E. Qls2

Loss from insulated vertical and top oven surfaces:

$$\frac{32 \text{ sq.ft. x } 8 \text{ w/sq.ft. x } .25 \text{ hrs.}}{1000 \text{ w/kw}} = 0.06\text{kwh}$$

+

Loss from insulated bottom oven surface:

$$\frac{8 \text{ sq.ft. x } 4 \text{ w/sq.ft. x } .25 \text{ hrs.}}{1000 \text{ w/kw}} = 0.01\text{kwh}$$

= **0.07kwh**

F. CF

30% (1.18 + 0.07) = **0.38kwh**

Wattage required for each 15 minute cycle:

1.18 + 0.07 + 0.38 = 1.63kwh

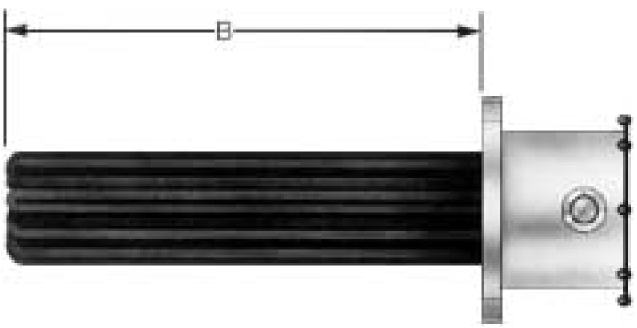
Wattage Required for Process Operation:

$$\frac{1.63 \text{ kw/cycle}}{.25 \text{ hr./cycle}} = \mathbf{6.52kw}$$

As can be seen, a 30% contingency factor was utilized in this process. Additional heat losses will likely occur as the oven doors are frequently opened. As the wattage requirement for the start-up is greater than the operating requirement, 7.75kw will be installed. The extra wattage can be considered an additional safety measure. Either tubular heaters or HD Strip Heaters mounted to the oven wall would be acceptable. A time proportioning ETR Temperature Control with an exposed junction type J thermocouple would provide the proper control.

DETERMINING WATT DENSITY

IMMERSION HEATERS:



$$\text{B dim.} = \frac{\text{EHL}}{\text{\#elements x 2}} + \text{cold area}$$

EHL = (# elements x 2 x B) - (cold area x # elements x 2)

$$\text{EHL} = \frac{\text{Wattage}}{\text{element dia. x w/sq.in. x } \pi}$$

$$\text{Watt Density (w/sq.in.)} = \frac{\text{Wattage}}{\text{element dia. x EHL x } \pi}$$

To determine the watt density when kw and immersion depth (B dim.) are known:

Assume—25kw
B = 30″(6 cold area)
6″ Flanged Immersion Heater—18 elements

Find—Watt density

EHL = (18 x 2 x 30) - (6 x 18 x 2)

EHL = 864″

$$\text{Watt density} = \frac{25000}{.475 \text{ x } 864 \text{ x } \pi}$$

Watt density = 19.4 w/sq.in.

To determine immersion depth when kw and watt density limitations are known:

Assume—48kw
22w/sq.in.
8″ Flanged Immersion Heater
24 elements (6″ cold area)

Find—B dimension

$$\text{EHL} = \frac{48000}{.475 \text{ x } 22 \text{ x } \pi}$$

EHL = 1463″

$$\text{B} = \frac{1463}{(24 \text{ x } 2)} + 6$$

B = 36½″

ESTIMATING SHEATH WATT DENSITY FOR OTHER PRODUCTS

BAND HEATERS:

$$\text{Watts/sq.in.} = \frac{\text{Wattage}}{(\text{dia x } \pi \text{ x width})\text{-width}}$$

See respective catalog section for each band heater for accurate watt density formulas.

CARTRIDGE AND TUBULAR HEATERS:

$$\text{Watts/sq.in.} = \frac{\text{Wattage}}{\text{dia. x heated length x } \pi}$$

MICA STRIP HEATERS:

$$\text{Watts/sq.in.} = \frac{\text{Wattage}}{(\text{heated length x width})\text{-width}}$$

HD STRIP HEATERS:

$$\text{Watts/sq.in.} = \frac{\text{Wattage}}{\text{heated length x } 3.75}$$

CHANNEL HEATERS:

$$\text{Watts/sq.in.} = \frac{\text{Wattage}}{\text{heated length x } 3.625}$$