Sizing

Average water demand during peak times

When calculating the size of service water pipes in a building, we must consider several factors:

- Minimum pressure available at the property and pressure loss due to components.
- Total developed length of the pipes. Caution: Not all pipes with the same diameter have the same friction losses.
- Minimum pressure to supply the units.

The following tools are essential for sizing:

- Table 2.6.3.2 of Chapter III, Plumbing, of the Québec Construction Code (CCQ).
- "Hunter's curve" flow patterns
- Table indicating friction based on pipe type, with maximum velocities and friction.

Hot water demand and use guidelines

Time	Litres (gallon) of water per person delivered to fixtures at a temperature of 49 °C (120 °F), in a residential setting (apartment) [1,2]	
Peak period time	15 minutes	30 minutes
High demand	11.5 (3.0)	19.5 (5.1)
Medium demand	6.4 (1.7)	11.0 (2.9)
Low demand	4.0 (1.0)	6.5 (1.7)

High demand[4]: high percentage of children, low-income, no occupants working, families, single parents households.
Medium demand[4]: families, single individuals, single-parent households.
Low demand[4]: all occupants working, seniors, couples, middle income.

Notes: Judgement by the designer is needed for mixed-vocation living situations. This table refers to the ASPE, Volume 2, 2018, Chapter 6, Table 6.3, as well as the ASHRAE Handbook 2015, Chapter 50, Table 7. This table is only valid for medium use in a building with diversity.

[1] Production of water at 60 °C (140 °F) mixed with domestic cold water for end usage.
[2] Data including diversity for medium to large scale residential buildings
[3] Maximum temperature of 43 °C (109.4 °F) in health care facilities and areas.
[4] Consult the documentation refered to, to have the exact definition of the demand levels.

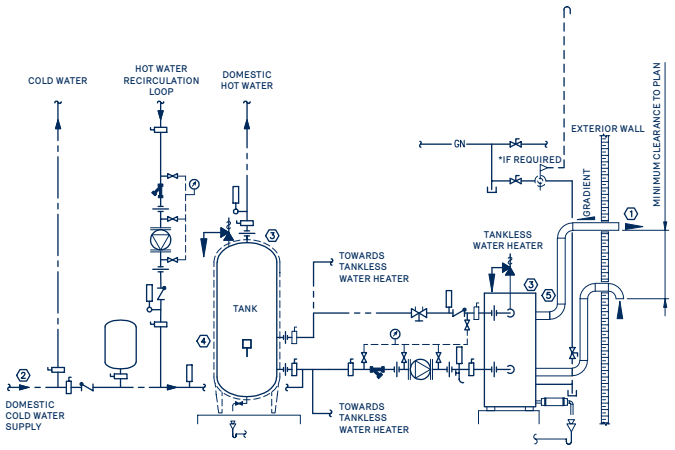
Maximum speed per pipe types at the given temperature

Pipe type	Maximum speed
Copper – cold water	2.4 m/s
Cooper – Hot water at a maximum of 60 °C	1.5 m/s
Stainless steel 304, Schedule 10	2.4 m/s, 1.5 m/s in occupied places (for acoustic reasons)
PVC	2.4 m/s, refer to each manufacturer's recommendations (Aquarise® pipes)
PEX	2.4 m/s, refer to each manufacturer's recommendations

Accessories and components

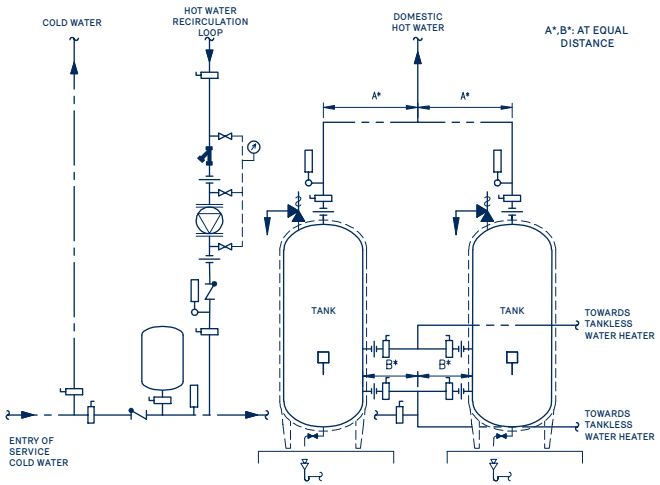
1. ULC-S636 certified vent Materials based on manufacturer's requirements.
   - Use a roof vent when possible (for simplicity and to avoid plume on walls)
   - Ensure the required clearances for wall venting.
   - For the design and selection of plastic combustion gas vents, see GA-12 of the CMMTQ and RBQ in partnership with Énergir.
2. For condensing water heaters, service cold water connection should be between the tank and water heater to maximize condensation.
3. Refer to the manufacturer's water heater and tank recommendations for connections.
4. Tank connections must be planned to ensure sufficient stratification of the tank to obtain at least 70% of the tank's volume at a usable temperature. Certain equipment cannot support the entry of cold water in the exchanger and must be connected in a different way.
5. See the information sheet on installing Énergir commercial natural gas equipment.

VALVES
BALANCING VALVE
CHECK VALVE
STRAINER
PRESSURE-REDUCING VALVE (WATER)
PRESSURE-REDUCING VALVE (GAS)
CIRCULATION PUMP
BLOWDOWN VALVE
FLOOR DRAIN
BLOCKED PIPE (CAP)
NEUTRALIZER
SAFETY RELIEF VALVE
PRESSURE GUAGE
PIPE UNION CONNECTION
WATER HAMMER ARRESTER
THERMOMETER
TEMPERATURE SENSOR



System with several tanks

- When designing and installing a system with several tanks, an equidistant pipe configuration should be considered.
- Whether this is done through mirror installation or a method of reverse-return for entry, the water exit and tankless water heater circulation must ensure an equal flow between the equipment to ensure equal temperature and stratification, as well as a temperature for tank maintenance and hot water production.
- Another way to ensure water heater circulation in tanks is to have a configuration in which each tank is joined to a water heater (water heater and tank pairs). This installation simplifies controls (one tank and one boiler). In the event of a heater or maintenance breakdown, however, this method will lead to a loss of both the heater and reserve capacity of the associated tank.



Cold and hot water distribution system

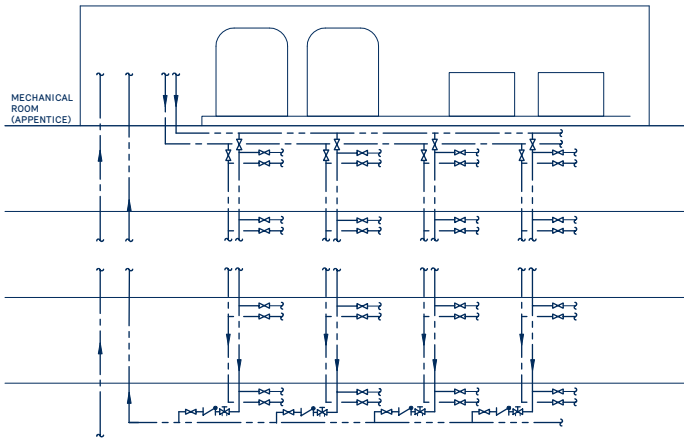
If pressure reduction or pressure control valves are not required, that is, under 550 kPa (80 psi) as prescribed by the CCQ – Chapter III, it is important that the domestic hot and cold water pipes come from the same place and have the same pressure loss, whether they are static or dynamic, so they have the same pressure and so that pressure is balanced between the networks.

For pressure reduction, it is important that pressure regulators are close together and are set to the same pressure.

Linear heat loss for fibreglass-insulated pipes

Nominal diameter	Minimum thickness of insulation (fibreglass)	Linear heat loss W/m (BTU/(h × foot))	Flow by length at 5 °C (9 °F) DT (L/s) per 100 m (gpm/100')
½	25 mm (1")	7.7 (8)	0.032 (0.16)
¾	25 mm (1")	9.6 (10)	0.047 (0.18)
1	25 mm (1")	9.6 (10)	0.041 (0.20)
1¼	25 mm (1")	12.5 (13)	0.051 (0.24)
1½	25 mm (1")	12.5 (13)	0.051 (0.24)
2	25 mm (1")	15.4 (16)	0.060 (0.29)
2½	38 mm (1½")	11.5 (12)	0.051 (0.24)
3	38 mm (1½")	15.4 (16)	0.064 (0.31)
4	38 mm (1½")	18.3 (19)	0.078 (0.38)
6	38 mm (1½")	26 (27)	0.106 (0.51)

These values were established based on a temperature difference of 39 °C (70 °F) between the hot water and ambient air and a fibreglass insulation (heat conductivity of 0.04 W/(m. °C) (0.25 BTU/h. °F-ft²). (From Table 5-4 of Chapter 5, Volume 4 20162017 of the ASPE for horizontal pipes.)



Recirculation network

The recirculation of service hot water, according to current regulations, must be maintained at all points at a temperature of 55 °C (131 °F) when the water is in circulation (Article 2.6.1.1.3, CCQ Chapter III). This means that the temperature observed at the recirculation pump must be maintained above this point.

For more details on recirculation design and sizing, see the PL-35 and PL-36 information sheets of the CMMTQ and RBQ in partnership with Énergir.

N.B. In Québec, Article 148 of the Regulation respecting energy conservation in new buildings (Chap. E-1.1, r. 1) stipulates that "Piping for recirculating service hot water must be insulated in conformance with the requirements of section 109 for pipes containing fluids at a temperature of between 50 °C and 95 °C" [(122 to 203 °F)].***

Avoid the oversizing of pumps (a frequently observed problem).

***A draft regulation modifying this text is currently out for consultation.

ASPE Montréal · CCTAR · CMMTQ · bouthillette parizeau · NovaMech

Thank you to our partners.

Project
Efficient Design Guide

Title
Circulating hot water system

Plan number: CE-8796-01-ECSC-01-EN
Revision : 07
Creation date: September 2019
Last update: January 2020
By: Mathieu Rondeau, P. Eng for Énergir

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* Estimates and assumptions for illustrating concepts.

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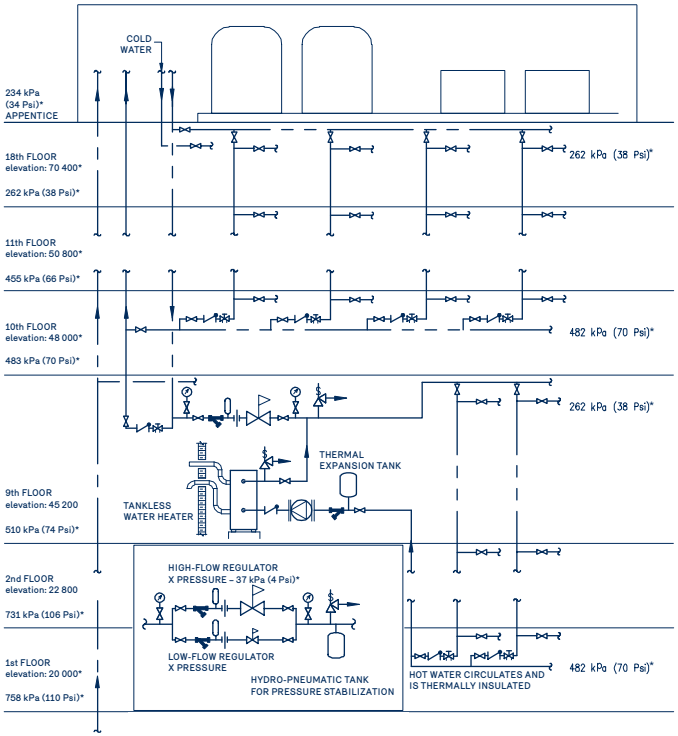
Tall buildings with reduced pressure areas

Several methods can be used to ensure recirculation at a minimum of 55 °C (131 °F) while maintaining an adequate pressure and temperature in the apartments:

Method 1
High-pressure distribution that provides water to each apartment and channels it back to hot water production system.

Method 2
Reduced pressure areas for a group of floors and low-pressure recirculation through a water heater designed to compensate for the energy losses of the reduced pressure area.

Method 2



Pipe thermal expansion

The thermal expansion of networks varies according to the type of pipes chosen.

Pipe thermal expansion must be taken into consideration. Thermal expansion is especially problematic in vertical pipes: the stress management is difficult without a specific method for managing this type of expansion.

Thermal expansion of pipes

Pipe type	Cold water network expansion mm (inches)	Hot water network expansion mm (inches)
Copper	11,5 (0,45)	28,1 (1,11)
Stainless steel (304)	11,9 (0,46)	29,1 (1,15)
PVC	46,2 (1,82)	115,8 (4,56)
Pex, various types	111,8 (4,4)	279,4 (11,0)

Pipe expansion per length of 30 m (100 ft) at temperatures of 4 to 60 °C (40 to 140 °F) for hot water and at temperatures of 4 to 27 °C (40 to 80 °F) for cold water.

To properly manage this expansion, several methods can be used:

1. Expansion loop
2. Expansion joint
3. By bending the pipes (based on the manufacturer's recommendations for flexible pipes only).
4. By managing expansion with spring type supports on floors to push the expansion toward the extremities.
5. Comprehensive configurations and arrangements in line with the recommendations of a thermal expansion expert.

Note: Expansion methods must be adjusted in consideration of all possible scenarios of operation, specifically the installation temperature and the hottest and coldest operating temperatures.

Thermal expansion calculation

For more details, refer to the CMMTQ's technical data sheet on calculating expansion tanks.

Important reminders

- Fire barriers (sealants, sleeves, etc.) must be present for each fire barrier separation, as required.
- For domestic water pipes, the necessary measurements must be made to adhere to seismic standards, as required.
- Safety valves must be selected according to the most restrictive points in the network, regardless of where they will be installed in the building.
- In tall buildings, the pipe type and joints selected must be able to resist pressure at the temperature of service at the most pressurized points (mainly problematic for plastic pipes).
- The temperature at which water is supplied to baths and showers must be limited by a certified mixing valve to 43 °C (109.4 °F) for health care facilities, residences for the elderly and health care areas, and to 49 °C (120.2 °F) for any other building types, in accordance with Article 2.2.10.7 of Chapter III, Plumbing, of the CCQ. Temperature limiting devices must be installed at the point of use and not at the water heater.
- For security purpose and maintenance, the minimum clearance of tankless water heaters and tanks must be adhered to the manufacturer's requirements.

Specifications

Documentation to consult (not limited to):

Tankless natural gas water heaters: ASME H badge for boilers and pressure vessels, ANSI Z21.10.3-2011/CSA 4.3-2011. AHRI

Tank: ASHRAE 90.1, ASME HLW, ASME IV

Pumps: bronze or stainless steel construction designed for domestic water

Vents: In conformity with CSA B-149.1 and manufacturers' recommendations for tankless water heaters, stacks must be made from materials that conform to smoke requirements, based on the buildings in which they are installed.

Design Codes and Standards Section

ASHRAE Handbook 2015, Chapter 50, Service Water Heating

ASHRAE 90.1-2010

ASPE Volume 2, Plumbing Systems, Chapter 6, Domestic Water Heating System

CSA B-149.1 National Building Code of Canada (NBC), Chapter 1

National building code, chapter 1

Construction Code

National Energy Code for Buildings (NECB)

Québec Safety Code, Chapter I: Plumbing, equipment accessibility

CCQ, Chapter III, Plumbing

Related articles:

CCQ, Chapter III, Plumbing, Division B

- 1.3.1.2: Certification
- 2.2.5.7: Crosslinked polyethylene pipe and fittings
- 2.2.5.8: PVC pipe and fittings
- 2.2.5.9: CPVC pipe, fittings and solvent cements (table on maximum permitted pressure for CPVC piping at various temperatures)
- 2.2.5.12: Above-ground plastic pipe, fittings and solvent
- 2.2.6.10: Stainless steel pipes
- 2.2.7.4: Copper tube
- 2.2.10.7: Water temperature control
- 2.2.10.11: Relief valves
- 2.2.10.12: Reducing valves
- 2.2.10.13: Solar domestic hot water
- 2.6.1.1.2): Domestic hot water recirculation
- 2.6.1.1.3): Temperature for recirculation
- 2.6.1.3.3): Shut-off valve located at the source of supply
- 2.6.1.3.5): Shut-off valve where the water supply enter each dwelling unit
- 2.6.1.7: Relief valves
- 2.6.1.11: Thermal expansion
- 2.6.1.12: Service water heaters
- 2.6.3.2: Hydraulic load
- 2.6.3.3: Maximum static pressure
- 2.6.3.4: Maximum size per speed
- 2.6.3.5: Maximum velocity for pipes with fixture units

Appendix

2.2.5, 2.2.6, 2.2.7: pipes accepted in a plumbing system

2.6.3.1: Domestic water design, fabrication and installation, Table A-2-6.3.1. (2)A. and Table A-2.6.3.1(2)F.

Grants

Financial assistance is available for the integration of efficient design elements recommended in this tool as part of Énergir's "Efficient Devices - Businesses" energy efficiency programme. Consult your client's Énergir Sales representative or Certified Partner for natural gas before installing equipment. Simplified forms are also available on our website. Do not hesitate to use them.

Recommendations and specifications of responsibilities

Anyone can apply for a grant for an Énergir client. However, to ensure that the application is made before initiating your work, it is important to specify in your quote who is responsible for applying for Énergir's grant. The application can be made by:

- the client;
- the contractor in charge of supplying the client with gas;
- the client's general contractor;
- or the client's engineer.

It is also important to specify who will submit the Declaration of Work – Gas Installations to the Régie du bâtiment du Québec (RBQ) and Énergir within the required time frames for obtaining financial assistance.

If there are changes to the equipment brands, models or capabilities during the course of the work, the contractor must notify Énergir of the changes and inform the client of any change with respect to the financial assistance granted.

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