Minnesota Rules, Chapter 1322
Residential Energy Code
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1322.0010 DEFINITIONS

ACCESSIBLE signifies acces that requires the removal of an access panel or similar removable obstruction
ACCESSIBLE, READILY signifies access with the necessity for removing a panel or similar obstruction
ACCA "Air Conditioning Contractors of America" or ACCA means the Air Conditioning Contractors of America
AIR CIRCULATION, FORCED A means of providing space conditioning utilizing movement of air through ducts or plenums by mechanical means
AIR, EXHAUST. Air discharged from any space to the outside by the residential ventilation system.
AIR, OUTDOOR. The air that is taken from the external atmosphere and therefore, not previously circulated through the HVAC system or the conditioned space.
AIR -CONDITIONING SYSTEM A system that consists of heat exchangers, blowers, filters, supply, exhaust and return air systems, and shall include any apparatus installed in connection therewith.
ASHRAE. "American Society of Heating, Refrigerating, and Air-Conditioning Engineers" or "ASHRAE" means the American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM. "American Society for Testing and Materials" or "ASTM" means the American Society for Testing and Materials.
BALANCED VENTILATION SYSTEM. A residential ventilation system where the design fan powered exhaust air, is equal to the fan powered supply air.
BUILDING Building means only a one- or two-family dwelling or portion thereof, including townhouses, that is used, or designed or intended to be used for human habitation, living, sleeping, cooking, or eating purposes, or any combination thereof, and shall include accessory structures
CONDITIONED SPACE For energy purposes, space within a building that is provided with heating or cooling equipment or or systems capable of maintaining, through design or heat loss or gain, 50 degrees Farenheit (10 degrees Celcius) at winter design conditions and 85 degrees farenheit (29 degrees celcius) at summer design conditions, or communicates directly with conditioned space. For mechanical purposes, an area, room, or space being heated or cooled by any equipment or appliance.
CUBIC FEET PER MINUTE (CFM). The quantity of air moved in one minute. A measurement typically applied to ventilation equipment.
ENERGY RECOVERY VENTILATOR (ERV) A device or combination of devices applied to transfer energy and moisture from the exhaust air stream for use within the dwelling.
EXHAUST VENTILATION SYSTEM. A residential ventilation system where a fan provides exhaust air and supply air is not fan powered.
FORCED AIR CIRCULATION SYSTEM. An air heating or cooling system.
FURNACE A vented heating appliance designed or arranged to discharge heated air into a conditioned space or through a duct or ducts.
HEAT RECOVERY VENTILATOR. **HRV.** means a device or combination of devices applied to transfer energy from the exhaust air stream for use within the dwelling

HVI. "Home Ventilating Institute" OR "hvi" MEANS THE Home ventilationg Institute
INTERNATIONAL BUILDING CODE OR IBC. "International Building Code" or "IBC" means the International Building Code as promulgated by the International Codes Council, Falls Church VA 22041 and as adopted in reference in part 1305.0011.
INTERNATIONAL RESIDENTIAL CODE OR IRC. "International residential Code"or "IRC" means the International Residential Code as promulgated by the International Codes Council, Falls Church VA 22041 and as adopted in reference in part 1309.0010.
MANUFACTURERS INSTALLATION INSTRUCTIONS. Printed instructions included with equipment as part of the conditions of listing and labeling.
MECHANICAL VENTILATION. The mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.
NATIONAL FENESTRATION RATING COUNCIL OR NFRC. "National Fenestration Rating Council" or "NFRC" means the National fenestration Rating Council.

1322.0015 ADMINISTRATION AND PURPOSE

Subpart. 1 Administration This code shall be administered according to chapter 1300.

Subpart 2. Purpose The purpose of this chapter is to establish a minimum code of standards for the construction, reconstruction, alteration, and repair of buildings governing, matters including design and construction standards regarding heat loss control, illumination, climate control and radon control methods pursuant to Minnesota Statues, sections 16B.59, 16B.61 and 16B.64

1322.0020 CODES ADOPTED BY REFERENCE.

A. The 2006 edition of the International Residential Code (IRC), chapter 11, is incorporated by reference and made part of the Minnesota State Building Code, except as qualified by the applicable provisions in chapter 1300, and as amended in this chapter. Chapter 11 of the 2006 IRC is not subject to frequent change, and a copy, with amendments for use in Minnesota, is available in the office of the commissioner of labor and industry. Portions of this chapter reproduce text and tables from chapter 11 of the 2006 IRC. The IRC is copyright 2006 by the International Code Council. All rights reserved.

B. The following standards and references are incorporated by reference:

ASHRAE, 2005 Handbook of Fundamentals, chapter 29;

ASTM E779-87(1992), Standard Test Method for Determining Air Leakage Rate by Fan Pressurization;

ASTM E1677-95, Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls;

HVI Standard 915-2006, Loudness Testing and Rating Procedures;

HVI Standard 916-2005, Airflow Test Procedure;

HVI Standard 920-2005, Product Performance Test Procedure;

HVI Standard 920-2005, Product Performance Certification Procedure;

ACCA Manual J, Load Calculation for Residential Winter and Summer Air Conditioning, 8th ed., Air Conditioning Contractors of America;

Rescheck, residential energy code software, published by the U.S. Department of Energy;

NFRC 100-2001, Procedure for Determining Fenestration Product U-factors, National Fenestration Rating Council.

NFRC 400-2001, Procedure for Determining Fenestration Product Air Leakage, National fenestration Council; and

101/l.s.2/A440-05 Specification for Windows, doors, and Skylights. American Architectural Manufacturers Association, Canadian Standards Association, Window and Door manufacturers Association.

1322.1101, SECTION N1101, GENERAL.

N1101.1 Scope. This chapter regulates energy efficiency for the design and construction of buildings regulated by the International Residential Code (IRC) as adopted and amended by the state of Minnesota. This chapter shall also be used to regulate the energy efficiency for the design and construction of new residential buildings regulated by the International Building Code (IBC) as adopted and amended by the state of Minnesota that are not more than three stories in height and contain no conditioned common space that is shared between dwellings, and each dwelling unit contains a separate means of egress. The intent of these criteria is to provide a means for furnishing quality indoor air, assuring building durability, and permitting energy efficient operation. Persuant to part 1322.2100, Appendix F of the 2006 International Residential Code (IRC) applies to all residential buildings covered by this chapter. Enforcement of this chapter shall not abridge safety, health or environmental requirements under other applicable codes or ordinances.

Exceptions:

1. Portions of the building that do not enclose conditioned space, including garages
2. Insulation R-values, air barrier, and vapor retarder requirements are not required for existing foundations, crawl space walls, and basements in existing dwellings or existing dwelling units whose alteration or repair require a permit if the original dwelling's permit was issued before the effective date of this chapter
3. Additions to existing dwelling's or dwelling units may be made without making the entire dwelling or dwelling unit comply, provided that the addition complies with all the requirements of this chapter.
4. Alteration or repairs to existing dwellings or dwelling units may be made without making the entire dwelling or dwelling unit comply, provided the alteration complies with as many requirements of this chapter as feasible, as determined by the designated building official.
5. Buildings that have been specifically designated as historically significant by the state or local governing body, or listed or determined to be eligible for listing in the National Register of Historical Places.
6. If a building houses more than one occupancy, each portion of the building must conform to the requirements for the occupancy housed in that portion.

7. This chapter does not cover buildings, structures, or portions of buildings or structures whose peak design energy rate usage is less than 3.4 Btu per hour per square foot or 1.0 Watt per hour per square foot of floor area for all purposes.

N1101.2 Compliance. Compliance shall be demonstrated by meeting the requirements of this chapter. Climate zones from Table N1101.2.1 shall be used in determining the applicable requirements from this chapter.

Table N1101.2.1

Minnesota

Northern Zone		Southern Zone	
Aitkin	Lake of the Woods	Anoka	Meeker
Becker	Mahnomen	Benton	Mower
Beltrami	Marshall	Big Stone	Murray
Carlton	Mille Lacs	Blue Earth	Nicollete
Cass	Morrison	Brown	Nobles
Clay	Norman	Carver	Olmstead
Clearwater	Otter Tail	Chippewa	Pipestone
Cook	Pennington	Chisago	Pope
Crow Wing	Pine	Cottonwood	Ramsey
Douglas	Polk	Dodge	Redwood
Grant	Red Lake	Dakota	Renville
Hubbard	Roseau	Faribault	Rice
Itasca	St Louis	Fillmore	Rock
Kanabec	Todd	Freeborn	Scott
Kittson	Traverse	Goodhue	Sherburne
Koochiching	Wadena	Hennipen	Sibley
Lake	Wilkin	Houston	Stearns
		Isanti	Steele
		Jackson	Stevens
		Kandiyohi	Swift
		La Qui Parle	Yellow Medicine
		Les Sueur	Wabasha
		Lincoln	Waseca
		Lyon	Watonwan
		Martin	Winona
		Mc Leod	Wright

N1101.3 Identification. Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

N1101.3.1 Plans and specifications Plans and specifications shall show in sufficient detail pertinent data and features of the building, the equipment, and the systems as governed by this chapter, including, but not limited to: design criteria, exterior envelope component materials and their locations, U-factors of the envelope systems, R-values of insulating materials, size and type of apparatus and equipment, equipment and system controls, and other pertinent data to indicate conformance with the requirements of this chapter.

N1101.4 Building thermal envelope insulation. All thermal insulation must conform to Minnesota Rules, chapter 7640 Minnesota Thermal Insulation Standards, adopted by the Department of Commerce. Insulation shall be manufactured for its intended use, installed according to the manufacturers specifications and be no less than the stated performance at winter design conditions. Insulation used on the exterior for the purpose of insulating foundation walls shall be a water resistant material and comply with ASTM C578, C612, or other approved standards. An *R*-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or more wide. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the building thermal envelope as described in section N1101.8. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed

density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the area covered and *R*-value of installed thickness shall be listed on the certificate. When using blown or sprayed insulation (fiberglass, cellulose or sprayed polyurethane foam) requirements from sections N1101.4.1, N1101.4.1.1and N1101.4.1.2 shall be met accordingly.

N1101.4.1 Blown or sprayed roof /ceiling insulation Installation of blown or sprayed roof /ceiling insulation must comply with sections N1104.1.1 and N1104.1.2.

N1101.4.1.1 Attic thickness markers The thickness of blown in or sprayed roof /ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 100 ft^2 (9.3 m^2) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) high. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be listed on the certificate provided by the insulation installer.

N1101.4.1.2 Attic insulation card A signed and dated insulation receipt attic card must be attached to the framing near the access opening, in a clearly visible place, and posted with the certificate required by N1101.8. The attic card must identify the type of insulation installed, the manufacturer, the installer, the R-value per inch, the designed settled thickness, the square footage of attic coverage area, and the number of bags installed.

N1101.4.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

N1101.5 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100-2001, air leakage shall be determined in accordance with Section N1102.4.2. Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from Tables N1101.5(1) and N1101.5(2).

Table N1101.5(1) Default Glazed Fenestration U-Factors

Frame Type	Single pane Fenestration	Double pane Fenestration	Single pane Skylight	Double pane Skylight
Metal	1.20	0.80	1.60	1.05
Metal With Thermal Break	1.1	0.65	1.9	1.1
Non metal or metal clad	0.95	0.55	1.25	0.80
Glass Block	0.6	0.6	0.6	0.6

Table N1101.5(2) Default Door U Factors

Door Type	U-Factor
Uninsulated Metal	**1.2**
Insulated Metal	**0.6**
Wood	**0.5**
Insulated, Non-metal edge, max 45% glazing, any glazing double pane	**0.35**

N1101.6 Installation. Materials, systems and equipment shall be installed according to the manufacturer's installation instructions, the conditions of any listing or required certifications and this code.

N1101.8 BuildingCertificate. A building certificate shall be posted in a permanently visible location inside the building. The certificate shall be completed by the builder and shall list information and values of components listed in table N1101.8

Table 1101.8

Component	**Certificate requirements**
Date certificate is installed	Posted date
Dwelling or dwelling unit location	Mailing address and city
Residential Contractor	Name of licensed residential contractor
Insulation installed in or on ceiling/roof, walls, slab-on-grade and floor	Type and installed R-value
Rim joist and foundation wall insulation	Installed R-value, type and whether the insulation is exterior, integral or interior
Fenestration	Average U-factor and SHGC
Ducts outside conditioned spaces	Installed R-value
Mechanical ventilation system	Type, location and design continuous & total ventilation rates
Make-up air & combustion air systems (if installed)	Type, location and size
Heating system	Type, input rating, AFUE or HSPF, manufacturer, model and the structures calculated heat loss
Domestic water heater	Type, size, manufacturer, and model,
Cooling system (if installed)	Type, output rating, SEER, manufacturer and model, calculated cooling load and the structures calculated heat gain
Radon Control System	Passive or Active

1322.1102 IRC SECTION N1102, BUILDING THERMAL ENVELOPE

N1102.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Tables N1102.1 and/or table N1102.1.2 based on the climate zone specified in Table N1101.2.

Exceptions:

1. When Using the R_Value computation method in Section N1102.1.1 individual components materials can be substituted with those that meet N1102.1.2, U-factor alternative.
2. When the provisions of Section N1102.1.3, Total UA alternative are met.
3. When the provisions of Section N1102.1.4, REScheck software alternative are met.
4. When the provision of Section N1102.1.5, Engineered Systems alternative are met.

N1102.1.1 *R*-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films. The thermal performance of a foundation insulation system that is not continuous or a concrete masonry block wall assembly with integral insulation must be determined by paragraph 1 or 2, and must exclude air film coefficients and the R-value of the surrounding soil.

1. The thermal performance must be calculated in accordance with ASHRAE Handbook of Fundamentals isotherm planes calculation method certified by a professional engineer registered in Minnesota
2. The thermal performance must be measured in accordance with the ASTM C 236 test procedure for thermal transmittance measurement performed by an approved laboratory as defined in Minnesota rules Chapter 7640.

N1102.1.2 *U*-factor alternative. An assembly with a *U*-factor equal to or less than that specified in Table N1102.1.2 shall be permitted as an alternative to the *R*-value in Table N1102.1.

N1102.1.3 Total UA alternative. If the total building thermal envelope UA (sum of *U*-factor times assembly area) is less than or equal to the total UA resulting from using the *U*-factors in Table N1102.1.2, the building shall be considered in compliance with Table N1102.1. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials.

Table N1102.1.

Insulation and Fenestration Requirements by Component[a]

Climate Zone	Fenestration[b] U-Factor	Skylight U-Factor	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value[f]	Floor R-Value	Foundation Wall & Rim Joist R-Value	Slab[c] R-Value & Depth	Crawl Space Wall R-Value
Southern	0.35	0.60	38	19 or 13+5[e]	15	30[d]	10	10, 3.5 ft	10
Northern	0.35	0.60	44	19	15	30[d]	10	10, 5 ft	10

(a) R-values are minimums. U-factors are maximums. R-19 shall be permitted to be compressed into a 2x6 cavity.
(b) The fenestration U-factor column excludes skylights.
(c) R-5 shall be added to the required slab edge R-values for heated slabs
(d) Or insulation sufficient to fill the framing cavity, R-19 minimum.
(e) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
(f) When Using log type Construction for thermal mass walls, the following shall apply
1. A minimum of a 7 inch diameter log shall be used
2. The U-value of fenestration products shall be 0.31 overall on average or better.

Table N1102.1.2

Equivalent U-Factors[(a)]

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
South	0.35	0.60	0.026	0.060	0.077	0.033	0.10	0.10
North	0.35	0.60	0.023	0.060	0.077	0.033	0.10	0.10
(a) Non-fenestration U-factors shall be obtained from measurement, calculation or an approved source.								

N1102.1.4 REScheck alternative A building shall be deemed to meet the requirements of section N1102 if the thermal envelope passes, using the U.S. Department of Energy's (DOE) REScheck software version with equivalencies as determined by the state of Minnesota. Alternatives are not permitted to be below the minimum R-values or above the maximum U-values allowed by tables N1102.1or N1102.1.2

N1102.1.5 Thermal Envelope System Alternative (**Engineered system alternative.)** A building shall be deemed to meet the requirements of Section N1102 if there is a designed drawing that has been certified by an architect or engineer licensed in Minnesota, Persuant to Minnesota Statutes, sections 326.02 to 326.15, certifying that it is equal to or better than the total energy efficiency performance of a building, including all of its systems, and that it is built meeting the requirements of this code.

N1102.2 Insulation Requirements

N1102.2.2 Ceilings without attic spaces. Where Section N1102.1 requires insulation levels above R-30 and the design of the roof / ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof / ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section N1102.1 shall be limited to 500 ft^2 (46 m^2) of ceiling area.

N1102.2.3 Mass walls. Mass walls, for the purposes of this chapter, shall be considered walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs. The provisions of Section N1102.1 for mass walls shall be applicable

N1102.2.4 Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table N1102.2.4 or shall meet the *U*-factor requirements in Table N1102.1.2. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

.Table N1102.2.4. Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

Wood Frame R-Value Requirement	Cold-Formed Steel Equivalent R –Value[1]

Steel Truss Ceilings[2]	
R-38	R-49 or R-38+3
R-44	R-38+5
Steel Joist Ceilings[2]	
R-30	R-21+R-6 in 2x6, R-21 + r-12 in 2x8 or 2x10
R-38	R-49 in 2x4 or 2x6 or 2x8 or 2x10
Steel Framed Wall	
R-19	R-13+9 or R-19+8 or R-25+7
Steel Joist Floor	
R-30	R-21+R-6 in 2x6 R-21+R-12 in 2x8 or 2x10
Notes: a. Cavity insulation R-value is listed first, followed by a "+" and the continuous insulation R-value, if applicable. b. Insulation exceeding the height of the framing shall cover the framing.	

N1102.2.5 Floors. Floor insulation shall be installed to maintain permanent contact with the underside of the sub-floor decking

N1102.2.6 Foundation Wall Insulation Prescriptive Option.

N1102.2.6.1 Foundation insulation Foundation insulation of basement and crawl space walls and the perimeter of slab-on grade floors must comply with this section. Insulation materials shall be installed according to manufacturer's installation specifications and any additional requirements of sections N1102.2.6.1 through N1102.2.6.11. Adding additional insulation to increase R-values or adding an additional vapor retarder to foundation wall assemblies, other than those required in this section, is prohibited.

Exceptions:

1. Foundation walls enclosing unconditioned spaces shall meet this requirement unless the floor overhead is insulated in accordance with Section N1102.1.
2. Permanent wood foundations shall meet the requirements of R401.1.
3. Frost protected shallow foundations shall meet the requirements of R403.3
4. Insulating concrete form materials shall meet the requirements of Section R611.

N1102.2.6.2 Basement foundation and crawl space walls. Basement foundation and crawl space walls shall be insulated from the top of the foundation wall down to the top of the footing or from the top edge of the interior wall to the top of the slab if insulation is on the interior.

N1102.2.6.3 Slab-on-grade and basement walkout foundation walls. Slab-on-grade and basement walkout foundation wall insulation shall extend to the design frost line or top of footing whichever is less. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall. Slab-

edge insulation is not required in jurisdictions designated by the code official as having termite infestation.

N1102.2.6.4 Foundation wall and rim joist area thermal insulation requirements. The foundation wall system and rim joist area shall have an insulating layer with minimum thermal properties as required in this section. The insulation layer must be a minimum R-10 in accordance with Table N1102.1.

Exception: In the Southern Zone, the foundation and rim joist area insulation may be reduced to a minimum of an R-5 if

1. The insulation is located on the exterior or is integral to the foundation wall; and
2. An additional R-5 insulation is added to the minimum attic R-value level; and.
3. The heating system meets the minimum efficiency ratings in Table N1102.2.6.4; and
4. A minimum of a 6 inch energy heel is used for the roof framing and/or truss system.

Table N1102.2.6.4 HVAC System Minimum Efficiency Requirement to Qualify for R-5 Exterior Insulation in the Southern Zone

Heating System Type (that is greater than or equal to)	Minimum Efficiency Rating	
	AFUE	HSPF
Furnace, Gas or Oil Fired	90%	N/A
Boiler, Gas or Oil Fired	85%	N/A
Heat Pump, Split Systems	N/A	8.0
Heat Pump, Single Package or Equipment (including gas/electric package units)	N/A	7.7

N1102.2.6.5 Integral foundation insulation requirements An insulation assembly installed integral to the foundation walls shall be manufactured for its intended use and installed according to the manufacturer's specifications.

N1102.2.6.6 Exterior foundation insulation requirements An insulation assembly installed on the exterior of the foundation walls and the perimeter of slabs on grade:

1. Shall be of water resistant materials manufactured for its intended use;
2. Installed according to the manufacturer's specifications;
3. Shall comply with either ASTM C578, C612 or C1029 as applicable and;
4. Shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (152 mm) below grade. The insulation and protective covering system shall be flashed in accordance with the IRC Section R703.8.

N1102.2.6.7 Interior foundation insulation requirements An insulation assembly installed on the interior of foundation walls shall meet the following provisions:

1. Masonry foundation walls shall be drained through the masonry block cores to an approved interior drainage system.
2. If a frame wall is installed it shall not be in direct contact with the foundation wall, unless that interior side of the foundation wall has been waterproofed.
3. Comply with the interior air barrier requirements in N1102.4.1
4. Comply with section N1102.2.6.8, N1104.2.2.6.9, N1102.2.6.10, or N1102.2.6.11.

N1102.2.6.8 Rigid interior insulation Rigid interior insulation shall comply with the following as applicable

1. Either ASTM C 578 or ASTM C 1289.
2. Dampproofing, waterproofing, or a water repellant shall be applied to the exposed above grade foundation walls or a layer of dampproofing or waterproofing shall be installed on the entire inside surface of the foundation wall. Water repellant materials shall comply

with ASTM E 514 with 90% or greater reduction in water permeance when compared to an untreated sample.

3. Installation requirements

a. Must be in contact with the foundation wall surface

b. Vertical edges shall be sealed with acoustic sealant

c. All interior joints, edges, and penetrations shall be sealed against air and water vapor penetration.

d. Horizontally continuous acoustic sealant between the foundation wall and the insulation at the top of the foundation wall.

e. Horizontally continuous acoustic sealant between the basement floor and the bottom insulation edge.

4. The insulation shall not be penetrated by the placement of utilities or by fasteners or connectors used to install a frame wall.

N1102.2.6.9 Spray applied interior insulation Spray applied interior insulation shall comply with the following as applicable

1. Closed cell polyurethane

a. ASTM C 1029 compliant with a permeance not greater than 1 in accordance with ASTM E 96 procedure A.

b. Sprayed directly onto the foundation wall surface. There must be a 1" minimum gap between the foundation wall surface and any framing.

c. The insulation shall not be penetrated by the placement of utilities.

d. Through penetrations shall be sealed

2. ½ pound free rise open cell foam

a. Sprayed directly onto the foundation wall surface. There must be a 1" minimum gap between the foundation wall surface and any framing.

b. The insulation shall not be penetrated by the placement of utilities.

c. Through penetrations shall be sealed

N1102.2.6.10 Semi-rigid interior insulation Semi-rigid interior insulation shall comply with the following

1. ASTM C1621 with a maximum permeance of 1.1 per inch.

2. Must have a minimum density of 1.3 pcf and have a fungal resistance per ASTM C1338.

3. Installation requirements

a. Must be in contact with the foundation wall surface

b. Vertical edges shall be sealed with acoustic sealant

c. All interior joints, edges, and penetrations shall be sealed against air and water vapor penetration.

d. Horizontally continuous acoustic sealant between the foundation wall and the insulation at the top of the foundation wall..

e. Horizontally continuous acoustic sealant between the basement floor and the bottom insulation edge.

N1102.2.6.11 Unfaced fiberglass batt interior insulation Unfaced fiberglass batt interior insulation shall comply with the following

1. Waterproofing shall be applied to the entire inside surface of the foundation wall.

2. The top and bottom plates must be air sealed to the foundation wall surface and the basement floor.

3. In addition an air barrier material and vapor retarder material with a minimum a permeance of at least 1 in accordance with ASTM E 96 procedure A.

a. Air sealed to the framing with construction adhesive or equivalent at the top and bottom plates and where the adjacent wall is insulated, and

b. Air sealed utility boxes and other penetrations, and

c. All seams shall be overlapped at least 6 inches and sealed with compatible sealing tape or

equivalent.

d. Up to R-13 batts are allowed.

N1102.2.6.12 Foundation Wall Insulation Performance Option. Insulated foundation systems designed and installed under the performance option shall meet the requirements of this section.

N1102.2.6.12.1 Water separation plane. The foundation shall be designed and built to have a continuous water separation plane between the interior and exterior. The interior side of the water separation plane must:

1. Have a stable annual wetting/drying cycle whereby foundation wall system water (solid, liquid and vapor) transport processes produce no net accumulation of ice or water over a full calendar year and the foundation wall system is free of adsorbed water for at least 4 months over a full calendar year;

2.Prevent conditions of moisture and temperature to prevail for a time period favorable to mold growth for the materials used; and

3.Prevent liquid water from the foundation wall system reaching the foundation floor system at any time during a full calendar year.

N1102.2.6.12.2 Documentation. The foundation insulation system designer shall provide documentation certified by a professional engineer registered in Minnesota demonstrating how the requirements of this section are fulfilled. The foundation insulation system designer shall also specify the design conditions for the wall and the design conditions for the interior space for which the water separation plane will meet the requirements of this section. The foundation insulation system designer shall provide a label disclosing these design conditions and the label shall be posted in accordance with N1101.8.

N1102.2.6.12.3 Installation. The *water separation plane* shall be designed and installed to prevent external liquid or capillary water flow across it after the foundation is backfilled.

N1102.2.6.12.4 Foundation air barrier. The foundation insulation system shall be designed and installed to have a foundation air barrier system between the interior and the exterior. The foundation air barrier system must be a material or combination of materials that is continuous with all joints sealed and is durable for the intended application. Material used for the foundation air barrier system must have an air permeability not to exceed 0.004 $ft^3/min.ft^2$ under a pressure differential of 0.3 in. water (1.57psf) (0.02 $L/s.m^2$ at 75Pa) as determined by either commonly accepted engineering tables or by being labeled by the manufacturer as having these values when tested in accordance with ASTM E2178.

N1102.2.9 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

N1102.2.10 Thermally isolated sunroom insulation. Sunrooms that are capable of maintaining, through design or heat loss, 50 degrees farenheight, (10 degrees celcius) during the heating season shall meet the building thermal envelope requirements of table N1102.1 or Table N1102.1.2. New ceilings and walls separating the thermally isolated sunroom from conditioned space shall meet the

building thermal envelope requirements of Table N1102.1 or Table N1102.1.2

Exception Insulation is not needed in ceilings, walls and floors that do not separate the sunroom from conditioned space and when the sunroom is not capable of maintaining, through design or heat gain, 50 degrees farenhiet (10 degrees celcius) during the heating season.

N1102.3 Fenestration.

N1102.3.1 *U*-factor. An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

N1102.3.2 Glazed fenestration exemption. Up to 15 square feet (1.4 m^2) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor requirements in Section N1102.1.

N1102.3.3 Opaque door exemption. One opaque door assembly is exempted from the *U*-factor requirement in Section N1102.1.

N1102.3.4 Thermally isolated sunroom *U*-factor. New windows and doors separating the sunroom from conditioned space shall meet the building thermal envelope requirements.

N1102.3.5 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, excluding those items considered as repair or maintanence the replacement fenestration unit shall meet the applicable requirements for *U*-factors found in Table N1102.1 or Table N1102.1.2 unless exempt under section N1102.3.3

N1102.4 Thermal envelope air leakage.

N1102.4.1 Interior air barrier The building thermal envelope shall be continuously sealed to limit the leakage of air through the thermal envelope. The air barrier shall be installed on the warm-in-winter side of the thermal insulation. Areas of potential air leakage in the building thermal envelope shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material to form an effective barrier between conditioned and unconditioned spaces. The integrity of all air barriers shall be maintained. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

1. walls, floors, ceilings, overhangs, kneewalls, and floor rim joist areas-separating conditioned from unconditioned spaces
2. at all joints, seams and penetrations of the building thermal envelope
3. at all electrical, plumbing, mechanical and other penetrations of the interior air barriers
4. at all interconnections in the thermal envelope between concealed vertical and horizontal spaces such as soffits, drop ceilings, cove ceilings, and similar locations.
5. in concealed spaces between stairs, fireplace framing, partition walls, chases, tubs, and showers directly adjacent to the building thermal envelope
6. at the top of interior partition walls and walls separating dwelling units where they join insulated ceilings.
7. at openings between framing members and window, skylight and door frame and jambs.

Exceptions:

1. Areas that do not separate conditioned from nonconditioned space.
2. When the insulation material or insulated assembly prevents the leakage of air through the thermal envelope.

N1102.4.2 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cubic foot per minute per square foot [1.5(L/s)/m2], and swinging doors no more than 0.5 cubic foot per minute per square foot [2.5(L/s)/m2], when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/ A440 by an accredited, independent laboratory, and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

N1102.4.3 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces by being:

1. IC-rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space;
2. IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 pounds per square foot (75 Pa) pressure differential with no more than 2.0 cubic feet per minute (0.944 L/s) of air movement from the conditioned space to the ceiling cavity; or
3. Located inside an airtight sealed box with clearances of at least 0.5 inch (13 mm) from combustible material and 3 inches (76 mm) from insulation.

N102.4.4 Exterior wind wash barrier An exterior wind wash barrier must be installed in the following areas when they separate conditioned from non-conditioned spaces. Where a sealed wind wash/weather barrier is required it must be sealed prior to covering or making it inaccessible. All penetrations in the wind wash/weather barrier must be sealed to prevent the intrusion of water and airborne moisture. In all other locations the wind wash/weather barrier shall be tightly fit to framing members and building components

1. Between an attached garage and interior conditioned spaces; (tightly fit)
2. At the exterior edge of the exterior wall top plate extending vertically to the underside of the truss top cord, or for non truss wood framing to within three and one half inches of the roof deck, or to the top of the ceiling insulation. (tightly fit)
3. At all exterior walls and all rim joist areas. (tightly fit)
4. At all cantalevers, cantilevered rims and floors over unconditioned spaces. (sealed)

N1102.5 Vapor diffusion Management

N1102.5.1 Exterior wall vapor retarder Above-grade frame walls, rim joists, floors and ceilings shall be provided with an approved vapor retarder as defined in IRC Section R202. The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation. Sub floor materials that meet the requirements of a vapor retarder are allowed. The vapor retarder does not need to be continuously sealed unless it also serves as an air barrier.

Exceptions:

1. In construction where moisture or its freezing will not damage the materials.

2 Where other approved means to avoid condensation are provided, such as when rim joists, crawl space walls, or basement walls are insulated on the exterior or are integral to the building assembly and meeting the vapor retarder requirements

N1102.5.2 Under-slab Vapor Retarders Under-slab vapor retarders shall meet the provisions of the IRC and appendix F

N1102.5.3 Crawl space floor vapor retarder The floors of crawl spaces shall be covered with a vapor retarder meeting the provisions of the IRC and appendix F

N1102.6 Alterations and repairs to existing residential buildings.

N1102.6.1 Reducing air leakage. If an addition or alteration reduces the air leakage characteristics or capacity of a building then a combustion and makeup air supply must be provided according to the Minnesota Mechanical Code, Chapter 1346. Alterations that will likely reduce the air leakage characteristics or capacity of a building include, but are not limited to, attic insulation, wall insulation, applying siding underlayment, or the replacement of a majority of window or door units.

N1102.6.2 Conversions. A change in the occupancy of an existing building meeting the scoping provisions of this chapter that would require an increase in demand for either fossil fuel or electrical energy supply shall comply with the requirements of this chapter.

EXCEPTION: Existing HVAC and service water heating equipment within an existing building is not required to be replaced.

N1102.6.3 Penetrations. Penetrations resulting as part of an alteration must be sealed. This includes, but is not limited to, penetrations for telecommunication wires and equipment, electrical wires and equipment, electronic wires and equipment, fire sprinklers, plumbing and ducts, and penetrations in exterior walls and ceilings.

N1102.6.4 Roof and ceilings.

A. Attic insulation may not be installed unless accessible attic bypasses have been sealed.

B. A ceiling vapor retarder may be omitted if the interior ceiling finish is not removed.

N1102.6.5 Walls.

A. Storm windows may be installed over existing glazing without meeting the additional requirements of this chapter.

B. Reglazing and repairs to existing windows are not required to meet the additional requirements of this chapter.

C. Interior wall finish may not be replaced unless wall cavities have been insulated to full depth. This item shall apply whenever plaster is removed, even though lath may not have been removed.

EXCEPTIONS: 1.Walls that are back-plastered and
2. Walls without framing cavities.

D. A vapor retarder is not required if the interior wall finish is not removed.

1322.1103, Section N1103, SYSTEMS

N1103.1 Controls: At least on thermostat shall be provided for each separate heating and cooling system.

N1103.2 Ducts:

N1103.2.1 Insulation: Ducts shall be insulated in accordance with the Minnesota Mechanical Code, Chapter 1346.

Minimum Required Duct Insulation
(see notes for explanations)

Duct Location	Requirements
Attics, garages, and ventilated crawl spaces	R-8 and V
Exterior of building	R-8, V and W
Inside of building and in unconditioned spaces TD less than or equal to 15°F	None required
TD greater than 15°F and less than or equal to 40°F	R-3.3 and V
TD greater than 40°F	R-5 and V
Within conditioned spaces, in basements with insulated walls, and in plenums within conditioned spaces	None required
Intake and exhaust ducts within conditioned spaces*	R-3.3 and V
Within cement slab or within ground (also see IMC Section 603.7)	R-3.5

Notes:

* Insulation required for a distance of 3 feet (914 mm) from the exterior.

TD = Design temperature differential between the air in the duct and the ambient temperature outside of the duct.

V = Vapor retarder required in accordance with the IMC Section 604.11. When a vapor retarder is required, duct insulation required by this section shall be installed without respect to other building envelope insulation.

W = Approved weatherproof barrier.

N1103.2.2 Sealing: Ducts shall be sealed in accordance the Minnesota Mechanical Code, Chapter 1346..

Location	Design Static Pressure	Minimum Required Sealing
All locations	Greater than 3.0 inches (750 Pa) water gauge	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Ductwork shall be equal to or less than Leakage Class 6 as defined in Section 4 of the *SMACNA HVAC Duct Leakage Test Manual**.
Portions of ducts not completely inside the vapor retarder/air barrier enclosing conditioned space	3.0 inches(750 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
Portions of return air ducts in the same space as an atmospherically vented or fan-assisted appliance.	3.0 inches(750 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
All locations	Greater than 0.50 to 3.0 inches (125 to 750 Pa) water gauge	All transverse joints and duct wall penetrations shall be sealed.
All locations	0.50 inches (125 Pa) water gauge and less	All transverse joints, longitudinal seams, and duct wall penetrations shall have no visible gaps and shall be sufficiently airtight in accordance with Section 1.7 of the *SMACNA HVAC Duct Construction Standards - Metal & Flexible.*

N1103.2.3 Supply Ducts: Supply ducts shall be continuously ducted in accordance with Minnesota Mechanical Code, Chapter 1346., from the point of origin to the point of discharge in the habitable spaces. The building framing cavities and building components shall not be used as supply ducts.

N1103.2.4. Domestic Water Piping Insulation: Pipe insulation shall have a k-value of 0.27. If the k-value of a product is less than 0.27, then the thickness shall be adjusted to have an equivalent R-value

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A. **Cold Water:** No insulation required.

Exception:

1. All piping located within 6 inches of any heating pipes, shall have a minimum of 1" insulation with an appropriate vapor jacket.

B. **Hot Water**: No insulation required.

Exceptions:

1. All recirculating systems, shall have a minimum of 0.5” insulation on the entire loop with appropriate vapor jacket.
2. Underground piping, shall have a minimum of 1” insulation with an appropriate vapor jacket.

N1103.2.5. HVAC Piping: Hydronic, steam, and condensate piping in all locations shall be insulated in accordance with Minnesota Mechanical Code, Chapter 1346.

Exceptions:

1. Piping installed within HVAC equipment; or
2. Piping installed in basements, crawl spaces, and cellars.

Insulation Thickness for Nominal Pipe Diameters

Fluid Temperature Range °F	Runouts (See item C)	1 inch (25.4 mm and less)	1.25 to 2" (31.7 to 50.8 mm)	2.5 to 4" (63.5 to 101.6 mm)	5 to 6" (127 to 152 mm)	8" (203 mm) and Larger
Piping System Type - Heating						
Above 350	1.5	2.5	2.5	3.0	3.5	3.5
251-350	1.5	2.0	2.5	2.5	3.5	3.5
201-250	1.0	1.5	1.5	2.0	2.0	3.5
141-200	0.5	1.5	1.5	1.5	1.5	1.5
105-140	0.5	1.0	1.0	1.0	1.5	1.5
Piping System Type - Cooling						
40-55	0.5	0.5	0.75	1	1	1
Below 40 (see item D)	1	1	1.5	1.5	1.5	1.5

A. Insulation thickness in this section assumes a k-value of 0.27. If the k-value of a product is less than 0.22, then the thickness must be adjusted to have an equivalent R-value.

B. For piping exposed to outdoor air, insulation thickness must be 0.5 inch (12.7 mm) greater than required in the table.

C. This column applies only to runouts (branches) 2 inches (50.8 mm) in diameter and less, not exceeding 12 feet (3658 mm) in length, to individual terminal units. All other runouts shall meet the requirements given in other columns in the table, as appropriate.

D. For applications with fluid temperatures of 32°F (0°C) and below, a vapor retarder shall be installed in accordance with IMC Section 604.11.

N1103.2.7: Equipment sizing. Heating and cooling equipment shall be sized per Minnesota Mechanical Code, Chapter 1346, and ACCA manual ‘J’.

N1103.4: : Domestic **circulating hot water systems** Circulating hot water systems shall include an automatic switch that can turn the hot water circulating pump off when the system is not in use or when the circulating loop temperature is satisfied.

SECTION N1104 MECHANICAL VENTILATION SYSTEMS

N1104.1 Mechanical ventilation requirements. A mechanical ventilation system shall be installed that meets the requirements of this section. This section covers the continuous and total mechanical ventilation requirements for whole house ventilation at summer and winter climatic design conditions according to section N1104.4.13 and Minnesota Mechanical Code, Chapter 1346. All unfinished basements, crawlspaces and levels shall be provided with a minimum ventilation rate of .02 cfm per square foot, or a minimum of one supply duct and one return duct. The supply and return

ducts shall be separated by one-half the diagonal dimension of the basement to avoid a short circuit of the air circulation.

Exception: Kitchen and bath fans that are not included as part of the mechanical ventilation system are exempt from the requirements of section N1104 but shall comply with the IRC.

N1104.1.1 Additions or alterations to existing buildings. Additions or alterations to existing buildings shall require a whole house mechanical ventilation system that meets section N1104.

Exception: Buildings whose permit of initial construction was applied for prior to April 15, 2000 and did not require a whole house mechanical ventilation system.

N1104.2 Total ventilation rate. The mechanical ventilation system shall provide sufficient outdoor air to equal the total ventilation rate average, for each one hour period in accordance with Table N1104.2, or equation 11-1, based on the number of bedrooms and the square footage of conditioned space, including the basement but excluding conditioned crawlspaces. For heat recovery ventilators and energy recovery ventilators the average hourly ventilation capacity must be determined in consideration of any reduction of exhaust or outdoor air intake, or both, for defrost or other equipment cycling per HVI Standard 920.

Equation 11-1:
Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) +
[15 x (number of bedrooms +1)]

N1104.2.1 Continuous ventilation. A minimum of 50% of the total ventilation rate, but not less than 40 cfm, shall be provided, on a continuous rate average for each one hour period in accordance with Table N1104.2 or Equation 11-2. The portion of the mechanical ventilation system that is intended to be continuous, may have automatic cycling controls providing the average flow rate for each hour meeting the requirements of N1104.2.1.

Equation 11-2:
Continuous ventilation (CFM) = total ventilation rate/2

N1104.2.1.1 Ventilation Rate. The continuous ventilation system shall be balanced in accordance with section N1104.4.2

Exception: If the local ventilation requirements according to IRC section R303.3, are being met by the continuous ventilation system, it shall be capable of operating at a rate not more than 100% greater than required by Section N1104.2.1

N1104.2.2 Intermittent ventilation. The difference between the total ventilation rate and the continuous ventilation rate shall be based on flow rates as designed or as installed.

Table N1104.2 Total and continuous ventilation rates (in CFM)

	Number of Bedrooms					
	1	**2**	**3**	**4**	**5**	**6[2]**
Conditioned space[1] (in sq. ft.)	**Total/ Continuous**	**Total/ Continuous**	**Total/ Continuous**	**Total/ Continuous**	**Total/ Continuous**	**Total/ Continuous**
1000 – 1500	**60/40**	**75/40**	**90/45**	**105/53**	**120/60**	**135/68**
1501 – 2000	**70/40**	**85/43**	**100/50**	**115/58**	**130/65**	**145/73**
2001 – 2500	**80/40**	**95/48**	**110/55**	**125/63**	**140/70**	**155/78**

2501 – 3000	**90/45**	**105/53**	**120/60**	**135/68**	**150/75**	**165/83**
3001 – 3500	**100/50**	**115/58**	**130/65**	**145/73**	**160/80**	**175/88**
3501 – 4000	**110/55**	**125/63**	**140/70**	**155/78**	**170/85**	**185/93**
4001 – 4500	**120/60**	**135/68**	**150/75**	**165/83**	**180/90**	**195/98**
4501 – 5000	**130/65**	**145/73**	**160/80**	**175/88**	**190/95**	**205/103**
5001 – 5500	**140/70**	**155/78**	**170/85**	**185/93**	**200/100**	**215/108**
5501 – 6000[2]	**150/75**	**165/83**	**180/90**	**195/98**	**210/105**	**225/113**

[1]Conditioned space includes the basement.
[2]If conditioned space exceeds 6000 sq. ft. or there are more than 6 bedrooms, use Equation 11-1 from section N1104.2 to calculate total ventilation rate.

N1104.3 Ventilation system requirements. The mechanical ventilation system shall be one of three types: exhaust in accordance with section N1104.3.1; balanced, and HRV/ERV in accordance with section N1104.3.2; or other method in accordance with N1104.3.3.

N1104.3.1 Exhaust systems. Fans used to comply with the continuous ventilation part of the mechanical ventilation system shall:

1. meet the minimum continuous ventilation rate in N1104.2.1.
2. be designed and certified by the equipment manufacturer as capable of continuous operation at the rated cfm.
3. have a maximum 1.0 sone per HVI Standard 915 for surface mounted fans.
4. be permitted to use a required overcurrent protection device as a disconnect per the National Electric Code, incorporated by reference in Minnesota. Rules Chapter 1315.
5. comply with the Minnesota Mechanical Code, Chapter 1346, which may require additional make-up air.

Fans used to comply with the intermittent ventilation part of the mechanical ventilation system shall have a maximum 2.5 sone per HVI Standard 915.

N1104.3.2 Balanced, and HRV/ERV systems. A heat recovery ventilator (HRV) or energy recovery ventilator (ERV) shall meet either:

1. the requirements of HVI Standard 920, 72 hour minus 13°F cold weather test, or
2. certified by a registered professional engineer and installed per manufactures installation instructions.

An HRV or ERV intended to comply with both the continuous and total ventilation rate requirements shall meet the rated design capacity of the continuous ventilation rate in N1104.2.1 under low capacity and meet the total ventilation rate in N1104.2.2 under high capacity.

Exception: The balanced, and HRV/ERV system may include exhaust fans to meet the intermittent ventilation rate. Surface mounted fans shall have a maximum 2.5 sones per HVI Standard 915.

N1104.3.3 Other methods. Any mechanical ventilation system consisting of exhaust fans, supply fans or combination of both, complying with Section N1104, shall be allowed. A mechanical ventilation system specifically identified in Section N1104.3.1 or N1104.3.2 shall not conflict with Sections N1104.3.1 and N1104.3.2. For the purposes of this section, the delivered ventilation rate is the larger of the total air flow of the operating supply fans, or total air flow of the operating exhaust fans.

N1104.4 Installation requirements. All types of mechanical systems shall meet the requirements

of this section. The mechanical ventilation system and its components shall also be installed according to the Minnesota Mechanical Code, Minnesota Rules Chapter 1346, and the equipment manufacturer's installation instructions.

N1104.4.1 Air distribution/circulation. Outdoor air shall be delivered to each habitable space by a forced air circulation system, separate duct system, individual inlets, or a passive opening.

N1104.4.1.1 Forced air circulation systems. When outdoor air is supplied directly through a forced air circulation system, the requirements of this section shall be met by either:
(a) When an outdoor air supply is not ducted to the forced air system, controls shall be installed to allow the forced air system to provide an average circulation flow rate each hour, of not less than 0.15 cfm per square foot of the conditioned floor area.
(b) When the outdoor air supply is ducted to the forced-air system, it shall be tempered so that the mixed air temperature shall be no less than 60 degrees F or the heating equipment manufacturers' installation instructions, and controls shall be installed to allow the forced air circulation system to provide an average flow rate not less than 0.075 cfm per square foot of conditioned floor area.

N1104.4.1.2 Directly ducted and individual room inlets . When outdoor air is supplied directly to habitable spaces with an airflow of 20 CFM or greater, the system shall be designed and installed to temper incoming air to not less than 40 degrees F measured at the point of distribution into the space.

Table N1104.4.1.1(1) Indirect Circulation Air Flow Rates for Forced Air Circulation Systems (in cfm)

		Forced-Air Circulation Systems Flow Rate (cfm)							
		600	800	1000	1200	1400	1600	1800	2000
Conditioned Floor Area	Average Air Flow each Hr (cfm)	Number of Minutes per Hour, if cycled							
1000 – 1500	225	23	17	14	12	10	9	8	7
1501 – 2000	300	30	23	18	15	13	12	10	9
2001 – 2500	375	38	29	23	19	16	14	13	12
2501 – 3000	450	45	34	27	23	20	17	15	14
3001 – 3500	525	53	40	32	27	23	20	18	16
3501 – 4000	600	60	45	36	30	26	23	20	18
4001 – 4500	675	na[1]	51	41	34	29	26	23	21
4501- 5000	750	na[1]	57	45	38	33	29	25	23
5001 – 5500	825	na[1]	na[1]	50	42	36	31	28	25
5501 – 6000	900	na[1]	na[1]	54	45	39	34	3	27

[1]Not allowed

Table N1104.4.1.1(2) Direct Distribution Air Flow Rates Using Forced Air Circulation Systems (in cfm)

		Forced-Air Circulation Systems Flow Rate (cfm)							
		600	800	1000	1200	1400	1600	1800	2000
Conditioned Floor Area	Average Air Flow each Hr (cfm)	Number of Minutes per Hour, if cycled							
1000 – 1500	115	13	9	7	6	5	5	4	4
1501 – 2000	150	15	13	9	8	7	6	5	5
2001 – 2500	190	19	15	13	10	8	7	7	6

2501 – 3000	225	23	17	14	13	10	9	8	7
3001 – 3500	265	27	20	15	14	13	10	9	8
3501 – 4000	300	30	23	18	15	13	13	10	9
4001 – 4500	340	34	26	21	17	15	13	13	11
4501- 5000	375	38	24	23	19	17	15	13	13
5001 – 5500	415	42	32	25	21	18	16	14	13
5501 – 6000	450	45	34	27	23	20	17	15	14

N1104.4.1.3 Passive openings. When outdoor air is brought in through a passive opening, the maximum cfm of the outdoor air requirement shall be combined with the maximum make up air requirement of Mn Rule Chapter1346. The combined air rates shall be brought into the building in accordance with Mn. Rules Chapter1346. Controls shall be installed to distribute air throughout the building as required by Section N1104.4.1.1a..

N1104.4.2 Airflow verification. Mechanical ventilation system airflows greater than 30 cfm at the building exhaust or intake, shall be tested and verified using a flow hood, flow grid, pitot tube, or other airflow measuring device. The airflow verification results shall be made available to the building official upon request.

N1104.4.2.1 Airflow requirements. When the system is intended to be unbalanced, the design supply air flow shall not exceed 0.05 cfm per square foot of conditioned space. The operating exhaust air flow shall meet the requirements of N1104.3.1 and the Minnesota Mechanical Code, Chapter 1346, which may require additional makeup air. When the system is intended to be balanced, the exhaust and supply airflows shall be within plus or minus 10 percent of each other or manufacturer's installation instructions, whichever is more restrictive.

N1104.4.3 Fans. When used as part of the mechanical ventilation system, fans shall be capable of delivering the designed air flow as determined by section N1104.2 according to HVI Standard 916. Fan(s) shall be designed and certified by the equipment manufacturer as capable of continuous operation at the rated cfm. Surface mounted fans used to comply with the continuous ventilation part of the mechanical ventilation system shall have a maximum 1.0 sone per HVI Standard 915. Fan(s) used to comply with the intermittent ventilation part of the mechanical ventilation system shall have a maximum 2.5 sone per HVI Standard 915.

Exception: Sone requirements do not apply to forced air circulation systems and remotely mounted fans, provided the remotely mounted fan is not in a habitable space and there is at least 4 feet of ductwork between the fan and grille.

N1104.4.4 Multi-fan systems. When two or more exhausts fans in a dwelling unit share a common exhaust duct, each fan shall be equipped with a backdraft damper to prevent recirculation of exhaust air into another room.

N1104.4.5 Connection to forced air circulation systems. Air ducts connected directly to the forced air circulation system can be used to meet the mechanical ventilation system requirements. Either the tempered outdoor air may be supplied to, or exhaust air may be drawn from the forced air circulation system, but not both.

Exception: Both outdoor air and exhaust air may be connected to the forced air circulation system, provided that controls are installed to ensure that the forced air circulation system is

operating whenever the mechanical ventilation system is operating or other means are provided to prevent short circuiting of fresh air in accordance with the manufacturer's recommendations.

N1104.4.6 Dampers. The mechanical ventilation system supply and exhaust ducts shall be provided with accessible backflow dampers to minimize flow to or from the outdoors when the ventilation system is off.

N1104.4.7 Intake openings. Exterior air intake openings shall be accessible for inspection and maintenance. Intake openings shall be located in accordance with Minnesota Mechanical Code, Chapter 1346, and shall be covered with corrosion resistant screen of not less than ¼ inch (6.4 mm) mesh. Intake openings shall be located at least 12 inches (305 mm) above adjoining grade level.

Exception: Combination air intake and exhaust hoods may be approved by the building official when specifically allowed by the equipment manufacturer's installation instructions.

N1104.4.8 Filtration. All mechanically supplied outdoor air shall have a filter with a designated minimum efficiency of MERV 4 as defined by ASHRAE Standard 52.2. The filter shall be located prior to the air entering the thermal conditioning components, blower, or habitable space and shall be installed to be readily accessible and facilitate regular service.

N1104.4.9 Noise and vibration. Mechanical ventilation system components shall be installed to minimize noise and vibration transmission. The equipment manufacturer's installation instructions shall be followed, and materials provided by the equipment manufacturer for this purpose. In the absence of specific materials or instructions, vibration dampening materials such as rubber grommets and flexible straps shall be used when connecting fans and heat exchangers to the building structure, and isolation duct connectors shall be used to mitigate noise transmission.

N1104.4.10 Controls. Mechanical ventilation system controls shall be provided in accordance with the following:

1. Controls shall be installed to ensure that the forced air circulation system is operating whenever the mechanical ventilation system is operating if required by the equipment manufacturer's installation instructions.
2. Controls shall be installed to ensure that whenever the mechanical ventilation system is operating, the forced air circulation system provides indirect circulation of 0.15 cfm per square foot of conditioned floor area or direct distribution of 0.075 cfm per square foot of conditioned floor area.
3. If the mechanical ventilation system is not designed to operate whenever the forced air circulation system is operating, the mechanical ventilation system shall incorporate an accessible backflow damper to prevent flow from the outside when the mechanical ventilation system is off.
4. Controls shall be compatible with the mechanical ventilation system.
5. Controls shall be installed to operate the mechanical ventilation system as designed.
6. Controls shall be readily accessible to occupants and shall be labeled to indicate their function
7. If a switch is used for continuous ventilation, it can be located centrally or remotely, but shall not be located in a bath toilet or toilet room. It centrally located, it shall be properly labeled and lighted when the system is on. If remotely located, there shall be a lighted status indicator in a central location that will be lighted when the system is on.

N1104.4.11 Labeling. The outdoor air intake and exhaust air outlet shall include a permanent, weather resistant identification label stating "OUTDOOR AIR INTAKE" or "EXHAUST AIR OUTLET" as appropriate. Controls provided for continuous and intermittent ventilation shall be provided with a label stating "VENTILATION SYSTEM" or "VENTILATION FAN" or "INTERMITTENT FAN" or ventilation symbols, as appropriate.

N1104.4.12 Documentation. Mechanical ventilation systems shall be provided with documentation that includes proper operation and maintenance instructions and a warning regarding potential problems if the system is not operated and maintained. A permanent warning label shall be affixed to mechanical ventilation system if it is readily accessible. If the mechanical ventilation system is not readily accessible, the documentation shall be in a conspicuous readily accessible location.

N1104.4.13 Climatic Design Conditions.

A. HVAC equipment must be sized according to the 2005 ASHRAE Handbook of Fundamentals, ACCA Manual J, or an equivalent method. Oversizing of heating equipment must not exceed 43 percent and cooling equipment must not exceed 21 percent.
B. Design conditions must be determined from Table N1104.4.13. Design condition adjustments may be made as determined by the Building Official to reflect local climates that differ from the tabulated temperatures or local weather experience.

Table N1104.4.13 - Outdoor Design Conditions

City	Summer Db/Wb ºF	Winter Db ºF
Aitkin	82/72	-24
Albert Lea	85/72	-15
Alexandria	86/70	-21
Bemidji	84/68	-24
Cloquet	82/68	-20
Crookston	84/70	-27
Duluth	81/67	-20
Ely	82/68	-29
Eveleth	82/68	-26
Faribault	86/73	-16
Fergus Falls	86/71	-21
Grand Rapids	81/67	-23
Hibbing	82/68	-19
International Falls	83/67	-28
Litchfield	85/71	-18
Little Falls	86/71	-20
Mankato	86/72	-15
Minneapolis/St. Paul	88/72	-15
Montevideo	86/72	-17
Mora	84/70	-21
Morris	84/72	-21
New Ulm	87/73	-15
Owatonna	86/73	-16
Pequot Lake	84/68	-23
Pipestone	85/73	-15
Redwood Falls	89/73	-17

Rochester	85/72	-17
Roseau	82/70	-29
St. Cloud	86/71	-20
Thief River Falls	82/68	-25
Tofte	75/61	-14
Warroad	83/67	-29
Wheaton	84/71	-20
Willmar	85/71	-20
Winona	88/74	-13
Worthington	84/71	-14
DB = dry bulb temperature, degrees Fahrenheit		
WB = wet bulb temperature, degrees Fahrenheit		

1322.2100 INCORPORATION BY REFERENCE. Appendix F, Radon Control Methods, of the 2006 edition of the International Residential Code (Appendix F) as promulgated by the International Code Council, Inc. (ICC), Falls Church, Virginia, is incorporated by reference and made part of the Minnesota State Building Code except as qualified by the applicable provisions in Minnesota Rules, chapter 1300, and as amended in parts 1322.2101 to 1322.2103. Appendix F is not subject to frequent change and a copy of Appendix F, with amendments for use in Minnesota, is available in the office of the commissioner of labor and industry. Portions of parts 1322.2101 to 1322.2103 reproduce text and tables from Appendix F, which is copy right by the ICC. All rights reserved.

1322.2101 SECTION AF101, SCOPE.

Subpart 1. **General.** Appendix F, Section AF101, is amended to read: The purpose of parts 1322.2101 to 1322.2103 is to establish requirements for radon-resistant construction in new residential construction built to Minnesota Rules, chapters 1305 or 1309.

1322.2102 SECTION AF102, DEFINITIONS.

AF102.1 General. The definitions in this part apply to parts 1322.2101 to 1322.2103.

SUBSLAB DEPRESSURIZATION SYSTEM (Passive). A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed through the conditioned space of a building and connecting the sub-slab area with outdoor air, thereby relying on the convective flow of air upward in the vent to draw air from beneath the slab.

SUBSLAB DEPRESSURIZATION SYSTEM (Active). A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

DRAIN TILE LOOP. A continuous length of drain tile or perforated pipe extending around all of the internal perimeter of a basement or crawl space.

RADON GAS. A naturally-occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through particles of soil and rock and can accumulate

under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.

SOIL-GAS RETARDER. A continuous membrane of 6-mil (0.15 mm) polyethylene, 3 mil (0.075 mm) cross-laminated polyethylene, or other equivalent material used to retard the flow of soil gases into a building.

SUBMEMBRANE DEPRESSURIZATION SYSTEM. A system designed to achieve lower-sub-membrane air pressure relative to crawl space air pressure by use of a vent drawing air from beneath the soil-gas-retarder membrane.

Subp. 2. **Figure AF102.** [Revisor: Please insert Figure AF102 here.]

1322.2103 SECTION AF103, REQUIREMENTS. Appendix F, Section AF103, is amended to read:

AF103.1 General. The following passive construction techniques are intended to resist radon entry and prepare the building for post construction active radon mitigation. (see Figure AF102).

AF103.2 Subfloor preparation. A layer of gas-permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces and conditioned crawl spaces, of the building, to facilitate the installation of an active sub-slab depressurization system if needed. The gas-permeable layer shall consist of one of the following:

1. A uniform layer of clean aggregate, a minimum of 4 inches (102 mm) thick. The aggregate shall consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4 inch (6.4 mm) sieve.

2. A uniform layer of sand (native or fill), a minimum of 4 inches (102 mm) thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.

3. Other materials, systems or floor designs with demonstrated capability to permit depressurization across the entire sub-floor area.

AF103.3 Soil-gas-retarder. A minimum of 6-mil (0.15 mm) [or 3-mil (0.075 mm) cross-laminated] polyethylene or equivalent flexible sheeting material shall be placed on top of the gas-permeable layer prior to casting the slab or placing the floor assembly to serve as a soil-gas-retarder by bridging any cracks that develop in the slab or floor assembly and to prevent concrete from entering the void spaces in the aggregate base material. The sheeting shall cover the entire floor area with separate sections of sheeting lapped at least 12 inches (305 mm). The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All punctures or tears in the material shall be sealed or covered with additional sheeting.

AF103.4 Entry routes. Potential radon entry routes shall be closed in accordance with Sections AF103.4.1 through AF103.4.10.

AF103.4.1 Floor openings. Openings around bathtubs, showers, water closets, pipes, wires or other objects that penetrate concrete slabs or other floor assemblies shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.

AF103.4.2 Concrete joints. All control joints, isolation joints, construction joints and any other joints in concrete slabs or between slabs and foundation walls shall be sealed with a caulk or sealant. Gaps and joints shall be cleared of loose material and filled with polyurethane caulk or other elastomeric sealant applied in accordance with the manufacturer's recommendations.

AF103.4.3 Condensate drains. Condensate drains shall be trapped or routed through nonperforated pipe to daylight.

AF103.4.4 Sumps. Sump pits open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid. Sumps used as the suction point in a sub-slab depressurization system shall have a lid designed to accommodate the vent pipe. Sumps used as a floor drain shall have a lid equipped with a trapped inlet.

AF103.4.5 Foundation walls. Hollow block masonry foundation walls shall be constructed with either a continuous course of solid masonry, one course of masonry grouted solid, or a solid concrete beam at or above finished ground surface to prevent passage of air from the interior of the wall into the living space. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall be sealed. Joints, cracks or other openings around all penetrations of both exterior and interior surfaces of masonry block or wood foundation walls below the ground surface shall be filled with polyurethane caulk or equivalent sealant. Penetrations of concrete walls shall be filled.

AF103.4.6 Waterproofing/dampproofing. The exterior surfaces of portions of concrete and masonry block walls below the ground surface shall be waterproofed/dampproofed in accordance with Section R406 of this code.

AF103.4.7 Air-handling units. Air-handling units in crawl spaces shall be sealed to prevent air from being drawn into the unit.

> **Exception:** Units with gasketed seams or units that are otherwise sealed by the manufacturer to prevent leakage.

AF103.4.8 Ducts. Ductwork passing through or beneath a slab shall be of seamless material unless the air-handling system is designed to maintain continuous positive pressure within such ducting. Joints in such ductwork shall be sealed to prevent air leakage.

Ductwork located in crawl spaces shall have all seams and joints sealed by closure systems in accordance with Minnesota Rules, Chapter 1346.

AF103.4.9 Unconditioned crawl space floors. Openings around all penetrations through floors above unconditioned crawl spaces shall be caulked or otherwise filled to prevent air leakage.

AF103.4.10 Unconditioned crawl space access. Access doors and other openings or penetrations between basements and adjoining unconditioned crawl spaces shall be closed, gasketed or otherwise filled to prevent air leakage.

AF103.5 Passive submembrane depressurization system. In buildings with crawl space foundations, the following components of a passive sub-membrane depressurization system shall be installed during construction.

AF103.5.1 Ventilation. Unconditioned crawl spaces shall be provided with vents to the exterior of the building. The minimum net area of ventilation openings shall comply with Section R408.1

of this code.

AF103.5.2 Soil-gas-retarder. The soil in crawl spaces shall be covered with a continuous layer of minimum 6-mil (0.15 mm) polyethylene soil-gas-retarder. The ground cover shall be lapped a minimum of 12 inches (305 mm) at joints and shall extend to all foundation walls enclosing the crawl space area.

AF103.5.3 Vent pipe. A plumbing tee or other approved connection shall be inserted horizontally beneath the sheeting with one ten foot section of a perforated pipe connected to each side of the "T" fitting and then connected to a 3- or 4-inch-diameter (76 mm or 102 mm) fitting with a vertical vent pipe installed through the sheeting. The vent pipe shall be extended up through the building floors, terminated at least 12 inches (305 mm) above the roof in a location at least 10 feet (3048 mm) away from any window or other opening into the conditioned spaces of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

Exception: If the vent pipe is connected directly to a sump basket it shall be of solid piping material.

AF103.6 Passive subslab depressurization system. In buildigs with basements, foundations and/or conditioned crawl spaces, or slab-on-grade buildings, the following components of a passive sub-slab depressurization system shall be installed during construction.

AF103.6.1 Vent pipe. A minimum 3-inch-diameter (76 mm) ABS, PVC or equivalent gas-tight pipe shall be embedded vertically into the sub-slab aggregate or other permeable material before the slab is cast. A "T" fitting with one ten foot section of a perforated pipe connected to each side of the "T" fitting or equivalent method shall be used to ensure that the pipe opening remains within the sub-slab permeable material. Alternatively, the 3-inch (76 mm) pipe shall be inserted directly into an interior perimeter drain tile loop or through a sealed sump cover where the sump is exposed to the sub-slab aggregate or connected to it through a drainage system.

The pipe shall be extended up through the building floors, terminate at least 12 inches (305 mm) above the surface of the roof in a location at least 10 feet (3048 mm) away from any window or other opening into the conditioned spaces of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

Exception: If an active sub-slab depressurization system is installed, the vent pipe may be routed through unconditioned space within the building or garage, provided the vent pipe is insulated to a minimum of R-4. each radon vent pipe shall terminate above the roof or shall be connected to a single vent that terminates above the roof. For active system a system monitoring device must also be installed. All other requirements of this section apply

AF103.6.2 Multiple vent pipes. In buildings where interior footings or other barriers separate the sub-slab aggregate or other gas-permeable material, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.

AF103.7 Vent pipe drainage. All components of the radon vent pipe system shall be installed to provide positive drainage to the ground beneath the slab or soil-gas-retarder.

AF103.8 Vent pipe accessibility. Radon vent pipes shall provide enough space around the pipe for future installation of a fan system. The space provided for installation of a future fan shall be a

minimum of 24 inches in diameter, centered on the axis of the vent stack, and extend for a minimum vertical distance of three feet.

Exception: The radon vent pipe need not be accessible in an attic space where an approved roof-top electrical supply is provided for future use.

AF103.9 Vent pipe identification. All radon vent pipes shall be identified with at least one label on each floor and in accessible attics. The label shall read: "Radon Reduction System."

AF103.10 Combination foundations. Combination basement/crawl space or slab-on-grade/crawl space foundations shall have separate radon vent pipes installed in each type of foundation area. Each radon vent pipe shall terminate above the roof or shall be connected to a single vent that terminates above the roof.

Exception: A single vent pipe is allowed in a building with a combination foundation as long as soil gasses can flow freely between the areas of the combination foundations and it is connected to an approved vent pipe.

AF103.11 Building depressurization. Joints in air ducts and plenums in unconditioned spaces shall meet the requirements of Minnesota Rules, Chapter 1346. Thermal envelope air infiltration requirements shall comply with the energy conservation provisions in Chapter 1322. Firestopping shall meet the requirements contained in Section R602.8.

AF103.12 Power source. To provide for future installation of an active sub-membrane or sub-slab depressurization system, an electrical circuit terminated in an approved box shall be installed during construction in the attic or other anticipated location of vent pipe fans.