# Chapter ILHR 22

# ENERGY CONSERVATION



Note: Chapter Ind 22 was renumbered to be chapter ILHR 22, Register, February, 1985, No. 350, eff. 3-1-85.

## Subchapter I—Scope and Purpose

**ILHR 22.01 Scope.** The provisions of this chapter shall apply to all newly constructed conventional and manufactured one- and 2-family dwellings.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78.

**ILHR 22.02 Purpose.** (1) The purpose of this chapter is to provide design requirements which will improve the utilization of energy in one- and 2-family dwellings as defined in s. ILHR 22.01, including minimum requirements for materials and methods of construction and for heating, cooling and air conditioning equipment and systems.

(2) The requirements of this chapter are intended to be flexible and to permit the use of innovative approaches and techniques to achieve effective utilization of energy.

(3) The requirements of this chapter are not intended to conflict with any safety or health requirements. Where such conflict occurs, the safety and health requirements shall govern.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78.

## Subchapter II—Definitions

**ILHR 22.03 Definitions.** (1) "Annual fuel utilization efficiency" or "AFUE" means the efficiency rating of the heating plant model determined on average usage conditions as set out in the U.S. Department of Energy test procedures.

Note: The higher the AFUE rating, the higher the heating plant efficiency will be.

(1m) COEFFICIENT OF PERFORMANCE (COP), COOLING OR HEATING. Coefficient of performance (COP) means the ratio of the rate of net heat removal or net heat output to the rate of total energy input, expressed in consistent units and under designated rating conditions.

(2) COMBUSTION EFFICIENCY. "Combustion efficiency" is expressed in percentage and is defined as 100% minus stack losses in percent of heat input. Stack losses are a) loss due to sensible heat in dry flue gas, b) loss due to incomplete combustion, and c) loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the fuel.

(3) COOLING LOAD. Cooling load is the rate at which heat must be removed from the space to maintain a selected indoor air temperature during periods of design outdoor weather conditions.

(4) DEGREE DAY, HEATING. Degree days are figured as the number of degrees the mean outdoor temperature deviates from 65° F each day during the heating season.

Note: For example, if, on December 15, the low temperature was + 30° F and the high temperature was + 50° F, the mean temperature would equal (30° + 50°) ÷ 2 = 40°; therefore, 65° - 40° = 25 degree days.

(4m) "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.

(5) ENERGY EFFICIENCY RATIO. The energy efficiency ratio is the ratio of net cooling capacity in Btu per hour to total rate of electric input, in watts, under designated operating conditions.

(5m) "Equivalent leakage area" or "ELA" means the estimated area of a hole in the thermal envelope of a building which would exist if all the leakage openings were gathered into one location.

(6) HEATED SPACE. Heated space is any space provided with a supply of heat to maintain the temperature of the space to at least 50° F. Heat supplied by convection from the energy-consuming systems may satisfy this requirement in basements if the energy-consuming systems are not insulated.

(7) HEATING LOAD. Heating load is the probable heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. The total heat load includes: the transmission losses of heat transmitted through the wall, floor, ceiling, glass or other surfaces; the infiltration losses or heat required to warm outdoor air which leaks in through cracks and crevices, around doors and windows, or through open doors and windows; or heat required to warm outdoor air used for ventilation.

(7m) "Infiltration barrier" means a material which restricts the movement of air and liquid water, but is permeable to water vapor.

(7r) "Overall thermal transmittance" or "$U_o$" means the area-weighted average of the thermal transmittance values of all materials, including framing and fenestration, which make up a building section.

Note: Additional explanatory material is contained in the appendix.

(8) PERM. Perm is the designation for the unit permeance which is a substitute for the unit, one grain per (hour) (square foot) (inch of mercury vapor pressure difference).

(9) RESISTANCE, THERMAL (R). Thermal resistance (R) is a measure of the ability to retard the flow of heat. The R-value is the reciprocal of a heat transfer coefficient, expressed by U (R = 1/U). The higher the R-value of a material, the more difficult it is for heat to flow through the material.

(9m) "Thermal envelope" means the collective assemblies of the building which enclose the heated space and define the surface areas through which the design heating loss is calculated. The components which make up the thermal envelope form a continuous, unbroken surface.

(10) THERMAL TRANSMITTANCE (U). Thermal transmittance (U) is the coefficient of heat transmission or thermal transmittance (air to air) expressed in units of Btu per (hour) (square foot) (degree F). It is the time rate of heat flow. 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 building section, and includes cavity air spaces and surface air films on both sides. The lower the U-value of a material, the more difficult it is for heat to flow through the material.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. (1) to be (1m), cr. (1), (4m), (5m), (7m), (7r) and (9m), Register, July, 1986, No. 367, eff. 1-1-87.

## Subchapter III—Design Criteria For Dwellings Which Use Fuels Other Than Electricity For Space Heating

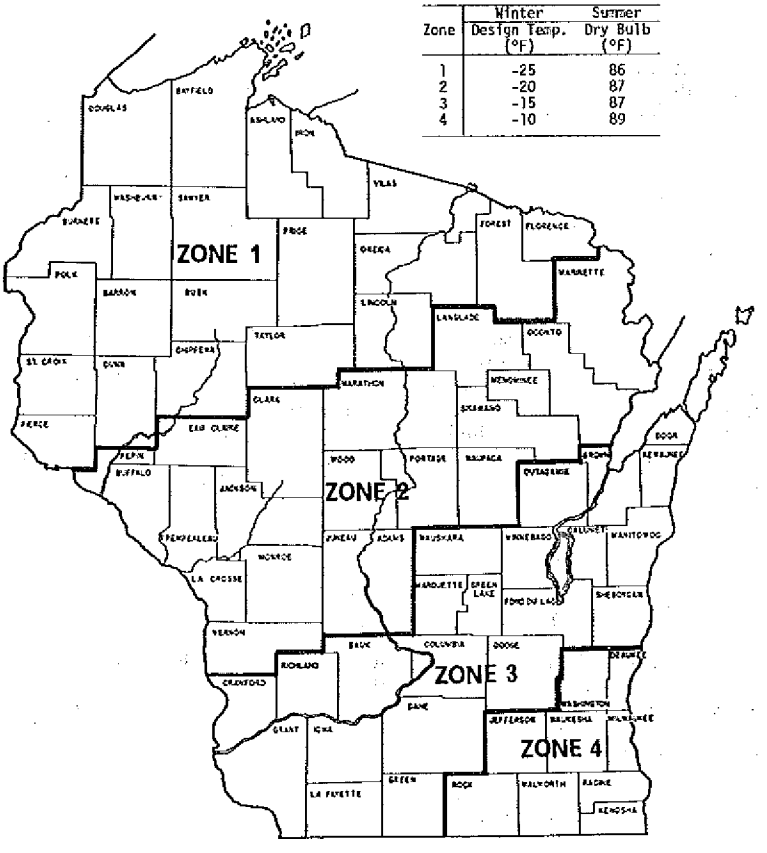
**ILHR 22.04 Indoor and outdoor temperatures.** The indoor temperatures listed in Table 22.04-A and the outdoor temperatures listed in Table 22.04-B shall be used to determine the total building heat loss or heat gain and to select the size of the heating or cooling equipment which is installed in dwellings which are not electrically heated.

TABLE 22.04-A
INDOOR DESIGN TEMPERATURES

| Season | Temperature |
|---|---|
| Winter | 70° F |
| Summer | 78° F |

## TABLE 22.04-B
## OUTDOOR DESIGN CONDITIONS

| Zone | Winter Design Temp. (°F) | Summer Dry Bulb (°F) |
|---|---|---|
| 1 | -25 | 86 |
| 2 | -20 | 87 |
| 3 | -15 | 87 |
| 4 | -10 | 89 |




History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; am. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.05 Moisture control for non-electrically heated dwellings.** The provisions of this section for moisture control shall apply to non-electrically heated dwellings.

(1) VAPOR BARRIERS. Where thermal insulation is used, a vapor barrier shall be installed. The vapor barrier shall be installed on the interior side of the insulation, facing the heated interior, and behind the interior finish at the wall, ceiling and roof/ceiling assemblies. The vapor barrier shall cover the exposed insulation and interior face of studs, joists and rafters. Vapor barriers shall also be provided in crawl spaces, under slab floors, and around the exterior insulation installed around ducts in unheated areas. The transmission rate shall not exceed one perm.

Note: In truss floor/ceiling systems, the vapor barriers may be applied to the bottom chord of the truss, extending up along each side of the truss and across the back side of the insulation in the truss cavity. Rigid plastic insulation board may be applied to the bottom chord, if protected with ½-inch gypsum wallboard.

(2) RELATIVE HUMIDITY. Where a power humidifier is installed, the humidifier shall be equipped with a control to regulate the relative humidity.

(3) VENTILATION. (a) *Attics.* Ventilation above the ceiling/attic insulation shall be provided.

1. The free ventilating area shall be at least 1/300 of the horizontal area of the ceiling. At least 50% of the required free ventilating area shall be distributed at the low sides of the roof, the remainder of the vents shall be provided in the upper one-half of the roof or attic area.

2. If all the ventilating area is provided at one level, then the ventilating area shall be at least 1/150 of the horizontal area of the ceiling.

3. The ventilation space above any non-rigid insulation in a cathedral ceiling assembly shall be at least one inch in height.

(b) *Crawl spaces.* Ventilation shall be provided in crawl spaces which are outside the thermal 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.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; cr. (intro), r. and recr. (3), Register, July, 1986, No. 367, eff. 1-1-87.

## Subchapter IV—Thermal Envelope Requirements For Dwellings Which Use Fuels Other Than Electricity For Space Heating

**ILHR 22.06 Insulation standards for non-electrically heated dwellings.** The thermal envelope of dwellings which are not electrically heated shall be insulated to meet the requirements of this section.

Note: If the office of state planning and energy certifies that there is a shortage of insulating materials that are routinely used in construction of one- and 2-family dwellings, the department will modify the requirements of s. ILHR 22.06 in accordance with the available supply of insulating material, with an emergency rule. When the office of state planning and energy certifies that shortages have been remedied, the department will reinstate the requirements of s. ILHR 22.06.

(1) SLAB-ON-GRADE. The overall thermal transmittance ($U_0$ value) through slab-on-grade floors shall not exceed .11 Btu per (hour) (square foot) (degree F). All slab-on-grade floors located within 24 inches of the exterior grade shall be insulated. The insulation shall extend downward from the top of the slab to below the frost depth, but not less than 48

inches; or downward vertically from the top of the slab 24 inches and 24 inches horizontally under the slab.

(2) FLOORS OVER UNHEATED AREAS. The overall thermal transmittance ($U_o$ value) through floors over unheated areas shall not exceed .09 Btu per (hour) (square foot) (degree F). Insulation is not required in floors over heated crawl space areas or basement areas.

(3) WINDOWS. All windows, except for basement windows, shall be double glazed or have storm windows.

Note: See Table A-1 of Appendix A which was developed to serve as a guide to indicate the percentage of glass which can be used for different types of wall construction.

(4) BOX SILL. The box sill area shall be insulated to the same level as the wall.

(5) ROOF/CEILINGS. The overall thermal transmittance ($U_o$ value) through roof/ceiling assemblies shall not exceed .029 Btu per (hour) (square foot) (degree F).

(6) EXTERIOR WALLS. The exposed exterior walls above grade shall be insulated in accordance with par. (a) or pars. (b) and (c).

(a) *Exposed exterior walls above grade.* The overall thermal transmittance ($U_o$ value) through exposed exterior walls above grade shall not exceed .13 Btu per (hour) (square foot) (degree F).

(b) *Exterior walls above the foundation wall.* The overall thermal trasnmittance ($U_o$ value) through exterior walls above the foundation wall shall not exceed .12 Btu per (hour) (square foot) (degree F).

(c) *Exposed foundation walls above grade.* The overall thermal transmittance exposed foundation walls above grade shall not exceed the following $U_o$ values:

1. If 25% or less of the foundation wall is exposed, $U_o$ = .25 Btu per (hour) (square foot) (degree F).

2. If more than 25% of the foundation wall is exposed, the thermal transmittance of 25% of the wall shall not exceed .25 Btu per (hour) (square foot) (degree F) and the remaining exposed portion shall have a thermal transmittance of not more than .12 Btu per (hour) (square foot) (degree F).

(7) ELECTRICAL BOXES. Insulation shall be provided behind electrical boxes located in exterior walls.

(8) BELOW GRADE FOUNDATION INSULATION. A thermal transmittance ($U_o$ value) of .20 Btu per (hour) (square foot) (degree F) shall be required for below grade foundation walls to a level of 3 feet below grade or to the top of the footing.

(9) SYSTEM DESIGN. The overall transmission of heat (U value) through any one component (such as wall, roof/ceiling or floor) may be increased and the U-value for other components decreased provided that the overall heat loss for the entire building enclosure does not exceed the total heat loss resulting from complying with subs. (1) through (8).

Note: See Appendix A for an example of the system design procedure.

(10) ACCURACY OF CALCULATIONS. The thermal transmittance ($U_o$) values and building 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.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; r. (5) and (6) eff. 3-31-79 and cr. (5a) and (6a), eff. 4-1-79; r. (6a), eff. 3-31-80 and cr. (6b), eff. 4-1-80; am. (intro.), renum. (5a) and (6b) to be (5) and (6) and am., Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.07 Air leakage.** Provisions for the limitation of air leakage in dwellings which are not electrically heated shall be made in accordance with this section.

(1) GENERAL. All windows and doors shall be constructed and installed to minimize air leakage.

(2) DOORS AND WINDOWS. Manufactured windows shall be constructed and installed to limit infiltration to .5 cubic feet per minute per foot of sash crack. The air infiltration rate of sliding glass doors shall not exceed .5 cubic feet per minute per square foot of door area. The air infiltration rate for swinging doors shall not exceed 1.25 cubic feet per minute per square foot of door area.

Note: The department will recognize windows and doors tested in conformance with ASTM E-283, Standard Method of Test for Rate of Air Leakage Through Exterior Curtain Walls and Doors.

(3) EXTERIOR OPENINGS. Exterior joints around windows and door frames; between wall cavities and window or door frames; between walls and foundations; between walls and roofs; between walls and floors; between separate wall panels; at penetrations of utility services through walls, floors and roofs; and all other openings in the exterior building envelope shall be caulked, gasketed, weatherstripped or otherwise sealed.

(4) INTERIOR OPENINGS. Openings through the top plate of frame walls shall be caulked, gasketed, packed with insulation, or otherwise sealed.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; Cr. (intro.), Register, July, 1986, No. 367, eff. 1-1-87.

## Subchapter V - Insulation and Infiltration Standards For Electrically Heated Dwellings

**ILHR 22.08 Purpose and authority.** The purpose of this subchapter is to provide design requirements to improve energy efficiency of conventionally built and manufactured one- and 2-family dwellings which use electricity for space heating as required by ss. 101.63 (1m) and 101.73 (1m), Stats.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.085 Applications.** (1) NEW DWELLINGS. The provisions of this subchapter shall apply to any new electrically heated dwelling or dwelling unit for which a uniform building permit was issued on or after January 1, 1987.

(2) DWELLINGS EXISTING BEFORE DECEMBER 1, 1978. The provisions of this subchapter shall not apply to any dwelling or dwelling unit for which a uniform building permit was issued before December 1, 1978, or to additions or alterations to such dwellings.

(3) ADDITIONS TO DWELLINGS OR DWELLING UNITS. (a) Additions to a dwelling or dwelling unit shall be constructed in compliance with the requirements of this subsection whenever one of the following conditions apply:

1. The uniform building permit for the original dwelling or dwelling unit was issued on or after January 1, 1987, and the dwelling or dwelling unit is electrically heated; or

2. The uniform building permit for the original dwelling or dwelling unit was issued on or after January 1, 1987, and the combined input capacity of permanently installed electrical space heating equipment of the original dwelling or dwelling unit and the new addition exceeds 3 kilowatts; or

3. The uniform building permit for the original dwelling or dwelling unit was issued on or after December 1, 1978, but before January 1, 1987, and the addition is provided with permanently installed electrical space heating equipment with an input capacity of 3 kilowatts of more.

(b) An addition to a dwelling or dwelling unit to which one of the 3 conditions of par. (a) apply, shall be insulated to meet the requirements of s. ILHR 22.12 with one of the following methods.

1. The addition alone may be insulated in accordance with s. ILHR 22.12 (1) via the component method;

2. The addition alone may be insulated in accordance with s. ILHR 22.12 (2) via the system method; or

3. The entire dwelling, including the addition, may be insulated in accordance with s. ILHR 22.12 (2) via the system method.

(4) ALTERATIONS TO DWELLINGS OR DWELLING UNITS CONSTRUCTED AFTER JANUARY 1, 1987. (a) *Electrically heated dwellings or dwelling units.* Any alteration made to an electrically heated dwelling or dwelling unit for which a uniform building permit was issued on or after January 1, 1987 shall be made in accordance with the provisions of this subchapter which are in effect at the time the permit for the alteration is issued.

(b) *Non-electrically heated dwellings and dwelling units.* 1. Whenever an alteration to a non-electrically heated dwelling or dwelling unit for which a uniform dwelling permit was issued on or after January 1, 1987, results in the addition of permanently installed space heating equipment so that the combined input capacity of all sources of permanently installed electrical space heating equipment in the dwelling or dwelling unit exceeds 3 kilowatts, the alteration shall be performed in accordance with the requirements of this subchapter which are in effect at the time that the permit for the alteration is issued.

2. Alterations which do not result in an increase in the electric space heating input capacity to over 3 kilowatts, shall be made in compliance with the provisions of subchapters III and IV which are in effect at the time the permit for alterations is issued.

(5) ALTERATIONS TO DWELLINGS OR DWELLING UNITS CONSTRUCTED AFTER DECEMBER 1, 1978, BUT BEFORE JANUARY 1, 1987. Any alteration which is made to a dwelling or dwelling unit for which a uniform building permit was issued on or after December 1, 1978, but before January 1,

1987, shall be made in compliance with the requirements for non-electrically heated dwellings specified in this chapter which are in effect at the time the permit for the alteration is issued.

Note: The intent of this subsection is to assure that a dwelling which is built in accordance with this code continues to meet minimum health, safety and energy conservation standards whenever additions and alterations are made to the dwelling. It is not the intent of this section however, to require additional modifications beyond those necessary to achieve the intended alteration or addition. For example, if a window is being replaced, the replacement window must meet the infiltration and thermal transmission requirements of the current code. If new windows are to be cut into the exterior wall, the new windows must meet code requirements and, because insulation had to be removed from the wall to put in the windows, the insulation requirements of the current code must be met by using either the component or system method. As another example, when electric heat is added to the basement area and the walls are not to be altered, insulation does not have to be installed. If insulation is removed from the basement ceiling, however, to create a heated basement, the insulation requirements of the current code must be met by the component or system method.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.09 Accuracy of calculations.** The thermal resistance or thermal transmittance values used in heat gain or loss calculations for electrically heated dwellings shall be supplied by the material manufacturer or as given in the ASHRAE Handbook of Fundamentals. The thermal transmittance values used in heat gain or loss calculations shall have a minimum decimal accuracy of 4 places, rounded to 3. Thermal envelope areas shall have a minimum decimal accuracy of 3 places, rounded to 2.

Note: ASHRAE is an acronym for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Copies of the ASHRAE Handbook of Fundamentals may be purchased from the ASHRAE Publications Sales Department, 1791 Tullie Circle, N.E., Atlanta, Georgia 30329. A list of R-values for most building materials reprinted from ASHRAE Fundamentals is given in Appendix A.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.10 Indoor and outdoor temperatures.** The indoor temperatures listed in Table 22.10-A and the outdoor temperatures listed in Table 22.04-B shall be used to determine the total building heat loss or gain and to select the size of the heating or cooling equipment which is installed in electrically heated dwellings in accordance with s. ILHR 22.15.

TABLE 22.10-A
Indoor Design Temperatures

| Season | Temperature |
|---|---|
| Winter | 70° F |
| Summer | 78° F |

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.11 Moisture control for electrically heated dwellings.** Provisions for the control of moisture in electrically heated dwellings shall be made in accordance with this section.

(1) VAPOR BARRIERS. A vapor barrier shall be installed to prevent water vapor from condensing within the insulated cavities of the thermal envelope. All joints in the vapor barrier shall be overlapped and secured or sealed. Rips and punctures in the vapor barrier shall be patched with vapor barrier materials and taped or sealed. Openings in the vapor barrier around electrical boxes and other utility services shall be taped or sealed. The transmission rate of the vapor barrier may not exceed 0.1 perm.

(2) RELATIVE HUMIDITY. Where a power humidifier is installed, the equipment shall be provided with a control to regulate the relative humidity.

(3) VENTILATION. (a) *Attics.* Ventilation above the ceiling/attic insulation shall be provided.

1. The free ventilating area shall be at least 1/300 of the horizontal area of the ceiling. At least 50% of the required free ventilating area shall be distributed at the low sides of the roof, the remainder of the vents shall be provided in the upper one-half of the roof or attic area.

2. If all the ventilating area is provided at one level, then the ventilating area shall be at least 1/150 of the horizontal area of the ceiling.

3. The ventilation space above any non-rigid insulation in a cathedral ceiling assembly shall be at least one inch in height.

(b) *Crawl spaces.* Ventilation shall be provided in crawl spaces which are outside the thermal 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.

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

(4) AIR QUALITY. (a) *General.* All electrically heated dwellings shall be provided with mechanical ventilation equipment.

1. The equipment shall be capable of providing 0.5 air changes per hour upon demand to the living space within the thermal envelope, or shall be capable of providing 0.5 air changes per hour to individual rooms of the living area during periods of occupancy.

2. The mechanical ventilation equipment may consist of one or more exhaust fans.

3. The air intakes may be operable windows or dampered openings.

4. All exhaust vents shall terminate outside the building.

5. Habitable spaces within basements shall be considered to be part of the living space.

(b) *Dwellings with combustion appliances and high ventilation rates.* Dwellings which are provided with gas-fired, oil-fired, solid fuel burning appliances or fireplaces and are also provided with mechanical ventilation systems capable of providing one air change per hour or more to the living space shall be provided with dampered outside air intakes.

Note #1: Residences with low levels of infiltration or occupants who smoke or situations which release pollutants or large quantities of moisture to the air may require a more extensive mechanical system or a greater number of air changes to assure a sufficient level of air quality.

Note #2: Information on ventilation capacity calculations is contained in Appendix E.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.12 Insulation standards.** Electrically heated dwellings shall be insulated to meet the requirements specified in sub. (1) or (2).

(1) COMPONENT METHOD. Each component of the thermal envelope of an electrically heated dwelling shall meet the thermal performance values specified in Table 22.12-1.

Note: Additional explanatory material is contained in the appendix.

TABLE 22.12-1
INSULATION STANDARDS FOR ELECTRICALLY HEATED DWELLINGS

| Component of Thermal Envelope | Maximum Overall Thermal Transmittances, $U_o$ |
|---|---|
| Roof-Ceiling[a] | 0.020 |
| Walls: | |
| above grade[b] | 0.080 |
| below grade[c] | 0.100 |
| Floors: | |
| slab-on-grade[d] | 0.100 |
| over unconditioned spaces[e] | 0.055 |

Note a: Roof-ceiling assemblies include attic access panels and skylites.

Note b: Walls include box sills, windows, doors, and those portions of the foundation wall above grade.

Note c: The thermal transmittance value applies to the surface area which extends from grade to the top of the footing. If insulation is to be applied to the exterior of the wall below grade, the insulation shall be a type suitable for this application.

Note d: The thermal transmittance value applies to a surface area which extends from the top of a slab to 48 inches vertically downward or horizontally or a combination thereof with a total dimension of 48 inches.

Note e: Includes unheated crawl spaces, basements, garages and other spaces outside of the thermal envelope.

(2) SYSTEM METHOD. The overall thermal transmittance for any component of an electrically heated dwelling specified in sub. (1) may be exceeded if the calculated heat loss or gain for the entire thermal envelope does not exceed the total heat loss or gain calculated using the maximum overall thermal transmittances for all the components as specified in sub. (1).

Note: Additional explanatory material and examples of some methods which may be used to meet these requirements are contained in Appendices A through C.

History: Cr. Register, July, 1986, No 367, eff. 1-1-87.

**ILHR 22.13 Infiltration control for electrically heated dwellings.** Provisions for the limitation of infiltration in electrically heated dwellings shall be made in accordance with this section.

(1) GENERAL. Windows and door assemblies and other portions of the thermal envelope shall be constructed and installed to minimize infiltration.

(2) WINDOWS AND DOORS. Manufactured windows and door assemblies which form a part of the thermal envelope of an electrically heated dwelling shall be constructed and installed to limit infiltration.

(a) *Windows.* Except as provided in par. (c), the air infiltration rate for manufactured windows of electricallly heated dwellings may not exceed 0.20 cubic feet per minute per foot of sash crack.

(b) *Sliding doors.* Except as provided in par. (c), the air infiltration rate for manufactured sliding doors of electrically heated dwellings may not exceed 0.25 cubic feet per minute per square foot of door area.

(c) *Exception.* Windows with a maximum infiltration rate of 0.30 cubic feet per minute per foot of sash crack and sliding doors with a maximum infiltration rate of 0.30 cubic feet per minute per square foot of door area may be used in electrically heated dwellings where a blower door test, performed in accordance with sub. (4), indicates that the infiltration rate of the entire thermal envelope does not exceed 4.4 air changes per hour at 50 pascals (Pa) or does not exceed an equivalent leakage area (ELA) of 2 square inches per 100 square feet of above grade thermal envelope at 10 pascals (Pa).

(d) *Swinging doors.* The air infiltration rate for swinging door assemblies of electrically heated dwellings may not exceed 0.35 cubic feet per minute per square foot of door area.

Note: The department will allow the use of windows and doors meeting the requirements of this section when tested in accordance with ASTM E-283, Standard Method of Test for Rate of Air Leakage Through Exterior Curtain Walls and Doors.

(3) EXTERIOR OPENINGS IN THE THERMAL ENVELOPE. (a) *Sealing of openings.* Except as provided in par. (b) or as provided in par. (c), the following openings and all other similar openings in the thermal envelope shall be caulked, gasketed, weatherstripped, tightly packed with fiberglass, or otherwise sealed with a flexible material to limit air infiltration:

Note: Additional explanatory material is contained in Appendix D.

1. At the junction of exterior walls and the roof, including but not limited to the joints between:

a. Double top plates; and

b. The top plate and the siding or exterior finish, where extruded polystyrene is not placed behind the siding or exterior finish.

2. Between exterior walls and floors, including but not limited to the joints between:

a. The subfloor and the exterior header joist;

Note: The header joist is also known as a band joist or a skirt.

b. The top plates of the exterior wall and the header joists of floors placed on wall;

c. The subfloor and bottom plates of exterior walls; and

d. The joints between double top plates or double bottom plates of exterior walls.

3. Between floors and foundation walls, including but not limited to the joints between:

a. The foundation and sill plate and between the sill plate and floor joist header; or

b. The foundation and floor joist header; and

c. Floor joist header and the subfloor.

4. Between exterior frame walls placed on foundations, including but not limited to the joint between foundation and sill plate and the joint between double bottom plates.

5. At openings in exterior walls, including but not limited to the joints between:

a. Window headers and top wall plates;

b. Window headers and plates at the heads of windows and doors;

c. Plates and window sills;

d. Plate and window frame;

e. Separate wall panels;

f. Siding or exterior finish joints at cantilevered floors, bay windows and at soffits; and

g. Siding and foundation where no sheathing is provided behind the siding.

6. At joints around window and door assemblies in the thermal envelope, including but not limited to the joints between:

a. Window and door assemblies and the wall framing;

b. Window and door assemblies and the exterior siding or finish; and

c. Door thresholds and the subfloor.

7. At the joint between the foundation wall and the sill plate or joist header of a floor, or between the foundation wall and the bottom plate of a wall.

8. At penetrations through the thermal envelope at walls, floors and ceilings or insulated roof assemblies, including but not limited to:

a. Piping;

b. Hose bibbs;

c. Plumbing vent stacks;

d. Electrical wiring;

e. Chimney or vent penetrations;

f. Dryer vents;

g. Bathroom vents;

h. Kitchen vents;

i. Telephone wire entrances;

j. Through-the-wall air conditioners;

k. Refrigeration lines;

l. Air vents and inlets; and

m. Recessed light fixtures.

9. Attic access panels in the thermal envelope shall be weatherstripped or otherwise sealed.

10. Air exhaust or intake openings shall be provided with back draft dampers or automatic dampers to limit air leakage.

11. All receptacles, switches or other electric boxes which are set into the vapor barrier or infiltration barrier shall be gasketed or otherwise sealed to limit infiltration. Insulation shall be placed behind all electric boxes and around wires in cavities of the thermal envelope.

12. Fireplaces shall be provided with:

a. Closable metal or glass doors covering the opening of the firebox;

b. A combustion air intake to draw air from the outside of the building directly into the firebox. The air intake shall be at least 6 square inches in area, or more if required by the manufacturers listing or installation instructions. The air intake shall be equipped with an accessible manual or automatic back draft damper; and

c. A flue damper with an accessible control.

(b) *Exception.* The sealing of any or all of the openings as specified in par. (a) 1. through 5. may be omitted if the openings are covered by an infiltration barrier installed as specified in this paragraph.

1. The infiltration barrier shall be installed on the exterior side of the insulation of the thermal envelope.

2. The infiltration barrier shall form a continuous surface over the walls of the building, extending from the bearing points of the roof to the top of the foundation.

3. All seams, joints, tears and punctures shall be sealed.

Note: Infiltration barriers include spun-bonded polyolefin sheets and tongue and groove extruded polystyrene.

(c) *Exception.* The sealing of any or all of the openings specified in par. (a) 1. through 5. may be omitted if a blower door test is performed in accordance with sub. (4) and the test indicates that the infiltration rate of the entire thermal envelope does not exceed 4.4 air changes per hour at 50 pascals (Pa) or does not exceed air equivalent leakage area (ELA) of 2 square inches per 100 square feet of above grade thermal envelope at 10 pascals (Pa).

(4) BLOWER DOOR TESTING PROCEDURE. Blower door tests which are performed to meet the requirements of sub. (2) (c) or (3) (c) shall be performed in accordance with this subsection:

(a) The test shall be performed in accordance with ASTM E-799, "Standard Practice for Measuring Air Leakage by the Fan Pressurization Method".

Note: ASTM is an acronym for the American Society for Testing and Materials. Copies of ASTM Standards may be purchased from the ASTM Publications Sales Department, 1916 Race Street, Philadelphia, PA 19103.

(b) The blower door test may not be conducted when the wind speed exceeds 10 miles per hour (mph).

(c) The results of the test shall be provided to the purchaser.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

## Subchapter VI—Heating and Air Conditioning Equipment and Systems

**ILHR 22.14 Scope.** This subchapter shall apply to all newly constructed conventional and manufactured one- and 2-family dwellings.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.15 Selection of equipment.** The output capacity of the mechanical heating, cooling and air conditioning equipment shall not exceed the calculated heating load and cooling load by more than 15%, except to satisfy the next closest manufacturer's nominal size.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.08, Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.16 Temperature control.** At least one thermostat for regulating the temperature of the space shall be provided for each separate system. Thermostats used to control the heating system may also be used to control the cooling system.

Note: Setting back the thermostat during periods of non-use or thermostats equipped with automatic controls which reduce the temperature during periods of non-use, conserve energy.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.09, Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.17 Zone control.** Each heating and cooling system shall be provided with an automatic or manually controlled damper or valve to shut off or reduce the heating or cooling to each zone or floor and to each room.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.10, Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.18 Duct and pipe insulation.** (1) DUCT INSULATION. All duct systems exposed to unheated spaces shall be insulated with materials having a minimum thermal resistance of R = 5.

(2) PIPE INSULATION. All heating pipes in unheated spaces and all cooling pipes in conditioned spaces shall be insulated with at least one inch of insulation. A vapor barrier on the exposed side of the insulation shall be provided on cooling pipes to prevent condensation. Pipes installed within heating and air conditioning equipment, installed in conditioned spaces, are not required to be insulated.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.11, Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.19 Equipment efficiencies.** (1) ELECTRICAL EQUIPMENT. (a) *Air conditioning equipment.* Air conditioning equipment shall have a minimum energy efficiency ratio (EER) of 7.8 or a COP of 2.3.

(b) *Heat pumps.* Heat pumps shall comply with the minimum coefficients of performance set forth in Table 22.19.

TABLE 22.19
MINIMUM COP FOR HEAT PUMPS, HEATING MODE

| Source and outdoor temperature (°F) | Minimum COP |
|---|---|
| Air source - 47 dry bulb/43 wet bulb | 2.2 |
| Air source - 17 dry bulb/15 wet bulb | 1.2 |
| Water source - 60 entering | 2.2 |

1. The heat pump shall be installed with a control to prevent the supplementary heater from operating when the heating load can be more efficiently satisfied by the heat pump alone.

2. Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set point advance, and during defrost.

Note: A two-stage room thermostat, which controls the supplementary heat on its second stage, will be accepted as meeting this requirement. The cut-on temperature for the compression heating should be higher than the cut-on temperature for the supplementary heat; the cut-off temperature for the compression heating should be higher than the cut-off temperature for the supplementary heat.

(2) COMBUSTION HEATING EQUIPMENT. (a) *General.* Except as provided in par. (b), all gas-fired and oil-fired heating equipment shall have a minimum annual fuel utilization efficiency (AFUE) of 80%. Where a vent damper is provided but not included in the AFUE rating of the equipment, the equipment, without the vent damper, shall have a minimum AFUE of 75.

(b) *Exception.* All gas-fired and oil-fired copper fin and coil type boilers shall meet the minimum energy efficiency standards of ASHRAE 90A-80 "Energy Conservation in New Building Design."

Note: ASHRAE is an acronym for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Copies of the ASHRAE standards may be purchased from the ASHRAE Publications Sales Department, 1719 Tullie Circle, N.E., Atlanta, Georgia 30329.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.12 and r. and recr. (1) (a) and (2), Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.20 Electronic ignition and automatic flue dampering.** Combustion space heating equipment shall be provided with intermittent ignition devices and automatic flue dampers. Automatic flue dampers may be eliminated where:

(1) Induced draft equipment is used;

(2) Where equipment with a condensing secondary heat exchanger is used;

(3) All combustion air is ducted to the furnace burner from the outside; or

(4) Where combustion equipment is located in an enclosure and provided with combustion air from the outside.

History: Cr. Register, May, 1978, No. 269, eff. 4-1-79; renum. from ILHR 22.13 and am. Register, July, 1986, No. 367, eff. 1-1-87.

## Subchapter VII—Buildings Utilizing Solar, Wind Or Other Nondepletable Energy Sources

**ILHR 22.21 Scope.** This subchapter shall apply to all newly constructed conventional and manufactured one- and 2-family dwellings.

History: Cr. Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.22 Innovative designs.** (1) DESIGNS UTILIZING NONDEPLETABLE ENERGY SOURCES. Any innovative building or system design, or a design which utilizes solar, geothermal, wind or other nondepletable energy sources will be accepted by the department provided the design utilizes less depletable energy than determined through the accepted practice method or the system design method.

(2) OTHER ALTERNATIVE DESIGNS. Proposed alternative designs may also consider energy savings resulting from orientation of the building on the site; the geometric shape of the building; the aspect ratio (ratio of length to width); the number of stories for a given floor area; the thermal mass of the building; the exterior surface color; shading or reflections from adjacent structures; surrounding surfaces of vegetation; natural ventilation; and wind direction and speed.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.14, Register, July, 1986, No. 367, eff. 1-1-87.

**ILHR 22.23 Documentation.** Proposed alternative designs shall be accompanied with an energy analysis comparing the energy utilized by the proposed design with the energy used by a design complying with subch. IV or V.

History: Cr. Register, May, 1978, No. 269, eff. 12-1-78; renum. from ILHR 22.15, Register, July, 1986, No. 367, eff. 1-1-87.