Chapter Comm 22

ENERGY CONSERVATION

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Note: Chapter Ind 22 was renumbered to be chapter ILHR 22, Register, February, 1985, No. 350, eff. 3–1–85. Chapter ILHR 22 was repealed and recreated to be chapter Comm 22, Register, January, 1999, No. 517, eff. 2–1–99. **Chapter Comm 22 as it existed on March 31, 2009, was repealed and a new chapter Comm 22 was created effective April 1, 2009.**

Subchapter I — Scope and Application

Comm 22.01 Scope. (1) This chapter applies to all one– and 2–family dwellings covered by this code that use any amount of non–renewable energy for heat generation.

Note: Non–renewable energy sources used for heat distribution only will not require compliance with this chapter.

Note: The Public Service Commission has rules regulating "non–essential uses" of natural gas, such as snow melting and lighting in ch. PSC 136 of the Wisconsin Administrative Code.

(2) The equipment efficiency standards in this chapter apply to all one– and 2–family dwellings covered by this code that use the respective equipment.

(3) The vapor retarder requirements under s. Comm 22.38 and the moisture control and ventilation requirements under s. Comm 22.39 apply to any dwelling with insulation installed, whether or not the insulation is required under this code.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.02 Application. (1) This chapter is not intended to conflict with any safety or health requirements. Where a conflict occurs, the safety and health requirements shall govern.

(2) This chapter allows the designer the option of using various methods to demonstrate compliance with thermal performance requirements. The designer shall identify on the plan submittal form what method or subchapter is being used, and indicate the design criteria and how it is being applied. Unless specifically exempted, all requirements of this chapter apply regardless of the method used.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter II — Definitions

Comm 22.10 Definitions. (1) "Air–impermeable" means having an air permeance less than or equal to 0.02 L/s–m^2 at a pressure differential of 75 pascals when tested according to ASTM E 2178 or ASTM E 283.

(2) "Conditioned floor area" means the sum of areas of all floors in conditioned space in the structure, including basements, cellars, and intermediate floored levels measured from the exterior faces of exterior walls or from the center line of interior walls, excluding covered walkways, open roofed–over areas, porches, exterior terraces or steps, chimneys, roof overhangs and similar features.

(3) "Conditioned space" means space within the dwelling thermal envelope which is provided with heated air or surfaces to provide a heated space capable of maintaining the temperature of the space to at least 50°F at design conditions.

(4) "Crawl space wall" means the opaque portion of a wall which encloses a crawl space and is partially or totally below grade.

(5) "Dwelling thermal envelope" means the elements of a dwelling with enclosed conditioned space through which thermal energy may be transferred to or from unconditioned space or the exterior.

(6) "Exterior wall area" means the normal projection of the dwelling envelope wall area bounding interior space which is conditioned by an energy–using system including opaque wall, window and door area. Any skylight shaft walls that are 12 inches or more in depth, measured from the ceiling plane to the roof deck, are considered in the area of exterior walls and are not considered part of the roof assembly.

(7) "Heated slab" means a floor slab in which an uninsulated heating element, uninsulated hydronic tubing or uninsulated hot air distribution system is in contact with the slab or placed within the slab or the subgrade.

(8) "HVAC" means heating, ventilating and air conditioning.

(9) "HVAC system" means the equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

(10) "Infiltration" means the uncontrolled inward air leakage through cracks and interstices in any dwelling element and around windows and doors of a dwelling caused by the pressure effects of wind, and the effect of differences in the indoor and outdoor air density.

(11) "IC–rated" means an electrical fixture tested and listed by an independent testing laboratory as being suitable for installation in a cavity where the fixture may be in direct contact with thermal insulation or combustible materials.

(12) "Mass wall" means a wall of concrete block, concrete, insulated concrete forms, masonry cavity, brick other than brick veneer, earth and solid timber or logs.

(13) "Opaque areas" means all exposed areas of a dwelling envelope which enclose conditioned space except openings for windows, skylights, doors and dwelling service systems.

(14) "Proposed design" means a description of the proposed dwelling used to estimate annual energy use for determining compliance based on total building performance.

(15) "Renewable energy sources" means sources of energy, excluding minerals and petroleum products, derived from incoming solar radiation, trees and other plants, wind, waves and tides, lake or pond thermal differences and from the internal heat of the earth.

(16) "Roof assembly" means all components of the roof and ceiling envelope through which heat flows, thus creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated space. Any skylight shaft walls less than 12 inches in depth, as measured from the ceiling plane to the roof deck, are considered in the roof assembly and are not considered in the area of exterior walls.

(17) "Sun room" means a one−story structure attached to a dwelling with a glazing area in excess of 40% of the gross area of the structure's exterior walls and roof.

Note: A thermally isolated sun room does not count in the calculation of amount of glazing.

(18) "System" means a combination of central or terminal equipment and their components, controls, accessories, interconnecting means, and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, water heating, or illumination.

(19) "Thermal resistance" or "R−value" means a measure of the ability to retard the flow of heat. The R−value is the reciprocal of thermal transmittance or U−factor expressed as R = 1/U.

Note: The higher the R−value of a material, the more difficult it is for heat to be transmitted through the material.

(20) "Thermal transmittance" or "U−factor" means the time rate of heat flow through a body or assembly which is located between 2 different environments, expressed in Btu/h • ft.^{2} • °F. The U−factor applies to combinations of different materials used in series along the heat flow path and also to single materials that comprise a dwelling section, including cavity air spaces and air films on both sides of a dwelling element.

Note: The lower the U−factor of a material, the more difficult it is for heat to be transmitted through the material.

Note: The thermal transmittance is also referred to as the coefficient of heat transfer or the coefficient of heat transmission.

(21) "Thermally isolated" means physically and thermally separated with separate zone or separate equipment controls for space heating.

(22) "Thermostat" means an automatic control device actuated by temperature and designed to be responsive to temperature.

(23) "Ventilation" means the process of supplying or removing air by natural or mechanical means to or from any space. The air may or may not have been conditioned.

(24) "Zone" means a space or group of spaces within a dwelling with heating requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Subchapter III — Insulation Materials and Installation

Comm 22.20 Basic requirements. (1) GENERAL. When available, information and values on thermal properties, performance of building envelope sections and components, and heat transfer shall be obtained from the ASHRAE Handbook of Fundamentals.

(2) COMPUTATION OF R−VALUES. (a) Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R−value.

(b) The manufacturer's settled R−value shall be used for blown insulation.

(c) Computed R−values may not include values for air films or for building materials other than insulation materials.

Note: The REScheck program will automatically account for air films and other building materials.

(3) LABORATORY OR FIELD TEST MEASUREMENTS. (a) *General dwelling thermal envelope materials.* When information specified under sub. (1) is not available, or when a different value is claimed, supporting data shall be obtained using one of the following test methods:

1. ASTM C177, Standard test method for steady state heat flux measurements and thermal transmission properties by means of the guarded−hot−plate apparatus.

2. ASTM C335, Standard test method for steady state heat transfer properties of pipe insulation.

3. ASTM C518, Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.

4. ASTM C1363, Standard test method for the thermal performance of building materials and envelope assemblies by means of a hot box apparatus.

(b) *Foam plastic insulation.* 1. When information specified under sub. (1) is not available, or when a different value is claimed, foam plastic insulation that uses a gas other than air as the insulating medium shall use laboratory or field tests conducted on representative samples that have been aged for the equivalent of 5 years or until the R−value has stabilized.

2. The tests shall be conducted by an independent third party using the standards listed under par. (a) and shall be submitted for department review and approval in accordance with s. Comm 20.18.

(c) *Concrete masonry units.* Systems using integrally−insulated concrete masonry units shall be evaluated for thermal performance in accordance with one of the following:

1. Default values as approved by the department with no extrapolations or interpolations.

2. Laboratory or field test measurements specified under par. (a).

3. The material approval process specified in s. Comm 20.18.

(4) GENERAL INSTALLATION. (a) Materials, equipment and systems shall be identified in a manner that will allow a determination of their compliance with the applicable provisions of this code.

(b) All insulation materials, caulking and weatherstripping, fenestration assemblies, mechanical equipment and systems components, and water−heating equipment and system components shall be installed in accordance with the manufacturer's installation instructions.

(c) Manufacturer's installation instructions shall be available on the job site at the time of inspection.

(d) Roof and ceiling, floor and wall cavity batt or board insulation shall be installed in a manner which will permit inspection of the manufacturer's R−value identification mark.

(5) IDENTIFICATION. (a) A thermal resistance identification mark shall be applied by the manufacturer to each piece of dwelling envelope insulation 12−inches or greater in width.

(b) 1. The thickness of blown−in roof and ceiling insulation shall be identified by thickness markings that are labeled in inches and installed at least one for every 300 square feet through the attic space.

2. The markers shall be affixed to trusses or joists marking the minimum initial installed thickness and minimum settled thickness with numbers a minimum of one−inch in height.

3. Each marker shall face the attic access.

4. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

(6) CERTIFICATE. (a) A permanent certificate shall be posted on or immediately adjacent to the electrical distribution panel.

(b) The certificate shall be completed by the owner, builder or insulation installer.

(c) The certificate shall list at least the following information:

1. The predominant R−values of insulation installed in or on ceilings or roofs, walls, foundation walls, slabs and any heating ducts that are outside the thermal envelope.

2. The U−factors of all windows, skylights and doors.

(d) If using the REScheck or REM/Rate software programs, the certificate shall be printed from that program.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09; correction in (3) (a) made under s. 13.92 (4) (b) 1., Stats., Register March 2009 No. 639.

Comm 22.21 Protection of insulation. (1) BLANKET INSULATION. Insulating blankets or batts shall be held in place with a covering or other means of mechanical or adhesive fastening.

Note: If the insulation is on a below−grade wall, s. Comm 22.08 (3) may prohibit the use of vapor retarder material used as the covering.

(2) WIND WASH PROTECTION. (a) Except as provided under s. Comm 22.39 (4) for cathedral ceilings, all air−permeable insulation materials installed in any position other than horizontal, shall be covered on the cold−in−winter side with a permanently attached material of low air permeability to maintain the R−value of the insulation.

Note: Suitable materials for this purpose include house wrap permanently attached with batten strips, asphalt−impregnated felt or tar paper, plywood, oriented strand board or OSB, siding material, rigid insulation sheathing, etc.

(b) If non−rigid sheet material is used, it shall be water vapor permeable.

Note: Water vapor permeable materials for this purpose include house wrap permanently attached with batten strips and asphalt−impregnated felt or tar paper.

(3) FOAM PLASTIC INSULATION. (a) Exterior foam plastic insulation shall be protected from physical damage and damage from ultraviolet light with a permanent, opaque, weather−resistant covering or coating.

(b) The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches below grade.

Note: For interior applications, a thermal barrier may be required under s. Comm 21.11.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Subchapter IV — Dwelling Thermal Envelope

Comm 22.30 General design requirements. (1) GENERAL. Dwelling thermal envelope insulation amounts and details shall be determined using one of the methods described in this subchapter.

(2) INFILTRATION. (a) Infiltration for heating design loads shall be calculated based on a maximum of 0.5 air change per hour in the heated space.

(b) 1. If the proposed design takes credit for a reduced air change per hour level, documentation of the measures providing the reduction or the results of a post−construction blower door test conducted in accordance ASTM E 779 shall be provided to the department.

2. The minimum air change per hour rate may not be less than 0.2, unless mechanical ventilation is provided.

(3) BASEMENTS AND CRAWL SPACES. Where basement and crawl space walls are part of the dwelling thermal envelope, their R−values and U−factors shall be based on the wall components. Adjacent soil may not be considered in the determination.

(4) GARAGES. (a) Except as provided under par. (b), a garage may not be provided with any supplemental heat unless all of the following conditions are met:

Note: Because of the scope of this chapter, the requirements under this subsection apply only to heat generated from non−renewable sources.

1. The dwelling shall be thermally isolated from the garage.

2. The garage floor, ceiling and walls shall be provided with a vapor retarder in accordance with s. Comm 22.38.

3. All building elements shall meet the requirements of s. Comm 22.31.

(b) The thermal envelope requirements under par. (a) are not required if all of the following conditions are met:

1. The thermostat is permanently limited to a maximum of 50°F.

2. Heating equipment is either separate from the dwelling unit equipment or installed as a separate zone.

3. Separate heating equipment shall be sized to provide a maximum indoor temperature of 50°F.

(5) MASONRY VENEER. When insulation is placed on the exterior of a foundation supporting a masonry veneer exterior, the horizontal foundation surface supporting the veneer is not required to be insulated to satisfy the foundation insulation requirement.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Comm 22.31 Prescriptive insulation and fenestration criteria. (1) REQUIREMENTS. (a) Except as specifically provided under this subchapter, dwellings using the prescriptive method shall meet the requirements of Table 22.31−1 or 22.31−2.

(b) In Tables 22.31−1 and 22.31−2, zone 2 consists of the following 15 northern counties: Ashland, Bayfield, Burnett, Douglas, Florence, Forest, Iron, Langlade, Lincoln, Oneida, Price, Sawyer, Taylor, Vilas and Washburn. Zone 1 consists of all other counties not included in zone 2.

TABLE 22.31–1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value	Floor R–Value	Basement or Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
1	0.35	0.60	49[e]	19[f] or 13+5[g]	15	30[h]	10/13	10/15	10
2	0.35	0.60	49[e]	21[f]	19	30[h]	10/13	10/15	10

[a] R–values are minimums. U–factors are maximums.

[b] The first R–value applies to continuous insulation. The second R–value applies to framing cavity insulation. Either insulation meets the requirement.

[c] The first R–value applies under the entire slab, regardless of depth below grade. The second R–value applies to the slab edge. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches.

[d] The R–value applies to any slab, the bottom of which is less than 12 inches below adjacent grade. Also, see s. Comm 21.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s. Comm 22.32 (1) for application and permitted reduced R–value.

[f] R–19 and R–21 may be compressed into a 2X6 cavity.

[g] "13+5" means R–13 cavity insulation plus R–5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of the exterior, structural sheathing shall be covered with insulated sheathing of at least R–2.

[h] Or insulation sufficient to fill the framing cavity with a minimum of R–19.

TABLE 22.31–2
EQUIVALENT U–FACTORS

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling U–Factor	Wood Frame Wall U–Factor	Mass Wall U–Factor	Floor U–Factor	Basement Wall U–Factor	Crawl Space U–Factor
1	0.35	0.60	0.026	0.060	0.060	0.033	0.065	0.065
2	0.35	0.60	0.026	0.057	0.057	0.033	0.065	0.065

(2) THERMAL ENVELOPE. (a) *General.* If the total dwelling thermal envelope UA is less than or equal to the total UA resulting from using the U–factors in Table 22.31–2 multiplied by the same assembly area as in the proposed building, the dwelling is in compliance with this chapter. 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.

Note: UA is equal to the product of the U–factor times the assembly area.

Note: REScheck and REM/Rate are acceptable software programs for determining compliance with this section.

(b) *Software edition.* If the REScheck software program is used to show compliance with this section, the version shall be 4.1.0, or later.

Note: Any version of REScheck with a beginning number of 3 or smaller will not support the requirements of this code.

(3) APPLIANCE EFFICIENCY. (a) Except as allowed under par. (b) and s. Comm 22.46, oil–fired and gas–fired furnaces and boilers shall meet the minimum efficiency requirements in Table 22.31–3.

(b) In new construction, an oil–fired or gas–fired furnace or boiler meeting the federal efficiency standard but not the requirements of Table 22.31–3 may be installed if the dwelling thermal envelope requirements of Table 22.31–4 are met.

TABLE 22.31–3
WARM AIR FURNACES AND BOILERS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Minimum Efficiency	Test Procedure
Natural gas and propane furnace	90% AFUE	DOE 10 CFR Part 430 or ANSI Z21.47
Natural gas and propane hot water boilers	90% AFUE	DOE 10 CFR Part 430
Oil–fired furnaces	83% AFUE	DOE 10 CFR Part 430 or UL 727
Oil–fired hot water boilers	84% AFUE	DOE 10 CFR Part 430

TABLE 22.31–4
COMPONENT DWELLING THERMAL ENVELOPE REQUIREMENTS FOR DWELLINGS USING LOWER EFFICIENCY APPLIANCES[a]

Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value	Floor R–Value	Basement or Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
0.30	0.60	49[e]	21[f] or 19+5[g]	19	30[h]	15/19	10/20	15
Equivalent U–Factors								
0.30	0.60	0.26*	0.057	0.057	0.033	0.045	0.033	0.047

* **Note:** The correct number is .026. An error was discovered in the rule order after completion of the rule–making process.

[a] R–values are minimums. U–factors are maximums.

[b] The first R–value applies to continuous insulation. The second R–value applies to framing cavity insulation.

[c] The first R–value applies under the entire slab, regardless of depth below grade. The second R–value applies to the slab edge. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches.

[d] The R–value applies to any slab, the bottom of which is less than 12 inches below adjacent grade. Also, see s. Comm 21.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s. Comm 22.32 (1) for application and permitted reduced R–value.

[f] R–21 may be compressed into a 2X6 cavity.

[g] "19+5" means R–19 cavity insulation plus R–5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of the exterior, structural sheathing shall be covered with insulated sheathing of at least R–2.

[h] Or insulation sufficient to fill the framing cavity with a minimum of R–19.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.32 Specific insulation requirements. **(1)** CEILINGS WITH ATTIC SPACES. R–38 will satisfy the ceiling R–value requirement for a dwelling where the full height of uncompressed R–38 insulation extends over the wall top plate at the eaves.

(2) CEILINGS WITHOUT ATTIC SPACES. Where the design of the roof or ceiling assembly does not allow sufficient space for the required R–49 insulation, the minimum required insulation for the roof or ceiling assembly shall be R–30. This reduction of insulation shall be limited to 500 square feet of ceiling area.

(3) MASS WALLS. (a) The requirements of Table 22.31–1 are applicable in a mass wall where at least 50 percent of the required insulation R–value is on the exterior of, or integral to, the wall.

(b) Mass walls that do not meet the specifications under par. (a) for insulation placement shall meet the wood frame wall insulation requirements of Table 22.31–1.

(4) STEEL–FRAME CEILINGS, WALLS AND FLOORS. (a) Steel–frame ceilings, walls and floors shall meet the insulation requirements of Table 22.32 or shall meet the U–factor requirements in Table 22.31–2.

(b) The calculation of the U–factor for a steel–frame envelope assembly shall use a series–parallel path calculation method.

(5) FLOORS. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

(6) BASEMENT WALLS. (a) Walls associated with conditioned basements shall be insulated from the top of the basement wall down to the basement floor.

(b) Walls associated with unconditioned basements shall meet the requirement in par. (a) unless the floor overhead is insulated in accordance with Table 22.31–1.

(c) Where the total basement wall area is less than 50 percent below grade, the entire wall area, including the below–grade portion, is included as part of the area of exterior walls.

(7) BOX SILL AND RIM JOIST SPACES. Box sills and joist spaces at outside walls shall be insulated to the required wall R–value with air–impermeable insulation that is sealed on all sides to all framing members and the foundation, or with air–permeable insulation held in place as required under s. Comm 22.21 (1).

(8) OVERHANG JOIST SPACES. (a) Joist spaces that extend beyond exterior walls shall be insulated with an R–value of 30 or higher with insulation that completely fills the cavity including over the top of the exterior wall supporting the joists.

(b) The joist space insulation shall be air sealed either by using an air–impermeable insulation that is sealed to all framing members or by covering the insulation with a rigid material that is caulked or sealed to all framing members.

(c) If piping that is subject to freezing is located in the joist space, additional insulation shall be provided on the unconditioned side of the space.

(9) WALL INSULATION. Except for closed–cell sprayed foam, wall insulation shall completely fill the wall cavity.

TABLE 22.32

STEEL–FRAME CEILING, WALL AND FLOOR INSULATION R–VALUES

Wood Frame R–Value Requirement	Cold–Formed Steel Equivalent R–Value[a]
Steel Truss Ceilings[b]	
R–30	R–38 or R–30 + 3 or R–26 + 5
R–38	R–49 or R–38 + 3
R–49	R–38 + 5
Steel Joist Ceilings[b]	
R–30	R–38 in 2X4 or 2X6 or 2X8 R–49 in any framing
R–38	R–49 in 2X4 or 2X6 or 2X8 or 2X10
Steel Framed Wall	
R–13	R–13 + 5 or R–15 + 4 or R–21 + 3
R–19	R–13 + 9 or R–19 + 8 or R–25 + 7
R–21	R–13 + 10 or R–19 + 9 or R–25 + 8
Steel Joist Floor	
R–13	R–19 in 2X6 R–19 + 6 in 2X8 or 2X10
R–19	R–19 + 6 in 2X6 R–19 + 12 in 2X8 or 2X10

[a] Cavity insulation R–value is listed first, followed by continuous insulation R–value.

[b] Insulation exceeding the height of the framing shall cover the framing.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.33 Slab floors. (1) HEATED OR UNHEATED SLABS. Any slab floor, the bottom of which is less than 12 inches below adjacent grade, shall be insulated in accordance with Table 22.31–1 or Table 22.31–4.

(2) HEATED SLABS. In addition to meeting the requirement under sub. (1), if applicable, heated slabs of any depth below grade shall meet the R–value requirement in accordance with Table 22.31–1 or Table 22.31–4.

(3) DETAILS. (a) The top edge of insulation installed between the exterior wall and the edge of the interior slab may be cut at a 45 degree angle away from the exterior wall.

(b) Horizontal insulation extending outside of the foundation shall be covered by soil a minimum of 10 inches thick or by pavement.

Note: See Appendix for further explanatory materials.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.34 Crawl spaces. (1) FROST PROTECTION. If the bottom of the crawl space serving as the dwelling foundation is less than 48 inches below adjacent grade, the foundation shall be frost protected in accordance with Table 22.31–1 for frost protected slabs.

(2) VAPOR RETARDER. Any exposed earth in crawl spaces shall be covered with a continuous vapor retarder.

(b) All decayable organic material, including topsoil, shall be removed from crawl space floors prior to placing the vapor retarder.

(c) All joints of the vapor retarder shall overlap by 6 inches and be sealed or taped.

(d) The edges of the vapor retarder shall extend at least 6 inches up the foundation wall and shall be attached to the foundation wall.

(3) UNINSULATED CRAWL SPACES. (a) For crawl spaces that are outside of the thermal envelope, ventilation openings equal to at least 1/1500 of the floor space shall be provided.

(b) At least 50% of the ventilating area shall be provided at opposite sides of the crawl space or as far apart as possible.

(c) The floor above the crawl space shall be insulated in accordance with Table 22.31–1.

(4) INSULATED CRAWL SPACES. (a) As an alternative to insulating floors over unheated crawl spaces, crawl space walls shall be insulated in accordance with Table 22.31–1.

(b) Crawl space wall insulation shall be permanently fastened to the wall and shall extend the entire height of the wall.

(c) The crawl space may not be vented to the outside unless the floor above is insulated in accordance with Table 22.31–1.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.35 Thermally isolated sunrooms. (1) The minimum opaque ceiling insulation R–value shall be R–24. The minimum opaque wall R–value shall be R–13.

(2) The maximum fenestration U–factor shall be 0.50 and the maximum skylight U–factor shall be 0.75.

(3) New walls, windows and doors separating a sunroom from conditioned space shall meet the building thermal envelope requirements.

(4) The temperature in the conditioned space shall be controlled as a separate zone or shall use separate heating equipment.

(5) Glazing in a thermally–isolated sunroom is not considered to be in the dwelling thermal envelope.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.36 Fenestration. (1) AVERAGE U–FACTORS. An area–weighted average of fenestration products may be used to satisfy the U–factor requirements.

(2) MAXIMUM FENESTRATION U–FACTOR. The area weighted average maximum fenestration U–factor permitted using trade offs from s. Comm 22.31 (2) or subchapter VI shall be 0.40 for vertical fenestration, and 0.75 for skylights.

(3) GLAZED FENESTRATION EXEMPTION. Up to 15 square feet of glazed fenestration per dwelling unit may be exempt from U–factor requirements of the chapter.

(4) OPAQUE DOOR EXEMPTION. One opaque door assembly is exempted from the U–factor requirements of this chapter.

(5) REPLACEMENT FENESTRATION. Where an existing fenestration unit is replaced with a new fenestration unit, including sash and glazing, the replacement unit shall meet the U–factor requirements of this chapter.

(6) CERTIFIED PRODUCTS. Except as provided in sub. (7), fenestration rating, certification and labeling of U–factors for windows, doors and skylights shall be in accordance with NFRC 100.

(7) DEFAULT VALUES. When a manufacturer has not determined product U–factor in accordance with NFRC 100, U–factors shall be determined by assigning a default value in accordance with Tables 22.36–1 and 22.36–2. Where a composite of materials of two different product types is used, the product shall be assigned the higher U–factor.

TABLE 22.36–1
U–FACTOR DEFAULT TABLE FOR WINDOWS, GLAZED DOORS AND SKYLIGHTS [a]

Metal without Thermal Break	Single Glazed	Double Glazed
Operable	1.27	0.87
Fixed	1.13	0.69
Door	1.26	0.80
Skylight	1.98	1.31
Site–assembled Skylight	1.36	0.82
Metal with Thermal Break		
Operable	1.08	0.65
Fixed	1.07	0.63
Door	1.10	0.66
Skylight	1.89	1.11
Site–assembled Skylight	1.25	0.70
Vinyl or Metal–clad Wood		
Operable	0.90	0.57
Fixed	0.98	0.56
Door	0.99	0.57
Skylight	1.75	1.05
Wood or Fiberglass		
Operable	0.89	0.55
Fixed	0.98	0.56
Door	0.98	0.56
Skylight	1.47	0.84

[a] Glass block assemblies shall have a default value of 0.60.

TABLE 22.36–2
U–FACTOR DEFAULT TABLE FOR NON–GLAZED DOORS

Steel Doors (1¾ inches thick)	With Foam Core	Without Foam Core
	0.35	0.60
Wood Doors (1¾ inches thick)	**Without Storm Door**	**With Storm Door**
Panel with $^{7}/_{16}$–inch panels	0.54	0.36
Hollowcore flush	0.46	0.32
Panel with $1^{1}/_{8}$–inch panels	0.39	0.28
Solid core flush	0.40	0.26

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.37 Air leakage. (1) GENERAL. The requirements of this section apply to those components that separate interior conditioned space from a garage or an unconditioned space.

(2) WINDOW AND DOOR ASSEMBLIES. (a) *General.* Except as specified in par. (b), windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot, and swinging doors no more than 0.5 cfm per square foot, 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.

(b) *Exception.* Site–constructed doors and windows shall be sealed with gasketing or weatherstripping or shall be covered with a storm door or storm window.

(3) JOINT AND PENETRATION SEALING. (a) Exterior joints, seams or penetrations in the dwelling envelope, which are sources of air leakage, shall be sealed with durable caulking materials, closed with gasketing systems, taped, or covered with water–vapor–permeable house wrap. Joints to be treated include all of the following:

1. Openings, cracks and joints between wall cavities and window or door frames.

2. Between separate wall assemblies or their sill–plates and foundations.

3. Between walls, roof, ceilings or attic ceiling seals, and between separate wall panel assemblies, including between interior and exterior walls.

4. Penetrations of utility services through walls, floor and roof assemblies, and penetrations through top and bottom wall plates.

(b) Sealing shall be provided at the attic and crawl space panels, at recessed lights and around all plumbing and electrical penetrations, where these openings are located in the dwelling thermal envelope.

(c) The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

(4) RECESSED LIGHTING. When installed in the dwelling envelope, recessed lighting fixtures shall be sealed to limit air leakage between conditioned and unconditioned spaces by one of the following means:

(a) The fixture shall be IC–rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space.

(b) The fixture shall be IC–rated and labeled as meeting ASTM E 283 when tested at 1.57 psi pressure differential with no more than 2.0 cfm of air movement from the conditioned space to the ceiling cavity.

(c) 1. The fixture shall be located inside an airtight sealed box with clearances of at least 0.5 inch from combustible material and 3 inches from insulation.

2. If the fixture is non–IC–rated, the box shall be constructed of noncombustible material that does not readily conduct heat.

Note: Cement board meets the requirements of this section. Drywall and metal do not.

(5) FAN HOUSINGS. Gaps between a fan housing and a ceiling or wall that could result in air leaks shall be gasketed, sealed or caulked.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.38 Vapor retarders. (1) GENERAL. (a) *Definition.* Under this section, a vapor retarder is a material with no intrinsic thermal or structural properties that has a rating of 1.0 perm or less when tested in accordance with ASTM standard E 96, Procedure A.

(b) *Continuity.* The vapor retarder shall be continuous. All joints in a vapor retarder consisting of sheet material shall be overlapped 6 inches and taped or sealed. Rips, punctures and voids in the vapor retarder shall be patched with vapor retarder materials and taped or sealed.

(2) FRAME ASSEMBLIES. (a) *General.* Except as provided under par. (c), all frame walls, frame floors and frame ceilings that comprise the thermal envelope, shall have a vapor retarder installed on the warm–in–winter side of the thermal insulation.

(b) *Coverage.* The vapor retarder shall cover the exposed insulation and the interior face of the framing.

(c) *Exceptions.* 1. Where the vapor retarder is omitted, as allowed under subds. 2. to 4., all sources of air leakage, such as between double top or bottom plates or between double studs, shall be caulked or sealed.

2. No vapor retarder is required in the box sill.

3. No vapor retarder is required where batt insulation is provided with foil or kraft paper backing on the warm–in–winter side and the nailing tabs are tightly fastened to the warm–in–winter face of the framing members.

4. No vapor retarder is required over cavities that are insulated solely with spray–applied foam unless required by the foam manufacturer.

Note: This requirement does not require the cavity to be completely filled. It only requires that the total required R–value come from the foam, including any exterior foam sheathing, and no other insulation material is present in the cavity.

(3) CONCRETE FLOORS. (a) Except as allowed under par. (e), a vapor retarder shall be installed directly under the concrete floor slab or under the base course of concrete floor slabs.

(b) Vapor retarder material shall be at least 6 mils in thickness or shall be a reinforced material.

(c) Joints in the vapor retarder shall be overlapped at least 6 inches and taped or sealed.

(d) The edges of the vapor retarder shall extend up the edges of the slab at least to the top of the slab.

(e) A vapor retarder is not required under the slab of an unconditioned attached garage.

(4) CONCRETE OR MASONRY BASEMENT WALLS. A non–rigid sheet vapor retarder with a perm rating of 0.1 or less is prohibited in all of the following locations:

(a) On a concrete or masonry wall which is below grade to any extent.

(b) On an insulated frame wall constructed in front of a concrete or masonry wall which is below grade to any extent.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.39 Ventilation and moisture control. (1) GENERAL. Design and construction shall prevent deterioration from moisture condensation and ice damming.

(2) VENTED ATTICS. (a) 1. Except as allowed under subd. 6., where air–permeable ceiling or attic insulation is installed in a horizontal position, ventilation shall be provided above the insulation in accordance with this paragraph.

2. At least 50% of the net free ventilating area shall be distributed at the high sides of the roof.

3. The remainder of the net free ventilating area shall be distributed in the lower half of the roof or attic area.

4. If more than 50%, but less than 75% of the net free ventilating area is provided at the high sides of the roof, the total net free ventilating area shall be a minimum of 1/300 of the horizontal area of the ceiling.

5. If 75% or more of the net free ventilating area is provided at the upper sides of the roof, the total net free ventilating area shall be at least 1/150 of the horizontal area of the ceiling.

6. Ventilation is not required for separated roof areas, such as dormers, bump–outs or bays that cover a floor area of 40 ft^2 or less.

(b) Engineered systems that provide equivalent ventilation to that required under this subsection may be used.

(c) Insulation shall not block the free flow of air.

(3) CONDITIONED ATTICS. Attic spaces are not required to be vented where air–impermeable insulation is attached directly to the underside of the roof deck and all of the following conditions are met:

(a) No interior vapor retarders are installed between the living space and the conditioned attic.

(b) The temperature in the attic space is maintained high enough to prevent any moisture condensation on the insulation.

Note: Maintaining the interior surface temperature of the insulation at or above the dew point temperature of the interior air will minimize condensation. Maintaining at least 45°F on the surface of the insulation will minimize condensation on the surface when the interior air temperature is 70°F and the interior relative humidity is 45%.

(4) CATHEDRAL CEILINGS. Air–permeable insulation in a cathedral ceiling assembly shall fill the entire cavity space unless an air barrier separates the top of the insulation from the ventilation space.

(5) MECHANICAL VENTILATION. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

(6) CLOTHES DRYERS. Clothes dryers shall be vented to the outside of the structure.

Note: See s. Comm 23.14 for vent material requirements.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter V — Systems

Comm 22.40 Indoor temperatures and equipment sizing. (1) GENERAL. The indoor temperatures listed under sub. (2) shall be used to determine the total dwelling heat loss and to select the size of the of the heating equipment.

(2) INDOOR DESIGN TEMPERATURES. Unheated, non–habitable basement areas shall use a heating design temperature of less than 50°F. All other areas of a dwelling shall use a heating design temperature of 70°F.

(3) EQUIPMENT SIZING. Heating design loads including ventilation loads for the purpose of sizing systems shall be determined in accordance with the REScheck or REM/RATE software programs or one of the procedures described in Chapter 29 of ASHRAE Handbook of Fundamentals.

Note: Residential heat balance, residential load factor, Canadian F280 and ACCA Manual J are among the methods recognized as equipment sizing protocols under chapter 29.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.41 Temperature control. (1) GENERAL. Each system shall be provided with an adjustable thermostat for the regulation of temperature.

(2) CIRCULATING HOT WATER SYSTEMS. Circulating hot water systems shall include an automatic or readily accessible manual switch to turn off the circulating pump when the system is not in use.

(3) MERCURY THERMOSTATS. The installation of thermostats containing mercury is prohibited.

Note: This section does not require the replacement of existing mercury–containing thermostats.

(4) HEAT PUMP SUPPLEMENTARY HEAT. Heat pumps having supplementary electric–resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.42 Duct systems. (1) Supply and return heating ducts, or portions thereof, that are not located completely within the thermal envelope, shall be provided with insulation with a thermal resistance of at least R–8.

(2) Building framing cavities may not be used as supply ducts.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.43 Duct and plenum sealing. (1) Duct systems with joints not located entirely within the conditioned space or with joints located on the unconditioned side of stud bays, joist cavities and similar spaces, shall be sealed in accordance with this section.

(2) Sealing shall be accomplished using welds, gaskets, mastics, mastic–plus–embedded–fabric systems or tapes installed in accordance with the manufacturer's instructions.

(3) Insulation that provides a continuous air barrier may be used in lieu of sealing metal ducts.

(4) Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled as complying with UL 181A.

(5) Tapes and mastics used with flexible air ducts shall be listed and labeled as complying with UL 181B.

(6) Tapes with rubber–based adhesives may not be used.

Note: Standard duct tape or "duck tape" has a rubber–based adhesive and does not comply with the requirements of this section.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.44 Pipe insulation. Heating pipes in unheated spaces shall be insulated with material providing a minimum thermal resistance of R−4 as measured on a flat surface in accordance with ASTM standard C 335 at a mean temperature of 75°F.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Comm 22.45 Air conditioner and heat pump efficiencies. (1) Heating and cooling equipment shall meet the minimum efficiency requirements in Table 22.45 when tested and rated in accordance with the applicable test procedure.

(2) The efficiency shall be verified through certification under an approved certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.

(3) Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all efficiency requirements under this chapter.

(4) Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrate that the combined efficiency of the specified components meets the requirements under this section.

TABLE 22.45

UNITARY AIR CONDITIONERS AND CONDENSING UNITS AND UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Minimum Efficiency	Minimum Efficiency	Test Procedure
Split system and single package air conditioner, air cooled	13.0 SEER		ARI 210/240
Space constrained product−air conditioner	12 SEER		ARI 210/240
Through−the−wall air conditioner, air cooled, split system	10.9 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)		ARI 210/240
Through−the−wall air conditioner, air cooled, single package	10.6 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)		ARI 210/240
Split system and single package air conditioner, water and evaporatively cooled	12.1 SEER		ARI 210/240
Split system and single package heat pump, air cooled	13.0 SEER	7.7 HSPF	ARI 210/240
Through−the−wall air conditioner and heat pump−split system	10.9 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)	7.1 HSPF (before Jan. 23, 2010) 7.4 HSPF (as of Jan. 23, 2010)	ARI 210/240
Through−the−wall air conditioners and heat pumps−single package	10.6 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)	7.0 HSPF (before Jan. 23, 2010) 7.4 HSPF (as of Jan. 23, 2010)	ARI 210/240
Space constrained products−heat pumps	12 SEER	7.4 HSPF	ARI 210/240
Water source, heating mode, 68°F entering water		4.2 COP	ARI/ASHRAE 13256−1
Groundwater source, heating mode, 50°F entering water		3.6 COP	ARI/ASHRAE 13256−1
Ground source, heating mode, 32°F entering water		3.1 COP	ARI/ASHRAE 13256−1

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Comm 22.46 Replacement furnace and boiler efficiencies. (1) A replacement furnace in existing construction may meet only the prevailing federal efficiency standard provided the duct distribution system is sealed and tested at 0.02 inches water gage across the entire system, including the manufacturer's air handler enclosure, to have air leakage less than 10 percent of the furnace manufacturer's rated air flow across the blower at high speed.

Note: 0.02 inches water gage is equal to approximately 25 pascals.

(2) A replacement boiler in existing construction may meet only the prevailing federal standard provided there is no installed circulation pump larger than $^1/_{20}$ horsepower and no circulation pump runs continuously.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Subchapter VI — Simulated Performance Alternative

Comm 22.50 General. This subchapter establishes criteria for compliance using simulated energy performance analysis. The analysis shall include heating, cooling, and service water heating energy only.

History: CR 08−043: cr. Register March 2009 No. 639, eff. 4−1−09.

Comm 22.51 Performance–based compliance. Compliance based on simulated energy performance requires that a proposed dwelling be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.52 Documentation. (1) COMPLIANCE SOFTWARE TOOLS. Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this subchapter shall be provided to the inspector.

(2) COMPLIANCE REPORT. Compliance software tools shall generate a report that documents that the proposed design has annual energy costs less than or equal to the annual energy costs of the standard reference design. The compliance documentation shall include all of the following information:

(a) Address of the dwelling.

(b) 1. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table 22.53–1.

2. The inspection checklist shall show the estimated annual energy cost for both the standard reference design and the proposed design.

(c) Name of individual completing the compliance report.

(d) Name and version of the compliance software tool.

(3) ADDITIONAL DOCUMENTATION. The inspector may require any of the following documents:

(a) Documentation of the building component characteristics of the standard reference design.

(b) A certification signed by the builder providing the building component characteristics of the proposed design as given in Table 22.53–1.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.53 Calculation procedure. (1) GENERAL. Except as specifically allowed under this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

(2) REFERENCE AND PROPOSED DESIGNS. The standard reference design and proposed design shall be configured and analyzed as specified by Table 22.53–1. Table 22.53–1 shall include by reference all notes contained in Table 22.31–1.

(3) CALCULATION SOFTWARE TOOLS. Calculation procedures used to comply with this section shall be capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

(a) Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure may not allow the user to directly modify the building component characteristics of the standard reference design.

(b) Calculation of whole–building sizing as a single zone for the heating and cooling equipment in the standard reference design residence in accordance with s. Comm 22.40 (3).

(c) Calculations that account for the effects of indoor and outdoor temperatures and part–load ratios on the performance of heating, ventilating and air conditioning equipment based on climate and equipment sizing.

(d) Printed code official inspection checklist listing each of the proposed design component characteristics from Table 22.53–1 determined by the analysis to provide compliance, along with their respective performance ratings.

TABLE 22.53–1
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Above–grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 22.31–2	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawlspace walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 22.31–2 with insulation layer on interior side of walls	As proposed
Above–grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 22.31–2	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 22.31–2	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
Doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U–Factor: same as fenestration from Table 22.31–2	As proposed

TABLE 22.53–1 (Continued)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Glazing[a]	Total area[b] =	
	(a) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area	As proposed
	(b) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area	
	Orientation: equally distributed to four cardinal compass orientations	As proposed
	U–Factor: from Table 22.31–2	As proposed
	SHGC = 0.40	As proposed
	Interior shade fraction:	
	Summer (all hours when cooling is required) = 0.70	Same as standard reference design[c]
	Winter (all hours when heating is required) = 0.85	
	External shading: none	As proposed
Skylights	U–Factor: from Table 22.31–2	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Specific Leakage Area (SLA)[d] = 0.00036 assuming no energy recovery	For residences that are not tested, the same as the standard reference design; For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] but not less than 0.35 ACH; For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] combined with the mechanical ventilation rate[f], which may not be less than 0.01 X CFA + 7.5 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = 0.03942 X CFA + 29.565 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 x CFA + 4,104 X N br (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[g] but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R–2 carpet and pad, and 20% of floor directly exposed to room air;	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table 22.31–2 located on the interior side of the walls;	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed

TABLE 22.53–1 (Continued)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Heating systems [h,i]	Fuel type: same as proposed design efficiencies: Electric: air–source heat pump with prevailing federal minimum efficiency; Nonelectric furnaces: natural gas furnace in accordance with Table 22.31–3; Nonelectric boilers: natural gas boiler in accordance with Table 22.31–3; Capacity: sized in accordance with section Comm 22.40 (3)	As proposed As proposed As proposed As proposed As proposed
Cooling systems [h,j]	Fuel type: electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with section Comm 22.40 (3)	As proposed As proposed As proposed
Service Water Heating [h,k]	Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 X N br Tank temperature: 120°F	As proposed As proposed Same as standard reference Same as standard reference
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies	Same as standard reference design, except as specified by Table 22.53–2
Thermostat	Type: manual, cooling temperature set point = 78°F; heating temperature set point = 68°F	Same as standard reference design

a Glazing shall be defined as sunlight–transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight–transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight–transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.

b For residences with conditioned basements, R–2 and R–4 residences and townhouses, the following formula shall be used to determine glazing area: AF = As X FA X F where:

1. AF = Total glazing area.
2. As = Standard reference design total glazing area.
3. FA = (Above–grade thermal boundary gross wall area)/(above–grade boundary wall area + 0.5 x below–grade boundary wall area).
4. F = (Above–grade thermal boundary wall area)/(above–grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

And where:

5. Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
6. Above–grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
7. Below–grade boundary wall is any thermal boundary wall in soil contact.
8. Common wall area is the area of walls shared with an adjoining dwelling unit.

c For fenestrations facing within 15 degrees of true south that are directly coupled to thermal storage mass, the winter interior shade fraction may be increased to 0.95 in the proposed design.

d Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where: SLA = L/CFA where L and CFA are in the same units.

e Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2005 ASHRAE Handbook of Fundamentals, Chapter 27, page 27.21, Equation 40, Sherman–Grimsrud model, or the equivalent shall be used to determine the energy loads resulting from infiltration.

f The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2005 ASHRAE Handbook of Fundamentals page 27.23 and the "Whole–house Ventilation" provisions of 2005 ASHRAE Handbook of Fundamentals, page 27.18 for intermittent mechanical ventilation.

g Thermal Storage Element means a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase–change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees of true south, or must be connected to a room with pipes or ducts that allow the element to be actively charged.

h For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

i For a proposed design without a proposed heating system, a heating system of 90% annual fuel utilization shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air–source heat pump shall be used for the standard reference design.

j For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

k For a proposed design with a non–storage–type water heater, a 40–gallon storage–type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40–gallon storage–type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

TABLE 22.53–2
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

Distribution System Configuration and Condition	Forced Air Systems	Hydronic Systems[b]
Distribution system components located in unconditioned space	0.80	0.95
Distribution systems entirely located in conditioned space[c]	0.88	1.00
Proposed "reduced leakage" with entire air distribution system located in the conditioned space[d]	0.96	—
Proposed "reduced leakage" air distribution system with components located in the unconditioned space	0.88	—
Ductless systems[e]	1.00	—

a Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b Hydronic systems means those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced air flows to maintain space temperatures.

c Entire system in conditioned space means that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.

d Proposed "reduced leakage" means leakage to outdoors not greater than 3 cfm per 100 ft^2 of conditioned floor area and total leakage not greater than 9 cfm per 100 ft^2 of conditioned floor area at a pressure differential of 0.02 inches w.g. across the entire system, including the manufacturer's air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft^2 of conditioned floor area at a pressure difference of 0.02 inches w.g. across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to the outdoors. This performance shall be specified as required in the construction documents and confirmed through field–testing of installed systems as documented by an approved independent party.

e Ductless systems may have forced airflow across a coil but may not have any ducted airflows external to the manufacturer's air handler enclosure.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.