

order that the heating capacity and consequently the size of the heater, or the load on the heating boiler may be as small as possible.

In estimating the hot water which can be drawn from a storage tank it should be borne in mind that only about 75 per cent of the volume of the tank is available, as by the time this quantity has been drawn off the incoming cold water has cooled the remainder down to a point where it can no longer be considered hot water.

Where steam from the heating boiler is used to heat domestic hot water, the computed load on the boiler should be increased by 4 sq ft EDR (equivalent direct radiation) for every gallon of water per hour heated through a 100 F rise. The actual requirement is $\frac{100 \times 8.33}{240} = 3.48$ sq ft 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 10 may be used.

Example 6. From Table 10, a residence housing five people would have a daily requirement of $5 \times 40 = 200$ gal per day, and a maximum hourly demand of $200 \times \frac{1}{4} = 28.5$ gal. The heater should have a storage capacity of $200 \times \frac{1}{5} = 40$ gal and a heating capacity of $200 \times \frac{1}{4} = 28.5$ gal per hour.

The conditions given in Example 6 may be cited as average. It is possible to vary the storage and heating capacity by increasing and

TABLE 10. 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	$\frac{1}{4}$	4	$\frac{1}{5}$	$\frac{1}{4}$
Office buildings	2 gal per person per day	$\frac{1}{5}$	2	$\frac{1}{5}$	$\frac{1}{5}$
Factory buildings	5 gal per person per day	$\frac{1}{3}$	1	$\frac{2}{5}$	$\frac{1}{3}$
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			$\frac{1}{10}$	$\frac{1}{10}$
Restaurants 3 meals per day		$\frac{1}{10}$	8	$\frac{1}{5}$	$\frac{1}{10}$
Restaurants 1 meal per day		$\frac{1}{5}$	2	$\frac{2}{5}$	$\frac{1}{5}$

TABLE 11. 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.
Basins, private lavatory.....	2	2	2	2	2	2	2	2	2	2
Basins, public lavatory.....	4	6	8	6	8	12	6	.....	15	8
Bath tubs.....	20	20	30	20	20	30	.....	20	.....	30
Dishwashers.....	15	50-150	.....	50-150	50-200	20-100	.....	15	20-100	20-100
Foot basins.....	3	3	12	3	3	12	.....	3	3	12
Kitchen sink.....	10	20	.....	20	20	20	.....	10	10	20
Laundry, stationary tubs....	20	28	.....	28	28	.....	.....	20	.....	28
Pantry sink.....	5	10	.....	10	10	.....	.....	5	10	10
Showers.....	75	150	225	75	75	225	.....	75	225	225
Slop sink.....	20	20	.....	20	30	20	15	15	20	20
Hourly heating capacity factor.....	30%	30%	40%	25%	25%	40%	30%	30%	40%	40%
Storage capacity factor.....	125%	90%	100%	60%	80%	100%	200%	70%	100%	100%

decreasing one over the other. Such a condition is illustrated in Example 7.

Example 7. Assume an apartment house housing 200 people. From the data in Table 10: Daily requirements = $200 \times 40 = 8000$ gal. Maximum hours demand = $8000 \times \frac{1}{4} = 1140$ 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.

In cases where the number of fixtures only are known, the data in Table 11 have been found satisfactory.

Example 8. An apartment building has a hot water requirement as follows:

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

Maximum hourly requirement..... = 3770 gal per hour
 Hourly heating capacity..... = $3770 \times 0.30 = 1161$ gal per hour
 Storage capacity..... = $1161 \times 1.25 = 1450$ gal 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