position action and the cooling unit by straight two-position action. Some form of humidity control may be added.

When an *add-on* unit is installed to obtain a year-round air conditioning system by change of straight heating system, it may be controlled separately or integrated with the heating control system. However it is accomplished, the control system should be simple enough for the user to understand how to operate it effectively.

ZONE CONTROL

Zone control for any heating, ventilating or air conditioning system is employed where it is desired to control the heating or cooling effect in a number of rooms or areas, having similar orientation or occupancy, through one set of controls. For zone control to be successful the requirements must be approximately consistent throughout the extent of the zone. Whether zoning a building for heating or cooling the following factors should be considered in determining the number and arrangement of the zones:

1. *Exposure.* Solar effect, prevailing winds, and the shelter afforded by surrounding structures affect the heat gain or loss.
2. *Occupancy.* Indoor temperature requirements for the various activities carried on in different portions of the building and the hours of occupancy of the various spaces impose definite control problems.
3. *Building Structure.* The physical characteristics of the building will influence the subdivisions of the system into zones since satisfactory temperature conditions throughout a single zone of given extent may not be enjoyed equally in buildings of dissimilar types of construction. Other factors are the height of the building and its horizontal extent and form.
4. *Floors.* Even though several floors have the same wall exposure, it is advisable

to have separate zones on the lowest and highest floors due to variations of basement or ground floor requirements and those with roof exposure. It is also desirable to have a separate zone or zones for the intermediate floors.

The initial investment will often influence the decision as to the final number of zones to be employed. In larger buildings accepted practice is to have at least one zone for each exposure. Each exposure may require subdivision vertically into two or more zones for the higher structures. Also, the presence of two or more wings having the same general exposure may suggest the desirability of more restrictive zoning. When the street floor or any other portion of the building is used for public occupancy or activities which differ from those carried on in the remainder of the building, it is desirable to provide separate thermostats and controls for each individual area.

Zone controls alone may not provide satisfactory temperature conditions in all rooms or areas within the zone because occupancy, lighting load, space arrangements and similar factors cannot always be predicted with accuracy. A combination of zone controls with individual room control in critical areas may be necessary to achieve complete satisfaction.

ZONE CONTROL SYSTEMS

This section is concerned with zone controls for steam or hot water heating systems.

Most zone control systems are designed to supply heat to a zone at a rate equal to the heat loss. This rate of heat input may be established by room thermostats, by controllers responsive to outdoor conditions, or by a combination of both. The outdoor controller responds to temperature and may respond to solar radiation and wind velocity and direction. Features which may be added to the basic zone control system include:

1. Means for automatically or manually varying the heat input to the zone to compensate for variations in internal heat gain. The automatic arrangement requires a thermostat at a representative location within the zone. The manual arrangement usually consists of a switch located where convenient.
2. Means for maintaining a lowered economy temperature or shutting off the heat completely at night or at other times when the zone is unoccupied. This may be accomplished manually or by means of a clock.
3. An arrangement providing rapid warm-up following a period at the non-occupancy temperature. During this warm-up period full heat may be admitted to the system or the heat input may be controlled at a higher-than-normal rate. The warm-up may be accomplished by a manual switch or may be part of the clock program. A warm-up thermostat located within the zone may be arranged to terminate the warm-up period independently of the switch or clock when the zone approaches the desired occupancy temperature.
4. A manual switch to provide full heat or no heat independently of other controls and to permit manual selection of the various clock functions.
5. Means for shutting off the heat completely when the outdoor temperature reaches a point where heat no longer is needed.
6. A high limit thermostat in the zone to shut off the heat completely when the zone becomes overheated.

Steam Heating Systems

In *continuous-flow steam systems* the quantity of steam supplied to the zone is varied in accordance with the demands of the control system. To obtain equalized distribution of the steam, metering orifices are generally required on the inlets to all radiators or convectors. Supplementary controls for low heat output are often desirable. The following two arrangements are common:

1. Varying the difference in pressure between the supply and return which results