Chapter Ind 22

ENERGY CONSERVATION

Part I Scope and Purpose
Ind 22.01 Scope
Ind 22.02 Purpose
Part II Definitions
Ind 22.03 Definitions
Part III Design Criteria
Ind 22.04 Indoor and outdoor temperatures
Ind 22.05 Moisture control
Part IV Building Envelope
Ind 22.06 Insulation standards
Ind 22.07 Air leakage
Part V Heating and Air Conditioning Equipment and Systems
Ind 22.08 Selection of equipment
Ind 22.09 Temperature control
Ind 22.10 Zone control
Ind 22.11 Duct and pipe insulation
Ind 22.12 Equipment efficiencies
Ind 22.13 Electronic ignition and automatic flue dampering
Part VI Buildings Utilizing Solar, Wind or Other Nondepletable Energy Sources
Ind 22.14 Innovative designs
Ind 22.15 Documentation

PART I—SCOPE AND PURPOSE

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

Note: The energy code is not intended to apply to dwellings exclusively using a renewable source of energy, such as wood or solar heat.

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

Ind 22.02 Purpose. (1) The purpose of this chapter is to provide design requirements which will improve the utilization of energy in one- and two-family dwellings as defined in section Ind 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.

PART II—DEFINITIONS

Ind 22.03 Definitions. (1) COEFFICIENT OF PERFORMANCE (COP), COOLING OR HEATING. Coefficient of performance (COP) is 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.

(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.

(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.

(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.

(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.

PART III—DESIGN CRITERIA

Ind 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.

TABLE 22.04-A
INDOOR DESIGN TEMPERATURES

Season	Temperature
Winter	70° F
Summer	78° F

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

Ind 22.05 Moisture control. (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.

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

(3) VENTILATION. Ventilation above the ceiling/attic insulation shall be required. The free ventilating area shall be at least 1/300 of the horizontal area.

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

PART IV—BUILDING ENVELOPE

Ind 22.06 Insulation standards. The exterior envelope of the building shall be insulated to meet the requirements of this part. More stringent overall thermal transmittance (U_o values) will be phased in at time intervals as specified for the designated building components.

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 two-family dwellings, the department will modify the requirements of section Ind 22.06 in accordance with the available supply of insulating material, through the promulgation of an emergency rule. When the office of state planning and energy certifies that such shortages have been remedied, the department will act to reinstate the requirements of section Ind 22.06.

(1) SLAB-ON-GRADE. The overall thermal transmittance (U_o 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.

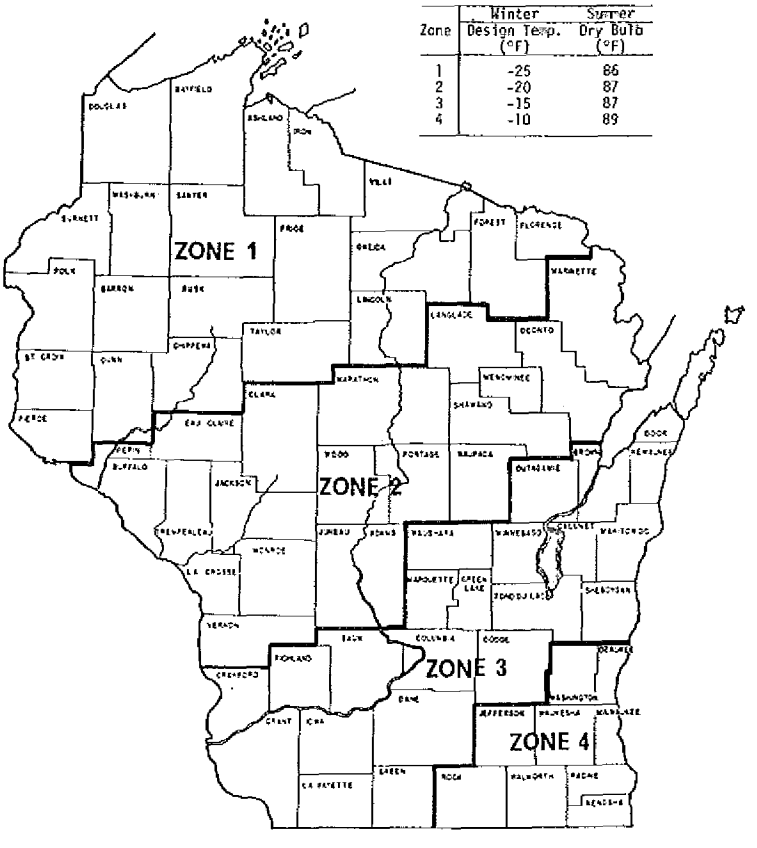
(4) BOX SILL. The box sill area shall be insulated to the same level as the wall.

(5a) ROOF/CEILINGS (effective April 1, 1979). The overall thermal transmittance (U_o value) through roof/ceiling assemblies shall not exceed .029 Btu per (hour) (square foot) (degree F).

(6a) EXTERIOR WALLS (effective April 1, 1979). The exposed exterior walls above grade shall be insulated in accordance with (a) or (b) and (c).

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



(a) *Exposed exterior walls above grade.* The overall thermal transmittance (U_o value) through exposed exterior walls above grade shall not exceed .14 Btu per (hour) (square foot) (degree F).

(b) *Exterior walls above foundation wall.* The overall thermal transmittance (U_o value) through exterior walls above the foundation wall shall not exceed .13 Btu per (hour) (square foot) (degree F).

(c) *Exposed foundation walls above grade.* The overall thermal transmittance through 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 .13 Btu per (hour) (square foot) (degree F).

Note: Section Ind 22.06 (6a) will be repealed effective March 31, 1980.

(6b) EXTERIOR WALLS (effective April 1, 1980). The exposed exterior walls above grade shall be insulated in accordance with (a) or (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 trasmittance (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 (effective April 1, 1979). 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 (1) through (8) of this section.

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.

Ind 22.07 Air leakage. (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.

PART V—HEATING AND AIR CONDITIONING EQUIPMENT AND SYSTEMS

Ind 22.08 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.

Ind 22.09 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.

Ind 22.10 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.

Ind 22.11 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.

Ind 22.12 Equipment efficiencies. (1) ELECTRICAL EQUIPMENT. (a) *Air conditioning equipment.* Air conditioning equipment shall have a minimum energy efficiency ratio (EER) of 6.1 (COP of 1.8).

(b) *Heat pumps.* Heat pumps shall comply with the minimum coefficients of performance set forth in Table 22.12.

TABLE 22.12
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. All gas-fired and oil-fired heating equipment shall have a minimum combustion efficiency of 75% at maximum rated output.

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

Ind 22.13 Electronic ignition and automatic flue dampering (effective April 1, 1979). Combustion space-heating equipment shall be provided with electronic ignition and automatic flue dampering, except

sealed combustion equipment or equipment located in enclosures and provided with combustion air need not be provided with automatic flue dampering.

History: Cr. Register, May, 1978, No. 269, eff. 4-1-79.

PART VI—BUILDINGS UTILIZING SOLAR, WIND OR OTHER NONDEPLETABLE ENERGY SOURCES

Ind 22.14 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.

Ind 22.15 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 Part IV.

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