CHAPTER 12
SPACE HEATING EQUIPMENT

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12.1 INTRODUCTION

The performance evaluation of space heating equipment for a geothermal application is generally considered from either of two perspectives: (a) selecting equipment for installation in new construction, or (b) evaluating the performance and retrofit requirements of an existing system.

With regard to new construction, the procedure is relatively straightforward. Once the heating requirements are determined, the process need only involve the selection of appropriately sized hot water heating equipment based on the available water temperature.

It is important to remember that space heating equipment for geothermal applications is the same equipment used in non-geothermal applications. What makes geothermal applications unique is that the equipment is generally applied at temperatures and flow rates that depart significantly from traditional heating system design.

This chapter presents general considerations for the performance of heating equipment at non-standard temperature and flow conditions, retrofit of existing systems, and aspects of domestic hot water heating.

12.2 HEATING EQUIPMENT PERFORMANCE AT NON-STANDARD CONDITIONS

For about the past 40 years, heating systems have been designed for a hot water supply temperature of 180 to 200°F with a 20°F temperature drop (ΔT). These temperatures were chosen largely to result in equipment requirements similar to those of the older steam systems. Equipment manufacturer's selection data are indexed to these temperatures as are the practices of many design professionals.

Geothermal resources, of the variety frequently applied to space heating applications, are generally characterized by temperatures less than the standard 180 to 200°F range. Because well pumping costs constitute a sizable portion of the operating costs of a geothermal system, it is in the best interest of the designer to minimize flow requirements. This requires higher system ΔT than conventional designs. Accordingly, it is beneficial to examine the performance of heating equipment at low flow or temperature conditions.

Figure 12.1 illustrates the effect of low water velocity on heat transfer in hot water heating equipment. As indicated by the curve, heat output is relatively unaffected by water side velocity above a certain critical value. It is important when designing for larger than normal ? T (low flow rate) that the critical velocity for the heating equipment in question be avoided, as capacity falls off asymptotically in this region.

Figure 12.1 is a generalized relationship. Because the issue illustrated is really one of Reynold's Number and transition to laminar flow, critical velocity will vary with temperature and line size. However, for the piping diameters and temperatures generally encountered in heating equipment, velocities of 0.25 ft/s or less should be avoided for 1 to 2 in. lines (typical of finned tube radiators) and 0.50 ft/s or less for 1 in.and smaller lines (typical of finned coil equipment). For the 5/8 in. tubes commonly found in finned coil equipment, this velocity corresponds to a flow rate of approximately 0.6 gal/min gpm. In most cases, this very low velocity would only become a factor in applications of very low capacity (<15,000 Btu/h) using a ΔT of 40°F or more.

Figure 12.2 illustrates the average effect of reduced water temperature on hot water heating equipment performance. Individual terminal equipment types respond differently. Consult ASHRAE (1983) for exact performance.

Figure 12.2, as for most heating equipment, is indexed to a temperature of 215°F. The percent capacity shown on the vertical axis is the percent of the 215°F rated capacity at the temperature in question. For example, the output of a particular piece of heating equipment at 150°F would be approximately 45% of its capacity at 215°F. This relationship holds for equipment such as finned tube radiators, unit heaters, cast iron radiators, and convectors.

For finned coils, the considerations are somewhat more complex with respect to low temperature service. For other types of equipment, compensation for low temperature operation is primarily in terms of additional length, larger individual units, or a greater number of units. For finned coils, the physical size (in terms of face area) can remain unchanged and the configuration of the coil (number of rows and fins/in. or both) adjusted to accommodate low temperature operation.