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COMMERCIAL BUILDING CODE COUNCIL MEETING
Room 121A, 1400 East Washington Avenue, Madison
Contact: Sandra Cleveland (608) 266-0797
April 5, 2016

The following agenda describes the issues that the Council plans to consider at the meeting. At the time of the meeting, items may be removed from the agenda. Please consult the resulting meeting minutes for a description of the recommendations of the Council.

AGENDA

9:00 A.M.

CALL TO ORDER – ROLL CALL

A. Adoption of Agenda (1)

B. Approval of Minutes of March 1, 2016 (2)

C. Department Update

D. Division of Facilities Development Suggestions (3-6)
- **1)** DFD Presentation with Doug Schorr and Rick Cibulka
- **2)** Council Discussion

E. Review of Preliminary Draft Language (7-128)

F. Significant Changes to the IECC Chapters 1-6 and Appendices as Time Allows (129-312)
- **1)** Code Revisions
- **2)** Wisconsin Considerations
- **3)** Engineers Newsletter **(313-322)**
- **4)** Fan Efficiency Grades **(323-325)**
- **5)** Fan Efficiency Ratios **(326-335)**

G. Public Comments

H. Future Business

I. Adjournment

COMMERCIAL BUILDING CODE COUNCIL
MEETING MINUTES
March 1, 2016

PRESENT: Kevin Bierce *(via GoToMeeting)*, Hunter Bohne, David Enigl *(arrived at 9:28 a.m.)*, Samuel Lawrence, Michael Mamayek, Irina Ragozin *(arrived at 9:11 a.m.)*, Corey Rockweiler, Peter Scheuerman

EXCUSED: Steven Howard, Steven Klessig

STAFF: Dan Smith, Rules Coordinator; Randy Dahmen, Building Plan Reviewer; Jeff Grothman, Legislative Liaison; Jason Hansen, Building Plan Reviewer; Robin Zentner, Section Chief-Field Operations; Kimberly Wood, Program Assistant Supervisor; and Nifty Lynn Dio, Bureau Assistant

CALL TO ORDER

Michael Mamayek, Chair, called the meeting to order at 9:00 a.m. A quorum of six (6) members was confirmed.

ADOPTION OF AGENDA

MOTION: Hunter Bohne moved, seconded by Samuel Lawrence, to adopt the agenda as published. Motion carried unanimously.

APPROVAL OF MINUTES

MOTION: Samuel Lawrence moved, seconded by Corey Rockweiler, to approve the minutes of February 15, 2016 as published. Motion carried unanimously.

(Irina Ragozin arrived at 9:11 a.m. and David Enigl arrived at 9:28 a.m.)

DEPARTMENT UPDATE

MOTION: Hunter Bohne moved, seconded by Peter Scheuerman, to recommend adoption of the Commercial Building Code updates effective of Spring 2017. Motion carried unanimously.

SIGNIFICANT CHANGES TO THE INTERNATIONAL FUEL GAS CODE (IFGC) CHAPTERS 1-8 AND APPENDICES

Code Revisions

MOTION: Peter Scheuerman moved, seconded by Hunter Bohne, to skip review of Significant Changes to Chapter 4 - Gas piping insulation, in both the 2012 and 2015 IFCG, due to the adoption of NFPA 54 in lieu of this chapter. Motion carried unanimously.

ADJOURNMENT

MOTION: Hunter Bohne moved, seconded by Irina Ragozin, to adjourn the meeting. Motion carried unanimously.

The meeting adjourned at 2:51 p.m.

IMC

1. **401.2** Ventilation Required
   This passage does not allow the use of natural ventilation in spaces that do not have a very high air infiltration rate. This would preclude the use of natural ventilation in virtually any new building including dorm rooms within college resident hall buildings. State projects have successfully utilized natural ventilation in virtually all dorm sleeping rooms while providing piped heating and sometimes cooling fan coils to maintain space temperature. The Partial Preliminary Proposed Draft Language dated December 21, 2015 proposes retaining the use of natural ventilation in occupancies specified in SPS Table 364.0402. We support retaining this modification to the IMC. We recommend the modification also refer to IMC 401.2 in addition to referring to IBC 1203.5 since IMC 401.2 spells out where natural ventilation can and cannot be utilized.

IECC

2. **C403.2.7** Energy Recovery Ventilation Systems
   This section requires energy recovery ventilation systems for as little as 10% design minimum outside air ventilation depending on system size. The State utilizes demand control ventilation by both CO2 sensing and occupancy sensing. Therefore, the majority of the time the actual minimum outside air volume is well below the design minimum outside air volume. During the heating season we frequently operate building with more than the design minimum outside air ventilation to provide the desired air handling unit mixed air temperature for internal heat gain dominated buildings. We do not believe that life cycle cost savings can be justified for energy recovery ventilation systems in buildings that have unoccupied periods when outside air is not introduced, have low minimum outside air requirements and/or incorporate demand control ventilation.

3. **C403.3** Economizers (prescriptive)
   We support the current Wisconsin modifications (SPS 363.0503(4) and (5)) to IECC 503.3.1 and 503.4.1 (old code numbers) which require supply air economizers on cooling systems greater or equal to 33,000 btu/hr for packaged rooftop units and greater or equal to 54,000 btu/hr for all other systems. However very small (3-5 ton) economizers on small unitary equipment will not be regularly maintained leading to malfunctions, which will cause them to become a significant source of wasted energy.

   Applications of small unitary equipment such as this include DNR park entrance buildings, dorm rooms and similar occupancies with operable windows. Occupants generally open the windows in lieu of using mechanical cooling when outdoor conditions are favorable, thereby negating the use or value of an economizer and providing greater savings than an economizer. Requiring

economizers for small unitary equipment serving dorm resident rooms, nursing resident rooms and similar occupancies prohibits the use of fan coils in these applications due to the impracticality of applying economizers to this equipment.

The 2013 ASHRAE 90.1, Table 6.5.1-1 indicates that for most climate zones, economizers are required on systems greater or equal to 54,000 btu/hr (same as the current SPS code requirements). ASHRAE 6.5.1 exception 5 indicates that the limit is 5 times higher for residential spaces. However the IECC appears to have strayed from this ASHRAE exception significantly and is not supported in 90.1.

Also Table C403.3(1), District Chilled-Water Systems for Wisconsin Climate Zones is unclear as to whether the 1,720,000 Btu/h reference applies to a building or to the district cooling plant. If this code is not otherwise modified, this reference will require better definition. If this is defined as applying to the district cooling plant, virtually all college campuses, veteran's homes and similar institutions with district cooling systems would prohibit the use of chilled water fan coils serving each resident room or require costly and prone to fail economizers on each fan coil. Again, this does not appear to be the intent of ASHRAE 90.1.

4. **C404.7** Demand recirculation controls for service water heating restricts recirculation pump operation to times when plumbing fixtures are actively used and the recirculated water has reached 104 degrees F. However this will lead to stagnant tepid water systems which are prime breeding environments for Legionella and similar bacteria. ASHRAE Guideline 12, Standard 188 and ASTM Standard D5952 highlight these conditions as factors associated with Legionella. These conditions pose significant health and safety risks, particularly in health care and elderly care facilities serving immune suppressed populations.

   Furthermore widespread institutional incidences of microbial induced corrosion resulting in largescale piping and plumbing equipment failures as well as water quality issues have been traced to these stagnant tepid water conditions. The State is expending significant resources to mitigate these issues in water distribution piping systems and plumbing equipment. We recommend an exception be added for systems where recirculation is used as a bacterial control measure.

5. **ASHRAE 90.1-2010, Section 8.4.2** requires automatic receptacle control of at least 50% of all 15 and 20 Amp receptacles, located in private offices, open offices and computer classrooms including those in modular partitions. ASHRAE 90.1-2013 expands this requirement to include conference rooms, break rooms, print/copy rooms, classrooms, and individual work stations.

   We do not support this requirement and recommend it not be accepted for the following reasons:

A) Safety. Occupants can easily circumvent the system by plugging their devices into the un-switched receptacles. This will lead to an increased use of extension cords which will create safety hazards.
B) Cost. The addition of automatic controls, control wiring, switch legs and system complexity will result in a significant cost increase to the branch circuit wiring system in affected areas. Also, it will inevitably result in an increased number of receptacles installed in these areas further increasing the cost.
C) Effectiveness. Unlike most energy conservation measures designed into building systems, this requirement can be easily circumvented by simply plugging electrical devices into the un-switched receptacles. It is questionable as to how much energy will actually be saved by this requirement.
D) Environmental. The environmental impact of producing more controls, wiring and components may outweigh any benefit gained from this requirement.

6. **ASHRAE 90.1-2013, Section 8.4.3** requires new buildings to include energy measuring devices to monitor electrical energy use separately for the total building, HVAC systems, interior lighting, exterior lighting, and receptacle circuits.

   We support monitoring the total energy usage. However, we oppose the requirement to separately meter various parts of the electrical system due to the cost impact. Monitoring the defined portions of the electrical system will require separating the electrical infrastructure throughout the building. At a minimum, this will require additional electrical feeders and panel boards along with the required metering equipment. This additional infrastructure will significantly increase the cost of the electrical system. Also, the data gathered will not necessarily lead to a reduction in energy since there is no requirement to react to the data.

IBC

7. **IBC 716.3.3.2 & IMC 607.3.3.2** Smoke Damper Actuation
   Provide an exception that allows the elimination of duct smoke detectors within 5 feet of the smoke damper or spot detectors as required by code for <u>supply air ductwork</u> if a duct smoke detector is installed in the discharge supply air ductwork downstream of the supply fan ahead of any branch duct connection and upon initiation of the duct detector the supply air system is shut down and all supply smoke dampers are closed. One smoke detector located in the discharge supply ductwork downstream of the supply fan and ahead of any branch duct connection, as recommended by NFPA-90A 6.4.2.1, will provide complete smoke detection for the entire supply air system. Additional local mounted smoke detectors adjacent to supply air smoke dampers would be redundant and not needed. This duct smoke detector arrangement provides the equivalent protection of multiple duct smoke detectors. All duct smoke dampers shall close whenever the AHU is shutdown per IMC which requires the dampers to close “where local smoke detectors require a minimum velocity to operate”. This variance has been successfully approved on multiple State of Wisconsin construction projects on UW Madison, UW Oshkosh, UW Parkside, UW Whitewater, and other locations. There is substantial maintenance cost involved with testing of duct smoke detectors. The use of duct smoke detectors is also the cause of high rates of false alarms that cause building occupants to ignore the fire alarm system.

Due to shortages in maintenance staff, the required testing is not occurring at the rates necessary. False alarms are a constant problem on buildings with large numbers of duct smoke detectors. If this change is not made we will continue to request variances to eliminate the redundant duct smoke detectors. This change would simplify design of buildings, reduce maintenance and first cost, and eliminate petitions for variances on this subject.

End of comments.

Partial Preliminary Proposed Draft Language

SECTION 1. SPS 361.02 (3) (h) is amended to read:

SPS 361.02 (3) (h) That portion of ~~or space~~ a live/work unit within a one− or 2−family dwelling in which a home occupation is located.

SECTION 2. SPS 361.02 (4) (intro.) is amended to read:

SPS 361.02 (4) In this ~~section~~ code, "~~home occupation~~ home-based business" means any business, profession, trade or employment conducted in a person's dwelling unit, that may involve the person's immediate family or household and a maximum of one other unrelated person, but does not involve any of the following:

SECTION 3. SPS 361.02 (4) (b) (Note) is created to read:

SPS 361.02 (4) (b) **Note:** A dwelling unit containing a home-based business is referred to as a "live/work unit" which has the meaning given in s. SPS 362.0202 (2) (g).

(From: Council recommendation from 6.2.15)

SECTION 4. SPS 361.03 (5) (a) 1. is amended to read:

SPS 361.03 (5) (a) Except as provided in par. (b) and where allowed under s. 101.02 (7r) Stats., pursuant to s. ~~101.02 (7)~~ 101.02 (7r), Stats., ~~a~~ no city, village, or town ~~or local board of health~~ may enact ~~and~~ or enforce ~~additional or more restrictive~~ an ordinance that establishes minimum standards for constructing, altering, or adding to public buildings ~~and~~ or buildings that are places of employment~~, provided the standards do not conflict with~~ unless that ordinance strictly conforms to this code.

(From: Industry Services recommendation #59)

SECTION 5. SPS 361.03 (13) (b) is amended to read:

SPS 361.03 (13) (b) Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC ~~300−02~~ 300-12.

(From: Industry Services recommendation #1)

SECTION 6. SPS 361.03 (14) (a) to (d) are amended to read:

SPS 361.03 (14) (a) Design and construction−related requirements shall apply that are addressed in IFC section 102.6; IFC chapters 2 to 4; IFC sections 501 to 502 and 504 to 510; IFC sections 601 to 605 and 607 to 609; IFC chapters 7 and 8; IFC sections 901.1 to ~~901.4.2~~ 901.4.3, ~~901.4.4~~ 901.4.5 to 909.18.9, and 909.20 to 913; IFC chapters 10 ~~and 12 to 21~~, 11, 21, and 22 ; IFC section ~~2211.7~~ 2311.7, and IFC chapters ~~23 to 29, 31 to 33, 36,~~ 24 to 37, ~~and 39 to 47~~ 50, 51, 54 to 57, 59, 60, 62 to 67, and 80.

(b) Occupant loads addressed in IFC section ~~1004.8~~ 1004.5 shall apply but shall be established by the owner rather than by the code official.

(c) Construction-related inspections and reports shall apply that are addressed in IFC chapters 2 to 8; IFC sections 901 to 909.18.9 and 909.20 to 913; and IFC chapters 10, ~~12 to 21~~ 11, 21, 22, ~~23 to 29,~~ 24 to ~~31, 32, 33, 36,~~ 37, ~~and 39 to 47~~ 50, 51, 54 to 56, 59, 60, and 62 to 67, but may be performed or compiled by any qualified agency, rather than by a special inspector.

(d) Use and operation provisions shall apply which are a contingency of design and construction-related requirements and which are addressed in IFC chapters 2 to 4; IFC sections 501 and 502 and 504 to 510; IFC sections 601 to 605 and 607 to 609; IFC chapters 7 and 8; IFC sections 901.1 to ~~901.4.2~~ 901.4.3, ~~901.4.4~~ 901.4.5 to 909.18.9, and 909.20 to 913; and IFC chapters 10, 11, ~~12 to~~ 21, 22, ~~23 to 29, 31 to 33, 36,~~ 24 to 37, ~~and 39 to 47~~ 50, 51, 54 to 56, 59, 60, 62 to 67, and 80.

(From: Editorial clarification – IFC section numbers changed)

SECTION 7. SPS 361.04 (7) is amended to read:

SPS 361.04 (7) "IEBC" and "International Existing Building Code" mean the ~~2006 edition of the~~ International Existing Building Code®, as adopted under s. SPS 361.05 and modified in this code.

(From: Editorial clarification: current adopted editions are listed in SPS 361.05)

SECTION 8. SPS 361.04 (16) is created to Read:

SPS 361.04 (16) "Volume" The volume of a building is the actual cubic space enclosed within the outer surfaces of the outside or enclosing walls and contained between the outer surfaces of the roof and the underside of the lowest floor. The volume of structures without enclosing walls (canopies, roofed shelters and similar structures) will be computed by projecting imaginary vertical planes as the enclosing walls at the outer surface of the exterior supports or columns. For cantilevered structures with interior supports, the imaginary vertical planes will be projected at the farthest roof projection or overhang. The definition of volume requires the cube of dormers, penthouses, vaults, pits, enclosed porches and other enclosed appendages to be included as a part of the cube of the building. It does not include the cube of courts or light shafts, open at the top, or the cube of outside steps, cornices, parapets, or open decks porches or loggias.

(From: Industry Services recommendation #28 and council recommendation from 9.1.2015)

SECTION 9. SPS 361.05 (1) to (5) and (Note 3) are amended to read:

SPS 361.05 (1) IBC. The *International Building Code®* – ~~2009~~ 2015, subject to the modifications specified in this chapter and ch. SPS 362 is hereby incorporated by reference into this code.

(2) IECC. The *International Energy Conservation Code®* – ~~2009~~ 2015, subject to the modifications specified in this chapter and ch. SPS 363 is hereby incorporated by reference into this code.

(3) IMC. The *International Mechanical Code®* – ~~2009~~ 2015, subject to the modifications specified in this chapter and ch. SPS 364 is hereby incorporated by reference into this code.

(4) IFGC. The *International Fuel Gas Code®* – ~~2009~~ 2015, subject to the modifications specified in this chapter and ch. SPS 365 is hereby incorporated by reference into this code.

(5) IEBC. The *International Existing Building Code®* – ~~2009~~ 2015, subject to the modifications specified in this chapter and ch. SPS 366, is hereby incorporated by reference into this code.

Note: Many of the model codes created by the International Code Council (ICC) and adopted by the Department of Safety and Professional Services may be viewed free of charge on the ICC Internet site. To access these codes go to ~~http://www.ecodes.biz/~~ http://codes.iccsafe.org/ and click on ~~"FreeCodes."~~ "I-Codes." Online viewers should determine whether the version available on the Internet is the version adopted above.

(From: Departmental goal not yet discussed by council but inserted as a place holder. Adoption of codes will be debated by council after review of significant changes)

SECTION 10. SPS 361.05 (6) is created to read:

SPS 361.05 (6) IFC. The *International Fire Code®* – 2015, subject to the modifications specified in this chapter, the portions of the IFC delineated in s. 361.03 (14) are hereby incorporated by reference into this code.

(From: Editorial clarification – year of IFC referenced is not in code)

SECTION 11. SPS 361.30 (2) and (a) to (d) are renumbered 361.30 (2) and (a) and 1. to 4. and as renumbered, 361.30 (2) (a) is amended to read:

SPS 361.30 (2) (a) Plans for all of the following types of structures shall be submitted to and approved by the department or authorized representative prior to commencement of the project:

(From: Editorial clarification)

SECTION 12. SPS 361.30 (2) (b) is created to read:

SPS 361.30 (2) (b) Plans for fire service drill towers used exclusively for hands-on training reflecting emergency conditions are not subject to plan submittal and review, but are required to meet applicable code requirements, including minimum structural requirements.

(From: Industry Services recommendation #17)

SECTION 13. SPS 361.30 (2) (d) (Note) is created to read:

SPS 361.30 (2) (d) **Note:** Plans for a freestanding columbarium that is not within a mausoleum structure are not required to be submitted and approved.

(From: Industry Services recommendation #46)

SECTION 14. SPS 361.36 (1) (g) is created to read:

SPS 361.36 (1) (g) *Bleachers and canopies*. Plan approval by the department or its authorized representative for bleachers or free standing canopies shall expire 2 years after the approval date on the approved plans of the structure.

(From: Industry Services recommendation #18)

SECTION 15. SPS 361.40 (3) is renumbered 361.40 (3) (title) and (a).

SECTION 16. SPS 361.40 (3) (b) is created to read:

SPS 361.40 (3) (b) If the supervising architect, engineer, or designer withdraws from the project, the owner of the building or structure shall retain a new supervising professional within 30 days and provide the authority that issued plan approval the name and Wisconsin registration number of the replacement supervising professional.

(From: Industry Services recommendation #71)

SECTION 17. SPS 361.60 (2) (c) 2. is amended to read:

SPS 361.60 (2) (c) 2. Provide a ~~monthly~~ report at least quarterly to the department of all projects completed under this subsection, in an electronic−based format prescribed by the department.

(From: Industry Services recommendation #73)

SECTION 18. SPS 361 Subchapters V and VI are renumbered 361 Subchapters VI and VII.

SECTION 19. SPS 361 Subchapter V is created to read:

SUBCHAPTER V

APPROVAL AND INSPECTION OF MODULAR MULTI-FAMILY DWELLINGS AND THEIR COMPONENTS.

SPS 361.45 Modular Multi-Family Housing Scope. This part shall govern the design, manufacture, installation and inspection of modular multi-family housing, manufactured multi-family building systems and the components of the building systems displaying the Wisconsin insignia.

361.46 Manufacture, sale and installation of dwellings. (1) MANUFACTURE AND SALE. No modular multi-family dwelling, manufactured building system or component of the building system subject to this part shall be manufactured for use, sold for initial use or installed in this state unless it is approved by the department and it bears the Wisconsin insignia issued.

(2) INSTALLATION. Building plan review and approval shall be obtained in accordance with SPS 361 Subchapter III before any on−site construction within the scope of this code is commenced for a modular multi-family dwelling

361.47 Approval procedures. (1) APPLICATION FOR APPROVAL. (a) An application for approval of any modular multi-family dwelling, building system or component shall be submitted to the department in the form required by the department, along with the appropriate fees in accordance with s. SPS 302.3.

(b) The department shall review and make a determination on an application for approval of a modular multi-family dwelling, building system or component within 3 months.

(2) APPROVAL OF BUILDING SYSTEMS AND COMPONENTS. (a) *Approval of building systems.* 1. 'Plans and specifications.' All of the following plans and specifications shall be submitted to the department according to subd. 1. a.: 4 complete sets of building, structural, and HVAC plans, (including elevations, sections and details), specifications and calculations shall be submitted to the department on behalf of the manufacturer for examination and approval.

Note: Plumbing plans submission criteria can be found in SPS 384.

2. ‘Compliance assurance program.’ a. Three sets of the compliance assurance program shall be submitted for examination and approval.

b. The compliance assurance program shall meet the standards of the Model Documents for the Evaluation, Approval and Inspection of Manufactured Buildings or an equivalent standard acceptable to the department.

(b) *Approval of building components.* 1. ‘Plans and specifications.’ All of the following plans and specifications shall be submitted to the department according to subd. 1. a.: at least 4 complete sets of plans and specifications for manufactured dwelling building components shall be submitted to the department on behalf of the manufacturer for examination and approval.

2. ‘Compliance assurance program.’ a. Three sets of the compliance assurance program shall be submitted to the department for examination and approval of components.

b. The compliance assurance program shall meet the requirements established by the department or, where applicable, be in the form of the Model Documents for the Evaluation, Approval and Inspection of Manufactured Buildings or an equivalent standard acceptable to the department.

(3) NOTIFICATION OF APPROVAL OR DENIAL OF PLANS, SPECIFICATIONS AND COMPLIANCE ASSURANCE PROGRAM. (a) *Conditional approval.* If the department determines that the plans, specifications, compliance assurance program and application for approval submitted for such building system or component substantially conform to the provisions of this code, a conditional approval shall be issued. A conditional approval issued by the department shall not constitute an assumption of any liability for the design or construction of the manufactured building.

1. ‘Written notice.’ The conditional approval shall be in writing and sent to the manufacturer and the person submitting the application for approval. Any noncompliance specified in the conditional approval shall be corrected before the manufacture, sale or installation of the dwelling, building system or component.

2. ‘Stamping of plans, specifications and compliance assurance program.’ Approved plans, specifications and compliance assurance programs shall be stamped “conditionally approved.” At least 3 copies shall be returned to the person designated on the application for approval; one copy shall be retained by the department.

(b) *Denial.* If the department determines that the plans, specifications, compliance assurance program or the application for approval do not substantially conform to the provisions of this code, the application for approval shall be denied.

1. ‘Written notice.’ The denial shall be in writing and sent to the manufacturer and the person submitting the application for approval. The notice shall state the reasons for denial.

2. ‘Stamping of plans, specifications and compliance assurance program.’ Plans, specifications and compliance assurance programs shall be stamped “not approved.” At least 3

copies shall be returned to the person submitting the application for approval; one copy shall be retained by the department.

(4) EVIDENCE OF APPROVAL. The manufacturer shall keep at each manufacturing plant where such building system or component is manufactured, one set of plans, specifications and compliance assurance program bearing the stamp of conditional approval. The conditionally approved plans, specifications and compliance assurance program shall be available for inspection by an authorized representative of the department during normal working hours.

(5) INSPECTIONS. Manufacturers shall contract with an independent inspection agency to conduct in−plant inspections to assure that the building system and components manufactured are in compliance with the plans, specifications and the compliance assurance program approved by the department. All inspections, for the purpose of administering and enforcing this code, shall be performed by a Wisconsin certified Commercial Building inspector or inspectors.

Note: Electrical installation inspection criteria can be found in SPS 316.

Note: Plumbing installation inspection criteria can be found in SPS 382.

(6) WISCONSIN INSIGNIA. Upon departmental approval of the plans, specifications and compliance assurance program, and satisfactory in−plant inspections of the building system and components, Wisconsin insignias shall be purchased from the department in accordance with the fee established in s. SPS 302.34. A manufacturer shall be entitled to display the Wisconsin insignia on any approved system or component.

(a) *Lost or damaged insignia.* 1. 'Notification.' If Wisconsin insignias become lost or damaged, the department shall be notified immediately, in writing, by the manufacturer or dealer.

2. 'Return of damaged insignias.' If Wisconsin insignias become damaged, the insignia shall be returned to the department with the appropriate fee to obtain a new insignia.

(b) *Affixing Wisconsin insignias.* Each Wisconsin insignia shall be assigned and affixed to a specific manufactured dwelling or component in the manner approved by the department before the dwelling is shipped from the manufacturing plant.

(c) *Insignia records.* 1. 'Manufacturer's insignia records.' The manufacturer shall keep permanent records regarding the handling of all Wisconsin insignias, including construction compliance certificates, indicating the number of Wisconsin insignias which have been affixed to manufactured dwellings or manufactured building components (or groups of components); which Wisconsin insignias have been applied to which manufactured dwelling or manufactured building component; the disposition of any damaged or rejected Wisconsin insignias; and the location and custody of all unused Wisconsin insignias. The records shall be maintained by the manufacturer or by the independent inspection agency for at least 10 years. A copy of the records shall be sent to the department upon request.

2. 'Construction compliance certificate.' Within 30 days after receiving the original Wisconsin insignias from the department, and at the end of each month thereafter, the

manufacturer shall submit a construction compliance certificate, in the form determined by the department, for each manufactured dwelling intended for sale, use or installation in the state.

(d) *Unit identification.* Each modular dwelling and major transportable section or component shall be assigned a serial number. 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 all of 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.

361.475 Effect of approval. (1) RIGHT TO BEAR INSIGNIA. A manufactured multi-family dwelling or building component approved by the department, and manufactured and inspected in accordance with this code, shall be entitled to bear the Wisconsin insignia.

(2) EFFECT OF INSIGNIA. Manufactured multi-family dwellings and manufactured building components bearing the Wisconsin insignia are deemed to comply with this code, except as to installation site requirements, regardless of the provisions of any other ordinance, rule, regulation or requirement.

(3) RIGHT TO INSTALL. Manufactured multi-family dwellings and components bearing the Wisconsin insignia may be manufactured, offered for sale and shall be entitled to be installed anywhere in Wisconsin where the installation site complies with the other provisions of this code.

361.48 Suspension and revocation of approval. The department shall suspend or revoke its approval of a manufactured building system or manufactured building component if it

determines that the standards for construction or the manufacture and installation of a manufactured building system or manufactured building component do not meet this code or that such standards are not being enforced as required by this code. The procedure for suspension and revocation of approval shall be as follows:

(1) FILING OF COMPLAINT. Proceedings to suspend or revoke an approval shall be initiated by the department or an independent inspection agency or Wisconsin Commercial Building certified inspector having a contract with the manufacturer whose approval is sought to be suspended or revoked. Initiation shall be by a signed, written complaint filed with the department. Any alleged violation of the code shall be set forth in the complaint with particular reference to time, place and circumstance.

(2) INVESTIGATION AND NOTIFICATION. The department may investigate alleged violations on its own initiative or upon the filing of a complaint. If it is determined that no further action is warranted, the department shall notify the persons affected. If the department determines that there is probable cause, it shall order a hearing and notify the persons affected.

(3) MAILING. Unless otherwise provided by law, all orders, notices and other papers may be served by the department by certified mail to the persons affected at their last known address. If the service is refused, service may be made by sheriff without amendment of the original order, notice or other paper.

(4) RESPONSE. Upon receipt of notification of hearing from the department, the person charged with noncompliance or nonenforcement may submit to the department a written response within 30 days of the date of service. If the person charged files a timely written response, such person shall thereafter be referred to as the respondent.

(5) CONCILIATION AGREEMENT PRIOR TO HEARING. If the department and the respondent are able to reach agreement on the disposition of a complaint prior to a hearing, such agreement shall be transmitted in writing to the secretary. Until the agreement has been accepted by the secretary, it is not considered a waiver of any defense, nor is it considered an admission of any fact, and is not binding upon any party until signed by all parties.

(6) HEARINGS. (a) *Subpoenas; witness fees.* Subpoenas shall be signed and issued by the department or the clerk of any court of record. Witness fees and mileage of witnesses subpoenaed on behalf of the department shall be paid at the rate prescribed for witnesses in circuit court.

(b) *Conduct of hearings.* All hearings shall be conducted by persons selected by the department. Persons so designated may administer oaths or affirmations and may grant continuances and adjournments for cause shown. The respondent shall appear in person and may be represented by an attorney−at−law. Witnesses may be examined by persons designated by all parties.

(7) FINDINGS. The department shall make findings and enter its order within 14 days of the hearing. Any findings as a result of petition or hearing shall be in writing and shall be binding unless appealed to the secretary.

(8) APPEAL ARGUMENTS. Appeal arguments shall be submitted to the department in writing in accordance with ch. 227, Stats., unless otherwise ordered. The department shall review and make a determination on an appeal of notification of suspension or revocation of approval within 45 business days of receipt of the appeal.

361.485 Effect of suspension and revocation.

(1) BEARING OF INSIGNIA. Upon suspension or revocation by the department of the approval of any modular dwelling or manufactured building component, no further insignia shall be attached to any dwelling or building component manufactured with respect to which the approval was suspended or revoked. Upon termination of such suspension or revocation, insignias may again be attached to the dwelling or building component manufactured after the date approval is reinstated. Should any dwelling or building component have been manufactured during the period of suspension or revocation, it shall not be entitled to bear the Wisconsin insignia unless the department has inspected, or caused to be inspected, such modular dwelling or manufactured building component and is satisfied that all requirements for certification have been met.

(2) RETURN OF INSIGNIAS. The manufacturer shall return to the department all insignias allocated for a modular dwelling or manufactured building component no later than 30 days from the effective date of any suspension or revocation of the approval by the department. The manufacturer shall also return to the department all insignias which it determines for any reason are no longer needed.

(From: Industry Services recommendation)

SECTION 20. SPS 362.0202 (1) is renumbered SPS 362.0202 (1) (title) and (a), and amended to read:

SPS 362.0202 Definitions. (1) ADDITIONS. ~~This is a~~ These are department ~~definition~~ definitions for this chapter in addition to the definitions in IBC section 202: (a) "High−piled combustible storage" means storage of combustible materials in closely packed piles, or on pallets, in racks or on shelves, where the top of storage is greater than 12 feet in height. When required by the fire code official, high−piled combustible storage also includes certain high−hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets and similar commodities, where the top of storage is greater than 6 feet in height.

SECTION 21. SPS 362.0202 (1) (b) is created to read:

SPS 362.0202 (1) (b) "Neutral Plane" A deep foundation's neutral plane is the level at which drag load, accumulated from the top down, added to the long−term static service load, equals the upward acting shaft resistance accumulated from the bottom up, added to the deep foundation's toe resistance.

SECTION 22. SPS 362.0202 (2) is renumbered SPS 362.0202 (2) and (a) and amended to read:

SPS 362.0202 (2) SUBSTITUTIONS. Substitute the following ~~definition~~ definitions for the corresponding definition in IBC section 202: (a) "Approved" means acceptable to the department.

SECTION 23. SPS 362.0202 (2) (b) to (g) and (Note) and (h) are created to read:

SPS 362.0202 (2) (b) "Automatic sprinkler system" or "Automatic fire sprinkler system" has the meaning given in s. 145.01 (2), Stats.

(c) "Fire area" means the aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or fire−resistance−rated horizontal assemblies of a building.

(d) "Fire separation distance" means the distance measured at right angles from the face of the building wall to one of the following:

(e) "Fuel−burning appliance" means a device that is installed in a building and burns fossil−fuel or carbon based fuel where carbon monoxide is a combustion by−product, including ranges, ovens, grills, clothes dryers, furnaces, boilers, water heaters, heaters, fireplaces and stoves.

(f) "Immediately dangerous to life and health (IDLH)" means a concentration of air−borne contaminants which poses a threat of death, immediate or delayed permanent adverse health effects, or effects which could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of Occupational Safety and Health based on both toxicity and flammability. It generally is expressed in parts per million by volume, or milligrams per cubic meter.

(g) "Live/work unit" means a dwelling unit which includes a "home-based business" as defined in s. SPS 361.02 (4).

Note: SPS 361.02 (4), reads as follows: In this code, "home-based business" means any business, profession, trade or employment conducted in a person's dwelling unit, that may involve the person's immediate family or household and a maximum of one other unrelated person, but does not involve any of the following:
(a) Explosives, fireworks or repair of motor vehicles.
(b) More than 25% of the habitable floor area of the dwelling unit.

(h) "Sealed combustion appliance" means a listed appliance that acquires all air for combustion through a dedicated sealed passage from the outside to a sealed combustion chamber and all combustion products are vented to the outside through a separate dedicated sealed vent.

SECTION 24. SPS 362.0202 (3) is amended to read:

SPS 362.0202 (3) (d) DELETIONS. The following terms and corresponding definitions in IBC section 202 are not included as part of this code: approved agency, approved fabricator, base flood, base flood elevation, certificate of compliance, design flood, design flood elevation, designated seismic system, dry floodproofing, ~~existing construction,~~ fabricated item, ~~inspection~~

~~certificate,~~ label, lowest floor, manufacturer's designation, mark, ~~special continuous inspection,~~ special flood hazard area, special inspection, ~~special periodic inspection,~~ sprayed fire−resistant materials, start of construction, and structural observation.

SECTION 25. SPS 362.0308 is created to read:

SPS 362.0308 Five or fewer persons receiving medical care. Substitute the following wording for IBC section 308.4.2: Five or fewer persons receiving medical care. A facility with five or fewer persons receiving medical care shall be classified as Group R-3.

(From: Editorial clarification and Council recommendation from 6.2.15)

SECTION 26. SPS 362.0406 is repealed.

(From: Editorial clarification - IBC section that is modified no longer exists)

SECTION 27. SPS 362.0412 (intro.) is renumbered 362.0412 and (1) (intro.) and amended to read:

SPS 362.0412 Aircraft related occupancies. (1) Substitute the following wording for exception 1 in IBC section ~~412.2.4~~ 412.4.4: Heating equipment that is suspended at least 10 feet above the upper surface of wings or engine enclosures of the highest aircraft which may be housed in the hangar; or at least 8 feet above the floor in shops, offices and other sections of the hangar communicating with storage or service areas.

(From: Editorial clarification – code referenced wrong section)

SECTION 28. SPS 362.0412 (2) is created to read:

SPS 362.0412 (2) Substitute the following wording for the requirements, but not the exception, in IBC section 412.4.3: Floor Surface. Floors shall be graded and drained to meet the requirements of s. SPS 382.34 (2).

(From: Industry Services recommendation #10)

SECTION 29. SPS 362.0415 (1) is amended to read:

SPS 362.0415 (1) Substitute the ~~following wording~~ definition in s. SPS 362.0202 (2) for the corresponding definition listed in IBC section 415.2: "Immediately dangerous to life and health (IDLH)." ~~The concentration of air−borne contaminants which poses a threat of death, immediate or delayed permanent adverse health effects, or effects which could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of~~

~~Occupational Safety and Health based on both toxicity and flammability. It generally is expressed in parts per million by volume, or milligrams per cubic meter.~~

(From: Editorial clarification and Council recommendation from 6.2.15)

SECTION 30. SPS 362.0509 is created to read:

SPS 362.0509 Incinerator rooms. In IBC section 509, Table 509, "incinerator rooms" does not include crematories as defined in s. 440.70 (8) Stats.

(From: Industry Services recommendation #46)

SECTION 31. SPS 362.0702 (1) to (4) are renumbered 362.0202 (2) (d) 1. to 4.

SECTION 32. SPS 362.0702 is amended to read:

SPS 362.0702 Substitute the ~~following~~ definition in s. SPS 362.0202 (2) for the corresponding definition listed in IBC section 702: "Fire separation distance." ~~means the distance measured at right angles from the face of the building wall to one of the following:~~

SECTION 33. SPS 362.0702 (title) is repealed and recreated to read:

SPS 362.0702 Definitions.

(From: Editorial clarification and Council recommendation from 6.2.15)

SECTION 34. SPS 362.0707 is repealed.

SECTION 35. SPS 362.0708 is repealed.

SECTION 36. SPS 362.0713 is created to read:

SPS 362.0713 Chute discharge room. This is a department rule in addition to the requirements in IBC section 713: the requirements of IBC 713.13.4 shall apply to recycling chutes in addition to waste and linen chutes.

SECTION 37. SPS 362.0716 (1) (title) and (2) are repealed.

SECTION 38. SPS 362.0716 and (1) are renumbered 362.0717.

(From: Council recommendations from 7.7.15)

SECTION 39. SPS 362.0721 is renumbered 362.0722; and 362.0722 (1) and (2), as renumbered, are amended to read:

SPS 362.0722 (1) Substitute the following wording for the exception in each of IBC sections ~~721.2.1.4.3~~ 722.2.1.4.3, ~~721.3.2.3~~ 722.3.2.3 and ~~721.4.1.4~~ 722.4.1.4: Exception: For an exterior wall with a fire separation distance greater than 10 feet, the fire shall be assumed to occur on the interior side only.

SPS 362.0722 (2) Substitute the following wording for IBC Section ~~721.6.2.3~~ 722.6.2.3: For an exterior wall with a fire separation distance greater than 10 feet, the wall is assigned a rating ~~dependant~~ dependent on the interior membrane and the framing as described in IBC Tables ~~721.6.2(1)~~ 722.6.2(1) and ~~721.6.2(2)~~ 722.6.2(2). The membrane on the outside of the nonfire–exposed side of exterior walls with a fire separation distance greater than 10 feet may consist of sheathing, sheathing paper and siding as described in IBC Table ~~721.6.2(3)~~ 722.6.2(3).

(From: Editorial clarification - IBC section number changed)

SECTION 40. SPS 362.0902 (1) (Note) is renumbered SPS 362.0202 (2) (b) (Note).

SECTION 41. SPS 362.0902 (1) and (2) are amended to read:

SPS 362.0902 Definitions. Substitute the ~~following~~ definitions and informational note in s. SPS 362.0202 (2) for the corresponding definitions listed in IBC section 902.1:

(1) "Automatic sprinkler system" or "Automatic fire sprinkler system." ~~has the meaning given in s. 145.01 (2), Stats.~~

(2) "Fire area." ~~means the aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or fire–resistance–rated horizontal assemblies of a building.~~

(From: Editorial clarification and Council recommendation from 6.2.15)

SECTION 42. SPS 362.0903 (5) (c) is repealed.

(From: Industry Services recommendation)

SECTION 43. SPS 362.0903 (12) is created to read:

SPS 362.0903 (12) The requirements of IBC 903.2.11.2 shall apply to recycling chutes in addition to rubbish and linen chutes.

SECTION 44. SPS 362.0903 (13) is created to read:

SPS 362.0903 (13) ALTERNATE AUTOMATIC FIRE SPRINKLER SYSTEM DESIGN STANDARD. This is a department rule in addition to the requirements of IBC 903.3.1.1: Where the provisions of this code require that a building or portion thereof be equipped with an automatic sprinkler system in accordance with this section, sprinklers shall be allowed to be installed throughout in accordance with the alternate design standard of the most recent publication of FM Global Loss Prevention Data Sheets 2-0 Installation Guidelines for Automatic Sprinklers and 8-9 Storage of Class 1, 2, 3, 4 and Plastic Commodities.

(From: Industry Services recommendation)

SECTION 45. SPS 362.0904 (2) (a) is repealed.

SECTION 46. SPS 362.0904 (2) (c) is created to read:

SPS 362.0904 (2) (c) Substitute the following wording for IBC 904.12.2: System interconnection. The actuation of the fire suppression system shall automatically shut down all sources of fuel and power to all equipment located beneath the exhaust hood and protected by the suppression system. The fuel and power reset shall be manual.

(From: Council recommendations from 7.7.15)

SECTION 47. SPS 362.0907 (4) is amended to read:

SPS 362.0907 (4) Substitute the following wording for the ~~requirements~~ exception in IBC section ~~907.5.2.3.2~~ 907.5.2.3.1: Where employee work areas have audible alarm coverage, the alarm system shall be designed so that visible notification appliances can be integrated into the system.

(From: Editorial clarification - IBC section language changed)

SECTION 48. SPS 362.0910 (1) and (2) are amended to read:

SPS 362.0910 (1) Substitute the following wording for exception 1. in IBC section ~~910.1~~ 910.2: Buildings protected by an approved automatic sprinkler system.

(2) Substitute the following wording for the requirements, but not the exception, in IBC section 910.2.1: Buildings and portions thereof used as Group F–1 or S–1 occupancies having

more than 50,000 square feet in area that is undivided by full−height walls ~~having smoke resisting characteristics which are similar to those under IBC section 910.3.5.1~~ constructed of sheet metal, lath and plaster, gypsum board or other approved materials which provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.

(From: Editorial clarification – language from IBC 2009 which was formerly referenced no longer exists and was thus incorporated in sub. (2) to replace the IBC reference)

SECTION 49. SPS 362.1004 is amended to read:

SPS 362.1004 Substitute the following wording for the requirements, but not the exceptions, in IBC section ~~1004.8~~ 1004.5: Yards, patios, courts and similar outdoor areas accessible to and usable by the building occupants shall be provided with means of egress as required by this chapter. The occupant load of such outdoor areas shall be based on the anticipated use. Where outdoor areas are to be used by persons in addition to the occupants of the building, and the path of egress travel from the outdoor areas passes through the building, means of egress requirements for the building shall be based on the sum of the occupant load of the building plus the outdoor areas.

SECTION 50. SPS 362.1006 (3) is created to read:

SPS 362.1006 (3) This is a department exception to the requirements in IBC table 1006.2.1: A single exit is allowed and the common path of travel can be the same as the maximum allowable exit access travel distance (250') in buildings or portions of buildings used exclusively for bulk material storage in piles including but not limited to salt storage sheds, sand storage, etc. where the building walls provide containment for the materials stored.

(From: Industry Services recommendation)

SECTION 51. SPS 362.1008 is renumbered 362.1010; and SPS.1010 (1) and (2), as renumbered, are amended to read:

SPS 362.1010 (1) This is a department exception to the requirements in IBC section ~~1008.1.1~~ 1010.1.1: The clear door opening for a nonaccessible toilet stall, shower stall, or other similar compartment, may be less than 32= inches wide.

SPS 362.1010 (2) This is a department exception to the requirements in IBC section ~~1008.1.8~~ 1010.1.8: Where maneuvering space is provided between the doors in accordance with IBC section 1101.2 such that use by an individual in a wheelchair will not block the operation of the doors.

SECTION 52. SPS 362.1009 is renumbered 362.1011 and amended to read:

SPS 362.1011 This is a department rule in addition to the requirements in IBC section ~~1009.1~~ 1011.1: Where installing an inclined platform lift or stairway chairlift, the clear−passage width shall be provided with the lift in the unfolded, usable position.

(From: Editorial clarifications - IBC section numbers changed)

SECTION 53. SPS 362.1009 is created to read:

SPS 362.1009 This is a department exception in addition to the exceptions in IBC section 1009.3: Areas of refuge are not required at floors that are not required to be accessible.

(From: Council recommendation from 12/1/15 meeting)

SECTION 54. SPS 362.1011 is created to read:

SPS 362.1011 This is a department rule in addition to the requirements in IBC section 1011.7: For platform buildings designed per IBC section 510.2 where a stair shaft serves two or more classes of construction and one of those classes of construction allows combustible materials the entire stair construction within the enclosure may be of combustible materials.

(From: Industry Services recommendation)

SECTION 55. SPS 362.1014, (title) and (intro.) and (1) and (2) are renumbered 362.1006, (1) (title) and (intro) and (a) and (b); and 362.1006 (1) and (1) (b), as renumbered, are amended to read:

SPS 362.1006 (1) EXIT ACCESS. This is a department exception to the requirements in IBC section ~~1014.3~~ 1006.2.1: The length of a common path of egress travel requirements shall not be limited within townhouse dwelling units provided the townhouse complies with all of the following:

(b) Each dwelling unit within the townhouse is separated from other dwelling units by at least 2−hour fire−resistive−rated separation walls constructed in accordance with the requirements of IBC section ~~705~~ 706 and do not contain any openings and plumbing equipment or mechanical equipment. The separation wall does not have to comply with the structural stability requirements of IBC section ~~705.2~~ 706.2 and the horizontal continuity requirements of IBC section ~~705.5~~ 706.5.

(From: Council recommendation from 8.4.15)

SECTION 56. SPS 362.1015 and (title) are renumbered 362.1006 (2) and (title) and 362.1006 (2), as renumbered, is amended to read:

SPS 362.1006 (2) Substitute the following wording for the exception in IBC section ~~1015.5~~ 1006.2.2.3: Where using refrigerants in quantities limited to the amounts based on the volume set forth in ch. SPS 345.

(From: IBC section number changed)

SECTION 57. SPS 362.1015 is created to read:

SPS 362.1015 Substitute the following wording for the requirements, but not the exception in IBC section 1015.2: Guards shall be located along the open side of walking surfaces, balconies, mezzanines, stairs, ramps, landings, roofs and similar surfaces intended to be used by building occupants or the public where the change in elevation is more than 30 inches (762 mm) to the floor or roof below or more than 30 inches (762 mm) measured vertically to the grade below at any point within 36 inches (914 mm) horizontally to the edge of the open side. Guards shall be adequate in strength and attachment in accordance with Section 1607.8.

(From: Recommendation from Harry Sulzer, City of Madison)

SECTION 58. SPS 362.1016 is created to read:

SPS 362.1016 This is a department exception to the requirements in IBC section 1016: Buildings or portions of buildings used exclusively for bulk material storage in piles including but not limited to salt or sand storage sheds where building walls provide containment for the materials stored may have a single exit and are allowed to have a common path of travel to be the same as the maximum allowable exit access travel distance.

(From: Recommendation from DSPS/ DOT meeting)

SECTION 59. SPS 362.1018 is renumbered 362.1020 and amended to read:

SPS 362.1020 This is a department exception to the requirements in IBC section ~~1018.6~~ 1020.6: Other spaces or rooms constructed as required for corridors, and that are adjacent to a fire−resistance−rated corridor, shall not be construed as intervening rooms; and may be open to the corridor when all of the following are satisfied:

(From: Editorial clarifications - IBC section numbers changed)

SECTION 60. SPS 362.1021 (1) is repealed.

SECTION 61. SPS 362.1021 (title) and (2) are renumbered 362.1006 (3) and (title) and amended to read:

SPS 362.1006 (3) This is a department exception to the requirements in IBC section ~~1021.1~~ 1006.3: Buildings of Group I−3 occupancy that are used as guard towers, provided the towers are no higher than 2 stories above grade, accommodate no more than 10 occupants, and have a travel distance of no more than 75 feet.

SECTION 62. SPS 362.1022 is repealed.

(From: Council recommendation from 8.4.15)

SECTION 63. SPS 362.1103 is amended to read:

SPS 362.1103 Substitute the following wording for the requirements in IBC section ~~1103.2.8~~ 1103.2.7:

(From: Editorial clarification - IBC section number changed)

SECTION 64. SPS 362.1104 (2) is repealed.

(From: Council recommendation from 8.4.15)

SECTION 65. SPS 362.1109 is repealed.

SECTION 66. SPS 362.1110 is renumbered 362.1111 and, as renumbered, 361.1111 (1) (a), (2) (a), and (2) (b) are amended to read:

SPS 362.1111 (1) (a) Substitute the following wording for the requirements for location 1 in IBC section ~~1110.1~~ 1111.1: Except as specified par. (b), accessible parking spaces required in IBC section 1106 for the general public shall be identified with a sign complying with the accessible parking sign requirements specified in s. Trans 200.07.

(2) (a) Substitute the following wording for the introductory paragraph of IBC section ~~1110.2~~ 1111.2: Signage indicating directional information or information about functional spaces or signage indicating special accessibility provisions shall comply with ICC A117.1 and be provided at the following locations:

(2) (b) This is a department informational note to be used under IBC section ~~1110.3~~ 1111.3.

(From: Editorial clarification - IBC section number changed)

SECTION 67. SPS 362.1200 is renumbered 362.0915 and 362.0915 (title) and (intro.) and (1) (b) and (d), as renumbered, are amended to read:

SPS 362.0915 Carbon monoxide ~~alarms~~ detection. ~~These are department rules in addition to~~ Substitute the following wording for the requirements in IBC ~~chapter 12~~ section 915:

(1) (b) "Fuel−burning appliance" ~~means a device that is installed in a building and burns fossil−fuel or carbon based fuel where carbon monoxide is a combustion by−product, including stoves, ovens, grills, clothes dryers, furnaces, boilers, water heaters, heaters, fireplaces and stoves~~ has the meaning as given in s. SPS 362.0202 (2).

(d) "Sealed combustion appliance" ~~means a listed appliance that acquires all air for combustion through a dedicated sealed passage from the outside to a sealed combustion chamber and all combustion products are vented to the outside through a separate dedicated sealed vent~~ has the meaning as given in s. SPS 362.0202 (2).

(From: Council recommendation from 6.2.15)

SECTION 68. SPS 362.1203 is created to read:

SPS 362.1203 Natural Ventilation. This is a department rule in addition to the requirements in ~~IMC section 402~~ IBC section 1203.5: The use of natural ventilation shall be permitted under either of the following:

(1) In occupancies specified in s. SPS 364.0402, Table 364.0402.

(2) For any occupancy, provided an engineered design satisfies the ventilation needs of the occupancy, with adequate justification found acceptable by the department.

(From: Council recommendations from 8.4.15)

SECTION 69. SPS 362.1210 (intro) and (1) and (2) and (a) to (c) are renumbered 362.1210 (1) and (a) and (b) and 1. to 3., and as renumbered, 362.1210 is amended to read:

SPS 362.1210 These are department rules in addition to the requirements in IBC section ~~1210.5~~ 1210:

(From: Editorial clarification - IBC section number changed)

SECTION 70. SPS 362.1210 (2) is created to read:

SPS 362.1210 (2) Substitute the following wording for the requirements in IBC section 1210.3.2: Urinals shall be arranged individually with or without partitions.

(From: Editorial clarification - IBC section number changed so the portion of SPS 362.2900 (3) (a) regarding partitions has been moved to 362.1210)

SECTION 71. SPS 362.1405 (1) and (2) are renumbered 362.1405 (2) and (3), and 362.1405 (2), as renumbered, is amended to read:

SPS 362.1405 (2) This is a department exception in addition to the exceptions in IBC section ~~1405.3~~ 1405.3.1: Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities and box sills are provided.

(From: Editorial clarification - IBC section number changed)

SECTION 72. SPS 362.1405 (1) is created to read:

SPS 362.1405 (1) Substitute the following wording for the requirements, but not the exceptions, in IBC section 1405.3.1: Class I and II vapor retarders. Class I or II vapor retarders shall be provided on the interior side of frame walls and ceiling assemblies.

(From: Industry Services recommendation #4)

SECTION 73. SPS 362.1503 is created to read:

SPS 362.1503 Roof drainage. Substitute the following wording for IBC section 1503.4: Design and installation of roof drainage systems shall comply with section 1503 of the IBC and all applicable provisions in chapter SPS 382.

(From: Council recommendations from 9.1.15)

SECTION 74. SPS 362.1509 is renumbered 362.1510 and amended to read:

SPS 362.1510 This is a department ~~informational note to be used under IBC section 509:~~ requirement in addition to the requirements of IBC section 1510.7: Rooftop photovoltaic systems shall meet the requirements in s. SPS 314.01 (2) 3. a. and b.

SECTION 75. SPS 362.1509 (note) is repealed.

(From: Industry Services recommendation #67)

SECTION 76. SPS 362.1607 (1) and (Table) 1607.1 and (2) are amended to read:

SPS 362.1607.1 (1) Substitute the following wording and live loads for the requirements in line ~~27~~ 25 and footnote j of IBC Table 1607.1:

Table 1607.1
Minimum Uniformly Distributed Live Loads
and Minimum Concentrated Live Loads[g]
(Partial Table)

Occupancy or Use	Uniform (psf)	Concentrated (lbs.)
~~27~~ 25. Residential		
Uninhabitable attics without storage [i]	5	
Uninhabitable attics with storage [i, j, k]	20	
Habitable attics	40	--
Hotels and Group R−2		
Private rooms and corridors serving them	40	
Public rooms and corridors serving them	100	

j. For attics with storage and constructed with trusses, this live load need only be applied to those portions of the bottom chord where there are two or more adjacent trusses with the same web configuration capable of containing a rectangle 42 inches high by 2 feet wide or greater, located within the plane of the truss. The rectangle shall fit between the top of the bottom chord and the bottom of any other truss member, provided that each of the following criteria is met:

i. The attic area is accessible by a pull−down stairway or framed opening in accordance with IBC section 1209.2, and

ii. The truss shall have a bottom chord pitch less than 2:12.

iii. Bottom chords of trusses shall be designed for the greater of actual imposed dead load or 10 psf, uniformly distributed over the entire span.

(2) Substitute the following wording for the requirements in IBC section ~~1607.6~~ 1607.7.3: Minimum live loads for garages having trucks or buses shall be as specified in IBC ~~Table 1607.6~~ Section 1607.7.3, but shall not be less than 50 pounds per square foot, unless other loads are specifically justified and approved by the department. Actual loads shall be used where they are greater than the loads specified in the table.

(From: Editorial clarification - IBC section and table classification numbers changed)

SECTION 77. SPS 362.1608 (2) (a) 1. and (b) are amended to read:

SPS 362.1608 (2) (a) 1. Where an existing roof, regardless of the date of its construction, is horizontally within ~~15~~ 20 feet of a proposed, taller structure on the same property, IBC section 1608.1 or an alternate recognized engineering method shall be applied to the existing roof, to address any drifting or sliding of snow onto the existing roof, as caused by the taller structure.

(b) Where an existing roof, regardless of the date of its construction, is horizontally within ~~15~~ 20 feet of a proposed, taller structure on an adjoining property, the owner of the proposed structure shall notify the adjoining owner of the potential for increased structural loads on the existing roof, due to sliding or drifting of snow, as caused by the taller structure.

(From: Council recommendation from 10.6.15)

SECTION 78. SPS 362.1613 is repealed.

(From: Editorial clarification – USGS no longer has the zip code input feature)

SECTION 79. SPS 362.1700 is amended to read:

SPS 362.1700 The requirements in IBC chapter 17, except for the requirements in IBC sections ~~1711 to 1716~~ 1706 to 1709, are not included as part of this code.

(From: Editorial clarification – some IBC section numbers changed and some were deleted)

SECTION 80. SPS 362.1802 is amended to read:

SPS 362.1802 ~~**Definition of neutral plane.**~~ **Definitions.** ~~This is a department definition in~~ In addition to the definitions listed in IBC section 1802.1, the following term has the meaning given in s. SPS 362.0202 (1): ~~NEUTRAL PLANE. A deep foundation's neutral plane is the level at which drag load, accumulated from the top down, added to the long-term static service load, equals the upward acting shaft resistance accumulated from the bottom up, added to the deep foundation's toe resistance.~~ "Neutral Plane."

(From: Council recommendation from 6.2.15)

SECTION 81. SPS 362.1809 (intro) and (1) and (2) are renumbered SPS 362.1809 (1) and (a) and (b).

SECTION 82. SPS 262.1809 (2) is created to read:

SPS 362.1809 (2) This is a department exception in addition to the exception in IBC 1809.5: Floating slabs used with non-masonry, unheated, non-occupied, single-story buildings in Risk Category I that are less than 12,000 square feet are exempt from the requirements for frost protection.

(From: Council recommendation from 10.6.15 and Industry Services recommendation #37)

SECTION 83. SPS 362.1913 is renumbered 362.1908 and amended to read:

SPS 362.1908 Substitute the following wording for the exception under IBC section ~~1913.4.2~~ 1908.4.2: Subject to the approval of the department, required clearances may be reduced where it is demonstrated by preconstruction tests that adequate encasement of the bars used in the design will be achieved.

(From: Editorial clarification –IBC section number changed)

SECTION 84. SPS 362.2103 is repealed.

(From: Council recommendation from 10.6.15)

SECTION 85. SPS 362.2210 is renumbered 362.2211 and amended to read:

SPS 362.2211 The requirements in IBC section ~~2210.3.4~~ 2211.3.3 are not included as part of this code.

SECTION 86. SPS 362.2304 is amended to read:

SPS 362.2304 This is a department rule in addition to the requirements in IBC section ~~2304.11.2.5~~ 2304.12.2.1: A moisture barrier shall be provided between an untreated or nondurable wood girder and an exterior masonry or concrete bearing surface.

(From: Editorial clarifications –IBC section numbers changed)

SECTION 87. SPS 362.2510 is created to read:

SPS 362.2510 This is a department rule in addition to the requirements in IBC section 2510.6: The vertical leg of flashing at the base of a wall with two layers of water-resistive barrier shall be installed behind both layers of water-resistive barrier.

(From: Council recommendation from 10.6.15)

SECTION 88. SPS 362.2900 (3) (b) 1. and 2. are repealed.

(From: Industry Services recommendation #24 and editorial clarification – these are now addressed in exceptions 1 and 2 in IBC section 1210.3.1)

SECTION 89. SPS 362.2900 (3) (title) and (a) are consolidated and renumbered 362.2900 (3) and as renumbered, are amended to read:

SPS 362.2900 (3) ~~ENCLOSURE OF FIXTURES~~ URINALS ~~Water closets and urinals within a toilet room shall be arranged to ensure privacy. Except as provided in par. (b), each water closet shall occupy a separate compartment with walls or partitions and a door enclosing the fixtures to ensure privacy.~~ Urinals shall be placed against walls at least 6 feet 8 inches high ~~and arranged individually with or without partitions~~.

SECTION 90. SPS 362.2900 (3) (b) 3. is renumbered 362.1210 (1) (a) 4.

(From: Industry Services recommendation #24 and editorial clarification)

SECTION 91. SPS 362.2902 (1) (a) 2. is amended to read:

SPS 362.2902 (1) (a) 2. Where ~~water is served in restaurants or other occupancies, or where other acceptable arrangements are made to provide drinking water,~~ drinking fountains are ~~not~~ required, other reasonable alternatives are acceptable.

(From: Industry Services recommendation #45)

SECTION 92. SPS 362.2902 (1) (e) is created to read:

SPS 362.2902 (1) (e) *Alternative to IBC Table 2902.1* This is a department alternative to the minimum fixture requirements of IBC Table 2902.1: The required number of toilet fixtures may be based on the actual occupancy load rather than the load determined by square footage per IBC Table 1004.1.1. The actual occupancy load shall be based on justification found acceptable to the department and deemed reasonable.

(From: Industry Services recommendation #66)

SECTION 93. SPS 362.3002 (title), (intro) and (1) to (3) are renumbered 362.3002 (1) (title), (intro) and (a) to (c).

SECTION 94. SPS 362.3002 (title) is created to read:

SPS 362.3002 Hoistway Enclosures.

SECTION 95. SPS 362.3004 (1) to (3) are renumbered 362.3002 (2) to (4) and amended to read:

SPS 362.3002 (2) This is a department rule in addition to the requirements in IBC section ~~3004.3~~ 3002: A ventilation opening in a hoistway wall, where provided, shall have guards securely anchored to the supporting structure inside the hoistway. The guards shall consist of a wire−mesh screen of at least 0.0915−inch diameter steel wire with openings that will reject a ball one−inch in diameter, or expanded metal screen of equivalent strength and open area.

(3) This is a department rule in addition to the requirements in ~~the exception under~~ IBC ~~3004.3~~ section 3002: Where vent openings automatically open upon detection of smoke in the elevator lobbies or hoistway, upon power failure and upon activation of a manual override control, ~~The~~ the manual override control shall comply with all of the following:

(a) Be a keyed switch of the open−auto−close type with the three positions labeled, that is operated with an FEO−K1 key or other approved key.

(b) Be located adjacent to the elevator hoistway door frame at the level of fire department vehicle access, approximately 48 inches above the floor, or other approved location. This location may be behind a locked panel.

(c) Be labeled "hoistway vent control."

(From: Editorial clarification - hoistway venting is no longer required by the IBC but if provided, should still meet old requirements)

SECTION 96. SPS 362.3004 (3) is renumbered 362.3002 (2) and amended to read:

SPS 362.3002 (4) Substitute the following wording for the requirements and the exception in IBC section ~~3004.4~~ 3002.9:

(From: Editorial clarification - IBC section number changed)

SECTION 97. SPS 362.3006 and (1) to (5) are renumbered 362.3005 and (1) to (5) and amended to read:

SPS 362.3005 (1) SCOPE. This is a department rule in addition to the requirements in IBC section ~~3006~~ 3005: This section applies to elevator machine rooms, machinery spaces, control rooms and control spaces not within the hoistway.

(2) ACCESS. This is a department informational note to be used under IBC section ~~3006.1~~ 3005.1:

(3) TEMPERATURE AND HUMIDITY. Substitute the following wording for the requirements in IBC section ~~3006.2~~ 3005.2: Elevator machine rooms that contain solid−state equipment for elevator operation shall be provided with an independent means to control the temperature and humidity in the machine room.

(4) PRESSURIZATION. This is a department exception to the requirements in IBC section ~~3006.3~~ 3005.3: An elevator machine room which serves a pressurized elevator hoistway and which is not directly connected to the pressurized elevator shaft is not required to be pressurized.

(5) PLUMBING SYSTEMS. Substitute the following wording for the requirements in IBC section ~~3006.6~~ 3005.6: Plumbing systems not used in connection with the operation of the elevator may not be located in elevator equipment rooms.

SECTION 98. SPS 362.3103 is amended to read:

SPS 362.3103 This is a department rule in addition to the requirements in IBC section 3103: Under IBC sections ~~3103.1.1~~ 3103.1.2 and 3103.2, the requirements for permits and construction documents for temporary structures are at the option of the local code official.

(From: Editorial clarifications – IBC section numbers changed)

SECTION 99. SPS 362.3400 is repealed.

(From: Editorial clarifications – IBC chapter eliminated)

SECTION 100. SPS 362.3500 (3) (b) is repealed.

SECTION 101. SPS 362.3500 (3) (c) and (d) are amended to read:

SPS 362.3500 (3) (c) NFPA ~~45–2004~~ 45 - 2015, Standard on Fire Protection for Laboratories Using Chemicals.

(d) NFPA ~~750–2010~~ 750 - 2015, Standard on Water Mist Fire Protection Systems.

SECTION 102. SPS 362.3500 (3) (e) is repealed.

SECTION 103. SPS 362.3500 (3) (f) and (Note) are amended to read:

SPS 362.3500 (3) (f) UL ~~2075–2007~~ 2075 - 2013, Gas and Vapor Detectors and Sensors.

Note: ~~ANSI/ASAE standards may be purchased from the American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085–9659.~~

NFPA standards may be purchased from the National Fire Protection Association, One Batterymarch Park, P.O. Box 9101, Quincy, MA 02269–9101.

UL standards may be purchased for Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062–2096.

Copies of the standards adopted under this section are on file in the offices of the department and the legislative reference bureau.

SECTION 104. SPS 362.3600 (1) is amended to read:

SPS 362.3600 (1) The provisions in IBC Appendices A, B, D, ~~and~~ F to K, and M are not included as part of this code.

(From: Editorial clarification - IBC appendix added)

SECTION 105. SPS 363.002 (1) is amended to read:

SPS 363.002 (1) Where a building includes both residential and commercial occupancies, each occupancy shall be separately considered and meet the applicable provisions of IECC ~~chapter 4~~ residential provisions for residential occupancies or IECC ~~chapter 5~~ commercial provisions for commercial occupancies.

SECTION 106. SPS 363.0100 (Note) is amended to read:

SPS 363.0100 Note: The sections in this chapter are generally numbered to correspond to the numbering used in the IECC, with a 0 to the right of the decimal point referring to the Commercial Provisions and a 5 to the right of the decimal point referring to the Residential Provisions of the IECC, i.e., s. SPS 363.0101 refers to section IECC ~~101~~ C101 and s. SPS 363.5101 refers to section IECC R101..

SECTION 107. SPS 363.0101 is amended to read:

SPS 363.0101 ~~Except for IECC 101.5.2, the~~ The requirements in IECC sections ~~101 and 103 to 109~~ C101, and C103 to C109 are not included as part of this chapter.

SECTION 108. SPS 363.0202 (1) and (2) are amended to read:

SPS 363.0202 (1) This is a department definition for this chapter in addition to the definitions in ~~IMC~~ IECC section ~~202~~ C202: "Effective aperture" or "EA" means for windows, the visible light transmittance times the window wall ratio per wall; and for sky lights, the well efficiency times the visible light transmittance times the sky light area times 0.85 divided by the gross exterior roof area.

(2) Substitute the following definition for the corresponding definition listed in IECC section 202 C202: "Approved" has the meaning given in s. SPS 362.0202 (2).

SECTION 109. SPS 363.0302 is amended to read:

SPS 363.0302 These are department rules in addition to the requirements in IECC section ~~302~~ C302: The exterior design temperatures used for heating and cooling load calculations shall be as specified under Table 363.0302.

SECTION 110. SPS 363.0303 is amended to read:

SPS 363.0303 These are department rules in addition to the requirements in IECC section ~~303~~ C303.

SECTION 111. SPS 363.0401 is renumbered 363.5401 and amended to read:

SPS 363.5401 The requirements in IECC section ~~401.3~~ R401.3 are not included as part of this code.

SECTION 112. SPS 363.0403 and (1) and (2) are renumbered 363.5403 and (1) and (2) and amended to read:

SPS 363.5403 (1) This is a department rule in addition to the requirements in IECC section ~~403~~ R403: In residential buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

(2) Substitute the following wording for the requirements in IECC section ~~403.2.2~~ R403.3.2: All ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with IMC section 603.9.

SECTION 113. SPS 363.0405 and (Note) are renumbered 363.5405 and (Note) and amended to read:

SPS 363.5405 This is a department informational note to be used under IECC section ~~405.6~~ R405.6:

Note: The federal Department of Energy has developed REScheckTM, a computer program that may be used in demonstrating compliance for a residential building which has no more than 3 stories above grade and has 3 or more dwelling units. The REScheck program may be downloaded at http://www.energycodes.gov/. When using the program, the applicable code must be defined as the "~~2009 IECC~~ 2015 IECC." ~~The use of the "Wisconsin" option will apply requirements associated with a 1 or 2 family dwelling, which are more restrictive than those associated with low=rise multifamily buildings.~~

SECTION 114. SPS 363.0501 is renumbered 363.0401 and amended to read:

SPS 363.0401 General application. This is a department rule in addition to the requirements in IECC section ~~501.2~~ R401.2: All of the following rules shall apply regardless of whether the IECC chapter ~~5~~ 4 [CE] or ASHRAE 90.1 standard is used to determine compliance:

(1) Section ~~SPS 363.0503~~ SPS 363.0403 (1) relating to design loads.

(2) Sections ~~SPS 363.0503~~ SPS 363.0403 ~~(3) and~~ (4) relating to economizers.

(3) Section ~~SPS 363.0505~~ SPS 363.0405 relating to lighting systems.

(4) IECC section ~~505.2.2.1~~ C405.2.2.2 relating to dual switching.

SECTION 115. SPS 363.0503 (5) is repealed.

SECTION 116. SPS 363.0503 and (1) to (4) and (6) are renumbered 363.0403 and (1) to (4) and (5) and 363.0503 and (1) to (4) and (a) and (5), as renumbered, are amended to read:

SPS 363.0403 (1) The following wording is a department requirement in addition to the requirements in IECC section ~~503.2.1~~ C403.2.1: Design heating and cooling loads shall be determined in accordance with s. SPS 363.0302 and Table 363.0302.

(2) Substitute the following wording for the requirements and the exceptions in IECC section ~~503.2.2~~ C403.2.2: Heating and cooling equipment and systems shall be sized to provide the minimum space and system loads calculated in accordance with s. SPS 363.0302.

(3) The requirements in IECC ~~sections 503.2.9 to 503.2.9.3~~ section C408 are not included as part of this chapter.

(4) Substitute the following wording for the requirements in IECC section ~~503.3.1~~ C403.3 ~~the first paragraph and Table 503.3.1 (1)~~: Supply air economizers shall be provided on the following cooling systems:

(a) Package roof top units ~~> 33,000Btu/h~~.

(5) Substitute the following wording for the requirements in IECC section ~~503.4.3.3.2.2~~ C403: For climate Zones 5 through 8 as indicated in IECC Figure ~~301.1~~ C301.1 and Table ~~301.1~~ C301.1, if an open−circuit cooling tower is used, then a separate heat exchanger shall be required to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.

SECTION 117. SPS 363.0504 is renumbered 363.0404 and amended to read:

SPS 363.0404 (1) TEMPERATURE CONTROLS. The requirements in IECC section ~~504.3~~ C404.3 are not included as part of this chapter.

(2) HEAT TRAPS. The requirements in IECC section ~~504.4~~ C404.3 are not included as part of this chapter.

(3) ~~POOL COVERS~~ POOLS AND SPAS. The requirements in IECC ~~section 504.7.3~~ sections C404.9.2 and C404.9.3 are not included as part of this chapter.

SECTION 118. SPS 363.0505 is renumbered 363.0405 and amended to read:

SPS 363.0405 (1) CONTROLS. These are department rules in addition to the requirements in IECC section ~~505~~ C405:

(a) *General.* Except as provided in par. (b), daylight zones in any interior enclosed space greater than 250 square feet and a lighting density more than 0.6 W/ft2 shall have at least one control that meets all of the following requirements:

1. Controls only luminaires in the daylight zones.

2. Controls at least 50% of the lamps or luminaires in the daylight zone, in a manner described in IECC section 505.2.2.1.

(b) *Exceptions.* The requirements of this subsection do not apply to any of the following:

1. Daylight zones where the effective aperture of glazing is equal or less than 0.1 for vertical glazing and 0.01 for horizontal glazing.

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

(2) LINE−VOLTAGE LIGHTING TRACK AND PLUG−IN ~~BUSYWAY~~ BUSWAY. Substitute the following for the requirements in IECC section ~~505.5.1.4~~ C405: The wattage of line−voltage lighting track and plug−in busway which allows the addition or relocation of luminaires without altering the wiring of the system shall be the volt−ampere rating of the branch circuit feeding the luminaries or an integral current limiter controlling the luminaires, or the higher of the maximum relamping rated wattage of all of the luminaires included in the system, listed on a permanent factory installed label, or 30 W/linear foot.

SECTION 119. SPS 363.0506 and (Note) are renumbered 363.0406 and (Note) and amended to read:

SPS 363.0406 This is a department informational note to be used under IECC section ~~506~~ C406:

Note: ComCheck is a computer program that may be used only for determining building envelope or lighting compliance. The ComCheck computer program may be downloaded at: http:/www.energycodes.gov/. The most recent version of COMcheck shall be used for demonstration of code compliance. The 2015 IECC option should be selected.

SECTION 120. SPS 363.0900 (1) to (4) are amended to read:

SPS 363.0900 (1) ~~ASTM C177−04~~ ASTM C177-13, Test method for steady−state heat flux measurements and thermal transmission properties by means of the guarded−hot−plate apparatus.

(2) ASTM ~~C335–05~~ C335/C335M-10, Test method for steady state heat transfer properties of horizontal pipe insulation.

(3) ASTM ~~C518–04~~ C518-15, Test Method for steady−state thermal transmission properties by means of the heat flow meter apparatus.

(4) ASTM ~~C1363–05~~ C1363-13, Test method for thermal performance of materials and envelope assemblies by means of a hot box apparatus.

SECTION 121. SPS 363.5101 is created to read:

SPS 363.5101 Administration and Enforcement. The requirements in IECC sections R101, and R103 to R109 are not included as part of this chapter.

SECTION 122. SPS 363.5202 is created to read:

SPS 363.5202 Substitutions. Substitute the following definition for the corresponding definition listed in IECC section R202: "Approved" has the meaning given in s. SPS 362.0202 (2).

SECTION 123. SPS 363.5302 is created to read:

SPS 363.5302 Exterior design conditions. These are department rules in addition to the requirements in IECC section ~~302~~ R302: The exterior design temperatures used for heating and cooling load calculations shall be as specified under Table 363.0302.

SECTION 124. SPS 363.5303 is created to read:

SPS 363.5303 Materials, systems and equipment. These are department rules in addition to the requirements in IECC section R303.

(1) GENERAL. Except as specified in sub. (2), when available, information on thermal properties, performance of building envelope sections, and components and heat transfer shall be obtained from ASHRAE Handbook of Fundamentals.

(2) EXCEPTIONS. (a) When the information is not available from ASHRAE Handbook of Fundamentals, the data shall be obtained from laboratory or field−test measurements. If laboratory or field test measurements are used for envelope heat transmission, the measurements shall be obtained using one of the following test methods:

1. ASTM C177, Test method by guarded hot plate apparatus.

2. ASTM C335, Test method of horizontal pipe insulation.

3. ASTM C518, Test method by means of the heat flow meter apparatus.

4. ASTM C1363, Test method by means of a hot box apparatus.

(b) For foam plastic insulation that incorporates a substance other than air as the insulating medium, laboratory or field tests shall be conducted on representative samples that have been aged for the equivalent of 5 years or until the R–Value has stabilized to determine thermal properties or performance. The tests shall be conducted by an independent third party.

(c) Integrally insulated concrete masonry systems within the scope of the National Concrete Masonry Association (NCMA) shall be evaluated for the thermal performance of the masonry or concrete units in accordance with one of the following:

1. NCMA Evaluation Procedures for the Integrally−Insulated Concrete Masonry Walls.

2. Default values as approved by the department.

(d) All other concrete or masonry units not within the scope of the NCMA Evaluation Procedures shall comply with one of the following methods for determining the thermal performance of the assembly or system:

1. Default values as approved by the department.

2. Laboratory or field−test measurements specified in par. (a).

3. Department material approval process as specified in ch. SPS 361 to determine the U−factor.

(From: Editorial clarifications – IECC section numbers changed)

SECTION 125. SPS 364.0101 is created to read:

SPS 364.0101 Administration. Except for IMC section 102.8, the requirements in IMC chapter 1 are not included as part of this chapter.

SECTION 126. SPS 364.0202 (1) (d) is amended to read:

SPS 364.0202 (1) (d) "Health care facility" means a hospital, nursing home, ~~or~~ outpatient surgical facility, or community based residential facility (CBRF).

(From: Editorial clarification)

SECTION 127. SPS 364.0202 (1) (e) is created to read:

SPS 364.0202 (1) (e) "Living area" means those areas within a dwelling unit involving living rooms, bedrooms, dens, family rooms, and recreation rooms, but not rooms used for cooking, bathing, washing, and sanitation purposes.

(From: Industry Services recommendation #21)

SECTION 128. SPS 364.0301 (3) is amended to read:

SPS 364.0301 (3) Substitute the following wording for the requirements in IMC section ~~301.~~4 301.7:

(From: Editorial clarification – IBC section number changed)

SECTION 129. SPS 364.0306 is repealed.

(From: Council recommendation from 8.4.15)

SECTION 130. SPS 364.0309 (1) and Table 364.0309 are amended to read:

SPS 364.0309 (1) For those interior spaces intended for human occupancy listed in Table 364.0309, the heating system shall be capable of maintaining an ~~inside~~ indoor temperature of not less than that shown in the table at 3 feet above the floor.

Table 364.0309
Alternate Minimum ~~Inside~~ Indoor Temperature

Occupancy Type	Minimum ~~Inside~~ Indoor Temperature (degrees F)
Dry cleaners, laundries, laundry rooms	60
Educational training shops	60
Commercial kitchens	60
Health care facilities, hospitals, nursing homes, ambulatory surgery centers	Footnote a.
Factories and machine shops	60
Foundries	NMR
Sawmills	NMR
Garages at private dwellings	NMR

Automotive service and repair garages	60
Car washes, enclosed:	
Self−serve	NMR
All other types	60
Ice skating rinks (indoor)	NMR
Natatoriums	76
Roller skating rinks (indoors)	60
Storage	NMR
Elevator cars	NMR
Janitor closets	NMR
Locker and dressing rooms	70
Shower rooms	70
Food processing	NMR
Printing	60

NMR = No minimum requirement
a For ~~inside~~ indoor temperature requirements in health care facilities, use American Institute of Architects (AIA) Guidelines for Design and Construction of Hospital and Health Care Facilities.

(From: Industry Services recommendation #12)

SECTION 131. SPS 364.0309 (3) is created to read:

SPS 364.0309 (3) SPOT HEATING. Spot heating may be used to heat individual work stations in industrial buildings in lieu of heating the entire space s specified in IMC 309, provided the design temperature at the fixed work station is at least 60° F.

(From: Industry Services recommendation #5)

SECTION 132. SPS 364.0312 (Note) is amended to read:

SPS 364.0312 Note: For design parameters in the IECC refer to ch. SPS 363 or IECC section ~~503~~ C403.

SECTION 133. SPS 364.0401 (4) (b) is amended to read:

SPS 364.0401 (4) (b) Substitute the following wording for the requirements in IMC section 401.4~~.~~, item 2.: Intake openings shall be located not less than 10 feet horizontally from any hazardous or noxious contaminant source except as specified in IMC section 401.4, item 3 and section 501.3.1.

(From: Industry Services recommendation #62)

SECTION 134. SPS 364.0401 (4) (e) is created to read:

SPS 364.0401 (4) (e) Substitute the following wording for the wording in IMC section 401.4, item 1: Intake openings shall be located a minimum of 10 feet (3048 mm) from lot lines or buildings on the same lot. Where openings front on a street or public way, the distance shall be measured to the centerline of the street or public way.

(From: Council recommendation from 12.1.15)

SECTION 135. SPS 364.0402 Table 364.0402 is amended to read:

Table 364.0402
Natural Ventilation
Allowed for Specific Occupancies

Occupancy Classification		
Correctional Facilities Cells without plumbing features Dining halls < 100 persons Guard stations Day room Booking/waiting **Dry cleaners, laundries** Coin-operated dry cleaners Coin-operated laundries Storage, pick up **Education** Auditoriums < 100 persons Media center Music/theatre/dance Day care facilities < 20 children (through age 4) ~~Lecture < 100 persons~~ Multiuse assembly < 100 persons **Food and beverage service** Bars, cocktail lounges < 100 persons Dining rooms < 100 persons Kitchens (cooking) **Hotels, motels, resorts and dormitories** Multipurpose assembly < 100 persons Bedroom/living room Conference/meeting < 100 persons	**Business areas** Conference rooms < 100 persons Reception areas < 100 persons Main entry lobbies < 100 persons Lecture < 100 persons **Public spaces** Places of religious worship < 100 persons Courtrooms < 100 persons Legislative chambers < 100 persons Libraries < 100 persons Museums < 100 persons Dwellings Garages Kitchens Living areas **Retail stores, sales floors, and showroom floors** Sales Dressing rooms Mall common areas Storage rooms **Specialty shops** Pet shops (animal areas) Supermarkets Car ~~Washes~~ washes Enclosed parking garages 850	**Sports and amusement** Discos/dance floors < 100 persons Bowling alleys (seating areas) < 100 persons Game arcades < 100 persons Ice arenas without combustion Places of religious worship engines < 100 persons Gym, stadium, arena (play area) Spectator areas < 100 persons Swimming pools (pool and deck area) < 100 persons Health club/aerobics room < 100 persons Health club/weight room < 100 persons **Theaters** Auditoriums < 100 persons Lobbies < 100 persons Stages, studios < 100 persons **Transportation** Platforms < 100 persons Waiting rooms < 100 persons Aircraft hangars (with single aircraft and no adjacent occupancies) **Workrooms** Meat processing Pharmacy (prep. area) Photo studios Copy, printing rooms

Dormitory sleeping areas Gambling casinos < 100 persons Lobbies/pre-function	S.F. or less in area and storing 5 or fewer vehicles	

SECTION 136. SPS 364.0403 (5) (d) 1. and (6) are amended to read:

SPS 364.0403 (5) (d) 1. Substitute the following wording for the requirements in IMC sections ~~403.3.1~~ 403.1.1.1 through ~~403.3.2.3.4~~ 403.3.1.1.2.3.4: Where multiple spaces having different ventilation rate requirements are served by a common ventilation system, the minimum amount of outdoor airflow supplied by the ventilation system shall equal the total outdoor airflow required for each space if each space is provided with minimum air changes in accordance with this paragraph.

(6) Substitute the following wording for the requirements in IMC section ~~403.5~~ 403.3.1.3: The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation may be based on the rate per person indicated in Table 364.0403 and the actual number of occupants present.

(From: Editorial clarification – IBC section number changed)

NOTE TO LRB: TABLE 364.0403 HAS HEADINGS THAT ARE UNDERSCORED. ALL OF THESE WERE CHANGED TO BOLD PRIOR TO THE CHANGES SHOWN BELOW SO THAT ADDITIONS AND DELETIONS CAN BE SHOWN WITH STRIKE THROUGHS AND UNDERSCORES. THE HEADINGS SHOULD REMAIN BOLD INSTEAD OF UNDERLINED.

SECTION 137. SPS 364.0403 Table 364.0403 is amended to read:

Table 364.0403
Ventilation Requirements

Occupancy Classification	**Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)**	**Exhaust [c] (cfm/net sq. ft. floor area)**	**Common Ventilation System Alternative – Minimum AC Rate per Hour with A/C**
Correctional Facilities			
Sleeping rooms [d]	20	NR	2.0
Dining halls	100	NR	2.0
Guard stations	40	NR	1.5
Dry cleaners, laundries			
Coin-operated dry cleaners	8	NR	1.0
Coin-operated laundries	8	NR	1.0
Commercial dry cleaners	NA	2.0	NR

Commercial laundries Storage, pick up Apartment laundry rooms	NA 8 NA	2.0 NR 0.5	NR 1.0 NR
Education Auditoriums Classrooms Day care facilities Laboratories Music rooms Special education Training shops	 150 50 30 30 50 35 30	 NR NR NR NR NR NR NR	 2.0 2.0 2.0 2.0 2.0 2.0 2.0
Food and beverage service Bars and cocktail lounges Cafeterias, fast food Dining rooms Kitchens (cooking) [d, c]	 100 100 70 20	 NR NR NR NR	 2.0 2.0 2.0 1.0
Health care facilities Hospitals Nursing homes Outpatient surgical facilities	 See s. SPS 364.0300 See s. SPS 364.0300 See s. SPS 364.0300	 See s. SPS 364.0300 See s. SPS 364.0300 See s. SPS 364.0300	 See s. SPS 364.0300 See s. SPS 364.0300 See s. SPS 364.0300
Hotels, motels, resorts and dorms Assembly rooms Bathrooms for guest rooms [c, d] Bedroom Conference rooms Dormitory sleeping areas Casinos Living rooms Lobbies	 120 NA footnote f 50 20 NA footnote f 30	 NR 35 cfm/room NR NR NR 2.0 NR NR	 2.0 NR 1.0 2.0 1.0 NR 1.0 2.0
Industrial/Factory Factories and machine shops Foundries Sawmills	 13 13 NA	 NR NR NR	 NR NR NR
Office Conference rooms Office spaces Reception areas Telecommunication canters and data entry	 50 7 60 60	 NR NR NR NR	 1.5 1.5 1.5 1.5
~~Private dwellings~~ Dwellings, single and multiple Living areas Kitchens [d] Toilet rooms and bathrooms [d]	 2 persons for first bedroom, plus one person for each additional bedroom NA NA	 NR 100 cfm intermittent or 20 cfm continuous Mechanical exhaust capacity 50 cfm	 1.0 NR NR

		intermittent or 20 cfm continuous per room [j]	
Garages, separated by a solid wall for each dwelling	NA	100 cfm/vehicle	NR
Garages, common for multiple units [c]	NA	0.5	NR
Retail stores, sales floors, and showroom floors	8	NR	1.0
Seasonal occupancies, camps, and lodges			
Dining and recreational areas	~~15~~ 70	NR	1.0
Living and sleeping areas	NA	NR	1.0
Club houses	15	NR	1.0
Drive-ins	15	NR	1.0
Specialty shops			
Automotive service and repair garages for gasoline or diesel fueled vehicles [e]	NA 25	0.5 NR	NR 1.0
Barber shops	NA	0.5	NR
Beauty Salons [h]	NA	NR	NR
Car washes	8	NR	1.0
Clothier, furniture ~~specialty~~ shops	8	NR	1.0
Florist shops	8	NR	1.0
Hardware, drugs, fabrics stores	8	NR	1.0
Supermarkets			
Sports and amusement			
Ballrooms and discos	100	NR	2.0
Bleacher areas	363 or 18 in./person	NR	2.0
Bowling centers (seating areas)	70	NR	2.0
Game rooms	70	NR	2.0
Ice skating rinks (indoor)	5	NR	NR
Natatoriums	NA	2.0 cfm/sq. ft. pool area	NR
Playing floor (gymnasium)	30	NR	2.0
Roller skating rinks (indoor)	30	NR	2.0
Spectator areas	150	NR	2.0
Storage			
Chlorine storage and handling rooms	NA	2.0	NR
Enclosed parking garages [i]	NA	0.5	NR
Warehouses	NA	NR	NR
Theaters			
Auditoriums	150	NR	2.0
Lobbies	150	NR	2.0
Stages, studios	70	NR	2.0
Ticket booths	60	NR	2.0
Transportation			
Platforms	100	NR	2.0
Waiting rooms	100	NR	2.0
Aircraft hangars (for multiple aircraft or hangars with adjacent occupancies)	NA	0.5	NR

Utility and public spaces			
Elevator cars [m]	NA	~~NR~~ 1.0	NR
Janitor closets	NA	2.0 or 75 cfm/sink [g]	NR
Locker and dressing rooms [c]	NA	0.5	NR
Shower rooms	NA	2.0	NR
Toilet rooms [c, d]	NA	75 cfm/TF [g]	NR
Workrooms			
Bank vault	5	NR	NR
Meat processing	10	NR	NR
Pharmacy	20	NR	1.5
Photo studios	10	NR	1.0
Printing	13	footnote [j]	NR

NA = not applicable; NR = none required; cfm = cubic feet per minute; TF = toilet fixtures (water closets and urinals); A/C = air conditioning

a Based upon net floor area.

b The ventilation rate is based upon cubic feet per minute per square foot of the floor area being ventilated.

c Mechanical exhaust is required and the recirculation of air from these spaces that would otherwise be allowed by IMC section 403.2.1 is prohibited.

d ~~Outdoor air shall be provided at the rate of 1.0 cfm/net sq. ft. floor area.~~ Transfer air is permitted in accordance with IMC section 403.2.2.

e The sum of the outdoor and transfer air from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 cfm/sf.

f The minimum mechanical ventilation rate is 15 cfm/room of outside air.

g Natural ventilation may be allowed under this section.

h ~~The classification of a 'beauty' salon depends on the types of services provided. Only beauty salons routinely provide chemical processing of hair to produce texture or color changes, or manicures or other services with a similar need for air-borne contaminant and odor control~~ Exhaust requirements for manicure and pedicure stations shall be addressed per IMC 502.20.

i Enclosed parking garages are parking garages ~~with less than 30% open areas in the total wall area enclosing the garage~~ that fail to meet the criteria for open garages in IBC section 406.5.2. Ventilation systems in enclosed parking garages shall comply with IMC section 404. A mechanical ventilation system shall not be required in garages having a floor area of 850 square feet or less and used for the storage of 5 or fewer motorized vehicles. The requirements for enclosed parking garages shall apply to all buildings, or parts of buildings, into which motor vehicles are driven for loading, unloading, or storage.

j Refer to IMC chapter 5 for exhaust requirements based upon the chemicals used.

SECTION 138. SPS 364.0404 (1) and (2) are amended to read:

SPS 364.0404 (1) Substitute the following wording for the requirements in IMC section ~~404.2~~ 404.1: ~~Automatic operation of the system shall not reduce the~~ A minimum ventilation rate ~~below~~ of 0.05 cfm per square foot of the floor area and ~~the~~ a system ~~shall be~~ capable of producing a ventilation rate of 0.75 cfm per square foot of floor area are required for a minimum of 5 hours per day. The ventilation system shall also meet the requirements of sub. (2).

(2) ~~This is a department alternative to the requirements in IMC sections 404.1 and 404.2:~~ Mechanical ventilation systems for enclosed parking garages ~~are not required to operate continuously where the system conforms~~ shall conform to all of the following:

(From: Industry Services recommendation)

SECTION 139. SPS 364.0407 (title) is repealed.

SECTION 140. SPS 364.0407 is renumbered 364.0401 (1) (a) 3. and amended to read:

SPS 364.0401 (1) (a) 3. ~~This is a department rule in addition to the requirements in IMC section 400:~~ Chemical or septic toilets and composting privies are prohibited in spaces under negative pressure. Toilet rooms with chemical or septic toilets shall be provided with natural ventilation via a window, louver or skylight with at least 2 square feet of area openable directly to the outside. The opening shall be provided with a screen to limit the passage of insects and vermin.

(From: Editorial clarification – no section 400)

SECTION 141. SPS 364.0502 (2) (Note) is amended to read:

SPS 364.0502 Note: Under s. SPS 361.03 (14) (a), IFC section ~~2211.7~~ 2311.7 exempts a natural−gas motor−vehicle repair garage from the requirements of IMC section 502.16 if no work is performed on the fuel system in the vehicles, and the work is also limited to exchanging parts and maintenance that does not include any open flame or welding.

(From: Editorial clarification – IBC section number changed)

SECTION 142. SPS 364.0507 (1) and (2) are amended to read:

SPS 364.0507 (1) Substitute the following wording for the introductory paragraph in IMC section ~~507.13~~ 507.5: Commercial food service hoods shall exhaust a minimum net quantity of air determined either through engineering analysis or in accordance with this subsection and IMC sections ~~507.13.1~~ 507.5.1 through ~~507.13.4~~ 507.5.4. The net quantity of exhaust air shall be calculated by subtracting any airflow supplied directly to a hood cavity from the total exhaust flow rate of a hood. Where any combination of heavy−duty, medium−duty and light−duty cooking appliances are utilized under a single hood, the exhaust rate required by IMC sections ~~507.13.1~~ 507.5.1 through ~~507.13.4~~ 507.5.4 for the heaviest duty appliance covered by the hood shall be used for the entire hood.

(2) The requirements of IMC section ~~507.13.5~~ 507.5.5 are not included as part of this chapter.

(From: Editorial clarification – IBC section numbers changed)

SECTION 143. SPS 364.0602 is amended to read:

SPS 364.0602 Substitute the following wording for the requirements, but not the exceptions, in IMC section 602.2.1: Except as required by Sections 602.2.1.1 through ~~602.2.1.5~~ 602.2.1.6, materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke−developed index of not more than 50 when tested in accordance with ASTM E84, CAN/ULC S102.2 or UL 723.

(From: Editorial clarification – IBC section number changed)

SECTION 144. SPS 364.0701 and (Note) are created to read:

SPS 364.0701 Combustion air. This is a department informational note to be used under IMC chapter 7.

Note: The intent of the IMC is that barometric dampers are not allowed for combustion air.

SECTION 145. SPS 364.0801 (2) is amended to read:

SPS 364.0801 (2) This is a department rule in addition to the requirements in IMC section 801.2: Portable or permanently installed, fuel−fired, unvented heating appliances~~,~~ shall not be installed except during construction or demolition of a building if the appliances are provided in accordance with ch. SPS 314.

(From: Editorial clarification – incomplete sentence)

SECTION 146. SPS 364.1500 (2) (a) is amended to read:

SPS 364.1500 (2) (a) FGI Guidelines for Design and Construction of ~~Health Care Facilities, 2010~~ Hospitals and Outpatient Facilities, 2014.

SECTION 147. SPS 364.1500 (2) (am) is created to read:

SPS 364.1500 (2) (am) FGI Guidelines for Design and Construction of Residential Health, Care, and Support Facilities, 2014.

(From: Recommendations from DHS/DQA)

SECTION 148. SPS 366.0101 (2) is amended to read:

SPS 366.0101 (2) (a) Except as provided in par. (b), where a building or portion of a building that has not been previously occupied or used as a public building or place of employment is to be changed to an occupancy or use that constitutes a public building or place of employment, the building or portion of a building shall comply with ~~the IBC for new construction~~ IEBC Chapter 14, Performance Compliance Methods.

(From: Recommendation from Tom Kasper)

SECTION 149. SPS 366.0101 (3) and (a) to (d) are renumbered 366.0101 (3) (a) and 1. to 4.

SECTION 150. SPS 366.0101 (3) (b) is created to read:

SPS 366.0101 (3) (b) Locally permitted temporary uses may be over-ridden by state corrective building orders.

(From: Recommendation from Tom Kasper)

SECTION 151. SPS 366.0101 (4) (b) and (c) are amended to read:

SPS 366.0101 (4) (b) Repairs, alterations, additions, changes in occupancy, and relocated buildings complying with the applicable requirements of IEBC chapters 4 5 through ~~12~~ 13 shall be considered in compliance with the provisions of this code.

(c) Repairs, alterations, additions, changes in occupancy, and relocated buildings complying with IEBC chapter ~~13~~ 14 shall be considered in compliance with the provisions of this code.

(From: Editorial clarification – IEBC chapter numbers changed)

SECTION 152. SPS 366.0202 is created to read:

SPS 366.0202 Definitions. Substitute the following definition for the corresponding definition in IEBC section 202: "Work area" means that portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code. The work area is the area reconfigured with full height walls and the area that has its required egress reconfigured.

(From: Recommendation from Tom Kasper)

SECTION 153. SPS 366.0300 is renumbered 366.0400 and amended to read:

SPS 366.0400 The requirements in IEBC Chapter ~~3~~ 4 are not included as part of this code, except for the requirements in IEBC Section ~~310~~ 410 when applied by IEBC Section ~~1301.2.5~~ 1401.2.5.

SECTION 154. SPS 366.0500 is renumbered 366.0600 and amended to read:

SPS 366.0600 These are department rules in addition to the requirements in IEBC chapter ~~5~~ 6 and are established under the authority of s. 101.127, Stats.:

SECTION 155. SPS 366.0506 is renumbered 366.0606 and amended to read:

SPS 366.0606 The requirements in IEBC sections ~~506.2~~ 606.2 to ~~506.2.5~~ 606.2.5 are not included as part of this code.

SECTION 156. SPS 366.0509 is renumbered 366.0609 and amended to read:

SPS 366.0609 The requirements in IEBC section ~~509~~ 609 are not included as part of this code.

SECTION 157. SPS 366.0602 and (1) and (2) is renumbered 366.0702 and (1) and (2) and amended to read:

SPS 366.0702 (1) MATERIALS AND METHODS. Substitute the following wording for the requirements in IEBC section ~~602.4~~ 702.4: All new work shall comply with materials and methods requirements in the IBC, IECC, IFGC, IMC, and IPC, as applicable, that specify material standards, detail of installation and connection, joints, penetrations, and continuity of any element, component, or system in the building.

(2) INTERNATIONAL FUEL GAS CODE. The requirements in IEBC section 602.4.1 are not included as part of this code.

SECTION 158. SPS 366.0604 is renumbered 366.0704 and amended to read:

SPS 366.0704 This is a department rule in addition to the requirements in IEBC section ~~604~~ 704: Where installing an inclined platform lift or stairway chairlift, the clear−passage width shall be provided with the lift in the unfolded, usable position — except where an existing, previously approved lift is being replaced, the clear−passage width may remain as it was with the original lift in place, but it may not be reduced by the replacement.

(From: Editorial clarifications – IEBC chapter numbers changed)

SECTION 159. SPS 366.0605 is repealed and recreated to read:

SPS 366.0605 Accessibility. Substitute the following wording for the requirements in IEBC section 605.1: General. Repairs shall be done in a manner that maintains any required accessibility in accordance with IEBC section 705.1.13.

(From: IEBC now includes these provisions which were taken from the 2012 IECC and recommendation from Tom Kasper)

SECTION 160. SPS 366.0607 is repealed.

(From: IEBC now includes these provisions which were taken from the 2012 IECC)

SECTION 161. SPS 366.0701 is created to read:

SPS 366.0701 General. Substitute the following wording for the requirements in IEBC section 701.2: Conformance. An existing building or portion thereof shall not be altered such that the building becomes less safe than was required in its existing condition.

SECTION 162. SPS 366.0703 is created to read:

SPS 366.0703 Fire Protection. Substitute the following wording for the requirements in IEBC section 703.1: General. Alterations shall be done in a manner that maintains the level of fire protection required prior to the alteration.

(From: Recommendation from Tom Kasper)

SECTION 163. SPS 366.0704 is renumbered 366.0804 and amended to read:

SPS 366.0804 This is a department exception to the requirement in IEBC section ~~704.2~~ 804.2: The installation or extension of an automatic sprinkler system may exclude the protection of combustible concealed spaces that are not accessible in existing buildings. This exclusion is also applicable to sprinkler systems triggered by changes of use or additions.

(From: Editorial clarifications – IEBC chapter numbers changed and recommendation from Tom Kasper)

SECTION 164. SPS 366.0704 is created to read:

SPS 366.0704 Means of Egress. Substitute the following wording for the requirements in IEBC section 704.1: General. Alterations shall be done in a manner that maintains the level of protection required for the means of egress prior to the alteration.

(From: Recommendation from Tom Kasper)

SECTION 165. SPS 366.0709 is renumbered 366.0809 and amended to read:

SPS 366.0809 The exception to the requirements in IEBC section ~~709.1~~ 809.1 and the requirements in IEBC section ~~709.2~~ 809.2 are not included as part of this code.

SECTION 166. SPS 366.0710 is renumbered 366.0810 and amended to read:

SPS 366.0810 Substitute the following wording for the requirements in IEBC section ~~710.1~~ 810.1: Where the occupant load of a story is increased by more than 20 percent, plumbing fixtures for the story shall be provided in quantities specified in the IBC based on the increased occupant load.

(From: Editorial clarifications – IEBC chapter numbers changed)

SECTION 167. SPS 366.0711 is repealed.

(From: IEBC now includes these provisions which were taken from the 2012 IECC)

SECTION 168. SPS 366.0802 is renumbered 366.0902 and amended to read:

SPS 366.0902 The requirements in IEBC section ~~802.2.1~~ 902.2.1 are not included as part of this code.

SECTION 169. SPS 366.0803 is created to read:

SPS 366.0803 Building elements and materials. Substitute the following wording for the requirements in IEBC section 803.2.1: All existing interior vertical openings in the work area connecting two or more floors shall be enclosed with approved assemblies having a fire resistance rating of not less than one hour with approved opening protectives.

(From: Recommendation from Tom Kasper)

SECTION 170. SPS 366.0808 is repealed.

(From: IEBC now includes these provisions which were taken from the 2012 IECC)

SECTION 171. SPS 366.0809 is renumbered 366.0909 and amended to read:

SPS 366.0909 These are department rules in addition to the requirements in IEBC chapter ~~8~~ 9:

SECTION 172. SPS 366.0901 and (1) to (3) are renumbered 366.1001 and (1) to (3) and amended to read:

SPS 366.1001 (1) CHANGE ~~IN~~ OF OCCUPANCY ~~WITH NO OCCUPANCY CLASSIFICATION~~. Substitute the following wording for the requirements in IEBC section ~~901.2~~ 1001.2: A change ~~in~~ of occupancy~~, as defined in IEBC section 202, with no~~ or a change of occupancy ~~classification~~ within a space where there is a different fire protection system threshold requirement in Chapter 9 of the International Building Code may not be made to any structure ~~that will subject the structure to any special provisions of this code, including the provisions of IEBC sections 902 through 911,~~ without the approval of the code official. An increased occupant load may trigger additional means of egress or fire protection requirements.

(2) CHANGE OF OCCUPANCY CLASSIFICATION. This is a department rule in addition to the requirements in IEBC section ~~901.3~~ 1001.2.2: Buildings undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with the IECC.

(3) CERTIFICATION OF OCCUPANCY REQUIRED. The requirements in IEBC section ~~901.4~~ 1001.3 are not included as part of this code.

(From: Editorial clarifications – IEBC chapter and section numbers and section titles changed, section content changed, and recommendation from Tom Kasper)

SECTION 173. SPS 366.0901 (4) is renumbered 366.1012 and amended to read:

SPS 366.1012 Standpipe systems. This is a department rule in addition to the requirements in IEBC section ~~912.2~~ 1012.2: Standpipe systems shall be provided in existing buildings and structures or portions of existing buildings and structures in accordance with chapter 9 of the IBC when existing buildings or structures that are greater than 60 feet in height are changed to include a Group R−1 or R−2 occupancy.

SECTION 174. SPS 366.0902 is created to read:

SPS 366.0902 Boiler and furnace equipment rooms. Substitute the following wording for the requirements, but not the exceptions, in IEBC section 902.2: Boiler and furnace equipment rooms. Boiler and furnace equipment rooms adjacent to or within Groups I-1, I-2, I-4, R-1, R-2 and R-4 occupancies shall be enclosed in compliance with IBC 509 heating equipment enclosure requirements.

(From: Recommendation from Tom Kasper)

SECTION 175. SPS 366.0911 is renumbered 366.1011 and amended to read:

SPS 366.1011 (1) ELEVATOR RECALL. This is a department rule in addition to the requirements in IEBC section ~~911~~ 1011: At least one existing elevator shall be provided with emergency recall operation and emergency in−car operation complying with ch. SPS 318 when an existing building or structure that is greater than 60 feet in height is changed to include a Group R−1 or R−2 occupancy.

(2) CARBON MONOXIDE ALARMS. This is a department rule in addition to the requirements in IEBC section ~~911~~ 1011: A building or a portion of a building changed to be or include a residential building as defined under s. 101.149 (1) (b), Stats., shall be provided with carbon monoxide alarms or detectors in accordance with s. SPS 362.1200.

SECTION 176. SPS 366.0912 is renumbered 366.1010 and amended to read:

SPS 366.1010 Substitute the following wording for the requirements in IEBC section ~~910~~ 1010: Where the occupant load of a story is increased by more than 20 percent, plumbing fixtures for the story shall be provided in quantities specified in the IBC based on the increased occupant load.

SECTION 177. SPS 366.1002 is renumbered 366.1102 and amended to read:

SPS 366.1102 This is a department exception to the requirements in IEBC section ~~1002.3~~ 1102.3: An automatic sprinkler system is not required for additions to individual dwelling units within existing townhouses that are not already protected with an automatic sprinkler system.

(From: Editorial clarifications – IEBC chapter numbers changed)

SECTION 178. SPS 366.1012 and (1) and (2) are created to read:

SPS 366.1012 Change of Occupancy Classification. (1) This is a department requirement in addition to the requirements in IEBC section 1012.1.1: The provision of chapters 7 to 9 of the IEBC are applicable to the work area.

(2) Substitute the following wording for the requirements, but not the exceptions, in IEBC section 1012.2.1: Fire sprinkler system. Where a change in occupancy classification occurs or where there is a change of occupancy within a space where there is a different fire protection system threshold requirement in Chapter 9 of the International Building Code that requires an automatic fire sprinkler system to be provided based on the new occupancy in accordance with Chapter 9 of the *International Building Code*, such system shall be provided throughout the work area.

(From: Recommendations from Tom Kasper)

SECTION 179. SPS 366.1101 is renumbered 366.1201 and amended to read:

SPS 366.1201 (1) SCOPE. This is a department rule in addition to the requirements in IEBC section ~~1101.1~~ 1201.1: Any historic building is exempt from the energy requirements of this code.

(2) REPORT. The requirements in IEBC section ~~1101.2~~ 1202.2 are not included as part of this code.

(From: Editorial clarifications – IEBC chapter numbers changed)

SECTION 180. SPS 366.1102 is created to read:

SPS 366.1102 This is a department exception in addition to the exception in IEBC section1102.2: Buildings meeting the legacy Wisconsin unlimited area provisions are allowed to have unlimited area additions per the current code without a separating firewall.

(From: Recommendations from Tom Kasper)

SECTION 181. SPS 366.1105 is renumbered 366.1205 and 366.1205 (intro) as renumbered, is amended to read:

SPS 366.1205 (intro) These are department rules in addition to the requirements in IEBC section ~~1105~~ 1205: Historic buildings to be used as exhibit buildings shall comply with all of the following requirements:

SECTION 182. SPS 366.1204 is created to read:

SPS 366.1204 Historic buildings. Historic buildings shall not be required to comply with the International Energy Conservation Code for building envelope compliance except as follows:

(1) Existing ceiling, wall or floor cavities exposed during alterations shall be filled with insulation.

(2) All replacement skylight, window and/or door assemblies shall meet the minimum code requirements of the International Energy Conservation Code unless specifically designed to address unique aesthetics associated with the historic nature of the building. Glass only replacements in an existing sash and frame are exempt from the application of the IECC.

(3) Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.

(From: Recommendations from Industry Services)

SECTION 183. SPS 366.1301 is renumbered 366.1401 and amended to read:

SPS 366.1401 ~~**Applicability**~~ **General** **(1)** APPLICABILITY. Substitute the following wording for the requirements in IEBC section ~~1301.2~~ 1401.2: The provisions of sections ~~1301.2.1~~ 1401.2.1 through ~~1301.2.5~~ 1401.2.5 shall apply to existing occupancies that will continue to be, or are proposed to be, in Groups A, B, E, F, M, R and S. These provisions shall not apply to buildings with occupancies in Group H or Group I.

(2) ACCESSIBILITY REQUIREMENTS. Substitute the following wording for the requirements in IEBC section ~~1301.2.5~~ 1401.2.5: All portions of the buildings proposed for change of occupancy or being altered shall conform to the accessibility provisions of IEBC section 310.

(3) OTHER CODES. The requirements in IEBC section ~~1301.3.2~~ 1401.3.2 are not included as part of this code.

SECTION 184. SPS 366.1401 (4) is created to read:

SPS 366.1401 (4) Minimum plumbing fixtures. This is a department rule in addition to the requirements in IEBC section 1401.2: Where the occupant load of a story is increased by more than 20 percent, plumbing fixtures for the story shall be provided in quantities specified in the IBC based on the increased occupant load.

(From: Recommendations from Tom Kasper)

SECTION 185. SPS 366.1400 is renumbered 366.1500 and amended to read:

SPS 366.1500 The requirements in IEBC chapter ~~14~~ 15 are not included as part of this code.

(From: Editorial clarifications – IEBC chapter numbers changed)

SECTION 186. Chapters SPS 361 – 366 Appendix A is deleted.

(From: Industry Services recommendation #77)

SECTION 187. Chapters SPS 361 – 366 Appendix B is renumbered SPS 361 to 366 Appendix B.

(From: Editorial clarification)

SECTION 188. EFFECTIVE DATE. The rules adopted in this order shall take effect on the first day of the month following publication in the Wisconsin administrative register, pursuant to s. 227.22 (2) (intro.), Stats.

File reference: SPS 361-366/partial proposed draft language 10

Chapter ATCP 93

FLAMMABLE, COMBUSTIBLE AND HAZARDOUS LIQUIDS

Note: Chapter Ind 8 as it existed on March 31, 1982 was repealed and a new chapter Ind 8 was created effective April 1, 1982; Chapter Ind 8 as it existed on April 30, 1991 was repealed and recreated as chapter Comm 10 effective May 1, 1991; corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, October, 1996, No. 490; chapter ILHR 10 was renumbered chapter Comm 10 under s. 13.93 (2m) (b) 1., Stats. and corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, February, 1999, No. 518. Chapter Comm 10 as it existed on January 31, 2009 was repealed and a new Chapter Comm 10 was created Register November 2008 No. 635, effective February 1, 2009. Chapter Comm 10 was renumbered chapter SPS 310 under s. 13.92 (4) (b) 1., Stats., Register December 2011 No. 672. **Chapter SPS 310 was renumbered Chapter ATCP 93 under s. 13.92 (4) (b) 1., Stats., Register October 2013 No. 694, pursuant to 2013 Wis. Act 20, section 9138 (3) (fm) and (4) (f).**

ATCP 93.010 Purpose. The purpose of this chapter is as follows:

(1) In accordance with ss. 101.02 (15) (a) and 101.14 (1) (a), Stats., to provide fire and life safety through the safe storage, display, installation, operation, use, maintenance and transportation of flammable, combustible and hazardous liquids and the equipment, facilities, buildings and premises that are used to store, transfer and dispense them.

Note: Section 101.02 (15) (a) of the Statutes reads in part:

The department has such supervision of every employment, place of employment and public building in this state as is necessary adequately to enforce and administer all laws and all lawful orders requiring such employment, place of employment or public building to be safe, and requiring the protection of the life, health, safety and welfare of every employee in such employment or place of employment and every frequenter of such place of employment, and the safety of the public or tenants in any such public building.

Note: Section 101.14 (1) (a) of the Statutes reads as follows:

The department may make reasonable orders for the repair or removal of any building or other structure which for want of repair or by reason of age or dilapidated condition or for any other cause is especially liable to fire, and which is so situated as to endanger other buildings or property and for the repair or removal of any combustible or explosive material or inflammable conditions, dangerous to the safety of any building or premises or the occupants thereof or endangering or hindering fire fighters in case of fire.

(2) To comply with s. 168.23 (1), Stats.

Note: Section 168.23 (1) of the Statutes reads in part:

The department shall promulgate by rule construction, maintenance and abandonment standards applicable to tanks for the storage, handling or use of liquids that are flammable or combustible or are federally regulated hazardous substances, and to the property and facilities where the tanks are located, for the purpose of protecting the waters of the state from harm due to contamination by liquids that are flammable or combustible or are federally regulated hazardous substances.

Note: The definition of federally regulated hazardous substances in section 168.21 (3) of the Statutes corresponds to the CERCLA List of Hazardous Substances and Reportable Quantities contained in 40 CFR 302.4, Table 302.4.

Note: The definition of "waters of the state," as used in section 168.21 of the Statutes, is found in section 281.01 (18) of the Statutes, and reads as follows:

"Waters of the state" includes those portions of Lake Michigan and Lake Superior within the boundaries of this state, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other surface water or groundwater, natural or artificial, public or private, within this state or its jurisdiction.

(3) To comply with the flammable and combustible liquid related provisions of subtitle I of the federal Hazardous and Solid Waste Amendments of 1984, Public Law 98−616, which extended and strengthened the provisions of the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act, also known as RCRA, of 1976 as contained in 42 USC 6912 and 6991.

(4) In accordance with s. 168.16, Stats., to establish standards for storing and dispensing motor fuel in a manner that does not compromise any minimum product grade specifications achieved under ch. ATCP 94.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2), (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.020 Scope and application. (1) NEW FACILITIES AND STRUCTURES. (a) The provisions of this chapter apply to all new facilities and structures and to new additions to facilities and structures that involve storage, transfer or dispensing of flammable, combustible or hazardous liquids, except as specified in par. (b).

(b) Plan approvals issued by an authorized agent or the department for viable plans received prior to February 1, 2009, shall remain valid until six months after that date, or until two years after the approval date shown on the plans, whichever occurs first. Any construction shown on those plans that is not commenced by that date, at the address shown on those plans, shall comply with the rest of this chapter's requirements for new facilities and structures.

(2) ALTERATIONS TO FACILITIES AND STRUCTURES. The provisions of this chapter apply to new remodeling and alterations — for any flammable, combustible or hazardous liquid facility or structure — that are integral to storage, transfer or dispensing of flammable, combustible or hazardous liquids, including remodeling and alterations which affect fire hazard, release mitigation or replacement of major equipment, except as specified in sub. (1) (b).

(3) EXISTING FACILITIES AND STRUCTURES. (a) All elements, systems or components of an existing facility or structure that are integral to storage, transfer or dispensing of flammable, combustible or hazardous liquids shall be maintained to conform with the requirements of this chapter that applied when the facility, structure, element, system or component was constructed, unless specifically stated otherwise in this chapter.

(4) CHANGE IN OPERATION. If the operation of an existing facility or structure is changed to an operation regulated by this chapter, the facility or structure shall be made to comply with the requirements for the new operation as provided in this chapter.

(5) GROUNDWATER PROTECTION AND FIRE SAFETY PROVISIONS. (a) Under ss. 101.14 (1) (a), 168.21 to 168.26, Stats., the groundwater protection and fire safety provisions of this chapter apply to all new and existing flammable, combustible or hazardous liquid facilities and structures even if the facility or structure is not undergoing remodeling, alteration or a change of operation.

Note: Examples of groundwater protection provisions include requirements for leak detection, secondary containment, corrosion protection, and spill and overfill protection. Some of these provisions, such as the spill and overfill protection requirements, are also fire safety provisions.

Note: Existing facilities are affected in this manner by these provisions because under section 168.23 (1) of the Statutes, this chapter "may include different standards for new and existing tanks, but all standards shall provide substantially similar protection for the waters of the state;" and because section 101.14 (1) (a) of the Statutes addresses dangerous conditions at both new and existing facilities. For a reprint of section 101.14 (1) (a) of the Statutes, see the second Note under section ATCP 93.010 (1).

(b) The rules of this chapter apply to tanks located at US EPA superfund sites.

(6) EXCLUSIONS. The following tanks, containers, tank systems and facilities are not regulated under this chapter:

(a) Underground storage tanks that have a capacity of less than 60 gallons.

(b) Aboveground storage tanks and intermediate bulk containers that have a capacity of less than 110 gallons.

(c) Tanks storing products regulated under ch. ATCP 33 that are located either at facilities which are also regulated under ch. ATCP 33 or on farm premises.

Note: Chapter ATCP 33 addresses bulk storage of pesticides and fertilizers.

(d) Aboveground storage tanks storing liquids that are used in processes covered in any of the following standards:

1. NFPA 33 Spray Application Using Flammable or Combustible Materials.

2. NFPA 34 Dipping & Coating Processes Using Flammable or Combustible Liquids.

3. NFPA 35 Manufacture of Organic Coatings.

4. NFPA 45 Fire Protection for Laboratories Using Chemicals.

(e) Dedicated breakout tanks that are located at pipeline facilities.

(f) Odorant or other additive injection tanks that are directly connected to a pipeline.

(g) Contractor tanks that are mounted on pickup trucks.

(h) Oil−filled electrical equipment and transformers.

(i) Accumulator tanks.

(j) Process tanks.

(k) Product recovery tanks.

(L) Service tanks.

(m) Marine fueling facilities where fuel is stored and dispensed into the fuel tanks of marine craft of 300 gross tons or more.

(n) Aboveground or underground tank systems that store nonflammable and noncombustible hazardous liquids in concentrations of less than 1 percent by volume.

Note: Material Safety Data Sheets (MSDS) should be consulted for flash point and concentration.

(o) Aboveground tank systems which have a capacity of less than 5,000 gallons and which store nonflammable and noncombustible hazardous liquids in concentrations of 1 percent or more by volume.

Note: Material Safety Data Sheets (MSDS) should be consulted for flash point and concentration.

(p) Tank systems that store a hazardous waste which is listed or identified under subtitle C of the federal Solid Waste Disposal Act, or a mixture of such hazardous waste and other regulated substances that is nonflammable and noncombustible.

(q) Any wastewater treatment tank system that is part of a wastewater treatment facility regulated under section 307 (b) or 402 of the federal Clean Water Act.

(r) Underground storage tank systems that contain radioactive material which is regulated under the federal Atomic Energy Act of 1954.

Note: The Atomic Energy Act of 1954 is contained in 42 USC 2011 et seq.

(s) Underground storage tank systems that are part of an emergency generator system at nuclear power generation facilities regulated by the Nuclear Regulatory Commission under 10 CFR 50 Appendix A.

(t) Asphalt−plant AC tanks which are used as burner or material−supply tanks in the process of making asphalt and which comply with all of the following:

1. Tank configurations are single−wall or double−wall, with or without heating coils.

2. The products stored in the tank are Class II or III liquids ranging from heating oil to used oil, to #4 or #5 heavy oils.

3. The asphalt process equipment and the tank are typically located at an isolated location, such as a quarry, and are generally relocated from year to year or every couple of years.

(u) 1. Facilities located on Indian reservation land that are held either in trust by the United States, or in fee by the tribe or a tribal member.

2. Facilities which are located on off−reservation Indian land that is held in trust by the United States, and which are held either in trust by the United States, or in fee by the tribe or a tribal member.

Note: Chapter SPS 314 has fire prevention requirements that may apply to tanks which are not regulated by chapter ATCP 93, such as service tanks, and to portable tanks or containers which have a capacity of less than 110 gallons and which are used for flammable or combustible liquids, or for other liquids that are hazardous. Also, in conjunction with addressing the quality and retail sales of petroleum products, chapter ATCP 94 regulates containers which have a capacity of less than 275 gallons and which are used for storing gasoline or any other petroleum product that has a flash point of less than 100°F. ATCP 94 requires these containers to be colored red and appropriately labeled, and prohibits using red containers for storing petroleum products that have a flash point of 100°F or more.

(7) DIFFERING RULES. (a) Where any department−written rule in this chapter differs from a requirement within a standard referenced in this chapter, the department−written rule shall govern.

(b) Where a rule prescribes a general requirement and another rule 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).

(8) LOCAL REGULATIONS. (a) This chapter does not limit the power of municipalities to make or enforce additional or more stringent regulations, provided the regulations do not conflict with this chapter or with any other rule of the department, except as provided in par. (b).

(b) A first class city may apply different requirements for administering plan review and inspections by the city.

Note: As of February 1, 2009, only the City of Milwaukee had become a first class city.

(9) RETROACTIVITY. The provisions of this chapter are not retroactively applied to existing facilities unless specifically stated in the administrative rule.

(10) INTERPRETATIONS. Under s. 168.23, Stats., the department reserves the right to interpret the requirements in this chapter and in all adopted codes and standards.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; **correction in (5), (10) made under s. 13.92 (4) (b) 7, Stats., Register October 2013 No. 694.**

ATCP 93.050 Definitions. In this chapter:

(1) "Aboveground storage tank" or "AST" means any vessel that has a liquid capacity of 110 gallons or more, is intended for fixed installation, is not solely used for processing, and does not meet the definition of an underground storage tank.

(2) "Accessible to the public" means any whole or part of property that due to its location and commercial or public purpose, the public or a section of the public has or may reasonably be expected to have access to.

(3) "Aircraft" has the meaning given in s. 114.002 (3), Stats.

Note: Section 114.002 (3) of the Statutes reads as follows:

"Aircraft" means any contrivance invented, used or designed for navigation of or flight in the air, but does not include spacecraft.

(4) "Airport" means any area of land or water that is designed for the landing and take−off of aircraft, regardless of whether buildings are provided for the shelter, servicing, or repair of aircraft or for receiving or discharging passengers or cargo, and all appurtenant areas used or suitable for aircraft, and all appurtenant rights of way, whether new or existing, which are either public, private or federal.

(5) "Alteration" means any modification to an installed tank system that involves cutting, drilling or welding on the tank shell or associated piping.

(6) "Ancillary equipment" means any device, including such devices as piping, fittings, flanges, valves, and pumps, that is used to distribute, meter, or control the flow of regulated substances to and from a storage tank.

(7) "Annual" means a period of time less than or equal to 365 calendar days.

(8) "Approved" means acceptable to the department.

(9) "ATV" or "all−terrain vehicle" means a self−propelled motor−driven vehicle with wheels or tracks, used to transport people on land, snow, ice or water for purposes of sport or recreation and which cannot be licensed through the department of transportation for highway use.

(10) "Authorized agent" means either a local program operator or a first class city, or their authorized representatives.

Note: See subsection (66) for a definition of local program operator. As of February 1, 2009, only the City of Milwaukee had become a first class city.

(11) "Automatic leak detection" means a release or leak detection or monitoring system that will provide continuous 24 hour monitoring for the detection of a release or leak of vapor or product and immediately communicate the detection of the release or leak to an electronic signaling device.

(12) "Automatic line leak detection" means a method of leak detection which alerts the operator to the presence of a leak without any manual effort on the part of the operator, including a device or mechanism that signals the presence of a leak by restricting or shutting off the flow of a hazardous substance through piping, or by triggering an audible or visual alarm, and which detects leaks of 3 gallons per hour at 10 psi line pressure within 1 hour.

(13) "Authority having jurisdiction" means the department or an authorized agent or deputy responsible for approving equipment, installations or procedures.

(14) "Biodiesel fuel" means a fuel that is comprised of monoalkyl esters of long chain fatty acids derived from vegetable oils or animal fats.

Note: Under section 168.14 (2m) (b) 2. of the Statutes, pure biodiesel fuel is generally identified with the alphanumeric B100, and does not contain any petroleum product, any additive, or other foreign material. A fuel that is a blend of biodiesel and petroleum−based fuel generally has a volume percentage of the biodiesel fuel to the petroleum−based fuel of at least 2 percent. B20 would identify a blend as being 20 percent biodiesel and 80 percent petroleum−based fuel, by volume.

(15) "Bulk plant" means a facility where flammable or combustible liquids are stored or blended in bulk, prior to further distribution.

(16) "Business day" means any day Monday to Friday, excluding Wisconsin legal holidays.

(17) "CERCLA" means the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended.

(18) "Certified cathodic protection tester" means a person certified in accordance with ch. SPS 305 who demonstrates an understanding of the principles and measurements of all common types of cathodic protection systems as applied to buried or submerged metal piping systems and metal tanks.

(19) "Certified corrosion expert" means a person certified in accordance with ch. SPS 305 who is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks by reason of thorough knowledge of the physical sciences and the principles of engineering and mathematics acquired by a professional education and related practical experience.

(20) "Certified tank system inspector" means a person certified in accordance with ch. SPS 305 to inspect storage tank systems.

(21) "Certified installer" means either of the following:

(a) For aboveground tank systems, a person certified in accordance with ch. SPS 305 to install and repair aboveground storage tank systems — and for underground tank systems, a person certified in accordance with ch. SPS 305 to install and repair underground storage tank systems.

(b) A registered professional engineer who directly supervises an installation by being present during the activities specified in s. SPS 305.84 (5) or 305.85 (5), and who is competent in the engineering methods and requirements in Wisconsin for designing and installing storage tank systems for flammable, combustible or hazardous liquids, except the registration requirement does not apply where exempted under s. 443.14, Stats.

(22) "Certified remover−cleaner" means a person certified in accordance with ch. SPS 305 to remove storage tank systems and to remove accumulated sludge and remaining product from tanks that are to be closed, undergo a change in service, or otherwise be completely emptied and made inert.

(23) "Certified tank system liner" means a person certified in accordance with ch. SPS 305 to install interior linings for storage tanks.

(24) "Certified tank−system site assessor" means a person certified in accordance with ch. SPS 305 to conduct tank−system site assessments and to collect samples necessary for those assessments.

(25) "Certified tank system tightness tester" means a person certified in accordance with ch. SPS 305 to perform precision tightness testing to determine the presence of leaks in storage tank systems.

(26) "Change in service" means continued use of a storage tank system in another status; or continued use of a tank that previously stored a regulated substance, to store a non−regulated substance.

Note: An example of change−of−service resulting from another status is an "In−use" tank that moves to "Temporary−out−of service" status. An example of change−of−service resulting from previously storing a regulated substance, to storing a non−regulated substance is a tank that is converted from storing heating oil to storing water.

(27) "Class I liquid" means a flammable liquid.

Note: See subsection (30) and Note for Class II and III liquids.

(28) "Cleaned tank system" means a tank system that is free of all residue and vapors.

(29) "Closure" means the procedure by which a tank system is evaluated and permanently rendered safe from contributing to human danger, fire, explosion, and environmental contamination.

(30) "Combustible liquid" means a liquid having a flash point at or above 100°F.

Note: Under NFPA 30 section 4.3.2, combustible liquids are further classified as being Class II, IIIA or IIIB liquids.

(31) "Connected piping" means all underground piping including valves, elbows, joints, flanges, and flexible connectors attached to a tank system through which regulated substances flow.

Note: For the purpose of determining how much piping is connected to any individual underground storage tank system, the piping that joins 2 underground storage tank systems should be allocated equally between them.

(32) "Construction project" means a site or project that is under development, renovation or demolition, and is temporary in nature and has restricted public access.

Note: A construction project may involve a transportation corridor, building or structure, excavation or landscaping, or the replacement or upgrade of an existing storage tank system.

(33) "Consumptive use" means consumed on the premises where the storage tank system is located.

(34) "Continuous monitoring" means a leak detection method using equipment that routinely performs the required monitoring on a periodic or cyclic basis throughout each day.

(35) "Contractor" means a person or firm undertaking to do work or supply goods or a service.

(36) "Day" means any calendar day unless specifically stated otherwise in the rule.

(37) "Department" means the department of agriculture, trade and consumer protection.

(38) "Dispenser" means a device or configuration of components consisting of a motor or fluid control, and an area for storing a hose nozzle valve with or without a pump, that dispenses and measures the amount of product dispensed by means of a mechanical or electronic metering mechanism.

(39) "Dispensing" means the transfer of fuel into a vehicle or portable container from a storage tank system.

(40) "Dispensing area" means a zone around the dispenser that extends a distance of 20 feet horizontally from the dispenser body, exclusive of the length of the hose and nozzle.

(41) "Dispensing system" or "product transfer system" includes the dispensers, nozzles, dispensing hoses, suction fuel pump, pipe and any necessary core components between the emergency shut−off valve and dispensing nozzle that allow the dispensing system to function as intended and in accordance with the installation requirements.

Note: In a typical fueling island, the dispensing system begins immediately downstream of the emergency shut−off valve, and all components upstream of that point, including the shut−off valve, are part of the tank system, as defined in section ATCP 93.050 (115).

(42) "Electronic monitoring" means an electrical device installed to monitor tanks or piping for leaks.

Note: Typically, electronic monitoring uses an audible or visual alarm and may incorporate an automatic shut down of the dispensing system. Examples include electronic line leak detectors and sump or interstitial liquid sensors.

(43) "Empty tank system" means a tank system from which all materials have been removed using commonly employed practices so that no more than 1 inch of residue remains in the system.

(44) "Excavation zone" means the volume containing the tank system and backfill material bounded by the ground surface, walls, and floor of the pit and trenches into which the underground storage tank system is placed at the time of installation.

(45) "Existing" means installed or in place since before February 1, 2009.

(46) "Existing tank system" means a tank system used to contain an accumulation of regulated substances, or for which installation commenced, prior to February 1, 2009. Installation is considered to have commenced if the owner or operator has obtained all federal, state, and local approvals or permits necessary to begin physical construction of the tank system site or installation of the tank system, and a continuous on−site physical construction or installation program has begun.

(47) "Facility" means a plot of land developed or designated to serve a particular function.

(48) "Farm premises" and "farming" have the meaning given in s. 102.04 (3), Stats.

Note: Section 102.04 (3) of the Statutes, reads as follows:

As used in this chapter, 'farming' means the operation of farm premises owned or rented by the operator. 'Farm premises' means areas used for operations herein set forth, but does not include other areas, greenhouses or other similar structures unless used principally for the production of food and farm plants. 'Farmer' means any person engaged in farming as defined. Operation of farm premises shall be deemed to be the planting and cultivating of the soil thereof; the raising and harvesting of agricultural, horticultural or arboricultural crops thereon; the raising, breeding, tending, training and management of livestock, bees, poultry, fur−bearing animals, wildlife or aquatic life, or their products, thereon; the processing, drying, packing, packaging, freezing, grading, storing, delivering to storage, to market or to a carrier for transportation to market, distributing directly to consumers or marketing any of the above−named commodities, substantially all of which have been planted or produced thereon; the clearing of such premises and the salvaging of timber and management and use of wood lots thereon, but not including logging, lumbering or wood cutting operations unless conducted as an accessory to other farming operations; the managing, conserving, improving and maintaining of such premises or the tools, equipment and improvements thereon and the exchange of labor, services or the exchange of use of equipment with other farmers in pursuing such activities. The operation for not to exceed 30 days during any calendar year, by any person deriving the person's principal income from farming, of farm machinery in performing farming services for other farmers for a consideration other than exchange of labor shall be deemed farming.

(49) "Flammable liquid" means any liquid that has a flash point below 100°F.

Note: Under NFPA 30 section 4.3.1, flammable liquids are classified as being Class I liquids, and are subclassified as Class IA, IB or IC liquids.

(50) "Flash point" means the minimum temperature at which a liquid will give off sufficient vapor to form an ignitable mixture with air near the surface of the liquid or within the test vessel.

Note: See NFPA 30 for the appropriate test method for a specific liquid.

(51) "Free product" means any regulated substance that exists outside of a tank system, a dispenser system or a container for transporting the substance.

(51m) "Hazardous liquid" means any liquid that is a federally regulated hazardous substance as defined in s. 168.21, Stats.

Note: The definition of federally regulated hazardous substances in s. 168.21, Stats., corresponds to the CERCLA List of Hazardous Substances and Reportable Quantities contained in 40 CFR 302.4, Table 302.4.

(52) "Hazardous substance storage tank system" means a storage tank system which contains a hazardous substance defined in section 101 (14) of CERCLA — but not including any substances regulated as hazardous wastes under subtitle C, or any mixture of such substances and petroleum products — and which is not a petroleum storage tank system.

(53) "Heating device" means equipment, fueled by liquids regulated by this chapter, intended to create or generate heat for the purpose of providing direct heat or heating another media for space heating, food processing, commercial and industrial manufacturing, or energy generation.

(54) "Heating fuel" or "heating oil" means petroleum that is No. 1, No. 2, No. 4−light, No. 4−heavy, No. 5−light, No. 5−heavy, and No. 6 technical grades of fuel oil; other residual fuel oils, including Navy Special Fuel Oil and Bunker C; and other fuels when used as substitutes for one of these, including used oil or used cooking oils when used in an oil burner to provide space heat or processing heat for consumptive use on the property.

History: Heating fuel used to produce steam for power generation such as electricity or emergency power does not apply to the general heating fuel application.

(55) "Housekeeping" means a facility management activity of keeping flammable, combustible and hazardous liquid storage organized and free of debris, vegetation, combustible goods and merchandise and non−essential combustible materials or products.

(56) "Hydrant system" means an underground pipe system, typically at airports, that carries fuel to various locations. At each of these locations, an access way typically provides connection points, or hydrants, for connecting filtering, metering or pumping equipment used to transfer the fuel from the piping system to the craft powered by the fuel. A storage tank is not considered part of the hydrant system, and the hydrant system is not considered part of an aboveground or underground storage tank system.

(57) "Important building" or "important building or structure" means a building or structure that is not considered by the owner, the authorized agent or the department to be expendable in an exposure fire.

Note: Examples include buildings occupied by 1 or more persons for other than incidental use, buildings that have a high−hazard use where products from fire can harm the community or the environment, control buildings that need the presence of personnel for orderly shutdown of important or hazardous processes, buildings that contain high−value contents or critical equipment or supplies, and buildings that are sited with respect to a storage tank system such that they will have a detrimental effect on release−response or fire−control activities.

(58) "Impressed current system" means a method of corrosion protection that generates cathodic current from an external, direct−current power source.

(59) "Intermediate bulk container or IBC" means a container that is manufactured and marked in accordance with 49 CFR 178, is intended for the storage of regulated substances within warehouses and other storage areas with automatic wet−pipe sprinkler systems, and has a liquid capacity of 793 gallons or less.

(60) "Interstitial monitoring" means a leak detection method that entails the surveillance of the space between a tank system's walls and the secondary containment system, for a change in steady−state conditions.

(61) "Inventory controls" means techniques used to identify a loss of product that are based on volumetric measurements in the tank and reconciliation of those measurements with product delivery and withdrawal records.

(62) "Leak" means any discharge of a regulated substance from a point in a tank system or dispensing system, that is not intended to be a discharge or dispensing point.

Note: See subsection (76) for a definition of "obvious release," subsection (103) for a definition of "release" and subsection (113) for a definition of "suspected release."

(63) "Leak detection" means determining whether a discharge of regulated substance has occurred from a storage tank system into the environment or into the interstitial space between the storage tank system and its secondary barrier or secondary containment around it.

(64) "Liquid" means any material that has both a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D 5 at standard conditions of temperature and pressure, and a vapor pressure of 40 pounds per square inch absolute (psia) or lower at 100ºF as determined by ASTM D 323 or 4953. For materials outside the scope of the ASTM D 5 test, liquid means any material that both starts to melt at temperatures less than 100°F and has a vapor pressure of 40 psia or lower at 100°F.

Note: For example, #5 and #6 fuel oil do not meet the criteria for a liquid and therefore are not regulated by this chapter.

(65) "Listed and labeled" means equipment or materials to which has been attached a label or identifying mark by, and which is included in a list published by, an organization acceptable to the department that is concerned with product evaluation, that maintains periodic inspections of listed and labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance for a specified purpose.

(66) "Local program operator" or "LPO" means an entity, either public or private, under contract with the department to enforce the provisions of this chapter and provide tank system plan review and inspection services in a specific region of the state.

(67) "Lowest floor, story, cellar or basement" means the lowest space in which heavier−than−air vapors can accumulate.

(68) "Maintenance" means the normal operational upkeep to prevent a storage tank system from releasing product, or to maintain the structural and operational condition of any portion of the system.

(69) "Marine−craft tank vehicle" means any tank having a liquid capacity of 110 gallons or more, used for carrying flammable or combustible liquids and mounted permanently or otherwise

upon a vessel or barge capable of water transportation. The tank is not solely for the purpose of supplying fuel for the propulsion of, or support of equipment on, the vessel upon which the tank is mounted.

Note: Section ATCP 93.130 requires marine−craft tank vehicles to have a material approval before being placed into service.

(70) "Mechanical monitoring" means a mechanical device not dependent upon electricity, installed to monitor tanks and piping for leaks.

Note: An example is a mechanical line leak detector.

(71) "Monthly monitoring" means an approved electronic or non−electronic method of testing a tank or pipe for a leak at least monthly. The test must detect a 0.2 gallon per hour leak rate with a probability of detection of 0.95 and a probability of false alarm of 0.05.

Note: For purposes of monitoring on a monthly cycle, the Department will accept tests no further than 30 days apart.

(72) "Motor fuel" means flammable or combustible liquid that is used in the operation of an internal combustion engine.

(73) "Motor vehicle" means a self−propelled motor−driven vehicle that is used for moving people or products on land, water or air.

Note: "Motor vehicle" in this definition is intended to apply to motorized equipment transporting people and goods for pleasure, construction or commerce, rather than equipment dedicated to warehousing and yard operations, such as forklifts; or for grounds and facility maintenance, such as lawnmowers; or for amusement facilities, such as go−carts.

(74) "New" means installed or constructed on or after February 1, 2009.

(75) "Non−discriminating" means not discriminating as to the type of liquid.

(76) "Obvious release" means there is an indication of a release, and there is both environmental evidence, such as soil discoloration, observable free product, or odors — and a known source, such as a tank or piping with cracks, holes or rust plugs, or leaking joints.

Note: See subsection (62) for a definition of "leak," subsection (103) for a definition of "release" and subsection (113) for a definition of "suspected release."

(77) "Oil−burning equipment" means an oil burner of any type, together with its tank, piping, wiring, controls and related devices, and including all oil burners, oil−fired units and heating and cooking appliances.

(78) "Operational life" means the period beginning when installation of the tank system has commenced and extending to when the tank system is properly closed.

(79) "Operator" means any person in control of, or having responsibility for, the daily operation of a storage tank system.

(80) "Owner" means either of the following:

(a) In the case of an in−use storage tank system, any person who owns at least the tank storage portion of a storage tank system used for storage or dispensing of regulated substances, or the person owning the property on which the storage tank system is located.

(b) In the case of a storage tank system not in use, any person who owned at least the tank storage portion of the storage tank system immediately before the discontinuation of its use, or the person owning the property on which the storage tank system is located.

(81) "Person" means an individual, trust, firm, joint stock company, federal agency, corporation, state, municipality, commission, political subdivision of a state, or any interstate body, and includes a consortium, joint venture, commercial entity, and the United States government.

(82) "Petroleum" means crude oil, crude oil fractions, and refined petroleum fractions, including gasoline, kerosene, heating oils, and diesel fuels.

(83) "Petroleum storage tank system" means a storage tank system that primarily contains petroleum products, such as motor fuels, jet fuels, fuel oils, lubricants, petroleum solvents, and used oil.

(84) "Pier" means any structure, such as a dock, which extends into navigable waters from the shore, with water on both sides, and which is built or maintained for the purpose of servicing watercraft, providing a berth for watercraft, or for loading or unloading cargo or passengers onto or from watercraft. A pier may be an open−deck or solid−fill structure.

(85) "Pipe" or "piping" means a pressure−tight cylinder used to convey, transfer or move a fluid, and is ordinarily designated "pipe" in applicable material specifications. Materials designated as tube or tubing in the specifications are considered pipe when intended for pressure service. This term includes pipe emanating from or feeding storage tanks, or transferring product to or from storage tanks.

(86) "Pipe system" or "piping system" means the primary piping, secondary containment, leak detection devices, tubing, including suction line drop tube, flanges, bolts, gaskets, valves, fittings, flexible connectors, the pressure−containing parts of other components such as expansion joints and strainers, and devices that serve such purposes as mixing, separating, distributing, metering, or controlling flow, and any core components which allow the piping system to function as intended and in accordance with the installation requirements.

Note: For a typical underground system, the pipe system would be from the point of connection at the tank to the connection to the dispenser, immediately downstream of the emergency shut−off valve.

(87) "Pipeline facilities," including gathering lines, means new and existing pipe rights−of−way and any equipment, facilities, or buildings.

(88) "Place of employment" includes every place, whether indoors or out or underground and the premises appurtenant thereto where either temporarily or permanently any industry, trade or business is carried on, or where any process or operation, directly or indirectly related to any industry, trade or business, is carried on, and where any person is, directly or indirectly, employed by another for direct or indirect gain or profit, but does not include any place where persons are employed in private domestic service which does not involve the use of mechanical power or in farming.

Note: This definition is taken from section 101.01 (11) of the Statutes.

(89) "Point−of−sale," or "POS" means a marketing or dispensing practice that accommodates a cash, credit card, key, personal identification number or similar dispenser−authorized transfer of fuel into a motor vehicle without the direct oversight, supervision or intervention of an employee of the fueling facility.

(90) "Precision tightness testing" or "precision tightness test" means a procedure for testing the ability of a tank system to prevent a release of a regulated substance, that is capable of detecting a 0.1 gallon per hour leak rate with a probability of detection of 0.95 and a probability of false alarm of 0.05.

(91) "Pressurized piping" means product piping that experiences product pressure above normal atmospheric pressure. Product pressure may be generated from a pump or static head of an aboveground storage tank.

(92) "Pressurized system" or "remote pumping system" means a dispensing system where the pump is not located at, or is remote from, the dispenser.

(93) "Product" means any regulated substance in a storage tank.

(94) "Public access fueling" means the use of a facility by persons who are not employees of the facility to dispense fuel into vehicles, or to transfer fuel for resale into vehicles that are not owned or operated by the facility.

(95) "Public building" means any structure, including exterior parts of the building, such as a porch, exterior platform or steps providing means of ingress or egress, used in whole or in part

as a place of resort, assemblage, lodging, trade, traffic, occupancy, or use by the public or by 3 or more tenants.

Note: This definition is taken from section 101.01 (12) of the Statutes.

(96) "Public used−oil collection center" means any used−oil collection facility that allows an individual who is not an employee of the facility to transfer used oil from a portable container into a storage tank.

(97) "Public way" means any public thoroughfare, sidewalk, dedicated alley, railroad, waterway or right−of−way. The point of measurement is from the engineered or natural borders of the vehicle or pedestrian traffic lanes.

(98) "Readily accessible" means capable of being reached easily and quickly for operation, maintenance and inspection.

(99) "Re−commission" means the process of returning a system, component or process to a code−complying, in−service condition.

(100) "Recreational vehicle" means any self−propelled motor−driven vehicle that is used for moving people typically off−road, on land, snow, ice or water for sport or recreation, such as snowmobiles and all−terrain vehicles.

(101) "Red−tag" means a red tag secured to a component of a storage or dispensing system, which gives notice that the system or the product stored is under enforcement action for failure to comply with the requirements of either this chapter or ch. ATCP 94, and which prohibits operation of the system until the tag is removed by an inspector.

(102) "Regulated substance" means any flammable or combustible liquid and any liquid that is a federally regulated hazardous substance as defined in s. 168.21, Stats.

Note: The definition of federally regulated hazardous substances in section 168.21 (3) of the Statutes corresponds to the CERCLA List of Hazardous Substances and Reportable Quantities contained in 40 CFR 302.4, Table 302.4.

(103) "Release" means any discharge, including spilling, leaking, pumping, pouring, emitting, emptying, leaching, dumping or disposal of a regulated substance into groundwater, surface water or subsurface soils.

Note: See subsection (62) for a definition of "leak," subsection (76) for a definition of "obvious release" and subsection (113) for a definition of "suspected release."

(104) "Release detection" means determining whether a discharge of regulated substance has occurred from a storage tank system into the environment or into the interstitial space between the storage tank system and its secondary barrier or secondary containment around it.

(105) "Repair" means any work necessary to correct or restore a tank or related storage tank system component to a condition suitable for safe operation.

(106) "Residential watercraft fueling facility" means that portion of a 1− or 2−family residential property where liquid fuels are stored in or dispensed for non−retail purposes from fixed equipment on land into the fuel tanks of self−propelled watercraft, including all facilities used for the storage, dispensing, and handling of flammable and combustible liquids.

(107) "Sacrificial anode system" means a method of corrosion protection that generates cathodic current from the galvanic corrosion of an expendable anode which is more electrochemically active than the structure being protected.

(108) "Secondary containment" means an approved barrier installed around a storage tank system that is designed to prevent a leak from the primary tank or piping from contacting the surrounding earth or the waters of the state before the leak can be detected and cleaned up.

(109) "Significant noncompliance" means the existence of one or more of the following:

(a) A violation that causes, or may cause, a substantial, continuing risk to public health or the environment.

(b) A violation that substantially deviates from a requirement of this chapter.

(c) A violation that includes failure to install, maintain or operate equipment essential to preventing or detecting leaks.

(d) A violation that is observed to reoccur repeatedly as a result of intentional or unintentional administrative or operational oversight.

(110) "Space heating" means heating of areas intended for occupancy or storage.

(111) "Storm water or wastewater collection system" means piping, pumps, conduits, and any other equipment necessary to collect and transport the flow of surface water run−off resulting from precipitation, or domestic, commercial, or industrial wastewater to and from retention areas or any areas where treatment is designated to occur. The collection of storm water and wastewater does not include treatment except where incidental to conveyance.

(112) "Structure" means an assembly of materials forming a construction for occupancy, storage, use, shelter or weather protection meeting the definition of place of employment or public building.

Note: The Department does not consider a tank to be a structure although local or municipal regulations may classify a tank as a structure.

(113) "Suspected release" means either of the following:

(a) There is indication that a tank system or dispensing system has leaked — such as inventory losses; observable free product or evidence of free product in secondary containment at dispensers, submersible pumps or spill buckets; petroleum odors; unexplained presence of water in a tank; or activation of a leak detection alarm system — but there is no observable environmental evidence of a release.

(b) There is observable environmental evidence of a release, such as soil discoloration or free product, but the source is unknown.

Note: See subsection (62) for a definition of "leak," subsection (76) for a definition of "obvious release" and subsection (103) for a definition of "release."

(114) "Tank" means a device designed to contain an accumulation of regulated substance and constructed of non−earthen materials such as concrete, steel, fiberglass or plastic, and including the following types of tanks, which have the following meanings:

(a) "Abandoned tank" means an aboveground or underground tank with or without product, that is not recognized by this chapter as in−use, temporarily−out−of−service or closed.

(b) "Accumulator tank" or "accumulator reservoir" means a container, integral to the closed−loop mechanical system operation of equipment, that is used to provide product on demand or to store product which is displaced from the functioning equipment, such as an elevator or hydraulic lift.

Note: Accumulator tanks are outside the scope of this chapter.

(c) "Breakout tank" means a tank that is used to relieve surges in an oil pipeline system or to receive and store oil transported by a pipeline for reinjection and continued transportation by a pipeline. Tanks considered by this chapter to be breakout tanks do not have piping that transfers product directly to or from a loading rack.

(d) "Day tank" means an intermediate tank in a product transfer system between a storage tank and the end use of the product, usually a generator. The purpose of a day tank is to provide immediate product to the end source where the supply may otherwise be influenced by product temperature, viscosity or inadequate supply pressure.

(e) "Farm tank" means a tank that is constructed in accordance with NFPA 30A section 13.2 and installed on a farm premises.

(f) "Field−erected tank" means a tank that is built on the site from sections and components.

Note: See par. (p) for a definition of "fixed tank."

(g) "Gravity tank" means a supply tank from which the product is delivered directly by gravity.

(h) "Integral tank" means a vessel with a liquid capacity of less than 110 gallons, which supplies fuel to an engine and which is assembled and used with the engine as a single unit of equipment.

Note: Vessels with a capacity of 110 gallons or more are included in the definition of storage tank in paragraph (p).

(i) "Movable tank" means an aboveground storage tank that meets all of the following:

1. Has a liquid capacity of 110 gallons or more, and is used for storing and dispensing liquid motor vehicle fuel.

2. Is supported on skids, wheels without axles, or similar means and is not mounted upon a tank vehicle or chassis capable of road travel.

3. Is designed and constructed in accordance with s. ATCP 93.250.

4. Is not intended for permanent placement.

Note: Movable tanks are acceptable for use at construction projects, farms, and other locations recognized in subchapter VI, where it is more practical to move the tank, typically by lifting equipment, to off−road motorized equipment for dispensing, rather than drive the motorized equipment to the tank.

(j) "Multi−compartment tank" or "multi−chamber tank" means a vessel that contains 2 or more compartments created by the presence of an interior wall so that 2 or more substances can be stored at the same time within a single tank shell.

Note: In accordance with section ATCP 93.250, each compartment of a multi−compartment tank is considered a separate tank, even if the same substance is stored in more than 1 compartment.

(k) "Portable tank" means an aboveground closed vessel that has a liquid capacity of 110 gallons or more; is not otherwise defined in this chapter; is equipped with skids, mountings or accessories to facilitate handling of the tank by mechanical means; and is not intended for fixed installation or for highway vehicle fueling; and includes intermediate bulk containers.

(L) 1. "Process tank" or "flow−through process tank" means a tank that forms an integral part of a production process through which there is a steady, variable, recurring, or intermittent flow of materials during the operation of the process and the tank is utilized to carry out or control the heating, cooling, mixing, blending, separating, metering, or chemical action of materials. The processing is done on a regular basis and it is the primary function of the tank.

2. "Process tank" or "flow−through process tank" does not include a tank that is used for the storage of materials before their introduction into the production process or for the storage of finished products or by−products from the production process, or a tank that is only used to recirculate materials. A process tank would be considered a storage tank if the vessel is used as storage for a period exceeding 96 hours after the processing ends.

Note: Process tanks are outside the scope of this chapter.

(m) "Product recovery tank" means a tank that forms an integral part of a ch. ATCP 93 regulated substance spill control system for a storage, processing or transfer area. The purpose of the tank is spill recovery and temporary containment. A product recovery tank does not include a tank that is used for the storage of materials or by−products from a flow−through reclamation process. A product recovery tank will be considered a storage tank if the vessel is used as storage for a period exceeding 96 hours after the control of a release or spill.

Note: Product recovery tanks are outside the scope of this chapter.

(n) "Residential tank" means a tank located on the same property as a 1− or 2−family dwelling or a residential building that falls within the scope of chs. SPS 361 to 366 and used only by the residents of the property or for the maintenance of the property.

(o) "Service tank" means a tank that is used for a limited period of time during the servicing of liquid−bearing equipment, to temporarily hold liquids during the servicing, cleaning or relocation of the equipment.

Note: Service tanks are outside the scope of this chapter. Service tanks include the defueling and refueling tanks that are used in commercial aviation environments. These tanks are used for removal of fuel from an aircraft to facilitate other maintenance for the aircraft, and for return of that fuel to the aircraft immediately thereafter. They are typically not moved from one site to another, and are operated by employees of an aviation service company under aviation service protocols and monitored situations.

(p) "Stationary tank" or "fixed tank" means a storage vessel intended for stationary installation and not intended for relocation, loading, unloading, or attachment to a transport vehicle, as part of its normal operation in the process of use.

(q) "Storage tank" means a liquid−tight vessel that is intended for fixed or stationary use or a tank that is used for fuel dispensing under subch. VI, but is not used for any of the excepted purposes in s. ATCP 93.020 (6). This term includes a vessel which has a liquid capacity of 110 gallons or more and which is assembled and used with an engine as a single unit of equipment.

(r) "Work−top tank" means an aboveground steel rectangular tank for combined use as a working surface and a storage tank for Class IIIB liquids.

(115) "Tank system" includes the primary tank and pipe, integral secondary containment, integral supports, leak detection, overfill prevention, spill containment, anti−siphon devices, and the necessary core components that allow the tank system to function as intended and in accordance with the installation requirements. Tank system configurations include on−shore underground storage tanks, on−shore aboveground storage tanks, and storage tanks over water that are integral with a stationary pier, floating vessel or floating structure for the purpose of storage or vehicle fueling.

Note: In a typical fueling island, the dispensing system, as defined in section ATCP 93.050 (41), begins immediately downstream of the emergency shut−off valve, and all components upstream of that point, including the shut−off valve, are part of the tank system.

(116) "Tank−system integrity assessment" or "TSIA" means the process by which the department seeks to determine if the integrity of a tank system or any component thereof has been compromised. This process includes precision tightness testing, inventory reconciliation, visual inspection of system components, and calibration checks of dispensers and automatic tank gauges.

Note: In general, TSIAs are to be performed if there are indications that the integrity of a system has been compromised.

(117) "Tank−system site assessment" or "TSSA" means the process by which the department expects tank−system owners or operators to determine if a tank system or any component of that system has released petroleum products or other hazardous substances into the soil, groundwater or surface waters. This process includes all of the following:

(a) Observation of field conditions, such as stained soils; odors; pitting, holes or cracks in tank system components; observable leaks; and elevated in−field soil−gas readings.

(b) Collection of soil samples for laboratory analysis of petroleum products or other hazardous substances, as prescribed in the department's *Assessment and Reporting of Suspected and Obvious Releases From Underground and Aboveground Storage Tank Systems*.

(c) Reporting of the field observations and sampling results in a format prescribed by the department.

Note: In general, TSSAs are to be performed at the time a storage tank system, or some component thereof, is to be permanently closed, upgraded or repaired, or if a change in service is to take place.

Note: *Assessment and Reporting of Suspected and Obvious Releases From Underground and Aboveground Storage Tank Systems* (Stock number 61D) is available from Document Sales and Distribution at 4622 University Avenue, Madison, WI 53705−2156; or at telephone (800) 362−7253; or at http:/docsales@doa.state.wi.us; or from the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(118) "Tank vehicle" means a tank truck or trailer system designed and constructed to comply with NFPA 385.

Note: NFPA 385 recognizes 3 types of tank vehicles: (1) a tank truck in which the cargo tank is supported entirely on the truck chassis, (2) a tank semi−trailer in which the cargo tank is supported by both the truck chassis and trailer chassis, and (3) a tank full−trailer in which the cargo tank is supported entirely on the trailer chassis.

(119) "Tank wagon" means a tank that is affixed to a trailer system with at least 1 axle, is constructed in accordance with s. ATCP 93.610 (1), has a liquid capacity of 1,100 gallons or less, and is used for storing and dispensing liquid motor vehicle fuel for

equipment used on the site, or is used for storing other liquids regulated under this chapter. A tank wagon is not constructed to comply with NFPA 385.

Note: Since a tank wagon is not designed and constructed under NFPA 385 criteria, it must be towed empty on the road for transport and placement in accordance with s. ATCP 93.610 (1).

(120) "Temporarily−out−of−service" means a storage tank system that is not being used, but is intended to be placed back into operation within the next annual registration period.

Note: Temporarily−out−of−service does not apply to stationary tanks that are of seasonal use, such as heating fuel storage tanks.

(121) "Transfer area" means the area where product is transferred, commonly referred to as loading or unloading, between a storage tank and a transport vehicle. Transfer areas are located at terminals, as well as at end−user and intermediate vendors in the product distribution stream. The transfer area may involve loading racks, pipe stands, or direct hose−to−valve connections, and accommodate top or bottom transfer.

(122) (a) "Underground storage tank system" or "UST" means any one or combination of tanks, including connected pipes, that is used to contain an accumulation of regulated substances, and the volume of which, including the volume of connected underground pipes, is 10 percent or more beneath the surface of the ground.

(b) "Underground storage tank system" or "UST" does not include any of the following or pipes connected to any of the following:

1. Surface impoundment, pit, pond, or lagoon.

2. Storm water or wastewater collection system.

3. A liquid trap or associated gathering lines directly related to oil or gas production and gathering operations.

4. A storage tank situated in an underground area, such as a basement, cellar, mine shaft or tunnel, if the storage tank is situated upon or above the surface of the floor and not surrounded by earth.

5. A pipeline facility, including gathering lines, regulated under any of the following:

a. The federal Natural Gas Pipeline Safety Act of 1968 (49 USC App. 1671, et seq.).

b. The federal Hazardous Liquid Pipeline Safety Act of 1979 (49 USC App. 2001, et seq.).

c. An intrastate pipeline facility regulated under state laws comparable to the provisions of the law referred to in this section.

(123) "Upgrade" means the addition to or retrofit of some part of a storage tank system, such as cathodic protection, leak detection, lining, or spill and overfill controls, to improve the ability of a storage tank system to prevent the release of product.

(124) "Used oil" or "waste oil" means any oil refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities; and means used cooking oils that are used as fuel for purposes such as space heating or fueling motor vehicles.

Note: See chapter NR 679 and section 287.15 of the Statutes for other definitions of used oil and waste oil, and for requirements relating to those definitions, such as criteria for transporting or recycling these liquids.

(125) "Vehicle collision protection" means a structure or mechanism to protect a tank or system component from vehicle impact.

(126) "Vehicle fueling" means the process of adding motor fuel to the engine fuel supply tank for motor driven vehicles, including aircraft, watercraft, on− or off−road vehicles and vehicles on rails.

Note: For definitions of terms associated with petroleum storage facilities or petroleum equipment, not provided in this list of definitions, refer to the Petroleum Equipment Lexicon.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (15) and (114) (k), cr. (51m) and (114) (p), renum. (114) (p) and (q) to be (114) (q) and (r) Register July 2009 No. 643, eff. 8−1−09; correction in (18), (19), (20), (21) (a), (b), (22), (23), (24), (25), (37), (101), (114) (i) 3., (m), (n), (q), (119) made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672; **corrections in (37), (51m), (101), (102), (114) (i) 3., (m), (q), (119) made under s. 13.92 (4) (b) 6., 7., Stats., Register October 2013 No. 694.**

Subchapter I — Administration and Enforcement

ATCP 93.100 Plan review. (1) GENERAL. (a) Plan review and written approval from the authorized agent or the department shall be obtained before any of the following activities are performed on storage tank systems used to store a regulated substance, except where exempted under par. (b):

1. Commencing any construction of new or additional tank or piping installation.

2. Changing the operation of a tank system from storage of a non−regulated substance to a regulated substance.

3. Adding or modifying tank or pipe corrosion protection.

4. Adding leak detection or modifying leak detection as specified in s. ATCP 93.110 (3) (e) when performed in conjunction with other changes that require plan review. A certified installer is not required to perform the modification of leak detection.

Note: Under subsection (3) (a) 5. c., the Department's leak detection installation form (ERS−9 LD) must be filled out and submitted anytime leak detection equipment is added or modified, whether or not plan review is required. This form is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

5. Upgrading or modifying spill or overfill protection.

6. Lining or relining of underground tanks.

7. Converting a full−service motor fuel dispensing facility or a self−service motor fuel dispensing facility to the use of a point−of−sale dispensing system or device. A certified installer is not required to perform the conversion to a point−of−sale dispensing system. The installer shall fill out the department's point−of−sale fueling installation form (ERS−6294 POS) and shall provide the form to the authorized agent or the department, for inspection of the system.

Note: Form ERS−6294 POS is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

8. a. Converting from the storage and dispensing of flammable or combustible liquids containing 10 percent or less ethanol by volume to liquids containing more than 10 percent ethanol by volume.

b. Converting from the storage and dispensing of flammable or combustible liquids containing 5 percent or less biodiesel fuel by volume to liquids containing more than 5 percent biodiesel fuel by volume.

9. Using a tank system to store a substance that poses a significant fire hazard or safety hazard to people or the environment due to material compatibility, equipment functionality or product characteristics, as determined by the authorized agent or the department, or fire department.

10. Adding or modifying any device or system component making an underground connection to a tank, product pipe or vent pipe.

(b) Plan review and approval is not required for any of the following:

1. Oil−burning installations for a 1− or 2−family dwelling which are located aboveground or in a basement, and which have a capacity of less than 1,100 gallons.

2. Integral fuel supply tanks of a motor vehicle, aircraft, watercraft, mobile power plant or mobile heating plant.

3. Aboveground tanks which have a capacity of less than 1,100 gallons and which store Class IIIB liquids other than used oil.

4. Reconfiguration of product piping that is located aboveground, from storage tanks supplying a regulated substance to a manufacturing, industrial or blending process.

5. Tank wagons, tank vehicles, or movable tanks, that are used for vehicle fueling operations under subch. VI.

6. Aboveground tank systems that store hazardous liquids which are not also flammable or combustible liquids, if the construction is supervised by a qualified engineer.

Note: See section ATCP 93.140 for registration requirements for tanks that store federally regulated hazardous substances. Section ATCP 93.350 requires aboveground hazardous substance tank systems to be designed by a qualified engineer.

7. Portable tanks that are not used as fixed tanks.

8. Tanks that are located at a US EPA superfund site.

9. Aboveground tanks which are used at a farm premises or construction project in accordance with s. ATCP 93.630, and which meet all of the following conditions:

a. Have a capacity of less than 1,100 gallons.

b. Are located at least 40 feet from either the buildings and structures listed in s. ATCP 93.630 (2) (a), or important buildings or structures.

Note: See section ATCP 93.630 (3) for administrative requirements for ASTs located at farms and construction projects.

10. Fuel supply tanks which are used for a mobile power plant or mobile heating plant and which meet all of the following requirements:

a. The tank system is built and operated in accordance with a national standard.

b. The tank system is intended to be at the site for a period of 24 months or less.

c. The tank system has an aggregate capacity of less than 1,100 gallons.

d. The tank system does not use any Class I liquids.

11. Where the department determines that the review of a specific application, modification or contractor activity would not meet the regulatory oversight objective for technical plan review and approval.

(2) PLANS, SPECIFICATIONS AND INFORMATION. Plans, specifications and information submitted to the authorized agent or the department for review and approval shall contain all of the following:

(a) At least 5 sets of plans and specifications, that are clear, legible and permanent copies, along with fees and a completed installation application.

(b) 1. The name of the owner.

2. The name of the person, firm or corporation proposing the installation, if other than the owner.

3. The address of the facility, including the names of adjacent streets and highways.

(c) 1. A plot plan, drawn to a minimum scale of 1 inch equals 20 feet, indicating the location of the installation with respect to property lines; adjoining streets or alleys; fences, including those installed over or through any part of the system; and other buildings on the same property. The plot plan shall indicate the location of buildings; other tanks; loading and unloading points; utilities; sanitary or storm sewers; water mains; water service piping; community and private potable water wells or other potable water source on the subject property; any private potable water wells on adjacent property that are within 100 feet of the tank, piping or dispenser; and any offsite community wells that are within 1200 feet of the tank, piping or dispenser.

Note: See section ATCP 93.260 for minimum separating distances between tank systems and potable water supply sources. See section ATCP 93.500 (1) for additional rules and information regarding separation from water wells and reservoirs.

Note: Chapter NR 116 requires municipalities to prohibit any storage of materials that are buoyant, flammable, explosive or injurious to animal, plant or aquatic life, in floodway areas of floodplains.

Note: For installations where cathodic protection will be installed, buried metal underground structures and components within 200 feet, such as culverts and guy wire anchor points, should be included in the plan drawing.

2. The class of construction of each building or room in a building that contains a storage tank shall also be indicated.

(d) The location, size and capacity of each tank and the following information on the contents of the tank:

1. The name of the stored liquid.

2. The flammability or combustibility classification of the stored liquid.

Note: Flammability and combustibility classifications are established in NFPA 30 sections 4.3.1 and 4.3.2, and are expressed as a roman numeral and a letter, such as IB or IIIA.

3. Whether the stored liquid is classified in any of the following hazard categories as defined in the applicable model fire code adopted by reference under ch. SPS 314:

a. Explosive or pyrophoric.

b. Oxidizer or organic peroxide.

c. Unstable or water reactive.

d. Toxic or highly toxic.

e. Cryogenic or corrosive to living tissue.

(e) The location of all piping runs and spacing between all tanks and piping.

(f) The type of tank supports and clearances, including clearances between tanks.

(g) The type of venting and pressure relief used and combined capacity of all venting and relief valves on each aboveground tank.

(h) The location of fill, gauge and vent pipes and other openings for the tank.

(i) Location of burners, tanks, pumps, piping and control valves and the relative elevations of any areas within the building where heavier−than−air vapors can accumulate.

(j) The distances to dispensers, sizes of islands and traffic flow patterns or vehicle routes around or through the facility.

(k) Information and specifications describing the design and placement of leak detection systems.

(L) 1. Information regarding the type and operation of corrosion protection systems for tanks and piping.

2. For impressed current systems, the location and materials of gas mains and gas service lines serving the facility.

(m) Information regarding the type of secondary containment system.

(n) Specifications describing the spill and overfill protection devices.

(o) Information regarding the compatibility of the tank and piping system with the regulated substance.

(p) A copy of any easement that reflects any property not owned by the system operator on which any portion of the system is located or any vehicle is parked while transferring product.

(q) Any material−approval numbers issued under s. ATCP 93.130.

(r) Information and specifications on materials, equipment and devices to be used in the project which do not have material−approval numbers issued under s. ATCP 93.130 and which have a direct impact on the regulated system.

Note: Examples of this equipment include valves, nozzles and hoses.

(s) Additional data and information regarding storage of regulated substances within buildings or enclosures to demonstrate compliance with the requirements of this chapter.

(t) Any other information necessary for the reviewer to determine code compliance.

(3) APPLICATION AND APPROVAL PROCESS. (a) *Submission of forms*. 1. 'General.' The department's installation application form (ERS−9) shall be completed and included with each application for approval, except as provided in subd. 5.

2. 'POS fueling.' For facilities that include dispenser point−of−sale fueling, the first page of the department's POS fueling installation form (ERS−6294 POS) shall also be completed and submitted.

3. 'Leak detection.' For facilities that include leak detection installation during the overall installation process, the first page of the department's leak detection installation form (ERS−9 LD) shall also be completed and submitted.

4. 'Alternative motor fuels.' For facilities that include ethanol− or biofuel−blended motor fuel, as regulated under s. ATCP 93.680, Part I of the department's alternative fuel installation/conversion application form (ERS−9 Alternative Fuels) shall be completed and submitted for approval. Part II shall serve as an addendum to the inspection checklist.

5. 'Exceptions.' a. For aboveground storage tanks that have a capacity of less than 1,100 gallons, at a farm premises or construction project, the department's farm and construction AST installation notification form (ERS−10764) shall be completed and submitted as notification to the authorized agent or the department at the time of installation inspection. This form shall also serve as the plan submittal application and the installation checklist.

b. Where conversion to point−of−sale fueling is the only change at a facility, the department's POS fueling installation form (ERS−6294 POS) shall be completed and submitted to the authorized agent or the department at least 10 days prior to conversion. This form shall also serve as the plan submittal application and the installation checklist.

c. Where an upgrade, exchange or conversion of installed leak detection methodology to another approved methodology or manufacturer is the only change at a facility, the department's leak detection installation form (ERS−9 LD) shall be completed and submitted to the department within 5 days of installation. This form shall also serve as the plan submittal application and the installation checklist.

d. Where conversion to storage and dispensing of alternative motor fuels is the only change at a facility, Part I of the department's alternative fuel installation/conversion application form (ERS−9 Alternative Fuels) shall be completed and submitted to the department prior to conversion. Part I shall serve as the plan submittal application and Part II as the installation checklist.

Note: Forms ERS−9 — Flammable/Combustible Liquid Tanks Installation Application, ERS−6294 POS — Point−of−Sale Fueling Installation Notification, ERS−9 LD — Storage Tank Leak Detection Installation or Upgrade Application / Notification, ERS−9 Alternative Fuels — Storage Tank Alternative Fuel Installation/ Conversion Application, and ERS−10764 — Farm & Construction AST Installation Notification, are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: Within a first class city, the provisions in subds. 5. c. and d. may be administered by that city instead of the department, as authorized in sections ATCP 93.020 (8) (b) and 93.110 (3) and (4). As of February 1, 2009, only the City of Milwaukee had become a first class city.

(b) *Review time*. The authorized agent or the department shall review and make a determination on an application for installation approval and plan review within 15 business days of receiving all of the required information and fees.

Note: Chapter SPS 302 addresses fees associated with ATCP 93 plan submittal, review and inspection.

Note: Chapter SPS 302 authorizes double fees when construction is initiated without the required plan approval.

(c) *Conditional approval*. 1. If the authorized agent or the department determines that the plans and the application substantially conform to the provisions of this chapter, a conditional approval shall be granted in writing.

2. All conditions stated in the conditional approval shall be met before or during construction or installation.

3. A conditional approval issued by the authorized agent or the department is not an assumption of any responsibility for the design, construction or maintenance of the facility.

Note: Various sections of this chapter address the responsibilities that contractors have, under section 168.22 (1) of the Statutes, in achieving compliance with the technical requirements of this chapter, after plans and specifications are approved. For example, section ATCP 93.115 (2) (b) 2. a. has requirements about completing a pre−construction installation form, and meeting then with an inspector; section ATCP 93.115 (2) (b) 3. has requirements about notifying an inspector before starting an installation; sections ATCP 93.400 (5) (b) and 93.500 (6) (a) have requirements about installing aboveground and underground tank systems according to the manufacturer's instructions, the applicable national standards in section ATCP 93.200, plans and specifications approved under section ATCP 93.100 and this chapter; sections ATCP 93.400 (5) (f) and 93.500 (6) (d) have requirements about completing a checklist during installation of aboveground and underground tanks or piping; and section ATCP 93.500 (9) (a) 2. has requirements about documenting the performance of newly installed leak detection equipment. Contractors also have compliance responsibilities under various other sections, such as notifying an inspector about installing small tanks at farms and construction sites, in section ATCP 93.630 (3) (c); notifying an inspector about converting a dispensing facility to a point−of−use dispenser, in section ATCP 93.100 (1) (a) 7.; performing tank linings for underground tanks, in section ATCP 93.530; applying for approval to convert an installed tank system to store alternative fuel, in section ATCP 93.680 (4) (b); not allowing releases to occur, in section ATCP 93.230 (a); stopping leaks and preventing migration of free product into the environment, in section ATCP 93.585 (1); reporting releases to the Department of Natural Resources, in section ATCP 93.585 (2); and cleaning or removing tanks during closure, in sections ATCP 93.315 (2) and 93.560 (2).

Note: Section ATCP 93.115 (2) (b) 4. addresses the responsibility of the authorized agent or the Department to inspect installation of shop−built tanks, and to record the results on the installation checklist.

(d) *Plan sets*. 1. A letter shall be sent to the designer and the owner of record with a statement relating to the examination of the plans and specifications and citing the conditions of approval or denial.

2. The plans and specifications shall be dated and stamped either "Conditionally Approved" or "Not Approved."

3. For all projects reviewed by the department, the department shall retain 2 copies of the plans and specifications — and shall forward 1 copy of the plans and specifications, the approval letter, and the installation application to the corresponding LPO if there is one.

4. The remaining 2 sets of plans and specifications and the approval letter shall be returned to the person designated on the installation application.

Note: Under sections ATCP 93.400 (11) (b) and 93.500 (9) (b), the approved plans and specifications and approval letter must be kept on site and available to the authorized agent or the department during all phases of installation. After installation is completed, the plans and and specifications and approval letter must be made available to the authorized agent or the department upon request.

(e) *Plan denial*. If the authorized agent or the department determines that the plans and specifications or application do not substantially conform to the provisions of this chapter, the application shall be denied in writing, specifying the reasons for denial.

(f) *Appeals*. In the event of a dispute as to whether the information submitted to an authorized agent shows compliance with the provisions of this chapter, the application may be submitted to the department for informal review, instead of filing a formal appeal under s. ATCP 93.190, and the decision of the department shall then govern.

(4) PLAN CHANGES. (a) *Submittal as new installation*. Additions or modifications to systems that occur or become known after the closing of the excavation and commencement of system operation shall be submitted for review as a new installation.

(b) *Submittal as a revision*. 1. Additions or modifications which deviate from the original conditionally approved plans and specifications and which are made before closing the excavation and using the system shall be submitted for plan review and approval as a revision.

2. The replacement of parts or components shall be submitted for plan review and approval as a revision, unless they will be identical in function to the previously approved parts or components, and they will be in the identical location of the previously approved parts or components.

Note: Examples of modifications that require plan review as a revision include changes in tank placement, size of tank, length or direction of piping run, additional system components, and changes in monitoring equipment. The Department will determine if the number and importance of items submitted for revision would be addressed more appropriately through a new plan submittal.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (1) (b) 6. Register July 2009 No. 643, eff. 8−1−09; correction in (1) (a) 4., (b) 9. (intro.), b., (2) (d) 3. (intro.), (q), (r), (3) (a) 4., (f) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a) 4., (b) 9. (intro.), b., (2) (q), (r), (3) (a) 4., (f) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.110 Jurisdiction over enforcement. (1) DEPARTMENT APPROVAL OF LPO. (a) With the approval of the chief elected municipal official, the municipality shall determine if a municipal department or other agent approved by the depart-

ment will exercise jurisdiction over the provisions of this chapter as the local program operator.

(b) The review of plans and specifications and the installation inspection for administering and enforcing this chapter shall be performed by a certified tank system inspector.

Note: LPOs are under contract with the Department. The contract specifies LPO qualifications and responsibilities, such as plan review, inspection and consultation.

(c) The department may revoke its approval of a local program operator where the plan examiners or inspectors do not meet the standards specified by the department or where other requirements of the department are not met.

(2) PLAN REVIEW BY LPO. All of the following types of plans shall be submitted to the LPO for review and approval, except as provided in sub. (3) (b):

(a) Plans in which all tanks for the storage, handling or use of flammable or combustible liquids have an individual capacity of less than 5000 gallons.

(b) Plans that consist solely of converting a full− or self−service motor fuel dispensing facility to the use of a point−of−sale dispensing system or device, regardless of tank size.

Note: Conversion to a point−of−sale dispensing system or device does not require a certified installer.

(3) DEPARTMENTAL PLAN REVIEW. Plan review and approval shall be obtained from the department in all of the following situations, except as provided in sub. (4):

(a) Where 1 or more tanks for storage of a regulated substance have an individual capacity of 5,000 gallons or more.

(b) Where the tank system is located in an area where there is no LPO.

(c) Where there is installation of, or an upgrade or addition to, the corrosion protection system, regardless of tank size.

(d) Where there is initial installation of leak detection to a tank system, regardless of tank size.

(e) Where there is an upgrade or addition to the leak detection system, regardless of tank size, including any of the following:

1. A change in manufacturer.

2. A change in model number.

3. A change in methodology.

Note: Examples of changes in methodology include switching from a mechanical line leak detector to an electronic one or changing from statistical inventory reconciliation (SIR) to an automatic tank gauge (ATG).

Note: A change from another leak detection methodology to statistical inventory reconciliation (SIR) is not required to have plan review but must follow the registration requirements in section ATCP 93.140 (2).

(f) Where there is a conversion from the storage and dispensing of flammable or combustible liquids containing 10 percent or less ethanol by volume to liquids containing more than 10 percent ethanol by volume.

(g) Where there is a conversion from the storage and dispensing of flammable or combustible liquids containing 5 percent or less biodiesel fuel by volume to liquids containing more than 5 percent biodiesel fuel by volume.

(4) PLAN REVIEW BY FIRST CLASS CITY. All plans for facilities within a first class city shall be submitted to that city for review and approval.

Note: As of February 1, 2009, only the City of Milwaukee had become a first class city.

(5) SEQUENCE OF JURISDICTION. Where an authorized agent has jurisdiction under this chapter, and a provision of this chapter refers to the authorized agent or the department, the authorized agent's jurisdiction shall be exercised in advance of the department's jurisdiction.

Note: Under section ATCP 93.020 (10), the Department reserves the right to interpret the requirements in this chapter and in all adopted codes and standards.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.115 Enforcement and inspections. **(1)** GENERAL ENFORCEMENT. (a) *Enforcing agents.* This chapter shall be enforced by the authorized agent and the department and by other code officials having jurisdiction and authority under this chapter.

(b) *Access.* The authorized agent or the department or other code official is authorized to enter any building, facility or premises and examine any tank system or component and associated records for the purpose of enforcing this chapter.

(c) *Re−exposure.* If any tank system or component that is subject to inspection is covered or concealed without the prior knowledge and authorization of the authorized agent or the department or other code official, the agent or department or official has the authority to require such work be exposed for inspection.

(d) *Tampering.* Signs, red−tags or seals posted or affixed by the authorized agent or the department or other code official may not be removed, mutilated or tampered with unless authorized by the agent, the department or official.

Note: Code officials with chapter ATCP 93 enforcement responsibility have the authority to shut down a system or to prohibit specific actions relating to the operation of a system, dispensing product from the system, or adding product to a tank, by securing a "red−tag" to a component of the system marking the respective component inoperable until compliance has been achieved. A chapter ATCP 93 code official is the only individual authorized to grant the removal of the red−tag.

(2) INSPECTIONS. (a) *General.* 1. Tank system inspections for administering and enforcing this chapter shall be conducted by certified tank system inspectors.

2. Fire safety inspections involving flammable, combustible or hazardous liquids shall be conducted by either the authorized agent or the department or by an authorized member of the local fire department.

3. This chapter is not intended to limit or deny the ability of department of safety and professional services deputies to conduct the activities under s. 101.14 (1) (a) and (b), Stats., for the purpose of ascertaining and causing to be corrected any condition liable to cause fire, or any violation of any law or order relating to fire hazards or to the prevention of fire.

Note: See chapter SPS 314 for requirements for fire prevention not otherwise covered in this chapter.

(b) *New and replacement installations.* 1. Inspections shall be conducted during the installation of new or replacement storage tanks or piping systems within the plan review scope of s. ATCP 93.100.

2. There shall be a minimum of 3 inspections performed on underground storage tank systems or on any system that has underground piping, at the following installation points:

a. At a pre−construction meeting. For installations involving underground tanks or piping, the department's pre−construction installation form (ERS−6294 PCM) shall be filled out by the certified installer, and a copy shall be provided to the certified tank system inspector at the end of the meeting. Where an LPO has jurisdiction, the LPO shall send a copy of the form to the department.

Note: Form ERS−6294 PCM — Pre−Construction UST/PIPE Installation is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 266−7874, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

b. During the line−pressure tests.

c. At the pre−commissioning start up in accordance with the applicable standard listed in s. ATCP 93.200.

3. The certified installer shall notify the authorized agent or the department, on form ERS−9198, at least 5 business days before starting an installation, to arrange for inspections.

Note: Form ERS−9198 — ATCP 93 Notification Record is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

4. a. Before a shop−built tank system is placed into operation, including back into operation after undergoing a modification or upgrade that is required to have plan approval or registration, the authorized agent or the department shall inspect the installation, and shall record the results by completing and signing the installation checklist, form ERS−9658, or ERS−6294 UST, as received from the installer, under s. ATCP 93.400 (5) (f) or 93.500 (6) (e).

b. The original of the installation checklist, form ERS−9658, or ERS−6294 UST, shall be completed and submitted to the department. A copy of the checklist shall be furnished to the owner, and a copy shall be retained by the authorized agent if there is one.

5. The owner or operator of a facility shall notify the authorized agent or the department before placing a tank into service.

Note: Section ATCP 93.145 specifies where a permit to operate must also be applied for before placing a tank into service.

(c) *Operating facilities.* Inspections at operating facilities, as determined by the authorized agent or the department, shall be conducted periodically by the authorized agent or the department to determine if the installation remains in conformance with the provisions of this chapter.

(d) *Written order.* When the tank system is inspected by a certified tank system inspector, any violations of this chapter shall be specifically listed, along with an allotted time to correct the violation.

(3) SYSTEM SHUTDOWN. Persons with enforcement authority under this chapter may shut down any part of a tank system, using the department−issued red−tag procedure, under any of the following conditions:

(a) *Immediate shutdown.* The following tank systems shall be subject to immediate shutdown:

1. Tank systems or their components that pose an immediate danger to life, safety or health. Conditions that cause immediate danger to life, safety, or health include visual evidence of leakage of a regulated substance, immediate human exposure to a regulated substance in the environment, defective equipment resulting in release of a regulated substance, overfill prevention that is not functioning properly or inadequate tank venting.

2. Tank systems that do not have leak detection, corrosion protection or spill and overfill protection installed as required under this chapter.

Note: Immediate shutdown is not authorized under subdivision 2. where equipment is installed properly but is operating improperly, such as a sacrificial anode system that fails to meet the negative 850−millivolt threshold in section ATCP 93.520 (2).

3. Tank wagons and movable tanks that are located, used or moved in a manner which presents an immediate environmental or safety hazard.

4. Tank systems undergoing installation that are not in compliance with this chapter, until the certified installer, professional engineer or owner obtains a petition for variance or code interpretation from the department showing that the action in question provides an equivalent degree of fire and environmental protection as the requirement in this chapter.

5. Tank systems that have experienced a lapse in financial responsibility required under subch. VII, until financial responsibility is obtained and the tank system is issued a permit to operate.

6. Tank systems used to store liquids that have been shown to be corrosive, reactive or otherwise incompatible with materials used in the construction of the tank system.

7. Tank systems with any breach that has the potential for liquid or vapor release, discovered as a result of an actual leak or a leak detection test, until the breach is repaired or otherwise corrected.

8. Tank systems that undergo a change of ownership in violation of s. ATCP 93.150, until all the requirements of that section are met.

(b) *Shutdown after investigation or inspection.* The following tank systems shall be subject to shutdown after investigation or inspection:

1. Tank systems or their components for which there is clear evidence of a release to the environment.

Note: Data sources that can yield evidence of these releases include inventory records, precision tightness testing results, and leak detection system results.

2. Tank systems that show evidence of attempts to mislead the authorized agent or the department regarding code compliance.

Note: Examples of this evidence include obviously falsified records, sensors that are altered or rendered inoperative, or spill and overfill prevention equipment that has been tampered with or altered.

(c) *Shutdown after continued violation.* 1. Tank systems or components for which there is a continuing code violation under this chapter are subject to shutdown provided all of the following conditions are met, except as specified in subd. 2.:

a. An initial order, allowing a period for compliance of at least 10 days, is issued with a specific compliance date.

b. The first re−inspection made after the specified compliance date shows that compliance has not been achieved.

c. A second specific compliance date, allowing at least 5 days, is set.

d. Re−inspection after the second compliance date shows that compliance has still not been achieved.

e. The owner has not filed a written appeal with the department within 15 calendar days of receiving the original order.

2. If the owner files a written appeal with the department within 15 calendar days of receiving the original order, enforcement action shall proceed until such time as a decision is issued in relation to the appeal, overturning or modifying the order.

Note: See section ATCP 93.190 for further requirements relating to appeals.

(d) *Required information.* The owner or operator shall provide the authorized agent or the department with all of the following information when a system is shut down:

1. The type and volume of product in the tank system.

2. The date of last delivery into the tank system.

3. The name of the transport provider.

(4) PRODUCT DELIVERY INTO NONCOMPLYING TANK SYSTEMS. (a) It is a violation of this chapter for any person to knowingly deliver or place a regulated substance into a tank system that has been shut down by an enforcement action under this section.

(b) The department may authorize delivery in human welfare or emergency situations, on a case−by−case basis, such as for emergency generator systems serving healthcare facilities.

(5) EQUIPMENT TAMPERING. It is a violation of this chapter for any person to tamper with or disable systems that provide corrosion protection, leak detection or spill and overfill protection.

(6) STOP−WORK ORDER. (a) When the code official determines that tank systems, components or work methods regulated under either this chapter or ch. SPS 305 are contrary to the provisions of these chapters, or are unsafe or dangerous in any manner, the official is authorized to issue an order to stop the work or activity until the unsafe or dangerous act or condition is corrected.

(b) The stop−work order shall be issued verbally to the individual responsible for supervising the actions.

(c) If the actions cannot be corrected immediately and witnessed by the code official, the code official shall issue a written order within 6 hours of the verbal stop−work directive.

(d) The written order shall state the reason for the order and the conditions under which the cited work activity is authorized to resume.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) (b) 1., 2. c., 4. a., (3) (a) 8., (6) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (a) 3., (b) 1., 2. c., 4. a., (3) (a) 8. made under s. 13.92 (4) (b) 6., 7., Stats., Register October 2013 No. 694.**

ATCP 93.120 Revocation and expiration of approval. (1) The authorized agent or the department may revoke any approval issued under the provisions of this chapter for any false statements or misrepresentation of facts upon which the approval was based.

(2) Plan approval by the authorized agent or the department shall expire 2 years after the date indicated on the approved plans if construction has not commenced within that 2 year period.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.130 Specific approval of materials, equipment, concepts, technology and devices. (1) SPECIFIC

APPROVAL REQUIRED. Specific approval shall be obtained in writing from the department for any of the following items:

(a) Any leak detection method for tanks or piping used to comply with a leak detection requirement under this chapter or federal law.

(b) Flexible non−metallic piping.

(c) Synthetic flexible dike liners.

(d) Prefabricated dike systems with integrated collision protection.

(e) Marine−craft tank vehicles.

(2) DISCRETIONARY APPROVAL. (a) The department may require specific, written approval in accordance with sub. (3) for use of new, unique or unproven materials, equipment, concepts, technology or devices. This approval may specify conditions or limitations.

(b) Any person may request specific, written approval in accordance with sub. (3) for use of new or unproven materials, equipment, concepts, technology or devices not specified in this chapter.

(3) APPLICATION FOR APPROVAL. (a) *General.* 1. Application for approval shall be made on the department's material approval application form (ERS−8028A) and shall include sufficient test results or other evidence from an independent third party to prove that the material, equipment, concept, technology or device meets the requirements or the intent of this chapter.

2. Application for approval shall include information on inspection, testing and maintenance of the product.

3. Upon receipt of a completed application, the fee specified in ch. SPS 302, and all information and documentation needed to complete the review, the department shall review and make a determination on the application within 60 business days.

(b) *Leak detection methods.* 1. The application for approval of leak detection methods specified in sub. (1) (a) shall include certification from an independent third party that the method has been evaluated in accordance with the applicable US EPA standard test procedure for evaluating the method.

Note: US EPA test protocols require precision tightness testing for tanks to be capable of detecting a 0.1 gallon per hour leak rate from any portion of the tank that routinely contains product when the tank is 95 percent full, with a probability of detection of 0.95 and probability of false alarm of 0.05. Precision tightness testing for piping must be capable of detecting a 0.1 gallon per hour leak rate with a probability of detection of 0.95 and a probability of false alarm of 0.05. Automatic tank gauges and all methods of monthly monitoring must be capable of detecting a 0.2 gallon per hour leak rate from any portion of the tank that routinely contains product with a probability of detection of 0.95 and probability of false alarm of 0.05.

2. The test methods shall be capable of detecting the minimum leak rate with the required probability of detection and false alarm, while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation or condensation, and the height of the water table.

3. Manufacturers of leak detection methods shall specify what threshold leak rate is used with their test methods to indicate a leak.

Note: Section ATCP 93.515 (5) (b) requires automatic tank gauges to be provided with a printer that prints out the measured leak rate, and to state whether that leak rate indicates an actual leak in the system.

(c) *Flexible non−metallic piping.* The application for approval of flexible non−metallic piping shall include certification from an independent third party that the material has been evaluated in accordance with UL 971 — Nonmetallic Underground Piping for Flammable Liquids or an equivalent standard.

(d) *Synthetic flexible dike liners.* 1. The application for approval of synthetic flexible dike liners shall include certification from an independent third party that the material has been evaluated according to a protocol acceptable to the department, along with information on product compatibility, construction methods and specifications, field installation, seam testing procedures, bedding specifications and any required soil cover.

2. For flexible dike liners that are not required to have a soil cover, information and test results shall be submitted to assess the fire hazard of the exposed liner material.

Note: NFPA 701 (Test Method 2) is an example of an appropriate fire test.

(e) *Marine−craft tank vehicles.* Marine−craft tank vehicles shall be evaluated on an individual basis considering the proposed area of operation.

(4) EXPIRATION OF APPROVAL. (a) Approvals issued under this section are valid for a period of 3 years, with an expiration date of December 31 of the third full year after initial approval, except as provided in par. (b).

(b) Approvals designated as experimental are issued for a maximum term of 12 months.

(c) Approvals may be terminated at any time the department considers them to be in noncompliance with the assumptions on which the approval was based or with the conditions of approval.

Note: Form ERS−8028−A — Wisconsin Material Approval Application is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(5) PRODUCTS REQUIRING LISTING AND LABELING. The following products or materials shall be listed and labeled to show compliance with a standard recognized by the department, that has been developed by a nationally recognized association or independent testing laboratory:

(a) Metallic flex connectors.

(b) Shop−built aboveground and underground storage tanks used for public access fueling of automobiles, trucks, watercraft, ATVs, snowmobiles or aircraft as specified in s. ATCP 93.620.

(c) Shop−built aboveground and underground storage tanks used for fueling fleet vehicles that are licensed for public highway use except for tank wagons, movable tanks, farm tanks and tank vehicles as defined in this chapter and used in accordance with s. ATCP 93.610 or 93.630.

(d) Work−top tanks.

(e) Any product or material required to be either listed or listed and labeled by a standard adopted in ss. ATCP 93.200 to 93.220.

Note: Examples include required listings for dispensing devices for Class I and II liquids under NFPA 30A section 6.3.2; aboveground tanks under NFPA 30 section 25.3.1.4; and used−oil burners and the tanks that supply them, under NFPA 31 section 7.5.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (a) 3., (5) (b), (c), (e) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (5) (b), (c), (e) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.140 Tank registration. (1) GENERAL. All new and existing storage tanks that are used to store a regulated substance shall be registered with the department, except this requirement does not apply to any of the following tanks:

(a) Aboveground tanks which have a capacity of less than 1,100 gallons and which have any of the following characteristics:

1. Are farm tanks, or are located at and serve a construction project.

2. Are used to store heating oil or used oil, for consumptive use on the premises.

3. Are used to store Class IIIB liquids other than used oil.

Note: There is no exemption for used oil unless it is consumed on the premises where stored. Therefore used−oil storage tanks that have a capacity of 110 gallons or more must be registered.

4. Are located inside a building and are used for industrial processes, if that use occurs through piping which connects the tank to the process.

(b) Aboveground tanks which are used to store nonflammable or noncombustible federally regulated hazardous substances and which have a capacity of less than 5,000 gallons.

Note: The list of federally regulated hazardous substances covered in this subchapter, also known as the CERCLA List, is located in 40 CFR 302.4, Table 302.4.

Note: Registration is not required for aboveground or underground tanks that are used to store nonflammable and noncombustible federally regulated hazardous sub-

stances in concentrations of less than 1 percent by volume, because section ATCP 93.020 (6) (o) excludes those tanks from this chapter.

(c) Tank vehicles.

(d) Tank wagons, portable tanks and movable tanks, that are located on a property for less than 24 months.

(e) Tanks that are located at a US EPA superfund site.

Note: Per Wisconsin Statutes, eligibility for Petroleum Environmental Cleanup Fund Act (PECFA) funds is conditioned upon prior tank registration.

(2) REGISTRATION DEADLINES AND RESPONSIBLE PARTY. (a) The owner of a newly−installed storage tank shall have the tank registered with the department in accordance with sub. (3) within 15 business days of completion of the installation.

Note: See section ATCP 93.150 for the deadline and other procedures for notifying the Department of a change in ownership for a registered storage tank.

(b) An owner of a registered tank who changes their name or mailing address, or an owner of a registered tank at a facility that undergoes a name change, shall have the change registered with the department on form ERS−7437, ERS−8731 or ERS−10861 E, as provided by the department, within 15 business days of the change.

Note: Form ERS−7437 — Underground Storage Tank Registration, form ERS−8731– Aboveground Storage Tank Registration, and form ERS−10861 E — Change of Ownership, Flammable/Combustible/Hazardous Liquid Storage Tank Registration are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942. Forms ERS−7437 and 8731 are also available from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(c) The owner of a registered tank system that undergoes any of the following changes or modifications shall have the change or modification registered with the department in accordance with sub. (3) (a) and (c) or (d) within 15 business days of completion of the change or modification:

1. Change in service, where the subsequent service is storing a regulated substance.

2. Addition of leak detection, spill or overfill control or corrosion protection for any part of the system; or upgrade, exchange or conversion of installed leak detection methodology to another approved methodology or manufacturer.

3. Converting to point−of−sale fueling.

(d) The owner of a tank system that is undergoing any of the following changes shall have the change registered with the department in accordance with sub. (3) (a) within 15 business days of the change:

1. Conversion to being either temporarily out of service or back into service.

2. Disconnecting and discontinuing use of a stage II vapor−recovery system.

(e) The owner of land on which unregistered tanks are discovered, including any that are permanently closed, shall have the tanks registered with the department in accordance with sub. (3) (a) and (b) within 15 business days of discovery.

Note: See section ATCP 93.400 (6) (c) for registration requirements that apply when an AST is relocated to a property with a different street address.

Note: See section ATCP 93.450 or 93.550 (1) (e) for registration requirements that apply when an AST or UST, respectively, is changed from storing a regulated substance to storing a non−regulated substance.

Note: See section ATCP 93.460 (4) or 93.560 (2) (d) for registration requirements that apply during permanent closure or removal of an AST or UST system, respectively.

Note: See section ATCP 93.530 (2) (f) for registration requirements that apply when a UST lining is installed.

(3) REGISTRATION PROCEDURE. (a) *General.* A storage tank registration form, form ERS−7437 or ERS−8731, shall be completed, signed by the owner and submitted to the department, for each tank which stores regulated substances and which is not exempted in sub. (1).

Note: Form ERS−7437 — Underground Flammable/Combustible/Hazardous Liquid Storage Tank Registration, and form ERS−8731 — Aboveground Flammable/Combustible/Hazardous Liquid Storage Tank Registration, are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(b) *Proof of financial responsibility.* For a tank owner meeting any of the conditions in sub. (2) (a) and (e), except for permanently closed tanks, proof of any required financial responsibility and an affidavit of financial responsibility, in accordance with subch. VII shall be submitted with the registration form.

Note: See section ATCP 93.700 (1) for the types of tanks that must have financial responsibility. See section ATCP 93.745 (2) (j) for requirements for an affidavit of financial responsibility.

(c) *Tank installation checklist and tests.* 1. Submittal of a registration form for a newly installed shop−built tank system, or for a registered shop−built tank system addressed in sub. (2) (c), shall include the original of the tank installation inspection checklist, form ERS−9658, or ERS−6294 UST, as completed by the certified tank system inspector under s. ATCP 93.115 (2) (b) 4., except as specified in par. (d).

2. Submittal of a registration form for a newly installed UST system shall include the results of the installation tests required in s. ATCP 93.500 (6).

(d) *Exceptions.* In the following circumstances, the specified documents shall be submitted instead of form ERS−9658 or ERS−6294 UST:

1. 'Newly installed aboveground tanks storing federally regulated hazardous substances.' Submittal of a registration form for an aboveground tank which stores federally regulated hazardous substances and which is put into service on or after February 1, 2009, shall include a statement from the qualified engineer responsible for designing and overseeing the construction of the tank system. The statement shall include the name, business address and signature of the qualified engineer and a summary list of design standards used.

Note: The list of federally regulated hazardous substances referred to in this subdivision, also known as the CERCLA List, is located in 40 CFR 302.4, Table 302.4.

2. 'Conversion to point−of−sale fueling.' Where conversion to point−of−sale fueling is the only change at a facility, submittal of the registration form shall include the POS fueling installation form (ERS−6294 POS) completed under s. ATCP 93.100 (3) (a) 5. b.

3. 'Upgrade, exchange or conversion of installed leak detection methodology to another approved methodology or manufacturer.' Where upgrade, exchange or conversion of installed leak detection methodology to another approved methodology or manufacturer is the only change at a facility, submittal of the registration form shall include the leak detection installation form (ERS−9 LD) completed under s. ATCP 93.100 (3) (a) 5. c.

4. 'Conversion to storage and dispensing of alternative motor fuels.' Where conversion to storage and dispensing of alternative motor fuels is the only change at a facility, submittal of the registration form shall include Part II of form ERS−9 Alternative Fuels, as completed by the tank owner under s. ATCP 93.100 (3) (a) 5. d.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; corrections in (3) (d) 2. to 4. made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; correction in (3) (c) 1., 2., (d) 2., 3., 4. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (3) (c) 1., 2., (d) 2. to 4. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.145 Tank permits. (1) GENERAL. All in−use and temporarily−out−of−service storage tanks, whether new or existing, that are used to store a regulated substance shall have a permit to operate from the department, except this requirement does not apply to any of the following tanks:

(a) Aboveground tanks.

(b) Farm and residential underground storage tanks which have a capacity of less than 1,100 gallons and which are used for storing motor fuel.

(c) Underground storage tanks storing heating oil for consumptive use on the premises.

(d) Tanks located at a US EPA superfund site.

(2) PERMIT APPLICATION TIMELINE. The tank owner shall apply for a permit to operate, in accordance with sub. (3), after all requirements for plan approval under s. ATCP 93.100 and registration under s. ATCP 93.140 are completed and the tank is installed, but before the tank is placed into service.

(3) PERMIT APPLICATION PROCEDURE. (a) The owner shall complete 1 permit application, form ERS−7658, as provided by the department, for each tank and submit it to the department along with the information required on the application, except as specified in par. (b), and with any fees due to the department as assessed under this chapter or ch. ATCP 94.

(b) Where registration information in full compliance with s. ATCP 93.140 (3) is submitted for a newly installed tank, the department shall use that information as the permit application.

(4) PERMIT PROCESSING. (a) The department shall review and make a determination on the permit application within 30 business days of receipt of the completed forms and required information.

(b) Upon review and acceptance of the required forms, information and fees specified in sub. (3), the department shall issue an underground storage tank operating permit for each storage tank.

(c) The department may decide to not issue or to not renew an operating permit for a tank if the department finds that there has been significant noncompliance with either this chapter or orders issued pursuant to this chapter. Upon making this decision, the department shall inform the owner or operator in writing of the reasons for the decision.

Note: See section ATCP 93.190 for requirements relating to appealing a decision by the department.

(5) PERMIT POSTING. Each permit to operate shall be posted at the premises where the tank is located, and in a location where the permit is visible to the public. The posted permit shall be maintained in a legible state.

(6) PERMIT EXPIRATION AND RENEWAL. (a) 1. The underground storage tank permit to operate shall annually expire on the 28th day of the month specified in the initially issued permit, except as provided in subd. 2.

2. When a change of ownership occurs, the permit to operate shall expire upon completion of the real−estate transaction.

(b) 1. The department shall send the tank owner of record a permit renewal notice, and a permit application, form ERS−7658, for each tank, before the expiration of the current permit, except as provided in subd. 2.

2. Where a change of ownership occurs, the department shall send the new tank owner a permit application, form ERS−7658, within 15 business days of being notified of the change of ownership, as addressed in s. ATCP 93.150.

(c) To renew a permit, the tank owner shall complete the application received under par. (b) 1. and submit it to the department along with the information required on the application, and with all of the following:

1. Proof of financial responsibility in accordance with subch. VII.

2. An affidavit of financial responsibility in accordance with s. ATCP 93.745 (2) (j)

3. Any fees due to the department as assessed under this chapter or ch. ATCP 94.

(7) PERMIT SUSPENSION. (a) 1. The department may suspend any permit issued under this section, upon determining that operation of any involved tank constitutes an imminent hazard to human health or the environment, or that financial responsibility required in subch. VII has been discontinued.

2. When suspending a permit, the department shall inform the owner or operator in writing of the reasons for the suspension.

(b) Upon suspension of a permit, all dispensing from any involved tank shall cease, and the department may order the owner or operator to properly empty the tank.

(c) The department may reinstate a suspended permit upon determining that the hazard or financial−responsibility failure which resulted in the suspension no longer exists.

Note: See section ATCP 93.190 for requirements relating to appealing a decision by the Department.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2), (3) (a), (b), (6) (b) 2., (c) 2., 3. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2), (3) (a), (b), (6) (b) 2., (c) 2., 3. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.150 Change of ownership. (1) An individual or company taking ownership of property with a storage tank registered under s. ATCP 93.140 shall notify the department of the change of ownership within 15 business days of completing the real−estate transaction.

(2) The ownership−change notification shall be on form ERS−7437, ERS−8731 or ERS−10861 E, as provided by the department, and shall include all of the following:

(a) The name and address of the new owner and of a local contact person.

(b) The date the documents evidencing the property transfer are executed.

(c) The name of the previous owner.

(d) The address of all locations included in the real−estate transaction that have tanks which are subject to the registration requirements in s. ATCP 93.140.

(e) A copy of the newly recorded deed showing the new owner.

Note: Form ERS−7437 — Underground Storage Tank Registration, form ERS−8731– Aboveground Storage Tank Registration, and form ERS−10861 E — Change of Ownership, Flammable/Combustible/Hazardous Liquid Storage Tank Registration are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942. Forms ERS−7437 and 8731 are also available from the Division's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(3) A permit application, form ERS−7658, if received under s. ATCP 93.145 (6) (b) 2., shall be completed and submitted to the department within 15 business days of its receipt; and shall include all of the following:

(a) Proof of financial responsibility in accordance with subch. VII.

(b) An affidavit of financial responsibility in accordance with s. ATCP 93.745 (2) (j)

(c) Any fees due to the department as assessed under chs. ATCP 94.

(4) All records that are required to be retained under either s. ATCP 93.400 (11) or 93.500 (9) shall be transferred to the new owner or operator.

(5) The authorized agent or the department shall inspect the tank system and dispensing system before the new owner puts the tank system into service.

Note: Marketer facilities should refer to: http://dsps.wi.gov/er/pdf/bst/Forms_FM/ER−BST−FM−8592−BRPSmap.pdf
Non−marketer facilities should refer to: http://dsps.wi.gov/er/pdf/bst/Forms_FM/ER−BST−Fm−9687TankerMap.pdf.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) made under s. 13.92 (4) (b) 1., Stats., Register November 2008 No. 635; CR 09−017: cr. (2) (e) Register July 2009 No. 643, eff. 8−1−09; correction in (1), (2) (d), (3) (intro.), (b), (c), (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (d), (3) (intro.), (b), (c), (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.160 Fees. (1) Fees shall be submitted to the department as specified in this chapter or ch. ATCP 94.

(2) Fees shall be submitted at the time of application.

(3) No examinations, approvals, variances, permits or inspections may be given until all fees are received.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.1605 Fees relating to storage tanks for liquids that are flammable, combustible or federally regulated hazardous substances. (1) PLAN EXAMINATION AND

INSPECTION FEES. Fees for the examination of plans, site inspections and reinspections for tanks used for the storage of liquids that are flammable, combustible or federally regulated hazardous substances shall be determined in accordance with Table 93.1605.

(2) GROUNDWATER FEE. Pursuant to s. 168.23 (5), Stats., in addition to any fee charged by the department by rule for plan review and approval for the construction of a new or additional installation or change in operation of a previously approved installation for the storage, handling or use of flammable, combustible or hazardous liquids, the department shall collect a groundwater fee of $100 for each plan review submittal. The moneys collected under this subsection shall be credited to the environmental fund for environmental management.

Note: In accordance with s. 168.23 (5) (b), Stats., an installation that has a capacity of less than 1,000 gallons is not subject to the groundwater fee.

(3) REINSPECTION FEE. The contractor, when performing activities covered under ss. SPS 305.84 to 305.87, shall pay the reinspection fee to the authorized agent if the authorized agent is required to make a return trip due to any of the following, or is required to reschedule a trip on less than 24 hours notice of any of the following:

(a) Failure to have the tank system accessible for inspection on the date and time specified for inspection.

(b) Installation inspection points that are incomplete on the date and time specified for inspection.

(c) Failure to correct deficiencies by the date and time specified for inspection.

Note: Section SPS 305.84 covers aboveground tank system installation certification requirements. SPS 305.85 covers underground tank system installation certification requirements. SPS 305.86 covers tank system lining certification requirements. SPS 305.87 covers tank system removing and cleaning certification requirements.

(4) SPECIAL INSPECTION FEE. The owner or operator shall pay the miscellaneous inspection fee specified in s. SPS 302.04 (2) to the authorized agent for any of the following reasons:

(a) Replacement of identical equipment where the department or local program operator has waived the plan submittal requirement.

(b) Pre−operational inspection required by the department as a result of compliance orders where plan submittal is not required.

Table 93.1605
Plan Examination and Inspection Fees for Liquid Storage Tanks

Tank System Category	Plan Review Fee*	Installation Inspection Fee	Plan Revision Fee	Reinspection Fee
Aggregate capacity of aboveground storage tanks equal to or less than 1,100 gallons installed on a farm premises with inspection in 5 days or less	$0	$75	$0	$0
Aggregate capacity of aboveground storage tanks equal to or less than 1,100 gallons installed on a farm premises with inspection in 2 days or less	$0	$100	$0	$0
Aggregate capacity equal to or less than 1,100 gallons	$60	$100	$100	$100
Aggregate capacity 1,101 gallons through 48,000 gallons capacity	$125	$250	$100	$100
Aggregate capacity 48,001 gallons through 80,000 gallons capacity	$150	$300	$100	$100
Aggregate capacity 80,001 gallons through 120,000 gallons capacity	$180	$450	$120	$150
Aggregate capacity 120,001 gallons capacity or greater	$360	$600	$150	$200
Addition of corrosion protection to an existing system	$35	$100	$100	$100
Conversion of existing system to a point−of−sale (POS) type of dispensing system**	$35	$100	$100	$100
Underground storage tank pre−lining inspection	Aggregate as above	$50/tank	$100	$100
Upgrade, exchange or conversion of existing leak detection methodology to another approved methodology or manufacturer***	$35	$100	$100	$100
Upgrade of secondary containment only, for tanks	$150	$100	$100	$100
Installation or modification of vent piping on existing system	$60	$100	$100	$100
Installation of Stage II vapor recovery on existing system	Aggregate as above	Aggregate as above	Aggregate as above	Aggregate as above
Upgrade or conversion of Stage II vapor recovery on existing system	$60	$100	$100	$100

[a] For all tanks which have a capacity of less than 5000 gallons and which are reviewed by a local program operator, no state fees are required. The local program operator will charge a fee which must be at least equal to the fee in this table, but which does not include the groundwater fee in sub. (2).

* If the Department is conducting plan review in the absence of an assigned local program operator, the appropriate Table 93.1605 fees must be submitted, along with the groundwater fee in sub. (2). Further information on where local program operators perform reviews is available at the following Web site: http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

** A point−of−sale system is any dispensing system that will authorize fuel dispensing by means of key, card or code activation. These conversions are reviewed by local program operators.

*** These reviews are performed only by the Department.

History: Cr. Register, June, 1992, No. 438, eff. 7−1−92; am. Table, Register, March, 1996, No. 483, eff. 4−1−96; correction in Table 2.43 made under s. 13.93 (2m) (b) 7., Stats., Register, November, 1999, No. 527; am. Table 2.43, Register, July, 2000, No. 535, eff. 9−1−00; CR 05−038: r. and recr. Register October 2005 No. 598, eff. 11−1−05; CR 07−029: am. Table 2.43 Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (title) and (1) Register July 2009 No. 643, eff. 8−1−09; correction in (1), (3) (intro.), (4) (intro.) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **SPS 302.43 renum. ATCP 93.1605 under s. 13.92 (4) (b) 1., Stats.; (title) revised under s. 13.92 (4) (b) 2., Stats.; corrections in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.170 Petition for variance and petition for rule change. (1) PETITION FOR VARIANCE. The department shall consider and may grant a variance to a provision of this chapter in accordance with ch. SPS 303. The petition for variance shall include, where applicable, a position statement from the fire department having jurisdiction.

Note: Chapter SPS 303 requires submittal of a petition for variance form (ERS−9890−A) and a fee, and that an equivalency is established in the petition for variance which meets the intent of the rule being petitioned. Chapter SPS 303 also requires the Department to process regular petitions within 30 business days and priority petitions within 10 business days. A position statement from the fire department is applicable when the rule being petitioned relates to fire safety issues.

Note: Form ERS−9890−A is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) PETITION FOR RULE CHANGE. As specified in s. 227.12, Stats., any municipality; any association which is representative of a farm, labor, business or professional group; or any 5 or more persons having an interest in a rule may petition the department requesting the adoption, amendment or repeal of the rule.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

ATCP 93.180 Penalties. Penalties for violations of this chapter shall be assessed in accordance with s. 168.26, Stats., and shall apply separately to each tank that is in violation of this chapter.

Note: Section 168.26 of the Statutes states "Any person who violates this section or any rule or order adopted under this section shall forfeit not less than $10 nor more than $5,000 for each violation. Each violation of this section or any rule or order under this section constitutes a separate offense and each day of continued violation is a separate offense."

Note: Section 40 CFR 281.41 allows the US EPA to assess fines of $5,000 or more for each tank for each day of violation.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; **correction made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.190 Appeals and hearings on enforcement decisions. (1) HEARINGS. (a) *General.* The owner or operator of a tank system may request a hearing with the department, as specified in s. ATCP 1.06 on any decision affecting that person's legal rights, including enforcement orders and any petition−for−variance, material−approval or permit decision issued under the scope of this chapter.

(b) *Appeal requirements.* 1. All appeals of enforcement orders issued under this chapter shall be in writing and shall be received by the department no later than 15 calendar days after the date of the enforcement order or decision being appealed, except as provided in subd. 2.

2. All appeals of petitions for variance or material−approval or permit decisions issued under this chapter shall be in writing and shall be received by the department no later than 30 calendar days after the date of the decision being appealed.

3. The department may make a determination not to proceed with a request for a hearing depending on the nature of the issue being appealed.

4. Appeals received after the appeal deadline shall be dismissed.

5. For purposes of this section, appeals filed after 4:30 p.m. shall be considered received on the next business day.

Note: The appellant or an attorney representing the appellant may request an administrative hearing to review this action by delivering, mailing, or faxing a written request for a hearing to one of the following:

In−person delivery address:

Department of Agriculture, Trade and Consumer Protection
2811 Agriculture Drive.
Madison, Wisconsin 53708

Mailing address:

Secretary of Department of Agriculture, Trade and Consumer Protection
P.O. Box 8911
Madison WI 53708−8911

6. An appeal shall be signed by the person whose legal rights are affected by the decision being appealed or an attorney representing such person. Any appeal filed by a person other than the person whose legal rights are affected by the decision being appealed or an attorney representing that affected person shall be dismissed.

7. The written appeal shall list every reason the department's or authorized agent's decision is incorrect and shall identify every issue to be considered at the hearing. Issues not raised in the written appeal under this paragraph are considered waived and shall be dismissed.

(c) *Response.* Upon receipt of notification of hearing from the department, the affected party shall submit to the department a written response within 15 calendar days of the date of service. Failure to respond within the prescribed time limit, or failure to appear at the scheduled hearing, may result in the allegations specified in the complaint being accepted as true and accurate.

(d) *Settlement agreement prior to hearing.* 1. If the department and the affected party are able to reach preliminary agreement on disposition of a complaint prior to a hearing, such agreement shall be processed in accordance with all of the following:

a. Be transmitted in writing to the secretary of the department or the person so designated by the secretary.

b. Not be binding upon any party until accepted by the secretary of the department or the person so designated by the secretary.

2. The settlement agreement shall be considered a joint motion by the parties to dismiss the appeal in its entirety with prejudice or to dismiss such portions of the appeal with prejudice as may be covered by the terms of the settlement agreement.

(e) *Witness fees.* Witness fees and mileage of witnesses subpoenaed on behalf of the department shall be paid at the rate prescribed for witnesses in circuit court.

(2) CONDUCT OF HEARINGS. (a) All hearings shall be conducted by persons selected by the department in accordance with ch. 227, Stats.

(b) Persons selected under par. (a) may administer oaths or affirmations and may grant continuances and adjournments for cause shown.

(c) The affected party shall appear in person and may be represented by legal counsel.

(d) Witnesses may be examined by persons designated by the department.

(e) There shall be no prehearing discovery except as provided in s. 227.45 (7), Stats.

(3) DETERMINATIONS. (a) The department may make determinations and enter its order on the basis of the facts revealed by its investigation.

(b) Any determinations as a result of petition or hearing shall be in writing and shall be binding unless appealed to the secretary of the department.

(4) APPEAL ARGUMENTS. Appeal arguments shall be submitted to the department in writing unless otherwise ordered.

(5) LOCATION OF HEARINGS. (a) All hearings shall be held at a location determined by the department.

(b) Telephone testimony of individual witnesses and telephone hearings may be held at the discretion of the person designated by the secretary as hearing officer.

(6) HEARING TRANSCRIPTS. (a) All hearings shall be electronically recorded.

(b) Any party may request a copy of the electronic recording.

(c) 1. A transcript of the recorded hearing shall be prepared upon request at the expense of the party requesting the transcript.

2. Copies of transcripts prepared under this subsection shall be provided to the other party or parties upon payment of the actual cost of copying or obtaining a copy of the transcript.

3. The department may require payment in advance.

4. A transcript may be provided at the department's expense to a party who demonstrates impecuniousness or financial need if that party has filed a petition for judicial review.

5. Where the department contracts with a court reporting firm for the preparation of transcripts, the fees charged for transcription and copying shall be equal to the fees charged to the department by the court reporting firm.

(7) ENFORCEMENT ACTION STATUS. Enforcement action shall proceed until such time as an administrative law judge has issued under this subsection a decision overturning or modifying the order.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; **correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

Subchapter II — Adopted Standards and General Requirements

ATCP 93.200 Adoption of standards. (1) INCORPORATION BY REFERENCE. The standards listed in Tables 93.200−1 to 93.200−11 are hereby incorporated by reference into this chapter.

Note: Copies of the adopted standards are on file in the offices of the department and the legislative reference bureau. Copies of the standards may be purchased through the respective organizations listed in Tables 93.200−1 to 93.200−11.

(2) ALTERNATE STANDARDS. Alternate standards that are equivalent to or more stringent than the standards incorporated by reference in this chapter may be used in lieu of incorporated standards if the alternate standard is approved by the department, or if written approval is issued by the department in accordance with s. ATCP 93.130, under all of the following conditions:

(a) Determination of approval shall be based on an analysis of the alternate standard and the incorporated standard, prepared by a qualified independent third party or the organization that published the incorporated standard.

(b) The department may include specific conditions in issuing an approval, including an expiration date for the approval. Violations of the conditions under which an approval is issued shall constitute a violation of this chapter.

(c) If the department determines that the alternate standard is not equivalent to or more stringent than the standards incorporated by reference, the request for approval shall be denied in writing.

(d) The department may revoke an approval for any false statements or misrepresentations of facts on which the approval was based. The department may re−examine an approved alternate standard or issue a revised approval at any time.

Table 93.200−1

ACI	American Concrete Institute PO Box 9094 Farmington Hills, MI 48333
Standard Reference Number	**Title**
350.2R–04, except for section 6.3	Concrete Structures for Containment of Hazardous Materials.

Table 93.200−2

API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005
Standard Reference Number	**Title**
1. 570–98 (With addenda 1 to 4, through June 2006)	Piping Inspection Code: Inspection, Repair, Alteration, and Rerating of In−service Piping Systems.
2. RP 575–05	Guidelines and Methods for Inspection of Existing Atmospheric and Low−pressure Storage Tanks.
3. Std 650–07	Welded Steel Tanks for Oil Storage.
4. RP 651–07	Cathodic Protection of Aboveground Petroleum Storage Tanks.
5. RP 652–05	Lining of Aboveground Petroleum Storage Tank Bottoms.
6. Std 653–09	Tank Inspection, Repair, Alteration, and Reconstruction.
7. Std 1529–05	Aviation Fuelling Hose and Hose Assemblies.
8. Std 1542–02	Identification Markings for Dedicated Aviation Fuel Manufacturing and Distribution Facilities, Airport Storage and Mobile Fuelling Equipment.
9. RP 1604–96	Closure of Underground Petroleum Storage Tanks.
10. RP 1615–96	Installation of Underground Petroleum Storage Systems.
11. RP 1621–93	Bulk Liquid Stock Control at Retail Outlets.
12. RP 1626–85	Storing and Handling Ethanol and Gasoline−Ethanol Blends at Distribution Terminals and Service Stations.
13. Std 1631–01	Interior Lining and Periodic Inspection of Underground Storage Tanks.
14. RP 1632–96	Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.
15. RP 1637–06	Using the API Color−Symbol System to Mark Equipment and Vehicles for Product Identification at Gasoline Dispensing Facilities and Distribution Terminals.
16. Std 2000–98	Venting Atmospheric and Low−Pressure Storage Tanks.

17. Std 2015–01	Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks.
18. RP 2200–94	Repairing Crude Oil, LP Gas and Product Pipelines.
19. RP 2350–05	Overfill Protection for Storage Tanks in Petroleum Facilities.
20. Std 2610–05	Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities.

Table 93.200−3

ASTM	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428
Standard Reference Number	**Title**
G158–98(2004)	Standard Guide for Three Methods of Assessing Buried Steel Tanks.

Table 93.200−4

KWA	Ken Wilcox Associates 1125 Valley Ridge Drive Grain Valley, MO 64029
Standard Reference Number	**Title**
1999 Version	Recommended Practice for Inspecting Buried Lined Steel Tanks Using a Video Camera.

Table 93.200−5

NACE	NACE International P.O. Box 218340 Houston, TX 77218
Standard Reference Number	**Title**
1. SP0169–07	Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
2. SP0178–07	Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
3. SP0188–06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. RP0193–01	External Cathodic Protection of On−Grade Carbon Steel Storage Tank Bottoms.
5. RP0285–02	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection.
6. SP0286–07	Electrical Isolation of Cathodically Protected Pipelines.
7. TM0497–02	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems.

Table 93.200−6

NFPA®	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269
Standard Reference Number	**Title**
1. 10–07	Standard for Portable Fire Extinguishers.
2. 30–08	Flammable and Combustible Liquids Code.
3. 30A–08	Code for Motor Fuel Dispensing Facilities and Repair Garages.
4. 30B–07	Code for the Manufacture and Storage of Aerosol Products.
5. 31–06	Standard for the Installation of Oil−Burning Equipment.
6. 37–06	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
7. 68–07	Standard on Explosion Protection by Deflagration Venting.
8. 110–05	Standard for Emergency and Standby Power Systems.
9. 326–05	Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning or Repair.
10. 385–07	Standard for Tank Vehicles for Flammable and Combustible Liquids.
11. 407–07	Standard for Aircraft Fuel Servicing.
12. 410–04 − Chapter 6 only	Standard on Aircraft Maintenance.
13. 418–06	Standard for Heliports.
14. 704–07	Standard System for the Identification of the Hazards of Materials for Emergency Response.

Table 93.200−7

PEI	Petroleum Equipment Institute P.O. Box 2380 Tulsa, OK 74101
Standard Reference Number	**Title**
1. RP100–05	Recommended Practices for Installation of Underground Liquid Storage Systems.

2. RP200–03	Recommended Practices for Installation of Aboveground Storage Systems for Motor−Vehicle Fueling.
3. RP300–04	Recommended Practices for Installation and Testing of Vapor−Recovery Systems at Vehicle−Fueling Sites.
4. RP400–02 (Reaffirmed 2007)	Recommended Procedure for Testing Electrical Continuity of Fuel−Dispensing Hanging Hardware.
5. RP500–05	Recommended Practices for Inspection and Maintenance of Motor Fuel Dispensing Equipment.
6. RP600–07	Recommended Practices for Overfill Prevention for Shop−Fabricated Aboveground Tanks.
7. RP800–08	Recommended Practices for Installation of Bulk Storage Plants.
8. RP900–08	Recommended Practices for the Inspection and Maintenance of UST Systems.
9. Lexicon, 1995	Petroleum Equipment Lexicon.

Table 93.200−8

SSPC	Society for Protective Coatings 40 24th Street Pittsburgh, PA 15222
Standard Reference Number	**Title**
VIS 2–00	Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces.

Table 93.200−9

STI	Steel Tank Institute 944 Donata Court Lake Zurich, IL 60047
Standard Reference Number	**Title**
1. F051–06	Standard for Double Bottom Steel Storage Tanks.
2. R051–06	Cathodic Protection Testing Procedures for sti−P3® USTs.
3. R972–06	Recommended Practice for the Addition of Supplemental Anodes to sti−P3® USTs.
4. R012–07	Recommended Practice for Interstitial Tightness Testing of Existing Underground Double Wall Steel Tanks.
5. SP001–06 (4th Edition)	Standard for the Inspection of Aboveground Storage Tanks.
6. SP031–08	Standard for Repair of Shop−Fabricated Aboveground Tanks for Storage of Flammable and Combustible Liquids.

Table 93.200−10

UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062−2096 USA
Standard Reference Number	**Title**
SU 2258–08	Nonmetallic Tanks for Oil−Burner Fuels and Other Combustible Liquids.

Note: Several other UL design standards are indirectly applied by this chapter through their inclusion in other standards that are directly adopted in this chapter. For example, UL 58, 80, 142, 1316, 1746, 2080 and 2085 are included in NFPA 30, in section 21.4.2, which is adopted in Table 93.200−6.

Table 93.200−11

U.S. Department of Energy	U.S. Department of Energy Alternative Fuels and Advanced Vehicles Data Center Phone: (800) 423−1363 e−mail: hotline@afdc.nrel.gov
Standard Reference Number	**Title**
1. DOE/GO−1002006−2343, July 2006	Handbook for Handling, Storing, and Dispensing E85.
2. DOE/GO−102006−2358, September 2006	Biodiesel Handling and Use Guidelines.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. Tables 2 and 9 Register July 2009 No. 643, eff. 8−1−09; correction in (1), (2) (intro.) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (intro.) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.210 Application of standards. (1) All flammable, combustible and hazardous liquids, and equipment and facilities that are used to store them shall be designed, constructed, installed, operated, inspected, tested and maintained as specified in the standards adopted in s. ATCP 93.200, as those standards apply to the specific liquid, equipment or facility, except as otherwise provided in this chapter.

(2) All codes and standards referenced in the standards adopted in s. ATCP 93.200 shall apply to the prescribed extent of each such reference, except as modified by this chapter.

(3) Any requirements in the standards adopted in s. ATCP 93.200 that address design and construction of public buildings or places of employment and which conflict with requirements in chs. SPS 361 to 366, are not included as part of this chapter.

Note: In addition to addressing new construction for public buildings and places of employment, chapters SPS 361 to 366 generally require in section SPS 361.03 (13) that every existing public building or place of employment be maintained to conform with the building code requirements which applied when the building, structure, element, system, or component thereof was constructed.

(4) All fire detection, prevention, suppression and isolation features required by a standard adopted in s. ATCP 93.200 shall be provided as specified in the standard, unless mandated otherwise by chs. SPS 361 to 366, under sub. (3).

(5) All fire detection, prevention, suppression and isolation features that are installed, whether or not they are required by rule

or standard, shall be inspected, tested and maintained as required by the applicable standard adopted in s. ATCP 93.200 or by other rules of the department.

Note: See also chapter SPS 314, *Wisconsin Fire Prevention Code*, for requirements on the inspection, testing and maintenance of fixed and portable fire protection systems.

(6) Any permit referenced in the standards adopted in s. ATCP 93.200 is not required by this chapter, but may be required at the local level if done so through a local ordinance.

Note: For example, the permit referenced in NFPA 30 section 6.5.3.1 for spark−producing operations is not required by this chapter, but may be applied through a local ordinance.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2), (3), (4), (5), (6) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) to (6) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.220 Secondary references. For the purposes of this chapter, the department of safety and professional services shall enforce the applicable provisions of the following Wisconsin administrative codes in lieu of the indicated standards that are referenced in the NFPA standards adopted in s. ATCP 93.200:

(1) BOILERS AND PRESSURE VESSELS. Chapter SPS 341 in lieu of the ASME Boiler and Pressure Vessel Code.

(2) BUILDING ELEMENTS. Chapters SPS 361 to 366 in lieu of the following NFPA standards:

(a) NFPA 101® — Life Safety Code®.

(b) NFPA 220 — Standard on Types of Building Construction.

(c) NFPA 221 — Standard for High Challenge Fire Walls, Fire Walls and Fire Barrier Walls.

(d) NFPA 5000® – Building Construction and Safety Code®.

Note: In addition to addressing new construction for public buildings and places of employment, chapters SPS 361 to 366 generally require in section SPS 361.03 (13) that every existing public building or place of employment be maintained to conform with the building code requirements which applied when the building, structure, element, system, or component thereof was constructed.

(3) ELECTRICAL INSTALLATIONS. Chapter SPS 316 in lieu of NFPA 70 — National Electrical Code®.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: cr. (2) (d) Register July 2009 No. 643, eff. 8−1−09; correction in (intro.), (1), (2) (intro.), (3) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (intro.) made under s. 13.92 (4) (b) 6., 7., Stats., Register October 2013 No. 694.**

ATCP 93.225 Alternate standards. (1) Alternate standards that are equivalent to or more stringent than the standards referenced in this chapter may used in lieu of the referenced standards when approved by the department or if written approval is issued by the department in accordance with sub. (2).

(2) (a) Upon receipt of a fee and a written request, the department may issue an approval for the use of the alternate standard.

(b) The department shall review and make a determination on an application for approval within 40 business days of receipt of all forms, fees and documents required to complete the review.

(3) Determination of approval shall be based on an analysis of the alternate standard and the standard referenced in this chapter, prepared by a qualified independent third party or the organization that published the standard contained in this chapter.

(4) The department may include specific conditions in issuing an approval, including an expiration date for the approval. Violations of the conditions under which an approval is issued shall constitute a violation of this chapter.

(5) If the department determines that the alternate standard is not equivalent to or more stringent than the referenced standard, the request for approval shall be denied in writing.

(6) The department may revoke an approval for any false statements or misrepresentations of facts on which the approval was based.

(7) The department may reexamine an approved alternate standard and issue a revised approval at any time.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.230 General requirements. (1) APPLICATION. This section applies to all new and existing tank systems, their appurtenances and the associated property and facilities.

(2) ACCESS. (a) Owners and operators of storage tank systems shall cooperate fully with inspections, monitoring, testing and requests for document submission conducted or required by the authorized agent or deputy of the department.

(b) Facilities shall have available keys, codes or other items necessary to open access to sumps, dispensers, pumps or areas that contain liquid system valves, controls, connections and fittings for the purpose of inspecting for leaks, functionality of fire safety and leak prevention equipment or verification of proper system operation.

Note: Section 93.08 of the Statutes reads as follows:

In performing their duties or in enforcing the laws entrusted to their administration, the department and its authorized agents may do all of the following:

(1) Enter, within reasonable hours, any field, orchard, garden, packing ground, building, freight or express office, warehouse, car, vessel, vehicle, room, cellar, storehouse, cold storage plant, packing house, stockyard, railroad yard or any other place of business, which it may be necessary or desirable for them to enter.

(2) Open any box, carton, parcel, package or other receptacle, inspect the contents thereof, and, upon payment or tender of the market value, take samples of any product or material contained therein.

(3) Inspect products and materials and collect and test samples of them.

(3) RELEASES. (a) Owners and operators and contractors performing work under this chapter may not allow releases to occur from tank systems or dispensing systems, or from spilling or overfilling.

(b) Fuel−delivery persons may not allow releases to result from any overfilling or spilling that occurs during their delivery procedure.

Note: For further information on industry practices for preventing or detecting releases with aboveground storage systems, and for protecting groundwater, surface water and soil in the event of a liquid release, see API Publication 340 — *Liquid Release Prevention and Detection Measures for Aboveground Storage Facilities.*

(4) MSDS. Facilities shall have available a material safety data sheet for each stored product regulated by this chapter.

Note: The flash point as noted in the MSDS will be used to resolve any disputes of the flammability or combustibility classification for the respective liquid product.

(5) UNITS OF MEASURE. Units of measurement shall be traditional U.S. measures.

Note: An important unit of measure used by this chapter is the U.S. gallon. It is equivalent to 4 U.S. quarts or 3.79 liters.

(6) DEGREASING AND CLEANING. (a) A Class I liquid may not be used for degreasing or cleaning any engine, machine, part or equipment, or for cleaning any part of a building or premises, except as provided under par. (b).

(b) Industrial processes that use Class I liquids for degreasing or cleaning shall incorporate a ventilation system to reduce and maintain vapor concentration to less than 25 percent of the lower explosive limit.

(7) SYSTEM COMPATIBILITY. Tank system components and containment systems shall be compatible with the substance stored in the tank system.

(8) FIRE EXTINGUISHER MAINTENANCE. All portable fire extinguishers shall be maintained in accordance with NFPA 10.

(9) PROPERTY MAINTENANCE. All surface area within a 20−foot radius of a storage tank or dispenser shall be maintained free of combustible material and debris, except as allowed for public−access motor vehicle fueling operations in s. ATCP 93.620.

(10) SYSTEM MAINTENANCE. (a) All system equipment and components shall be maintained to function to the manufacturer's original specifications and shall be maintained to be leak−free.

(b) 1. At least monthly, except as provided in subd. 2., sumps and secondary containment systems for tanks, piping and dispensers shall be inspected, and any liquids and debris contained then shall be removed.

2. Sumps with a non−discriminating electronic sensor that detects liquid in the sump shall be inspected at least semiannually unless more frequent inspection is required by RP500 or RP900.

(c) Deficiencies in product lines or structural or transition components that allow for liquid leaks or water intrusion shall be repaired or corrected.

(d) Leak detection, fill and overfill prevention equipment shall be maintained in a functional condition.

(e) Fire and leak prevention and detection equipment installed, but not required by the department's rules, shall be maintained functional or be removed.

Note: Section ATCP 93.115 (3) (a) 7. allows the authorized agent or the Department or fire department to shut down the tank system until any breach in the tank system is repaired or otherwise corrected.

(11) DAMAGE TO UNDERGROUND COMPONENTS. (a) When damage has occurred to underground pressurized tank system components or to underground vent and remote fill lines, the affected portion of the tank system shall be removed from service, and the following actions shall be taken before that portion of the system is put back into service, except as provided in par. (b):

1. Perform third−party precision tightness testing of the portion of the tank system where damage occurred, in accordance with s. ATCP 93.515 (4) (a) 1.

2. Isolate system components through the use of pressure−retaining components.

3. Perform functional operational tests of existing monitoring equipment.

4. Perform any additional monitoring, processes, or procedures needed to verify system integrity.

5. Comply with the tank−system site assessment and response requirements in ss. ATCP 93.575 to 93.585 if a release is suspected.

(b) The actions in par. (a) 1. to 4. are not required where the damage is limited to dispenser system components that are isolated from the rest of the dispenser or tank system through the use of pressure−retaining components.

Note: These are minimum requirements for the restart of a damaged system, dependent on the situation at the incident site. Additional safety or environmental protection actions or repairs may be needed by the owner or operator.

(12) PRODUCT COLOR CODING FOR FILL PIPE CAPS AND MANHOLE COVERS. (a) *General*. 1. All fill pipe caps and manhole covers for underground fuel tanks at distribution terminals, bulk plants and motor fuel dispensing facilities shall be identified by the standard color and symbol coding in API 1637.

2. Products containing extenders such as ethanol shall be designated by the addition of a black border around white symbols and a white border around other colored symbols.

Note: Extenders or oxygenates are added to gasoline and typically comprise a maximum of 10 percent of the fuel by volume.

3. Vapor−recovery connections and manholes shall be marked with orange circles.

4. a. Observation and monitoring wells shall be marked with a black triangle on a white background.

b. The well shall be provided with a durable label warning against the introduction of petroleum products into the well.

(b) *Location of identification*. 1. The color coding required in par. (a) shall be applied to the fill pipe cap and manhole cover or within the spill containment.

2. At all facilities with more than one tank, the color coding applied to the fill cap or manhole cover shall extend at least 12 inches beyond the edge of the cap or cover onto adjacent concrete or pavement.

Note: See section ATCP 93.340 for additional information on product identification at bulk plants and terminals.

(13) DEACTIVATION OF VAPOR RECOVERY. When deactivating a stage II vapor−recovery system or a portion thereof, the deactivated pipe shall be removed, or be capped or plugged at the dispenser. If the pipe is removed, the connection to the tank shall be capped or plugged.

Note: Each connection of a tank to deactivated, unremoved vapor−recovery pipe should be capped or plugged at the tank, if readily accessible, to minimize the potential for water intrusion from the pipe.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (9), (11) (a) 1., 5. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (9), (11) (a) 1., 5. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.240 Certifications and enforcement. (1) CERTIFICATIONS. Persons and firms providing or supervising any of the following services shall be credentialed by the department in accordance with ch. SPS 305:

(a) Tank−system site assessment as referenced in s. ATCP 93.465 for aboveground tanks and s. ATCP 93.580 for underground tanks.

(b) Underground tank system lining under ss. ATCP 93.530 and 93.535.

(c) The cleaning and removal of underground storage tanks and stationary shop−built aboveground storage tanks.

(d) Storage tank system precision tightness testing using equipment that is not permanently installed on the tank system.

Note: All methods of precision tightness testing are required to be approved by the department in accordance with section ATCP 93.130

(e) Corrosion protection services as required in s. ATCP 93.520.

(f) Installation of underground storage tanks and shop−built aboveground storage tanks, except this requirement does not apply to any of the following tanks:

1. Aboveground heating oil tanks at 1− or 2−family dwellings.

2. Tanks or piping that are installed or constructed under the direct supervision of a registered professional engineer.

Note: "Under the direct supervision of a registered professional engineer" means the registered professional engineer must be on the site during, and responsible for, the key installation and test activities described in section SPS 305.84 (5) or 305.85 (5).

(2) ENFORCEMENT ACTIONS. (a) The department may take actions to ensure compliance with the provisions of this chapter, including revoking or suspending credentials.

Note: Section 168.23 (3) of the Statutes, reads in part

Any rule requiring certification or registration shall also authorize the revocation or suspension of the certification or registration.

Note: See chapter SPS 305 for revocation and suspension criteria.

Note: Sections SPS 305.83, 305.88 and 305.89 prohibit a person from engaging in tank−system site assessment, tank system tightness testing, or cathodic protection specialties if the person or the person's employer has a personal or financial interest in the facility.

(b) The department may require attendance at a specified education class.

(c) The department may commence civil action or administrative action under the provisions of ss. 168.25 and 168.26, Stats.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (intro.), (a), (b), (e) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (b), (e), (2) (c) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.250 Tank construction and marking. (1) MULTI−COMPARTMENT TANKS. Each compartment of a multi−compartment tank shall be considered a separate tank, even if the same substance is stored in 2 or more of the compartments.

(2) CONSTRUCTION. Tanks containing flammable or combustible liquids shall be constructed to one of the recognized design standards in NFPA 30 section 21.4.2, or to another standard or design approved by the department, except this requirement does not apply to any of the following tanks:

(a) Tanks that contain liquids which are also hazardous substances.

Note: Section ATCP 93.350 requires hazardous substance tanks to be designed and constructed under the supervision of a qualified engineer.

(b) Tank wagons, farm tanks and tank vehicles used in accordance with the requirements in ss. ATCP 93.610 and 93.630, for

fuel dispensing from aboveground tanks and at farms and construction projects.

Note: Design standards recognized by NFPA 30 section 21.4.2 include API 12B, API 12D, API 12F, API 650, UL 58, UL 80, UL 142, UL 1316, UL 1746, UL 2080 and UL 2085. Another standard approved by the department is SU 2258 from Underwriters Laboratories Inc.

Note: Tank wagons have construction requirements in section ATCP 93.610 (1). Farm tanks are required to meet the construction specifications in NFPA 30A section 13.2.3. Tank vehicles are required to meet the construction specifications in NFPA 385 chapters 2 and 3. Movable tanks covered under the dispensing requirements in section ATCP 93.610 (2) are not exempted from this requirement.

(c) Tanks which are custom built for a specific purpose and which are supported by a statement acceptable to the department, from a qualified engineer, as defined in s. ATCP 93.350 (2) (d), except the competency of the engineer shall relate to the purpose for the custom−built tank.

(d) Aboveground used−oil tanks at a scrap recycling or auto recycling facility that are exempted from these requirements under s. ATCP 93.300 (9).

(3) MARKING. Newly manufactured or constructed tanks shall have at least all of the following information permanently marked on the exterior of the tank by the manufacturer or the party responsible for tank construction:

(a) The name of the manufacturer or the party responsible for tank construction.

(b) The year of manufacture or construction.

(c) The standard under which the tank is manufactured or constructed.

(d) The minimum rate of any required emergency venting.

Note: The applicable construction standard may already require this information or additional information to be marked on the tank. This marking requirement especially applies to farm tanks which have a capacity of less than 1,100 gallons and which are not required to be manufactured to any specific construction standard other than the minimal requirements in NFPA 30A section 13.2.3.

Note: The department periodically publishes program letters to address issues in relation to applications of this chapter. The program letters are intended to provide and communicate implementation of regulatory and enforcement policy. Storage Tank Program Letters can be accessed on the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: cr. (2) (d), r. and recr. (3) Register July 2009 No. 643, eff. 8−1−09; correction in (2) (b), (c), (d) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (b) to (d) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.260 Setbacks from already−installed potable water supply sources. (1) (a) Tank systems and their dispensing systems shall comply with the setback requirements in Table 93.260, except as specified in pars. (b) and (c).

(b) These setbacks do not apply where piping or dispensers are being replaced without replacing the tank.

(c) These setbacks do not apply where shorter setbacks are specified by the department of natural resources.

Note: The Department of Natural Resources administers separating distances for *proposed* public community water supply wells regulated under chapter NR 811, and those distances may differ from the distances in Table 93.260. See footnote 4 under Table 93.260 for DNR requirements about separating distances for proposed and already−installed private water supply wells regulated under chapter NR 812.

Note: Longer setback distances may be imposed through local wellhead−protection requirements.

Table 93.260

Setbacks From Already−Installed Potable Water Supply Sources

Tank Type[1]	**Minimum Distance to a Water Supply Well Regulated Under Chapter NR 811 (feet)** [2]	**Minimum Distance to a Water Supply Well Regulated Under Chapter NR 812 (feet)** [3,4]
Farm UST or AST system with single wall	1200	100
Farm UST system with double wall and with electronic interstitial monitoring for the system	600[5]	50[5]
Farm AST system with double wall, or with other secondary containment that is under a canopy	600[6]	50[6]
One− or two−family residential heating oil UST or AST system	200	25
Emergency or standby power system AST with double wall and with continuous electronic interstitial monitoring for the tank	10[7]	10[7]
Other UST or AST system with single wall	1200	100
Other UST system with double wall and with electronic interstitial monitoring for the system	600[5]	50[5]
Other AST system with double wall, or with other secondary containment that is under a canopy; and with electronic interstitial monitoring for double wall, or electronic sensor for other secondary containment	600[6]	50[6]

[1] Any reference in this column to a UST or AST "system" means both the tank and any product piping connected to it have the subsequently specified features.

[2] The setback in this column is at least 1200 feet if any associated fueling area is not on a concrete surface, and any associated AST is not on a concrete surface, except this requirement does not apply to the setback for a one− or two−family residential heating oil AST.

[3] The setback in this column is at least 100 feet if any associated fueling area is not on a concrete surface, and any associated AST is not on a concrete surface, except this requirement does not apply to the setback for a one− or two−family residential heating oil AST.

[4] Any setback in this column that is less than 100 feet, other than the 25−foot setback for one− and two−family residences, may be utilized only after obtaining a variance or other approval from the department of natural resources, except a variance or other approval is not required for an AST that has a capacity of 1500 gallons or less.

[5] This distance may be reduced by 50% if all of the following features are provided and maintained in addition to the features in the tank−type column: tank system construction of corrosion−resistant material, such as fiber−reinforced plastic, or steel with a fiber−reinforced plastic wrap or jacket; non−discriminating sump sensors; testable secondary containment spill bucket; continuous electronic liquid−filled, pressure, or vacuum interstitial monitoring with automatic system shut−down; audible and visual high−level alarm at 90% full, and automatic shut−off at 95%; all fueling area protected by canopy; and downspouts for drainage of rainwater do not discharge into a fueling area.

[6] This distance may be reduced by 50% if all of the following features are provided and maintained in addition to the features in the tank−type column: either continuous non−discriminating electronic interstitial monitoring for double wall, or continuous non−discriminating electronic sensor for other secondary containment; audible and visual high−level alarm at 90% full, and either automatic shut−off at 95% or no latch−open device is used with any manual−shutoff nozzle; all dispensing by suction pump fuel transfer; all motor vehicle fueling limited to private or fleet use; all fueling area protected by canopy; and downspouts for drainage of rainwater do not discharge into a fueling area.

[7] This reduced setback is only permitted for emergency or standby power systems that are operated by the same facility which operates the well, and only if all of the following features are provided and maintained in addition to the features in the tank−type column: audible and visual high−level alarm at 90% full, and either automatic shut−off at 95% or no latch−open device is used with any manual−shutoff nozzle. This setback may be reduced further where approved in writing by the department, upon submittal of an explanation of why reducing the setback is needed, along with demonstration that additional features will be included which will provide adequate protection for the well.

Note: Aboveground storage tanks (ASTs) include tanks that are inside a building and have a liquid capacity of 110 gallons or more, are intended for fixed installation, and are not solely used for processing.

(2) Tank systems and their dispensing systems shall be at least 50 feet from ground−level potable water reservoirs regulated under ch. NR 811, except as specified in sub. (1) (b) and (c).

(3) Tank systems and their dispensing systems shall be at least 25 feet from potable water mains regulated under ch. NR 811, except as specified in sub. (1) (b) and (c).

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

Subchapter III — Specific Tank Storage Applications

ATCP 93.300 Tanks storing used oil. (1) GENERAL. (a) Used oil shall be considered a Class IIIB liquid unless designated otherwise in this chapter or as shown by product flashpoint testing.

(b) Tanks used to store used oil to supply an oil burner shall comply with the heating−fuel storage requirements in s. ATCP 93.310 and NFPA 31 section 7.2.9.

Note: Devices that burn used oil are regulated by the Commercial Building Code, chapters SPS 361 to 366, and the Fire Prevention Code, chapter SPS 314. The tank that stores the oil is regulated by this chapter.

Note: NFPA 31 section 12.9.1 requires tanks that supply used oil to an oil burner to be listed.

(2) TANK CONSTRUCTION AND INSTALLATION. (a) Tanks for the storage of used oil shall comply with the construction and marking requirements in s. ATCP 93.250 anytime a tank system is installed.

(b) Aboveground tanks for used−oil storage that have a capacity of less than 750 gallons are not required to be listed, or marked in accordance with s. ATCP 93.250 (3), except for tanks which supply oil to an oil burner.

Note: See section ATCP 93.250 for minimum marking requirements for newly manufactured or constructed tanks.

(c) Tanks shall be constructed of noncombustible materials, unless constructed and utilized in accordance with SU 2258 from Underwriters Laboratories Inc.

(d) The fill opening shall be screened to prevent the passage of solid objects into the tank.

(e) The fill opening may be located directly at the tank.

(f) The fill opening shall be closed except when a transfer is actually taking place.

(g) Tanks that store used oil shall be installed by or under the supervision of a certified installer.

(h) The building setback for tanks which have a capacity of less than 1,100 gallons and which store used oil may be less than the setbacks listed in NFPA 30 Table 22.4.1.6 if approved in writing by the authorized agent or the department; and that approval shall be based on consideration of the construction material for the building wall, the size of the tank, and the adjacent vehicular traffic.

Note: See section ATCP 93.260 for minimum separating distances between tanks and water supply wells.

(3) SPILL AND OVERFILL PREVENTION. All tanks, whether new or existing, shall comply with all of the following:

(a) The fill opening shall be provided with spill containment.

(b) If the fill opening is located outdoors, the opening shall be located in a watertight enclosure of noncombustible construction.

(c) 1. If the fill point is remote from the tank or if the delivery person cannot readily observe the tank gauge, an overfill alarm shall be provided at the fill point.

2. The alarm shall be readily audible or visible at the fill point and shall alert the delivery person when the tank is 90 percent full.

3. All overfill alarms shall be labeled as such.

(4) SIGNAGE. All tanks, whether new or existing, shall be provided with a permanent and durable sign installed at the used−oil handler site or facility, that includes all of the following:

(a) "NO SMOKING."

(b) "USED−OIL COLLECTION ONLY."

(c) "DEPOSITING OTHER MATERIAL IS PROHIBITED."

(5) VEHICLE COLLISION PROTECTION. Vehicle collision protection shall be provided for aboveground tanks in accordance with s. ATCP 93.430 unless the authorized agent or the department determines the tank system is not subject to vehicle collision.

(6) SECONDARY CONTAINMENT. (a) Aboveground tanks located outdoors shall have secondary containment that complies with s. ATCP 93.420 (1) to (4).

(b) Tanks located inside a building shall have secondary containment for 100 percent of the tank capacity if a leak from the storage tank could reach a floor drain, the exterior of the building or areas that pose an ignition hazard.

Note: An oil−water separator connected to a floor drain may be used for all or a portion of the required secondary containment, depending on the system capacity.

(7) UNDERGROUND TANKS. (a) *General*. Underground tanks for used−oil storage shall comply with the applicable portions of NFPA 30 and this section.

(b) *Spill protection*. For underground tanks that store used oil, spill protection is not required at any point other than the fill point, if the tank meets all of the following conditions:

1. The tank receives used oil in batches of 25 gallons or less by manual transfer.

2. The tank is emptied only by suction transfer.

(c) *Corrosion protection*. Corrosion protection shall be provided in accordance with s. ATCP 93.520 except this protection is not required for piping that is associated with an underground tank which stores used oil, provided the tank and piping meet all of the following conditions:

1. The tank receives used oil in batches of 25 gallons or less by manual transfer.

2. All piping that is underground is sloped at an angle of at least 30 degrees from horizontal between the point at which it enters the ground and the tank, to allow for the free flow of oil.

Note: This section does not exempt the tank itself from corrosion protection requirements.

(d) *Leak detection*. Leak detection shall be provided in accordance with ss. ATCP 93.510 and 93.515.

(8) TANK CLOSURE AND GENERAL ADMINISTRATIVE REQUIREMENTS. (a) *Aboveground tanks*. Aboveground tanks that store used oil shall comply with ss. ATCP 93.440 to 93.470.

Note: Sections ATCP 93.440 to 93.470 address inspections; seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank closures; tank−system site assessments; and confirming and responding to leaks, spills, overfills and releases.

(b) *Underground tanks*. Underground tanks that store used oil shall comply with ss. ATCP 93.545 to 93.585.

Note: Sections ATCP 93.545 to 93.585 address seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank system closures; conditions indicating releases; tank−system integrity assessments; tank−system site assessments; and responding to leaks, spills, overfills and releases.

(9) SCRAP RECYCLING AND AUTOMOBILE RECYCLING FACILITIES. Subsections (1) (a), (2) (a), (c) to (h), (3) to (5), (6) (a), (7) and (8) do not apply to a new or existing aboveground tank which contains used oil and which is located at a scrap recycling or automobile recycling facility adequately participating in a cooperative compliance program approved by the department of natural resources, provided all of the following requirements are met:

(a) The tank is constructed of a durable material acceptable to the department.

(b) If located outside of a building, the tank has secondary containment acceptable to the department.

(c) If located inside a building, the tank has venting and fire prevention features acceptable to the department.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (h), cr. (9) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (b), (2) (a), (b), (5), (6) (a), (7) (c) (intro.), (d), (8) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (b), (2) (a), (b), (5), (6) (a), (7) (c) (intro.), (d), (8) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.305 Public used−oil collection centers. (1) GENERAL. Public used−oil collection centers shall comply with s. ATCP 93.300 and this section.

Note: Also see chapter NR 679 for additional rules pertaining to used−oil collection centers, such as operational criteria.

(2) TANK CONSTRUCTION. The tank shall be constructed to one of the recognized design standards in NFPA 30 chapter 21 unless otherwise accepted by the department.

Note: Design standards recognized by NFPA 30 chapter 21 include API 12B, API 12D, API 12F, API 650, UL 58, UL 80, UL 142, UL 1316, UL 1746, UL 2080 and UL 2085.

(3) TANK SIZE AND INSTALLATION REQUIREMENTS. (a) The tank may be of any size.

(b) Tanks located outdoors shall comply with the setback requirements of NFPA 30 Tables 22.4.1.1(a) and (b) for a Class IIIA liquid.

(c) Tanks located inside a building shall have venting that terminates outdoors.

(4) DIKING. (a) A single−wall tank shall be placed within a diked area that meets the requirements of s. ATCP 93.420.

(b) A tank of double−wall construction, that is accessible to the public, shall be placed within secondary containment which meets all of the following requirements:

1. Any curb shall have a height of at least 4 inches.

2. The containment shall extend at least 2 feet beyond the greatest tank dimension in all directions.

(c) The tank shall be set back from the curb or dike wall such that an overflow of the tank will be contained within the diked or curbed area.

(d) The fill opening with spill containment shall be located within the diked or curbed area.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction to (4) (d) made under s. 13.92 (4) (b) 1., Stats., Register November 2008 No. 635; correction in (1), (4) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (4) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.310 Heating fuel storage. (1) SCOPE. This section applies to any new or existing aboveground or underground tank that is used to supply liquid fuel to a heating device, including a used oil burner, if the device and the fuel have the following characteristics:

(a) The heating device is used for space heating, processing or manufacturing.

(b) The fuel is consumed on the premises where stored.

Note: Number 5 and #6 fuel oil do not meet the criteria for a liquid and therefore are not regulated by this chapter.

(2) INSTALLATION, USE AND MAINTENANCE. (a) Tanks that supply oil−burning equipment shall be installed, used and maintained in accordance with NFPA 31 chapters 7 and 12, and this section.

(b) Tanks used to store heating fuel shall be installed by or under the supervision of a certified installer.

Note: Tanks installed at 1− or 2−family dwellings are not required to have plan review under section ATCP 93.100, and aboveground tanks that have a capacity of less than 1,100 gallons are not required to have registration under section ATCP 93.140.

Note: Devices that burn used oil are regulated by the Commercial Building Code, chapters SPS 361 to 366, and the Fire Prevention Code, chapter SPS 314. The tank that stores the oil is regulated by this chapter.

(3) UNDERGROUND TANKS THAT HAVE A CAPACITY OF 4000 GALLONS OR LESS. Underground heating oil tank systems that have a capacity of 4000 gallons or less shall have all of the following:

(a) A vent whistle, or equivalent means of overfill protection.

(b) Corrosion protection that complies with s. ATCP 93.520, except this requirement does not apply to tanks that were installed before November 1, 1994.

(c) 1. Precision tightness testing every 2 years or leak detection in accordance with s. ATCP 93.510, except this requirement does not apply to residential tanks which have a capacity of less than 1,100 gallons and which were installed before October 29, 1999, for consumptive use on the property where stored.

2. The tightness testing or leak detection methods used to comply with subd. 1. shall be specifically approved for use with the specific type of heating oil in accordance with s. ATCP 93.130.

(4) UNDERGROUND TANKS THAT HAVE A CAPACITY OF MORE THAN 4000 GALLONS. Underground heating oil storage tanks that have a capacity of more than 4000 gallons shall have leak detection that complies with s. ATCP 93.510 and corrosion protection that complies with s. ATCP 93.520.

(5) SPILL AND OVERFILL PREVENTION. (a) Spill and overfill prevention for aboveground tanks shall be provided in accordance with s. ATCP 93.300 (3).

(b) Spill and overfill prevention for underground tanks shall be provided in accordance with s. ATCP 93.505.

(c) Fill pipes for used−oil tanks that are part of a heating system may be located inside a building.

(6) TANK CLOSURE AND GENERAL ADMINISTRATIVE REQUIREMENTS. (a) *Aboveground tanks*. Aboveground tanks that store heating oil shall comply with ss. ATCP 93.440 to 93.470.

Note: Sections ATCP 93.440 to 93.470 address inspections; seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank closures; tank−system site assessments; and confirming and responding to leaks, spills, overfills and releases.

(b) *Underground tanks*. Underground tanks that store heating oil shall comply with ss. ATCP 93.545 to 93.585.

Note: Sections ATCP 93.545 to 93.585 address seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank system closures; conditions indicating releases; tank−system integrity assessments; tank−system site assessments; and responding to leaks, spills, overfills and releases.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (b), (c) 1., 2., (4), (5) (a), (b), (6) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (3) (b), (c) 1., 2., (4), (5) (a), (b), (6) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.315 Heating oil tanks that are removed from service. (1) APPLICATION. This section applies to aboveground heating oil storage tanks which are connected to heating appliances and which store heating oil that is consumed on the premises.

(2) GENERAL. Placing a heating oil storage tank out of service for any reason other than immediate repair or replacement shall follow the procedure in either par. (a) or (b):

(a) The tank and all connected piping, including the vent and fill piping, shall be emptied, cleaned and removed from the premises.

(b) 1. The tank and all connected piping shall be emptied and purged of all vapors.

2. If the tank is not removed, the tank vent shall be left intact and open.

3. If the fill pipe is not removed, it shall be filled to the top with concrete and capped.

4. Any piping that is not removed, other than a tank vent, shall be capped or otherwise sealed.

(3) RESPONSIBLE PARTIES. (a) *Contractors.* A person who is under contract, with the person who owns or controls a property, to remove a heating oil storage tank or to place a heating oil storage tank out of service shall comply with the requirements in sub. (2).

Note: A contractor must be certified in accordance with chapter SPS 305 to perform tank cleaning and tank removal at other than 1− and 2−family dwellings. Section ATCP 93.460 states that certification is not required for persons performing cleaning and removal of heating fuel tanks located aboveground or in basements at 1− and 2−family dwellings.

(b) *Owners.* If there is no contractor, the person who owns or controls a property from which a heating oil storage tank is removed, or on which a heating oil storage tank is placed out of service, shall comply with the requirements in sub. (2).

(4) NOTIFICATION REQUIREMENT. The person who owns or controls property from which a heating oil storage tank has been removed, or on which a heating oil storage tank has been placed out of service, shall provide written notice to the current heating oil vendor within 7 days after removing the tank or placing the tank out of service. If there is a scheduled delivery in less than 7 days, notification may be given verbally provided it is followed by written notification within 7 days after verbal notification.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.320 Fuel storage for stationary combustion engines and gas turbines. (1) INSTALLATION AND USE. (a) *General.* This section applies to the fuel storage tanks of stationary combustion engines and gas turbines, except when used at a farm premises or construction project.

Note: Stationary combustion engines are commonly used to power emergency generators and pumps that provide fire protection. For setbacks for storage tanks that are used to fuel stationary combustion engines at a farm premises or construction project, see section ATCP 93.630 (2).

(b) *Certified installer.* The installation of tanks used to store fuel for stationary combustion engines and gas turbines shall be supervised by a certified installer.

Note: See section ATCP 93.100 (1) (b) 11. for criteria that can be used to exempt these tanks from plan review.

(c) *Marking.* 1. Aboveground tanks with the fill point remote from the tank and all new and existing underground storage tanks used to store fuel for stationary combustion engines and gas turbines shall have the fill point labeled with the type of fuel.

2. Aboveground storage tanks used to store fuel for stationary combustion engines and gas turbines shall have the tank labeled with the type of fuel.

(d) *Aboveground storage tanks located in buildings.* Aboveground storage tanks located in buildings and used to store fuel for stationary combustion engines and gas turbines shall comply with NFPA 37 chapter 6 and all of the following:

1. The fill connection shall be located outside the building.

2. Spill and overfill prevention shall be provided in accordance with s. ATCP 93.410.

(e) *Aboveground storage tanks not located in a building.* Aboveground storage tanks not located in a building and used to store fuel for stationary combustion engines and gas turbines shall comply with subch. IV and NFPA 37 chapter 5, except that double−wall tanks which are only filled with a manual−shutoff nozzle without a latching mechanism are not required to have additional spill prevention at the fill point.

(f) *Underground storage tanks.* Underground storage tanks used to store fuel for stationary combustion engines and gas turbines shall comply with subch. V and NFPA 37 chapter 5.

(2) SPILL AND OVERFILL PREVENTION. (a) Spill and overfill prevention shall be provided in accordance with s. ATCP 93.410, except as exempted in par. (b).

(b) Tanks that are filled by hand using a nozzle without a latch−open device are not required to have spill containment at the fill point.

(3) TANK CLOSURE AND GENERAL ADMINISTRATIVE REQUIREMENTS. (a) *Aboveground tanks.* Aboveground tanks that store fuel for stationary combustion engines and gas turbines shall comply with ss. ATCP 93.440 to 93.470.

Note: Sections ATCP 93.440 to 93.470 address inspections; seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank closures; tank−system site assessments; and confirming and responding to leaks, spills, overfills and releases.

(b) *Underground tanks.* Underground tanks that store fuel for stationary combustion engines and gas turbines shall comply with ss. ATCP 93.545 to 93.585.

Note: Sections ATCP 93.545 to 93.585 address seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank system closures; conditions indicating releases; tank−system integrity assessments; tank−system site assessments; and responding to leaks, spills, overfills and releases.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (d) 2., (2) (a), (3) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (d) 2., (2) (a), (3) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.330 Converted tanks for the storage of flammable and combustible liquids. (1) APPLICATION. This section applies to all converted tanks, whether new or existing.

(2) GENERAL INSTALLATION AND USE. Converted tanks for the storage of flammable and combustible liquids shall be installed by a certified installer.

(3) PRESSURE VESSELS. (a) Low−pressure tanks and pressure vessels that are being converted to the storage of flammable or combustible liquids at atmospheric pressure shall meet the applicable tank storage requirements of this chapter, specific to the liquid stored.

(b) Tank supports shall be capable of supporting a static load equal to at least 2 times the weight of the full tank. This capability shall be confirmed by engineering structural analysis, field testing, or by reference to an approved design standard.

(4) TANK VEHICLES. (a) The cargo tank of a tank vehicle that is converted to a stationary tank for the storage of flammable or combustible liquids shall meet the applicable tank storage requirements of this chapter, specific to the liquid stored, along with the requirements in pars. (b) to (d).

(b) Cargo tanks for permanent stationary use shall be constructed of steel only.

(c) The cargo tank vehicle platform shall be supported off the vehicle wheels and landing gear, and secured against movement, by the use of blocking devices and anchoring mechanisms that are acceptable to the department.

(d) Venting of the cargo tank shall follow the requirements of either NFPA 385 chapter 5 or this chapter.

(5) GENERAL ADMINISTRATIVE REQUIREMENTS. Converted tanks shall follow the operating requirements of this chapter applicable to their current use.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (4) (c) Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.340 Bulk plants and terminals. (1) CLEARANCES AT BULK PLANTS THAT WERE IN EXISTENCE ON MAY 1, 1991. Bulk plant facilities that were in existence on May 1, 1991, with setbacks less than those specified in NFPA 30 section 22.4 may be renovated or updated, but no additional storage capacity may be added in violation of the specified clearances.

(2) PRODUCT IDENTIFICATION. (a) *Standard color code.* All new and existing tanks and piping at bulk plants and terminals shall use the identification scheme in API 1637.

Note: See section ATCP 93.230 (11) for color coding of fill pipe caps and manhole covers, for underground tanks.

(b) *Type of identification*. The product identification scheme in API 1637 shall be accomplished by one of the following methods:

1. A disc tag of non−sparking material.

2. A label using minimum 1−inch block letters.

3. Painted sections at least 12 inches long.

(c) *Location of identification*. Tags shall be permanently affixed to the valve at the unloading riser, the pump control valves, the valve of a storage tank and load rack and on the product pipe lines in at least 3 locations equally spaced between terminating points or valves.

(3) PROPERTY MAINTENANCE. Tank yards and diked areas shall be kept free from weeds, high grass, rubbish and combustible materials that are not essential to the operation and shall be kept clean and orderly.

(4) SECURITY AT BULK PLANTS AND TERMINAL STORAGE FACILITIES. Owners and operators shall be aware of regulations, standards and operating practices that relate to facility security.

Note: Information on how to develop a comprehensive site security program is available in the API document *Security Guideline for the Petroleum Industry*, or the American Chemistry Council document *Site Security Guidelines for the U.S. Chemical Industry.*

(5) TRANSFER OPERATIONS. In order to prevent a spill from moving beyond the loading or unloading area, any new or existing aboveground tank that has a capacity of 5000 gallons or more shall be provided with a catchment basin or treatment facility to contain the maximum capacity of the largest compartment of a tank car or tank vehicle loaded or unloaded at the facility. Existing tanks shall comply with this subsection within 2 years after December 31, 2009.

Note: Federal Spill Prevention Control and Countermeasure requirements in 40 CFR 112 may apply to smaller product transfers.

(6) GENERAL REQUIREMENTS. (a) *Aboveground tanks at existing facilities*. Aboveground tank systems at existing bulk plants and terminals shall comply with subch. IV.

(b) *Underground tanks at existing facilities*. Underground tank systems at existing bulk plants and terminals shall comply with subch. V.

(c) *New facilities.* New bulk plants and terminals shall comply with PEI RP800; aboveground tank systems there shall also comply with s. ATCP 93.400 (3), (4), (5) and (7) to (11); and underground tank systems there shall also comply with subch. V.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (5), (6) (a) and (b), cr. (6) (c) Register July 2009 No. 643, eff. 8−1−09; correction in (6) (c) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (6) (c) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.350 Hazardous substances. (1) SCOPE AND APPLICATION. (a) *General*. 1. The requirements of this section apply to tanks that store, handle or use liquids which are federally regulated hazardous substances, in any concentration of 1 percent or more by volume, for the purpose of protecting the waters of the state from contamination.

Note: The list of federally regulated hazardous substances covered in this subchapter, also known as the CERCLA List, is located in 40 CFR 302.4, Table 302.4.

Note: Other sections of this chapter regulate the storage and use of flammable and combustible liquids. Chapter SPS 314 — the *Wisconsin Fire Prevention Code*, through the adoption of NFPA 1, *Fire Code* also regulates the storage and use of liquids that have properties such as being flammable, combustible, toxic, water reactive, explosive, and corrosive.

2. Liquids within the scope of subd. 1. that are flammable or combustible shall also meet the requirements of this chapter which apply to flammable or combustible liquids.

(b) *Exemptions.* The requirements of this section do not apply to any of the following:

1. Hazardous waste storage tanks that are licensed under s. 291.25, Stats., except any tank containing a flammable or combustible mixture of hazardous wastes regulated under that section, and other liquids, is not exempt from this chapter.

2. Aboveground tanks which are used to store a federally regulated hazardous substance and which have a capacity of less than 5,000 gallons, and transfer operations involving these tanks, unless the substance is flammable or combustible.

Note: Section ATCP 93.140 requires registration with the department for all aboveground storage tanks that have a capacity of 5000 gallons or more and all underground tanks, unless the stored substance is nonflammable and noncombustible, and has a concentration of less than 1 percent by volume.

3. Accumulator tanks, process tanks or service tanks.

4. Portable tanks containing liquids that are not flammable or combustible.

5. Tanks regulated under, and maintained in compliance with the rules in 40 CFR 430.03.

Note: 40 CFR 430.03 is entitled "Best Management Practices for Spent Pulping Liquor, Soap, and Turpentine Management, Spill Prevention and Control."

(2) TANK SYSTEM DESIGN AND CONSTRUCTION. (a) *General*. 1. Design, construction and maintenance of tank systems for the storage of federally regulated hazardous substances shall be in accordance with good engineering practices and this chapter and shall be under the supervision of a qualified engineer, except as provided in subd. 2.

2. Construction supervision by a qualified engineer is not required where all of the following occur:

a. Plans for the tank system are approved by an authorized agent or the department.

b. Construction is by a certified installer.

c. An authorized agent or the department inspects and accepts the construction.

(b) *Notification.* The qualified engineer shall notify the department, on form ERS−9198, of an impending installation of a tank system under this section, unless this notice is provided under s. ATCP 93.115 (2) (b) 3.

(c) *Testing.* All new tanks and pipe systems shall have pressure or vacuum testing that shall assure that all components and connections are tight, in a manner equivalent to the protocol and parameters specified in NFPA 30 section 21.5 and PEI RP 100 sections 11 and 14, before the tanks and pipe systems are placed into service.

(d) *Qualified engineer.* 1. The qualified engineer responsible for design and oversight of construction of federally regulated hazardous substance liquid storage tank systems under this chapter shall meet the requirements of this paragraph.

2. The qualified engineer shall be competent in the engineering methods for designing and installing hazardous liquid tank systems.

3. The qualified engineer shall be a registered professional engineer, unless one of the exemptions in s. 443.14, Stats., applies.

(3) GENERAL REQUIREMENTS FOR TANKS. Storage tanks shall meet all of the following requirements:

(a) *Structural.* Tanks shall have a stable foundation, under all operating conditions, and be of sufficient structural strength to withstand normal handling and use.

(b) *Chemical compatibility.* Tanks shall be chemically compatible with the substance being stored.

(c) *Wear, vibration, shock and corrosion.* Tanks shall be protected from failure due to internal and external wear, vibration, shock and corrosion.

(d) *Fire, heat, vacuum and pressure.* Tanks shall be protected from fire, heat, vacuum and pressure that might cause tank failure.

(e) *Collision protection.* Tanks that are subject to vehicle collision shall be protected from collision damage by vehicles and equipment.

(f) *Fiberglass−reinforced plastic.* If fiberglass−reinforced plastic material is used, the material shall be of sufficient density and strength to form a hard, impermeable shell that will not crack, wick, wear, soften or separate under normal service conditions.

(g) *National standards*. Tanks shall be designed, constructed and installed or certified by a qualified engineer in accordance

with a standard, recognized by the department, that is developed by a nationally recognized association or independent testing laboratory.

Note: Examples of recognized standards include NACE RP 0178 — Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service; UL 142 — Steel Aboveground Tanks for Flammable and Combustible Liquids; API 620 — Design and Construction of Large, Welded, Low−Pressure Storage Tanks; API 650 — Welded Steel Tanks for Oil Storage; ULC−S601−2000 — Aboveground Horizontal Shop−Fabricated Steel Tanks; ULC−S630−1993 — Aboveground Vertical Shop−Fabricated Steel Tanks; ASTM D 4097 — Standard Specification for Contact−Molded Glass−Fiber−Reinforced Thermoset Resin Corrosion−Resistant Tanks; and ASTM D 3299 — Standard Specification for Filament−Wound Glass−Fiber−Reinforced Thermoset Resin Corrosion−Resistant Tanks.

(h) *Listing*. Tanks used for underground storage shall be listed or shall be approved by the department.

(i) *Reinstallation of used tank systems*. 1. Used tank systems that do not meet the standards for new tanks under par. (g) or new piping under sub. (4) may not be reinstalled for hazardous substance storage.

2. If a used tank meets the standards for new tanks under par. (g), it may be reinstalled provided it is certified by a qualified engineer for use.

(j) *Compliance schedules for existing tanks*. 1. All tanks within the scope of this section that were in existence or under construction before February 1, 2009, shall comply with the registration requirements in s. ATCP 93.140 within 6 months after that date.

2. All tank systems within the scope of this section that were in existence or under construction before February 1, 2009, shall comply with the secondary containment requirements in sub. (5) (a) by December 31 of the fifth year after that date.

(k) *Spill prevention at pumps and valves*. The owner or operator shall prevent spills and leaks at all pumps and valves that control a liquid hazardous substance, by using one or more of the following methods:

1. Installation of seal−less pumps and valves, double−seal pumps and valves or equivalent technology.

2. a. Implementation of a pump and valve inspection, maintenance and repair program that complies with subd. 2. b.

b. The frequency of inspection and scope of maintenance and repair shall be based on a minimum of 5 years of actual operating and service records, manufacturer's recommendation or records for similar operations.

3. a. Installation of pumps and valves within a catchment basin, such as a drip pan, pad or secondary containment system, that complies with subd. 3. b. and c.

b. The catchment basin shall be compatible with the substance stored for a period of time that will allow for cleanup under all operating conditions.

c. The catchment basin shall be inspected each day of operation for accumulation of liquid and shall have the capacity to contain all spills likely to accumulate in the basin.

(L) *Tanks subject to melting*. Aboveground storage tanks constructed of a material subject to melting when exposed to fire shall be located so that any spill or leak resulting from the failure of the material could not unduly expose persons, structures or the environment.

(m) *Tanks subject to scouring*. 1. Storage tanks subject to scouring by the inflow of materials, or subject to wear from manual gauging shall be equipped with wear plates, diffusers or other means to prevent localized wear or corrosion.

2. If wear plates are used, they shall cover an area of at least 1 square foot and be installed in a manner that prevents crevice corrosion of the tank.

(n) *Explosion protection*. Tanks shall be protected from explosion in accordance with generally accepted engineering practices. Protection shall be provided by cooling systems, fire−resistance measures, depressurizing valves, foundation sloping to prevent burning liquids from accumulating under the tank, or other means determined by a qualified engineer and acceptable to the department.

(o) *Protection from freezing*. Tanks, piping, valves and other ancillary equipment shall be protected from physical damage by freezing.

(4) PIPING SYSTEMS. (a) *General requirements*. Piping systems serving hazardous substance storage tanks shall meet all of the following requirements:

1. Piping systems shall be compatible with the substance stored and be protected from failure due to internal and external wear, vibration, shock and corrosion.

2. Piping systems shall be free of leakage, structurally sound, properly supported under all operating conditions and be protected from fire, heat, vacuum and pressure that would cause the system to fail.

3. Piping systems shall be designed, installed and maintained to prevent damage from expansion, jarring, vibration, contraction and frost.

4. Piping systems shall be protected from collision damage or crushing loads by vehicles and equipment.

5. Joint compounds and gaskets shall be compatible with the substance stored.

6. Piping with pump or compressor connections shall be provided with shut−off valves located adjacent to the connections.

7. Flexible connectors, elbows, loops, expansion chambers or similar measures shall be installed to allow for movement and prevent damage from water hammer.

8. Piping systems that carry liquids which expand upon freezing shall be protected from freezing or shall have provisions to prevent rupture due to freezing.

9. Refrigerated piping systems shall be constructed of materials suitable for extreme temperatures and pressures in the storage system.

(b) *National standards*. Hazardous substance piping systems serving storage tanks shall be designed, constructed and installed or certified by a qualified engineer in accordance with a standard, as recognized by the department, that is developed by a nationally recognized association or independent testing laboratory.

Note: Examples of recognized standards include ORD−C107.7 — Glass−Fibre Reinforced Plastic Pipe and Fittings; and ASTM D 2996 — Standard Specification for Filament−Wound "Fiberglass" (Glass−Fiber−Reinforced Thermosetting Resin) Pipe.

(5) SECONDARY CONTAINMENT. (a) *General*. 1. Tank systems used to store hazardous liquids shall be provided with secondary containment.

2. Secondary containment systems shall be designed, constructed and installed to prevent the release of regulated substances to the environment at any time during the operational life of a tank system by containing a leak or spill from the system until the leak or spill is detected and removed.

3. A building may serve as secondary containment if at least one of the following requirements is met:

a. The building is an enclosed structure resting on or above impermeable surfaces, from which a discharge of the entire contents of the largest tank would not escape through any doorway, floor drain or other means.

b. The building drains and spillways are connected to an onsite wastewater treatment facility and are designed and maintained such that any leak or spill cannot drain elsewhere.

c. The building drains and spillways are connected to a municipal wastewater treatment facility with agreement of the municipality on the specific materials stored, and drains and spillways are designed and maintained such that any leak or spill cannot drain elsewhere.

4. Secondary containment systems shall be checked for evidence of a leak or spill at least every 30 days.

5. Double−walled tanks shall be designed, constructed, and installed to contain a leak from any portion of the inner tank, and to detect a failure of the inner or outer wall.

6. Capacity requirements for secondary containment structures may be reduced by the amount of available treatment plant capacity that is directly accessible to the tank.

7. Secondary containment, including liners and vaults, shall be designed, constructed, and installed to do all of the following:

a. Contain 100 percent of the capacity of the largest tank within the containment area, except as provided in subd. 8.

b. Prevent precipitation or groundwater intrusion from interfering with the ability to contain or detect a leak or spill of a regulated substance.

c. Surround the tank completely and be capable of preventing migration of a regulated substance.

d. Use materials that are compatible with the substances stored and the environment.

e. Isolate incompatible liquids and tank materials from each other and from the environment.

8. a. Permanent containment structures that are not protected from the weather shall be designed and maintained to allow for the containment of 125 percent of the volume of the largest tank within the containment area.

b. Precipitation and debris shall be removed from the containment structure on a regular basis.

c. No precipitation, ice or debris that is noticeably contaminated may be discharged to the environment.

9. Underground piping shall be provided with secondary containment and leak detection in accordance with sub. (8).

10. a. Connections to tanks shall be located within a containment structure constructed of compatible material and capable of containing leaks from the connections.

b. The containment structure for underground tanks shall have an access way so connections can be inspected and repaired.

(b) *Secondary containment systems for product transfers*. Transfer of hazardous substances shall take place within a secondary containment system that meets all of the following requirements:

1. a. For facilities that are designed on or after February 1, 2009, the system shall be capable of containing leaks and spills from the largest compartment of the vehicle being loaded or unloaded, including leaks or spills from connections, couplings, vents, pumps and valves, hose failure or overturning of a container.

b. For facilities designed or installed before February 1, 2009, the system shall be capable of containing the volume of any leak or spill deemed likely to occur, in the professional judgment of a qualified engineer. Facility modifications to meet this requirement shall be completed no later than December 31 of the fifth year following February 1, 2009.

c. Open−ended fill lines shall be located within the secondary containment system.

2. a. The system shall be designed, installed, and operated to prevent any migration of hazardous substances into the soil or the waters of the state, before cleanup occurs, except as allowed in subd. 2. b.

b. The system may allow migration of the gaseous component of a spill.

3. The system shall be constructed, coated, or lined with materials that are compatible with the substances to be transferred and the environment.

4. a. Product transfers using temporary containment structures shall be constantly attended.

b. The attendant shall be familiar with emergency procedures such that the secondary containment capacity will not be exceeded in the event of a leak or spill.

5. a. Permanent containment structures shall have sufficient strength and thickness to withstand wear, hydrostatic forces, frost heaving and weathering.

b. The structure shall support any vehicle brought into the transfer area.

6. Permanent containment structures shall have a foundation that prevents failure due to settlement, compression, or uplift.

7. a. Permanent containment structures shall be designed with a manually controlled drainage system to permit the drainage of liquids resulting from leaks, spills and precipitation, such as a manually controlled pump or siphon or a manually controlled dike valve.

b. Pump, siphon and valve controls shall be located outside of the diked area.

c. All drainage systems shall be locked in a closed position when a transfer of a hazardous substance is in progress.

d. Spilled or leaked substances shall be removed from the containment system to prevent a release to the waters of the state.

(6) PRESSURE RELIEF AND VENTING. (a) *General pressure relief and venting requirements*. 1. a. Tanks shall be protected from over−pressurization and excessive vacuum that may be caused by operator error, filling, emptying, atmospheric temperature changes, pumping, refrigeration, heating and fire exposure.

b. Tanks subject to failure due to pressure or vacuum shall be provided with pressure control devices as determined by the qualified engineer.

c. Protection shall be provided by vents, rupture discs, pressure or vacuum relief devices, controllers, fail−safe vessel designs or other means determined by a qualified engineer.

2. If a pilot−operated relief valve is used, it shall be designed so the main valve will open automatically and will protect the tank in the event of failure of the pilot valve or other device.

3. Venting used on a tank containing a flammable or combustible hazardous substance shall follow the requirements of NFPA 30 sections 21.4.3 and 22.7.

4. Vent discharge openings shall be designed and constructed to prevent interference of operation due to precipitation.

5. Vents shall have provisions for draining any condensate that may accumulate.

6. Vents shall be protected from tampering.

7. Vents shall have direct contact with the vapor space of the tank.

8. Venting shall be sized to limit the back pressure to less than the maximum pressure allowed by the design of the system.

9. Tanks fitted with relief valves may not be equipped with an isolation valve below the relief valve unless 2 or more relief valves are provided, and isolation valves are interlocked.

10. Cooled tanks with sealed double−wall construction shall have a pressure relief valve on the outer wall in addition to a pressure relief valve or safety disk on the inner tank.

(b) *Normal venting*. Closed−roof atmospheric tanks and low−pressure tanks shall be equipped with normal vents designed to accommodate all of the following conditions:

1. Inbreathing resulting from maximum outflow of liquid from the tank.

2. Inbreathing resulting from contraction of vapors caused by a decrease in atmospheric temperature.

3. Out−breathing resulting from maximum inflow of liquid into the tank and maximum evaporation caused by the inflow.

4. Out−breathing resulting from expansion and evaporation that result from maximum increase in atmospheric temperature.

Note: Examples of normal venting include pilot−operated relief valves, pressure relief valves, pressure−vacuum valves, conservation vents, open vents or a combination of devices.

(c) *Emergency venting*. 1. Atmospheric, low−pressure and high−pressure aboveground tanks shall have emergency venting to insure that the maximum pressure for the tank is not exceeded.

2. Emergency venting shall be designed by a qualified engineer in accordance with good engineering practices.

Note: Examples of emergency venting include larger or additional open vents, pressure−vacuum valves, pressure relief valves, a gauge hatch that permits the cover to lift under abnormal internal pressure or a manhole cover that lifts when exposed to abnormal internal pressure.

(d) *Labeling of pressure relief valves*. 1. Where safety, pressure relief or vacuum relief valves are used, each valve shall be permanently labeled with all of the following information:

a. The name or identifying trademark of the manufacturer.

b. The manufacturer's design or type number.

c. The pipe size of the inlet.

d. The set pressure or vacuum, in pounds per square inch gauge.

e. The full open pressure or vacuum, in pounds per square inch gauge.

f. The capacity at the indicated pressure or full open vacuum, in either cubic feet of gas per minute or cubic feet of gas per hour.

2. The labeling shall be provided either on the valve itself or on a plate securely fastened to the valve.

(7) TEMPERATURE MONITORING. (a) Temperature indicators and corresponding alarms shall be provided for storage tanks where heat from a reaction could cause damage to the system or a release to the environment.

(b) Heated or cooled tanks shall be equipped with appropriate thermal controls and gauges.

(c) Protection against overheating or overcooling shall be provided for heated or cooled tanks in accordance with generally accepted engineering practices.

Note: Means of protection may include temperature controllers, insulation, alarms, cooling systems and special material selection.

(8) LEAK DETECTION FOR UNDERGROUND TANK SYSTEMS. (a) Underground storage tank systems that contain federally regulated hazardous substances shall be equipped with a leak detection system which will detect a leak in the primary containment of the tank and piping.

(b) The leak detection method shall be capable of meeting the requirements in s. ATCP 93.510, except as provided in par. (c).

(c) Other methods of leak detection may be used if approval from the department is obtained before the installation and operation of the new UST system.

(9) CORROSION PROTECTION. Corrosion protection shall be provided in accordance with s. ATCP 93.520 for underground storage tank systems or s. ATCP 93.400 for aboveground storage tank systems.

(10) IDENTIFICATION AND LABELING. (a) Transfer points shall be labeled with the name of the substance transferred.

(b) Aboveground tanks storing hazardous substances within the scope of this section shall be identified and labeled in accordance with s. ATCP 93.400 (7).

Note: Section ATCP 93.400 (7) requires conformance with NFPA 704.

(c) All tanks on a property shall have a unique tank identification number that is readily visible to emergency response personnel.

(11) INSPECTIONS, CHANGES IN SERVICE, TANK CLOSURE AND RELEASES FROM A TANK. (a) *Aboveground storage tanks*. 1. Aboveground storage tanks shall comply with ss. ATCP 93.440 to 93.470, except as provided in subd. 2.

2. Periodic inspections of aboveground tanks may be conducted in accordance with any nationally recognized standard that is more applicable to hazardous tanks than STI SP001.

Note: Aboveground storage tanks which store hazardous substances and which have a capacity of less than 5,000 gallons are exempt from this chapter unless the substance is also flammable or combustible.

Note: Sections ATCP 93.440 to 93.470 address inspections; seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank closures; tank−system site assessment; and confirming and responding to leaks, spills, overfills and releases.

(b) *Underground storage tanks*. Underground storage tanks shall comply with ss. ATCP 93.545 to 93.585.

Note: Sections ATCP 93.545 to 93.585 address seldom−used and temporarily−out−of−service tanks; change in service to store a non−regulated substance; tank system closures; conditions indicating releases; tank−system integrity assessments; tank−system site assessments; and responding to leaks, spills, overfills and releases.

(12) QUALIFICATIONS OF TANK INSTALLERS. The installation of a storage tank under this section shall be performed under the direct supervision of a qualified engineer who is competent in the engineering methods for installing hazardous substance tank systems.

(13) SECURITY AT CHEMICAL STORAGE FACILITIES. Owners and operators shall be aware of regulations, standards and operating practices that relate to facility security.

Note: Information on how to develop a comprehensive site security program is available in the API document *Security Guideline for the Petroleum Industry*, or the American Chemistry Council document *Site Security Guidelines for the U.S. Chemical Industry*.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (k) 3. a. made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; CR 09−017: am. (2) (a) to (c) Register July 2009 No. 643, eff. 8−1−09; correction in (2) (b), (3) (j) 1., (8) (b), (9), (10) (b), (11) (a) 1., (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (b), (3) (j), (8) (b), (9), (10) (b), (11) (a) 1., (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.360 Storage of Class IA flammable liquids. **(1)** All storage, whether new or existing, of Class IA flammable liquids with a Reid vapor pressure not exceeding 25.3 psig (40 psia) and a boiling point of less than 100°F shall comply with the applicable requirements of NFPA 30 and this chapter, except as provided in sub. (2).

(2) Design standards for new tank systems do not apply to existing tank systems unless specified otherwise.

Note: See chapter SPS 341 for additional requirements that may apply to flammable liquid storage in pressure vessels at pressures greater than 15 psig.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.370 Emergency shut−off for transfers. An emergency electrical shut−off shall be installed in accordance with NFPA 30A section 6.7 on any new or existing system that provides for the transfer of product from a fixed storage tank system to a tank vehicle, rail tank car or vehicle fuel tank. Existing systems shall comply with this section within 2 years after December 31, 2009.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. Register July 2009 No. 643, eff. 8−1−09.

Subchapter IV — General AST Storage

ATCP 93.400 General requirements. **(1)** ABOVEGROUND TANK DESIGN. (a) *General*. Tanks designed and built for underground use may not be used aboveground.

(b) *Tanks for Class I, II or IIIA liquids*. Tanks used for aboveground storage of Class I, II or IIIA liquids shall comply with the tank construction and marking requirements in s. ATCP 93.250.

(c) *Tanks for Class IIIB liquids*. Tanks which have a capacity of 1,100 gallons or more and which are used for aboveground storage of Class IIIB liquids shall be listed or shall be acceptable to the department.

Note: See section ATCP 93.130 (5) for listing and labeling requirements for aboveground tanks.

(d) *Tank foundations*. Tank foundations shall be designed to prevent uneven settling of the tank. Tank supports shall be placed on a prepared, flat, smooth, solid surface.

(2) CORROSION PROTECTION. (a) *General*. Aboveground storage tank systems shall be protected from excessive external corrosion through the use of paint, protective coatings, or corrosion resistant materials that are applied after the surface has been prepared in accordance with the manufacturer's recommendations.

(b) *Tank systems*. Any portion of an aboveground tank system that is in contact with the ground shall be protected from corrosion by one of the following methods:

1. The tank system is constructed of an inherently corrosion−resistant material.

2. The tank system is isolated from the ground by a method acceptable to the department.

Note: Methods of isolation acceptable to the Department include dielectric coating, placement on clean concrete, placement on an elevated ring wall or mounting on listed saddles.

3. The tank system is protected by a sacrificial anode or impressed current system.

4. a. Single− or double−wall tanks which are constructed of material subject to corrosion and which are supported on runners or tank supports shall be constructed such that the bottom of the tank shell is at least 3 inches but no more than 12 inches above grade, as measured from the lowest point of the tank shell, except the 12−inch maximum does not apply where subd. 4. b. is met.

b. The 12−inch maximum in subd. 4. a. may be exceeded where structural fire resistance is provided that complies with NFPA 30 section 22.5.2.4.

(c) *Underground piping*. All new and existing underground piping connected to an aboveground tank shall be protected from corrosion using one of the methods in s. ATCP 93.520 (1). Existing piping shall comply with this paragraph and par. (d) within 2 years after February 1, 2009.

(d) *Designed corrosion protection systems*. 1. Aboveground tank systems equipped with a new sacrificial anode or impressed current corrosion protection system shall follow the installation, operation, maintenance and testing requirements in s. ATCP 93.520.

2. Existing sacrificial anode or impressed current corrosion protection systems shall follow the operation, maintenance and testing requirements in s. ATCP 93.520.

(3) SECONDARY CONTAINMENT FOR PIPING. (a) When any underground piping is installed as part of a new tank system or when 50 percent or more of a run is replaced, the piping shall be provided with approved secondary containment with approved non−discriminating interstitial monitoring, except as specified in par. (g).

(b) 1. The material used for fabricating both the primary and secondary containment shall be listed in accordance with a standard that assures liquid− and vapor−tightness.

2. a. Secondary containment sumps shall be fabricated and installed in a manner that prevents release of liquids. These sumps shall be tested for leaks hydrostatically at installation, to the levels specified in subd. 2. b. to d., in accordance with the manufacturer's instructions and the requirements of this chapter, for a period of not less than 60 minutes.

b. To no less than 1 inch over the top of the highest penetration.

c. To no less than 1 inch over the top of any horizontal joint between wall sections.

d. To no lower than the top of any vertical joint.

(c) All pipe connections at a dispenser for motor vehicle fueling that are installed or replaced on or after February 1, 2009, shall be placed within a secondary containment sump at the time of installation or replacement, except as exempted in par. (e).

(d) All pipe connections at a dispenser for motor vehicle fueling that were in existence or under construction before February 1, 2009, shall be placed within a secondary containment sump by December 31 of the fifth year following February 1, 2009, except as exempted in par. (e).

(e) A secondary containment sump is not required under the pipe connections at a dispenser if the storage tank system meets all of the following conditions:

1. All piping is aboveground and readily accessible for inspection.

2. The dispenser and all the pipe connections at the dispenser are on or above a surface that is at least as impermeable as concrete.

(f) All pipe connections at a transition between aboveground and underground piping that are installed or replaced on or after February 1, 2009, shall be placed within a secondary containment sump at the time of installation or replacement.

(g) Secondary containment is not required for underground piping that is evaluated and maintained in accordance with API Standard 570, by organizations that maintain or use an authorized inspection agency, a repair organization, and technically qualified piping engineers, inspectors and examiners, all as defined in API 570.

(h) 1. Secondary containment sumps provided under this subsection shall have non−discriminating electronic sensors that will detect liquids in the sump, unless approved otherwise by the department.

2. Piping that is installed or replaced on or after August 1, 2009, at secondary containment sumps provided under this subsection may not pass through the bottom of the sump.

3. All electrical conduit and wiring that is installed or replaced on or after August 1, 2009, at secondary containment sumps provided under this subsection for dispensers shall pass over the top of the sump wall rather than through the wall or bottom of the sump.

Note: This subsection recognizes dispenser pans, spray−on liners, brushed−on liners, formed−in−place containment products, and other effective secondary containment practices that are currently in use.

(4) LEAK DETECTION FOR PIPING. (a) All new and existing underground piping connected to an aboveground tank shall be provided with approved leak detection in accordance with s. ATCP 93.510 (4), except as specified in par. (c). Existing piping shall comply with this paragraph within 2 years after February 1, 2009.

(b) Leak detection in accordance with par. (a) shall be installed immediately at the time of new installation or replacement of pipe.

(c) 1. Piping over 4 inches in diameter shall follow the plan and system requirements and deadlines in s. ATCP 93.517, except as specified in subd. 2. Leak detection for piping of 4 inches in diameter or less may be provided as specified in subd. 2. only if approved in writing by the department.

2. Leak detection for piping may consist of evaluations that are performed in accordance with API 570, by organizations that maintain or use an authorized inspection agency, a repair organization, and technically qualified piping engineers, inspectors and examiners, all as defined in API 570.

(5) INSTALLATION. (a) 1. The installation of shop−built tanks and associated piping shall be performed or supervised by a certified installer.

2. A certified installer shall verify that the installation of the electrical components for a tank system does not conflict with this chapter, except this verification is not required for the electrical criteria in ch. SPS 316.

(b) All installation shall be in accordance with the manufacturer's instructions, the applicable national standards adopted in s. ATCP 93.200, plans and specifications approved under s. ATCP 93.100 and this chapter.

(c) Single wall horizontal−cylindrical and rectangular aboveground storage tanks shall be installed to allow full visual inspection of the outer tank shell, except for any portion of the shell that is in contact with a support for it.

(d) The foundations for all types of tanks shall be designed to minimize the possibility of uneven settling, and to minimize corrosion in any part of the tank resting on the foundation.

(e) Tank supports shall be placed on a prepared, flat, compacted surface.

(f) Upon completion of any installation of new or replacement shop−built tanks or piping, or any modification or upgrade thereto that requires plan approval or registration, the certified installer

shall provide the authorized agent or the department with a completed tank installation checklist, form ERS−9658.

Note: Form ERS−9658 − Checklist for Aboveground Tank Installation is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(6) MOVING SHOP−BUILT TANKS. Aboveground shop−built tanks that are moved from one location to another shall meet all of the following requirements, except for tanks covered in s. ATCP 93.610:

(a) The tank shall meet all the plan review, installation and registration requirements in this chapter for the new location.

(b) If the tank contained Class I liquids, it shall be rendered free of flammable vapors before the move and maintained vapor−free until placed into service at the new location.

(c) If the tank is relocated to a property with a different street address, a revised tank registration, form ERS−8731 or ERS−10861 E, and part A of a tank−system service and closure assessment report, form ERS−8951, shall be completed and submitted to the department for the former location.

Note: Form ERS−8731 — Aboveground Flammable/Combustible/Hazardous Liquid Storage Tank Registration; form ERS−10861 E — Change of Ownership, Flammable/Combustible/Hazardous Liquid Storage Tank Registration; and form ERS−8951 — Tank System Service and Closure Assessment Report are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942. Forms ERS−8731 and 8951 are also available from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(d) The tank shall undergo pre−operational testing and inspection in accordance with PEI RP200 chapter 14.

(e) The tank shall have an inspection performed by an certified tank system inspector before being placed into operation.

(f) The tank shall continue to follow the inspection schedule in STI SP001 that was established at the former location.

(7) ABOVEGROUND TANK MARKING. (a) 1. All aboveground tanks, whether new or existing, that store Class I liquids, other than at refineries or at marine, pipeline or transport terminals shall have attached, the wording "FLAMMABLE—KEEP FIRE AWAY."

2. The wording shall be clearly visible and written in letters of a contrasting color at least 5 inches high with a minimum stroke width of 1 inch.

(b) 1. All aboveground tanks, whether new or existing, that store flammable or combustible liquids shall be labeled in accordance with NFPA 704.

2. The visibility and size of the label shall be in accordance with Table 93.400.

Table 93.400
Tank Labels

Tank Capacity in Gallons	Distance From Which the Label Shall Be Visible	Minimum Size of Label
Up to 5,000	75 feet	5″ x 5″
5,001 to 50,000	100 feet	10″ x 10″
50,001 to 250,000	200 feet	12″ x 12″
Greater than 250,000	300 feet	15″ x 15″

(8) MAINTENANCE. (a) *Tanks*. 1. a. All shop−built aboveground steel storage tanks, whether new or existing, shall be maintained and repaired in accordance with STI SP031.

b. All repairs or modifications under STI SP031 shall be recorded on the department's ERS−10873 form.

Note: Form ERS−10873–STI SP031 Tank Repair/Modification Summary, is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

c. A copy of the completed ERS−10873 form shall be provided to the tank owner or operator.

d. The tank owner or operator shall have the completed ERS−10873 form on site and available for inspection within 30 days after receiving it from the party that performed the repair.

2. Field−erected aboveground storage tanks shall be maintained and repaired in accordance with API 653.

(b) *Property.* Tank yards and diked areas shall be kept free from weeds, high grass, rubbish, and combustible materials that are not essential to the operation, and shall be kept clean and orderly.

(9) FACILITY LIGHTING. Adequate lighting shall be provided for loading, unloading and dispensing operations.

(10) SYSTEM ACCESS. (a) All new aboveground storage tank systems shall be designed and constructed to allow access to all connections between the tank and piping, venting, and appurtenances that require maintenance or replacement.

(b) The means of access shall be sufficient in size to allow for installation, maintenance and inspection of all connections and appurtenances.

(11) RECORD KEEPING. (a) *General.* Operators of new and existing aboveground storage tank systems shall maintain all of the following records:

1. Documentation of any system repairs, alterations or upgrades — including software and hardware upgrades — and any inspections required under this chapter.

2. Testing results obtained from any leak detection equipment, as retained from the equipment's printer or a hand−written log kept on site.

3. Documentation maintained for all calibration, inspection, monitoring, testing, repair, and annual performance verification of any leak detection equipment, if so equipped.

4. Response to and investigation of any leak detection alarms.

5. Documentation maintained for all calibration, inspection, monitoring, testing, repair, and periodic performance verification of any corrosion protection equipment permanently located on−site.

6. Records of any environmental information that has accrued for a site, such as from site investigations, phase I or II environmental site assessments, repairs and tank−system site assessments.

7. Results of functional testing of impact and emergency shut−off valves.

8. Electrical continuity testing for dispensers of motor fuels that are Class I liquids.

9. One set of stamped, approved plans and specifications and a copy of the approval letter.

(b) *Availability of records.* 1. Operators shall maintain the required records at the site, except as provided in subds. 2. and 3., and par. (c) 9.

2. Owners and operators of unattended sites shall make the records available for inspection at the site when given 72 hours of prior notice.

3. The approved plans and specifications and approval letter shall be kept on site and available to the authorized agent or the department during all phases of installation. After installation is completed, the approved plans and specifications and approval letter shall be made available to the authorized agent or the department upon request.

4. Records may be kept electronically, provided they are in a format acceptable to the department.

(c) *Maintenance of records*. Records shall be maintained for the following periods from the date of the most recent test, inspection or upgrade:

1. Monthly leak detection monitoring for underground piping — 1 year.

2. Annual precision tightness testing for underground piping — 1 year.

3. Impressed current corrosion protection system, 60−day inspection — the previous 3 inspections.

4. Corrosion protection system, annual test — the previous 3 tests.

5. Annual performance verification of leak detection equipment and flow restrictor, for underground piping — 2 years.

6. Results of functional testing of impact and emergency shut−off valves and electrical continuity testing for dispensers — 2 years.

7. The owner's manual provided by the leak detection equipment manufacturer — until the leak detection system is replaced or no longer used.

8. Any tank or pipe system modification or repair — the life of the system.

9. Inspection records — 3 years or the interval between required inspections, whichever is longer.

10. Tank−system site assessments and other environmental assessments, such as assessments for property transactions — 3 years after completion of any permanent closure, upgrade, repair or change in service. These records shall be maintained at one of the following locations:

a. With the owner or operator who took the AST system out of service.

b. With the current operator of the AST system site.

c. With the department if records cannot be maintained at the closed facility.

11. Leak detection alarm investigation — 2 years.

Note: All leak detection records should be retained. The documentation could be helpful to exclude the site as a possible source of contamination at a later date.

12. One set of stamped, approved plans and specifications and a copy of the approval letter — the life of the system.

(12) TANKS AT REMEDIATION SITES. (a) 1. Recovery systems using oil water separators or recovery systems pumping free product at the rate of 60 gallons or more per week shall comply with this paragraph.

2. Recovery product piping and storage tanks shall comply with either the plan review requirements in s. ATCP 93.100 or the design and construction requirements in s. ATCP 93.350 (2) for hazardous substances.

3. Tanks shall be registered in accordance with s. ATCP 93.140.

4. Tank construction and marking shall comply with the requirements in ss. ATCP 93.250 and 93.400 (7).

(b) Tanks used in recovery systems that pump free product at the rate of less than 60 gallons per week shall be constructed and marked in accordance with ss. ATCP 93.250 and 93.400 (7).

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (b) (title), (intro.) to 3., (3) (a), (c), and (d), renum. (3) (e) to (g) to be (3) (f) to (h) and am. (3) (h) 2. and 3., cr. (3) (e) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (b), (2) (c), (d) 1., 2., (4) (a), (c) 1., (5) (a) 2., (b), (6) (intro.), (7) (b) 2., (12) (a) 2., 3., 4., (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (b), (2) (c), (d) 1., 2., (4) (a), (c) 1., (5) (b), (6) (intro.), (7) (b) 2., (12) (a) 2. to 4., (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.410 Spill and overfill prevention. (1) Prior to delivery, the operator of the product delivery equipment that is transferring the product shall ensure that the volume available in the tank is greater than the volume of product to be transferred to the tank.

(2) The transfer operation shall be monitored constantly by the operator of the delivery equipment so as to prevent overfilling and spilling.

(3) Equipment shall be clearly marked so visual and audible warning signals are recognizable to the delivery person.

(4) Spill and overflow prevention equipment shall be maintained to work as originally designed and installed.

(5) The fill opening shall be separate from the vent opening.

(6) (a) All aboveground storage tanks, whether new or existing, with the fill point not located within a diked area shall be provided with a catch basin or similar containment, except for tanks exempted by par. (d) and tanks that are exempted from secondary containment by s. ATCP 93.420 (1) (a) to (c). Existing tanks shall comply with this paragraph within 1 year after February 1, 2009.

(b) The catch basin or similar containment to contain spillage at the fill point shall have a minimum liquid capacity of 5 gallons, except where the catch basin or similar containment was installed before February 1, 2009.

(c) The basin shall be equipped with a method to remove product or a drain system that directs spilled product into the tank.

(d) The following tanks are exempt from this requirement:

1. Tanks provided with controls before February 1, 2009 that comply with this subsection.

2. Tanks filled with a manual−shutoff nozzle without a latch−open device.

3. Tanks filled with a tight−connect with either a dry break connection or a manual shutoff valve on the hose−end connection.

(7) Tanks that are filled via hand−held nozzles shall be constantly attended during product delivery and shall be provided with a vent whistle or with other overfill prevention equipment which provides a visual signal at 90 percent of the tank's capacity.

(8) Tanks located remote from the fill point, that are filled only with a manual−shutoff nozzle without a latching mechanism shall be provided with overfill prevention equipment which notifies the person filling the tank, with both an audible and a visual signal, that the liquid level has reached 90 percent of the tank's capacity.

(9) (a) The following new and existing tanks that have a fill point not located within a diked area shall be provided with overfill prevention equipment which notifies the person filling the tank, with both an audible and a visual signal, that the liquid level has reached 90 percent of the tank's capacity, and which automatically shuts off flow when the quantity of liquid in the tank reaches 95 percent of the tank's capacity:

1. Tanks using tight−connect delivery.

2. Tanks located remote from the fill point, that use delivery nozzles with latch−open devices.

(b) Existing tank systems shall comply with this subsection within 2 years after August 1, 2009.

(10) (a) Operators shall utilize the procedures and equipment as specified in PEI RP600 for preventing overfilling of new and existing shop−built aboveground tanks.

(b) Fuel−delivery persons shall utilize the procedures in PEI RP600 for preventing overfilling of new and existing shop−built aboveground tanks, and may not interfere with equipment that is intended to prevent overfilling.

Note: PEI RP600 does not mandate installation of equipment, but instead addresses how to effectively use the equipment that is provided, as required by other sections and referenced standards in this chapter.

Note: Under sections ATCP 93.470 and ATCP 93.585 (2) (b), fuel−delivery persons must immediately inform the owner or operator of any spilling or overfilling which occurs during the delivery procedure and which may result in or be a release. Requirements for the owner or operator to report, investigate and clean up any spills and overfills are contained in sections ATCP 93.575 to 93.585.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (6) (c) and (9) Register July 2009 No. 643, eff. 8−1−09; correction in (6) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (6) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.420 Secondary containment. (1) APPLICATION. Aboveground storage tanks using secondary containment as a method of spill control shall comply with the secondary containment requirements in NFPA 30 section 22.11 and this section, except this requirement does not apply to any of the following tanks:

(a) Tanks covered in ss. ATCP 93.610 (1) to (3) and 93.630.

Note: Sections ATCP 93.610 (1) to (3) and 93.630 cover tank wagons, movable tanks, tank vehicles and aboveground farm tanks.

(b) Tanks storing Class IIIB liquids other than used oil.

Note: Federal regulations, such as the Spill Prevention Control and Countermeasure requirements in 40 CFR 112, may also apply to these tanks and be more restrictive, but are not enforced by the Department.

(c) Tanks storing Class IIIB liquids that are not in the same diked area as a tank containing Class I, II, or IIIA liquids.

(2) DIKE SYSTEMS FOR TANKS. (a) *Weather exposure.* Where a dike system is used to provide secondary containment for a tank system that is exposed to the weather, the dike system shall be constructed in accordance with NFPA 30 section 22.11; ACI 350.2R, if concrete is used; and this subsection.

(b) *Capacity.* The capacity of a dike system open to the weather shall be 25 percent larger than required under NFPA 30 section 22.11.1.2 or 22.11.2.2.

(c) *Construction.* The walls and floor of the dike system shall be constructed of earth, solid masonry, steel, pre−cast concrete, engineered poured concrete, or other materials approved by the department.

(d) *Sealing.* Dike systems with the walls and floor made of steel or poured or pre−cast concrete shall have all cracks, seams and joints sealed to be liquid−tight.

(e) *New earthen or masonry dikes.* 1. New dike systems that have walls or floor made of earth or masonry shall be lined with a synthetic material having a permeability of no faster than 10^{-6} centimeters per second for the substance stored, except as provided in subd. 2.

2. a. Tanks included in either subd. 2. b. or c. may have dike systems designed by an engineer, with the walls and floor made of clay material having a permeability of no faster than 10^{-6} centimeters per second for the substance stored. The dike system shall be designed to maintain the permeability for a minimum of 35 years.

b. Tanks that have a double bottom which includes interstitial monitoring.

c. Single−bottom tanks that are constructed to ensure that any leaks from the bottom will drain to a conspicuous location and be contained there.

Note: A method to achieve compliance with subdivision 2. c. could include placing a tank over coarse aggregate that rests on a concrete base which is configured to provide the specified drainage and containment.

Note: As applied under sections ATCP 93.440 (2) and (3), API 653 requires routine inspection of field−erected tanks, and STI SP001 requires periodic inspection of shop−built tanks, for evidence of leaks. Section ATCP 93.440 (6) requires submitting records of these inspections to the Department, for all tanks within a dike system that has walls or floor made of earth or masonry.

(f) *Existing earthen or masonry dikes.* 1. Tanks may be installed within an existing dike system that has walls or floor made of earth or masonry only if all of the following conditions are met:

a. The dike system complies with par. (b).

b. The new tanks comply with par. (e) 2. b. or c.

c. All other tanks within the dike system have overfill protection as specified in NFPA 30 section 21.7.1.

2. An existing dike system that has walls or floor made of earth or masonry may be expanded with materials which are similar to the materials in the existing walls and floor. After that expansion, tanks may be installed within the dike system only if all of the conditions in subd. 1. a. to c. are met.

3. Tanks within an existing dike system that has walls or floor made of earth or masonry may be converted from storing an unregulated substance to storing a regulated substance only if all of the following conditions are met:

a. The dike system complies with par. (b).

b. The converted tanks comply with par. (e) 2. b. or c.

c. All other tanks within the dike system have overfill protection as specified in NFPA 30 section 21.7.1.

(g) *Installation of synthetic liners.* Synthetic liners shall be installed under the direct supervision of a qualified representative of the manufacturer.

(h) *Testing and maintenance.* All new and existing synthetic liners and their seams shall be tested and maintained in accordance with the manufacturer's recommendations.

(i) *Inspection of seams.* Dike systems shall be constructed and maintained such that the liquid−tight seams can be visually inspected, except as provided in pars. (j) and (k).

(j) *Seam exceptions.* The following dike systems are not required to have seams that can be visually inspected:

1. Concrete or steel systems that are coated with a liquid−proof sprayed coating.

2. Systems using an additional synthetic liner.

3. Systems using a synthetic liner that is covered with earthen material.

(k) *Existing seams.* For existing dike systems, the seams directly under the tank are not required to be visible for inspection.

(L) *Separation.* A separation of at least 2 feet shall be provided between any new tank and the toe of any new or existing dike wall, and a minimum of 3 inches shall be provided between the bottom of any new tank and the dike floor, to allow for visual inspection of the exterior tank surface — except this 3−inch requirement does not apply to tanks that comply with par. (e) 2. b. or c., or where otherwise approved by the department.

(m) *Drainage.* Permanent containment structures shall be designed with a manually controlled drainage system to permit the drainage of liquids resulting from leaks, spills and precipitation, such as a manually controlled pump or siphon or a manually controlled dike valve.

(3) SECONDARY CONTAINMENT TANKS. (a) The department may accept secondary containment tanks of any size as providing acceptable secondary containment, except where dike systems are specifically required by this chapter.

(b) Secondary containment tanks shall be provided with an approved method of interstitial leak detection.

(4) PIPING. All underground piping connected to an aboveground tank shall comply with the secondary containment requirements in s. ATCP 93.400 (3).

(5) TRANSFER OPERATIONS. In order to prevent a spill from moving beyond the loading or unloading area, any tank which has a capacity of 5,000 gallons or more and which is involved in transfer operations for bulk loading and unloading of tank cars or tank vehicles at facilities that refine, process, distribute or manufacture liquids regulated under this code shall be provided with a catchment basin or treatment facility to contain the maximum capacity of the largest compartment of a tank car or tank vehicle loaded or unloaded at the facility.

Note: This transfer requirement does not apply to transfers of used oil or fuel oil for heating or other burning purposes.

Note: For further information on industry practices for preventing or detecting releases with aboveground storage systems, and for protecting groundwater, surface water and soil in the event of a liquid release, see API Publication 340 — *Liquid Release Prevention and Detection Measures for Aboveground Storage Facilities.*

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) (L) made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; CR 09−017: am. (5) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (a), (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.425 Tank lining of aboveground storage tanks. (1) The installation or repair of tank linings or coatings for aboveground storage tanks shall comply with API 652 and this section.

(2) The interior lining or coating of aboveground storage tanks or the repair of such linings or coatings shall be supervised and conducted by persons as required by the material manufacturer.

(3) Any openings cut for tank lining or similar purposes shall comply with API 653 for field−erected tanks and STI SP031 for shop−built tanks.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.430 Vehicle collision protection. (1) Permanent vehicle collision protection shall be provided for any new or existing tank or system component that could result in a release of product when damaged, in any area where impact due to speed, turning, or backing of any type of motorized or self−propelled vehicle is likely to occur, except for tanks covered in ss. ATCP 93.610 (1) to (3) and 93.630.

Note: Sections ATCP 93.610 (1) to (3) and 93.630 cover tank wagons, movable tanks, tank vehicles and aboveground farm tanks.

Note: Vehicle collision protection is required for tanks located outside or inside a building in motorized−vehicle or self−propelled−equipment traffic areas, where impact resulting from vehicle speed, turning or backing is a risk factor. For example, vehicle collision protection is required for tanks located adjacent to traffic areas that accommodate public and fleet fueling, service and delivery vehicles, self−propelled construction and service equipment, and forklift equipment.

Vehicle collision protection is not required for tanks adjacent to vehicle and equipment service bays where traffic patterns and speed would not be expected to impact the tank system.

Vehicle collision protection is generally not required at a terminal where roadways are clearly defined, access is restricted to authorized personnel, and vehicle drivers are familiar with the layout of the facilities.

(2) At least 24 inches of clearance shall be provided between a vehicle impact barrier and the tank or system component to be protected, unless otherwise approved by the department.

(3) Impact barriers shall be designed to protect the tank or component from impact damage by the force of the largest vehicle routinely in the traffic area traveling at 5 miles per hour or at the average traveling speed, if higher than 5 miles per hour, except as provided in sub. (4).

(4) (a) For impact barriers designed primarily to protect from the impact of automobiles, the portion determined to be most vulnerable to vehicle impact shall be capable of withstanding a single impact of 12,000−lb force applied at 10 miles per hour or equivalent impact energy.

(b) The impact shall be applied using a minimum 0.5−inch thick steel plate having a frontal surface area of 12 inches by 12 inches centered at 18 inches above grade.

Note: For many applications, the Department will accept either D.O.T. guardrails or 4−inch steel posts filled with concrete, set at least 3 feet into the ground and spaced no more than 4 feet on center.

(5) Vehicle impact barriers shall have a minimum height of 3 feet above grade or as acceptable to the authorized agent or the department.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.440 Aboveground tank inspection. (1) DELAYED EFFECTIVE DATE FOR EXISTING TANKS. The requirements in this section shall become effective for existing tanks within 1 year after February 1, 2009.

(2) INSPECTION OF FIELD−ERECTED METALLIC ABOVEGROUND STORAGE TANKS. (a) Metallic aboveground storage tanks within the scope of API 653 shall be inspected in accordance with the requirements of API 653.

(b) Initial inspections shall be conducted as required in Table 93.440.

(c) 1. The agency conducting an API 653 inspection shall report all applicable information from the inspection on an API 653 tank inspection summary form supplied by the department.

Note: Form ERS−10737−API 653 Tank Inspection Summary is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

2. A copy of the API 653 tank inspection summary shall be provided to the tank owner or operator along with the complete API 653 inspection report.

(d) The tank owner or operator shall have the API 653 inspection summary on site and available for inspection within 30 days after receiving it from the agency that performed the inspection.

(e) For tanks undergoing a transition from storing an unregulated substance to storing a regulated substance, any inspection in Table 93.440 that has not occurred shall be performed before putting the regulated substance into the tank. For the purposes of this paragraph, the service date is the date the tank was initially placed into service after construction.

Table 93.440
Inspection Type and Schedule

API 653 Inspection Type	First Required Inspection From Initial Service Date	Re−Inspection Frequency
In−Service	1 month	Monthly
External	5 years	Follow API 653
Ultrasonic, external	5 years	Follow API 653
Internal	10 years	Follow API 653

(3) INSPECTION OF SHOP−BUILT METALLIC ABOVEGROUND STORAGE TANKS. (a) 1. The owner or operator of all shop−built metallic aboveground fixed storage tanks shall have the tanks inspected in accordance with STI SP001, except as provided in subd. 2.

2. a. An alternate inspection procedure that provides equivalent environmental and fire safety protection may be used if accepted in writing by the department, or if developed by the certifying engineer for a facility in accordance with the federal spill prevention control and countermeasure regulations in 40 CFR 112.

b. This paragraph does not apply to tanks that have a capacity of less than 1,100 gallons.

c. This paragraph does not apply to heating oil tanks or to tanks at farms and construction projects.

Note: STI SP001 requires monthly and annual inspections, and requires maintaining records of these inspections. For almost all ASTs that have a capacity of 5000 gallons or less, these inspections are only required to be visual. For most tanks that have a capacity of more than 5,000 gallons, the requirements include, but are not limited to, having a certified inspection every 20 years, consisting of a visual exam and spot, ultrasonic examination, with no requirement for an integrity pressure test. STI SP001 includes optional checklists that may be used for the required recordkeeping. These checklists and a compendium that contains further guidance for these inspections are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: Tanks that are not required by this paragraph to have periodic inspections may otherwise be required to have periodic inspections, by the federal Spill Prevention Control and Countermeasure regulations in 40 CFR 112.

Note: Heating oil tanks and tanks at farms and construction projects are subject to the requirements in NFPA 31 or 30A, under sections ATCP 93.310 and 93.630, respectively.

(b) 1. The inspection schedule required in par. (a) shall be implemented as stated, for tanks put into service on or after February 1, 2009.

2. The inspection schedule required in par. (a) shall be implemented within 4 years after February 1, 2009, for tanks put into service before February 1, 2009.

3. The inspection schedule required in par. (a) shall be based on the tank's time in service.

4. Monthly inspections may be omitted for seasonal−use tanks during periods when the tank does not contain a regulated substance.

(c) If product is found within a tank's interstitial space during an inspection under this subsection, delivery of product into the

tank shall be immediately suspended, and either of the following actions shall be taken within 10 business days:

1. A vacuum or pressure test shall be performed in accordance with the manufacturer's recommendations.

2. The tank shall be closed in accordance with s. ATCP 93.460.

Note: See subsection (5) for further requirements for corrective action.

(4) INSPECTION OF NON−METALLIC ABOVEGROUND STORAGE TANKS. (a) The owner or operator of all non−metallic aboveground storage tanks — including concrete, tile−lined, fiber−reinforced plastic, and homogeneous plastic tanks — that have a capacity of 1,100 gallons or more shall have the tanks inspected in accordance with all of the following:

1. 'Monthly inspection.' a. At least monthly there shall be a visual inspection of the tank exterior, pipe connections and secondary containment, for signs of leakage, physical damage, and environmentally induced degradation.

b. Any product or water present in the secondary containment shall be removed.

2. 'Annual inspection.' a. At least annually there shall be a visual inspection of tank supports and foundation for signs of physical damage and chemical or environmentally induced degradation.

b. At least annually there shall be a test of the functionality of the tank venting system, if so equipped.

3. 'Qualifications for inspection.' The monthly and annual inspections shall be done by owners, contractors or operations personnel, who are knowledgeable of the facility operations, the tank construction and operation, and the characteristics of the product stored.

4. 'Every 5 years.' At least every 5 years there shall be an external and internal examination of tank and pipe connections for physical or chemical damage or environmentally induced degradation, conducted by personnel trained and experienced in examining the specific tank construction type.

(b) Inspection records shall be maintained at the site and available for review by the authorized agent or the department upon request.

(5) CORRECTIVE ACTION. (a) If a suspected or obvious release is encountered during the inspections under this section, a tank−system site assessment shall be conducted in accordance with s. ATCP 93.465 before the tank is returned to service.

(b) All corrective actions, including repairs, that are indicated by the inspections under this section shall be completed before the tank system is returned to service.

(6) SUBMITTAL OF INSPECTION RECORDS. (a) For all tanks within a new or existing dike system that has walls or floor made of earth or masonry, all inspections required by API 653 or STI SP001 section 1.6 shall be documented as required or recommended by those standards. Each of these inspection records shall be submitted to the department no later than 1 month after the inspection, except as specified in par. (b).

(b) For all tanks within an existing dike system that has walls or floor made of earth or masonry, a record of the most recent inspection shall be submitted to the department no later than 6 months after February 1, 2009, and records of subsequent inspections shall be submitted to the department no later than 1 month after each inspection.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) (b), (e), (3) (c) 2., (5) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (b), (e), (3) (c) 2., (5) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.445 Seldom−used and temporarily−out−of−service tanks. (1) OPERATIONAL REQUIREMENTS. Owners or operators of aboveground seldom−used and temporarily−out−of−service tanks shall comply with the applicable requirements of s. ATCP 93.545 (1).

(2) PLACING A TANK BACK INTO SERVICE. (a) The respective API 653 or STI SP001 inspection cycle shall be current for a tank before it is placed back into service.

(b) All leak detection, overfill, vent and fire valve devices shall be verified as functional before being placed back into service.

(c) Tank systems out of service for more than 365 days shall have a pressure test of the ullage portion to assure that tank connections are tight before the tanks are placed back into service.

(3) NON−COMPLYING TANKS. Tanks that are placed out of service which do not comply with this section shall be permanently closed in accordance with s. ATCP 93.460 within 60 calendar days.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: r. and recr. Register July 2009 No. 643, eff. 8−1−09; correction in (1), (3) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (3) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.450 Change in service to store a non−regulated substance. Owners or operators of aboveground tanks shall comply with the change−in−service requirements of s. ATCP 93.550, except a revised registration for aboveground tanks, form ERS−8731, shall be completed and submitted.

Note: Form ERS−8731 — Aboveground Flammable/Combustible/Hazardous Liquid Storage Tank Registration is available from the Division of Trade and Consumer Protection, PO Box 8911, Madison WI, 53708−8911, or at telephone (608) 224−4942, or from the Division's Web site at http://datcp.wi.gov.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.460 Closure of aboveground tanks. (1) GENERAL. Owners or operators of aboveground tanks shall comply with the closure requirements of s. ATCP 93.560, except as provided in this section.

(2) CERTIFICATIONS. Certified persons are not required to perform the following closure functions:

(a) Cleaning and removal of heating fuel tanks, at 1− and 2−family dwellings, that are located aboveground or in the basement.

(b) Cleaning and removal of field−erected tanks.

(c) Cleaning and removal of tanks storing a Class III liquid that is neither petroleum nor CERCLA−listed.

(3) MARKINGS. (a) All aboveground tanks closed before, on or after February 1, 2009, and not immediately removed from the site shall have the word "CLOSED" and the date of permanent closure permanently marked on the exterior tank wall, at least 3 feet above grade, with lettering at least 3 inches in height.

(b) A certified tank system inspector may perform the marking specified in par. (a).

(4) FORMS. When an aboveground tank is closed, a revised tank registration, form ERS−8731, and part A of a tank−system service and closure assessment report, form ERS−8951, shall be completed and submitted to the department within 21 business days of closure.

Note: Form ERS−8731, Aboveground Flammable/Combustible/Hazardous Liquid Storage Tank Registration, and form ERS−8951, Tank System Service and Closure Assessment Report are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; renumbering in (2) made under s. 13.92 (4) (b) 1., Stats., Register November 2008 No. 635; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.465 Tank−system site assessment. (1) GENERAL. (a) Tank−system site assessments for aboveground tanks shall comply with this section and the assessment requirements in s. ATCP 93.580, except as provided in sub. (2).

(b) Tank−system site assessments for aboveground storage tank systems shall include assessment of any underground piping, the loading rack or transfer area, and the area under each tank; and

shall be performed after notifying the authorized agent or the department but before completing any permanent closure.

Note: For further information on sampling and reporting for these assessments, see the Department's *Assessment and Reporting of Suspected and Obvious Releases From Underground and Aboveground Storage Tank Systems* (Stock number 61D) which is available from Document Sales and Distribution at 4622 University Avenue, Madison, WI 53705−2156; or at telephone (800) 362−7253; or at docsales@doa.state.wi.us; or from the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: The format for the reporting is available at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) EXCEPTIONS. (a) Aboveground storage tanks or underground piping that have been placed in secondary containment complying with s. ATCP 93.420 (2) (d), (e) or (g) for their entire operational life, and loading rack or transfer areas that have been placed in secondary containment complying with s. ATCP 93.420 (5) for their entire operational life are exempt from tank−system site assessment requirements, unless there is a suspected or obvious release outside the secondary containment.

(b) Aboveground storage tanks that have a capacity of less than 5,000 gallons are exempt from tank−system site assessment requirements unless a suspected or obvious release is present.

(c) A tank−system site assessment is not required for closure of double−wall pipe when modification or upgrading is conducted on an existing system that will remain in operation, unless a suspected or obvious release is present.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a), (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.470 Responding to a leak, spill, overfill or release. Owners or operators, contractors and fuel−delivery persons for aboveground tanks shall comply with the requirements relating to the presence of a leak, spill, overfill or release, and the assessment of, and response to a leak or release, in ss. ATCP 93.570 to 93.585.

Note: In section ATCP 93.585, releases are required to be reported to the Department of Natural Resources. Failure to notify the DNR of a release may have serious consequences — such as forfeitures under section 168.26 of the Statutes of $10 to $5000 for each violation. Each day of continued violation is a separate offense, and under section ATCP 93.180, each tank that is in violation is a separate offense.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction made under s. 13.92 4. (b) 7., Stats., Register October 2013 No. 694.**

Subchapter V — General UST Storage and Underground Piping

ATCP 93.500 General requirements. (1) SECONDARY CONTAINMENT. (a) *General.* All new and replacement underground storage tanks and piping systems shall be provided with secondary containment and continuous electronic interstitial monitoring, except as provided in par. (b).

Note: This section is coordinated with the federal Energy Policy Act of 2005, which addresses secondary containment for federally regulated tanks or piping installed within 1,000 feet of any community water system or any potable drinking water well, and which requires interstitial monitoring for any associated double−wall tanks or piping.

(b) *Exceptions.* This section does not apply to any of the following:

1. Any farm or residential underground storage tank system which has a capacity of less than 1,100 gallons and which is used for storing motor fuel for noncommercial purposes.

2. Any underground storage tank system which has a capacity of less than 4,000 gallons and which is used for storing heating oil for consumptive use on the premises where stored.

3. Piping of safe suction systems, that is installed before August 1, 2009.

4. A pipe manifold connecting 2 or more tanks, that is installed before August 1, 2009.

5. Airport fuel hydrant systems.

(c) *Motor fuel dispenser containment.* All new motor fuel dispensing systems and all new dispensers added to an existing island or to an extension of existing pipe shall have under−dispenser containment.

(2) FLEXIBLE CONNECTIONS. Flexible piping approved under s. ATCP 93.130 or listed metallic flex connectors shall be used in all of the following locations:

(a) At the top of the tank.

(b) Between the tank and the vent pipe.

(c) Below the dispenser.

(d) In fiberglass pipe, where there are sections less than 4 feet long between turns.

(3) UNDERGROUND TANK DESIGN. (a) *General.* Tanks designed and built for underground use may not be used aboveground.

(b) *Tanks for Class I, II, IIIA or IIIB liquids.* Tanks used for underground storage of Class I, II, IIIA or IIIB liquids shall be listed and shall comply with the construction and marking requirements in s. ATCP 93.250.

Note: See section ATCP 93.130 (5) for listing and labeling requirements for underground tanks.

(c) *Reuse of tanks.* Tanks that are moved from one underground location to another shall meet all of the following requirements:

1. The integrity of the tank shall be assessed and certified by the manufacturer, or a registered professional engineer, stating that the tank still meets the construction requirements in s. ATCP 93.250. The certification and a report of the assessment shall be included in the plan review documentation for the new installation.

2. The integrity assessment required in subd. 1. shall occur after the tank has been removed.

3. The tank shall meet all the installation requirements in this chapter.

(4) SYSTEM ACCESS. (a) Underground storage tank systems shall be designed and constructed to allow access to all connections between the tank and piping, venting, and appurtenances that require maintenance, inspection or replacement.

Note: Piping elbows are an example of connections that do not need access because typically they do not need maintenance or inspection. Valves, extractor fittings, flex connectors, corrosion−protection test connections and overfill prevention devices are examples of connections that need this access.

(b) The means of access shall be sufficient in size to allow for installation, maintenance and inspection of all system appurtenances.

(c) The means of access shall allow sufficient clearance for proper drainage from surface water incursion.

(5) SECONDARY CONTAINMENT FOR PIPING. (a) 1. When any underground product piping is installed as part of a new tank system or when 50 percent or more of a run is replaced, the piping shall be provided with approved secondary containment with non−discriminating electronic interstitial monitoring, except as specified in subd. 2.

Note: Underground fill piping is included in the piping that is addressed by this paragraph.

2. a. Sumps for new or replacement underground fill piping that does not drop vertically into a tank may be monitored visually on a monthly basis, instead of monitored with an electronic sensor.

b. Secondary containment is not required for underground fill piping that drops vertically into a tank.

(b) The material used for fabricating both the primary and secondary containment shall be listed in accordance with a standard that assures liquid− and vapor−tightness.

Note: The UL 971 standard meets this requirement.

(c) All pipe connections provided at the dispenser and at the top of the tank, that routinely contain product and are installed or replaced on or after February 1, 2009, shall be placed within a secondary containment sump.

(d) All existing pipe connections at the top of the tank and beneath all freestanding pumps and dispensers, that routinely con-

tain product shall be placed within secondary containment sumps by December 31 of the fifth year following February 1, 2009.

(e) All pipe connections at a transition between aboveground and underground piping that are installed or replaced on or after February 1, 2009, shall be placed within a secondary containment sump at the time of installation or replacement.

(f) 1. Secondary containment sumps provided under this subsection shall have non−discriminating electronic sensors that will detect liquids in the sump, unless approved otherwise by the department.

2. Piping that is installed or replaced on or after August 1, 2009, at secondary containment sumps provided under this subsection may not pass through the bottom of the sump.

3. All electrical conduit and wiring that is installed or replaced on or after August 1, 2009, at secondary containment sumps provided under this subsection for dispensers shall pass over the top of the sump wall rather than through the wall or bottom of the sump.

Note: This subsection recognizes dispenser pans, spray−on liners, brushed−on liners, formed−in−place containment products, and other effective secondary containment practices that are currently in use.

(6) INSTALLATION. (a) *General.* 1. a. The installation of underground tanks and associated piping shall be performed or supervised by a certified installer.

b. A certified installer shall verify that the installation of the electrical components for a tank system does not conflict with this chapter, except this verification is not required for the electrical criteria in ch. SPS 316.

2. All installation shall be in accordance with the manufacturer's instructions, the applicable national standards adopted in s. ATCP 93.200, plans and specifications approved under s. ATCP 93.100 and this chapter.

(b) *Tanks.* 1. Tanks shall have an air pressure and soap test performed after unloading.

2. a. All new tanks and pipe systems shall have pressure or vacuum testing that shall assure that the tank, pipe and all connections are tight in accordance with NFPA 30 section 21.5 and PEI RP100 sections 11 and 14 before the tanks and pipe systems are placed into service.

Note: For further guidance, see the program letter at the following Web site: http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

b. If a volumetric tank integrity test is used, it shall be capable of detecting a release of 0.1 gallon per hour from any portion of the tank when the tank is at least 70 percent full of product, shall be approved in accordance with s. ATCP 93.130, and shall be conducted in accordance with the approval. In addition, a precision tightness test shall be performed on the ullage portion of the tank.

Note: Volumetric tests approved under section ATCP 93.130 at 90 percent capacity are acceptable under this section at 70 percent capacity in combination with the ullage test.

c. If a non−volumetric tank integrity test is used, it shall be capable of detecting a release of 0.1 gallon per hour from any portion of the tank at any product level.

d. The volumetric or non−volumetric tests performed under this section shall be conducted by a certified tank system tightness tester.

3. If the tank has integral secondary containment, both the primary and secondary containment shall be tested in accordance with this section.

(c) *Piping*. 1. Piping shall be shown to be leak free by testing before backfilling and after backfilling.

2. Pressure piping, or suction piping with a check valve located at the tank, shall pass an approved precision tightness test before being placed into service.

3. Piping that has leak detection provided by electronic line leak detection shall have the leak detection system certified as operable by performing a functional leak test in accordance with the material approval issued under s. ATCP 93.130, before the piping is placed into service.

4. Any aboveground product or vent piping that is adjacent to or in the path of motorized vehicles or equipment shall have vehicle collision protection meeting the performance requirements in s. ATCP 93.430, unless approved otherwise by the authorized agent or the department.

(d) *Sumps*. 1. Secondary containment sumps shall be fabricated and installed in a manner that prevents release of liquids. These sumps shall be tested for leaks hydrostatically at installation, to the levels specified in subds. 2. to 4., in accordance with the manufacturer's instructions and the requirements of this chapter, for a period of not less than 60 minutes.

2. To no less than 1 inch over the top of the highest penetration.

3. To no less than 1 inch over the top of any horizontal joint between wall sections.

4. To no lower than the top of any vertical joint.

(e) *Installation checklist*. Upon completion of any installation of new or replacement shop−built tanks or piping, or any system modification or upgrade that requires plan approval or registration or permitting, the certified installer shall provide the authorized agent or the department with a completed tank installation checklist, form ERS−6294 UST.

Note: Form ERS−6294 UST, Checklist for Underground Tank Installation, is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: Section ATCP 93.140 (3) (c) requires the tank installation checklist to be submitted to the Department as part of the tank registration process.

(7) REPAIRS. (a) *General*. Owners and operators of tank systems shall ensure that repairs will prevent releases due to structural failure or corrosion as long as the tank system is used to store regulated substances.

(b) *Standards*. Repairs to tank systems shall be made by the manufacturer's authorized representative or in accordance with a code of practice developed by a nationally recognized association or an independent testing laboratory that is acceptable to the department.

(c) *Pipe repair and replacement*. Metal pipe and fittings that have released product as a result of corrosion or other damage shall be replaced. Fiberglass pipe and fittings that have released product shall be replaced or repaired in accordance with the manufacturer's specifications.

(d) *Tank−system site assessment*. When repairs are made to piping or fittings that have released product to the environment, an assessment of the piping run, to identify points of release, shall be performed in accordance with ss. ATCP 93.575 to 93.585.

(e) *Precision tightness testing*. Repaired tanks and piping shall have precision tightness testing in accordance with s. ATCP 93.515 (4) before being placed back into service.

(8) INSPECTION AND MAINTENANCE OF UST SYSTEMS. Operators of new and existing UST systems shall conduct routine and periodic inspection and maintenance in accordance with the applicable sections of PEI RP900.

(9) RECORD KEEPING. (a) *General*. Operators of new and existing underground storage tank systems shall maintain all of the following records:

1. Documentation of any system repairs, alterations or upgrades, including software and hardware upgrades, and any inspections required under this chapter.

2. Documentation demonstrating conformance with leak detection requirements, and the manner in which these claims have been justified or tested by the equipment manufacturer and certified installer, including all of the following:

a. Information pertaining to the leak detection system, including the material approval as issued under s. ATCP 93.130 that was valid when the system was installed; operator manual; warranty;

and documentation verifying that the equipment has been installed, programmed and tested to perform as required in this chapter.

b. Testing results obtained from leak detection equipment, as retained from the equipment's printer or a hand−written log kept on site.

c. Documentation maintained for all calibration, inspection, monitoring, testing, repair, and annual performance verification of leak detection equipment permanently located on−site.

3. Response to and investigation of leak detection alarms.

4. Documentation maintained for all calibration, inspection, monitoring, testing, repair, and periodic performance verification of any corrosion protection equipment permanently located on−site.

5. Analysis from a corrosion expert of site corrosion potential if corrosion protection equipment is not used.

6. Records of any environmental information that has accrued for a site, such as from site inspections or investigations, phase I or II environmental site assessments, or repairs, or from tank−system site assessments conducted under ss. ATCP 93.560 to 93.585.

7. Documentation of product inventory verification, at facilities that are subject to the requirements of ch. ATCP 94.

8. Results of functional testing of impact and emergency shut−off valves.

Note: See NFPA 30A section 6.3.9.1 for testing requirements.

9. Electrical continuity testing for dispensers of motor fuels that are Class I liquids.

10. One set of stamped, approved plans and specifications and a copy of the approval letter.

(b) *Availability of records*. 1. Operators shall maintain the required records at the site, except as provided in subds. 2. and 3., and par. (c) 11.

2. Operators of unattended sites shall make the records available for inspection at the site when given 72 hours of prior notice.

3. The approved plans and specifications and approval letter shall be kept on site and available to the authorized agent or the department during all phases of installation. After installation is completed, the approved plans and specifications and approval letter shall be made available to the authorized agent or the department upon request.

4. Records may be kept electronically, provided they are in a format acceptable to the department.

(c) *Maintenance of records*. Records shall be maintained for the following periods from the date of the most recent test, inspection or upgrade:

1. Monthly leak detection monitoring — 1 year.

2. Annual precision tightness testing — 1 year.

3. Periodic precision tightness testing in association with inventory control — until the next test is conducted.

4. Impressed current corrosion protection system, 60−day inspection — the previous 3 inspections.

5. Corrosion protection system, annual test — the previous 3 tests.

6. Internal inspection associated with underground tank lining — 10 years.

7. Annual performance verification of leak detection equipment and flow restrictor — 2 years.

8. Results of functional testing of impact and emergency shut−off valves and electrical continuity testing for dispensers — 2 years.

9. The owner's manual provided by the leak detection equipment manufacturer — until the leak detection system is replaced or no longer used.

10. Any tank or pipe system modification or repair — the life of the system.

Note: Lifetime maintenance of upgrading records is required by 40 CFR 281.32 (e).

11. Inspection records — 3 years or the interval between required inspections, whichever is longer.

12. Tank−system site assessments and other environmental assessments, such as assessments for property transactions — 3 years after completion of any permanent closure, upgrade, repair or change in service. These records shall be maintained at one of the following locations:

a. With the owner or operator who took the UST system out of service.

b. With the current operator of the UST system site.

c. With the department if records cannot be maintained at the closed facility.

13. Leak detection alarm investigation — 2 years.

14. Product inventory verification in accordance with s. ATCP 93.503, inventory control in accordance with s. ATCP 93.515 (2), or statistical inventory reconciliation in accordance with s. ATCP 93.515 (6) — 10 years.

15. One set of stamped, approved plans and specifications and a copy of the approval letter — the life of the system.

Note: All leak detection records should be retained permanently. The documentation could be helpful to exclude the site as a possible source of contamination at a later date.

Note: Section ATCP 93.870 has recordkeeping requirements for operator training, for USTs that are required to have a permit to operate from the department.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (1) (b) 3., 4., (5) (a) 2. a., (f) 2., 3., (6) (b) 2. a. and (9) (c) 14. Register July 2009 No. 643, eff. 8−1−09; correction in (2) (intro.), (3) (b), (c) 1., (6) (a) 1. b., 2., (b) 2. b., (c) 3., 4., (7) (d), (e), (9) (a) 2. a., 6., 7., (c) 14. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (intro.), (3) (b), (c) 1., (6) (a) 2., (b) 2. b., (c) 3., 4., (7) (d), (e), (9) (a) 2. a., 6., 7., (c) 14. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.503 Product inventory verification at retail facilities. (1) This section applies to any tank system from which products are offered for retail sale to the public that are subject to the requirements of ch. ATCP 94.

Note: Inventory verification can be particularly effective during regulatory investigations of consumer complaints about the quality of purchased fuels.

Note: The inventory verification specified in this section is not required to conform to the inventory control specifications in API 1621.

(2) To verify and maintain the integrity and quantity of delivered products, product inventory verification shall be conducted monthly for the life of the tank system, and reconciled on a monthly basis, in the following manner:

(a) Inventory volume measurements for regulated substance inputs, withdrawals, and the amount still remaining in the tank are recorded each operating day.

(b) The equipment used is capable of measuring the level of product over the full range of the tank's height, to the nearest one−eighth of an inch.

(c) The regulated substance inputs are reconciled with delivery receipts by measurement of the tank inventory volume before and after delivery. Where tanks are interconnected by a manifold, reconciliation may address all of the interconnected tanks as a group rather than as individual tanks.

(d) Product dispensing is metered and recorded in accordance with applicable requirements in ch. ATCP 92 for meter calibration, or an accuracy of 6 cubic inches for every 5 gallons of product withdrawn.

(e) The measurement of any water level in the bottom of the tank is made to the nearest one−eighth of an inch at least once a month.

(3) The reconciliation under sub. (2) shall be used to determine whether either of the following are indicated:

(a) A leak detection method has failed, as addressed in s. ATCP 93.570 (4).

(b) Unauthorized product mixing has occurred, as addressed in ch. ATCP 94.

Note: Where inventory control is used as the leak detection method, under section ATCP 93.515 (2), the measurements and procedures followed there will satisfy the requirements for inventory verification in this section.

Note: Where statistical inventory reconciliation (SIR) is used as the leak detection method, under section ATCP 93.515 (6), the same data may be used for the SIR and the inventory verification in this section, provided the requirements of the SIR vendor and this section are both met, including the monthly reconciliation in this section.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) (d) made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; CR 09−017: am. (1), (2) (intro.) and (c) Register July 2009 No. 643, eff. 8−1−09; correction in (1), (3) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (3) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.505 Spill and overfill prevention. (1) GENERAL. (a) Prior to delivery, the operator of the fuel delivery equipment that is transferring the product shall ensure that the volume available in the tank is greater than the volume of product to be transferred to the tank.

(b) The transfer operation shall be monitored constantly by the operator of the delivery equipment so as to prevent overfilling and spilling.

(2) EQUIPMENT. All underground storage tank systems, whether new or existing, shall meet all of the following requirements:

(a) 1. A liquid−tight containment system with a minimum capacity of 5 gallons shall be provided on top of the tank where connections are made for product fill piping, except the 5−gallon minimum does not apply to containment that was installed before February 1, 2009.

2. The basin shall be equipped with either a drain system that directs spilled product into the tank, or a mechanism to pump product out of the basin.

(b) Storage tank overfill prevention equipment shall be provided that complies with NFPA 30 section 21.7.1.5 and PEI RP100 chapter 7. Existing tank systems shall comply with this paragraph within 2 years after February 1, 2009.

Note: NFPA 30 section 21.7.1.5 requires equipment that will (1) automatically shut off the flow into a tank when the tank is no more than 95 percent full; and (2) alert the transfer operator when the tank is no more than 90 percent full, by restricting the flow into the tank or triggering a high−level alarm. Retrofit equipment is available which complies with these requirements and which can be installed in a tank without removing pavement. See PEI RP100 section 7.3.2 for description of how the contents of the delivery hose can be drained into the tank after an automatic shut−off valve closes.

(3) MAINTENANCE. All new and existing spill and overfill protection shall be maintained to perform as originally intended.

Note: Under section ATCP 93.585 (2) (b), fuel−delivery persons must immediately inform the owner or operator of any spilling or overfilling which occurs during the delivery procedure and which may result in or be a release. Requirements for the owner or operator to report, investigate and clean up any spills and overfills are contained in sections ATCP 93.575 to 93.585.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (a) 2. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.510 Leak detection requirements. (1) GENERAL. (a) All new and existing underground tank systems used to store regulated substances shall be provided with a method of leak detection that complies with this section and s. ATCP 93.515, except as exempted in par. (d).

(b) The method of leak detection shall be approved in accordance with s. ATCP 93.130.

(c) All monitoring equipment used to satisfy the requirements of this section shall be installed, calibrated, operated and maintained to perform as originally intended in accordance with the manufacturer's instructions and the department's approval, such as issued under s. ATCP 93.130.

(d) Leak detection is not required for any of the following tanks:

1. Tanks which have a capacity of less than 1,100 gallons and which are located on farm premises or at private residences.

2. Tanks storing Class IIIB liquids that are neither petroleum nor CERCLA−listed products.

(e) If a tank system exhibits a continuing pattern of failing and then not failing leak detection testing, a precision tightness test shall be performed within 10 business days in accordance with s. ATCP 93.515 (4), and if a tank system fails to pass that test, the site shall be assessed for the presence of a release in accordance with ss. ATCP 93.575 to 93.585.

(2) ANNUAL CALIBRATION VERIFICATION. (a) The following equipment shall be verified by a qualified person every 12 months for the same degree of operability and capability as when the equipment was newly installed:

1. Equipment for measuring product levels that is used for manual tank gauging or statistical inventory reconciliation.

2. Automatic tank gauging equipment used for monthly monitoring, statistical inventory reconciliation or precision tightness testing.

3. Interstitial monitoring equipment.

4. Sensors used to detect leaks in tanks, lines or sumps.

(b) Under this subsection, a qualified person is a person certified by the equipment manufacturer as being trained in the operational characteristics of the equipment.

(c) Annual monitoring equipment certification shall be made on the department's underground tank system prevention and detection functionality verification form (ERS−10778) and shall be maintained onsite in accordance with s. ATCP 93.500 (9) (a).

Note: Form ERS−10778, Underground Tank System Prevention and Detection Functionality Verification, is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(3) LEAK DETECTION FOR TANKS. (a) *General*. 1. Tanks shall be monitored at least every 30 days for leaks using one of the methods listed in s. ATCP 93.515, except as provided in subd. 2.

2. Tanks that have a capacity of 1,000 gallons or less may use manual tank gauging conducted in accordance with s. ATCP 93.515 (3) as the sole means of leak detection provided it is performed weekly.

Note: Under section section ATCP 93.500 (1) (a), continuous electronic interstitial monitoring is generally required for all secondary containment installed on or after February 1, 2009.

(b) *Failed tests*. If a passing test using monthly monitoring is not achieved for 2 consecutive months, a precision tightness test shall be performed within 10 business days in accordance with s. ATCP 93.515 (4), and if a tank fails to pass that test, the site shall be assessed for the presence of a release in accordance with ss. ATCP 93.575 to 93.585.

(c) *Inconsistent results*. The authorized agent or the department may require a precision tightness test to be performed where any of the following events occur:

1. A tank system is accumulating water for no apparent reason.

2. A leak detection method is providing erratic results.

3. A tank system is tested with multiple leak detection methods that show different results.

(d) *Inventory control as leak detection*. Tank systems may use monthly inventory control performed in accordance with s. ATCP 93.515 (2) as leak detection provided all of the following conditions are met:

1. The tank is 10 years old or less.

2. The tank has precision tank tightness testing conducted in accordance with s. ATCP 93.515 (4) at least once every 5 years from the date of installation until the tank is 10 years old.

3. The tank system has corrosion protection in accordance with s. ATCP 93.520.

(4) LEAK DETECTION FOR PIPING. (a) *Pressurized piping*. Underground piping that conveys regulated substances under

pressure shall comply with all of the following requirements unless all of the piping is visible:

1. The system shall be equipped with an automatic line leak detector in accordance with s. ATCP 93.515 (8) (b).

2. Single−wall piping systems shall have at least one of the following leak detection methods:

a. An annual precision tightness test.

b. Monthly monitoring to the 0.2 gallon per hour rate.

3. Double−wall piping systems shall use one of the leak detection methods in subd. 2., or statistical inventory reconciliation, or continuous interstitial monitoring.

Note: Under section s. ATCP 93.500 (1) (a), continuous electronic interstitial monitoring is generally required for all secondary containment installed on or after February 1, 2009.

4. If a passing test using monthly monitoring is not achieved for 2 consecutive months, a precision tightness test shall be performed within 10 business days in accordance with s. ATCP 93.515 (4), and if the piping fails to pass that test, the site shall be assessed for the presence of a release in accordance with ss. ATCP 93.575 to 93.585.

(b) *Suction piping*. 1. Piping which conveys regulated substances under suction and which is not entirely visible shall use one of the following leak detection methods, except as provided in subd. 2.:

a. A precision tightness test conducted at least every 3 years.

b. Interstitial monitoring.

2. Leak detection may be omitted for suction piping that meets all of the following requirements:

a. The below−grade piping operates at less than atmospheric pressure.

b. The below−grade piping is sloped so that the contents of the pipe will drain back into the storage tank if the suction is released.

c. Only 1 check valve is included in each suction line.

d. The check valve is visibly located directly below and as close as practical to the suction pump.

e. A method is provided that allows compliance with subd. 2. b. to d. to be readily observed or otherwise determined.

(c) *Inventory control as leak detection.* Piping connected to a tank using inventory control in accordance with sub. (3) (d) shall comply with one of the following:

1. Pressurized piping shall have leak detection complying with par. (a).

2. Suction piping shall have leak detection complying with par. (b).

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (title) and (c) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (a), (b), (c), (e), (2) (c), (3) (a) 1., 2., (b), (d) (intro.), 2., 3., (4) (a) 1., 4. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a) to (c), (e), (2) (c), (3) (a) 1., 2., (b), (d) (intro.), 2., 3., (4) (a) 1., 4. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.515 Leak detection methods. (1) GENERAL. (a) Leak detection methods for tank systems shall meet the requirements of this section.

(b) The leak detection test information reports submitted to the department, or maintained on site as required in s. ATCP 93.500 (9), shall include at least all of the following:

1. Site information including the name of the business, the street address, and the municipality in which the site is located.

2. Tank system information including the department−assigned tank identification number, the site identification number designated by the owner or operator, the tank capacity, the product in the tank, the type of pipe system, and whether there are pipe manifolds in the tank system.

3. Test method information including the name of the method or equipment used, the material approval number as issued under s. ATCP 93.130, the date the test was performed, the threshold value used to declare a leak, the rate of volumetric change, whether the final result was a pass or fail, and the name and certification of the technician performing the test.

(2) INVENTORY CONTROL. (a) *General methodology.* Inventory control that is used as the leak detection method shall be conducted in accordance with API 1621 and with this subsection.

(b) *Prescriptive requirements*. Product inventory control shall be conducted monthly and reconciled to detect a leak rate of at least 0.5 percent of throughput on a monthly basis, in the following manner:

Note: A leak rate of 0.5 percent is equal to 5 gallons out of every 1000 gallons of throughput.

1. Inventory volume measurements for inputs, withdrawals, and the amount still remaining in the tank shall be recorded each operating day.

2. The equipment used shall be capable of measuring the level of product over the full range of the tank's height, to the nearest one−eighth of an inch.

3. a. The inputs shall be reconciled with delivery receipts by measurement of the tank inventory volume before and after delivery.

b. Where tanks are interconnected by a manifold, reconciliation may address all of the interconnected tanks as a group rather than as individual tanks.

4. The measurement of any water level in the bottom of the tank shall be electronically or manually gauged to the nearest one−eighth of an inch at least once a month and recorded.

(c) *Product losses*. Tank systems that exceed the losses allowed under par. (b) for 2 consecutive months shall follow the requirements in ss. ATCP 93.575 to 93.585 for assessing and responding to a release.

(d) *Precision tightness test.* A precision tightness test shall be performed within 10 business days of notification from the authorized agent or the department for any of the following reasons:

1. Failure to provide monthly inventory control data for the past 12 months.

2. Incomplete or inconsistent data entry reflected during any 2 months of data entry out of the most recent 3 months of inventory control recordkeeping.

(3) MANUAL TANK GAUGING. (a) *Where allowed*. 1. Manual tank gauging may be used as the sole method of leak detection for tanks that have a capacity of 1,000 gallons or less, for the life of the tank.

2. For tanks that have a capacity of more than 1000 gallons, to 2,000 gallons, manual tank gauging may be used if all of the following conditions are met:

a. The tank system has a precision tightness test performed in accordance with sub. (4) at least once every 5 years.

b. The tank is less than 10 years old.

c. The piping either receives an annual precision tightness test or has electronic line leak detection testing, and this tightness test or leak detection testing is performed in accordance with the capabilities specified in s. ATCP 93.130 (3) (b).

3. Tanks which have a capacity of more than 1000 gallons, to 2,000 gallons and which are more than 10 years old shall be provided with monthly monitoring in accordance with sub. (5), (6) or (7).

4. Tanks that have a capacity of more than 2,000 gallons may not use manual tank gauging as the method of required leak detection.

(b) *Manual tank gauging procedures*. Manual tank gauging shall meet all of the following requirements:

1. Liquid level measurements shall be taken with a gauge stick that is marked to measure the liquid to the nearest one−eighth of an inch over the full range of the tank's height.

2. Tank liquid level measurements shall be taken at the beginning and ending of the test duration periods given in Table 93.515, during which no liquid may be added to or removed from the tank, and shall be based on the average of 2 stick readings taken at both the beginning and ending of the period.

3. A leak is suspected and subject to the requirements of ss. ATCP 93.575 to 93.585 if the variation between beginning and ending measurements exceeds the weekly or monthly standards in Table 93.515.

Table 93.515
Test Duration and Standards

Nominal Tank Capacity	Minimum Test Duration	Weekly Standard (1 test)	Monthly Standard (average of 4 tests)
550 gallons or less	36 hours	10 gallons	5 gallons
551−1000 gallons, tank diameter of 48 inches	58 hours	12 gallons	6 gallons
551−1000 gallons, tank diameter of 64 inches	44 hours	9 gallons	4 gallons
551−1,000 gallons and using precision tightness testing every 5 years	36 hours	13 gallons	7 gallons
1001−2000 gallons[1]	36 hours	26 gallons	13 gallons

[1] Requires precision tightness testing every 5 years. This method is only allowed until the tank is 10 years old.

(4) PRECISION TIGHTNESS TESTING. (a) Precision tightness testing shall be conducted in one of the following ways:

1. By a certified tank system tightness tester, using methods approved under s. ATCP 93.130 to perform precision tightness testing for tanks or piping.

2. With permanently installed leak detection equipment as approved under s. ATCP 93.130 to perform precision tightness testing for tanks or piping.

(b) Where a certified tank system tightness tester is used, the tester shall include the date and the beginning and end times in the test results report.

(5) AUTOMATIC TANK GAUGING. Automatic tank gauging shall meet all of the following requirements:

(a) 1. No more than 30 days may elapse between monthly monitoring tests using an automatic tank gauge.

2. Monthly monitoring tests shall have the capabilities specified in s. ATCP 93.130 (3) (b).

3. An automatic tank gauge shall be placed in the center of the tank and no closer than 24 inches from the fill pipe and the submersible pump, unless approved otherwise by the department.

(b) Automatic tank gauges shall be provided with a printer that provides at least all of the following information:

1. The starting date and time and ending date and time of the test.

2. The volume of liquid in the tank during the test.

3. The measured leak rate in gallons per hour and whether this leak rate indicates a pass or a fail.

4. The specific identification of the tank and any associated piping that is being tested.

(6) STATISTICAL INVENTORY RECONCILIATION. (a) Operators using statistical inventory reconciliation (SIR) as the primary method of leak detection shall have in effect a process to submit their data to the vendor within 4 business days of the end of the monthly reporting period.

(b) The daily tank product inventory records shall be maintained current and be maintained on site.

(c) The SIR vendor shall analyze the data and supply a summary report to the operator on a monthly basis.

(d) The SIR vendor shall return the summary report to the submitter within 10 business days after the postmark on the submittal.

(e) Operators using statistical inventory reconciliation shall review the vendor summary report within 24 hours of receipt. If the summary report indicates a failure, the operator shall take immediate action in accordance with the requirements in ss. ATCP 93.575 to 93.585 for assessing and responding to a release.

(f) Operators who receive summary reports that indicate either a failure or inconclusive results, or 1 of each, for 2 out of any 3 consecutive months shall have a precision tightness test performed on the tank system within 7 calendar days of receipt of the report.

(g) Statistical inventory reconciliation may not be used as a method of precision tightness testing.

(h) Before changing from another method of leak detection to statistical inventory reconciliation, the operator shall provide the department with proof of a precision tightness test completed within the previous 12 months showing the tank system to be tight.

(7) INTERSTITIAL MONITORING. Interstitial monitoring between an underground tank system and a secondary barrier immediately around it may be used only if the system is installed and maintained to detect a leak from any portion of the tank that could contain product, and the system meets one of the following requirements:

(a) *System testing*. Post−installation testing shall be performed on the interstitial monitoring system to verify that the system operates in accordance with the manufacturer's specifications.

(b) *Double−walled systems*. For double−walled systems, the sampling or testing method shall be capable of detecting a leak through the inner wall in any portion of the tank that routinely contains product.

(c) *Systems with internally fitted liners*. 1. For tank systems with an internally fitted liner, a monitoring system shall be installed that is capable of detecting a leak between the inner wall of the tank and the liner.

2. The liner shall be chemically compatible with the substance stored.

(d) *Systems with a barrier in the excavation zone*. Systems with a secondary barrier within the excavation zone shall meet all of the following requirements:

1. The testing method shall be capable of detecting a leak between the system and the secondary barrier.

2. The secondary barrier around the system shall consist of manufactured material which is impermeable to at least 10^{-6} cm/sec for the regulated substance stored, and which will direct a leak to the monitoring point, to be detected.

3. The liner shall be chemically compatible with the substance stored.

4. For cathodically protected tanks, the secondary barrier shall be installed so that it does not interfere with the proper operation of the cathodic protection system.

5. The test method shall be designed, installed and maintained so groundwater, soil moisture, and rainfall do not render the method inoperative, so that a leak could go undetected.

6. The site shall be investigated to ensure that the secondary barrier is always above groundwater and not in a 25−year flood

plain, unless the barrier and monitoring designs are for use under such conditions.

7. Monitoring wells shall be clearly marked and secured to avoid unauthorized access and tampering.

(8) METHODS OF LEAK DETECTION FOR PIPING. (a) *General*. Leak detection for piping shall follow the requirements of s. ATCP 93.510 (4) and this section.

(b) *Automatic line leak detectors*. Underground piping systems serving a storage tank with a submersible pump or pressurized booster pump shall be provided with an automatic line leak detector that alerts the operator to the presence of a leak by restricting or shutting off flow from the pump, when it detects leaks of 3 gallons per hour at 10 pounds per square inch line pressure within 1 hour.

(c) *Line tightness testing*. 1. In addition to the automatic line leak detection required by par. (b), a periodic precision tightness test of piping shall be conducted in accordance with sub. (4), except as provided in subds. 2 and 3. The test shall be performed by a certified tank system tightness tester.

2. Where piping leak detection is installed that has the capability to perform monthly monitoring, a separate precision tightness test is not required.

3. Any of the methods in subs. (6) and (7) may be used in lieu of complying with subd. 1. if they are designed and approved under s. ATCP 93.130 to detect a leak from any portion of the underground piping that routinely contains product.

(d) *Periodic line leak detection equipment testing*. 1. A start−up functionality test of the operation of the leak detector shall be conducted in accordance with the manufacturer's procedures for testing to the leak thresholds in par. (b) by inducing a physical line leak.

2. A functionality test of the operation of a mechanical line leak detector shall be conducted annually in accordance with the manufacturer's procedures for testing to the leak thresholds in par. (b) by inducing a physical line leak.

3. A functionality test of the operation of an electronic line leak detector shall be conducted at least annually in accordance with the manufacturer's procedures for periodic testing to the leak thresholds in par. (b) by inducing a physical line leak, except as provided in subd. 4.

4. A leak shall be introduced to the line system to prove the functionality of the electronic line leak detector unless the manufacturer has an alternate approved or equivalent method for testing whether the detector is functioning as intended by the manufacturer. This testing shall be conducted annually by an individual who has no financial interest in the facility and who is certified by the manufacturer to perform the testing, and it shall include all of the following elements:

a. Review of the test diagnostics for a 3 and 0.2 gallon per hour leak test and the history reports for the leak detector showing monthly leak tests.

b. Verification that the programming parameters are correctly set.

c. Verification that the leak detector is producing normal pump−on pressures, by activating a 3 gallon per hour test from the tank monitor console.

d. Verification that electrical wiring and connections have not deteriorated.

e. Verification that associated sensors are functioning as intended.

(9) OTHER METHODS. The department may approve other methods of leak detection in accordance with s. ATCP 93.130.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (b) 3. b., r. (5) (b) and (c), renum. (5) (d) and (6) (b) to (g) to be (5) (b) and (6) (c) to (h), cr. (6) (b) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (b) (intro.), 3., (2) (c), (3) (a) 2. c., (b) 2., 3., (4) (a) 1., 2., (5) (a) 2., (6) (e), (8) (a), (c) 3., (9) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (b) (intro.), 3., (2) (c), (3) (a) 2. c., (b) 2., 3., (4) (a) 1., 2., (5) (a) 2., (6) (e), (8) (a), (c) 3., (9) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.517 Airport hydrant leak detection requirements. (1) GENERAL. All new and existing airport fuel hydrant systems shall comply with this section.

(2) LEAK DETECTION PLANS. All fuel hydrant systems shall have a leak detection plan that is specifically approved by the department in accordance with s. ATCP 93.130.

(3) PLAN DEADLINES. (a) For new fuel hydrant systems, leak detection plans shall be submitted to the department before the system becomes operational.

(b) For existing fuel hydrant systems, leak detection plans shall be submitted to the department within 10 years after February 1, 2009.

(4) PLAN REQUIREMENTS. Fuel hydrant leak detection plans shall include all of the following:

(a) A description of the fuel hydrant system.

(b) A description of the leak detection method used.

Note: A designer of an airport hydrant leak detection system who does not have a financial interest in the airport may be considered to be the independent third party that is required in section ATCP 93.130 (3) (b) 1. for leak detection methods.

(c) A schedule for testing the system.

(d) Any limitations of the leak detection method.

(e) An action plan in the event a leak is identified.

(5) SYSTEM REQUIREMENTS. (a) All new fuel hydrant systems shall be designed and equipped with isolation valves appropriate for leak testing.

(b) Any repair or upgrade to an existing fuel hydrant system shall include the installation of isolation valves in the section that is repaired or upgraded.

(c) Existing fuel hydrant systems shall have isolation valves for leak testing installed within 10 years after February 1, 2009.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.520 Operation and maintenance of corrosion protection. (1) GENERAL. (a) *Where required*. Vent lines, vapor lines and any portion of a single or double−wall tank system, whether new or existing, that routinely contains product and is in contact with the ground or with water shall be protected from corrosion by one of the following methods:

1. The tank and piping are constructed of an inherently corrosion−resistant material.

2. a. The tank and piping are installed at a site that is determined by a certified corrosion expert to be non−corrosive during the operational life of the system.

b. A certified corrosion expert retained for the purpose of determining a non−corrosive site shall make at least 1 personal visit to each tank site during the design stage.

Note: See section ATCP 93.200, Table 93.200–5 for information on contacting NACE.

3. The tank is a listed composite or jacketed tank designated as complying with UL 1746, and the piping is protected by one of the methods in this subsection.

Note: In addition to composite and jacketed tanks, the UL 1746 standard also includes requirements for coated tanks and tanks with pre−engineered cathodic protection systems. These last 2 types of cathodic protection are not included in the blanket approval under this section.

4. The tank and piping are protected with a sacrificial anode system in accordance with a standard developed by a nationally recognized association or independent testing laboratory that is acceptable to the department.

5. a. The tank and piping are protected with a corrosion protection system designed by a certified corrosion expert and meet the requirements of either sub. (2) or (3).

b. A corrosion expert retained for the purpose of designing an impressed current corrosion protections system shall make at least 1 personal visit to each tank site during the design stage.

(b) *Design and construction.* 1. To allow for periodic testing, new and replacement factory− or field−installed corrosion protection systems shall have appropriate connections, insulated lead wires and accessible test stations, including as specified in subds. 2. and 3.

2. All lead wires connected to a tank, anode, reference electrode, or other component associated with the corrosion protection system shall terminate at a test station.

3. The termination of each lead wire at a test station shall be clearly labeled or coded to identify the specific component to which it is connected.

4. Impressed current systems shall be designed to prevent stray current conditions that may negatively impact other underground structures, utility lines, or cable anchors, or any impressed current systems protecting those items.

5. Local utilities shall be notified by the contractor when impressed current systems are installed, repaired or adjusted, including where an increase in rectifier amperage or voltage output occurs.

(c) *Operation and maintenance*. 1. Operation and maintenance of corrosion protection systems shall be in accordance with national standards acceptable to the department.

2. All new and existing corrosion protection systems shall be operated and maintained to continuously provide corrosion protection for the life of the tank system.

3. For impressed current systems, operation and maintenance practices and procedures shall be evaluated, and conducted in a manner that minimizes DC interference to or from any underground structure, utility line or cable anchors in the area.

(d) *Testing periods*. 1. a. All new and existing corrosion protection for UST systems shall be tested within 6 months of installation or repair and at least annually, except as provided in subd. 3.

b. Structure−to−soil potential readings shall be conducted with a minimum of three readings per tank along the center line, located at the ends and in the middle, and with one reading remote from the structure.

c. For each product line, structure−to−soil potentials shall be taken above the piping, at the ends and middle, away from the anode locations. Piping runs over 30 feet shall have additional readings taken every 10 feet.

d. For impressed current systems, the annual test shall include instant−off potentials.

2. In addition to the requirements in subd. 1., impressed current corrosion protection systems shall be inspected and evaluated by the site operator at least every 60 days to ensure the equipment is providing adequate current in accordance with its design.

3. Tanks designated as sti−P3®, equipped with a pre−installed sacrificial anode system and test station, shall be tested in accordance with all of the following:

a. Testing shall occur within 6 months of installation and at least every 3 years thereafter until the tank is 10 years old.

b. Testing shall occur annually in accordance with subd. 1. after the tank is 10 years old.

4. The results of the inspections, evaluations and testing under this paragraph shall be summarized on the department's form ERS−10785, and retained at the site in accordance with s. ATCP 93.500 (9).

Note: Form ERS−10785, Underground Tank System Corrosion Protection Summary Documentation, is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: Section ATCP 93.500 (9) specifies retention requirements for testing and repair records of corrosion protection systems.

(e) *Certifications for corrosion protection*. 1. A certified cathodic protection tester shall be on the site to supervise and monitor the initial post−installation start−up of impressed current corrosion protection systems.

Note: NACE requires a person with Senior Corrosion Technologist certification or higher for corrosion protection system commissioning.

2. A certified cathodic protection tester shall perform or supervise the performance of reinstallation or replacement of anodes.

Note: NACE requires a person with Level 1 Cathodic Protection Tester certification or higher for reinstallation or replacement of anodes.

3. a. All new and existing corrosion protection for UST systems shall be tested by a certified cathodic protection tester, except as provided in subd. 3. b.

Note: NACE requires a person with corrosion technologist certification or higher or a person with corrosion technician certification who is directly supervised by a certified corrosion technologist or higher to perform work as a state−certified cathodic protection tester.

b. Tanks designated as sti−P3® shall be tested by a person holding a certification from the Steel Tank Institute or one of the certifications in subd. 3. a.

Note: Additional information on corrosion protection certifications is available from the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) SACRIFICIAL ANODE SYSTEMS. (a) *General*. All new and existing sacrificial anode systems shall maintain the standard protection threshold reading of at least negative 850 millivolts or shall comply with the requirements of par. (b).

(b) *Failing sacrificial anode systems*. 1. Unless arrangements are made with the authorized agent or the department to conduct follow−up testing, the cause of the failure shall be investigated and repaired within 90 days of the failed reading; or the entire tank system shall be emptied in accordance with s. ATCP 93.545 (1) (a) 2. b. within 90 days of the failed reading, and shall remain empty until the repair is completed.

2. If more than 2 years has elapsed since the previous corrosion protection test, or if the corrosion protection system has been inoperative for 2 years or more, an internal inspection shall be performed by a third party in accordance with one of the following standards:

a. For lined tanks, the internal inspection shall be in accordance with API 1631 or KWA.

b. For unlined tanks, the internal inspection shall be in accordance with ASTM G 158.

3. If the tank fails the internal inspection, one of the following shall occur:

a. The tank system shall be permanently closed.

b. The tank system shall be lined or any present lining shall be repaired in accordance with API 1631, and an impressed current corrosion protection system shall be installed.

4. After an inspection under this paragraph, if the tank is not closed under subd. 3. a., a precision tightness test shall be performed on the tank system in accordance with s. ATCP 93.515 (4). The tightness test shall test 100 percent of the tank's volume.

(3) IMPRESSED CURRENT SYSTEMS. (a) *General*. 1. Equipment for impressed current systems shall be served by a dedicated and clearly marked electrical circuit that remains energized at all times.

2. All new and existing impressed current systems shall maintain either of the following standard protection levels:

a. An instant−off reading of at least negative 850 millivolts.

b. A 100 millivolt or greater polarization shift from the instant−off reading.

3. When a new impressed current system is installed or an existing system is replaced in whole or in part, an ammeter shall be installed, along with an hour meter that totals the number of hours during which electric current flows through the system.

(b) *Failing impressed current systems*. If impressed current corrosion protection readings taken in accordance with sub. (1) (d) 2. indicate the system is not maintaining adequate continuous protection, the system shall be analyzed by a certified corrosion

expert for site corrosion potential and qualification of system functionality.

(c) *Inoperative impressed current systems*. 1. Impressed current systems that have been inoperative for 120 days or less shall comply with all of the following requirements:

a. Power shall be restored and the system shall be tested by a certified cathodic protection tester for system functionality.

b. If the impressed current system is damaged or inoperable, a certified corrosion expert shall repair, survey and re−commission the system.

2. Impressed current systems that have been inoperative for 121 to 180 days shall comply with all of the following requirements:

a. A precision tightness test shall be performed on the tank system in accordance with s. ATCP 93.515 (4) within 15 days of discovery.

b. Power shall be restored and the system shall be tested for system functionality by a certified cathodic protection tester.

c. If the impressed current system is damaged or inoperable, a certified corrosion expert shall repair, survey and re−commission the system.

3. Impressed current systems that have been inoperative for 181 to 365 days shall comply with all of the following requirements:

a. A precision tightness test shall be performed on the tank system in accordance with s. ATCP 93.515 (4) within 15 days of discovery.

b. A certified corrosion expert shall assess, survey and re−commission the impressed current system and perform any necessary repairs.

4. Impressed current systems that have been inoperative for more than 365 days shall comply with all of the following requirements:

a. An internal inspection of the tank shall be performed in accordance with sub. (2) (b) 2.

b. If the tank fails the internal inspection, the tank owner shall either have the tank repaired and lined, or have the lining repaired in accordance with s. ATCP 93.530, or have the tank permanently closed and removed in accordance with s. ATCP 93.560.

c. If the tank is not closed under subd. 4. b., a certified corrosion expert shall assess, survey and re−commission the impressed current system and perform any necessary repairs.

d. If the tank is not closed under subd. 4. b., a precision tightness test shall be performed on the tank system in accordance with s. ATCP 93.515 (4). The tightness test shall test 100 percent of the tank's volume.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (c) 4. a. made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; CR 09−017: am. (1) (b) 1., cr. (2) (b) 4. Register July 2009 No. 643, eff. 8−1−09; correction in (1) (d) 4., (2) (b) 1., 4., (3) (c) 2. a., 3. a., 4. b., d. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (d) 4., (2) (b) 1., 4., (3) (c) 2. a., 3. a., 4. b., d. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.530 Tank lining of underground storage tanks. (1) GENERAL. (a) The installation of interior tank lining for underground storage tanks shall comply with API 1631 and this section.

(b) An underground storage tank that does not meet the structural requirements specified in API 1631 may not be upgraded or repaired by lining and shall be permanently closed in accordance with this chapter.

(c) When lining a tank, an access way for an inspector to enter the tank shall be installed from the tank interior to finished grade, if not already provided.

(2) INSPECTION AND REPORTING REQUIREMENTS FOR TANK LINING. (a) *General*. 1. It is the responsibility of the lining contractor to communicate with the authorized agent or the department to establish the time for inspections.

2. The lining contractor shall give the authorized agent or the department at least 5 days written notice before beginning the tank lining or any excavation preliminary to tank lining.

(b) *Plan approval*. The tank owner is responsible for obtaining plan approval from the authorized agent or the department in accordance with s. ATCP 93.100 before beginning the tank lining or any excavation preliminary to tank lining.

(c) *Tank integrity assessment before lining*. 1. The tank−lining contractor shall provide the tank owner and the authorized agent or the department with a written report of the assessment of the interior surface and structural condition of the tank, before leaving the site and before installing the lining.

2. The tank integrity assessment shall include all of the following:

a. A description of the internal wall condition including any deflection and any defects, rust plugs, holes or leaks, regardless of size or number.

b. A description of any repair or other conditioning necessary to prepare the tank for interior lining.

c. A description of the degree of compliance with all requirements under API 1631 regarding structural qualification, tank cleaning and other pre−lining activities.

Note: Section 292.11 of the Statutes requires immediate notification of the Department of Natural Resources in the event of a hazardous substance discharge.

3. If holes or rust plugs are observed during the visual internal inspection, the tank−lining contractor shall notify the owner, before lining the tank, that a tank−system site assessment must be performed, and that assessment shall be performed in accordance with ss. ATCP 93.575 to 93.585.

(d) *Inspection before lining*. 1. The authorized agent or the department shall be at the site before the actual application of the lining.

2. The application of the interior lining may proceed only when authorized by the authorized agent or the department after verifying all of the following:

a. The tank integrity assessment and any required tank−system site assessment have been completed.

b. An approved set of plans is on the site.

c. The condition of the tank has been communicated to the owner.

(e) *Completion of forms*. 1. a. The certified tank system liner shall provide a completed, signed and notarized API 1631 Form B inspection affidavit to the tank owner within 10 business days of completing the lining procedure.

b. The signature on API 1631 Form B shall be that of the certified tank system liner who conducted the pre−lining tank integrity assessment and the lining procedure.

2. An underground tank installation checklist, form ERS−6294 UST, shall be completed and signed by the certified tank system liner and the certified tank system inspector.

Note: Form ERS−6294 UST — Checklist For Underground Tank Installation is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: See chapter SPS 305, Licenses, Certifications and Registrations, for requirements that certified tank system liners supervise specific lining−related activities involving underground storage tanks.

(f) *Submittal of forms*. The tank owner shall have all of the following documents submitted to the department within 15 business days of completing the lining procedure:

1. The pre−lining tank integrity assessment under par. (c).

2. The completed and signed API 1631 Form B under par. (e) 1.

3. The tank installation checklist under par. (e) 2.

4. A revised tank registration, form ERS−7437.

Note: Form ERS−7437 — Underground Flammable/Combustible/Hazardous Liquid Storage Tank Registration is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: cr. (1) (c) Register July 2009 No. 643, eff. 8−1−09; correction in (2) (b), (c) 3. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (b), (c) 3. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.535 Periodic inspection and repair of previously lined tanks. (1) (a) The owner of a lined tank shall obtain an internal inspection of the tank lining within 5 years after the date of initial tank lining, or repair to a previously installed tank lining, and at least every 5 years thereafter. The first inspection shall be conducted within the years specified in Table 93.535.

(b) This section applies whether or not cathodic protection has been added to the tank system.

Table 93.535
Year of Initial Required Lining Inspection

Date of Initial Lining or Repair	First Required 5−Year Inspection
1993–2004	2009
2005 and after	Within 5 years after initial lining or repair

(2) Any complete or partial tank lining conducted anytime after the original tank lining was installed is considered a repair of the lining.

(3) The owner shall notify the authorized agent or the department in writing at least 5 business days before having the inspection performed.

(4) (a) Tank lining inspections shall use one or more of the following methods:

1. Video camera in accordance with KWA.
2. Ultrasound tester.
3. Other method acceptable to the department.

(b) The use of the equipment to perform the inspection under par. (a) 2. and 3. shall be in accordance with national consensus standards.

(5) The person performing the inspection shall be certified by the manufacturer of the inspection equipment and acceptable to the department.

(6) (a) The person performing the inspection shall ascertain that the tank has been adequately emptied and cleaned to allow for a complete inspection of the tank.

(b) The authorized agent or the department may not accept an inspection that does not include all interior portions of the tank.

(7) The person performing the inspection shall provide a report to the owner and to the authorized agent and the department within 15 days of completing the inspection, that describes all of the following items in addition to those required in API 1631:

(a) The type of repairs that have been made.

(b) The total dimension of the area in square inches that has been repaired by lining.

(c) A schematic drawing of the tank showing the area of repairs.

(8) A previously lined tank that is repaired to more than 10 percent of the lined surface may be returned to service only if all of the following conditions are met:

(a) The tank meets the structural requirements for lining when tested in accordance with API 1631 before the lining repair.

(b) The tank has impressed current corrosion protection installed in accordance with s. ATCP 93.520 before being placed back into service.

(9) Prior to placing any tank back into service under this section, both of the following shall occur, in the following order:

(a) An access way for an inspector to enter the tank shall be installed from the tank interior to finished grade, if not already provided.

(b) A precision tightness test shall be performed on the tank system in accordance with s. ATCP 93.515 (4). The tightness test shall test 100 percent of the tank's volume.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: cr. (9) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (a), (8) (b), (9) (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (8) (b), (9) (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.545 Seldom−used and temporarily−out−of−service tanks. (1) OPERATIONAL REQUIREMENTS. When a storage tank system is placed temporarily out of service, the owner or operator shall comply with all of the following:

(a) 1. Operation and maintenance of corrosion protection and leak detection systems shall be continued, except as provided in subd. 2.

2. a. Leak detection shall be maintained in accordance with this chapter unless the tank system is empty.

b. The tank system is empty when all liquid has been removed from the tank and the associated piping so that no more than 1 inch of residue, or 0.3 percent by weight of the total capacity of the tank system, remains in the system.

(b) The tank shall be protected against floatation caused by flooding or soil saturation.

(c) 1. The tank, piping, dispensing equipment, lines, pumps, manways, and other ancillary equipment shall be secured to prevent tampering, except as exempted in subd. 2.

2. Facilities that are in operation and secured against general public access are not required to have the additional security required in subd. 1.

(d) All vent lines shall be left open and functioning.

(e) All periodic inspections and maintenance shall be performed as if the tank were still in service.

(f) Financial responsibility requirements of subch. VII shall be maintained.

(2) PLACING A TANK BACK INTO SERVICE. (a) A precision tightness test shall be performed on the tank and piping in accordance with s. ATCP 93.515 (4) before placing the tank system back into service.

(b) Tank systems out of service for more than 365 days shall have a pressure test of the ullage portion to assure that tank connections are tight and shall fully comply with this chapter before being placed back into service, except double−wall construction is not newly required for tank systems installed before February 1, 2009.

(c) Tank systems covered in par. (a) shall immediately have the leak detection system verified in accordance with s. ATCP 93.510 (2).

(d) Tanks covered in par. (b) shall have all the respective components documented as functional on form ERS−10778.

Note: Form ERS−10778, Underground Tank System Release and Leak Monitoring Functionality Verification, is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(3) NON−COMPLYING TANK SYSTEMS. Tank systems that are placed out of service which do not comply with this section shall be permanently closed in accordance with s. ATCP 93.560 within 60 calendar days.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (1) (a) 2. b., (2) (b), (c), and (3), cr. (2) (d) Register July 2009 No. 643, eff. 8−1−09; correction in (2) (a), (c), (3) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (a), (c), (3) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.550 Change in service to store a non−regulated substance. (1) When a tank system that held a regulated substance undergoes a change in service to store a non−regu-

lated substance, the owner or operator shall comply with all of the following requirements:

(a) At least 5 business days before beginning a change in service, the owner or operator shall notify the authorized agent or the department of the intended change.

(b) Before a change in service, the owner or operator shall have the tank emptied and cleaned, by removing all liquid and accumulated sludge in accordance with the procedures specified in API 2015.

(c) A tank−system integrity assessment, and if necessary, a tank−system site assessment shall be performed for the tank system in accordance with ss. ATCP 93.575 to 93.585 after notifying the authorized agent or the department but before completing the change in service.

(d) Cleaning of tanks and tank−system site assessments shall be performed by persons certified in accordance with ss. SPS 305.82 to 305.89.

(e) The owner shall have a revised tank registration, form ERS−7437, and part A of the department's tank−system service and closure assessment report, form ERS−8951, completed and submitted to the department within 21 business days of changing a tank system to storage of a non−regulated substance.

Note: Forms ERS−7437 − Underground Flammable/Combustible/Hazardous Liquid Storage Tank Registration, and form ERS−8951 – Tank System Service and Closure Assessment Report are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) When a tank system that held a non−regulated substance undergoes a change in service to store a regulated substance, all applicable requirements of this chapter apply upon placing the tank system into service.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (c), (d) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (c), (d) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.560 Tank system closure. (1) NOTIFICATION. At least 5 business days before beginning permanent closure of a tank system, the owner or operator shall notify the authorized agent or the department of the intended closure, on form ERS−9198, except a shorter notification period is permitted where unexpected closure is commenced upon finding adverse conditions during a corrective action conducted under s. ATCP 93.585.

Note: Form ERS−9198 – ATCP 93 Notification Record is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) CLOSURE PROCEDURES. (a) To permanently close an underground tank system, the owner or operator shall have the tank and piping emptied and cleaned, by removing all liquids and accumulated sludge, and shall remove the tank and piping from the site unless allowed otherwise under par. (e). Tanks that are removed shall be scrapped unless reused in accordance with s. ATCP 93.350 (3) (i) or 93.500 (3) (c).

(b) Tank cleaning processes shall comply with the appropriate national standard referenced in s. ATCP 93.200.

(c) Individuals cleaning tanks or removing tanks or portions of tank systems shall be certified in accordance with ss. SPS 305.82 to 305.89.

(d) When an underground tank is closed, or when a previously closed tank is removed under sub. (4), the owner shall have a revised tank registration, form ERS−7437, and part A of the department's tank−system service and closure assessment report, form ERS−8951, completed and submitted to the department within 21 business days of closure or removal.

Note: Form ERS−7437 — Underground Flammable/Combustible/Hazardous Liquid Storage Tank Registration, and form ERS−8951 – Tank System Service and Closure Assessment Report are available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(e) Underground tanks systems may be closed in−place by filling with an inert, solid material, after emptying and cleaning, if the authorized agent or the department determines, upon written request from the owner or operator, that one or more of the following conditions exist:

1. Excavation would impact the structural integrity of an adjacent building or structure.

2. Overhead utilities at a commercial site pose a safety hazard.

3. Excavation would impact adjacent transformers or substations.

4. Unauthorized encroachment would occur onto neighboring property under different ownership.

5. The tank location is inaccessible to necessary equipment.

6. Excavation would result in the destruction of mature trees.

7. Excavation would encroach upon a public way.

8. Excavation would necessitate the disconnection or relocation of underground utilities.

Note: Closing a tank in−place does not exempt the tank from tank−system site assessment requirements.

(3) TANK−SYSTEM SITE ASSESSMENT. A tank−system site assessment shall be performed in accordance with ss. ATCP 93.575 to 93.585 after notifying the authorized agent or the department but before installing a new system or backfilling the tank basin and the piping trenches.

Note: The Department and the Department of Natural Resources share jurisdiction over tank closures and tank−system site assessments. The DNR must be notified if a release is discovered.

(4) APPLICABILITY TO PREVIOUSLY CLOSED SYSTEMS. (a) *General*. When directed by the department, the owner or operator of any tank system closed in−place before December 22, 1988, shall have the system removed in accordance with this section and have the tank basin assessed in conformance with s. ATCP 93.580.

(b) *Systems previously closed without solid, inert fill.* The owner or operator of any tank system that was closed before October 1, 1971, without removing the tank from the site but by filling the tank with water, shall bring the closed system into compliance with sub. (2) within a time period established by the department on a case−by−case basis, except that the tank−system site assessment in s. ATCP 93.580 is not required unless there is a suspected or obvious release. Written documentation shall be provided to prove closure with water before September 1, 1971.

Note: Before September 1, 1971, chapter Ind 8 — Flammable and Combustible Liquids Code allowed UST systems to be filled with water when closed or abandoned in−place.

(c) *Other tanks.* Empty or improperly closed or abandoned tanks that do not meet the requirements of sub. (2) or the exemption under par. (b) shall be permanently closed in accordance with all of the provisions of this section.

(5) ABANDONED TANKS. Tanks that are abandoned with or without product shall be permanently closed within 60 days of being abandoned or discovered.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) (a), (b), (c), (3), (4) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (a) to (c), (3), (4) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.570 Conditions indicating a release. The owner or operator of a storage tank system shall follow the procedures in s. ATCP 93.575 when any of the following conditions exist or when ordered to do so by the department:

(1) OPERATING CONDITIONS. Unusual operating conditions exist, such as erratic behavior of product dispensing equipment, loss of product from the tank system or an unexplained presence of water in the tank.

Note: Significant damage to equipment would be considered to be an unusual operating condition that could result in needing to perform the assessments specified in section ATCP 93.575.

(2) MONITORING RESULTS. Results from a leak detection method indicate that a release may have occurred.

(3) OFFSITE IMPACTS. Offsite impacts appear, such as the presence of contaminated soils or free product, dissolved phase product or vapors in soils, basements, sewer or utility lines or nearby waters of the state.

(4) INVENTORY VERIFICATION. Inventory verification results indicate that a required method of leak detection has failed.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (intro.) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (intro.) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.575 Tank−system integrity assessment. (1) GENERAL. The owner or operator shall assess all suspected or obvious releases in accordance with sub. (2) within 7 business days of discovery of any of the conditions described in s. ATCP 93.570, unless any of the following conditions occur:

(a) System equipment or the monitoring device is found to be defective and is immediately repaired, re−calibrated or replaced, and additional monitoring does not confirm the initial result.

(b) Inventory control is the method of leak detection, as allowed by s. ATCP 93.510 (3) (d), and the data is re−evaluated using an additional 7 days of data, and the re−evaluation does not show a loss.

(2) ASSESSMENT. The owner or operator shall evaluate and confirm all suspected or obvious releases by taking one or all of the following actions and shall also do so in accordance with any corresponding directive of the department:

(a) *Tank−system integrity assessment*. The owner or operator shall have a precision tightness test conducted in accordance with s. ATCP 93.515 (4) to determine whether a leak exists.

(b) *Tank−system site assessment*. The owner or operator shall have the site assessed for the presence of a release in accordance with s. ATCP 93.580.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (intro.) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (intro.), (b), (2) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) (intro.), (b), (2) (a), (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.580 Tank−system site assessment. (1) GENERAL. When a tank−system site assessment is required by this chapter, or when directed by the department, the owner or operator shall have the site evaluated for the presence of a suspected or obvious release in accordance with sub. (3).

Note: An "obvious release" means there is an indication of a release, and there is both environmental evidence, such as soil discoloration, observable free product, or odors — and a known source, such as a tank or piping with cracks, holes or rust plugs, or leaking joints.

A "suspected release" means either of the following: (a) There is an indication that a tank system has leaked — such as inventory losses; observable free product or evidence of free product in secondary containment at dispensers, submersible pumps or spill buckets; petroleum odors; or leak detection alarm system activation — but there is no observable environmental evidence of a release; or (b) There is observable environmental evidence of a release, such as soil discoloration or free product, but the source is unknown.

(2) EXEMPTION FROM ASSESSMENT. A tank−system site assessment is required for the following tank systems or components only if there is a suspected or obvious release:

(a) Tanks which have a capacity of less than 4,000 gallons and which stored heating oil for consumptive use on the premises where stored.

(b) Tanks located at a private residence or on a farm premises, which have a capacity of less than 1,100 gallons, and which stored fuel for dispensing into motorized vehicles.

(c) The closure of double−wall pipe when modification or upgrading is conducted on a system that will remain in operation, unless the piping is to be closed in−place.

(d) Where the entire tank system, including the connections at the tank and dispensers, has been placed in liquid−tight secondary containment for the entire life of the system.

(3) TANK−SYSTEM SITE ASSESSMENT PROCEDURES. (a) *General*. When a tank−system site assessment is required, the owner or operator shall have a certified tank−system site assessor document field observations and sample for the presence of a release wherever contamination is identified or is most likely to be present at the tank site. If the assessor discovers obvious contamination, he or she shall complete the appropriate assessment sampling, such as for the entire system; or for only the tank, or piping, or sumps, or dispensers, and complete the documentation and reporting in its entirety. All sampling, documentation and reporting under this paragraph shall be in a format prescribed by the department.

Note: The sampling documentation and reporting prescribed by the Department is contained in *Assessment and Reporting of Suspected and Obvious Releases From Underground and Aboveground Storage Tank Systems* (Stock number 61D) which is available from Document Sales and Distribution at 4622 University Avenue, Madison, WI 53705−2156; or at telephone (800) 362−7253; or at docsales@doa.state.wi.us; or from the Department's Web site at http://165.189.64.111/Documents/Industry%20Services/ERS/BST/ER−BST−PL−TSSA_Guide.pdf.

Note: The format for the reporting is available at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx..

Note: In section ATCP 93.585, releases are required to be reported to the Department of Natural Resources. Failure to notify the DNR of a release may have serious consequences – such as forfeitures under section 168.26 of the Statutes of $10 to $5000 for each violation. Each day of continued violation is a separate offense, and under section ATCP 93.180, each tank that is in violation is a separate offense.

(b) *Exception*. A person who is not a certified tank−system site assessor may perform assessments if directly supervised by a certified tank−system site assessor who is on the site during the entire assessment.

(c) *Filing*. 1. The documentation required in par. (a) shall be filed with the owner or operator no later than 21 business days after discovery of the conditions that resulted in the assessment.

2. For all tank or piping removals, and for all releases that must be reported to the department of natural resources under s. ATCP 93.585 (2), the documentation required in par. (a) shall also be filed with the department of natural resources no later than 21 business days after the tank removal or the discovery of the release.

Note: Send the documentation that must be filed with the Department of Natural Resources under this section to the Environmental Program Associate in the applicable DNR regional office. A map of those regions and the contact information for the Environmental Program Associates is available through the following DNR Web site: http://dnr.wi.gov/topic/brownfields/contact.html.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (c) 2. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (3) (c) 2. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.585 Responding to a leak, spill, overfill or release. (1) GENERAL. (a) *Leaks*. Immediately upon discovery of any evidence of a leak from a tank system or dispensing system, the owner or operator or any contractor performing work under this chapter shall take all measures necessary to stop the leak and to prevent migration of any free product into the environment.

(b) *Releases*. Immediately upon confirming any suspected release or discovering any obvious release, the owner or operator shall investigate the extent of contamination, and undertake corrective and mitigation actions in accordance with s. 292.11 (3), Stats.

(2) REPORTING A RELEASE. (a) *Reporting to the department of natural resources*. The owner or operator or a person who causes it shall immediately report any release of a regulated substance to the department of natural resources in accordance with s. 292.11 (2), Stats.

Note: Releases that must be reported to the Department of Natural Resources under section 292.11 (2) of the Statutes include the discovery of contaminated soils or free product; dissolved phase product or vapors, in soils, in basements, in sewer or utility lines, or in surface water or groundwater either at the tank site or in the surrounding area; and spills or overfills.

Note: Releases of substances defined in section 101 (14) of CERCLA that are not flammable or combustible liquids must also be reported to the Department of Natural Resources in accordance with chapter 292 of the Statutes.

Note: For more information about reporting releases to the Department of Natural Resources, refer to the DNR Web site at http://dnr.wi.gov/topic/Spills/Report.html. That site includes a notice to use a 24−hour hotline number of 800−943−0003 for reporting spills.

Note: Failure to notify the DNR of a release may have serious consequences — such as forfeitures under section 168.26 of the Statutes of $10 to $5000 for each violation. Each day of continued violation is a separate offense, and under section ATCP 93.180, each tank that is in violation is a separate offense.

Note: Department of Agriculture, Trade and Consumer Protection staff and authorized agents of the Department, such as Local Program Operators, periodically inspect storage facilities for petroleum products and other hazardous substances. These inspectors have authority to report any release encountered during these inspections that has not been reported to the DNR by the owner or operator — and these releases may become the subject of formal enforcement actions.

(b) *Reporting to the owner or operator.* Fuel−delivery persons shall immediately inform the owner or operator of any overfilling or spilling which occurs during the delivery procedure and which may result in or be a release.

(c) *Reporting under CERCLA.* The release of a regulated substance to the environment, that equals or exceeds its reportable quantity under CERCLA shall be reported immediately to the U.S. environmental protection agency.

Note: The CERCLA List of Hazardous Substances and Reportable Quantities is contained in 40 CFR 302.4, Table 302.4.

(3) FIRE HAZARD RESPONSE. The owner or operator shall identify, mitigate and monitor fire and explosion hazards, such as the presence of free product or vapors in structures.

(4) PREVENTION OF FURTHER RELEASE. The owner or operator shall take action to prevent further release of the regulated substance to the environment, including all of the following:

(a) Removing and safely storing as much of the regulated substance from the tank system as necessary to prevent further release to the environment.

(b) Taking steps to prevent migration of the substance, including managing any contaminated soils or water in accordance with ch. 292, Stats.

(5) DEMONSTRATION OF ADEQUATE CORRECTIVE ACTION. (a) No later than 21 business days after reporting a release under this section, the owner or operator shall submit documentation to the department of natural resources demonstrating compliance with subs. (1) (b) and (4), and demonstrating that the corrective and mitigation actions which were taken have accomplished or will accomplish all of the following:

1. Restoration of the environment to the extent practical.

2. Minimization of the harmful effects from the release to the air, lands or waters of Wisconsin.

(b) Any repairs or changes to a tank system that are made because of a release reported under this section shall be reported to the department within 21 business days of completing the repair or change.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

Subchapter VI — Dispensing of Motor Fuels

ATCP 93.600 Applicability. This subchapter applies to all new and existing motor fuel dispensing facilities, except where specified otherwise.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.605 General fuel dispensing requirements. (1) STANDARDS AND INSPECTIONS. (a) *General.* Periodic and annual inspections and maintenance shall be conducted in accordance with PEI RP500 and RP900.

(b) *Electrical continuity.* At least once each calendar year, dispensers for motor fuel that is a Class I liquid shall be tested for electrical continuity in accordance with PEI RP400.

(c) *Records.* Records shall be maintained for underground tanks in accordance with s. ATCP 93.500 (9), and for aboveground tanks in accordance with s. ATCP 93.400 (11).

(d) *Nozzles*. 1. Nozzles used for dispensing motor fuel shall be listed and shall be automatic closing.

Note: Latch−open nozzles may be prohibited in some of the circumstances addressed by this chapter.

2. New and replacement nozzle spouts shall comply with one of the following:

a. Nozzle spouts used for spark−ignition fuels shall have an outside diameter of 0.807 to 0.840 inches.

b. Nozzle spouts used for compression−ignition fuels for passenger cars and light−duty trucks shall have an outside diameter of 0.929 to 0.9375 inches.

c. Nozzle spouts used for compression−ignition fuels for heavy−duty trucks and off−road heavy equipment shall have an outside diameter of either 1.122 to 1.250 inches or 0.929 to 0.9375 inches.

(e) *Hose*. 1. Hose used for dispensing motor fuels shall be listed and labeled.

Note: Per section ATCP 93.650, hose used for fueling aircraft must also meet the requirements of API 1529.

2. Where fueling hose is allowed to be longer than 18 feet, the hose shall be reeled or racked unless approved otherwise by the authorized agent or the department.

3. All fueling hose shall be protected from damage.

4. Hose and fittings used for dispensing motor fuels shall be maintained in a manner where they are not subject to being driven over by vehicle traffic.

5. Hose and fittings used for dispensing of flammable and combustible liquids shall be periodically inspected for wear and stress. Hose or fittings that are suspect or have the appearance of wear shall be immediately replaced.

(f) *Emergency shut−off valve*. 1. All new or replacement dispensing devices for Class I liquids shall be provided with a double−poppet, heat−actuated emergency shut−off valve that will stop the flow of fuel if the dispenser is displaced from its base, or if the fusible link is activated.

2. Anytime an emergency shut−off valve is replaced, the valve shall meet the requirements of subd. 1.

(g) *Water level in tanks.* 1. Tanks used to store motor fuels or kerosene shall have the water level checked and recorded at least once per month.

2. Anytime the water level exceeds 2 inches, the water shall be removed within 5 days.

(2) PORTABLE CONTAINERS. (a) Portable containers for the sale or purchase of a flammable or combustible liquid shall be clearly marked with the name of the product.

(b) Liquids having a flash point of less than 100ºF may not be dispensed into a portable container or portable tank unless all of the following conditions are met:

1. The container or tank is substantially bright red in color.

2. The container or tank has a listing mark from an independent testing agency.

(c) No kerosene, fuel oil or similar liquids having a flash point of 100ºF or more may be filled into any portable container or portable tank that is colored red.

(3) DISPENSING OPERATIONS. (a) All dispensing areas shall be provided with lighting where fueling operations are performed during hours of darkness.

(b) Dispenser displays shall be located to be fully visible to the person fueling the vehicle.

(c) All surface area within a 30 foot radius of the dispenser shall be maintained free of high grass, weeds and debris.

(d) Fuel may not be dispensed using tank pressurization.

(4) DISPENSER LABELING. Dispensers at facilities subject to the requirements of ch. ATCP 94 shall be labeled in accordance with the requirements of that chapter.

(5) ATTENDED AND UNATTENDED FUELING. (a) To be considered as being an attended fueling facility, there shall be at least 1 attendant regularly on duty on a daily basis, but not necessarily during all hours of operation, to supervise, observe and control the actual dispensing of fuel.

(b) All point−of−sale dispensing systems, whether attended or not, shall meet the requirements in NFPA 30A section 9.5 for unattended self−service motor fuel dispensing facilities.

(c) 1. All new fueling facilities that are not attended as specified in par. (a) shall have pipeline catastrophic leak detection, and

sump monitors if so equipped, that will automatically shut down either the submersible pump or the dispenser operation upon detection of a system leak.

2. All existing fueling facilities that are not attended as specified in par. (a) shall have pipeline catastrophic leak detection, and sump monitors if so equipped, that will do either of the following upon detection of a system leak:

a. Automatically shut down either the submersible pump or the dispenser operation.

b. Send an alarm to a facility that is staffed 24 hours a day, 7 days a week.

Note: As an example, paragraph (c) would not apply to a convenience store and retail station that closes each day at 10:00 p.m. and then continues to operate its point−of−sale, card−reader dispensers until the store and station reopen the next day.

(6) OVERFILL PROTECTION. Before delivery of product into a storage tank, the driver, operator or attendant of the tank vehicle shall measure the available capacity of the tank. The available capacity shall be more than the volume of the product to be delivered.

(7) PRODUCT TRANSFERS. Fuel from public access fueling dispensers may only be transferred into integral vehicle and equipment fuel supply tanks, contractor pickup mounted cross−over tanks, and approved portable containers that have a capacity of 10 gallons or less.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: (1) (f) and (g) renum. from Comm 10.615 (5) (a) 1., 2. and (6) (b), cr. (1) (f) (title) and (g) (title) Register July 2009 No. 643, eff. 8−1−09; correction in (1) (c), (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (c), (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.610 Fuel dispensing systems using aboveground mobile tanks. (1) TANK WAGONS. (a) *General*. 1. Tank wagons shall be constructed and used in accordance with this subsection.

2. Existing tank wagons shall be brought into compliance with the requirements in par. (e) within 5 years after February 1, 2009.

Note: In accordance with section ATCP 93.700, tank wagon owners and operators are required to comply with the financial responsibility requirements in subchapter VII.

(b) *Duration of use*. A tank wagon may stay on the customer's premises for a maximum of 24 months.

(c) *Location and type of use*. The use of tank wagons is limited to the fueling of vehicles and equipment in the following operations:

1. Landfill and mine, pit and quarry operations.

2. Highway or runway construction, including associated material processing sites.

3. Construction projects for buildings, structures and utilities.

4. Logging and woodcutting operations.

5. De−watering operations.

6. Farming operations included under the definition of farming.

7. Trail grooming.

8. Fueling of heating or cooling units on semi−trailers.

(d) *Limitations on location and type of use*. 1. Tank wagons may not be used for fueling vehicles unless the vehicles are dedicated to the operation of the specific project or facility.

2. Tank wagons may not be used for general fueling of fleet vehicles or any retail sales.

(e) *Specifications for tank wagons*. Tank wagons shall be constructed in accordance with all of the following:

1. The maximum total capacity of a tank wagon shall be 1,100 gallons.

2. The maximum capacity of a tank or individual compartment used to store Class I liquids shall be 330 gallons.

3. The tank shall be permanently affixed to the chassis.

4. Tanks shall be coated on the exterior to inhibit rust.

5. Tank wall thickness and joint configuration shall be in accordance with UL 142.

6. a. The fill opening for the tank shall be liquid tight, lockable and separate from any other opening.

b. Tanks used to dispense gasoline shall be equipped with a drop tube at the fill opening, that terminates within 6 inches of the tank bottom.

7. Tanks shall be provided with an updraft−type vent affixed to an 18−inch high standpipe, and the vent shall comply with one of the following:

a. For tanks up to 660 gallons — a 2−inch vent.

b. For tanks of 661 to 900 gallons — a 2.5−inch vent.

c. For tanks of 901 to 1,100 gallons — a 3−inch vent.

8. Tanks shall be provided with a liquid−level gauge.

9. a. Tanks that store Class I liquids shall be provided with a permanently mounted, listed pumping device.

b. A pump using a gasoline combustion engine may only be used on tanks containing Class II or III liquids.

10. Tank wagons shall be provided with listed fueling hose that is stored and secured on a hanger or hose reel.

11. The pump shall be equipped with a manufactured anti−siphon device.

12. Where Class I or II liquids are dispensed, means shall be provided to electrically bond the tank to the equipment being fueled.

13. Frames, chassis, tires, and rims shall be constructed and maintained so they are adequate to support the weight of the system and keep it stable.

14. a. The product stored in the tank shall be clearly marked on the tank.

b. Tanks with multiple compartments shall also be marked at the fill point of the tank.

15. Nozzles may not have a latch−open device.

(f) *Operations involving tank wagons*. 1. Tank wagons shall be empty of liquid product while being towed off the premises where used or on any public−access road, lane or highway.

2. Tank wagons shall be protected from public access and public vehicle collision while on the premises where used.

3. Tanks placed within 25 feet of a public roadway shall be protected by collision protection.

4. Tank wagons that contained Class I liquids immediately before transport shall be purged of flammable vapors before transport off of the premises where used.

5. The fueling operator shall remain in attendance at the dispensing nozzle while fuel is flowing.

6. Fuel may not be dispensed using gravity discharge.

7. No more than 1 tank wagon may be towed at one time by a transport vehicle.

8. Support shall be provided for single−axle units to prevent tipping.

9. a. Tank placements shall comply with the setback requirements in s. ATCP 93.630 (2) (a), except as provided in subd. 9. b.

b. Where setbacks required in subd. 9. a. cannot be met, the setbacks from buildings and public ways shall be the maximum allowed by the current conditions at the site, as approved by the authorized agent or the department.

(2) MOVABLE TANKS. (a) *General*. This section applies to temporary uses of aboveground storage tanks constructed in accordance with NFPA 30 section 21.4.2. or a similar standard recognized by the department.

(b) *Duration of use*. A movable tank may be used on the customer's property for a maximum of 24 months.

(c) *Location and type of use*. Movable tanks may be used only for fueling of vehicles and equipment in the following situations:

1. In accordance with sub. (1) (c) 1. to 7.

2. At recycling centers and refuse centers.

3. At power generating stations.

4. For short−term use during fuel storage equipment changeovers.

(d) *Limitations on location and type of use.* Movable tanks may not be used for any retail sales, or for fueling vehicles unless the vehicles are dedicated to the operation of the specific project or facility.

(e) *Specifications for movable tanks.* 1. Movable tanks shall be constructed in accordance with the design standards of NFPA 30 section 21.4.2 or a similar standard recognized by the department.

2. Nozzles may not have a latch−open device.

3. The maximum capacity of a movable tank shall be 1,100 gallons.

4. Movable tanks are not required to be listed.

(f) *Operations involving movable tanks.* 1. a. Tank placements shall comply with the setback requirements in s. ATCP 93.630 (2) (a), except as provided in subd. 1. b.

b. Where setbacks required in subd. 1. a. cannot be met, the setbacks from buildings and public ways shall be the maximum allowed by the current conditions at the site, as approved by the authorized agent or the department.

Note: For farming operations, there are additional setback requirements in section ATCP 93.630.

2. Movable tanks shall be protected from public access and public vehicle collision.

3. Tanks placed within 25 feet of a public roadway shall be protected by collision protection.

4. The fueling operator shall remain in attendance at the dispensing nozzle while fuel is flowing.

(3) TANK VEHICLES. (a) *General.* This section applies to temporary uses of tank vehicles that are constructed in accordance with NFPA 385.

Note: See section ATCP 93.330 (4) for requirements for converting a tank vehicle to a stationary tank.

Note: In accordance with section ATCP 93.700, owners or operators of tank vehicles who conduct fueling in accordance with this section are required to comply with the financial responsibility requirements in subchapter VII.

(b) *Duration of use.* Tank vehicles may remain on the customer's property for a maximum of 5 days unless any of the following conditions apply:

1. The tank vehicle is used to fill aircraft in accordance with s. ATCP 93.650, or aircraft support equipment.

2. Prior to the tank vehicle arriving at the customer's property, the local fire department has approved conditional use for more than 5 days.

3. The tank vehicle is converted to a stationary tank in accordance with s. ATCP 93.330.

Note: Federal Spill Prevention Control and Countermeasure requirements in 40 CFR 112 include provisions for secondary containment for tank vehicles while parked.

(c) *Location and type of use.* Tank vehicles may be used only for transferring fuel into a fixed−tank system, or for fueling of vehicles and equipment in the following situations:

1. With the expressed permission of the local fire department.

2. Fueling of vehicles and equipment on the customer's premises and in connection with the business, for the uses listed in subs. (1) (c) 1. to 7. and (2) (c) 2.

3. Fueling of fleet vehicles or locomotives in accordance with this subsection.

Note: This type of fueling is also known by the term "wet−hose fueling."

4. Fueling of watercraft under emergency conditions in accordance with s. ATCP 93.640 (5) or as allowed under NFPA 30A section 9.6.

Note: NFPA 30A section 11.9 allows fueling of Class II fuels directly from a tank vehicle, for commercial or governmental watercraft used in connection with the business.

5. Fueling of aircraft in accordance with s. ATCP 93.650.

(d) *Specifications for tank vehicles.* 1. Tank vehicles shall be constructed in accordance with NFPA 385.

2. Readily accessible and functional portable fire extinguishers shall be carried on the vehicle as required by NFPA 385.

Note: NFPA 385 requires 1 portable fire extinguisher with a minimum rating of 4A, 40−B:C – or 2 or more extinguishers, each having a minimum rating of 2A, 20−B:C. NFPA 385 and this chapter require portable fire extinguishers to be maintained in accordance with NFPA 10.

3. Tank vehicles shall carry all of the following supplies:

a. A storm drain plug kit.

b. A containment berm with a minimum effective length of 12 feet.

c. Non−water absorbent material capable of absorbing a minimum of 25 gallons of fuel.

(e) *Transfer into tank vehicles.* Fuel may be transferred into a tank vehicle only from a fixed storage tank system, except where this chapter permits otherwise for emergencies.

(f) *Operations involving tank vehicles.* All operations involving tank vehicles shall be in accordance with all of the following requirements:

1. The fueling operation shall take place outdoors, and the point of transfer shall be at least 15 feet from a building.

2. Fuel may not be dispensed using gravity discharge.

3. Expansion space shall be left in each tank to prevent overflow in the event of a rise in temperature.

4. Nighttime deliveries shall be made in well−lighted areas, or a means of lighting shall be provided for the dispensing and delivery area.

5. The tank vehicle shall have its flasher lights in operation during fueling.

6. Fueling operations are prohibited within 25 feet of an ignition source.

7. Dispensing operations may not take place where either the operation or a fuel spill would impede either egress from a building or facility access by emergency response personnel.

8. Fueling operations shall take place in locations that utilize natural features or manmade barriers such that a spill will not flow into a building or into the waters of the state.

9. The company providing the mobile fueling service shall maintain an agreement with a local emergency response provider unless the company is equipped to provide emergency response.

10. The 2 vehicles shall be electrically bonded when dispensing Class I or II liquids.

11. a. Where the fueling operation is accessible to the public, precautions shall be taken, such as the placement of signs, to notify the public that fueling is in process.

b. The signs shall have black letters at least 2 inches high with a minimum stroke width of ½ inch on a yellow background.

c. The signs shall read as follows:

"NO SMOKING
FUELING IN PROGRESS
AUTHORIZED PERSONNEL ONLY"

12. All engines, motors, and electrical equipment not essential to the fueling operation shall be shut down.

13. The fuel delivery nozzle shall be put in contact with the fill pipe before the flow of fuel begins, and this contact shall be continuously maintained until the flow stops.

14. The operator shall remain in attendance at the dispensing nozzle while fuel is flowing.

(4) OTHER MOBILE TANKS. Written approval shall be obtained from the department prior to dispensing fuel from any mobile tank that is not addressed in subs. (1) to (3).

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (f) 9. a., (2) (f) 1. a., (3) (b) 1., 3., (c) 4., 5. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (f) 9. a., (2) (f) 1. a., (3) (b) 1., 3., (c) 4., 5. Register October 2013 No. 694.**

ATCP 93.615 Fuel dispensing systems using aboveground fixed tanks. (1) GENERAL. Aboveground fixed−tank fuel dispensing facilities shall comply with NFPA 30, NFPA 30A, PEI RP200, ss. ATCP 93.445 to 93.470 and this section.

(2) DURATION OF USE. There is no limit on the duration of use for a fixed−tank fuel dispensing facility, provided the system is installed, operated and maintained in compliance with this chapter.

(3) LOCATION AND TYPE OF USE. (a) A fixed−tank fuel dispensing facility may be used for any type of fueling, subject to the requirements of this chapter.

(b) A fixed−tank fuel dispensing facility shall be used for all of the following types of fueling:

1. Public access fueling of trucks and automobiles.

2. General fueling of fleet vehicles, except where a tank vehicle is allowed under s. ATCP 93.610 (3).

3. Fueling from aboveground tanks at a farm premises or a construction project, which have a capacity of 1,100 gallons or more or which do not meet the required setbacks.

4. Fueling from tanks that are used on the same premises for more than 2 years, unless otherwise allowed under this chapter.

5. Aircraft fueling in accordance with the dispensing requirements in s. ATCP 93.650, except where use of tank vehicles is also allowed, in accordance with the requirements for tank vehicles in s. ATCP 93.610 (3).

6. Watercraft, snowmobile and ATV fueling in accordance with the dispensing requirements in s. ATCP 93.640, except as provided in s. ATCP 93.640 (4) and (5) for residential watercraft and emergency fueling.

Note: Section ATCP 93.640 (4) has requirements for residential non−public fueling of watercraft. Section ATCP 93.640 (5) allows watercraft to be fueled from a tank vehicle under emergency conditions.

(4) LIMITATIONS ON LOCATION AND TYPE OF USE. There are no general limitations on location or use for fixed fuel tanks.

(5) SPECIFICATIONS FOR FIXED−TANK FUEL DISPENSING FACILITIES. (a) *Tank listing.* Tanks shall be listed and labeled appropriate to their use.

(b) *Installer certification.* Installation shall be by a certified installer.

(c) *Setbacks for public access fueling.* The setbacks specified in Table 93.615−A for public access fueling shall be maintained at all times.

(d) *Setbacks for other fueling*. 1. The setbacks specified in Table 93.615−B for fleet vehicle fueling shall be maintained at all times.

2. There is no required setback between the dispenser and the tank at a farm premises or construction project, in accordance with s. ATCP 93.630.

(e) *Setback measurement*. 1. The setback distances for vaulted tanks shall be measured from the outer perimeter of the vault.

2. The setback distances for tanks that are placed in diked areas shall be measured from the inner edge of the dike wall.

3. The setback distances for all tanks other than vaulted or diked tanks shall be measured from the outermost surface of the tank.

Table 93.615−A
Setbacks for Aboveground Tanks Used for Public Access Vehicle Fueling

Type of Tank	Individual Tank Capacity (gal)	Setback From Nearest Important Building on Same Property (ft)	Setback From Nearest Retail Dispenser (ft)	Setback From Lot Line That Can be Built Upon, Including the Far Side of a Public Way (ft)	Setback From Near Side of a Public Way (ft)	Minimum Distance Between Tanks (ft)
Vaulted[1]	0−15,000	0	0	0	0	Separate compartment for each tank
Protected[2]	0−6,000	5	0	15	5	3
	6,001−12,000	15	0	25	15	3
Fire−Resistant[3]	0−2,000	25	25	25	25	3
	2,001−12,000	25	25	50	25	3
Other code−complying tank	0−2,000	25	30	50	50	3
	2,001−12,000	50	50	100	50	3

[1]A vaulted tank is one placed in a liquid−tight concrete enclosure consisting of 4 walls, a top and a bottom that completely encloses the tank and provides protection from physical damage and limits heat transfer from a high intensity liquid pool fire.

[2] A protected tank is a listed and labeled system that consists of a primary tank along with integral secondary containment which provides protection from physical damage and limits heat transfer from a high intensity liquid pool fire. Systems listed as complying with UL 2085 or an equivalent standard are considered protected tanks.

[3] A fire−resistant tank is a listed and labeled primary tank with or without integral secondary containment that provides protection from heat transfer from a high intensity liquid pool fire. Systems listed as complying with UL 2080 or an equivalent standard are considered fire−resistant tanks.

Table 93.615−B
Setbacks for Aboveground Tanks Used for Fleet Vehicle Fueling Only

Type of Tank	Individual Tank Capacity (gal)	Setback From Nearest Important Building on Same Property (ft)	Setback From Nearest Dispenser (ft)	Setback From Lot Line That Can be Built Upon, Including the Far Side of a Public Way (ft)	Setback From Near Side of a Public Way (ft)	Minimum Distance Between Tanks (ft)
Vaulted[1]	0−15,000	0	0	0	0	Separate compart−ment for each tank
Protected[2]	0−6,000	5	0	15	5	3
	6,001−12,000	15	0	25	15	3
Fire−Resistant[3]	0−2,000	25	0	25	25	3
	2,001−12,000	25	0	50	25	3
Other code−complying tank	≤12,000 for Class I ≤20,000 for Class II or III	25	0	50	25	3

[1]A vaulted tank is one placed in a liquid−tight concrete enclosure consisting of 4 walls, a top and a bottom that completely encloses the tank and provides protection from physical damage and limits heat transfer from a high intensity liquid pool fire.

[2]A protected tank is a listed and labeled system that consists of a primary tank along with integral secondary containment which provides protection from physical damage and limits heat transfer from a high intensity liquid pool fire. Systems listed as complying with UL 2085 or an equivalent standard are considered protected tanks.

[3]A fire−resistant tank is a listed and labeled primary tank with or without integral secondary containment that provides protection from heat transfer from a high intensity liquid pool fire. Systems listed as complying with UL 2080 or an equivalent standard are considered fire−resistant tanks.

(f) *Secondary containment*. 1. Diking or a similar system shall be used to provide secondary containment for aboveground tanks in accordance with NFPA 30 section 22.11.1 or 22.11.2, and s. ATCP 93.420.

2. a. When any underground piping is installed as part of a new tank system or when 50 percent or more of a run is replaced, the piping shall be provided with approved secondary containment with approved leak detection.

b. The material used for both the primary and secondary containment shall be liquid− and vapor−tight.

(g) *Collision protection.* Aboveground motor fuel tanks shall be protected from vehicle impact in accordance with s. ATCP 93.430.

(h) *Aboveground piping.* 1. Aboveground piping may not rest directly on grade.

2. All aboveground piping shall be of steel and be coated or otherwise protected to inhibit corrosion.

3. Piping shall be supported against impact, vibration, expansion and contraction.

4. Collision protection shall be provided on all sides of aboveground piping not protected by a structure, building or dike wall.

5. Collision protection shall meet the performance requirements in s. ATCP 93.430.

(i) *Underground piping.* Any underground piping shall comply with the leak detection requirements for pressurized piping specified in s. ATCP 93.510 (4).

(j) *Check valves.* A check valve shall be installed in the piping at a point where connection and disconnection is made for tank vehicle unloading. The valve shall be protected from tampering.

(k) *Vents and fill opening.* 1. Fill and vent openings shall be separate.

2. Tanks shall be provided with bottom loading or a fill pipe that terminates within 6 inches of the bottom of the tank.

3. All fill pipes for aboveground fueling tanks shall be locked, and shall be labeled and color coded as specified in s. ATCP 93.230 (12).

(L) *Spill prevention.* Spill and overfill control shall be provided in accordance with s. ATCP 93.410.

(m) *Overfill prevention.* 1. Tanks that are filled via hand−held nozzles shall be constantly attended during product delivery and shall be provided with a vent whistle or with other overfill prevention equipment which provides a visual signal at 90 percent of the tank's capacity.

2. Tanks that are filled by means of a tight connection between the delivery hose and the fill pipe or a similar device acceptable to the department shall be provided with overfill protection equipment which complies with NFPA 30 section 21.7.1.5.

(n) *Leak detection for aboveground tanks.* Leak detection for aboveground tanks shall be provided in accordance with one of the following:

1. Where dikes are provided, a minimum of 2 feet shall be provided between any new tank and the toe of the dike walls, and a minimum of 3 inches shall be provided between the bottom of any new tank and the dike floor, to allow for visual inspection of the exterior tank surface, except as provided in subd. 2. or as otherwise approved by the department.

2. Where double−walled tanks are used or where clearances for visual inspection of the primary containment surface are not provided as specified in subd. 1., interstitial monitoring shall be provided as specified in s. ATCP 93.515 (7).

(o) *Tank enclosures.* Aboveground tanks shall be provided with enclosures in accordance with sub. (7).

(6) OPERATIONS INVOLVING FIXED−TANK FUEL DISPENSING FACILITIES. Operations involving fixed−tank fuel dispensing facilities shall follow the requirements in NFPA 30, NFPA 30A and all of the following:

(a) Fuel may not be dispensed using gravity discharge.

(b) Aboveground tanks may not be used for vehicle fueling at residences, except as allowed in s. ATCP 93.640 (4) for watercraft fueling.

(7) ABOVEGROUND TANK ENCLOSURES. (a) The area around an aboveground motor vehicle fuel tank and its secondary containment shall be secured by a 6−foot high noncombustible building

or by a 6−foot high noncombustible fence with a gate, except where exempted under par. (b) or (c).

(b) If the property on which the tanks are located has a perimeter security fence, additional enclosure of the tank system is not required.

(c) For tanks that have a capacity of 1320 gallons or less, enclosure of the tank and secondary containment by one of the structures listed in par. (a) is not required if all of the following conditions are met:

1. The fill opening of the tank is kept locked.
2. The electrical control panel is secured inside of a building.
3. The dispenser is secured against unauthorized use.
4. The top of the tank is at least 6 feet above grade.
5. Dusk−to−dawn lighting is provided above the tank area.
6. All tank system vents terminate at least 12 feet above grade.

Note: Federal Spill Prevention Control and Countermeasure regulations in 40 CFR 112 may require fencing for tanks with capacities of more than 1320 gallons.

(d) Buildings or fences under this subsection shall be made entirely of noncombustible materials and have a minimum of 1 exit in compliance with chs. SPS 361 to 366.

(e) Buildings or fences may not be supported by the tanks they enclose.

(f) Buildings or fenced enclosures shall not be used for occupancy, storage or any other use unless specifically allowed under chs. SPS 361 to 366.

(g) Fences surrounding tanks shall be of chain−link design or other open fencing approved by the department.

(h) Gates and doors shall be normally locked.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (5) (n) 2. made under s. 13.92 (4) (b) 7., Stats., Register November 2008 No. 635; CR 09−017: am. (1), renum. (5) (a) 1., 2., and (6) (b) to be Comm 10.605 (1) (f) and (g), renum (5) (b) to (p) and (6) (c) to be (5) (a) to (o) and (6) (b), r. (5) (a) (title) and 3. to 6. Register July 2009 No. 643, eff. 8−1−09; correction in (1), (3) (b) 2., 5., 6., (5) (c), (d) 1., 2., (f) 1., (g), (h) 5., (i), (k) 3., (L), (n) 2., (6) (b), (7) (d), (f) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (3) (b) 2., 5., 6., (5) (c), (d) 1., 2., (f) 1., (g), (h) 5., (i), (k) 3., (L), (n) 2., (6) (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.620 Public access motor vehicle fueling operations. (1) GENERAL. (a) Public access fueling operations shall follow the operational requirements of NFPA 30A and this section.

(b) When the product dispensed from a tank system is changed from a Class I liquid to a Class II or III liquid, the department's district petroleum products inspection office shall be notified, and the new product shall be tested and approved before being dispensed.

Note: See the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(2) DISPENSING AREA SAFETY. (a) Equipment or devices not required for, or not integral to the fueling operation, such as vending machines or automated teller machines, may only be installed outside of the fuel dispensing area.

(b) Containers of LP gas and similar fuels may not be located within 20 feet of any motor fuel dispenser.

(c) No Class I liquid, other than fuel being dispensed, may be located within 20 feet of any motor fuel dispenser.

(d) A person shall be at least 14 years old to dispense fuel into the fuel tank of a motor vehicle.

(e) Combustible merchandise placed within 20 feet of a fuel dispenser shall meet all of the following requirements:

1. No combustible merchandise, including pallets and packaging material, may be within 3 feet horizontally of the dispenser cabinet.

2. The height of the merchandise display, including pallets and packaging material, may not exceed 3 feet above grade.

Note: Trash receptacles and window washing containers that are for public use are not considered merchandise under this section. Window washing solution in containers for sale to the public would be considered merchandise under this section.

(f) A means of two−way voice communication between the customer and attendant shall be maintained while the facility is open to the public and an attendant is on duty.

(g) No vehicle may be fueled from an aboveground storage tank while the storage tank is being filled.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09.

ATCP 93.630 Fuel dispensing at farms and construction projects. (1) GENERAL. (a) *Aboveground tanks.* Aboveground storage tank systems for fueling operations at a farm premises or construction project shall comply with the requirements of NFPA 30A chapter 13 and this section.

(b) *Limitations on location and type of use.* The tanks may not be used for fueling vehicles unless the vehicles are dedicated to the operation of the farm premises or construction project.

(c) *Specifications for tanks.* 1. The tanks shall be constructed in accordance with NFPA 30A chapter 13 and this section.

2. Nozzles may not have a latch−open device.

3. There is no minimum required setback between the tank and the dispenser.

(d) *Operations involving tanks.* Operations shall be in accordance with NFPA 30A chapter 13.

(e) *Security.* The tank system shall be equipped so either the hose, hanger or outlet valve can be locked to prevent tampering.

(2) MODIFICATIONS TO SETBACKS IN NFPA 30A SECTION 13.2.3.6. (a) *Farming operations*. For farming operations using a tank without secondary containment, the tank and the fueling operation shall be placed outside of a building and at least 40 feet from the near side of a public way and from a building or structure used for any of the following purposes:

1. Human occupancy.
2. Housing of any livestock.
3. Storage or repair of any motor−driven vehicle or machine.
4. Storage of chemicals, pesticides or other fuels.
5. Storage of hay or similar crops susceptible to spontaneous combustion**,** if stored in a combustible building or structure.

(b) *Other operations.* For all operations within the scope of this section using a tank without secondary containment, other than farming, the tank and the fueling operation shall be placed outside and at least 40 feet from the near side of a public way and from any important building or structure.

(c) *Operations using secondary containment tanks.* All operations within the scope of this section using a tank with secondary containment shall follow the setback requirements in Table 93.630.

(3) TANKS OF LESS THAN 1,100 GALLONS. (a) Aboveground tanks that have a capacity of less than 1,100 gallons shall comply with this subsection before use.

(b) Installation shall be by a certified installer.

(c) The certified installer shall fill out a tank installation notification, form ERS−10764, and provide the form to the authorized agent or the department for inspection of the tank system.

Note: Form ERS−10764 — Farm & Construction AST Installation Notification is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(d) Before a tank may be filled or used, the tank system shall be inspected or authorized for use by the authorized agent or the department, except as allowed otherwise by par. (g).

(e) The owner shall remit the inspection fee under ch. SPS 302 to the authorized agent or the department before filling or using the tank.

(f) The tank shall be inspected within 5 business days after notification for a standard inspection and within 2 business days after notification for a priority inspection, except as provided in par. (g).

(g) The tank may be filled and used if the inspection has not been completed within the time limits after notification specified in par. (f).

(h) Tanks that are filled via hand−held nozzles shall be constantly attended during product delivery and shall be provided with a vent whistle or with other overfill prevention equipment that provides a visual signal at 90 percent of the tank's capacity.

(i) 1. Tanks shall be mounted on noncombustible supports that are adequate to provide stability.

2. The base of the tank supports shall be at the same grade level as the vehicles when positioned for fueling.

3. The bottom of the tank, irrespective of any supports, shall be elevated at least 6 inches above the surrounding grade.

(4) TANKS OF 1,100 GALLONS OR MORE, OR LOCATED LESS THAN 40 FEET FROM BUILDINGS. Aboveground tanks which have a capacity of 1,100 gallons or more, or which are located less than 40 feet from either the buildings and structures listed in sub. (2) (a), or important buildings or structures, shall comply with all of the following:

(a) *Tank listing*. The tank shall be listed and labeled for aboveground use.

(b) *System design and location*. The tank system shall comply with the specifications for dispensing facilities in s. ATCP 93.615 (5), with the following exceptions:

1. The tank system and the fueling operation shall be located in accordance with Table 93.630.

2. Vehicle collision protection may be omitted where a dike meeting the requirements of this chapter is provided for secondary containment.

Table 93.630
Tank System Setbacks for Tanks With Secondary Containment

Aggregate Capacity (gallons)	Distance to Nearest Building, Haystack or Combustible Structure or Nearest Side of Any Public Way	Distance to Property Line That Is or Can Be Built Upon, Including the Opposite Side of a Public Way
275 or less	5 feet	5 feet
276−750	5 feet	10 feet
751−12,000	5 feet	15 feet
12,001−30,000	5 feet	20 feet
Any size	The minimum setback between multiple tank fueling systems is 200 feet.	

(c) *Administrative requirements.* 1. The tank system shall be installed in accordance with the manufacturer's instructions, the applicable national standards adopted in s. ATCP 93.200, plans and specifications approved under s. ATCP 93.100 and this chapter.

2. The tank system installation shall be performed or supervised by a certified installer.

3. The tank system shall be inspected in accordance with s. ATCP 93.115 (2).

4. The tank shall be registered in accordance with s. ATCP 93.140.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) (c), (3) (e), (4) (b) (intro.), 1., (c) 1., 3., 4. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (c), (4) (b) (intro.), 1., (c) 1., 3., 4. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.640 Watercraft, snowmobile and ATV fueling. (1) GENERAL REQUIREMENTS. (a) *General.* Use of aboveground storage tank systems and fueling operations for watercraft, snowmobiles and ATVs shall comply with NFPA 30A chapter 11, the requirements for dispensing systems in s. ATCP 93.615, and the requirements of this section, except as otherwise approved under this chapter.

(b) *Tank location.* 1. Aboveground tanks located on land shall be set back at least 10 feet from the ordinary high water mark of a navigable body of water.

Note: The ordinary high water mark is determined by the county zoning department or the Department of Natural Resources.

Note: The municipality in which the tank is located may have additional requirements for the siting of the tank.

2. Tanks shall follow the setback requirements of Table 93.615−A, except that there is no required separation between the tank and the dispenser if the tank is used exclusively for watercraft, snowmobile or ATV fueling.

(c) *Tank appurtenances*. 1. Any dispenser used for a fueling operation above or within 100 feet of navigable water shall use a dry−break connection or a listed no−drip nozzle with automatic shutoff.

2. A nozzle latch−open device may not be installed or used above or within 100 feet of navigable water.

(d) *Hose*. Hose lengths more than 18 feet long, used for dispensing fuel, shall be reeled, racked or otherwise protected from damage.

(2) PUBLIC ACCESS WATERCRAFT FUELING. (a) *General.* 1. All tanks, and any associated pump that is not integral with the dispensing device, which are used in fueling watercraft shall be located on land or on a pier of solid−fill construction, except as allowed otherwise in subd. 2.

Note: The placement of piers is subject to the requirements of chapter 30 of the Statutes, and may need permits from the Department of Natural Resources or local zoning or building departments.

2. The components listed in subd. 1. may be located on other types of piers if all of the following conditions are met:

a. The plans submitted for review clearly describe the size and type of pier.

b. The tank is a listed and labeled double−wall tank.

c. The primary tank has a capacity of 1,100 gallons or less.

(b) *Piping.* 1. 'General.' Piping that extends from shore onto a pier shall meet the requirements of NFPA 30 chapter 27 and this paragraph.

2. 'Material requirements.' Piping used along a pier shall be one of the following types:

a. Steel piping that is coated to prevent corrosion.

b. Flexible piping that is listed and rated for aboveground marine use.

c. Fiberglass piping placed in steel containment that has standoffs to maintain clearance between the piping and the containment.

3. 'Flex connectors.' a. At least 1 flex connector, listed and labeled for aboveground use, shall be placed between rigid pipe that is connected to the shore and rigid pipe that serves a dispenser located on a pier.

b. An accessible shutoff valve with an expansion relief device shall be located on at least one end of the flex connector, where it connects to the rigid pipe from shore.

(3) SEASONAL INSTALLATION OF A FUELING SYSTEM ON A PIER. (a) *Plan requirements*. Before installing a fueling system on a pier, plans shall be submitted for review and shall specify the requirements of this subsection.

(b) *Pipe and tank requirements.* 1. All connections that are broken shall use dry−break couplings listed for use with petroleum products.

2. Broken connections shall be plugged during storage.

3. The tank vent shall be left open.

(c) *Management plan.* 1. The owner shall develop and maintain onsite, a written plan for safely draining the tank and pipe system before disassembly.

2. For systems first installed on or after February 1, 2009, the disassembly plan shall also be submitted with the plans at the time of review.

(4) RESIDENTIAL WATERCRAFT FUELING OPERATIONS. (a) Aboveground tanks for watercraft fueling for noncommercial purposes at a private residence shall comply with the requirements for aboveground tanks in ss. ATCP 93.400 to 93.420, and this subsection.

(b) No more than 2 tanks are allowed at any residence.

(c) Tanks shall be listed and may not exceed 600 gallons in aggregate capacity.

(d) The tank shall be used only by the residents of the property, for fueling their watercraft or for maintenance of their property.

(e) 1. The tank shall be located outdoors, on land, at least 25 feet from the dwelling and other important buildings, and at least 10 feet from the ordinary high water mark of a navigable waterway, public roadway or property line.

2. All setbacks shall be measured from the inside of the dike wall to the dwelling, important building, ordinary high water mark, public roadway or property line.

(f) A means shall be provided to prevent the discharge of liquid due to a siphoning effect. Gravity dispensing systems may not be used.

(g) Transfer of product shall be from a tank by means of an approved, fixed, fuel dispensing hand pump or a listed, fixed, electrical pump.

(5) EMERGENCY FUELING FROM A TANK VEHICLE. Where fixed dispensing facilities are not available, dispensing of Class I or II liquids directly from a tank vehicle into permanently installed fuel tanks of self−propelled watercraft shall be permitted for emergency fueling, provided the operation is in accordance with the requirements for tank vehicles in s. ATCP 93.610 (3).

(6) SNOWMOBILE AND ATV FUELING. (a) *General.* Tank systems used for fueling snowmobiles or ATVs shall meet the requirements for dispensing systems in s. ATCP 93.615 and this subsection.

(b) *Tank location.* Tank systems adjacent to a body of water shall also meet the requirements for watercraft fueling.

(c) *Collision protection*. 1. Aboveground tank systems used for snowmobile and ATV fueling shall be provided with collision protection.

2. The collision protection shall be spaced no more than 30 inches on center.

3. If the fueling area is adjacent to vehicle traffic or a parking area, bollards or equivalent protection shall be placed to separate the snowmobile or ATV fueling area from motor vehicle traffic.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a), (b) 2., (4) (a), (5), (6) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (4) (a), (5), (6) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.650 Aircraft fuel dispensing. (1) GENERAL REQUIREMENTS. Fueling operations shall follow the requirements in s. ATCP 93.610 (3) or 93.615, NFPA 407, NFPA 418 and this subchapter.

(2) SETBACKS. (a) Aboveground tanks used for public access fueling shall be at least 30 feet from the point of fuel transfer into the aircraft.

(b) Aboveground tank setbacks from buildings, public ways and property lines shall follow the requirements in Table 93.615−B.

(c) 1. The point of fuel transfer into the aircraft, from any tank or truck supply source, shall be at least 100 feet from public traffic or assembly areas at public events, unless a reduced distance is authorized by the fire chief.

2. The public events referred to in subd. 1. do not include passenger terminals, fixed base operators, or persons entering or exiting the aircraft.

(3) COLLISION PROTECTION. (a) Barriers shall be provided to protect tanks, pumps, dispensers and vents from collision damage from aircraft or other vehicles in accordance with s. ATCP 93.430.

(b) Where subject to collision from aircraft, barriers protecting an aboveground tank shall extend at least 12 inches above the top of the tank.

(4) PRODUCT IDENTIFICATION. (a) All fuel handling equipment and installations within the scope of API 1542, whether new or existing, shall be marked as referenced in the standard.

(b) All aboveground tanks and fill pipes for underground tanks, whether new or existing, shall be labeled or otherwise marked using the identification scheme in API 1542.

Note: API 1542 has requirements for identifying aviation gasoline (AVGAS) and turbine fuels and the equipment used to store and dispense them.

(5) FUELING HOSE. (a) All public access, self−service fueling hose that is installed or replaced on or after February 1, 2009, shall be reeled or racked unless approved otherwise by the authorized agent or the department.

(b) All fueling hose shall be protected from damage.

(6) OPERATIONS. (a) *General*. Individuals who dispense fuel into aircraft shall be knowledgeable in operations and emergency procedures specific to the fuel and fueling systems they are operating.

(b) *Amphibious aircraft*. Shoreline fuel dispensing systems for amphibious aircraft shall follow the requirements of s. ATCP 93.640.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) (b), (3) (a), (6) (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (b), (3) (a), (6) (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.660 Racetrack and amusement vehicle fueling operations. (1) Racing vehicles and amusement ride vehicles with integral internal combustion engines shall follow the requirements of this section.

(2) The fuel tanks of racing vehicles shall be filled from safety cans or a fixed fueling system meeting the requirements of s. ATCP 93.615.

(3) During a race in which the vehicle is competing, the vehicle may be refueled with the engine running, if the racetrack is equipped with onsite fire protection that is capable of responding adequately to fires ignited during the fueling.

(4) Fueling areas shall be posted with signs that read as follows:

"NO SMOKING OR OPEN FLAMES"

(5) A portable fire extinguisher with a minimum 40−B:C rating shall be provided at each fueling area, including pit stalls, pit work areas and garages.

(6) Fueling areas that use methanol shall provide a minimum of 10 gallons of water at each fueling area, including pit stalls, pit work areas and garages, for the purpose of diluting a methanol fire.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.680 Alternative motor fuels. (1) APPLICATION. All storage or dispensing systems for fuel consisting of more than 10 percent ethanol by volume shall follow the requirements of this section.

Note: Alternative motor fuels include ethanol blends greater than 10 percent by volume, and biodiesel blends greater than 5 percent by volume.

(2) MATERIAL COMPATIBILITY. Equipment used to store or dispense fuel consisting of more than 10 percent ethanol by volume may not contain or consist of any of the following materials:

(a) *Metals*. Zinc, lead, aluminum or alloys containing these metals, such as brass or terne.

Note: Terne−plated steel and lead−based solder are commonly used in equipment that handles gasoline. These materials will dissolve when in contact with high concentrations of ethanol.

(b) *Natural materials.* Cork, leather or natural rubber.

(c) *Polymers.* Polyurethane, polyvinyl chloride, polyamides, or methyl−methacrylate plastics.

Note: Materials that have been shown to be generally compatible with high concentrations of ethanol include unplated steel, stainless steel, black iron, bronze, Neoprene rubber, Buna−N, polypropylene, nitrile, Viton, Teflon, thermoset reinforced fiberglass and thermoplastic piping material.

(3) GENERAL REQUIREMENTS. (a) *Tank cleaning*. 1. If another type of fuel was stored in the tank, the tank shall be cleaned in accordance with API 2015 or another method approved by the department, before introducing the ethanol−blended fuel.

2. All cleaning work shall be performed by a certified tank cleaner unless specifically approved by the department based on an alternate cleaning method.

Note: Most metal storage tanks and pipe are compatible with ethanol. However, some fiberglass storage tank systems manufactured before 1992 might not be compatible with higher levels of ethanol. The tank manufacturer and installation contractor should be consulted for additional information on the reuse of underground storage tanks.

(b) *Tightness testing*. A precision tightness test shall be performed on the tank and piping in accordance with s. ATCP 93.515 (4) before placing the tank system back into service.

(c) *Equipment requirements*. 1. 'Listed equipment.' Equipment used for dispensing ethanol−blended motor fuel shall be listed or shall be recognized by the manufacturer as being compatible with ethanol−blended fuel, except where otherwise approved in writing by the department.

2. 'Dispenser nozzles and hoses.' Dispensers that are installed on or after February 1, 2009, shall use a separate fueling nozzle and hose for dispensing ethanol−blended motor fuels of more than 10 percent ethanol by volume.

Note: See chapter ATCP 94 for signage requirements for ethanol−blended fuels.

3. 'In−line filters.' A 1− or 2−micron in−line filter shall be used for dispensing ethanol−based fuel.

4. 'Lined tanks.' Tanks with linings regulated under s. ATCP 93.530 may not be used to store ethanol−blended fuels.

(4) NOTIFICATION PROCEDURES. (a) Before commencing normal fueling operations using ethanol−blended fuel, the operator shall notify the department's district petroleum products inspection office.

Note: See the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

(b) A certified installer or professional engineer shall complete part I of the department's alternative fuel installation/conversion application form (ERS−9 Alternative Fuels) and submit it to the department as part of the plan review submittal.

Note: Within a first class city, the provisions in par. (b) may be administered by that city instead of the department, as authorized in sections ATCP 93.020 (8) and 93.110 (3) and (4). As of February 1, 2009, only the City of Milwaukee had become a first class city.

(c) Before commencing normal fueling operations using ethanol−blended fuel, the operator shall complete part II of the department's alternative fuel installation/conversion application form (ERS−9 Alternative Fuels) and provide the completed form to the certified tank system inspector performing the pre−operational inspection.

Note: Form ERS−9 Alternative Fuels — Storage Tank Alternative Fuel Installation/Conversion Application is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: Plan review is required in section ATCP 93.100 for facilities converted to store and dispense ethanol−based fuels.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (3) (b), (c) 4. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (3) (b), (c) 4. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

Subchapter VII — Financial Responsibility

ATCP 93.700 Applicability. (1) This subchapter applies to owners and operators of any of the following storage tank systems, whether new or existing, that are in−use, seldom−used or temporarily−out−of−service:

(a) Petroleum underground storage tank systems.

(b) Petroleum aboveground storage tank systems located on piers that are not of solid−fill construction.

(c) Petroleum aboveground storage tank systems, located on floating structures or watercraft, that are not used exclusively for the propulsion of that floating structure or watercraft.

(d) Tank wagons. Financial responsibility requirements for tank wagons shall begin 1 year after February 1, 2009.

(e) Tank vehicles that perform fueling operations covered in s. ATCP 93.610 (3).

(f) Petroleum aboveground storage tank systems using tanks with individual capacities of 5,000 gallons or more, with single bottoms, that were upgraded with tank lining but not placed in impermeable dike systems.

(g) Petroleum aboveground storage tank systems using tanks with individual capacities of 5,000 gallons or more, with double bottoms, that are not provided with interstitial monitoring and not placed in impermeable dike systems.

(2) This subchapter does not apply to owners and operators of the following storage tank systems:

(a) State and federal government entities whose debts and liabilities are the debts and liabilities of a state or the United States.

(b) Farm and residential underground storage tanks which have a capacity of less than 1,100 gallons and which are used for storing motor fuel for noncommercial purposes.

(c) Storage tanks used for storing heating oil for consumptive use on the premises.

(d) Any portion of an airport hydrant fuel distribution system except for the underground storage tanks included in those systems.

(e) Any tank in sub. (1) (a) that is permanently closed, or registered as temporarily−out−of−service, with an environmental assessment which demonstrates the absence of a release of product from the tank.

(3) If the owner and operator of a petroleum storage tank are separate persons, only 1 person is required to demonstrate financial responsibility; however, both parties are liable in event of noncompliance.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (e) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) (e) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.703 Definitions. In this subchapter:

(1) "Accidental release" means any release of petroleum from a storage tank system that results in a need for compensation for bodily injury or property damage neither expected nor intended by the tank owner or operator or corrective action, or both.

(2) "Affidavit of financial responsibility" means a form, supplied by the department on which the owner and operator attest to compliance with 40 CFR 280.111.

Note: The affidavit of financial responsibility is available from the Bureau of Weights and Measures, PO Box 8911, Madison, WI 53708−8911, or at telephone (608) 224−4942, or from the Bureau's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

Note: The affidavit of financial responsibility is required in addition to the certification showing the specific type of financial responsibility. See section ATCP 93.745 (2) (j) for further information.

(3) "Aggregate" means an accident or a continuous or repeated exposure to conditions that result in a release from a storage tank system which might occur in 1 year.

Note: This definition is intended to assist in the understanding of these regulations and is not intended either to limit the meaning of "aggregate" in a way that conflicts with standard insurance usage or to prevent the use of other standard insurance terms in place of "aggregate."

(4) "Bodily injury" has the meaning given to this term by applicable Wisconsin statutes; however, this term does not include those liabilities that, consistent with standard insurance industry practices, are excluded from coverage in liability insurance policies for bodily injury.

Note: For further information about this term, see chapter Ins 6, which interprets this term as it is used in section 292.63 (1) (ad) of the Statutes, for petroleum storage environmental cleanup.

(5) "Controlling interest" means direct ownership of at least 50 percent of the voting stock of another entity.

(6) "Financial reporting year" means the latest consecutive 12−month period for which any of the following reports are prepared:

(a) A 10−K report submitted to the US securities and exchange commission.

(b) An annual report of tangible net worth submitted to Dun and Bradstreet.

(c) An annual report submitted to the federal energy information administration or rural electrification administration.

Note: "Financial reporting year" may thus comprise a fiscal or a calendar year period.

(7) "Legal defense cost" means any expense that an owner or operator or provider of financial assurance incurs in defending against claims or actions brought by any of the following:

(a) By the US EPA or the department to require corrective action or to recover the costs of corrective action.

(b) By or on behalf of a third party for bodily injury or property damage caused by an accidental release.

(c) By any person to enforce the terms of a financial assurance mechanism.

(8) "Occurrence" means an accident or a continuous or repeated exposure to conditions, that results in a release from a storage tank system.

Note: This definition is intended to assist in the understanding of these regulations and is not intended either to limit the meaning of "occurrence" in a way that conflicts with standard insurance usage or to prevent the use of other standard insurance terms in place of "occurrence."

(9) "Operation" or "in operation" means the underground storage tank was used to store a regulated substance at any time after December 22, 1988, regardless of the current status of the tank.

(10) "Owner or operator," when the owner or operator are separate parties, means the party that is obtaining or has obtained financial assurances.

(11) "Petroleum marketing facilities" means all facilities at which petroleum is produced or refined and all facilities from which petroleum is sold or transferred to other petroleum marketers or to the public.

(12) "Petroleum marketing firms" means all firms owning petroleum marketing facilities. Firms owning other types of facilities with tanks covered in the scope of this subchapter as well as petroleum marketing facilities are considered to be petroleum marketing firms.

(13) "Property damage" has the meaning given to this term by administrative rules of the office of commissioner of insurance. This term does not include those liabilities that, consistent with standard insurance industry practices, are excluded from coverage in liability insurance policies for property damage. However, such exclusions for property damage do not include corrective action associated with releases from tanks that are covered by the policy.

Note: For further information about this term, see chapter Ins 6, which interprets this term as it is used in section 292.63 (1) (ad) of the Statutes, for petroleum storage environmental cleanup.

(14) "Provider of financial assurance" means an entity that provides financial assurance to an owner or operator of a tank system covered in this subchapter through one of the mechanisms listed in ss. ATCP 93.710 to 93.735, including a guarantor, insurer, risk retention group, surety, issuer of a letter of credit, issuer of a state−required mechanism, or a state.

(15) "Substantial business relationship" means the extent of a business relationship necessary under Wisconsin law to make a guarantee contract issued incident to that relationship valid and enforceable. A guarantee contract is issued incident to that relationship if it arises from and depends on current economic transactions between the guarantor and the owner or operator.

(16) "Tangible net worth" means the tangible assets that remain after deducting liabilities; the assets do not include intangibles such as goodwill and rights to patents or royalties. For purposes of this definition, "assets" means all current and all probable future economic benefits obtained or controlled by a particular entity as a result of past transactions.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (14) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (14) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.705 Amount and scope of required financial responsibility. (1) Owners or operators of petroleum storage tank systems within the scope of this subchapter shall demonstrate financial responsibility for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum storage tank systems within the scope of this subchapter in at least the following per−occurrence amounts:

(a) For owners or operators of petroleum underground storage tank systems that are located at petroleum marketing facilities, or that throughput an average of more than 10,000 gallons of petroleum per month based on annual throughput for the previous calendar year; $1 million.

(b) For all other owners or operators of petroleum storage tank systems covered in s. ATCP 93.700 (1); $500,000.

(2) Owners or operators of petroleum underground storage tank systems shall demonstrate financial responsibility for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum underground storage tank systems in at least the following annual aggregate amounts:

(a) For owners or operators of 1 to 100 petroleum underground storage tanks; $1 million.

(b) For owners or operators of 101 or more petroleum underground storage tanks; $2 million.

(c) For the purposes of this subsection, a petroleum underground storage tank means a single containment unit and does not mean combinations of single containment units.

(3) Owners or operators of petroleum aboveground storage tanks covered in this subchapter shall demonstrate financial responsibility for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from their operation in the amount of $1 million per occurrence.

(4) If the owner or operator uses separate mechanisms or separate combinations of mechanisms to demonstrate financial responsibility, the amount shall be in the full amount specified in subs. (1) to (3) for any of the following, except as provided in sub. (5):

(a) Taking corrective action.

(b) Compensating third parties for bodily injury and property damage caused by sudden accidental releases.

(c) Compensating third parties for bodily injury and property damage caused by non−sudden accidental releases.

(5) If an owner or operator uses separate mechanisms or separate combinations of mechanisms to demonstrate financial responsibility for different petroleum storage tank systems, the annual aggregate required shall be based on the number of tanks

covered by each such separate mechanism or combination of mechanisms.

(6) (a) Owners or operators shall review the amount of aggregate assurance provided whenever additional petroleum storage tank systems are acquired or installed.

(b) If the number of petroleum storage tank systems for which assurance is needed exceeds 100, the owner or operator shall demonstrate financial responsibility in the amount of at least $2 million of annual aggregate assurance by the anniversary of the date on which the mechanism demonstrating financial responsibility became effective.

(c) If assurance is being demonstrated by a combination of mechanisms, the owner or operator shall demonstrate financial responsibility in the amount of at least $2 million of annual aggregate assurance by the first−occurring effective date anniversary of any one of the mechanisms combined, other than a financial test or guarantee, to provide assurance.

(7) The amounts of assurance required in this section exclude legal defense costs.

(8) The required per−occurrence and annual aggregate coverage amounts do not in any way limit the liability of the owner or operator.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.707 Allowable mechanisms and combinations of mechanisms. (1) Subject to the limitations of subs. (3) and (4), an owner or operator may use any one or combination of the mechanisms listed in ss. ATCP 93.710 to 93.735 to demonstrate financial responsibility under this subchapter for 1 or more storage tank systems.

(2) Subject to the limitations of subs. (3) and (4), a local government owner or operator may use any one or combination of the mechanisms listed in ss. ATCP 93.727 to 93.735 to demonstrate financial responsibility under this subchapter for 1 or more storage tank systems.

(3) An owner or operator may use a guarantee or surety bond to establish financial responsibility only if "for value received" is included in the guarantee or surety bond mechanisms.

(4) An owner or operator may use self−insurance in combination with a guarantee only if, for the purpose of meeting the requirements of the financial test under this subchapter, the financial statements of the owner or operator are not consolidated with the financial statements of the guarantor.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.710 Financial test of self−insurance. (1) To use the financial test of self−insurance to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator, or guarantor, or both, shall meet the criteria of either sub. (2) or (3) based on year−end financial statements for the latest completed fiscal year.

(2) (a) The owner or operator, or guarantor, or both, shall have a tangible net worth of at least 10 times each one of the following:

1. The total of the applicable aggregate amount required by s. ATCP 93.705, based on the number of storage tank systems for which a financial test is used to demonstrate financial responsibility to the department.

2. The sum of the corrective action cost estimates, the current closure and post−closure care cost estimates, and amount of liability coverage for which a financial test is used to demonstrate financial responsibility to the department.

3. The sum of current plugging and abandonment cost estimates for which a financial test is used to demonstrate financial responsibility to the department.

(b) The owner or operator, or guarantor, or both, shall have a tangible net worth of at least $10 million.

(c) The owner or operator, or guarantor, or both, shall have a letter signed by the chief financial officer as specified in sub. (4).

(d) The owner or operator, or guarantor, or both, shall do one of the following:

1. File financial statements annually with the U.S. securities and exchange commission, energy information administration, or rural electrification administration.

2. Report annually the firm's tangible net worth to Dun and Bradstreet, if Dun and Bradstreet has assigned the firm a financial strength rating of 4A or 5A.

(e) The firm's year−end financial statements, if independently audited, may not include an adverse auditor's opinion, a disclaimer of opinion, or a going concern qualification.

(3) (a) The owner or operator, or guarantor, or both, shall meet the financial test requirements of 40 CFR 264.147(f)(1), substituting the appropriate amounts specified in s. ATCP 93.705 (2) or (3) for the amount of liability coverage each time specified in that section.

(b) The fiscal year−end financial statements of the owner or operator, or guarantor, or both, shall be examined by an independent certified public accountant and be accompanied by the accountant's report of the examination.

(c) The firm's year−end financial statements may not include an adverse auditor's opinion, a disclaimer of opinion, or a going concern qualification.

(d) The owner or operator, or guarantor, or both, shall have a letter signed by the chief financial officer as specified in sub. (4).

(e) If the financial statements of the owner or operator or guarantor, or both, are not submitted annually to the U.S. securities and exchange commission, energy information administration or rural electrification administration, the owner or operator, or guarantor, or both, shall obtain a special report by an independent certified public accountant stating all of the following:

1. The accountant has compared the data that the letter from the chief financial officer specifies as having been derived from the latest year−end financial statements of the owner or operator, or guarantor, or both, with the amounts in such financial statements.

2. In connection with that comparison, no matters came to the attention of the accountant which caused him or her to believe that the specified data should be adjusted.

(4) To demonstrate that the financial test is met under sub. (2) or (3), the chief financial officer of the owner or operator, or guarantor, shall sign, within 120 days of the close of each financial reporting year, as defined by the 12−month period for which financial statements used to support the financial test are prepared, a letter worded exactly as found in 40 CFR 280.95(d) except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks.

2. Certification that wording is identical to the wording required in 40 CFR 280.95(d) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/otgg_final080807.pdf

(5) If an owner or operator using the test to provide financial assurance finds that he or she no longer meets the requirements of the financial test based on the year−end financial statements, the owner or operator shall obtain alternative coverage within 150 days of the end of the year for which financial statements have been prepared.

(6) The department may require reports of financial condition at any time from the owner or operator, or guarantor, or both. If the department finds, on the basis of such reports or other information, that the owner or operator, or guarantor, or both, no longer meet the financial test requirements of either sub. (2) or (3), and sub. (4), the owner or operator shall obtain alternate coverage within 30 days after notification of such a finding.

(7) If the owner or operator fails to obtain alternate assurance within 150 days of finding that he or she no longer meets the requirements of the financial test based on the year−end financial statements, or within 30 days of notification by the department that he or she no longer meets the requirements of the financial test, the owner or operator shall notify the department of such failure within 10 days.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) (a) 1., (3) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (a) 1., (3) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.713 Guarantee. (1) To use a guarantee to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator shall obtain a guarantee that conforms to the requirements of this section. The guarantor shall be a firm that is engaged in a substantial business relationship with the owner or operator and issues the guarantee as an act incident to that business relationship or the guarantor shall be a firm that meets at least one of the following requirements:

(a) The firm possesses a controlling interest in the owner or operator.

(b) The firm possesses a controlling interest in a firm described under par. (a).

(c) The firm is controlled through stock ownership by a common parent firm that possesses a controlling interest in the owner or operator.

(2) (a) Within 120 days of the close of each financial reporting year, the guarantor shall demonstrate that it meets the financial test criteria of s. ATCP 93.710 based on year−end financial statements for the latest completed financial reporting year by completing the letter from the chief financial officer described in s. ATCP 93.710 (4), and the guarantor shall deliver the letter to the owner or operator.

(b) If the guarantor fails to meet the requirements of the financial test at the end of any financial reporting year, within 120 days of the end of that financial reporting year, the guarantor shall send by certified mail, before cancellation or non−renewal of the guarantee, notice to the owner or operator.

(c) If the department notifies the guarantor that he or she no longer meets the requirements of the financial test of s. ATCP 93.710 (2) or (3), the guarantor shall notify the owner or operator within 10 days of receiving such notification from the department.

(d) Under either par. (b) or (c), the guarantee shall terminate no less than 120 days after the date the owner or operator receives the notification, as evidenced by the return receipt.

(e) The owner or operator shall obtain alternative coverage as specified in s. ATCP 93.753.

(3) The guarantee shall be worded exactly as found in 40 CFR 280.96(c), except for the following:

(a) The instructions in brackets in the guarantee shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the guarantee to underground tanks shall be amended to refer to aboveground tanks.

2. Certification that wording is identical to the wording required in 40 CFR 280.96(c) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(4) (a) An owner or operator who uses a guarantee to satisfy the requirements of s. ATCP 93.705 shall establish a standby trust fund when the guarantee is obtained.

(b) Under the terms of the guarantee, all amounts paid by the guarantor under the guarantee shall be deposited directly into the standby trust fund in accordance with instructions from the department under s. ATCP 93.747.

(c) This standby trust fund shall meet the requirements for standby trust funds in s. ATCP 93.725.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (intro.), (2) (a), (c), (e), (4) (a), (b), (c) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (a), (c), (e), (4) (a) to (c) Register October 2013 No. 694.**

ATCP 93.715 Insurance and risk retention group coverage. (1) To use insurance and risk retention group coverage to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator shall obtain liability insurance that conforms to the requirements of this section from a qualified insurer or risk retention group. Such insurance may be in the form of a separate insurance policy or an endorsement to a current insurance policy.

(2) "Termination," as used in the forms required under this section, means only those changes that would result in a gap in coverage as where the insured has not obtained required coverage or has obtained required coverage with a different retroactive date than the retroactive date of the original policy.

(3) Each insurance policy shall be issued by an insurer or a risk retention group that is licensed to transact the business of insurance or eligible to provide insurance as an excess or surplus lines insurer in 1 or more states.

(4) Each insurance policy shall be amended by an endorsement worded as specified in 40 CFR 280.97(b)(1), or evidenced by a certificate of insurance worded as specified in 40 CFR 280.97(b)(2), except for the following:

(a) The instructions in brackets in the endorsement or certificate shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the endorsement or certificate to underground tanks shall be amended to refer to aboveground tanks.

2. Certification that wording is identical to the wording required in 40 CFR 280.97(b)(1) or (2) shall be deleted.

Note: A link to 40 CFR 280 is available by accessing the following Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(5) (a) The owner of the property on which tanks are located has ultimate responsibility under this chapter and shall be listed as a co−beneficiary of any policy issued.

(b) This subsection shall take effect on the first policy renewal date or issuance date following February 1, 2009.

(6) (a) If the insurer or group terminates coverage for any reason, the insurer or group shall notify the department of such termination at the same time the insured is notified.

(b) If the insured allows coverage to lapse or changes insurers or groups, the insured shall notify the department within 10 days.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.717 Surety bond. (1) To use a surety bond to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator shall obtain a surety bond that conforms to the requirements of this section. The surety company issuing the bond shall be listed as an acceptable surety on federal bonds in the latest Circular 570 of the U.S. department of the treasury.

(2) The surety bond shall be worded exactly as found in 40 CFR 280.98(b), except for the following:

(a) The instructions in brackets in the surety bond shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the surety bond to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.98(b) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(3) Under the terms of the bond, the surety shall be liable on the bond obligation when the owner or operator fails to perform as guaranteed by the bond. In all cases, the surety's liability is limited to the per−occurrence and annual aggregate penal sums.

(4) (a) The owner or operator who uses a surety bond to satisfy the requirements of s. ATCP 93.705 shall establish a standby trust fund when the surety bond is acquired.

(b) Under the terms of the bond, all amounts paid by the surety under the bond shall be deposited directly into the standby trust fund in accordance with instructions from the department under s. ATCP 93.747.

(c) This standby trust fund shall meet the requirements for standby trust funds in s. ATCP 93.725.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (4) (a), (b), (c) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (4) (a) to (c) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.720 Letter of credit. (1) To use a letter of credit to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator shall obtain an irrevocable standby letter of credit that conforms to the requirements of this section. The issuing institution shall be authorized to issue letters of credit in each state where the letters are used and the institution's letter−of−credit operations shall be regulated and examined by a federal or state agency.

(2) The letter of credit shall be worded exactly as found in 40 CFR 280.99(b), except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.99(b) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(3) (a) An owner or operator who uses a letter of credit to satisfy the requirements of s. ATCP 93.705 shall also establish a standby trust fund when the letter of credit is acquired.

(b) Under the terms of the letter of credit, all amounts paid pursuant to a draft by the department shall be deposited by the issuing institution directly into the standby trust fund in accordance with instructions from the department under s. ATCP 93.747.

(c) This standby trust fund shall meet the requirements for standby trust funds in s. ATCP 93.725.

(4) (a) The letter of credit shall be irrevocable with a term specified by the issuing institution.

(b) The letter of credit shall provide that credit be automatically renewed for the same term as the original term, unless, at least 120 days before the current expiration date, the issuing institution notifies the owner or operator by certified mail of its decision not to renew the letter of credit.

(c) Under the terms of the letter of credit, the 120 days shall begin on the date the owner or operator receives the notice, as evidenced by the return receipt.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (3) (a), (b), (c) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (3) (a) to (c) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.723 Trust fund. (1) To use a trust fund to meet the financial responsibility requirements of s. ATCP 93.705, an owner or operator shall establish a trust fund that conforms to the requirements of this section. The trustee shall be an entity that has the authority to act as a trustee and whose trust operations are regulated and examined by a federal agency or an agency of the state in which the fund is established.

(2) The wording of the trust agreement shall be identical to the wording specified in 40 CFR 280.103(b)(1), except for the following:

(a) The instructions in brackets in the agreement shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the agreement to underground tanks shall be amended to refer to aboveground tanks.

2. Certification that wording is identical to the wording required in 40 CFR 280.103(b)(1) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(3) The trust agreement shall be accompanied by a formal certification of acknowledgment as specified in 40 CFR 280.103(b)(2).

(4) The trust fund, when established, shall be funded for the full required amount of coverage, or funded for part of the required amount of coverage and used in combination with other mechanisms that provide the remaining required coverage.

(5) If the value of the trust fund is greater than the required amount of coverage, the owner or operator may submit a written request to the department for release of the excess.

(6) If other financial assurance as specified in this subchapter is substituted for all or part of the trust fund, the owner or operator may submit a written request to the department for release of the excess.

(7) Within 60 days after receiving a request from the owner or operator for release of funds as specified in sub. (5) or (6), the department shall instruct the trustee to release to the owner or operator such funds as the department specifies in writing.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.725 Standby trust fund. (1) (a) An owner or operator using any one of the mechanisms authorized by s. ATCP 93.713, 93.717, or 93.720 shall establish a standby trust fund when the mechanism is acquired.

(b) The trustee of the standby trust fund shall be an entity that has the authority to act as a trustee and whose trust operations are regulated and examined by a federal agency or an agency of the state in which the fund is established.

(2) The wording of the standby trust agreement, or trust agreement, shall be identical to the wording specified in 40 CFR 280.103(b)(1), except for the following:

(a) The instructions in brackets in the agreement shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the agreement to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.103(b)(1) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(3) The department shall instruct the trustee to refund the balance of the standby trust fund to the provider of financial assurance if the department determines that no additional corrective action costs or third−party liability claims will occur as a result of a release covered by the financial assurance mechanism for which the standby trust fund was established.

(4) An owner or operator may establish one trust fund as the depository mechanism for all funds assured in compliance with this section.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.727 Local government bond rating test. (1) (a) To use the bond rating test to meet the financial responsibility requirements of s. ATCP 93.705, a general purpose local government owner or operator or local government serving as a guarantor shall have a currently outstanding issue or issues of general obligation bonds of $1 million or more, excluding refunded obligations, with a Moody's rating of Aaa, Aa, A, or Baa, or a Standard & Poor's rating of AAA, AA, A, or BBB.

(b) Where a local government has multiple outstanding issues, or where a local government's bonds are rated by both Moody's and Standard and Poor's, the lowest rating shall be used to determine eligibility.

(c) Bonds that are backed by credit enhancement other than municipal bond insurance may not be considered in determining the amount of applicable bonds outstanding.

(2) (a) A local government owner or operator or local government serving as a guarantor that is not a general purpose local government and does not have the legal authority to issue general obligation bonds may satisfy the requirements of s. ATCP 93.705 by having a currently outstanding issue or issues of revenue bonds of $1 million or more, excluding refunded issues, and by also having a Moody's rating of Aaa, A, A, or Baa, or a Standard & Poor's rating of AAA, AA, A, or BBB as the lowest rating for any rated revenue bond issued by the local government.

(b) Where bonds are rated by both Moody's and Standard & Poor's, the lower rating for each bond shall be used to determine eligibility.

(c) Bonds that are backed by credit enhancement may not be considered in determining the amount of applicable bonds outstanding.

(3) The local government owner or operator or guarantor shall maintain a copy of its bond rating published within the last 12 months by Moody's or Standard & Poor's.

(4) To demonstrate that it meets the local government bond rating test, the chief financial officer of a general purpose local government owner or operator or guarantor shall sign a letter that is identical to the letter specified in 40 CFR 280.104(d), except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.104(d) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(5) To demonstrate that it meets the local government bond rating test, the chief financial officer of a local government owner or operator or guarantor other than a general purpose government shall sign a letter which is identical to the letter specified in 40 CFR 280.104(e), except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.104(e) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(6) The department may require reports of financial condition at any time from the local government owner or operator, or local government guarantor. If the department finds that the local government owner or operator or guarantor no longer meets the local government bond rating test requirements of this section, the local government owner or operator shall obtain alternative coverage within 30 days after notification of such a finding.

(7) If a local government owner or operator using the bond rating test to provide financial assurance finds that it no longer meets the bond rating test requirements, the local government owner or operator shall obtain alternative coverage within 150 days of the change in status.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a), (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.730 Local government financial test. (1) To use a financial test to meet the financial responsibility requirements of s. ATCP 93.705, a local government owner or operator shall pass the financial test specified in this section. To be eligible to use the financial test, the local government owner or operator shall have the ability and authority to assess and levy taxes or to freely establish fees and charges. To pass the local government financial test, the owner or operator shall meet the criteria of this section based on year−end financial statements for the latest completed fiscal year.

(2) The local government owner or operator shall have the following information available, as shown in the year−end financial statements for the latest completed fiscal year:

(a) Total revenues consisting of the sum of general fund operating and non−operating revenues including net local taxes, licenses and permits, fines and forfeitures, revenues from use of money and property, charges for services, investment earnings, sales of assets such as property and publications, restricted and unrestricted intergovernmental revenues, and total revenues from all other governmental funds including enterprise, debt service, capital projects, and special revenues, but excluding revenues to funds held in a trust or agency capacity. For purposes of this test, the calculation of total revenues excludes all transfers between funds under the direct control of the local government using the financial test, liquidation of investments and issuance of debt.

(b) Total expenditures consisting of the sum of general fund operating and non−operating expenditures including public safety, public utilities, transportation, public works, environmental protection, cultural and recreational, community development, revenue sharing, employee benefits and compensation, office management, planning and zoning, capital projects, interest payments on debt, payments for retirement of debt principal, and total expenditures from all other governmental funds including enterprise, debt service, capital projects and special revenues. For purposes of this test, the calculation of total expenditures excludes all transfers between funds under the direct control of the local government using the financial test.

(c) Local revenues consisting of total revenues, as defined in par. (a), minus the sum of all transfers from other governmental entities, including all monies received from federal, state or local government sources.

(d) Debt service consisting of the sum of all interest and principal payments on all long−term credit obligations and all interest−bearing short−term credit obligations. For purposes of this test, debt service includes interest and principal payments on general obligation bonds, revenue bonds, notes, mortgages, judgments and interest bearing warrants. For purposes of this test, debt service excludes payments on non−interest−bearing short−term obligations, interfund obligations, amounts owed in a trust or agency capacity and advances and contingent loans from other governments.

(e) Total funds consisting of the sum of cash and investment securities from all funds, including general, enterprise, debt service, capital projects and special revenue funds, but excluding employee retirement funds, at the end of the local government's financial reporting year. For purposes of this test, the calculation of total funds includes federal securities, federal agency securities, state and local government securities, and other securities such as bonds, notes and mortgages. For purposes of this test, the calculation of total funds excludes agency funds, private trust funds, accounts receivable, value of real property and other non−security assets.

(f) Population consisting of the number of people in the area served by the local government.

(3) The local government's year−end financial statements, if independently audited, may not include an adverse auditor's opinion or a disclaimer of opinion. The local government may not have outstanding issues of general obligation or revenue bonds that are rated as less than investment grade.

(4) To demonstrate that it meets the financial test of this section, the chief financial officer of the local government owner or operator, shall sign, within 120 days of the close of each financial reporting year, as defined by the 12−month period for which financial statements used to support the financial test are prepared, a letter which is identical to the letter specified in 40 CFR 280.105(c), except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks**.**

2. Certification that wording is identical to the wording required in 40 CFR 280.105(c) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(5) If a local government owner or operator using the test to provide financial assurance finds that it no longer meets the requirements of the financial test based on the year−end financial statements, the owner or operator shall obtain alternative coverage within 150 days of the end of the year for which financial statements have been prepared.

(6) The department may require reports of financial condition at any time from the local government owner or operator. If the department finds that the local government owner or operator no longer meets the financial test requirements of this section, the owner or operator shall obtain alternate coverage within 30 days after notification of such a finding.

(7) If the local government owner or operator fails to obtain alternate assurance within 150 days of finding that it no longer meets the requirements of the financial test based on the year−end financial statements or within 30 days of notification by the department that it no longer meets the requirements of the financial test, the owner or operator shall notify the department of such failure within 10 days.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2013 No. 694.**

ATCP 93.733 Local government guarantee. (1) To use a guarantee to meet the financial responsibility requirements of s. ATCP 93.705, a local government owner or operator shall obtain a guarantee that conforms to the requirements of this section. The guarantor shall be either the state in which the local government owner or operator is located or a local government having a substantial governmental relationship with the owner and operator and issuing the guarantee as an act incident to that relationship.

(2) A local government acting as the guarantor shall do one of the following:

(a) Demonstrate that it meets the bond rating test requirement of s. ATCP 93.727 and deliver a copy of the chief financial officer's letter as contained in s. ATCP 93.727 (4) to the local government owner or operator.

(b) Demonstrate that it meets the worksheet test requirements of s. ATCP 93.730 and deliver a copy of the chief financial officer's letter as contained in s. ATCP 93.730 (4) to the local government owner or operator.

(c) Demonstrate that it meets the local government fund requirements of s. ATCP 93.735 (1) and deliver a copy of the chief financial officer's letter as contained in s. ATCP 93.735 (2) to the local government owner or operator.

(3) If the local government guarantor is unable to demonstrate financial assurance under any of s. ATCP 93.727, 93.730 or 93.735 (1) at the end of the financial reporting year, the guarantor shall send by certified mail, before cancellation or non−renewal of the guarantee, notice to the owner or operator. The guarantee shall terminate no less than 120 days after the date the owner or operator receives the notification, as evidenced by the return receipt. The owner or operator shall obtain alternative coverage as specified in s. ATCP 93.753.

(4) (a) The guarantee agreement shall be worded as specified in subs. (5) to (8) of this section, depending on which of the following alternative guarantee arrangements is selected:

1. If, in the default or incapacity of the owner or operator, the guarantor guarantees to fund a standby trust as directed by the department, the guarantee shall be worded as specified in subs. (5) or (6).

2. If, in the default or incapacity of the owner or operator, the guarantor guarantees to make payments as directed by the department for taking corrective action or compensating third parties for bodily injury and property damage, the guarantee shall be worded as specified in subs. (7) or (8).

(b) The local government guarantor shall sign a guarantee that is identical to the guarantee specified in the CFR section referenced in subs. (5) to (8), except for the following:

1. The instructions in brackets in the guarantee shall be replaced by the relevant information and the brackets deleted.

2. If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

a. Reference in the guarantee to underground tanks shall be amended to refer to aboveground tanks**.**

b. Certification that wording is identical to the wording required in 40 CFR 280.106(d) or 40 CFR 280.106(e) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm. There are 2 different documents specified in 40 CFR 280.106.

(5) If the guarantor is a state, the local government guarantee with standby trust shall be identical to the wording found in 40 CFR 280.106(d), except as modified under sub. (4).

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(6) If the guarantor is a local government, the local government guarantee with standby trust shall be identical to the wording found in 40 CFR 280.106(d), except as modified under sub. (4).

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(7) If the guarantor is a state, the local government guarantee without standby trust shall be identical to the wording found in 40 CFR 280.106(e), except as modified under sub. (4).

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

(8) If the guarantor is a local government, the local government guarantee without standby trust shall be identical to the wording found in 40 CFR 280.106(e), except as modified under sub. (4).

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) (a), (b), (c), (3) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (a) to (c), (3) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.735 Local government fund. (1) (a) To use a local government fund to meet the financial responsibility requirements of s. ATCP 93.705, a local government owner or operator shall establish a dedicated fund account that conforms to the requirements of this section. A dedicated fund may not be commingled with other funds or otherwise used in normal operations, except as specified in par. (c). A dedicated fund shall be considered eligible if it meets the requirements in one of pars. (b), (c) or (d).

(b) The fund is dedicated by state constitutional provision, or local government statute, charter, ordinance, or order to pay for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum underground storage tanks and is funded for the full amount of coverage required under s. ATCP 93.705, or funded for part of the required amount of coverage and used in combination with other mechanisms that provide the remaining coverage.

(c) 1. The fund is dedicated by state constitutional provision, or local government statute, charter, ordinance, or order as a contingency fund for general emergencies, including taking corrective action and compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum underground storage tanks, and is funded for 5 times the full amount of coverage required under s. ATCP 93.705, or funded for part of the required amount of coverage and used in combination with other mechanisms that provide the remaining coverage.

2. If the fund is funded for less than 5 times the amount of coverage required under s. ATCP 93.705, the amount of financial responsibility demonstrated by the fund may not exceed one−fifth the amount in the fund.

(d) 1. The fund is dedicated by state constitutional provision, or local government statute, charter, ordinance or order to pay for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum storage tanks.

2. A payment is made to the fund once every year for 7 years until the fund is fully funded. This 7−year period is hereafter referred to as the pay−in period.

3. The amount of each payment shall be determined by the formula (TF − CF)/Y, where TF is the total required financial assurance for the owner or operator, CF is the current amount in the fund, and Y is the number of years remaining in the pay−in period.

4. If the method in this paragraph is chosen, one of the following is also required:

a. The local government owner or operator has available bonding authority, approved through voter referendum if such approval is necessary prior to the issuance of bonds, for an amount equal to the difference between the required amount of coverage and the amount held in the dedicated fund. This bonding authority shall be available for taking corrective action and for compensating third parties for bodily injury and property damage caused by accidental releases arising from the operation of petroleum storage tanks.

b. The local government owner or operator has a letter signed by the appropriate state attorney general stating that the use of the bonding authority will not increase the local government's debt beyond the legal debt ceilings established by Wisconsin statutes. The letter shall also state that prior voter approval is not necessary before use of the bonding authority.

(2) To demonstrate that it meets the requirements of the local government fund, the chief financial officer of the local government owner or operator or guarantor shall sign a letter worded exactly as specified in 40 CFR 280.107(d), except for the following:

(a) The instructions in brackets in the letter shall be replaced by the relevant information and the brackets deleted.

(b) If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

1. Reference in the letter to underground tanks shall be amended to refer to aboveground tanks.

2. Certification that wording is identical to the wording required in 40 CFR 280.107(d) shall be deleted.

Note: A link to 40 CFR 280 is available at the following U.S. EPA Web site: http://www.epa.gov/oust/fedlaws/cfr.htm.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a), (b), (c) 1., 2. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (b), (c) 1., 2. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.737 Substitution of financial assurance mechanisms by owner or operator. (1) An owner or operator may substitute any alternate financial assurance mechanisms as specified in this subchapter, provided that at all times an effective financial assurance mechanism or combination of mechanisms is maintained which satisfies the financial responsibility requirements of s. ATCP 93.705.

(2) After obtaining alternate financial assurance as specified in this subchapter, an owner or operator may cancel a financial assurance mechanism by providing notice to the provider of financial assurance.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.740 Cancellation or nonrenewal by a provider of financial assurance. (1) (a) Except as otherwise provided, a provider of financial assurance may cancel or fail to renew an assurance mechanism by sending a notice of termination by certified mail to the owner or operator.

(b) Termination of a guarantee, a surety bond, or a letter of credit may not occur until 120 days after the date on which the owner or operator receives the notice of termination, as evidenced by the return receipt.

(c) 1. Termination of insurance or risk retention group coverage or state−funded assurance, except for nonpayment or misrepresentation by the insured, may not occur until 60 days after the date on which the owner or operator received notice of termination, as evidenced by the return receipt.

2. Termination for nonpayment of premium or misrepresentation by the insured may not occur until a minimum of 10 days after the date on which the owner or operator receives the notice of termination, as evidenced by the return receipt.

(2) (a) If a provider of financial responsibility cancels or fails to renew for reasons other than incapacity of the provider as specified in s. ATCP 93.753, the owner or operator shall obtain alternate coverage as specified in this subchapter within 60 days after receipt of the notice of termination.

(b) If the owner or operator fails to obtain alternate coverage within 60 days after receipt of the notice of termination, the owner or operator shall notify the department of such failure and submit all of the following to the department:

1. The name and address of the provider of financial assurance.

2. The effective date of termination.

3. The evidence of the financial assistance mechanism subject to the termination maintained in accordance with s. ATCP 93.745 (2).

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; CR 09−017: am. (2) (a) Register July 2009 No. 643, eff. 8−1−09; correction in (2) (a), (b) 3. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (a), (b) 3. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.743 Reporting by owner or operator. (1) GENERAL. The owner or operator of a petroleum storage tank subject to financial responsibility requirements under the scope of this subchapter shall submit a copy of the applicable forms listed in s. ATCP 93.745 (2) documenting current evidence of financial responsibility to the department in accordance with this section.

(2) TIMING. (a) *Underground tanks.* Copies of the applicable forms listed in s. ATCP 93.745 (2) shall be submitted to the department upon annual permit renewal as required in s. ATCP 93.145, along with all of the following:

1. The specific location and designated regulated object number of tanks at each facility covered by the respective mechanism of financial responsibility.

2. If insurance and risk retention under s. ATCP 93.715 is used, the insurance underwriter certificate of insurance, and schedule of covered locations and storage tanks as provided by the insurer, reflecting pollution coverage in the amounts required under s. ATCP 93.705.

(b) *Aboveground tanks*. Copies of the applicable forms listed in s. ATCP 93.745 (2) shall be submitted to the department within 30 days after the owner or operator identifies a release from an aboveground storage tank, that is required to be reported under s. ATCP 93.585.

(c) *All tanks*. If the owner or operator of an underground or aboveground petroleum storage tank fails to obtain alternate coverage as required by this subchapter, copies of the applicable forms listed in s. ATCP 93.745 (2) shall be submitted to the department within 30 days after the owner or operator receives notice of any of the following:

1. Commencement of a proceeding under Title 11, U.S. Code, naming a provider of financial assurance as a debtor.

2. Suspension or revocation of the authority of a provider of financial assurance to issue a financial assurance mechanism.

3. Failure of a guarantor to meet the requirements of the financial test.

4. Other incapacity of a provider of financial assurance.

(3) NEW TANKS. The owner or operator of an underground petroleum storage tank, or an aboveground petroleum storage tank used or intended for use over water, shall certify compliance with the financial responsibility requirements of this subchapter as specified in the new tank registration form when notifying the department of the installation of a new storage tank as required in s. ATCP 93.140.

(4) ADDITIONAL SUBMITTALS. The department may require an owner or operator to submit evidence of financial assurance as described in s. ATCP 93.745 (2) or other information relevant to compliance with this subchapter at any time.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) (a) (intro.), 2., (b), (c) (intro.), (3), (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (a) (intro.) 2., (b), (c) (intro.), (3), (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.745 Record keeping. (1) (a) Owners or operators shall maintain evidence of all financial assurance mechanisms used to demonstrate financial responsibility under this subchapter until released from the requirements of this subchapter under s. ATCP 93.750.

(b) An owner or operator shall maintain such evidence at the storage tank site or the owner's or operator's place of business.

(c) Records maintained off−site shall be made available to the department or authorized agent upon request.

(2) An owner or operator shall maintain the following types of evidence of financial responsibility:

(a) An owner or operator using an assurance mechanism specified in ss. ATCP 93.710 to 93.720, or in ss. ATCP 93.727 to 93.735, or in s. ATCP 93.723 shall maintain a copy of the instrument.

(b) An owner or operator using a financial test or guarantee, or a local government financial test or a local government guarantee supported by the local government financial test shall maintain a copy of the chief financial officer's letter based on year−end financial statements for the most recent completed financial reporting year. Such evidence shall be on file no later than 120 days after the close of the financial reporting year.

(c) An owner or operator using a guarantee, surety bond, or letter of credit shall maintain a copy of the signed standby trust fund agreement and copies of any amendments to the agreement.

(d) A local government owner or operator using a local government guarantee under s. ATCP 93.733 (4) shall maintain a copy of the signed standby trust agreement and copies of any amendments to the agreement.

(e) A local government owner or operator using the local government bond rating test under s. ATCP 93.727 shall maintain a copy of its bond rating published within the last 12 months by Moody's or Standard & Poor's.

(f) A local government owner or operator using the local government guarantee under s. ATCP 93.733 where the guarantor's demonstration of financial responsibility relies on the bond rating test under s. ATCP 93.727 shall maintain a copy of the guarantor's bond rating published within the last 12 months by Moody's or Standard & Poor's.

(g) An owner or operator using an insurance policy or risk retention group coverage shall maintain a copy of the signed insurance policy or risk retention group coverage policy, with the endorsement or certificate of insurance and any amendments to the agreements.

(h) An owner or operator using a local government fund under s. ATCP 93.735 shall maintain all of the following documents:

1. A copy of the state statute or provision or local government ordinance or order that dedicates the fund.

2. a. Year−end financial statements for the most recent completed financial reporting year showing the amount in the fund.

b. If the fund is established using incremental funding backed by bonding authority, financial statements showing the previous year's balance, the amount of funding during the year and the closing balance in the fund.

3. If the fund is established using incremental funding backed by bonding authority, documentation showing the required bonding authority, including either the results of a voter referendum or attestation by the Wisconsin attorney general.

(i) A local government owner or operator using the local government guarantee supported by the local government fund shall maintain a copy of the guarantor's year−end financial statements for the most recent completed financial reporting year showing the amount of the fund.

(j) 1. An owner or operator using an assurance mechanism specified in ss. ATCP 93.710 to 93.735 shall maintain an updated copy of an affidavit of financial responsibility worded exactly as specified in 40 CFR 280.111(b)(11)(i), except as specified in subds. 2. and 3.

2. The instructions in brackets in the affidavit shall be replaced by the relevant information and the brackets deleted.

3. If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, all of the following changes shall be made:

a. Any reference in the affidavit to underground tanks shall be amended to refer to aboveground tanks.

b. Any certification that wording is identical to the wording required in 40 CFR 280.111(b)(11)(i) shall be deleted.

Note: A copy of the affidavit of financial responsibility required in 40 CFR 280.111(b)(11)(i) is available from the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx

4. The owner or operator shall update the affidavit referenced in subd. 1. annually and whenever the financial assurance mechanisms used to demonstrate financial responsibility change or when requested by the department.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (a), (2) (a), (d), (e), (f), (h) (intro.), (j) 1. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (a), (2) (a), (d) to (f), (h) (intro.), (j) 1. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No 694.**

ATCP 93.747 Drawing on financial assurance mechanisms. (1) (a) The department shall require the guarantor, surety, or institution issuing a letter of credit to place the amount of funds stipulated by the department, up to the limit of funds provided by the financial assurance mechanism, into the standby trust if the conditions under either par. (b) or (c) apply.

(b) 1. The owner or operator fails to establish alternate financial assurance within 60 days after receiving notice of cancellation of the guarantee, surety bond, letter of credit, or other financial assurance mechanism.

2. The department determines or suspects that a release from a storage tank covered by the mechanism has occurred and so notifies the owner or operator, or the owner or operator has notified the department of natural resources pursuant to s. ATCP 93.585 of a release from a storage tank covered by the mechanism.

(c) The conditions of sub. (2) (b) or (c) 1. or 2. are satisfied.

(2) (a) The department may draw on a standby trust fund when the conditions under either par. (b) or (c) apply.

(b) The department makes a final determination that a release has occurred and immediate or long−term corrective action for the release is needed, and the owner or operator, after appropriate notice and opportunity to comply, has not conducted corrective action in accordance with ss. ATCP 93.570 to 93.585.

(c) The department has received one of the following:

1. Certification from the owner or operator and the third−party liability claimants and from attorneys representing the owner or operator and the third−party liability claimants that a third−party liability claim should be paid. The certification shall be worded exactly as specified in 40 CFR 280.112(b)(2)(i), except for the following:

a. The instructions in brackets in the certification shall be replaced by the relevant information and the brackets deleted.

b. If financial responsibility for aboveground tanks within the scope of this subchapter is demonstrated using this method, reference in the certification to underground tanks shall be amended to refer to aboveground tanks, and any certification that wording is identical to the wording required in 40 CFR 280.112(b)(2)(i) shall be deleted.

Note: A copy of the affidavit of financial responsibility required in 40 CFR 280.111(b)(2)(i) is available from the Department's Web site at http://datcp.wi.gov/Consumer/Weights_and_Measures/index.aspx.

2. A valid final court order establishing a judgment against the owner or operator for bodily injury or property damage caused by an accidental release from a storage tank covered by financial assurance under this subchapter and the department determines that the owner or operator has not satisfied the judgment.

(3) If the department determines that the amount of corrective−action costs and third−party liability claims eligible for payment under sub. (2) may exceed the balance of the standby trust fund and the obligation of the provider of financial assurance, the first priority for payment shall be corrective action costs necessary to protect human health and the environment. The department shall pay third−party liability claims in the order in which the department receives certifications under sub. (2) (c) 1. and valid court orders under sub. (2) (c) 2.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1) (b) 2., (2) (b) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1) (b) 2., (2) (b) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.750 Release from the requirements. An owner or operator is no longer required to maintain financial responsibility under this subchapter for a storage tank after the tank has been permanently closed or, if corrective action is required, after corrective action has been completed and the tank has been permanently closed in accordance with ss. ATCP 93.560 to 93.585 for underground tanks and ss. ATCP 93.460 to 93.470 for aboveground tanks.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.753 Bankruptcy or other incapacity of owner or operator or provider of financial assurance. (1) Within 10 days after commencement of a proceeding under Title 11, U.S. Code, naming an owner or operator as debtor, the owner or operator shall notify the department by certified mail of such commencement and submit the appropriate forms listed in s. ATCP 93.745 (2) documenting current financial responsibility.

(2) Within 10 days after commencement of a proceeding under Title 11, U.S. Code, naming a guarantor providing financial assurance as debtor, such guarantor shall notify the owner or operator by certified mail of such commencement as required under the terms of the guarantee specified in s. ATCP 93.713.

(3) (a) An owner or operator who obtains financial assurance by a mechanism other than the financial test of self−insurance shall be deemed to be without the required financial assurance in the event of a bankruptcy or incapacity of its provider of financial assurance, or a suspension or revocation of the authority of the provider of financial assurance to issue a guarantee, insurance policy, risk retention group coverage policy, surety bond, letter of credit, or state−required mechanism.

(b) The owner or operator shall obtain alternate financial assurance as specified in this subchapter within 30 days after receiving notice of such an event.

(c) If the owner or operator does not obtain alternate coverage within 30 days after such notification, he or she shall notify the department.

(4) Within 30 days after receipt of notification that the state fund or other state assurance has become incapable of paying for assured corrective action or third−party compensation costs, the owner or operator shall obtain alternate financial assurance.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.755 Replenishment of guarantees, letters of credit, or surety bonds. (1) If at any time after a standby trust is funded upon the instruction of the department with funds drawn from a guarantee, letter of credit, or surety bond, and the

amount in the standby trust is reduced below the full amount of coverage required, the owner or operator shall comply with either sub. (2) or (3) by the anniversary date of the financial mechanism from which the funds were drawn.

(2) The owner or operator shall replenish the value of financial assurance to equal the full amount of coverage required.

(3) The owner or operator shall acquire another financial assurance mechanism for the amount by which funds in the standby trust have been reduced.

(4) For purposes of this section, the full amount of coverage required is the amount of coverage to be provided under s. ATCP 93.705. If a combination of mechanisms was used to provide the assurance funds that were drawn upon, replenishment shall occur by the earliest anniversary date among the mechanisms.

History: CR 07−029: cr. Register November 2008 No. 635, eff. 2−1−09; correction in (4) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (4) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

Subchapter VIII — Training for Operators of Underground Storage Tank Systems

ATCP 93.800 Purpose. The purpose of this subchapter is to implement the operator−training requirements issued by the U.S. environmental protection agency in response to the federal Energy Policy Act of 2005.

Note: The USEPA operator−training requirements, as contained in publication EPA−510−R−07−005, are available through the following Web site: http://www.astswmo.org/Files/Policies_and_Publications/Tanks/2011.06_Operator_Training_Resource_Guide.pdf.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.805 Scope. This subchapter applies to all underground storage tank systems that are required by s. ATCP 93.145 to have a permit to operate from the department.

Note: This subchapter generally does not specify operation or maintenance requirements. For applicable operation or maintenance requirements, refer to previous sections of this chapter, such as section ATCP 93.605 (1) (a), which requires fuel dispensing facilities to have periodic and annual inspections and maintenance in accordance with PEI RP500 and RP900.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.810 Definitions. In this subchapter:

(1) "Class A operator" means an individual who has primary responsibility to operate and maintain an underground storage tank system in accordance with this chapter.

Note: In general, this individual focuses on the broader aspects of the statutory and regulatory requirements and standards necessary to properly operate and maintain an underground storage tank system, such as the requirements in 40 CFR 280 and this chapter.

(2) "Class B operator" means an individual who implements, on−site, the day−to−day aspects of operating, maintaining and recordkeeping for an underground storage tank system.

Note: This individual generally focuses on field implementation of applicable UST requirements and the day−to−day aspects of operating, maintaining, and recordkeeping for USTs at one or more facilities.

(3) "Class C operator" means an individual who has on−site responsibility to respond to emergencies or alarms relating to spills, leaks or releases from an underground storage tank system.

Note: This individual typically is the first line of response to alarms and to events indicating emergency conditions. Not all employees of the facility are necessarily Class C operators.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.820 Designation of Class A, Class B and Class C operators. (1) GENERAL. Beginning no later than January 1, 2012, each new or existing underground storage tank system or group of underground storage tank systems at a facility shall have a Class A operator, a Class B operator and a Class C operator, as designated by the owner or operator, and as accredited in accordance with this subchapter, except as provided in sub. (2).

(2) SMALL BUSINESS EXCEPTION. For any entity demonstrating to the authorized agent or the department that it meets the definition of small business in s. 227.114 (1), Stats., the beginning date for having an accredited Class A, Class B and Class C operator is August 8, 2012.

Note: Section 227.114 (1) of the Statutes reads in part:

"Small business" means a business entity, including its affiliates, which is independently owned and operated and not dominant in its field, and which employs 25 or fewer full−time employees or which has gross annual sales of less than $5,000,000."

Note: This subchapter does not preclude any individual from being designated to more than one of the operator classes, provided the individual complies with the requirements for each designated class.

Note: This subchapter does not preclude any individual from being a designated operator for more than one facility that includes an underground storage tank system.

Note: This subchapter does not preclude an owner or operator from contracting with another party to provide Class A, Class B and Class C operators.

Note: There may be occasions when a Class A, Class B or Class C operator will not be present at a facility. For example, operators are frequently not present at unmanned facilities, such as emergency generators at telecommunication towers, and card lock/card access facilities. However, these operators are still responsible for operation and maintenance activities or responding to emergencies or alarms, and are still subject to the requirements of this subchapter.

(3) If the owner and operator of the tank system are separate persons, either the owner or operator may designate the Class A, Class B and Class C operators at the facility, but both the owner and the operator are under the same responsibility under this section to ensure that Class A, Class B and Class C operators are designated.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.830 Responsibilities of Class A, Class B and Class C operators. (1) CLASS A OPERATORS. Responsibilities of a Class A operator include all of the following:

(a) Managing resources and personnel, such as establishing work assignments, to achieve and maintain compliance with regulatory requirements.

(b) Ensuring that appropriate individuals do all of the following:

1. Properly operate and maintain the underground storage tank system.

2. Maintain appropriate records.

3. Receive training to operate and maintain the underground storage tank system and keep records.

4. Properly respond to emergencies or alarms relating to spills, leaks or releases from the underground storage tank system.

5. Make financial responsibility documents available to the authorized agent or the department as required.

(2) CLASS B OPERATORS. Responsibilities of a Class B operator include ensuring that all of the following occur:

(a) Requirements for leak or release detection methods, recordkeeping and reporting are met.

(b) Requirements for leak or release prevention equipment, recordkeeping and reporting are met.

(c) All relevant equipment complies with performance standards.

(d) Appropriate individuals are trained to properly respond to emergencies or alarms relating to spills, leaks or releases from the underground storage tank system.

(e) All Class C operators are provided with written instructions that include all of the following:

1. Emergency response procedures, including all of the following:

a. Procedures for overfill protection during delivery of regulated substances.

b. Operation of emergency shut−off systems.

c. Appropriate responses to all alarms.

d. Reporting of leaks, spills and releases.

e. Any site−specific emergency procedures.

2. The name and other information needed for contacting appropriate parties if a leak, spill, release or alarm occurs.

(f) 1. A Class C operator is present during all operating hours of the underground storage tank system, except as provided in subd. 2.

2. a. For fueling facilities which are attended as specified in s. ATCP 93.605 (5) (a) and which include hours of operation when no attendant is on duty, a sign shall be posted in a conspicuous place, stating the emergency shut−off procedures and the name, address and telephone number of the Class B operator, along with the name and telephone number of the local emergency responders, including 911 personnel.

Note: Section ATCP 93.605 (5) (a) reads as follows:

To be considered as being an attended fueling facility, there shall be at least 1 attendant regularly on duty on a daily basis, but not necessarily during all hours of operation, to supervise, observe and control the actual dispensing of fuel.

b. For fueling facilities that are not attended as specified in s. ATCP 93.605 (5) (a), signage shall be posted in accordance with the location and information requirements in subd. 2. a.

c. For facilities which are not addressed in subd. 2. a. or b. and which typically are unmanned, such as emergency generators, signage shall be posted in accordance with the location and information requirements in subd. 2. a.

(3) CLASS C OPERATORS. Responsibilities of a Class C operator include all of the following:

(a) Initially responding to alarms, spills, leaks or releases.

(b) Notifying the Class B or Class A operator and appropriate emergency responders, including 911 personnel, when necessary.

(c) Controlling or monitoring the dispensing or sale of regulated substances.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction in (2) (f) 2. a., b. made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (2) (f) 2. a., b. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.840 Training elements for Class A operators. Each Class A operator shall be trained in all of the following:

(1) Basic underground storage tank system requirements, so that he or she can make informed decisions regarding compliance and ensure appropriate individuals are fulfilling operation, maintenance, and recordkeeping requirements and standards of this chapter regarding all of the following:

(a) Spill prevention.

(b) Overfill prevention.

(c) Leak and release detection.

(d) Corrosion protection.

(e) Emergency response.

(f) Product compatibility.

(2) Financial responsibility documentation requirements.

(3) Notification requirements.

(4) Requirements for reporting obvious and suspected releases.

(5) Requirements for permanently closing a tank system and for placing a tank system temporarily out of service.

(6) Operator training requirements.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.841 Training elements for Class B operators. (1) Compared with training for a Class A operator, training for a Class B operator shall provide a more in−depth understanding of operation and maintenance aspects, but may cover a more narrow breadth of applicable regulatory requirements.

(2) Each Class B operator shall receive either of the following:

(a) Site−specific operator training that is focused only on equipment used at the operator's underground storage tank system facility.

(b) Broader training regarding regulatory requirements that encompass all of the following:

1. Components of underground storage tank systems.

2. Materials of underground storage tank system components.

3. Methods of leak and release detection, and leak and release prevention applied to underground storage tank system components.

4. Operation and maintenance requirements of this chapter which apply to underground storage tank systems and which address each of the following:

a. Spill prevention.

b. Overfill prevention.

c. Leak and release detection.

d. Corrosion protection.

e. Emergency response.

f. Product compatibility.

5. Reporting and recordkeeping requirements.

6. Class C operator training requirements.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

ATCP 93.842 Training elements for Class C operators. (1) Each Class C operator shall be trained to take appropriate action in response to both of the following:

(a) Emergencies, including situations which pose an immediate danger or threat to the public or to the environment and which require immediate action.

(b) Alarms caused by spills, leaks or releases from an underground storage tank system.

(2) Each Class C operator shall be trained to understand the instructions specified in s. ATCP 93.830 (2) (e).

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.850 Acceptable training and certification processes. (1) Operator training shall include evaluation and accreditation of the operator's knowledge of the applicable requirements in ss. ATCP 93.840 to 93.842.

(2) Acceptable methods for meeting the requirements in sub. (1) and ss. ATCP 93.840 to 93.842 include all of the following:

(a) *Class A and Class B Operators.* Class A and Class B operators shall obtain either of the following, except as provided in sub. (4):

1. A certificate issued by the International Code Council® showing that the individual has passed the Wisconsin UST operator examination for the class the individual is designated to.

2. a. Written proof of successfully completing an equivalent, alternate operator training program that has received prior written approval from the department.

b. Any alternate program under subd. 2. a. shall include an evaluation and accreditation of operator knowledge through testing, practical demonstration or other tools that the department determines are acceptable.

(b) *Class C Operators.* Class C operators shall obtain a certificate issued by an accredited Class A or Class B operator showing that the Class C operator has successfully completed training conducted or authorized by an accredited Class A or Class B operator for the facility where the Class C operator is employed.

(3) For a Class B training program that focuses on the site−specific training specified in s. ATCP 93.841 (2) (a), the written proof in sub. (2) (a) shall also include identification of the type of tank system addressed in the training.

(4) (a) To address Class A and Class B operators who are responsible for underground storage tank systems in multiple states, the department may accept operator training verification from other states that have equivalent operator training requirements.

(b) Class A and Class B operators who choose to proceed under this subsection shall obtain written proof of their training verification and the department acceptance, as specified in par. (a).

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction in (1), (2) (intro.), (3) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) (intro.), (3) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.860 Documentation deadlines. (1) CLASS A, CLASS B AND CLASS C OPERATORS. All Class A, Class B and Class C operators shall obtain the documentation specified in s. ATCP 93.850 before assuming their responsibilities under this subchapter, except as provided in sub. (2).

(2) EXISTING, COMPLIANT FACILITIES. An incoming Class A or Class B operator for a facility that was complying with section ATCP 93.820 immediately before that personnel change may obtain the documentation specified in s. ATCP 93.850 no later than 30 days after assuming the responsibilities under this subchapter.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.870 Recordkeeping. (1) The owner or operator shall maintain the documentation specified in s. ATCP 93.850 at the underground storage tank system site and have it immediately available for inspection by the authorized agent or the department, except as provided in sub. (2).

(2) For fueling facilities that are not attended as specified in s. ATCP 93.605 (5) (a), and facilities that typically are unmanned, such as emergency generators, the owner or operator shall maintain the documentation specified in s. ATCP 93.850 at a readily available site and provide it for inspection to the authorized agent or the department upon request.

Note: Section ATCP 93.605 (5) (a) reads as follows:

To be considered as being an attended fueling facility, there shall be at least 1 attendant regularly on duty on a daily basis, but not necessarily during all hours of operation, to supervise, observe and control the actual dispensing of fuel.

(3) The documentation referenced in sub. (1) or (2) shall be accompanied with contact information for each designated operator, including a telephone number and mailing address.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09; correction in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; **corrections in (1), (2) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.**

ATCP 93.880 Retraining. (1) (a) If the authorized agent or the department determines that an underground storage tank system is not in significant compliance with this chapter, the Class B operator shall be retrained within either 60 days or another time period prescribed by the department, in the areas that are determined to not be in compliance, except both the Class A and Class B operators shall be retrained if so directed by the department.

(b) Retraining under this section shall be in accordance with a directive by the department.

Note: Significant operational compliance performance measures for release prevention and release detection, as developed by the U.S. environmental protection agency, are available at the following Web site: http://www.epa.gov/oust/cmplastc/soc.htm.

(2) In this section, "significant compliance" means, in addition to release prevention and release detection efforts, that an ample amount of the required activity is performed through a concerted effort aimed at total compliance. A determination of significant compliance is obtained through a common−sense approach to evaluating whether enough effort was made to comply with the applicable requirements. Substantial compliance is not a specific number or percent of compliance.

Note: Section ATCP 93.115 (3) (c) allows shutdown of any underground storage tank system for which there is a continuing violation of the requirements in this chapter.

History: CR 09−017: cr. Register July 2009 No. 643, eff. 8−1−09.

State of Wisconsin

DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES

MEMORANDUM

DATE: 3/23/2016

TO: Jeff Weigand, Michael Berndt, and Kirsten Reader

FROM: Zachary Hetfield

SUBJECT: Exhaust Requirements at West Allis Self Storage

Does the storage of boats in West Allis Self Storage require the installation of a mechanical exhaust system?

Wis. Admin. Code SPS Table 364.0403 (which is the Department's version of 2009 International Mechanical Code (IMC) Table 403.3) lists two occupancy classifications that would potentially apply to the usage that is occurring at West Allis Self Storage; enclosed parking garage or warehouse. An enclosed parking garage occupancy classification would require the installation of a mechanical exhaust system capable of producing a ventilation rate of 0.75 cfm per square foot of floor area, whereas a warehouse occupancy classification would not require this installation. The 2009 International Building Code (IBC), which is a companion code to the IMC, defines enclosed parking garage as a structure used for the parking or storage of private motor vehicles which is not open on two or more sides. IBC §§ 406.3.2 & 406.4.1. There is no direct answer as to whether or not a boat constitutes a motor vehicle as the Department of Safety and Professional Services (Department) does not have a definition, in statute or code, of a motor vehicle. The Wisconsin Statutes do not provide a definitive answer as the various definitions of motor vehicle are not consistent as to whether or not a boat is a motor vehicle.

The Department's code has provisions that apply when a usage does not fit entirely within one of the defined occupancy classes in either the IBC or IMC. The Department has specifically modified IMC § 403.3 to this end. Ventilation rates for occupancies not represented in Wis. Admin. Code SPS Table 364.0403 shall be determined by using the most similar occupancy in the table. Wis. Admin. Code § SPS 364.0403(5)(a)2.d. The storage of a boat is more similar to storage of a vehicle than it is to a general warehouse usage. Additionally, when different rules prescribe a general requirement and the other a more specific requirement, on the same subject, the more specific shall govern. Wis. Admin. Code § SPS 361.03(3)(c). Both of the storage occupancy classifications listed in Wis. Admin. Code SPS Table 364.0403 and IMC Table 403.3 could potentially relate to the storage of boats; however, enclosed parking structure is a more specific designation. The guidelines present in both Wis. Admin. Code §§ 364.0403(5)(a)2.d. and 361.03(3)(c) support requiring boat storage to comply with the exhaust requirements of an enclosed parking garage.

Summary of 2012 and 2015 IECC Changes[a] Significant[b] in Wisconsin[c] and Comparison With Wisconsin's Requirements[d]

IECC / ASHRAE 90.1 Code Sections	Description			Comments
	SPS 363	2012 IECC / 2010 ASHRAE 90.1 Changes	2015 IECC / 2013 ASHRAE 90.1 Changes	
		DIS Recommendations / Editorial Clarifications		
P A R T 1 - I E C C				
C H A P T E R 1 - S C O P E A N D A D M I N I S T R A T I O N				
2012 IECC Table of Contents	SPS 363 numbering is based on the older page numbering of the IECC; *the new chapter designations with the C or R prefix will need to be incorporated into SPS 363 to maintain a connection to the appropriate provisions in the IECC*	The 2012 IECC was completely reorganized and renumbered for an easier and more user friendly format; the code has been broken into two separate parts for Commercial Energy Efficiency and Residential Commercial Efficiency		Residential chapters apply to multi-family dwellings
	Renumber: **SPS 363.001**	SPS 363.0010		
	Renumber: **SPS 363.002**	SPS 363.0020		
	Amend: **SPS 363.002**	**Application. (1)** MIXED OCCUPANCY. Where a building includes both residential and commercial occupancies, each occupancy shall be separately considered and meet the applicable provisions of IECC ~~chapter 4~~ Residential Provisions for residential or IECC ~~chapter 5~~ Commercial Provisions for commercial.		
C101.2 R101.2	SPS 363.0101 states "Except for IECC 101.5.2, the requirements in IECC sections 101 and 103 to 109 are not included as part of this chapter"; additional administrative requirements regarding commissioning occur elsewhere in the 2015 edition of the IECC; *the SPS 363.0101 statement*	Modifies the scope of the code to include the building site and associated systems and equipment; clarifies that the IECC is not limited to a structure shell and its contents		Should the expanded scope of IECC be included in SPS 363.001?

	may need to address these changes			
	Amend: **SPS 363.0100 Note:**	**Note:** The sections in this chapter are generally numbered to correspond to the numbering used in the IECC, with a 0 to the right of the decimal point referring to the Commercial Provisions and a 5 to the right of the decimal point referring to the Residential Provisions of the IECC, i.e., s. SPS 363.0101 refers to section IECC ~~101~~ C101 and s. SPS 363.5101 refers to section IECC R101.		
	Amend: **SPS 363.0101**	~~Except for IECC 101.5.2, the~~ The requirements in IECC sections ~~101 and 103 to 109~~ C101, and C103 to C109 are not included as part of this chapter.		The low-energy building exemption has been moved to C402.1.1 and R402.1, Exception
	Create **SPS 363.5101**	The requirements in IECC sections R101, and R103 to R109 are not included as part of this chapter.		
C101.3 R101.3		Modifies the intent statement from "effective use of energy" to "effective use and conservation over the useful life of each building"	Removes the word "effective" from the intent statement	
CHAPTER 2 - DEFINITIONS				
Section 202 New		Definitions which are new to the 2012 IECC and their applicable sections are: C Building Commissioning C Building Entrance C,R Building Site C Coefficient of Performance (COP) – Cooling C Coefficient of Performance (COP) – Heating C,R Continuous Air Barrier C,R Demand Recirculation Water System C,R [B] Dwelling Unit C Dynamic Glazing C Enclosed Space C Equipment Room C Fenestration Product, Field Fabricated C,R Fenestration Product, Site Built C Furnace Electricity Ratio C General Lighting C Integrated Part Load Value (IPLV)		

		C Nonstandard Part Load Value (NPLV) C On-site Renewable Energy C,R [B] Sleeping Unit C,R Visible Transmittance (VT) R Whole House Mechanical Ventilation System		
Section 202 Modified		Definitions which are modified in the 2012 IECC and their applicable sections are: C,R Residential Building C,R Skylight		
	Amend: **SPS 363.0202 (2)**	SUBSTITUTIONS. Substitute the following definition for the corresponding definition listed in IECC section ~~202~~ C202: "Approved" has the meaning given in s. SPS 362.0202 (2).		
	Create: **SPS 363.5202**	SUBSTITUTIONS. Substitute the following definition for the corresponding definition listed in IECC section R202: "Approved" has the meaning given in s. SPS 362.0202 (2).		
202	Application of "daylight zone"	Add former amendment from 2006 IECC Comm 63.0505(1)(b) Alternative. The daylit (daylight) area (zone) shall be as calculated using a method acceptable to the department". This allows single fixtures whose placement is odd for control situations to be placed with lighting controls more appropriate to its location. Location of single fixtures that may visually not seem appropriate for daylight zone controls, can be more appropriately grouped for control purposes, without the need for petition for variance		Amend 363.0202 Daylight zone adjacent to vertical fenestration, "method acceptable to the department" 3
Section 202 C402.2.2.1		Clarifies that the provisions include multiple definitions of "Above-Grade Wall" for the commercial requirements, the alternate definition in C402.2.2.1 pertains only to walls covered by section C402.2.3		ASHRAE 90.1 uses a third definition for "above grade wall"
CHAPTER 3 - GENERAL REQUIREMENTS				
302	SPS 364.0403(5)(d)2.d.	IECC 302 references 75°F as the indoor design temperature, while SPS 364.0403(5)(d)2.d. references 78°F. Modify WI amendment to compliment wording of the IMC		SPS 364.0403 minimum 75° F cooling 13
	Amend: **SPS 363.0302**	**Exterior design conditions.** These are department rules in addition to the requirements in IECC section ~~302~~ C302: The exterior design temperatures used for heating and cooling load calculations shall be as specified under Table 363.0302.		
	Create: **SPS 363.5302**	**Exterior design conditions.** These are department rules in addition to the requirements in IECC section R302: The exterior design temperatures used for heating and cooling load calculations shall be as specified under Table 363.0302.		
	Amend: **SPS 363.0303**	**Materials, systems and equipment.** These are department rules in addition to the requirements in IECC section ~~303~~ C303.		

	Create: **SPS 363.5303** Copy (1) and (2) from 363.0303	**Materials, systems and equipment.** These are department rules in addition to the requirements in IECC section R303.		
Tables C303.1.3(3), R303.1.3(3)		Adds Visual Transmittance (VT) values to Table 102.1.3(3); VT is the ratio of visible light entering the space through the fenestration product assembly to the incident visible light, it includes the effects of glazing material and frame, and is expressed as a number between 0 and 1; a "0" is opaque, a "1" is totally transparent"		VT is one of the factors used when calculating the performance of "dynamic glazing" in a commercial building for compliance with C402.3.3
PART 2 - IECC - COMMERCIAL ENERGY				
CHAPTER C4 - COMMERCIAL ENERGY EFFICIENCY				
C401.1		Modifies the format to more clearly show the three options for compliance, [1] following ANSI/ASHRAE/IESNA 90.1, [2], a prescriptive path, and [3] a performance path**; the prescriptive path** follows requirements for building envelope in C402, mechanical systems in C403, service water heating in C404, and electrical and lighting in C405, with a requirement for meeting efficiency requirements for either HVAC in C406.2, lighting in C406.3, or on-site renewable energy in C406.4**; the performance path** follows the requirements of C407, along with C402.4, C403.2, C404, C405.2, C405.3, C405.4, C405.6, and C405.7, and must have an energy cost equal to or less than 85 percent of the standard reference building		Numbering of SPS 363 will have to change to adapt to the new format in the IECC For example: Use SPS 363.0405 to modify C405 Use SPS 363.5405 to modify R405
	Renumber and amend **SPS 363.0501**	**SPS 363.0401 General application.** This is a department rule in addition to the requirements in IECC section ~~501.2~~ R401.2: All of the following rules shall apply regardless of whether the IECC chapter ~~5~~ 4 [CE] or ASHRAE 90.1 standard is used to determine compliance: **(1)** Section ~~SPS 363.0503~~ SPS 363.0403 (1) relating to design loads. **(2)** Sections ~~SPS 363.0503~~ SPS 363.0403 ~~(3) and~~ (4) relating to economizers. **(3)** Section ~~SPS 363.0505~~ SPS 363.0405 relating to lighting systems.		

		(4) IECC section ~~505.2.2.1~~ C405.2.2.2 relating to dual switching.		
C401.2.1		Adds a new section with requirements for additions, alterations, and repairs of existing buildings to either follow ANSI/ASHRAE/IESNA 90.1 or the prescriptive requirements of the IECC without the added efficiency requirements of C406		
Section C402		Focuses more on building envelope where the previous commercial section focused more on mechanical, lighting, and service water heating systems; **new sections include:** ▪ roof solar reflectance and thermal emittance ▪ insulation of radiant heating systems ▪ increased vertical fenestration with daylighting controls ▪ increased skylighting with daylighting controls ▪ minimum skylight daylight fenestration area ▪ haze factor ▪ dynamic glazing ▪ air barrier construction ▪ air barrier compliance options ▪ materials ▪ assemblies ▪ building test, air barrier penetrations ▪ building test, air leakage of fenestration **revised sections include:** ▪ specific insulation requirements ▪ opaque thermal envelope requirements ▪ building envelope requirements, fenestration ▪ maximum fenestration area ▪ vestibules ▪ outdoor air intakes and exhausts ▪ recessed lighting		
C402.1.1	SPS 363.002 exempts			

	glazed structures from the requirements of the energy code; similar language is now found in IECC C402.1.1, where greenhouses have been added to the list of building types exempt from the thermal envelope provisions of the IECC; *the SPS 363.002 statement should be reviewed*			
C402.2		Modifies thermal performance values and adds provisions for the installation of continuous insulation		(prescriptive)
C402.2.1.1		Adds a new section that addresses the amount of solar heat reflected and radiated from low sloped roofs in Climate Zones 1, 2, and 3		NA
C402.2.6		Modifies requirements for slabs on grade by adding a new minimum prescriptive protection requirement for insulation extending away from the building, and by adding a new exception for perimeter insulation with slab on grade floors greater than 24 inches below the finished exterior grade		
C402.2.8		Adds a requirement for insulation of all radiant heated floor slabs and radiant panels designed for sensible heating of internal space		
C402.3		Modifies the building envelope requirements: fenestration table C402.3 with a major overhaul and supplements it with a table for SHGC adjustment multipliers, C405.2.2.3.2		(prescriptive)
C402.3.1		Modifies the baseline maximum for vertical fenestration from 40 percent to 30 percent, but up to 10 percent can be added with the use of automatic daylighting controls; the baseline maximum of 3 percent for skylights can be		Skylights are now required over certain large spaces for specific uses, but Climate Zones 6-8 are exempt

		increased to 5 percent with daylighting controls; and skylights are now required over large spaces exceeding 10,000 square feet with certain uses, but Climate Zones 6-8 are exempt from this requirement		
C402.3.3		Modifies the method of determining the maximum U-factor and solar heat gain coefficient (SHGC) by no longer allowing for an area-weighted projection factor; each area with a different projection factor will be required to be evaluated separately		
C402.3.3.1-4		Modifies provisions by providing additional variables to allow increased design flexibility for adjusting the SHGC		
C402.4.1		Adds requirements for air-barriers with new prescriptive and/or measurable mandatory requirements		
C402.4.7		Modifies vestibule requirements by requiring vestibules for doors adjacent to revolving doors, and by exempting doors used only by employees from needing a vestibule		
	Renumber and amend: **SPS 363.0503**	**SPS 363.0403 Building mechanical systems.** **(1)** CALCULATION OF HEATING AND COOLING LOADS. The following wording is a department requirement in addition to the requirements in IECC section ~~503.2.1~~ C403.2.1: Design heating and cooling loads shall be determined in accordance with s. SPS 363.0302 and Table 363.0302. **(2)** EQUIPMENT AND SYSTEM SIZING. Substitute the following wording for the requirements and the exceptions in IECC section ~~503.2.2~~ C403.2.2: Heating and cooling equipment and systems shall be sized to provide the minimum space and system loads calculated in accordance with s. SPS 363.0302. **(3)** HVAC SYSTEM COMPLETION. The requirements in IECC sections ~~503.2.9~~ C403.2.11 is not included as part of this chapter. **(4)** ECONOMIZERS ~~SIMPLE HVAC SYSTEMS~~. Substitute the following wording for the requirements in IECC section ~~503.3.1 the first paragraph~~ C403.3 and Table ~~503.3.1 (1)~~ C403.3.3(1): Supply air economizers shall be provided on the following cooling systems: (a) Package roof top units > 33,000 Btu/h. (b) All other cooling systems > 54,000 Btu/h. ~~**(5)** ECONOMIZERS COMPLEX HVAC SYSTEMS. Substitute the following wording for the requirements, but not the exceptions, in IECC section 503.4.1: Supply air economizers shall be provided on cooling systems as described under sub. (4). Economizers shall be capable of~~		

		~~operating at 100 percent outside air, even if additional mechanical cooling is required to meet the cooling load of the building.~~ ~~(6)~~ **(5)** CLIMATE ZONES ~~3 AND 4~~ 5 THROUGH 8. Substitute the following wording for the requirements in IECC section ~~503.4.3.3.2.2~~ C403.4.2.3.2.2: For climate Zones 5 through 8 as indicated in Figure ~~301.1~~ C301.1 and Table ~~301.1~~ C301.1, if an open−circuit cooling tower is used, then a separate heat exchanger shall be required to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.		
C403.2.2		Limits sizing of equipment Request committee to review since past advice & practice via previous committees was to allow oversizing to address pick-up loads in factories, warehouses, offices, etc. Review language and acceptable options		97
C403.2.3 C403.2.3.2 Tables C403.2.3 (1-9)		Modifies the equipment performance requirements; adds a new column "Heating Section Type" which differentiates electric resistance equipment from other types; additional equipment types (through-the-wall, air-cooled) have been added; new tables have been added for heat rejection and heat transfer equipment; SEER requirements have been improved; and some equipment efficiencies have improved		
C403.2.4.3.3		Adds a requirement for all HVAC systems to be capable of automatically adjusting the daily start time in order to bring the space that is controlled up to temperature immediately prior to scheduled occupancy		
C403.2.5.1		Modifies the threshold for Demand Control Ventilation (DCV) from average occupant load of 40 people/1,000 square feet to 25 people/1,000 square feet; adds an exception for process loads		
C403.2.6		Modifies energy recovery ventilation system requirements by adding a new table which replaces a single fixed trigger point of 5,000 cfm and 70 percent outdoor air, and provides a comprehensive and scalable energy recovery requirement based on the climate zone and percentage of outdoor air at full design flow		

		rate		
C403.2.8		Modifies piping insulation by expanding and clarifying exceptions for smaller strainers, control valves and balancing valves, as well as direct buried piping that conveys fluids at or below 60 degrees Fahrenheit; provides a scalable table which bases insulation thickness on fluid operating temperature range and insulation conductivity		
C403.2.8.1		Adds a requirement for protecting insulation exposed to the elements, but prohibits the utilization of adhesive tape as the protective measure		
C403.2.11	SPS 363.0503 removes IECC 503.2.9 (2009) and its subsections from the code; the IECC commissioning and completion requirements are much stricter now; in the 2015 edition of the IECC, this is now section C403.2.11 and references section C408, which deals with commissioning; *the SPS 361 regulations regarding completion may need to be revised in order to address the commissioning aspects of the current code*			
C403.3.1, Table C403.3.1 (1)	The IECC 2009 requirements for economizers were made more strict by SPS 363.0503; they were made stricter yet in IECC 2012 and in 2015	Modifies the provisions regarding economizers, making requirements more comprehensive than previous editions of the IECC		

	the IECC continued this trend; *SPS 363.0503 (4) and (5) should be revisited in light of these modifications*			
C403.3.1 (2015) C503.3.1 (2009)	SPS 363.0503 (4)	Challenges by designers have pointed out that a zone (see Definition in IMC 202) within an enclosed area could be treated differently when attempting to apply this section Add language that defines a zone as an enclosed room or space, or that the application of this section is specific to the enclosed area via walls, ceilings, windows, doors, skylights, etc. served by the cooling system(s).		Clarify definition of Zone as related to economizer requirements 52
C403.4.1.3, C403.4.1.4		Adds a requirement for economizers to be integrated with the associated mechanical cooling system, operate even when additional cooling is required, and provide no-to-minimal impact on the heating system		
C403.4.2		Modifies variable air volume (VAV) controls by reducing minimum motor sizes and allowing vane axial fans with variable pitch blades; and specifies the location(s) for static pressure sensors		
C403.4.3.2.2	SPS 363.0503 (6) removes closed-circuit cooling towers from this requirement; this paragraph is now found at C403.4.2.3.2.2			
C404	SPS 363.0504 removes sections of the IECC 2009 related to service water heating dealing with temperature controls, heat traps, and pool covers; the latter two may still be appropriate, but the referenced section on temperature controls is not in the 2015 IECC			
	Renumber and amend	~~SPS 363.0504~~ **SPS 363.0404 Service water heating. ~~(1) TEMPERATURE CONTROLS. The~~**		

	SPS 363.0504	~~requirements in IECC section 504.3 are not included as part of this chapter.~~ ~~(2)~~ **(1)** HEAT TRAPS. The requirements in IECC section ~~504.4~~ C404.3 are not included as part of this chapter. ~~(3)~~ **(2)** POOL COVERS. The requirements in IECC section ~~504.7.3~~ C404.9.3 are not included as part of this chapter.		
	Create **363.0504 (3)**	**SPS 363.0504 (3)** COMMISSIONING. The requirements in IECC section C404.11 are not included as part of this chapter.		?
C404.5		Modifies pipe insulation requirements for automatic circulating hot water and heat traced systems by addressing heat traced systems as an individual item and clarifying insulation requirements for non-circulating systems; modifies the control section to clarify that manually controlled circulating systems are required to stop pumping when there is limited hot water demand		
C404.7		Modifies requirements for pools by excluding temporary and above ground spas from the scope of the regulations, raising the benchmark percentage for site recovered energy, and setting the criteria for energy use calculations**;** revises the section title to include in-ground permanently installed spas		
C404.9 (2015) 504.7.2 (2009)		This section requires that time switches be installed in pools. Rules issued by DHS mandate that pump operation occur continuously, 24 hrs/day, 365 days per year.		Amend this section such that the requirements is eliminated 85
C405.1		Modifies from 50 percent to 75 percent the amount of line voltage fixtures required to have high efficacy bulbs		(mandatory)
C405.2.1.2		Modifies lighting reduction controls by limiting the size of exempted single luminaires and by exempting electrical and mechanical rooms		
C405.2.2		Deletes the section on automatic lighting shutoff and adds this section on additional lighting controls which includes automatic daylighting controls**;** and provides exceptions for sleeping rooms, spaces for patient care, spaces where automatic shutoff would		

		endanger safety or security, and lighting intended for continuous operation		
C405.2.2.1		Modifies requirements for automatic controls by eliminating the 5,000 square feet threshold, and making reductions in the allowable maximum override control area**;** exempts emergency egress lighting and lighting controlled by occupancy sensors from this requirement		
C405.2.2.2		Adds requirements for occupancy sensors in classrooms, conference rooms, restrooms, private offices, and all areas 300 square feet or less enclosed by floor to ceiling height partitions		
C405.2.2.2.1	SPS 363.0505 (1) (a) 2. References IECC 505.2.2.1, which now pertains to C405.2.2.2.1, *this chapter has changed enough that SPS 0505 should be reviewed; additionally, the definitions and provisions regarding daylight zones and daylighting have change and been expanded considerably since 2009*			
C405	SPS 363.0505 (2) references IECC section 505.5.1.4 (2009), which has no equivalent section in the 2015 IECC			
	Renumber and amend **SPS 363.0505**	**SPS 363.0405 Lighting systems**. (1) CONTROLS. These are department rules in addition to the requirements in IECC section ~~505~~ C405: (a) *General*. Except as provided in par. (b), daylight zones in any interior enclosed space greater than 250 square feet and a lighting density more than 0.6 W/ft2 shall have at least one control that meets all of the following requirements:		Only reference to track lighting in C405.4.1

		1. Controls only luminaires in the daylight zones. 2. Controls at least 50% of the lamps or luminaires in the daylight zone, in a manner described in IECC section ~~505.2.2.1~~ C405.2.2.2. (b) *Exceptions*. The requirements of this subsection do not apply to any of the following: 1. Daylight zones where the effective aperture of glazing is equal or less than 0.1 for vertical glazing and 0.01 for horizontal glazing. 2. Daylight zones where existing adjacent structures or natural objects obstruct daylight to the extent that effective use of daylighting is not feasible. ~~(2) LINE-VOLTAGE LIGHTING TRACK AND PLUG-IN BUSYWAY BUSWAY. Substitute the following for the requirements in IECC section 505.5.1.4 C405: The wattage of line-voltage lighting track and plug-in busway which allows the addition or relocation of luminaires without altering the wiring of the system shall be the volt-ampere rating of the branch circuit feeding the luminaries or an integral current limiter controlling the luminaires, or the higher of the maximum relamping rated wattage of all of the luminaires included in the system, listed on a permanent factory installed label, or 30 W/linear foot.~~		Renumber section accordingly if (2) is eliminaed
C405.2.2.3		Modifies provisions related to daylight zones, which are areas likely to have sufficient sunlight for compliance with IBC minimum lighting requirements during the day		
C405.2.2.3.2		Adds requirements for automatic daylighting controls to give the user a choice between continuous dimming or stepped dimming		
C405.2.3		Adds additional specific application controls in addition to those for hotel sleeping rooms, and lighting equipment for sale or for lighting demonstrations by including**:** ▪ display and accent lighting ▪ lighting in cases used for display ▪ supplemental task lighting ▪ lighting for non-visual applications		
C405.5.2		Modifies the provisions by providing two methods of demonstrating compliance with the total interior lighting power allowance; the Building Area Method, and the Space by Space Method		
Table C405.5.2.1		Modifies the Interior Lighting Power Allowances: Building Area Method by removing the additional power allowance for specific merchandizing categories and moves		

		them to the Space by Space Method (Table C405.5.2(2)		
Table C405.5.2 (2)		Adds the Space by Space Method of compliance with Interior Lighting Power Allowance determination and includes the additional power allowance for specific merchandizing categories, which were formally only applicable to the Building Area Method of compliance		
C406		This section requires that one (1) efficiency option be met. The Dept. does not require the submittal of lighting plans, thus review is in question. Additionally, water service is addressed by the plumbing group, and not the building code group. Add language that requires that the specific efficiency project option chosen is clearly addressed on the building/HVAC plans, with appropriate justification of code compliance included. IECC 2015 has requirements that are not spelled out on submitted plans. Not able to track. No lighting submittal makes it difficult to track option selected.		50
C406.1		Adds a new section with additional efficiency package options; where the prescriptive compliance path is followed; at least one of these options is required in addition to all other code requirements; they are described in C406.2, C406.3, and C406.4		
C406.1		Direct Comcheck for use under prescriptive requirements instead of Total Building Performance so that the program may be used prescriptively with C406.1 -the additional efficiency requirements Failure to do so will require that bldg design will be required to meet the prescriptive requirement only. This allows for greater flexibility.		Creates code flexibility for design 102
	Renumber and amend SPS 363.0506	~~**SPS 363.0506**~~ **SPS 363.0407. Total building performance.** This is a department informational note to be used under IECC section ~~506~~ C407: **Note:** ComCheck is a computer program that may be used only for determining building envelope or lighting compliance. The ComCheck computer program may be downloaded at~~:~~ http:/www.energycodes.gov/.		
C406.2		Adds an efficiency option to continue to use off site generated energy and to increase the HVAC efficiency		
C406.3		Adds an efficiency option to use an efficient lighting system for the entire building as the additional energy efficiency package		

C406.4		Adds an efficiency option to provide on-site renewable energy that is equivalent to or greater than: 75 Btu or 0.50 watts per square foot of conditioned floor area, or three percent of the energy used in the building for non-process loads		
C407.3		Modifies performance based compliance methodology by keeping the requirements the same, but requiring buildings to achieve 15 percent greater energy efficiency, since C401.2 states that "*The building energy cost shall be equal to or less than 85 percent of the standard reference design building*"		
C408.1		Adds a section for building system commissioning which allows performance and efficiencies to be verified, giving a reasonable idea of how a well maintained building will perform		
C408.2		Adds requirements for the **registered design professional** to: ▪ provide evidence of commissioning and compliance ▪ indicate provisions for commissioning and completion in construction documents ▪ provide copies of documents to owner, and if requested, to code official ▪ provide written commissioning plan		
C408.2.2		Modifies requirements for balancing both air and hydronic systems in a manner intended to minimize throttling losses		
C408.2.3		Adds requirements for testing of mechanical equipment, controls, and economizers prior to a final inspection		
C408.2.4		Adds requirements for the registered design professional or approved agency to complete and certify a preliminary report of the commissioning test procedures itemizing: ▪ uncorrected deficiencies ▪ deferred tests		

		▪ conditions for performing deferred tests		
C408.2.5		Modifies documentation requirements by removing the mechanical contractor as the responsible party; and spelling out that documentation include: ▪ drawings ▪ manuals ▪ system balancing report ▪ final commissioning report		
C408.3		Adds functional lighting control testing as part of the commissioning process with the design professional responsible for identifying the party who will do the testing, the plan reviewer is responsible to see that the party is named, and the inspector has a contact to assure compliance prior to approving occupancy		
C403.2.4.2 (2015) 503.2.4.3 (2009)		ASHRAE 90.1 exempts radiant floor and ceiling heating systems from requiring setback controls because the mass/heat capacity of these building systems. This exception should be incorporated into the IECC because requiring the use of such setback controls is inappropriate for such systems. Add language exempting the need for setback controls for radiant floor & ceiling heating systems. Provides recognition of system limitations, and limited energy savings		32
C503.1 exc.7 C503.6		Two referenced sections list different percentages of luminaire replacement (ie. 50% vs 10%) Dept. to define which is to be applicable for code use		104
C600	SPS 363.0900 adds 1 NCMA standard and 4 ASTM standards, one of which is now also cited in the IECC			
	Renumber and amend: **SPS 363.0900**	~~**SPS 363.0900**~~ **SPS 363.0600 Referenced standards.** This is a department rule in addition to the requirements in IECC chapter ~~6~~ 6 [CE]: The following standards are hereby incorporated by reference into this code: **(1)** ASTM ~~C177–04~~ C177-13, Test method for steady–state heat flux measurements and thermal transmission properties by means of the guarded–hot–plate apparatus. **(2)** ASTM ~~C335–05~~ C335/C335M-10e1, Test method for steady state heat transfer properties of horizontal pipe insulation. **(3)** ASTM ~~C518–04~~ C518-15, Test Method for steady–state thermal transmission properties by		

		means of the heat flow meter apparatus. ~~(4) ASTM C1363–05, Test method for thermal performance of materials and envelope assemblies by means of a hot box apparatus.~~ ~~(5)~~ (4) National Concrete Masonry Association (NCMA) Evaluation Procedures of Integrally Insulated Concrete Masonry Walls, January 1, 1999.		
PART 3 - IECC - RESIDENTIAL ENERGY				
CHAPTER R4 - RESIDENTIAL ENERGY EFFICIENCY				
	Renumber and amend: **SPS 363.0401**	**SPS 363.5401 Certificate.** The requirements in IECC section ~~401.3~~ R401.3 are not included as part of this code.		
R402.1.1		Section references both the IRC and IBC for vapor retarder requirements Reference to the IRC for vapor retarder requirements should be stricken since this code is applicable to commercial buildings only Clarifies that IBC 1405.3 is to be used.		103
Table R402.1.1		Modifies the prescriptive insulation and fenestration requirements by component including requirements for continuous insulation at wood framed walls in Climate Zones 6 and 7	Renamed Table R402.1.2	!
Table R402.1.1		Modifies the footnotes for the table including: ▪ footnote ***a*** notes the reduction in R-value when batt insulation is compressed ▪ footnote ***b*** allows the exclusion of certain skylights from some SGHC requirements ▪ footnote ***h*** allows for consistent sheathing thickness while maintaining wall bracing ▪ footnote ***j*** regarding impact rated fenestration has been eliminated	Renamed Table R402.1.2	
Table R402.1.3		Modifies the prescriptive Equivalent U-factor table, an alternative to the R-value table, R402.1.1	Renamed Table R402.1.4	
R402.2.3		Adds requirements for eave baffles to maintain openings between soffit and eave vents and a vented attic space		
R402.2.6		Modifies the R-values significantly for steel framed walls to account for the conduction properties of the steel		
R402.2.12, R402.3.5		Modifies requirements for sunrooms by clarifying the wall separation provision and		

		making it clear that these provisions do not apply to spaces that are not thermally isolated; requires the wall separating the conditioned space and the thermally isolated sunroom to meet exterior wall criteria of IECC 2012		
R402.4.1		Modifies building thermal envelope provisions by requiring testing and visual inspection; the code official is authorized to require an approved third party to inspect and verify compliance		Administration issues
R402.4.1.2		Modifies air leakage provisions by requiring inspection and testing while increasing tightness requirements; in most cases mechanical ventilation will be required in houses to meet the air tightness requirements		
R402.4.2		Modifies the requirement for gasketed doors at fireplaces by moving it from the text of the code to table R402.4.1.1; and adds a requirement for tight fitting flue dampers		
	Renumber and amend: **SPS 363.0403**	**SPS 363.5403 Systems. (1)** ELECTRICAL POWER AND LIGHTING. This is a department rule in addition to the requirements in IECC section ~~403~~ R403: In residential buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units. **(2)** DUCTS. Substitute the following wording for the requirements in IECC section ~~403.2.2~~ RR403.3.2: All ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with IMC section 603.9.		
R403.2	SPS 363 0403 (2) reads in part "all ducts, air handlers, and filter boxes shall be sealed, joints and seams shall comply with IMC section 603.9	Modifies requirements for duct construction and sealing by requiring joints and seams to comply with either the *International Mechanical Code* (IMC) or the *International Residential Code* (IRC), which includes: ▪ SMACNA HVAC duct construction standards ▪ NAIMA fibrous glass duct construction standards ▪ UL-181 listing for duct board construction ▪ UL-181b listing for flexible construction ▪ unlisted duct tape is prohibited		

		▪ exception for certain longitudinal seams		
R403.2		Modifies requirements for duct tightness and verification by compliance with provisions related to a post construction test and a rough-in test		
R403.3.1		Adds a requirement for protecting insulation exposed to the elements, but prohibits the utilization of adhesive tape as the protective measure		
R403.4		Modifies insulation requirements for service hot water systems by increasing the minimum R-value to R-3 and including a list of specific situations where insulation is required, detailed in table R403.4.2		
R403.5		Adds requirements for mechanical ventilation in any building that has less than five air changes per hour at 50 Pascals (5ACH/50)		(mandatory)
R403.5.1		Adds a simple efficiency requirement for various mechanical ventilation system fans in table R403.5.1		
R403.6		Modifies requirements for equipment sizing from a reference through the IRC to a direct reference requiring sizing of equipment per Air Conditioning Contractors of America (ACCA) Manual S based on loads calculated in accordance with ACCA Manual J or other approved method		(mandatory)
R403.9		Modifies requirements for pools by excluding temporary and above ground spas from the scope of the regulations, insulated pool covers are no longer required		(mandatory)
R403.10 (2015) 403.9.2 (2009)		This section requires that time switches be installed in pools. Rules issued by DHS mandate that pump operation occur continuously, 24 hrs/day, 365 days per year.		Amend this section such that the requirements is eliminated 85
R403.10.4 (2015) 403.9.3 (2009)	SPS 363.0504 (3)	This section req's a pool cover be installed for pools located within low rise residential bldgs < 3 stories above grade. SPS 363.0504(3) was created due to health issues from the field that chloramines would overwhelm people when the pool cover was removed, and cause them to go unconscious.		

		Amend this section such that the req't for a pool cover is eliminated just as has been previously done to IECC 504.7.3		86
R404.1		Modifies lighting equipment provisions by requiring that 75 percent of the lamps in permanently installed light fixtures contain only high efficacy lamps		(mandatory)
R405.3		Clarifies that the Commercial provisions require computer modeled performance 15 percent better than the standard reference design, the Residential provisions do not		
Table R405.5.2 (1)		Modifies the language of the table to clarify acceptable compliance methodology with the inclusion of technical details		
	Renumber and amend: **SPS 363.0405**	**SPS 363.5405 Calculation software tools.** This is a department informational note to be used under IECC section ~~405.6~~ R405.6:		
	Renumber and amend: **SPS 363.0405 Note:**	**SPS 363.5405 Note:** The federal Department of Energy has developed ~~REScheckTM~~ REScheck™, a computer program that may be used in demonstrating compliance for a residential building which has no more than 3 stories above grade and has 3 or more dwelling units. The REScheck program may be downloaded at http://www.energycodes.gov/. ~~When using the program, the applicable code must be defined as the "2009 IECC." The use of the "Wisconsin" option will apply requirements associated with a 1 or 2 family dwelling, which are more restrictive than those associated with low-rise multifamily buildings.~~ (new text)		
405.6	363.0405	RESCheck has multiple versions in use, for uniformity the dept recommends using the most recent version. 363.0405 Calculation software tools. Add: The most recent version of REScheck shall be used when demonstrating code compliance. This will provide uniformity for reviewers, submitters and users of energy standard to all be consistent and current with energy requirements. As this is utilized in the design stage, there should be minimal impact to construction cost. Software is free download.		Add to the Note: The most recent version of REScheck shall be used when demonstrating code compliance. 2
PART 4 - ASHRAE/IES 90.1				
THE BUILDING ENVELOPE				
4.2.4		Adds continuous air barriers to the list of required inspection items		
5.1.2		Adds language clarifying that the new requirement for the addition of skylights to certain spaces also applies to unconditioned spaces		

5.4.3.1		Modifies provisions for sealing the building envelope by adding requirements for **design, installation,** and **materials** for the construction of a continuous air barrier for the entire building envelope		
5.4.3.2		Modifies air leakage criteria at fenestration and doors to more closely reflect current practice		
5.5.3.1		Modifies and expands the types of roofs shown by research to reduce the conduction loads through roofs into the conditioned space, allowing designers to select from a number of alternatives and reduce space loads, reducing energy use and cost		
5.5.3.4		Modifies the vestibule requirements for Climate Zone 4		NA
5.5.4.2.2		Adds skylight requirements in larger spaces with specific uses to promote daylighting energy savings, but Climate Zones 6-8 are exempt		NA
5.5.4.4.1		Adds a requirement that the minimum values for dynamic glazing be used to show compliance; in the envelope trade off rules found in Appendix C, the dynamic glazing must use the Standard values from C3.5 to show compliance; when dynamic glazing is used in the Appendix G models, the average values are to be used		
5.5.4.5		Adds a requirement that the area of south facing glass be equal to or larger than the area of east or west facing glass		
5.8.1.10		Adds a requirement for offsetting joints by staggering boards when multiple layers of insulation are used		
5.8.2		Adds Visible Transmittance (VT) to the list of rating and labeling requirements for fenestration products		
PART 5 - ASHRAE/IES 90.1				

H V A C				
6.4.1.1		Modifies the minimum equipment efficiencies tables by adding new equipment types and requiring compliance with the Standard for equipment used in buildings as defined by the new scope of the Standard		
6.4.1.2		Modifies provisions by introducing a new equation to adjust the performance of centrifugal chillers operating at non-standard conditions to show compliance with the Standard		
6.4.1.2.2		Modifies provisions related to positive displacement chillers that use glycol and other additives by requiring them to be tested with water at standard rating conditions		
6.4.2		Modifies heating and cooling load calculations by reference to ANSI/ASHRAE/ACCA Standard 183, *Peak Heating and Cooling Load Calculations in Buildings Except Low-Rise Residential Buildings*; and requires pump head calculation for the critical circuit		
6.4.3.4.3		Modifies provisions to separate the requirements for exhaust/relief dampers from ventilation intake dampers		
6.4.3.4.5		Adds an allowance for a reduction in ventilation in unconditioned garages and requires an automatic control that is capable of staging fans or modulating fan volume as required to maintain carbon monoxide contaminant levels		
6.4.3.10		Adds a requirement for variable air volume fan speed controls to be included in single zone units		
6.4.4.1.4		Adds a requirement for minimum insulation to be applied to the back of radiant heating panels		
6.4.4.1.5		Adds a requirement for minimum insulation		

		to be applied to the bottom of radiant heated floors		
6.4.4.2.1		Modifies provisions regarding duct sealing to require ducts and plenums with pressure class ratings to be constructed to seal Class A, and provides a definition for the seal class		
6.5.1		Modifies provisions so as to provide minimum fan cooling unit sizes for required economizers on computer rooms		
6.5.1	*SPS 363.0503 (4) and (5) should be revisited in light of these modifications*	Modifies the economizer table, requiring economizers to be installed in all units with 54,000 Btu/h or more of cooling in all but Climate Zone 1		
6.5.1.2		Adds requirements for water economizers in computer rooms		
6.5.1.3		Modifies provisions by removing all exceptions from the requirement for integrated economizer control		
6.5.2.1		Adds a control strategy for VAV reheat boxes and eliminates some exceptions from the section		
6.5.2.1.1		Adds a provision limiting the heating air temperature of reheat boxes when the supply and return grilles are both six feet above the floor		
6.5.3.3		Adds a requirement to use ASHRAE 62.1, Appendix A, to optimize the ventilation efficiency and reduce the outside air amount used with room loads below design		
6.5.3.4		Adds a requirement for supply air temperature automatic reset controls for multiple zone HVAC systems		
6.5.4.1		Modifies the pumping power requirements for HVAC systems		
6.5.4.4.2		Modifies provisions to include water cooled unitary air conditioners with hydronic heat pumps and require both to provide automatic valves that shut off when the compressor		

		does, and provide variable speed pumps		
6.5.4.5		Adds requirements to use a standard table for sizing HVAC piping in order to control pump energy		
6.5.5.3		Adds requirements limiting the power used in open cooling towers with centrifugal fans		
6.5.6.1		Modifies provisions by increasing the requirement for air energy recovery in most climate zones		
6.5.7.1		Modifies provisions for kitchen exhaust systems by modifying make-up air requirements to prevent short circuiting, by establishing maximum net exhaust flow rates for exhaust hoods, and by requiring exhaust system performance testing		
6.5.7.2		Modifies the equation for designing laboratory exhaust systems by integrating the alternative paths of compliance to allow each system to contribute to the energy savings		
PART 6 - ASHRAE/IES 90.1				
LIGHTING				
9.1.2		Modifies the provisions to clarify that alterations to the lighting system must comply with all of the section 9 requirements		
9.1.3		Modifies details of the calculations needed to determine the installed exterior lighting power density requirements		
9.2.2.3		Adds two additional exceptions to the lighting types which are not to be included in the installed lighting power calculation		
9.4.1		Modifies provisions by requiring bi-level lighting control and automatic shutdown in all buildings regardless of size, with exceptions: ▪ public corridors and stairwells ▪ restrooms ▪ primary building entrance areas and lobbies ▪ areas where manual-on operation would		

		endanger the safety or security of the room or building occupants		
9.4.1.3		Modifies provisions for lighting control in garages by requiring bi-level lighting control and daylighting controls		
9.4.1.4		Adds a requirement for multilevel daylighting controls for areas adjacent to sidelights		
9.4.1.5		Adds a requirement for multilevel daylighting controls for areas lit by skylights		
9.4.1.6		Modifies provisions to exclude bathroom lighting from being controlled by the master switch required in hotel/motel guest rooms and adds new control requirements for the bathroom lighting		
9.4.1.6		Adds requirements for occupancy lighting controls in building stairwells to dim lighting after occupants leave		
9.4.1.7		Modifies provisions to require controls for exterior lights to turn off the lights under daylight conditions; older versions of the code merely required that the controls were provided		
9.4.2		Deletes requirements for tandem wiring of light fixtures because of improvements in ballast design		
9.4.3		Modifies provisions to apply a five zone lighting power density approach, each with its own base site allowance, and provide allowances for varying site use classifications in different exterior lighting zones		
9.4.4		Deletes the requirement for minimum efficacy of exterior lamps over 100 watts		
9.4.4		Adds a requirement for functional testing of lighting control devices and control systems		
9.5.1		Modifies the lighting power densities used with the building area method of lighting power allowance calculation		
9.6.1		Modifies the Standard to set the lighting		

		power density by space function whether the function is separated by full height wall or not		
9.6.2		Modifies additional retail lighting provisions to reflect the use of modern lamp technology and adds a power allowance requirement to encourage the use of advanced lighting controls		
9.6.3		Adds an allowance for 20 percent more lighting power to be used in small rooms with high ceilings		
9.7		Adds provisions for submittals to the lighting section requiring the submittal of compliance documentation and supplemental information		Administration issues
PART 7 - ASHRAE/IES 90.1				
OTHER CHANGES				
1 Purpose and Scope		Modifies the purpose and scope of the Standard by adding building operation and maintenance, on-site renewable energy systems, and commercial systems to those for which the Standard may develop requirements		

3.2		Modifies provisions by adding multiple definitions, mostly related to daylighting, including:
		▪ Daylight area
		  ▪ Under skylights
		  ▪ Under rooftop monitors
		▪ Daylighted area
		▪ Dynamic glazing
		▪ Fenestration, field fabricated
		▪ Multi-level occupancy sensor
		▪ Multi-scene control
		▪ Primary sidelighted area
		▪ Secondary sidelighted area
		▪ Sidelighting effective aperture
		▪ Toplighting
		▪ Vegetative roof system
		▪ Visible transmittance (VT)		

8.4.2		Adds a requirement for the installation of		

		controls to turn off 50 percent of receptacles when the space is unoccupied		
10.4.2		Adds requirements addressing energy waste in service water pressure booster systems		
10.4.3		Modifies energy consumption in elevators by requiring more efficient lighting and fans and by requiring controls that turn the lighting and ventilation off when the elevators are not in use for an extended period of time		

a. Published sources:

2009 *International Energy Conservation Code*® – International Code Council® (ICC)
2012 *International Energy Conservation Code* – International Code Council
2015 *International Energy Conservation Code* – International Code Council
Significant Changes to the International Energy Conservation Code and ANSI/ASHRAE/IES Standard 90.1, IECC 2012 Edition, ANSI/ASHRAE/IES 2010 Edition – International Code Council
ANSI/ASHRAE Standard 90.1-2007 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ANSI/ASHRAE/IES Standard 90.1-2010 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ANSI/ASHRAE/IES Standard 90.1-2013 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

b. Various ICC code section number references in SPS 363 will be updated where code section numbering has changed, but these modifications are not referenced here.

c. Changes that are not addressed because they do not apply in Wisconsin include the changes for most of chapter 1 Administration

d. Chapters SPS 361 and 363 of the *Wisconsin Administrative Code* (Register, December 2011)

Prepared by Dan Smith
File Reference: SPS 363/Summary 2012 & 2015 IECC changes

The International Energy Conservation Code® (IECC®) is recognized as the national model energy code of choice for U.S. cities, counties and states that adopt codes. The IECC and its predecessor, the Model Energy Code (MEC), are cited throughout Federal law for national private and public housing initiatives.

The 2015 edition of the IECC is intended to provide flexibility to permit the use of innovative approaches and techniques. This is achieved by allowing the choice of a prescriptive or performance-based compliance path for both commercial and residential buildings.

Goal

Participants will be able to use this document to identify changes from the 2012 IECC to the 2015 IECC, allowing them to apply these code requirements to the design, plan review, inspection and commissioning of both residential and commercial buildings.

Objectives

Upon completion, participants will be better able to:

- Identify the most significant differences between the 2012 IECC and the 2015 IECC
- Explain the differences between the commercial and residential provisions
- Understand the choice of compliance paths
- Identify newly-regulated systems and components
- Identify the applicability of design, plan review, inspection and commissioning requirements

The 2015 edition has numerous changes that provide users of the Code considerably more compliance choices without trading energy efficiency. While there will be regional variability in the technology advances, a preliminary estimate from U.S. Department of Energy (DOE) suggests the 2015 IECC will at least as energy efficient as the 2012 edition [reference: PNNL-23438], which yielded a 32 percent energy savings over the 2006 IECC. Homes built to the IECC consume less energy, and families who live in those homes save energy costs.

The 2015 IECC contains two separate sets of provisions—one for commercial buildings and one for residential buildings. Each set is applied separately to buildings within its scope.

- The IECC—Residential Provisions are referenced as R before the section number. They apply to detached one- and two-family dwellings and multiple single-family dwellings, as well as Group R-2, R-3 and R-4 buildings, three stories or less in height.
- IECC—Commercial Provisions are referenced as C before the section number and apply to all others.

The Commercial and Residential Provisions are independent; and each contains the following chapters:

1. Scope and Administration
2. Definitions
3. Climate Zones and General Materials Requirements
4. Energy Efficiency Requirements *(applicable to buildings within its scope)*
5. Existing Buildings
6. Referenced Standards

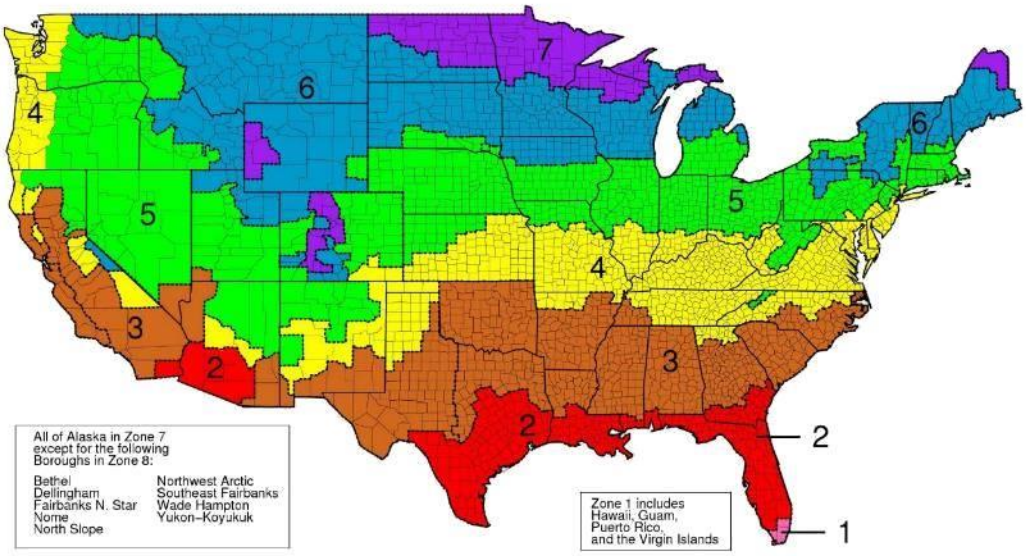
2015 IECC Table of Contents for both Residential and Commercial Provisions

TABLE OF CONTENTS

Chapters 1, 2 and 3 are nearly identical for the Commercial and Residential Provisions and have been marked as Section C and R accordingly. For the purpose of this document, they will be explained together, and the differences will be highlighted.
Chapter 4 of the Commercial and Residential Provisions contains the technical requirements for energy efficiency.
Chapter 5 of the Commercial and Residential Provisions contains requirements for existing building.
Chapter 6 of the Commercial and Residential Provisions contains the Referenced Standards.

The 2015 edition of the IECC remains fully compatible with all the International Codes® (I-Codes®) published by the International Code Council® (Code Council®).

Chapter 1: Scope and Administration			
Code Section		Section Title	Description of Change
2015	2012		
C103.2.1 R103.2.1	**NEW**	Building Thermal Envelope Depiction	Code now requires the building thermal envelope to be explicitly shown on the construction drawings.
C104.1 R104.4	**NEW**	Inspections - General	Improved and enhanced details governing inspection of construction. The provisions are more specific and written to relate to the Energy Code.
C104.2 R104.2	**NEW**	Required Inspections	
C104.3 R104.3	**NEW**	Reinspection	
C104.4 R104.4	**NEW**	Approved Inspection Agencies	

Chapter 3: General Requirements			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C301.4 R301.4	**NEW**	Tropical Climate Zone	New additional defined Climate Zone 1: • Area between the Tropic of Cancer & Tropic of Capricorn • Recognizes the unusually constant and unique climate of this region
			
R401.2.1	**NEW**	Tropical Zone Compliance	Unique compliance path for *residential occupancies.*

Chapter 3: General Requirements			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C303.1.3 R303.1.3	**C303.1.3** **R303.1.3**	Fenestration Product Rating	*U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100. Allows ANSI/DASMA 105 to be used as a standard for determination of U-factors for garage doors 
C303.1.4.1 R303.1.4.1	**NEW**	Insulated Siding	Requires R-value of insulated siding to be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's instructions.

Chapter 4: Energy Efficiency			
Code Section		***Section Title***	***Description of Change***
2015	***2012***		
Table C402.1.3	Table C402.2	Opaque thermal envelope insulation component minimum requirements, *R*-value methods	Minimum thermal performance increased for roof insulation entirely above deck in Climate Zones 1 – 5 Increased to be compatible with ASHRAE 90.1
R402.1.2	R402.1.1	Insulation and fenestration criteria	
Table C402.1.4	Table C402.1.2	Opaque thermal envelope insulation component minimum requirements, *U*-factor methods	
R402.1.4	R402.1.3	*U*-factor alternative	
C402.1.2	**New**	Equipment buildings	Exempt from envelope provisions: • Separate buildings not more than 500 ft^2 • Intended to house electronic equipment • Heating system capacity ≤ 17,000 Btu/hr • Thermostat set point restricted to ≤ 50°F • Have a maximum average wall and roof *U*-factor (0.2 or 0.12) • Roof provisions of Climate Zone 1

Chapter 4: Energy Efficiency			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
Table C402.1.4.1	**New**	Effective *R*-values for steel stud wall assemblies	Method to determine effective *R*-values for steel stud wall assemblies

TABLE C402.1.4.1
EFFECTIVE *R*-VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE *R*-VALUE (ER) (Cavity *R*-Value × F_c)
$3^1/_2$	16	13	0.46	5.98
		15	0.43	6.45
$3^1/_2$	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

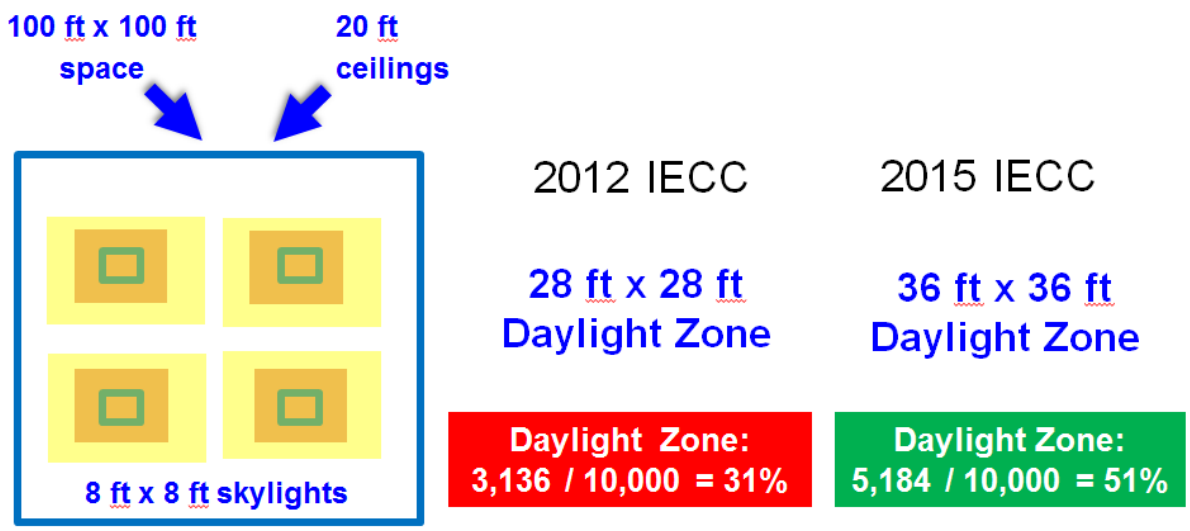
C402.1.5	**New**	Component performance alternative.	Alternative component performance path for commercial buildings allows trade-offs in building envelope

Chapter 4: Energy Efficiency			
Code Section		Section Title	Description of Change
2015	2012		
R406	**New**	Energy rating index compliance alternative	ERI analysis requires that the rated design ERI be ≤ the appropriate value listed in Table R406.4

TABLE R406.4
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

Chapter 4: Energy Efficiency			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C402.4	C402.3 & C402.3.3.1	Fenestration (Prescriptive)	Building Envelope Fenestration Maximum U-Factor and SHGC Requirements • Maximum SHGCs based on Projection Factors are folded back into the fenestration table (like 2009 IECC) • North-facing fenestrations are allowed higher SHGCs
C402.4.2	C402.3.2	Minimum skylight fenestration area.	Lowers the threshold for requiring a daylight zone in an enclosed space from 10,000 ft^2 to 2,500 ft^2



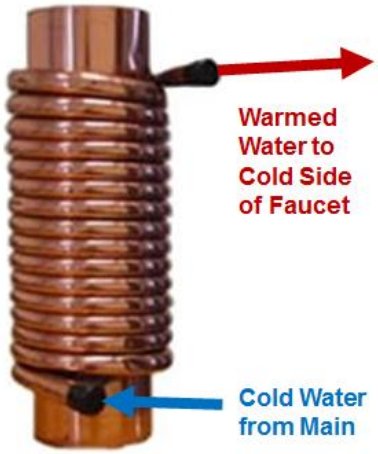
Chapter 4: Energy Efficiency			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C402.4.1.1	C402.3.1.1	Increased vertical fenestration area with daylight responsive controls.	In Climate Zones 1-6, up to 40% permitted to be vertical fenestration area, provided: • In buildings ≤ 2 stories above grade, ≥ 50 % floor area is within a daylight zone. • In buildings ≥ 3 stories above grade, ≥ 25% floor area is within a daylight zone. • Equipped with daylight responsive controls • VT ≥ 1.1 x SHGC
Deleted	C402.3.3.2	Increased vertical fenestration SHGC	Removes an exception that allowed an increase in SHGC values in Climate Zones 1, 2, and 3
C402.4.3.3 R402.4.3.2	C402.4.3.3.5 **New**	Dynamic glazing	Requires a minimum ratio of 2.4 for the higher to lower SHGC rating of dynamic glazing UNLESS both the lower and higher labeled SHGCs comply
C402.5.3 R402.4.4	**New** **New**	Rooms containing fuel-burning appliances	Rooms containing fuel-burning appliances and their open-combustion air openings: • In Climate Zones 3 - 8 • To be isolated from remainder of building in accordance with envelope provisions
C402.5.7	C402.4.7	Vestibules	New exception allows an air curtain tested in accordance with ANSI/AMCA 220 to be used instead of a vestibule
C403.2.4.4	**New**	Zone isolation	Requires zones served by HVAC systems over 25,000 square feet or more than one floor to be subdivided into isolation areas to control the HVAC system in each isolation area
C403.2.6.2	**New**	Enclosed parking garage ventilation controls	Ventilation optimization controls to modulate airflow

Chapter 4: Energy Efficiency			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C403.2.8	**New**	Kitchen exhaust systems	Regulates efficiency of kitchen exhaust systems: • Replacement air • Maximum exhaust rates
C403.2.14	**New**	Refrigeration equipment performance	Tables C403.2.14 (1) & (2): • List the maximum energy use in kWh/day • Organized by equipment type, operating mode & rating temperature
C403.2.15 C403.2.16	**New**	Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers	Requirements include: • Door self-closures • Min. floor, wall & ceiling insulation • Anti-sweat heaters and controls • Lighting efficiency
C403.4.2.5	**New**	Boiler turndown	Turndown ratio for boilers with design input over 1,000,000 Btu/h.

TABLE C403.4.2.5
BOILER TURNDOWN

BOILER SYSTEM DESIGN INPUT (Btu/h)	MINIMUM TURNDOWN RATIO
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
> 5,000,000 and less than or equal to 10,000,000	4 to 1
> 10,000,000	5 to 1

For SI: 1 British thermal unit per hour = 0.2931 W.

Chapter 4: Energy Efficiency			
Code Section		**Section Title**	**Description of Change**
2015	**2012**		
C404.5 R404.5	**New**	Efficient heated water supply piping	Maximum allowable pipe length method (Table C404.5.1): • From the nearest source of heated water to termination of the fixture supply pipe • 2 columns: public lavatory faucets and all other fixtures Maximum allowable pipe volume method: • Volume from the nearest source of heated water to the termination of the fixture supply pipe • 2 oz. public lavatory faucet, ½ gallon for other fixtures
C404.8 R403.5.4	**New**	Drain water heat recovery units	CSA B55.2 (commercial) Max 10 psi pressure loss (C404.8) CSA B55.1 (residential) Max 3 psi pressure loss (R403.5.4) 
C405.9	**New**	Vertical and horizontal transportation systems and equipment	• Luminaires • Ventilation fans • Speed reduction • Variable frequency regenerative drive
C406	C406	Additional Efficiency Package Option	• More efficient HVAC performance • Reduced lighting power density system • Enhanced lighting controls • On-site supply of renewable energy • Provision of a dedicated outdoor air system for certain HVAC equipment • High-efficiency service water heating

Chapter 4: Energy Efficiency			
Code Section		Section Title	Description of Change
2015	2012		
C408	C408	System Commissioning	• Mechanical and service water report in separate sections to allow for independent review • Functional testing of lighting – requirements were broken up and expanded ▪ Construction documents specify performance criteria ▪ O&M manuals ▪ Schedule for inspection & recalibrating

Summary

- The format of the IECC slightly changed
- New regulated systems and components were added
- Additional compliance paths are allowed
- Requirements for some systems have been tightened
- Daylight zone dimensions have changed
- Thermal envelope provisions remain mostly unchanged

Accreditation

IACET
The Standard for Lifelong Learning

- The International Code Council has been accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET).
  - As a result of their Authorized Provider accreditation status, ICC is authorized to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standard.
- Participants will earn 0.1 CEUs for this webinar

2015 IECC Update 1

2015 International Energy Conservation Code Update

Based on the International Energy Conservation Code® (IECC®)

Description

This webinar will discuss the important changes from the 2012 to the 2015 IECC. Participants will be presented with those changes that most impact their use of the code when they adopt the 2015 edition.

2015 IECC Update 3

Welcome

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2015 IECC Update 4

Questions and Answers

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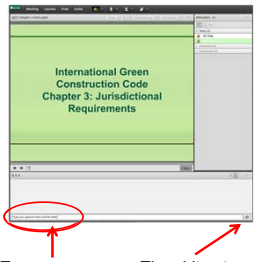

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2015 IECC Update 5

Polling Questions

2015 IECC Update 6

Arrangement and format of the 2015 IECC

- The IECC contains two separate sets of provisions.
  - **The IECC—Residential Provisions** apply to:
    - 1 & 2 family detached
    - Townhouses
    - Group R-2, R-3 and R-4 buildings ≤ 3 stories above grade
  - **The IECC—Commercial Provisions** apply to:
    - All other buildings

7

Arrangement and format of the 2015 IECC

TABLE OF CONTENTS

2015 IECC Update 8

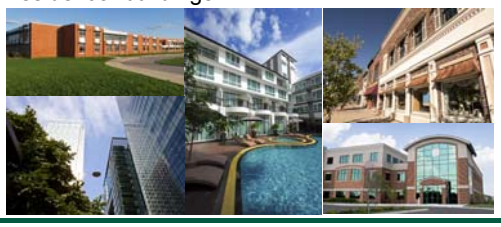
Arrangement and format of the 2015 IECC

Residential Building. For this code, includes detached one- and two-family dwellings and multiple single family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

2015 IECC Update 9

Arrangement and format of the 2015 IECC

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential buildings."



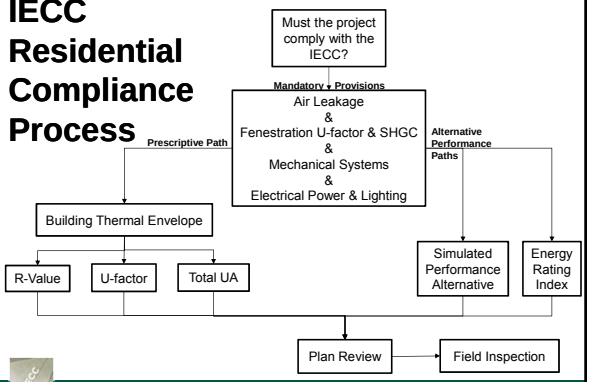
2015 IECC Update 10

Five steps in the IECC compliance process

1. Determine if the project must comply with the IECC
2. Determine if the project is residential or commercial
3. Clearly identify that all regulated, energy-related systems meet or exceed code requirements
4. Submit compliance documentation to jurisdiction
5. Install regulated energy systems per plans and documentation

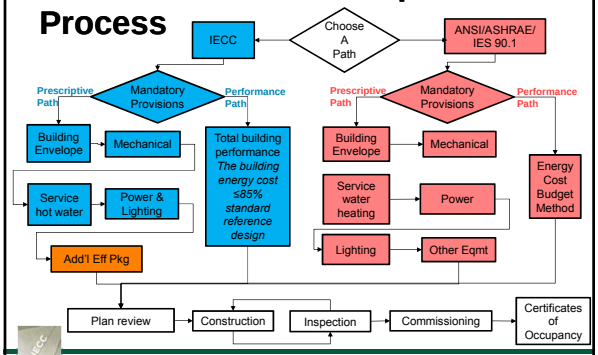
11

IECC Residential Compliance Process



2015 IECC Update 12

IECC Commercial Compliance Process



2015 IECC Update 13

Chapter 1: Scope and Administration

IECC Commercial & Residential Provisions

14

Scope and Administration

Building Thermal Envelope Depiction

2015	2012
C103.2.1 R103.2.1	(NEW)

Code now requires the building thermal envelope to be explicitly shown on the construction drawings.

2015 IECC Update 15

Scope and Administration

- C/R104.1 Inspections - General
- C/R104.2 Required inspections
- C/R104.3 Reinspection
- C/R104.4 Approved inspection agencies

2015	2012
C104.1 - C104.4 R104.1 - R104.4	(NEW)

Improved and enhanced details governing inspection of construction. The provisions are more specific and written to relate to the Energy Code.

2015 IECC Update 16

Chapter 5: Existing Buildings

IECC Commercial & Residential Provisions

17

Existing Buildings

Additions, alterations, repairs, and changes in occupancy or use

2015	2012
Chapter 5 (CE) Chapter 5 (RE)	(NEW)

Requirements pertaining to existing buildings are consolidated into one chapter.

2015 IECC Update 18

Chapter 3: General Requirements

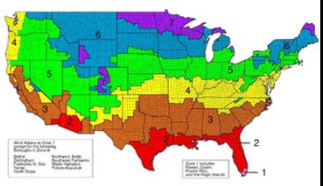
IECC Commercial & Residential Provisions

19

General Requirements

- Tropical Climate Zone
- R401.2.1 Tropical Zone Compliance

2015	2012
C301.4 R301.4 R401.2.1	**(NEW)**



New defined Climate Zone
- Area between the Tropic of Cancer & Tropic of Capricorn
- Recognizes the unusually constant and unique climate of this region
- R401.2.1 – unique compliance path for *residential occupancies*

2015 IECC Update 20

General Requirements

- Building envelope product ratings
- C/R303.1.3 Fenestration product rating
- C/R303.1.4.1 Insulated siding

2015	2012
C303.1.3 R303.1.3 C303.1.4.1 R303.1.4.1	C303.1.3 R303.1.3 **(NEW)**

- Allows ANSI/DASMA 105 to be used as a standard for determination of U-factors for garage doors
- Requires R-value of insulated siding to be determined in accordance with ASTM C1363

2015 IECC Update 21

Chapter 4: Commercial/Residential Energy Efficiency

IECC Commercial & Residential Provisions

22

Commercial Energy Efficiency

Opaque Thermal Envelope Insulation Component Minimum Requirements, R-Value & U-factor Methods

2015	2012
Table C402.1.3 C402.1.4	Table C402.2 C402.1.2

- Minimum thermal performance increased for roof insulation entirely above deck in Climate Zones 1 - 5
- Increased to be compatible with ASHRAE 90.1

2015 IECC Update 23

Commercial Energy Efficiency

Equipment Buildings

2015	2012
C402.1.2	**(NEW)**

Exempt from Envelope Provisions:

- Separate buildings not more than 500 ft^2
- Intended to house electronic equipment
- Heating system capacity ≤ 17,000 Btu/hr
- Thermostat set point restricted to ≤ 50°F
- Have a max avg wall and roof U-factor (0.2 or 0.12)
- Roof provisions of Climate Zone 1

2015 IECC Update 24

Commercial Energy Efficiency

Effective R-Values for Steel Stud Wall Assemblies

2015	2012
Table C402.1.4.1	**(NEW)**

Method to determine effective R-values for steel stud wall assemblies

TABLE C402.1.4.1
EFFECTIVE *R*-VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY *R*-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE *R*-VALUE (ER) (Cavity *R*-Value × F_c)
3 1/2	16	13	0.46	5.98
		15	0.43	6.45
	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

2015 IECC Update 25

Commercial Energy Efficiency

C402.1.5 Component performance alternative

2015	2012
C402.1.5	**(NEW)**

A + B + C + D + E ≤ Zero **(Equation 4-2)**

Where:

A = Sum of the (UA Dif) values
B = Sum of the (FL Dif) values
C = Sum of the (CA Dif) values
D = (DA · UV) - (DA · U_{Roof}), but not less than zero
E = (EA · US) - (EA · U_{Roof}), but not less than zero

Alternative component performance path for commercial buildings allows trade-offs among building envelope components.

2015 IECC Update 26

Residential Energy Efficiency

R406 Energy rating index

2015	2012
R406	**(NEW)**

TABLE R406.4
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

ERI analysis requires that the rated design ERI be ≤ the appropriate value listed in Table R406.4

2015 IECC Update 27

Commercial Energy Efficiency

Building Envelope Fenestration Maximum U-Factor and SHGC Requirements

2015	2012
C402.4	C402.3 & C402.3.3.1

- Maximum SHGCs based on Projection Factors are folded back into the fenestration table (like 2009 IECC)
- North-facing fenestration are allowed higher SHGCs

2015 IECC Update 28

Commercial Energy Efficiency

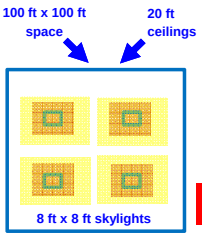
Minimum skylight fenestration area

2015	2012
C402.4.2	C402.3.2

Lowers the threshold for requiring a daylight zone in an enclosed space from 10,000 ft^2 to 2,500 ft^2

2015 IECC Update 29

Minimum skylight fenestration area



2012 IECC	2015 IECC
28 ft x 28 ft Daylight Zone	36 ft x 36 ft Daylight Zone
Daylight Zone: 3,136 / 10,000 = 31%	Daylight Zone: 5,184 / 10,000 = 51%

2015 IECC Update 30

Commercial Energy Efficiency

Increased vertical fenestration area with daylight responsive controls

2015	2012
C402.4.1.1	C402.3.1.1

Climate Zones 1-6, up to 40% vertical fenestration area:

1. Buildings ≤ 2 stories above grade, ≥ 50 % floor area is within a *daylight zone*.
2. Buildings ≥ 3 stories above grade, ≥ 25% floor area is within a *daylight zone*.
3. *Daylight responsive controls*
4. VT ≥ 1.1 x SHGC

2015 IECC Update 31

Commercial Energy Efficiency

Increased vertical fenestration SHGC

2015	2012
DELETED	C402.3.3.2

Removed an exception that allowed an increase in SHGC values in Climate Zones 1, 2, and 3.

2015 IECC Update 32

Commercial/Residential Energy Efficiency

Dynamic glazing

2015	2012
C402.4.3.3 R402.3.2	C402.3.3.5 **(NEW)**

Requires a minimum ratio of 2.4 for the higher to lower SHGC rating of dynamic glazing UNLESS both the lower and higher labeled SHGCs comply

2015 IECC Update 33

Commercial/Residential Energy Efficiency

Rooms containing fuel-burning appliances

2015	2012
C402.5.3 R402.4.4	(NEW)

Rooms containing fuel-burning appliances and their open-combustion air openings:

- Climate Zones 3 - 8
- Isolated from remainder of building in accordance with envelope provisions

2015 IECC Update 34

Commercial Energy Efficiency

Vestibules

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2015	2012
C402.5.7	C402.4.7

New exception allows an air curtain tested in accordance with ANSI/AMCA 220 to be used instead of a vestibule

2015 IECC Update 35

Commercial Energy Efficiency

Zone isolation

2015	2012
C403.2.4.4	(NEW)

Requires zones served by HVAC systems over 25,000 square feet or more than one floor to be subdivided into isolation areas to control the HVAC system in each isolation area.

2015 IECC Update 36

Commercial Energy Efficiency

Enclosed parking garage ventilation controls

2015	2012
C403.2.6.2	**(NEW)**

Ventilation optimization controls to modulate airflow

2015 IECC Update 37

Commercial Energy Efficiency

Kitchen exhaust systems

2015	2012
C403.2.8	**(NEW)**

Regulates efficiency of kitchen exhaust systems
- Replacement air
- Maximum exhaust rates

2015 IECC Update 38

Commercial Energy Efficiency

Refrigeration equipment performance

2015	2012
C403.2.14	**(NEW)**

Tables C403.2.14 (1) & (2):
- List the maximum energy use in kWh/day
- Organized by equipment type, operating mode & rating temperature

2015 IECC Update 39

Commercial Energy Efficiency

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers

2015	2012
C403.2.15 C403.2.16	(NEW)

Requirements include:
- Door self-closures
- Min. floor, wall & ceiling insulation
- Anti-sweat heaters and controls
- Lighting efficiency

2015 IECC Update 40

Commercial Energy Efficiency

Boiler turndown

2015	2012
C403.4.2.5	(NEW)

TABLE C403.4.2.5
BOILER TURNDOWN

BOILER SYSTEM DESIGN INPUT (Btu/h)	MINIMUM TURNDOWN RATIO
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
> 5,000,000 and less than or equal to 10,000,000	4 to 1
> 10,000,000	5 to 1

Turndown ratio for boilers with design input over 1,000,000 Btu/h.

2015 IECC Update 41

Commercial Energy Efficiency

Efficient heated water supply piping

2015	2012
C404.5	(NEW)

Maximum allowable pipe length method (Table C404.5.1)
- From the nearest source of heated water to termination of the fixture supply pipe
- 2 columns: public lavatory faucets and all other fixtures

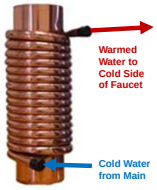
Maximum allowable pipe volume method
- Volume from the nearest source of heated water to the termination of the fixture supply pipe
- 2 oz. public lavatory faucet, ½ gallon for other fixtures

2015 IECC Update 42

Commercial/Residential Energy Efficiency

Drain water heat recovery units

2015	2012
C404.8 R403.5.4	**(NEW)**



- CSA B55.2 (commercial) CSA B55.1 (residential)
- Max 10 psi pressure loss (C404.8)
- Max 3 psi pressure loss (R403.5.4)

2015 IECC Update 43

Commercial Energy Efficiency

Vertical and horizontal transportation systems and equipment

2015	2012
C405.9	**(NEW)**

- Luminaires
- Ventilation fans
- Speed reduction
- Variable frequency regenerative drive

2015 IECC Update 44

Commercial Energy Efficiency

Additional Efficiency Package Option

2015	2012
C406	C406

- More efficient HVAC performance
- Reduced lighting power density system
- **Enhanced lighting controls**
- On-site supply of renewable energy
- **Provision of a dedicated outdoor air system for certain HVAC equipment**
- **High-efficiency service water heating**

2015 IECC Update 45

Commercial Energy Efficiency

System Commissioning

2015	2012
C408	C408

- Mechanical and service water report in separate sections to allow for independent review
- Functional testing of lighting – requirements were broken up and expanded
  - Construction documents specify performance criteria
  - O&M manuals
  - Schedule for inspection & recalibrating

2015 IECC Update 46

Summary

- The format of the IECC slightly changed
- New regulated systems and components were added
- Additional compliance paths are allowed
- Requirements for some systems have been tightened
- Daylight zone dimensions have changed
- Thermal envelope provisions remain mostly unchanged

2015 IECC Update 47

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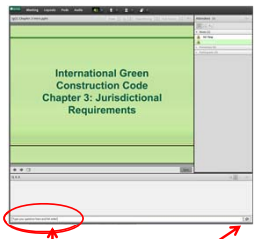

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Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings

June 2015

J Zhang
Y Xie
R Athalye
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U.S. DEPARTMENT OF ENERGY
Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The U.S. Department of Energy (DOE) Building Energy Codes Program supports the development and implementation of building energy codes and standards, which set minimum requirements for energy-efficient design and construction for new and renovated buildings, and impact energy use and greenhouse gas emissions for the life of buildings. As required by federal statute (42 USC 6833), DOE recently issued a determination that ANSI/ASHRAE/IES[1] Standard 90.1-2013 would achieve greater energy efficiency in buildings compared to the 2010 edition of the standard. In support of DOE's determination, Pacific Northwest National Laboratory (PNNL) conducted an energy savings analysis for Standard 90.1-2013 (Halverson et al. 2014). While Standard 90.1 is the national model energy standard for commercial buildings (42 USC 6833), many states have historically adopted the International Energy Conservation Code (IECC) for both residential and commercial buildings.

This report provides an assessment as to whether new buildings constructed to the commercial energy efficiency provisions of the 2015 IECC would save energy and energy costs as compared to the 2012 IECC. PNNL also compared the energy performance of the 2015 IECC with the corresponding Standard 90.1-2013. The purpose of this analysis is to help states and local jurisdictions make informed decisions regarding model code adoption.

The analysis builds on previous work done by PNNL that assessed the energy performance of the 2012 IECC compared to the 2006 and 2009 editions of the IECC (Zhang et al. 2013). For this analysis, PNNL first reviewed all code changes from the 2012 to 2015 IECC and identified those having a quantifiable impact on energy. These changes were then implemented in a suite of 16 prototype building models covering all 15 climate zones in the United States. This results in a total of 480 building models, 240 models each for the 2012 and 2015 editions of the IECC. Prototype models for the 2015 IECC were developed by implementing code changes to the 2012 IECC models. The 16 prototype building models represent more than 80% of the national stock of commercial buildings in the United States.

Whole-building energy simulations were conducted using DOE's *EnergyPlus Version 8.0* (DOE 2013) building simulation software. The resulting energy use from the complete suite of 480 simulation runs was converted to site energy use intensity (EUI, or energy use per unit floor area), and energy cost index (ECI) for each simulation. For each prototype, the resulting EUIs and ECIs in each climate zone were weighted to calculate the aggregate national level EUI and ECI. Weighting factors were developed using commercial construction data and are based on construction floor area of the different building types in each climate zone (Jarnagin and Bandyopadhyay 2010). Finally, the EUIs were aggregated across building types to the national level using the same weighting data.

Overall, the 2015 edition of the IECC results in site energy savings of 11.5% at the aggregate national level compared to the 2012 IECC edition; on a national average basis for all prototypes combined, the 2015 IECC and Standard 90.1-2013 are within 1% for both energy use and energy costs (see Appendix B in this report). Savings from the 2012 to 2015 IECC vary significantly by prototype. This is expected

[1] ANSI – American National Standards Institute; ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers; IES – Illuminating Engineering Society; IESNA – Illuminating Engineering Society of North America (IESNA rather than IES was identified with Standard 90.1 prior to 90.1-2010)

because code requirements are different by building type and by climate. A few high impact changes resulting in significant energy savings are listed below:

- Envelope: Changes to opaque envelope (see Section 3.2.1 in this report) and continuous air barrier (see Section3.2.2).
- HVAC: Equipment efficiency improvements (see Section 3.3.1), ERV (see Section 3.3.3), kitchen exhaust systems (see Section 3.3.4), staged cooling (see Section 3.3.9), fan airflow control (see Section 3.3.10), VAV reheat control (see Section 3.3.14), VAV system for critical area in healthcare facility (see Section 3.3.15), and outdoor air ventilation optimization (see Section 3.3.17).
- Lighting: Daylight responsive control (see Section 3.5.3), exterior lighting control (see Section 3.5.5), interior lighting power (see Section 3.5.6), and exterior lighting power (see Section 3.5.7).

Table ES.1 summarizes the analysis results. The 16 building prototypes are listed along with their construction weighting factors. Side-by-side comparisons of the site EUI and ECI for the 2012 and 2015 IECC are shown in the table along with their percent savings. Positive percentage savings indicate a reduction in energy or energy costs from the 2012 IECC. As shown in Table ES.1, the analysis shows an estimated site energy savings of 11.1% and energy cost savings of 11.5% on a national aggregated basis. The analysis also indicates that all building prototypes, except the Warehouse prototype, use less energy under the 2015 IECC. The Warehouse prototype uses more energy because the requirements in the 2015 IECC resulted in reduced daylit area under control compared to the 2012 IECC. These changes are specific to the Warehouse prototype and are more pronounced because lighting energy is a large portion of the total energy consumption in the Warehouse prototype.

Table ES.1. Site Energy and Energy Cost Savings between the 2012 and 2015 IECC

Building Activity	Building Prototype	Floor Area Weight (%)	Site EUI (kBtu/ft^2-yr)		Site EUI Savings (%)	ECI ($/ft^2-yr)		ECI Savings (%)
			2012 IECC	2015 IECC		2012 IECC	2015 IECC	
Office	Small Office	5.6	31.1	29.6	4.8	0.93	0.88	4.8
	Medium Office	6.0	35.5	34.6	2.5	0.99	0.97	1.9
	Large Office	3.3	76.2	71.7	6.0	2.15	2.04	5.2
Retail	Standalone Retail	15.3	54.1	47.3	12.6	1.44	1.21	16.0
	Strip Mall	5.7	58.3	54.0	7.4	1.54	1.39	9.7
Education	Primary School	5.0	62.3	55.5	10.9	1.52	1.34	11.4
	Secondary School	10.4	51.8	42.8	17.4	1.35	1.12	16.8
Healthcare	Outpatient Healthcare	4.4	137.2	117.6	14.3	3.53	3.07	13.0
	Hospital	3.4	172.2	128.0	25.7	3.72	2.98	20.0
Lodging	Small Hotel	1.7	66.4	60.4	9.2	1.49	1.3	12.6
	Large Hotel	5.0	109.5	87.9	19.8	2.37	1.81	23.9
Warehouse	Warehouse	16.7	15.0	15.5	-3.1	0.34	0.36	-5.2
Food Service	Quick-Service Restaurant	0.6	602.5	582	3.4	9.66	8.83	8.6
	Full-Service Restaurant	0.7	405.6	373.8	7.8	7.22	6.44	10.8
Apartment	Mid-Rise Apartment	7.3	45.0	44.2	1.7	1.23	1.22	1.0
	High-Rise Apartment	9.0	49.1	47.6	3.0	1.14	1.11	3.1
National Weighted Average		**100**	**61.4**	**54.5**	**11.1**	**1.49**	**1.31**	**11.5**

Figures ES.1 and ES.2 illustrate the weighted EUI and ECI for each prototype and the national weighted average results for the 2012 and 2015 editions of the IECC, respectively.

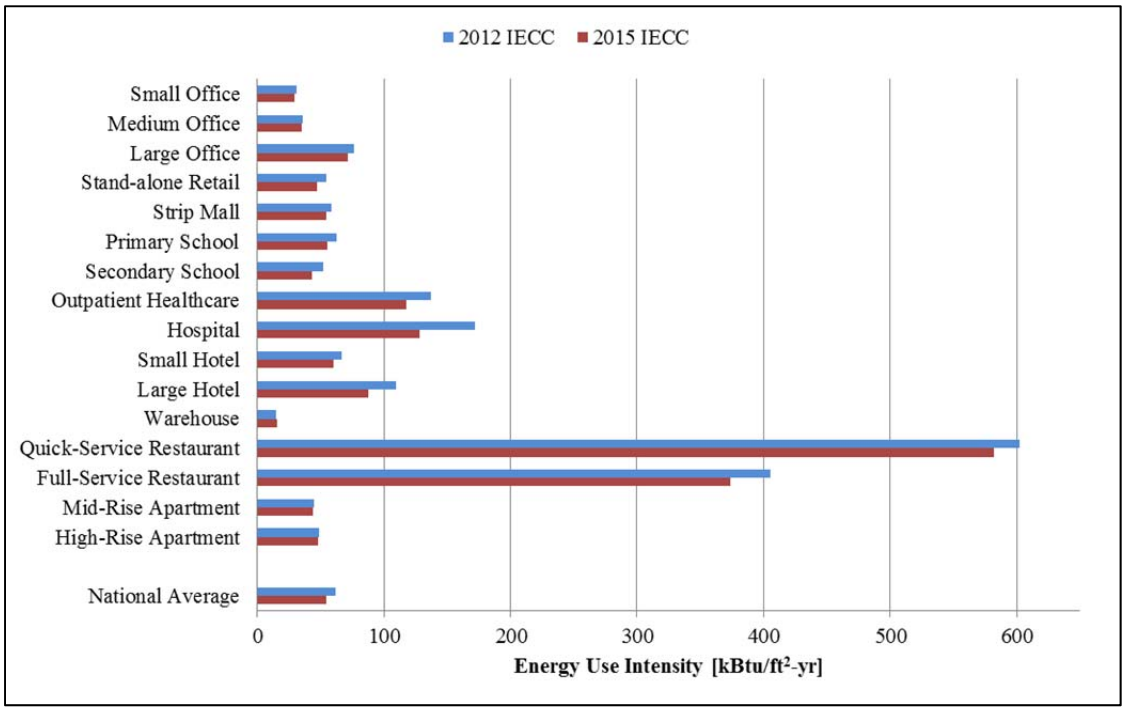

Figure ES.1. National Average Energy Use Intensity for all IECC Prototypes

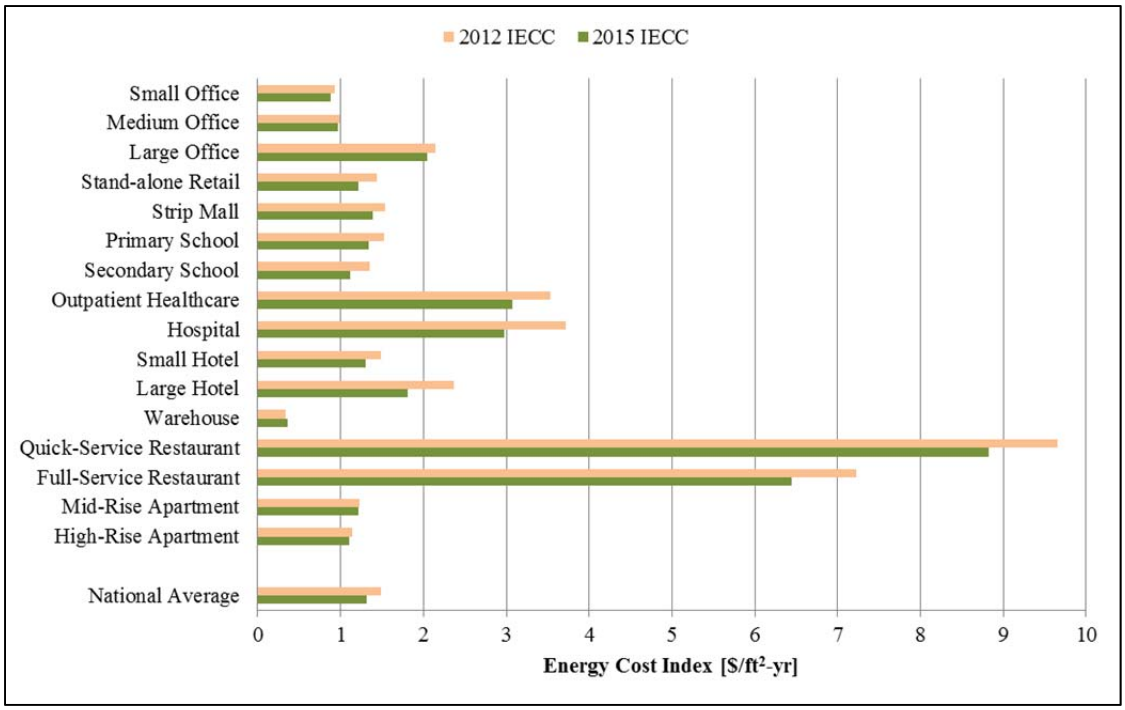

Figure ES. 2. National Average Energy Cost Index for all IECC Prototypes

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Acronyms and Abbreviations

AEDG	Advanced Energy Design Guide
AIA	American Institute of Architects
ANSI	American National Standards Institute
AHU	air handling unit
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BECP	Building Energy Codes Program
bhp	brake horsepower
Btu/h	British thermal unit(s) per hour
CBECS	Commercial Building Energy Consumption Survey
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DX	direct expansion
EC	electronically commutated
ECI	energy cost index
ECPA	Energy Conservation and Production Act
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
EMS	energy management system
EPAct	Energy Policy Act
ERV	energy recovery ventilator
EUI	energy use intensity
ft^2	square feet
hp	horsepower
HVAC	heating, ventilation, and air-conditioning
ICC	International Code Council
IECC	International Energy Conservation Code
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IMC	International Mechanical Code
$kBtu/ft^2$-yr	thousand British thermal unit(s) per square foot per year
kBtu/h	thousand British thermal unit(s) per hour
kWh	kilowatt hour(s)
LPD	lighting power density
MAT	mixed air temperature
NAECA	National Appliance Energy Conservation Act
PLR	part load ratio

PNNL	Pacific Northwest National Laboratory
SAT	supply air temperature
SEER	seasonal energy efficiency ratio
SHGC	solar heat gain coefficient
SWH	service water heating
TMY	typical meteorological year
VAV	variable air volume
VT	visible transmittance
WSHP	water source heat pump
WWR	window-to-wall ratio
w.c.	water column

Contents

List of Figures

List of Tables

1.0 Introduction

The U.S. Department of Energy (DOE) Building Energy Codes Program supports the development and implementation of building energy codes and standards, which set minimum requirements for energy-efficient design and construction for new and renovated buildings, and impact energy use and greenhouse gas emissions for the life of buildings.

As required by federal statute (42 USC 6833), DOE recently issued a determination that ANSI/ASHRAE/IES[1] Standard 90.1-2013 would achieve greater energy efficiency in buildings subject to the code compared to the 2010 edition of the standard.[2] Pacific Northwest National Laboratory (PNNL) conducted an energy savings analysis for Standard 90.1-2013 in support of the determination (Halverson et al. 2014). While Standard 90.1 is the national model energy standard for commercial buildings (42 USC 6833), many states have historically adopted the International Energy Conservation Code (IECC) for both residential and commercial buildings. Of the 47 states with statewide commercial building energy codes currently, 37 use a version of the IECC (BECP 2015). The Commercial Energy Efficiency chapter in the 2015 IECC (International Code Council, ICC 2015a) allows users to either follow the provisions in the IECC or use Standard 90.1-2013 as an alternative compliance path. This report provides an assessment as to whether new buildings constructed to the commercial energy efficiency provisions of the 2015 IECC would save energy and energy costs compared to the 2012 IECC (ICC 2012). Because PNNL used the same methodology for both this 2015 IECC analysis and the previous Standard 90.1-2013 analysis, comparisons between the estimated energy performance of the 2015 IECC and that of its referenced Standard 90.1-2013 are presented in Appendix B of this report. The goal of this analysis is to help states and local jurisdictions make informed decisions regarding model code adoption.

This report documents the approach and results for PNNL's analysis for energy and energy cost savings of the 2015 IECC for commercial buildings. PNNL first reviewed all code changes from the 2012 to 2015 IECC and identified those having a quantifiable impact. PNNL then used two suites of building prototypes, each suite complying with one edition of the IECC. Each suite consists of 240 building prototypes; a combination of 16 building prototypes in all 15 U.S. climate zones. The 2012 IECC prototypes were taken from PNNL's previous analysis of the energy performance of the 2012 IECC compared to its previous editions which was documented in *Energy and Energy Cost Savings Analysis of the IECC for Commercial Buildings* (Zhang et al. 2013), referred to here as *Analysis of the 2012 IECC*.

The current report is organized as follows: Section 2.0 summarizes the general methodology about the building prototypes, their development, and simulation for their energy use and cost. The same methodology was applied in the previous *Analysis of the 2012 IECC* and the Standard 90.1-2013 determination (Halverson et al. 2014). Section 3.0 describes how PNNL developed the 2015 IECC prototypes using the 2012 IECC prototypes as a basis. Finally, Section 4.0 summarizes the results of the comparison of the two editions of the IECC. Appendix A summarizes the identified code changes between the 2012 and 2015 IECC (with quantified energy impacts) and identifies which building prototypes are impacted by each change. Appendix B provides energy and energy cost comparisons between Standard 90.1-2013 and the 2015 IECC.

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[1] ANSI – American National Standards Institute; ASHRAE – American Society of Heating, Refrigerating, and Air- Conditioning Engineers; IES – Illuminating Engineering Society; IESNA – Illuminating Engineering Society of North America (IESNA rather than IES was identified with Standard 90.1 prior to 90.1-2010)

[2] For more information on the DOE Determination of energy savings, see http://www.energycodes.gov/regulations/determinations

2.0 Methodology

To support the development and implementation of building energy codes, PNNL researchers have developed building prototypes that comply with various editions of energy codes including both Standard 90.1 and IECC. These building prototypes represent the majority of new commercial building stock and were developed using DOE's *EnergyPlus Version 8.0* building energy simulation software (DOE 2013). The results allow comparison of the national weighted average savings of one code to its earlier edition and the relative performance differences between the codes. This section summarizes the general methodology used for this 2015 IECC analysis, which is consistent with that used for the *Analysis of the 2012 IECC*.

2.1 Building Prototypes

For this analysis, PNNL used a suite of building prototypes representing the first seven principal building activities in the Commercial Buildings Energy Consumption Survey (CBECS; EIA 2003). These seven principal building activities represent 76% of the building energy usage of commercial buildings. In addition, two multifamily prototypes (Mid-Rise and High-Rise Apartments) which are not included in CBECS were added into the suite of prototypes. These two prototypes were included in the analysis because they are regulated by the commercial provisions of the IECC. Table 2.1 shows the seven principal activities as defined in CBECS and the added apartment activity. These eight building activities were further divided into 16 building prototypes as listed in Table 2.1 along with their floor area, representing 80% of new construction floor area in the United States. Detailed descriptions of these prototypes and enhancements are documented in Thornton et al. (2011) and Goel et al. (2014).

2.2 Climate Zones

The climate zone and moisture regime definitions used by the IECC include eight zones (climate zones 1 through 8) and three moisture regimes (A – moist, B – dry, and C – marine). Each combination of climate zone and moisture regime defines a climate subzone. For this analysis, a specific climate (city) is selected (representing 15 climate subzones covering the entire United States) as shown in Figure 2.1 (Briggs et al. 2003). The term climate zone is used interchangeably with climate subzone in this report.

Table 2.1. Building Prototypes

Building Activity	Building Prototype	Prototype Floor Area (ft^2)
Office	Small Office	5,500
	Medium Office	53,630
	Large Office	498,640
Retail	Standalone Retail	24,690
	Strip Mall	22,500
Education	Primary School	73,970
	Secondary School	210,910
Healthcare	Outpatient Healthcare	40,950
	Hospital	241,410
Lodging	Small Hotel	43,210
	Large Hotel	122,120
Warehouse	Warehouse	52,050
Food Service	Quick-Service Restaurant	2,500
	Full-Service Restaurant	5,500
Apartment	Mid-Rise Apartment	33,740
	High-Rise Apartment	84,360

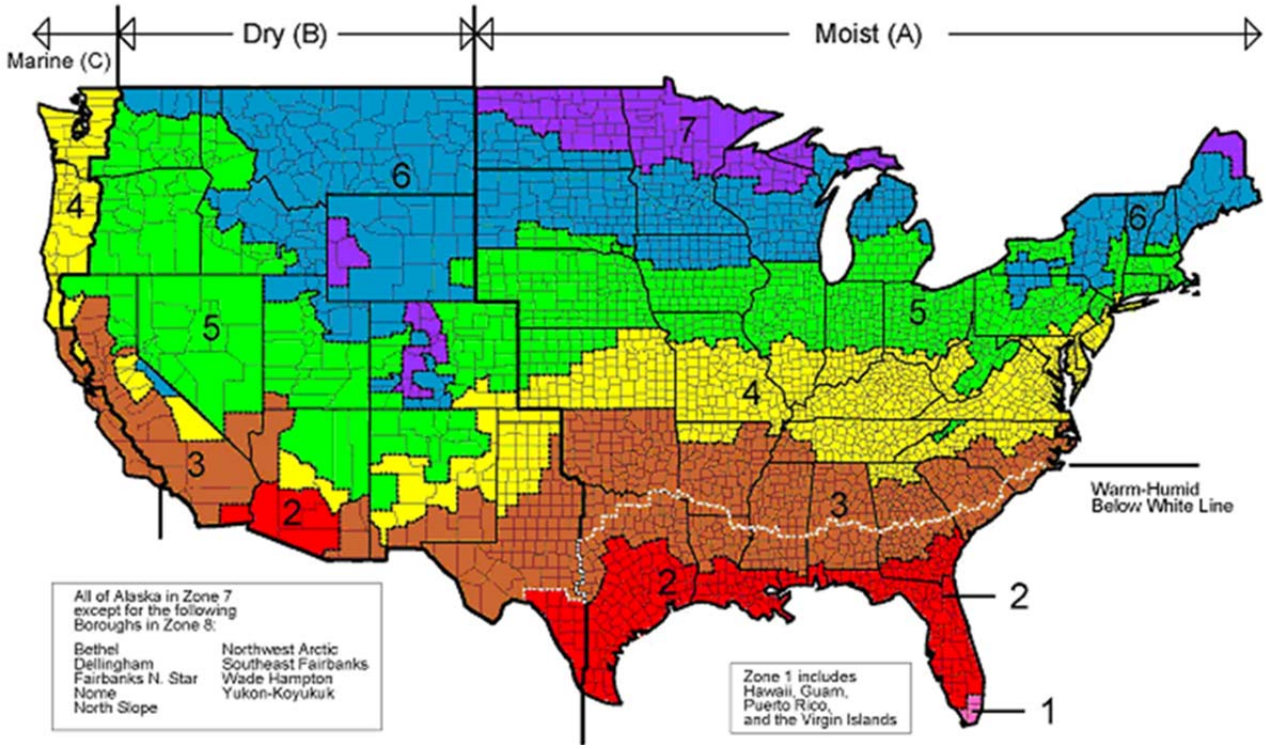

Figure 2.1. Climate Zone Map (Briggs et al. 2003)

The 15 climate locations representing the climate zones are:

- 1A: Miami, Florida (very hot, humid)
- 2A: Houston, Texas (hot, humid)
- 2B: Phoenix, Arizona (hot, dry)
- 3A: Memphis, Tennessee (warm, humid)
- 3B: El Paso, Texas (warm, dry)
- 3C: San Francisco, California (warm, marine)
- 4A: Baltimore, Maryland (mixed, humid)
- 4B: Albuquerque, New Mexico (mixed, dry)
- 4C: Salem, Oregon (mixed, marine)
- 5A: Chicago, Illinois (cool, humid)
- 5B: Boise, Idaho (cool, dry)
- 6A: Burlington, Vermont (cold, humid)
- 6B: Helena, Montana (cold, dry)
- 7: Duluth, Minnesota (very cold)
- 8: Fairbanks, Alaska (subarctic)

2.3 Comparison Metrics and Construction Weights

Annual electricity and natural gas energy use in each building prototype was simulated across 240 buildings, a combination of 16 prototypes in all 15 U.S. climate zones. This simulated energy use is utility electricity and natural gas delivered and used at the building site. The site energy use was converted to site energy use intensity (site EUI, or energy use per unit floor area).

To estimate the energy cost, PNNL used annual national average commercial building energy prices of $0.1029/kWh of electricity and $8.17 per 1000 cubic feet ($0.796/therm) of natural gas. These prices were available from the Energy Information Administration (EIA) and are listed in Table 2, "U.S. Energy Prices," of the February 2014 Short Term Energy Outlook for commercial sector natural gas and electricity[1]. The same set of prices was used for all prototypes and in all climate zones. The annual energy costs for each building were calculated for each fuel type (electricity and natural gas) by using the energy prices for all buildings. These costs were converted to energy cost index (ECI, or energy cost per unit floor area) for each building.

The EUI and ECI results of each building are weighted by construction volume for each building prototype and climate zone to calculate the national weighted average EUI and ECI. Weighting factors developed by building type and climate-related geographic areas in the United States were derived from 5 years of recent construction data (Jarnagin and Bandyopadhyay 2010). Table 2.2 lists the weighting factors assigned to each prototype in all 15 U.S. climate zones.

[1] EIA Short Term Energy Outlook available at http://www.eia.gov/forecasts/steo/report/.

Table 2.2. Construction Area Weights by Building Prototype and Climate Zone (Jarnagin and Bandyopadhyay 2010)

	1A (%)	2A (%)	2B (%)	3A (%)	3B (%)	3C (%)	4A (%)	4B (%)	4C (%)	5A (%)	5B (%)	6A (%)	6B (%)	7 (%)	8 (%)	Weights by Building Type (%)
Small Office	0.084	1.064	0.289	0.963	0.475	0.078	0.936	0.047	0.123	0.920	0.322	0.241	0.030	0.032	0.005	5.608
Medium Office	0.129	0.813	0.292	0.766	0.715	0.136	1.190	0.036	0.196	1.060	0.342	0.298	0.035	0.033	0.007	6.047
Large Office	0.102	0.326	0.061	0.445	0.285	0.117	1.132	0.000	0.154	0.442	0.121	0.133	0.000	0.011	0.000	3.327
Standalone Retail	0.224	2.220	0.507	2.386	1.250	0.191	2.545	0.119	0.428	3.429	0.792	0.948	0.091	0.109	0.014	15.254
Strip Mall	0.137	0.991	0.254	1.021	0.626	0.103	1.008	0.023	0.107	1.023	0.201	0.153	0.016	0.007	0.001	5.669
Primary School	0.064	0.933	0.164	0.944	0.446	0.048	0.895	0.030	0.094	0.920	0.224	0.168	0.037	0.023	0.003	4.994
Secondary School	0.160	1.523	0.230	1.893	0.819	0.109	2.013	0.063	0.243	2.282	0.438	0.415	0.086	0.075	0.012	10.361
Outpatient Healthcare	0.037	0.567	0.134	0.581	0.275	0.061	0.818	0.023	0.181	1.058	0.218	0.342	0.033	0.039	0.002	4.371
Hospital	0.040	0.479	0.096	0.468	0.273	0.039	0.615	0.022	0.106	0.812	0.218	0.221	0.024	0.034	0.001	3.448
Small Hotel	0.010	0.288	0.030	0.268	0.114	0.022	0.315	0.020	0.039	0.365	0.089	0.107	0.031	0.020	0.004	1.721
Large Hotel	0.109	0.621	0.125	0.635	0.793	0.106	0.958	0.037	0.123	0.919	0.200	0.227	0.058	0.038	0.004	4.951
Warehouse	0.349	2.590	0.580	2.966	2.298	0.154	2.446	0.068	0.435	3.580	0.688	0.466	0.049	0.043	0.002	16.716
Quick-Service Restaurant	0.008	0.092	0.020	0.102	0.063	0.007	0.089	0.005	0.014	0.128	0.026	0.025	0.003	0.004	0.000	0.587
Full-Service Restaurant	0.009	0.106	0.025	0.111	0.047	0.006	0.127	0.006	0.010	0.143	0.031	0.031	0.004	0.004	0.000	0.660
Mid-Rise Apartment	0.257	1.094	0.093	0.825	0.862	0.260	1.694	0.022	0.371	1.122	0.318	0.313	0.056	0.032	0.000	7.321
High-Rise Apartment	1.521	1.512	0.076	0.652	0.741	0.173	2.506	0.000	0.358	1.163	0.115	0.125	0.016	0.008	0.000	8.967
Weights by Climate Zone	**3.242**	**15.217**	**2.975**	**15.025**	**10.081**	**1.609**	**19.286**	**0.522**	**2.981**	**19.366**	**4.344**	**4.214**	**0.569**	**0.513**	**0.056**	**100**

2.4 Enhancements to the 2012 IECC Building Prototypes

The 2012 IECC prototypes from the *Analysis of the 2012 IECC* served as a starting point for developing the 2015 IECC prototypes. In this analysis, PNNL made enhancements to the 2012 IECC prototypes for several reasons. The major ones, grouped by reason, include:

1) Improvements to simulation accuracy

a. added multilevel automatic daylighting control to the multipurpose room in Primary School;

b. revised modeling strategy for demand control ventilation in Primary School and Secondary School;

c. revised modeling inputs for pipe heat loss of service water heating (SWH) for all prototypes;

2) Simulation infrastructure updates

a. updated simulation models of the prototypes from DOE *EnergyPlus Version 6.0* to *8.0*;

b. updated the weather files from typical meteorological year (TMY) 2 to TMY3;

3) Enhancements to provide more detail to capture new requirements

a. added additional infiltration loads to selected guestrooms in Small Hotel and Large Hotel to reflect balcony door opening;

b. revised thermostat setpoints during the morning warmup hours for heating, ventilation, and air-conditioning (HVAC) systems in Small Office, Large Office, Primary School, Secondary School, Quick-Service Restaurant, Full-Service Restaurant, Mid-Rise Apartment, and High-Rise Apartment;

c. revised part-load curves of boilers in Large Office, Primary School, Secondary School, Outpatient Healthcare, Hospital, and High-Rise Apartment;

d. added plug-in lights to Mid-Rise and High-Rise Apartments; and

e. added retail display lighting allowance for Strip Mall.

In addition, there are code changes in the 2015 IECC which reflect changes to DOE's Appliance and Commercial Equipment Standards for HVAC, SWH, and refrigeration equipment[1]. These standards were previously developed by DOE or enacted independently through federal legislation. Because the energy savings attributable to these would accrue no matter what edition of the IECC is complied with, they were not considered as code changes contributing to energy savings in this analysis. Therefore, PNNL updated the efficiency of the affected products in the 2012 IECC prototypes to match requirements in the 2015 IECC as follows:

- refrigerators, freezers, and walk-in coolers and freezers in Primary School, Secondary School, Hospital, Large Hotel, Quick-Service Restaurant, and Full-Service Restaurant; and
- gas-fired boiler with capacity under 300,000 British thermal unit(s) per hour (Btu/h) in Outpatient Healthcare.

[1] Energy efficiency standards for appliances and equipment established by DOE are available at the http://energy.gov/eere/buildings/appliance-and-equipment-standards-program

Table 2.3 shows the site EUI for the 2012 IECC before and after the enhancements were made to the prototypes. Although these enhancements show different levels of impacts on the results on a prototype -by- prototype basis, the impacts on the national weighted average site EUI is small, from 62.1 to 61.4 thousand British thermal units per square foot per year (kBtu/ft^2-yr).

Table 2.3. Site EUI of the 2012 IECC Before and After Enhancements

Building Type	Building Prototype	Floor Area Weight %	Site EUI (kBtu/ft^2-yr) Pre-Enhancements	Site EUI (kBtu/ft^2-yr) Post-Enhancements
Office	Small Office	5.6	30.5	31.1
	Medium Office	6.0	36.2	35.5
	Large Office	3.3	77.7	76.2
Retail	Standalone Retail	15.3	53.8	54.1
	Strip Mall	5.7	55.8	58.3
Education	Primary School	5.0	63.3	62.3
	Secondary School	10.4	51.2	51.8
Healthcare	Outpatient Healthcare	4.4	147.9	137.2
	Hospital	3.4	173.4	172.2
Lodging	Small Hotel	1.7	66.2	66.4
	Large Hotel	5.0	109.3	109.5
Warehouse	Warehouse	16.7	15.6	15.0
Food Service	Quick-Service Restaurant	0.6	609.5	602.5
	Full-Service Restaurant	0.7	412.2	405.6
Apartment	Mid-Rise Apartment	7.3	44.6	45.0
	High-Rise Apartment	9.0	51.5	49.1
National Weighted Average		**100**	**62.1**	**61.4**

3.0 2015 IECC Building Prototype Development

The starting point for the 2015 prototypes was the enhanced versions of the 2012 prototypes as described in the preceding section. In this section, PNNL compares code changes in commercial energy efficiency provisions between the 2012 and 2015 IECC and documents how they were implemented in the 2015 IECC prototypes and modeled in *EnergyPlus*. Where an implementation approach is similar to one described in previous PNNL reports (e.g., Thornton et al. 2011, Zhang et al. 2013, Goel et al. 2014, and Halverson et al. 2014), reference is made to these reports rather than reproducing the text here.

3.1 Review of Code Changes

Chapter 4 Commercial Energy Efficiency of the IECC provides three alternative paths for a new building to show compliance: (1) the mandatory and prescriptive requirements in the IECC; (2) the mandatory and total building performance requirements in the IECC; or (3) the requirements in the referenced Standard 90.1. This analysis looks only at compliance path (1), comparing the energy performance of the 2012 requirements relative to the 2015 requirements.

PNNL classified code changes into three categories, including 1) clarify requirements without changing their efficiency; 2) result in energy efficiency impacts but cannot be quantified using the building prototypes; and 3) result in energy efficiency impacts that can be quantified. Only those in the third category (see Appendix A) were incorporated into the 2015 IECC building prototypes. The most common reason why a change in the second category was not implemented was that the class of equipment or the particular requirements impacted by the change were not represented in the building prototypes. Other reasons were if *EnergyPlus* was not able to simulate the change or the change applied only to existing buildings instead of new buildings.

3.2 Building Envelope

Section C402 of the 2012 and 2015 IECC specifies requirements for building thermal envelope performance. The code as it relates to the envelope was modified in three areas: opaque envelope performance, fenestration area, and continuous air barrier. Because the fenestration area requirements are related to code changes for daylight responsive controls, these changes are discussed in Section 3.5.3 of this report.

3.2.1 Opaque Envelope Performance

Table C402.1.2 in the 2012 IECC becomes Table C402.1.4 in the 2015 IECC. This table lists opaque thermal envelope assembly requirements using U-factor, C-factor and F-factor-based method. The code changes in the U-factor requirements for roof (insulation entirely above deck type) and exterior wall (mass wall type) are applicable to all building prototypes, except for Small Office, Quick-Service Restaurant, and Full-Service Restaurant. PNNL calculated the R-value of the insulation layer in the wall or roof construction assembly in a prototype by using the changed U-factor requirements. PNNL implemented this R-value in the simulation models of the 2015 IECC prototypes.

3.2.2 Continuous Air Barrier

Section C402.4 of the 2012 IECC addresses the air leakage requirements. A continuous air barrier (CAB) is needed throughout the building envelope except for buildings in climate zones 1 through 3. Three compliance options are provided: (1) materials, (2) assemblies, and (3) whole building air leakage test. In this study, PNNL assumed a prototype has an air leakage rate of 1.8 cfm/ft^2 of exterior wall under a pressure differential of 0.30 in. water column (w.c.) if it is exempted from the CAB requirement. We assumed a rate of 1.0 cfm/ft^2 when the CAB requirement applied. These values were derived in previous analysis (see Section 5.2.1.1 of Thornton et al 2011).

The 2015 IECC (Section C402.5) only allows climate zone 2B to be exempted from the CAB requirement. To implement the code change, PNNL extended CAB to the 2015 IECC prototypes in climate zones 1A, 2A, 3A, 3B, and 3C by using an air leakage rate of 1.0 cfm/ft^2.

3.3 Building Mechanical Systems

Section C403 of the 2012 and 2015 IECC specifies requirements for building mechanical systems. There are several code changes to the Section C403, such as changes to minimum equipment efficiency, controls of HVAC equipment, and extension of the scope to cover more equipment types. Because the building prototypes only cover limited types of equipment and systems with certain capacity ranges, this analysis only estimates the code changes that are applicable to the prototypes.

3.3.1 Heating, Ventilating, and Air-Conditioning Equipment Performance Requirements

Section C403.2.3 of the 2012 IECC specifies minimum efficiency requirements for various HVAC equipment types. The requirements for the following types of equipment were changed from the 2012 to 2015 IECC:

- air-cooled unitary air conditioners (single package, size category of <65 thousand British thermal units per hour, or kBtu/h),
- air-cooled unitary heat pumps (single package, both heating and cooling modes, size category of <65 kBtu/h),
- water-to-air water loop heat pumps (cooling mode, size categories of <17 kBtu/h, 17-65 kBtu/h, and 65-135 kBtu/h),
- water-to-air water loop heat pumps (heating mode, size category of <135 kBtu/h),
- packaged terminal air conditioners (all sizes),
- hot water boilers (gas-fired, size category of <300 kBtu/h),
- air-cooled chillers (all sizes),
- water-cooled chillers (all sizes), and
- axial fan for open-circuit cooling tower (all sizes).

The changed efficiency was modeled in the 2015 IECC prototypes using the same methodology as in the 2012 IECC prototypes. Required equipment efficiency is based on equipment capacity that was calculated for each prototype at each climate zone using a design day sizing simulation in *EnergyPlus*. PNNL used this capacity to identify the required efficiency in the IECC and then ran an annual simulation using this efficiency. When efficiency values vary by effective dates in the IECC, PNNL used the values with latest dates. For example, Table C403.2.3(1) in the 2015 IECC lists single package air-cooled air conditioners under 65,000 Btu/h to have a minimum efficiency of 13 seasonal energy efficiency ratio (SEER) before January 1, 2016, and 14 SEER as of January 1, 2016. Efficiency of 14 SEER was used in this analysis.

While there is an increase in efficiency requirements for gas-fired hot water boilers with capacity less than 300 kBtu/h from the 2012 to 2015 IECC, this reflects the minimum federally mandated equipment efficiency for this type of boilers. Therefore, the higher boiler efficiency listed in the 2015 IECC was applied to both the 2012 and 2015 IECC building prototypes. Only Outpatient Healthcare has boilers smaller than 300,000 Btu/h.

3.3.2 Hot Water Boiler Outdoor Temperature Setback Control

Section C403.2.5 of the 2015 IECC introduces a new requirement that hot water boilers shall have a control that can automatically lower the boiler water temperature setpoint based on the outdoor air temperature. Section C403.4.2.4 of the 2012 IECC requires that hydronic heating systems have either a temperature reset control or variable flow.

Six building prototypes, i.e., Large Office, Secondary School, Outpatient Healthcare, Hospital, Large Hotel, and High-Rise Apartment, use hot water boilers for heating. Because the 2012 IECC buildings all use variable flow hydronic heating systems, temperature reset control was not implemented.

For the 2015 IECC, PNNL applied outdoor temperature setback control to Large Office, Secondary School, Outpatient Healthcare, Hospital, and Large Hotel. The implemented control is that boiler temperature setpoint is

- equal to the design supply temperature if the outdoor temperature is below 20°F,
- reset by 25% of the design supply-to-return water temperature difference if the outdoor temperature is above 50°F, and
- reset to a value that is linearly interpolated between the two setpoint temperatures above if the outdoor temperature is between 20°F and 50°F.

High-Rise Apartment uses a closed-loop water source heat pump (WSHP) system to provide both heating and cooling to the space. The recirculated water in WSHP serves as heating and cooling source for the water-to-air heat pump in each zone. The water temperature is maintained between two setpoints: 68°F and 86°F by a central fluid cooler and a central boiler. No central heating or cooling is needed if the temperature is within this range. Even when the water temperature is at the lower setpoint of 68°F, the water could serve as both heating and cooling sources for different zones at the same time. Therefore, resetting the setpoint from 68°F to a lower value is not desired. As such, PNNL did not implement this control requirement to High-Rise Apartment for the 2015 IECC. An exception to this hot water boiler outdoor temperature setback control requirement may be added for WSHP systems in the future edition of the IECC.

3.3.3 Energy Recovery Ventilator

Section C403.2.6 of the 2012 IECC specifies the energy recovery ventilator (ERV) requirements by climate zone for different outdoor air fraction and design supply fan size thresholds. These requirements are for systems with outdoor air fractions above 30%. The changes from the 2012 to 2015 IECC, in Table C403.2.7(1) in Section C403.2.7, reduced the fraction threshold to 10% in climate zones 1A, 2A, 3A, 4A, 5A, 6A, 6B, 7, and 8. Additionally, the requirements for climate zones 3B, 3C, 4B, 4C, and 5B for systems with the outdoor air fraction above 70% were removed from the 2012 to 2015 IECC. Finally, Table C403.2.7(2) in the 2015 IECC adds a new set of requirements for ventilation systems operating more than 8,000 hours per year.

Based on the HVAC system sizing information from the *EnergyPlus* design day simulation, each air handling unit (AHU) of the building prototypes in each climate zone was checked to determine whether an ERV should be required by the 2015 IECC. Hospital and Large Hotel are assumed to operate more than 8,000 hours per year. This code change was implemented in Medium Office, Large Office, Standalone Retail, Strip Mall, Primary School, Secondary School, Outpatient Healthcare, Hospital, and Large Hotel.

AHUs in Mid-Rise Apartment, High-Rise Apartment, and Small Hotel in certain climate zones meet the trigger for the ERV requirements in the 2015 IECC. However, ERVs were not added to these prototypes because ERV products are usually not available for those small AHUs. An exception to this ERV requirement may be added in the future edition of the IECC for systems with very low outdoor air intake.

3.3.4 Kitchen Exhaust Systems

The 2012 IECC does not have requirements for kitchen exhaust hoods and kitchen ventilation systems. Baseline assumptions were made in previous analysis (Zhang et al. 2013) for kitchens in Primary School, Secondary School, Quick-Service Restaurant, Full-Service Restaurant, Large Hotel, and Hospital based on engineering judgment and a review of actual kitchen designs for these building types.

The 2015 IECC introduces new requirements for all kitchen exhaust systems, as listed in Section C403.2.8. The requirements that were implemented to the 2015 IECC prototypes are:

- All available transfer air from adjacent spaces shall be used before any other makeup air is introduced to the kitchen for any size hood.
- All hoods shall meet maximum net exhaust flow rate requirements listed in Table C403.2.8 if the total kitchen exhaust airflow rate in the kitchen/dining facility is greater than 5,000 cfm.
- Kitchen/dining facilities with total kitchen hood exhaust airflow rate larger than 5,000 cfm shall meet one of three options: (a) at least 50% of replacement air from transfer air; (b) cooking-load-based demand control ventilation; and (c) energy recovery devices on exhaust airflow.

Changes to building prototypes for the 2015 IECC include the use of transfer air, reduction of exhaust airflow rate, and the use of demand control ventilation. These changes vary by prototype and by climate zone.

3.3.5 Fan Power Limitation Adjustment Credits

The 2012 IECC specifies maximum allowable fan power limits for HVAC systems at their fan system design conditions. Depending on the devices used in the systems, which affect the system air pressure drop, the IECC allows adjustments (credits) to the allowable limits using Table C403.2.10.1(2).

The 2015 IECC adds new adjustment items (deductions) to the table, Table C403.2.12.1(2). With this code change, systems without a central cooling coil are required to deduct 0.6 in. w.c. from their fan power limits. Systems without a central heating coil are required to deduct 0.3 in. w.c. Finally, systems with a central electric resistance heating element are required to deduct 0.2 in. w.c.

All building prototypes have central cooling coils but none has central electric resistance coils. Therefore, the code changes only affect those without central heating coils. All single-zone HVAC systems in the building prototypes need central heating coils. Hospital, Large Hotel, Large Office, Medium Office, Outpatient Healthcare, Primary School, and Secondary School have multiple-zone variable air volume (VAV) systems. A central heating coil in a VAV system serves to heat the mixed return and outdoor ventilation air from a mixed air temperature (MAT) to a supply air temperature (SAT) setpoint of 55°F. If the MATs never drop below 55°F, the VAV system does not need a central heating coil.

To determine the systems that must take the deduction to their fan power limits, PNNL calculated the lowest MAT for each prototype in each climate zone by using their heating design outdoor air temperature, return air temperature, and design outdoor air fraction. For those systems with the calculated lowest MATs higher or equal to 55°F, PNNL reduced their fan power limits by 0.3 in. w.c. in the 2015 IECC prototypes.

3.3.6 Reach-in Refrigerator and Freezer

The 2012 IECC does not prescribe requirements for commercial refrigerators and freezers. The 2015 IECC expands the scope of the code to add requirements for such equipment in Section C403.2.14. These new requirements reflect changes to national manufacturing standards per 10 Code of Federal Regulations (CFR) part 431, which went into effect on January 1, 2012. Because the energy savings that are attributable to these national manufacturing standards would accrue no matter what edition of the IECC is used, PNNL applied the same efficiency requirements in the 2015 IECC to both the 2012 and 2015 IECC building prototypes.

PNNL assumed that solid-door commercial refrigerators and freezers are used in the kitchens of Quick-Service Restaurant, Full-Service Restaurant, Hospital, Large Hotel, Primary School, and Secondary School. Table 3.1 shows the sizes and numbers of commercial freezers and refrigerators in the building prototypes. The efficiency requirements, in kWh/day, were modelled as a plug load with a constant operation schedule in *EnergyPlus*. Table 3.2 shows the energy use limits used to calculate the input power of commercial refrigerators and freezers for both the 2012 and 2015 IECC.

Table 3.1. Commercial Solid-Door Refrigerators and Freezers in Prototypes

Building Prototype	Number of Freezers (typical volume V=24 ft^3)	Number of Refrigerators (typical volume V=48 ft^3)
Quick-Service Restaurant	1	2
Full-Service Restaurant	1	2
Hospital	2	3
Large Hotel	1	1
Primary School	2	2
Secondary School	2	2

Table 3.2. The 2015 IECC Requirements for Commercial Refrigerators and Freezers in Prototypes

Equipment	Energy Use Limits (kWh/day)
Reach-in refrigerators with solid doors	0.10V + 2.04
Reach-in freezers with solid doors	0.40V + 1.38

3.3.7 Manufactured Walk-in Cooler and Freezer

The 2012 IECC does not have any requirements for walk-in coolers and freezers. The 2015 IECC expands the scope of the code to add requirements for such equipment as defined in Section C403.2.15. The new requirements have been defined and legislated as the national manufacturing standard and described in 10 CFR 431.306. The requirements are for cover doors, insulation, evaporator fan motor, lighting, anti-sweat heater, condenser fan motor, and their controls.

The code change affects six building prototypes with commercial kitchens: Quick-Service Restaurant, Full-Service Restaurant, Hospital, Large Hotel, Primary School, and Secondary School. PNNL assumed that the walk-in coolers and freezers in these prototypes are manufactured as opposed to site-assembled or site-constructed. We also assumed them to be packaged equipment without remote compressors and condensers.

Navigant (2009) developed characteristics of baseline walk-in coolers and freezers, which show typical efficiency levels of the equipment before the new manufacturing standard. PNNL found that these characteristics either meet or exceed most requirements in the 2015 IECC, except for the evaporator fan motor and the lighting requirements. To capture these new requirements, the evaporator fan motors in the prototypes were assumed to be electronically commutated (EC) motors with an average motor efficiency of 70%, which was determined by surveying typical efficiencies listed in manufacturer catalogs. The efficiency was modelled as the fan power inputs in *EnergyPlus* models of the prototypes. The impact of the lighting control requirement was modeled as a 10% reduction in the hourly lighting schedule from the baseline models. This simulates the energy saving benefits from an occupancy-sensor-based lighting control. Because the energy savings that are attributable to the national manufacturing standards would

accrue no matter what edition of the IECC is used, PNNL applied the same efficiency requirements to both the 2012 and 2015 IECC building prototypes.

3.3.8 Economizer

There are several changes to the economizer requirements from the 2012 (Section C403.3.1 and C403.4.1) to 2015 IECC (Section C403.3) including capacity threshold increase, water economizer requirements, and combined requirements for simple and complex systems (previously separate in the 2012 IECC). This section describes the implementation for capacity threshold increase; Sections 3.3.9 and 3.3.10 discuss other code changes related to economizers in the prototypes.

To capture the energy impacts of the increased thresholds, first, a sizing simulation was conducted for each prototype with air economizers disabled in *EnergyPlus* to determine the cooling capacity of each direct expansion (DX) coil in the prototype. Second, the prototype was modified to enable the air economizer if the capacity exceeded the thresholds in the IECC. If the capacity was below the thresholds, the economizer remained disabled. This two-step procedure was followed for both the 2012 and 2015 IECC prototypes, and the differences between them are the thresholds shown in Table 3.3.

Table 3.3. Economizer Requirements by Cooling Capacity Thresholds and Climate Zones

Cooling Capacity Threshold (Btu/hr)	2012 IECC (climate zone)	2015 IECC (climate zone)
No requirement	1A, 1B	1A, 1B
>=33,000	2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	
>=54,000		2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8

3.3.9 Staged Cooling

Section C403.3.1 in the 2015 IECC introduces a new staged cooling requirement for DX units, which is not contained in the 2012 IECC. According to item 3 under Section C403.3.1, for DX units that control 75,000 Btu/h or greater of rated capacity directly based on occupied space temperature (usually serving a single zone), a minimum of two stages of mechanical cooling capacity are required. Another related new code requirement (see Section 3.3.10 of this report) in Table C403.4.1.1 of the 2015 IECC requires a two-stage fan control for DX units with cooling capacity over 65,000 Btu/h (after January 1, 2016). In practice, a DX unit would either have both staged cooling and staged fan controls together or neither of them. For this reason, PNNL used 65,000 Btu/h as the threshold for the staged cooling requirement instead of 75,000 Btu/h.

Eight building prototypes use packaged single-zone DX cooling units: Standalone Retail, Strip Mall, Quick-Service Restaurant, Full-Service Restaurant, Primary School, Secondary School, Small Hotel, and Warehouse. For the 2012 IECC, these prototypes all use single-stage cooling control. For the 2015 IECC, except for the single-zone units in Small Hotel and Warehouse, the cooling capacities of DX units found in the prototypes are larger than 65,000 Btu/h in most climate zones; therefore, they were modelled with two-stage cooling. For units required to have two-stage cooling, the low-stage capacity was assigned to be half of the full capacity.

Improved economizer integration is a source of energy savings from the new staged cooling requirement in the 2015 IECC. When two-stage cooling and air economizer controls are both required in a 2015 IECC building prototype, economizer operation was modeled to represent increased economizer effectiveness. The fraction of time spent by the system in each mode—full economizer, partial economizer, and full mechanical cooling—was used to calculate an average economizer effectiveness for a given time step. PNNL adjusted the economizer effectiveness by changing the maximum outside air schedule that controls the amount of outside air available at a simulation time step. PNNL implemented this modeling strategy using the *EnergyPlus* energy management system (EMS) feature. The implementation is described in more detail in Section 5.2.2.6 of the PNNL report (Halverson et al. 2014).

3.3.10 Fan Airflow Control

Fan airflow control is another new requirement introduced in the 2015 IECC. Section C403.4.1.1 and Table C403.4.1.1 require two stages of fan control for DX units (capacity larger than 65,000 Btu/h) that control cooling capacity directly based on space temperature (usually serving a single zone). The requirement states that low or minimum fan speed shall not be greater than 66% of full speed. Section C403.4.1.1 of the 2015 IECC also requires that units with air economizers shall have a minimum of two speeds of fan control during economizer operation.

Six building prototypes, i.e., Standalone Retail, Strip Mall, Quick-Service Restaurant, Full-Service Restaurant, Primary School, and Secondary School, qualify for this requirement because they have packaged single-zone DX cooling units with capacity larger than 65,000 Btu/h. The requirements in the 2015 IECC are identical to those in Standard 90.1-2013 and their implementation in the prototype models has been described in a previous analysis (Halverson et al. 2014). The same modeling strategy applies to the 2012 and 2015 IECC models.

3.3.11 Part-load Controls for Hydronic Systems

Section C403.4.3.4 in the 2012 IECC requires hydronic heating and cooling systems with capacity over 300,000 Btu/h to include either supply-water temperature reset or variable flow controls. The 2015 IECC (Section C403.4.2.4) changes the capacity threshold to 500,000 Btu/h. Additionally, the code is changed from requiring one of these two controls to requiring both of them, plus a variable (or stepped) pumping control.

Six building prototypes, i.e., Large Office, Secondary School, Outpatient Healthcare, Hospital, Large Hotel, and High-Rise Apartment, have variable flow hydronic heating systems with variable flow pumps. Based on engineering judgment, PNNL assumed this type of system to be typical design in these prototypes no matter what edition of the IECC is used.

Four building prototypes, Large Office, Hospital, Secondary School, and Large Hotel, have primary-secondary variable-flow chilled water systems with variable-flow secondary pumps. Based on engineering judgment, PNNL assumed this type of system to be a typical design. Therefore, these prototypes meet the part-load control requirements for hydronic heating and cooling systems in the 2012 IECC.

For the 2015 IECC, the hydronic heating systems in the six prototypes already have the variable flow, variable pumping, and supply-water temperature reset (described in Section 3.3.2). As such, they meet the requirements in 2015 IECC already. For the hydronic cooling systems in the four prototypes, PNNL implemented supply-water temperature setpoint reset using the following reset rule, the setpoint is:

- the design supply temperature if the outdoor temperature is below 80°F,
- reset by 25% of the design supply-to-return water temperature difference if the outdoor temperature is above 60°F, and
- linearly interpolated between the two setpoint temperatures above if the outdoor temperature is between 60°F and 80°F.

The capacities of all hydronic systems in the building prototypes exceed the increased threshold of 500,000 Btu/h in the 2015 IECC. Therefore, the impact of the threshold change was not captured in the simulations.

3.3.12 Boiler Turndown

Section C403.4.2.5 in the 2015 IECC adds a boiler turndown requirement, which does not exist in the 2012 IECC. The new section requires that boiler systems with design input of 1,000,000 Btu/h or more comply with different turndown ratios, as shown in Table 3.4, using multiple single input boilers, one or more modulating boilers, or a combination of single input and modulating boilers.

Table 3.4. Boiler Turndown in Table C403.4.2.5 of the 2015 IECC

Boiler System Design Input (Btu/h)	Minimum Turndown Ratio
≥ 1,000,000 and less than or equal to 5,000,000	3 to 1
> 5,000,000 and less than or equal to 10,000,000	4 to 1
> 10,000,000	5 to 1

The following building prototypes use boilers that may be affected by the turndown requirements: Large Office, Hospital, Primary School, Secondary School, Large Hotel, High-Rise Apartment, and Outpatient Healthcare. PNNL assumed single-stage capacity control to be typical design in the 2012 IECC building prototypes based on a review of the certified boilers in the American Heating and Refrigeration Institute (AHRI) directory[1]. For the 2015 IECC, PNNL assumed that the prototypes would use modulating boiler capacity control, one of the three compliance options required by the 2015 IECC, if the building's system capacity was greater than 1,000,000 Btu/h.

EnergyPlus models boiler's part-load performance with a part-load efficiency (through a part-load curve as function of part load ratio (PLR)), which describes the normalized heating efficiency (as a fraction of nominal thermal efficiency) of the boiler's burner. PNNL modelled all boilers in the 2012 IECC prototypes using the curve described in Equation 3-1. For the 2015 IECC, PNNL applied Equation 3-1 curve to boilers with input capacity ≤1,000,000 Btu/h and Equation 3-2 curve to those with input

[1] AHRI's Directory of Certified Product Performance database. Last accessed in May 2013 at http://www.ahridirectory.org/ahridirectory/pages/cblr/defaultSearch.aspx

capacity >1,000,000 Btu/h. These curves are based on research by Bertagnolio and Andre (2010). Although these curves were only developed for PLR in the range of minimum turn down load and full load, *EnergyPlus* could allow a boiler to work at a PLR below the range. PNNL implemented an *EnergyPlus* EMS algorithm in the simulation models to adjust curve outputs when the PLR was lower than the range.

$$Curve_{single\text{-}stage\ control} = 0.907 + 0.320 * PLR - 0.420 * PLR^2 + 0.193 * PLR^3 \quad (3\text{-}1)$$

$$Curve_{modulating\ control} = 0.975+0.305 * PLR-0.527 * PLR^2+0.249 * PLR^3 \quad (3\text{-}2)$$

3.3.13 Heat Rejection Equipment

The 2015 IECC includes two major changes for heat rejection as compared to the 2012 IECC: fan control for multi-cell heat rejection equipment (Section C403.4.3.2.2) and open-circuit cooling tower fan flow turndown (Section C403.4.3.2.1). The second change also requires that the maximum number of fans to operate in multi-cell heat rejection equipment to minimize energy. It is more energy efficient to operate all fans in tandem at the same (lower) fan speed than to have an on/off or sequenced fan operation (operating a select number of cells at full speed to meet load). Using more cells also increases heat transfer area and more heat can be rejected with less airflow and fan speed.

Large Office and Hospital use open-circuit cooling towers. Each prototype has two variable-speed cooling towers. Each tower has one dedicated condenser water pump and two cells. Because the two cooling towers are equally sized, the two condenser water pumps have the same design flow rate. In the 2012 IECC building prototypes, the number of operating cooling towers and condenser water pumps corresponds to the number of operating chillers. When one chiller operates, one cooling tower operates and the corresponding condenser water pump operates. When both chillers are running, both cooling towers and both condenser water pumps are running.

The 2015 IECC requires that the maximum number of fans operate to minimize fan energy. This means that when one chiller is running, all four cell fans in the two cooling towers will be operating unless the fan in one cooling tower already runs at its minimum speed. Running two towers implies that the condenser water flow will be reduced by 50% for each cell in comparison with running one tower.

The strategy for modeling the cooling tower control requirements in the 2015 IECC includes the following:

- Change the cell control strategy for variable-speed cooling towers in *EnergyPlus* from “minimum cells” to “maximum cells.”
- For each time step, find the number of operating chillers.
- If one chiller is running and the current airflow ratio is greater than the minimum, run the two towers in parallel. Use the *EnergyPlus* EMS to halve the airflow ratio, which is then used to calculate the fan power according to the cubic power law. The EMS control is necessary because the *EnergyPlus* native control algorithms cannot run both towers in parallel while delivering the condenser water flow for just one chiller if there are two chillers in the plant.
- If two chillers are running or the current airflow is at the minimum when one chiller is running, the EMS algorithm will not override the tower fan curve input and output.

3.3.14 VAV Reheat Control

Section 403.4.5 in the 2012 IECC specifies requirements for zone airflow under multiple zone VAV systems. Thirty percent (30%) of the maximum supply air to each zone is required as the minimum zone supply airflow to reduce VAV reheat at the zone terminals. The 2015 IECC (Section C403.4.4) adds a new exception (item 4) to the 30% minimum; it states that a rate higher than 30% is allowed if it can be demonstrated to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system. Standard 90.1-2013 has a similar exception and PNNL has established a modeling strategy to determine the minimum zone supply airflow to meet this requirement. The calculation procedure includes four steps: (1) calculate zone ventilation efficiency; (2) calculate system ventilation efficiency; (3) increase the minimum damper fraction (i.e., ratio of minimum to maximum zone supply airflow) from 30% to a new value based on a target value of system ventilation efficiency; and (4) calculate the system design outdoor air intake.

In the 2012 IECC prototypes, only Steps 1, 2, and 4 were applied. For the 2015 IECC, all four steps were followed, which resulted in different minimum damper fractions and system design outdoor airflow rates from those in the 2012 IECC prototypes. The implementation of the four-step methodology is described in detail in Section 5.2.2.21 of Thornton et al. (2011) and Section 2.2.6 of Goel et al. (2014). All prototypes with multiple-zone VAV systems are affected by the code change related to VAV reheat control (i.e., Medium Office, Large Office, Primary School, Secondary School, Outpatient Healthcare, and Hospital).

3.3.15 VAV System for Critical Area in Healthcare Facility

Section C403.4.5 in the 2012 IECC includes Exception (1) to the VAV system requirement for supply air systems serving multiple zones. This exception is for "zones where special pressurization relationships or cross-contamination requirements are such that VAV systems are impractical". This exception allows designers to use constant volume reheat systems in critical areas of hospitals and similar spaces needing pressure differentials with adjacent areas.

The exception for the VAV requirement is removed in the 2015 IECC (Section C403.4.4). Instead, the 2015 IECC adds an allowance to the airflow rate that can be reheated to achieve reasonable energy savings in these types of spaces, while not compromising health and safety. A new compliance option is to reduce the zone primary air supply to "the airflow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates". The code changes mean that if the peak design airflow to any of these spaces is greater than the required minimum air change rate or the minimum rate required maintaining pressure differentials, the system must use VAV, reducing airflow as much as possible before reheat is allowed. Also, if the minimum air change rate is only required during occupied periods (as in operating rooms), the airflow must be reduced during those unoccupied periods before reheat is allowed.

The Hospital and Outpatient Healthcare prototypes include critical spaces that are affected by the changes from the 2012 to 2015 IECC. In the 2012 IECC Hospital and Outpatient Healthcare prototypes, critical spaces, such as operating rooms, patient rooms, intensive care units, and laboratories, were modelled to receive constant airflow with terminal reheat. To capture the impacts of the new requirement, PNNL compared the design airflow to the critical spaces with minimum airflow requirements according to the most commonly used accreditation standard, *AIA Guidelines for Design and Construction of*

Hospital and Health Care Facilities (American Institute of Architects, AIA 2001). PNNL determined that the operating rooms (during unoccupied periods) and patient rooms should be changed to use VAV systems for the 2015 IECC.

3.3.16 Fractional HP Fan Motors

The 2015 IECC adds a new Section C403.4.4.4 that requires motors from 1/12 horsepower (hp) to under 1 hp to be EC motors or have a minimum efficiency of 70%. The intention is to replace standard permanent-split capacitor (PSC) motors having efficiencies in the range of 15% to 65% with more-efficient EC motors. The intended applications are toilet exhaust fans, small kitchen exhaust fans, series fan-powered VAV boxes, and fan-coil units. The following motors are exempt under the new requirement: motors in an airstream where only heating is provided, motors in packaged equipment, poly-phase small motors, and capacitor-start capacitor-run and capacitor-start induction-run motors that are covered by Table C405.8(3) and Table C405.8(4) in the 2015 IECC.

In the building prototypes, the new requirements apply to fan-coil units, exhaust fans, kitchen exhaust fans, and elevator fans. Table 3.5 provides details on the building prototypes and fans to which the new requirements apply.

Table 3.5. Prototype Buildings Affected by Section C403.4.4.4 in the 2015 IECC

Prototype Building	Fan-Coil Unit	Exhaust Fan	Kitchen Exhaust Fan	Elevator Fan
High-Rise Apartment				Yes
Mid-Rise Apartment				Yes
Hospital			Yes	Yes
Large Hotel	Yes	Yes	Yes	Yes
Small Hotel				Yes
Large Office				Yes
Medium Office				Yes
Outpatient Healthcare		Yes		Yes
Quick-Service Restaurant		Yes	Yes	
Full-Service Restaurant		Yes	Yes	
Primary School		Yes	Yes	
Secondary School		Yes		Yes

To determine the motors whose efficiency must be changed, a set of criteria was established based on motor size. From a review of catalogs, motors in the smallest fans were selected from standard fractional horsepower motor sizes even if the required brake horsepower (bhp) is much lower. Therefore, maximum bhp is set at 90% of 3/4 hp or 560 W (above 90% of 3/4 hp, a 1 hp or larger motor would be used) and minimum bhp is set at 25% of 1/12 hp, or 14 W. Motors between the minimum and maximum bhp are considered to be applicable to the new IECC requirements.

To implement the new requirements, motor efficiency was changed in the prototypes. A motor efficiency of 29% was used in the 2012 IECC prototypes based on an intermediate value between highest potential efficiency and lowest efficiency found through literature review. For the 2015 IECC, the motor efficiency was set to 70%, which is close to the average typical EC motor efficiency.

3.3.17 Outdoor Air Ventilation Optimization Control

The 2015 IECC adds a multiple-zone VAV system ventilation optimization control requirement in Section C403.4.4.6. Under this requirement, multiple-zone VAV systems shall have automatic controls to reduce outdoor air intake flow from the design rates in response to dynamic system ventilation efficiency as defined by the 2015 International Mechanical Code (IMC) (ICC 2015b). According to Exception (2), a system having an ERV, as described in Section 3.3.3, is exempted from this requirement. Without such a requirement, the VAV systems in the 2012 IECC prototypes maintain constant outdoor air intake flowrate at the design level. This is a waste of energy to condition excess outdoor air intake.

To capture the savings of the 2015 IECC requirement, the Controller:MechanicalVentilation object in *EnergyPlus* was used with the System Outdoor Air field set to ventilation rate procedure. This is the option for meeting ventilation requirements in the 2015 IMC. Under these modeling settings, *EnergyPlus* implements the multiple-zone calculation per the 2015 IMC at each simulation time step and calculates system efficiency and system outdoor air intake, which is a reduced airflow from the design level. When a system has an ERV, the ventilation optimization control was not implemented; therefore, the system outdoor air intake remains at its design level. The energy savings impacts of the new 2015 IECC requirements were captured in Medium Office, Large Office, Primary School, Secondary School, Outpatient Healthcare, and Hospital.

3.4 Service Water Heating

PNNL reviewed all code changes under Section C404 Service Water Heating and determined that only the new demand-based control requirements for recirculation SWH systems have energy impacts that can be quantified using the building prototypes.

3.4.1 Demand-based Controls for Recirculated Service Water Heating Systems

Section C404.6.1 in the 2015 IECC adds new control requirements for buildings with recirculated SWH systems. The controls shall automatically turn off the circulation pumps when the water temperature in the circulation loop is either at or above the desired setpoint or when there is no hot water demand. These controls are not required in the 2012 IECC.

A recirculated SWH system provides more instant hot water at the water taps but energy losses are greater through pipe thermal losses and pump energy losses than a non-recirculated system. Ten prototypes use recirculated SWH systems. PNNL assumed that the SWH pumps in the 2012 IECC prototypes are always on at constant speed and the SWH temperatures are always maintained at their design setpoint. For each prototype, PNNL estimated the SWH pipe heat loss (kBtu/h) based on the average temperature difference between the water and indoor spaces, total pipe surface area, and pipe insulation. This loss was converted to SWH energy consumption inputs in the *EnergyPlus* models. Pump power in each prototype was also estimated based on pipe design, flow rate, and SWH system operations. This power was converted to pump pressure head in the *EnergyPlus* models. Details of the inputs are available in Section 2.1.4 of Goel et al. (2014). To estimate the energy savings impacts of the 2015 IECC requirements, reductions to the pipe heat loss inputs and recirculation pump power inputs were applied to the 2015 IECC building prototypes based on the baseline inputs in the 2012 IECC prototypes, as shown in Table 3.6. PNNL estimated the savings based on assumed SWH demand profiles in these prototypes.

Although Hospital, Small Hotel, and Large Hotel use recirculated SWH systems, PNNL did not quantify the impacts of the new requirements on them because we assumed the occupants in these building always have SWH demand.

Table 3.6. Percent Energy Savings of the 2015 IECC Controls Attributable to Reductions in Pipe Thermal Losses and Pump Energy Savings (as based on the 2012 IECC Building Prototypes)

Building Prototype	Energy Savings Attributable to Reductions in Pipe Thermal Loss	Savings Attributable to Pump Energy Savings
Medium Office	57%	89%
Large Office	57%	89%
Primary School	48%	90%
Secondary School	48%	90%
Outpatient Healthcare	57%	89%
High-Rise Apartment	44%	90%

3.5 Electrical Power and Lighting Systems

Section C405 of the 2012 and 2015 IECC specifies requirements for electrical power and lighting systems. Through review of the code changes, PNNL identified changes in several areas that have energy impacts and can be quantified using the building prototypes. Some of these changes are related to code changes in other areas, e.g., daylight responsive control is related to skylight and window areas and thermal performance of the fenestration components. These are also related to the changes in Section C406 (additional efficiency package options) of the two editions.

3.5.1 Additional Efficiency Package Options

Section C406 of the 2012 IECC requires choosing one from three additional efficiency package options:

1. Efficiency HVAC performance (Section C406.2),
2. Efficient lighting system (Section C406.3), and
3. On-site supply of renewable energy (Section C406.4).

The 2015 IECC modifies these options and adds three more options in Section C406. The six options are:

1. More efficient HVAC performance (Section C406.2),
2. Reduced lighting power density (LPD) system (Section C406.3),
3. Enhanced lighting controls (Section C406.4),
4. On-site supply of renewable energy (Section C406.5),
5. Provision of a dedicated outdoor air system for certain HVAC equipment (Section C406.6), and
6. High-efficiency service water heating (Section C406.7).

In the *Analysis for the 2012 IECC*, PNNL chose the high-efficiency lighting for the 2012 IECC prototypes because this option is more likely to be chosen for most building designs than the on-site supply of renewable energy option (Section C406.4). The efficient HVAC performance option (Section C406.2) was not chosen because this option would not allow a comparison of the 2012 IECC with its referenced Standard 90.1 with the HVAC equipment at the same minimum efficiencies addressed in the National Appliance Energy Conservation Act (NAECA), Energy Policy Act (EPAct), and the Energy Independence and Security Act (EISA). For the same reason and for keeping consistent choices for this analysis, PNNL chose the corresponding reduced LPD system option (Section C406.3 in the 2015 IECC) for the 2015 IECC prototypes. The impacts of the code changes in the selected option are related to daylight responsive control, skylights and window areas, and thermal performance of the fenestration components in the prototypes, and are discussed in Sections 3.5.3 and 3.5.6.1 in this report.

3.5.2 Occupant Sensor Controls

Section C405.2.2.2 in the 2012 IECC requires occupancy sensors in classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms, janitorial closets, and other areas less than 300 ft^2 enclosed by floor-to-ceiling partitions. The control devices need to turn the lights off within 30 minutes of the occupants leaving the space and can be either manually turned on or automatically controlled to turn the lighting on to no more than 50% power. Full automatic-on controls are allowed in some specified areas.

The 2015 IECC (Section C405.2.1) extends the occupancy sensor control requirements to copy/print rooms, lounges, locker rooms, and warehouses.

An outline of the procedure for determining savings from occupancy sensors is as follows.

- Appropriate building areas that fall into the occupancy sensor requirements were identified.
- In prototypes like the Small, Medium, and Large Offices and Standalone Retail, where detailed zoning is unavailable, appropriate building areas were determined using the National Commercial Construction Characteristics database.[1] This database provides a compilation of the building prototypes and the proportion of common building areas.
- Percent lighting energy reduction from the use of occupancy sensors was determined for all qualifying areas based on literature review.
- This percentage reduction was applied to the occupied hour values of the lighting schedule used by the specific zone.
- Where a separate zone does not exist in the model for a particular space, the reduction factor was calculated as a product of (1) space area as a fraction of whole-building area from the National Commercial Construction Characteristics database, and (2) target lighting energy savings percentage. This reduction was similarly applied to the occupied hours of the whole-building lighting schedule.

[1] National Commercial Construction Characteristics Database (NC^3), an internal PNNL database of nationwide commercial construction energy-related characteristics.

3.5.3 Daylight Responsive Controls and Fenestration Area

The daylight control requirements in the IECC are related to several other requirements, such as window size, fenestration performance, and lighting power density. The requirements and their implementation in the prototypes are separately discussed in this section for sidelight (daylight through windows) and toplight (daylight through skylights).

3.5.3.1 Sidelighting Area and Control Requirements in the 2012 IECC

The 2012 IECC defines daylight zone adjacent to vertical fenestration in Chapter 2 and specifies control options for sidelight daylight zone in Section C405.2.2.3. However, automatic daylighting controls are not required. However, because the efficient lighting system option was chosen (see Section 3.5.1 and 3.5.6.1), an LPD of 0.9 W/ft^2 from Table C406.3 was selected to meet the reduced LPD requirements for the Small Office and Medium Office prototypes. This triggered Footnote (b) of the table to apply. Therefore, two prototypes, which have sidelight daylight zones over 30% of their total conditioned floor area, are required to have automatic daylighting controls. Automatic stepped daylight controls were implemented in the two prototypes for all climate zones for the 2012 IECC.

A window provides a path for daylight entering the space. The 2012 IECC (Section 402.3.1) limits maximum window-to-wall ratio (WWR) of 30%. In climate zones 1 through 6, a maximum WWR of 40% is allowed if 50% of the conditioned floor area is within a daylight zone (including sidelight and toplight areas) and automatic daylighting controls are installed. Through a literature review, PNNL defined typical WWR for each prototype, which is assumed in its design characteristic. Such characteristics remain the same unless certain code provision requires them to be changed. Most prototypes have WWRs of less than 30% as their characteristics. However, four prototypes (Primary School, Secondary School, Medium Office, and Large Office) have typical WWRs between 30% and 40%. PNNL verified that the 40% limit does not apply to these prototypes because they do not have sufficient daylight area. Therefore, their WWRs were reduced from their typical values to 30% for the 2012 IECC prototypes.

In summary, Small Office and Medium Office prototypes were implemented with automatic controls for general lighting in their sidelight daylight zones. In addition, the WWRs of Primary School, Secondary School, Medium Office, and Large Office were set to 30% for the 2012 IECC.

3.5.3.2 Sidelighting Area and Control Requirements in the 2015 IECC

The 2015 IECC (Section C405.2.3) requires automatic daylight responsive controls for sidelight daylight area as opposed to manual controls (an allowed option in the 2012). It specifies 150 Watts of general lighting within sidelight daylight zone as the minimum threshold to apply the control requirement. As such, many sidelight zones in the 2015 prototypes were implemented with automatic daylight controls, such as Small Office, Medium Office, Large Office, Primary School, Secondary School, Outpatient Healthcare, Hospital, Small Hotel, Large Hotel, Warehouse, Quick-Service Restaurant, and Full-Service Restaurant.

In addition, the 2015 IECC specifies control settings for different space types. Where located in offices, classrooms, laboratories and library reading rooms, daylight responsive controls shall dim lights continuously from full light output to 15% of full light output or lower. Daylight responsive controls shall

be capable of a complete shutoff of all controlled lights. For these space types, continuous dimming controls were used and for others, stepped controls were used.

Similar to the 2012 IECC, the 2015 IECC (Section C402.4.1.1) limits the maximum WWR to 30% but allows buildings in climate zones 1 through 6 to use WWR up to 40% if a certain amount of floor area falls under daylight zones. Code changes were made to the criteria for which the 40% limit applies. For buildings with two stories or less, the area in daylight zones must be at least 50% of the net floor area. For buildings with more than two stories, at least 25% of the net floor area must be in a daylight zone. Net floor area excludes corridors, stairwells, bathrooms and mechanical rooms from the conditioned floor area. As mentioned earlier, 30% WWR limit was implemented to Large Office, Medium Office, Primary School, and Secondary School for the 2012 IECC. PNNL checked these prototypes against the changed criteria and compared the ratio of the daylight area (including both sidelight and toplight areas) to the net floor area with the new criteria. It was found that the WWR of Medium Office can be changed to its characteristic size, i.e., WWR of 33%. This was implemented to this prototype in climate zones 1 through 6. In addition, the visible transmittance (VT) of these changed windows was changed to 1.1 times solar heat gain coefficient (SHGC) to meet Section C402.4.1.1 (4) requirement. The WWR remains at 30% in Medium Office (same as the 2012 IECC counterparts) in climate zones 7 and 8.

3.5.3.3 Toplighting Area and Control Requirements in the 2012 IECC

Skylight Area

Section C402.3.2 of the 2012 IECC requires a minimum skylight area in certain spaces larger than 10,000 ft^2 to provide toplight daylight area under skylights to be at least 50% of the space area. The skylight area shall not be less than 3% of this daylight area. Buildings in climate zones 6 through 8 are exempted.

Spaces in some of the building prototypes have skylights in their typical design, i.e., skylights are a characteristic of the prototype. Such characteristics remain the same unless certain code provisions require them to be changed. The spaces in these prototypes with skylights are listed in Table 3.7 along with other design characteristics related to daylight area under skylights. As seen in the table, the zones in Primary School and Secondary School meet the minimum skylight area requirements in Section C402.3.2 of the 2012 IECC.

Footnote (c) of Table C406.3 in the efficient light system option, used in the 2012 IECC prototype, as discussed in Section 3.5.6.1, requires 70% of floor area in warehouse and 30% in retail to be in the daylight zone. Because of this requirement, PNNL increased the number of skylights in the 2012 IECC Warehouse and Standalone Retail prototypes.

Daylight Responsive Control in Toplight Daylight Area

Section C402.3.2.1 in the 2012 IECC requires all lighting in the toplight daylight zone to be controlled by multilevel lighting controls except for climate zones 6 through 8. For Warehouse and Standalone Retail prototypes, Footnotes (b) and (c) of Table C406.3 require automatic daylighting control without climate zone exceptions. Therefore, these multilevel lighting controls were implemented to zones

listed in Table 3.7 for Primary School and Secondary School in climate zones 1 through 5. Warehouse and Standalone Retail in all climate zones were modelled with automatic daylighting control.

Thermal Performance of Skylights

Sections C402.3.3.3 in the 2012 IECC allows skylights to have an increased SHGC from the requirements in Table C402.3 in climate zones 1 through 6 where the toplight daylight area under the skylights has automated daylighting controls. Similarly, according to Section C402.3.3.4, these skylights can use increased U-factor in all climate zones. These increased SHGC and U-factor requirements were implemented to the prototypes as they apply.

Table 3.7. Typical Skylight and Toplight Area in the Building Prototypes

Prototype	Zone Name	Zone Area (ft^2)	Skylight Area (ft^2)	Toplight Daylight Area (ft^2)	Toplight Daylight Area / Zone Area (%)	Skylight Area / Toplight Daylight Area (%)
Primary School	Multipurpose Room	3843	144	3843	100%	4%
Secondary School	Gymnasium	21269	864	21269	100%	4%
	Auxiliary Gymnasium	13433	576	13433	100%	4%
Warehouse	Bulk Storage [a, b]	34497	160	4876	14%	0%
	Fine Storage [a, b]	15000	0	0	0%	0%
Standalone Retail	Core Retail [a, b]	17227	72	2584	15%	0%

a. Daylight areas were increased to 70% (Warehouse) and 30% (Standalone Retail) of the zone area for all climate zones to meet the requirements of Footnotes (b) and (c) of Table C406.3 in the 2012 IECC.
b. Daylight areas were set to 50% to meet the requirements of Section C402.4.2 in the 2015 IECC for climate zones 1-5. They remain as values shown in this table for climate zone 6-8.

3.5.3.4 Toplight in the 2015 IECC

Skylight Area

To save energy from use of daylight responsive control, the requirements of minimum skylight area were modified in the 2015 IECC (Section C402.4.2). The size threshold of a zone, for which the requirements applies, was changed from 10,000 ft^2 to 2,500 ft^2. As shown in Table 3.7, this new threshold does not affect the Primary School and Secondary School because their skylight areas already exceed the requirements.

The reduced lighting power density system, Section C406.3 used in the 2015 IECC prototype, as discussed in Section 3.5.1 of this report, was changed from specifying requirements for LPD, minimum daylight area, and daylighting controls to LPD only. As such, the minimum skylight area requirements in Section C402.4.2 of the 2015 IECC were implemented to Warehouse and Standalone Retail with respect to their skylight areas. PNNL set the toplight daylight area in the bulk and fine storage zones in Warehouse and core retail zone in Standalone Retail in climate zones 1 through 5 to 50% of the zone area. The skylight areas remain the same as values shown in the Table 3.7 for those building prototypes located in climate zones 6 through 8. PNNL implemented the daylight area by changing the number of skylights

on the roof. As illustrated in Figure 3.1 these changes resulted in a decrease in the number of skylights in Warehouse from the 2012 and the 2015 IECC buildings. The major impacts of these changes on energy performance of the warehouse include envelope thermal performance, daylight responsive control, and HVAC system sizes.

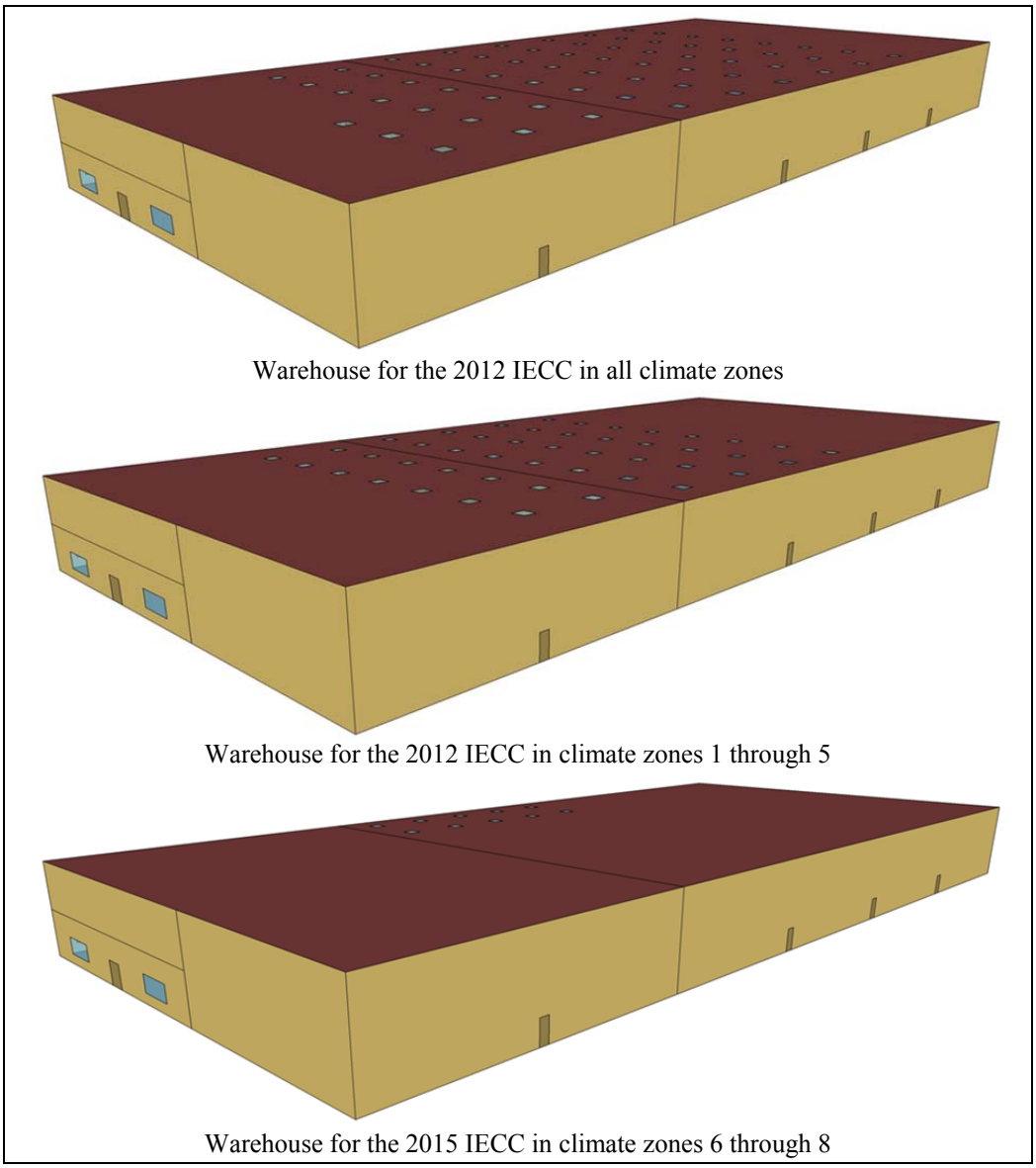

Figure 3.1. Schematic of Skylights in the Warehouse Prototype

Daylight Responsive Control in Toplight Daylight Area

Section C402.4.2.1 in the 2015 IECC requires all lighting in the toplight daylight zone to be controlled for all climate zones, as opposed to having exceptions in climate zones 6 through 8. Section C405.2.3 also defines a new threshold of 150 watts of general lighting within the zone to qualify daylight responsive control defined in the 2015 IECC.

Section C405.2.3.1 in the 2015 IECC specifies continuously dimming control from full light output for offices, classrooms, laboratories, and library reading rooms. PNNL used a stepped control setting in *EnergyPlus* to model this requirement for all toplight daylight areas in zones listed in Table 3.7 in all climate zones.

Thermal Performance of Skylights

Similar to the 2012 IECC, the 2015 IECC permits increased SHGC and U-factor from values in Table C402.4 for skylights where located above daylight area with daylight controls. Requirements do not change from the 2012 to 2015. However, toplight daylight controls were not implemented in Primary School and Secondary School located in climate zones 6 through 8 for the 2012 IECC but were implemented for the 2015 IECC. These differences resulted in different U-factor inputs in the simulation models of these two schools between the two editions of the IECC.

3.5.4 Guestroom Lighting Controls

Section C405.2.4 in the 2015 IECC modified the existing requirement in the 2012 IECC (Section C405.2.4) for hotel and motel sleeping units and guest suites. The requirement changed from manual control to automatically switching off all installed luminaires and switched receptacles within 20 minutes after all occupants leave the room.

The new requirement affects Small Hotel and Large Hotel. The implementation assumes 10% reduction in lighting energy in bathroom lighting and that the bathroom lighting contributes 31% of the guestroom lights. Besides lighting control, the new requirement also applies to the switched receptacles in guestrooms. A new schedule for guestroom lighting was calculated using the hourly reduction fraction for guestroom lighting in the advanced case in the *Technical Support Document: 50% Energy Savings Design Technology Packages for Highway Lodging Buildings* (Jiang et al. 2009). The daily weighted reduction in the lighting power using this schedule is 38%. The hourly reduction fraction for guestroom receptacles in advanced models from Jiang et al. (2009) was used to calculate the 2015 IECC savings. This results in a daily weighted reduction of 17% in equipment energy consumption.

3.5.5 Exterior Lighting Automatic Controls

Section C405.2.4 in the 2012 IECC requires that lighting not designated for dusk-to-dawn operation shall be controlled by either a combination of a photosensor and a time switch, or an astronomical time switch. Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. These requirements mean the exterior lights are off during daytime but do not enforce light power to be reduced at night. The 2015 IECC (Section C405.2.5) requires exterior facade and landscape lighting to be automatically turned off as a function of dawn/dusk and a set business opening and closing time. Exterior lighting not specified as facade or landscape lighting is to be automatically reduced by 30% of its peak power from between no later than midnight to 6 a.m., or from 1 hour after business closing to 1 hour before business opening, or during any period when activity has not been detected for a time longer than 15 minutes.

The code changes have energy savings impacts on all prototypes except for those that are open 24 hours a day, such as Hospital, Outpatient Healthcare, Small Hotel, Large Hotel, Mid-Rise Apartment, and

High-Rise Apartment. Exterior lighting operating schedules were changed to reflect the minimum required power reduction at night. The exterior lighting schedule was separated into a facade schedule with lights off at night and the rest of the exterior lighting schedule with lights reduced by 30% at night.

3.5.6 Interior Lighting Power

The IECC requirements related to the interior lighting power were modified in three areas: general LPD, additional lighting power allowance for retail display lighting, and sleeping unit LPD.

3.5.6.1 Interior Lighting Power Density

The 2012 and 2015 IECC specify total interior lighting power allowance through Section C405. However, the building prototypes need to meet more stringent requirements in Section C406.3 because the efficient lighting system option (Section C406.3 in the 2012 IECC and Section C406.4 in the 2015 IECC) was selected. The reasons for the selection are discussed in Section 3.5.1 of this report.

Section C406.3 in the 2012 IECC specifies LPD allowance using the building area method. The LPDs listed in Table C406.3 were used to model the lighting systems in the prototypes. There are two spaces types, i.e., office and retail, that are each provided with two LPDs in the table. The table allows the higher LPD to be used if daylight zones comprise more than 30% of the total conditioned floor area in the building. It also requires that the daylight zone be controlled by automatic controls. Standalone Retail, Small Office, and Medium Office prototypes have daylight zones comprising 30% or more of the total conditioned floor area in the building. Therefore, the higher LPDs (0.9 W/ft^2 for office and 1.4 W/ft^2 for retail) were used in these prototypes. The implementation for the daylighting control requirements is described in Section 3.5.3 of this report.

The 2015 IECC has both space-by-space and building area methods to calculate the allowance in Section C406.3. PNNL switched the approach from building area method used in the 2012 IECC prototypes to the space-by-space method to develop the 2015 IECC prototypes for two reasons:

1. the space-by-space method allows use of zone-specific lighting powers, which help better capture the energy impacts of zone-specific lighting control requirements; and
2. the space-by-space method was used for the analysis for Standard 90.1-2013 (Halverson et al. 2014). Using the same method in the analysis for 2015 IECC means that PNNL kept consistent choices between these two analyses.

According to Section C406.3, the LPDs in the 2015 IECC prototypes were calculated by multiplying values from Table C405.4.2(2) by 90%. Table 3.8 shows a side-by-side comparison of the area-weighted prototype building LPD between the 2012 and 2015 IECC building prototypes. In the simulation models for the prototypes, space-specific LPDs were used as inputs and Table 3.8 shows their area-weighted average LPD for each prototype. LPD for dwelling units in Mid-Rise Apartment and High-Rise Apartment, sleeping units in Small Hotel and Large Hotel, and additional display lighting in Strip Mall were not included when calculating the average LPD. As shown in Table 3.8 , there are reductions in average LPD in all prototypes except for Warehouse and the two apartment prototypes. The changes in LPD (including all buildings) are partly because PNNL applied different methods. For the 2012 IECC prototypes, the building area method was used, which is the only method in the 2012 IECC. For the 2015 IECC prototypes, the space-by-space method was used. Table 3.9 shows an example of zone-specific

LPDs in Warehouse. This is a small difference (0.03 w/ft^2) in area-weighted average LPD between the two prototypes but the difference by zone is larger; for example, fine storage has an LPD of 0.59 W/ft^2 for the 2012 IECC and 0.86 W/ft^2 for the 2015 IECC. This can impact the whole- building energy performance when different zone-specific lighting controls are applied to these spaces.

Table 3.8. Area-weighted LPD of General Lighting in the 2012 and 2015 IECC Prototypes

Building Prototype	2012 IECC, LPD (W/ft^2)	2015 IECC, LPD (W/ft^2)
Small Office	0.9	0.74
Medium Office	0.9	0.74
Large Office	0.9	0.74
Standalone Retail	1.4	1.30
Strip Mall	1.3	1.22
Primary School	0.99	0.96
Secondary School	0.99	0.85
Outpatient Healthcare	0.87	0.92
Hospital	1.1	0.88
Small Hotel	0.88	0.71
Large Hotel	0.88	0.84
Warehouse	0.6	0.63
Quick-Service Restaurant	0.9	0.84
Full-Service Restaurant	0.89	0.88
Mid-Rise Apartment	0.6	0.68
High-Rise Apartment	0.6	0.64

Table 3.9. Comparison of LPDs in Warehouse Prototype Built to the 2012 and 2015 IECC

Zone Name	Area (ft^2)	2012 IECC, LPD (W/ft^2)	2015 IECC, LPD (W/ft^2)
Office	2549	0.74	0.74
Fine Storage	14993	0.59	0.86
Bulk Storage	34484	0.59	0.52
Area-Weighted Average		**0.60**	**0.63**

3.5.6.2 Additional Lighting Power Allowance for Retail Display Lighting

The 2012 IECC is not very clear whether the additional lighting power allowance for retail display lighting applies if the efficient lighting system option (Section C406.3 in the 2012 IECC) is selected. In the 2012 IECC prototypes, PNNL did not model the allowed display lighting in Strip Mall, in which some sales areas of certain merchandise qualify for the allowance.

Section C405.4.2.2.1 in the 2015 IECC indicates areas in Strip Mall that are allowed to have additional lighting power for display lighting. This provision applies when the reduced lighting power

density option, Section C406.3, is selected. In addition, the base allowance (Equation 4-10 in the 2015 IECC) is changed from 1000 Watts in the 2012 IECC to 500 Watts.

To capture this code change, PNNL enhanced the Strip Mall prototype built to the 2012 IECC to add the allowance. The code change was captured by applying different display lighting power in the prototypes.

3.5.6.3 Sleeping Unit Lighting Power Density

Sleeping unit lighting in hotels is exempted from the interior LPD requirements in the 2012 IECC according to Exception 1.2 to Section C405.5.1. For the 2012 IECC, PNNL assumed an LPD of 1.1 W/ft^2 for guestrooms in Small and Large Hotel based on the early edition of Standard 90.1.

The 2015 IECC modified the provision (Exception 1.2 to Section C405.4.1) that this exemption applies, but 75% of permanently installed light fixtures must be fitted with high-efficacy lamps.

PNNL applied a reduction factor of 0.25 to 75% of the baseline. This factor is based on an assumption that the 60-Watt incandescent lamps in the 2012 IECC prototypes are switched to 15-Watt compact fluorescent lamps to meet the 2015 IECC requirement. Therefore, the LPD in the 2015 IECC hotel guestrooms is 75% x 1.1 W/ft^2 x 0.25 + 25% x 1.1 W/ft^2 = 0.48 W/ft^2.

3.5.7 Exterior Lighting Power

The building façade lighting power allowance in Table C405.6.2(2) of the 2012 IECC is modified in the 2015 IECC (Table C405.5.2(2)) to reduce allowance in lighting zones 2 through 4. The code change applies to all building prototypes. The reduced allowance was implemented using the modelled façade lighting power inputs in *EnergyPlus*.

3.5.8 Elevator Lighting and Ventilation

The 2012 IECC does not have requirements for elevators. Section C405.9.1 in the 2015 IECC does have such requirements. These include: 1) the cab lighting to have efficacy of not less than 35 lumens per Watt; 2) ventilation fans in elevators without air-conditioning systems shall not consume more than 0.33 watts/cfm at the maximum fan speed; and, 3) the cab lighting and ventilation should be off when the elevator is not used for over 15 minutes.

Medium Office, Large Office, Secondary School, Outpatient Healthcare, Hospital, Small Hotel, Large Hotel, Mid-Rise Apartment, and High-Rise Apartment have elevators. To analyze the energy savings of the code changes, the 2012 IECC baseline assumptions for elevator lights, fans, and their operation schedules are set and then modified lighting power, fan power, and operation schedules reflecting the code changes are used as the 2015 IECC model inputs. The same modeling strategy was used to quantify similar changes from Standard 90.1-2007 to Standard 90.1-2010. Details of the modeling assumptions can be found in Thornton et al. (2011).

4.0 Site Energy and Energy Cost Savings Results

This section summarizes the estimated site energy and energy cost savings for the 2015 IECC compared to the 2012 IECC. The results of the analysis are summarized in Table 4.1. This table groups the building prototypes by their principal activity and shows the construction weighting factors by building prototype. The table provides a side-by-side comparison of the site energy use intensity (EUI) and energy cost index (ECI) for the 2012 and 2015 editions of the IECC. Site energy is utility electricity and natural gas delivered and used at the building site. The EUI and ECI shown in Table 4.1 for each prototype are national weighted averages across climate zones in the United States. The percent savings (reduction) in EUI and ECI are presented as well. Negative percentages reflect increases in EUI or ECI. The last row of Table 4.1 shows the national weighted average results from all 16 prototypes and 15 climate zones using the construction weighting factors (see Table 2.2 in this report). As shown in Table 4.1, on a weighted national basis, the 2015 IECC results in 11.1% energy savings and 11.5% energy cost savings over the 2012 IECC. As a result of federally mandated efficiency improvements of appliances and equipment that have taken effect since (but independent of) the publication of the 2012 IECC, the actual EUI and ECI savings would be higher for most new buildings subject to the 2015 IECC than the results indicate. The savings attributed to DOE's Appliance and Commercial Equipment Standards are not included in the results in Table 4.1 as discussed in Section 2.4.

Table 4.1. Site Energy and Energy Cost Savings between the 2012 and 2015 IECC

Building Activity	Building Prototype	Floor Area Weight (%)	Site EUI (kBtu/ft^2-yr)		Site EUI Savings (%)	ECI ($/ft^2-yr)		ECI Savings (%)
			2012 IECC	2015 IECC		2012 IECC	2015 IECC	
Office	Small Office	5.6	31.1	29.6	4.8	0.93	0.88	4.8
	Medium Office	6.0	35.5	34.6	2.5	0.99	0.97	1.9
	Large Office	3.3	76.2	71.7	6.0	2.15	2.04	5.2
Retail	Standalone Retail	15.3	54.1	47.3	12.6	1.44	1.21	16.0
	Strip Mall	5.7	58.3	54.0	7.4	1.54	1.39	9.7
Education	Primary School	5.0	62.3	55.5	10.9	1.52	1.34	11.4
	Secondary School	10.4	51.8	42.8	17.4	1.35	1.12	16.8
Healthcare	Outpatient Healthcare	4.4	137.2	117.6	14.3	3.53	3.07	13.0
	Hospital	3.4	172.2	128.0	25.7	3.72	2.98	20.0
Lodging	Small Hotel	1.7	66.4	60.4	9.2	1.49	1.3	12.6
	Large Hotel	5.0	109.5	87.9	19.8	2.37	1.81	23.9
Warehouse	Warehouse	16.7	15.0	15.5	-3.1	0.34	0.36	-5.2
Food Service	Quick-Service Restaurant	0.6	602.5	582	3.4	9.66	8.83	8.6
	Full-Service Restaurant	0.7	405.6	373.8	7.8	7.22	6.44	10.8
Apartment	Mid-Rise Apartment	7.3	45.0	44.2	1.7	1.23	1.22	1.0
	High-Rise Apartment	9.0	49.1	47.6	3.0	1.14	1.11	3.1
National Weighted Average		**100**	**61.4**	**54.5**	**11.1**	**1.49**	**1.31**	**11.5**

As can be seen from Table 4.1, the savings vary significantly by prototype. This is expected because code requirements are different by building type and by climate. PNNL did not separately quantify the

national impacts of individual code changes because that would require substantial additional resources. Although this approach does not allow us to rank the code changes based on their energy savings impacts, we can still identify a few high impact changes resulting in significant energy savings as listed below:

a. Envelope: Changes to opaque envelope (see Section 3.2.1 in this report) and continuous air barrier (see Section3.2.2).

b. HVAC: Equipment efficiency improvements (Section 3.3.1), ERV (see Section 3.3.3), kitchen exhaust systems (Section 3.3.4), staged cooling (see Section 3.3.9), fan airflow control (see Section 3.3.10), VAV reheat control (see Section 3.3.14), VAV system for critical area in healthcare facility (see Section 3.3.15), and outdoor air ventilation optimization (see Section 3.3.17).

c. Lighting: Daylight responsive control (see Section 3.5.3), exterior lighting control (see Section 3.5.5), interior lighting power (see Section 3.5.6), and exterior lighting power (see Section 3.5.7).

The analysis also indicates that all building prototypes, except the Warehouse prototype, use less energy under the 2015 IECC. The Warehouse prototype uses more energy because the requirements in the 2015 IECC resulted in reduced daylit area under control compared to the 2012 IECC (see Section 3.5.3.4 in this report). These changes are specific to the Warehouse prototype and are more pronounced because lighting energy is a large portion of the total energy consumption in the Warehouse prototype.

Figures 4.1 and 4.2 illustrate the weighted EUI and ECI for each prototype and the national weighted EUI and ECI for the 2012 and 2015 editions of the IECC, respectively.

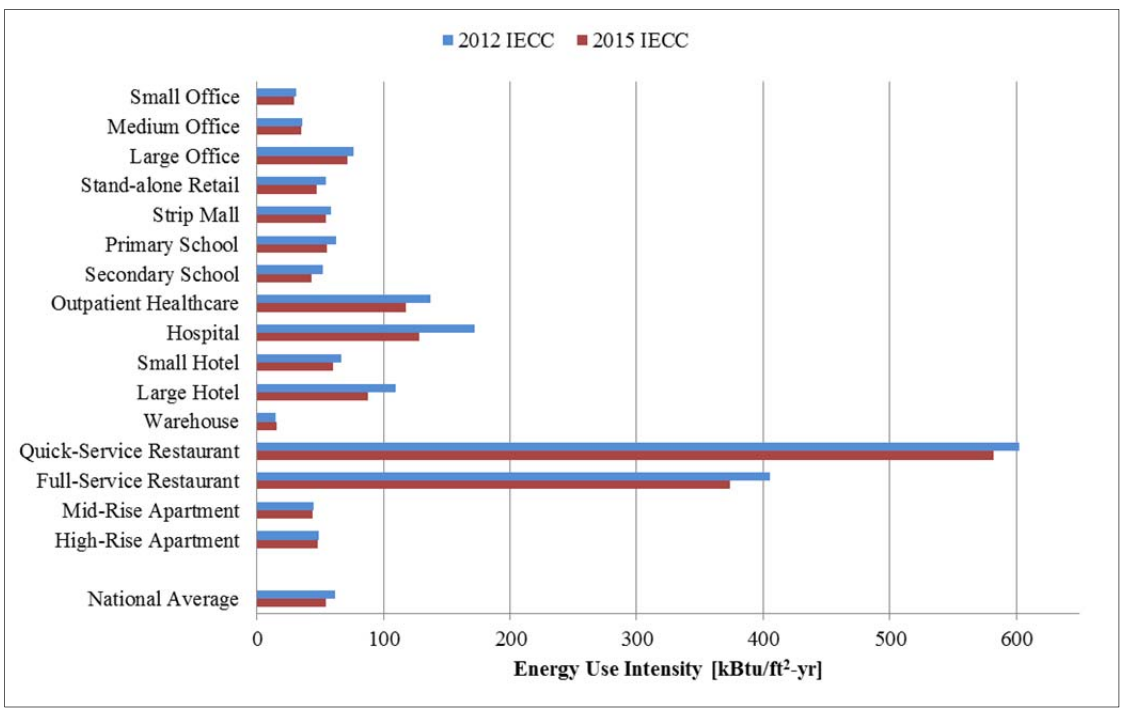

Figure 4.1. National Average Energy Use Intensity for all IECC Prototypes

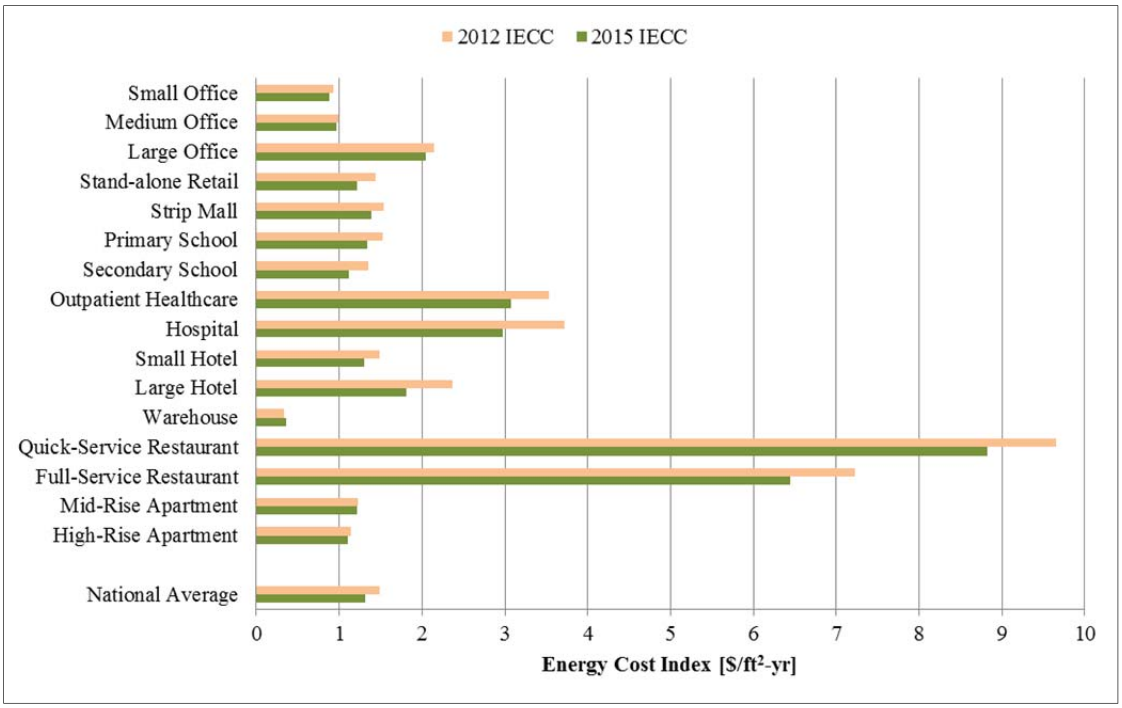

Figure 4.2. National Average Energy Cost Index for all IECC Prototypes

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Appendix A

Code Changes from the 2012 to 2015 IECC Included in Analysis and their Impact on Building Prototypes

Appendix A

Code Changes from the 2012 to 2015 IECC Included in Analysis and their Impact on Building Prototypes

Table A.1. Changes between the 2012 and 2015 IECC with Quantified Energy Impacts

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C402.1.4 Assembly U-factor, C-factor or F-factor-based method	Modifies the building envelope requirements for opaque assemblies using U-factor, C-factor or F-factor-based method in Table C402.1.4.		x	x	x	x	x	x	x	x	x	x	x			x	x
C402.4.1.1 Increased vertical fenestration area with daylight responsive controls	Modifies minimum daylighting area thresholds above which the maximum window-to-wall ratio of 40% is permitted.		x														
C402.4.2.1 Lighting controls in daylight zones under skylights	Removes the exception to responsive daylighting controls in daylighting zones under skylights in climate zones 6 through 8.				x		x	x					x				
C402.5.1 Air barriers	Extends continuous air barrier requirements to include climate zones 1, 2A, and 3.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C403.2.3 HVAC equipment performance requirements	Improves HVAC equipment efficiency.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C403.2.5 Hot water boiler outdoor temperature setback control	Requires boiler temperature setback control based on the outdoor temperature.			x				x	x	x		x					
C403.2.7 Energy recovery ventilation systems	Reduces the system size and outdoor air thresholds at which ERV is required. Relaxed in some climate zones. Adds new thresholds for systems that operate more than 8000 hours per year.		x	x	x		x	x	x	x		x					
C403.2.8 Kitchen exhaust systems	Modifies the requirements for kitchen hood exhaust and make-up air systems.						x	x		x		x		x	x		
C403.2.12.1 Allowable fan floor horsepower	Adjusts fan power limitation credits.		x	x			x	x	x	x		x					
C403.2.14 Refrigeration equipment performance	Adds efficiency requirements for commercial refrigerators, freezers and refrigeration equipment.						x	x		x		x		x	x		
C403.2.16 Walk-in coolers and walk-in freezers	Adds requirements for walk-in coolers and freezers and refrigerated display cases.						x	x		x		x		x	x		

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C403.3 Economizers (Prescriptive) Exception 2	Increases cooling capacity threshold for air economizer to be required in DX cooling systems from 33,000 Btu/h to 54,000 Btu/h.	x	x		x	x	x	x	x				x	x	x		
C403.3.1 Integrated economizer control	Enhances the requirements for integrated economizer control and defines DX unit capacity staging requirements.				x	x	x	x						x	x		
C403.4.1.1 Fan airflow control	Extends the requirements for fan speed control for unitary direct expansion systems based on cooling capacity and enhances the requirements for integrated economizer control.				x	x	x	x						x	x		
C403.4.2.4 Part-load controls	Increases capacity threshold for hydronic system part-load controls and extends the control types.			x				x		x		x					
403.4.2.5 Boiler turndown	Establishes minimum turndown for boilers and boiler plants with design input power of at least 1,000,000 Btu/h.			x			x	x	x	x		x					x

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C403.4.3 Heat rejection equipment	Modifies heat rejection equipment (cooling tower) requirements to require that variable speed drive controlled fans operate all fans at the same speed instead of sequencing them, and require that open-circuit towers with multiple cells operate all cells in parallel down to 50% of design flow.			x						x							
C403.4.4 Requirements for complex mechanical systems serving multiple zones	Allows optimization of minimum damper positions based on multiple-zone calculation.		x	x			x	x	x	x		x					
C403.4.4 Requirements for complex mechanical systems serving multiple zones	Removes exception for VAV turndown for zones with special pressurization requirements.								x	x							
C403.4.4.4 Fractional hp fan motors	Requires fractional horsepower motors ≥1/12 hp to be EC motors or have a minimum 70% efficiency in accordance with DOE 10 CFR 431. Also requires adjustable speed or other method to balance airflow.		x	x			x	x	x	x	x	x		x	x	x	x

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C403.4.4.6 Multiple-zone VAV system ventilation optimization control	Requires multi-zone VAV systems to have controls that optimize ventilation.		x	x			x	x	x	x		x					
C404.6.1 Circulation systems	Adds temperature maintenance and demand control for circulation pump.		x	x			x	x	x								x
C405.2.1 Occupant sensor controls	Adds lounge, locker room, and warehouse spaces to the list for occupancy sensor controls.	x	x	x	x		x	x	x	x	x	x	x		x		
C405.2.3 Daylight-responsive controls	Modifies control functions and threshold for both sidelight and toplight daylight controls.	x	x	x	x		x	x	x	x	x	x	x	x	x		
C405.2.4 Specific application controls	Requires automatic light controls for hotel and motel sleeping units										x	x					
C405.2.5 Exterior lighting controls	1. Requires exterior lighting controls rather than just control capability. 2. Adds bi-level controls for general all-night applications such as parking lots to reduce lighting when not needed. 3. Adds control of facade and landscaping lighting not needed after midnight.	x	x	x	x	x	x	x					x	x	x		

Section Number in the 2015 IECC	Description of Code Changes	Small Office	Medium Office	Large Office	Standalone Retail	Strip Mall	Primary School	Secondary School	Outpatient Healthcare	Hospital	Small Hotel	Large Hotel	Warehouse	Quick-Service Restaurant	Full-Service Restaurant	Mid-Rise Apartment	High-Rise Apartment
C405.4.1 Total connected interior lighting power	Modifies sleeping unit exception to lighting power limits. They need to meet R404.1.										x	x					
C405.5.1 Exterior building lighting power	Changes façade lighting power in Table C405.5.2(2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C405.9.1 Elevator cabs	Adds requirements for elevator fan and lights.		x	x				x	x	x	x	x				x	x
C406.3 Reduced lighting power density	1. Replaces LPD table in the 2012 IECC with 10% increase in efficiency over the base LPD requirements for whole building or space-by-space. 2. Adds space-by-space method option to provides flexibility. 3. removes the daylighting control requirements in 2012 IECC table footnotes. 4. Removes additional skylight requirements (footnote c) in the 2012 for warehouse.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Appendix B

Energy and Energy Cost Savings for the 2015 IECC and Corresponding Standard 90.1-2013

Appendix B

Energy and Energy Cost Savings for the 2015 IECC and Corresponding Standard 90.1-2013

Section 304(b) of the ECPA (Energy Conservation and Production Act), as amended, requires the Secretary of Energy to make a determination each time a revised edition of Standard 90.1 is published with respect to whether the revised standard would improve energy efficiency in commercial buildings. When DOE issues an affirmative determination on Standard 90.1, states are statutorily required to certify within two years that they have reviewed and updated the commercial provisions of their building energy code, with respect to energy efficiency, to meet or exceed the revised standard (42 USC 6833).

In support of DOE's determination, PNNL conducted an energy savings analysis for Standard 90.1-2013 compared to Standard 90.1-2010 (Halverson et al. 2014). Based on that analysis, DOE issued a determination that Standard 90.1-2013 would achieve greater energy efficiency in buildings compared to the 2010 edition of the standard.

As many states have historically adopted the IECC for both residential and commercial buildings, PNNL has also compared energy performance of Standard 90.1-2013 with the 2015 IECC to help states and local jurisdictions make informed decisions regarding model code adoption. Of the 47 States with statewide commercial building energy codes currently, 37 use a version of the IECC (BECP 2015).

Table B.1 shows side-by-side comparisons of the site EUI and ECI for Standard 90.1-2013 and the 2015 IECC for each of 16 prototype buildings along with the percent difference between the two. The national weighted average of all prototypes combined is also shown. Figures B.1 and B.2 show the same results graphically. Negative percentage differences indicate higher energy or energy costs for buildings designed to the 2015 IECC compared to those designed to Standard 90.1-2013. For most prototypes, both EUIs and ECIs were slightly lower using Standard 90.1-2013. One notable exception is the Warehouse prototype where the 2015 IECC resulted in lower energy use and energy costs. This difference is because Standard 90.1-2013 has a category for semi-heated spaces allowing relaxed levels of insulation, while the 2015 IECC does not.

The comparisons show the combined energy impacts of differences between the 2015 IECC and Standard 90.1-2013. Although the current analysis does not compare or rank the individual differences based on their energy savings, a few high impact differences by category can be identified as follows:

a. Envelope
   - Prescriptive WWR limit: the 2015 IECC allows a WWR up to 30% unless a significant portion of the building is equipped with daylight responsive controls, in which case up to 40% is allowed. Standard 90.1-2013 requires WWR less than 40%.
   - Semi-heated space envelope requirements: the 2015 IECC does not have separate envelope requirements for semi-heated spaces. Semi-heated spaces are required to follow conditioned space requirements. Standard 90.1-2013 has less stringent insulation requirements for semi-heated spaces.

- Vertical fenestration U-factor independent of frame material: the U-factor requirements for vertical fenestrations in the 2015 IECC are independent of the frame material. Standard 90.1-2013 has higher U-factors for metal-framed fenestrations than for nonmetal-framed fenestrations.
- SHGC for north-oriented vertical fenestrations: the 2015 IECC sets higher maximum SHGCs for north-oriented fenestrations than those facing other orientations. Standard 90.1-2013 allows a much smaller relaxation of SHGC (SHGC-0.05) for north-oriented fenestrations. The impact of this difference is not captured in the current analysis because the prototype building facades are all facing true east, south, west, or north and the energy impact is negligible for true north-oriented facades. However, both the 2015 IECC and Standard 90.1-2013 define north-oriented fenestration as that which is facing within 45 degrees of true north in the northern hemisphere. For fenestration offset from true north by up to 45 degrees, the relaxation of SHGC may be significant.
- Vestibule exceptions: the 2015 IECC exempts building entrance doors that open up to a space less than 3,000 sf; Standard 90.1-2013 does not. The 2015 IECC also includes an exception from vestibule requirements if an air curtain is installed instead; Standard 90.1-2013 does not have such an exception.
- Fenestration orientation: the 2015 IECC does not limit the distribution of fenestration area. Standard 90.1-2013 limits the fenestration area on the east and west façades.

b. Building mechanical systems
   - Shutoff damper controls: the 2015 IECC exempts buildings with less than 3 stories from the motorized damper requirements for ventilation air intakes; Standard 90.1-2013 does not have such an exception.

c. Lighting
   - Dwelling unit (apartment) lighting power: the 2015 IECC requires 75% of all permanently installed luminaires in dwelling units to be high efficacy. Standard 90.1-2013 exempts dwelling units from lighting power requirements.
   - Controls for secondary daylight zone: the 2015 IECC does not require secondary daylight zones to have daylight responsive controls; Standard 90.1-2013 does.

d. Additional efficiency package options
   - The 2015 IECC requires one of the six high efficiency package options to be included; Standard 90.1-2013 does not have such options.

On a national average basis for all prototypes combined, the 2015 IECC and Standard 90.1-2013 are within 1% for both energy use and energy costs. The 2015 IECC has a national weighted EUI of 54.5 kBtu/ft²-yr while the corresponding number for Standard 90.1-2013 is 54.1 kBtu/ft²-yr. Likewise, the ECIs are very close between the 2015 IECC (1.31 $/ft²-yr) and Standard 90.1-2013 (1.30 $/ft²-yr).

Table B.1. Site Energy and Energy Cost Savings between Standard 90.1-2013 and the 2015 IECC

Building Prototype	Site EUI			ECI		
	Standard 90.1-2013 (kBtu/ft²/yr)	2015 IECC (kBtu/ft²/yr)	2015 IECC compared to 90.1-2013 (%)	Standard 90.1-2013 ($/ft²/yr)	2015 IECC ($/ft²/yr)	2015 IECC compared to 90.1-2013 (%)
Small Office	29.4	29.6	-0.7	0.88	0.88	0.0
Medium Office	34.1	34.6	-1.5	0.95	0.97	-2.1
Large Office	70.8	71.7	-1.3	2.01	2.04	-1.5
Standalone Retail	45.9	47.3	-3.1	1.20	1.21	-0.8
Strip Mall	55.1	54.0	2.0	1.42	1.39	2.1
Primary School	54.2	55.5	-2.4	1.28	1.34	-4.7
Secondary School	41.7	42.8	-2.6	1.08	1.12	-3.7
Outpatient Healthcare	115.8	117.6	-1.6	3.00	3.07	-2.3
Hospital	123.7	128.0	-3.5	2.85	2.98	-4.6
Small Hotel	60.0	60.4	-0.7	1.29	1.30	-0.8
Large Hotel	89.0	87.9	1.2	1.81	1.81	0.0
Warehouse	17.1	15.5	9.4	0.38	0.36	5.3
Quick-Service Restaurant	576.4	582.0	-1.0	8.78	8.83	-0.6
Full-Service Restaurant	372.5	373.8	-0.3	6.41	6.44	-0.5
Mid-Rise Apartment	43.9	44.2	-0.7	1.21	1.22	-0.8
High-Rise Apartment	46.9	47.6	-1.5	1.08	1.11	-2.8
National Weighted Average	**54.1**	**54.5**	**-0.7**	**1.30**	**1.31**	**-0.8**

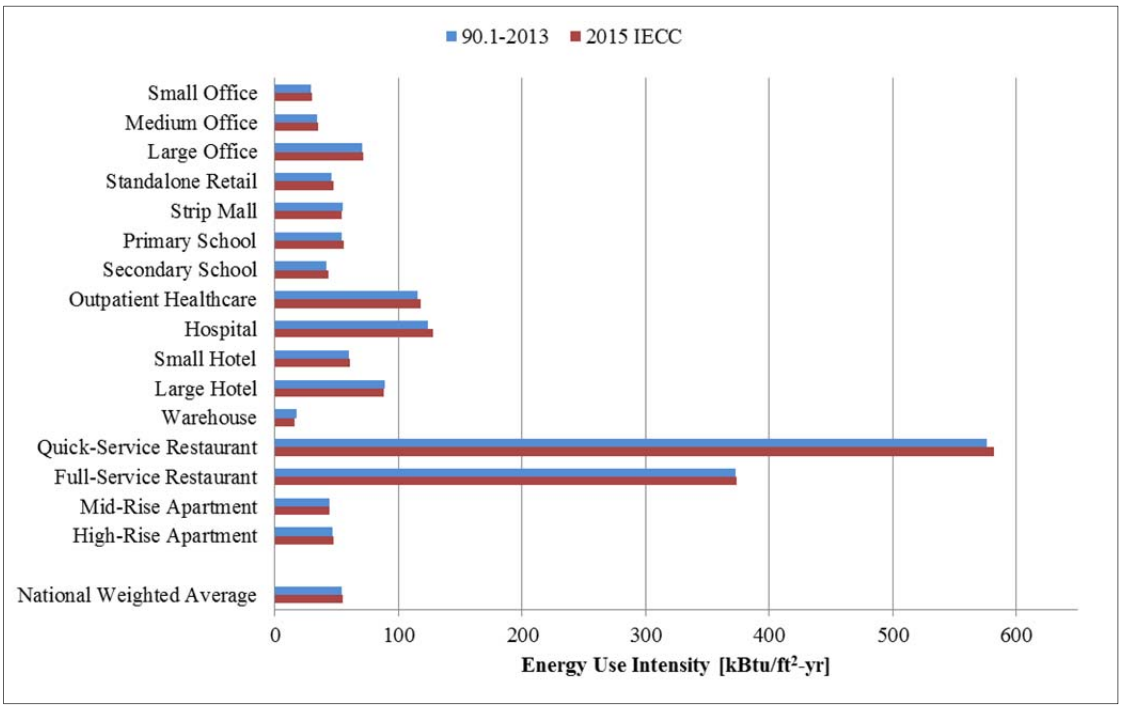

Figure B.1. National Average Energy Use Intensity for Standard 90.1 and IECC Prototypes

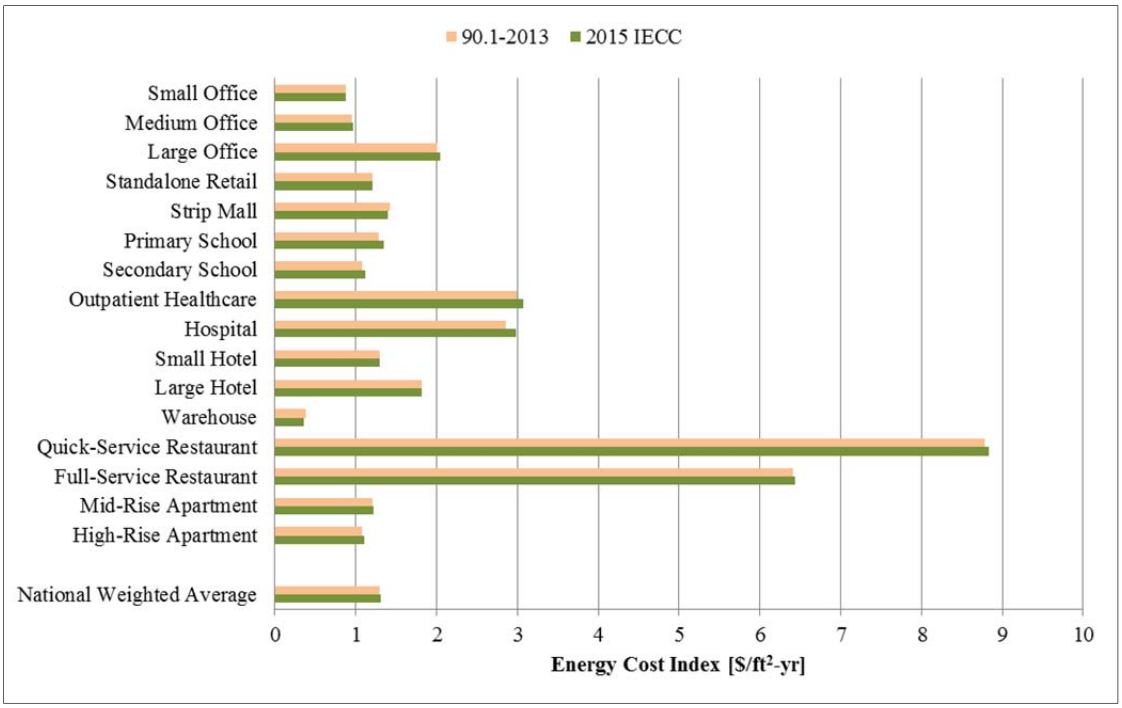

Figure B.2. National Average Energy Cost Index for Standard 90.1 and IECC Prototypes

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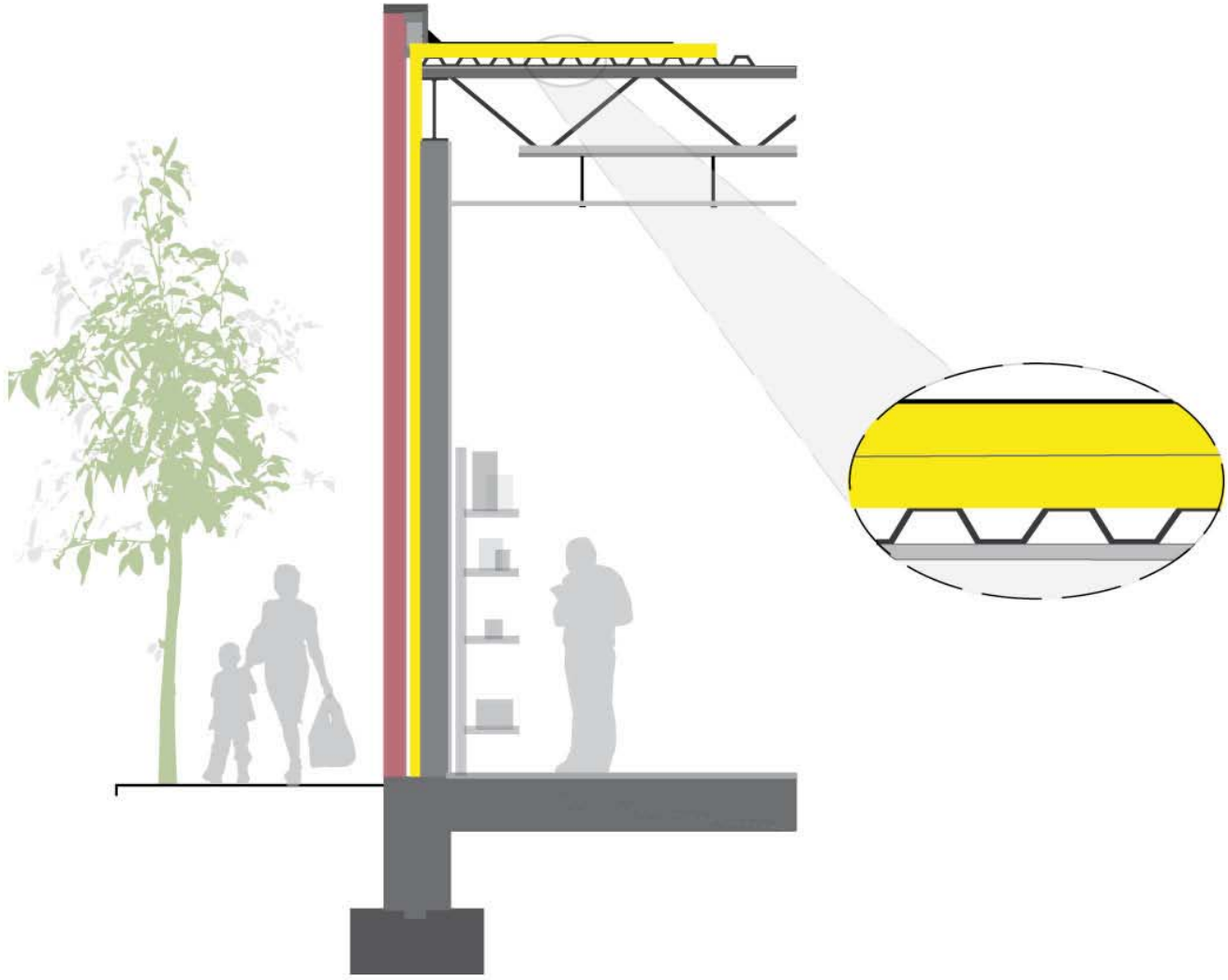

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DISCLAIMER

The authors of this building energy simulation and life cycle study have compiled detailed information provided by internal and external sources, and have conducted engineering calculations and generated market and technical data to the best of their knowledge and belief at the time of this writing. The authors endeavor to improve and expand on the results of this report in subsequent studies. No representation is made or warranty given, either expressly or tacitly, for the completeness or correctness of the information in this study. Neither Bayer MaterialScience nor third parties involved in providing information for this study may be held liable for use or misuse of information provided in this report. This report contains references to non-Bayer MaterialScience companies, services and websites. By providing these references, Bayer MaterialScience is not endorsing or approving their products, services and websites, and cannot confirm the accuracy or completeness of the information or services provided therein. Access and use of these references is at the user's risk. Bayer MaterialScience will not be liable for any harm resulting from the use of non-Bayer MaterialScience products, services or websites. It is the responsibility of the user of non-Bayer MaterialScience products, services and information to comply with all applicable laws and regulations.

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We also acknowledge the Department of Energy's Office of Energy Efficiency and Renewable Energy, contributing contractors and the National Laboratories involved in the development and continuing optimization of the EnergyPlus simulation program as well as the Commercial Building Benchmark Models through the "Net Zero Commercial Building Initiative". These tools provided vital resources on which this study was conducted and will certainly contribute highly to other energy efficiency and environmental based research in the future.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Substantial reductions in operating costs, energy, and Global Warming Potential (GWP) emissions can be achieved in existing buildings. Much of the three billion square feet of low-slope roofs that require replacement every year in this country can be retrofitted with an energy efficient system in a practical and economically feasible fashion. The extensive research conducted in this study provides the basis for concluding that at least one and one half billion square feet of high thermal performance roofing can be installed each year for many years, ultimately saving billions of dollars in utility costs, preserving trillions of Btu of energy and preventing hundreds of millions of metric tons of GWP and other environmentally damaging emissions. The results presented in this report range from individual building type in specific climate zones to aggregate national results. The table below provides research findings following ten consecutive years of replacing failing existing low-slope roofs with energy efficient systems:

Impact Basis	***Floor Area*** **(billion ft^2)**	***Cost Savings*** **(billion $)**	***Source Energy Savings*** ***trillion Btu***	***Emissions Prevention*** ***million tons CO_2-eq.***
Annual	**15.4**	**2.4**	**266**	**19**
Ten Year Cumulative		**12.2**	**1,464**	**105**

The research involved in this analysis is based on several credible resources, tools and standardized procedures including the following:

- Performing **Whole Building Energy Analysis** (WBEA) with more frequently than hourly energy balance calculations and climatic data in order to estimate a building design's annual energy performance using the state of the art DOE simulation tool, **EnergyPlus**.
- Utilization of ten of the sixteen DOE Office of Energy Efficiency and Renewable Energy (EERE) **Commercial Building Benchmark Prototypes**. These models are fully described in EnergyPlus input files for each of the locations. The WBEA simulations for this study are performed on these files.
- In order to perform the impact assessment, a connection is made between each of the models and their respective estimated market weightings. For this exercise, the latest Energy Information Administration (EIA) **Commercial Building Energy Consumption Survey** (CBEC-2003) data are utilized.
- The consumed utilities of electricity and natural gas as well as the additional installed insulation required for an energy efficient roof system are evaluated from a **"Cradle to Grave"** (Life Cycle Assessment, LCA) perspective. As a result, the complete life cycle energy, known as **Source Energy** and the resulting GWP emissions are quantified and compared.
- Economic analyses performed utilize established resources for the basis of all calculations. **Utility cost** calculations are left to the EnergyPlus program, flat **annual inflation rates** on electricity and natural gas are based on EIA projections, and current installed insulation costs are taken from **RS Means CostWorks Online Construction Estimator**.

1.0 BACKGROUND, PURPOSES AND SCOPE

A rapidly accelerating awareness of the energy and environmental challenges facing us today has spurred enhanced energy efficiency standards, stricter codes and emerging technologies in new construction. As a result, there is confidence that buildings constructed over the coming years will consume less and less energy. Unfortunately, these activities rarely impact the energy consumption levels of the more than 70 billion square feet of existing commercial building floor space in this country.

This study explores one of the most practical and economically feasible opportunities for improving the energy efficiency in existing buildings: Roof replacement of low-slope roofed buildings, i.e. replacement of waterproofing membrane. It is commonly known that a typical building requires three roof replacements during its lifetime or roughly one replacement every twenty years. Thus, routine roof replacement facilitates implementation of the long-proven energy efficiency measure of added levels of insulation.

The current economic crisis has all but stalled the re-roofing market and thus so has also deeply impacted the opportunity to decrease energy consumption in buildings. Initial costs and tight capital cause building owners to resort to patch work in order to extend the life of roofs. This report serves to aid in evaluating the impact of this dilemma and provides support to measures taken to help resolve it.

The Polyisocyanurate Insulation Manufacturers Association (PIMA) and Center for Environmental Innovation in Roofing (CEIR) are proposing that the U.S. Congress implement a tax incentive for the purpose of encouraging the installation of energy efficient roofs on existing buildings. This incentive would be applicable specifically to any existing commercial and high rise (i.e. greater than three stories) residential building with a low-slope roof. The majority of commercial floor space in the United States is in buildings that have low-slope roofs. In order to qualify, the replacement roof would be required to have a minimum insulation R-value of 25, 30 or 35 depending on the climate zone in which the building is located, and would required to be placed in service during 2009 through 2013.

The adoption of a tax incentive requires full vetting of tax revenue impacts weighed against incurred benefits to the public. Here, the benefits would include immediate and long lasting energy cost and resource savings, prevention of substantial global warming emissions, and jobs creation. One of the purposes of this study is to assess the potential impact of a surge of energy efficient roof replacements in terms of cumulative national energy savings, global warming emissions prevention. Therefore, by conducting this analysis, the authors are providing detailed and credible information for legislators so that a sound decision can be made regarding the merits of this proposal.

The scope established for this research is all existing buildings in the United States with low-slope roofs that are in need of roof replacement, or whose owners upgrade their facility in such ways as installing solar equipment or improving energy efficiency. This serves as the boundary for relating the energy modeling performed in this analysis to available commercial building market information. The energy modeling, along with weighting factors developed from market data (Section 7) form the basis for performing the impact assessment (Section 8).

2.0 ENERGY MODELING

Climatic conditions, location and building orientation, envelope characteristics, HVAC and other operating systems, and building use and occupant activities along with the interactions between these components create great complexity in determining the energy consumption of any specific building. Computer-based simulation programs which make thousands of complete energy balance calculations that incorporate all of these variables and their interactions are utilized to perform Whole Building Energy Analysis (WBEA). WBEA is frequently conducted on individual building designs in order to predict energy performance. This analysis is required during the design phase in cases such as qualifying for LEED certification and tax deductions under the Energy Conservation Act of 2005. Appendix G of ASHRAE 90.1, "Performance Rating Method", includes WBEA as a key component and lists in Section G2 a number of requirements which any simulation tool must satisfy in order to be utilized in this widely accepted energy rating method.

Clearly, the use of a rigorous energy simulation tool is essential in order to closely predict the performance of any specific building design. However, the resources required in order to conduct this type of analysis make it impractical for every project, particularly retrofit jobs such as roof replacement. The authors believe that one can reference specific detailed results from this study to provide an estimate of the benefits realized by completing an energy efficient roof replacement project.

2.1 EnergyPlus

EnergyPlus is a fully integrated building and HVAC simulation software program. It is a product of the Department of Energy (DOE) and was originally developed and is updated twice annually by DOE contractors. The basis for EnergyPlus is BLAST and DOE-2.1E, two earlier DOE programs. The strongest features of these programs were incorporated into EnergyPlus along with additional capabilities.[1]

The latest version of EnergyPlus, 3.0.0, can be downloaded from the DOE Energy Efficiency and Renewable Energy website free of charge. Along with the program setup and launch, the download provides extensive reference documentation on the engineering basis behind the simulation calculations. The website also provides access to hundreds of hourly weather data files from around the world which can be linked to the specific EnergyPlus simulation file that one is utilizing.

[1] U.S. Department of Energy, Energy Efficiency and Renewable Energy, www.eere.energy.gov Programs: Building Technologies.

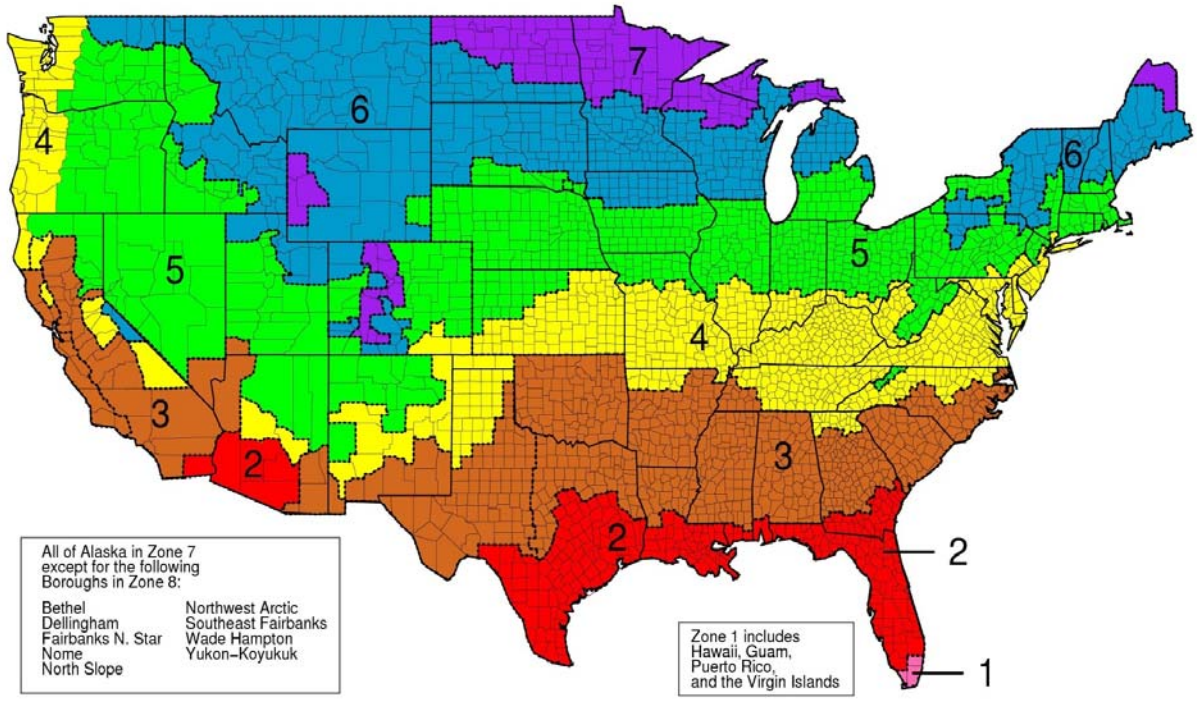
2.2 Commercial Building Benchmark Models

The DOE has sanctioned three of its national laboratories to develop commercial building benchmark models which will provide complete descriptions for WBEA using EnergyPlus. This project includes the establishment of 16 separate building prototypes which, according to DOE analysis, represents approximately 70 percent of the commercial buildings in the U.S. For each building prototype, EnergyPlus files are generated with specific input data for 16 U.S. locations representing each of the ASHRAE sub-climate zones (Figure 2.2). Lastly, the project includes establishing three prototype categories according to building vintage:

- New Construction
- Buildings constructed in or after 1980
- Buildings constructed prior to 1980

In November, 2008, the DOE released the complete set of EnergyPlus input files for the first vintage category, New Construction.[2]

Figure 2.2: ASHRAE Climate Zones



[2] U.S. Department of Energy, Energy Efficiency and Renewable Energy, www.eere.energy.gov Programs: High Performance Commercial Building/Commercial Building Benchmark.

3.0 STUDY SIMULATION DESCRIPTIONS

The release of the DOE Benchmark Models was important for conducting this study. Even though these input files were designed for new construction, the building envelope and operating parameters are appropriate for the modeling completed here. In addition to providing the credibility of the national laboratories, this greatly reduced the workload of researching parameters and populating the many input files involved. Nevertheless, the modeling was very onerous and by far and away the greatest time-consuming portion of this project. Throughout the development of the energy modeling protocol, care was taken to limit the number of required simulations without sacrificing the credibility of the assessment and realized benefits of energy efficient roof replacements. Nearly 400 individual simulations were conducted in this project. The authors are confident that this objective was achieved and credits this largely to possessing a strong understanding of the low-slope commercial roofing market prior to establishing the modeling protocol.

3.1 Model Building Types

Of the sixteen building types established in the DOE Commercial Building Benchmark Project, ten were used in this study and are listed in Table 3.1 below. Analyses of existing commercial building data indicate that the modeling of these types would provide a sufficient representation of the energy performance of buildings with low-slope roofs. Section 7, "Commercial Building Market Analysis", offers further explanation to substantiate this conclusion.

Table 3.1: Building Types Used in Simulation And Impact Assessment Weighting

Retail
Strip Mall
Warehouse
Small Office
Medium Office
Restaurant
Supermarket
Primary School
Secondary School
Small Hotel

3.2 Building Locations and Climate Zones

Of the sixteen building locations in which EnergyPlus input files were developed in the DOE Commercial Building Benchmark Project, thirteen were used in this study and are listed in Table 3.2 below. These thirteen locations represent Climate Zones 2 through 6 and all three of the Moist, Dry and Marine locations. Market data indicate that greater than 97 percent of total floor area in existing buildings is located in these five climate zones.

Table 3.2: Simulation Locations, Climate Zones and Energy Efficient R-value Requirement

Location	Climate Zone	Minimum R-Value
Houston, TX	2A	25
Phoenix, AZ	2B	25
Atlanta, GA	3A	25
Los Angeles, CA	3B	25
Las Vegas, NV	3B	25
San Francisco, CA	3C	25
Baltimore, MD	4A	30
Albuquerque, NM	4B	30
Seattle, WA	4C	30
Chicago, IL	5A	30
Boulder, CO	5B	30
Minneapolis, MN	6A	30
Helena, MT	6B	30

3.3 Characteristics of Existing and Retrofit Building Models

As mentioned above, the DOE benchmark models released thus far are designed as prototypical of newly constructed buildings. Therefore, the input parameters included building envelope and operating systems criteria as established in ASHRAE 90.1-2004 and include equipment specifications representative of current day technologies. Two specific examples of substantial advancements in technologies include lighting and HVAC efficiencies. The authors chose not to make modifications in the benchmark files in order to account for these differences in technologies. There are several reasons why this decision was made, the least of which was certainly not the amount of time involved in researching the specifications of 15 – 45 year old equipment and entering it into the input files. Rather, it is likely that the original equipment in any given existing building has been or will soon be replaced with modern technology, as it has reached its functional life or the building owner decides that replacement would be beneficial.

As noted, the benchmark models were designed to ASHRAE 90.1-2004 including the thermal envelope. For post-1980 commercial buildings, across all building types and climate areas, the average roof insulation level is R-12.4 and for pre-1980 buildings the average is R-10.4.[3] For this study, the input models representing all of the existing buildings were modified to reflect an "Insulation Entirely Above the Deck" (IEAD) of R-12.4. In the input files for the energy efficient roofs following replacement, the overall R-value for IEAD of 25.4 for Climate Zones 2 and 3 and 30.5 for Climate Zones 4, 5 and 6 were represented. This assumes that the existing R-12.4 insulation is reused and 2.2 inches or 3 inches of Polyiso, respectively, is installed on top of it (See Table 3.2). These insulation thicknesses were used because they were the nearest advertised LTTR valued Polyiso product that met or exceeded the total insulation requirements for an energy efficient roof.

No modifications were made to the thermal characteristics of the walls and foundations of the benchmark models. The input files of the Small Office and Restaurant were modified to reflect the redesign of a building with an attic to a building with a flat roof. Also, a minor change in the Warehouse model was made to convert the building from a generic metal building roof to one with IEAD plus a membrane.

The original benchmark models included a built-up-roof (BUR) waterproofing system which is typical for existing buildings. This was maintained in this analysis in the model for the simulation. For the simulation of the energy efficient roof, a Thermoplastic Polyolefin (TPO) membrane was modeled for all buildings simulated in Climate Zones 2, 3 and 4. For all simulations for Climate Zones 5 and 6, models with a TPO membrane and with a BUR system were both modeled. The model selected for the study comparison was the system that exhibited the better energy performance in the simulation.

[3] Huang, J. and E. Franconi (1999), Commercial Heating and Cooling Loads Component Analysis," LBL-37208, Berkeley, CA: Lawrence Berkley Ntaional Laboratory, table 2-7.

3.4 U-value Calculation Methodology

It is known that small, yet unavoidable gaps occur between adjoining boards of single layer roof insulation.[4] Parallel flow heat transfer calculations show that the percentage of heat loss is much greater in proportion to the percent area of the gaps. For re-roofing projects in which the original insulation is re-used and the new insulation is installed so that board edges of both layers are overlapped, much of this heat loss can be eliminated.

The benefits of double layering of insulation are illustrated in the U-value calculations conducted to determine the input data utilized in this study. The R-values of the individual roofing materials are listed in Table 3.4:[5]

Table 3.4: R-value of roofing materials

	$^{o}F \cdot ft^{2} \cdot h/Btu$
$R_{OutsideAir}$	**0.170**
$R_{membrane}$	**0.068**
R_{deck}	**0.015**
$R_{InsideAir}$	**0.610**
R_{M+D}	**0.863**
Insulation	
$R_{layer\ 1}$	**12.4**
$R_{layer\ 2}$	**13.0, 18.1**
$R_{air\ space}$	**1.0**

With gaps accounting for 0.5 percent of total area of each layer, the U-value calculations are as follows:

One layer:

$U = 0.995/(R_{PIR}+R_{M+D}) + 0.005/(R_{air\ space}+R_{M+D})$

Existing insulation at R-12.4 $U = 0.078$ Btu/ $^{o}F \cdot ft^{2} \cdot h/Btu$

Average Insulation layer R-value = 12.0 $^{o}F \cdot ft^{2} \cdot h/Btu$

Two layers:

$U = 0.99/(R_{PIR\ layers\ 1+2}+R_{M+D}) + 0.005/(R_{PIR\ layer\ 1} + R_{air\ space}+R_{M+D}) + 0.005/(R_{PIR\ layer\ 2} + R_{air\ space}+R_{M+D})$

For adding R-13.0 to total R-25.4 $U = 0.038$ Btu/ $^{o}F \cdot ft^{2} \cdot h$

Average Insulation layer R-value = 25.2 $^{o}F \cdot ft^{2} \cdot h/Btu$

For adding R-18.1 to total R-30.5 $U = 0.032$ Btu/ $^{o}F \cdot ft^{2} \cdot h$

Average Insulation layer R-value = 30.2 $^{o}F \cdot ft^{2} \cdot h/Btu$

[4] Lewis, J.E. (Date NA), "Thermal Evaluation of the Effects of Gaps Between Adjacent Roof Insulation Panels," Granville, Ohio Research and Development Division, Owens Corning Fiberglass Corporation.

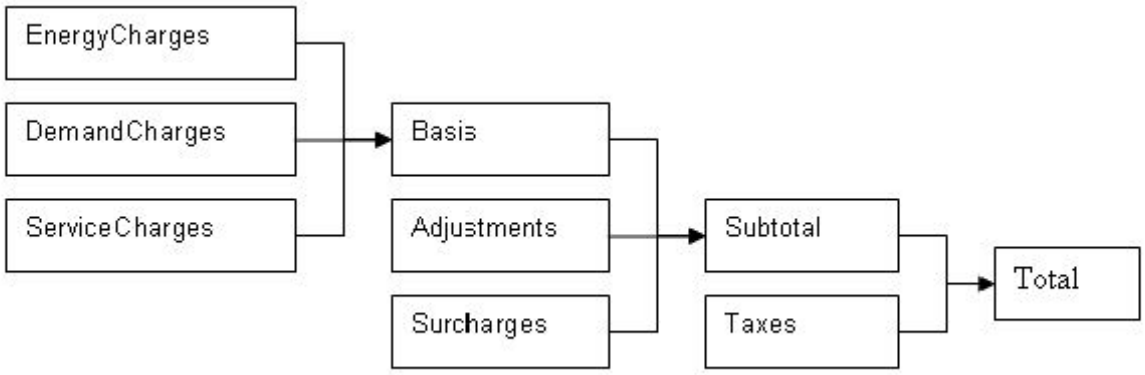
[5] ASHRAE (2005, Handbook of Fundamentals: ASHRAE Research.

4.0 Economic Analysis

4.1 Utility Costs

The utility costs for the models in this study were calculated entirely by the EnergyPlus program and serve as the first year operating savings basis for the review of simulation results (Section 5) and the impact assessment (Section 8). The average energy costs varied widely by location as well as by building type within the same location. EnergyPlus has a number of program modules to model the economics of a building including utility rate charges that calculates monthly costs based on all charges listed on the bills. Figure 4.1 below is taken from the EP Input-Output Reference Manual available in the Documentation file of the download.

Figure 4.1: EnergyPlus Monthly Utility Charges Calculation Hierarchy



Lifetime (thirty year) energy savings were calculated using the first year utility costs calculated by EnergyPlus as described above with a fuel inflation rate starting in the second year. The annual inflation rates used for these calculations are 2.2 percent for electricity and 2.8 percent for natural gas. These rates of inflation are forecasted by the Energy Information Administration (EIA).

4.2 First Costs

As was indicated earlier, Polyiso was chosen for the roof insulation in this study. It is the most widely used insulation for low-slope IEAD applications. In addition, the authors published a report in 2008 on the energy and environmental benefits of Polyiso, referenced in Section 6, Energy and Environmental Impacts. In order to establish credible information on the material and labor costs of installing Polyiso, the RS Means CostWorks Online Construction Estimator was subscribed to and utilized. This tool provides cost estimation information on all building materials and the labor involved in their installation specific to dozens of locations.

For Polyiso, CostWorks has costing data on products of several thicknesses. In reviewing the data available, the relative pricing on the various thicknesses appeared to be inconsistent. Contact was made to RS Means Customer Support in order to understand the data collection process. It was from this conversation that the author chose to use the most commonly used product, two inch Polyiso, as the basis for the first costs of the insulation. For each location modeled in this study, the most recent CostWorks material and installed labor data for this product were collected. Using this as the basis, the costs were prorated on a board foot basis to determine the estimated installed price. The square foot installed costs for each location are listed below in Table 4.2.

Table 4.2: Polyiso Installed Costs

Location	R-Value	Thickness, inches	Cost per ft^2
Houston	25.4	2.1	$1.02
Phoenix	25.4	2.1	$1.04
Atlanta	25.4	2.1	$1.01
Los Angeles	25.4	2.1	$1.20
Las Vegas	25.4	2.1	$1.26
San Francisco	25.4	2.1	$1.33
Baltimore	30.5	2.9	$1.36
Albuquerque	30.5	2.9	$1.37
Seattle	30.5	2.9	$1.45
Chicago	30.5	2.9	$1.58
Boulder	30.5	2.9	$1.44
Minneapolis	30.5	2.9	$1.60
Helena	30.5	2.9	$1.40

5.0 SIMULATION RESULTS

The purpose of this section of the report is to organize this information into general conclusions regarding the characteristics of this large cross section of building types, uses and locations as well as the benefits of an energy efficient roof. Sub-sections 5.1 through 5.3 describe the conclusions from the simulations for the existing buildings (R-12.4 roof insulation) and Sub-sections 5.4 through 5.6 summarize the benefits.

5.1 Energy Consumption Characteristics by Building Type

5.1.1 Building Size

In terms of the quantity of energy required to operate a building, the size of the building or floor area comes to mind as a very important characteristic. This, of course, provides an idea of the volume of spaced required to be conditioned, a general idea of the number of occupants, etc. When studying the impact of greater insulation levels on the roof, the square footage of roof area and the proportion of roof area to the overall building envelope (i.e. "Roof to Skin Ratio") are also important criteria. In order to provide reference for analysis, Table 5.1.1 lists the building types in descending order of floor area, the roof areas, and the roof to skin ratios.

Table 5.1.1 Building Size Criteria

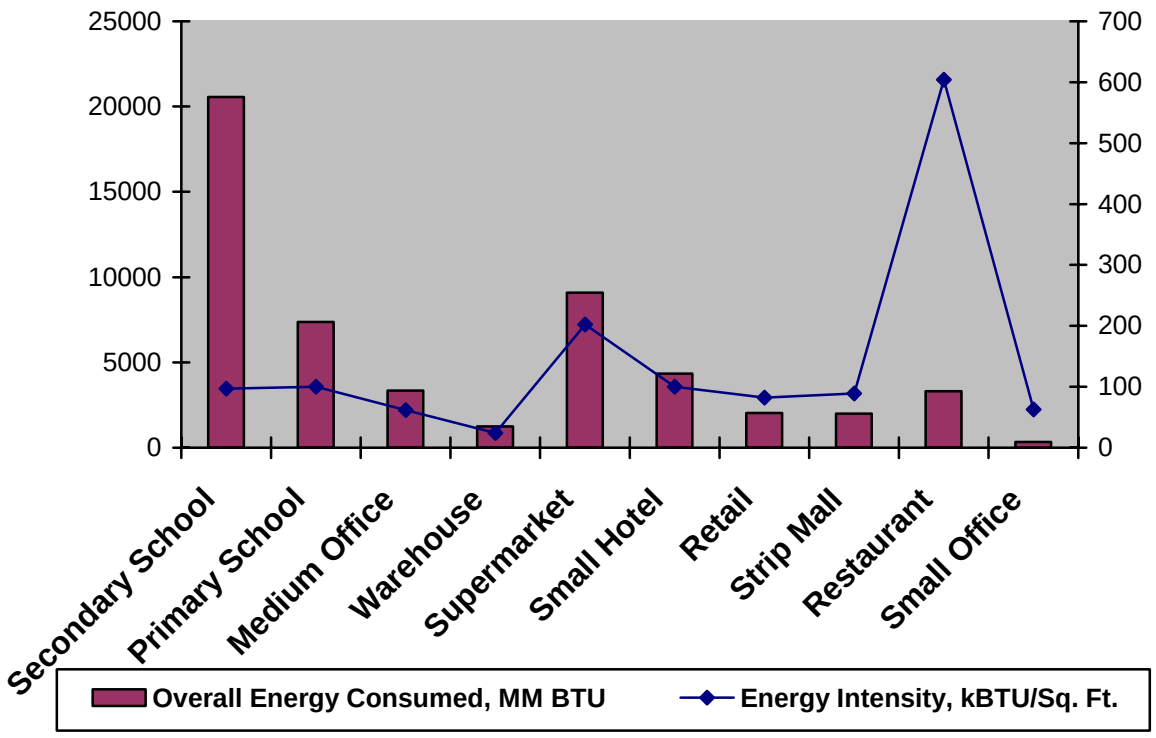
	Floor Area	Roof Area		Roof To Skin	
	ft^2	ft^2	Ranking	Ratio	Ranking
Secondary School	210,886	126,677	1	0.65	4
Primary School	73,959	73,959	2	0.73	1
Medium Office	53,626	17,879	7	0.46	8
Warehouse	52,043	49,492	3	0.65	4
Supermarket	45,004	45,004	4	0.72	2
Small Hotel	43,206	10,796	8	0.37	9
Retail	24,692	24,692	5	0.66	3
Strip Mall	22,500	22,500	6	0.64	6
Small Office	5,500	5,500	9	0.46	8
Restaurant	5,500	5,500	9	0.55	7

5.1.2 Overall Energy Consumption and Energy Intensity

Regardless of climate, the largest building, Secondary School, is also the largest consumer of energy at more than double the next largest consumer. Next, though, on the list of overall energy use is the fifth largest building, Supermarket, due to the large internal loads required for the refrigerators and freezers. The Small Office reflects its name by being the smallest energy building type, consuming less than 2 percent of the prototypical Secondary School.

Size is not at all a reliable indicator of energy intensity (energy/floor area) for buildings according to this analysis. Restaurant, consumes energy on an intensity basis many times greater than any other building type with Supermarket second, again due to the high internal load requirements of these two building uses. The semi-heated and low internal load nature of Warehouse puts it low on the list in terms of both overall energy and intensity. Figure 5.1.2 illustrates the widely varying energy consumption characteristics of these ten building types.

Figure 5.1.2: Overall Energy and Energy Intensity for Climate Zone 5



5.1.3 Energy Costs

Comparisons of the various building types in terms of operating costs are very similar to that of site energy. Total costs range from a few thousand dollars annually for Small Office to well over $400,000 for Secondary School. Restaurant is far and away the most costly building type to operate on a square footage basis.

5.2 Energy Consumption Characteristics by Climate Zones

5.2.1 Overall Energy Consumption and Energy Intensity

In general, energy usage is highest in the colder Climate Zones modeled (5 and 6). Climate Zones 2 and 4 are very similar in consumption rates and Zone 3 exhibits the lowest rate. These differences, though, are not nearly as wide as those seen between the different building types.

5.2.2 Energy Costs

The average annual utility rates established by the program calculations are listed below (Table 5.2.2) in ranges. The last column is intended to provide a general conclusion (although somewhat subjective) of the costs of operating existing buildings in these locations on a utility rate basis. Based on this analysis, the highest costs of operation are buildings located in California, followed by the highest cooling load regions of the south and the coldest locations are the least costly to operate.

Upon review of the overall operating costs of these existing buildings to include both utility rates and climate, this general picture looks only slightly different. Climate Zone 2 (Houston and Phoenix) has the highest costs, followed by Zone 3 (Atlanta, Los Angeles, Las Vegas and San Francisco), Zone 6 (Minneapolis and Helena), Zone 5 (Chicago and Boulder), and lastly, Zone 4 (Baltimore, Albuquerque and Seattle) with the lowest costs.

Table 5.2.2 Utility Rate Ranges

	Electricity	Natural Gas	Scale
	$/kWh	$/Therm	
Houston	$0.109 - 0.124	$0.849 – 0.865	High
Phoenix	$0.076 – 0.124	$0.852 – 0.908	Medium
Atlanta	$0.084 – 0.116	$0.989 – 1.064	High
Los Angeles	$0.123 – 0.136	$0.887 - 0.935	Highest
Las Vegas	$0.094 – 0.103	$0.796 – 0.861	High
San Francisco	$0.124 – 0.162	$0.889 – 0.934	Highest
Baltimore	$0.067 – 0.081	$1.016 – 1.059	Medium
Albuquerque	$0.037 – 0.075	$0.719 – 0.758	Lowest
Seattle	$0.071 – 0.079	$0.876 – 0.895	Medium
Chicago	$0.052 – 0.078	$0.867 – 0.930	Low
Boulder	$0.037 – 0.075	$0.722 – 0.756	Lowest
Minneapolis	$0.053 – 0.075	$0.831 – 0.839	Low
Helena	$0.068 – 0.077	$0.837 – 0.912	Low

5.2.3 Energy and Environmental Impacts

Section 6 explains in detail full life cycle energy and environmental benefits of energy efficient construction. In Section 6.1.2, the concept of "source versus site energy" is explained. In order to assess the full impact of resource depletion and Global Warming Potential (GWP), one must "consider the source". Table 5.2.3 illustrates the source energy and emissions involved in operating these buildings in Climate Zone 6. In the simulations, Zone 6 exhibited the highest levels of source impact. In order to illustrate the relative magnitude of emissions from the operation of each building type, the last two columns list the equivalent emissions from the annual energy used and the gasoline burned in the number of homes and vehicles, respectively. The data in these columns were obtained from the calculator on the Clean Energy page of the EPA website.[6]

Table 5.2.3: Building Type Source Energy and Emissions Comparisons - Zone 6

	Annual Source Energy	Annual Emissions	Annual Emissions Equivalent	
	Gigajoules, GJ	*Metric Tons, CO_2 equivalents*	*Homes*	*Vehicles*
Secondary School	**55,505**	**967**	**88**	**177**
Primary School	**20,059**	**341**	**31**	**63**
Medium Office	**9,771**	**167**	**15**	**31**
Warehouse	**3,906**	**67**	**6**	**12**
Supermarket	**24,911**	**424**	**39**	**78**
Small Hotel	**11,564**	**197**	**18**	**36**
Retail	**5,475**	**93**	**9**	**17**
Strip Mall	**5,359**	**91**	**9**	**17**
Small Office	**1,060**	**18**	**2**	**4**
Restaurant	**7,236**	**122**	**11**	**23**

Conversions: 948 kBtu/GJ; 2,205 LB/Metric Ton

5.3 Energy Savings from Energy Efficient Roof Construction

This sub-section of the report provides a comprehensive summary of the results of the comparative analysis of the energy performance upon upgrading a typical existing building with an "Energy Efficient Roof". To review, a twenty to fifty year old building with a low-slope roof likely would have insulation above the roof deck amounting to R-12.4 or less. For this analysis, ten typical buildings with widely varying energy consumption characteristics have been modeled. The definition of the "Energy Efficient Roof" is that of a roof having roof insulation equal to or greater than R-20 for Climate Zone 1, equal to or greater than R-25 for Zones 2, 3, 4 and 5, equal to or greater than R-30 for Zone 6 and equal to or greater than R-35 for Zones 7 and 8. This study includes the comparative analysis of buildings located in Zones 2 – 6. Please note that the simulations were modeled with R-30.5 in Zones 4 and 5 as opposed to R-25. The reason for this is that when the boundaries of this study were established, ASHRAE and the Industry set this minimum level at R-30 for these Zones and have since adjusted to R-25.

[6] www.epa.gov/cleanenergy/energy-resouces/calulator.html

5.3.1 Retail Benchmark

Figure 5.3.1: Retail Building

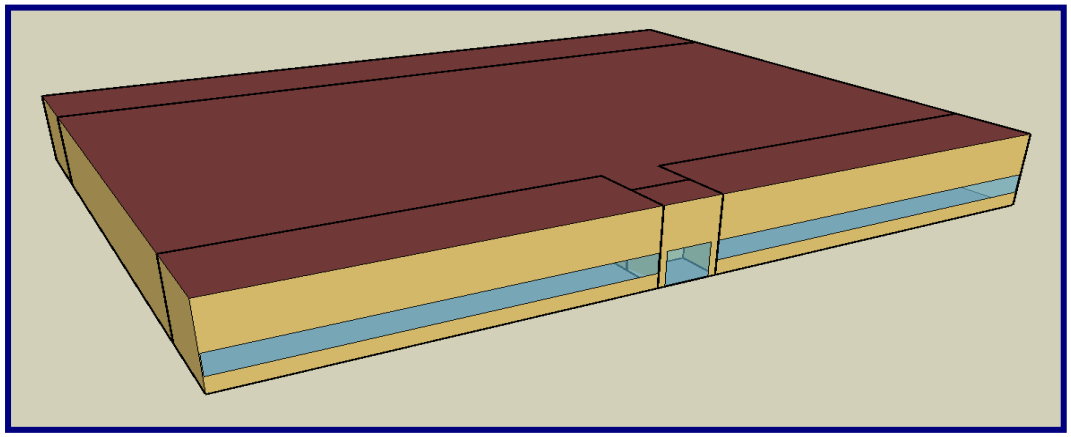


Table 5.3.1: Retail Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	4.2 %	4.0 %	6.4 %	8.8 %	9.1 %
		MM Btu	73	57	111	180	221
		kBtu/ft^2	3.0	2.3	4.5	7.3	9.0
Source	30 Yrs.	kBtu/ft^2	254	161	229	383	470
Emissions		kg CO_2-eq/ft^2	18.3	11.6	16.2	27.0	33.2
Dollar Savings							
First Year		% Savings	4.1 %	3.3 %	5.2 %	7.4 %	8.0 %
		$	$2,173	$1,416	$1,375	$1,642	$2,723
		$/ft^2	$0.09	$0.06	$0.06	$0.07	$0.11
30 Yrs.		$	$89,510	$58,879	$59,169	$71,368	$116,675

5.3.2 Strip Mall Benchmark

Figure 5.3.2: Strip Mall Building

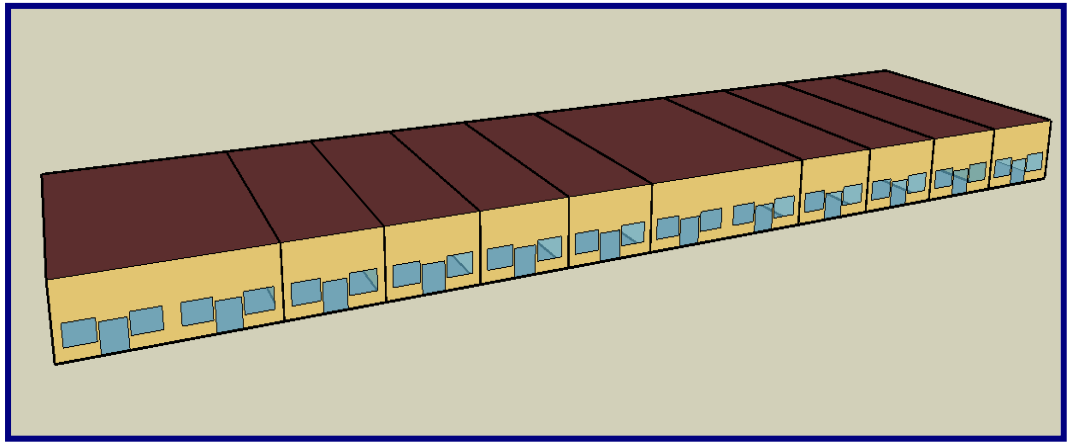


Table 5.3.2: Strip Mall Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	5.5 %	6.4 %	8.1 %	9.6 %	9.8 %
		MM Btu	84	86	139	194	241
		kBtu/ft^2	3.7	3.8	6.2	8.6	10.7
Source	30 Yrs.	kBtu/ft^2	310	323	400	437	558
Emissions		kg CO_2-eq/ft^2	22.4	23.3	28.6	30.8	39.4
Dollar Savings							
First Year		% Savings	5.4 %	6.7 %	7.4 %	8.1 %	8.4 %
		$	$2,487	$2,660	$1,909	$1,756	$2,811
		$/ft^2	$0.11	$0.12	$0.08	$0.08	$0.12
30 Yrs.		$	$102,804	$109,387	$80,624	$76,368	$121,092

5.3.3 Warehouse Benchmark

Figure 5.3.3: Warehouse Building

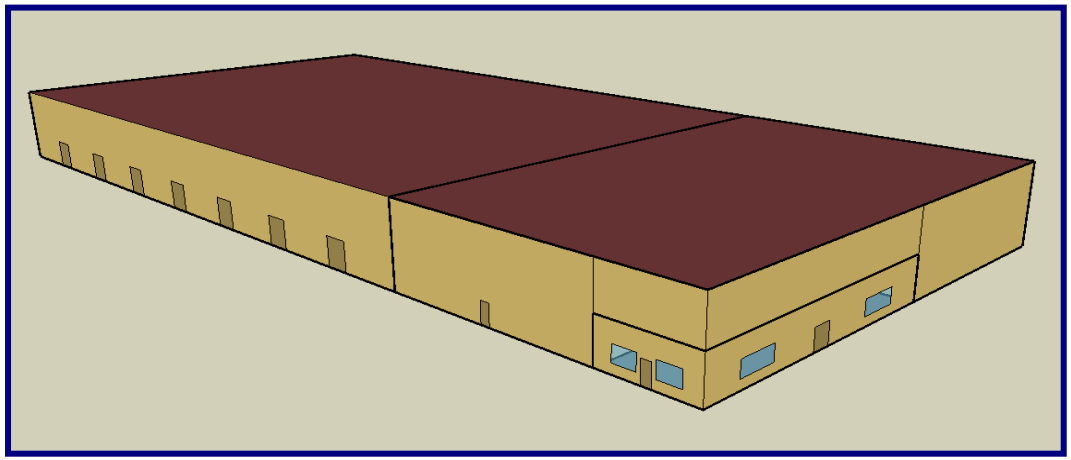
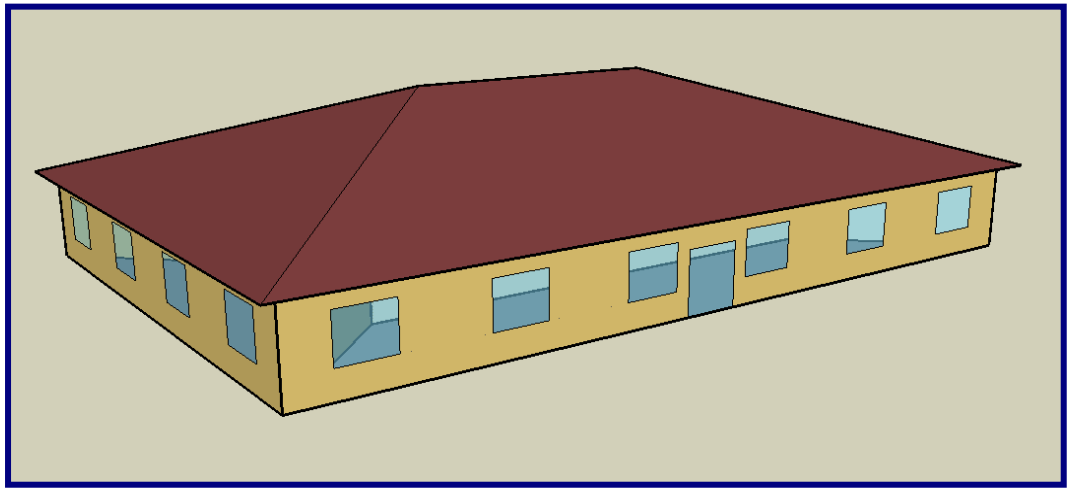


Table 5.3.3: Warehouse Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	5.5 %	3.3 %	5.1 %	5.7 %	8.2 %
		MM Btu	51	29	54	71	126
		kBtu/ft^2	1.0	0.6	1.0	1.4	2.4
Source	30 Yrs.	kBtu/ft^2	92	51	58	78	151
Emissions		kg CO_2-eq/ft^2	6.7	3.7	4.1	5.5	10.7
Dollar Savings							
First Year		% Savings	6.0 %	3.2 %	3.9 %	4.7 %	7.8 %
		$	$1,789	$931	$677	$677	$1,982
		$/ft^2	$0.03	$0.02	$0.01	$0.01	$0.04
30 Yrs.		$	$73,579	$38,496	$29,064	$28,935	$83,319

5.3.4 Small Office Benchmark

Figure 5.3.4: Small Office Building



Note: Attic converted to flat roof for modeling

Table 5.3.4: Small Office Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	8.0 %	8.5 %	8.4 %	8.8 %	9.6 %
		MM Btu	27	23	25	30	37
		kBtu/ft^2	4.8	4.2	4.6	5.5	6.8
Source	30 Yrs.	kBtu/ft^2	458	380	359	356	392
Emissions		kg CO_2-eq/ft^2	33.2	33.6	35.1	39.2	44.9
Dollar Savings							
First Year		% Savings	7.8 %	8.4 %	7.6 %	6.7 %	7.3 %
		$	$874	$755	$443	$393	$508
		$/ft^2	$0.16	$0.14	$0.08	$0.07	$0.09
30 Yrs.		$	$35,803	$31,088	$18,352	$16,755	$21,650

5.3.5 Medium Office Benchmark

Figure 5.3.5: Medium Office Building

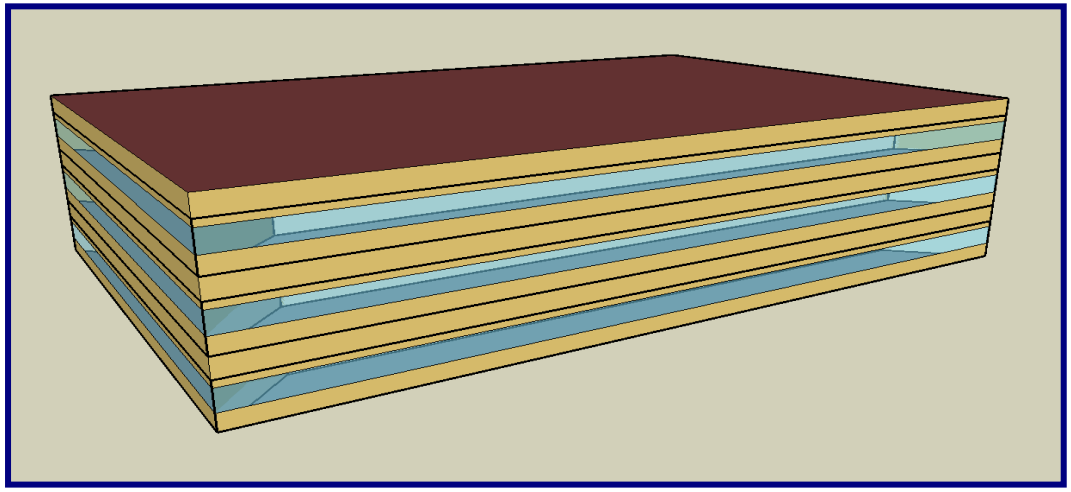
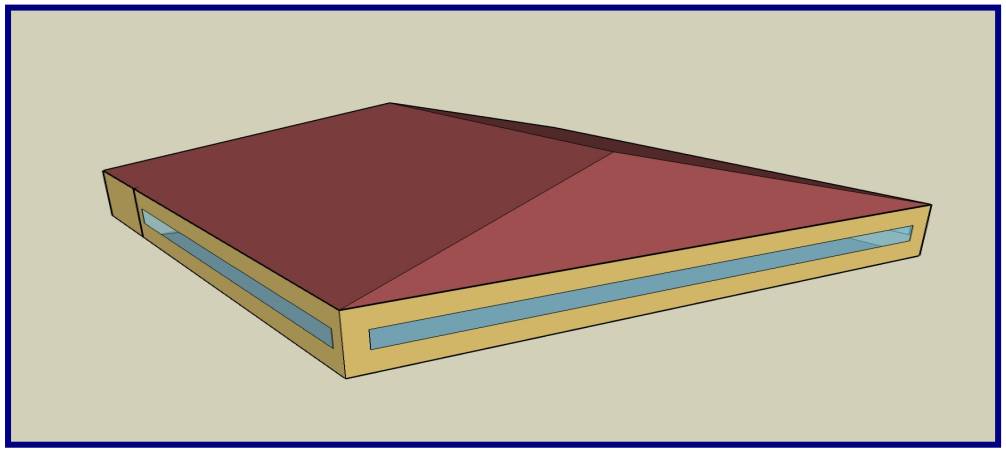


Table 5.3.5: Medium Office Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	2.0 %	1.4 %	1.8 %	2.9 %	3.3 %
		MM Btu	62	40	57	97	125
		kBtu/ft^2	1.2	0.7	1.1	1.8	2.3
Source	30 Yrs.	kBtu/ft^2	100	63	65	102	120
Emissions		kg CO_2-eq/ft^2	7.2	4.5	4.6	7.3	8.4
Dollar Savings							
First Year		% Savings	2.3 %	1.5 %	1.5 %	2.1 %	2.5 %
		$	$2,068	$1,246	$781	$1,096	$1,520
		$/ft^2	$0.04	$0.02	$0.01	$0.02	$0.03
30 Yrs.		$	$85,108	$51,650	$32,870	$47,679	$64,599

5.3.6 Restaurant Benchmark

Figure 5.3.6: Restaurant Building



Note: Attic converted to flat roof for modeling

Table 5.3.6: Restaurant Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	1.4 %	0.9 %	1.1 %	1.3 %	1.6 %
		MM Btu	43	27	33	42	59
		kBtu/ft^2	7.9	4.8	6.1	7.7	10.7
Source	30 Yrs.	kBtu/ft^2	753	463	487	546	631
Emissions		kg CO_2-eq/ft^2	54.7	33.6	35.1	39.2	44.9
Dollar Savings							
First Year		% Savings	2.1 %	1.4 %	1.3 %	1.3 %	1.8 %
		$	$1,313	$883	$521	$450	$761
		$/ft^2	$0.24	$0.16	$0.09	$0.08	$0.14
30 Yrs.		$	$53,835	$36,216	$21,680	$19,043	$32,390

5.3.7 Supermarket Benchmark

Figure 5.3.7: Supermarket Building

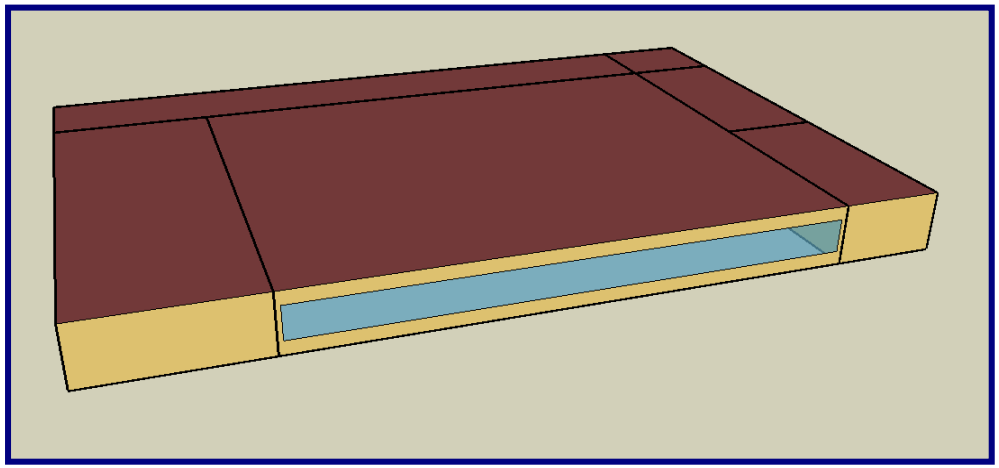


Table 5.3.7: Supermarket Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	1.4 %	1.2 %	3.2 %	3.8 %	4.3 %
		MM Btu	118	91	272	350	425
		kBtu/ft^2	2.6	1.7	6.1	7.8	8.8
Source	30 Yrs.	kBtu/ft^2	245	171	353	402	416
Emissions		kg CO_2-eq/ft^2	17.8	12.3	25.1	28.4	29.1
Dollar Savings							
First Year		% Savings	1.9 %	1.1 %	2.6 %	2.9 %	3.2 %
		$	$3,888	$2,519	$3,317	$4,181	$4,495
		$/ft^2	$0.09	$0.06	$0.07	$0.09	$0.10
30 Yrs.		$	$159,781	$104,006	$141,714	$178,322	$195,056

5.3.8 Primary School Benchmark

Figure 5.3.8: Primary School Building

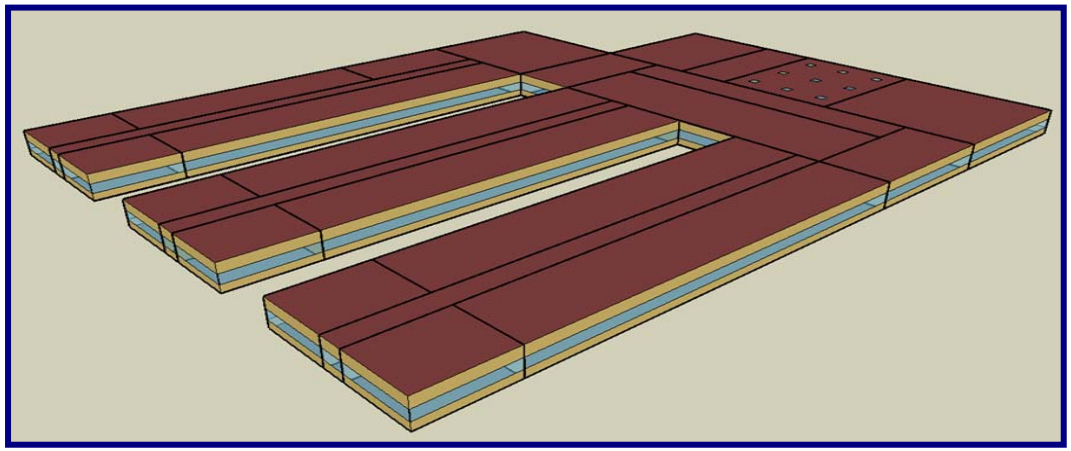


Table 5.3.8: Primary School Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	12.2 %	11.3 %	14.3 %	14.2 %	12.7 %
		MM Btu	814	696	943	1,046	1,073
		kBtu/ft^2	11.0	9.4	12.8	14.1	14.5
Source	30 Yrs.	kBtu/ft^2	848	685	832	904	887
Emissions		kg CO_2-eq/ft^2	61.0	49.2	59.5	64.5	63.2
Dollar Savings							
First Year		% Savings	8.1 %	9.7 %	12.3 %	12.5 %	11.8 %
		$	$13,948	$17,040	$12,574	$13,261	$14,567
		$/ft^2	$0.19	$0.23	$0.17	$0.18	$0.20
30 Yrs.		$	$580,851	$708,143	$531,727	$560,103	$616,752

5.3.9 Secondary School Benchmark

Figure 5.3.9: Secondary School Building

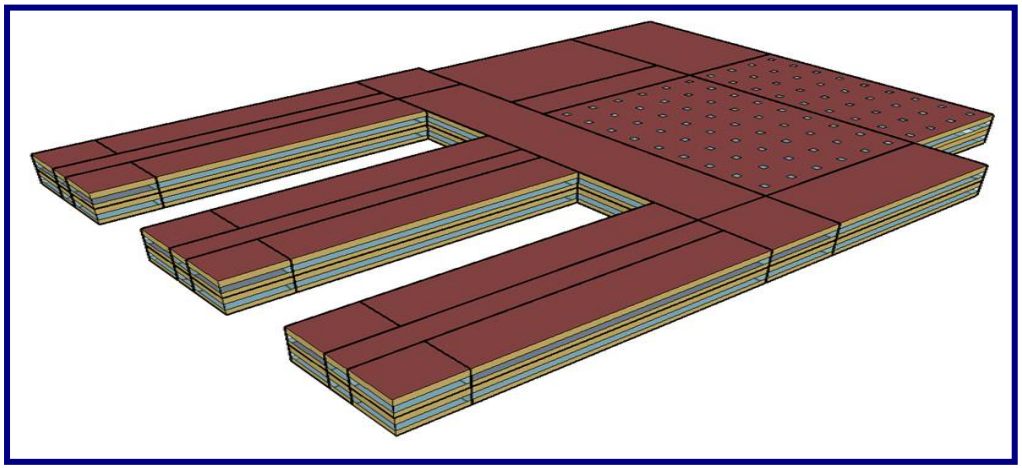


Table 5.3.9: Secondary School Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	8.7 %	7.6 %	9.5 %	9.4 %	9.0 %
		MM Btu	1,501	1,190	1,695	1,925	2,180
		kBtu/ft^2	7.1	5.6	8.0	9.1	10.3
Source	30 Yrs.	kBtu/ft^2	602	455	573	630	652
Emissions		kg CO_2-eq/ft^2	43.5	32.8	41.1	45.1	51.0
Dollar Savings							
First Year		% Savings	7.9 %	6.9 %	8.6 %	9.0 %	8.7 %
		$	$35,266	$31,920	$22,923	$25,763	$29,878
		$/ft^2	$0.17	$0.15	$0.17	$0.12	$0.14
30 Yrs.		$	$1,454,406	$1,318,566	$961,400	$1,081,580	$1,262,887

5.3.10 Small Hotel Benchmark

Figure 5.3.10: Small Hotel Building

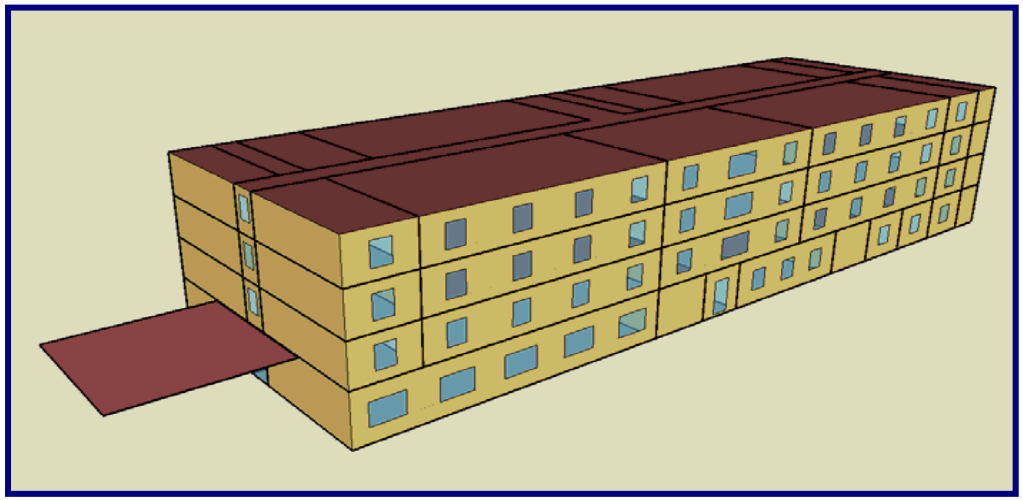


Table 5.3.10: Small Hotel Building

		Zone	2	3	4	5	6
Energy Savings							
Site	Annual	% Savings	0.8 %	0.3 %	0.3 %	0.6 %	0.8 %
		MM Btu	30	11	14	26	39
		kBtu/ft^2	0.6	0.3	0.3	0.6	1.0
Source	30 Yrs.	kBtu/ft^2	59	31	23	35	54
Emissions		kg CO_2-eq/ft^2	4.3	2.3	1.7	2.5	3.9
Dollar Savings							
First Year		% Savings	0.8 %	0.5 %	0.3 %	0.5 %	0.9 %
		$	$783	$482	$187	$321	$662
		$/ft^2	$0.02	$0.01	$0.004	$0.01	$0.02
30 Yrs.		$	$31,331	$19,392	$7,336	$13,156	$25,584

5.3.11 Results Compilation

In order to provide a side-by-side comparison of the benefits of upgrading to an energy efficient roof, Figure 5.3.11a shows all the savings on an energy intensity basis (i.e. decrease in energy consumption on a square foot basis) and Figure 5.3.11b shows cost savings on a dollar-per-square-foot basis. From a second perspective, Tables 5.3.11a and b lists all of the decreased energy consumption results.

Figure 5.3.11a: Energy Savings – Energy Intensity Basis, kBtu/ft^2

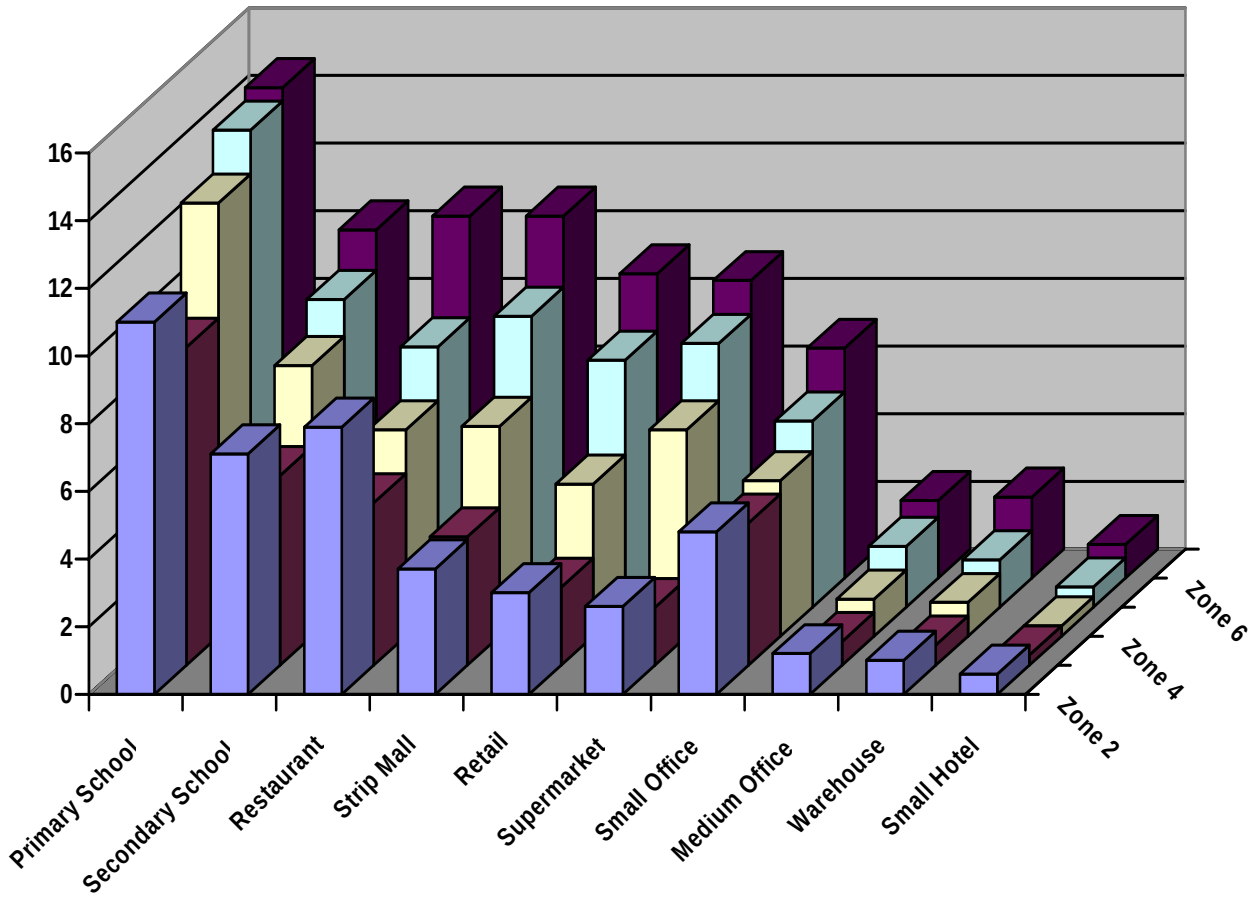


Table 5.3.11a: Energy Savings – MM Btu

	Primary School	Secondary School	Restaurant	Strip Mall	Retail	Supermkt	Small Office	Med. Office	Warehse	Small Hotel
Zone 2	**814**	**1,501**	**43**	**84**	**73**	**118**	**27**	**62**	**51**	**30**
Zone 3	**696**	**1,190**	**27**	**86**	**57**	**91**	**23**	**40**	**29**	**11**
Zone 4	**943**	**1,695**	**33**	**139**	**111**	**272**	**25**	**57**	**54**	**14**
Zone 5	**1,046**	**1,925**	**42**	**180**	**180**	**350**	**30**	**71**	**71**	**26**
Zone 6	**1,073**	**2,180**	**59**	**241**	**221**	**425**	**37**	**125**	**126**	**39**

Figure 5.3.11b: Energy Savings – Cost Intensity Basis, cents/ft^2

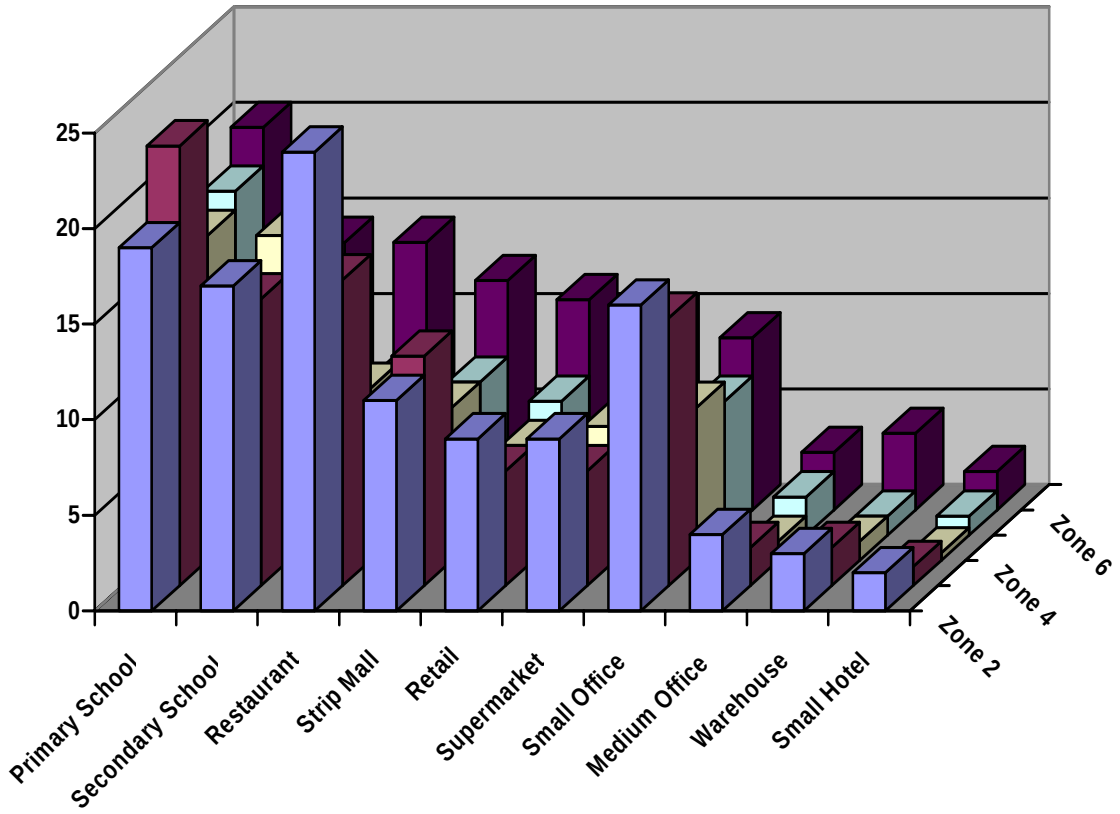


Table 5.3.11b: Lifetime Energy Savings – Cost Basis

	Primary School	Restaurant	Retail	Small Office	Warehouse
Zone 2	$580,851	$53,835	$89,510	$35,803	$73,579
Zone 3	$708,143	$36,216	$58,879	$31,088	$38,496
Zone 4	$531,727	$21,680	$59,169	$18,352	$29,064
Zone 5	$560,103	$19,043	$71,368	$16,755	$28,935
Zone 6	$616,752	$32,390	$116,675	$21,650	$83,319
	Secondary School	Strip Mall	Supermarket	Medium Office	Small Hotel
Zone 2	$1,454,406	$102,804	$159,781	$85,108	$31,331
Zone 3	$1,318,566	$109,387	$1054,006	$51,650	$19,392
Zone 4	$961,400	$80,624	$141,714	$32,870	$7,336
Zone 5	$1,081,580	$76,368	$178,322	$47,679	$13,156
Zone 6	$1,262,887	$121,092	$195,056	$64,599	$25,584

6.0 ENERGY AND ENVIRONMENTAL IMPACT

6.1 Energy Impacts

6.1.1.1 Life Cycle Energy

The entire insulation life cycle consists of cradle to end-of-life processes for making, processing, transporting, installing, using and finally disposing of insulation at end-of-life. Since polyiso is generally recognized as effective and durable, and is the most common type of insulation used in commercial roofing, each phase or process of the polyiso insulation life cycle was analyzed to determine energy consumption. These processes included: 1) Chemical Raw Materials Manufacturing; 2) Facer Manufacturing; 3) Plastic Packaging Manufacturing; 4) Polyiso Raw Materials Transportation; 5) Polyiso Manufacturing; 6) Polyiso Product Transportation; 7) Installation; 8) Use and 9) End-of-life.

Processes 1 to 7 and 9 consume energy associated with essentially making, installing and disposing of polyiso. Energy consumed in these life cycle processes is commonly called the embodied energy of a product. Standard life cycle inventory methods described in ISO 14040[7] were used to estimate the energy for a specified quantity of insulation.

Based on a previous study[8] for selected cities, Table 6.1.1 below summarizes the embodied energy for polyiso insulation installed on a one-story retail building roof.

Table 6.1.1: Estimated Embodied Energy for Polyiso Insulation based on Installation on a One-Story 125,000 ft^2 Commercial Building Roof

Building Location	R15 to R25.4 (2.2 inches extra)		R15 to R30.5 (3.0 inches extra)	
	MJ/kg	MJ/BF	MJ/kg	MJ/BF
Chicago	79.0	6.9	82.6	6.8
Los Angeles	83.6	7.3	87.2	7.2
Houston	78.7	6.9	82.3	6.8

Notes: MJ = Megajoules, based on installed kg or BF = Boardfoot (1 ft^2 insulation 1 inch thick)

Thus, a complete and balanced picture of the insulation life cycle must subtract the additional embodied energy associated with the insulation from the energy savings, thereby yielding a net energy savings. It is also worth emphasizing that the embodied energy, i.e. the energy used to make, install and transport the polyiso insulation product is negligible compared to the energy saved in using the insulation over its lifetime. These aspects are discussed in detail under Impact Assessment, section 8.

[7] ISO 14040:2006 – Environmental Management, Life Cycle Assessment, Principles & Framework

[8] Phelan, J and G. Pavlovich, Energy & Environmental Benefits of Insulating Commercial Buildings with Polyiso, Center for the Polyurethanes Industry 2008 Proceedings

Embodied energy also includes the total life cycle from energy sources used throughout steps 1 to 7 and 9. This total life cycle from energy sources such as electric power, natural gas, diesel fuel, etc. is often referred to as “source” energy, as discussed below.

6.1.2 Source Energy Versus Site Energy

When estimating energy consumption, it is not sufficient to measure the energy metered at a building or production unit or consumed as transportation fuel. These measurements only include the energy actually measured at a specific location or site, such as a building electricity meter, an orifice meter on a natural gas feed line into a manufacturing unit, or a fuel gauge on a truck using diesel fuel. Actual energy consumption includes the life cycle or “source energy” needed to produce the energy delivered to a specific location or user (i.e. site).

“Source energy” can be thought of as the “energy to make the energy”. Using electrical energy as an example, 3.24 kilowatt hour (kWh) of electricity are needed to generate 1 kWh of electricity delivered to a consumer (based on an average U.S. electric power grid mix). The 3.24 kWh is normally called the “source energy” and the 1 kWh is really the “site energy”. The total source energy of 3.24 kWh per kWh may also be thought of as the life cycle “cradle-to-plug” energy.

In other words, for each kWh of electricity measured at the meter of the building, 3.24 kWh is needed to supply this energy. This energy is required to extract coal, natural gas crude from the earth, refine these fuels as needed, deliver the fuels to the power plant, generate steam in the boilers to drive the turbines and generators, deliver the electricity throughout the grid with transformers, all of which includes efficiency and line losses.

Similarly, based on an average U.S. natural gas mix, 1.156 Mega joules (MJ) of “source energy” are needed for one MJ of natural gas “site energy” delivered to a consumer. The same concept applies to all sources of energy used in embodied energy calculations as well as energy consumed to heat, cool and light a building. Using transportation by a diesel-fueled truck as an example, the energy from combustion (lower heating value) is 128,450 Btu/gallon. However, the total energy associated with the diesel fuel life cycle must include the “pre-combustion energy” (energy for extracting, transporting, refining crude etc), which is 23 percent greater than the combustion energy. Thus, it takes 1.23 MJ of energy to produce one MJ of diesel fuel.

Table 6.1.2(a) shows the source energy factors used to adjust the metered building electricity and natural gas consumption from site energy to source energy in Simulation Results, Section 5. The “metered” values estimated from Whole Building Energy Analysis are multiplied by these source energy factors to obtain the “source” or “total life cycle” energy.

Table 6.1.2(a): Source-Site Ratios for Electricity and Natural Gas[9]

Type of Energy	Source-Site Ratio
US Electric Power Grid Mix (2002)	3.24
US Thermal Energy from Natural Gas (2002)	1.156

Note: Data from GaBi Life Cycle Engineering database (2006), lower heating value

These factors are relatively consistent with the factors published by the Environmental Protection Agency (EPA) on their Energy Star website[10], as the US EPA site-source ratio for electricity is 3.34 (3 percent greater than the electricity factor used in this report) and for natural gas the factor is 1.047 (9 percent lower than the natural gas factor used in this report).

The factors in Table 6.1.2(a) were chosen for this study since the authors are familiar with the rigorous life cycle methodology upon which the calculations are based. The methodology considers, for example: 1) The entire "cradle-to-plug" (electricity) or "cradle-to-valve" (natural gas) life cycle, i.e., the data considers the entire supply chain of fuels from exploration to extraction, processing and transport; 2) Life cycle inventory methods in conformance with ISO 14040 and 14044; 3) Cut-off rule coverage for unit processes includes 95 percent of mass and energy for input/output flows and 98% for environmental, with coverage for exploration (crude oil etc) at 90 percent of mass and energy and 95 percent for environmental aspects; 4) Grid mix data based on national US statistics, and power plant models according to US combustion technology mix; 5) All relevant transport processes used in the energy production are included; 6) US-specific boundary conditions and sources for a base year of 2002 (within the 2001 to 2005 averaged range used as the base years for the EPA data).

Table 6.1.2(b) shows source-site energy ratios for common fuels used in the embodied energy calculations, where diesel is used for truck and rail transportation, and lifting equipment such as cranes, and propane is used for fork-lift trucks.

Table 6.1.2(b): Source-Site Ratios for Some Petroleum Refinery Fuels[11]

Type of Energy	Source-Site Ratio
US Diesel from Refinery	1.23
US Propane from Refinery	1.24

Note: Data from GaBi Life Cycle Engineering database (2006), lower heating value

These factors were used, as the EPA site-source ratios for diesel and propane (both 1.01) do not appear to account for the pre-combustion energy required to extract, refine and transport these fuels. Also, similar to the justification provided for the electricity and natural gas, the factors in Table 6.1.2(b) were chosen for this study since the authors are familiar with the rigorous life cycle methodology upon which the calculations are based (ISO 14040/14044 methodology, comprehensive life cycle approach, etc).

[9] GaBi 4 Life Cycle Engineering Software and Database (2008), PE International
[10] http://www.energystar.gov
[11] GaBi 4 Life Cycle Engineering Software and Database (2008), PE International

6.2 Global Warming Potential (GWP) Impacts

6.2.1 Life Cycle GWP Emissions

Similar to embodied energy calculations, GWP associated with making, installing and disposing of polyiso was based on a "cradle to end-of-life" analysis that includes all GWP associated with the final polyiso product. The GWP generated during these phases also included GWP associated with pre-combustion and combustion of fuels such as natural gas, diesel, propane, etc. GWP is normally measured in kg CO_2-equivalents (kg CO_2-eq.), as different types of emissions (e.g. methane, nitrous oxides) have a greater global warming impact than CO_2 and must be adjusted to express the emissions on a common basis.

The TRACI model from US EPA was used to estimate the GWP emissions to air from all of the processes used to make polyiso insulation, i.e. processes 1 to 7 and 9 noted in Section 6.1.1. Standard life cycle inventory methods described in ISO 14040 were used to estimate the GWP for a specified quantity of insulation.

Based on a previous study for selected cities, Table 6.1.1 below summarizes the GWP associated with all of the polyiso insulation life cycle phases except for the use phase, when polyiso is installed on a one-story retail building roof.

Table 6.1.1: Estimated GWP Emissions from Increased Polyiso Insulation on a One-Story 125,000 ft^2 Commercial Building Roof

Building Location	R15 to R25.4 (2.2 inches extra)		R15 to R30.5 (3.0 inches extra)	
	kg CO_2-eq./kg	kg CO_2-eq./BF	kg CO_2-eq./kg	kg CO_2-eq./BF
Chicago	4.96	0.43	5.18	0.43
Los Angeles	5.35	0.47	5.58	0.46
Houston	4.99	0.43	5.21	0.43

Notes: kg CO_2-equivalents = kg CO_2-eq., BF = Boardfoot or 1 ft^2 insulation 1 inch thick

Thus, a complete and balanced picture of the insulation life cycle must subtract the additional GWP emissions generated from making, installing and transporting the insulation from the GWP emissions prevented in the use phase, thereby yielding a net GWP emissions prevented. It is also worth emphasizing that the GWP emissions generated to make, install, transport etc the polyiso insulation product is negligible compared to GWP prevented when using the insulation over its lifetime. These aspects are discussed in detail under Impact Assessment, Section 8.

6.2.2 GWP Life Cycle Emissions Factors

When estimating GWP emissions, it is not always sufficient to measure the GWP associated with combustion at a building, production unit or from internal combustion engines used for transportation. Actual GWP emissions generated include the life cycle GWP associated with life cycle processes for producing electricity, natural gas and other diesel fuels (extraction, refining, distribution, etc.) as well as GWP emissions generated from combustion of fuels.

Table 6.2.2 shows the GWP life cycle factors used to estimate kg CO_2-equivalents associated with electricity and natural gas consumption for the various building types/locations shown in the Simulation Results, Section 5. The metered energy values estimated from Whole Building Energy Analysis are multiplied by these life cycle GWP emissions factors to obtain the "total life cycle" kg CO_2-equivalents associated with energy use at the buildings.

Table 6.2.2: Life Cycle GWP Emissions Factors for Electricity and Natural Gas[12]

Type of Energy	MJ kg CO_2-eq./MJ
US Electric Power Grid Mix (2002)	0.223
US Thermal Energy from Natural Gas (2002)	0.0749

Note: Data from GaBi Life Cycle Engineering database (2006), lower heating value, MJ = Megajoules

These factors differ considerably from the EPA AP42 factors published in the Energy Plus simulation model guidance[13], as the EPA factor for electricity is 0.1691 kg CO_2-eq./MJ (24 percent lower than the electricity factor used in this report) and for natural gas the factor is 0.0503 kg CO_2-eq./MJ (33 percent lower than the natural gas factor used in this report). It appears that these AP42 factors are based mainly on combustion, as it is not clear that GWP emissions associated with life cycle CO_2-eq. are considered.

Therefore, the factors in Table 6.2.2 were chosen for this study since the authors are familiar with the rigorous life cycle methodology upon which the calculations are based, as described in Section 6.1.2 (ISO 14040/14044 methodology, comprehensive life cycle approach etc).

Similarly, calculations made for common fuels (diesel for truck and rail transportation, propane for fork-lifts, etc.) in life cycle phases for insulation manufacture, installation, transportation, etc. also include the GWP emissions associated with both the pre-combustion and combustion stages.

[12] GaBi 4 Life Cycle Engineering Software and Database (2008), PE International
[13] U.S. Department of Energy (2007), EnergyPlus Engineering Reference

6.3 Other Environmental Aspects

Since the scope of this study is energy and cost reductions associated with increased levels of insulation, other environmental benefits have not been quantified with the exception of more commonly discussed GWP emissions.

For example, for every kWh (3.6 Megajoules) of electricity reduced at a building, there is a corresponding 0.803 kg CO_2-eq./kWh (0.223 kg CO_2-eq./MJ) reduction based on the average U.S. power grid (see Section 6.1.2). In this study, GWP reductions in private and public sector buildings over 30 years total 76,904,634 thousand metric tons of kg CO_2-eq., or approximately 77 billion metric tons of kg CO_2-eq. (equivalent to 76,904,634,000,000 or almost 77 trillion kg, i.e. 170,000,000,000,000 or 170 trillion pounds of kg CO_2-eq.). Since a significant portion of the kg CO_2-eq. reduction is associated with electricity generation at power plants, it is apparent from analogy that other environmental aspects associated with electric power generation are also significantly reduced.

Besides the global warming impact measured in kg CO_2-eq. (includes green house gases such as methane and nitrous oxide), additional environmental aspects associated with burning fossil/other fuels and electric power plants include, but are not limited to:

- Nitrogen oxides (NO_x) emissions, ozone
- Sulfur dioxide (SO_x) emissions
- Mercury, other heavy metals and pollutants from burning coal
- Coal mining including strip mining
- Particulate matter emissions
- Water usage
- Wastewater discharges
- Solid waste

The EPA publishes a regularly updated inventory of environmental attributes related to air emissions (greenhouse gases, criteria pollutants) of electric power systems on their “eGRID” webpage[15]. The data provide an indication of the magnitude of such emissions associated with electric power generation.

Since quantification of these other environmental aspects is beyond the scope of this report, these issues are mentioned to promote awareness that reduction in building energy use from increased insulation has benefits far more extensive than energy and greenhouse gas reductions. Quantification of these other environmental benefits will be the subject of future studies by the authors of this report.

[15] www.epa.gov/cleanenergy/energy-resources/egrid

7.0 COMMERCIAL BUILDING MARKET ANALYSIS

The Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) is generally recognized as providing the most complete data regarding existing commercial buildings. The CBECS Survey is essential for relating the extensive and rigorous energy modeling results performed in this study to commercial building market data. Therefore, data from the most recent available survey, CBECS 2003, were utilized as the basis for the impact assessment (Section 8) of the energy modeling results. The information from the report entitled "DOE Commercial Building Benchmark Models for Energy Simulation" also was very useful in linking the modeling results to the market data.

7.1 CBECS 2003

The CBECS is a national-level sample quadrennial survey of buildings greater than 1,000 square feet in size that devote more than 50 percent of their floor space to commercial activity. The CBECS 2003 reports that the commercial market comprises more than 71.6 billion square feet of floor space in nearly 4.9 million buildings. In addition, it reports that these commercial buildings consume more than 6,500 trillion Btu of energy, with electricity accounting for 55 percent and natural gas 32 percent. Space heating, cooling and ventilation consume more than half of this energy.

7.2 Building Type and Climate Zone Weighting Methodologies

7.2.1 Roof Area Correlation and Weighting by Building Type

As stated in Section 3.1, Model Building Types, the ten DOE benchmark prototype models listed in Table 3.1 are believed to adequately represent the energy performance of buildings with low-slope roofs. This conclusion was established based on CBECS 2003 data and the use of a mapping methodology developed by Crawley and his colleagues.[16] This methodology was used to connect the CBECS data, which lists floor area by Principal Building Type (PBT) with the roof area of the DOE benchmark models. The commercial building roofing area was calculated using building floor space and numbers of floors. Table 7.2.1a provides a detailed analysis of the commercial building market by Principal Building Activity (PBA) as well as a correlation to roof area. The selected ten prototypes for this study account for nearly 54 percent and 60 percent of the total floor and roof area, respectively. The individual percentages are prorated in order to calculate the distribution of floor and roof area among the ten prototypes. These are summarized in Table 7.2.1b.

[16] " DOE Commercial Building Benchmark Models for Energy Simulation", NREL: Michael Deru, Brent Griffith, Kyle Benne, Paul Torcellini; PNNL: Mark Halversion, Dave Winiarski, Bing Liu; LBNL: Joe Huang and Mehry Yazdanian; DOE: Drury Crawley, December, 2008

Table 7.2.1a: Commercial Building Market Analysis

CBECS[1]		DOE Benchmark Models[2,3]				Roof Area Distribution[4]	
PBA	*Floor Area MM Ft^2*	*Prototypes*	*Distri-bution*	*Floor Area MM Ft^2*	*No. of Floors*	*Roof Area MM Ft^2*	*% Roof Area*
Office	12,208	Large	0.39	4,761	12	397	0.7%
		1. Medium	0.41	5,005	3	1,668	3.1%
		2. Small	0.20	2,442	1	2,442	4.6%
Education	9,874	3. Primary	0.55	5,431	1	5,431	10.2%
		4. Secondary	0.45	4,443	2	2,222	4.2%
Lodging	5,096	5. Small	0.36	1,835	4	459	0.9%
		Large	0.64	3,261	6	544	1.0%
Warehouse	10,078	6. Warehouse	1.0	10,078	1	10,078	18.9%
Health Care	3,163	Hospital	0.6	1,898	5	380	0.7%
		Outpatient	0.4	1,265	2	633	1.2%
Retail	4,317	7. Retail	1.0	4,317	1	4,317	8.1%
Malls	6,875	Mall	0.66	4,538	2	2,269	4.3%
		8. Strip Mall	0.34	2,338	1	2,338	4.4%
Food Sales	1,255	9. Supermarket	1.0	1,255	1	1,255	2.4%
Food Service	1,654	Fast Food	0.18	298	1	298	0.6%
		10. Restaurant	0.82	1,356	1	1,356	2.5%
All Other	17,138	All Other	1.0	17,138	1	17,138	32.2
Total	**71,658**			**71,658**		**53,222**	
		Ten Model Totals				**31,566**	**59.3%**

Table references and notes:

(1) **"2003 Commercial Buildings Energy Consumption Survey", Energy Information Administration**

(2) **" DOE Commercial Building Benchmark Models for Energy Simulation", NREL: Michael Deru, Brent Griffith, Kyle Benne, Paul Torcellini; PNNL: Mark Halversion, Dave Winiarski, Bing Liu; LBNL: Joe Huang and Mehry Yazdanian; DOE: Drury Crawley, December, 2008**

(3) **Mall: 2 floors; Public Assembly, Public Order and Safety, Religious Worship, Other and Vacant: 1 floor**

(4) **Roofing (MM SF) = Benchmark model floor area (MM SF)/# of Floors**

Table 7.2.1b: Weighting Factors for Model Building Type

	Building Type Distribution	
	By Floor Area	***By Roof Area***
Retail	**0.112**	**0.137**
Strip Mall	**0.061**	**0.074**
Warehouse	**0.262**	**0.304**
Small Office	**0.063**	**0.077**
Medium Office	**0.130**	**0.053**
Restaurant	**0.035**	**0.043**
Supermarket	**0.033**	**0.040**
Primary School	**0.141**	**0.172**
Secondary School	**0.115**	**0.085**
Small Hotel	**0.048**	**0.015**
Total	**1.0**	**1.0**

7.2.2 Climate Zone Weighting Factors

The key assumption in the distribution of the benchmark models by climate zones is that it is the same for both existing and new buildings. The new construction benchmark building weighting factors, the allocation of new construction value by type of construction and the climate zone and square foot cost model (developed by Crawley et al, 2008) are utilized to generate the "New Construction BB Model Climate Zone Distribution".

The 13 locations included in this study represent every Climate Zone and Sub-zone in the country with the exceptions of 1A (Miami), 7 (northern continental U.S.) and 8 (northern Alaska). These omitted climate zones account for 1.6 percent, 0.6 percent and 0.5% of the total floor area, respectively. Considering these are a minor portion of the overall weighting, they were combined with the results of the nearest climate zone. In other words, the 1.6 percent for 1A is combined with Climate Zone 2 and the 0.6 percent for 7 and the 0.5 percent for 8 are combined with Climate Zone 6. Considering these are the three most extreme climates, the energy savings results can be assumed to be at least as high as the modeled location. The weightings by climate zone used for the impact assessment are compiled in Table 7.2.2.

Table 7.2.2: Distribution of Existing Buildings by Climate Zone for Impact Assessment

Zone	1, 2	3	4	5	6, 7, 8
Weighting Factors	0.140	0.252	0.245	0.264	0.099

7.3 The Commercial Roof Replacement Market

Roofing industry consensus data indicates that the 2006 North American Low-Slope Roofing market was four billion square feet. This market size is divided between new construction and re-roofing as one and three billion square feet, respectively. [9] It is reasonable to assume that a portion of this roof replacement market has little or no potential for insulation requirements.

From the perspective of the CBECS data on roofing materials, the conclusion can be drawn that approximately 65 percent of the 72 billion square feet of existing floor area (or just less than 50 billion square feet) is in low-slope roof buildings with insulation above the deck. Assuming that this roof area requires replacement approximately every twenty years, and a similar amount is replaced each year, then an estimated two to two and one-half billion square feet are replaced annually.

Finally, the Polyisocyanurate Insulation Manufacturers Association (PIMA) compiles member production data that estimates approximately four and one-half billion board feet of Polyiso produced annually. It is common knowledge in the industry that on average the vast majority of this board footage goes into re-roof applications. Concluding that this amounts to about two-thirds of the market or three billion board feet and assuming an average thickness of two inches means that Polyiso is used in roughly one and one-half billion square feet of re-roofing jobs annually. The National Roofing Contractors Association's (NRCA) market survey for 2006-2007 concludes that Polyiso has a 66 percent share of insulation used in low-slope re-roofing projects.[10] Thus, considering the remainder of the insulation types used, 1.5 billion square feet /0.66 = 2.3 billion square feet. This also supports a conclusion of the size of the annual insulated low-slope re-roofing market in the neighborhood of 2.2 to 2.5 billion square feet.

Therefore, for use in the impact assessment (Section 8) portion of this study, the re-roof market size of 2.25 billion square feet is used.

7.4 Private Versus Public Existing Commercial Buildings

One of the intents of conducting this study is to provide a resource for substantiating evidence to support potential tax incentive legislation. Therefore, an effort was made to separate private and public buildings in the impact assessment. Once again, the exercise of accurately portraying the very complex and uncontrollable variable driven nature of energy consumption in buildings can be a monumental task. However, the wide energy performance variety of the selected ten prototype models is believed to highly aid in this endeavor. Table 7.4 summarizes the weightings utilized for the breakdown of private versus public buildings in the impact assessment. Note that the overall distribution of existing floor area between private and public is 72 percent and 28 percent, respectively.

Table 7.4: Distribution of Private and Public Floor Area in Existing Buildings

	Floor Area Distribution	
	Private	***Public***
Retail	**1.0**	**0**
Strip Mall	**1.0**	**0**
Warehouse	**0.9**	**0.1**
Small Office	**0.9**	**0.1**
Medium Office	**0.9**	**0.1**
Restaurant	**1.0**	**0**
Supermarket	**1.0**	**0**
Primary School	**0.1**	**0.9**
Secondary School	**0.1**	**0.9**
Small Hotel	**0.9**	**0.1**
Aggregate Floor Area Distribution*	**0.72**	**0.28**

* Using the floor area weighting factors of Table 7.2.1b

8.0 IMPACT ASSESSMENT

As explained in Section 7.2, the basis for the initial impact assessment is two and one-quarter billion square feet of re-roofing (two and three-quarter billion square feet of floor area), representing the entire average annual square footage potential market for the installation of an energy efficient roof. However, a side by side comparison of results as is done in Section 5.3.11 could provide a different conclusion of the potential market. Specifically, Figures 5.3.11 a and b illustrate quite clearly that the benefits achieved with the first seven listed building types in all climate zones could easily motivate a building owner to install an energy efficient roof. On the other hand, based on these results, owners of the other three building types (i.e. Small Hotel, Warehouse and Medium Office) could conclude otherwise. Therefore, in order to provide the reader with separate perspectives, the impact assessments conducted below are based on two market potential scenarios as described in Table 8.0.

Table 8.0: Basis Scenarios for Impact Assessment

	Description	Building Types	Roof Area billion ft^2	Floor Area billion ft^2
Scenario 1	Insulated Re-roof Market	All	2.25	2.75
Scenario 2	Limited portion of Re-roof Market: Savings >4 kBtu/ ft^2	All except: Small Hotel, Warehouse & Medium Office	1.53	1.54

8.1 Validation of Modeling Results

The results of the state-of-the art EnergyPlus simulation modeling performed in this study correlate closely with results of US commercial building energy consumption published by the EIA in their CBECS 2003 survey.[17] Using energy intensity as a parameter, Table 8.1.1 shows that the commercial building energy consumption reported for all buildings in the U.S. in 2003 is very similar to the modeling results of this study. As explained in Section 7.2, the basis for the initial impact assessment is two and one-quarter billion square feet of re-roofing (two and three-quarter billion square feet of floor area). In Section 8.2.1.1

This close correlation indicates how realistic modeling results can be achieved applying the rigorous simulation models for Whole Building Energy Analysis developed by the DOE, and also demonstrates the validity of the results used for this impact assessment.

Table 8.1.1: Energy Intensity - CBECS 2003 and Modeling Results

Data Source	Floor Area	Annual Energy Consumed	Energy Intensity
	billion ft^2	billion Btu	kBtu/ft^2
CBECS 2003	**71.6**	**6,500,000**	**90.8**
Modeling Results	**2.75**	**230,113**	**83.7**

[17] www.eia.doe.goc/emeu/cbecs/cbecs2003

8.2 Annual Energy Savings – Site

8.2.1 Scenario 1 - All Building Types (2.75 billion ft^2 of floor area)

Table 8.2.1 shows the site (i.e. metered) energy savings for additional insulation levels by both private and public sector for all buildings modeled in this study. The percent energy savings are based on the ratio of the annual energy savings due to increased insulation versus the total annual building energy consumption.

The annual site energy savings realized <u>nationally</u> under Scenario 1 are as follows:

5.7%
13.1 trillion Btu
4.8 kBtu/ft^2

8.2.1.1 Private Sector

Significant points of interest regarding site energy savings under Scenario 1 from the private sector:

- **6.4 trillion Btu of energy saved or just under half of national savings.**
  - **Majority from Zones 3 & 4 (3.7 trillion Btu).**
- **3.8% savings.**
  - **Highest in Zones 6, 7 & 8 (5.3%)**
  - **Lowest in Zone 3 (2.6%)**
- **Intensity savings of 3.3 kBtu/ft^2.**
  - **Range in Zones between 1.9 kBtu/ft^2 (3) and 5.4 kBtu/ft^2 (6, 7, & 8).**

8.2.1.2 Public Sector

Significant points of interest regarding site energy savings under Scenario 1 from the public sector:

- **6.7 trillion Btu of energy saved or over half of national savings.**
  - **Majority from Zones 4 & 5 (3.8 trillion Btu).**
- **10.6% savings.**
  - **Highest in Zone 4 (11.4%)**
  - **Lowest in Zone 3 (9.1%)**
- **Intensity savings of 8.7 kBtu/ft^2.**
  - **Range in Zones between 6.5 kBtu/ft^2 (3) and 10.9 kBtu/ft^2 (6, 7, & 8).**

Table 8.2.1: Annual Energy Savings Scenario 1 - All Building Types

Private Sector

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	277	3.2%	2.54
Zone 3	498	2.6%	1.92
Zone 4	484	3.7%	3.07
Zone 5	522	4.6%	4.23
Zone 6, 7, 8	196	5.3%	5.44
Total U.S.	1,976	3.8%	3.25

Public Sector

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	108	10.1%	7.87
Zone 3	195	9.1%	6.52
Zone 4	189	11.4%	8.98
Zone 5	204	11.3%	10.10
Zone 6, 7, 8	76	10.5%	10.87
Total U.S.	773	10.6%	8.69

Total

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	385	5.1%	4.04
Zone 3	693	4.4%	3.21
Zone 4	673	5.8%	4.73
Zone 5	726	6.5%	5.88
Zone 6, 7, 8	272	6.7%	6.97
Total U.S.	2,748	5.7%	4.78

8.2.2 Scenario 2 – 7 Building Types (1.54 billion ft^2 Floor area)

Table 8.2.2 shows the site (i.e. metered) energy savings for additional insulation levels by both private and public sector for all buildings modeled in this study. The percent energy savings are based on the ratio of the annual energy savings due to increased insulation versus the total annual building energy consumption.

The annual site energy savings realized <u>nationally</u> under Scenario 2 are as follows:

6.5%
11.8 trillion Btu
7.7 kBtu/ft^2

8.2.2.1 Private Sector

Significant points of interest regarding site energy savings under Scenario 2 from the private sector:

- **5.2 trillion Btu of energy saved or 44% of national savings.**
  - **Majority from Zones 4 & 5 (3.0 trillion Btu).**
- **4.2% energy savings.**
  - **Highest in Zones 6, 7 & 8 (5.6%)**
  - **Lowest in Zone 3 (3.0%)**
- **Intensity savings of 5.9 kBtu/ft^2.**
  - **Range in Zones between 3.6 kBtu/ft^2 (3) and 9.4 kBtu/ft^2 (6, 7, & 8).**

8.2.2.2 Public Sector

Significant points of interest regarding site energy savings under Scenario 2 from the public sector:

- **6.6 trillion Btu of energy saved or over half of national savings.**
  - **Majority from Zones 4 & 5 (3.7 trillion Btu).**
- **11.2% energy savings.**
  - **Highest in Zone 4 (12.1%).**
  - **Lowest in Zone 3 (9.7%).**
- **Intensity savings of 10.1 kBtu/ft^2.**
  - **Range in Zones between 7.6 kBtu/ft^2 (3) and 10.5 kBtu/ft^2 (6, 7, & 8).**

Table 8.2.1: Annual Energy Savings Scenario 2 - 7 Building Types

Private Sector

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	124	3.3%	4.43
Zone 3	224	3.0%	3.55
Zone 4	218	4.1%	5.64
Zone 5	235	5.1%	7.68
Zone 6, 7, 8	88	5.6%	9.37
Total U.S.	889	4.2%	5.85

Public Sector

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	91	10.7%	9.14
Zone 3	164	9.7%	7.62
Zone 4	160	12.1%	10.47
Zone 5	172	12.0%	11.71
Zone 6, 7, 8	65	11.0%	12.47
Total U.S.	652	11.2%	10.09

Total

	Floor Area	Energy Savings Site	
	MM ft²	*%*	*kBTU/ft²*
Zone 1, 2	216	5.6%	6.43
Zone 3	388	5.1%	5.27
Zone 4	377	6.7%	7.68
Zone 5	407	7.3%	9.39
Zone 6, 7, 8	153	7.3%	10.68
Total U.S.	1,541	6.5%	7.65

8.2.3 Annual Energy Savings Compared to US Total

The impact of adding additional roofing insulation on total US commercial building energy consumption can be seen in Table 8.2.3 below. If insulation were added to all buildings (2.75 billion ft^2 of floor area or Scenario 1) in this study, annual energy savings total 13.1 trillion Btu. This savings is divided by 6,500 trillion Btu, which is the total energy consumed at all US commercial buildings, to obtain the 0.2 percent impact.

Adding additional roof insulation to small hotels, medium offices and warehouses may not be as financially attractive compared to other types of buildings, as hotels and offices are typically multi-storied (i.e. roof insulation has less energy savings impact relative to total square footage) and warehouses are generally not conditioned to comfortable temperatures since their function is storage of goods. However, even if small hotels, medium offices and warehouses were not insulated, the significant impact of additional insulation compared to the U.S. total energy consumption remains about the same. As shown in Scenario 2 below, excluding these buildings means increasing roofing insulation on just 2 percent of existing commercial buildings based on floor area (1.54 billion ft^2/71.6 billion ft^2), still resulting in approximately 0.2 percent energy savings versus the entire US commercial energy consumption.

Table 8.2.3: Impact of More Insulation on Annual US Commercial Building Energy

Scenario	Portion of US Total Commercial Building Floor Area	Floor Area (billion ft^2)	Annual Energy Saved (billion Btu)	Impact: Energy Saved vs. US Commercial Total
1	3.8%	2.75	13,128	0.20 %
2	2.1%	1.54	11,781	0.18 %

8.2.4 Net Cumulative Energy Savings

As discussed in section 6.2.1, when estimating energy consumption, it is not sufficient to measure the energy metered at a building. These measurements only include the energy actually measured at a specific building site, whereas actual energy consumption includes the life cycle or “source energy” needed to produce the energy delivered to a specific site.

Moreover, it is also important from a life cycle perspective to consider the total life cycle energy of materials installed to save energy on the building. Thus, one must estimate the so called "embodied energy" that goes into making, installing, transporting etc the insulation, and then subtract this embodied energy from the energy savings to obtain a net energy savings, i.e.

Net Energy Saved equals Energy Saved at Buildings minus Embodied Energy of Installed Insulation

For the case of all buildings insulated in this study, for example, the source energy saved over 30 years is 888 trillion Btu, and for the subset excluding warehouses, small hotels and medium offices the 30 year source energy saved is 799 trillion Btu. Based on embodied energy estimates for polyiso insulation discussed in section 6.1.1, a conservative (higher) value for the embodied energy of 90 Megajoules/kg or approximately 7.5 Megajoules/BF (7.1 kBtu/BF) is assumed.

Since 2.25 billion ft^2 of roof area (Scenario 1) and 1.53 billion ft^2 of roof area (Scenario 2) are insulated, the Boardfeet (BF) are estimated using an of average insulation thicknesses modeled in this study, i.e. 2.6 inches, which yields BF values ranging from 5.85 to 3.98 billion BF, respectively. These values are multiplied by the embodied energy factor of 7.1 kBtu/BF to estimate the embodied energy of both scenarios.

These results are shown in Table 8.2.4, where the building energy saved far exceeds the embodied energy. In fact, the embodied energy ranges from only 3.6 percent to 4.7 percent of the energy saved over the 30 years of insulation use. In other words, the incremental energy saved by adding additional insulation is 20 to 28 times greater than the energy that went into making, installing, transporting etc insulation. Thus, from a total life cycle energy perspective, insulation pays energy dividends many times over compared to the one time energy used to make it.

Table 8.2.4: Net Cumulative Energy Saved and Embodied Energy Impact

Scenario	Roof Area (billion ft^2)	Energy Saved at Buildings (trillion Btu)	Embodied Energy of Insulation (trillion Btu)	Net Cumulative Energy Saved (trillion Btu)	Ratio: Embodied to Saved Energy	Ratio: Energy Saved to Embodied Energy
1	2.25	888	41.5	846	4.7%	20
2	1.53	799	28.2	787	3.6%	28

8.3 First Year Energy Cost Savings

8.3.1 Scenario 1 - All Building Types (2.75 billion ft^2 of floor area)

Table 8.3.1 shows the energy cost savings for additional insulation levels by both private and public sector for all buildings modeled in this study. The percent energy cost savings are based on the ratio of the first year utility cost savings due to increased insulation versus the total first year building utility costs.

The first year costs savings realized <u>nationally</u> under Scenario 1 are as follows:

5.1%
$217,000,000
$0.079/ft^2

8.3.1.1 Private Sector

Significant points of interest regarding energy cost savings under Scenario 1 from the private sector:

- **$107,100,000 of energy cost saving or nearly half of national savings.**
  - **$20-$29,000,000 per Zone.**
- **3.5% energy cost savings.**
  - **Highest in Zones 6, 7 & 8 (4.9%).**
  - **Lowest in Zone 3 (2.9%).**
- **Intensity cost savings of $0.054/ft^2.**
  - **Range in Zones between $0.042/ft^2 (4) and $0.076/ft^2 (1, 2).**

8.3.1.2 Public Sector

Significant points of interest regarding energy cost savings under Scenario 2 from the public sector:

- **$109,900,000 of energy cost saving or just over half of national savings.**
  - **A wide range of $11,400,000-$32,300,000 per Zone.**
- **8.9% energy cost savings.**
  - **Highest in Zones 5 (10.2%).**
  - **Lowest in Zone 1, 2 (7.6%).**
- **Intensity cost savings of $0.142/ft^2.**
  - **Range in Zones between $0.121/ft^2 (4) and $0.166/ft^2 (3).**

Table 8.3.1: Annual Energy Cost Savings Scenario 1 - All Building Types

Private Sector

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	277	3.6%	$21.1	$0.076	$3.14
Zone 3	498	2.9%	$28.6	$0.057	$2.37
Zone 4	484	3.5%	$20.4	$0.042	$1.78
Zone 5	522	3.9%	$23.2	$0.044	$1.90
Zone 6, 7, 8	196	4.9%	$21.1	$0.071	$3.01
Total U.S.	1,976	3.5%	$107.1	$0.054	$2.27

Public Sector

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	108	7.6%	$16.9	$0.156	$6.46
Zone 3	195	8.0%	$32.3	$0.166	$6.88
Zone 4	189	9.9%	$22.9	$0.121	$5.09
Zone 5	204	10.2%	$26.5	$0.130	$5.48
Zone 6, 7, 8	76	9.8%	$11.4	$0.149	$6.28
Total U.S.	773	8.9%	$109.9	$0.142	$5.96

Total

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	385	4.7%	38.0	$0.099	$4.07
Zone 3	693	4.4%	60.9	$0.088	$3.64
Zone 4	673	5.3%	43.3	$0.064	$2.71
Zone 5	726	5.8%	49.7	$0.068	$2.91
Zone 6, 7, 8	272	6.3%	25.2	$0.092	$3.93
Total U.S.	2,748	5.1%	$217.0	$0.079	$3.31

8.3.2 Scenario 2 – 7 Building Types (1.54 billion ft^2 Floor area)

Table 8.3.2 shows the energy cost savings for additional insulation levels by both private and public sector for all buildings modeled in this study. The percent energy cost savings are based on the ratio of the first year utility cost savings due to increased insulation versus the total first year building utility costs.

The first year costs savings realized <u>nationally</u> under Scenario 2 are as follows:

5.9%
$193,000,000
$0.125/ft^2

8.3.2.1 Private Sector

Significant points of interest regarding energy cost savings under Scenario 1 from the private sector:

- **$85,800,000 of energy cost saving or nearly half of national savings.**
  - **A wide range of $10,300,000-$23,500,000 per Zone (6, 7, 8 - Lowest; 3 – Highest).**
- **4.0% energy cost savings.**
  - **Highest in Zones 6, 7 & 8 (5.1%).**
  - **Lowest in Zone 3 (3.4%).**
- **Intensity cost savings of $0.097/ft^2.**
  - **Range in Zones between $0.079/ft^2 (4) and $0.128/ft^2 (1, 2).**

8.3.2.2 Public Sector

Significant points of interest regarding energy cost savings under Scenario 2 from the public sector:

- **$107,500,000 of energy cost saving or just over half of national savings.**
  - **A wide range of $11,000,000-$31,800,000 per Zone (6, 7, 8 - Lowest; 3 – Highest).**
- **9.5% energy cost savings.**
  - **Highest in Zone 5 (10.9%).**
  - **Lowest in Zone 1, 2 (8.0%).**
- **Intensity cost savings of $0.165/ft^2.**
  - **Range in Zones between $0.141/ft^2 (4) and $0.193/ft^2 (3).**

Table 8.3.2: Annual Energy Cost Savings Scenario 2 (7 Building Types)

Private Sector

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	124	3.8%	$15.9	$0.128	$5.28
Zone 3	224	3.4%	$23.4	$0.105	$4.33
Zone 4	218	4.0%	$17.1	$0.079	$3.32
Zone 5	235	4.5%	$19.0	$0.081	$3.47
Zone 6, 7, 8	88	5.1%	$10.3	$0.117	$5.00
Total U.S.	889	4.0%	$85.8	$0.097	$4.05

Public Sector

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	91	8.0%	$16.3	$0.178	$7.40
Zone 3	164	8.5%	$31.8	$0.193	$8.01
Zone 4	160	10.6%	$22.5	$0.141	$5.93
Zone 5	172	10.9%	$26.1	$0.151	$6.38
Zone 6, 7, 8	65	10.3%	$11.0	$0.170	$7.19
Total U.S.	652	9.5%	$107.5	$0.165	$6.91

Total

	Floor Area	Cost Savings			
		First Year			30 Years
	MM ft²	*%*	*MM $*	*$/ft²*	*$/ft²*
Zone 1, 2	216	5.2%	32.2	$0.149	$6.17
Zone 3	388	5.2%	55.2	$0.142	$5.89
Zone 4	377	6.2%	39.6	$0.105	$4.42
Zone 5	407	6.8%	45.0	$0.111	$4.70
Zone 6, 7, 8	153	7.0%	21.2	$0.139	$5.93
Total U.S.	1,541	5.9%	$193.3	$0.125	$5.26

8.4 GWP Emissions Prevented

8.4.1 GWP Prevented Compared to Buildings Modeled in this Study

Similar to the significant energy reductions resulting from increased insulation, there is an associated significant quantity of GWP emissions prevented. GWP emissions associated with energy consumption for all buildings in Scenario 1 is estimated at 40,834,510 metric tons CO_2-eq./yr. This is calculated from the annual energy consumption in all buildings of 230,113 billion Btu/yr for Scenario 1. The split is electricity accounting for 55 percent and natural gas accounting for 32 percent of this energy[17]. For estimation purposes using readily available factors, the electricity to natural gas split was scaled up to 63 percent and 37 percent respectively, and the total annual GWP was obtained by multiplying the respective energy consumptions by the factors previously noted, i.e. 0.223 kg CO_2-eq./MJ for electricity and 0.0749 kg CO_2-eq./MJ for natural gas. The same estimation method was used for Scenario 2 to obtain 32,327,180 metric tons CO_2-eq./yr.

The impact of adding additional roofing insulation on commercial building GWP generation modeled in this study can be seen in Table 8.4.1 below. If insulation were added to all buildings (Scenario 1) in this study, annual GWP prevented totals 2.12 million metric tons CO_2-eq.

This is divided by 40,834,510 metric tons CO_2-eq./yr., which is the total GWP generated at all Scenario 1 buildings, to obtain the 5.2 percent impact. The same estimation method was used for Scenario 2.

As previously mentioned, additional roof insulation for small hotels, medium offices and warehouses may not be as financially attractive compared to other types of buildings. However, even if small hotels, medium offices and warehouses were not insulated, the significant impact of additional insulation compared to the total GWP generation is in the same range, and somewhat higher since there annual GWP prevented is only slightly less (2.12 versus 1.91 million metric tons CO_2-eq.) but the total GWP generation is reduced from 40,834,510 to 32,327,180 metric tons CO_2-eq./yr.

Table 8.4.1: Impact of Insulation on Annual GWP Generation

Scenario	Portion of US Total Commercial Building Floor Area	Floor Area (billion ft^2)	Annual GWP Prevented (million metric tons CO_2-eq.)	Impact: GWP Prevented vs. All Buildings in this Study
1	3.8%	2.75	2.12	5.2 %
2	2.1%	1.54	1.91	5.9 %

As expected, the ratio of GWP prevented by additional insulation compared to the total GWP generated at the buildings is in the same range as the ratio of energy saved by additional insulation compared to the total energy consumed.

8.4.2 Annual GWP Prevented Compared to US Total

The impact of additional roofing insulation on total GWP emissions related to US commercial building energy use can be seen in Table 8.4.2 below. If insulation were added to all buildings (2.75 billion ft^2 of floor area or Scenario 1) in this study, annual GWP emissions prevented total 2.12 million metric tons CO_2-eq. This value is divided by 1153 million metric tons CO_2-eq., which is the total estimated GWP associated with energy consumption at all US commercial buildings, yielding a ratio of 0.18 percent as shown in Table 8.4.2 below. The GWP associated with all US commercial building energy consumption is estimated based on CBECS 2003 data indicating that 6500 trillion Btu of energy are consumed at all commercial buildings annually, with electricity accounting for 55 percent and natural gas for 32 percent of this energy. For estimation purposes using readily available factors, the electricity to natural gas split was scaled up to 63 percent and 37 percent respectively, and the total annual GWP was obtained by multiplying the respective energy consumptions by the factors previously noted, i.e. 0.223 kg CO_2-eq./MJ for electricity and 0.0749 kg CO_2-eq./MJ for natural gas.

As previously noted under the energy impact section, additional roofing insulation on small hotels, medium offices and warehouses may not be as financially attractive compared to other types of buildings. However, even if small hotels, medium offices and warehouses were not insulated, the significant impact of additional insulation compared to the US total GWP associated with commercial buildings remains about the same. As shown in Scenario 2 below, excluding these buildings results in 0.17 percent GWP emissions prevented versus the GWP emissions associated with all U.S. commercial building energy consumption.

Table 8.4.2: Impact of Insulation on Annual GWP Emissions Associated with US Commercial Building Energy Consumption

Scenario	Portion of US Total Commercial Floor Area	Floor Area (billion ft^2)	GWP Prevented (million metric tons CO_2-eq.)	Impact: GWP Prevented vs. US Commercial Total
1	3.8%	2.75	2.12	0.18 %
2	2.1%	1.54	1.91	0.17 %

8.4.3 Net Cumulative GWP Prevented (Total Life Cycle GWP)

As discussed previously, it is important from a life cycle perspective to consider the total life GWP emissions of materials installed to save energy on the building. Thus, one must estimate the GWP emissions resulting from making, installing, transporting etc the insulation, and then subtract these GWP emissions from the GWP prevented during insulation use to obtain a net cumulative GWP prevented, i.e.

Net Cumulative GWP Prevented *equals* ***GWP Prevented at Buildings*** *minus* ***GWP from Making, Installing, Transporting, etc. Insulation***

For the case of all buildings insulated in this study, for example, the GWP prevented over 30 years is 63.69 million metric tons CO_2-eq., and for the subset excluding warehouses, small hotels and medium offices the 30 year source energy saved is 57.31 million metric tons CO_2-eq. Based on GW emissions estimates for polyiso insulation discussed in section 7.1.1, a conservative (higher) value for the GWP emissions from making, installing, transporting, etc. the insulation is 0.5 kg CO_2-eq./BF is assumed.

Since 2.25 billion ft^2 of roof area (Scenario 1) and 1.53 billion ft^2 of roof area (Scenario 2) are insulated, the Boardfeet (BF) are estimated using an of average insulation thicknesses modeled in this study, i.e. 2.6 inches, which yields BF values ranging from 5.85 to 3.98 billion BF, respectively. These values are multiplied by the GWP emissions factor of 0.5 kg CO_2-eq. /BF to estimate the GWP emissions from making the insulation in both scenarios.

These results are shown in Table 8.4.3, where the GWP emissions prevented during insulation use far exceed the GWP emissions from making the insulation. In fact, the GWP emissions from making insulation range from only 3.5 percent to 4.6 percent of the GWP emissions prevented over the 30 years of insulation use. In other words, the incremental GWP prevented by adding additional insulation is 22 to 29 times greater than the GWP emissions from making, installing, transporting etc insulation. Thus, from a total life cycle energy perspective, insulation pays GWP dividends many times over compared to the one time GWP emissions generated when it was made.

Table 8.4.3: Net Cumulative GWP Prevented from a Life Cycle Perspective

Scenario	Roof Area (billion ft^2)	Cumulative GWP Prevented (million metric tons CO_2-eq.)	GWP from Making Insulation (million metric tons CO_2-eq.)	Net Cumulative GWP Prevented (million metric tons CO_2-eq.)	Ratio: GWP from Making Insulation vs. GWP Prevented in Use	Ratio: GWP Prevented in Use vs. GWP from Making Insulation
1	2.25	63.69	2.93	60.76	4.6%	22
2	1.53	57.31	1.99	55.32	3.5%	29

8.5 Cumulative Impact Assessment

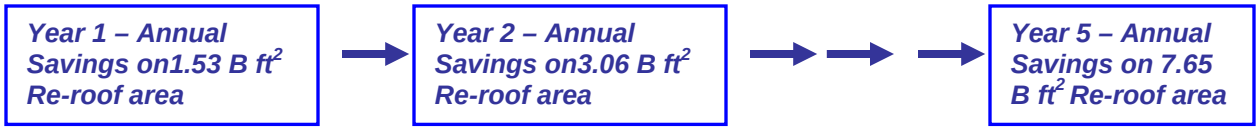
Throughout this report, the focus for the analysis and impact assessment of the research conducted utilizes a boundary limit of a single year of potential energy efficient roof replacements. The purpose for doing this is to produce clear and concise conclusions that can be useful for decision-makers involved with improving the energy efficiency of buildings. As stated in Section 8.2.3, "Annual Energy Savings Compared to US Total", the conclusion was made that the amount of floor area involved in Scenario 2 represents only 2 percent of the total floor area for existing buildings. These roofs would be installed over many consecutive years and, therefore, the actual market potential is multiples of the annual boundary evaluated in this study. In this section, this boundary will be expanded to evaluate the impact of replacing existing roofs in this fashion year after year. For this exercise, Scenario 2 (See Table 8.0 for description) will provide the market potential basis.

8.5.1 Cumulative Impact Parameters

In order to represent the cumulative benefits, four parameters were established and are described below:

- **Annual energy savings and emissions prevention after five years.**
- **Annual energy savings and emissions prevention after ten years.**

Under Scenario 2, 1.53 billion square feet of existing low-slope roofs are replaced through the installation of an energy efficient roofing system in any given year. The key assumption used in this assessment is that this potential market will be available every year for many years. Therefore, linear growth in annual energy savings and GWP emissions is achieved each year.



- **Accumulation of energy savings and emissions prevention through five years.**
- **Accumulation of energy savings and emissions prevention through ten years.**

As is evident by the data presented regarding the cumulative savings calculations, the opportunity for energy consumption reductions in roof replacements of existing buildings is dramatic.

8.5.1.1 Annual Benefits after 5 Years

Table 8.5.1.1a: Annual Cost Savings after 5 Years

Sector	Floor Area billion ft^2		Annual Cost Savings	
	First Year	Fifth Year	First Year	Fifth Year
Private	0.9	4.4	$86 MM	$471 MM
Public	0.7	3.3	$108 MM	$589 MM
Total	1.5	7.7	$193 MM	$1,100 MM

Table 8.5.1.1b: Annual Site Energy Savings after 5 Years

Sector	Annual Site Energy Savings trillion Btu	
	First Year	Fifth Year
Private	5.2	26
Public	6.6	33
Total	11.8	59

Table 8.5.1.1c: Annual Source Energy Savings after 5 Years

Sector	Annual Source Energy Savings trillion Btu	
	First Year	Fifth Year
Private	11.4	57
Public	15.2	76
Total	26.6	133

Table 8.5.1.1d: Annual Emissions Prevention after 5 Years

Sector	Annual Emissions Prevention million metric tons CO_2-eq.	
	First Year	Fifth Year
Private	0.8	4.1
Public	1.1	5.5
Total	1.9	9.6

8.5.1.2 Annual Benefits after 10 Years

Table 8.5.1.2a: Annual Cost Savings after 10 Years

Sector	Floor Area billion ft^2		Annual Cost Savings	
	First Year	Tenth Year	First Year	Tenth Year
Private	0.9	8.9	$86 MM	$1,100 MM
Public	0.7	6.5	$108 MM	$1,300 MM
Total	1.5	15.4	$193 MM	$2,400 MM

Table 8.5.1.2b: Annual Site Energy Savings after 10 Years

Sector	Annual Site Energy Savings trillion Btu	
	First Year	Tenth Year
Private	5.2	52
Public	6.6	66
Total	11.8	118

Table 8.5.1.2c: Annual Source Energy Savings after 10 Years

Sector	Annual Source Energy Savings trillion Btu	
	First Year	Tenth Year
Private	11.4	114
Public	15.2	152
Total	26.6	266

Table 8.5.1.2d: Annual Emissions Prevention after 10 Years

Sector	Annual Emissions Prevention million metric tons CO_2-eq.	
	First Year	Tenth Year
Private	0.8	8.2
Public	1.1	10.9
Total	1.9	19.1

8.5.1.3 Accumulation of Benefits through 5 Years

Table 8.5.1.3a: Cumulative Cost Savings through 5 Years

Sector	Floor Area billion ft^2		Cumulative Cost Savings	
	First Year	Fifth Year	First Year	Fifth Year
Private	0.9	4.4	$86 MM	$1,400 MM
Public	0.7	3.3	$108 MM	$1,700 MM
Total	1.5	7.7	$193 MM	$3,100 MM

Table 8.5.1.3b: Cumulative Site Energy Savings through 5 Years

Sector	Cumulative Site Energy Savings trillion Btu	
	First Year	Fifth Year
Private	5.2	78
Public	6.6	99
Total	11.8	177

Table 8.5.1.3c: Cumulative Source Energy Savings through 5 Years

Sector	Cumulative Source Energy Savings trillion Btu	
	First Year	Fifth Year
Private	11.4	171
Public	15.2	228
Total	26.6	399

Table 8.5.1.3d: Cumulative Emissions Prevention through 5 Years

Sector	Cumulative Emissions Prevention million metric tons CO_2-eq.	
	First Year	Fifth Year
Private	0.8	12.2
Public	1.1	16.4
Total	1.9	28.6

8.5.1.4 Accumulation of Benefits through 10 Years

Table 8.5.1.4a: Cumulative Cost Savings through 10 Years

Sector	Floor Area billion ft^2		Cumulative Cost Savings	
	First Year	Tenth Year	First Year	Tenth Year
Private	0.9	8.9	$86 MM	$5,400 MM
Public	0.7	6.5	$108 MM	$6,800 MM
Total	1.5	15.4	$193 MM	$12,200 MM

Table 8.5.1.4b: Cumulative Site Energy Savings through 10 Years

Sector	Cumulative Site Energy Savings trillion Btu	
	First Year	Tenth Year
Private	5.2	286
Public	6.6	362
Total	11.8	648

Table 8.5.1.4c: Cumulative Source Energy Savings through 10 Years

Sector	Cumulative Source Energy Savings trillion Btu	
	First Year	Tenth Year
Private	11.4	628
Public	15.2	836
Total	26.6	1,464

Table 8.5.1.4d: Cumulative Emissions Prevention through 10 Years

Sector	Cumulative Emissions Prevention million metric tons CO_2-eq.	
	First Year	Tenth Year
Private	0.8	45
Public	1.1	60
Total	1.9	105

9.0 PAYBACK ANALYSIS

As reviewed in Economic Analysis, Section 4, first-year utility costs were calculated by the EnergyPlus model and annual inflation rates of 2.2 percent and 2.8 percent were applied for sequential years to electricity and natural gas, respectively. In addition, the current costs for the required rigid insulation were obtained from RS Means CostWorks Online Construction Estimator software. These data provide the basis for the simple payback calculations that are reviewed in this section.

9.1 Overall Results

As is the case with the energy analysis results, payback calculations show widely varying results by building type and climate. Please note that all results were rounded up to the first full year following exact payback occurrence.

9.1.1 Payback by Building Type

It comes as no surprise that the most favorable payback results are exhibited by the two school models. Warehouse, on the other hand, does not show payback during the thirty-year lifetime in any case except one. Table 9.1.1 lists the payback range results for each location.

Table 9.1.1 Payback Results by Building Type

	Payback Range
	Less than, Yrs.
Secondary School	4 - 10
Primary School	5 - 10
Restaurant	4 - 18
Small Office	6 - 17
Supermarket	9 - 21
Strip Mall	7 - 19
Retail	11 - 29
Medium Office	8 - >30
Small Hotel	12 - >30
Warehouse	22 - >30

9.1.2 Payback by Climate Zone

Variables affecting payback by climate zone include regional installation costs and the mildness of the climate. Consistently, the mildest Climate Zones of 4 and 5 exhibits the lengthiest payback results. The shortest payback periods are always achieved in the Zone 2 simulations.

9.2 Market Weighted Findings

In Impact Assessment, Section 8, energy savings results are not favorable with Warehouse, Small Hotel and Medium Office. Payback results further confirm this conclusion. Therefore, market weighted results calculated here are based on Scenario 2 described in Table 8.0. Payback periods are summarized in Table 9.2. Please note that figure is rounded up to the first full year above payback.

Table 9.2: Full Insulation Cost Market Weighted Payback Results
(Note: All payback results are rounded up to first full year, therefore exact payback can be up to 1 year less than indicated)

Zone	1, 2	3	4	5	6, 7, 8	National Average
Private Sector	8.8	12.7	16.1	16.5	11.7	13.9
Public Sector	5.2	5.1	8.2	7.8	7.3	6.8
Total	7.7	10.1	13.6	13.7	10.5	11.6

9.3 Tax Incentive Impact

This study confirms that substantial energy consumption reduction opportunities exist with energy efficient roof replacements on existing buildings. In light of the current economic conditions, these opportunities are lost due to the tendency to eliminate, or at least delay, capitol projects. The implementation of a tax incentive could reverse this tendency dramatically. The PIMA/CEIR proposed Federal tax credit of 30 per cent for the installation of an energy efficient roof would highly reduce first costs as well as payback fulfillment periods. This credit will apply to the costs associated with the installation of the insulation and applies to Private Sector buildings only. Table 9.3 illustrates the benefit of this tax credit proposal to accelerate energy saving activity for existing buildings. This incentive will serve to reduce the payback period on energy efficient roof replacements by nearly four years in the private sector and over three years on the national average.

Table 9.3: Payback Results with 30% Tax Credit for Private Sector Buildings
(Note: All payback results are rounded up to first full year, therefore exact payback can be up to 1 year less than indicated)

Zone	1, 2	3	4	5	6, 7, 8	National Average
Private Sector	6.4	9.3	12.0	12.3	8.9	10.3
Public Sector	5.2	5.1	8.2	7.8	7.3	6.8
Total	5.6	7.5	10.1	10.1	8.0	8.6

10.0 CONCLUSIONS

Representing eighteen percent of all U.S. annual energy use at 91 kBtu/ft^2 based on floor area, existing commercial buildings play an important role in the challenge to achieve substantial reductions in consumption of energy and impact on the environment. A key lies in the fact that the vast majority of building stock will require roof replacement over the next fifteen to twenty five years providing a practical opportunity to improve the thermal performance of buildings. From the research conducted and the results presented in this report, the following conclusions have been established:

- One and one half billion square feet of existing floor area is a viable annual potential for installation of low-slope energy efficient roofing systems. Clearer and more stringent energy code language as well as increased enforcement specific to re-roofing projects could enhance this potential.
- After ten years, fifteen billion square feet or greater than 20 percent of today's existing floor area will be saving 6.5 percent of total site energy consumption or 118 billion Btu and 266 billion Btu of source energy annually. It is presumed that during this period, a portion of non-retrofitted buildings will be demolished, further contributing to the relative impact of energy efficient roofing systems in lowering the energy intensity level of buildings. Lastly, from a life cycle perspective, the total embodied energy involved in the insulation is recovered in the first year of its use through the energy saved.
- The economic impact includes a cumulative savings of $12.2 billion and annual savings of $2.4 billion which, of course, continues throughout the lifetime of the insulation. The total capitol required (installed cost of additional insulation) over this ten year period is approximately $23 billion. Please note that the economic impact in this study is limited to the site utility costs and the installed costs of the insulation. There are other potential economic benefits associated with reductions in energy generation and use as well as reduction in emissions and other environmental impacts that are beyond the scope of this research.
- Energy savings realized with energy efficient roof systems vary significantly between climate zones and vary dramatically between building types. Of the ten building types studied, seven exhibit substantial savings in all climate zones with schools reaping the greatest benefits.
- With respect to GWP, this practical means of thermal performance improvement prevents nearly 0.2 percent of the total building stock emissions in the first year alone. The compounding impact provides a GWP emissions prevention benefit of greater than 100 million metric tons CO_2-equiv. after ten years. Again, comparing this to the life cycle emissions involved in the additional insulation shows that the net zero emissions period is roughly one year.

Biographies

Jerry Phelan

Jerry Phelan holds a B. S. degree in Chemical Engineering from the University of Rochester. He has been with Bayer MaterialScience in Pittsburgh for 29 years. For much of that time, Jerry has been, and continues to be, engaged in Bayer's business with polyurethane and polyisocyanurate insulation in Construction. Jerry has been very active in PIMA (Polyisocyanurate Insulation Manufacturers Association) for the last 14 years, where he is currently serving a third term on the Board of Directors, participates on the Industry Promotion Committee, the ASHRAE Task Force and with colleague Pavlovich, manages PIMA's Life Cycle Inventory Program. He also actively participates on the Building and Construction Market Team of ACC (American Chemistry Council), participates in CPI (Center for the Polyurethanes Industry) and member of both ASHRAE and NRCA. Alongside many respected colleagues in PIMA and the Polyurethane Industry, Jerry has been deeply involved in and committed to the advancement of polyisocyanurate/polyurethane insulation products for many years. Much of this involvement in recent years has been in the fields of Life Cycle Assessment and Whole Building Energy Analysis.

George Pavlovich

George Pavlovich works for Bayer MaterialScience in Pittsburgh focusing on Life Cycle Assessments. He has worked with chemical processes at Bayer since 1987, implementing pollution prevention programs, conducting environmental impact analyses, and developing global EH&S management systems and Product Stewardship programs. This included several years in Europe and Asia, as well as assignments in China, India, Japan, Belgium, Mexico, Brazil and many plants in the U.S.A. He has an MS in Civil Engineering from Carnegie Mellon University and BS degrees in Chemical Engineering and Biology from the University of Pittsburgh.

Eric Ma

Eric Ma has over 26 years experience in merger and acquisition, sales and marketing, consulting, business development, strategic planning and technology with Bayer MaterialScience. Eric has 11 publications and patents.

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FANtastic! A Closer Look At Fan Efficiency Metrics

This EN will explore two of the most talked-about fan efficiency metrics (Fan Efficiency Grade and Performance Based Efficiency Requirement), and identify their benefits and limitations. It will conclude with a summary of where and how these metrics are currently being applied in standards and codes.

Types of Fan Efficiency Metrics

Fans are at the heart of every air-distribution system so it makes sense that improvements to fan system design coupled with higher efficiency fans can provide substantial HVAC energy savings. The Air Movement and Control Association (AMCA) estimates that fans consume between 30% and 40% of commercial HVAC energy.* Improving fan efficiency is therefore an important next step towards reducing global, overall energy use.

Before diving in, we need to explain some terminology to better understand the usefulness and limitations of each fan efficiency metric.

Application-Independent vs. Application-Dependent. The subject of dependency on the fan's operating point is an important one. Depending on the authority of the organization utilizing fan efficiency metrics, they may have influence over the manufacturer, the designer, or both. Let's therefore broadly characterize the metrics based on whether the fan's operating point is being considered:

- Application-Independent: An efficiency metric in which the fan's actual operating point **is not** considered.
- Application-Dependent: An efficiency metric in which the fan's actual operating point **is** considered.

As we will see, some metrics function better as one dependency type over another.

Product Efficiency vs. System Efficiency. The next subject segregates the fan (product) itself and the overall system:

- Product efficiency: The efficiency metric considers the fan alone
- System efficiency: The efficiency metric considers the overall system, including fan system effects, duct leakage, duct design, etc.

Even if a fan has a high peak efficiency, how one applies that fan in a system will ultimately determine how much energy will be used. The impact of the **system** on fan energy use heavily outweighs the impact of the fan alone.

Total Pressure Versus Static Pressure. Fan efficiency metrics tend to be defined in terms of *total* pressure. Fan **total** pressure is the total pressure (static pressure plus velocity pressure) at the fan outlet minus the total pressure at the fan inlet. It is a measure of the total mechanical energy added to the air by the fan.

On the other hand, *static* pressure is total pressure minus velocity pressure. By definition, fan **static** pressure is the total pressure at the fan outlet minus the total pressure at the fan inlet *minus* the velocity pressure at the fan outlet. This can be a source of confusion. When the fan **inlet** is *unducted*, the *inlet velocity pressure* is zero and the total pressure equals the static pressure. However, when the inlet is *ducted*, care must be taken in the field to measure the total pressure at the inlet rather than just the static pressure. When the **outlet** is *unducted*, the *outlet velocity pressure* is zero, in which case the change in fan total pressure will equal the change in fan static pressure.

To ensure all forms of energy are accounted for, the total pressure should be considered for ducted systems. Note that many engineers will design their systems using only static pressure. They are still accounting for any velocity pressure changes and, therefore, total pressure changes by ensuring the duct connection to the fan matches the intent (e.g., 3 duct diameters of straight duct sized the same as the fan outlet) and by using dynamic loss coefficients ("Kt" factors).

* W. Smith, "2012 Fan Market Data Defines the Path to Higher Efficiency" AMCA International *inmotion* August 2014.

Extended Product (i.e., wire-to-gas). Let's briefly explore an important topic that's not addressed in today's codes and standards. The metrics currently being discussed tend to address only the power applied to the fan shaft. AMCA will soon release AMCA Publication 207, "Fan System Efficiency and Fan System Input Power Calculation," which will provide guidance, a method, and tabulated data to calculate fan system input power and overall efficiency of the complete fan system (see Figure 1). This will include the fan efficiency, the electric motor efficiency, and the efficiency of the power transmission and/or motor controller, if present.

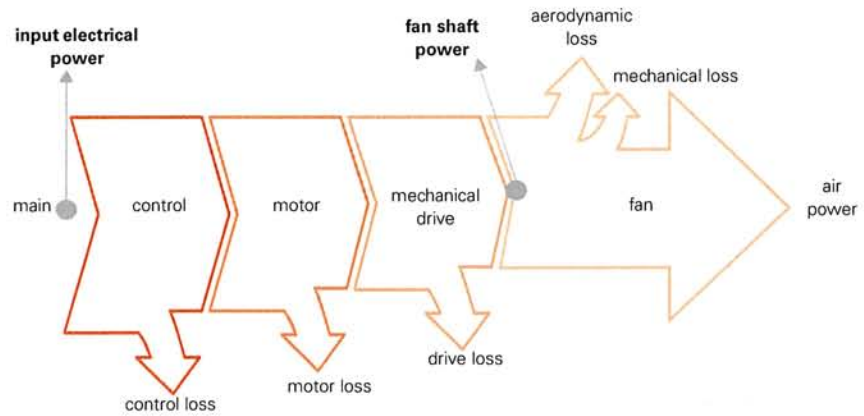
Direct measurement of input kW is preferred, but this publication will at least give manufacturers and other interested parties a common basis for calculation and comparison.

The Air-Conditioning, Heating & Refrigeration Institute (AHRI) recently published another important step towards an accurate, calculated system input power: AHRI Standard 1210, "Performance Rating of Variable Frequency Drives." This standard will provide a uniform method of measuring and comparing Variable Frequency Drives by establishing testing and rating requirements.

Fan Efficiency Grade (FEG)

Many of the latest energy codes and standards, including the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 90.1-2013, reference a fan efficiency classification system known as Fan Efficiency Grade (FEG). The FEG metric was defined when AMCA published Standard 205 in 2010. It was first adopted into ASHRAE Standard 90.1 through Addendum u to the 2010 version, and is now included in ASHRAE 90.1-2013. It has also been adopted by the International Green Construction Code (IgCC) and is being considered for a number of other model construction and energy codes. FEG is by far the most commonly applied fan efficiency metric in use today.

Figure 1. Overall efficiency of a complete fan system



Note: There is a version of the Fan Efficiency Grade (FEG) metric that incorporates input power: Fan Motor Efficiency Grade (FMEG). The metric is not widely used in the U.S., where the fan is often sold separate from the motor and/or motor controller, but it is an important metric in the European Union, where fan-motor-drive combinations are more commonly sold.

The first question we need to ask is: Why can't we use the simple fan efficiency calculation, rather than something more complicated like FEG? Let's look at the impact of fan diameter on efficiency.

Larger Fans vs. Smaller Fans. Increased turbulence and tolerance magnification result in smaller fans operating at a reduced efficiency when compared to a larger fan. As shown in Figure 2, this change can be rather dramatic as the diameter is increased – even for the same type of fan. Consider the area in the shaded box. A single-number efficiency limitation (such as > 65%) would either a) effectively eliminate the use of smaller diameter fans or b) require a limit so lenient (such as > 45%) that it would have little impact on reducing building energy use.

FEGs solve this small fan diameter dilemma by accounting for the impact diameter has on fan efficiency.

The FEG classification number alone is an application-independent metric, based on the peak aerodynamic efficiency of a ducted fan separate from its motor and drive. It's important to note, however, that the fan's peak aerodynamic efficiency will not ultimately determine how much

Figure 2. Fan size versus total efficiency comparison

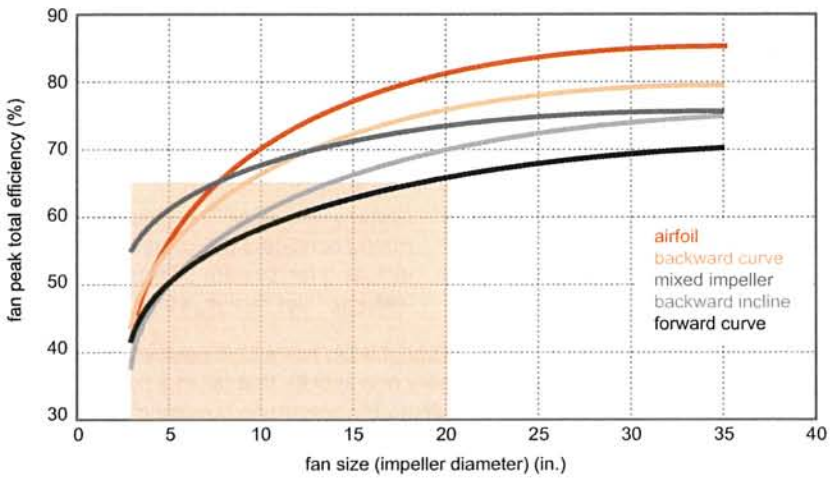


Image courtesy of AMCA International.

energy is used. Even with a highly efficient fan, that fan could be selected to operate at a point far from this peak efficiency.

To use FEG as an application-dependent metric, the FEG classification number can be accompanied by an allowable selection range or "window". This is accomplished by defining a number of percentage points from peak efficiency; as shown in Figure 3.

Note that the selection window is in terms of percentage points; not a percentage. For example, if the peak efficiency is 70%, a 15-point window means that the fan must be selected with an efficiency of at least 55% (not 0.85 x 70% = 59.5%).

Since FEG ratings are an indicator of peak fan efficiency, and not actual operating efficiency, their main value is in segregating fans during selection. Once an engineer has narrowed a list of available fans to only those that meet the minimum FEG rating – and has filtered those outside of the allowable selection window – the focus should turn to other selection parameters, such as actual power consumed, sound power levels, size, and cost.

When published, AMCA Publication 206, "Fan Efficiency Grade (FEG) Application Guide," will provide an overview of issues associated with fan energy consumption and offer guidance for using FEG in codes, standards and regulations as a means to increase the use of energy-efficient fans.

How to determine the FEG classification. To determine the FEG classification for a particular fan, a calculation is not required. Instead, the fan's peak aerodynamic efficiency based on **total** pressure is compared to the chart published in AMCA 205.

For example, consider a 25-inch diameter fan with a peak total efficiency of 68 percent. Using the chart in Figure 4, 68 percent falls above the FEG71 curve, but still below the FEG75 curve. Therefore, this fan would be labeled FEG71.

By definition, an FEG label is assigned based on fan **component** performance

Figure 3. Fan minimum efficiency window

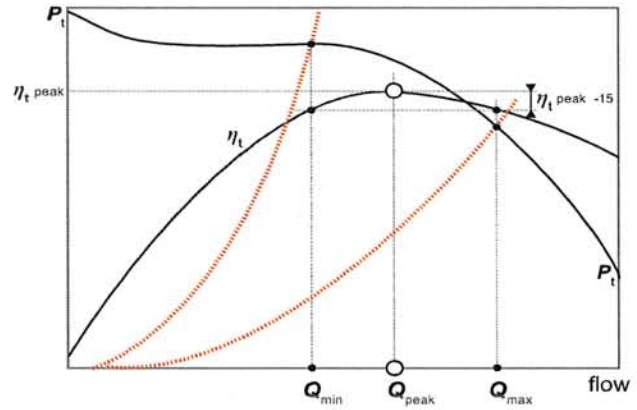


Image courtesy of AMCA International. ANSI/AMCA Standard 205-12, Energy Efficiency Classification For Fans.

data in accordance with a standard like AMCA 210. If an equipment-mounted fan is being evaluated (see sidebar p.6), the equipment manufacturer will need to provide two data sets: a fan component performance data set and an equipment performance data set. The former is used to determine whether a given operating point would meet an application-independent FEG selection window while the latter is used to provide in situ performance data.

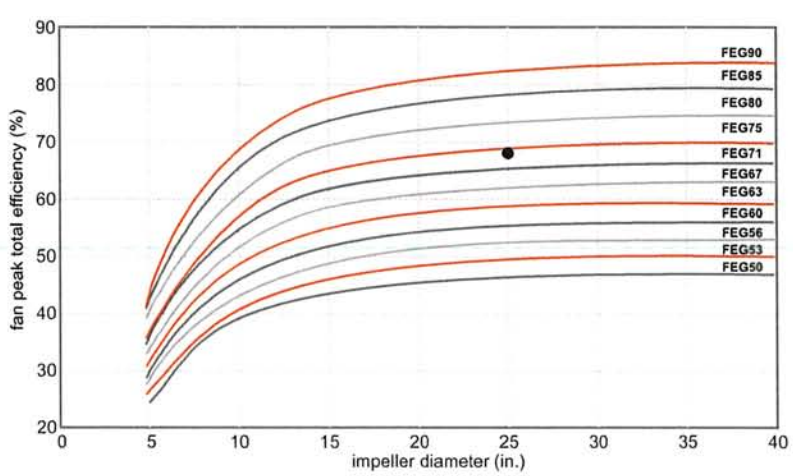
Note that the shape of these curves is generally intended to ensure that an entire product line of geometrically similar fans can meet the same FEG. However, several factors could cause some diameters or variations to have different FEG labels.

The FEG classification is determined by the fan manufacturer, so the system designer need only filter the available fan selections by the minimum FEG level prescribed by the appropriate code or standard. As described earlier, the designer is then expected to determine whether the desired fan operating point meets the allowable selection window requirement.

How does FEG differ from ASHRAE Standard 90.1 fan power limitation?
The fan power limitation in Standard 90.1 is an overall system design limitation, not a requirement of the fan as a component. There are many examples of equipment (such as those listed in Section 6.4.1.1) or components (such as motors) which contribute to the overall system power, while still having a separate limitation on the component.

To meet the requirements of 90.1, a system designer should consider only those fans that meet the application-

Figure 4. FEG classification for a 25-in. diameter fan with peak total efficiency of 68 percent



independent (FEG level) and application-dependent (allowable selection window) requirements. If the fan power limitation still cannot be met, the entire system needs to be analyzed to reduce fan power.

FEG Shortcomings. FEG is an elegant metric that solves the small diameter dilemma and provides users with a simple classification system to segregate fans based on peak aerodynamic efficiency. However, FEG is not without limitations.

First, it's important to note that FEG is best suited for ducted applications. The application-dependent selection region will often eliminate some fans from consideration in unducted or low pressure applications. Even lower pressure applications (such as return or exhaust fans) will suffer as the minimum FEG limit would force the use of a larger diameter fan or a different fan type altogether (an axial fan in lieu of a centrifugal fan, for example). This could make retrofits more expensive and difficult. Keep in mind: these lower pressure fans typically use less energy than their supply counterparts.

Second, the requirement to use total pressure and total efficiency complicates the selection of an unducted fan. Fan **static** pressure is the only useful work in an unducted application, but FEG requires the use of **total** pressure. To accomplish this, artificial outlet areas must be defined in an attempt to quantify energy that's ultimately unused.

Within the fan community however, there is a metric that is being considered that could address some, if not all, of these shortcomings.

An Alternative Fan Efficiency Metric: Performance-Based Efficiency Requirement (PBER)

An alternative fan efficiency metric currently under consideration is the Performance Based Efficiency Requirement or PBER (sometimes referred to as Fan Efficiency Ratio or FER). Specifically formulated to address the unducted or low pressure fan dilemma, the PBER metric yields a minimum required efficiency based on the useful work performed at a given operating point (airflow and pressure). Alternatively, maximum power in lieu of a minimum efficiency could be output. This type of metric would continue to allow fans with lower peak efficiencies, or fans selected at an inefficient operating point, to be used as long as their energy use is relatively low.

How to calculate PBER. The procedure to determine PBER is a little more complicated than FEG. We first start with a target efficiency and apply a series of factors to adjust that efficiency for those operating points where actual energy use is relatively low:

$$\text{Required Efficiency} = \left(\text{Target Efficiency}\right) \times \left(\text{Flow Factor}\right) \times \left(\text{Pressure Factor}\right)$$

Where:

Target Efficiency: The minimum, peak aerodynamic efficiency allowed. (Note that the required efficiency of the fan will never exceed this Target Efficiency.)

Flow Factor: An adjustment to reduce the target efficiency for a fan operating at lower airflows. (Note that FEG has an implicit flow factor, which is how smaller diameter fans are handled.)

Pressure Factor: An adjustment to reduce the target efficiency for a fan operating at lower pressures. (Unlike FEG, PBER considers the pressure capability of the fan.)

Determining which pressure to use is dependent on whether the fan is ducted or unducted:

- For ducted fans, use total pressure.
- For unducted fans, use static pressure.

The formula would be the same for either pressure type; only the constants would change. For example, the target efficiency could be set to 66 percent for ducted fans and 60 percent for unducted fans.

Let's consider a PBER calculation example assuming an unducted fan. We first need to assume some flow and pressure factors:

$$\text{Required Efficiency} = \left(60\%\right) \times \left(\frac{\text{CFM}}{250 + \text{CFM}}\right) \times \left(\frac{\text{P}}{0.40 + \text{P}}\right)$$

It's important to note that the 60 percent, 250, and 0.40 values are for illustrative purposes only. Different code bodies may choose to use different values. The 250 value in particular was chosen here to closely approximate the implicit FEG flow factor.

Assuming 10,000 CFM and 3.0 in. H_2O static pressure, the required fan static efficiency for an unducted fan would then be:

$$\text{Required Efficiency} = \left(60\%\right) \times \left(\frac{10{,}000}{250 + 10{,}000}\right) \times \left(\frac{3}{0.40 + 3}\right) = 52\%$$

Therefore, any unducted fan with a static efficiency of 52 percent or higher at this operating point would be accepted.

PBER compared to FEG. As fans become more efficient, the shape of the allowable PBER selection region will more closely match the shape of the allowable FEG selection region. Consider the two fans illustrated in Figure 5. The region bounded by the dashed black line (surge region), the dashed gray line (peak efficiency - 15 points), and the solid black line (maximum RPM) is the allowable FEG selection region. The region bounded by the orange solid line is the allowable PBER region. The two regions are quite dissimilar for the inefficient fan but are very similar for the more efficient fan.

Therefore, both metrics will allow similar operating points for highly efficient fans. But unlike FEG, the PBER metric does not actually eliminate any fan from being considered – rather, it reduces the valid operating region for less efficient fans.

As mentioned previously, some standard/code bodies or regulators may need to consider an application-independent metric. How can PBER be used as an application-independent metric and would an application-independent PBER still provide advantages over the FEG metric?

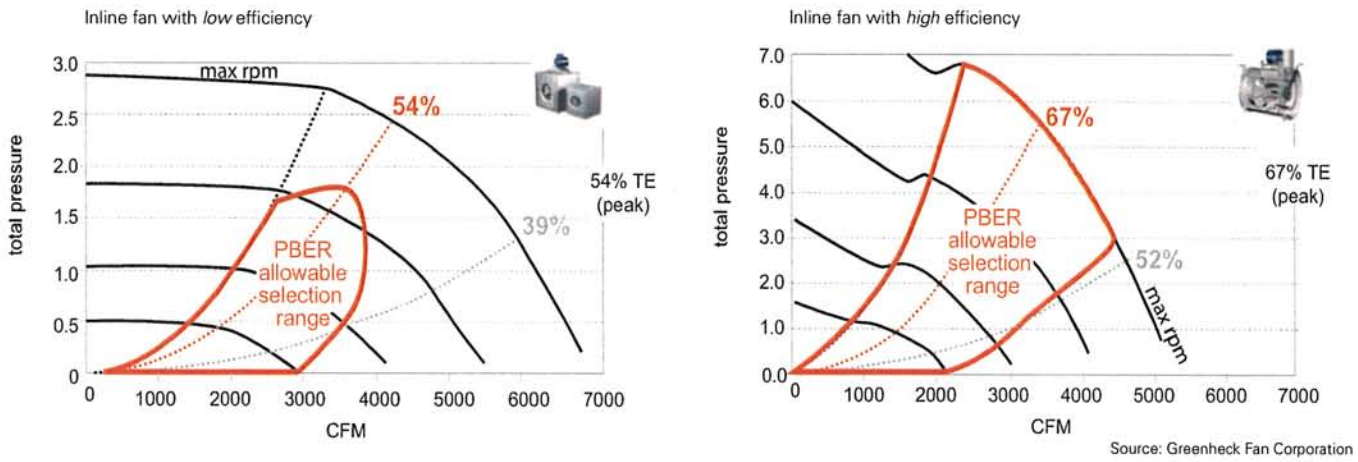
One option is to determine the input airflow and pressure based on a known intersection: peak aerodynamic efficiency and maximum *cataloged* fan speed, for example. This calculation wouldn't be the system designer's responsibility. Instead, the calculation could be used to determine a maximum *allowable* fan speed. Designers would then simply compare their operating RPM with the maximum as defined by the code or standard being considered.

As illustrated in Figure 6, a maximum allowable RPM would permit some selections outside of the PBER range but unlike FEG, it would significantly reduce those operating points at which the fan would consume the highest amount of energy.

Note that PBER, unlike FEG, would also close any loopholes associated with a steep efficiency curve. Typical of axial fans in particular, a steep efficiency curve is one where the fan may have a very high peak efficiency, but low operating efficiency off peak.

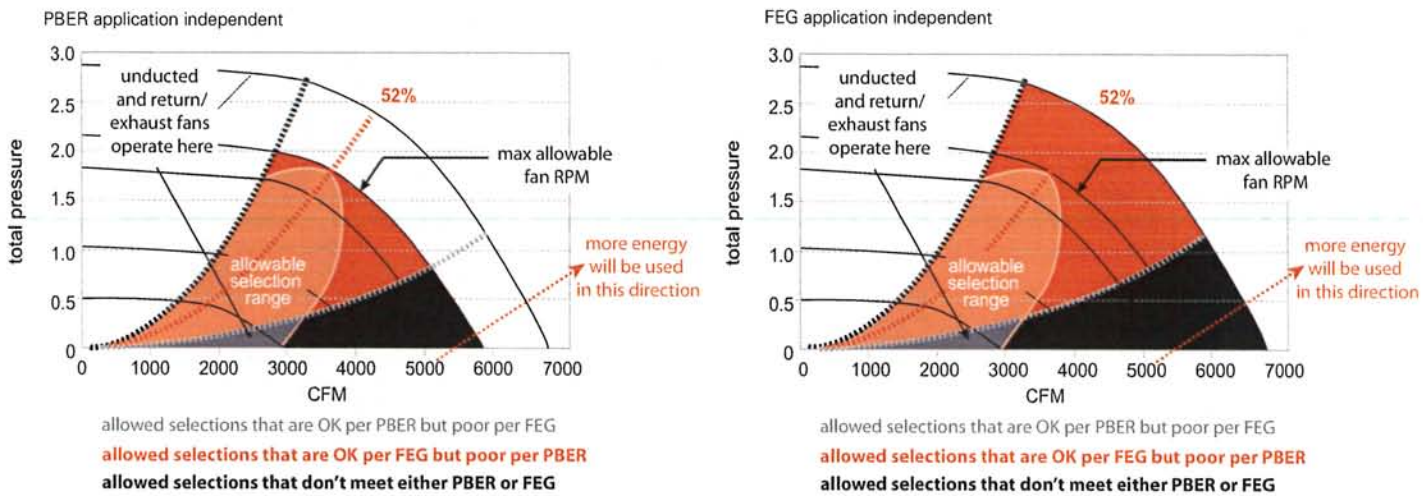
We see how a metric like PBER can maximize energy efficiency by considering the selection point or by trimming the most energy-intensive regions off the fan's valid selection window. In addition to these very important benefits, PBER also considers actual input power as a factor, thus allowing alternative fan types, like forward-curved (FC) fans, to be used even if they may have a lower peak efficiency (see sidebar p.7). The alternative would be to assign a unique FEG limit for FC

Figure 5. Allowable selection range comparison examples



Source: Greenheck Fan Corporation

Figure 6. PBER versus FEG application independent comparison



allowed selections that are OK per PBER but poor per FEG

allowed selections that are OK per FEG but poor per PBER

allowed selections that don't meet either PBER or FEG

Table 1. Fan efficiency requirements in published codes

	AMCA Standard 205-12 Annex B (recommendations)	2012 International Green Construction Code (IgCC)	ASHRAE Standard 90.1-2013	ASHRAE Standard 189.1-2014	2015 International Energy Conservation Code (IECC)
Minimum	Not specified	Minimum: FEG71	Minimum: FEG67	Minimum: FEG67	Minimum: FEG67
Selection window	within 15 percentage points of peak total efficiency	within 10 percentage points of peak total efficiency	within 15 percentage points of peak total efficiency	within 10 percentage points of peak total efficiency	within 15 percentage points of peak total efficiency
Details	Standard scope: • An impeller diameter of 5 in. or greater • Operating with a shaft power 1 HP and above • Total efficiency calculated according to one of the common fan test standards (such as AMCA 210)	Scope: • For "standalone supply, return and exhaust fans" over 1 HP	Notable exceptions: • Single fans with a motor nameplate of 5 HP or less • Fan arrays with a combined motor nameplate of 5 HP or less • Fans contained in equipment listed under Section 6.4.1.1 • Fans included in equipment bearing a third-party certified seal for air or energy performance of the equipment package	Notable exceptions: Same as ASHRAE Standard 90.1-2013	Notable exceptions: Same as ASHRAE Standard 90.1-2013

fans. However, this FEG approach wouldn't prevent an FC fan from being used in an inappropriate, high energy-use application. The same can be said for return/exhaust fans. The PBER approach would require supply fan selections to be more efficient than return/exhaust fan selections.

Current Requirements

Table 1 details the latest fan efficiency requirements in published codes, standards, or publications.

Note: As mentioned previously, the selection window is in terms of percentage points; not a percentage. For example, if the peak efficiency is 70 percent, a 15-point window means that the fan must be selected with an efficiency of at least 55 percent (not 0.85 x 70% = 59.5%).

Peak total efficiency is based on component performance data. If evaluating an equipment-mounted fan, care must be taken to ensure the correct data set is being used.

Component fans can now be certified in accordance with AMCA publication 211 as an FEG-rated fan and will carry a specific label. To date, this is the only certification program for component fan energy efficiency.

Product Affected

Based on the current requirements detailed in Table 1, the following exceptions are common:

- Fans that are part of equipment listed in Section 6.4.1.1 of ASHRAE Standard 90.1
- Fans included in equipment with a third-party certified seal for air or energy performance of the equipment package

Section 6.4.1.1 (Minimum Equipment Efficiencies) addresses the following equipment which contain fans: DX air conditioners (packaged rooftops, split systems, and self-contained units), air-cooled condensing units, water-source heat pumps, air-cooled chillers, PTACs, furnaces, cooling towers, and VRF systems. Therefore, the fans in these products are currently exempt from having to also meet the minimum FEG and selection window limitations.

Equipment mounted fans

Test and rating standards are created to ensure uniformity amongst manufacturers thus affording system designers and equipment manufactures consistent data for evaluation. ANSI/AMCA Standard 210 (ANSI/ASHRAE Standard 51), "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating," was created for fans which are used as a standalone **component** and is undoubtedly the industry standard for fan airflow performance.

Once a fan is installed in a cabinet (such as an air-handling unit), however, a number of factors can influence performance. Known generally as "system effects," many of these factors can be approximated, but the combinations must be tested for accurate performance. Some common "system effects" include:

- Cabinet proximity
- Component proximity (coils, filters, internal control enclosures, etc.)
- Motor proximity
- Bearings, sheaves, and other drive components
- Discharge orientation

Equipment test and rating standards are created to include these effects. For example, AHRI Standard 430 describes the test and rating requirements for central station air-handling equipment. An equipment standard will provide the most accurate estimate of final, in situ performance. In the absence of an equipment standard, a fan that has been tested and rated in accordance with AMCA Standard 210, coupled with any appropriate systems effects (reference Publication 201 from the AMCA Fan Application Manual), should be used.

The cabinet's effect on a fan can be quite significant. Addressing these effects can have as much, if not more, influence on overall energy use than addressing fan efficiency itself. By considering the equipment a fan is mounted in, additional energy savings can be realized.

Most air-handling products bear a "third-party certified seal" from AHRI. Catalogued air handlers and blower coils are certified to AHRI Standard 430, which evaluates the air handler on the basis of airflow, static pressure, fan speed, and brake horsepower. Likewise, fan-coils and unit ventilators are certified to AHRI Standard 440. Therefore, the fans in these products are currently exempt from having to also meet the minimum FEG and selection window limitations.

Custom air-handling units do not typically carry an AHRI seal. However, most custom manufacturers will incorporate fans that are certified in accordance with AMCA Publication 211, and it's likely they will now carry the new FEG seal.

Looking Ahead

FEG, and metrics like PBER, are certainly a step in the right direction. But where will the industry go from here?

Considering the substantial amount of energy that can be saved at part-load, a metric to encourage speed control (e.g., VFDs) would seem to make sense. The regulation activity for other components (pumps, in particular) seems to suggest such a metric might be forthcoming. Similarly, a metric to account for efficiency at part-load operation would be beneficial. Endeavors like AMCA 207 and AHRI 1210 are helping to get us there.

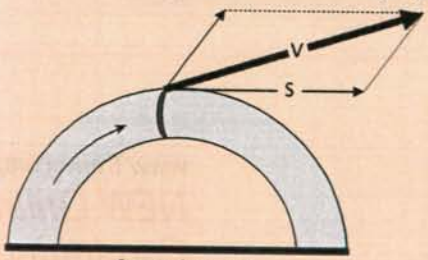
Direct-driven fans are becoming more and more prominent. Having a way to encourage their use would make sense. For example, PBER could include a drive factor (in addition to the existing flow and pressure factors) to encourage the use of direct-driven fans. The drive factor could also provide a method to incorporate a wire-to-gas consideration.

Other possible changes to fan efficiency regulations could include:

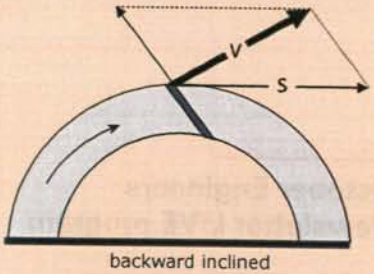
- Raising the minimum FEG requirement (from FEG67 to FEG71, for example)
- Narrowing of the allowable selection window (from 15 percentage points to 10 points, for example)
- Eliminating or reducing some of the exceptions (from a 5 HP threshold to 1 HP, for example)
- Assigning different FEG requirements for different fan types (FEG67 for FC fans and FEG71 for AF fans, for example)
- Switching from the FEG metric to the PBER metric, or using some combination thereof

Whatever the future holds, it's obvious that fan efficiency will continue to be one of the critical design parameters for tomorrow's system designers.

A Special Fan Type: Forward-Curved (FC) Fans.



forward curved



backward inclined

FC fans are unique in that they can be used in two different ways. They can be used as a low cost, less efficient option for an application where a more expensive, more efficient airfoil (AF) fan should be used. They can also be used for their unique characteristics as described further below. Alternatively, backward-inclined (BI) fans are generally used for one purpose only: as a low cost, less efficient alternative to an AF fan.

As mentioned previously, AF or BI fans are most efficient when selected close to the surge region. Moving towards the surge region along a constant speed (RPM) curve, the severity of stall is gradual for an FC fan. Therefore, they can be operated at peak efficiency with less concern about crossing into the surge region.

Consider that some products are simply selected out of a catalog and in this instance, little may be known about the system resistance. Additionally, the user might not be as experienced in fan selection. If they were to select the more efficient fan with an appropriate safety factor, the fan could very well end up not being as efficient as the more tolerant FC fan.

Advantages of using FC fans (versus other housed fan types)

- FC fans have a relatively flat acoustical spectrum without an objectionable blade tone. They are particularly suited for lower pressure applications where the fan is in close proximity to occupied spaces.
- FC fans are most efficient at low pressure. They are particularly suited for lower static supply fan applications and return or exhaust fan applications.
- FC fans are compact and often result in a smaller unit footprint.
- FC fans typically operate at a lower RPM, which improves bearing life and results in higher reliability.
- FC fans are very forgiving. The onset of objectionable stall is very subtle and the fans can be operated at much lower airflows.
- FC fans are overloading, meaning the input power naturally decreases as system pressure increases (i.e., filter loading).
- FC fans are easier to assemble and install - the inlet cone/impeller gap is not critical.

Drawbacks of using FC fans (versus other housed fan types)

- Lower peak efficiency than BI or AF fans.
- Lower fan static pressure capacity - generally due to structural limitations.
- Low frequency noise is higher than BI or AF fans.
- The relatively flat CFM vs. pressure curve will cause larger changes in CFM when system pressure changes.
- FC fans are overloading, meaning the input power increases as flow increases and system pressure decreases (i.e., filter change out).

By Dustin Meredith applications engineer, and Jeanne Harshaw information designer, Trane. You can find this and previous issues of the Engineers Newsletter at www.trane.com/engineersnewsletter. To comment, send e-mail to ENL@trane.com.

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Understanding Fan Efficiency Grades (FEG) (CS/104-13)

February 13th, 2013

Government agencies and regulatory bodies in the U.S. and around the world are working on regulations to help reduce power consumed by fans in commercial and industrial ventilation. As a part of this effort, an efficiency metric known as Fan Efficiency Grade (FEG) was developed by AMCA International* (in support of a request from ASHRAE** Standard 90.1) that could be used to establish minimum acceptable fan efficiency. This paper will define the Fan Efficiency Grade metric, explain how FEG ratings are determined, and review key limitations of the FEG metric.

FEG Definition and Rating

FEGs, as defined in AMCA 205, are designed to be a simple system to indicate the aerodynamic quality of the fan and are based on the fan's peak total efficiency. The total efficiency is calculated using the traditional airflow, pressure, and input power as measured per AMCA Standard 210. It does not take into effect the efficiency of the drive (belt drive) or the motor. Fan efficiency is defined as the air power divided by the fan input power. Both Static and Total Efficiency can be calculated from fan performance data as follows:

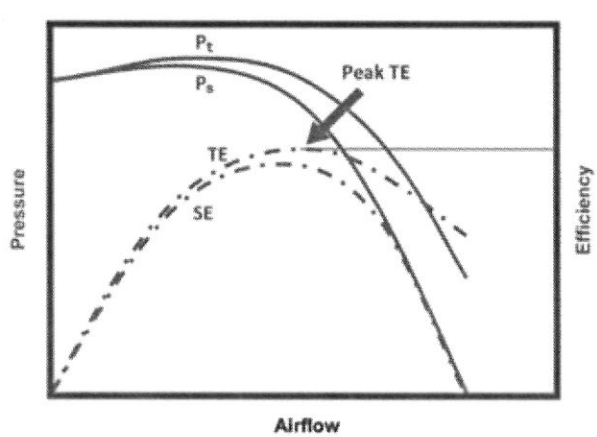
$$\text{Static Efficiency (SE)} = \frac{CFM \times P_s}{6343 \times BHP}$$

$$\text{Total Efficiency (TE)} = \frac{CFM \times P_t}{6343 \times BHP}$$

Where:
CFM = Fan flow rate, ft^3/min
P_s = Static pressure, in. wg
P_t = Total pressure, in. wg
BHP = Fan power input, hp

Static and total fan efficiency *(Figure 1)* can be plotted along with the fan curve. The peak total efficiency occurs at the top of the "bell" shaped efficiency curve. This peak efficiency is used to determine the FEG value.

Figure 1



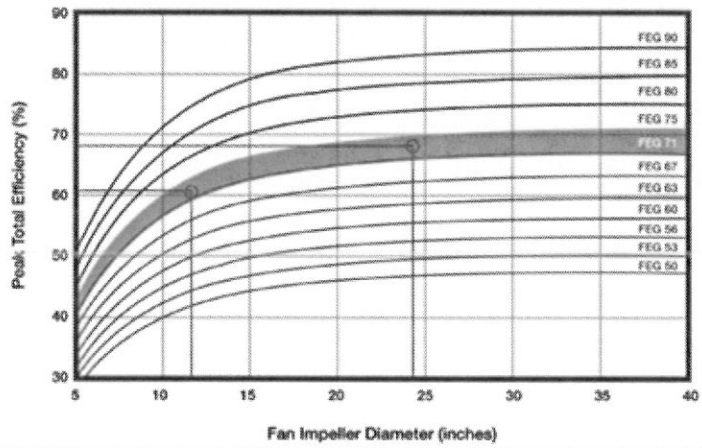
Note that the peak efficiency occurs at just one point on the curve and all other points on the curve have a lower efficiency. It is important to understand, as the efficiency curves

illustrate, that each fan has a large range of efficiencies depending on the airflow and pressure of the operating point. For example, a fan with a peak efficiency of 70% can easily be selected to operate at a point of only 50% efficiency.

Another aspect of AMCA FEGs is that their value depends on the fan size. Smaller fans are inherently less efficient than larger fans. This is because the smallest dimensions - material thicknesses and running clearances between parts - cannot be held as tightly in proportion to other dimensions as they can on larger fans. The AMCA FEG curves have been established such that fans of a given model that are geometrically similar will each have the same, or nearly the same, grade.

Once the Peak TE is known, the FEG value can be determined from AMCA Standard 205-12. *(Figure 2)* For example, a 24.5- inch diameter fan with a Peak TE of 69% would be classified as an FEG71. *Note that a 12-inch diameter fan with a Peak TE of 60% is also FEG71.*

Figure 2



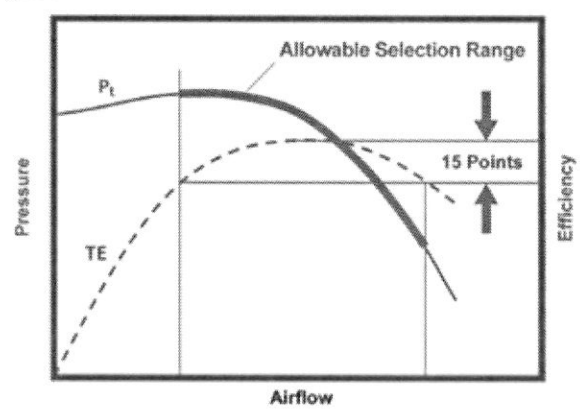
Selection Range

all selections be made within 15 percentage points of the Peak TE. This requirement effectively reduces the allowable selection range as shown in the fan curve shown in Figure 3.

Limitations of FEG

A significant shortcoming of the FEG metric is that the highest FEG fan does not necessarily result in the lowest energy consumption. Table 1 below illustrates this point. Notice that the 72-inch fan requires the least energy (lowest BHP). Yet, the 48- inch fan has a greater total efficiency (66% vs. 60%) and a higher FEG (71 vs. 63).

Figure 3



So how can the fan with a higher efficiency consume more than twice the power?

First, the FEG is based on fan total efficiency and fan total pressure. Total pressure is used because it is a measure of the total energy imparted to the air. However, the velocity pressure exiting a fan can only be used when it is contained in a duct â€" and is lost on non-ducted fans. This makes FEG an inappropriate and often misleading metric for many fan applications, such as sidewall propeller fans, powered roof ventilators (PRVs) and plenum fans. For fans without a discharge duct, static efficiency will correlate to power consumption.

Note: In the example in table 1, the 48-inch fan has a much greater discharge velocity than the 72-inch fan. This contributes to the high TE and FEG values, but since this is a non-

ducted application, the velocity pressure is lost. Notice that the 72-inch fan has the highest static efficiency which is the proper metric for nonducted applications.

Table 1	Sidewall Propeller Fans Selected for 40,000 CFM at 0.125 in. wg								
Diameter	RPM	PS	PV	PT	BHP	SE	TE	Peak TE	FEG
48 inches	638	0.13	0.60	0.72	6.91	11%	66%	67%	71
54 inches	488	0.13	0.37	0.49	5.81	14%	54%	55%	56
60 inches	346	0.13	0.24	0.36	3.93	20%	58%	59%	60
72 inches	260	0.13	0.13	0.25	2.63	30%	60%	60%	63

Second, as communicated earlier, the FEG value is based on the peak efficiency of the fan. For a given point of operation (CFM and pressure) an FEG63 fan could consume less power than an FEG75 fan simply because it is selected closer to its peak efficiency point. Fans with higher peak efficiencies do have a greater potential to operate more efficiently. However, the actual fan efficiency as selected is the correct measure of actual energy consumed.

Another limitation is that while specifying a single FEG value for all fan applications would be desirable, it is just not that simple. The current direction is to use a minimum FEG67 in ASHRAE Standard 90.1 and the International Energy Conservation Code (IECC) for all fans. Yet, it is well known that weather guarding of PRVs inherently impacts fan efficiency negatively. And as discussed above, PRVs and other fans with a non-ducted discharge should not be held to the same metric that is based on ducted total efficiency. To accommodate these realities, several exemptions have been added to the proposed language so that the industry doesn't unwittingly eliminate economical and efficient fans from existence. Meanwhile, ducted housed airfoil centrifugal fans and ducted vane axial fans already greatly exceed the proposed minimum value of FEG67, so this won't drive greater efficiency for these fans. The end result is that the single FEG value approach as proposed in ASHRAE Standard 90.1 has little ability to actually save energy.

Conclusion

FEGs are a simple measure of the peak total efficiency of a fan. Although other alternatives are being considered for code regulation and energy savings, FEG was initially incorporated into proposed code language and has not been replaced (as of the time of this writing). Because of the current state of events on this front, the final code language may use FEGs to establish minimum aerodynamic efficiency levels. If this occurs, fans below the mandated FEG value will not be allowed.

Regardless of the outcome of code language, FEG is a poor metric in determining the most efficient fan (in terms of actual power consumption) for a given airflow and pressure operating point. Clearly the best simple metric to ensure the lowest power consumption is the operating BHP at the specified design point. From a specifying engineer's perspective, there are really two key take-away points regarding fan efficiency:

1. Specify the specific operating BHP in your fan schedule AND specify that fans are licensed to bear the AMCA seal for air performance. This ensures that your fan application performance / energy intent is met.

2. When the code language is finalized, reputable manufacturers will continue to provide information and tools to help you comply with the minimum code requirements. And in many cases, economical products will be available that exceed the code minimum.

*AMCA International, Air Movement and Control Association, International

**ASHRAE, American Society Heating Refrigeration and Air Conditioning Engineers

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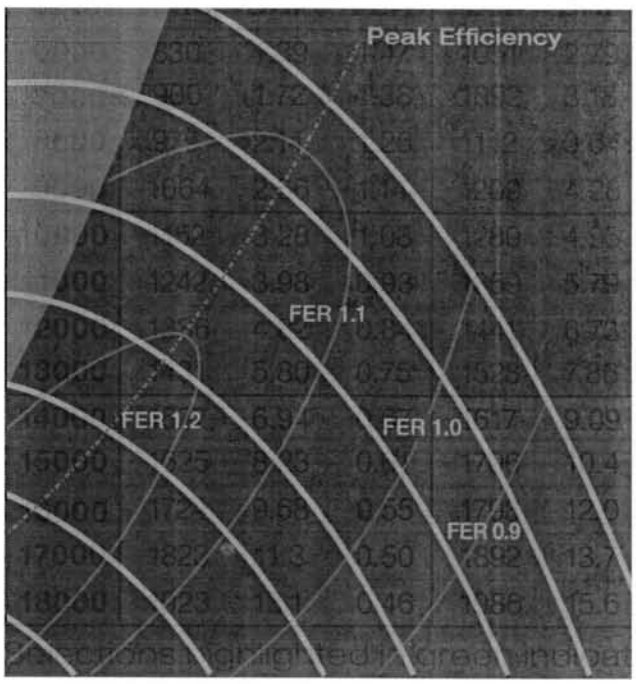
Introducing Fan Efficiency Ratios

An AMCA International Whitepaper



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Introducing Fan Efficiency Ratios

ABSTRACT

This document introduces the fan efficiency ratio (FER), an energy efficiency metric developed by AMCA International. This metric is a ratio of the actual fan efficiency to a baseline fan efficiency, both calculated at a given airflow and pressure point. The FER was designed to encourage responsible application of fans and drive significant and quantifiable energy savings through energy codes, utility rebate programs and federal regulations. This is accomplished by establishing the minimum fan efficiency at design airflow and pressure. The FER can also be used as an application-independent metric when design conditions are not known because it allows the consideration of a single point of rating condition, such as the peak efficiency point.

INTRODUCTION

Fan energy consumption is receiving much attention worldwide. Europe has implemented fan efficiency regulation and is ratcheting up its requirements. China, Malaysia and Taiwan have also implemented fan efficiency requirements. Other countries are considering alternatives. The U.S. Department of Energy (DOE) is working toward the regulation of fan efficiency, while public utilities and code bodies are also looking for ways to drive measurable reductions in fan energy use. AMCA, as an advisor to interested parties worldwide, plays a key role in establishing appropriate fan efficiency metrics. As part of a continuing effort to create metrics that can be used to drive fan energy use down, AMCA has developed the FER, which addresses both fan design and fan application.

Regulators can use the FER to improve the efficiency of fan designs and limit market availability of less efficient fans. Utility companies can use it to establish rebate programs that incentivize the efficient application of fans, and code bodies can use the FER to drive building owners and contractors toward using more energy-efficient fans for ventilation and process applications. Purchasing agents also can use the FER to evaluate fan selections and their suitability for specific applications.

PROBLEM DEFINITION

Fans are unique from other appliances in that their operating efficiency varies significantly based on how they are applied and where they are selected within their operating envelope. Fan application and selection is therefore far more influential than peak fan efficiency in determining the actual energy consumed by a fan. Since fans are not typically sold to building owners (who pay electric bills), market pressures push toward smaller fans with a lower

first cost. This market dynamic works against the effectiveness of regulations that focus on raising fan peak efficiency requirements. If minimum peak efficiency mandates result in higher product cost, then selection and application decisions may shift to compensate. This shift will negate at least a portion of the efficiency gains expected from the regulation. A fan efficiency metric that addresses both product efficiency and product selection can use natural market pressures to encourage the behaviors desired of both fan manufacturers and air system design professionals. In order to best accomplish this, the metric must address each of the following issues.

Fan size is the first thing to be considered. Smaller diameter impellers cannot attain the peak efficiency levels of larger diameter impellers with the same aerodynamic design. This aspect is well-documented and can be addressed in a number of ways. The FEG metric of AMCA Standard 205 relates fan peak efficiency to impeller diameter. The FMEG metric of ISO 12759 takes slightly different approach by relating fan peak efficiency to absorbed input power. The third alternative detailed in this document, FER, relates fan efficiency to both airflow and pressure. An efficiency metric that varies with airflow not only accounts for the size impact but also directly addresses fan selection.

"The FER discourages the unintended consequences of adverse selection behavior in a market driven by first cost."

Another issue, fan pressure, has an impact on achievable efficiency levels as well. Fans designed for lower pressure applications generally have lower peak efficiencies than those designed for higher pressures. The same aerodynamic features that increase fan pressure (number of blades, turning vanes, housing shapes, etc.) also tend to increase fan peak efficiency. However, these features make fans designed for higher pressure less efficient when applied at low pressures. Other fan efficiency metrics address this issue by varying efficiency requirements based on fan type. The FER metric varies with pressure instead of fan type and can be applied universally, using a single baseline target efficiency, to impact both fan design and fan application. The FER can thus be applied to a broad range of products, encouraging best practices in aerodynamic design.

Proper application of fans also requires the correct use of fan static and total pressure. The industry is currently in a state of confusion on this subject. Although system resistance is properly calculated in terms of duct total pressure, fan performance specifications and resulting fan selections are nearly always made using fan static pressure. Fans with ducts attached to the fan discharge *should* be selected using fan total pressure, since both the static pressure and fan velocity pressure are available to overcome system resistance. However, fans that do not have a duct connected to their discharge should always be selected using fan static pressure, since the velocity pressure cannot be used to overcome system resistance. The FER recognizes the value of velocity pressure in ducted applications and encourages the proper use of fan pressures.

Direct-driven fans offer an obvious improvement in efficiency over belt-driven fans and should be encouraged as a means to save energy. However, belt-driven fans are commonly used because they provide a flexible solution to a number of challenges: matching the fan speed to design conditions; providing a means to modify fan performance in the field; and enabling the use of large, low speed fans when motors matched to these speeds are either not available or are cost prohibitive. Direct drives should be evaluated based on their ability to save energy. In order to accomplish this, an efficiency metric must be applied to the entire fan, motor and drive from wire to air.

Speed control and inlet vanes also offer energy savings and should be encouraged. Capacity control of fans by changing the speed of the fan wheel saves energy as the cube of the speed reduction. However, when considered in a wire-to-air metric, the use of a speed controller or of inlet vanes will always reduce the efficiency of the fan system at the full load design point. Therefore, some adjustment is warranted — either to the design point efficiency metric or to the required efficiency levels — in order to eliminate this penalty and encourage the use of fan speed control.

The FER takes into account all of these issues. It takes advantage of the large energy savings available from an application-dependent requirement while accommodating the application-independent sales that occur through distributors. It encourages the proper use of fan total pressure for fans applied with outlet ducts while also recognizing that fan static pressure and static efficiency are correct measures to drive energy savings for non-ducted fans. The FER, when used as a wire-to-air metric, also encourages the use of direct-driven fans. But it does so only as a means to save energy, since there are some applications in which belt drives better match the fan speed to the application. By making an adjustment for capacity control, the FER encourages the use of variable speed and inlet vanes, taking advantage of energy savings at reduced fan loads. Finally, the FER discourages the unintended consequences of adverse selection behavior in a market driven by first cost.

HIGH-LEVEL SOLUTION

The FER is an alternative to other metrics available that are based on peak fan efficiency. With so many different

fan designs on the market, a peak efficiency approach requires the categorization of fans with a different minimum peak efficiency requirement for each product category. Because operating efficiency is so dependent on fan selection, a peak efficiency metric that does not address fan selection could result in increased energy consumption.

Instead of specifying a minimum peak efficiency level for each of the various fan types, the FER establishes a baseline efficiency that varies with both airflow and pressure. This baseline efficiency represents a reasonable efficiency level that can be universally applied to all fan categories. The ratio of fan efficiency to this baseline efficiency at design conditions is used to package the metric and make it easier for customers, owners, regulatory bodies and utility rebate programs to use.

With this baseline efficiency established for all fan types and applications, the simple FER carries significant value. For a given application (airflow and pressure), different fan types and sizes can be compared using the same baseline. An FER equal to one means the actual fan efficiency meets the baseline efficiency. An FER greater than one means the fan efficiency exceeds the baseline, while an FER less than one does not meet the baseline. A higher value FER for the same airflow and pressure will always equate to energy savings.

Since the baseline has been chosen to represent a reasonable efficiency, it is expected that code bodies and the DOE will establish 1.0 as a minimum FER requirement. However, there may be exceptions to this. For example, fans used for variable air volume systems should have a lower FER requirement to encourage their use. Fans used infrequently as emergency fans or fans used for material handling could also have lower FER requirements. On the other hand, stretch codes or utility rebate programs could have a higher FER requirement. It is also expected that minimum FER requirements will increase over time as fan technology improves.

The FER can either be used to assess the efficiency of the fan alone, or it can be applied to the driven fan (extended product or fan-motor-drive system). The calculation method of AMCA Standard 207 and the measurement method of AMCA Standard 210 are available to establish the FER as a wire-to-air metric. While code authorities and the DOE will establish minimum FER levels as they deem appropriate, fan suppliers and users have the freedom to meet these requirements in any manner they choose. A fan user can utilize any combination of fan, transmission, motor and speed control, as long as the combined FER level meets the minimum requirement.

INDUSTRY BENEFITS

The FER is designed to address the wide variability in efficiency of every fan. It does so by concentrating on the energy consumed by a fan as it is applied — at the design point of operation. By focusing on the application, the FER can effectively impact both the fan design and the fan selection. For example, to meet an energy efficiency goal at design conditions, one could either use a very efficient fan design selected at some distance off peak or a fan with lower aerodynamic efficiency selected closer to its peak efficiency. Either way, the goal of energy savings will be achieved. The customer (a contractor principally concerned about first cost) will actually force manufacturers to design products that are more efficient and cost effective.

While driving significant energy savings and technological improvements, the FER will also teach proper fan selection. Every source used by a fan consumer to make a fan selection— performance tables, fan curves or electronic selection software — will show the FER value for that selection. Consumers will know immediately how their fan selection compares to the minimum allowable fan efficiency. They will also see how the energy consumption of one product compares to another, regardless of product type, category or drive method.

Even though the FER was developed to focus on fan efficiency as applied, it can also be used as an application-independent metric when the design operating point is not known. In this case, the FER is evaluated at the best efficiency point (BEP) at the maximum published fan speed. By considering this single point, the metric establishes a restricted speed range while remaining consistent with its use at the design point of operation.

SOLUTION DETAILS

GENERAL DEFINITION

The general definition of fan efficiency ratio is this:

$$FER = \frac{\text{Fan Efficiency}}{\text{Baseline Fan Efficiency}} \qquad \textbf{Eq. 1}$$

Since these efficiencies are both calculated at the same airflow and pressure, this ratio can also be written as follows:

$$FER = \frac{\text{Baseline Fan Input Power}}{\text{Fan Input Power}} \qquad \textbf{Eq. 2}$$

This second equation is equivalent, but it is easier to work with and has the added benefit of working along the entire fan curve. Since the static efficiency is always zero at free air (zero pressure), there is no way to regulate efficiency at this point on the fan curve. However, with the ratio in terms of fan input power, there is a solution for baseline power (and the resulting FER), even at zero pressure.

The FER can either refer to shaft power and traditional fan efficiency, or it can refer to electrical input to a driven fan and overall fan efficiency (wire to air). In this document, the subscripts *H* and *W* shall indicate shaft power and electrical power, respectively. First, the FER_H for the fan alone will be described. Later, the FER_W for the driven fan will be covered.

BASELINE EFFICIENCY CALCULATION

In order to encourage the appropriate use of fan pressures, the baseline efficiency is calculated in terms of total efficiency for fans with outlet ducts and static efficiency for fans tested with no outlet duct.

Fans tested with ducted discharge:

$$\eta_{t,baseline} = \eta_{t,target} \times \left(\frac{Q}{Q + Q_0}\right)\left(\frac{P_t}{P_t + P_0}\right) \qquad \textbf{Eq. 3}$$

Fans tested without ducted discharge:

$$\eta_{s,baseline} = \eta_{s,target} \times \left(\frac{Q}{Q + Q_0}\right)\left(\frac{P_s}{P_s + P_0}\right) \qquad \textbf{Eq. 4}$$

The values $\eta_{t,target}$ and $\eta_{s,target}$ are constants based on the expected efficiency for very high airflow and pressure applications. Q_0 and P_0 are constants that control how the expected efficiencies are reduced at low airflows and pressures. Note that all pressures shown refer to standard air density. In order to use the equations at other air densities, each of the pressures (P_t, P_s, and P_0) must be corrected to the actual density. The resulting power will also be at the actual density.

This baseline efficiency can be plotted to show its relationship to airflow and pressure, as in Figure 1.

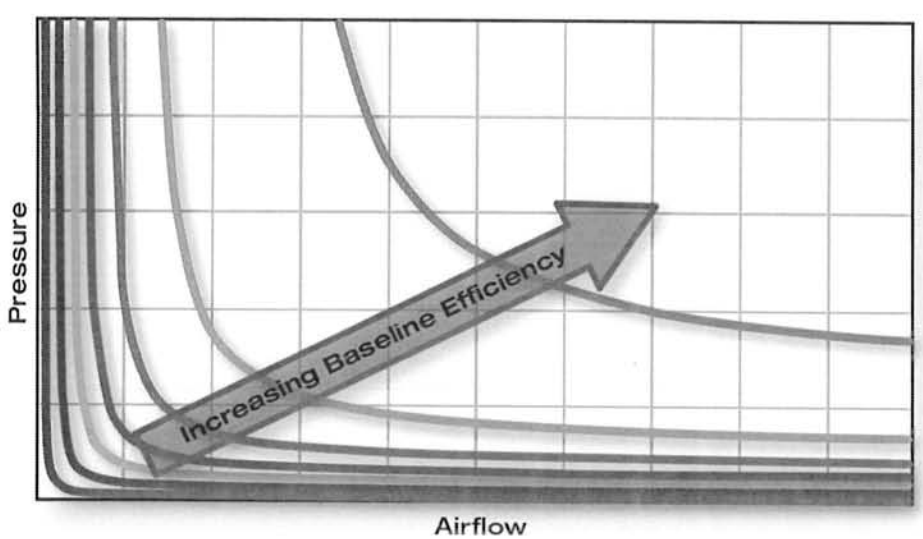


Figure 1. Baseline fan efficiency with lines of constant efficiency varying with airflow and pressure

The baseline efficiency can also be shown as a contour surface that increases at high airflow and pressure while approaching the target efficiency, as in Figure 2.

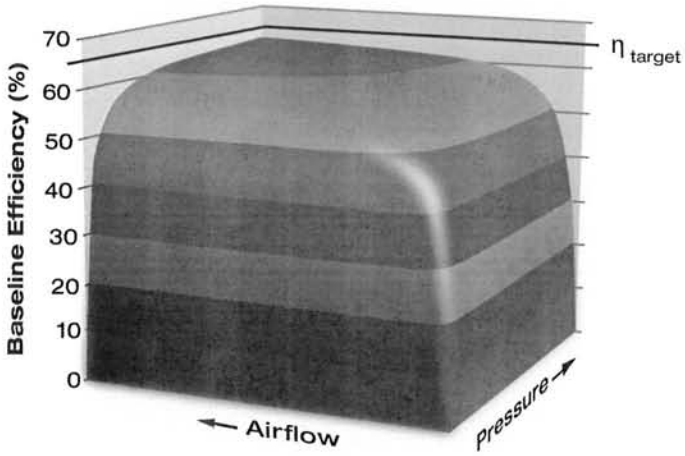


Figure 2. Contour plot of baseline fan efficiency as a function of airflow and pressure. This baseline approaches but never reaches the target efficiency

BASELINE POWER CALCULATION

The baseline power of Equation 2 can be calculated from the general equation for fan efficiency at the same airflow and pressure:

$$\eta = \frac{Q \times P}{6343 \times H} \quad \text{or} \quad H = \frac{Q \times P}{6343 \times \eta}$$

In these equations, *H* is fan shaft input power (bhp in I-P units, kW in SI units) at standard density, and the constant *6343* is omitted when using SI units.

By combining the baseline efficiency of Equations 3 and 4 into the general equation for fan efficiency, the baseline power can be calculated as follows:

For fans tested with ducted discharge:

$$H_{baseline} = \frac{(Q + Q_0)(P_t + P_0)}{6343 \times \eta_{t,target}} \qquad \textbf{Eq. 5}$$

For fans tested without a ducted discharge:

$$H_{baseline} = \frac{(Q + Q_0)(P_s + P_0)}{6343 \times \eta_{s,target}} \qquad \textbf{Eq. 6}$$

Again, the conversion constant *6343* is not used with SI units.

Fan mechanical input power (as determined in an AMCA Standard 210 test) at any point of operation can be compared to this baseline power at the same point of operation using Equation 2 to calculate the FER_H. Note that the FER_H will vary for each point on the fan curve. It will also vary with fan speed. Figures 3–7 provide visual examples of this.

	1 in. wg			2 in. wg			3 in. wg			4 in. wg			5 in. wg			6 in. wg		
CFM	**RPM**	**BHP**	**FER**	**RPM**	**BHP**	**FER**	**RPM**	**BHP**	**FER**	**RPM**	**BHP**	**FER**	**RPM**	**BHP**	**FER**	**RPM**	**BHP**	**FER**
6000	830	1.39	1.47	1051	2.79	1.33												
7000	900	1.72	1.38	1092	3.18	1.35	1267	4.83	1.28									
8000	979	2.14	1.26	1142	3.64	1.34	1306	5.41	1.30	1458	7.34	1.25						
9000	1064	2.66	1.14	1209	4.28	1.28	1358	6.13	1.29	1499	8.15	1.27	1633	10.3	1.23			
10000	1152	3.28	1.03	1280	4.95	1.22	1411	6.86	1.28	1550	9.11	1.26	1674	11.3	1.25	1798	13.8	1.22
11000	1242	3.98	0.93	1359	5.79	1.15	1479	7.84	1.22	1597	10.0	1.26	1722	12.5	1.24	1835	14.9	1.24
12000	1336	4.82	0.84	1441	6.73	1.08	1549	8.82	1.19	1660	11.1	1.23	1770	13.6	1.25	1883	16.3	1.23
13000	1431	5.80	0.75	1528	7.86	1.00	1627	10.1	1.13	1728	12.4	1.19	1828	14.9	1.23	1932	17.6	1.23
14000	1527	6.94	0.67	1617	9.09	0.93	1707	11.3	1.07	1799	13.8	1.15	1897	16.6	1.18	1987	19.1	1.22
15000	1625	8.23	0.61	1706	10.4	0.86	1791	12.8	1.01	1878	15.5	1.10	1964	18.1	1.16	2054	21.1	1.19
16000	1724	9.68	0.55	1798	12.0	0.80	1879	14.6	0.95	1957	17.2	1.06	2038	20.0	1.12			
17000	1823	11.3	0.50	1892	13.7	0.75	1967	16.4	0.90	2041	19.1	1.01						
18000	1923	13.1	0.46	1986	15.6	0.69	2056	18.4	0.85									

Selections highlighted in green indicate $FER_H \geq 1.0$ Non-highlighted selections indicate $FER_H < 1.0$

Figure 3. Fan selection tables commonly found in product catalogs showing FER_H levels at each point

Figure 3 is a fan selection table that would be found in a product catalog. FER_H values greater than 1.0 would be clearly differentiated from those less than 1.0 in order to direct customers to proper selections. Figure 4 shows how this differentiation could look on the fan selection page of an electronic catalog.

Fan Size (in.)	Fan Speed (rpm)	Fan Power (bhp)	Total Efficiency	Baseline Power (bhp)	Baseline Total Efficiency	FER_H
18	3238	11.8	40.1 %	7.96	59.4%	0.67
20	2561	9.56	49.5%	7.96	59.4%	0.83
22	1983	8.02	59.0%	7.96	59.4%	0.99
24	1579	6.84	69.1 %	7.96	59.4%	1.16
27	1289	6.24	75.8%	7.96	59.4%	1.28
30	1033	5.73	82.5%	7.96	59.4%	1.39
33	887	5.67	83.4%	7.96	59.4%	1.40
36	778	6.01	78.7 %	7.96	59.4%	1.32

Selections highlighted in green indicate $FER_H \geq 1.0$ All fans selected for 10,000 CFM at 3.0" Pt

Figure 4. Fan selection page of an electronic catalog for a single point of operation. Note that FER_H is inversely proportional to fan power

Families of fan curves are also useful during fan selection. Figures 5 and 6 show multiple speed fan curves for fans with high and low efficiency levels. In these figures, higher FER_H levels occur closer to the peak fan efficiency.

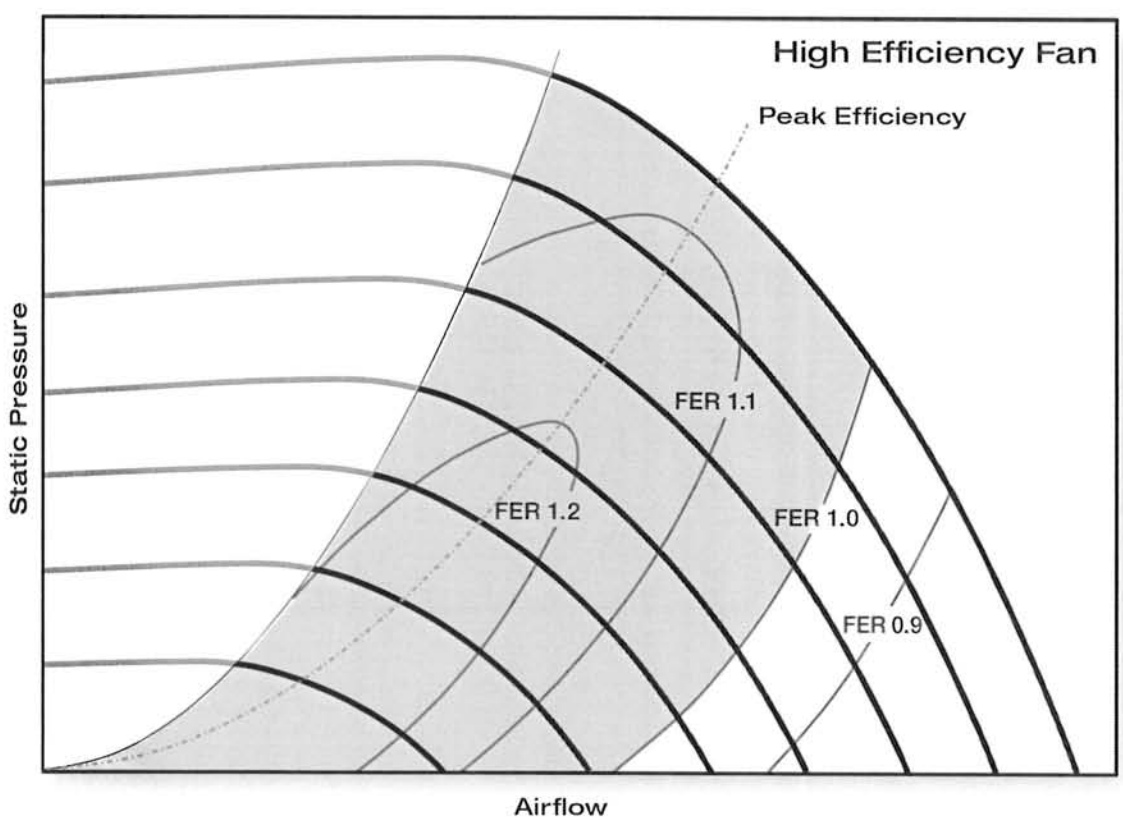


Figure 5. Multiple speed fan curves for a high efficiency fan have a large allowable selection range ($FER_H \geq 1$)

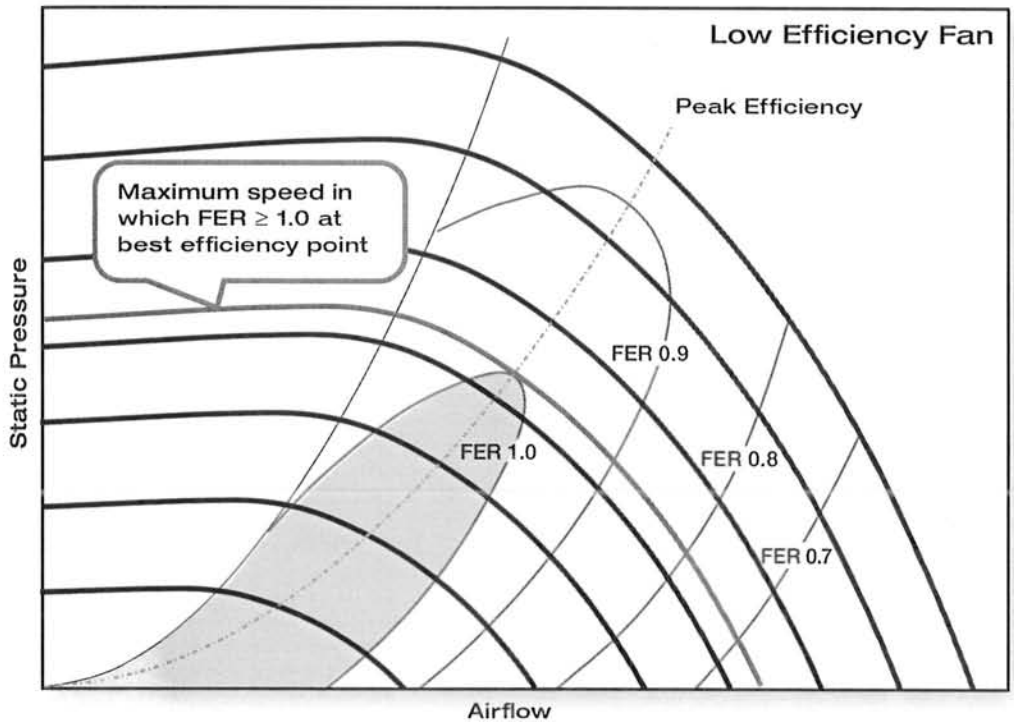


Figure 6. Multiple speed fan curves for a low efficiency fan have a smaller allowable selection range ($FER_H \geq 1$).

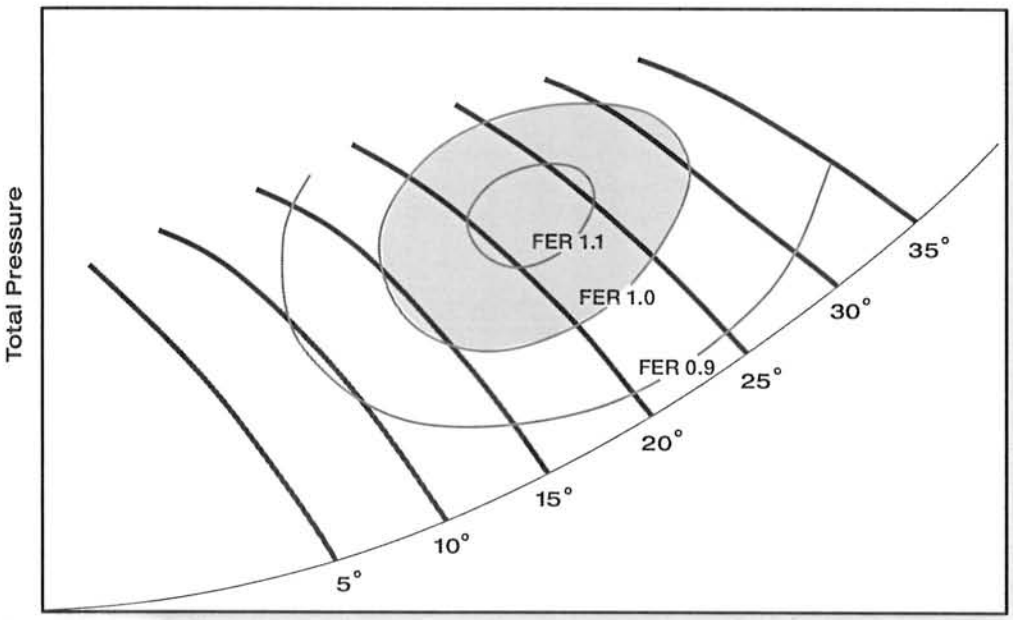
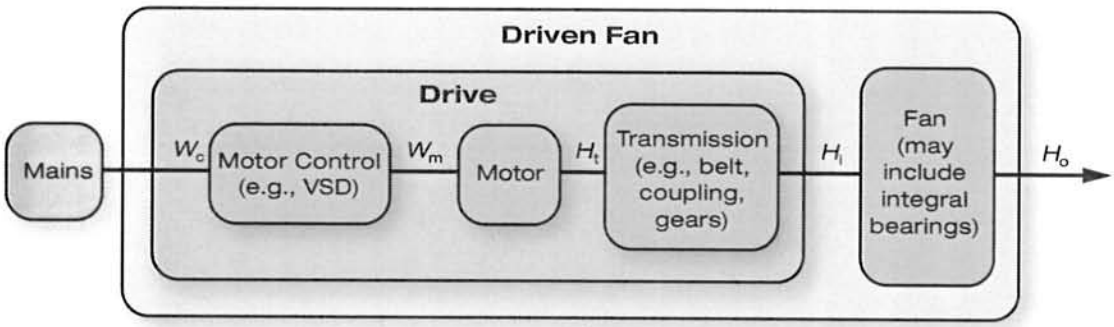


Figure 7. Concentric FER_H curves for adjustable pitch axial fans show highest efficiency areas and allowable selection range ($FER_H \geq 1$)

Finally, Figure 7 shows how adjustable pitch axial fans have FER_H levels that form concentric curves.

WIRE-TO-AIR CONCEPT

In order to address the electrical energy consumed by the fan and drive, the FER can also be expressed in terms of electrical input power and overall fan efficiency. Figure 8, taken from the current draft of AMCA Standard 210, shows how power flows into a fan.



W shall designate electrical input power, the product of voltage and current, and, in the case of an AC circuit, power factor

H shall designate mechanical power, the product of torque and shaft speed when considering input power

Figure 8 Power flow into fan and identification of losses associated with each component.

The general definition of FER from Equations 1 and 2 becomes a general definition for FER_W when expressed in terms of overall wire-to-air efficiency of the driven fan (Equation 7) and electrical energy input to the driven fan (Equation 8):

$$FER_W = \frac{\text{Driven Fan Efficiency}}{\text{Baseline Driven Fan Efficiency}} \qquad \textbf{Eq. 7}$$

$$FER_W = \frac{\text{Baseline Electrical Input Power}}{\text{Fan Electrical Input Power}} \qquad \textbf{Eq. 8}$$

The baseline electrical input power, $W_{baseline,}$ is calculated from the baseline power of Equations 5 and 6 and a baseline drive efficiency:

$$W_{baseline} = \frac{H_{baseline}}{\text{Baseline Drive Efficiency}} \qquad \textbf{Eq. 9}$$

The baseline drive efficiency covers all drive components, including the motor and belt drives or speed controllers, if used. This factor is not intended to predict the actual efficiency of the specific drive components used; however, it is established based on reasonable efficiencies of typical components. This baseline is a simple equation of drive efficiency as a function of shaft power. Since the same baseline is used for both belt and direct driven fans, and since the actual drive efficiency for a direct driven fan will normally exceed that of a belt drive, a direct drive fan will have a higher FER_W than an equivalent belt driven fan.

Fan electrical input power (as determined in an AMCA Standard 210 test or as calculated in AMCA Standard 207) at any point of operation can be compared to this baseline power at the same point of operation using Equation 8 to calculate the FER_W. As with the FER_H, the value of FER_W will vary for each point on the fan curve, and it will vary with fan speed.

It is important to note that the baseline drive efficiency is the same whether or not the fan has a motor speed controller. The use of a motor speed controller or inlet vanes will always decrease the overall drive efficiency at full speed (and decrease the calculated FER_W), yet the use of fan speed control or inlet vanes will always result in significant energy savings at part loads. No attempt is made to arbitrarily increase the FER_W for fans with speed controllers or inlet vanes. The potential energy savings with speed control will be evaluated by the DOE, code and rebate authorities. Minimum FER_W values for fans with speed control should be set lower by these authorities, based on these potential savings, in order to encourage their use.

Figure 9 was created to assist in the visualization of the FER calculation process.

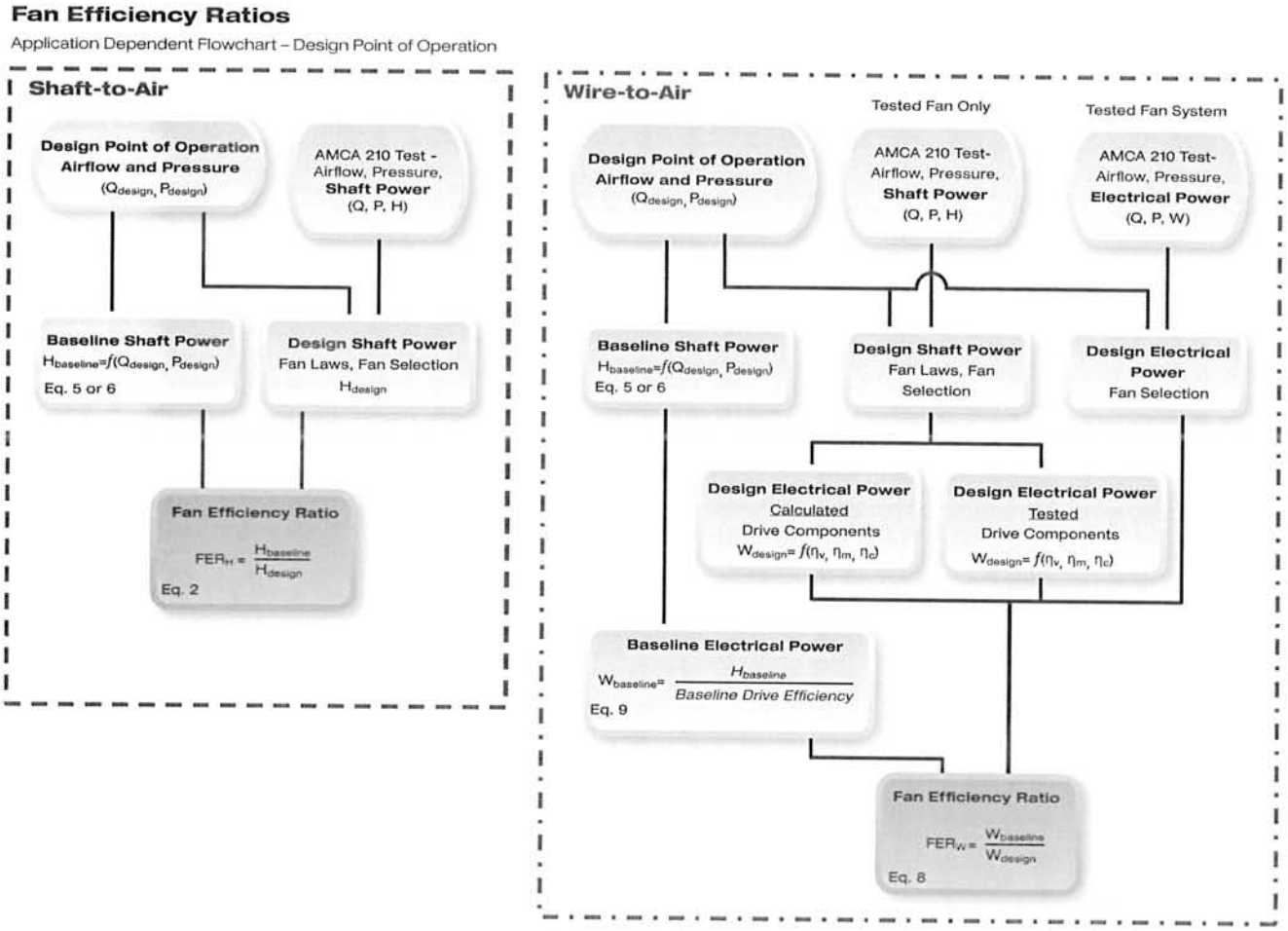


Figure 9. Flowchart of calculation procedures used to determine the fan efficiency ratio at the design point of operation. Both the shaft-to-air FER_H and the wire-to-air FER_W can be calculated from AMCA Standard 210 performance test results

CONCLUSION

The FER is a metric that allows many different types of fans to be compared on equal footing, and it does so by concentrating on the energy consumed by a fan as it is applied. It can be used by regulators and purchasers alike to make a price-sensitive market favor true efficiency, helping consumers see how a fan can be affordable and efficient at the same time. Additionally, the FER can provide manufacturers with concrete assurance they are creating energy-saving products that will appeal to their customers. It is an all-encompassing, high level solution to a complex problem.

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