

Building Standards Guide

Promoting construction of safe, healthy, habitable buildings

Hydronics Installation

This guide was prepared with the assistance of the following:

- Canadian Institute of Plumbing and Heating
- Canadian Hydronics Council

Building Standards and Licensing Branch 100 - 1855 Victoria Avenue Regina, Saskatchewan S4P 3T2 (306) 787-4113 Phone (306) 798-4172 Fax building_standards@gov.sk.ca www.saskatchewan.ca/buildingstandards	Building Standards Advisory Hydronics Systems Guide July 2019 Original approved and signed by: Wm. Hawkins, Executive Director/Chief Building Official
This advisory is published by the Saskatchewan Ministry of Government Relations for purposes of providing information to users on the topic contained herein. In case of conflict between <i>The Uniform Building and Accessibility Standards Act</i> (the UBAS Act) and Regulations, the National Building Code of Canada 2015 (NBC 2015), the National Energy Code for Buildings 2015 (NECB 2015) and this advisory, provisions of the UBAS Act, Regulations, and the NECB 2015 shall apply.	

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Introduction

This guide is intended to help provide clarity about the design, installation, and regulation of hydronic systems used in the province of Saskatchewan.

Hydronic systems are defined in Canadian Standards Association Standard B214 (CSA B214) “Installation Code for Hydronic Heating Systems” as systems that the final heat transfer medium is either a fluid or steam. The National Building Code of Canada (NBC) provides requirements for the design, installation and use of hydronic systems as a source of heating and/or cooling for buildings which are within the scope of the NBC. Furthermore, the Canadian Institute of Plumbing and Heating (CIPH) provides commentary on hydronic system standards in the publication ‘The Canadian Hydronics Council Handbook on Hydronic Heating Systems’ to aid designers, contractors and other industry stakeholders in the requirements for hydronic systems.

This guidance document outlines the roles and responsibilities that pertain through the various stages of hydronic system design, installation, inspection and maintenance of these systems.

Scope

This guide applies to all hydronic systems that fall under the NBC, with focus on buildings that fall under Part 9 of the NBC, including buildings that are three storeys or less in building height, have a building area of not more than 600 m², and are used for major occupancy classifications as follows:

Group C – Residential occupancies

Examples include: apartments, dormitories, hotels, houses, lodging houses, motels, schools (residential), etc.

Group D – Business and personal services occupancies

Examples include: banks, barber and hairdressing shop, dental offices, laundries (self-service), police stations without detention quarters, small tool and appliance rental and service establishments, etc.

Group E – Mercantile occupancies

Examples include: department stores, markets, shops, stores, supermarkets, etc.

Group F2 – Medium-hazard occupancies

Examples include: aircraft hangers, cold storage plants, factories, laboratories, printing plants, salesrooms, service stations, etc.

Group F3 – Low-hazard occupancies

Examples include: creameries, factories, laboratories, power plants, salesrooms, storage garages, storage rooms, warehouses, workshops, etc.

Note: other buildings that fall outside the scope for Part 9 buildings, may require professional design in order to conform with Part 6 of the NBC. (see NBC 2015, Division A, Article 1.3.3.2. for clarification)

Definitions - CSA B214

Approved – acceptable to the authority having jurisdiction

The definition of ‘approved’, for the purpose of this document is as referenced in CSA B214, which may apply to products, design or construction.

Authority having jurisdiction – a federal, provincial or municipal, department, board, agency, ministry or commission that has responsibility for regulating the use of products, materials or services within its jurisdiction.

In Saskatchewan this includes:

- the Government of Saskatchewan referred to as the ‘Crown’ defined in the UBAS Act and represented by the Ministry of Government Relations;
- municipalities as the ‘local authority’; and
- other ‘local authorities’ such as a regional park authority within the *Regional Parks Act, 2013* or park land within the meaning of *The Parks Act*.

Auxiliary system – any system heating loads, other than those for space heating and domestic hot-water heating (e.g. pool and spa heating, snow melt applications, etc.).

Definitions - Other

UBAS Act and Regulations – Legislative and regulatory framework published by the Government of Saskatchewan to provide minimum standards for buildings, accessibility and energy. This includes the application of the National Building Code of Canada and the National Energy Code of Canada for Buildings.

Roles and Responsibilities

Owner/Operator

The Uniform Building and Accessibility Standards Act (the UBAS Act) defines owner as any person, firm, or corporation that controls that property under consideration. The owner is ultimately responsible for compliance through the UBAS Act and *The Uniform Building and Accessibility Standards Regulations* (the UBAS Regulations), which includes the NBC and National Energy Code of Canada for Buildings (NECB).

Local Authority (Municipality)

Local authorities are responsible for enforcing the UBAS Act, associated Regulations and all provisions of the NBC which may be applicable to a building within their jurisdiction. Including building codes which reference the installation standards for hydronic systems.

Government of Saskatchewan

The Government of Saskatchewan is responsible for establishing the legislative framework, high-level policy, the licensing of building officials and providing support to stakeholders. The Ministry of Government Relations is assigned responsibility for administering the UBAS Act and associated Regulations. The ministry provides support to owners, industry, local authorities, building officials, the fire service and other Code users on the application of the NBC, NECB, National Fire Code of Canada and accessibility standards.

Building Officials

Building officials are appointed by and work for local authorities to provide plan review, inspection and enforcement services of the minimum standards required by the UBAS Act. Building officials must be licensed by the Government of Saskatchewan prior to providing building official services.

Building officials have the following powers under the UBAS Act:

- entering a building at a reasonable hour;
- ordering the production of documents, tests, certificates, etc. related to a building;
- taking material samples;
- issuing notices to owners that order actions within a prescribed time;
- stopping construction including the use or occupancy of a building;
- eliminating unsafe conditions;
- taking action where imminent danger exists; and,
- conducting enforcement measures to ensure compliance.

Professional Designers

Designer's responsibilities for hydronic systems are outlined in CSA B214, through the NBC 2015 as referenced in Part 6, Division B, Sentence 6.2.1.1.(1) that heating, ventilation and air-conditioning systems including mechanical refrigeration equipment, shall be designed, constructed and installed in conformance with good engineering practice.

Installation Contractors

Installation contractors should have knowledge, skills, and abilities similar to plumbing contractors and be familiar with CSA B214 to ensure compliance with the standard (e.g., insulation, pipe diameters, pipe spacing, zoning, etc.) to provide an efficient system.

Background

This guide is intended to provide clarity for all parties involved with hydronic systems with the objective of achieving increased consistency from initial design to the end use of these systems. Hydronic systems have been around since the 19th century but as times have evolved, so has the science of these systems to aid in reliable and efficient use.

Legislation and Regulations

The UBAS Act and Regulations are the framework under which building, accessibility and energy standards apply to building construction within Saskatchewan. Standards for the installation of equipment and systems are referenced in the NBC, which is adopted by regulation under the UBAS Act, as the minimum applicable standard.

National Building Code Requirements for Hydronic Systems

Part 6 of the NBC 2015 outlines that all heating, ventilation and air-conditioning systems shall be designed, constructed and installed in conformance with good engineering practice, such as, but not limited to:

- ASHRAE Handbooks and Standards
- HRAI Digest
- Hydronics Institute Manuals
- CSA B214, “Installation Code for Hydronic Heating Systems”

The NBC 2015, Division B, Article 9.33.4.1. requires that design, construction and installations follow good practice, such as following the standard CSA B214 or CHC Handbook on Hydronic Heating Systems. The owner is required to show that the layout and the calculations for compliance with the NBC are prepared by a competent designer. Since adopted on January 1, 2019, Section 9.36. of the NBC and the provisions of the NECB 2017 should also be taken into account in the calculations required for heat gain and loss.

Further, NBC 2015, Division B, Article 9.33.4.2. requires all installers of hydronic systems to conform to applicable provincial or territorial regulations, municipal bylaws or, in the absence of such requirements, to CSA B214.

CSA B214 and Other Regulations

CSA B214 provides the minimum provisions for installation, extension, alteration and renewal of hydronic systems, this guide will focus on:

- design of hydronic systems;
- construction of hydronic systems; and,
- installation of hydronic systems.

Design of Hydronic Systems

The design of all hydronic systems must meet the requirements of the NBC 2015. This includes complying to Part 6 for large buildings, as well as Section 9.33. for buildings that are in the scope of Part 9 of the NBC 2015.

NBC 2015, Division B, Article 9.33.4.1. outlines that compliance for designs must:

“...with good practice such as that described in the ASHRAE Handbooks and Standards, the HRAI Digest, the CHC Handbook on Hydronic Heating Systems, the Hydronics Institute Manuals and the SMACNA Manuals.”

Local authorities should review documentation to ensure the hydronic design complies with all provisions of the NBC 2015, and take into account Section 9.36. Energy Efficiency for small buildings.

Construction of Hydronic Systems

Once design approval has been granted by building permit, CSA B214 outlines additional provisions during the construction of hydronic systems including the provision that hydronic systems be installed in accordance with applicable code(s) and/or the manufacturer instructions. Additional provisions include the training of personnel, quality of work, and accessibility for serviceable components. In addition, the heating appliance used for the hydronic system is to be installed and protected during construction or renovation, as per manufacturer’s recommendations and installation codes.

Installation of Hydronic Systems

CSA B214 is the primary installation standard for hydronic systems in Part 9 buildings. Local authorities should be aware of the requirements in CSA B214 for the installation of hydronic systems, unless there are local bylaws in effect which regulate hydronic systems. Additionally, installers of hydronic systems should also be aware of the role they play with compliance of CSA B214. Some of the key factors to account for both parties include:

- hydronic fluid quality (water);
- responsibility of installer;
- system documentation and operational instructions;
- pipe diameter, spacing and lengths;
- heating and system requirements & standards;
- system heating maximums; and
- insulation requirements.

Hydronic Fluid Quality (Water)

CSA B214 states:

“The water used to fill the system shall fulfill the requirements of pH and hardness as specified by the manufacturers of the various system components. Any additives or glycol/ antifreeze solutions added to this water should result in a final hydronic fluid acceptable to the manufacturers of the various system components”

Responsibility of Installer

CSA B214 states:

“Before leaving an installation, the installer shall ensure that the installed system complies with the requirements of this Code (CSA B214) and, after activating the system, shall ensure that the system is in safe working order and is operating as intended by the system design.”

The Saskatchewan Codes of Practice, Gas Installation Supplement for CSA-B149.1 also has requirements specifically for installations of hydronic systems and their components. Installers should be aware of these provisions to comply with CSA B214 in conjunction with CSA B149.1.

Below is a link for the Saskatchewan Codes of Practice, Gas Installation Supplement for CSA-B149.1, provided through SaskPower’s website:

<https://www.saskpower.com/Accounts-and-Services/Permits-and-Inspections/Gas-Permits/Gas-Codes-Inspection-Act-and-Regulations>

System Documentation and Instructions

Installers are required to leave system documentation as well as manufacturer’s operational instructions for the owners/operators of the building. Documentation should be left by the primary heating equipment, or if that is not practical, near the main electrical panel.

Pipe Diameter, Spacing and Lengths

Within CSA B214, requirements for pipes are specified due to the unique placement and operation within a hydronic system. Therefore, careful selection of pipe for a hydronic system should be site specific to maximize the systems potential.

Heating and System Requirements & Standards

CSA B214 requires that all system components shall be in compliance with the installation code, and/or any standards that apply to them. For example, the pipes and appropriate fittings chosen for a hydronic system should comply to all applicable standards (CSA, ASTM, ISO, etc.) in order to meet compliance to CSA B214.

System Heating Maximums

CSA B214 requires that any radiant under-floor heating system installed shall not exceed the following floor surface temperatures:

- 29°C (84°F) in occupied areas;
- 31°C (88°F) in industrial spaces;
- 33°C (91°F) in bathrooms, indoor swimming pools, foyers; and,
- 35°C (95°F) in radiant panel perimeter areas (i.e. up to 0.8 m (2.5 ft) from outside walls).
- For applications of radiant heating panels, the maximum temperature rating of any of the materials used in the construction of the radiant heating panel shall be protected with a high limit control as specified within CSA B214.

Tube Placement

CSA B214, Clause 14.3 has requirements for installation of system tubing variance from design, if the manufacturers specifications cannot be met. The spacing required for tube placement shall not vary more than +/-10% unless on-site conditions conflict with the design in which the variance may not be more than +/- 20%.

Consultation with a designer is key prior to installation to ensure that a system is as efficient as possible.

Insulation Requirements

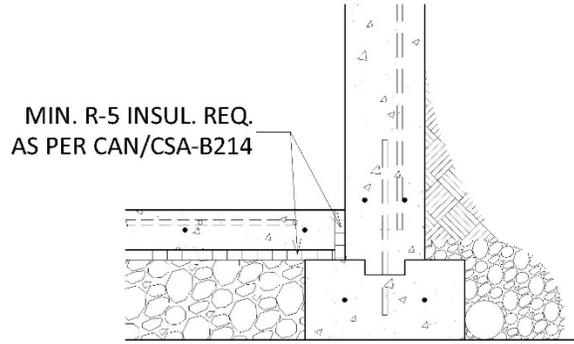
Insulation requirements are outlined in CSA B214 and are dependent on the location of the hydronic system to the materials around it and the building. For example, if the hydronic system is within a slab or floor assembly, the following illustrations reflect CSA B214 insulation requirements only. Energy efficiency requirements found in NBC 2015, Section 9.36. or the NECB 2017 may impact the insulation requirements for hydronic systems.

NOTE: The illustrations on the following pages are provided as examples only. Each project should be based on project specific requirements.

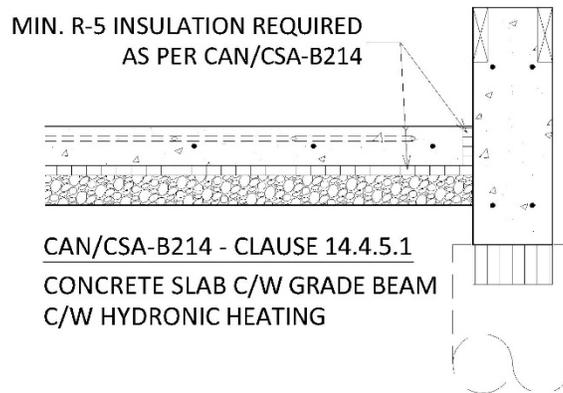
CSA B214 - Clause 14.4.5.1

Insulation with a minimum RSI of 0.9 (R-5) for poured concrete radiant floor system in contact with soil underneath shall:

- a) be placed between the soil and the concrete (see Illustration 1)
- b) extend as close as practical to the outside edges of the concrete (see Illustration 2); and
- c) be placed on all slab edges (see Illustration 3)

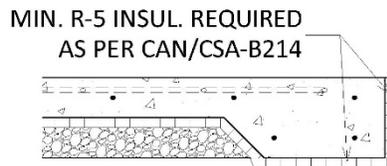


CAN/CSA-B214 - CLAUSE 14.4.5.1
CONCRETE FOUNDATION SLAB
C/W HYDRONIC HEATING
Illustration 1 (example only)



CAN/CSA-B214 - CLAUSE 14.4.5.1
CONCRETE SLAB C/W GRADE BEAM
C/W HYDRONIC HEATING

Illustration 2 (example only)

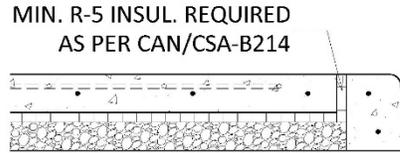


CAN/CSA-B214 - CLAUSE 14.4.5.1
CONCRETE THICKENED EDGE SLAB
C/W HYDRONIC HEATING

Illustration 3 (example only)

CSA B214 - Clause 14.4.5.2

Insulation with a minimum RSI of 0.9 (R-5) for poured concrete radiant floor system installed on grade shall be placed on all vertical slab edges. (see Illustration 4)

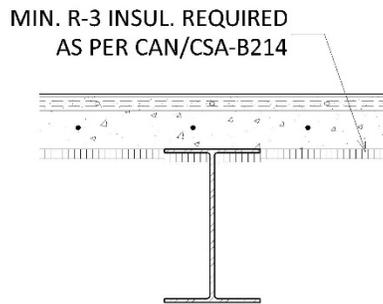


CAN/CSA-B214 - CLAUSE 14.4.5.2
CONCRETE SLAB (SNOW MELT)
C/W HYDRONIC HEATING

Illustration 4 (example only)

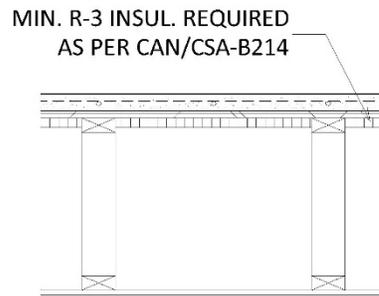
CSA B214 - Clause 14.4.5.4

For a poured concrete radiant floor system where there is habitable spaces above and below, the total RSI value of the floor system shall be greater than the total RSI value of the material lying above the concrete slab, but the floor system shall not have an RSI value less than 0.5 (R-3). (See Illustrations 5 and 6.)



CAN/CSA-B214 - CLAUSE 14.4.5.4
POURED CONCRETE
C/W HYDRONIC HEATING

Illustration 5 (example only)



CAN/CSA-B214 - CLAUSE 14.4.5.4
CONCRETE TOPPING OVER
SUBFLOOR C/W HYDRONIC HEATING

Illustration 6 (example only)

CSA B214 - Clause 14.5.4.1

When tubing is installed in a joist cavity, the insulation in the cavity shall have a minimum RSI of 2.1 (R-12). When there is insulation installed in the joist cavity, there shall be a 50 mm (2 inch) continuous gap maintained from the underside of the floor unless a conductive plate is used. (See Illustration 7.)

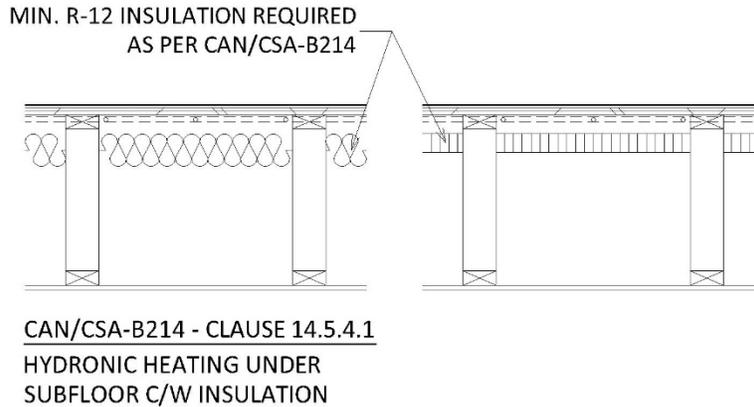


Illustration 7 (example only)

CSA B214 - Clause 14.5.4.3

When tubing is installed above or in the subfloor and not in concrete, the floor assembly shall be insulated with a minimum RSI of 2.1 (R-12) below the tubing. (See Illustration 8.)

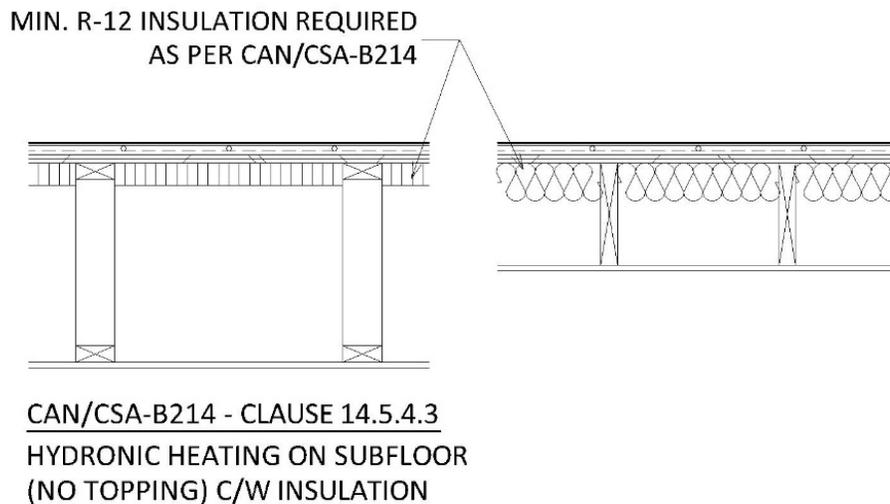


Illustration 8 (example only)

CSA B214 - Clause 14.6.1

When piping is installed in a wall cavity or a ceiling joist cavity, insulation requirements are similar to floor assemblies. The insulation shall have an RSI of at least 2.1 (R-12) where the insulation shall be installed in a way to direct the heat towards the intended heated space. Similarly, there should be an air space of 50 mm (2 inches) between the insulation and the interior of surface of the panel unless a conductive plate is used.

CSA B214 - Clause 17.5

Snow melt applications (e.g., sidewalks, ramps, driveways, etc.) require insulation under the poured slab and compacted grade, extended as close as possible to the edges, and all vertical edges. The insulation shall have an RSI value of 0.9 (R-5). (see Illustration 4)

Other Considerations

Other considerations that should be taken into account for loads on the hydronic system include:

- heat exchangers;
- indirect-fired domestic hot water heater (storage tank with heat exchanger capabilities);
- auxiliary systems (pools or spas); and/or,
- snow melt application of hydronic system.

Other Code Requirements

In addition to the NBC 2015 which applies to all buildings, the province of Saskatchewan also adopts other codes and standards related to electrical installations, gas installations, and plumbing systems.

Canadian Electrical Code

The CAN/CSA C22.1 Canadian Electrical Code (Part I) establishes safety standards for electrical installations. The adoption and enforcement of this standard is assigned to the Gas and Electrical Inspections Divisions of SaskPower.

Natural Gas and Propane Installation Code

The CAN/CSA B149.1 Natural Gas and Propane Installation Code establishes the safety standards for the installation of gas appliances, equipment, components and accessories, piping and tubing systems for natural gas and propane. The adoption and enforcement of this standard is assigned to the Gas and Electrical Inspections Divisions of SaskPower.

National Plumbing Code

The National Plumbing Code (NPC) sets out the technical provisions for the design and installation of new plumbing systems and also applies to the extension, alteration, renewal and repair of existing plumbing systems. The adoption of the NPC is assigned to the Ministry of Health. Enforcement is assigned to the cities of Lloydminster, Regina and Saskatoon in their respective jurisdictions and to the Saskatchewan Health Authority throughout the rest of Saskatchewan.

Other Information

The NBC references many standards, such as CSA B214. These standards are published by accredited standards development organizations in Canada and other countries. Referencing a document in a Code has the effect of making the provisions of that document part of the NBC.

Documents referenced in a Code apply only to the extent that they relate to buildings and the part of the Codes where they are referenced. If there is conflict between a Code provision and a referenced document, the provisions of the Codes govern.

Referenced documents shall be the edition designated by the Codes currently adopted for use in Saskatchewan.

Contact Information

The Ministry of Government Relations is responsible for development, adoption and implementation of the NBC 2015 and NECB 2017. For more information, please contact Building Standards and Licensing.

Building Standards and Licensing Branch - Ministry of Government Relations

Email Inquiries	building_standards@gov.sk.ca
Telephone Inquiries	306-787-4113
Web Information	www.saskatchewan.ca/buildingstandards
Office	Suite 100, 1855 Victoria Avenue REGINA SK S4P 3T2

Appendix 'A'

CSA B214 Checklist	v	X
• Is the designer competent for the design (i.e., certification, experience, etc.)	<input type="radio"/>	<input type="radio"/>
• Does the design meet the needs of the end user (i.e., zones, location, etc.)?	<input type="radio"/>	<input type="radio"/>
• Does the installer have previous experience with hydronic systems with knowledge of the applicable codes (NBC, NECB or CSA B214)?	<input type="radio"/>	<input type="radio"/>
• Does the insulation meet the CSA minimum requirements?	<input type="radio"/>	<input type="radio"/>