per gallon of water heated 100 F. The value of 4 allows for transmission losses, etc.

There are two ways in common use of estimating the hot water requirements of a building; first, by the number of people and second, by the number of plumbing fixtures installed. Where the number of people to be served is known or can be reasonably estimated, the data in Table 1 may be used.

Example 1. From Table 1, a residence housing five people would have a daily requirement of $5 \times 40 = 200$ gal per day, and a maximum hourly demand of $200 \times 1/7 = 28.5$ gal. The heater should have a storage capacity of $200 \times 1/5 = 40$ gal and a heating capacity of $200 \times 1/7 = 28.5$ gal per hour.

The conditions given in *Example 1* may be cited as average. It is possible to vary the storage and heating capacity by increasing and

TABLE 1. ESTIMATED HOT WATER DEMAND PER PERSON FOR VARIOUS TYPES OF BUILDINGS

TYPE OF BUILDING	HOT WATER REQUIRED AT 140 F	MAX. HOURLY DEMAND IN RELATION TO DAY'S USE	DURATION OF PEAK LOAD HOURS	STORAGE CAPACITY IN RELATION TO DAY'S USE	HEATING CAPACITY IN RELATION TO DAY'S USE
Res., apts., hotels, etc.	40 gal per person per day	1/7	4	1/5	1/7
Office buildings	2 gal per person per day	1/5	2	1/5	1/6
Factory buildings	5 gal per person per day	1/8	1	2/5	1/8
Restaurants $0.50 meals $1.00 meals $1.50 meals	 1.5 gal per meal 2.5 gal per meal 4.5 gal per meal			1/10	1/10
Restaurants 3 meals per day		1/10	8	1/5	1/10
Restaurants 1 meal per day		1/5	2	2/5	1/6

decreasing one over the other. Such a condition is illustrated in *Example 2.*

Example 2. Assume an apartment house housing 200 people. From the data in Table 1: Daily requirements $= 200 \times 40 = 8000$ gal. Maximum hours demand $= 8000 \times 1/7 = 1140$ gal. Duration of peak load = 4 hours. Water required for 4-hour peak $= 4 \times 1140 = 4560$.

If a 1000 gal storage tank is used, hot water available from the tank $= 1000 \times 0.75 = 750$. Water to be heated in 4 hours $= 4560 - 750 = 3710$ gal. Heating capacity per hour $= \frac{3710}{4} = 930$ gal.

If instead of a 1000 gal tank, a 2500 gal tank had been installed, the required heating capacity per hour would be $\frac{4560 - (2500 \times 0.75)}{4} = 671$ gal.

Table 2 may be used to determine the size of water heating equipment from the number of fixtures. To obtain the *probable maximum demand* multiply the total quantity for the fixtures by the Demand Factor in line 11. The heater or coil should have a water heating capacity equal

to this *probable maximum demand.* The storage tank should have a capacity equal to the *probable maximum demand* multiplied by the storage capacity factor in line 12. *Example 3* will illustrate the procedure.

Example 3. Determination of heater and storage tank size for an apartment building from number of fixtures.

60 lavatories	$\times$ 2 =	120 gal per hour
30 bath tubs	$\times$ 20 =	600 gal per hour
30 showers	$\times$ 75 =	2250 gal per hour
60 kitchen sinks	$\times$ 10 =	600 gal per hour
15 laundry tubs	$\times$ 20 =	300 gal per hour
Possible maximum demand	=	3870 gal per hour
Probable maximum demand	= 3870 $\times$ 0.30 =	1161 gal per hour
Heater or coil capacity	=	1161 gal per hour
Storage tank capacity	= 1161 $\times$ 1.25 =	1450 gal.

TABLE 2. HOT WATER DEMAND PER FIXTURE FOR VARIOUS TYPES OF BUILDINGS

Gallons of water per hour per fixture, calculated at a final temperature of 140 F

	APARTMENT HOUSE	CLUB	GYMNASIUM	HOSPITAL	HOTEL	INDUSTRIAL PLANT	OFFICE BUILDING	PRIVATE RESIDENCE	SCHOOL	Y.M.C.A.
1. Basins, private lavatory	2	2	2	2	2	2	2	2	2	2
2. Basins, public lavatory	4	6	8	6	8	12	6	....	15	8
3. Bathtubs	20	20	30	20	20	30	....	20	....	30
4. Dishwashers	15	50–150	....	50–150	50–200	20–100	....	15	20–100	20–100
5. Foot basins	3	3	12	3	3	12	....	3	3	12
6. Kitchen sink	10	20	....	20	20	20	....	10	10	20
7. Laundry, stationary tubs	20	28	....	28	28	....	....	20	....	28
8. Pantry sink	5	10	....	10	10	....	....	5	10	10
9. Showers	75	150	225	75	75	225	....	75	225	225
10. Slop sink	20	20	....	20	30	20	15	15	20	20
11. Demand factor	0.30	0.30	0.40	0.25	0.25	0.40	0.30	0.30	0.40	0.40
12. Storage capacity factor[a]	1.25	0.90	1.00	0.60	0.80	1.00	2.00	0.70	1.00	1.00

[a] Ratio of storage tank capacity to probable maximum demand per hour.

METHODS OF HEATING WATER

Hot water may be heated either by the direct combustion of fuel, by an intermediate carrier such as steam or hot water, or by electrically heated surfaces. The simplest method is to have the fire on one side of a metal barrier and water on the other. In such a method if the water surfaces of heat transfer are small, and if the water carries a heavy proportion of precipitable salts, the water passages may soon clog and then burn out. A familiar example of such trouble is the water back of the firebox in the kitchen stove or the pipe coil inserted into the firebox of a warm air furnace or small boiler. The critical water temperature at which the lime, magnesia, etc. collect on hot surfaces, varies with the character and proportions of the solids, but generally such deposits are not a serious trouble with water temperatures lower than 140 F.

Coal-burning direct-fired water heaters may be constructed of cored cast-iron sections or of steel. In some cases the external appearance of