PUREFIRE® PFW Series

Hot Water Supply Boiler Sizing Guide

⚠ NOTICE

PB Heat, LLC provides the following information as a courtesy to our customers to aid in the sizing of hot water systems. The application of this data is the responsibility of the customer or engineer specifying the equipment.

Purpose:

This sizing guide is intended to provide a general method of sizing hot water supply boilers in conjunction with hot water storage.

Step 1: Determine maximum possible demand

Determine the quantity & type of fixtures to be supported by the hot water supply system. Use manufacturer specifications for typical fixture usage and flow rate to determine the hourly usage for each fixture.

For example, using a shower head that is designed to provide a maximum of 1.5 gpm of water at 60 psi for an estimated average shower time of 12 minutes will use 18 gallons of hot water. Therefore, using 18 gph per fixture will be a reasonable estimated usage for each shower head.

Table 1 shows typical hot water fixture demand values for various types of buildings. Note that the source of the values predates low-flow fixtures and appliances mandated by the U.S. federal energy efficiency standards in 1992.

Table 1: 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	Club	Gymnasium	Hospital	Hotel	Industrial Plant	Office Building	Private Residence	School	YMCA
1	Basin, private lavatory	2	2	2	2	2	2	2	2	2	2
2	Basin, public lavatory	4	6	8	6	8	12	6	-	15	8
3	Bathtub[c]	20	20	30	20	20	-	-	20	-	30
4	Dishwasher[a]	15	50-150	-	50-150	50-200	20-100	-	15	20-100	20-100
5	Foot basin	3	3	12	3	3	12	-	3	3	12
6	Kitchen sink	10	20	-	20	30	20	20	10	20	20
7	Laundry , stationary tub	20	28	-	28	28	-	-	20	-	28
8	Pantry sink	5	10	-	10	10	-	10	5	10	10
9	Shower	30	150	225	75	75	225	30	30	225	225
10	Service sink	20	20	-	20	30	20	20	15	20	20
11	Hydrotherapeutic shower	-	-	-	400	-	-	-	-	-	-
12	Hubbard bath	-	-	-	600	-	-	-	-	-	-
13	Leg bath	-	-	-	100	-	-	-	-	-	-
14	Arm bath	-	-	-	35	-	-	-	-	-	-
15	Sitz bath	-	-	-	30	-	-	-	-	-	-
16	Continuous-flow bath	-	-	-	165	-	-	-	-	-	-
17	Circular wash sink	-	-	-	20	20	30	20	-	30	-
18	Semicircular wash sink	-	-	-	10	10	15	10	-	15	-
19	DEMAND FACTOR	0.30	0.30	0.40	0.25	0.25	0.40	0.30	0.30	0.40	0.40
20	STORAGE CAPACITY FACTOR[b]	1.25	0.90	1.00	0.60	0.80	1.00	2.00	0.70	1.00	1.00

Note: Data Sources predate low-flow fixtures and appliances.

[a]Dishwasher requirements should be taken from this table or from manufacturers' data for model to be used, if known.

[b]Ratio of storage tank capacity to probable maximum demand/hr. Storage capacity may be reduced where unlimited supply of steam is available from central street steam system or large boiler plant

[c]Whirlpool baths require specific consideration based on capacity. They are not included in the bathtub category.

The following example shows how to determine the maximum possible demand for a 30 unit apartment building based on the number of fixtures using hot water:

50 Lavatories	x	2 gph	=	100 gph
30 Showers	x	30 gph	=	900 gph
30 Kitchen Sinks	x	10 gph	=	300 gph
30 Dishwashers	x	15 gph	=	450 gph
10 Laundry Tubs	x	20 gph	=	200 gph
Possible maximum demand			**=**	**1,950 gph**

Therefore the maximum possible demand is 1,950 gph. However, it is unlikely that all 30 units will be using all hot water fixtures at once so, in step 2, we will apply a demand factor to this total.

Step 2: Apply Demand Factor

Apply a demand factor, from table 1, row 19, based on the type of building to which the sizing is to be applied. This is the probable maximum demand.

Following along with our apartment building example, we use a demand factor of 0.30 based for this type of building.

Probable maximum demand = 1,950 gph x 0.30 = **585 gph**

Next, we will apply a storage capacity factor.

Step 3: Apply Storage Capacity Factor

Apply a storage capacity factor, from table 1, row 20, based on the type of building to which the sizing is to be applied. This value will be used to size the hot water supply boiler and storage tank. Tradeoff between boiler recovery capacity and tank size will be addressed in Step 4.

For our Apartment house example, we will apply a storage capacity factor of 1.25 gallons per gph.

Delivery Capacity = $585\ gph \times 1.25 \frac{gal}{gph}$ = **731 gallons**

Step 4: Determine Peak Usage Demand Period and apply

Determine the peak usage demand period for the hot water supply system. For systems in which the peak demand lasts for 1 hour or less, such as some dormitories, the 1st hour capacity should be used (table 2a for PFW-200 and table 2b for PFW-399). Buildings, such as hotels, with typical peak demand periods between 1 and 2 hours should be sized according to the 2nd hour capacity (table 3a for PFW-200 and table 3b for PFW-399). Buildings with peak demands between 2 and 3 hours should be sized using 3rd hour capacity (table 4a and 4b). The building owner should be consulted regarding the water usage patterns for the occupants.

In our example, assuming a 2 to 3 hour peak demand period, we can use table 4a to determine the storage tank requirement if we use a PFW-200 boiler. If the inlet water is 40°F and the water is stored at 140°F then we can use a ΔT of 100°F.

From table 4a:

- Selection 1: PFW-200 with one 119 gallon storage tank
  This can be used since the 3rd hour rating of 742 gallons exceeds the 731 gallons required.

Using table 4b:

- Selection 2: PFW-399 boiler with one 60 gallon storage tank
  This is more than adequate for this application since the 3rd hour capacity of 1385 exceeds 731 gallons. In fact, this combination would also be acceptable if the peak demand period were between 1 and 2 hours (table 3b) since the 2nd hour rating is 938 gallons.

We can also calculate the 3rd hour rating as follows:

$$hours \times recovery\ cap. + (\#\ of\ tanks) \times (tank\ storage\ volume) \times (usable\ capacity\ factor) = capacity\ Rating$$

- Selection 3: For a PFW-200 with two 80 gallon storage tanks:

$$3\ hr \times 220\ gph + (2)80\ gal \times 0.70 = 772\ gallons$$

PUREFIRE® PFW Series Hot Water Supply Boiler Sizing Guide

Table 2a: PFW-200 - 1st Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	549	591	605	633	716
60	366	408	422	449	533
80	275	317	331	358	441
100	220	262	276	303	386

Table 2b: PFW-399 - 1st Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	1119	1161	1175	1203	1286
60	746	788	802	830	913
80	560	602	616	643	726
100	448	490	504	531	614

Table 3a: PFW-200 – 2nd Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	549	1140	1154	1182	1265
60	366	774	788	816	899
80	275	591	605	633	716
100	220	481	495	523	606

Table 3b: PFW-399 – 2nd Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	1119	2281	2295	2322	2405
60	746	1535	1549	1576	1659
80	560	1161	1175	1203	1286
100	448	938	952	979	1062

Table 4a: PFW-200 – 3rd Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	549	1690	1704	1731	1814
60	366	1140	1154	1182	1265
80	275	866	880	907	990
100	220	701	715	742	826

Table 4b: PFW-399 – 3rd Hour Capacity (gallons)*

ΔT	Recovery Capacity (gph)	Tank Storage Capacity (gallons)			
		60	**80**	**119**	**2 x 119**
40	1119	3400	3414	3442	3525
60	746	2281	2295	2322	2405
80	560	1721	1735	1762	1846
100	448	1385	1399	1427	1510

* The capacities shown above are based on a usable tank volume of 70%. Consult the tank manufacture for the actual usable volume of tanks.

<u>The calculations used for the capacities above follow:</u>

$1^{st}\ hour\ capacity = recovery\ rate + usable\ volume$

For PFW-200 with 100°F rise and an 80 gallon tank: $220\ gph + 80\ gallons \times 0.70 = 276\ gallon$

$2^{nd} hour\ capacity = 2 \times recovery\ rate + usable\ volume$

For PFW-399 with 100°F rise and a 119 gallon tank: $2 \times 448\ gph + 119 \times 0.70 = 979\ gallon$

$3^{rd} hour\ capacity = 3 \times recovery\ rate + usable\ volume$

For PFW-200 with 80°F rise and two 119 gallon tanks: $3 \times 275\ gph + 2\ \times 119 \times 0.70 = 990\ gallon$

PeerlessBoilers.com

PB HEAT, LLC

131 S. CHURCH STREET • BALLY, PA 19503

PF8252 R1 (140917)