

For electrical heating actual heat losses should be figured accurately because the utility company rates and minimum charge items are commonly based on the size of equipment installed, so that cost of operation might be penalized by rule-of-thumb sizing of the heating equipment.

### POWER PROBLEMS

The first point to determine is the cost of the power which is available for electric heating. Unlike fuels, there is no uniform cost for electric power because of the unequal cost of distribution to large and small users. The fact that electricity cannot be economically stored, but must be used as fast as it is generated, makes it impossible to operate power plants at uniform loads; hence, even the time of use may affect the cost of power.

Homes are almost universally supplied with lighting current of 115 volts, which cannot be used economically for any but the smallest heaters. Usually the service lines will not permit more than plug-in devices. The underwriters permit heaters of 1250 watts to be used from approved baseboard receptacles. Where homes have 230 volt service for cooking and water heating, and rates are favorable, larger heaters can be installed. For industrial purposes, heaters should be designed to use polyphase power, which is usually supplied at 230, 460 or 575 volts. All polyphase heaters should be balanced between phases.

### INSULATION

The value of building construction which incorporates built-in insulation to reduce the outward heat loss in winter and the inward heat gain in summer has been placed in the spotlight by the increasing adoption of complete air conditioning. With electric heating, adequate insulation is very important. Two groups of 16 homes each, in Southern California, are compared in the following actual figures taken from operating records of not less than two years, and in some cases up to eight years.

| ITEM                                       | INSULATED HOMES | UNINSULATED HOMES |
|--------------------------------------------|-----------------|-------------------|
| Average Size of Home: Number of Rooms..... | 8.7             | 8.7               |
| Number of Bathrooms.....                   | 2.6             | 2.3               |
| Average kw Connected Load per Home:        |                 |                   |
| Range.....                                 | 9.6             | 9.3               |
| Water Heater.....                          | 6.3             | 5.9               |
| Heating.....                               | 34.0            | 32.7              |
| Total kw.....                              | 49.9            | 47.9              |
| Annual kwhr for Heat per Home.....         | 4562            | 8223              |
| Annual kwhr per kw Heat Connected.....     | 134             | 252               |

### Cost of Heating

If the consumer obtains heating at 2 cents per kwhr his annual cost of heating an insulated home would be \$91.24, as compared with \$164.46 for heating an uninsulated home. Thus, insulation in the average home creates an annual saving of \$73.22, representing 45 per cent of the annual heating cost if the house is not insulated.

### Cost of Insulation

When the average cost of insulating a home is from \$25.00 to \$50.00 per room, or from \$200.00 to \$400.00 for a home of the size used herein, it is therefore apparent that savings in heating costs will pay for the cost of insulation in from 3 to 6 years. In case the insulation warrants a reduction in connected load, the subsequent reduction in installation cost of heating equipment can be applied against insulating costs which would materially reduce total cost.

### ELECTRIC HEATING DATA

Electric heater capacity is rated in kilowatts (kw). Electric energy is measured in kilowatt-hours (kwhr). Cost of operation = kw rating × hours used × cost per kwhr.

One boiler horsepower (bhp) = 33,471.9 Btu per hour.

One kilowatt-hour (kwhr) = 3,415 Btu.

One boiler horsepower =  $\frac{33,471.9}{3,415} = 9.80$  kwhr.

One boiler horsepower will evaporate 34.5 lb water per hour from and at 212 F.

One kilowatt-hour =  $\frac{34.5}{9.80} = 3.52$  lb of water per hour at 212 F.

Additional conversion factors are given in Chapter 44.

### PROBLEMS IN PRACTICE

#### 1 • Under what conditions are electric heaters most feasible?

- In climates such as in the South and in California, where they are used economically for many heating purposes.
- As auxiliary to central steam or hot water heating plants.
  - Fall and spring.
  - During peak loads.
  - During shut-down periods.
- In factories, offices, etc., where they have a large minimum load charge for electrical power due to large size of connected motors that they cannot use up but must pay for regardless of non-use.

#### 2 • On what basis should electric heating costs be compared to heating with fuels?

- Use.
- Safety.
- Rates.
- Locality.
- Initial investment:
  - Interest.
  - Depreciation.
- Ease of serving electric heaters.
- Ease of control.