

## The JETS Challenge

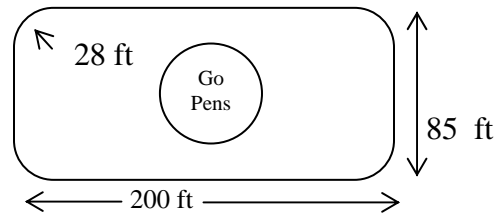
Provided by Dave Meredith, Associate Professor,  
Penn State University-Fayette

### Challenge 84 – The Ice Rink Challenge

---

#### Problem:

You are designing the refrigeration system to support a professional ice rink. The basic dimensions are 200 feet long by 85 feet wide. Each corner is curved with a 28 foot radius. The ice sheet is 0.8 inches thick, and the ice weighs 57 pounds per cubic foot. ( $\text{lb}/\text{ft}^3$ ). To build the ice, you will need to remove 185 Btu of energy for each pound of ice frozen to form the ice sheet.



If you want to prepare the ice surface in 18 hours, what is the hourly design load (Btu/hr) for the refrigeration system?

---

**Solution:**

$$\begin{aligned}\text{Area} &= (200 \text{ ft.})(85 \text{ ft.}) - \text{corners} \\ &= 17,000 \text{ sq ft.} - \text{corners}\end{aligned}$$

Corner

$$= 28^2 - \frac{1}{4}\pi(28^2)$$

$$= 784 - 615.752$$

$$= 168.248 \text{ ft}^2$$

$$\text{Area} = 17,000 - 4(168,248) = 16,327 \text{ ft}^2$$

$$\text{Volume} = 16,327 \text{ ft}^2 \times \frac{.8}{12} \text{ ft} = 1,088.47 \text{ ft}^3$$

$$\Rightarrow (1,088.47 \text{ ft}^3) \left(57 \frac{\text{lb}}{\text{ft}}\right) = 62,042.6 \text{ lbs}$$

$$\Rightarrow 62,042.6 \text{ lbs.} \times 185 \frac{\text{BTU}}{\text{lb}} = 11,477,881 \text{ BTU}$$

$$\Rightarrow \frac{11,477,881 \text{ BTU}}{18 \text{ hr.}} = 637,660 \frac{\text{BTU}}{\text{hr.}}$$