FOREST COUNTY POTAWATOMI COMMUNITY

RESIDENTIAL BUILDING CODE

§ 1. General

1.1. Purpose

The purpose of this Code is to establish uniform construction standards and inspection procedures for one- and two-family Dwellings on Tribal Lands. The provisions of this Code apply to all of the following:

(a) All one- and two-family Dwellings built or Structurally Altered after the effective date of this Code;

(b) All Garages, Carports, Porches, stoops, Decks, Balconies, Stairways, and similar structures, that were constructed or had a production date after the effective date of this Code, and that are Attached to any Dwelling.

(c) Adjacent, unattached structures listed in this Code that serve as an Exit from a Dwelling.

1.2. Authority

The Forest County Potawatomi Community General Council enacts this Ordinance pursuant to its authority granted under the Forest County Potawatomi Community Tribal Constitution, Article IV, §1(d).

1.3. Effective Date and Title

This Ordinance is hereby adopted immediately following the majority approval from the Forest County Potawatomi Community General Council and it shall be known as the Forest County Potawatomi Community Residential Building Code.

1.4. Sovereign Immunity

The Tribe, by adoption of this Ordinance, does not waive its sovereign immunity in any respect. Any Person acting under good faith of this Ordinance shall be immune from any civil liability arising out of such actions.

1.5. Amendment or Repeal

This Ordinance may be amended or repealed by a majority vote of the Forest County Potawatomi Community General Council. Due to the extensive nature of this Code, the Public Works Division

may propose technical amendments to Executive Council on an annual basis. Such technical amendments may only correct clear errors in the Code. All nontechnical amendments must be approved by the General Council.

1.6 Jurisdiction

The Forest County Potawatomi Community Tribal Court shall have original jurisdiction over all proceedings under this Ordinance.

1.7 Interpretation

The Forest County Potawatomi Community Tribal Court shall defer to the Public Works Division's reasonable interpretation of this Ordinance, including the amount of any fine imposed or corrective action taken. The Court shall follow an "Abuse of Discretion" standard in any review of the Division's interpretation or action.

Approved by General Council ..... (5/13/2023)
Amended by General Council Resolution G.C. 018-2024.....(11/9/2024)

Forest County Potawatomi Community

Code requirements in addition to WI UDC

The provisions on this list shall supersede any conflicting language in the UDC or this Code.

1. Attic/ceiling insulation must achieve at minimum R-49.
2. Exterior wall insulation must achieve at minimum R-21.
3. Increase minimum stair headroom to 80".
4. Increase roof live load to 50 lbs/sq.ft.
5. Air sealing in box sills, new exterior wall construction, and above wall to proper vent is required.
6. Heat Recovery Ventilator (HRV) or Energy Recovery Ventilator (ERV) for proper air exchange is mandatory in all new construction.
7. 10" minimum tread depth and 7-3/4" maximum tread rise for conventional stairways.
8. Any new or replacement atmospheric vent water heaters and furnaces are not allowed.
9. Contractor is responsible for installing all radon control methods identified by the Department. See International Residential Code (IRC) Appendix F, Radon Control Methods. APPENDIX F RADON CONTROL METHODS, 2018 International Residential Code (IRC) | ICC Digital Codes (iccsafe.org)
10. Any full height basement constructed after the adoption of this Code shall have at least two means of egress.
11. Exhaust Discharge, domestic cooking exhaust equipment shall discharge to the outdoors through a duct. The duct shall have a smooth interior surface, shall be airtight, shall be equipped with a backdraft damper, and shall be independent of all other exhaust systems.
12. Erosion Mat needs to be made of natural fiber (Urban Class I).
13. All use of polymers for sediment control in waters must be approved by Land and Natural Resources Division.
14. All construction site erosion control seed selection must be approved by Land and Natural Resources Division.
15. Contractor shall be responsible for removing all silt fence when notified by the Department that vegetation has been established or be subject to civil forfeiture.
16. Setback encumbrances. (see chart)

Code Comparison -POWTS Code Setback Encumbrances (ft)																	
	Vertical Separation SAS		Horizontal Separation Soil Absorption System (SAS)								Horizontal Separation Treatment Tank[e]						
Effective Date	Ground-water	Bedrock	Well	100[m]	Wetlands	Building	Lot Line	Swimming Pool	Water Service	Public W Main	Well	50[m]	Wetlands	Building	Lot Line	Swimming Pool	Water Service
11/16/2022	2/3/2005	2/3/2005	50[l]	50[m]	100	10	5	15	10	25[n]	25[l]	10[m]	50	5	2	0	10

Chapter SPS 320
ADMINISTRATION AND ENFORCEMENT

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Subchapter I — Purpose and Scope

SPS 320.01 Purpose.

(1) The purpose of this Code is to establish uniform construction standards and inspection procedures for one- and two-family Dwellings on Tribal Lands.

SPS 320.02 Scope.

(1) General. The provisions of this Code apply to all of the following:

(a) All one- and two-family Dwellings built or Structurally Altered after the effective date under SPS 320.03.

Note: This includes site-built Dwellings, Manufactured buildings used as Dwellings, Modular Homes and Dwellings that may be designated as cabins, seasonal homes, temporary residences, etc., (except for Manufactured or HUD homes, which are covered separately under this section).

(g) All Garages, Carports, Porches, stoops, Decks, Balconies, Stairways, and similar structures, that were constructed or had a production date after the effective date under SPS 320.03, and that are Attached to any Dwelling.

(h) Adjacent, unattached structures listed under par. (g) that serve as an Exit from a Dwelling.

(6) LANDSCAPING. Except for construction Erosion control, the scope of this Code does not extend to driveways, sidewalks, landscaping, and other similar features not having an impact on the Dwelling structure. **SPS 320.03 Effective date.** The effective date of this ordinance.

SPS 320.04 Applications.

(1) NEW DWELLINGS.

(a) This Code applies to all Dwellings, Dwelling Units, and Foundations for Dwelling Units, for which the building permit application was made, or construction commenced after the effective date of this Code.

(b) All Dwellings covered under par. (a) shall meet the requirements of Ch. SPS 321.

1. The Installation of heating, air conditioning, plumbing or electrical systems is not required.

2. If any of the systems under subd. 1. are installed, the systems and their Installation shall comply with this Code.

3. If a heating or air conditioning system is installed, the Dwelling shall comply with ch. SPS 322.

(2) ADDITIONS AND ALTERATIONS. Additions and Alteration s to Dwellings covered by this Code shall comply with all provisions of this Code at the time of permit application or the beginning of the project if no permit is required.

(4) CHANGE OF USE. A building previously used for another purpose, such as a barn or Garage, shall comply with this Code upon conversion to residential use.

(5) REUSE OF A DWELLING OR FOUNDATION.

(a) ***Existing Dwelling or Manufactured Home placed on a different Foundation***. Where an existing Dwelling or Manufactured Home is placed on a different Foundation, the new Foundation is considered an Addition or Alteration to the existing Dwelling or Manufactured Home.

Note: The applicability of this Code to an Addition or Alteration to an existing Dwelling or Manufactured Home is determined by the original date of construction of the Dwelling or Manufactured Home and is not altered by any movement of the structure.

(b) ***New Dwelling or Manufactured Home.*** A new Dwelling or Manufactured Home placed on a new or existing Foundation shall meet the permitting, construction and inspection requirements of a new Dwelling or Manufactured Home.

(6) SEPARATED BUILDINGS. For a building to be considered a separate single-family Dwelling or a separate 2-family Dwelling within the scope of this Code, regardless of ownership or occupancy arrangements, all of the following conditions shall be met:

(a) No structural members other than a common footing may be shared between any 2 Dwellings.

Note: Two separated, insulated Foundation walls may share the same structural footing.

(b) The adjoining exterior walls of the separate Dwellings shall each have exterior coverings meeting the requirements of SPS 321.24.

(c) The adjoining exterior walls, including Foundations, of the separate Dwellings shall each meet the energy requirements under ch. SPS 322, irrespective of any adjacent Dwelling.

(d) Both sides of any 2 adjoining walls, floors, ceilings and Attics between Dwellings shall meet the Dwelling separation requirements of SPS 321.08 (1) for 2 Dwellings on the same property less than 5 feet apart.

Note: 1. Flashing is acceptable to connect the roofs between Dwelling Units. See Ch. SPS 325 Appendix A for further information.

SPS 320.05 Exemptions.

(1) EXISTING DWELLINGS. The provisions of this Code shall not apply to Dwellings and Dwelling Units, or to Additions or Alterations to such Dwellings, the construction of which was commenced prior to the effective date of this Code.

(3) REPAIRS. The provisions of this Code do not apply to Repairs or maintenance to Dwellings or Dwelling Units, or to the Repair of electrical, plumbing, heating, Ventilating, air conditioning and other systems installed therein.

(4) ACCESSORY BUILDINGS. With the exception of SPS 321.08 (1), the provisions of this Code do not apply to detached Garages or to any Accessory Buildings detached from the Dwelling.

(5) DETACHED DECKS. The provisions of this Code do not apply to detached Decks provided the Deck does not serve an Exit from the Dwelling.

(6) FARM BUILDINGS. The provisions of this Code do not apply to the buildings used exclusively for farm operations and not for human habitation.

Subchapter III — Definitions

SPS 320.07 Definitions. In chs. SPS 320 to 325:

(1) "Accessory Building" means a Detached Building, not used as a Dwelling Unit but is incidental to that of the main building and which is located on the same lot. Accessory Building does not mean farm building.

(2) "Addition" means new construction performed on a Dwelling which increases the outside dimensions of the Dwelling.

(3) "Allowable Stress" means the specified maximum permissible Stress of a material expressed in load per unit area.

(4) "Alteration" means an enhancement, upgrade or substantial change or modification other than an Addition or Repair to a Dwelling or to electrical, plumbing, heating, Ventilating, air conditioning and other systems within a Dwelling.

(5) "Approved" means an approval by the Public Works Division. (Approval is not to be construed as an assumption of any legal responsibility for the design or construction of the Dwelling or Building Component).

(5m) "Attached" defining the relationship between another building and a Dwelling, means at least one of the following conditions is present:

(a) There is a continuous, weatherproof roof between the two structures.

Note: The sides are not required to be enclosed with walls.

(b) There is a continuous, structural floor system between the two structures.

(c) There is a continuous Foundation system between the two structures.

(6) "Attic" means a space under the roof and above the ceiling of the topmost part of a Dwelling.

(6a) "Authorized Inspector " (previously "Certified Inspector" means a person authorized by the Public Works Division to engage in the administration and enforcement of this Code.

(7) A **"Balcony"** is a landing or Porch projecting from the wall of a building.

(7m) "Base Flood Elevation" means the depth or peak elevation of flooding, including wave height, which has a one percent or greater chance of occurring in any given year.

(8) "Basement" means that portion of a Dwelling below the First Floor or Ground Floor with its entire floor below grade.

(8m) "Best Management Practices" means practices, techniques, or measures that the Department determines to be effective means of preventing or reducing pollutants of surface water generated from construction sites.

(9) "Building Component" means any subsystem, subassembly or other system designed for use in or as part of a structure, which may include structural, electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety.

(10) "Building System" means plans, specifications and documentation for a system of Manufactured building or for a type or a system of Building Components, which may include structural, electrical, mechanical, plumbing and variations which are submitted as part of the Building System.

(10m) "Business Day" means any day the Public Works Division is open for business.

(10t) "Carport" means a structure used for storing motorized vehicles that is Attached to a Dwelling and that has at least 2 sides completely unenclosed.

(11) "Ceiling Height" means the clear vertical distance from the finished floor to the finished ceiling.

(12m) "Ch. SPS 325 Appendix" means chs. SPS 320 to 325 Appendix.

(13) "Chimney" is one or more vertical, or nearly so, passageways or flues for the purpose of conveying flue gases to the atmosphere.

(14) "Chimney Connector" Same as smoke pipe.

(15) "Closed Construction" means any building, Building Component, assembly, or system Manufactured in such a manner that it cannot be inspected before Installation at the building site without disassembly, damage, or destruction.

(15g) "Coarse Aggregate" means granular material, such as gravel or crushed stone, that is predominately retained on a sieve with square openings of 4.75 mm or 0.18 inch.

(15m) "Coastal Floodplain" means an area along the coast of Lake Michigan or Lake Superior below Base Flood Elevation that is subject to wave runup or wave heights of 3 feet or more.

(16) "Code" means the Forest County Potawatomi Community Residential Building Code.

(17) "Combustion Air" means the total amount of air necessary for the complete combustion of a fuel.

(18) "Common Use Area" means Kitchens, hallways, Basements, Garages, and all Habitable Rooms.

Note: These areas must meet the circulation requirements under SPS 321.035.

(19) "Compliance Assurance Program" means the detailed system documentation and methods of assuring that Manufactured Dwellings and Dwelling components are Manufactured, stored, transported, assembled, handled, and installed in accordance with this Code.

(19m) "Composting Toilet System" means a method that collects, stores, and converts by bacterial digestion nonliquid-carried human wastes or organic Kitchen wastes, or both, into humus.

(19r) "Control Practice" means a method or device implemented to prevent or reduce Erosion or the resulting deposition of soil or sediment.

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

(21) "Dead Load" means the vertical load due to all permanent structural and nonstructural components of the building such as joists, rafters, sheathing, finishes and construction assemblies such as walls, partitions, floors, ceilings and roofs, and systems.

(21m) "Deck" means an unenclosed exterior structure, attached or adjacent to the exterior wall of a building, which has a floor, but no roof.

(23) "Department" for the purposes of this Code, means the FCPC Public Works Division.

(24) "Detached Building " means any building which is not physically connected to the Dwelling.

(24m) "Dilution Air" means air that is provided for the purpose of mixing with flue gases in a draft hood or draft regulator.

(24r) "Direct-Vent Appliance" means a gas-burning appliance that is constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

(xx) "Division" means a unit of Tribal government that reports directly to the Executive Council.

(25) "Dwelling" means any building, the Initial Construction of which is commenced on or after the effective date of this Code, which contains one or 2 Dwelling Units.

(26) "Dwelling Contractor" means any person, firm or corporation engaged in the business of performing Erosion control or construction work such as framing, roofing, siding, insulating, masonry, or Window replacement work covered under this Code and who takes out a building permit. "Dwelling Contractor" does not include the Owner of an existing Dwelling, an Owner who will reside in a new Dwelling or a person, firm or corporation engaging exclusively in electrical, plumbing, or heating, ventilating and air conditioning work.

(27) "Dwelling Unit" means a structure, or that part of a structure, which is used or intended to be used as a home, residence or sleeping place by one person or by 2 or more persons maintaining a common household, to the exclusion of all others.

(28t) "Erosion" means the detachment and movement of soil, sediment or rock fragments by water, wind, ice, or gravity.

(29) "Exit" means a direct, continuous, unobstructed means of egress from inside the Dwelling to the exterior of the Dwelling.

(33m) "Fire Blocking" means a material or device used to retard or prevent the spread of flame or hot gases through concealed spaces into adjacent rooms or areas.

(34) "Firebox" means that part of the fireplace used as the combustion chamber.

(34e) "First Floor" means the first-floor level above any Ground Floor or Basement or, in the absence of a Ground Floor or Basement, means the lowest floor level in the Dwelling.

(34f) "Flight" means a continuous series of risers and treads, with no intermediate Landings.

(34g) "Flood Fringe Area" means that portion of the Floodplain outside of the Floodway that is at or below Base Flood Elevation. The term "flood fringe" is intended to designate an area of standing, rather than flowing, water.

(34h) "Floodplain" means land which is subject to flooding which is at or below Base Flood Elevation. The Floodplain includes the Floodway and Flood Fringe Areas.

(34i) "Floodway" means the channel of a river or stream and those portions of the Floodplain adjoining the channel required to carry the flood discharge. The term "Floodway" is intended to designate an area of flowing, rather than standing, water.

(34s) "Foundation" means the structural system used to transfer the weight of the building to the earth.

Note: The Foundation may include one or more components such as footings, piers, columns, slabs, and walls.

(35) "Garage" means a structure used for storing motorized vehicles that has any more than 2 sides completely enclosed.

(36) "Gas Appliance" means any device that uses gas as a fuel or raw material to produce light, heat, power, refrigeration, or air conditioning.

(36m) "Ground Floor" means that level of a Dwelling, below the First Floor, located on a site with a sloping or multilevel grade and which has a portion of its floor line at grade.

(36r) "Guard" means a barrier erected to prevent a person from falling to a lower level.

(37) "Habitable Room" means any room used for sleeping, living, or dining purposes, excluding such enclosed places as Kitchens, closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms, and similar spaces.

(37m) "Handrail" means a horizontal or sloping rail intended for grasping by a hand, for guidance or support or preventing a fall down a Stair.

(38) "Hearth" means the floor area within the fire chamber of a fireplace.

(38m) "Hearth Extension" means the surfacing applied to the floor area extending in front of and at the sides of the fireplace opening.

(40) "Heating Load" is the estimated heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. The total heat load includes: the transmission losses of heat transmitted through the wall, floor, ceiling, glass, or other surfaces; and either the infiltration losses or heat required to warm outdoor air used for ventilation.

Note: Infiltration losses include heat required to warm outside air which leaks through cracks and crevices, around doors and Windows or through open doors and Windows.

(40m) "Hollow Unit" means a masonry unit which has a net cross-sectional area parallel to the bearing face which is less than 75% of the gross cross-sectional area.

(40t) "Incinerating Toilet" means a self-contained device for the treatment of nonliquid carried wastes that deposits the wastes directly into a combustion chamber, reduces the solid portion to ash and evaporates the liquid portion.

(41) "Independent Inspection Agency" means any person, firm, association, partnership, or corporation certified by the Department to perform certified inspections under this Code.

(42) "Initial Construction" means the date of issuance of the building permit.

(44) "Installation" means the assembly of a Manufactured building on site and the process of affixing a Manufactured building to land, a Foundation, footing or an existing building.

(46) "Kitchen" means an area used, or designed to be used, for the preparation of food.

(46m) "Land Disturbing Construction Activity" means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in storm water runoff and lead to an increase in soil Erosion and movement of sediment. Land Disturbing Construction Activity includes clearing and grubbing, demolition, excavating, pit or trench dewatering, filling, and grading activities.

(47) "Landing" means the level portion of a Stairs located between Flights of Stairs or located at the top and base of a Stairs.

(48) "Listed and Listing" means equipment or Building Components which are tested by an independent testing agency and accepted by the Department.

(49) "Live Load" means the weight superimposed on the floors, roof, and structural and nonstructural components of the Dwelling through use and by snow, ice, or rain.

(50) "Loft" means an upper room or floor which has at least 50% of the common wall open to the floor below. The opening may be infringed upon by an open Guard constructed in compliance with SPS 321.04 (2), but not by a Window or half-wall Guard. All Habitable Rooms of Lofts are open to the floor below.

(51) "Manufacture" means the process of making, fabricating, constructing, forming, or assembling a product from raw, unfinished, semifinished, or finished materials.

(52m) "Manufactured Home" means any of the following:

(am) A structure that is designed to be used as a Dwelling with a permanent Foundation and that is certified by the federal Department of Housing and Urban Development as complying with the standards established under 42 USC 5401 to 5425.

(c) A Mobile Home unless a Mobile Home is specifically excluded under the applicable statute.

(53a) "Mobile Home" means a vehicle Manufactured or assembled before June 15, 1976, designed to be towed as a single unit or in sections upon a highway by a motor vehicle and equipped and used, or intended to be used, primarily for human habitation, with walls of rigid un-collapsible construction, which has an overall length in excess of 45 feet. `Mobile Home' includes the Mobile Home structure, its plumbing, heating, air conditioning and electrical systems, and all appliances and all other equipment carrying a Manufacturer's warranty."

(53) "Mechanical Drat Venting System" means a Venting system for a gas burning appliance that is designed to remove flue or Vent gases by mechanical means, such as a fan, which may consist of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure.

(53f) "Modular Home" means any structure or component thereof which is intended for use as a Dwelling and:

a. Is of Closed Construction and fabricated or assembled on-site or off-site in manufacturing facilities for Installation, connection, or assembly and Installation, at the building site; or

b. Is a building of Open Construction which is made or assembled in manufacturing facilities away from the building site for Installation, connection, or assembly and Installation, on the building site and for which certification is sought by the Manufacturer.

(53m) "Multiple Station Smoke Alarm" means an assembly that incorporates the smoke detector, the control equipment, and the alarm-sounding device in one unit that is capable of being interconnected with one or more additional alarms so that the actuation of one alarm causes the operation of all interconnected alarms.

(54) "Multi-Wythe Wall" is a masonry wall composed of 2 or more wythes of masonry units tied or bonded together.

(55m) "Naturally Vented Appliance" means an appliance with a Venting system designed to remove flue or Vent gases under non-positive static Vent pressure entirely by natural draft.

(56) "Open Construction" means any building, Building Component, assembly, or system Manufactured in such a manner that it can be readily inspected at the building site without disassembly, damage, or destruction.

(57) "Owner" means any person having a legal or equitable interest in the Dwelling.

(58) "Perm" means a unit of permeance which is measured in grains per (hour) (square foot) (inch of mercury vapor pressure difference).

Note: The lower the Perm rating of a material is, the more difficult it is for water vapor to pass through it.

(59) "Pilaster" is a projection of masonry or a filled cell area of masonry for the purpose of bearing concentrated loads or to stiffen the wall against lateral forces.

(59m) "Porch" means an unenclosed exterior structure at or near grade attached or adjacent to the exterior wall of any building and having a roof and floor.

(59t) "Privy" means an enclosed nonportable toilet into which non-water-carried human wastes are deposited to a subsurface storage chamber.

(61) "Repair" means the act or process of restoring to original soundness, including redecorating, refinishing, nonstructural Repairs or maintenance, or the replacement of existing fixtures, systems or equipment with the equivalent fixture, system, or equipment.

(62) "Shingle" means a unit of roof-covering material that has been Manufactured to specific dimensions and is applied in overlapping fashion. "Shingle" includes all of the following:

(a) "Fiberglass Asphalt Shingle" means a type of Shingle with an internal mat composed of nonwoven, resin-bonded glass fibers, that is impregnated and coated with asphalt.

(b) "Laminated Shingle" means a Shingle with a second layer of asphalt and mat laminated to the first layer, usually in a design pattern to simulate the dimensional appearance of natural slate or wood shakes.

(c) "Organic Asphalt Shingle" means a Shingle with an internal mat composed of organic fibers, such as cellulose, that is saturated and coated with asphalt.

(d) "Strip Shingle" means a rectangular Shingle that relies either on a sealant or on a combination of weight and stiffness to resist wind uplift, rather than using interlocking tabs.

(63) A "Single-Wythe Wall" is a masonry wall consisting of one unit of thickness.

(64) A "Smoke Chamber" is that part of a fireplace which acts as a funnel to compress the smoke and gases from the fire so that they will enter the Chimney above.

(65) A "smoke pipe" is a connector between the solid or liquid fuel-burning appliance and the Chimney.

(65m) "Solid Unit" means a masonry unit which has a net cross-sectional area parallel to the bearing face which is 75% or more of the gross cross-sectional area.

(65r) "Stabilized" means the condition where vegetation is established, or other practices are in place on exposed soil surfaces so as to reduce Erosion.

(66) "Stair," "Stairs," or "Stairway" means one or more risers and the necessary treads, which form a continuous passage from one elevation to another. Multiple Stairways can be connected by platforms and Landings.

(68) A "Story" is that portion of a building located above the Basement, between the floor and the ceiling.

(69) A "Stove" is a nonportable solid-fuel-burning, Vented, non-ducted heat-producing appliance located in the space that it is intended to heat. This definition does not include cooking appliances.

(70) "Stovepipe" Same as smoke pipe.

(71) "Strain" means a change in the physical shape of a material caused by Stress.

(72) "Stress" means internal resistance to an external force expressed in load per unit area; Stresses acting perpendicular (compression or tension) to the surface, shear Stresses acting in the plane of the surface or bending Stresses which cause curving.

(73) "Structurally Altered" means any change to a supporting member of a building including Foundations, bearing walls, or partitions, columns, beams, girders, or any structural change in the roof or exterior wall.

(74) "Structural Analysis" is a branch of the physical sciences which uses the principles of mechanics in analyzing the impact of loads and forces and their effect on the physical properties of materials in the form of internal Stress and Strain.

(75) The **"Throat"** of a fireplace is the slot-like opening above the Firebox through which flames, smoke, and other products of combustion pass into the Smoke Chamber.

(75a) "Tribal Lands" means all lands of the Forest County Potawatomi Community, the legal title to which is held by the United States of America.

(75m) "UDC" means Wisconsin Uniform Dwelling Code.

(76) "Vent" means a vertical flue or passageway to Vent fuel-burning appliances.

(77) A **"Vent Connector"** is a connector between a fuel-burning appliance and the Chimney or Vent.

(77f) "Water-Resistive Barrier" means a material, including flashing, behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the permanent weather-resistant finish from further intruding into the exterior wall assembly.

(77m) "Waters of the State" includes those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other surface waters or groundwaters, natural or artificial, public, or private, within the state or over which the state claims jurisdiction.

(78) "Window" means a glazed opening in an exterior wall, including glazed portions of doors, within a conditioned space.

Subchapter IV — Approval and Inspection of One- and Two-Family Dwellings

SPS 320.08 Building permit.

(1) (INTENTIONALLY OMITTED)

(2) (INTENTIONALLY OMITTED)

SPS 320.09 Procedure for obtaining uniform building permit.

(1) APPLICATION. Application for a FCPC uniform building permit shall be on forms obtained from the Public Works Division. No application shall be accepted that does not contain all the information requested on the form.

(2) FILING OF PERMIT APPLICATIONS.

(a) ***Construction, Structural Alterations, or Installation of a Dwelling.***

1. A building permit application for the construction, Structural Alterations, or Installation of a Dwelling shall be filed with the Public Works Division.

2. A building permit shall not be required for any Construction, Structural Alterations, or Installation of a Dwelling performed by employees of the Public Works Division.

4. The building permit shall not be issued prior to the receipt of all completed forms, fees, plans, and documents required to process the application.

(c) ***General requirements.***

1. The permit application shall be reviewed by an Authorized Inspector.

2. A permit may be issued only after approval of the requirements under this section by an Authorized Inspector.

3. Dwellings for which a permit has been issued shall be inspected in accordance with SPS 320.10.

(3) FEES.

(a) Executive Council Approval

All fees under this Code will be subject to review and approval by the Executive Council on an annual basis.

(b) ***Inspection fees***.

1. Standard inspections (identified on the Inspection Checklist) will be provided at no cost to the Owner. UDC inspection agency fees, if necessary, shall be determined by contract between the Tribe and the agency, where the agency has been authorized to conduct inspections on behalf of the Tribe. The cost of repeat, special, or nonstandard inspections shall be borne by the Owner.

(4) PLAN SUBMITTALS. At least 2 sets of plans for all one- and two-family Dwellings shall be submitted to the Public Works Division for examination and approval at the time the building permit application is filed.

(5) REQUIRED PLANS. The required building plans shall be legible and drawn to scale or dimensioned and shall include all of the following:

(a) ***Site plan.*** The site plan shall show all of the following:

1. The location of the Dwelling and any other buildings, wells, surface waters and dispersal systems on the site with respect to property lines and surface waters adjacent to the site.

2. The areas of land-disturbing construction activity and the location of all Erosion and sediment control measures to be employed in order to comply with SPS 321.125.

3. The pre-construction ground surface slope and direction of runoff flow within the proposed areas of land disturbance.

(b) ***Floor plan.***

1. Floor plans shall be provided for each floor.

2. The following features shall be included on all floor plans:

a. The size and location of all rooms, doors, Windows, structural features, Exit passageways and Stairs.

b. The use of each room.

c. The location of plumbing fixtures, Chimneys, heating and cooling appliances, and a heating distribution layout.

d. The location and construction details of wall bracing on each building side and floor level. The details may consist of the Wall Bracing Compliance Worksheet or a legend showing which wall bracing method is used and the lengths or number of braced wall panels and demarcation of the circumscribed rectangles if more than one is used.

(c) ***Elevations.*** The elevations shall show all of the following:

1. The exterior appearance of the building, including the type of exterior materials.

2. The location, size, and configuration of doors, Windows, roof, Chimneys, exterior grade, footings, and Foundation walls.

(6) REQUIRED DATA.

(a) All plans submitted for approval shall be accompanied by sufficient data, calculations, and information to determine if the Dwelling will meet the requirements of this Code.

(b) The data and information for determining compliance with the energy conservation standards shall be submitted in a format Approved by the Public Works Division.

(d) The name of the initial downstream receiving water of the state from the Dwelling shall be identified, regarding Erosion and sediment control.

(7) MASTER PLANS.

(a) Where a Dwelling is intended to be identically and repetitively constructed at different locations, a master plan may be submitted for approval.

(b) The plans shall include plans and data as required under subs. (5) and (6).

(c) If the plans conform to the provisions of the Code, an approval and a master plan number shall be issued.

(d) The number issued may be used in lieu of submitting building plans for each location.

(e) A site plan shall be submitted for each location at the time of application for the building permit.

(8) APPROVAL OF PLANS.

(a) If the Public Works Division determines that the plans submitted for a one- or two-family Dwelling substantially conform to the provisions of this Code and other legal requirements, an approval shall be issued.

(b) The plans shall be stamped “conditionally Approved" by an Authorized Inspector who holds the respective credential for the plans reviewed.

(c) One copy shall be returned to the applicant and one copy shall be retained by the Public Works Division.

(d) The conditions of approval shall be indicated by a letter or on the permit.

(e) All conditions of the approval shall be met during construction.

(9) ISSUANCE AND POSTING OF PERMITS.

(a) ***Building permit.***

1. The building permit shall be issued if the requirements for filing and fees are satisfied, and the plans have been conditionally Approved.

3. A person applying for a building permit for work covered under ch. SPS 321 or 322 who is not the Owner who resides or will reside in the Dwelling or is not an employee of the FCPC Government applying on behalf of FCPC shall hold one of the following credentials:

a. A Dwelling Contractor certification.

b. A Dwelling Contractor — restricted certification.

c. A Dwelling Contractor financial responsibility certification.

d. A Dwelling Contractor financial responsibility — restricted certification.

4. A person applying for a building permit for work covered under ch. SPS 321 or 322 who is not the Owner who resides or will reside in the Dwelling shall hold or engage, as an employee, a person who holds a certification issued by the Department as a Dwelling Contractor qualifier.

5. The permit shall expire 24 months after issuance if the Dwelling exterior has not been completed.

6. The name and license number of the Wisconsin master plumber responsible for the Installation of plumbing shall be entered on the permit by the Department at the time of issuance.

(c) ***Private onsite wastewater treatment systems.*** If the proposed construction requires connection to a private onsite wastewater treatment system, a building permit may not be issued unless conformance with SPS 383.25 (2) has first been determined.

Note: See Ch. SPS 325 Appendix A for a reprint of SPS 383.25 (2).

(d) ***Posting of permit.***

1. The Approved building permit shall be posted in a conspicuous place at the Dwelling site.

(10) DISAPPROVAL OF PLANS AND DENIAL OF PERMITS.

(a) ***General.*** Approval shall be denied if the Public Works Division determines that the building permit application or the plans do not substantially conform to the provisions of this Code and other legal requirements.

(b) ***Denial of application.*** A copy of the denied application, accompanied by a written statement specifying the reasons for denial, shall be sent to the applicant and to the Owner as specified on the building permit application.

(c) ***Stamping of plans.***

1. Plans which do not substantially conform to the provisions of the Code shall be stamped “not Approved."

2. One copy shall be returned to the person applying for the building permit and one copy shall be retained by the Public Works Division.

(d) ***Appeals.*** The applicant may appeal a denial of the application in accordance with the procedure outlined in SPS 320.21.

(11) TIME-SPAN FOR APPROVAL OR DENIAL. Action to approve or deny a building permit application shall be completed within 10 Business Days of receipt of all forms, fees, plans and documents required to process the application, and completion of other prerequisite permitting requirements. During this 10 Business Day period, if questions arise that may affect approval or denial of the permit, the required approval period will be paused until all questions are satisfactorily answered.

SPS 320.10 Inspections.

(1) INSPECTOR CERTIFICATION. All inspections, for the purpose of administering and enforcing this Code, shall be performed by the Public Works Division or its authorized representative.

(2) GENERAL INSPECTION REQUIREMENTS.

(a) ***General.*** Inspections shall be conducted by the Public Works Division or its authorized representative to determine if the construction or Installations conform to the conditionally Approved plans, the building permit application, and the provisions of this Code. For each individual inspection, a separate fee may be charged for any inspection after initial and one reinspection.

(b) ***Inspection notice.***

1. The applicant or an authorized representative shall request inspections from the Public Works Division.

2. Construction may not proceed beyond the point of inspection until the inspection has been completed.

3. Construction may proceed if the inspection has not taken place by the end of the fourth Business Day following the day of notification or as otherwise agreed between the applicant and the Public Works Division.

(3) INSPECTION TYPES.

(a) ***General***. The inspections described in pars. (b) to (i) shall be performed to determine if the work complies with this Code.

(b) ***Erosion control inspection***. Erosion control inspections shall be performed concurrently with all other required construction inspections. Additional inspections for Erosion control may be performed by the delegated authority.

(c) ***Foundation excavation inspection.***

1. The excavation for the Foundation shall be inspected after the placement of any forms or required reinforcement and prior to the placement of the permanent Foundation material.

2. If a drain tile system is required, by the Public Works Division or by groundwater levels in the excavation, the presence and location of bleeders used to connect the interior and exterior drain tile shall be inspected at the same time as the excavation.

Note: This excavation inspection may be used to determine the need for drain tile under SPS 321.17.

(d) ***Foundation reinforcement inspection***. The placement of reinforcement shall be inspected where the reinforcement is required for Code compliance.

(e) ***Foundation inspection***. The Foundation shall be inspected after completion. Where damp proofing, exterior insulation or drain tile are required for Code compliance, the Foundation shall be inspected prior to backfilling.

(f) ***Rough inspection.***

1. A rough inspection shall be performed for each inspection category listed under subd. 1. a. to e. after the rough work is constructed but before it is concealed.

a. The Basement floor area.

Note: The inspection of the Basement floor area should include the following: any underfloor plumbing, electrical, or HVAC; any interior drain tile with base course required under SPS 321.17; the structural base course for the floor slab if required under SPS 321.20; and the underfloor vapor retarder as required under SPS 322.38.

b. General construction, including framing.

c. Rough electrical.

d. Rough plumbing.

e. Rough heating, Ventilating and air conditioning.

2. All categories of work for rough inspections may be completed before the notice for inspection is given, provided the work has not been covered.

3. The applicant may request one rough inspection or individual rough inspections.

(g) ***Insulation inspection***. An inspection shall be made of the insulation and vapor retarders after they are installed but before they are concealed.

(h) ***Final inspection.***

1. The Dwelling may not be occupied until a final inspection has been made that finds no critical violations of this Code that could reasonably be expected to affect the health or safety of a person using the Dwelling, and an occupancy permit has been issued.

(i) ***Installation inspection***. An inspection shall be performed on the Installation of a Manufactured Home or Modular Home.

(4) NOTICE OF COMPLIANCE OR NONCOMPLIANCE.

(a) ***General.***

1. Notice of compliance or noncompliance with this Code shall be written on the building permit or another readily visible means and posted at the job site. Additionally, the notice may be delivered electronically if mutually agreed upon by the applicant and inspector.

2. Upon finding noncompliance, the Public Works Division shall also notify the applicant of record and the Owner, in writing, of the violations to be corrected. Alternatively, the notification may be delivered electronically if mutually agreed upon by the applicant and inspector.

3. Except as specified under par. (b), the Public Works Division shall order all cited violations corrected within 5 Business Days after notification, unless an extension of time is granted by the Public Works Division.

(b) ***Erosion and sediment control requirements.***

1. The time period allowed for compliance with the Erosion and sediment control provisions under SPS 321.125 shall be determined based on the severity of the noncompliance in relation to soil loss or potential damage to the Waters of the State.

2. The Land and Natural Resources Division may issue a special order directing an immediate cessation of construction work on other aspects of the Dwelling until compliance with the Erosion and sediment control provisions under SPS 321.125 is attained. Construction work may resume once the Erosion and sediment control compliance corrections are completed.

(5) VOLUNTARY INSPECTION. The Public Works Division or its authorized representative may, at the request of the Owner or the lawful occupant, enter and inspect Dwellings, subject to the provisions of this Code, to ascertain compliance with this Code.

SPS 320.11 Suspension or revocation of building permit.

(1) Suspension or Revocation

(a) The Public Works Division may suspend or revoke any building permit where it appears that the permit or approval was obtained through fraud or deceit, where the applicant has willfully refused to correct a violation order or where the inspector is denied access to the premises.

(b) No construction may take place on the Dwelling after suspension or revocation of the permit.

(2) Any person aggrieved by a determination made by the Public Works Division may appeal the decision in accordance with SPS 320.21.

SPS 320.13 Manufacture, sale, and Installation of homes.

(1) MANUFACTURE AND SALE. No Modular Home, Manufactured Building System, or component of the Building System subject to this part shall be installed on Tribal Lands unless it is Approved by the Public Works Division and/or meets the requirements of this Code and bears the Wisconsin insignia issued or a state seal or an insignia reciprocally recognized by the State of Wisconsin.

(2) INSTALLATION. A building permit shall be obtained in compliance with SPS 320.09 (1) to (5) (a) before any on-site construction falling within the scope of this Code is commenced for a Modular Home. The permit shall be issued in compliance with SPS 320.09 (9).

SPS 320.14 Approval procedures.

(1) APPLICATION FOR APPROVAL.

(a) An application for approval of any Modular Home, Building System or component shall be submitted to the Public Works Division in the form required by the Public Works Division, along with the appropriate fees in compliance with SPS 302.34.

(b) The Public Works Division shall review and make a determination on an application for approval of a Modular Home, Building System or component within 30 days.

(d) ***Unit identification***. Each Modular Home and major transportable section or component shall be assigned a serial number prior to delivery to Tribal Lands. The serial number shall be located on the Manufacturer's data plate.

(e) ***Manufacturer's data plate.*** The Manufacturer's data plate for Building Systems shall contain the following information, where applicable:

1. Manufacturer's name and address;

2. Date of Manufacture;

3. Serial number of unit;

4. Model designation;

5. Identification of type of gas required for appliances and directions for water and drain connections;

6. Identification of date of the Codes or standards complied with;

7. State insignia number;

8. Design loads;

9. Special conditions or limitations of unit;

10. Electrical ratings; instructions and warnings on voltage, phase, size and connections of units and grounding requirements.

Subchapter VI — Approval of Products

SPS 320.18 Building product approvals.

(1) VOLUNTARY APPROVAL.

(a) The Owner may voluntarily submit materials, equipment, and products regulated by this Code to the Public Works Division for a determine whether such materials, equipment, and/or products comply with the requirements of this Code.

1. Approval of materials, equipment and products shall be based on sufficient data, tests and other evidence that prove the material, equipment or product is in compliance with the standards specified in this Code.

2. Tests, compilation of data, and calculations for materials, equipment and products shall be conducted by a qualified independent third party.

(2) ALTERNATE APPROVAL.

(a) Materials, equipment and products which meet the intent of this Code and which are not Approved under sub. (1) shall be permitted if Approved in writing by the Public Works Division.

1. Approval of materials, equipment and products shall be based on sufficient data, tests, and other evidence that proves the material, equipment or product meets the intent of the standards specified in this Code.

2. Tests, compilation of data, and calculations for materials, equipment and products shall be conducted by a qualified independent third party.

(3) EXPERIMENTAL APPROVAL.

(a) The Public Works Division may allow use of an experimental material, equipment, or product for the purpose of proving compliance with the intent of this Code.

(b) The Public Works Division may require the submission of any information deemed necessary for review.

(c) The Public Works Division may limit the number of applications it will accept for approval of experimental materials, equipment, or products.

(d) Installations of a material, equipment or product under an experimental approval shall comply with all of the following:

1. Plans detailing the Installation for each project where the experimental material, equipment or product is to be used shall be submitted to the Public Works Division.

2. A copy of the experimental approval shall be attached to the submitted plans and Approved plans.

a. A letter of consent from the Owner of the Installation shall be attached to the submitted plans and Approved plans.

b. The letter under subd. 3. a. shall acknowledge that the Owner has received and read a copy of the experimental approval and is in compliance with all conditions of the approval.

4. A person responsible for construction of the project shall be designated in writing by the Owner.

5. The person designated as responsible for the construction of the project shall, upon completion of construction, certify in writing to the Public Works Division that the Installation is in compliance with the experimental approval, Approved plans, specifications, and data.

(e)

1. Any onsite inspections shall be performed by the Public Works Division, or other person authorized by the Public Works Division, at time intervals as specified by the Public Works Division, but not less than once a year. The inspector shall write an inspection report.

2. The Public Works Division may assess a fee for each inspection conducted under subd. 1.

(f) Five years and 6 months after the date of the completed Installation, the Public Works Division shall order the removal of the experimental material, equipment, or product, or issue an approval for the material, equipment, or product.

(4) REVIEW, APPROVAL, AND REVOCATION PROCESSES.

(a)

1. Upon receipt of a fee and a written request, the Public Works Division may issue an approval for a material, equipment, or product.

2. The Public Works Division shall review and make a determination on an application for approval after receipt of all forms, fees, plans, and information required to complete the review.

3. For voluntary and alternate approvals, a determination shall be made within 40 Business Day s of receipt of all required materials.

4. For an experimental approval, a determination shall be made within 6 months of receipt of all required materials.

(b)

1. The Public Works Division may include specific conditions in issuing an approval, including an expiration date for the approval.

2. Violations of the conditions under which an approval is issued shall constitute a violation of this Code.

(c) If the Public Works Division determines that the material, equipment, or product does not comply with this Code or the intent of this Code, or that an experimental approval will not be issued, the request for approval shall be denied in writing.

(e)

1. The Public Works Division may revoke or deny an approval of a material, equipment or product for any false statements or misrepresentations of relevant facts or data, unacceptability of a third-party providing information, or as a result of material, equipment, or product failure.

2. The Public Works Division may re-examine an Approved material, equipment or product and issue a revised approval at any time.

(g) An approval issued by the Public Works Division may not be construed as an assumption of any responsibility for defects in design, construction or performance of the Approved material, equipment, or product nor for any damages that may result.

(h) Fees for the review of a material, equipment or product under this section and any onsite inspections shall be submitted in accordance with the fee schedule contained in this Code.

(5) UNGRADED OR USED MATERIALS.

(a) Ungraded or used building materials may be used or reused as long as the material possesses the essential properties necessary to achieve the level of performance required by the Code for the intended use.

(b) The Public Works Division may require tests in accordance with sub. (1) or (2) at the Owner's expense as a condition of approval.

Subchapter VII — Variances, Appeals, Violations and Penalties

SPS 320.19 Petition for variance. The Public Works Division may grant a variance to a rule only if the variance does not result in lowering the level of health, safety and welfare established or intended by the rule.

(1) APPLICATION FOR VARIANCE. The applicant shall submit the petition for variance application to the Public Works Division. The following items shall be submitted when requesting a variance:

(a) A clear written statement of the specific provisions of this Code from which a variance is requested and the method of establishing equivalency to those provisions.

Note: A copy of the Petition for Variance is available upon request from the Public Works Division.

SPS 320.21 Appeals of orders, determinations, and for extension of time.

(2) APPEALS OF ORDERS AND DETERMINATIONS BY THE DEPARTMENT. Appeals of an order of the Public Works Division, including denials of application for permits, shall be made to the Public Works Division. The Public Works Division shall review and make a determination on an appeal within 60 Business Day s of receipt of all calculations and documents necessary to complete the review.

(3) EXTENSIONS OF TIME.

(a) The time for correction of cited orders as set out in SPS 320.10 shall automatically be extended in the event that an appeal of said orders is filed. The extension of time shall extend to the termination of the appeal procedure and for such additional time as the Public Works Division may allow.

(b) The Public Works Division may grant additional reasonable time in which to comply with a violation order.

(4) APPEALS OF SOIL EROSION CONTROL ORDERS BY THE LAND AND NATURAL RESOURCES DIVISION FOR CESSATION OF WORK.

(a) Appeals of orders for cessation of work issued under SPS 320.10 (4) may be made to the Land and Natural Resources Division. The Land and Natural Resources Division shall make a determination on such appeal within 3 Business Day s.

(c) If the Land and Natural Resources Division determines the site to be compliant with SPS 321.125, the order(s) shall be rescinded and work may commence.

SPS 320.22 Penalties and violations.

(1) VIOLATIONS. No person shall construct or alter any Dwelling in violation of any of the provisions of this Code.[1]

(a) ***Injunction.*** When violations occur, the Public Works Division may bring legal action to enjoin any violations.

(b) ***Ordinances.*** This Code shall not affect the enforcement of any ordinance or regulation, the violation of which occurred prior to the effective date of this Code.

(2) PENALTIES.

(a) In case of violation by any person, the Public Works Division may issue citations on citation forms Approved by the Executive Council. The penalty for any citations issued pursuant to this ordinance will be in accordance with the fine schedule Approved by the Executive Council on an annual basis.

Subchapter IX — Adoption of Standards

SPS 320.24 Adoption of standards.

[1] Public Works Division employees performing any work subject to this Code shall comply with all applicable standards contained in the Code or be subject to disciplinary action imposed by the Division, up to and including termination. Such Public Works Division employees shall not be subject to the provisions of SPS 320.22.

(2) ADOPTION OF STANDARDS. The standards referenced in Tables 320.24-1 to 320.24-13 are incorporated by reference into this chapter.

Table 320.24-1 - See PDF for table
Table 320.24-3 - See PDF for table
Table 320.24-4 - See PDF for table
Table 320.24-5 - See PDF for table
Table 320.24-6 - See PDF for table
Table 320.24-6m - See PDF for table
Table 320.24-7 - See PDF for table
Table 320.24-9 - See PDF for table
Table 320.24-10 - See PDF for table
Table 320.24-11 - See PDF for table
Table 320.24-12 - See PDF for table
Table 320.24-13 - See PDF for table

Table 320.24-1

ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333 www.concrete.org
Standard Reference Number	**Title**
1. 318-14	Building Code Requirements for Structural Concrete
2. 332-14	Residential Code Requirements for Structural Concrete
3. 530-13	Building Code Requirements for Masonry Structures
4. 530.1-13	Specification for Masonry Structures

Table 320.24-3

AISC	American Institute of Steel Construction One East Wacker Drive, Suite 700 Chicago, IL 60601 www.aisc.org
Standard Reference Number	**Title**
ANSI/AISC 360-10	Specification For Structural Steel Buildings

Table 320.24-4

ASTM	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA 19428-2959 www.astm.org
Standard Reference Number	**Title**
1. C62-13a	Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
2. C90-14	Standard Specification for Load-bearing Concrete Masonry Units
3. C216-14	Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale)
4. C270-14a	Standard Specification for Mortar for Unit Masonry
5. C476-10	Standard Specification for Grout for Masonry
6. C652-14	Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
7. D226/D226M-09	Standard Specification for Asphalt-Saturated Organic Felt Used In Roofing And Water Proofing
8. D3462/D3462M-10a	Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules
9. D4869/D4869M-15	Standard Specification for Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing

Table 320.24–5

ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 www.asce.org
Standard Reference Number	**Title**
SEI/ASCE 32–01	Design and Construction of Frost–Protected Shallow Foundations

Table 320.24–6

ASHRAE	American Society of Heating, Refrigerating, and Air–conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org
Standard Reference Number	**Title**
1. 2013 Fundamentals	ASHRAE Handbook — Fundamentals
2. 2011 HVAC Applications	ASHRAE Handbook — HVAC Applications
3. 2012 HVAC Systems & Equipment	ASHRAE Handbook — HVAC Systems & Equipment

Table 320.24–6m

AWC	American Wood Council 222 Catoctin Circle SE Suite 201 Leesburg, VA 20175 www.americanwoodcouncil.org
Standard Reference Number	**Title**
1. ANSI/AWC NDS–2015	National Design Specification For Wood Construction
2. ANSI/AWC PWF – 2007	Permanent Wood Foundation Design Specification

Table 320.24–7

ICC	The International Code Council 500 New Jersey Avenue, NW, 6th Floor Washington, D.C. 20001 www.iccsafe.org
Standard Reference Number	**Title**
ICC 400–2012	Standard on the Design and Construction of Log Structures

Table 320.24–9

NAIMA	North American Insulation Manufacturers Association 11 Canal Canter Plaza, Suite 103 Alexandria, VA 22314 www.naima.org
Standard Reference Number	**Title**
1. 3rd Edition, 2002	Fibrous Glass Residential Duct Construction Standards

Table 320.24–10

NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269 www.nfpa.org
Standard Reference Number	**Title**
1. NFPA 13D 2013	Standard for the Installation of Sprinkler Systems in One– and Two–Family Dwellings and Manufactured Homes
2. NFPA 54/ANSI Z223.1 2015	National Fuel Gas Code

Table 320.24–11

NIST	National Institute of Standards and Technology U.S. Department of Commerce Washington, D.C. 20234 http://catalog.hathitrust.org/Record/009487395
Standard Reference Number	**Title**
1. NBS Building Science Series 87, July 1976	Model Documents for the Evaluation, Approval, and Inspection Of Manufactured Buildings

Table 320.24–12

SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Drive Chantilly, VA 20151–1219 www.smacna.org
Standard Reference Number	**Title**
1. Seventh Edition, 1998	Residential Comfort System Installation Standards Manual
2. Seventh Edition, 2003	Fibrous Glass Duct Construction Standards
3. Third Edition, 2005	HVAC Duct Construction Standards — Metal and Flexible

Table 320.24–13

TPI	Truss Plate Institute, Inc. 218 North Lee Street, Suite 312 Alexandria, VA 22314 www.tpinst.org
Standard Reference Number	**Title**
ANSI/TPI 1–2007	National Design Standard for Metal Plate Connected Wood Truss Construction

Chapter SPS 321
CONSTRUCTION STANDARDS

Subchapter I — Scope

SPS 321.01 Scope.

Subchapter II — Design Criteria

SPS 321.02 Loads and materials.
SPS 321.03 Exits.
SPS 321.035 Interior circulation.
SPS 321.04 Stairways and elevated areas.
SPS 321.042 Ladders.
SPS 321.045 Ramps.
SPS 321.05 Natural light and natural ventilation.
SPS 321.06 Ceiling Height.
SPS 321.07 Attic and crawl space access.
SPS 321.08 Fire separation and Dwelling Unit separation.
SPS 321.085 Fire Blocking.
SPS 321.09 Smoke detectors.
SPS 321.095 Automatic fire sprinklers.
SPS 321.097 Carbon monoxide detectors.
SPS 321.10 Protection against decay and termites.
SPS 321.11 Foam plastic.
SPS 321.115 Installation of elevators or dumbwaiters.

Subchapter III — Excavations

SPS 321.12 Drainage.
SPS 321.125 Erosion control and sediment control.
SPS 321.13 Excavations adjacent to adjoining property.
SPS 321.14 Excavations for footings and Foundations.

Subchapter IV — Footings

SPS 321.15 Footings.
SPS 321.16 Frost protection.
SPS 321.17 Drain tiles.

Subchapter V — Foundations

SPS 321.18 Foundations.

Subchapter VI — Floors

SPS 321.19 Floor design.
SPS 321.20 Concrete floors.
SPS 321.203 Garage floors.
SPS 321.205 Wood floors in contact with the ground.
SPS 321.21 Precast concrete floors.
SPS 321.22 Wood frame floors.
SPS 321.225 Decks.

Subchapter VII — Walls

SPS 321.23 Wall design.
SPS 321.24 Exterior covering.
SPS 321.25 Wood frame walls.
SPS 321.26 Masonry walls.

Subchapter VIII — Roof and Ceilings

SPS 321.27 Roof design and framing.

SPS 321.28 Weather protection for roofs.

Subchapter IX — Fireplace Requirements

SPS 321.29 Masonry fireplaces.
SPS 321.30 Masonry Chimneys.
SPS 321.32 Factory-built fireplaces.

Subchapter X — Construction in Floodplains

SPS 321.33 Construction in Floodplains.
SPS 321.34 Construction in Coastal Floodplains.

Subchapter XI — Installation of Manufactured Homes

SPS 321.40 Installation standards.

Subchapter I — Scope

SPS 321.01 Scope. The provisions of this chapter shall apply to the design and construction of all one- and 2-family Dwellings.

Subchapter II — Design Criteria

SPS 321.02 Loads and materials. Every Dwelling shall be designed and constructed in accordance with the requirements of this section.

(1) DESIGN LOAD. Every Dwelling shall be designed and constructed to support the actual Dead Load, Live Loads and wind loads acting upon it without exceeding the allowable Stresses of the material. The construction of buildings and structures shall result in a system that provides a complete load path capable of transferring all loads from point of origin through the load-resisting elements to the Foundation.

(a) ***Dead Loads.*** Every Dwelling shall be designed and constructed to support the actual weight of all components and materials. Earth-sheltered Dwellings shall be designed and constructed to support the actual weight of all soil loads.

(b) ***Live loads.***

1. `Floors and ceilings.' Floors and ceilings shall be designed and constructed to support the minimum Live Loads listed in Table 321.02. The design load shall be applied uniformly over the component area. - See PDF for table

2. `Snow loads.' Roofs shall be designed and constructed to support the minimum snow loads listed on the zone map. The loads shall be assumed to act vertically over the roof area projected upon a horizontal plane.

(c) ***Wind loads.*** Dwellings shall be designed and constructed to withstand either a horizontal and uplift pressure of 20 pounds per square foot acting over the surface area or the wind loads determined in accordance with ASCE 7–05, *Minimum Design Loads for Buildings and Other Structures*.

Note: ASCE 7–05 allows for substantial reduction from 20 psf as applied to the surface area.

(2) METHODS OF DESIGN. All Dwellings shall be designed by the method of structural analysis, or the method of accepted practice specified in each part of this Code.

(3) STRUCTURAL STANDARDS.

(a) ***General.*** Design, construction, installation, practice, and structural analysis shall conform to the following nationally recognized standards.

(b) ***Wood.***

1. Except as provided in subd. 1. a. and b., structural lumber, glue-laminated timber, timber pilings and fastenings shall be designed in accordance with the "National Design Specification for Wood Construction" and the "Design Values for Wood Construction," a supplement to the National Design Specification for Wood Construction.

Figure 321.02
ZONE MAP FOR ROOF LOADS - See PDF for diagram

a. Section 2.2.5.3. The cumulative effects of short time loads, such as snow, shall be considered in determining duration of load. For snow load, no greater duration of load factor than 1.15 shall be used.

b. Section 4.1.7. The provisions of this section shall also apply to reused lumber. Reused lumber shall be considered to have a duration of load factor of 0.90.

2. Span tables for joists and rafters printed in Ch. SPS 325 Appendix A or Approved by the Department may be used in lieu of designing by structural analysis.

3. Sawn lumber that is not graded in accordance with the standards under subd. 1., shall use the NDS published allowable design Stresses for the lumber species using grade number 3 when used for studs, stringers, rafters, or joists and may use grade number 1 when used for beams, posts, or timbers.

(c) ***Structural steel.*** The design, fabrication, and erection of structural steel for buildings shall conform to Specification for Structural Steel Buildings and the provisions of the accompanying commentary as adopted under Table 320.24-3.

(d) ***Concrete.*** Plain, reinforced, or prestressed concrete construction shall conform to the following standards:

1. ACI Standard 318, Building Code Requirements for Structural Concrete.

2. ACI Standard 332, Residential Code Requirements for Structural Concrete.

Note: Concrete construction in one- and two-family Dwellings should meet the standards established in ACI 332. Construction means, materials, or methods not addressed in ACI 332 should meet the standards established in ACI 318.

(e) ***Masonry.*** The design and construction of masonry shall conform to the following standards:

1. ACI 530, Building Code Requirements for Masonry Structures.

2. ACI 530.1, Specification for Masonry Structures.

(f) ***Engineered structural components.*** Engineered structural components shall be used in accordance with structural analysis or with load tables supplied by the manufacturer, provided those load tables were developed using structural analysis or load testing.

(g) ***Whole logs.*** Dwellings constructed of whole logs shall conform to ICC 400, Standard on the Design and Construction of Log Structures.

Note: This standard requires the minimum log diameter to be 8 inches.

(h) ***Fasteners.***

1. All Building Components shall be fastened to withstand the Dead Load, Live Load, snow load, and wind load.

2. Fasteners shall comply with the schedule listed in Table 321.02-2.

Note: Other fastening methods may be allowed if engineered under SPS 321.02 (3).

Table 321.02-2

MINIMUM FASTENER SCHEDULE TABLE

Other interior and exterior panel products and finishes installed per manufacturer requirements. For engineered connectors, use manufacturer's specified fasteners. - See PDF for table - See PDF for table

1. All nails are smooth-common, box or deformed shank except where otherwise stated.

2. Nail is a general description and may be T-head, modified round head or round head.

3. Staples are 16-gauge wire, unless otherwise noted, and have a minimum 7/16 " o.d. crown width.

4. Staples shall be spaced at not more than 10 " o.c. at intermediate supports for floors.

5. Apply vertically 4' x 8' or 4' x 9 ' panels.

(4) ALTERNATE MATERIALS AND STANDARDS. No part of this Code is intended to prohibit or discourage use of alternate, equivalent materials or standards; or the construction of innovative Dwellings such as a Dwelling built below ground, a geodesic dome, a concrete house, a fiberglass house, or any other nonconventional structure.

Note: Examples of materials addressed by this subsection include structural insulated panels that are used in accordance with the manufacturer's instructions or structural analysis, and cold-formed steel framing complying with AISI S230 *Standard for Cold-Formed Steel Framing — Prescriptive Method for One- and Two- Family Dwellings*.

SPS 321.03 Exits. Exits, doors and hallways shall be constructed as specified in this section.

(1) EXITS FROM THE FIRST FLOOR.

(a) Except as allowed under par. (h), every Dwelling Unit shall be provided with at least 2 Exit doors accessible from the First Floor.

(b) At least one of the Exits shall discharge to grade and may not go through a Garage. This Exit may include interior or exterior Stairs.

Note: Under this paragraph, only one of the two Exit doors that are addressed in par. (a) is required to exit directly to grade.

(c) Any Exit that does not comply with par. (b) may discharge to an outside Balcony that complies with sub. (8).

(d) Any Exit that does not comply with par. (b) may discharge into an Attached Garage provided the Garage has an Exit door that discharges to grade. An overhead Garage door may not be used as an Exit door.

(e) Except as allowed under pars. (f) and (h), the 2 required Exit doors shall be separated by at least the greater of the following distances:

1. One-third the length of the longest diagonal of the floor in plan view, exclusive of an Attached Garage.

2. 20 feet.

Note: See Ch. SPS 325 Appendix A for examples of Exit separation design.

(f)

1. First Floor levels that do not meet the separation requirements under par. (e), shall have at least one egress Window complying with sub. (6) on that floor level.

2. An egress Window to comply with subd. 1. shall be separated from at least one door on the First Floor by one of the distances under par. (e).

3. If First Floor levels that do not meet the separation requirements under par. (e) contain one or more sleeping rooms, each sleeping room shall have at least one egress Window complying with sub. (6).

(g)

1. The Exit separation distance required under par. (e) shall be calculated or measured as a straight line from the midpoint of one doorway to the midpoint of the other doorway.

2. For exiting through an Attached Garage, the separation distance shall be measured using the door connecting the Garage and the Dwelling. Distance within the Garage shall be ignored.

(h)

1. Dwellings consisting of no more than a First Floor with a maximum floor area of 400 square feet and a Loft area not exceeding half of the First Floor area, shall be provided with at least one Exit door leading directly to the exterior and at least one egress Window that complies with sub. (6).

2.

a. Dwellings that meet the size restrictions under subd. 1., are not required to meet the exit separation requirements under par. (e) or (f).

b. If a Dwelling that meets the size restrictions under subd. 1., has more than one room on the First Floor, the door, and the egress Window shall be located in different rooms.

3. One of the Exit doors required in par. (a) may be omitted for a Dwelling Unit that has one or more egress Windows on the First Floor. If there are bedrooms, each must have a Window that complies with sub. (6).

(2) EXITS FROM THE SECOND FLOOR.

(a) At least 2 Exits shall be provided from the second floor. At least one of the Exits shall be a Stairway or ramp and lead to the First Floor or discharge to grade. The second Exit may be via a Stairway or ramp that discharges to grade, or to a Balcony which complies with sub. (8), or to a Deck that complies with SPS 321.225 and that is no more than 15 feet above the grade below.

(b) Windows that comply with sub. (6) may be provided in each second floor bedroom — or in another location on the second floor if there are no bedrooms on that floor — in lieu of the second Exit from that floor.

(c) Where the second floor of a building is the lowest floor level in a Dwelling Unit, as in an up-and-down duplex, no Exit from the unit may go through another Dwelling Unit or other party's occupancy on the First Floor.

(3) EXITS ABOVE THE SECOND FLOOR.

(a) Except as provided under pars. (b) and (c), each habitable floor above the second floor shall be provided with at least 2 Exits that meet all of the following requirements:

1. The Exits shall be Stairways or ramps that lead to the second floor or discharge to grade.

2. The Exits shall be located such that an Exit is accessible to the second floor if another Exit is blocked.

(b) A second Stairway or ramp Exit is not required for habitable areas on a third floor that meet all of the following requirements:

1. The habitable area consists of a single room.

Note: Non-habitable areas, such as closets and bathrooms may be partitioned off.

2. The room is not used for sleeping.

3. The habitable area has a floor area of 400 square feet or less.

4. There is at least one egress Window meeting the requirements of sub. (6) in the habitable area.

(c) A second Stairway or ramp Exit is not required for habitable areas on a third floor that meet all of the following requirements:

1. The Dwelling is fully sprinklered in accordance with NFPA 13R or NFPA 13D.

2. If a required Exit includes an Attached Garage, the Garage shall be sprinklered.

(4) EXITS FROM LOFTS.

(a) At least one Stairway Exit shall be provided, to the floor below, for a Loft exceeding 400 square feet in area.

(b) At least one Stairway or ladder Exit shall be provided to the floor below for a Loft, 400 square feet or less, in area.

(5) EXITS FROM BASEMENTS AND GROUND FLOORS.

(a) ***General.*** Except as provided in par. (b), all Basements and Ground Floors shall be provided with at least one Exit of the following types:

1. A door to the exterior of the Dwelling.

2. A Stairway or ramp that leads to the floor above.

(b) ***Basements and Ground Floors used for sleeping.***

1. Basements and Ground Floors used for sleeping shall be provided with at least 2 Exits.

2. The Exits shall be located as far apart as practical.

3. The Exits may not be accessed from the same ramp or Stairway.

4. In addition to the Exit type required under par. (a), the second Exit from a Basement or Ground Floor used for sleeping shall be one of the following types:

a. A door to the exterior of the Dwelling.

b. A Stairway or ramp that leads to the floor above.

c. A Stairway that leads to a Garage provided the Garage has an Exit door other than the overhead door.

d. An egress Window that complies with sub. (6), located in each bedroom.

(6) WINDOWS USED FOR EXITING. Windows which are installed for Exit purposes shall comply with the requirements of this subsection.

(a) The Window shall be openable from the inside without the use of tools or the removal of a sash. If equipped with a storm or screen, it shall be openable from the inside.

(b)

1. The nominal size of the net clear Window opening shall be at least 20 inches by 24 inches irrespective of height or width. Nominal dimensions shall be determined by rounding up fractions of inches if they are ½-inch or greater or rounding down fractions of inches if they are less than ½-inch.

2. No portion of the Window, including stops, stools, meeting rails and operator arms, shall infringe on the required opening.

(c) The area and dimension requirements of par. (b) may be infringed on by a storm Window.

(d)

1. For any Window used for Exiting, the lowest point of clear opening shall be no more than 60 inches above the floor.

2. If the lowest point of clear opening is more than 46 inches above the floor, a permanent platform or fixture shall be installed such that a flat surface at least 20 inches wide and 9 inches deep is located no more than 46 inches directly below the clear opening.

3. The topmost surface of the platform or fixture shall be no more than 24 inches above the floor.

4. The topmost surface of the platform or fixture shall support a Live Load of at least 200 pounds.

5. A Stair used for the sole purpose of reaching the top of the platform or fixture is exempt from the requirements of SPS 321.04.

(e)

1. An egress Window with any point of clear opening below adjacent grade shall be provided with an areaway in accordance with this section.

2. The width of the areaway shall be at least equal to the width of the Window.

3. The areaway shall be a minimum of 36 inches measured perpendicular from the outer surface of the below grade wall.

4. If the bottom of the areaway is more than 46 inches below adjacent grade or the top of the areaway enclosure, the areaway shall be provided with a ladder or Stair to aid egress. Stairs used to comply with this section are exempt from the requirements of SPS 321.04.

5.

a. Ladders or other Stairs used to comply with subd. 4. may infringe on the required area of the areaway by a maximum of 6 inches.

b. Ladder rungs shall have a minimum inside width of at least 12 inches and shall project at least 3 inches from the wall behind the ladder.

c. Ladder rungs shall be able to support a concentrated load of 200 pounds.

d. Ladder rungs shall have a maximum rise of 12 inches between rungs and shall extend to within 12 inches of exterior grade.

6. The areaway shall be constructed such that water entering the areaway does not enter the Dwelling.

(f) An egress Window under a Deck or Porch shall discharge through a clear path of at least 36 inches in height and 36 inches in width, and no more than 15 feet in length, to a yard or open space.

Note: Under this paragraph, there is no maximum height above grade for an egress Window. Similarly, egress Windows are not prohibited from discharging to a roof, regardless of the slope of the roof.

(7) DOORS USED FOR EXITING.

(a) Doors used for exiting from a Dwelling shall meet the following dimensions:

1. At least one Exit door shall be a swing-type door at least 80 inches high by 36 inches wide.

2. Except as allowed under subds. 3. and 4., other required Exit doors shall be at least 76 inches high by 32 inches wide.

3. Where double doors are used as a required Exit, each door leaf shall provide a clear opening at least 30 inches wide and be at least 76 inches high.

4. Where sliding doors are used as a required Exit, the clear opening shall be at least 29 inches wide and be at least 76 inches high.

(b) All Exit doors shall be openable from the interior without the use of a key.

(8) BALCONIES.

(a) Balconies shall be made of concrete, metal or wood which is treated, protected or naturally decay-resistive in accordance with SPS 321.10.

(b) Balconies shall be provided with Guards in accordance with SPS 321.04 (3).

(c) Balconies which are required for Exit purposes shall also comply with all of the following requirements:

1. The Balcony Guard shall terminate no more than 46 inches above the floor level of the Balcony.

2. The floor level of the Balcony shall be no more than 15 feet above the grade below.

3. The floor of the Balcony shall have minimum dimensions of 3 feet by 3 feet. The Guard and its supports may infringe on the dimensions of the required area no more than 4.5 inches.

(9) SPLIT LEVEL DWELLINGS. In determining the Exit requirement in a split-level Dwelling, all levels that are to be considered a single Story shall be within 5 feet of each other.

(10) TWO-FAMILY DWELLINGS. In a 2-family Dwelling, each Dwelling Unit shall be provided with Exits in compliance with this section.

(11) EXITS TO COURTYARDS. No Exit may discharge to a courtyard having a perimeter that is entirely enclosed by exterior building walls or other obstructions that prevent pedestrian passage.

SPS 321.035 Interior circulation.

(1) DOORS AND OPENINGS. All doors and openings to the following areas shall be at least 80 inches high and provide either a net clear opening width of 30 inches or be a 32-inch door:

(a) Except as provided under pars. (b) and (c), all entrances into Common Use Areas.

(b) At least 50% of the bedrooms.

(c)

1. At least one full bathroom, including doors or openings to a sink, toilet and tub or shower. If this bathroom is accessible only through a bedroom, the bedroom door shall meet the minimum width requirements of this section.

2. If one or more full bathrooms are provided on the First Floor, the bathroom meeting the requirements under this section shall be on the First Floor.

Note: This section does not require a full bathroom on the First Floor.

(2) HALLWAYS.

(a) Except as allowed under par. (b), the clear width of hallways shall be at least 36 inches.

(b) The following are allowed to infringe on the required clear width of a hallway:

1. Door hardware and finish trim.

2. Handrails may infringe into the minimum width of a hallway up to 4½ inches on each side.

3. Heating registers may infringe into the minimum width of a hallway up to 4½ inches and no part of the register may be more than 38 inches above the floor.

4. Ducts, pipes, light fixtures, structural features, and corner treatments that are within 84 inches of the floor may infringe into the minimum width of a hallway by a maximum of 4½ inches on each side.

5. Unlimited infringements are allowed in a hallway more than 84 inches above the floor.

(3) KITCHENS.

(a) There shall be at least 30 inches of clearance between a wall, a permanently installed Kitchen island, permanently installed Kitchen cabinets and the following Kitchen appliances, if provided:

1. A range, cook top or oven.

2. A sink, refrigerator, or freezer.

(b) Measurements shall be taken from the face of the wall, island, cabinet, or appliance, ignoring knobs and handles.

Note: See ICC/ANSI A117.1 chapter 10 for more guidelines relating to doors and accessible routes. Under that standard, doors must be at least 80-inches in height and provide a minimum net clear opening of 31¾-inches in width in order to provide accessibility for people with disabilities.

SPS 321.04 Stairways and elevated areas.

(1) SCOPE.

(a) ***General.*** Except as provided under par. (b), the following Stairways shall conform to the requirements of this section.

1. Every interior and exterior Stairway attached to, or supported by any part of the structure covered under this Code.

2. Tub access Stairs, unless they are an integral part of an Approved plumbing product.

(b) ***Exceptions***. The following Stairways are not required to comply with the requirements of this section:

1. Stairways leading to non-habitable Attics or crawl spaces.

2. Non-required Stairways connecting the Basement directly to the exterior of the structure without communicating with any other part of the structure.

(2) DETAILS.

(a) ***Width.***

1. Except for spiral Staircases under subd. 2., Stairways shall measure at least 36 inches in width. Handrails and associated trim may project a maximum of 4.5 inches into the required width at each side of the Stairway. The minimum clear width at and below the Handrail, including at treads and Landings, may not be less than 31.5 inches where a Handrail is installed on one side, and 27 inches where Handrails are provided on both sides.

2. Spiral staircases shall be at least 26 inches wide measured from the outer edge of the supporting column to the inner edge of the Handrail.

(b) ***Riser height.***

1.

a. Except for spiral staircases under subd. 2., risers may not exceed 8 inches in height measured vertically from tread to tread.

b. At the top and bottom of a Flight, measurement shall be taken from the top of the nosing to the finished floor surface unless the finished surface is carpeting, in which case measurement shall be made to the hard surface below the carpeting.

2. Risers in spiral staircases may not exceed 9.5 inches in height measured vertically from tread to tread.

(c) ***Tread depth.***

1. `Rectangular treads.' Rectangular treads shall have minimum tread depth of 9 inches measured horizontally from nosing to nosing.

2. `Spiral staircase treads.' Spiral staircase treads shall have a minimum tread depth of 7 inches from nosing to nosing measured at a point 12 inches from the outer edge of the center column.

3. `Winder treads in series.' Two or more winder treads may be placed immediately adjacent to each other anywhere in a Stairway provided both of the following conditions are met:

a. The winder treads shall have a minimum tread depth of 7 inches measured at a point 12 inches from the narrow end of the tread.

b. The depth of the immediately adjoining winder treads shall be equal at a point 12 inches from the narrow end of the tread or inside face of spindles or balusters.

c. Winder treads may not be used on a straight Stairway.

4. `Individual winder treads.'

a. An individual winder tread may be placed between rectangular treads or at the end of a Flight of rectangular treads provided the tread depth is at least 9 inches, when measured at a distance of 12 inches from the narrow end of the tread or from the inside face of the wall.

b. There may be more than one individual winder tread in a Stairway.

c. Winder treads may not be used on a straight Stairway.

(d) ***Headroom.***

1. Stairways shall be provided with a minimum headroom clearance of 80 inches measured vertically from a line parallel to the nosing of the treads to the ceiling, soffit, or any overhead obstruction directly above that line.

2. The headroom clearance shall be maintained over an intermediate Landing.

3. The headroom clearance shall be maintained over a Landing that is at the top or bottom of a Stairway for a minimum distance of 36 inches in the direction of travel of the Stairway.

(e) ***Uniformity.***

1. Within a Stairway Flight, the greatest tread depth may not exceed the smallest tread depth by more than 3/8 inch and the greatest riser height may not exceed the smallest riser height by more than 3/8 inch.

2. The allowed variation in uniformity under subd. 1. may not be used to exceed the maximum riser height under par. (b) or to decrease the minimum tread depth under par. (c).

(f) ***Open risers.*** Stairways with open risers shall be constructed to prevent the through-passage of a sphere with a diameter of 4 inches or larger between any 2 adjacent treads.

(g) ***Walking surface****.* The walking surface of Stair treads and Landings shall be a planar surface that is free of lips or protrusions that could present a tripping hazard.

(3) **HANDRAILS AND GUARDS.**

(a) ***General.***

1. A Flight of Stairs with more than 3 risers shall be provided with at least one Handrail for the full length of the Flight.

2. Guards shall be provided on all open sides of Stairs consisting of more than 3 risers and on all open sides of areas that are elevated more than 24 inches above the floor or exterior grade.

Note: A Handrail provided at 30 to 38 inches above the tread nosing meets the height requirement for a Guard on a Stairway.

3.

a. Except as provided in subd. 3. b., Guards shall be constructed to prevent the through-passage of a sphere with a diameter of 4 3/8 inches, when applying a force of 4 pounds.

b. The triangular area formed by the tread, riser and bottom rail shall have an opening size that prevents the through-passage of a sphere with a diameter of 6 inches, when applying a force of 4 pounds.

c. Rope, cable, or similar materials used in Guard infill shall be strung with maximum openings of 3 1/2 inches with vertical supports a maximum of 4 feet apart.

Note: In some cases, the vertical supports could be simple cable stays that offer vertical support to the rope or cable span. Structural posts must be supplied to provide the rail with the minimum 200-pound load resistance, as well as to resist the tensile loads exerted by the tightened rope or cable.

4.

a. Handrails and Guards shall be designed and constructed to withstand a 200-pound load applied in any direction.

b. Handrail or Guard infill components, balusters and panel fillers shall withstand a horizontally applied perpendicular load of 50 pounds on any one-foot-square area.

c. Glazing used in Handrail or Guard assemblies shall be safety glazing.

5. Exterior Handrails and Guards shall be constructed of metal, decay resistant or pressure-treated wood, or shall be protected from the weather.

(b) ***Handrails.***

1. `Height.'

a. Handrails shall be located at least 30 inches, but no more than 38 inches above the nosing of the treads, except as provided in subds. 1. b. to d. Measurement shall be taken from the hard structural surface beneath any finish material to the top of the rail. Variations in uniformity are allowed only when a rail contacts a wall or newel post or where a turnout or volute is provided at the bottom tread.

b. A volute, turnout, or starting easing that does not comply with subd. 1. a. may extend over the lowest tread.

c. Transition fittings on Handrails may extend above the 38-inch height limit.

d. Where Handrail fittings or bendings are used to provide a continuous transition between Flights, or at winder treads, or from a Handrail to a Guard, or at the start of a Flight, the height at the fittings or bendings may exceed 38 inches.

2. `Clearance.' The clearance between a Handrail and the wall surface shall be at least 1 1/2 inches.

3. `Winders.'

a. Except as provided under subd. 3. b., the required Handrail on winder Stairs shall be placed on the side where the treads are wider.

b. Where all winder treads in a Flight have a depth of at least 9 inches from nosing to nosing measured at a point 12 inches from the narrow end of the tread, the required Handrail may be located on either side of the Stairway.

4. `Projection.' Handrails and associated trim may project into the required width of Stairs and Landings a maximum of 4 1/2 inches on each side.

5. `Size and configuration.' Handrails shall be symmetrical about the vertical centerline to allow for equal wraparound of the thumb and fingers.

a. Handrails with a round or truncated round cross-sectional gripping surface shall have a maximum whole diameter of 2 inches.

b. Handrails with a rectangular cross sectional gripping surface shall have a maximum perimeter of 6 1/4 inches with a maximum cross sectional dimension of 2 7/8 inches.

c. Handrails with other cross sections shall have a maximum cross-sectional dimension of the gripping surface of 2 7/8 inches with a maximum linear gripping surface measurement of 6 1/4 inches and a minimum linear gripping surface of 4 inches.

Note: See Ch. SPS 325 Appendix A for further information on Handrail measurement.

6. `Continuity.' Handrails shall be continuous for the entire length of the Stairs except in any one of the following cases:

a. A Handrail may be discontinuous at an intermediate Landing.

b. A Handrail may have newel posts.

c. A Handrail may terminate at an intermediate wall provided the lower end of the upper rail is returned to the wall or provided with a flared end, the horizontal offset between the 2 rails is no more than 12 inches measured from the center of

the rails, and both the upper and lower rails can be reached from the same tread without taking a step.

(c) ***Guards.***

1. `Application.'

a. All openings between floors, and open sides of Landings, platforms, balconies, or Porches that are more than 24 inches above grade or a floor shall be protected with Guards.

b. The requirements under subd. 1. a. apply where insect screens are the only means of enclosure or protection for a surface that is more than 24 inches above grade or a floor.

c. For exterior applications, the 24-inch vertical measurement shall be taken from the lowest point within 3 feet horizontally from the edge of the Deck, Landing, Porch, or similar structure.

d. This paragraph does not apply to Window wells, egress wells, and retaining walls.

2. `Height.' Guards shall extend to at least 36 inches above the floor or to the underside of a Stair Handrail complying with SPS 321.04 (3) (b). Measurement shall be taken from the hard structural surface beneath any finish material to the top of the Guard.

3. `Opening size.' Guards shall be constructed to prevent the through-passage of a sphere with a diameter of 4 3/8 inches, when applying a force of 4 pounds.

(4) LANDINGS.

(a) ***Intermediate Landings.***

1. A level intermediate Landing shall be provided in any Stairway with a height of 12 feet or more.

2. Intermediate Landings that connect 2 or more straight Flights of Stairs, or 2 Flights of Stairs at a right angle, shall be at least as wide as the treads and shall measure at least 36 inches in the direction of travel.

3. Curved or irregular Landing shall have a radius of at least 36 inches.

4. Curved or irregular Landings shall have a minimum straight-line measurement of 26 inches between the nosing of the 2 connecting treads measured at a point 18 inches from the narrow end of the Landing measured along the nosing of the 2 treads.

(b) ***Landings at the top and base of Stairs.*** A level Landing shall be provided at the top and base of every Stairs except as provided in par. (d). The Landing shall be at least as wide as the treads and shall measure at least 3 feet in the direction of travel.

(c) ***Doors at Landings***. Except as provided in subds. 1. to 3. and par. (d), level Landings shall be provided on each side of any door located at the top or base of a Stair, regardless of the direction of swing. In the following exceptions, a Stairway between a Dwelling and an Attached Garage, Carport or Porch is considered to be an interior Stair:

1. A Landing is not required between the door and the top of interior Stairs if the door does not swing over the Stairs.

2. A Landing is not required between the door and the top of an interior Stairs of 1 or 2 risers regardless of the direction of swing.

3. A Landing is not required between a sliding glass door or an in-swinging glass door and the top of an exterior Stairway of 3 or fewer risers.

(d) ***Exterior Landings.***

1. The exterior Landing, platform, or sidewalk at an exterior doorway shall be located a maximum of 7 ¾ inches below the interior floor elevation, be sloped away from the doorway at a minimal rate that ensures drainage and have a length of at least 36 inches in the direction of travel out of the Dwelling.

2. The Landing at the base of an exterior Stair shall be sloped away from the Stair at a minimal rate that ensures drainage.

SPS 321.042 Ladders. Ladders which are used as part of a required Exit shall conform to this section.

(1) DESIGN LOAD. Ladders shall be designed to withstand loads of at least 200 pounds.

(2) TREAD OR RUNGS.

(a) Minimum tread requirements shall be specified in Table 321.042. Treads less than 10 inches in width shall have open risers. All treads shall be uniform in dimension.

(b) Rungs may only be used for ladders with a pitch range of 75° to 90°. Rungs shall be at least 1 inch in diameter for metal ladders and 1 1/2 inch for wood ladders. All rungs shall be uniform in dimension.

(3) RISERS. Risers shall be uniform in height and shall conform with Table 321.042.

(4) WIDTH. The width of the ladder shall be a minimum of 20 inches wide and a maximum of 30 inches wide.

(5) HANDRAILS.

(a) Handrails shall be required for ladders with pitches less than 65°.

(b) Handrails shall be located so the top of the Handrail is at least 30 inches, but not more than 38 inches, above the nosing of the treads.

(c) Open Handrails shall be provided with intermediate rails or an ornamental pattern such that a sphere with a diameter of 6 inches or larger cannot pass through.

(d) The clearance between the Handrail and the wall surface shall be at least 1½ inches.

(e) Handrails shall be designed and constructed to withstand a 200-pound load applied in any direction.

(6) CLEARANCES.

(a) The ladder shall have a minimum clearance of at least 15 inches on either side of the center of the tread.

(b) The edge of the tread nearest to the wall behind the ladder shall be separated from the wall by at least 7 inches.

(c) A passageway clearance of at least 30 inches parallel to the slope of a 90° ladder shall be provided. A passageway clearance of at least 36 inches parallel to the slope of a 75° ladder shall be provided. Clearances for intermediate pitches shall vary between these 2 limits in proportion to the slope.

(d) For ladders with less than a 75° pitch the vertical clearance above any tread or rung to an overhead obstruction shall be at least 6 feet 4 inches measured from the leading edge of the tread or rung.

SPS 321.045 Ramps.

(1) **GENERAL**. Every exterior or interior ramp which leads to or from an Exit shall comply with the requirements of this section.

Note: See ICC/ANSI A117.1 chapter 5 for more guidelines relating to the design and construction of an accessible ramp. Under that standard, ramps along an accessible route for people with disabilities should have a slope of not more than 1-foot of rise in 12-feet of run and should have Handrails on both sides of the ramp.

(2) **SLOPE.** Ramps shall not have a gradient greater than 1 in 8 or one foot of rise in 8 feet of run. Walkways with gradients less than 1 in 20 or one foot of rise in 20 feet of run are not considered to be ramps.

(3) **SURFACE AND WIDTH.** Ramps shall have a slip resistant surface and shall have a minimum width of 36 inches measured between Handrails.

(4) **HANDRAILS.** Handrails shall be provided on all open sides of ramps. Every ramp that overcomes a change in elevation of more than 8 inches shall be provided with at least one Handrail.

(a) Ramps which have a gradient greater than 8.33% or 1:12 or one foot rise in 12 feet of run and which overcome a change in elevation of more than 24 inches, shall be provided with Handrails on both sides.

(b) Handrails shall be located so the top of the Handrail is at least 30 inches, but not more than 38 inches above the ramp surface.

(c)

1. Open-sided ramps shall have the area below the Handrail protected by intermediate rails or an ornamental pattern to prevent the passage of a sphere with a diameter of 4 3/8 inches when applying a force of 4 pounds, except as provided in subd. 2.

2. This paragraph does not apply to ramps having a walking surface that is less than 24 inches above adjacent grade, if a toe-kick or side rail is provided to 4 inches above the walking surface, and a mid-rail is provided between the toe-kick or side rail and the Handrail.

(d) The clear space between the Handrail and any adjoining wall shall be at least 1½ inches.

(5) **LANDINGS**. A level Landing shall be provided at the top, at the foot and at any change in direction of the ramp. The Landing shall be at least as wide as the ramp and shall measure at least 3 feet in the direction of travel.

SPS 321.05 Natural light and natural ventilation.

(1) **NATURAL LIGHT.** Each Habitable Room shall be provided with natural light by means of glazed openings. The area of the glazed openings shall be at least 8% of the net floor area, except under the following circumstances:

(a) ***Exception.*** Habitable Rooms, other than bedrooms, located in Basements, Ground Floors or above Garages do not require natural light.

(b) ***Exception.*** Natural light may be obtained from adjoining areas through glazed openings, louvers, or other Approved methods. Door openings into adjoining areas may not be used to satisfy this requirement.

(1m) **NET FLOOR AREA.** For the purposes of subs. (1) and (2), “net floor area" does not include any area with a Ceiling Height of less than 5 feet.

(2) VENTILATION.

(a) ***Natural ventilation.***

1. Natural ventilation shall be provided to each Habitable Room by means of openable doors, skylights, or Windows. The net area of the openable doors, skylights or Windows shall be at least 3.5% of the net floor area of the room, except as provided in subd. 2. Balanced mechanical ventilation may be provided in lieu of openable exterior doors, skylights or Windows provided the system is capable of providing at least one air change per hour of fresh outside air while the room is occupied. Infiltration may not be considered as make-up air for balancing purposes.

2. Any area with a Ceiling Height of less than 5 feet may be excluded from the net floor area.

(b) ***Exhaust ventilation.*** All exhaust ventilation shall terminate outside the building.

(3) SAFETY GLASS.

(am) Except as provided in par. (bm), glazing shall consist of safety glass meeting the requirements of either 16 CFR Part 1201 or ANSI Z97.1 when installed in any of the following locations:

1. In any sidelight or glazing adjacent to a door, that meets all of the following:

a. The nearest point of the glazing is within 2 feet of the door when the door is in the closed position.

b. The nearest point of the glazing is within 5 feet of the floor.

c. The plane of the glazing is within 30 degrees of the plane of the door when the door is in the closed position.

2. In any wall where the glazing is within 5 feet vertically of the lowest drain inlet and within 3 feet horizontally of the nearest part of the inner rim of a bathtub, hot tub, shower, spa, or whirlpool appliance.

3. Within 4 feet vertically of a tread or Landing in a Stairway and within one foot horizontally of the near edge of the tread or Landing.

4. Within 4 feet vertically of the floor and 3 feet horizontally of the nosing of the top or bottom tread of a Stair.

5. In Guard assemblies.

(bm) Safety glass is not required where glazing meets any of the following:

1. The size of an individual pane of glass is 8 inches or less in the least dimension.

2. The safety glass is required by sub. (3) (am) 1. and the only door within 2 feet of the glazing is the fixed panel of a patio door.

3. The safety glass is required by sub. (3) (am) 1. and there is an intervening wall or other permanent barrier between the door and the glazing.

Note: The U.S. Consumer Product Safety Commission requires safety glass for glazing in internal and external doors, including storm doors and patio doors, as well as for the tub or shower enclosures themselves. These federal rules, contained in 16 CFR, subchapter B, part 1201, apply in addition to any state rules or statutes.

Note: Glass blocks are considered to be masonry products and are regulated under the ACI 530 standard adopted under SPS 320.24. They are not required to be safety glazing.

SPS 321.06 Ceiling Height All Habitable Rooms, Kitchens, hallways, bathrooms, and corridors shall have a Ceiling Height of at least 7 feet, except as follows:

(1)

(a) Rooms may have Ceiling Heights of less than 7 feet provided at least 50% of the room's floor area has a Ceiling Height of at least 7 feet. Any area with a Ceiling Height of less than 5 feet may be ignored in this calculation.

(b) The 50% limit in par. (a) does not apply to subs. (3) to (6).

(2) Beams and girders or other projections may project to no more than 8 inches below the required Ceiling Height.

(3) The Ceiling Height extending back from the front edge of a water closet may slope to below 7 feet, but may not go below 5 feet until beyond the back of the water closet.

(4) The Ceiling Height extending back from the front edge of a lavatory may be less than 7 feet, but may not go below 5 feet until beyond the back of the lavatory.

(5) A Ceiling Height of less than 7 feet may be provided between the rear rim of a bathtub and a wall of the room abutting that rim, or between the side rim and a room wall abutting that rim.

(6) A Ceiling Height of less than 7 feet may be provided between the rear wall of a shower stall and a wall of the room abutting that rear wall, or between the side wall of a shower and a room wall abutting that side wall.

Note: Section SPS 384.20 (5) (o) 4. establishes minimum horizontal clearances for water closets, and reads as follows: “A water closet may not be located closer than 15 inches from its center to any side wall, partition, vanity, or other obstruction, nor closer than 30 inches center to center, between water closets. There shall be at least 24 inches clearance in front of a water closet to any wall, fixture or door."

Note: See Ch. SPS 384 Appendix for further explanatory material.

SPS 321.07 Attic and crawl space access.

(1) ATTIC. Attics with 150 or more square feet of area and 30 or more inches of clear height between the top of the ceiling framing and the bottom of the rafter or top truss chord framing shall be provided with an access opening of at least 14 by 24 inches, accessible from inside the structure.

(2) CRAWL SPACES. Crawl spaces with 18 inches of clearance or more between the crawl space floor and the underside of the house floor joist framing shall be provided with an access opening of at least 14 by 24 inches.

Note: Access to plumbing or electrical systems may be required under chs. SPS 382 to 387, Plumbing Code or ch. SPS 316, Electrical Code, Volume 2.

SPS 321.08 Fire separation and Dwelling Unit separation.

(1) FIRE SEPARATION. Dwelling Units shall be separated from Garage spaces, accessory buildings, property lines and other Dwelling Units in accordance with Table 321.08 and the following requirements: - See PDF for table

1. Distance shall be measured perpendicular from wall to wall or property line, ignoring overhangs.

2. Fire rated construction shall protect the Dwelling from an exterior fire source.

3. Fire rated construction may be in either facing wall.

4. Fire rated construction shall be in both facing walls.

5. The methods for Garage separation in par. (a) 1. are examples of ¾ hour wall construction.

(a) ***Attached Garages.***

1. The walls and ceiling between an Attached Garage and any portion of the Dwelling, including Attic or soffit areas, shall be ¾-hour fire-resistive construction or shall be constructed as specified in any of the following:

a. One layer of 5/8-inch Type X gypsum drywall shall be used on the Garage side of the separation wall or ceiling.

b. One layer of ½-inch gypsum drywall shall be used on each side of the separation wall or ceiling.

c. Two layers of ½-inch gypsum drywall shall be used on the Garage side of the separation wall or ceiling.

2. For all methods listed under subd. 1., drywall joints shall comply with one of the following:

a. Joints shall be taped or sealed.

b. Joints shall be fitted so that the gap is no more than 1/20-inch with joints backed by either solid wood or another layer of drywall such that the joints are staggered.

Note: 1/20-inch is approximately the thickness of a U.S. dime.

3. Vertical separations between an Attached Garage and a Dwelling shall extend from the top of a concrete or masonry Foundation to the underside of the roof sheathing or fire-resistive ceiling construction.

(b) ***Structural elements exposed in an Attached Garage.*** Beams, columns and bearing walls which are exposed to the Garage and which provide support for habitable portions of the Dwelling shall be protected by one of the methods specified in par. (a) 1. a. or c. or other ¾ hour fire-resistive protection.

(c) ***Doors.***

1. The door and frame assembly between the Dwelling Unit and an Attached Garage shall be labeled by an independent testing agency as having a minimum fire-resistive rating of 20 minutes. The test to determine the 20-minute rating is not required to include the hose stream portion of the test.

Note: Acceptable tests for fire rating of door assemblies include ASTM E-152, UL 10B, and NFPA 252.

2. Only glazing allowed by the door's listing may be installed in any door required under this section.

(d) ***Other openings.***

1. Access openings in fire separation walls or ceilings shall be protected in one of the following ways:

a. The opening is protected with a material that has a finish rating of at least 20 minutes.

b. The opening is protected in the same way as the wall or ceiling where the opening is located.

2. The cover or door of the access opening shall be permanently installed with hardware that will maintain it in the closed position when not in use.

(2) DWELLING UNIT SEPARATION.

(a) ***General.*** In 2-family Dwellings, Dwelling Units shall be separated from each other and from shared tenant spaces including Attics, Basements, Garages, vestibules, and corridors.

(b) ***Attic separation.*** Dwelling Units with Attic space that extends over both units shall be separated in accordance with one of the following:

1. `Complete separation.' The units shall be provided with wall construction under par. (d) that extends all the way to the underside of the roof Deck.

2. `Vertical and horizontal separation.'

a. The units shall be provided with wall construction under par. (d) that extends to the Dwelling Unit ceiling and ceiling construction under par. (e).

b. Dwelling Units using this method of separation shall provide Attic draft stopping under par. (f) that extends all the way to the underside of the roof Deck above and in line with the separation wall.

(c) ***Doors.*** Any door installed in the Dwelling Unit separation shall have the door and frame assembly labeled by an independent testing agency as having a minimum fire-resistive rating of 20 minutes. The test to determine the 20-minute rating is not required to include the hose stream portion of the test.

(d) ***Walls.*** Walls in the Dwelling Unit separation shall be protected by not less than one layer of 5/ 8-inch Type X gypsum wallboard or 2 layers of ½-inch gypsum wallboard or equivalent on each side of the wall with joints in compliance with sub. (1) (a) 2.

(e) ***Floors and ceilings.*** A fire protective membrane of one layer of 5/8-inch Type X gypsum wallboard with joints in compliance with sub. (1) (a) 2., shall be provided on the ceiling beneath the floor construction that provides the separation.

(f) ***Draft stopping for concealed roof spaces and Attics.***

1. Attic areas, mansards, overhangs, and other concealed roof spaces shall be draft stopped above and in line with the separation wall.

2. Acceptable draft stopping materials include:

a. 3/8-inch wood structural panel.

b. ½ -inch gypsum board.

(3) PENETRATIONS.

(a) ***Ducts.***

1. Except as allowed under subd. 2., all heating and ventilating ducts that penetrate a required separation shall be protected with a listed fire damper with a rating of at least 90 minutes.

2. The fire damper required under subd. 1. may be omitted in any of the following cases:

a. There is a minimum of 6 feet of continuous steel ductwork on at least one side of the penetration.

b. The duct has a maximum cross-sectional area of 20 square inches.

(b) ***Electrical and plumbing components.*** Penetrations of a required separation by electrical and plumbing components shall be firmly packed with noncombustible material

or shall be protected with a listed through-penetration firestop system with a rating of at least one hour.

(c) ***Plastic Piping.*** Penetrations of a required separation by plastic pipe shall be protected by a penetration firestop system Approved by the Department and installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (3 pa), and shall have an F rating of not less than the required fire-resistance rating of the assembly penetrated.

SPS 321.085 Fire Blocking.

(1) **FIRE BLOCKING LOCATIONS.** Fire Blocking shall be provided in all of the following locations:

(a) In concealed spaces of walls and partitions, including furred spaces, at the ceiling and floor levels.

(b) At all interconnections between concealed vertical and horizontal spaces including the attachment between a Carport and a Dwelling.

(c) In concealed spaces between Stair stringers at the top and bottom of the run and at any intervening floor level.

(d) At all openings around wires, cables, Vents, pipes, ducts, Chimneys and fireplaces at ceiling and floor level.

(2) **FIRE BLOCKING MATERIALS.** Fire Blocking shall consist of one of the following:

(a) 2-inch nominal lumber.

(b) Two layers of one-inch nominal lumber.

(c) One thickness of ¾-inch nominal plywood or wood structural panel with any joints backed with the same material.

(d) One thickness of ½-inch gypsum wallboard, face nailed, or face screwed to solid wood, with any joints backed with the same material.

(e) Fiberglass or mineral wool batt insulation may be used if both of the following conditions are met:

1. The least dimension of the opening may not exceed 4 inches.

2. The batt shall be installed to fill the entire thickness of the opening or stud cavity.

(f) For wires, cables, pipes and Vents only, non-shrinking caulk, putty mortar, or similar material may be used provided no dimension of the opening exceeds ½ inch around the penetrating object.

(g) For Chimneys, fireplaces, and metal Vents, Fire Blocking shall be metal, cement board or other noncombustible material.

SPS 321.09 Smoke detectors.

(1) A listed and labeled multiple-station smoke alarm with battery backup shall be installed in all of the following locations:

(a) An alarm shall be installed inside each sleeping room.

(b) On floor levels that contain one or more sleeping areas, an alarm shall be installed outside of the sleeping rooms, within 21 feet of the centerline of the door opening to any sleeping room and in an Exit path from any sleeping room.

(c) On floor levels that do not contain a sleeping area, an alarm shall be installed in a common area on each floor level.

Note: This Code requires the Owner of a Dwelling to install a functional smoke detector in the Basement of the Dwelling and on each floor level except the Attic or storage area of each Dwelling Unit. The occupant of such a Dwelling Unit shall maintain any smoke detector in that unit.

(2)

(a) Except for Dwellings with no electrical service, smoke detectors required by this section shall be continuously powered by the house electrical service and shall be interconnected so that activation of one detector will cause activation of all detectors.

Note: Wireless interconnectivity is permitted under this paragraph.

(b) Dwellings with no electrical service shall be provided with battery-powered smoke detectors in the locations under sub. (1). Interconnection and battery-backup are not required in these Dwellings.

(3) For family living units with one or more communicating split levels or open adjacent levels with less than 5 feet of separation between levels, one smoke detector on the upper level shall suffice for an adjacent lower level, including Basements. Where there is an intervening door between one level and the adjacent lower level, smoke detectors shall be installed on each level.

(4) Smoke alarms and detectors shall be maintained in accordance with the manufacturer's specifications.

(5) For envelope Dwellings, at least 3 smoke alarms shall be placed in the air passageways. The alarms shall be placed as far apart as possible.

(6) In Basements where two required Exits are separated by a continuous wall, a smoke detector shall be placed on each side of the wall within 21 feet of each Exit.

SPS 321.095 Automatic fire sprinklers.

(1) Except as provided in subs. (2) and (3), the design, installation, testing and maintenance of automatic fire sprinklers shall conform to NFPA 13D.

(2)

(a) The requirements of NFPA 13D sections 6.3 (4), 8.1.3 and 8.6 are not included as part of this Code.

(b) Fire department connections are prohibited in multipurpose piping systems.

(3)

(a) Limited area automatic fire sprinkler systems are allowed in Dwellings.

(b)

1. A limited area automatic fire sprinkler system shall add the following wording to the warning sign required in 6.3(5) of NFPA 13D: “The number and location of sprinklers in this system does not conform to NFPA 13D."

2. An automatic fire sprinkler system providing fire protection throughout the Dwelling in accordance with NFPA 13D shall add the following wording to the warning sign required in 6.3(5) of NFPA 13D: “The number and location of sprinklers in this system conform with NFPA 13D."

Note: Multipurpose piping systems need to conform to provisions of the Plumbing Code, chs. SPS 381 to 387. These systems attach fire sprinkler heads to the Dwelling's potable water piping system.

SPS 321.097 Carbon monoxide detectors.

(1) DEFINITIONS. In this section:

(ag) "Carbon monoxide detector" means an electronic or battery-operated device or system that sounds an alarm when an unsafe level of carbon monoxide is in the air.

(ar) "Fuel-burning appliance" means a device that burns fossil fuel or carbon-based fuel and that produces carbon monoxide as a combustion by-product. Fuel-burning appliances include Stoves, ovens, grills, clothes dryers, furnaces, boilers, water heaters, fireplaces, and heaters.

(2) NEW CONSTRUCTION.

(a) ***General.*** Listed and labeled carbon monoxide detectors shall be installed and maintained in accordance with this Code, in one and 2-family Dwellings, for which building permit applications were made or construction commenced prior to the adoption of this Code.

(b) ***Location.***

1. On floor levels that contain one or more sleeping areas, a carbon monoxide detector shall be installed outside of the sleeping area, within 21 feet of the centerline of the door opening to any sleeping area and in an Exit path from any sleeping area.

2. On floor levels that do not contain a sleeping area, a carbon monoxide detector shall be installed in a common area on each floor level.

(c) ***Electrical service and interconnection.***

1. Except as provided in subd. 2., carbon monoxide detectors shall be continuously powered by the house electrical service, shall have a backup power supply and shall be interconnected so that activation of one alarm will cause activation of all alarms.

2. Dwellings with no electrical service shall be provided with battery-powered carbon monoxide detectors in the locations under par. (b). Interconnection is not required in these Dwellings.

(d) ***Standards.*** The devices shall conform with one of the following standards:

1. Carbon monoxide detectors shall be listed and labeled identifying conformance with UL 2034.

Note: Pursuant to this subdivision, carbon monoxide detectors need to be acceptable under the 2005 edition of the UL 2034 standard, *Single and Multiple State Carbon Monoxide Alarms*.

2. Carbon monoxide detectors and sensors as part of a gas detection or emergency signaling system shall be listed and labeled identifying conformance with UL 2075.

Note: Pursuant to this subdivision, carbon monoxide detectors and sensors need to be acceptable under the 2007 edition of the UL 2075 standard, *Gas and Vapor Protectors and Sensors*.

(3) EXISTING DWELLINGS. Listed and labeled carbon monoxide detectors shall be installed and maintained in accordance with this Code, in one and 2-family Dwellings, for which

building permit applications were made or initial construction commenced prior to the adoption of this Code.

Note: See statutory reprint under SPS 321.097 (2) (a).

SPS 321.10 Protection against decay and termites.

(1) Wood used in any of the applications under this section shall meet all of the following requirements:

(a) The wood shall be labeled and pressure treated with preservative in accordance with an AWPA standard or shall be naturally durable and decay-resistant or shall be engineered to be decay resistant.

(b) The wood shall be pressure treated with preservative or shall be naturally termite-resistant unless additional steps are taken to make the wood termite-resistant.

(2) Wood used in the following locations shall be as required under sub. (1):

(a) Resting directly upon or embedded in earth.

(b) Floor joists or sleepers that meet all of the following conditions:

1. The joists or sleepers are protected from the weather.

2. The joists or sleepers are within 18 inches above a lower floor surface, Deck, or soil.

3. There is no vapor retarder that meets the requirements under SPS 322.38 (1) (a) between the joists or sleepers and the soil below.

Note: This situation could occur with a floor over a crawl space or when a floor is added over a patio Deck or a Garage slab.

(c) Floor joists exterior to the Dwelling that are within 18 inches above exterior grade, unless protected with a moisture barrier.

Note: Acceptable moisture barriers for this application include ¾ -inch exterior preservative-treated plywood, or ice dam protection material listed as meeting the requirements of ASTM D 1970 or vapor retarder material, provided they are protected from physical and UV light damage.

(d) Girders that span directly over and within 12 inches of earth.

(e) Sills and rim joists that rest on concrete or masonry and are also below grade or within 8 inches above final exterior grade.

(f)

1. Siding and sheathing in contact with concrete, masonry, or earth and within 6 inches above final exterior grade.

2. Siding and sheathing in contact with concrete or masonry and within 2 inches above an impervious surface.

(g) Ends of wood structural members and their shims resting on or supported in masonry or concrete walls and having clearances of less than ½ inch on the top, sides and ends.

(h) Bottom plates or sole plates of walls that rest on concrete or masonry and that are below exterior grade or less than 8 inches above final exterior grade.

(i) Columns in direct contact with concrete or masonry unless supported by a structural pedestal or plinth block at least one inch above the floor.

(j) Any structural part of an outdoor Deck, including the Decking.

(k) Permanent wood Foundations.

(3) Wood girders that rest directly on exterior concrete or masonry shall be protected by one of the following methods:

(a) The wood shall be pressure treated with preservative or shall be a naturally durable and decay-resistant species.

(b) Material, such as pressure-treated plywood, flashing material, steel shims, or water-resistant membrane material shall be placed between the wood and the concrete or masonry.

(4) All pressure-treated wood and plywood shall be identified by a quality mark or certificate of inspection of an Approved inspection agency which maintains continued supervision, testing and inspection over the quality of the product.

Note: Heartwood of redwood, cypress, black walnut, catalpa, chestnut, sage orange, red mulberry, white oak, or cedar lumber are considered by the Department to be naturally decay-resistant. Heartwood of bald cypress, redwood, and eastern red cedar are considered by the Department to be naturally termite resistant.

(5) FASTENERS.

(a) Fasteners for pressure-preservative treated wood and fire-retardant-treated wood shall meet one of the following requirements:

1. The fastener is a steel bolt with a diameter of 0.5 inch or greater.

2. The fastener is made of stainless steel.

3. The fastener is made of hot-dipped, zinc-galvanized steel with the coating weight and thickness labeled as complying with ASTM A 153.

4. The fastener is made of steel with a mechanically deposited zinc coating labeled as complying with ASTM B 695, Class 55 or greater.

5. The fastener has coating types and weights in accordance with the fastener manufacturer's recommendations. In the absence of the manufacturer's recommendations subd. 1., 2., 3., or 4. shall apply.

Note: “Zinc plated," “zinc coated," “chrome plated," etc., fasteners do not necessarily comply with either of these standards.

(b) When a fastener is used with a hanger or other metal fixture, the fastener shall be of the same material as the hanger or metal fixture.

Note: When separate pieces are in close contact, zinc corrodes rapidly in the presence of plain steel. Zinc corrodes much more rapidly in the presence of stainless steel.

(c) For the purposes of this section, a fastener includes nails, screws, and bolts, along with nuts and washers.

SPS 321.11 Foam plastic.

(1)

(a) ***General.*** Foam plastic insulation shall have a flame-spread rating of 75 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E-84.

(b) ***Thermal barrier.*** Except as provided in par. (c), foam plastic insulation shall be separated from the interior of the Dwelling by one of the following thermal barriers:

1. ½ -inch gypsum wallboard.
2. ½ -inch nominal wood structural panel.
3. ¾ -inch sawn lumber with tongue-and-groove or lap joints.
4. 1-inch of masonry or concrete.
5. A product or material shown by an independent laboratory to limit the temperature rise on the unexposed surface to 250°F for 15 minutes when tested in accordance with ASTM E-119.
6. For doors only, sheet metal with a minimum thickness of 26 standard steel gauge or aluminum with a minimum thickness of 0.032 inch.
Note: Number 26 standard steel gauge is approximately equal to 0.018-inch.

(c) ***Exemptions from thermal barrier requirement.*** The following applications of foam plastic do not require a thermal barrier:

1. On overhead Garage doors.
2. In the box sill of the Basement or Ground Floor, above the bottom of the floor joists.

(2) Insulation that does not meet the requirements of this section may be Approved by the Department in accordance with SPS 320.18. Approval will be based on tests that evaluate materials or products representative of actual end-use applications.

Note: See SPS 322.21 (3) for requirements for protecting foam plastic on the exterior of a Dwelling.

SPS 321.115 Installation of elevators or dumbwaiters. Elevators or dumbwaiters serving Dwelling Units shall comply with the requirements under ch. SPS 318.

Subchapter III — Excavations

SPS 321.12 Drainage.

(1) GRADE. The finished grade of the soil shall slope away from the Dwelling at a rate of at least 1/2 inch per foot for at least 10 feet, except as provided in subs. (2) and (3).

(2) OTHER SURFACES. Where the finished surface is impervious, it shall slope away from the Dwelling for at least 10 feet at a rate that ensures equivalent drainage.

(3) OBSTRUCTIONS. Where lot lines, walls, slopes, or other barriers prevent having the 10-foot distance in sub. (2), swales or other means shall be provided to ensure equivalent drainage away from the Dwelling.

SPS 321.125 Erosion control and sediment control.

(1) GENERAL.

(a) Where Land Disturbing Construction Activity is to occur Erosion and sediment Control Practices shall be employed, as necessary, and maintained to prevent or reduce the potential deposition of soil or sediment to all of the following:

1. The Waters of the State.
2. Adjacent properties.

(b) Land disturbing construction activities, except those activities necessary to implement Erosion or sediment Control Practices, may not begin until the sediment Control Practices are in place for each area to be disturbed in accordance with the Approved plan.

(c) Erosion and sediment Control Practices shall be maintained until the disturbed areas are Stabilized. A disturbed area shall be considered Stabilized by vegetation when a perennial cover has been established with a density of at least 70%.

(d) Erosion and sediment Control Practices must be Approved by the Department.

(2) MANDATED PRACTICES. Specific practices at each site where Land Disturbing Construction Activity is to occur shall be utilized to prevent or reduce all of the following:

(a) The deposition of soil from being tracked onto streets by vehicles.

(b) The discharge of sediment from disturbed areas into on-site storm water inlets.

(c) The discharge of sediment from disturbed areas into abutting Waters of the State.

(d) The discharge of sediment from drainage ways that flow off the site.

(e) The discharge of sediment by dewatering activities.

(f) The discharge of sediment eroding from soil stockpiles existing for more than 7 days.

(3) CONTROL STANDARDS. Including the practices under sub. (2), additional Erosion and sediment Control Practices shall be employed, as necessary, to accomplish one of the following:

(a) A potential annual cumulative soil loss rate of not more than one of the following:

1. Five tons per acre per year where sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay, or clay textures are exposed.

2. Seven and 1/2 tons per acre per year where silt, silty clay loam, or silt loam textures are exposed.

(c) A reduction of at least 40% of the potential sediment load in storm water runoff from the site on an average annual basis as compared with no sediment or Erosion controls for the site where less than one acre of Land Disturbing Construction Activity is to occur.

Note: See ch. SPS 325 Appendix A for further explanatory material regarding compliance solutions for 80 and 40% reductions.

(4) SOIL LOSS ANALYSIS. Potential soil loss shall be determined using an engineer analytical modeling acceptable to the Department.

Note: The Revised Universal Soil Loss Equation II is an example of an acceptable model to determine soil loss.

(5) MONITORING.

(a) The Owner or Owner's agent shall check the Erosion and sediment Control Practices for maintenance needs at all the following intervals until the site is Stabilized:

1. At least weekly.

2. Within 24 hours after a rainfall event of 0.5 inches or greater. A rainfall event shall be considered to be the total amount of rainfall recorded in any continuous 24-hour period.

3. At all intervals cited on the Erosion and sediment control plan.

(b) The Owner or Owner's agent shall maintain a monitoring record when the Land Disturbing Construction Activity involves one or more acres.

(c) The monitoring record shall contain at least the following information:

1. The condition of the Erosion and sediment Control Practices at the intervals specified under par. (a).

2. A description of the maintenance conducted to Repair or replace Erosion and sediment Control Practices.

(6) MAINTENANCE.

(a)

1. Except as provided in subd. 3., off-site sediment deposition resulting from the failure of an Erosion or sediment Control Practice shall be cleaned up by the end of the next day.

Note: Contact the Land and Natural Resources Division before attempting to clean up any sediment deposited or discharged into the Waters of the State.

2. Except as provided in subd. 3., off-site soil deposition, resulting from construction activity, that creates a nuisance shall be cleaned up by the end of the workday.

3. A municipality may enact more stringent requirements regarding cleanup of soil or sediment deposition onto public ways.

(b)

1. Except as required in subd. 2., the Owner or Owner's agent shall complete Repair or replacement of Erosion and sediment Control Practices as necessary within 48 hours of an interval specified under sub. (5).

2. When the failure of Erosion or sediment Control Practices results in an immediate threat of sediment entering public sewers or the Waters of the State, procedures shall be implemented immediately to Repair or replace the practices.

Note: See ch. SPS 325 Appendix A for further explanatory material.

SPS 321.13 Excavations adjacent to adjoining property.

(1) NOTICE. Any person making or causing an excavation which may affect the lateral soil support of adjoining property or buildings shall provide at least 30 days written notice to all Owners of adjoining buildings of the intention to excavate. The notice shall state that adjoining buildings may require permanent protection.

(a) *Exception.* The 30-day time limit for written notification may be waived if such waiver is signed by the owner(s) of the adjoining properties.

(2) RESPONSIBILITY FOR UNDERPINNING AND FOUNDATION EXTENSIONS.

(a) *Excavations less than 12 feet in depth.* If the excavation is made to a depth of 12 feet or less below grade, the person making or causing the excavation shall not be responsible for any necessary underpinning or extension of the Foundations of any adjoining buildings.

(b) *Excavations greater than 12 feet in depth*. If the excavation is made to a depth in excess of 12 feet below grade, the Owner(s) of adjoining buildings shall be responsible for any necessary underpinning or extension of the Foundations of their buildings to a depth of 12 feet below grade. The person making or causing the excavation shall be responsible for any underpinning or extension of Foundations below the depth of 12 feet below grade.

SPS 321.14 Excavations for footings and Foundations.

(1) EXCAVATIONS BELOW FOOTINGS AND FOUNDATIONS. No excavation shall be made below the footing and Foundation unless provisions are taken to prevent the collapse of the footing or Foundation.

(2) EXCAVATIONS FOR FOOTINGS. All footings shall be located on undisturbed or compacted soil, free of organic material, unless the footings are reinforced to bridge poor soil conditions.

Subchapter IV — Footings

SPS 321.15 Footings.

(1) GENERAL.

(a) The Dwelling and Attached structures, such as Decks and Garages, shall be supported on a structural system designed to transmit and safely distribute the loads to the soil.

(b) The loads for determining the footing size shall include the weight of the Live Load, roof, walls, floors, pier, or column, plus the weight of the structural system and the soil over the footing.

(c) Footings shall be sized to not exceed the allowable material Stresses.

(d) The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing capacity of the soil.

(e)

1. Structures supported on floating slabs or similar shallow Foundations may not be physically attached to structures that are supported by footings that extend below the frost line unless an isolation joint is used between the structures, except as provided in subd. 2. This isolation shall extend for the full height of the structure.

2. Exterior ramps are not required to comply with subd. 1.

(2) SIZE AND TYPE. Unless designed by structural analysis, unreinforced concrete footings shall comply with the following requirements:

(a) ***Continuous footings.*** The minimum width of the footing on each side of the Foundation wall shall measure at least 4 inches wider than the wall. The footing depth shall be at least 8 inches nominal. Footing placed in unstable soil shall be formed. Lintels may be used in place of continuous footings when there is a change in footing elevation.

Note: Unstable soil includes soils that are unable to support themselves at a 90-degree angle for the full depth of the footing.

(b) ***Column or pier footing.***

1. The minimum width and length of column or pier footings shall measure at least 2 feet by 2 feet.

2. The minimum depth of column or pier footings shall measure at least 12 inches nominal.

(c) ***Trench footings.*** Footings poured integrally with the wall may be used when soil conditions permit. The minimum width shall be at least 8 inches nominal.

(d) ***Chimney and fireplace footings.*** Footing for Chimneys or fireplaces shall extend at least 4 inches on each side of the Chimney or fireplace. The minimum depth shall measure at least 12 inches nominal.

(e) ***Floating slabs***. Any Dwelling supported on a floating slab on grade shall be designed through structural analysis.

(f) ***Deck footings.*** Decks attached to Dwellings and detached Decks which serve an Exit shall be supported on a structural system designed to transmit and safely distribute the loads to the soil. Footings shall be sized to not exceed the allowable material Stresses. The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing values of the soil.

(3) **SOIL-BEARING CAPACITY.** No footing or Foundation shall be placed on soil with a bearing capacity of less than 2,000 pounds per square foot unless the footing or Foundation has been designed through structural analysis. The soil-bearing values of common soils may be determined through soil identification.

Note: The Department will accept the soil-bearing values for the types of soil listed in the following table: **- See PDF for table**

(a) ***Minimum soil-bearing values.*** If the soil located directly under a footing or Foundation overlies a layer of soil having a smaller allowable bearing value, the smaller soil-bearing value shall be used.

(b) ***Unprepared fill material, organic material.*** No footing or Foundation shall be placed upon unprepared fill material, organic soil, alluvial soil, or mud unless the load will be supported. When requested, soil data shall be provided.

Note: The decomposition of organic material in landfill sites established for the disposal of organic wastes may produce odorous, toxic, and explosive concentrations of gas which may seep into buildings through storm sewers and similar underground utilities unless provisions are taken to release the gases to the atmosphere.

SPS 321.16 Frost protection.

(1) **GENERAL.**

(a) Footings and Foundations, including those for Landings and stoops, shall be placed below the frost penetration level or at least 48 inches below adjacent grade, whichever is deeper, except as allowed under sub. (2).

(b) Footings may not be placed on frozen material.

(2) **EXCEPTIONS.**

(a) Frost protected shallow Foundations shall be designed in accordance with ASCE–32 as adopted in Table 320.24-5.

(b) Portions of footings or Foundations located directly under Window areaways do not require frost protection provided the rest of the Foundation is protected in accordance with this section.

(c) Footings and Foundations may bear directly on bedrock less than 48 inches below adjacent grade provided all of the following conditions are met.

1. The rock shall be cleaned of all earth prior to placement.

2. All clay in crevices of the rock shall be removed to the level of frost penetration or to 1.5 times the width of the rock crevice, whichever is less.

3. Provisions shall be taken to prevent water from collecting anywhere along the Foundation.

(d) Subsection (1) (a) does not apply to the footing for a ramp and its Handrail posts unless the ramp abuts a frost-protected stoop or Landing, in which case only the footing for that abutting end of the ramp is required to have the frost protection under sub. (1) (a), such as by bearing onto the stoop or Landing, so that a tripping hazard is not created.

Note: See ch. SPS 325 Appendix A for further information.

SPS 321.17 Drain tiles.

(1) DETERMINATION OF NEED.

(a) ***New construction***.

1. Except as provided under sub. (2), a complete drain tile or pipe system shall be installed around the Foundation of Dwellings under construction where groundwater occurs above the bottom of the footing.

2. For the purposes of this section, a complete drain tile or pipe system includes all of the following:

a. The drain tile or pipe installed inside and outside the Foundation, except as allowed under SPS 321.17 (3) (d) 1. b.

b. Bleeders connecting the inside tile or pipe to the outside tile or pipe.

c. The sump pit or crock.

d. The discharge piping.

e. A pump or other means of discharging water to grade.

(b) ***Optional systems.***

1. If a complete drain tile or pipe system is not required by natural conditions under par. (a) or by the Department, a partial drain tile or pipe system may be installed.

2. For the purposes of this section, a partial drain tile or pipe system includes a means of discharging water from the tile or pipe and may include any of the other elements under par. (a) 2.

Note: Means of discharging water include a sump pit, a crock, or natural means of drainage to daylight.

(2) OPTIONAL SYSTEMS.

(a) ***New construction***.

1. For new Dwelling construction, the Department may determine the soil types and natural or seasonal groundwater levels for which a complete drain tile or pipe system is required.

(3) MATERIAL AND INSTALLATION REQUIREMENTS FOR REQUIRED SYSTEMS.

(a) ***General.*** Complete drain tile or pipe systems required by natural conditions under sub. (1) (a) or by the Department shall comply with the requirements of this subsection.

(b) ***Basement floor slabs.*** The Basement slab shall be placed on at least 4 inches of clean graded sand, gravel, or crushed stone.

(c) ***Manufactured drainage systems***. Manufactured drainage systems not meeting the requirements of this section shall be submitted to the Department for review and approval prior to installation.

(d) ***Drain tile or pipe installation***. Drain tile or pipe used for Foundation drainage shall comply with the following requirements:

1.

a. Except as allowed under subd. 1. b., the top of the tile or pipe shall be at or below the top of the footing.

b. Where the top of the footing is more than 4 inches below the bottom of the floor slab, tile or pipe is required on the interior of the Foundation only and it shall be placed directly under the floor.

Note: This situation will commonly occur with a walk-out Basement.

2. Drain tile or pipe shall have an inside diameter of at least 3 inches.

3. Drain tile or pipe shall have open seams, joints, or perforations to allow water to enter.

4. Where individual tiles are used, they shall be laid with 1/ 8-inch open joints. Joints between tiles shall be covered with a strip of asphalt or tar impregnated felt.

5. The tile or pipe shall be placed upon at least 2 inches of Coarse Aggregate and shall be covered on the top and the side facing away from the Dwelling with at least 12 inches of Coarse Aggregate that meets all of the following criteria:

a. 100% of the aggregate shall pass a 1-inch sieve.

b. 90-100% of the aggregate shall pass a ¾-inch sieve.

c. 0-55% of the aggregate shall pass a 3/8-inch sieve.

d. 0-5% of the aggregate shall pass a #8 sieve.

Note: A #8 sieve has square openings of 2.36 mm or 0.09 inch.

Note: These specifications encompass aggregate sizes #6 and #67 per ASTM standard C 33. Of the two sizes, #6 is coarser.

6.

a. Bleeder tiles or pipes shall be provided at no more than 8-foot intervals to connect the exterior drain tile or pipe to the interior drain tile or pipe.

b. Bleeder tiles or pipes shall have a minimum interior diameter of 3 inches.

c. Direct connection of the bleeders is not required if the intersection of the bleeder with the tile or pipe is covered with a membrane or fabric that prevents soil and fines from entering the system.

7. The drain tiles or pipe that lead from the footing tiles to the sump pit shall be laid at a grade of at least 1/8 inch per foot leading to the sump pit. The remaining drain tiles or pipe shall be level or graded downward to the line leading to the sump pit.

(e) ***Drain tile or pipe discharge.***

1. Drain tiles or pipe shall be connected to the sump pit.

2. The sump pit shall discharge to natural grade or be equipped with a pump.

3. All other aspects of drain tile discharge shall be in accordance with this Code.

Subchapter V — Foundations

SPS 321.18 Foundations.

(1) GENERAL.

(a) *Design.* Foundation walls shall be designed and constructed to support the vertical loads of the Dwelling, lateral soil pressure, and other loads without exceeding the allowable Stresses of the materials of which the Foundations are constructed.

(b) *Lateral support at base.* Lateral support such as floor slabs or framing shall be provided at the base of Foundation walls.

(c) *Lateral support at top.* Lateral support shall be provided at the top of the Foundation walls by one of the following:

2. Structural analysis. A system designed through structural analysis.

3. Anchor bolts.

a. Structural steel anchor bolts, at least 1/2 inch in diameter, embedded at least 7 inches into the concrete or grouted masonry with a maximum spacing of 72 inches and located within 18 inches of wall corners.

b. A properly sized nut and washer shall be tightened on each bolt to the plate or sill.

c. When vertical-reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements under subd. 3. a. shall be modified as necessary so anchor bolts are placed in the same core as the reinforcement without exceeding the limits of subd. 3. a.

d. Alternate Foundation anchorage, designed and spaced in accordance with structural analysis and as required to provide equivalent anchorage to the requirements of subd. 3. a., is allowable.

4. Other mechanical fasteners.

a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. When vertical-reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements under subd. 4. a. shall be modified as necessary so the fasteners are placed in the same core as the reinforcement without exceeding the limits of subd. 4. a.

(d) ***Floor framing.***

1. Floor framing shall be fastened to the sill plate by one of the following methods:

a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. In accordance with structural analysis.

c. In accordance with the fastener table printed in Ch. SPS 325 Appendix A.

Note: Per SPS 321.22 (1), sill plates are not required on Foundation walls of poured concrete or on masonry walls with mortar or grout filled cores or on masonry walls with a solid block top course.

2.

a. Where the floor framing is parallel to the Foundation wall, solid blocking or bridging shall be installed in at least the first adjacent joist space at a spacing of no more than 32 inches on center.

b. Blocking and bridging shall be the same depth as the joist.

c. Fastening of the blocking or bridging shall be in accordance with structural analysis or the fastener schedule in Table 321.02-2.

Note: The floor-framing elements required in this section are intended to provide lateral support to the top of the Foundation wall. See SPS 321.22

(9) for further requirements relating to floor framing, including for bridging of floor framing to provide restraint against rotation or lateral displacement of the floor framing.

(e) ***Soil lateral load***. Unless designed through structural analysis, soil lateral loads shall be determined from Table 321.18-A. - See PDF for table

(2) CONCRETE FOUNDATION WALLS.

(a) ***General structural requirements.*** Except as provided in par. (b), unless designed through structural analysis, the minimum thickness of concrete Foundation walls shall be determined from Table 321.18-B, but in no case shall the thickness of the Foundation wall be less than the thickness of the wall it supports.

(b) ***Equalized loading.*** A 6-inch nominal wall thickness may be used provided the fill on one side of the wall is within 12 inches vertically of the fill on the other side of the wall.

Note: See SPS 321.15 (1) (c) for trench footing requirements. - See PDF for table

(3) MASONRY FOUNDATION WALLS.

(a) ***Damp proofing***.

1. Except as allowed under subd. 3., masonry block Foundation walls shall be coated with a layer of minimum 3/ 8-inch-thick type M or S portland cement mortar parging on the exterior of the wall from footing to finished grade.

2. Masonry Foundation walls shall be damp-proofed by applying to the exterior surface of the portland cement parging from footing to finished grade, a continuous coating of one of the following:

a. A bituminous coating applied in accordance with the manufacturer's instructions.

b. Acrylic-modified cement applied at a minimum rate of 3 pounds per square yard.

c. A layer of minimum 1/8-inch-thick structural surface bonding material labeled as complying with ASTM C887.

Note: The ASTM C887 standard is entitled, “Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar."

d. A waterproofing treatment applied in accordance with the manufacturer's instructions.

3.

a. Parging of masonry block Foundation walls is not required where a damp proofing material is sufficiently flexible to be listed or designed for direct application to masonry block.

b. Parging of masonry block Foundation walls is not required where a layer of minimum ¼-inch thick structural surface bonding material labeled as complying with ASTM C887 is used for damp proofing.

(b) ***Structural requirements.*** Unless designed through structural analysis, the masonry Foundation walls shall be constructed in accordance with ACI 530.1 and the following requirements:

1. The minimum thickness of unreinforced masonry Foundation walls shall be determined by Table 321.18-C, but in no case shall the thickness be less than the thickness of the wall it supports.

2. Reinforced masonry walls shall be reinforced in accordance with the requirements of Tables 321.18-D, 321.18-E or 321.18-F. Vertical reinforcement shall be provided on each side of any opening and at intervals indicated in the appropriate table. - See PDF for table - See PDF for table - See PDF for table - See PDF for table

3. Vertical reinforcement shall have a minimum yield strength of 60,000 psi.

4. Solid-grouted Hollow Units or cores containing vertical reinforcement shall be filled with masonry grout that complies with ASTM C 476.

5. In lieu of the reinforcement provisions of Tables 321.18-D, 321.18-E and 321.18-F, alternative reinforcing bar size and spacing having an equivalent cross-sectional area or reinforcement per linear foot of wall is permitted, provided the spacing of the reinforcement does not exceed 72 inches and reinforcing bar size does not exceed No. 11.

6. The depth below grade, wall height and reinforcement spacing may exceed the maximum values indicated in Tables 321.18-D, 321.18-E and 321.18-F only if the design is based on structural analysis.

(4) WOOD FOUNDATIONS. Wood Foundations shall be designed and constructed in accordance with the wood-Foundation standard adopted in Table 320.24-6m.

Note: The Department will accept Permanent Wood Foundations Design and Construction Guide published by the Southern Forest Products Association through the Southern Pine Council, as complying with this standard. The Design and Construction Guide requires a 3.5-inch-thick floor slab if a poured concrete floor slab is used.

Subchapter VI — Floors

SPS 321.19 Floor design. Floors shall support all Dead Loads plus the minimum unit Live Loads as set forth in SPS 321.02. The Live Loads shall be applied to act vertically and uniformly to each square foot of horizontal floor area. Basements shall be provided with wood or concrete or similar type floors that comply with SPS 321.20 or 321.205.

SPS 321.20 Concrete floors.

(1) When concrete floors are provided, the thickness of the concrete shall measure at least 3 inches.

(2) When a concrete floor is placed in clay soils, a 4-inch-thick base course shall be placed in the subgrade consisting of clean graded sand, gravel, or crushed stone.

(3) When a concrete floor is placed on sand or gravel soils, the base course may be omitted unless drain tile is installed. If drain tile is installed, the requirements of SPS 321.17 shall be met.

SPS 321.203 Garage floors.

(1) MATERIALS. Garage floors shall be constructed of concrete or other noncombustible materials which are impermeable to petroleum products. Slab-on-grade concrete Garage floors shall be at least 4 inches thick and placed over at least 4 inches of granular fill.

Note: It is not the intent of sub. (1) to require a concrete floor to be sealed to make it completely impermeable.

(2) CONFIGURATION. The floor shall be sloped such that water is removed in accordance with one of the following:

(a) Water drains toward the overhead door or to exterior grade such that no damage will be caused to any structural member or wall covering of the Garage or the Dwelling.

(b) Water drains into an interior floor drain that complies with the requirements of ch. SPS 382.

Note: See SPS 382.34 for floor drain requirements.

SPS 321.205 Wood floors in contact with the ground. Wood floors in contact with the ground shall comply with the requirements under SPS 321.18 (4).

SPS 321.21 Precast concrete floors. Precast concrete floors shall be designed through structural analysis, or load tables furnished by the precast product fabricator may be used, provided the load tables were developed using structural analysis or load testing.

SPS 321.22 Wood frame floors. Unless designed through structural analysis, wood frame floors shall comply with the following requirements:

(1) FLOOR JOISTS.

(a) ***General.***

1. Floor joists shall comply with the structural requirements and Live Load determination under SPS 321.02.

Note: See Ch. SPS 325 Appendix A for design information.

2. Where the joists of a floor system are parallel to, and located between bearing walls above and below, the joists shall be doubled.

(b) ***Floor joists on concrete walls.*** Where a sill plate is provided for floor joists on poured concrete, the sill plates shall be fastened to the Foundation.

Note: Section SPS 321.18 (1) (d) requires the floor joists to also be fastened to the sill plate.

(c) ***Floor joists on masonry walls with a solid top course.*** Where a sill plate is provided for floor joists on solid block top course masonry, the sill plate shall be fastened to the Foundation.

(d) ***Floor joists on masonry walls with open top course.***

1. Where the masonry wall has an open top course, a sill plate at least as wide as the Foundation wall shall be fastened to the Foundation.

2. Where anchor bolts are used on masonry walls with an open top course, the minimum width of an individual piece making up the sill plate shall be at least 5.5 inches.

Note: A sill plate can be made of multiple pieces to achieve the full width.

(2) FLOOR TRUSSES. Metal plate connected wood floor trusses shall be designed in accordance with the Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses and the National Design Specification for Wood Construction. Truss members shall not be cut, bored, or notched.

(3) GIRDERS AND BEAMS.

(a) Girders and beams shall be selected from Table 321.22-A1 or Table 321.22-A2 or shall be designed through structural analysis.

(b) Wood girders and beams shall be fitted at the post or column. Adjoining ends shall be fastened to each other to transfer horizontal loads across the joint. Beams shall also be fastened to the posts with framing anchors, angle clips, or equivalent.

(c) Where intermediate beams are used, they shall rest on top of the girders; or shall be supported by ledgers or blocks fastened to the sides of the girders; or they may be supported by Approved metal hangers into which the ends of the beams shall be fitted.

(d) Lateral restraint for all wood beams shall be provided at all columns using a saddle or other Approved connection where the beam meets one of the following conditions:

1. The beam is not restrained at both ends.

2. The beam is more than 11.25 inches deep using actual measurement.

Note: A saddle supports the beam on the bottom and allows for the through-connection of fasteners into the side of the beam.

(4) BEARING AND END CONFIGURATION.

(a) ***Sawn lumber.***

1. `Joists.' Wood joists made of sawn lumber shall meet the following bearing requirements:

a. Wood joists supported on wood or metal shall have a bearing surface of at least 1½-inches measured from the end of the joist.

b. Wood joists supported on masonry or concrete shall have a bearing surface of at least 3 inches measured from the end of the joist.

c. The tail end of a floor joist may not extend past the edge of a beam by more than the depth of the floor joist.

d. Wood floor joists with ends that intersect over a beam shall have the ends overlap at least 3 inches and be securely fastened together with at least two 12d common nails or the ends shall be butt-jointed or face-jointed and fastened with ties, straps, plates, or solid blocking.

2. `Beams and girders.' Beams and girders made of sawn lumber shall have a bearing surface on their supports of at least 3 inches parallel to the beam or girder and be at least as wide as the beam or girder.

(b) ***Engineered wood products.*** Bearing surface for engineered wood products shall be in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing and are applicable to the configuration.

(5) NOTCHING AND BORING. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

(a) ***Notching of floor joists.***

1. Notches located in the top or bottom of floor joists shall not have a depth exceeding 1 /6 the depth of the joist, shall not have a length exceeding 1/3 the joist depth nor be located in the middle 1/3 of the span of the joist.

2. Where floor joists are notched on the ends, the notch shall not exceed ¼ the depth of the joist. Notches over supports may extend the full bearing width of the support.

(b) ***Boring of floor joists***.

1. `General.' A hole may not be bored in a floor joist within 2 inches of a notch or another hole. In no case shall the distance between adjacent holes be less than the diameter of the larger hole.

2. `Holes near the edge.' Holes bored in the top or bottom 2 inches of a joist shall follow the limitations for notching under par. (a).

3. `Other holes.' Holes bored in floor joists that are not within 2 inches of the top or bottom of the joist shall have their diameter limited to 1/3 the depth of the joist.

(c) ***Engineered wood products.*** Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing.

(6) OVERHANG OF FLOORS.

(a) ***General.*** Except as provided in pars. (b) and (c), a floor joist overhang shall be cantilevered beyond the outer edge of the supporting wall below it by no more than the actual depth of the joist or shall be designed through structural analysis in accordance with SPS 321.02 (3).

(b) ***Joist overhangs parallel to the main floor framing system***. Joist overhangs that are extensions of, and parallel to, the main floor framing system may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.

2.

a. The overhang supports a uniform load limited to the weight of the bearing wall and the tributary roof area above it.

b. The tributary length of the roof area, excluding the eave overhang, is no more than 2 feet greater than the actual length of the joist directly below.

c. The eave overhang is no more than 2 feet.

Note: The tributary length is usually half the span of the joist or rafter.

3. The joist overhang does not support any concentrated loads. For the purposes of this subsection, a framed opening in the wall with a rough opening of 4 feet or less shall be considered uniform loading.

4.

a. The cantilevered joist is doubled at the supporting wall.

b. The doubled joist length extends inward beyond the inner edge of the supporting wall by the same distance as the cantilever.

c. The added joist member is secured to the main joist as stated in the nailing schedule in Ch. SPS 325 Appendix A, under the heading for “floor framing, built-up girder and beams, top loaded".

(c) ***Joist overhangs perpendicular to the main floor framing system.*** Joist overhangs that are perpendicular to the main floor framing system, or lookout joists, may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The joist overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.

2.

a. A double floor joist is used to support the lookout joist.

b. The double floor joist is located a distance of at least 2 times the cantilever length inward from the outer edge of the supporting wall below.

c. The lookout joists are fastened to the double joist with metal hangers.

3. The joist overhang supports no more than either a non-bearing wall or a wall that supports only a roof which spans no more than the floor overhang cantilever length plus the eave overhang.

(d) All overhangs longer than the depth of the supporting joist that do not meet all of the conditions under par. (b) or (c) shall be designed through structural analysis.

(7) FLOOR OPENINGS. Trimmers and headers shall be doubled when the span of the header exceeds 4 feet. Headers which span more than 6 feet shall have the ends supported by joist hangers or framing anchors unless the ends are supported on a partition or beam. Tail joists (joists which frame into headers) more than 8 feet long shall be supported on metal framing anchors or on ledger strips of at least 2 inches by 2 inches nominal.

1. This table is based upon wood with a fiber bending Stress of 1,000 psi. Two acceptable wood beam selections are listed for each loading condition.

2. Two acceptable steel beam selections are listed for each loading condition. The first entry is the most economical selection based upon beam weight.

3. Wood main beams or girders may be built up from nominal 2-inch members. The 2-inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½-inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece. Where built-up beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam. - See PDF for table

1. This table provides maximum allowable spans in feet and inches for main beams or girders which are built-up from nominal 2-inch members.

2. Fiber bending Stress for various species and grades of wood is given in Appendix A321.

3. The 2-inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½-inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece.

4. Where built-up wood beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

5. Where built-up wood beams are continued over more than one span and where lengths of individual pieces are less than the total length of the complete beam, butt joints shall be located over supports or within 6 inches of the quarter points of the clear span. Where located near the quarter points, the joints in built-up beams shall be separated by at least one lamination and shall not exceed the beam width.

(8) FLOOR SHEATHING, BOARDS AND PLANKS.

(a) ***Plywood sheathing.*** Plywood sheathing used for floors shall be limited to the allowable loads and spans shown in Table 321.22-B.

(c) ***Combination subfloor-underlayment.*** Combination subfloor-underlayment shall be installed in accordance with Table 321.22-D.

(d) ***Floorboards.*** Where wood boards are used for floor sheathing, the boards shall comply with the minimum thicknesses shown in Table 321.22-E.

(e) ***Planks***. Planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed to each beam.

(9) BRIDGING.

(a) ***Sawn lumber.*** Bridging shall be provided for sawn lumber framing at intervals not exceeding 8 feet where the nominal depth to thickness ratio is greater than 4 to 1.

Note: This 4:1 ratio means bridging is required for wood-framed floors having nominal 2X10 or deeper solid-sawn-lumber joists, to provide restraint against rotation or lateral displacement.

(b) ***Engineered products.*** Bridging shall be provided for engineered framing products in accordance with the manufacturer's recommendations.

Note: See SPS 321.18 (1) (d) for further requirements relating to floor framing, including for bridging or blocking of floor framing to provide lateral support to the top of Foundation walls.

(10) SILL PLATES. All of the following requirements apply to a sawn-lumber sill plate with uniform loading that is partially extended beyond the load-bearing surface of a Foundation wall in order to put the exterior surface of an upper-lying wall flush with or beyond the exterior surface of insulation that is placed on the outside of the Foundation wall:

(a) The center of any anchor bolt shall be set back from the side edge of the sill plate by a distance of at least 4 times the diameter of the bolt.

(b) The thickness of the concrete or mortar cover around any anchor bolt shall comply with ACI 318 section 7.7.

Note: Under ACI 318 section 7.7, the minimum cover for a 5/8-inch-diameter or smaller bolt is 1 1/2 inches.

(c) With wood floor joists that are parallel to the Foundation wall, the sill plate may not extend beyond the load-bearing surface of the wall by more than one-half of the nominal thickness of the joist that bears on the sill plate.

Note: As used throughout this chapter and in the standards that the chapter incorporates by reference, the shorter side of the cross-sectional area of a wood member is the thickness of the member. The longer side of the cross-sectional area is the depth when the longer side is vertical; and it is the width when the longer side is horizontal.

Note: Under sub. (6), wood floor joists that are perpendicular to the Foundation wall can extend beyond the Foundation wall by a distance of up to the depth of the joist.

Note: Subsection (1) (d) requires a full-width sill plate for floor joists over open-core masonry units. - See PDF for table - See PDF for table - See PDF for table

SPS 321.225 Decks.

(1) Decks attached to Dwellings and any detached Decks that serve an Exit shall comply with the applicable provisions of subchs. II to X of ch. SPS 321, including all of the following:

(a) Excavation requirements under SPS 321.14;

(b) Footing requirements under SPS 321.15 (2) (f);

(c) Frost penetration requirements under SPS 321.16;

(d) Load requirements under SPS 321.02;

(e) Stair, Handrail and Guard requirements of SPS 321.04.

(f) Decay protection requirements of SPS 321.10.

(2) A Deck that complies with the standards in Ch. SPS 325 Appendix B, and Ch. SPS 325 Appendix C, if applicable, shall be considered as complying with sub. (1).

Subchapter VII — Walls

SPS 321.23 Wall design.

(1) LIVE AND DEAD LOADS. All walls shall support all superimposed vertical Dead Loads and Live Loads from floors and roofs.

(2) HORIZONTAL WIND LOAD. Walls shall be designed to withstand a horizontal wind pressure of at least 20 pounds per square foot applied to the vertical projection of that portion of the Dwelling above grade. No wind load reduction shall be permitted for the shielding effect of other buildings.

SPS 321.24 Exterior covering.

(1) GENERAL. The exterior walls shall be covered with a permanent weather resistant finish.

(2) DURING CONSTRUCTION. During construction, wall cavity insulation may not be installed until a water-resistant covering is in place over the wall cavity and Windows, doors, and a roof with at least underlayment are installed.

Note: An example of acceptable water-resistant covering for a wall is foam sheathing with permanently taped joints.

(3) FLASHING.

(a) Corrosion-resistant flashing shall be installed in the exterior wall to prevent water from entering the wall cavity or coming in contact with the structural framing components.

(b) The flashing shall extend to the surface of the exterior wall finish and prevent water from reentering the exterior wall.

(c)

1. Any joints between 2 pieces of flashing that form a vertical joint shall be lapped a minimum of 6 inches and sealed.

2. Any joints between 2 pieces of flashing that form a horizontal joint shall be lapped a minimum of 2 inches and sealed unless otherwise specified by the flashing manufacturer.

3. Sealants used for flashing shall be exterior grade and shall be compatible with the materials being sealed.

(d) Flashing shall be provided at all of the following locations:

1. At the top of all exterior door and Window openings, unless using self-flashing Windows that provide at least one inch of flashing around the opening, including the corners.

2. At the intersection of Chimneys or other masonry construction with frame walls.

3. Under and at the ends of masonry, wood or metal copings and sills.

4. Continuously above all projecting wood trim.

5. Where Porches, Decks or Stairs attach to a wall or floor assembly of wood frame construction.

6. At wall and roof intersections.

7. At built-in gutters.

8. Along the bottom of door openings that are elevated above-grade.

Note: Flashing placed along the bottom of a door opening that is elevated above-grade can subsequently accommodate adding a Deck outside the door.

(e) For a roof that intersects with an upper-lying head wall and rake wall, such as where a dormer is provided, the vertical metal flashing along the rake wall shall extend down the roof at least one-half inch past the vertical flashing on the head wall.

Note: A head wall as addressed in this paragraph intersects a sloping roof at a horizontal line along the top of a roof segment. A rake wall intersects a sloping roof along the side of a roof segment.

(f) For a roof eave that intersects with a sidewall, the end of the roof flashing shall be installed so that it diverts water away from the sidewall and onto the roof or into the gutter.

Note: See SPS 321.26 (5) for additional flashing requirements with masonry cavity walls and SPS 321.28 (7) for additional flashing requirements with roofing.

Note: See SPS 321.26 (8) for further requirements relating to flashing for masonry.

(4) WATER-RESISTIVE BARRIER REQUIREMENTS.

(a) ***General.***

1. Exterior walls of wood or metal frame construction shall be provided with a Water-Resistive Barrier from the highest point to the bottom of the permanent weather-resistant covering.

Note: Acceptable Water-Resistive Barrier materials include polymeric-based house wraps and spray-applied Water-Resistive Barriers installed per the manufacturer's instructions, #15 or greater asphalt-saturated felts that comply with ASTM D 226 for type I felt and extruded foam sheathing with permanently taped joints. Duct tape or similar will not result in a permanently taped joint.

2. Structural products with an integral Water-Resistive Barrier may be Approved by the Department as a complete assembly.

(b) ***Material compatibility.*** The Water-Resistive Barrier material shall be compatible with the other materials in the wall with which it will come into contact.

Note: Spray-applied Water-Resistive Barriers may not be compatible with foam plastic insulation.

(c) ***Performance requirements.***

1. Polymer-based house wraps shall meet all of the following requirements:

a. A water vapor permeability rating of 5 perms or higher when tested in accordance with ASTM E96.

b. An acceptable water-resistance rating determined in accordance with ASTM D779, AATCC 127 or CCMC 07102.

Note: Asphalt-saturated felt or “tar paper" is not a polymeric-based house wrap.

Note: For more information on the water-resistance tests and their results, see the International Code Council Evaluation Services Acceptance Criteria AC 38.

2. Spray-applied Water-Resistive Barriers shall be Approved under the International Code Council Evaluation Services.

Note: For approval criteria, see ICC-ES acceptance criteria AC 212 or successor document.

(d) ***Application.***

1. Horizontal seams in sheet or strip material shall be overlapped such that the upper layer extends over the lower layer at least 2 inches.

2. Vertical seams in sheet or strip materials shall be overlapped at least 6 inches.

3. Any rips, tears or voids shall be patched in accordance with subds. 1. and 2.

(e) ***Penetrations.***

1. Penetrations caused by fasteners of the Water-Resistive Barrier or the weather-resistant exterior covering do not require sealing.

2. Penetrations of 5 square inches or less with an annular space of no more than ½ inch shall be sealed with caulk or similar material.

3. Penetrations of greater than 5 square inches shall be flashed in accordance with sub. (3).

SPS 321.25 Wood frame walls. Unless designed through structural analysis, wood frame walls shall comply with the following requirements.

(1) STUD CONFIGURATION. Wood studs shall comply with the size and spacing requirements indicated in Table 321.25-A. Studs in the exterior walls shall be placed with the wide faces perpendicular to the plane of the wall.

Note: See Ch. SPS 325 Appendix A for acceptable nailing schedule.

Note: See SPS 321.10 for requirements on treating wood for decay and termite resistance.

(2) TOP PLATES.

(a) ***General.*** Except as allowed under subd. 3., top plates shall be provided and configured as follows:

1. Studs at bearing walls shall be capped with double top plates.

2. End joints in double top plates shall be offset at least 2 stud spaces.

3. Double top plates shall be overlapped at the corners and at intersections of partitions.

4. The plate immediately above the stud may have a joint only when directly over the stud.

(b) ***Notching and boring.***

1. When piping or ductwork is placed in an exterior wall or an interior load-bearing wall, such that at least half of the top plate is removed, the plate shall be reinforced with a steel angle at least 2 inches by 2 inches by 20 gauge thick.
Note: 20 gauge is approximately 0.036 inch.

2. The steel angle shall span the gap and extend at least to the midpoint of the adjacent stud spaces.

3. Other equivalent materials may be used in accordance with SPS 321.02.

(c) ***Exceptions.***

1. A single top plate may be used in place of a double top plate provided a rafter is located directly over the studs and the plate is securely tied at the end joints, corners, and intersecting walls. Joints may occur in single top plates only when directly over a stud.

2. A continuous header, consisting of two 2-inch members set on edge, may be used in lieu of a double plate if tied to the adjacent wall.

(2m) BOTTOM PLATES.

(a) ***Masonry Foundation walls with open top course.***

1. Where a masonry Foundation wall has an open top course, a bottom plate at least as wide as the Foundation wall shall be fastened to the Foundation.

2. Where anchor bolts are used on a masonry Foundation wall with an open top course, the minimum width of an individual piece making up the bottom plate shall be at least 5 1/2 inches.

Note: A sill plate can be made of multiple pieces to achieve the full width.

(b) ***Extension beyond the bearing surface.*** All of the following requirements apply to a sawn-lumber sill plate with uniform loading that is partially extended beyond the load-bearing surface of a Foundation wall in order to put the exterior surface of an upper-lying wall flush with or beyond the exterior surface of insulation which is placed on the outside of the Foundation wall:

1. The center of any anchor bolt shall be set back from the side edge of the sill plate by a distance of at least 4 times the diameter of the bolt.

2. The thickness of the concrete or mortar cover around any anchor bolt shall comply with ACI 318 section 7.7.

Note: Under ACI 318 section 7.7, the minimum cover for a 5/8-inch-diameter or smaller bolt is 1 1/2 inches.

3. Where a stud wall bears directly on a double bottom plate, the plate may not extend more than 1 1/2 inches beyond the load-bearing surface of the Foundation wall.

4. Where a stud wall bears directly on a single bottom plate, the plate may not extend more than 1 inch beyond the load-bearing surface of the Foundation wall.

(3) WALL OPENINGS.

(am) ***Headers.*** Where doors or Windows occur, headers shall be used to carry the load across the opening.

(bm) ***Header size.*** The size of headers shall be determined in accordance with the spans and loading conditions listed in Tables 321.25-B, 321.25-C and 321.25-D. Headers for longer spans shall be designed by an engineering method under SPS 321.02.

(cm) ***Header support***. Headers in bearing walls shall be supported in accordance with subd. 1. or 2. or 3.

1. Headers 3 feet or less in length shall be directly supported on each end by either:

a. The single common stud and a shoulder stud; or

b. The single common stud with a framing anchor attached.

2. Headers greater than 3 feet but less than or equal to 6 feet in length shall be directly supported on each end by the single common stud and a shoulder stud.

3. Headers greater than 6 feet in length shall be directly supported on each end by the single common stud and 2 shoulder studs.

(4) NOTCHING. Notching and boring of columns or posts is prohibited unless designed through structural analysis. Studs shall not be cut or bored more than 1/ 3 the depth of the stud unless the stud is reinforced.

(5) PARTITIONS. Load-bearing partitions shall be placed over beams, girders, or other load-bearing partitions. Load-bearing partitions running at right angles to the joists shall not be offset from the main girder or walls more than the depth of the joist unless the joists are designed to carry the load.

(6) POSTS AND COLUMNS.

(a) ***General***.

1. Posts and columns shall be installed to resist imposed loads.

2. Posts and columns shall bear directly over the middle 1/3 of a footing.

3. Posts and columns shall be restrained at the top and bottom to resist displacement.

4. All columns shall be positively attached to the beams they support using clips, straps, or saddles.

5. Posts and columns that use a height adjustment mechanism shall have the mechanism imbedded in concrete or permanently disabled after installation.

(b) ***Bearing surface.*** Posts and columns shall have a steel bearing plate affixed to one or both ends to distribute any applied loads and to prevent fiber crushing of any structural member being supported.

(c) ***Steel posts or columns.*** Steel posts or columns shall be sized according to one of the following methods:

1. Manufactured columns shall follow the manufacturer's testing and listing. - See PDF for table

Note: A 3-Story frame house with walls constructed of 2 x 4 standard grade studs would require a 12-inch stud spacing on the lowest level, a 24-inch stud spacing on the intermediate level, and a 24-inch stud spacing on the upper level.

2. Columns made solely of steel pipe stock shall follow Table 321.25-E.

3. Columns made of steel stock, not meeting the requirements of subd. 1.or 2., shall follow a nationally accepted design specification or the size shall be determined through structural analysis or load testing.

(d) ***Wood posts or columns.*** Wood posts or columns shall be sized according to Table 321.25-F or the size shall be determined through structural analysis or load testing. - See PDF for table - See PDF for table - See PDF for table

*These tables are based on wood with a fiber bending Stress of 1,000 psi. For other species with different fiber bending Stresses, multiply the span by the square root of the ratio of the actual bending Stress to 1,000 psi. Example: From Table 321.25-B, the

allowable roof/ceiling span for a 28-foot wide house in zone 2, using two 2 x 8 header members with a 1400 psi bending Stress, is 5 feet - See PDF for diagram = 5.9 feet. - See PDF for table - See PDF for table

Note: This Table is based on a modulus of elasticity or E of 1,000,000 psi and a fiber bending strength or Fb of 1,000 psi.

(7) FOUNDATION CRIPPLE WALLS.

(a) Foundation cripple walls shall be framed with studs at least as large as the studs above.

(b) When more than 4 feet in height, cripple walls shall be framed with studs needed for an additional floor level.

(c) Cripple walls with a stud height of less than 14 inches shall be sheathed on at least one side for its entire length with a wood structural panel that is fastened to both the top and bottom plates or the cripple walls shall be constructed of solid blocking.

(d) Cripple walls with a stud height of 14 inches or greater shall be braced in accordance with sub. (8).

(e) Cripple walls shall be fully supported by a continuous Foundation.

(8) WALL BRACING.

(a) ***General.*** Dwellings using wood-framed walls shall be braced in accordance with this section. Where a building, or a portion thereof, does not comply with one or more of the bracing requirements in this section, those portions shall be designed and constructed in accordance with accepted engineering practice.

Note: Acceptable engineering wall bracing practices include any of the following:

1. The provisions under section R602.10 or R602.12 of the International Residential Code (IRC) – 2012.

2. Design in accordance with the engineering basis of the 2012 IRC bracing provisions, such as described in Crandell, J. and Martin, Z., "The Story Behind the *2009 IRC* Wall Bracing Provisions (Part 2: New Wind Bracing Requirements)," *Wood Design Focus*, Forest Products Society, Peachtree Corners, GA, Spring 2009.

3. Installation instructions from the manufacturer of the bracing product that are compliant with SPS 321.02.

Note: For a walk-out Basement where some of the walls are concrete and other walls or portions thereof are wood-framed, the Department considers a minimum 8-inch-nominal-thickness poured-in-place concrete Basement wall as being equivalent in lateral load and shear resistance to any of the allowable wood-framed wall bracing materials. To determine the required bracing for a walk-out Basement, first draw a rectangle around the entire floor plan and projections as if all of the walls are wood-framed. Determine the required bracing amounts per the chosen bracing material and method and then locate the bracing to meet the requirements of Figure 321.25-C. Any required braced wall panel locations that occur on a wall or portion of a wall that is actually of poured-in-place concrete construction is considered equivalent, and that amount of bracing will count towards the minimum required amount and will not need to be provided in another location on that rectangle side.

(b) ***Bracing Materials and Methods.*** Wall bracing shall consist of the materials and methods listed in Table 321.25–G or Approved alternatives capable of providing the required wind load resistance as determined in accordance with SPS 321.02 (1) (c). - See PDF for table - See PDF for table

(a) The interior side of all exterior walls shall be sheathed with minimum ½-inch gypsum wallboard unless otherwise permitted to be excluded by this subsection. All edges of panel-type wall bracing, except horizontal joints in GB bracing, shall be attached to framing or blocking.

(b) The actual measured wall height shall include stud height and thickness of top and bottom plates. The actual wall height shall be permitted to exceed the listed nominal values by not more than 4½ inches. Tabulated bracing amounts in SPS 321.25 (8)(c) are based on a 10-foot nominal wall height for all bracing methods and shall be permitted to be adjusted to other nominal wall heights not exceeding 12 feet in accordance with footnotes to Table 321.25–I or Table 321.25–J.

(c)LIB is not permitted for walls supporting a roof and two floors. Two LIB braces installed at a 60o angle from horizontal shall be permitted to be substituted for each 45o angle LIB brace.

(d) Bracing with CS-WSP and CS-SFB shall have sheathing installed on all sheathable surfaces above, below, and between wall openings.

(d) Shall be attached to the top and bottom plates and any intermediate studs, in one continuous length.

(e) Each braced panel may contain no more than one hole, having a maximum dimension of no more than ten percent of the least dimension of the panel, and confined to the middle three-fourths of the panel. - See PDF for table - See PDF for table

(a) Sheathing shall extend from the top of the top plate to the bottom of the bottom plate and may be multiple sheets. All joints shall be blocked.

(b) Interpolation is permitted.

Figure 321.25–A
METHOD PF – PORTAL FRAME BRACE CONSTRUCTION
- See PDF for diagram

Note: Steel headers are permitted if designed by structural analysis.

Note: As shown in the above cross-section, 1/2-inch gypsum wallboard is not required on the interior side of the wall.

(c) ***Bracing amount.*** Bracing methods and materials complying with Table 321.25–G shall be applied to walls in accordance with all of the following requirements:

1. For the purpose of determining bracing amounts, the outermost extents of the building plan at each floor level shall be circumscribed with a rectangle to define the overall length of each building side as shown in Figure 321.25–B.

2. In no case may the amount of bracing be less than two braced wall panels on walls parallel to each rectangle side for each floor level of the building.

3. Where used, the number of intermittent brace panels applied to walls parallel to each rectangle side shall comply with Table 321.25–I.
4. Where used, the total length of continuous sheathed brace panels applied to walls parallel to each building side shall comply with Table 321.25–J.
5. The location of brace panels applied to walls parallel to each building side shall comply with Figure 321.25–C.
6. Balloon-frame walls may be no longer than 21 feet and shall have a maximum height of two floors unless constructed in accordance with an Approved design. Wall framing shall be continuous from the lowest floor to the wall top plate at the roof. All edges of sheathing shall be supported on and fastened to blocking or framing. Braced wall panels may not be required on the balloon-frame wall portion provided the bracing amount and brace spacing requirement are satisfied for the building side. Where brace panels are located on the balloon-frame wall portion, they shall have a height-to-width ratio of not more than 2.5:1.
7. For a gable end wall, if the brace-panel height does not exceed 12 feet at the highest portion and if the 12½-foot and 21-foot spacing requirements in Figure 321.25–C are met, the wall is adequately braced. Where a brace panel exceeds 12 feet in height, it shall have a height-to-width ratio of not more than 2.5:1, and comply with Figure 21.25–C.

FIGURE 321.25-B
DEFINING BUILDING SIDES AND LENGTHS WITH ONE OR MORE CIRCUMSCRIBED RECTANGLES

- See PDF for diagram

(1) Basic floor plan

- See PDF for diagram

(2) Angled-building-side plan d

- See PDF for diagram

(3) Angled floor plan e

a) Each floor plan level shall be circumscribed with one or more rectangles around the entire floor plan at the floor level under consideration as shown. When multiple rectangles are used, each side shall be braced as though it were a separate building and the bracing amount added together along the common wall where adjacent rectangles overlap or abut.
b) Rectangles shall surround all enclosed plan offsets and projections. Chimneys, partial height projections, and open structures, such as Carports and Decks, shall be excluded from the rectangle.
c) Each rectangle shall have a maximum rectangle length-to-width ratio of 3:1.
d) Projected contributing lengths of angled braced wall panels shall be assigned to the closest rectangle sides, as shown for the angled corner in the angled-building-side-plan shown above.
e) Braced wall panels located on a common wall where angled rectangles intersect, as shown in Figure 321.25-B (3), shall have their contributing length applied towards the required length of bracing for the parallel rectangle side and its projected contributing lengths towards the adjacent angled rectangle sides. Where the common side of rectangle 2 as shown in Figure 321.25-B(3)

has no physical wall, the portion shall be designed in accordance with SPS 321.25 (8) (a).

TABLE 321.25–I
REQUIRED NUMBER OF INTERMITTENT BRACED WALL PANELS ON WALLS PARALLEL TO EACH RECTANGLE SIDE AT EACH FLOOR LEVEL - See PDF for table

a) Interpolation is permitted. Extrapolation to buildings larger than addressed in this table is prohibited.

b) This table applies to wind exposure category B. For wind exposure category C or D, multiply the number of braced wall panels required by 1.3 or 1.6, respectively.

Wind exposure category B is comprised of urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family Dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type of exposure.

Wind exposure category C is comprised of flat, open country and grasslands with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet extending more than 1,500 feet from the building site in any quadrant. This exposure also applies to any building located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 feet.

Wind exposure category D is comprised of flat, unobstructed areas exposed to wind flowing over open water for a distance of at least 1 mile. This exposure applies only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet or 10 times the height of the building or structure, whichever is greater.

c)Tabulated values are based on a nominal wall height of 10 feet. For nominal wall heights other than 10 feet and not more than 12 feet, multiply the required number of brace panels by the following factors: 0.9 for 8 feet, 0.95 for 9 feet, 1.15 for 11 feet, or 1.3 for 12 feet.

d)Tabulated values are based on a roof with a top-of-wall-to-ridge height of 10 feet. For top-of-wall-to-ridge heights other than 10 feet, multiply the required number of brace panels by the following factors for each floor level support condition:

Roof only – 0.7 for 5 feet, 1.3 for 15 feet, or 1.6 for 20 feet

Roof + 1 Floor – 0.85 for 5 feet, 1.15 for 15 feet, or 1.3 for 20 feet

Roof + 2 Floors – 0.9 for 5 feet or 1.1 for 15 feet.

e) Where minimum 1/2-inch gypsum wallboard is not included on the interior side of the wall, multiply the number of braced wall panels by 1.7 for LIB bracing or 1.4 for all other bracing methods, except this increase is not required for the portal frame method.

f) Adjustments in footnotes b to e apply cumulatively. Fractions of panels shall be rounded to the nearest one-half braced wall panel.

g) Perpendicular sides to the front and rear sides are the left and right sides. Perpendicular sides to the left and right sides are the front and rear sides. See Figure 321.25–B.

h) The following braced wall panel conditions shall be permitted to be counted as one-half a braced wall panel toward meeting the required number of panels: (1) one 60 degree LIB; (2) one 48" GB or one 96" GB with gypsum wallboard on one side; (3) one 36" WSP or SFB braced wall panel for wall heights not more than 9 feet; (4) a 48" WSP or SFB braced wall panel where there is no more than one unblocked horizontal joint; or (5) one PF brace panel complying with Figure 321.25–A.

i) This value of less than 2 serves only as the beginning value for calculation purposes. The resulting value shall be 2 or greater, to be consistent with subd. 2.

j) Any floor, habitable or otherwise, that is contained wholly within the roof rafters or roof trusses is exempt from being considered a floor for purposes of determining wall bracing if the top-of-wall-to-ridge height does not exceed 20 feet and if no opening in the roof exceeds 48 inches in height.

Table 321.25–J

REQUIRED LENGTH OF CONTINUOUS BRACING ON WALLS PARALLEL TO EACH RECTANGLE SIDE AT EACH FLOOR LEVEL - See PDF for table

a) Interpolation is permitted. Extrapolation to buildings larger than addressed in this table is prohibited.

b) This table applies to wind exposure category B. For wind exposure category C or D, multiply the required length of wall bracing by 1.3 or 1.6, respectively. Wind exposure categories are as defined in Table 321.25–I footnote b.

c)Tabulated values are based on a nominal wall height of 10 feet. For nominal wall heights other than 10 feet, multiply the required length of bracing by the following factors: 0.90 for 8 feet, 0.95 for 9 feet, 1.05 for 11 feet, or 1.10 for 12 feet.

d) Where minimum ½-inch gypsum wallboard interior finish is not provided, the required bracing amount for the affected rectangle side shall be multiplied by 1.4, except this increase is not required for the portal frame method.

e) Adjustments in footnotes b to d apply cumulatively.

f) Perpendicular sides to the front and rear sides are the left and right sides. Perpendicular sides to the left and right sides are the front and rear sides. See Figure 321.25–B.

g) Continuous sheathing shall be applied to all surfaces of the wall, including areas between brace panels and above and below wall openings.

h) When used on a wall line with continuous sheathing, each portal frame panel is counted for its actual length in contributing toward the length of continuous sheathing used on other portions of the same wall line, such as the building side at a given Story level.

i) Any value of less than 4.0 in this table serves only as the beginning value for calculation purposes. The resulting value shall be 4.0 or greater, to be consistent with Table 321.25–H and subd. 2.

j) Any floor, habitable or otherwise, that is contained wholly within the roof rafters or roof trusses is exempt from being considered a floor for purposes of determining wall bracing if the top-of-wall-to-ridge height does not exceed 20 feet and if no opening in the roof exceeds 48 inches in height.

Figure 321.25–C
LOCATION OF BRACED WALL PANELS ALONG A BUILDING SIDE

- See PDF for diagram

(d) ***Braced wall panel support.*** Braced wall panels shall be supported on floor framing or Foundations as follows:

1. Where joists are perpendicular to braced wall lines above or below, blocking shall be provided between the joists at braced wall panel locations to permit fastening of wall plates in accordance with the fastener table in the Ch. SPS 325 Appendix A.

2. Where joists are parallel to braced wall lines above or below, a rim joist or other parallel framing member shall be provided at the wall to permit fastening of wall plates in accordance with the fastener table in the Ch. SPS 325 Appendix A.

3. Braced wall panels shall be permitted to be supported on cantilevered floor joists meeting the cantilever limits of SPS 321.22 (6) provided joists are blocked at the nearest bearing wall location, except such blocking is not required for cantilevers not exceeding 24 inches where a full height rim joist is provided.

SPS 321.26 Masonry walls. Masonry walls shall be constructed in accordance with the requirements of this section.

(1) COLD WEATHER WORK. When ambient air temperature is below 40°F, the cold weather construction procedures under ACI 530.1 shall be followed.

Note: The requirements for cold weather work are in sections 1.8 and 1.8C of the 2005 edition of the ACI standard.

(2) MASONRY UNITS.

(a) ***Unused concrete units***. Previously unused concrete masonry units shall conform to the ASTM C 90 standard.

(b) ***Unused clay or shale units.*** Previously unused clay or shale masonry units shall conform to the appropriate ASTM standard: C 62; C 216; or C 652. Units which will be exposed to weathering or frost action shall be Grade SW as specified in these standards.

(c) ***Used masonry units***. All previously used masonry units shall be free from physical defects which interfere with the Installation or impair the structural properties of the unit.

(3) TYPES OF MORTAR.

(a) ***Mortar specifications.*** The type of mortar shall be determined from Table 321.26-A. The mortar shall conform to the requirements of ASTM C-270.

(b) ***Surface bond mortars***. Surface bond mortars for masonry walls shall be mixed in accordance with the proportions specified on the bag.

(4) MORTAR COMPONENTS. Mortar components shall comply with the following requirements:

(a) ***Water***. Water shall be clean and free of deleterious amounts of acids, alkalis, or organic materials.

(b) ***Admixtures or mortar colors.*** Admixtures or mortar colors shall not be added to the mortar unless the resulting mortar conforms to the mortar specifications. Only mineral oxide may be used as mortar color and shall not exceed 10% by weight of the cement.

(c) ***Mixing.*** Mortar shall be mixed for at least 3 minutes after all ingredients have been added with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to water evaporation shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2½ hours after mixing.

Note: To ensure proper mortar mixing, machine mixing is recommended. - **See PDF for table**

(d) ***Cementitious material.*** Cementitious material shall conform to the standards Approved by the Department.

Note: The Department will accept cementitious material conforming to the following standards: ASTM C91, Masonry Cement; ASTM C150, Portland Cement; ASTM C595, Portland Blast-Furnace Slag Cement; ASTM C207, Hydrated Lime for Masonry Purposes; and ASTM C5, Quick Lime for Structural Purposes.

(e) ***Aggregates.*** Aggregates for use in masonry mortar shall consist of natural sand or manufactured sand and shall be graded.

Note: The Department will accept aggregates in accordance with ASTM C144.

(5) CAVITY WALL.

(a) ***Corbels.*** Corbels shall be constructed in accordance with ACI 530.

(b) ***Projections.*** The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed 1¼ inches, unless at least 2/3 the mass of the wythe of masonry involved is located directly over the load-carrying member.

(6) OPENINGS AND LINTELS.

(a) ***Openings.*** The masonry above openings shall be supported. The bearing length of structural elements which support the masonry above the opening shall be not less than 4 inches.

(b) ***Lintels***. Unless designed through structural analysis, lintels shall be provided using either steel angles or reinforcing bars in accordance with Table 321.26-C. - **See PDF for table**

(7) MASONRY VENEERS.

(a) ***Veneer over frame construction.***

1. Masonry veneers may be corbeled over the Foundation wall, but the corbeling shall not exceed one inch.

2. A minimum one-inch air space shall be provided between the veneer and the sheathing unless a manufactured offset material is used.

3. Where no brick ledge is formed in the Foundation wall, corrosion resistant metal or other water-resistant flashing shall extend over the top of the Foundation wall from the outside face of the wall and shall extend at least 6 inches up on the sheathing. The flashing shall be installed to drain any water outward.

4. Weep holes shall be provided at the bottom masonry course at maximum intervals of 2 feet.

5. Ventilation openings shall be provided at the top of the wall.

Note: The ventilation opening could be other than a weep hole.

6. Studs and sheathing behind masonry veneer shall be covered with material used to construct the Water-Resistive Barrier as required under SPS 321.24 (4).

Note: Acceptable Water-Resistive Barrier materials include polymeric-based house wraps and #15 or greater asphalt-saturated felts that comply with ASTM D 226 for type I felt.

7. Masonry or brick veneer shall be above final exterior grade unless there is through-wall flashing at grade or within 2 courses above grade.

(b) ***Veneer over masonry back-up.*** Corrosion-resistant metal or other water-resistant base flashing shall be provided at the bottom of the veneer and shall extend over the top of the Foundation and up at least 6 inches and be embedded in the back-up course. The flashing shall be installed to drain any water outward. Weep holes shall be provided at maximum intervals of 3 feet.

(c) ***Veneer attachment.*** Veneers shall be anchored or adhered in accordance with ACI 530 and ACI 530.1.

(8) FLASHING.

(a) ***General.***

1. Flashing shall be installed in accordance with this section to drain any water outward away from structural members, sheathing and insulation.

2. Open joints or weep holes shall be provided in the facing immediately above the flashing at a horizontal spacing not exceeding 2 feet.

3. Flashing that will be exposed to ultraviolet light shall consist of materials which are durable and permanently UV-resistant, such as sheet metal or heavy-gauge PVC.

Note: Materials including house wrap, asphalt-impregnated building paper, plastic sheeting, peel-and-stick rubberized sheet material, and light-gauge PVC are not acceptable as meeting this requirement.

(b) ***Location.***

1. `Lintels and Chimneys.' In exterior hollow masonry walls, flashing shall be installed at the backsides of Chimneys and at the bottom of the cavity formed by openings such as lintels over doors and Windows.

2. `**Veneer.**' Flashing shall be installed at the bottom of veneer and shall extend over the top of the Foundation and up at least 8 inches and be embedded in the backing course.

(c) ***Weep holes.***

1. Weep holes may not be placed below final grade.

2. Rope or similar material used to form a weep hole shall be removed as soon as the mortar sets.

3. Weep holes shall be 3/8-inch minimum diameter.

Note: See SPS 321.24 (3) for further requirements relating to flashing for masonry.

(9) BEARING.

(a) ***Concentrated loads.*** Beams, girders, trusses, joists, and other members producing concentrated loads shall bear a minimum of 3 inches on one of the following:

1. `Concrete beam.' The equivalent of a nominally reinforced 2,500 psi concrete beam 8 inches in height.

2. `Solid masonry.' At least 8 inches in height of masonry composed of solid masonry units with all voids and joints completely filled with mortar.

3. `Metal plate.' A metal plate of sufficient thickness and size to distribute the load to masonry units. For piers and columns, the bearing plate shall not exceed 60% of the cross-sectional area of the pier or column and the resultant reaction of all vertical and horizontal loads shall fall within the middle third of the member.

4. `Bond beam.' The bond beam shall be the equivalent of not less than an 8-inch lintel (bond beam) block with 2 No. 4 bars embedded in high strength mortar fill or equivalent. The loads shall bear on the fill.

(b) ***Continuous loads.*** Joists, trusses, and beams other than wood, spaced 4 feet or less on center and 40 feet or less in length, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing of 3 inches upon solid masonry at least 2½ inches in height, or as indicated for concentrated loads.

(c) ***Stack bond walls.*** Concentrated loads shall be distributed into masonry laid in stack bond by a concrete beam or bond beam as defined in par. (a). For masonry of Solid Units, 2 additional rows of a continuous tie assembly may be used instead of a concrete beam or bond beam.

(d) ***Support of wood floor members.*** Where a wood structural member is buried in masonry for support, it shall be fire cut or a self-releasing device shall be used. Where the end of a wood structural member is built into an exterior wall, a ½-inch air space shall be provided at the sides, top and end of such member.

(10) BONDING. Unless designed through structural analysis, all masonry walls shall be bonded as follows:

(a) ***Single-Wythe Walls.*** Masonry units in Single-Wythe Walls shall be lapped at least 2 inches or one-third the height of the masonry unit, whichever is greater, or through the use of continuous tie assemblies spaced at 16-inch vertical intervals.

(b) ***Multi-Wythe Walls.*** Adjacent wythes shall be bonded with continuous tie assemblies spaced at vertical intervals not exceeding 16 inches; or individual ties of at least 3/16-inch diameter for each 4½ square feet of wall area, spaced at a maximum vertical distance of 18 inches and a maximum horizontal distance of 36 inches; or bonded with a full course of masonry headers every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid masonry units and 24 inches for hollow masonry units. Hollow walls shall not be bonded with headers.

(11) BOLTS AND ANCHORS. The allowable shear on steel bolts and anchors shall not exceed the values given in Table 321.26. - See PDF for table

(12) JOINTS. Joints in masonry construction shall be constructed in accordance with ACI 530.1.

(13) CLEANING. Chemical cleaning agents shall be prevented from harming the metal reinforcement of structural components and shall not be of a strength which will adversely affect the mortar.

Subchapter VIII — Roof and Ceilings

SPS 321.27 Roof design and framing.

(1) STRUCTURAL DESIGN.

(a) ***General.*** Roof and roof-ceiling assemblies shall support all Dead Loads plus the minimum Live Loads under par. (c) and SPS 321.02.

(b) ***Applicability of tables.*** The joist and rafter tables in Ch. SPS 325 Appendix A are valid for roofs with a minimum slope of 3 in 12. Lesser slopes require engineering analysis or shall be provided with a ridge beam.

(c) ***Sloped roof snow loads.*** Snow loads specified in SPS 321.02 (1) (b) 2. may be reduced for roof slopes greater than 30 ° by multiplying the snow load by Cs. The value of Cs shall be determined by the following: - See PDF for diagram

where a is the slope of the roof expressed in degrees.

Note: A roof pitch of 7 in 12 is equal to 30°.

(2) LATERAL RESTRAINT OF WALLS. Provisions shall be taken to absorb the horizontal thrust produced by a sloping roof through the use of wall ties, ceiling joists, beams at the ridge or at the wall or a system designed through structural analysis.

(3) UPLIFT AND SUCTION FORCES.

(a) ***General.***

1. Roofs shall withstand a pressure of at least 20 pounds per square foot acting upward normal to the roof surface.

2. Roof overhangs, eaves, canopies, and cornices shall withstand an upward wind pressure of at least 20 pounds per square foot applied to the entire exposed area.

(b) ***Anchorage.***

1. Roof framing members spanning more than 6 feet measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using engineered clips, straps, or hangers.

2. Roof framing members spanning 6 feet or less measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using toe-nailing or engineered clips, straps, or hangers.

Note: For information on toe nailing, see the fastener schedule table in the Ch. SPS 325 Appendix A.

(4) ROOF RAFTERS.

(a) ***General.***

1. Rafters shall be notched to fit the exterior wall plate and fastened to the wall.

2. Collar ties shall be installed on the upper third of every third pair of abutting roof rafters or every 48 inches, whichever is less.

Note: Collar ties are intended to provide stability to the roof at the ridge. Lateral restraint for the walls must be provided in accordance with sub. (2).

(b) ***Ridge boards.***

1. Where rafters meet to form a ridge, the rafters shall be attached to a ridge board.

2. The ridge board shall have a depth at least equal to the length of the cut end of the rafter abutting it.

3. Where all rafters are placed directly opposite each other or are offset at the ridge board by less than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 1 inch.

4. Where one or more rafters are offset at the ridge board by more than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 2 inches.

(c) ***Ridge beams***. Rafters shall be attached to ridge beams using engineered clips, straps or hangers or the connection shall be designed through structural analysis.

(d) ***Bearing***. The required bearing for wood rafters shall be in accordance with the NDS adopted in Table 320.24-6m, except in no case shall the bearing be less than 1 1/2 inches on wood or metal or less than 3 inches on masonry or concrete.

(e) ***Ladders.***

1. Overhangs at gable end walls of more than 12 inches shall be provided with ladders which extend into the structure a distance no less than the length of the overhang.

2. The ladders shall be fastened at the wall.

3. The interior end of each ladder shall be attached to a rafter or truss with a hanger.

Note: For the purposes of this section, a ladder is defined as a perpendicular projection extending beyond the face of the wall below.

(5) CEILING JOISTS.

(a) Ceiling joists shall be nailed to exterior walls and to the ends of rafters.

(b) Ends of ceiling joists shall be lapped at least 3 inches and be fastened either with 3-16d nails or in accordance with the floor joist requirements under SPS 321.22 (4) (a) 1. d.

Note: See the fastener table in the Ch. SPS 325 Appendix A for a nailing schedule for ceiling joists.

(c) Where ceiling joists are placed at right angles to the rafters, the lookout joist or ties shall be fastened to the parallel ceiling joists or rafters using engineered clips, straps or hangers or the connection shall be designed through structural analysis.

(6) VALLEY AND HIP RAFTERS.

(a) ***Valley rafters.***

1. Where no bearing is provided under valley rafters at the intersection of 2 roof areas, the valley rafters shall be doubled in thickness and shall be at least 2 inches deeper than the required common rafter to permit full bearing at the beveled end.

2. Where ridges are provided at different elevations, vertical support shall be provided for the interior end of the lower ridge board or ridge beam.

(b) ***Hip rafters.*** Where no bearing is provided under hip rafters, the hip rafters shall be of the same thickness as common rafters and shall be at least 2 inches deeper than required to permit full contact with the jack rafter.

(7) ROOF TRUSSES.

(a) Metal plate connected wood roof trusses shall be designed in accordance with TPI 1 and the NDS adopted under SPS 320.24.

(b) Truss members shall not be cut, bored or notched, except as allowed under sub. (8) (d).

(c) If connection is provided to stabilize a non-load bearing wall, a slotted expansion joint or clip shall be used.

(8) NOTCHING AND BORING.

(a) ***General.***

1. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

2. Notching and boring of ceiling joists and rafters shall comply with pars. (b) and (c).

(b) ***Notching.***

1. Notches located in the top or bottom of ceiling joists and rafters are prohibited from all of the following:

a. Having a depth exceeding 1/6 the depth of the member.

b. Having a length exceeding 1/3 the depth of the member.

c. Being located in the middle 1/3 of the span of the member.

2. Where ceiling joists or rafters are notched at the ends, the notch may not exceed ¼ the depth of the member.

3. Bird mouth cuts may not exceed 1/3 the depth of the rafter unless the seat cut bears fully on the wall plate.

(c) ***Boring.***

1. Holes bored within 2 inches of the top or bottom of ceiling joists or rafters may not be located in the middle 1/3 of the span of the member.

2. The diameter of a hole may not exceed 1/3 the depth of the member.

3. A hole may not be bored within 2 inches of a notch or another hole.

4. The distance between adjacent holes may not be less than the diameter of the larger hole.

(d) ***Engineered wood products.*** Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing.

(9) ROOF SHEATHING, BOARDS AND PLANKING.

(a) ***Structural sheathing.*** The allowable loads and spans for structural sheathing shall be in accordance with the grade stamp on the panel.

(b) ***Roof boards.***

1. Where the rafter spacing is 24 inches on center or less, roof boards may be used that have a minimum thickness of 5/8-inch for solid sheathing and 3/4-inch for spaced sheathing.

2. Where the rafter spacing is greater than 24 inches on center, roof boards shall be tongue and groove, at least 1.5 inches thick.

(c) ***Roof planks.***

1. Roof planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness.

2. Planks shall terminate over beams unless the joints are end matched.

3. The planks shall be laid so that no continuous line of joints will occur except at points of support.

4. Planks shall be nailed or fastened to each beam.

SPS 321.28 Weather protection for roofs.

(1) GENERAL.

(a) All roofs shall be designed and constructed to assure drainage of water.

(b) All fasteners shall be corrosion resistant.

(2) UNDERLAYMENT FOR SHINGLES. Underlayment consisting of number 15 asphalt-impregnated felt paper or equivalent or other type I material that shows no water transmission when tested in accordance with ASTM D 226 or ASTM D 4869 shall be provided under Shingles.

Note: Underlayment materials meeting the requirements of ASTM D 1970 meet the performance requirements of this section.

(3) ASPHALT SHINGLES.

(a) ***General.***

1. Shingles that have a self-sealing adhesive strip shall include a sealant which has an average bond strength of at least 1.5 pounds per 3.75 inches of Shingle width, at 32°F.

Note: The Department will accept results of testing conducted in accordance with an Approved test method for verifying compliance with the sealant uplift resistance required in this paragraph. Information on the applicable test method may be obtained from the Department.

2. Each Shingle package shall be labeled by the manufacturer to indicate conformance to the applicable ASTM standard for each type of Shingle or the exception in par. (c).

3. Shingles shall be installed in accordance with the manufacturer's recommendations.

4. Shingles shall have at least 4 fasteners per strip Shingle or 2 fasteners per interlocking Shingle unless the manufacturer has other specifications.

5. Shingle head lap shall be at least 2 inches, unless the manufacturer has other specifications.

6. All fasteners for Shingles shall be corrosion resistant.

Note: See SPS 320.07 (62) for definitions of Shingle terms.

Note: Section SPS 320.04 (2) requires compliance with all parts of this Code, including these roofing provisions, for an alteration to any Dwelling that is regulated under this Code.

(c) ***Fiberglass Shingles.*** Fiberglass asphalt Shingles shall conform to ASTM D 3462 except that laminated Shingles shall have a tear strength of at least 1450 grams in each ply.

(4) ICE DAM PROTECTION.

(a) Shingled or shake roofs that extend over a heated area of a Dwelling or attached Garage and that have a slope of 4:12 or less shall be provided with ice dam protection in the form of sheet metal or a product labeled as meeting the requirements of ASTM D 1970.

(b) The ice dam protection shall extend at least 30 inches up the roof slope from the roof edge and at least 12 inches up the roof slope beyond the inner face of the exterior wall.

(5) OTHER ROOF COVERINGS. All roof coverings not otherwise addressed in this section shall be installed in accordance with the manufacturer's instructions or a national standard recognized by the Department.

(6) REROOFING. New roof coverings may not be installed over existing roof coverings where any of the following conditions exist:

(a) The existing roof or roof covering is water-soaked or has deteriorated such that it is inadequate as a base for additional roofing.

(b) The existing roof is wood shake, slate, clay, cement, or asbestos-cement tile.

(c) The existing roof has 2 or more applications of any type of permanent roof covering.

(7) FLASHING.

(a) ***General.*** Flashing shall be installed at the junction of Chimneys and roofs, in all valleys, and around all roof openings.

(b) ***Flashing of open valleys.***

1. Open valleys shall be flashed with at least No. 28 gauge corrosion-resistant sheet metal, 16 inches wide, or a layer of at least 50-pound roll roofing, 16 inches wide, placed over a layer of number 15 roofing underlayment.

2. Flashing sections shall be overlapped by at least 4 inches.

(c) ***Flashing of closed valleys.*** Where Shingles are laced or woven over the valley, the valley shall be flashed with one of the following:

1. At least one layer of 50-pound roofing, at least 20 inches wide, over a layer of number 15 roofing underlayment.

2. A product labeled as meeting the requirements of ASTM D1970.

(d) ***Chimney flashing.***

1. Chimneys shall be flashed and counter-flashed to a height of at least 6 inches.

2. Chimney crickets or saddles shall be installed where the upper side of a Chimney is more than 30 inches wide on a sloping roof.

3. The intersection of the cricket and the Chimney shall be flashed and counter-flashed to a height of at least 6 inches.

Subchapter IX — Fireplace Requirements

SPS 321.29 Masonry fireplaces. Masonry fireplaces shall be constructed of masonry, stone, or concrete. Masonry fireplaces shall be supported on Foundations of concrete or masonry. Structural walls shall be at least 8 inches thick. Masonry fireplaces shall conform to the following requirements:

(1) FLUE SIZE. The fireplace flue size shall be based on the type of flue and the fireplace opening indicated in Table 321.29. - **See PDF for table**

(2) TERMINATION OF CHIMNEY. Masonry fireplace Chimneys shall extend at least 3 feet above the highest point where the Chimney passes through the roof and at least 2 feet higher than any portion of the Dwelling within 10 feet of the Chimney.

(3) FIREBOX MATERIALS. The Firebox shall be of the preformed metal type, at least ¼-inch thick, or listed by a nationally recognized laboratory; or shall be lined with firebrick, at least 2 inches thick and laid in thin joints of refractory cement. The back and sidewalls of the Firebox, including the lining, shall be at least 8 inches nominally thick masonry, at least 4 inches of which shall be solid.

(4) LINTEL. Masonry over the fireplace opening shall be supported by a lintel of steel or masonry.

(5) DUCTS. Warm air circulating ducts shall be constructed of masonry or metal.

(5m) RETURN AIR GRILLES. Return air grilles shall not be located in bathrooms, Kitchens, Garages, utility spaces or in a confined space defined under SPS 323.06 in which a draft diverter or draft regulator is located.

(6) HEARTH EXTENSION.

(a) Masonry fireplaces shall have a Hearth Extension made of noncombustible material.

(b) The structural support for the Hearth and Hearth Extension shall be a minimum of 4 inches of reinforced concrete.

(c) There shall be no structural framing material within 1 inch of the Hearth or Hearth Extension in any direction. Any wooden forms or supports used during construction shall be removed.

(d) The minimum dimensions of the Hearth Extension shall be in accordance with Table 321.29-1. - See PDF for table

(7) DAMPERS. Dampers shall be made of cast iron or at least No. 12 gauge sheet metal. The area of the damper opening shall be at least 90% of the required flue area when in the open position.

(8) HOODS. Metal hoods used in lieu of a masonry Smoke Chamber, shall be constructed of at least No. 19 gauge corrosion-resistant metal with all seams and connections of smokeproof construction. The hood shall be sloped at an angle of 45° or less from the vertical and shall extend horizontally at least 6 inches beyond the Firebox limits. Metal hoods shall be kept a minimum of 18 inches from the combustible materials unless Approved for reduced clearances.

Note: The Department will accept dampers and hoods listed by nationally recognized laboratories.

(9) FLUE LINERS.

(a) Flue liners shall be installed in accordance with SPS 321.30 (7) and this section.

(b) Flue liners shall start at the top of the fireplace Throat and extend to a point at least 4 inches above the top of the Chimney cap.

(c) Firebrick may be used in the Throat of the fireplace as an inlet to the flue liner.

(10) CLEANOUT OPENINGS. Fireplaces with ash dumps shall be provided with cleanout openings at the base. Doors and frames of the opening shall be made of ferrous materials.

(11) MANTEL SHELVES AND COMBUSTIBLE TRIM. Woodwork or other combustible materials shall not be placed within 6 inches of the fireplace opening. Combustible materials located within 12 inches of the fireplace opening shall not project perpendicularly more than 1/8-inch for each inch distance from the opening.

(12) FRAMING AROUND FIREPLACES. Combustible materials located near fireplaces shall be installed in accordance with SPS 321.30 (9).

(13) CORBELING. Unless designed through structural analysis, masonry Chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry Chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one-inch projection for each brick course.

SPS 321.30 Masonry Chimneys. Masonry Chimneys shall conform to the following provisions:

(1) MATERIALS. No masonry Chimney shall rest upon wood. The Foundation shall be designed and built in conformity with the requirements for Foundations. Masonry Chimney walls shall be at least 4 inches in nominal thickness. Hollow cored masonry units may be used to meet the 4-inch nominal thickness requirement.

(2) FLUE SIZE. Chimney flues for appliances shall be at least equal in area to that of the area of the connector from the appliance.

(3) MULTIPLE FLUE SEPARATION. When more than one flue is contained in the same Chimney, a masonry separation of at least 4 inches nominal in thickness shall be provided between the individual flues. The joints of adjacent flue linings shall be staggered by at least 7 inches.

(4) CORBELING. Unless designed through structural analysis, masonry Chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry Chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one-inch projection for each brick course.

(5) INLETS. Inlets to masonry Chimneys shall enter the side and be provided with thimbles. Thimbles shall be at least No. 24 manufacturer's standard gauge (0.024 inch) or 5/8-inch thick, refractory material. Each Chimney shall have an inlet installed at the time of construction.

(6) CLEAN-OUT OPENING. Every masonry Chimney shall be provided with a clean-out opening at the base. Such openings shall be equipped with metal doors and frames arranged to remain closed when not in use. Clean-out openings shall be located below the lowest inlet to the flue.

(7) FLUE LINERS.

(a) Masonry Chimneys shall be lined with a material that will resist corrosion, softening and cracking at temperatures up to 1800°F, such as vitrified clay sewer pipe or minimum 5/8-inch-thick fireclay lining material.

(b) All flue liners shall be laid in a full bed of refractory mortar or refractory cement.

(c) Variations in inside and outside dimensions shall not exceed ¼ inch for clay flue liners.

(d) There shall be a minimum clearance of ½-inch and a maximum clearance of 1-inch between the flue liner and the Chimney walls.

(e) Unless serving a masonry fireplace under SPS 321.29, flue liners shall commence at the Chimney footing.

(8) CHIMNEY CAPS. Chimneys shall be provided with precast or cast-in-place concrete Chimney caps. Chimney caps shall have a minimum thickness of 2 inches, shall slope outwards away from the flue, and shall provide a one-inch overhang and drip edge on all sides. A slip joint shall be installed between the flue and the cap. The slip joint shall be filled with ¼-inch felt or similar material and shall be caulked with high-temperature caulk or similar material to prevent water infiltration.

(9) CLEARANCE TO COMBUSTIBLES.

(a) The minimum clearance between combustibles and masonry Chimneys which have any portion located within the exterior wall of the Dwelling shall be 2 inches. The minimum clearance between combustibles and masonry Chimneys which have all parts completely outside the Dwelling, exclusive of soffit or cornice areas, shall be one inch.

(b) Except as required under pars. (c) and (d), the clearance spaces shall remain completely open.

(c) The clearance spaces between Chimneys and wood joists, beams, headers, or other structural members shall be fire blocked at each floor level from Chimney footing all the

way to the roof flashing with galvanized steel, at least 26 gage thick or with noncombustible sheet material.

(d) Noncombustible material shall be used to prevent entry of debris into the clearance spaces.

SPS 321.32 Factory-built fireplaces. Factory-built fireplaces consisting of a fire chamber assembly, one or more Chimney sections, a roof assembly and other parts shall be tested and listed by a nationally recognized testing laboratory.

(1) FIREPLACE ASSEMBLY AND MAINTENANCE. The fireplace assembly shall be erected and maintained in accordance with the conditions of the listing.

(a) All joints between the wall or decorative facing material and the fireplace unit shall be completely sealed, fire stopped or draft-stopped with a noncombustible caulk or equivalent.

(b) Doors installed on factory-built fireplaces shall conform with the terms of the listing and the manufacturers Installation instructions for the fireplace unit.

(2) DISTANCE FROM COMBUSTIBLES. Portions of the manufactured Chimney extending through combustible floors or roof/ceiling assemblies shall be installed in accordance with the distances listed on the Chimney in order to prevent contact with combustible materials.

(3) HEARTH EXTENSIONS. Hearth Extensions shall be provided in accordance with the manufacturer's listing. Where no Hearth Extension is specified in the listing, a Hearth Extension shall be provided in accordance with SPS 321.29 (6).

Subchapter X — Construction in Floodplains

SPS 321.33 Construction in Floodplains.

(1) GENERAL. Where Dwelling construction is allowed by the Department to take place in Flood Fringe Areas of Floodplains, the Dwelling shall meet the requirements of this subchapter.

Note: The Land and Natural Resources Division and the Federal Emergency Management Agency (FEMA) also have regulations that apply to construction in Flood Fringe Areas.

(2) ELEVATION.

(a) ***General.*** Except as provided in pars. (b) and (c), all Dwellings constructed within a Flood Fringe Area shall be elevated so the lowest floor and all Basement floor surfaces are located at or above the Base Flood Elevation .

(b) ***Certified floodproof Basements.*** Floodproof Basements may have the top of the Basement floor no more than 5 feet below the Base Flood Elevation provided the Basement is designed by a registered architect or engineer to be watertight and impermeable. No limitation is placed on the use or occupancy of a certified floodproof Basement by the provisions of this subchapter.

© ***Other enclosed spaces.***

1. Enclosed spaces not meeting the requirements of par. (b) are allowed at any depth below the Base Flood Elevation provided the spaces are used only for one or more of the following purposes:

a. Means of egress.

b. Entrance foyers.

c. Stairways.

d. Incidental storage of portable or mobile items.

2. Fully enclosed spaces used only for those purposes listed in subd. 1. shall be designed to automatically equalize the hydrostatic pressure on exterior walls by allowing the entry and exit of floodwaters. Designs for meeting this requirement shall be certified by a registered architect or engineer or shall meet all of the following requirements:

a. There shall be at least 2 pressure-relieving openings and the openings shall have a total net area of not less than one square inch for every square foot of enclosed area subject to flooding.

b. The bottom of all openings shall be no more than 12 inches above grade.

c. Openings may not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

(3) CERTIFICATION OF ELEVATION. A registered land surveyor, architect, or engineer shall certify the actual elevation in relation to mean sea level of the lowest structural member required to be elevated by the provisions of this subchapter.

(4) ANCHORAGE. The structural systems of all Dwellings shall be designed, connected, and anchored to resist flotation, collapse, or permanent lateral movement due to structural loads and Stresses at the Base Flood Elevation.

(5) PROTECTION OF ELECTRICAL AND MECHANICAL SYSTEMS. Electrical and mechanical equipment shall be placed above the Base Flood Elevation or shall be designed to prevent water contact with the equipment in case of a flood up to the Base Flood Elevation .

(6) CONSTRUCTION MATERIALS AND METHODS. All Dwellings constructed in Floodplains shall be constructed using materials and methods designed to minimize flood and water damage.

SPS 321.34 Construction in Coastal Floodplains.

(1) GENERAL. All Dwellings constructed in Coastal Floodplains shall be designed by a registered architect or engineer and shall meet the requirements of this section and SPS 321.33.

(2) ELEVATION. All Dwellings constructed in a Coastal Floodplain shall be elevated so the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft Foundations, pilings, piling caps, columns, grade beams and bracing, is located at or above the Base Flood Elevation .

(3) ENCLOSURES BELOW BASE FLOOD ELEVATION. Enclosures below the Base Flood Elevation in a Coastal Floodplain may not be used for human occupancy and shall be free of all obstructions, except for non-loadbearing walls and partitions. Non-loadbearing walls and partitions below Base Flood Elevation shall be constructed to break away without causing any structural damage to the elevated portion of the Dwelling or Foundation system due to the effect of wind loads and water loads acting simultaneously.

(4) FOUNDATIONS. All Dwellings located in a Coastal Floodplain shall be supported and anchored on pilings or columns. The piling or column shall have adequate soil penetration to resist combined water and wind loads at the Base Flood Elevation. Piling or column design

shall consider the effect of scouring soil strata. Mat or raft Foundations to support columns may not be used where soil under the mat or raft is subject to scour or other Erosion from wave flow conditions.

Subchapter XI — Installation of Manufactured Homes

SPS 321.40 Installation standards. All Manufactured Homes shall comply with the Installation standards contained in this Code.

SPS 321.40(2)(b)17.17. A minimum clearance of 12 inches shall be maintained beneath the lowest point of the main frame in the area of any utility connection. A minimum clearance of 12 inches shall also be maintained under the home for at least 75% of the home. The remainder of the home may be less than 12 inches above the ground but may not touch the ground.

Table 321.02–1

Component	Live Load (pounds per sq. ft.)
Floors	40
Garage floors	50
Exterior balconies, decks, porches	40
Ceilings (with storage)	20
Ceilings (without storage)	5

Table 321.042

Pitch of Ladder Angle to Horizontal (degrees)	Maximum rise (inches)	Minimum Tread (inches)
41.6 to 48.4	8	9
greater than 48.4 to 55.0	9	8
greater than 55.0 to 61.4	10	7
greater than 61.4 to 67.4	11	6
greater than 67.4 to 71.6	12	5
greater than 71.6 to 75.9	12	4
greater than 75.9 to 80.5	12	3
greater than 80.5 to 90	12	2

Table 321.02–2
MINIMUM FASTENER SCHEDULE TABLE

Other interior and exterior panel products and finishes installed per manufacturer requirements.
For engineered connectors, use manufacturer's specified fasteners.

Description of Building Materials/Connection	Number and Type of Fastener[1 2 3]
Floor Framing	
Joist to joist, face nailed over support	3–8d
Joist to sill or girder, toe nail	3–8d
Band or rim joist to joist, end nail	3–16d
Band or rim joist to sill or top plate	2–16d at 16″ o.c.
Bridging to joist, toe nail each end	2–8d
Built–up girder and beams, top loaded	10d at 32" o.c. at top and bottom and staggered and two at ends and at each splice
Built–up girder and beams, side–loaded	16d at 16" o.c. at top and bottom and staggered and two at ends and at each splice
Ledger strip to beam, face nail	3–16d each joist
Joist on ledger to beam, toe nail	3–8d
Wall Framing	
Sole plate to joist or blocking, face nail	2–16d at 16″ o.c.
Top or sole plate to stud, end nail	2–16d
Stud to sole plate, toe nail	3–8d or 2–16d
Doubled studs, face nail	10d at 24″ o.c.
Doubled top plates, face nail	10d at 24″ o.c.
Doubled top plates, minimum 24–inch offset of end joints, face nail in lapped area	8–16d
Top plates, laps and intersections, face nail	2–10d
Continuous header, two pieces	16d at 16″ o.c. along each edge
Continuous header to stud, toe nail	4–8d
1″ corner brace to each stud and plate, face nail	2–8d or 2 staples, 1¾″
Built–up corner studs	10d at 24″ o.c.

Description of Building Materials/Connection	Number and Type of Fastener[1 2 3]
Roof/Ceiling Framing	
Ceiling joists to plate, toe nail	3–8d
Ceiling joist, laps over partitions, face nail	3–10d
Ceiling joist to parallel rafters, face nail	3–16d
Rafter to plate, toe nail (maximum 6 rafter span, engineered connector for longer)	2–16d
Roof rafters to ridge, valley or hip rafters, toe nail	4–16d
Roof rafters to ridge, valley or hip rafters, face nail	3–16d
Collar ties to rafters, face nail	3–8d
Boards and planks	
1″ x 6″ subfloor or less to each joist, face nail	2–8d or 2 staples, 1¾″
Wider than 1″ x 6″ subfloor toe to each joist, face nail	3–8d or 4 staples 1¾″
2″ subfloor to joist or girder, blind and face nail	2–16d
1″ x 6″ roof or wall sheathing to each bearing, face nail	2–8d or 2 staples, 1¾″
1″ x 8″ roof or wall sheathing to each bearing, face nail	2–8d or 3 staples, 1¾″
Wider than 1″ x 8″ roof sheathing to each bearing, face nail	3–8d or 4 staples, 1¾″
2″planks	2–16d at each bearing

Panel Sheathing

Material	Fastener	Spacing of Fastener	
		Edges	Intermediate Supports
Engineered wood panel for subfloor and roof sheathing and wall corner wind bracing to framing			
$^5/_{16}$″ to ½″	6d common or deformed nail or staple, 1½″	6″	12″ [4]
$^5/_8$″ to ¾″	8d smooth or common, 6d deformed nail, or staple, 14 ga. 1¾″	6″	12″ [4]
$^7/_8$″ to 1″	8d common or deformed nail	6″	12″
$1^1/_8$″ to 1¼″	10d smooth or common, or 8d deformed nail	6″	12″
Combination subfloor/ underlayment to framing			
¾″ or less	6d deformed or 8d smooth or common nail	6″	12″
$^7/_8$″ to 1″	8d smooth, common or deformed nail	6″	12″
$1^1/_8$″ to 1 ¼″	10d smooth or common or 8d deformed nail	6″	12″
Wood panel siding to framing			
½″ or less	6d corrosion–resistant siding and casing nails	6″	12″
$^5/_8$″	8d corrosion–resistant siding and casing nails	6″	12″
½″ structural cellulosic fiberboard sheathing	1½″ galvanized roofing nail; 8d common nail; staple 16 ga., 1½″ long	3″	6″
$^{25}/_{32}$″ structural cellulosic fiberboard sheathing	1¾″ galvanized roofing nail; 8d common nail; staple 16 ga., 1¾″ long	3″	6″
½″ gypsum sheathing[5]	1½″ galvanized roofing nail; 6d common nail; staple galvanized 1½″ long; 1¼″ screws, Type W or S	4″	8″
$^5/_8$″ gypsum sheathing[5]	1¾″ galvanized roofing nail; 8d common nail; staple galvanized $1^5/_8$″ long; $1^5/_8$″ screws, Type W or S	7″	7″

[1] All nails are smooth–common, box or deformed shank except where otherwise stated.
[2] Nail is a general description and may be T–head, modified round head or round head.
[3] Staples are 16–gauge wire, unless otherwise noted, and have a minimum $^7/_{16}$″ o.d. crown width.
[4] Staples shall be spaced at not more than 10″ o.c. at intermediate supports for floors.

Figure 321.02
ZONE MAP FOR ROOF LOADS

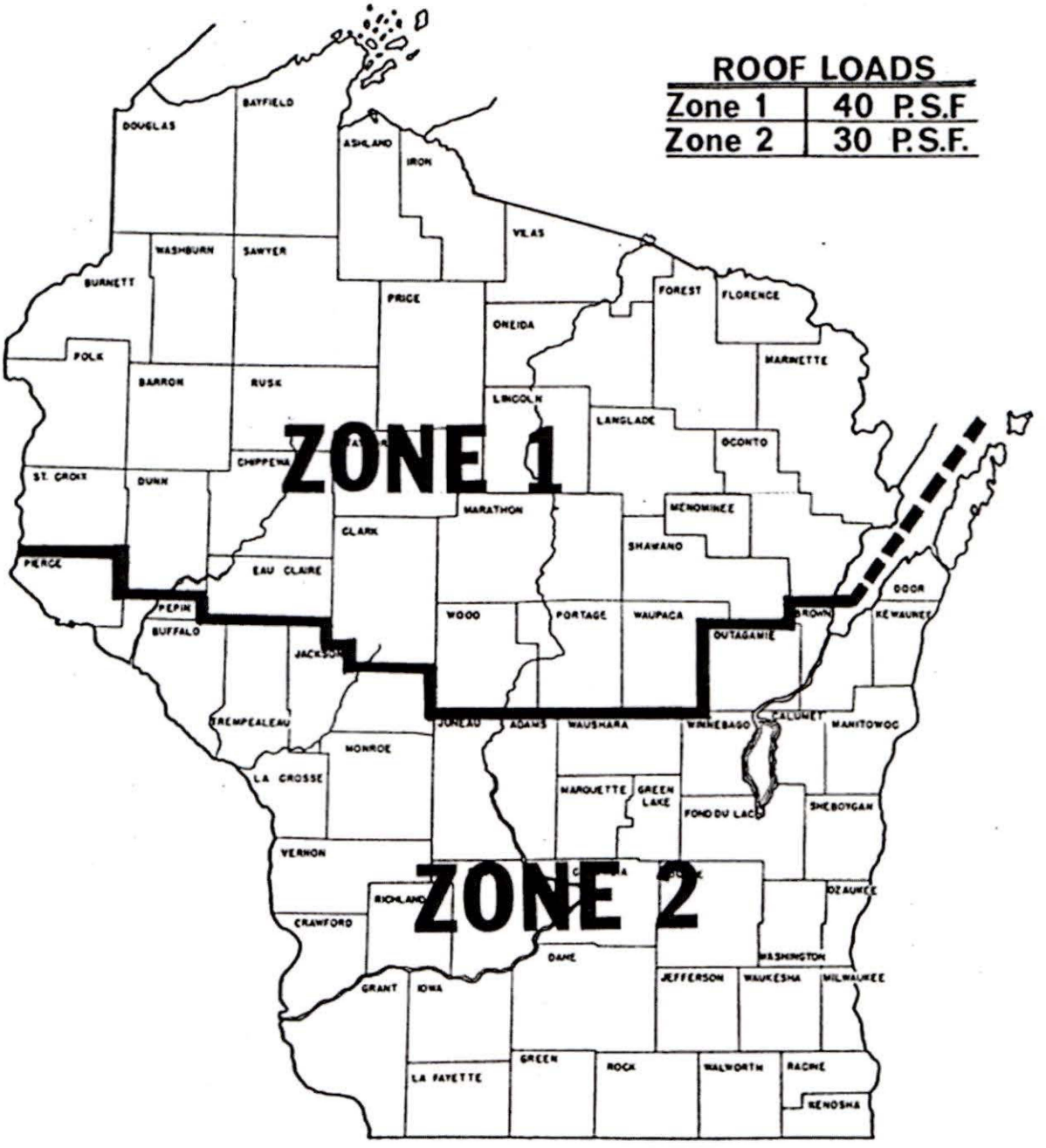


Table 321.08

Between Dwelling And:	Distance Between Objects[1]	Fire Rated Construction[2,5]
Detached garage or accessory building on same property	Less than 5 feet	3/4–hour wall[3] 1/3–hour door or window[3]
Another dwelling on same property	Less than 5 feet	3/4–hour wall[4] 1/3–hour door or window[4]
Detached garage, accessory building, or other dwelling on same property	5 to 10 feet	3/4–hour wall[3] 1/3–hour door or window[3]
Detached garage, accessory building, or other dwelling on same property	More than 10 feet	No requirements
Property Lines	Less than 3 feet	3/4–hour wall 1/3–hour door or window
Property Lines	3 feet or more	No Requirements
Zero Lot Line	None	Follow sub. (2) (d) requirements

[1]Distance shall be measured perpendicular from wall to wall or property line, ignoring overhangs.

[2] Fire rated construction shall protect the dwelling from an exterior fire source.

[3] Fire rated construction may be in either facing wall.

[4] Fire rated construction shall be in both facing walls.

[5] The methods for garage separation in par. (a) 1. are examples of ¾ hour wall construction.

Table 321.22–D

MINIMUM THICKNESS FOR PLYWOOD COMBINATION SUBFLOOR–UNDERLAYMENT. PLYWOOD CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1,2]

		Maximum Support Spacing[3]		
		16" o.c.	20" o.c.	24" o.c.
Plywood Grade	Plywood Species Group	Panel Thickness (inches)	Panel Thickness (inches)	Panel Thickness (inches)
Sanded exterior type	1	1/2	5/8	3/4
	2 & 3	5/8	3/4	7/8
	4	3/4	7/8	1
Underlayment C–C Plugged Sturd–I–Floor[4]	All Groups	APA Rated Sheathing and APA Rated Sturd–I–Floor shall be installed consistent with their rating.		

[1]Spans shall be limited to values shown, based on possible effect of concentrated loads.

[2]Unsupported edges shall be tongue and groove or blocked except where ¼–inch underlayment or 25/32–inch finish floor is used.

[3]Underlayment, C–C Plugged, sanded exterior type: allowable uniform load based on deflection of L/360 span for spans 24 inches or less is 125 psf; and for spans 48 inches, 65 psf.

[4]The department will accept subfloor underlayment panels such as Sturd–I–Floor which meet the requirements of APA manufacturing specifications for Sturd–I–Floor panels.

Table 321.22–E

MINIMUM THICKNESS OF FLOOR BOARDS

Joist Spacing (inches)	Minimum Net Thickness (inches)	
	Perpendicular to Joist	Diagonal to Joist
24	11/16	3/4
16	5/8	5/8

Type of soil	PSF
1. Wet, soft clay; very loose silt; silty clay	2,000
2. Loose, fine sand; medium clay; loose sandy clay soils	2,000
3. Stiff clay; firm inorganic silt	3,000
4. Medium (firm) sand; loose sandy gravel; firm sandy clay soils; hard dry clay	4,000
5. Dense sand and gravel; very compact mixture of clay, sand and gravel	6,000
6. Rock	12,000

Table 321.18–B

CONCRETE WALL THICKNESSES

Type of Concrete	Nominal Thickness (inches)	Maximum Height of Unbalanced Fill[1] for Material of Wall Being Supported (Wood frame — feet)
3000 psi	8	8
Unreinforced concrete	10	9
	12[2]	10
	14	11.5

[1]Unbalanced fill is the difference in elevation between the outside grade and the basement floor.

[2]The maximum height of unbalanced fill for a 12–inch thick plain concrete wall may be increased to 12 feet provided the wall is constructed of concrete with a minimum compressive value of 6,000 psi at 28 days.

Table 321.18–A

SOIL LATERAL LOAD

Description of Backfill Material[c]	Unified Soil Classification	Design Lateral Soil Load[a] PSF per Foot of Depth
Well graded, clean gravels; gravel–sand mixes	GW	30[c]
Poorly graded clean gravels; gravel–sand mixes	GP	30[c]
Silty gravels, poorly graded gravel–sand mixes	GM	40[c]
Clayey gravels, poorly graded gravel–and–clay mixes	GC	45[c]
Well–graded, clean sands; gravelly sand mixes	SW	30[c]
Poorly graded clean sands; sand–gravel mixes	SP	30[c]
Silty sands, poorly graded sand–silt mixes	SM	45[c]
Sand–silt clay mix with plastic fines	SM–SC	45[d]
Clayey sands, poorly graded sand–clay mixes	SC	60[d]
Inorganic silts and clayey silts	ML	45[d]
Mixture of inorganic silt and clay	ML–CL	60[d]
Inorganic clays of low to medium plasticity	CL	60[d]
Organic silts and silt clays, low plasticity	OL	[b]
Inorganic clayey silts, elastic silts	MH	60[d]
Inorganic clays of high plasticity	CH	[b]
Organic clays and silty clays	OH	[b]

Table 321.22–B

ALLOWABLE SPANS FOR PLYWOOD FLOOR SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1]

Span Rating[2]	Plywood Thickness (in inches)	Maximum span[3] (in inches)
32/16	15/32, 1/2, 5/8	16[5]
40/20	19/32, 5/8, 3/4, 7/8	20[4,5]
48/24	23/32, 3/4, 7/8	24

[1]These values apply to C–D, C–C, and Structural I and II grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

Table 321.25–B

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ROOF/CEILING ASSEMBLIES*

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone2/Zone 1		Zone 2/Zone 1	
24	2.5	2.5	4	4	5	5	7	6	9	8
26	2.5	2	4	3	5	5	7	6	8	7
28	2.5	2	4	3	5	4	6	6	8	7
30	2.5	2	4	3	5	4	6	6	8	7
32	2	2	3	3	5	4	6	5	7	7

Table 321.25–C

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR*

House Width (feet)	Header Members				
	Two 2 x 4s	Two 2 x 6s	Two 2 x 8s	Two 2 x 10s	Two 2 x 12s
24	2.5	4	5	6	8
26	2.5	3	5	6	8
28	2	3	5	6	7
30	2	3	4	6	7
32	2	3	4	5	7

Table 321.25–D

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR AND ROOF/CEILING ASSEMBLY*

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone2/Zone 1		Zone 2/Zone 1	
24	1.5	1.5	3	2.5	4	3	5	4	6	5
26	1.5	1.5	2.5	2.5	3	3	4	4	5	5
28	1.5	1.5	2.5	2.5	3	3	4	4	5	5
30	1.5	1.5	2.5	2.5	3	3	4	4	5	5
32	1.5	1.5	2.5	2	3	3	4	4	5	5

*These tables are based on wood with a fiber bending stress of 1,000 psi. For other species with different fiber bending stresses, multiply the span by the square root of the ratio of the actual bending stress to 1,000 psi. Example: From Table 321.25–B, the allowable roof/ceiling span for a 28–foot wide house in zone 2, using two 2 x 8 header members with a 1400 psi bending stress, is 5 feet $\times \sqrt{1400/1000}$ = 5.9 feet.

Table 321.18–C

PLAIN MASONRY FOUNDATION WALLS[d]

Maximum Wall Height (ft–in)	Depth of unbalanced backfill height (ft)	Minimum nominal wall thickness (inches)		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	8	8	8
	5	8	10	10
	6	10	12	10 (solid[b])
	7	12	10 (solid[b])	12 (solid[b])
8–4	4 (or less)	8	8	8
	5	8	10	12
	6	10	12	12 (solid[b])
	7	12	12 (solid[b])	Note c
	8	10 (solid[b])	12 (solid[b])	Note c
9–1	4 (or less)	8	8	8
	5	8	10	12
	6	12	12	12 (solid[b])
	7	12 (solid[b])	12 (solid[b])	Note c
	8	12 (solid[b])	Note c	Note c
	9	Note c	Note c	Note c

[a] For design lateral soils, see s. SPS 321.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

[b] Solid grouted hollow units.

[c] An analysis in compliance with ACI 530 or reinforcement in accordance with Table 321.18–D, 321.18–E or 321.18–F is required.

[d] Mortar shall be Type M or S and masonry shall be laid in running bond.

Table 321.18–D[b,c,d]

8, 10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 5 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#5 at 40″ o.c.
	7	#4 at 40″ o.c.	#5 at 40″ o.c.	#6 at 48″ o.c.
8–4	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#5 at 40″ o.c.
	7	#5 at 48″ o.c.	#6 at 48″ o.c.	#6 at 40″ o.c.
	8	#5 at 40″ o.c.	#6 at 40″ o.c.	#7 at 40″ o.c.
9–1	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#5 at 48″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#6 at 48″ o.c.
	7	#5 at 48″ o.c.	#6 at 48″ o.c.	#7 at 48″ o.c.
	8	#5 at 40″ o.c.	#7 at 48″ o.c.	#8 at 48″ o.c.
	9	#6 at 40″ o.c.	#8 at 48″ o.c.	#8 at 32″ o.c.

[a] For design lateral soil loads, see s. SPS 321.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

[b] Provisions for this table are based on construction requirements specified in s. SPS 321.18 (3) (b).

[c] For alternative reinforcement, see s. SPS 321.18 (3) (b).

[d] Mortar shall be Type M or S and masonry shall be laid in running bond.

[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

Table 321.18–E[b,c,d]

10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 6.75 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	6	#4 at 56″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	7	#4 at 56″ o.c.	#5 at 56″ o.c.	#5 at 40″ o.c.
8–4	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 48″ o.c.
	6	#4 at 56″ o.c.	#4 at 48″ o.c.	#5 at 56″ o.c.
	7	#4 at 48″ o.c.	#4 at 32″ o.c.	#6 at 56″ o.c.
	8	#5 at 56″ o.c.	#5 at 40″ o.c.	#7 at 56″ o.c.
9–1	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 48″ o.c.
	6	#4 at 56″ o.c.	#4 at 40″ o.c.	#4 at 32″ o.c.
	7	#4 at 40″ o.c.	#5 at 48″ o.c.	#6 at 48″ o.c.
	8	#4 at 32″ o.c.	#6 at 48″ o.c.	#4 at 16″ o.c.
	9	#5 at 40″ o.c.	#6 at 40″ o.c.	#7 at 40″ o.c.

[a] For design lateral soil loads, see s. SPS 321.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

[b] Provisions for this table are based on construction requirements specified in s. SPS 321.18 (3) (b).

[c] For alternative reinforcement, see s. SPS 321.18 (3) (b).

[d] Mortar shall be Type M or S and masonry shall be laid in running bond.

[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

Table 321.18–F[b,c,d]

12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 8.75 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	6	#4 at 72″ o.c.	#4 at 64″ o.c.	#4 at 48″ o.c.
	7	#4 at 72″ o.c.	#4 at 48″ o.c.	#5 at 56″ o.c.
8–4	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	6	#4 at 72″ o.c.	#4 at 56″ o.c.	#5 at 72″ o.c.
	7	#4 at 64″ o.c.	#5 at 64″ o.c.	#4 at 32″ o.c.
	8	#4 at 48″ o.c.	#4 at 32″ o.c.	#5 at 40″ o.c.
9–1	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 64″ o.c.
	6	#4 at 72″ o.c.	#4 at 56″ o.c.	#5 at 64″ o.c.
	7	#4 at 56″ o.c.	#4 at 40″ o.c.	#6 at 64″ o.c.
	8	#4 at 40″ o.c.	#6 at 64″ o.c.	#6 at 48″ o.c.
	9	#5 at 56″ o.c.	#7 at 72″ o.c.	#6 at 40″ o.c.

[a] For design lateral soil loads, see s. SPS 321.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

[b] Provisions for this table are based on construction requirements specified in s. SPS 321.18 (3) (b).

[c] For alternative reinforcement, see s. SPS 321.18 (3) (b).

[d] Mortar shall be Type M or S and masonry shall be laid in running bond.

[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

TABLE 321.22–A1

MINIMUM SIZES FOR BEAMS AND GIRDERS OF STEEL OR WOOD

Column Spacing	One Floor Only		Roof/Ceiling and One Floor				Roof/Ceiling+ One Floor/Ceiling + One Floor			
	Wood Beams[1] (in., nominal)	A 36 Steel Beams[2]	Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]		Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]	
			Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone2	Zone 1
24 ft. wide house:										
8 ft.	8x8	—	8x10	10x10	—	—	8x12	10x12	—	—
			6x12	6x12	—	—	6x14	8x14	—	—
10 ft.	8x10	—	8x12	10x12	M 10x9	M 10x9	10x14	10x14	M 12x11.8	M 12x11.8
			6x14	8x14	W 6x12	W 8x10	8x16	8x16	W8x15	W 8x15
12 ft.	8x12	—	12x12	10x14	W 12x10	M 12x11.8	14x14	14x14	W 12x16	W 12x16
			10x14	8x16	W 10x11.5	W 8x15	10x16	12x16	W10x17	W 8x21
15 ft.	12x12	—	—	—	W 12x16	W 12x16	—	—	W 12x22	W 14x22
			—	—	W 10x17	W 6x25	—	—	W 8x28	W 8x31
26 ft. wide house:										
8 ft.	6x10	—	10x10	10x10	—	—	10x12	10x12	—	—
			6x12	8x12	—	—	8x14	8x14	—	—
10 ft.	10x10	—	10x12	10x12	M 10x9	M 12x10	10x14	12x14	M 12x11.8	W 12x14
			8x14	8x14	W 8x10	W 8x13	8x16	8x16	W 8x15	W 8x17
12 ft.	8x12	—	10x14	10x14	M 12x11.8	M 12x11.8	14x14	12x16	W 12x16	W 10x19
			8x16	8x16	W 8x15	W 6x20	12x16	10x18	W 8x21	W 8x24
15 ft.	10x14	—	—	—	W 12x16	W 10x19	—	—	W 14x22	W 14x22
			—	—	W 8x21	W 8x24	—	—	W 8x31	W 8x35
28 ft. wide house:										
8 ft.	6x10	—	10x10	8x12	—	—	10x12	10x12	—	—
			8x12	4x16	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	W 10x12	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	8x14	W 8x13	W 8x13	8x16	10x16	W 8x17	W 10x15
12 ft.	10x12	M 10x9	10x14	12x14	M 12x11.8	W 12x14	12x16	12x16	W 10x19	M 14x18
		W 6x12	8x16	10x16	W 8x15	W 8x18	10x18	10x18	W 8x24	W 8x24
15 ft.	10x14	M 12x10	—	—	W 10x19	M 14x18	—	—	W 14x22	W 14x26
		W 8x13	—	—	W 8x24	W 8x24	—	—	W 8x35	W 8x35
30 ft. wide house:										
8 ft.	8x10	—	10x10	8x12	—	—	10x12	12x12	—	—
			8x12	6x14	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	M 12x10	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	10x14	W 8x13	W 8x13	10x16	10x16	W 10x15	W 10x15
12 ft.	10x12	M 10x9	12x14	12x14	W 12x14	W 12x14	12x16	14x16	M 14x18	M 14x18
		W 6x12	8x16	10x16	W 8x18	W 8x18	10x18	12x18	W 8x24	W 8x24
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 10x21	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 8x35	W 10x33
32 ft. wide house:										
8 ft.	8x10	—	8x12	8x12	—	—	12x12	12x12	—	—
			6x14	6x14	—	—	8x14	10x14	—	—
10 ft.	10x10	M 10x7.5	12x12	12x12	W 10x12	W 10x12	12x14	14x14	W 12x14	W 12x16
		W 6x9	8x14	10x14	W 8x13	W 6x16	10x16	10x16	W 10x15	W 10x17
12 ft.	10x12	M 10x9	12x14	14x14	W 12x14	W 12x14	14x16	14x16	M 14x18	W 12x22
		W 6x12	10x16	10x16	W 10x15	W 10x17	12x18	12x18	W 8x24	W 8x28
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 12x22	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 10x33	W 10x33

[1]This table is based upon wood with a fiber bending stress of 1,000 psi. Two acceptable wood beam selections are listed for each loading condition.

[2]Two acceptable steel beam selections are listed for each loading condition. The first entry is the most economical selection based upon beam weight.

[3]Wood main beams or girders may be built up from nominal 2–inch members. The 2–inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½–inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece. Where built–up beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

TABLE 321.22–A2

MINIMUM SIZES FOR BUILT–UP WOOD BEAMS IN BASEMENTS AND CRAWL SPACES SUPPORTING ONE FLOOR ONLY

	F_b=800 psi		F_b=1000 psi		F_b=1200 psi		F_b=1400 psi	
HOUSE WIDTH	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size
16 ft.	7–8	3–2x8	8–7	3–2x8	9–4	3–2x8	10–2	3–2x8
	8–11	4–2x8	9–11	4–2x8	10–11	4–2x8	11–10	4–2x8
	9–11	3–2x10	11–1	3–2x10	12–1	3–2x10	13–1	3–2x10
	11–4	4–2x10	12–8	4–2x10	13–1	4–2x10	15–0	4–2x10
	12–0	3–2x12	13–5	3–2x12	14–8	3–2x12	15–10	3–2x12
	13–10	4–2x12	15–7	4–2x12	17–0	4–2x12	18–4	4–2x12
20 ft.	6–11	3–2x8	7–8	3–2x8	8–5	3–2x8	9–1	3–2x8
	7–11	4–2x8	8–11	4–2x8	9–9	4–2x8	10–7	4–2x8
	8–10	3–2x10	9–11	3–2x10	10–10	3–2x10	11–8	3–2x10
	10–2	4–2x10	11–4	4–2x10	12–6	4–2x10	13–6	4–2x10
	10–9	3–2x12	12–0	3–2x12	13–2	3–2x12	14–3	3–2x12
	11–5	4–2x12	13–11	4–2x12	15–2	4–2x12	16–5	4–2x12
24 ft.	6–3	3–2x8	7–1	3–2x8	7–8	3–2x8	8–4	3–2x8
	7–3	4–2x8	8–2	4–2x8	8–11	4–2x8	9–8	4–2x8
	8–1	3–2x10	9–0	3–2x10	9–11	3–2x10	10–8	3–2x10
	9–4	4–2x10	10–4	4–2x10	11–5	4–2x10	12–4	4–2x10
	9–9	3–2x12	10–11	3–2x12	12–0	3–2x12	12–11	3–2x12
	11–3	4–2x12	12–7	4–2x12	13–11	4–2x12	15–0	4–2x12
28 ft.	5–10	3–2x8	6–6	3–2x8	7–2	3–2x8	7–8	3–2x8
	6–8	4–2x8	7–6	4–2x8	8–3	4–2x8	8–11	4–2x8
	7–5	3–2x10	8–4	3–2x10	9–1	3–2x10	9–11	3–2x10
	8–7	4–2x10	9–8	4–2x10	10–6	4–2x10	11–4	4–2x10
	9–0	3–2x12	10–1	3–2x12	11–1	3–2x12	10–11	3–2x12
	10–5	4–2x12	11–8	4–2x12	12–10	4–2x12	13–10	4–2x12
32 ft.	5–4	3–2x8	6–1	3–2x8	6–8	3–2x8	7–3	3–2x8
	6–3	4–2x8	7–1	4–2x8	7–8	4–2x8	8–4	4–2x8
	7–0	3–2x10	7–9	3–2x10	8–7	3–2x10	9–2	3–2x10
	8–1	4–2x10	8–11	4–2x10	9–10	4–2x10	10–8	4–2x10
	8–5	3–2x12	9–6	3–2x12	10–4	3–2x12	11–1	3–2x12
	9–9	4–2x12	11–0	4–2x12	12–0	4–2x12	12–11	4–2x12
36 ft.	5–1	3–2x8	5–9	3–2x8	6–3	3–2x8	6–9	3–2x8
	5–11	4–2x8	6–7	4–2x8	6–9	4–2x8	7–10	4–2x8
	6–6	3–2x10	7–4	3–2x10	8–1	3–2x10	8–8	3–2x10
	7–6	4–2x10	8–6	4–2x10	9–4	4–2x10	10–0	4–2x10
	7–11	3–2x12	8–11	3–2x12	9–9	3–2x12	10–7	3–2x12
	9–2	4–2x12	10–4	4–2x12	11–4	4–2x12	12–4	4–2x12

[1]This table provides maximum allowable spans in feet and inches for main beams or girders which are built–up from nominal 2–inch members.

[2]Fiber bending stress for various species and grades of wood is given in Appendix A321.

[3]The 2–inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½–inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece.

[4]Where built–up wood beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

[5]Where built–up wood beams are continued over more than one span and where lengths of individual pieces are less than the total length of the complete beam, butt joints shall be located over supports or within 6 inches of the quarter points of the clear span. Where located near the quarter points, the joints in built–up beams shall be separated by at least one lamination and shall not exceed the beam width.

Table 321.25–A

SIZE, HEIGHT AND SPACING OF WOOD STUDS[a, c]

Nominal Stud Size (inches)	Bearing and Exterior Nonbearing Walls					Interior Nonbearing Walls	
	Maximum Laterally Unsupported Stud Height[a] (feet)	Maximum Spacing When Supporting Roof and Ceiling Only (inches)	Maximum Spacing When Supporting One Floor, Roof and Ceiling (inches)	Maximum Spacing When Supporting Two Floors, Roof and Ceiling (inches)	Maximum Spacing When Supporting One Floor Only (inches)	Maximum Laterally Unsupported Stud Height[a] (feet)	Maximum Spacing (inches)
2 x 3[b]	–	–	–	–	–	10	16
2 x 4	10	24	16	–	24	14	24
3 x 4	10	24	24	16	24	14	24
2 x 5	10	24	24	–	24	16	24
2 x 6	12[d]	24	24	16	24	20	24

[a]Listed heights are distances between points of lateral support placed perpendicular to the plane of the wall. Increases in unsupported height are permitted where justified by analysis. Studs shall be stud grade or better, except that utility grade may be used when spaced not more than 16 inches on center, supports no more than a roof and ceiling and does not exceed 8 feet in height for exterior walls or 10 feet in height for interior nonload–bearing walls.

[b]May not be used in exterior walls.

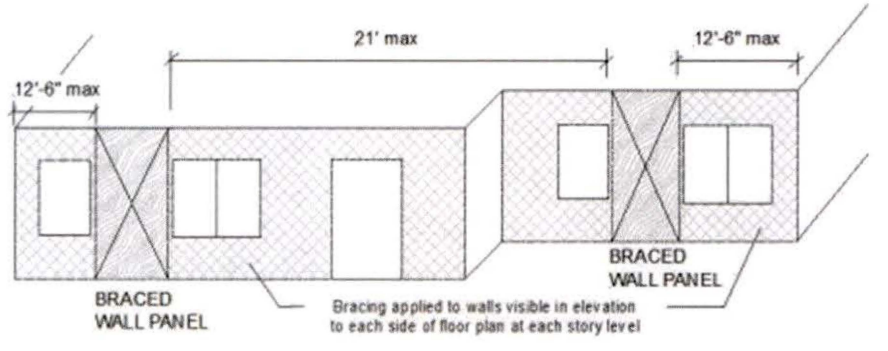
[c]All spacing dimensions are to the center of the studs.

[d]Use of stud heights that range from over 10 feet to 12 feet for bearing and exterior nonbearing walls is prohibited unless supported by structural analysis. The allowable deflection may not exceed whichever of the following are applicable:

Interior walls and partitions — span height/180.
Exterior walls with plaster or stucco finish — span height/360.
Exterior walls with other brittle finishes — span height/240.
Exterior walls with flexible finishes — span height/120.
Exterior walls with interior gypsum wallboard finish — span height/180.
Any manufacturer–specified limits for any included windows or doors.

Figure 321.25–C

LOCATION OF BRACED WALL PANELS ALONG A BUILDING SIDE[a]



[a]A braced wall panel can be anything from one–half to one brace panel.

Table 321.25–E

COLUMNS MADE OF STEEL PIPE STOCK[1,2]

Column Diameter (inches)	Wall Thickness (inches)	Weight/ft (pounds)	Height (feet)	Allowable Load (pounds)
3	0.216	7.58	8	34,000
			10	28,000
			12	22,000
3.5	0.226	9.11	8	44,000
			10	38,000
			12	32,000
4	0.237	10.79	8	54,000
			10	49,000
			12	43,000
5	0.258	14.62	8	78,000
			10	73,000
			12	68,000
6	0.280	18.97	8	106,000
			10	101,000
			12	95,000

[1]This Table is based on a yield strength or Fy of 36,000 psi.

[2]This table is for columns made solely of steel pipe stock. The addition of any adjustment mechanism or other feature will alter the load–carrying capacity of the column.

Table 321.25–F

WOOD COLUMNS

Wood Nominal Size (inches)	Cross Section Area (inches)	Height (feet)	Allowable Load (pounds)
4 x 4	12.25	8	4,900
		10	3,100
		12	2,150
4 x 6	19.25	8	7,700
		10	4,900
		12	3,400
6 x 6	30.25	8	30,000
		10	18,900
		12	13,300

Table 321.25–H[a, b]

MINIMUM WIDTHS OF CS–WSP AND CS–SFB BRACED WALL PANELS

Maximum Opening Height Adjacent to Braced Wall Panel	Minimum Width of Full–Height Braced Wall Panel (inches)			
	8' Tall Wall	9' Tall Wall	10' Tall Wall	12' Tall Wall
5'– 4"	24	27	30	36
6'– 8"	32	30	30	36
8'	48	41	38	36
9'	–	54	46	41
10'	–	–	60	48
12'	–	–	–	72

[a]Sheathing shall extend from the top of the top plate to the bottom of the bottom plate and may be multiple sheets. All joints shall be blocked.

[b]Interpolation is permitted.

Table 321.25–G

BRACING METHODS[a, f]

Material	Minimum Brace Material Thickness or Size	Maximum Nominal Wall Height[b]	Minimum Braced Wall Panel Width or Brace Angle	Connection Criteria	
				Minimum Fasteners	Maximum Spacing
Intermittent Bracing Methods					
LIB[c] Let–in bracing	1x4 wood brace (or approved metal brace installed per manufacturer instructions)	10'	45° angle and maximum 16" o.c. stud spacing[b]	2–8d common nails or 3–8d box nails (2 3/8" long x 0.113" diameter)	Per stud and top and bottom plates[e]
DWB Diagonal wood boards	¾" (1" nominal) for maximum 24" o.c. stud spacing	10'	48"	2–8d box nails (2 3/8" long x 0.113" diameter) or 2 – 1 3/4" long 16–gage staples	Per stud and top and bottom plates[e]
WSP Wood structural panel	3/8" for maximum 16"o.c. stud spacing; 7/16" for maximum 24" o.c. stud spacing	10'	48"	6d common nail or 8d box nail (2 3/8" long x 0.113" diameter); or 7/16"– or 1/2"–crown 16–gage staples, 1 1/4" long	6" edges, 12" field (nails) 3" edges, 6" field (staples)
SFB Structural fiber-board sheathing	½" for maximum 16" o.c. stud spacing	10'	48"	1 1/2" long x 0.120" diameter galvanized roofing nails or 1"–crown 16–gage staples, 1 1/4" long	3" edges, 6" field
GB Gypsum board (installed on both sides of wall)	½" for maximum 24" o.c. stud spacing	10'	96"	5d cooler nails, or #6 screws	7" edges, 7" field (including top and bottom plates)
Continuous Sheathed Bracing Methods					
CS–WSP[d] Continuous sheathed WSP	3/8" for maximum 16"o.c. stud spacing; 7/16" for maximum 24" o.c. stud spacing	12'	Refer to Table 321.25–H	Same as WSP	Same as WSP
CS–SFB[d] Continuous sheathed SFB	½" for maximum 16" o.c. stud spacing			Same as SFB	Same as SFB
Narrow Panel Bracing					
PF Portal frame	7/16"	12'	Refer to Figure 321.25–A	Refer to Figure 321.25–A	Refer to Figure 321.25–A

[a]The interior side of all exterior walls shall be sheathed with minimum ½–inch gypsum wallboard unless otherwise permitted to be excluded by this subsection. All edges of panel–type wall bracing, except horizontal joints in GB bracing, shall be attached to framing or blocking.

[b]The actual measured wall height shall include stud height and thickness of top and bottom plates. The actual wall height shall be permitted to exceed the listed nominal values by not more than 4½ inches. Tabulated bracing amounts in s. SPS 321.25 (8) (c) are based on a 10–foot nominal wall height for all bracing methods and shall be permitted to be adjusted to other nominal wall heights not exceeding 12 feet in accordance with footnotes to Table 321.25–I or Table 321.25–J.

[c]LIB is not permitted for walls supporting a roof and two floors. Two LIB braces installed at a 60° angle from horizontal shall be permitted to be substituted for each 45° angle LIB brace.

[d]Bracing with CS–WSP and CS–SFB shall have sheathing installed on all sheathable surfaces above, below, and between wall openings.

[d]Shall be attached to the top and bottom plates and any intermediate studs, in one continuous length.

[e]Each braced panel may contain no more than one hole, having a maximum dimension of no more than ten percent of the least dimension of the panel, and confined to the middle three–fourths of the panel.

Table 321.25–H[a, b]

MINIMUM WIDTHS OF CS–WSP AND CS–SFB BRACED WALL PANELS

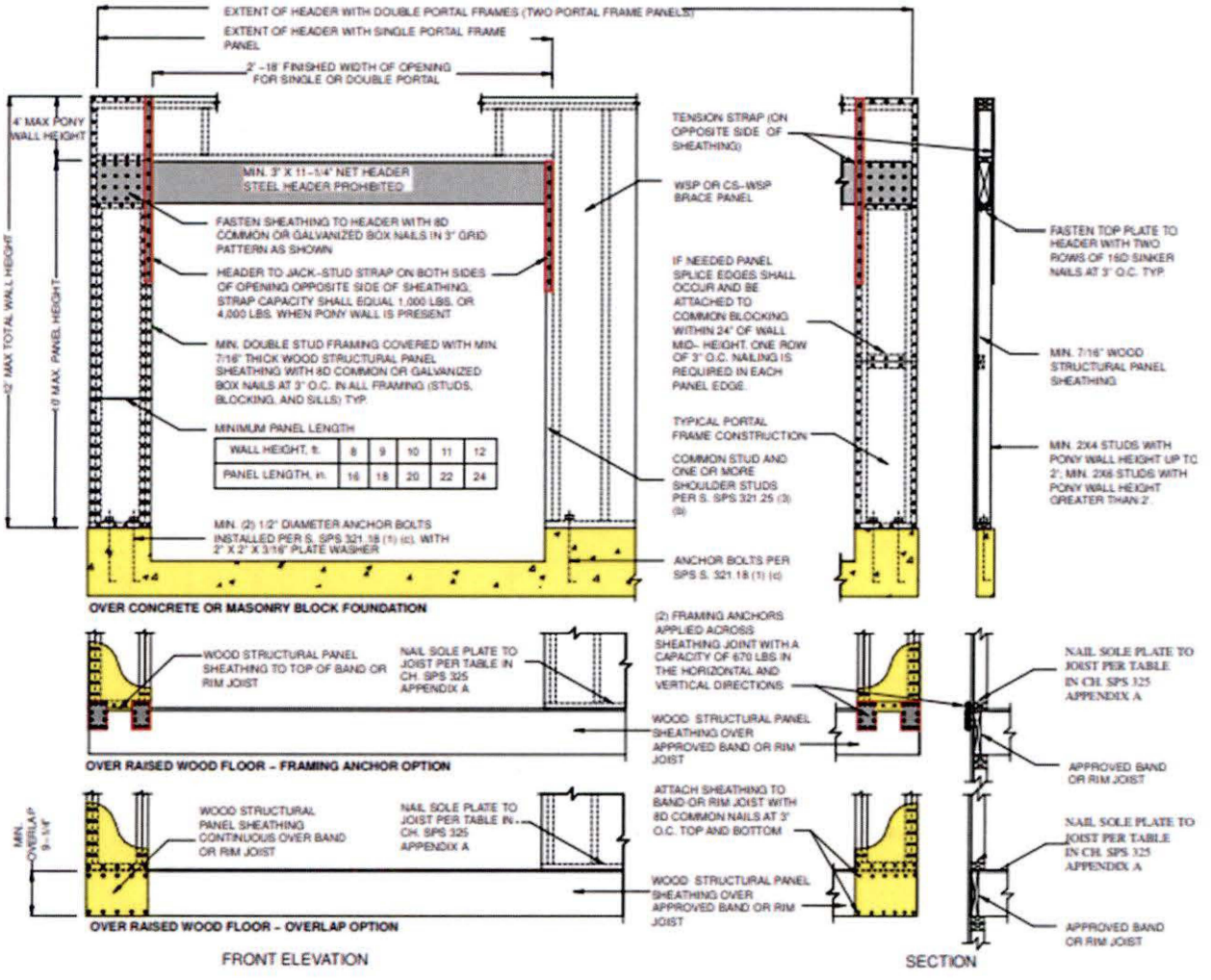
Maximum Opening Height Adjacent to Braced Wall Panel	Minimum Width of Full–Height Braced Wall Panel (inches)			
	8' Tall Wall	9' Tall Wall	10' Tall Wall	12' Tall Wall
5'– 4"	24	27	30	36
6'– 8"	32	30	30	36
8'	48	41	38	36
9'	–	54	46	41
10'	–	–	60	48
12'	–	–	–	72

[a]Sheathing shall extend from the top of the top plate to the bottom of the bottom plate and may be multiple sheets. All joints shall be blocked.

[b]Interpolation is permitted.

Figure 321.25–A

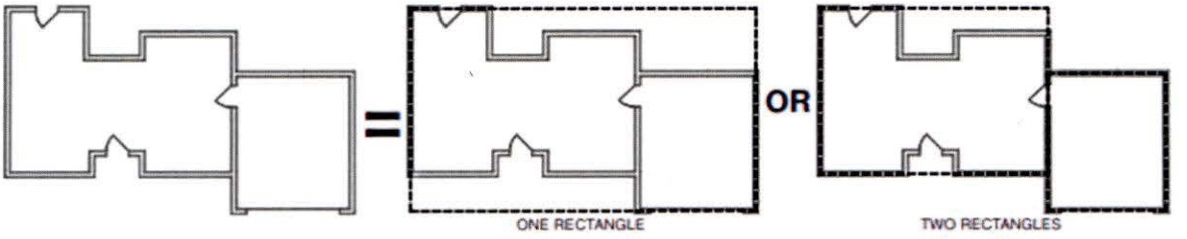
METHOD PF – PORTAL FRAME BRACE CONSTRUCTION



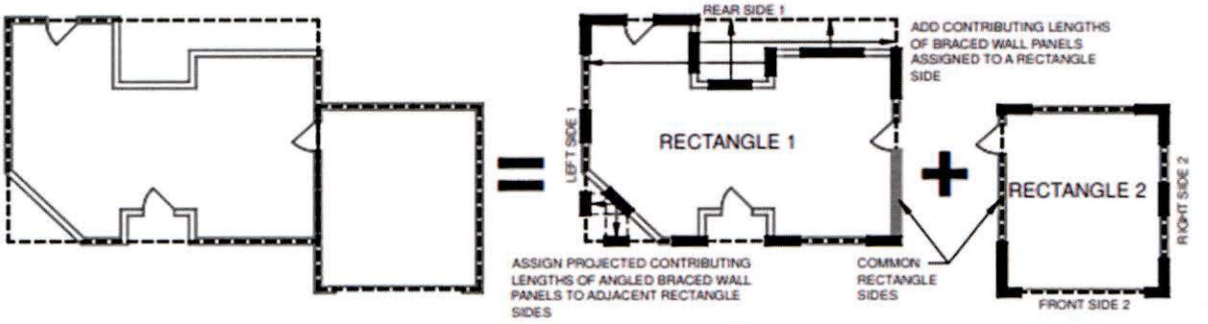
Note: Steel headers are permitted if designed by structural analysis.

Note: As shown in the above cross–section, 1/2–inch gypsum wallboard is not required on the interior side of the wall.

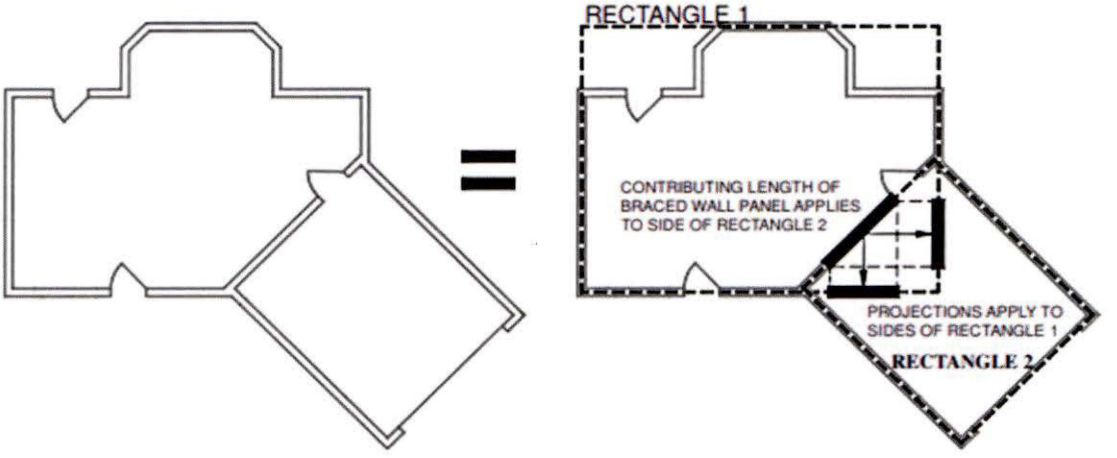
FIGURE 321.25–B
DEFINING BUILDING SIDES AND LENGTHS WITH ONE OR MORE CIRCUMSCRIBED RECTANGLES[a,b,c]



(1) Basic floor plan



(2) Angled–building–side plan[d]



(3) Angled floor plan[e]

[a]Each floor plan level shall be circumscribed with one or more rectangles around the entire floor plan at the floor level under consideration as shown. When multiple rectangles are used, each side shall be braced as though it were a separate building and the bracing amount added together along the common wall where adjacent rectangles overlap or abut.

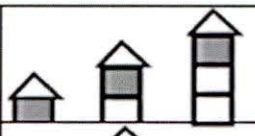
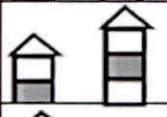
[b]Rectangles shall surround all enclosed plan offsets and projections. Chimneys, partial height projections, and open structures, such as carports and decks, shall be excluded from the rectangle.

[c]Each rectangle shall have a maximum rectangle length–to–width ratio of 3:1.

[d]Projected contributing lengths of angled braced wall panels shall be assigned to the closest rectangle sides, as shown for the angled corner in the angled–building–side–plan shown above.

[e]Braced wall panels located on a common wall where angled rectangles intersect, as shown in Figure 321.25–B(3), shall have their contributing length applied towards the required length of bracing for the parallel rectangle side and its projected contributing lengths towards the adjacent angled rectangle sides. Where the common side of rectangle 2 as shown in Figure 321.25–B(3) has no physical wall, the portion shall be designed in accordance with [c, SPS 321.25 (8) (a).]

TABLE 321.25–I
REQUIRED NUMBER OF INTERMITTENT BRACED WALL PANELS ON WALLS PARALLEL TO EACH RECTANGLE SIDE AT EACH FLOOR LEVEL[a,b,c,d,e,f, h, j]

Wall Supporting:		Required Number of Brace Panels on a Building Side Length of Perpendicular Side (feet)[g]		
		≤25	≤50	≤75
Roof and ceiling only		1[i]	2	3
One floor, roof and ceiling		2	4	6
Two floors, roof and ceiling		3	6	9

[a]Interpolation is permitted. Extrapolation to buildings larger than addressed in this table is prohibited.

[b]This table applies to wind exposure category B. For wind exposure category C or D, multiply the number of braced wall panels required by 1.3 or 1.6, respectively.

Wind exposure category B is comprised of urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single–family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type exposure.

Wind exposure category C is comprised of flat, open country and grasslands with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet extending more than 1,500 feet from the building site in any quadrant. This exposure also applies to any building located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 feet.

Wind exposure category D is comprised of flat, unobstructed areas exposed to wind flowing over open water for a distance of at least 1 mile. This exposure applies only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet or 10 times the height of the building or structure, whichever is greater.

[c]Tabulated values are based on a nominal wall height of 10 feet. For nominal wall heights other than 10 feet and not more than 12 feet, multiply the required number of brace panels by the following factors: 0.9 for 8 feet, 0.95 for 9 feet, 1.15 for 11 feet, or 1.3 for 12 feet.

[d]Tabulated values are based on a roof with a top–of–wall–to–ridge height of 10 feet. For top–of–wall–to–ridge heights other than 10 feet, multiply the required number of brace panels by the following factors for each floor level support condition:

Roof only – 0.7 for 5 feet, 1.3 for 15 feet, or 1.6 for 20 feet

Roof + 1 Floor – 0.85 for 5 feet, 1.15 for 15 feet, or 1.3 for 20 feet

Roof + 2 Floors – 0.9 for 5 feet or 1.1 for 15 feet.

[e]Where minimum 1/2–inch gypsum wallboard is not included on the interior side of the wall, multiply the number of braced wall panels by 1.7 for LIB bracing or 1.4 for all other bracing methods, except this increase is not required for the portal frame method.

[f]Adjustments in footnotes b to e apply cumulatively. Fractions of panels shall be rounded to the nearest one–half braced wall panel.

[g]Perpendicular sides to the front and rear sides are the left and right sides. Perpendicular sides to the left and right sides are the front and rear sides. See Figure 321.25–B.

[h]The following braced wall panel conditions shall be permitted to be counted as one–half a braced wall panel toward meeting the required number of panels: (1) one 60 degree LIB; (2) one 48" GB or one 96" GB with gypsum wallboard on one side; (3) one 36" WSP or SFB braced wall panel for wall heights not more than 9 feet; (4) a 48" WSP or SFB braced wall panel where there is no more than one unblocked horizontal joint; or (5) one PF brace panel complying with Figure 321.25–A.

[i]This value of less than 2 serves only as the beginning value for calculation purposes. The resulting value shall be 2 or greater, to be consistent with subd. 2.

[j]Any floor, habitable or otherwise, that is contained wholly within the roof rafters or roof trusses is exempt from being considered a floor for purposes of determining wall bracing if the top–of–wall–to–ridge height does not exceed 20 feet and if no opening in the roof exceeds 48 inches in height.

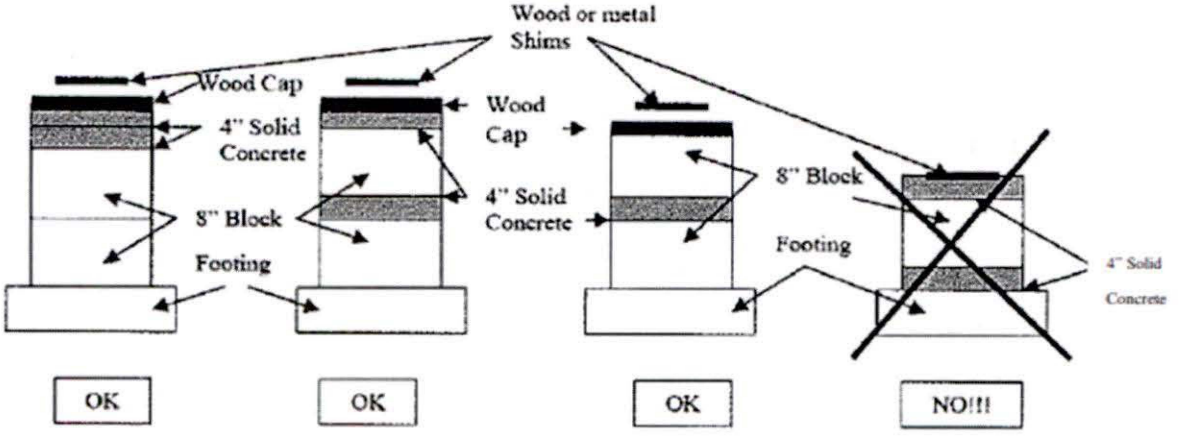
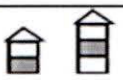
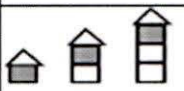


Table 321.25–J
REQUIRED LENGTH OF CONTINUOUS BRACING ON WALLS PARALLEL TO EACH RECTANGLE SIDE AT EACH FLOOR LEVEL[a,b,c,d,e,g,h, j]

Top–of–Wall–to–Ridge Height (feet)	Wall Supporting:		Total Required Length (feet) of Full–Height Bracing on Any Side of Rectangle							
			Length of Perpendicular Side (feet)[f]							
			10	20	30	40	50	60	70	80
10	Roof and ceiling only		2.0[i]	3.5[i]	5.0	6.0	7.5	9.0	10.5	12.0
	One floor, roof and ceiling		3.5[i]	6.5	9.0	12.0	14.5	17.0	19.8	22.6
	Two floors, roof and ceiling		5.0	9.5	13.5	17.5	21.5	25.5	29.2	33.4
15	Roof and ceiling only		2.6[i]	4.6	6.5	7.8	9.8	11.7	13.7	15.7
	One floor, roof and ceiling		4.0	7.5	10.4	13.8	16.7	19.6	22.9	26.2
	Two floors, roof and ceiling		5.5	10.5	14.9	19.3	23.7	27.5	32.1	36.7
20	Roof and ceiling only		2.9[i]	5.2	7.3	8.8	11.1	13.2	15.4	17.6
	One floor, roof and ceiling		4.5	8.5	11.8	15.6	18.9	22.1	25.8	29.5
	Two floors, roof and ceiling		6.2	11.9	16.8	21.8	27.3	31.1	36.3	41.5

[a]Interpolation is permitted. Extrapolation to buildings larger than addressed in this table is prohibited.

[b]This table applies to wind exposure category B. For wind exposure category C or D, multiply the required length of wall bracing by 1.3 or 1.6, respectively. Wind exposure categories are as defined in Table 321.25–I footnote b.

[c]Tabulated values are based on a nominal wall height of 10 feet. For nominal wall heights other than 10 feet, multiply the required length of bracing by the following factors: 0.90 for 8 feet, 0.95 for 9 feet, 1.05 for 11 feet, or 1.10 for 12 feet.

[d]Where minimum ½–inch gypsum wallboard interior finish is not provided, the required bracing amount for the affected rectangle side shall be multiplied by 1.4, except this increase is not required for the portal frame method.

[e]Adjustments in footnotes b to d apply cumulatively.

[f]Perpendicular sides to the front and rear sides are the left and right sides. Perpendicular sides to the left and right sides are the front and rear sides. See Figure 321.25–B.

[g]Continuous sheathing shall be applied to all surfaces of the wall, including areas between brace panels and above and below wall openings.

[h]When used on a wall line with continuous sheathing, each portal frame panel is counted for its actual length in contributing toward the length of continuous sheathing used on other portions of the same wall line, such as the building side at a given story level.

[i]Any value of less than 4.0 in this table serves only as the beginning value for calculation purposes. The resulting value shall be 4.0 or greater, to be consistent with Table 321.25–H and [subd. 2.]

[j]Any floor, habitable or otherwise, that is contained wholly within the roof rafters or roof trusses is exempt from being considered a floor for purposes of determining wall bracing if the top–of–wall–to–ridge height does not exceed 20 feet and if no opening in the roof exceeds 48 inches in height.

Table 321.26–A

TYPES OF MORTAR FOR VARIOUS KINDS OF MASONRY

Kind of Masonry	Types of Mortar
Foundations:	
Footings	M, S
Walls of solid units	M, S, N
Walls of hollow units	M, S
Hollow walls	M, S
Masonry other than foundation masonry:	
Piers of solid masonry	M, S, N
Piers of hollow units	M, S
Walls of solid masonry	M, S, N, O
Walls of solid masonry not less than 12 in. thick or more than 35 ft. in height, supported laterally at intervals not exceeding 12 times the wall thickness	M, S, N, O
Walls of hollow units; load–bearing or exterior, and hollow walls 12 in. or more in thickness	M, S, N
Hollow walls, less than 12 in. thick	M, S, N
Linings of existing masonry, either above or below grade	M, S
Masonry other than above	M, S, N

(d) *Cementitious material.* Cementitious material shall conform to the standards approved by the department.

Note: The department will accept cementitious material conforming to the following standards: ASTM C91, Masonry Cement; ASTM C150, Portland Cement; ASTM C595, Portland Blast–Furnace Slag Cement; ASTM C207, Hydrated Lime for Masonry Purposes; and ASTM C5, Quick Lime for Structural Purposes.

(e) *Aggregates.* Aggregates for use in masonry mortar shall consist of natural sand or manufactured sand and shall be graded.

Note: The department will accept aggregates in accordance with ASTM C144.

(5) CAVITY WALL. (a) *Corbels.* Corbels shall be constructed in accordance with ACI 530.

(b) *Projections.* The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed 1¼ inches, unless at least $^2/_3$ the mass of the wythe of masonry involved is located directly over the load–carrying member.

(6) OPENINGS AND LINTELS. (a) *Openings.* The masonry above openings shall be supported. The bearing length of structural elements which support the masonry above the opening shall be not less than 4 inches.

(b) *Lintels.* Unless designed through structural analysis, lintels shall be provided using either steel angles or reinforcing bars in accordance with Table 321.26–C.

Table 321.29–1

HEARTH EXTENSION DIMENSIONS

Fireplace Opening (Sq. Ft.)	Extension from Fireplace Opening (inches)	
	Side	Front
Less than 6	8	16
6 or Greater	12	20

Table 321.26–C

ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER

Size of Steel Angle[1,3]	No Story Above	One Story Above	Two Stories Above	No. of $^1/_2$" or Equivalent Reinforcing Bars[2]
L 3 x 3 x $^1/_4$	6′ – 0″	3′ – 6″	3′ – 0″	1
L 4 x 3 x $^1/_4$	8′ – 0″	5′ – 0″	3′ – 0″	1
L 6 x 3$^1/_2$ x $^1/_4$	14′ – 0″	8′ – 0″	3′ – 6″	2
2 – L 6 x 3$^1/_4$ x $^1/_4$	20′ – 0″	11′ – 0″	5′ – 0″	4

[1]Long leg of the angle shall be placed in a vertical position.

[2]Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.

[3]Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.

Table 321.26

ALLOWABLE SHEAR ON BOLTS AND ANCHORS

Bolt or Anchor Diameter (inches)	Embedment[1] (inches)	Allowable Shear (pounds)
$^1/_4$	4	270
$^3/_8$	4	410
$^1/_2$	4	550
$^5/_8$	4	750
$^3/_4$	5	1100
$^7/_8$	6	1500
1	7	1850
1$^1/_8$	8	2250

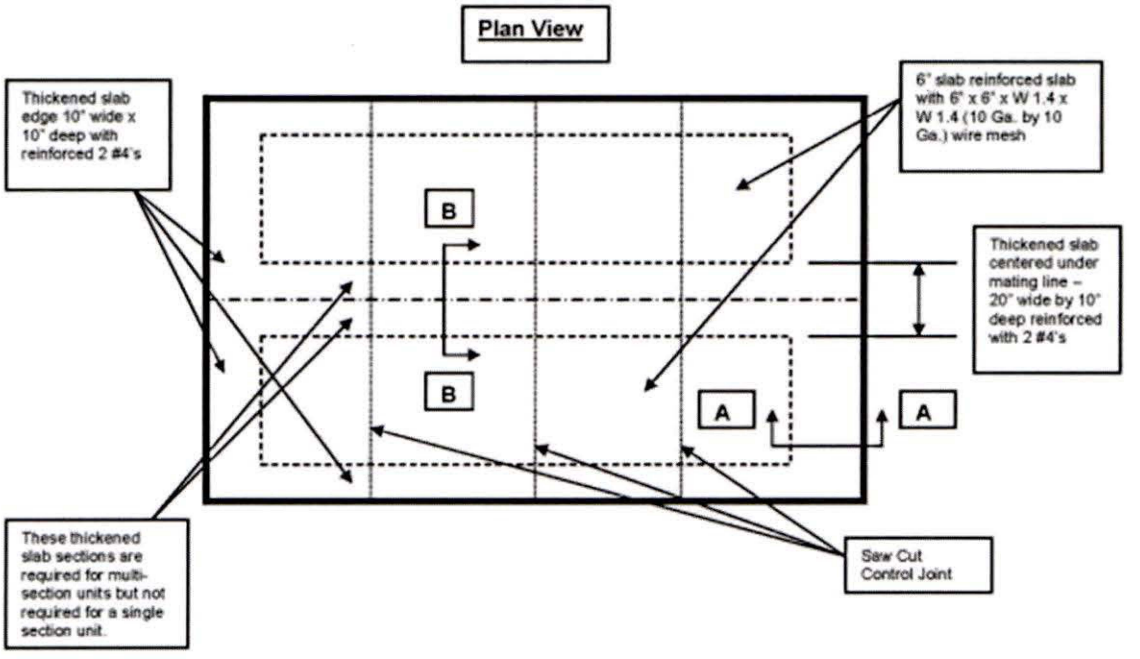
[1]Bolts and anchors shall be solidly embedded in mortar or grout.

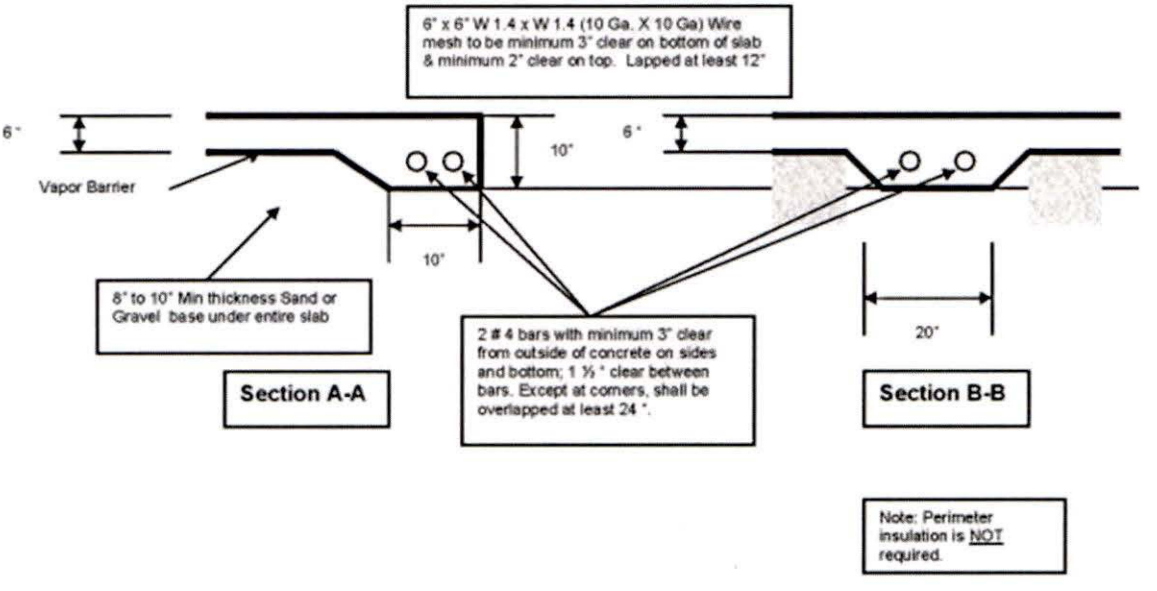
Table 321.29

MINIMUM FLUE SIZE FOR MASONRY FIREPLACES

Type of Flue	Minimum Cross–Sectional Area
Round	$^1/_{12}$ of fireplace opening but not less than 75 square inches.
Square or rectangular	$^1/_{10}$ of fireplace opening but not less than 75 square inches.

Acceptable slab on grade for pier supported manufactured home produced on or after April 1, 2007 [per SPS 321.40 (1)]





Limitations:

1. Minimum 3,000 psi concrete. [24 CFR 3285.312(a)(1)(ii)]
2. Rebar and mesh at least grade 40.
3. Soil bearing capacity at least 2,000 psf. [SPS 321.40 (2) (b) 2.]
4. Placed on undisturbed soil. May not be placed on unprepared fill material, organic soil, alluvial soil, mud, or frozen soil. [SPS 321.40 (2) (b) 1. and 24 CFR 3285.312(a)]

Chapter SPS 322
ENERGY CONSERVATION

Subchapter I — Scope and Application

SPS 322.01 Scope.
SPS 322.02 Application.

Subchapter II — Definitions

SPS 322.10 Definitions.

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SPS 322.21 Protection of insulation.

Subchapter IV — Dwelling Thermal Envelope

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Subchapter VI — Simulated Performance Alternative

SPS 322.50 General.
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SPS 322.53 Calculation procedure.

Subchapter I — Scope and Application

SPS 322.01 Scope

(1) This chapter applies to all one- and two-family Dwellings covered by this Code that use any amount of non-renewable energy for heat generation.

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

Note: Although the actual source of heat delivered by a heat pump is renewable, a Dwelling using a heat pump is not exempt from the requirements of this chapter due to the required input of electricity to run the pump and compressor.

(2) The equipment efficiency standards in this chapter apply to all one- and two-family Dwellings covered by this Code that use the respective equipment.

(3)

(a) The vapor retarder requirements under SPS 322.38 and the moisture control and Ventilation requirements under SPS 322.39 apply to any Dwelling with insulation installed, whether or not the insulation is required under this Code.

(b) The vapor retarder requirements under SPS 322.38 do not apply to an unheated space, such as an Attached, unheated Garage.

SPS 322.02 Application.

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

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

Subchapter II — Definitions

SPS 322.10 Definitions.

(1) " Air-Impermeable" means having an air permeance less than or equal to 0.02 L/s-m2 at a pressure differential of 75 pascals when tested according to ASTM E 2178 or ASTM E 283.

(2) "Conditioned Floor Area" means the sum of areas of all floors in Conditioned Space in the structure, including Basements, cellars, and intermediate floored levels measured from the exterior faces of exterior walls or from the center line of interior walls, excluding covered walkways, open roofed-over areas, Porches, exterior terraces or steps, Chimneys, roof overhangs, and similar features.

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

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

(5) "Dwelling Thermal Envelope" means the elements of a Dwelling with enclosed Conditioned Space through which thermal energy may be transferred to or from unconditioned space or the exterior.

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

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

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

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

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

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

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

(13) "Opaque Areas" means all exposed areas of a Dwelling envelope which enclose Conditioned Space except openings for Windows, skylights, doors, and Dwelling service Systems.

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

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

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

(17) "Sunroom" means a one-story structure Attached to a Dwelling with a glazing area in excess of 40% of the gross area of the structure's exterior walls and roof and with any screened areas capable of being covered or replaced with glazing during the heating season.

> **Note:** A Thermally Isolated Sunroom does not count in the calculation of amount of glazing.

(18) "System" means a combination of central or terminal equipment and their components, controls, accessories, interconnecting means, and terminal devices by which energy is

transformed so as to perform a specific function, such as HVAC, water heating, or illumination.

(19) "Thermal Resistance" or **"R-Value"** means a measure of the ability to retard the flow of heat. The R-Value is the reciprocal of Thermal Transmittance or U-Factor expressed as R = 1/U.

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

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

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

Note: Thermal Transmittance is also referred to as the coefficient of heat transfer or the coefficient of heat transmission.

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

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

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

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

Subchapter III — Insulation Materials and Installation

SPS 322.20 Basic requirements.

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

(2) COMPUTATION OF R-VALUES.

(a) Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-Value.

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

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

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

(3) LABORATORY OR FIELD TEST MEASUREMENTS.

(a) ***General Dwelling Thermal Envelope materials***. When information specified under sub. (1) is not available, or when a different value is claimed, supporting data shall be obtained using one of the following test methods:

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

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

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

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

(b) ***Foam plastic insulation.***

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

2. The tests shall be conducted by an independent third party using the standards listed under par. (a) and shall be submitted for Department review and approval in accordance with SPS 320.18.

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

1. Default values as Approved by the Department with no extrapolations or interpolations.

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

3. The material approval process specified in SPS 320.18.

(4) GENERAL INSTALLATION.

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

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

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

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

(5) IDENTIFICATION.

(a) A Thermal Resistance identification mark shall be applied by the manufacturer to each piece of Dwelling envelope insulation 12-inches or greater in width.

(b)

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

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

3. Each marker shall face the Attic access.

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

(6) CERTIFICATE.

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

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

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

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

2. The U-Factors of all Windows, skylights, and doors.

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

SPS 322.21 Protection of insulation.

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

Note: If the insulation is on a below-grade wall, SPS 322.38 (4) may prohibit the use of vapor retarder material used as the covering.

(2) WIND WASH PROTECTION.

(a) Except as provided under SPS 322.39 (4) for cathedral ceilings, all air-permeable insulation materials installed in any position other than horizontal, shall be covered on the cold-in-winter side with a permanently attached material of low air permeability to maintain the R-Value of the insulation.

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

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

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

(3) FOAM PLASTIC INSULATION.

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

(b) The protective covering shall cover the exposed exterior insulation and extend a minimum of 2 inches below grade, except the covering is not required below a brick ledge.

Note: For interior applications, a thermal barrier may be required under SPS 321.11.

Subchapter IV — Dwelling Thermal Envelope

SPS 322.30 General design requirements.

(1) GENERAL. Dwelling Thermal Envelope insulation amounts and details shall be determined using one of the methods described in this subchapter.

(2) INFILTRATION.

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

(b)

1. If the Proposed Design takes credit for a reduced air change per hour level, documentation of the measures providing the reduction, or the results of a post-construction blower door test conducted in accordance ASTM E 779 shall be provided to the Department.

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

(3) BASEMENTS AND CRAWL SPACES. Where Basement and Crawl Space Wall s are part of the Dwelling Thermal Envelope, their R-Values and U-Factors shall be based on the wall components. Adjacent soil may not be considered in the determination.

(4) GARAGES.

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

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

1. The Dwelling shall be Thermally Isolated from the Garage.

2. The Garage floor, ceiling and walls shall be provided with a vapor retarder in accordance with SPS 322.38.

3. All building elements shall meet the requirements of SPS 322.31.

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

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

2. Heating equipment is either separate from the Dwelling Unit equipment or installed as a separate Zone.

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

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

SPS 322.31 Prescriptive insulation and fenestration criteria.

(1) REQUIREMENTS.

(a) Except as specifically provided under this subchapter, Dwellings using the prescriptive method shall meet the requirements of Table 322.31-1 or 322.31-2.

(b) In Tables 322.31-1 and 322.31-2, Zone 2 consists of the following 15 northern counties: Ashland, Bayfield, Burnett, Douglas, Florence, Forest, Iron, Langlade, Lincoln, Oneida, Price, Sawyer, Taylor, Vilas, and Washburn. Zone 1 consists of all other counties not included in Zone 2.

(2) THERMAL ENVELOPE.

(a) ***General.*** If the total Dwelling Thermal Envelope UA is less than or equal to the total UA resulting from using the U-Factors in Table 322.31-2 multiplied by the same assembly area as in the proposed building, the Dwelling is in compliance with this chapter. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials.

Note: UA is equal to the product of the U-Factor times the assembly area.

Note: REScheck is an acceptable software program for determining compliance with this section.

(b) ***Software version***. If a REScheck software program is used to show compliance with this section, a version Approved by the Department shall be used.

Note: The IECC 2009 version of REScheck meets the thermal envelope requirements of this Code.

(3) APPLIANCE EFFICIENCY.

(a) Except as allowed under par. (b) and SPS 322.46, oil-fired and gas-fired furnaces and boilers shall meet the minimum efficiency requirements in Table 322.31-3.

(b) In new construction, an oil-fired or gas-fired furnace or boiler meeting the federal efficiency standard but not the requirements of Table 322.31-3 may be installed if the Dwelling Thermal Envelope requirements of Table 322.31-4 are met.

TABLE 322.31-1

INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT a - See PDF for table

TABLE 322.31-2

EQUIVALENT U-FACTORS - See PDF for table - See PDF for table

TABLE 322.31-4

COMPONENT DWELLING THERMAL ENVELOPE REQUIREMENTS FOR DWELLINGS USING LOWER EFFICIENCY APPLIANCES - See PDF for table

SPS 322.32 Specific insulation requirements.

(1) CEILINGS WITH ATTIC SPACES.

(a) R-49 will satisfy the ceiling R-Value requirement for a Dwelling where the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves.

(b) An Attic-access cover shall be weather stripped and insulated to a level equivalent to the insulation on the surrounding surfaces when the Attic is an unconditioned space. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent loose fill insulation from spilling into the living space when the Attic access is opened, and to provide a permanent means of maintaining the installed R-Value of the loose fill insulation.

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

(3) MASS WALLS. The requirements of Table 322.31-1 are applicable to Mass Walls.

(4) STEEL-FRAME CEILINGS, WALLS, AND FLOORS.

(a) Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table 322.32 or shall meet the U-Factor requirements in Table 322.31-2.

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

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

(6) BASEMENT WALLS.

(a) Walls associated with conditioned Basements shall be insulated from the top of the Basement wall down to the Basement floor.

(b) Walls associated with unconditioned Basements shall meet the requirement in par. (a) unless the floor overhead is insulated in accordance with Table 322.31-1.

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

(7) BOX SILL AND RIM JOIST SPACES. Box sills and joist spaces at outside walls shall be insulated to the required wall R-Value with Air-Impermeable insulation that is sealed on all sides to all framing members and the Foundation, or with air-permeable insulation held in place as required under SPS 322.21 (1).

(8) OVERHANG JOIST SPACES.

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

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

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

(9) WALL INSULATION.

(a) Except for closed-cell spray foam, wall insulation shall completely fill the wall cavity.

(b) The vertical and flared walls in a skylight shall meet the insulation requirements for walls. Tube skylights shall be insulated per the manufacturer's recommendations. - See PDF for table

SPS 322.33 Slab floors.

(1) HEATED OR UNHEATED SLABS.

(a) Any heated or unheated slab floor, the bottom of which is less than 12 inches below adjacent grade, shall be provided with perimeter insulation in accordance with Table 322.31-1 or Table 322.31-4, except as provided in par. (b).

(b) At the threshold or the base of any door opening that leads directly to the exterior of the structure, the vertical perimeter insulation shall be at least R-5, excluding all Garage doors.

(2) HEATED SLABS. In addition to meeting the requirement under sub. (1), if applicable, Heated Slab floors of any depth below grade shall meet the under-slab R-Value requirement in accordance with Table 322.31-1 or Table 322.31-4.

(3) DETAILS.

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

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

(c) Insulation on a Foundation wall for a Basement may be interrupted at the junction with a Foundation wall.

Note: See Appendix for further explanatory materials.

SPS 322.34 Crawl spaces.

(1) FROST PROTECTION. If the bottom of the crawl space serving as the Dwelling Foundation is less than 48 inches below adjacent grade, the Foundation shall be frost protected in accordance with Table 322.31-1 for frost protected slabs.

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

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

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

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

(3) CRAWL SPACES.

(a) Crawl Space Wall s shall be insulated in accordance with Table 322.31-1.

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

SPS 322.35 Thermally Isolated Sunrooms.

(1) The minimum opaque ceiling insulation R-Value shall be R-24. The minimum opaque wall R-Value shall be R-13.

(2) The maximum fenestration U-Factor shall be 0.50 and the maximum skylight U-Factor shall be 0.75.

(3) New walls, Windows and doors separating a Sunroom from Conditioned Space shall meet the building thermal envelope requirements.

(4) The temperature in the Conditioned Space shall be controlled as a separate Zone or shall use separate heating equipment.

(5) Glazing in a Thermally Isolated Sunroom is not considered to be in the Dwelling Thermal Envelope.

SPS 322.36 Fenestration.

(1) AVERAGE U-FACTORS. An area-weighted average of fenestration products may be used to satisfy the U-Factor requirements.

(2) MAXIMUM FENESTRATION U-FACTOR. The area weighted average maximum fenestration U-Factor permitted using tradeoffs from SPS 322.31 (2) or subchapter VI shall be 0.40 for vertical fenestration, and 0.75 for skylights.

(3) GLAZED FENESTRATION EXEMPTION. Up to 15 square feet of glazed fenestration per Dwelling Unit may be exempt from U-Factor requirements of the chapter.

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

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

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

(7) DEFAULT VALUES. When a manufacturer has not determined product U-Factor in accordance with NFRC 100, U-Factors shall be determined by assigning a default value in accordance with Tables 322.36-1 and 322.36-2. Where a composite of materials of two different product types is used, the product shall be assigned the higher U-Factor. - See PDF for table

a) Glass block assemblies shall have a default value of 0.60. - See PDF for table

SPS 322.37 Air leakage.

(1) GENERAL. The requirements of this section apply to those components that separate interior Conditioned Space from a Garage or an unconditioned space.

(2) WINDOW AND DOOR ASSEMBLIES.

(a) ***General.*** Except as specified in par. (b), Windows, skylights and sliding glass doors shall have an air Infiltration rate of no more than 0.3 cfm per square foot, and swinging doors no more than 0.5 cfm per square foot, when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

(b) ***Exception.*** Site-constructed doors and Windows shall be sealed with gasketing or weatherstripping or shall be covered with a storm door or storm Window.

(3) JOINT AND PENETRATION SEALING.

(a) Exterior joints, seams, or penetrations in the Dwelling envelope, which are sources of air leakage, shall be sealed with durable caulking materials, closed with gasketing Systems, taped, or covered with water-vapor-permeable house wrap. Joints to be treated include all of the following:

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

2. Between separate wall assemblies or their sill-plates and Foundations.

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

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

(b) Sealing shall be provided at the Attic and crawl space panels, at recessed lights and around all plumbing and electrical penetrations, where these openings are located in the Dwelling Thermal Envelope.

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

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

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

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

(c)

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

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

Note: The Department will accept cement board, drywall, and other materials that exhibit flame spread and smoke developed indices of 10 or less when tested in accordance with ASTM E-84.

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

(6) COMPLIANCE DEMONSTRATION. Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options:

(a) ***Testing option.*** Building envelope tightness and insulation installation shall be considered acceptable when tested air leakage is less than seven air changes per hour (ACH) when tested with a blower door at a pressure of 33.5 psf (50 Pa). Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, Ventilation, and combustion appliances. During testing all of the following shall be done:

1. Exterior Windows and doors, fireplace and Stove doors shall be closed, but not sealed.

2. Dampers shall be closed, but not sealed, including exhaust, intake, makeup air, backdraft, and flue dampers.

3. Interior doors shall be open.

4. Exterior openings for continuous Ventilation Systems and heat recovery ventilators shall be closed and sealed.

5. Heating and cooling System(s) shall be turned off.

6. HVAC ducts shall not be sealed.

7. Supply and return registers shall not be sealed.

(b) ***Visual inspection option.*** Building envelope tightness and insulation installation shall be considered acceptable when the items listed in Table 332.37, applicable to the method of construction, are field verified. Where required by the Department, an Approved party independent from the installer of the insulation shall inspect the air barrier and insulation. - See PDF for table

SPS 322.38 Vapor retarders.

(1) GENERAL.

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

(b) ***Continuity.***

1. The vapor retarder shall be continuous. All joints in a vapor retarder consisting of sheet material shall be overlapped 6 inches and taped or sealed, except as provided in subd. 2. Rips, punctures, and voids in the vapor retarder shall be patched with vapor retarder materials and taped or sealed. Seams that are not over a framing member shall be taped or sealed.

2. Taping or sealing a vapor retarder is not required around doors and Windows, behind bathtub enclosures, and at top and bottom wall plates, if the retarder is held to those materials in an airtight manner by other Building Components, such as gypsum wallboard.

(2) FRAME ASSEMBLIES.

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

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

(c) ***Exceptions.***

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

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

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

4. No vapor retarder is required over cavities that have at least 50% of the required R-Value provided by spray-applied foam having a Perm rating of 1.0 or less, unless required by the foam manufacturer.

5. A vapor retarder for a floor over an open, unheated area may consist of 5/8-inch tongue-and-groove oriented-strand board, or 3/4-inch tongue-and-groove CDX plywood, which is exposure-rated plywood.

(3) CONCRETE FLOORS.

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

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

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

(d) A vapor retarder is not required under the slab of an unconditioned Attached Garage.

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

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

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

SPS 322.39 Ventilation and moisture control.

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

(2) VENTED ATTICS.

(a)

1. Except as allowed under subd. 6., where air-permeable ceiling or Attic insulation is installed in a horizontal position, Ventilation shall be provided above the insulation in accordance with this paragraph.

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

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

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

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

6. Ventilation is not required for separated roof areas, such as dormers, bump-outs or bays that cover a floor area of 40 ft2 or less.

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

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

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

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

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

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

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

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

Note: See SPS 323.14 for vent material requirements.

Subchapter V — Systems

SPS 322.40 Indoor temperatures and equipment sizing.

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

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

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

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

SPS 322.41 Temperature control.

(1) GENERAL. Each System shall be provided with an adjustable Thermostat for the regulation of temperature.

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

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

Note: This section does not require the replacement of existing mercury-containing Thermostats.

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

SPS 322.42 Duct Systems.

(1) Supply and return heating ducts, or portions thereof, that are not located completely within the thermal envelope, shall be provided with insulation with a Thermal Resistance of at least R-8.

(1m) Cooling supply ducts that pass through unconditioned spaces conducive to condensation, such as Attics, shall be provided with insulation having a Thermal Resistance

of at least R–8. The exterior of that insulation shall be covered with a vapor retarder that meets the requirements in SPS 322.38 (1)

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

SPS 322.43 Duct and plenum sealing.

(1) Duct Systems with joints not located entirely within the Conditioned Space or with joints located on the unconditioned side of stud bays, joist cavities and similar spaces, shall be sealed in accordance with this section.

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

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

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

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

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

(7) Except where exempted as indicated in sub. (8), duct tightness shall be verified by either of the following:

(a) Postconstruction test: Leakage to outdoors shall be less than or equal to 8 cfm per 100 ft2 of Conditioned Floor Area or a total leakage less than or equal to 12 cfm per 100 ft2 of Conditioned Floor Area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire System, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.

(b) Rough-in test: Total leakage shall be less than or equal to 6 cfm per 100 ft2 of Conditioned Floor Area when tested at a pressure differential of 0.1 inches w.c. (25 Pa) across the roughed in System, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm per 100 ft2 of Conditioned Floor Area.

(8) A duct tightness test is not required if the air handler and all ducts are located within Conditioned Space.

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

SPS 322.44 Pipe insulation.

(1) Mechanical System piping capable of carrying fluids above 105°F (41 °C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

(2) All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water Systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the System is not in use.

(3) Heating pipes in unheated spaces shall be insulated with material providing a minimum Thermal Resistance of R-4 as measured on a flat surface in accordance with ASTM standard C 335 at a mean temperature of 75°F.

SPS 322.45 Air conditioner and heat pump efficiencies.

(1) Heating and cooling equipment shall meet the minimum efficiency requirements in Table 322.45 when tested and rated in accordance with the applicable test procedure.

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

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

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

SPS 322.46 Replacement furnace and boiler efficiencies.

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

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

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

SPS 322.47 Equipment requirements.

(1) Mechanical Ventilation outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the Ventilation System is not operating.

(2) Snow melt System controls. Snow- and ice-melting Systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the System when the pavement temperature is above 50°F, and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F.

SPS 322.48 Indoor Pools. Indoor pools shall be provided with energy-conserving measures in accordance with all of the following:

(1) POOL HEATERS. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the Thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

(2) TIME SWITCHES.

(a) Except where allowed in pars. (b) and (c), time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

(c) Where pumps are required to operate solar- and waste-heat-recovery pool heating Systems, time switches are not required.

SPS 322.49 Lighting Equipment. A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.

Subchapter VI — Simulated Performance Alternative

SPS 322.50 General. This subchapter establishes criteria for compliance using simulated energy performance analysis. The analysis shall include heating, cooling, and service water heating energy only.

SPS 322.51 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed Dwelling be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design.

SPS 322.52 Documentation.

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

Note: REM/Rate is an acceptable software program for determining compliance with this section.

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

(a) Address of the Dwelling.

(b)

1. An inspection checklist documenting the Building Component characteristics of the Proposed Design as listed in Table 322.53-1.

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

(c) Name of individual completing the compliance report.

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

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

(a) Documentation of the Building Component characteristics of the standard reference design.

(b) A certification signed by the builder providing the Building Component characteristics of the Proposed Design as given in Table 322.53-1.

SPS 322.53 Calculation procedure.

(1) GENERAL. Except as specifically allowed under this section, the standard reference design and Proposed Design shall be configured and analyzed using identical methods and techniques.

(2) REFERENCE AND PROPOSED DESIGNS. The standard reference design and Proposed Design shall be configured and analyzed as specified by Table 322.53-1. Table 322.53-1 shall include by reference all notes contained in Table 322.31-1.

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

(a) Computer generation of the standard reference design using only the input for the Proposed Design. The calculation procedure may not allow the user to directly modify the Building Component characteristics of the standard reference design.

(b) Calculation of whole-building sizing as a single Zone for the heating and cooling equipment in the standard reference design residence in accordance with SPS 322.40 (3).

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

(d) Printed code official inspection checklist listing each of the Proposed Design component characteristics from Table 322.53-1 determined by the analysis to provide compliance, along with their respective performance ratings. - See PDF for table

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

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

1. AF = Total glazing area.

2. As = Standard reference design total glazing area.

3. FA = (Above-grade thermal boundary gross wall area)/ (above-grade boundary wall area + 0.5 x below-grade boundary wall area).

4. F = (Above-grade thermal boundary wall area)/ (above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

And where:

5. Thermal boundary wall is any wall that separates Conditioned Space from unconditioned space or ambient conditions.

6. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

7. Below-grade boundary wall is any thermal boundary wall in soil contact.

8. Common wall area is the area of walls shared with an adjoining Dwelling Unit.

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

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

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

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

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

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

i) For a Proposed Design without a proposed heating System, a heating System of 90% annual fuel utilization shall be assumed for both the standard reference design and Proposed Design. For electric heating Systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.

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

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

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

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

c) Entire System in Conditioned Space means that no component of the distribution System, including the air handler unit, is located outside of the Conditioned Space.

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

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

TABLE 322.31–1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value[i]	Floor R–Value	Basement Wall R–Value[b]	Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
1	0.35	0.60	49[e]	20[f] or 13+5[g]	15/19	30[h]	15/19	10/13	10/15	10
2	0.35	0.60	49[e]	21[f]	19/21	38[h]	15/19	10/13	10/15	10

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

[b] "15/19" means R–15 continuous insulated sheathing on the interior or exterior of the home or R–19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R–13 cavity insulation on the interior of the basement wall plus R–5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R–10 continuous insulated sheathing on the interior or exterior of the home or R–13 cavity insulation at the interior of the basement wall.

[c] The first R–value applies under the entire slab, regardless of depth below grade. The second R–value applies to the slab edge where the bottom of the slab is less than 12 inches below adjacent grade. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches. Also, see s. SPS 321.16 for protection against frost for slabs with supports less that 4 feet below grade.

[d] The R–value applies to any slab, the bottom of which is less than 12 inches below adjacent grade. Also, see s. SPS 321.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s. SPS 322.32 (1) for application and permitted reduced R–value.

[f] R–20 and R–21 may be compressed into a 2X6 cavity.

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

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

[i] The second R–value applies when more than half of the insulation is on the interior of the mass wall.

TABLE 322.31–2
EQUIVALENT U–FACTORS

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling U–Factor	Wood Frame Wall U–Factor	Mass Wall U–Factor	Floor U–Factor	Basement Wall U–Factor	Crawl Space U–Factor	Unheated Slab U–Factor
1	0.35	0.60	0.026	0.057	0.060[a]	0.033	0.050	0.065	10
2	0.35	0.60	0.026	0.057	0.057[a]	0.028	0.050	0.065	10

[a] When more than half the insulation is on the interior, the mass wall U–factors shall be the same as the frame wall U–factor.

TABLE 322.31–4
COMPONENT DWELLING THERMAL ENVELOPE REQUIREMENTS
FOR DWELLINGS USING LOWER EFFICIENCY APPLIANCES[a]

Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value	Floor R–Value	Basement or Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
0.30	0.60	49[e]	21[f] or 19+5[g]	19	30[h]	15/19	10/20	15
Equivalent U–Factors								
0.30	0.60	0.026	0.057	0.057	0.033	0.045	0.033	0.047

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

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

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

[d] The R–value applies to the slab perimeter insulation, where the bottom of the slab is less than 12 inches below adjacent grade. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches. Also, see s. SPS 321.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s.SPS 322.32 (1) for application and permitted reduced R–value.

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

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

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

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09; EmR0917: emerg. am. (2) (b), eff. 9–5–09; CR 09–072: am. (2) (b) Register March 2010 No. 651, eff. 4–1–10; CR 09–104: am. Tables 22.31–1 and 22.31–4 Register December 2010 No. 660, eff. 1–1–11; correction in (1) (a), (b), (2) (a), (b), (3) (a), (b), Table 322.31–1, Table 322.31–4 made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; CR 15–041: am. Table 322.31–1, Table 322.31–2, Table 322.31–4 Register December 2015 No. 720, eff. 1–1–16.

TABLE 322.32

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

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

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

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

TABLE 322.36–1

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

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

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

TABLE 322.36–2

U–FACTOR DEFAULT TABLE FOR NON–GLAZED DOORS

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

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09; correction in (2), (7) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

TABLE 332.37
AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air–permeable insulation is not used as a sealing material. Air–permeable insulation is inside of an air barrier.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above–garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception–fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed–type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

TABLE 322.45

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

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

TABLE 322.53–1
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Above–grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 322.31–2	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawlspace walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 322.31–2 with insulation layer on interior side of walls	As proposed
Above–grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 322.31–2	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U–Factor: from Table 322.31–2	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
Doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U–Factor: same as fenestration from Table 322.31–2	As proposed
Glazing[a]	Total area[b] =	
	(a) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area	As proposed
	(b) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area	
	Orientation: equally distributed to four cardinal compass orientations	As proposed
	U–Factor: from Table 322.31–2	As proposed
	SHGC = 0.40	As proposed
	Interior shade fraction:	
	Summer (all hours when cooling is required) = 0.70	Same as standard reference design[c]
	Winter (all hours when heating is required) = 0.85	
	External shading: none	As proposed
Skylights	U–Factor: from Table 322.31–2	As proposed
Thermally isolated sunrooms	None	As proposed

TABLE 322.53–1 (Continued)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Air exchange rate	Specific Leakage Area (SLA)[d] = 0.00036 assuming no energy recovery	For residences that are not tested, the same as the standard reference design; For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] but not less than 0.35 ACH; For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] combined with the mechanical ventilation rate[f], which may not be less than 0.01 X CFA + 7.5 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = 0.03942 X CFA + 29.565 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 x CFA + 4,104 X N br (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[g] but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R–2 carpet and pad, and 20% of floor directly exposed to room air; For masonry basement walls, as proposed, but with insulation required by Table 322.31–2 located on the interior side of the walls; For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed As proposed As proposed
Heating systems [h,i]	Fuel type: same as proposed design efficiencies: Electric: air–source heat pump with prevailing federal minimum efficiency; Nonelectric furnaces: natural gas furnace in accordance with Table 322.31–3; Nonelectric boilers: natural gas boiler in accordance with Table 322.31–3; Capacity: sized in accordance with section SPS 322.40 (3)	As proposed As proposed As proposed As proposed As proposed
Cooling systems [h,j]	Fuel type: electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with section SPS 322.40 (3)	As proposed As proposed As proposed
Service Water Heating [h,k]	Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 X N br Tank temperature: 120°F	As proposed As proposed Same as standard reference Same as standard reference

TABLE 322.53–1 (Continued)

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies	Same as standard reference design, except as specified by Table 322.53–2
Thermostat	Type: manual, cooling temperature set point = 78°F; heating temperature set point = 68°F	Same as standard reference design

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

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

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

And where:

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

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

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

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

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

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

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

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

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

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

TABLE 322.53–2

DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

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

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

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

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

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

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

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09; correction in (2), (3) (b), (d), Table 322.53–1 made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

Chapter SPS 323
HEATING, VENTILATING AND AIR CONDITIONING

Subchapter I — Scope

SPS 323.01 Scope.

Subchapter II — Design

SPS 323.02 Design.

Subchapter III — Heating Equipment

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SPS 323.04 Types and location of equipment.
SPS 323.045 Solid-fuel-burning appliances.
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Subchapter IV — Delivery Systems

SPS 323.07 Air distribution systems.
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Subchapter V — Chimneys and Vents

SPS 323.11 General requirements.
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SPS 323.155 Multiple appliance Venting.
SPS 323.156 Condensate drains.

Subchapter VI — Fuel Supply Systems

SPS 323.16 Fuel storage.

Subchapter VII — Equipment Location and Operation

SPS 323.17 Equipment location.
SPS 323.18 Operation.

Subchapter I — Scope

SPS 323.01 Scope. The provisions of this chapter shall apply to the design, installation, and construction of all heating, ventilating and air conditioning systems in Dwellings covered by this Code.

Subchapter II — Design

SPS 323.02 Design. Every Dwelling shall be equipped with a heating system designed in accordance with this section. Heating equipment requirements may be waived for recreational Dwellings used only during the non-heating season. Where a cooling system is provided, the cooling requirements of this section shall be met.

(1) HEATING AND COOLING SYSTEM DESIGN.

(a) The heating and cooling systems shall be designed to maintain the indoor design temperature at outdoor design conditions.

(b) When requested, room-by-room heat loss and heat gain calculations shall be furnished.

Note: See Appendix for outdoor design temperature map.

(2) DISTRIBUTION SYSTEMS. Distribution systems shall be sized and located to satisfy the heating and Cooling Loads of each conditioned space. When requested, a layout of the distribution system shall be furnished to show that the system meets the requirements of this Code.

(3) VENTILATION.

(a) ***General.***

1. All exhaust Vents shall terminate outside the structure.

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

(b) ***Balancing.***

1. General. Except as provided under subd. 2., mechanical ventilation systems shall be balanced.

2. Exception. Passive intake air ducts providing makeup air for intermittent exhaust fans shall be sized to provide at least 40% of the total air that would be exhausted with all intermittent exhaust ventilation in the Dwelling operating simultaneously.

3. Kitchen range hoods.

a. Kitchen range hoods that exhaust air from the Kitchen area are considered as exhaust ventilation for balancing and makeup purposes.

b. Kitchen range hoods that are listed and installed to recirculate air without exhausting it are not required to be balanced.

4. Infiltration.

a. Infiltration may be considered as makeup air for balancing purposes only where there are no naturally Vented space- or water-heating appliances in the Dwelling.

b. For the purpose of complying with this subdivision, naturally Vented space or water heating appliances are those that take combustion or Dilution Air from inside the Dwelling, including unsealed fireplaces and draft hood appliances with power Venting.

Note: Whole-house fans that are used in the summer to bring cool night air in through open Windows and exhaust into the Attic are considered to be a supplemental cooling system rather than part of the ventilation system.

Note: See SPS 322.39 (5) for additional requirements on mechanical ventilation.

(c) ***Habitable Rooms.*** Habitable Rooms without openable Windows shall be provided with a balanced mechanical ventilation system producing one air change per hour of fresh outside air while the room is occupied.

(d) ***Rooms with toilets, tubs, or showers.***

1. Except as provided under subd. 2., any room with a toilet, tub or shower shall be provided with exhaust ventilation capable of exhausting 50 cubic feet per minute on an intermittent basis or 20 cubic feet on a continuous basis.

2. For Dwellings with no electrical service, any room with a toilet, tub or shower shall be provided with an openable Window.

Note: The Department will accept designs which meet the Air Conditioning Contractors of America manual; the Mechanical Contractors Association manual; and the Sheet Metal and Air Conditioning Contractors National Association standards for heating and air conditioning systems for one- and two-family Dwellings.

(4) CONTROLS. The temperature rise through the equipment shall not exceed 100° F unless listed. Controls shall be provided to maintain the inside temperature. Where forced, warm-air systems are used, controls shall be installed to control air movement.

Subchapter III — Heating Equipment

SPS 323.03 Selection of equipment. All heating and central cooling equipment shall be selected on the basis of air-handling capacity, pumping capacity, and thermal capacity to handle the calculated design heating or Cooling Load.

SPS 323.04 Types and location of equipment.

(1) GENERAL.

(a) All heat producing appliances and cooling appliances shall be listed by a testing agency acceptable to the Department.

(b) Installation and maintenance of gas-fueled appliances shall comply with the appliance listing and the requirements of NFPA 54, National Fuel Gas Code, except as otherwise required under this chapter.

(c) The clearances from combustible materials in Tables 323.04-A and 323.04-B shall apply unless otherwise shown on listed appliances.

TABLE 323.04-A

STANDARD INSTALLATION CLEARANCES (INCHES) FOR HEAT-PRODUCING APPLIANC–S - **See PDF for table** Standard clearances may be reduced by affording protection to combustible material in accordance with Table 323.04-B.

2. Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual Ceiling Height of a room is greater than 8 feet, the volume of a room should be figured on the basis of a Ceiling Height of 8 feet.

3. The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

4. For a listed oil, combination gasoil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250° F or this dimension may be one inch if the limit control cannot be set higher than 200 ° F.

5. To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at lea¼1/4-inch thick covered with sheet metal of not less than No. 28 gauge, the distance may be not less than 24 inches. Also, if the manufacturer of the range, cooktop, or cooking stove specifies a shorter clearance, that clearance may be used instead.

6. Clearance above charging door should be not less than 48 inches.

TABLE 323.04-B

CLEARANCES, INCHES, WITH SPECIFIED FORMS OF PROTECTION* - See PDF for table

*All clearances shall be measured from the outer surface of the equipment to the combustible material disregarding any intervening protection applied to the combustible material.

**A factory fabricated board formed with noncombustible materials, normally fibers, and having a thermal conductivity in the range of 1 Btu inch per square foot per °F, or less.

***Spacers shall be of noncombustible material.

(2) FURNACES. The input and output capacity of furnaces shall be listed on the nameplate. All nameplates shall show evidence that the equipment has been listed by a recognized testing laboratory.

(a) ***Fuel supply***. Furnaces shall be fired with the fuel for which they have been Approved, except as provided in par. (d). Fuels shall be supplied to the furnace in the volume and at the pressure required on the label.

(b) ***Unvented furnaces and space heaters.*** The use of unvented furnaces and space heaters fueled by natural gas, kerosene, alcohol, or other fuel shall be prohibited due to concerns about oxygen depletion; contamination from carbon monoxide, carbon dioxide, nitrogen dioxide, formaldehyde, and other combustion related contaminants; and water vapor buildups.

(c) ***Vented wall furnaces.*** Vented wall furnaces shall not be equipped with duct extensions beyond the vertical and horizontal limits of the enclosure unless listed. Vented wall furnaces shall be located to prevent the restriction of air circulation by doors, projections, or other openings. Vented wall furnaces shall be provided with Combustion Air.

(d) ***Conversion burners.*** Conversion burners shall be listed by a recognized testing laboratory. The existing equipment shall be reconditioned, and defective parts replaced before a conversion burner is installed. Conversion burners shall be installed in accordance with the installation instructions.

(3) HEAT PUMP APPLIANCES.

(a) ***Size.*** Heat pump appliances shall be sized to provide control of the wet and dry bulb temperatures during cooling and maximum performance during heating. The heating

balance point shall be considered to determine the outdoor temperature at which the heat pump must operate 100% of the time to offset the Dwelling heat loss.

(b) ***Auxiliary heaters.*** Provisions for auxiliary heat to supplement the heat pump at outdoor temperatures below the balance point shall be provided. Auxiliary heaters shall be sized so that the heat pump auxiliary will offset the Dwelling heat loss down to the heating design temperature.

(4) BOILERS.

(a) Boilers and solid fuel-fired water-heating appliances that serve a one-or two-family Dwelling, whether located inside or outside the Dwelling, shall comply with Ch. SPS 341, Boilers and Pressure Vessels.

(b) Solid fuel-fired water-heating appliances installed inside one or two family Dwellings are exempt from the requirements of SPS 341.49 (3).

Note: The Department will accept equipment listed by the American Society of Mechanical Engineers, Underwriters' Laboratories, and the American Gas Association.

Note: The appliances addressed in this section include non-pressurized solid-fuel-fired water-heating appliances used for space heating.

(5) WATER HEATERS USED FOR SPACE HEATING.

(a) ***Listing.***

1. Water heaters used for space heating shall be listed for such use.

2. The data plate shall indicate that the unit is suitable for simultaneous water heating and space heating.

Note: ANSI Z21.10.1 or ANSI Z21.10.3 are acceptable listing standards for dual use water heaters.

(b) ***Sizing***. A dual use water heater shall be sized to provide sufficient hot water to supply both the daily and hourly peak loads of the Dwelling.

(c) ***Installation.*** Dual use water heaters shall be installed to provide both space heating and potable water.

Note: This Code requires dual use water heaters to be installed by a licensed plumber when installed in a new, not-yet-occupied Dwelling. This Code also requires that a floor drain be provided if the water heater is installed on the lowest floor level and that all piping be suitable for potable water.

(d) ***Heat exchanger***. A single-wall heat exchanger may not be used with a toxic heat transfer fluid.

(6) LOCATION.

(a) ***Enclosed spaces.*** Except as provided in par. (c), no space heating or water-heating appliance shall be installed in a bedroom, bathroom, closet, or Garage unless listed for such installation.

(b) ***Garages.*** Appliances installed in Garages shall have burners and burner ignition devices located at least 18 inches above the floor and shall be protected or located so the furnace is not subject to damage from a vehicle.

(c) ***Exceptions.***

1. Vented decorative Gas Appliances and decorative Gas Appliances for installation in Vented fireplaces may be installed in bedrooms or bathrooms only when both of the following conditions are met:

a. The volume of the space in which the appliance is located is not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances installed in that space. The space may be made up of more than one room if the rooms are connected through doorway openings without doors.

b. The vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed under SPS 322.38.

2. Water heaters may be installed in a closet located in a bathroom or bedroom where the closet is used exclusively for the water heater, where the enclosed space has a weather-stripped solid door with a self-closing device, and where all air for combustion is obtained from the outdoors.

Note: Section SPS 323.06 still requires Combustion Air to be provided to the appliance.

SPS 323.045 Solid-fuel-burning appliances.

(1) GENERAL. Solid-fuel-burning appliances shall be installed as specified in this section unless the manufacturer or listing specifies the use of protection or clearances other than those specified in this section. All solid-fuel-burning appliances shall be tested and listed by an accepted testing agency.

Note: Factory-built fireplaces shall comply with SPS 321.32.

(2) LOCATION OF APPLIANCES.

(a) ***Servicing***. Every appliance shall be located to permit access to the appliance. Sufficient clearance shall be maintained around the equipment to permit cleaning of surfaces; the replacement of air filters, blowers, motors, controls, and Chimney Connectors; the lubrication and servicing of moving parts; and the adjustment and servicing of stokers and appliance components.

(b) ***Garages***. Solid-fuel-burning appliances may not be installed in a Garage unless listed for that application.

(3) CHIMNEYS.

(a) Solid-fuel-burning appliances shall be connected to one of the following types of Chimneys:

1. `Factory-built Chimneys or Vents'. A listed residential-type and building heating appliance Chimney may be used with solid-fuel-burning appliances if the Chimneys have been tested 3 times to a minimum flue gas temperature exposure of 2100°F, under the conditions specified by the listing agency, for at least 10 minutes each time.

Note: Products listed and labeled as complying with UL 103 - “Type HT" meet this requirement. UL 103 uses several temperature ranges for different products but only the “Type HT"-designated products have met the 2100°F testing requirement.

2. `**Masonry Chimneys'**. Masonry Chimneys shall be constructed as specified in SPS 321.30.

(b) Wood-burning equipment shall not be connected to a flue serving a fireplace or other equipment.

(c) The Chimney shall be designed to create a natural draft to carry away the products of combustion or provision shall be made for mechanically maintaining constant updraft during equipment operation.

(d) A cleanout opening shall be provided.

(e) A listed, multifuel appliance may be Vented into a single flue.

(4) CHIMNEY CONNECTORS.

(a) All solid-fuel-burning appliances shall be connected to Chimneys with factory-built Chimney material, Type L Vent material or steel pipe with minimum thicknesses as specified in Table 323.045-A.

TABLE 323.045-A

METAL THICKNESS FOR PIPE CONNECTORS - See PDF for table

(b) The required clearance to combustibles for Chimney Connectors shall be 18 inches. This clearance may be reduced in accordance with Table 323.045-B. The specified protection shall be applied to and covers all combustible material as specified in Figure 323.045-A.

(c) Connectors and Chimneys for solid fuel-burning appliances shall be designed, located, and installed to permit ready access for internal inspection and cleaning.

(d)

1. Chimney Connectors shall have no more than two 90° elbows.

2. The horizontal length shall not exceed 75% of the total vertical height of the entire Venting system measured from the appliance outlet.

3. The connector shall maintain a rise of at least 1/4 inch per foot from the appliance outlet to the Chimney inlet.

4. Connectors shall be securely supported, and joints fastened with a minimum of 3 sheet metal screws or rivets.

5. Appliances used mainly for wood burning shall have the joints assembled so that the crimped end points towards the Stove. Appliances burning coal shall have the joints assembled so that the crimped end points away from the appliance.

6. A connector to a masonry Chimney shall extend through the wall to the inner face of the liner but not beyond.

7. The effective area of the connector shall not be less than the area of the appliance flue collar.

(e) No Chimney Connectors may pass through any floor, ceiling, Window, door or combustible wall nor be concealed in any closet, Attic or similar space. A connector may pass through a combustible wall if the connector is guarded at the point of passage by one of the following methods:

1. Metal ventilated thimble not less than 12 inches larger in diameter than the connector.

2. All combustible material in the wall is cut away from the connector a sufficient distance to provide the required 18-inch clearance. Any material used to close up such openings shall be noncombustible.

(f) A manual, cast iron damper to control draft shall be provided in the Chimney Connector. The damper shall not obstruct more than 80% of the connector area. Listed solid-fuel appliances whose listing prohibits the use of manual dampers in the connector shall not require a manual damper to be installed.

FIGURE 323.045-A

CONSTRUCTION USING COMBUSTIBLE MATERIAL

- See PDF for diagram

“A" Equals the required clearance with no protection, specified in s. SPS 323.045 (4) (b).

“B" Equals the reduced clearance permitted in accordance with Table 323.045-B. The wall protection should extend far enough in each direction to make `C' equal to `A'.

TABLE 323.045-B
CONNECTOR CLEARANCES WITH SPECIFIED FORMS OF PROTECTION1,2,3,4
- See PDF for table

1. Spacers and ties shall be of noncombustible material.

2. All methods of protection require adequate ventilation between protective material and adjacent combustible walls and ceilings.

3. Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1550° F.

4. If a single wall connector passes through the masonry wall there shall be at least 1/2 inch of open ventilated air space between the connector and the masonry.

(5) MOUNTING ON FLOORS. Appliances shall be placed on surfaces as described in Table 323.045-C. Solid-fuel-burning appliances listed specifically for installation on a floor constructed of combustible material may be installed in accordance with the terms of the listing and the manufacturer's instructions.

(5m) MOUNTING ON THE GROUND. Ground-based solid-fuel-burning appliances shall be installed in accordance with the manufacturer's specifications.

(6) CLEARANCES.

(a) ***General.*** Solid-fuel-burning appliances shall be installed with clearances not less than specified in Table 323.045-D, except as provided in pars. (b) and (c).

(b) ***Listed appliances exception.*** Listed appliances shall be installed in accordance with the terms of their listing if greater clearances other than those specified by Table 323.045-D are required in accordance with the listing.

(c) ***Clearance with protection exception.*** Solid-fuel-burning appliances may be installed with reduced clearances provided the combustible material is protected as described in Table 323.045-E. The specified protection shall be applied to and covers all combustible material as specified in Figure 323.045-B.

(7) ACCESSORIES. Accessories for solid fuel-burning appliances such as heat exchangers, Stove mats, floor pad and protection shields, shall be listed and shall be installed in accordance with the terms of their listing.

(8) SUPPLEMENTAL UNITS. Supplemental solid-fuel-burning units connected to a furnace shall be connected to the warm air side of the furnace as illustrated in Figures 323.045-C to E, and shall be installed in accordance with all of the following:

(a) ***Return air duct.*** The area of the return air duct shall be at least equal to the area of the warm air supply duct. The return air duct shall be of the same material as specified for supply air ducts. Return air grilles shall not be located in bathrooms, Kitchens, Garages, utility spaces or in a confined space defined under SPS 323.06 in which a draft diverter or draft regulator is located.

(b) ***Blower.*** The blower on the furnace shall maintain the manufacturer's specifications for cubic feet per minute air flow and static pressure when the supplemental unit is in operation.

(c) ***Outside air intake.*** The outside air intake shall be connected to the cold air return plenum of the furnace. A volume damper shall be placed in the duct for the fresh air intake.

(d) ***Thermostat.*** The thermostat control on the supplemental heating unit shall activate the blower motor at a temperature between 100° and 120° F.

(e) ***Supplemental units.*** Supplemental solid-fuel-burning units shall be installed to maintain a 3-foot clearance between the unit and the furnace or shall be installed in accordance with the listings of both the supplemental unit and the furnace if such an installation is specifically covered by the listings. - See PDF for table

TABLE 323.045-D
STANDARD CLEARANCES FOR
SOLID-FUEL-BURNING APPLIANCES - See PDF for table - See PDF for table

FIGURE 323.045-B
PROTECTION OF COMBUSTIBLE WALLS
AND FLOORS

- See PDF for diagram
- See PDF for diagram

FIGURE 323.045-C

- See PDF for diagram

FIGURE 323.045-D

- See PDF for diagram

(9) SUPPLY DUCTS. Supply ducts connected to solid-fuel-burning appliances shall have the following minimum clearances to combustibles:

(a) ***Horizontal ducts.*** The clearance from combustibles for horizontal ducts shall be as specified in Table 323.045-F.

TABLE 323.045-F - See PDF for table

1. Clearance can be reduced in accordance with Table 323.045-B

(b) ***Vertical ducts.***

1. Air shall travel 6 feet and change direction equivalent to one 90° turn before entering an enclosure of combustible material.

2. Ducts shall have 3/16-inch clearance between the duct and any combustible material.

(10) COMBINATION APPLIANCES. Appliances capable of burning multi-types of fuel shall be listed and installed in accordance with their listing.

FIGURE 323.045-E

- See PDF for diagram

SPS 323.05 Safety controls. High limit, maximum outlet air temperature and similar safety controls shall be provided on heating equipment.

SPS 323.06 Combustion Air.

(1) SCOPE.

(a) Naturally Vented Appliances and other appliances that require air for combustion and dilution of flue gases to be taken from within the building shall comply with this section.

(b) Appliances that are provided with a direct supply of outside air for combustion in accordance with the manufacturer's installation instructions and listing are not required to comply with this section.

(c) Where the appliance listing and manufacturer's instructions are more stringent than the provisions of this section, the listing and manufacturer's instructions apply.

(d) Listed fireplace Stoves are not required to comply with this section if permitted in the manufacturer's instructions.

(e) Masonry fireplaces shall conform to the requirements of SPS 321.29.

(f) Listed factory-built fireplaces shall comply with the manufacturer's recommendations and shall conform with the requirements of SPS 321.32.

(2) METHODS FOR PROVIDING AIR. Air for combustion and dilution shall be provided in accordance with one of the following:

(a) If the vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed by SPS 322.38, air may be provided from inside the building in accordance with sub. (3).

(b) Air may be provided from outside the building in accordance with sub. (4).

(c) The appliance may be installed in accordance with its listing and manufacturer's instructions. Where all walls and ceilings exposed to the outside atmosphere are provided with a continuous vapor retarder, any requirements for unusually tight construction shall be met.

(d) An engineered system providing an adequate supply of air for combustion ventilation and dilution of flue gases may be installed if Approved by the Department.

(3) AIR FROM INSIDE THE BUILDING.

(a)

1. The equipment shall be located in a space with a volume not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances drawing combustion and Dilution Air from that space.

2. The space may be made up of more than one room if the rooms are connected through doorways without doors or connected through sets of openings described in par. (b).

(b)

1. When needed to connect rooms, two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

2. The net free area of openings shall be calculated in accordance with sub. (5).

3. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and Dilution Air from the communicating rooms but shall be not less than 100 square inches.

(4) AIR FROM OUTSIDE THE BUILDING.

(a) When air for combustion and dilution is provided from outside the building, as allowed under sub. (2) (b), one of the methods specified in pars. (b) to (d) shall be used.

(b) Openings may be provided to connect rooms containing appliances to the outdoors.

1.

a. Two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

b. Openings may connect directly to the outdoors or to the outdoors through a horizontal or vertical duct.

c. The net free area of openings shall be calculated in accordance with sub. (5).

2. The net free area of each direct opening to the outdoors not using a duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and Dilution Air from the room.

3.

a. The net free area of each opening connected to the outdoors through a horizontal duct shall be a minimum of one square inch per 2000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and Dilution Air from the room.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

4.

a. The net free area of each opening connected to the outdoors through a vertical duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and Dilution Air from the room.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

(c)

1. Where all appliances drawing air for combustion and dilution from the room are Gas Appliances, air may be provided via a single opening to connect the room to the outdoors in accordance with this paragraph.

2.

a. The opening shall be located within one foot of the ceiling of the room.

b. The opening may connect directly to the outdoors, may connect to the outdoors through a horizontal duct, or may connect to the outdoors through a vertical duct.

c. The net free area of the opening shall be calculated in accordance with sub. (5).

3.

a. The net free area of the opening shall be a minimum of one square inch per 3000 Btu/h of combined input rating of the fuel-burning appliances drawing combustion and Dilution Air from the room, and not less than the combined cross-sectional flow areas of the appliance flue collars or draft hood outlets.

b. The cross-sectional area of the duct shall be equal to or greater than the required size of the opening.

4. The appliances shall have a minimum clearance to the surfaces of the room of one inch at the sides and back of the appliance and 6 inches at the front of the appliance.

(d)

1. A combination of openings to the outside and openings to other rooms may be used in accordance with this paragraph.

2.

a. One opening shall connect directly to the outdoors, connect to the outdoors through a horizontal duct, or connect to the outdoors through a vertical duct.

b. The net free area of the openings shall be calculated in accordance with sub. (5).

c. The net free area of the opening shall be a minimum of one square inch per 5000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and Dilution Air from the room.

d. The cross-sectional area of a duct, if used, shall be equal to or greater than the required size of the opening.

3.

a. The equipment shall be located in a space with a volume not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel-burning appliances installed in that space.

b. The space may be made up of more than one room if the rooms are connected through openings without doors or connected through sets of openings described in subd. 4.

4.

a. When needed to connect rooms, two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

b. The net free area of openings shall be calculated in accordance with sub. (5).

c. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and Dilution Air from the communicating rooms but shall be not less than 100 square inches.

(5) NET FREE AREA CALCULATION.

(a) The required size of openings for combustion and Dilution Air shall be based on the net free area of each opening.

(b) The net free area of an opening shall be that specified by the manufacturer of the opening covering or by a source Approved by the Department.

(c) In the absence of such information, openings covered with metal louvers shall be deemed to have a net free area of 75 percent of the area of the opening, and openings covered with wood louvers shall be deemed to have a net free area of 25 percent of the area of the opening.

(6) INTERLOCKING OF DAMPERS.

(a) Where the Combustion Air openings are provided with volume, smoke or fire dampers, the dampers shall be electronically interlocked with the firing cycle of the appliances served, so as to prevent operation of any appliance that draws combustion and Dilution Air from the room when any of the dampers are closed.

(b) Manually operated dampers shall not be installed in Combustion Air openings.

(7) SIMULTANEOUS OPERATION.

(a) The equipment and appliance within every room containing fuel-burning appliances shall be installed so as to allow the free circulation of air.

(b) Provisions shall be made to allow for the simultaneous operation of mechanical exhaust systems, fireplaces, clothes dryers or other equipment and appliances operating in the same room or space from which Combustion Air and Dilution Air is being drawn. The provisions shall prevent the operation of the appliances, equipment, and systems from affecting the supply of combustion and Dilution Air.

Note: Wood typically has a heating value of 8600 BTU per pound.

SPS 323.062 Mechanical draft systems. Where a mechanical draft system, such as a fan is used, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the system for safe performance.

SPS 323.065 Equipment maintenance information. Required regular maintenance actions for equipment shall be clearly stated and incorporated on a readily accessible label. The label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of equipment. Maintenance instructions shall be furnished for equipment which requires preventive maintenance for efficient operation. The manufacturer's manuals for all installed heating and cooling equipment and service water heating equipment shall be provided.

Subchapter IV — Delivery Systems

SPS 323.07 Air distribution systems.

(1) SIZING. All air distribution systems shall be sized using the velocities and static pressure losses listed in Table 323.07.

TABLE 323.07
DUCT VELOCITIES - See PDF for table

(2) SYSTEM SIZING. The distribution system, including the evaporator coil, air filters (installed external to the heating unit), ducts, fittings, grilles, and registers, shall be sized so that the total external static pressure shall not exceed the static pressure capacity of the fan at the system rated air flow.

(3) CHANGES IN DUCT SIZE. Where duct sizes are changed, the slope angle of the transition duct shall not exceed 45°.

SPS 323.08 Ductwork.

(1) DUCT USE. Ducts designed for the transmission of air shall be used for no other purpose.

(2) INTERIOR DUCTS. All interior ducts shall be constructed in accordance with the following:

(a) ***Supply and return air ducts.*** Supply and return air ducts shall comply with this paragraph except that ducts attached to appliances may be constructed of materials specified in the appliance listing.

1. Kitchen exhaust ducts and ducts for air exceeding 250° F shall be constructed of sheet metal or lined with sheet metal or constructed of other noncombustible noncorrugated materials.

2. Ducts connected to furnaces shall be constructed of sheet metal at least 6 feet from the furnace.

3. Spaces formed by unlined wood joists, studs or wood I-joists with solid webs may be used as return air ducts. Spaces used as return air ducts shall be cut off from all remaining unused portions of the space by tight-fitting stops of sheet metal or of wood joist material. Bridging shall be removed from the joist space.

(b) ***Under-floor plenums.*** An under-floor space may be used as a plenum in a single Dwelling Unit in accordance with this section.

1. The use of the under-floor space shall be limited to buildings not more than 2 stories in height. Except for the floor immediately above the under-floor plenum, supply ducts shall be provided extending from the plenum to registers or other floor levels.
2. The under-floor spaces shall not be used for storage, shall be cleaned of all loose scrap material, and shall be tightly and substantially enclosed.
3. The enclosed material of the under-floor space, including the side wall insulation and vapor barriers, shall not be more flammable than one inch (nominal) wood boards (flame spread classification of 200).
4. Access shall be through an opening in the floor which shall be 18 inches by 24 inches.
5. The furnace supplying warm air to the under-floor space shall be equipped with an automatic control which will start the air circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150° F. Such control shall be one that cannot be set higher than 150° F.
6. The furnace supplying warm air to the under-floor space shall be equipped with an approved temperature limit control that will limit outlet air temperature to 200° F.
7. A noncombustible receptacle shall be placed below each floor opening into the air chamber. The receptacle shall be securely suspended from the floor members and shall be not more than 18 inches below the floor opening. The area of the receptacle shall extend 3 inches beyond the opening on all sides. The perimeter of the receptacle shall have a vertical lip at least one inch high at the open sides if it is at the level of the bottom of the joist, or 3 inches high if the receptacle is suspended.
8. Floor registers shall be designed for easy removal to permit access for cleaning the receptacles.
9. Exterior walls and interior stud partitions shall be fire stopped at the floor.
10. Each wall register shall be connected to the air chamber by a register box or boot.
11. A duct conforming to par. (a) shall extend from the furnace supply outlet at least 6 inches below combustible framing.
12. The entire ground surface and enclosing exterior walls of the under-floor space shall be covered with a vapor barrier having a vapor permeability rating of one Perm or less and a flame spread rating of 200 or less.
13. Fuel gas lines may not be located within the under-floor space.
14. A smoke detector shall be placed in the under-floor space. The alarm and low-battery signal of the smoke detector shall be audible in the occupied areas of the Dwelling, when actuated.
15. The exterior walls of the under-floor spaces shall be insulated in accordance with subch. IV of Ch. SPS 322. The insulation may not be omitted under the provisions of SPS 322.21 or subch. VII of Ch. SPS 322.
16. Electrical wiring installed in the plenum shall be in conformance with this Code.

(3) EXTERIOR DUCTS.

(a) ***General.*** Except as provided in par. (b), ducts, which are located in Garages, storage Attics and similar spaces susceptible to physical damage, shall be constructed of galvanized steel or corrosion-resistive metal.
(b) ***Exception.*** Plastic may be used for bath fan or air-to-air heat exchanger exhaust runs located in spaces outside the Dwelling.

(4) UNDERGROUND DUCTS. Ducts, plenums, and fittings constructed of metal encased in concrete or ceramic, or other Approved materials, may be installed in the ground. Encasement of underground supply air ducts shall be moisture proof.

Note: See SPS 322.42 for insulation requirements for underground ducts.

(5) DUCT CONSTRUCTION. Ductwork shall be constructed and installed in accordance with any one of the appropriate following standards:

(a) ASHRAE Handbook HVAC Systems and Equipment.
(b) SMACNA, Residential Comfort System Installation Standards Manual
(c) SMACNA, HVAC Duct Construction Standards-Metal and Flexible.
(d) SMACNA Fibrous Glass Duct Construction Standards.
(e) ASHRAE HVAC Applications Handbook.
(f) NAIMA Fibrous Glass Duct Construction Standards.

(6) THICKNESS. Sheet metal ducts shall conform to the minimum thicknesses listed in Table 323.08-A.

(7) DUCT SUPPORT. Rigid metal ductwork shall be supported in accordance with Table 323.08-B.

TABLE 323.08-A
DUCT CONSTRUCTION MINIMUM
SHEET METAL GAUGES - See PDF for table

TABLE 323.08-B
DUCT SUPPORT FOR RIGID DUCTS —
16 GAGE MAXIMUM THICKNESS - See PDF for table

1. These hangers are the minimum required to support the weight of the duct off of the joist, stud, or similar structure. The band, wire or strap cradling the duct shall not cause any deformation of the duct.

2. “Pair" means that there are 2 vertical legs. One continuous strap can form both vertical legs.

Note: This table does not prohibit nailing for duct support.

(8) JOINTS AND SEAMS. All joints and seams shall be securely fastened or locked. Round pipe slip joints shall be lapped at least one inch.

(9) VIBRATION CONTROL. When used, vibration isolation connectors shall be installed at the joint between the duct and fan or heating equipment. Vibration isolation connectors shall not be used where the air temperature is in excess of 250° F.

(10) AIR PASSAGEWAYS OF ENVELOPE DWELLINGS. The air passageways of envelope type Dwellings shall comply with this subsection.

(a) No heating equipment shall be placed in the air passageways.
(b) Wood exposed to the air passageways shall be of at least 2 inches nominal thickness.
(c) Finishes and insulation exposed to the air passageway shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.
(d) A vapor barrier shall be installed on the warm side of insulation which forms a part of the thermal envelope of the Dwelling. In the roof-ceiling air passageway, a vapor barrier for the insulation of the ceiling may be omitted if heated air is circulated on both sides of the ceiling insulation. The insulation on the roof side of the air passageway shall be provided with a vapor barrier on the warm side of the insulation. Any vapor barrier

exposed to circulating air shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.

SPS 323.09 Dampers, registers, and grilles.

(1) VOLUME AND BACKDRAFT DAMPERS.

(a) Volume duct dampers shall be provided to permit balancing of the system.

(b) Volume dampers shall be provided with access.

Note: Acceptable means of access include a manufactured access panel, an air grille used as a cover, a plastic ceiling cap or a damper accessible through an air diffuser or grille.

(c) Supply ducts may not terminate in a Garage unless a backdraft damper is provided.

(2) AIR REGISTERS AND GRILLES.

(a) ***Supply air registers.*** All supply air outlets shall be provided with registers or devices which will provide a uniform distribution of air.

(b) ***Return air grilles***. Return air grilles shall not be located in bathrooms, Kitchens, Garages, utility spaces or a confined space in which a draft diverter or draft regulator is located. All other habitable spaces shall have permanent openings to a return air grille equal in area to the supply outlet serving those areas. At least one return air opening shall be provided for each floor.

SPS 323.10 Piping.

(1) PIPE SIZES AND ARRANGEMENT. All steam and hot water supply and return piping, air-line piping and auxiliary equipment shall be of appropriate sizes, elevations, and arrangements to accomplish the calculated results without Stress or other detriment.

Note: The sizes of pipe to be used for mains and risers may be selected from the ASHRAE Guide and Data Book, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers; or the manuals published by the Institute of Boiler and Radiator Manufacturers or the Mechanical Contractors Association of America.

(2) EXPANSION AND CONTRACTION. The piping for the heating system shall be equipped with anchors, expansion swings or joints, supports and similar devices to relieve Stress and Strain caused by temperature change of the pipe material.

(3) PIPE INSULATION. Unguarded steam, hot water supply and return piping shall be covered with insulating material where the pipes pass through occupied areas and the surface temperature exceeds 180° F.

(4) STEAM AND HOT WATER PIPES. No pipe carrying hot water or steam at a surface temperature exceeding 250° F shall be placed within one inch of any combustible material, pass through a combustible floor, ceiling, or partition unless the pipe is protected by a metal sleeve one inch larger in diameter than the pipe or with Approved pipe covering.

(5) BALANCING. Balancing cocks shall be provided in each circuit of a hot water distribution system.

Subchapter V — Chimneys and Vents

SPS 323.11 General requirements.

(1) TYPES OF CHIMNEYS AND VENTS. All heating appliances using solid, liquid or gas fuels shall be Vented to the outside by an all-fuel factory-built, masonry Chimney or other listed Venting system designed to remove the products of combustion.

(2) TERMINATION.

(a) *Chimneys*. All listed factory manufactured Chimneys depending on a principle of gravity for the removal of the products of combustion shall terminate at the location specified in the product listing. For masonry Chimneys or where termination location is not specified as a part of the listing, the Chimney shall extend at least 3 feet above the highest point where the Chimney passes through the roof of the building, and at least 2 feet higher than any ridge, peak, wall, or roof within 10 feet horizontally of the Chimney.

(b) *Vents.* Gas and oil appliance Vents shall terminate in locations specified in their listings.

(3) SIZING. Vents for new or replacement equipment shall be sized to adequately exhaust combustion products from the Dwelling.

Note: The Department recommends Vent sizing in accordance with NFPA 54, National Fuel Gas Code or its appendix.

SPS 323.12 Masonry Chimneys. Masonry Chimneys shall conform to the requirements of SPS 321.30.

SPS 323.13 Factory-built Chimneys or Vents. Factory-built Chimneys or Vents shall be of an Approved type.

Note: The Department recognizes as Approved, factory-built Chimneys or Vents designated as “residential type and building heating appliance," “building heating appliance," “B," “BW," and “L" types listed by Underwriters' Laboratories, Inc.

(1) RESIDENTIAL TYPE AND BUILDING HEATING APPLIANCE. An Approved “residential type and building heating appliance" Chimney may be used with liquid or gas-fired heating appliances where the flue gas temperature does not exceed 1000° F continuously and does not exceed 1400° F for infrequent brief periods of forced firing.

(2) TYPE “B". An Approved type “B" gas Vent may be used with a Vented, recessed wall heater.

(3) TYPE “BW". An Approved type “BW" gas Vent may be used with a Vented, recessed wall heater.

SPS 323.14 Gas Vents.

(1) GENERAL.

(a) All gas-fired equipment shall be provided with Vent pipes conforming with SPS 323.15 (2) (e), unless the manufacturer specifies other materials.

(b) Plastic pipes and fittings used in Venting flue gas shall bear the manufacturer's identification data.

(2) DRYER VENTING.

(a)

1. All Venting for clothes dryers, including for electric dryers, shall be rigid and smooth-walled. The connection to the dryer shall be made in accordance with the manufacturer's recommendations.

2. Gas-fired clothes dryers shall be provided with metal Venting.

Note: Section SPS 322.39 (6) requires all dryer Venting to terminate outside the structure.

(b) Where dryer Vent piping is concealed, a rigid metal Vent pipe conforming with SPS 323.15 (2) (e) shall be used.

(3) VENTING SYSTEM LOCATION.

(a) A Venting system shall terminate at least 3 feet above any forced air inlet located within 10 feet horizontally. This provision does not apply to the Combustion Air intake of a Direct-Vent Appliance.

(b) The Venting system of other than a Direct-Vent Appliance shall terminate at least 4 feet below, 4 feet horizontally from, or one foot above any door, Window, or gravity air inlet into any building. The bottom of the Vent shall be located at least 12 inches above grade.

(c) The Vent terminal of a Direct-Vent Appliance with an input of 10,000 Btu per hour or less shall be located at least 6 inches from any air opening into a building.

(d) The Vent terminal of a Direct-Vent Appliance with an input over 10,000 Btu per hour but not over 50,000 Btu per hour shall be located at least 9 inches from any air opening into a building.

(e) The Vent terminal of a Direct-Vent Appliance with an input over 50,000 Btu per hour shall be located at least 12 inches from any air opening into a building.

(f) The bottom of the Vent terminal and the air intake of a Direct-Vent Appliance shall be located at least 12 inches above grade.

(g) The exit terminal of a mechanical draft system shall be not less than 7 feet above grade where located within 3 feet of a public walkway that is intended for use by the general public.

SPS 323.15 Chimney Connectors, Smoke Pipes and Stovepipes.

(1) DEFINITION. Chimney Connectors, Smoke Pipes or Stovepipes are passages for conducting the products of combustion from a fuel-fired appliance to the Chimney.

(2) CONSTRUCTION AND INSTALLATION. The construction and installation of Chimney Connectors of solid-fuel-burning appliances shall comply with SPS 323.045 (4). The Chimney Connectors of all other fuel-fired appliances shall conform with the following requirements:

(a) ***Concealed space.*** No Chimney Connector shall pass through any outside Window, door, or combustible outside wall, nor be concealed in any closet, Attic, or similar space.

(b) ***Combustible partitions.*** Connectors for appliances shall not pass through walls or partitions constructed of combustible material unless they are guarded at the point of passage by:

1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector;

2. Metal or burned fireclay thimbles built in brickwork or other Approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

(c) ***Pitch and length.*** Chimney or Vent connectors shall have no more than two 45° offsets with the vertical. The horizontal length shall not exceed 75% of the total vertical height of the total Venting system measured from the appliance outlet. Chimney or Vent connectors shall be pitched at least 1/4-inch per foot from the appliance outlet collar Vent to the Chimney inlet.

(d) ***Dampers.***

1. Manually operated dampers are prohibited in Chimney or Vent connectors of all appliances except wood-burning appliances.

2. A listed, automatically operated damper may be used with any heating appliance provided it is installed and used in accordance with the appliance and damper listing.

(e) ***Materials and thickness.*** Chimney or Vent connectors serving liquid fuel or Gas Appliances shall conform to the type of material and thickness indicated in Table 323.15-A or 323.15-B.

(f) ***Clearance.*** Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table 323.15-C. These clearances may be reduced if the combustible material is protected in accordance with the requirements of Table 323.04-B.

TABLE 323.15-A
MINIMUM CHIMNEY CONNECTOR GAUGES FOR OIL-FIRED APPLIANCES - See PDF for table

TABLE 323.15-B
MINIMUM VENT CONNECTOR GAUGES FOR GAS - See PDF for table

TABLE 323.15-C
CHIMNEY CONNECTOR AND VENT CONNECTOR CLEARANCES FROM COMBUSTIBLE MATERIALS (See Note 4) - See PDF for table

1. These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

2. If listed type L Venting system piping is used, the clearance may be in accordance with the Venting system listing.

3. If listed type B or type L Venting system piping is used, the clearance may be in accordance with the Venting system listing.

4. The clearances from connectors to combustible materials may be reduced if the combustible material is protected in accordance with Table 323.04-B.

SPS 323.155 Multiple appliance Venting. Two or more listed gas-or liquid-fueled appliances may be connected to a common gravity-type flue provided the appliances are equipped with listed primary safety controls and listed shutoff devices and comply with the following requirements.

(1) The appliances shall be located in the same Story, except for engineered Venting systems.

(2) The appliances shall be joined at a manifold or Y-type fitting as close to the chimney as possible unless the connector from each appliance enters a separate Chimney inlet and the inlets are offset at least 12 inches vertically or the separate inlets occur at right angles to each other.

(3) The Chimney Connector and Chimney flue shall be sized to accommodate the total volume of flue gases. For gas-burning appliances the Venting area shall be at least equal to the size of the largest Vent connectors plus at least 50% of the area of the other Vent connectors.

SPS 323.156 Condensate drains. Provisions shall be made so that condensate from heating equipment drains into the sanitary drain system.

Subchapter VI — Fuel Supply Systems

SPS 323.16 Fuel storage.

(1) LP GAS STORAGE TANKS.

(a) All LP gas storage tanks shall be constructed, installed and maintained to conform with the applicable sections of WI Ch. SPS 340.

(b) LP gas tanks may not be located inside Dwellings.

(c) LP gas tanks shall have welded steel supports and be permanently installed on concrete pads or Foundations.

(2) OIL STORAGE TANKS.

(a) The total oil storage capacity inside any Dwelling Unit shall be limited to 550 gallons in one tank, or not more than 275 gallons in each of 2 tanks cross-connected to a single burner.

(b) Oil storage tanks on the inside of any Dwelling shall be located at the same level as the burner it serves.

Note: Except as provided in pars. (a) and (b), the installation of oil storage tanks is regulated under Ch. ATCP 93, Flammable, Combustible, and Hazardous Liquids.

(3) GAS PIPING SYSTEMS. Gas piping systems, extending from the point of delivery to the connection with each gas-fired appliance or device, shall be installed to conform with NFPA 54, National Fuel Gas Code.

(4) SHUTOFF AND CONTROL DEVICES.

(a) Any oil-fired appliance or device connected to a fuel piping system shall have an accessible, Approved manual shutoff valve installed upstream of any connector.

(b) Automatic gas-burning heating appliances shall be equipped with listed devices which will shut off the gas to the pilot light and main burner(s) in the event of pilot failure.

(c) Liquid fuel-burning appliances shall be equipped with primary safety controls which will shut off the flow of fuel to the burner(s) in the event of ignition failure.

Subchapter VII — Equipment Location and Operation

SPS 323.17 Equipment location.

(1) OUTDOOR EQUIPMENT. Outdoor equipment shall be located so as to not restrict the air flow or recirculation of air. Outdoor equipment so located as to be subject to damage shall be protected.

(2) INDOOR EQUIPMENT. All indoor equipment shall be installed with a minimum of 24 inches of clearance for service.

SPS 323.18 Operation.

(1) INSTRUCTIONS. Written instructions shall be provided to the Owner for the operation and maintenance of the system and equipment.

(2) FINAL TEST REQUIRED. The installer shall test and balance every heating, ventilating and air conditioning system.

TABLE 323.04–A
STANDARD INSTALLATION CLEARANCES (INCHES) FOR HEAT–PRODUCING APPLIANCES

Residential Type Appliances for Installation in Rooms Which are Large (See Note 2)		Appliance[1]				
		Above Top of Casing or Appliance	From Top and Sides of Warm–Air Bonnet or Plenum	From Front See Note 3	From Back	From Sides
Boilers and Water Heaters	Automatic Oil					
Steam Boilers – 15 psi	or	6	—	24	6	6
Water Boilers – 250° F	Comb. Gas–Oil					
Water Heaters – 200° F	Automatic Gas	6	—	18	6	6
All Water Walls or Jacketed	Electric	6	—	18	6	6
Furnaces – Central	Automatic Oil					
Gravity, Upflow, Downflow,	or	6[4]	6	24	6	6
Horizontal and Duct,	Comb. Gas–Oil					
Warm–Air – 250° F	Automatic Gas	6[4]	6	18	6	6
	Electric	6[4]	6	18	6	6
Furnaces – Floor	Automatic Oil					
For Mounting in Combustible Floors	or	36	—	12	12	12
	Comb. Gas–Oil					
	Automatic Gas	36	—	12	12	12
	Electric	36	—	12	12	12
Heat Exchanger						
Steam – 15 psi Max.						
Hot Water – 250° F Max.	—	1	1	1	1	1
Room Heaters						
Circulating Type	Oil	36	—	24	12	12
Vented or Unvented	Gas	36	—	24	12	12
Radiant or Other Type	Oil	36	—	36	36	36
Vented or Unvented	Gas	36	—	36	18	18
	Gas with dbl metal					
	or ceramic back	36	—	36	12	18
Radiators						
Steam or Hot Water	Gas	36	—	6	6	6
		See Note 5			Firing Side	Opp. Side
Ranges – Cooking Stoves	Oil	30	—	—	—	
Vented or Unvented	Gas	30	—	—	6	6
	Electric	30	—	—	6	6
Clothes Dryers	Gas	6	—	24	6	6
Listed Types	Electric	6	—	24	0	0
Incinerators		See Note 6				
Residential Types	—	36	—	48	36	36

[1] Standard clearances may be reduced by affording protection to combustible material in accordance with Table 323.04–B.

[2] Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room should be figured on the basis of a ceiling height of 8 feet.

[3] The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

[4] For a listed oil, combination gas–oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250° F or this dimension may be one inch if the limit control cannot be set higher than 200° F.

[5] To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at least 1/4–inch thick covered with sheet metal of not less than No. 28 gauge, the distance may be not less than 24 inches. Also, if the manufacturer of the range, cooktop, or cooking stove specifies a shorter clearance, that clearance may be used instead.

[6] Clearance above charging door should be not less than 48 inches.

TABLE 323.04–B
CLEARANCES, INCHES, WITH SPECIFIED FORMS OF PROTECTION*

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection. Thicknesses are minimum.	Where required clearance with no projection is:											
	36 inches			18 inches			12 inches			6 inches		
	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector
(a) 1/4–in. insulating millboard** spaced out 1"***	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on 1/4" insulating millboard**	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on 1/4" insulating millboard** spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1/4" insulated millboard** on 1" mineral wool batts reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(f) 22 gage sheet metal on 1" mineral wool batts reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(g) 1/4" insulated millboard**	36	36	36	18	18	18	12	12	9	4	4	4

*All clearances shall be measured from the outer surface of the equipment to the combustible material disregarding any intervening protection applied to the combustible material.

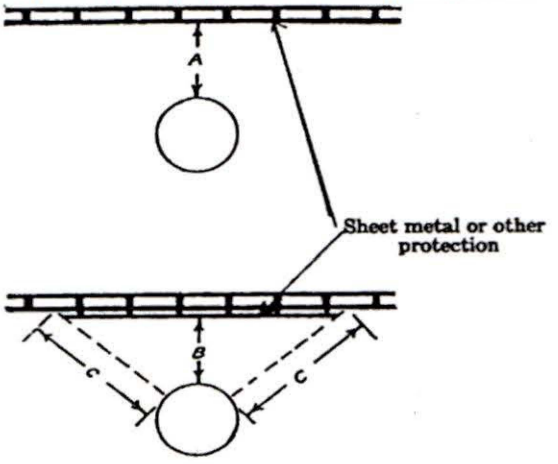
**A factory fabricated board formed with noncombustible materials, normally fibers, and having a thermal conductivity in the range of 1 Btu inch per square foot per °F. or less.

***Spacers shall be of noncombustible material.

TABLE 323.045–A
METAL THICKNESS FOR PIPE CONNECTORS

Diameter of Connector (inches)	Sheet Gage No.	Minimum Thickness (inches)
6 to 10	24	.023
over 10 to 16	22	.029
over 16	16	.056

FIGURE 323.045–A
CONSTRUCTION USING COMBUSTIBLE MATERIAL



"A" Equals the required clearance with no protection, specified in s. SPS 323.045 (4) (b).

"B" Equals the reduced clearance permitted in accordance with Table 323.045–B. The wall protection should extend far enough in each direction to make 'C' equal to 'A'.

TABLE 323.045–B
CONNECTOR CLEARANCES WITH SPECIFIED FORMS OF PROTECTION[1,2,3,4]

Type of Protection	Minimum Required Connector Clearances (inches)
0.013 in. (28 gage) sheet metal spaced out a minimum of one inch.	9
31/2 in. thick masonry wall spaced out a minimum of one inch and adequately tied to the wall being protected (see Note 4).	9
0.027 in. (22 gage) sheet metal on one–inch mineral wool batts reinforced with wire or equivalent spaced out a minimum of one inch.	3

[1] Spacers and ties shall be of noncombustible material.

[2] All methods of protection require adequate ventilation between protective material and adjacent combustible walls and ceilings.

3 Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1550° F.

4 If a single wall connector passes through the masonry wall there shall be at least 1/2 inch of open ventilated air space between the connector and the masonry.

TABLE 323.045–C
FLOOR MOUNTINGS FOR SOLID FUEL–BURNING APPLIANCES

Kind of Appliance	Allowed Mounting
(1) All forced air and gravity furnaces, steam and water boilers. or	Floors of fire–resistive construction with noncombustible flooring and surface finish, or fire–resistive arches or slabs. This construction may not have combustible material against the underside. Such construction shall extend at least 18 inches beyond the appliance on all sides.
(2) Residential–type ranges, water heaters, fireplace stoves,room heaters and combination fireplace stove/room heaters, having less than 2 inches of ventilated open space beneath the fire chamber or base of the appliance.	These appliances shall not be placed on combustible floors.
(3) Residential–type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters having legs or pedestals providing 2 to 6 inches of ventilated open space beneath the fire chamber or base of the appliance.	On combustible floors when such floors are protected by 4 inches of hollow masonry, laid to provide air circulation through the masonry layer. Such masonry shall be covered with 24 gage sheet metal. The required floor protection shall extend at least 18inches on all sides of the appliance. Noncombustible floors shall extend at least 18 inches on all sides of the appliance.

TABLE 323.045–D
STANDARD CLEARANCES FOR SOLID–FUEL–BURNING APPLIANCES

Type of Appliance	Above Top of Casing or Appliance. Above Top and Sides of Furnace Plenum or Bonnet (inches)	Minimum Standard Clearances (inches)		
	Above Top of Casing or Appliance. Above Top and Sides of Furnace Plenum or Bonnet (inches)	From Front	From Back	From Sides
Residential Appliances				
Steam Boilers – 15 psi Water Boilers – 250° F max. Water Boilers – 200° F max. All Water Walled or Jacketed	6	48	6	6
Furnaces				
Gravity and Forced Air	18	48	18	18
Room Heaters, Fireplace Stoves, Combinations	36	36	36	36
			Firing Side	Opp. Side
Ranges				
Lined Firechamber	30	36	24	18
Unlined Firechamber	30	36	36	18

TABLE 323.045–EMINIMUM ALLOWABLE APPLIANCE CLEARANCE WITH PROTECTION[1,2,3,4,5,6]

Type of Protection	Unprotected Clearances (inches) From Table 323.045–D								
	For Ceilings				For Walls				
	6	18	30	36	6	18	24	36	48
3 1/2 in. thick masonry wall without ventilated air space	–	–	–	–	4	12	16	24	32
1/2 in. thick noncombustible insulation board over 1 in. glass fiber or mineral wool batts without ventilated air space	4	12	20	24	3	9	12	18	24
0.024 in. (24 gage) sheet metal over 1 in. glass fiber or mineral wool batts reinforced with wire, or equivalent, or rear face with ventilated air space	3	9	15	18	2	6	8	12	16
3 1/2 in. thick masonry wall with ventilated air space	–	–	–	–	2	6	8	12	16
0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1/2 in. thick noncombustible insulation board with ventilated air space	3	9	15	18	2	6	8	12	16
0.024 in. (24 gage) sheet metal with ventilated air space over0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1 in. glass fiber or mineral wool batts sandwiched between two sheets 0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16

[1] Spacers and ties shall be of noncombustible material. No spacers or ties shall be used directly behind appliance or conductor.

[2] With all clearance reduction systems using a ventilated air space, at least two sides of the protection shall be open to provide adequate air circulation. There shall be at least one inch between the clearance reduction system and combustible walls and ceilings.

[3] Mineral wool bats, blanket or board shall have a minimum density of 8 lb. per cubic foot and have a minimum melting point of 1,500° F.

[4] Insulation material used as part of a clearance reduction system shall have a thermal conductivity (k) of One (Btu) (in)/(Sq. ft.) (Hr.) (°F) or less. Insulation board shall be formed of noncombustible material.

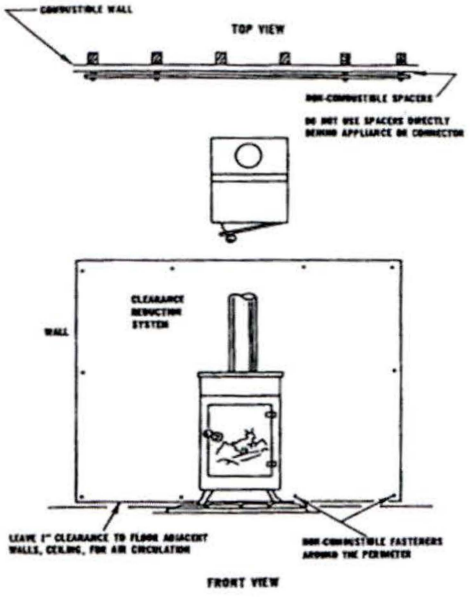
[5] If a single wall connector passes through a masonry wall used as a wall shield, there shall be at least 1/2 inch of open, ventilated space between the connector and the masonry.

[6] Clearances in front of the loading door or ash removal door of the appliance shall not be reduced.

FIGURE 323.045–B

PROTECTION OF COMBUSTIBLE WALLS

AND FLOORS



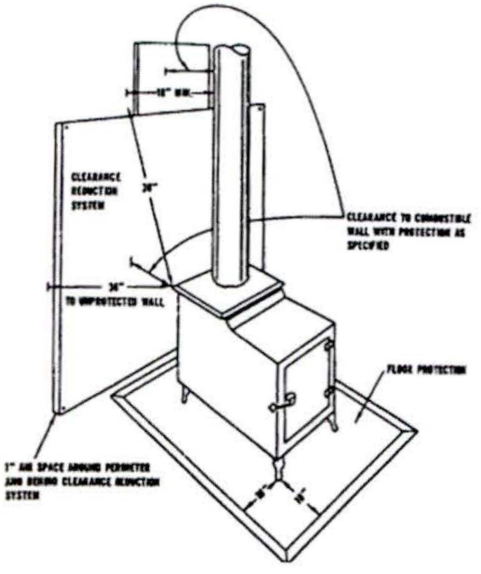


FIGURE 323.045–C

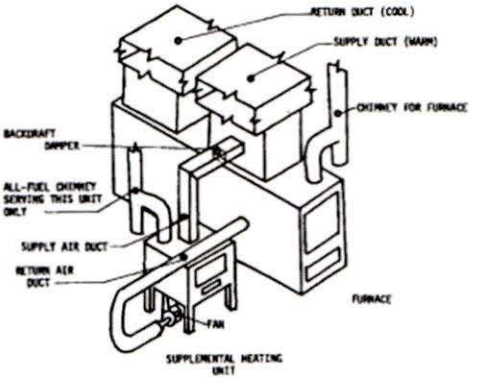
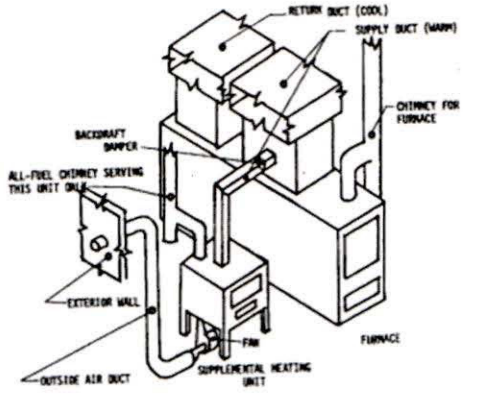


FIGURE 323.045–D



(9) SUPPLY DUCTS. Supply ducts connected to solid–fuel–burning appliances shall have the following minimum clearances to combustibles:

(a) *Horizontal ducts.* The clearance from combustibles for horizontal ducts shall be as specified in Table 323.045–F.

TABLE 323.045–F

Distance of Ducts From Bonnet or Plenum (inches)	Clearance to Combustibles[1] Required (inches)
0 to 36	18
over 36 to 72	6
over 72	1

[1] Clearance can be reduced in accordance with Table 323.045–B

(b) *Vertical ducts.* 1. Air shall travel 6 feet and change directions equivalent to one 90° turn before entering an enclosure of combustible material.

2. Ducts shall have 3/16 inch clearance between the duct and any combustible material.

FIGURE 323.045–E

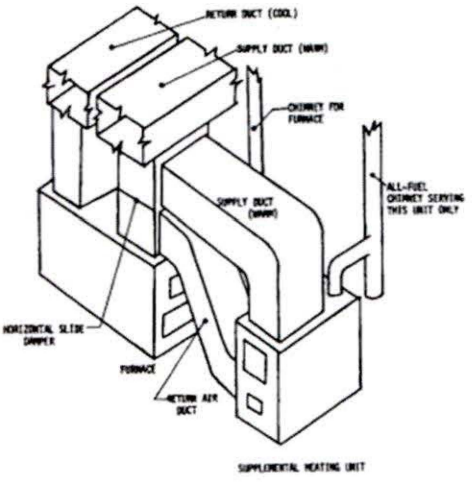


TABLE 323.08–A
DUCT CONSTRUCTION MINIMUM SHEET METAL GAUGES

	Minimum thickness galvanized sheet gauge	Minimum thickness aluminum B & S gauge
Metal gauges (duct not enclosed in partitions)		
Round ducts		
Diameter, inches		
Less than 12	30	26
12–14	28	26
15–18	26	24
Over 18	24	22
Rectangular Ducts		
Width, inches		
Less than 14	28	24
14–24	26	22
25–30	24	22
Over 30	22	20
Metal gauges (ducts enclosed in partition)		
Width, inches		
14 or less	30	26
Over 14	28	24

TABLE 323.08–B
DUCT SUPPORT FOR RIGID DUCTS —
16 GAGE MAXIMUM THICKNESS

Duct Type	Maximum Size	Duct Position	Hanger Type, Size and Spacing[1]
Circular	10″ diam.	Vertical	Strap — one 18 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — one 22 ga. galv. steel X 1″ @ 12′ o.c. Rod — one ¼″ @ 12′ o.c. Wire — one 12 ga. @ 12′ o.c.
	18″ diam.	Vertical	Strap — one 16 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — one 22 ga. galv. steel X 1″ @ 12′ o.c. Rod — one ¼″ @ 12′ o.c. Wire — one 8 ga. @ 12′ o.c.; or Wire — two 12 ga. @ 12′ o.c.
Rectangular	60″ perim.	Vertical	Strap — one 18 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — pair[2] 22 ga. galv. steel X 1″ @ 10′ o.c. Rods or Wires — pair[2] 10 ga. @ 10′ o.c.; or Rods or Wires — pair[2] 12 ga. @ 5′ o.c.
	144″ perim.	Vertical	Strap— one 16 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — pair[2] 18 ga. galv. steel X 1″ @ 10′ o.c.; or Strap — pair[2] 20 ga. galv. steel X 1″ @ 8′ o.c.; or Strap — pair[2] 22 ga. galv. steel X 1″ @ 5′ o.c. Rods or Wires — pair[2] ⅜″ @ 10′ o.c.; or Rods or Wires — pair[2] ¼″ @ 8′ o.c.

[1] These hangers are the minimum required to support the weight of the duct off of the joist, stud or similar structure. The band, wire or strap cradling the duct shall not cause any deformation of the duct.

[2] "Pair" means that there are 2 vertical legs. One continuous strap can form both vertical legs.

Note: This table does not prohibit nailing for duct support.

TABLE 323.07
DUCT VELOCITIES

Designation	Maximum Static Pressure Loss (in WG/100 ft)	Minimum Velocity (feet/minute)	Maximum Velocity (feet/minute)
Main trunk duct	.10	700–900	800–1200
Branch duct	.10	600	700–1000
Branch riser	.10	500	650–800
Outdoor intake	.10	500	800
Grilles or openings	.10	400	600
Return air door undercuts	.10	200	300
Return air door or wall louvers	.10	200	300

WG = Water gauge per 100 feet.

Chapter SPS 324
ELECTRICAL STANDARDS

SPS 324.01 Electrical standards.

SPS 324.01 Electrical standards.

(1) All electrical wiring, installations, equipment and materials used in the construction of dwellings shall comply with the requirements of the Wisconsin Administrative Electrical Code, Vol. 2., ch. SPS 316, except as provided in sub. (2).

(2) The requirements in NEC section 210.70 (A) (2) (b) do not apply to a stairway for a deck.

Note: A light over the stairs is not required, but a light outside the door is.

Chapter SPS 325
PLUMBING

SPS 325.01 Plumbing.
SPS 325.02 Sanitation facilities and devices.

SPS 325.01 Plumbing.

(1) GENERAL. The design, construction, and installation of plumbing shall comply with the requirements of Chs. SPS 382 to 385, except as provided in this section.

(2) TANKLESS WATER HEATERS.

(a) The minimum flow rate of a tankless type of water heater may be obtained by multiplying 0.65 by the calculated hot water gallons per minute demand, as determined by SPS 382 Tables 382.40–1b and 382.40–3, provided the heater will achieve a water temperature of 110° F at the terminal fitting or faucet.

(b) The sizing method in par. (a) may not be used for sizing a water heater serving a high-flow fixture, a hose bibb, a hydrant, or a fixture that is required to have a supply line with a diameter larger than one-half inch.

(c) For the purposes of this subsection, “high-flow fixture" means a fixture with a flow rate of more than 4 gallons per minute, at 80 pounds per square inch, and a water velocity not exceeding 8 feet per second.

(3) LOCAL WASTE PIPING. A trap may be omitted in local waste piping having a length of up to 20 feet.

(4) FLOOR DRAINS FOR GARAGES.

(a) A trap may be omitted for a Garage-floor drain that discharges to the ground surface.

(b) The sediment trap for a Garage-floor drain shall be removable.

(c) The grate for a Garage-floor drain may be nonmetallic if it has a thickness and strength that will withstand the anticipated loads.

Note: For notice of plumbing inspection refer to SPS 382.21 (1).

SPS 325.02 Sanitation facilities and devices. The design, construction, installation, and maintenance of sanitation facilities and devices such as Composting Toilets, Incinerating Toilets and Privies to serve one- and two-family Dwellings shall comply with the requirements of Ch. SPS 391.

Chapters SPS 320 to 325 Appendix A

UDC Appendix

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DO NOT REMOVE

OFFICIAL NOTICE

Location/Item: _____

☐ **Lacking** _____ **Permit(s)** ☐ **Need** _____ **Inspection**
☐ **Expired** _____ **Permit** ☐ **Premises Housekeeping**
☐ **Unfit for Use**
☐ **Erosion Control:** ☐ **Perimeter Measures** ☐ Install ☐ Maintain
☐ **Non-Tracking Driveway** ☐ Install ☐ Maintain
☐ **Sediment Cleanup** ☐ Street & Sidewalks ☐ Adjoining Property

Code Section/Other: _____

_____

Action:

☐ **Contact Inspector** ☐ Now ☐ After Corrections
☐ **Correct** ☐ Now ☐ By End Of Today (UDC Tracking Cleanup)
☐ By End Of Next Workday (UDC Sediment Cleanup)
☐ In 48 Hrs (UDC Erosion Controls) ☐ By _____
☐ **Stop All Work** ☐ Except Corrections Code Section: _____

Failure To Comply Subjects You To Applicable Fines & Penalties or Work Stoppages

_____ _____ _____
Inspector/Agency **Phone Number** **Date**

SBD-10266 (R.6/07)

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Petition for Variance
Information and Instructions SPS 320

In instances where exact compliance with a particular Code requirement cannot be met or alternative designs are desired, the division has a petition for variance process in which it reviews and considers acceptance of alternatives which are not in strict conformance with the letter of the Code, but which meet the intent of the Code. **A variance is not a waiver from a Code requirement.** The petitioner must **provide an equivalency which meets the intent** of the Code section petitioned to obtain a variance. Documentation of the rationale for the equivalency is required. Failure to provide adequate information may delay a decision on the petition. Pictures, sketches, and plans may be submitted to support equivalency. If the proposed equivalency does not adequately safeguard the health, safety, and welfare of building occupants, frequenters, firefighters, etc., the variance request will be denied. NOTE: A SEPARATE PETITION IS REQUIRED FOR EACH DWELLING AND EACH CODE ISSUE PETITIONED (i.e., window issue cannot be processed on the same petition as stair issue). It should be noted that **a petition for variance does not take the place of any required plan review submittal.**

The Department is unable to process petitions for variance that are not properly completed. Before submitting the application, the following items should be checked for completeness in order to avoid delays:

- Petitioner's name (typed or printed)
- Petitioner's signature
- The application must be signed by the Owner of the Dwelling.
- Notary Public signature with affixed seal
- Analysis to establish equivalency, including any pictures, illustrations or sketches of the existing and proposed conditions to clearly convey your proposal to the reviewer.

SANITARY PERMIT REQUIREMENTS

(c) *Construction affecting wastewater flow or contaminant load.* 1. The Department/municipality may not issue a building permit to commence construction of any addition or alteration to an existing structure when the proposed construction will modify the design wastewater flow or contaminant load, or both, to an existing POWTS, unless the Owner of the property:

a. Possesses a sanitary permit to either modify the existing POWTS or construct a POWTS to accommodate the modification in wastewater flow or contaminant load, or both; or

b. Provides documentation to verify that the existing POWTS is sufficient to accommodate the modification in wastewater flow or contaminant load, or both.

2. For the purpose of this paragraph, a modification in wastewater flow or contaminant load shall be considered to occur:

a. For Dwellings, when there is an increase or decrease in the number of bedrooms.

(d) *Documentation of existing capabilities.* Documentation to verify whether an existing POWTS can accommodate a modification in wastewater flow or contaminant load, or both, shall include at least one of the following:

1. A copy of the plan for the existing POWTS that delineates minimum and maximum performance capabilities and which has been previously approved by the Department.

2. Information on the performance capabilities for the existing POWTS that has been recognized through a product approval under ch. SPS 384.

3. A written investigative report prepared by an architect, engineer, designer of plumbing systems, designer of private sewage systems, master plumber, master plumber restricted service, or certified POWTS inspector analyzing the proposed modification and the performance capabilities of the existing POWTS.

(e) Where the performance capability of the existing POWTS serving a Dwelling is not based on the number of bedrooms within the Dwelling, information documenting that design condition shall be recorded by the Department.

(f) *Setbacks. See attached FCPC Variations from Wisconsin UDC Requirements.*

2. The applicant for a building permit shall provide documentation to the Department showing the location and setback distances for the proposed construction relative to all of the following:

a. Existing POWTS treatment components.

b. Existing POWTS holding components.

c. Existing POWTS dispersal components.

UDC Floor & Ceiling Joist and Roof Rafter Span Tables and Design Value Tables

Use the following Span Tables to determine the maximum spans for floor and ceiling joists and roof rafters. These spans are based on:

- Simple, single spans (although the tables may be safely used for continuous two–span floor joists)
- Uniformly distributed loads
- Fully supported members with one edge properly sheathed and nailed
- For floor joists and roof rafters, the top edge shall be properly sheathed and nailed
- Rafters with a minimum 3:12 slope

The criteria for each Span Table is given in the upper left hand corner and is also summarized in the table of Span Tables below. Choose the appropriate Span Table based on the member type and required loading. Select your desired member depth, member spacing and span to determine the minimum Fb value. Note that these tables include recommended deflection criteria. However, for strict code compliance, only the Fb strength requirements must be satisfied. The modulus of elasticity (E) values, would be met for serviceability purposes only.

Note that straight–line interpolation is permitted for intermediate spans and design values. Span is measured from face to face of supports plus one–half of the required bearing of 1.5″ on wood or metal and 3″ on masonry or concrete at each end. For sloping rafters, the span is measured along the horizontal projection.

Section SPS 321 allows reduction of the snow live load for roof slopes greater than 30 degrees (7/12 slope) based on the formula Cs = 1 – (a–30)/40, where "a" is the slope of the roof expressed in degrees. Following is a table of tabulated values for certain roof slopes.

Slope	Angle in Degrees	Zone 1 Live Load (psf)	Zone 2 Live Load (psf)
7/12	30	40	30
10/12	40	30	22.5
12/12	45	25	18.8
14/12	50	20	15

Use the Design Value tables following the Span Tables to determine the acceptable species and grades to satisfy minimum Fb values obtained from the Span Tables. The Design Value tables assume at least three members spaced no more than 24″ on center. Use the Normal Duration column Fb values for joists and the Snow Loading column Fb values for rafters.

See the following examples for further guidance.

Tables are reprinted courtesy of American Forest & Paper Association.

Table No.	Member Type	Live Load (psf)	Dead Load (psf)	Condition	(Deflection)*
F–2	Floor Joists	40	10	–	L/360
C–1	Ceiling Joists	10	5	Drywall ceiling, no attic storage	L/240
C–2	Ceiling Joists	20	10	Attic storage	L/240
R–2	Roof Rafters	30 (Zone 2)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/240
R–3	Roof Rafters	40 (Zone 1)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/240
R–10	Roof Rafters	30 (Zone 2)	20	Heavy roof covering (clay tile)	L/240
R–11	Roof Rafters	40 (Zone 1)	20	Heavy roof covering (clay tile)	L/240
R–14	Roof Rafters	30 (Zone 2)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/180
R–15	Roof Rafters	40 (Zone 1)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/180
R–22	Roof Rafters	30 (Zone 2)	20	Heavy roof covering (clay tile)	L/180
R–23	Roof Rafters	40 (Zone 1)	20	Heavy roof covering (clay tile)	L/180

*Deflection criteria are optional. For roof rafters with drywall on the underside, use the stricter L/240 tables to limit deflection.

Example 1. Floor Joists. Assume a required single span of 12′–9″, dead load of 10 psf and joists spaced 16″ on center. Table F–2 (see following highlighted tables) shows that one solution is a grade of 2x8 having an Fb value of 1255 would allow a span of 12′–10″ which satisfies the condition. (Note that the recommended E value to limit deflection would be 1,600,000.) Going to the Design Value Tables, we find that as an example, 2x8 Hem Fir grade No.1 has an Fb value of 1310 for normal duration. (It also has an E value of 1,500,000 which does not satisfy the recommended deflection criteria.)

Example 2. Rafters. Assume a horizontal projected span of 13′–0″, a live load of 40 psf, dead load of 10 psf, a roof slope of 4/12 and rafters spaced 16″ on center. Since the slope is shallower than 7/12, there is no allowable reduction of the snow live load. Table R–3 shows that a 2x8 having an Fb value of 1300 would allow a span of 13′–1″ which satisfies the condition. (Note that the recommended E value to limit deflection would be 1,120,000.) Going to the Design Value Tables, we find that as an example, 2x8 Douglas Fir–Larch grade No.2 has an Fb value of 1390 for snow loading. (It also has an E value of 1,600,000 which satisfies the recommended deflection criteria.)

Example 1

TABLE F- 2

FLOOR JOISTS WITH L/360 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection - For 40 psf live load.
Limited to span in inches divided by 360.
Strength - Live load of 40 psf plus dead load
of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	8- 6	8-10	9- 2	9- 6	9- 9	10- 0	10- 3	10- 6	10- 9	10-11	11- 2	11- 4	11- 7	11- 9	11-11	12- 1	12- 3
	16.0	7- 9	8- 0	8- 4	8- 7	8-10	9- 1	9- 4	9- 6	9- 9	9-11	10- 2	10- 4	10- 6	10- 8	10-10	11- 0	11- 2
2x 6	19.2	7- 3	7- 7	7-10	8- 1	8- 4	8- 7	8- 9	9- 0	9- 2	9- 4	9- 6	9- 8	9-10	10- 0	10- 2	10- 4	10- 6
	24.0	6- 9	7- 0	7- 3	7- 6	7- 9	7-11	8- 2	8- 4	8- 6	8- 8	8-10	9- 0	9- 2	9- 4	9- 6	9- 7	9- 9
	12.0	11- 3	11- 8	12- 1	12- 6	12-10	13- 2	13- 6	13-10	14- 2	14- 5	14- 8	15- 0	15- 3	15- 6	15- 9	15-11	16- 2
	16.0	10- 2	10- 7	11- 0	11- 4	11- 8	12- 0	12- 3	12- 7	12-10	13- 1	13- 4	13- 7	13-10	14- 1	14- 3	14- 6	14- 8
2x 8	19.2	9- 7	10- 0	10- 4	10- 8	11- 0	11- 3	11- 7	11-10	12- 1	12- 4	12- 7	12-10	13- 0	13- 3	13- 5	13- 8	13-10
	24.0	8-11	9- 3	9- 7	9-11	10- 2	10- 6	10- 9	11- 0	11- 3	11- 5	11- 8	11-11	12- 1	12- 3	12- 6	12- 8	12-10
	12.0	14- 4	14-11	15- 5	15-11	16- 5	16-10	17- 3	17- 8	18- 0	18- 5	18- 9	19- 1	19- 5	19- 9	20- 1	20- 4	20- 8
	16.0	13- 0	13- 6	14- 0	14- 6	14-11	15- 3	15- 8	16- 0	16- 5	16- 9	17- 0	17- 4	17- 8	17-11	18- 3	18- 6	18- 9
2x10	19.2	12- 3	12- 9	13- 2	13- 7	14- 0	14- 5	14- 9	15- 1	15- 5	15- 9	16- 0	16- 4	16- 7	16-11	17- 2	17- 5	17- 8
	24.0	11- 4	11-10	12- 3	12- 8	13- 0	13- 4	13- 8	14- 0	14- 4	14- 7	14-11	15- 2	15- 5	15- 8	15-11	16- 2	16- 5
	12.0	17- 5	18- 1	18- 9	19- 4	19-11	20- 6	21- 0	21- 6	21-11	22- 5	22-10	23- 3	23- 7	24- 0	24- 5	24- 9	25- 1
	16.0	15-10	16- 5	17- 0	17- 7	18- 1	18- 7	19- 1	19- 6	19-11	20- 4	20- 9	21- 1	21- 6	21-10	22- 2	22- 6	22-10
2x12	19.2	14-11	15- 6	16- 0	16- 7	17- 0	17- 6	17-11	18- 4	18- 9	19- 2	19- 6	19-10	20- 2	20- 6	20-10	21- 2	21- 6
	24.0	13-10	14- 4	14-11	15- 4	15-10	16- 3	16- 8	17- 0	17- 5	17- 9	18- 1	18- 5	18- 9	19- 1	19- 4	19- 8	19-11
F_b	12.0	718	777	833	888	941	993	1043	1092	1140	1187	1233	1278	1323	1367	1410	1452	1494
F_b	16.0	790	855	917	977	1036	1093	1148	1202	1255	1306	1357	1407	1456	1504	1551	1598	1644
F_b	19.2	840	909	975	1039	1101	1161	1220	1277	1333	1388	1442	1495	1547	1598	1649	1698	1747
F_b	24.0	905	979	1050	1119	1186	1251	1314	1376	1436	1496	1554	1611	1667	1722	1776	1829	1882

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

Example 1

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern White Pine					
Select Structural	2x4	2155	2480	1,200,000	NELMA NSLB
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	
Select Structural	2x8	1725	1985	1,200,000	
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Hem Fir					
Select Structural	2x4	2415	2775	1,600,000	WCLIB WWPA
No.1 & Btr		1810	2085	1,500,000	
No.1		1640	1885	1,500,000	
No.2		1465	1685	1,300,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	2095	2405	1,600,000	
No.1 & Btr		1570	1805	1,500,000	
No.1		1420	1635	1,500,000	
No.2		1270	1460	1,300,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1930	2220	1,600,000	
No.1 & Btr		1450	1665	1,500,000	
No.1		1310	1510	1,500,000	
No.2		1175	1350	1,300,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1770	2035	1,600,000	
No.1 & Btr		1330	1525	1,500,000	
No.1		1200	1380	1,500,000	
No.2		1075	1235	1,300,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1 & Btr		1210	1390	1,500,000	
No.1		1095	1255	1,500,000	
No.2		980	1125	1,300,000	
No.3		575	660	1,200,000	

Example 2

TABLE R-3
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength - Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection - For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																				
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
2x 6	12.0	5-6	6-4	7-1	7-9	8-5	9-0	9-6	10-0	10-6	11-0	11-5	11-11	12-4	12-8	13-1	13-6	13-10	14-2				
	16.0	4-9	5-6	6-2	6-9	7-3	7-9	8-3	8-8	9-1	9-6	9-11	10-3	10-8	11-0	11-4	11-8	12-0	12-4	12-7	12-11		
	19.2	4-4	5-0	5-7	6-2	6-8	7-1	7-6	7-11	8-4	8-8	9-1	9-5	9-9	10-0	10-4	10-8	10-11	11-3	11-6	11-9	12-0	12-4
	24.0	3-11	4-6	5-0	5-6	5-11	6-4	6-9	7-1	7-5	7-9	8-1	8-5	8-8	9-0	9-3	9-6	9-9	10-0	10-3	10-6	10-9	11-0
2x 8	12.0	7-3	8-4	9-4	10-3	11-1	11-10	12-7	13-3	13-11	14-6	15-1	15-8	16-3	16-9	17-3	17-9	18-3	18-9				
	16.0	6-3	7-3	8-1	8-11	9-7	10-3	10-10	11-6	12-0	12-7	13-1	13-7	14-0	14-6	14-11	15-5	15-10	16-3	16-7	17-0		
	19.2	5-9	6-7	7-5	8-1	8-9	9-4	9-11	10-6	11-0	11-6	11-11	12-5	12-10	13-3	13-8	14-0	14-5	14-10	15-2	15-6	15-10	16-3
	24.0	5-2	5-11	6-7	7-3	7-10	8-4	8-11	9-4	9-10	10-3	10-8	11-1	11-6	11-10	12-2	12-7	12-11	13-3	13-7	13-11	14-2	14-6
2x10	12.0	9-3	10-8	11-11	13-1	14-2	15-1	16-0	16-11	17-9	18-6	19-3	20-0	20-8	21-4	22-0	22-8	23-3	23-11				
	16.0	8-0	9-3	10-4	11-4	12-3	13-1	13-10	14-8	15-4	16-0	16-8	17-4	17-11	18-6	19-1	19-7	20-2	20-8	21-2	21-8		
	19.2	7-4	8-5	9-5	10-4	11-2	11-11	12-8	13-4	14-0	14-8	15-3	15-10	16-4	16-11	17-5	17-11	18-5	18-11	19-4	19-10	20-3	20-8
	24.0	6-6	7-7	8-5	9-3	10-0	10-8	11-4	11-11	12-6	13-1	13-7	14-2	14-8	15-1	15-7	16-0	16-6	16-11	17-4	17-9	18-1	18-6
2x12	12.0	11-3	13-0	14-6	15-11	17-2	18-4	19-6	20-6	21-7	22-6	23-5	24-4	25-2	26-0								
	16.0	9-9	11-3	12-7	13-9	14-11	15-11	16-10	17-9	18-8	19-6	20-3	21-1	21-9	22-6	23-2	23-10	24-6	25-2	25-9			
	19.2	8-11	10-3	11-6	12-7	13-7	14-6	15-5	16-3	17-0	17-9	18-6	19-3	19-11	20-6	21-2	21-9	22-5	23-0	23-6	24-1	24-8	25-2
	24.0	7-11	9-2	10-3	11-3	12-2	13-0	13-9	14-6	15-3	15-11	16-7	17-2	17-9	18-4	18-11	19-6	20-0	20-6	21-1	21-7	22-0	22-6
E	12.0	0.14	0.22	0.31	0.41	0.51	0.63	0.75	0.88	1.01	1.15	1.30	1.45	1.61	1.77	1.94	2.12	2.30	2.48				
E	16.0	0.12	0.19	0.27	0.35	0.44	0.54	0.65	0.76	0.88	1.00	1.12	1.26	1.39	1.54	1.68	1.83	1.99	2.15	2.31	2.48		
E	19.2	0.11	0.18	0.24	0.32	0.41	0.50	0.59	0.69	0.80	0.91	1.03	1.15	1.27	1.40	1.54	1.67	1.81	1.96	2.11	2.26	2.42	2.58
E	24.0	0.10	0.16	0.22	0.29	0.36	0.44	0.53	0.62	0.71	0.81	0.92	1.03	1.14	1.25	1.37	1.50	1.62	1.75	1.89	2.02	2.16	2.30

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

Example 2

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Cottonwood					
Select Structural	2x4	1510	1735	1,200,000	NSLB
No.1		1080	1240	1,200,000	
No.2		1080	1240	1,100,000	
No.3		605	695	1,000,000	
Stud		600	690	1,000,000	
Construction		805	925	1,000,000	
Standard		460	530	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		935	1075	1,200,000	
No.2		935	1075	1,100,000	
No.3		525	600	1,000,000	
Stud		545	630	1,000,000	
Select Structural	2x8	1210	1390	1,200,000	
No.1		865	990	1,200,000	
No.2		865	990	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1105	1275	1,200,000	
No.1		790	910	1,200,000	
No.2		790	910	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		720	825	1,200,000	
No.2		720	825	1,100,000	
No.3		405	465	1,000,000	
Douglas Fir-Larch					
Select Structural	2x4	2500	2875	1,900,000	WCLIB WWPA
No.1 & Btr		1985	2280	1,800,000	
No.1		1725	1985	1,700,000	
No.2		1510	1735	1,600,000	
No.3		865	990	1,400,000	
Stud		855	980	1,400,000	
Construction		1150	1325	1,500,000	
Standard		635	725	1,400,000	
Utility		315	365	1,300,000	
Select Structural	2x6	2170	2495	1,900,000	
No.1 & Btr		1720	1975	1,800,000	
No.1		1495	1720	1,700,000	
No.2		1310	1505	1,600,000	
No.3		750	860	1,400,000	
Stud		775	895	1,400,000	
Select Structural	2x8	2000	2300	1,900,000	
No.1 & Str		1585	1825	1,800,000	
No.1		1380	1585	1,700,000	
No.2		1210	1390	1,600,000	
No.3		690	795	1,400,000	
Select Structural	2x10	1835	2110	1,900,000	
No.1 & Btr		1455	1675	1,800,000	
No.1		1265	1455	1,700,000	
No.2		1105	1275	1,600,000	
No.3		635	725	1,400,000	
Select Structural	2x12	1670	1920	1,900,000	
No.1 & Btr		1325	1520	1,800,000	
No.1		1150	1325	1,700,000	
No.2		1005	1155	1,600,000	
No.3		575	660	1,400,000	

TABLE F–2
FLOOR JOISTS WITH L/360 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 40 psf live load.
Limited to span in inches divided by 360.
Strength – Live load of 40 psf plus dead load
of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	8–6	8–10	9–2	9–6	9–9	10–0	10–3	10–6	10–9	10–11	11–2	11–4	11–7	11–9	11–11	12–1	12–3
	16.0	7–9	8–0	8–4	8–7	8–10	9–1	9–4	9–6	9–9	9–11	10–2	10–4	10–6	10–8	10–10	11–0	11–2
2x 6	19.2	7–3	7–7	7–10	8–1	8–4	8–7	8–9	9–0	9–2	9–4	9–6	9–8	9–10	10–0	10–2	10–4	10–6
	24.0	6–9	7–0	7–3	7–6	7–9	7–11	8–2	8–4	8–6	8–8	8–10	9–0	9–2	9–4	9–6	9–7	9–9
	12.0	11–3	11–8	12–1	12–6	12–10	13–2	13–6	13–10	14–2	14–5	14–8	15–0	15–3	15–6	15–9	15–11	16–2
	16.0	10–2	10–7	11–0	11–4	11–8	12–0	12–3	12–7	12–10	13–1	13–4	13–7	13–10	14–1	14–3	14–6	14–8
2x 8	19.2	9–7	10–0	10–4	10–8	11–0	11–3	11–7	11–10	12–1	12–4	12–7	12–10	13–0	13–3	13–5	13–8	13–10
	24.0	8–11	9–3	9–7	9–11	10–2	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–3	12–6	12–8	12–10
	12.0	14–4	14–11	15–5	15–11	16–5	16–10	17–3	17–8	18–0	18–5	18–9	19–1	19–5	19–9	20–1	20–4	20–8
	16.0	13–0	13–6	14–0	14–6	14–11	15–3	15–8	16–0	16–5	16–9	17–0	17–4	17–8	17–11	18–3	18–6	18–9
2x10	19.2	12–3	12–9	13–2	13–7	14–0	14–5	14–9	15–1	15–5	15–9	16–0	16–4	16–7	16–11	17–2	17–5	17–8
	24.0	11–4	11–10	12–3	12–8	13–0	13–4	13–8	14–0	14–4	14–7	14–11	15–2	15–5	15–8	15–11	16–2	16–5
	12.0	17–5	18–1	18–9	19–4	19–11	20–6	21–0	21–6	21–11	22–5	22–10	23–3	23–7	24–0	24–5	24–9	25–1
	16.0	15–10	16–5	17–0	17–7	18–1	18–7	19–1	19–6	19–11	20–4	20–9	21–1	21–6	21–10	22–2	22–6	22–10
2x12	19.2	14–11	15–6	16–0	16–7	17–0	17–6	17–11	18–4	18–9	19–2	19–6	19–10	20–2	20–6	20–10	21–2	21–6
	24.0	13–10	14–4	14–11	15–4	15–10	16–3	16–8	17–0	17–5	17–9	18–1	18–5	18–9	19–1	19–4	19–8	19–11
F_b	12.0	718	777	833	888	941	993	1043	1092	1140	1187	1233	1278	1323	1367	1410	1452	1494
F_b	16.0	790	855	917	977	1036	1093	1148	1202	1255	1306	1357	1407	1456	1504	1551	1598	1644
F_b	19.2	840	909	975	1039	1101	1161	1220	1277	1333	1388	1442	1495	1547	1598	1649	1698	1747
F_b	24.0	905	979	1050	1119	1186	1251	1314	1376	1436	1496	1554	1611	1667	1722	1776	1829	1882

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE C–1
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 10 psf live load.
Limited to span in inches divided by 240.
Strength – Live Load of 10 psf plus
dead load of 5 psf determines the required fiber stress value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	9–10	10–3	10–7	10–11	11–3	11–7	11–10	12–2	12–5	12–8	12–11	13–2	13–4	13–7	13–9	14–0	14–2
	16.0	8–11	9–4	9–8	9–11	10–3	10–6	10–9	11–0	11–3	11–6	11–9	11–11	12–2	12–4	12–6	12–9	12–11
2x 4	19.2	8–5	8–9	9–1	9–4	9–8	9–11	10–2	10–4	10–7	10–10	11–0	11–3	11–5	11–7	11–9	12–0	12–2
	24.0	7–10	8–1	8–5	8–8	8–11	9–2	9–5	9–8	9–10	10–0	10–3	10–5	10–7	10–9	10–11	11–1	11–3
	12.0	15–6	16–1	16–8	17–2	17–8	18–2	18–8	19–1	19–6	19–11	20–3	20–8	21–0	21–4	21–8	22–0	22–4
	16.0	14–1	14–7	15–2	15–7	16–1	16–6	16–11	17–4	17–8	18–1	18–5	18–9	19–1	19–5	19–8	20–0	20–3
2x 6	19.2	13–3	13–9	14–3	14–8	15–2	15–7	15–11	16–4	16–8	17–0	17–4	17–8	17–11	18–3	18–6	18–10	19–1
	24.0	12–3	12–9	13–3	13–8	14–1	14–5	14–9	15–2	15–6	15–9	16–1	16–4	16–8	16–11	17–2	17–5	17–8
	12.0	20–5	21–2	21–11	22–8	23–4	24–0	24–7	25–2	25–8								
	16.0	18–6	19–3	19–11	20–7	21–2	21–9	22–4	22–10	23–4	23–10	24–3	24–8	25–2	25–7	25–11		
2x 8	19.2	17–5	18–1	18–9	19–5	19–11	20–6	21–0	21–6	21–11	22–5	22–10	23–3	23–8	24–0	24–5	24–9	25–2
	24.0	16–2	16–10	17–5	18–0	18–6	19–0	19–6	19–11	20–5	20–10	21–2	21–7	21–11	22–4	22–8	23–0	23–4
	12.0	26–0																
	16.0	23–8	24–7	25–5														
2x10	19.2	22–3	23–1	23–11	24–9	25–5												
	24.0	20–8	21–6	22–3	22–11	23–8	24–3	24–10	25–5	26–0								
F_b	12.0	711	769	825	880	932	983	1033	1082	1129	1176	1221	1266	1310	1354	1396	1438	1480
F_b	16.0	783	847	909	968	1026	1082	1137	1191	1243	1294	1344	1394	1442	1490	1537	1583	1629
F_b	19.2	832	900	965	1029	1090	1150	1208	1265	1321	1375	1429	1481	1533	1583	1633	1682	1731
F_b	24.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE C–2
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 20 psf live load.
Limited to span in inches divided by 240.
Strength – Live Load of 20 psf plus
dead load of 10 psf determines the required bending design value.

Size (in)	Spacing (in)	Joist Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	7–10	8–1	8–5	8–8	8–11	9–2	9–5	9–8	9–10	10–0	10–3	10–5	10–7	10–9	10–11	11–1	11–3
	16.0	7–1	7–5	7–8	7–11	8–1	8–4	8–7	8–9	8–11	9–1	9–4	9–6	9–8	9–9	9–11	10–1	10–3
2x 4	19.2	6–8	6–11	7–2	7–5	7–8	7–10	8–1	8–3	8–5	8–7	8–9	8–11	9–1	9–3	9–4	9–6	9–8
	24.0	6–2	6–5	6–8	6–11	7–1	7–3	7–6	7–8	7–10	8–0	8–1	8–3	8–5	8–7	8–8	8–10	8–11
	12.0	12–3	12–9	13–3	13–8	14–1	14–5	14–9	15–2	15–6	15–9	16–1	16–4	16–8	16–11	17–2	17–5	17–8
	16.0	11–2	11–7	12–0	12–5	12–9	13–1	13–5	13–9	14–1	14–4	14–7	14–11	15–2	15–5	15–7	15–10	16–1
2x 6	19.2	10–6	10–11	11–4	11–8	12–0	12–4	12–8	12–11	13–3	13–6	13–9	14–0	14–3	14–6	14–8	14–11	15–2
	24.0	9–9	10–2	10–6	10–10	11–2	11–5	11–9	12–0	12–3	12–6	12–9	13–0	13–3	13–5	13–8	13–10	14–1
	12.0	16–2	16–10	17–5	18–0	18–6	19–0	19–6	19–11	20–5	20–10	21–2	21–7	21–11	22–4	22–8	23–0	23–4
	16.0	14–8	15–3	15–10	16–4	16–10	17–3	17–9	18–1	18–6	18–11	19–3	19–7	19–11	20–3	20–7	20–11	21–2
2x 8	19.2	13–10	14–5	14–11	15–5	15–10	16–3	16–8	17–1	17–5	17–9	18–1	18–5	18–9	19–1	19–5	19–8	19–11
	24.0	12–10	13–4	13–10	14–3	14–8	15–1	15–6	15–10	16–2	16–6	16–10	17–2	17–5	17–9	18–0	18–3	18–6
	12.0	20–8	21–6	22–3	22–11	23–8	24–3	24–10	25–5	26–0								
	16.0	18–9	19–6	20–2	20–10	21–6	22–1	22–7	23–1	23–8	24–1	24–7	25–0	25–5	25–10			
2x10	19.2	17–8	18–4	19–0	19–7	20–2	20–9	21–3	21–9	22–3	22–8	23–1	23–7	23–11	24–4	24–9	25–1	25–5
	24.0	16–5	17–0	17–8	18–3	18–9	19–3	19–9	20–2	20–8	21–1	21–6	21–10	22–3	22–7	22–11	23–4	23–8
F_b	12.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864
F_b	16.0	986	1067	1145	1220	1293	1364	1433	1500	1566	1631	1694	1756	1817	1877	1936	1995	2052
F_b	19.2	1048	1134	1216	1296	1374	1449	1522	1594	1664	1733	1800	1866	1931	1995	2058	2120	2181
F_b	24.0	1129	1221	1310	1396	1480	1561	1640	1717	1793	1866	1939	2010	2080	2149	2217	2283	2349

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–2
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																					
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
	12.0	6–2	7–1	7–11	8–8	9–5	10–0	10–8	11–3	11–9	12–4	12–10	13–3	13–9	14–2	14–8	15–1	15–6	15–11				
	16.0	5–4	6–2	6–10	7–6	8–2	8–8	9–3	9–9	10–2	10–8	11–1	11–6	11–11	12–4	12–8	13–1	13–5	13–9	14–1	14–5		
2x 6	19.2	4–10	5–7	6–3	6–10	7–5	7–11	8–5	8–11	9–4	9–9	10–1	10–6	10–10	11–3	11–7	11–11	12–3	12–7	12–10	13–2	13–6	
	24.0	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4
	12.0	8–1	9–4	10–6	11–6	12–5	13–3	14–0	14–10	15–6	16–3	16–10	17–6	18–1	18–9	19–4	19–10	20–5	20–11				
	16.0	7–0	8–1	9–1	9–11	10–9	11–6	12–2	12–10	13–5	14–0	14–7	15–2	15–8	16–3	16–9	17–2	17–8	18–1	18–7	19–0		
2x 8	19.2	6–5	7–5	8–3	9–1	9–9	10–6	11–1	11–8	12–3	12–10	13–4	13–10	14–4	14–10	15–3	15–8	16–2	16–7	16–11	17–4	17–9	
	24.0	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3
	12.0	10–4	11–11	13–4	14–8	15–10	16–11	17–11	18–11	19–10	20–8	21–6	22–4	23–1	23–11	24–7	25–4	26–0					
	16.0	8–11	10–4	11–7	12–8	13–8	14–8	15–6	16–4	17–2	17–11	18–8	19–4	20–0	20–8	21–4	21–11	22–6	23–1	23–8	24–3		
2x10	19.2	8–2	9–5	10–7	11–7	12–6	13–4	14–2	14–11	15–8	16–4	17–0	17–8	18–3	18–11	19–6	20–0	20–7	21–1	21–8	22–2	22–8	
	24.0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8
	12.0	12–7	14–6	16–3	17–9	19–3	20–6	21–9	23–0	24–1	25–2												
	16.0	10–11	12–7	14–1	15–5	16–8	17–9	18–10	19–11	20–10	21–9	22–8	23–6	24–4	25–2	25–11							
2x12	19.2	9–11	11–6	12–10	14–1	15–2	16–3	17–3	18–2	19–0	19–11	20–8	21–6	22–3	23–0	23–8	24–4	25–0	25–8				
	24.0	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2
E	12.0	0.15	0.23	0.32	0.43	0.54	0.66	0.78	0.92	1.06	1.21	1.36	1.52	1.69	1.86	2.04	2.22	2.41	2.60				
E	16.0	0.13	0.20	0.28	0.37	0.47	0.57	0.68	0.80	0.92	1.05	1.18	1.32	1.46	1.61	1.76	1.92	2.08	2.25	2.42	2.60		
E	19.2	0.12	0.18	0.26	0.34	0.43	0.52	0.62	0.73	0.84	0.95	1.08	1.20	1.33	1.47	1.61	1.75	1.90	2.05	2.21	2.37	2.53	
E	24.0	0.11	0.16	0.23	0.30	0.38	0.46	0.55	0.65	0.75	0.85	0.96	1.08	1.19	1.31	1.44	1.57	1.70	1.84	1.98	2.12	2.27	2.41

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–3
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																				
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
	12.0	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2				
	16.0	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11		
2x 6	19.2	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4
	24.0	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0
	12.0	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9				
	16.0	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0		
2x 8	19.2	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3
	24.0	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6
	12.0	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11				
	16.0	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8		
2x10	19.2	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8
	24.0	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6
	12.0	11–3	13–0	14–6	15–11	17–2	18–4	19–6	20–6	21–7	22–6	23–5	24–4	25–2	26–0								
	16.0	9–9	11–3	12–7	13–9	14–11	15–11	16–10	17–9	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9			
2x12	19.2	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2
	24.0	7–11	9–2	10–3	11–3	12–2	13–0	13–9	14–6	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6
E	12.0	0.14	0.22	0.31	0.41	0.51	0.63	0.75	0.88	1.01	1.15	1.30	1.45	1.61	1.77	1.94	2.12	2.30	2.48				
E	16.0	0.12	0.19	0.27	0.35	0.44	0.54	0.65	0.76	0.88	1.00	1.12	1.26	1.39	1.54	1.68	1.83	1.99	2.15	2.31	2.48		
E	19.2	0.11	0.18	0.24	0.32	0.41	0.50	0.59	0.69	0.80	0.91	1.03	1.15	1.27	1.40	1.54	1.67	1.81	1.96	2.11	2.26	2.42	2.58
E	24.0	0.10	0.16	0.22	0.29	0.36	0.44	0.53	0.62	0.71	0.81	0.92	1.03	1.14	1.25	1.37	1.50	1.62	1.75	1.89	2.02	2.16	2.30

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–10
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA
Strength – Live Load of 30 psf plus
Dead Load of 20 psf determines the required bending design value
Deflection – For 30 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																								
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
	12.0	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11		
	16.0	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3
2x 6	19.2	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1
	24.0	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8
	12.0	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11		
	16.0	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10
2x 8	19.2	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2
	24.0	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5
	12.0	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7				
	16.0	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0
2x10	19.2	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11
	24.0	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7
	12.0	11–3	13–0	14–6	15–11	17–2	18–4	19–6	20–6	21–7	22–6	23–5	24–4	25–2	26–0												
	16.0	9–9	11–3	12–7	13–9	14–11	15–11	16–10	17–9	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9							
2x12	19.2	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2	25–8		
	24.0	7–11	9–2	10–3	11–3	12–2	13–0	13–9	14–6	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6	23–0	23–5	23–10
E	12.0	0.11	0.17	0.23	0.31	0.38	0.47	0.56	0.66	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60		
E	16.0	0.09	0.14	0.20	0.26	0.33	0.41	0.49	0.57	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53
E	19.2	0.09	0.13	0.18	0.24	0.30	0.37	0.44	0.52	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31
E	24.0	0.08	0.12	0.16	0.22	0.27	0.33	0.40	0.46	0.54	0.61	0.69	0.77	0.85	0.94	1.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–11
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																							
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
2x6	12.0	5–0	5–10	6–6	7–1	7–8	8–2	8–8	9–2	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11		
	16.0	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3
	19.2	4–0	4–7	5–1	5–7	6–1	6–6	6–10	7–3	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1
	24.0	3–7	4–1	4–7	5–0	5–5	5–10	6–2	6–6	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8
2x8	12.0	6–7	7–8	8–7	9–4	10–1	10–10	11–6	12–1	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11		
	16.0	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10
	19.2	5–3	6–0	6–9	7–5	8–0	8–7	9–1	9–7	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2
	24.0	4–8	5–5	6–0	6–7	7–2	7–9	8–1	8–7	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5
2x10	12.0	8–5	9–9	10–11	11–11	12–11	13–9	14–8	15–5	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7				
	16.0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0
	19.2	6–8	7–8	8–7	9–5	10–2	10–11	11–7	12–2	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11
	24.0	6–0	6–11	7–8	8–5	9–1	9–9	10–4	10–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7
2x12	12.0	10–3	11–10	13–3	14–6	15–8	16–9	17–9	18–9	21–7	22–6	23–5	24–4	25–2	26–0												
	16.0	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9						
	19.2	8–1	9–4	10–6	11–6	12–5	13–3	14–1	14–10	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	25–2	25–8			
	24.0	7–3	8–5	9–4	10–3	11–1	11–10	12–7	13–3	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6	23–0	23–5	23–10
E	12.0	0.11	0.17	0.24	0.31	0.39	0.48	0.57	0.67	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60		
E	16.0	0.09	0.15	0.20	0.27	0.34	0.41	0.49	0.58	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53
E	19.2	0.09	0.13	0.19	0.24	0.31	0.38	0.45	0.53	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31
E	24.0	0.08	0.12	0.17	0.22	0.28	0.34	0.40	0.47	0.54	0.61	0.69	0.77	0.85	0.94	2.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–14
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	3–2	3–11	4–6	5–1	5–6	6–0	6–5	6–9	7–2	7–6	7–10	8–2	8–5	8–9	9–0	9–4	9–7	9–10	10–1	10–4	10–7	10–10	11–1						
	16.0	2–9	3–5	3–11	4–4	4–10	5–2	5–6	5–10	6–2	6–6	6–9	7–1	7–4	7–7	7–10	8–1	8–40	8–6	8–9	9–0	9–2	9–5	9–7	9–9	10–0				
	19.2	2–6	3–1	3–7	4–0	4–4	4–9	5–1	5–4	5–8	5–11	6–2	6–5	6–8	6–11	7–2	7–4	7–7	7–9	8–0	8–2	8–5	8–7	8–9	8–11	9–1	9–3	9–5		
	24.0	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
2x6	12.0	5–0	6–2	7–1	7–11	8–8	9–5	10–0	10–8	11–3	11–9	12–4	12–10	13–3	13–9	14–2	14–8	15–1	15–6	15–11	16–3	16–8	17–0	17–5						
	16.0	4–4	5–4	6–2	6–10	7–6	8–2	8–8	9–3	9–9	10–2	10–8	11–1	11–6	11–11	12–4	12–8	13–1	13–5	13–9	14–1	14–5	14–9	15–1	15–4	15–8				
	19.2	4–0	4–10	5–7	6–3	6–10	7–5	7–11	8–5	8–11	9–4	9–9	10–1	10–6	10–10	11–3	11–7	11–11	12–3	12–7	12–10	13–2	13–6	13–9	14–0	14–4	14–7	14–10		
	24.0	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
2x8	12.0	6–7	8–1	9–4	10–6	11–6	12–5	13–3	14–0	14–10	15–6	16–3	16–10	17–6	18–1	18–9	19–4	19–10	20–5	20–11	21–5	21–11	22–5	22–11						
	16.0	5–9	7–0	8–1	9–1	9–11	10–9	11–6	12–2	12–10	13–5	14–0	14–7	15–2	15–8	16–3	16–9	17–2	17–8	18–1	18–7	19–0	19–5	19–10	20–3	20–8				
	19.2	5–3	6–5	7–5	8–3	9–1	9–9	10–6	11–1	11–8	12–3	12–10	13–4	13–10	14–4	14–10	15–3	15–8	16–2	16–7	16–11	17–4	17–9	18–1	18–6	18–10	19–3	19–7		
	24.0	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
2x10	12.0	8–5	10–4	11–11	13–4	14–8	15–10	16–11	17–11	18–11	19–10	20–8	21–6	22–4	23–1	23–11	24–7	25–4	26–0											
	16.0	7–4	8–11	10–4	11–7	12–8	13–8	14–8	15–6	16–4	17–2	17–11	18–8	19–4	20–0	20–8	21–4	21–11	22–6	23–1	23–8	24–3	24–10	25–4	25–10					
	19.2	6–8	8–2	9–5	10–7	11–7	12–6	13–4	14–2	14–11	15–8	16–4	17–0	17–8	18–3	18–11	19–6	20–0	20–7	21–1	21–8	22–2	22–8	23–1	23–7	24–1	24–6	25–0		
	24.0	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
E	12.0	0.06	0.11	0.17	0.24	0.32	0.40	0.49	0.59	0.69	0.79	0.91	1.02	1.14	1.27	1.39	1.53	1.66	1.80	1.95	2.10	2.25	2.40	2.56						
E	16.0	0.05	0.10	0.15	0.21	0.28	0.35	0.43	0.51	0.60	0.69	0.78	0.88	0.99	1.10	1.21	1.32	1.44	1.56	1.69	1.82	1.95	2.08	2.22	2.36	2.50				
E	19.2	0.05	0.09	0.14	0.19	0.25	0.32	0.39	0.47	0.54	0.63	0.72	0.81	0.90	1.00	1.10	1.21	1.32	1.43	1.54	1.66	1.78	1.90	2.03	2.15	2.28	2.42	2.55		
E	24.0	0.04	0.08	0.12	0.17	0.23	0.29	0.35	0.42	0.49	0.56	0.64	0.72	0.81	0.89	0.99	1.08	1.18	1.28	1.38	1.48	1.59	1.70	1.81	1.93	2.04	2.16	2.28	2.41	2.53

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–15
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																												
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–10	3–6	4–0	4–6	4–11	5–4	5–9	6–1	6–5	6–8	7–0	7–3	7–7	7–10	8–1	8–4	8–7	8–10	9–1	9–3	9–6	9–8	9–11	10–1						
	16.0	2–6	3–0	3–6	3–11	4–3	4–8	4–11	5–3	5–6	5–10	6–1	6–4	6–7	6–9	7–0	7–3	7–5	7–8	7–10	8–0	8–2	8–5	8–7	8–9	8–11	9–1				
	19.2	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7		
	24.0	2–0	2–6	2–10	3–2	3–6	3–9	4–0	4–3	4–6	4–9	4–11	5–2	5–4	5–6	5–9	5–11	6–1	6–3	6–5	6–7	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–8	7–10	
2x6	12.0	4–6	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11						
	16.0	3–11	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3				
	19.2	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6		
	24.0	3–2	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–4	
2x8	12.0	5–11	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11						
	16.0	5–2	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10				
	19.2	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10		
	24.0	4–2	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5	15–8	15–11	16–3	
2x10	12.0	7–7	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7								
	16.0	6–6	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0				
	19.2	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9		
	24.0	5–4	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7	20–0	20–4	20–8	
E	12.0	0.06	0.11	0.17	0.23	0.31	0.38	0.47	0.56	0.66	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60						
E	16.0	0.05	0.09	0.14	0.20	0.26	0.33	0.41	0.49	0.57	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53				
E	19.2	0.05	0.09	0.13	0.18	0.24	0.30	0.37	0.44	0.52	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31	2.43	2.57		
E	24.0	0.04	0.08	0.12	0.16	0.22	0.27	0.33	0.40	0.46	0.54	0.61	0.69	0.77	0.85	0.94	1.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06	2.18	2.30	2.41	

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–22
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																												
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–10	3–6	4–0	4–6	4–11	5–4	5–9	6–1	6–5	6–8	7–0	7–3	7–7	7–10	8–1	8–4	8–7	8–10	9–0	9–3	9–6	9–8	9–11	10–1	10–4	10–6	10–8	10–11	11–1
	16.0	2–6	3–0	3–6	3–11	4–3	4–8	4–11	5–3	5–6	5–10	6–1	6–4	6–7	6–9	7–0	7–3	7–5	7–8	7–10	8–0	8–2	8–5	8–7	8–9	8–11	9–1	9–3	9–5	9–7
	19.2	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
	24.0	2–0	2–6	2–10	3–2	3–6	3–9	4–0	4–3	4–6	4–9	4–11	5–2	5–4	5–6	5–9	5–11	6–1	6–3	6–5	6–7	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–8	7–10
2x6	12.0	4–6	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11	16–2	16–6	16–10	17–1	17–5
	16.0	3–11	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3	14–7	14–10	15–1
	19.2	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
	24.0	3–2	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–4
2x8	12.0	5–11	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11	21–4	21–9	22–2	22–6	22–11
	16.0	5–2	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10	19–2	19–6	19–10
	19.2	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
	24.0	4–2	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5	15–8	15–11	16–3
2x10	12.0	7–7	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7							
	16.0	6–6	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0	24–6	24–11	25–4
	19.2	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
	24.0	5–4	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7	20–0	20–4	20–8
E	12.0	0.04	0.08	0.12	0.17	0.23	0.29	0.35	0.42	0.49	0.57	0.65	0.73	0.82	0.91	1.00	1.09	1.19	1.29	1.39	1.50	1.61	1.72	1.83	1.95	2.07	2.19	2.31	2.43	2.56
E	16.0	0.04	0.07	0.11	0.15	0.20	0.25	0.31	0.36	0.43	0.49	0.56	0.63	0.71	0.78	0.86	0.95	1.03	1.12	1.21	1.30	1.39	1.49	1.59	1.69	1.79	1.89	2.00	2.11	2.22
E	19.2	0.03	0.06	0.10	0.14	0.18	0.23	0.28	0.33	0.39	0.45	0.51	0.58	0.65	0.72	0.79	0.86	0.94	1.02	1.10	1.19	1.27	1.36	1.45	1.54	1.63	1.73	1.83	1.92	2.03
E	24.0	0.03	0.06	0.09	0.12	0.16	0.20	0.25	0.30	0.35	0.40	0.46	0.52	0.58	0.64	0.71	0.77	0.84	0.91	1.99	1.06	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.81

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–23
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–7	3–2	3–8	4–1	4–6	4–11	5–3	5–6	5–10	6–1	6–5	6–8	6–11	7–2	7–5	7–7	7–10	8–0	8–3	8–5	8–8	8–10	9–0	9–3	9–5	9–7	9–9	9–11	10–1
	16.0	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
	19.2	2–1	2–6	2–11	3–3	3–7	3–10	4–1	4–4	4–7	4–10	5–1	5–3	5–5	5–8	5–10	6–0	6–2	6–4	6–6	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–9	7–10	8–0
	24.0	1–10	2–3	2–7	2–11	3–2	3–5	3–8	3–11	4–1	4–4	4–6	4–8	4–11	5–1	5–3	5–5	5–6	5–8	5–10	6–0	6–1	6–3	6–5	6–6	6–8	6–9	6–11	7–0	7–2
2x6	12.0	4–1	5–0	5–10	6–6	7–1	7–8	8–2	8–8	9–2	9–7	10–0	10–5	10–10	11–3	11–7	11–11	12–4	12–8	13–0	13–3	13–7	13–11	14–2	14–6	14–9	15–1	15–4	15–7	15–11
	16.0	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
	19.2	3–3	4–0	4–7	5–1	5–7	6–1	6–6	6–10	7–3	7–7	7–11	8–3	8–7	8–11	9–2	9–5	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–2	12–4	12–7
	24.0	2–11	3–7	4–1	4–7	5–0	5–5	5–10	6–2	6–6	6–10	7–1	7–5	7–8	7–11	8–2	8–5	8–8	8–11	9–2	9–5	9–7	9–10	10–0	10–3	10–5	10–8	10–10	11–0	11–3
2x8	12.0	5–5	6–7	7–8	8–7	9–4	10–1	10–10	11–6	12–1	12–8	13–3	13–9	14–4	14–10	15–3	15–9	16–3	16–8	17–1	17–6	17–11	18–4	18–9	19–1	19–6	19–10	20–3	20–7	20–11
	16.0	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
	19.2	4–3	5–3	6–0	6–9	7–5	8–0	8–7	9–1	9–7	10–0	10–6	10–11	11–4	11–8	12–1	12–5	12–10	13–2	13–6	13–10	14–2	14–6	14–10	15–1	15–5	15–8	16–0	16–3	16–7
	24.0	3–10	4–8	5–5	6–0	6–7	7–2	7–8	8–1	8–7	9–0	9–4	9–9	10–1	10–6	10–10	11–2	11–6	11–9	12–1	12–5	12–8	12–11	13–3	13–6	13–9	14–0	14–4	14–7	14–10
2x10	12.0	6–11	8–5	9–9	10–11	11–11	12–11	13–9	14–8	15–5	16–2	16–11	17–7	18–3	18–11	19–6	20–1	20–8	21–3	21–10	22–4	22–10	23–5	23–11	24–5	24–10	25–4	25–10		
	16.0	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
	19.2	5–5	6–8	7–8	8–7	9–5	10–2	10–11	11–7	12–2	12–9	13–4	13–11	14–5	14–11	15–5	15–11	16–4	16–10	17–3	17–8	18–1	18–6	18–11	19–3	19–8	20–0	20–5	20–9	21–1
	24.0	4–11	6–0	6–11	7–8	8–5	9–1	9–9	10–4	10–11	11–5	11–11	12–5	12–11	13–4	13–9	14–3	14–8	15–0	15–5	15–10	16–2	16–6	16–11	17–3	17–7	17–11	18–3	18–7	18–11
E	12.0	0.04	0.08	0.13	0.18	0.23	0.29	0.36	0.43	0.50	0.58	0.66	0.74	0.83	0.92	1.01	1.11	1.21	1.31	1.41	1.52	1.63	1.74	1.86	1.98	2.10	2.22	2.34	2.47	2.60
E	16.0	0.04	0.07	0.11	0.15	0.20	0.25	0.31	0.37	0.43	0.50	0.57	0.64	0.72	0.80	0.88	0.96	1.05	1.13	1.22	1.32	1.41	1.51	1.61	1.71	1.82	1.92	2.03	2.14	2.25
E	19.2	0.04	0.06	0.10	0.14	0.18	0.23	0.28	0.34	0.40	0.46	0.52	0.59	0.65	0.73	0.80	0.88	0.95	1.04	1.12	1.20	1.29	1.38	1.47	1.56	1.66	1.75	1.85	1.95	2.05
E	24.0	0.03	0.06	0.09	0.13	0.16	0.21	0.25	0.30	0.35	0.41	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.93	1.00	1.08	1.15	1.23	1.31	1.40	1.48	1.57	1.66	1.75	1.84

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

Design Values for Joists and Rafters

These "Fb" values are for use where repetitive members are spaced not more than 24 inches. Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Cottonwood					
Select Structural	2x4	1510	1735	1,200,000	
No.1		1080	1240	1,200,000	
No.2		1080	1240	1,100,000	
No.3		605	695	1,000,000	
Stud		600	690	1,000,000	
Construction		805	925	1,000,000	
Standard		460	530	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		935	1075	1,200,000	
No.2		935	1075	1,100,000	
No.3		525	600	1,000,000	
Stud		545	630	1,000,000	
Select Structural	2x8	1210	1390	1,200,000	NSLB
No.1		865	990	1,200,000	
No.2		865	990	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1105	1275	1,200,000	
No.1		790	910	1,200,000	
No.2		790	910	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		720	825	1,200,000	
No.2		720	825	1,100,000	
No.3		405	465	1,000,000	
Douglas Fir–Larch					
Select Structural	2x4	2500	2875	1,900,000	
No.1 & Btr		1985	2280	1,800,000	
No.1		1725	1985	1,700,000	
No.2		1510	1735	1,600,000	
No.3		865	990	1,400,000	
Stud		855	980	1,400,000	
Construction		1150	1325	1,500,000	
Standard		635	725	1,400,000	
Utility		315	365	1,300,000	
Select Structural	2x6	2170	2495	1,900,000	
No.1 & Btr		1720	1975	1,800,000	
No.1		1495	1720	1,700,000	
No.2		1310	1505	1,600,000	
No.3		750	860	1,400,000	
Stud		775	895	1,400,000	
Select Structural	2x8	2000	2300	1,900,000	WCLIB
No.1 & Str		1585	1825	1,800,000	WWPA
No.1		1380	1585	1,700,000	
No.2		1210	1390	1,600,000	
No.3		690	795	1,400,000	
Select Structural	2x10	1835	2110	1,900,000	
No.1 & Btr		1455	1675	1,800,000	
No.1		1265	1455	1,700,000	
No.2		1105	1275	1,600,000	
No.3		635	725	1,400,000	
Select Structural	2x12	1670	1920	1,900,000	
No.1 & Btr		1325	1520	1,800,000	
No.1		1150	1325	1,700,000	
No.2		1005	1155	1,600,000	
No.3		575	660	1,400,000	

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Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Douglas Fir–Larch (North)					
Select Structural	2x4	2245	2580	1,900,000	NLGA
No.1 /No.2		1425	1635	1,600,000	
No.3		820	940	1,400,000	
Stud		820	945	1,400,000	
Construction		1095	1255	1,500,000	
Standard		605	695	1,400,000	
Utility		290	330	1,300,000	
Select Structural	2x6	1945	2235	1,900,000	
No.1 /No.2		1235	1420	1,600,000	
No.3		710	815	1,400,000	
Stud		750	860	1,400,000	
Select Structural	2x8	1795	2065	1,900,000	
No.1 /No.2		1140	1310	1,600,000	
No.3		655	755	1,400,000	
Select Structural	2x10	1645	1890	1,900,000	
No.1 /No–2		1045	1200	1,600,000	
No.3		600	690	1,400,000	
Select Structural	2x12	1495	1720	1,900,000	
No.1 /No.2		950	1090	1,600,000	
No.3		545	630	1,400,000	
Douglas Fir–South					
Select Structural	2x4	2245	2580	1,400,000	WWPA
No.1		1555	1785	1,300,000	
No.2		1425	1635	1,200,000	
No.3		820	940	1,100,000	
Stud		820	945	1,100,000	
Construction		1065	1225	1,200,000	
Standard		605	695	1,100,000	
Utility		290	330	1,000,000	
Select Structural	2x6	1945	2235	1,400,000	
No.1		1345	1545	1,300,000	
No.2		1235	1420	1,200,000	
No.3		710	815	1,100,000	
Stud		750	860	1,100,000	
Select Structural	2x8	1795	2065	1,400,000	
No.1		1240	1430	1,300,000	
No.2		1140	1310	1,200,000	
No.3		655	755	1,100,000	
Select Structural	2x10	1645	1890	1,400,000	
No.1		1140	1310	1,300,000	
No.2		1045	1200	1,200,000	
No.3		600	690	1,100,000	
Select Structural	2x12	1495	1720	1,400,000	
No.1		1035	1190	1,300,000	
No.2		950	1090	1,200,000	
No.3		545	630	1,100,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern Hemlock–Tamarack					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Eastern Softwoods					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern White Pine					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Hem Fir					
Select Structural	2x4	2415	2775	1,600,000	
No.1 & Btr		1810	2085	1,500,000	
No.1		1640	1885	1,500,000	
No.2		1465	1685	1,300,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	2095	2405	1,600,000	
No.1 & Btr		1570	1805	1,500,000	
No.1		1420	1635	1,500,000	
No.2		1270	1460	1,300,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1930	2220	1,600,000	WCLIB
No.1 & Btr		1450	1665	1,500,000	WWPA
No.1		1310	1510	1,500,000	
No.2		1175	1350	1,300,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1770	2035	1,600,000	
No.1 & Btr		1330	1525	1,500,000	
No.1		1200	1380	1,500,000	
No.2		1075	1235	1,300,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1 & Btr		1210	1390	1,500,000	
No.1		1095	1255	1,500,000	
No.2		980	1125	1,300,000	
No.3		575	660	1,200,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Hem-Fir (North)					
Select Structural	2x4	2245	2580	1,700,000	NLGA
No.1 /No.2		1725	1985	1,600,000	
No.3		990	1140	1,400,000	
Stud		980	1125	1,400,000	
Construction		1325	1520	1,500,000	
Standard		720	825	1,400,000	
Utility		345	395	1,300,000	
Select Structural	2x6	1945	2235	1,700,000	
No.1 /No.2		1495	1720	1,600,000	
No.3		860	990	1,400,000	
Stud		890	1025	1,400,000	
Select Structural	2x8	1795	2065	1,700,000	
No.1 /No.2		1380	1585	1,600,000	
No.3		795	915	1,400,000	
Select Structural	2x10	1645	1890	1,700,000	
No.1 /No.2		1265	1455	1,600,000	
No.3		725	835	1,400,000	
Select Structural	2x12	1495	1720	1,700,000	
No.1 /No.2		1150	1325	1,600,000	
No.3		660	760	1,400,000	
Mixed Maple					
Select Structural	2x4	1725	1985	1,300,000	NELMA
No.1		1250	1440	1,200,000	
No.2		1210	1390	1,100,000	
No.3		690	795	1,000.000	
Stud		695	Boo	1,000,000	
Construction		920	1060	1,100,000	
Standard		520	595	1,000,000	
Utility		260	300	900,000	
Select Structural	2x6	1495	1720	1,300,000	
No.1		1085	1245	1,200,000	
No.2		1045	1205	1,100,000	
No.3		600	690	1,000,000	
Stud		635	725	1,000,000	
Select Structural	2x8	1380	1585	1,300,000	
No.1		1000	1150	1,200,000	
No.2		965	1110	1,100,000	
No.3		550	635	1,000,000	
Select Structural	2x10	1265	1455	1,300,000	
No.1		915	1055	1,200,000	
No.2		885	1020	1,100,000	
No.3		505	580	1,000,000	
Select Structural	2x12	1150	1325	1,300,000	
No.1		835	960	1,200,000	
No.2		805	925	1,100,000	
No.3		460	530	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Mixed Oak					
Select Structural	2x4	1985	2280	1,100,000	
No.1		1425	1635	1,000,000	
No.2		1380	1585	900,000	
No.3		820	940	800,000	
Stud		790	910	800,000	
Construction		1065	1225	900,000	
Standard		605	695	800,000	
Utility		290	330	800,000	
Select Structural	2x6	1720	1975	1,100,000	
No.1		1235	1420	1,000,000	
No.2		1195	1375	900,000	
No.3		710	815	800,000	
Stud		720	825	800,000	NELMA
Select Structural	2x8	1585	1825	1,100,000	
No.1		1140	1310	1,000,000	
No.2		1105	1270	900,000	
No.3		655	755	800,000	
Select Structural	2x10	1455	1675	1,100,000	
No.1		1045	1200	1,000,000	
No.2		1010	1165	900,000	
No.3		600	690	800,000	
Select Structural	2x12	1325	1520	1,100,000	
No.1		950	1090	1,000,000	
No.2		920	1060	900,000	
No.3		545	630	800,000	
Mixed Southern Pine					
Select Structural	2x4	2360	2710	1,600,000	
No.1		1670	1920	1,500,000	
No.2		1500	1720	1,400,000	
No.3		865	990	1,200,000	
Stud		890	1020	1,200,000	
Construction		1150	1320	1,300,000	
Standard		635	725	1,200,000	
Utility		315	365	1,100,000	
Select Structural	2x6	2130	2450	1,600,000	
No.1		1490	1720	1,500,000	
No.2		1320	1520	1,400,000	
No.3		775	895	1,200,000	
Stud		775	895	1,200,000	SPIB
Select Structural	2x8	2010	2310	1,600,000	
No.1		1380	1590	1,500,000	
No.2		1210	1390	1,400,000	
No.3		720	825	1,200,000	
Select Structural	2x10	1730	1980	1,600,000	
No.1		1210	1390	1,500,000	
No.2		1060	1220	1,400,000	
No.3		605	695	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1		1120	1290	1,500,000	
No.2		1010	1160	1,400,000	
No.3		575	660	1,200,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Northern Red Oak					
Select Structural	2x4	2415	2775	1,400,000	NELMA
No.1		1725	1985	1,400,000	
No.2		1680	1935	1,300,000	
No.3		950	1090	1,200,000	
Stud		950	1090	1,200,000	
Construction		1265	1455	1,200,000	
Standard		720	825	1,100,000	
Utility		345	395	1,000,000	
Select Structural	2x6	2095	2405	1,400,000	
No.1		1495	1720	1,400,000	
No.2		1460	1675	1,300,000	
No.3		820	945	1,200,000	
Stud		865	990	1,200,000	
Select Structural	2x8	1930	2220	1,400,000	
No.1		1380	1585	1,400,000	
No.2		1345	1545	1,300,000	
No.3		760	875	1,200,000	
Select Structural	2x10	1770	2035	1,400,000	
No.1		1265	1455	1,400,000	
No.2		1235	1420	1,300,000	
No.3		695	800	1,200,000	
Select Structural	2x12	1610	1850	1,400,000	
No.1		1150	1325	1,400,000	
No.2		1120	1290	1,300,000	
No.3		635	725	1,200,000	
Northern Species					
Select Structural	2x4	1640	1885	1,100,000	NLGA
No.1 /No.2		990	1140	1,100,000	
No.3		605	695	1,000,000	
Stud		570	655	1,000,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1420	1635	1,100,000	
No. 1 / No.2		860	990	1,100,000	
No.3		525	600	1,000,000	
Stud		520	595	1,000,000	
Select Structural	2x8	1310	1510	1,100,000	
No.1/No.2		795	915	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1200	1380	1,100,000	
No.1 /No.2		725	835	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1095	1255	1,100,000	
No.1 /No.2		660	760	1,100,000	
No.3		405	465	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Northern White Cedar					
Select Structural	2x4	1335	1535	800,000	
No.1		990	1140	700,000	
No.2		950	1090	700,000	
No.3		560	645	600,000	
Stud		540	620	600,000	
Construction		720	825	700,000	
Standard		405	465	600,000	
Utility		200	230	600,000	
Select Structural	2x6	1160	1330	800,000	
No.1		860	990	700,000	
No.2		820	945	700,000	
No.3		485	560	600,000	
Stud		490	560	600,000	NELMA
Select Structural	2x8	1070	1230	800,000	
No.1		795	915	700,000	
No.2		760	875	700,000	
No.3		450	515	600,000	
Select Structural	2x10	980	1125	800,000	
No.1		725	835	700,000	
No.2		695	800	700,000	
No.3		410	475	600,000	
Select Structural	2x12	890	1025	800,000	
No.1		660	760	700,000	
No.2		635	725	700,000	
No.3		375	430	600,000	
Red Maple					
Select Structural	2x4	2245	2580	1,700,000	
No.1		1595	1835	1,600,000	
No.2		1555	1785	1,500,000	
No.3		905	1040	1,300,000	
Stud		885	1020	1,300,000	
Construction		1210	1390	1,400,000	
Standard		660	760	1,300,000	
Utility		315	365	1,200,000	
Select Structural	2x6	1945	2235	1,700,000	
No.1		1385	1590	1,600,000	
No.2		1345	1545	1,500,000	
No.3		785	905	1,300,000	
Stud		805	925	1,300,000	NELMA
Select Structural	2x8	1795	2065	1,700,000	
No.1		1275	1470	1,600,000	
No.2		1240	1430	1,500,000	
No.3		725	835	1,300,000	
Select Structural	2x10	1645	1890	1,700,000	
No.1		1170	1345	1,600,000	
No.2		1140	1310	1,500,000	
No.3		665	765	1,300,000	
Select Structural	2x12	1495	1720	1,700,000	
No.1		1065	1225	1,600,000	
No.2		1035	1190	1,500,000	
No.3		605	695	1,300,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Red Oak					
Select Structural	2x4	1985	2280	1,400,000	NELMA
No.1		1425	1635	1,300,000	
No.2		1380	1585	1,200,000	
No.3		820	940	1,100,000	
Stud		790	910	1,100,000	
Construction		1065	1225	1,200,000	
Standard		605	695	1,100,000	
Utility		290	330	1,000,000	
Select Structural	2x6	1720	1975	1,400,000	
No.1		1235	1420	1,300,000	
No.2		1195	1375	1,200,000	
No.3		710	815	1,100,000	
Stud		720	825	1,100,000	
Select Structural	2x8	1585	1825	1,400,000	
No.1		1140	1310	1,300,000	
No.2		1105	1270	1,200,000	
No.3		655	755	1,100,000	
Select Structural	2x10	1455	1675	1,400,000	
No.1		1045	1200	1,300,000	
No.2		1010	1165	1,200,000	
No.3		600	690	1,100,000	
Select Structural	2x12	1325	1520	1,400,000	
No.1		950	1090	1,300,000	
No.2		920	1060	1,200,000	
No.3		545	630	1,100,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Redwood					
Clear Structural	2x4	3020	3470	1,400,000	RIS
Select Structural		2330	2680	1,400,000	
Select Structural, open grain		1900	2180	1,100,000	
No.1		1680	1935	1,300,000	
No.1, open grain		1335	1535	1,100,000	
No.2		1595	1835	1,200,000	
No.2, open grain		1250	1440	1,000,000	
No.3		905	1040	1,100,000	
No.3, open grain		735	845	900,000	
Stud		725	835	900,000	
Construction		950	1090	900,000	
Standard		520	595	900,000	
Utility		260	300	800,000	
Clear Structural	2x6	2615	3010	1,400,000	
Select Structural		2020	2320	1,400,000	
Select Structural, open grain		1645	1890	1,100,000	
No.1		1460	1675	1,300,000	
No.1, open grain		1160	1330	1,100,000	
No.2		1385	1590	1,200,000	
No.2, open grain		1085	1245	1,000,000	
No.3		785	905	1,100,000	
No.3, open grain		635	730	900,000	
Stud		660	760	900,000	
Clear Structural	2x8	2415	2775	1,400,000	
Select Structural		1865	2140	1,400,000	
Select Structural, open grain		1520	1745	1,100,000	
No.1		1345	1545	1,300,000	
No.1, open grain		1070	1230	1,100,000	
No.2		1275	1470	1,200,000	
No.2, open grain		1000	1150	1,000,000	
No.3		725	835	1,100,000	
No.3, open grain		585	675	900,000	
Clear Structural	2x10	2215	2545	1,400,000	
Select Structural		1710	1965	1,400,000	
Select Structural, open grain		1390	1600	1,100,000	
No.1		1235	1420	1,300,000	
No.1, open grain		980	1125	1,100,000	
No.2		1170	1345	1,200,000	
No.2, open grain		915	1055	1,000,000	
No.3		665	765	1,100,000	
No.3, open grain		540	620	900,000	
Clear Structural	2x12	2015	2315	1,400,000	
Select Structural		1555	1785	1,400,000	
Select Structural, open grain		1265	1455	1,100,000	
No.1		1120	1290	1,300,000	
No.1, open grain		890	1025	1,100,000	
No.2		1065	1225	1,200,000	
No.2, open grain		835	960	1,000,000	
No.3		605	695	1,100,000	
No.3, open grain		490	560	900,000	

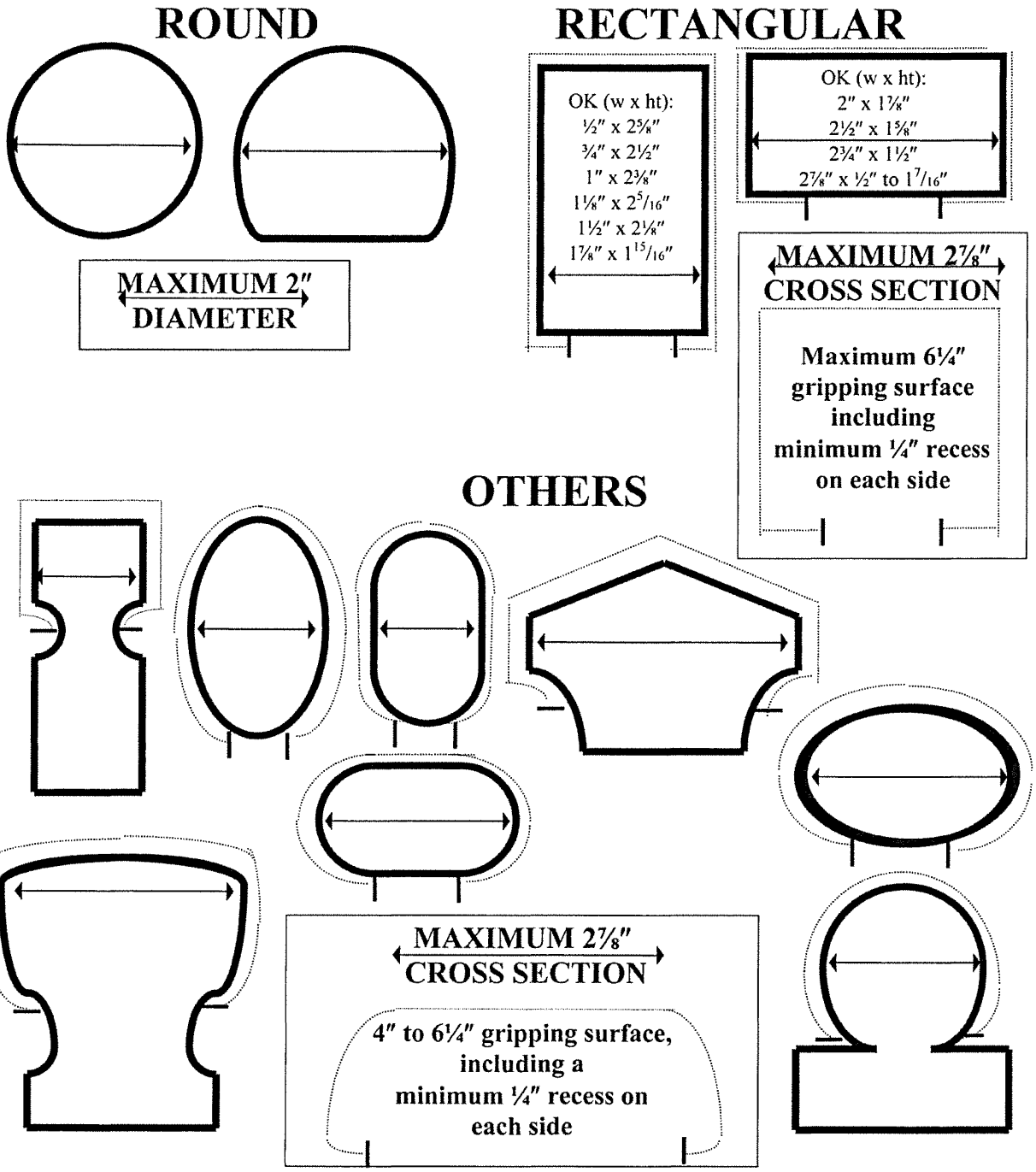
Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Southern Pine					
Dense Select Structural	2x4	3510	4030	1,900,000	SPIB
Select Structural		3280	3770	1,800,000	
Non-Dense Select Structural		3050	3500	1,700,000	
No.1 Dense		2300	2650	1,800,000	
No.1		2130	2450	1,700,000	
No.1 Non-Dense		1950	2250	1,600,000	
No.2 Dense		1960	2250	1,700,000	
No.2		1720	1980	1,600,000	
No.2 Non-Dense		1550	1790	1,400,000	
No.3		980	1120	1,400,000	
Stud		1010	1160	1,400,000	
Construction		1270	1450	1,500,000	
Standard		720	825	1,300,000	
Utility		345	395	1,300,000	
Dense Select Structural	2x6	3100	3570	1,900,000	
Select Structural		2930	3370	1,800,000	
Non-Dense Select Structural		2700	3110	1,700,000	
No.1 Dense		2010	2310	1,800,000	
No.1		1900	2180	1,700,000	
No.1 Non-Dense		1720	1980	1,600,000	
No.2 Dense		1670	1920	1,700,000	
No.2		1440	1650	1,600,000	
No.2 Non-Dense		1320	T520	1,400,000	
No.3		865	990	1,400,000	
Stud		890	1020	1,400,000	
Dense Select Structural	2x8	2820	3240	1,900,000	
Select Structural		2650	3040	1,800,000	
Non-Dense Select Structural		2420	2780	1,700,000	
No.1 Dense		1900	2180	1,800,000	
No.1		1730	1980	1,700,000	
No.1 Non-Dense		1550	1790	1,600,000	
No.2 Dense		1610	1850	1,700,000	
No.2		1380	1590	1,600,000	
No.2 Non-Dense		1260	1450	1,400,000	
No.3		805	925	1,400,000	
Dense Select Structural	2x10	2470	2840	1,900,000	
Select Structural		2360	2710	1,800,000	
Non-Dense Select Structural		2130	2450	1,700,000	
No.1 Dense		1670	1920	1,800,000	
No.1		1500	1720	1,700,000	
No.1 Non-Dense		1380	1590	1,600,000	
No.2 Dense		1380	1590	1,700,000	
No.2		1210	1390	1,600,000	
No.2 Non-Dense		1090	1260	1,400,000	
No.3		690	795	1,400,000	
Dense Select Structural	2x12	2360	2710	1,900,000	
Select Structural		2190	2510	1,800,000	
Non-Dense Select Structural		2010	2310	1,700,000	
No.1 Dense		1550	1790	1,800,000	
No.1		1440	1650	1,700,000	
No.1 Non-Dense		1320	1520	1,600,000	
No.2 Dense		1320	1520	1,700,000	
No.2		1120	1290	1,600,000	
No.2 Non-Dense		1040	1190	1,400,000	
No.3		660	760	1,400,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Spruce–Pine–Fir					
Select Structural	2x4	2155	2480	1,500,000	NLGA
No.1 /No.2		1510	1735	1,400,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	1870	2150	1,500,000	
No.1 /No.2		1310	1505	1,400,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1725	1985	1,500,000	
No. 1 / No.2		1210	1390	1,400,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1580	1820	1,500,000	
No.1/No.2		1105	1275	1,400,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1440	1655	1,500,000	
No.1 /No.2		1005	1155	1,400,000	
No.3		575	660	1,200,000	
Spruce–Pine–Fir (South)					
Select Structural	2x4	2245	2580	1,300,000	NELMA NSLB WCLIB WWPA
No.1		1465	1685	1,200,000	
No.2		1295	1490	1,100,000	
No.3		735	845	1,000,000	
Stud		725	835	1,000,000	
Construction		980	1125	1,000,000	
Standard		545	630	900,000	
Utility		260	300	900,000	
Select Structural	2x6	1945	2235	1,300,000	
No.1		1270	1460	1,200,000	
No.2		1120	1290	1,100,000	
No.3		635	730	1000,000	
Stud		660	760	1,000,000	
Select Structural	2x8	1795	2065	1,300,000	
No.1		1175	1350	1,200:000	
No.2		1035	1190	1,100,000	
No.3		585	675	1,000,000	
Select Structural	2x10	1645	1890	1,300,000	
No.1		1075	1235	1,200,000	
No.2		950	1090	1,100,000	
No.3		540	620	1,000,000	
Select Structural	2x12	1495	1720	1,300,000	
No.1		980	1125	1,200,000	
No.2		865	990	1,100,000	
No.3		490	560	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Western Cedars					
Select Structural	2x4	1725	1985	1,100,000	
No.1		1250	1440	1,000,000	
No.2		1210	1390	1,000,000	
No.3		690	795	900,000	
Stud		695	800	900,000	
Construction		920	1060	900,000	
Standard		520	595	800,000	
Utility		260	300	800,000	
Select Structural	2x6	1495	1720	1,100,000	
No.1		1085	1245	1,000,000	
No.2		1045	1205	1,000,000	
No.3		600	690	900,000	
Stud		635	725	900,000	WCLIB
Select Structural	2x8	1380	1585	1,100,000	WWPA
No.1		1000	1150	1,000,000	
No.2		965	1110	1,000,000	
No.3		550	635	900,000	
Select Structural	2x10	1265	1455	1,100,000	
No.1		915	1055	1,000,000	
No.2		885	1020	1,000,000	
No.3		505	580	900,000	
Select Structural	2x12	1150	1325	1,100,000	
No.1		835	960	1,000,000	
No.2		805	925	1,000,000	
No.3		460	530	900,000	
Western Woods					
Select Structural	2x4	1510	1735	1,200,000	
No.1		1120	1290	1,100,000	
No.2		1120	1290	1,000,000	
No.3		645	745	900,000	
Stud		635	725	900,000	
Construction		835	960	1,000,000	
Standard		460	530	900,000	
Utility		230	265	800,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		970	1120	1,100,000	
No.2		970	1120	1,000,000	
No.3		560	645	900,000	
Stud		575	660	900,000	WCLIB
Select Structural	2x8	1210	1390	1,200,000	WWPA
No.1		895	1030	1,100,000	
No.2		895	1030	1,000,000	
No.3		520	595	900,000	
Select Structural	2x10	110	1275	1,200,000	
No.1		820	945	1,100,000	
No.2		820	945	1,000,000	
No.3		475	545	900,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		750	860	1,100,000	
No.2		750	860	1,000,000	
No.3		430	495	900,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
White Oak					
Select Structural	2x4	2070	2380	1,100,000	NELMA
No.1		1510	1735	1,000,000	
No.2		1465	1685	900,000	
No.3		820	940	800,000	
Stud		820	945	800,000	
Construction		1095	1255	900,000	
Standard		605	695	800,000	
Utility		290	330	800,000	
Select Structural	2x6	1795	2065	1,100,000	
No.1		1310	1505	1,000,000	
No.2		1270	1460	900,000	
No.3		710	815	800,000	
Stud		750	860	800,000	
Select Structural	2x8	1655	1905	1,100,000	
No.1		1210	1390	1,000,000	
No.2		1175	1350	900,000	
No.3		655	755	800,000	
Select Structural	2x10	1520	1745	1,100,000	
No.1		1105	1275	1,000,000	
No.2		1075	1235	900,000	
No.3		600	690	800,000	
Select Structural	2x12	1380	1585	1,100,000	
No.1		1005	1155	1,000,000	
No.2		980	1125	900,000	
No.3		545	630	800,000	
Yellow Poplar					
Select Structural	2x4	1725	1985	1,500,000	NSLB
No.1		1250	1440	1,400,000	
No.2		1210	1390	1,300,000	
No.3		690	795	1,200,000	
Stud		695	800	1,200,000	
Construction		920	1060	1,300,000	
Standard		520	595	1,100,000	
Utility		230	265	1,100,000	
Select Structural	2x6	1495	1720	1,500,000	
No.1		1055	1245	1,400,000	
No.2		1045	1205	1,300,000	
No.3		600	690	1,200,000	
Stud		635	725	1,200,000	
Select Structural	2x8	1380	1585	1,500,000	
No.1		1000	1150	1,400,000	
No.2		965	1110	1,300,000	
No.3		550	635	1,200,000	
Select Structural	2x10	1265	1455	1,500,000	
No.1		915	1055	1,400,000	
No.2		885	1020	1,300,000	
No.3		505	580	1,200,000	
Select Structural	2x12	1150	1325	1,500,000	
No.1		835	960	1,400,000	
No.2		805	925	1,300,000	
No.3		460	530	1,200,000	

321.04 (3) (b) 5.
HANDRAIL SHAPES



321.125 (3) CONTROL STANDARDS

The following are designs acceptable by the Department to achieve compliance with the control standards of acceptable soil loss or percent reduction of sediment load in runoff from a site.

Less than one acre disturbance (regardless of the lot or property size).

A. Mandated practices:

1. A method to prevent or reduce soil from leaving a site via entries or roads. This may include a tracking pad or tire washing stand designed and installed to meet DNR Standard 1057. Other means of compliance include a gravel mulch, frozen soil, bedrock or some other physical means to prevent soil from leaving the site on vehicle tires which is equivalent to the tracking pad or tire washing stand.

2. Storm water inlet protection. Inlet protection may be accomplished by using DNR Technical Standard, number 1050, "Storm Drain Inlet Protection for Construction Sites". The protection of storm water inlets in the code is specific to "on–site" inlets; however an off–site inlet may create a direct conduit to a water of the state, which links any inlet that leads to a water of the state to the #3 mandated practice. In that case, special care should be taken to protect both types of inlets from sediment in runoff from a construction site.

3. Protection of adjoining Waters of the State. The installation of practices is necessary if runoff from the disturbance could impact a water of the state. Practices may include channel erosion mats, silt fences, vegetative buffers or any other practices applicable to the specific site.

4. Drainage way protection. Any ditches or drainage ways that flow off–site must be protected with appropriate best management practices (BMPs). This may include but is not limited to ditch checks, channel erosion control mats or riprap.

5. Dewatering activity sediment reduction. Any dewatering necessary on the construction site must include measures to reduce the sediment in the water leaving the site. Dewatering BMPs may include filters, fiber rolls or gravel bag berms.

6. Stockpile protection. Any soil stockpiles which are left more than 7 days must be protected by seeding and mulching, erosion mat, silt fencing, covering or other methods. This does not include fill or topsoil piles that are in active use.

B. In addition to mandated practices, the owner/contractor or designer must choose one or more of the following methods in order to achieve compliance with the standards.

1. The Revised Universal Soil Loss Equation may be used to determine the amount of soil lost from a site in order to stay below the 5 tons/acre/year for sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay or clay textures or the 7.5 tons/acre/year soil loss for silt, silty clay loam or silt loam textures. The Department accepted version of an Excel worksheet that is used to calculate the soil loss is available at: http://dsps.wi.gov/Default.aspx?Page=224e686e–b2b6–44ac–b79d–d8ad3d3cb560.

2. Silt fence may be placed in accordance with this Code's technical standard and remain on the site until the previous area is stabilized. This practice, in addition to the mandated practices in part "A" is accepted by the Department as compliant with the 40% reduction in sediment load goal.

3. The site may be seeded and mulched, erosion control mat may be installed or polymers may be applied. The erosion control BMPs must be applied within one week of disturbance. Seeding and mulching must be accomplished in accordance with this Code. Erosion control mat must be installed in accordance with this Code. Polymer application must be pre-approved by Land and Natural Resources Division. This method is only acceptable when the maximum slope length is 300 feet and the maximum slope is no more than that specified in Table A–321.125–1 and Table A –321.125–2.

4. Practices may be included in the erosion and sediment control plan for the site that achieve compliance with the 40% reduction in sediment load in the runoff from the site. Table A–321.125–3 lists several erosion and sediment control BMPs and the USEPA (United States Environmental Protection Agency) efficiency rating for that BMP.

5. A unique design may be submitted with the permit application for review.

Table A–321.125–1

Slope Limitations for Permissible Soil Loss with max. 300′ slope length[1]

When sites are seeded, mulched or otherwise stabilized within one week of disturbance[2]

Soil Texture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7.5 tons/acre/year allowable soil loss												
Silt loam or Silty clay loam	20%	20%	16%	9%	6%	5%	6%	8%	12%	17%	20%	20%
5 tons/acre/year allowable soil loss												
Sand	20%	20%	20%	14%	10%	8%	9%	12%	19%	20%	20%	20%
Loamy sand	20%	20%	20%	13%	9%	8%	9%	11%	17%	20%	20%	20%
Sandy loam	20%	20%	16%	9%	7%	5%	6%	8%	16%	17%	20%	20%
Loam, Sandy clay loam, Clay loam, Sandy clay	20%	20%	13%	8%	5%	4%	5%	6%	10%	17%	20%	20%
Silty clay	20%	20%	16%	9%	7%	5%	6%	8%	13%	17%	20%	20%
Clay	20%	20%	15%	9%	6%	5%	5%	7%	12%	16%	20%	20%

[1] The information in the table is derived from Grant County rainfall information and the use of the Revised Universal Soil Loss Equation. The slope limitation refers to the maximum slope permitted in order to achieve code compliance for the site specifics in the table. Opening date is the 15th of each month and closing is the 22nd. End date is 60 days past closing date.

[2] Stabilization may be accomplished by temporary seeding and mulching, permanent seeding and mulching, application of polymers or placement of erosion control mats. Additionally, the mandated practices specific to the site must be in place.

Table A–321.125–2

Slope Limitations for Permissible Soil Loss with max. 300′ slope length[1]

When sites are seeded, mulched or otherwise stabilized within 4 weeks of disturbance[2]

Soil Texture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7.5 tons/acre/year allowable soil loss												
Silt loam or Silty clay loam	18%	11%	8%	4%	3%	2%	3%	4%	6%	10%	15%	20%
5 tons/acre/year allowable soil loss												
Sand	20%	20%	17%	12%	7%	5%	4%	4%	6%	10%	15%	20%
Loamy sand	20%	20%	16%	11%	6%	4%	4%	4%	5%	9%	14%	20%
Sandy loam	20%	18%	11%	8%	4%	3%	2%	3%	4%	6%	10%	16%
Loam, Sandy clay loam, Clay loam, Sandy clay	20%	9%	6%	4%	2%	2%	4%	3%	5%	8%	13%	20%
Silty clay	18%	11%	8%	4%	3%	2%	4%	6%	6%	10%	15%	20%
Clay	17%	11%	7%	4%	3%	2%	4%	6%	6%	9%	14%	20%

[1] The information in the table is derived from Grant County rainfall information and the use of the Revised Universal Soil Loss Equation. The slope limitation refers to the maximum slope permitted in order to achieve code compliance for the site specifics in the table. Opening date is the 15th of each month and closing is the 15th of the following month End date is 60 days past closing date.

[2] Stabilization may be accomplished by temporary seeding and mulching, permanent seeding and mulching, application of polymers or placement of erosion control mats. Additionally, the mandated practices specific to the site must be in place.

Erosion and sediment control for construction sites having a landdisturbance area of one acre or more is regulated by the Land and Natural Resources Division.

Table A–321.125–3

Erosion/Sediment Control BMP Efficiency[1]

Practice	Type of Practice		Recognized Efficiency
Straw Bales	Sediment Control		10%[4]
Fiber Rolls	Sediment Control		40%
Sediment Traps	Sediment Control		40%
Silt Fence	Sediment Control		Sand 80% Other soils 40%
Compost Blankets	Erosion Control		80%
Polymers	Erosion Control		80%
Sodding	Erosion Control		80%
Seeding	Erosion Control		80%
Mulching	Erosion Control		80%
Non channel control mat	Erosion Control		80%[3]

[1] BMP efficiency is derived from information provided on the Environmental Protection Construction Erosion Control website in August, 2006 and only when the BMP is installed per the listed standard.

[3] This efficiency measure is provided by the Land and Natural Resources Division.

[4] This efficiency measure is provided by the Land and Natural Resources Division and only for a short duration as described in the standard.

There are several BMPs that do not have an efficiency assigned by the EPA. These include mandatory controls such as inlet protection, drainage way protection (riprap) and tracking pads. Diversions, both temporary and permanent are also not included in Table A–321.125 –2. Diversions impact the erosion on a site by shortening the length of slope in the Revised Universal Soil Loss Equation (RUSLE).

Following is an example of an erosion and sediment control plan (Figure A–321.125). This plan may be used for reference, however each site is unique and each plan will address the site–specific issues.

Figure A–325.125–1

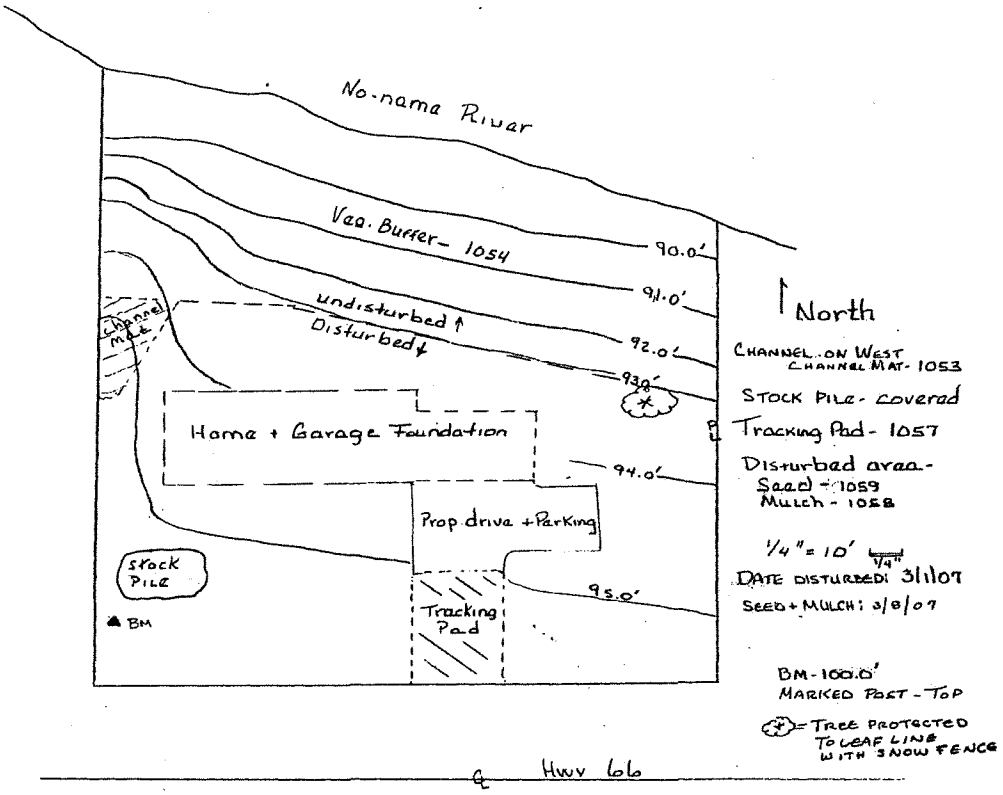


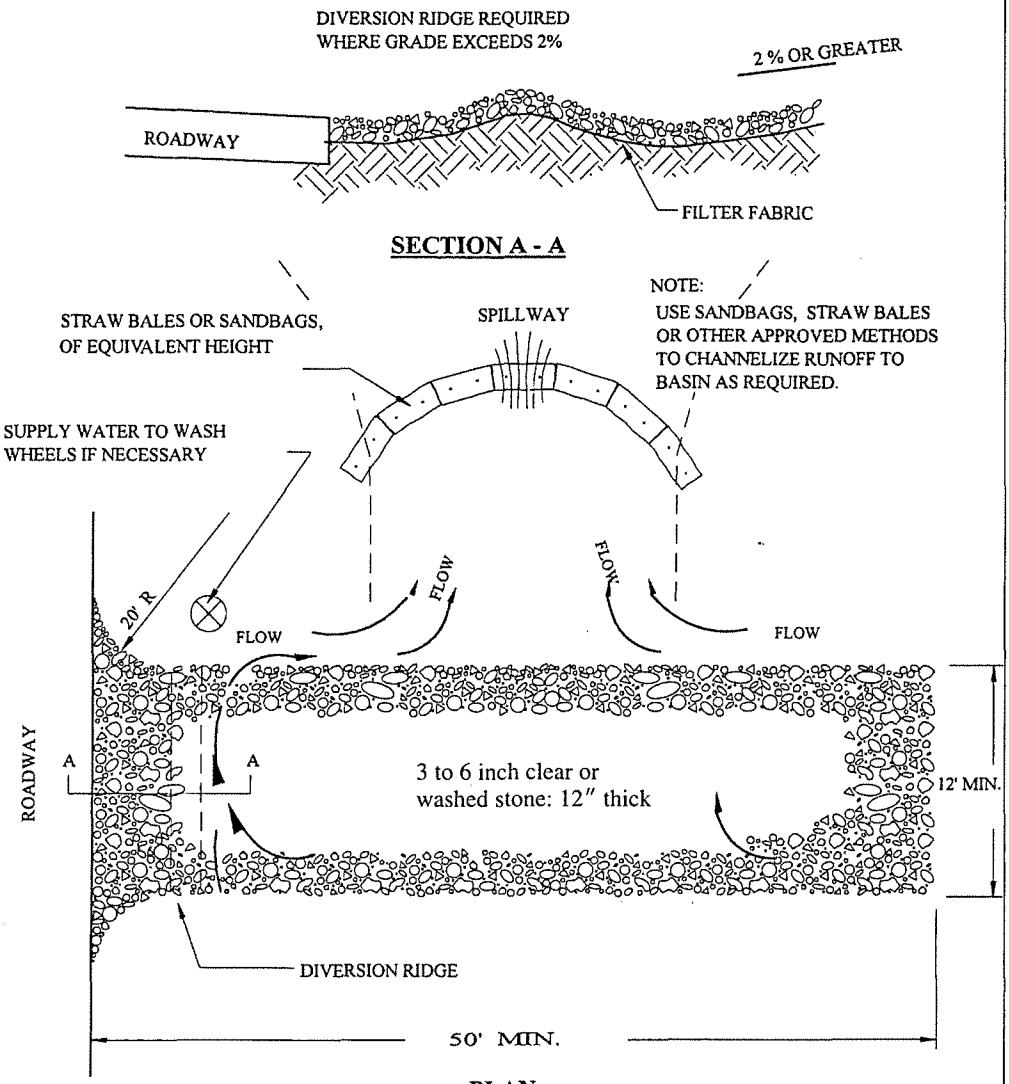
Figure A–325.125–2
Sample Page from Erosion Control Checklist

Y	N	N/A	Seeding for Erosion Control – 1059
			Topsoil depth 2 inches for temporary seeding?
			Topsoil depth 4 inches for permanent seeding?
			Rocks, twigs and foreign material removed?
			Clods < 2 inch?
			Seed sown < 1/4 inch deep?
			Temporary species and rates per table?

Species	Lbs/Acre	% Purity	Season
Oats	131	98	Spring & Summer
Cereal Rye	131	97	Fall
Winter Wheat	131	95	Fall
Annual Ryegrass	80	97	Fall

Y	N	N/A	Mulching for Construction Sites 1058
			Area under mulch free of gullies and rills?
			Mulch not in concentrated flow channels?
			Erosion occurring in mulched areas?
			Natural biodegradable materials?
			Free of toxic, noxious or diseased substances?
			Marsh hay only on upland sites?
			Crimped straw or hay fiber length > 6 inches?
			No bark or wood chips on seeded sites?
			Mulch covers 80% of unseeded areas?
			Mulch covers 70% of seeded areas?
			Mulch 1/2 to 1–1/2 inches thick in seeded areas?
			Mulch 1–1/2 to 3 inches thick for unseeded areas?
			Wood chips 1/2 to 1–1/2 inches thick?
			Mulch anchors w/crimping, matting and tackifier?

Note: The entire checklist can be found at: http://dsps.wi.gov/Default.aspx? Page=224e686e–b2b6–44ac–b79d–d8ad3d3cb560.



NOTES:

IF SOILS ARE MAINLY COMPOSED OF CLAYS OR SILTS, USE OF A FILTER FABRIC AS A SEPARATION BARRIER BETWEEN THE ROCK AND SOIL IS RECOMMENDED.

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.

2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.

3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABLIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.

FIG. E - 11
TEMPORARY
GRAVEL CONSTRUCTION ENTRANCE/EXIT

Also see Standard 1060 for additional information.

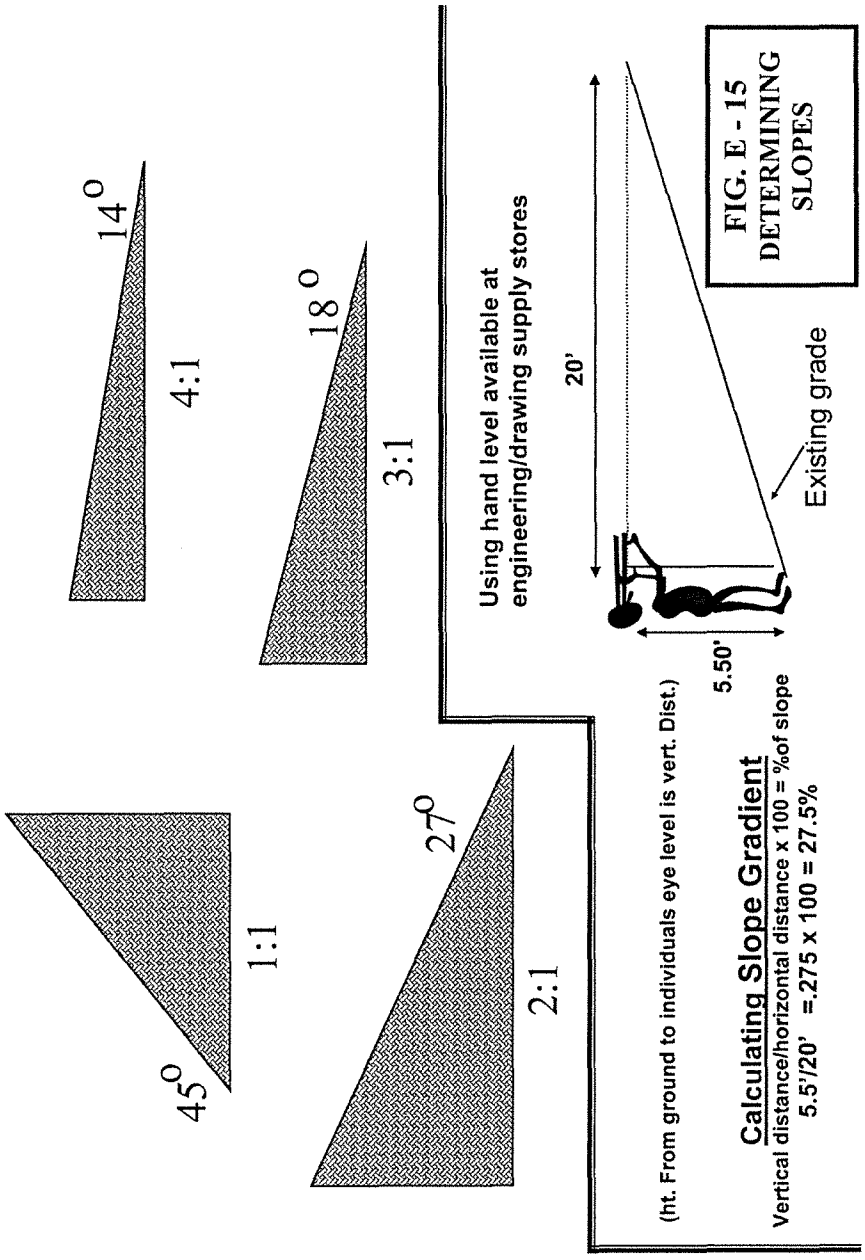


FIG. E - 15
DETERMINING SLOPES

Following are reprints of the DNR Erosion Control Technical Standards, also available at http://www.dnr.state.wi.us/runoff/stormwater/techstds.htm

STANDARD	Number	Effective Date	Page
Channel Erosion Mat	1053	08/05	156
De–watering	1061	04/07	159
Ditch Checks	1062	03/06	166
Construction Site Diversion	1066	03/06	170
Dust Control	1068	03/04	172
Grading Practices for Erosion Control — Temporary	1067	03/04	173
Interim Sediment Control: Water Application of Polymers	1051	11/02	175
Land Application of Anionic Polyacrylamide	1050	07/01	185
Mulching for Construction Sites	1058	06/03	188
Non–channel Erosion Mat	1052	08/03	191
Sediment Bale Barrier	1055	08/03	194
Sediment Basin	1064	03/06	196
Sediment Trap	1063	09/05	205
Seeding	1059	11/03	209
Silt Fence	1056	03/06	213
Silt Curtain	1070	09/05	218
Stone Tracking Pad and Tire Washing	1057	08/03	221
Storm Drain Inlet Protection for Construction Sites	1060	10/03	223
Turbidity Barriers	1069	09/05	227
Vegetative Buffer for Construction Sites	1054	05/03	232

Channel Erosion Mat

Note: Words in the standard that are shown in italics are described in XI. Definitions. The words are italicized the first time they are used.

I. Definition-Erosion Mat

A protective soil cover of straw, wood, coconut fiber or other suitable plant residue, or natural fibers formed into a mat. Erosion mats are rolled products available in many varieties and combination of materials and with varying life spans.

II. Purpose

The purpose of this practice is to protect the channel from erosion or act as turf reinforcement during and after the establishment of grass or other vegetation in a channel. This practice applies to both *Erosion Control Revegative Mats* (*ECRM*[1]) and *Turf –Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies where runoff channelizes in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable waters.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of erosion mat.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. To complete the shear calculations, a 2 year, 24 hour storm event shall be used to calculate depth of flows for an ECRM. For sizing a TRM, use the depth of flow corresponding to the maximum design capacity of the channel.

Only mats approved by Land and Natural Resources Division and listed on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be accepted for use in this standard.

VI: Installation

A. ECRM shall be installed after all topsoiling, fertilizing, liming, and seeding is complete.

B. Erosion mats shall extend for whichever is greater: upslope one–foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.

C. The mat shall be in firm and continuous contact with the soil. It shall be anchored, overlapped, staked and entrenched per the manufacturer's recommendations.

D. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

E. At time of installation, document the manufacturer and mat type by saving material labels and manufacturer's installation instructions. Retain this documentation until the site is stabilized.

VII. Considerations

A. Erosion mats shall be selected so that they last long enough for the grass or other vegetation to become densely established.

B. Consider using Class II, Type C mats adjacent to waterways where trapping small animals is to be avoided.

C. Class III TRM may be appropriate as a replacement for riprap as a channel liner. Check the shear stress criteria for the channel to determine mat applicability.

D. Once a gully has formed in a channel, it is difficult to stabilize due to loss of soil structure. Even when the gully is filled with topsoil and reseeded, the soil has a tendency to dislodge in the same pattern. If gully formation continues to be a problem the design should be reevaluated, including other mat classes or riprap.

E. It may be difficult to establish permanent vegetation and adequate erosion protection in a channel with continuous flow. Consider riprap or planting wetland species with an ECRM.

F. Documentation of materials used, monitoring logs, project diary, and weekly inspection forms including erosion and stormwater management plans, should be provided to the authority charged with long term maintenance of the site.

G. Channel cross sections may be parabolic, v–shaped or trapezoidal. The use of "V" channels is generally discouraged due to erosion problems experienced.

H. To help determine the appropriate channel liner, designers can refer to the design matrix in the back of the WisDOT PAL. However, for channels not conforming to the typical section shown in the channel matrix or having a depth of flow greater than 6 inches (150 mm), the designer will need to design for an appropriate channel liner. One way to do this is to use the "tractive force" method presented in FHWA's Hydraulic Engineering Circular (HEC) No. 15. This method requires that the calculated maximum shear stress of a channel is not to exceed the permissible shear stress of the channel liner. To use this method, permissible shear stress values are stated next to each device listed in the channel matrix.

VIII. Plans and Specifications

IX. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat
2. Installation sequence
3. Material specification conforming to standard

X. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

XI. Operation and Maintenance

A. Erosion mats shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. Maintenance shall be completed as soon as possible with consideration to site conditions.

XII. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm.

XI. Definitions

Channel Erosion: The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Erosion Control Revegative Mats (ECRM) (II): Erosion control revegetative mats are designed to be placed on top of soil.

Turf–Reinforcement Mats (TRM) (II): Turf–reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved soil stabilizer Type A (as classified in the WisDOT PAL)

Dewatering

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A compartmented container, settling basin, filter, or other appropriate best management practice through which sediment–laden water is conveyed to trap and retain the sediment.

II. Purposes

The purpose of this standard is to determine appropriate methods and means to remove sediment from water generated during dewatering activities prior to discharging off–site or to waters of the state. Practices identified in this standard shall be deemed to meet the de–watering performance standard to prevent the discharge of sediment to the maximum extent practicable (MEP).

III. Conditions where Practice Applies

This practice applies where sediment laden water needs to be removed for construction or maintenance activities. Dewatering practices shall be in keeping with the effective operating and applicability criteria listed on Figure 2, Dewatering Practice Selection Matrix.

This practice does not apply to:

- Water being discharged directly to groundwater or *karst features*[1]. Refer to NR140
- Well dewatering systems. Refer to NR 812

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of this practice.

V. Criteria

This section establishes the minimum allowable limits for design parameters, installation, and performance requirements.

Dewatering practices shall be selected based on the predominant soil texture encountered at the dewatering site with consideration given to pumping or flow rates, volumes and device effectiveness. Refer to Figure 1 USDA Soil textural triangle to assist with soil classifications at the site. Figure 2, Dewatering Practice Selection Matrix illustrates acceptable dewatering options and their effective ranges. Practices selected that are not on the matrix must provide an equivalent level of control, with justification provided to the reviewing authority.

A. Site Assessment – A site assessment shall be conducted and documented to determine the physical site characteristics that will affect the placement, design, construction and maintenance of dewatering activities. The site assessment shall identify characteristics such as ground slopes, soil types, soil conditions, bedrock, sinkholes, drainage patterns, runoff constituents, proximity to regulated structures, natural resources, and specific land uses. The site assessment shall include the following:
   - Sanitary and storm sewer locations
   - Potential contamination – Odor or discoloration other than sediment, or an oily sheen on the surface of the sediment laden water. If contamination is present, notify Land and Natural Resources Division.
   - Soil textural class for areas where dewatering will occur. Soil investigation shall extend below grading and trenching activities
   - Depth to the seasonally highest water table
   - Discharge outfall locations
   - Distance and conveyance method to receiving waters

B. General Criteria Applicable To All Dewatering Activities

1. Contact the Land and Natural Resources Division when the discharge from a dewatering practice will enter a WDNR listed *Exceptional Resource Water (ERW), Outstanding Resource Water (ORW)*, or a wetland in an area of special natural resource interest as identified in NR 103.
2. Contact the Public Works Division if the discharge is to a Tribal storm water conveyance system. The allowable discharge rate shall be limited by the capacity of the system.
3. When practical, dewatering effluent shall be collected in a pump truck for transport to a *treatment facility* or discharged directly to a treatment facility.
4. For surface dewatering, utilize a floating suction hose, or other method, to minimize sediment being sucked off the bottom.
5. For discharges that will be directed to locations on–site verify that the anticipated volume of water can be fully contained.
6. The topography and condition of the ground cover between the pump discharge point and potential receiving waters shall be evaluated for potential erosion. Appropriate stabilization measures shall be incorporated to prevent erosion.
7. When discharge to a karst feature or other direct groundwater connection can not be avoided, the dewatering system must be designed and operated to maintain compliance with the groundwater quality standards contained in applicable regulations.
8. If the discharge directly or indirectly enters a stream, the discharge flow rate shall not exceed 50 percent of the peak flow rate of the 2–year 24–hour storm event.

C. Geotextile Bags

1. Geotextile bags shall meet the criteria listed in Table 1.

Table 1: Properties for Geotextile Bags

Property	Test Method	Type I Value	Type II Value
Maximum Apparent Opening Sizes	ASTM D–4751	0.212 mm	0.212 mm
Grab Tensile Strength	ASTM D–4632	200 lbs.	300 lbs.
Mullen Burst	ASTM D–3786	350 psi	580 psi
Permeability	ASTM D–4491	0.28 cm/sec	0.2 cm/sec
Fabric	Nominal Representative Weight	8 oz	12 oz

2. Geotextile bags shall be sized according to the particle size being trapped, expected flow or pumping rate (gallons per minute) per square foot of fabric and a 50% clogging factor. The footprint of the bag shall be no smaller than 100 square feet.
3. Geotextile bags shall be securely attached to the discharge pipe.
4. Polymers can be used to enhance the efficiency of geotextile bags. If polymer is used, the polymer shall be approved by the Land and Natural Resources Division.

D. Gravity Based Settling Systems

Gravity based systems rely on settling of particles as the primary means of treatment. To effectively accomplish this, quiescent conditions should exist with sufficient detention time. Practices include portable sediment tanks, sediment traps, sediment basins, and wet detention basins.

If polymer is used to enhance settling, the polymer shall be approved by the Land and Natural Resources Division.

1. Portable Sediment Tank: These tanks are intended to settle only sands, loamy sands, and sandy loams. If polymer is added, these tanks will also be appropriate for settling loams, silt loams and silts. Portable sediment tanks shall have a minimum of two baffled compartments, and be a minimum of three feet deep. The inlet and outlet pipe shall be a minimum diameter of three inches. Use one of the following methods to size a tank:

   a. Settling: Account for settling of the suspended sediments with the following equation:

      Sa = 1.83 * Q;

   where

      Sa = Tank surface area (sq ft)

      Q = Pumping rate (gallons per minute)

      Note: 1.83 is a factor that includes the conversion from gpm to cfs (1 gpm = 0.0022 cfs) and the particle settling velocity for Soil Class 1 (0.0012 ft/sec).

   b. Filtration: Build the first chamber as large as possible to aid in settling. Flow capacity shall be determined by the end area of the filter media (fabric) and the flow rate (gallons per minute) per square foot of the finest filter media and a 50% clogging factor.

2. Sediment Trap or Sediment Basin: This device is a temporary sediment control device. The design, installation, and operation of the sediment trap or basin must be approved by the Land and Natural Resources Division.

3. Wet Detention Basin: This device is generally a permanent structure designed to address post–construction pollutant reduction requirements. The design, installation, and operation of the wet detention basin shall meet the requirements of the Land and Natural Resources Division.

E. Passive Filtration Systems

Passive filtration systems rely on filtration as the primary method of removing particles. Sediment removal efficiency will be related to the particle size distribution in the stormwater. Practices include manufactured filters, filter tanks, filter basins, vegetative filters, grass swales, and filtration fabric.

Filter fabric sediment removal efficiency shall be based on the properties specified in Table 1.

1. Manufactured Filters: Filters shall be sequenced from the largest to the smallest pore opening. Sand media filters are available with automatic backwashing features that can filter to 50 μ m particle size. Screen or bag filters can filter down to 5 μ m. Fiber wound filters can remove particles down to 0.5 μ m.

2. Filter Tank (portable): Install, operate and maintain according to manufacturer recommendations.

3. Filter Basin: Install, operate and maintain according to Wisconsin Department of Transportation technical guidance.

4. Vegetative Filter: Refer to WDNR Conservation Practice Standard 1054 Vegetated Buffer for Construction Sites.

F. Pressurize Filtration Systems

Pressurized filtration systems differ from passive systems in that the water flowing through the media is pressurized and the filter media is designed to handle higher flow rates. Practices include portable sand filters, wound cartridge units, membranes and micro–filtration units.

Pressurized filters typically have automatic backwash systems that are triggered by a pre–set pressure drop across the filter. If the backwash water volume is small or substantially more turbid than the stormwater stored in the holding pond or tank, returning backwash water to the pond or tank may be appropriate. However, land application or another means of treatment and disposal may be necessary.

Screen, bag, and fiber filters must be cleaned and/or replaced when they become clogged.

1. Portable Sand Filter: Install, operate and maintain according to manufacturer recommendations.

2. Wound Cartridge Units: Secondary filtration of sediments using high efficiency filter cartridges may be necessary to remove fine particles such as clays. Install, operate and maintain according to manufacturer recommendations.

3. Membranes and Micro–filtration: Install, operate and maintain according to manufacturer recommendations.

4. If polymer is used to enhance settling, the polymer shall be approved by the Land and Natural Resources Division.

VI. Considerations

A. It may be necessary to clean the municipal storm drainage system prior to and after discharging to the system to prevent scouring solids from the drainage system.

B. Geotextile bags are generally not appropriate when discharging to ORW, ERW, waterbodies supporting cold water communities, trout streams, or to *highly susceptible* and *less susceptible wetlands*.

C. Pressurized filtration systems are the most efficient for removing fine sediments.

D. Portable sediment tanks may be appropriate when other sediment trapping practices cannot be installed due to lack of space or other reasons.

E. Filtration is not an efficient treatment of water with heavy sediment loads. Use a settling tank or sand filter as pretreatment when possible.

F. It may be necessary to use a combination of dewatering practices to achieve the intended results.

VII. Plans and Specifications

All plans, standard detail drawings, or specifications shall include the schedule for installation, inspection, and maintenance and shall be kept on–site with the erosion control plan.

VIII. Operation and Maintenance

A. Sediment shall be removed from devices to maintain effectiveness. All sediment collected in dewatering devices shall be properly disposed of to prevent discharge to waters of the state.

B. The following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site:

1. Discharge duration and specified pumping rate
2. Observed water table at time of dewatering
3. If used, type and amount of chemical used for pH adjustment
4. If used, type and amount of polymer used for treatment
5. Maintenance activities

IX. References

The American Association of State Highway Officials (AASHTO) Soil Classification System

X. Definitions

Exceptional Resource Waters (ERW) (V.B.1): are waters listed in s. NR 102.11.

Highly susceptible wetland (VI.B): include the following types: fens, sedge meadows, bogs, low prairies, conifer swamps, shrub swamps, other forested wetlands, fresh wet meadows, shallow marshes, deep marshes and seasonally flooded basins.

Karst feature (III): are an area or geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.

Less susceptible wetland (VI.B): include degraded wetlands dominated by invasive species such as reed canary grass.

Outstanding Resource Waters (ORW) (V.B.1): are waters listed in s. NR 102.10.

Targeted performance standard (IV): means a performance standard that will apply in a specific area, where additional practices beyond those contained in NR 151 are necessary to meet water quality standards.

Treatment facility (V.B.3): includes wastewater treatment plants or wet detention basins constructed in accordance with WDNR Conservation Practice Standard 1001 Wet Detention Basin or other approved land application sites.

Figure 1: USDA Soil Textural Triangle

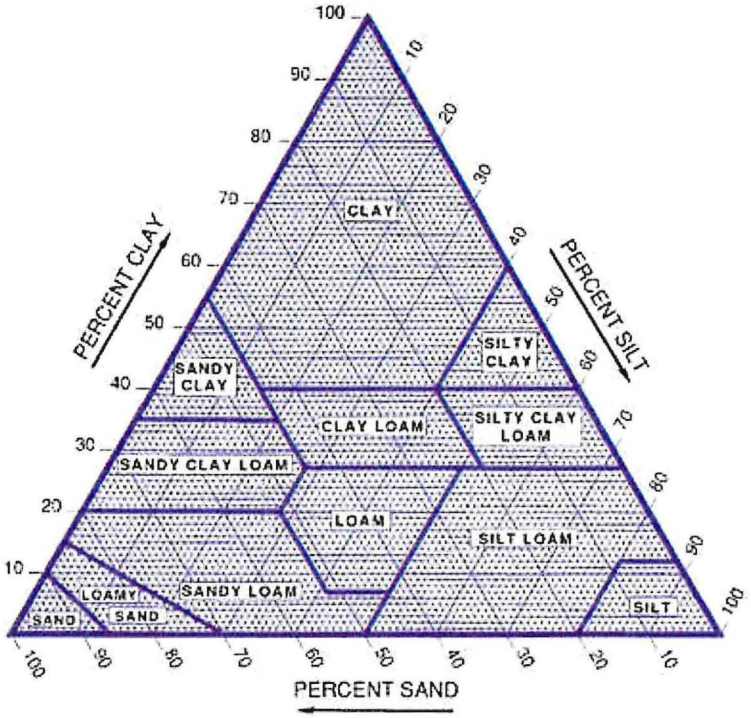


Figure 2: Dewatering Practice Selection Matrix

Type of Dewatering Practice	Soil and Particle Size Classification			Notes
	Coarse to Medium Particles	Medium to Fine Particles	Fine to Very Fine Particles	
	Sand, Loamy Sands, and Sandy Loams	*Loams, Silt Loams, and Silts*	*Clay Loams, Silty Clays and Clay*	
Geotextile Bags				
Type I	▬▬▬	● ● ● ● ● ● ● ● ● ● ●		
Type II	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	▬▬▬	● ● ● ● ● ● ● ● ● ● ●	
Gravity Based Settling				
Sediment Tank (Portable)	▬▬▬	● ● ● ● ● ● ● ● ● ● ●		
Sediment Trap (Temporary)	▬▬▬	● ● ● ● ● ● ● ● ● ● ●		Use Standard 1063 Sediment Trap
Sediment Basin (Temporary)	▬▬▬	▬▬▬	● ● ● ● ● ● ● ● ● ● ●	Use Standard 1064 Sediment Basin
Wet Detention Basin (Perm)	▬▬▬	▬▬▬	▬▬▬	Use Standard 1001 Wet Detention Basin
Passive Filtration				
Filter Tank (Portable)	▬▬▬	▬▬▬	● ● ● ● ● ● ● ● ● ● ●	Use according to manufacturer's recommendations
Filter Basin	▬▬▬	▬▬▬	● ● ● ● ● ● ● ● ● ● ●	See WisDOT Standard Specifications
Vegetative Filter	▬▬▬	▬▬▬	▬▬▬	Effectiveness depends upon the width of the filter and the runoff rate of flow. See Standard 1054 for design guidelines.
Pressurized Filtration				The contractor shall provide a certification sheet from the manufacturer specifiying performance of the device based on soil type and pumping rate.
Portable Sand Filter	▬▬▬	● ● ● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ● ●	
Wound Cartridge Units	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	▬▬▬	▬▬▬	
Membranes & Micro-filtration	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Very effective but high maintenance requirements
Other Practices				
Sanitary Sewer Discharge	▬▬▬	▬▬▬	▬▬▬	
Pump Truck	▬▬▬	▬▬▬	▬▬▬	Transported to treatment facility
Alternative Method				Discuss with regulatory authority

Key:
- Effective range of device: ▬▬▬
- Device applicable but may not be cost effective: ■ ■ ■ ■ ■
- Effective range with addition of polymer: ● ● ● ● ● ● ●

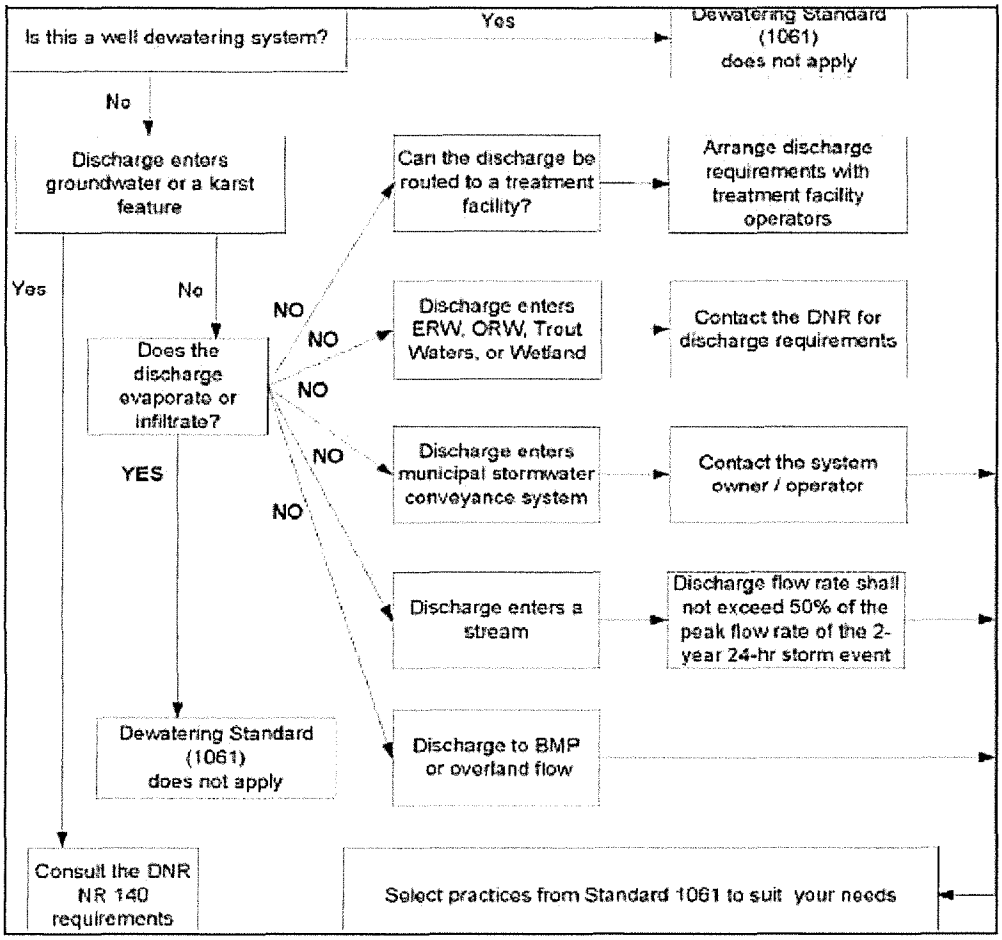
Notes:
(1) The effectiveness of many practices can be enhanced through the use of polymer mixture.
(2) Soil classification shall be done in accordance to an accepted method (i.e. USDA, AASHTO)

Conservation Practice Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI.

WDNR, WI
4/07

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Figure 3: Factors Influencing The Selection of Dewatering Practices



If the dewatering effluent is discolored, has an order, an oily sheen, or other toxins are present notify the DNR immediately

24 Hours Spills Reporting Hotline 1-800-943-0003

Ditch Check

(Channel)

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary dam constructed across a swale or drainage ditch to reduce the velocity of water flowing in the channel. *Ditch checks*[1] can be constructed out of stone, a double row of straw bales, or from engineered products approved by the Land and Natural Resources Division.

II. Purpose

The purpose of this practice is to reduce flow velocity and to pond water, thereby reducing active channel erosion and promoting settling of suspended solids behind the ditch check.

III. Conditions Where Practice Applies

This Standard applies where grading activity occurs in areas of channelized flows and a temporary measure is needed to control erosion of the channel until permanent stabilization practices can be applied.

Under no circumstance shall ditch checks be placed in intermittent or perennial stream without permission from WDNR. This Practice may not be substituted for major perimeter trapping measures.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of ditch checks.

V. Criteria

This section establishes the minimum standards for design, installation, and performance requirements.

A. Height

1. Installed, the minimum height of ditch checks shall be 10 inches and shall not exceed a maximum height of 16 inches for manufactured or biodegradable materials and 36 inches for stone (or other inorganic materials).
2. Ditch checks must be installed with the center lower than the sides forming a weir. If this is not done stormwater flows are forced to the edge of the ditch check thus promoting scour, or out of the channel causing excessive erosion.
3. Stone ditch checks shall have a minimum top width of 2–feet measured in the direction of flow with maximum slopes of 2:1 (2 horizontal to 1 vertical) on the upslope side and 2:1 on the down slope side.

B. Placement

1. At a minimum install one ditch check for every two feet of drop in the channel.
2. Ditch checks shall be placed such that the resultant ponding will not cause inconvenience or damage to adjacent areas.

C. Material Specifications

1. Stone ditch checks shall be constructed of a well–graded angular stone, a D_{50} of 3 inch or greater, sometimes referred to as breaker run or shot rock.
2. Ditch checks may be constructed of other approved materials but must be capable of withstanding the flow velocities in the channel. Manufactured products listed in WisDOT's PAL are also acceptable for temporary ditch checks.

Note: Silt fence and single rows of straw bales are ineffective as ditch checks and are not permitted.

D. Construction – Refer to Figure 1 & 2

1. Ditch checks shall be utilized during rough grading and shall be removed once the final grading and channel stabilization is applied, unless intended to be part of a permanent storm water management plan.
2. Channel erosion mat or other non–erodible materials shall be placed at the base of a ditch check, and extended a minimum of 6 feet, to prevent scour and washing out the toe of the ditch check. Contact the Land and Natural Resources Division for the placement of erosion mat in this location.
3. Chink or seal stone and rock ditch checks to minimize the flow through the ditch check.

DI. Considerations

A. For added stability, the base of a stone or rock ditch check should be keyed into the soil to a depth of 6–inches.

B. Stone ditch checks may be underlain by a nonwoven geotextile fabric to ease installation and removal. If the geotextile fabric is extended, it can serve purpose specified in section V.D.2

C. Ditch checks installed in grass lined channels may kill the vegetation if water is ponded for extended periods or excessive siltation occurs. Proper maintenance is required to keep areas above and below the ditch check stabilized.

D. The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.

E. When placing ditch checks in swales adjacent to roadways consider designating a 'clear zone' free of obstacles posing a threat to out of control vehicles.

F. Mowing operations may throw stones from ditch checks causing a potential safety hazard.

VII. Plans and Specifications

A. Plans and specifications for installing ditch checks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location and spacing of ditch check
2. Schedules and sequence of installation and removal
3. Standard drawings and installation details
4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Ditch checks shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

B. Unless incorporated into a permanent stormwater management system, ditch checks shall be removed once the final grading and channel stabilization is applied.

C. Sediment deposits shall be removed when deposits reach 0.5 the height of the barrier. Removal of sediment may require replacement of stone. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Printed copies are no longer distributed.

X. Definitions

D_{50} (V.C.1): The particle size for which 50% of the material by weight is smaller than that size.

Ditch Checks (I) Are commonly referred to as temporary check dams. Stone ditch checks refer to those made out of either stone or rock.

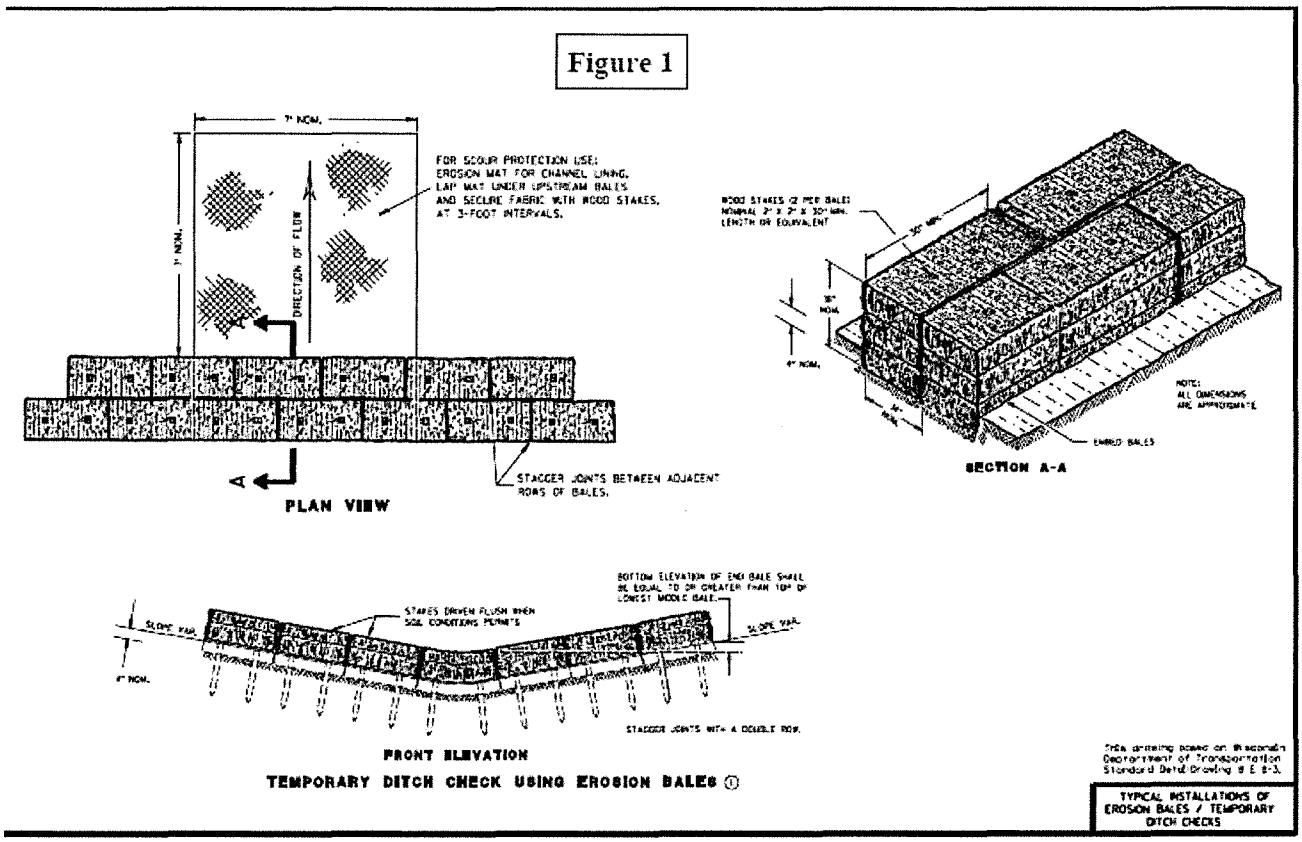
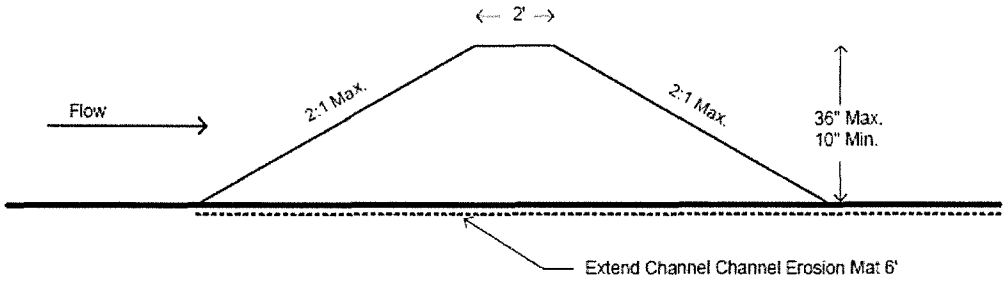


Figure 2. Stone Ditch Check



Side View

Construction Site Diversion

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A *temporary*[1] berm or channel constructed across a slope to collect and divert runoff.

II. Purpose

To intercept, divert, and safely convey runoff at construction sites in order to divert clean water away from disturbed areas, or redirect sediment laden waters to an appropriate sediment control facility.

III. Conditions Where Practice Applies

A. This practice is applicable to construction sites where temporary surface water runoff control or management is needed. Locations and conditions include:

1. Above disturbed areas, to limit runoff onto the site.
2. Across slopes to reduce slope length.
3. Below slopes to divert excess runoff to stabilized outlets.
4. To divert sediment–laden water to sediment control facilities.
5. At or near the perimeter of the construction area to keep sediment from leaving the site.

B. This standard does not pertain to permanent diversions. Refer to appropriate design criteria and local regulations when designing permanent diversions.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of this practice.

V. Criteria

A. The diversion shall have stable side slopes and shall not be overtopped during a 2–year frequency, 24–hour duration storm. The minimum berm cross section shall be as follows:

1. Side slopes of 2:1 (horizontal:vertical) or flatter.
2. Top width of two feet.
3. Berm height of 1.5 feet.

B. Sediment–laden runoff from disturbed areas shall be diverted into a sediment control practice. For typical sediment control practices see WDNR Conservation Practice Standards Sediment Trap (1063) or Sediment Basin (1065) for design criteria.

C. When diverting clean water the diversion channel and its outfall shall be immediately *stabilized* for the 2–year frequency, 24–hour duration storm. Build and stabilize clean water diversions before initiating down slope land disturbing activities.

D. Diversions shall be protected from damage by construction activities. At all points where diversion berms or channels will be crossed by construction equipment, the diversion shall be stabilized or shaped appropriately. Temporary culverts of adequate capacity may be used.

E. For diversions that are to serve longer than 30 days, the side slopes including the ridge, and down slope side the diversion shall be stabilized as soon as they are constructed. The diversion channel should be stabilized (i.e. erosion mat) or a larger sediment control practice shall be needed. For diversions serving less than 30 days, the down slope side of the diversion shall be stabilized as soon as constructed.

VI. Considerations

A. The channel cross section may be parabolic, v–shaped or trapezoidal. The use of "V" channels is generally discouraged due to potential erosion problems.

B. Ditch checks may be used to enhance sediment removal.

C. For diversion berms consider designing an emergency overflow section or bypass area to limit damage from storms that exceed the 2–year frequency 24–hour duration storm. The overflow section may be designed as a stabilized weir with riprap protection.

VII. Plans and Specifications

A. Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Diversion location.
2. Channel grade or elevations.
3. Typical cross section.
4. Channel stabilization if required.

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Diversions shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. Maintenance shall be completed as soon as possible with consideration to site conditions.

C. Accumulated sediment shall be removed when it reaches one half the height of the diversion berm. Properly dispose of any sediment removed from the diversion.

D. Diversions shall be removed and the area stabilized according to construction plans.

IX. Definitions

Temporary (I): an erosion control measure that is utilized during construction and grading operations prior to final stabilization.

Stabilized (V.C): means protecting exposed soil from erosion.

Dust Control On Construction Sites

I. Definition

Dust control includes practices used to reduce or prevent the surface and air transport of dust during construction.

Dust control measures for construction activities include minimization of soil disturbance, applying mulch and establishing vegetation, water spraying, surface roughening, applying polymers, spray–on tackifiers, chlorides, and barriers.

II. Purpose

This practice may be used to:

- Reduce wind erosion and dust.
- Minimize deposition of dust and wind transported soils into water bodies through runoff or wind action.
- Reduce respiratory problems.
- Minimize low visibility conditions caused by airborne dust.

III. Conditions Where Practice Applies

Dust control measures may be applied at any construction site, but is particularly important for sites with dry exposed soils which may be exposed to wind or vehicular traffic.

IV. Applicable Laws

Users of this standard shall comply with applicable laws, rules, regulations or permit requirements governing this practice.

V. Criteria

This section establishes the minimum standards for design, installation, and performance requirements.

A. The implementation of dust control shall limit the area exposed for dust generation.

B. Asphalt and petroleum based products cannot be used for dust control.

C. Mulch and Vegetation – Mulch or seed and mulch may be applied to protect exposed soil from both wind and water erosion.

Refer to WDNR Conservation Practice Standards Mulching for Construction Sites (1058) and Seeding for Construction Site Erosion Control (1059) for criteria.

D. Water – Water until the surface is wet and repeat as needed. Water shall be applied at rates so that runoff does not occur.

Treated soil surfaces that receive vehicle traffic require a stone tracking pad or tire washing at all point of access. Refer to WDNR Conservation Practice Standard Stone Tracking Pad and Tire Washing (1057) for criteria.

E. Tillage – A control measure performed with chisel type plows on exposed soils. Tillage shall begin on the windward side of the site. Tillage is only applicable to flat areas.

F. Polymers – Polymers can be an effective practice for areas that do not receive vehicle traffic. Dry applied polymers must be initially watered for activation to be effective for dust control. Refer to WDNR Conservation Practice Standard Erosion Control Land Application of Polymers (1050) for application criteria.

G. Tackifiers and Soil Stabilizers Type A – Products must be selected from and installed at rates conforming to the WisDOT Erosion Control PAL. See Section IX for reference.

Temporary Grading Practices For Erosion Control

(Surface Roughening and Temporary Ditch Sumps)

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

Temporary[1] grading practices used to minimize construction site erosion. These practices include, but are not limited to surface roughening (directional tracking and tillage) and temporary ditch sumps.

II. Purpose

The purpose of these practices are to minimize erosion and sediment transport during grading operations on construction sites.

III. Conditions Where Practice Applies

These practices apply where land disturbing activities occur on construction sites. These practices shall be used in conjunction with other erosion control practices.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing these practices.

V. Criteria

These interim practices may be employed in addition to the approved grading plan to reduce erosion and sediment transport.

A. Surface Roughening – Surface roughening is abrading the soil surface with horizontal ridges and depressions across the slope to reduce runoff velocities.

1. Directional Tracking – The process of creating ridges with tracked vehicles on unvegetated slopes. This method is used for short durations on sites actively being grad and shall be used in conjunction with other practices. This practice shall be in place at the end of each workday.

   Directional tracking involves driving a tracked vehicle up and down a slope. The tracks create horizontal grooves and ridges. The rough surface slows sheet runoff and helps to prevent rills from forming. (Conversely, if the tracked vehicle is driven along the contour the tracks create vertical grooves and ridges for the water to follow, increasing erosion.)

2. Tillage – Utilizing conventional tillage equipment to create a series of ridges and furrows on the contour no more than 15 inches apart.

B. Temporary Ditch Sump – Temporary ditch sumps are ½ to 5 cubic yard excavations made in a drainageway during earthmoving operations. Their purpose is to slow and pond runoff during the time that drainageways are being graded. Sumps shall be in place prior to anticipated rain events.

Construction involves excavating sumps (holes) in the rough ditch grade, and using the excavated material to form a dike on the downstream side of the sump.

Temporary ditch sumps are not effective perimeter controls. Other sediment control practices shall be utilized prior to channels discharging into public waterways.

VI. Considerations

A. Directional tracking may compact the soil, therefore additional seedbed preparation may be required. Refer to WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059) for seedbed preparation and seeding criteria.

B. When constructing a temporary ditch sump, compacting the dike provides additional stability.

C. Consider at a minimum excavating ½ cubic yard per 1% gradient, for every 500 feet of channel when constructing temporary ditch sumps.

VII. Plans and Specifications

Due to the interim nature of these practices, and the fact that location determinations are made in the field, they need only be referenced in the erosion control plan narration or general notes.

VIII. Operation and Maintenance

These practices shall be inspected and repaired or reinstalled after every runoff event.

IX. Definitions

Temporary (I): An erosion control measure that is utilized during construction site grading activities.

Interim Sediment Control

Water Application of Polymers

(Land and Natural Resources
Division Approval Required)

Erosion Control

Land Application of Anionic Polyacrylamide

(LAND AND NATURAL RESOURCES DIVISION APPROVAL REQUIRED)

I. Definition

The land application of products containing watersoluble anionic polyacrylamide (PAM) as temporary soil binding agents to reduce erosion.

II. Purpose

The purpose of this practice is to reduce erosion from wind and water on construction sites and agricultural lands.

III. Conditions Where Practice Applies

This practice is intended for direct soil surface application to sites where the timely establishment of vegetation may not be feasible or where vegetative cover is absent or inadequate. Such areas may include agricultural lands where plant residues are inadequate to protect the soil surface and construction sites where land disturbing activities or winter shutdown prevent establishment or maintenance of a cover crop. This practice is not intended for application to surface waters of the state as defined by the Wisconsin Department of Natural Resources (WDNR) ch. NR 102.

IV. Federal, State and Local Laws

Anionic PAM application shall comply with all federal, state, and local laws, rules or regulations governing anionic PAM. The operator is responsible for securing required permits. This standard does not contain the text of the federal, state, or local laws governing anionic PAM.

V. Criteria

A. Toxicity Criteria. Anionic PAM mixtures shall be environmentally benign, harmless to fish, aquatic organisms, wildlife, and plants. Anionic PAM mixtures shall be non–combustible.

1. Cationic PAM shall not be used at any level because its toxicity to aquatic test species occurs at very low concentrations.
2. Anionic PAM mixtures shall have _ .05% free acrylamide monomer by weight as established by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA).
3. Each manufacturer or supplier shall provide to the WDNR acute toxicity test data from a certified lab, as defined in ch. NR149 Wis. Adm. Code, for their anionic PAM mixture. Procedures specified in the "State of Wisconsin Aquatic Life Toxicity Testing Methods Manual", WDNR, as referenced in s. NR 219.04, Wis. Adm. Code shall be used. The WDNR use restriction shall be developed from this data.
4. Users of anionic PAM mixtures shall obtain and follow all Material Safety Data Sheet requirements, manufacturer recommendations, and WDNR use restrictions.

B. Application Criteria

1. The manufacturer or supplier shall provide a product expiration date for anionic PAM mixtures based on product expiration date of PAM in pure form. The manufacturer or supplier shall provide general written application methods, based on site conditions, such as slope and soil type.
2. Application rates shall not exceed manufacturer's written application rate recommendations that shall not exceed the WDNR use restrictions.
3. Maximum application rates, in parts per million (ppm or mg/L or mg/kg), shall be determined by multiplying 1.4 by the number of pounds applied per acre. This number shall be less than or equal to the WDNR use restriction. Higher concentrations of anionic PAM mixtures may actually decrease effectiveness. Repeated applications of anionic PAM mixtures may be applied, if necessary, to ensure adequate effectiveness.
4. The application method shall provide uniform coverage to the target area and avoid drift to non–target areas.

5. The manufacturer or supplier shall provide written instructions to insure proper safety, storage, and mixing of their product.
6. Anionic PAM mixtures shall be used in conjunction with other Best Management Practices (BMPs).
7. When used on bare soil, without seed or mulch, anionic PAM mixtures shall be used on slopes 2.5:1 or flatter.
8. Anionic PAM mixtures shall not be applied to channel bottoms.
9. The applicator of anionic PAM mixture shall document, at the time of application, the following: name of applicator, application rate per acre, date applied, product type, weather conditions during application, and method of application. Copies of this documentation shall be entered into the contractor's monitoring log or project diary and made available upon request.
10. Unused liquid anionic PAM mixtures shall be minimized. Excess material shall not be applied at a rate greater than the maximum application rate. Disposal shall not occur in storm water conveyance systems (ie. Storm sewer manholes, storm sewer inlets, ditches, and culverts).

C. Product Approval Criteria

1. Toxicity test results shall be reviewed by the WDNR and shall receive a written product use restriction. Toxicity test results shall be submitted to: Water Quality Standards Section, WDNR, 101 South Webster St., P.O. Box 7921, Madison, WI 53707, as a pre–qualification for field testing.
2. Anionic PAM mixtures shall achieve _ 80% reduction in soil loss as measured by a 1 hour storm duration 2"/hour rainfall simulator test performed in accordance with methods used by Bubenzer and Patterson (1982) as a prequalification for field testing.
3. Performance of anionic PAM mixtures shall be verified and field–tested by the WisDOT or other WisDOT –designated facility.
4. The Wisconsin Department of Transportation, Erosion Control Storm Water – Product Acceptability List Committee (ECSW), will review and approve products as per the process set forth in WisDOT's PAL. **Only products approved for use in Wisconsin may be used.** Copies of the PAL are available off the State DOT web site: http://www.dot.state.wi.us. Questions may be sent to: New Products Engineer, WisDOT, Technology Advance-ment, 3502 Kinsman Blvd., Madison, WI 53704.

CI. Considerations

The following are additional recommendations, which may enhance the use of, or avoid problems with the practice.

A. Adding seed to the anionic PAM mixture may provide additional erosion protection beyond the life of the anionic PAM.

B. Mulching is typically needed to protect the seed from the effects of wind and sun. Seed germination is not enhanced or impeded by the anionic PAM mixture.

C. Using a minimum 30 ft setback when applying anionic PAM mixture near surface waters of the state is recommended.

D. Applying anionic PAM mixture to soil may provide benefits of improved water quality, infiltration, soil fertility, and visibility by reducing wind and water erosion.

E. For erosion control, the anionic PAM mixture may be applied upgradient of lands planted in food crops.

F. Application of anionic PAM mixture may be particularly effective in the following situations:
- During rough grading operations
- Phased construction projects
- Stockpiles
- After final grading and before paving or final seeding and planting
- Sites having a winter shutdown
- Agricultural lands where plant residues are inadequate
- Sites receiving final landscaping, but where adequate vegetation cannot be established prior to winter.

G. Application of anionic PAM mixture may not be as effective in the following situations:
- When the soil surface is pure sand or gravel with no fines.
- When applied over snow cover.

H. Visible tracer or colorant to visually track application is recommended.

I. Anionic PAM mixtures may be applied in liquid and granular forms.

J. Application rates of anionic PAM mixtures may need to be adjusted based on soil type, slope, and type of erosion targeted (ie. wind or water). Based on manufacturer's recommendations, higher application rates may be necessary when applied in granular form.

K. Anionic PAM mixtures combined with water are very slippery and can be a safety hazard. Care must be taken to prevent spills of anionic PAM mixtures onto paved surfaces. During an application of anionic PAM mixture, prevent over–spray from reaching pavement, as pavement will become slippery.

L. Care should be taken when applying anionic PAM mixtures in liquid form on saturated slopes due to the possibility of slope structural failure. Anionic PAM mixtures may be applied to steeper slopes when used with other erosion control BMPs such as seed and mulch or erosion mat.

VII. Specifications

Erosion control and stormwater plans specifying anionic PAM mixtures for erosion control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

VIII. Operation and Maintenance

Maintenance will consist of reapplying anionic PAM mixtures to disturbed areas, including high use traffic areas, which interfere in the performance of this practice. Anionic PAM mixture may lose its effectiveness in as little as two months due to weather conditions. Anionic PAM mixtures should be reapplied in areas where wind or rill erosion is apparent and whenever an area has been graded, driven upon, or otherwise disturbed since the anionic PAM mixture was last applied.

IX. References

Bubenzer, G.D., and Patterson, A.E., *Intake Rate: Sprinkler Infiltrometer,* Method of Soil Analysis, Part 1 Physical and Mineralogical Method, Second Edition, Chapter 33, pp. 845–870. (Agronomy Monograph Series #9, 1982). *Managing Irrigation–Induced Erosion And Infiltration With Polyacrylamide, Proceedings From First Conference,* University of Idaho Miscellaneous Publication No. 101–96, (Kimberly, Idaho, USDA–ARS Northwest Irrigation and Soils Research Lab, 1996).

Roa–Espinosa, A., Bubenzer, G.D. and Miyashita, E., Sediment and Runoff Control on Construction Sites Using Four Application Methods of Polyacrylamide Mix, National Conference on Tools for Urban Water Resource Management and Protection, Chicago, February 7–10, 2000, pp. 278– (EPA, 2000).

Roa–Espinosa, A., Bubenzer, G.D. and Miyashita, E., *Determination of PAM Use in Erosion Control on Construction Sites,* 1st Inter–Regional Conference on Environment–Water: Innovative Issues in Irrigation and Drainage, Lisbon, Portugal, September 1998 (Portuguese National Committee of ICID, 1998).

Roa– Espinosa, A., *Are there Safety Concerns or Environmental Concerns with PAM?* (Dane County Land Conservation Department, 1997).

Sojka, R.E. and Lentz, R.D., "A PAM Primer: A brief history of PAM and PAM related issues," http://kimberly.ars.usda.gov, (Kimberly, ID: USDA–ARS Northwest Irrigation and Soils Research Lab, 1996).

Wisconsin Administration Code (Wis.Adm.Code), Legislative Reference Bureau, Section 35.84 of the statutes (available online: http://legis.wisconsin.gov/rsb/code.htm).

Special recognition goes to Steve Decker of Construction Fabrics & Materials Corp. (CFM). Steve was invaluable during the development of this technical standard because of his extensive field experience, his personal commitment to funding the research for toxicity testing, his vision and his steadfast determination to find an environmentally safe and effective erosion control product.

Mulching For

Construction Sites

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

Mulching is the application of organic material to the soil surface to protect it from raindrop impact and overland flow. Mulch covers the soil and absorbs the erosive impact of rainfall and reduces the flow velocity of runoff.

II. Purpose

This practice may be used to:

- Reduce soil erosion
- Aid in seed germination and establishment of plant cover
- Conserve soil moisture

III. Conditions Where Practice Applies

This practice may be applied on exposed soils as a temporary control where soil grading or landscaping has taken place or in conjunction with temporary or permanent seeding. Mulching is generally not appropriate in areas of concentrated flow.

IV. Applicable Laws

Users of this standard shall comply with applicable laws, rules, regulations or permit requirements governing mulching.

V. Criteria

This section establishes the minimum standards for design, installation, and performance requirements.

A. Site Preparation:

Soil surface shall be prepared prior to the application of mulch in order to achieve the desired purpose and to ensure optimum contact between soil and mulch. All areas to be mulched shall be reasonably free of rills and gullies.

B. Materials:

Mulch shall consist of natural biodegradable material such as plant residue (including but not limited to straw, hay, wood chips, bark, and wood cellulose fiber), or other equivalent materials of sufficient dimension (depth or thickness), and durability to achieve the intended effect for the required time period.

Mulch shall be environmentally harmless to wildlife and plants. Materials such as gravel, plastic, fabric, sawdust, municipal solid waste, *solid waste byproducts*[1], shredded paper, and non–biodegradable products shall not be used.

Mulch shall be free of diseased plant residue (i.e. oak wilt), *noxious weed* seeds, harmful chemical residues, heavy metals, hydrocarbons and other known environmental toxicants.

Marsh hay shall not be used as mulch in lowland areas but may be used on upland sites to prevent the spread of invasive, non–native species (i.e. reed canary grass) commonly found in marsh hay.

Straw and hay mulch that will be crimped shall have a minimum fiber length of 6 inches.

Wood chips or wood bark shall only be used for sites that are not seeded.

C. Application Rate:

1. Mulch shall cover a minimum of 80% of the soil surface for unseeded areas. For seeded areas, mulch shall be placed loose and open enough to allow some sunlight to penetrate and air to circulate but still cover a minimum of 70% of the soil surface.

2. Mulch shall be applied at a uniform rate of 1½ to 2 tons per acre for sites that are seeded, and 2 to 3 tons per acre for sites that are not seeded. This application results in a layer of ½ to 1½ inches thick for seeded sites, and 1½ to 3 inches thick for sites not seeded.

3. Wood chips or wood bark shall be applied at a rate of 6 to 9 tons per acre to achieve a minimum of 80% ground cover. This application should result in a layer of wood chips or wood bark ½ to 1½ inches thick.

D. Mulch Anchoring Methods

Anchoring of mulch shall be based on the type of mulch applied, site conditions, and accomplished by one of the following techniques:

1. Crimping
   Immediately after spreading, the mulch shall be anchored by a mulch crimper or equivalent device consisting of a series of dull flat discs with notched edges spaced approximately 8 inches apart. The mulch shall be impressed in the soil to a depth of 1 to 3 inches.

2. Natural or Organic Biodegradable Netting

3. Tackifier
   Tackifier shall be sprayed in conjunction with mulch or immediately after the mulch has been placed. Tackifiers must be selected from those that meet the WisDOT Erosion Control Product Acceptability List (PAL). Asphalt based products shall not be applied.
   The tackifiers shall be applied at the following minimum application rates per acre:

   a. Latex–Base: mix 15 gallons of adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 375 gallons of water.

   b. Guar Gum: mix 50 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as tracer with 1,300 gallons of water.

   c. Other Tackifiers: (Hydrophilic Polymers) mix 100 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 1,300 gallons of water.

VI. Considerations

A. Wood products typically absorb available soil nitrogen as they degrade, thus making it unavailable for seed.

B. The use of mulch behind curb and gutter may not be desirable unless anchored by netting, because air turbulence from nearby traffic can displace the mulch. Consider the use of erosion mat or sod as an alternative.

C. In areas where lawn type turf will be established, the use of tackifiers is the preferred anchoring method. Crimping will tend to leave an uneven surface and plastic netting can become displaced and entangled in mowing equipment.

D. A heavier application of mulch may be desired to prevent seedlings from being damaged by frost.

E. Concentrated flows above the site where mulch is applied should be diverted.

F. Mulch should be placed within 24 hours of seeding.

G. Mulching operations should not be performed during periods of excessively high winds that would preclude the proper placement of mulch.

H. Materials such as gravel may be effective for erosion control but are not considered mulches.

VII. Plans and Specifications

A. Plans and specifications for mulching shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Type of mulch used
2. Application rate
3. Timing of application
4. Method of anchoring

B. All plans, standard detail drawings, or specifications shall include schedules for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

Mulch shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

Mulch that is displaced shall be reapplied and properly anchored. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. Definitions

Noxious weed (V.B): Any weed a governing body declares to be noxious within its respective boundaries. The State of Wisconsin list of noxious weeds can be found in s. 66.0407, Stats.

Solid Waste Byproducts (V.B): Includes industrial, commercial, residential, and agricultural wastes that have been processed, incinerated, or composted and still contain inorganic wastes such as glass and metals and organic wastes including plastics, textiles, rubber, leather, and other miscellaneous organic wastes which may be toxic or hazardous in nature.

Non–Channel Erosion Mat

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

II. Purpose

The purpose of this practice is to protect the soil surface from the erosive effect of rainfall and prevent *sheet erosion* [1] during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. This practice applies to both *Erosion Control Revegetative Mats (ECRM)* and *Turf–Reinforcement Mats (TRM)*.

III. Conditions Where Practice Applies

This standard applies to erosion mat selection for use on erodible slopes.

This standard is not for channel erosion; for channel applications reference WDNR Conservation Practice Standard (1053) Channel Erosion Mat.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of erosion mat.

V. Criteria

This section establishes the minimum allowable standards for design, installation and performance requirements. Only mats approved by the Land and Natural Resources Division and listed on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be accepted for use in this standard.

Slope and slope length shall be taken into consideration. This information can be found in the Slope Erosion Control Matrix located in the PAL.

D. Material Selection

1. For mats that utilize netting, the netting shall be bonded to the parent material to prevent separation of the net for the life of the product.
2. For urban class mats the following material requirements shall be adhered to:
   a. Only 100% organic biodegradable netted products are allowed, including parent material, stitching, and netting.
   b. The netting shall be stitched with biodegradable thread/yarn to prevent separation of the net from parent material.
   c. All materials and additive components used to manufacture the anchoring devices shall be completely biodegradable as determined by ASTM D 5338.
   d. Mats with photodegradable netting shall not be installed after September 1st.

DI. Installation

1. ECRMs shall be installed after all topsoiling, fertilizing, liming and seeding is complete.
2. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.
3. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation. Any TRM installation must be approved by Land and Natural Resources Division.
4. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.

DII. Considerations

A. Urban mats may be used in lieu of sod.

B. Documentation of materials used, monitoring logs, project diary and weekly inspection forms, including erosion and stormwater management plans, should be turned over to the authority charged with long term maintenance of the site.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat
2. Installation Sequence
3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Erosion mat shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

X. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. Definitions

Sheet and Rill Erosion (II): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Erosion Control Revegetative Mats (ECRM) (II): Erosion control revegetative mats are designed to be placed on the soil surface.

Turf–Reinforcement Mats (TRM) (II): Turf–reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved Type A soil stabilizer.

Sediment Bale Barrier

(Non–Channel)

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales, hay bales or equivalent material used to intercept sediment–laden sheet flow from small drainage areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications where:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).
2. Where adjacent areas need protection from sediment–laden runoff.
3. Effectiveness is required for less than 3 months.
4. Conditions allow for the bales to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall sediment bale barriers be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
2. Where the maximum gradient upslope of the sediment bale barriers is greater than 50% (2:1).

C. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of the sediment bale barrier.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. At a minimum, sediment bale barriers shall be placed in a single row, lengthwise on the contour, with the ends of adjacent sediment bale barriers tightly abutting one another. The holes between bales shall be chinked (filled by wedging) with straw, hay or equivalent material to prevent water from escaping between the bales.
2. The maximum allowable slope lengths contributing runoff to a sediment bale barrier are specified in Table 1.

Table 1

Slope	Barrier Row Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
33 to 50%	20 feet
> 50%	Not Permitted

3. Sediment bale barriers shall not be placed perpendicular to the contour.
4. The end of the sediment bale barrier shall be extended upslope to prevent water from flowing around the barrier ends.

B. Height – Installed sediment bale barrier shall be a minimum of 10 inches high and shall not exceed a maximum height of 20 inches from ground level.

C. Anchoring and Support

1. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a sediment bale barrier and the length of the proposed barrier to a minimum depth of 4 inches. After bales are staked and chinked, the excavated soil shall be backfilled and compacted against the barrier. Backfill to ground level on the down slope side. On the upslope side of the sediment bale barrier backfill to 4 inches above ground level.
2. At least two wood stakes, "T" or "U" steel posts, or ½ inch rebar driven through at equidistance along the centerline of the barrier shall securely anchor each bale. The minimum cross sectional area for wood stakes shall be 2.0 by 2.0 inches nominal. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven a minimum 12–inches into the ground to securely anchor the sediment bale barriers.
3. Bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of sediment bale barriers will significantly decrease the effectiveness of this practice.

B. Sediment bale barriers should not be used upslope of the disturbed area.

C. A double row of sediment bale barriers may be installed in areas where additional protection is needed.

D. For safety, place all anchoring flush with the sediment bale barrier or cap any exposed anchoring device.

VII. Plans and Specifications

A. Plans and specifications for installing sediment bale barriers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of sediment bale barrier
2. Contributory drainage area
3. Schedules
4. Standard drawings and installation details
5. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Sediment bale barriers shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. Damaged or decomposed sediment bale barriers, any undercutting, or flow channels around the end of the sediment bale barriers shall be repaired.

C. Sediment shall be properly disposed of once the deposits reach 1/2 the height of the sediment bale barrier.

D. Sediment bale barriers and anchoring devices shall be removed and properly disposed of when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

E. Any sediment deposits remaining in place after the sediment bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

IX. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate soil detachment occurs primarily as a result of shear. The transport capacity of the flow in a channel is based on the availability of sediment and is a monatomic function of velocity.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Sediment Basin

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A sediment control device constructed with an engineered outlet, formed by excavation or embankment to intercept sediment–laden runoff and retain the sediment.

II. Purposes

Detain sediment–laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment basins are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment basins shall be constructed at locations accessible for clean out. Site conditions must allow for runoff to be directed into the basin.

Sediment basins are designed to be in place until the contributory drainage area has been *stabilized*[1]. Sediment basins are temporary and serve drainage areas up to 100 acres however other conservation practices are often more economical for smaller drainage areas. For drainage areas smaller than 5 acres sediment traps or ditch checks may be applicable; for design criteria refer to WDNR conservation Practice Standard Sediment Trap (1063) or Ditch Check (1062).

Design to WDNR Conservation Practice Standard Wet Detention Basin (1001) when a permanent stormwater basin is required.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of sediment basins.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. Sediment basins meeting these design criteria are deemed 80% effective by design in trapping sediment.

A. Timing – Sediment basins shall be constructed prior to disturbance of up–slope areas and placed so they function during all phases of construction. Sediment basins shall be placed in locations where runoff from disturbed areas can be diverted into the basin.

B. Sizing Criteria – Properly sized sediment basins are more effective at trapping fine–grained particles than sediment traps. Specific trapping efficiency varies based on the surface area and the particle size distribution of the sediment entering the device. See Figure 1 for clarification of terms. Attachment 1 includes a sample design problem.

Treatment Surface Area – The surface area of the sediment basin measured at the invert of the lowest outlet. The treatment surface area shall be sized based on the texture of the soil entering the device and the peak outflow during the 1–year, 24–hour design storm using Equation 1:

$$S_a = 1.2 * (q_{out} / v_s)$$

Where:

S_a = Treatment surface area measured at the invert of the lowest outlet of sediment basin (square feet)

q_{out} = Peak outflow (cubic feet / second) during the 1–year, 24–hour design storm for the principal outlet

v_s = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor

Particle settling velocities (*Vs*) shall be based on representative soil class as follows:

a. Soil Class 1: $v_s = 1.2*10^{-3}$ ft/sec

b. Soil Class 2: $v_s = 7.3*10^{-5}$ ft/sec

c. Soil Class 3: $v_s = 1.2*10^{-5}$ ft/sec

Note: Particle settling velocities calculated assuming a specific gravity of 2.65 and a water temperature of 68 degrees Fahrenheit.

Soil Class 1 includes particles greater than 20 microns generally corresponding to sand, loamy sand, and sandy loam.

Soil Class 2 includes particles between 5 and 20 microns generally corresponding to loam, silt, and silt loam aggregates as transported in runoff.

Soil Class 3 includes particles between 2 and 5 microns generally corresponding to clay loam, silty clay, and clay aggregates as transported in runoff.

The representative soil class shall be selected based on the dominant textural class of the soil entering the device.

The treatment surface area of sediment basins can be reduced when used in conjunction with water applied polymers. When employing polymers, size the treatment surface area for controlling fine soils (Class 3) using the settling velocity for medium soils (Class 2). When designing for medium sized soils (Class 2) use the settling velocity for coarse soils (Class 1). See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.

Note: Use of all polymers must be approved by Land and Natural Resources Division.

Depth below Treatment Surface Area – The depth below the treatment surface area as measured from the invert of the lowest outlet of the sediment basin shall be a minimum of 5 feet deep (2 feet for sediment storage plus 3 feet to protect against scour/ resuspension) and a maximum of 10 feet deep to limit the potential for thermal stratification.

Due to side slope requirements and safety shelf considerations it maybe difficult to maintain 5 feet of depth for the entire treatment surface area. Therefore, 50% of the total treatment surface area shall be a minimum of 5 feet deep. For basins less than 5,000 square feet, maximize the area of 5 feet depth.

Interior side slopes below the lowest invert shall be 2:1 (horizontal: vertical) or flatter to maintain soil stability.

While a permanent pool of water below the lowest invert may form, it is not required to be maintained through irrigation or installation of a liner system.

Active Storage Volume – The volume above the treatment surface area shall be calculated using one of the following methods:

a. The method outlined in TR–55 for determining the storage volume for detention basins. This can be accomplished by using Figure 2 where:

   $\mathbf{q_o}$ = Peak outflow (cubic feet / second) during the 1–year, 24–hour design storm for the principal outlet calculated using Equation 1 (see section V.B.1).

   $\mathbf{q_i}$ = Calculated peak inflow or runoff rate (cubic feet / second) during the 1–year, 24–hour design storm. **Vr** = Calculated volume of runoff from the 1–year 24–hour design storm for the entire contributory area with the maximum area of disturbance characterized as bare soil.

   Vs = Is the required active storage volume determined using Figure 2.

b. The active storage volume may be calculated based on routing the 1–year, 24–hour storm provided the principal outlet requirements stipulated in section V.D.2 are maintained. This method will require the use of a model.

Note: Both these methods require iterative calculations.

Shape – The length to width ratio of the flow path shall be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the basin including the treatment surface area and any forebay.

C. Embankments – Earthen embankments shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

1. The base of the embankment shall be stripped of all vegetation, stumps, topsoil and other organic matter.

2. Side slopes shall be 3:1 or flatter. The minimum embankment top width shall be adequate to provide structural stability. Where applicable the top width shall be wide enough to provide maintenance access.

3. There shall be a core trench or key–way along the embankment.

Any pipes extending through the embankment shall be bedded and backfilled with equivalent soils used to construct the embankment. The bedding and backfill shall be compacted in lifts and to the same standard as the original embankment. Excavation through a completed embankment shall have a minimum side slope of 1:1 or flatter.

Measures shall be taken to minimize seepage along any conduit buried in the embankment.

D. Outlet – Sediment basins shall have both a principal outlet and an overflow spillway.

1. Timing – Outlets must be constructed in conjunction with the remainder of the basin and must be constructed prior to the basin receiving runoff. Sediment basins are ineffective until the outlet is constructed.

2. Principal Water Quality Outlet – The principal water quality outlet shall be designed to pass the 1–year 24–hour storm without use of the overflow spillway or other outlet structures. The maximum outflow (q_o) from the principal water quality outlet shall be less than or equal to the q_o used in Equation 1 (V.B.1). If the sediment basin is to serve as a permanent stormwater basin, the principal outlet structure can be modified (i.e. removable plates) to meet flow requirements encountered during and after construction; separate outlet structures do not need to be constructed.

3. Overflow (Emergency) Spillway – An overflow spillway shall be provided consisting of an open channel constructed adjacent to the embankment and built over a stabilized area. The spillway shall be designed to carry the peak rate of runoff expected from a 10–year, 24–hour design storm or one commensurate with the degree of hazard, less any reduction due to flow in the principal outlet. The top of the embankment shall be at least one foot above the design high water level and a minimum of 1 foot above the invert of the overflow spillway. The overflow spillway shall be protected from erosion. Flow from the overflow spillway shall be directed away from the embankment.

4. Outlet Protection – All outlet designs shall incorporate preventive measures for ice damage, trash accumulation, and erosion at the outfall. For orifices less than 8–inches in diameter, or equivalent, additional measures to prevent clogging are required.

DI. Inlet Protection – Inlets shall be designed to prevent scour and reduce velocities during peak flows. Possible design options include flow diffusion, plunge pools, directional berms, baffles, or other energy dissipation structures.

DII. Location – Temporary sediment basins should be located to provide access for cleanout and disposal of trapped sediment.

DIII. Removal – Temporary sediment basins shall be removed after the contributing drainage area has been stabilized. Complete final grading and restoration according to the site plans. If standing water needs to be removed it shall be done in accordance with the Dewatering Practice Standard above.

VI. Considerations

A. When constructing a sediment basin that will also serve as the long–term stormwater detention pond, build the sediment basin to the larger of the two sizes required either for stormwater control or erosion control. In addition, when sizing the outlet structure first design the outlet for the long–term stormwater management requirements then check to satisfy the flow requirements for sediment control during construction. If additional flow restriction is needed consider use of a temporary restriction plates or other measures to avoid having to construct separate outlet structures for the sediment basin and stormwater basin.

B. Over–excavation beyond the required depth in the sediment storage area of the sediment basin may allow for less frequent maintenance. Addition of other measures in the contributing drainage area may reduce sediment accumulation and associated maintenance requirements.

C. The use of a sediment forebay can extend the useful life of the main sediment storage area by trapping the majority of sediment in the forebay area. Separation of the forebay from the rest of the basin requires construction of a submerged shelf (if wet) or a stone or stabilized earthen embankment. The forebay should have a surface area equal to at least 12% of the total basin area.

D. In addition to soil stability issues, interior slopes of sediment basins should be selected based on safety issues commensurate with the degree of hazard.

VII. Plans and Specifications

A. Plans and specifications for installing sediment basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

1. Location of sediment basin
2. Schedules and sequence of installation and removal
3. Standard drawings and installation details
4. Control structure detail and layout
5. Sizing of sediment storage area
6. Maintenance requirements

B. All plans, standard detail drawings, or specifications shall include sequence for installation, inspection, and maintenance requirements. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Sediment basins shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

X. Sediment shall be removed to maintain the three foot depth of the treatment surface area as measured from the invert of the principal outlet. Sediment may need to be removed more frequently.

XI. If the outlet becomes clogged it shall be cleaned to restore flow capacity.

XII. Provisions for proper disposal of the sediment removed shall be made.

XIII. Maintenance shall be completed as soon as possible with consideration to site conditions.

XIV. References

Chapter NR 333, Dam and Design Construction.

Hann, Barfield, and Hayes. Design Hydrology and Sedimentology for Small Catchments. Academic Press Inc., 1994.

Robert E. Pitt, Small Storm Hydrology.

US Bureau of Reclamation, Design of Small Dams. http://www.usbr.gov/pmts/hydraulics_lab/pubs/index.cfm.

USDA, Natural Resources Conservation Service, Ponds – Planning, Design, Construction. Agriculture Handbook No. 590, Revised September 1997.

WDNR Conservation Practice Standard 1001 Wet Detention Basin.

X. Definitions

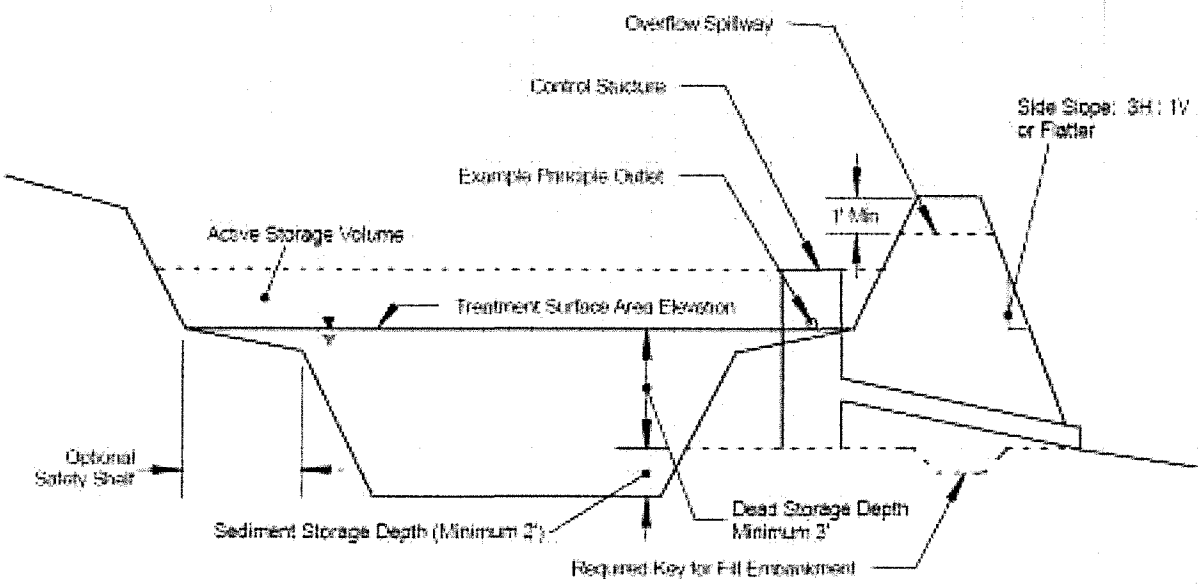
Active Storage Volume (V.B.3) – Is measured from the invert of the lowest outlet to the invert of the emergency spillway.

Stabilized (III) – Means protecting exposed soil from erosion.

Treatment Surface Area (V.B.1) – Is the surface area of the sediment basin measured at the invert of the lowest outlet.

Figure 1

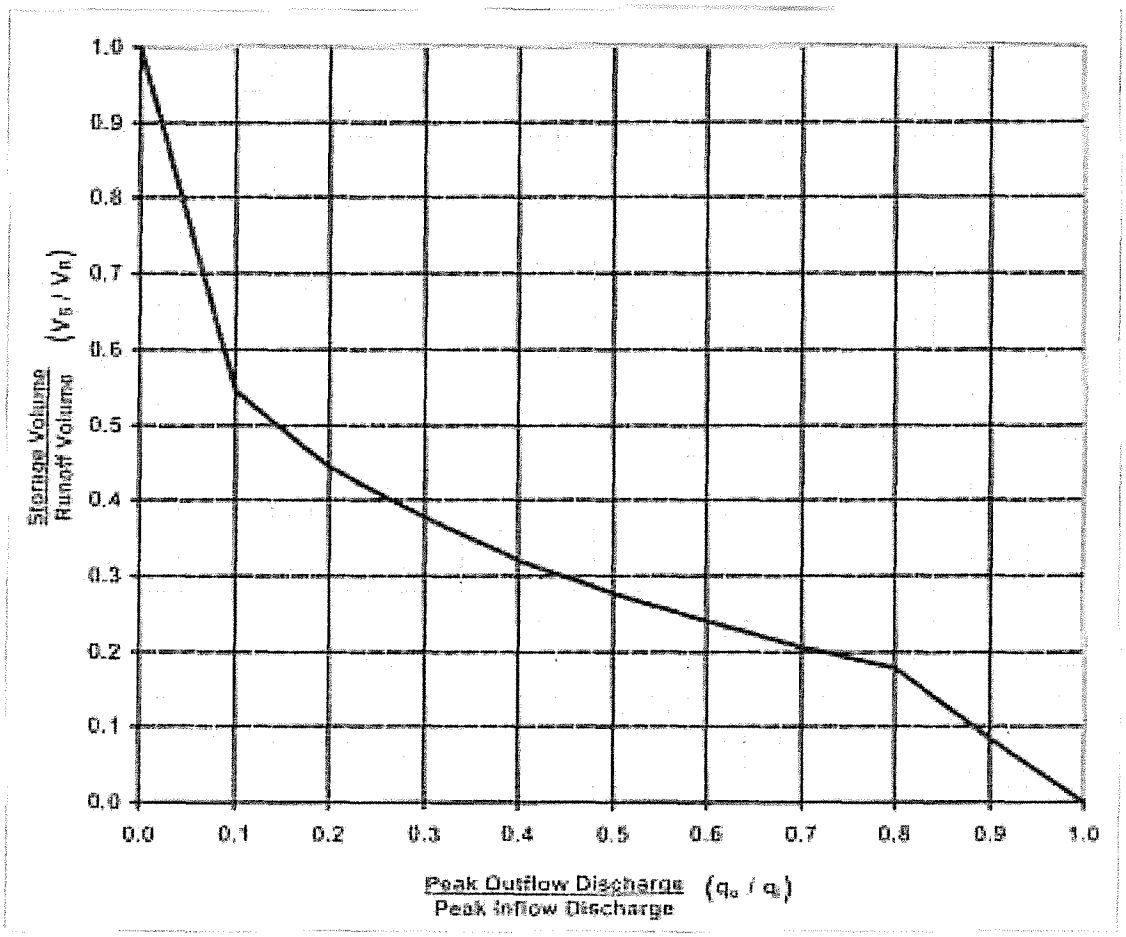
Clarification of Sediment Basin Terminology



Note: Features illustrated are for the purpose of defining terms used in the standard. The Drawing is not to scale

Figure 2

Approximate Detention Basin Routing for Type II Storms



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington D.C. 1988

Rainfall Quantities:

Table 1 provides a summary of the 1–year, 24–hour rainfall totals using NRCS mandated TP–40 which has not been updated since 1961. Table 2 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 1
Rainfall for Wisconsin Counties for a 1–Year, 24–Hour Rainfall[1]

Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Keno-ha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette

[1]TP – 40 – Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.

Table 2
Rainfall for Wisconsin Counties for a 1–Year, 24–Hour Rainfall[2]

Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond Du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha

[2] Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.

Sediment Trap

I. Definition

A *temporary*[1] sediment control device formed by excavation and/or embankment to intercept sediment–laden runoff and to retain the sediment.

II. Purposes

To detain sediment–laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment traps are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment traps shall be constructed at locations accessible for clean out. Sediment traps are designed to be in place until the contributory drainage area has been *stabilized*. The contributory drainage area shall be a maximum of 5 acres. For concentrated flow areas smaller than one acre, ditch checks may be installed; refer to conservation practice standard Ditch Check (above). For larger drainage areas and/or for sediment basins requiring an engineered outlet structure refer to conservation practice standard Sediment Basin or Wet Detention Basin (above).

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of sediment traps.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. **Timing** – Sediment traps shall be constructed prior to disturbance of up–slope areas and placed so they function during all phases of construction. Sediment traps shall be placed in locations where runoff from disturbed areas can be diverted into the traps.

B. **Sizing Criteria** – Properly sized sediment traps are relatively effective at trapping medium and coarse–grained particles. To effectively trap fine–grained particles, the sediment trap must employ a large surface area or polymers. The specific trapping efficiency of a sediment trap varies based on the surface area, depth of dead storage, and the particle size distribution and concentration of sediment entering the device.

1. Surface Area – The minimum surface area of a sediment trap shall be based on the dominant textural class of the soil entering the device. The surface area calculated below represents the surface for the permanent pool area (if wet) or the surface area for the dead storage. This surface area is measured at the invert of the stone outlet (see Figure 1).

   a. For coarse textured soils (loamy sand, sandy loam, and sand):

   $A_{s\,(coarse)} = 625 * A_{dr}$

   b. For medium textured soils (loams, silt loams, and silt):

   $A_{s\,(medium)} = 1560 * A_{dr}$

   c. For fine textured soils (sandy clay, silty clay, silty clay loam, clay loam, and clay):

   $A_{s\,(fine)} = 5300 * A_{dr}$

   For the equations above:

   A_s = surface area of storage volume in square feet

   A_{dr} = contributory drainage area in acres

Note: The equations above were derived using a representative particle distribution for detached sediment for each textural class.

Sediment traps designed based on this standard will achieve 80% reduction of suspended solids for the drainage area.

d. The surface area of sediment traps used in areas with fine to medium sized soils can be reduced when used in conjunction with water applied polymers. When employing polymers, size the surface area for controlling fine particles using the criteria for medium soils (V.B.1.b.) and when controlling medium sized particles use the sizing equation contained in (V.B.1.a.) for coarse soils.

2. Depth – The depth of the sediment trap measured from the sediment trap bottom to the invert of the stone outlet, shall be at least three feet to minimize re–suspension and provide storage for sediment.

3. Shape – The sediment trap shall have a length to width ratio of at least 2:1. The position of the outlet to the inlet shall be as such to minimize short–circuiting of the water flow path.

4. Side Slopes – Side slopes shall be no steeper than 2:1.

Note: A sediment trap sized with the surface area equations above, a three–foot depth, and 2:1 side slopes will generally result in an 80% sediment reduction. Slopes flatter than 2:1 will require larger surface areas to provide adequate storage.

C. **Embankment** – Embankments of temporary sediment traps shall not exceed five feet in height measured from the downstream toe of the embankment to the top of the embankment. Construct embankments with a minimum top width of four feet, and side slopes of 2:1 or flatter. Earthen embankments shall be compacted. Where sediment traps are employed as a perimeter control, the embankments shall have stabilization practices place prior to receiving runoff.

D. **Outlet** – Sediment traps shall be constructed with both a principal and emergency spillway. The stone outlet of a sediment trap shall consist of a stone section of embankment (stone outlet) located at the discharge point. The stone outlet section provides a means of dewatering the basin back to the top of the permanent storage between storm events, and also serves as a non–erosive emergency spillway for larger flow events.

1. Outlet Size – The size of the outlet shall depend on the contributory drainage area and desired outflow. The length of the stone outlet / weir outlet can be calculated based on the size of the drainage area found in Table 1. Refer to section IX References for the equation used to calculate flow through a stone outlet or gabion.

Table 1 Weir Length

Drainage Area (acres)	Weir Length (feet)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0

The emergency spillway (top of the weir) shall be sized to adequately pass the 10–year 24–hour storm without over topping the sediment trap. The crest of the spillway shall be at least one foot below the top of the embankment. The, minimum weir lengths provided in Table 1 are adequate to pass the 10 year event.

Note: The weir length has little effect on overall treatment efficiency provided the sizing criteria in Section V.B. is adhered to. The stone outlet shall have a minimum top width of 2 feet and a maximum side–slope of 2:1. Discharge from the sediment basin shall be safely conveyed to a stormwater facility, drainage way, or waterbody. The discharge velocity shall be below the velocity to initiate scour unless appropriate stabilization methods are employed.

2. Stone Size – Stone shall consist of angular well graded 3 to 6 inch clear washed stone.

3. Keyway Trench – The stone outlet shall be protected from undercutting by excavating a keyway trench across the stone foundation and up the sides to the height of the outlet. See Figure 1. Underlying with geotextile fabric is optional.

E. Provide access for cleanout and disposal of trapped sediment.

VI Considerations

A. Sediment traps generally require excessive surface areas to settle clay particles and fine silts. If these conditions exist on the site consider using a sediment basin (Conservation Practice Standard Sediment Basin listed above).

B. To improve trapping efficiency, filter fabric can be placed on the up–slope side of the stone outlet / gabion and anchored with stone. When fabric is utilized to enhance filtering, more frequent maintenance is required to prevent clogging. When using fabric, a monofilament type fabric shall be used (such as WisDOT Type FF). The apparent opening size of the fabric, not the stone size, will dictate the flow rate through the outlet therefore outlet lengths need to be calculated since values in Table 1 are based on stone. When calculating the size of the outlet a clogging factor of 50% should be used for the fabric.

C. Consider possible interference with construction activities when locating sediment traps.

D. Provisions should be made for protecting the embankment from failure caused by storms exceeding the 10–year design requirement. Consider a stabilized and non–erosive emergency spillway bypass.

E. In general, groundwater impacts from temporary sediment traps that have storage areas in contact with groundwater are not a major concern. However, sediment trap contact with groundwater should be avoided in areas with karst features, fractured bedrock, or areas of significant groundwater recharge.

F. Sediment trapping is achieved primarily by settling within the pool formed by the trap. Sediment trapping efficiency is a function of surface area, depth of pool, and detention time. If site conditions permit, a length to width ratio greater than 2:1 will increase efficiency.

G. If site conditions prevent the sediment trap from having a three–foot depth, then an equivalent storage volume must be created through increasing the surface area.

H. For sediment traps in place longer than 6 months, consider outlets constructed of two types of stone. A combination of coarse aggregate and riprap (WisDOT light riprap classification) should be used to provide stability. A one–foot layer of one inch washed stone then should be placed on the up–slope face to reduce drainage flow rate.

VII Plans and Specifications

A. Plans and specifications for installing sediment traps shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location and spacing of sediment traps
2. Schedules and sequence of installation and removal
3. Standard drawings and installation details
4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include a schedule for installation, inspection, maintenance, and identify the responsible party.

VIII Operation and Maintenance

Sediment Traps shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period. Sediment may need to be removed more frequently.

A. Deposits of sediment shall be removed when they reach a depth of one foot.

B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.

C. Recommend provisions for proper disposal of the sediment removed from the trap.

D. Maintenance shall be completed as soon as possible with consideration given to site conditions.

E. Sediment traps shall be removed and the location stabilized after the disturbed area draining to the sediment trap is stabilized and no longer susceptible to erosion.

IX References

Flow through the stone outlet and gabion can be calculated using the following equation:

$Q = (h_{2/3} * L) / [(W/D) + 25 + W_2]_{1/2}$

Where:

Q = total flow through stone (cfs)

h = depth of flow measured from invert of the stone outlet to the crest of emergency spillway (ft)

W = average width of weir or flow

length through stone outlet (ft)

L = length of weir (ft)

D = Average Rock Diameter (ft)

Note: For a stone outlet, the length of stone outlet (L) will vary with the depth and slope of stone outlet. For a gabion, the length of flow is fixed to gabion width. A complete discussion of this equation and its proper application can be found in:

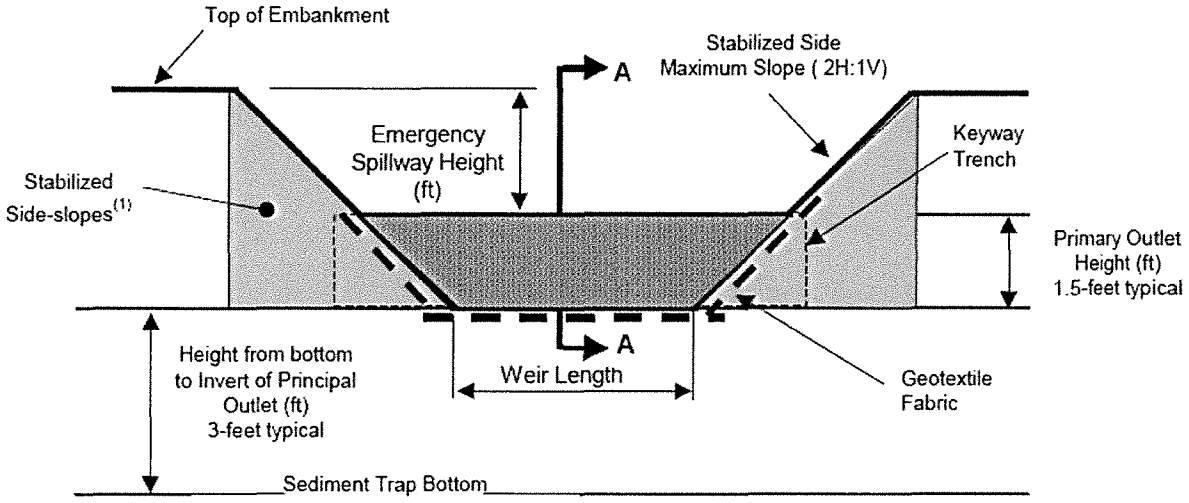
C. McIntyre, G. Aron, J. Willenbrock, and M. Deimler. Report No. 10: Analysis of flow through porous media as applied to gabion dams regarding the storage and release of storm water runoff. NAHB/NRC Designated Housing Research Center at Penn State, Department of Civil Engineering; August 1992.

X Definitions

Stabilized (III): Means that all land disturbing construction activities at the construction site have been completed and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures or that employ equivalent stabilization measures.

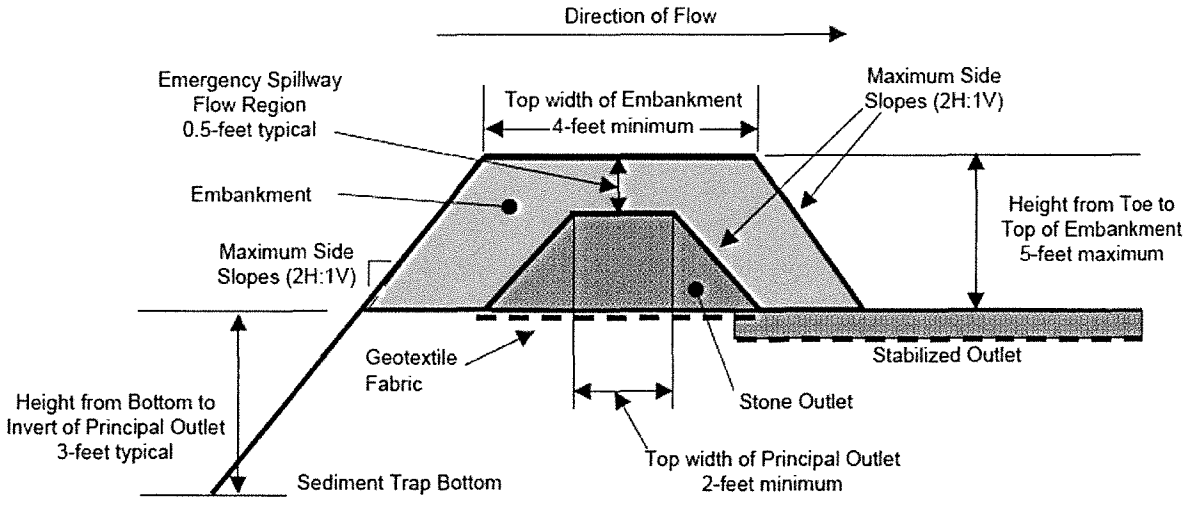
Temporary (I): An erosion control measure that is in place for the duration of construction or until the site is stabilized.

Figure 1: Sediment Trap Outlet Detail



Cross-section View of Principal Outlet

Notes: (1) Side-slopes and faces of earthen embankment around outlet shall be armored with riprap or stabilized with erosion mat sufficient to handle flows from the 10-year storm.



View A - A of Principal Outlet

Seeding For Construction Site Erosion Control

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Planting seed to establish temporary or permanent vegetation for erosion control.

II. Purpose

The purpose of *temporary seeding*[1] is to reduce runoff and erosion until permanent vegetation or other erosion control practices can be established. The purpose of *permanent seeding* is to permanently stabilize areas of exposed soil.

III. Conditions Where Practice Applies

This practice applies to areas of exposed soil where the establishment of vegetation is desired. Temporary seeding applies to disturbed areas that will not be brought to final grade or on which land–disturbing activities will not be performed for a period greater than 30 days, and requires vegetative cover for less than one year. Permanent seeding applies to areas where perennial vegetative cover is needed.

IV. Applicable Laws

Users of this standard shall be aware of all applicable laws, rules, regulations or permit requirements governing seeding.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site and Seedbed Preparation

Site preparation activities shall include:

1. Temporary Seeding
   a. Temporary seeding requires a seedbed of loose soil to a minimum depth of 2 inches.
   b. Fertilizer application is not generally required for temporary seeding. However, any application of fertilizer or lime shall be based on soil testing results.
   c. The soil shall have a pH range of 5.5 to 8.0.
2. Permanent Seeding
   a. Topsoil installation shall be completed prior to permanent seeding.
   b. Permanent seeding requires a seedbed of loose topsoil to a minimum depth of 4 inches with the ability to support a *dense* vegetative cover.
   c. Application rates of fertilizer or lime shall be based on soil testing results.
   d. Prepare a tilled, fine, but firm seedbed. Remove rocks, twigs foreign material and clods over two inches that cannot be broken down.
   e. The soil shall have a pH range of 5.5 to 8.0.

B. Seeding

1. Seed Selection
   a. Seed mixtures that will produce dense vegetation shall be selected based on soil and site conditions and intended final use. Section IX References, lists sources containing suggested seed mixtures. All seed mixtures are subject to approval by Land and Natural Resources Division.

c. Seed mixtures that contain potentially invasive species or species that may be harmful to native plant communities shall be avoided.

d. Seed shall not be used later than one year after the test date that appears on the label.

e. Seed shall be tested for purity, germination and noxious weed seed content and shall meet the minimum purity and germination requirements as prescribed in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

2. Seed Rates

a. Temporary Seeding (Cover Crop)

Areas needing protection during periods when permanent seeding is not applied shall be seeded with annual species for temporary protection. See Table 1 for seeding rates of commonly used species. The residue from this crop may either be incorporated into the soil during seedbed preparation at the next permanent seeding period or left on the soil surface and the planting made as a no–till seeding.

Table 1
Temporary Seeding Species and Rates

Species	Lbs/Acre	Percent Purity
Oats	131[1]	98
Cereal Rye	131[2]	97
Winter wheat	131[2]	95
Annual Ryegrass	80[2]	97

1 Spring and summer seeding

2 Fall seeding

b. Permanent Seeding

Rates shall be based on pounds or ounces of Pure Live Seed (PLS) per acre. Section IX contains some possible reference documents that provide seeding rates. Permanent seeding rates may be increased above the minimum rates shown in the reference documents to address land use and environmental conditions.

If a *nurse crop* is used in conjunction with permanent seeding, the nurse crop shall not hinder establishment of the permanent vegetation.

A nurse crop shall be applied at 50% its temporary seeding rate when applied with permanent seed.

3. Inoculation

Legume seed shall be inoculated in accordance with the manufacturer's recommendations. Inoculants shall not be mixed with liquid fertilizer.

4. Sowing

Seed grasses and legumes no more than ¼ inch deep. Distribute seed uniformly. Mixtures with low seeding rates require special care in sowing to achieve proper seed distribution.

Seed may be broadcast, drilled, or hydroseeded as appropriate for the site.

Seed when soil temperatures remain consistently above 53° F. *Dormant seed* when the soil temperature is consistently below 53° F (typically Nov. 1st until snow cover). Seed shall not be applied on top of snow.

VI. Considerations

A. Consider seeding at a lower rate and making two passes to ensure adequate coverage.

B. Compacted soil areas may need special site preparation prior to seeding to mitigate compaction. This may be accomplished by chisel plowing to a depth of 12 inches along the contour after heavy equipment has left the site.

C. Sod may be considered where adequate watering is available.

D. When working in riparian areas refer to the NRCS Engineering Field Handbook, Chapter 16, Streambank and Shore-line Protection and Chapter 18, *Soil Bioengineering* for Upland Slope Protection and Erosion Reduction.

E. A site assessment should be conducted to evaluate soil characteristics, topography, exposure to sunlight, proximity to natural plant communities, proximity to nuisance, noxious and/or invasive species, site history, moisture regime, climatic patterns, soil fertility, and previous herbicide applications.

F. Lightly roll or compact the area using suitable equipment when the seedbed is judged to be too loose, or if the seedbed contains clods that might reduce seed germination.

G. See Section IX. References for suggested seed mixes (NRCS, WisDOT, UWEX) or use their equivalent. All seed mixtures must be approved by Land and Natural Resources Division.

H. Turf seedlings should not be mowed until the stand is at least 6 inches tall. Do not mow closer than 3 inches during the first year of establishment.

I. Seeding should not be done when the soil is too wet.

J. Consider watering to help establish the seed. Water application rates shall be controlled to prevent runoff and erosion.

K. Prairie plants may not effectively provide erosion control during their establishment period without a nurse crop.

L. Topsoil originating from agricultural fields may contain residual chemicals. The seedbed should be free of residual herbicide or other contaminants that will prevent establishment and maintenance of vegetation. Testing for soil contaminants may be appropriate if there is doubt concerning the soil's quality.

M. Consider using mulch or a nurse crop if selected species are not intended for quick germination. When mulching refer to Conservation Practice Standard Mulching for Construction Sites.

VII. Plans and Specifications

Plans and specifications for seeding shall be in keeping with this standard and shall describe the requirements for applying this practice.

All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. During construction areas that have been seeded shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period. Inspect weekly during the growing season until vegetation is densely established or permit expires. Repair and reseed areas that have erosion damage as necessary.

B. Limit vehicle traffic and other forms of compaction in areas that are seeded.

C. A fertilizer program should begin with a soil test. Soil tests provide specific fertilizer recommendations for the site and can help to avoid over–application of fertilizers.

IX. References

A. Seed Selection References

United States Department of Agriculture – Natural Resource Conservation Service Field Office Technical Guide Section IV, Standard 342, Critical Area Planting.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications For Highway and Structure Construction. Section 630, Seeding.

B. General References

Association of Official Seed Analysts, 2003. Rules for Testing Seed. http://www.aosaseed.com.

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3–85 – 3–91. Minneapolis.

The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication GWQ002 Lawn & Garden Fertilizers.

X. Definitions

Dense (V.A.2.b) A stand of 3–inch high grassy vegetation that uniformly covers at least 70% of a representative 1 square yard plot.

Dormant seed (V.B.4): Seed is applied after climatic conditions prevent germination until the following spring.

Introduced Species (VI.F) Plant species that historically would not have been found in North America until they were brought here by travelers from other parts of the world. This would include smooth bromegrass and alfalfa. Some of these species may have a wide distribution such as Kentucky bluegrass.

Nurse Crop (V.B.2.b): Also known as a companion crop; is the application of temporary (annual) seed with permanent seed.

Permanent seeding (II) Seeding designed to minimize erosion for an indefinite period after land disturbing construction activities have ceased on the site.

Soil Bioengineering (VI.D) Practice of combining mechanical, biological and ecological concepts to arrest and prevent shallow slope failures and erosion.

Temporary Seeding (II) Seeding designed to control erosion for a time period of one year or less that is generally removed in order to perform further construction activities or to permanently stabilize a construction site.

Topsoil (V.A.2.a) Consists of loam, sandy loam, silt loam, silty clay or clay loam humus–bearing soils adapted to sustain plant life with a pH range of 5.5 – 8.0. Manufactured topsoil shall through the addition of sand or organic humus material, peat, manure or compost meet the above criteria.

Silt Fence

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Silt fence is a temporary sediment barrier of entrenched permeable geotextile fabric designed to intercept and slow the flow of sediment–laden sheet flow runoff from small areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).
2. Where adjacent areas need protection from sediment–laden runoff.
3. Where effectiveness is required for one year or less.
4. Where conditions allow for silt fence to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall silt fence be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
2. Where the maximum gradient upslope of the fence is greater than 50% (2:1).

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of silt fence.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. When installed as a stand–alone practice on a slope, silt fence shall be placed on the contour. The parallel spacing shall not exceed the maximum slope lengths for the appropriate slope as specified in Table 1.

Table 1

Slope	Fence Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
> 33%	20 feet

2. Silt fences shall not be placed perpendicular to the contour.
3. The ends of the fence shall be extended upslope to prevent water from flowing around the ends of the fence.

B. Height – Installed silt fences shall be a minimum 14 inches high and shall not exceed 28 inches in height measured from the installed ground elevation.

C. Support – Silt fences shall be supported by either steel or wood supports as specified below:

1. Wood supports

   a. The full height of the silt fence shall be supported by 1 1/8 inches by 1 1/8 inches air or kiln dried posts of hickory or oak.

   b. The silt fence fabric shall be stapled, using at least 0.5–inch staples, to the upslope side of the posts in at least 3 places.

   c. The posts shall be a minimum of 3 feet long for 24–inch silt fence and a minimum of 4 feet for 36–inch silt fence fabric.

2. Steel supports

   a. The full height of the silt fence shall be supported by steel posts at least 5 feet long with a strength of 1.33 pounds per foot and have projections for the attachment of fasteners.

   b. The silt fence fabric shall be attached in at least three places on the upslope side with 50 pound plastic tie straps or wire fasteners. To prevent damage to the fabric from fastener, the protruding ends shall be pointed away from the fabric.

3. The maximum spacing of posts for non–woven silt fence shall be 3 feet and for woven fabric 8 feet.

4. Silt fence shall have a support cord.

5. Where joints are necessary, each end of the fabric shall be securely fastened to a post. The posts shall then be wrapped around each other to produce a stable, secure joint or shall be overlapped the distance between two posts.

6. A minimum of 20 inches of the post shall extend into the ground after installation.

D. Anchoring – Silt fence shall be anchored by spreading at least 8 inches of the fabric in a 4 inch wide by 6 inch deep trench, or 6 inch deep V–trench on the upslope side of the fence. The trench shall be backfilled and compacted. Trenches shall not be excavated wider and deeper than necessary for proper installation.

On the terminal ends of silt fence the fabric shall be wrapped around the post such that the staples are not visible.

E. Geotextile Fabric Specifications – The geotextile fabric consists of either woven or non–woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Non–woven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof. All fabric shall meet the following requirements as specified in Table 2.

Table 2

Test Requirement	Method	Value[1]
Minimum grab tensile strength in the machine direction	ASTM D 4632	120 lbs. (550 N)
Minimum grab tensile strength in the cross machine direction	ASTM D 4632	100 lbs. (450 N)
Maximum apparent opening size equivalent standard sieve	ASTM D 4751	No. 30 (600 µm)
Minimum permittivity	ASTM D 4491	0.05 scc^{-1}
Minimum ultraviolet stability percent of strength retained after 500 hours of exposure	ASTM D 4355	70%

(WisDOT Standard Specifications for Road and Bridge Construction, 2001)

[1] All numerical values represent minimum / maximum average roll values. (For example, the average minimum test results on any roll in a lot should meet or exceed the minimum specified values.)

Silt fence shall have a maximum flow rate of 10–gallons/minute/square foot at 50mm constant head as determined by multiplying permittivity in 1/second as determined by ASTM D–4491 by a conversion factor of 74.

F. Removal – Silt fences shall be removed once the disturbed area is permanently stabilized and no longer susceptible to erosion. Failure to comply with this requirement may subject the contractor to civil forfeiture for each day of noncompliance.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of silt fences will significantly decrease the effectiveness of this practice.

Silt fences should be considered for trapping sediment where sheet and rill erosion may be expected to occur in small drainage areas. Silt fences should not be placed in areas of concentrated flow.

B. Silt fences should be installed prior to disturbing the upslope area.

C. Silt fences should not be used to define the boundaries of the entire project. Silt fence should be placed only in areas where it is applicable due to its cost and the fact that it is not biodegradable. For example, silt fence should not be placed in locations where the natural overland flow is from an undisturbed area into disturbed areas of the project. It should also not be used as a diversion.

D. Silt fence should not be used in areas where the silt fence is at a higher elevation than the disturbed area.

E. When placing silt fence near trees, care should be taken to minimize damage to the root system. Avoid compaction and root cutting within 1.5 feet multiplied by the inch diameter of the tree (for example: for 10–inch trees keep out a 15–foot radius from the trunk). Refer to UWEX publication Preserving Trees During Construction for more information.

F. To protect silt fence from damage in areas of active construction or heavy traffic, silt fence should be flagged, marked, or highlighted to improve visibility.

G. Silt fence effectiveness is generally increased when used in conjunction with other upslope erosion control practices. To further strengthen the silt fence, straw / hay bales can be placed on the down slope side.

H To help ensure effectiveness, silt fence should be inspected and repaired as necessary prior to forecasted rain events.

I. Where installation with wood posts is difficult, such as when hard or frozen ground is encountered, the use of steel post is recommended.

J. Silt fence can be mechanically installed with a plow type device provided that the silt fence is trenched in a manner such that equivalent performance is achieved to that specified in Section V.D.

VII. Plans and Specifications

A. Plans and specifications for installing silt fence shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of silt fence
2. Contributory drainage area
3. Schedules
4. Material specification conforming to standard
5. Standard drawings and installation details
6. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Silt fences shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

X. Damaged or decomposed fences, undercutting, or flow channels around the end of barriers shall be repaired or corrected.

XI. Sediment shall be properly disposed of once the deposits reach ½ the height of the fence.

IX. References

UWEX Publication A0327 "Preserving Trees During Construction"

X. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

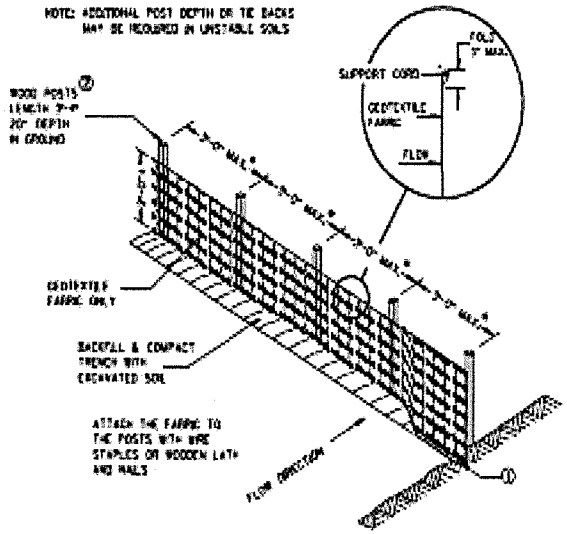
Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

GENERAL NOTES

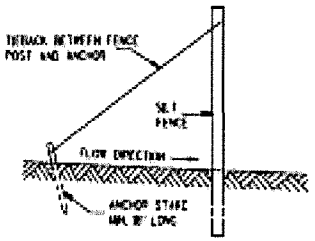
① TRENCH SHALL BE A MINIMUM OF 4" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.

② WOOD POSTS SHALL BE A MINIMUM SIZE OF 1½" x 1½" OF OAK OR HICKORY.

③ CONSTRUCT SILT FENCE FROM A CONTINUOUS ROLL IF POSSIBLE BY CUTTING LENGTHS TO AVOID JOINTS. IF A JOINT IS NECESSARY USE ONE OF THE FOLLOWING TWO METHODS: A) TWIST METHOD - OVERLAP THE END POSTS AND TWIST, OR ROTATE, AT LEAST 180 DEGREES. B) HOOK METHOD - HOOK THE END OF EACH SILT FENCE LENGTH.

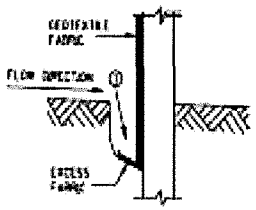


SILT FENCE

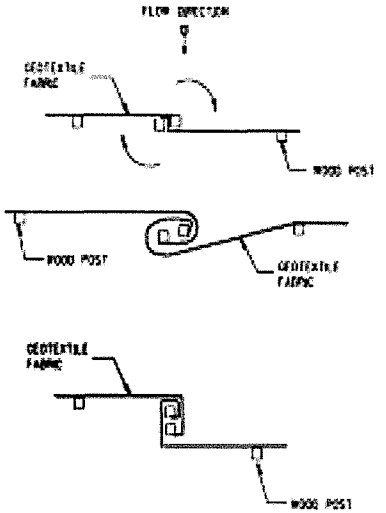


SILT FENCE TIE BACK

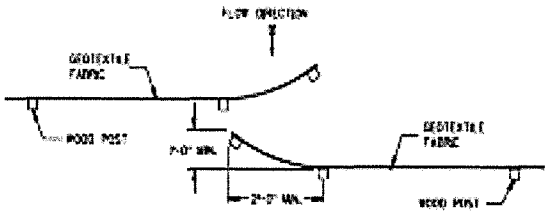
WHEN ADDITIONAL SUPPORT REQUIRED



TRENCH DETAIL



TWIST METHOD



HOOK METHOD

JOINING TWO LENGTHS OF SILT FENCE ③

This drawing based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 9-5.

SILT FENCE

SPS 320 to 325 APPENDIX A

Silt Curtain

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary permeable fabric installed in a waterway or waterbody to minimize sediment transport. A silt curtain does not extend to the bottom of the channel and is placed parallel or perpendicular to the direction of flow.

II. Purposes

The purpose of this practice is to provide sediment containment while construction activities are occurring in or directly adjacent to a waterway or waterbody.

III. Conditions Where Practice Applies

This practice applies where construction activities intrude or are directly adjacent to a waterway or water body. This includes but is not limited to bridge construction, rip rap placement, utility work, stream bank restoration, boat launches and dredging.

Silt curtain is intended for calm water conditions where it will not be subjected to wind, wave, or current. Silt curtains are appropriate to settle out coarse and granular soils where water depth at the time of construction is greater than or equal to 4 feet. For applications in finer sediment or moving water see Turbidity Barrier Technical Standard below.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of silt curtains.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Installation – Details of construction not listed in the text shall conform to the pertinent requirements of Figure 1.

1. The silt curtain shall be installed before construction activities are initiated in or adjacent to the waterway or water body. Install the silt curtain as close to the construction as practical. The curtain shall remain in place and be maintained until the construction activity is completed and the disturbed area is *stabilized* [1].
2. The ends of the silt curtain shall be securely anchored and keyed into the shoreline to fully enclose the area where sediment may enter the water.
3. A 2–foot gap shall exist between the weighted lower end of the curtain and the bottom of the waterway or water body.
4. Bottom anchors shall be used to hold the silt curtain in the same position relative to the bottom the waterway or water body without interfering with the function of the curtain. Anchors shall either be driven into the bottom of the waterway or water body or be weighted and attached to the curtain flotation device via an anchor line. Manufacture's recommendations shall be followed for the number and spacing of anchors.
5. Danger buoys shall be used as directed by the Coast Guard or DNR permit when working in navigable waters.

B. Material:

1. Reusable components of the silt curtain system shall be clean and free of potential exotic species. Fabric cannot be reused.
2. The silt curtain shall be constructed from heavy woven filter fabric to allow water to pass through the barrier yet retain sediment. All fabric seams shall be heat sealed or sewn. Silt curtain fabric shall conform to the specifications in Table 1.

Table 1

Requirement	Value
Thickness	15 mils (0.38 mm)
Min. grab tensile strength (ASTM D 4632)	120 lb (550 N)
Min. equivalent opening	No. 170 sieve (90 µm)

3. Flotation devices shall be flexible, buoyant units contained in an individual floatation sleeve or collar attached to the curtain. Use expanded polystyrene logs or equivalent having a 49 square inch minimum end area. Do not use polystyrene beads or chips. Buoyancy provided by the floatation device shall be sufficient to support the weight of the curtain and maintain a freeboard of at least 3 inches above the water surface level.
4. Top load lines shall consist of 5/16 inch steel cable.
5. Bottom load lines shall consist of a minimum ¼–inch steel chain incorporated into the bottom hem of the curtain. Larger chain sizes may be used where additional weight to serve as ballast to hold the curtain in a vertical position is required.

VI. Considerations

A. Sediment that has settled out by the silt curtain should only be removed as directed by the regulatory authority because re–suspension of sediment will likely occur during the removal process.

B. Silt curtains are meant to manage sediment in the waterbody. The best way to prevent sediment from entering the water body is through the implementation of effective upland erosion control, stopping sediment transport at its source.

VII. Plans and Specifications

Plans and specifications for installing a silt curtain shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of silt curtain.

B. Material specification conforming to standard.

C. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Silt curtains shall be inspected daily and repaired if necessary.

X. Regardless of upland stabilization conditions silt curtains shall not be removed until the water behind the curtain has equal or greater clarity than the waterway or water body. Soil particles shall be allowed to settle for a minimum of 24 hours prior to removal of the curtain.

XI. Care shall be taken when removing the silt curtain to minimize the release or re–suspension of accumulated sediment.

XII. To prevent the spread of exotic species silt curtains shall not be reused on other sites. Buoys and chains can be reused but shall be either disinfected with vinegar or cleaned with hot water greater than 104 deg. F then allowed to completely dry for a minimum period of five days. If there are any questions about the occurrence of zebra mussels, Eurasian water–milfoil, or other aquatic invasive species in a water body that you are working in or intend to work in contact the Land and Natural Resources Division.

XIII. References

WisDOT Facilities Development Manual: Chapter 10, Section 10, Subject 43, Silt Screen

X. Definitions

Stabilized (V.A.1): Means that all land disturbing construction activities at the construction site have been completed, and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures, or that employ equivalent stabilization measures.

Stone Tracking Pad and Tire Washing

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A stabilized pad of stone aggregate or tire washing station located at any point where traffic will egress a construction site.

II. Purpose

The purpose of this standard is to reduce off–site sedimentation by eliminating the tracking of sediment from construction sites.

III. Conditions Where Practice Applies

Either a stone tracking pad or tire washing station shall be used at all points of construction egress. This standard applies where construction traffic is likely to transport sediment off site.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of this practice.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Tracking Pad:

1. The tracking pad shall be installed prior to any traffic leaving the site.
2. The aggregate for tracking pads shall be 3 to 6 inch clear or washed stone. All material to be retained on a 3–inch sieve.
3. The aggregate shall be placed in a layer at least 12 inches thick. On sites with a high water table, or where saturated conditions are expected during the life of the practice, stone tracking pads shall be underlain with a WisDOT Type R geotextile fabric to prevent migration of underlying soil into the stone.
4. The tracking pad shall be the full width of the egress point. The tracking pad shall be at a minimum 50 feet long.
5. Surface water must be prevented from passing through the tracking pad. Flows shall be diverted away from tracking pads or conveyed under and around them by using a variety of practices, such as culverts, *water bars*[1], or other similar practices.

B. Tire washing: If conditions on the site are such that the sediment is not removed from vehicle tires by the tracking pad, then tires shall be washed utilizing pressurized water before entering a public road.

1. The washing station shall be located on–site in an area that is stabilized and drains into suitable sediment trapping or settling device.
2. The wash rack shall consist of a heavy grating over a lowered area. The rack shall be strong enough to support the vehicles that will cross it.

C. Rocks lodged between the tires of dual wheel vehicles shall be removed prior to leaving the construction site.

VI. Considerations

A. Vehicles traveling across the tracking pad should maintain a slow constant speed.

B. The best approach to preventing off–site tracking is to restrict vehicles to stabilized areas.

C. It is always preferable to prevent sediment from being deposited upon the road than cleaning the road later. Sediment on a road can create a safety hazard as well as a pollution problem.

D. Any sediment tracked onto a public or private road should be removed by street cleaning, not flushing, before the end of each working day.

VII. Plans and Specifications

A. Plans and specifications for installing tracking pads shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of all points of egress with tracking pad locations shown
2. Material specifications conforming to standard
3. Schedule for installation and removal
4. Standard drawings and installation details
5. Stabilization after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Tracking pads and tire washing stations shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

X. The tracking pad performance shall be maintained by scraping or top–dressing with additional aggregate.

XI. A minimum 12–inch thick pad shall be maintained.

XII. Definitions

Water bar (V.A.5): A shallow trench or diversion dam that diverts surface water runoff into a dispersion area.

Storm Drain Inlet Protection For Construction Sites

I. Definition

A temporary barrier installed around a storm drain inlet, drop inlet or curb inlet.

II. Purposes

The purpose of this practice is to reduce sediment from entering storm drains before stabilizing the contributing drainage area.

III. Conditions Where Practice Applies

This practice applies where runoff from construction sites enters conveyance system structures such as drain inlets, drop inlets, and curb inlets. Inlet protection devices are for drainage areas of one acre or less. Runoff from areas larger than one acre should be routed through a properly designed sediment trapping or settling practice upstream of the inlet.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of storm drain inlet protection.

V. Design Criteria

This section establishes the minimum standards for design, installation and performance requirements.

The appropriate type of inlet protection barrier shall be installed once the drain, drop, or curb inlet can receive runoff. The device shall remain in place and be maintained until the disturbed area is stabilized.

A. General Criteria that is applicable to all inlet protection devices

1. Ponding water to settle sediment is encouraged; however ponding shall not interfere with the flow of traffic, create a safety hazard, or cause property damage. All devices shall have provisions such as weep holes or "emergency spillways" to safely pass water if the device becomes clogged.

2. The contributing drainage area to the inlet protection device shall be one acre or less. In instances were a larger contributing drainage area exists, runoff shall be routed through a properly designed sediment trapping or settling device upstream of inlet.

3. Other than Type D inlet protection devices, no gaps shall be left in the material used that would allow the flow of water to bypass the inlet protection device.

4. All fabrics used as part of an inlet protection device must be selected from the list of approved fabrics certified for inlet protection, Geotextile Fabric, Type FF in the current addition of the WisDOT Product Acceptability List (PAL).

B. Criteria Applicable to Unpaved areas or the Pre–Paving Phase of Construction

1. Inlet Protection Barriers include, but are not limited to, straw bales, sandbags, other material filled bags and socks, and stone weepers. These devices can be used to either settle sediments or divert flows.

   a. Manufactured bags, when used, shall conform to the standards in Table 1.

Table 1

Minimum Size	14 x 26 inches
Grab Tensile strength of fabric, ASTM D–4632	95 lb. min.
UV stability, ASTM D–4355	70 % min.
Note: To provide sufficient strength, fabric shall be sewn together with double stitching.	

b. Straw Bale installation shall conform to the criteria outlined in the Conservation Practice Standard Sediment Bale Barrier (Non–Channel).

c. Stone weeper installation shall conform to the criteria in Conservation Practice Standard Sediment Trap.

2. Filter Fabric Barrier Criteria – See Figure 1 Inlet Protection

a. Inlet protection Type A devices shall be utilized around inlets and unpaved areas until permanent stabilization methods have been established. Type A devices shall be utilized on inlets prior to installation of curb and gutter or pavement, and where safety considerations are not compromised on the site.

b. Type B shall be utilized after the casting and grate are in place.

c. Type D shall be utilized in areas where other types of inlet protection are identified as incompatible with roadway and traffic conditions, causing possible safety hazards when ponding occurs at the inlet. Type D shall only be used after castings are in place on top of the inlet boxes.
Type D inlet protection shall conform to the standard drawing as shown in the plans. There shall be a three–inch space between the bag and the sides of the inlet to prevent the inlet sides from blocking the overflow; and shall only be used in inlets deeper than 30 inches from the top of grate to bottom of the inlet. If such clearance is not available, cinch or tie the sides of the bag (with rope or ties) to provide clearance.

C. Criteria Applicable to the Post–Paving / Curbing Phase of Construction

1. Inlet protection Types B, C, and D are applicable to post paving construction. See Figure 1 Inlet Protection.

- Type B shall be utilized on inlets without curb box.
- Type C shall be utilized on street inlets with curb heads. A 1½" x 3 ½" (37mm by 87 mm) minimum, piece of wood shall be wrapped and secured in the fabric and placed in front of the curb head as shown in the plans. The wood shall not block the entire opening of the curb box and be secured to the grate with wire or plastic ties.
- Type D

CI. Considerations

A. When site conditions allow, inlets should be temporarily closed or sealed to prevent entrance of runoff and sediment.

B. The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.

C. Storm drain inlet protection consists of several types of inlet filters and traps and should be considered as only one element in an overall erosion control plan. Each type differs in application with selection dependent upon site conditions and inlet type. Not all designs are appropriate in all cases. The user must carefully select a design suitable for the needs and site conditions.

D. Inlet protection is only as effective as the filter or barrier used around the inlet. Effectiveness decreases rapidly if the inlet protection is not properly maintained. In general, inlet protection provides relatively good removal of coarse and medium–sized soil particles from runoff however, most fine silt and clay particles will pass through the filtering mechanisms.

E. Properly maintaining inlet protection can be difficult and often inlets can become clogged. Field experience has shown that inlet protection that causes excessive ponding in an area of high construction activity may become so inconvenient that it is simply removed or bypassed, thus transmitting sediment–laden flows unchecked. In such situations, a structure with an adequate overflow mechanism should be utilized instead of simply removing the inlet protection device.

F. Inlet protection devices can be enhanced by additional excavation to increase the storage capacity around the inlet.

G. Good construction site housekeeping measures, such as keeping the gutters clean, and street sweeping are important.

VII. Plans and Specifications

Plans and specifications for installing inlet protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of inlet protection and type employed

B. Material spec conforming to standard

C. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Remove inlet protection devices once the contributing drainage area is stabilized with appropriate vegetation or impervious area.

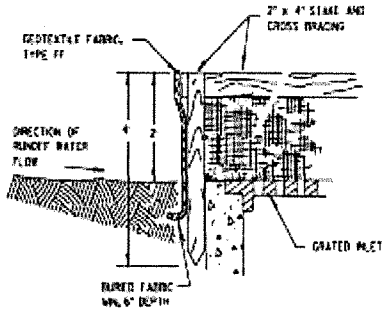
X. Inlet protection shall be at a minimum inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

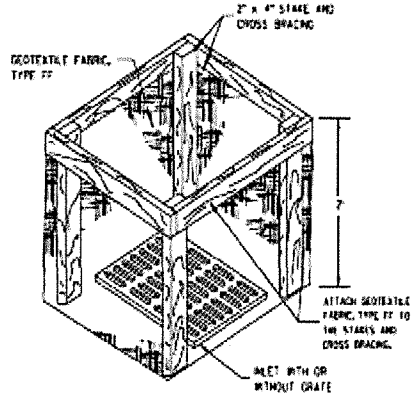
XI. Sediment deposits shall be removed and the inlet protection device restored to its original dimensions when the sediment has accumulated between 1/3 to 1/2 the design depth of the device, or when the device is no longer functioning as designed. Removed sediment shall be deposited in a suitable area and stabilized.

XII. Due care shall be taken to ensure sediment does not fall into the inlet and impede the intended function of the device. Any material falling into the inlet shall be removed.

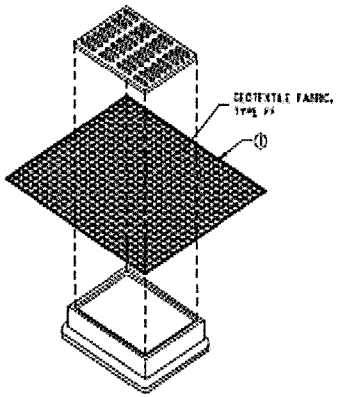
XIII. References

WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm.

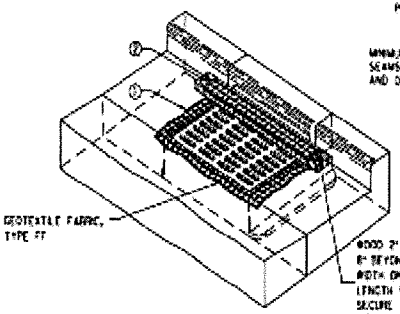




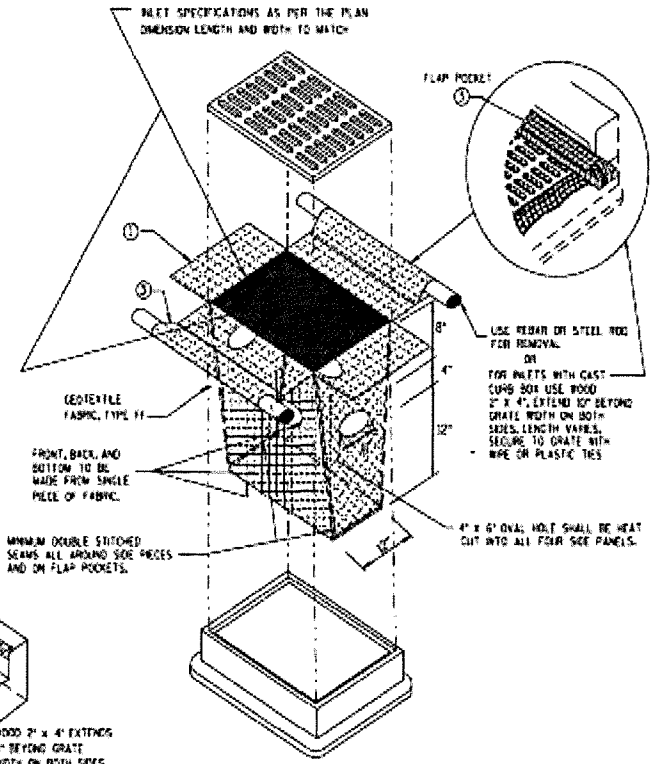
INLET PROTECTION, TYPE A



INLET PROTECTION, TYPE B
(WITHOUT CURB BOX)
CAN BE INSTALLED IN ANY INLET WITHOUT A CURB BOX



INLET PROTECTION, TYPE C (WITH CURB BOX)



INLET PROTECTION, TYPE D
CAN BE INSTALLED IN ANY INLET TYPE WITH OR WITHOUT A CURB BOX AS PER NOTE ② I

GENERAL NOTES

MANUFACTURED ALTERNATIVES APPROVED AND LISTED ON THE DEPARTMENTS EROSION CONTROL PRODUCT ACCEPTABILITY LIST MAY BE SUBSTITUTED.

WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED ON THE GEOTEXTILE FABRIC DOES NOT FALL INTO THE INLET. ANY MATERIAL FALLING INTO THE INLET SHALL BE REMOVED IMMEDIATELY.

① FINISHED SIZE, INCLUDING FLAP POCKETS WHERE REQUIRED, SHALL EXTEND A MINIMUM OF 30" AROUND THE PERIMETER TO FACILITATE MAINTENANCE OR REMOVAL.

② FOR INLET PROTECTION, TYPE C (WITH CURB BOX), AN ADDITIONAL 18" OF FABRIC IS WRAPPED AROUND THE WOOD AND SECURED WITH STAPLES. THE WOOD SHALL NOT BLOCK THE ENTIRE HEIGHT OF THE CURB BOX OPENING.

③ FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2x4.

INSTALLATION NOTES

TYPE B & C

TRIM EXCESS FABRIC IN THE FLOW LINE TO WITHIN 3" OF THE GRATE.

THE CONTRACTOR SHALL DEMONSTRATE A METHOD OF MAINTENANCE, USING A SEWN FLAP, HAND HOLDS OR OTHER METHOD TO PREVENT ACCUMULATED SEDIMENT FROM ENTERING THE INLET.

TYPE D

DO NOT INSTALL INLET PROTECTION TYPE D IN INLETS SHALLOWER THAN 30", MEASURED FROM THE BOTTOM OF THE INLET TO THE TOP OF THE GRATE.

TRIM EXCESS FABRIC IN THE FLOW LINE TO WITHIN 3" OF THE GRATE.

THE INSTALLED BAG SHALL HAVE A MINIMUM SIDE CLEARANCE, BETWEEN THE INLET WALLS AND THE BAG, MEASURED AT THE BOTTOM OF THE OVERFLOW HOLES, OF 3". WHERE NECESSARY THE CONTRACTOR SHALL CINCH THE BAG USING PLASTIC ZIP TIES. TO ACHIEVE THE 3" CLEARANCE, THE TIES SHALL BE PLACED AT A MINIMUM OF 4" FROM THE BOTTOM OF THE BAG.

This drawing based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 10-2.

INLET PROTECTION
TYPE A, B, C, AND D

Turbidity Barrier

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary fabric barrier with very low permeability, installed in or near the bed of a waterway or water body to minimize sediment transport and is installed parallel to flow. Turbidity barrier cannot be installed perpendicular to a moving channel.

II. Purposes

The purpose of this practice is to provide sediment containment while construction activities are occurring in or directly adjacent to a waterway or water body.

III. Conditions Where Practice Applies

This practice applies where construction activities intrude or are directly adjacent to a waterway or water body. This includes but is not limited to bridge construction, riprap placement, utility work, stream bank restoration, boat launches, and dredging.

Use turbidity barriers in conditions with fine soils and flow velocities not exceeding 5 feet per second, unless additional reinforcement is installed.

IV. Applicable Laws

Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of turbidity barriers.

V. Criteria

This section establishes the minimum standards for design, installation, and performance requirements.

A. Installation – Details of construction not listed in the text shall conform to the pertinent requirements of Figures 1 and 2.

1. The barrier shall be installed before construction activities are initiated in, or adjacent to the waterway or water body. Install the turbidity barrier as close to the construction as practical. The barrier shall remain in place and be maintained until the construction activity is completed and the disturbed area *stabilized* [1].
2. The ends of the barrier shall be securely anchored and keyed into the shoreline to fully enclose the area where sediment may enter the water.
3. Driven steel posts shall be used to hold the barrier in position. The maximum spacing between posts shall be 10 feet. When barrier height exceeds 8 feet, post spacing may need to be decreased.
   When bedrock prevents the installation of posts, float devices may be used. Flotation devices shall be flexible, buoyant units contained in an individual flotation sleeve or collar attached to the turbidity barrier. Use solid expanded polystyrene logs or equivalent having a 49 square inch minimum end area. Do not use polystyrene beads or chips. Buoyancy provided by the flotation devices shall be sufficient to support the weight of the turbidity barrier and maintain a freeboard of at least three inches above the water surface. Refer to Figure 1.
4. The barrier and steel posts shall extend from the bottom of the waterway or water body to an elevation 2 feet above the anticipated high water level during the time of year and duration the barrier will be in place. The elevation shall not exceed the top of bank.
5. Ballast shall be used to hold the barrier in a vertical position. Bottom load lines shall consist of a chain incorporated into the bottom hem of the screen, of sufficient weight to serve as ballast to hold the screen in a vertical position. Additional anchorage shall be provided if necessary.
6. Danger buoys shall be used as directed by the Coast Guard or DNR permit when working in navigable waters.
7. Turbidity barriers shall be installed parallel to the direction of flow and shall not be installed across channels.

B. Material

1. Reusable components of the turbidity barrier system shall be clean and free of potential exotic species. Fabric cannot be reused.
2. Top load lines shall consist of 5/16 inch steel cable.
3. Fabric shall be selected according to the specifications in Table 1.

Table 1

Requirement	Method	Value
Min. grab tensile strength	ASTM D 4632	200 lb (890 N)
Min. puncture strength	ASTM D 4833	90 lb (400 N)
Maximum permeability	ASTM D 4491	= $1X10^{-7}$ cm/s
Min. ultraviolet stability	ASTM D 4355	70%

Source: WisDOT Spec 628.2.10.

VI. Considerations

A. The 5 feet per second flow velocity specified in Section III can be the base flow of the stream or the base flow plus the addition of storm event runoff. Base flow can be used alone for short term projects (typically one day duration, i.e. culvert installation) when the chance of precipitation is low. Longer term projects (i.e. bridge work) should consider storm flow in addition to base flow (typically the two year event).

B. If the current exceeds 5 feet per second, other methods to divert flow away from the turbidity barrier such as temporary concrete traffic barriers, coffer dams, pumping, or sheet piling should be considered.

C. Sediment that has been settled out by the turbidity barrier should only be removed if so directed by the regulatory authority because re-suspension of sediment will likely occur during the removal process.

D. Turbidity barriers are meant to manage sediment in the water body. The best way to prevent sediment from entering the water body is through the implementation of effective upland erosion control, stopping sediment transport at its source.

E. Turbidity barriers should not be used to reduce the conveyance capacity of the channel. An example is use on bridge projects where the turbidity barrier is installed adjacent to each abutment simultaneously.

F. Turbidity barriers may be installed on the banks of a waterway or water body if higher water levels are anticipated during construction.

VII. Plans and Specifications

Plans and specifications for installing a turbidity barrier shall be in keeping with this standard and attached detail drawing and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of turbidity barrier.

B. Material specification conforming to standard.

C. All plans, standard detail drawings, or specifications shall include schedule sequence or notes for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Turbidity barriers shall be inspected daily and repaired if necessary.

B. Turbidity barriers shall not be removed until the water behind the barrier has equal or greater clarity than the waterway or waterbody.

C. Care shall be taken when removing the barrier to minimize the release or re-suspension of accumulated sediment.

D. To prevent the spread of exotic species turbidity barriers shall not be reused on other sites. Buoys and chains can be reused but shall be either disinfected with vinegar or cleaned with hot water greater than 104 deg. F then allowed to completely dry for a minimum period of five days. If there are any questions about the occurrence of zebra mussels, Eurasian water–milfoil, or other aquatic invasive species in a waterbody that you are working in, or intend to work in, contact the Land and Natural Resources Division.

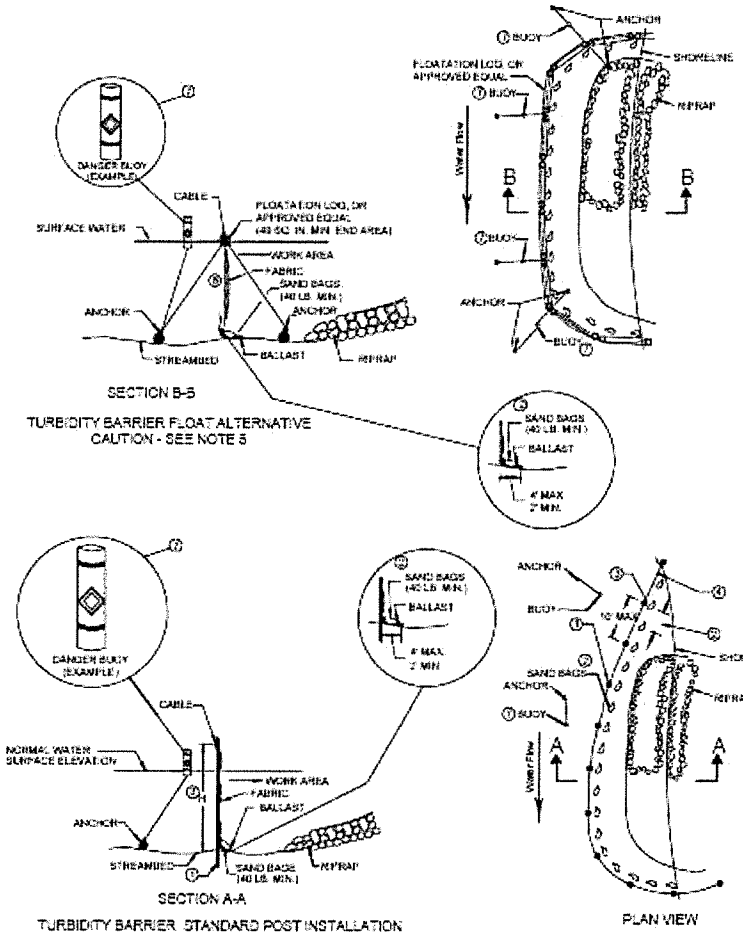
IX. References

WisDOT Facilities Development Manual: Chapter 10, Section 10, Subject 45, Turbidity Barrier

X. Definitions

Stabilized (V.A.1): Means that all land disturbing construction activities at the construction site have been completed, and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures, or that employ equivalent stabilization measures.

Figure 1. Turbidity Barrier Placement Details



GENERAL NOTES

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD AND THE APPLICABLE SPECIAL PROVISIONS

TURBIDITY BARRIER MAY BE REMOVED AT THE ENGINEERS OR PROJECT MANAGERS DISCRETION WHEN PERMANENT EROSION CONTROL MEASURES HAVE BEEN ESTABLISHED

① DRIVEN STEEL POSTS, PIPES OR CHANNELS. LENGTH SHALL BE SUFFICIENT TO SECURELY SUPPORT BARRIER AT HIGH WATER ELEVATIONS.

② SANDBAGS TO BE USED AS ADDITIONAL BALLAST WHEN ORDERED BY THE ENGINEER OR PROJECT MANAGER TO MEET ADVERSE FIELD CONDITIONS. SPACE AS APPROPRIATE FOR SITE CONDITIONS.

③ WHEN BARRIER HEIGHT, H, EXCEEDS 6 FT., POST SPACING MAY NEED TO BE DECREASED

④ IN WATERWAYS SUBJECT TO FLUCTUATING WATER ELEVATIONS, PROVISIONS SHOULD BE MADE TO ALLOW THE WATER TO EQUALIZE ON EACH SIDE OF THE BARRIER. THIS MAY BE ACCOMPLISHED BY LEAVING A PORTION OF THE BARRIER OPEN ON THE UPSTREAM END

⑤ FLOAT ALTERNATIVE WILL ONLY BE ALLOWED WITH WRITTEN APPROVAL OF THE ENGINEER OR PROJECT MANAGER, AND IS MEANT FOR LOCATIONS WHERE BED ROCK PREVENTS THE INSTALLATION OF POSTS.

⑥ ALLOW SUFFICIENT SLACK VERTICALLY AND HORIZONTALLY SO THAT SEDIMENT BUILD UP WILL NOT SEPARATE OR LOWER THE TURBIDITY BARRIER.

⑦ USE AS DIRECTED BY COAST GUARD OR DNR PERMIT WHEN WORKING IN NAVIGABLE WATERWAYS

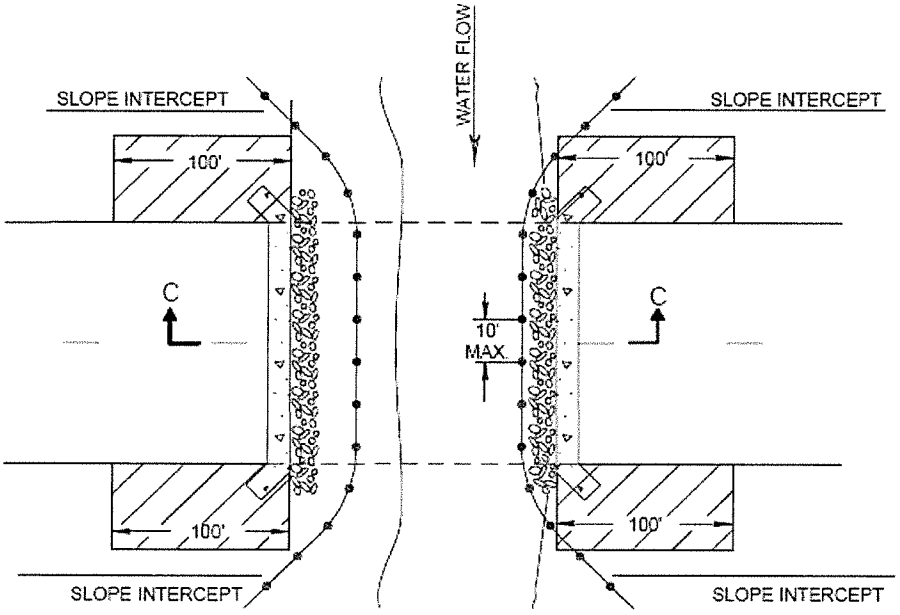
NOT TO SCALE

This drawing based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 11-2

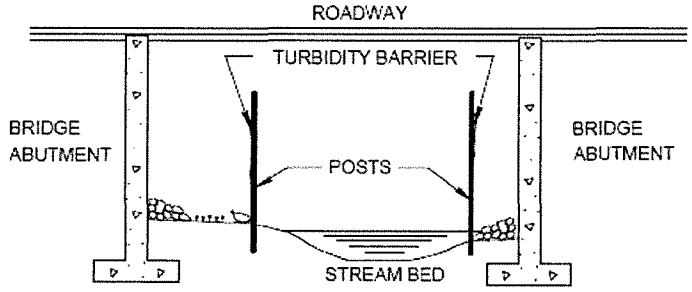
FIGURE 2. TURBIDITY BARRIER DETAIL SHOWING TYPICAL PLACEMENT AT STRUCTURES

GENERAL NOTE

FLOAT ALTERNATIVE WILL ONLY BE ALLOWED WITH WRITTEN APPROVAL OF THE ENGINEER OR PROJECT MANAGER AND IS MEANT FOR LOCATIONS WHERE BEDROCK PREVENTS THE INSTALLATION OF POSTS.



PLAN VIEW



SECTION C-C

NOT TO SCALE

This Drawing is Based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 11-2.

Vegetative Buffer

For Construction Sites

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

An area of *dense vegetation*[1] intended to slow runoff and trap sediment. Vegetative Buffers are commonly referred to as filter or buffer strips.

II. Purpose

The purpose of this practice is to remove sediment in *sheet flow* by velocity reduction.

III. Conditions Where Practice Applies

This practice applies to areas where sediment delivery is in the form of *sheet and rill erosion* from disturbed areas.

IV. Applicable Laws

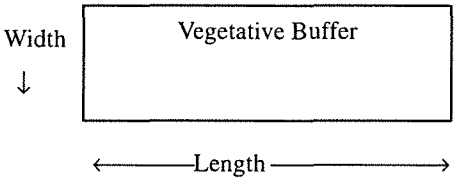
Users of this standard shall be aware of applicable laws, rules, regulations, or permit requirements governing the use and placement of a vegetative buffer.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

Vegetative Buffer

Disturbed Area ↓**Direction of Flow**↓



A. The vegetative buffer shall be located along the entire length of the down slope edge of the entire disturbed area for which the practice is being applied.

B. The vegetative buffer shall be located on the contour.

C. The width of the vegetative buffer shall have slopes less than 5%.

D. The disturbed area draining to the vegetative buffer shall have slopes of 6% or less.

E. The vegetative buffer shall have a minimum *width* of 25 feet. 25 feet is adequate for disturbed areas up to 125 feet upslope from the vegetative buffer. An additional one foot of width shall be added to the buffer for every 5 feet exceeding 125 feet upslope of the disturbed area draining to the vegetative buffer.

F. To minimize compaction and destruction of the vegetative cover, designate the vegetative buffer as an area of no disturbance. Construction equipment shall be excluded from the designated area. Vegetative buffers shall be clearly shown on plans and marked in the field.

G. Vegetative buffers shall be densely vegetated prior to upslope soil disturbance.

VI. Considerations

A. Maintaining sheet flow is critical to the function of a vegetative buffer. In some conditions, a *level spreader* may need to be constructed at the upslope side of the vegetative buffer to minimize concentrated flow.

B. Vegetative buffers may require large land areas compared to other erosion control practices.

C. Trees should not be cut down to establish a vegetative buffer. Other erosion control measures are preferred.

VII. Plans and Specifications

A. Plans and specifications for vegetative buffers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of vegetative buffer.
2. Limits and slopes of disturbed area and any additional contributory drainage area.
3. Dimensions and slope of vegetative buffer.

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

IX. Vegetative buffers shall be inspected for proper distribution of flows, sediment accumulation and signs of rill formation. Vegetative buffers shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

X. If the vegetative buffer becomes silt covered, contains rills, or is otherwise rendered ineffective, other perimeter sediment control measures shall be installed. Eroded areas shall be repaired and stabilized. Repair shall be completed as soon as possible with consideration to site conditions.

XI. A stand of dense vegetation shall be maintained to a height of 3–12 inches.

XII. Prior to land disturbance the perimeter of vegetative buffers shall be flagged or fenced to prevent equipment from creating ruts, compacting the soil and to prevent damage to vegetation.

XIII. Definitions

Dense vegetation (I): is defined as an existing stand of 3–12 inch high grassy vegetation that uniformly covers at least 90 % of a representative 1 square yard plot. Woody vegetation shall not be counted for the 90% coverage. No more than 10% of the overall buffer can be comprised of woody vegetation.

Level Spreader (VI.A): Level spreaders disperse flows over a wide area, dissipating the energy of the runoff and creating sheet flow. Common types of level spreaders are weirs and stone trenches.

Sheetflow (II): Sheet flow is over plane surfaces, where runoff water flows in a thin uniform sheet across the land before it collects in a concentrated flow.

Sheet and Rill Erosion (III): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper.

Width (V.E): Is measured in the direction of flow.

SPS 321.16

Frost–Protected Shallow Footings

In lieu of frost walls, the Code recognizes frost–protected shallow foundations designed per ASCE 32, "Design and Construction of Frost–Protected Shallow Foundations". The Department also recognizes the similar design standards of U.S.HUD "Design Guide for Frost–Protected Shallow Foundations", available for free download from www.huduser.org/publications/destech/desguide.html and summarized below. Consult it or the ASCE standard for full design and installation information, including a more flexible, detailed design method that should be used for heated buildings with attached, unheated garages.

Note that both standards offer design methods for both heated and unheated buildings. For heated buildings, the designs rely upon containing the building's heat under the footings to avoid frost heaving. In the case of unheated buildings, the designs rely upon containing the earth's natural warmth under the footings and slab by the use of more extensive insulation. (For both design approaches, compliance with their frost–protection requirements is not necessarily the same as compliance with the ch. SPS 322 Energy Conservation standards for slab–on–grade designs.)

Because the simplified heated building design methods rely upon buildings, including attached garages, with at least a 63 degree internal temperature, it is important the building designer consult with the owner regarding their intended use. Even if the initial owner plans to keep the building heated throughout the winter, future owners may use it otherwise. Therefore, the designer should be sure to communicate the operational needs of the building through means such as building placarding, notating the Rescheck Energy Report, and/or recording relevant information with the Tribe. **Failure to do so may cause severe structural damage to the building if future owners do not keep the building heated.**

Unheated Building Design

Minimum Ground Insulation Requirements[1]

		Mean Annual Temperature [2, 6] (see map)			Minimum Footing Depth [7, 8]	
Air Freezing Index (°F–days) [3] (see map)	**D_g–Insulation Width from Edge of Footing [4, 5]**	**38**	**40**	**≥41**	**D**– Concrete & Insulation Depth	**G**–Granular Base Thickness
2,250 or less	63″	R–13.6	R–11.4	R–10.2	10″	6″
2,251–3,000	79″	R–18.2	R–15.3	R–14.2	10″	6″
3,001–3,750	91″	R–22.7	NA	NA	10″	6″

1 Also see s. SPS 322.33 for additional slab–edge insulation requirements.

2 Units are degrees Fahrenheit. See estimate provided on Mean Annual Temperature Contour Map.

3 Air freezing index shall be based on maximum year expected for a 100–year return period. See estimate provided on AFI Contour Map.

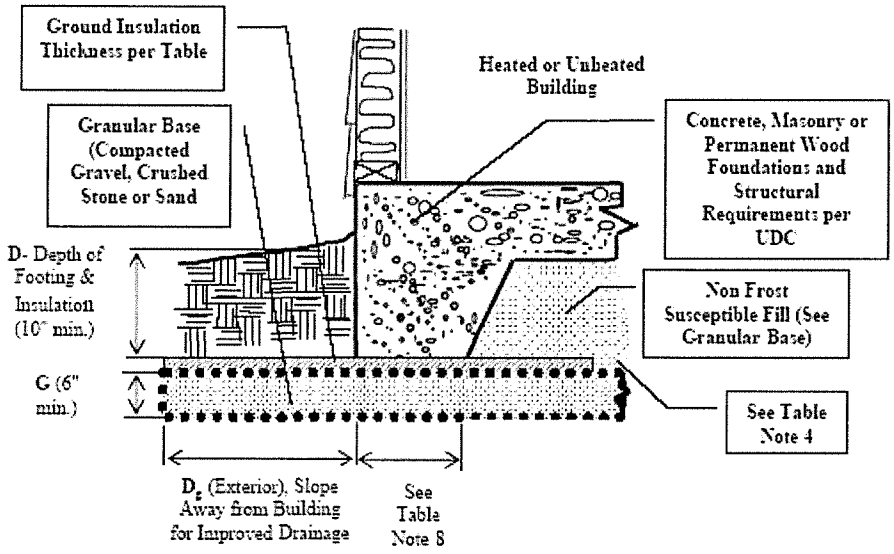
4 Ground insulation to the building interior can be extended beneath the entire slab where it is desired to protect the entire slab from frost heave action.

5 Ground insulation to the building interior can be in one horizontal plane (as shown in the detail) and covered with non frost–susceptible fill or the insulation maybe placed directly beneath the slab.

6 Insulation thickness recommendations are for extruded polystyrene (XPS) insulation.

7 The minimum depth of concrete footing and horizontal insulation is 10″. A 6″ drainage layer is required under the insulation.

8 Insulation placed directly beneath the footing shall be Type IV or Type VI XPS in accordance with ASTM C578. Maximum deadload placed on the Type IV insulation shall be 1200 pounds/square foot. Maximum deadload placed on Type VI shall be 1900 psf.



Heated Building Design

Minimum Insulation Requirements for Frost–Protected Footings in Heated Buildings[1]
(Simplified Method)

Air Freezing Index (°F days)[2] (see map)	Vertical Insulation R–Value[3, 4]	Horizontal Insulation R–Value [3, 5]		Horizontal Insulation Dimensions per Figure Below (inches)			Minimum Footing Depth (inches)
		Along walls	At corners	A	B	C	D
2,000 or less	5.6	NR	NR	NR	NR	NR	14
2,500 or less	6.7	1.7	4.9	12	24	40	16
3,000 or less	7.8	6.5	8.6	12	24	40	16
3,500 or less	9.0	8.0	11.2	24	30	60	16

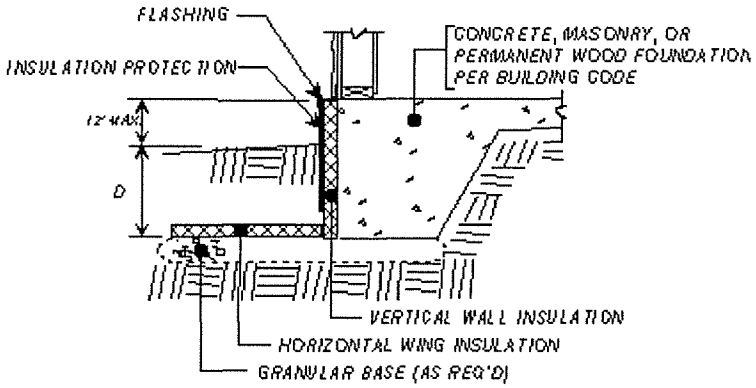
1 Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissible.

2 See AFI Contour Map for Air Freezing Index values.

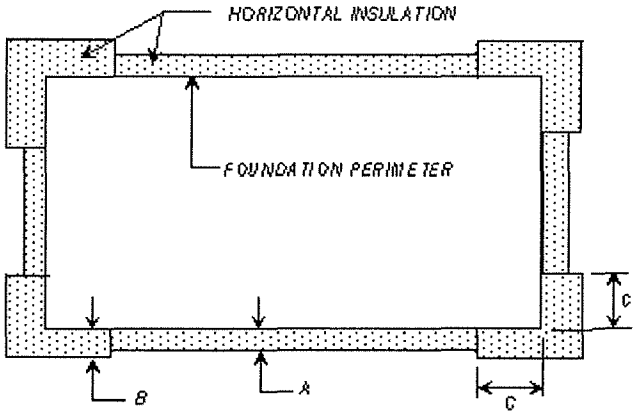
3 Insulation materials shall provide the stated minimum R–values under long–term exposure to moist, below–ground conditions in freezing climates. The following R–values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene – 2.4R per inch; Types IV, V, VI, VII extruded polystyrene – 4.5R per inch; Type IX expanded polystyrene – 3.2R per inch. NR indicates that insulation is not required.

4 Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.

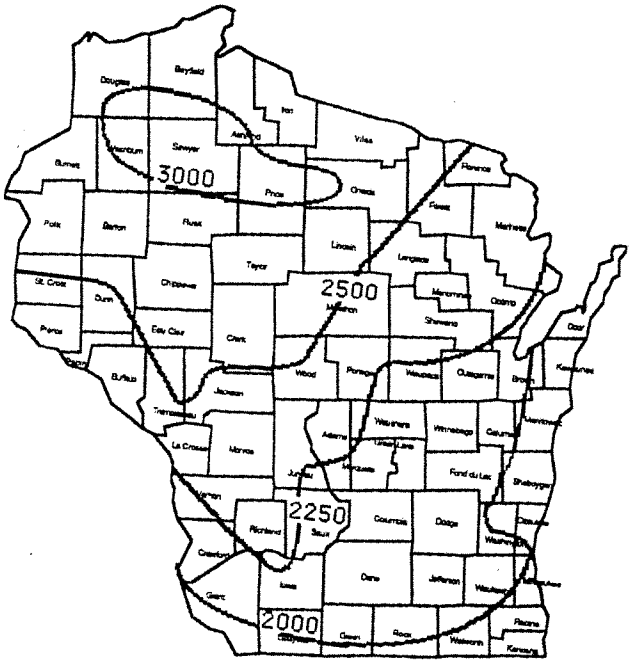
5 Horizontal insulation shall be extruded polystyrene insulation.



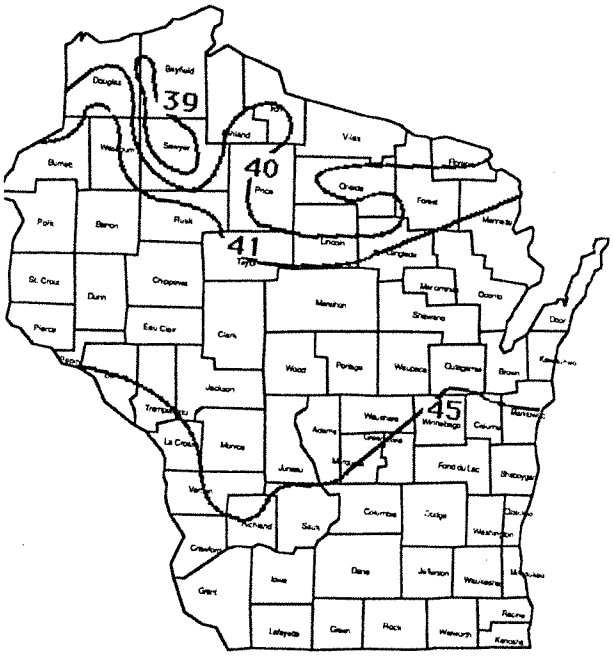
INSULATION DETAIL



INSULATION PLAN

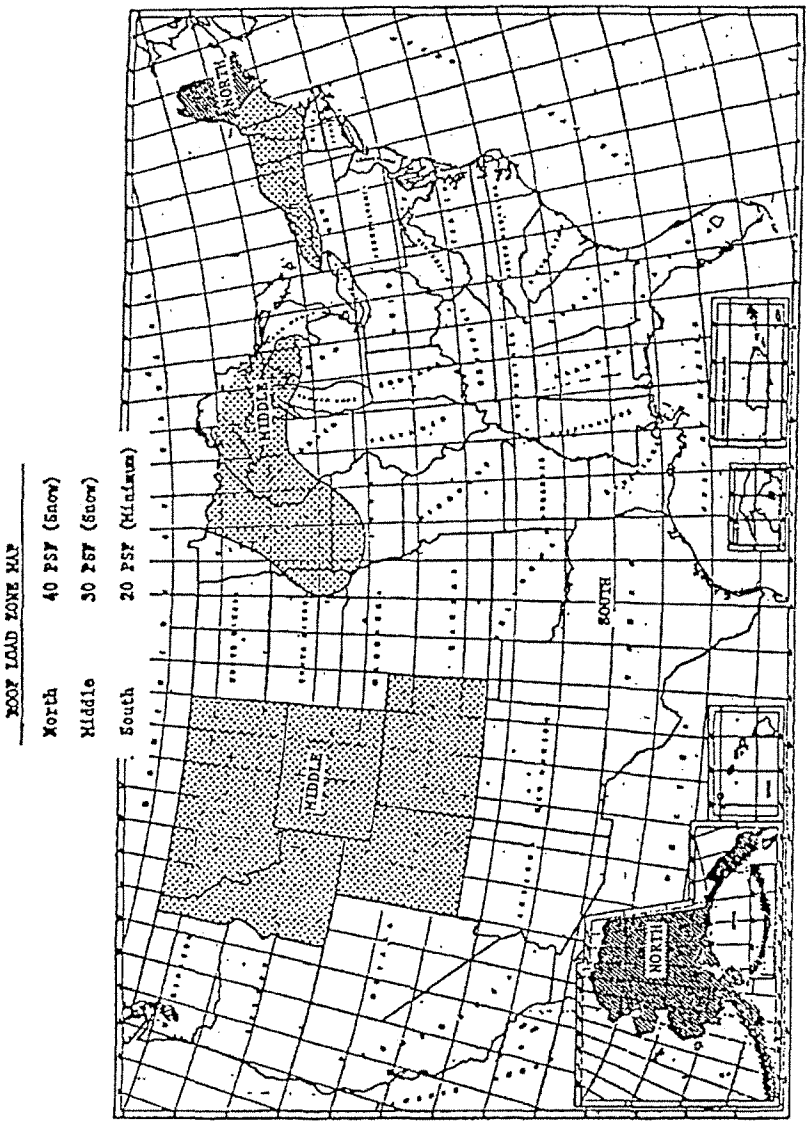


Air-Freeze Index Contour Map

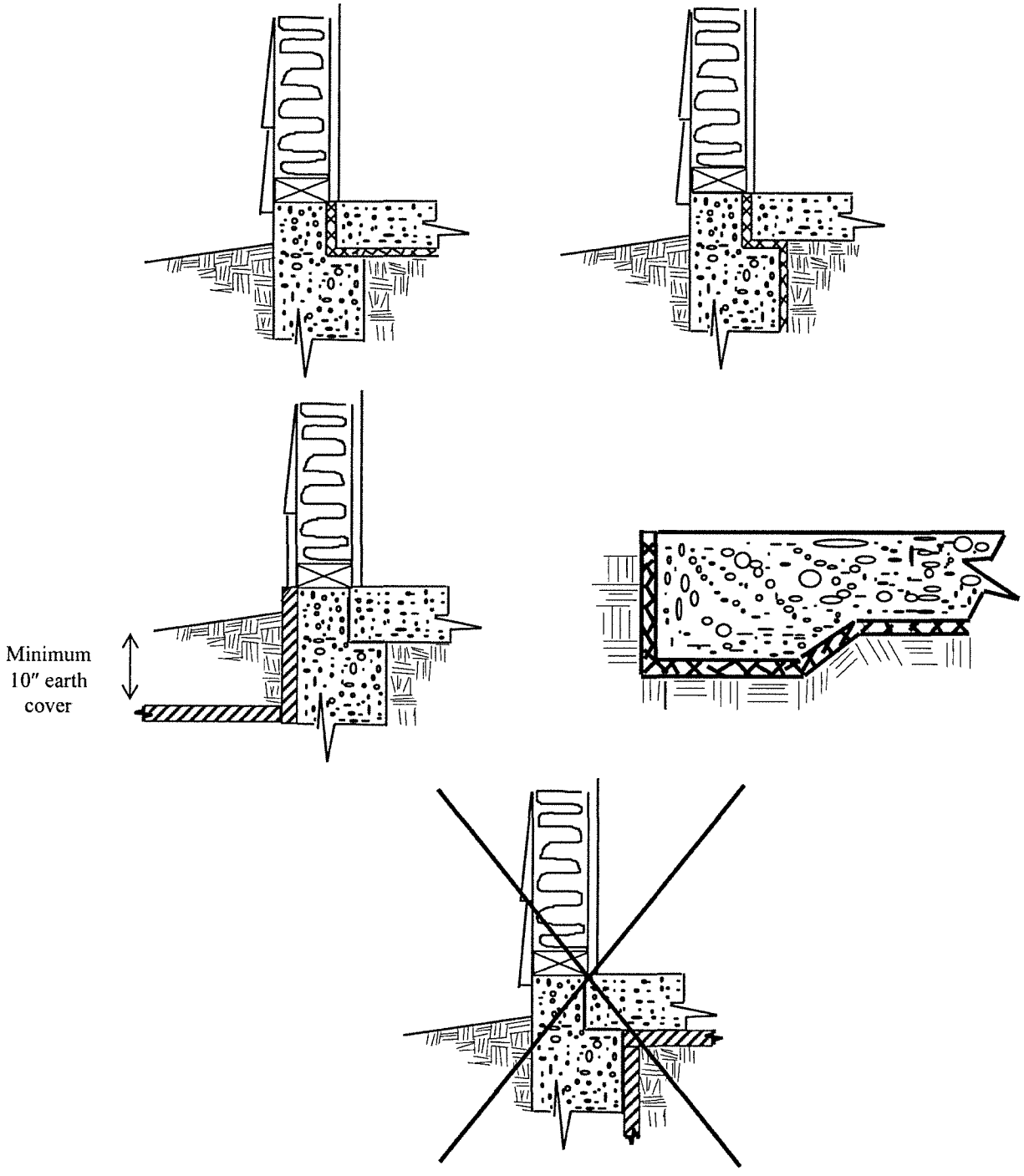


Mean Annual Temperature Contour Map

321.40 (1) (h), HUD Roof-Load Zone Map



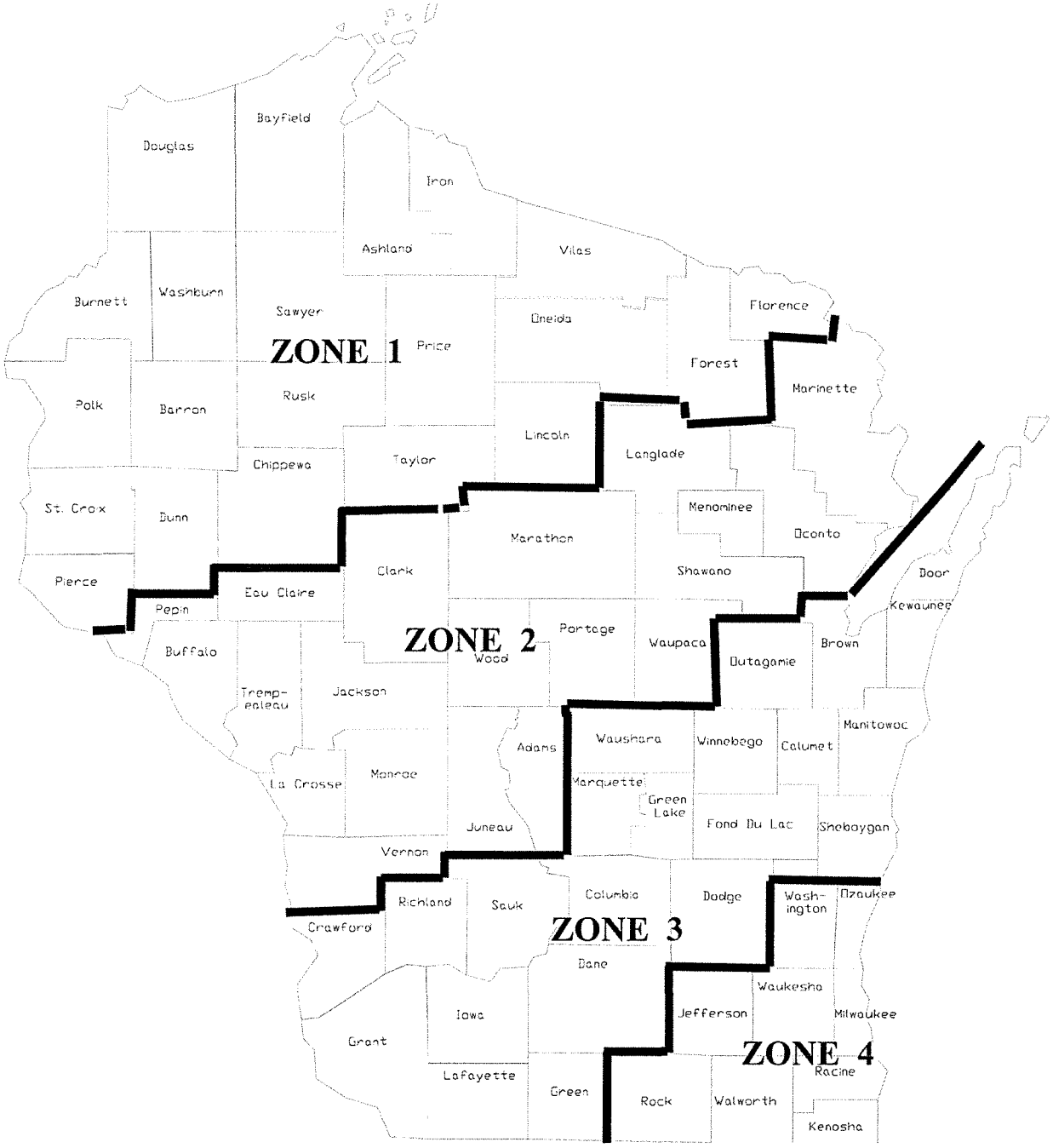
Section SPS 322.33
Slab-On-Grade Insulation Details



Insulation shall extend vertically and horizontally for a total of 48″. In all cases the insulation shall insulate to the top edge of the floor perimeter. The last diagram is not an acceptable method. Additional insulation may be necessary to comply with the structural stability requirements of s. SPS 321.16 for frost-protected shallow foundations.

SPS 323.02 (1) Outdoor Design Temperatures

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



Chapters SPS 320 to 325

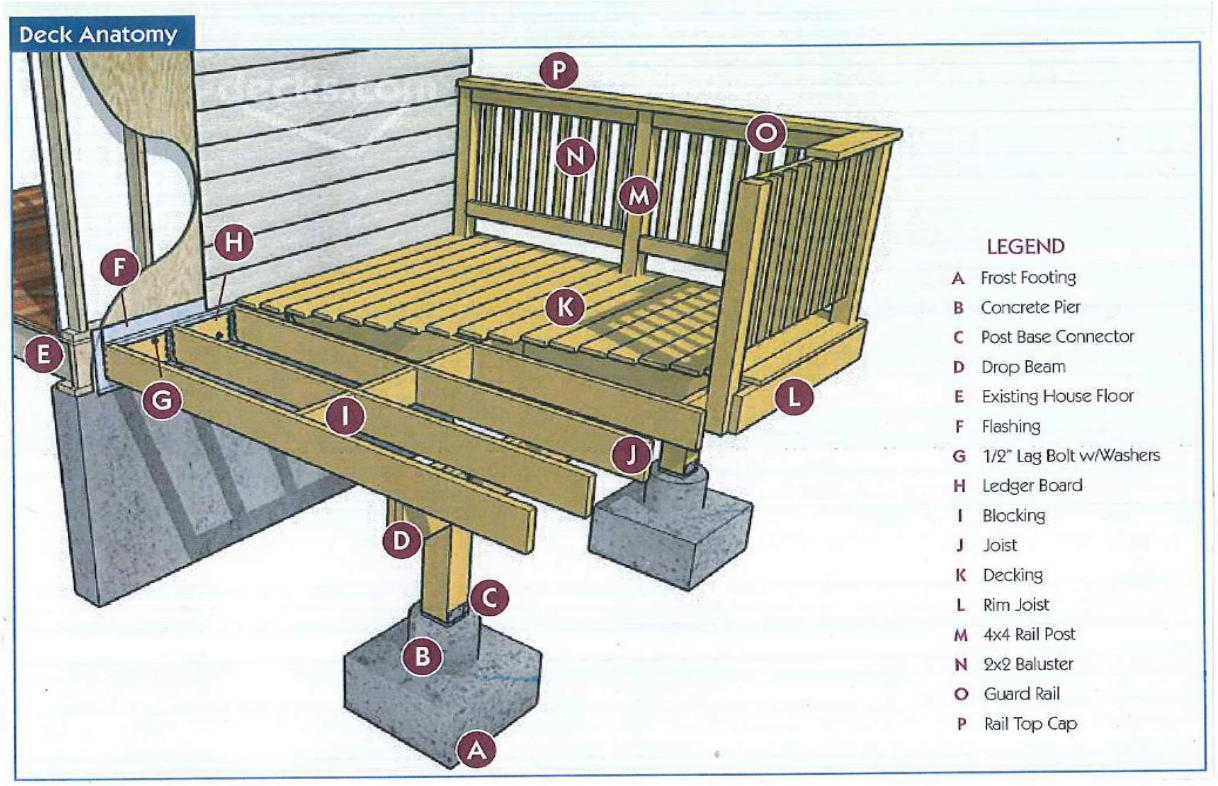
APPENDIX B

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SECTION 1: GENERAL REQUIREMENTS

1. All lumber, including for decking, must be pressure–preservative–treated and must be either douglas fir/larch, hemlock/fir, spruce/pine/fir (SPF), or southern pine, of grade #2 or better – unless a naturally durable species such as a western red cedar is used. Lumber in contact with the ground must be rated as "ground–contact." The lumber must be identified by the grade mark of, or certificate of inspection issued by, a professional lumber–grading or inspection bureau or agency (www.alsc.org).

Note: Not all treated lumber is rated for ground contact. See Table C–1 in Appendix C for further information.



2. Wood–plastic composites must bear a label indicating their performance criteria and compliance with ASTM D7032.

Note: Wood−plastic composites are materials composed of wood fibers or powder that is bound with plastic and used typically as decking and elements of a guard or handrail.

Note: When using a wood−plastic composite, exercise caution as some composite members do not have the same capabilities as their equivalent wood sizes.

3. Nails must be threaded, which includes ring−shanked (annular−grooved) and spiral−grooved.

   Note: A 1/8 inch pilot hole is recommended for all toe−nailing locations.

4. All fasteners must be galvanized steel, stainless steel, or approved for use with preservative−treated lumber.

5. Throughout this document, 1/2 inch−diameter bolts and lag screws are specified for various connections. Edge distance and spacing requirements are based on 1/2 inch−diameter fasteners. If larger (or smaller) fasteners are specified, edge distance and spacing need to be adjusted.

6. Carriage−bolts may be substituted where through−bolts are specified, if carriage−bolt washers are installed at the bolt head.

   Note: Carriage−bolt washers have square holes.

7. Hardware, including joist hangers or post anchors, must be galvanized steel with 1.85 ounces of zinc per square foot (G−185 coating), or stainless steel. All fasteners that are used with any hardware must be the same material as the hardware. All hardware must be installed in accordance with any instructions from the manufacturer.

   Note: For galvanized steel, look for product lines such as "Zmax," "Triple Zinc," or "Gold Coat."

   Note: Galvanized steel is not compatible with stainless steel, which can result in rapid corrosion and structural failure.

   Note: Hardware and fasteners that are beneath a hot tub which uses salt−water disinfection should be stainless steel, grade 304 or 316.

8. Every deck must have an electrical outlet along the perimeter of the deck and within 6.5 feet of the floor in accordance with NEC section 210.52(E)(3). See ch. SPS 316 for requirements about installing electrical wiring.

9. A deck constructed in accordance with these standards is not approved for concentrated loads that exceed 40 pounds per square foot (psf), such as from privacy screens, planters, built−in seating, hot tubs, stairs for multiple−level decks, or from snow−drift loads or sliding−snow loads. Engineering analysis is needed for these loads.

   Note: See Appendix C for features of a deck which are somewhat uncommon or which have more complexity than is addressed in this Appendix – such as design values for joists consisting of western cedar or red pine, framing details around chimneys and bay windows, or ledger boards for metal−plate−connected wood floor trusses. Appendix C also includes reference material, such as more detailed specifications for fasteners.

10. Specifications for fasteners and hardware**.** All nails must meet the requirements of ASTM F1667. Wood screws must meet the requirements of ANSI/ASME B18.6.1. Bolts and lag screws must meet the requirements of ANSI/ASME B18.2.1.

    Fasteners to be hot−dipped galvanized must meet the requirements of ASTM A153, *Standard Specification for Zinc Coating (Hot−Dip) on Iron and Steel Hardware,* Class D for fasteners 3/8" diameter and smaller or Class C for fasteners with diameters over 3/8".

    Fasteners other than nails and timber rivets may consist of mechanically deposited zinc−coated steel with coating weights in accordance with ASTM B695, Class 55, minimum.

    Hardware to be hot−dipped prior to fabrication must meet ASTM A653*, Standard Specification for Steel Sheet, Zinc−Coated (Galvanized) or Zinc−Iron Alloy−Coated (Galvannealed) by the Hot−Dip Process*, G−185 coating. Hardware to be hot−dipped galvanized after fabrication must meet ASTM A123*, Specification for Zinc (Hot−Dip Galvanized) Coatings on Iron and Steel Products.*

11. Safety glazing at decks shall be in accordance with the safety glazing requirements in this Code.

SECTION 2: FOOTINGS, AND POST CONNECTIONS

Footings must comply with all of the following:

1. Concrete must be used and must have a minimum compressive strength of 3,000 pounds per square inch.

2. Footing size and thickness must be in accordance with Table 1. (See sections 4 and 5 for determining post spacing and joist length.)
3. Post attachments must be in accordance with Figure 1 except expansion anchors are also permitted – and any instructions from the manufacturer of the anchor must be followed.
4. Post anchors must include a 1−inch−minimum base plate. Steel plates are not required.
5. Each post must bear directly over the middle one−third of a footing.
6. Footings must bear on solid ground below the frost penetration level or at least 48 inches below finished grade, whichever is deeper. Bearing onto unprepared fill material, organic soil, alluvial soil, or mud is prohibited. The bearing capacity of the soil is presumed to be at least 2000 pounds per square foot (psf), and must be verified by a building inspector prior to placement of concrete.
7. If the edge of a deck footing is closer than 5 feet to an existing house wall, the footing must bear at the same elevation as the existing footing for that wall.
8. Construction of footings over utility lines or any service pipe is prohibited.

Note: Call the utility provider before digging.

Table 1
FOOTING SIZE (In Inches)[1,2,3]

Joist Length		Post Spacing (Measured Center to Center)										
		4’	5’	6’	7’	8’	9’	10’	11’	12’	13’	14’
6’	Corner Footing	8	9	10	11	11	12	12	13	14	14	15
	Intermediate Footing	10	11	12	13	14	15	15	16	17	17	18
	Footing Thickness	6	6	6	6	6	6	6	6	6	6	8
7’	Corner Footing	9	10	11	11	12	13	13	14	15	15	16
	Intermediate Footing	11	12	13	14	15	16	17	17	18	19	19
	Footing Thickness	6	6	6	6	6	6	6	6	8	8	8
8’	Corner Footing	10	10	11	12	13	14	14	15	15	16	17
	Intermediate Footing	12	13	14	15	16	17	18	19	19	20	21
	Footing Thickness	6	6	6	6	6	6	8	8	8	8	8
9’	Corner Footing	10	11	12	13	14	14	15	16	16	17	18
	Intermediate Footing	12	14	15	16	17	18	19	20	20	21	22
	Footing Thickness	6	6	6	6	6	8	8	8	8	8	8
10’	Corner Footing	10	12	12	13	14	15	16	16	17	18	18
	Intermediate Footing	13	14	15	17	18	19	20	21	21	22	23
	Footing Thickness	6	6	6	6	8	8	8	8	8	8	10
11’	Corner Footing	11	12	13	14	15	16	16	17	18	19	19
	Intermediate Footing	13	15	16	17	19	20	21	22	22	23	24
	Footing Thickness	6	6	6	6	8	8	8	8	8	10	10
12’	Corner Footing	11	12	14	15	15	16	17	18	19	19	20
	Intermediate Footing	14	15	17	18	19	20	21	22	23	24	25
	Footing Thickness	6	6	6	8	8	8	8	8	10	10	10
13’	Corner Footing	12	13	14	15	16	17	18	19	19	20	21
	Intermediate Footing	14	16	17	19	20	21	22	23	24	25	26
	Footing Thickness	6	6	6	8	8	8	8	10	10	10	10
14’	Corner Footing	12	13	15	16	17	18	18	19	20	21	22
	Intermediate Footing	15	17	18	19	21	22	23	24	25	26	27
	Footing Thickness	6	6	8	8	8	8	10	10	10	10	10
15’	Corner Footing	12	14	15	16	17	18	19	20	21	22	22
	Intermediate Footing	15	17	19	20	21	23	24	25	26	27	28
	Footing Thickness	6	6	8	8	8	10	10	10	10	10	12
16’	Corner Footing	13	14	15	17	18	19	20	20	21	22	23
	Intermediate Footing	16	18	19	21	22	23	25	26	27	28	29
	Footing Thickness	6	8	8	8	8	10	10	10	10	12	12

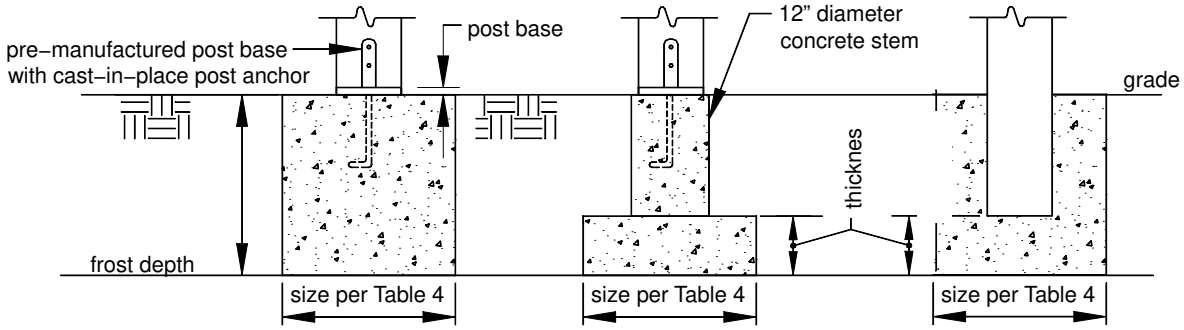
[1]All footing sizes are base diameters[2].

[2]For square footings, insert the diameter (d) into the following formula: $\sqrt{((d/2)^2 \times \pi)}$. This number will give you the square dimension and must be rounded up to the nearest inch.

[3]Joist length is the joist span plus any overhang beyond a beam. See section 5.4.

Figure 1

FOOTINGS



SECTION 3: POSTS AND POST–TO–BEAM CONNECTIONS

Posts must comply with all of the following:

1. The post height, measured from the top of the footing to the underside of the beam, must be in accordance with Table 2.

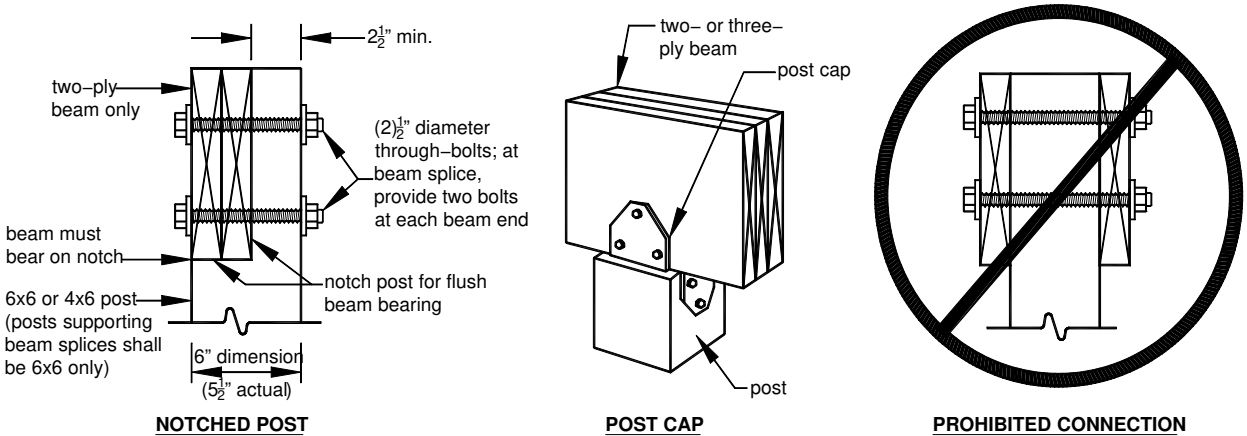
Table 2
MAXIMUM POST HEIGHT

Post Size	Maximum Height
4"x4"	6'
4"x6"	8'
6"x6"	14'

2. Any post supporting a beam splice must be a minimum of 6"x6".
3. Beams must be attached to posts by the appropriate methods shown in Figure 2. Toe–nailing of beams to posts is prohibited.
4. Post caps, as shown in Figure 2, must be specifically designed for 2– or 3–ply beams and the post size used. Attachment must be in accordance with the manufacturer's instructions.
5. It is recommended that cut–ends of posts should be field–treated with a wood preservative. These preservatives can be found in the paint department of most hardware or home center stores.

Figure 2

POST–TO–BEAM CONNECTIONS

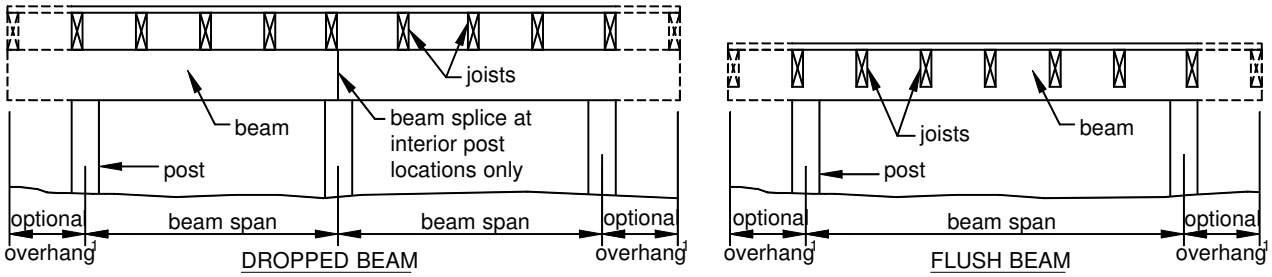


SECTION 4: BEAMS

Beams must comply with all of the following:

1. As shown in Figure 3, the beam−span length is measured between the centerlines of 2 adjacent posts and does not include the overhangs.
2. Beam size is determined using Table 3A or 3B. The depth of flush beams must be greater than or equal to the joist depth.
3. Beams may overhang past the center of the post up to one−fourth of the actual beam span, as shown in Figure 3.
4. Where multiple 2x members are used to assemble a beam, the plies of the beam must be fastened in accordance with Figure 4.
5. Pressure−preservative−treated glulam beams are permissible for spans longer than those shown in Table 3. However, a design and plan submission is required during the permit application process.

Figure 3
BEAM TYPES



[1]The maximum length of the overhang is equal to one−fourth of the actual beam span length (0.25 x beam span).

Table 3A
MAXIMUM BEAM−SPAN LENGTH[1] FOR DOUGLAS FIR/LARCH[3], HEM/FIR[3], SPRUCE/PINE/FIR (SPF)[3], WESTERN CEDAR, PONDEROSA PINE[4], AND RED PINE[4]

Joist Span	(Number of Plies) Beam Size[2] – Inches											
	3x6 (2)2x6	3x8 (2)2x8	3x10 (2)2x10	3x12 (2)2x12	4x6	4x8	4x10	4x12	(3)2x6	(3)2x8	(3)2x10	(3)2x12
≤ 6’	5’−5”	6’−10”	8’−4”	9’−8”	6’−5”	8’−5”	9’−11”	11’−5”	7’−4”	9’−8”	12’−0”	13’−11”
≤ 8’	4’−8”	5’−11”	7’−3”	8’−5”	5’−6”	7’−3”	8’−7”	9’−11”	6’−8”	8’−6”	10’−5”	12’−1”
≤ 10’	4’−2”	5’−4”	6’−6”	7’−6”	4’−11”	6’−6”	7’−8”	8’−10”	6’−0”	7’−7”	9’−4”	10’−9”
≤ 12’	3’−10”	4’−10”	5’−11”	6’−10”	4’−6”	5’−11”	7’−0”	8’−1”	5’−6”	6’−11”	8’−6”	9’−10”
≤ 14’	3’−6”	4’−6”	5’−6”	6’−4”	4’−2”	5’−6”	6’−6”	7’−6”	5’−1”	6’−5”	7’−10”	9’−1”
≤ 16’	3’−1”	4’−1”	5’−1”	5’−11”	3’−11”	5’−2”	6’−1”	7’−0”	4’−9”	6’−0”	7’−4”	8’−6”
≤ 18’	2’−9”	3’−8”	4’−8”	5’−7”	3’−8”	4’−10”	5’−8”	6’−7”	4’−6”	5’−8”	6’−11”	8’−1”

[1]Spans are based on 40 psf live load, 10 psf dead load, normal loading duration, wet service conditions, and deflections of Δ =L/360 for main span and L/180 for overhang with a 220 lb. point load.

[2]Beam depth must be equal to or greater than joist depth if joist hangers are used (see Figure 8, Option 3).

[3]Incising is assumed.

[4]Design values based on northern species with no incising assumed.

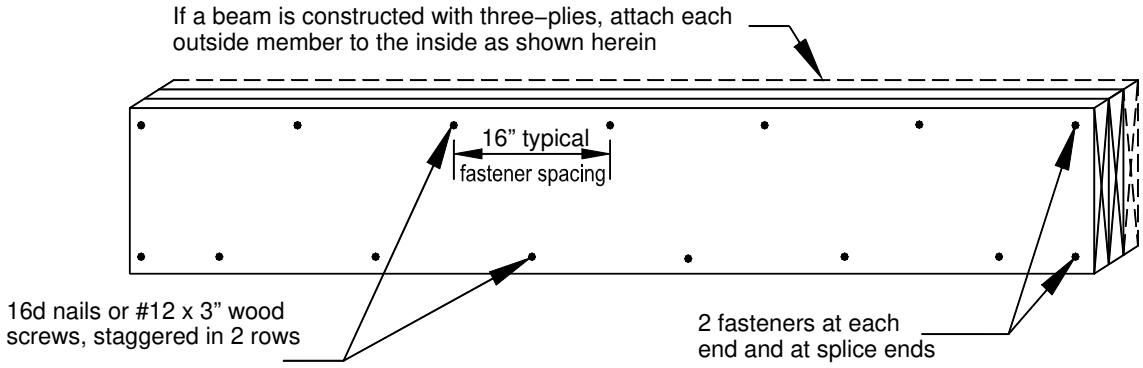
Table 3B
MAXIMUM BEAM–SPAN LENGTH FOR SOUTHERN PINE[1]

Joist Span	(Number of Plies) Beam Size[2] – Inches							
	(2) 2x6	**(2) 2x8**	**(2) 2x10**	**(2) 2x12**	**(3) 2x6**	**(3) 2x8**	**(3) 2x10**	**(3) 2x12**
≤ 6’	6’–11”	8’–9”	10’–4”	12’–2”	8’–2”	10’–10”	13’–0”	15’–3”
≤ 8’	5’–11”	7’–7”	9’–0”	10’–7”	7’–5”	9’–6”	11’–3”	13’–3”
≤ 10’	5’–4”	6’–9”	8’–0”	9’–5”	6’–8”	8’–6”	10’–0”	11’–10”
≤ 12’	4’–10”	6’–2”	7’–4”	8’–7”	6’–1”	7’–9”	9’–2”	10’–9”
≤ 14’	4’–6”	5’–9”	6’–9”	8’–0”	5’–8”	7’–2”	8’–6”	10’–0”
≤ 16’	4’–3”	5’–4”	6’–4”	7’–6”	5’–3”	6’–8”	7’–11”	9’–4”
≤ 18’	4’–0”	5’–0”	6’–0”	7’–0”	5’–0”	6’–4”	7’–6”	8’–10”

[1]Spans are based on 40 psf live load, 10 psf dead load, normal loading duration, wet service conditions, and deflections of Δ =L/360 for main span and L/180 for overhang with a 220 lb. point load.

[2]Beam depth must be equal to or greater than joist depth if joist hangers are used (see Figure 8, Option 3).

Figure 4
BEAM ASSEMBLY

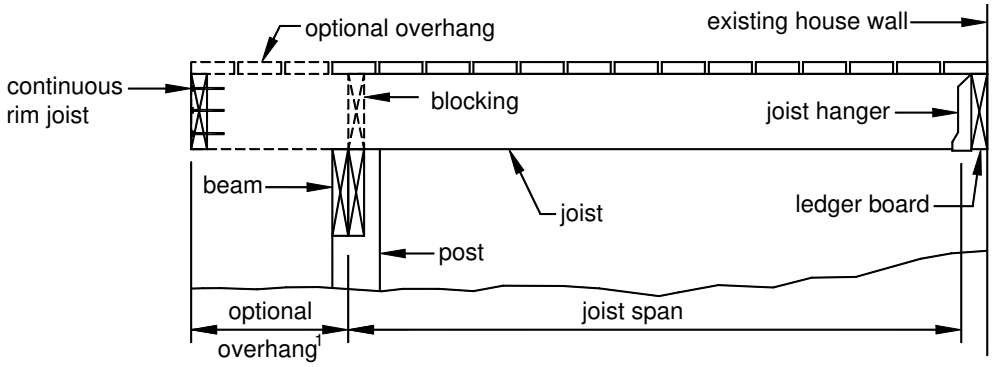


SECTION 5: JOISTS

Joists must comply with all of the following:

1. The joist–span length is measured between the centerline of bearing at each joist–span end and does not include the overhangs. Use Table 4 to determine the joist size based on span length and joist spacing. See section 12.4 for limits on joist spacing if the decking consists of a wood–plastic composite.
2. See Figures 5 through 7 for joist–span types.
3. Joists must bear at least 3 inches nominal onto beams, unless joist hangers are used in accordance with section 7.
4. Joists may overhang past the center of the beam up to one–fourth of the actual joist span.
5. Provide full–depth 2x blocking or bridging for 2”x10” or deeper joists at intervals not exceeding 8 feet – except the blocking can be reduced to 60% of the height if placed above a beam, for drainage purposes. Attach the blocking or bridging with (3)10d toe–nails at each end.
6. Attach a continuous rim joist as shown in Figures 5 and 7 unless blocking or bridging is provided for each joist at the beam where a joist overhang begins. Attach the rim joist to the end of each joist with (3)10d nails or (3)#10 by 3–inch wood screws.

Figure 5
JOISTS WITH DROPPED BEAM – DECK ATTACHED AT HOUSE



[1]The maximum length of the overhang is equal to one–fourth of the actual joist span length (0.25 x joist span).

Figure 6
JOISTS WITH FLUSH BEAM – DECK ATTACHED AT HOUSE

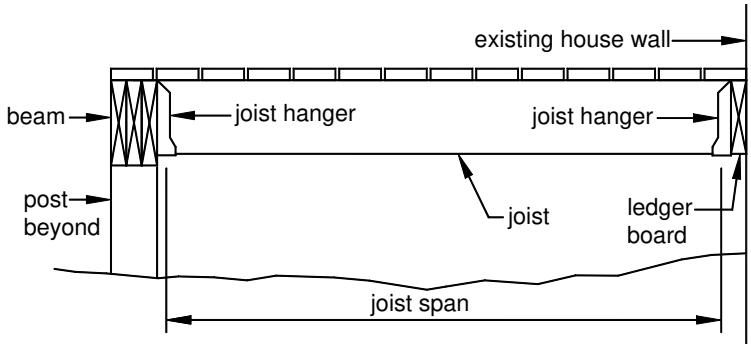
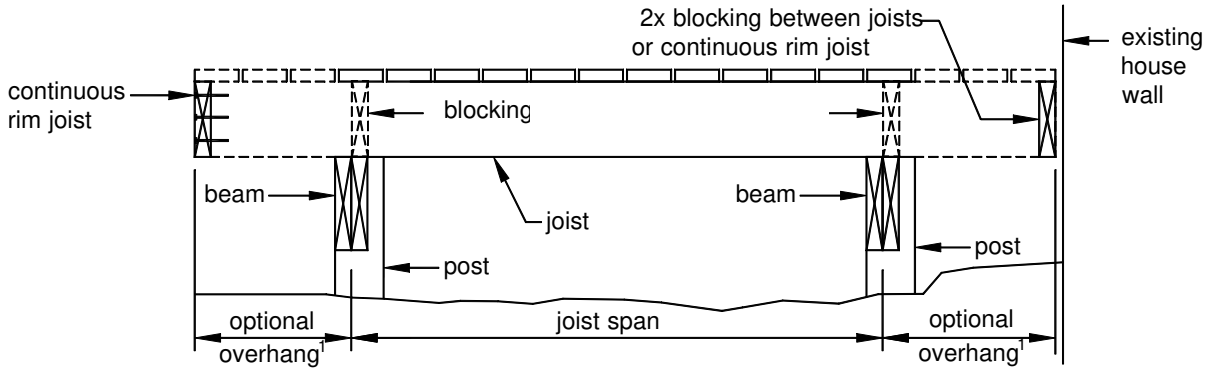


Figure 7
JOISTS WITH TWO DROPPED BEAMS/FREE–STANDING DECK
(See section 10 for more information.)



[1]The maximum length of the overhang is equal to one–fourth of the actual joist span length (0.25 x joist span).

Table 4
MAXIMUM JOIST–SPAN LENGTH[1]

Joist Spacing (on center)	Joist Size	Douglas Fir/Larch, Hem/Fir, SPF[2]		Southern Pine	
		Without Overhang	With Over-hangs	Without Overhang	With Over-hangs
12"	2"x6"	9'–1"	8'–1"	9'–6"	8'–7"
	2"x8"	12'–6"	9'–5"	13'–1"	10'–1"
	2"x10"	15'–8"	13'–7"	16'–2"	14'–6"
	2"x12"	18'–0"	18'–0"	18'–0"	18'–0"
16"	2"x6"	8'–3"	8'–0"	8'–7"	8'–7"
	2"x8"	11'–1"	9'–5"	11'–10"	10'–1"
	2"x10"	13'–7"	13'–7"	14'–0"	14'–0"
	2"x12"	15'–9"	15'–9"	16'–6"	16'–6"
24"	2"x6"	6'–9"	6'–9"	7'–6"	7'–6"
	2"x8"	9'–1"	9'–1"	9'–8"	9'–8"
	2"x10"	11'–1"	11'–1"	11'–5"	11'–5"
	2"x12"	12'–10"	12'–10"	13'–6"	13'–6"

[1]Spans are based on 40 psf live load, 10 psf dead load, normal loading duration, wet service conditions, and deflections of Δ =L/360 for main span and L/180 for overhang with a 220 lb. point load.

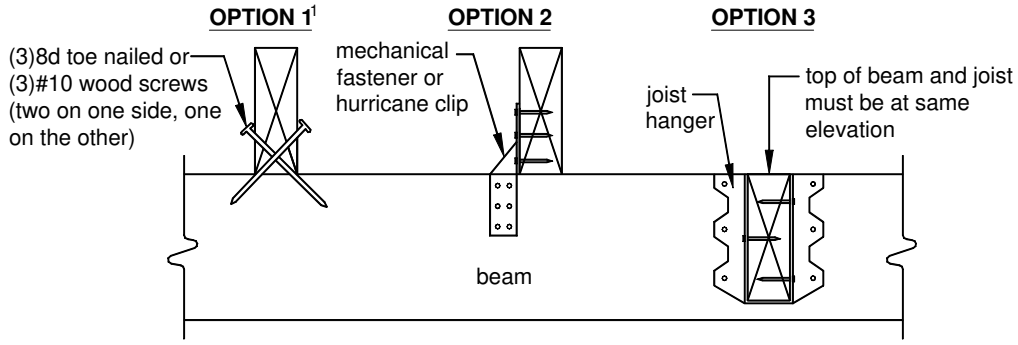
[2]Incising is assumed.

SECTION 6: JOIST – TO – BEAM CONNECTIONS

Joists must be attached to beams in accordance with Figure 8 and all of the following:

1. Use Options 1 or 2 if joists bear on a dropped beam.
2. Use Option 3 if joists bear at a flush beam; see section 7 for hanger requirements.
3. Mechanical fasteners or hurricane clips must have a minimum capacity of 100 pounds in both uplift and lateral directions. Installation must be in accordance with the manufacturer's instructions.

Figure 8
JOIST–TO–BEAM CONNECTIONS



[1]Option 1 is not allowed on free–standing decks.

SECTION 7: JOIST HANGERS

Joist hangers must comply with all of the following:

1. The joist–hanger depth (d, as shown in Figure 9) must be at least 60 percent of the joist depth.
2. The manufactured width of the joist hanger must accommodate the number of plies being carried.
3. Do not bend hanger flanges to accommodate field conditions.

4. For joist hangers that are fastened to a ledger board, screws which are recommended by the manufacturer must be used. All other fasteners are permitted to be nails. The number of fasteners and the manner in which they are used must be as specified by the manufacturer.
5. Use joist hangers with inside flanges if clearances to the edge of the beam or ledger board dictate.
6. Clip−angles or brackets used to support framing members in lieu of joist hangers are prohibited.
7. Joists must not frame in from both sides of the same beam. Engineering analysis is needed if more beams are needed than are shown in Figures 5 to 7.
8. Each joist hanger must have the minimum capacity listed in Table 5.

Figure 9
JOIST HANGERS

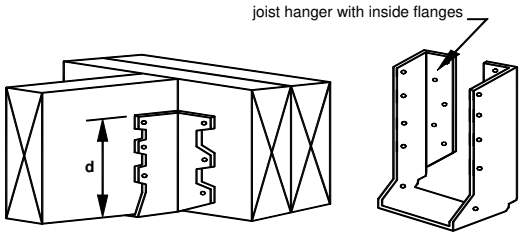


Table 5
JOIST HANGER DOWNLOAD

Joist Size	Minimum Capacity, lbs
2”x6”	500
2”x8”	500
2”x10”	600
2”x12”	700

SECTION 8: LEDGER ATTACHMENTS

General requirements. Ledger boards must be attached to the existing house in accordance with all of the following and section 9. Compliance is critical to ensure the safety and structural stability of your deck.

1. The ledger−board depth must be greater than or equal to the depth of the deck joists, but not less than a 2”x8”.
2. The ledger board must be attached in accordance with one of the conditions shown in Figures 11 through 13 – except if metal−plate−connected wood floor trusses were used in the house, see the text below for manufactured wood trusses.
3. The existing band board on the house must be capable of supporting the deck. If this cannot be verified or if existing conditions differ from the details here, then a free−standing deck or an engineered design is required.
4. The top of the ledger board and the top of the deck joists must be at the same elevation.

Wood I−joists. Many homes are constructed with wood I−joists, as shown in Figure 10. Rather than utilize a 2x band board, these systems are often constructed with a minimum 1−inch−thick engineered wood product (EWP) band board capable of supporting a deck. If a minimum 1−inch EWP or 2x band board is not present, then a freestanding deck is required, as addressed in section 10.

Figure 10: WOOD I−JOISTS



Manufactured wood trusses. A metal−plate−connected wood truss (MPCWT) is an engineered, prefabricated structural component that is designed for each specific application. MPCWT systems that are used in residential floors are often installed with a 2”x4” lumber “ribbon” board at the ends of the trusses to tie the ends of the trusses together (see Detail 1 in Appendix C.). The ribbon board, by itself, is not intended to support the deck ledger and deck. Installing a residential deck where the floor for the house uses a MPCWT system must be in accordance with a standard detail provided by the truss designer, a corresponding detail in section 7 of Appendix C, or a full plan submission – unless the deck is freestanding as addressed in section 10.

Siding and flashing. Flashing must be installed in accordance with all of the following:

1. The exterior finish, such as house siding, must be removed in the area for the ledger board prior to the installation of the ledger board.
2. Continuous flashing with a drip edge, as shown in Figure 11, is required at a ledger board that is attached to wood-framed construction. Caulking is needed with the flashing at a threshold to prevent water intrusion due to splash from the deck or due to melting snow and ice.

3. Flashing must be a corrosion−resistant metal having a minimum nominal 0.019−inch thickness – such as galvanized steel coated with 1.85 ounces of zinc per square foot (G−185 coating), copper (attached using copper nails only), or stainless steel – or must be a UV−resistant plastic recommended by its manufacturer for this use. Do not use aluminum in direct contact with lumber treated with preservatives that contain copper, such as ACQ, copper azole, or ACZA.

Figure 11
ATTACHMENT OF LEDGER BOARD TO BAND BOARD OR BAND JOIST

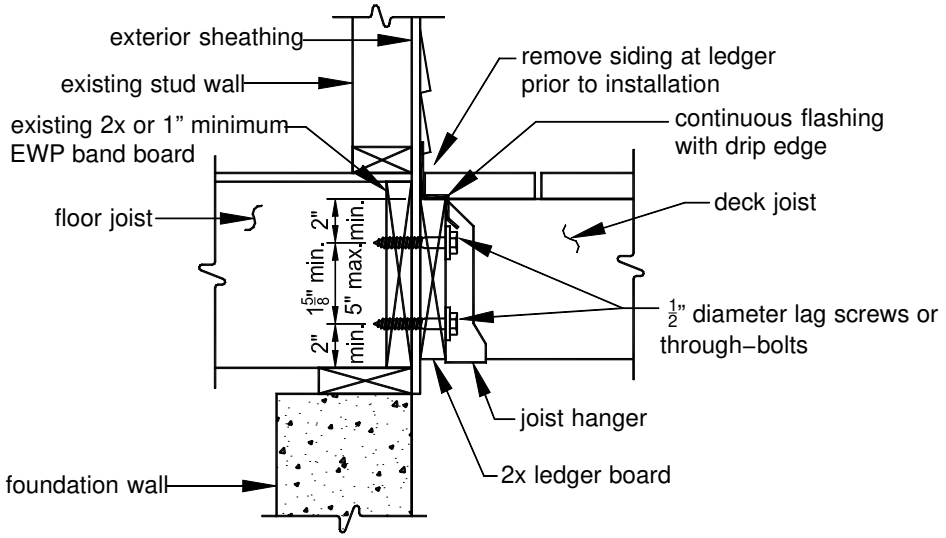


Figure 12
ATTACHMENT OF LEDGER BOARD TO SOLID FOUNDATION

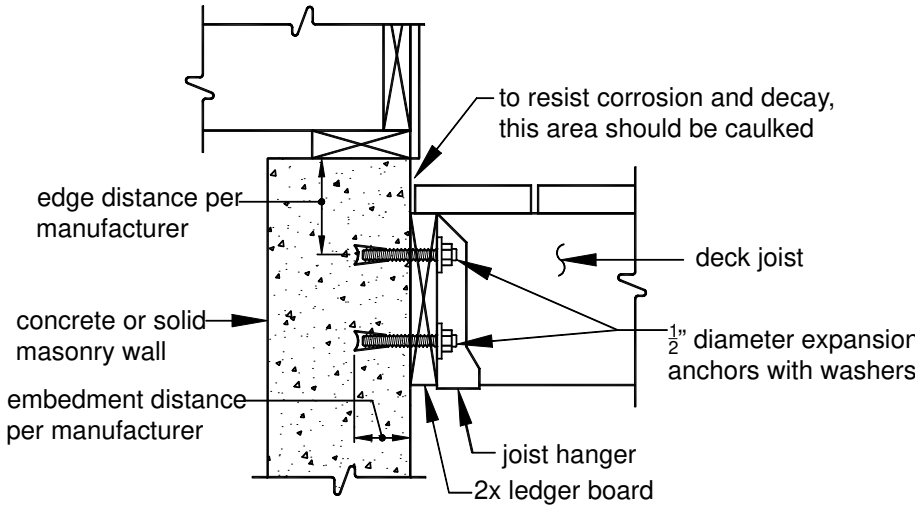
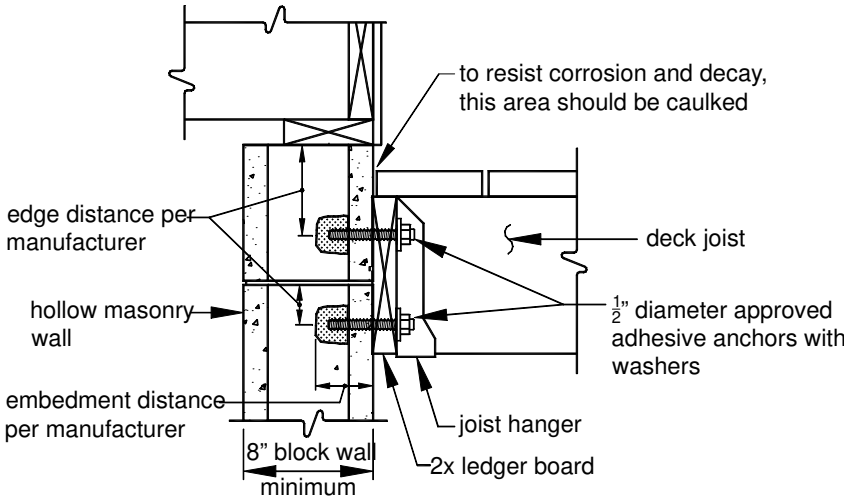
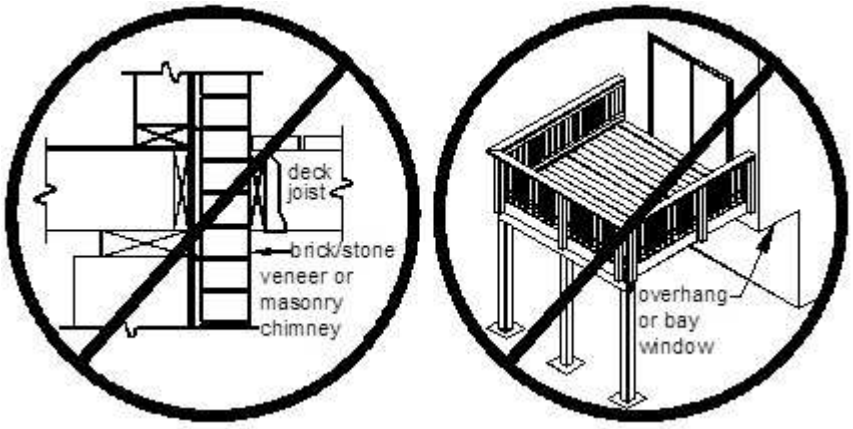


Figure 13
ATTACHMENT OF LEDGER BOARD TO HOLLOW FOUNDATION



Prohibited ledger attachments. Attaching a ledger board to or through an exterior veneer such as brick or stone, or to or through a masonry chimney, or to a house overhang – as shown below – are prohibited. In such cases, the deck must be free–standing, as addressed in section 10. Attaching a ledger board to a house overhang is allowed if supported by engineering.

Figure 14
PROHIBITED LEDGER ATTACHMENTS



SECTION 9: LEDGER–BOARD FASTENERS

General requirements. Ledger board fasteners must be installed in accordance with this section. Placement and spacing must be in accordance with Figure 15 and Table 6. Only the fastener types listed here are approved for use; lead anchors are prohibited. Adequacy of connections may be verified by local inspectors.

Figure 15
LEDGER BOARD FASTENER SPACING AND CLEARANCES

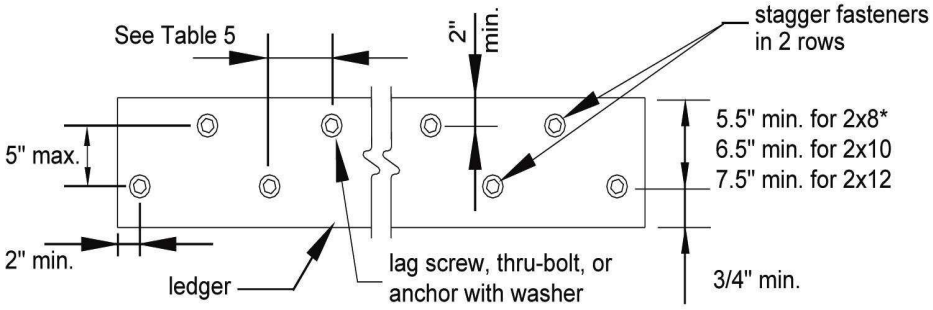


Table 6
LEDGER BOARD FASTENER SPACING, ON CENTER[1,2,3]

Fastener	Band Board	Joist Span: less than or equal to						
		6'	8'	10'	12'	14'	16'	18'
Lag screws	1" EWP	24"	18"	14"	12"	10"	9"	8"
	1 1/8" EWP	28"	21"	16"	14"	12"	10"	9"
	2x Lumber	30"	23"	18"	15"	13"	11"	10"
Through–Bolts	1" EWP	24"	18"	14"	12"	10"	9"	8"
	1 1/8" EWP	28"	21"	16"	14"	12"	10"	9"
	2x Lumber	36"	36"	34"	29"	24"	21"	19"
Through–Bolts with 1/2" stacked washers[4,5]	2x Lumber	36"	36"	29"	24"	21"	18"	16"
Adhesive anchors	——	32"	32"	32"	24"	24"	16"	16"

[1]These values are valid for deck ledgers consisting of douglas fir/larch, hem/fir, or southern pine; and for band boards consisting of douglas fir–larch, hem–fir, spruce–pine–fir, southern pine, or engineered wood product (EWP).

[2]Where solid–sawn pressure–preservative–treated deck ledgers are attached to engineered wood products (minimum 1" thick wood structural panel band joist or structural composite lumber including laminated veneer lumber), the ledger attachment must be designed in accordance with accepted engineering practice. These tabulated values are in accordance with that practice and are based on 300 lbs and 350 lbs for 1" and 1 1/8" EWP rim board, respectively.

[3] The thickness of the sheathing over the band board must not exceed 15/32".

[4] The maximum gap between the face of the ledger board and face of the wall sheathing is 1/2".

[5] Wood structural panel sheathing, gypsum board sheathing, or foam sheathing is permitted between the ledger board and the band board. Stacked washers are permitted in combination with wood structural panel sheathing, but are not permitted in combination with gypsum board or foam sheathing. The maximum distance between the face of the ledger board and the face of the band board is 1".

Through–bolts. Through–bolts must have a diameter of 1/2 inch. Pilot holes for through–bolts must be 17/32 to 9/16 inches in diameter. Through–bolts must be equipped with washers at the bolt head and nut. Bolts should be tightened 6 to 12 months after construction due to drying and wood shrinkage.

Expansion anchors. Expansion or adhesive anchors must be used for attaching a ledger board to a concrete or solid masonry wall, as shown in Figure 12. The bolt or threaded rod of expansion anchors must have a diameter of 1/2 inch, which in some cases may result in needing a 5/8 inch–diameter anchor. Expansion anchors must be installed in accordance with the manufacturer's instructions and must be equipped with washers.

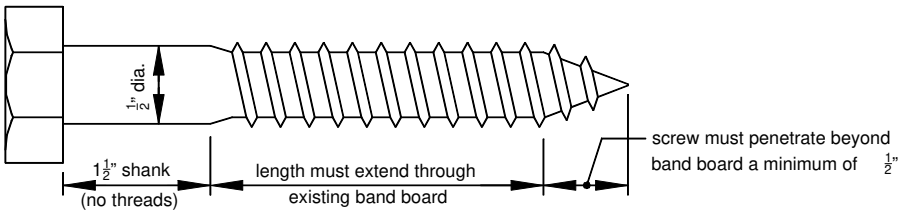
Adhesive anchors. Approved adhesive anchors with a 1/2 inch–diameter threaded rod must be used for attaching a ledger board to hollow masonry, as shown in Figure 13. Examples of approved adhesive anchors include the Epcon Acrylic 7 by ITW Ramset/Red Head, and the HY–20 by Hilti. Adhesive anchors are also permitted with concrete or

solid masonry installations. Adhesive anchors must be installed in accordance with the manufacturer's instructions and must be equipped with washers. Adhesive cartridges should remain on the jobsite for inspector verification.

Lag screws. The diameter, length, and shank of lag screws must comply with Figure 16. Lag screws must be equipped with washers and be installed in the following sequence:

1. Drill a 1/2 inch–diameter hole in the ledger board and a 5/16 inch–diameter pilot hole into the solid–connection material of the existing house.
2. Insert the lag screw through the ledger board and into the pilot hole by turning. Do not drive with a hammer. Use soap or a wood–compatible lubricant if needed to facilitate tightening.
3. Tighten each lag screw snugly, but do not over–tighten so as to cause wood damage.

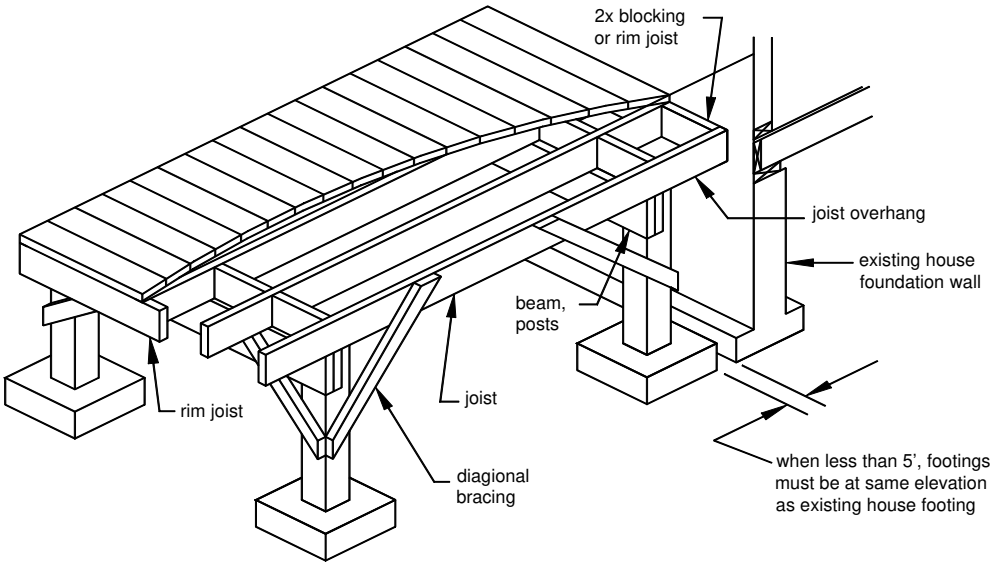
Figure 16
LAG SCREW



SECTION 10: FREE–STANDING

A deck that is free–standing does not utilize the exterior wall of the existing house to support vertical loads. Instead, an additional beam is provided at or offset from the existing house wall, as shown in Figure 17. If the edge of a deck footing is closer than 5 feet to an existing exterior house wall, the footing must bear at the same elevation as the existing wall footing as shown in Figure 17. For a house with a basement, a cylindrical footing (caisson) is recommended to minimize required excavation at the basement wall.

Figure 17
FREE–STANDING DECK



SECTION 11: LATERAL SUPPORT

A deck that is more than 24 inches above grade must resist lateral loads in accordance with the following:

Diagonal Bracing. Provide diagonal bracing both parallel and perpendicular to the beam at each post as shown in Figure 18. Where parallel to the beam, the bracing must be bolted to the post at one end and to the beam at the other. Where perpendicular to the beam, the bracing must be bolted to the post at one end and to a joist or blocking between joists at the other. Where a joist does not align with the bracing location, provide blocking between the adjacent joists.

Exceptions: Bracing is not required perpendicular to the house for a deck that is attached to the house with both a ledger board under sections 8 and 9 and the connection specified in either Figure 19 or 20. For a free−standing deck that is attached to the house as specified in Figure 21, bracing parallel to the house may be omitted at the beam adjacent to the house. All bracing may be omitted for a deck which is attached to the house in accordance with sections 8 and 9 or Figure 21 and which has all of its decking installed at a 45 degree angle to the deck joists.

Figure 18
DIAGONAL BRACING REQUIREMENTS

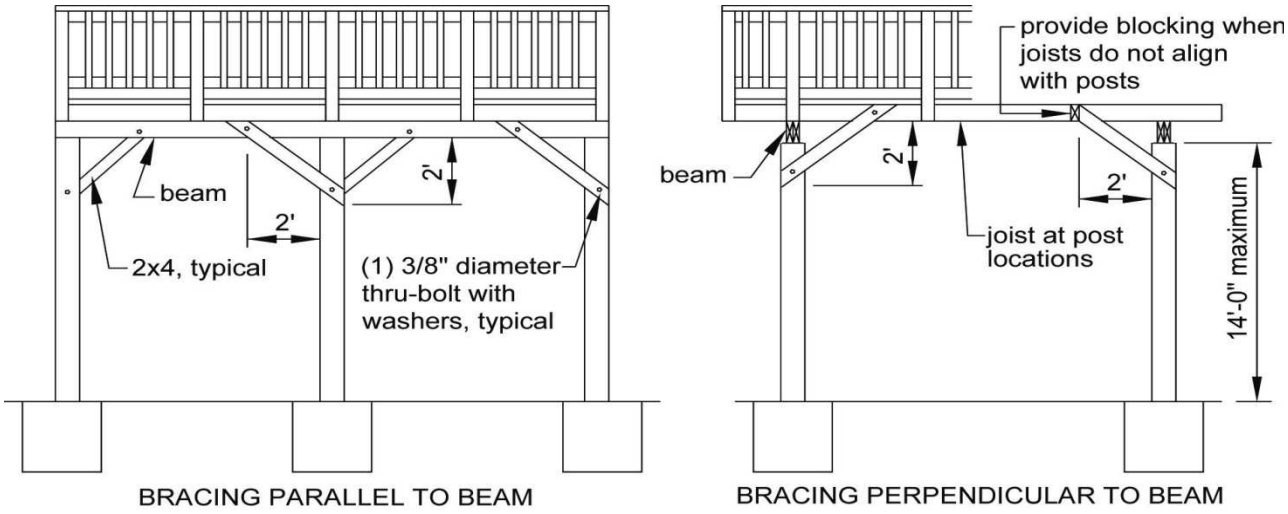
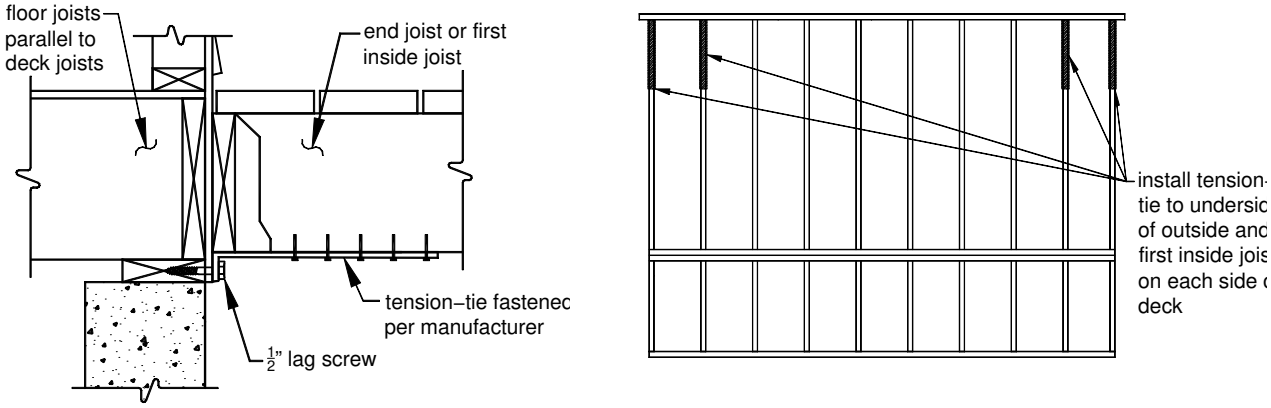


Figure 19
TENSION−TIE CONNECTION, WITH LEDGER BOARD

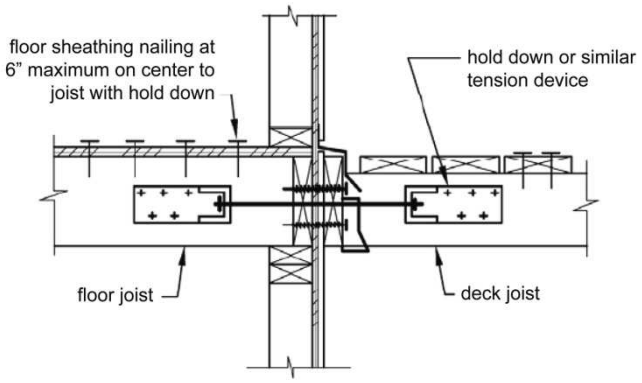


Tension−tie requirements. Tension ties, if used instead of perpendicular bracing as described above, must comply with all of the following, but are not permitted for free−standing decks:

1. The deck joists and floor joists must be parallel.
2. At least 4 ties must be installed, at the end joist and first inside joist at each end of the deck as shown in Figure 19. A set of tension−ties must be installed for each structurally independent section of a multi−level deck.
3. Approved tension−ties include the LTS19−TZ from USP or DTT1Z from Simpson Strong−Tie.
4. The minimum capacity of each tension−tie is 750 pounds.

5. Tension ties which are not available in a G−185 zinc coating require a barrier membrane separating the tension tie and the preservative−treated joist. The barrier membrane must be recommended for this location by its manufacturer.
6. Tension−ties must be attached to the underside of the joists in accordance with the manufacturer's instructions. Tension−ties must be attached to the exterior wall with lag screws as shown in Figure 19. Lag screws must penetrate a minimum of 3 inches into the sill plate or top plate of a wood−framed wall.
7. Where attaching to a concrete wall, lags screws may be replaced with adhesive or expansion anchors and a 1/2 inch threaded rod, with a withdrawal capacity of at least 750 pounds. The anchor must be installed in accordance with the manufacturer's instructions.

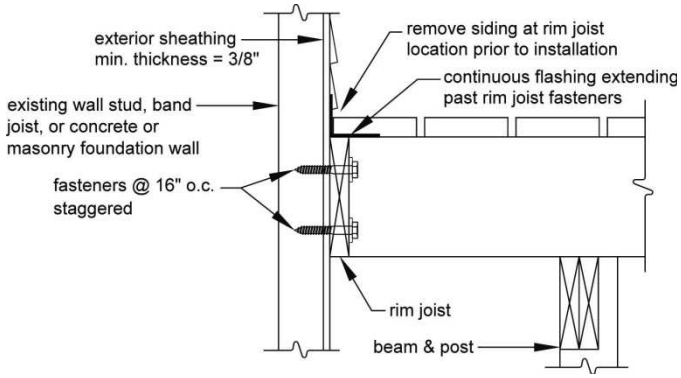
Figure 20
HOLD−DOWN TENSION DEVICE, WITH LEDGER BOARD



Hold−down tension devices. Hold−down tension devices, if used instead of perpendicular bracing as described above, must be provided in at least 2 locations per deck, and each device must have an allowable−stress−design capacity of at least 1,500 pounds.

Free−standing deck – attachment to house. Attach the deck's rim joist to the existing house exterior wall as shown in Figure 21 for a free−standing deck, if diagonal bracing parallel to the house is omitted, as described above. The wall must be sheathed with minimum 3/8 inch wood structural panel sheathing. Use lag screws or through−bolts if fastening to an existing band joist or wall stud; and use expansion or adhesive anchors if fastening to concrete or masonry. Do not attach to brick veneers. Verify this condition in the field prior to utilizing this method. Fasteners must be 16 inches on center and staggered in 2 rows. Flashing over the rim joist is required and must be installed in accordance with the flashing provisions in section 8.

Figure 21
ATTACHMENT OF FREE−STANDING DECK TO HOUSE FOR LATERAL SUPPORT



SECTION 12: DECKING

All decking materials must be wood or a wood−plastic composite and must comply with all of the following:

1. Wood decking must be 2x4s, 2x6s, or five−quarter span−rated decking boards. Wood−plastic−composite sizes must be in accordance with the manufacturer's instructions. Plastic decking may be used if it is approved by a professional testing organization for supporting a live load of 40 psf and is installed according to the manufacturer's instructions.
2. Decking must be attached in accordance with Figure 22, and may be placed at an angle of 45 to 90 degrees to the joists unless disallowed in the manufacturer's instructions. If the decking is wet, place it with no gap so that after drying, a ?−inch gap is created.
3. Decking may overhang a joist by up to 3 inches unless disallowed in the manufacturer's instructions.
4. The center−to−center joist spacing may be up to 24 inches for wood decking, but may not exceed 16 inches for wood−plastic−composite decking unless specified otherwise by the manufacturer.
5. Each wood decking member must bear on a minimum of 4 joists or intermediate blocking between joists.
6. Placement and attachment of wood−plastic composites must be in accordance with the manufacturer's instructions.
7. Attach the decking to the rim joist in accordance with Figure 23.

Figure 22
TYPICAL DECKING

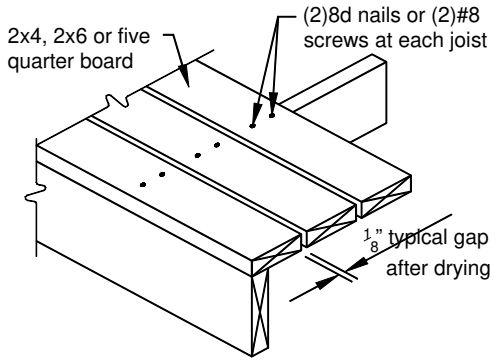
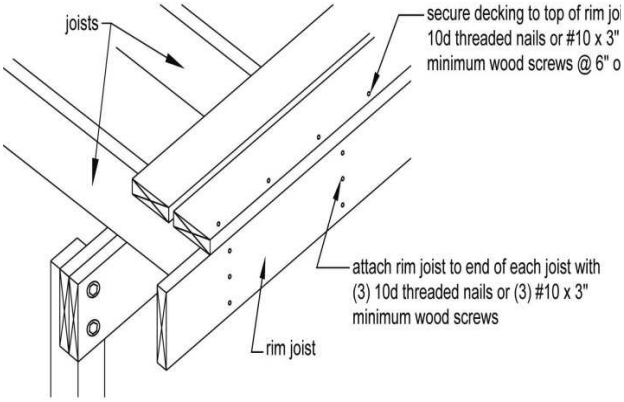


Figure 23
RIM JOIST CONNECTION

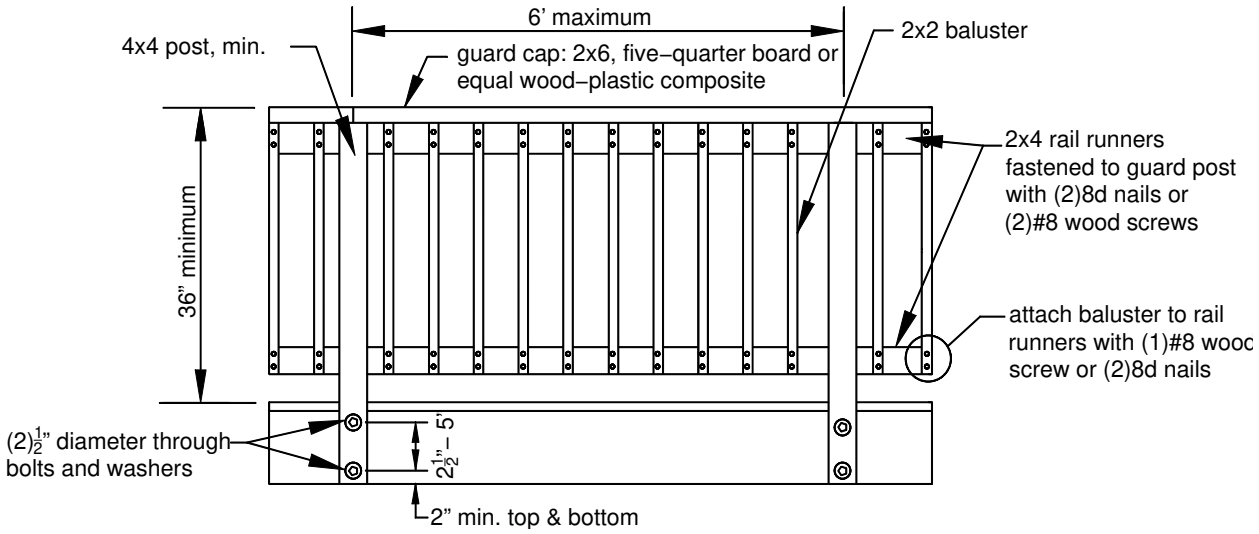


SECTION 13: GUARD AND POSTS

All open sides of a deck area that is more than 24 inches above grade – at any point within 36 inches beyond the edge of the deck – must have a guard that complies with Figure 24 and with all of the following:

1. Required horizontal guards shall not have openings from the walking surface to the required guard height which allow passage of a sphere 4 inches in diameter, when applying a force of 4 pounds.
2. Required guards at stairs shall not have openings which allow passage of a sphere 4 3/8 inches in diameter, when applying a force of 4 pounds, other than the triangular opening at the side of an open stair formed by the riser, tread, and bottom rail of a guard, which shall not allow passage of a 6 inch sphere, when applying a force of 4 pounds.
3. Wet lumber must be spaced such that when shrinkage due to drying occurs, a compliant opening is maintained.
4. Rope, cable, or a similar non−rigid material may be used instead of balusters if it is strung with maximum openings of 3 1/2 inches and with vertical supports no more than 4 feet apart.
5. The guard and posts must withstand a 200−pound load applied in any direction.
6. Guard−infill components, such as balusters and panel fillers, must withstand a horizontally applied, perpendicular load of 50 pounds on any one−foot−square area.
7. Wood−plastic composites of equivalent dimensions may be substituted for the guard cap and infill elements shown in Figure 24 if the manufacturer's instructions permit this use.

Figure 24
GUARDS



Guard posts. Guard posts must be attached to the deck structure in accordance with all of the following:

Notching guard posts, as shown in Figure 25, is prohibited.

1. Notching guard posts, as shown in Figure 25, is prohibited.
2. Hold–down anchors must have a minimum capacity of 1,800 pounds.
3. Guard posts may be attached to either side of the end joist or rim joist.
4. Bolt holes for a post must be at least 2 inches from the wood edge, at least 2½ inches apart, and no more than 5 inches apart.
5. Hold–down anchors, as shown in Figures 26 and 27, must be used to attach the guard post to the end joist and rim joist, respectively.

Figure 25

POST NOTCHING PROHIBITED

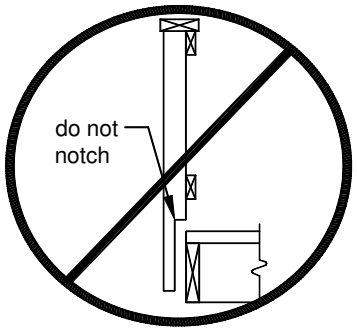


Figure 26
GUARD POST TO END JOIST

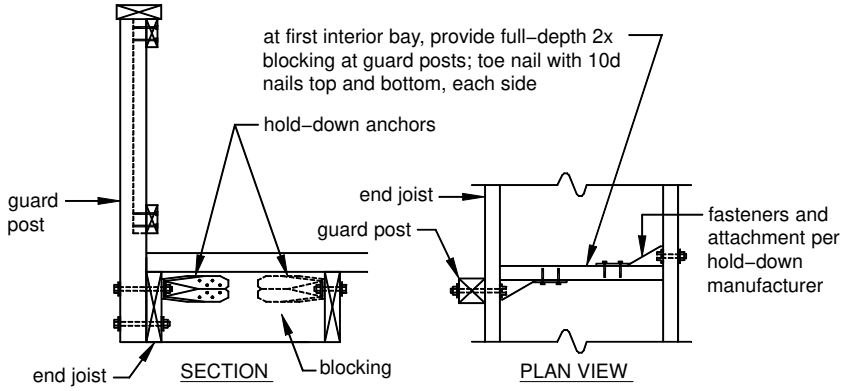
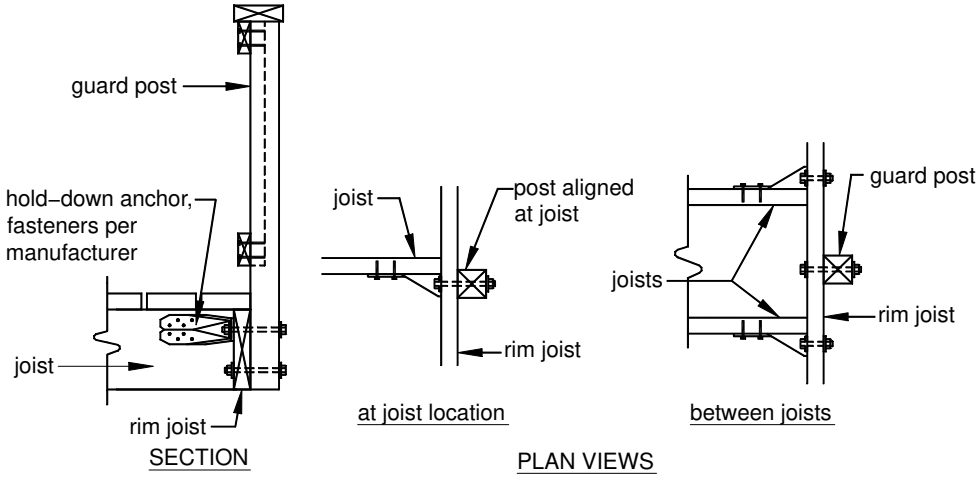


Figure 26
GUARD POST TO RIM JOIST

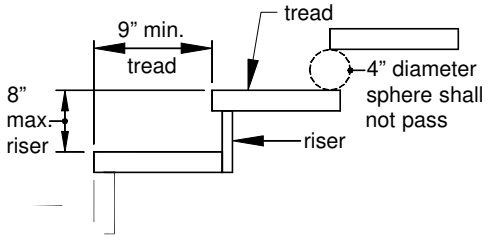


SECTION 14: STAIRS

Stair dimensions. Stair dimensions must comply with all of the following:

1. The minimum width of a stairway is 36 inches.
2. Handrails and associated trim may project a maximum of 4 1/2 inches into the required width at each side of the stairway. The minimum clear width at and below the handrail, including at treads and landings, cannot be less than 31 1/2 inches where a handrail is installed on one side, and 27 inches where handrails are provided on both sides.
3. Stair geometry and openings must be as shown in Figure 27.

Figure 27
TREADS AND RISERS



4. Within a stairway flight, the largest tread depth may not exceed the smallest tread depth by more than 3/8 inch, and the largest riser height may not exceed the smallest riser height by more than 3/8 inch.
5. If the total vertical height of a stairway exceeds 12 feet, an intermediate landing is required and must be constructed as a free−standing deck with flush beams and with posts.
6. Any landing width must equal or exceed the total width of the stairway it serves.

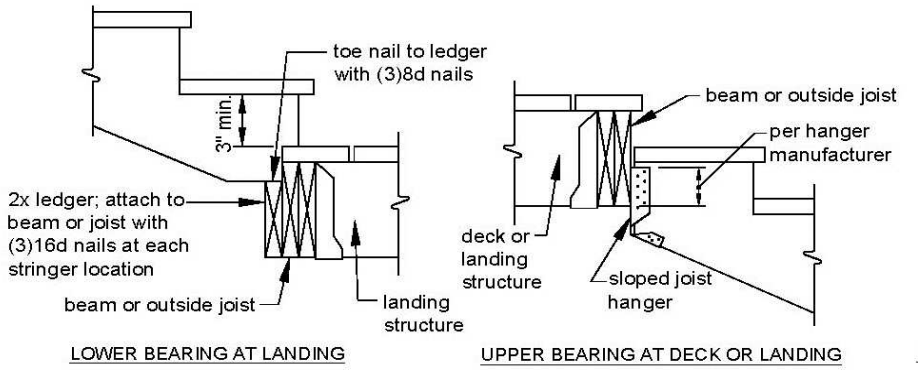
Stair stringers. Stringers must comply with all of the following:

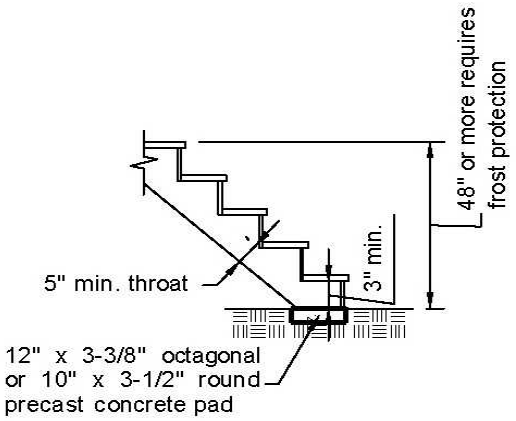
1. Stringers must be sawn or solid 2"x12"s complying with the above tread and riser dimensions.
2. Cut stringers must be spaced no more than 18 inches on center.
3. Stringers must bear on a solid surface, a minimum of 3 1/2 inches thick and 8 inches in diameter, and attach to the deck or a landing in accordance with Figure 28. Prior to placement of solid surface, all loose or organic material shall be removed.
4. Stringer−span length is measured using the horizontally projected distance between the centerlines of bearing at each end.
5. The span length of a cut stringer must not exceed 6 feet−0 inches, and the throat size of cut stringers must not be less than 5 inches, as shown in Figure 29.

Solid−stringer exception: Stringers for a stairway that has a width of 36 inches may have a horizontally projected span of up to 13 feet 3 inches if the stairway is framed solely with 2 solid stringers.

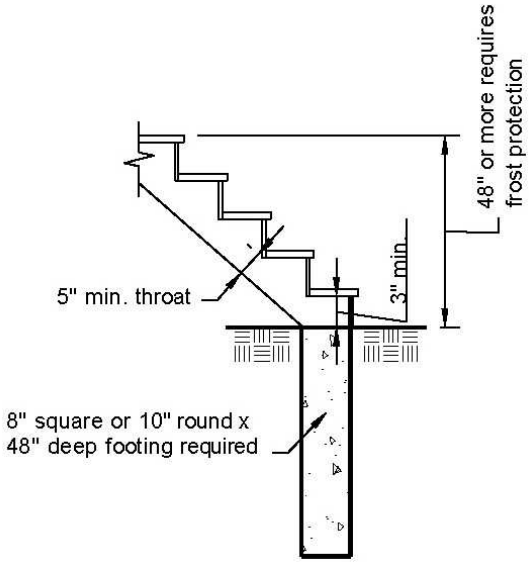
Intermediate−supported stringers: If the total stringer length exceeds the above dimensions, a 4"x4" post may be provided to support the stringer and shorten its span length. The 4"x4" post must be notched and bolted to the stringer in accordance with Figure 2. The post must bear over the middle one−third of a footing that is constructed in accordance with Figure 29 and must be attached as shown in Figure 2. An intermediate landing as described above may also be provided to shorten the stringer span.

Figure 28
STRINGER BEARING





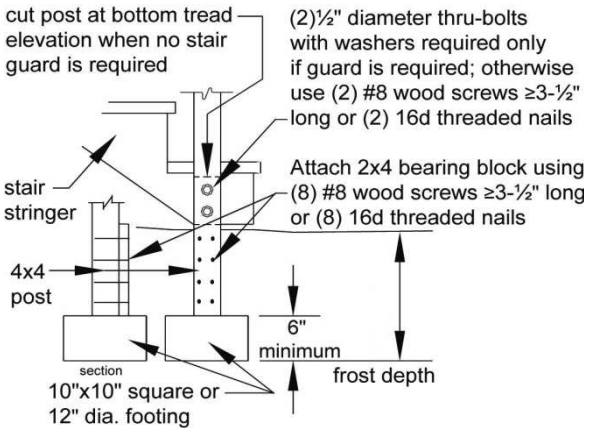
LOWER BEARING AT FOOTING

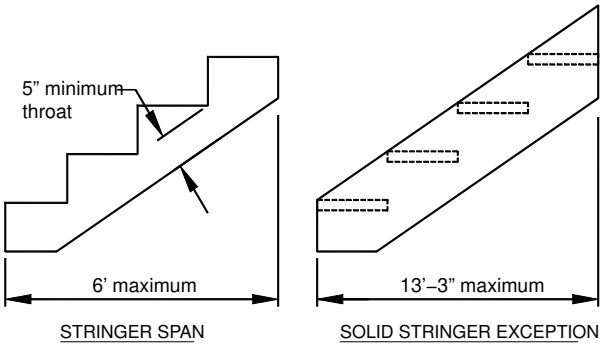


LOWER BEARING AT FOOTING – FROST PROTECTED

Figure 29
STRINGER BEARING

Figure 30
STRINGER SPAN LENGTH





STRINGER SPAN SOLID STRINGER EXCEPTION

Tread and riser material. Treads and risers must comply with all of the following:

1. Tread material must be equivalent to the decking specified in section 12 and be attached in accordance with Figure 31, except wood–plastic composites must be attached in accordance with the manufacturer's instructions.
2. Stairs constructed using the solid–stringer exception noted above must have treads constructed of 2x wood material only and be attached in accordance with Figure 30.
3. Risers that are not open (as shown in Figure 27) must be framed with 1x lumber minimum or an manufacturer recommended wood–plastic composite.

Figure 31
STAIRWAY TREADS

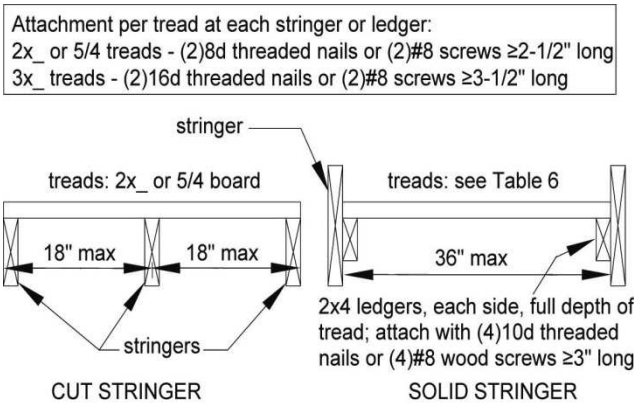


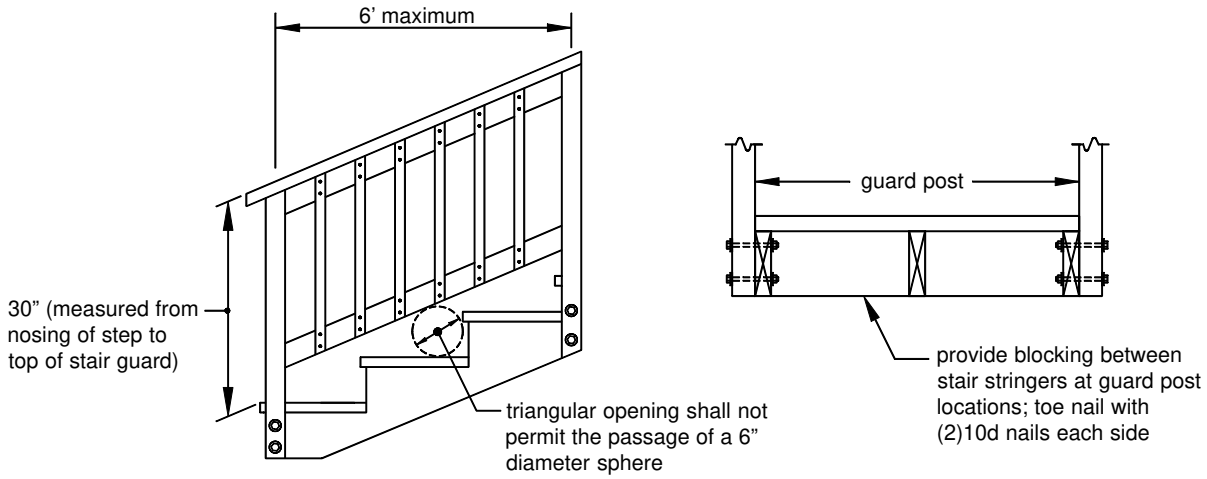
Table 7
MINIMUM TREAD SIZES[1]

Species	Cut Stringer	Solid Stringer
Douglas Fir/ Larch, Hem/ Fir, SPF[2]	2x4 or 5/4	2x8 or 3x4
Southern Pine	2x4 or 5/4	2x8
Redwood, Western Cedars, Ponderosa Pine[3], Red Pine[3]	2x4 or 5/4	2x10 or 3x4

[1] Assumes 300 lb concentrated load, L/288 deflection limit, No. 2 grade, and wet service conditions.
[2] Incising assumed for refractory species including Douglas fir–larch, hem–fir, and spruce–pine–fir.
[3] Design values based on northern species with no incising assumed.

Stair guards. Guards must be provided on all open sides of stairs consisting of more than 3 risers. Stair guards must comply with section 13 and Figure 32.

Figure 32
STAIR GUARDS



Stair handrails. A flight of stairs with more than 3 risers must have at least one handrail that complies with all of the following:

1. The handrail must be located at least 30 inches, but no more than 38 inches above the nosing of the treads – except that a volute, turnout, starting easing, or transition fitting may depart from these dimensions. Measurement must be taken from the nosing to the top of the rail.
2. The handrail must be attached to a stair guard or exterior wall acting as a barrier as shown in Figure 33.
3. The handrail and connecting hardware must be decay– and corrosion–resistant.
4. The handrail must have a smooth surface with no sharp corners and must be graspable, as shown in Figure 34. Recessed sections may be shaped from a 2"x6" or five–quarter board, as shown there.
5. Handrails must run continuously from a point directly over the lowest riser to a point directly over the highest riser.
6. Handrails may be interrupted by guard posts.

Figure 33
STAIR HANDRAILS

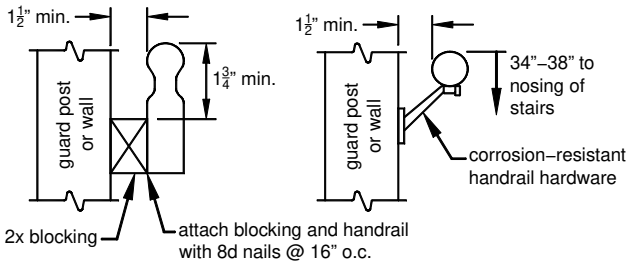
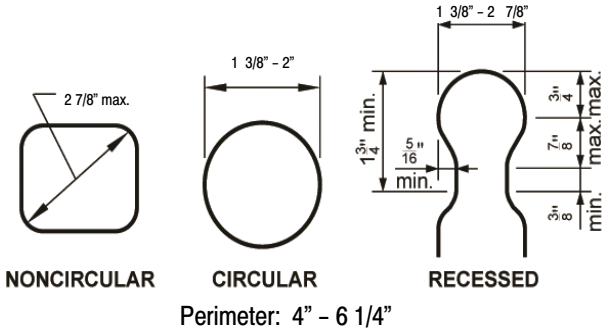


Figure 34
HANDRAIL GRASPABILITY

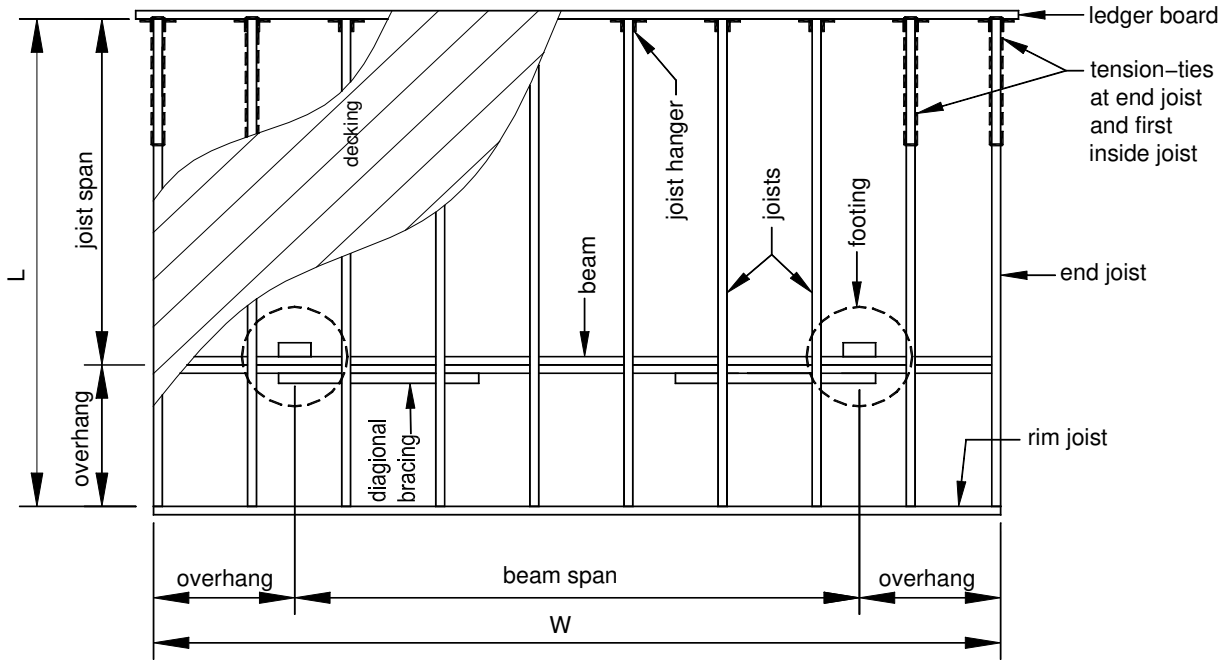


Spiral stairs. Stair dimensions above are for standard stairs secured in accordance with methods shown in this appendix. Spiral stairs are allowed at decks when designed in accordance with the provisions of Chapter SPS 321.04. Connection of spiral stairs to decks and the supporting load path shall be designed in accordance with accepted engineering practices and with applicable provisions of the Uniform Dwelling Code.

SECTION 15: FRAMING PLAN

A typical framing plan shows a bird's–eye or plan view of the joist and beam layout; the location of the ledger board, diagonal bracing or hold–down devices, posts, and footings; and the type, size, and spacing of the ledger board fasteners. You can use the sample typical deck framing plan shown on the next page in combination with the requirements in this document to complete your deck.

Figure 35
TYPICAL DECK FRAMING PLAN



Decking: ☐ 2x4 ☐ 2x6 ☐ five–quarter board ☐ wood–plastic composite (per ASTM D 7032)
☐ Other decking, evaluation report number:____

Joists: size: ☐ 2x6 ☐ 2x8 ☐ 2x10 ☐ 2x12 spacing: ☐ 12 in. ☐ 16 in. ☐ 24 in.
joist span dimension: _____ft. – _____in.
overhang: ☐ Yes ☐ No overhang dimension: _____ft. – _____in.
rim joist: ☐ 2x6 ☐ 2x8 ☐ 2x10 ☐ 2x12

Beam(s): number of plies: ☐ 2 ☐ 3 size: ☐ 2x6 ☐ 2x8 ☐ 2x10 ☐ 2x12
overhang: ☐ Yes ☐ No overhang dimension: _____ft. – _____in.

Posts: size: ☐ 4x4 ☐ 4x6 ☐ 6x6 height: _____ft. – _____in.

Footings: size:_____in. ☐ square ☐ round thickness: _____in.

Ledger: ledger board size: ☐ 2x8 ☐ 2x10 ☐ 2x12 ☐ Not applicable (free–standing deck)
fastener: ☐ Through bolt ☐ Lag screw ☐ Wood screw
☐ Expansion anchor ☐ Adhesive anchor

Lateral support: ☐ Tension–tie ☐ Diagonal bracing, size: ☐ 2x
(not permitted for free–standing deck)

Deck size: L=_____ft. – _____in. W=_____ft. – _____in.

Chapters SPS 320 to 325

APPENDIX C

Section	Page	Section	Page
1 Wood preservatives for ground contact	233	4 Alternate beam and joist spans..	243
2 Sources of design values	236	5 Framing around a Chimney or bay window.	245
3 Joist spans for alternate wood species.	237	6 Attachment of ledger boards to metal–plate–connected wood floor trusses.	246

1. Wood preservatives for ground contact. The following Table lists common pressure preservative treatments and retention levels, in pounds per cubic foot, for sawn lumber in ground contact – based on the American Wood Protection Association's *Book of Standards*.

Table C–1
PRESERVATIVE TREATMENTS AND RETENTION LEVELS FOR GROUND CONTACT (IN POUNDS PER CUBIC FOOT)

Species	ACQ–B	ACQ–C	ACQ–D	CA–B	CuN–W
Southern Pine	0.40	0.40	0.40	0.21	0.11
Douglas Fir–Larch	0.40	0.40	NR	0.21	0.11
Hem–Fir	0.40	0.40	0.40	0.21	0.11
Ponderosa Pine	0.40	0.40	0.40	0.21	0.11
Red Pine	0.40	0.40	0.40	0.21	0.11
Spruce–Pine–Fir	NR[1]	0.40	NR	NR	NR
Redwood	NR	NR	NR	NR	NR

[1]NR = treatment not recommended.

2. Sources of design values. The sources of the design values in Appendix B are as follows:

Table 1 – Minimum footing sizes: The Building Inspectors Association of Southeast Wisconsin, December 2014.

Table 2 – Maximum post heights: *Typical Deck Details*, *Based on the 2009 International Residential Code*, Fairfax County, Virginia, July 2013.

Tables 3A and 3B – Maximum beam spans: *Design for Code Acceptance 6,* American Wood Council, May 2013.

Table 4 – Maximum joist spans: *Design for Code Acceptance 6* (DCA 6), American Wood Council, May 2013; except for the 2x6 values, which are from the Building Inspectors Association of Southeast Wisconsin, December 2014.

Table 5 – Minimum joist–hanger download capacity: *Design for Code Acceptance 6,* American Wood Council, May 2013; except for the 2x6 values, which are repeated from the 2x8 values.

Table 6 – Ledger–board–fastener spacing: *Design for Code Acceptance 6,* American Wood Council, May 2013.

Figure 29 – Stringer span length, and Table 7 – Minimum tread sizes: *Design for Code Acceptance 6,* American Wood Council, May 2013.

Table C–2 – Maximum joist spans for redwood, western cedars, ponderosa pine, and red pine: *Design for Code Acceptance 6,* American Wood Council, May 2013; except for the

2x6 values, which are from the Building Inspectors Association of Southeast Wisconsin, December 2014.
Table C–3 – Trimmer joist download capacity: *Design for Code Acceptance 6,* American Wood Council, May 2013.

3. Joist spans for alternate wood species. The following Table lists maximum joist–span lengths for redwood, western cedars, ponderosa pine, and red pine.

Table C–2
MAXIMUM JOIST–SPAN LENGTH[1] FOR REDWOOD, WESTERN CEDARS, PONDEROSA PINE[2], AND RED PINE[2]

Joist Spacing (on center)	Joist Size	Without Overhang	With Over-hangs
12”	2x6	8’–5”	7’–3”
	2x8	11’–8”	8’–6”
	2x10	14’–11”	12’–3”
	2x12	17’–5”	16’–5”
16”	2x6	7’–8”	7’–3”
	2x8	10’–7”	8’–6”
	2x10	13’–0”	12’–3”
	2x12	15’–1”	15’–1”
24”	2x6	6’–7”	6’–7”
	2x8	8’–8”	8’–6”
	2x10	10’–7”	10’–7”
	2x12	12’–4”	12’–4”

[1]Spans are based on 40 psf live load, 10 psf Dead Load, normal loading duration, wet service conditions and deflections of Ä=L/360 for main span and L/180 for overhang with a 220–lb. point load.

[2]Design values based on northern species with no incising assumed.

4. Alternate beam and joist spans. The table on the following two pages lists alternate beam and joist spans and corresponding footing sizes from the Southeast Wisconsin Building Inspectors Association that can be used instead of the values in Appendix B**.**

Beam and Footing Sizes with Overhangs
Based on No. 2 or better Southern Pine, Douglas Fir–Larch2, and Ponderosa Pine

		Post Spacing (Measured Center to Center)																																				
Joist Length (JL)[1]		**4’**			**5’**			**6’**			**7’**			**8’**			**9’**			**10’**			**11’**			**12’**			**13’**			**14’**		
6’	Southern Pine Beam	1–2x6			1–2x6			1–2x8			2–2x6			2–2x8			2–2x8			2–2x10			2–2x10			2–2x12			3–2x10			3–2x12		
	Douglas Fir–Larch Beam	1–2x6			1–2x8			1–2x8			2–2x8			2–2x8			2–2x10			2–2x10			2–2x12			2–2x12			3–2x10			3–2x12		
	Ponderosa Pine Beam	1–2x6			1–2x8			1–2x8			2–2x8			2–2x8			2–2x10			2–2x10			2–2x12			2–2x12			3–2x10			3–2x12		
	Corner Footing	8	7	6	9	8	7	10	8	7	11	9	8	11	9	8	12	10	9	12	10	9	13	11	9	14	11	10	14	12	10	15	12	10
	Intermediate Footing	10	8	7	11	9	8	12	10	9	13	11	9	14	12	10	15	12	11	15	13	11	16	13	12	17	14	12	17	14	13	18	15	13
	Footing Thickness	6			6			6			6			6			6			6			6			6			6			8		

Beam and Footing Sizes with Overhangs
Based on No. 2 or better Southern Pine, Douglas Fir–Larch2, and Ponderosa Pine

		Post Spacing (Measured Center to Center)										
Joist Length (JL)[1]		**4'**	**5'**	**6'**	**7'**	**8'**	**9'**	**10'**	**11'**	**12'**	**13'**	**14'**
7'	Southern Pine Beam	1–2x6	1–2x8	1–2x8	2–2x8	2–2x8	2–2x10	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12
	Douglas Fir–Larch Beam	1–2x6	1–2x8	2–2x6	2–2x8	2–2x8	2–2x10	2–2x10	2–2x12	3–2x10	3–2x12	3–2x12
	Ponderosa Pine Beam	1–2x6	1–2x8	2–2x6	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x10	3–2x12	Eng Bm
	Corner Footing	9 7 7	10 8 7	11 9 8	11 9 8	12 10 9	13 11 9	13 11 10	14 12 10	15 12 10	15 12 11	16 13 11
	Intermediate Footing	11 9 8	12 10 9	13 11 9	14 12 10	15 12 11	16 13 11	17 14 12	17 14 12	18 15 13	19 15 13	19 16 14
	Footing Thickness	6	6	6	6	6	6	6	6	8	8	8
8'	Southern Pine Beam	1–2x6	1–2x8	2–2x6	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm
	Douglas Fir–Larch Beam	1–2x6	1–2x8	2–2x8	2–2x8	2–2x10	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm
	Ponderosa Pine Beam	1–2x6	1–2x8	2–2x8	2–2x8	2–2x10	2–2x10	2–2x12	3–2x10	3–2x12	3–2x12	Eng Bm
	Corner Footing	10 8 7	10 9 8	11 9 8	12 10 9	13 11 9	14 11 10	14 12 10	15 12 11	15 13 11	16 13 12	17 14 12
	Intermediate Footing	12 10 8	13 11 9	14 12 10	15 12 11	16 13 11	17 14 12	18 15 13	19 15 13	19 16 14	20 16 14	21 17 15
	Footing Thickness	6	6	6	6	6	6	8	8	8	8	8
9'	Southern Pine Beam	1–2x6	1–2x8	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x10	3–212	Eng Bm	Eng Bm
	Douglas Fir–Larch Beam	1–2x8	1–2x8	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm
	Ponderosa Pine Beam	1–2x8	2–2x6	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm
	Corner Footing	10 8 7	11 9 8	12 10 9	13 11 9	14 11 9	14 12 10	15 12 11	16 13 11	16 13 12	17 14 12	18 14 13
	Intermediate Footing	12 10 9	14 11 10	15 12 11	16 13 11	17 14 12	18 15 13	19 15 13	20 16 14	20 17 15	21 17 15	22 18 16
	Footing Thickness	6	6	6	6	6	8	8	8	8	8	8
10'	Southern Pine Beam	1–2x6	1–2x8	2–2x8	2–2x8	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm
	Douglas Fir–Larch Beam	1–2x8	2–2x6	2–2x8	2–2x10	2–2x10	2–2x12	3–2x10	3–2x12	3–2x12	Eng Bm	Eng Bm
	Ponderosa Pine Beam	1–2x8	2–2x6	2–2x8	2–2x10	2–2x10	2–2x12	3–2x10	3–2x12	Eng Bm	Eng Bm	Eng Bm
	Corner Footing	10 9 8	12 10 8	12 10 9	13 11 10	14 12 10	15 12 11	16 13 11	16 14 12	17 14 12	18 15 13	18 15 13
	Intermediate Footing	13 11 9	14 12 10	15 13 11	17 14 12	18 15 13	19 15 13	20 16 14	21 17 15	21 18 15	22 18 16	23 19 16
	Footing Thickness	6	6	6	6	8	8	8	8	8	8	10
11'	Southern Pine Beam	1–2x8	2–2x6	2–2x8	2–2x10	2–2x10	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm	Eng Bm
	Douglas Fir–Larch Beam	1–2x8	2–2x8	2–2x8	2–2x10	2–2x10	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm	Eng Bm
	Ponderosa Pine Beam	1–2x8	2–2x6	2–2x8	2–2x10	2–2x12	2–2x12	3–2x12	3–2x12	Eng Bm	Eng Bm	Eng Bm
	Corner Footing	11 9 8	12 10 9	13 11 9	14 12 10	15 12 11	16 13 11	16 14 12	17 14 12	18 15 13	19 15 13	19 16 14

Beam and Footing Sizes with Overhangs

Based on No. 2 or better Southern Pine, Douglas Fir–Larch2, and Ponderosa Pine

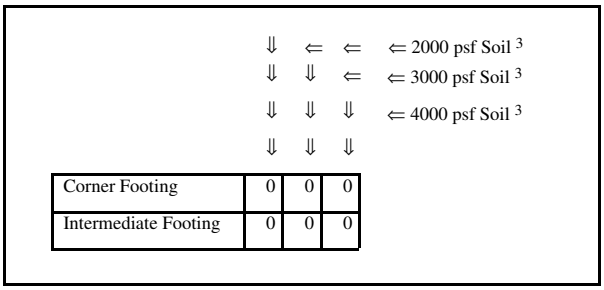
		Post Spacing (Measured Center to Center)																																
Joist Length (JL)[1]		4’			5’			6’			7’			8’			9’			10’			11’			12’			13’			14’		
	Intermediate Footing	13	11	10	15	12	11	16	13	12	17	14	12	19	15	13	20	16	14	21	17	15	22	18	15	22	18	16	23	19	17	24	20	17
	Footing Thickness	6			6			6			6			8			8			8			8			8			10			10		
	Southern Pine Beam	1–2x8			2–2x6			2–2x8			2–2x10			2–2x12			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm		
	Douglas Fir–Larch Beam	1–2x8			2–2x8			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm		
12’	Ponderosa Pine Beam	1–2x8			2–2x8			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Corner Footing	11	9	8	12	10	9	14	11	9	15	12	10	15	13	11	16	13	12	17	14	12	18	15	13	19	15	13	19	16	14	20	17	14
	Intermediate Footing	14	12	10	15	13	11	17	14	12	18	15	13	19	16	14	20	17	15	21	18	15	22	18	16	23	19	17	24	20	17	25	21	18
	Footing Thickness	6			6			6			8			8			8			8			8			10			10			10		
	Southern Pine Beam	1–2x8			2–2x8			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Douglas Fir–Larch Beam	1–2x8			2–2x8			2–2x10			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
13’	Ponderosa Pine Beam	1–2x8			2–2x8			2–2x10			2–2x10			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Corner Footing	12	10	8	13	11	9	14	12	10	15	12	11	16	13	12	17	14	12	18	15	13	19	15	13	19	16	14	20	17	14	21	17	15
	Intermediate Footing	14	12	10	16	13	12	17	14	13	19	15	13	20	16	14	21	17	15	22	18	16	23	19	17	24	20	17	25	21	18	26	21	19
	Footing Thickness	6			6			6			8			8			8			8			10			10			10			10		
	Southern Pine Beam	1–2x8			2–2x8			2–2x8			2–2x10			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Douglas Fir–Larch Beam	1–2x8			2–2x8			2–2x10			2–2x10			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
14’	Ponderosa Pine Beam	1–2x8			2–2x8			2–2x10			2–2x12			2–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Corner Footing	12	10	9	13	11	10	15	12	10	16	13	11	17	14	12	18	14	13	18	15	13	19	16	14	20	17	14	21	17	15	22	18	15
	Intermediate Footing	15	12	11	17	14	12	18	15	13	19	16	14	21	17	15	22	18	16	23	19	16	24	20	17	25	21	18	26	21	19	27	22	19
	Footing Thickness	6			6			8			8			8			8			10			10			10			10			10		
	Southern Pine Beam	1–2x8			2–2x8			2–2x10			2–2x12			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Douglas Fir–Larch Beam	2–2x6			2–2x8			2–2x10			2–2x12			2–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
15’	Ponderosa Pine Beam	2–2x6			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
	Corner Footing	12	10	9	14	11	10	15	12	11	16	13	12	17	14	12	18	15	13	19	16	14	20	16	14	21	17	15	22	18	15	22	18	16
	Intermediate Footing	15	13	11	17	14	12	19	15	13	20	17	14	21	18	15	23	19	16	24	20	17	25	21	18	26	21	19	27	22	19	28	23	20
	Footing Thickness	6			6			8			8			8			10			10			10			10			10			12		
	Southern Pine Beam	1–2x8			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm		
16’	Douglas Fir–Larch Beam	2–2x6			2–2x8			2–2x10			2–2x12			3–2x10			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm		

Beam and Footing Sizes with Overhangs
Based on No. 2 or better Southern Pine, Douglas Fir–Larch2, and Ponderosa Pine

		Post Spacing (Measured Center to Center)																																				
Joist Length (JL)[1]		**4'**			**5'**			**6'**			**7'**			**8'**			**9'**			**10'**			**11'**			**12'**			**13'**			**14'**							
16'	Ponderosa Pine Beam	2–2x6			2–2x8			2–2x10			2–2x12			3–2x12			3–2x12			Eng Bm			Eng Bm			Eng Bm			Eng Bm			Eng Bm							
	Corner Footing	13	11	9	14	12	10	15	13	11	17	14	12	18	15	13	19	15	13	20	16	14	20	17	15	21	18	15	22	18	16	23	19	16					
	Intermediate Footing	16	13	11	18	15	13	19	16	14	21	17	15	22	18	16	23	19	17	25	20	18	26	21	18	27	22	19	28	23	20	29	24	21					
	Footing Thickness	6			8			8			8			8			10			10			10			10			12			12							

Notes:

1. Joist Length (J_L) is Joist Span (L_J) plus any cantilever at the beam that is being sized.
2. Incising assumed for refractory species Douglas Fir–Larch.
3. All footing sizes above are base diameters (in inches) and are listed for THREE SOIL CAPACITIES. Soil capacity is based on the requirements of State of Wisconsin SPS 321.15 (3).[4]
4. For square footings, insert the diameter (d) into the following formula:$\sqrt{((d/2)^2 \times \pi)}$. This number will give you the square dimension and shall be rounded up to the nearest inch.



5. Framing around a chimney or bay window. All members at a chimney or bay window must be framed in accordance with Figure C–1. Headers may span a maximum of 6'–0". Where a chimney or bay window is wider than 6'–0", one or more 6x6 posts may be added to reduce header spans to less than 6'–0". In such cases, the post footing must meet the requirements in section 2 of Appendix B. Plan submittal and approval is required for headers with a span length greater than 6'–0". Headers must be located no more than 3'–0" from the end of the trimmer joist.

Triple trimmer joists are required on each side of the header if joist spacing is 12" or 16" on center or if the trimmer joist span exceeds 8'–6"; otherwise, double trimmer joists are permitted. Trimmer joists may bear on the beam and extend past the beam centerline up to $L_J/4$ as shown in Figures 5 and 7 in Appendix B, or the trimmer joist may attach to the side of the beam with joist hangers as shown in Figure 6 in Appendix B. Joist hangers must each have a minimum download capacity in accordance with Table C–3. Bolts or lag screws used to attach the hanger to the ledger must fully extend through the ledger into the 2–inch nominal lumber band joist (1 1/2" actual) or the EWP rim board. See Figure 15 in Appendix B for fastener spacing, and edge and end distances. Otherwise a free–standing deck is required.

Figure C–1
DETAIL FOR FRAMING AROUND A CHIMNEY OR BAY WINDOW

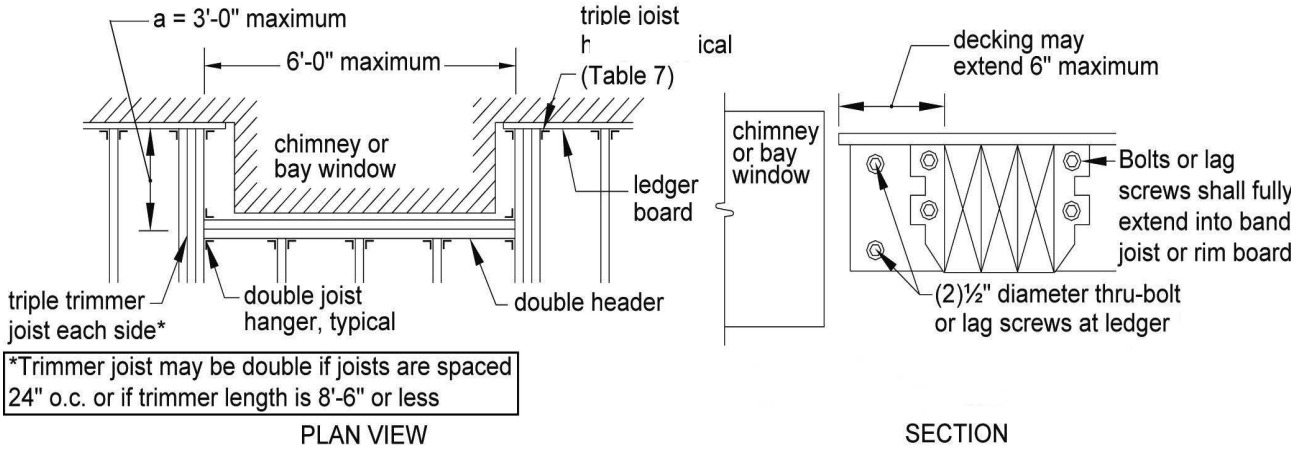


Table C–3
TRIMMER JOIST HANGER DOWNLOAD CAPACITY

Joist Size	Minimum Capacity, lbs
2x8	1050
2x10	1380
2x12	1500

6. Attachment of ledger boards to metal–plate–connected wood floor trusses. The research report on the following pages shows acceptable methods for attaching a ledger board to a metal–plate–connected wood–floor–truss system.

Attachment of Residential Deck Ledger to Metal Plate Connected Wood Truss Floor System

SRR No. 1408–01

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Introduction:

This research report provides construction details for residential Deck ledger attachment to metal plate connected wood truss floor systems. The applicable codes and standards follow the *2009* and *2012 International Building Code* (*IBC*) and the *2009* and *2012 International Residential Code* (*IRC*). Proper attachment of the Deck ledger to the house is critical for ensuring that an “attached” Deck is safely and securely supported at this location. This report provides details for attaching a 2” nominal lumber Deck ledger to residen-tial floor systems constructed with metal plate connected wood (MPCW) floor trusses.

Key Definitions:

Deck Ledger – A horizontal lumber beam attached to an existing wall and used to tie in construction elements such as porch roofs and decks. A Deck ledger is installed as part of the Deck frame construction and supports one end of the Deck joists.
Truss – An engineered structural component, assembled from wood members, metal connector plates and other mechanical fasteners, designed to carry its own weight and superimposed design loads. The truss members form a semi–rigid structural framework and are assembled such that the members form triangles.
Wood Structural Panel (WSP) – A panel manufactured from wood veneers, strands or wafers or a combination of veneer and wood strands or wafers bonded together with waterproof synthetic resins or other suitable bonding systems. Examples include: plywood, Oriented Strand Board (OSB), waferboard, and composite panels.

Background:

The *2009* and *2012 IRC* include prescriptive provisions for attaching a 2” nominal lumber Deck ledger to a 2” nominal lumber band joist bearing directly on a sill plate or wall plate using 1/2”–diameter bolts or lag screws. AF&PA’s American Wood Council, in cooperation with the International Code Council, has also developed *Design for Code Acceptance No. 6* (*DCA6*) – *Prescriptive Residential Deck Construction Guide*, available at awc.org.

The prescriptive provisions for the Deck ledger connection to the band joist in the *IRC* and *DCA6* are based on the results from a series of ultimate load tests conducted at Virginia Polytechnic Institute and State University (VT) Department of Wood Science and Forest Products, and Washington State University (WSU) Wood Materials and Engineering Laboratory. This testing evaluated the capacity 2” nominal pressure –preservative–treated (PPT) Hem–Fir (HF) and Southern Pine (SP) ledgers attached to either 2” nominal Spruce–Pine–Fir (SPF) or 1” net Douglas–Fir (DF) laminated veneer lumber (LVL) band joists, through $^{15}/_{32}$”–thick oriented strand board (OSB) sheathing, with 1/2”–diameter hot–dipped galvanized (HDG) bolts or lag screws, meeting the requirements *of ANSI/ASME Standard B18.2.1*.

The Deck ledger assemblies evaluated at VT and WSU were deemed to represent commonly accepted means of connecting Deck ledgers to band joints that cannot be evaluated using the provisions of the *National Design Specification® for Wood Construction* (*NDS®*) because:

1. The ledger is not in direct contact with the band joist (i.e., separated by $^{15}/_{32}$” OSB sheathing).
2. The minimum required penetration depth of four diameters (4D) is not met when using 1/2”–diameter lag screws into an 1 1/2”–thick band joist.

Application:

The details and fastener spacing tables provided in this report for connecting a 2" nominal lumber Deck ledger to a residential floor system constructed with MPCW trusses use a single shear reference lateral design value, Z, of 710 lbs. for a 1/2"–diameter bolt and 375 lbs. for a 1/2" x 6" lag screw. These lateral design values were developed from the VT and WSU testing, and assume the fasteners are installed in accordance with the *NDS* requirements for clearance holes, lead holes, edge distance and end distance.

Detail 1 includes construction information for attaching 2" nominal lumber Deck ledgers to the ends of MPCW floor trusses spaced no more than 24" o.c. Table 1 provides the maximum on–center spacing for each 1/2"–diameter bolt or 1/2" x 6" lag screw used to attach the ledger to the floor truss system for Deck joist spans up to 18', assuming a design Deck load of 40 psf live load (or 40 psf snow load) and 10 psf Dead Load. Table 2 includes similar information as Table 1, except for a design Deck load of 60 psf live load (or 60 psf snow load) and 10 psf Dead Load.

Detail 2 includes construction information for attaching 2" nominal lumber Deck ledgers to the side of a MPCW floor ladder frame with 4x4 vertical webs spaced no more than 16" o.c. provides the maximum on-center spacing for each 1/2"–diameter bolt and 1/2" x 6" lag screw used to attach the ledger to the ladder frame for Deck joist spans up to 18', assuming a design Deck load of 40 psf live load (or 40 psf snow load) and 10 psf Dead Load. Table 4 includes similar information as Table 3 Detail 3, except for a design Deck load of 60 psf live load (or 60 psf snow load) and 10 psf Dead Load.

Detail 3 includes Deck lateral load connection options capable of resisting the 1500 lbf lateral load requirement specified in *2009* and 2012 IRC Section 507.

Support of concentrated loads from Deck beams of girders are beyond the scope of this report. Deck ledgers shall not be supported on stone or masonry veneer.

Installation:

The following is a summary of the minimum requirements and limitations for installing a 2" nominal lumber Deck ledger with residential floor systems constructed with MPCW floor trusses.

1. Ledger must be 2x10 or 2x12 PPT or Code–Approved decay–resistant lumber with a specific gravity, G $\geq$ 0.43. Ledger shall be identified by the grade mark of, or certificate of inspection issued by, an Approved lumber grading or inspection bureau or agency. PPT material must be pressure treated with an Approved process in accordance with American Wood Protection Association standards
2. Install ledger directly over wood structural sheathing ($^{15}/_{32}$" maximum thickness) fastened to the wall per the building code.
3. Attach ledger through wood structural sheathing into 2–ply 2x4 truss end vertical, 4x4 vertical web or key–block with 1/2" x 6" lag screws or 1/2"–diameter bolts with washers and nuts.
   - 3.1 Only one (1) fastener into each truss member or key–block.
   - 3.2 Install each fastener through the centerline of the truss member or key–block and position so as not to interfere with bottom and top chord joints and connector plates. Refer to Detail 1 and Detail 2 for spacing requirements
   - 3.3 Lag screws and bolts shall be installed according to *2005 NDS* requirements. A "test" installation is recommended before drilling the lead holes, to ensure that the lead holes are neither too small nor too large.
     - 1/2" x 6" lag screws:
       - Lead holes for the threaded portion shall be $^{5}/_{16}$".
       - Clearance holes shall be 1/2" and the same depth of penetration as the length of unthreaded shank.
     - 1/2" –diameter bolts:

Holes shall be a minimum of $^{17}/_{32}$" to a maximum of $^{9}/_{16}$".

All fasteners used with PPT wood shall be hot–dip zinc–coated galvanized steel, stainless steel, silicon bronze, or copper. Fasteners to be hot–dipped galvanized shall meet the requirements of *ASTM A153 – Standard Specification for Zinc Coating (Hot–Dip) on Iron and Steel Hardware*, Class D, for fasteners $^{3}/_{8}$" diameter and smaller or Class C for fasteners with diameters over $^{3}/_{8}$". Lag screws, bolts, nuts and washers are permitted to be mechanically deposited zinc–coated steel with coating weights in accordance with *ASTM B695*, Class 55, minimum.

All hardware (e.g., joist hangers, hold–down devise, etc.) shall be galvanized or shall be stainless steel. Hardware to be hot–dipped prior to fabrication shall meet *ASTM A653 – Standard Specification for Steel Sheet, Zinc–Coated (Galvanized) or Zinc–Iron Alloy–Coated (Galvannealed) by the Hot–Dip Process,* G–185 coating. Hardware to be hot–dipped galvanized after fabrication shall meet *ASTM A123 – Specification for Zinc (Hot–Dip Galvanized) Coatings on Iron and Steel Products*.

Fasteners and hardware exposed to saltwater or located within 300' of a salt water shoreline shall be stainless steel grade 304 or 316.

Fasteners and hardware shall be of the same corrosion–resistant material.

Other coated or non–ferrous fasteners or hardware shall be as Approved by the authority having jurisdiction.

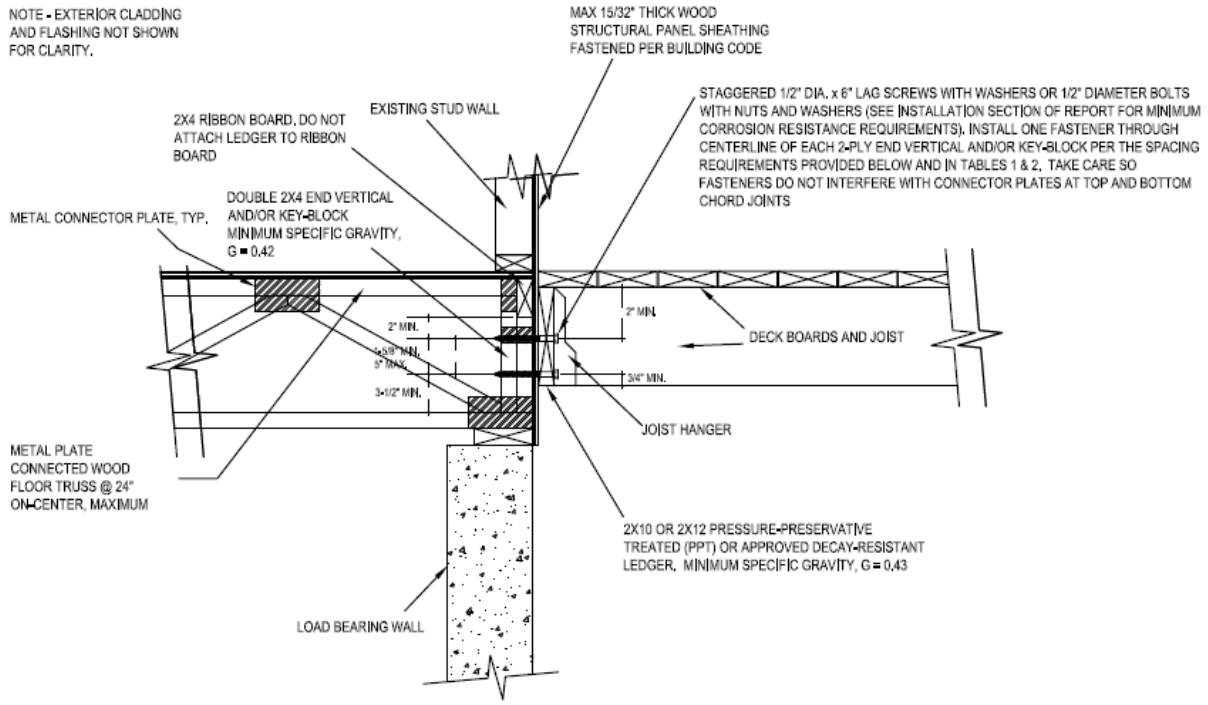
4. Install flashing at top of ledger for water tightness. Flashing shall be corrosion–resistant metal of minimum nominal 0.019" thickness or an Approved non–metallic material. Do not use aluminum flashing in direct contact with lumber treated with preservatives containing copper, such as ACQ, Copper Azole or ACZA.
5. Two–ply 2x4 truss end verticals, 4x4 truss vertical webs and key–blocks connected to ledger with lag screws or bolts shall have a specific gravity, G = 0.42 (includes DF, HF, SP and SPF).

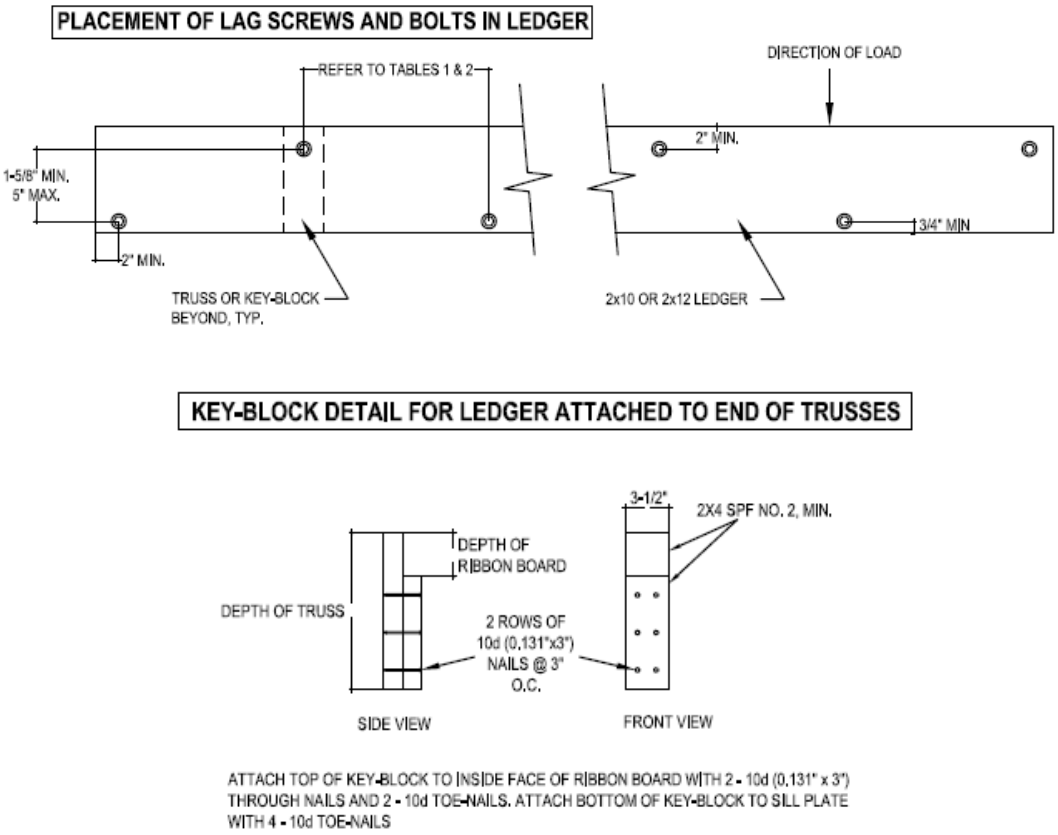
   Construct key–blocks with minimum 2x4 No. 2 or better lumber.

   Install key–blocks at required locations. Cut to fit tight.

   Refer to Detail 1 and Detail 2 for additional information concerning key–block construction and attachment.

WALL SECTION





Detail 1: Attachment of Deck Ledger to Floor System with MPCW Trusses

Joist Span	**≤ to 6'**	**6'-1" to 8'**	**8'-1" to 10'**	**10'-1" to 12'**	**12'-1" to 14'**	**14'-1" to 16'**	**16'-1" to 18'**
Connection Details	On-center Spacing of Fasteners (in.)[4]						
1/2"x 6" lag screw with 15/32",max., wood structural panel sheathing	24	12[5]	12[5]	12[5]	12[5]	8[6]	8[6]
1/2" diameter bolt with 15/32", max., wood structural panel sheathing	24	24	24	24	24	12[5]	12[5]

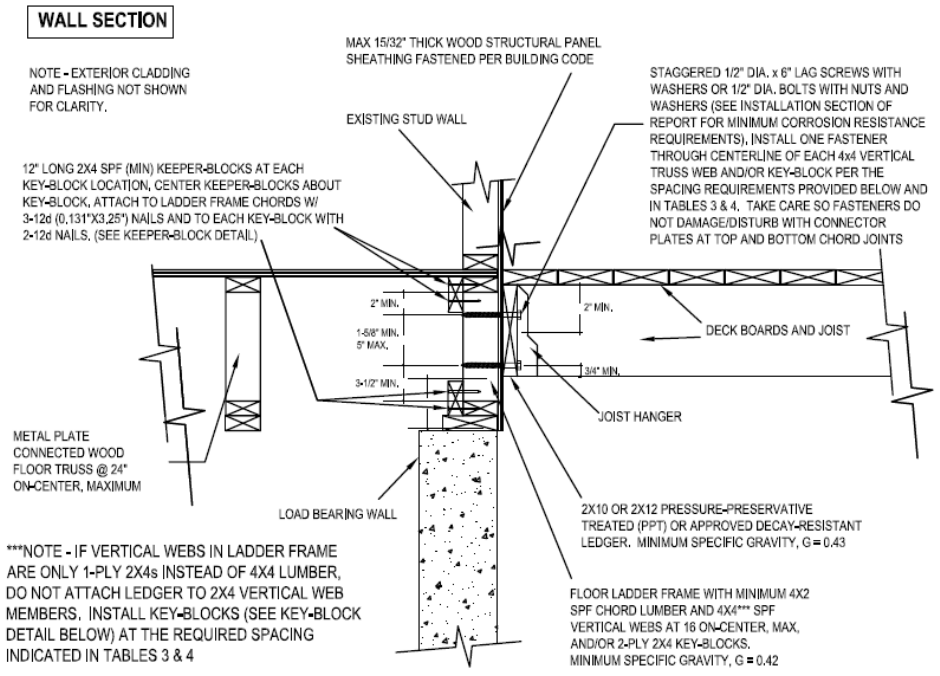
5. Ledgers shall be flashed in accordance with applicable building code requirements to prevent water from contacting the exposed wood structural sheathing and floor truss.
6. Snow load shall not be assumed to act concurrently with live load.
7. Ledgers must be 2x10 or 2x12 PPT or code-Approved decay-resistant lumber with specific gravity, G ≥ 0.43. Truss 2-ply 2x4 end verticals and key-blocks must have a G ≥ 0.42.
8. Stagger lag screws and bolts as shown in Detail 1.
9. Requires key-blocks at 24" o.c., maximum. Attach ledger to 2-ply end vertical of each truss with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 1 for key-block construction and installation information.
10. Requires two (2) key-blocks at 8" o.c., maximum, between each truss. Attach ledger to 2-ply end vertical of each truss with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 1 for key-block construction and installation information.

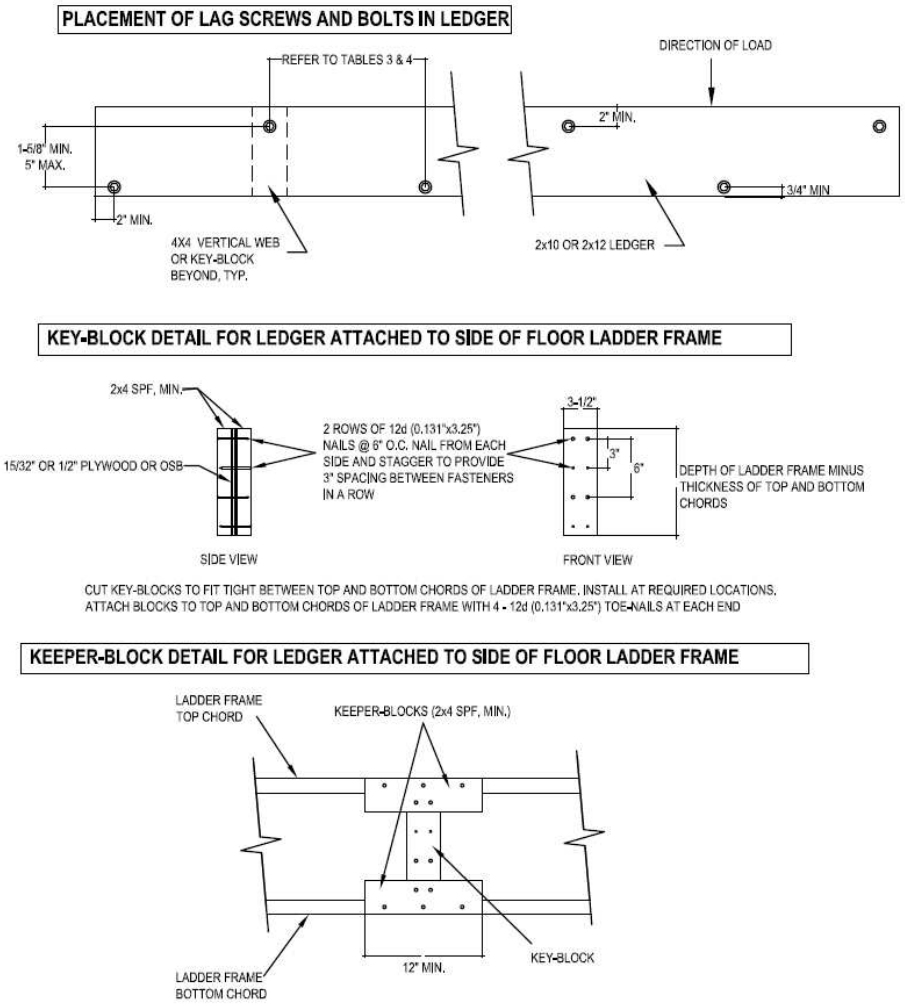
Table 1: Deck Ledger Connection to Ends of MPCW Floor Trusses Spaced 24" o.c., Max.[1,2,3]
(Deck Live Load = 40 psf, Deck Dead Load = 10 psf, Snow Load ≤ 40 psf)

Joist Span	≤ to 6'	6'–1" to 8'	8'–1" to 10'	10'–1" to 12'	12'–1" to 14'	14'–1" to 16'	16'–1" to 18'
Connection Details	On-center Spacing of Fasteners (in.)[4]						
1/2" x 6" lag screw with $^{15}/_{32}$",max., wood structural sheathing	12[5]	12[5]	12[5]	8[6]	8[6]	8[6]	Use bolted connection
1/2" diameter bolt with $^{15}/_{32}$", max., wood structural sheathing	24	24	24	12[5]	12[5]	12[5]	12[5]

1. Ledgers shall be flashed in accordance with applicable building code requirements to prevent water from contacting the exposed wood structural sheathing and floor truss.
2. Snow load shall not be assumed to act concurrently with live load.
3. Ledgers must be 2x10 or 2x12 PPT or code-Approved decay-resistant lumber with specific gravity, G ≥ 0.43. Truss 2-ply 2x4 end verticals and key-blocks must have a G ≥ 0.42.
4. Stagger lag screws and bolts as shown in Detail 1.
5. Requires key-blocks at 24" o.c., maximum. Attach ledger to 2-ply end vertical of each truss with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 1 for key-block construction and installation information.
6. Requires two (2) key-blocks at 8" o.c., maximum, between each truss. Attach ledger to 2-ply end vertical of each truss with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 1 for key-block construction and installation information.

Table 2: Deck Ledger Connection to Ends of MPCW Floor Trusses Spaced 24" o.c., Max.[1,2,3]
(Deck Live Load = 60 psf, Deck Dead Load = 10 psf, Snow Load ≤ 60 psf)





Detail 2: Attachment of Deck Ledger to Floor System with MPCW Trusses,
When Ledger is Installed Parallel to Truss Span & Spacing of Screws is Less Than the Spacing of the Verticals

Joist Span	**< 6' to 8'**	**8'–1" to 10'**	**10'–1" to 12'**	**12'–1" to 14'**	**14'–1" to 16'**	**16'–1" to 18'**
Connection Details	On-center Spacing of Fasteners (in.)[4]					
1/2" x 6" lag screw with $^{15}/_{32}$",max., wood structural sheathing	16	16	8[5]	8[5]	8[5]	8[5]
1/2" diameter bolt with $^{15}/_{32}$", max., wood structural sheathing	32	32	16	16	16	16

1. Ledgers shall be flashed in accordance with applicable building code requirements to prevent water from contacting the exposed wood structural sheathing and floor truss.
2. Snow load shall not be assumed to act concurrently with live load.
3. Ledgers must be 2x10 or 2x12 PPT or code-Approved decay-resistant lumber with specific gravity, G > 0.43. Truss 4x4 vertical web and key-blocks must have a G > 0.42.
4. Stagger lag screws and bolts as shown in Detail 2.
5. Requires key-blocks at 16" o.c., maximum. Attach ledger to each 4x4 vertical web with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 2 for key-block construction and installation information.

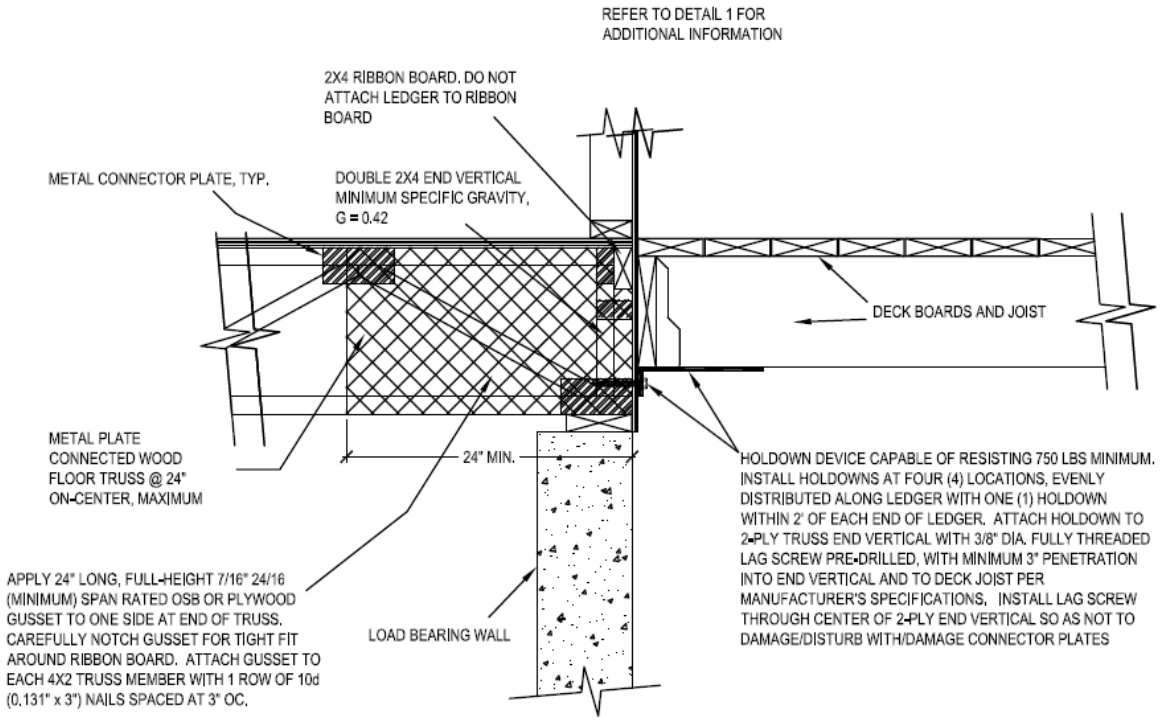
Table 3: Deck Ledger Connection to Side of MPCW Floor Ladder Frame with 4s4 Vertical Webs Spaced at 16" o.c., Max.[1,2,3]
(Deck Live Load = 40 psf, Deck Dead Load = 10 psf, Snow Load ≤ 40 psf)

Joist Span	**< 6' to 8'**	**8'–1" to 10'**	**10'–1" to 12'**	**12'–1" to 14'**	**14'–1" to 16'**	**16'–1" to 18'**
Connection Details	On-center Spacing of Fasteners (in.)[4]					
1/2" x 6" lag screw with $^{15}/_{32}$",max., wood structural sheathing	16	8[5]	8[5]	8[5]	8[5]	Use bolted connection
1/2" diameter bolt with 15/32", max., wood structural sheathing	32	16	16	16	8[5]	8[5]

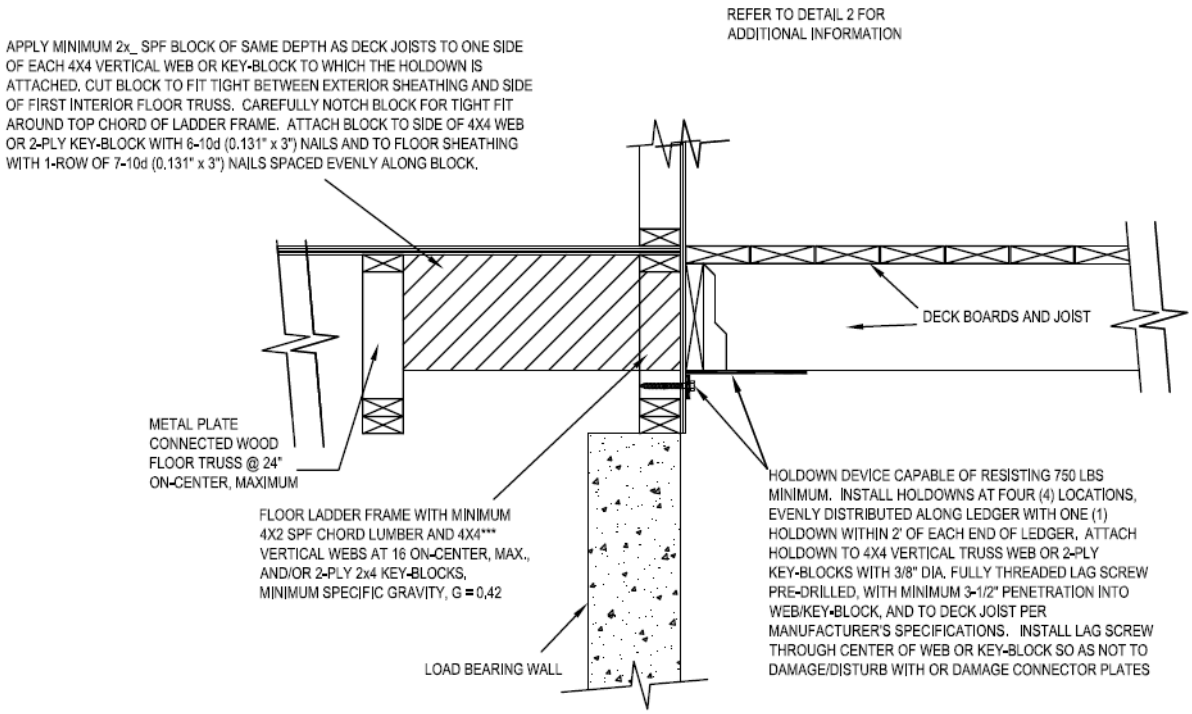
1. Ledgers shall be flashed in accordance with applicable building code requirements to prevent water from contacting the exposed wood structural sheathing and floor truss.
2. Snow load shall not be assumed to act concurrently with live load.
3. Ledgers must be 2x10 or 2x12 PPT or code-Approved decay-resistant lumber with specific gravity, G > 0.43. Truss 4x4 vertical web and key-blocks must have a G > 0.42.
4. Stagger lag screws and bolts as shown in Detail 2.
5. Requires key-blocks at 16" o.c., maximum. Attach ledger to each 4x4 vertical web with one (1) fastener and to each key-block with one (1) fastener. Refer to Detail 2 for key-block construction and installation information.

Table 4: Deck Ledger Connection to Side of MPCW Floor Ladder Frame with 4x4 Vertical Webs Spaced at 16" o.c., Max.[1,2,3]
(Deck Live Load = 60 psf, Deck Dead Load = 10 psf, Snow Load ≤ 60 psf)

LEDGER ATTACHED TO ENDS OF TRUSSES



LEDGER ATTACHED TO SIDE OF FLOOR LADDER FRAME



Detail 3: Deck Lateral Load Connection Capable of Resisting the 1500 lbf Lateral Load Requirement Specified in *2009* & 2012 IRC Section 507

Findings:

Nailing deck ledgers to metal plate connected wood truss floor systems is not sufficient. The deck ledger must be attached to the truss or key–block with lag screws or bolts. Various options and connection details for achieving the connection of the deck ledger to the metal plate connected wood truss floor system are provided in this report, which may be referred to by the building designer to achieve a code–conforming deck ledger connection.

IBC Section 104.11 and IRC Section R104.11 (IFC Section 104.9 is similar) state:

> **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *Approved*. An alternative material, design or method of construction shall be *Approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. … Where the alternative material, design or method of construction is not *Approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *Approved*.[1]

[1] The last sentence is adopted language in the 2015 codes.

Chapter SPS 316

ELECTRICAL

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Subchapter I — Purpose, Scope, and Application

SPS 316.001 Purpose.

(1) PRACTICAL SAFEGUARDING. The purpose of this chapter is the practical safeguarding ofpersons and property from hazards arising from the installation and use of electricity.

Note: Hazards often occur because of overloading of wiring systems by methods or usage not in conformity with this chapter. This occurs because initial wiring did not provide for increases in the use of electricity. An adequate initial installation and reasonable provisions for system changes will provide for future increases in the use of electricity.

(2) CODE INTENTION. This chapter is not intended as a design specification or as an instruction manual for untrained persons.

SPS 316.002 Scope.

(1) GENERAL. Except as provided in sub. (2), this chapter applies to Electrical Wiring installations.

(2) EXCLUSIONS. This chapter does not cover any of the following Electrical Wiring installations:

a) Installations of communication equipment under exclusive control of communication utilities, located outdoors or in building spaces used exclusively for such installations.

b) Installations in Manufactured Homes, other than Electrical Wiring Alteration s in existing Manufactured Homes.

c) Installations under the exclusive control of an electric utility, or an electric cooperative where such installations meet any of the following situations:

1. Consist of service drops or service laterals, and associated metering.

2. Are located in legally established easements or right−of− ways designated by public service commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations.

3. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission, storage, or distribution of electric energy.

d) Installations for the purpose of street or area lighting owned and under exclusive control of electrical utilities, or the Tribe, where located outdoors on property owned or leased by the utility; on or along public highways, streets, roads, or similar public thoroughfares; or outdoors on private property by established rights such as easements shall comply with this chapter or Ch. PSC 114.

SPS 316.003 Application.

(1) TYPES OF INSTALLATIONS.

The provisions of this chapter apply to all new installations, reconstructions, Alteration s, and extensions.

(2) TESTING. Rooms which are used exclusively for routine or special electrical test work and are under the supervision of a qualified person, shall comply with this chapter where practicable for the character of the testing done.

(3) EXISTING INSTALLATIONS. Existing electrical installations shall conform to the electrical code that applied when the installations were installed. An existing electrical installation may be required to be brought into compliance with the current Code's requirements by the Public Works Division and within the time period determined by the Department when a hazard to life, health or property exists or is created by the installation.

(4) REPAIRS. Repairs to electrical installations shall conform to the electrical code that applied when the installations were installed. A Repair may be required to be brought into compliance with the current Code's requirements by the Public Works Division and within the time period determined by the Public Works Division, when a hazard to life, health or property exists or is created by the Repair.

(5) DIFFERING RULES.

(a) Where any Public Works Division policy or rule differs from a requirement within a standard referenced in this chapter, the Department rule shall govern.

(b) Where a provision of this chapter prescribes a general requirement and another provision of this chapter prescribes a specific or more detailed requirement regarding the same subject, the specific or more detailed requirement shall govern, except as provided in par. (a).

(c) Where different sections of this chapter specify conflicting requirements, the most restrictive requirement, as determined by the Public Works Division shall govern, except as provided in pars. (a) and (b).

(6) ADDITIONS AND ALTERATIONS. Additions and Alteration s to electrical systems covered by this chapter shall comply with all provisions of this chapter at the time of permit application or, if no permit is required, the beginning of the project.

Note: This chapter does not nullify any exclusions specified in the standards adopted under SPS 316.007.

SPS 316.004 Division authority. The Public Works Division reserves the right to interpret the requirements in this chapter, subject to the petitioner's right to request a variance. See SPS 320.

SPS 316.005 Petition for variance. (S e e S P S 3 2 0)

SPS 316.006 Definitions. In this chapter:

(1) "Division" means the FCPC Public Works Division

(2) "Electrical Wiring" means all equipment, wiring, material, fittings, devices, appliances, fixtures, and apparatus used for the production, modification, regulation, control, distribution, utilization, or safeguarding of electrical energy for mechanical, chemical, cosmetic, heating, lighting, or similar purposes, as specified under the state Electrical Wiring code.

Note: "Electrical Wiring" does not include the equipment, wiring, material, fittings, devices, appliances, fixtures, and apparatus used by a public utility, an electric cooperative, or a wholesale merchant operator for the purpose of generating, transmitting, distributing, or controlling heat, light, power, or natural gas to its customers or members.

(3) "One− and 2− Family Dwellings" means any buildings that contain one or 2 Dwelling Units the construction of which commenced on or after December 1, 1978.

SPS 316.007 Adoption of standards by reference.

(1) PRIMARY STANDARDS. The following standards are incorporated by reference into this chapter, subject to the modifications specified in this chapter:

(a) Except as provided under par. (am), National Fire Protection Association (NFPA), One Batterymarch Park, Quincy, MA 02169−7471, telephone 800−344−3555, www.nfpa.org: NFPA 70 National Electrical Code, (NEC) – 2017.

(am) Prior to January 1, 2020, for all Electrical Wiring, installations, equipment, and materials used in the construction of One−and 2− Family Dwellings, National Fire Protection Association (NFPA), One Batterymarch Park, Quincy, MA 02169−7471, tele-phone 800−344−3555, www.nfpa.org: NFPA 70 National Electrical Code, (NEC) – 2011.

(b) If a requirement in the standards adopted in pars. (a) and (am) contain a cross−reference to another requirement modified by this chapter, the modification shall apply to the cross−reference unless specified otherwise in this chapter.

(2) SECONDARY REFERENCES. Any codes or standards referenced in the standards adopted in sub. (1) (a) and (am) shall apply to the prescribed extent of each such reference, except as modified by this chapter.

(3) ALTERNATE STANDARDS. Any alternate standard that is equivalent to or more stringent than a standard incorporated by reference or otherwise referenced under this chapter may be used in lieu of the incorporated or referenced standard if the alternate standard is accepted in writing by the Public Works Division.

Subchapter II — Administration and Enforcement

5. The Tribe employs or contracts with certified electrical inspectors or independent inspection agencies to perform electrical inspection activities.

SPS 316.011 Administration.

(1) ADMINISTRATION.

(a) ***Jurisdiction.*** The Tribe shall exercise jurisdiction over the inspection of Electrical Wiring installations at all residential buildings on Tribal Lands.

(b) Under emergency conditions, the necessary Electrical Wiring may commence without obtaining a permit, provided the Owner of the premises where the installation is to occur or their agent submits a permit application to the inspection agency designated by the Public Works Division to provide electrical inspections for the installation no later than the next Business Day after commencement of the installation.

(2) The application for a permit required under sub. (1) shall contain all of the following information:

(b) The name of the applicant.

(c) The name of the building or property Owner.

(d) The location of the Electrical Wiring installation.

(e) The scope and extent of the Electrical Wiring installation.

(f)

1. The name of the person responsible for the installation.

2. The name and license number of the master electrician, residential master electrician, or registered master electrician under Wisconsin s. SPS 305.437 responsible for the installation, unless otherwise Approved by the Department.

(3)

(a) The Department shall indicate on the electrical permit the date of issuance.

(b) A permit required under sub. (1) shall expire 24 months after the date of issuance, if installation of the Electrical Wiring has not commenced.

SPS 316.012 Permits.

(1) No Electrical Wiring project may commence unless the Owner of the premises where the installation is to occur or their agent holds a permit issued by the Department or designated inspection agency, if the project involves the installation of new or an addition to any electrical service, feeder, or branch circuit.

SPS 316.013 Inspections.

(1) Electrical Wiring installations shall be subject to inspection.

Note: See SPS 320 regarding the inspections for the construction of new One− and 2− Family Dwellings.

(2) Inspections of Electrical Wiring installations described under SPS 316.012 (1) (a) shall be conducted by the Department's inspector.

(3)

(a) The building Owner or their agent shall notify the Public Works Division to provide electrical inspections when the Electrical Wiring installation is ready for inspection.

(b) Except as provided in par. (c), to facilitate inspection all of the following shall apply:

1. Electrical Wiring shall remain accessible and exposed for inspection purposes.

2. Electrical Wiring may not be energized.

(c)

1. The concealment or energizing of Electrical Wiring, other than an electrical service, may proceed if inspection has not been completed within 2 Business Days after notification is received or as otherwise agreed between the wiring installer and the Department.

2. The notification that an Electrical Wiring installation is ready for final inspection shall be made to indicate when all electrical fixtures, outlets and face plates are in place and the installation or that portion of the installation is energized.

(d)

1. If upon inspection, it is found that the installation is in compliance with this chapter, the Authorized Inspector shall approve the installation prior to concealment or energizing of the Electrical Wiring.

2. If upon inspection it is found that the installation is incomplete or not in compliance with this chapter, orders to correct shall be issued. An order may include the condition that the Electrical Wiring is to remain unconcealed and non−energized until re−inspected.

SPS 316.014 Penalties. (See SPS 320)

SPS 316.015 Appeals (See SPS 320)

SPS 316.016 Electrical plan review. Upon request, the Public Works Division may perform electrical plan review for Dwellings and electrical services.

SPS 316.017 Technical assistance. The Public Works Division shall provide technical assistance to the extent possible with the available resources to any person, upon written request, regarding interpretation and application of this chapter. The technical assistance may consist of telephone, written, in−office or on−site review of specific problems.

Subchapter III — General Requirements

SPS 316.020 Construction and operation.

(1) GENERAL. All electrical power and communication equipment and lines shall be constructed, installed, operated, and maintained so as to minimize hazards to life and property. All electrical installations shall conform to the National Electrical Code, incorporated by reference in this chapter, and the requirements specified in this chapter.

SPS 316.021 Maintenance. All Electrical Wiring installations and equipment shall be cleaned and inspected at intervals as experience has shown to be necessary. Any equipment or Electrical Wiring

installation known to be defective so as to endangerlife or property shall be promptly Repaired, permanently disconnected or isolated until Repairs can be made.

SPS 316.022 Use of Approved materials and construction methods.

(1) MATERIALS. Materials, equipment, and products that do not comply with the requirements of this chapter shall not be used unless Approved in writing by the Public Works Division. Approval of materials, equipment, and products shall be based on sufficient data, tests, and other evidence that proves the material, equipment,or product meets the intent of the requirements of this chapter. Data, tests, and other evidence shall be provided by a qualified independent third party.

Note: Examples of a qualified independent third party include a nationally recognized testing laboratory and a professional engineer.

(2) METHODS OF INSTALLATION. Methods of installation that donot comply with the regulations of this chapter shall not be usedunless Approved in writing by the Public Works Division.

(3) NEW PRODUCTS, CONSTRUCTIONS OR MATERIALS. The incorporated *National Electrical Code*® may require new products, constructions, or materials that may not be available at the time this chapter is adopted. In such an event, the Public Works Division may permitthe use of the products, constructions or materials which complywith a previous edition of the *National Electrical Code*®.

SPS 316.023 Electric fences. The following are Public Works Division rules in addition to the requirements of the *NEC*®:

(1) ELECTRIC FENCE CONTROLLERS.

(a) Electric fence controllers shall be of a type listed by a nationally recognized testing laboratory.

(b) Electric fence controllers shall be installed and used in theexact manner and for the exact purpose indicated by the manufacturer's instructions, markings, listings, or labels.

(2) GROUNDING. Electric fence controllers shall be grounded as specified in NEC 250, except where stray voltages in dairybarns or milking parlors create physical problems to the animals,the use of a single made electrode shall be permitted.

Subchapter IV-Changes, Additions, or Omissions to the *NEC* @

SPS 316.080 Changes, additions, or omissions to *NEC*®. Changes, additions, or omissions to the *National Electrical Code*® (*NEC*®) are specified in this subchapter.

Note: The referenced *NEC*®article or section number will correspond with the SPS designation number and title and will precede the text of the rule. (Example: SPS 316.100 [NEC100]).

SPS 316.090 Introduction. The requirements specified in 2011 and 2017 NEC 90.1, NEC 90.2, and NEC 90.4 are not included as part of this chapter.

SPS 316.100 Definitions.

(1) ADDITIONS. The following are Residential Building Code definitions in addition to the definitions in NEC 100:

(a) "Floors" means stories as specified in Wisconsin chs. SPS 361 to 366.

(b) "Non-rated construction" means Types III, IV and V construction in accordance with Wisconsin chs. SPS 361 to 366 and is consideredto be non-fire rated for the purposes of this chapter.

SPS 316.110 Examination, identification, installation, use, and listing of equipment.

(1) Substitute the following wording for the requirements in 2011 NEC 110.3 (B): Listed or labeled equipment shall be installed or used, or both, in accordance with any instructions included in the listing or labeling, provided the instructions, listing, or labeling do not conflict with this chapter.

(3) This is an exception to the requirements of 2017 NEC 110.3 (C): Exception: As provided under SPS 316.022 (1), product testing and evaluation may be conducted by a qualified independent third party, including a nationally recognized testing laboratory, or a professional engineer.

SPS 316.210 Branch circuits.

(1) GROUND−FAULT CIRCUIT−INTERRUPTER PROTECTION FOR PERSONNEL.

(a) The requirements in 2017 NEC 210.8 (A) (7) do not apply to sinks located in Kitchens.

(b) The requirements in 2017 NEC 210.8 (A) (9) and (10) are not included as part of this chapter.

(c) Substitute the following wording for 2017 NEC 210.8 (B): All 125−volt, single−phase, 15− and 20−ampre receptacles installed in the following locations shall have ground−fault circuit interrupter protection for personnel.

(d) This is an exception to the requirements in 2011 NEC 210.8 (A) and 2017 NEC 210.8 (A) and (B): Exception: Ground−fault circuit−interrupter protection shall not be required for a single receptacle providing power for sump, sewage, or condensate pumps where an accessible ground−fault circuit−interrupter protected receptacle is located within 3 ft of the non−GFCI protected receptacle.

(2) BRANCH CIRCUITS REQUIRED.

(a) This is in addition to the requirements of 2011 NEC 210.11: Where an air conditioner sleeve is provided in a building wall, a receptacle outlet shall be located within 4 feet of the sleeve. If a circuit is not run to the outlet, a raceway shall be provided. When the air conditioner is installed in the sleeve, it shall be supplied by an individual branch circuit. A receptacle outlet installed for an air conditioner may not be counted as one of the receptacles required by NEC 210.52 (A).

(b) The requirements in 2017 NEC 210.11 (C) (4) are not included as part of this chapter.

(3) ARC−FAULT CIRCUIT−INTERRUPTER PROTECTION. The requirements in 2017 NEC 210.12 (A) do not apply to Kitchens.

(4) BRANCH CIRCUIT EXTENSIONS OR MODIFICATIONS —The requirements in 2011 NEC 210.12 (B) and 2017 NEC 210.12 (D) are not included as part of this chapter.

(5) LIGHTING OUTLETS REQUIRED. Substitute the following wording for 2011 NEC 210.70 (A) (1): At least one wall switch−controlled lighting outlet shall be installed in every Habitable Room, Kitchen, and bathroom.

(6) COUNTERTOP RECEPTACLES. The requirements in 2011 NEC 210.52 (A) (4) are not included as part of this chapter.

GARAGES. Substitute the following wording for 2017 NEC 210.52 (G) (1): In each Attached Garage and in each detached Garage with electric power.

SPS 316.220 Branch−circuit, feeder, and service calculations. (N/A)

SPS 316.225 Outside branch circuits and feeders.

(1) CLEARANCES FROM BUILDINGS FOR CONDUCTORS NOT OVER 600 VOLTS. Substitute the following wording for 2011 NEC 225.19 (A) Exception No. 4: The requirement for maintaining the vertical clearance 3 feet from the edge of the roof does not apply to the final conductor span to the building.

(2) NUMBER OF SUPPLIES. The following are in addition to the requirements in 2011 and 2017 NEC 225.30:

(a) For the purpose of this section, multiple feeders that are supplied from the same distribution point, having a total rating of 300 amperes or more, and that supply not more than 6 disconnecting means grouped at the same location shall be considered as one supply.

SPS 316.230 Services.

(1) NUMBER OF SERVICES.

Note: It is recommended that the electric utility or cooperative supplying electric current be contacted prior to service equipment installations for any special requirements.

(b) Substitute the following wording for NEC 230.2 (B) (2): Two or more service drops or laterals for the same class of service if located more than 150 feet apart, measured in a straight line, and provided that all Electrical Wiring supplied by each service has no common raceway or connection with any other service.

(2) NUMBER OF SERVICE−ENTRANCE CONDUCTOR SETS. The requirements specified in 2011 and 2017 NEC 230.40 Exception No. 3 are not included as part of this chapter.

(3) SERVICE EQUIPMENT — DISCONNECTING MEANS. (a) *General*: Disconnecting means shall be provided to disconnect the utility wiring from the premises wiring at any point where utility wiring terminates, and premises wiring extends overhead or underground to more than one building or structure.

(b) *Location.* This is in addition to the requirements of 2011 and 2017 NEC 230.70 (A): Raceways containing service conductors or cables, or service entrance cable not contained within a raceway, may not extend longer than 8 feet into a building to the service disconnect or the first service disconnect of a group of disconnects as permitted by NEC 230.71. The raceways or conductors shall be considered to have entered the building at the point where they pass through the outer surface of the building exterior, except as permitted by NEC 230.6.

(4) RATING OF SERVICE DISCONNECTING MEANS – 2011 NEC. This is in addition to the requirements of 2011 NEC 230.79:

(a) *Two− family Dwellings.* Except as provided in par. (b), for 2−family Dwellings, the service equipment shall have a rating of not less than 150 amperes, 3−wire or 4−wire. Where the combined rating of all service disconnecting means is 150 amperes or larger, the service or feeder equipment rating for each Dwelling Unit shall have a rating of not less than 60 amperes.

(b) *Exception*. Service equipment having a rating of not less than 100 amperes, 3−wire, or 4−wire, may be installed in an existing 2−family Dwelling only where both of the following conditions are complied with:

1. The load computed in accordance with NEC 220 does not exceed 80 amperes.

(5) Specific written approval is granted by the Public Works Division.

(6) RATING OF SERVICE DISCONNECTING MEANS — 2017 NEC. (N/A)

SPS 316.240 Overcurrent protection. The requirements in 2017 NEC 240.67 do not apply to this chapter.

SPS 316.250 Grounding and bonding.

(1) SUPPLEMENTAL ELECTRODE REQUIRED. The exception in 2011 and 2017 NEC 250.53 (A) (2) is not included as part of this chapter.

(2) SUPPLEMENTAL ELECTRODE. This is in addition to the requirements in 2011 and 2017 NEC 250.53 (A) (3): A single electrode consisting of a rod, pipe, or plate shall be augmented by one additional electrode of any of the types in NEC 250.52 (A) (4) to (A) (8).

TYPES OF EQUIPMENT GROUNDING CONDUCTORS. This is a Code requirement in addition to the requirements of 2017 NEC 250.118: A metallic raceway installed in direct contact with earth, in concrete slabs or floors poured on earth, or in exterior concrete walls below grade shall be augmented with a supplemental equipment grounding conductor identified in NEC 250.118 (1). This supplemental conductor shall be sized in accordance with NEC 250.122. An aluminum equipment grounding conductor used for this purpose shall be insulated.

SPS 316.300 Wiring methods.

(1) ELECTRICAL REQUIREMENTS FOR PRIVATE ONSITE WASTEWATER TREATMENT SYSTEMS. These provisions apply to private onsite wastewater treatment systems and are in addition to the requirements of 2011 and 2017 NEC 300:

(a) ***Wiring methods.*** All effluent pump circuit wiring shall comply with the Approved wiring methods as specified in NEC 300 and all of the following requirements:

1. Effluent pumps shall be supplied by a separate branch circuit supplying no other loads.

2. Alarm wiring may not be connected to the pump circuit.

3. All aboveground cables and flexible cords shall be enclosed to protect against physical damage.

4. The neutral conductor may not be common to both alarm and pump circuits.

5. Where the wiring enclosure for the alarm and pump circuit is located outside the pump chamber, any openings into the pump chamber for circuit wiring shall be sealed or plugged to prevent the passage of gas or vapor into the wiring enclosure.

Note: This prohibits use of a multi−wire branch circuit to supply both the alarm and pump.

Note: See NEC 430.102 for location of disconnects.

(b) ***Ground−fault circuit protection.*** A single receptacle located at the pump chamber that has an alarm or pump connected to it does not require ground−fault circuit−interrupter protection.

(2) PROTECTION AGAINST PHYSICAL DAMAGE.

(a) The requirements specified in 2011 NEC 300.4 (D) are not included as part of this chapter.

(b) This is an exception in addition to the exceptions under 2017 NEC 300.4 (D): Exception No. 4: This distance does not need to be maintained within 8 inches of a device, junction box, splice, or termination point.

SPS 316.310 Conductors for general wiring.

(1) This is in addition to the requirements in 2011 NEC 310.15 (B) (3) (a): The derating factors shown in NEC Table 310.15 (B) (3) (a) do not apply to branch circuits supplying an individual Dwelling Unit except under the following conditions: Exception No. 6: The derating factors shown in NEC Table 310.15 (B) (3) (a) do not apply to branch circuits supplying an individual Dwelling Unit except under the following conditions:

(a) Where more than two NM cables containing two or more current−carrying conductors are installed, without maintaining spacing between the cables, through the same opening in wood framing that is to be fire− or draft−stopped using thermal insulation, caulk, or sealing foam, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15 (B) (3) (a) and the provisions of 310.15 (A) (2) shall not apply.

(b) Where more than two NM cables containing two or more current−carrying conductors are installed in contact with thermal insulation without maintaining spacing between cables, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15 (B) (3) (a).

(2) This is in addition to the requirements in 2017 NEC 310.15 (B) (3) (a): The derating factors shown in NEC Table 310.15 (B) (3) (a) do not apply to branch circuits supplying an individual Dwelling Unit.

SPS 316.312 Cabinets, cutout boxes and meter socket enclosures.

(1) CABLES. Substitute the following wording for 2011 and 2017 NEC 312.5 (C) Exception (intro.): Exception: Cables with entirely nonmetallic sheaths may enter an enclosure through one or more nonflexible raceways of not less than 12 inches and not more than 10 feet in length, provided all of the following conditions are met:

(2) OMISSION. The requirements specified in 2011 NEC 312.5 (C) Exception paragraph (b) and 2017 NEC 312.5 (C) Exception number 2 are not included as part of this chapter.

(3) FITTING. Substitute the following wording for 2011 NEC 312.5 (C) Exception paragraph (c) and 2017 NEC 312.5 (C) Exception number 3: A fitting is provided on each end of the raceway to protect the cable from abrasion.

SPS 316.314 Outlet, device, pull and junction boxes; conduit bodies; fittings; and handhole enclosures.

(1) CONDUCTORS ENTERING BOXES, CONDUIT, BODIES, OR FITTINGS. This is an exception to the requirements of 2011 and 2017 NEC 314.17 (B) and (C): Exception: Nonmetallic sheathed cable is not required to be secured to the box or conduit body where it is installed in accordance with the wiring method specified in SPS 316.312.

(2) OUTLET BOXES. This is in addition to the requirements of 2011 NEC 314.27 (A): In a Dwelling Unit, a ceiling outlet box installed for use as a lighting fixture outlet in a Habitable Room or Kitchen and located where a ceiling fan could be installed shall be a type listed for ceiling fan support.

SPS 316.334 Nonmetallic−sheathed cable: Types NM, NMC and NMS.

(1) USES PERMITTED. Substitute the following wording for 2011 and 2017 NEC 334.10 (3): Other structures permitted to be of Types III, IV, and V construction except as prohibited in NEC 334.12.

(2) TYPES NM, NMC, AND NMS. The requirements specified in 2011 and 2017 NEC 334.12 (A) (2) are not included as part of this chapter.

SPS 316.358 Uses permitted. This is in addition to the requirements of 2011 and 2017 NEC 358.12: Electrical metallic tubing may not be used in direct contact with earth, in concrete slabs or floors poured on earth, or in exterior concrete walls below grade.

SPS 316.400 Flexible cords and cables.

(1) This is an exception in addition to the exception in 2011 NEC 400.8 (4): Exception No. 2: Flexible cords and cables permitted by NEC 400.7 (A) that are connected to sources other than busways may be attached to adequately supported equipment or building surfaces provided the type of cord or cable, the attachment to the building and equipment, and the support comply with the provisions of NEC 368.56 (B).

(2) This is an exception in addition to the exception in 2017 NEC 400.12 (4): Exception No. 2: Flexible cords and cables permitted by NEC 400.10 (A) that are connected to sources other than busways may be attached to adequately supported equipment or building surfaces provided the type of cord or cable, the attachment to the building and equipment, and the support comply with the provisions of NEC 368.56 (B).

SPS 316.404 Switches controlling lighting loads. The requirements in 2017 NEC 404.2 (C) do not apply to Dwelling Units.

SPS 316.406 Receptacles, cord connectors and attachment plugs (caps).

(1) The requirements in 2011 and 2017 NEC 406.4 (D) (4) are not included as part of this chapter.

(2) Substitute the following wording for 2017 NEC 406.9 (B)(1): Receptacles of 15 and 20 amperes, 125 and 250 volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted.

SPS 316.450 Transformers and transformer vaults (including secondary ties).

(1) OVERCURRENT PROTECTION. This is in addition to the requirements in 2011 and 2017 NEC Table 450.3 (A) Note 3: The qualified person shall be either an employee at that location or an employee contracted for this purpose who is readily available.

(2) LOCATION. Substitute the following wording for 2011 and 2017 NEC 450.41: Vaults containing oil−insulated transformers shall be located where the vaults can be ventilated to the outside air without using flues or ducts, except where a petition for variance is Approved.

SPS 316.511 Commercial Garages, Repair, and storage.

(1) The requirements specified in 2011 NEC 511.3 (C) (1)(a) are not included as part of this chapter.

(2) Substitute the following wording for 2011 NEC 511.3 (C)(2)(a): The ceiling area shall be unclassified where ventilation is provided from a point not more than 18 inches from the highest point in the ceiling. The ventilation shall conform to Wisconsin chs. SPS 361 to 366.

(3) Substitute the following wording for "Extent of Classified Location" in 2017 NEC Table 511.3 © under which the floor area of a major Repair Garage is considered unclassified: Up to 18 in. above floor level of the room where the room is provided with ventilation from a point not more than 12 in. from the lowest point of the floor area and the ventilation conforms to Wisconsin chs. SPS 361 to 366.

(4) Substitute the following wording for "Extent of Classified Location" in 2017 NEC Table 511.3 (D) under which the ceiling area of a major Repair Garage is considered unclassified: Within 18 in. of ceiling where ventilation is provided from a point not more than 18 in. from the highest point in the ceiling and the ventilation conforms to Wisconsin chs. SPS 361 to 366.

SPS 316.547 Agricultural Buildings (Intentionally omitted)

SPS 316.551 Recreational vehicles and recreational vehicle parks (Intentionally omitted)

SPS 316.620 Elevators and stairway chairlifts. This is an exception to the requirements in 2011 and 2017 NEC 620: Exception: Wherever NEC 620 requires disconnecting means with overcurrent protection to be located in an elevator machine room, control room, machinery space or control space and the elevator does not have such a room or space directly accessible from a building floor level, such devices shall be located instead in lockable cabinets or electrical rooms accessible only to qualified persons.

SPS 316.675 Electrically driven or controlled irrigation machines. (Intentionally omitted)

SPS 316.680 Swimming pools, fountains, and similar installations.

(1) PERIMETER SURFACES. This is in addition to the requirements of 2011 NEC 680.26 (B) (2): The requirements specified in NEC 680.26 (B) (2) do not apply to a listed self−contained spa or hot tub constructed with nonmetallic walls.

(2) POOL WATER. This is in addition to the requirements of 2011 NEC 680.26 ©: The requirements specified in NEC 680.26 (C) do not apply to a listed self−contained spa or hot tub constructed with nonmetallic walls.

SPS 316.700 Emergency systems.

(1) WIRING, EMERGENCY SYSTEM. This is in addition to the requirements of 2011 and 2017 NEC 700.10 (B):

(a) Except as provided in par. (b), emergency circuit wiring shall be listed raceways, Type AC cable or Type MC cable.

(b) Emergency lighting fixtures may use flexible cord connections in compliance with NEC 410.62 (C) for electric discharge luminaries.

(2) GENERAL REQUIREMENTS. This is in addition to the requirements in 2011 and 2017 NEC 700.12 (intro.): The enclosure of the alternate source of power located outdoors for emergency systems shall be located at least 10 feet horizontally from any combustible portion of a Type III, Type IV, or Type V building and at least 20 feet from an outdoor electrical transformer, electrical metering, service equipment, or normal power distribution equipment. These dimensions may be reduced where a noncombustible barrier is installed that extends at least 3 feet beyond each side of the alternate power source and transformer. The height of the barrier shall be at least one foot above the top of the transformer, electrical metering, service equipment, or alternate power source, whichever is higher.

(3) GENERAL REQUIREMENTS, DUAL SUPPLIES. The requirements in 2011 and 2017 NEC 700.12 (B) (3) are not included as part of this chapter.

Note: See Wisconsin chs. SPS 361 to 366 for further requirements.

SPS 316.701 Legally required standby systems. (Intentionally omitted)

Chapter SPS 328-Smoke Detectors and Carbon Monoxide Detectors

SPS 328.01

Smoke Detectors

(1) DEFINITIONS. As used in this Code:

(a) "Residence" means any one- or two-family Dwelling which is used for sleeping or lodging purposes.

(b) "Sleeping Area" means the area of the unit in which the bedrooms or sleeping rooms are located. Bedrooms or sleeping rooms separated by another use area such as a Kitchen or living room are separate Sleeping Areas but bedrooms or sleeping rooms separated by a bathroom are not separate Sleeping Areas.

(c) "Smoke Detector" means a device which detects particles or products of combustion other than heat.

(2) APPROVAL. A Smoke Detector required under this section shall be approved by Underwriters Laboratory (UL).

(3) INSTALLATION AND MAINTENANCE.

(a) The Owner of a Residence shall install any Smoke Detector required under this section according to the directions and specifications of the manufacturer of the Smoke Detector.

(b) The Owner of a Residence shall maintain any such Smoke Detector that is located in a common area of that residential building.

(c) The occupant of a Residence shall maintain any Smoke Detector in that Residence.

(4) REQUIREMENT. The Owner of a Residence shall install and maintain a functional Smoke Detector in the Basement and at the head of any stairway on each floor level of the building and shall install a functional Smoke Detector in each Sleeping Area and elsewhere in accordance with SPS 321.09.

(5) PENALTY. If the Public Works Division determines after an inspection of a Residence under this section that the Owner of the Dwelling has violated sub. (2) or (3), the Public Works Division shall issue an order requiring the person to correct the violation within 5 days or within such shorter period as the Public Works Division determines is necessary to protect public health and safety. If the person does not correct the violation within the time required, he or she shall forfeit $50 for each day of violation occurring after the date on which the Public Works Division finds that the violation was not corrected.

(6) PUBLIC WORKS DIVISION INSPECTION AND ORDERS. The Public Works Division may inspect all Residences rented from the Tribe with due notice, to ensure compliance with this section. The Public Works Division may inspect the interior of private Dwellings at the request of the Owner, as may be necessary to ensure compliance with this section.

(7) TAMPERING PROHIBITED. No person may tamper with, remove, destroy, disconnect, or remove batteries from an installed Smoke Detector, except in the course of inspection, maintenance, or replacement of the detector.

Carbon Monoxide Detectors

(1) **DEFINITIONS**. In this section:

(am) "Carbon Monoxide Detector" means an electronic or battery-operated device or system that sounds an alarm when an unsafe level of carbon monoxide is in the air.

(as) "Fuel-Burning Appliance" means a device that burns fossil fuel or carbon-based fuel and that produces carbon monoxide as a combustion by-product.

(2) **INSTALLATION AND MAINTENANCE REQUIREMENTS.**

(a) The Owner of a Residence shall install any Carbon Monoxide Detector required under this section according to the directions and specifications of the manufacturer of the Carbon Monoxide Detector.

(b) The Owner of a Residence shall maintain any such Carbon Monoxide Detector that is located in a common area of that Residence.

(c) The occupant of a Residence shall maintain any Carbon Monoxide Detector in that Residence.

(ac) ***Carbon Monoxide Detectors required.*** Except as provided in sub. (5), the Owner of a Residence shall provide Carbon Monoxide Detectors at the locations specified in par. (ax) as required under pars. (ag) to (at).

(ag) ***Fuel-Burning Appliances.*** Carbon Monoxide Detectors shall be provided in Residences that contain a Fuel-Burning Appliance.

(ah) ***Forced-air furnaces.*** Carbon Monoxide Detectors shall be provided in Residences served by a fuel-burning, forced-air furnace, except that Carbon Monoxide Detectors are not required in a Residence if a Carbon Monoxide Detector is provided in the first room or area served by each main duct leaving the furnace.

(at) ***Attached Garages.*** Carbon Monoxide Detectors shall be provided in Residences with Attached Garages, except as follows:

1. Carbon Monoxide Detectors are not required where there are no openings between the Attached Garage and the Residence through which carbon monoxide can get into the Residence.

2. Carbon Monoxide Detectors are not required in Residences located more than one Story above or below the Attached Garage.

3. Carbon Monoxide Detectors are not required where the Attached Garage connects to the building through an open-ended corridor.

4. Where Carbon Monoxide Detectors are provided between openings to the Attached Garage and Residences, Carbon Monoxide Detectors are not required in the directly adjacent area of the Residence.

(ax) ***Locations.*** If required under pars. (ag) to (at), Carbon Monoxide Detectors shall be installed in the following locations:

1. In Residences, outside of each separate Sleeping Area in the immediate vicinity of the sleeping rooms.

2. ***Sleeping rooms.*** In sleeping rooms, if a Fuel-Burning Appliance is located within the sleeping room or its Attached bathroom.

(d) ***Certification.*** Any Carbon Monoxide Detector that bears an Underwriters Laboratories, Inc. (UL), listing mark or similar mark from an independent product safety certification organization satisfies the requirements of this subsection.

(e) ***Manufacturer directions and specifications***. The Owner shall install every Carbon Monoxide Detector required by this subsection according to the directions and specifications of the manufacturer of the Carbon Monoxide Detector.

(4) TAMPERING PROHIBITED. No person may tamper with, remove, destroy, disconnect, or remove batteries from an installed Carbon Monoxide Detector, except in the course of inspection, maintenance, or replacement of the detector.

(5) PENALTY. If the Public Works Division determines after an inspection of a Residence under this section that the Owner of the Dwelling has violated sub. (2) or (3), the Public Works Division shall issue an order requiring the person to correct the violation within 5 days or within such shorter period as the Public Works Division determines is necessary to protect public health and safety. If the person does not correct the violation within the time required, he or she shall forfeit $50 for each day of violation occurring after the date on which the Public Works Division finds that the violation was not corrected.

(6) PUBLIC WORKS DIVISION INSPECTION AND ORDERS. The Public Works Division may inspect all Residences rented from the Tribe with due notice, to ensure compliance with this section. The Public Works Division may inspect the interior of private Dwellings at the request of the Owner, as may be necessary to ensure compliance with this section.

(7) INSTALLATION AND SAFETY CERTIFICATION. The Owner of a Dwelling shall install any Carbon Monoxide Detector required under this section according to the directions and specifications of the manufacturer of the Carbon Monoxide Detector. A Carbon Monoxide Detector required under this section shall bear a UL, listing mark and may be a device that is combined with a Smoke Detector.

CHAPTER SPS 341

BOILERS AND PRESSURE VESSELS

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Subchapter I — Scope, Definitions and Administration

SPS 341.01 Purpose The purpose of this chapter is to protect the health, safety, and welfare of the public by establishing minimum standards for the design, construction, installation, operation, inspection, testing, maintenance, Alteration, and Repair of Boilers, Pressure Vessels, Power Piping, and Solid-Fuel-Fired Water-Heating Appliances.

SPS 341.02 Scope.

(1) BOILERS AND PRESSURE VESSELS.

(a) This chapter applies to Boilers and piping components associated with Boilers, Pressure Vessels, Power Piping, and Solid-Fuel-Fired Water-Heating Appliances in use at places of one- or two-family Dwellings.

3. This chapter does not apply to the gas systems that are within the scope of Ch. SPS 340.

Note: The gas systems addressed in chapter SPS 340 include pressurized vessels and piping for gases that are used for fueling purposes, such as for heating appliances or engines.

SPS 341.03 Application.

(1) APPLICABILITY.

(a) The operation, testing, maintenance, and inspection requirements of this chapter apply to all Boilers, Pressure Vessels, Power Piping, Solid-Fuel-Fired Water-Heating Appliances, and their components, that exist on or after the adoption of this Code.

(b) A design, construction, or installation rule of this chapter, including the applied criteria from the standards adopted in SPS 341.10, does not apply retroactively to Boilers, Pressure Vessels, Power Piping, Solid-Fuel-Fired Water-Heating Appliances, and their components, that were installed prior to the effective date of this Code.

(c) The design, construction, and installation requirements of this chapter apply to any Alterations, Repairs, and replacement parts or components for all Boilers, Pressure Vessels, Power Piping, Solid-Fuel-Fired Water-Heating Appliances, and their components, that exist on or after the adoption of this Code.

(2)-(5) (INTENTIONALLY OMITTED)

SPS 341.04 Definitions. In this chapter:

(1)

(a) "Alteration," for a Boiler or Pressure Vessel, has the meaning given in NBIC part 3 section 9.1.

(b) "Alteration," for Power Piping or a Solid-Fuel-Fired Water-Heating Appliance, means a change that involves an extension or addition to, or involves the arrangement, type, or purpose of, an existing installation or component.

(2) "Approved" means acceptable to the Department.

Note: The Department will ordinarily accept items approved by a nationally recognized testing laboratory.

(3) "ASME Code" means the Boiler and Pressure Vessel code published by the American society of mechanical engineers.

(4) "Authorized Agent" means any of the following or their authorized representatives:

(a) A certified inspector who is referred to as enforcing this chapter, in a written contract between an inspection provider and the Department.

(5) "Boiler" means a vessel intended for use in heating water or other fluids or for generating steam or other vapors by the application of heat.

(6) "Boiler External Piping" means piping that is within the scope of section I of the ASME Code and is required by section I to have ASME Code symbol stamping.

(7) "Authorized Inspector" means a person who the Department authorizes to inspect Boiler-Pressure Vessels or a certified in-service field inspector Approved by the Department.

(8) "Condemned" means a Boiler or Pressure Vessel declared to be unsafe by the Department.

(10) "Dwelling" and **"Dwelling Unit"** means any building that contains one- or two-Dwelling Units. **"Dwelling Unit"** means a structure or that part of a structure which is used or intended to be used as a home, residence or sleeping place by one person or by two or more persons maintaining a common household, to the exclusion of all others.

(15) "Hot-Water Heating Boiler" means a Boiler in which no steam is generated, from which hot water is circulated for heating or process purposes and then returned to the Boiler, and which operates at a pressure not exceeding 160 psig or a temperature of 250°F at or near the Boiler outlet.

(16) "Hot-Water Storage Tank" means a tank used to store water that is heated indirectly by a circulating Water Heater, by steam, or hot water circulating through coils, or by other heat exchange methods internal or external to the tank.

(17) "Hot-Water Supply Boiler" means a Boiler completely filled with water that furnishes hot water to be used externally to itself at pressures not exceeding 160 psig or at temperatures not exceeding 250°F at or near the Boiler outlet.

(18) "Internal Inspection" means an inspection made when the Boiler or Pressure Vessel is shut down and handholes and manholes or other inspection openings are opened or removed for inspection of the interior as required by the inspector.

(19) "Low-Pressure Steam Boiler" means a Boiler on which the Safety Valves are set at pressures not exceeding 15 psig.

(20) "Maximum Allowable Working Pressure" means the maximum gage pressure permissible at the top of a completed vessel in its operating position for a designated temperature.

(21) "Miniature Boiler" means a power Boiler or high temperature water Boiler that does not exceed any of the following limits:

(a) Inside shell diameter of 16 inches.

(b) Heating surface of 20 square feet, except for electric Boilers.

I Gross volume of 5 cubic feet, exclusive of casing and insulation.

(d) Maximum Allowable Working Pressure of 100 psig.

(22) "National Board" means the National Board of Boiler and Pressure Vessel Inspectors.

(26) "Portable Boiler" means an internally fired Boiler primarily intended for temporary location and whose construction and usage is of a movable nature.

(27) "Power Boiler" means a Boiler in which steam or other vapor is generated at a pressure of more than 15 psig.

(28) "Power Piping" means any steam piping system beyond the scope of section I of the ASME Code and having a Maximum Allowable Working Pressure in excess of 15 psig, any hot water piping system beyond the scope of section I of the ASME Code and subject to temperatures in excess of 250°F, or any piping system using an organic or synthetic fluid as a heat-transfer media and subject to temperatures in excess of 250°F.

(29) "Pressure Vessel" means a container for the containment of pressure, either internal or external. This pressure may be obtained from an external source or by the application of heat from a direct or indirect source, or any combination thereof.

(31) "Relief Valve" means a pressure-actuated valve which is normally held closed by a spring or other means and which is designed to automatically open enough when needed to prevent internal pressure from exceeding a predetermined level.

Note: A Relief Valve is used primarily for liquid service.

(32) "Repair" means work and materials necessary to restore a Boiler, Pressure Vessel, Power Piping, or Solid-Fuel-Fired Water-Heating Appliance to a safe operating condition.

(33) "Rupture Disk" means a nonmechanical overpressure relief device that releases pressure when its preestablished rating is attained.

(34) "Safety Relief Valve" means an automatic pressure-actuated relieving device suitable for use either as a Safety Valve or Relief Valve, depending upon application.

(35) "Safety Valve" means an automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by full-opening pop action.

Note: A Safety Valve is used for gas or vapor service.

(36) "Secondhand Vessel" means a Boiler or Pressure Vessel that has changed location subsequent to the original installation.

(37) "Solid-Fuel-Fired Water-Heating Appliance" means atmospherically vented equipment used to heat water by burning solid fuels, for the purpose of providing space or process heat.

(38) "Uniform Dwelling Code" or "UDC" means this Residential Building Code.

(39) "Water Heater" means a closed vessel in which water is heated by the combustion of fuels, electricity, or other energy source, and withdrawn for use external to the system at pressures not exceeding 160 psig, including the apparatus by which heat is generated and all controls and devices necessary to prevent water temperatures from exceeding 210°F.

(40) "Welding" means the melting together of filler metal and base metal, or of base metal only, that results in coalescence.

Note: For further explanation of definitions, see the ASME Code section VIII, scope and appendix 3.

SPS 341.05 Petition for variance. The Department shall consider and may grant a variance to a provision of this chapter in accordance with Ch SPS 320.19.

SPS 341.06 Penalties. Penalties for violations of this chapter shall be assessed in accordance with SPS 320.22.

SPS 341.07 Appeals. Refer to SPS 320.21

SPS 341.08 Fees. Fees for inspections and other services performed by the Department (if applicable) shall be submitted to the Department.

SPS 341.09 Enforcement.

(1) This chapter shall be enforced by the Department and its Authorized Agents.

SPS 341.10 Adoption of standards by reference. The following standards, as produced by each listed organization, are hereby incorporated by reference into this chapter, subject to the modifications specified in this chapter:

(1) American Petroleum Institute, 1220 L Street, Northwest, Washington, D.C. 20005, telephone 202/682-8000, www.api.org. Pressure Vessel Inspection Code, API 510, 9th edition, June 2006.

(2) American Society of Mechanical Engineers (ASME), Order Department, P.O. Box 2900, Fairfield, NJ 07007-2900, telephone 800/843-2763, www.asme.org, which produces each of the following:

(a) ASME Boiler and Pressure Vessel Code, 2010 edition: Section I – Rules for Construction of Power Boilers, Section II –Materials, Section IV – Rules for Construction of Heating Boilers, Section V – Nondestructive Examination, Section VIII – Rules for Construction of Pressure Vessels, Section IX – Welding and Brazing Qualifications, and Section X – Fiber-Reinforced Plastic Pressure Vessels.

Note: Section VI of the ASME Code, Recommended Rules for the Care and Operation of Heating Boilers and section VII of the ASME Code, Recommended Guidelines for the Care of Power Boilers may be used as reference guides.

(b) Power Piping, ASME B31.1–2010.

(e) Controls and Safety Devices for Automatically Fired Boilers, ASME CSD-1–2009.

Note: See section SPS 341.11 (2) for modifications of ASME CSD-1.

(3) National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229-1183, telephone 614/888-8320, www.nationalboard.org. National Board Inspection Code (NBIC), ANSI/NB-23, 2011 edition.

Note: See section SPS 341.11 (1) for modifications of the NBIC.

(4) National Fire Protection Association®, 1 Batterymarch Park, Quincy, MA 02169-7471, telephone 800-344-3555. *C*ompressed Gases and Cryogenic Fluids Code, NFPA® 55, 2010 edition.

SPS 341.11 Application of standards.

(1) NBIC OMISSIONS. The requirements in the following portions of the NBIC are not included as part of this chapter:

(a) In part 1 – sections 1, 2.4.1, 2.5.4, 2.10.2, 2.10.6, 3.2.3, 3.4.1, 3.5.3, 3.5.4, 3.7.5.2, 3.7.7.2, 3.7.9.2, 3.8.3, 3.9.4, 3.10, and 5; Figures 3.7.5-d and 3.5.7-e; and Table 3.7.9.2.

(b) In part 2 – sections 1.1, 1.2, 1.3, 1.4, 1.4.1, 2.2.12.5, 2.2.12.6, 2.3.5.4, 2.3.6.4, 2.4, 2.5.3, 5.3 and supplement 6.

(c) In parts 1 and 2 – any reference to using an NBIC form.

(2) MODIFICATIONS OF ASME CSD-1.

(a) ***Sections CG-120 and CG-140.*** ASME CSD-1 does not apply to Boilers and burner assemblies with fuel input ratings of 400,000 Btu per hour or less.

(b) ***Shutdown switch***. The requirement in ASME CSD-1 section CE-110 (a) to locate a shutdown switch or circuit breaker just outside the Boiler room door is changed to include an alternative of locating the switch or breaker just inside the principal entrance into the room, where Approved by the Department or Authorized Agent.

(3) SECONDARY REFERENCES. Any codes or standards referenced in the standards adopted in SPS 341.10 shall apply to the prescribed extent of each such reference, except as modified by this chapter.

(4) ALTERNATE STANDARDS. Any alternate standard that is equivalent to or more stringent than a standard incorporated by reference or otherwise referenced under this chapter may be used in lieu of the incorporated or referenced standard if the alternate standard is accepted in writing by the Department.

Subchapter II — Inspections

SPS 341.15 General inspection requirements.

(1) ALL INSPECTIONS. : All inspections done by a FCPC Public Works Division Authorized Inspector or Authorized Agent.

SPS 341.16 Installation inspections.

(1) BOILER AND PRESSURE VESSEL INSPECTIONS.

(a) Boilers and Pressure Vessels shall be inspected by a certified inspector before they are placed in operation.

SPS 341.17 Periodic Inspections (Intentionally Omitted).
SPS 341.18 Exemptions from periodic inspections (Intentionally Omitted).
SPS 341.19 Preparation for Internal Inspection (Intentionally Omitted).
SPS 341.23 Reporting of periodic inspections (Intentionally Omitted).
SPS 341.24 Permit to operate (Intentionally Omitted).

Subchapter III — All Installations

SPS 341.27 Application. Except as specified under SPS 341.29 (2), this subchapter applies to all Boilers and Pressure Vessels existing on or after the adoption of this Code.

SPS 341.28 Safety rules.

(1) MAXIMUM ALLOWABLE WORKING PRESSURE. No Boiler or Pressure Vessel may be operated at a pressure in excess of the Maximum Allowable Working Pressure stated in owner's manual.

(2) ALTERATION TO SAFETY DEVICES. No unauthorized person may remove or tamper with any connected safety device.

(3) INSTALLATION LOCATION.

(a) Except as specified in par. (b), Boilers and Pressure Vessels shall be installed in accordance with the manufacturer's installation specifications.

(b) Clearances shall be maintained around Boilers, generators, heaters, tanks and related equipment and appliances to permit inspection, servicing, Repair, replacement, and visibility of all gages. When Boilers are installed or replaced, clearance shall be provided to allow access for inspection, maintenance, and Repair. Passageways around all sides of Boilers shall have an unobstructed width of not less than 18 inches unless otherwise Approved by the Department or Authorized Agent.

SPS 341.29 Safety controls.

(1) GENERAL. Oil-fired, gas-fired, and electrically heated Boilers shall be equipped with primary safety controls, safety limit switches, and burners or electric elements that bear the stamp, monogram, or other evidence of compliance with a nationally recognized standard.

Note: Typical acceptable stamps are the American Gas Association (AGA) and the Underwriters Laboratories (UL).

(2) PRESSURE AND TEMPERATURE CONTROLS.

(a) ***Boilers installed prior to 1957.*** Boilers installed prior to January 1, 1957, shall have at least one pressure control for steam Boilers or one temperature control for hot water Boilers or for organic- or synthetic-fluid heat-transfer systems. Compliance with par. (b) is optional for Boilers installed prior to January 1, 1957.

(b) ***Boilers installed on or after January 1, 1957.*** Boilers installed on or after January 1, 1957, shall comply with SPS 341.42 and with all of the following:

1. `Pressure controls.'

a. Each automatically fired steam Boiler or system of commonly connected steam Boilers shall have at least one steam pressure control device that will shut off the fuel supply to each Boiler or system of commonly connected Boilers when the steam pressure reaches a preset maximum operating pressure.

b. Each individual automatically fired steam Boiler shall have a high steam pressure limit control that will prevent generation of steam pressure in excess of the Maximum Allowable Working Pressure.

c. Each limit control and operating control shall be clearly separated and have its own sensing element and operating switch.

d. No shut-off valve of any type may be placed in the steam pressure connection between the Boiler and high-pressure limit control device.

2. `Temperature controls.'

a. Each automatically fired hot-water heating Boiler shall have at least one water temperature-actuated control to shut off the fuel supply when the system Boiler water reaches a preset operating temperature.

b. Each system of commonly connected automatically fired hot-water heating Boilers shall have at least one temperature-actuated control to shut off the fuel

supply to all units when the system Boiler water reaches a preset operating temperature.

c. Each individual automatically fired hot-water heating Boiler unit shall have a high temperature limit control that prevents the Boiler water temperature from exceeding the maximum allowable temperature of the Boiler.

d. Each limit control and operating control shall be clearly separated and shall have its own sensing element and operating switch.

e. No shut-off valve of any type may be placed in the piping between a Boiler and its high-temperature-limit control device.

SPS 341.30 Low-water cutoff, water feeder and fusible plug.

(1) GENERAL REQUIREMENTS.

(a) Every automatically fired power Boiler that does not have a full-time attendant and every automatically fired low-pressure steam Boiler shall be equipped with an automatic low-water fuel cutoff or other device which will perform a similar function, so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe water line.

(b) If a water-feeding device is installed, it shall be so constructed that the water inlet valve cannot feed water into the Boiler through the float chamber and so located as to supply requisite feed water. The lowest safe water line shall be not lower than the lowest visible part of the water glass.

(c) Boilers that are manually fired and have a residual heat source shall have a fusible plug installed which will extinguish the fire in the event of low water. Fire doors shall be provided with secure latches on manually fired Boilers having fusible plugs.

(2) BOWL DESIGNS. Designs embodying a float and float bowl, or probe control installed in a bowl or chamber external to the Boiler, shall have a vertical, straight-run, valved drainpipe at the lowest point in the water-equalizing pipe connections, by which the bowl or chamber and the equalizing pipe can be flushed, and the device tested.

SPS 341.31 Boiler blowoff equipment.

(1) PRESSURE-TEMPERATURE LIMITS. The blowdown from a Boiler that enters a sewer system or blowdown which is considered a hazard to life or property shall pass through some form of blowoff equipment that will reduce pressure and temperature as specified in pars. (a) and (b).

(a) The temperature of the water leaving the blowoff equipment may not exceed 160°F.

(b) The pressure of the blowdown leaving the blowoff equipment may not exceed 5 psig.

(2) PIPING AND FITTINGS. The blowoff piping and fittings between the Boiler and the blowoff tank shall comply with ASME B31.1 or the code in effect at the time of construction.

(3) TANKS AND SEPARATORS. The blowoff tank or separator shall be designed in accordance with SPS 341.42 or the code in effect at the time of construction for a Maximum Allowable Working Pressure of at least 50 psig.

(4) GENERAL REQUIREMENTS. All blowoff equipment, except centrifugal blowdown separators, shall be fitted with openings to facilitate cleaning and inspection and shall have all of the following:

(a) A pressure gage graduated from 0-50 psi.

(b) A thermometer well located near the water outlet connection and in contact with the retained water in the tank.

(c) A gage glass at least one-half inch in diameter with the lower connection to the glass at a point about 6 inches below the water line and the upper connection at a point about 6 inches above the water line.

(d) A drain connection of at least 2-inch standard pipe size.

(e) Connections designed so that freezing will not close the inlet, the outlet, or the vent.

(5) VENT PIPING. All blowoff equipment shall have vent piping, full size, piped to the outside atmosphere and discharged to a safe location.

Note: Blowoff equipment designed in accordance with the Boiler blowoff equipment rules issued by the National Board of Boiler and Pressure Vessel Inspectors will meet the requirements of this section. Other methods of designing blowoff equipment may be used if Approved by the Department.

SPS 341.32 Pressure gages for air receivers.

(1) GAGE LOCATION. Air receivers shall be equipped with an indicating pressure gage so located as to be readily visible.

(2) GAGE DIAL. The dial of the pressure gage shall be graduated to approximately double the pressure at which the Safety Valve is set but may not be less than one and one-half times that pressure.

SPS 341.33 Protection of vessels supplied through pressure-reducing stations.

(1) SIZING SAFETY VALVES. The requirements in this section shall be used for determining the sizes of Safety Valves on Pressure Vessels such as pressure cookers, indirect hot Water Heaters and equipment in heating systems, that are supplied through pressure-reducing stations from Boilers carrying a higher steam pressure. Where a pressure-reducing station is supplied from a Boiler, the capacity of the Safety Valves on the low-pressure side of the system need not exceed the capacity of the Boiler.

(2) REDUCING-STATION CAPACITY.

(a) The following formula shall be used to determine the steam flow rate through the pressure-reducing station. - See PDF for diagram - See PDF for table

(b) The critical flow capacity data supplied by the reducing valve manufacturer may be used in place of the above formula to select the required Safety Valve capacity. The capacity calculations shall be the largest obtainable by internal trim change of the reducing valve.

(c) In using Table 341.33-1, the pressure-reducing station inlet pressure is the lowest set pressure of any Safety Valve on the high-pressure side of the pressure-reducing station.

(3) BYPASS CAPACITY. The following formula shall be used to determine the steam flow rate through the bypass when pressure-reducing stations are arranged with a valved bypass that

also acts as a potential steam source hazard in case the bypass is left open. - See PDF for diagram - See PDF for table

(4) SELECTING SAFETY VALVE. The larger of the steam flow rates calculated by the formulas in subs. (2) and (3) shall be used for selecting the Safety Valve on the low-pressure side of the system. - See PDF for table - See PDF for table - See PDF for table

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column. - See PDF for table

Note: In applying Table 341.33-2, the area of the pipe is always based upon standard weight pipe and the inlet size of the pressure-reducing valve.

SPS 341.34 Portable Boilers.

(1) PERMIT REQUIRED. The owner or user of a portable Boiler located in Wisconsin or brought into Wisconsin for use, shall possess a permit to operate issued by the Department prior to use.

(2) BOILER REQUIREMENTS. The permit to operate shall be issued only after all of the following requirements are met:

(a) The Boiler complies with SPS 341.42.

(b) The Boiler is installed according to the applicable requirements of this chapter.

(c) An internal or external inspection of the Boiler has been made that is acceptable to the Department.

SPS 341.35 Interconnected Boilers. When Boilers of different Maximum Allowable Working Pressures with minimum Safety Valve settings varying more than 6% are so connected that steam can flow toward the lower pressure units, the latter shall be protected by additional Safety Valve capacity, if necessary, on the lower pressure side of the system. The additional Safety Valve capacity shall be based upon the maximum amount of steam that can flow into the lower pressure system. The additional Safety Valves shall have at least one valve set at a pressure not to exceed the lowest allowable pressure and the other valves shall be set within a range not to exceed 3% above that pressure.

SPS 341.37 Maintenance.

(1) CORROSION PREVENTION. All Boilers and Pressure Vessels shall be installed and maintained in such a manner as to prevent excessive corrosion and deterioration.

(2) SAFE CONDITIONS. The certified inspector shall note conditions during Internal Inspection, external inspection, or hydrostatic pressure test and shall order changes or Repairs that will place the Boiler or Pressure Vessel in a safe working condition.

Note: Sections VI and VII of the ASME Boiler and Pressure Vessel code, Recommended Rules for Care and Operation of Heating Boilers and Recommended Rules for Care of Power Boilers, are excellent guides for Boiler owners and operators.

(3) MODIFICATION OF BOILER BURNER ASSEMBLY. Any modification to or installation of a Boiler burner assembly may not exceed the original stamping of the Boiler rated output capacity.

Note: See section SPS 341.38 for Department reporting requirements relating to fuel conversions and to modifications for increasing heat input.

SPS 341.39 Condemnation.

(1) AUTHORITY. Only the Department may condemn a Boiler or Pressure Vessel. Any Boiler or Pressure Vessel declared by a Authorized Inspector to be unsafe and beyond Repair shall be referred to the Department for condemnation proceedings.

(2) SYMBOL.

(a) Any Boiler or Pressure Vessel confirmed by the Department to be unsafe for further use shall be stamped as follows: - See PDF for table

(3) UNLAWFUL USE. It shall be unlawful for any person, firm, partnership, or corporation to use, operate, or offer for sale for operation on Tribal Lands any Condemned Boiler or Pressure Vessel.

Subchapter IV — New Installations

SPS 341.40 Application. This subchapter applies to all Boilers and Pressure Vessels, or components thereof, that are installed on or after the adoption of this Code.

SPS 341.41 Installation registration.

(1) BOILER OR PRESSURE VESSEL INSTALLATION REGISTRATION.

(a) The installation of any Boiler or Pressure Vessel shall be registered with the Department by the installer before the operation of the Boiler or Pressure Vessel.

SPS 341.42 ASME Code vessels.

(1) ASME CODE COMPLIANCE. Except as provided in SPS 341.43 to 341.45 and 341.53 (2), Boilers and Pressure Vessels shall be constructed, installed, operated and maintained in accordance with the ASME Code, ASME CSD-1 and the NBIC. Boilers and Pressure Vessels designed to other national or international standards may be Approved if the design has been accepted by a nationally recognized independent third party and the Department, or if the standard has been accepted by the Department.

Note: Section SPS 341.43 also allows construction of Boilers and Pressure Vessels that do not comply with the ASME Code, if they comply with criteria in a variance issued by the Department. As referenced in section SPS 341.05, any such variance must comply with Wisconsin chapter SPS 303, which requires establishing an equivalency that meets the intent of the rule.

Note: The Department will recognize the applicable case interpretations of the ASME Boiler and Pressure Vessel code as being acceptable.

Note: The ASME Code specifies that persons installing Boiler External Piping by Welding are required to possess the appropriate ASME credentials.

Note: Design and construction complying with Canadian standard CSA B51 is accepted by the Department under this section.

(2) REGISTERING WITH NATIONAL BOARD.

(a) Except as provided in par. (b), all Boilers and Pressure Vessels, including any that are constructed and installed in accordance with Canadian standard CSA B51, shall have the manufacturer's data report registered with the National Board and shall bear a National Board number. Copies of the registration shall be provided to the Department when requested.

(b) Cast iron sectional Boilers and cast aluminum Boilers stamped "H" and Pressure Vessels stamped "UM" are exempt from National Board registration.

(3) OWNER-BUILT. NOT PERMITTED ON TRIBAL LANDS.

SPS 341.43 Wisconsin special vessels (Intentionally Omitted).
SPS 341.44 U.S. department of transportation vessels (Intentionally Omitted).
SPS 341.45 Non-code vessels (Intentionally Omitted).

SPS 341.46 Power Piping.

(1) GENERAL. Power Piping shall be installed in accordance with ASME B31.1. The use of slip-on flanges shall be limited in applications to no higher than Class 300 primary pressure service rating. Slip-on flanges shall be installed with double fillet welds in accordance with ASME B31.1.

(2) BOILER EXTERNAL PIPING. Boiler External Piping within the scope of section I of the ASME Code shall be installed in accordance with ASME B31.1.

(3) APPLICATION. This section applies to new systems as well as all replacements, modifications, and Alterations to existing systems.

SPS 341.47 Multi-Boiler installations. When hot-water heating Boilers are installed in multiples with a common header and a common return, isolation valves may be eliminated between units and the units may be considered as one Boiler provided all of the following conditions are met:

(1) OUTPUT LIMIT. No single unit exceeds 500,000 Btu per hour output.

(2) PRESSURE RELIEF. Each unit has a pressure relief device as required by the ASME Code, or the common header has a pressure relief device with sufficient relieving capacity for all units in the installation.

(3) CONTROLS. Each unit has operating controls and safety controls acceptable to the Department.

(4) LOW-WATER CUTOFF. The fuel supply to each unit is shut off by a low-water cutoff in the event of low water in the system.

SPS 341.48 Organic- or synthetic-fluid heat-transfer systems. Boilers and coil-type heaters that utilize organic or synthetic fluids as a heat-transfer media shall be designed, constructed, and installed in accordance with the ASME Code. Piping for organic or synthetic fluids used as a heat-transfer media and subject to temperatures in excess of 250°F shall be installed in accordance with ASME B31.1.

Note: See sections SPS 341.41 (1) and (2) for requirements relating to registering these installations with the Department.

SPS 341.49 Solid-Fuel-Fired Water-Heating Appliances.

(1) GENERAL. This section applies to Solid-Fuel-Fired Water-Heating Appliances that are not constructed and installed in accordance with the ASME Code.

(2) DESIGN.

(a) A Solid-Fuel-Fired Water-Heating Appliance shall be constructed with self-contained weather proofing or other weather protection acceptable to the Department.

(b) A Solid-Fuel-Fired Water-Heating Appliance shall be listed by a nationally recognized testing laboratory acceptable to the Department.

Note: Examples of acceptable testing laboratories include, but are not limited to, Underwriters Laboratory (UL) and Factory Mutual (FM).

(c) A Solid-Fuel-Fired Water-Heating Appliance shall be designed and constructed for operation at atmospheric pressure and shall be properly vented to prevent a positive pressure condition.

(3) INSTALLATION.

(a) A Solid-Fuel-Fired Water-Heating Appliance shall be located away from occupiable structures in accordance with the manufacturer's recommendation. If provided, a canopy shall be open on all sides and constructed of substantially nonflammable materials and may not fully cover the unit.

(b) A Solid-Fuel-Fired Water-Heating Appliance shall be enclosed by fencing or other barriers to prevent access and tampering by unauthorized persons.

(c) Any automatic fuel-feeding system for a Solid-Fuel-Fired Water-Heating Appliance shall be designed or approved by the manufacturer of the appliance.

(d) The installation of a Solid-Fuel-Fired Water-Heating Appliance shall be provided with means to prevent freezing of the supply and return lines.

(4) REPAIRS. Repairs to the Boiler shall be made in accordance with the manufacturer's recommendation.

Subchapter V — Nuclear Power Plants (Intentionally Omitted)

SPS 341.53 Application (Intentionally Omitted).
SPS 341.54 Installation registration (Intentionally Omitted).
SPS 341.55 Periodic inspections (Intentionally Omitted).
SPS 341.56 Welded Repairs and Alterations (Intentionally Omitted).
SPS 341.57 Report of incidents (Intentionally Omitted).

Subchapter VI — Repairs and Alterations

SPS 341.60 General requirements. Welded Repairs, Repair parts or Alterations to any Boiler or Pressure Vessel or their fittings, settings or appurtenances shall comply with the NBIC.

SPS 341.61 General rules for Repairs and Alterations.

(1) Repairs and Alterations to Boilers and Pressure Vessels shall be performed by an organization in possession of a valid National Board Repair “R" certificate of authorization for the intended scope of work.

SPS 341.62 Reports and stamping.

(1) NATIONAL BOARD PROGRAM.

(a) Anyone performing Repairs or Alterations under the National Board "R" stamp program shall register the Repairs and Alterations with the National Board on the appropriate NBIC "R" forms.

(b)

1. Stamping of or attaching a nameplate to a Repaired or altered pressure-retaining item under NBIC part 3 section 5.7 shall be completed and then verified by a certified inspector before the NBIC "R" form is signed by the inspector.

2. Any stamping or attaching of a nameplate under this section shall be in accordance with the NBIC, except as provided in subd. 3.

3. If the stamping or attaching cannot be placed in accordance with the NBIC, the substitute placement shall be described on the appropriate NBIC "R" form, and the description shall be verified by the inspector.

(2) ADDITIONAL REPORTING REQUIREMENTS.

(a)

1. Anyone performing routine Repairs as defined in the NBIC shall register the Repairs with the National Board on NBIC form R-1 and shall stamp or attach a nameplate to the Repaired item.

2. Any stamping or attaching of a nameplate under this section shall be in accordance with the NBIC and shall be completed and then verified by the certified inspector before the inspector signs the NBIC R-1 form, except as provided in subd. 3.

3. If the stamping or attaching cannot be placed in accordance with the NBIC, the substitute placement shall be described on the NBIC R-1 form, and the description shall be verified by the inspector.

(b) Anyone performing seal Welding of 6 or more Boiler tubes shall register the Repair with the National Board on form R-1.

Note: Copies of the National Board forms are available from the National Board, at 1055 Crupper Avenue, Columbus, OH 43229-1183, or telephone 614/888-8320, or www.nationalboard.org.

SPS 341.63 Riveted Repairs.

(1) GENERAL. When riveted patches are used, they shall be designed and applied using methods acceptable to the Department.

Note: Information regarding the use of riveted patches is available from the Department.

(2) MATERIALS FOR RIVETED PATCHES. Patch material shall meet the applicable requirements of the NBIC.

(3) PRESSURE TEST. The certified inspector may require a pressure test, as specified in the NBIC, after completion of a riveted Repair.

SPS 341.64 Safety and safety Relief Valve Repairs.

(1) DEFINITIONS. In this section:

(a) "Repair of a Safety Valve or safety Relief Valve" means the replacement, re-machining, or cleaning of any critical part; lapping of seat and disc or any other operation that may affect the flow passage, capacity, function, or pressure-retaining integrity; and disassembly, re-assembly and adjustments which affect the Safety Valve or safety Relief Valve function.

(b) "Repair of a Safety Valve or safety Relief Valve" does not include the initial adjustments of a new Safety Valve or safety Relief Valve on a Boiler or Pressure Vessel if made by the manufacturer or assembler of the valve.

(2) BROKEN SEALS. Safety Valves and safety Relief Valves on which the seals have been broken shall be subject to the requirements for Repairs.

(3) AUTHORIZED REPAIRS. Repair of a Safety Valve or safety Relief Valve shall be performed by an organization in possession of one or more of the following:

(a) ASME V, HV or UV code symbol stamp.

(b) National Board VR stamp covering the work to be performed.

(4) NAMEPLATES.

(a) When Repair of a Safety Valve or safety Relief Valve occurs, a metal Repair nameplate stamped with the information required by par. (b) shall be welded or otherwise permanently attached to the valve either above, adjacent to or below the original stamping. On small valves, a metal tag showing the Repair nameplate information may be securely attached to the Repaired valve.

(b) The information on the valve nameplate shall include the name of the Repair organization, the symbol stamp and symbol stamp number, and the date of Repair. If the set pressure has been changed, the new set pressure and capacity shall be indicated and the original nameplate or stamping shall be modified by marking out, although leaving legible, the prior set pressure and capacity. The new capacity shall be based on that for which the valve was originally certified. Only the current Repair nameplate need be attached to the valve with the original or duplicate nameplate.

Subchapter VII — Secondhand Vessels

SPS 341.70 Application. This subchapter applies to secondhand Boilers and secondhand Pressure Vessels.

SPS 341.71 Existing vessels. Secondhand Boilers and secondhand Pressure Vessels, originally installed in Wisconsin and not constructed and stamped according to some edition of the ASME Code, may be reinstalled if the Maximum Allowable Working Pressure is recalculated with a factor of safety of 6.

Note: The pressure calculation formula for shells is as follows:

P = (T.S. x t x E)/(R x F.S.)

where P = Maximum Allowable Working Pressure, pounds per square inch

T.S. = tensile strength of shell plate, pounds per square inch

t = minimum thickness of shell plates, inches

E = efficiency of longitudinal joint
R = inside radius of the outside course of the shell, inches
F.S. = factor of safety
Note: The pressure calculation formula for flat heads and flat surfaces is as follows:
P = (T.S. x t2)/(0.5 x d2 x F.S.)
where P = Maximum Allowable Working Pressure, pounds per square inch
T.S. = tensile strength of shell plate, pounds per square inch
t = thickness of plate, inches
d = diameter of head or shortest unsupported span of head or maximum pitch between stays, inches
F.S. = factor of safety

SPS 341.72 Vessels from out-of-state. Secondhand Boilers and secondhand Pressure Vessels, from out-of-state, shall be constructed and stamped according to some edition of the ASME Code. A copy of the manufacturer's data report shall be furnished to the Department for each vessel indicating that it was manufactured originally to the requirements of an earlier edition of the applicable ASME Code. If a vessel has been Repaired or altered since its fabrication, a copy of the manufacturer's data report, welded Repair report or Alteration report shall be furnished to the Department.

SPS 341.73 Lap seam Boilers. Secondhand Boilers which have lap seam construction and which are larger than 36 inches in diameter shall be limited to a Maximum Allowable Working Pressure of not more than 15 psig.

SPS 341.74 Prohibited Boilers. The installation of secondhand Boilers that have the longitudinal joint exposed to the intense heat of the furnace is prohibited. The locomotive or inside butt strap may not be considered as strengthening or changing the original type of Boiler joint.

SPS 341.75 Inspection and testing.

(1) HYDROSTATIC PRESSURE TEST. Every secondhand vessel shall be inspected and given a hydrostatic pressure test at one and one-half times the Maximum Allowable Working Pressure at its new point of installation location before it is placed in operation. The test shall be witnessed by a certified inspector.

(2) ALTERNATIVE TESTS. When the certified inspector determines that a hydrostatic test at one and one–half times the Maximum Allowable Working Pressure is not possible or desirable, the certified inspector may accept alternative means to determine if the vessel is safe for its intended use.

Note: Where water is used in a hydrostatic test, the temperature of the water should not be less than 70oF and the maximum temperature during inspection should not exceed 120oF. If a test is conducted at 1.5 times the Maximum Allowable Working Pressure (MAWP) and the owner specifies a temperature higher than 120oF, the pressure should

be reduced to the MAWP and the temperature should be reduced to 120oF for the close examination.

(3) EXEMPT VESSELS. Boilers and Pressure Vessels used for portable or emergency use shall be exempt from secondhand vessel test requirements.

SPS 341.76 Installation. Except for vessels exempted in SPS 341.18, all secondhand vessels when reinstalled, shall comply with the ASME Code in regard to fittings, appliances, valves, connections, settings and supports. These vessels shall also comply with the installation and permit to operate requirements in this Code.

Subchapter VIII — Pressure Vessels in Petroleum Refineries (Intentionally Omitted).

SPS 341.80 General requirements (Intentionally Omitted).

Subchapter IX – Historical Boilers (Intentionally Omitted)

SPS 341.90 Application (Intentionally Omitted).

SPS 341.91 General requirements (Intentionally Omitted).

SPS 341.92 Testing, maintenance, and out-of-state Boilers (Intentionally Omitted).

SPS 341.93 Interruption of inspection cycle (Intentionally Omitted).

TABLE 341.33–1 (continued)

ORIFICE RELIEVING CAPACITIES
(Pounds per hour per square inch)

OUTLET PRESSURE	PRESSURE–REDUCING VALVE INLET PRESSURE, PSIG												
PSIG	900	850	800	750	700	650	600	550	500	450	400	350	300
1000	—	—	—	—	—	—	—	—	—	—	—	—	—
950	—	—	—	—	—	—	—	—	—	—	—	—	—
900	—	—	—	—	—	—	—	—	—	—	—	—	—
850	23190	—	—	—	—	—	—	—	—	—	—	—	—
800	31610	22550	—	—	—	—	—	—	—	—	—	—	—
750	37110	30600	21800	—	—	—	—	—	—	—	—	—	—
700	40860	35730	29420	21020	—	—	—	—	—	—	—	—	—
650	43400	39200	34250	28260	20190	—	—	—	—	—	—	—	—
600	45010	41500	37470	32800	27090	19480	—	—	—	—	—	—	—
550	45800	42840	39850	35730	31310	25940	18620	—	—	—	—	—	—
500	45850	43330	40530	37610	33880	29760	24630	17720	—	—	—	—	—
450	45870	43330	40730	38150	35260	31980	28080	23290	16680	—	—	—	—
400	—	—	40760	38220	35680	33050	29980	26380	21870	15760	—	—	—
350	—	—	—	—	—	33120	30690	27910	24570	20460	14790	—	—
300	—	—	—	—	—	33240	—	28140	25610	22620	18860	13630	—
250	—	—	—	—	—	—	—	28150	25650	23200	21000	17100	10800
200	—	—	—	—	—	—	—	—	—	—	21350	18250	15350
175	—	—	—	—	—	—	—	—	—	—	—	18250	16000
150	—	—	—	—	—	—	—	—	—	—	—	18250	16200
125	—	—	—	—	—	—	—	—	—	—	—	18780	—
110	—	—	—	—	—	—	—	—	—	—	—	—	—
100	—	—	—	—	—	—	—	—	—	—	—	—	—
85	—	—	—	—	—	—	—	—	—	—	—	—	—
75	—	—	—	—	—	—	—	—	—	—	—	—	—
60	—	—	—	—	—	—	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	—	—	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—	—	—	—	—	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE 341.33–1 (continued)

ORIFICE RELIEVING CAPACITIES
(Pounds per hour per square inch)

OUTLET PRESSURE PSIG	PRESSURE–REDUCING VALVE INLET PRESSURE, PSIG												
	250	200	175	150	125	100	85	75	60	50	40	30	25
1000	—	—	—	—	—	—	—	—	—	—	—	—	—
950	—	—	—	—	—	—	—	—	—	—	—	—	—
900	—	—	—	—	—	—	—	—	—	—	—	—	—
850	—	—	—	—	—	—	—	—	—	—	—	—	—
800	—	—	—	—	—	—	—	—	—	—	—	—	—
750	—	—	—	—	—	—	—	—	—	—	—	—	—
700	—	—	—	—	—	—	—	—	—	—	—	—	—
650	—	—	—	—	—	—	—	—	—	—	—	—	—
600	—	—	—	—	—	—	—	—	—	—	—	—	—
550	—	—	—	—	—	—	—	—	—	—	—	—	—
500	—	—	—	—	—	—	—	—	—	—	—	—	—
450	—	—	—	—	—	—	—	—	—	—	—	—	—
400	—	—	—	—	—	—	—	—	—	—	—	—	—
350	—	—	—	—	—	—	—	—	—	—	—	—	—
300	—	—	—	—	—	—	—	—	—	—	—	—	—
250	—	—	—	—	—	—	—	—	—	—	—	—	—
200	10900	—	—	—	—	—	—	—	—	—	—	—	—
175	12600	7250	—	—	—	—	—	—	—	—	—	—	—
150	13400	9540	6750	—	—	—	—	—	—	—	—	—	—
125	13600	10800	8780	6220	—	—	—	—	—	—	—	—	—
110	13600	11000	9460	7420	4550	—	—	—	—	—	—	—	—
100	13600	11000	9760	7970	5630	—	—	—	—	—	—	—	—
85	13600	11000	—	8480	6640	4070	—	—	—	—	—	—	—
75	13600	11000	—	—	7050	4980	3150	—	—	—	—	—	—
60	13630	11000	—	—	7200	5750	4540	3520	—	—	—	—	—
50	—	11000	—	—	—	5920	5000	4230	2680	—	—	—	—
40	—	11000	—	—	—	—	5140	4630	3480	2470	—	—	—
30	—	11050	—	—	—	—	—	—	3860	3140	2210	—	—
25	—	—	—	—	—	—	—	—	—	3340	2580	1485	—
15	—	—	—	—	—	—	—	—	—	—	2830	2320	1800
10	—	—	—	—	—	—	—	—	—	—	—	—	2060
5	—	—	—	—	—	—	—	—	—	—	—	—	—

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

(2) REDUCING-STATION CAPACITY. (a) The following formula shall be used to determine the steam flow rate through the pressure–reducing station.

$$W = 1/3 \times OC \times VSPA$$

Where:

W = steam flow in pounds of steam per hour through the pressure–reducing valve

OC = orifice capacity in pounds of steam per hour per square inch from Table 341.33–1

VSPA = reducing valve size pipe area in square inches from Table 341.33–2

(b) The critical flow capacity data supplied by the reducing valve manufacturer may be used in place of the above formula to select the required safety valve capacity. The capacity calculations shall be the largest obtainable by internal trim change of the reducing valve.

(c) In using Table 341.33–1, the pressure–reducing station inlet pressure is the lowest set pressure of any safety valve on the high pressure side of the pressure–reducing station.

(3) BYPASS CAPACITY. The following formula shall be used to determine the steam flow rate through the bypass when pressure–reducing stations are arranged with a valved bypass that also acts as a potential steam source hazard in case the bypass is left open.

$$W = 1/2 \times OC \times BPA$$

Where:

W = steam flow in pounds of steam per hour through the bypass valve

OC = orifice capacity in pounds of steam per hour per square inch from Table 341.33–1

BPA = bypass pipe area in square inches from Table 341.33–2

(4) SELECTING SAFETY VALVE. The larger of the steam flow rates calculated by the formulas in subs. (2) and (3) shall be used for selecting the safety valve on the low–pressure side of the system.

TABLE 341.33–1

ORIFICE RELIEVING CAPACITIES
(Pounds per hour per square inch)

OUTLET PRESSURE	PRESSURE–REDUCING VALVE INLET PRESSURE, PSIG											
PSIG	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950
1000	76560	72970	69170	64950	60540	55570	49930	43930	35230	25500	—	—
950	77430	74180	70760	67000	63100	58770	53920	48610	42380	34890	24910	—
900	77750	74810	71720	68340	64870	61040	56820	52260	47050	41050	33490	23960
850	77830	74950	72160	69130	66020	62610	58900	54930	50480	45470	39660	29080
800	—	75070	72330	69490	66700	63680	60390	56910	53060	48800	43980	38340
750	—	—	—	69610	66880	64270	61260	58200	54840	51170	47080	42420
700	—	—	—	—	66900	64270	61520	58820	55870	52670	49170	45230
650	—	—	—	—	—	—	61550	58860	56260	53480	50440	47070
600	—	—	—	—	—	—	—	58980	56270	53660	51020	48470
550	—	—	—	—	—	—	—	—	—	53810	51040	48470
500	—	—	—	—	—	—	—	—	—	—	—	—
450	—	—	—	—	—	—	—	—	—	—	—	—
400	—	—	—	—	—	—	—	—	—	—	—	—
350	—	—	—	—	—	—	—	—	—	—	—	—
300	—	—	—	—	—	—	—	—	—	—	—	—
250	—	—	—	—	—	—	—	—	—	—	—	—
200	—	—	—	—	—	—	—	—	—	—	—	—
175	—	—	—	—	—	—	—	—	—	—	—	—
150	—	—	—	—	—	—	—	—	—	—	—	—
125	—	—	—	—	—	—	—	—	—	—	—	—
110	—	—	—	—	—	—	—	—	—	—	—	—
100	—	—	—	—	—	—	—	—	—	—	—	—
85	—	—	—	—	—	—	—	—	—	—	—	—
75	—	—	—	—	—	—	—	—	—	—	—	—
60	—	—	—	—	—	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	—	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—	—	—	—	—
25	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE 341.33–2
INTERNAL PIPE AREA

Nominal pipe size, inches	STANDARD WEIGHT PIPE		
	Actual External Diameter, Inches	Approx. Internal Diameter, Inches	Approx. Internal Area, Square Inches
3/8	0.675	0.49	0.19
1/2	0.840	0.62	0.30
3/4	1.050	0.82	0.53
1	1.315	1.05	0.86
1–1/4	1.660	1.38	1.50
1–1/2	1.900	1.61	2.04
2	2.375	2.07	3.36
2–1/2	2.875	2.47	4.78
3	3.5	3.07	7.39
3–1/2	4.0	3.55	9.89
4	4.5	4.03	12.73
5	5.563	5.05	19.99
6	6.625	6.07	28.89
8	8.625	8.07	51.15
10	1.750	10.19	81.55
12	12.750	12.09	114.80

Note: In applying Table 341.33–2, the area of the pipe is always based upon standard weight pipe and the inlet size of the pressure–reducing valve.

Chapter SPS 345

MECHANICAL REFRIGERATION

Subchapter I — Purpose, Scope, and Application
SPS 345.10 Purpose and scope.
SPS 345.11 Application.
SPS 345.12 Local regulations.
Subchapter II — Definitions
SPS 345.20 Definitions.
Subchapter III — Administration and Enforcement
SPS 345.30 Installation registration.
SPS 345.31 Enforcement and inspections.
SPS 345.32 Permit to operate (Intentionally Omitted).
SPS 345.33 Reporting of accidents.
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SPS 345.36 Appeals.
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Subchapter IV — Standards
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SPS 345.500 General.
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SPS 345.509 Design and construction.
SPS 345.511 General requirements (Intentionally Omitted).
SPS 345.550 ANSI/ASME B31.5.
Subchapter VI — Changes, Additions or Omissions to ANSI/IIAR 2
SPS 345.600 General.
SPS 345.601 Scope.
SPS 345.611 Overpressure protection.
SPS 345.613 Machinery room (Intentionally Omitted).
Subchapter VII — Ozone−Depleting Refrigerants
SPS 345.70 Ozone-Depleting Refrigerants.

Subchapter I — Purpose, Scope, and Application

SPS 345.10 Purpose and scope. The purpose of this chapter is to establish all of the following:

(1) Minimum safety standards for the design, construction, installation, operation, testing, maintenance, Repairs, and inspection of mechanical refrigeration systems in public buildings and places of employment.

(2) Minimum standards for preventing the release of ozone− depleting refrigerants to the atmosphere.

Note: Pursuant to federal regulations, individuals who install or service HVAC equipment involving Ozone-Depleting Refrigerants are required to hold a Type I, II, III, or Universal technician certification issued in accordance with section 608 of the federal Clean Air Act and title 40 CFR part 82, subpart F.

Note: The Public Works Division may have additional rules that affect the design, construction, installation, operation, testing, maintenance, Repair, and inspection of mechanical refrigeration systems

Note: Under chapters SPS 314 and 361, neither NFPA□ 1 nor the *International Fire Code*□ are applied by the Department to mechanical refrigeration systems.

SPS 345.11 Application.

(1) GENERAL. This chapter applies to all of the following except as provided in sub. (2):

(a) All mechanical refrigeration systems that are installed or constructed on or after September 1, 2010.

(b) A change to a refrigerant of a different number designation.

(c) Replacement parts or components for any mechanical refrigeration system that exists on or after September 1, 2010.

(d) Alterations to any mechanical refrigeration system that exists on or after September 1, 2010.

Note: A proposed Alteration for an existing system may necessitate modifying other components of the system in order to make the proposed Alteration comply with this chapter and some Alterations may necessitate modifying other features of a building

Note: As referenced in section SPS 345.40 (2) (c), see subchapter VI of chapter SPS 341 for additional requirements relating to Alterations and Repairs for pressure vessels and their fittings, settings, or appurtenances.

Note: Designers, contractors and Owners are encouraged to contact the Department to discuss their intentions for Alterations and to determine, on a case−by−case basis, any upgrades that are needed.

(e) Operation, testing, maintenance, and inspection of all mechanical refrigeration systems that exist on or after September 1, 2010.

(f) Any removal, transfer, storage, release, recovery, charging or other use of any Ozone-Depleting Refrigerant that exists on Tribal Lands on or after September 1, 2010.

(2) EXEMPTIONS. This chapter does not apply to the use of water or air as the primary refrigerant.

(3) RETROACTIVITY. A design, construction, or installation rule in sub chs. III to VI does not apply retroactively to mechanical refrigeration systems or components existing prior to the effective date of the rule unless specifically stated in the rule.

(4) DIFFERING RULES.

(a) Where any Department rule in this chapter differs from a requirement within a standard

referenced in this chapter, the Department rule shall govern.

(b) Where a provision of this chapter prescribes a general requirement and another provision of this chapter prescribes a specific or more detailed requirement regarding the same subject, the specific or more detailed requirement shall govern, except as provided in par. (a).

(c) Where different sections of this chapter specify conflicting requirements, the most restrictive requirement, as determined by the Department, shall govern, except as provided in pars. (a) and (b).

(5) INTERPRETATIONS. The Public Works Division reserves the right to interpret the requirements in this chapter and in all adopted Codes and standards.

Subchapter II — Definitions

SPS 345.20 Definitions. In this chapter:

(1) "Alteration" means any of the following:

(a) A change in a mechanical refrigeration system that involves an extension, addition or change to the arrangement, type or purpose of the existing installation or component.

(b) A change in the type of refrigerant for a mechanical refrigeration system.

(2) "Approved" means acceptable to the Department.

(3) "Approved Nationally Recognized Testing Laboratory" means a laboratory acceptable to the Department, which provides uniform testing and examination procedures and standards for meeting design, manufacturing, and factory test requirements of this chapter; is organized, equipped, and qualified for testing; and has a follow−up inspection service of the current production of the listed products.

(4) "Authorized Agent" means any of the following or their authorized representatives:

(a) A boiler−pressure vessel inspector who is so certified under Ch. SPS 305 and is addressed in a written contract with the Department as enforcing this chapter.

(5) "Ozone-Depleting Refrigerant" means a substance used in refrigeration that is or contains a class I substance, as defined in 42 USC 7671 (3) or a Class II substance, as defined in 42 USC 7671 (4).

(8)"Repair" means the restoration of any portion or component of a mechanical refrigeration system to a safe operating condition.

Subchapter III — Administration and Enforcement

SPS 345.30 Installation registration.

(1) CLASSIFICATIONS. Any installation of the following mechanical refrigeration systems or components thereof shall be registered with the Department:

(a) Any system using a Group A1 or B1 refrigerant and having a capacity rated at or greater than 50 horsepower, 50 tons or 50,000 volt−amperes.

(b) Any system using a Group A2, B2, A3 or B3 refrigerant and having a capacity rated at or greater than 10 horsepower, 10 tons or 10,000 volt−amperes.

(c) Any alteration of a mechanical refrigeration system, that causes the system to have or exceed the capacity in par. (a) or (b).

(d) Any alteration or Repair of a currently registered mechanical refrigeration system.

Note: See normative appendix C in ANSI/ASHRAE standard 15, as adopted in subchapter IV, for characteristics of the refrigerant safety groups listed in paragraphs (a) and (b). For characteristics of individual refrigerants, such as the safety groups they are assigned to, see Tables 1 and 2 in ANSI/ASHRAE standard 34, as referenced in appendix E

of ANSI/ASHRAE standard 15.

SPS 345.31 Enforcement and inspections.

(1) ENFORCEMENT.

(a) This chapter shall be enforced by the Department and its Authorized Agents.

(2) INSTALLATION INSPECTION.

(a) The Authorized Agent or the Department may, in its discretion, inspect all newly installed mechanical refrigeration systems within 45 Business Days after completion of the initial construction or installation, and within 45 Business Days after completion of construction or installation relating to any alteration, Repair, or replacement.

2. If applicable and if required by the Authorized Agent or the Department, the following documents shall be made available for review during inspections under this paragraph:

b. Welding procedure specification.

c. Procedure qualification record.

d. Welder performance qualification.

e. Welder continuity record.

f. Design calculations.

g. Design plans for the piping system.

h. Material test reports.

i. Certificates of compliance.

Note: For further information relating to the welding documentation listed in sub-division 3. a. to d., see section IX of the ASME Boiler and Pressure Vessel Code, as referenced in section SPS 345.550 (1).

(3) (INTENTIONALLY OMITTED)

SPS 345.32 Permit to operate (Intentionally Omitted).

SPS 345.33 Reporting of Accidents. For any accident releasing Ozone-Depleting refrigerants, contact the Department.

SPS 345.34 Petition for variance. The Department shall consider and may grant a variance to a provision of this chapter in accordance with SPS320.

SPS 345.35 Compliance responsibilities.

(1) Any inspection report describing any noncompliance with this chapter shall be provided to the owner of the mechanical refrigeration system.

(2) The owner of a mechanical refrigeration system shall correct any aspects of the system that do not comply with applicable requirements of this chapter, within any time period prescribed by the Authorized Agent or the Department.

SPS 345.36 Appeals.

(1) APPEAL OF DEPARTMENT ORDER.

Any person who owns or occupies a property that is affected by an order of the Department may appeal to the Public Works Division Administrator. Decisions of the Public Works Division Administrator shall be final.

SPS 345.37 Penalties. Penalties for violations of this chapter shall be assessed in accordance with SPS 320.

SPS 345.38 Fees. See SPS 320.

Subchapter IV — Standards

SPS 345.40 Design, construction, and operation.

(1) ADOPTION.

(a) ANSI/ASHRAE standard 15−2007 and its addenda a to i, subject to the modifications specified in subch. V, are hereby incorporated by reference into this chapter.

(b) ANSI/IIAR 2−2008, subject to the modifications specified in subch. VI, is hereby incorporated by reference into this chapter.

(2) GENERAL.

(a) All mechanical refrigeration systems shall be designed, constructed, installed, operated, maintained, tested, and inspected in accordance with ANSI/ASHRAE standard 15, except as otherwise provided in this chapter.

(b) Closed−circuit ammonia mechanical refrigeration systems may be designed, constructed, installed, and tested in accordance with subch. VI and ANSI/IIAR 2, in combination with ANSI/ ASHRAE standard 15 sections 10.2 and 11.

(c) Any Repair or alteration to a pressure vessel in a mechanical refrigeration system shall comply with ss. SPS 341.60 to 341.64.

Note: Copies of the adopted standards are on file in the offices of the Department and the Legislative Reference Bureau, and may be purchased as follows: For ANSI/ ASHRAE Standard 15−2007, contact the American Society of Heating, Refrigerating and Air−Conditioning Engineers, Inc., at 1791 Tullie Circle NE, Atlanta, GA 30329; or at www.ashrae.org. For ANSI/IIAR 2−2008, contact the International Institute of Ammonia Refrigeration at 1110 North Glebe Road, Arlington, VA 22201; or at www.iira.org.

(3) SECONDARY REFERENCES. Any codes or standards referenced in the standards adopted in sub. (1) shall apply to the pre- scribed extent of each such reference, except as modified by this chapter.

(4) ALTERNATE STANDARDS. Any alternate standard that is equivalent to or more stringent than a standard incorporated by reference or otherwise referenced under this chapter may be used in lieu of the incorporated or referenced standard if the alternate standard is accepted in writing by the Department.

(5) RELEASING REFRIGERANT. Release of any refrigerant to the environment shall be minimized as fully as practical.

Subchapter V — Changes, Additions or Omissions to ANSI/ASHRAE Standard 15

SPS 345.500 General. Changes, additions, or omissions to ANSI/ASHRAE standard 15 are specified in this subchapter and are rules of the Department and are not requirements of ANSI/ ASHRAE standard 15.

SPS 345.501 Scope. The requirements of ANSI/ASH- RAE standard 15 sections 1 and 2 are not included as part of this chapter.

Note: The sections in this subchapter are generally numbered to correspond with both the numbering of the subchapter and the section numbering in ANSI/ASHRAE standard 15. For example, section

SPS 345.511 corresponds to subchapter 5 and to section 11 in ANSI/ASHRAE standard 15.

SPS 345.503 Definitions (See above).

SPS 345.508 Eye Wash and Showers (Intentionally Omitted).

SPS 345.509 Design and construction.

(1) MATERIALS. This is an additional, Department exception to the requirements in ANSI/ASHRAE standard 15 section 9.1.5: Discharge piping for mechanical refrigeration safety relief valves that discharges outside a building may consist of plastic materials and joint primers and adhesives which the Department has Approved specifically for this purpose, provided all of the following conditions are met:

(a) The design pressure in the refrigeration system does not exceed 15 psi.

(b) The refrigeration system does not contain a refrigerant other than Group A1 or B1.

(c) The piping is noncombustible when tested in accordance with ASTM E 136 or is self−extinguishing with a rating of 5V−A, V−O or V−1 when tested in accordance with UL 94.

Note: As of September 1, 2010, the plastic materials Approved under this subsection include polyvinyl chloride piping.

(2) ASME B31.3 PIPING. This is a Department informational note to be used under ANSI/ASHRAE standard 15 section 9.10.1:

Note: Process piping complying with ASME B31.3 is an example of piping that complies with this section by being appropriately listed rather than by complying with ASME B31.5.

SPS 345.550 ANSI/ASME B31.5.

(1) Substitute the following wording for the requirements in ANSI/ASHRAE standard 15 normative appendix E citation 5: *ASME Boiler and Pressure Vessel Code,* Section VIII, Rules for Construction of Pressure Vessels, Division 1, 2007, The American Society of Mechanical Engineers (ASME), 3 Park Avenue, New York, NY 10016−5990.

(2) Substitute the following wording for the requirements in ANSI/ASHRAE standard 15 normative appendix E citation 6: *ASME B31.5−2006, Refrigeration Piping and Heat Transfer Components,* The American Society of Mechanical Engineers (ASME), 3 Park Avenue, New York, NY 10016−5990.

Subchapter VI — Changes, Additions or Omissions to ANSI/IIAR 2

SPS 345.600 General. Changes, additions, or omissions to ANSI/IIAR 2 are specified in this subchapter and are rules of the Department and are not requirements of ANSI/IIAR 2.

Note: Under section SPS 345.40 (2) (b), closed−circuit ammonia mechanical refrigeration systems may be designed, constructed, installed and tested in accordance with ANSI/IIAR 2 and this subchapter, in combination with ANSI/ASHRAE standard 15 sections 10.2 and 11.

SPS 345.601 Scope. The requirements of ANSI/IIAR 2 sections 1 and 2 are not included as part of this chapter.

Note: The sections in this subchapter are generally numbered to correspond with both the numbering of the subchapter and the section numbering in ANSI/IIAR 2. For example, section SPS 345.613 corresponds to subchapter 6 and to section 13 in ANSI/IIAR 2.

SPS 345.611 Overpressure protection.

(1) See Wisconsin SPS 345.611 for all equations

SPS 345.613 Machinery Room (Intentionally Omitted).

Subchapter VII — Ozone−Depleting Refrigerants

SPS 345.70 Ozone-Depleting Refrigerants.

(1) CLEANING OF EQUIPMENT. Ozone-Depleting Refrigerant may not be used for cleaning purposes, including the cleaning of interior or exterior surfaces of refrigeration equipment.

(2) TRANSFERRING REFRIGERANT. Whenever Ozone-Depleting Refrigerant is removed from refrigeration equipment, the ozone− depleting refrigerant shall be transferred to storage containers using equipment that is Approved by the Department. The Department shall approve any transfer equipment if an approved nationally recognized testing laboratory has certified the equipment.

Note: The Department will accept equipment that has been tested and certified in accordance with the Air−Conditioning and Refrigeration Institute (ARI) standard ARI 740.

(3) RELEASING REFRIGERANT. Ozone-Depleting Refrigerant may not be knowingly or negligently released to the environment, except for minimal releases that occur as a result of efforts to recover, reclaim, or recycle Ozone-Depleting Refrigerant removed from refrigeration equipment.

(4) ADDING REFRIGERANT. Before putting additional ozone depleting refrigerant into refrigeration equipment, the refrigeration equipment shall be inspected and Repaired if a leak is found or suspected. A yearly leak rate identified by the federal environmental protection agency shall be used to determine whether Repairs are necessary.

Note: See subpart F of part 82 in title 40 of the Code of Federal Regulations for further requirements relating to Ozone-Depleting Refrigerants.

Chapter SPS 382

DESIGN, CONSTRUCTION, INSTALLATION, SUPERVISION, MAINTENANCE AND INSPECTION OF PLUMBING

SPS 382.01 Scope.
SPS 382.015 Purpose.
SPS 382.03 Application.

Subchapter I — Intent and Basic Requirements

SPS 382.10 Basic plumbing principles.

Subchapter II — Administration and Enforcement

SPS 382.20 Plan review and cross connection control assembly registration.
SPS 382.21 Testing and inspection.
SPS 382.22 Maintenance and Repairs.

Subchapter III — Drain and Vent Systems

SPS 382.30 Sanitary drain systems.
SPS 382.31 Vents and venting systems.
SPS 382.32 Traps and direct fixture connections.
SPS 382.33 Indirect and local waste piping.
SPS 382.34 Wastewater treatment and holding devices.
SPS 382.35 Cleanouts.
SPS 382.36 Stormwater and clearwater plumbing systems.
SPS 382.365 Stormwater and clearwater subsurface infiltration plumbing systems.
SPS 382.37 Sanitation facilities and campgrounds (Intentionally Omitted).
SPS 382.38 Discharge points.

Subchapter IV — Water Supply Systems

SPS 382.40 Water supply systems.
SPS 382.41 Cross connection control.

Subchapter V — Special Plumbing Installations (Intentionally Omitted).

SPS 382.50 Health care and related facilities (Intentionally Omitted).
SPS 382.51 Manufactured Homes and Manufactured Home communities (Intentionally Omitted).

Subchapter VI — Installation

SPS 382.60 Pipe hangers and supports.

Subchapter VII — Plumbing Treatment Standards

SPS 382.70 Plumbing treatment standards.

SPS 382.01 Scope. The provisions of this chapter apply uniformly to the design, construction, installation, supervision, maintenance and inspection of plumbing, including but not limited to sanitary and storm drainage,

water supplies, wastewater treatment, and dispersal or discharge for buildings, except for POWTS ("Private Onsite Water Treatment System") systems as regulated by ch. SPS 383.

SPS 382.015 Purpose. The purpose of this chapter is to provide that all plumbing in connection with all residences built on Tribal Lands shall be safe, sanitary and such as to safeguard the public health and all the waters running through or adjacent to Tribal Lands.

SPS 382.03 Application.

(1) The provisions of this chapter are not retroactive, unless specifically stated otherwise in the rule.

Subchapter I — Intent and Basic Requirements

SPS 382.10 Basic plumbing principles. This chapter is founded upon basic principles of environmental sanitation and safety through properly designed, installed, and maintained plumbing systems. Some of the details of plumbing construction may vary, but the basic sanitary and safety principles desirable and necessary to protect the health of people are the same. As interpretations may be required and as unforeseen situations arise which are not specifically addressed, the following intent statements and basic requirements shall be used to evaluate equivalency where applicable:

(1) INTENT.

(a) Plumbing in connection with all residences intended for human occupancy, shall be installed, and maintained in such a manner so as to protect the health, safety, and welfare of the public or occupants and the waters running through or adjacent to Tribal lands.

(b) Plumbing fixtures, appliances, and appurtenances, whether existing or to be installed, shall be supplied with water in sufficient volume and at pressures adequate to enable the fixtures, appliances, and appurtenances to function properly and efficiently at all times and without undue noise under normal conditions of use. Plumbing systems shall be designed and adjusted to use the minimum quantity of water consistent with proper performance and cleaning.

(c) Devices for heating and storing water in pressure vessels or tanks shall be so designed and installed as to prevent dangers of explosion or overheating.

(d) Drain systems shall be designed, constructed, and maintained so as to conduct the wastewater or sewage efficiently and shall have adequate cleanouts.

(e) The drain systems shall be so designed as to provide an adequate circulation of air in all pipes and no danger of siphonage, aspiration or forcing of trap seals under conditions of ordinary use.

(f) A plumbing system shall be of durable material, free from defective workmanship, and designed and constructed so as to provide satisfactory service for its reasonable expected life.

(g) Proper protection shall be provided to prevent contamination of food, water, sterile goods, and similar materials by backflow of wastewater.

(h) All plumbing fixtures shall be installed so as to provide adequate spacing and accessibility for the intended use and cleaning.

(2) BASIC REQUIREMENTS.

(a) Every residential building intended for human occupancy shall be provided with an adequate, safe, and potable water supply.

(b) To fulfill the basic needs of sanitation and personal hygiene, each Dwelling connected to a POWTS or public sewer shall be provided with at least the following plumbing fixtures: one water closet, one wash basin, one Kitchen sink and one bathtub or shower.

(c) Hot or tempered water shall be supplied to all plumbing fixtures that normally require hot or tempered water for proper use and function.

(d) Where plumbing fixtures exist in a residence that is not connected to a public sewer system, suitable provision shall be made for treating, recycling, dispersing, or holding the wastewater.

(e) Plumbing fixtures shall be made of durable, smooth, non-absorbent and corrosion resistant material, and shall be free from concealed fouling surfaces.

Subchapter II — Administration and Enforcement

SPS 382.20 Plan review and cross connection control assembly registration.

(1) GENERAL. Plans and specifications for any plumbing on Tribal Lands shall be submitted to the Public Works Division and, if the project is connected to a non-tribal community water treatment system not located on Tribal lands, to the appropriate jurisdiction.

(a) ***Division review.*** Plumbing plans and specifications for the types of plumbing installations, except direct replacements, listed in Table 382.20-1 shall be submitted to the Public Works Division for review. Written approval for the plumbing plans shall be obtained prior to installation of the plumbing.

(c) ***Cross connection control assembly registration.*** The installation of each reduced pressure principle backflow preventer, reduced pressure fire protection principle backflow preventer, spill resistant vacuum breaker, reduced pressure detector fire protection backflow prevention assembly or pressure vacuum breaker shall be registered with the Department no later than 7 days after installation of the assembly.

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(2) Inspectors

(a) The Tribe may utilize an Authorized Inspector to conduct plumbing inspection and plan review based on need.

1. The primary duties of the inspectors shall include plumbing plan review.

2. The inspectors shall be Wisconsin licensed master or journeyman plumbers.

(4) PLANS AND SPECIFICATIONS.

(a) At least 2 sets of plans and one copy of specifications which are clear, legible, and permanent copies shall be submitted for examination and approval.

(b) All plans submitted for approval shall be accompanied by sufficient data and information for the Division to determine if the installation and its performance will meet the requirements of Chs. SPS382 to 384.

1. Information to accompany the plans shall include the location or address of the installation and the name of the Owner.

2. Plans proposing the installation, creation or extension of a sanitary private interceptor main sewer which is to discharge to a Tribal treatment facility shall:

a. Be accompanied by a letter from the appropriate designated planning or management agency indicating conformance with an Approved areawide water quality management plan under Ch. NR 121; and

b. Not be Approved if the property is ineligible for sanitary sewer extension approval.

Note: For plans proposing the installation, creation or extension of a private interceptor main sewer which is to discharge to a municipal treatment facility.

3. Except as provided in subd. 4., plans proposing the installation of a building sewer for new construction which is to discharge to the Tribe's treatment facility shall:

a. Be accompanied by a letter from either the appropriate designated management agency or sanitary district indicating conformance with an Approved Tribal or areawide water quality management plan; and

b. Not be Approved if the property is ineligible for sanitary sewer extension approval.**4.** Plans proposing the installation of a building sewer for new construction which is to discharge to a municipal treatment facility shall not be required to comply with subd. 3., if:

a. The proposed installation is served by an existing building sewer which extends from the lot line to the public sewer and the proposed installation does not exceed the capacity of the existing building sewer or sewers; or

b. The plans indicate that a drainage load of not more than 54 drainage fixture units will be discharged through the building sewer.

Note: See Ch. SPS 382 Appendix for listing of water quality management agencies.

(c) Plumbing plans, index sheets and specifications for a plumbing system submitted for review and approval shall be signed in accordance with any of the following methods:

1. A Wisconsin registered architect, engineer or plumbing designer shall sign and seal or stamp all plans and accompanying specifications in accordance with ch. A-E 2.

2. A master plumber, master plumber-restricted service, master plumber-restricted appliance or a utility contractor shall sign and date all plumbing plans and accompanying specifications. Each sheet of plans and specifications submitted shall be signed and dated and shall include the valid Wisconsin license number of the individual responsible for the installation. Where more than one sheet is bound together into one volume, only the title sheet or index sheet shall be signed and dated by the individual responsible for the installation. The signed title or index sheet shall clearly identify all of the other sheets in the volume.

3. A pump installer shall sign and date all plumbing plans and accompanying specifications for which the individual is responsible for the installation. Each sheet of plans and specifications submitted shall be signed and dated and shall include the valid Wisconsin license number of the individual responsible for the installation. Where more than one sheet is bound together into one volume, only the title sheet or index sheet shall be signed and dated by the individual responsible for the installation. The signed title or index sheet shall clearly identify all of the other sheets in the volume.

(d)

1. When requesting approval of an experimental plumbing system, all of the following shall be submitted:

a. At least 2 sets of plans signed in accordance with par. (d) and detailing the system installation for each site.

b. A letter of consent from the Owner of the Dwelling. The letter shall acknowledge that the Owner has received and read a copy of the experimental plumbing system submittal and is in agreement with all requirements listed within this subdivision.

c. Any additional information as requested by the Department.

2. The registered architect, engineer, designer, or master plumber responsible for the design of the experimental plumbing system shall, upon completion, certify in writing to the Public Works Division that the installation is in compliance with the Approved plans, specifications, and data.

3. Onsite inspections shall be performed by the Public Works Division at time intervals as specified by the Division, but not less than once a year. Time intervals shall be included as conditions of approval. An inspection report shall be written. The Department may assess a fee for each re-inspection.

4. No later than five years after the date of the completed installation the Division may perform one of the following:

a. Order the removal of the experimental plumbing system.

b. Issue an alternate approval as specified in sub. (12) (a).

c. Provide an extension of the experiment with conditions.

5. If an experimental plumbing system is subsequently codified in chs. SPS 382 and 384, the requirements as specified in subds. 3. and 4. do not apply.

(5) PLAN REVIEW. The Public Works Division shall review and make a determination on an application for plan review within 15 Business Days.

(a) ***Conditional approval.*** If, upon review, the Department determines that the plans substantially conform to the provisions of chs. SPS 382 to 384, a conditional approval, in writing, shall be granted.

All non-Code complying conditions stated in the conditional approval shall be corrected before or during installation.

(b) ***Denial of approval.*** If, upon review, the Public Works Division determines that the plans do not substantially conform to the provisions of chs. SPS 382 to 384 or any other provision of this Code, the request of conditional approval shall be denied in writing.

(6) EVIDENCE OF APPROVAL. The plumber responsible for the installation of the plumbing shall keep at the construction site at least one set of plans bearing the Public Works Division letter of approval and at least one copy of specifications. The plans and specifications shall be open to inspection by an authorized representative of the Division.

(8) REVISIONS. All changes or modifications, which involve the provisions of chs. SPS 382 to 384, made to plumbing plans and specifications, which have been granted approval under sub. (1), shall be submitted to the Public Works Division for examination. All changes and modifications shall be Approved in writing by the Public Works Division prior to installation of the plumbing.

(9) REVOCATION OF APPROVAL. The Public Works Division may revoke any approval, issued under the provisions of this chapter, for any false statements or misrepresentation of facts on which the approval was based.

(10) DIVISION LIMITATION AND EXPIRATION OF APPROVAL.

(a) A conditional approval of a plan by the Public Works Division shall not be construed as an assumption by the Division of any responsibility for the design; and the Division does not hold itself liable for any defects in construction, nor for any damages that may result from the specific installation.

(b) Plan approval by the Public Works Division or its authorized representative shall expire 1 year after the date indicated on the approval letter if construction has not commenced within that 1-year period.

(11) PETITION FOR VARIANCE.

(a) ***Procedure.*** The Public Works Division shall consider and may grant a variance to a provision of this chapter.

(b) ***Petition processing time.*** The Public Works Division shall review and make a determination on a petition for variance within 30 Business Days of receipt of all calculations and documents required to complete the review.

(12) ALTERNATE AND EXPERIMENTAL PLUMBING SYSTEM REVIEW AND APPROVAL. The provisions of this chapter, ch. SPS 384 are not intended to prevent the design and use of Approved innovative plumbing systems.

(a) ***Alternate plumbing systems.*** The Public Works Division may issue an approval of an alternate plumbing system if the system complies with the intent of chs. SPS 382 and 384.

1. For an alternate plumbing system, before availability for statewide installation and use, an alternate plumbing system approval shall be issued. Concepts, plans, specifications, and the documentation to support the system design shall be submitted to the Public Works Division for review.

2. The Public Works Division may require the submission of any information deemed necessary for review. Sufficient evidence shall be submitted to substantiate at least the following:

a. Assertions of function and performance.

b. Compliance with the intent of chs. SPS 382 and 384.

3. The Public Works Division shall review and make a determination on an application for an alternate plumbing system within 3 months. Approval for an alternate plumbing system shall be issued by the Division in writing.

4. The Public Works Division may include specific conditions in issuing an approval for an alternate plumbing system, including an expiration date for the approval. A violation of any of the conditions under which approval is issued shall constitute a violation of this chapter.

5. If upon review the Public Works Division determines that an alternate plumbing system does not comply with the intent of chs. SPS 382 and 384, the request for approval shall be denied in writing.

(b) ***Experimental plumbing systems.*** The Public Works Division may issue an approval of an experimental plumbing system for the purpose of proving compliance with the intent of chs. SPS 382 and 384.

1. For an experimental plumbing system, a separate approval shall be obtained for each system or project to be installed for the purpose of proving compliance with the intent of chs. SPS 382 and 384. Approval for an experimental plumbing system shall be issued by the Public Works Division in writing.

2. The Public Works Division may require the submission of additional information deemed necessary for determining that the design meets the intent of chs. SPS 382 and 384.

3. The Public Works Division shall review and make a determination on an application for an experimental plumbing system within 6 months.

4. The Public Works Division may include specific conditions in issuing an approval for an experimental plumbing system, including an expiration date for the approval. A violation of any of the conditions under which approval is issued shall constitute a violation of this chapter.

5. Denial of an experimental plumbing system or project by the Public Works Division shall be made in writing.

6. The Public Works Division may establish parameters to limit the number of applications for review it will accept for experimental plumbing systems.

(c) ***Modification.*** If an Approved alternate or experimental plumbing system is modified or additional assertions of function or performance are made, the approval shall be void, unless the system is resubmitted to the Public Works Division for review and approval is granted.

(d) ***Revocation of approval.*** The Public Works Division may revoke an approval issued under this section for any false statements or misrepresentations of facts or data on which the approval was based, or as a result of system failure.

(e) ***Limitations.*** An approval issued by the Public Works Division for an alternate or experimental plumbing system may not be construed as an assumption of any responsibility for defects in design, construction, or performance of any system nor for any damages that may result.

(13) CROSS CONNECTION CONTROL REGISTRATION.

(a) Registration, as specified in sub. (1) (c), shall be submitted in a format acceptable to the appropriate jurisdiction.

(b) The form for registering cross connection control devices and assemblies with the Public Works Division shall include at least all of the following information:

1. The address where the device or assembly is or will be installed.

2. The location of the cross-connection control device or assembly within the Dwelling.

3. A description of the cross-connection control device or assembly including the size, model number, serial number, and manufacturer.

4. The name of the Owner or Owner's agent submitting the registration form and contact information.

(c) Each registration form submitted shall be accompanied by the appropriate fee.

(d) Upon receipt of a completed registration form, the Public Works Division shall issue written confirmation of registration

(e) Upon permanent removal or replacement of any reduced pressure principle backflow preventer, reduced pressure fire protection principle backflow preventer, spill resistant vacuum breaker, reduced pressure detector fire protection backflow prevention assembly, or pressure vacuum breaker, the Owner shall notify the Public Works Division in writing.

SPS 382.21 Testing and inspection.

(1) TESTING OF PLUMBING SYSTEMS. Except as provided in par. (a), all new plumbing and all parts of existing systems which have been altered, extended or Repaired shall be tested as specified in sub. (2) to disclose leaks and defects before the plumbing is put into operation.

(a) ***Waiver of testing.***

1. The testing of the plumbing shall not be required where the installation does not include the addition, replacement, alteration, or relocation of any water distribution, drain or Vent piping.

2.

a. Field testing the installation of a storm building sewer and a storm private interceptor main sewer is not required.

b. The joints and connections to be employed for storm building sewer piping shall conform with s. SPS 384.40 (1) (a).

(b) ***Local inspection.*** Where the plumbing is installed on Tribal Lands, the testing of the plumbing shall be done in the presence of the Authorized Inspector, except as provided in subd. 1. b.

1. `Notice of inspection.'

a. The plumber responsible for the installation shall notify the Authorized Inspector in person, by telephone or in writing when the work is ready for inspection.

b. Except as permitted in par. (c), if the inspection is not made by the end of the normal Business Day following the day of notification, not including Saturday, Sunday or legal holidays, the plumber may proceed with the testing and the installation.

c. Testing may be done without the presence of the Authorized Inspector, if the master plumber responsible for the installation obtains the inspector's permission to provide a written test report in a format acceptable to the inspector.

2. `Preparations for inspection.' When the installation is ready for inspection, the plumber shall make such arrangements as will enable the inspector to inspect all parts of the plumbing system. The plumber shall have presented the proper apparatus and appliances for making the tests and shall furnish such assistance as may be necessary in making the inspection.

3. `Rough-in inspection.' A rough-in inspection shall be made when the plumbing system is roughed-in and before fixtures are set. Except as provided in subd. 1., plumbing work shall not be closed in, concealed, or covered until it has been inspected and Approved by the inspector and permission is granted to do so.

4. `Final inspection.'

a. Upon completion of the plumbing installation and before final approval is given, the inspector shall inspect the work.

b. The Tribe may require that a final test be conducted in accordance with sub. (2) (h) and that the final test shall be observed by the inspector.

5. `Re-inspections.' Whenever the plumbing official finds that the work or installation does not pass any initial test or inspection, the necessary corrections shall be made to comply with this chapter. The work or installation shall then be resubmitted for inspection to the Authorized Inspector.

(c) ***Inspection of one-and two-family Dwellings.*** The inspection of plumbing installations for one- and two-family Dwellings shall be in accordance with ss. SPS 320.08 to 320.11.

(d) The initial testing of cross connection control assemblies shall comply with SPS 382.22 (8).

(2) TESTING PROVISIONS.

(a) ***General.*** The testing of plumbing installations shall be conducted in accordance with this paragraph.

1. `Equipment, material, and labor for tests.' All equipment, material and labor required for testing a plumbing system or part thereof shall be furnished by the plumber responsible for the installation.

2. `Exposure of work.' Except as provided in pars. (b) and (e), all new, altered, extended or replaced plumbing shall be left uncovered and unconcealed until it has been tested. Where the work has been covered or concealed before it is tested, it shall be exposed for testing.

(c) ***Building drain.*** The Dwelling’s entire building drain with all its branches, receptacles and connections shall be brought so far as practical to the surface or grade of the Basement floor and shall be tested with water or air in accordance with par. (g).

(d) ***Drain and Vent systems****.* The piping of a drain and Vent systems, including conductors, shall be tested upon completion of the rough piping installation with water or air in accordance with par. (g).

(e) ***Private water mains and water services.*** Private water mains and water services shall be inspected before being covered. The private water mains and water services shall be tested and proven watertight under water pressure, not less than the working pressure under which it is to be used. The water used for testing shall be obtained from a potable source of supply.

Note: Standard NFPA 24 for combination water services and combination private water mains may include more stringent requirements for testing.

(f) ***Water distribution system.*** The piping of a water distribution system shall be tested and proved watertight under a water pressure not less than the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply.

(g) ***Test methods for drain and Vent systems.*** A test for watertightness shall be applied to the entire drain and Vent system at one time or to the entire system in sections after the rough piping has been installed in accordance with either subd. 1. or 2.

1. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but a section shall not be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested, so that no joint or pipe in the building, except the uppermost 10 feet of the system, is subjected to a test of less than a 10-foot head of water. The water shall be kept in the system or in the portion under test for at least 15 minutes before inspection starts. The system shall then be tight at all points.

2. The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds per square inch or sufficient to balance a column of mercury 10" in height. This pressure shall be held without introduction of additional air for a period of at least 15 minutes.

(h) ***Final test.*** Where required by the Authorized Inspector, after the plumbing fixtures have been installed and the traps filled with water, the connections shall be tested and proved gas and watertight by either one of the methods specified in subd. 1. or 2.

1. The smoke test shall be made by introducing a pungent, thick smoke, produced by one or more smoke machines, into the completed system. When the smoke appears at stack openings on the roof, the openings shall be closed and a pressure equivalent to a one-inch water column shall be built and maintained for the period of the inspection.

2. The air test shall be made by attaching a gauge to any suitable opening and, after closing all other inlets and outlets in the system, adding air into the system until a pressure equivalent to a one-inch water column exists. The pressure shall remain constant for at least a 5-minute test period without the introduction of additional air.

SPS 382.22 Maintenance and Repairs.

(1) GENERAL.

(a) All plumbing systems, both existing and new, and all parts thereof, shall be maintained in a safe and sanitary condition.

(b) All devices or safeguards that are required by this chapter shall be maintained in good working order.

(c) The Owner shall maintain plumbing systems.

(2) EXISTING SYSTEMS.

(a) Except as specified in par. (b), any existing plumbing system may remain and maintenance continue if the maintenance is in accordance with the original system design and any of the following:

1. The plumbing system was installed in accordance with the Code in effect at the time of installation.

2. The plumbing system conforms to the present Code.

(b) When a hazard to life, health or property exists or is created by an existing system, that system shall be Repaired or replaced.

Note: A cross connection is considered a health hazard by the Public Works Division.

(c) Existing sewers and water services may only be connected to new buildings when determined by examination and test to conform to the requirements of this Code.

(3) FIXTURES REPLACED.

(a) When a fixture, appliance or section of pipe is replaced, the replacement fixture, appliance or pipe shall conform to the provisions of this Code.

(b) Where the existing drain or Vent piping does not conform to the current provisions of this Code, the Public Works Division may require the new fixtures to be provided with deep seal traps.

(4) PLUMBING REUSED.

(a)

1. Except as provided in par. (b) plumbing materials, fixtures or devices removed and found to be in good condition may be reused if such reuse is Approved by the Public Works Division or its Authorized Inspector.

2. The Owner of the Dwelling in which the reused materials are to be installed shall provide written consent.

(b) Water supply piping materials may only be reused when the intended use involves an equal or higher degree of hazard than the previous use as specified in Table 382.70–1.

(5) REPAIRS. All Repairs to fixtures, devices or piping shall be completed in conformance with the provisions of this Code, except Repair clamps or bands may be used for emergency situations.

(6) DEMOLITION OF STRUCTURES. When a structure is demolished or removed, all sanitary sewer, storm sewer and water supply connections shall be sealed and plugged in a safe manner.

(7) DEAD ENDS. If a dead end is created in the removal of any part of a drain system, all openings in the drain system shall be properly sealed.

(8) TESTING OF CROSS-CONNECTION CONTROL ASSEMBLIES.

(a) The performance testing requirements of this subsection apply to all cross-connection control assemblies regardless of date of installation.

Note: For further clarification see Table 382.22–1.

(b)

1. A performance test shall be conducted for the assemblies listed in Table 382.22–1 at all of the following intervals:

a. At the time of installation.

b. Immediately after Repairs or alterations to the assembly have occurred.

c. At least annually.

2. The performance test shall be conducted using the appropriate test standard for the assembly as specified in Table 382.22–1.

3. A cross connection assembly performance test shall be conducted by an individual registered by the State of Wisconsin in accordance with s. SPS 305.99.

4.

a. The results of the cross connection control assembly performance test shall be submitted as specified in Table 382.22–1 in a format prescribed by the State of Wisconsin accompanied by a filing fee as specified in Wisconsin s. SPS 302.645 (2).

b. As specified in Table 382.22–1, the results of the cross-connection assembly performance test shall be submitted to the State of Wisconsin and purveyor within 60 days of completion of the test.

5. The results of performance tests for the assemblies listed in Table 382.22–1 shall be made available upon request to the Department.

Table 382.22-1

Testing And Submitting Requirements For Cross Connection Control Assemblies - See PDF for table

Subchapter III — Drain and Vent Systems

SPS 382.30 Sanitary drain systems.

(1) SCOPE. The provisions of this section set forth the requirements for the design and installation of sanitary drain systems, including building drains and building sewers.

Note: The provisions for storm and clear water drain systems are specified in s. SPS 382.36.

(2) MATERIALS. All sanitary drain systems shall be constructed of Approved materials in accordance with ch. SPS 384.

(3) LOAD ON DRAIN PIPING.

(a) ***Intermittent flow.***

1. `Fixture.' The load factor on drain piping shall be computed in terms of drainage fixture unit values specified in Table 382.30–1 for the corresponding listed fixture.

2. `Devices.' Drainage fixture unit values for intermittent flow devices not listed in Table 382.30–1 shall be computed on the basis of one fixture unit equaling one gallon per minute of flow.

Note: Equipment with a timed discharge cycle(s) of 2 minutes or less may be considered as an intermittent flow device.

(b) ***Continuous flow devices***. Drainage fixtures unit values for continuous flow devices such as pumps, ejectors, air conditioning equipment or similar devices that discharge continuously shall be computed on the basis of 2 fixture units for each one gallon per minute of flow.

(4) SIZE OF DRAIN PIPING.

(a) ***Maximum loading.***

1. The total drainage load in any portion of drain piping shall not exceed the limits specified in Tables 382.30-2 and 382.30-3.

2. The drainage fixture unit values assigned to a receptor which is to receive only the indirect waste discharge from a relief valve on a domestic water heater may be disregarded when determining the minimum size of the building drain and building sewer. Any drain piping between the receptor and the building drain shall be sized by including the assigned fixture unit values for the type of receptor.

Note: See s. SPS 382.31 (17) for sizing requirements of combination drain and Vent systems.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Minimum size of building sewers.***

1. `Gravity flow sewers.' The minimum size of a gravity flow sanitary building sewer shall be 4" in diameter. The Tribe may require that portion of the building sewer between the lot line and the public sewer to be larger than 4" in diameter.

2. `Pressurized sewers.'

a. Sewers pressurized through the use of sewage ejectors, sewage pumps or sewage grinder pumps shall be sized to maintain a minimum flow velocity of 2 feet per second and shall be in accordance with the ejector or pump manufacturer's recommendations.

b. Pressurized building sewers shall be sized not less than 2" in diameter for sewage ejectors and sewage pumps, and 1¼ " in diameter for all sewage grinder pumps.

(c) ***Minimum size of private interceptor main sewers.***

1. Except as provided in subd. 3., the minimum size of a gravity flow private interceptor main sewer shall be 4" in diameter.

2. Except as provided in subd. 3., the minimum size of pressurized private interceptor main sewer shall be such so as to maintain a minimum flow velocity of 2 feet per second.

3. The Tribe may require the minimum size of a private interceptor main sewer to be larger than 4" in diameter.

4. Private interceptor main sewers 6" or less in diameter may not exceed the drainage fixture limits in Table 382.30-3.

5. Private interceptor main sewers 8" or larger in diameter shall conform with the design criteria.

Note: See ch. SPS 382 Appendix A-382.30 (4) for further explanatory material.

(d) ***Future fixtures.*** Where provisions are made for the future installation of fixtures, the drainage fixture unit values of such fixtures shall be considered in determining the required sizes of drain and Vent pipes. Construction to provide for future installations shall be terminated with a plugged fitting or fittings. - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table - See PDF for table

Note: For further explanatory material see ch. SPS 382 Appendix A-382.30 (4).

(5) PITCH OF HORIZONTAL DRAIN PIPING. All horizontal drain piping 4" or larger in diameter shall be installed at a pitch which produces a computed velocity of at least 2 feet per second when flowing half full.

(a) ***Horizontal branch drains.***

1. The minimum pitch of horizontal branch drains 2" or less in diameter shall be 1/4" per foot.

2. The minimum pitch of horizontal branch drains larger than 2" in diameter shall be 1/ 8" per foot.

(b) ***Building drains and building sewers.***

1. The minimum pitch of building drains shall be in accordance with Table 382.30-3.

2.

a. The minimum pitch of building sewers 10" or less in diameter shall be in accordance with Table 382.30-3.

b. The minimum pitch of building sewers 12" or larger in diameter shall conform with the minimum pitch specified.

Note: See also s. SPS 382.30 (4) (c) 5. for further explanatory material.

(c) ***Private interceptor main sewers.***

1. The minimum pitch of private interceptor main sewers 6" or less in diameter shall be in accordance with Table 382.30-3.

2. The minimum pitch of private interceptor main sewers 8" or larger in diameter shall conform with the minimum pitch specified. **Note:** See ch. SPS 382 Appendix for further explanatory material.

(6) OFFSETS IN VERTICAL DRAINS. Offsets in vertical drain piping shall be in accordance with this subsection.

(a) ***Offsets of 45° or less.***

1. An offset in a vertical drain, with a change in direction of 45° or less from the vertical, shall be sized as a vertical drain piping in accordance with sub. (4).

2. Except as provided in par. (c), where a horizontal branch connects to a drain stack within 2 feet above or below an offset with a change of direction of 30° to 45° from the vertical and the offset is located 5 or more branch intervals below the top of the stack, the offset shall be vented in accordance with s. SPS 382.31 (5) (a).

(b) ***Offsets of more than 45°.*** Except as provided in par. (c), a drain stack with an offset of more than 45° from the vertical shall be installed in accordance with subds. 1. to 5.

1. That portion of the drain stack above the highest offset shall be sized as for vertical drain piping in accordance with sub. (4).

2. That portion of the offset between and including the offset fittings shall be sized as building drain piping in accordance with sub. (4).

3. That portion of stack below the offset shall be not less than the size of the offset.

4. Where an offset of more than 45o is located more than four branch intervals below the top of the drain stack, a horizontal branch may not connect within the offset or within 2 feet above or below such offset.

5.

a. Except as exempted in subd. 5. b., or par. (c), where an offset in a drain stack with a change of more than 45° from vertical is located below 5 or more branch intervals, the offset shall be vented in accordance with s. SPS 382.31 (5) (b).

b. The Vent required in subd. 5. a. shall not be required where the drain stack, including the offset, is sized one pipe size larger than required for a building drain designed to serve as per sub. (4) and the entire stack and offset are not less in cross sectional area than that required for a stack plus the area of a Ventas required in s. SPS 382.31 (5) (b).

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Exception.*** Where an offset is located two or more feet below the lowest branch drain connection to the stack, the venting specified in this subsection and s. SPS 382.31 (5) (b) is not required.

(7) HORIZONTAL BRANCH DRAIN CONNECTION AT BASE OF A STACK.

(a) A horizontal branch drain may not connect downstream from the base fitting of a drain stack 2" or larger in diameter within the distance equal to 10 pipe diameters of the drain to which the horizontal branch drain connects.

(b) A building drain branch or building subdrain branch may not connect to a building drain or building subdrain downstream from the base fitting of a drain stack 2" or larger in diameter within the distance equal to 20 pipe diameters of the building drain or building subdrain.

Note: See ch. SPS 382 Appendix for further explanatory material.

(8) PIPING CHANGES IN DIRECTION. Changes in the direction of drain piping shall be accomplished in accordance with the requirements of this subsection.

(a) ***Fittings.*** All changes in direction of flow in drain piping shall be made by the appropriate use of 45-degree wyes, long or short sweep quarter bends, sixth, eighth, or sixteenth bends, or by a combination of these or other equivalent fittings. Except as provided in subds. 1. to 3., fittings which change the direction of flow for drain piping 8" or less in diameter shall conform to the minimum radii specified in Table 382.30-4.

Note: See ch. SPS 382 Appendix for further explanatory material.

1. The minimum radius for the first 90° fitting downstream from a trap serving a lavatory or sink shall be 1-3/4" for drain piping 1-1/2" in diameter. The fitting shall be a tee or quarter bend.

2. The minimum radius for the first 90° bend or elbow downstream from a water closet shall be 2-1/2" for drain piping 3" in diameter.

3. The minimum radius for the first 90° bend or elbow downstream from a water closet shall be 3" for drain piping 4" in diameter. - See PDF for table

(b) ***Blowout type fixtures.*** Where blowout type fixtures are installed back-to-back, appropriate fittings shall be installed to prevent the passage of wastes from one fixture to the other.

(9) DRAIN FITTINGS AND CONNECTIONS. Drain fittings, connections, devices, and methods of installation shall not obstruct or retard the flow of water, wastes, sewage or air in the drain system or venting system in an amount greater than the normal frictional resistance to flow, unless as otherwise permitted in this chapter or unless Approved by the Department.

(a) ***Closet bend.*** The reduction of a 4 x 3 inch closet bend or collar fitting from 4" to 3" shall not be considered an obstruction.

(b) ***Side inlet tees or bends.*** The side inlet of a low pattern or high pattern tee or bend shall not be used as a Vent connection when the side inlet is placed in a horizontal position or when any arrangement of piping or fittings produces a similar effect.

(c) ***Prohibited fittings and connections.*** The types of fittings and connections specified in subds. 1. to 4. shall not be used for drain piping:

1. A heel inlet bend when the heel inlet is in the horizontal position;

2. A fitting or connection which has an enlargement chamber or recess with a ledge or shoulder, or reduction in pipe area in the direction of flow;

3. A fitting which has running threads; and

4. A connection by means of drilling and tapping of a drain or Vent pipe, unless as otherwise Approved by the Department.

(d) ***Saddles.*** If a pipe saddle is used to connect drain piping together, the saddle shall be installed in accordance with s. SPS 384.30 (5) (d).

(10) SUMPS, EJECTORS AND PUMPS.

(a) ***Sumps.***

1. `General.' All sanitary building subdrains shall discharge into an Approved, vented sump with an airtight cover. The sump shall be so located as to receive the wastewater by gravity flow and shall be located at least 25 feet from any water well.

2. `Capacity.' Except as provided in pars. (c) and (d), the minimum capacity of the sump shall be determined in accordance with the provisions of subd. 2. a. to e.

a. The water supply fixture unit method shall be used to determine peak input flow in gallons per minute; only the fixtures that drain to the sump shall be included.

Note: When converting water fixture units to gallons per minute it is permissible to calculate the load as a supply system with predominantly flush tanks.

b. The capacity of the sump shall be such that the pump when actuated by the lowest "pump on" switch runs at least 20 seconds.

c. Between the highest "pump on" switch level and the sump inlet, the sump shall hold the amount of input that exceeds the discharge of the pumping equipment in a 5-minute peak input period, but in no case shall the vertical distance between the switch and the inlet be less than 3".

d. The low water level shall be maintained in accordance with the pump manufacturer's requirements, but shall not be less than 4" above the sump bottom.

e. Sumps containing one pump shall have an inside diameter of at least 24". Sumps containing 2 pumps shall have an inside diameter of at least 30".

Note: See ch. SPS 382 Appendix for further explanatory material.

3. `Vents.' All sumps and all drains leading to a sump shall be vented in accordance with s. SPS 382.31.

4. `Materials.' All sumps shall be constructed in a watertight manner of Approved materials in accordance with ch. SPS 384.

5. `Removable covers.' Penetrations through the top of removable sump covers shall be limited to those for the electrical supply, the Vent piping and the discharge piping for the pump or pumps.

(b) ***Ejectors and pumps.***

1. `Where required.' The liquid from all sanitary building sumps shall be lifted and discharged into the building sanitary drain system by automatic ejectors, pumps, or any other equally efficient method Approved by the Department.

2. `Duplex equipment.'

a. Duplex ejector or pumping equipment shall be installed in a building where 3 or more water closets or more than 20 drainage fixture units discharge into a sump.

b. Duplex ejector or pumping equipment shall be installed where the sanitary wastes of 2 or more one- or two-family Dwellings discharge into a sump.

c. Where duplex ejector or pumping equipment is installed, appropriate devices shall be installed to automatically alternate operation of the pumps or ejectors and to operate both pumps or ejectors when one unit cannot handle the load.

d. Where duplex pumping equipment is installed, an audible or visual alarm system with a manual control reset shall be installed to indicate pump failure.

3. `Size.' The size and design of an ejector or pump shall be determined by the capacity of the sump to be served, the discharge head and discharge frequency. All ejectors and pumps shall provide a minimum flow velocity of 2 feet per second in the forced discharge piping.

Note: See ch. SPS 382 Appendix for velocity in relation to flow rate by various pipe sizes.

Note: Ejectors or pumps discharging to septic tanks may disturb the normal settling properties of the tank environment; contact the Public Works Division for more information.

a. All sewage grinder pumps shall have a minimum 11/4" diameter discharge opening and discharge piping.

b. All non-grinder type sewage pumps serving water closets shall be capable of passing a 2" diameter solid ball and shall have a minimum 2" diameter discharge opening and discharge piping. All other pumps handling sanitary wastes shall be rated by the manufacturer as an effluent pump, shall be capable of passing a 1/2" diameter solid ball and shall have a minimum 11/4" diameter discharge opening and discharge piping.

4. `Discharge connections.'

a. The discharge pipe from the ejector or pump shall be connected to the gravity drain by means of a wye pattern fitting. Where the fitting connects to a horizontal drain, the bottom of the wye branch of the fitting shall be located above the horizontal center line.

b. With the exception of exterior sumps, a full flow check valve shall be installed in the discharge piping from each ejector or pump.

c. Where duplicate ejector or pumping equipment is installed, each discharge pipe from an ejector or pump shall be provided with a gate or ball type valve installed downstream of each full flow check valve.

5. `Discharge pipe air relief.' Air relief valves shall be provided at all high points in the discharge piping of an ejector or pump where the piping arrangement creates an air trap.

6. `Prohibited connections.' No fixtures may be connected to the discharge pipe between the ejector or pump and the point where it enters the gravity drain.

7. `Maintenance.' All ejectors, pumps and like appliances shall receive care as needed to keep them in a satisfactory operating condition.

(c) ***Prefabricated pumps and sump systems.*** The minimum capacity of a prefabricated pump and sump system shall be determined in accordance with all of the following:

1. The water supply fixture unit, WSFU, method shall be used to determine peak input flow in gallons per minute. The peak input shall include all the fixtures that drain to the sump.

2. Unless storage is provided as specified in par. (a) 2., the capacity of the prefabricated pump and sump system shall accommodate the peak input flow.

3. The low water level shall be maintained in accordance with the pump manufacturer's requirements.

(d) ***Exterior sumps.*** The minimum capacity of exterior sumps shall be determined in accordance with all of the following:

1. Peak input flow in gallons per minute shall be determined in accordance with either of the following:

a. The water supply fixture unit, WSFU, method of all the fixtures that drain to the sump.

b. The provisions as specified in s. SPS 383.43 (2) through (6).

2. In lieu of providing the duplex pumping equipment as specified in par. (b) 2., a one-day holding capacity may be provided above a high level alarm when installed on a simplex system.

(11) BUILDING DRAINS AND BUILDING SEWERS.

(a) ***Limitations.*** No building sewer may pass through or under a building to serve another building.

1. HIGHLIGHT FOR CONTRACTORS

(b) ***Building drains.***

1. `Elevation.'

a. All building drains shall be installed below the lowest floor levels on which fixtures may be installed if the public sewer, POWTs or private interceptor main sewer elevation permits.

b. Where any portion of an above-ground building drain discharges to a vertical pipe, the building drain shall connect to the building sewer at an elevation at least 30" above the Basement floor.

Note: See ch. SPS 382 Appendix for further explanatory material.

2. `Backwater protection.' A building drain subject to backflow or backwater shall be protected with a backwater valve or with a sump with pumping equipment in accordance with sub. (10).

a. Backwater valves, when fully open, shall have a capacity no less than that of the pipes in which installed.

b. Backwater valves shall be so located as to be readily accessible for cleaning.

3. `Floor drain required.'

a. Where a plumbing fixture or appliance is located on a floor which is entirely below grade, a floor drain shall be installed to serve that floor.

(c) ***Building sewers***.

1. `Minimum depth.'

a. The top of a building sewer shall be located at a depth of not less than 42" below finished grade, except as provided in subd. 1. b. or subd. 2.

b. The top of a building sewer which discharges to a septic tank, holding tank or grease interceptor shall be located at a depth of not less than 18" below finished grade.

2. `Protection from frost.'

a. Except as provided in subd. 2. c. to e., a building sewer or private interceptor main sewer shall be protected from frost in accordance with subd. 3. in areas where the top of the building sewer or private interceptor main sewer is located less than 60" below a surface area from which snow will be cleared.

b. Except as provided in subd. 2. c. to e., a building sewer or private interceptor main sewer shall be protected from frost in accordance with subd. 3. in areas where the top of the building sewer or private interceptor main sewer is located less than 42" below a surface area which snow will not be cleared.

c. Where a building sewer or private interceptor main sewer discharges to a holding tank, POWTs treatment tank or grease interceptor, the portion of a building sewer or private interceptor main sewer which is within 30 feet from the connecting building drain, and which is under a surface area from which snow will not be cleared shall not be required to be protected from frost.

d. Frost protection for a building sewer shall not be required where the predicted depth of frost as determined from Figure 382.30-1 and Table 382.30-6 does not extend below the top of the building sewer.

e. Where a building sewer or private interceptor main sewer is installed to serve summer use public facilities, frost protection requirements shall not apply.

Note: This exemption applies to frost sleeves as provided in s. SPS 382.35 (5) (a) 2.

3. `Insulation for building sewers.' Where required by subd. 2. a. or b., building sewer or private interceptor main sewer insulation for frost protection shall be provided in accordance with one of the methods specified in subd. 3. a. to d.

a. Extruded polystyrene foam insulation shall be installed at a depth of at least 18" below finished grade and at least 6" above the top of the sewer pipe. The minimum thickness and width of the foam insulation shall be determined from Figure 382.30-1 and Tables 382.30-5 to 382.30-7. If the insulation is to be installed more than 6" above the top of the sewer, the number of inches exceeding 6" shall be added to the width of insulation determined from Table 382.30-7.

b. Extruded polystyrene foam insulation shall be installed using a box method. The 3-sided box shall be formed with 3 lengths of polystyrene foam insulation where the top of the box extends horizontally to the farthest edge of both vertical sides. The insulation shall be installed at or below a depth of at least 12" below finished grade and 6" above the top and 6" from each side of the building sewer or private interceptor main sewer. The minimum thickness of the foam insulation shall be determined from Figure 382.30-1 and Table 382.30-5.

Note: See ch. SPS 382 Appendix for further explanatory material.

c. Lightweight insulating concrete shall be installed to the depth of the spring line of the sewer and shall extend laterally at least 6" on both sides of the sewer. The minimum thickness of the insulating concrete shall be determined from Figure 382.30-1 and Table 382.30-5. The thickness shall be measured from the top of the sewer. The top of the insulation shall be installed at least 12" below finished grade.

d. Alternative methods of frost protection shall be Approved by the Department.

Figure 382.30-1. Frost protection zones.

- See PDF for diagram - See PDF for table - See PDF for table - See PDF for table

(d) ***Location limitations.*** Building drains, building sewers or private interceptor main sewers shall be separated from water wells by the applicable separation distances contained in chs. NR 811 and 812 or as otherwise Approved by the Public Works Division.

Note: See s. SPS 382.40 for provisions regarding the separation of water supply piping, building sewers and private interceptor main sewers.

Note: See ch. SPS 382 Appendix for further explanatory material. Section NR 812.08 may require additional setbacks.

(e) ***Installation of building drains and building sewers.***

1. `Trenching.' All excavations for building drains and building sewers shall be open trench work, unless otherwise permitted by the Department.

2. `Stable bottom.' Where the bottom of the trench can be maintained in a stable condition and free of water during the time of installation the building drain and the building sewer shall be bedded and initially backfilled to comply with all the following requirements:

a. Where the trench bottom does not contain stone larger than one inch in size or where bedrock is not encountered, the trench may be excavated to grade.

b. Where stone larger than one inch size or when bedrock is encountered, the trench shall be excavated to a depth at least 3 inches below the grade elevation and shall be brought back to grade with a bedding of sand, gravel or crushed stone that shall be of a size that all the material shall pass a ¾-inch sieve.

c. Bedding shall be sufficiently dry and hand or mechanically compacted to a minimum of 90 percent standard proctor density.

d. Initial backfill to a depth of 12 inches over the pipe shall be sand, crushed stone or excavated material which is neither corrosive nor organic in nature.

e. Initial backfill shall be of a size that passes a one-inch sieve.

f. A concrete floor may be placed over a building drain having less than 12 inches of initial backfill.

g. Initial backfill shall be placed in increments not to exceed 6 inches in depth.

h. Initial backfill shall be well tamped for the full width of the trench and length of the sewer.

3. `Unstable bottom.' Where a mucky or unstable bottom is encountered in the trench, the required dry and stable Foundation conditions shall be provided by providing one of the following options:

a. Sheathing shall be driven and left in place to a depth of 48 inches below the trench bottom or to solid Foundation to a lesser depth.

b. Removal of wet and yielding material to a depth of 24 inches or to solid material and replacement of the unstable material with limestone screenings, pea gravel or equivalent material.

c. Install a longitudinally reinforced concrete cradle the width of the trench and at least 3 inches thick.

d. Install a longitudinally reinforced concrete slab the width of the trench and at least 3 inches thick.

e. Backfill and bedding shall comply with subd. 2. d. to h.

4. `Backfill completion.' Care shall be exercised in placing the balance of the backfill to prevent breakage of the pipe. Large boulders or rock, concrete slabs, or frozen masses shall not be used in the backfill. At least 36" of backfill cover shall be provided over the top of the pipe before the pipe trench is wheel-loaded.

5. `Pipe openings protected.' The ends of all pipes not immediately connected shall be closed so as to prevent the introduction of earth or drainage from an excavation.

(f) ***Connection to public sewer.*** The connections of building sewers to Tribal sewers shall be in accordance with conditions of approval for the Tribal sewer granted by the Department.

1. **`Gravity public sewer.'** When a building sewer connection to the Tribal sewer is not found within 3 feet of the point designated by the Public Works Division, the connection may be made.:

a. If the saddle fitting is Approved by the Public Works Division.

b. If acceptable to the Public Works Division, a portion of the main sewer may be removed, and a tee or wye fitting Approved by the Department may be inserted with compression joints in the Tribal sewer acceptable to the Department. The insertion shall be made under the supervision of the authorized representative of the Department.

c. If the public sewer is concrete or clay, the end of the connecting sewer may be set upon or in an opening cut into the top half of the public sewer but shall not protrude into the Tribal sewer. The connection shall be secured by encasing the main sewer pipe and the connection in concrete at least 3" thick so as to assure permanency of the connection and adequate backing of the Tribal sewer pipe.

d. In lieu of the use of a fitting and if an opening cannot be located in the top half of the public sewer, a length of concrete or clay Tribal sewer pipe may be removed and a section with a wye fitting shall be inserted in its place. The joints at the ends of the section shall be encased in concrete at least 3" thick. The connection or insertion shall be made under the supervision of the authorized representative of the Tribe.

2. `Pressurized Tribal sewer.' Where a forced building sewer discharges to a pressurized Tribal sewer all of the following requirements shall apply:

a. A curb stop shall be installed on the same property as close as possible to the connection to the common forced main sewer.

b. A check valve shall be installed in the pressurized building drain or building sewer.

c. An accessible quick disconnect shall be installed upstream of the check valve.

Note: See ch. SPS 382 Appendix for further explanatory material.

(g) ***Prohibited installations.***

1. `Harmful discharge.' No person may connect to a Tribal sewer any building drain or building sewer through which is discharged any substance likely to cause undue corrosion, obstruction, nuisance, explosion, or interference with sewage treatment processes.

2. `Storm water and clear water connections.' Except as provided in s. SPS 382.36 (3), storm drain piping and clear water drain piping may not discharge to a sanitary building drain which connects to a Tribally-owned treatment works.

Note: See s. SPS 382.36 for provisions relative to storm sewers.

(h) ***Locating requirements.*** A means to locate buried non-metallic sewers and private interceptor main sewers discharging to Tribal mains shall be accomplished in accordance with one of the following options:

Note: See ch. SPS 382 Appendix for further information.

1. A tracer wire shall be installed in accordance with all of the following:

a. Tracer wire shall be installed along the length of the non-metallic pipe.

b. Tracer wire shall be a minimum of 18 gauge, insulated, single-conductor copper wire or equivalent.

c. Tracer wire shall be located directly above and within 6 inches of the non-metallic pipe.

d. Tracer wire shall be accessible and locatable within the Owner's property at 400-foot intervals or increments thereof.

e. Exterior access locations shall include a means of protecting the tracer wire.

f. In-ground sleeves shall be installed as provided in s. SPS 382.35 (5) (a) 2. c. and d.

g. Where tracer wire is more than 6 inches from the pipe, tracer wire insulation color shall comply with subd. 1. h.

i. Tracer wire conductivity shall be tested prior to use.

j. Conductive warning tape may not be utilized in lieu of tracer wire.

2. Global positioning system data shall be recorded with the Tribe where the non-metallic pipe is installed.

3. Another equally effective means acceptable to the Department shall be employed to mark the location of the non-metallic pipe.

(12) PRIVATE INTERCEPTOR MAIN SEWERS.

(a) The connection of a private interceptor main sewer to a Tribal sewer shall be in accordance with the conditions of approval for the public sewer granted by the Land and Natural Resources Division.

(b) Private interceptor main sewers which discharge to a Tribal treatment facility shall be designed in accordance with the Tribe's water quality management plan.

(c) All private interceptor main sewers shall be tested in accordance with SPS 382.21.

(d) Private interceptor main sewers 6" or less in diameter shall be installed in accordance with the criteria for building sewers specified in sub. (11) (b) and (c) and (d) and (e).

(e) Private interceptor main sewers 8" or larger in diameter shall be:

1. Provided with frost protection in accordance with sub. (11) (c); and

2. Installed in accordance with the Tribal sewer criteria.

(f) No private interceptor main sewer may pass through or under a building to serve another building

(13) LOCATION OF DRAIN PIPING.

(a) Drain piping located below the ceilings of areas where food, ice or potable liquids are prepared, handled, stored, or displayed shall be installed with the least number of joints and shall be installed in accordance with subds. 1. to 5.

1. All pipe openings through floors shall be provided with sleeves bonded to the floor construction and protruding not less than one inch above the top of the finish floor with the space between sleeve and the piping sealed.

2. Plumbing fixtures, except bathtubs and showers, shall be of the wall mounted type. Bathtubs shall have waste and overflow connections made above the floor and piped to a trap below the floor.

3. Floor and shower drains installed shall be equipped with integral seepage pans.

4. Cleanouts for piping shall be extended through the floor construction above.

5. Piping subject to operation at temperatures that will form condensation on the exterior of the pipe shall be thermally insulated.

(b) Where drain piping is located in ceilings of areas where food, ice or potable liquids are prepared, handled stored or displayed, the ceilings shall be of the removable type, or shall be provided with access panels in order to provide an access for inspection of the piping.

(c) Exposed drain piping shall not be located over a pool, surge tank or an open filter for a pool.

SPS 382.31 Vents and venting systems.

(1) SCOPE. The provisions of this section set forth the requirements for the design and the installation of vents and venting systems.

(2) MATERIALS. All vents and venting systems shall be constructed of Approved materials in accordance with ch. SPS 384.

(3) GENERAL.

(a) ***Vents.*** Every trap and trapped plumbing fixture shall be provided with an individual vent, except as otherwise permitted in this chapter. Vents and venting systems shall be designed and installed so that the water seal of a trap shall be subject to a maximum pneumatic pressure differential equal to one inch of water column.

(b) ***Main stack.*** Each gravity-flow sanitary building sewer shall be served by at least one stack which extends from a building drain to a Vent terminal or Vent header. The stack shall be not less than 3" in diameter from the building drain to the Vent terminal or Vent header.

(4) VENT STACKS AND STACK VENTS.

(a) ***Where required.*** A Vent stack and a stack Vent shall be installed to serve any drain stacks of 5 or more branch intervals.

(b) ***Installation.***

1. The connection of the Vent stack to a drain stack shall be at or below the lowest branch drain connection to the drain stack. The connection to the drain stack shall be by means of a wye pattern fitting installed in a vertical portion of the stack.

2. A Vent stack and a stack Vent shall:

a. Extend to a Vent terminal in accordance with sub. (16);

b. Connect to a Vent stack which extends to a Vent terminal; or

c. Connect to a stack Vent at least 6" above the flood level rim of the highest fixture discharging into a drain stack.

3. Vent stacks and stack vents may connect into a common Vent header and then shall extend to a Vent terminal.

4. The connection of a Vent stack with another Vent may not be less than 38" above the next higher floor level where the plumbing fixtures are vented, but in no case lower than 2" above the elevation of the highest flood level rim of any fixture served by the vent.

Note: See ch. SPS 382 Appendix for further explanatory material.

(5) RELIEF AND YOKE VENTS FOR STACK OFFSETS.

(a) ***Vents serving offsets of 30 to 45° in drain stacks.***

1. Except as permitted in subd. 2., where a horizontal branch connects to a drain stack within 2 feet above or below an offset with a change of direction of 30 to 45° from the vertical and the offset is located below 5 or more branch intervals, the offset shall be vented in accordance with par. (b) 1. to 3.

2. Where the drain stack and offset are sized as building drain as per Table 382.30–3, the vents serving the offset of 30 to 45° in a drain stack are not required.

(b) ***Vents serving offsets of more than 45o in drain stacks.*** Offsets of more than 45o in drain stacks shall be vented where 5 or more branch intervals are located above the offset. The offset shall be vented by venting the upper and lower section of the stack.

1. `Upper section.' The upper section of the stack shall be vented as a separate stack with a Vent stack connection installed in accordance with sub. (4). The offset shall be considered the base of the stack.

2. `Vent connection above offset.' The Vent stack shall connect with a wye pattern fitting above the stack offset and at or below the lowest drain branch above the offset.

3. `Lower section.' The lower section of the stack shall be vented by a yoke Vent connecting below the offset above or at the next lower horizontal branch.

a. Except as provided in subd. 3. b., the connection of the yoke Vent to the drain stack shall be by means of a wye pattern fitting.

b. The yoke Vent connection may be a vertical extension of the stack.

c. The connection of the yoke Vent to another Vent shall not be less than 38 inches above the next higher floor level where plumbing fixtures are installed that discharge into the drain stack.

(6) RELIEF VENTS FOR STACKS OF MORE THAN 10 BRANCH INTERVALS.

(a) Drain stacks of more than 10 branch intervals shall be provided with a relief Vent at each tenth interval installed.

(b) The lower end of the relief Vent required in par. (a) shall connect to the stack by use of a wye pattern fitting below the horizontal branch serving that floor.

(c) The upper end of the relief Vent required in par. (a) shall connect to the Vent stack not less than 38 inches above the next higher floor level where plumbing fixtures are installed that discharge into the drain stack.

(7) RELIEF VENTS FOR BUILDING DRAINS. A building drain with a change in elevation of 12 feet or more and at an angle of 45° or more from the horizontal shall be provided with a relief vent.

(a) The connection of the relief Vent to the building drain shall be by means of a wye pattern fitting installed within 2 feet upstream of the top of the change in elevation.

(b) The connection of the relief Vent to another Vent shall be not less than 38" above the next higher floor level where plumbing fixtures are installed that discharge through the building drain.

Note: See ch. SPS 382 Appendix for further explanatory material.

(8) VENTS FOR SANITARY SUMPS.

(a) ***Interior sanitary sumps.*** Sanitary sumps shall be provided with a Vent connecting either to the sump above the drain inlet or to the drain inlet within 12" of the sump.

(b) ***Exterior sanitary sumps.*** Sanitary sumps shall be provided with a Vent that terminates in accordance with sub. (16) (h).

(9) FIXTURE VENTS.

(a) ***Developed length between Vent and trap.*** Each fixture trap shall be protected with a Vent located in accordance with the provisions of subds. 1. and 2.

1. Each fixture trap which is not an integral part of the fixture shall be protected with a Vent so located that the developed length of the fixture drain piping from the trap weir to the Vent connection is within the limits set forth in Table 382.31-1.

2. Each fixture trap which is an integral part of the fixture shall be protected with a Vent so located that the developed length of the fixture drain piping from fixture outlet to the Vent connection is within the limits set forth in Table 382.31-1. For a floor outlet water closet or similar fixture, the point where the fixture drain piping turns horizontal shall be considered as the fixture outlet.

(b) ***Minimum distance.*** A Vent shall not connect to a fixture drain within the distance equal to 2 diameters of the drain piping from the weir of a trap.

Note: See ch. SPS 382 Appendix for further explanatory material. - See PDF for table

(10) CIRCUIT VENTING. In lieu of providing individual vents, a horizontal drain to which at least 2 but not more than 8 wall outlet fixtures or at least 2 but not more than 8 floor outlet fixtures, other than blowout type fixtures and wall-outlet carrier type water closets, are connected to the same horizontal branch drain, may be vented by a circuit Vent in accordance with pars. (a) to (e).

(a) The circuit Vent shall connect to the horizontal drain at a point between the 2 most upstream fixtures.

(b)

1. A circuit vented horizontal drain into which 4 or more fixtures discharge shall be provided with a relief vent. The relief Vent shall connect to the circuit vented horizontal drain downstream of the most downstream fixture drain which is vented by the circuit Vent and upstream of any other drain connections.

2. Two circuit vented horizontal drains serving a total of 8 fixtures, 4 on each branch, shall be provided with at least one relief vent, unless the horizontal drains connect to a drain stack with no other drain connections located above the circuit vented horizontal drains. One relief Vent may serve both horizontal drains, if installed downstream of the point where the 2 horizontal drains are joined.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) A horizontal drain served by a circuit Vent may not diminish in size from the most downstream fixture drain connection vented by the circuit vented drain to the circuit Vent connection. Where a relief Vent is installed, the horizontal drain served by the circuit Vent shall not diminish in size from the relief Vent connection to the circuit Vent connection.

(d) Fixture drains served by a circuit Vent shall conform to the provisions of sub. (9). The connection of the fixture drain to the branch drain served by the circuit Vent shall be considered as the Vent connection.

(e) Additional wall outlet fixtures with a drainage fixture unit value of one or less which are served by individual vents or common vents may discharge into a horizontal drain served by a circuit vent.

(11) COMMON VENTS. In lieu of providing individual vents, fixtures may be common vented in accordance with pars. (a) and (b).

(a) ***Vertical drains.*** A common Vent may serve a maximum of 2 fixtures where both fixture drains connect to a vertical drain at the same elevation. Where this connection is by means of a sanitary tee fitting with a side inlet, the centerline of the side inlet opening may not be below the centerline of the larger opening. The drain connection of a blowout type fixture or a Kitchen sink served by a common Vent may not be by means of a double sanitary tee fitting.

(b) ***Horizontal branches.*** The fixture drains from 2 wall-outlet fixtures, each with a drainage fixture unit value of one or less, or the fixture drains from 2 traps serving a Kitchen sink with or without a dishwasher may connect to a horizontal branch without individual vents provided a common Vent connects to the branch drain downstream of both fixture drains. Both fixture drains shall be of the same diameter. The developed length of the drain from the Vent to the farthest trap shall conform to sub. (9).

Note: See ch. SPS 382 Appendix for further explanatory material.

(12) RETURN VENTS. Plumbing fixtures may be vented in accordance with pars. (a) to (d).

(a) Wall outlet fixtures may be vented by extending an individual vent, vertical wet Vent or a common Vent as high as possible under the fixture enclosure and returning the Vent vertically downward and connecting the Vent to the fixture drain or branch drain by means of a wye pattern fitting.

(b) Horizontal Vent piping shall connect to the vertical section of the fixture Vent and extend to a point where it can extend vertically to a Vent terminal in accordance with sub. (16) or connect to another Vent in accordance with sub. (15).

(c) Drainage fittings shall be used on all sections of the Vent pipe below the floor level and a minimum slope of 1/4" per foot to the drainage point shall be provided.

(d) Cleanouts shall be provided on the Vent piping in accordance with SPS 382.35.

Note: See ch. SPS 382 Appendix for further explanatory material.

(13) WET VENTING. In lieu of providing individual vents, fixtures may be wet vented in accordance with pars. (a) to (c).

(a) ***Vertical wet vents.***

1. Where 2 wall outlet fixtures are located on the same floor level with their fixture drains connecting to the same vertical drainpipe at different elevations, the lower fixture drain may be wet vented in accordance with subd. 1. a. to e.

a. No other fixtures may discharge into the vertical drainpipe above or between the 2 wall outlet fixtures. Additional fixtures may discharge into the vertical drainpipe below the 2 wall outlet fixtures.

b. A branch Vent shall connect to the vertical drainpipe immediately above the higher fixture drain connection.

c. The drain between the 2 fixtures shall be at least one pipe size larger than the upper fixture drain, but not smaller than 2" in diameter.

d. Both fixture drains shall conform to sub. (9). The connection of the lower fixture drain to the vertical drain shall be considered as the Vent connection.

e. The higher fixture drain may not serve a water closet.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Horizontal wet vents.*** A drain from a lavatory or lavatories which are either provided with individual vents or a common Vent may serve as the wet Vent for not more than 2 bathtubs or showers and not more than 2 water closets in accordance with subds. 1. to 7. No other fixtures may discharge into or be served by the wet vent.

1. All of the fixtures shall be located in nonpublic bathroom groups.

2. The lavatories and bathtubs or showers shall have a common horizontal drain with the drain for the lavatories serving as a wet Vent for the bathtubs or showers.

3. Where 2 bathtubs or showers are served by the same wet vent, their fixture drains shall connect independently to the common horizontal drain downstream of the vertical drain serving the lavatory or lavatories.

4. Where 2 bathtubs or showers and 2 water closets are served by the same wet Vent a relief Vent shall be provided, unless the wet vented horizontal drain connects to a drain stack with no other drain connections located above the wet-vented horizontal drain. The relief Vent shall connect to the horizontal drain at a point downstream of the fixture drains for the water closets and upstream of any other fixture drain connections.

5. One or 2 water closets may connect to the common horizontal drain with the drain from the lavatories and bathtubs or showers also serving as a wet Vent for the water closets. Where 2 water closets are served by the same wet vent, their fixture drains shall connect independently to the common horizontal drain at the same point.

6. The wet Vent shall be at least 2" in diameter. No more than 4 drainage fixture units may discharge into a 2" diameter wet vent.

7. A branch Vent shall connect immediately above the highest fixture drain connection and shall be sized in accordance with sub. (14).

(c) ***Other types of wet vents.*** An individual Vent serving a floor outlet fixture, a common Vent serving floor outlet fixtures, a circuit vent, a relief Vent serving a circuit vented drain or a relief Vent serving a wet vented horizontal drain may serve as a wet Vent in accordance with subds. 1. to 4.

1. No more than 2 wall outlet fixtures, each fixture with a drainage fixture unit value of one or less, may have their fixture drains connected into the individual vent, common vent, circuit Vent or relief vent.

2. The wet Vent shall be at least 2" in diameter.

3. The branch Vent to which the wet Vent connects shall be sized in accordance with sub. (14). The branch Vent may serve the wall outlet fixtures in lieu of individual vents or a common vent.

4. The fixtures discharging into the wet Vent shall be located on the same floor level as the fixtures served by the wet vent.

Note: For explanatory material refer to ch. SPS 382 Appendix A-382.31 (13).

(14) VENT SIZE.

(a) ***Stack vents and Vent stacks.*** Stack Vent and Vent stack pipe sizes shall be determined in accordance with Table 382.31-2 on the basis of developed length and the diameter of the drain stack at its base.

1. The developed length of the stack Vent shall be measured along the Vent pipe, from the highest drain branch connection to the Vent terminal or to the connection to a Vent header.

2. The developed length of the Vent stack shall be measured along the Vent pipe from the Vent stack base connection to the Vent terminal or to the connection to a Vent header.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Vent headers.***

1. Vent header pipe sizes shall be determined in accordance with Table 382.31-3 with the number of drainage fixture units being the sum of the fixture unit loads of the stacks vented through that portion of the header. The diameter of a Vent header shall not be less than any Vent connecting to it.

2. The developed length of the Vent header shall be measured along the pipe from the most distant Vent stack or stack Vent base connection to the Vent terminal.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Branch vents***. Branch Vent pipe sizes shall be determined in accordance with Table 382.31-3. The developed length of the branch Vent shall be measured along the pipe from the furthest fixture drain served by the branch Vent to the point where it connects to a Vent pipe of a larger diameter or to a Vent terminal.

Note: See ch. SPS 382 Appendix for further explanatory material.

(d) ***Individual vents.*** Individual Vent pipe sizes shall be determined in accordance with Table 382.31-3. The developed length of an individual Vent shall be measured along the Vent pipe from the fixture drain served by the Vent to the point where it connects to a Vent pipe of a larger diameter or to a Vent terminal.

Note: See ch. SPS 382 Appendix for further explanatory material.

(e) ***Common vents.*** Common Vent pipe sizes shall be determined in accordance with Table 382.31-3. The developed length of a common Vent shall be measured along the Vent pipe from the drain served by the Vent to the point where it connects to a Vent pipe of a larger diameter or to the Vent terminal. - See PDF for table - See PDF for table

(f) ***Circuit vents.*** Circuit Vent pipe sizes shall be determined in accordance with Table 382.31-3. The developed length of the circuit Vent shall be measured along the Vent from the connection with the branch drain served by the Vent to the point where it connects to a Vent pipe of a larger diameter or to a Vent terminal.

(g) ***Relief vents***. Relief vents shall be sized in accordance with the provisions of subds. 1. to 3. The developed length of a relief Vent shall be measured along the Vent from the connection with the branch

drain served by the Vent to the point where it connects to a Vent pipe of a larger diameter or to a Vent terminal.

1. `Circuit vented branch drain.' The diameter of a relief Vent for a branch drain served by a circuit Vent shall be at least one half the diameter of the branch drain. The maximum developed length shall be determined from Table 382.31-3 based on the number of drainage fixture units served by the vent.

2. `Building drain.' The diameter of a relief Vent serving a building drain, as required in sub. (7), shall be at least one half the diameter of the building drain. The maximum developed length shall be determined from Table 382.31-3 based on the number of drainage fixture units served by the vent.

3. `Horizontal wet vent.' The diameter of a relief Vent serving a horizontal wet Vent shall be at least 1⁄2". The maximum developed length shall be determined from Table 382.31-3 based on the number of drainage fixture units served by the vent.

(h) ***Yoke vents.*** A yoke Vent serving a drain stack shall be sized as a Vent stack in accordance with par. (a).

(i) ***Vents for sumps.***

1.

a. Except as provided in subd. 1. b., the size of a Vent for a sanitary pump with other than a pneumatic ejector, shall be determined in accordance with Table 382.31-4.

b. The size of a Vent for a sanitary sump located outside with other than a pneumatic ejector shall be determined in accordance with Table 382.31-4 but shall not be less than 2" in diameter.

2. The air pressure relief pipe from a pneumatic ejector shall not be connected to Vent or Vent system serving a sanitary drain system, storm drain system or chemical waste system.

a. The relief pipe shall be of a size to relieve the air pressure inside the ejector to atmospheric pressure but shall not be less than 2" in diameter where the ejector is located outside and 11/4" in diameter for all other ejector locations.

b. The Vent shall terminate in accordance with the provisions of sub. (16). - See PDF for table

(j) ***Vents for chemical basins.*** The size of vents serving chemical dilution or neutralizing basins shall be determined in accordance with Table 382.31-3 and based upon the number of drainage fixture units discharging into the basins.

(15) VENT GRADES AND CONNECTIONS.

(a) ***Vent grade.*** All Vent and branch Vent pipes shall be graded and connected so as to drain back to a drainpipe by means of gravity.

(b) ***Installation.*** Vents shall be installed in accordance with subds. 1. to 3.

1. Except for wet Vent piping, the connection of a Vent to horizontal drain piping shall be at a point above the horizontal center line of the drain piping.

2. Except as provided in subs. (12) and (17), Vent piping serving a wall-outlet fixture may not offset horizontally less than 36" above the floor, but in no case lower than the elevation of the highest flood level rim of any fixture served by the vent.

3. Vent piping may not connect to a branch Vent less than 38" above the floor, but in no case lower than 2" above the elevation of the highest flood level rim of any fixture served by the vent.

Note: See ch. SPS 382 Appendix for further explanatory material.

(16) VENT TERMINALS. All vents and Vent systems shall terminate in the open air in accordance with this subsection.

(a) ***Extension above roofs.*** Extensions of vents through a roof shall terminate at least 8" above the roof. Where the roof is to be used for any purpose other than weather protection, the vents shall extend at least 7 feet above the roof.

(b) ***Waterproof flashings.*** The penetration of a roof system by a Vent shall be made watertight with an Approved flashing.

(c) ***Prohibited uses.*** Vent terminals shall not be used as flag poles, support for antennas or other similar purposes.

(d) ***Location of Vent terminals.***

1. A Vent shall not terminate under the overhang of a building.

2. All Vent terminals shall be located:

a. At least 10 feet from an air intake;

b. At least 5 feet from a power exhaust vent;

c. At least 10 feet horizontally from or 2 feet above roof scuttles, doors, and openable Windows; and

d. At least 5 feet from or 2 inches above parapet walls.

3. Where a structure has an earth covered roof extending from surrounding grade, the Vent extension shall run at least 7 feet above grade and terminate with an Approved Vent cap. The portion of Vent pipe outside the structure shall be without joints, except one fitting may be installed where the pipe leaves the top or side of the structure.

(e) ***Extension through wall.*** Where Approved by the Department, a Vent may terminate through an exterior wall. Such a Vent shall terminate at least 10 feet horizontally from any lot line and shall terminate downward. The Vent shall be screened and shall comply with par. (d).

(f) ***Extensions outside buildings.*** Drain or Vent pipe extensions shall not be located or placed on the outside of an exterior wall of any new building but shall be located inside the building.

(g) ***Frost closure.*** For protection against frost closure, each Vent terminal shall be at least 2" in diameter. Where it is necessary to increase the diameter of the vent, the change in diameter shall be made at least 6" inside the building.

Note: See ch. SPS 382 Appendix for further explanatory material.

(h) ***Penetrations through grade.*** Except when installation is in accordance with par. (d) 3., penetrations through grade shall terminate at least 12" above finished grade and terminate with a Vent cap or return bend.

(17) COMBINATION DRAIN AND VENT SYSTEMS. In lieu of providing individual vents, fixtures may be vented in accordance with pars. (a) to (c).

(a) ***Stacks.***

1. A drain stack may serve as a combination drain and Vent system for fixtures in accordance with subd. 1. a. to e.

a. The drain stack shall not serve more than 3 fixtures. Each fixture shall be located on a separate floor level.

b. The drain stack shall be limited to serving fixtures with a drainage fixture unit value of no greater than 2.0. A urinal may not discharge into the combination drain and Vent portion of the stack. The largest drainage fixture unit value served by the stack shall determine the stack size as specified in Table 382.31-5.

c. The drain stack shall not be offset horizontally above the lowest fixture drain connection.

d. The developed length of any fixture drain from the trap weir to the drain stack shall not exceed the limits specified in Table 382.31-1.

e. The drain stack and its attendant Vent shall be sized in accordance with Table 382.31-5.

Note: See ch. SPS 382 Appendix for further explanatory material. - See PDF for table

2. A drain stack may serve as a combination drain and Vent system for a Kitchen sink and a wall outlet fixture with a drainage fixture unit value of 2 or less in accordance with subd. 2. a. to d.

a. One Kitchen sink within a Dwelling Unit, with or without a food waste grinder or dishwasher connection, shall connect to the drain stack above the wall outlet fixture with a drainage fixture unit value of 2 or less. No other fixtures may connect to the drain stack.

b. The drain stack shall be at least 2 inches in diameter below the Kitchen sink connection and it shall be at least 4 inches in diameter below the connection to the lower fixture.

c. In lieu of the minimum sizes as required in subd. 2. b., the entire stack below the Kitchen sink connection may be 3 inches in diameter.

d. The drain stack shall not offset horizontally above the fixture drain connection for the lower fixture.

(b) ***Building drains.*** A building drain or a building subdrain may serve as a combination drain and Vent system for floor drains and floor outlet fixtures in accordance with subds. 1. to 6.

1. A Vent or drain at least 2 inches in diameter shall be connected upstream of any building drain branch or building subdrain branch.

2. No more than 2 water closets may connect to the building drain or building subdrain by means of building drain branches or building subdrain branches.

3.

a. That portion of the building drain or building subdrain between the connection of the building drain branch or building subdrain branch and the Vent or drain required in subd. 1. shall be at least one pipe size larger than the minimum size permitted in Table 382.30–3 based on the total drainage fixture unit load, but not less than 3 inches.

b. The Vent or drain required in subd. 1. shall be at least one-half the diameter of that portion of the building drain or building subdrain which is vented by the Vent or drain but may not be less than 2 inches in diameter.

c. A Vent serving a drain required in subd. 1., shall be at least one half the diameter of that portion of the building drain or building subdrain which is vented by the system, but may not be less than 2 inches in diameter.

4. The trap of a floor drain or a floor outlet fixture, except a water closet, connected to a building drain branch or building subdrain branch shall be at least 3" in diameter.

5. A building drain branch or building subdrain branch may not connect to a building drain or building subdrain downstream from the base fitting of a drain stack 2" or larger in diameter within the distance equal to 20 pipe diameters of the building drain or building subdrain.

6. The pitch and the developed length of the building drain branch or building subdrain branch may not exceed the limits specified in Table 382.31-1.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Laboratory sink venting.*** A horizontal drain may serve as a combination drain and Vent system for island laboratory sinks in accordance with subds. 1. to 7.

1. A Vent stack or a drain stack at least 2" in diameter shall be connected upstream of any fixture drain vented by the combination drain and Vent system.

2.

a. That portion of the horizontal drain between the connection of fixture drain and the Vent stack or drain stack required in subd. 1. shall be at least one pipe size larger than the minimum size permitted in Table 382.30-2 based on total drainage fixture unit load.

b. The Vent stack or drain stack required in subd. 1. shall be at least one-half the diameter of that portion of the horizontal drain, which is vented by the stack, but may not be less than 2" in diameter.

c. A stack Vent serving a drain stack required in subd. 1. shall be at least one half the diameter of that portion of the horizontal drain, which is vented by the stack, but may not be less than 2" in diameter.

3. All fixture drains vented by the horizontal drain shall be at least 3" in diameter.

4. Fixture drains to be vented by the horizontal drain shall connect individually to the horizontal drain.

5. An individual Vent or common Vent shall be extended as high as possible under the sink enclosure and then returned vertically downward and connected to the horizontal drain. A cleanout shall be provided on the Vent piping.

6. In lieu of connecting the Vent to the horizontal drain which forms the combination drain and Vent system, the Vent may connect to a horizontal fixture drain vented by the combination drain and Vent system. The pitch and developed length of the horizontal fixture drain shall not exceed the limits specified in Table 382.31-1.

7. Fixture drains to be vented by the horizontal drain shall not connect to a horizontal drain downstream from the base fitting of a drain stack 2" or larger in diameter within the distance equal to 20 pipe diameters of the horizontal drain serving the stack.

Note: See ch. SPS 382 Appendix for further explanatory material.

(18) PROHIBITED USES. A Vent or Vent system shall not be used for purposes other than the venting of the plumbing system.

(a) ***Boiler blowoff basin vents.*** Vent piping from boiler blowoff basins shall not be connected to a Vent or Vent system serving a sanitary drain system, storm drain system or chemical waste system.

(b) ***Chemical waste vents.*** Vent piping for chemical waste systems shall not be connected to a Vent system serving a sanitary drain system or storm drain system.

(c) ***Steam vents.*** Vents serving steam operated sterilizers, cleansing, or degreasing equipment, pressing machines or any other apparatus which normally discharges steam into the Vent shall not be connected to a Vent or a Vent system serving a sanitary drain system, storm drain system or chemical waste system.

SPS 382.32 Traps and direct fixture connections.

(1) SCOPE. The provisions of this section set forth the requirements for the types and installation of traps and direct fixture connections.

(2) MATERIALS. All traps and fixture connections shall be of Approved materials in accordance with ch. SPS 384.

(3) GENERAL. Each plumbing fixture, each compartment of a plumbing fixture and each floor drain shall be separately trapped by a water seal trap, except as provided in par. (a) or as otherwise permitted by this chapter. A fixture shall not be double trapped.

(a) ***Trap exceptions***. The plumbing fixtures listed in subds. 1. to 3. shall not be required to be separately trapped:

1. Fixtures having integral traps;

2. Compartments of a combination plumbing fixture installed on one trap, provided:

a. No compartment is more than 6" deeper than any other;

b. The distance between the compartments' waste outlets farthest apart does not exceed 30"; and

c. No compartment waste outlet is equipped with a food waste grinder.

3. Storm drains as provided in s. SPS 382.36 (12) (a).

Note: Residential exclusion see s. SPS 325.01 (4) (a).

(b) ***Trap seals.*** Each trap shall provide a liquid seal depth of not less than 2" and not more than 4", except as otherwise specified in this chapter.

(c) ***Loss of trap seal***. A trap seal primer valve may be installed on a trap subject to high rates of evaporation.

1. A trap seal primer valve or other means of trap seal protection acceptable to the Department shall be provided for a trap subject to seal loss due to evaporation.

Note: Liquids acceptable to use for reducing trap seal evaporation include mineral oil, vegetable oil, propylene glycol and glycerin.

2. Trap seal primer valves shall conform to ASSE 1018.

Note: A list of referenced standards is contained in ch. SPS 381.

(d) ***Design.*** Traps shall be self-scouring and shall not have interior partitions, except where such traps are integral with the fixture. Uniform diameter P-traps shall be considered self-scouring.

(e) ***Size.*** Traps shall be of diameters not less than those specified in Table 382.30-1 of SPS 382.30.

(f) ***Prohibited traps.*** The installation of the types of traps listed in subds. 1. to 6. shall be prohibited:

1. Bell traps;

2. Drum traps, except where specifically Approved by the Department;

3. S-traps which are not integral parts of fixtures;

4. Separate fixture traps which depend on interior partitions for the trap seal;

5. Traps which depend upon moving parts to maintain the trap seal; and

6. Traps which in case of defect would allow the passage of sewer air.

(4) INSTALLATION.

(a) ***Setting of traps.*** All traps shall be rigidly supported and set true with respect to the water level and so located as to protect the water seals and shall be protected from freezing and evaporation.

(b) ***Distance from fixture drain outlets.***

1. `Vertical distance.' Except as provided in subd. 1. a. to c., the vertical distance between the top of the fixture drain outlet and the horizontal center line of the trap outlet shall not exceed 15".

a. The vertical distance between the top of the strainer of a floor drain or the opening of a standpipe receptor and the horizontal center line of the trap outlet shall not exceed 36".

b. The vertical distance between the top of the fixture drain outlet of a pedestal fixture or a cuspidor and the horizontal center line of the trap outlet shall not exceed 60".

c. The vertical distance between the water level in the bowl of a floor outlet water closet and the center line of the horizontal portion of the fixture drain shall not exceed 36".

d. The vertical distance from the inlet to the horizontal centerline of the fixture drain for a campsite receptor, exterior storm drain inlet, or a receptor for a sanitary dump station may exceed 3 feet so as to permit the trap to be installed below the predicted depth of frost.

2. `Horizontal distance.' Except as provided in subd. 2. a. and b., the horizontal distance between the vertical centerline of a fixture drain outlet and the vertical centerline of the trap inlet shall not exceed 15".

a. The horizontal distance for a pedestal drinking fountain shall not exceed 24".

b. The horizontal distance for an exterior sanitary area drains or a residential Garage floor drain discharging through an interior trap shall not exceed 25 feet.

c. The minimum horizontal distance between the vertical centerline of the outlet from a floor-mounted water closet and a 3-inch double tee shall be 30 inches.

Note: See ch. SPS 382 Appendix for further explanatory material.

(5) DIRECT FIXTURE DRAIN CONNECTION. Except as provided in SPS 382.33, all plumbing fixtures and appliances discharging wastes shall connect directly to a drain system.

(a) ***Floor drains.***

1. Floor drains shall be so located as to be accessible for cleaning purposes.

2. A floor drain receiving the wash from garbage cans shall be at least 3" in diameter.

(b) ***Kitchen sinks.*** Horizontal drain piping serving a Kitchen sink trap shall not connect to vertical drain piping by means of a double sanitary tee.

(c) ***Water closets.*** A water closet shall discharge through a drainpipe or fitting with a minimum diameter of 3".

1. A floor mounted wall outlet water closet shall connect to a 4 inch or 4 × 3inch closet collar fitting or to a horizontal or vertical carrier type fitting.

2. A floor outlet water closet shall connect to a 4 inch or 4 × 3-inch closet collar fitting. A 4 × 3-inch closet bend fitting may be installed where a 4-inch closet collar fitting is used.

3. A wall mounted wall outlet water closet shall connect to a horizontal or vertical carrier type fitting.

4. Two water closets discharging to a vertical drain from opposite sides by means of the same fitting shall be installed in accordance with subd. 4. a. and b.

a. Where the vertical drain is 3" in diameter, the fitting for floor outlet water closets shall be a 3-inch double wye pattern fitting.

b. Where the water closets are wall outlet types the fitting shall be a double wye pattern fitting or a carrier-type fitting.

(d) ***Blowout-type fixtures.*** Blowout-type plumbing fixtures shall be installed in accordance with the approval of the Department.

SPS 382.33 Indirect and local waste piping.

(1) SCOPE.

(a) The provisions of this section set forth the requirements for the installation of indirect waste piping and local waste piping.

(b) Indirect waste piping and local waste piping draining the fixtures, appliances and devices having a public health concern, including but not limited to those listed in Table 382.33-1, shall be considered as plumbing and shall comply with the provisions of this section.

(2) MATERIALS. Indirect waste piping more than 30" in length and all local waste piping shall be of Approved materials in accordance with ch. SPS 384.

(3) SIZE. Except as provided in pars. (a) and (b), indirect waste piping more than 30" in length and all local waste piping shall be sized in accordance with SPS 382.30.

(a) Indirect or local waste piping not exceeding 20 feet in length for refrigerated food display cases may not be less than one inch in diameter.

(b) Indirect waste piping, attached to an appliance, appurtenance, or equipment through which pressurized waste is discharged, shall be sized in accordance with specifications of the manufacturer of the appliance, appurtenance, or equipment. - See PDF for table

(4) INSTALLATION. Indirect waste piping and local waste piping shall be so installed as to permit access for flushing and cleaning.

(5) TRAPS.

(a) ***Indirect waste piping.***

1. Gravity flow indirect waste piping more than 30" in length shall be provided with a trap in accordance with s. SPS 382.32 (4), except indirect waste piping draining a sterilizer shall not be trapped.

2. All indirect waste piping draining a refrigerated food storage room, compartment or display case shall be provided with a trap in accordance with SPS 382.32 (4).

(b) ***Local waste piping.*** Local waste piping handling sanitary wastes and more than 30" in length shall be provided with a trap in accordance with SPS 382.32 (4).

Note: Residential exclusion see SPS 325.01 (3).

(6) MAXIMUM LENGTH. Indirect waste piping and local waste piping handling sanitary wastes shall not exceed 30 feet in length horizontally nor 15 feet in length vertically.

Note: See ch. SPS 382 Appendix for further explanatory material.

(7) AIR-GAPS AND AIR-BREAKS. All indirect waste piping and all local waste piping shall discharge by means of an airgap or air-break into a receptor.

(a) ***Air-gap installation***. The installation of an air gap shall conform to any of the following requirements:

1. The distance of an air gap shall comply with one of the following:

a. The distance of an air gap serving indirect waste piping one inch or less in diameter and a receptor shall be at least twice the diameter of the indirect waste piping.

b. The distance of an air gap between indirect waste piping larger than one inch in diameter and a receptor shall not be less than 2 inches.

2. The installation of all air-gap fittings shall comply with ASME A112.1.3.

3. The installation of a residential dishwashing machine manufactured air gap shall comply with ASSE 1021.

(b) ***Air–break installation.*** The air-break between indirect waste piping or local waste piping and the receptor shall be accomplished by extending the indirect waste piping or local waste piping below the flood level rim of the receptor and terminating at an elevation above the trap outlet.

Note: See ch. SPS 382 Appendix for further explanatory material.

(8) RECEPTORS. A receptor receiving the discharge from indirect waste piping or local waste piping shall be of a shape and capacity as to prevent splashing or flooding. Receptors shall be installed in accordance with this subsection and shall be accessible.

(a) ***Waste sinks and standpipes.*** A waste sink or a standpipe serving as a receptor shall have its rim at least one inch above the floor.

(b) ***Floor sinks.*** A floor sink serving as a receptor shall be equipped with a removable metal basket over which the indirect waste piping or local waste piping is to discharge, or the floor sink shall be equipped with a dome strainer. Indirect waste piping or local waste piping shall not discharge through a traffic grate but shall terminate over an un-grated portion of the floor sink.

(c) ***Local waste piping.*** Local waste piping may not receive discharge from another local waste pipe.

(d) ***Other receptors.*** A plumbing fixture may not be used as a receptor for indirect or local waste piping, except as provided in subds. 1. to 7.

1. The indirect waste piping of a portable dishwasher or water treatment device serving one or 2 outlets may discharge into a Kitchen sink of a Dwelling Unit or to a branch tail piece serving a Kitchen sink.

2. The indirect waste piping of an automatic clothes washer or water treatment device may discharge into a laundry tray.

3. The indirect or local waste piping serving a cross connection control device or assembly, water treatment device, air conditioner, humidifier or furnace condensate may discharge into a branch tailpiece serving a laundry tray.

4. The local waste piping serving a water heater temperature and pressure relief valve, water treatment device, cross connection control device or assembly, humidifier, sterilizer, or a furnace or air conditioner may discharge into the riser of a floor drain when installed in accordance with sub. (7) (b).

5. The indirect or local waste piping serving a water heater temperature and pressure relief valve, water treatment device, cross connection control device or assembly, or a furnace or air conditioner may discharge to a floor served by a floor drain so as not to create a health or safety hazard.

6. The indirect or local waste piping serving a water heater temperature and pressure relief valve or water treatment device may discharge through the cover of a clear water sump so as not to adversely affect floats by means of a fixed air gap installed in accordance with subs. (7) (a) 2. and (8).

7. The indirect waste piping serving a dental mold grinder may discharge into the riser or a trap serving a laboratory sink that is provided with a plaster trap and is installed within 3 feet of the mold grinder.

Note: See ch. SPS 382 Appendix A-382.33 (8) (a) to (d) for further explanatory material.

(9) INDIRECT WASTE PIPING REQUIRED.

(a) ***Boilers, pressure tanks and relief valves.*** Boilers, pressure tanks, relief valves and similar equipment discharging to a drain system shall be by means of an airgap.

1. Steam pipes shall not connect or discharge to any part of a plumbing system.

2.

a. Except as provided in subd. 2. b., wastewater more than 160° F in temperature shall be discharged by means of indirect waste to the plumbing system.

b. Steam condensate blow down shall be cooled to 160°F in temperature prior to discharging to a plumbing system.

(b) ***Clear water.*** When discharging to a plumbing system, all clear water shall discharge by means of an airgap.

(c) ***Clothes washers.***

1. `Residential types.' Residential-type clothes washers shall discharge into the sanitary drain system by means of an air-break.

a. A standpipe receptor may not extend more than 36 inches nor less than 18 inches above the centerline of the trap outlet.

b. A standpipe receptor shall terminate at least 26 inches but not more than 48 inches above the floor on which the clothes washer is located.

Note: See ch. SPS 382 Appendix for further explanatory material.

c. All wastes from the washers shall flow through a Commercial laundry interceptor as specified in SPS 382.34. - See PDF for table

(d) ***Dishwashing machines.*** All dishwashing machines shall discharge to the sanitary drain system.

1. `Residential type.' The indirect waste piping from a residential-type dishwashing machine shall not exceed a developed length of 10 feet. The indirect waste piping from a residential-type dishwashing machine shall be installed in accordance with one of the following methods:

a. Where an airgap or air-break is located below the countertop, the indirect waste piping from the dishwashing machine shall discharge to a standpipe. The standpipe shall be at least 1 ½ inches in diameter and shall extend at least 15 inches above the trap weir.

b. Where an airgap or air-break is located above the countertop, the indirect waste piping from the dishwashing machine shall discharge to local waste piping. The local waste piping shall connect to the Kitchen sink branch tailpiece above the trap inlet, the standpipe or to the dishwashing machine connection of a food waste grinder. When the local waste piping discharges to a standpipe, the standpipe shall be at least 1 ½ inches in diameter and shall extend at least 15 inches above the trap weir. Where a hose is used for local waste piping, the developed length shall not exceed 18 inches.

(f) ***Elevator drains.***

1. All drains serving elevator pits shall discharge to the storm drain system as specified in SPS 382.36 (4).

2. Drains serving elevator pits shall not connect directly with the storm drain system by means of gravity flow piping.

3. A sump may not be located in an elevator machine room.

4. A drain serving an elevator pit that discharges to a sump shall have a submerged inlet constructed to maintain a minimum 6" trap seal.

5. A sump located in an elevator pit may only receive storm or clear water waste from the elevator pit or the elevator machine room, or both.

Note: See ch. SPS 382 Appendix for further explanatory material.

(10) WATER TREATMENT DEVICES.

(a) The waste discharge of a water treatment device to the drain system shall be protected in accordance with SPS 382.41 with respect to cross connection control.

(b) The indirect waste piping or tubing from a water treatment device shall be of a material conforming to one or more of the standards listed in Tables 384.30-8 or 384.30-11.

Note: For appliances, devices and equipment not included in this section or other sections contact the Department for information and proposed installation review.

SPS 382.34 Wastewater treatment and holding devices.

(1) SCOPE. The provisions of this section set forth the requirements for design and installation of plumbing wastewater treatment and holding devices, appurtenances, and systems, including but not limited to interceptors, catch basins, decontamination tanks and dilution and neutralizing basins.

(2) MATERIALS. All piping, devices and appliances for wastewater treatment and holding devices, appurtenances and systems shall be of Approved materials in accordance with ch. SPS 384.

(3) GENERAL. Any deleterious waste material which is discharged into a plumbing system shall be directed to a wastewater treatment or holding device. The wastewater treatment or holding device shall be capable of separating, diluting, or neutralizing the deleterious waste material to a degree that the wastewater is no longer deleterious. Wastewater treatment or holding devices that retain any waste materials shall be designed and installed to facilitate periodic removal or treatment, or both.

(a) ***Treatment for reuse.***

1. Except as limited in subd. 2., graywater, storm water, clear water, blackwater and other wastewaters as Approved by the Department may be reused in conformance with SPS 382.70.

2. Except as provided in subd. 3., wastewater discharged from water closets or urinals shall not be reused for drinking water.

3. All treatment works permitted by the Department, or a POWTS which includes an in-situ soil dispersal or treatment component may treat wastewater discharged from water closets or urinals for reuse.

(b) ***Deleterious waste materials.*** For the purpose of this subsection, deleterious waste materials include any waste material, other than that from Dwelling Units, which may:

1. Congeal, coagulate, or accumulate in drains and sewers, thereby, creating stoppages or retarding the discharge flow;

2. Retard or interfere with municipal sewage treatment processes;

3. Pass through a treatment process and pollute the watercourse receiving the treatment effluent;

4. Create explosive, flammable, noxious, toxic, or other hazardous mixtures of materials; or

5. Damage, destroy or deteriorate sewers or piping materials or structures.

Note: See ch. ATCP 93 as to flammable, combustible, and hazardous liquids.

(c) ***Private systems.*** The special or industrial wastes from any plumbing system shall be treated, held, or dispersed in compliance with the rules of the agency having jurisdiction. The treatment, holding or dispersal system shall be installed so as not to endanger any water supply which is or may be used or which may create a nuisance, unsanitary conditions, or water pollution.

(d) ***Velocity control.*** Interceptors, catch basins and other similar devices shall be designed, sized, and installed so that flow rates shall be developed and maintained in a manner that solid and floating materials of a harmful, hazardous, or deleterious nature will be collected in the interceptor for disposal.

(e) ***Maintenance.*** All devices installed for the purpose of intercepting, separating, collecting, holding, or treating harmful, hazardous, or deleterious materials in liquid or liquid-borne wastes shall be operated and cleaned of intercepted or collected materials or of any residual from treatment at such intervals which may be required to prevent their passage through the interceptor.

(f) ***Service reassembly.*** Any fixed orifice, vent, or trap of an interceptor, catch basin or other similar device shall remain intact and shall not be removed or tampered with except for cleaning purposes. After service, all parts of the interceptor, collector, or treatment device, such as baffles, weirs, orifice plates, channels, vents, traps, tops, and fastening bolts or screws shall be replaced in proper working position.

(g) ***Location.***

1. Wastewater holding devices, interceptors, catch basins and other similar devices shall be accessible for service, maintenance, Repair, and inspection.

a. No wastewater holding device, interceptor, catch basin or similar device may be surrounded or covered as to render it inaccessible for service or inspection.

b. No wastewater holding device, interceptor, catch basin or similar device may have its top located more than 6 feet above the surrounding floor.

c. Enough space shall be provided to enable the removal of any interior parts of the wastewater holding device, interceptor, catch basin or similar device.

d. At least 18 inches of clear space shall be provided above the top of the wastewater holding device, interceptor, catch basin or similar device.

2. An exterior wastewater holding device, interceptor, catch basin or similar device shall not be located within 5 feet of a building or any portion of a building or swimming pool; 10 feet of water service; 2 feet of a lot line and 10 feet of a clearwater cistern.

3. An exterior wastewater holding device, interceptor, catch basin, or similar device shall not be located within 10 feet of the high-water mark of a lake, stream, pond, or flowage.

(h) ***Disposition of retained materials.*** Deleterious waste materials retained by a wastewater holding device, interceptor, catch basin or similar device shall not be introduced into any drain, sewer, or natural body of water without approval of the agency having jurisdiction.

(4) GARAGE FLOOR AREA WASTEWATER.

(b) ***Garages for one- and two-family Dwellings.***

1. Floor drains serving Garages for one- and two-family Dwellings shall be provided with a solid bottom sediment basket.

Note: See ch. SPS 382 Appendix for further explanatory material.

2.

a. Except as permitted in subd. 2. b., catch basins serving Garages for one- and two-family Dwellings shall be designed and installed in accordance with par. (a) 2.

b. The minimum inside diameter of catch basins serving Garages for one- and two-family Dwellings shall be 18 inches.

(c) ***Grates for Garage catch basins, floor drains and trenches.*** A Garage catch basin, floor drain and trench drain shall be provided with an Approved, removable cast iron or steel grate of a thickness and strength for the anticipated loads. The grate shall have an available inlet area equal to at least the outlet drain for the catch basin, floor drain or trench drain.

Note: Residential exclusion see SPS 325.01 (4) (c).

(5) GREASE AND OIL TREATMENT.

(a) All plumbing installations for occupancies, other than Dwelling Units, where grease, fats, oils or similar waste products of cooking or food are introduced into the drain system shall be provided with grease and oil treatment in accordance with this subsection.

(b) ***General.***

1. `Public sewers.' All new, altered, or remodeled plumbing systems which discharge to public sewers shall be provided with one or more grease interceptors.

a. Where one or more exterior grease interceptors are provided all, and only, Kitchen wastes shall be discharged to an exterior interceptor.

b. Except as required in subd. 1. c. or d., where one or more interior grease interceptors are provided the wastes from a food waste grinder, a sanitizing compartment of a sink or a rinse compartment of a sink, may bypass the interceptor or interceptors.

c. The wash compartment of a scullery sink shall discharge through a grease interceptor.

d. The pre-wash compartment not discharging through a garbage disposal shall discharge through a grease interceptor.

2. `Private onsite wastewater treatment systems.' All new, altered or remodeled plumbing systems which discharge to private onsite wastewater treatment systems shall be provided with exterior grease interceptors.

a. Except as provided in subd. 2. b., only Kitchen and food wastes shall be discharged to an exterior grease interceptor.

b. For remodeling, when it is not practicable to separate Kitchen and toilet wastes, combined Kitchen wastes and toilet wastes may be discharged directly to a private onsite wastewater treatment component tank or tanks which conform to par. (c). The required capacity of a grease interceptor shall be added to the required septic tank capacity as specified in ch. SPS 383.

c. For holding tank installations, the combined Kitchen and toilet wastes may discharge directly to a holding tank where the location accepting the pumpage from the tank provides written acceptance of the combined waste to the Department.

3. `Existing installations.' The Department may require the installation of any treatment device deemed necessary by the Department for existing plumbing installations where the waterway of a drain system, sewer system or private onsite wastewater treatment system is reduced or filled due to grease.

(c) ***Exterior grease interceptors.*** Exterior grease interceptors shall receive the entire waste discharge from Kitchens or food processing areas. All exterior interceptors shall be designed and constructed in accordance with this paragraph, so as to constitute an individual structure.

1. `Design.'

a. The liquid depth of the interceptor shall not be less than 42" nor more than an average of 72".

b. A rectangular interceptor tank shall have a minimum width of 36" and a minimum length of 72". The longest dimension of the tank shall be parallel to the direction of waste flow.

c. A horizontal-cylindrical interceptor tank shall have a minimum inside diameter of 52" and a minimum length of 72". The longest dimension of the tank shall be parallel to the direction of waste flow.

d. Vertical-cylindrical interceptor tanks shall have a minimum inside diameter of 72".

e. Each prefabricated interceptor tank shall be clearly marked to indicate liquid capacity and the name and address or registered trademark of the manufacturer. The markings shall be impressed into or embossed onto the outside wall of the tank immediately above the outlet opening. Each site-constructed concrete tank shall be clearly marked at the outlet opening to indicate the liquid capacity. The marking shall be impressed into or embossed onto the outside wall of the tank immediately above the outlet opening.

f. The inlet and outlet openings of interceptor tanks or tank compartments shall be provided with open-end sanitary tee fittings or baffles, so designed and constructed as to distribute the flow and retain the grease in the tank or tank compartments. The sanitary tee fittings or baffles shall extend at least 6" above the liquid level. At least 2" of clear space shall be provided above the top of the sanitary tee fittings or baffles. The sanitary tee fitting or baffle at the inlet opening shall extend below the liquid level of the tank a distance equal to 1⁄3 of the total liquid depth. The sanitary tee fitting or baffle at the outlet opening shall extend below the liquid level of the tank a distance equal to 2⁄3 of the total liquid depth. The waterline in the interceptor shall be at least 2" below the horizontal drain discharging to the interceptor.

g. Each compartment of an interceptor tank shall be provided with at least one manhole opening located over either the inlet or outlet opening. Additional manhole openings shall be provided such that no interior compartment wall of a tank is more than 4 feet from the edge of the manhole opening. The distance between manhole openings serving the same compartment shall not exceed 8 feet. Manhole openings shall be not less than 23" in the least dimension. Manholes shall terminate at or above ground surface and be of Approved materials. Steel tanks shall have a minimum 2" collar for the manhole extensions permanently welded to the tank. The manhole

extension on fiberglass tanks shall be of the same material as the tank and an integral part of the tank. The collar shall have a minimum height of 2".

h. Manhole risers for interceptor tanks shall be provided with a substantial, fitted, watertight cover of concrete, steel, cast iron or other Approved material. Manhole covers shall terminate at or above grade and shall have an Approved locking device.

i. A minimum 4 × 6-inch permanent label shall be affixed to the manhole cover, identifying the interceptor tank with the words GREASE INTERCEPTOR. Where the tank acts as the septic tank and grease interceptor the label shall identify it as such. The wording used on the warning label shall be Approved by the Department, as part of the materials approval for the tank under ch. SPS 384.

j. An inlet or outlet opening which does not have a manhole opening as specified in subd. 1. g. shall be provided with an airtight inspection opening located over the inlet or outlet. The inspection opening shall be at least 4" in diameter. The inspection opening shall terminate at or above grade.

Note: See ch. SPS 382 Appendix for further explanatory material.

2. `Capacity and sizing.' The minimum liquid capacity of a grease interceptor shall be determined in accordance with the provisions of this subdivision, except no grease interceptor may have a capacity of less than 1000 gallons if the interceptor is to discharge to a private onsite wastewater treatment system or less than 750 gallons if the interceptor is to discharge to a municipal sewer system and treatment facility.

a. The minimum capacity of a grease interceptor serving a restaurant with seating shall be equal to C, where. See PDF for diagram - See PDF for table - See PDF for diagram - See PDF for table

c. The minimum capacity of a grease interceptor as determined in subd. 2. a. or b. may be halved for establishments with all paper service, but may not be less than 1000 gallons if the interceptor is to discharge to a private sewage system or less than 750 gallons if the interceptor is to discharge to a municipal sewer system and treatment facility.

3. `Installation.'

a. Grease interceptor tanks may not be located within 5 feet of a building or any portion of the building or swimming pool; 10 feet of a water service; 2 feet of a lot line; 10 feet of a cistern or 10 feet of a reservoir or high-water mark of a lake, stream, pond, or flowage.

b. Where a grease interceptor tank is installed in groundwater, the tank shall be adequately anchored.

c. Grease interceptor tanks shall be installed on a bedding of at least 3" in depth. The bedding material shall be sand, gravel, granite, limestone, or other noncorrosive materials of a size that all will pass through a 3⁄4" sieve.

d. The backfill material for steel and fiberglass grease interceptor tanks shall be as specified in subd. 3. c. for bedding and shall be tamped into place. The backfill material for concrete grease interceptor tanks shall be soil material, of a size that will pass through a 4-inch screen and shall be tamped into place.

e. All joints on concrete risers and manhole covers for a grease interceptor shall be tongue and groove or shiplap type and sealed watertight using neat cement, mortar, or bituminous compound. All joints on steel risers for a grease interceptor shall be welded or flanged and bolted and be watertight. All steel manhole extensions from a grease interceptor shall be bituminous coated inside and outside. All methods of attaching fiberglass risers for a grease interceptor shall be watertight and Approved by the Department.

(d) ***Interior grease interceptors.***

1. `Flow rating.' An interior grease interceptor shall be capable of accommodating a flow of at least 15 gallons per minute, but not less than the manufacturer's specifications.

2. `Flow rate related to connected capacity.' Three-fourths of the total holding capacity in gallons of all fixtures and devices discharging to an interior grease interceptor, shall not exceed the value of the maximum flow rate which the interceptor can accommodate.

3. `Grease holding capacity as related to flow rate.' The grease holding capacity in pounds shall not be less than double the value of the maximum flow rate which the interceptor can accommodate.

4. `Flow controls.' Where required by the manufacturer, devices which control the rate of flow through an interior grease intercept shall be installed.

a. The flow control devices shall be accessible for inspection, service, and cleaning.

b. Flow controls shall be installed in the drain branch leading to each fixture and shall be so rated that the combined flow from all combinations of discharge will not develop either sufficient static or velocity head so the established flow rate of the interceptor can be exceeded.

Note: See ch. SPS 382 Appendix for further explanatory material.

5. `Flow control vents.' Orifice type flow controls for an interior grease interceptor shall be vented in accordance with SPS 382.31.

6. `Prohibited locations and types.' No water-cooled grease interceptor may be installed. No grease interceptor may be located where the surrounding temperatures, under operating conditions, are less than 40º F.

7. A maximum of 12 inches of horizontal inlet pipe may be submerged.

(e) ***Prohibited treatment.*** The introduction of grease or fat emulsifiers into a grease interceptor shall be prohibited.

(8) OIL AND FLAMMABLE LIQUIDS. Oily and flammable wastewater that discharges to a building sewer shall be intercepted or treated by a means acceptable to the Department.

(a) ***Site-constructed interceptors.*** Site-constructed interceptors shall be designed in accordance with the requirements in sub. (4) (a) 2.

(b) ***Prefabricated oil interceptors and separators.*** Prefabricated oil interceptors and separators shall be manufactured with adequate capacity for the anticipated load.

(c) ***Venting.*** Oil and flammable interceptors and separators shall be so designed to prevent the accumulation of explosive gases.

1. A covered interceptor or separator shall be provided with an individual Vent of at least 3 inches in diameter. The Vent shall extend from the top of the interceptor or separator or as high as possible, from the side of the interceptor or separator to a point at least 12 feet above grade.

2. The drainpipe to the interceptor or separator shall be provided with a fresh air inlet connected within 2 feet of the inlet of the interceptor or separator. The fresh air inlet shall terminate at least one foot above grade, but not less than 6 feet below the terminating elevation of the Vent serving the interceptor or separator. The fresh air inlet shall be at least 3 inches in diameter.

Note: See ch. SPS 382 Appendix for further explanatory material.

(12) SAND INTERCEPTORS. Sand interceptors and other similar interceptors for heavy solids shall be so designed and located as to be accessible for cleaning. The outlet for the interceptor shall be submerged to form a trap with a water seal of at least 12".

(13) PLASTER AND HEAVY SOLIDS TRAP TYPE INTERCEPTORS. Plaster sinks shall be provided with plaster and heavy solids trap type interceptors.

(a) The interceptor shall be installed as the fixture trap.

(b) The drain piping between the sink and the interceptor shall not exceed a length of 36".

Note: See ch. SPS 382 Appendix for further explanatory material.

(15) SPECIAL WASTEWATER OR MIXED WASTEWATER TREATMENT OR CONTAINMENT DEVICES. Mixed wastewater treatment and containment devices, decontamination tanks or other special wastewater treatment devices shall discharge to a dispersal or treatment system in accordance with this section or as Approved by the Department.

Note: A sanitary permit may be required. See ch. SPS 383 for requirements relating to containment tank installation with no valved discharge.

(a) ***Installation.***

1. Exterior containment devices or treatment systems for mixed wastewater, decontamination tanks and other special wastewater treatment devices shall not be located within 5 feet of a building or any portion of the building or swimming pool; 10 feet of a water service; 2 feet of a lot line; 10 feet of a clearwater cistern or 10 feet of the high-water mark of a lake, stream, pond or flowage.

2. Exterior containment devices or treatment systems for mixed wastewater, decontamination tanks or other special wastewater treatment devices shall be constructed in accordance with SPS 384.25 or as Approved by the Department.

(b) ***Vents.*** Vents for mixed wastewater, decontamination tanks and other special wastewater treatment systems shall be sized and installed in accordance with SPS 382.31.

(c) ***Alarm system.*** Containment devices or treatment systems for mixed wastewater, decontamination tanks and other special wastewater treatment devices shall be equipped with an alarm.

(d) ***Sampling provision.*** Containment devices or treatment systems for mixed wastewater, decontamination tanks and other special wastewater treatment devices shall be equipped to allow the collection of a representative sample.

(e) ***Pump requirements.***

1. A discharge line serving a containment tank for servicing purposes shall comply with all of the following:

a. A pipe serving as the discharge line shall be of an acceptable type in accordance with ch. SPS 384.

b. A discharge line shall terminate with a service port consisting of a quick disconnect fitting with a removable plug.

c. The service port of a discharge line shall terminate at least 2 feet above final grade.

d. The service port of a discharge line shall be identified as such with a permanent sign with lettering at least 1/2 inch in height.

e. The service port of a discharge line shall be secured to a permanent support that is capable of withstanding the loads and forces placed on the port.

f. A discharge line shall be at least 3 inches in diameter.

2. Where a lift station is employed for servicing a containment tank, the pump discharge line shall conform with subd. 1., except as provided in subd. 2. a. and b.

a. A discharge line from the lift station shall be at least 2 inches in diameter.

b. The lift station pump shall be activated by means of a keyed switch at the service port.

(f) ***Sizing.*** The volume of the mixed wastewater treatment or containment device shall be based on anticipated use.

SPS 382.35 Cleanouts.

(1) SCOPE. The provisions of this section set forth the requirements for the installation of cleanouts and manholes for all drain piping.

(2) MATERIALS. Cleanouts shall be constructed of Approved materials in accordance with ch. SPS 384.

(3) WHERE REQUIRED.

(a) ***Horizontal drains.*** All gravity horizontal drains within or under a building shall be accessible through a cleanout in accordance with one of the following requirements:

1. The developed length of drain piping between cleanouts for above-ground piping may not exceed 75 feet.

2. The developed length of drain piping between cleanouts for below ground piping 2 inches or less in diameter may not exceed 40 feet.

3. The developed length of drain piping between cleanouts for below ground piping greater than 2 inches in diameter may not exceed 75 feet.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Sanitary building sewers.***

1. Sanitary building sewers 6" or less in diameter shall be provided with cleanouts or manholes such that:

a. Cleanouts are located not more than 100 feet apart;

b. Manholes are located not more than 400 feet apart;

c. The distance from a clean out to a manhole located upstream is not more than 200 feet; or

d. The distance from a manhole to a cleanout located upstream is not more than 300 feet.

2. Sanitary building sewers 8" or larger in diameter shall be provided with manholes at:

a. Every horizontal change in direction of more than 45 degrees where the change in direction is created within a distance of less than 10 feet;

b. Every change in pipe diameters where both connections are 8 inches or larger; and

c. Intervals of not more than 400 feet.

(c) ***Storm building sewers.***

1. Storm building sewers 10" or less in diameter shall be provided with cleanouts or manholes such that:

a. Cleanouts are located not more than 100 feet apart;

b. Manholes are located not more than 400 feet apart;

c. The distance from a clean out to a manhole located upstream is not more than 200 feet; or

d. The distance from a manhole to a cleanout located upstream is not more than 300 feet.

2. Storm building sewers 12" or larger in diameter shall be provided with manholes or storm drain inlets with an inside diameter of at least 36" at:

a. Every horizontal change in direction of more than 45 degrees where the change in direction is created within a distance of less than 10 feet,

b. Every change in pipe diameter where both connections are 12 inches or larger, and

c. Intervals of not more than 400 feet.

(d) ***Private interceptor main sewers.***

1. Private interceptor main sewers 5" or less in diameter shall be provided with an exterior cleanout or manhole upstream of the point of the creation of the private interceptor main sewer and such that:

a. Cleanouts are located not more than 100 feet apart;

b. Manholes are located not more than 400 feet apart;

c. The distance from a clean out to a manhole located upstream is not more than 200 feet; or

d. The distance from a manhole to a cleanout located upstream is not more than 300 feet.

2. Private interceptor main sewers 6" or larger in diameter shall be provided with a manhole at:

a. The most upstream point of the private interceptor main sewer;

b. Every horizontal change in direction of more than 45 degrees where the change in direction is created within a distance of less than 10 feet,

c. Every change in pipe diameter where both connections are 6 inches or larger, and

d. Intervals of not more than 400 feet.

(e) ***Junction of building drain and building sewer.*** A cleanout shall be provided near the junction of a building drain and a building sewer.

1. The cleanout shall be located within 5 feet of where the building drain and the building sewer connect. The cleanout may be located either inside or outside the building.

2. A cleanout in a drain stack may serve as the cleanout at the junction of the building drain and building sewer, if the stack is within 5 feet of where the building drain and building sewer connect.

(f) ***Stacks.*** Where a cleanout is provided in a drain stack, the cleanout shall be located 28 to 60 inches above the lowest floor penetrated by the stack.

(g) ***Branches.***

1. Except as provided in subd. 2., cleanouts shall be provided in connection with batteries of fixtures at such points that all parts of the branch drain may be accessible for cleaning or removal of stoppages. For the purposes of this requirement, removable fixture traps may serve as cleanout openings.

2. A cleanout shall not be required for a branch drain when the fixtures on the branch include one floor outlet fixture and any fixtures discharging into an accompanying wet vent.

(h) ***Greasy wastes.*** Drainpipes carrying greasy wastes shall be provided with cleanouts located not more than 40 feet apart and at all changes in direction of more than 45°.

(i) ***Double sanitary tees.*** A cleanout shall be provided immediately above or below a double sanitary tee drain fitting which is installed in a vertical drain pipe of less than 3" in diameter, unless a stack cleanout is provided in accordance with par. (f).

(j) ***Traps and fixture drains.***

1. All traps shall be constructed or installed so that stoppages may be removed from the traps and the horizontal portions of fixture drains.

2. If a trap is not accessible for removal or does not contain a removable dip, a cleanout or a removable inlet shall be installed to enable cleaning of the trap passageway and the horizontal portions of the fixture drain.

(k) ***Conductors.*** Where a cleanout is provided in a conductor, the cleanout shall be located 28 to 60" above the lowest floor penetrated by the conductor.

(L) ***Sampling manholes.*** Municipalities or sanitary sewage districts by ordinance or rule may require the installation of sampling manholes for periodic sewage monitoring.

Note: The installation of sampling manholes may be needed for the monitoring of industrial wastes. See ch. SPS 382 Appendix for further explanatory material.

(m) ***Catch basins and interceptors.*** The fixture drain from all interceptors designed in accordance with SPS 382.34 (4) (a) 2. shall be provided with an accessible cleanout located outside of the basin and not more than 15 inches from the weir of the trap.

(4) DIRECTION OF FLOW. Every cleanout shall be installed so as to open in the direction of the waste flow or at a right angle thereto.

(5) ACCESSIBILITY. Cleanout plugs shall not be covered with cement, plaster, or any other similar permanent finishing material.

(a) ***Underground piping.*** Cleanouts installed in underground drain piping shall be extended vertically to or above the finish grade.

1. All interior and exterior cleanouts where the vertical distance between the horizontal drainpipe being served and the top of the cleanout opening exceeds 18 inches in length, shall connect to the drain piping through a fitting as specified in Table 382.30–4.

2. A cleanout located outside of a building shall be provided with a frost sleeve.

a. The frost sleeve shall be of a material Approved for building sewers in accordance with SPS 384.30 (2) (c).

b. Where a cleanout is located in an area subject to vehicular traffic the top of the frost sleeve shall terminate in a concrete pad at least 4" thick and extending at least 9" from the sleeve on all sides, sloping away from the sleeve.

c. The bottom of the frost sleeve shall terminate 6" to 12" above the top of the drain piping or at least 6" below the predicted frost depth in accordance with SPS 382.30 Table 382.30-6.

d. The frost sleeve shall have a removable watertight top of sufficient thickness and strength to sustain the weight of anticipated traffic.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Concealed piping.*** Cleanout access for drain piping located in concealed spaces shall be provided by either extending the cleanout to at least the surface of a wall or floor or by providing access panels of a sufficient size to permit removal of the cleanout plug and proper cleaning of the pipe.

(6) CLEANOUT SIZE. Cleanouts and cleanout extensions shall be sized in accordance with Table 382.35.
- See PDF for table

(7) PROHIBITED USE OF CLEANOUT OPENINGS. Cleanout openings shall not be used for the installation of fixtures or floor drains, except where another cleanout of equal access and capacity is provided.

SPS 382.36 Stormwater and clearwater plumbing systems.

(1) SCOPE. The provisions of this section set forth the requirements for the design, installation and maintenance of piping, conveyance, venting, detention, and treatment of stormwater and clearwater in plumbing systems.

(2) MATERIALS. All stormwater and clearwater plumbing systems shall be constructed of Approved materials in accordance with SPS 384. 30 (3).

(3) DESIGN OF STORMWATER PLUMBING SYSTEMS.

(a) Plumbing systems upstream of detention shall be designed, at a minimum, based on the 10-year, 24-hour storm event.

(b) Plumbing detention systems and plumbing systems located downstream of detention shall be designed based on anticipated flows and volumes.

(c) Stormwater and clearwater infiltration systems shall comply with SPS 382.365.

Note: For a listing of Best Management Practices (BMPs) refer to ch. SPS 382 Appendix A-382.36 (3)-1.

Note: Where local discharge requirements are more stringent, stormwater plumbing systems may provide detention and treatment to comply with the local stormwater management plan.

(4) DISCHARGE, DISPERSAL, CLEARWATER REUSE OR STORMWATER USE.

(a) ***Discharge points.*** The discharge points for stormwater and clearwater shall be as specified in Table 382.38-1.

(b) ***Segregation of wastewater.***

1. Except as provided in subd. 2., stormwater or clearwater piping may not connect to a sanitary drain system.

2. Where a combined sanitary-storm sewer system is available, stormwater, clearwater and sanitary wastewater may be combined in the building sewer.

3. Stormwater gravity drains shall not be combined with clearwater drains prior to discharging to the storm building drain except where Approved by the Department.

Note: See also Table SPS 382.38-1 which limits clearwater discharges to sanitary sewer at 50 gpd.

Note: For the use of stormwater or reuse of clearwater, refer to the appropriate requirements in SPS 382.30, 382.34, 382.40, 382.41, 382.70 and this section.

Note: For further explanatory material regarding the rational method, other methods and runoff co-efficient, see ch. SPS 382 Appendix A-382.36 (4).

(5) INPUT CALCULATIONS.

(a) ***Peak flow.*** The peak flow of stormwater influent to a plumbing system shall be calculated using any of the following methods:

1. `Area method.' For sizing of conveyance piping, when calculating stormwater peak flow based on the tributary area, the area in square feet shall be divided by the following applicable divisors:

a. For roofs the divisor is 26 square feet/gpm.

b. For paved or graveled ground surfaces the divisor is 32.5 square feet/gpm.

c. For lawns, parks, and similar land surfaces the divisor is 104 square feet/gpm.

Note: For example, 10,000 square feet of roof area/26 square feet/gpm = 385 gpm or 0.85 cubic feet/second.

2. `Rational method.' For calculating peak flow, the intensity shall be determined using the time of concentration for the tributary area.

Note: For the equation procedure for runoff coefficients for use with the rational method, refer to ch. SPS 382 Appendix A-382.36 (5)-1.

3. `Engineering analysis method.' An engineering analysis, acceptable to the Department, shall be based on the peak flow calculated in accordance with sub. (3) (a).

Note: A model that calculates peak flow such as SWMM, TR-20, TR-55, P8 or an equivalent methodology may be used.

(b) ***Volume.*** The volume of stormwater influent to a plumbing system shall be based on an engineering design acceptable to the Department and a minimum of a two-year, 24-hour storm event and designed so that no property damage occurs at 100-year, 24-hour storm event with a Type II distribution.

Note: For runoff coefficients and use of other methods or models, refer to ch. SPS 382 Appendix A-382.36 (5)-2 and A-382.36 (5)-3.

Note: The intensity of rainfall varies considerably during a storm as well as geographic regions. To represent various regions of the United States, the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) developed four synthetic 24-hour rainfall distribution types from available National Weather Service (NWS) duration-frequency data (Hershfield 1961; Frederick et al., 1977) or local storm data. Type IA is the least intense and type II is the most intense short duration rainfall. Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Type III represents Gulf of Mexico and Atlantic coastal areas where tropical storms bring large 24-hour rainfall amounts. Type II represents the rest of the country, including Wisconsin. For more information, see the USDA-NRCS webpage: http://www.nrcs.usda.gov/.

(c) ***Additional inputs to stormwater systems.*** Additional inputs to stormwater systems shall be estimated based on anticipated flows and volumes.

(6) CONVEYANCE AND DETENTION SYSTEMS.

(a) ***Design.*** The design of stormwater and clearwater conveyance systems shall conform to all of the following:

1. Horizontal stormwater conveyance piping shall be sized using either of the following:

a. An engineering analysis, based on full flow capacity, acceptable to the Department.

b. Tables 382.36-1 to 382.36-5 based on pipe type, diameter, and pitch.

2.

a. A vertical conductor for stormwater may not be smaller than the largest horizontal branch discharging into the conductor.

b. Vertical conductors shall be sized in accordance with Tables 382.36-1 and 382.36-3 or by an engineering analysis acceptable to the Department.

Note: For the use of Baird's equation, refer to ch. SPS 382 Appendix A-382.36 (6)-1.

3. Clearwater conveyance systems shall be sized in accordance with SPS 382.30 (3) and (4).

4. Underground, gravity-flow storm building sewers shall have a minimum 3-inch inside diameter.

(b) ***Velocity in stormwater conveyance system piping.*** The pitch of stormwater conveyance system piping shall be designed to create a minimum velocity of one foot per second when flowing full.

(c) ***Fittings and connections.***

1. Except as provided in subd. 2., fittings and connections for stormwater and clearwater conveyance systems shall comply with SPS 382.30 (8) and (9).

2. The minimum radius for the first 90° fitting located downstream of a roof drain shall comply with the horizontal to vertical requirements in Table 382.30-4.

(d) ***Stack offsets.*** Stack offsets for piping of a clearwater conveyance system piping shall comply with SPS 382.30 (6).

(e) ***Pitch of clearwater gravity conveyance system piping.***

1. The minimum pitch of gravity conveyance system piping having a 2-inch inside diameter or less shall be 1/8 inch per foot.

2. The minimum pitch of clearwater gravity conveyance system piping having at least a 3-inch inside diameter or more shall be 1/16 inch per foot.

(f) ***Branch connections near base of stack.*** Branch drains from interior clearwater inlets may not connect downstream from the base fitting or fittings of a drain stack within a distance equal to 20 pipe diameters of the building drain.

(g) ***Detention systems***.

1. The storage volume of a dry detention system shall be designed and installed with a drain time of 72 hours after a storm event.

2. Paved surfaces or parking lots serving as detention areas shall be limited to a design depth of 6 inches, unless otherwise limited by local ordinance.

3. By design, ground surface ponding shall drain within 24 hours after a storm event. - See PDF for table

Note: To convert to cubic feet per second (cfs) divide gpm by 448.8. - See PDF for table

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(7) OTHER DESIGN REQUIREMENTS.

(a) ***Subsoil drains.***

1. A subsoil drain discharging to a plumbing system shall discharge into an area drain, manhole or storm sewer, trapped receptor or a sump with a pump.

2. Where a Foundation drain is subject to backwater, the drain shall be protected by a backwater valve or a sump with a pump.

(b) ***Backwater valve.*** All backwater valves shall be accessible for maintenance.

(c) ***Sewer location.***

1. No storm building sewer or private interceptor main storm sewer may pass through or under a building to serve another building, unless one of the following conditions is met:

b. Where a storm building sewer or private interceptor main storm sewer serves buildings that are located on one property, a document that indicates the piping and distribution arrangement for the property and buildings is recorded with the register of deeds no later than 90 days after installation.

2. The location of storm building drains and building sewers shall comply with SPS 382.30 (11) (d) and 382.40 (8) (b) 7.

(d) ***Installation requirements.***

1. The connection of a stormwater leader discharging to a storm building sewer shall be made above the finished grade.

Note: For more information regarding joints and connections, refer to SPS 384.40.

2. The elevation of a storm building drain shall comply with SPS 382.30 (11) (b) 1.

3. Interior inlets and drains subject to backflow or backwater shall be protected with a check valve or backwater valve.

4. Storm building drains and building sewers shall be installed to comply with SPS 382.30 (11) (e).

5. Storm building sewer connections to public sewers shall be in accordance with. SPS 382.30 (11) (f).

6. Cleanouts for conveyance system piping shall be installed in accordance with SPS 382.35.

7. Storm building sewers that receive clearwater and that may be subject to freezing shall be installed in accordance with SPS 382.30 (11) (c) 2.

8. Storm building drains, clearwater building drains, and building storm sewers and appurtenances shall be separated from water wells by the applicable separation distances, or as otherwise permitted by the Land and Natural Resources Division.

9. All underground stormwater storage tanks for water reuse shall be separated from sanitary sewers by a minimum of 8 feet.

10.

a. A means to locate buried non-metallic storm building sewers and private interceptor main sewers that discharge to municipal mains shall be provided in accordance with the options under SPS 382.30 (11) (h), except as provided in subd. 10. b.

b. Tracer wire insulation color for non-metallic storm pipe shall be brown.

(8) SUMPS AND PUMPS.

(a) ***Sumps.***

1. `General.' All storm building subdrains shall discharge into a sump, the contents of which shall be automatically lifted and discharged, dispersed or used in accordance with sub. (4).

2. `Construction and installation'.

a. Except as provided in subd. 2. c. and d., an interior sump shall have a rim extending at least one inch above the floor immediately adjacent to the sump.

b. A sump shall have a removable cover of sufficient strength for anticipated loads.

c. Where a sump is installed in an exterior meter pit or elevator pit, the rim may be level with the floor.

d. When a sump is provided with an airtight, solid cover.

3. `Location'. All sumps installed for the purpose of receiving clearwater, groundwater or stormwater shall be separated from water wells by the applicable separation distances, or as otherwise permitted by the Land and Natural Resources Division.

4. `Size'.

a. Except as permitted under subd. 4. b. or c. the size of each sump shall be no smaller than 16 inches in diameter at the top, 14 inches in diameter at the bottom, and 22 inches in depth.

b. The minimum sump diameter may be smaller than 16 inches when specified by the manufacturer for a combination sump and pump.

c. A sump located in an elevator pit may have a width or diameter of not less than 12 inches and a depth of not less than 12 inches.

(b) ***Pumps.***

1. `Size.' The pump shall be of a capacity appropriate for the anticipated use.

2. `Discharge piping.'

a. Where a pump discharges into a storm drain system, a check valve shall be installed.

b. The minimum diameter discharge piping shall be based on the design flow rate of the pump and a minimum velocity of one foot/second.

(9) INLET REQUIREMENTS.

(a) ***Interior clearwater drain inlets.*** Interior clearwater drain inlets shall terminate at least one inch above the finished floor.

(b) ***Exterior stormwater inlets.***

1. `Construction.'

a. All exterior stormwater inlets shall be constructed of material in accordance with SPS 384.30.

Note: For additional information on Approved materials, refer to SPS 384.30 (3) (f).

b. All exterior stormwater inlets subject to vehicular traffic shall be set on a suitable base capable of sustaining the anticipated load.

2. `Design'. All exterior stormwater inlets shall be designed for the anticipated flow.

Note: For manhole requirements, refer to SPS 382.35 (3).

3. `Inlet grates'

a. General. All inlets shall be provided with a well-fitted, removable grate of a thickness and strength to sustain the anticipated loads.

Note: Sections SPS 362.1101 to 362.1110 specify that for floor or ground surface inlets when placed within an identifiable accessible route, openings in the floor or ground surface shall be of a size that does not permit the passage of a ½-inch sphere. Also, it states that grates having elongated openings be placed so that the longest dimension is perpendicular to the dominant direction of travel.

b. Floor or ground surface inlets. Openings in the floor or ground surface shall be of a size that prohibits the entrapment of wheeled vehicles, wheelchairs, or pedestrians within the grate openings.

c. Grates on horizontal pipes. Grates shall be provided on horizontal inlets greater than 6 inches in diameter. The grates shall be placed so that the rods or bars are not more than 3 inches downstream of the inlet. Rods or bars shall be spaced so that the openings do not permit the passage of a 6-inch sphere.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Subsurface areas of 50 square feet or less.*** Other than Stairwells, all subsurface areas not exceeding 50 square feet and exposed to the weather, shall comply with one of the following:

1. Drain to Foundation drains through a minimum 2-inch diameter pipe or a through a continuous layer of washed stone aggregate.

2. Drain to the storm building drain, storm subdrain or storm sewer through a minimum 3-inch diameter pipe.

(d) ***Subsurface areas of more than 50 square feet and Stairwells.*** An area drain shall be provided in subsurface areas greater than 50 square feet and in all Stairwells exposed to the weather. The area drain shall comply with all of the following:

1. Drain to the storm building drain, storm subdrain or storm sewer.

2. The fixture drain shall have a minimum 3-inch inside diameter and may not discharge into a subsoil or Foundation drain.

(10) ROOF DRAINS.

(a) ***General roofs.*** Roof drains shall be equipped with strainers extending not less than 4 inches above the surface of the roof immediately adjacent to the roof drain. Strainers shall have an available inlet area above the roof of not less than 1.5 times the area of the conductor to which the drain connects.

(b) ***Flat Decks.*** Roof drain strainers used on sun Decks, open parking Decks and similar areas shall be of the flat surface type, shall be level with the Deck and shall have an available inlet area of not less than 2 times the area of the conductor to which the drain connects.

(11) SECONDARY ROOF DRAINS.

(a) ***Sizing.*** When secondary roof drain systems are installed, the secondary system shall be sized and installed in accordance with the requirements in this section.

(b) ***Prohibited connection.*** Secondary roof drain systems may not be connected to primary roof drain systems.

(c) ***Discharge.*** All secondary roof drain systems shall discharge in accordance with Table 382.38–1.

(12) TRAPS AND VENTS.

(a) ***Traps.***

1. Traps are required for interior drain inlets receiving clearwater.

2. Except for exterior loading dock drains, traps are required for exterior drain inlets located within 10 feet of an air inlet, door, or openable Window.

3. More than one drain inlet may discharge to the same trap.

4. A Foundation drain that discharges by gravity to a storm sewer shall be trapped. The trap shall be provided with cleanouts.

(b) ***Vents.***

1. A trap receiving clearwater shall be vented in accordance with SPS 382.31. Vent piping for a clearwater drain system may not be connected to a Vent system serving a sanitary drain system or chemical waste system.

2.

a. Vents serving a solid covered sump shall terminate a minimum of one inch above finished floor.

b. Sump vents shall be sized as per Table 382.31-4.

(13) OPERATION AND MAINTENANCE.

(a) ***Plan.*** An operation and maintenance plan shall be implemented for all stormwater plumbing systems for drainage areas of one or more acres that are installed on or after the effective date of this Code.

(b) ***Plan information.*** An operation and maintenance plan as required in par. (a) shall include at least all of the following information, applicable to the system:

1. Accumulated solids or byproduct removal requirements.

2. Identification of safety hazards.

3. Cleaning and inspection schedule.

4. Inspection and maintenance checklist, including at least the following items:

a. Filters.

b. Disinfection units.

c. Sedimentation chambers.

d. Detention devices.

e. Infiltration systems.

5. Start up and shutdown procedures.

6. Vector control requirements.

7. A contingency plan in the event of system failure.

(c) ***Plan location.*** The operation and maintenance plan shall remain onsite and be available for inspection when requested by the Department.

(d) ***Record of maintenance.*** When requested the Owner shall make available for inspection all maintenance records to the Department or agent for the life of the system.

SPS 382.365 Stormwater and clearwater subsurface infiltration plumbing systems.

(1) SCOPE. The provisions of this section set forth the requirements for the design, installation, and maintenance of stormwater and clearwater subsurface infiltration plumbing systems serving building sites.

Note: The Land and Natural Resources Division has registration requirements for class V injection wells. See ch. SPS 382 Appendix for further explanatory material.

(2) SITE AND SOIL EVALUATION.

(a) ***Site evaluation.*** A site evaluation shall be conducted in accordance with the methods and standards as provided in SPS 385.40 (3) (a).

(b) ***Soil evaluation.***

1. A soil evaluation shall be conducted in accordance with the methods and standards as provided in SPS 385.30 (1) (c).

2. Individuals qualified to conduct soil evaluation under this subsection shall be an individual that maintains either a registration as provided in SPS 305.33 or a license as provided in ch. GHSS 4.

(3) INFILTRATION SYSTEM DESIGN.

(a) ***Influent quality***. For stormwater and clearwater infiltration plumbing systems, the influent quality shall comply with the requirements in Table 382.70-1 for subsurface infiltration and irrigation.

(b) ***In situ soil requirements.***

1. Except as provided in subd. 2., the minimum depth of suitable in situ soil for infiltration systems shall be as specified in Table 382.365-1 to separate the system from the highest groundwater elevation or bedrock. When groundwater mounding calculations affect the depth to seasonal groundwater, the depth of suitable soil shall be measured to the calculated elevation of mounded groundwater.

2. For roof runoff or where treatment has afforded an equivalent level of water quality, the depth of in situ soil shall be no less than one foot of materials finer than coarse sand.

Note: See ch. SPS 382 Appendix for representative water quality levels. - See PDF for table - See PDF for table

(c) ***Hydraulic application rates.*** The maximum hydraulic application rate for stormwater and clearwater subsurface infiltration plumbing systems shall be in accordance with one of the following methods.

1. The maximum hydraulic application rate shall be determined by soil analysis in accordance with sub. (2) (b) and Table 382.365-2.

2. The maximum hydraulic application rate shall be determined by field measurement using a nationally accepted method and the correction factor as determined using Table 382.365-3. To determine the maximum hydraulic application rate, the measured infiltration rate at the infiltrative surface shall be divided by the correction factor as listed in Table 382.365-3. - See PDF for table

a. Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

b. Infiltration rates represent the lowest value for each textural class presented; based on Rawls et al., 1998 [Use of Soil Texture, Bulk Density and Slope of Water Retention Curve to Predict Saturated Hydraulic Conductivity, ASAE, Vol. 41(2), pp. 983-988].

c. Infiltration rate is an average, based on Rawls et al., 1982 (Estimation of Soil Water Properties, Transactions of the American Society of Agricultural Engineers Vol. 25, No. 5 pp. 1316 –1320 and 1328) and Clapp & Hornberger, 1978 (Empirical equations for some hydraulic properties. Water Resources Research 14:601-604). - See PDF for table - See PDF for table

a Ratio is determined by dividing the design infiltration rate from Table 382.365-2 for the textural classification at the bottom of the infiltration device by the design infiltration rate from Table 382.365-3 for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.

(d) ***Groundwater mounding.*** Groundwater mounding consideration shall be included in the design of any stormwater and clearwater subsurface infiltration plumbing system that has a width that exceeds 15 feet and a depth to the estimated highest groundwater elevation.

Note: An acceptable model is provided by the USGS, webpage: http://water.usgs.gov/ogw/techniques.html.

(e) ***Drain down time.***

1. Stormwater and clearwater subsurface infiltration plumbing systems shall be designed to drain within 72 hours after a storm event.

2. By design, ground surface ponding shall drain within 24 hours after a storm event.

(f) ***Setbacks.***

1. Stormwater and clearwater subsurface infiltration plumbing systems shall be located as provided in Table 382.365-4, except for irrigation systems. - See PDF for table

2. All stormwater and clearwater subsurface infiltration plumbing systems shall be separated from water wells by the applicable separation distances or as otherwise Approved by the Land and Natural Resources Division.

(4) INSTALLATION.

(a) ***Orientation.*** Except for subsurface irrigation systems, all of the following shall apply:

1. The longest dimension of a stormwater or clearwater subsurface infiltration plumbing system consisting in part of in situ soil shall be oriented along the surface contour of the site location, unless otherwise Approved by the Department.

2. The infiltrative surface of a stormwater or clearwater subsurface infiltration plumbing system consisting in part of in situ soil and located below the surface of the original grade shall be level.

(b) ***Other requirements.***

1. A stormwater or clearwater subsurface infiltration plumbing system consisting in part of in situ soil may not be installed if the soil is frozen at the infiltrative surface.

2. Snow cover shall be removed before excavating or installing a stormwater or clearwater system component consisting in part of in situ soil.

3. For a stormwater or clearwater subsurface infiltration plumbing system consisting in part of in situ soil, the soil moisture content shall be evaluated immediately prior to installation of the component. If the soil evaluation at the infiltrative surface results in the sample capable of being rolled into a ¼ – inch wire, the installation may not proceed.

Note: To accomplish a field test for soil wetness, a soil sample the size of one's palm may be rolled to form at least a ¼-inch wire.

4. All vessels and pipes of a stormwater or clearwater subsurface infiltration plumbing system shall be bedded in accordance with a product approval under SPS 384.10 or a plan approval under SPS 382.20.

(5) OPERATION AND MAINTENANCE.

(a) ***General.*** Operation and maintenance shall be performed in accordance with the operation and maintenance plan submitted with the stormwater and clearwater subsurface infiltration plumbing system design and SPS 382.36 (13), where applicable.

SPS 382.37 Sanitation Facilities and Campgrounds (Intentionally Omitted).

SPS 382.38 Discharge points.

(1) PURPOSE. The purpose of this section is to establish allowable discharge points for wastewater discharging from plumbing systems.

(2) SCOPE. The provisions of this section set forth the requirements for the discharge points for wastewater based on the use of the fixtures, appurtenances, appliances, and devices discharging into the plumbing system.

(3) GENERAL REQUIREMENTS.

(a) Wastewater from plumbing systems shall be discharged as specified in Table 382.38-1.

(b) Wastewater from uses other than those listed in Table 382.38-1, shall be discharged as specified by the Department on a site-specific basis. - See PDF for table

Subchapter IV — Water Supply Systems

SPS 382.40 Water supply systems.

(1) SCOPE. The provisions of this section set forth the requirements for the design and installation of water supply systems.

(2) MATERIALS. All water supply systems shall be constructed of Approved materials in accordance with ch. SPS 384.

(3) GENERAL.

(a) ***Water quality.***

1. Every outlet providing water shall be provided with water of the quality as specified under SPS 382.70 (3) for the intended use.

2. Non potable water may be supplied to water treatment devices or systems designed to treat water for compliance with Table 382.70-1.

(b) ***Hot water required.*** Except as provided in subds. 1. and 2., hot water shall be provided to all plumbing fixtures, appliances and equipment used for personal washing, culinary purposes or laundering.

1. Tempered water.

a. Tempered water or hot water shall be provided to lavatories, wash fountains and shower heads which are not located in Dwelling Units or living units.

b. Tempered water supplied to serve multiple lavatories, wash fountains and shower heads shall be provided by means of temperature-actuated mixing valves that comply with ASSE 1017.

(c) ***Protection.***

1. The interconnection of 2 or more water supply systems, one system served by a public supply source and the other system served by another supply source is prohibited, unless Approved in writing by the Department.

2. A water supply system shall be designed and installed in accordance with SPS 382.41 and maintained to prevent non potable liquids, solids or gases from being introduced into the potable water supply system through cross connections.

3.

a. Except as provided in subd. 3. b., when a connection between 2 water supply systems exists, one system having a higher degree of hazard than the other system as specified in SPS 382.41, the water supply system with a lower degree of hazard shall be protected as specified in SPS 382.41.

b. When a water treatment device is provided to lower the concentration of a health-related contaminant, cross connection control shall not be required to protect the water supply system downstream of the treatment device from the upstream contaminated source.

(d) ***Identification.***

1. Where buildings or facilities contain water supply systems where the water supply systems have different degrees of hazard, then those water supply systems shall be labeled in accordance with this section.

a. Above ground piping supplying water other than potable shall be labeled by tags or colored bands according to Table 382.40–1a.

Note: When identifying potable water piping or valves with tags or bands, label according to Table 382.40–1a.

b. Valves supplying other than potable water shall be identified by tags according to Table 382.40–1a.

c. The tags or colored bands shall be placed at intervals of not more than 25 feet. Where piping passes through a wall, floor or roof, the piping shall be so identified on each side of the wall and within each compartment.

d. The colored bands shall be at least 3 inches wide and shall bear text identifying the water or the specific use.

e. Tags used to identify water outlets, valves and piping shall be of metal or plastic in the shape specified in Table 382.40–1a.

f. The lettering on the triangular and circular tags shall be at least 1/2 inch in height.

g. A hose bibb intended to discharge water that does not meet drinking water quality as specified in SPS 382.70, shall be labeled as non-potable or so identified for the specific use or uses, and shall be equipped with a removable handle.

2. Piping downstream of cross connection control assemblies as listed in Table 382.22–1 shall be labeled with bands or tags as specified in subd. 1. a. to f.

3. Where a building or a structure is served by 2 distribution systems, one system supplied by a public water supply and the other system supplied by a private well, each water distribution system shall be identified to indicate the supply source.

4. The installation of each reduced pressure principle backflow preventer, reduced pressure fire protection principle backflow preventer, reduced pressure detector fire protection backflow preventer, spill resistant vacuum breaker and pressure vacuum breaker shall display a Wisconsin DSPS assigned identification number.

a. The method to display the Department assigned identification number shall be a weather-resistant tag, securely attached to the cross-connection control assembly.

b. The tag shall contain at least the following information. - See PDF for table

c. The Wisconsin DSPS assigned identification number shall be printed in the blank area with a permanent, waterproof marker or similar indelible method.

(e) ***Multipurpose piping system.***

1. Except as provided in subd. 2., a multipurpose piping system shall be designed and installed in accordance with this section and NFPA 13D.

Note: Pursuant to this subdivision and sub. (2), materials for multipurpose piping systems need to be acceptable under the NFPA 13D standard and SPS 384.30, Table 384.30–9.

Note: See SPS 321.095 of the Dwelling Code as to fire protection provisions for multipurpose piping systems.

2. Fire department connections are prohibited in a multipurpose piping system.

(4) CONTROL VALVES.

(a) ***Private water mains.*** Private water mains shall be provided with control valves as specified in this subsection.

1. `Corporation cocks.'

a. If a private water main 2" or less in diameter connects to a public water main, a corporation cock shall be installed at the connection to the public water main.

b. If a private water main 2-1/2" or larger in diameter connects to a public water main, a corporation cock shall be installed not more than 8 feet from the connection to the public water main.

2. `Curb stops.'

a. Except as provided in subd. 2. b., if a private water main connects to public water main, a curb stop shall be installed in the private water main between the corporation cock and the property line.

b. If a private water main 2-1/2" or larger in diameter connects to a public water main, one control valve may serve as the corporation cock and the curb stop. The control valve shall be located not more than 8 feet from the connection to the public water main and shall be accessible for operation.

Note: See ch. SPS 382 Appendix A-382.40 (4) for further explanatory material.

(b) ***Water services.*** Water services shall be provided with control valves as specified in this subsection.

1. `Corporation cocks.'

a. If a water service 2" or less in diameter connects to a public water main, a corporation cock shall be installed at the connection to the public water main.

b. If a water service 2-1/2" or larger in diameter connects to a public water main, a corporation cock shall be installed not more than 8 feet from the connection to the public water main.

2. `Curb stops.'

a. A curb stop shall be installed in each water service which connects to a private water main. The curb stop shall be located outside the building served by the water service.

b. Except as provided in subd. 2. c., a curb stop shall be installed in each water service which connects to a public water main. The curb stop shall be located between the corporation cock and the property line.

c. If a water service 2-1/2" or larger in diameter connects to a public water main, one control valve may serve as the corporation cock and the curb stop. The control valve shall be located not more than 8 feet from the connection to a public water main and shall be accessible for operation.

3. **`Building control valves.'** If a water service serves a building, a building control valve shall be provided in the water service as specified in this subsection.

a. If the water service connects to a public water supply or to a private water supply which has an external pressure tank, the building control valve shall be installed inside the building and located within 3 feet of developed length from the point where the water service first enters the building. If a water meter is provided, the building control valve shall be located upstream of the water meter.

b. If a private water supply includes an internal pressure tank, the building control valve shall be installed inside the building and located within 3 feet of developed length downstream from the internal pressure tank.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Water distribution systems.***

b. A control valve shall be installed in the supply piping to each water heater and water treatment device and in the fixture supply to each plumbing fixture, plumbing appliance, and piece of equipment. The control valve may be part of the bypass piping or an internal part of a water treatment device. When the valve is an internal part of the water treatment device, the device shall be removable for service.

c. If a hot water circulation system is provided, a control valve shall be installed on both the inlet and outlet piping to the circulation pump. If a hot water circulation system has 2 or more return pipelines, a balancing control valve shall be installed in each return piping line.

Note: See sub. (8) (g) for the valve requirements for water temperature control.

2. Control valves shall be installed in water distribution systems serving one- and two-family Dwellings as specified in this subdivision.

a. If a water meter is provided, a control valve shall be installed within 3 feet of developed length downstream from the outlet of the water meter. If bypass piping is provided around a water meter, a control valve shall be installed in the bypass piping.

Note: See sub. (8) (d) 3. for the requirements relating to the bypassing of water meters.

b. A control valve shall be installed in the supply piping to each water heater and water treatment device and in the fixture supply to each water closet, exterior hose bibb, plumbing appliance and piece of equipment. When the valve is an internal part of the water treatment device, the device shall be removable for service.

c. If a hot water circulation system is provided, a control valve shall be installed on both the inlet and outlet piping to the circulation pump. If a hot water circulation system has 2 or more return pipelines, a balancing control valve shall be installed in each return piping line.

(5) HOT WATER SUPPLY SYSTEMS.

(a) ***General.*** Water heating systems shall be sized to provide sufficient hot water to supply peak demand.

Note: Residential exclusion see SPS 325.01 (2).

(b) ***Temperature maintenance.*** If the developed length of hot water distribution piping from the source of the hot water supply to a plumbing fixture or appliance exceeds 100 feet, a circulation system or self-regulating electric heating cable shall be provided to maintain the temperature of the hot water within the distribution piping.

1. If a circulation system is used to maintain the temperature, no uncirculated hot water distribution piping may exceed 25 feet in developed length.

2. If a self-regulating electric heating cable is used to maintain the temperature, the cable shall extend to within 25 feet of each fixture or the appliance.

3. Water distribution piping conveying circulated water or served by a self-regulating electric heating cable shall be insulated to limit the heat loss at the external surface of the pipe insulation to a maximum of 25 BTUs per hour per square foot for aboveground piping and 35 BTUs per hour per square foot for underground piping. The maximum heat loss shall be determined at a temperature differential, ▲T, equal to the maximum water temperature minus a design ambient temperature no higher than 65° F.

4. Water distribution piping served by self-regulating electric heating cable shall be identified as being electrically traced in accordance with ch. SPS 316.

5. The installation of self-regulating electric heating cable may be subcontracted by a plumber to another trade.

Note: See A-382.40 (5) for pipe insulation requirements.

(c) ***Water heaters.*** All water heaters and safety devices shall be designed and constructed in accordance with SPS 384.20 (5) (p).

Note: Water heaters are to be installed in accordance with the requirements specified in Wisconsin chs. SPS 361 to 366 and this Code.

(d) ***Safety devices.*** Water heaters shall be equipped with safety devices as specified in this paragraph.

1. All pressurized storage-type water heaters and unfired hot water storage tanks shall be equipped with one or more combination temperature and pressure relief valves. The temperature steam rating of a combination temperature and pressure relief valve or valves shall equal or exceed the energy input rating in BTU per hour of the water heater. No shut off valve or other restricting device may be installed between the water heater or storage tank and the combination temperature and pressure relief valve.

Note: The temperature steam rating of a combination temperature and pressure relief valve is commonly referred to as the AGA temperature steam rating.

2. All pressurized non-storage type water heaters shall be provided with a pressure relief valve installed at the hot water outlet with no shut off valve between the heater and the relief valve.

3. Temperature and pressure relief valves shall be installed so that the sensing element of the valve extends into the heater or tank and monitors the temperature in the top 6" of the heater or tank.

4. A vacuum relief valve shall be installed in each water heater and hot water storage tank which, when measured from the bottom of the heater or tank, is located more than 20 feet above any faucet or outlet served by the heater or tank.

5. Every relief valve which is designed to discharge water or steam shall be connected to a discharge pipe.

a. The discharge pipe and fittings shall be made of a material acceptable for water distribution piping in accordance with SPS 384.30 (4) (e) 1.

b. The discharge pipe and fittings shall have a diameter not less than the diameter of the relief valve outlet.

c. The discharge pipe may not be trapped.

d. No valve may be installed in the discharge pipe.

e. The discharge pipe shall be installed to drain by gravity flow to a floor served by a floor drain or to a receptor in accordance with SPS 382.33 (8). The outlet of the discharge pipe shall terminate within 6" over the floor or receptor, but not less than a distance equal to twice the diameter of the outlet pipe. The outlet of the discharge pipe may not be threaded.

f. The discharge pipe for a water heater shall terminate within the same room or enclosure within which the water heater or hot water storage tank is located.

(e) ***Controls.***

1. All hot water supply systems shall be equipped with automatic temperature controls capable of adjustments from the lowest to the highest acceptable temperature settings for the intended use.

2. A separate means shall be provided to terminate the energy supplied to each water heater and each hot water circulation system.

(6) LOAD FACTORS FOR WATER SUPPLY SYSTEMS.

(a) ***Intermittent flow fixtures.*** The load factor for intermittent flow fixtures on water supply piping shall be computed in terms of water supply fixture units as specified in Tables 382.40-1b and 382.40-2 for the corresponding fixture and use. Water supply fixture units may be converted to gallons per minute in accordance with Table 382.40-3 or 382.40-3e.

(b) ***Continuous flow devices.*** The load factor for equipment which demands a continuous flow of water shall be computed on the basis of anticipated flow rate in terms of gallons per minute. - See PDF for table - See PDF for table

a. All nonpotable water outlets shall be identified at the point of use for each outlet with the following legends or as otherwise Approved by the Department.

b. Tag should reflect the intended use.

c. Serving an individual or similar plumbing fixtures or appliances. - See PDF for table - See PDF for table - See PDF for table

Note: Values not specified in the table may be calculated by interpolation.

Table 382.40–3e
Conversion of Water Supply Fixture Units to Gallons Per Minute for Water Treatment Devices Serving an Individual Dwelling - See PDF for table

(7) SIZING OF WATER SUPPLY PIPING. The sizing of the water supply system shall be based on the empirical method and limitations outlined in this subsection or on a detailed engineering analysis acceptable to the Department.

(a) ***Methodology.*** The determination of minimum pipe sizes shall take into account the pressure losses which occur throughout the entire water supply system and the flow velocities within the water distribution system. Calculations for sizing a water distribution system shall include:

1. The load factor in water supply fixture units or gallons per minute on the piping;

2. The minimum pressure available from the water main or pressure tank;

3. The pressure loss due to the differences in elevation from the:

a. Water main or pressure tank to the building control valve; and

b. Building control valve to the controlling plumbing fixture;

4. The pressure losses due to flow through water heaters, water treatment devices, water meters and backflow preventers;

5. The minimum flow pressure needed at the controlling plumbing fixture; and

6. The pressure losses due to flow friction through piping, fittings, valves, and other plumbing appurtenances. This pressure loss may be calculated in terms of equivalent lengths of piping. The

equivalent length of piping to a controlling plumbing fixture, including fittings, valves, and other appurtenances, may be obtained by multiplying the developed length by 1.5.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) ***Private water mains and water services.*** Private water mains and water services shall be designed to supply water to the water distribution systems to maintain the minimum flow pressures specified in par. (d), but shall not be less than 3/4" in diameter.

Note: See ch. SPS 382 Appendix for further explanatory material.

(c) ***Maximum loading.*** The calculated load on any portion of the water distribution system may not exceed the limits specified in Tables 382.40-4 to 382.40-9.

(d) ***Pressure.***

1. Except as provided in subd. 1. a. to c., water supply systems shall be designed to provide at least 8 psig of flow pressure at the outlets of all fixture supplies.

a.

b. The flow pressure at the outlets of the fixture supplies serving one piece tank type water closets, pressure balance mixing valves, Manufactured Homes, and thermostatic mixing valves shall be at least 20 psig.

c. The flow pressure at the outlets of the fixture supplies serving blowout type urinals and blowout type water closets shall be at least 25 psig.

2.

a. Except as provided in subd. 3., if the water pressure available from a water main or private water supply exceeds 80 psig, a pressure reducing valve and strainer, if a strainer is not a component of the valve, shall be installed in the water distribution system.

b. A pressure reducing valve required under subd. 2. a. shall be installed upstream from all plumbing fixtures and plumbing appliances and downstream from the water meter of a utility if a meter is provided.

3. A pressure reducing valve shall not be required to be installed in a water distribution system which supplies water directly to a water pressure booster pump.

4. If the pressure available from the water main or private water supply is inadequate by calculation to provide the minimum pressures specified in subd. 1., a hydropneumatic pressure booster system or a water pressure booster pump shall be installed to increase the supply of water.

a. Each water pressure booster pump shall be provided with an automatic low pressure cut-off switch. The cut-off switch shall be located on the inlet side of the pump and shall be set to terminate the energy supplied to the pump when a positive pressure of less than 10 psig occurs.

b. A vacuum relief valve not less than one-half inch in diameter shall be installed in each water pressure tank, if the bottom of the pressure tank is more than 20 feet above any water supply outlet served by the pressure tank.

(e) ***Maximum velocity.*** A water distribution system shall be designed so that the flow velocity does not exceed 8 feet per second.

(f) ***Minimum sizes.***

1. Water distribution piping 1/2" in diameter serving 2 or more plumbing fixtures may not have a load of more than 2 water supply fixture units.

2. Water distribution piping 1/2" in diameter serving a shower which is not individually pressure balanced or individually thermostatically blended may not serve any additional fixtures.

(g) ***Minimum sizes for fixture supplies.*** Except as provided in subds. 1. to 3., the fixture supplies serving all plumbing fixtures, appliances and pieces of equipment shall be at least 1/2" in diameter.

1. Fixture supplies serving syphon jet type urinals shall be at least 3/4" in diameter.

2. Fixture supplies serving flushometer type water closets shall be at least one inch in diameter.

3. Fixture supplies serving emergency eye wash or shower outlets shall be not less than recommended by the manufacturer.

(h) ***Maximum lengths of fixture supply connectors.***

1.

a. Except as provided in subd. 1. b. and c., fixture supply connectors may not exceed more than 24" in developed length upstream from a plumbing fixture or the body of a faucet.

b. A fixture supply connector located downstream of a water cooler, water treatment device or water heater which individually serves a faucet or outlet may not exceed more than 10 feet in developed length.

c. A fixture supply connector located upstream of a water treatment device serving no more than 2 fixtures or outlets may not exceed 10 feet in developed length.

2. Fixture supply connectors may not extend more than 10 feet in developed length upstream of a plumbing appliance.

(8) INSTALLATION.

(a) ***Frost protection.***

1. Adequate measures shall be taken to protect all portions of the water supply system from freezing. All private water mains and water services shall be installed below the predicted depths of frost specified in SPS 382.30 (11) (c) 2. d., Figure 382.30-1 and Table 382.30-6, unless other protective measures from freezing are taken.

2. A hose bibb or a hydrant that penetrates an exterior wall of a heated structure shall be frost proof and self-draining type.

Note: See SPS 382.41 (4) (m) relative to cross connection control devices.

(b) ***Location.***

1. Exterior water supply piping may not be located in, under or above sanitary sewer manholes, or POWTS treatment, holding or dispersal components.

2. If a private water main or a water service crosses a sanitary sewer, the water piping within 5 feet of the point of crossing shall be installed in accordance with any of the following requirements:

a. The water piping shall be installed at least 12 inches above the top of the sewer.

b. The water piping shall be installed at least 18 inches below the bottom of the sewer.

c. The water or sewer piping shall be installed within a waterproof sleeve made of materials as specified for sanitary building sewers in SPS 384.30 (2).

3. Except as permitted in subds. 4 and 5., private water mains and water services shall be installed at least 5 feet horizontally from any sanitary sewer.

Note: The Department has limitations for the separation of water mains and sanitary sewers.

4. Private water mains and water services may be installed less than 5 feet horizontally from a pressurized sanitary sewer if all of the following conditions are met:

a. The bottom of the water piping is installed at least 18 inches above the pressurized sewer.

b. The water piping is installed at least 3 feet horizontally from the pressurized sewer.

5. Private water mains and water services may be installed less than 5 feet horizontally from a non-pressurized sanitary sewer if any of the following conditions are met:

a. The bottom of the water piping is installed at least 12 inches above the sewer.

b. The sewer is constructed of materials listed in Table 384.30-2.

c. The water service is 2 inches or less in diameter and is located more than 24 inches from the sewer.

6. The portion of a private water main or water service within 5 feet of developed length from the point where the water service first enters the building may be less than 12 inches above the sewer and within 24 inches of the sewer.

7. No private water main or water service may be installed within 6 inches of a storm sewer.

Note: See ch. SPS 382 Appendix A-382.30 (11) (d) for setback distance from yard hydrant to well.

Note: See ch. SPS 383 Table 383.43–1 for setback distances to POWTS components.

9. No underground water supply storage tank shall be installed within 8 feet of a storage vessel containing a substance of a higher hazard than that contained in the water supply storage tank.

(c) ***Limitations.*** No private water main or water service may pass through or under a building to serve another building unless one of the following conditions are met:

1.

2. The private water main or water service serves buildings that are located on the same property and a document which indicates that the piping and distribution arrangement for the property and buildings will be recorded with the Public Works Division no later than 90 days after installation.

(d) ***Water distribution piping.***

1. Water distribution piping shall be supported in accordance with SPS 382.60.

2. Provisions shall be made to evacuate all water out of the water distribution system.

3.

a. Except where parallel water meters are installed, water distribution piping shall be provided to bypass a water meter 1½ " or larger.

b. The minimum diameter of water distribution piping serving as a meter bypass shall be one nominal pipe size smaller than the meter.

4. Except as provided in subds. 5. and 6., a bypass shall be provided to serve a water treatment device. The bypass piping may be an internal part of the water treatment device.

5. A bypass shall not be required when a water treatment device serves no more than 2 fixtures or outlets.

6. A bypass shall be prohibited for a water treatment device installed to reduce a contaminant in order to comply with the provisions in SPS 382.70 (3).

(e) ***Valves.***

1. All control valves installed in a water service, except a valve serving only as a corporation cock, shall be accessible.

c. Emergency fixtures.

3. All control valves and fixture stop valves installed in a water distribution system shall be accessible. Control valves for the individual plumbing fixtures and appliances within Dwelling Units shall be accessible from within the Dwelling Unit.

(f) ***Water hammer arrestors.*** All plumbing fixtures, appliances, and appurtenances with 3/8" or larger inlet openings and with solenoid actuated quick closing valves shall be provided with water hammer arrestors. Water hammer arrestors shall be installed in the fixture supplies serving the fixtures, appliances, or appurtenances. Water hammer arrestors shall be accessible.

(h) ***Fittings and connections.*** The drilling and tapping of water supply piping shall be prohibited except for:

1. Corporation cocks for a water service or a private water main; and

2. Self-tapping valves which serve individual plumbing appliances.

(i) ***Flushing and disinfection of potable water supply systems.***

1.

a. Before a newly constructed water supply system is to be put into use, the piping of the system shall be filled with water and allowed to stand for at least 24 hours. After 24 hours each water outlet shall be flushed beginning with the outlet closest to the building control valve and then each successive outlet in the system. The flushing at each water outlet shall continue for at least one minute and until the water appears clear at the outlet.

b. Each portion of a water supply system which is altered or Repaired shall be flushed for at least one minute and until the water appears clear.

2. New private water mains and extensions to private water mains shall be disinfected prior to use in accordance with AWWA C651 or the following method:

a. The pipe system shall be flushed with clean water until no dirty water appears at the points of outlet.

b. The system or part thereof shall be filled with a solution of water and chlorine containing at least 50 parts per million of chlorine and the system or part thereof shall be valved off and allowed to stand for 24 hours or the system or part thereof shall be filled with a solution of water and chlorine containing at least 200 parts per million of chlorine and allowed to stand for 3 hours.

c. Following the allowed standing time, the system shall be flushed with clean potable water.

d. The procedures shall be repeated if it is shown by a bacteriological examination that contamination still exists in the system.

3. The Department may require a water quality analysis to be done for a new or Repaired water supply system. The analysis shall be performed in accordance with acceptable nationally recognized laboratory practices. If the water supply system has been disinfected, water samples for the analysis may not be taken sooner than 24 hours after disinfection.

Note: See SPS 384.30 (1) regarding the bending of pipe and protection from puncture.

4. New or Repaired combination water services or combination private water mains shall be flushed and disinfected prior to use in accordance with NFPA 24.

(j) ***Water softeners.*** Ion exchange water softeners used primarily for water hardness reduction that, during regeneration, discharge a brine solution shall be of a demand-initiated regeneration type equipped with a water meter or a sensor unless a wastewater treatment system downstream of the water softener specifically documents the reduction of chlorides.

(k) ***Locating requirements.***

1. A means to locate buried non-metallic water services and private water mains connected to municipal supply systems shall be provided in accordance with the options under SPS 382.30 (11) (h), except as provided in subds. 2. and 3.

2. Tracer wire insulation color for non-metallic, potable water pipe shall be blue.

3. Tracer wire insulation color for non-metallic, non-potable water pipe shall be purple.

- See PDF for diagram

Table 382.40-4

- See PDF for diagram **MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE K, ASTM B88; (C=150)**

Table 382.40-5

- See PDF for diagram **MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE L, ASTM B88; (C=150)**

Table 382.40-6

- See PDF for diagram **MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)**

Table 382.40-7

- See PDF for diagram **MAXIMUM ALLOWABLE LOAD FOR GALVANIZED STEEL PIPE, SCHEDULE 40, ASTM A53; (C=150)**

Table 382.40-8

- See PDF for diagram **CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM D2846 and F442, SDR 11; (C=150)**

Table 382.40-9

MAXIMUM ALLOWABLE LOAD FOR CROSSLINKED POLYETHYLENE (PEX) TUBING, ASTM F876 and F877; (C=150) - See PDF for diagram

Table 382.40-10

- See PDF for diagram MAXIMUM ALLOWABLE LOAD FOR CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM F442, SDR 13.5; (C=150)

Table 382.40-11

- See PDF for diagram MAXIMUM ALLOWABLE LOAD FOR POLYETHYLENE ALUMINUM POLYETHYLENE TUBING (PexAlPex), ASTM F1281; (C=150)

SPS 382.41 Cross connection control.

(1) SCOPE. The provisions of this section set forth the requirements for the protection of water within water supply systems when and where there is the possibility of contamination due to cross connections or backflow conditions.

Note: Public Works Division governs the operation and design of community water systems requires the supplier of water to develop and implement a comprehensive cross connection control program.

(2) MATERIALS.

(a) All devices, assemblies and mechanisms intended to protect water supplies relative to cross connection or backflow shall be of a type recognized and Approved in accordance with ch. SPS 384 and as described in sub. (4).

(b) All methods including barometric loops and air gaps intended to protect water supplies relative to cross connection or backflow shall be constructed of materials suitable for water supply systems in accordance with ch. SPS 384.

(3) GENERAL REQUIREMENTS. Water supply systems and the connection of each plumbing fixture, piece of equipment, appliance or non-potable water piping system shall be designed, installed, and maintained in such a manner to prevent the contamination of water supplies by means of cross connections.

(a) ***Types of cross connection control.***

1. Water supply systems shall be protected against contamination due to cross connections or backflow conditions by one of the methods or devices specified in Table 382.41-1 depending upon the situation or Table 382.41-2 depending upon the specific application or use, and the limitations specified in sub. (4).

2. For the situations described in par. (b) 3., cross connection control shall be provided as part of the fixture fitting outlet or in the water supply piping for the fixture fitting outlet.

(b) ***Classifications.*** For the purposes of this section:

1. The designation of a high hazard or low hazard situation shall be determined on the basis of how a toxic or nontoxic solution is intended or recommended by the manufacturer of the solution to interface with the potable water supply system.

2.

a. A continuous pressure situation shall be considered to exist when a pressure greater than atmospheric within the water supply system exists for more than 12 continuous hours.

b. A noncontinuous pressure situation shall be considered to exist if the conditions in subd. 2. a. do not occur.

3. A high hazard cross connection situation shall be considered to exist for a connection of the water supply system to:

a. Any part of the drain system; and

b. Any other piping system conveying water from non-potable sources, including but not limited to lakes, rivers, streams, or creeks.

4. Except as provided in subd. 5., a high hazard cross connection situation shall be considered to exist at:

a. A water supply hose bibb, faucet, wall hydrant, sill cock or other outlet which terminates with hose threads allowing a hose to be attached;

b. A water supply faucet, wall hydrant or other outlet which terminates with a serrated nipple allowing a hose to be attached;

5. A cross connection shall not be considered to exist at the hose threaded outlet installed for the sole purpose of:

a. Draining a water supply system or any portion thereof;

b. Obtaining water quality samples of the water supply system or any portion thereof; or

c. Connecting individual residential automatic clothes washers.

6.

a. A high hazard situation shall be considered to exist for the connection of 2 water supply systems, one supplied by a public water supply and the other system supplied by a private well.

b. Except as provided in subd. 7., a low hazard situation shall be considered to exist for the connection of a piping system, including but not limited to automatic fire sprinkler systems, standpipe systems, and processing purposes, which provides potable water for nonrequired potable water uses.

7. A cross connection situation shall not be considered to exist when a multipurpose piping system serves a one- or two- family Dwelling provided the sprinkler system is constructed of materials and joints suitable for water distribution systems as specified in SPS 384.30 (4) (e) and 384.40, respectively.

(c) ***Containment.***

1. For sewerage treatment facilities which are required to conform with this Code, in addition to the cross-connection control required for each potable water usage or water outlet, a reduced pressure principle backflow preventer shall be installed:

a. In the water service to each building or structure within the complex;

b. In the private water main upstream of all water services serving the facility; or

c. In the water distribution system upstream of all water outlets and in the process piping network upstream of all points of use, if both a water distribution system and a process network is contained within the same building or structure.

2.

3. The installation of a cross connection control device in the water supply system for a building or structure shall not alleviate the requirement to provide cross connection control for the connection of each plumbing fixture, piece of equipment, appliance, or other piping system.

(d) ***Prohibitions.*** The use of a toxic solution as a heat transfer fluid in single-wall heat exchanger for potable water is prohibited.

(e) ***Existing automatic fire sprinkler systems.*** An alteration, modification or addition to an existing automatic fire sprinkler shall necessitate conformance with this section, if the:

1. Existing water supply line to the existing sprinkler system is increased in diameter; or

2. Existing device or method which had been previously recognized to address cross connection concerns is to be removed or replaced. - See PDF for table - See PDF for table

a See limitation listed under SPS 382.41 (4) (c) 1. a. - See PDF for table

(4) LIMITATIONS.

(a) Cross connection control devices shall be limited in use in accordance with the respective standard, unless otherwise specifically permitted under this subsection.

(b)

1. Except for a Deck-mounted device, a pipe applied atmospheric vacuum breaker shall be installed such that the bottom of the device or the critical level mark on the device is at least 6 " above all of the following:

a. The flood level rim of the receptor serving the water supply port.

b. The highest point downstream from the device where backpressure would be created.

c. The highest point of an injection or aspiration port.

2. A Deck-mounted pipe applied atmospheric type vacuum breaker shall be installed such that the bottom of the device or the critical level mark on the device is at least one inch above all of the following:

a. The flood level rim of the receptor serving the water supply port.

b. The highest point downstream from the device where backpressure would be created.

c. The highest point of an injection or aspiration port.

(c)

1.

a. The use a of a hose connection backflow preventer, dual check backflow preventer wall hydrant-freeze resistant or a hose connection vacuum breaker in a continuous pressure situation shall be limited to campgrounds and marinas.

b. The use of a hose connection backflow preventer and a hose connection vacuum breaker shall be limited to the discharge side of a control valve such as a faucet or hose bibb.

2. A hose connection backflow preventer and a hose connection vacuum breaker may not be employed in backpressure situations of more than 10 feet of water column.

(d) A backflow preventer with intermediate atmospheric vent:

1. May not be employed in backpressure situations of more than 150 psig; and

2. May not serve boilers having a maximum steam pressure setting greater than 15 psig or a maximum water pressure setting greater than 30 psig.

(e)

1. A reduced pressure principle backflow preventer and a reduced pressure detector backflow preventer may not be subjected to a backpressure greater than twice the rated working pressure of the device.

2. A reduced pressure principle backflow preventer and a reduced pressure detector backflow preventer which serve a water-based fire protection system may have a test outlet located between the number 2 check valve and the number 2 listed indicating control valve.

3. A reduced pressure principle backflow preventer and a reduced pressure detector backflow preventer which are 2" or smaller in size and which serve a water-based fire protection system are not required to have a test cock on the number one listed indicating control valve.

(f) A hand-held shower may not be employed in backpressure situations of more than 5 feet of water column.

(g)

1. A double check backflow prevention assembly and a double check detector assembly backflow preventer may not be subjected to a backpressure greater than twice the rated working pressure of the device.

2. A double check backflow prevention assembly and a double check detector assembly backflow preventer which serve a water-based fire protection system may have a test outlet located between the number 2 check valve and the number 2 listed indicating control valve.

3. A double check backflow prevention assembly and a double check detector assembly backflow preventer which are 2" or smaller in size and which serve a water-based fire protection system are not required to have a test cock on the number one listed indicating control valve.

(h) A water supply fed trap seal primer valve shall be installed such that the bottom of the device or the critical level as marked on the device is at least 12" above:

1. The connection to the trap; and

2. The highest point downstream from the device where backpressure would be created.

(i) A vacuum breaker wall hydrant, freeze resistant automatic draining type or a freeze resistant sanitary yard hydrant, may not be employed in backpressure situations of more than 10 feet of water column.

(k)

1. A pressure type vacuum breaker assembly shall be installed such that the bottom of the device or the critical level mark on the device is at least 12" above all of the following:

a. The flood level rim of the receptor serving the water supply port.

b. The highest point downstream from the device where backpressure would be created.

c. The highest point of an injection or aspiration port.

2. A pressure vacuum breaker assembly shall be located only outside.

(L) A laboratory faucet backflow preventer may not be employed in backpressure situations of more than 6 feet of water column.

(m) The cross connection control device to serve a hose bibb or hydrant that penetrates an exterior wall of a heated structure may not prevent a hose bibb or hydrant from being freeze resistant automatic draining as required under SPS 382.40 (8) (a).

(n) A spill resistant vacuum breaker shall be installed so that the bottom of the device or the critical level mark on the device is at least 12" above all of the following:

1. The flood level rim of the receptor serving the water supply port.

2. The highest point downstream from the device where back pressure would be created.

3. The highest point of an injection or aspiration port.

(5) INSTALLATION.

(a) An air gap for cross connection control shall conform to ASME A112.1.2.

Note: See ch. SPS 382 Appendix for further explanatory material.

(b) Cross connection control methods, devices and assemblies shall be installed in accordance with the manufacturer's written installation specifications and this chapter. The methods, devices and assemblies shall be accessible for inspection, testing, maintenance, and replacement.

Note: See SPS 384.30 (5) (c).

(c) Cross connection control devices shall be protected from freezing.

(d)

1. A cross connection control device may not be located in uninhabitable spaces susceptible to flooding.

2. A cross connection control device which has one or more Vent ports may not be located in a pit, vault or depression which is below the adjacent grade or floor level, even if the pit, vault, or depression is provided with a drain at the bottom of the pit.

(e)

1. Vent ports of cross connection control devices shall be positioned:

a. Away from areas where toxic gases and fumes may accumulate;

b. Downward or protected to protect the ports from falling debris; and

c. So as to drain dry.

2. Cross connection control devices or assemblies shall be so located that any Vent ports are provided with an air gap so as to comply with SPS 382.33 or ASME A112.1.3.

3.

a. If a reduced pressure principle backflow preventer or a reduced pressure detector backflow preventer is located within a building, a drain or receptor shall be provided to receive the discharge from the Vent ports of the device. If a floor drain is to receive the discharge from the Vent ports of a reduced pressure principle backflow preventer or a reduced pressure detector backflow preventer, the flow or pathway of the discharge may not create a nuisance.

b. Where drain piping is provided for the discharge from a Vent port, an air gap in accordance with par. (a) shall be provided between the Vent port and the drain piping.

c. Where a receptor is provided for the discharge from a Vent port, an air gap in accordance with par. (a) shall be provided between the Vent port and the receptor.

(f) The installation of a reduced pressure principle backflow preventer, a reduced pressure fire protection principle backflow preventer, a reduced pressure detector backflow preventer, a reduced pressure detector fire protection backflow prevention assembly, a double check backflow prevention assembly, a double check detector assembly backflow preventer, a pressure vacuum breaker assembly and a spill resistant vacuum beaker shall conform to all of the following limitations:

1. The minimum distance between the floor, surface or platform which is to provide access and the lowest point of the assembly may not be less than 12".

2. The maximum distance between the floor, surface or platform which is to provide access and the lowest point of the assembly may not be more than 7 feet.

3. The minimum distance between a ceiling or other obstruction and the highest point of the assembly may not be less than 18".

4. The minimum distance between a wall or other obstruction and the back and ends of the assembly may not be less than 4".

5. The minimum distance between a wall or other obstruction and the front of the assembly may not be less than 24".

Note: See ch. SPS 382 Appendix for further explanatory material.

(g) The discharge outlet of local waste piping serving a cross connection control device shall be visible and not be located within a concealed space.

(h) No control valve may be placed downstream from a pipe applied atmospheric type vacuum breaker or a laboratory faucet backflow preventer.

(i) A barometric loop to provide cross connection control for back siphonage shall be formed by creating a loop in the potable water supply piping upstream to the source of cross connection.

1. The loop shall extend at least 35 feet above:

a. The highest point downstream from the loop where backpressure would be created; and

b. The point of discharge.

2. No outlets for potable water use shall be installed downstream of the peak of the loop.

(j) Vacuum breaker tees shall be assembled such that:

1. The bottom of the horizontal portion of the tee is installed at least one inch above the flood level rim of the receptor;

2. The inside diameter of the tee is equal to or greater than the inside diameter of the drain piping from the water treatment device;

3. The tee is installed in such a position that the discharge will not create a nuisance;

4. The piping upstream of the tee is of a type suitable for water distribution in accordance with SPS 384.30 (4) (e).

5. The Vent portion of the tee is equal to or greater than the inside diameter of the drain piping from the water treatment device; and

6. The Vent port of the tee is:

a. Positioned away from areas where toxic gases and fumes may accumulate; and

b. Constructed to protect the port from falling debris.

(k) A chemical dispensing system shall be connected to the water distribution system in either of the following manners:

1. The fixture supply shall be individually connected to the water distribution system.

2. The fixture supply shall be installed with a pressure bleeding device. The pressure bleeding device shall create a visually free flow of water through the atmosphere from the faucet connection into the fixture drain.

Subchapter V - Special Plumbing Installations (Intentionally Omitted)

SPS 382.50 Health care and related facilities (Intentionally Omitted).

SPS 382.51 Manufactured Homes and Manufactured Home communities (Intentionally Omitted).

Subchapter VI — Installation

SPS 382.60 Pipe hangers and supports. The provisions of this section control the types, materials and installation of anchors, hangers and supports for plumbing piping.

(1) MATERIAL.

(a) ***Strength.*** Hangers, anchors and supports for piping shall be of sufficient strength to support the piping and its contents. Drain piping shall be considered as being full of water. Underground piers for pipe support shall be of concrete, masonry, plastic, or pressure treated wood.

(b) ***Compatibility.***

1. Hangers and straps shall be of a compatible material that will reduce the potential for galvanic action with the piping.

2. Hangers and straps may not distort, cut, or abrade piping.

(2) INSTALLATION.

(a) Piping hangers and anchors shall be securely attached to the building's structure at intervals to support the piping and its contents, but not at intervals greater than those specified in Table 382.60. The connection of drain piping to a fixture or appliance shall be considered a point of support.

(b) Hub-less pipe installed in the horizontal position shall be supported within 24" on each side of a joint, unless the joint has an alignment retaining shield.

(c) Hangers shall not be attached to a building's structure by means of wood plugs.

(d) Shower valves and piping from the shower valve to the shower head outlet shall be securely attached to the structure. - See PDF for table

Subchapter VII — Plumbing Treatment Standards

SPS 382.70 Plumbing treatment standards.

(1) PURPOSE. The purpose of this section is to establish plumbing treatment standards for plumbing systems that supply water to outlets based on the intended use.

(2) SCOPE. The provisions of this section apply to plumbing systems that supply water to outlets.

Note: For requirements and specifications for POWTS, refer to ch. SPS 383.

(3) GENERAL REQUIREMENTS. A plumbing system shall supply water that is of a quality that will protect public health and the Waters of the State and be suitable for the intended use.

Note: Refer to SPS 382.34 for requirements for wastewater reuse.

(4) MINIMUM REQUIREMENTS.

(a) Except as provided under par. (b), a plumbing system shall supply a quality of water at the outlet or at the termination of the plumbing system that meets or exceeds the minimum requirements as specified in Table 382.70-1.

(b) For an outlet other than a plumbing fixture, appliance or appurtenance, there may be more stringent requirements. - See PDF for table

Table 382.20–1

Submittals To Department

	Type of Plumbing Installation
1.	All plumbing, new installations, additions and alterations, regardless of the number of plumbing fixtures involved, serving hospitals, nursing homes and ambulatory surgery centers.[a]
2.	Plumbing, new installations, additions and alterations involving 16 or more plumbing fixtures, serving buildings owned by a metropolitan or sanitary sewer district.[b]
3.	Plumbing, new installations, additions and alterations involving 16 or more plumbing fixtures, serving buildings owned by the state.[b]
4.	Alternate and experimental plumbing systems.
5.	Reduced pressure principle backflow preventers, reduced pressure fire protection principle backflow preventers, pressure vacuum breaker assemblies, reduced pressure detector fire protection backflow prevention assemblies, and spill resistant vacuum breakers serving health care and related facilities.
6.	Stormwater and clearwater infiltration plumbing systems serving a public building or facility.[c]
7.	Treatment systems, other than POWTS, designed to treat water for compliance with Table 382.70–1.[c]

[a] The registration of cross connection control devices as required under s. SPS 382.20 (1) (c) is included as a part of plan review and approval.

[b] For the purpose of plan review submittal, water heaters, floor drains, storm inlets, roof drains, multi–purpose piping (mpp) fire sprinklers and hose bibbs are to be included in the count.

c Agent municipalities may perform this review when so authorized by the department.

Table 382.20–2

Submittals To Department Or Agent Municipality

	Type of Plumbing Installation
1.	New installations, additions and alterations to drain systems, vent systems, water service systems, and water distribution systems involving 16 or more plumbing fixtures to be installed in connection with public buildings.[a,b]
2.	Grease interceptors to be installed for public buildings.
3.	Garage catch basins, carwash interceptors and oil interceptors to be installed for public buildings and facilities.
4.	Sanitary dump stations.
5.	Piping designed to serve as private water mains.
6.	Water supply systems and drain systems to be installed for manufactured home communities and campgrounds.[c]
7.	Piping designed to serve as private interceptor main sewers greater than 4 inches in diameter when sized for gravity flow.
8.	Chemical waste systems regardless of the number of plumbing fixtures.[c]
9.	Stormwater systems, not including infiltration plumbing systems, serving a public building or facility where the drainage area is one acre or more.[d]
10.	Mixed wastewater holding device.

Table 382.31–4

Size and Length of Vents for Sanitary Sumps

Discharge Capacity of Ejector (gpm)	Maximum Developed Length of Vent[a] (feet)				
	Diameter of Vent (inches)				
	$1^1/_4$[d]	$1^1/_2$[d]	2	3	4
10	NL[b]				
20	270	NL			
40	72	160	NL		
60	31	75	270	NL	
80	16	41	150	NL	
100	10	25	97	NL	
150	NP[c]	10	44	370	NL
200		NP	20	210	NL
250		NP	10	132	NL
300		NP	10	88	380
400			NP	44	210
500			NP	24	130

[a] The developed length of the vent is measured along the pipe from the connection to the sump, to the point where it connects to a vent pipe of a larger diameter.
[b] NL means No Limit.
[c] NP means Not Permitted.
[d] Diameter not permitted for exterior sumps.

Table 382.31–5

Stack Sizing by DFU Value

Drainage Fixture Unit (dfu) Value	Size of Stack (inches)
0.5	$1^1/_2$
1.0	2
2.0	3

Table 382.33–1

Types of Fixtures, Appliances and Devices of a Public Health Concern

Refrigerated food storage rooms and compartments
Refrigerated food display cases
Ice compartments
Vending machines
Steam tables and kettles
Food preparation sinks
Potato peelers
Egg boilers
Boiler blowoff basin outlet drains
Coffee makers and urns
Food processing equipment
Baptismal founts
Clothes washers and extractors
Dishwashers
Stills
Sterilizers
Bar and soda fountains
Boiler blowoff basin outlet drains

Table 382.34

Minimum Capacities for Dilution and Neutralizing Basins

Maximum Number of Sinks	Minimum Retention Capacity in Gallons
1	5
4	15
8	30
16	55
25	100
40	150
60	200
75	250
100	350
150	500

Table 382.35

Cleanout Sizes

Diameter of Pipe Served by Cleanout (inches)	Minimum Diameter of Cleanout Extension (inches)	Minimum Diameter of Cleanout Opening (inches)
$1^1/_4$	$1^1/_4$	$1^1/_4$
$1^1/_2$	$1^1/_2$	$1^1/_4$
2	$1^1/_2$	$1^1/_2$
3	3	$2^1/_2$
4	4	$3^1/_2$
5	5	4
6	6	5
8 and larger	6	6

Table 382.36–1

Maximum Capacity of Stormwater Conveyance Piping for PVC, ASTM D1785, D2665, F891 and ABS, ASTM D1527, D2661, F628

Nominal Pipe Size (in inches)	Maximum Capacities in gallons per minute (gpm)					
	Pitch of Piping Per Foot					
	1/32 inch (0.26% slope)	1/16 inch (0.52% slope)	1/8 inch (1.04% slope)	¼ inch (2.08% slope)	½ inch (4.16% slope)	Vertical
3	30	40	60	80	110	89
4	60	80	120	160	230	183
5	110	150	210	300	420	334
6	170	240	340	480	690	545
8	360	510	710	1,010	1,430	1,133
10	660	930	1,310	1,850	2,620	2,079
12	1,050	1,480	2,090	2,960	4,180	3,316
14	1,350	1,900	2,690	3,810	5,390	4,271
16	1,920	2,720	3,840	5,440	7,690	6,097
18	2,630	3,720	5,270	7,440	10,520	8,348
20	3,520	4,970	7,030	9,956	14,060	11,155
24	5,750	8,140	11,490	16,260	22,990	18,244

Note: To convert to cubic feet per second (cfs) divide gpm by 448.8.

Table 382.36–2

Maximum Capacity of Stormwater Horizontal Conveyance Piping for PVC, ASTM D3034

Nominal Pipe Size (in inches)	Maximum Capacities in gallons per minute (gpm)				
	Pitch of Piping Per Foot				
	1/32 inch (0.26% slope)	1/16 inch (0.52% slope)	1/8 inch (1.04% slope)	¼ inch (2.08% slope)	½ inch (4.16% slope)
4	60	80	110	160	220
6	160	230	320	450	640
8	350	490	700	990	1,400
10	630	900	1,270	1,790	2,540
12	1,010	1,430	2,020	2,850	4,040
15	1,730	2,450	3,460	4,900	6,920

Note: To convert to cubic feet per second (cfs) divide gpm by 448.8.

Table 382.36–3

Maximum Capacity of Stormwater Conveyance Piping for Cast Iron, ASTM A74 and ASTM A888

Nominal Pipe Size (in inches)	Maximum Capacities in Gallons Per Minute (gpm)					
	Pitch of Piping Per Foot					
	1/32 inch (0.26% slope)	1/16 inch (0.52% slope)	1/8 inch (1.04% slope)	¼ inch (2.08% slope)	½ inch (4.16% slope)	Vertical
3	20	30	40	60	80	80
4	50	60	90	130	180	173
5	80	120	170	230	330	315
6	140	190	270	380	540	516
8	290	420	590	830	1,170	1,118
10	540	770	1,090	1,540	2,170	2,068
12	870	1,230	1,740	2,490	3,490	3,318
15	1,630	2,310	3,270	4,620	6,530	6,217

Note: To convert to cubic feet per second (cfs) divide gpm by 448.8.

Table 382.36–4

Maximum Capacity of Stormwater Horizontal Conveyance Piping for Concrete, ASTM C76 and ASTM C14

Nominal Pipe Size (in inches)	Maximum Capacities in gallons per minute (gpm)				
	Pitch of Piping Per Foot				
	1/32 inch (0.26% slope)	1/16 inch (0.52% slope)	1/8 inch (1.04% slope)	¼ inch (2.08% slope)	½ inch (4.16% slope)
4	40	60	90	120	170
6	130	180	260	360	510
8	280	390	550	780	1,110
10	500	710	1,000	1,420	2,010
12	820	1,150	1,630	2,310	3,260
15	1,480	2,090	2,960	4,180	5,910
18	2,400	3,400	4,810	6,800	9,620
21	3,630	5,130	7,250	10,260	14,500
24	5,180	7,320	10,350	14,640	20,710
27	7,090	10,020	14,170	20,050	28,350
30	9,390	13,270	18,770	26,550	37,550
33	12,100	17,120	24,210	34,230	48,410
36	15,260	21,590	30,530	43,170	61,060
39	18,900	26,720	37,790	53,440	75,580
42	23,020	32,560	46,050	65,120	92,100
48	32,870	46,490	65,740	92,980	131,490
54	45,000	63,640	90,010	127,290	180,010
60	59,600	84,290	119,200	168,580	238,410

Note: To convert to cubic feet per second (cfs) divide gpm by 448.8.

Table 382.36–5

Maximum Capacity Of Stormwater Horizontal Conveyance Piping For Elliptical Reinforced Concrete Pipe

Pipe Diameters in inches (circular pipe equivalent)	Maximum Capacities in gallons per minute (gpm)			
	Pitch of Piping Per Foot			
	1/16 inch (0.52% slope)	1/8 inch (1.04% slope)	¼ inch (2.08% slope)	½ inch (4.16% slope)
14 X 23 (18)	3,300	4,675	6,700	9,500
19 X 30 (24)	7,200	10,060	14,700	21,000
24 X 38 (30)	13,250	18,740	26,500	37,475
29 X 45 (36)	21,545	30,475	43,095	60,940
34 X 53 (42)	32,500	45,965	65,000	91,925
38 X 60 (48)	46,405	65,625	92,800	131,245
43 X 68 (54)	63,525	89,840	127,050	179,800
48 X 76 (60)	84,135	118,985	168,270	237,965

Table 382.365–1
Depth of Suitable Soils by USDA Soil Texture and Percent Fines of the Infiltrative Surface

Soil Texture	Minimum 5 ft. of Suitable Soil Separation and ≥10% but <20% Fines [a]		Minimum 3 ft. of Suitable Soil Separation and ≥20% Fines [a]	
	Texture Suitability	Maximum Rock Fragment Content [b]	Texture Suitability	Maximum Rock Fragment Content [b]
Sands				
COS	NP [c]	—	NP	—
S	NP [c]	—	NP [c]	—
FS	NP [c]	—	NP [c]	—
VFS	X	NP [c] > 60%	X	NP [c] > 20%
Loamy sands				
LCOS	X	NP [c] > 0%	NP [c]	—
LS	X	NP [c] > 0%	NP [c]	—
LFS	X	NP [c] > 0%	NP [c]	—
LVFS	X	NP [c] > 82%	X	NP [c] > 63%
Sandy loams				
COSL	X	NP [c] > 56%	X	NP [c] > 13%
SL	X	NP [c] > 56%	X	NP [c] > 13%
FSL	X	NP [c] > 56%	X	NP [c] > 13%
VFSL	X	NP [c] > 74%	X	NP [c] > 47%
Loam (L)	X	NP [c] > 79%	X	NP [c] > 58%
Silt Loam (SIL)	X	NP [c] > 84%	X	NP [c] > 68%
Silt (SI)	X	NP [c] > 88%	X	NP [c] > 75%
Clay Loams				
SCL	X	NP [c] > 71%	X	NP [c] > 43%
SICL	X	NP [c] > 88%	X	NP [c] > 75%
CL	X	NP [c] > 81%	X	NP [c] > 63%
Clays				
SC	X	NP [c] > 78%	X	NP [c] > 56%
SIC	X	NP [c] > 88%	X	NP [c] > 75%
C	X	NP [c] > 82%	X	NP [c] > 63%

NP = Not permitted.
X = Suitable for use under the specified conditions.
[a] Fines are mineral particles passing a 200 mesh sieve (less than 0.075mm). Content is measured by weight.
[b] Rock fragments are unattached pieces of rock 2 mm in diameter or larger. Content is measured by volume.
[c] Permitted only where laboratory analysis provides evidence of percent fines required.

USDA Soil Texture Abbreviations:

COS = Coarse Sand
S = Sand
LCOS = Loamy Coarse Sand
LS = Loamy Sand
LFS = Loamy Fine Sand
LVFS = Loamy Very Fine Sand
COSL = Coarse Sandy Loam
SL = Sandy Loam
FSL = Fine Sandy Loam
VFSL = Very Fine Sandy Loam
L = Loam
SIL = Silt Loam
SI = Silt
SCL = Sandy Clay Loam
SICL = Silty Clay Loam
CL = Clay Loam
SC = Sandy Clay
SIC = Silty Clay
C = Clay

Table 382.365–2
Design Infiltration Rates For Soil Textures Receiving Stormwater

Soil Texture [a]	Design Infiltration Rate Without Measurement inches/hour [b]
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty clay loam	0.04 [c]
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

[a] Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

[b] Infiltration rates represent the lowest value for each textural class presented; based on Rawls et al., 1998 [Use of Soil Texture, Bulk Density and Slope of Water Retention Curve to Predict Saturated Hydraulic Conductivity, ASAE, Vol. 41(2), pp. 983–988].

[c] Infiltration rate is an average, based on Rawls et al., 1982 (Estimation of Soil Water Properties, Transactions of the American Society of Agricultural Engineers Vol. 25, No. 5 pp. 1316 –1320 and 1328) and Clapp & Hornberger, 1978 (Empirical equations for some hydraulic properties. Water Resources Research 14:601–604).

Table 382.365–3
Total Correction Factors Divided Into Measured Infiltration Rates

Ratio of Design Infiltration Rates [a]	Correction Factor
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

[a] Ratio is determined by dividing the design infiltration rate from Table 382.365–2 for the textural classification at the bottom of the infiltration device by the design infiltration rate from Table 382.365–3 for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.

Table 382.365–4
Horizontal Setback Parameters by Physical Feature

Physical Feature	Setback Parameters in feet
Building	10
Holding tank, stormwater collection tank	10
POWTS dispersal component	5
POWTS holding or treatment component	10
Property line	5
Swimming pool, in ground	15

Table 382.38 – 1

Allowable Discharge Points by Fixture or Specific Uses

Use or Fixture	Allowable Discharge Points					
	POWTS[a]	Municipal Sanitary Sewer	Municipal Storm Sewer	Ground Surface	Combined Sanitary–Storm Sewer	Subsurface Dispersal[i]
1. Cross connection control device or assembly [see s. SPS 382.33 (9) (i)]	X	X		X[b, c,e]	X	
2. Domestic wastewater	X	X			X	
3. Condensate from high efficiency furnace or water heater	X	X			X	
4. Drinking fountain	X	X	X	X[b]	X	X
5. Elevator pit drain [see s. SPS 382.33 (9) (f)]			X	X[b]	X	X
6. Enclosed public parking levels	X	X		X[b]	X	X
7. Industrial wastewater[h]	X[f]	X			X	
8. Municipal well pump house floor drain and sink	X	X		X[b]	X	X
9. One– and 2–family garage floor area [see s. SPS 382.34 (4) (b)]	X	X		X[b]	X	
10. Residential living unit air conditioner condensate	X	X[g]	X[c]	X[b]	X	X
11. Storm water, groundwater, fire sprinkler test discharge and clear water	X	X[g]	X[c]	X[b]	X	X
12. Secondary roof drain systems				X[j]		
13. Swimming pool or wading pool — diatomaceous earth filter backwash	X	X			X	
14. Swimming pool or wading pool — drain wastewater	X	X[b]	X[b,c]	X[b,c]	X[b]	X
15. Swimming pool or wading pool — sand filter backwash	X	X[b]	X[b,c]	X[b,c]	X[b]	X
16. Water heater temperature and pressure relief valve [see s. SPS 382.40 (5)]	X	X	X	X[b]	X	X
17. Wastewater from water treatment device	X	X	X[c]	X[b,c]	X	X
18. Whirlpool backwash drain and wastewater	X	X	X[c]	X[b,c]	X	
19. Discharges not specifically listed above	Contact the department					

[a] Allowed when the POWTS is designed to include designated wastewater.

[b] Unless prohibited by local municipality and when no nuisance is created.

[c] A discharge permit may be required by the department of natural resources.

[e] Allowed for exterior installation and when no sanitary sewer is in the building.

[f] Refer to the department of natural resources for discharge regulations.

[g] Fifty gallons per day.

[h] The department of natural resources may require WPDES permits for industrial discharges and may allow other options.

[i] Subsurface dispersal must comply with s. SPS 382.365.

[j] Discharge separate from the primary system and where observable.

Table 382.40–1a
Distribution and Service

Supply	Tag and Band Color	Tag Shape	Tag Size	Tag Legend[a]
Potable	Green	Round	3″ diameter	Safe Water
Nonpotable	Yellow	Triangle	4″ sides	Nonpotable Water or Not Safe for Drinking
Reuse (Nonpotable)	Purple	Triangle	4″ sides	Nonpotable Water or Not Safe for Drinking or Specific Use[b]
Device Specific[c]	Gray	Triangle	4″ sides	Specific Use[b]

[a] All nonpotable water outlets shall be identified at the point of use for each outlet with the following legends or as otherwise approved by the department.
[b] Tag should reflect the intended use.
[c] Serving an individual or similar plumbing fixtures or appliances.

Table 382.40–1b
Water Supply Fixture Units for Nonpublic Use Fixtures

Type of Fixture[a]	Water Supply Fixture Units (wsfu)		
	Hot	Cold	Total
Automatic Clothes Washer	1.0	1.0	1.5
Bar Sink	0.5	0.5	1.0
Bathtub, with or without Shower Head	1.5	1.5	2.0
Bidet	1.0	1.0	1.5
Dishwashing Machine	1.0		1.0
Glass Filler		0.5	0.5
Hose Bibb:			
1/2″ diameter		3.0	3.0
3/4″ diameter		4.0	4.0
Kitchen Sink	1.0	1.0	1.5
Laundry Tray, 1 or 2 Compartment	1.0	1.0	1.5
Lavatory	0.5	0.5	1.0
Manufactured Home	—	15	15
Shower, Per Head	1.0	1.0	1.5
Water Closet, Flushometer Type		6.0	6.0
Water Closet, Gravity Type Flush Tank		2.0	2.0
Bathroom Groups:			
Bathtub, Lavatory and Water Closet–FM[b]	2.0	7.5	8.0
Bathtub, Lavatory and Water Closet–FT[c]	2.0	3.5	4.0
Shower Stall, Lavatory and Water Closet–FM	1.5	7.0	7.5
Shower Stall, Lavatory and Water Closet–FT	1.5	3.0	3.5

[a] For fixtures not listed, factors may be assumed by comparing the fixture to a listed fixture which uses water in similar quantities and at similar rates.
[b] FM means flushometer type.
[c] FT means flush tank type.

Table 382.40–2

Water Supply Fixture Units for Public Use Fixtures

Type of Fixture[a]	Water Supply Fixture Units (wsfu)		
	Hot	Cold	Total
Automatic Clothes Washer, Individual	2.0	2.0	3.0
Automatic Clothes Washer, Large Capacity	b	b	b
Autopsy Table	2.0	2.0	3.0
Bathtub, With or Without Shower Head	2.0	2.0	3.0
Coffeemaker		0.5	0.5
Dishwasher, Commercial	b	b	b
Drink Dispenser		0.5	0.5
Drinking Fountain		0.25	0.25
Glass Filler		0.5	0.5
Health Care Fixtures:			
Clinic sink	2.0	7.0	7.0
Exam/treatment sink	0.5	0.5	1.0
Sitz bath	1.5	1.5	2.0
Surgeon washup	1.5	1.5	2.0
Hose Bibb:			
$^1/_2$″ diameter		3.0	3.0
$^3/_4$″ diameter		4.0	4.0
Icemaker		0.5	0.5
Lavatory	0.5	0.5	1.0
Shower, Per Head	2.0	2.0	3.0
Sinks:			
Bar and Fountain	1.5	1.5	2.0
Barber and Shampoo	1.5	1.5	2.0
Cup		0.5	0.5
Flushing Rim		7.0	7.0
Kitchen and Food Preparation per faucet	2.0	2.0	3.0
Laboratory	1.0	1.0	1.5
Service sink	2.0	2.0	3.0
Urinal:			
Syphon Jet		4.0	4.0
Washdown		2.0	2.0
Wall Hydrant, Hot and Cold Mix:			
$^1/_2$″ diameter	2.0	2.0	3.0
$^3/_4$″ diameter	3.0	3.0	4.0
Wash Fountain:			
Semicircular	1.5	1.5	2.0
Circular	2.0	2.0	3.0
Water Closet:			
Flushometer		6.5	6.5
Gravity Type Flush Tank		3.0	3.0

[a] For fixtures not listed, factors may be assumed by comparing the fixture to a listed fixture which uses water in similar quantities and at similar rates.

[b] Load factors in gallons per minute, gpm, based on manufacturer's requirements.

Table 382.40–3

Conversion of Water Supply Fixture Units to Gallons Per Minute

Water Supply Fixture Units	Gallons per Minute	
	Predominately Flushometer Type Water Closets or Syphon Jet Urinals	Predominately Flush Tank Type Water Closets or Washdown Urinals
1	—	1
2	—	2
3	—	3
4	10	4
5	15	4.5
6	18	5
7	21	6
8	24	6.5
9	26	7
10	27	8
20	35	14
30	40	20
40	46	24
50	51	28
60	54	32
70	58	35
80	62	38
90	65	41
100	68	42
120	73	48
140	78	53
160	83	57
180	87	61
200	92	65
250	101	75
300	110	85
400	126	105
500	142	125
600	157	143
700	170	161
800	183	178
900	197	195
1000	208	208
1250	240	240
1500	267	267
1750	294	294
2000	321	321
2250	348	348
2500	375	375
2750	402	402
3000	432	432
4000	525	525
5000	593	593

Note: Values not specified in the table may be calculated by interpolation.

Table 382.40–3e
Conversion of Water Supply Fixture Units to Gallons Per Minute for Water Treatment Devices[a] Serving an Individual Dwelling[b]

Water Supply Fixture Units (WSFUs)	Gallons Per Minute (GPM)
1	1
2	2
3	3
4	4
5	4.5
6	5
7	6
8	6.5
25	7
35	8
40	9

[a] Treatment devices providing treatment for compliance with Table 382.70–1 shall use Table 382.40–3 for conversion.

[b] Table shall not be used for converting hose bibb, high flow fixture or hydrant wsfu.

Table 382.40–4

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE K, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.5	–	1.5	3.5	–	3.5	6.5	–	8.0	10.5	4.0	14.0	22.0	7.0	35.0	39.0	28.0	83.0	62.0	80.0	185	132	437	538
1	1.0	–	1.0	2.5	–	2.5	5.0	–	6.0	9.5	–	12.5	15.5	5.0	22.5	32.0	16.0	60.0	57.0	67.0	160	91.0	196	330	192	864	882
2	1.0	–	1.0	3.5	–	3.5	7.5	–	9.5	14.0	4.5	20.0	22.0	7.0	35.0	47.0	42.0	116	83.0	160	290	132	437	538	279	1611	1611
3	1.5	–	1.5	4.5	–	5.0	9.5	–	12.5	17.5	5.5	25.5	28.0	11.0	50.0	58.0	70.0	165	103	261	390	165	661	723	291	1725	1725
4	2.0	–	2.0	5.0	–	6.0	11.5	4.0	15.5	20.5	6.5	31.0	32.0	16.0	60.0	68.0	100	215	116	338	455	165	665	726	NP		
5	2.0	–	2.0	6.0	–	7.0	13.0	4.5	18.0	23.0	7.5	37.0	36.0	22.0	73.0	75.0	128	250	NP			NP					
6	2.5	–	2.5	6.5	–	8.0	14.0	4.5	20.0	25.0	8.5	42.0	40.0	30.0	86.0	NP											
7	2.5	–	2.5	7.0	–	9.0	15.5	5.0	22.5	28.0	11.0	50.0	42.0	34.0	103												
8	3.0	–	3.0	7.5	–	9.5	16.5	5.5	24.0	30.0	13.5	55.0	NP														
9	3.0	–	3.0	8.0	–	10.0	17.5	5.5	25.5	NP																	
10	3.5	–	3.5	8.5	–	10.5	18.5	6.0	27.5																		
11	3.5	–	3.5	9.0	–	11.5	19.0	6.0	28.5																		
12	3.5	–	3.5	9.5	–	12.5	NP																				
13	4.0	–	4.0	10.0	4.0	13.0																					
14	4.0	–	4.0	10.5	4.0	14.0																					
15	4.0	–	4.0	10.5	4.0	14.5																					
16	4.5	–	5.0	NP																							
17	4.5	–	5.0																								
18	4.5	–	5.0																								
19	5.0	–	6.0																								
	NP																										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–5
MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE L, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	11.0	4.0	15.0	23.0	7.5	37.0	40.0	30.0	86.0	65.0	90.0	200	136	462	561
1	1.0	–	1.0	2.5	–	2.5	5.5	–	6.5	10.0	4.0	13.0	16.0	5.0	23.0	33.0	17.5	63.0	59.0	72.0	170	94.0	211	345	198	909	923
2	1.5	–	1.5	4.0	–	4.0	8.5	–	10.5	14.5	4.5	20.5	23.0	7.5	37.0	48.0	44.0	120	86.0	175	305	137	468	566	288	1694	1694
3	2.0	–	2.0	5.0	–	6.0	10.5	4.0	14.0	18.5	6.0	27.5	29.0	12.5	52.0	60.0	75.0	175	107	283	410	169	698	752	298	1792	1792
4	2.0	–	2.0	6.0	–	7.0	12.0	4.0	16.5	21.5	7.0	33.0	34.0	18.5	66.0	70.0	108	225	119	356	469	NP			NP		
5	2.5	–	2.5	6.5	–	8.0	14.0	4.5	20.0	24.0	8.0	40.0	38.0	26.0	80.0	77.0	136	260	NP								
6	2.5	–	2.5	7.5	–	9.5	15.5	5.0	22.5	26.0	9.0	45.0	42.0	33.0	100	NP											
7	3.0	–	3.0	8.0	–	10.0	16.5	5.5	24.0	29.0	12.5	52.0	44.0	37.0	107												
8	3.0	–	3.0	8.5	–	10.5	18.0	6.0	26.5	31.0	15.0	58.0	NP														
9	3.5	–	3.5	9.5	–	12.5	19.0	6.0	28.0	NP																	
10	3.5	–	3.5	10.0	4.0	13.0	20.0	6.5	30.0																		
11	4.0	–	4.0	10.5	4.0	14.0	20.5	6.5	31.0																		
12	4.0	–	4.0	11.0	4.0	15.0	NP																				
13	4.0	–	4.0	11.5	4.0	15.5																					
14	4.5	–	5.0	12.0	4.0	16.5																					
15	4.5	–	5.0	NP																							
16	5.0	–	6.0																								
17	5.0	–	6.0																								
18	5.0	–	6.0																								
19	5.0	–	6.0																								
20	5.5	–	6.5																								
	NP																										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–6
MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	–	1.0	3.0	–	3.0	6.0	–	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	–	1.5	4.5	–	5.0	9.0	–	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	–	2.0	5.5	–	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	–	2.5	6.5	–	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	2.5	–	2.5	7.5	–	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP								
6	3.0	–	3.0	8.0	–	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP											
7	3.5	–	3.5	9.0	–	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	–	3.5	9.5	–	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP														
9	4.0	–	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP																	
10	4.0	–	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	–	5.0	11.5	4.0	15.5	NP																				
12	4.5	–	5.0	12.0	4.0	16.5																					
13	5.0	–	6.0	12.5	4.5	17.5																					
14	5.0	–	6.0	12.5	4.5	18.0																					
15	5.0	–	6.0	NP																							
16	5.5	–	6.5																								
17	5.5	–	6.5																								
18	5.5	–	6.5																								
19	6.0	–	7.0																								
20	6.0	–	7.0																								
21	6.0	–	7.5																								
	NP																										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–7

MAXIMUM ALLOWABLE LOAD FOR GALVANIZED STEEL PIPE, SCHEDULE 40, ASTM A53; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.5	–	1.5	3.5	–	3.5	7.0	–	9.0	11.0	4.0	15.0	21.0	7.0	32.0	34.0	18.5	66.0	60.0	75.0	175	123	381	490
1	1.0	–	1.0	2.5	–	2.5	5.0	–	6.0	10.5	4.0	14.0	16.0	5.0	23.0	31.0	15.0	57.0	49.0	46.0	124	87.0	180	310	179	769	805
2	1.5	–	1.5	4.0	–	4.0	7.5	–	9.5	15.5	5.0	22.5	23.0	7.5	37.0	45.0	38.0	110	72.0	116	235	127	406	511	260	1435	1435
3	2.0	–	2.0	5.0	–	6.0	9.0	–	11.5	19.0	6.0	28.0	29.0	12.5	52.0	56.0	65.0	155	89.0	188	320	158	607	683	317	1966	1966
4	2.5	–	2.5	5.5	–	6.5	11.0	4.0	15.0	22.0	7.0	35.0	34.0	18.5	66.0	65.0	90	200	104	266	395	184	809	837	NP		
5	3.0	–	3.0	6.5	–	8.0	12.0	4.0	16.5	25.0	8.5	42.0	38.0	26.0	80.0	74.0	124	245	118	350	465	NP					
6	3.0	–	3.0	7.0	–	9.0	13.5	4.5	19.0	28.0	11.0	50.0	42.0	33.0	100	81.0	152	280	119	358	471						
7	3.5	–	3.5	7.5	–	9.5	14.5	4.5	20.5	30.0	13.5	55.0	46.0	40.0	113	83.0	163	293	NP								
8	4.0	–	4.0	8.0	–	10.0	16.0	5.0	23.0	33.0	17.5	63.0	49.0	46.0	124	NP											
9	4.0	–	4.0	9.0	–	11.5	17.0	5.5	25.0	35.0	20.0	70.0	50.0	49.0	131												
10	4.5	–	5.0	9.5	–	12.5	18.0	6.0	26.5	37.0	24.0	76.0	NP														
11	4.5	–	5.0	10.0	4.0	13.0	19.0	6.0	28.0	37.0	24.0	77.0															
12	5.0	–	6.0	10.5	4.0	14.0	19.5	6.5	29.0	NP																	
13	5.0	–	6.0	11.0	4.0	15.0	20.5	6.5	31.0																		
14	5.0	–	6.0	11.0	4.0	15.0	21.5	7.0	33.0																		
15	5.5	–	6.5	11.5	4.0	15.5	NP																				
16	5.5	–	6.5	12.0	4.0	16.5																					
17	6.0	–	7.0	12.5	4.5	17.5																					
18	6.0	–	7.0	13.0	4.5	18.0																					
19	6.0	–	7.0	13.0	4.5	18.5																					
20	6.5	–	8.0	NP																							
21	6.5	–	8.0																								
22	7.0	–	9.0																								
23	7.0	–	9.0																								
24	7.0	–	9.0																								
25	7.5	–	9.5																								
	NP																										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–8

CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM D2846 and F442, SDR 11; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																	
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.5	–	1.5	3.0	–	3.0	5.0	–	6.0	8.0	–	10.0	16.0	5.0	23.0
1	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.5	–	9.5	11.5	4.0	15.5	23.0	7.5	37.0
2	1.0	–	1.0	3.0	–	3.0	6.0	–	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0
3	1.5	–	1.5	4.0	–	4.0	8.0	–	10.0	13.5	4.5	19.0	21.0	7.0	32.0	42.0	33.0	100
4	1.5	–	1.5	4.5	–	5.0	9.0	–	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128
5	2.0	–	2.0	5.0	–	6.0	10.5	4.0	14.0	17.5	5.5	25.5	27.0	10.0	47.0	56.0	65.0	155
6	2.0	–	2.0	6.0	–	7.0	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	59.0	73.0	171
7	2.0	–	2.0	6.5	–	8.0	12.5	4.5	17.5	21.5	7.0	33.0	33.0	17.5	63.0	NP		
8	2.5	–	2.5	7.0	–	9.0	13.5	4.5	19.0	23.0	7.5	37.0	34.0	19.0	68.0			
9	2.5	–	2.5	7.0	–	9.0	14.5	4.5	20.5	24.0	8.0	40.0	NP					
10	2.5	–	2.5	7.5	–	9.5	15.0	5.0	21.5	24.0	8.0	41.0						
11	3.0	–	3.0	8.0	–	10.0	16.0	5.0	23.0	NP								
12	3.0	–	3.0	8.5	–	10.5	16.5	5.5	24.0									
13	3.0	–	3.0	9.0	–	11.5	NP											
14	3.0	–	3.0	9.5	–	12.5												
15	3.5	–	3.5	9.5	–	12.5												
16	3.5	–	3.5	10.0	4.0	13.0												
17	3.5	–	3.5	NP														
18	4.0	–	4.0															
19	4.0	–	4.0															
20	4.0	–	4.0															
21	4.0	–	4.0															
22	4.0	–	4.0															
23	4.5	–	5.0															
	NP																	

Note: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals.

FT means predominately flush tank type water closets or wash down urinals.

NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–9
MAXIMUM ALLOWABLE LOAD FOR CROSSLINKED POLYETHYLENE (PEX) TUBING, ASTM F876 and F877; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																				
	1/2"			5/8"			3/4"			1"			1 1/4"			1 1/2"			2"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	0.5	–	0.5	1.0	–	1.0	2.5	–	2.5	4.0	–	4.0	6.5	–	8.0	13.5	4.5	19.0
1	0.5	–	0.5	1.0	–	1.0	1.5	–	1.5	3.5	–	3.5	6.0	–	7.0	9.5	–	12.5	19.5	6.5	29.0
2	1.0	–	1.0	1.5	–	1.5	2.5	–	2.5	5.0	–	6.0	9.0	–	11.5	14.0	4.5	20.0	28.0	11.0	50.0
3	1.0	–	1.0	2.0	–	2.0	3.0	–	3.0	6.5	–	8.0	11.0	4.0	15.0	17.5	5.5	25.5	36.0	22.0	73.0
4	1.5	–	1.5	2.5	–	2.5	4.0	–	4.0	7.5	–	9.5	13.0	4.5	18.0	20.5	6.5	31.0	42.0	33.0	100
5	1.5	–	1.5	3.0	–	3.0	4.5	–	5.0	8.5	–	10.5	15.0	5.0	21.5	23.0	7.5	37.0	47.0	42.0	116
6	2.0	–	2.0	3.0	–	3.0	5.0	–	6.0	9.5	–	12.5	16.5	5.5	24.0	25.0	8.5	42.0	51.0	53.0	135
7	2.0	–	2.0	3.5	–	3.5	5.5	–	6.5	10.5	4.0	14.0	18.0	6.0	26.5	28.0	11.0	50.0	NP		
8	2.0	–	2.0	3.5	–	3.5	5.5	–	6.5	11.0	4.0	15.0	19.0	6.0	28.0	30.0	13.5	55.0			
9	2.5	–	2.5	4.0	–	4.0	6.0	–	7.0	12.0	4.0	16.5	20.5	6.5	31.0	NP					
10	2.5	–	2.5	4.0	–	4.0	6.5	–	8.0	12.5	4.5	17.5	21.5	7.0	34.0						
11	2.5	–	2.5	4.5	–	5.0	7.0	–	9.0	13.5	4.5	19.0	NP								
12	2.5	–	2.5	4.5	–	5.0	7.0	–	9.0	14.0	4.5	20.0									
13	3.0	–	3.0	5.0	–	6.0	7.5	–	9.5	14.5	4.5	20.5									
14	3.0	–	3.0	5.0	–	6.0	8.0	–	10.0	NP											
15	3.0	–	3.0	5.5	–	6.5	8.0	–	10.0												
16	3.0	–	3.0	5.5	–	6.5	8.5	–	10.5												
17	3.5	–	3.5	5.5	–	6.5	8.5	–	11.0												
18	3.5	–	3.5	6.0	–	7.0	NP														
19	3.5	–	3.5	6.0	–	7.0															
20	3.5	–	3.5	6.0	–	7.5															
21	4.0	–	4.0	NP																	
	NP																				

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means – not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40(7)(f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–10

MAXIMUM ALLOWABLE LOAD FOR CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM F442, SDR 13.5; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																				
	3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	2.5	–	2.5	4.5	–	5.0	9.0	–	11.5	13.0	4.5	18.0	23.0	7.5	37.0	38.0	26.0	80.0	65.0	90.0	200
1	3.5	–	3.5	7.0	–	9.0	13.0	4.5	18.0	18.5	6.0	27.5	34.0	18.5	66.0	56.0	65.0	155	94.0	211	345
2	5.5	–	6.5	10.0	4.0	13.0	19.0	6.0	28.0	27.0	10.0	47.0	49.0	46.0	124	82.0	156	285	138	475	572
3	7.0	–	9.0	12.5	4.5	17.5	23.0	7.5	37.0	34.0	18.5	66.0	62.0	80.0	185	102	255	385	170	703	755
4	8.0	–	10.0	15.0	5.0	21.5	27.0	10.0	47.0	40.0	30.0	86.0	72.0	116	235	114	331	449	NP		
5	9.0	–	11.5	16.5	5.5	24.0	31.0	15.0	57.0	45.0	38.0	110	78.0	142	267	NP					
6	10.0	4.0	13.0	18.5	6.0	27.5	34.0	18.5	66.0	49.0	46.0	124	NP								
7	11.0	4.0	15.0	20.0	6.5	30.0	37.0	24.0	76.0	50.0	48.0	128									
8	11.5	4.0	15.5	21.5	7.0	33.0	38.0	26.0	80.0	NP											
9	12.5	4.5	17.5	23.0	7.5	37.0	NP														
10	13.0	4.5	18.0	23.0	7.5	39.0															
11	14.0	4.5	20.0	NP																	
12	14.5	4.5	20.5																		
13	14.5	5.0	21.5																		
	NP																				

Note:
WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.
Approved for cold water use only.
Intended use is for MPP systems.

Table 382.40–11

MAXIMUM ALLOWABLE LOAD FOR POLYETHYLENE ALUMINUM POLYETHYLENE TUBING (PexAlPex), ASTM F1281; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)											
	1/2"			5/8"			3/4"			1"		
		WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.0	–	1.0	2.0	–	2.0	4.0	–	4.0
1	0.5	–	0.5	1.5	–	1.5	3.0	–	3.0	6.0	–	7.0
2	1.0	–	1.0	2.0	–	2.0	4.5	–	5.0	8.5	–	10.5
3	1.5	–	1.5	3.0	–	3.0	5.5	–	6.5	10.5	4.0	14.0
4	1.5	–	1.5	3.5	–	3.5	6.5	–	8.0	12.5	4.5	17.5
5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	14.0	4.5	20.0
6	2.0	–	2.0	4.0	–	4.0	8.0	–	10.0	15.5	5.0	22.5
7	2.5	–	2.5	4.5	–	5.0	8.5	–	10.5	17.0	5.5	25.0
8	2.5	–	2.5	5.0	–	6.0	9.5	–	12.5	18.0	6.0	26.5
9	2.5	–	2.5	5.5	–	6.5	10.0	4.0	13.0	19.5	6.5	29.0
10	3.0	–	3.0	5.5	–	6.5	10.5	4.0	14.0	20.5	6.5	31.0
11	3.0	–	3.0	6.0	–	7.0	11.0	4.0	15.0	20.5	6.5	32.0
12	3.0	–	3.0	6.0	–	7.0	11.5	4.0	15.5	NP		
13	3.5	–	3.5	6.5	–	8.0	12.5	4.5	17.5			
14	3.5	–	3.5	7.0	–	9.0	NP					
15	3.5	–	3.5	7.0	–	9.0						
16	3.5	–	3.5	7.5	–	9.5						
17	4.0	–	4.0	NP								
18	4.0	–	4.0									
19	4.0	–	4.0									
20	4.0	–	4.0									
21	4.5	–	5.0									
	NP											

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.41–1

Acceptable Cross Connection Control Methods, Devices or Assemblies

Methods or Assemblies of Cross Connection Control (Standard)	Situations and Conditions							
	Backpressure				Backsiphonage			
	Low Hazard		High Hazard		Low Hazard		High Hazard	
	Continuous Pressure	Noncontinuous Pressure	Continuous Pressure	Noncontinuous Pressure	Continuous Pressure	Noncontinuous Pressure	Continuous Pressure	Noncontinuous Pressure
Air–gap Fittings for use with Plumbing Fixtures, Appliances, and Appurtenances (ASME A112.1.3)					X	X	X	X
Air Gaps (ASME A112.1.2)	X	X	X	X	X	X	X	X
Atmospheric Vacuum Breaker (CAN/CSA B64.1.1)						X		X
Backflow Preventers with Intermediate Atmospheric Vent (ASSE 1012)	X	X			X	X		
Barometric Loops					X	X	X	X
Dual Check Valve Type with Atmospheric Port Backflow Preventer (CAN/CSA B64.3)	X	X			X	X		
Hose Connection Backflow Preventers (ASSE 1052)	X[a]	X	X[a]	X	X[a]	X	X[a]	X
Hose Connection Vacuum Breakers (CAN/CSA B64.2 and B64.2.2)	X[a]	X	X[a]	X	X[a]	X	X[a]	X
Hose Connection Vacuum Breakers (ASSE 1011)	X[a]	X	X[a]	X	X[a]	X	X[a]	X
Pipe Applied Atmospheric Type Vacuum Breakers (ASSE 1001)						X		X
Pressure Vacuum Breaker Assembly (ASSE 1020)					X	X	X	X
Reduced Pressure Principle Backflow Preventers And Reduced Pressure Fire Protection Principle Backflow Preventers (ASSE 1013)	X	X	X	X	X	X	X	X
Reduced Pressure Principle Backflow Preventer (CAN/CSA B64.4)	X	X	X	X	X	X	X	X
Spill Resistant Vacuum Breaker (ASSE 1056 and CAN/CSA B64.1.3)					X	X	X	X
Vacuum Breaker (CAN/CSA B64.1.2)					X	X	X	X

[a] See limitation listed under s. SPS 382.41 (4) (c) 1. a.

Table 382.41–2

Acceptable Cross Connection Control Methods, Devices or Assemblies for Specific Applications

Methods or Assemblies (Standard)	Types of Application or Use
Backflow Preventer for Beverage Dispensing Machines (ASSE 1022)	Beverage dispensers
Chemical Dispensing Systems (ASSE 1055)	Chemical dispensing systems
Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies (ASSE 1015)	Automatic fire sprinkler systems and standpipe systems Water–based fire protection system
Double Check Detector Fire Protection Backflow Prevention Assemblies (ASSE 1048)	Automatic fire sprinkler systems and standpipe systems Water–based fire protection system
Double Check Detector Valve Type Backflow Preventer (CAN/CSA B64.5)	Automatic fire sprinkler systems and standpipe systems Water–based fire protection system
Dual Check Backflow Preventer Wall Hydrant — Freeze Resistant Type (ASSE 1053)	Hose threaded outlet connection
Hand Held Showers (ASSE 1014)	Hand held shower assemblies
Laboratory Faucet Type Vacuum Breakers (CAN/CSA B64.7)	Laboratory faucets
Laboratory Faucet Vacuum Breakers (ASSE 1035)	Laboratory faucets
Pressurized Flushing Devices (Flushometers) For Plumbing Fixtures (ASSE 1037)	Flushometer plumbing fixtures
Reduced Pressure Detector Fire Prevention Backflow Prevention Assemblies (ASSE 1047)	Automatic fire sprinkler systems
Trap Seal Primer Valves, Water Supply Fed (ASSE 1018)	Traps for drain systems
Vacuum Breaker Tees [s. SPS 382.41 (5) (j)]	Water treatment devices
Wall Hydrants, Frost Proof Automatic Draining Anti–Backflow Type (ASSE 1019), types A or B	Hose threaded outlet connections
Water Closet Flush Tank Ball Cocks (ASSE 1002)	Gravity water closet flush tanks

Table 382.50–1
Spouts and Actions Required in Health Care and Related Facilities

Fixture Location	Type of Spout		Type of Action		
	Standard	Gooseneck or provide a 5–inch clearance	Hand	Wrist	Foot, Knee or Electronic Sensor
NURSING DEPARTMENT					
Patient toilet room		X		X	X
Patient toilet room, isolation		X			X
Utility room		X		X	X
Treatment room		X		X	X
Medicine room		X		X	X
Kitchen floor lavatory		X		X	X
Kitchen floor sink	X	X		X	X
Nurses toilet room	X	X	X	X	X
Floor laboratory		X	X	X	X
NURSERY					
Nursery		X		X	X
Exam/treatment room		X		X	X
Infant intensive care unit		X			X
Labor room		X		X	X
SURGICAL					
Scrub room		X [a]			X
Sub–sterile room	X	X		X	X
Clean–up room	X	X		X	X
Frozen sections room		X	X	X	X
Surgical supply room		X		X	X
Work room	X	X		X	X
Cystoscopic room		X [a]		X	X
Fracture room	X	X		X	X
Recovery room		X			X
CENTRAL SUPPLY					
Work room	X	X		X	X
Solutions room	X	X		X	X
Pharmacy		X	X	X	X
Manufacturing		X		X	X
EMERGENCY DEPARTMENT					
Observation bedroom		X		X	X
Utility room		X		X	X
Operating room		X [a]			X
Exam room		X		X	X
DIAGNOSTIC AND TREATMENT					
Occupational therapy room		X		X	X
Hydro–therapy room		X		X	X
Exam/treatment room		X		X	X
Radium treatment/exam room		X		X	X
Toilet room		X		X	X
Dark room		X		X	X
Autopsy room		X [a]			X
Lavatory in autopsy shower room		X	X	X	X
Laboratory		X	X	X	X

Table 382.50–1 (Continued)
Spouts and Actions Required in Health Care and Related Facilities

Fixture Location	Type of Spout		Type of Action		
	Standard	Gooseneck or provide a 5–inch clearance	Hand	Wrist	Foot, Knee or Electronic Sensor
CLINIC OR OUTPATIENT DEPARTMENT					
Exam/treatment room		X		X	X
Dental operating room		X			X
Dental laboratory		X	X	X	X
Dental recovery room		X		X	X
Surgical room		X [a]			X
Eye exam room		X			X
Ear, nose and throat exam room		X			X
SERVICE DEPARTMENT					
Lavatory in kitchen	X	X		X	X

X = Spout and action meet required type.

[a] Spout includes a spray head.

Table 382.60

Support Spacing

Material	Maximum Horizontal Spacing (feet)	Maximum Vertical Spacing (feet)
Acrylonitrile Butadiene Styrene (ABS)	4	10
Brass	10	10
Cast iron	5[a]	15
Copper or Copper–Alloy Pipe	12	10
Copper or Copper–Alloy Tubing:		
≤ 1¼″ diameter[c]	6	10
≥ 1½″ diameter[c]	10	10
Chlorinated Polyvinyl Chloride (CPVC):		
≤ 1″ diameter[c]	3	5[b]
≥ 1¼″ diameter[c]	4	6[b]
Crosslinked Polyethylene (PEX)	2 2/3	4
Ductile Iron	5[a]	15
Galvanized Steel	12	15
Lead	Continuous	4
Polybutylene (PB)	2 ft. 8 in.	4
Polyethylene (PE)	2	4
Polypropylene (PP)	2	4
Polyvinylidene Fluoride (PVDF)	2	4
Polyvinyl Chloride, flexible (PVC)	2	4
Polyvinyl Chloride (PVC)	4	10
Stainless Steel	12	15

[a] The maximum horizontal spacing for supports may be increased to 10 feet when 10–foot lengths of pipe are employed.
[b] Mid–story guide is to be employed.
[c] "≥" means greater than or equal to.
"≤" means less than or equal to.

Table 382.70–1
Plumbing Treatment Standards

Intended Use	Plumbing Treatment Standards [f]
1. Drinking, cooking, food processing, preparation and cleaning, pharmaceutical processing and medical uses	NR 811 and 812 approved sources
2. Personal hygiene, bathing and showering	NR 811 and 812 approved sources
3. Automatic fire protection systems	As acceptable by local authority
4. Swimming pool makeup water	NR 811 and 812 approved sources
5. Swimming pool fill water	DHS 172 requirements
6. Cooling water [b]	pH 6 – 9 [b] ≤ 50 mg/L BOD_5 ≤ 30 mg/L TSS Free chlorine residual 1.0 – 10.0 mg/L [b]
7. Subsurface infiltration and irrigation, using reuse as the source [c]	≤ 15 mg/L oil and grease ≤ 30 mg/L BOD_5 ≤ 35 mg/L TSS < 200 fecal coliform cfu/100 mL [d]
8. Subsurface infiltration and irrigation, using stormwater as the source [c]	< 15 mg/L oil and grease < 60 mg/L TSS
9. Surface or spray irrigation using stormwater and clearwater as the source [c]	≤ 10 mg/L BOD_5 ≤ 5 mg/L TSS
10. Surface irrigation except food crops, vehicle washing, clothes washing, air conditioning, soil compaction, dust control, washing aggregate and making concrete [a, c]	pH 6 – 9 [b] ≤ 10 mg/L BOD_5 ≤ 5 mg/L TSS Free chlorine residual 1.0 – 10.0 mg/L [b]
11. Toilet and urinal flushing	pH 6 – 9 [b] 200 mg/L BOD_5 ≤ 5 mg/L TSS Free chlorine residual .1 mg/L – 4.0 mg/L [b]
12. Uses not specifically listed above	Contact department for standards

Chapter SPS 383

PRIVATE ONSITE WASTEWATER TREATMENT SYSTEMS

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SPS 383.02 Scope.
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Subchapter VI — Recognized Methods and Technologies

SPS 383.60 Purpose.
SPS 383.61 Parameters for using acceptable methods and technologies.

Subchapter VII — Department Performance Monitoring

SPS 383.70 Purpose.
SPS 383.71 Department procedures.

Subchapter I — Scope and Application

SPS 383.01 Purpose. The purpose of this chapter is to establish uniform standards and criteria for the design, installation, inspection, and management of a private onsite wastewater treatment system, POWTS, so that the system is safe and will protect public health and the Waters of the State.

SPS 383.02 Scope.

(1) WASTEWATER GENERATION. Except as delineated in sub. (2), this chapter applies to all of the following:

(a) A situation where domestic wastewater is collected and conducted by means of plumbing drain systems and is not conveyed to a wastewater treatment facility regulated by the Department of Natural Resources.

(b) A POWTS where domestic wastewater is treated and dispersed to the subsurface.

(c) A holding tank that is utilized as a POWTS or as part of a POWTS to collect and hold domestic wastewater for transport and treatment elsewhere.

Note: The Wisconsin Department of Natural Resources is responsible for establishing, administering, and enforcing standards relative to domestic wastewater treatment systems which either disperse to the surface or to surface waters. The Department of Natural Resources also establishes effluent limitations and monitoring requirements where the design daily influent wastewater flow to a POWTS exceeds 12,000 gallons per day for the purpose of fulfilling WPDES permit requirements under Ch. 283, Stats.

(3) SUBDIVISION STANDARDS. This chapter does not establish minimum lot sizes or lot elevations for the purpose of the Department reviewing proposed subdivisions which will not be served by public sewers.

SPS 383.03 Application.

(1) INSTALLATIONS.

(a) ***New POWTS installations.*** **The** design, installation, and management of a new POWTS shall conform with this chapter.

(b) ***Modifications to existing POWTS.*** A modification to an existing POWTS, including the replacement, Alteration or addition of materials, appurtenances or POWTS components, shall require that the modification conform to this chapter.

Note: The modification of one part of a POWTS may affect the performance or the operation of other parts of the POWTS thereby necessitating further modifications for the `other parts' to be or remain compliant with the appropriate edition of the state plumbing code; see sub. (2) (b) 1.

(c) ***Modifications to existing structures served by existing POWTS.*** When an Addition or Alteration is proposed to an existing building, structure or facility that is served by an existing POWTS and the proposed Addition or Alteration will result in a change that affects the wastewater flow or wastewater contaminant load beyond the minimum or maximum capabilities of the existing POWTS, the POWTS shall be modified to conform to the rules of this chapter.

(2) RETROACTIVITY.

(a) This chapter does not apply retroactively.

(4) GROUNDWATER STANDARDS.

(a) The design, installation, use or maintenance of a POWTS is not required to comply with the nitrate standard specified in Wisconsin Ch. NR 140 Table . .

Subchapter II — Administration and Enforcement

SPS 383.20 Purpose.

(1) This subchapter establishes the following:

(a) Regulatory processes and procedures which are to be followed when designing, installing, or maintaining a POWTS.

SPS 383.21 Sanitary permits.

(1) GENERAL.

(a) The installation or construction of a POWTS may not commence or continue unless all of the following have been fulfilled:

1. The Owner of the property on which the POWTS is to be installed possesses a valid sanitary permit.

2. Plan approval for the POWTS has been obtained in accordance with SPS 383.22.

(b) The modification of an existing POWTS may not commence or continue unless the Owner of the property on which the POWTS is located possesses a valid sanitary permit and has obtained plan approval for the modification under SPS 383.22, if the modification involves the addition or replacement of any of the following:

1. A POWTS holding component.

2. A POWTS treatment component.

3. A POWTS dispersal component.

(2) APPLICATION.

(a) The application for a sanitary permit shall be made in a format prescribed by the Department.

Note: The Department forms required in this chapter are available on the Wisconsin Department of Safety and Professional Services' website at dsps.wi.gov.

(b)

1. Except as provided in subd. 2., the application for a sanitary permit shall be submitted to the appropriate governmental unit where the POWTS is located or will be located.

2. The application for a sanitary permit shall be submitted to the Department for a POWTS that is located or will be located on property owned by the state.

(c) The application for a sanitary permit submitted to the Department shall be accompanied by all of the following:

1. At least one set of clear and legible plans and specifications delineating the information under SPS 383.22 (2) (a) 3. and (c).

3. Sufficient supporting information to determine whether the proposed design, installation, and management of the POWTS or the proposed modification to an existing POWTS conforms with this chapter.

4. Documentation that the master plumber or the master plumber-restricted service who is to be responsible for the installation or modification of the POWTS has completed approved training or has documentation that approved training will be provided during the installation of the POWTS, if the application for the sanitary permit involves one or more of the technologies or methods specified in SPS 383.04 (1).

5. Documentation that maintenance requirements for the proposed POWTS technology or method have been recorded with the Department for the property.

7. A fee as specified by the Department (if any).

(3) PROCESSING.

(a) A sanitary permit may not be issued until the plans and specifications have been Approved by the Department

(b) The Department may not issue a sanitary permit for the installation or modification of the POWTS that involves one or more of the technologies or methods specified in SPS 383.04 (1) unless the master plumber or the master plumber-restricted who is to be responsible for the installation or modification has completed approved training or has documentation that approved training will be provided during the installation of the POWTS.

(c) The Department shall review and make a determination on the submission of an application for a sanitary permit within 30 days after receiving all the required information and fees under sub. (2) (c).

(d)

1. If upon review of the application and the supporting information, the Department determines that the proposed design, installation, and management of the POWTS or the proposed modification of an existing POWTS conforms with this chapter, a sanitary permit shall be issued.

2.

a. If upon review of the application and the supporting information, the Department determines that the proposed design, installation, and management of the POWTS or the proposed modification of an existing POWTS does not conform with this chapter, a sanitary permit may not be issued.

b. When the issuance of a sanitary permit is denied, the Department reviewing the application shall provide in writing to the applicant the reasons for denial, and a notice of the right to appeal.

d. The appeal of the denial by the Department for a sanitary permit shall be made in writing within 30 days from the date of the decision.

(f) The Department may deny the issuance of a sanitary permit only if the application does not comply with the requirements of chs. SPS 383, 384 or 385.

(4) TRANSFERS. A sanitary permit may be transferred from an Owner to a subsequent Owner.

(5) EXPIRATION. A sanitary permit shall expire 2 years from the date of issuance unless renewed in accordance with sub. (6).

(6) RENEWALS.

(a)

1. The application for renewal of a sanitary permit shall be made in a format prescribed by the Department.

2. The application for renewal of a sanitary permit shall be submitted to the Department in accordance with sub. (2) (b).

(b) The renewal of a sanitary permit shall be contingent upon the proposed POWTS or the proposed modification of an existing POWTS conforming with the rules of this chapter in effect at the time the sanitary permit is renewed.

(6m) SUSPENSION.

(a) The Department may temporarily suspend a sanitary permit issued under this section if it is determined prior to construction that a POWTS cannot be installed based on the information that was available when the permit was issued.

(b) The suspension of the sanitary permit shall terminate no later than the date the sanitary permit expires.

(7) REVOCATION.

(a) The Department may revoke a sanitary permit issued under this section for any false statements or misrepresentation of facts on which the sanitary permit was issued.

(c) The revocation of a sanitary permit and the reasons for revocation shall be conveyed in writing to the individual to whom the sanitary permit was issued or transferred.

(d) If a sanitary permit is revoked, the installation or modification of a POWTS may not commence or continue until another sanitary permit is obtained.

(8) POSTING. When a sanitary permit is obtained under sub. (2), the sanitary permit shall comply with all of the following:

(a) The sanitary permit shall be posted in such a location and manner on the proposed site where the POWTS is to be installed or modified so that the information on the permit is visible for inspection.

(b) The sanitary permit shall be posted until a POWTS installation or modification is completed and an opportunity for a final inspection occurs in accordance with SPS 383.26.

(9) PERMIT STORAGE. The Department shall maintain a permanent record of each sanitary permit and permit application supporting information listed in SPS 383.21 (2) (c) until the property is no longer served by a POWTS.

(10) PERMIT SUMMARY REPORTING. (INTENTIONALLY OMITTED)

SPS 383.22 Plan review and approval.

(1) SUBMISSION OF PLANS.

(a) Plans shall be submitted to the Department in accordance with this section for all of the following types of installations or modifications:

1. The installation or construction of a POWTS.

2. The replacement or addition of a POWTS treatment component.

3. The replacement or addition of a POWTS holding component.

4. The replacement or addition of a POWTS dispersal component.

(b) Plans for the types of POWTS delineated in Table 383.22-1 shall be submitted to the Department for review.

(c) Plans for the types of POWTS delineated in Table 383.22-2 shall be submitted for review to the Department.

(2) PLANS AND SPECIFICATIONS.

(a)

1. When plans are submitted to the Department for review, a set of plans and specifications shall be provided.

Note: Specifications for a project do not have to be a separate document but may be delineated on the plans.

3. Plans and specifications submitted for review shall be clear, legible, and permanent copies.

4. Plans submitted for review shall include all of the following:

a. Details and configuration layouts depicting how the design is to be constructed and how the design is to accomplish the treatment in accordance with SPS 383.43 and 383.44 and dispersal that is claimed or the holding of wastewater.

b. Specifications, including a description of the materials for the project and the installation or construction practices and methods to be employed.

c. A site plan with a benchmark either scaled or dimensioned, delineating all treatment and dispersal components and their relationship to any items listed in Table 383.43-1.

(b)

1. All plans submitted for review shall be accompanied by sufficient data and information to determine if the proposed POWTS or modification of an existing POWTS and their performance will conform with chs. SPS 382 to 384 including all of the following:

a. A plan review application form specified by the Department.

Note: The Department forms required in this chapter shall be available from the Department.

b. The minimum and maximum wastewater flow and load of the proposed project and the method or rationale for determining the flow and load.

c. Documentation to support treatment and dispersal claims.

d. A management plan for the proposed design reflecting conformance to subch. V.

e. A soil and site evaluation report in accordance with SPS 385.40 for those POWTS components that consist in part of in situ soil.

f. A description of a contingency plan in the event the proposed POWTS fails and cannot be Repaired.

g. Other information requested by the Department.

3. In addition to the information required under subd. 1., plans for a POWTS that is to serve a Dwelling where the design of the POWTS is not based upon the number of

bedrooms within the Dwelling shall be accompanied by information documenting that design condition with the Department.

4. In addition to the information required under subd. 1., plans for an experimental POWTS shall be accompanied by information required under SPS 383.27 (3).

6.

(c) Plans and specifications which are required to be submitted for review under sub. (1) shall be one of the following:

1. Signed and sealed by an individual who is registered by the State of Wisconsin as an architect, engineer, designer of plumbing systems, or designer of private onsite wastewater treatment systems.

2. Signed, including license number, and dated by an individual who is responsible for the installation of the POWTS and who is licensed by the State of Wisconsin as a master plumber or master plumber-restricted service.

(3) PLAN REVIEW PROCESS.

(a) ***Time limits.*** The Department shall review and make a determination on an application for plan review within 15 Business Days.

(b) ***Conditional approval.***

1. If, upon review, the Department determines that the plans conform to chs. SPS 382 to 384, a conditional approval shall be granted in writing.

2. All conditions indicating nonconformance to chs. SPS 382 to 384 shall be corrected before or during installation.

(c) ***Denial of approval.*** If, upon review, the Department determines that the plans do not conform to chs. SPS 382 to 384, the request for conditional approval shall be denied in writing.

(4) REVISIONS.

(a) A modification to the design of a POWTS for which a plan has been previously granted approval under sub. (3) (b) shall be submitted to the Department for review in accordance with this section, if the proposed modification involves any of the following:

1. A change in wastewater flow or contaminant load.

2. The replacement or addition of a POWTS component listed in Table 383.04-1.

3. The addition of a POWTS dispersal component.

4. A change to one or more dispersal components involving any of the following:

a. Location outside suitable evaluated areas or proposed depths or elevations.

b. Dimensions of any distribution cell or basal area.

c. Type of dispersal component.

d. Design of a pressure distribution component, except for changes to pumps, force main lengths, total dynamic head, (TDH), or pump control settings.

(b) A modification to the design of a POWTS for which a plan has been previously granted approval under sub. (3) (b) may be submitted to the Department, if the proposed modification involves a change which is not listed in par. (a) and if the Department agrees to review the proposed minor revision.

(c) The installer of a POWTS may not implement or undertake the proposed revisions under par. (a) or (b) until written approval is obtained from the Department.

(d) Revisions to previously Approved plans shall be reviewed in accordance with sub. (3).

(e) If revisions under par. (a) are submitted to and Approved by the Department, the Owner of the site for the POWTS or the Owner's agent shall file the revisions with the Department.

(5) LIMITATION OF RESPONSIBILITY. A conditional approval of a plan by the Department may not be construed as an assumption by the Department of any responsibility for the design of the POWTS or any component of the system. The Department shall not be liable for any defects in construction, or for any damages that may result from a specific installation.

(6) REVOCATION OF APPROVAL.

(a) The Department may revoke any plan approval issued under this section for any false statements or misrepresentation of facts on which the approval was based.

(c) The revocation of a plan approval and the reasons for revocation shall be conveyed in writing to the submitter of the plans as noted on the application.

(d) If a plan approval is revoked, the installation or Alteration of a POWTS may not continue until another plan approval is obtained.

(7) EVIDENCE OF APPROVAL.

(a) When plans are required to be Approved by the Department under sub. (1), the plumber responsible for the installation of a POWTS or the modification of an existing POWTS shall keep at the construction site at least one set of plans bearing evidence of approval by the Department and at least one copy of specifications.

(b) The plans and specifications shall be maintained at the construction site until the POWTS installation or modification is completed and an opportunity for a final inspection occurs in accordance with SPS 383.26.

(c) The plans and specifications shall be made available to the Department upon request.

SPS 383.23 Review agent status. (INTENTIONALLY OMITTED)

SPS 383.24 Petitions for variance. (See SPS 320)

SPS 383.25 Governmental programs.

(2) ISSUANCE OF BUILDING PERMITS.

(a) ***General.*** The issuance of building permits by the Department for unsewered properties shall be in accordance with this subsection.

(b) ***New construction.*** The Department may not issue a building permit to commence construction or installation of a structure that necessitates the use of a POWTS to serve the structure unless one of the following conditions apply:

1. The Owner of the property possesses a sanitary permit for the installation of a POWTS in accordance with SPS 383.21.

Note: Section SPS 383.21 outlines the procedures for the issuance of sanitary permits. No private sewage system may be installed unless the Owner of the property holds a valid sanitary permit.

2. A POWTS of adequate capability and capacity to accommodate the wastewater flow and contaminant load already exists to serve the structure.

Note: See SPS 383.02 and 383.03 concerning the application of current code requirements to existing POWTS.

(c) ***Construction affecting wastewater flow or contaminant load.***

1. The Department may not issue a building permit to commence construction of any Addition or Alteration to an existing structure when the proposed construction will modify the design wastewater flow or contaminant load, or both, to an existing POWTS, unless the Owner of the property complies with at least one of the following:

a. Possesses a sanitary permit to either modify the existing POWTS or construct a POWTS to accommodate the modification in wastewater flow or contaminant load, or both.

b. Provides documentation to verify that the existing POWTS is sufficient to accommodate the modification in wastewater flow or contaminant load, or both.

2. For the purpose of this paragraph, a modification in wastewater flow or contaminant load shall be considered to occur for both of the following:

b. For Dwellings, when there is an increase or decrease in the number of bedrooms.

(d) ***Documentation of existing capabilities.*** Documentation to verify whether an existing POWTS can accommodate a modification in wastewater flow or contaminant load, or both, shall include at least one of the following:

1. A copy of the plan for the existing POWTS that delineates minimum and maximum performance capabilities, and which has been previously Approved by the Department.

2. Information on the performance capabilities for the existing POWTS that has been recognized through a product approval under ch. SPS 384.

3. A written investigative report prepared by an architect, engineer, designer of plumbing systems, designer of private onsite wastewater treatment systems, master plumber, master plumber-restricted service or certified POWTS inspector analyzing the proposed modification and the performance capabilities of the existing POWTS.

(e) Where the performance capability of the existing POWTS serving a Dwelling is not based on the number of bedrooms within the Dwelling, information documenting that design condition shall be recorded with the Department.

(f) ***Setbacks.***

1. The Department may not issue a building permit for construction of any structure or Addition to a structure on a site where there exists a POWTS, unless the proposed construction conforms to the applicable setback. See SPS 325 Appendix A.

SPS 383.255 The Department inventory and maintenance program.

(1)

(a)

1. The Department shall maintain an inventory of all POWTS located on Tribal Lands.

2. The inventory shall be updated as existing POWTS are identified and new POWTS are installed or constructed.

(b) At a minimum, a POWTS inventory shall consist of all of the following elements:

1. Legal description of all properties where a POWTS is located on Tribal Lands.

2. The address of the Dwelling where each POWTS is located on Tribal Lands.

(2)

(a) The Department shall be responsible for administering a POWTS maintenance program.

(b) At a minimum, a POWTS maintenance program shall consist of all of the following elements:

1. An inventory of all POWTS located on Tribal Lands.

2. A process that accepts and records inspection, evaluation, maintenance, and servicing reports listed in the Department's inventory.

3. A process that accepts and creates a record for each inspection, evaluation, maintenance, and servicing report for a POWTS on Tribal Lands not listed in the Department's inventory.

5. A process that includes measures meant to ensure that required inspection, evaluation, maintenance, and servicing is performed and the results are reported to the Department.

6. Reports summarizing the results of the maintenance program on an annual basis.

SPS 383.26 Inspections and testing.

(1)

(a) The Department may inspect the construction, installation, operation, or maintenance of a POWTS to ascertain whether the POWTS conforms to plans Approved by the Department, the conditions of approval and this chapter.

(b) The Department may issue an order directing an immediate cessation of the installation of a POWTS or the modification to an existing POWTS for failure to comply with a corrective order.

(2)

(a) When a sanitary permit is required under SPS 383.21 (1), no part of a POWTS component may be covered nor any POWTS component put into service until the Department has had an opportunity to inspect the system in accordance with this subsection.

Note: An individual authorized by the Department to administer and enforce the provisions of chs. SPS 382 to 385 relative to POWTS is required to be a certified POWTS inspector.

(b) The master plumber or the master plumber-restricted service responsible for the installation of a POWTS or the modification to an existing POWTS shall notify the Department when the work will be or is ready for inspection.

(c) The master plumber or the master plumber-restricted service responsible for the installation of a POWTS or the modification shall maintain records of the inspection

notifications. The records shall include the date and time of notification and the name of the person contacted.

(d) The master plumber or master plumber-restricted service responsible for the POWTS installation or modification shall provide the necessary equipment and properly licensed personnel required for the inspection as requested by the Department.

(e) If an inspection is not made by the end of the next Business Day, after the requested inspection day, the master plumber or the master plumber-restricted service may proceed with the installation of the POWTS, including backfilling and covering.

(3) The Department by ordinance may require other inspections in addition to that specified under this section.

(4) The Department maintains a written record of each inspection conducted for a POWTS. The record shall include information relative to all of the following:

(a) The location of the POWTS.

(b) The date of the inspection.

(c) The nature and findings of the inspection.

(5) Before being put into service, components of a POWTS shall be tested in accordance with the manufacturer's specifications or as specified as a condition of approval under SPS 383.22 and 384.10.

SPS 383.27 Experiments. (INTENTIONALLY OMITTED)

SPS 383.28 Penalties. Penalties for violations of this chapter shall be assessed in accordance with SPS 320.

SPS 383.29 Range of responses.

(1)

(a) The Department shall respond with any one or more of the actions delineated under Table 383.29 if the preventive action limits or standards enumerated in ch. NR 140 Tables 1 and 2 are exceeded at a point of standards application as a result of the performance of a POWTS, including a POWTS existing prior to adoption of this Code., except as provided in par. (b).

(b) The design, installation, use, or maintenance of a POWTS is not required to comply with the nitrate standard specified in ch. NR 140 Table 1, except as provided under SPS 383.03 (5). - See PDF for table

(2) The point of standards application relative to the performance of POWTS shall be:

(a) Any point of present groundwater use for potable water supply; and

(b) Any point beyond the boundary of the property on which the facility, practice, or activity is located.

Subchapter III — General Requirements

SPS 383.30 Purpose. This subchapter establishes parameters for the types of POWTS that may be used and how a POWTS may be used.

SPS 383.31 Principles. A POWTS shall be operated and used in such a manner so as not to render the POWTS inoperative or beyond its capabilities, and thereby, create a human health hazard.

SPS 383.32 Prohibitions and limitations.

(1) PROHIBITIONS.

(a) Except as provided in SPS 383.03 (4), the introduction of wastewater or substances in such quantities or concentrations to a POWTS, including a POWTS existing prior to July 1, 2000, that results in exceeding the enforcement standards and preventive action limits specified in ch. NR 140 Tables 1 and 2 at a point of standards application shall be prohibited.

Note: Section SPS 383.03 (4) reads:

(4) GROUNDWATER STANDARDS.

(a) The design, installation, use or maintenance of a POWTS is not required to comply with the nitrate standard specified in ch. NR 140 Table 1, except as provided under sub. (5).

(b) Compliance with the preventive action limit for chloride specified in ch. NR 140, Table 2, is not required.

(c) Substances deleterious to a POWTS shall be intercepted, diluted, or treated in accordance with SPS 382.34 prior to the substance discharging into a POWTS.

(d) The use of a cesspool as a POWTS is prohibited.

(e) The final discharge of domestic wastewater or POWTS effluent to open bodies of water is prohibited, including by means of plumbing outfall pipes.

(f) The final discharge of domestic wastewater or POWTS effluent to the ground surface is prohibited, including by means of plumbing outfall pipes.

(g) The infiltrative surface of a treatment or dispersal component of a POWTS which consists in part of soil may not be located in bedrock or groundwater.

SPS 383.33 Abandonment. A subsurface tank or pit that is no longer used as a POWTS component shall be abandoned by complying with all of the following:

(1) Disconnecting all piping to the tanks and pits.

(2) Sealing all disconnected piping to the tanks and pits.

(3) Pumping and disposing of the contents from all tanks and pits.

Note: The removal and disposal of the contents from treatment tanks, distribution tanks, seepage pits, and holding components is regulated by the Department.

(4) Removing all tanks, crushing in place, or removing the covers of the tanks or pits and filling the tanks and pits with soil, gravel, or an inert solid material.

Subchapter IV — Design and Installation

SPS 383.40 Purpose. This subchapter establishes minimum parameters for the design and installation of a POWTS for the purpose of:

(1) Safeguarding public health;

(2) Minimizing the level of substances which have a reasonable probability of entering Waters of the State; and

(3) Delineating measures, conditions, and performance standards by which to evaluate designs.

SPS 383.41 Principles.

(1) A POWTS shall be designed to hold wastewater or reduce the contaminant load and disperse the flow of wastewater as specified in this subchapter.

Note: See SPS 382.34 (15) for requirements relating to special wastewater or mixed wastewater treatment or containment devices.

(2) A POWTS shall be designed to have sufficient capacity to accommodate the anticipated quantities of wastewater that will be discharged into the system.

(3) A POWTS intended to treat and disperse wastewater shall be designed to have sufficient ability to treat or separate out the anticipated types, quantities, and concentrations of wastewater contaminants to be discharged into the system so that the dispersed wastewater will not create a human health hazard.

(4) A POWTS shall be designed to disperse wastewater below the surface of the ground at a rate that promotes long term assimilation into the soil and limits the possibility of surfacing.

SPS 383.42 Application.

(1) DESIGN BASIS. The design of a POWTS shall be based on the methods and limitations outlined in this subchapter.

(2) DESIGN RELATION TO ACTUAL FLOWS AND CONTAMINANT LOADS. For any situation where it is known that the wastewater flow or contaminant load exceeds the parameters of this subchapter, the POWTS shall be designed in relation to the known flow or load.

(3) DESIGN CONSIDERATIONS. The evidence to support assertions relative to contaminant reduction and hydraulic dispersal shall include at least all of the following:

(a) The flow and contaminant load of the influent wastewater.

(b) The ability of all treatment and dispersal components to reduce contaminant load and disperse hydraulic flow into the environment.

(c) The flow velocities and friction losses throughout the system based upon accepted engineering practice.

SPS 383.43 General requirements.

(1) MATERIALS. The components of a POWTS shall be constructed of materials and products that are of a type recognized under this chapter or ch. SPS 384.

(2) DESIGN FLOW. In order to accommodate peak wastewater flow, the design wastewater flow of a POWTS shall equal at least 150% of the estimated daily flow generated from the source or sources, unless otherwise Approved by the Department.

(3) ESTIMATED DAILY COMBINED FLOW FOR A POWTS SERVING A DWELLING. The estimated daily wastewater flow of combined graywater, clear water and blackwater from a Dwelling shall be based on one or more of the following:

(a) The following equation:

100 gallons x B = F

Where: B = number of bedrooms, based on 2 persons per bedroom, unless otherwise Approved by the Department.

F = Estimated daily wastewater flow per Dwelling per day (in gallons), excluding storm water discharges.

(b) A detailed estimate of wastewater flow based upon per capita occupancy or usage of the Dwelling or per function occurrence within the Dwelling.

(4) ESTIMATED DAILY SEGREGATED GRAYWATER FLOW FOR A POWTS SERVING A DWELLING. The estimated daily wastewater flow of graywater and clear water from a Dwelling shall be based on one or more of the following:

(a) The following equation:

60 gallons x B = F

Where: B = number of bedrooms, based on 2 persons per bedroom, unless otherwise Approved by the Department.

F = Estimated daily graywater flow per Dwelling per day (in gallons), excluding storm water discharges.

(b) A detailed estimate of graywater flow based upon per capita occupancy or usage of the Dwelling or per function occurrence within the Dwelling.

(5) ESTIMATING SEGREGATED BLACKWATER FLOW FOR A POWTS SERVING A DWELLING. The estimated daily wastewater flow of blackwater from a Dwelling shall be based on one or more of the following:

(a) The following equation:

40 gallons x B = F

Where: B = number of bedrooms, based on 2 persons per bedroom, unless otherwise Approved by the Department.

F = Estimated daily blackwater flow per Dwelling per day (in gallons).

(b) A detailed estimate of blackwater flow based upon per capita occupancy or usage of the Dwelling or per function occurrence within the Dwelling.

(7) ESTIMATING CONTAMINANT LOADS. Estimates of contaminant loads from Dwellings shall be based on a detailed analysis including all contaminants listed in SPS 383.44 (2) (a).

Note: See ch. SPS 383 Appendix for further information.

(8) GENERAL DESIGN REQUIREMENTS.

(a) ***Flow velocity.***

1. Piping within a POWTS shall be designed and installed to supply wastewater to POWTS treatment and dispersal components while maintaining the velocity required to ensure operation of the POWTS.

2. Gravity flow piping between POWTS components shall be installed at a pitch that produces a computed flow velocity of at least one foot per second when flowing half full.

3. Pressurization equipment or devices and piping to be utilized upstream of a POWTS treatment or dispersal component consisting in part of in situ soil shall be designed and installed to produce a computed velocity of at least 2 feet per second.

4. Gravity piping within a POWTS treatment or dispersal component consisting in part of in situ soil shall be installed level or pitched downstream a maximum 4 inches per 100 feet.

(b) ***Distribution and drainpipe sizing***. The piping within a POWTS shall be of a diameter to permit the operation of the POWTS.

(c) ***Frost protection.*** All POWTS components shall be protected from freezing temperatures that could detrimentally affect component operation to provide wastewater conveyance, treatment, or dispersal.

(d) ***Component placement.*** The orientation of a POWTS treatment or dispersal component consisting in part of in situ soil shall take into account landscape variations in elevation, slope orientation, and other conditions that could affect component performance relative to dispersal or aeration.

(e) ***Alarms or warning systems.***

1.

a. A POWTS component utilizing a mechanical device to treat wastewater or to distribute effluent shall be provided with an automatic visual or audible means of notifying the user of the POWTS of the failure of the mechanical device.

Note: In accordance with SPS 316.300 (1) (a), an alarm that is electrically powered is to be on a separate circuit from the circuit supplying power to the mechanical device.

b. An alarm indicating the failure of a pump shall remain audible or visible until manually turned off.

c. Where duplex pumping equipment is employed to provide continuous component operation in the event that one pump fails, the pumps shall be installed in such a manner so as to provide the continuous operation automatically.

2. A POWTS holding tank shall be provided with an automatic visual or audible means of notifying the user of the POWTS of the necessity for servicing.

(f) ***Accessibility.*** The design of a POWTS shall include provisions to provide access to all components that require maintenance or observation.

(g) ***Anchoring system components.*** An exterior subsurface POWTS treatment tank or POWTS holding component to be installed in an area subject to saturated conditions shall be installed so as to prevent flotation of the tank or component.

Note: See ch. SPS 383 Appendix for further information.

(h) ***Treatment byproducts.***

1. All treatment byproducts discharged from or as a result of operating a POWTS shall be disposed of so as not to create a human health hazard.

2. Deleterious or hazardous materials segregated out from effluent flows shall be disposed of in a manner conforming with Environmental Protection Agency (“EPA”) standards.

3. Effluent from a POWTS shall be dispersed so as not to create a human health hazard.

4. All POWTS components within a building or structure shall be gas tight unless provisions are made assuring the safety of individuals entering the building or structure.

(i) ***Site parameters and limitations.*** POWTS treatment, holding and dispersal components shall be located so as to provide the minimum horizontal setback distances as outlined in Table 383.43-1 as safety factors for public health, Waters of the State, and structures in the event of component failure.

Note: Chapter NR 812 establishes upslope location criteria for wells relative to contamination sources. - See PDF for table

OHWM = Ordinary High-Water Mark

b See SPS 383.43 (8) (f) relative to accessibility.

c Road-right-of-way lines may be more restrictive than property lines.

Note: See SPS 382.365, Table 382.365-4 relative to horizontal setback distances to subsurface infiltrative systems.

Note: The Wisconsin Department of Transportation has established setback limits from the centerline of state trunk highways or connecting highways to structures and improvements which include septic systems.

(j) ***Service suction and discharge lines.***

1. A suction line or discharge line serving a holding tank for servicing purposes shall comply with all of the following:

a. A pipe serving as the suction or discharge line shall be of an acceptable type in accordance with ch. SPS 384.

b. A suction or discharge line shall terminate with a service port consisting of a quick disconnect fitting with a removable plug.

c. The service port of a suction or discharge line shall terminate at least 2 feet above final grade.

d. The service port of a suction or discharge line shall be identified as such with a permanent sign with lettering at least - See PDF for diagram inch in height.

e. The service port of a suction or discharge line shall be secured to a permanent support that is capable of withstanding the loads and forces placed on the port.

f. A suction or discharge line shall be at least 3 inches in diameter.

2. A suction line serving a holding tank may not be installed in such a manner or arrangement that the tank can be drained by gravity or siphonic action.

3. Where a lift station is employed for servicing a holding tank, the pump discharge line shall conform with subd. 1., except as provided in subd. 3. a. and b.

a. A discharge line from the lift station shall be at least 2 inches in diameter.

b. The lift station pump shall be activated by means of a keyed switch at the service port.

SPS 383.44 Parameters for POWTS components consisting of in situ soil.

(1) EVALUATION. POWTS treatment and dispersal components consisting in part of in situ soil shall be evaluated in accordance with ch. SPS 385.

(2) INFLUENT QUALITY.

(a) The quality of influent discharged into a POWTS treatment or dispersal component consisting in part of in situ soil shall be equal to or less than all of the following:

1. A monthly average of 30 mg/L fats, oil, and grease.

2. A monthly average of 220 mg/L BOD5.

3. A monthly average of 150 mg/L TSS.

(b) The monthly average under par. (a) shall be calculated as the sum of all measurements taken over 30 consecutive days, with at least 6 measurements occurring on 6 separate days, and divided by the number of measurements taken during that period.

(c) Influent discharged to a POWTS treatment or dispersal component that consists in part of unsaturated soil may not contain any solid or suspended solid exceeding 1/8 inch in diameter.

Note: Under SPS 383.03 (1) (b), the replacement of a POWTS anaerobic treatment tank (septic tank) in conjunction with this rule would limit any solids within the effluent leaving the tank to a maximum of 1/8-inch diameter.

(d) The Department may designate a new Dwelling as "at-risk" if the Department determines that the Dwelling may generate waste with influent quality in excess of the parameters under par. (a). The Department may inspect and take corrective action for any Dwelling on Tribal Lands found to be "at-risk". The owner of a Dwelling that repeatedly produces influent with parameters above the limits in par. (a) or the Approved design may be subject to a service fee Approved by the Executive Council.

(3) INFILTRATIVE SURFACE.

(a) The infiltrative surface of unsaturated soil to which influent is discharged shall be located at least 24 inches above the estimated highest groundwater elevation and bedrock.

(b)

1. A POWTS designed utilizing a component manual recognized under SPS 383.60 (1) shall have at least 6 inches of the soil separation required under par. (a) consisting of an in situ soil type for which soil treatment capability has been credited under Table 383.44-3.

2. The purpose of the 6 inches of in situ soil under subd. 1. shall be to assure that the influent will be assimilated into the original subsurface soils without ponding on the ground surface.

(c) The infiltrative surface of unsaturated soil to which influent is discharged shall be located at least one inch below the finished grade.

(4) CAPABILITIES.

(a)

1.

a. Except as provided under subd. 2., the dispersal capability of a POWTS treatment or dispersal component consisting in part of unsaturated soil shall be limited to that specified in Table 383.44-2 based upon the influent quality concentrations being applied.

b. Under subd. 1. a., the influent quality parameter with the highest concentration shall determine the maximum application rate.

c. Except as provided in par. (c), the soil conditions at the infiltrative surface of unsaturated soil to which influent is to be discharged shall be used to establish the maximum application rate for a POWTS dispersal design.

d. The moist soil consistence of the soil horizon in which the infiltrative surface of a POWTS treatment or dispersal component will be located may not be stronger than firm or any cemented classification.

e. The maximum soil application for soil with moderate to strong platy structure shall not exceed 0.2 gals./sq. ft./day for effluent concentrations of ≤30 mg/L BOD5 and TSS and shall be 0.0 gals./sq. ft./day for effluent concentrations of > 30 mg/L BOD5 and TSS.

2. Maximum soil application rates other than those specified in Table 383.44-2 may be employed for the design of a POWTS treatment or dispersal component consisting in part of in situ soil if documentation is submitted and Approved under SPS 383.22 and is based on soil permeability and evapotranspiration estimates correlated to specific soil characteristics described in a detailed morphological soil evaluation.

(b) The treatment capability of a POWTS treatment component consisting of unsaturated soil shall be limited to that specified in Table 383.44-3, unless otherwise Approved by the Department.

(c) The design of a treatment or dispersal component consisting in part of in situ soil shall reflect restrictive soil horizons that affect treatment or dispersal.

(5) EFFLUENT DISTRIBUTION.

(a)

1. Except as provided in subd. 2., the distribution of effluent to a treatment or dispersal component shall be by means of pressure distribution as specified in Tables 383.44-2 and 383.44-3.

2. Pressure distribution is not required when rehabilitating an existing non-pressurized in situ soil treatment or dispersal component that is persistently ponded and that has at least 24 inches of unsaturated soil beneath the infiltrative surface of the component.

(b) Each dose of effluent by means of pressurized distribution into a treatment or dispersal component consisting in part of in situ soil may not be less than 5 times the void volume of the POWTS distribution laterals. - See PDF for table

Note a: With ≤60% rock fragments

Note b: With >60 to <90% rock fragments

Note c: Requires pressure distribution under sub. (5) (a)

Note d: COS - Coarse Sand LVFS - Loamy Very Fine Sand SI - Silt
S-Sand COSL - Coarse Sandy Loam SCL - Sandy Clay Loam
LCOS - Loamy Coarse Sand SL - Sandy Loam CL - Clay Loam
LS - Loamy Sand FSL - Fine Sandy Loam SICL - Silty Clay Loam
FS - Fine Sand VFSL - Very Fine Sandy Loam SC - Sandy Clay
LFS - Loamy Fine Sand L - Loam C - Clay
VFS - Very Fine Sand SIL - Silt Loam SIC - Silty Clay

Note e: PL - Platy 0 - Structureless
PR - Prismatic 1 - Weak

BK - Blocky 2 - Moderate
GR - Granular 3 - Strong
M - Massive - See PDF for table

Note a: Influent quality as per s. SPS 383.44 (2)

Note b: Requires pressure distribution under sub. (5) (a)

Note c: All coarse fragment voids must be filled with fine earth

Note d: COS - Coarse Sand LVFS - Loamy Very Fine Sand SI - Silt
S-Sand COSL - Coarse Sandy Loam SCL - Sandy Clay Loam
LCOS - Loamy Coarse Sand SL - Sandy Loam CL - Clay Loam
LS - Loamy Sand FSL - Fine Sandy Loam SICL - Silty Clay Loam
FS - Fine Sand VFSL - Very Fine Sandy Loam SC - Sandy Clay
LFS - Loamy Fine Sand L - Loam C - Clay
VFS - Very Fine Sand SIL - Silt Loam SIC - Silty Clay

Note e: The values for fecal coliform are reported as a monthly geometric mean. The geometric mean shall be determined on the basis of measurements taken over 30 consecutive days, with at least 6 measurements occurring on 6 separate days.

(6) ORIENTATION.

(a)

1. The infiltrative surface of a distribution cell within a POWTS treatment or dispersal component consisting in part of in situ soil and located in fill material above original grade shall be level.

2. The longest dimension of a POWTS treatment or dispersal component located at or above the original grade shall be oriented within 1 percent of the surface contour unless otherwise Approved by the Department.

(b) The infiltrative surface of a distribution cell within a POWTS treatment or dispersal component consisting in part of in situ soil and located below the surface of the original grade shall be level.

(c) POWTS treatment or dispersal components consisting in part of in situ soil shall be so located as to minimize the infiltration of storm water into the component.

(7) GEOMETRY. The geometry of a subsurface treatment or dispersal component consisting in part of the in-situ soil shall take into account linear loading rates that are based on soil texture, structure, consistence and distance to seasonal soil saturation and restrictive soil horizons.

SPS 383.45 Installation.

(1) GENERAL. A POWTS shall be constructed and installed in such a manner to hold wastewater or reduce the contaminant load and disperse the flow of wastewater in accordance with this subchapter and the plan approval under SPS 383.22.

(2) FROZEN SOIL. POWTS treatment and dispersal components consisting in part of in situ soil may not be installed if the soil is frozen at or below the infiltrative surface of the component.

(3) SNOW COVER. Snow cover shall be removed before excavating or installing POWTS treatment and dispersal components consisting in part of in situ soil.

(4) MOISTURE. The soil moisture content for a POWTS treatment or dispersal component consisting in part of in situ soil shall be evaluated immediately prior to installation of the component. If the soil at the infiltrative surface can be rolled into a ¼ -inch wire, the installation may not proceed.

(5) BEDDING. All vessels and pipes of a POWTS shall be bedded in accordance with a product approval under SPS 384.10 or a plan approval under SPS 383.22.

(6) FLOODPLAIN.

(a) All POWTS treatment tanks, holding and dispersal tanks that are located in floodplain areas shall be made and maintained watertight to prevent infiltration.

(b) Vent pipes serving POWTS components that are located in floodplain areas shall terminate at least 2 feet above regional flood levels.

(7) MINIMUM DEPTH. The top of the effluent lines and force mains shall be covered by a minimum of 12 inches of soil.

Note: See SPS 383.43 (8) (g) relative to anchoring provisions.

Subchapter V — Management

SPS 383.50 Purpose. The purpose of this subchapter is to accomplish all of the following:

(1) Establish monitoring, inspection, evaluation, maintenance, and servicing requirements for all POWTS, in order to ensure that the POWTS will operate as designed and thereby protect the public health and Waters of the State.

(2) Establish maintenance programs operated by the Department to ensure that all POWTS will be inspected, evaluated, maintained, and serviced so that the POWTS will operate as designed and thereby protect the public health and Waters of the State.

(3) Provide the Department with data by which to make regulatory decisions.

SPS 383.51 Principles.

(1) All POWTS shall be maintained at all times so as not to create a human health hazard.

(2) When upon inspection of a POWTS any part of the system that is found to be defective in conformance with the applicable provisions of this chapter, the installation or modification plan, or the approvals, the part shall be Repaired, renovated, replaced, or removed.

SPS 383.52 Responsibilities.

(1) Owner must notify the Public Works Division of any malfunctions with the POWTS located at their address, which may be detrimental to public health including fellow occupants of the Dwelling.

SPS 383.53 General.

(1) No product for chemical or physical restoration or chemical or physical procedures for POWTS, may be used unless Approved by the Department.

SPS 383.54 Management requirements.

(1) MANAGEMENT PLAN.

(a) The management plan for each POWTS shall include information and procedures for maintaining the POWTS to operate and function within the standards of this chapter and as designed and Approved.

(b) The management plan for a POWTS shall be a part of the plan submittal under SPS 383.22 or 384.10.

(c) The management plan for POWTS shall specify all necessary maintenance and servicing information which may include, but is not limited to all of the following:

1. Accumulated solids or byproduct removal requirements.

2. Influent quantities and qualities and effluent quantities and qualities.

3. Metering, sampling, and monitoring schedules and requirements.

4. Load and rest schedules.

5. Servicing frequency requirements.

6. Installation and inspection checklists.

7. Evaluation, monitoring, and maintenance schedules for mechanical POWTS components.

8. Start up and shutdown procedures.

9. Procedure for abandonment.

(d) If the Owner of the POWTS wishes to operate or maintain a POWTS differently than that specified in the Approved management plan, a written request for approval to amend the management plan shall be submitted to the agency that initially reviewed the installation plan under SPS 383.22.

(e) The management plan for a POWTS shall specifically address the servicing mechanics of an aerobic or anaerobic treatment tank or a holding tank where either of the following conditions exist:

1. The bottom of the tank is located more than 15 feet below the elevation where the servicing pad is located.

2. The bottom of the tank is located more than 150 feet horizontally from where the servicing pad is located.

(2) METERING AND MONITORING.

(a) ***General.*** The management plan specified in sub. (1) shall include procedures for metering or monitoring POWTS influent or effluent as specified in this subsection.

(b) ***Department option.*** The Department may require the metering or monitoring of any POWTS to evaluate the operation of the POWTS.

(d) ***Metering influent flows.***

1. When and where the metering of a POWTS is required, influent flows to POWTS shall be metered by one of the following methods:

a. Installing event counters and elapsed time meters.

b. Installing water meters to meter the water distribution system flow to the POWTS.

c. Metering wastewater flow from all parts of the plumbing system discharging to the POWTS.

d. Metering the water distribution system and metering exterior hydrant use, except as provided in subd. 2.

2. Where meters are installed on water distribution systems, the entire water distribution system may be metered and the exterior hydrant usage estimated and subtracted from the total flow to meet the requirements of this paragraph.

(e) ***Monitoring influent and effluent loads.***

1. When and where the monitoring of groundwater is required, the Department may construct groundwater monitoring wells as necessary to measure the spread of contamination.

2. When influent or effluent contaminants are to be monitored, samples shall be collected in accordance with the requirements of the Approved management plan.

3. All groundwater samples collected to evaluate influent or effluent quality, except samples collected for total coliform bacteria analysis and the field analyses for pH, specific conductance, and temperature, shall be analyzed by a certified laboratory.

4. The results of the analysis required under subd. 2. shall be maintained by the Department.

(3) SERVICING REQUIREMENTS.

(a) The management plan specified in sub. (1) shall reflect the servicing schedules of POWTS components as specified in this subsection

(b) The servicing frequency of an anaerobic treatment tank for a POWTS shall occur at least when the combined sludge and scum volume equals 1/3 of the tank volume.

(c) The servicing frequency of a holding tank for a POWTS shall occur at least when the wastewater of the tank reaches a level of one foot below the inlet invert of the tank.

Note: The servicing of POWTS holding and treatment components, including septic tanks and holding tanks, is required to be performed by licensed pumpers.

(d) The servicing of a RV transfer tank shall be performed in a manner to prevent the discharge of wastewater into the surrounding soil or onto the ground surface.

Note: "Servicing" shall be defined as "…removing the scum, liquid, sludge, or other wastes from a private sewage system such as septic or holding tanks, dosing chambers, grease interceptors, seepage beds, seepage pits, seepage trenches, privies, or portable restrooms and properly disposing or recycling of the contents as provided in this chapter."

(4) EXISTING POWTS.

(a) The servicing frequency of an anaerobic treatment tank for a POWTS existing prior to the adoption of this Code, shall occur at least when the combined sludge and scum volume equals 1/3 of the tank volume.

(b)

1. The servicing of a holding tank for a POWTS existing prior to the adoption of this Code, shall occur at least when the wastewater of the tank reaches a level of one foot below the inlet invert of the tank.

2. The servicing of a RV transfer tank shall be performed in a manner to prevent the discharge of wastewater into the surrounding soil or onto the ground surface.

(c) The inspection, evaluation, or maintenance or servicing of POWTS treatment components other than those under pars. (a) and (b) existing prior to the adoption of this Code, shall be provided in accordance with the requirements specified by the manufacturer or designer of the component.

(d)

1. Except as provided in subd. 3., a POWTS that exists prior to the adoption of this Code, and that utilizes a treatment or dispersal component consisting in part of in situ soil shall be visually inspected at least once every 3 years to determine whether wastewater or effluent from the POWTS is ponding on the surface of the ground.

2. The inspection required by subd. 1. shall be performed by one of the following:

a. A licensed master plumber.

b. A licensed master plumber-restricted service.

c. A licensed journeyman plumber.

d. A licensed journeyman plumber-restricted service.

e. A certified POWTS inspector.

f. A certified septage servicing operator.

g. A registered POWTS maintainer.

SPS 383.55 Reporting requirements. (INTENTIONALLY OMITTED)

Subchapter VI — Recognized Methods and Technologies (INTENTIONALLY OMITTED)

Subchapter VII — Department Performance Monitoring

SPS 383.70 Purpose.

(1) To address the desire for an ongoing source of information on the performance of POWTS system designs, the Department shall maintain an ongoing performance-monitoring program for the various POWTS methods and technologies.

(2) The purpose of the performance monitoring program is to:

(a) Provide additional information on the long-term performance of the various POWTS methods and technologies, to confirm their reliability, and to provide data for improvements; and

(b) Monitor the various methods and technologies relative to long-term compliance with the groundwater standards.

SPS 383.71 Department procedures. (INTENTIONALLY OMITTED)

Table 383.43–1

Horizontal Setback Parameters

Physical Feature	POWTS Treatment Component Consisting in Part of In Situ Soil or Dispersal Component	Exterior Subsurface Treatment Tank or Holding Tank Component	Forcemains Servicing, Suction Lines, and Pump Discharge Lines
Building	10 feet	5 feet[a]	none[b]
Property Line[c]	5 feet	2 feet	2 feet
Swimming Pool	15 feet	none[b]	none[b]
OHWM of Navigable Waters	50 feet	10 feet	10 feet
Water Service and Private Water Main	10 feet	10 feet	5 feet
Public Water Main	ch. NR 811	ch. NR 811	ch. NR 811
Well	chs. NR 811 & 812	chs. NR 811 & 812	chs. NR 811 & 812

OHWM = Ordinary High–Water Mark

[a] Except RV transfer tanks.

[b] See s. SPS 383.43 (8) (f) relative to accessibility.

[c] Road–right–of–way lines may be more restrictive than property lines.

Note: See s. SPS 382.365, Table 382.365–4 relative to horizontal setback distances to subsurface infiltrative systems.

Note: The department of transportation under s. Trans 233.08 establishes setback limits from the centerline of state trunk highways or connecting highways to structures and improvements which include septic systems.

Table 383.44–2

Maximum Soil Application Rates Based Upon Morphological Soil Evaluation (in gals./sq. ft./day)

Soil Characteristics			Maximum Monthly Average			
Texture[d]	Structure[e]		BOD_5 >30 ≤220mg/L TSS >30 ≤150mg/L		BOD_5 ≤30 mg/L[c] TSS ≤30 mg/L[c]	
	Shape	Grade				
COS, S, LCOS, LS	—	0	0.7[a]	0.5[b,c]	1.6[a]	0.5[b]
FS, LFS	—	0	0.5		1.0	
VFS, LVFS	—	0	0.4		0.6	
COSL, SL	—	0M	0.2		0.6	
	PL	1	0.4		0.6	
		2, 3	0.0		0.2	
	PR, BK, GR	1	0.4		0.7	
		2, 3	0.6		1.0	
FSL, VFSL	—	0M	0.2		0.5	
	PL	2, 3	0.0		0.2	
	PL, PR, BK, GR	1	0.2		0.6	
	PR, BK, GR	2, 3	0.4		0.8	
L	—	0M	0.2		0.5	
	PL	2, 3	0.0		0.2	
	PL, PR, BK, GR	1	0.4		0.6	
	PR, BK, GR	2, 3	0.6		0.8	
SIL	—	0M	0.0		0.2	
	PL	2, 3	0.0		0.2	
	PL, PR, BK, GR	1	0.4[c]		0.6	
	PR, BK, GR	2, 3	0.6		0.8	
SI	—	—	0.0		0.0	
Soil Characteristics			**Maximum Monthly Average**			
Texture[d]	**Structure[e]**		**BOD_5 >30 ≤220mg/L TSS >30 ≤150mg/L**		**BOD_5 ≤30 mg/L[c] TSS ≤30 mg/L[c]**	
	Shape	**Grade**				
SCL, CL, SICL	—	0M	0.0		0.0	
	PL	1, 2, 3	0.0		0.2	
	PR, BK, GR	1	0.2		0.3	
		2, 3	0.4		0.6	
SC, C, SIC	—	0M	0.0		0.0	
	PL	1, 2, 3	0.0		0.0	
	PR, BK, GR	1	0.0		0.0	
		2, 3	0.2		0.3	

Note a: With ≤60% rock fragments

Note b: With >60 to <90% rock fragments

Note c: Requires pressure distribution under sub. (5) (a)

Note d:
- COS – Coarse Sand
- S–Sand
- LCOS – Loamy Coarse Sand
- LS – Loamy Sand
- FS – Fine Sand
- LFS – Loamy Fine Sand
- VFS – Very Fine Sand
- LVFS – Loamy Very Fine Sand
- COSL – Coarse Sandy Loam
- SL – Sandy Loam
- FSL – Fine Sandy Loam
- VFSL – Very Fine Sandy Loam
- L – Loam
- SIL – Silt Loam
- SI – Silt
- SCL – Sandy Clay Loam
- CL – Clay Loam
- SICL – Silty Clay Loam
- SC – Sandy Clay
- C – Clay
- SIC – Silty Clay

Note e:
- PL – Platy
- PR – Prismatic
- BK – Blocky
- GR – Granular
- M – Massive
- 0 – Structureless
- 1 – Weak
- 2 – Moderate
- 3 – Strong

Table 383.44–3

Minimum Depth of Unsaturated Soil for Treatment Purposes[a] (in inches)

Soil Characteristics	Influent Quality[e] and Percent Coarse Fragments					
Texture[d]	Fecal Coliform >10^4 cfu/100mL			Fecal Coliform ≤10^4 cfu/100mL[b]		
	≤35%	>35 to ≤60%	>60 to ≤90%[b,c]	≤35%	>35 to ≤60%	>60 to ≤90%[c]
COS, S, LCOS, LS	36	60	60	24	36	60
FS, VFS, LFS, LVFS	36			24		
COSL, SL	36			24		
FSL, VFSL	36			24		
L	36			24		
SIL	36			24		
SI	36			24		
SCL, CL, SICL	36			24		
SC, C, SIC	36			24		

Note a: Influent quality as per s. SPS 383.44 (2)

Note b: Requires pressure distribution under sub. (5) (a)

Note c: All coarse fragment voids must be filled with fine earth

Note d:

COS – Coarse Sand	LVFS – Loamy Very Fine Sand	SI – Silt
S–Sand	COSL – Coarse Sandy Loam	SCL – Sandy Clay Loam
LCOS – Loamy Coarse Sand	SL – Sandy Loam	CL – Clay Loam
LS – Loamy Sand	FSL – Fine Sandy Loam	SICL – Silty Clay Loam
FS – Fine Sand	VFSL – Very Fine Sandy Loam	SC – Sandy Clay
LFS – Loamy Fine Sand	L – Loam	C – Clay
VFS – Very Fine Sand	SIL – Silt Loam	SIC – Silty Clay

Note e: The values for fecal coliform are reported as a monthly geometric mean. The geometric mean shall be determined on the basis of measurements taken over 30 consecutive days, with at least 6 measurements occurring on 6 separate days.

Chapter SPS 384
PLUMBING PRODUCTS

SPS 384.01 Scope.
SPS 384.02 Penalties.
SPS 384.10 Department approval.
SPS 384.11 Device listing.
SPS 384.12 Identification.
SPS 384.13 Penetrations of fire-resistive assemblies.
SPS 384.14 Chemical or biochemical treatments for private sewage systems.
SPS 384.15 Health care plumbing appliances.
SPS 384.20 Plumbing fixtures, appliances, and equipment.
SPS 384.25 POWTS holding components or treatment components.
SPS 384.30 Plumbing materials.
SPS 384.40 Joints and connections.
SPS 384.50 Alternate approvals and experimental approvals (Intentionally Omitted).

SPS 384.01 Scope.

(1) The provisions of this chapter govern the quality and installation of materials, fixtures, appliances, appurtenances, and equipment relating to plumbing.

SPS 384.02 Penalties. (See SPS 320)

SPS 384.10 Department approval. No fixture, appliance, appurtenance, material, device, or product may be sold for use in a plumbing system or may be installed in a plumbing system, unless it is of a type conforming to the standards or specifications of chs. SPS 382 to 384.

(1) ALTERNATE OR EXPERIMENTAL PRODUCT APPROVAL. If it is alleged that the approval of a fixture, appliance, appurtenance, material, device or product under this section would result in an adverse health effect or potentially adverse health effect on the Waters of the State, the Department may require an alternate or experimental product approval under SPS 384.50.

(2) PRODUCT REVIEW AND APPROVAL.

(a)

1. Each type of plumbing product which falls into one of the categories specified in Table 384.10 shall be Approved by the Department in accordance with this subsection before the product may be sold for use in a plumbing system or installed in a plumbing system.

2. Specifications and plans or drawings for each type of product shall be submitted to the Department for review. The submittal shall be accompanied by sufficient data and information to determine if the product and its performance comply with the provisions of chs. SPS 382 to 384.

(b)

1. The Department may require that a submitter of a product for review have the product tested and its performance certified by an Approved testing laboratory

(c) If, upon review, the Department determines that a product conforms to the provisions of chs. SPS 382 to 384,the Department shall issue an approval in writing. The Department may impose specific conditions in granting an approval. Violations of the conditions under which an approval is granted shall constitute a violation of this chapter.

(d) If, upon review, the Department determines that a product does not conform to provisions of chs. SPS 382 to 384, the request for approval shall be denied in writing.

(e) The Department shall review and make a determination on an application for a product approval within 40 Business Days of receipt of all fees, plans, drawings, specifications, and other information required to complete the review.

(f) If an Approved plumbing product is modified or additional assertions of function or performance are made, the approval shall be considered null and void, unless the change is submitted to the Department for review and the approval is reaffirmed.

(h) Approvals for plumbing products issued by the Department after November 1, 1985, shall expire at the end of the 60th month after the date of approval issuance. - **See PDF for table**

Note: More information about the certification bodies accredited by the American National Standards Institute (ANSI), such as the National Sanitation Foundation, is available at the ANSI website at www.ansi.org; or at 1899 L Street, NW, 11th Floor Washington, DC, 20036; or at telephone 202.293.8020.

(3) VOLUNTARY POWTS COMPONENT MANUAL REVIEW.

(a) The Department may issue an approval, upon request and review, for specific methods or technologies that are proposed to be utilized as POWTS holding, treatment or dispersal components which conform to the standards or specifications referenced in chs. SPS 381to 384, but do not require approval under sub. (2) or SPS 384.50.

(b) Each request for approval shall be made on an application for review, petition for variance form provided by the Department.

(c) The submittal shall be accompanied by sufficient data and information to determine if the method or technology complies with the provisions of chs. SPS 381 to 384. The submittal shall include all of the following:

1. Plans and specifications.

2. Theory of operation.

3. Testing protocol.

4. Testing data.

5. Limits of reliable operation.

6. Installation requirements and procedures.

7. Inspection checklist and worksheet.

8. Inspection requirements and procedures.

9. Operation and maintenance requirements.

10. Operation and maintenance schedule.

11. Operation and maintenance checklist and worksheet.

12. Other information requested by the Department.

(f)

1. If, upon review, the Department determines that the method or technology conforms to the provisions of chs. SPS 381 to 384, the Department shall issue an approval in writing.

2. The Department may impose specific conditions in granting an approval, including a provision to provide training to POWTS installers and POWTS inspectors.

3. Violations of the conditions under which an approval is granted shall constitute a violation of this chapter.

(g) If, upon review, the Department determines that the method or technology does not conform to the provisions of chs. SPS 381 to 384, the request for approval shall be denied in writing.

(h) The Department shall review and make a determination on an application for a method or technology approval within 3 months of receipt of all fees, plans, drawings, specifications, and other information required to complete the review.

(i) If an Approved method or technology is modified or additional assertions of function or performance are made, the approval shall be considered null and void, unless the change is submitted to the Department for review and the approval is reaffirmed.

(4) REVOCATION. The Department may revoke any approval issued under this section for any false statements or misrepresentation of facts on which the approval was based, or as a result of the product's failure, or if data indicate a health hazard or threat to the Waters of the State.

(5) LIMITATIONS. An approval of a plumbing product by the Department may not be construed as an assumption of any responsibility for defects in design, construction, or performance of any product nor for any damages that may result. All products shall be installed in accordance with the manufacturer's printed instructions and as specified

in chs. SPS 382 to 384. If there is a conflict between the manufacturer's printed instructions and requirements of chs. SPS 382 to 384, the requirements of chs. SPS 382 to 384 shall take precedence.

(6) FEES. (See SPS 320)

SPS 384.11 Device listing. Cross connection control devices and water treatment devices complying with the referenced standard in Table 384.11 shall be listed by a nationally recognized listing agency acceptable to the Department.

Note: See Ch. SPS 384 Appendix for acceptable listing agencies. – See PDF for table

SPS 384.12 Identification. Each length of pipe and each pipe fitting, trap, fixture, material, device, and product to be used in plumbing shall be marked as required by the applicable standard specified by reference in this chapter or as specified by rule in this chapter.

SPS 384.13 Penetrations of fire-resistive assemblies. Penetrations of fire-resistive assemblies, such as walls and floor-ceiling systems, by plumbing systems or plumbing materials shall be protected in accordance with requirements of Wisconsin chs. SPS 361 to 366.

SPS 384.14 Chemical or biochemical treatments for private sewage systems. Chemical or biochemical treatments for private sewage systems shall function and perform in accordance with the assertions submitted to the Department. Chemical or biochemical treatments for private sewage systems may not directly or indirectly adversely affect bacterial action in the systems, soil hydraulic conductivity in the absorption areas, or groundwater quality beneath the systems.

SPS 384.15 Health care plumbing appliances. Health care plumbing appliances shall function and perform in accordance with the drain, vent, water supply and backflow protection requirements of Ch. SPS 382.

SPS 384.20 Plumbing fixtures, appliances, and equipment.

(1) DESIGN AND CONSTRUCTION. All plumbing fixtures, appliances and equipment shall be designed and constructed to:

(a) Ensure durability, proper service, and sanitation;

(b) Be free from defects;

(c) Be free from concealed fouling surfaces;

(d) Not require undue efforts in cleaning and operating; and

(e) Prevent non-potable liquids, solids, or gasses from being introduced into a potable water supply system through cross-connections.

(2) MATERIALS.

(a) Plumbing fixtures shall have smooth surfaces that are impervious to water.

(b) All plumbing fixture fittings which are end-point devices, covered by the scope of NSF 61, section 9, and installed to supply water intended for human ingestion, shall conform to NSF 61, section 9.

Note: The scope of NSF 61, annex G, defines which devices are intended for use for human ingestion in response to Section 1417 of the federal Safe Drinking Water Act, as amended.

(3) WATER CONSERVING FAUCETS, SPOUTS AND PLUMBING FIXTURES. Water conserving faucets, spouts and plumbing fixtures which meet or exceed the water conservation requirements established in par. (b) shall be installed as specified in par. (a).

(a)

1. All lavatory faucets, shower heads, urinals, urinal flushing devices, water closets and water closet flushing devices shall conform to par. (b).

2. All faucets installed on Kitchen sinks of Dwelling Units and living units shall conform to par. (b) 4.

(b)

1. `General.' Flow control or flow restricting devices shall be installed on the water inlet side or shall be an integral part of the faucet, spout, or fixture. A flow controlling or restricting aerator shall be considered to be an integral part of a faucet or spout.

2. `Lavatory faucet.'

a. The maximum discharge rate of lavatory faucets shall be 2.2 U.S. gallons per minute at a 60-psig flowing supply pressure.

b. Lavatory faucets that are of the metering type shall allow a maximum of 0.25 U.S. gallon per metering cycle at an 80-psig flowing supply pressure.

3. `Shower heads.' The maximum discharge rate of shower heads shall be 2.5 U.S. gallons per minute at an 80 psig flowing supply pressure.

4. `Sink faucets.' The maximum discharge rate of sink faucets shall be 2.2 U.S. gallons per minute at 80 psig flowing supply pressure.

5. `Urinals.' Urinals shall function properly with a maximum of one U.S. gallon per flush at an 80 psig flowing supply pressure.

6. `Urinal flushing devices.' The flushing cycle for urinal flushing devices shall discharge a maximum of one U.S. gallon per flush per fixture use at static test pressure of 20 psig and 80 psig.

7. `Water closets.' Water closets shall function properly with a maximum of 1.6 U.S. gallons per flush over the range of static test pressure specified in Table 384.20.

8. `Water closet flushing devices.' The flushing cycle for water closet flushing devices shall discharge a maximum of 1.6 U.S. gallons over the range of static test pressures specified in Table 384.20.

Table 384.20

STATIC TEST PRESSURES FOR WATER CLOSETS AND WATER CLOSET FLUSHING DEVICES - See PDF for table

(4) GENERAL REQUIREMENTS.

(a) ***Fixture outlets.***

1. The outlet passageway of a fixture shall be free from impairments and of sufficient size to insure proper discharge of the fixture contents under normal conditions.

2. The outlet connection of a fixture which directly connects to the drain system shall be an air and watertight joint.

(b) ***Installation of fixtures.***

1. `Access for cleaning.' Plumbing fixtures shall be so installed as to afford easy access for cleaning both the fixture and the area around it.

2. `Securing wall mounted fixtures.' Wall mounted fixtures shall be rigidly supported by a hanger which is attached to structural members so that the load is not

transmitted to the fixture drain connection or any other part of the plumbing system. The hanger for a wall mounted water closet shall conform to ASME A112.6.1M.

3. `Water supply protection.' The water supply pipes and fittings within every plumbing fixture shall be so installed as to prevent backflow.

4. `Design of overflow.' A fixture which is provided with an overflow outlet shall be designed and installed so that standing water in the fixture cannot rise in the overflow when the fixture's stopper is closed, and so that no water remains in the overflow when the fixture is empty.

5. `Connection of overflows.' The overflow from any fixture shall discharge into the drain system on the inlet or fixture side of the trap.

6. `Overflows in flush tanks.' Flush tanks shall be provided with overflows discharging to the fixture served and shall be of sufficient size to prevent flooding the tank at the maximum rate at which the tanks are supplied with water.

7. `Strainers.' All plumbing fixtures other than water closets, clinic sinks, trap standard service sinks with flush rims, urinals, standpipes, and waste sinks shall be provided with strainers, cross bars or pop-up stoppers which restrict the clear opening of the waste outlet.

8. `Flushometer valves.' Flushometer valves shall be equipped with vacuum breakers which conform to ASSE 1001. Flushometer valves may not be used where the water pressure is insufficient to properly operate them. When the valve is operated, it shall complete the cycle of operation automatically, opening fully and closing positively under the water supply pressure. Each flushometer shall be provided with a means for regulating the flow through it.

9. `Safing.'

a. The floor of all site-constructed shower stalls and shower rooms shall be protected with a safing material installed beneath the finished floor of the entire enclosure or room and upward along the sides to a minimum of 6 inches above the curb or maximum water level of the room or enclosure. The corners of the enclosure or room shall be safed to a height of 6 feet and at least 3 inches in each direction from the corners.

b. All floor drains or other similar fixtures shall be installed with a safing material extending a minimum of 12 inches from the fixture.

c. The safing material shall conform to SPS 384.30 (6).

d. The safing material shall be properly drained.

e. All installations directly over an unexcavated portion of a building are exempt from this subdivision.

(5) PLUMBING FIXTURES AND PLUMBING APPLIANCES.

(a) ***Automatic clothes washers***. Residential type automatic clothes washers shall conform to ASSE 1007.

(b) ***Bathtubs.***

1.

a. Enameled cast iron bathtubs shall conform to ASME A112.19.1M.

b. Porcelain enameled formed steel bathtubs shall conform to ASME A112.19.4.

c. Plastic bathtubs shall conform to ANSI Z124.1.2.

2. Bathtubs shall have waste outlets and overflows at least 1-1/2 inches in diameter. A closing device shall be provided on the waste outlet.

3. All whirlpool piping for bathtubs shall drain by gravity to the trap serving the bathtub.

4. All waterways of the whirlpool pump for a bathtub shall drain by gravity to the trap serving the bathtub.

(c) ***Bidets.*** Vitreous china bidets shall conform to the material requirements in ASME A112.19.2M.

1. A bidet may not be located closer than 15 inches from its center to any side wall, partition, vanity, or other obstruction, nor closer than 30 inches center to center from a water closet.

2. Bidets with submerged inlet fittings shall be protected by vacuum breakers which conform to ASSE 1001 or CAN/CSA B64.1.1.

(d) ***Chemical dispensing systems.*** Chemical dispensing systems shall conform to ASSE 1055.

(e) ***Dishwashing machines.***

1. Residential type dishwashing machines shall conform to ASSE 1006.

2. Commercial type dishwashing machines shall conform to ASSE 1004.

(f) ***Drinking fountains.***

1. Drinking fountains and water coolers shall conform to ARI 1010 or ASME A112.19.2.

2. Drinking fountains may not be installed in toilet rooms.

3. The water supply for drinking fountains shall be provided with an adjustable valve fitted with a loose key or an automatic self-closing valve permitting regulation of the rate of flow of water. The water supply issuing from the nozzle shall be of sufficient volume and height so that persons using the fountain need not come in direct contact with the nozzle or orifice.

4. A drinking fountain may not have a waste outlet less than 1-1/4 inches in diameter.

(g) ***Floor drains.***

1. Floor drains shall be provided with removable strainers of sufficient strength to carry the anticipated loads.

2. The floor drain shall be so constructed that it can be cleaned, and the drain inlet shall be accessible at all times.

3. Floor drains shall be of a size to efficiently serve the intended purpose. The floor drain outlet shall not be less than 2 inches in diameter.

(h) ***Food waste grinders.***

1. Residential type food waste grinders shall conform to ASSE 1008. Commercial type food waste grinders shall conform to ASSE 1009.

2. Food waste grinders shall be connected to a drain of sufficient size to serve the unit, but not less than 1 ½ inches in diameter.

3. All food waste grinders shall be provided with an adequate supply of cold water at a sufficient flow rate to insure proper functioning of the unit.

(i) ***Laundry trays.*** Each compartment of a laundry tray shall be provided with a waste outlet not less than 1 ½ inches in diameter.

(j) ***Lavatories.***

1.

a. Enameled cast iron lavatories shall conform to ASME A112.19.1M.

b. Vitreous china lavatories shall conform to ASME A112.19.2M.

c. Stainless steel lavatories shall conform to ASME A112.19.3.

d. Porcelain enameled formed steel lavatories shall conform to ASME A112.19.4.

e. Plastic lavatories shall conform to ANSI Z124.3.

2. Cultured marble vanity tops with an integral lavatory shall conform to ANSI Z124.3.

3. Lavatories shall have waste outlets not less than 1¼ inches in diameter.

(k) ***POWTS design packages and POWTS components.*** POWTS design packages and POWTS components shall function and perform in accordance with assertions submitted to and Approved by the Department under SPS 384.10.

(L) ***Showers.***

1. Prefabricated plastic showers and shower compartments shall conform to ANSI A124.1.2.

2. Except for combination bathtub-shower units, waste outlets serving showers shall be at least 2 inches in diameter and shall have removable strainers of sufficient strength for the anticipated loads.

3. Where a waste outlet serves more than one shower space or shower head, the waste outlet shall be at least 2 inches in diameter and the waste outlet shall be so located and the floor so pitched that wastewater from one shower does not flow over the floor area serving another shower.

4. All shower compartments, regardless of shape, shall have a minimum finished interior of 900 square inches and shall be capable of encompassing a circle with a diameter of 30 inches. The minimum required area and dimension shall be measured in a horizontal plane 24 inches above the top of the threshold and may not extend beyond the centerline of the threshold. The minimum area and dimensions shall be maintained to a point 70 inches above the shower waste outlet with no protrusions other than the fixture valve or valves, showerheads, soap dishes, retractable seats and safety grab bars or rails.

Note: See Ch. SPS 384 Appendix for further explanatory materials.

(m) ***Sinks.***

1.

a. Enameled cast iron sinks shall conform to ASME A112.19.1M.

b. Vitreous china sinks shall conform to ASME A112.19.2.

c. Stainless steel sinks shall conform to ASME A112.19.3.

d. Porcelain enameled formed steel sinks shall conform to ASME A112.19.4.

e. Plastic sinks shall conform to ANSI Z124.6.

2. Sinks shall be provided with waste outlets not less than 1½ inches in diameter.

(n) ***Urinals.***

1.

a. Vitreous china urinals shall conform to ASME A112.19.2.

b. Plastic urinals shall conform to ANSI Z124.9.

2. A urinal may not be located closer than 15 inches from its center to any side wall, partition, vanity, or other obstruction, nor closer than 30 inches center to center, between urinals.

Note: See Ch. SPS 384 Appendix for further explanatory material.

3. Stall type urinals shall be set into the floor and the floor shall be pitched toward the fixture.

4. Automatic siphon urinal flush tanks may not be installed.

5. Pressurized flushing devices to serve urinals shall conform to ASSE 1037.

(o) ***Water closets.***

1.

a. Vitreous china water closets shall conform to ASME A112.19.2.

b. Plastic water closets shall conform to ANSI Z124.4.

4. A water closet may not be located closer than 15 inches from its center to any side wall, partition, vanity, or other obstruction, nor closer than 30 inches center to center, between water closets. There shall be at least 24 inches clearance in front of a water closet to any wall, fixture, or door.

Note: See Ch. SPS 384 Appendix for further explanatory material.

5. No person may install or maintain pan, plunger, offset washout, washout, long hopper, frost proof and other types of water closets having invisible seals or unventilated spaces or walls not thoroughly cleansed at each flushing.

6. Each water closet shall be individually equipped with a flushing device. Pressurized flushing devices shall conform to ASSE 1037. All flushing devices shall be readily accessible for maintenance and Repair. Ballcocks and fill valves shall be of the anti-siphon type and shall conform to ASSE 1002. The critical level mark on the ballcock and fill valve shall be located at least one inch above the full opening of the overflow pipe.

(p) ***Water heaters.***

1. Listed equipment. All water heaters shall bear the label of a listing agency acceptable to the Department.

Note: See Ch. SPS 384 Appendix A-384.11 for listing agencies acceptable to the Department.

2. Design.

a. All pressurized water heaters and pressurized hot water storage tanks, except those bearing the label of the American Society of Mechanical Engineers, shall be designed, and constructed to withstand a minimum test pressure of 150% of the maximum allowable working pressure of the heater or tank.

b. All pressurized water heaters and pressurized hot water storage tanks shall be rated for a minimum working pressure of 125 psig.

c. A drain valve shall be installed at the lowest point of each water heater and hot water storage tank.

3. Safety devices.

a. Relief valves shall be listed by the American Gas Association, Underwriters Laboratories, Inc. (UL) or American Society of Mechanical Engineers when the heat input to a water heater is less than or equal to 200,000 Btu per hour.

b. Relief valves shall be listed by the American Society of Mechanical Engineers when the heat input to a water heater exceeds 200,000 Btu per hour.

c. Pressure relief valves shall be set to open at either the maximum allowable working pressure rating of the water heater or storage tank or 150 psig, whichever is smaller.

d. Temperature and pressure relief valves shall be set to open at a maximum of 210º F and in accordance with subd. 3. c.

Note: See SPS 382.40 (5) (d) 1. concerning the sizing of temperature and pressure relief valves.

4. Hot water dispensers. Non-pressurized point-of-use water heaters shall conform to ASSE 1023.

(q) ***Water meters.*** A water meter which is used pursuant to SPS 383.54 (2) shall conform to AWWA C700, AWWA C701, AWWA C702, AWWA C704, AWWA C706, AWWA C707, AWWA C708, or AWWA C710.

(r) ***Water treatment devices.***

1. Water softeners shall conform to NSF-44.

Note: See SPS 382.40 for limitations as to the types of water treatment devices which may discharge to a POWTS.

2.

a. Except as provided in subd. 2. b., water treatment devices shall function and perform in accordance with the assertions submitted to the Department under SPS 384.10, relating to rendering inactive or removing contaminants.

b. A water treatment device which injects a water treatment compound into a water supply system shall maintain the compound concentration in the system over the working flow rate range and pressure range of the device.

3. Except as specified in subd. 4., water treatment compounds introduced into the water supply system by a water treatment device shall be listed as an acceptable drinking water additive by a listing agency Approved by the Department. Listing agencies Approved by the Department shall include:

a. United States Environmental Protection Agency;

b. United States Food and Drug Administration; and

c. National Sanitation Foundation.

4. A water supply system shall be protected from backflow when unlisted water treatment compounds, which may affect the potability of the water, are introduced into the system. The Department shall determine the method of backflow protection. Water supply outlets for human use or consumption may not be installed downstream of the introduction of an unlisted water treatment compound.

5. Water treatment devices designed for contaminated water supplies shall be labeled to identify the following information:

a. The name of the manufacturer of the device;

b. The device's trade name; and

c. The device's model number.

(s) ***Other plumbing fixtures, appliances, and equipment.*** Plumbing fixtures, appliances and equipment not specifically covered in this subsection shall conform to the applicable performance standards of chs. SPS 382 to 384.

(6) FAUCETS, SPOUTS AND FIXTURE SUPPLY CONNECTORS.

(a) All faucets and showerheads shall conform to ASME A112.18.1 or CAN/CSA B125.

(c)

1. Except as provided in subd. 2., all fixture supply connectors shall be designed and constructed to withstand a minimum pressure of 100 psig at 180ºF.

2. All fixture supply connectors installed on a cold-water supply serving fixtures, appliances and devices that provide ≤1.0 gpm at each outlet shall be designed and constructed to withstand a minimum pressure of 100 psig at 73.4ºF.

(d) Hand-held showers shall conform to ASSE 1014.

SPS 384.25 POWTS holding components or treatment components.

(1) GENERAL. All POWTS holding components or treatment components shall conform to the requirements of this section.

(2) WATER TIGHTNESS.

(a) ***General.*** Tank assemblies, including fittings and access openings, shall be manufactured to be watertight as required under this subsection.

(b) ***Concrete tanks.***

1. Where concrete tanks are required to have covers, the tanks shall meet one of the following requirements:

a. Withstand a vacuum of at least 2 inches of mercury for 60 minutes, without loss of pressure.

b. Hold water for one hour, without leakage after the tank has been filled with water to the top of the cover and let stand for 24 hours, then refilled to the top of the cover.

2. Concrete tanks that are not required to have a cover shall hold water for one hour, without leakage after the tank has been filled with water and let stand for 24 hours, then refilled to the highest liquid level required to be held in the tank.

(c) ***Steel tanks.***

1. Steel tanks that are required to have a cover shall be capable of withstanding one of the following requirements:

a. An internal air pressure of at least 5 psig for 15 minutes, without loss of pressure.

b. An internal water pressure of at least 5 psig for 60 minutes, without loss of pressure.

2. Steel tanks that are not required to have a cover shall be capable of holding water after being filled to their inlet or outlet, whichever is higher, for 24 hours without loss of water.

(d) ***Tanks constructed of materials other than concrete or steel.***

1. Tanks constructed of materials other than concrete or steel that are required to have a cover shall be capable of withstanding one of the following requirements:

a. A vacuum of at least 2 inches of mercury for 60 minutes, without loss of pressure.

b. An internal air pressure of at least 5 psig for 15 minutes, without loss of pressure.

c. An internal water pressure of at least 5 psig for 60 minutes, without loss of pressure.

2. Tanks constructed of materials other than concrete or steel that are not required to have a cover shall be capable of holding water after being filled to their inlet or outlet, whichever is higher, for one hour without loss of water.

(3) STRENGTH. Tank assemblies, including fittings and access openings, shall be capable of withstanding loads and pressures that the tanks are intended to encounter and remain watertight.

(4) PROTECTION FROM ELEMENTS.

(a) ***Concrete tanks.***

1. The interior of a concrete tank assembly, including fittings and access openings, shall have a protective coating or be constructed of material, above the lowest liquid level expected in the tank, that will inhibit the deterioration of the concrete due to internal environmental effects.

2. Under subd. 1., concrete with a water cement ratio not exceeding 0.45 shall be considered resistant to deterioration due to internal environmental effects.

(b) ***Steel tanks.***

1. Steel tank assemblies, including fittings and access openings, shall have a protective coating that will inhibit the deterioration of the steel due to internal and external environmental effects.

2. Steel tank assemblies, including fittings and access openings, installed underground shall be provided with cathodic protection in accordance with UL Standard 1746 or STI-P3.

(c) ***Tanks constructed of materials other than concrete or steel.*** Tank assemblies, including fittings and access openings, constructed of materials other than concrete or steel shall be protected against deterioration due to internal and external environmental effects.

(5) VENTING.

(a) Each tank shall be provided with a means of venting gases formed inside of the tank to the atmosphere.

(b) The tank vent shall terminate in accordance with SPS 382.31 (16).

(6) PIPE CONNECTION. All pipe connection openings to a tank shall be designed to allow connections in accordance with SPS 384.40.

(7) ACCESS.

(a) Each covered tank shall be provided with one or more openings of sufficient size and located in such a manner to provide a means for inspection or required servicing or maintenance of the tank.

(b) Manhole openings shall be at least 23 inches in the least dimension.

(c) Anaerobic treatment tanks located below ground shall have a manhole opening over the inlet of the most upstream compartment, in each compartment, and over all treatment apparatuses and pumps.

(d)

1. Except as provided in subd. 2., manhole openings for anaerobic treatment tanks located below ground shall extend to a distance not greater than 6 inches below finished grade.

2. Manhole openings over all anaerobic treatment apparatuses and pumps shall extend to at least 4 inches above finished grade.

(e) Servicing and maintenance openings for holding components shall comply with all of the following:

1. Extend to at least 4 inches above finished grade.

2. Be at least 23 inches in the least dimension and be located above pumps or siphons located in the holding component.

(f) Inspection openings for tanks located below ground shall extend at least to the finished grade.

(g) Inspection, servicing, and maintenance openings shall terminate with a means that prevents entrance of deleterious materials.

(h) Covers located at or above ground for openings larger than 8 inches in diameter shall be provided with locking devices or other effective measures to prevent unauthorized access.

(8) WARNING LABEL.

(a) Covers for all tank openings larger than 8 inches in diameter shall be provided with a permanent warning label indicating the dangers of entering the tank, in accordance with this subsection.

(b) The warning label shall be securely attached and made of a noncorrosive metal or plastic bearing the legend “DO NOT ENTER WITHOUT PROPER EQUIPMENT" or “DANGEROUS GASES EXIST IN TANK" or similar language.

(c) The label shall be rectangular in shape with minimum dimensions of 4 by 5 inches.

(d) The wording on the label shall be a minimum of ½ inch in height and be either indented or raised.

(9) DOSING APPARATUS.

(a) Pumps for POWTS used to disperse air, treated wastewater or final effluent shall be rated by the pump manufacturer for such use.

(b) Siphons for POWTS shall be rated by the siphon manufacturer for wastewater use.

(c) All other dosing apparatus for POWTS shall be constructed of corrosive resistant materials and designed to perform as intended.

(10) ALARM SYSTEM. All pump and alarm controls for POWTS shall be specifically designed by the manufacturer for such use.

(11) TANK LABEL.

(a) ***Anaerobic treatment tanks.*** Each treatment tank which has an anaerobic treatment compartment shall be labeled with a permanent label located near an inlet or outlet opening of the tank. The label shall be embossed, impressed, or securely attached to the tank. The label shall include all of the following information:

1. Name or trademark of the manufacturer.

2. Capacity of each compartment of the tank or the manufacturer's model number.

(b) ***Aerobic treatment tanks.***

1. Each aerobic treatment tank complying with NSF Standard 40 and listed by a nationally recognized ANSI accredited third party certified listing agency acceptable to the Department shall be provided with 2 label plates. The labels shall conform with all of the following:

a. Label plates shall be inscribed to be easily read and understood and be securely attached.

b. One label plate shall be attached to the front of the electrical control box and the second label plate shall be attached to the aeration equipment assembly, tank, or riser at a location normally subject to access during inspection of the unit.

c. Each label plate shall include name or trademark of the manufacturer, model number, and rated daily flow capacity of the unit.

Note: See Ch. SPS 384 Appendix section A-384.11 for acceptable listing agencies.

(c) ***Other treatment, holding and combination treatment-holding tanks***. Except as required in par. (a) or (b), each treatment tank and holding tank shall be labeled with a permanent label located near an inlet or outlet opening. The label shall be embossed,

impressed, or securely attached to the tank. The label shall include all of the following information:

1. Name or trademark of the manufacturer.

2. Capacity of each compartment of the tank or the manufacturer's model number.

(12) OTHER TREATMENT COMPONENTS. A treatment component not specifically covered in this section may not be sold for use in a POWTS or may not be installed in a POWTS, unless it has received Department approval and conforms to the applicable performance standards of chs. SPS 382 to 384.

SPS 384.30 Plumbing materials.

(1) GENERAL. When selecting the material and determining size for a plumbing system, due consideration shall be given to the waste that will discharge to the plumbing system and to the soil, liquid, and atmospheric environments where the plumbing system will be located.

(a) The bending or offsetting of flexible or annealed pipe or tubing shall be in accordance with the applicable material standard or the instructions of the manufacturer of the pipe or tubing.

(b) Pipe or tubing with gouges, cuts or deep scratches may not be installed.

(c) Pipe or tubing which has been kinked may not be installed.

(d) The bending or offsetting of rigid pipe shall be prohibited.

(e) Nailing plates shall be installed to protect copper or plastic pipe or tubing from puncture.

(f) Pipe and tubing for water distribution systems downstream of treatment devices designed to serve fixtures, appliances and devices that provide ≤1 gpm at each outlet shall be sleeved when penetrating a wall, floor, or structural member.

(2) SANITARY DRAIN AND VENT SYSTEMS AND POWTS INSPECTION AND OBSERVATION PIPING. Sanitary drain systems and vent systems and POWTS inspection and observation piping shall be of such material and workmanship as set forth in this subsection.

(a) ***Above ground drain and vent pipe.*** Except as provided in SPS 382.33 (2), drain pipe and vent pipe installed above ground shall conform to one of the standards listed in Table 384.30-1.

(b) ***Underground drain and vent pipe.*** Except as provided in par. (d), drain pipe and vent pipe installed underground shall conform to one of the standards listed in Table 384.30-2.

(c) ***Sanitary building sewer pipe.*** Sanitary building sewer pipe shall conform to one of the standards listed in Table 384.30-3.

(d) ***Treated wastewater piping.***

1. Non-pressurized, nonperforated drain piping conveying treated wastewater from a POWTS treatment or holding component to a POWTS treatment or holding component, distribution cell or dispersal zone shall conform to one of the standards listed in Table 384.30-3.

2. Non-pressurized perforated drain piping conveying treated wastewater in a POWTS soil treatment or dispersal component shall conform to one of the standards listed in Table 384.30-4.

3. Pressurized perforated drain piping conveying treated wastewater in a POWTS treatment or dispersal component shall conform to one of the standards listed in Table 384.30-5 and shall be perforated in accordance with the POWTS design.

(e) ***Pressurized drainpipe.*** Except as provided in par. (d) 3., pressurized drain pipe shall conform to one of the standards listed in Table 384.30-5 and shall be rated for the working pressure and temperature to which it will be subjected for a specific installation.

(f) ***Chemical drain and vent pipe.*** Drain systems and vent systems for chemical wastes shall be of Approved corrosion resistant material. The manufacturer of the pipe shall indicate to the Department the material's suitability for the concentrations of chemicals involved.

(g) ***Catch basins, interceptors, and sumps.*** Catch basins, interceptors and sumps shall be constructed in a watertight manner of precast reinforced concrete, reinforced monolithic concrete, cast iron, coated 12-gauge steel, vitrified clay, fiberglass, plastic, or other Approved materials.

(h) ***Manholes.*** Manholes shall be constructed in a watertight manner of precast reinforced concrete, reinforced monolithic concrete, brick or block, fiberglass, or other Approved materials. Fiberglass manholes may be Approved for use in traffic areas if the top section of the manhole is not made of fiberglass.

(i) ***Service suction lines.*** A service suction line or pump discharge line serving a holding tank for cleaning purposes shall conform to one of the standards listed in Table 384.30-5. Joints and connections for suction lines shall conform to SPS 384.40. The use of mechanical joints shall be in accordance with the recommendations and instructions specified by the manufacturer.

(j) ***POWTS inspection and observation pipe.*** A POWTS inspection and observation pipe shall conform to at least one of the standards listed in Table 384.30-1. - See PDF for table

Note a: The installation of synthetic rubber hose is limited in use to indirect waste piping or local waste piping from dishwashers in accordance with SPS 382.33 (9) (d).

Note b: Limited to pipe weight of schedule 40. - See PDF for table

Note a: Copper tubing, type M, may not be installed underground.

Note b: Limited to pipe with a SDR of 26 or less.

Note c: Limited to pipe weight of schedule 40. - See PDF for table

a) Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.

b) Copper tubing, type M, may not be installed underground. **- See PDF for table**

Note a: The pipe shall have 2 rows, and only 2 rows, of perforations parallel to the axis of the pipe and 120° ± 5° apart. The perforations shall be at the nominal 4 and 8 o'clock positions when the pipe is installed. - See PDF for table

a) Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.

b) Copper tubing, type M, may not be installed underground.

(3) **STORM AND CLEAR WATER DRAIN AND VENT SYSTEMS.** Storm and clear water drain and vent systems shall be of such material and workmanship as set forth in this subsection.

(a) ***Above ground drain and vent pipe.*** Drainpipe and vent pipe installed above ground and inside a building shall conform to one of the standards listed in Table 384.30-1, except black steel pipe conforming to ASTM A53 may be used for storm water conductors. Black steel conductors may not be embedded in concrete or masonry.

(b) ***Underground drain and vent pipe.*** Drainpipe and vent pipe installed underground shall conform to one of the standards listed in Table 384.30-2.

(c) ***Storm building sewer pipe.*** Storm building sewer pipe shall conform to one of the standards listed in Table 384.30-6.

(d) *Subsoil drainpipe.* Subsoil drains shall be open jointed, horizontally split, or perforated pipe conforming to one of the standards listed in Table 384.30-7.

(e) ***Roof drains.***

1. Roof drains shall be provided with removable strainers of sufficient strength to carry the anticipated loads.

2. Roof drains shall be so constructed that the drains can be cleaned and the drain inlets accessible at all time.

3. Roof drains shall be sized in accordance with SPS 382.36 and the drain outlet shall not be less than 21/ 2 inches in diameter.

Note: See SPS 382.36 (10) and (11) for additional roof drain requirements.

(f) ***Area drain inlets.*** Area drain inlets shall be constructed in a watertight manner of precast concrete, reinforced monolithic concrete, brick or block, cast iron, coated 12-gauge steel, vitrified clay, fiberglass or other Approved materials. – See PDF for table

a) Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.

b) Copper tubing, type M, may not be installed underground.

(4) WATER SUPPLY SYSTEMS. Water supply systems shall be of such material and workmanship as set forth in this subsection. All materials in contact with water, in a water supply system, shall be suitable for use with the water within the system. All pipes and pipe fittings for water supply systems shall be made of a material that contains a weighted average of not more than 0.25 percent lead in the wetted surface material.

(a) ***Water quality.*** A water supply system shall be resistive to corrosive action and degrading action from the water being conveyed.

(b) ***Soil and groundwater.*** The installation of water supply systems shall be prohibited in soil and groundwater that is contaminated with solvents, fuels, organic compounds, or other detrimental materials which will cause permeation, corrosion, degradation, or structural failure of the piping material.

1. Where detrimental conditions are suspected, a chemical analysis of the soil and groundwater conditions shall be required to ascertain the acceptability of the proposed water supply system materials for the specific installation.

2. Where a detrimental condition exists, no underground water supply system may be installed until the detrimental condition can be:

a. Eliminated and the source of the condition can be eliminated;

b. Identified and the pipe and joining method can be proven resistant to the detrimental condition; or

c. Avoided by choosing an alternate route that will not be affected by the detrimental condition.

(c) ***Certification of plastic pipe.*** Plastic pipe for a water supply system shall be certified for potable water contact by a nationally recognized listing agency acceptable to the Department.

Note: For a listing of nationally recognized agencies acceptable to the Department, see Ch. SPS 384 Appendix A-384.11.

(d) ***Water services and private water mains.***

1. Water service pipe and private water mains shall conform to one of the standards listed in Table 384.30-7. Pipe and tubing for water services and private water mains shall have a minimum working pressure of 150 psig at 73.4°F.

3. Materials for combination water services and combination private water mains shall comply with NFPA 24 and the provisions specified in par. (d).

(e) ***Water distribution pipe.***

1. Except as provided in subd. 2. or 3., water distribution pipe shall have a minimum working pressure of 100 psig at 180°F and shall conform to one of the standards listed in Table 384.30-8

2. Cold water distribution pipe installed underground shall have a minimum working pressure of 150 psig at 73.4°F and shall conform to one of the standards listed in Table 384.30-7 or 384.30-8.

Note: Portions of a water supply system that supply water to a water-based fire protection system are to also conform to chs. SPS 361 to 365.

Note: See Ch. SPS 384 Appendix for further explanation.

3. Pipe and tubing for cold water distribution systems downstream of water treatment devices designed to serve fixtures, appliances and devices that provide ≤1 gpm at each outlet shall conform to one of the standards listed in Table 384.30-8 or 384.30-11, and shall have a minimum working pressure of 100 psig at 73.4°F.

4. Plastic pipe and tubing for water distribution systems downstream of water treatment devices designed to serve fixtures, appliances and devices that provide ≤1 gpm at each outlet shall be marked at intervals not to exceed 4 feet with the following information:

a. The manufacturer's name.

b. The trade designation of the pipe or tubing.

c. The type of material.

d. The minimum working temperature and pressure of the pipe or tubing.

e. The mark of the certifying agency.

(f) ***Used piping.*** Piping which has been used for any other purpose than conveying potable water may not be used for water supply systems. - See PDF for table

a) Plastic water service systems shall be installed in accordance with ASTM D2774.

b) Copper tubing, type M, may not be installed underground c) Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less. - See PDF for table

a) Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774.

b) Copper tubing, type M, may not be installed underground.

c) Use is limited to pipe 21/ 2 inches or less in diameter for sch 80 and 1 inch or less in diameter for sch 40.

d) Use is limited to pipe with a SDR 11 or less.

e) Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less. - See PDF for table

a) Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774.

b) Copper tubing, type M, may not be installed underground.

(5) PIPE FITTINGS AND VALVES.

(a) ***Fittings.*** Pipe fittings shall conform to the pipe material standards listed in this chapter or one of the standards listed in Table 384.30-10. Threaded drainpipe fittings shall be of the recessed drainage type.

(b) ***Water supply valves.***

1. Control valves for water services and private water mains shall be designed and constructed to withstand a minimum pressure of 125 psig at 73.4°F.

2. Control valves for water distribution systems shall be designed and constructed to withstand a minimum pressure of 100 psig at 180°F.

3. Except for a valve integral to a device, a control valve which serves 2 or more plumbing fixtures shall have, with the valve in a fully open position, a flow through passageway of not less than one nominal pipe size smaller than the nominal size of the piping connecting to the valve.

4. A control valve which serves 2 or more plumbing fixtures may not be a globe type valve.

(c) ***Special fittings and valves.***

1. Water hammer arrestors shall conform to ASME A112.26.1 or ASSE 1010.

2. Relief valves and automatic gas shutoff devices for hot water supply systems shall conform to ANSI Z21.22.

3. Backwater valves shall conform to ASME A112.14.1, CAN/CSA B181.1 or CAN/CSA B181.2.

4. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001, and CAN/CSA B64.1.1.

5. Water pressure reducing valves and strainers for water pressure reducing valves for domestic water supply systems shall conform to ASSE 1003.

6. Hose connection vacuum breakers shall conform to ASSE 1011 or CAN/CSA B64.2.

7. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012 and dual check type atmospheric port backflow preventers shall conform to CAN/CSA B64.3.

8. Reduced pressure backflow preventers and reduced pressure fire protection principle backflow preventers, or backflow preventers, reduced pressure principle type (RP) shall conform with ASSE 1013 or CAN/CSA B64.4.

> **Note:** Reduced pressure backflow preventers and reduced pressure detector fire protection backflow preventers are not permitted for cross connection control.

9. Double check backflow prevention assemblies shall conform to ASSE 1015 or CAN/CSA B64.5.

> **Note:** Double check fire protection backflow preventer assemblies are not permitted for cross connection control.

10. Individual thermostatic, pressure balancing, and combination pressure balancing and thermostatic control valves serving individual showers shall conform to ASSE 1016 or CAN/CSA B125.

11. Trap seal primer valves, water fed shall conform to ASSE 1018.

12. Vacuum breaker wall hydrants, freeze resistant automatic draining type shall conform to ASSE 1019, types A or B.

13. Pressure vacuum breaker assemblies shall conform to ASSE 1020 or CAN/CSA B64.1.2.

14. Laboratory faucet backflow preventers shall conform to ASSE 1035 and laboratory faucet type vacuum breakers shall conform to CAN/CSA B64.7.

15. Reduced pressure detector fire protection, backflow prevention assemblies shall conform to ASSE 1047.

16. Double check detector assembly backflow preventers shall conform to ASSE 1048.

17. Back siphonage backflow vacuum breakers shall conform to ASSE 1056.

18. Hose connection backflow preventers shall conform to ASSE 1052.

19. Backflow preventers for carbonated beverage machines shall conform to ASSE 1022.

20. Dual check backflow preventers in freeze resistant types of wall hydrants shall conform to ASSE 1053.

(d) ***Pipe saddles.*** Pipe saddles shall be installed in accordance with the instructions of the saddle manufacturer and conform to all of the following limitations:

1. Pipe saddles may be installed on private interceptor main sewers, building sewers, underground drain and vent pipe and tubing, and where otherwise Approved by the Department.

2. A saddle for drain piping shall have a radius in accordance with SPS 382.30 (8) (a).

3. The material of the saddle shall be compatible with the materials of the pipes which are to be connected to the saddle.

4. The hole in the pipe which is to receive the saddle shall be drilled or cored to match the saddle outlet.

5. Straps or clamps which wrap around the pipe and saddle shall be provided by the manufacturer of the saddle.

6. Saddles shall be installed with straps or clamps which wrap around the pipe and saddle.

7. Proper hangers or bedding shall be provided to maintain alignment between the opening in the pipe and the saddle. - See PDF for table

a) Steel fittings and malleable iron fittings to be used in a water supply system shall be galvanized-coated in accordance with ASTM A123/123M.

b) See SPS 384.30 (4) (intro.) concerning the maximum lead content for fittings.

c) Copper and copper alloy fittings conforming to MSS SP-103, may not be installed underground. - See PDF for table

a) These materials are Approved for cold water use only.

b) Copper tubing, Type M, shall not be installed underground.

c) Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less.

(6) SPECIAL MATERIALS.

(a) ***Sheet lead.*** Sheet lead for the following uses may not weigh less than indicated in subds. 1. and 2.

1. Site-fabricated flashings for vent pipes, 3 pounds per square foot; and

2. Prefabricated flashings for vent pipes, 2½ pounds per square foot.

(b) ***Traps and fixture drain connection fittings.*** Copper or tubular brass traps and fixture drain connection fittings shall be at least of 20 gage material.
(c) ***Sheet copper.*** Sheet copper for the following uses may not weigh less than indicated in subds. 1. and 2. and shall conform to ASTM B152.

1. Flashing for vent pipes, 8 ounces per square foot; and

2. Flush tank linings, 10 ounces per square foot.

(d) ***Cleanout plugs.*** Cleanout plugs shall be of brass or plastic. Brass cleanout plugs shall be used with metallic piping only and shall conform to ASTM A74. Plastic cleanout plugs shall conform to the requirements of sub. (5) (a).
(e) ***Flush pipes and fittings.*** Flush pipes and fittings shall be of nonferrous material and shall conform to ASME A112.19.5.
(f) ***Safing material.*** Safing materials shall be waterproof when subjected to 2 feet of hydrostatic head when tested in accordance with ASTM C1306 or ASTM D4068. The material shall be recognized by the manufacturer for use as a safing material.
(g) ***Geotextile fabrics.*** Geotextile fabric used in a POWTS to prevent backfill material from entering the distribution cell shall meet the requirements listed in Table 384.30-12.
- See PDF for table
(h) ***Leaching chambers.*** Leaching chambers for distribution cell components of POWTS or stormwater subsurface infiltration systems shall meet all of the following requirements:

1. Constructed of corrosion resistant materials.

2. Designed to prevent soil surrounding the chamber from entering the chamber.

3. Capable of withstanding pressures that the leaching chamber is intended to encounter.

(i) ***Stone aggregate.*** Stone aggregate which is used as a filtering medium or to create a distribution cell in a treatment or dispersal component of a POWTS or stormwater subsurface infiltration system shall meet all of the following requirements:

1. Conform to ASTM Standard C33 for coarse aggregate prior to washing.

2. Be washed to remove fine material.

3. Be ½ to 2½ inch in size.

4. Have a hardness value of at least 3 on Moh's Scale of Hardness.

Note: Stone that can scratch a copper penny without leaving any residual stone material on the penny has a hardness value of at least 3 on Moh's Scale of Hardness.

(j) ***Sand.*** Sand that is placed as a filtering medium in a stormwater subsurface infiltration system shall conform to ASTM Standard C33 for fine aggregate.
(k) ***Synthetic aggregate.*** Synthetic aggregate that is used as a filtering medium or to create a distribution cell in a treatment or dispersal component of a POWTS or stormwater subsurface infiltration system shall meet all of the following requirements:

1. Be made from inert materials.

2. Be ½ inch to 2½ inches in size.

3. Be made of material that will not contaminate groundwater.

4. Be recognized by the manufacturer for use as a filtering media or a material to create a distribution cell.

SPS 384.40 Joints and connections.

(1) GENERAL.

(a) ***Tightness.*** Joints and connections in the plumbing system shall be watertight and gastight as required by test or system design, whichever is greater, or as required by the adopted product standard or Department approval.

Note: The testing requirements for tightness are in SPS 382.21.

(b) ***Preparation of pipe ends.*** Pipe ends shall be prepared in accordance with the applicable pipe standard or the pipe or fitting manufacturer's instructions.

(c) ***Prohibited joints and connections***. Unless otherwise permitted in this chapter or Ch. SPS 382 or 383, all of the following types of joints and connections shall be prohibited:

1. Cement or concrete joints.

2. Mastic or hot poured bituminous joints.

3. Elastomeric rolling O-rings between different diameter pipes.

4. Solvent cement joints between different types of plastic pipe other than ABS and PVC in non-pressurized systems.

5. Roll grooving of galvanized steel pipe.

(2) ABS PLASTIC PIPE. Joints between acrylonitrile butadiene styrene plastic pipe or fittings shall be installed in accordance with pars. (a) to (c).

(a) ***Mechanical joints.*** Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1. `Drain and vent systems.' Mechanical push-on joints for drain and vent systems shall conform to ASTM D3212.

2. `Water supply systems.' Mechanical push-on joints and mechanical compression-type joints for water supply systems which use a flexible elastomeric seal shall be suitable for potable water.

(b) ***Solvent cemented joints.*** Solvent cemented joints shall be made in accordance with ASTM D2235 and its appendix, ASTM D2661 or ASTM F628.

1. Joint surfaces shall be clean and free of moisture.

2. Solvent cement conforming to ASTM D2235 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.

3. Solvent cement shall be handled in accordance with ASTM F402.

4. Solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The container for the solvent cement shall bear the certification mark of the testing agency.

(c) ***Threaded joints.*** Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape Approved for such use shall be applied to the male threads only.

(3) BLACK STEEL PIPE. Joints between black steel pipe or fittings shall be in accordance with pars. (a) to (d).

(a) ***Threaded joints.*** Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(b) ***Mechanical joints.*** Mechanical joints shall be installed in accordance with the manufacturer's instructions.

(c) ***Caulked joints.*** Caulked joints shall only be used for drain or vent piping. Caulked joints for hub and spigot piping and fittings shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than 1/8 inch below the rim of the pipe and caulked tight. Paint, varnish, or other coatings may not be used on the joining material until after the joint has been tested and Approved.

1. Caulked joints for drain piping shall be used only in a vertical position.

2. Caulked joints for vent piping may be used for piping in a vertical or horizontal position.

(d) ***Welded joints.*** Joints between black steel pipe or fittings may be welded.

(4) BRASS PIPE. Joints between brass pipe or fittings shall be in accordance with the provisions of pars. (a) to (d).

(a) ***Brazed joints***. All joint surfaces to be brazed shall be cleaned bright by other than chemical means. Brazing filler metal conforming to AWS A5.8 or other Approved material shall be used. The joining of water supply piping shall be made with lead-free materials. Solders and fluxes containing in excess of 0.2% lead shall not be used.

(b) ***Mechanical joints***. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(c) ***Soldered joints.*** All joint surfaces to be soldered shall be cleaned bright by other than chemical means. A nontoxic flux shall be applied to all joint surfaces. Solder conforming to ASTM B32, or other Approved material shall be used. The joining of water supply piping shall be made with lead-free materials. Solders and fluxes containing in excess of 0.2% lead shall not be used.

(d) ***Threaded joints.*** Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(5) CAST IRON PIPE. Joints between cast iron pipe or fittings shall be installed in accordance with pars. (a) and (b).

(a) ***Caulked joints.***

1. `Drain and vent systems.' Caulked joints for hub and spigot pipe of drain and vent systems shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than 1/8 inch below the rim of the pipe and caulked tight. Paint, varnish, or other coatings may not be used on the joining material until after the joint has been tested and Approved.

2. `Water supply systems.' Joints for bell and spigot pipe of water supply systems shall be firmly packed with treated paper rope. Molten lead shall be poured in one operation to a depth of 2½ inches.

(b) ***Mechanical joints.***

1. `Drain and vent systems.'

a. Mechanical push-on joints for drain and vent systems shall have gaskets which conform to ASTM C564.

b. Mechanical sleeve joints for drain and vent systems shall have a rubber sealing sleeve conforming to ASTM C564, CISPI 310 or FM 1680. Where a stainless-steel band assembly is used, the band assembly shall conform to CISPI 310 or FM

1680. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

2. `Water supply systems.' Mechanical push-on joints and mechanical compression type joints for water supply systems shall conform to AWWA C111/A21.11. Lead tipped gaskets may not be used.

(c) *Threaded joints.* Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(6) CPVC PLASTIC PIPE. Joints between chlorinated polyvinyl chloride plastic pipe or fittings shall be installed in accordance with the provisions of pars. (a) to (c).

(a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on type joints which use flexible elastomeric seals shall be suitable for potable water.

(b) *Solvent cemented joints*. Solvent cemented joints shall be made in accordance with ASTM D2846 or ASTM F493.

1. Joint surfaces shall be clean and free of moisture. Cleaner, primer and cement shall be installed in accordance with the manufacturer's instructions for use of the solvent cement.

2. Solvent cement conforming to ASTM F493 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.

3. Solvent cement shall be handled in accordance with ASTM F402.

4. Primer and solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The containers for the primer and the solvent cement shall bear the certification mark of the testing agency.

(c) *Threaded joints.* Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape Approved for such use shall be applied to the male threads only.

(7) CONCRETE PIPE.

(a) *Circular pipe.* Joints between circular concrete pipe or fittings shall be made by use of an elastomeric seal conforming to ASTM C443 or C990.

(b) *Elliptical pipe.* Joints between elliptical concrete pipe or fittings shall be made by use of materials conforming to ASTM C887 Type II or ASTM C990.

(8) COPPER PIPE AND TUBING. Joints between copper pipe, tubing or fittings shall be installed in accordance with pars. (a) to (e).

(a) *Brazed joints.* All joint surfaces to be brazed shall be cleaned bright by other than chemical means. Brazing filler metal conforming to AWS A5.8, NSF/ANSI 61, annex G, or other Approved material shall be used. The joining of water supply piping shall be made with lead-free materials.

(b) *Flared joints.* Flared joints may be used on annealed tubing for water supply systems and shall be made by the use of a tool designed for that operation.

(c) *Mechanical joints*. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(d) ***Soldered joints***. All joint surfaces to be soldered shall be made in accordance with ASTM B828. Flux Approved by NSF for use in potable water systems shall be applied to all joint surfaces. Solder conforming to ASTM B32, NSF/ANSI 61, annex G, or other Approved material shall be used. The joining of water supply piping shall be made with lead-free materials.

(e) ***Threaded joints.*** Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(9) DUCTILE IRON PIPE.

(a) ***Mechanical joints.*** Mechanical push-on joints and mechanical compression type joints for water supply systems shall conform to AWWA C111. Lead tipped gaskets may not be used.

(b) ***Threaded joints.*** Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(10) GALVANIZED STEEL PIPE. Joints between galvanized steel pipe or fittings or between galvanized steel pipe and cast-iron fittings shall be installed in accordance with pars. (a) to (c).

(a) ***Threaded joints.*** Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(b) ***Mechanical joints.*** Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(c) ***Caulked joints.*** Caulked joints shall only be used for drain or vent piping. Caulked joints for hub and spigot piping and fittings shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than 1/8 inch below the rim of the pipe and caulked tight. Paint, varnish, or other coatings may not be used on the joining material until after the joint has been tested and Approved.

1. Caulked joints for drain piping shall be used only for piping in a vertical position.

2. Caulked joints for vent piping may be used for piping in a vertical or horizontal position.

(11) LEAD PIPE. Joints between lead pipe or fittings shall be installed in accordance with pars. (a) and (b).

(a) ***Burned joints.*** Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.

(b) ***Wiped joints.*** A wiped joint shall be full wiped, having an exposed surface on each side of the joint not less than 3/4 inch and shall be at least 3/8 inch thick at the thickest point.

(12) PE PLASTIC PIPE AND TUBING. Joints between polyethylene plastic pipe, tubing or fittings shall be in accordance with pars. (a) to (c).

(a) ***Flared joints.*** Flared joints shall be made by use of a tool designed for that operation. Flared joints shall be made in accordance with ASTM D3140.

(b) ***Heat fusion joints.*** Heat fusion joints shall be made in accordance with ASTM D2657. Heat fusion joints shall be of a socket fusion type.

1. Joint surfaces to be fused shall be clean and free of moisture.

2. All joint surfaces shall be heated to the temperature recommended by the pipe or fitting manufacturer and joined.

3. The joint shall be undisturbed until cool.

(c) ***Mechanical joints.*** Mechanical joints may be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints which use flexible elastomeric seals shall be suitable for potable water.

(13) PEX PLASTIC TUBING. Joints between crosslinked polyethylene plastic pipe, tubing or fittings shall be made in accordance with the manufacturer's instructions.

(14) PVC PLASTIC PIPE. Joints between polyvinyl chloride plastic pipe or fittings shall be in accordance with pars. (a) to (c).

(a) ***Mechanical joints.*** Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1. `Drain and vent systems.' Mechanical push-on joints for drain and vent systems shall conform to ASTM D3212.

2. `Water supply systems.' Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(b) ***Solvent cemented joints***. Solvent cemented joints shall be made in accordance with ASTM D2855.

1. Joint surfaces shall be clean and free of moisture. A primer conforming to ASTM F656 shall be applied to all joint surfaces.

2. Solvent cement conforming to ASTM D2564 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.

3. Solvent cement shall be handled in accordance with ASTM F402.

4. Primer and solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The containers for the primer and the solvent cement shall bear the certification mark of the testing agency.

(c) ***Threaded joints.*** Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape Approved for such use shall be applied to the male threads only.

(15) STAINLESS STEEL. Joints between stainless steel pipe or fittings shall be installed in accordance with the provisions of pars. (a) to (c).

(a) ***Mechanical joints.*** Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on type joints which use flexible elastomeric seals shall be suitable for potable water.

(b) ***Threaded joints.*** Threaded joints shall conform to ANSI B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(c) ***Welded joints.*** Joints between stainless steel pipe or fittings may be welded.

(16) JOINTS BETWEEN PIPE AND FITTINGS OF DIFFERENT MATERIALS. Connections between pipes of different materials shall be made with mechanical compression type joints, installed in accordance with manufacturer's instructions or as specified in pars. (a) to (e).

(a) ***Copper to cast iron.*** Connections between copper pipe or tube and cast iron pipe shall be by means of either caulked joints in accordance with sub. (5) (a) or threaded fittings in accordance with sub. (5) (c).

(b) ***Copper to galvanized steel.*** Connections between copper pipe or tube and galvanized steel pipe shall be by use of an adapter fitting. The copper pipe shall be soldered to the adapter in accordance with sub. (8) (d). The galvanized steel shall be threaded to the adapter in accordance with sub. (10) (a).

(c) ***Cast iron to steel or brass pipe.*** Connections between cast iron pipe and galvanized or black steel or brass pipe shall be by means of:

1. Caulked joints in accordance with sub. (5) (a); or

2. Threaded joints in accordance with sub. (5) (c).

(d) ***Plastic to other materials.***

1. Connections between plastic pipe and cast-iron pipe shall be by means of:

a. Caulked joints in accordance with sub. (5) (a); or

b. Threaded joints in accordance with sub. (5) (c).

2. Except as provided in par. (f), connections between different types of plastic pipe or between plastic pipe and other piping materials other than cast iron shall be by means of threaded joints in accordance with sub. (14) (c).

(e) ***Lead to other piping materials.*** Connections between lead pipe and other piping materials shall be by use of an adapter fitting conforming to SPS 384.30 (5) (a). The lead pipe shall be caulked or burned to the adapter fitting in accordance with sub. (11).

(f) ***ABS plastic to PVC plastic.*** For solvent-cemented connections between ABS and PVC piping in non-pressurized systems, all of the following shall apply:

1. Joint surfaces shall be clean and free of moisture.

2. Primer conforming to ASTM F656 shall be applied to all PVC joint surfaces.

3. Solvent conforming to ASTM D3138 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.

4. Solvent shall be handled in accordance with ASTM F402.

(17) CONNECTION OF FIXTURES. Flanged fixtures which have integral traps shall be mechanically fastened to the drain piping by means of a compatible fitting. The joint between the fixture and the fitting shall be sealed with a watertight gasket or setting compound.

(18) CONNECTION OF PIPE TO CONCRETE STRUCTURES. Joints between concrete structures and piping shall be made with mechanical joints in conformance with ASTM C923, ASTM C564 or as otherwise permitted by local authority. Openings for pipe connections that are installed with mechanical joints conforming to ASTM C564 shall have an inside diameter of that required for cast iron pipe in conformance with ASTM A74.

SPS 384.50 Alternate approvals and experimental approvals. (Intentionally Omitted)

Table 384.10
SUBMITTALS TO DEPARTMENT

	Product Categories
1.	Bottled–water vending machines that are not listed by a certification body accredited by the American National Standards Institute
2.	Chemical or biochemical treatments for POWTS
3.	Health care plumbing appliances
4.	Physical restoration processes for POWTS
5.	Prefabricated holding or treatment components for POWTS
6.	Prefabricated plumbing
7.	Wastewater treatment devices used to meet the requirements in s. SPS 382.70
8.	Water treatment devices that make a contaminant reduction claim which is not certified by a certification body accredited by the American National Standards Institute
9.	Water treatment devices that are not certified to a standard which covers material safety, by a certification body accredited by the American National Standards Institute

Note: More information about the certification bodies accredited by the American National Standards Institute (ANSI), such as the National Sanitation Foundation, is available at the ANSI website at www.ansi.org; or at 1899 L Street, NW, 11th Floor Washington, DC, 20036; or at telephone 202.293.8020.

Table 384.11
DEVICE LISTINGS

Device	Referenced Standard
Anti–siphon Fill Valves (Ballcocks) for Gravity Water Closet Flush Tanks	ASSE 1002
Atmospheric Type Vacuum Breakers	ASSE 1001
Atmospheric Vacuum Breakers	CAN/CSA B64.1.1
Backflow Preventers for Beverage Dispensing Equipment	ASSE 1022
Backflow Preventer with Intermediate Atmospheric Vent	ASSE 1012
Backflow Prevention Devices for Hand–Held Showers	ASSE 1014
Chemical Dispensing Systems	ASSE 1055
Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies	ASSE 1015
Double Check Detector Fire Protection Backflow Prevention Assemblies	ASSE 1048
Double Check Valve Backflow Preventers	CAN/CSA B64.5
Dual Check Valve Backflow Preventers with Atmospheric Port	CAN/CSA B64.3
Hose Connection Backflow Preventers	ASSE 1052
Hose Connection Vacuum Breakers	CAN/CSA B64.2
Hose Connection Vacuum Breakers	ASSE 1011
Laboratory Faucet Backflow Preventers	ASSE 1035
Laboratory Faucet Type Vacuum Breakers	CAN/CSA B64.7
Pressure Vacuum Breakers	CAN/CSA B64.1.2
Pressure Vacuum Breaker Assembly	ASSE 1020
Pressure Vacuum Breaker Assembly	ASSE 1020
Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures	ASSE 1037
Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies	ASSE 1047
Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers	ASSE 1013
Reduced Pressure Principle Backflow Preventers	CAN/CSA B64.4
Spill Resistant Vacuum Breakers	ASSE 1056
Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type	ASSE 1019
Residential Cation Exchange Water Softeners	NSF 44

History: Cr. Register, July, 2000, No. 535, eff. 9–1–00; CR 02–002: am. Table Register April 2003 No. 568, eff. 5–1–03; CR 04–035: am. Table 84.11 Register November 2004 No. 587, eff. 12–1–04; CR 08–055: am. Table 84.11 Register February 2009 No. 638, eff. 3–1–09; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

Table 384.20
STATIC TEST PRESSURES FOR WATER CLOSETS AND WATER CLOSET FLUSHING DEVICES

Tank Type	Flushometer Type	
	Siphonic	Blow Out
20 to 80 psig	25 to 80 psig	35 to 80 psig

Table 384.30–1
ABOVE GROUND DRAIN AND VENT PIPE AND TUBING

Material	Standard
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2661; ASTM F628
Brass	ASTM B43
Cast iron	ASTM A74; ASTM A888; CISPI 301
Copper	ASTM B42; ASTM B88; ASTM B306
Galvanized steel	ASTM A53
Polyvinyl chloride (PVC)	ASTM D2665; ASTM D1785; ASTM F891[b]
Synthetic rubber hose[a]	AHAM DW–1

Note a: The installation of synthetic rubber hose is limited in use to indirect waste piping or local waste piping from dishwashers in accordance with s. SPS 382.33 (9) (d).

Note b: Limited to pipe weight of schedule 40.

Table 384.30–2
UNDERGROUND DRAIN AND VENT PIPE AND TUBING

Material	Standard
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2661; ASTM F628
Cast iron	ASTM A74; ASTM A888; CISPI 301
Copper[a]	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2665; ASTM D3034[b]; ASTM F891[c]

Note a: Copper tubing, type M, may not be installed underground.

Note b: Limited to pipe with a SDR of 26 or less.

Note c: Limited to pipe weight of schedule 40.

Table 384.30–3
SANITARY BUILDING SEWER PIPE AND TUBING

Material	Standard
Acrylonitrile butadiene styrene (ABS)[a]	ASTMD1527; ASTM D2661; ASTM D2751; ASTM F628
Acrylonitrile butadiene styrene (ABS) composite[a]	ASTM D2680
Cast iron	ASTM A74; ASTM A888; CISPI 301
Concrete	ASTM C14; ASTM C76
Copper[b]	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)[a]	ASTM D1785; ASTM D2665; ASTM D3034; ASTM F891
PVC Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F949
PVC Large–Diameter Plastic Gravity Sewer Pipe and Fittings	ASTM F679
PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter	ASTM F794
Type PS–46 and Type PS–115 PVC Plastic Gravity Flow Sewer Pipe and Fittings	ASTM F789

[a]Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.
[b]Copper tubing, type M, may not be installed underground.

Table 384.30–4
PERFORATED EFFLUENT DISTRIBUTION PIPING FOR NONPRESSURIZED SOIL ABSORPTION SYSTEMS

Material	Standard
Polyethylene (PE)[a]	ASTM F405; ASTM F810
Polyvinyl chloride (PVC)[a]	ASTM D2729

Note a: The pipe shall have 2 rows, and only 2 rows, of perforations parallel to the axis of the pipe and 120° ± 5° apart. The perforations shall be at the nominal 4 and 8 o'clock positions when the pipe is installed.

Table 384.30–5
PRESSURIZED DRAIN PIPE AND TUBING AND SERVICE SUCTION LINES

Material	Standard
Acrylonitrile butadiene styrene (ABS)[a]	ASTM D1527; ASTM D2282; ASTM D2661; ASTM F628
Brass	ASTM B43
Chlorinated Poly (Vinyl Chloride) (CPVC)[a]	ASTM D2846; ASTM F441/F441M; ASTM F442/F442M
Concrete	ASTM C14; ASTM C76
Copper[b]	ASTM B42; ASTM B88; ASTM B306
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene Pressure Pipe and Fitting, 4 in. through 63 in., for Water Distribution	AWWA C906
Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in.	AWWA C901–02
Polyvinyl chloride (PVC)[a]	ASTM D1785; ASTM D2241; ASTM D2665; AWWA C900
Stainless Steel	ANSI B36.19M; ASTM A269; A312/A312M; ASTM A450; A778; AWWA C220

[a]Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.
[b]Copper tubing, type M, may not be installed underground.

Table 384.30–6
STORM BUILDING SEWER PIPE AND TUBING

Material	Standard
Acrylonitrile butadiene styrene (ABS)[a]	ASTM D1527; ASTM D2661; ASTM D2751; ASTM F628
Acrylonitrile butadiene styrene (ABS) composite[a]	ASTM D2680
Cast iron	ASTM A74; ASTM A888; CISPI 301
Concrete, circular	ASTM C14; ASTM C76
Concrete, elliptical	ASTM C507/C507M
Copper[b]	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)[a]	ASTM D1785; ASTM D2665; ASTM D3034; ASTM F891
PVC Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F949
PVC Large–Diameter Plastic Gravity Sewer Pipe and Fittings	ASTM F679
PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter	ASTM F794
Type PS–46 and Type PS–115 PVC Plastic Gravity Flow Sewer Pipe and Fittings	ASTM F789

[a] Thermoplastic sewer pipe shall be installed in accordance with ASTM D2321.
[b]Copper tubing, type M, may not be installed underground.

Table 384.30–7
PIPE AND TUBING FOR
WATER SERVICES AND PRIVATE WATER MAINS

Material	Standard
Acrylonitrile butadiene styrene (ABS)[a]	ASTM D1527; ASTM D2282
Brass	ASTM B43
Chlorinated Poly (Vinyl Chloride) (CPVC)[a]	ASTM D2846; ASTM F441/F441M; ASTM F442/F442M
Copper[b,c]	ASTM B42; ASTM B88
Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene	CAN/CSA B137.10; ASTM F1281
Crosslinked polyethylene (PEX)[a]	ASTM F876; ASTM F877
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene (PE)[a]	ASTM D2239; ASTM D2737; ASTM D2104; ASTM D2447; ASTM D3035; AWWA C906; AWWA C901
Polyethylene/Aluminum/ Polyethylene	CAN/CSA B137.9
Polyethylene/Aluminum/ Polyethylene (PE–AL–PE) Composite Pressure Pipe	ASTM F1282
Polyvinyl chloride (PVC)[a]	ASTM D1785; ASTM D2241; AWWA C900
Stainless steel	ASME B36.19/B36.19M

[a]Plastic water service systems shall be installed in accordance with ASTM D2774.
[b]Copper tubing, type M, may not be installed underground.
[c]Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less.

Table 384.30–8
WATER DISTRIBUTION PIPE AND TUBING

Material	Standard
Brass	ASTM B43
Cast iron	AWWA C115
Chlorinated Poly (Vinyl Chloride) (CPVC)[a]	ASTM D2846; ASTM F441/441[c]; ASTM F442/442M[d]
Copper[b,e]	ASTM B42; ASTM B88
Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene	CAN/CSA B137.10, ASTM F1281
Crosslinked polyethylene (PEX)[a]	ASTM F876; ASTM F877
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene/Aluminum/ Polyethylene	CAN/CSA B137.9
Polyethylene/Aluminum/ Polyethylene (PE–AL–PE) Composite Pressure Pipe	ASTM F1282
Stainless Steel	ASME B36.19M; ASTM A270; ASTM A450

[a]Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774.

[b]Copper tubing, type M, may not be installed underground.

[c]Use is limited to pipe $2\frac{1}{2}$ inches or less in diameter for sch 80 and 1 inch or less in diameter for sch 40.

[d]Use is limited to pipe with a SDR 11 or less.

[e]Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less.

Table 384.30–9
MINIMUM BENDING RADIUS OF POLYBUTYLENE WATER DISTRIBUTION PIPE AND TUBING

Pipe Size (inches)	Bending Radius (inches)	Tubing Size (inches)	Bending Radius (inches)
$\frac{3}{4}$	$12\frac{3}{4}$	$\frac{1}{4}$	$4\frac{1}{2}$
1	$15\frac{3}{4}$	$\frac{3}{8}$	6
$1\frac{1}{4}$	20	$\frac{1}{2}$	$7\frac{1}{2}$
$1\frac{1}{2}$	23	$\frac{3}{4}$	$10\frac{1}{2}$
2	$28\frac{1}{2}$	1	$13\frac{1}{2}$
		$1\frac{1}{4}$	$16\frac{1}{2}$
		$1\frac{1}{2}$	$19\frac{1}{2}$
		2	$25\frac{1}{2}$

[a]Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774.

[b]Copper tubing, type M, may not be installed underground.

Table 384.30–10
PIPE FITTINGS

Material	Standard
Acrylonitrile butadiene styrene (ABS)	ASTM D2468; ASTM D3311; ASTM F409
Cast bronze	ANSI B16.15; ANSI B16.24
Cast copper alloy	ASME B16.18; ASME B16.23; ASME B16.26
Cast iron	ASME B16.4; ASME B16.12; ASME B16.1; ASME B16.45
Chlorinated polyvinyl chloride (CPVC)	ASTM F437; ASTM F438; ASTM F439
Copper	ASME B16.22; ASME B16.29
Crosslinked Polyethylene (PEX)	ASTM F1807
Ductile iron and gray iron	AWWA C110; AWWA C153; ANSI B16.42
Malleable iron	ANSI B16.3
Polyethylene (PE)	ASTM D2609; ASTM D2683; ASTM D3261
Polyvinyl Chloride (PVC)	ASTM D2464; ASTM D2466; ASTM D2467; ASTM D3311; ASTM F409; ASTM F1336; ASTM F1866
Polyvinyl Chloride (PVC) Gasketed Sewer Fittings	ASTM F1336
Stainless steel	ASTM A403
Steel[a]	ANSI B16.5; ANSI B16.9; ANSI B16.11; ANSI B16.28
Styrene–rubber (SR)	ASTM D2852

[a] Steel fittings and malleable iron fittings to be used in a water supply system shall be galvanized–coated in accordance with ASTM A123/123M.

[b] See s. SPS 384.30 (4) (intro.) concerning the maximum lead content for fittings.

[c] Copper and copper alloy fittings conforming to MSS SP–103, may not be installed underground.

Table 384.30–11

Pipe And Tubing For Water Distribution Systems Downstream Of Treatment Devices Designed To Serve Fixtures, Appliances And Devices That Provide ≤1 Gpm At Each Outlet

Material	Standard
Copper[b,c]	ASTM B42; ASTM B88
Polyethylene (PE)[a]	NSF 51; NSF 61
Polypropylene (PP)[a]	NSF 51; NSF 61
Polyvinylidene fluoride (PVDF)[a]	NSF 51; NSF 61
Polyvinyl chloride (PVC)[a]	NSF 51; NSF 61

[a] These materials are approved for cold water use only.

[b] Copper tubing, Type M, shall not be installed underground.

[c] Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less.

Table 384.30–12
GEOTEXTILE FABRICS

Property	Test Method	Minimum Average Roll Value
Grab Tensile, lbs	ASTM D4632	35 lbs, minimum
Grab Elongation, %	ASTM D4632	50%, minimum
Puncture, lbs	ASTM D4833	10 lbs, minimum
Trapezoidal tear, lbs	ASTM D4533	11 lbs, minimum
AOS, US Sieve #	ASTM D4751	20 US sieve #, minimum
AOS, US Sieve #	ASTM D4751	70 US sieve #, maximum

Chapter SPS 385
SOIL AND SITE EVALUATIONS

SPS 385.01 Purpose.
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SPS 385.10 Qualifications.
SPS 385.20 Soil evaluations.
SPS 385.30 Soil profile description and interpretations.
SPS 385.40 Evaluation reports.
SPS 385.50 Public Works Division review.
SPS 385.60 Soil saturation determinations.

SPS 385.01 Purpose. The purpose of this chapter is to establish the minimum requirements for evaluating and reporting soil and site characteristics that may affect treatment or dispersal of wastewater, treated wastewater, final effluent, or non-water-carried human wastes.

SPS 385.02 Scope.

(1) This chapter applies to all soil and site evaluations conducted relative to the treatment or dispersal of wastewater, treated wastewater, final effluent, or non-water-carried human wastes into soil.

SPS 385.10 Qualifications.

(1) SOIL EVALUATION. A soil evaluation for treatment or dispersal of wastewater, treated wastewater, final effluent or non-water-carried human wastes regulated by chs. SPS 383 and 391 shall be performed by an individual who is an authorized soil tester. A soil evaluation for the treatment or dispersal of stormwater regulated under ch. SPS 382 shall be performed by an individual who is either an Authorized soil tester or one who holds a professional soil scientist license under Ch. GHSS 4.

(2) SITE EVALUATION. A site evaluation, relative to the installation of a POWTS treatment, holding or dispersal component location, or to determine land slope or setback distances to topographic or other site features shall be performed by a Wisconsin registered architect, professional engineer, designer of plumbing systems, designer of private sewage systems or land surveyor; an Authorized soil tester or POWTS inspector; or a licensed master plumber or master plumber-restricted service.

(3) SOIL SATURATION DETERMINATIONS. Soil saturation determinations may only be conducted and reported by an individual who is an authorized soil tester.

SPS 385.20 Soil evaluations.

(1) GENERAL.

(a) Soil boring methods and procedures shall comply with this section.

(b) Maximum soil application rates shall be determined relative to the soil texture, structure and consistence for each soil horizon or layer.

Note: Section SPS 383.44 establishes maximum soil application rates and soil treatment capability for the design of POWTS treatment or dispersal components consisting in part of in situ soil.

(2) NUMBER, TYPE AND DEPTH OF EVALUATIONS.

(a) ***General.*** The number, type, depth, and location of soil profile evaluations shall be sufficient to delineate the area under investigation and to assure consistency of the data within that area.

(b) ***Number and area.***

1.

a. Except as provided in subd. 1. d. and subd. 2., a minimum of 3 soil profile evaluation excavations shall be used to delineate a site within which POWTS treatment or dispersal components consisting in part of in situ soil are to be located.

b. For estimated daily flows of 1,000 gallons per day or less, at least one soil profile evaluation excavation per treatment or dispersal site shall be constructed as a soil pit, and described in accordance with SPS 385.30 (1) (c).

c. For estimated daily flows greater than 1,000 gallons per day, at least 3 soil profile evaluations per treatment or dispersal site shall be constructed as soil pits, and described in accordance with s. SPS 385.30 (1) (c).

d. The Tribe may require additional soil profile evaluation excavations to be constructed where soil variability considerations may not be adequately addressed. The Tribe may specify that soil profile descriptions in accordance with SPS 385.30 (1) (c) be conducted for any additional soil profile evaluation excavations.

2. At least one soil pit or soil boring shall be used to establish soil suitability for a pit privy.

Note: Sections SPS 383.44 (3) and 391.12 (1) (b) 1. contain further information regarding privy siting and soil requirements.

(c) ***Type.***

1. Soil profile evaluations used to determine soil application rates shall be conducted using soil pits.

2. Soil profile evaluations used to determine or identify soil horizon depths, soil color, soil texture, redoximorphic feature colors or depth to groundwater or bedrock shall be conducted using either soil pits or soil borings.

(d) ***Depth.*** Soil profile evaluations shall extend an adequate depth below the land surface to identify soil properties critical to soil treatment or dispersal of wastewater, treated wastewater, final effluent, or non-water-carried human waste.

(3) EXCAVATION METHODS.

(a) ***Soil profile excavations.*** A soil profile excavation shall be of such size and construction to allow accurate determination of soil characteristics.

(b) ***Soil borings.***

1. Soil borings shall be created by means of a soil bucket auger, soil probe, split-spoon sampler or Shelby tube having at least a 2-inch diameter.

2. A soil boring may not be created by means of a power auger.

(c) ***Soil pits.*** A soil pit shall be of adequate size, depth, and construction to enable a person to safely enter and exit the pit and to complete a morphological soil profile description.

Note: Occupational safety and health administration regulations (29 CFR 1926, Subpart P) apply to certain types of excavations, and the persons entering such excavations need to be familiar with those regulations.

(4) SOIL EVALUATION CONDITIONS.

(a) Soil color evaluations shall be performed on days when light conditions permit accurate color determinations.

(b) Frozen soil material shall be thawed prior to conducting evaluations for soil color, texture, structure, and consistence.

SPS 385.30 Soil profile description and interpretations.

(1) GENERAL.

(a) A soil profile description shall be prepared for each soil profile excavation constructed.

(b) Soil profile descriptions shall be written in accordance with the descriptive procedures, terminology and interpretations found in Chapter 3 of the *Soil Survey*

Manual, USDA, October, 1993, except where modified by, or in conflict with, this chapter.

(c) A soil profile description to substantiate soil application rates shall include at least all of the following morphological information for each soil horizon or layer:

1. Thickness in inches or decimal feet.

2. Munsell soil color notation.

3. Soil mottle or redoximorphic feature color, abundance, size, and contrast.

4. United States Department of Agriculture, USDA, soil textural class with rock fragment modifiers.

5. Soil structure grade, size, and shape.

6. Soil consistence.

7. Root abundance and size.

8. Soil boundary.

9. Occurrence of saturated soil, groundwater, bedrock, or disturbed soil.

(d) A soil profile description to substantiate soil characteristics other than for application rates shall include the information specified in par. (c) 1. to 4. and 9.

(2) SOIL INTERPRETATIONS.

(a) Redoximorphic features or mottles shall be interpreted as zones of seasonal or periodic soil saturation or groundwater, except as provided under sub. (3).

(b) Unless otherwise determined under SPS 385.60, the highest elevation of seasonal soil saturation shall be the ground surface where redoximorphic features are present within 4 inches of any of the following:

1. An A horizon that extends to the ground surface.

2. The lower boundary of overlying fill material where no buried A horizon exists.

3. An A horizon buried by overlying fill material.

(3) SOIL COLOR PATTERN EXEMPTIONS.

(a) Without filing a report under SPS 385.60 (2), an authorized soil tester may discount the following conditions, not limited by enumeration, as indicators of seasonally saturated soil:

1. Fossilized soil color patterns formed by historic periodic soil saturation.

2. A soil profile where redoximorphic features are confined within 12 inches of tension saturated silt loam or finer textured soil immediately overlying unsaturated coarse sandy loam or coarser textured soil that has a depth in the coarser material adequate to accommodate a distribution cell and dispersal zone.

3. A soil profile where redoximorphic features are confined within 24 inches of tension saturated silt loam or finer textured soil immediately overlying unsaturated coarse loamy sand or coarser textured soil that has a depth in the coarser material adequate to accommodate a distribution cell and dispersal zone.

4. Residual sandstone colors.

5. Unevenly weathered glacially deposited material, glacially deposited material naturally gray in color, or concretionary material in various stages of decomposition.

6. Deposits of lime.

7. Light colored silt or fine sand coatings on soil ped surfaces.

(b) Without filing a report under SPS 385.60 (2) for a specific site, the Department may accept the results of soil saturation determinations or of the hydrograph procedure under SPS 385.60 previously conducted for areas adjacent to the site, provided that the

soil profile descriptions and interpretations confirms that the soil and site conditions are similar for the specific site and the adjacent areas.

(4) SOIL COLOR PATTERN REPORTS. The Authorized soil tester shall report and describe any soil color pattern exemptions encountered.

(5) DETERMINATION REQUESTS. An Authorized soil tester may request assistance by the Department staff in evaluating the significance of unusual soil color patterns as indicators of soil saturation that may not indicate saturated soil conditions. The Department may decline to provide such assistance, and defer to the use of soil saturation determinations pursuant to SPS 385.60 or some other method.

SPS 385.40 Evaluation reports.

(1) GENERAL. A soil evaluation report shall be prepared and submitted to the Department upon the completion of the evaluation and associated report form.

(2) SOIL REPORT CERTIFICATION AND FORMAT.

(a) ***Soil evaluation reports.*** Soil evaluation reports shall be prepared in a format specified by the Department and this chapter.

(b) ***Certification.***

1. Except as provided in subd. 2., each page of a soil evaluation report shall bear:

a. The signature of the authorized soil tester who collected the data;

b. The authorized soil tester's identification number; and

c. The date the report is signed.

2. When more than one sheet of a soil evaluation report is bound together into one volume, only the title sheet shall:

a. Be required to be signed, dated, and bear the identification number of the authorized soil tester who collected the data; and

b. Clearly identify all other sheets comprising the bound volume.

Note: Nothing in this chapter is intended to prohibit the submission and acceptance of planning documents in an electronic or digital media.

(3) REPORT CONTENTS.

(a) ***Site report.*** A site evaluation report shall include at least all of the following:

1. The site's legal description to within 40 acres.

2. The date the data was collected.

3. A legible and permanent site plan that complies with all of the following:

a. Is presented on paper no smaller than 8 ½ inches by 11 inches in size.

b. Is drawn to scale or fully dimensioned.

c. Shows the extent of the site evaluated for soil dispersal or treatment.

4. Location information for all points under investigation including structures, property lines and other encumbrances to the treatment or dispersal component placement on the site.

5. Pertinent elevation data, such as:

a. A reference to, and description of, a permanent vertical and horizontal reference point or benchmark from which all distances and elevations are delineated on the site plan;

b. The natural, undisturbed surface grade elevation for all soil profile excavations;

c. The percent and direction of land slope for the site under evaluation;

d. Ground surface contour lines at an interval appropriate for the conditions present;

e. The Floodplain elevation, if established, and current surface elevation of any adjacent navigable waters or reservoir; and

f. The existing grade adjacent to the groundwater elevation observation pipe, the top of the observation pipe, and the bottom of the observation pipe.

(b) ***Soil report.*** A soil evaluation report shall include at least all of the following:

1. A site evaluation report pursuant to par. (a).

2. The date soil evaluations were conducted.

3. The site's legal description to within 40 acres.

4. Soil profile descriptions pursuant to s. SPS 385.30 for all soil profile evaluation excavations.

SPS 385.50 Public Works Division review.

(1) GENERAL.

(a) The Department shall review all soil evaluation reports and site evaluation reports within 6 months of receipt.

(b) Upon completing the review of a soil evaluation report the Department shall accept the report, reject the report, request additional information or clarification, or require verification under sub. (2).

(c) When a report is deemed acceptable, the Department shall so indicate on the report and file the report for future reference.

(d) If the report is not acceptable, the Department shall notify the submitter in writing and shall state the deficiencies or actions, or both, necessary to bring the report into compliance with this chapter or Ch. SPS 383.

(2) VERIFICATION.

(a) ***Soil.***

1. The Department may require the applicant or the authorized soil tester to provide soil pits in accordance with SPS 385.20 (3) for verification of soil profile evaluation data.

2. The authorized soil tester who is responsible for the soil report shall be present at the site during the verification of soil profile evaluation data if so requested by the Department.

3. Soil verifications may not be conducted under adverse weather or light conditions that may lead to inaccurate results.

(b) ***Site.***

1. The Department may require the applicant or authorized individual who prepared the site report to provide assistance and equipment to verify site conditions.

2. The authorized individual who is responsible for the site report shall be present at the site during the verification of site conditions if so requested by the Department.

(c) ***Report.*** The Department shall complete a written report for each soil or site verification completed, and the results or findings of the report shall be filed with the soil and site evaluation report for future reference.

SPS 385.60 Soil saturation determinations.

(1) GENERAL.

(a) An Applicant, or the applicant's agent, may submit documentation to prove that redoximorphic features, or other soil color patterns, at a particular site are not indicative of periodically saturated soil conditions or high groundwater elevation.

(b) Documentation shall be in the form of an interpretive determination, soil saturation determination, hydrograph procedure or artificially controlled navigable water determination pursuant to this section.

(2) INTERPRETIVE DETERMINATIONS.

(a) A written report by an Authorized soil tester evaluating and interpreting redoximorphic soil features, or other soil color patterns, may be submitted to the Department in lieu of high groundwater determination data. The written report shall conclusively determine current conditions of periodic soil saturation and assess their effect upon the operation of a POWTS.

(b) The Department shall make a determination on the validity of the data, results and conclusions set forth in the report.

€ The written report shall include, but is not limited to, all of the following information:

1. A soil evaluation report pursuant to SPS 385.40.

2. An interpretive review of the site including, but not limited to, all of the following:

a. Local hydrology.

b. A historical interpretation of the local geomorphology.

c. Soil disturbance and hydraulic modification.

d. The landscape position and local topography in the area under investigation.

3. Soil series and mapping units, if available, for the immediate area, as listed in the USDA soil survey.

4. Data, if any, from previous soil saturation determinations in similar soil conditions and landscape position.

5. Any written reports, comments, or recommendations by the Department.

(3) SOIL SATURATION DETERMINATION.

(a) ***General.*** Actual elevations of soil saturation may be determined at specific sites in accordance with the soil saturation determination procedures in par. (c).

(c) ***Precipitation.***

1. Precipitation data reported for soil saturation determination purposes shall include monthly totals for September through May, and daily totals for February through May.

2. Precipitation data totals under subd. 1. shall be from either the closest local station to the site where the observation pipe is installed, or the average from the 3 closest local stations to the site. If averaging is used, the totals under subd. 1. shall be submitted for all 3 stations.

(d) ***Regional water tables.***

1. Where sites are subject to a broad, relatively uniform, regional water table, the fluctuation observed over a several year cycle shall be considered.

2. At such sites, and where free water levels are more than 5 feet below grade, determinations shall be made using the hydrograph procedures contained in sub. (4).

3. Areas affected by a regional water table shall be delineated by the Department in consultation with the affected counties and the Wisconsin Geological and Natural History Surve€**(e)** ***Fine textured soil.***

1. The Department may prohibit soil saturation determinations in fine textured soil with high matric potentials where determination results may be inconclusive.

2. In such cases, the Department may approve alternative methods to address the direct determination of saturated or near saturated soil conditions not enumerated in this section.

(f) ***Groundwater elevation observation pipe installation and construction.***

1. Number of observation pipes.

a. At least 3 groundwater elevation observation pipes shall be installed to delineate the area under investigation.

b. The Department may require more than 3 observation pipes to adequately evaluate potential soil saturation conditions.

2. Observation pipe depth.

a. At the request of the Department , at least one observation pipe shall be constructed to a depth of 15 feet below the ground surface to determine if high groundwater elevation conditions are due to a perched water table and the possible extent of the saturated zone.

b. Other observation pipes shall terminate at specific depths below grade that will serve to evaluate where shallow perched zones of soil saturation occur within the soil profile.

c. The Department may designate specific observation pipe depths and locations based on soil and site conditions, or experience in a particular geographic area or topographic position.

d. An observation pipe may not be less than 24 inches deep.

3. Observation pipe construction. The direct observation of soil saturation conditions shall be accomplished by means of observation pipes conforming to this subdivision and Figure 385.60-1.

a. The observation pipe shall be of a material meeting the standards in SPS 384.30 Table 384.30-1, except that lead pipe may not be used.

b. The inside diameter of an observation pipe may not be less than 2 inches or more than 4 inches nominal size.

c. The borehole diameter shall be 2 to 4 inches larger than the outside diameter of the observation pipe.

d. The top of the observation pipe shall terminate at least 18 inches above grade and be provided with a vented cap.

e. The bottom of the observation pipe shall terminate with a slotted, or screened pipe. The slots or screen shall extend 6 to 18 inches above the bottom of the pipe and be at least 4 inches below the filter pack seal. The slots or screen shall not be hand cut and shall be designed to retain soil particles with a diameter of greater than 0.02 inch.

f. Except for the vented end cap, joints between lengths of pipe and fittings shall conform to SPS 384.40.

g. Finished grade around the observation pipe shall be sloped away from the observation pipe using soil material.

h. At a minimum, the upper 12 inches of annular space surrounding the observation pipe shall be sealed by puddled clay, bentonite, or an equal-parts

mixture of soil, bentonite, and cement. A surface seal may not be necessary if the entire soil profile is sand.

i. The annular space seal below 12 inches and to the top of the filter pack seal may be of unspecified soil material.

j. A filter pack seal shall be installed above the filter pack to prevent soil migration downward into the filter pack.

k. The observation pipe shall be set on at least 2 inches of pea gravel that extends 4 to 6 inches above the top of the screen or highest slot. The gravel filter pack is not necessary if the natural soil is coarse sand or coarser.

Figure 385.60-1

- See PDF for diagram

(g) ***Observations.***

1. Observation period. The observation period for soil saturation determinations shall begin on or before the appropriate date specified in Figure 385.60-2, and end June 1.

2. Alternate observation period. The Department may approve an alternate observation period if the data presented conclusively demonstrates equivalency to conditions encountered during a normal spring observation period.

3. Minimum frequency. Observations shall be made on the first day of the observation period and at least every 7 days thereafter until the observation period is complete.

(h) ***Conclusions.***

1. The highest level of soil saturation shall be considered the highest level of free water observed in an observation pipe on 2 occasions 7 days apart during the observation period.

2. The results of soil saturation determinations under this section shall be considered inconclusive if the precipitation totals under par. (c) do not equal or exceed:

a. 8.5 inches from September 1 through the last day of February; and

b. 7.6 inches from March 1 through May 31.

- See PDF for diagram

Figure 385.60-2

Latest Date to Begin Spring Soil Saturation Monitoring - See PDF for table

(i) ***Reporting data.***

1. Within 180 days of the completion of the observations, 3 copies of the following data shall be submitted to the Department for review:

a. A soil and site evaluation report pursuant to SPS 385.40.

b. Observation pipe installation, depth, location, and elevation information.

c. Precipitation data and name of any local station used.

d. Observation dates.

e. Current and any prior observation results.

f. Any Tribal observations or reports pertaining to the soil saturation determination observations, observation pipe construction or soil/site conditions.

2. Within 180 days of the completion of the observations, one copy of the data specified in subd. 1. shall be filed with the Department having jurisdiction.

(j) ***Report forms.*** Soil saturation determination results shall be reported on forms specified by the Department.

(k) ***Failure to report.*** Failure to file soil saturation determination results with the Department within 60 days may disqualify the site from future soil saturation or interpretive determinations.

(4) HYDROGRAPH PROCEDURE.

(a)

1. Except as provided in subd. 3., where regional water table fluctuations are considered in deep sandy soil, the predicted high groundwater elevation shall be established using hydrograph documentation.

2. Except as provided in subd. 3., the highest groundwater elevation shall be determined by direct observation during the soil profile evaluation or by one of the hydrograph methods outlined in pars. (b) to (d), whichever is highest.

3. The Department may accept use of the hydrograph procedure to predict regional water table levels on sites where inclusions of sandy loam or finer soil material, or massive conditions exist.

(b)

1. If there is less than 5 feet to free water below original grade, the procedures detailed in sub. (2) or (3) shall be used to determine the highest predicted groundwater elevation at the site.

2. If there is 5 feet or more to free water below original grade, the hydrograph procedure may be used to determine the highest predicted groundwater elevation at the site.

(c) When free water at the site is 5 to 10 feet below grade, all of the following procedures apply:

1. A completed soil and site evaluation report pursuant to SPS 385.40 that confirms the elevation of free water, if observed, shall be prepared.

2.

a. A slotted or screened groundwater elevation observation pipe shall be installed at the proposed system location to a depth of at least 12 inches below the free water elevation.

b. The observation pipe shall be installed pursuant to sub. (3) (f) 3.

3.

a. The water level in the observation pipe shall be recorded after completion of the observation pipe installation and 7 days later.

b. The highest of the 2 water levels shall be used to complete the hydrograph procedure.

4. The permanent USGS groundwater elevation well or wells as assigned by the Department shall be read within 24 hours of establishing the actual free water elevation at the site.

5. The hydrograph procedure shall be completed and the results shall be submitted for review to the Department.

(d) When free water at the site is more than 10 feet below grade, all of the following procedures apply:

1. A completed soil and site evaluation report pursuant to SPS 385.40 that confirms the elevation of free water, if observed, shall be prepared.

2. The permanent USGS groundwater elevation well or wells assigned to the project by the Department shall be read within 24 hours of the actual free water determination at the site.

3. The hydrograph procedure shall be completed and the results shall be submitted for review to the Department.

(e) The Department may request more than one USGS groundwater well or other wells assigned by the Department be used to complete the hydrograph procedure.

(f) The Department may reject or suspend use of the hydrograph procedure when erratic groundwater tables are present due to recent, significant recharge events.

(6) SOIL SATURATION OBSERVATION PIPE REMOVAL. The following requirements shall apply to all groundwater elevation observation pipes installed pursuant to this section:

(a) ***Removal timeline.*** Unless specifically Approved by the Department, all groundwater elevation observation pipes shall be removed within 60 days after the completion of soil saturation determination.

(b) ***Contamination conduit.*** Any groundwater elevation observation pipe found by the Department to be acting as a conduit for groundwater contamination shall be ordered removed immediately.

(7) VERIFICATION.

(a) ***Verification.***

1. The Department may request verification of soil saturation determinations pursuant to SPS 385.50 (2), and proper observation pipe installation pursuant to this section.

2. The Department may require any groundwater elevation observation pipe deemed by the Department to be in poor contact with the surrounding soil to be reinstalled pursuant to this section.

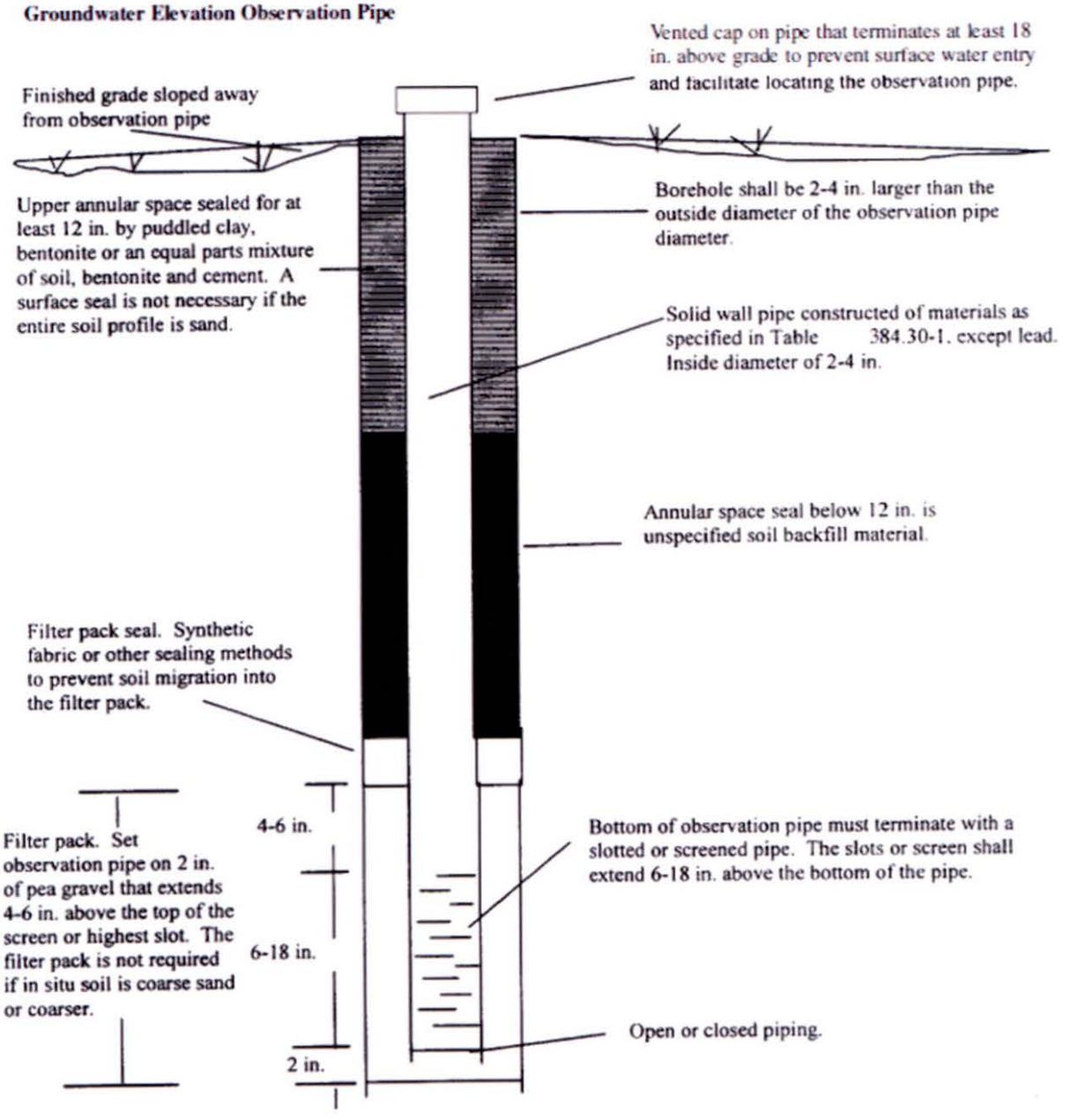
(b) ***On-site visits.***

1. The Department may visit sites during soil saturation determination periods or at other reasonable times to determine the accuracy of data.

SPS 385.60(7)(b)2.

2. A written record of on-site visits in subd. 1. shall be maintained by the Department conducting the visits.

Groundwater Elevation Observation Pipe



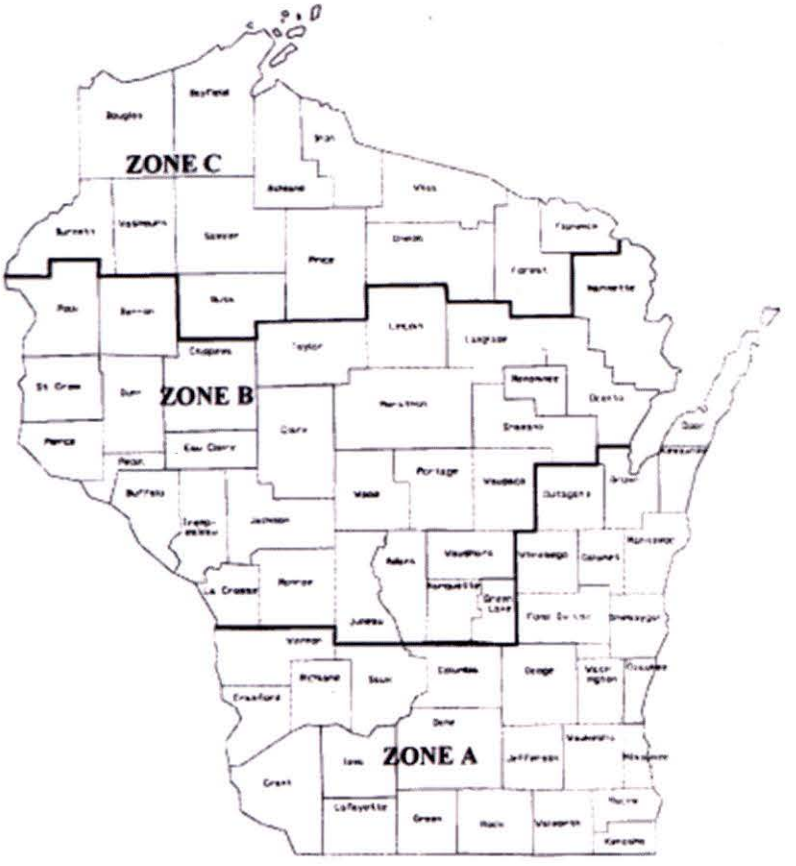


Figure 385.60–2
Latest Date to Begin Spring Soil Saturation Monitoring

Zone A	February 15
Zone B	March 1
Zone C	March 15

Chapter SPS 371
SOLAR ENERGY SYSTEMS

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Subchapter I — Administration

SPS 371.01 Purpose. The purpose of this chapter is to:

(1) Establish standards for Solar Energy Systems which do not impede the development of innovative systems but which do:

(a) Promote accurate Tribal consumer evaluation of Solar Energy Systems;

(b) Conform, where feasible, with national performance standards promulgated or recognized by the federal government for Solar Energy Systems; and

(c) Promote the production, marketing, and installation of Solar Energy Systems.

(3) Establish quality standards for, but not limited to:

(a) The minimum requirements of a warranty;

(b) The minimum requirements of an operation and maintenance manual; and

(c) Minimum specifications for materials, workmanship, durability, and efficiency.

(4) Provide for the inspection of any Solar Energy System at the request of any buyer.

SPS 371.02 Scope. The seller must obtain a Wisconsin state Seal of Quality for all Solar Energy Systems and components.

Subchapter II — Consumer Evaluation

SPS 371.05 Pre-sale information.

(1) PRE-SALE FORM. Prior to the sale of any Solar Energy System with a value of more than $300, the seller shall furnish to the prospective buyer a completed copy of the “Solar Energy System Pre-Sale Information" form. The “Solar Energy System Pre-Sale Information" form is available from the state of Wisconsin at the Department's Web site at www.dsps.wi.gov through links to Division of Industry Services forms.

(2) SELLER'S RESPONSIBILITY. The seller shall:

(a) Complete each item on the pre-sale information form;

(b) Sign and date the pre-sale information form and provide one completed copy to the prospective buyer; and

(c) Present, written and orally, the information required on the pre-sale information form with the prospective buyer present.

SPS 371.06 Solar inspections. The Department may, at the request of any buyer, inspect a Solar Energy System that has been sold and declared to meet the quality standards specified in this chapter.

SPS 371.07 Seal of Quality. Any Solar Energy System or component installed on Tribal Lands shall bear a Seal of Quality issued by the State of Wisconsin. The manufacturer or retailer of the Solar Energy System or component shall be responsible for obtaining a Seal of Quality which meets or exceeds the quality standards established in this chapter.

Note: All panels and other electrical components must be Underwriters Laboratories, Inc. (UL) approved.

Subchapter III — Definitions

SPS 371.10 Definitions. In this chapter, the following definitions shall apply.

(1) "Absorber" means that part of a solar Collector whose primary function is to absorb radiant energy and transfer it to a Fluid. In Photovoltaic Solar Energy Systems, the function is to generate electrical energy.

(2) "Active Solar Energy System" means any mechanical system which collects solar radiation in the form of thermal energy and uses a heat transfer Fluid to transport the thermal energy to meet load requirements or to Thermal Storage.

(3) "Air System" means an Active Solar Energy System that uses air as the heat transfer Fluid.

(4) "Approved" means acceptable to the Department.

(5) "Auxiliary Energy System" means equipment using non-solar energy sources to supplement or backup the output provided by a Solar Energy System.

(6) "Building" means a structure for support, shelter or enclosure of persons or property, other than a one- or two-family Dwelling.

(7) "Closed Loop System" means an Active Solar Energy System in which a closed piping system, containing a fixed charge of heat transfer Fluid, transfers heat from Collectors to storage or use.

(8) "Collector" means a device designed to absorb incident solar radiation and to transfer the energy to a Fluid passing through it.

(9) "Collector Cover" means the material covering the aperture to provide thermal and environmental protection.

(10) "Component" means a distinct device or assembly that forms a functional part of a Solar Energy System including, but not limited to, Collectors, Thermal Storage, Heat Exchangers, controls, pumps, fans, dampers, and valves. Unless otherwise specified, such as a Building Component, a component shall have the above definition.

(12) "Design Pressure" means the maximum allowable continuous or intermittent pressure for which a specific part of a Solar Energy System is designed to operate safely and reliably.

(13) "Design Temperature" means the maximum allowable continuous or intermittent temperature for which a specific part of a Solar Energy System is designed to operate safely and reliably.

(14) "Drain Back System" means a Closed Loop System which allows gravity draining of the heat transfer Fluid into lower portions of the solar loop under prescribed circumstances.

(15) "Drain Down System" means an Active Solar Energy System in which the Fluid in the solar Collector is drained from the Solar Energy System under prescribed circumstances.

(16) "Dwelling" means any Building which contains one or 2 Dwelling Units.

(17) "Flammable Liquid" means a liquid having a flash point below 100ºF and having a vapor pressure not exceeding 40 psia at 100ºF.

(18) "Fluid" means a liquid or gas.

(19) "Heat Exchanger" means a device designed to transfer heat between two physically separated Fluids.

(20) "Heat Transfer Fluid" means the medium used to transfer energy from the solar Collectors to the Thermal Storage or load.

(21) "Heated Space" means any space maintained at a temperature of at least 50ºF.

(22) "Hot Water" means water heated for domestic use.

(23) "Liquid System" means an Active Solar Energy System that uses liquid as the heat transfer Fluid.

(24) "Maximum Operating Pressure" means the maximum pressure experienced in a system, under any normal operating conditions including no-flow.

(25) "Maximum Operating Temperature" means the maximum temperature experienced in a system, under any normal operating conditions including no-flow.

(26) "No-Flow Condition" means the condition that results when the heat transfer Fluid does not flow through the Collector array due to normal shut-down or malfunction.

(27) "Open Loop System" means an Active Solar Energy System in which water for domestic or industrial use is directly heated in Collectors.

(28) "Outgassing" means the emission of gases by component materials usually during exposure to elevated temperatures or reduced pressures.

(29) "Owner" means any person having a legal or equitable interest in the Solar Energy System.

(30) "Photovoltaic" means a Solar Energy System that converts radiant solar energy directly into electrical energy.

(31) "Potable Water" means water which is:

(a) Safe for drinking, personal or culinary use; and

(b) Free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming in its bacteriological and chemical quality to the requirements specified in Ch. NR 809.

(32) "Primary Solar Duct System" means the duct system between the Collectors and Thermal Storage and the ducts making connection to the space distribution system.

(33) "Seal of Quality" means a written approval by the State of Wisconsin documenting certification and compliance with specific quality standards.

(34) "Solar Energy System" means equipment which directly converts and then transfers or stores solar energy into usable forms of thermal or electrical energy.

(35) "System Designer" means a person who offers for sale a Solar Energy System as a complete package, the components of which may be produced by different manufacturers.

(36) "Thermal Resistance (R)" means a measure of the ability to retard the flow of heat.

Note: The R-value is the reciprocal of the heat transfer coefficient, expressed by U (R = 1/U). The higher the R-value of a material, the more difficult it is for heat to flow through the material.

(37) "Thermal Storage" means a container and its contents used for storing thermal energy.

(38) "Tilt Angle" means the angle above horizontal of a plane surface.

(39) "Toxic Fluids" means Fluids which are poisonous or irritating in nature or composition.

Subchapter IV — Materials and Workmanship

SPS 371.20 Purpose. This subchapter establishes quality standards for materials and workmanship for Solar Energy Systems and components. Sections SPS 371.21 to 371.26 shall

apply to Active Solar Energy Systems and components. Section SPS 371.30 shall apply to Photovoltaic Solar Energy Systems and components.

SPS 371.21 General installation requirements.

(1) ACCESS, LOCATION AND CLEARANCES.

(a) ***Access.*** Components shall be accessible for required routine maintenance without trespassing on adjoining property or disassembling any major portion of the Solar Energy System, Building, or Dwelling.

(b) ***Location.***

1. Components within 10 feet horizontally of a chimney or vent shall be at least 2 feet below the top of the chimney or vent.

2. The location of components may not interfere with the operation of required doors, windows, or other Building Components.

(c) ***Clearances.***

1. Combustible materials may not be exposed to components having Maximum Operating Temperatures that can cause ignition. Clearances to combustible materials specified in the component listing or by the component manufacturer shall be maintained.

2. Clearance between combustible materials and unlisted components shall be maintained in accordance with Table 371.21-A.

Table 371.21-A
Clearance Between Combustible Materials and Unlisted Components - See PDF for table

If Approved insulation protects the component, the required clearance may be reduced by 50%.

(2) MATERIAL TESTS AND STANDARDS. The installation of, as well as all materials used in the construction of, Solar Energy Systems shall meet the applicable requirements specified in chs. SPS 320 to 325, 381 to 385, and this chapter. Where different chapters specify different requirements, the most restrictive material test and installation standard shall apply.

(3) INSULATION.

(a) ***General.*** Insulation of piping, ducts and Thermal Storage containers shall be of a type satisfactory for its intended purpose and installed in accordance with recognized standards and practices.

1. `Flame spread rating.' The flame spread rating for all insulation materials may not exceed the following values:
Plastic foam: 75
Other insulation materials: 150

2. `Compressive loads.' Insulation shall be protected against compressive loads from pipe and duct supports and storage tanks.

3. `Exterior insulation.' Exterior insulation shall be capable of withstanding moisture, ultraviolet radiation, and environmental exposure.

(b) ***Piping.*** Pipes of nominal size of one and one-half inch or larger shall be insulated to a Thermal Resistance value of R-4 or greater. All other piping in the Solar Energy System

shall be insulated to a Thermal Resistance value of R-3 or greater. A vapor barrier, if installed, shall be located on the warm side of the insulation.

(c) ***Ducts.*** Ductwork located in un-Heated Spaces shall be insulated to a Thermal Resistance value of R-11 or greater, where space permits. Ductwork in Heated Spaces shall be insulated to a Thermal Resistance value of R-3 or greater. A vapor barrier, if installed, shall be located on the warm side of the insulation.

(d) ***Thermal Storage.***

1. `Thermal Storage - Liquid Systems.' Thermal Storage for Liquid Systems located in unheated spaces shall be insulated to an overall Thermal Resistance value of R-16 or greater. Thermal Storage for Liquid Systems installed in Heated Spaces shall be insulated to an overall Thermal Resistance value of R-11 or greater.

2. `Thermal Storage - Air Systems.' Thermal Storage for Air Systems located in unheated spaces shall be insulated to an overall Thermal Resistance value of R-38 or greater. Thermal Storage for Air Systems installed in Heated Spaces shall be insulated to an overall Thermal Resistance value of R-11 or greater.

(4) PROTECTION.

(a) ***Protection against vermin.*** All penetrations of the Building or Dwelling by components shall be properly sealed with noncombustible material to prevent the entrance of vermin.

(b) ***Protection against vehicular or pedestrian traffic.*** Components exposed to vehicular or pedestrian traffic shall be protected against impact damage.

(c) ***Protection against water penetration.*** All penetrations by components into a Building or Dwelling from the outside shall be properly sealed and waterproofed with Approved materials to prevent leaks, insects, and drafts from entering the Building or Dwelling. All penetrations shall be made using weatherproof devices which will allow for expansions and contractions.

(d) ***Protection against decay and termites.*** Wood used in the construction of the Collector or mounting and exposed to outdoor conditions shall be pressure-treated with preservative or shall be a naturally durable, decay resistant species of lumber and shall be protected against termites.

(f) ***Protection from heated components.*** Components which are maintained at temperatures above 170° F shall be protected from human contact. The protections may be in the form of insulation, metal, or plastic guards.

(5) SMOKE DETECTORS. All Dwellings that contain Air Systems with wood-frame Collectors shall be provided with smoke detectors as specified in SPS 321.09.

(6) FIRE PROTECTION. The design and installation of the Solar Energy System and components shall provide a level of fire safety consistent with chs. SPS 320 to 325 for one- and two-family Dwellings.

(a) ***Vents, pipes, and ducts.***

2. `Existing Dwellings.' Existing Dwellings shall be provided with draft stopping at openings around vents, pipes and ducts installed for the operation of the Solar Energy System. Draft stopping materials may not be less than 1/2 -inch gypsum board, 3/8 -inch plywood, mineral-based insulation, or other Approved materials.

(b) ***Collectors.*** A Collector intended for installation integral with or forming a part of the Dwelling roof structure and its associated roof covering material, may not reduce or impair the fire resistance of the designated roof covering material.

(7) LOADS. The structural design of the Solar Energy System, including connections and supporting structural elements, shall be based on loads anticipated during the design life of the Solar Energy System. Roof loading due to the following loading effects shall be included in the design of all structural elements influenced by these loads:

(a) ***Dead loads.***

1. `Collector.' The Collector and supporting structure, including Building Components, shall be designed, and constructed to support the weight of the Collector, other components, and heat transfer Fluids.

2. `Thermal Storage.' The Thermal Storage and supporting structure shall be designed and constructed to support the weight of the storage container, components, heat transfer Fluids and storage medium.

(b) ***Live loads.***

1. `Use.' Surfaces that must support maintenance personnel shall resist a load of 250 pounds distributed over a 4-inch square area.

2. `Wind, snow and seismic.' The Collector, including any mounting hardware and Building Components, shall be designed and constructed to resist the wind and snow loads specified in chs. SPS 320 to 325 for one- and two-family Dwellings.

- See PDF for diagram

SPS 371.22 General mechanical requirements.

(1) INTERCONNECTIONS. When a Solar Energy System and an Auxiliary Energy System are interconnected, the Design Temperature or Design Pressure of either system may not be exceeded. The interconnection may not compromise or bypass any required safety devices on either system. Auxiliary equipment shall be compatible with the Solar Energy System output, including but not limited to, temperatures, pressures, and heat transfer Fluid type.

(2) IDENTIFICATION OF MATERIALS. Components and materials used in Solar Energy Systems shall be permanently marked or labeled by the manufacturer as to the component's limitations. All listed components shall have the seal of the listing agency permanently affixed to the component.

(3) RELIEF VALVES.

(a) ***Pressure relief.***

1. All components of the Solar Energy System having valves capable of isolating heat generating or heat transfer components shall be provided with an Approved, adequately sized pressure relief valve. The installation of the relief valve discharge shall be in accordance with SPS 382.40 (5).

2. The pressure relief valve shall be set at a pressure not to exceed the Design Pressure of the Solar Energy System or component or 150 psig, whichever is lesser. The relief valve settings may not exceed the recommendations of the valve manufacturer.

(b) ***Vacuum relief.*** Vacuum relief valves shall be installed as required in SPS 382.40 (5).

(c) ***Temperature relief.***

1. Temperature relief valves shall be of adequate relief rating expressed in Btu/hr for the components served.

2. Temperature relief valves shall be installed in Thermal Storage so that the temperature sensing element is immersed within the top 6 inches of a storage tank that contains liquid. The temperature relief valve shall be set to open at 210° F or less.

(d) ***Combination pressure-temperature relief valves.*** Combination pressure-temperature relief valves shall comply with all the requirements of the separate pressure and temperature relief valves.

(e) ***Entrapped air.*** Except for Drain Back Systems, the Solar Energy System shall provide means for removing air at the highest point of the system when liquid heat transfer Fluids are used.

(4) HEAT EXCHANGERS.

(a) Except as provided in par. (b), wherever Potable Water is interfaced with toxic heat transfer Fluids, a double wall Heat Exchanger, with positive leak detection vented to the atmosphere, shall be provided. The vent shall be located at the lowest part of the Heat Exchanger or as Approved by the Department.

(b) Where air is the heat transfer Fluid, a single wall Heat Exchanger may be used. Where Potable Water is the heat transfer Fluid, direct connection to the Potable Water system is allowed or a single wall Heat Exchanger may be used.

(5) HEAT TRANSFER FLUIDS.

(a) Solar Energy Systems using liquid heat transfer Fluids shall have a label attached to the Thermal Storage indicating the heat transfer Fluid's name, freezing point and pH, and the System Designer's recommendations for checking and maintaining the heat transfer Fluid.

(b) The heat transfer Fluid contained in a non-drain down or non-Drain Back System shall be able to withstand temperatures of at least -35ºF before freezing.

(c) Only heat transfer Fluids recommended by the System Designer for use in the Solar Energy System shall be used. Ethylene glycol may not be used for Solar Energy Systems in one- and two-family Dwellings.

(d) Flammable Liquids may not be used as heat transfer Fluids.

(e) The heat transfer Fluid shall be capable of withstanding Design Temperatures without rapid thermal degradation.

(f) The flash point of the heat transfer Fluid shall exceed, by 50ºF, the Maximum Operating Temperature of the Solar Energy System.

(g) Drains and other designated heat transfer Fluid discharge or fill points in Solar Energy Systems at which toxic, combustible, or high temperature heat transfer Fluids may be discharged shall be labeled with a warning describing the identification and hazardous properties of the Fluid, instructions concerning the safe handling of the Fluid, and emergency first aid procedures.

(6) CONTROLS.

(a) Controls, dampers, and valves shall be marked to identify their function. Any control that serves as an emergency shutdown device shall be so identified by a conspicuous and permanent label.

(b) Automatic control of the heat transfer Fluid circulation between the Collector and Thermal Storage or load shall be used to limit operations to conditions when useful energy can be collected.

(c) Fail-safe controls shall be designed so that in the event of a power failure, or a failure of any component in the Solar Energy System, the temperature or pressure or both developed in the Solar Energy System, will not damage the component or the Building or present a danger to the occupants.

(d) Controls shall be selected and installed so that the Solar Energy System and Auxiliary Energy System will operate together and independently.

(e) Space heating and control thermostats shall be installed in accordance with the manufacturer's or System Designer's instructions. Space heating thermostats shall be located away from drafts, heat sources and exterior walls. Mercury bulb thermostats shall be leveled to assure satisfactory operation. Thermostats mounted outdoors shall be suitable for outdoor environmental exposure.

(f) Controls shall be installed to prevent component damage from thermal shock.

(g) Controls shall include provisions for manual bypass, adjustment or override of automatic controls as is required to facilitate installation, startup, shutdown, and maintenance.

(7) CORROSION.

(a) All materials used in the Solar Energy System shall be compatible. All components in contact with the heat transfer Fluid used in the Solar Energy System shall be compatible with the heat transfer Fluid.

(b) All metal parts, including screws, bolts, and washers, which are not inherently corrosion resistant and are exposed to atmospheric conditions, shall be protected from corrosion by painting, plating, or similar means.

(c) Metallic parts which provide protection to either electrical components or internal Building structures shall be galvanically compatible and protected from corrosion.

SPS 371.23 Collectors.

(1) COLLECTOR CERTIFICATION REQUIREMENTS. All Collectors shall be certified by the Solar Rating and Certification Corporation (SRCC), the Air Conditioning and Refrigeration Institute (ARI) or equivalent. This provision does not apply to home-built systems, custom-built systems, and small manufacturers. As used in this subsection:

(a) "Home-built system" means an Owner-installed Solar Energy System incorporating a Collector assembled by the system Owner from components, but does not include manufactured Collectors supplied as an integral unit and installed by the Owner.

(b) "Custom-built system" means a one-of-a-kind Solar Energy System incorporating a Collector fabricated at the installation site from components but does not include modular systems in which the modular components are assembled at the installation site.

(c) "Small manufacturer" means a business that builds or assembles less than 2500 square feet of Collector per year and elects not to list with SRCC or ARI.

Note: Certification of Collectors by the SRCC and the ARI is based on the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards 93-77 and 95-1981.

(2) COLLECTOR TILT AND ORIENTATION. Collectors shall be installed as close to the optimum Tilt Angle as conditions allow.

(3) COLLECTOR DESIGN AND CONSTRUCTION.

(a) ***Transmission losses due to Outgassing.*** Outgassing of volatiles from components may not reduce the Collector performance below the declared Collector performance when the Collector is exposed to the temperatures and pressures that will occur in actual service.

(b) ***Dirt retention.*** The cover plate under normal weather conditions may not, with normal maintenance, collect or retain excessive dirt.

(c) ***Glass.*** Glass used in Collector construction shall be tempered.

(d) ***Glazings.*** Glazings subject to human impact and within 7 feet of ground level shall be safety glazing material constructed, treated, or combined with other materials so as to minimize the likelihood of cutting and piercing injuries resulting from human impact with the glazing material.

(e) ***Plastic.*** Plastic used in Collector construction shall be capable of withstanding the Maximum Operating Pressure and temperature and shall be used in accordance with manufacturer's recommendations.

(f) ***No-flow.*** The Collector shall be capable of withstanding No-Flow Conditions.

(g) ***Leakage.*** The construction of the Collector shall provide protection against:

1. External leakage of the heat transfer Fluid from the Collector;

2. Internal leakage into the Collector from environmental conditions; and

3. Internal leakage of the heat transfer Fluid from the Collector from cleaning operations as performed during routine maintenance as specified in the operation and maintenance manual.

(h) ***Corrosion.***

1. All materials used in the Absorber or heat transfer Fluid conduits may not be pitted, corroded, or otherwise degraded by the heat transfer Fluid to an extent that will result in failure during its design life.

2. In Closed Loop Systems, aluminum may not be connected with copper or iron. Separation of different pipe materials by isolating bushings is not acceptable.

(i) ***Ultraviolet stability.*** All materials used in the Collector may not degrade when exposed to ultraviolet radiation to an extent that will reduce the Collector performance below the declared Collector performance.

(j) ***Insulation.*** Collector insulation shall be capable of withstanding moisture, ultraviolet radiation, and environmental exposure.

(4) COLLECTOR MOUNTING AND INSTALLATION.

(a) ***Mounting.***

1. `Mounting on roofs.' Load design requirements shall be in accordance with SPS 371.21 (7).

2. `Mounting on the ground.' When Collectors are located on concrete slabs, the slab shall be a minimum of 4 inches thick. Collectors shall be located a minimum of 6 inches above the ground surface. Collectors installed on the ground shall be adequately supported and anchored.

3. `Collector stresses.' Structural supports may not impose undue stresses on the Collector.

4. `Wood.' All wood components used in Collector mounting which are exposed to the environment shall be resistant to decay in accordance with SPS 371.21 (4) (d). Wood used in Collector frames or housings shall be protected against structural degradation due to high temperature exposure.

5. `Metal.' All metal parts shall be protected from environmental conditions in accordance with SPS 371.22 (7) (b) and (c).

6. `Tilt and orientation.' Structural supports shall be constructed to maintain Collector tilt and orientation within design conditions throughout the life of the Solar Energy System.

(b) ***Installation.***

1. `Instructions.' Collectors shall be installed in accordance with the instructions provided by the System Designer.

2. `Fire protection.' Collectors made of combustible materials may not be located on or adjacent to construction required to be of noncombustible materials. Collector installation shall also comply with SPS 371.21 (6).

3. `Safety.' Safe access to components subject to deterioration or failure, such as rubber hoses, joint sealants, and cover plates, shall be provided to allow for maintenance or repair. For roof-mounted Collectors, the workspace adjacent to Collectors and provisions for safe placement of ladders shall be considered.

4. `Moisture protection.' Collector installation may not contribute to moisture buildup, rotting, or other accelerated deterioration of roofing materials. Collectors and structural supports shall be installed in a manner such that water flowing off the Collector surface and structural supports will not accelerate formation of ice dams or cause water damage to the Building or Dwelling. Provisions shall be taken to minimize buildup of snow upon Collectors, which may reduce their effectiveness.

5. `Caulking and sealing.' Joints between structural supports and Buildings or Dwellings shall be caulked and flashed to prevent water leakage. Bolts or other means of fastening the Collector or structural supports to the roof shall be sealed from water penetration.

6. `Filling and draining.' Interconnecting piping or ducting shall be installed to minimize flow restrictions and to provide balanced flow. Piping shall be installed to allow for filling and draining.

SPS 371.24 Air Systems. This section shall apply to Active Solar Energy Systems and components that use air as a heat transfer Fluid.

(1) AIR DISTRIBUTION.

(a) ***Size.*** Air distribution components shall be adequately sized to insure a uniform distribution of air.

(b) ***Dust and dirt prevention.***

1. `Flow efficiency and health hazard.' Duct and fan systems shall be protected against accumulation of deposits of dust or dirt that could reduce flow and efficiency or create a potential health hazard when admitted into occupied spaces.

2. `Air filters'. Air filters shall be installed on the outlet side of the Thermal Storage in Solar Energy Systems. Air filters shall be removable to allow cleaning. Solar Energy Systems used for space heating shall incorporate the use of a high efficiency air filter installed in the cold air riser duct to the Collectors unless the air does not pass over the Absorber.

(c) ***Insulation.*** The Primary Solar Duct System shall be insulated as specified in SPS 371.21 (3).

(d) ***Ductwork.***

1. `Interior ducts'. Interior ducts shall comply with chs. SPS 320 to 325 for one- and two-family Dwellings.

2. `Exterior ducts'. Ducts located outside the Dwelling or Building shall be constructed of galvanized steel or corrosion-resistant metal.

(e) ***Temperature, pressure, and exposure.*** Ducts, insulation, gaskets, sealants, and adhesives shall be capable of withstanding Maximum Operating Temperatures, pressures, and environmental exposure.

(f) ***Bypass.*** Solar Energy Systems providing both space heating and domestic water heating shall be equipped with a bypass of the Thermal Storage during the non-heating season.

(2) SEALING OF AIR SYSTEMS.

(a) ***Duct system.*** The Primary Solar Duct System shall be sealed in accordance with the following requirements:

1. All joints in metal ducts shall be made with good fit-up and closure.

2. Joints and seams shall be sealed with adhesives, mastics or compatible combinations of tape binders and adhesives in ducts conveying air to and from storage units and solar Collectors and in ducts conveying air from such circuits to points of connections with ducts circulating air to and from the occupied space.

3. Tapes shall be used in accordance with manufacturer's recommendations.

4. Oil-base caulking and glazing compounds may not be used.

5. Stapled closures of duct connections and stapled fitting assemblies shall be sealed.

Note: The purpose of these requirements is to reduce the duct loss to 10% or less. It is not the intent to require testing of the installed system to determine duct leakage, but to assure construction standards which will essentially provide the required degree of airtightness in the Primary Solar Duct System. Construction which will provide equivalent airtightness will be allowed in lieu of the sealing requirements.

(b) ***Thermal Storage.*** Thermal Storage shall be constructed and sealed or otherwise fabricated to limit air leakage. Sealing shall include joints in Thermal Storage, duct, and access openings.

Note: This is not intended to apply to Thermal Storage which is thermally coupled to Heated Spaces. Concrete should be considered potentially porous and may require lining and sealing to limit air leakage. Problems associated with shrinking, warping and cracking should be considered for Thermal Storage constructed of wood.

(c) ***Collectors and components.*** Collectors and other components, such as air handling units, Heat Exchangers and filters, shall be assembled and sealed in accordance with manufacturer's and System Designer's instructions. Sealing shall include all joints between components and ducts. Equivalent airtightness shall be provided for site-built Collectors.

(3) FREEZE PROTECTION.

(a) ***Cold airflow prevention.*** The Solar Energy System shall be designed and installed to prevent cold airflow across the water heater coil. If mechanical dampers are used to meet this requirement, they shall not allow leakage of more than 5% of the Solar Energy System design airflow rate at one-inch water column.

(b) ***Secondary freeze protection.*** Solar Energy Systems using electrical or mechanical devices for freeze protection, shall incorporate a secondary freeze protection system in case of mechanical failure. An electrical freeze sensor which activates the pump to circulate Fluid through the water heater coil may be used to meet this requirement.

(c) ***Nonautomatic freeze protection.*** Any nonautomatic freeze protection shall be noted as such in the operation and maintenance manual.

(4) THERMAL STORAGE.

(a) ***Air quality.*** Heat transfer Fluid, heat storage media and Thermal Storage materials, including any interior protective coating, may not impart toxic elements or offensive odors to air distributed to areas of human occupancy.

(b) ***Insulation.*** Thermal Storage shall be insulated in accordance with SPS 371.21 (3).

(c) ***Loads and environmental conditions***. Loads shall meet the requirements of SPS 371.21 (7). Thermal Storage located outside or underground shall be waterproof.

(d) ***Rock storage***. When rock is utilized for Thermal Storage, the rock shall be cleaned and dried before it is placed into the storage area. The Thermal Storage shall be provided with an inlet and an outlet plenum.

(e) ***Phase change.*** If phase change storage materials are used, they shall be placed in sealed containers.

(5) DAMPERS.

(a) Volume control dampers shall be installed in each branch or zone duct. Single leaf dampers which are a part of a manufactured air grille may not be used.

(b) Opposed blade dampers which are a part of a manufactured air grille shall be acceptable if sufficient space is provided behind the grille face for proper operation of the damper. Where space prohibits the use of an opposed blade damper behind the grille face, an opposed blade damper may be installed in the register stack at a location where it is accessible from the grille opening.

(c) Volume control dampers shall be of a type and size that will satisfy the design conditions of the duct system.

(d) Backdraft dampers or motorized dampers shall be installed so as to prevent air passage through the Collectors when solar energy is not being collected.

(e) Dampers installed in the Primary Solar Duct System shall have felted blade edges or otherwise be treated to insure tight cutoff of the airstream.

(f) Volume control dampers shall be furnished with a locking control device to hold the damper in its fixed control position unless the damper is motor controlled.

(6) BLOWERS.

(a) Blowers shall be of a type and size that will satisfy the design conditions of the Solar Energy System.

(b) All blowers shall be rated by the manufacturers in cfm capacity against a specific external static pressure.

SPS 371.25 Liquid Systems. This section shall apply to Active Solar Energy Systems and components that use liquid as a heat transfer Fluid.

Note: The connection of a Solar Energy System to the Potable Water supply system may require inspection and approval from the Department.

(1) LIQUID DISTRIBUTION.

(a) ***Design.*** Components shall be designed for flow rates, temperatures, pressures, mechanical stresses, material properties and heat transfer Fluid characteristics to provide proper and efficient performance.

(b) ***Pipe.***

1. `Size.' Pipe sizing shall be in accordance with accepted design practice or recognized methods.

Note: The sizes of pipe to be used for mains and risers may be selected from the ASHRAE Guide and Data Book, published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers; or from the manuals published by The Hydronics Institute, 35 Russo Place, Berkely Heights, New Jersey 07922 or the Mechanical Contractors Association of America, 5410 Grosvenor Lane, Suite 120, Bethesda, Maryland 20814.

2. `Pipe materials.' Piping materials for Open Loop Systems shall comply with SPS 384.30. Piping materials for Closed Loop Systems shall be schedule 40 black pipe, type K, L or M copper, or other pipe Approved by the Department. Unglazed, non-concentrating Collectors, limited to unpressurized systems for swimming pool and spa heating applications, with a Maximum Operating Temperature of 200ºF, may utilize rubber or plastic plates and piping.

3. `Draining and filling.' Where the design requires piping to be drained to protect the Solar Energy System from freezing or where the heat transfer Fluid must be replaced as part of regular maintenance, the piping shall be pitched toward a designated point in the Solar Energy System to permit drainage. Appropriate valving to drain and fill the Solar Energy System shall also be supplied.

4. `Hangers and supports'. Pipe hangers and supports shall be in accordance with SPS 382.60.

5. **`Identification of potable and non-Potable Water.'** The identification of potable and non-Potable Water piping systems shall be in accordance with SPS 382.40 (3) (b).

6. `Insulation.' Piping shall be insulated in accordance with SPS 371.21 (3).

(c) ***Valves.***

1. Relief valves shall be designed and installed in accordance with SPS 371.22 (3).

2. All required shutoff or control valves shall be readily accessible.

3. Valves used to charge or drain Closed Loop Systems shall be the loose-key type, have valve outlets capped or have handles removed when the Solar Energy System is operational.

4. The cold water branch to each Thermal Storage tank or water heater shall be provided with a valve located in the same room near the equipment and serving only this equipment in accordance with SPS 382.40 (4).

(d) ***Sealants and gaskets.*** Gaskets, sealants, hoses and other plastic, rubber and synthetic parts may not be adversely affected by contact with heat transfer Fluids, high temperatures, high pressures, or sunlight to an extent that their ability to function is impaired.

(2) PUMPS. Pumps shall be sized to provide an adequate flow. Pumps shall be properly matched with the heat transfer Fluid so that Potable Water quality is maintained and pump and loop parts are not degraded under normal operating conditions.

Note: It is recommended to use centrifugal-type pumps.

(3) PROVISIONS FOR LIQUID EXPANSION.

(a) ***Liquid expansion required.*** Any portion of the Solar Energy System utilizing a closed loop shall be provided with a means for liquid expansion. The expansion tank, or other Approved method, shall have the capacity to withstand the heat transfer Fluid expansion from minimum to maximum Design Temperatures and be compatible with the heat transfer Fluid.

(b) ***Open expansion tanks***. Solar Energy Systems, equipped with an open expansion tank to satisfy heat transfer Fluid expansion, shall be provided with an indoor overflow, from the upper portion of the expansion tank, in addition to an open vent. The indoor overflow shall be carried within the Building or Dwelling to an Approved drain.

(c) ***Closed Loop Systems.***

1. Closed Loop Systems shall have an airtight tank or other suitable air cushion that shall be:

a. Consistent with the volume and capacity of the Closed Loop System; and

b. Suitably designed for a hydrostatic test pressure of 2.5 times the Design Pressure of the Closed Loop System.

2. Expansion tanks for Closed Loop Systems designed to operate at or above 50 psig shall be constructed in accordance with Ch. SPS 341.

(4) THERMAL STORAGE. Thermal Storage for domestic or industrial use shall meet the requirements of SPS 382.40 (5) and the following:

(a) Thermal Storage shall be located in heated areas whenever possible.

(b) Thermal Storage shall be insulated in accordance with SPS 371.21 (3).

(c) Thermal Storage shall be located to provide for servicing.

(d) Thermal Storage shall be designed and installed to withstand all anticipated loads and environmental conditions.

(e) Thermal Storage shall be designed for Maximum Operating Temperatures and pressures.

(f) Pressurized Thermal Storage shall be provided with relief valves in accordance with SPS 371.22 (3).

(g) Only pressurized Thermal Storage shall be used for Potable Water.

(h) Concrete Thermal Storage tanks may not be pressurized.

(i) Thermal Storage buried outdoors shall be located at least 3 feet away from the Building for every foot excavated below the footing.

(j) Non-pressurized Thermal Storage shall be provided with a vent to the outside atmosphere. The Thermal Storage opening for the vent shall be sealed at the penetration of the Thermal Storage, and the vent shall be provided with a 1/16-inch mesh screen to prevent the entrance of vermin.

(k) Non-pressurized Thermal Storage shall be provided with an overflow piped to an Approved drain.

(5) JOINTS AND CONNECTIONS.

(a) Except as provided in pars. (b) and (c), joints and connections for Solar Energy Systems shall meet the requirements of SPS 384.40.

(b) Joints and connections for Closed Loop Systems with non-concentrating Collectors and type K, L or M copper tubing may be soldered with 50/50 solder to within 5 feet of the Collectors. Within 5 feet of the Collectors, soldering shall be in compliance with par. (a).

(c) Joints and connections within 5 feet of concentrating Collectors shall be silver brazed or attached with proper flare, compression or threaded joint.

(6) FREEZE PROTECTION.

(a) All Solar Energy Systems, except drain down and Drain Back Systems, utilized during periods when outdoor temperatures are below 40ºF, shall be provided with freeze protection.

(b) Components containing liquid heat transfer Fluids shall be provided a means of protection from freeze damage. Automatic freeze protection shall be provided in a power failure mode.

(c) Any nonautomatic freeze protection shall be noted as such in the operation and maintenance manual.

(d) Collectors and piping which must drain for freeze protection shall be installed with a slope of at least 1/8 inch per foot.

(7) POTABLE WATER PROTECTION.

(a) ***Prohibited connections to fixtures and equipment.*** Protection against backflow or back siphonage shall be provided for connections to Potable Water supply systems in accordance with SPS 382.41.

(b) ***Recirculating water.*** Water used for space heating may not be returned to the Potable Water system.

(c) ***Toxic elements.*** Heat transfer Fluids, heat storage media and Thermal Storage materials, including any interior protective coatings, may not impart toxic elements to Potable Water.

SPS 371.26 Electrical requirements. All electrical work shall conform to SPS 316.

SPS 371.30 Photovoltaic Solar Energy Systems.

(1) GENERAL INSTALLATION REQUIREMENTS. Photovoltaic Solar Energy Systems shall comply with SPS 371.21 (1), (2), (4), (6) and (7).

(2) ELECTRICAL REQUIREMENTS. All electrical wiring, installation, equipment and materials used in the construction and installation of Photovoltaic Solar Energy Systems shall comply with SPS 316.

Note: For design requirements and definitions for Photovoltaic Solar Energy Systems, see Article 690, of the National Electrical Code (NEC), as adopted by reference in the Wisconsin Electrical Code, Volume 2, Ch. SPS 316.

Subchapter V — Warranty

SPS 371.40 Purpose. This subchapter establishes the requirement of a warranty and minimum warranty requirements for Solar Energy Systems and components.

SPS 371.41 System Designer's warranty. All new Solar Energy Systems shall be covered by a System Designer's warranty. The System Designer's warranty shall meet or exceed the following requirements:

(1) TYPE AND DURATION OF WARRANTY. The System Designer shall issue to every buyer a written warranty that meets the following minimum requirements:

(a) A 5-year warranty on the entire Solar Energy System and the installation of the Solar Energy System.

(b) A 5-year warranty on the Collectors and the installation of the Collectors.

(c) The warranty shall specify those items covered and those items not covered.

(d) The warranty shall begin the day the Solar Energy System is put into operation.

(2) VOIDING OF A WARRANTY.

(a) The warranty may specify reasonable installation and maintenance procedures, including specifications of incompatible components, and may state reasonable use conditions for the System Designer's warranty to be effective.

(b) The warranty may not be voided or in any way reduced by conditions that may occur in the normal operation of the Solar Energy System.

(c) The warranty shall list any actions that will void the warranty.

(3) NOTIFICATION. The warranty shall contain the name, address, and telephone number of the customer service representative.

Note: By federal law, all warranties must be in accordance with the standards, terms and conditions specified in the Magnuson-Moss Warranty - Federal Trade Commission Improvement Act, 15 United States Code, Sections 2301-2312 (1976), and the regulations promulgated thereunder as found in 16 Code of Federal Regulations, Subchapter G (1981). The requirements of this section are in addition to the federal warranty requirements.

Subchapter VI — Operation and Maintenance Manual

SPS 371.50 Purpose. This subchapter establishes the minimum requirements of an operation and maintenance manual for Solar Energy Systems.

Note: The requirements of this subchapter are recommended standards. See SPS 371.03.

SPS 371.51 General requirements.

(1) The operation and maintenance manual shall be supplied by the System Designer.

(2) Additional instructions for operation and maintenance may be added by the installer but may not:

(a) Contradict the manufacturer's instructions;

(b) Contradict the System Designer's instructions;

(c) Void the manufacturer's warranty;

(d) Void the System Designer's warranty; or

(e) Void the installer's warranty.

(3) Any pre-installation instructions shall be supplied by the installer.

(4) All operation and maintenance manuals, installation instructions and other instructions shall be supplied to the buyer on or before the day the Solar Energy System is operational.

SPS 371.52 Operation and maintenance manual for Active Solar Energy Systems. The operation and maintenance manual for Active Solar Energy Systems shall include, but is not limited to, the following requirements:

(1) OPERATING INSTRUCTIONS. Operating instructions shall contain the following:

(a) Operating instructions for normal Solar Energy System operations;

(b) Operating instructions for leaving the Solar Energy System inactive for extended periods of time, such as vacations;

(c) Operating instructions for disengaging the Solar Energy System and operating and maintaining the Auxiliary Energy System, if present, independently of the Solar Energy System;

(d) A valving diagram clearly showing the position that each valve should be in, for operation of the Solar Energy System;

(e) A detailed explanation of the freeze protection and no-flow protection features of the Solar Energy System including what the Owner needs to do, if anything, in the event a power failure occurs simultaneously with freezing or No-Flow Conditions. If the Solar Energy System does not provide freeze or no-flow protection or both, the operation and maintenance manual shall state so in a clear and concise manner;

(f) The conditions at which the Solar Energy System may be damaged by freezing or No-Flow Conditions or both;

(g) Operating instructions for start-up procedures; and

(h) Operating instructions for diagnostic procedures. Operating instructions for diagnostic procedures shall state on every page warnings if the diagnostic procedure performed by the Owner voids any warranty.

(2) MAINTENANCE INSTRUCTIONS. Routine maintenance, performed by the Owner, may not void the System Designer's or installer's warranty unless certain routine maintenance, performed by the Owner, is prohibited by the System Designer or installer. If routine maintenance, performed by the Owner, is prohibited, it shall be stated accordingly in a

contrasting color next to the prohibited routine maintenance. Routine maintenance instructions shall include the following:

(a) The time intervals for routine maintenance. The operation and maintenance manual shall provide a space for logging maintenance done on the Solar Energy System by the Owner, installer, or System Designer;

(b) Instructions for changing the heat transfer Fluid, if a heat transfer Fluid is present. A detailed description of the heat transfer Fluid used in the system shall be provided. The description shall include the following:

1. The exact name of the heat transfer Fluid;

2. Whether the heat transfer Fluid is toxic or non-toxic;

3. If the heat transfer Fluid is toxic, a cautionary statement regarding the poisonous characteristics of the heat transfer Fluid;

4. First aid instructions in case the heat transfer Fluid is ingested, splashed on skin, or splashed in eyes;

5. The System Designer's or installer's recommended heat transfer Fluid change interval;

6. A caution that the heat transfer Fluid may be hot;

7. A warning against the use of toxic heat transfer Fluids in systems not designed and installed for the use of toxic heat transfer Fluids; and

8. A proper disposal method for the heat transfer Fluid.

(c) Cleaning instructions, if any, for the following components that are present:

1. Collector plate and cover;

2. Heat Exchanger; and

3. Collector Absorber.

(d) Instructions for any other required routine maintenance.

(3) COMPONENT SPECIFICATIONS AND DETAILED DRAWINGS. Component specifications and detailed drawings for Solar Energy Systems shall contain the following:

(a) A detailed drawing of the entire Solar Energy System and each major component;

(b) A list of the Solar Energy System's specifications including all of the following that are applicable:

1. The Collector manufacturer and model number;

2. Gross Collector area;

3. Collector performance test results or system performance rating or both;

4. The name of the organization doing the performance rating;

5. Fluid capacity of the Collectors and Thermal Storage;

6. Full weights of the Collectors and Thermal Storage;

7. Temperature and pressure ratings of the Thermal Storage, Collectors, and pump;

8. The size of all piping and ducts; and

9. The type of Thermal Storage.

SPS 371.53 Operation and maintenance manual for Photovoltaic Solar Energy Systems. The operation and maintenance manual for Photovoltaic Solar Energy Systems shall include, but is not limited to, the following requirements:

(1) OPERATING INSTRUCTIONS. Operating instructions shall contain the following:

(a) Operating instructions for normal Solar Energy System operations;

(b) Operating instructions for leaving the Solar Energy System inactive for extended periods of time, such as vacations;

(c) Operating instructions for disengaging the Solar Energy System and operating and maintaining the Auxiliary Energy System, if present, independently of the Photovoltaic Solar Energy System;

(d) Operating instructions for start-up procedures; and

(e) Operating instructions for diagnostic procedures. Operating instructions for diagnostic procedures shall state on every page warnings if the diagnostic procedure performed by the Owner voids any warranty.

(2) MAINTENANCE INSTRUCTIONS. Routine maintenance, performed by the Owner, shall not void the System Designer's or installer's warranty unless certain routine maintenance, performed by the Owner, is prohibited by the System Designer or installer. If routine maintenance, performed by the Owner, is prohibited, it shall be stated accordingly in a contrasting color next to the prohibited routine maintenance. Routine maintenance instructions shall include the following:

(a) The time intervals for such maintenance. The operation and maintenance manual shall provide a space for logging maintenance done on the Solar Energy System by the Owner, installer, or System Designer.

(b) Cleaning instructions, if any, for the following components that are present:

1. Collector plate;

2. Collector Cover; and

3. Batteries.

(c) Routine maintenance instructions, if any, for the following:

1. Checking and restoring battery Fluid level;

2. Checking for and removing corrosion; and

3. Cleaning of battery top.

(d) Instructions for any other required routine maintenance.

(3) COMPONENT SPECIFICATIONS AND DETAILED DRAWINGS. Component specifications and detailed drawings for Solar Energy Systems shall contain the following:

(a) A detailed drawing of the entire Solar Energy System and each major component;

(b) A list of the Solar Energy System's specifications including all of the following that are applicable:

1. The Collector manufacturer and model number;

2. Gross Collector area;

3. Collector performance test results or system performance rating or both;

4. The name of the organization doing the performance rating;

5. Temperature and pressure ratings of the electrical storage and Collectors;

6. Weights of Collector and electrical storage;
7. Voltage, current and kilowatt rating of Collectors;
8. Amp-hour capacity of batteries; and
9. Temperature and ventilation requirements for the battery storage area.

Table 371.21–A
Clearance Between Combustible Materials and Unlisted Components

Maximum Sustained Surface Temperature	[1]Required Clearance (inches)
200°F or less	0
201°F to 250°F	1
251°F to 500°F	6
Over 500°F	Approval required

[1]If approved insulation protects the component, the required clearance may be reduced by 50%.



Chapter SPS 391
SANITATION

SPS 391.01 Purpose.
SPS 391.02 Scope.
SPS 391.03 Definitions.
SPS 391.04 Registrations (Intentionally Omitted).
SPS 391.10 Composting Toilet Systems.
SPS 391.11 Incinerating Toilets.
SPS 391.12 Privies.
SPS 391.13 Portable Restrooms.
SPS 391.14 Equal speed of access to toilets (Intentionally Omitted).
SPS 391.20 Incorporation of standards by reference (Intentionally Omitted).

SPS 391.01 Purpose. This chapter has the following purposes:

(1) This chapter establishes minimum standards and criteria for the design, installation and maintenance of sanitation systems and devices which are alternatives to water-carried waste plumbing fixtures and drain systems so that these sanitation systems and devices are safe and will safeguard public health and the Waters of the State.

SPS 391.02 Scope.

This chapter applies to all Composting Toilet Systems, Incinerating Toilets, pit Privies and vault Privies installed or constructed on or after the effective date of this chapter.

SPS 391.03 Definitions

(2) "Composting Toilet System" means a method that collects, stores, and converts by bacterial digestion nonliquid-carried human wastes or organic Kitchen wastes, or both, into humus.

(5) "Incinerating Toilet" means a self-contained device for the treatment of nonliquid carried wastes that deposits the wastes directly into a combustion chamber, reduces the solid portion to ash and evaporates the liquid portion.

(6) "Pit Privy" means an enclosed nonportable toilet into which non-water-carried human wastes are deposited to a subsurface storage chamber that is not watertight.

(7) "Portable Restroom" means a self-contained portable unit that includes fixtures, incorporating holding tank facilities, designed to receive human excrement.

(9) "Vault Privy" means an enclosed nonportable toilet into which non-water-carried human wastes are deposited to a subsurface storage chamber that is watertight.

SPS 391.04 Registrations (Intentionally Omitted)

SPS 391.10 Composting Toilet Systems.

(1) The materials, design, construction, and performance of a Composting Toilet System shall conform to NSF Standard 41.

(2) All Composting Toilet Systems shall be listed by a testing agency acceptable to the Department.

Note: Listing agencies acceptable to the Department include the American Gas Association; Canadian Standards Association; NSF International; Underwriter's Laboratories; and Warnock Hersey.

(3)

(a) Components for the storage or treatment of wastes shall be continuously ventilated.

(b) Ventilation ducts or vents for the Composting Toilet System shall conform to SPS 382.31 (16).

Note: See appendix for a reprint of portions of SPS 382.31 (16).

(4)

(a) The disposal of the compost shall be in accordance with 40 CFR part 503.

(b) The disposal of any liquid from a Composting Toilet System shall be either to a public sanitary sewer system or a POWTS conforming to Ch. SPS 383.

SPS 391.11 Incinerating Toilets.

(1) The design, construction and installation of a gas-fired Incinerating Toilet shall conform to ANSI Z21.61.

(2) The materials, design, construction, and performance of an electric-fired Incinerating Toilet shall conform to NSF Protocol P157.

(3) All electric and gas-fired Incinerating Toilets shall be listed by a testing agency acceptable to the Department.

Note: Listing agencies acceptable to the Department include the American Gas Association, Canadian Standards Association, NSF International, Underwriter's Laboratories, and Warnock Hersey.

(4)

(a) The disposal of the end product shall be of in accordance with 40 CFR Part 503, Standards for the Use or Disposal of Sewage Sludge.

Note: Materials relating to 40 CFR part 503, including, "Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule", are available at epa.org.

(b) The disposal of any liquid from an Incinerating Toilet shall be either to a public sanitary sewer system or a POWTS conforming to Ch. SPS 383.

SPS 391.12 Privies.

(1)

(a) The storage chamber of a vault Privy shall conform with the requirements of SPS 384.25 relating to holding tanks, and shall have a minimum storage capacity of 200 gallons or one cubic yard.

(b)

1. The storage chamber of a pit Privy shall be sited and located in soil recognized to provide treatment and dispersal in accordance with SPS 383.44 (4) (b).

Note: Chapter SPS 385 establishes procedures for conducting soil evaluations and preparing soil evaluation reports. Section of WI SPS 305.33 delineates the qualifications and certification procedures for individuals who conduct soil evaluations.

2. The Department may set standards for the structure above the vault or pit for one- and two-family Dwellings.

(c) The storage chamber of a vault Privy shall be anchored to prevent flotation caused by saturated soil conditions.

(2)

(a) The storage chamber of a pit or vault Privy shall be provided with a vent for the purpose of relieving explosive gases.

(b) The vent serving the storage chamber of a Privy shall be:

1. At least 3 inches in diameter;

2. Installed in accordance with SPS 382.31 (16) (a) to (f); and

3. Fabricated or provided with screening to prevent insects from entering the storage chamber.

(3) The servicing of a vault Privy relative to the pumping, transporting and disposal of the contents shall be in accordance with this Code.

(4) The abandonment of a vault Privy shall be accomplished by:

(a) Having the contents of the storage chamber pumped and disposed of in accordance with this Code;

(b) Removing the entire top of the chamber; and

(c) Filling the remaining portion of the emptied storage chamber with soil or other inert material to an elevation equal to or above the surrounding grade.

(5) The abandonment of a pit Privy shall be accomplished by filling the storage chamber with soil or other inert material to an elevation equal to the surrounding grade.

(6)

(a) A Privy may not be installed in a Floodway.

SPS 391.13 Portable Restrooms.

(1) The storage chamber of a Portable Restroom into which human waste is to be deposited shall be watertight.

(2) The entire floor and the side walls to a height of not less than 4 inches of a Portable Restroom shall be of a material impervious to water.

SPS 391.14 Equal Speed of Access to Toilets (Intentionally Omitted).

SPS 391.20 Incorporation of Standards by Reference (Intentionally Omitted).