# Chapter Comm 22

# ENERGY CONSERVATION



**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 Chapter ILHR 22 was repealed and recreated to be chapter Comm 22, Register, January, 1999, No. 517, eff. 2–1–99.

## Subchapter I — Scope and Application

**Comm 22.01 Scope.** This chapter applies to all one– and 2–family dwellings covered by this code.

**History:** Cr. Register, January, 1999, No. 517, eff. 2–1–99.

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

**(2)** This chapter allows the designer the option of using subchs. V and VI or VII to demonstrate compliance with equipment and 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. Requirements of all other subchapters apply regardless of choice.

**Note:** The UDC Energy Worksheet specifies the insulation requirements to apply to the dwelling envelope. A copy of the worksheet is in the appendix. Other code requirements apply to material and equipment identification, sealing of the building envelope, the heating and cooling system including ducts, and the hot water system. Copies of worksheets may be obtained from the Department of Commerce, Safety and Buildings Division P.O. Box 2509 Madison, WI 53701.

**History:** Cr. Register, January, 1999, No. 517, eff. 2–1–99.

## Subchapter II — Materials and Equipment.

**Comm 22.03 Identification. (1)** DWELLING ENVELOPE INSULATION. (a) Except as provided in par. (b), 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) Insulation without a thermal resistance identification mark may be used if the insulation installer provides a signed and dated certification for the insulation installed in each element of the building envelope, listing the type of insulation, the manufacturer and the R–value. For blown–in or sprayed insulation, the installer shall also provide the initial installed thickness, the calculated settled thickness, the coverage area and the number of bags installed. The installer shall post the certification in a readily accessible conspicuous place on the job site.

**(2)** INSULATION INSTALLATION. (a) 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.

(b) The thickness of roof and ceiling insulation that is either blown in or sprayed shall be identified by thickness markings that are labeled in inches installed at least one for every 300 square feet through the attic space. 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. Each marker shall face the attic access. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

**History:** Cr. Register, January, 1999, No. 517, eff. 2–1–99.

**Comm 22.04 Protection of insulation. (1)** BLANKET INSULATION. Except in the box sill, insulating blankets or batts shall be held in place with a covering or other means of mechanical or adhesive fastening.

**Note:** Acceptable covering or fastening for interior or warm–side applications includes drywall, vapor retarder material, foil or kraft paper backing or other means of holding the blankets in place. Air barrier material may be used for cold–side support.

**(2)** FOAM PLASTIC INSULATION. Exterior foam plastic insulation shall be protected from physical damage and damage from ultraviolet light.

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

**History: Cr. Register, March, 2001, No. 543, eff. 4–1–01.**

**Comm 22.05 Fenestration product rating certification and labeling. (1)** CERTIFIED PRODUCTS. Except as provided in sub. (2), fenestration product rating, certification and labeling, U–values of windows, doors and skylights shall be determined in accordance with the National Fenestration Rating Council standard 100, Procedures for Determining Fenestration Product Thermal Properties, by an accredited, independent laboratory. Fenestration products shall be labeled and certified by the

manufacturer. Such certified and labeled values shall be accepted for purposes of determining compliance with the dwelling envelope requirements of this code.

**(2)** DEFAULT VALUES. When a manufacturer has not determined product U−value in accordance with NFRC 100 for a particular product line, compliance with the dwelling envelope requirements of the code shall be determined by assigning such products a default U−value in accordance with Tables 22.05−1 and 22.05−2. Product features must be verifiable for the product to qualify for the default value associated with those features. Where the existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials of two different product types is used, the product shall be assigned the higher U−value.

**TABLE 22.05−1**
**U−VALUE DEFAULT TABLE FOR WINDOWS, GLAZED DOORS AND SKYLIGHTS***

| **METAL WITHOUT THERMAL BREAK** | **Single Glazed** | **Double Glazed** |
|---|---|---|
| Operable | 1.27 | 0.87 |
| Fixed | 1.13 | 0.69 |
| Garden Window | 2.60 | 1.81 |
| Curtain Wall | 1.22 | 0.79 |
| 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 |
| Curtain Wall | 1.11 | 0.68 |
| Door | 1.10 | 0.66 |
| Skylight | 1.89 | 1.11 |
| Site Assembled Skylight | 1.25 | 0.70 |
| **REINFORCED 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/VINYL/FIBERGLASS** | | |
| Operable | 0.89 | 0.55 |
| Fixed | 0.98 | 0.56 |
| Garden Window | 2.31 | 1.61 |
| Door | 0.98 | 0.56 |
| Skylight | 1.47 | 0.84 |

* Glass block assemblies shall have a default U−value of 0.60.

**TABLE 22.05−2**
**U−VALUE DEFAULT TABLE FOR NON−GLAZED DOORS**

| **STEEL DOORS (1−3/4 inches thick )** | **With Foam Core** | **Without Foam Core** |
|---|---|---|
| | 0.35 | 0.60 |
| **WOOD DOORS (1−3/4 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. Register, January, 1999, No. 517, eff. 2−1−99.

## Subchapter III – Definitions

**Comm 22.06 Definitions.** In ch. Comm 22:

**(1)** "Accessible", as applied to equipment, means admitting close approach to equipment not guarded by locked doors, elevation or other effective means.

**Note:** See "Readily accessible".

**(2)** "Air conditioning" means the process of treating air to control simultaneously its temperature, humidity, cleanness, and distribution to meet the requirements of the conditioned space.

**(3)** "Automatic" means self−acting, operating by its own mechanism when actuated by some impersonal influence, such as a change in current strength, pressure, temperature or mechanical configuration.

**(4)** "Basement wall" is the opaque portion of a wall that encloses one side of a basement and is partially or totally below grade.

**(5)** "Conditioned space" means space within the dwelling envelope which is provided with heated or cooled air or surfaces to provide a heated space or a cooled space.

**(6)** "Cooled space" means a space directly or indirectly supplied with mechanical cooling to maintain air temperature within the space of 85°F or less at design conditions.

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

**(8)** "Deadband" means the range of values within which an input variable can be varied without initiating any noticeable change in the output variable.

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

**(10)** "Electrically heated" means provided with permanently installed electrical space heating equipment which has an input capacity of 3 kilowatts or more to meet all or part of the space heating requirements.

**(11)** "Energy" means the capacity for doing work, taking a number of forms which may be transformed from one form into another, such as thermal heat, mechanical work, electrical and chemical in customary units, measured in kilowatt−hours (kWh) or British thermal units (Btu).

**Note:** See "New energy".

**(12)** "Energy, Recovered". See "Recovered energy".

**(13)** "F−value" means the rate of heat loss through a slab per foot of perimeter measured in Btu/h • ft • °F.

**(14)** "Glazing area" means the interior surface area of all glazed surfaces including sash, curbing or other framing elements that enclose conditioned spaces.

**Note:** Glazed surfaces include windows, sliding glass doors, and skylights.

**(15)** "Gross 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. The gross area of exterior walls consists of all opaque wall areas, including between floor spandrels, box sills, window area including sash, and door areas when they are exposed to outdoor air or unconditioned spaces and enclosed heated or mechanically cooled space, including interstitial area between 2 such spaces. The gross exterior wall area includes the total basement wall area if it is less than 50% below grade. The gross exterior wall area includes non−opaque areas such as windows and doors of all basement walls.

**(16)** "Gross floor area" means the sum of areas of all floors of the structure, including basements, cellars, and intermediate floored tiers measured from the exterior faces of exterior walls or from the center line of interior walls, excluding covered walkways, open roofed−over areas, porches, pipe trenches, exterior terraces or steps, chimneys, roof overhangs and similar features.

**(17)** "Heat" means energy that is transferred by virtue of a temperature difference or a change in state of a material.

**(18)** "Heated slab" means slab−on−grade construction in which the heating elements or hot air distribution system is in contact with or placed within the slab or the subgrade.

**(19)** "Heated space" means any enclosed space provided with a direct or indirect supply of heat to maintain the temperature of the space to at least 50° F at design conditions.

**(20)** "Humidistat" means a regulating device, actuated by changes in humidity, used for automatic control of relative humidity.

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

**(22)** "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.

**(23)** "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.

**(24)** "Inherently protected type IC" means 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 and the fixture construction is such that, even without a thermal protector, the fixture cannot be overlamped or mislamped.

**(25)** "Manual" means capable of being operated by personal intervention.

**Note:** See "Automatic ".

**(26)** "New energy" means energy other than recovered energy, utilized for the purpose of heating or cooling.

**Note:** See "Energy".

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

**(28)** "Readily accessible" means capable of being reached quickly for operation, renewal or inspections, without requiring a person to climb over or remove obstacles or to resort to portable ladders or access equipment.

**Note:** See "Accessible".

**(29)** "Recovered energy" means energy utilized which would otherwise be wasted and would not contribute to a desired end use, from an energy utilization system.

**(30)** "Renewable energy sources" means sources of energy, excluding minerals, derived from incoming solar radiation, including natural daylighting and photosynthetic processes: from phenomena resulting therefrom, including wind, waves and tides, lake or pond thermal differences and from the internal heat of the earth, including nocturnal thermal exchanges.

**(31)** "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 or mechanically cooled space. The gross area of a roof assembly consists of the total interior surface of the assembly, including skylights exposed to the heated or mechanically cooled space.

**(32)** "Sequence" means a consecutive series of operations.

**(33)** "Service systems" means all energy−using systems in a dwelling that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

**(34)** "Service water heating" means a supply of hot water for purposes other than comfort heating.

**(35)** "Service water heating demand" means the maximum design rate of energy withdrawal from a service water heating system in a designated period of time; usually an hour or a day.

**(36)** "Slab−on−grade floor insulation" means insulation around the perimeter of the floor slab or its supporting foundation.

**(37)** "Solar energy source" means a source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

**(38)** "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, service water heating or illumination.

**(39)** "Thermal conductance" means the time rate of heat flow through a body, frequently per unit area, from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces, under steady state conditions. It is expressed as Btu/h • $ft^2$ • °F.

**(40)** "Thermal resistance" or "R" means a measure of the ability to retard the flow of heat. The R−value is the reciprocal of thermal transmittance or U−value 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.

**(41)** "Thermal resistance overall" or "$R_o$" means the reciprocal of overall thermal conductance expressed as Btu/h • $ft^2$ • °F. The overall thermal resistance of the gross area or individual component of the exterior dwelling envelope such as, roof and ceiling, exterior walls, floors, crawl space walls, foundation walls, windows, skylights, doors, and opaque walls, includes the weighted R−values of the component assemblies, including air−film, insulation, drywall, framing, and glazing.

**(42)** "Thermal transmittance" or "U" means the time rate of heat flow through a body or assembly which is located in between 2 different environments, expressed in Btu/h • $ft.^2$ • °F. The U−value 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−value 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.

**(43)** "Thermal transmittance overall" or "$U_o$" means the overall, average heat transmission of a gross area of the exterior dwelling envelope expressed as Btu/h • $ft^2$ • °F. The $U_o$−value applies to the combined effect of the time rate of heat flow through various paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior dwelling components, such as walls, floors or roof and ceilings.

**(44)** "Thermally protected type IC " means tested and listed by an independent testing laboratory as being suitable for installation in a cavity where thermal insulation will be in direct contact with the fixture.

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

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

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

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99

## Subchapter IV – Design Criteria

**Comm 22.07 Indoor and outdoor temperatures.** The indoor temperatures listed in Table 22.07−1 and the outdoor temperatures listed in Table 22.07−2 shall be used to determine the total dwelling heat loss or heat gain and to select the size of the heating or cooling equipment.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99; **am. Table 22.07−1, Register, March, 2001, No. 543, eff. 4−1−01.**

**TABLE 22.07−1**
**INDOOR DESIGN TEMPERATURES**

| Season | Location | Design Temperature |
|---|---|---|
| Winter | All areas except nonhabitable basement areas | 70°F |
| | Unheated, nonhabitable basement areas only | Less than 50°F |
| Summer | All areas | 78°F |

**TABLE 22.07−2**
**OUTDOOR DESIGN CONDITIONS BASED ON FIGURE 22.07**

| | |
|---|---|
| Zone 1 | 25° below zero F |
| Zone 2 | 20° below zero F |
| Zone 3 | 15° below zero F |
| Zone 4 | 10° below zero F |

**Note:** See Figure 22.07 for zone boundaries.

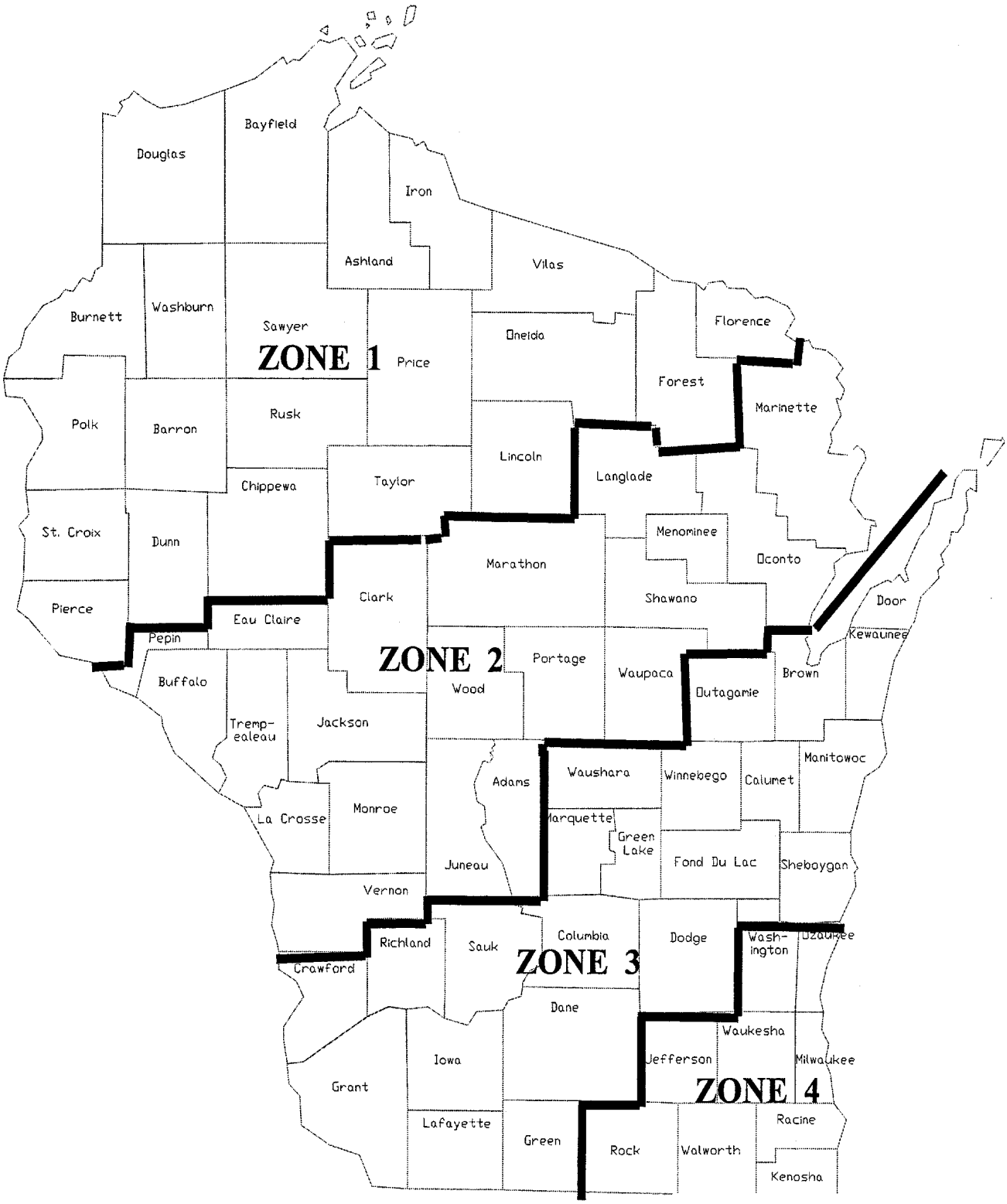


FIGURE 22.07

**Comm 22.08 Ventilation and moisture control.** **(1)** ATTICS. (a) Ventilation shall be provided above the ceiling or attic insulation. At least 50% of the net free ventilating area shall be distributed at the low sides of the roof. The remainder of the net free ventilating area shall be distributed in the upper one−half of the roof or attic area.

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

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

(b) As an exception to par. (a), the ventilation space above any non−rigid insulation in a cathedral ceiling assembly shall be at least one inch in height.

(c) Engineered systems that provide equivalent ventilation to that specified in par. (a) may be used.

(d) The ventilation area required in par. (a) shall be maintained after the installation of insulation.

**(2)** CRAWL SPACES. Ventilation shall be provided in crawl spaces which are outside the dwelling envelope. The area of ventilation shall be at least 1/1500 of the floor space. At least 50% of the ventilating area shall be provided at opposite sides of the crawl space or as far apart as possible.

**(3)** CLOTHES DRYERS. If clothes dryers are provided, the dryers shall be vented to the outside of the dwelling. The dryer vents may not terminate in an attic space or crawl space or basement.

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

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

## Subchapter V – Heating and Air Conditioning Equipment and Systems

**Comm 22.09 Scope.** This subchapter covers the determination of system heating and cooling loads, design requirements, system and component performance, control requirements, and distribution system construction and insulation.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.10 Calculating heating and cooling loads.** The design requirements specified in Subchapter IV shall apply for all computations.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.11 Calculation procedures.** **(1)** Heating and cooling design loads including ventilation loads for the purpose of sizing systems shall be determined in accordance with one of the procedures described in Chapter 25 of ASHRAE Handbook of Fundamentals.

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

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.12 Selection of equipment.** **(1)** GENERAL. Except as provided in sub. (2), the output capacity of the mechanical heating equipment shall not exceed the calculated heating load by more than 15%, except to satisfy the manufacturer's next closest nominal size.

**(2)** WATER HEATERS USED FOR SPACE HEATING. The output capacity of water heaters that are used for simultaneous space heating shall exceed the calculated space heating load by at least 43%, but by no more than 49%. Other sizing methods may be used if approved by the department for water heaters providing simultaneous space and domestic water heating.

**Note:** Heat exchanger units that are part of the plumbing system shall meet the requirements of Chs. Comm 81−84.

**(3)** EQUIPMENT EFFICIENCY. The efficiency of equipment installed in a dwelling shall match the efficiency used to claim any credit under the method of design by system analysis or other approved compliance method.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99**; cr. (3), Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.13 Supplementary heater for heat pumps.** **(1)** If a heat pump is installed, it shall include a control to prevent supplementary heater operation when the operating load can be met by the heat pump alone.

**(2)** Supplementary heater operation is permitted during transient periods, such as start−up periods, following room thermostat set−point advance, and during defrost periods.

**(3)** A two−stage thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement. The cut−on temperature for the compression heating shall be higher than the cut−on temperature for the supplementary heat. Supplementary heat may be derived from any source including, electric resistance, combustion heating, and solar stored−energy heating.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.14 Mechanical ventilation.** **(1)** Mechanical ventilation system supply and exhaust shall be equipped with a readily accessible means for shutoff when ventilation is not required.

**(2)** Automatic or gravity dampers that close when the system is not operating shall be provided for outdoor air intake and exhaust.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.15 Temperature control.** **(1)** A readily accessible manual or automatic means shall be provided to restrict or shut off the heating or cooling input to each zone or floor.

**(2)** Each system shall be provided with an adjustable thermostat for the regulation of temperature. A thermostat shall be capable of being set by adjustment or selection of sensors as follows:

(a) When used to control heating only, the thermostat shall be capable of being set from 55°F to 75°F.

(b) When used to control cooling only, the thermostat shall be capable of being set from 70°F to 85°F.

(c) When used to control both heating and cooling, the thermostat shall be capable of being set from 55°F to 85°F and shall be capable of operating the system heating and cooling in sequence. The thermostat or control system shall have an adjustable deadband of at least 10°F.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.16 Humidity control.** If a system is equipped with a means for adding or removing moisture to maintain a selected relative humidity in spaces or zones, a humidistat shall be provided.

**(1)** Humidistats of humidifiers shall be capable of being set to prevent new energy from being used to produce a space or zone relative humidity above 30%.

**(2)** Humidistats of dehumidifiers shall be capable of being set to prevent new energy from being used to produce a space or zone relative humidity of less than 60%.

**Note:** This requirement does not restrict the actual operation of the equipment. The only requirement is that the specified setpoints be available to the occupants so that they can minimize energy consumption. The controls are not limited to the specified settings alone.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.17 Duct system insulation.** **(1)** Except as provided in sub. (4), all heating and cooling duct systems, or portions thereof, that are located in unheated or uncooled spaces respectively, shall be provided with insulation with a thermal resistance of at least R−5.

**Note:** Where control of condensation is required for compliance with s. Comm 22.22, additional insulation, vapor retarders, or both, may need to be provided to limit vapor transmission and condensation.

**(2)** Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this section or s. Comm 22.21.

**(3)** Insulation resistance shall be measured on a horizontal plane in accordance with ASTM standard C 518 at a mean temperature of 75°F at the installed thickness.

**(4)** Duct insulation, except as required to prevent condensation, is not required on any of the following ducts:

(a) Supply−air or return−air ducts that are installed in basements, cellars or unventilated crawl spaces having insulated walls.

(b) Ducts for which heat gain or loss, without insulation, will not increase the energy requirements of the building.

(c) Ducts located within HVAC equipment.

(d) Exhaust air ducts.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99; **am. (1), Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.18 Duct and plenum sealing. (1)** Sections of supply and return ducts not located entirely within the conditioned space and the unconditioned side of enclosed stud bays or joist cavities or spaces used to transport air shall be sealed.

**(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 has a rubber−based adhesive and does not comply with the requirements under this section.

**History: Cr. Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.19 Pipe insulation. (1)** Except as provided in sub. (2), all heating pipes in unheated spaces and all cooling pipes in uncooled spaces shall be insulated with material providing a minimum thermal resistivity of R−4 as measured on a flat surface in accordance with ASTM standard C 335 at a mean temperature of 75 °F.

**(2)** Piping insulation is not required in any of the following cases:

(a) Pipes installed within heating and air conditioning equipment, installed in conditioned spaces.

(b) Piping at fluid temperatures between 55°F and 120°F when not required for energy conservation purposes.

(c) When the heat loss or gain of the piping without insulation does not increase the energy requirements of the dwelling.

(d) When piping is installed in basements, cellars or unventilated crawl spaces having insulated walls.

**Note:** Additional insulation and vapor retarders may be necessary to prevent condensation in accordance with s. Comm 22.22.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

## Subchapter VI – Dwelling Envelope Design

**Comm 22.20 General.** The dwelling envelope of all 1− and 2−family dwellings shall comply with this subchapter, unless the requirements of system analysis design of subch. VII are met.

**Note:** See appendix for a copy of the UDC Energy Worksheet used to show compliance with the envelope insulation requirements of ss. Comm 22.21 to 22.28. Copies of the worksheets may be obtained from the Department of Commerce, Safety and Buildings Division, P. O. Box 2509 Madison, WI 53701. Other forms or software may be used when approved by the department. WIScheck software may be used to show compliance and is available from the Safety and Buildings page on the Department of Commerce Website www.commerce.state.wi.us.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.21 Envelope requirements. (1)** GENERAL. The stated $U_o$ − , U − or R−value of an assembly may be increased, or the stated $U_o$ − , U − or R−value of an assembly may be decreased, provided the total heat gain or loss for the entire dwelling does not exceed the total $U_o$ − ,U − or R−value of an assembly resulting from conformance to the values specified in ss. Comm 22.23 to 22.28.

**(2)** APPLICATION OF STANDARDS FOR ELECTRICALLY HEATED DWELLINGS. (a) *New dwellings.* New dwellings that are electrically heated shall meet the thermal performance standards of this subchapter for electrically heated dwellings.

(b) *Additions.* If the combined input capacity of permanently installed electrical space heating equipment of the original dwelling and a new addition exceeds 3 kilowatts, either the addition shall meet the thermal performance standards of this subchapter for electrically heated dwellings or the entire dwelling and addition shall meet the thermal performance standards of this subchapter for electrically heated dwellings.

(c) *Alterations.* If an alteration results in the addition of permanently installed electrical space heating equipment with a combined input capacity of permanently installed electrical space heating equipment of the altered dwelling exceeds 3 kilowatts, either the area served by the new electrical space heating equipment shall meet the thermal performance standards of this subchapter for electrically heated dwellings or the entire dwelling, and the addition shall meet the thermal performance standards of this sub−chapter for electrically heated dwellings.

**TABLE 22.21**
**HEATING AND COOLING CRITERIA [g]**

| Component of Dwelling Envelope | Maximum Overall Thermal Transmittance, $U_0$ or Minimum Thermal Resistance, R | |
|---|---|---|
| | Non−electrically Heated | Electrically Heated |
| *Roof and Ceiling*[a] | $U_0 = 0.026$ | $U_0 = 0.020$ |
| *Walls:* | | |
| crawl space[c, f] | $U_0 = 0.060$ | $U_0 = 0.060$ |
| basement[c, f] | $U_0 = 0.091$ | $U_0 = 0.091$ |
| walls[b] | $U_0 = 0.110$ | $U_0 = 0.080$ |
| *Floors:* | | |
| heated slab−on−grade[c, d,f] | R = 8.5 | R = 10 |
| over unheated space[e] | $U_0 = 0.050$ | $U_0 = 0.050$ |
| unheated slab−on−grade[c, d,f] | R = 6.5 | R = 10 |
| over outside air (overhang) | $U_0 = 0.033$ | $U_0 = 0.033$ |

a Roof and ceiling assemblies include attic access panels and skylights.
b See definition of gross exterior wall area.
c Insulation installed below grade shall be suitable for that application.
d "Heated slab" means slab−on−grade construction in which the heating elements or hot air distribution system is in contact with or placed within the slab or the subgrade. The required U−value refers to the insulation only.
e Includes unheated crawl spaces, basements, garages, and other spaces outside of the dwelling envelope.
f The required U−value applies to the floor or wall assembly only, excluding the effect of soil.
g The maximum overall heat loss requirement may be increased when an equivalent amount of energy savings is provided by equipment that exceeds the federal efficiency standards of 10 CFR part 230. See Energy Worksheets in the Appendix for how the credit is applied. A more exact calculation of this credit may be submitted to the department for review in accordance with s. Comm 22.34.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.22 Vapor retarders. (1)** GENERAL. (a) Designs shall prevent deterioration from moisture condensation.

(b) Vapor retarders shall have a rating of 1.0 perm or less when tested in accordance with ASTM standard E 96, Procedure A.

(c) The vapor retarder shall be continuous. All joints in the vapor retarder shall be overlapped and secured or sealed. Rips and punctures in the vapor retarder shall be patched with vapor retarder materials and taped or sealed.

**(2)** FRAME ASSEMBLIES. In all frame walls, floors and ceilings, the vapor retarder shall be installed on the warm side of the thermal insulation. The vapor retarder shall cover the exposed insulation and the interior face of studs, joists and rafters. No vapor retarder is required in the box sill.

**(3)** CONCRETE FLOORS. A vapor retarder shall be installed under the slab or under the base course of slabs and basement floors unless the slab is in an unheated attached garage.

**(4)** CONCRETE OR MASONRY BASEMENT WALLS. A vapor retarder is not required in concrete or masonry basement wall below−ground applications.

**(5)** CRAWL SPACES. A vapor retarder shall be provided over crawl space floors in accordance with s. Comm 21.05 (4).

**(6)** WOOD FOUNDATIONS. Vapor retarders for wood foundations shall be in accordance with the standards adopted under s. Comm 20.24 (5) (b).

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99**; correction in (6) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543.**

**Comm 22.23 Walls. (1)** GENERAL. The combined thermal transmittance value ($U_o$) of the gross area of exterior walls shall not exceed the value given in Table 22.21. Equation 1 in s. Comm 22.31 (1) shall be used to determine acceptable combinations to meet this requirement.

**(2)** METAL STUD FRAMING. When metal stud framing is used, the value of $U_w$ used in Equation 1 in s. Comm 22.31 (1) shall be recalculated using a series−parallel heat flow path procedure to correct for parallel path thermal bridging. The $U_w$ for purposes of Equation 1 in s. Comm 22.31 (1), of metal stud walls shall be determined as follows:

$$U_w = \frac{1}{R_1 + (R_{ins} \times F_c)}$$

where:

$R_1$ = the total thermal resistance of the elements, in series along the path comprising the wall assembly of heat transfer, excluding the cavity insulation and the metal stud.

$R_{ins}$ = the R−value of the cavity insulation.

$F_c$ = the correction factor listed in Table 22.23.

**TABLE 22.23**

**$F_c$ Values For Wall Sections With Metal Studs Parallel Path Correction Factors**

| Size of Member | Gage of Stud[1] | Spacing of Framing Inches | Cavity Insulation R−Value | Correction Factor |
|---|---|---|---|---|
| 2 X 4 | 18 – 16 | 16 o.c. | R – 11 | 0.50 |
| | | | R – 13 | 0.46 |
| | | | R – 15 | 0.43 |
| 2 X 4 | 18 – 16 | 24 o.c. | R – 11 | 0.60 |
| | | | R – 13 | 0.55 |
| | | | R – 15 | 0.52 |
| 2 X 6 | 18 – 16 | 16 o.c. | R – 19 | 0.37 |
| | | | R – 21 | 0.35 |
| 2 X 6 | 18 – 16 | 24 o.c. | R – 19 | 0.45 |
| | | | R – 21 | 0.43 |
| 2 X 8 | 18 – 16 | 16 o.c. | R – 25 | 0.31 |
| 2 X 8 | 18 – 16 | 24 o.c. | R – 25 | 0.38 |

1These factors shall be applied to metal studs of this gage or thinner.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.24 Roof and ceiling.** The combined thermal transmittance value ($U_o$ ) of the gross area of the roof or ceiling assembly shall not exceed the value given in Table 22.21. Equation 2 in s. Comm 22.31 (1) shall be used to determine acceptable combinations to meet this requirement.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.25 Floors over unheated spaces.** The combined thermal transmittance value $U_o$ of the gross area of floors that are over unheated spaces and of floors over outdoor air, such as overhangs, shall not exceed the values given in Table 22.21. Equation 3 in s. Comm 22.31 (1) shall be used to determine acceptable combinations to meet this requirement.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99; **am., Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.26 Slab−on−grade floors. (1)** Where the perimeter edge of a slab−on−grade floor is above grade or less than 12 inches below the finished grade, the thermal resistance of the insulation around the perimeter of the floor shall not be less than the value given in Table 22.21.

**(2)** Insulation shall be placed on the outside of the foundation or on the inside of a foundation wall. The 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.

**(3)** Horizontal insulation extending outside of the foundation shall be covered by pavement or by soil a minimum of 10 inches thick. The top edge of insulation installed between the exterior wall and the edge of the interior slab may be cut at a 45° angle away from the exterior wall.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.27 Crawl space walls. (1)** If the crawl space does not meet the requirements of s. Comm 22.25 and does not have ventilation openings which communicate directly with outside air, then the exterior walls of the crawl space shall have a thermal transmittance value not exceeding the value given in Table 22.21.

**(2)** (a) The vertical wall insulation shall extend from the top of the wall to at least the inside ground surface.

(b) Where the vertical wall insulation stops less than 12 inches below the outside finish ground level, crawl space wall insulation shall extend horizontally and vertically downward a minimum total distance of 24 inches linearly from the outside finish ground level.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99**; r. and recr. (2), Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.28 Basement walls. (1)** Except as provided in subs. (3) and (4), the exterior walls of basements below uninsulated floors shall have a transmittance value not exceeding the value given in Table 22.21.

**(2)** (a) Except as provided in par. (b), the insulation shall extend to the level of the basement floor.

(b) Changes in the exterior insulation area and basement wall minimum thermal transmittance may be included as part of a tradeoff allowed under the method of design by system analysis or other approved compliance method.

(c) If interior insulation is used for code compliance, it shall extend the full height of the wall from basement floor to the underside of the joists above unless tradeoffs are justified by supporting calculations that consider lateral heat conduction in the wall.

**(3)** Where the total gross basement wall area is less than 50% below grade, the entire wall area, including the below−grade portion, is included as part of the gross area of exterior walls.

**(4)** For the purpose of determining compliance with dwelling envelope performance requirements, non−opaque areas, including windows and doors, of all basement walls shall be included in the gross area of exterior walls.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99; **r. and recr. (2), Register, March, 2001, No. 543, eff. 4−1−01.**

**Comm 22.29 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. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.30 Air leakage. (1)** GENERAL. The requirements of this section apply to those dwelling components that separate interior dwelling conditioned space from the outdoor ambient conditions, or unconditioned spaces such as crawl spaces, and exempted portions of the dwelling from interior spaces that are heated or mechanically cooled. The requirements are not applicable to the separation of interior conditioned spaces from each other.

**(2)** EXTERIOR DOORS AND WINDOWS. Exterior doors and windows shall be designed to limit air leakage into or from the dwelling envelope. Manufactured doors and windows shall have air infiltration rates of less than 0.3 cfm/sq. ft, determined in

accordance with ASTM standard E 283 and AAMA/NWWDA standard 101/I.S.2. Door and window units constructed or fabricated in the field shall be sealed in accordance with sub. (3).

**Note:** Windows and doors that meet the maximum air infiltration rate specified in the 1997 edition of AAMA/NWWDA standard 101/I.S.2 when tested in accordance with ASTM standard E 283 are acceptable to the department as meeting the 0.3 cfm/sq. ft. infiltration limit.

**(3)** JOINT PENETRATION SEALING. (a) Exterior joints, seams or penetrations in the dwelling envelope, that are sources of air leakage, shall be sealed with durable caulking materials, closed with gasketing systems, taped, or covered with moisture vapor permeable house wrap. Exterior 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.

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

(b) Sealing shall be provided around tubs and showers, 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 envelope between conditioned space or between the conditioned space and the outside.

**History:** Cr. Register, January, 1999, No. 517, eff. 2–1–99.

**Comm 22.31 Calculations.** The following equations shall be used as specified in this chapter:

**(1)** EQUATION 1.

$$U_o = \frac{(U_w\ A_w) + (U_g\ A_g) + (U_d\ A_d)}{A_o}$$

where:

$U_o$ = the overall thermal transmittance of the gross exterior wall area.

$A_o$ = the gross area of the exterior walls.

$U_w$ = the overall thermal transmittance of the various paths of heat transfer through the opaque exterior wall area.

$A_w$ = area of exterior walls that are opaque.

$U_g$ = the thermal transmittance of the windows.

$A_g$ = the area of all windows within the gross wall area.

$U_d$ = the thermal transmittance of the door area.

$A_d$ = door area.

(a) When more than one type of wall, window or door is used, the U and A terms for those items shall be expanded into sub–elements as:

$(U_{w1}A_{w1}) + (U_{w2}A_{w2}) + (U_{w3}A_{w3})$ ( etc. )

(b) Unless exact areas are calculated, the gross exterior wall area with framing 24–inches on center shall be assumed to be at least 22% framing area, and the gross exterior wall area with framing 16–inches on center shall be assumed to be at least 25% framing area.

**(2)** EQUATION 2.

$$U_o = \frac{(U_R\ A_R) + (U_S\ A_S)}{A_o}$$

where:

$U_o$ = the overall thermal transmittance of the roof and ceiling gross area.

$A_0$ = the gross area of the roof and ceiling assembly.

$U_R$ = the thermal transmittance of all elements of the opaque roof and ceiling area.

$A_R$ = the gross area of the opaque roof and ceiling assembly.

$U_S$ = the thermal transmittance of the area of all skylight elements in the roof and ceiling assembly.

$A_S$ = the area, including the frame, of all skylights in the roof and ceiling assembly.

(a) When more than one type of roof or ceiling, skylight or door is used, the U and A terms for those items shall be expanded into sub–elements as:

$(U_{R1}A_{R1}) + (U_{R2}A_{R2}) +$ (etc.)

(b) Access doors, hatches, plenums, or other areas in a roof and ceiling assembly shall be included as a sub–element of the roof and ceiling assembly.

(c) Unless exact areas are calculated, wood frame ceilings shall be assumed to be 7% framing area for joists 24–inches on center and 10% framing area for joists 16–inches on center.

**(3)** EQUATION 3.

$$U_0 = \frac{(U_{f1} \times A_{f1}) + (U_{f2} \times A_{f2}) + (U_{fn} \times A_{fn})}{A_0}$$

where:

$U_o$ = the overall thermal transmittance of the floor assembly.

$A_o$ = the gross area of the floor assembly.

$U_{fn}$ = the thermal transmittance of the various heat transfer paths through the floor.

$A_{fn}$ = the area associated with the various paths of heat transfer.

Unless exact areas are calculated, wood frame floors shall be assumed to be 7% framing area for joists 24–inches on center and 10% framing area for joists 16–inches on center.

**(4)** ACCURACY OF CALCULATIONS. The thermal transmittance ($U_o$) values and dwelling dimensions used in heat gain or loss calculations shall have a minimum decimal accuracy of 3 places rounded to 2, except that the $U_o$ values used for calculating ceiling transmission shall have a minimum decimal accuracy of 4 places rounded to 3.

**(5)** VALUES. Unless otherwise specified in this chapter, the thermal transmittance and resistance values used in heat gain or loss calculations shall be determined by one of the following methods:

(a) The values shall be those given in the ASHRAE Handbook of Fundamentals as adopted under s. Comm 20.24 (8).

**Note:** See the appendix under "Typical Thermal Properties of Building Materials" for the ASHRAE values.

(b) 1. Testing to a nationally–recognized test standard by an independent third party that is submitted for department review and approval under s. Comm 20.18.

2. The testing shall verify the claimed thermal resistance for the specific application of the product or assembly.

3. For foam plastic insulation that uses a blowing agent other than air, the independent third–party tests shall use samples that have been aged for the equivalent of 5 years or until the R–value has stabilized.

**History:** Cr. Register, January, 1999, No. 517, eff. 2–1–99; **r. and recr. (5), Register, March, 2001, No. 543, eff. 4–1–01.**

**Comm 22.32 Recessed lighting fixtures.** When installed in the dwelling envelope, recessed lighting fixtures shall meet any one of the following requirements:

**(1)** The fixture shall be inherently or thermally protected type IC and installed inside an air–tight assembly maintaining any clearances required by the listing.

**(2)** The fixture shall be inherently or thermally protected type IC, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity, and sealed or gasketed to prevent air leakage into the unconditioned space.

**(3)** The fixture shall be inherently or thermally protected type IC, and labeled as being tested in accordance with ASTM E 283 at a pressure difference of 75 pascals or 1.57 lb/ft$^2$ with no more than 2.0 cfm air movement from the conditioned space to the ceiling cavity.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

## Subchapter VII – Design By Systems Analysis and Design of Dwellings Utilizing Renewable Energy Sources

**Comm 22.33 General.** The requirements of subch. V,"Heating and Air Conditioning Equipment and Systems" and the requirements of subch. VI, "Dwelling Envelope Design"establish design criteria for energy−consuming and enclosure elements of the dwelling. As an alternative, an energy use analysis may be used to show equivalent compliance. The analysis shall comply with this subchapter or shall be approved by the department.

**Note:** The department recognizes the use of tradeoffs between higher efficiency furnaces and lower insulation levels. See appendix for an example of the UDC Energy Worksheet. Copies of the worksheet may be obtained from the Department of Commerce, Safety and Buildings Division, P. O. Box 2509, Madison, WI 53701. Other forms or software may be used when approved by the department. WIScheck software may be used to show compliance and is available from the Safety & Buildings page on the Department of Commerce Website www.commerce.state.wi.us.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.34 Energy analysis. (1)** Newly constructed one− and 2−family dwellings designed in accordance with this subchapter comply with subchs. V and VI if the calculated annual energy consumption is not greater than a similar dwelling, designed as a standard design, whose energy−consuming systems and enclosure elements are designed in accordance with subchs. V and VI.

**Note:** In this subchapter, "standard design" means a dwelling whose enclosure elements and energy−consuming systems are designed in accordance with subchs. V and VI.

**(2)** For a proposed alternate dwelling design to be considered similar to a standard design, it shall utilize the same energy sources for the same functions and have equal floor area and the same ratio of dwelling envelope area to floor area, exterior design conditions, climate data, and usage operational schedule.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.35 Input values. (1)** GENERAL. The input values in this section shall be used in calculating annual energy performance. The requirements of this section specifically indicate which variables shall remain constant between the standard dwelling and proposed dwelling calculations. The standard dwelling shall be a base−version of the design that directly complies with the provisions of this chapter. The proposed dwelling may utilize a design that is demonstrated, through calculations satisfactory to the department, to have equal or lower annual energy use than the standard design.

**(2)** INPUT VALUES FOR GLAZING AREAS. (a) The orientation of the standard design shall have equal area on the north, south, east, and west exposures.

(b) Shading in the form of draperies, roller shades or blinds shall be assumed to be closed during periods of mechanical air conditioning operation.

(c) Glazed areas shall not be provided with extra exterior shading beyond shading that is provided by typical construction practices such as with tinted glass, outside fixed shading devices and roof overhangs. The energy performance impacts of added exterior shading for glazed areas may be accounted for in the proposed design for a specific dwelling, provided that the actual installation of such systems is approved by the department.

(d) Passive solar designs shall provide documentation acceptable to the department, that fixed external or other acceptable shading is provided to limit excessive summer cooling energy gains to the dwelling interior.

**(3)** INPUT VALUES FOR HEAT STORAGE AND THERMAL MASS. (a) Internal mass shall be 8 pounds per square foot.

(b) Structural mass shall be 3.5 pounds per square foot.

(c) Passive solar designs shall utilize at least 45 Btu/°F of additional thermal mass, per square foot of added glass area, when south−facing glass exceeds 33% of the total glass area in walls.

**(4)** INPUT VALUES FOR DWELLING ENVELOPE. (a) *Surface area and volume.* 1. Floors, walls and ceilings of the standard and proposed designs shall have equal areas.

2. The foundations and floor types for both the standard and the proposed designs shall be equal.

3. The glazing area including skylights in the standard design shall not be greater than the glazing area in the proposed design. The U− value of the glazing in the standard design shall be selected to permit calculated compliance of the $U_o$ of the wall in the standard design.

4. The standard design of doors shall have at least 40 square feet of door area.

5. Building volume of both the standard and proposed design shall be equal.

(b) *HVAC controls.* Input values are given in Table 22.35−1.

**TABLE 22.35−1**

**INPUT VALUES FOR HVAC CONTROLS**

| Parameter | | Value |
|---|---|---|
| Thermostat (constant) | Heating set point | 68°F (20°C) |
| | Cooling set point | 78°F (26°C) |
| | Night set back | 60°F (16°C) |
| | Set back duration | 7 hours |
| | Number of set back periods | equals the number of dwelling units |
| | Maximum number of zones | 2 |
| | Number of thermostats per zone | 1 |
| Internal Sensible Heat Gain (constant) | Btu/hr per dwelling unit | 1500 Btu/hr |
| Domestic Water Heater (calculate, then use as constants) | Temperature set point | 120°F |
| | Daily hot water consumption | Gallons = (30 x the number of dwelling units) + (10 x the number of bedrooms) |

**(5)** SITE WEATHER DATA CONSTANTS. Weather data from the typical meteorological year or its equivalent from the National Oceanic and Atmospheric Administration or an approved equivalent for the closest available location shall be used.

**(6)** DISTRIBUTION SYSTEM LOSS FACTORS. The heating and cooling systems efficiency shall be proportionally adjusted for those portions of the ductwork located outside or inside the conditioned space using the values shown in the following equations:

Adjusted Efficiency = Equipment Efficiency x Distribution Loss Factor

Total Adjusted System Efficiency = ( Equipment Efficiency x Distribution Loss Factor x Percent of Ducts Outside ) + ( Equipment Efficiency x Distribution Loss Factor x Percent of Ducts Inside ).

**TABLE 22.35−2**
**DISTRIBUTION LOSS FACTORS**

| Mode | Duct Location * | |
|---|---|---|
| | Outside | Inside |
| Heating | 0.75 | 1.00 |
| Cooling | 0.80 | 1.00 |

* Ducts located in a heated or cooled space are considered as being in an inside location.

**(7)** AIR INFILTRATION. (a) For the purpose of calculation, air changes per hour for the standard design is 0.50.

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

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.36 Design.** The standard design and the proposed alternative design shall be designed on a common basis as specified in this section:

**(1)** The comparison shall be expressed in Btu input per square foot of gross floor area per year or other time unit, at the dwelling site.

**(2)** If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, even though similar sources are used for similar purposes, the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.

**(3)** The different energy sources shall be compared on the basis of energy use at the dwelling site where 1 kWh = 3,413 Btu.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.37 Analysis procedure.** The dwelling heating and cooling load calculation procedures shall be detailed to permit the evaluation factors specified in s. Comm 22.38 to provide a comparison of energy consumption between the alternative design and the standard design.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.38 Calculation procedure.** The calculation procedure shall cover all of the following items that are expected to have a significant impact on the comparison of the energy consumption between the alternate design and the proposed design:

**(1)** Environmental design requirements as specified in subch. IV.

**(2)** Coincident hourly climatic data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation.

**(3)** Dwelling orientation, size, shape, mass and volume.

**(4)** Air, moisture and heat transfer characteristics.

**(5)** Operational characteristics of controls for inside air temperature, humidity, ventilation, lighting, and the control mode for occupied and unoccupied hours.

**(6)** Mechanical equipment design capacity load profile.

**(7)** Dwelling loads of internal heat generation, lighting, equipment, and the number of occupants during occupied and unoccupied periods.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.39 Use of approved calculation tool.** The same calculation tool or method shall be used to estimate the energy usage for space heating and cooling of the standard design and the proposed design. The calculation tool or method and the documentation shall be approved by the department.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.40 Documentation.** Proposed alternative designs submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report. The report shall provide technical detail on the 2 dwellings, system designs, and data used in and resulting from the comparative analysis verifying that both analysis designs meet the criteria of of this chapter.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.41 Renewable energy source analysis.** **(1)** A proposed dwelling utilizing solar, geothermal, wind or other renewable energy sources for all or part of its energy sources shall meet the requirements of s. Comm 22.33, except such renewable energy may be excluded from the total annual energy consumption allowed for the proposed dwelling by this subchapter.

**(2)** To qualify for the exclusion in sub. (1), the renewable energy must be derived from a specific collection, storage, and distribution system. The solar energy passing through windows shall also be considered as qualifying if such windows are provided with one of the following:

(a) Operable insulation shutters or other devices which, when drawn or closed, cause the window area to reduce maximum outward heat flows to those in accordance with s. Comm 22.31 (2), and the windows are shaded from direct solar radiation during periods when mechanical cooling is requested.

(b) The glass is double or triple pane insulated glass with a low−emittant coating on one or both surfaces of the glass, or insulated glass with a low−emittant plastic film suspended in the air space, and the glass areas are shaded from direct solar radiation during periods when mechanical cooling is requested.

**(3)** Other criteria covered in ss. Comm 22.23 to 22.39 shall apply to the proposed alternative designs utilizing renewable sources of energy.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.

**Comm 22.42 Documentation.** **(1)** Proposed alternative designs submitted as requests for an exception to the standard design criteria, shall be accompanied by an energy analysis, as specified in s. Comm 22.40. The report shall provide technical detail on the alternative dwelling, system designs, and the data employed in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of this code.

**(2)** The energy derived from renewable sources and the reduction in conventional energy requirements derived from nocturnal cooling shall be separately identified from the overall dwelling energy use. Supporting documentation on the basis of the performance estimates for the renewable energy sources and nocturnal cooling means specified in this subchapter shall be submitted to the department.

**History:** Cr. Register, January, 1999, No. 517, eff. 2−1−99.