



HOT WATER FOR MULTIPLE DWELLINGS

INTRODUCTION

An adequate supply of hot water is a must in apartment houses, motels, hotels, dormitories, etc. Users expect hot water in adequate amounts, just as they expect lights at the flick of a switch. Improper sizing and design of hot water supply systems will invariably lead to problems — dissatisfied users of undersized systems — wasteful economics of oversized systems.

Experience has shown that the hot water requirements for multiple dwellings are directly related to: (1) the bathing (shower) load which depends on the building size (no. of units and unit occupancy) (2) the type of shower heads utilized, and (3) the peak demand period over which the bathing load is spread.

Peak demand periods vary with the type of dwelling, apartments having a 3 hour period, hotels and motels a two hour period, dormitories & convention hotels/motels a one hour period.

Hot water generating systems should be sized to adequately supply the needs of the bathing load spread over the peak period.

The A. O. Smith sizing recommendations presented herein, are based on these parameters. The requirements for hot water for other large loads such as clothes washers, have not been considered. Designers should provide additional storage and recovery capacity to satisfy the needs of these additional loads.

A. O. SMITH SYSTEMS FOR MULTIPLE DWELLINGS

A. O. Smith offers a wide range of water heating systems ideally suited for use in multiple dwelling applications. Equipment utilizing gas, electricity or fuel oil is available. A number of distinct advantages are inherent in A. O. Smith water heating systems such as low standby losses, excellent tank draw characteristics and space saving features. See Section A for complete equipment and system information. One and two temperature factory skid mounted systems available (see specification sheet for details).

SPECIAL CONSIDERATIONS

- The use of a recirculating loop should be considered whenever hot water at point of use is needed quickly. Studies show that continuously recirculating systems are not generally energy efficient. Where recirculating lines are exposed to temperatures substantially lower than the temperature of the recirculated water, the lines should be insulated.

NOTE: The pump for the building recirculating loop should be separate from the water heating system and provisions should be made for turning off of circulating pump(s) when hot water system is not in operation.

- Ideally, the system should be designed so that it is not necessary to store water above 140°F. The inherent danger of extremely hot water getting into a shower is obvious.
- The volume of storage of a particular system may be partially augmented by the volume of stored water in the building hot water mains only if recirculation is employed. **The volume of storage in the building main if considered as storage must be known and compared with minimum storage recommended.**

CAUTION: Modern piping designs generally result in a comparatively small storage volume.

- **Increasing the size of the space heating boiler is not the most economical way to furnish domestic hot water, nor does it provide the best in hot water service.** The increase in standby loss due to the additional bulk of a larger space heating boiler greatly reduces the overall efficiency of the system. The same is true with storage tanks. The tank size should be compatible with the hot water demand.

VARIOUS SIZING METHODS

As stated earlier, A. O. Smith recommends the sizing method that considers the bathing load of the dwelling. The tables herein are based on this method. The designer familiar with other methods, such as fixture sizing, may use the tables to compare with his own calculations.

FHA

U. S. Department of Housing and Urban Development Minimum Property Standards 4910.1 (1973) paragraph 615-6 states hot water requirements for multiple dwellings should be based on design criteria shown in the ASHRAE/IESNA Guide.

A. O. Smith tables may not be applicable to FHA sizing for some apartment categories due to different diversity factors than those applied in the ASHRAE/IESNA Guide.

BUILDING CODES AND HOUSING AUTHORITIES

The requirements of recovery capacity and storage tank size may, in some areas, be fixed on a per apartment or per person basis by building codes or housing authorities. In these cases, the designer must meet the specified requirements.

DIVERSITY FACTORS

Diversity factors are used as a correction factor for the demand per person to be accommodated. The diversity factors have been derived from extensive hot water usage studies conducted by the Edison Electric Institute. These studies have shown that as building size increases, the peak demand per person decreases. This factor is also reflected in the minimum recommended storage capacity per building.

STORAGE REQUIREMENTS

Minimum storage requirements shown in the tables should be considered as a guide for sizing storage tanks. As mentioned earlier, the designer can cautiously consider the storage in the building main and may deduct this amount from storage tank requirements. Larger than required storage tank size may be selected to provide peak demand availability with lower fuel input. All storage volume is considered to be 140°F.

NOTE: Systems requiring reheat time in excess of 5 hours are not recommended. Applications where semicontinuous water usage can be expected between peak periods are more appropriately handled with 3 hour reheat time for storage tanks.

ESTIMATING SHOWER LOAD

Table A: APARTMENTS and Table B: MOTELS AND HOTELS in this section are constructed on the following basis: The most accurate method of estimating the shower load is to establish a known flow rate by the use of flow-regulated shower heads. In the past, a maximum flow rate of 4.5 gallons per minute was used. Currently, in the interest of energy conservation, a maximum flow rate of 3 GPM of approximately 105°F per shower is recommended. This flow rate will require 2 GPM of 140°F water from the storage tank, mixed with 1 GPM of 40°F water. It is also assumed that the average shower time is 5 minutes. The total volume of 140°F water per shower is 10 gallons (2 GPM x 5 min. = 10 gal.). Diversity factors were applied to Tables A and B. If shower flow rates closer to 5 GPM are required, multiply the quantities in these two tables by a factor of 1.6.

If actual shower head flow rate is known, the estimated peak period hot water requirements can be corrected by using the following formula:

$$\begin{array}{rcl} \text{Gallons} & & \text{Actual Shower Head} \\ \text{required for} & = & \text{required (from X} \\ \text{peak period} & & \text{Table A or B)} \\ & & \frac{\text{flow rate}}{3.0} \end{array}$$

Consult shower head water consumption data for more information.

Table C "Dormitories" is constructed from data taken from the Edison Electric Institute studies. These studies have shown that in dormitories the maximum peak hourly hot water load is 5.0 gallons per hour per person for women, and 3.8 gallons per hour per person for men. Diversity factors were used in this table for groups less than 100 persons.

Estimated peak period requirements for areas subject to severe winters (40°F inlet water) and those that have milder climates (60°F inlet water) are also shown in the tables.

INDUSTRIAL WASHROOMS AND SHOWER ROOMS

This type of load has a very high hot water peak demand and the tank and heater capacities must be sized accordingly. Usually, large storage volume is required.

Determine actual flow rates of the shower heads from the manufacturer. In the interest of conservation, flow restrictors should be specified for shower heads with excessive flow rates. When a known flow rate of 105° water is established, 65% of that quantity is required from the 140°F stored water assuming 40°F inlet water temperature.

In addition, there are usually lavatory basins, Bradley wash sinks, and possible other hot water fixtures. These must be considered as drawing concurrently with the showers.

No sizing charts are given for this type of usage because of the many variables. When the flow rates of the showers and other fixtures are known, a determination of time usage must be made. Five minutes for a shower is considered average. Multiply the number of people to shower by 5 minutes each and divide by the number of shower heads – obtaining the shower time required. Add the hot water requirements of the other fixtures for that time period to the hot water shower usage, to get total hot water usage.

If it is not possible to obtain a reasonable estimate of the shower time, it is general practice to assume a 20-minute shower period. One-third of the hourly capacity of the heaters would then be available; the remainder must be supplied by the storage tank.

SIZING FOR LIMITED KW DEMANDS

The optimum hot water supply system normally will consist of either self contained heaters of the storage type or booster heaters coupled to auxiliary storage tanks. The ratio of storage capacity to recovery capacity is dictated by the peak hot water demand requirements for any given installation. Systems utilizing gas or fuel oil (where peak fuel demand is not restricted) often result in a high ratio of recovery capacity to storage capacity.

When electricity is used as fuel, the cost of providing the peak KW load can be economically prohibitive due to "demand charges" assessed by utility companies. This extra charge is based on the highest demand for energy during a given time period. It is therefore, important to the operating economy of the system, where demand charges exist, that short duration high energy demand be avoided. In these cases the common remedy is to provide larger storage capacity so that peak hot water demands can be met with lower energy demands.

The availability tables in this section demonstrate how larger storage tanks and lower KW input can be selected to satisfy the hot water for a particular estimated peak demand. CAUTION – Very large storage capacity and low KW input can cause excessive system reheat time.

A. O. Smith offers a wide range of commercial electric water heating equipment including special control systems, to provide the flexibility of design required for sizing electric water heating systems. Consult your local utility company for information regarding power availability and rate structures.