

the non-heating season with the operation of the fuel burning device controlled by the water heater thermostat. (See Chapter 38.) During the heating season the water heater temperature control functions as a low limit control.

When an indirect water heater is applied to a gravity hot water system, it is necessary to provide a valve in the supply to the heating system to prevent the flow of hot water from the boiler when heat is not required in the house. This valve may be controlled from a room thermostat and the automatic fuel-burning device controlled from the water heater thermostat. To prevent circulation in a forced hot water heating system flow control valves may be installed in the flow and return lines which act merely as check valves when the circulating pump is not operating. In this arrangement the pump is controlled by the room thermostat and the automatic fuel-burning device is controlled from the water heater thermostat.

STORAGE CAPACITY AND BOILER ALLOWANCES

The amount of storage provided in the hot water tank or heater is somewhat a matter of choice but is usually made ample to carry over the peak shortage which is likely to occur and is based on the assumption that only 75 per cent of the storage capacity will be available, as it has been found that if more than this amount is withdrawn from storage, the tank is so cooled down as to make the balance useless. The general rule may be cited that the less the heating capacity the greater must be the storage, and the greater the storage the less may be the heating capacity down to a point where the heating capacity will fail to be sufficient to heat up the tank storage during the periods of small load.

Example 5. A heater to supply 500 persons will have an average daily use of about $500 \times 40 \text{ gal} = 20,000 \text{ gal}$ and this is an average of $\frac{20,000 \text{ gal}}{24} = 833 \text{ gph}$ but the peak hour will require $\frac{1}{10}$ of 20,000 = 2000 gal and the shortage during the peak hour, if the heating capacity is made to suit the average hourly use of 833 gal, will be $2000 - 833 = 1167 \text{ gal}$ so that the storage capacity, based on 75 per cent being available from this capacity without cooling the tank excessively, will be $\frac{1167}{0.75} = 1556 \text{ gal}$.

Should it be desired to reduce the size of storage tanks and to use a greater heating capacity, it is only necessary to increase the heating capacity to say 1200 gph which then gives $2000 - 1200 = 800 \text{ gal}$ as the shortage during the peak hour, and the necessary storage will be $\frac{800 \text{ gal}}{0.75} = 1067 \text{ gal}$; or the heating capacity can be increased to 1500 gal, leaving a shortage of $2000 - 1500 = 500 \text{ gal}$.

Good design requires that the heating capacity be made as small as possible without introducing undesirable amounts of storage, as the heating capacity directly determines the load on the source of heat.

As indicated in Example 5, the heating load is proportional to the heating capacity and the boiler capacity must be increased for higher heating capacities and may be reduced for smaller heating capacities with greater storage. It may be assumed that a boiler capacity of about 4 sq ft of equivalent steam heating surface² (radiation) must be provided for every gallon of water heated 100 F or from 50 F to 150 F, which is

²Actual requirement for 100 deg temperature difference = $\frac{100 \times 8.33}{240} = 3.48 \text{ sq ft per gallon of water heated.}$

CHAPTER 44. WATER SUPPLY PIPING AND WATER HEATING

TABLE 13. ORDINARY MAXIMUM HOURLY DEMAND FOR HOT WATER FOR VARIOUS FIXTURES IN GALLONS AND PROBABLE PERCENTAGE OF USAGE

TYPE OF BUILDING	LAVATORIES		BATHS	SHOWERS	SLOP SINKS	KITCHEN SINKS	PANTRY SINKS	FOOT BATHS	WASH TRAYS	AVG. MAX. USE*
	Private	Public								
MAXIMUM PROBABLE USAGE GPH	20	20	40	300	30	30	20	20	50	
	Probable Usage in Per Cent of Maximum Ordinary Use									
Apt. house	25	50	33	67	67	33	50	25	60	35
Club	25	75	50	67	67	67	100	25	80	60
Gymnasium	25	100	100	100	---	---	---	100	---	80
Hospital	25	75	50	33	67	67	100	25	80	45
Hotel	25	100	50	33	100	67	100	25	80	70
Industrial	25	150	100	100	67	67	---	100	---	90
Laundries	25	100	---	---	33	---	---	---	100	100
Office building	25	75	---	---	50	---	---	---	---	20
Baths	25	150	150	100	50	---	---	---	---	100
Residences	25	---	50	33	50	33	50	50	60	50
Schools	25	75	---	100	67	33	100	50	---	25
Y. M. C. A.	25	100	100	100	67	67	100	100	80	75

*Percentage of fixtures likely to be demanding maximum probable usage at any one time.

TABLE 14. HOT WATER CONSUMPTION IN VARIOUS TYPES OF BUILDINGS FOR DIFFERENT PURPOSES

TYPE OF BUILDING	CONDITIONS	GALLONS
Hotels	Room with basin only	10 (per day)
	Room with bath	40 (per day)
	(Transient)	40 (per day)
	(Men)	60 (per day)
	(Mixed)	80 (per day)
	(Women)	80 (per day)
	Two-room suite and bath	80 (per day)
	Three-room suite and bath	100 (per day)
Public Buildings	Public bath or lavatory	150 (per day per fixture)
	Public shower	200 (per day per fixture)
	Public lavatory with attendant	200 (per day per fixture)
Industrial Buildings	Per office employee	2 (per day)
	Per factory employee	5 (per day)
	Cleaning floors	3 (per 1000 sq ft per day)
Restaurants	\$0.50 Meals	0.5 (per customer with hand washing) 1.0 (per customer with machine washing)
	\$1.00 Meals	1.0 (per customer with hand washing) 2.0 (per customer with machine washing)
	\$1.50 Meals	1.5 (per customer with hand washing) 4.0 (per customer with machine washing)