# BC BUILDING CODE INTERPRETATION COMMITTEE
# AIBC, APEGBC, BOABC, POABC

**File No: 98- 0115** **INTERPRETATION** 

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| Interpretation Date: | September 29, 2004 |
| Building Code Edition: | BC Building Code 1998 |
| Subject: | Recirculation systems |
| Keywords: | Potable water systems, recirculation |
| Building Code Reference(s): | 7.6.1.1.(1)&(3)(a); 7.6.3.1.(2)(b)&(c) |

**Question:**

What methods are acceptable for sizing recirculation systems including pumps to maintain velocities below the maximum permitted in Clauses 7.6.3.1.(2)(b)&(c)?

**Interpretation:**

The American Society of Plumbing Engineers (ASPE) Data Book titled "Service Hot Water Systems" referenced in Sentence 7.6.1.1.(1) and the Appendix is considered good engineering practice for systems required by Clause 7.6.1.1.(3)(a).

Circulation velocities required by Clauses 7.6.3.1.(2) (b)&(c) can be controlled by the installation of a flow restriction device downstream of the circulation pump. All circulation pumps must be sized in accordance with the manufacturers flow curves.

Attached for information is the appropriate section of the referenced ASPE Data Book.

RJ Light

R. J. Light, Committee Chair

98-0115

Table 1 Hot Water Demands and Use for Various Types of Buildings

| Type of Building | Maximum Hour | Maximum Day | Average Day |
|---|---|---|---|
| Men's dormitories | 3.8 gal (14.4 L)/student | 22.0 gal (83.4 L)/student | 13.1 gal (49.7 L)/student |
| Women's dormitories | 5.0 gal (19 L)/student | 26.5 gal (100.4 L)/student | 12.3 gal (46.6 L)/student |
| Motels: No. of units[a] | | | |
| 20 or less | 6.0 gal (22.7 L)/unit | 35.0 gal (132.6 L)/unit | 20.0 gal (75.8 L)/unit |
| 60 | 5.0 gal (19.7 L)/unit | 25.0 gal (94.8 L)/unit | 14.0 gal (53.1 L)/unit |
| 100 or more | 4.0 gal (15.2 L)/unit | 15.0 gal (56.8 L)/unit | 10.0 gal (37.9 L)/unit |
| Nursing homes | 4.5 gal (17.1 L)/bed | 30.0 (113.7 L)/bed | 18.4 gal (69.7 L)/bed |
| Office buildings | 0.4 gal (1.5 L)/person | 2.0 gal (7.6 L)/person | 1.0 gal (3.8 L)/person |
| Food service establishments: | | | |
| Type A—full meal restaurants and cafeterias | 1.5 gal (5.7 L)/max meals/h | 11.0 gal (41.7 L)/max meals/h | 2.4 gal (9.1 L)/avg meals/day[b] |
| Type B—drive-ins, grilles, luncheonettes, sandwich and snack shops | 0.7 gal (2.6 L)/max meals/h | 6.0 gal (22.7 L)/max meals/h | 0.7 gal (2.6 L)/avg meals/day[b] |
| Apartment houses: No. of apartments | | | |
| 20 or less | 12.0 gal (45.5 L)/apt. | 80.0 gal (303.2 L)/apt. | 42.0 gal (159.2 L)/apt. |
| 50 | 10.0 gal (37.9 L)/apt. | 73.0 gal (276.7 L)/apt. | 40.0 gal (151.6 L)/apt. |
| 75 | 8.5 gal (32.2 L)/apt. | 66.0 gal (250 L)/apt. | 38.0 gal (144 L)/apt. |
| 100 | 7.0 gal (26.5 L)/apt. | 60.0 gal (227.4 L)/apt. | 37.0 gal (140.2 L)/apt. |
| 200 or more | 5.0 gal (19 L) | 50.0 gal (195 L)/apt. | 35.0 gal (132.7 L)/apt. |
| Elementary schools | 0.6 gal (2.3 L)/student | 1.5 gal (5.7 L)/student | 0.6 gal (2.3 L)/student[b] |
| Junior and senior high schools | 1.0 gal (3.8 L)/student | 3.6 gal (13.6 L)/student | 1.8 gal (6.8 L)/student[b] |

[a]Interpolate for intermediate values. [b]Per day of operation.

when sizing hot water lines, particularly where instantaneous water heaters are used and the available pressure is low.

## Return Piping System

For hot water systems in which piping from the heater to the fixture or appliance is 100 ft (30 m) or less, circulation systems are not generally used. However, circulation piping is commonly provided in any hot water supply system in which it is desirable to have hot water available continously at the fixtures. This includes cases where the hot water piping system exceeds 100 ft (30 m). The water circulation pump may be controlled by a thermostat (in the return line) set to start and stop the pump over an acceptable temperature range. Since hot water is corrosive because of its high oxygen content and high temperature, circulating pumps should be made of bronze or other corrosion-resistant material. For small installations, a simplified pump sizing is to allow 1 gpm (63 mL/s) for every 20 fixture units in the system; 0.5 gpm (32 mL/s) for each 0.75 or 1 in. (20 or 25 mm) riser; 1 gpm (63 mL/s) for each 1.25 or 1.5 in. (32 or 40 mm) riser; and 2 gpm (126 mL/s) for each riser 2 in. (50 mm) or larger.

Where multiple risers or horizontal loops are used, balancing valves in the return lines are recommended. A check valve should be placed in each return to prevent entry of cold water or reversal of flow, particularly during periods of hot water demand.

The circulation hot water supply may be an up-feed or down-feed piping system. Three common methods of arranging circulation lines are shown in Figure 3. Although the diagrams apply to multi-story buildings, arrangements (A) and (B) are also used in residential designs.

In circulation systems, air venting, pressure drops through the heaters and storage tanks, balancing, and line losses should be considered. In Figures 3A and 3B, air is vented by connecting the circulating line below the top fixture supply. With this arrangement, air is eliminated from the system each time the top fixture is opened. Generally, for small installations, a 0.5 or 0.75 in. (13 or 20 mm) hot water return is ample. Werden and Spielvogel (1969), Dunn *et al.* (1959), and NSF Standard 5-83 cover heat loss calculations for large systems.

For larger installations, heat losses of lines become significant. A quick method to size the return follows:

1. Determine total length of all hot water supply and return piping.
2. Multiply this total by 30 Btu/h · ft (28.8 W/m) to obtain approximate total heat loss in Btu/h (W) for covered pipe. For uninsulated pipe, use 60 Btu/h · ft (57.7 W/m). Actual heat losses in pipes as given in Table 2 for 140°F (60°C) water in pipe and 70°F (21°C) ambient temperature of 30 and 60 Btu/h · ft (28.8 and 57.7 W/m) are recommended for ease in calculation.
3. Divide total heat loss by 10,000 (40 000) to obtain total pump capacity in gpm (L/s). Required circulating pump capacity based on 8.33 lb. water/gal (1 kg water/L) · 60 min/h (3600 s/h) · 20°F (11.1°C) allowable temperature drop = 10,000 (40 000).
4. Select a pump to provide the required gpm (L/s) and obtain from the pump curves the head created at this flow.
5. Multiply the head by 100 and divide by the total length of hot water return piping to determine the allowable friction loss per 100 ft (100 m) of pipe.
6. Determine the required gpm (L/s) in each circulating loop and size the hot water return pipe based on this gpm (L/s) and the allowable friction loss from Step 5.

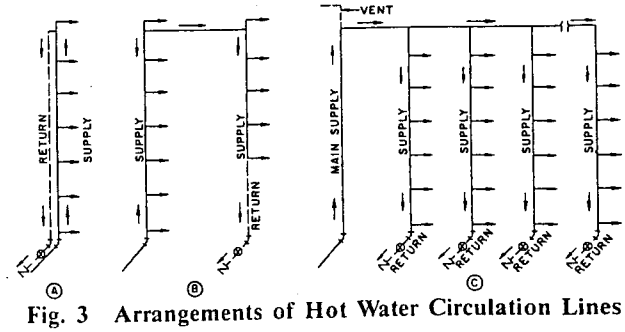


Fig. 3 Arrangements of Hot Water Circulation Lines