Chapter ILHR 63

ENERGY CONSERVATION

Note: Chapter ILHR 63 was revised in December, 1995 effective April 1, 1996. On April 6, 1996 the department of industry, labor and human relations published an emergency rule stating that the effective date of the December, 1995 rule revision was delayed. A permanent rule was adopted in December, 1996 stating that the revised text of ch. ILHR 63, as published, would be effective April 1, 1997.

Note: Chapter Ind 63 was renumbered to be chapter ILHR 63 effective January 1, 1984. **Chapter ILHR 63 as it existed on March 31, 1997 was repealed and a new chapter ILHR 63 was created effective April 1, 1997.**

Subchapter I — Scope and Purpose

ILHR 63.001 Scope. (1) GENERAL. The provisions of this chapter shall apply to all public buildings and places of employment. These provisions are not retroactive unless specifically stated in the administrative rule. Where different sections of this chapter specify different requirements, the most restrictive requirement shall govern.

(2) EXEMPT BUILDINGS AND STRUCTURES. Buildings and structures, or portions thereof, without space heating or cooling, service water heating, or illumination are exempt from the requirements of this chapter that apply to those systems.

(3) APPLICATIONS TO EXISTING BUILDINGS. (a) 1. Additions to existing buildings or structures may be made without making the entire building or structure comply, but the addition shall comply with the requirements of this chapter

2. If a system serves both the existing building and the addition, any portion of the system or equipment that is altered shall comply with subch. IV.

(b) 1. Any change of occupancy of a building that would increase the required minimum inside temperature as specified in Table 64.05 shall not be permitted unless the building is made to comply with the requirements of this chapter.

2. Any change of use of a building or space within a building that would increase the minimum inside temperature as specified in Table 64.05 shall not be permitted unless the building or space is altered to comply with the requirements of this chapter.

3. Alterations to the building envelope governed by subch. III shall comply with one of the following:

a. The alteration shall not increase the rate of heat loss through the portion of the thermal envelope containing the alteration; or

b. The alteration shall not increase the annual energy use from heat gain or loss through the entire thermal envelope; or

c. The thermal envelope shall be brought into compliance with the requirements of subch. III.

4. Any alteration to the equipment and systems governed by subch. IV shall not be permitted unless the portion of the governed equipment or system being altered is brought into compliance with the requirements of subch IV.

(c) 1. Heating and cooling equipment replacement shall comply with the requirements of this chapter.

2. Rooftop fan systems that are replaced shall be provided with economizers that comply with the requirements of this chapter.

Note: It is the intent of the department to have every new building or addition and every change of occupancy meet the energy conservation requirements of this chapter. It is not the intent to prevent a previously built building from installing air conditioning, nor to cause equipment with several years of remaining service to be discarded due to not being able to meet the required efficiencies of this chapter. However, occupancy changes such as building a warehouse and later remodeling it into an office space will not be permitted unless all the requirements of this chapter are met.

(d) 1. New lighting systems installed in conjunction with an increase of conditioned floor area, such as the addition of a mezzanine, shall meet the requirements of this chapter.

2. Alterations to existing lighting systems that increase the connected lighting load of the building or replace more than 50% of the lighting fixtures in the area of the alteration shall meet the requirements of this chapter.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.002 Purpose. The purpose of this chapter is to provide design requirements which will promote efficient utilization of energy in public buildings and places of employment.

(1) GENERAL. The intent of this chapter is to provide minimum requirements for construction and equipment to conserve energy.

(2) FLEXIBILITY IN USE. It is intended that this chapter be flexible and permit the use of innovative approaches and techniques to achieve effective utilization of energy.

(3) CONFLICT WITH OTHER RULES. This chapter is not intended to conflict with any safety or health requirements. Where such conflict occurs, the safety and health requirements shall govern.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.01 Plans and specifications. Architectural and mechanical plans and specifications shall be submitted in accordance with the requirements outlined in ss. ILHR 50.07 and 50.12 and shall contain details and data to demonstrate compliance with the requirements of this chapter. Such information shall include, but is not limited to: design criteria, exterior envelope component materials, and resistance values of insulating materials. Size and type of equipment, system and equipment controls and equipment efficiencies shall be submitted with the mechanical plans.

Note: The resistance values for insulating materials are expressed in Fahrenheit degrees per Btu/(hour)(square foot). See A50.12 of the appendix for sample copies of forms.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Subchapter II — Definitions

ILHR 63.05 Definitions. In this chapter:

(1) "Ambient Lighting" is lighting designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect. When designed for lower–than–task illuminance used in conjunction with other specific task lighting systems, it is also called "general" lighting.

(2) "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.

(3) "Automatic time switch control devices" means control devices that are capable of automatically turning loads off and on based on time schedules.

(4) "Building envelope" means the elements of a building that enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces.

(5) "Comfort cooling" or "comfort heating" means treating air to control one or more of the following: temperature, relative humidity, or distribution to meet the comfort requirements of the human occupants of the conditioned space.

(6) "Conditioned floor area" or "CFA" means the floor area in square feet of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

(7) "Conditioned space" means a cooled space, heated space, or indirectly conditioned space.

(8) "Cooled space" means an enclosed space within a building that is conditioned by a cooling system with a sensible capacity that either exceeds 5 Btu/hr sq ft or is capable of maintaining a space dry–bulb temperature of 90°F or less at design conditions.

(9) "Daylighting control" means a device that automatically regulates the power input to electric lighting near the fenestration to maintain the desired workplace illumination, thus taking advantage of direct or indirect sunlight.

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

(11) "Degree day" means a unit based upon temperature difference and time, used in estimating annual heating or cooling energy consumption. One degree day accrues for each degree of difference between the daily mean temperature and a reference temperature.

(12) "Display lighting" means lighting confined to the area of a display that provides a higher level of illuminance than the level of surrounding ambient illuminance.

(13) "Daylit area" means the space on the floor that is the larger of par. (a) or (b) as follows:

(a) 1. For areas daylit by vertical glazing, the daylit area has the length of 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60–inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side, the distance to an opaque partition, or one–half the distance to the closest skylight or vertical glazing, whichever is least.

2. For areas daylit by horizontal glazing, the daylit area is the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of the floor–to–ceiling height, the distance to the nearest 60–inch or higher opaque partition, or one–half the horizontal distance to the edge of the closest skylight or vertical glazing.

(b) The daylit area calculated using a method acceptable to the department.

Note: See Appendix A for additional illustrative information.

(14) "Economizer, air" means a ducting arrangement and automatic control system that allows a cooling supply fan to supply outside air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather.

(15) "Economizer, water" means a system by which the supply air of a cooling system is cooled directly or indirectly or both by evaporation of water or other appropriate fluid in order to reduce or eliminate the need for mechanical refrigeration during some time periods.

(16) "Effective aperture" or "EA" means 1) for windows, the visible light transmittance times the window wall ratio; and 2) for sky lights, the well efficiency times the visible light transmittance times the sky light area times 0.85 divided by the gross exterior roof area.

(17) "Efficacy" means the ratio of light from a lamp to the electrical power consumed, including ballast losses, expressed in lumens per watt.

(18) "Emissivity" means the ratio of the rate of radiant heat energy emitted by a body at a given temperature to the rate of radiant heat energy emitted by a standard called a blackbody, at the same temperature in the same surroundings.

(19) "Exterior envelope" has the same meaning as "building envelope."

(20) "Exterior roof or ceiling" means an exterior partition, or partition separating a conditioned space from an enclosed unconditioned space, that has a slope less than 60° from horizontal, that has conditioned space below, and that is not an exterior door or skylight.

(21) "Exterior roof or ceiling area" means the area of the exterior surface of exterior roof or ceiling.

(22) "Exterior wall" means an exterior partition that is not an exterior floor or soffit, exterior door, exterior roof or ceiling, window, or skylight.

(23) "Exterior wall area" means the area of the opaque exterior surface of exterior walls.

(24) "Fenestration" means any light–transmitting section in a building wall or roof. The fenestration includes glazing material, which may be glass or plastic, framing such as mullions, muntins, and dividers, external shading devices, internal shading devices, and integral or between glass shading devices.

(25) "Fenestration area" means the total area of fenestration measured using the rough opening and including the glazing material, sash, and frame.

(26) "General lighting" means lighting designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect. When designed for lower–than– task illuminance used in

conjunction with other specific task lighting systems, it is also called "ambient" lighting.

(27) "Gross exterior wall area" means the gross area of exterior walls separating a conditioned space from the outdoors or from unconditioned spaces as measured on the exterior above grade. It consists of the opaque wall, excluding vents and grills, including between floor spandrels, peripheral edges of flooring, window areas including sash, and door areas.

(28) "Gross floor area" means the sum of the floor areas of the conditioned spaces within the building including basements, mezzanine and intermediate–floored tiers, and penthouses of headroom height 7.5 ft or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, excluding covered walkways, open roofed–over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

(29) "Gross floor area over outside or unconditioned spaces" means the gross area of a floor assembly separating a conditioned space from the outdoors or from unconditioned spaces as measured from the exterior faces of exterior walls or from the center line of walls separating buildings. The floor assembly shall be considered to include all floor components through which heat may flow between indoor and outdoor or unconditioned environments.

(30) "Gross lighted area" or "GLA" means the sum of the total lighted areas of a building measured from the inside of the perimeter walls for each floor of the building.

(31) "Gross roof area" means the gross area of a roof assembly separating a conditioned space from the outdoors or from unconditioned spaces, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings. The roof assembly shall be considered to include all roof or ceiling components through which heat may flow between indoor and outdoor environments including skylights but excluding service openings.

(32) "Gross exterior roof area" means the sum of the skylight area and the exterior roof/ceiling area.

(33) "Gross exterior wall area" means the sum of the window area, door area and exterior wall area.

(34) "Heat capacity" or "HC" means the amount of heat necessary to raise the temperature of a given mass one degree. Numerically, it is the mass multiplied by the specific heat.

(35) "Heated space" means an enclosed space within a building that is conditioned by a heating system with an output capacity either exceeds 10 Btu/hr sq ft or is capable of maintaining a space dry–bulb temperature of 50°F or more at design conditions.

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

(37) "Humidistat" means a device that is capable of being set to prevent the use of fossil fuel or electricity to humidify air above 30% relative humidity or dehumidify air to below 60% relative humidity, or both.

(38) "Indirectly conditioned space" means an enclosed space including, but not limited to, unconditioned volume in atria, that is not directly conditioned space; and either has an area–weighted heat transfer coefficient to directly conditioned space exceeding that to the outdoors or to unconditioned space, or is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

(39) "Listed space area" or "LS" means any interior space with an identified area of activities for which a lighting power budget is calculated and listed in the lighting power allowance determination.

(40) "Lumen maintenance control device" means a device capable of automatically adjusting the light output of a lighting system throughout a continuous range to provide a preset level of illumination.

(41) "Luminaire" means a complete lighting unit consisting of at least one lamp and the parts designed to distribute the light, to position and protect the lamp, to connect the lamp to the power supply and ballasting, when applicable. Luminaires are commonly referred to as "lighting fixtures" or "instruments."

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

(43) "Mass wall" means a wall assembly with a heat capacity (HC) greater than or equal to 5 Btu/ft^2°F.

(44) "Mass wall insulation position" means:

(a) Exterior insulation position: a wall having all or nearly all of its mass exposed to the room air with the insulation on the exterior of that mass.

(b) Integral insulation position: a wall having mass exposed to both room and outside air with substantially equal amounts of mass on the inside and outside of the insulation layer.

(c) Interior insulation position: a wall not meeting either par. (a) or (b), particularly a wall having most of its mass external to an insulation layer.

(45) "Medical and clinical care" means the promotion of the condition of being sound in body or mind through medical, dental or psychological examination and treatment.

(46) "Multiscene dimming system" means a lighting control device that has the capability of setting light levels throughout a continuous range, and that has pre–established settings within the range.

(47) "Occupant–sensing device" means a device that automatically controls the lights based on occupancy.

(48) "Opaque areas" means all exposed areas of a building envelope which enclose conditioned space except fenestration areas and building service openings such as vents and grilles.

(49) "Ornamental chandeliers" means ceiling–mounted, close–to–ceiling, or suspended decorative luminaires that use glass, crystal, ornamental metals, or other decorative material and that typically are used in hotels/motels, restaurants, or churches as a significant element in the interior architecture.

(50) "Precision commercial or industrial work" means an art, craft, or manufacturing operation requiring a certain degree of refinement.

(51) "Private driveways, walkways, and parking lots" means exterior transit areas that are associated with a commercial or residential building and intended for use solely by the employes or tenants and not by the general public.

(52) "Public driveways, walkways, and parking lots" means exterior transit areas that are intended for use by the general public.

(53) "Recooling" means lowering the temperature of air that has been previously heated by a heating system.

(54) "Recovered energy" means energy utilized from an energy–using system which would otherwise be wasted or not contribute to a desired end use.

(55) "Reduced flicker operation" means the operation of a light, in which the light has a visual flicker less than 30% for frequency and modulation.

(56) "Reheating" means raising the temperature of air that has been previously cooled either by refrigeration or an economizer system.

Note: Introducing outdoor air necessary to meet ventilation requirements or to assure adequate indoor air quality is not considered to be cooling.

(57) "Reset" means adjustment of the controller set point to a higher or lower value automatically or manually.

(58) "Sconce" means a wall mounted decorative light fixture.

(59) "Shading coefficient" or "SC_x" means the ratio of solar heat gain through fenestration, with or without integral shading

devices, to that occurring through unshaded 1/8–in. thick clear double strength glass.

(60) "Shell building" means a building for which the envelope is designed, constructed, or both prior to knowing the occupancy type.

Note: See also speculative building.

(61) "Speculative building" means a building for which the envelope is designed, constructed, or both prior to the design of the lighting, HVAC systems, or both. A speculative building differs from a shell building in that the intended occupancy is known for the speculative building.

Note: See also shell building.

(62) "Support area" means an area for functions that are different from but necessary to accomplish the main activity or purpose of other listed space areas.

(63) "Tandem wiring" means pairs of luminaires operating with one lamp in each luminaire powered from a single two–lamp ballast contained in the other luminaires.

(64) "Task oriented lighting" means lighting that is designed specifically to illuminate a task location, and that is generally confined to the task location.

(65) "Thermal break" means an element of low thermal conductivity placed in an assembly to reduce the flow of heat between highly conductive materials.

(66) "Thermal conductance" or "C" means the constant time rate of heat flow thorough a unit area of a body induced by a unit temperature difference between the surfaces, expressed in Btu/h ft^2 $^\circ$F or equivalent units. It is the reciprocal of thermal resistance.

(67) "Thermal resistance" or "R" means the reciprocal of thermal conductance, 1/C expressed in h ft^2 $^\circ$F/Btu or equivalent units. The total thermal resistance of an assembly is $1/U_o$.

(68) "Thermal transmittance" or "U" means the overall coefficient of heat transfer from fluid to fluid. It is the time rate of heat flow per unit area under steady conditions from the fluid on the warm side of the barrier to the fluid on the cold side, per unit temperature difference between the 2 fluids, expressed in Btu/h ft^2 $^\circ$F or equivalent units.

(69) "Thermal transmittance, overall" or "U_o" means the gross overall (area weighted average) coefficient of heat transfer from air to air or fluid to fluid for a gross area of the building envelope, expressed in Btu/h ft^2 $^\circ$F or equivalent units. The U_o value applies to the combined effect of the time rate of heat flows through the various parallel paths such as windows, doors, and opaque construction areas comprising the gross area of one or more building envelope components such as walls, floors, and roof or ceiling.

(70) "Thermostat" means an automatic control device responsive to temperature.

(71) "Throw distance" means the distance between the luminaire and the center of the plane on a subject lit by the luminaire.

(72) "Unconditioned space" means a space within a building that is not a conditioned space.

Note: See conditioned space.

(73) "Unlisted space" means the difference in area between the gross lighted area and the sum of all listed space areas.

(74) "Variable air volume HVAC system" or "VAV HVAC system" means HVAC systems that control the dry–bulb temperature within a space by varying the volume of air supply to the space.

(75) "Visible light transmittance" or "VLT" means the ratio expressed as a decimal of visible light that is transmitted through a glazing material to the light that strikes the material.

(76) "Wall heat capacity" or "HC" means the sum of products of the mass of each individual material in the wall per unit area of wall surface times its individual specific heat, Btu/(ft^2 $^\circ$F).

(77) "Well efficiency" means the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well and is calculated as follows:

(a) for rectangular wells:

$$\frac{\text{Well height (well length + well width)}}{\text{2 x well length x well width}} = \text{the well index}$$

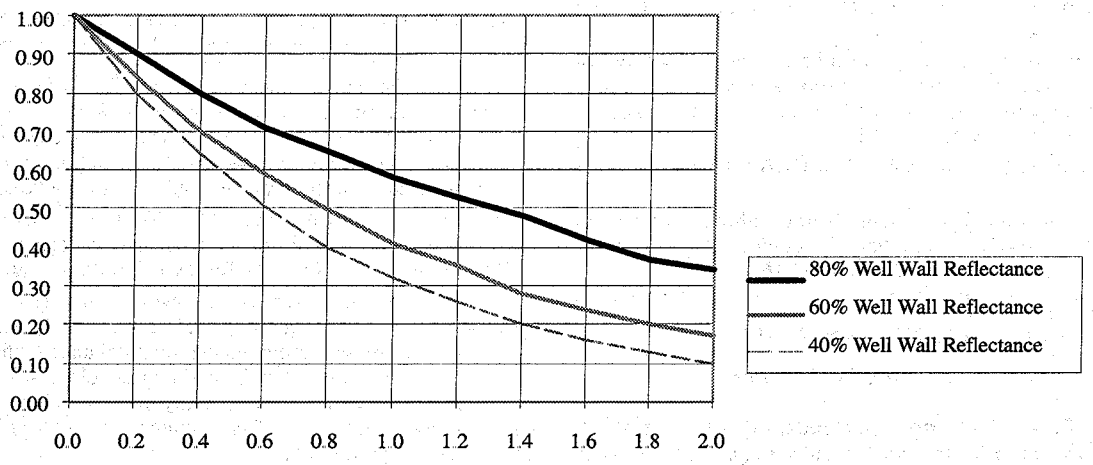
; or

(b) for irregular shaped wells:

$$\frac{\text{Well height x well perimeter}}{\text{4 x well area}} = \text{the well index}$$

(c) The length, width, perimeter, and area expressed in pars. (a) and (b) are measured at the bottom of the well. The well index and the weighted average well wall reflectance are used in Figure 63.02 to determine the well efficiency.

Figure 63.02 Well Efficiency



Information taken from: Fig 7–38, IES Lighting Handbook, 1984 Reference

(78) "Window" means glazing that is not a skylight.

(79) "Window area" means the area of the surface of a window, plus the area of the frame, sash, and mullions.

(80) "Window wall ratio" means the ratio of the window area, including glazed areas of doors, to the gross exterior wall area.

(81) "Zone" means a space or group of spaces within a building with any combination of heating, cooling, or lighting requirements sufficiently similar so that desired conditions can be maintained throughout by a single controlling device.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Subchapter III — Building Envelope

ILHR 63.10 Exempt buildings. This subchapter applies to buildings or separately enclosed identifiable areas that have a mechanical space heating or air conditioning system.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Part 1 – General Requirements

ILHR 63.11 Air leakage and moisture migration. **(1)** GENERAL. The requirements of this section apply to those building components that separate interior building conditioned space from the outdoors or from unconditioned spaces or crawl spaces. Compliance with the criteria for air leakage through building components shall be determined by tests conducted in accordance with specified standards.

(2) AIR LEAKAGE REQUIREMENTS FOR FACTORY MANUFACTURED FENESTRATION AND DOORS. (a) Factory manufactured fenestration shall meet one of the following standards for air leakage as adopted in s. ILHR 51.25:

1. ANSI/AAMA 101 Aluminum and Poly Vinyl Chloride (PVC) Prime Windows and Glass Doors.

2. ASTM D 4099 Specification for Poly Vinyl Chloride (PVC) Prime Windows.

3. ANSI/NWWDA I.S.2 Wood Windows (Improved Performance Rating Only).

(b) Factory manufactured sliding doors shall meet one of the following standards for air leakage:

1. ANSI/AAMA 101 Aluminum and Poly Vinyl Chloride (PVC) Prime Windows and Glass Doors.

2. ANSI/NWWDA I.S.3 Wood Sliding Patio Doors.

(c) Factory manufactured commercial entrance swinging or revolving doors shall limit air leakage to a rate not to exceed 1.25 cfm/ft^2 of door area when tested at standard test conditions in accordance with ASTM E 283.

(d) Factory manufactured residential swinging doors shall limit air leakage to a rate not to exceed 0.5 cfm/ft^2 of door area when tested at standard test conditions in accordance with ASTM E 283.

Note: The term "factory manufactured" does not apply to units constructed or fabricated in the field or to units assembled from individual components at a lumber yard or building material center.

(3) AIR LEAKAGE REQUIREMENTS FOR EXTERIOR ENVELOPE JOINTS AND PENETRATIONS. Exterior joints, cracks, and holes in the building envelope shall be caulked, gasketed, weather stripped, or otherwise sealed. Such joints include the following:

(a) Around window or door frames.

(b) Between wall or floor and foundation.

(c) Between wall and roof or roof decking.

(d) Through wall panels and top and bottom plates in exterior walls.

(e) At penetrations of utility services or other service entry through walls, floors, and roofs.

(f) Between wall panels particularly at corners and changes in orientation.

(g) Between wall and floor where floor penetrates wall.

(h) Around penetrations made through the insulated envelope by chimneys, flue vents, or attic hatches.

Note: Sealing methods should be designed to be compatible with the chimney or vent listing.

(4) MOISTURE CONDENSATION. The design of buildings shall not create conditions of accelerated deterioration from moisture condensation.

Note: Vapor retarders and ventilation should be considered to prevent moisture from collecting within the envelope. The principles of ASHRAE Handbook, Fundamentals Volume, may be used as a guide.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.12 Daylight credits for skylights. **(1)** When determining building roof compliance using either the component standards of s. ILHR 63.15 or the system standards of s. ILHR 63.16, daylight credits for skylights may be used if the criteria of this section are met.

Note: Skylights used in conjunction with automatic lighting controls for daylighting can significantly reduce the lighting energy consumption thereby more than offsetting the increase in envelope heat transfer.

(2) Skylights for which daylight credit is taken may be excluded from the calculations of the overall thermal transmittance value of the roof assembly (Uor) if all of the following conditions are met:

(a) The opaque roof thermal transmittance value Uor does not exceed the values determined for the roof within the appropriate Alternate Component Package (ACP) table selected under s. ILHR 63.15 (1) or by s. ILHR 63.16.

(b) The criteria of section 8.4.8 of ASHRAE Standard 90.1 are met.

(c) Areas for vertical glazing, or glazing within 30° of vertical of clerestories or roof monitors shall be included in the wall fenestration calculation of s. ILHR 63.15 or 63.16.

Note: See A63.12 of the appendix for general information on the criteria of section 8.4.8 of ASHRAE Standard 90.1.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Part 2 – Thermal Performance

ILHR 63.14 Building envelope thermal performance. (1) Except as provided in subs. (2) and (3), building envelopes shall comply with either the component standards of s. ILHR 63.15 or the system standards of s. ILHR 63.16. The calculation procedures of s. ILHR 63.18 shall be used to show compliance.

(2) Buildings and areas of buildings that are used as factories shall comply with s. ILHR 63.165.

(3) Buildings and areas of buildings that are used as warehouses that have documentation provided to verify that the HVAC system to be installed does not use energy primarily to provide human comfort shall comply with s. ILHR 63.165.

Note: See s. ILHR 63.10 for exempt buildings and spaces.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.15 Component standards option. This section describes the component standards for building envelope thermal performance. Because component requirements consider the effect of solar gain as well as conductive heat transfer, the requirements for each component shall be met independently under this option. The wall and roof trade–off exception in sub. (3) may be used with this option. The System Analysis Design Method of Subchapter III shall be used to demonstrate the acceptability of trade–offs between component energy–conserving features. Separate occupancies in the same building shall meet the requirements of this section independently.

(1) DETERMINATION OF APPROPRIATE ACP TABLE. The appropriate alternate component package or ACP table shall be determined based on building location using Figure 63.15.

(2) MAXIMUM ALLOWABLE WINDOW WALL RATIO. The percentage of windows, including glazed areas of doors, relative to the gross external wall area of the building shall be less than or equal to the maximum allowable window wall ratio chosen from the appropriate ACP table for the glazing type of the building. The window wall ratio is the total area of window assemblies, including glazed areas of doors, divided by the total gross exterior wall area, considering all elevations of the building. The maximum allowable window wall ratio shall be determined using the following steps:

(a) Select the Shading Coefficient (SC_x) range that is no less than the fenestration SC_x including permanently installed internal, integral and external shading devices, but excluding the effect of external shading projections. Note that this includes curtains, shades, or blinds that are permanently installed. For a shell or speculative building for which the envelope is designed or constructed prior to the design of the lighting, HVAC systems, or both, only those shading devices that are part of the design when it is being evaluated for compliance shall be considered when determining compliance.

Note: Refer to ASHRAE Handbook, Fundamentals Volume, Chapter 27 for more information on shading coefficients. Shading coefficients for fenestration are obtained from the manufacturer. See also s. ILHR 63.18 (4).

(b) Select appropriate fenestration type. This is determined by the thermal transmittance value (Uof) of the fenestration assembly. The Uof of all assemblies must fall within the range, or lower, to determine the maximum window wall ratio, or an area–weighted average thermal transmittance value may be used.

(3) WALL AND ROOF TRADE–OFF. Trade–offs between the above grade exterior wall opaque areas and the gross roof area shall be allowed if either of the following conditions are met:

(a) The thermal transmittance, overall value (Uo) for any above grade exterior opaque wall area or gross roof area may be increased or decreased, provided that the total annual energy use due to heat gain and loss for the building envelope shall be less than or equal to the total annual energy use due to heat gain and loss resulting from the use of the values in the appropriate ACP table given in Figure 63.15.

Note: The latest version of the ENVSTD computer program may be used to determine required thermal transmittance values in lieu of the ACP tables. ENVSTD is the computer program included in the ASHRAE Standard 90.1.

(b) A submittal to the department for review and approval, incorporating recognized engineering practices, that the annual energy use due to heat gain and loss for the building envelope shall be less than or equal to that established in par (a).

(4) THERMAL TRANSMITTANCE VALUES FOR ROOFS, WALLS NEXT TO UNCONDITIONED SPACES, AND FLOORS OVER UNCONDITIONED SPACES. (a) The U–values for the building roofs, walls next to unconditioned spaces, and floors over unconditioned spaces shall be less than or equal to those listed in the appropriate ACP table given in Figure 63.15.

(b) Skylights for which daylight credit cannot be taken in accordance with s. ILHR 63.12 shall be included in the calculation of the overall thermal transmittance value of the roof assembly (Uor).

(c) Unconditioned below–grade spaces that have floor or ceiling assemblies insulated as specified on the appropriate ACP table do not require below–grade wall insulation.

(5) THERMAL RESISTANCE VALUE FOR SLAB–ON–GRADE FLOORS. (a) Unheated slab–on–grade floors shall have insulation around the perimeter of the floor with the thermal resistance (Ru) of the insulation as listed in the appropriate ACP table.

(b) For heated slabs–on–grade, the required minimum R–value shall be the R–value for the unheated slab–on–grade plus 2.0.

(c) The slab insulation specified shall extend either in a vertical plane downward from the top of the slab for the minimum distance given in the appropriate ACP table or downward to the bottom of the slab then in a horizontal plane beneath the slab or outward from the building for the minimum distance given in the ACP table. Vertical insulation shall not be required to extend below the foundation footing.

(d) The R–value and dimensions required for slabs refer only to the building insulation materials. Insulative continuity shall be maintained in the design of slab edge insulation systems. Continuity shall be maintained from the wall insulation through the intersection of the slab, wall and footing to the body of the slab edge insulation.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Figure 63.15
Degree Day Regions

REGIONS	ACP TABLE
1,2,4	A
3,5,6,7,8	B
9. 10, 11	C

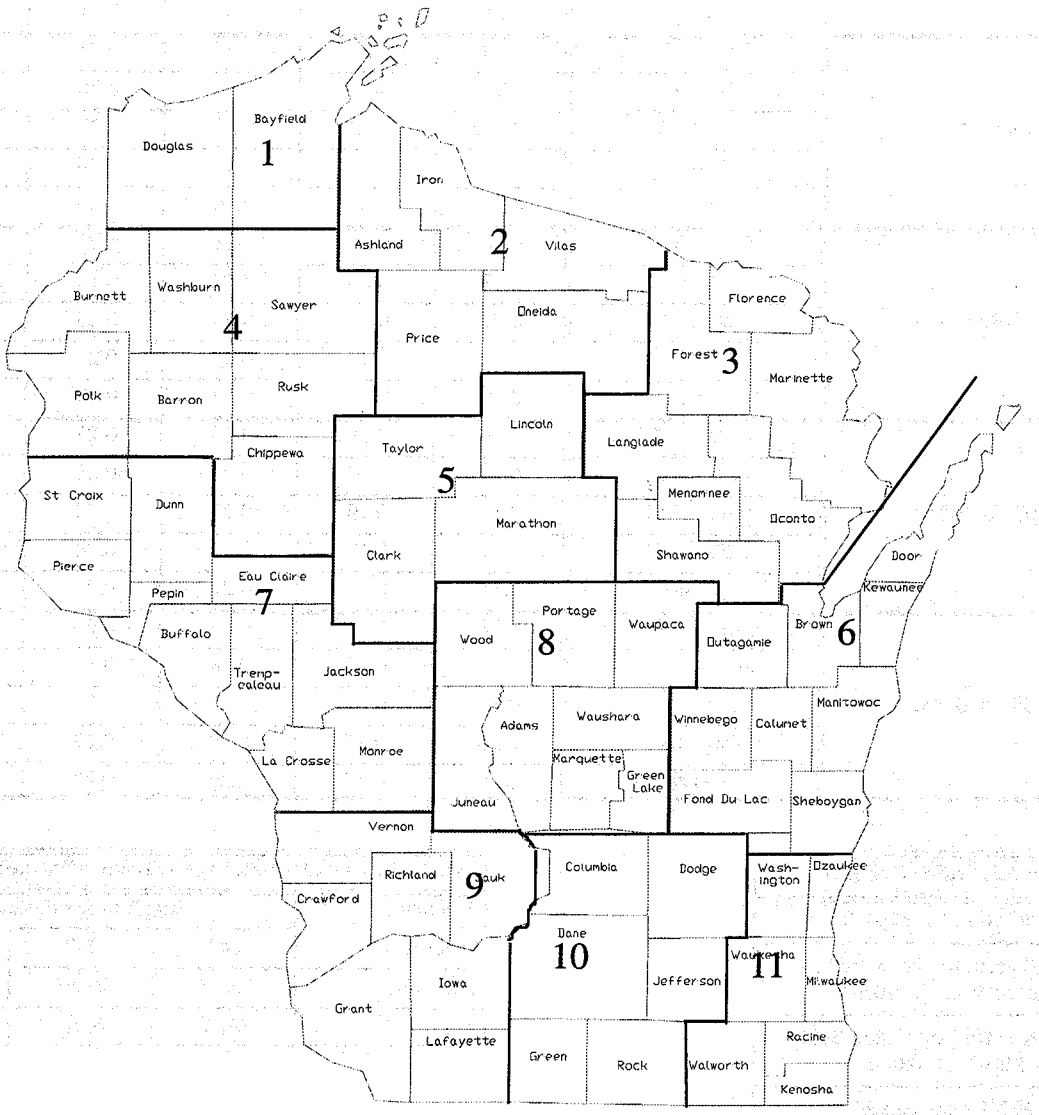


Figure 63.15 (Continued)
Alternate Component Package
ACP Table A

Part A1: Maximum Window Area/Gross Exterior Wall Area						
Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range 0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.450 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.23	0.25	0.27
	0.70 – 0.61	0.20	0.22	0.24	0.26	0.28
	0.60 – 0.51	0.21	0.22	0.25	0.27	0.30
	0.50 – 0.41	0.21	0.23	0.25	0.28	0.31
	≤ 0.40	0.21	0.23	0.26	0.29	0.33
0.061 to 0.070	0.80 – 0.71	0.18	0.20	0.21	0.23	0.25
	0.70 – 0.61	0.18	0.20	0.22	0.24	0.27
	0.60 – 0.51	0.19	0.21	0.23	0.25	0.28
	0.50 – 0.41	0.19	0.21	0.23	0.26	0.30
	≤ 0.40	0.19	0.21	0.24	0.27	0.31
0.071 to 0.080	0.80 – 0.71	0.16	0.18	0.20	0.22	0.24
	0.70 – 0.61	0.17	0.18	0.20	0.23	0.25
	0.60 – 0.51	0.17	0.19	0.21	0.23	0.26
	0.50 – 0.41	0.17	0.19	0.21	0.24	0.27
	≤ 0.40	0.18	0.19	0.22	0.25	0.28
0.081 to 0.090	0.80 –0.71	0.15	0.16	0.18	0.20	0.22
	0.70 – 0.61	0.15	0.17	0.18	0.21	0.23
	0.60 – 0.51	0.15	0.17	0.19	0.21	0.24
	0.50 – 0.41	0.16	0.17	0.19	0.22	0.25
	≤ 0.40	0.16	0.17	0.20	0.22	0.26

Part A2: Other Criteria
Roof Max U_o = 0.040
Wall Adjacent to Unconditioned Space Max U_o = 0.10
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 13

Part A3: Unheated Slab–On–Grade Minimum R–Value			
Insulation Orientation	Length of Insulation 24"	36"	48"
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

Figure 63.15 (continued)
Alternate Component Package
ACP Table B

Part B1: Maximum Window Area/Gross Exterior Wall Area						
Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range 0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.45 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.22	0.23	0.24
	0.70 – 0.61	0.21	0.22	0.24	0.25	0.27
	0.60 – 0.51	0.22	0.24	0.25	0.27	0.29
	0.50 – 0.41	0.24	0.25	0.27	0.30	0.32
	≤ 0.40	0.25	0.27	0.29	0.32	0.35
0.061 to 0.070	0.80 – 0.71	0.19	0.20	0.21	0.22	0.23
	0.70 – 0.61	0.20	0.21	0.22	0.24	0.25
	0.60 – 0.51	0.21	0.23	0.24	0.26	0.28
	0.50 – 0.41	0.22	0.24	0.26	0.28	0.31
	≤ 0.40	0.24	0.26	0.28	0.31	0.34
0.071 to 0.080	0.80 – 0.71	0.18	0.19	0.20	0.21	0.23
	0.70 – 0.61	0.19	0.20	0.21	0.23	0.24
	0.60 – 0.51	0.20	0.21	0.23	0.25	0.27
	0.50 – 0.41	0.21	0.23	0.25	0.27	0.29
	≤ 0.40	0.22	0.24	0.27	0.29	0.32
0.081 to 0.090	0.80 –0.71	0.17	0.18	0.19	0.20	0.21
	0.70 – 0.61	0.18	0.19	0.20	0.21	0.23
	0.60 – 0.51	0.19	0.20	0.21	0.23	0.25
	0.50 – 0.41	0.20	0.21	0.23	0.25	0.28
	≤ 0.40	0.21	0.23	0.25	0.27	0.30

Part B2: Other Criteria
Roof Max U_o = 0.045
Wall Adjacent to Unconditioned Space Max U_o = 0.11
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 12

Part B3: Unheated Slab–On–Grade Minimum R–Value			
Insulation Orientation	Length of Insulation 24"	36"	48"
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

Figure 63.15 (continued)
Alternate Component Package
ACP Table C

Part C1: Maximum Window Area/Gross Exterior Wall Area						
Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range 0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.45 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.22	0.22	0.23
	0.70 – 0.61	0.22	0.23	0.24	0.25	0.26
	0.60 – 0.51	0.23	0.25	0.26	0.27	0.29
	0.50 – 0.41	0.25	0.27	0.29	0.30	0.32
	≤ 0.40	0.27	0.29	0.32	0.34	0.37
0.061 to 0.070	0.80 – 0.71	0.19	0.20	0.21	0.22	0.23
	0.70 – 0.61	0.21	0.22	0.23	0.24	0.25
	0.60 – 0.51	0.22	0.24	0.25	0.26	0.28
	0.50 – 0.41	0.24	0.26	0.27	0.29	0.31
	≤ 0.40	0.26	0.28	0.30	0.33	0.35
0.071 to 0.080	0.80 – 0.71	0.18	0.19	0.20	0.21	0.22
	0.70 – 0.61	0.20	0.21	0.22	0.23	0.24
	0.60 – 0.51	0.21	0.23	0.25	0.26	0.27
	0.50 – 0.41	0.23	0.25	0.26	0.28	0.30
	≤ 0.40	0.25	0.27	0.29	0.31	0.34
0.081 to 0.090	0.80 –0.71	0.17	0.18	0.19	0.20	0.21
	0.70 – 0.61	0.19	0.20	0.21	0.22	0.23
	0.60 – 0.51	0.20	0.22	0.23	0.24	0.26
	0.50 – 0.41	0.22	0.23	0.25	0.27	0.29
	≤ 0.40	0.24	0.26	0.28	0.30	0.33

Part C2: Other Criteria
Roof Max U_o = 0.049
Wall Adjacent to Unconditioned Space Max U_o = 0.11
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 11

Part C3: Unheated Slab–On–Grade Minimum R–Value			
Insulation Orientation	Length of Insulation 24”	36”	48”
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

ILHR 63.16 System standards option. To comply with the system standards for building envelope thermal performance, the building shall comply with section 8.6 of ASHRAE standard 90.1 as adopted in s. ILHR 51.25 or with the system analysis design of s. ILHR 63.70 to 63.72 applied to the thermal envelope alone. Building site climate data shall be determined using Wisconsin Division of State Energy Statistics or other source acceptable to the department.

Note: Section 8.6 of ASHRAE 90.1 requires use of the latest version of the ENVSTD computer program. ENVSTD is the computer program included in the ASHRAE 90.1 Standard.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.165 Design criteria. **(1)** THERMAL PERFORMANCE. (a) Except as provided in par. (b), the thermal performance values for the exterior envelope of buildings or areas of buildings that are warehouses that meet the criteria of s. ILHR 63.14 (3), or that are factories shall not exceed the values in Table 63.165–1. The calculation procedures of s. ILHR 63.18 shall be used to show compliance.

Table 63.165–1
Thermal Performance Values

Number of Stories	Thermal Performance Values*
1–2	12
3–4	13
5–7	16
8–12	18
13–20	20
Over 20	21

*Expressed in Btu/hour/square foot of above–grade exterior envelope. See s. ILHR 63.23 (2) and (3) for design conditions.

(b) The thermal performance values specified in par. (a) may be increased or decreased provided the U–value for other components is decreased or increased so the total heat gain or loss for the entire building envelope and floor area does not exceed the total heat gain or loss resulting from conformance to the values specified in this section.

(2) FLOORS OVER UNCONDITIONED SPACES. The overall heat transmission coefficient (U–value) for floors of heated or mechanically cooled spaces over unconditioned spaces shall not exceed 0.08 Btu/F. Sq. Ft. hour.

(3) SLAB–ON–GRADE PERIMETER INSULATION. For slab–on–grade floors with or without a grade beam, a foundation bearing wall or a foundation frost wall, the thermal resistance of the insulation around the perimeter of the floor shall not be less than the values shown in Table 63.165–2. The insulation shall extend 48 inches in the vertical or horizontal direction or combination thereof with a total dimension of 48 inches. Slab–on grade perimeter insulation shall be moisture resistant.

Table 63.165–2
Perimeter Insulation Requirements[1]

Slab–on–grade Perimeter Insulation		Zone 1	Zone 2	Zone 3	Zone 4
R = °F Sq. Ft. Hour / Btu	Unheated Slabs	6.7	6.2	5.9	5.2
	Heated Slabs[2]	9.3	9.0	8.6	8.2

[1]See Fig. 63.23 for zone definitions.

[2]Heated slabs have piping, duct work or other heat distribution system components embedded in or under them.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Part 3 – Calculations and Standards

ILHR 63.17 Material properties. **(1)** When available, information on thermal properties, performance of building envelope sections, and components and heat transfer shall be obtained from ASHRAE Handbook, Fundamentals Volume, adopted in s. ILHR 51.25.

(2) (a) When the information is not available from ASHRAE Handbook, Fundamentals Volume, the data may be obtained from manufacturer's information or laboratory or field test measurements. If laboratory or field test measurements are used for envelope heat transmission, they shall be obtained using one of the following test methods adopted in s. ILHR 51.25:

1. GUARDED HOT PLATE: ASTM C 177;
2. HEAT FLOW METER: ASTM C 518;
3. GUARDED HOT BOX: ASTM C 236;
4. CALIBRATED HOT BOX: ASTM C 976; or
5. PIPE INSULATION: ASTM C 335.

(b) For foam plastic insulations that use a gas other than air as the insulating medium, laboratory or field tests shall be conducted on representative samples that have been aged for the equivalent of 5 years or until the R–Value has stabilized. The tests shall be conducted by an independent third party and shall be submitted for department review and approval in accordance with s. ILHR 50.19.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.18 Required calculation procedures. The following procedures shall be used to calculate the thermal performance of above– and below–grade envelope sections of any building that is heated or mechanically cooled.

(1) OVERALL THERMAL TRANSMITTANCE (U_O). The overall thermal transmittance of the building envelope assembly shall be calculated in accordance with the equation given below.

$$U_o = \Sigma U_i A_i / A_o$$
$$= (U_1A_1 + U_2A_2 + \bullet\ \bullet\ \bullet\ \bullet + U_nA_n)/A_o$$

where:

U_o =The area–weighted average thermal transmittance of the gross area of an envelope assembly; that is the exterior wall assembly including fenestration and doors, the roof and ceiling assembly, and the floor assembly, Btu/hft^2°F.

A_o =The gross area of the envelope assembly, ft^2.

U_i =The thermal transmittance of each individual path of the envelope assembly, for example, the opaque portion of the wall assembly, Btu/hft^2°F. U_i also equals $1/R_i$ where R_i is the total resistance to heat flow of an individual path through an envelope assembly.

A_i =The area of each individual element of the envelope assembly, ft^2.

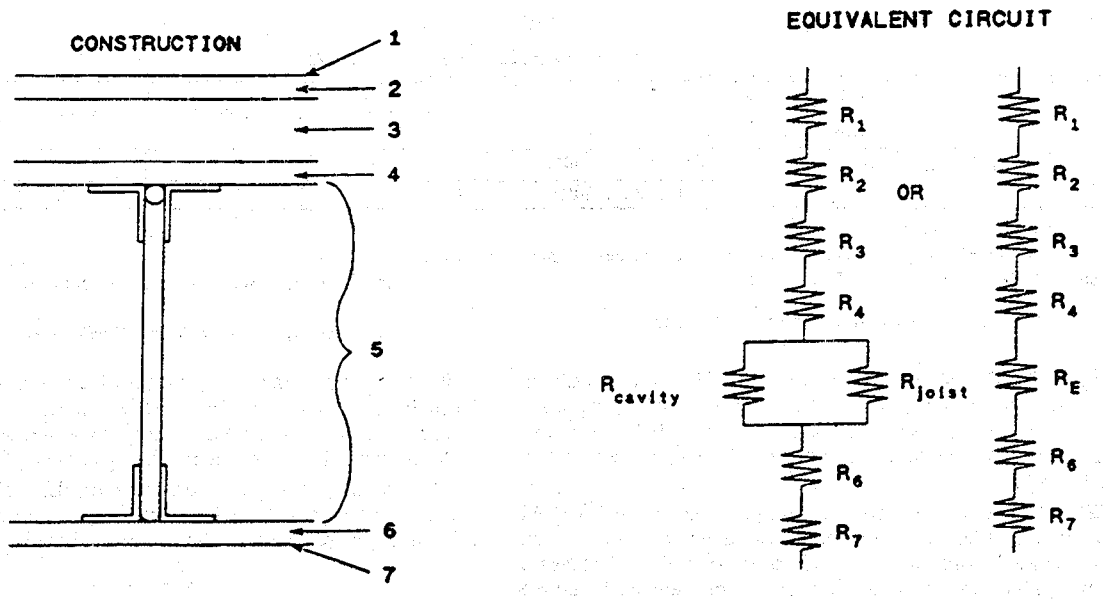
(2) THERMAL TRANSMITTANCE (U_I) OF AN INDIVIDUAL PATH THROUGH AN ENVELOPE ASSEMBLY. The thermal transmittance of each envelope shall be determined with consideration of all major series and parallel heat flow paths through the elements of the assembly and film coefficients. Compression of insulation shall be considered in determining the thermal resistance.

(a) *Thermal transmittance of opaque elements.* The thermal transmittance of opaque elements of assemblies shall be determined using a series path procedure with correction for the presence of parallel paths within an element of the envelope assembly such as wall cavities with parallel paths through insulation and studs. An acceptable procedure shall be used, as specified in Figure 63.18–1. Figure 63.18–2 illustrates a typical roof assembly.

Figure 63.18–1 Calculation Procedures for Evaluating Major Series and Parallel Heat Flow Paths

Acceptable Procedures for Determining U_i for Opaque Elements		
Sheathing	Framing	
	Metal	Nonmetal
Metal on One or Both Sides	Tests – s. ILHR 63.18 (2)(a) 1.a. Thermal Bridges – s. ILHR 63.18 (2)(a) 1.c.	Tests – s. ILHR 63.18 (2)(a) 1.a. Series or Parallel Path – s. ILHR 63.18 (2)(a) 2.
Nonmetal on Both Sides	Tests – s. ILHR 63.18 (2)(a) 1.a. Parallel Path Correction Factor – s. ILHR 63.18 (2)(a) 1.b. Zone Method – s. ILHR 63.18 (2)(a) 1.d.	Tests – s. ILHR 63.18 (2)(a) 1.a. Series or Parallel Path – s. ILHR 63.18 (2)(a) 2.

Figure 63.18–2 Calculation Procedure for Thermal Resistance of a Typical Roof Assembly



$$\text{Where } 1/R_e = \frac{(1 - \%\ \text{joist})}{R\ \text{cavity}} + \frac{\%\ \text{Joist}}{R\ \text{joist}} \quad \text{or } R_e = R\ \text{cavity} \times F_c$$

R_e is the equivalent resistance of the element contacting the parallel path. F_c is the parallel path correction factor.

1. For envelope assemblies containing metal framing, the U_i shall be determined by using one of the following methods:

a. Results from laboratory or field test measurements. One of the procedures specified in s. ILHR 63.17 shall be used.

b. The thermal resistance of those roof and wall assemblies listed in Tables 63.18–1 and 63.18–2 shall be corrected using the following parallel path correction factor procedure:

Considering the total resistance of the series path:

$$U_i = 1/R_t$$

$$R_t = R_i + R_e$$

where:

R_t = The total resistance of the envelope assembly.

R_i =The resistance of the series elements (for i = 1 to n) excluding the parallel path element(s)

R_e =The equivalent resistance of the element containing the parallel path, the value of R_e is:

R_e =R–value of insulation x F_c

The Parallel Path Correction Factors (F_c) may be obtained from tests conducted using procedures listed in s. ILHR 63.17. Parallel Path Correction Factors for some envelope assemblies are listed in Tables 63.18–1 and 63.18–2.

c. For elements with internal metallic structures bonded on one or both sides to a metal skin or covering, the calculation procedure specified in the ASHRAE Handbook, Fundamentals Volume, or specified in ASHRAE 90.1, or other procedure acceptable to the department shall be used to include the effects of thermal bridges in metal construction.

d. For elements other than those covered above, the zone method described in the ASHRAE Handbook, Fundamentals Volume shall be used for calculation.

Table 63.18–1
Roofs
Parallel Path Correction Factors[a]

Bridged R–Value	0	5	10	15	20	25	30	35	40	45	50	55
Correction Factor	1.0	0.96	0.92	0.88	0.85	0.81	0.79	0.76	0.73	0.71	0.69	0.67

[a] Table values are based upon metal trusses with 4–foot spacing that penetrate the insulation, and 0.66–inch diameter cross members every 1 foot.

Table 63.18–2
Wall Sections With Metal Studs
Parallel Path Correction Factors

Size of Members	Gauge of Stud[a]	Spacing of Framing, in.	Cavity Insulation R–Value	Correction Factor	Effective Framing/Cavity R–Values
2 x 4	18–16	16 o.c.	R–11	0.50	R–5.5
			R–13	0.46	R–6.0
			R–15	0.43	R–6.4
2 x 4	18–16	24 o.c.	R–11	0.60	R–6.6
			R–13	0.55	R–7.2
			R–15	0.52	R–7.8
2 x 6	18–16	16 o.c.	R–19	0.37	R–7.1
			R–21	0.35	R–7.4
2 x 6	18–16	24 o.c.	R–19	0.45	R–8.6
			R–21	0.43	R–9.0
2 x 8	18–16	16 o.c.	R–25	0.31	R–7.8
2 x 8	18–16	24 o.c.	R–25	0.38	R–9.6

[a] These factors can be applied to metal studs of this gauge or thinner.

2. For assemblies containing nonmetal framing, the U_i shall be determined from one of the laboratory or field test measurements specified in s. ILHR 63.17 or from the ASHRAE series–parallel method. Formulas in the ASHRAE Handbook, Fundamentals Volume, shall be used for these calculations.

3. The opaque portions of doors shall be considered to be a part of the opaque wall assembly in the calculation of the average thermal transmittance. The thermal transmittance of the entire opaque door assembly including the frame shall be included in the calculation.

Note: See Appendix A for sample U–values for doors and explanatory information.

Note: See s. ILHR 51.06 for thermal barrier requirements for foam plastics.

(b) *Thermal transmittance of fenestration.* Values of U_{of} shall be determined using one of the following methods:

1. The National Fenestration Rating Council (NFRC) 100 Procedure for Determining Fenestration Product Thermal Properties. The thermal performance values shall be certified through the NFRC Fenestration Thermal Performance Rating Certification and Labeling Program as described in the NFRC Product Certification Program LAP 1, PCP 1, and CAP 1.

2. The values for the appropriate product type given in Table 63.18–3 may be used.

Note: Interpolation between tables for glazing other than 0°, 45° and 90° is acceptable.

Note: In order to use the component standards option of s. ILHR 63.15, the U–value of fenestration must be 0.52 or less.

Table 63.18–3, Part I
Window U–Values

Glazing Type	Aluminum Frame—no thermal break*	Aluminum Frame—thermal break*	Wood or Vinyl Frame
Single glazing			
Glass	1.23	1.10	0.98
1/8 in. acrylic	1.16	1.03	0.92
Double glass, air filled			
1/4 in. air space	0.78	0.65	0.55
3/8 in. air space	0.74	0.60	0.51
1/2 in. and greater	0.72	0.59	0.49
Double glass, low emissivity = 0.4 on surface 2 or 3			
1/4 in. air space	0.73	0.59	0.50
3/8 in. air space	0.67	0.54	0.45
1/2 in. and greater	0.65	0.52	0.42
Double glass, low emissivity = 0.15 on surface 2 or 3			
1/4 in. air space	0.68	0.55	0.46
3/8 in. air space	0.62	0.48	0.39
1/2 in. and greater	0.60	0.46	0.37
Double glass, argon filled			
1/4 in. argon space	0.74	0.61	0.51
3/8 in. argon space	0.71	0.57	0.48
1/2 in. and greater	0.69	0.56	0.47
Double glass, low emissivity = 0.4 on surface 2 or 3, argon filled			
1/4 in. argon space	0.67	0.54	0.45
3/8 in. argon space	0.63	0.49	0.40
1/2 in. and greater	0.62	0.48	0.39
Double glass, low emissivity = 0.15 on surface 2 or 3, argon filled			
1/4 in. argon space	0.62	0.48	0.39
3/8 in. argon space	0.57	0.43	0.34
1/2 in. and greater	0.55	0.42	0.33
Double glazing, 1/8 in. acrylic or polycarbonate			
1/4 in. air space	0.74	0.61	0.51
3/8 in. air space	0.71	0.57	0.48
1/2 in. and greater	0.69	0.56	0.47
Double glazing, 1/4 in. acrylic or polycarbonate			
1/4 in. air space	0.71	0.57	0.48
3/8 in. air space	0.68	0.54	0.45
1/2 in. and greater	0.66	0.53	0.43
Triple glass			
1/4 in. air space	0.64	0.50	0.41
3/8 in. air space	0.60	0.46	0.38
1/2 in. and greater	0.58	0.45	0.36
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. air space	0.59	0.45	0.37
3/8 in. air space	0.54	0.41	0.32
1/2 in. and greater	0.52	0.39	0.30
Triple glass, argon filled			
1/4 in. argon space	0.60	0.46	0.38
3/8 in. argon space	0.57	0.44	0.35
1/2 in. and greater	0.56	0.42	0.34
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. argon space	0.54	0.41	0.32
3/8 in. argon space	0.51	0.37	0.29
1/2 in. and greater	0.50	0.36	0.28

Table 63.18–3, Part II
Skylight U–Values – 45 Degree Slope

Glazing Type	Aluminum Frame—no thermal break*	Aluminum Frame—thermal break*	Wood or Vinyl Frame
Single glazing			
Glass	1.36	1.22	1.09
1/8 in. acrylic	1.29	1.14	1.02
Double glass, air filled			
1/4 in. air space	0.88	0.74	0.63
3/8 in. air space	0.83	0.68	0.58
1/2 in. and greater	0.81	0.67	0.56
Double glass, low emissivity = 0.4 on surface 2 or 3			
1/4 in. air space	0.82	0.67	0.57
3/8 in. air space	0.76	0.61	0.52
1/2 in. and greater	0.74	0.59	0.49
Double glass, low emissivity = 0.15 on surface 2 or 3			
1/4 in. air space	0.77	0.63	0.53
3/8 in. air space	0.70	0.55	0.46
1/2 in. and greater	0.68	0.53	0.44
Double glass, argon filled			
1/4 in. argon space	0.83	0.69	0.58
3/8 in. argon space	0.80	0.65	0.55
1/2 in. and greater	0.78	0.64	0.54
Double glass, low emissivity = 0.4 on surface 2 or 3, argon filled			
1/4 in. argon space	0.76	0.61	0.52
3/8 in. argon space	0.71	0.56	0.47
1/2 in. and greater	0.70	0.55	0.46
Double glass, low emissivity = 0.15 on surface 2 or 3, argon filled			
1/4 in. argon space	0.70	0.55	0.46
3/8 in. argon space	0.65	0.50	0.40
1/2 in. and greater	0.63	0.49	0.39
Double glazing, 1/8 in. acrylic or polycarbonate			
1/4 in. air space	0.83	0.69	0.58
3/8 in. air space	0.80	0.65	0.55
1/2 in. and greater	0.78	0.64	0.54
Double glazing, 1/4 in. acrylic or polycarbonate			
1/4 in. air space	0.80	0.65	0.55
3/8 in. air space	0.77	0.61	0.52
1/2 in. and greater	0.75	0.60	0.50
Triple glass			
1/4 in. air space	0.72	0.57	0.48
3/8 in. air space	0.68	0.53	0.45
1/2 in. and greater	0.66	0.52	0.43
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. air space	0.67	0.52	0.44
3/8 in. air space	0.61	0.48	0.38
1/2 in. and greater	0.59	0.46	0.36
Triple glass, argon filled			
1/4 in. argon space	0.68	0.53	0.45
3/8 in. argon space	0.65	0.51	0.42
1/2 in. and greater	0.64	0.49	0.40
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. argon space	0.61	0.48	0.38
3/8 in. argon space	0.58	0.44	0.35
1/2 in. and greater	0.57	0.43	0.34

Table 63.18–3, Part III
Skylight U–Values – Horizontal

Glazing Type	Aluminum Frame— no thermal break*	Aluminum Frame— thermal break*	Wood or Vinyl Frame
Single glazing			
Glass	1.38	1.25	1.12
1/8 in. acrylic	1.31	1.17	1.06
Double glass, air filled			
1/4 in. air space	0.91	0.77	0.67
3/8 in. air space	0.86	0.72	0.62
1/2 in. and greater	0.84	0.71	0.60
Double glass, low emissivity = 0.4 on surface 2 or 3			
1/4 in. air space	0.85	0.71	0.61
3/8 in. air space	0.79	0.65	0.56
1/2 in. and greater	0.77	0.63	0.53
Double glass, low emissivity = 0.15 on surface 2 or 3			
1/4 in. air space	0.80	0.67	0.57
3/8 in. air space	0.74	0.59	0.50
1/2 in. and greater	0.72	0.57	0.48
Double glass, argon filled			
1/4 in. argon space	0.86	0.73	0.62
3/8 in. argon space	0.83	0.69	0.59
1/2 in. and greater	0.81	0.68	0.58
Double glass, low emissivity = 0.4 on surface 2 or 3, argon filled			
1/4 in. argon space	0.79	0.65	0.56
3/8 in. argon space	0.75	0.60	0.51
1/2 in. and greater	0.74	0.59	0.50
Double glass, low emissivity = 0.15 on surface 2 or 3, argon filled			
1/4 in. argon space	0.74	0.59	0.50
3/8 in. argon space	0.69	0.54	0.44
1/2 in. and greater	0.67	0.53	0.43
Double glazing, 1/8 in. acrylic or polycarbonate			
1/4 in. air space	0.86	0.73	0.62
3/8 in. air space	0.83	0.69	0.59
1/2 in. and greater	0.81	0.68	0.58
Double glazing, 1/4 in. acrylic or polycarbonate			
1/4 in. air space	0.83	0.69	0.59
3/8 in. air space	0.80	0.65	0.56
1/2 in. and greater	0.78	0.64	0.54
Triple glass			
1/4 in. air space	0.76	0.61	0.52
3/8 in. air space	0.72	0.57	0.49
1/2 in. and greater	0.70	0.56	0.47
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. air space	0.71	0.56	0.48
3/8 in. air space	0.65	0.52	0.42
1/2 in. and greater	0.63	0.50	0.40
Triple glass, argon filled			
1/4 in. argon space	0.72	0.57	0.49
3/8 in. argon space	0.69	0.55	0.46
1/2 in. and greater	0.68	0.53	0.44
Triple glass or double glass with polyester film suspended in between, low emissivity = 0.15 on surface 2, 3, 4, or 5			
1/4 in. argon space	0.65	0.52	0.42
3/8 in. argon space	0.62	0.48	0.39
1/2 in. and greater	0.61	0.47	0.38

*** Note to Table 63.18–3:** An aluminum thermal break framed window shall incorporate the following minimum design characteristics:

a. The thermal conductivity of the thermal break material shall be not more than 3.6 Btu–in/hr/ft2/F°;

b. The thermal break material shall not be less than 0.210 inches; and

c. All metal framing members of the product to interior and exterior air must incorporate a thermal break meeting the criteria in a. and b. above.

(3) GROSS AREA OF ENVELOPE COMPONENTS. (a) *Roof assembly.* The gross area of a roof assembly consists of the total surface of the roof assembly exposed to outside air or unconditioned spaces. The roof assembly shall be considered to include all roof or ceiling components through which heat may flow between indoor and outdoor environments including skylight surfaces but excluding service openings. For thermal transmittance purposes when return air ceiling plenums are employed, the roof or ceiling assembly shall not include the resistance of the ceiling or the plenum space as part of the total resistance of the assembly.

(b) *Floor assembly.* The gross area of a floor assembly over outside or unconditioned spaces consists of the total surface of the floor assembly exposed to outside air or unconditioned space. The floor assembly shall include all floor components through which heat may flow between indoor and outdoor or unconditioned space environments.

(c) *Exterior walls.* The gross area of exterior walls enclosing a heated or cooled space is measured on the exterior and consists of the opaque wall including between floor spandrels, peripheral edges of flooring, window areas including sash, and door areas, but excluding vents, grilles, and pipes.

(4) SHADING COEFFICIENTS. The Shading Coefficient (SC_x) for fenestration shall be obtained from the ASHRAE Handbook, Fundamentals Volume or from manufacturer's test data. SC_x is the Shading Coefficient of the fenestration including permanently installed internal and external shading devices but excluding the effect of external shading projections, which is calculated separately. The Shading Coefficient used for louvered shade screens shall be determined using a profile angle of 30° as found in the ASHRAE Handbook, Fundamentals Volume.

Note: Manufacturers should be able to provide shading coefficients for their products

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.19 Prohibition of heated sidewalks. The installation or use of heated sidewalks is prohibited as specified in s. 101.124, Stats.

Note: Section 101.124, Stats., reads as follows:

101.124 Heated Sidewalks Prohibited. In this section "exterior pedestrian traffic surface" means any sidewalk, ramp, stair, stoop, step, entrance way, plaza or pedestrian bridge not fully enclosed within a building and "heated" means heated by electricity or energy derived from the combustion of fossil fuels, but not including the use of waste thermal energy. "Exterior pedestrian traffic surface" does not include any means of ingress or egress by the physically disabled required under s. 101.13 (2). No person may construct a heated exterior pedestrian traffic surface. The department or any city, village, town or county is prohibited from approving any plan under s. 101.12 which includes such heated surface. The department shall order any existing heated exterior pedestrian traffic surface in operation to be shut off. This section does not apply to any inpatient health care facility as defined in s. 50.135 (1), or community–based residential facility, as defined in s. 50.01 (1g).

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Subchapter IV Equipment And Systems

Part 1 – Equipment Efficiencies

ILHR 63.20 Minimum equipment efficiencies. **(1)** Space heating or cooling equipment that is not covered by 10 CFR Part 430, Energy Conservation Program for Consumer Products, shall have a minimum efficiency at the specified rating conditions not less than the values given in ASHRAE 90.1, section 10.4.1.

Note: Equipment that is covered by the federal regulation 10 cfr Part 430 is not included under the scope of this code. Efficiencies required by that standard are reprinted in Appendix A. Efficiencies required by ASHRAE 90.1–1989 are also printed in Appendix A.

(2) Equipment ratings shall be certified under a nationally recognized certification program or rating procedure or data furnished by the equipment manufacturer to show compliance with the minimum efficiency requirements.

Note: The following certification programs are accepted by the department: GAMMA and ARI.

(3) Compliance with minimum efficiency requirements specified for HVAC equipment shall include compliance with part–load requirements where indicated as well as standards for full–load requirements. The part–load efficiency shall be determined as specified in the ARI standards specified in ASHRAE 90.1.

(4) Space heating or cooling equipment used to provide additional functions such as water heating for plumbing, as part of a combination or integrated system shall comply with minimum performance requirements for the appropriate space heating or cooling equipment category.

(5) Equipment providing water heating for plumbing that is used to provide additional functions, such as space heating, as part of a combination or integrated system shall comply with minimum performance requirements for water heating equipment as specified in s. Comm 84.20 (5) (n).

(6) Combination space and plumbing water heating equipment may only be used when at least one of the following conditions is met:

(a) The annual space heating energy is less than 50% of the annual water heating energy for plumbing.

(b) The energy input or storage volume of the combined boiler or water heater is less than twice the energy input or storage volume of the smaller of the separate boilers or water heaters otherwise required.

(c) The combined system uses no more energy than separate systems that meet the requirements of this section.

(d) The input to the combined boiler or water heater system is less than 150,000 Btu/h.

Note: See s. ILHR 64.22 (10) for additional requirements for combined systems.

(7) Equipment that is not used for comfort cooling or comfort heating is exempt from the energy efficiency requirements of this chapter.

Note: Omission of minimum performance requirements for certain classes of HVAC equipment does not preclude use of that equipment.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.21 Field–assembled equipment and components. When components such as indoor or outdoor coils are used from more than one manufacturer as parts of air–conditioning or heating equipment, component efficiencies shall be specified based on data provided by the component manufacturers.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.22 Equipment controls. **(1)** Heat pumps equipped with supplementary heaters shall be installed with controls to prevent heater operation when the heating load can be met by the heat pump, except under the conditions listed below:

(a) Where it can be shown that supplementary heating reduces energy consumption.

(b) Supplementary heater operation is permitted during short transient periods of less than 15 minutes during defrost cycles.

(2) The setback recovery and tempering of indoor air during defrost cycles shall be controlled so as to minimize use of supplemental heat.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Part 2 – System Design

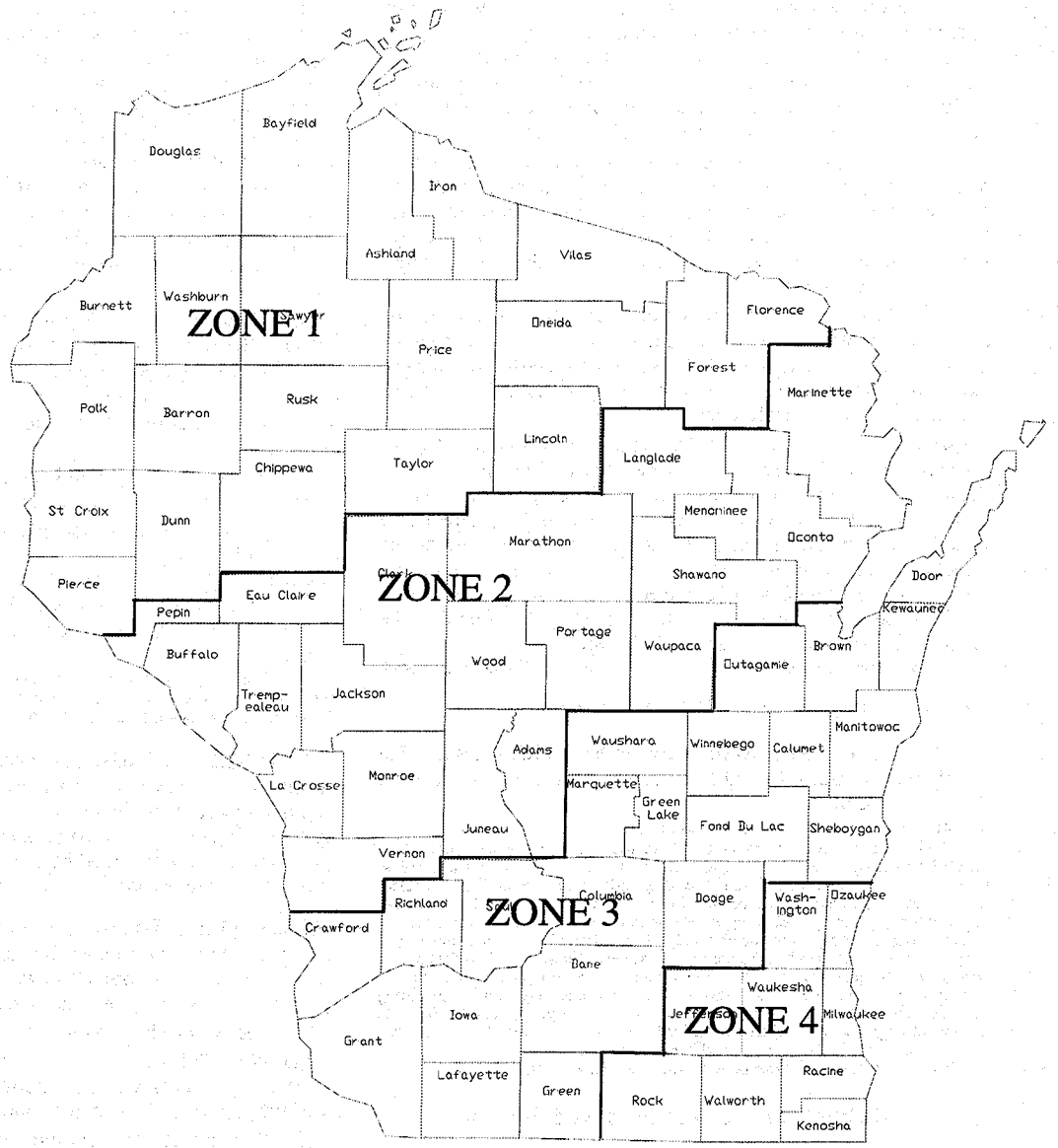
ILHR 63.23 Load calculations for sizing. **(1)** CALCULATION PROCEDURES. Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with the procedures described in the ASHRAE Handbook, Fundamentals Volume, or a similar computation procedure approved by the department. For those design parameters addressed in subs (2) to (7), the values specified shall be used.

Note: This section does not require the installation of cooling equipment.

(2) INDOOR DESIGN CONDITIONS. The winter indoor design temperature is specified in Table 64.05. When air conditioning is provided in accordance with s. ILHR 64.06 (2)(b), the summer indoor design temperature is 78°F or lower.

(3) OUTDOOR DESIGN CONDITIONS. Outdoor design temperatures shall be taken from Figure 63.23.

Figure 63.23
Outdoor Design Conditions



Zone	Winter	Summer	
	Design Temp. (°F)	Dry Bulb (°F)	Wet Bulb (°F)
1	–25	86	75*
2	–20	87	75
3	–15	87	75
4	–10	89	77

*Exception: For Douglas, Bayfield, Ashland and Iron Counties, use 70°F summer wet bulb design temperature.

(4) VENTILATION. Outdoor air ventilation loads shall be based on ventilation rates specified in s. ILHR 64.05.

(5) ENVELOPE. Envelope heating and cooling loads shall be based on envelope characteristics such as thermal conductance, shading coefficient, and air leakage consistent with the values used to demonstrate compliance with subch. III.

(6) LIGHTING. Lighting loads shall be based on actual design lighting levels or power budgets consistent with subch. V. Lighting loads may not be included for the purpose of calculating design heating loads.

(7) PICK–UP LOADS. Transient loads such as warm–up or cool–down loads which occur after off–hour setback or shutoff may be calculated from principles based on the heat capacity of the building and its contents, the degree of setback, and desired recovery time; or may be assumed to be up to 30% for heating and 10% for cooling of the steady–state design loads.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.24 System and equipment sizing. HVAC systems and equipment shall be sized to provide the minimum space and system loads calculated in accordance with s. ILHR 63.23.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.25 Separate air distribution systems. **(1)** Except as provided in sub. (2), zones with special process temperature requirements, humidity requirements, or both, shall be served by air distribution system separate from those serving zones requiring only comfort conditions; or shall include supplementary provisions so that the primary systems may be specifically controlled for comfort purposes only.

(2) As an exception to sub. (1), zones requiring only comfort heating or comfort cooling that are served by a system primarily used for process temperature and humidity control need not be served by a separate system if the total supply air to these comfort zones is no more than 25% of the total system supply air or the total conditioned floor area of the zones is less than 1,000 square feet.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.26 Temperature controls. **(1)** SYSTEM CONTROL. Each HVAC system shall include at least one temperature control device.

(2) ZONE CONTROLS. (a) 1. Except as provided in subd. 2., the supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls responding to temperature within the zone.

2. Independent perimeter systems that are designed to offset only envelope heat losses or gains or both may serve one or more zones also served by an interior system with the following limitations:

a. The perimeter system shall include at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet or more; and

b. The perimeter system heating and cooling supply shall be controlled by thermostats located within the zones served by the system.

(b) Where used to control comfort heating, zone thermostatic controls shall be capable of being set locally or remotely by adjustment or selection of sensors down to 55°F or lower.

(c) Where used to control comfort cooling, zone thermostatic controls shall be capable of being set locally or remotely by adjustment or selection of sensors up to 85°F or higher.

(d) Except as provided in subds. 1. to 3., zone thermostatic controls used to control both comfort heating and cooling shall be capable of providing a temperature range, or deadband, of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

1. Deadbands are not required for special occupancy, special usage, or code–required systems where deadband controls are not appropriate.

2. Deadbands are not required for buildings complying with the ASHRAE energy cost budget method under Subchapter VII if, in the proposed building energy analysis, heating and cooling thermostat set–points are set to the same value between 70°F and 75°F inclusive and assumed to be constant throughout the year.

3. Deadbands may be omitted for thermostats that have manual changeover between heating and cooling modes.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.27 Zone controls. **(1)** Except as provided in sub. (2), zone thermostatic and humidistatic controls shall be capable of operating in sequence to supply heating and cooling energy to the zone. Such controls shall prevent:

(a) Reheating;

(b) Recooling;

(c) Mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by mechanical refrigeration or by economizer systems; or

(d) Other simultaneous operation of heating and cooling systems to the same zone.

(2) The following systems and zones are exempt from this section:

(a) Variable air volume (VAV) systems which, during periods of occupancy, are designed to reduce the air supply to each zone to a minimum before reheating, recooling, or mixing takes place. This minimum volume shall be no greater than the largest of the following:

1. 30% of the peak supply volume;

2. The minimum required to meet ventilation requirements of s. ILHR 64.05;

3. 0.4 cfm/square foot of zone conditioned floor area.

(b) Zones where special pressurization relationships or cross–contamination requirements are such that the cost of controls for variable air volume systems exceeds the value of the energy saved, such as some areas of hospitals and laboratories;

(c) Where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site–recovered or site–solar energy source.

(d) Zones where specified humidity levels are required to satisfy process needs, such as computer rooms and museums; and

(e) Zones with a peak supply air quantity of 150 cfm or less.

(f) Multiple reheat systems serving multiple zones, other than those employing variable air volume for temperature control, that are provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the coolest air.

(g) Dual duct and multizone systems that are provided with controls that will automatically reset:

1. The cold duct air supply to the highest temperature that will satisfy the zone requiring the coolest air; and

2. The hot duct air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

(h) Systems in which heated air is recooled, directly or indirectly, to maintain space temperature that are provided with controls that will automatically reset the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the warmest air.

(i) A multiple zone heating, ventilating and air–conditioning system that employs reheating or recooling for control of not more than 5,000 cfm or 20% of the total supply air of the system, whichever is less.

(3) OFF–HOUR CONTROLS. Except as provided in pars. (a) to (c), mechanical HVAC systems shall be equipped with automatic

controls capable of accomplishing a reduction of energy use through control setback or equipment shutdown during periods of nonuse or alternate use of the zones served by the system. The following systems are exempt from this subsection:

(a) Systems serving areas expected to operate continuously;

(b) Where it can be shown that setback or shutdown will not result in a decrease in overall building energy costs; or

(c) Equipment with full load demands of 2 kW or 6826 Btu/h or less may be controlled by readily accessible manual off–hour controls.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.28 Humidity control. If a system is equipped with a means for adding moisture to maintain specific humidity levels in a zone or zones, a humidistat shall be provided.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.29 Insulation, materials and construction. (1) GENERAL. Insulation required by subs. (2) and (3) shall be suitably protected from damage.

Note: Insulation should be installed in accordance with practices acceptable to the department such as MICA Commercial and Industrial Insulation Standards.

(2) PIPING INSULATION. Except as provided in pars. (a) to (c), recirculating plumbing system piping, plumbing piping in the first 8 feet from storage tanks for noncirculating systems, any piping served by a self–regulating electric heating cable, HVAC system piping, and related HVAC fluid conveying conduit, such as heat exchanger bodies, shall be thermally insulated in accordance with Table 63.29–1 or equivalent. The following piping or conduit is exempted from this subsection:

(a) Factory–installed piping or conduit within HVAC equipment tested and rated in accordance with s. ILHR 63.20;

(b) Piping or conduit for which no insulation is specified in Table 63.29–1.

(c) Where it can be shown that the heat gain or heat loss to or from piping or conduit without insulation will not increase building energy use.

Note: For equivalent insulation levels using alternative insulation types, the calculation procedure specified in A63.29 of Appendix A is acceptable to the department.

Table 63.29–1

Plumbing and HVAC Piping Minimum Insulation (in.)[a,b]

Fluid	Nominal Pipe Diameter (in.)					Insulation Conductivity	
Operating Temperature Range, °F	1 and Less	1–1 1/4 to 2	2 1/2 to 4	5 and 6	8 and up	Conductivity Range Btu-•in./(h•ft^3•°F)	Mean Rating Temperature °F
Hot Systems (Steam, Steam Condensate, and Hot Water)							
Above 350	2.5	2.5	3.0	3.5	3.5	0.32 – 0.34	250
251 – 350	2.0	2.5	2.5	3.5	3.5	0.29 – 0.31	200
201 – 250	1.5	1.5	2.0	2.0	3.5	0.27 – 0.30	150
141 – 200	1.5	1.5	1.5	1.5	1.5	0.25 – 0.29	125
105 – 140	1.0	1.0	1.0	1.5	1.5	0.24 – 0.28	100
80 – 104	0.5	0.5	0.5	1.0	1.0	0.24 – 0.28	100
Cold Systems (Chilled Water, Brine, and Refrigerant)[c]							
40 – 55	0.5	0.75	1.0	1.0	1.0	0.23 – 0.27	75
Below 40	1.0	1.5	1.5	1.5	1.5	0.23 – 0.27	75

[a] For minimum thicknesses of alternative insulation types, see Appendix A.

[b] Plumbing piping systems without a heat trap to prevent circulation due to natural convection shall be considered circulating systems.

[c] The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation, vapor retarders, or both, may be required to limit water vapor transmission and condensation.

(3) AIR–HANDLING SYSTEM INSULATION. All air–handling ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Table 63.29–2, except where it can be shown that the heat gain to or heat loss from ducts without insulation will not increase building energy use.

Table 63.29–2

Minimum Duct Insulation[a]

Duct Location	Cooling[b] Insulation R–Value[d] (hrft^2 F)/Btu	Heating[c] Insulation R–Value[d] (hrft^2 F)/Btu
Exterior of Building	5.0	9.0
Interior[g]		
$Td^e \leq 15$	None Required	None Required
$40 \geq Td^e > 15$	3.3	3.3
$Td^e > 40$	5.0[f]	5.0[f]

[a] Insulation R–values shown are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation, vapor retarders, or both, may be required to limit vapor transmission and condensation. For ducts which are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this section or Subchapter III.

[b] Cooling ducts are those designed to convey cooled air or return ducts in such systems.

[c] Heating ducts are those designed to convey heated air or return ducts in such systems.

[d] Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.

[e] Td is defined as the temperature difference at design conditions (see s. ILHR 63.25) between the space within which the duct is located and the design air temperature in the duct.

[f] Insulation resistance for runouts to terminal devices less than 10 feet in length need not exceed 3.3 (h ft^2 °F)/Btu.

[g] Interior ducts include any ducts inside the building thermal envelope. Exterior ducts include ducts in unconditioned spaces such as crawlspaces and attics.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.31 Economizer controls. (1) Except as provided in sub. (2), each fan system shall be designed and capable of being controlled to take advantage of favorable weather conditions to reduce mechanical cooling requirements. The system shall include either of the following:

(a) A temperature or enthalpy air economizer system which is capable of automatically modulating outside air and return air dampers to provide 100% of the design supply air quantity as outside air for cooling;

(b) A water economizer system which is capable of cooling supply air by direct evaporation, indirect evaporation, or both. Such a system shall be designed and capable of being controlled to provide 100% of the expected system cooling load at outside air temperatures of 50°F dry–bulb/45°F wet–bulb and below.

(2) The following systems are exempt from this subsection:

(a) Individual fan–cooling units with a supply capacity of less than 2,000 cfm or a total system cooling capacity of less than 62,000 Btu/hour for split systems or less than 55,000 Btu/hour for all other types. The total capacity of all such units complying by use of this exception shall not exceed 600,000 Btu/hour per building or 10% of the total installed cooling capacity, whichever is larger;

(b) Systems with air or evaporatively cooled condensers for which it can be shown that the use of outdoor air cooling affects the operation of other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building energy costs;

Note: Other areas that may use controlled humidification or dehumidification are computer rooms, museums, library stacks and drafting rooms.

(c) Where the overall building energy use resulting from alternative designs, such as internal to external zone heat recovery systems, can be shown to be less than those resulting from an economizer system.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.32 Electrical motors. (1) Any permanently wired motor that meets all of the criteria specified in pars. (a) through (g) shall meet the efficiency requirements specified in Table 63.32 and the requirements of this section.

(a) The motor is used in a HVAC fan or pumping system;

(b) The motor is polyphase;

(c) The motor is one horsepower or more;

(d) The motor is a design A or B squirrel–cage, foot–mounted, T–frame induction motor that has synchronous speeds of 3600, 1800, 1200, and 900 rpm;

(e) The motor is expected to operate more than 1000 hours per year;

(f) The motor is not a multispeed motor used in a system designed to use more than one speed; and

(g) The motor is not a component of equipment that meets the efficiency requirements of s. ILHR 63.20 and the motor input is included in the determination of the equipment efficiency.

(2) The motor nameplate shall list the minimum nominal full–load motor efficiency.

Note: Motors that are classified as "energy efficient" under the National Electric Manufacturer's Association Standard MG 12.55, dated 3–14–91, are acceptable to the department as meeting the efficiency requirements of this section.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Table 63.32
Minimum Acceptable Nominal Full–Load Motor Efficiency For Single–Speed Polyphase Squirrel–Cage Induction Motors Having Synchronous Speeds of 3600, 1800, 1200 and 990 rpm

Full–Load Efficiencies – Open Motors								
HP	2–Pole		4–Pole		6–Pole		8–Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	—	—	82.5	81.5	80.0	78.5	74.0	72.0
1.5	82.5	81.5	84.0	82.5	84.0	82.5	75.5	74.0
2.0	84.0	82.5	84.0	82.5	85.5	84.0	85.5	84.0
3.0	84.0	82.5	86.5	85.5	86.5	85.5	86.5	85.5
5.0	85.5	84.0	87.5	86.5	87.5	86.5	87.5	86.0
7.5	87.5	86.5	88.5	87.5	88.5	87.5	88.5	87.5
10.0	88.5	87.5	89.5	88.5	90.2	89.5	89.5	88.5
15.0	89.5	88.5	91.0	90.2	90.2	89.5	89.5	88.5
20.0	90.5	89.5	91.0	90.2	91.0	90.2	90.2	89.5
25.0	91.0	90.2	91.7	91.0	91.7	91.0	90.2	89.5
30.0	91.0	90.2	92.4	91.7	92.4	91.7	91.0	90.2
40.0	91.7	91.0	93.0	92.4	93.0	92.4	91.0	90.2
50.0	92.4	91.7	93.0	92.4	93.0	92.4	91.7	91.0
60.0	93.0	92.4	93.6	93.0	93.6	93.0	92.4	91.7
75.0	93.0	92.4	94.1	93.6	93.6	93.0	93.6	93.0
100.0	93.0	92.4	94.1	93.6	94.1	93.6	93.6	93.0
125.0	93.6	93.0	94.5	94.1	94.1	93.6	93.6	93.0
150.0	93.6	93.0	95.0	94.5	94.5	94.1	93.6	93.0
200.0	94.5	94.1	95.0	94.5	94.5	94.1	93.6	93.0
Full–Load Efficiencies – Enclosed Motors								
HP	2–Pole		4–Pole		6–Pole		8–Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	75.5	74.0	82.5	81.5	80.0	78.5	74.0	72.0
1.5	82.5	81.5	84.0	82.5	85.5	84.0	77.0	75.5
2.0	84.0	82.5	84.0	82.5	86.5	85.5	82.5	81.5
3.0	85.5	84.0	87.5	86.5	87.5	86.5	84.0	82.5
5.0	87.5	86.5	87.5	86.5	87.5	86.5	85.5	84.0
7.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	84.0
10.0	89.5	88.5	89.5	88.5	89.5	88.5	88.5	87.5
15.0	90.2	89.5	91.0	90.2	90.2	89.5	88.5	87.5
20.0	90.2	89.5	91.0	90.2	90.2	89.5	89.5	88.5
25.0	91.0	90.2	92.4	91.7	91.7	91.0	89.5	88.5
30.0	91.0	90.2	92.4	91.7	91.7	91.0	91.0	90.2
40.0	91.7	91.0	93.0	92.4	93.0	92.4	91.0	90.2
50.0	92.4	91.7	93.0	92.4	93.0	92.4	91.7	91.0
60.0	93.0	92.4	93.6	93.0	93.6	93.0	91.7	91.0
75.0	93.0	92.4	94.1	93.6	93.6	93.0	93.0	92.4
100.0	93.6	93.0	94.5	94.1	94.1	93.6	93.0	92.4
125.0	94.5	94.1	94.5	94.1	94.1	93.6	93.6	93.0
150.0	94.5	94.1	95.0	94.5	95.0	94.5	93.6	93.0
200.0	95.0	94.5	95.0	94.5	95.0	94.5	94.1	93.6

Subchapter V Lighting Power

ILHR 63.40 Scope. Sections 63.41 to 63.51 shall apply to the following rooms, spaces and areas:

(1) Interior spaces of buildings;

(2) Building exteriors and exterior areas such as entrances, exits, loading docks; and

(3) Roads, grounds, parking, and other exterior areas where lighting is energized through the building electrical service.

Note: See Appendix for worksheets.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.41 Exterior lighting power requirement. The exterior lighting power of a building or a group of buildings in a multibuilding facility calculated in accordance with s. ILHR 63.42 shall be no greater than the lighting power allowance calculated in accordance with s. ILHR 63.43.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.42 Calculation of exterior lighting power. The calculated exterior lighting power is the sum of the power for all exterior luminaires that are included in the scope of this subchapter, s. ILHR 63.40, minus the power for exempted exterior lighting as specified in subs. (1) to (5):

(1) Task lighting for outdoor activities such as manufacturing, commerce, and processing facilities.

(2) Lighting power for theatrical productions.

(3) Lighting for outdoor athletic facilities, including playing and seating areas.

(4) Lighting for dwelling units that is controlled within the dwelling unit.

(5) Exit way or egress lighting required by s. ILHR 73.21 that has switching regulated by Article 700 of the National Electrical Code as adopted by reference in ch. Comm 16.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.43 Exterior lighting power allowance. **(1)** CALCULATION METHOD. The exterior lighting power allowance for a building or a multibuilding facility is the sum of all the allowed lighting powers for all exterior areas. The lighting power for each area is calculated by multiplying the unit power allowance from Table 63.43 by the applicable length or area.

(2) APPLICABLE AREAS AND LENGTHS. The applicable areas and lengths used with Table 63.43 to calculate the exterior lighting power allowance are described in pars. (a) to (d).

(a) Horizontal areas of grounds, driveways, lots, gardens or parks may be calculated as if they were flat, or the actual area of the surfaces of contours may be used.

(b) Canopied areas are the area of the horizontal surface under the canopy. A canopy includes an exterior awning, soffit or ornamental or functional structure signifying a main entrance to a building.

(c) The linear length of door openings is measured in plan view and includes the door opening only. Sidelights and other portions of the door which do not open are not included.

(d) The applicable area of the building facade includes all vertical and horizontal areas that are intended to be illuminated.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Table 63.43
Exterior Lighting Unit Power Allowances

Area Description	Allowances
Exit (with or without canopy)	25 W/lin ft of door opening
Entrance (without canopy)	30 W/lin ft of door opening
Entrance (with canopy)	
High traffic (retail, hotel, airport, theater, etc.)	10 W/ft^2 of canopied area
Light traffic (hospital, office, school, etc.)	4 W/ft^2 of canopied area
Loading area	0.40 W/ft^2
Loading door	20 W/lin ft of door opening
Building exterior surfaces/facades	0.25 W/ft^2 of surface area to be illuminated
Storage and nonmanufacturing work areas	0.20 W/ft^2
Other activity areas for casual use such as picnic grounds, gardens, parks and other landscaped areas.	0.10 W/ft^2
Private driveways/walkways	0.10 W/ft^2
Public driveways/walkways	0.15 W/ft^2
Private parking lots	0.12 W/ft^2
Public parking lots	0.18 W/ft^2

ILHR 63.44 Interior lighting power requirement. The interior lighting power of a building calculated in accordance with s. ILHR 63.45 shall be no greater than the interior lighting power allowance calculated in accordance with s. ILHR 63.46.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.45 Calculation of interior lighting power. The calculated interior lighting power of a building is the total watts of all interior luminares including, but not limited to, track and flexible lighting systems, lighting that is integral with modular furniture, movable displays and cabinets, and internally illuminated case work for task or display purposes, minus any adjustments allowed under subs. (1) through (4).

(1) MULTIPLE INTERLOCKED LIGHTING SYSTEMS SERVING A SPACE. When multiple interlocked lighting systems serve a space, the watts of all systems except the system with the highest wattage may be excluded from the calculated lighting power if:

(a) The lighting systems are interlocked to prevent simultaneous operation; or

(b) The lighting systems are controlled by a preset dimming system or other device that prevents simultaneous operation of more than one lighting system, except under the direct control of authorized personnel.

(2) REDUCTION OF WATTAGE THROUGH CONTROLS. The watts of any luminaire that is controlled may be reduced by the number of watts times the applicable power adjustment factor from Table 63.45 if:

(a) The control complies with s. ILHR 63.51; and

(b) At least 50% of the light output of the luminaire is within the applicable space listed in Table 63.45; and

(c) Except as noted in Table 63.45, only one power adjustment factor is used for the luminaire; and

(d) For daylighting control credits, the luminaire is controlled by the daylighting control, and the luminaire is located within the daylit area; and

(e) For automatic time switch control devices, a timed manual override is provided at each switch location required by s. ILHR 63.50. The override device shall control only the lights in the surrounding area enclosed by ceiling–height partitions.

Table 63.45
Lighting Power Adjustment Factors

Type of control	Type of space	Factor
Automatic daylighting controls	Daylit areas	
Continuous dimming		0.30
Multiple step dimming		0.20
On/off		0.10
Automatic time switch control device in conjunction with automatic daylighting controls	Daylit areas ≤ 250 square feet	
Continuous dimming		0.35
Multiple step dimming		0.25
On/off		0.15
Automatic time switch control device in conjunction with lumen maintenance and automatic daylighting controls	Daylit areas ≤ 250 square feet	
Continuous dimming		0.40
Multiple step dimming		0.30
On/off		0.20
Lumen maintenance	Any space	0.10
Lumen maintenance in conjunction with an automatic time switch control device	Spaces ≤ 250 square feet	0.15
Automatic time switch control device	Spaces ≤ 250 square feet	0.15
Occupant–sensing device with a separate sensor for each space	Spaces ≤ to 250 square feet enclosed by opaque floor–to–ceiling partitions; any size classroom, corridor, conference or waiting room	0.30*
Occupant–sensing device with separate sensor for each space	Rooms of any size that are used exclusively for storage	0.60*
Occupant–sensing device with separate sensor for each space	Spaces > 250 square feet	0.10*
Occupant–sensing device with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space	Spaces ≤ 250 square feet within a daylit area and enclosed by opaque floor–to–ceiling partitions	
Continuous dimming		0.40*
Multiple step dimming		0.35*
On/off		0.35*
Occupant–sensing device with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space and lumen maintenance	Spaces ≤ 250 square feet within a daylit area and enclosed by opaque floor–to–ceiling partitions	0.35*
Continuous dimming		0.45*
Multiple step dimming		0.40*
On/off		0.35*
Occupant–sensing device with a separate sensor for each space used with lumen maintenance	Spaces ≤ 250 square feet and enclosed by opaque floor–to–ceiling partitions	0.35*
Occupant–sensing device with a separate sensor for each space used in conjunction with an automatic time switch control device	Spaces ≤ 250 square feet enclosed by opaque floor to ceiling partitions	0.35*
Manual dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.10
Multiscene programmable dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.20
Occupant–sensing device with programmable multiscene dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.35

***Note to Table 63.45:** Adjustment factors for occupant–sensing devices are for devices with on–off operation. If devices are used that turn lights down, rather than off, the adjustment factor shall be multiplied by the percent of energy savings that occur while the lights are turned down.

(3) LIGHTING WATTAGE EXCLUDED. The watts of the following lighting applications may be excluded from the calculated interior lighting power of the building.

(a) Lighting for theatrical productions and other live performances, television broadcasting, audio–visual presentations, and those portions of entertainment facilities such as stage areas in hotel ballrooms, night clubs, dance floors, and casinos where lighting is an essential technical element for the function performed, if the lighting is an addition to a general lighting system, and if the lighting is separately controlled and accessible only to authorized operators.

(b) Lighting for television, video and film production.

(c) Lighting for photographic processes.

(d) Lighting for theme parks.

(e) Lighting for exhibits in areas such as exhibit, convention, and hotel function areas, if the lighting is an addition to a general lighting system, and if the lighting is separately controlled and accessible only to authorized operators.

(f) Specialized local lighting installed in nonlighting process equipment by its manufacturer used to illuminate process related tasks only.

(g) In buildings for medical and clinical care, examination and surgical lights, low–level night lights, and lighting integral to medical equipment.

(h) Lighting fixtures that are an integral part of refrigeration equipment.

(i) Nonretail display lighting required for art exhibits or displays in galleries, museums and monuments.

(j) Special lighting needed for research.

(k) Task lighting for plant growth or maintenance, if it is equipped with an automatic 24–hour time switch that has program back–up capabilities that prevent the loss of the switch's program and time setting for at least 10 hours if power is interrupted.

(L) Exit way or egress illumination that is normally off.

(m) Task lighting specifically designed for primary use by visually impaired, for lip reading, and by senior citizens.

(n) Lighting for signs, including exit signs.

Note: See s. ILHR 63.52 for exit sign requirements.

(o) Display window lighting in retail facilities provided the display area is separated from the store sales area by opaque ceiling–height partitions.

(p) Lighting in dwelling units that provide complete independent living facilities for one or more persons including permanent provisions for living, sleeping, eating, cooking, and sanitation.

(q) In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.

(r) Lighting equipment that is for sale.

(s) Lighting demonstration equipment in lighting education facilities.

(4) LIGHTING FIXTURES THAT ALLOW SUBSTITUTION OF SOURCES. The watts of track and other lighting fixtures that allow the substitution of low efficacy sources for high efficacy sources without altering the wiring of the fixture shall be determined by this subsection or other method approved by the department.

(a) *Track lighting.* The wattage of track lighting shall be determined by the method described in subd. 1. or 2.

1. The wattage of track lighting shall be the larger of the following two values:

a. 45 watts per foot of track; or

b. The total luminaire wattage proposed to operate on each track.

2. If interlocked switching is provided that limits the circuits that can be operated simultaneously, the wattage shall be the maximum luminaire wattage that can be operated simultaneously.

(b) *Incandescent medium base sockets.* The wattage for medium base fixtures shall be the listed lighting power capacity, in watts, of the fixture.

Note: See Appendix for default lamp/ballast wattages acceptable to the department.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.46 Calculation of interior lighting power allowance. The interior lighting power allowance shall be calculated using one of the methods in s. ILHR 63.47, 63.48, or 63.49 as applicable.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.47 Complete building method. The Complete Building Method may be used only on projects involving entire buildings where plans and specifications are submitted for the entire building and at least 80 percent of the areas of the building are the same type of use. Under this approach, the interior lighting power allowance is the lighting power density value in Table 63.47 times the conditioned floor area of the entire building. Hotel, motel and residential buildings shall not use this method. Building uses that are not listed in Table 63.47 shall be assigned the allowed lighting power density given under "All Others."

Table 63.47
Complete Building Method
Lighting Power Density Values (Watts/ft^2)

Type of Use	Allowed Lighting Power Density
Banks and Financial Institutions	1.7
Correctional Housing	1.4
General Commercial and Industrial Work Buildings	1.2
Grocery Store	1.8
Industrial and Commercial Storage Buildings	0.8
Medical Buildings and Clinics	1.5
Office Building	1.5
Religious Worship, Auditorium, and Convention Centers	2.0
Restaurants	1.5
Retail and Wholesale Store	2.0
Schools	1.8
Theaters	1.5
All Others	0.8

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.48 Area category method. Under the Area Category Method, the interior lighting power allowance for the building is the sum of all allowed lighting powers for all areas in the building. The allowed lighting power for an area is the lighting power density in Table 63.48 times the area. For purposes of the Area Category Method, an "Area" means all contiguous spaces which accommodate or are associated with a single one of the primary functions listed in Table 63.48. Buildings with primary functions not listed in Table 63.48 shall not use this method. Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall not be included in any area. The area shall not include enclosed retail display windows with exempted lighting as described in s. ILHR 63.45 (3) (o). When the Area Category Method is used to calculate the interior lighting power allowance for an entire building, main entry lobbies, corridors, rest rooms, and support functions shall be treated as separate areas.

Table 63.48
Area Category Method – Lighting Power Density Values (Watts/ft²)

Primary Function	Allowed Lighting Power Density
Auditorium	2.0
Bank/Financial Institution	1.8
Classrooms	2.0
Convention, Conference and Meeting Centers	1.6
Corridors, Rest Rooms and Support Areas	0.8
Detention Facilities	1.6
Dining	1.2
Exhibit	2.3
Storage Garage	0.2
General Commercial and Industrial Work	1.3
Grocery	2.0
Hotel Function	2.3*
Industrial and Commercial Storage	0.6
Kitchen	2.2
Laboratory	3.3
Living Unit or Guest Room	1.4
Lobbies:	
Hotel Lobby	2.3*
Main Entry Lobby	1.6*
Malls, Arcades, and Atria	1.2*
Medical and Clinical Care	1.8
Office	1.6
Precision Commercial and/or Industrial Work	2.0
Religious Worship	2.2*
Retail Sales, Wholesale Showrooms	2.2
Theaters:	
Motion Picture	1.0
Performance	1.5*

*** Note to Table 63.48:** The smallest of the following values may be added to the allowed lighting power listed in Table 63.48 for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting:

a. One watt per square foot times the area of the space in which the chandelier or sconce is used; or

b. The actual design wattage of the chandelier or sconce.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.49 Activity method. Under the activity method, the interior lighting power allowance for a building is determined by calculating a lighting power budget for each space in accordance with subs. (1) to (4) and summing them in accordance with sub. (5).

(1) The lighting power budget of each interior space shall be determined in accordance with the equation given below:

$$LPB = A \times UPD \times AF$$

Where:

LPB = lighting power budget of the space, W

A = area of the space, ft^2

UPD = unit power density, W/ft^2 [Table 63.49]

AF = area factor of the room [Figure 63.49]

(a) The UPD shall be selected from Table 63.49. For applications to areas or activities other than those given, select values for the most similar areas or activities. The UPD for a multifunctional space shall be based on the lowest UPD of any of the activities of the space.

(b) The area factor (AF) shall be determined from Figure 63.49 based on the room area (A_r) and ceiling height. The room area shall be calculated from the inside dimensions of the room. Rooms of identical ceiling height and activities may be evaluated as a group. The AF of a group of rooms shall be determined from the average area of these rooms.

The equation below gives the formula used in developing Figure 63.49.

$$AF = 0.2 + 0.8(1/0.9^n)$$

Where:

$$n = \left[\frac{10.21(CH-2.5)}{\sqrt{A_r}}\right] - 1$$

AF = Area factor

CH = Ceiling height, ft.

A_r = Room area, ft^2

If AF < 1.0, then AF = 1.0

If AF > 1.8, then AF = 1.8

(2) For rooms serving multiple functions such as hotel banquet or meeting rooms and office conference or presentation rooms; an adjustment factor of 1.5 times the UPD may be used if a supplementary system is actually installed and meets the following conditions:

(a) The installed power for the supplementary system shall not be greater than 33 percent of the adjusted lighting power budget calculated for that space, and

(b) Independent controls shall be installed for the supplementary system.

(3) In rooms containing multiple simultaneous activities, such as a large general office having separate accounting and drafting areas within the same room, the lighting power budget for the rooms shall be the weighted average of the activities in proportion to the areas being served.

(4) The activity of indoor sports areas shall be considered as an area 10 feet beyond the playing boundaries of the sport, not to exceed the total floor area of the indoor sports space less the spectator seating area.

(5) The interior lighting power allowance shall be calculated in accordance with the equation given below. The interior lighting power allowance shall include a 0.20 W/ft^2 allowance for unlisted spaces.

$$ILPA = (LPB_1 + LPB_2 + \ldots + LPB_n) + (0.20\ W/ft^2 \times \text{unlisted space area})$$

Where:

ILPA = interior lighting power allowance, W

Unlisted space area = GLA – $\sum$(LS), ft^2

GLA = gross lighted area, ft^2

LPB = lighting power budget, W

LS = listed space

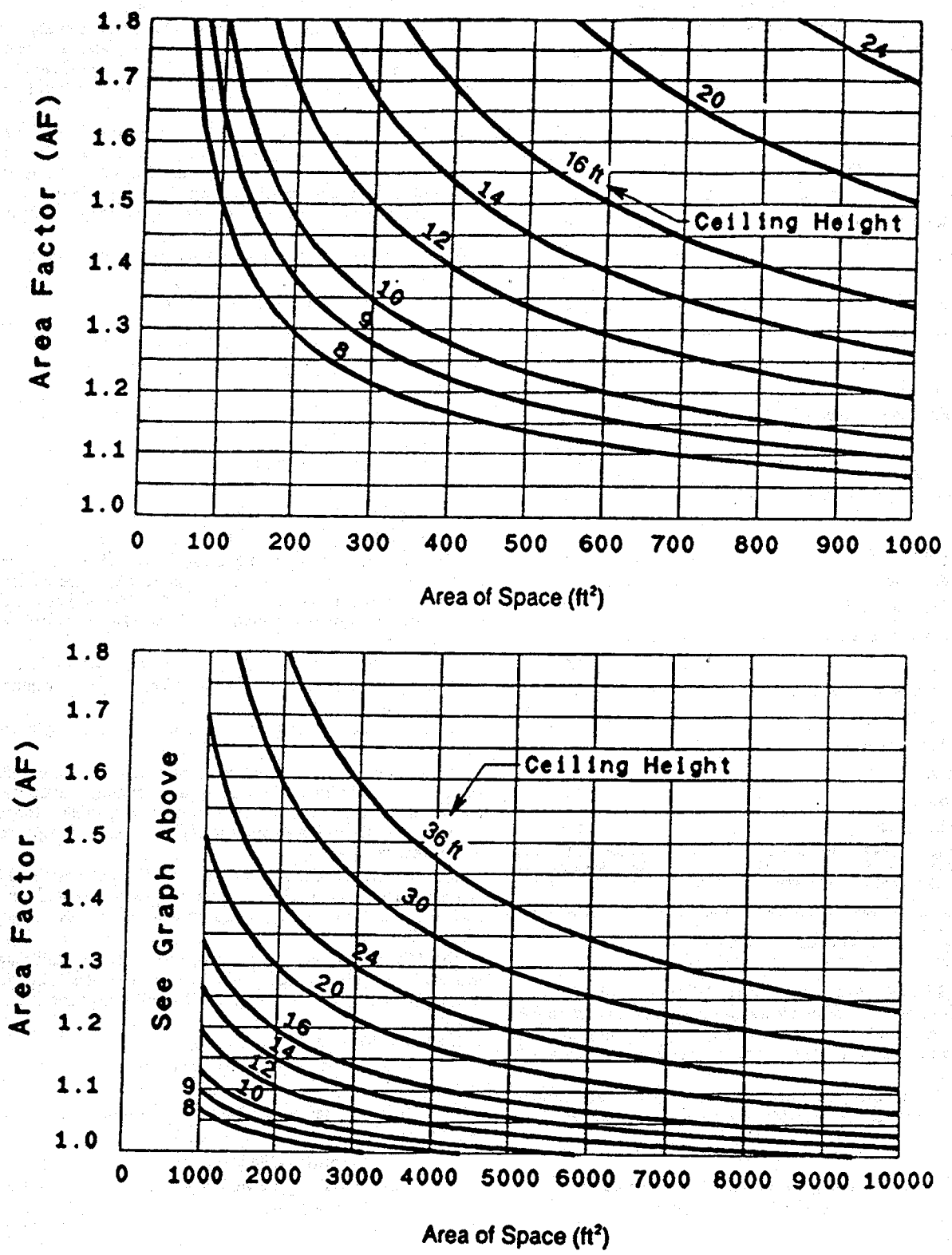


Figure 63.49 Area Factor

Table 63.49
Unit Power Densities

Part a – Common Activity Areas

Activity/Area	UPD W/ft^2	Note
Auditorium	1.6	a
Corridor	0.8	b
Classroom/Lecture Hall	2.0	
Electrical/Mechanical Equipment Room		
General	0.7	b
Control Rooms	1.5	b
Food Service		
Fast Food/Cafeteria	1.3	
Leisure Dining	2.5	c
Bar Lounge	2.5	c
Kitchen	1.4	
Recreation/Lounge	0.7	
Stair		
Active Traffic	0.6	
Emergency Exit	0.4	
Toilet and Washroom	0.8	
Garage		
Auto and Pedestrian Circulation Area	0.3	
Parking Area	0.2	
Laboratory	3.0	
Library		
Audio/Visual	1.1	
Stack Area	1.5	
Card File and Cataloging	1.6	
Reading Area	1.9	
Lobby (General)		
Reception and Waiting	1.0	
Elevator Lobbies	0.8	
Atrium (Multistory)		
First Three Floors	0.7	
Each Additional Floor	0.2	
Locker Room and Shower	0.8	
Office Category 1		
Enclosed offices, all open plan offices without partitions or with partitions* lower than 4.5 feet below the ceiling		
Reading, Typing and Filing	1.8	d
Drafting	2.6	d
Accounting	2.1	d
Office Category 2		
Open plan offices 900 square feet or larger with partitions* 3.5 to 4.5 feet below the ceiling offices less than 900 square feet shall use Category 1		
Reading, Typing and Filing	1.9	b
Drafting	2.9	b
Accounting	2.4	b

Table 63.49 (continued)
Unit Power Densities

Part a – Common Activity Areas (Continued)

Activity/Area	UPD W/ft^2	Note
Office Category 3		
Open plan offices 900 square feet or larger with partitions* higher than 3.5 feet below the ceiling offices less than 900 square feet shall use Category 1		
Reading, Typing and Filing	2.2	b
Drafting	3.4	b
Accounting	2.7	b
Common Activity Areas		
Conference Meeting Room	1.8	a
Computer Office Equipment	2.1	
Filing, Inactive	1.0	
Mail Room	1.8	
Shop (Nonindustrial)		
Machinery	2.5	
Electrical/Electronic	2.5	
Painting	1.6	
Carpentry	2.3	
Welding	1.2	
Storage and Warehouse		
Inactive Storage	0.3	
Active Storage, Bulky	0.3	
Active Storage, Fine	1.0	
Material Handling	1.0	
Unlisted Space	0.2	

* Not less than 90 percent of all work stations shall be individually enclosed with partitions of at least the height described.

Part b – Specific Buildings

Activity/Area	UPD W/ft^2	Note
Airport, Bus and Rail Station		
Baggage Area	1.0	
Concourse/Main Thruway	0.9	
Ticket Counter	2.5	
Waiting and Lounge Area	1.2	
Bank		
Customer Area	1.1	
Banking Activity Area	2.8	
Barber and Beauty Parlor	2.0	
Church, Synagogue, Chapel		
Worship/Congregational	2.5	
Preaching and Sermon	2.7	
Dormitory		
Bedroom	1.1	
Bedroom With Study	1.4	
Study Hall	1.8	

Table 63.49 (continued)
Unit Power Densities

Part b – Specific Buildings (Continued)

Activity/Area	UPD W/ft^2	Note
Fire and Police Department		
Fire Engine Room	0.7	
Detention Dayroom	1.5	
Jail Cell	1.2	
Hospital/Nursing Home		
Corridor	1.3	b
Dental Suite/Examination/Treatment	1.6	
Emergency	2.3	
Laboratory	3.0	
Lounge/Waiting Room	0.9	
Medical Supplies	2.4	
Nursery	2.0	
Nurse Station	2.1	
Occupational Therapy/Physical Therapy	1.6	
Patient Room	1.4	
Pharmacy	1.7	
Radiology	2.1	
Surgical and O.B. Suites		
General Area	2.1	
Operating Room	7.0	
Recovery	2.3	
Hotel/Conference Center		
Banquet Room/Multipurpose	2.4	a
Bathroom/Powder Room	1.2	
Guest Room	1.4	
Public Area	1.2	
Exhibition Hall	2.6	
Conference/Meeting	1.8	a
Lobby	1.9	
Reception Desk	2.4	
Laundry		
Washing	0.9	
Ironing and Sorting	1.3	
Museum and Gallery		
General Exhibition	1.9	
Inspection/Restoration	3.9	
Storage (Artifacts)		
Inactive	0.6	
Active	0.7	
Post Office		
Lobby	1.1	
Sorting and Mailing	2.1	
Service Station/Auto Repair	1.0	

Table 63.49 (continued)
Unit Power Densities

Part b – Specific Buildings (Continued)

Activity/Area	UPD W/ft^2	Note
Theater		
Performance Arts	1.5	
Motion Picture	1.0	
Lobby	1.5	
Retail Establishments		
Merchandising and Circulation Area – Applicable to all lighting, including accent and display lighting, installed in merchandising and circulation areas	2.2	
Mall Concourse	1.4	
Retail Support Areas		
Tailoring	2.1	
Dressing/Fitting Rooms	1.4	

Part c – Indoor Athletic Areas[e,f]

Activity/Area	UPD W/ft^2	Note
Seating Area, All Sports	0.4	
Badminton		
Club	0.5	
Tournament	0.8	
Basketball/Volleyball		
Intramural	0.8	
College	1.3	
Professional	1.9	
Bowling		
Approach Area	0.5	
Lanes	1.1	
Boxing or Wrestling (platform)		
Amateur	2.4	
Professional	4.8	
Gymnasium		
General Exercising and Recreation Only	1.0	
Handball/Raquetball/Squash		
Club	1.3	
Tournament	2.6	
Hockey, Ice		
Amateur	1.3	
College or Professional	2.6	
Skating Rink		
Recreational	0.9	
Exhibition/Professional	2.6	
Swimming		
Recreational	0.9	
Exhibition	1.5	
Under Water	1.0	

Table 63.49 (continued)
Unit Power Densities

Part c – Indoor Athletic Areas[e,f] (Continued)

Activity/Area	UPD W/ft^2	Note
Tennis		
Recreational (Class III)	1.3	
Club/College (Class II)	1.9	
Professional (Class I)	2.6	
Tennis, Table		
Club	1.0	
Tournament	1.6	

Notes for Table 63.49:
Note a. A 1.5 power adjustment factor is applicable for multifunctional spaces.
Note b. Area factor of 1.0 shall be used for these spaces.
Note c. UPD includes lighting power required for clean–up purpose.
Note d. Area factor shall not exceed 1.55.
Note e. Area factor of 1.0 shall be used for all indoor athletic spaces.
Note f. Facilities that are used for more than one level of play shall have appropriate switching between the different levels specified in Table 63.49. Dimming shall not be used to accomplish the reduction in illumination. The illumination at all levels shall be uniform.
History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.50 Lighting controls that must be installed.

(1) AREA CONTROLS. (a) Except as provided in pars. (c) and (d), each interior area enclosed by ceiling–height partitions shall have an independent switching or control device. This switching or control device shall be:

1. Readily accessible; and

2. Located so that a person using the device can see the lights or area controlled by that switch, or so that the area being lit is annunciated; and

3. Manually operated, or automatically controlled by an occupant–sensing device that meets the requirements of s. ILHR 63.51 (4).

(b) Other devices may be installed in conjunction with the switching or control device required by par. (a) provided that they:

1. Permit the required switching or control device to override the action of the other devices; and

2. Reset the mode of any automatic system to normal operation without further action.

(c) Up to one–half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress are exempt from par. (a) if:

1. The area is designated a security or emergency egress area on the plans and specifications submitted to the department; and

2. The area is controlled by switches accessible only to authorized personnel.

(d) Public areas with switches that are accessible only to authorized personnel are exempt from the area control requirements of par. (a).

(2) CONTROLS TO REDUCE LIGHTING. (a) Except as provided in par. (b), the general lighting of any enclosed interior space 100 square feet or larger in which the connected lighting load exceeds 1.2 watts per square foot for the space as a whole, and that has more than one light source or luminaire, shall be controlled so that the load for the lights may be reduced by at least one–half while maintaining a reasonably uniform level of illuminance throughout the area. A reasonably uniform reduction of illuminance shall be achieved by one of the following or other method approved by the department:

1. Controlling all lamps or luminaires with dimmers; or

2. Dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps; or

3. Switching the middle lamps of three lamp luminaires independently of the outer lamps; or

4. Switching each luminaire or each lamp.

(b) The requirements of par. (a) do not apply to:

1. Lights in areas that are controlled by an occupant–sensing device that meets the requirements of s. ILHR 63.51 (4);

2. Lights in corridors; or

3. Lights in areas that are controlled by an automatic time switch control device that has a timed manual override available at each switch location required by sub. (1), and that controls only the lights in that area enclosed by ceiling height partitions.

(3) DAYLIT AREAS. (a) Except as provided in par. (b), daylit areas in any interior enclosed space greater than 250 square feet shall meet the requirements of subds. 1. and 2.

1. Such areas shall have at least one control that:

a. Controls only luminaires in the daylit area; and

b. Controls at least 50% of the lamps or luminaires in the daylit area, in a manner described in sub. (2)(a) 1. to 4., independently of all other lamps or luminaires in the enclosed space. The other luminaires in the enclosed space may be controlled in any manner allowed by sub. (2)(a) 1. to 4.

2. Such areas shall have controls that control the luminaires in each vertically daylit area separately from the luminaires in each horizontally daylit area.

(b) The requirements of this subsection do not apply to:

1. Daylit areas where the effective aperture of glazing is equal or less than 0.1 for vertical glazing and 0.01 for horizontal glazing; or

2. Daylit areas where existing adjacent structures or natural objects obstruct daylight to the extent that effective use of daylighting is not feasible.

(4) SHUT-OFF CONTROLS. (a) Except as provided in par. (b), for every floor or metered space, all interior lighting systems shall be equipped with at least one separate automatic control to shut off the lighting. This automatic control shall meet the requirements of s. ILHR 63.51 and may be an occupancy sensor, automatic time switch, or other device capable of automatically shutting off the lighting.

(b) The requirements of par. (a) do not apply to the following:

1. Buildings or separately metered spaces of less than 5,000 square feet of conditioned space;

2. Where the system is serving an area that must be continuously lit, or where the use of the space prohibits the use of a preestablished lighting program;

3. Lighting in corridors, guest rooms, and lodging quarters of residential buildings hotels and motels;

4. Up to one–half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress, if:

a. The area is designated a security or emergency egress area on the plans and specifications submitted to the department; or

b. The area is controlled by switches accessible only to authorized personnel.

(c) If an automatic time switch control device is installed to comply with par. (a), it shall incorporate an override switching device that:

1. Is readily accessible; and

2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated; and

3. Is manually operated; and

4. Allows the lighting to remain on for no more than two hours when an override is initiated; and

5. Controls an area not exceeding 5,000 square feet.

6. Two overrides may be provided for a maximum of 10,000 square feet if the lighting is dual level controlled in accordance with sub. (2) (a) 2. or 3.

(5) DISPLAY LIGHTING CONTROLS. Display lighting shall be separately switched on circuits that are 20 amps or less.

(6) EXTERIOR LIGHTING CONTROLS. Except in lighting in parking garages, tunnels, and large covered areas that require illumination during daylight hours, exterior lighting shall be controlled by a directional photocell or astronomical time switch that automatically turns off the exterior lighting when daylight is available. Time switches shall be equipped with back–up provisions to keep time during a power outage of 10 hours or more.

(7) HOTEL AND MOTEL GUEST ROOM CONTROLS. Hotel and motel guest rooms or suites excluding bathrooms shall have one or more master switches at the main entry door or at the entry door of each room that turn off all permanently wired lighting fixtures and switched receptacles in the room or suite.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.51 Requirements for lighting control devices. Automatic time switch control devices, occupant–sensing devices, automatic daylighting control devices, lumen maintenance control devices, or interior photocell sensor devices that are used to justify a wattage reduction factor in the calculation of the actual internal lighting power in s. ILHR 63.45 (2) shall be approved for compliance with all of the applicable requirements of subs. (1) to (7) and shall be installed in compliance with sub. (8). Approval of devices shall be obtained via the material approval program in accordance with s. ILHR 50.19 or via manufacturer certification to the California Energy Commission.

Note: Information on California Energy Commission Certification may be obtained from the California Energy Commission, Energy Efficiency and Local Assistance Division, 1516 9th Street, MS–2S, Sacramento, CA 95814–5512, 416/654–4021. A list of approved control devices is available on the internet at ftp://sna.com/pub/users...h/appliance/–readme.txt.

(1) ALL DEVICES: INSTRUCTIONS FOR INSTALLATION AND CALIBRATION. The manufacturer shall provide step–by–step instructions for installation and start–up calibration of the device.

(2) ALL DEVICES: STATUS SIGNAL. The device shall have an indicator that visibly or audibly informs the device operator that it is operating properly, or that it has failed or malfunctioned, except for photocell sensors or other devices where a status signal is infeasible because of inadequate power.

(3) AUTOMATIC TIME SWITCH CONTROL DEVICES. Automatic time switch control devices shall:

(a) Be capable of programming different schedules for weekdays and weekends; and

(b) Incorporate an automatic "holiday shut–off" feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation; and

(c) Have program backup capabilities that prevent the loss of the device's program and time setting for at least 10 hours if power is interrupted.

(4) OCCUPANT–SENSING DEVICES. Occupant–sensing devices shall be capable of automatically controlling all the lights in an area no more than 30 minutes after the area has been vacated. In addition, ultrasonic and microwave devices shall have a built–in mechanism that allows calibration of the sensitivity of the device to room movement in order to reduce the false sensing of occupants and shall comply with either par. (a) or (b), as applicable:

(a) If the device emits ultrasonic radiation as a signal for sensing occupants within an area, the device shall:

1. Have had an Initial Report submitted to the Bureau of Radiological Health, Federal Food and Drug Administration, under 21 CFR 1002.10; and

2. Emit no audible sound; and

3. Not emit ultrasound in excess of the decibel (dB) values given in Table 63.51 measured no more than 5 feet from the source on axis.

Table 63.51
Maximum Ultrasound Emissions

Midfrequency of Sound Pressure Third–Octave Bank (in kHz)	Maximum dB Level within Third–Octave Band (in dB reference 20 micropascals)
less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

(b) If the device emits microwave radiation as a signal for sensing occupants within area, the device shall:

1. Comply with all applicable provisions in 47 CFR Part 5, and have an approved Federal Communications Commission identification number that appears on all units of the device and that has been submitted to the department; and

2. Not emit radiation in excess of 1 milliwatt per square centimeter measured at no more than 5 centimeters from the emission surface of the device; and

3. Have permanently affixed to it installation instructions recommending that it be installed at least 12 inches from any area normally used by room occupants.

(5) AUTOMATIC DAYLIGHTING CONTROL DEVICES. Automatic daylighting control devices shall:

(a) Be capable of reducing the light output of the general lighting of the controlled area by at least one–half while maintaining a uniform level of illuminance throughout the area; and

(b) If the device is a dimmer, provide electrical outputs to lamps for reduced flicker operation through the dimming range and without causing premature lamp failure; and

(c) If the device is a stepped dimming system, incorporate time delay circuits to prevent cycling of light level changes of less than three minutes; and

(d) If the device uses step switching with separate "on" and "off" settings for the steps, have sufficient separation or deadband of "on" or "off" points to prevent cycling; and

(e) Have provided by the manufacturer step–by–step instructions for installation and start–up calibration to design foot–candle levels.

(6) LUMEN MAINTENANCE CONTROL DEVICES. Lumen maintenance control devices shall:

(a) Be capable of reducing the light output of the general lighting of the controlled area by at least 30% while maintaining a uniform illuminance throughout the area; and

(b) Provide electrical outputs to lamps for reduced flicker operation through the dimming range and without causing premature lamp failure; and

(c) Incorporate an alarm, either audible or visible, to announce when a specified setpoint of lumens or watts has been reached; and

(d) Have provided by the manufacturer step–by–step instructions for installation and start up calibration to design foot–candle levels.

(7) INTERIOR PHOTOCELL SENSOR DEVICES. Interior photocell sensors shall not have a mechanical slide cover or other device that permits easy unauthorized disabling of the control, and shall not be incorporated into a wall–mounted occupant–sensing device.

(8) INSTALLATION IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. If an automatic time switch control device, occupant–sensing device, automatic daylighting control device, lumen maintenance control device, or interior photocell sensor device is installed, it shall comply with both pars. (a) and (b).

(a) The device shall be installed in accordance with the manufacturer's instructions; and

(b) Automatic daylighting control devices and lumen maintenance control devices shall:

1. Be installed so that automatic daylighting control devices control only luminaries within the daylit area; and

2. Have photocell sensors that are either ceiling mounted or located so that they are accessible only to authorized personnel, and that are located so that they maintain adequate illumination in the area according to the designer's or manufacturer's instructions.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.52 Exit signs. Exit signs shall have an installed wattage of 20 watts or less.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.53 Reduction of single lamp ballasts. The following luminaries located within the same room shall be tandem wired or provided with three–lamp ballasts:

(1) One–lamp or three–lamp fluorescent luminaries recess–mounted within 10 feet center–to–center of each other; and

(2) One–lamp or three–lamp fluorescent luminaries pendant– or surface–mounted within one foot edge–to–edge of each other.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Subchapter VI Nondepletable Energy Source

ILHR 63.60 Buildings utilizing solar, geothermal, wind or other nondepletable energy source. Any building, or portion thereof, utilizing any nondepletable energy source shall meet all the requirements of this chapter. An energy credit will be given to the building envelope in the amount of the net nondepletable energy collected. The nondepletable energy must be derived from a specific collection, storage and distribution system, which may include active and passive systems.

Note: An energy credit to the building envelope in the amount of the net recovered energy will be given to the use of recovery systems which will conserve energy, provided the amount expended is less than the amount recovered when the energy transfer potential and the operating hours are considered.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.61 Documentation. Proposed alternative designs, submitted as variations to the standard design criteria, shall be accompanied by an energy analysis. This department will accept alternative systems designed according to the requirements of nationally recognized agencies.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

Subchapter VII System Analysis Design

ILHR 63.70 Annual energy consumption. A building designed in accordance with this part will be deemed as complying with this chapter if the calculated annual energy consumption is not greater than a similar building with enclosure elements and energy consuming systems designed in accordance with subchapters I through V. If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.

Note: Use of the ASHRAE 90.1 Energy Cost Budget Method will not verify compliance with all portions of subchapters I through V. Compliance with the following sections of ch. ILHR 63 must be shown independently if the Energy Cost Budget Method is used: ss. ILHR 63.11 to 63.12, 63.20 to 63.29, 63.32 (2) and subchapter V.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.71 Simulation. The calculation procedure used to simulate the operation of the building and its service systems through a full year operating period shall be detailed to permit the evaluation of the effect of system design, climatic factors, operational characteristics, and mechanical equipment on annual energy usage. Manufacturer's data or comparable field test data shall be used when available in the simulation of all systems and equipment. the calculation procedure shall be based upon 8,760 hours of operation of the building and its service systems and shall utilize the following input:

(1) CLIMATIC DATA. Coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation.

(2) BUILDING DATA. Orientation, size, shape, thermal mass, air moisture and heat transfer characteristics.

(3) OPERATIONAL CHARACTERISTICS. Temperature, humidity, ventilation, illumination, control mode for occupied and unoccupied hours.

(4) MECHANICAL EQUIPMENT. Design capacity, partial load profile.

(5) BUILDING LOADS. Internal heat generation, lighting, equipment, number of people during occupied and unoccupied periods.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

ILHR 63.72 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 building and system design and on the data used.

History: Cr. Register, March, 1997, No. 495, eff. 4–1–97.

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