# Board of Building Standards

**EDUCATION COMMITTEE MEETING**
**AGENDA**

DATE: NOVEMBER 18, 2021
TIME: 10:00 AM
LOCATION: 6606 TUSSING ROAD, TRAINING ROOM 3, REYNOLDSBURG, OHIO

**Call to Order**

**Consent Agenda**

**Course Applications**

ER-1 Ohio Pre-engineered Extinguishing Equipment Other Than Water (Fire Tech Productions)
BO, MPE, BPE, FPPE, BI, FPI, NRIUI (6 hours)
Staff Notes:
Committee Recommendation:

ER-2 Ohio Plumbing Code Updates (Ohio Contractor Training)
PI (10 hours)
Staff Notes: See "Explanation of Slides" document
Committee Recommendation:

ER-3 ICC Learn Live - Building Information Management Solutions
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-4 ICC Learn Live - Metal Building Systems
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-5 ICC Learn Live - ACI 318 Requirements for Structural Concrete
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-6 ICC Learn Live - Communicating in a Digital World
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-7 ICC Learn Live - Getting Back to Normal in a Hybrid World
1 hour, all certifications
Staff Notes

Committee Recommendation:

ER-8 ICC Learn Live - Offsite Construction: State Industrialized Building Program Panel
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-9 ICC Learn Live - Best Practices: Collaboration Techniques and Tools
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-10 ICC Learn Live - Technology Demands in the Building Safety World
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-11 ICC Learn Live - Code Enforcement Officer Safety
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-12 ICC Learn Live - FEMA BRIC Program
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-13 ICC Learn Live - UN Climate Conference (COP26)
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-14 ICC Learn Live - Building Department Recognition and Accreditation
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-15 ICC Learn Live - Extreme Structures
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-16 ICC Learn Live - Homelessness in the United States - How are Major Jurisdictions Dealing with this Issue?
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-17 ICC Learn Live - Best Practices: Major Jurisdiction Committee

1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-18 ICC Learn Live - Architectural Practice: Collaborative Efforts for Public Safety
1 hour, all certifications
Staff Notes
Committee Recommendation:

ER-19 CBO Code Summit (Miami Valley Building Officials Council)
BO, MPE, BPE, EPE, MechPE, FPPE, BI, RBO, RPE, RBI (2 hours)
Staff Notes: This course is currently approved for BO, MPE, BPE, and BI. Request is to add six more certifications. The attached material is from the original approval in 2018. It has been renewed annually since then.
Committee Recommendation:

ER-20 NEC 2017 Code Study Articles 300, 310, 312, 314, 695, 700 (Ohio Division of Industrial Compliance)
ESI, BO, MPE (7 hours)
Staff Notes: This course was approved in January for ESI. Mike Thompson of DIC now wants to add BO and MPE.
Committee Recommendation:

ER-21 NEC 2017 Code Study Articles 90, 100, 110, 200-250 (Ohio Division of Industrial Compliance)
ESI, BO, MPE (3 hours)
Staff Notes: This course was approved in January for ESI. Mike Thompson of DIC now wants to add BO and MPE to the 2021 approval.
Committee Recommendation:

**Old Business**

**New Business**

NB-1 Recognizing other education not granted BBS number
Staff Notes: Occasionally, we receive requests from certified personnel to recognize education offered by groups outside Ohio that have not applied for BBS continuing education approval. Most recently, it was the Western Division of IAEI conference in September, (see certificate attached) but this has come up before.
Committee Recommendation:

**Adjourn**

**EDUCATION COMMITTEE MEETING**
**CONSENT AGENDA**

## Course Applications

**File Attachments for Item:**

ER-1 Ohio Pre-engineered Extinguishing Equipment Other Than Water (Fire Tech Productions)

BO, MPE, BPE, FPPE, BI, FPI, NRIUI (6 hours)

Staff Notes:

Committee Recommendation:

THOMAS DOTY
21 Meadowcrest Dr.
Franklin, OH 45005
937-434-3473
tom@firetech.com

Seasoned fire protection professional following strong adherence to the codes and top-notch attention to customer service.

Certifications include: Sprinkler/Standpipe • Fire Alarm and Detection Systems • Fire Pumps • Fire Service Mains • Portable Fire Extinguishers • Pre-Engineered Extinguishers – OTW • State of Kentucky Certified

PROFESSIONAL EXPERIENCE

- Fire Tech Productions, Inc., 7986B Clyo Rd., Centerville, Ohio 45459
  *President - 2015 - Present*

- Craynon Fire Protection Inc., 2801 Thunderhawk Court, Dayton, Ohio 45414
  *Partner/Vice-President – 2011 – Present*
  *Operations Manager* -- 12/11/2005 – Present

- Guardian Fire Protection, 480 Randy Lane, Monroe, Ohio 45050
  *Owner* – 11/30/2003 – 12/11/2005

- Sprinkler Inspection Services, Inc., 8 Perkins Drive, Alexandria, KY 41001
  *Superintendent / Operations Manager* – 10/07/1995 – 11/30/2003

- Bestol Plumbing Company, P.O. Box 4192, Branson, MO
  *Foreman* – 2/1995 – 10/1995

- Grinnell Fire Protection Systems, Inc., San Diego, CA
  *Service Foreman* – 8/1993 – 2/1995

- Advanced Fire Protection Company, 1657 Monte Vista Drive, Vista, CA 92084
  *Owner* – 10/1990 – 8/1993

- Ryan Automatic Sprinkler Company, San Marcos, CA
  *Superintendent* – 4/1988 – 10/1990

- Vanguard Fire Protection, Carlsbad, CA
  *Foreman* – 3/1985 – 4/1988

- Sentinel Fire Protection, San Diego, CA -- 8/1983 – 3/1985
- Local Union 669 – 5/1981 – 8/1983
- Local #821, Central Florida – 4/1980 – 5/1981
- American Automatic Fire Protection – 1/1979 – 4/1980
- Illinois Central Gulf Railroad – 4/1978 – 12/1978
- Orlando Automatic Sprinkler Company – 10/1976 – 3/1978

Ohio Pre-engineered Extinguishing Equipment Other Than Water

- Introduction to Pre-engineered Systems
- Ohio Codes for Pre-engineered Systems
- Administrative Requirements for Pre-engineered Systems
- Terms and Definitions for Pre-engineered Systems
- Wet Chemical Components and System Requirements
- Wet Chemical Plans and Acceptance Tests
- Wet Chemical Inspection, Maintenance, and Recharging
- Dry Chemical Components and System Requirements
- Dry Chemical Plans and Acceptance Tests
- Dry Chemical Pre-engineered Systems
- Dry Chemical Inspection, Maintenance, and Recharging
- Clean Agent Components and System Requirements
- Clean Agent Inspection, Testing, Maintenance, and Training
- Clean Agent Room Integrity Tests

| **MODULE** | **SLIDES** | **QUIZ QUES** | **60 SEC/SLIDE** | **60 SEC/QUES** | **TOTAL TIME (SEC) PER MODULE** | **TOTAL TIME (MIN) PER MODULE** | **HOURS** |
|---|---|---|---|---|---|---|---|
| · Introduction to Pre-engineered Systems | 11 | 6 | 495 | 270 | 765 | 12.75 | |
| · Ohio Codes for Pre-engineered Systems | 14 | 15 | 630 | 675 | 1305 | 21.75 | |
| · Administrative Requirements for Pre-engineered Systems | 17 | 15 | 765 | 675 | 1440 | 24 | |
| · Terms and Definitions for Pre-engineered Systems | 15 | 15 | 675 | 675 | 1350 | 22.5 | |
| · Wet Chemical Components and System Requirements | 16 | 10 | 720 | 450 | 1170 | 19.5 | |
| · Wet Chemical Plans and Acceptance Tests | 9 | 11 | 405 | 495 | 900 | 15 | |
| · Wet Chemical Inspection, Maintenance, and Recharging | 18 | 20 | 810 | 900 | 1710 | 28.5 | |
| · Dry Chemical Components and System Requirements | 18 | 14 | 810 | 630 | 1440 | 24 | |
| · Dry Chemical Plans and Acceptance Tests | 8 | 10 | 360 | 450 | 810 | 13.5 | |
| Dry checmical Pre-engineered Systems | 16 | 10 | 720 | 450 | 1170 | 19.5 | |
| · Dry Chemical Inspection, Maintenance, and Recharging | 19 | 23 | 855 | 1035 | 1890 | 31.5 | |
| · Clean Agent Components and System Requirements | 28 | 15 | 1260 | 675 | 1935 | 32.25 | |
| · Clean Agent Inspection, Testing, Maintenance, and Training | 28 | 22 | 1260 | 990 | 2250 | 37.5 | |
| · Clean Agent Room Integrity Tests | 28 | 10 | 1260 | 450 | 1710 | 28.5 | |
| | | 50 | | 2250 | 2250 | 37.5 | |
| | | 246 | | | | 368.25 | |
| | | | | | | | 6.1375 |

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors**: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors:** provide participants a certificate of completion containing the following information: name of participant, title of approved courses, BBS approval #, BBS approved certifications, date of the continuing education program, number of approved credit hours awarded and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants**: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval**: Remains in effect through the calendar year of approval. The course may be renewed administratively by sponsor application in subsequent years so long as it references current codes and standards Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area**: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.


**Board of Building Standards**
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Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm


COURSE SUBMITTER:

Course Submitter: Julie Miller
(Contact Name)
Organization: Fire Tech Productions, Inc.
(Organization/Company)
Address: 7976 Clyo Rd.
(Include Room Number, Suite, etc.)
City: Centerville State: Ohio Zip: 45459
E-Mail: julie@firetech.com
Telephone: 937-434-3473 Fax: 937-813-8205
Course Sponsor: _____

COURSE INFORMATION:

**Course Title:** Ohio Pre-engineered Extinguishing Equipment Other Than Water

New Course Submittal: ■ Update Course: ☐ Prior Approval Number: _____

**Purpose and Objective:**
The Ohio Pre-engineered Extinguishing Equipment Other Than Water course will discuss requirements pertaining to common pre-engineered fire suppression systems (wet chemical systems, dry chemical systems, and clean-agent systems), reviewing applicable Ohio Building Code and Fire Code requirements, as well as NFPA requirements related to system components and installation, inspection, testing, maintenance, and recharge of these systems.

**Number of Instructional Contact Hours that can be obtained upon completion:** 6

**If Multi-Session, Number of Instructional Contact Hours Per Session:** _____

**Program Applicable for the Following Participants:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Building Official | ■ | Master Plans Examiner | ■ | Building Inspector | ■ | Fire Protection Inspector | ■ |
| | | Building Plans Exam. | ✔ | | | | |
| | | Plumbing Plans Exam. | ☐ | | | | |
| | | Electrical Plans Exam. | ☐ | | | | |
| | | Mechanical Plans Exam. | ☐ | | | | |
| | | Fire Protect. Plans Exam. | ✔ | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mechanical Inspector | ☐ | Plumbing Inspector | ☐ | Non-Res IU Inspector | ■ | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Res Building Official | ☐ | Res Plans Examiner | ☐ | Res Building Inspector | ☐ | Res Mechanical Inspector | ☐ | Res IU Inspector | ☐ |

Electrical Safety Inspectors ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

| SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**: | | Check Off |
|---|---|---|
| **Course Submitter:** | Name of contact person and their certification numbers, organization, address, fax, phone | X |
| | Organization sponsoring or requesting the program (if any) | |
| **Course Title:** | Name of course (related to content) | X |
| **Purpose/Objective:** | Describe purpose and how course will improve competency of certification(s) listed | X |
| **Contact Hours:** | Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs) | X |
| **Participants:** | Check off each certification for which credit is requested (for which course relates to certification) | X |
| **Content of Program:** | Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered | X |
| **Course Materials:** | Collated workbooks, handouts, hard copy or electronic versions of program is available | |
| **Instructor(s) Info.:** | Resume of professional/educational qualifications & teaching/training experience/BBS certifications | X |
| **Test Materials:** | | |
| **Completed Application:** | | X |

***NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.***

# Fire Tech Productions

*…training that makes a difference*

Pre-engineered Extinguishing Equipment Other Than Water

Introduction

1

# Fire Tech Productions

*…training that makes a difference*

Pre-engineered Extinguishing Equipment Other Than Water

Ohio Building and Fire Codes

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## Outline

- Ohio Fire Code and Building Code
- Alternative Fire-Extinguishing Systems

**Key References**

✓ **Ohio Administrative Code** Section 1301:7-7-09 (Ohio Fire Code), 2017

✓ **Ohio Building Code** Chapter 9, 2017



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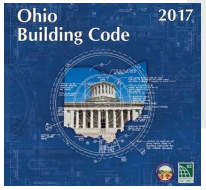
## Ohio Fire Code and Building Code

Links to the Ohio Building Code and Ohio Fire Code:

**Ohio Building Code:** https://codes.iccsafe.org/content/OHBCU2017/chapter-9-fire-protection-systems

**Ohio Fire Code:** https://codes.iccsafe.org/content/OHFC2017/ohio-administrative-code-1301-7-7-09-fire-protection-systems







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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.2)**

**Where Permitted**

If automatic fire-extinguishing systems are installed instead of automatic sprinkler systems, Authority Having Jurisdiction (AHJ) approval is required prior to system installation.

Commercial kitchen hood exhaust hood and duct systems required to have a Type I hood shall also be protected by an automatic fire-extinguishing system.




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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.3)**

**Installation**

Automatic fire-extinguishing systems are required to actuate automatically and also have a manual means of actuation.

Automatic equipment interlocks with the following are required to be provided per the referenced design and installation standard (in this case, NFPA 17A, NFPA 17, and NFPA 2001):

- Fuel shutoffs
- Ventilation controls
- Door closers
- Window shutters
- Conveyor openings
- Smoke and heat vents
- Other features needed for proper system operation



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.3)**

**Installation (continued)**

If alarms are required to signify system operation, they are to be distinct audible and visible alarms. Warning signs are also required to be posted to warn occupants of possible agent discharge.

If agent exposure is hazardous to the occupants, AND a delay in the system activation is required to allow occupants time to evacuate the premises before agent discharge begins, a separate warning signal is required to alert occupants once the agent discharges.

If automatic fire-extinguishing systems are installed in a building with a fire alarm system, the fire-extinguishing system is required to be monitored by this fire alarm system.



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.4)**

**Inspection and Testing**

Automatic fire-extinguishing systems are required to be inspected and tested prior to final acceptance tests. This includes the following inspections:

- Hazard specification for consistency with the design hazard
- Type, location, and spacing of automatic- and manual-initiating devices
- Size, placement, and position of nozzles or discharge orifices
- Location and identification of audible and visible alarm devices
- Identification of devices with proper designations
- Operating instructions



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.4)**

**Inspection and Testing (continued)**

Notification appliances, connections to fire alarm systems, and connections to supervising stations are required to be tested.

Verify visibility and audibility for those notification appliances that signal agent discharge or system operation.

Test the connections to protected premises and supervising fire alarm systems to confirm proper identification and retransmission of alarms from the automatic fire-extinguishing systems.




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## Alternative Fire-Extinguishing Systems

**(Ohio Fire Code Sections 904.5 and 904.6)**

**Wet Chemical and Dry Chemical Systems**

Both wet- and dry-chemical systems are required to be properly installed, periodically inspected and tested, and maintained per their respective NFPA standard. Retain all inspection and test records.

Both types of systems are to be inspected and tested every 6 months to verify proper operation. Tests shall include the following:

- Check the detection system, alarms, and releasing devices, including manual stations and other related equipment.
- Weigh and verify the required agent amount.
- Confirm stored pressure-type units have the correct pressure.
- Weigh the cartridge of cartridge-operated units, replacing them at intervals recommended by the manufacturer.



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## Alternative Fire-Extinguishing Systems

**(Ohio Fire Code Section 904.10)**

**Clean Agent Systems**

Clean-agent systems are required to be properly installed, periodically inspected and tested, and maintained per NFPA 2001. Retain all inspection and test records.

These systems are required to be inspected and tested every 12 months. However, the quantity and pressure of the extinguishing agent containers are required to be checked more frequently, every 6 months. If a container shows a weight loss greater than 5%, or a pressure loss greater than 10% (adjusted for temperature), the container is required to be refilled or replaced. Record the weight and pressure on the tag attached to the container.

Inspect system hoses every 12 months. Damaged hoses are required to be replaced or tested. Hoses are required to be tested every 5 years.



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.12)**

**Commercial Cooking Systems**

Ensure the type of automatic fire-extinguishing system used to protect a commercial cooking system is correct for the intended application. Pre-engineered automatic dry-and wet-chemical systems are required to be tested per UL 300, listed, and labeled.

System installation shall fulfill the OH Fire Code requirements, its listing, the manufacturer's installation instructions, and the following NFPA standards:

- Wet-chemical systems – NFPA 17A
- Dry-chemical systems – NFPA 17

Note, there is an exception for factory-built commercial cooking recirculation systems.



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.12)**

**Commercial Cooking Systems (continued)**

A manual actuation device is required to be at or near a means of egress from the cooking area, located 10 – 20 ft from the kitchen exhaust system. This device is required to be situated 42 – 48 in. above floor level and clearly labeled to identify the hazard protected. The maximum force to activate this device is 40 lbs, with 14 in. being the maximum movement permitted to actuate the system.

Automatic sprinkler systems are not required to have manual actuation devices.

When an automatic fire extinguishing system activates, the fuel or electric power supply to the cooking equipment shall also automatically shut down. Any resets to fuel or electric power are required to be manual.

Service automatic fire-extinguishing systems at least every 6 months and all times after system activation. All inspections are to be conducted by qualified personnel, with the certificate of inspection sent to the fire code official once completed.



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## Alternative Fire-Extinguishing Systems

**(Ohio Building Code and Ohio Fire Code Section 904.13)**

**Domestic Cooking Systems in Group I-2 Condition 1 Occupancies**

Pre-engineered automatic fire extinguishing systems for Group I-2 Condition 1 occupancies are required to be tested per UL 300A, listed, and labeled. Manual system operation and system interconnection requirements are the same as those for commercial cooking systems.

A portable fire extinguisher is required to be located within a 30 ft. travel distance from the domestic cooking appliances.



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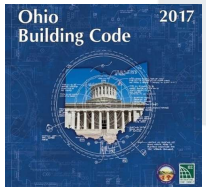
## Fire Tech Productions

# On to the Quiz!

**(Select "Next" to proceed)**







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## Outline

- Introduction
- About the Exam
- Preparing for the Exam

**Key References**

- ✓ **Ohio Administrative Code** Section 1301:7-7-09 (Ohio Fire Code), 2017
- ✓ **Ohio Building Code** Chapter 9, 2017
- ✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017
- ✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017
- ✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015



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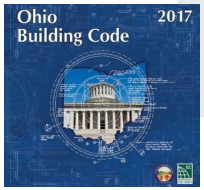
## Introduction

Pre-engineered systems are designed to protect small areas during a fire event. These fast-acting automatic systems can rapidly detect and extinguish a fire.

This course will discuss requirements pertaining to common pre-engineered fire suppression systems (dry chemical systems, wet chemical systems, and clean-agent systems), reviewing applicable Ohio Building Code, Ohio Fire Code, and NFPA requirements related to system components and installation, inspection, testing, maintenance, and recharge of these systems.





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## About the Exam

The 50-question, closed-book exam will cover the following sources:

- Ohio Administrative Code Section 1301:7-7-09 (Ohio Fire Code), 2017 edition
- Ohio Building Code Chapter 9, 2017 edition
- NFPA 17 – Standard for Dry Chemical Extinguishing Systems, 2017 edition
- NFPA 17A – Standard for Wet Chemical Extinguishing Systems, 2017 edition
- NFPA 2001 – Standard on Clean Agent Fire Extinguishing Systems, 2015 edition






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## About the Exam

The Ohio Administrative Code requires “an individual to be associated with a certified company when such individual engages in the business of servicing, testing, repairing, or installing fire protection or firefighting equipment for profit.”

All persons and entities (sole proprietors, companies, corporations, partnerships, etc.) involved in the installation, service, or maintenance of "fire protection equipment", including fire extinguishing systems are required to have a fire protection certification in the state of Ohio.

To become certified to work with pre-engineered systems, submit your application to the State Fire Marshal along with a $35.00 application fee.

www.com.ohio.gov/documents/FireProtectionExamApplication.pdf





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## About the Exam

Prior to being approved to take the pre-engineered systems exam, one of the following must also be submitted:

1. Proof from the manufacturer of training or approval to work on the manufacturer’s pre-engineered systems.

or

2. Inspection Reports demonstrating that the applicant has witnessed the code compliant installation/major repairs of ten (10) pre-engineered systems within two (2) years immediately prior to making application.

The documentation shall include:

a. The name and license number of the individual performing such installation/major repairs

b. Type of systems observed/installed

c. Date and location of installation/major repairs




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## About the Exam

Once you have been approved by the State Fire Marshal's Office to take the exam, you can schedule your exam with PSI Services. Important test information is found in the PSI Candidate Information Bulletin:

https://candidate.psiexams.com/bulletin/display_bulletin.jsp?ro=yes&actionname=83&bulletinid=837&bulletinurl=.pdf

*Take the time to read this bulletin in its entirety.*

Review these important links for the Ohio exam information from the Ohio Department of Commerce – Division of State Fire Marshal:

www.com.ohio.gov/fire/

www.com.ohio.gov/documents/FireProtectionExamApplication.pdf

https://com.ohio.gov/fire/FAQ.aspx



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## About the Exam

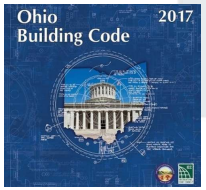
Links to the Ohio Building Code and Ohio Fire Code:

**Ohio Building Code:**

https://codes.iccsafe.org/content/OHBCU2017/chapter-9-fire-protection-systems

**Ohio Fire Code:**

https://codes.iccsafe.org/content/OHFC2017/ohio-administrative-code-1301-7-7-09-fire-protection-systems







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## Preparing for the Exam

Be prepared to refer to your copy of the referenced NFPA standards constantly throughout these modules. Be comfortable with the technical material.

Each training module is carefully planned and designed to highlight areas of the standards that you need to know in order to increase your chances of success on the exam. The goal of these training modules is to help you become knowledgeable of important areas of the codes and standards and to gain a working understanding of how to apply these requirements.

Highlight areas of the standards that are important to know. Study the Fire Tech Training material and answer the practice test questions. Look up the answer to each question before answering. The more familiar you are with the requirements, tables, and figures, the better your chances of succeeding on the exam. Your success will be directly related to how quickly you know an answer within the Ohio codes and NFPA standards.



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## Preparing for the Exam

As you are taking each practice quiz and during the actual exam as well, read each test question carefully. Sift through what is pertinent to the question and what is irrelevant information that may be included as a distractor.

Fire Tech provides a practice quiz for each training module, which should be taken following completion of the module. As you take these practice quizzes, use your copy of the referenced Ohio codes and NFPA standards to look up every answer to each question. This will assist you in becoming more familiar with the requirements and where they are located in each of these codes and standards.

You will achieve the highest chances of success by learning and understanding the training material. Fire Tech does not recommend that you solely attempt to memorize practice quiz questions. These questions are examples only and do not reflect actual test questions.

*Remember, this is a closed-book exam, and no references may be brought into the exam area.*



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## Fire Tech Productions

# On to the Next Lesson!

**(Select "Next" to proceed)**





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# Fire Tech Productions

*…training that makes a difference*

## Pre-engineered Extinguishing Equipment Other Than Water

## Administrative Requirements

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## Outline

- Introduction
- Wet Chemical Systems
- Dry Chemical Systems
- Clean Agent Systems

**Key References**

- ✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017
- ✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017
- ✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015




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## Introduction

**Chapter 1 – Administration**

Before we discuss specific NFPA requirements related to pre-engineered system components and installation, inspection, testing, maintenance, and recharge of these systems, let's learn a little more about what these systems protect, and the NFPA administrative requirements associated with each type of pre-engineered system, found in Chapter 1 of NFPA 17A, NFPA 17, and NFPA 2001.





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## Wet Chemical Systems

**Wet Chemical Systems**

Pre-engineered wet chemical fire suppression systems protect commercial kitchen appliances, exhaust hoods, ductwork, and plenum chambers. These systems use water-based solutions mixed with additives such as potassium acetate, carbonate, or citrate to produce a soapy blanket that smothers or cools the fire. The chemical agents are typically harmless to humans but can be corrosive to system equipment.

When a fire starts, an automatic detection network detects the fire and releases the chemical agent throughout the hood and on the appliances. Alternatively, a manual pull station can be used to release the chemical over the fire. Any gas and/or electric cooking power will be shut down to the appliances when the system discharges. Maintenance on kitchen fire suppression systems is required at least semiannually in accordance with Fire Code and NFPA 17A requirements as well as the manufacturer's design, installation, and maintenance manual.




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## Wet Chemical Systems

**(NFPA 17A 2017, Sections 1.1 and 1.2)**

**Scope and Purpose**

NFPA 17A provides design considerations for wet chemical systems that discharge wet chemical from fixed nozzles and piping. Because each manufacturer of these systems will have different designs and design parameters, it is important to rely on the system design details found in the manufacturer's design, installation, and maintenance manuals.

NFPA 17A contains the requirements and recommendations to be used by those qualified in this area of fire protection, ensuring these wet chemical systems function as intended throughout the life of the system.




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## Wet Chemical Systems

**(NFPA 17A 2017, Section 1.7)**

**Qualifications**

It is important to note that only trained individuals are permitted to design, layout, install, and service wet chemical systems.

The Annex explains this training should be obtained through the manufacturer of the equipment being installed or serviced, or as an alternative, be completed by a manufacturer's representative.




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## Dry Chemical Systems

**Dry Chemical Systems**

Dry chemical fire suppression systems protect equipment and processes in industrial applications such as chemical storage, auto paint booths, dip tanks, and mixing rooms. The chemical agents use small solid particles that are either sodium carbonate based, potassium based, or multipurpose based that rely on pressurized gas for distribution. Typically, these agents are nontoxic to humans, but once released, they can create a cloud that limits visibility and poses respiratory problems. Similar to wet chemical systems, the agents can corrode dry system equipment.

When a dry chemical system activates, either electrically or manually, the valve on the pressurized tank opens, and the dry powder is released into a piping system and out the nozzles of the fire suppression system, quickly smothering and extinguishing the fire. These systems are non-conductive and are effective for fire suppression on flammable liquid fires that involve live electrical equipment. A drawback to these systems is the clean-up needed after the system discharges.




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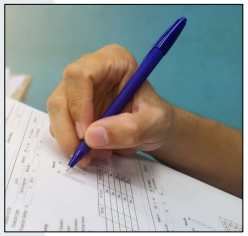
## Dry Chemical Systems

**(NFPA 17 2017, Sections 1.1 and 1.2)**

NFPA 17 provides requirements for dry chemical fire-extinguishing systems that use an expellant gas to discharge dry chemical from fixed nozzles and piping or hose lines.

Similar to NFPA 17A, each manufacturer of these systems will have different designs and design parameters. As a result, it is important to rely on the system design details found in the manufacturer's design, installation, and maintenance manuals.

NFPA 17 contains the requirements and recommendations to be used by those qualified in this area of fire protection, ensuring these dry chemical systems function as intended throughout the life of the system.





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## Dry Chemical Systems

**(NFPA 17 2017, Section 1.6)**

**Qualifications**

As with wet chemical systems, only trained individuals are permitted to design, install, and service dry chemical systems.

The Annex explains this training should be obtained through the manufacturer of the equipment being installed or serviced, or as an alternative, be completed by a manufacturer's representative.



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## Clean Agent Systems

**Clean Agent Systems**

Clean agent fire suppression systems are electrically nonconducting, discharging an inert gas or chemical, to rapidly suppress a fire in its incipient (beginning) stage. For an agent to qualify as a "clean agent", it must be nontoxic to humans, have no known effect on the ozone layer, and have no effect on human survival within an enclosure protected by the agent.

There are two categories of clean agent: halocarbon agents and inert gas clean agents. Halocarbons are stored as a liquid and distributed to the hazard as a gas. This agent extinguishes a fire by chemical and physical means of breaking the chain of combustion, rather than relying on oxygen deprivation. Inert gas clean agents contain one or more non-reactive gases, such as helium, neon, or argon that lower the oxygen concentration in a room from 21% (normal level) to 12-13% (less than what is needed to sustain combustion).



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## Clean Agent Systems

**Clean Agent Systems (continued)**

Three common clean agents are Novec 1230, FM-200, and Inergen.

Clean agents are typically used to protect areas such as computer rooms, telecommunications facilities, subfloors and concealed spaces, and laboratory and medical equipment. Clean agents do not leave a residue behind, eliminating the need for clean-up after discharge.



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## Clean Agent Systems

**(NFPA 2001 2015, Sections 1.2.1 – 1.4.1)**

**Purpose and General Information**

NFPA 2001 contains the requirements and recommendations to be used by anyone purchasing, designing, installing, testing, inspecting, approving, listing, operating, and maintaining clean agent systems.

The design, installation, service, and maintenance of these systems shall be performed only by those qualified and trained in this area of fire protection, ensuring these clean agent systems function as intended throughout the life of the system.



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## Clean Agent Systems

**(NFPA 2001 2015, Section 1.4.2)**

**Use and Limitations**

Pre-engineered systems are required to be listed to one of the following:

1. Systems consisting of components designed to be installed using pre-tested limitations from a testing laboratory. These systems are permitted to use special nozzles, flow rates, methods of application, nozzle placement, and pressurization levels that may deviate from the associated requirements in NFPA 2001. However, all other requirements found in NFPA 2001 apply.
2. Automatic extinguishing units using special nozzles, flow rates, methods of application, nozzle placement, actuation techniques, piping materials, discharge times, mounting techniques, and pressurization levels that may deviate from the associated requirements in NFPA 2001.



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## Clean Agent Systems

**(NFPA 2001 2015, Section 1.4.2)**

**Use and Limitations (continued)**

Clean agents are not permitted to suppress the following types of fires, without AHJ approval:

- Certain chemicals or mixtures of chemicals, such as cellulose nitrate and gunpowder,
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium
- Metal hydrides
- Chemicals capable of autothermal decomposition, such as certain organic peroxides and hydrazine



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## Clean Agent Systems

**(NFPA 2001 2015, Section 1.5)**

**Safety**

Discharge of clean agents to extinguish a fire should also consider potential hazards to humans, including:

- Noise
- Turbulence
- Cold temperature

Avoid unnecessary exposure to both halocarbon clean agents and inert gas clean agents. For both these agents, limit exposure to no more than 5 minutes. Unprotected personnel are not permitted to enter a protected space during or after agent discharge. In some instances, a pre-discharge alarm and time delay may be required.




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## Clean Agent Systems

**(NFPA 2001 2015, Section 1.5)**

**Safety (continued)**

Provide safeguards in areas where atmospheres will become hazardous due to clean agent discharge. Assure rapid evacuation of an area, prevent entry or re-entry into the area, and allow prompt rescue of any trapped personnel. Consider adopting the following safety measures:

- Personnel training
- Warning signs
- Discharge alarms
- Self-containing breathing apparatus (SCBA)
- Evacuation plans
- Fire drills




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## Fire Tech Productions

# On to the Quiz!

**(Select "Next" to proceed)**



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# Fire Tech Productions

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## Pre-engineered Extinguishing Equipment Other Than Water

## Terms and Definitions

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## Outline

- Introduction
- Official NFPA Definitions
- Other Common NFPA Definitions

**Key References**

- ✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017
- ✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017
- ✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015



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## Introduction

**Chapter 3 – Definitions**

Now that we've learned a little about what wet, dry, and clean agent systems protect, as well as the NFPA administrative requirements associated with these systems, we need to explore some important definitions as defined by NFPA.

It's important to know what these terms means in the context of each of the standards. Some definitions are found in all three standards, while others are specific to that standard alone.



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## Official NFPA Definitions

**(NFPA 17A 2017, NFPA 17 2017, and NFPA 2001 2015, Section 3.2)**

**Approved:** *Acceptable to the Authority Having Jurisdiction*

**Authority Having Jurisdiction (AHJ):** *An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.*

**Shall:** *Indicates a mandatory requirement.*

**Should:** *Indicates a recommendation or that which is advised but not required.*



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## Official NFPA Definitions

**(NFPA 17A 2017, NFPA 17 2017, and NFPA 2001 2015, Section 3.2)**

**Labeled:** *Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.*

**Listed:** *Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing state that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.*


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## Other Common NFPA Definitions

**(NFPA 17A 2017 and NFPA 17 2017, Section 3.3)**

**Wet and Dry Chemical Systems**

**Inspection:** *A visual examination of a system or portion thereof to verify that it appears to be in operating condition and is free of physical damage.*

The Annex explains that this task verifies the system is in place and intact, has not been activated, and shows no clear signs of physical damage or other conditions that could prevent operation.

**Indicator:** *A mechanical or electrical device that shows when an extinguishing system or critical component of it is ready to operate or if it has already operated.*

**Maintenance:** *Work, including, but not limited to, repair, replacement, and service, performed to ensure that equipment operates properly.*

**Servicing:** *Performing maintenance, recharging, or hydrostatic testing.*

**Recharge:** *The replacement of the extinguishing agent and expellant gas.*


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## Other Common NFPA Definitions

**(NFPA 17A 2017 and NFPA 17 2017, Section 3.3)**

**Wet and Dry Chemical Systems**

**Trained:** *A person who has undergone the instruction necessary to safely design, install, and reliably perform the maintenance and recharge service in accordance with the manufacturer's design, installation, and maintenance manual.*

**Manufacturer's Design, Installation, and Maintenance Manual:** *The document referenced for design, installation, and maintenance of the listed wet (or dry) chemical extinguishing system equipment.*

The Annex explains that this manual provides information on the hazards that can be protected and the limitations of the pre-engineered system. It will require the system be designed, installed, inspected, maintained, and serviced per the appropriate NFPA standard (NFPA 17 or NFPA 17A).

**Owner's Manual:** *A pamphlet containing the manufacturer's recommendations for inspection and operation of the extinguishing system.*



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## Other Common NFPA Definitions

**(NFPA 17A 2017 and NFPA 17 2017, Section 3.3)**

**Wet and Dry Chemical Systems**

**Automatic Operation:** *Operation without human intervention.*

**Manual Operation:** *Operation of a system or its components through human interaction.*

**Pre-engineered systems:** *Those systems having predetermined flow rates, nozzle pressures, and quantities of extinguishing agent and having specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles.*

**Discharge nozzles:** *Device from which the extinguishing agent is discharged to provide for suppression of a fire in the designated area.*

**Expellant Gas:** *The medium used to discharge extinguishing agent from its container.*



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## Other Common NFPA Definitions

**(NFPA 17A 2017, Section 3.3)**

**Wet Chemical Systems**

**Wet Chemical:** *Normally an aqueous solution of organic or inorganic salts or a combination thereof that forms an extinguishing agent.*

**(NFPA 17 2017, Section 3.3)**

**Dry Chemical Systems**

**Dry Chemical:** *A powder composed of very small particles, usually sodium bicarbonate-, potassium bicarbonate-, or ammonium phosphate-based, with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities.*

**Multipurpose Dry Chemical:** *Ammonium phosphate-based extinguishing agent that is effective on fires involving ordinary combustibles, such as wood or paper, and fire involving flammable liquids.*



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## Other Common NFPA Definitions

**(NFPA 17 2017, Section 3.3)**

**Dry Chemical Systems (continued)**

**Caking:** *A phenomenon that occurs when moisture chemically reacts with a dry chemical fire-extinguishing agent. This reaction results in materials that, being hydrated by moisture, stick together to form a large agglomerate, or what is more commonly referred to as lumps.*

**Lumps:** *Agglomerations of dry chemical that do not crumble into particles when dropped from a height of 4 in. onto a hard surface.*

**Calculation and Design:** *The process of computing, with the use of equations, graphs, or tables, the system characteristics such as flow rate, pipe size, area, or volume protected by each nozzle, nozzle pressure, and pressure drop.*

The Annex explains this information is not required for listed pre-engineered systems because these systems must be installed per their pretested limitations as shown in the manufacturer's design, installation, and maintenance manual.



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## Other Common NFPA Definitions

**(NFPA 17 2017, Section 3.3)**

**Dry Chemical Systems (continued)**

**Clearance:** *The air distance between extinguishing system equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components not at ground potential.*

**Hand Hose Line System:** *A hose and nozzle assembly connected by fixed piping or connected directly to a supply of extinguishing agent.*

**Local Application System:** *A supply of dry chemical permanently connected to fixed piping with nozzles arranged to discharge directly onto the fire.*

**Total Flooding System:** *A supply of dry chemical permanently connected to fixed piping and nozzles that are arranged to discharge dry chemical into an enclosure surrounding the hazard.*




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## Other Common NFPA Definitions

**(NFPA 2001 2015, Section 3.3)**

**Clean Agent Systems**

**Clean Agent:** *Electrically nonconducting, volatile, or gaseous fire extinguishment that does not leave a residue upon evaporation. The word "agent" as used in this document means clean agent unless otherwise indicated.*

**Clearance:** *The air distance between extinguishing system equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components not at ground potential.*

**Halocarbon Agent:** *An agent that contains as primary components one or more organic compounds containing one or more of the elements fluorine, chlorine, bromine, or iodine.*

**Inert Gas Agent:** *An agent that contains as primary components one or more of the gases helium, neon, argon, or nitrogen. Inert gas agents that are blends of gases can also contain carbon dioxide as a secondary component.*




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## Other Common NFPA Definitions

**(NFPA 2001 2015, Section 3.3)**

**Clean Agent Systems (continued)**

**Class A Fire:** *A fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.*


**Class B Fire:** *A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.*


**Class C Fire:** *A fire that involves energized electrical equipment.*





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## Other Common NFPA Definitions

**(NFPA 2001 2015, Section 3.3)**

**Clean Agent Systems (continued)**

**Adjusted Minimum Design Concentration (AMDC):** *The target minimum design concentration after the safety factor and the design factors have been taken into account.*

**Final Design Concentration (FDC):** *The actual concentration of agent discharged into the enclosure.*

**Pre-Engineered System:** *A system having pre-determined flow rates, nozzle pressures, and quantities of agent. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The hazards protected by these systems are specifically limited as to type and size by a testing laboratory based upon actual fire tests. Limitations on hazards that can be protected by these systems are contained in the manufacturer's installation manual, which is referenced as part of the listing.*




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## Fire Tech Productions

# On to the Quiz!

**(Select "Next" to proceed)**




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# Fire Tech Productions

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## Pre-engineered Extinguishing Equipment Other Than Water

## Wet Chemical Components and System Requirements

58

## Outline

- Introduction
- Wet Chemical System Components
- Wet Chemical System Requirements

**Key References**

✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017



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## Introduction

**(NFPA 17A 2017, Chapters 4 and 5)**

In this lesson, we will discuss requirements for wet chemical system components, including discharge nozzles, manual actuators, and shutoff devices, as defined in NFPA 17A 2017 Chapter 4.

Additionally, we will look at system requirements, including system installation, actuation, location, and initiation, as defined in NFPA 17A 2017, Chapter 5.




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## Wet Chemical System Components

**(NFPA 17A 2017, Sections 4.1 and 4.3)**

In general, only system components permitted by the manufacturer are permitted for each specific wet chemical system. Used components are not permitted in new systems without AHJ approval.

**Discharge Nozzles**

Discharge nozzles are required to have either an internal strainer or a separate listed strainer placed immediately upstream of the nozzle. These nozzles are required to be protected from corrosion, both internally and externally, using brass, stainless steel, or other corrosion-resistant material, and are to be constructed from noncombustible material. Additionally, the nozzles are expected to be able to withstand fire exposure without damage.

Discharge nozzles are required to have a permanent marking for identification purposes. Stamping part numbers on the nozzle body is acceptable.

Protective covers are required for the nozzles, to stop grease vapors, moisture, environmental contaminants or other foreign objects from entering the nozzle. When the agent discharges, these covers are to blow off, blow open, or blow out.


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## Wet Chemical System Components

**(NFPA 17A 2017, Section 4.4)**

**Operating Devices**

Operating devices are required to function in an environment ranging from 32°F - 120°F. They are not permitted to be rendered inoperative or be prone to inadvertent operation.

Manual actuator operations include:

- Initial force to operate shall be no more than 40 lb.
- Maximum movement to initiate operation shall be no more than 14 in.
- Operating instructions are required. Pictographs are permitted to be included, with lettering at least ¼ in. in height.
- The hazards protected are required to be identified.



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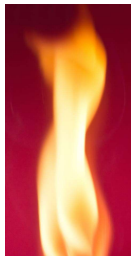
## Wet Chemical System Components

**(NFPA 17A 2017, Section 4.4)**

**Operating Devices (continued)**

A placard located near each Class K extinguisher is required to state, "*the fire protection system shall be activated prior to using the fire extinguisher*."



Anytime a cooking equipment fire extinguishing system activates due to a fire event, fire re-ignition is a concern. As a result, all sources of fuel and electric power producing heat to all protected equipment are required to shut down. This includes gas appliances not requiring protection that are located under the same ventilation equipment. Steam supplied from an external source and solid fuel cooking operations are not required to be shut down.

All shutoff devices are to be manually reset before fuel or power is restored.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## Wet Chemical System Components

**(NFPA 17A 2017, Section 4.5)**

**Pipe and Fittings, Tubing, and Hose**

All pipe and associated fittings are required to be composed of noncombustible material that is compatible with the wet chemical solution. Galvanized pipe and fittings are not permitted.

**(NFPA 17A 2017, Section 4.6)**

**Wet Chemical**

*Do not mix different wet chemical solutions.*


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## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.1)**
**General Use and Application**

When protecting cooking operations, wet chemical systems are required to meet or exceed ANSI/UL 300 requirements. Hazards and equipment that can be protected include the following:

- Restaurant, commercial, and institutional hoods
- Plenums, ducts, and filters with their associated cooking appliances
- Special grease removal devices
- Odor control devices
- Energy recovery devices installed in the exhaust system


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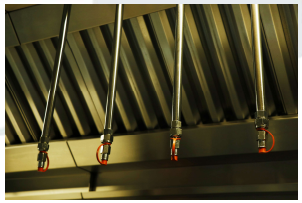
## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.1)**
**General Use and Application (continued)**

Know the system limitations and applications of the installed wet chemical system. Consult NFPA 96 and the manufacturer's design, installation, and maintenance manual for further information. Each protected cooking appliance, individual hood, and branch exhaust duct directly connected to the hood is required to be protected by one or more systems.

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## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.2)**
**System Actuation**

Both automatic and manual actuation is required, designed to be separate and independent of each other. If operation of one method fails, operation of the other method cannot be impacted. At least one manual actuator is required for each system.

Protect all operating devices from mechanical, environmental, or other conditions that can result in accidental system activation or cause them to become inoperative.

Either an audible or a visual indicator is required to show the following:

- The system has operated
- Personnel response is necessary
- System recharge is needed


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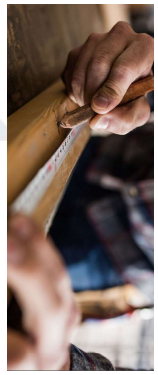
## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.2)**
**System Actuation (continued)**

Manual actuation devices are required to be mechanical and not rely on electric power for activation. Installation requirements include:

- At least one device installed in a means of egress or location approved by the AHJ
- Devices installed 42 – 48 in. above floor level
- Devices are clearly marked to identify the protected hazard and provide operating instructions

Automatic systems solely protecting common exhaust ducts are not required to have a manual actuator.

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## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.3)**
**Supervision**

If electrical power is needed to operate the fixed automatic wet chemical system, it is required to be monitored by a supervisory alarm with a reserve power supply. Trouble indications shall include:

- Automatic detection system
- Electrical actuation circuit
- Electrical power supply

Signals indicating failure of supervised devices or equipment are to be distinctly different from operating or hazardous conditions signals, providing a prompt and positive indication of these failures.

If the system is interconnected or interlocked with the cooking equipment power sources causing the system to become inoperable due to power failure, all sources of fuel and heat to all cooking appliances serviced by that hood are required to automatically shut off. In this case, electrical power monitoring is not required.




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## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.6)**
**Special Requirements**

Wet chemical systems initiate operation one of three ways:

- Heat detectors
- Fusible links
- Manual operation

At least one fusible link or heat detector is required within each exhaust duct opening, and above each protected appliance. There is an exception for appliances using a downdraft ventilation system, which are required to have either a fusible link or heat detector for each protected cooking appliance located in the plenum area. Fusible links or detectors located at or within 12 in. into the exhaust duct opening and above the protected appliance also fulfil this requirement.




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## Wet Chemical System Requirements

**(NFPA 17A 2017, Section 5.6)**
**Special Requirements (continued)**

The maximum distance between detection devices is 36 in. unless otherwise allowed by the manufacturer. One detection device is permitted to cover more than one appliance, when installed per the system's listing.

If pipe or other conduit penetrates a duct or hood, the penetration is required to be sealed by a listed device or have a liquid tight continuous external weld.




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## Summary

As you proceed further through this course, be aware of the many similarities between wet chemical system and dry chemical system requirements for components and the actual systems.

Be able to identify what wet chemical systems are permitted to protect, as well as system limitations and applications of the wet chemical system once installed.

Understand the requirements for manual actuators, including installation and operations, and how wet chemical systems initiate operation.




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## Fire Tech Productions

**On to the Quiz!**

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# Fire Tech Productions

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Pre-engineered Extinguishing Equipment Other Than Water

Wet Chemical System Plans and Acceptance Tests

74

## Outline

- Introduction
- Plans
- Approval of Installations

**Key References**

✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017



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## Introduction

We will now discuss requirements for wet chemical system plans and approval of the installation once it is completed, including:

- Who is permitted to prepare plans
- What details are required in these plans
- Once installed, what needs to be verified for the installation to be approved
- What tests are permitted or not permitted
- Steps to take following test completion



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## Plans

**(NFPA 17A 2017, Section 6.3)**

Only trained personnel are permitted to prepare plans for wet chemical systems. These plans are to provide adequate detail for the AHJ to properly evaluate the protection of the hazard. Plan details are to include the following:

- Size, length, and arrangement of connected piping
- Description and location of nozzles

Information on the location and function of the following is also required:

- Detection devices
- Operating devices
- Auxiliary equipment
- Electrical circuitry



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## Approval of Installations

**(NFPA 17A 2017, Section 6.4)**

The following are required to be verified:

- Appliances, hoods, and ducts are properly protected with nozzles and positioned per the manufacturer's design
- Pipe sizes and nozzles meet the manufacturer's design
- Piping supports are securely fastened
- Installed appliances are the same and in the same locations as the approved system design
- All devices are labeled with the proper designations and instructions
- All manual pull stations are easily accessible and properly identified



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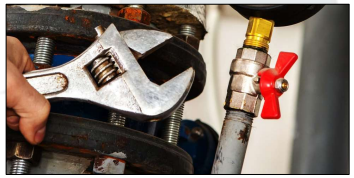
## Approval of Installations

**(NFPA 17A 2017, Section 6.4) (continued)**

A nitrogen or air test is required to be conducted on the piping network to verify the nitrogen or air has discharged out of each nozzle in the system. This test is to be performed at or below normal system operating pressure. Prior to conducting the test, check the tightness of all piping.

Hydrostatic testing on wet chemical system piping is not permitted.

If the system is connected to a building fire alarm system, confirm all alarm-sounding or notification devices and remote annunciation devices are operating as intended.





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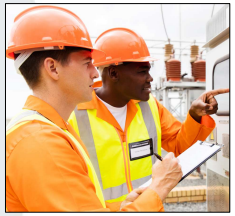
## Approval of Installations

**(NFPA 17A 2017, Section 6.4) (continued)**

Conduct system operational tests following the manufacturer's requirements, including the following functional tests:

- Automatic detection system
- Manual release devices
- Gas shutoff
- Shutoff of makeup air supplied internally to a hood
- Electrical power shutdown



If a releasing panel is installed, confirm it is:

- Properly labeled
- Connected to a dedicated circuit
- Readily accessible
- Restricted from unauthorized personnel



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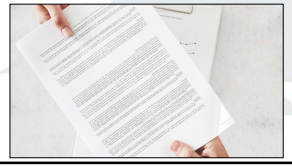
## Approval of Installations

**(NFPA 17A 2017, Section 6.4) (continued)**

Upon test completion, verify each extinguishing agent storage container is reconnected and that the system has been returned to its fully operational condition. Notify the alarm-receiving office and all impacted personnel at the end user's facility that testing is complete, and the system has been restored to full-service.

The installing contractor is required to complete and sign an acceptance test report. The owner is to be given a copy of either the manufacturer's design, installation, and maintenance manual or the owner's manual.

Figure A.6.4.10.3 provides a sample wet chemical system acceptance test report.





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## Fire Tech Productions

# On to the Quiz!

**(Select "Next" to proceed)**



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## Pre-engineered Extinguishing Equipment Other Than Water

## Wet Chemical System Inspection, Maintenance, and Recharging

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## Outline

- Introduction
- Owner's Inspection
- Maintenance
- Recharging
- Hydrostatic Testing
- Service Collars

**Key References**

✓ **NFPA 17A** – Standard for Wet Chemical Extinguishing Systems, 2017



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## Introduction

**(NFPA 17A 2017, Section 7.1)**

In general, the owner of the system is responsible for all inspection, testing, maintenance (ITM), and recharging of the wet chemical fire protection system, unless this duty has been transferred, in writing, to a management company, tenant, or other party.

This lesson will explore inspection frequencies, record retention, servicing and maintaining wet chemical systems, recharging, and hydrostatic testing requirements.



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## Owner's Inspection

**(NFPA 17A 2017, Section 7.2)**

Inspections are required monthly, in accordance with the owner's manual, verifying at least the following:

- The extinguishing system remains in its proper location.
- The manual actuators are unobstructed.
- The tamper indicators and seals are intact.
- The maintenance tag or certificate is in place.
- No obvious physical damage exists that might prevent operation.
- The pressure gauges are in the operable range.
- Nozzle blowoff caps are intact and undamaged.
- The hazard has not changed, including replacement, modification, and relocation of protected equipment.



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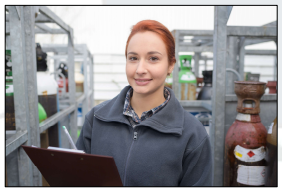
## Owner's Inspection

**(NFPA 17A 2017, Section 7.2)**

Any deficiencies noted during the inspection are required to be corrected immediately. If corrective actions involve maintenance, it is to be performed by a trained and certified service technician who has passed a written or online test approved by the AHJ.

Record the date of the inspection and the initials of the individual performing the inspection. These records are to be retained for the period between the semiannual maintenance inspections.





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## Maintenance

**(NFPA 17A 2017, Section 7.3)**

All maintenance activities are to be performed by a trained and certified service technician who has passed a written or online test approved by the AHJ. This qualified individual is required to service the wet chemical systems at least semiannually and after any system activation. This maintenance shall include:

- Confirmation that the hazard has not changed.
- Examination of all detectors, expellant gas containers, agent containers, releasing devices, piping, hose assemblies, nozzles, signals, auxiliary equipment, and the liquid level of all nonpressurized wet chemical containers.
- Confirmation that the agent distribution piping is unobstructed.



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## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

If the wet chemical containers show signs of excessive corrosion or pitting, structural or fire damage, or repairs by soldering, welding, or brazing, the containers are required to be hydrostatically tested or replaced. If excessive corrosion or pitting, structural damage, or fire damage are found as part of routine maintenance for wet chemical system components, those parts are required to be replaced. System tests shall include operating the detection system signals and releasing device, including manual stations and other equipment.

Any failed or impaired parts are to be replaced, and the system tagged as impaired. Notify the owner and the AHJ (if required) of the impairment. Once the repairs are made and the system restored to normal operations, notify the owner and AHJ that the system is fully operational.



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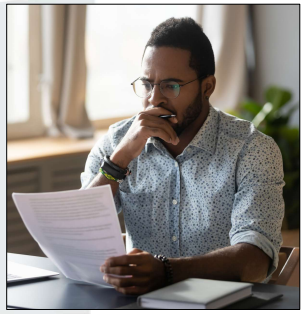
## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

File a maintenance report with the owner. The owner is responsible for keeping all maintenance reports for one year after the next maintenance of that same type.

Each wet chemical system is required to have a tag or label firmly attached to the system, identifying the individual performing the work and the date this work was performed (month and year). Only the current tag or label needs to be attached. Previous tags can be removed.





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## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

Replace fixed temperature-sensing elements (fusible metal alloy-type or glass bulb-type) at least semiannually from the date of installation, or more frequently if needed. Once removed, destroy these elements. Replacement elements are required to have the same temperature ratings as those being replaced.

The Annex provides the reminder to take temperature readings at each installation to confirm the replacement devices are appropriate and there is no need to change elements. Since these elements are designed to operate at predetermined temperatures, incorrect replacement devices could cause unwanted discharge or a delayed activation response.

See Table A.7.3.4.1 for temperature ratings, shown on the following slide.



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## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

**NFPA 17A 2017, Table A.7.3.4.1**
**Typical Temperature Ratings of**
**Fixed Temperature-Sensing Elements**

| Temperature Classification | Maximum Ambient Temperature (°F) | Temperature Rating (°F) |
|---|---|---|
| Low* | 90 | 125-130 |
| Ordinary | 100 | 135-170 |
| Intermediate | 150 | 175-225 |
| High | 225 | 250-300 |
| Extra High | 300 | 325-375 |
| Very Extra High | 375 | 400-475 |
| Ultra High | 475 | 500-575 |



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## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

Both the year of manufacture and the date of installation of these elements are required to be shown on the system inspection tag. This tag is to be signed or initialed by the installer.

Fixed temperature-sensing elements that are not a fusible metal type are permitted to remain in service if they are inspected and cleaned or replaced every 12 months, or more frequently if required for proper system operation.




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## Maintenance

**(NFPA 17A 2017, Section 7.3) (continued)**

Maintenance of restorable-type heat detectors shall include:

- A visual inspection to determine if the detector is damaged or there is debris buildup
- An operational/functional test following the detector manufacturer's test procedures
- A calibration verification test following the detector manufacturer's test procedures

Nonrestorable heat detectors are required to be functionally tested per the manufacturer's procedures.

Confirm there is the proper amount or pressure of expellant gas to operate the system. Instructions and methodology are to be provided for this process.




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## Recharging

**(NFPA 17A 2017, Section 7.4)**

The following procedures are to be followed after any system discharge or if an insufficient charge is found during inspection or maintenance:

- Recharge the system.
- Place the system in the normal operating condition.
- After discharge, flush the piping and blow it out with dry air or nitrogen, following the manufacturer's instructions.

Always follow the manufacturer's instructions when recharging a system.




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## Recharging

**(NFPA 17A 2017, Section 7.4) (continued)**

Store wet chemical recharging supplies in their original closed shipping container.

Keep the containers closed until the system needs to be recharged and locate them in an area within the temperature range provided by the manufacturer. Storing the wet chemical solution in different containers can cause agent contamination or result in agent deterioration.





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## Hydrostatic Testing

**(NFPA 17A 2017, Section 7.5)**

A hydrostatic pressure test is required at least every 12 years for the following:

- Wet chemical containers
- Auxiliary pressure containers
- Hose assemblies

There are two exceptions:

- If the auxiliary pressure containers do not exceed 2 in. in the outside diameter and are less than 2 ft. in length
- If the auxiliary pressure containers bear the DOT "3E" marking



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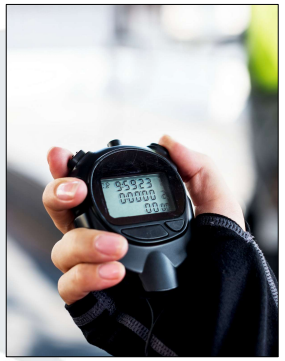
## Hydrostatic Testing

**(NFPA 17A 2017, Section 7.5) (continued)**

Hose couplings are not permitted to leak, rupture, or move during the test.

During the hydrostatic test of the cylinder, maintain the pressure for at least 30 seconds. Allow time for the cylinder to completely expand, and time to complete the visual inspection.

Discard all wet chemical agent removed from the containers before conducting the hydrostatic test.





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## Service Collars

**(NFPA 17A 2017, Section 7.6)**

Verification-of-service collars are required to be placed around the neck of each system container that undergoes maintenance, showing the following:

- Month and year of service, indicated by a perforation (hand punch)
- Name of agency completing the maintenance or recharge

There is an exception for cartridge- or cylinder-operated wet chemical system containers.

The collar is required to consist of a single circular piece of uninterrupted material that forms a hole sized so the collar assembly cannot move over the neck of the container unless the valve is completely removed. Additionally, the collar cannot interfere with the system discharge valve.



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# On to the Quiz!

**(Select "Next" to proceed)**



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## Pre-engineered Extinguishing Equipment Other Than Water

## Dry Chemical Components and System Requirements

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## Outline

- Introduction
- Dry Chemical System Components
- Dry Chemical System Requirements

**Key References**

✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017



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## Introduction

**(NFPA 17 2017, Chapters 4 and 5)**

In this lesson, we will discuss requirements for dry chemical system components, including discharge nozzles, actuators, and shutoff devices, as defined in NFPA 17 2017, Chapter 4.

We will also look at additional system requirements, including types of protected hazards, dry chemical distribution, and safety considerations, as defined in NFPA 17A 2017, Chapter 5.




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## Dry Chemical System Components

**(NFPA 17 2017, Sections 4.1 and 4.2)**

**Detectors and Hand Hose Line and Nozzle Assembly**

**Detectors** – Automatic detectors are required to be listed devices capable of detecting and indicating heat, flame, smoke, combustible vapors, or an abnormal condition that can likely produce fire.

**Hand Hose Line and Nozzle Assembly** – Hose lines on systems are to be coupled to the dry chemical supply and are required to use hose listed for this purpose. Identifying markings on the hose should indicate the acceptability of the hose for this purpose.

Hose nozzles are required to have a shutoff device to control the dry chemical flow.

If a hose line is stored outdoors, it is required to be protected against the weather.



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## Dry Chemical System Components

**(NFPA 17 2017, Section 4.3)**

**Nozzles**

Discharge nozzles are required to be constructed from noncombustible materials, and be made of brass, stainless steel, or other corrosion-resistant material. They are to be protected against both internal and external corrosion, and permanently marked for identification purposes.

Blowoff caps are required on the nozzles, to prevent foreign material, environmental contaminants, or moisture from entering the piping. These caps (or other suitable devices) are to blow off, blow open, or blow out when the agent discharges.



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## Dry Chemical System Components

**(NFPA 17 2017, Section 4.4)**

**Operating Devices**

Similar to wet chemical systems, operating devices for dry chemical systems are required to function in an environment ranging from 32ºF - 120ºF. They are not permitted to be made inoperative or be prone to inadvertent operation.

Manual actuator operations include:

- Initial force to operate shall be no more than 40 lb.
- Maximum movement to initiate operation shall be no more than 14 in.
- Operating instructions are required. Pictographs are permitted to be included, with lettering at least ¼ in. in height.
- Remote manual actuators are required to identify the hazards protected.

Shutoff devices are required to be manually reset prior to restoring fuel or power.

Selector valves are required to be quick-opening and allow the dry chemical to freely pass through.



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## Dry Chemical System Components

**(NFPA 17 2017, Section 4.5)**

**Pipe and Fittings**

All pipe and associated fittings are required to be composed of noncombustible material that is compatible with the dry chemical solution. Pipe and fittings are permitted to be galvanized steel, stainless steel, copper, or brass. Black steel pipe and fittings are permitted in noncorrosive environments. In extremely corrosive environments, special coatings or corrosion-resistant materials are required.

The following are not permitted:

- Cast iron pipe and fittings
- Steel pipe meeting ASTM A53/A53M
- Aluminum pipe
- Nonmetallic pipe



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## Dry Chemical System Components

**(NFPA 17 2017, Section 4.5)**

**Pipe and Fittings (continued)**

Install all piping following good commercial practice. Securely support the piping system, allowing for agent thrust forces, as well as thermal expansion and contraction. Do not subject piping to mechanical, chemical, vibration, or other damage. Where explosions are likely, attach the piping to supports that are least likely to be displaced.

All pipe, tubing, and fitting materials for pre-engineered systems are to follow the manufacturer's design, installation, and maintenance manual.



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## Dry Chemical System Components

**(NFPA 17 2017, Section 4.6)**

**Dry Chemical**

The type of dry chemical used in the system cannot be changed unless proven to be changeable by a testing laboratory, recommended by the manufacturer of the equipment, and approved by the Authority Having Jurisdiction (AHJ).

*Do not mix different dry chemical solutions.*

Section A.4.6.1 provides a list of different types of dry chemical:

- Sodium bicarbonate-based dry chemical
- Dry chemicals based on the salts of potassium
- Multipurpose dry chemical
- Foam-compatible dry chemical



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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.1)**

**Use and Limitations**

The types of hazards and equipment that can be protected using dry chemical extinguishing systems include the following:

- Flammable or combustible liquids
- Flammable or combustible gases
- Combustible solids including plastics, which melt when involved in fire
- Electrical hazards such as oil-filled transformers or circuit breakers
- Textile operations subject to flash surface fires
- Ordinary combustibles such as wood, paper, or cloth
- Restaurant and commercial hoods, ducts, and associated cooking appliance hazards such as deep-fat fryers


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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.1)**

**Use and Limitations (continued)**

Dry chemical extinguishing systems shall not be considered satisfactory protection for the following:

- Chemicals containing their own oxygen supply, such as cellulose nitrate
- Combustible metals such as sodium, potassium, magnesium, titanium, and zirconium
- Deep-seated or burrowing fires in ordinary combustibles where the dry chemical cannot reach the point of combustion

Multipurpose dry chemical is not permitted to protect machinery such as carding equipment in textile operations and delicate electrical equipment.


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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.4)**

**Dry Chemical Requirements and Distribution**

Consider the following when determining the amount of dry chemical required:

- Minimum quantity of dry chemical
- Minimum flow rate of dry chemical
- Nozzle placement limitations including spacing, distribution, and obstructions
- High ventilation rates, if applicable
- Prevailing wind conditions, if applicable

In pre-engineered systems, the above factors are established for specific volume and conditions shown in the manufacturer's listed installation and maintenance manual.


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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.5)**
**Special Considerations**

If protected hazards are heated, the power/fuel supply to heaters is required to be shut off automatically when actuating the extinguishing systems. The Annex provides examples of these hazards: wax tanks, deep-fat fryers, charbroilers, upright broilers, griddles, and ranges.

For protected hazards with flowing flammable or combustible fluids or gases, the systems are required to be provided with automatic means to ensure shutoff of power and fuel valves when operating the extinguishing systems.

If protected hazards have conveyers moving flammable or combustible materials or commodities, the conveyors shall be automatically shut off upon operation of the extinguishing systems.




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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.5)**
**Special Considerations (continued)**

All shutoff systems shall:

- Be fail-safe
- Require manual resetting before restoring the system back to normal operating conditions (prior to the extinguishing system activating)
- Function with the system operation

Expellant gas that is used to pneumatically operate shutoff devices shall be taken prior to its entry into the dry chemical tank.




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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.6)**
**Safety**

Safety items to be considered shall include, but not be limited to, the following:

- Personnel training
- Warning signs
- Pre-discharge alarms
- Discharge alarms
- Respiratory protection
- Emergency eye wash stations





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## Dry Chemical System Requirements

**(NFPA 17 2017, Section 5.7)**
**Operation and Control of Systems**

Systems are required to provide both automatic and manual means of operation. However, hand hose line systems shall not require automatic means of operation. At least one manual actuator is required for each system.

The manual actuation device shall be installed between 42 in. – 48 in. above the floor and shall clearly identify the hazard protected. This requirement does not apply to mobile equipment.

Supervision of electrically or pneumatically operated automatic systems is required to be provided unless specifically waived by the AHJ.

An audible or visual indicator is required to provide notification of the following:

- The system has operated.
- Personnel response might be needed
- The system needs to be recharged.




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## Summary

As noted in the wet chemical components lesson, there are many similarities between wet chemical and dry chemical system requirements for components and the actual systems.

Be able to identify what dry chemical systems are permitted to protect, as well as system limitations and applications of the dry chemical system once installed.

Understand the requirements for manual actuators, including installation and operations.



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# On to the Quiz!

**(Select "Next" to proceed)**




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## Pre-engineered Extinguishing Equipment Other Than Water

## Dry Chemical Pre-engineered Systems

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## Outline

- Introduction
- Use
- Types of Systems
- Commercial Kitchen Hood, Duct, and Cooking Appliance Systems
- Manual Actuation
- System Supervision
- Review and Certification
- Vehicle Fueling Service Station Systems
- Protecting Mobile Equipment
- Hand Hose Line Systems

**Key References**

✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017



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## Introduction

Pre-engineered dry chemical systems are primarily used for protecting paint booths, vehicle fueling service stations, mobile equipment, and deep-fat fryers.

This lesson will explore requirements for some of these pre-engineered applications, including:

- Commercial kitchen hood, duct, and cooking appliance systems
- Vehicle fuel service station systems
- Mobile equipment protection



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.1)**

**Use**

Only system components specified in the manufacturer's design, installation, and maintenance manual, listed for the specific application, are permitted. Used components cannot be installed in new systems without AHJ approval.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.2)**

**Types of Systems**

The following types of pre-engineered systems are permitted:

- Local application
- Total flooding
- Hand hose line
- Combination of local application and total flooding



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.3)**

**Commercial Kitchen Hood, Duct, and Cooking Appliance Systems**

Dry chemical fire-extinguishing systems are required to comply with ANSI/UL 300. The manufacturer's design, installation, and maintenance manual is required to be followed.

Each protected cooking appliance, individual hood, and branch exhaust duct directly connected to the hood is required to be protected by a system (or systems) designed to allow simultaneous operation. At least one fusible link or heat detector is required within each exhaust duct opening, and above each protected appliance. Fusible links or detectors located at or within 12 in. into the exhaust duct opening and above the protected appliance also fulfil this requirement.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.3)**

**Commercial Kitchen Hood, Duct, and Cooking Appliance Systems (continued)**

Common exhaust ducts require one of the following methods of protection:

- Simultaneous operation of all independent hood, duct, and appliance protection systems
- Simultaneous operation of any hood, duct, and appliance protection system and the system protecting the entire common exhaust duct

All sources of fuel or heat to appliances that produce heat to equipment protected by the system are required to shut down when cooking equipment fire-extinguishing systems activate. This includes fuel or heat sources for common exhaust ducts. There are two exceptions: steam supplied from an external source and exhaust fans and dampers are not required to shut down.

Shutoff devices require a manual reset before fuel or power is restored.


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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.4)**

**Manual Actuation**

Only mechanical devices are permitted for manual actuation. However, electrical power is permitted if a reserve power supply is also provided. Both automatic and manual actuation is required, designed to be separate and independent of each other. If operation of one method fails, operation of the other method cannot be impacted.

At least one manual actuator is required for each system.


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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.6)**

**System Supervision**

If electrical power is needed to operate the fixed automatic dry chemical system, it is required to be monitored by a supervisory alarm with a reserve power supply.

If the system is interconnected or interlocked with the cooking equipment power sources resulting in the system becoming inoperable due to power failure, all sources of fuel and heat to all cooking appliances serviced by that hood are required to automatically shut off. In this case, electrical power monitoring is not required.


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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.7)**

**Review and Certification**

Only properly trained individuals are permitted to design and install dry chemical pre-engineered systems. The installer is required to show certification to the AHJ, proving the installation follows the terms of the listing and the manufacturer's instructions and/or approved design.

The Annex recommends all system design and installation personnel be certified per the manufacturer's requirements. It is standard industry practice for training certifications to expire. Re-certification will be necessary to maintain certification currency.


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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.8)**

**Vehicle Fueling Service Station Systems**

Hazards protected by two or more systems are required to have the systems connected, allowing simultaneous operation. The protected area includes the area within the arc scribed by the nozzle end of the hose on each vehicle fuel dispenser. Consult the manufacturer for additional coverage needs due to strong wind conditions.

System activation shall result in all vehicle fuel dispensers being shutdown with the protected hazard not returned to service until the system is recharged and operational. Special equipment may be required for the shutdown function.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.8)**

**Vehicle Fueling Service Station Systems (continued)**

Automatic detection and actuation of the extinguishing system is required. Any remote manual devices are to be located in an easily accessible area, away from the vehicle fuel dispensers and the protected area.

Locate all discharge nozzles in areas that will reduce the chances of damage or misalignment, while staying within limits defined in the manufacturer's design, installation, and maintenance manual.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.9)**

**Protecting Mobile Equipment**

Only pre-engineered systems, including detection systems listed for this purpose are permitted on mobile equipment. Each protected compartment or area is required to have a listed fire detection device to automatically actuate the extinguishing system.

Manual activation is only allowed if acceptable by the AHJ.

Locate all discharge nozzles to reduce the chances of damage or misalignment, while staying within limits defined in the manufacturer's design, installation, and maintenance manual.

Locate all agent containers, expellant gas cartridges or cylinders, and manual actuator stations in areas appropriate for each application. Ensure they are protected from physical damage and are easily accessible.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.10)**

**Hand Hose Line Systems**

Dry chemical hand hose line systems are required to have:

- Turrets
- Skid-mounted hose reels
- Remote hose reels, or
- Combinations of the above

The length and size of the piping and hose, the types of nozzles, and any elevation changes between the dry chemical storage tank and each turret or hose reel are required to comply with the manufacturer's manual.



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## Pre-engineered Systems

**(NFPA 17 2017, Section 9.10)**

**Hand Hose Line Systems (continued)**

If multiple cylinders are used for pressurizing dry chemical agent containers, each cylinder is required to have a pressure gauge and a manual means of operation.

Slave cylinders without manual actuators are permitted if there are at least two master cylinders with manual actuators. Self-contained skid-mounted systems only require one manual actuator.

Each turret and hose reel are required to have a shut-off nozzle or flow control valve.

Turret nozzles are required to have caps or other devices that will prevent moisture or other materials from entering the turret or piping.



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# On to the Quiz!

**(Select "Next" to proceed)**



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## Pre-engineered Extinguishing Equipment Other Than Water

## Dry Chemical Systems Plans and Acceptance Tests

135

## Outline

- Plans
- Installation Approval

**Key References**

✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017



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## Plans and Acceptance Tests

**(NFPA 17 2017, Section 10.2)**

**Plans**

Only trained personnel are permitted to prepare plans for dry chemical systems. These plans are to provide adequate detail for the AHJ to properly evaluate the protection of the hazard.

Details for the hazard are required, including:

- Materials involved
- Location and arrangement
- Exposure to the hazard

Plan details are to include the following:

- Amount of dry chemical
- Size, length, and arrangement of connected piping
- Description and location of nozzles



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## Plans and Acceptance Tests

**(NFPA 17 2017, Section 10.2)**

**Plans (continued)**

Information on the location and function of the following is also required:

- Detection devices
- Operating devices
- Auxiliary equipment
- Electrical circuitry



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## Plans and Acceptance Tests

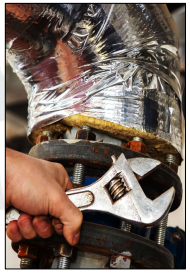
**(NFPA 17 2017, Section 10.4)**

**Installation Approval**

The following are required to be verified:

- Pipe sizes and nozzles meet the manufacturer's design
- Piping supports are securely fastened
- All devices are labeled with the proper designations and instructions
- All manual pull stations are easily accessible and properly identified

Conduct a nitrogen or air test on the piping network to verify the nitrogen or air has discharged out of each nozzle in the system. This test is to be performed at or below normal system operating pressure. Prior to conducting the test, check the tightness of all piping.





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## Plans and Acceptance Tests

**(NFPA 17 2017, Section 10.4)**

**Installation Approval (continued)**

Hydrostatic testing on dry chemical system piping is not permitted.

If the system is connected to a building fire alarm system, confirm all alarm-sounding or notification devices and remote annunciation devices are operating as intended.

If a releasing panel is installed, confirm it is:

- Properly labeled
- Connected to a dedicated circuit
- Readily accessible
- Restricted from unauthorized personnel



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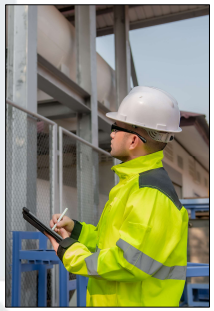
## Plans and Acceptance Tests

**(NFPA 17 2017, Section 10.4)**

**Installation Approval (continued)**

Upon test completion, verify each extinguishing agent storage container is reconnected and that the system has been returned to its fully operational condition. Notify the alarm-receiving office and all impacted personnel at the end user's facility that testing is complete, and the system has been restored to full-service.



The installing contractor is required to complete and sign an acceptance test report. The owner is to be given a copy of either the manufacturer's design, installation, and maintenance manual or the owner's manual.

Figure A.10.4.6 provides a sample dry chemical system acceptance test report.



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# On to the Quiz!

**(Select "Next" to proceed)**



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## Pre-engineered Extinguishing Equipment Other Than Water

## Dry Chemical Systems Inspection, Maintenance, & Recharging

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## Outline

- Introduction
- General
- Owner's Inspection
- Maintenance
- Recharging
- Hydrostatic Testing

**Key References**

✓ **NFPA 17** – Standard for Dry Chemical Extinguishing Systems, 2017



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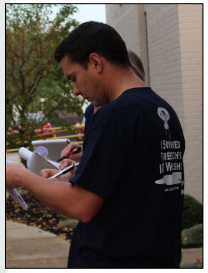
## Introduction

**(NFPA 17 2017, Section 11.1)**

In general, the owner of the dry chemical system is responsible for all inspection, testing, maintenance (ITM), and recharging of the system, unless this duty has been transferred, in writing, to a management company, tenant, or other party.

This lesson will explore inspection frequencies, record retention, servicing and maintaining dry chemical systems, recharging, and hydrostatic testing requirements.





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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.1)**

**General**

If dry chemical pressure containers are not attached to piping or hand hose lines, the discharge outlet is required to have a protective diffusing safety cap. The purpose of the cap is to protect personnel from recoil and high-flow discharge in the event of inadvertent activation. Protective caps are also required on empty pressure containers to protect the threads.

Store all dry chemical charging supplies in an area that is always dry. Store dry chemical in metal drums or other containers that stop moisture from entering.

All service technicians are required to be trained and certified, having passed a written or online test acceptable to the AHJ.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.2)**

**Owner's Inspection**

Inspections are required monthly, in accordance with the owner's manual, verifying at least the following:

- The extinguishing system remains in its proper location.
- The manual actuators are unobstructed.
- The tamper indicators and seals are intact.
- The maintenance tag or certificate is in place.
- No obvious physical damage exists that might prevent operation.
- The pressure gauges are in the operable range.
- Nozzle blowoff caps are intact and undamaged.
- The hazard has not changed, including replacement, modification, and relocation of protected equipment.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.2)**

**Owner's Inspection (continued)**

Any deficiencies noted during the inspection are required to be corrected immediately. If corrective actions involve maintenance, it is to be performed by a trained and certified service technician.

Record the date of the inspection and the initials of the individual performing the inspection. These records are to be retained for the period between the semiannual maintenance inspections.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance**

All maintenance activities are to be performed by a trained and certified service technician who has passed a written or online test approved by the AHJ. This qualified individual is required to service the dry chemical systems at least semiannually and after any system activation. This maintenance shall include:

- Confirmation that the hazard has not changed.
- Examination of all detectors, expellant gas containers, agent containers, releasing devices, piping, hose assemblies, nozzles, signals, and auxiliary equipment.
- Confirmation that the agent distribution piping is unobstructed.
- Dry chemical assessment – If caking is found, discard the dry chemical, and recharge the system.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

Dry chemical in stored pressure systems do not require a semiannual examination but are required to be checked at least every 6 years. Dry chemical containers that pass the 6-year check are required to have this information recorded on a weatherproof label, at least 2 in. x 3 ½ in., attached to the container using a heatless method. Remove all old labels.

Include the following information on the label:

- Month and year of maintenance, indicated by a perforation (hand punch)
- Name of agency or individual performing the maintenance

There is an exception for cartridge- or cylinder-operated dry chemical system containers.

If the dry chemical containers show signs of excessive corrosion or pitting, structural or fire damage, or repairs by soldering, welding, or brazing, the containers are required to be hydrostatically tested or replaced.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

If excessive corrosion or pitting, structural damage, or fire damage are found as part of routine maintenance for dry chemical system components, those parts are required to be replaced. System tests shall include operating the detection system signals and releasing device, including manual stations and other equipment.

Any failed or impaired parts are to be repaired or replaced, and the system tagged as impaired. Notify the owner and the AHJ (if required) of the impairment. Once the repairs are made and the system restored to normal operations, notify the owner and AHJ that the system is fully operational.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

Check pressure regulators on an annual basis, to confirm they meet the recommended static outlet pressure and minimum flow rate tolerances. Replace any defective regulators or return them to a factory-authorized facility for repair. Do not attempt to adjust defective regulators.

Check the pressure for auxiliary pressure cylinders with hand-operable valves on an annual basis, using a device to confirm the cylinder pressure is within the manufacturer's accepted tolerances.



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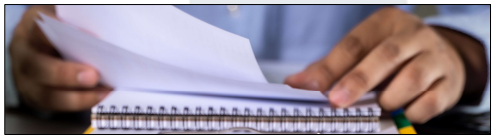
## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

File a maintenance report with the owner. The owner is responsible for keeping all maintenance reports for one year after the next maintenance of that same type.

Each dry chemical system is required to have a tag or label firmly attached to the system, identifying the individual performing the work and the date this work was performed (month and year). Only the current tag or label needs to be attached. Previous tags can be removed.





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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

Replace fixed temperature-sensing elements (fusible metal alloy-type) at least semiannually from the date of installation, or more frequently if needed. Once removed, destroy these elements. Replacement elements are required to have the same temperature ratings as those being replaced.


The Annex provides the reminder to take temperature readings at each installation to confirm the replacement devices are appropriate and there is no need to change elements. Since these elements are designed to operate at predetermined temperatures, incorrect replacement devices could cause unwanted discharge or a delayed activation response.

Both the year of manufacture and the date of installation of these elements are required to be shown on the system inspection tag. This tag is to be signed or initialed by the installer.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

Maintenance of restorable-type heat detectors shall include:

- A visual inspection to determine if the detector is damaged or there is debris buildup
- An operational/functional test per the manufacturer's test procedures
- A calibration verification test per the manufacturer's test procedures

Nonrestorable heat detectors are required to be functionally tested as defined in the manufacturer's procedures.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.3)**

**Maintenance (continued)**

Any heat detectors and associated wiring that exhibit fire damage are required to be tested and replaced, if needed. Replace fixed temperature-sensing or rate-compensated thermal detection devices installed on mobile equipment that:

- Display signs of a fire incident
- Were subjected to flame contact
- Show scorch marks or other signs of excessive temperatures



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.4)**

**Recharging**

All dry chemical systems are required to be recharged after use, or if needed per an inspection or maintenance procedure.

Always follow the manufacturer's instructions when recharging a system.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.5)**

**Hydrostatic Testing**

Only those individuals trained in pressure-testing procedures are permitted to conduct hydrostatic tests. The proper test equipment, facilities, and service manuals are additionally required.

Conduct a hydrostatic test on the following components at least every 12 years:

- Dry chemical containers
- Auxiliary pressure containers
- Hose assemblies



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.5)**

**Hydrostatic Testing (continued)**

Note the following exceptions:

- The dry chemical containers are part of extinguishing systems with an agent capacity greater than 150 lbs.
- The auxiliary pressure containers do not exceed a 2 in. outside diameter and are less than 2 ft. in length.
- The auxiliary pressure containers have the DOT "3E" marking

Hose couplings are not permitted to leak, rupture, or move during the test.



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## Inspection, Maintenance & Recharging

**(NFPA 17 2017, Section 11.5)**

**Hydrostatic Testing (continued)**

During the hydrostatic test of the cylinder, maintain the pressure for at least 30 seconds. Allow time for the cylinder to completely expand, and time to complete the visual inspection.

Discard all dry chemical agent removed from the containers before conducting the hydrostatic test.

Thoroughly dry all tested equipment before reusing.



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## Fire Tech Productions

# On to the Quiz!

**(Select "Next" to proceed)**



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# Fire Tech Productions

*…training that makes a difference*

## Pre-engineered Extinguishing Equipment Other Than Water

## Clean Agent Components and System Requirements

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## Outline

- Introduction
- Clean Agent System Components
- Clean Agent System Design

**Key References**

✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015



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## Introduction

We will now look at clean agent system requirements as defined in NFPA 2001 2015, Chapter 4, including:

- Discharge nozzles
- Operating devise
- Control equipment
- Predischarge alarms and time delays

System design requirements in Chapter 5 will also be discussed, addressing working plans and approval, enclosures, and design factors.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.1.3)**

**Storage Container Arrangement**

Locate and arrange storage containers and their accessories to allow inspection, testing, recharging, and other maintenance activities to be completed without disrupting protection of the area. Storage containers are permitted to be in the same area of the protected hazard, or outside of this area. Regardless of their storage location, they are required to be protected from mechanical damage, exposure to chemicals or harsh climates, or any other exposures that would make them inoperable.

Any storage containers connected to a manifold are required to have a check valve or other automatic means to prevent agent loss and safeguard personnel if the system is operated when containers are moved.




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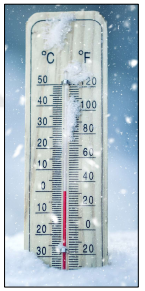
## Clean Agent System Components

**(NFPA 2001 2015, Section 4.1.4)**

**Agent Storage Containers**

Store clean agent in appropriate containers, designed for that specific agent at ambient temperature. Charge these containers to a fill density or super-pressurization level within the ranges defined in the manufacturer's manual.




Clean agent containers are required to have a permanent nameplate or other permanent marking showing the following:

- Halocarbon agent containers: agent, tare and gross weights, super-pressurization level of the container
- Inert gas agents: agent, pressurization level of the container, nominal agent volume

Store all clean agent containers in areas that comply with the manufacturer's temperature range.

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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.2.1)**

**Pipe**

Install piping following good commercial practices. Securely fasten the piping system to allow for agent thrust forces and thermal expansion and contraction. Protect the pipe from mechanical, chemical, vibration, or other damage.

Special corrosion-resistant materials or coatings are required in severely corrosive environments. Piping for pre-engineered systems shall follow the manufacturer's installation manual.




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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.2.1)**

**Pipe (continued)**

The following are not permitted:

- Cast-iron pipe
- Steel pipe conforming to ASTM A120
- Nonmetallic pipe

Flexible pipe, flexible nonmetallic pipe, tubing, or hoses, including connections, are permitted, if they are of approved materials and pressure ratings.

The pipe network is required to be free of particulate matter and oil residue prior to installing nozzles or discharge devices. Clean each pipe section thoroughly after preparation and before assembly, swabbing with a nonflammable cleaner.




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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.2.3)**

**Fittings**

Cast-iron fittings and Class 150 fittings are not permitted.

All threads used in joints and fittings shall meet ANSI B1.20.1 or ISO 7-1 requirements. Apply joint compound, tape, or thread lubricant to only the male threads of the joint.

The melting point for welding and brazing alloys shall be over 1000ºF.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.2.4)**

**Valves**

Valves are required to be protected from mechanical, chemical, or other damage. Ensure compatibility of all gaskets, O-rings, sealants, or other valve components with the chosen agent.

Special corrosion-resistant materials or coatings are required for severely corrosive atmospheres.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.2.5)**

**Discharge Nozzles**

Discharge orifices and discharge orifice plates and inserts shall be corrosion resistant materials for the agent used and the application environment.

Permanently mark discharge nozzles, showing the type and size of the orifice and the manufacturer.

Install nozzles so they are free of any obstructions that could limit agent distribution. If clogged nozzles are probable, provide frangible discs, blow-off caps, or other devices that will provide an unobstructed opening when the system operates. Locate these devices so they do not injure personnel.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.3)**

**Operating Devices**

Operating devices include the following:

- Agent-releasing devices or valves
- Discharge controls
- Shutdown equipment needed for system performance

Listed mechanical, electrical, or pneumatic means shall be used. source is required.

All operating devices are expected to function within a temperature range of -20ºF – 130ºF. Locate or protect these devices from inadvertent operation, and mechanical, chemical, or other damage that would make them inoperative.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.3)**

**Operating Devices (continued)**

Provide a manual means of release of the system. Use a mechanical manual release or an electrical manual release when the control equipment monitors the battery voltage level of the standby battery supply and provides a low-battery signal. The release shall trigger simultaneous operation of automatically operated valves controlling agent release and distribution.

A discharge switch is required for mechanical system activation, providing an alarm-initiating signal to the releasing panel. The switch can initiate electrical functions that typically occur once the system activates, including shutdown functions and control panel actuation.

Manual release is not required for automatic systems if the protected hazard is unoccupiable and is in a remote location with no personnel present.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.3)**

**Operating Devices (continued)**

Manual controls are required to have ease of access, including at the time of a fire event. These controls are to be distinct and easily recognizable. Operating any manual control shall cause the system to operate per the design criteria.

Similar to wet chemical and dry chemical systems, a manual control for activation is required to be situated no more than 4 ft. above floor level and clearly labeled to identify the hazard protected. The maximum force to activate this device is 40 lbs, with 14 in. being the maximum movement needed to actuate the system.




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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.4)**

**Control Equipment**

If an electric actuator is removed from the agent storage container discharge valve that it controls, an audible and visual (trouble) indication of system impairment is required at the system releasing control panel.

- *This became effective as of January 1, 2016.*

If an electric actuator is removed from the selector valve it controls, an audible and visual (trouble) indication of system impairment is required at the system releasing control panel.

- *This also became effective as of January 1, 2016.*




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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.4)**

**Control Equipment (continued)**

The control equipment supervises the actuating devices and associated wiring and, as required, causes actuation. The control equipment will be specifically listed for the number and type of actuating devices utilized, and their compatibility must be listed.

Removal of the primary agent container actuating device from the discharge valve and/or selector valve shall result in a trouble or supervisory signal at the releasing control unit.

If pneumatic control equipment is used, protect the lines against crimping and mechanical damage.

In situations where installations could potentially be exposed to conditions that may result in the loss of integrity of the pneumatic lines, take special precautions to ensure loss of integrity will not occur.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.5)**
**Operating Alarms and Indicators**

Alarms, indicators, or both shall be used to indicate the operation of the system, hazards to personnel, or failure of any supervised device.

The type (audible, visual, or olfactory), number, and location of the devices shall be such that their purpose is satisfactorily accomplished.

- *Follow the applicable NFPA code/standard and/or the manufacturer's published instructions to ensure all devices are located and spaced as necessary to make sure we have proper coverage.*


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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.5)**
**Operating Alarms and Indicators (continued)**

The extent and type of alarms or indicator equipment, or both, shall be approved by the AHJ.

Audible and visual pre-discharge alarms shall be provided within the protected area to give positive warning to all occupants of an impending discharge.

The warning device is required to operate after agent discharge until the alarm is acknowledged and appropriate action has been taken.


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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.5)**
**Operating Alarms and Indicators (continued)**

Abort switches, where provided, are required to be located within the protected area, near the means of egress for the area.

Abort switches must be momentary switches which require someone to constantly apply manual pressure to cause abort.

In all cases, the normal manual control and the manual emergency control shall override the abort function.


Operation of the abort function shall result in both audible and distinct visual (trouble) indication of system impairment. The abort switch has to be clearly recognizable for the purpose intended.

Alarms indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.


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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.5)**
**Operating Alarms and Indicators (continued)**

Warning and instruction signs are required at entrances and inside protected areas, located so that they will be readily visible to personnel in the area where the clean agent design concentration exceeds that approved for use in normally occupied spaces.

Additionally, warning and safety instruction signs are required outside each entrance to clean agent cylinder storage rooms.

Warning sign formatting, colors, and lettering styles of the signal words shall be in accordance with ANSI Z535.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.5.6)**

**Time Delays**

A pre-discharge alarm and time delay that allows personnel to evacuate prior to discharge is required for clean agent extinguishing systems.

If the hazard area is subject to fast growth fires, and a time delay would seriously increase the threat to life and property, the time delay is allowed to be eliminated.

Time delays shall be used only for personnel evacuation or to prepare the hazard area for discharge.

Time delays cannot be used as a way of confirming operation of a detection device before automatic actuation occurs.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.6)**

**Unwanted System Operation**

A supervised disconnect switch that interrupts the releasing circuit to the suppression system is required. This is needed to avoid unwanted discharge of a clean agent system.

When used, the disconnect switch will cause a supervisory signal at the releasing control unit that will remain until the switch is returned to the normal position.

The disconnect switch must be located inside a lockable fire alarm control panel, inside a lockable enclosure, or require a key for activation of the switch to prevent unauthorized personnel from turning off the releasing circuit.



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## Clean Agent System Components

**(NFPA 2001 2015, Section 4.3.6)**

**Unwanted System Operation (continued)**

When the disconnect switch requires a key for activation, the access key shall not be removable while the circuit is disconnected. This allows the suppression system to quickly be returned to the operational condition in the event of a fire.

Suppression system disconnect achieved via software programming is not permitted in lieu of a physical disconnect switch.

- *It may take too long to reactivate in case of a fire.*

The disconnect switch must be listed for use with the system.



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## Clean Agent System Design

**(NFPA 2001 2015, Sections 5.1.2 and 5.1.3)**

**Working Plans and Plan Approval**

Only trained personnel are permitted to prepare plans for clean agent systems. These plans are to provide adequate detail for the AHJ to properly evaluate the protection of the hazard. For pre-engineered systems, the detail of the system plan shall include the following:

- Information and calculations on the quantity of agent
- Container storage pressure
- Location and type of each nozzle, including equivalent orifice area
- Location and size of the storage facility
- Pipe size reduction and orientation of tees
- Location and function of detection devices, operating devices, auxiliary equipment, and electrical circuitry


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## Clean Agent System Design

**(NFPA 2001 2015, Sections 5.1.2 and 5.1.3)**

**Working Plans and Plan Approval (continued)**

Plans for pre-engineered clean agent systems are not required to identify the following, when used within their listing:

- An internal volume of the container
- Nozzle flow rates
- Equivalent lengths of pipe, fittings, and hose
- Flow calculations

The information provided in the manufacturer's design manual shall be given to the AHJ to prove the system is within its listed limitations.

Plans and calculations are required to be approved before beginning installation. Any necessary changes also require prior approval.




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## Clean Agent System Design

**(NFPA 2001 2015, Section 5.3)**

**Enclosures**

Proper room construction is necessary to maintain the room's integrity and hold the extinguishing agent for the required amount of time. This may necessitate having minimal un-closable openings, permanently sealing the openings, or equipping them with automatic enclosures. If reasonable agent confinement is not possible, expand the protection to include the adjacent connected hazards or work areas, or introduce additional agent into the protected enclosure through an extended discharge configuration.

If a clean agent total flooding system is protecting a room with a raised or sunken floor, these areas are required to be simultaneously protected. If only the space under a raised floor is to be protected, use an inert gas.




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## Clean Agent System Design

**(NFPA 2001 2015, Section 5.5.3)**

**Design Factors**

Changes of altitude have an effect on suppression agents. Every 3,000 feet of change will increase or decrease ambient pressure by about 11%. Changes of more than 11% will require the clean agent pressure be adjusted. As with altitude, barometric pressure differences will require adjustments in the quantity of agent more or less than 3,000 ft.

Table 5.5.3.3 provides the atmospheric correction factor and enclosure pressure depending on altitude. Altitude is a comparison to sea level and the number can be less than zero. A negative altitude indicates below sea level.

**NFPA 2001 2015, Table 5.5.3.3 Atmospheric Correction Factors**

| Equivalent Altitude (ft) | Enclosure Pressure (Absolute) (psi) | Atmospheric Correction Factor |
|---|---|---|
| -3,000 | 16.25 | 1.11 |
| -2,000 | 15.71 | 1.07 |
| -1,000 | 15.23 | 1.04 |
| 0 | 14.70 | 1.00 |
| 1,000 | 14.18 | 0.96 |
| 2,000 | 13.64 | 0.93 |
| 3,000 | 13.12 | 0.89 |
| 4,000 | 12.58 | 0.86 |
| 5,000 | 12.04 | 0.82 |
| 6,000 | 11.53 | 0.78 |
| 7,000 | 11.03 | 0.75 |
| 8,000 | 10.64 | 0.72 |
| 9,000 | 10.22 | 0.69 |
| 10,000 | 9.77 | 0.66 |




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## Clean Agent System Design

**(NFPA 2001 2015, Section 5.7)**

**Distribution System**

**Discharge time** is defined as *the time required to discharge from the nozzles 95% of the agent mass necessary to achieve the minimum design concentration based on a 20% safety factor for flame extinguishment.*

Discharge time requirements vary by agent. For halocarbon agents, the discharge time needed to achieve 95% of the minimum design concentration for flame extinguishment based on a 20% safety factor shall be 10 seconds or less. For inert gas agents, the discharge time required to achieve 95% of the minimum design concentration for flame extinguishment shall be no more than 60 seconds for Class B fuel hazards, and 120 seconds for Class A surface fire hazards or Class C hazards.

Use flow calculations based on the manufacturer's instruction manual to show compliance with these time periods.




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## Fire Tech Productions

**On to the Quiz!**

**(Select "Next" to proceed)**



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# Fire Tech Productions

*…training that makes a difference*

Pre-engineered Extinguishing Equipment Other Than Water

Clean Agent Systems
Inspection, Testing, Maintenance, and Training

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## Outline

- Introduction
- Inspection and Tests
- Container Tests
- Hose Tests
- Enclosure Inspection
- Maintenance
- Training
- Approval of Installations
- Safety

**Key References**

✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015



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## Introduction

This lesson will explore requirements for clean agent systems inspection and testing, including:

- Periodic inspection frequencies
- Hose tests
- Maintenance
- Installation acceptance testing



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.1)**

**Inspection and Tests**

Inspect and test all systems for proper operation on an annual basis, or more frequently if needed. Inspection and test personnel are required to be qualified in clean agent systems to conduct these tasks.

Discharge tests are not required to be included in these inspections and tests.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.1)**

**Inspection and Tests (continued)**

Check agent quantity and pressure of refillable containers at least semiannually.

If a halocarbon clean agent container shows an agent loss of more than 5% or a pressure loss of more than 10%, refill or replace the container. Properly dispose of any halocarbon clean agent removed from refillable containers by recycling the recovered agent or destroying it in an environmentally friendly manner. Never release recovered halocarbon agent into the atmosphere and ensure disposed containers also do not release any agent.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.1)**

**Inspection and Tests (continued)**

For halocarbon clean agents, record the following on the tag attached to the container:

- Date of inspection
- Gross weight of cylinder plus agent or net weight of agent
- Type of agent
- Person performing the inspection
- Pressure at the recorded temperature



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.1)**

**Inspection and Tests (continued)**

For inert gas clean agents, record the following on the tag attached to the container:

- Date of inspection
- Type of agent
- Person performing the inspection
- Pressure at the recorded temperature

Pressure indicates inert gas agent quantities. If the inert gas container shows a loss of more than 5% (adjusted for temperature), refill or replace the container. If container pressure gauges are used for this inspection, compare the readings to a separate calibrated device on an annual basis.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.2)**

**Container Tests**

US Department of Transportation or similar clean agent containers are not permitted to be recharged without re-testing if more than 5 years have passed since the last inspection and test.

Cylinders continuously in-service without discharging require a complete external visual inspection every 5 years, or more frequently if required. This inspection shall comply with CGA C-6 guidelines, but the cylinders do not need to be emptied or stamped while under pressure.



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## Inspection, Testing, Maintenance & Training

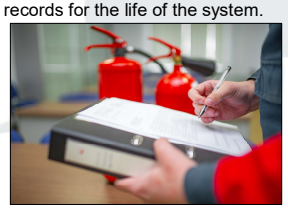
**(NFPA 2001 2015, Section 7.2)**

**Container Tests (continued)**

Record the inspection results on both of the following:

- A record tag permanently attached to the container
- An inspection report

Provide a completed copy of the inspection report to the owner. The owner is required to retain these records for the life of the system.

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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.3)**

**Hose Tests**

Check all system hoses on an annual basis. If damage is found, replace the hose, or test it following hose test procedures.

Test all hose every 5 years. Tests shall be conducted at 1 ½ times the maximum container pressure at 130ºF, as follows:

- Remove the hose from any attachment.
- Place the hose assembly in a protective enclosure that allows visual observation during the test.
- Fill the hose with water.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.3)**

**Hose Tests (continued)**

Test all hose every 5 years. Tests shall be conducted at 1 ½ times the maximum container pressure at 130ºF, as follows: (continued)

- Apply pressure at a rate-of-pressure rise to reach the test pressure within 1 minute, then maintain this pressure for 1 minute. Note any distortion or leakage.
- Release the pressure if there is no pressure drop or if the couplings have not moved. If there is no permanent distortion, the hose assembly passes the hydrostatic test,
- Completely dry the inside of the hose. If using heat, do not exceed the manufacturer's requirements.
- If the hose assembly fails the hydrostatic test, mark and destroy the hose. Replace it with a new hose assembly.
- Mark each hose assembly that passed the hydrostatic test with the test date.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.4)**

**Enclosure Inspection**

Inspect the enclosure protected by the clean agent at least annually, to identify if penetrations have occurred that could lead to agent leakage, if other changes have occurred that could change the hazard volume, or both.

Correct all conditions that could compromise the integrity of the enclosure.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.5)**

**Maintenance**

Clean agent systems are required to be maintained in a fully operational state. Promptly correct all problems or impairments. Report any system actuation, impairments, and restoration to the AHJ.

Seal any penetrations made through the enclosure to restore the original fire resistance rating of the enclosure.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.6)**

**Training**

All those inspecting, testing, maintaining, or operating clean agent systems are required to be properly trained in their expected functions. Train those working in an enclosure protected by a clean agent on all relevant agent safety issues.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations**

Once completed, the clean agent system is reviewed and tested to determine that it has been properly installed and will function as designed. The following tests are required:

1. Acceptance test
2. Mechanical Components Review
   - Confirm nozzles and pipe follow the design and installation documents.
   - Confirm all piping joints, discharge nozzles, and piping supports are securely fastened to prevent movement during discharge.
   - Internally inspect the piping distribution system during assembly to confirm no oil or particulates have contaminated the hazard area or reduced agent distribution.
   - Confirm the installation of discharge nozzles, piping, and mounting brackets will not harm personnel.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

2. Mechanical Components Review (continued)
   - Verify all containers and mounting brackets are fastened securely.
   - Weigh agent containers before and after conducting a discharge test. Record container pressure before and after discharge.
   - Cross reference the drawings against the actual room size to confirm proper agent quantity.
   - Pressure-test the pipe system to at least 40 psi in a closed-circuit using nitrogen or other gas. Once the source of pressurized gas is removed, verify the pipe pressure is not less than 80% of the test pressure after 10 minutes.
   - Conduct a flow test on the piping network using nitrogen or inert gas to confirm continuous flow and unobstructed piping and nozzles.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

3. Enclosure Integrity Review
   - Examine all total flooding system enclosures to locate and seal any significant air leaks.

The Annex recommends leakage and retention time for an enclosure be determined following procedures defined in Annex C (Enclosure Integrity Procedure) or other alternate methods.

A door fan test and smoke pencil is the preferred method. Care should be taken not to activate smoke detectors in the enclosure.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

4. Electrical Components Review

Confirm the following:

- All wiring systems are properly installed.
- Power is supplied to the control unit from a dedicated source that will not shut down when the system operates.
- 24 hour standby power is provided for operating detection, signaling, control, and actuation devices.
- All auxiliary functions operate properly, and silencing alarms does not impact these functions.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

4. Electrical Components Review (continued)

Confirm the following:

- Detection devices are the proper type and location per the system drawings.
- Detectors have not been placed near obstructions or air ventilations and cooling equipment.
- Manual pull stations are accessible, correctly identified, and protected from damage.
- The two separate and distinct actions for operating manual stations are identified.
- The main/reserve switch is accessible, correctly identified, and installed properly.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

4. Electrical Components Review (continued)

Confirm the following:

- All abort switches are of the deadman type requiring constant pressure, and are accessible, correctly identified, and installed properly. Switches remaining in the abort position when released are not permitted. Manual pull stations shall always override abort switches.
- The control unit is properly installed and accessible.



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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

5. Functional Testing

Perform the following preliminary tests:

- Notify the alarm receiving facility (if needed) and all personnel at the end user's facility of the alarm test. Inform personnel of the sequence of events.
- Disable each agent storage container release so that no agent is released when the circuit activates. Reconnect the release circuit with a functional device instead.
- Confirm each detector has the proper response.
- Observe polarity on all polarized alarm devices and auxiliary relays.
- Confirm all end-of-line resistors are installed across the detection and alarm bell circuits.
- Confirm a proper trouble response occurs on all supervised circuits.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

6. Functional Operational Test

Operate and test the following:

- Detection initiating circuits – Confirm all alarm functions occur per the design specifications.
- Circuit initiating second alarm circuit – Confirm all second alarms function per the design specifications.
- Manual release – Confirm manual release functions occur per the design specifications.
- Abort switch circuit – Confirm abort functions occur per the design specifications. Confirm visual and audible supervisory signals are received at the control panel.
- Automatic valves – Do not test if the valve will release agent or damage the valve
- Pneumatic equipment – Confirm proper operation


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

7. Remote Monitoring Operations

Conduct the following tests:

- Input devices – Operate one of each type while on standby power. Confirm an alarm signal is received at the remote panel once the device is operated. Reconnect the primary power supply.
- Alarm conditions – Operate each type on each signal circuit. Confirm receipt of trouble condition at the remote station.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

8. Control Panel Power Primary Source

Conduct the following tests:

- Control panel – Confirm proper connections to a dedicated circuit, correctly labeled, and readily accessible to authorized personnel only.
- Primary power failure – Use the manufacturer's specifications with the system fully operated on standby power.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.7)**

**Approval of Installations (continued)**

9. Return of System to Operational Condition
   - Once pre-discharge tasks are complete, reconnect each agent storage container so agent releases when the circuit activates.
   - Return the system to a fully operational status.
   - Notify the alarm-receiving office and all personnel at the end user's facility that testing is complete, and the system is returned to a full service.

The photo above shows an example of a FM-200 System. Note the unistrut is bolted to the wall and the flexible hose is bracketed. Always remember to put the strap back on the FM-200 tank once testing is completed.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.8)**

**Safety**

Safety is paramount during any installation, inspection, test, maintenance, servicing, recharging, and handling of clean agent systems and their agent containers.

The Annex provides the reminder that all personnel working with these systems are required to be trained, experienced, and qualified in working with these systems and the system cylinders. This includes those responsible for handling, shipping, and filling the containers, and those connecting and removing associated devices such as discharge hoses, control heads, discharge heads, initiators, and anti-recoil devices.


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## Inspection, Testing, Maintenance & Training

**(NFPA 2001 2015, Section 7.8)**

**Safety (continued)**

Follow all manufacturer's directions provided in the following:

- Operation and Maintenance Manual
- Owner's Manual
- Service Manual
- Service Bulletins

*Never assume a cylinder is empty. Treat all cylinders as if they are fully charged.*


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## Fire Tech Productions

**On to the Quiz!**

**(Select "Next" to proceed)**



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# Fire Tech Productions

*…training that makes a difference*

Pre-engineered Extinguishing Equipment Other Than Water

Clean Agent Systems
Room Integrity Tests

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## Outline

- Introduction
- Below-Ceiling-Leakage Area
- Protected Height Requirements
- Calculations
- As-Built Drawings
- Infiltrometer
- Room Integrity

**Key References**

✓ **NFPA 2001** – Standard on Clean Agent Fire Extinguishing Systems, 2015



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## Introduction

The purpose of a room integrity test is to ensure clean agents will not escape during system activation. An enclosure's ability to contain a clean agent for an extended period of time enables the system to extinguish combustion. A thorough visual and functional inspection will identify and correct sources of leakage.

The General Contractor is responsible for correcting areas of leakage during acceptance testing. Leakage discovered during periodic inspections are corrected by the owner.

The amount of leakage is measured by conducting a room integrity test.



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## Below-Ceiling-Leakage Area (BCLA)

**(NFPA 2001 2015, Section C.1.2.2.(4))**

Enclosures protected by a clean agent system may have a sub-floor or drop ceiling. These areas must be evaluated for leakage when testing. Most clean agents are heavier than air and will drop to the floor. This is the most common location for leaks.

One method of integrity testing will determine the total **Equivalent Leakage Area (ELA)** and assume half of the leakage is above ceiling. A **Below-False Ceiling-Leakage Area (BCLA)** integrity test evaluates leakage above and below the ceiling to more precisely identify enclosure leakage.



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## Protected Height Requirements

**(NFPA 2001 2015, Sections C.1.3.9 and C.1.3.20)**

It is assumed that enclosures will leak agent and air will enter the protected space. Leakage is typically at the bottom of the enclosure and air enters from the top. Over time, the level of the agent will drop with a layer of air above.

This is described by NFPA 2001 as the **Descending Interface**. The Authority Having Jurisdiction (AHJ) will specify the **minimum protected height**. This is the height from the floor to the descending interface during retention time of the clean agent.



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## Calculations

**(NFPA 2001 2015, Section C.2.4.2.1)**

An evaluation of enclosure leakage will involve documenting dimensions of the enclosure and volume. The total volume is the size of the protected enclosure. Large solid objects are deducted from the enclosure volume to produce the net volume.

Technicians should be able to perform pen and paper calculations and cannot depend on smart-devices during certification exams. An understanding of basic geometric shapes and formulas is needed for these calculations.



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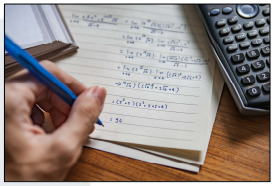
## Calculations

**Compartment Area**

The compartment area is a two-dimensional value consisting of the length and width of the enclosure. The formula to find area (A) is the length multiplied by the width:

**A = L x W**

This calculation is rather simple for rectangular rooms but may not be the case for all applications. Rooms with odd shapes can be divided into simple geometric shapes, with the areas of each shape added together for the total area.



**Handy Formulas for Area:**
Triangle = ½ x b x h
Circle = $\pi r^2$
Rectangle = l x w
Square = l x w, where l = w



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## Calculations

**Compartment Volume**

The compartment volume of an enclosure is a three-dimensional value. The formula to find volume (V) is the length multiplied by the width, then multiplied by the height:

**V = L x W x H**

Similar to the techniques in finding total area, enclosures with varying construction can be divided into basic shapes. Various volume formulas exist for other shapes such as spheres, cylinders, and cones.

**Handy Formulas for Volume:**
Volume of a pyramid = 1/3 x B x h
Volume of a cylinder = $\pi r^2$ x h
Volume of a rectangle = l x w x h
Volume of a square = l x w x h (where l = w = h)
Volume of a cone = 1/3 $\pi r^2$ x h
Volume sphere = 4/3 $\pi r^3$


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## Calculations

| Area and Volume Formulas | | | |
|---|---|---|---|
| | **Formula** | **Units** | **Abbreviations** |
| **Square or Rectangle** | | | |
| Area | L x H | ft x ft = square feet<br>inches x inches = square inches | sq ft or $ft^2$<br>sq. in. or $in^2$ |
| Volume | L x W x H | feet x feet x feet = cubic feet<br>inches x inches x inches = cubic inches | $ft^3$<br>$in^3$ |
| **Triangle** | | | |
| Area | ½ x b x h | ft x ft = square feet<br>inches x inches = square inches | sq ft or $ft^2$<br>sq. in. or $in^2$ |
| Volume (Pyramid) | 1/3 x B x h | feet x feet x feet = cubic feet<br>inches x inches x inches = cubic inches | $ft^3$<br>$in^3$ |
| **Circle** | | | |
| Area | $\pi r^2$ | feet x feet x feet = cubic feet<br>inches x inches x inches = cubic inches | sq ft or $ft^2$<br>sq. in. or $in^2$ |
| Volume (Cylinder)<br>(Cone)<br>(Sphere) | $\pi r^2$ x h<br>1/3 $\pi r^2$ x h<br>4/3 $\pi r^3$ | feet x feet x feet = cubic feet<br>inches x inches x inches = cubic inches<br>*(units and abbreviations apply to all 3 formulas)* | $ft^3$<br>$in^3$ |


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## As-Built Drawings

Often the installation of a clean agent system will deviate from the initial design. These changes are required to be documented and the drawings revised. The revised drawings are commonly called “As-Builts” and represent the install as it was built.

As-built drawings will depict the location of control equipment, automatic detection, and mechanical piping and devices. Conducting inspection and testing of a system oftentimes requires the technician to interpret installation drawings.


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## Infiltrometer

The **Door Fan Test** was initially developed by the U.S. Department of Energy to determine leaks in buildings that could waste energy. The same test is used to determine the integrity of enclosures.

The basic operation of a door fan is to pressurize and de-pressurize the enclosure during a series of tests. Fluctuations in pressure can identify the amount of leakage, or integrity of the enclosure. The infiltrometer measures the pressure and airflow and data is used to calculate leakage.


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## Infiltrometer

**(NFPA 2001 2015, Section C.1.2.2(1))**

**Infiltrometer Use**

**Infiltrometer** is a registered trademark by Retrotec, a manufacturer of door fan test equipment. The term is interchangeable with door fan and is considered calibrated test equipment. NFPA 2001 cites ASTM E779, ASTM E1827, and Canadian standards as guidance for door fan design maintenance and operation.

Technicians are required to be factory trained by the door fan manufacturer to ensure proper operation of this equipment.



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## Infiltrometer

**Infiltrometer Gauge Calibration**

To ensure proper enclosure integrity testing results, the equipment is required to be calibrated and checked. A field verification is performed periodically to verify the equipment is operating correctly. The verification is not considered a calibration.

A field calibration can be performed to ensure proper operation. A fan test is performed with a measured hole in the door opening. Results are compared to hand calculations to determine accuracy. Door fan test equipment that fails a field verification test is required to be returned to the manufacturer for a complete calibration test.



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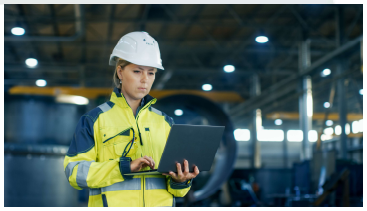
## Infiltrometer

**Infiltrometer Testing Procedures**

Manufacturer's published instructions for fan door test equipment will include computer software. Data collected during fan testing is entered and evaluated by a software program developed by the fan manufacturer.

The software package will include reports for test results of the enclosure integrity test. Test results are included with the acceptance testing documentation.





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## Room Integrity

**(NFPA 2001 2015, Section C.2.2.1.6)**

The room integrity of a protected space is verified prior to acceptance testing. Room integrity is typically determined by a test using the Door Fan System, commonly called a fan test.

The door fan system is required to be calibrated every five years and the test certificate should be available during testing. The technician performing the test is required to be factory trained by the equipment manufacturer.



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## Room Integrity

**Identifying Leakage Sources**

The task of identifying sources of leakage begins with a visual inspection. Areas of focus are openings such as doors, windows, and louvers. A visual inspection will identify large openings or gaps in preparation for a fan test.

Spaces above and below the enclosure are potential sources of leakage and should be tested independently. During a visual inspection, an easy way to locate leaks is using a light source outside a darkened enclosure.


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## Room Integrity

**(NFPA 2001 2015, Section C.2.9.1)**

**Smoke Pencil Test**

Fan door test equipment will determine the amount of enclosure leakage but will not identify the location. However, the test equipment can assist in the task of finding leaks by creating pressure, or a vacuum, within the enclosure.

The door fan is used to pressurize or de-pressurize the enclosure creating a difference in pressure from the outside. Smoke from a smoke pencil or other approved source will flow with the leaking air flow to identify leaks. Care should be made to not activate smoke detectors in the enclosure.


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## Room Integrity

**Recommended Leakage Solutions**

The owner is responsible for correcting leaks discovered during enclosure integrity testing. To facilitate correcting the leaks, a report listing discrepancies found should be provided.

A common method to seal small cracks is with caulking, preferable one that is fire-rated. Correcting leaks may involve other trades to replace door and window seals or adjust dampers that do not close completely.


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## Room Integrity

**(NFPA 2001 2015, Section 7.7)**

**Reviewing Enclosure Integrity**

NFPA 2001 provides requirements and methods to determine and achieve room integrity. Chapter 7 provides the requirements for approval of clean agent system installations, including information concerning the review of enclosure integrity.

Enclosures are examined, tested, and sealed to ensure the compartment will hold a certain amount of clean agent for a defined period of time. Although a variety of methods exist to measure room integrity, NFPA 2001 recommends using a door fan, or methods approved by the AHJ.


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## Room Integrity

**(NFPA 2001 2015, Annex C)**

**Enclosure Integrity Procedures**

Annex C of NFPA 2001 offers supplemental information for performing room integrity testing and documenting this process. The section provides guidance to perform calculations to determine the amount of clean agent leakage.

The ability of clean agents to extinguish a fire depend on maintaining a sufficient concentration over time. Calculations will ensure leakage is within limits to maintain clean agent. Keep in mind that material found in the Annex portion of a standard are recommendations for informational purposes and not enforceable requirements.



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## Room Integrity

**(NFPA 2001 2015, Section 5.3.7)**

**Venting Design Compliance**

Enclosure integrity testing also involves the structure's ability to contain the increase in pressure when clean agents are discharged. The system designer will evaluate the construction and consult with the building manufacturer.

Enclosures that may be damaged by the increase in pressure will incorporate venting. The door fan test will pressurize the enclosure and the technician will verify proper operation of venting equipment. Any discrepancies should be corrected by the mechanical contractor.


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## Room Integrity

**(NFPA 2001 2015, Sections 5.4.1 and C.1.2.3)**

**Room Agent Concentration Level Retention**

There is considerable work and planning involved in designing a clean agent system for fire protection. The system designer will determine the best agent for flame extinguishment for a particular fuel.

The critical aspect of the system is the enclosure's ability to retain enough of the agent, at sufficient concentration to extinguish combustion. Section C.1.2.3 shows items to consider when enclosure retention calculations are made:

- ✓ Dynamic discharge pressures
- ✓ Bias pressures
- ✓ Floor area
- ✓ Leak flow characteristics
- ✓ Leak flow direction
- ✓ Leak discharge
- ✓ Leak locations
- ✓ Clean agent delivery


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## Room Integrity

**Comparing Room with Record Drawings**

The owner is provided with a set of Record Drawings at the completion of a project. The Record Drawings are sealed by the Engineer of Record (EOR) and include As-Built drawings of the clean agent suppression system.

The technician performing acceptance testing should ensure the Record Drawings accurately depict the enclosure. The drawings will be used in the future for inspections and producing test data. Any discrepancies should be brought to the attention of the owner or their designated representative.


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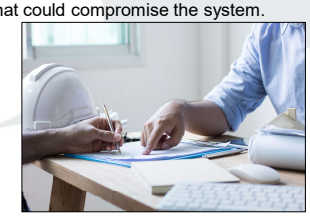
## Room Integrity

**(NFPA 2001 2015, Section 7.1)**

**Comparing Historic Test Results Data**

The purpose of periodic testing and inspections is to ensure the system will perform as designed. Periodic inspections will identify any deficiency or changes that would affect or compromise the system.

Test data is generated during annual inspections as a result of a thorough inspection. Any changes or modifications that would question the enclosure integrity necessitate retesting the enclosure. Test data is evaluated over time to identify trends or scenarios that could compromise the system.





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## Room Integrity

**(NFPA 2001 2015, Sections C.2.1 – C.2.10)**

**Testing Procedures and Documentation**

Door fan testing procedures are found in Annex C, Sections C.2.1 – C.2.10. These sections cover:

- Preliminary preparations
- Required equipment and accessories
- Steps to conduct a field calibration check
- Conducting an initial evaluation of the enclosure
- Setting up the door fan installation
- Evaluating the enclosure with pressure run-up inspection and bias pressure measurement
- Determining enclosure leakage with performing leakage calculations
- Identifying leakage
- Completing a test report



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## Room Integrity

**(NFPA 2001 2015, Sections C.2.1 – C.2.10)**

**Testing Procedures and Documentation (continued)**

These testing procedures not only require the technician to produce documentation, but also requires coordination between the owner and other trades who are present and needed for test completion.

The technician needs to effectively communicate with these trades and other associated parties at the time of testing.



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## Room Integrity

**(NFPA 2001 2015, Section C.2.1 – C.2.10)**

**Testing Procedures and Documentation (continued)**

Enclosure testing results and documentation produced by software programs are compiled into a written report for the AHJ. Care should be taken for accuracy and include the following information:

- Site address
- Time and date
- Enclosure volume and measurements
- Data produced during testing
- Special testing techniques
- Full explanation and documentation to support technical judgments
- Test equipment model, make, and serial number
- Test equipment calibration certificate
- Signature, name, and affiliation of technician performing test.



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Fire Tech Productions

# On to The Quiz!

**(Select "Next" to proceed)**



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**File Attachments for Item:**

ER-2 Ohio Plumbing Code Updates (Ohio Contractor Training)

PI (10 hours)

Staff Notes:  See "Explanation of Slides" document

Committee Recommendation:

# CHAPTER 3 General Requirements

| | |
|---|---|
| 301.1 Scope. The provisions of this chapter shall govern the general regulations regarding the design and installation of plumbing not specific to other chapters. | 301.2 System installation. Plumbing shall be installed with due regard to preservation of the strength of structural members and prevention of damage to walls and other surfaces through fixture usage |
| 301.3 Connections to drainage system. Plumbing fixtures, drains, appurtenances and appliances used to receive or discharge liquid waste or sewage shall be directly connected to the sanitary drainage system of the building or premises, in accordance with the requirements of this code and the requirements of the department of the city engineer, in cities having such departments, the boards of health of health districts, or the sewer purveyor, as appropriate (see division (D) of section 3781.03 of the Revised Code). This section shall not be construed to prevent indirect waste systems required by Chapter 8. Exceptions: 1. Bathtubs, showers, lavatories, clothes washers and laundry trays shall not be required to discharge to the sanitary drainage system where such fixtures discharge to a recycled water system approved by the “Ohio Environmental Protection Agency” in accordance with Chapter 3745-42 of the Administrative Code or approved by the “Ohio Department of Health” in accordance with Chapter 3701-28 of the Administrative Code. 2. Wastes from dental or cuspidor fountains, drinking fountains, bar sinks, soda fountains, floor drains or shower drains may be indirectly connected by means of an air break to the sanitary drainage system. Each indirectly connected item listed above shall individually discharge to a directly connected floor drain, waste receptor or standpipe. | 301.4 Connections to water supply. Every plumbing fixture, device or appliance requiring or using water for its proper operation shall be directly or indirectly connected to the water supply system in accordance with the provisions of this code. |

# CHAPTER 3 General Requirements

| | |
|---|---|
| 301.5 Pipe, tube and fitting sizes. Unless otherwise indicated, the pipe, tube and fitting sizes specified in this code are expressed in nominal or standard sizes as designated in the referenced material standards. | 301.6 Prohibited locations. Plumbing systems shall not be located in an elevator shaft or in an elevator equipment room. Exception: Floor drains, sumps and sump pumps shall be permitted at the base of the shaft, provided that they are indirectly connected to the plumbing system. |
| 301.7 Conflicts. In instances where conflicts occur between this code and the manufacturer's installation instructions, the more restrictive provisions shall apply. | 302.1 Detrimental or dangerous materials. Ashes, cinders or rags; flammable, poisonous or explosive liquids or gases; oil, grease or any other insoluble material capable of obstructing, damaging or overloading the building drainage or sewer system, or capable of interfering with the normal operation of the sewage treatment processes, shall not be deposited, by any means, into such systems. |

| | |
|---|---|
| 302.2 Industrial wastes. Waste products from manufacturing or industrial operations shall not be introduced into the public sewer until it has been determined by the building official or other authority having jurisdiction that the introduction thereof will not damage the public sewer system or interfere with the functioning of the sewage treatment plant. | 303.1 Identification. Each length of pipe and each pipe fitting, trap, fixture, material and device utilized in a plumbing system shall bear the identification of the manufacturer and any markings required by the applicable referenced Standards. |
| 303.3 Plastic pipe, fittings and components. All plastic pipe, fittings and components shall be listed as conforming to NSF 14. | 303.4 Approved agency testing and certification. All plumbing products and materials shall be listed by an approved agency as complying with the applicable referenced standards. Products and materials shall be identified in accordance with Section 303.1. |

| | |
|---|---|
| 304.1 General. Plumbing systems shall be designed and installed in accordance with Sections 304.2 through 304.4 to prevent rodents from entering structures. | 304.2 Strainer plates. All strainer plates on drain inlets shall be designed and installed so that all openings are not greater than 1 /2 inch (12.7 mm) in least dimension. |
| 304.3 Meter boxes. Meter boxes shall be constructed in such a manner that rodents are prevented from entering a structure by way of the water service pipes connecting the meter box and the structure. | 304.4 Openings for pipes. In or on structures where openings have been made in walls, floors or ceilings for the passage of pipes, the annular space between the pipe and the sides of the opening shall be sealed with caulking materials or closed with gasketing systems compatible with the piping materials and locations. |

| | |
|---|---|
| 305.1 Corrosion. Pipes passing through concrete or cinder walls and floors or other corrosive material shall be protected against external corrosion by a protective sheathing or wrapping or other means that will withstand any reaction from the lime and acid of concrete, cinder or other corrosive material. Sheathing or wrapping shall allow for movement including expansion and contraction of piping. The wall thickness of the material shall be not less than 0.025 inch (0.64 mm). | 305.2 Stress and strain. Piping in a plumbing system shall be installed so as to prevent strains and stresses that exceed the structural strength of the pipe. Where necessary, provisions shall be made to protect piping from damage resulting from expansion, contraction and structural settlement. |
| 305.3 Pipes and fittings through foundation walls wall assemblies. Any pipe that passes through or fitting making a through penetration of a foundation wall assembly shall be provided with a relieving arch, or a pipe sleeve pipe shall be built into the foundation wall assembly. The sleeve shall be two pipe sizes greater than the pipe or fitting passing through the foundation wall assembly. Pipe joints or fitting joints shall not occur within the exterior foundation wall assembly. | 305.4 Freezing. Water, soil and waste pipes shall not be installed outside of a building, in attics or crawl spaces, concealed in outside walls, or in any other place subjected to freezing temperatures unless a provision is made to protect such pipes from freezing. Exterior water supply system piping shall be installed not less than 6 inches (152 mm) below the frost line and not less than 12 inches (305 mm) below grade. |

| | |
|---|---|
| 305.5 Waterproofing of openings. Joints at the roof and around vent pipes shall be made water tight by the use of lead, copper, galvanized steel, aluminum, plastic or other approved flashings or flashing material. Exterior wall openings shall be made water tight. | 305.6 Protection against physical damage. In concealed locations where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 11 /2 inches (38 mm) from the nearest edge of the member, the pipe shall be protected by steel shield plates. Such shield plates shall have a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage). Such plates shall cover the area of the pipe where the member is notched or bored, and shall extend not less than 2 inches (51 mm) above sole plates and below top plates. |
| 305.7 Protection of components of plumbing system. Components of a plumbing system installed along alleyways, driveways, parking garages or other locations exposed to damage shall be recessed into the wall or otherwise protected in an approved manner. | 306.1 Support of piping. Buried piping shall be supported throughout its entire length. |

| | |
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| 306.2 Trenching and bedding. Where trenches are excavated such that the bottom of the trench forms the bed for the pipe, solid and continuous load-bearing support shall be provided between joints. Bell holes, hub holes and coupling holes shall be provided at points where the pipe is joined. Such pipe shall not be supported on blocks to grade. In instances where the materials manufacturer's installation instructions are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. | 306.2.1 Over excavation. Where trenches are excavated below the installation level of the pipe such that the bottom of the trench does not form the bed for the pipe, the trench shall be backfilled to the installation level of the bottom of the pipe with sand or fine gravel placed in layers not greater than 6 inches (152 mm) in depth and such backfill shall be compacted after each placement. |
| 306.2.2 Rock removal. Where rock is encountered in trenching, the rock shall be removed to not less than 3 inches (76 mm) below the installation level of the bottom of the pipe, and the trench shall be backfilled to the installation level of the bottom of the pipe with sand tamped in place so as to provide uniform load-bearing support for the pipe between joints. The pipe, including the joints, shall not rest on rock at any point. | 306.2.3 Soft load-bearing materials. If soft materials of poor load-bearing quality are found at the bottom of the trench, stabilization shall be achieved by over excavating not less than two pipe diameters and backfilling to the installation level of the bottom of the pipe with fine gravel, crushed stone or a concrete foundation. The concrete foundation shall be bedded with sand tamped into place so as to provide uniform load-bearing support for the pipe between joints. |

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| 306.3 Backfilling. Backfill shall be free from discarded construction material and debris. Loose earth free from rocks, broken concrete and frozen chunks shall be placed in the trench in 6-inch (152 mm) layers and tamped in place until the crown of the pipe is covered by 12 inches (305 mm) of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. | 306.4 Tunneling. Where pipe is to be installed by tunneling, jacking or a combination of both, the pipe shall be protected from damage during installation and from subsequent uneven loading. Where earth tunnels are used, adequate supporting structures shall be provided to prevent future settling or caving. |
| 307.1 General. In the process of installing or repairing any part of a plumbing and drainage installation, the finished floors, walls, ceilings, tile work or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the building code. | 307.2 Cutting, notching or bored holes. A framing member shall not be cut, notched or bored in excess of limitations specified in the building code. |

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| 307.3 Penetrations of floor/ceiling assemblies and fire-resistance-rated assemblies. Penetrations of floor/ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with the building code. | 307.4 Alterations to trusses. Truss members and components shall not be cut, drilled, notched, spliced or otherwise altered in any way without written concurrence and approval of a registered design professional. Alterations resulting in the addition of loads to any member (e.g., HVAC equipment, water heater) shall not be permitted without verification that the truss is capable of supporting such additional loading. |
| 307.5 Protection of footings. Trenching installed parallel to footings and walls shall not extend into the bearing plane of a footing or wall. The upper boundary of the bearing plane is a line that extends downward, at an angle of 45 degrees (0.79 rad) from horizontal, from the outside bottom edge of the footing or wall. | 307.6 Piping materials exposed within plenums. Piping materials exposed within plenums shall comply with the provisions of the mechanical code. |

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| 307.7 Enforcement. Enforcement of the provisions of this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance. | 308.1 General. Plumbing piping shall be supported in accordance with this section. |
| 308.2 Piping seismic supports. Where earthquake loads are applicable in accordance with the building code, plumbing piping supports shall be designed and installed for the seismic forces in accordance with the building code. | 308.3 Materials. Hangers, anchors and supports shall support the piping and the contents of the piping. Hangers and strapping material shall be of approved material that will not promote galvanic action. |

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| 308.4 Structural attachment. Hangers and anchors shall be attached to the building construction in an approved manner. | 308.5 Interval of support. Pipe shall be supported in accordance with Table 308.5. Exception: The interval of support for piping systems designed to provide for expansion/contraction shall conform to the engineered design in accordance with Section 106.5 of the building code. |

**TABLE 308.5**
**HANGER SPACING**

| PIPING MATERIAL | MAXIMUM HORIZONTAL SPACING (feet) | MAXIMUM VERTICAL SPACING (feet) |
|---|---|---|
| Acrylonitrile butadiene styrene (ABS) pipe | 4 | 10[b] |
| Aluminum tubing | 10 | 15 |
| Brass pipe | 10 | 10 |
| Cast-iron pipe | 5a | 15 |
| Chlorinated polyvinyl chloride (CPVC) pipe and tubing, 1 inch and smaller | 3 | 10[b] |
| Chlorinated polyvinyl chloride (CPVC) pipe and tubing, 1 1/4 inches and larger | 4 | 10[b] |
| Copper or copper-alloy pipe | 12 | 10 |
| Copper or copper-alloy tubing, 1 1/4-inch diameter and smaller | 6 | 10 |
| Copper or copper-alloy tubing, 1 1/2-inch diameter and larger | 10 | 10 |
| Cross-linked polyethylene (PEX) pipe | 2.67 (32 inches) | 10[b] |
| Cross-linked polyethylene/ aluminum/cross-linked polyethylene (PEX-ALPEX) pipe | 2.67 (32 inches) | 4 |
| Lead pipe | Continuous | 4 |
| Polyethylene/aluminum/ polyethylene (PE-AL-PE) pipe | 2.67 (32 inches) | 4 |
| Polyethylene of raised temperature (PE-RT) pipe | 2.67 (32 inches) | 10[b] |
| Polypropylene (PP) pipe or tubing 1 inch and smaller | 2.67 (32 inches) | 10[b] |
| Polypropylene (PP) pipe or tubing, 1 1/4 inches and larger | 4 | 10[b] |
| Polyvinyl chloride (PVC) pipe | 4 | 10[b] |
| Stainless steel drainage systems | 10 | 10[b] |
| Steel pipe | 12 | 15 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm. a. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed. b. For sizes 2 inches and smaller, a guide shall be installed midway between required vertical supports. Such guides shall prevent pipe movement in a direction perpendicular to the axis of the pipe.

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| 308.6 Sway bracing. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees (0.79 rad) for pipe sizes 4 inches (102 mm) and larger. | 308.7 Anchorage. Anchorage shall be provided to restrain drainage piping from axial movement. |
| 308.7.1 Location. For pipe sizes greater than 4 inches (102 mm), restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes. Braces, blocks, rodding and other suitable methods as specified by the coupling manufacturer shall be utilized. | 308.8 Expansion joint fittings. Expansion joint fittings shall be used only where necessary to provide for expansion and contraction of the pipes. Expansion joint fittings shall be of the typical material suitable for use with the type of piping in which such fittings are installed. |

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| 308.9 Parallel water distribution systems. Piping bundles for manifold systems shall be supported in accordance with Table 308.5. Support at changes in direction shall be in accordance with the manufacturer's instructions. Where hot water piping is bundled, each hot water pipe shall be insulated. | 309.1 General. All buildings and structures which have been determined to require flood resistant construction by the local flood plain administrator, as a participant in the "National Flood Insurance Program", shall be constructed as required by the provisions of section 1612 of the building code for approval under the "Regulations for Floodplain Management and Flood Hazard Identification" of the "National Flood Insurance Program" pursuant to "FEMA 44 CFR Parts 59-77" and the authority's "Flood Damage Prevention Ordinance.". |
| 309.2 Flood hazard. For structures located in flood hazard areas, the following systems and equipment shall be located and installed as required by Section 1612 of the building code. 1. Water service pipes. 2. Deleted. 3. Deleted. 4. Sanitary drainage piping. 5. Storm drainage piping. 6. Deleted. 7. Other plumbing fixtures, faucets, fixture fittings, piping systems and equipment. 8. Water heaters. 9. Vents and vent systems. Exception: The systems listed in this section are permitted to be located below the elevation required by Section 1612 of the building code for utilities and attendant equipment, provided that the systems are designed and installed to prevent water from entering or accumulating within their components and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation. | 310.1 Light and ventilation. Washrooms and toilet rooms shall be illuminated and ventilated in accordance with the building code and mechanical code. |

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| 310.2 Location of fixtures and compartments. The location of plumbing fixtures and the requirements for compartments and partitions shall be in accordance with Section 405.3. | 310.2 Location of fixtures and compartments. The location of plumbing fixtures and the requirements for compartments and partitions shall be in accordance with Section 405.3. |
| 310.4 Enforcement. Enforcement of the provisions of this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance. | 312.1 Required tests. The owner or owner's representative shall cause the applicable tests and inspections prescribed in Sections 312.2 through 312.11 to be performed to determine that the work will withstand the prescribed test without leakage and to demonstrate the integrity of the device or assembly. In accordance with OBC Section 108.8, reasonable advanced notice shall be given to the building official when the plumbing work is ready for tests. The building official may require that the tests be conducted in the presence of the building official or certified plumbing inspector. The owner or owner's representative shall keep records of the tests and inspections and shall submit such records to the building official upon request |

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| 312.1.1 New, altered, extended or repaired systems. New plumbing systems and parts of existing systems that have been altered, extended, or repaired shall be tested as prescribed herein to disclose leaks and defects, except that testing is not required in the following cases: 1. In any case that does not include addition to, replacement, alteration or relocation of any water supply, drainage or vent piping. 2. In any case where plumbing equipment is set up temporarily for exhibition purposes. | 312.1.2 Equipment, material, power and labor for tests. Equipment, material, power and labor necessary for testing a plumbing system or part thereof shall be furnished by the owner or the owner's representative. Required tests shall be conducted by and at the expense of the owner or the owner's representative. |
| 312.1.3 Test gauges. Gauges used for testing shall be as follows:<br>1. Tests requiring a pressure of 10 pounds per square inch (psi) (69 kPa) or less shall utilize a testing gauge having increments of 0.10 psi (0.69 kPa) or less. 2. Tests requiring a pressure of greater than 10 psi (69 kPa) but less than or equal to 100 psi (689 kPa) shall utilize a testing gauge having increments of 1 psi (6.9 kPa) or less. 3. Tests requiring a pressure of greater than 100 psi (689 kPa) shall utilize a testing gauge having increments of 2 psi (14 kPa) or less. | 312.1.4 Test media. All plumbing system piping, fittings, and shower liners shall be tested with water. Exception: Plumbing system piping and fittings are permitted to be tested as prescribed in Sections 312.2 to 312.8 with air, another compressed gas, vacuum, or other media or method only when the manufacturer of the proposed piping, fittings and solvent cement (if applicable) allows the alternative method of testing. Where this code does not address or prescribe an alternative test method, an alternative test method prescribed by the manufacturer of the piping, fittings, or solvent cement in the published manufacturer's installation instructions will be acceptable as meeting the requirements of this code. |

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| 312.1.5 Reinspection and testing. Where any work or installation does not pass any initial test or inspection, the necessary corrections shall be made to comply with this code. | 312.2 Drainage and vent rough-in test. Drainage and vent piping and fittings shall be tested prior to the installation of the plumbing fixtures and prior to the installation of wall and ceiling coverings to verify the integrity of the system in accordance with one of the following methods prescribed in Section 312.2.1, 312.2.2, or 312.2.3: |
| 312.2.1 Drainage and vent rough-in water test. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot (3048 mm) head of water. In testing successive sections, at least the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet (3048 mm) of the system, shall have been submitted to a test of less than a 10-foot (3048 mm) head of water. This pressure shall be held for at least 15 minutes. The system shall then be tight at all points. | 312.2.2 Drainage and vent rough-in air test. When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi (34.5 kPa) or sufficient to balance a 10-inch (254 mm) column of mercury. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period. Testing shall be done with dual pressure relief valves rated for 7.5 psig. |

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| 312.2.3 Alternative drainage and vent rough–in test. When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an alternative method of testing the drainage and vent system, such as compressed gas or vacuum, may be permitted to meet the drainage and vent rough-in test requirements of this code as long as the test is conducted strictly in accordance with the requirements published in the manufacturer's installation instructions. | 312.4 Drainage and vent final test. After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be subjected to one of the following final tests as prescribed by the building official: |
| 312.4.1 Visual and operational final test. All plumbing fixtures shall be operated and a visual inspection of accessible piping and joints shall be performed to determine that there are no visible leaks. | 312.4.2 Drainage and vent final test. The final test of the completed drainage and vent systems shall be made, after the fixtures are connected, as follows: 1. Close all stack openings; 2. A manometer tube shall be placed through a trap seal to the system side and water shall be added to a fixture until an equivalent of at least 1 in. water column (248.8 Pa) is read on the manometer gauge or watercan. Water may be added to a water closet bowl or trap tailpiece extension until the water level is at least one inch higher than the original trap seal;<br>3. Maintain the initial water column for fifteen (15) minutes; 4. The system shall then be separated at a trap seal, AAV, or other means as directed by the plumbing inspector for verification that the entire system is interconnected. |

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| 312.4.3 Alternative drainage and vent final test. Any other testing method equal to the 1 in. water column. Except as provided for in Section 312.4.2, compressed or stored air may not be used unless otherwise permitted by the manufacturer of piping, fittings, and solvent cement (if part of the plumbing system). | 312.5 Water supply system test. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested to verify the integrity of the system in accordance with one of the following methods prescribed in Sections 312.5.1 or 312.5.2: |
| 312.5.1 Water supply working pressure test. A water pressure test at not less than the working pressure under which the system is to be used shall be performed to prove the system watertight. This pressure shall be held for at least 15 minutes. The water utilized for tests shall be obtained from a potable source of supply. | 312.5.2 Water supply air test. When permitted by the manufacturer of the piping, fittings, and solvent cement (if part of the plumbing system), an air test of not less than 50 psi (344 kPa) shall be performed to prove the system airtight. This pressure shall be held for at least 15 minutes. |

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| 312.8 Storm drainage system test. Storm drain systems within a building shall be tested in accordance with Section 312.2. | 312.9 Shower liner test. Where shower floors and receptors are made water-tight by the application of materials required by Section 417.5.2, the completed liner installation shall be tested. The pipe from the shower drain shall be plugged water tight for the test. The floor and receptor area shall be filled with potable water to a depth of not less than 2 inches (51 mm) measured at the threshold. Where a threshold of at least 2 inches (51 mm) high does not exist, a temporary threshold shall be constructed to retain the test water in the lined floor or receptor area to a level not less than 2 inches (51 mm) deep measured at the threshold. The water shall be retained for a test period of not less than 15 minutes, and there shall not be evidence of leakage. Exception: The shower liner test is not required for one-, two-, or threefamily dwellings unless required by the shower liner manufacturer's installation instructions. |
| 312.10 Inspection and testing of isolation backflow prevention devices required by this code. Inspection and testing of isolation backflow prevention devices shall comply with Sections 312.10.1 and 312.10.2. Inspection and testing requirements for containment backflow prevention devices required by the water supplier shall be in accordance with rule 3745-95-06 of the Administrative Code and enforced by the water supplier. | 312.10.1 Inspections. The owner shall maintain all backflow prevention assemblies and air gaps in good working condition. Annual inspections shall be made of all backflow prevention assemblies and air gaps to determine whether they are operable. |

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| 312.10.2 Testing. Reduced pressure principle, double check, pressure vacuum breaker, reduced pressure detector fire protection, double check detector fire protection, and spill-resistant vacuum breaker backflow prevention assemblies and hose connection backflow preventers shall be tested at the time of installation, immediately after repairs or relocation and at least annually. The testing procedure shall be performed in accordance with one of the following standards: ASSE 5013 for reduced pressure principle and reduced pressure principle fire protection backflow prevention assemblies, ASSE 5015 for double check and double check fire protection backflow prevention assemblies, ASSE 5020 for pressure vacuum breaker assemblies, ASSE 5047 for reduced pressure detector fire protection backflow prevention assemblies, ASSE 5048 for double check detector fire protection backflow prevention assemblies, ASSE 5052 for hose connection backflow preventers, ASSE 5056 for spill resistant vacuum breaker assemblies, CSA B64.10 or CSA B64.10.1. | 312.11 Operational testing of low pressure cut-off device, low suction throttling valves, and variable speed suction limiting controls. Although enforcement of this section is outside the scope of the plumbing code, it is important for owners to note that rule 3745-95-07 of the Administrative Code requires that the owner certify to the supplier of water that their low pressure cut-off devices, low suction throttling valves, and variable speed suction limiting controls are maintained in proper working order. Enforcement of this requirement and the referenced rule is the responsibility of the water supplier. See Section 606.5.5 of this code for additional information. |
| 312.12 Inspections. No part of any plumbing or drainage system shall be covered until it has been inspected, tested, and approved, except as provided in this section. Failure of the inspector to inspect the work within four days, exclusive of Saturdays, Sundays, and legal holidays, after the work is ready for inspection, allows the work to proceed. | 313.1 General. Equipment efficiencies shall be in accordance with the applicable standard referenced in Chapter 13 of the building code or Chapter 11 of the “Residential Code of Ohio”. |

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| 314.1 Fuel-burning appliances. Liquid combustion byproducts of condensing appliances shall be collected and discharged to an approved plumbing fixture or disposal area in accordance with the manufacturer's instructions. Condensate piping shall be of approved corrosion-resistant material and shall not be smaller than the drain connection on the appliance. Such piping shall maintain a horizontal slope in the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope). | 314.2 Evaporators and cooling coils. Condensate drain systems shall be provided for equipment and appliances containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with Sections 314.2.1 through 314.2.5. |
| 314.2.1 Condensate disposal. Condensate from all cooling coils and evaporators shall be conveyed from the drain pan outlet to an approved place of disposal. Such piping shall maintain a horizontal slope in the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1- percent slope). Condensate shall not discharge into a street, alley or other areas so as to cause a nuisance. | 314.2.2 Drain pipe materials and sizes. Components of the condensate disposal system shall be cast iron, galvanized steel, copper, cross-linked polyethylene, polyethylene, ABS, CPVC or PVC or polypropylene pipe or tubing. All components shall be selected for the pressure and temperature rating of the installation. Joints and connections shall be made in accordance with the applicable provisions of Chapter 7 relative to the material type. Condensate waste and drain line size shall be not less than 3 /4-inch (19.1 mm) internal diameter and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with Table 314.2.2. |

**TABLE 314.2.2**
**CONDENSATE DRAIN SIZING**

| EQUIPMENT CAPACITY | MINIMUM CONDENSATE PIPE DIAMETER (inch) |
|---|---|
| Up to 20 tons of refrigeration | 3/4 inch |
| Over 20 tons to 40 tons of refrigeration | 1 inch |
| Over 40 tons to 90 tons of refrigeration | $1^{1}/_{4}$ inch |
| Over 90 tons to 125 tons of refrigeration | $1^{1}/_{2}$ inch |
| Over 125 tons to 250 tons of refrigeration | 2 inch |

For SI: 1 inch = 25.4 mm, 1 ton of capacity = 3.517 kW.

314.2.3 Auxiliary and secondary drain systems. In addition to the requirements of Section 314.2.1, where damage to any building components could occur as a result of overflow from the equipment primary condensate removal system, one of the following auxiliary protection methods shall be provided for each cooling coil or fuel-fired appliance that produces condensate: 1. An auxiliary drain pan with a separate drain shall be provided under the coils on which condensation will occur. The auxiliary pan drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The pan shall have a depth of not less than 11 /2 inches (38 mm), shall be not less than 3 inches (76 mm) larger than the unit or the coil dimensions in width and length and shall be constructed of corrosion-resistant material. Galvanized sheet metal pans shall have a thickness of not less than 0.0236-inch (0.6010 mm) (No. 24 gage) galvanized sheet metal. Nonmetallic pans shall have a thickness of not less than 0.0625 inch (1.6 mm). 2. A separate overflow drain line shall be connected to the drain pan provided with the equipment. Such overflow drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The overflow drain line shall connect to the drain pan at a higher level than the primary drain connection. 3. An auxiliary drain pan without a separate drain line shall be provided under the coils on which condensate will occur. Such pan shall be equipped with a water-level detection device conforming to UL 508 that will shut off the equipment served prior to overflow of the pan. The auxiliary drain pan shall be constructed in accordance with Item 1 of this section. 4. A water-level detection device conforming to UL508 shall be provided that will shut off the equipment served in the event that the primary drain is blocked. The device shall be installed in the primary drain line, the overflow drain line or in the equipment-supplied drain pan, located at a point higher than the primary drain line connection and below the overflow rim of such pan. Exception: Fuel-fired appliances that automatically shut down operation in the event of a stoppage in the condensate drainage system.

314.2.3.1 Water-level monitoring devices. On down-flow units and all other coils that do not have a secondary drain or provisions to install a secondary or auxiliary drain pan, a water-level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served in the event that the primary drain becomes restricted. Devices installed in the drain line shall not be permitted.

314.2.3.1 Water-level monitoring devices. On down-flow units and all other coils that do not have a secondary drain or provisions to install a secondary or auxiliary drain pan, a water-level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served in the event that the primary drain becomes restricted. Devices installed in the drain line shall not be permitted.

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| 314.2.4 Traps. Condensate drains shall be trapped as required by the equipment or appliance manufacturer. | 314.2.4.1 Ductless mini-split system traps. Ductless mini-split equipment that produces condensation shall be provided with an in-line check valve located in the drain line or a trap. |
| 314.2.5 Cleanouts. Condensate drain lines shall be configured to permit the clearing of blockages and performance of maintenance without requiring the drain line to be cut. | 314.3 Enforcement. Enforcement of the provisions of this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance. |

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| 315.1 Sealing of annular spaces. The annular space between the outside of a pipe and the inside of a pipe sleeve or between the outside of a pipe and an opening in a building envelope wall, floor, or ceiling assembly penetrated by a pipe shall be sealed in an approved manner with caulking material, foam sealant or closed with a gasketing system. The caulking material, foam sealant or gasketing system shall be designed for the conditions at the penetration location and shall be compatible with the pipe, sleeve and building materials in contact with the sealing materials. Annular spaces created by pipes penetrating fireresistance-rated assemblies or membranes of such assemblies shall be sealed or closed in accordance with Section 714 of the building code. | 317.1 Scope. This section, consistent with section 4104.44 of the Revised Code, governs the requirements for welding and brazing of metallic building services (including medical gas) piping systems referenced by this code. |
| 317.2 Procedure specification. Each manufacturer or contractor of metallic building services piping systems is responsible for the welding and brazing done by his company or organization and shall specify and certify, in writing, a welding or brazing procedure that provides specific direction to the welder or brazer and complies with section IX of the ASME Boiler and Pressure Vessel Code. | 317.3 Procedure qualification records. Each manufacturer or contractor is responsible for getting each procedure described in section 317.2 qualified by an independent testing laboratory that has, on staff, a welding inspector certified by the “American Welding Society (AWS).” Qualification testing determines that the specified joint construction is capable of providing the required properties for its intended application. The procedure qualification record (PQR) documents what occurred during the welding or brazing of the test coupon, identifies all essential variables, and documents the test results. The manufacturer or contractor shall certify on the record that the tests were conducted in accordance with section IX of the ASME Boiler and Pressure Vessel Code. |

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| 317.4 Performance qualification testing. Each welder and brazer that performs a welding or brazing procedure as described in section 317.2 shall be tested and qualified on that procedure as required in section IX of the ASME Boiler and Pressure Vessel Code. The manufacturer or contractor, shall certify on the performance qualification record that the welder or brazer prepared and welded or brazed the test coupons in accordance with section IX and that the test coupons were tested by an independent testing laboratory that has, on staff, a welding inspector certified by the "American Welding Society (AWS)." | 317.5 Submission of welding and brazing forms to the division of industrial compliance (DIC). Each manufacturer or contractor of metallic building services piping systems referenced by this code who causes welding or brazing to be performed shall file with the superintendent of the division of industrial compliance in the department of commerce, or the superintendent's designee, certified copies of the welding and brazing procedure specifications, the procedure qualification records, and the welder and brazer performance qualifications of the welders and brazers used in the proposed construction of a new or altered piping system. The required documentation shall be submitted in accordance with rules adopted by the superintendent. |
| | |

From: Karen Turnau <kturnau@hotmail.com>

Sent: Wednesday, November 03, 2021 9:53 AM

To: Lane, Michael

Subject:Re: course submission

Hi Mike,

The plumbing code I submitted are the slides. The instructor talks from the plumbing code on the slide and gives inspectors the opportunity to ask questions.

Thanks

Karen

# SECTION 701 GENERAL

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| 701.1 Scope. The provisions of this chapter shall govern the materials, design, construction and installation of sanitary drainage systems. In accordance with section 3781.03 of the Revised Code, the department of the city engineer, in cities having such departments, the boards of health districts, or the sewer purveyor, as appropriate, shall have complete supervision and regulation of the entire sewerage and drainage system of the jurisdiction, including the building sewer and all laterals draining into the street sewers. Exception: Private sewage disposal systems within the scope of the "Ohio Department of Health" rules contained within Chapter 3701-29 of the Administrative Code, "Household Sewage Disposal Systems". | 701.2 Sewer required. Except where permitted by the "Ohio Environmental Protection Agency", every building in which plumbing fixtures are installed and premises having drainage piping shall be connected to a public sewer, where available, or an approved private sewage disposal system. |
| 701.3 Separate sewer connection. Except where permitted by the "Ohio Environmental Protection Agency", every building having plumbing fixtures installed and intended for human habitation, occupancy or use on premises abutting on a street, alley or easement in which there is a public sewer shall have a separate connection with the sewer. Where located on the same lot, multiple buildings shall not be prohibited from connecting to a common building sewer that connects to the public sewer. | 701.4 Sewage treatment. Sewage or other waste from a plumbing system that is deleterious to surface or subsurface waters shall not be discharged into the ground or into any waterway without prior approval from the "Ohio Environmental Protection Agency" for the form of treatment and for the location of discharge. |

# SECTION 701 GENERAL

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| 701.5 Damage to drainage system or public sewer. Except where permitted by the “Ohio Environmental Protection Agency”, wastes detrimental to the public sewer system or to the functioning of the sewage-treatment plant shall be treated and disposed of in accordance with requirements of the local sewer purveyor. | 701.6 Tests. The sanitary drainage system shall be tested in accordance with Section 312. |
| 701.7 Engineered systems. Engineered sanitary drainage systems shall conform to the provisions of Sections 106.5 of the building code and 714. | 701.8 Drainage piping in food service areas. Exposed soil or waste piping shall not be installed above any areas used for food preparation or storage, or above storage or eating surfaces in food service establishments. |

# SECTION 701 GENERAL

702.1 Above-ground sanitary drainage and vent pipe. Above-ground soil, waste and vent pipe shall conform to one of the standards listed in Table 702.1.

702.2 Underground building sanitary drainage and vent pipe. Underground building sanitary drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

**TABLE 702.1**
**ABOVE-GROUND DRAINAGE AND VENT PIPE**

| MATERIAL | STANDARD |
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| Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall | ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1 |
| Brass pipe | ASTM B 43 |
| Cast-iron pipe | ASTM A 74; ASTM A 888; CISPI 301 |
| Copper or copper-alloy pipe | ASTM B 42; ASTM B 302 |
| Copper or copper-alloy tubing (Type K, L, M or DWV) | ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306 |
| Galvanized steel pipe | ASTM A 53 |
| Glass pipe | ASTM C 1053 |
| Polyolefin pipe | ASTM F 1412; CSA B181.3 |
| Polyvinyl chloride (PVC) plastic pipe in IPS diameters, incluing Schedule 40, DR 22 (PS 200), and DR 24 (PS 140); with a solid, cellular core or composite wall | ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2 |
| Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall | ASTM D 2949, ASTM F 1488 |
| Polyvinylidene fluoride (PVDF) plastic pipe | ASTM F 1673; CSA B181.3 |
| Stainless steel drainage systems, Types 304 and 316L | ASME A112.3.1 |

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| 702.4 Fittings. Pipe fittings shall be approved for installation with the piping material installed and shall comply with the applicable standards listed in Table 702.4. | 702.5 Temperature rating. Where the waste water temperature will be greater than 140°F (60°C), the sanitary drainage piping material shall be rated for the highest temperature of the waste water. |
| 702.6 Chemical waste system. A chemical waste system shall be completely separated from the sanitary drainage system. The chemical waste shall be treated in accordance with Section 803.2 before discharging to the sanitary drainage system. Separate drainage systems for chemical wastes and vent pipes shall be of an approved material that is resistant to corrosion and degradation for the concentrations of chemicals involved. | 702.7 Lead bends and traps. The wall thickness of lead bends and traps shall be not less than 1 /8 inch (3.2 mm). |

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**TABLE 702.2**
**UNDERGROUND BUILDING DRAINAGE AND VENT PIPE**

| MATERIAL | STANDARD |
|---|---|
| Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall | ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1 |
| Cast-iron pipe | ASTM A 74; ASTM A 888; CISPI 301 |
| Copper or copper-alloy tubing (Type K, L, M or DWV) | ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306 |
| Polyolefin pipe | ASTM F 1412; CSA B181.3 |
| Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall | ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2 |
| Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall | ASTM D 2949, ASTM F 1488 |
| Polyvinylidene fluoride (PVDF) plastic pipe | ASTM F 1673; CSA B181.3 |
| Stainless steel drainage systems, Type 316L | ASME A 112.3.1 |

For SI: 1 inch = 25.4 mm.

**TABLE 702.4**
**PIPE FITTINGS**

| MATERIAL | STANDARD |
|---|---|
| Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters | ASTM D 2661; ASTM F 628; CSA B181.1 |
| Acrylonotrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters | ASTM D 2751 |
| Cast iron | ASME B 16.4; ASME B 16.12; ASTM A 74; ASTM A 888; CISPI 301 |
| Copper or copper alloy | ASME B 16.15; ASME B 16.18; ASME B 16.22; ASME B 16.23; ASME B 16.26; ASME B 16.29 |
| Glass | ASTM C 1053 |
| Gray iron and ductile iron | AWWA C 110/A21.10 |
| Malleable iron | ASME B 16.3 |
| Polyolefin | ASTM F 1412; CSA B181.3 |
| Polyvinyl chloride (PVC) plastic in IPS diameters | ASTM D 2665; ASTM F 1866 |
| Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters | ASTM D 3034 |
| Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. | ASTM D 2949 |
| Polyvinylidene fluoride (PVDF) plastic pipe | ASTM F 1673; CSA B181.3 |
| Stainless steel drainage systems, Types 304 and 316L | ASME A 112.3.1 |
| Steel | ASME B 16.9; ASME B 16.11; ASME B 16.28 |
| Vitrified clay | ASTM C 700 |

For SI: 1 inch = 25.4 mm.

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704.1 Slope of horizontal drainage piping. Horizontal drainage piping shall be installed in uniform alignment at uniform slopes. The slope of a horizontal drainage pipe shall be not less than that indicated in Table 704.1.

**TABLE 704.1**
**SLOPE OF HORIZONTAL DRAINAGE PIPE**

| SIZE (inches) | MINIMUM SLOPE (inch per foot) |
|---|---|
| $2^1/_2$ or less | $^1/_4$ |
| 3 to 6 | $^1/_8$ |
| 8 or larger | 1/16 |

For SI: 1 inch = 25.4 mm, 1 inch per foot = 83.33 mm/m.

704.2 Change in size. The size of the drainage piping shall not be reduced in size in the direction of the flow. A 4-inch by 3-inch (102 mm by 76 mm) water closet connection shall not be considered as a reduction in size.

704.3 Connections to offsets and bases of stacks. Horizontal branches shall connect to the bases of stacks at a point located not less than 10 times the diameter of the drainage stack downstream from the stack. Horizontal branches shall connect to horizontal stack offsets at a point located not less than 10 times the diameter of the drainage stack downstream from the upper stack.

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| 704.4 Future fixtures. Drainage piping for future fixtures shall terminate with an approved cap or plug. | 705.1 General. This section contains provisions applicable to joints specific to sanitary drainage piping. |
| 705.2 ABS plastic. Joints between ABS plastic pipe or fittings shall comply with Sections 705.2.1 through 705.2.3. | 705.2.1 Mechanical joints. Mechanical joints on drainage pipes shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed only in underground systems unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions. |

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| 705.2.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent cement joints shall be permitted above or below ground. | 705.2.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only. |
| 705.3 Brass. Joints between brass pipe or fittings shall comply with Sections 705.3.1 through 705.3.4. | 705.3.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8. |

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| 705.3.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 705.3.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only. |
| 705.3.4 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal. | 705.4 Cast iron. Joints between cast-iron pipe or fittings shall comply with Sections 705.4.1 through 705.4.3. |

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| 705.4.1 Caulked joints. Joints for hub and spigot pipe shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation to a depth of not less than 1 inch (25 mm). The lead shall not recede more than 1 /8 inch (3.2 mm) below the rim of the hub and shall be caulked tight. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acid-proof cement shall be permitted. | 705.4.2 Compression gasket joints. Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C 564 and shall be tested to ASTM C 1563. Gaskets shall be compressed when the pipe is fully inserted. |
| 705.4.3 Mechanical joint coupling. Mechanical joint couplings for hubless pipe and fittings shall consist of an elastomeric sealing sleeve and a metallic shield that comply with CISPI 310, ASTM C 1277 or ASTM C 1540. The elastomeric sealing sleeve shall conform to ASTM C 564 or CSA B602 and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's instructions. | 705.5 Concrete joints. Joints between concrete pipe and fittings shall be made with an elastomeric seal conforming to ASTM C 443, ASTM C 1173, CSA A257.3M or CSA B602. |

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| 705.6 Copper pipe. Joints between copper or copper-alloy pipe or fittings shall comply with Sections 705.6.1 through 705.6.5. | 705.6.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8. |
| 705.6.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 705.6.3 Solder joints. Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32. |

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| 705.6.4 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only | 705.6.5 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal. |
| 705.7 Copper tubing. Joints between copper or copper-alloy tubing or fittings shall comply with Sections 705.7.1 through 705.7.3. | 705.7.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8 |

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| 705.7.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 705.7.3 Solder joints. Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32. |
| 705.8 Borosilicate glass joints. Glass-to-glass connections shall be made with a bolted compression-type, 300 series stainless steel coupling with contoured acidresistant elastomeric compression ring and a fluorocarbon polymer inner seal ring; or with caulked joints in accordance with Section 705.8.1. | 705.8.1 Caulked joints. Lead-caulked joints for hub and spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch (25 mm) in depth and not to recede more than 1 /8 inch (3.2 mm) below the rim of the hub. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acidresistant rope and acidproof cement shall be permitted. |

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| 705.9 Steel. Joints between galvanized steel pipe or fittings shall comply with Sections 705.9.1 and 705.9.2. | 705.9.1 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only. |
| 705.9.2 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 705.10 Lead. Joints between lead pipe or fittings shall comply with Sections 705.10.1 and 705.10.2. |

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| 705.10.1 Burned. Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe. | 705.10.2 Wiped. Joints shall be fully wiped, with an exposed surface on each side of the joint not less than 3 /4 inch (19.1 mm). The joint shall be not less than 3 /8 inch (9.5 mm) thick at the thickest point. |
| 705.11 PVC plastic. Joints between PVC plastic pipe or fittings shall comply with Sections 705.11.1 through 705.11.3. | 705.11.1 Mechanical joints. Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions. |

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| 705.11.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. A primer that conforms to ASTM F 656 shall be applied. Solvent cement conforming to ASTM D 2564, CSA B137.3, CSA B181.2 or CSA B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent cement joints shall be permitted above or below ground. Exception: A primer is not required where both of the following conditions apply:<br>1. The solvent cement used is third-party certified as conforming to ASTM D 2564.<br>2. The solvent cement is used only for joining PVC drain, waste and vent pipe and fittings in nonpressure applications in sizes up to and including 4 inches (102 mm) in diameter | 705.11.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only. |
| 705.12 Vitrified clay. Joints between vitrified clay pipe or fittings shall be made with an elastomeric seal conforming to ASTM C 425, ASTM C 1173 or CSA B602. | 705.13 Polyethylene plastic pipe. Joints between polyethylene plastic pipe and fittings shall be underground and shall comply with Section 705.13.1 or 705.13.2. |

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| 705.13.1 Heat-fusion joints. Joint surfaces shall be clean and free from moisture. All joint surfaces shall be cut, heated to melting temperature and joined using tools specifically designed for the operation. Joints shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657 and the manufacturer's instructions. | 705.13.2 Mechanical joints. Mechanical joints in drainage piping shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed in accordance with the manufacturer's instructions. |
| 705.14 Polyolefin plastic. Joints between polyolefin plastic pipe and fittings shall comply with Sections 705.14.1 and 705.14.2. | 705.14.1 Heat-fusion joints. Heat-fusion joints for polyolefin pipe and tubing joints shall be installed with sockettype heat-fused polyolefin fittings or electrofusion polyolefin fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1412 or CSA B181.3. |

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| 705.14.2 Mechanical and compression sleeve joints. Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's instructions. | 705.15 Polyvinylidene fluoride plastic. Joints between polyvinylidene plastic pipe and fittings shall comply with Sections 705.15.1 and 705.15.2. |
| 705.15.1 Heat-fusion joints. Heat-fusion joints for polyvinylidene fluoride pipe and tubing joints shall be installed with socket-type heat-fused polyvinylidene fluoride fittings or electrofusion polyvinylidene fittings and couplings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1673. | 705.15.2 Mechanical and compression sleeve joints. Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's instructions. |

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| 705.16 Joints between different materials. Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type conforming to ASTM C 1173, ASTM C 1460 or ASTM C 1461. Connectors and adapters shall be approved for the application and such joints shall have an elastomeric seal conforming to ASTM C 425, ASTM C 443, ASTM C 564, ASTM C 1440, ASTM F 477, CSA A257.3M or CSA B602, or as required in Sections 705.16.1 through 705.16.7. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal. Joints shall be installed in accordance with the manufacturer's instructions. | 705.16.1 Copper or copper-alloy tubing to cast-iron hub pipe. Joints between copper or copper-alloy tubing and cast-iron hub pipe shall be made with a brass ferrule or compression joint. The copper or copper-alloy tubing shall be soldered to the ferrule in an approved manner, and the ferrule shall be joined to the cast-iron hub by a caulked joint or a mechanical compression joint. |
| 705.16.2 Copper or copper-alloy tubing to galvanized steel pipe. Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe. | 705.16.3 Cast-iron pipe to galvanized steel or brass pipe. Joints between cast-iron and galvanized steel or brass pipe shall be made by either caulked or threaded joints or with an approved adapter fitting. |

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| 705.16.4 Plastic pipe or tubing to other piping material. Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting. Joints between plastic pipe and cast-iron hub pipe shall be made by a caulked joint or a mechanical compression joint. | 705.16.5 Lead pipe to other piping material. Joints between lead pipe and other piping material shall be made by a wiped joint to a caulking ferrule, soldering nipple or bushing or shall be made with an approved adapter fitting. |
| 705.16.6 Borosilicate glass to other materials. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal and shall be installed in accordance with the manufacturer's instructions. | 705.16.7 Stainless steel drainage systems to other materials. Joints between stainless steel drainage systems and other piping materials shall be made with approved mechanical couplings. |

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705.17 Drainage slip joints. Slip joints shall comply with Section 405.8.

705.18 Caulking ferrules. Ferrules shall be of red brass and shall be in accordance with Table 705.18.

**TABLE 705.18**
**CAULKING FERRULE SPECIFICATIONS**

| PIPE SIZES (inches) | INSIDE DIAMETER (inches) | LENGTH (inches) | MINIMUM WEIGHT EACH |
|---|---|---|---|
| 2 | 2 ⅜ | 4 ½ | 1 pound |
| 3 | 3 ⅜ | 4 ½ | 1 pound 12 ounces |
| 4 | 4 ⅜ | 4 ½ | 2 pounds 8 ounces |

For SI: 1 inch = 25.4 mm, 1 ounce = 28.35 g, 1 pound = 0.454 kg.

705.19 Soldering bushings. Soldering bushings shall be of red brass and shall be in accordance with Table 705.19.

**TABLE 705.19**
**SOLDERING BUSHING SPECIFICATIONS**

| PIPE SIZES (inches) | MINIMUM WEIGHT EACH |
|---|---|
| 1 ¼ | 6 ounces |
| 1 ½ | 8 ounces |
| 2 | 14 ounces |
| 2 ½ | 1 pound 6 ounces |
| 3 | 2 pounds |
| 4 | 3 pounds 8 ounces |

For SI: 1 inch = 25.4 mm, 1 ounce = 28.35 g, 1 pound = 0.454 kg.

705.20 Stainless steel drainage systems. O-ring joints for stainless steel drainage systems shall be made with an approved elastomeric seal.

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706.1 Connections and changes in direction. All connections and changes in direction of the sanitary drainage system shall be made with approved drainage fittings. Connections between drainage piping and fixtures shall conform to Section 405.

706.2 Obstructions. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type. This section shall not be applicable to tubular waste fittings used to convey vertical flow upstream of the trap seal liquid level of a fixture trap.

706.3 Installation of fittings. Fittings shall be installed to guide sewage and waste in the direction of flow. Change in direction shall be made by fittings installed in accordance with Table 706.3. Change in direction by combination fittings, side inlets or increasers shall be installed in accordance with Table 706.3 based on the pattern of flow created by the fitting. Double sanitary tee patterns shall not receive the discharge of back-to-back water closets and fixtures or appliances with pumping action discharge. When a through penetration of an exterior foundation wall assembly occurs, drainage fitting joints shall not occur within that exterior foundation wall assembly.
Exception: Back-to-back water closet connections to double sanitary tees shall be permitted where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee pattern is 18 inches (457 mm) or greater.

**TABLE 706.3**
**FITTINGS FOR CHANGE IN DIRECTION**

| TYPE OF FITTING PATTERN | CHANGE IN DIRECTION | | |
|---|---|---|---|
| | Horizontal to vertical | Vertical to horizontal | Horizontal to horizontal |
| Sixteenth bend | X | X | X |
| Eighth bend | X | X | X |
| Sixth bend | X | X | X |
| Quarter bend | X | X[a] | X[a] |
| Short sweep | X | X[a,b] | X[a] |
| Long sweep | X | X | X |
| Sanitary tee | X[c] | — | — |
| Wye | X | X | X |
| Combination wye and eighth bend | X | X | X |

For SI: 1 inch = 25.4 mm.
a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.
b. Three inches or larger.
c. For a limitation on double sanitary tees, see Section 706.3.

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| 706.4 Heel- or side-inlet quarter bends. Heel-inlet quarter bends shall be an acceptable means of connection, except where the quarter bend serves a water closet. A low-heel inlet shall not be used as a wet-vented connection. Side-inlet quarter bends shall be an acceptable means of connection for drainage, wet venting and stack venting arrangements. | 707.1 Prohibited joints. The following types of joints and connections shall be prohibited:<br>1. Cement or concrete joints.<br>2. Mastic or hot-pour bituminous joints.<br>3. Joints made with fittings not approved for the specific installation.<br>4. Joints between different diameter pipes made with elastomeric rolling Orings.<br>5. Solvent-cement joints between different types of plastic pipe.<br>6. Saddle-type fittings. |
| 708.1 Cleanouts required. Cleanouts shall be provided for drainage piping in accordance with Sections 708.1.1 through 708.1.11. | 708.1.1 Horizontal drains and building drains. Horizontal drainage pipes in buildings shall have cleanouts located at intervals of not more than 100 feet (30 480 mm). Building drains shall have cleanouts located at intervals of not more than 100 feet (30 480 mm) except where manholes are used instead of cleanouts, the manholes shall be located at intervals of not more than 400 feet (122 m). The interval length shall be measured from the cleanout or manhole opening, along the developed length of the piping to the next drainage fitting providing access for cleaning, the end of the horizontal drain or the end of the building drain. Exception: Horizontal fixture drain piping serving a nonremovable trap shall not be required to have a cleanout for the section of piping between the trap and the vent connection for such trap. |

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| 708.1.3 Building drain and building sewer junction. The junction of the building drain and the building sewer shall be served by a cleanout that is located at the junction or within 10 feet (3048 mm) of the developed length of piping upstream of the junction. For the requirements of this section, the removal of the water closet shall not be required to provide cleanout access. | 708.1.4 Changes of direction. Where a horizontal drainage pipe, a building drain or a building sewer has a change of horizontal direction greater than 45 degrees (0.79 rad), a cleanout shall be installed at the change of direction. Where more than one change of horizontal direction greater than 45 degrees (0.79 rad) occurs within 40 feet (12 192 mm) of developed length of piping, the cleanout installed for the first change of direction shall serve as the cleanout for all changes in direction within that 40 feet (12 192 mm) of developed length of piping. |
| 708.1.5 Cleanout size. Cleanouts shall be the same size as the piping served by the cleanout, except that cleanouts for piping larger than 4 inches (102 mm) need not be larger than 4 inches (102 mm).<br>Exceptions:<br>1. A removable P-trap with slip or ground joint connections can serve as a cleanout for drain piping that is one size larger than the P-trap size.<br>2. Cleanouts located on stacks can be one size smaller than the stack size.<br>3. The size of cleanouts for cast-iron piping can be in accordance with the referenced standards for cast-iron fittings as indicated in Table 702.4. | 708.1.6 Cleanout plugs. Cleanout plugs shall be of brass, plastic or other approved materials. Cleanout plugs for borosilicate glass piping systems shall be of borosilicate glass. Brass cleanout plugs shall conform to ASTM A 74 and shall be limited for use only on metallic piping systems. Plastic cleanout plugs shall conform to the referenced standards for plastic pipe fittings, as indicated in Table 702.4. Cleanout plugs shall have a raised square head, a countersunk square head or a countersunk slot head. Where a cleanout plug will have a trim cover screw installed into the plug, the plug shall be manufactured with a blind end threaded hole for such purpose. |

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| 708.1.7 Manholes. Manholes and manhole covers shall be of an approved type. Manholes located inside of a building shall have gas-tight covers that require tools for removal. | 708.1.8 Installation arrangement. The installation arrangement of a cleanout shall enable cleaning of drainage piping only in the direction of drainage flow.<br>Exceptions:<br>1. Test tees serving as cleanouts.<br>2. A two-way cleanout installation that is approved for meeting the requirements of Section 708.1.3. |
| 708.1.9 Required clearance. Cleanouts for 6-inch (153 mm) and smaller piping shall be provided with a clearance of not less than 18 inches (457 mm) from, and perpendicular to, the face of the opening to any obstruction. Cleanouts for 8-inch (203 mm) and larger piping shall be provided with a clearance of not less than 36 inches (914 mm) from, and perpendicular to, the face of the opening to any obstruction. | 708.1.10 Cleanout access. Required cleanouts shall not be installed in concealed locations. For the purposes of this section, concealed locations include, but are not limited to, the inside of plenums, within walls, within floor/ceiling assemblies, below grade and in crawl spaces where the height from the crawl space floor to the nearest obstruction along the path from the crawl space opening to the cleanout location is less than 24 inches (610 mm). Cleanouts with openings at a finished wall shall have the face of the opening located within 11 /2 inches (38 mm) of the finished wall surface. Cleanouts located below grade shall be extended to grade level so that the top of the cleanout plug is at or above grade. A cleanout installed in a floor or walkway that will not have a trim cover installed shall have a countersunk plug installed so the top surface of the plug is flush with the finished surface of the floor or walkway. |

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| 708.1.10.1 Cleanout plug trim covers. Trim covers and access doors for cleanout plugs shall be designed for such purposes and shall be approved. Trim cover fasteners that thread into cleanout plugs shall be corrosion resistant. Cleanout plugs shall not be covered with mortar, plaster or any other permanent material. | 708.1.10.2 Floor cleanout assemblies. Where it is necessary to protect a cleanout plug from the loads of vehicular traffic, cleanout assemblies in accordance with ASME A112.36.2M shall be installed. |
| 708.1.11 Prohibited use. The use of a threaded cleanout opening to add a fixture or to extend piping shall be prohibited except where another cleanout of equal size is installed with the required access and clearance. | 709.1 Values for fixtures. Drainage fixture unit values as given in Table 709.1 designate the relative load weight of different kinds of fixtures that shall be employed in estimating the total load carried by a soil or waste pipe, and shall be used in connection with Tables 710.1(1) and 710.1(2) of sizes for soil, waste and vent pipes for which the permissible load is given in terms of fixture units. |

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709.2 Fixtures not listed in Table 709.1. Fixtures not listed in Table 709.1 shall have a drainage fixture unit load based on the outlet size of the fixture in accordance with Table 709.2. The minimum trap size for unlisted fixtures shall be the size of the drainage outlet but not less than 11 /4 inches (32 mm).

TABLE 709.2
DRAINAGE FIXTURE UNITS FOR FIXTURE DRAINS OR TRAPS

| FIXTURE DRAIN OR TRAP SIZE (inches) | DRAINAGE FIXTURE UNIT VALUE |
|---|---|
| 1 ¼ | 1 |
| 1 ½ | 2 |
| 2 | 3 |
| 2 ½ | 4 |
| 3 | 5 |
| 4 | 6 |

For SI: 1 inch = 25.4 mm.

709.3 Values for continuous and semicontinuous flow. Drainage fixture unit values for continuous and semicontinuous flow into a drainage system shall be computed on the basis that 1 gpm (0.06 L/s) of flow is equivalent to two fixture units.

709.4 Values for indirect waste receptor. The drainage fixture unit load of an indirect waste receptor receiving the discharge of indirectly connected fixtures shall be the sum of the drainage fixture unit values of the fixtures that discharge to the receptor, but not less than the drainage fixture unit value given for the indirect waste receptor in Table 709.1 or 709.2

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709.4.1 Clear-water waste receptors. Where waste receptors such as floor drains, floor sinks and hub drains receive only clear-water waste from display cases, refrigerated display cases, ice bins, coolers and freezers, such receptors shall have a drainage fixture unit value of one-half.

710.1 Maximum fixture unit load. The maximum number of drainage fixture units connected to a given size of building sewer, building drain or horizontal branch of the building drain shall be determined using Table 710.1(1). The maximum number of drainage fixture units connected to a given size of horizontal branch or vertical soil or waste stack shall be determined using Table 710.1(2).

**TABLE 710.1(1)**
**BUILDING DRAINS AND SEWERS**

| DIAMETER OF PIPE (inches) | MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS CONNECTED TO ANY PORTION OF THE BUILDING DRAIN OR THE BUILDING SEWER, INCLUDING BRANCHES OF THE BUILDING DRAIN[a] | | | |
|---|---|---|---|---|
| | Slope per foot | | | |
| | 1/16 inch | 1/8 inch | 1/4 inch | 1/2 inch |
| 11/4 | — | — | 1 | 1 |
| 11/2 | — | — | 3 | 3 |
| 2 | — | — | 21 | 26 |
| 21/2 | — | — | 24 | 31 |
| 3 | — | 36 | 42 | 50 |
| 4 | — | 180 | 216 | 250 |
| 5 | — | 390 | 480 | 575 |
| 6 | — | 700 | 840 | 1,000 |
| 8 | 1,400 | 1,600 | 1,920 | 2,300 |
| 10 | 2,500 | 2,900 | 3,500 | 4,200 |
| 12 | 3,900 | 4,600 | 5,600 | 6,700 |
| 15 | 7,000 | 8,300 | 10,000 | 12,000 |

For SI: 1 inch = 25.4 mm, 1 inch per foot = 83.3 mm/m.
a. The minimum size of any building drain serving a water closet shall be 3 inches.

**TABLE 709.1**
**DRAINAGE FIXTURE UNITS FOR FIXTURES AND GROUPS**

| FIXTURE TYPE | DRAINAGE FIXTURE UNIT VALUE AS LOAD FACTORS | MINIMUM SIZE OF TRAP (inches) |
|---|---|---|
| Automatic clothes washers, commercial[e,g] | *Note a* | *Note a* |
| Automatic clothes washers, residential[g] | 2 | 2 |
| Bathroom group as defined in Section 202 (1.6 gpf water closet)[f] | 5 | — |
| Bathroom group as defined in Section 202 (water closet flushing greater than 1.6 gpf)[f] | 6 | — |
| Bathtub[b] (with or without overhead shower or whirlpool attachments) | 2 | 1½ |
| Bidet | 1 | 1¼ |
| Combination sink and tray | 2 | 1½ |
| Dental lavatory | 1 | 1¼ |
| Dental unit or cuspidor | 1 | 1¼ |
| Dishwashing machine[c], domestic | 2 | 1½ |
| Drinking fountain | ½ | 1¼ |
| Emergency floor drain | 0 | 2 |
| Floor drains[b] | 2h | 2 |
| Floor sinks | Note h | 2 |
| Kitchen sink, domestic | 2 | 1½ |
| Kitchen sink, domestic with food waste disposer and/or dishwasher | 2 | 1½ |
| Laundry tray (1 or 2 compartments) | 2 | 1½ |
| Lavatory | 1 | 1¼ |

# SECTION 701 GENERAL

| | | |
|---|---|---|
| Shower (based on the total flow rate through showerheads and body sprays)<br>Flow rate:<br>5.7 gpm or less | 2 | 1½ |
| Greater than 5.7 gpm to 12.3 gpm | 3 | 2 |
| Greater than 12.3 gpm to 25.8 gpm | 5 | 3 |
| Greater than 25.8 gpm to 55.6 gpm | 6 | 4 |
| Service sink | 2 | 1½ |
| Sink | 2 | 1½ |
| Urinal | 4 | Note d |
| Urinal, 1 gallon per flush or less | 2e | Note d |
| Urinal, nonwater supplied | ½ | Note d |
| Wash sink (circular or multiple) each set of faucets | 2 | 1½ |
| Water closet, flushometer tank, public or private | 4e | Note d |
| Water closet, private (1.6 gpf) | 3e | Note d |
| Water closet, private (flushing greater than 1.6 gpf) | 4e | Note d |
| Water closet, public (1.6 gpf) | 4e | Note d |
| Water closet, public (flushing greater than 1.6 gpf) | 6e | Note d |

For SI: 1 inch = 25.4 mm, 1 gallon = 3.785 L, gpf = gallon per flushing cycle, gpm = gallon per minute.

a. Calculate *per Section 709.3.*
b. A showerhead over a bathtub or whirlpool bathtub attachment does not increase the drainage fixture unit value.
c. See Sections 709.2 through 709.4.1 for methods of computing unit value of fixtures not listed in this table or for rating of devices with intermittent flows.
d. Trap size shall be consistent with the fixture outlet size.
e. For the purpose of computing loads on building drains and sewers, water closets and urinals shall not be rated at a lower drainage fixture unit unless the lower values are confirmed by testing.
f. For fixtures added to a bathroom group, add the dfu value of those additional fixtures to the bathroom group fixture count.
g. See Section *406.2* for sizing requirements for fixture drain, branch drain and drainage stack for an automatic clothes washer standpipe.
h. See Sections 709.4 and 709.4.1.

**TABLE 710.1(2)**
**HORIZONTAL FIXTURE BRANCHES AND STACKS[a]**

| DIAMETER OF PIPE (inches) | MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (dfu) | | | |
|---|---|---|---|---|
| | Total for | Stacks[b] | | |
| | horizontal branch | Total discharge into one branch interval | Total for stack of three branch Intervals or less | Total for stack greater than three branch intervals |
| 11/2 | 3 | 2 | 4 | 8 |
| 2 | 6 | 6 | 10 | 24 |
| 21/2 | 12 | 9 | 20 | 42 |
| 3 | 20 | 20 | 48 | 72 |
| 4 | 160 | 90 | 240 | 500 |
| 5 | 360 | 200 | 540 | 1,100 |
| 6 | 620 | 350 | 960 | 1,900 |
| 8 | 1,400 | 600 | 2,200 | 3,600 |
| 10 | 2,500 | 1,000 | 3,800 | 5,600 |
| 12 | 3,900 | 1,500 | 6,000 | 8,400 |
| 15 | 7,000 | Note c | Note c | Note c |

For SI: 1 inch = 25.4 mm.

a. Does not include branches of the building drain. Refer to Table 710.1(1).
b. Stacks shall be sized based on the total accumulated connected load at each story or branch interval. As the total accumulated connected load decreases, stacks are permitted to be reduced in size. Stack diameters shall not be reduced to less than one-half of the diameter of the largest stack size required.
c. Sizing load based on design criteria.

710.1.1 Horizontal stack offsets. Horizontal stack offsets shall be sized as required for building drains in accordance with Table 710.1(1), except as required by Section 711.3.

710.1.2 Vertical stack offsets. Vertical stack offsets shall be sized as required for straight stacks in accordance with Table 710.1(2), except where required to be sized as a building drain in accordance with Section 711.1.1.

# SECTION 701 GENERAL

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| 710.2 Future fixtures. Where provision is made for the future installation of fixtures, those provided for shall be considered in determining the required sizes of drain pipes. | 711.1 Horizontal branch connections above or below vertical stack offsets. If a horizontal branch connects to the stack within 2 feet (610 mm) above or below a vertical stack offset, and the offset is located more than four branch intervals below the top of the stack, the offset shall be vented in accordance with Section 906 907. |
| 711.1.1 Omission of vents for vertical stack offsets. Vents for vertical offsets required by Section 711.1 shall not be required where the stack and its offset are sized as a building drain [see Table 710.1(1)]. | 711.2 Horizontal stack offsets. A stack with a horizontal offset located more than four branch intervals below the top of the stack shall be vented in accordance with Section 907 and sized as follows: 1. The portion of the stack above the offset shall be sized as for a vertical stack based on the total number of drainage fixture units above the offset. 2. The offset shall be sized in accordance with Section710.1.1. 3. The portion of the stack below the offset shall be sized as for the offset or based on the total number of drainage fixture units on the entire stack, whichever is larger [see Table 710.1(2), Column 5]. |

# SECTION 701 GENERAL

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| 711.2.1 Omission of vents for horizontal stack offsets. Vents for horizontal stack offsets required by Section 711.2 shall not be required where the stack and its offset are one pipe size larger than required for a building drain [see Table 710.1(1)] and the entire stack and offset are not less in cross-sectional area than that required for a straight stack plus the area of an offset vent as provided for in Section 907. | 711.3 Offsets below lowest branch. Where a vertical offset occurs in a soil or waste stack below the lowest horizontal branch, a change in diameter of the stack because of the offset shall not be required. If a horizontal offset occurs in a soil or waste stack below the lowest horizontal branch, the required diameter of the offset and the stack below it shall be determined as for a building drain in accordance with Table 710.1(1). |
| 712.1 Building subdrains. Building subdrains that cannot be discharged to the sewer by gravity flow shall be discharged into a tightly covered and vented sump from which the liquid shall be lifted and discharged into the building gravity drainage system by automatic pumping equipment or other approved method. In other than existing structures, the sump shall not receive drainage from any piping within the building capable of being discharged by gravity to the building sewer. | 712.2 Valves required. A check valve and a full open valve located on the discharge side of the check valve shall be installed in the pump or ejector discharge piping between the pump or ejector and the gravity drainage system. Access shall be provided to such valves. Such valves shall be located above the sump cover required by Section 712.1 or, where the discharge pipe from the ejector is below grade, the valves shall be accessibly located outside the sump below grade in an access pit with a removable access cover.<br>Exception:<br>In buildings where the “Residential Code of Ohio” applies, only a check valve shall be required, located on the discharge piping from the sewage pump or ejector. |

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| 712.3 Sump design. The sump pump, pit and discharge piping shall conform to the requirements of Sections 712.3.1 through 712.3.5. | 712.3.1 Sump pump. The sump pump capacity and head shall be appropriate to anticipated use requirements. |
| 712.3.2 Sump pit. The sump pit shall be not less than 18 inches (457 mm) in diameter and not less than 24 inches (610 mm) in depth, unless otherwise approved. The pit shall be accessible and located such that all drainage flows into the pit by gravity. The sump pit shall be constructed of tile, concrete, steel, plastic or other approved materials. The pit bottom shall be solid and provide permanent support for the pump. The sump pit shall be fitted with a gastight removable cover that is installed flush with grade or floor level, or above grade or floor level. The cover shall be adequate to support anticipated loads in the area of use. The sump pit shall be vented in accordance with Chapter 9. | 712.3.3 Discharge pipe and fittings. Discharge pipe and fittings serving sump pumps and ejectors shall be constructed of materials in accordance with Sections 712.3.3.1 and 712.3.3.2 and shall be approve |

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| 712.3.3.1 Materials. Pipe and fitting materials shall be constructed of brass, copper, CPVC, ductile iron, PE, or PVC. | 712.3.3.2 Ratings. Pipe and fittings shall be rated for the maximum system operating pressure and temperature. Pipe fitting materials shall be compatible with the pipe material. Where pipe and fittings are buried in the earth, they shall be suitable for burial. |
| 712.3.4 Maximum effluent level. The effluent level control shall be adjusted and maintained to at all times prevent the effluent in the sump from rising to within 2 inches (51 mm) of the invert of the gravity drain inlet into the sump | 712.3.5. Pump connection to the drainage system. Pumps connected to the drainage system shall connect to a building sewer, building drain, soil stack, waste stack or horizontal branch drain. Where the discharge line connects into horizontal drainage piping, the connection shall be made through a wye fitting into the top of the drainage piping and such wye fitting shall be located not less than 10 pipe diameters from the base of any soil stack, waste stack or fixture drain. |

# SECTION 701 GENERAL

712.4 Sewage pumps and sewage ejectors. A sewage pump or sewage ejector shall automatically discharge the contents of the sump to the building drainage system.

712.4.1 Macerating toilet systems. Macerating toilet systems shall comply with ASME A112.3.4/CSA B45.9 and shall be installed in accordance with the manufacturer's instructions.

712.4.2 Capacity. A sewage pump or sewage ejector shall have the capacity and head for the application requirements. Pumps or ejectors that receive the discharge of water closets shall be capable of handling spherical solids with a diameter of up to and including 2 inches (51 mm). Other pumps or ejectors shall be capable of handling spherical solids with a diameter of up to and including 1 inch (25 mm). The capacity of a pump or ejector based on the diameter of the discharge pipe shall be not less than that indicated in Table 712.4.2. Exceptions: 1. Grinder pumps or grinder ejectors that receive the discharge of water closets shall have a discharge opening of not less than 11 /4 inches (32 mm). 2. Macerating toilet assemblies that serve single water closets shall have a discharge opening of not less than 3 /4 inch (19.1 mm).

**TABLE 712.4.2**
**MINIMUM CAPACITY OF SEWAGE PUMP OR SEWAGE EJECTOR**

| DIAMETER OF THE DISCHARGE PIPE (inches) | CAPACITY OF PUMP OR EJECTOR (gpm) |
|---|---|
| 1½-2 | 21 |
| 2½ | 30 |
| 3 | 46 |

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

# SECTION 701 GENERAL

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| 713.1 Scope. This section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to this section in addition to the other requirements of this code. The provisions of this section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes; homes for the aged; orphanages; infirmaries; first aid stations; psychiatric facilities; clinics; professional offices of dentists and doctors; mortuaries; educational facilities; surgery, dentistry, research and testing laboratories; establishments manufacturing pharmaceutical drugs and medicines; and other structures with similar apparatus and equipment classified as plumbing. | 713.2 Bedpan washers and clinical sinks. Bedpan washers and clinical sinks shall connect to the drainage and vent system in accordance with the requirements for a water closet. Bedpan washers shall also connect to a local vent. |
| 713.3 Indirect waste. Sterilizers, steamers and condensers shall discharge to the drainage through an indirect waste pipe by means of an air gap. Where a battery of not more than three sterilizers discharges to an individual receptor, the distance between the receptor and a sterilizer shall not exceed 8 feet (2438 mm). The indirect waste pipe on a bedpan steamer shall be trapped. | 713.4 Vacuum system station. Ready access shall be provided to vacuum system station receptacles. Such receptacles shall be built into cabinets or recesses and shall be visible. |

# SECTION 701 GENERAL

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| 713.5 Bottle system. Vacuum (fluid suction) systems intended for collecting, removing and disposing of blood, pus or other fluids by the bottle system shall be provided with receptacles equipped with an overflow prevention device at each vacuum outlet station. | 713.6 Central disposal system equipment. Central vacuum (fluid suction) systems shall provide continuous service. Systems equipped with collecting or control tanks shall provide for draining and cleaning of the tanks while the system is in operation. In hospitals, the system shall be connected to the emergency power system. The exhausts from a vacuum pump serving a vacuum (fluid suction) system shall discharge separately to open air above the roof. |
| 713.7 Central vacuum or disposal systems. Where the waste from a central vacuum (fluid suction) system of the barometric-lag, collection-tank or bottledisposal type is connected to the drainage system, the waste shall be directly connected to the sanitary drainage system through a trapped waste. | 713.7.1 Piping. The piping of a central vacuum (fluid suction) system shall be of corrosion-resistant material with a smooth interior surface. A branch shall be not less than 1 /2inch (12.7 mm) nominal pipe size for one outlet and shall be sized in accordance with the number of vacuum outlets. A main shall be not less than 1-inch (25 mm) nominal pipe size. The pipe sizing shall be increased in accordance with the manufacturer's instructions as stations are increased. |

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| 713.7.2 Velocity. The velocity of airflow in a central vacuum (fluid suction) system shall be less than 5,000 feet per minute (25 m/s). | 713.8 Vent connections prohibited. Connections between local vents serving bedpan washers or sterilizer vents serving sterilizing apparatus and normal sanitary plumbing systems are prohibited. Only one type of apparatus shall be served by a local vent. |
| 713.9 Local vents and stacks for bedpan washers. Bedpan washers shall be vented to open air above the roof by means of one or more local vents. The local vent for a bedpan washer shall be not less than a 2-inch-diameter (51 mm) pipe. A local vent serving a single bedpan washer is permitted to drain to the fixture served. | 713.9.1 Multiple installations. Where bedpan washers are located above each other on more than one floor, a local vent stack is permitted to be installed to receive the local vent on the various floors. Not more than three bedpan washers shall be connected to a 2-inch (51 mm) local vent stack, not more than six to a 3-inch (76 mm) local vent stack and not more than 12 to a 4-inch (102 mm) local vent stack. In multiple installations, the connections between a bedpan washer local vent and a local vent stack shall be made with tee or tee-wye sanitary pattern drainage fittings installed in an upright position. |

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| 713.9.2 Trap required. The bottom of the local vent stack, except where serving only one bedpan washer, shall be drained by means of a trapped and vented waste connection to the sanitary drainage system. The trap and waste shall be the same size as the local vent stack. | 713.9.3 Trap seal maintenance. A water supply pipe not less than 1 /4 inch (6.4 mm) in diameter shall be taken from the flush supply of each bedpan washer on the discharge or fixture side of the vacuum breaker, shall be trapped to form not less than a 3-inch (76 mm) water seal and shall be connected to the local vent stack on each floor. The water supply shall be installed so as to provide a supply of water to the local vent stack for cleansing and drain trap seal maintenance each time a bedpan washer is flushed. |
| 713.10 Sterilizer vents and stacks. Multiple installations of pressure and nonpressure sterilizers shall have the vent connections to the sterilizer vent stack made by means of inverted wye fittings. Access shall be provided to vent connections for the purpose of inspection and maintenance. | 713.10.1 Drainage. The connection between sterilizer vent or exhaust openings and the sterilizer vent stack shall be designed and installed to drain to the funnel or basket type waste fitting. In multiple installations, the sterilizer vent stack shall be drained separately to the lowest sterilizer funnel or basket-type waste fitting or receptor. |

# SECTION 701 GENERAL

713.11.1 Bedpan steamers. The minimum size of a sterilizer vent serving a bedpan steamer shall be 11 /2 inches (38 mm) in diameter. Multiple installations shall be sized in accordance with Table 713.11.1.

**TABLE 713.11.1**
**STACK SIZES FOR BEDPAN STEAMERS AND BOILING-TYPE STERILIZERS (Number of Connections of Various Sizes Permitted to Various-sized Sterilizer Vent Stacks)**

| STACK SIZE | CONNECTION SIZE | | |
|---|---|---|---|
| (inches) | 1½" | | 2" |
| 1½a | 1 | or | 0 |
| 2a | 2 | or | 1 |
| 2b | 1 | and | 1 |
| 3a | 4 | or | 2 |
| 3b | 2 | and | 2 |
| 4a | 8 | or | 4 |
| 4b | 4 | and | 4 |

For SI: 1 inch = 25.4 mm.
a. Total of each size.
b. Combination of sizes.

713.11.2 Boiling-type sterilizers. The size of a sterilizer vent stack shall be not less than 2 inches (51 mm) in diameter where serving a utensil sterilizer and not less than 11 /2 inches (38 mm) in diameter where serving an instrument sterilizer. Combinations of boiling-type sterilizer vent connections shall be sized in accordance with Table 713.11.1.

713.11.3 Pressure sterilizers. Pressure sterilizer vent stacks shall be 21 /2 inches (64 mm) minimum. Those serving combinations of pressure sterilizer exhaust connections shall be sized in accordance with Table 713.11.3.

# SECTION 701 GENERAL

713.11.4 Pressure instrument washer sterilizer sizes. The diameter of a sterilizer vent stack serving an instrument washer sterilizer shall be not less than 2 inches (51 mm). Not more than two sterilizers shall be installed on a 2- inch (51 mm) stack, and not more than four sterilizers shall be installed on a 3-inch (76 mm) stack.

TABLE 713.11.3 STACK SIZES FOR PRESSURE STERILIZERS (Number of Connections of Various Sizes Permitted To Various-sized Vent Stacks)

| STACK SIZE (inches) | CONNECTION SIZE | | | |
|---|---|---|---|---|
| | ¾" | 1" | 1¼" | 1½" |
| 1½a | 3 or | 2 or | 1 | — |
| 1½b | 2 and | 1 | — | — |
| 2a | 6 or | 3 or | 2 or | 1 |
| 2b | 3 and | 2 | — | — |
| 2b | 2 and | 1 and | 1 | — |
| 2b | 1 and | 1 and | — | 1 |
| 3a | 15 or | 7 or | 5 or | 3 |
| 3b | 1 and | 1 and 5 and | 2 and | 2 1 |

For SI: 1 inch = 25.4 mm.
a. Total of each size.
b. Combination of sizes.

714.1 Design of drainage system. The sizing, design and layout of the drainage system shall be permitted to be designed by approved computer design methods.

714.2 Load on drainage system. The load shall be computed from the simultaneous or sequential discharge conditions from fixtures, appurtenances and appliances or the peak usage design condition.

# SECTION 701 GENERAL

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| 714.2.1 Fixture discharge profiles. The discharge profiles for flow rates versus time from fixtures and appliances shall be in accordance with the manufacturer's specifications. | 714.3 Selections of drainage pipe sizes. Pipe shall be sized to prevent full-bore flow. |
| 714.3.1 Selecting pipe wall roughness. Pipe size calculations shall be conducted with the pipe wall roughness factor (ks), in accordance with the manufacturer's specifications and as modified for aging roughness factors with deposits and corrosion. | 714.3.2 Slope of horizontal drainage piping. Horizontal drainage piping shall be designed and installed at slopes in accordance with Table 704.1. |

# SECTION 701 GENERAL

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| 715.1 Sewage backflow. If required by the "Ohio Environmental Protection Agency" or local sewer purveyor, a backwater valve shall be installed only for plumbing fixtures installed on a floor with a finished floor elevation below the elevation of the manhole cover of the next upstream manhole in the public sewer. Such fixtures shall be protected by a backwater valve installed in the building drain, or horizontal branch serving such fixtures. Plumbing fixtures installed on a floor with a finished floor elevation above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not discharge through a backwater valve. Exception: In existing buildings, fixtures above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not be prohibited from discharging through a backwater valve. | 715.2 Material. Bearing parts of backwater valves shall be of corrosion-resistant material. Backwater valves shall comply with ASME A112.14.1, CSA B181.1 or CSA B181.2. |
| 715.3 Seal. Backwater valves shall be so constructed as to provide a mechanical seal against backflow. | 715.4 Diameter. Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed. |

# SECTION 701 GENERAL

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| 715.5 Location. Backwater valves shall be installed so that access is provided to the working parts for service and repair. | 716.1 Scope. Vacuum drainage systems shall be in accordance with Sections 716.2 through 716.4. |
| 716.2 System design. Vacuum drainage systems shall be designed in accordance with the vacuum drainage system manufacturer's instructions. The system layout, including piping layout, tank assemblies, vacuum pump assembly and other components necessary for proper function of the system shall be in accordance with the manufacturer's instructions. Plans, specifications and other data for such systems shall be submitted to the code official for review and approval prior to installation. | 716.2.1 Fixtures. Gravity-type fixtures installed in vacuum drainage systems shall comply with Chapter 4. |

# SECTION 701 GENERAL

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| 716.2.2 Drainage fixture units. Drainage fixture units for gravity drainage systems that discharge into, or receive discharge from, vacuum drainage systems shall be based on the values in this chapter. | 716.2.3 Water supply fixture units. Water supply fixture units shall be based on the values in Chapter 6 of this code, except that the water supply fixture unit for a vacuum-type water closet shall be 1. |
| 716.2.4 Traps and cleanouts. Gravity drainage fixtures shall be provided with traps and cleanouts in accordance with this chapter and Chapter 10. | 716.2.5 Materials. Vacuum drainage pipe, fitting and valve materials shall be in accordance with the vacuum drainage system manufacturer's instructions and the requirements of this chapter. |

# SECTION 701 GENERAL

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| 716.3 Testing and demonstrations. After completion of the entire system installation, the system shall be subjected to a vacuum test of 19 inches (483 mm) of mercury and shall be operated to function as required by the code official and the manufacturer of the vacuum drainage system. Recorded proof of all tests shall be submitted to the code official. | 716.4 Written instructions. Written instructions for the operation, maintenance, safety and emergency procedures shall be provided to the building owner. The code official shall verify that the building owner is in receipt of such instructions. |
| | |

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.


**Board of Building Standards**
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613 Fax: (614) 644-3147
dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm


COURSE SUBMITTER:

Course Submitter: Karen Turnau (Contact Name)
Organization: Ohio Contractor Training (Organization/Company)
Address: PO Box 431 (Include Room Number, Suite, etc.)
City: Pickerington State: OH Zip: 43147
E-Mail: Kturnau@hotmail.com
Telephone: 614-203-1531 Fax: None
Course Sponsor: Karen Turnau

COURSE INFORMATION:

**Course Title:** Ohio Plumbing Code Updates

New Course Submittal: ☑ Update Course: ☐ Prior Approval Number: _____

**Purpose and Objective:** To provide plumbing inspectors with information and education on the Ohio Plumbing code and the updates necessary for the plumbing inspector to perform duties as required.

**Number of Instructional Contact Hours that can be obtained upon completion:** 10 hours

**If Multi-Session, Number of Instructional Contact Hours Per Session:** _____

**Program Applicable for the Following Participants:**

Building Official ☐ Master Plans Examiner ☐
Building Plans Exam. ☐
Plumbing Plans Exam. ☐
Electrical Plans Exam. ☐
Mechanical Plans Exam. ☐
Fire Protect. Plans Exam. ☐

Building Inspector ☐ Fire Protection Inspector ☐ Mechanical Inspector ☐
Plumbing Inspector ☑
Non-Res IU Inspector ☐

Res Building Official ☐ Res Plans Examiner ☐ Res Building Inspector ☐ Res Mechanical Inspector ☐ Res IU Inspector ☐

Electrical Safety Inspectors ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

| SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted:** | | Check Off |
|---|---|---|
| **Course Submitter:** | Name of contact person and their certification numbers, organization, address, fax, phone | |
| | Organization sponsoring or requesting the program (if any) | |
| **Course Title:** | Name of course (related to content) | |
| **Purpose/Objective:** | Describe purpose and how course will improve competency of certification(s) listed | |
| **Contact Hours:** | Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs) | |
| **Participants:** | Check off each certification for which credit is requested (for which course relates to certification) | |
| **Content of Program:** | Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered | |
| **Course Materials:** | Collated workbooks, handouts, hard copy or electronic versions of program is available | |
| **Instructor(s) Info.:** | Resume of professional/educational qualifications & teaching/training experience/BBS certifications | |
| **Test Materials:** | | |
| **Completed Application:** | | |

***NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.***

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BOARD OF BUILDING

Form: 1526

BBS 81028110

Agenda:

Welcome – Sign In

7:00am – 9:00am - 2hr -Ohio Plumbing Code Amendments – Chapter 3

9:00 – 9:15 am Break

9:00am -12:00pm 3hr - Ohio Plumbing Code Amendments – Chapter 6

12-1pm – Lunch

1:00 - 3pm 2hr - Ohio Plumbing Code Amendments – Chapter 6

3:00- 3:15 pm Break

4:00 – 6:00pm 3hr -Ohio Plumbing Code Amendments – Chapter 7

Sign out and receive certificate of completion

Total of 10-hr CEU

---

Course Material will be the changes listed on the BBS Website at this location:

Ohio Board Of Building Standards – Latest Ohio Plumbing Code Changes

Ohio Plumbing Code Book adopted by State of Ohio Board of Building Standards

Personal Bio: **JACK SOMA**

Current Status: Ohio Plumbing Code Instructor

Current Duties: Continuing Education Instructor for plumbing code courses (Contractors & Inspectors)

Previous Employment: State of Ohio, Department of Industrial Compliance, Building Code Compliance, Plumbing Code Section.

Certifications: Certified Plumbing Inspector

Certified Medical Gas Inspector (NITC/NFPA99/ASSE6020)

Certified Medical Gas Instructor (NITC/NFPA99/ASSE6050)

Certified Plans Examiner

Certified OHSA Instructor

Master Plumber

Certified Refrigerant (Universal)

Certified Welder (NCPWB)

Certified Instructor in Industrial Education

Education: Graduated High School/Inglewood, Calif. (1968)

U.S. Navy Training Schools (numerous)

Plumbers & Pipe Fitters Apprenticeship

Plumbers & Pipe Fitters Local 189 (41 yrs.)

U.A. Instructor Training (Ann Arbor, Michigan)

Graduated Michigan State/ Washtenaw Community College (2005),

With certificate in Industrial Education

# SECTION 601 GENERAL

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| 601.1 Scope. This chapter shall govern the materials, design and installation of water supply systems within a building, both hot and cold, for utilization in connection with human occupancy and habitation. Exceptions: 1. This chapter shall not apply to private water systems or recycled water systems as defined in section 3701.344 of the Revised Code and as defined in rule 3701-28-01 of the Administrative Code and within the scope of the rules of the “Ohio Department of Health”. 2. This chapter shall not apply to public water systems as defined in division (A) of section 6109.01 of the Revised Code and as defined in rule 3745-81- 01 of the Administrative Code and within the scope of the rules of the “Ohio Environmental Protection Agency”. | 601.2 Solar energy utilization. Solar energy systems used for heating potable water or using an independent medium for heating potable water shall comply with the applicable requirements of this code. The use of solar energy shall not compromise the requirements for cross connection or protection of the potable water supply system required by this code. |
| 601.3 Existing piping used for grounding. Existing metallic water service piping used for electrical grounding shall not be replaced with nonmetallic pipe or tubing until other approved means of grounding is provided. | 601.4 Tests. The potable water distribution system shall be tested in accordance with Section 312.5. |

# SECTION 601 GENERAL

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| 601.5 Rehabilitation of piping systems. Where pressure piping systems are rehabilitated using an epoxy lining system, such lining system shall comply with ASTM F 2831. | 602.1 General. Structures equipped with plumbing fixtures and utilized for human occupancy or habitation shall be provided with a potable supply of water in the amounts and at the pressures specified in this chapter. |
| 602.2 Potable water required. Only potable water shall be supplied to plumbing fixtures that provide water for drinking, bathing or culinary purposes, or for the processing of food, medical or pharmaceutical products. Unless otherwise provided in this code, potable water shall be supplied to all plumbing fixtures. | 603.1 Size of water service pipe. The water service pipe shall be sized to supply water to the structure in the quantities and at the pressures required in this code. The water service pipe shall be not less than 3 /4 inch (19.1 mm) in diameter. |

# SECTION 601 GENERAL

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| 603.2 Separation of water service and building sewer. Deleted Where water service piping is located in the same trench with the building sewer, and the building sewer piping is not constructed of materials listed in Table 702.2, the water service pipe and the building sewer shall be horizontally separated by not less than 5 feet (1524 mm) of undisturbed or compacted earth. The required separation distance shall not apply where a water service pipe crosses a sewer pipe, provided the water service is sleeved to a point not less than 5 feet (1524 mm) horizontally from the sewer pipe centerline on both sides of such crossing. The sleeve shall be of pipe materials listed in Table 605.3, 702.2, or other pipe material acceptable to the authority having jurisdiction for the building sewer. The required separation distance shall not apply where the bottom of the water service pipe, located within 5 feet (1524 mm) of the sewer, is not less than 12 inches above the highest point of the top of the building sewer. | 603.2.1 Water service near sources of pollution. Deleted Potable water service pipes shall not be located in, under or above cesspools, septic tanks, septic tank drainage fields or seepage pits (see Section 605.1 for soil and ground water conditions). |
| 603.3 Enforcement. Enforcement of the provisions of this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance. | 604.1 General. The design of the water distribution system shall conform to accepted engineering practice. Methods utilized to determine pipe sizes shall be approved. |

# SECTION 601 GENERAL

604.2 System interconnection. At the points of interconnection between the hot and cold water supply piping systems and the individual fixtures, appliances or devices, provisions shall be made to prevent flow between such piping systems.

604.3 Water distribution system design criteria. The water distribution system shall be designed, and pipe sizes shall be selected such that under conditions of peak demand, the capacities at the fixture supply pipe outlets shall be not less than shown in Table 604.3. The minimum flow rate and flow pressure provided to fixtures and appliances not listed in Table 604.3 shall be in accordance with the manufacturer's installation instructions.

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|---|---|---|
| Drinking fountain | 0.75 | 8 |
| Laundry tray | 4 | 8 |
| Lavatory, private | 0.8 | 8 |
| Lavatory, private, mixing valve | 0.8 | 8 |
| Lavatory, public | 0.4 | 8 |
| Shower | 2.5 | 8 |
| Shower, balanced-pressure, thermostatic or combination balanced-pressure/thermostatic mixing valve | 2.5[b] | 20 |
| Sillcock, hose bibb | 5 | 8 |
| Sink, residential | 1.75 | 8 |
| Sink, service | 3 | 8 |
| Urinal, valve | 12 | 25 |
| Water closet, blow out, flushometer valve | 25 | 45 |
| Water closet, flushometer tank | 1.6 | 20 |
| Water closet, siphonic, flushometer valve | 25 | 35 |
| Water closet, tank, close coupled | 3 | 20 |
| Water closet, tank, one piece | 6 | 20 |

For SI: 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 3.785 L/m.

a. For additional requirements for flow rates and quantities, see Section604.4.

b. Where the shower mixing valve manufacturer indicates a lower flow rating for the mixing valve, the lower value shall be applied.

# SECTION 601 GENERAL

604.4 Maximum flow and water consumption. The maximum water consumption flow rates and quantities for all plumbing fixtures and fixture fittings shall be in accordance with Table 604.4. Exceptions:

1. Blowout design water closets having a water consumption not greater than 31 /2 gallons (13 L) per flushing cycle.
2. Vegetable sprays.
3. Clinical sinks having a water consumption not greater than 41 /2 gallons (17 L) per flushing cycle.
4. Service sinks.
5. Emergency showers.

**TABLE 604.4**
**MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS**

| PLUMBING FIXTURE OR FIXTURE FITTING | MAXIMUM FLOW RATE OR QUANTITY[b] |
|---|---|
| Lavatory, private | 2.2 gpm at 60 psi |
| Lavatory, public (metering) | 0.25 gallon per metering cycle |
| Lavatory, public (other than metering) | 0.5 gpm at 60 psi |
| Shower head[a] | 2.5 gpm at 80 psi |
| Sink faucet | 2.2 gpm at 60 psi |
| Urinal | 1.0 gallon per flushing cycle |
| Water closet | 1.6 gallons per flushing cycle |

For SI: 1 gallon = 3.785 L, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. A hand-held shower spray is a shower head.
b. Consumption tolerances shall be determined from referenced standards.

604.5 Size of fixture supply. The minimum size of a fixture supply pipe shall be as shown in Table 604.5. The fixture supply pipe shall terminate not more than 30 inches (762 mm) from the point of connection to the fixture. A reduced size flexible water connector installed between the supply pipe and the fixture shall be of an approved type. The supply pipe shall extend to the floor or wall adjacent to the fixture. The minimum size of individual distribution lines utilized in gridded or parallel water distribution systems shall be as shown in Table 604.5.

604.6 Variable street pressures. Where street water main pressures fluctuate, the building water distribution system shall be designed for the minimum pressure available.

# SECTION 601 GENERAL

604.7 Inadequate water pressure. Wherever water pressure from the street main or other source of supply is insufficient to provide flow pressures at fixture outlets as required under Table 604.3, a water pressure booster system conforming to Section 606.5 shall be installed on the building water supply system.

604.8 Water pressure-reducing valve or regulator. Where water pressure within a building exceeds 80 psi (552 kPa) static, an approved water pressurereducing valve conforming to ASSE 1003 or CSA B356 with strainer shall be installed to reduce the pressure in the building water distribution piping to not greater than 80 psi (552 kPa) static.
Exception:
Service lines to sill cocks and outside hydrants, and main supply risers where pressure from the mains is reduced to 80 psi (552 kPa) or less at individual fixtures.

**TABLE 604.5**
**MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPE**

| FIXTURE | MINIMUM PIPE SIZE (inch) |
|---|---|
| Bathtubs[a] (60" × 32" and smaller) | ½ |
| Bathtubs[a] (larger than 60" × 32") | ½ |
| Bidet | ⅜ |
| Combination sink and tray | ½ |
| Dishwasher, domestic[a] | ½ |
| Drinking fountain | ⅜ |
| Hose bibbs | ½ |
| Kitchen sink[a] | ½ |
| Laundry, 1, 2 or 3 compartments[a] | ½ |
| Lavatory | ⅜ |
| Shower, single head[a] | ½ |
| Sinks, flushing rim | ¾ |
| Sinks, service | ½ |
| Urinal, flush tank | ½ |
| Urinal, flushometer valve | ¾ |
| Wall hydrant | ½ |
| Water closet, flush tank | ⅜ |
| Water closet, flushometer tank | ⅜ |
| Water closet, flushometer valve | 1 |
| Water closet, one piece[a] | ½ |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa.

a. Where the developed length of the distribution line is 50 feet or less, and the available pressure at the meter is 35 psi or greater, the minimum size of an individual distribution line supplied from a manifold and installed as part of a parallel water distribution system shall be one nominal tube size smaller than the sizes

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| 604.8.1 Valve design. The pressure-reducing valve shall be designed to remain open to permit uninterrupted water flow in case of valve failure. | 604.8.2 Repair and removal. Water pressure-reducing valves, regulators and strainers shall be so constructed and installed as to permit repair or removal of parts without breaking a pipeline or removing the valve and strainer from the pipeline. |
| 604.9 Water hammer. The flow velocity of the water distribution system shall be controlled to reduce the possibility of water hammer. A water-hammer arrestor shall be installed where quick-closing valves are utilized. Water-hammer arrestors shall be installed in accordance with the manufacturer's instructions. Waterhammer arrestors shall conform to ASSE 1010. | 604.10 Gridded and parallel water distribution system manifolds. Hot water and cold water manifolds installed with gridded or parallel connected individual distribution lines to each fixture or fixture fitting shall be designed in accordance with Sections 604.10.1 through 604.10.3. |

# SECTION 601 GENERAL

604.10.1 Manifold sizing. Hot water and cold water manifolds shall be sized in accordance with Table 604.10.1. The total gallons per minute is the demand of all outlets supplied.

**TABLE 604.10.1**
**MANIFOLD SIZING**

| NOMINAL SIZE INTERNAL DIAMETER (inches) | MAXIMUM DEMAND (gpm) | |
|---|---|---|
| | Velocity at 4 feet per second | Velocity at 8 feet per second |
| ½ | 2 | 5 |
| ¾ | 6 | 11 |
| 1 | 10 | 20 |
| 1¼ | 15 | 31 |
| 1½ | 22 | 44 |

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m, 1 foot per second = 0.305 m/s.

604.10.2 Valves. Individual fixture shutoff valves installed at the manifold shall be identified as to the fixture being supplied.

604.10.3 Access. Access shall be provided to manifolds with integral factoryor field-installed valves.

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| 604.11 Individual pressure balancing in-line valves for individual fixture fittings. Where individual pressure balancing in-line valves for individual fixture fittings are installed, such valves shall comply with ASSE 1066. Such valves shall be installed in an accessible location and shall not be utilized alone as a substitute for the balanced pressure, thermostatic or combination shower valves required in Section 424.3. | 605.1 Soil and ground water. The installation of a water service or water distribution pipe shall be prohibited in soil and ground water contaminated with solvents, fuels, organic compounds or other detrimental materials causing permeation, corrosion, degradation or structural failure of the piping material. Where detrimental conditions are suspected, a chemical analysis of the soil and ground water conditions shall be required to ascertain the acceptability of the water service or water distribution piping material for the specific installation. Where detrimental conditions exist, approved alternative materials or routing shall be required. |
| 605.2 Lead content of water supply pipe and fittings. Pipe, pipe fittings, joints, valves, faucets, and fixture fittings utilized to supply water for drinking or cooking purposes shall comply with NSF 372 and shall have a weighted average lead content of 0.25 percent lead or less.<br>Exceptions: The following items are exempt from the lead content limitations of this section (even though the potable water supply pipe which serves the fixture or supplies the nonpotable water system is not exempt):<br>1. Pipes, pipe fittings, plumbing fittings, or fixtures, including backflow preventers that are used exclusively for nonpotable services such as process piping, irrigation piping, and outdoor watering piping.<br>2. Toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, and service saddles.<br>3. Water distribution main gate valves two inches in diameter or larger. | 605.3 Water service pipe. Water service pipe shall conform to NSF 61 and shall conform to one of the standards listed in Table 605.3. Water service pipe or tubing, installed underground and outside of the structure, shall have a working pressure rating of not less than 160 psi (1100 kPa) at 73.4ºF (23ºC). Where the water pressure exceeds 160 psi (1100 kPa), piping material shall have a working pressure rating not less than the highest available pressure. Water service piping materials not listed by and approved agency for water distribution shall terminate at or before the full open valve located at the entrance to the structure. Ductile iron water service piping shall be cement mortar lined in accordance with AWWA C104. |

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| 605.3.1 Dual check-valve-type backflow preventer. Dual check-valve backflow preventers installed on the water supply system shall comply with ASSE 1024 or CSA B64.6. | 605.4 Water distribution pipe. Water distribution pipe shall conform to NSF 61 and shall conform to one of the standards listed in Table 605.4. Hot water distribution pipe and tubing shall have a pressure rating of not less than 100 psi (690 kPa) at 180ºF (82ºC). |
| 605.5 Fittings. Pipe fittings shall be approved for installation with the piping material installed and shall comply with the applicable standards listed in Table 605.5. Pipe fittings utilized in water supply systems shall also comply with NSF 61. Ductile and gray iron pipe and pipe fittings utilized in water service piping systems shall be cement mortar lined in accordance with AWWA C104. | 605.5.1 Mechanically formed tee fittings. Mechanically extracted outlets shall have a height not less than three times the thickness of the branch tube wall. |

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| 605.5.1.1 Full flow assurance. Branch tubes shall not restrict the flow in the run tube. A dimple serving as a depth stop shall be formed in the branch tube to ensure that penetration into the collar is of the correct depth. For inspection purposes, a second dimple shall be placed 1 /4 inch (6.4 mm) above the first dimple. Dimples shall be aligned with the tube run. | 605.5.1.2 Brazed joints. Mechanically formed tee fittings shall be brazed in accordance with Section 605.14.1. |
| 605.6 Flexible water connectors. Flexible water connectors exposed to continuous pressure shall conform to ASME A112.18.6/CSA B125.6. Access shall be provided to all flexible water connectors | |

**TABLE 605.3**
**WATER SERVICE PIPE**

| MATERIAL | STANDARD |
|---|---|
| Acrylonitrile butadiene styrene (ABS) plastic pipe | ASTM D 1527; ASTM D 2282 |
| Brass pipe | ASTM B 43 |
| Chlorinated polyvinyl chloride (CPVC) plastic pipe | ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6 |
| Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) | ASTM F 2855 |
| Copper or copper-alloy pipe | ASTM B 42; ASTM B 302 |
| Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM) | ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447 |
| Cross-linked polyethylene (PEX) plastic pipe and tubing | ASTM F 876; ASTM F 877; AWWA C904; CSA B137.5 |
| Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe | ASTM F 1281; ASTM F 2262; CSA B137.10 |
| Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE) | ASTM F 1986 |
| Ductile iron water pipe | AWWA C151/A21.51; AWWA C115/A21.15 |
| Galvanized steel pipe | ASTM A 53 |
| Polyethylene (PE) plastic pipe | ASTM D 2239; ASTM D 3035; AWWA C901; CSA B137.11 |
| Polyethylene (PE) plastic tubing | ASTM D 2737; AWWA C901; CSA B137.1 |
| Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe | ASTM F 1282; CSA B137.9 |
| Polyethylene of raised temperature (PE-RT) plastic tubing | ASTM F 2769 |
| Polypropylene (PP) plastic pipe or tubing | ASTM F 2389; CSA B137.11 |
| Polyvinyl chloride (PVC) plastic pipe | ASTM D 1785; ASTM D 2241; ASTM D 2672; CSA B137.3 |
| Stainless steel pipe (Type 304/304L) | ASTM A 312; ASTM A 778 |
| Stainless steel pipe (Type 316/316L) | ASTM A 312; ASTM A 778 |

**TABLE 605.4**
**WATER DISTRIBUTION PIPE**

| MATERIAL | STANDARD |
|---|---|
| Brass pipe | ASTM B 43 |
| Chlorinated polyvinyl chloride (CPVC) plastic pipe and tubing | ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6 |
| Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) | ASTM F 2855 |
| Copper or copper-alloy pipe | ASTM B 42; ASTM B 302 |
| Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM) | ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447 |
| Cross-linked polyethylene (PEX) plastic tubing | ASTM F 876; ASTM F 877; CSA B137.5 |
| Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe | ASTM F 1281; ASTM F 2262; CSA B137.10 |
| Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE) | ASTM F 1986 |
| Ductile iron pipe | AWWA C151/A21.51; AWWA C115/A21.15 |
| Galvanized steel pipe | ASTM A 53 |
| Polyethylene/aluminum/polyethylene (PE-AL-PE) composite pipe | ASTM F 1282 |
| Polyethylene of raised temperature (PE-RT) plastic tubing | ASTM F 2769 |
| Polypropylene (PP) plastic pipe or tubing | ASTM F 2389; CSA B137.11 |
| Stainless steel pipe (Type 304/304L) | ASTM A 312; ASTM A 778 |
| Stainless steel pipe (Type 316/316L) | ASTM A 312; ASTM A 778 |

605.7 Valves. Valves shall be compatible with the type of piping material installed in the system. Valves shall conform to one of the standards listed in Table 605.7 or shall be approved. Valves intended to supply drinking water shall meet the requirements of NSF 61.

605.8 Manufactured pipe nipples. Manufactured pipe nipples shall conform to one of the standards listed in Table 605.8.

**TABLE 605.8**
**MANUFACTURED PIPE NIPPLES**

| MATERIAL | STANDARD |
|---|---|
| Brass-, copper-, chromium-plated | ASTM B 687 |
| Steel | ASTM A 733 |

605.9 Prohibited joints and connections. The following types of joints and connections shall be prohibited:
1. Cement or concrete joints.
2. Joints made with fittings not approved for the specific installation.
3. Solvent-cement joints between different types of plastic pipe.
4. Saddle-type fittings.

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| 605.10 ABS plastic. Joints between ABS plastic pipe and fittings shall comply with Sections 605.10.1 through 605.10.3. | 605.10.1 Mechanical joints. Mechanical joints on water pipes shall be made with an elastomeric seal conforming to ASTM D 3139. Mechanical joints shall only be installed in underground systems, unless otherwise approved. Joints shall be installed only in accordance with the manufacturer's instructions. |
| 605.10.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235. Solvent-cement joints shall be permitted above or below ground. | 605.10.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only. |

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| 605.11 Brass. Joints between brass pipe and fittings shall comply with Sections 605.11.1 through 605.11.4. | 605.11.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8. |
| 605.11.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 605.11.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipejoint compound or tape shall be applied on the male threads only. |

# SECTION 601 GENERAL

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| 605.11.4 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal. | |
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**PIPE FITTINGS**

| MATERIAL | STANDARD |
|---|---|
| Acrylonitrile butadiene styrene (ABS) plastic | ASTM D 2468 |
| Cast iron | ASME B16.4 |
| Chlorinated polyvinyl chloride (CPVC) plastic | ASSE 1061; ASTM D 2846; ASTM F 437; ASTM F 438; ASTM F 439; CSA B137.6 |
| Copper or copper alloy | ASME B16.15; ASME B16.18; ASME B16.22; ASME ~~16.26~~ B16.26; ASME B16.51; ASSE 1061; ASTM F 1476; ASTM F 1548 |
| Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE) | ASTM F 1986 |
| Fittings for cross-linked polyethylene (PEX) plastic tubing | ASSE 1061, ASTM F 877; ASTM F 1807; ASTM F 1960; ASTM F 2080; ASTM F 2098, ASTM F 2159; ASTM F 2434; ASTM F 2735; CSA B137.5 |
| Fittings for polyethylene of raised temperature (PE-RT) plastic tubing | ASTM F 1807; ASTM F 2098; ASTM F 2159; ASTM F 2735; ASTM F 2769 |
| Gray iron and ductile iron | ASTM F 1476; ASTM F 1548; AWWA C110/A21.10; AWWA C153/A21.53; |
| Insert fittings for polyethylene/aluminum/polyethylene (PE-AL-PE) and cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) | ASTM F 1974; ASTM F 1281; ASTM F 1282; CSA B137.9; CSA B137.10M |
| Malleable iron | ASME B16.3 |
| Metal (brass) insert fittings for polyethylene/aluminum/polyethylene (PE-AL-PE) and cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) | ASTM F 1974 |
| Polyethylene (PE) plastic pipe | ASTM D 2609; ASTM D 2683; ASTM D 3261; ASTM F 1055; CSA B137.1 |
| Polypropylene (PP) plastic pipe or tubing | ASTM F 2389; CSA B137.11 |
| Polyvinyl chloride (PVC) plastic | ASTM D 2464; ASTM D 2466; ASTM D 2467; CSA B137.2; CSA B137.3 |
| Stainless steel (Type 304/304L) | ASTM A 312; ASTM A 778; ASTM F 1476; ASTM F 1548 |
| Stainless steel (Type 316/316L) | ASTM A 312; ASTM A 778; ASTM F 1476; ASTM F 1548 |
| Steel | ASME B16.9; ASME B16.11; ASME B16.28; ASTM F 1476; ASTM F 1548 |

# SECTION 601 GENERAL

**VALVES**

| MATERIAL | STANDARD |
|---|---|
| Chlorinated polyvinyl chloride (CPVC) plastic | ASME A112.4.14; ASME A112.18.1/CSA B125.1; ASTM F 1970; CSA B125.3 |
| Copper or copper alloy | ASME A112.4.14; ASME A112.18.1/CSA B125.1; ASME B16.34; CSA B125.3; MSS SP-67; MSS SP-80; MSS SP-110 |
| Cross-linked polyethylene (PEX) plastic | ASME A112.4.14; ASME A112.18.1/CSA B125.1; CSA B125.3; NSF 359 |
| Gray iron and ductile iron | AWWA C500; AWWA C504; AWWA C507; MSS SP-67; MSS SP-70; MSS SP-71; MSS SP-72; MSS SP-78 |
| Polypropylene (PP) plastic | ASME A112.4.14; ASTM F 2389 |
| Polyvinyl chloride (PVC) plastic | ASME A112.4.14; ASTM F 1970 |

605.12 Gray iron and ductile iron joints. Joints for gray and ductile iron pipe and fittings shall comply with AWWA C111/A21.11 and shall be installed in accordance with the manufacturer's instructions.

605.13 Copper pipe. Joints between copper or copper-alloy pipe and fittings shall comply with Sections 605.13.1 through 605.13.5.

605.13.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

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| 605.13.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 605.13.3 Solder joints. Solder joints shall be made in accordance with ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. Joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32. The joining of water supply piping shall be made with lead-free solder and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2-percent lead. |
| 605.13.4 Threaded joints. Threads shall conform to ASME B1.20.1. Pipejoint compound or tape shall be applied on the male threads only | 605.13.5 Welded joints. Joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal |

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| 605.14 Copper tubing. Joints between copper or copper alloy tubing and fittings shall comply with Sections 605.14.1 through 605.14.5. | 605.14.1 Brazed joints. Joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8. |
| 605.14.2 Flared joints. Flared joints for water pipe shall be made by a tool designed for that operation. | 605.14.3 Grooved and shouldered mechanical joints. Grooved and shouldered mechanical joints shall comply with ASTM F 1476, shall be made with an approved elastomeric seal and shall be installed in accordance with the manufacturer's instructions. Such joints shall be exposed or concealed. |

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| 605.14.4 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 605.14.5 Press-connect joints. Press-connect joints shall conform to one of the standards listed in Table 605.5, and shall be installed in accordance with the manufacturer's instructions. Cut tube ends shall be reamed to the full inside diameter of the tube end. Joint surfaces shall be cleaned. The tube shall be fully inserted into the press-connect fitting. Press-connect joints shall be pressed with a tool certified by the manufacturer. |
| 605.14.6 Solder joints. Solder joints shall be made in accordance with the methods of ASTM B 828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32. The joining of water supply piping shall be made with lead-free solders and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2-percent lead. | 605.15 CPVC plastic. Joints between CPVC plastic pipe and fittings shall comply with Sections 605.15.1 through 605.15.3. |

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| 605.15.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions | 605.15.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. Joints shall be made in accordance with the pipe manufacturer's installation instructions. Where such instructions require that a primer be used, the primer shall be applied to the joint surfaces and a solvent cement orange in color and conforming to ASTM F 493 shall be applied to the joint surfaces. Where such instructions allow for a one-step solvent cement, yellow in color and conforming to ASTM F 493, to be used, the joint surfaces shall not require application of a primer before the solvent cement is applied. The joint shall be made while the cement is wet and in accordance with ASTM D 2846 or ASTM F 493. Solvent cemented joints shall be permitted above or below ground. |
| 605.15.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe, but the pressure rating of the pipe shall be reduced by 50 percent. Thread by socket molded fittings shall be permitted. Approved thread lubricant or tape shall be applied on the male threads only. | 605.16 Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) pipe and tubing. Joints between CPVC/AL/CPVC plastic pipe or CPVC fittings shall comply with Sections 605.16.1 and 605.16.2. |

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| 605.16.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 605.16.2 Solvent cementing. Joint surfaces shall be clean and free from moisture, and an approved primer shall be applied. Solvent cement, orange in color and conforming to ASTM F 493, shall be applied to joint surfaces. The joint shall be made while the cement is wet, and in accordance with ASTM D 2846 or ASTM F 493. Solvent cement joints shall be permitted above or below ground.<br>Exception: A primer is not required where all of the following conditions apply:<br>1. The solvent cement used is listed by an approved agency as conforming to ASTM F 493.<br>2. The solvent cement used is yellow in color.<br>3. The solvent cement is used only for joining 1 /2inch (12.7 mm) through 2-inch-diameter (51 mm) CPVC/AL/CPVC pipe and CPVC fittings.<br>4. The CPVC fittings are manufactured in accordance with ASTM D 2846. |
| 605.17 PEX plastic. Joints between cross-linked polyethylene plastic tubing and fittings shall comply with Sections 605.17.1 and 605.17.2. | 605.17.1 Flared joints. Flared pipe ends shall be made by a tool designed for that operation. |

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| 605.17.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for cross-linked polyethylene (PEX) plastic tubing shall comply with the applicable standards listed in Table 605.5 and shall be installed in accordance with the manufacturer's instructions. PEX tubing shall be factory marked with the appropriate standards for the fittings that the PEX manufacturer specifies for use with the tubing. | 605.18 Steel. Joints between galvanized steel pipe and fittings shall comply with Sections 605.18.1 through 605.18.3. |
| 605.18.1 Threaded joints. Threads shall conform to ASME B1.20.1. Pipejoint compound or tape shall be applied on the male threads only. | 605.18.2 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions. |

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| 605.18.3 Grooved and shouldered mechanical joints. Grooved and shouldered mechanical joints shall comply with ASTM F 1476, shall be made with an approved elastomeric seal and shall be installed in accordance with the manufacturer's instructions. Such joints shall be exposed or concealed. | 605.19 PE plastic. Joints between polyethylene plastic pipe or tubing and fittings shall comply with Sections 605.19.1 through 605.19.4. |
| 605.19.1 Flared joints. Flared joints shall be permitted where so indicated by the pipe manufacturer. Flared joints shall be made by a tool designed for that operation. | 605.19.2 Heat-fusion joints. Joint surfaces shall be clean and free from moisture. All joint surfaces shall be heated to melt temperature and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657. |

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| 605.19.3 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. | 605.19.4 Installation. Polyethylene pipe shall be cut square, with a cutter designed for plastic pipe. Except where joined by heat fusion, pipe ends shall be chamfered to remove sharp edges. Kinked pipe shall not be installed. The minimum pipe bending radius shall be not less than 30 pipe diameters, or the minimum coil radius, whichever is greater. Piping shall not be bent beyond straightening of the curvature of the coil. Bends shall be prohibited within 10 pipe diameters of any fitting or valve. Stiffener inserts installed with compression-type couplings and fittings shall not extend beyond the clamp or nut of the coupling or fitting. |
| 605.20 Polypropylene (PP) plastic. Joints between PP plastic pipe and fittings shall comply with Section 605.20.1 or 605.20.2. | 605.20.1 Heat-fusion joints. Heat-fusion joints for polypropylene pipe and tubing joints shall be installed with socket-type heat-fused polypropylene fittings, butt-fusion polypropylene fittings or electrofusion polypropylene fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 2389. |

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| 605.20.2 Mechanical and compression sleeve joints. Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's instructions. | 605.21 Polyethylene/aluminum/polyethylene (PE-AL-PE) and cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX). Joints between PE-AL-PE or PEX-AL-PEX pipe and fittings shall comply with Section 605.21.1 |
| 605.21.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for PE-AL-PE and PEX-AL-PEX as described in ASTM F 1974, ASTM F 1281, ASTM F 1282, CSA B137.9 and CSA B137.10 shall be installed in accordance with the manufacturer's instructions. | 605.22 PVC plastic. Joints between PVC plastic pipe and fittings shall comply with Sections 605.22.1 through 605.22.3. |

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| 605.22.1 Mechanical joints. Mechanical joints on water pipe shall be made with an elastomeric seal conforming to ASTM D 3139. Mechanical joints shall not be installed in above-ground systems unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions. | 605.22.2 Grooved and shouldered mechanical joints. Grooved and shouldered mechanical joints shall comply with ASTM F 1476, shall be made with an approved elastomeric seal and shall be installed in accordance with the manufacturer's instructions. Such joints shall be exposed or concealed. |
| 605.22.3 Solvent cementing. Joint surfaces shall be clean and free from moisture. A primer that conforms to ASTM F 656 shall be applied. Solvent cement conforming to ASTM D 2564 or CSA B137.3 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground. | 605.22.4 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe, but the pressure rating of the pipe shall be reduced by 50 percent. Thread by socket molded fittings shall be permitted. Approved thread lubricant or tape shall be applied on the male threads only. |

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| 605.23 Stainless steel. Joints between stainless steel pipe and fittings shall comply with Sections 605.23.1 and 605.23.3. | 605.23.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. |
| 605.23.2 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded autogenously or with an approved filler metal as referenced in ASTM A 312. | 605.23.3 Grooved and shouldered mechanical joints. Grooved and shouldered mechanical joints shall comply with ASTM F 1476, shall be made with an approved elastomeric seal and shall be installed in accordance with the manufacturer's instructions. Such joints shall be exposed or concealed. |

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| 605.24 Joints between different materials. Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type, or as permitted in Sections 605.24.1, 605.24.2 and 605.24.3. Connectors or adapters shall have an elastomeric seal conforming to ASTM F 477. Joints shall be installed in accordance with the manufacturer's Instructions. | 605.24.1 Copper or copper-alloy tubing to galvanized steel pipe. Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass fitting or dielectric fitting or a dielectric union conforming to ASSE 1079. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe. |
| 605.24.2 Plastic pipe or tubing to other piping material. Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with approved adapters or transition fittings. | 605.24.3 Stainless steel. Joints between stainless steel and different piping materials shall be made with a mechanical joint of the compression or mechanical sealing type or a dielectric fitting or a dielectric union conforming to ASSE 1079. |

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| 605.25 PE-RT plastic. Joints between polyethylene of raised temperature plastic tubing and fittings shall be in accordance with Section 605.25.1. | 605.25.1 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for polyethylene of raised temperature plastic tubing shall comply with the applicable standards listed in Table 605.5 and shall be installed in accordance with the manufacturer's instructions. Polyethylene of raised temperature plastic tubing shall be factory marked with the applicable standards for the fittings that the manufacturer of the tubing specifies for use with the tubing. |
| 606.1 Location of full-open valves. Full-open valves shall be installed in the following locations:<br>1. On the building water service pipe from the public water supply near the curb.<br>2. On the water distribution supply pipe at the entrance into the structure.<br>3. On the discharge side of every water meter.<br>4. On the base of every water riser.<br>5. On the top of every water down-feed pipe in occupancies other than one-, two- and three-family residential occupancies.<br>6. On the entrance to every water supply pipe to a dwelling unit, except where supplying a single fixture equipped with individual stops.<br>7. On the water supply pipe to a gravity or pressurized water tank.<br>8. On the water supply pipe to every water heater. | 606.2 Location of shutoff valves. Shutoff valves shall be installed in the following locations:<br>1. On the fixture supply to each plumbing fixture other than in individual sleeping units that are provided with unit shutoff valves in hotels, motels, boarding houses and similar occupancies.<br>2. On the water supply pipe to each sillcock. 3. On the water supply pipe to each appliance or mechanical equipment. |

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| 606.3 Access to valves. Access shall be provided to all full-open valves and shutoff valves. | 606.4 Valve identification. Service and hose bibb valves shall be identified. All other valves installed in locations that are not adjacent to the fixture or appliance shall be identified, indicating the fixture or appliance served. |
| 606.5 Water pressure booster systems. Water pressure booster systems shall be provided as required by Sections 606.5.1 through 606.5.10. | 606.5.1 Water pressure booster systems required. Where the water pressure in the public water main or individual water supply system is insufficient to supply the minimum pressures and quantities specified in this code, the supply shall be supplemented by an elevated water tank, a hydropneumatic pressure booster system or a water pressure booster pump installed in accordance with Section 606.5.5. |

606.5.2 Support. All water supply tanks shall be supported in accordance with the building code.

606.5.3 Covers. All water supply tanks shall be covered to keep out unauthorized persons, dirt and vermin. The covers of gravity tanks shall be vented with a return bend vent pipe with an area not less than the area of the down-feed riser pipe, and the vent shall be screened with a corrosion resistant screen of not less than 16 by 20 mesh per inch (630 by 787 mesh per m).

606.5.4 Overflows for water supply tanks. A gravity or suction water supply tank shall be provided with an overflow with a diameter not less than that shown in Table 606.5.4. The overflow outlet shall discharge at a point not less than 6 inches (152 mm) above the roof or roof drain; floor or floor drain; or over an open water-supplied fixture. The overflow outlet shall be covered with a corrosion-resistant screen of not less than 16 by 20 mesh per inch (630 by 787 mesh per m) and by 1 /4-inch (6.4 mm) hardware cloth or shall terminate in a horizontal angle seat check valve. Drainage from overflow pipes shall be directed so as not to freeze on roof walks.

**TABLE 606.5.4**
**SIZES FOR OVERFLOW PIPES FOR WATER SUPPLY TANKS**

| MAXIMUM CAPACITY OF WATER SUPPLY LINE TO TANK (gpm) | DIAMETER OF OVERFLOW PIPE (inches) |
|---|---|
| 0 – 50 | 2 |
| 50 – 150 | 2½ |
| 150 – 200 | 3 |
| 200 – 400 | 4 |
| 400 – 700 | 5 |
| 700 – 1,000 | 6 |
| Over 1,000 | 8 |

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

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606.5.5 Low-pressure cutoff required on booster pumps. In accordance with rule 3745-95-07 of the Administrative Code, a low-pressure cutoff, a low suction throttling valve, or variable speed suction limiting controls shall be installed on all booster pumps in a water pressure booster system to prevent creation of a vacuum or negative pressure on the suction side of the pump when a positive pressure of 10 psi (68.94 kPa) or less occurs on the suction side of the pump while the pump is operating. Enforcement of the referenced rule is the responsibility of the local water supplier.

606.5.6 Potable water inlet control and location. Potable water inlets to gravity tanks shall be controlled by a fill valve or other automatic supply valve installed so as to prevent the tank from overflowing. The inlet shall be terminated so as to provide an air gap not less than 4 inches (102 mm) above the overflow.

606.5.7 Tank drain pipes. A valved pipe shall be provided at the lowest point of each tank to permit emptying of the tank. The tank drain pipe shall discharge as required for overflow pipes and shall not be smaller in size than specified in Table 606.5.7

**TABLE 606.5.7**
**SIZE OF DRAIN PIPES FOR WATER TANKS**

| TANK CAPACITY (gallons) | DRAIN PIPE (inches) |
|---|---|
| Up to 750 | 1 |
| 751 to 1,500 | 1½ |
| 1,501 to 3,000 | 2 |
| 3,001 to 5,000 | 2½ |
| 5,000 to 7,500 | 3 |
| Over 7,500 | 4 |

For SI: 1 inch = 25.4 mm, 1 gallon = 3.785 L.

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| 606.5.8 Prohibited location of potable supply tanks. Potable water gravity tanks or manholes of potable water pressure tanks shall not be located directly under any soil or waste piping or any source of contamination. | 606.5.9 Pressure tanks, vacuum relief. All water pressure tanks shall be provided with a vacuum relief valve at the top of the tank that will operate up to a maximum water pressure of 200 psi (1380 kPa) and up to a maximum temperature of 200ºF (93ºC). The size of such vacuum relief valve shall be not less than 1 /2 inch (12.7 mm). Exception: This section shall not apply to pressurized captive air diaphragm/bladder tanks. |
| 606.5.10 Pressure relief for tanks. Every pressure tank in a hydropneumatic pressure booster system shall be protected with a pressure relief valve. The pressure relief valve shall be set at a maximum pressure equal to the rating of the tank. The relief valve shall be installed on the supply pipe to the tank or on the tank. The relief valve shall discharge by gravity to a safe place of disposal. | 606.6 Water supply system test. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested in accordance with Section 312. |

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| 606.7 Labeling of water distribution pipes in bundles. Where water distribution piping is bundled at installation, each pipe in the bundle shall be indentified using stenciling or commercially available pipe labels. The identification shall indicate the pipe contents and the direction of flow in the pipe. The interval of the identification markings on the pipe shall not exceed 25 feet (7620 mm). There shall be not less than one identification label on each pipe in each room, space or story. | 607.1 Where required. In residential occupancies, hot water shall be supplied to plumbing fixtures and equipment utilized for bathing, washing, culinary purposes, cleansing, laundry or building maintenance. In nonresidential occupancies, hot water shall be supplied for culinary purposes, cleansing, laundry or building maintenance purposes. In nonresidential occupancies, hot water or tempered water shall be supplied for bathing and washing purposes. Tempered water shall be delivered from public hand-washing facilities. |
| 607.1.1 Temperature limiting means. A thermostat control for a water heater shall not serve as the temperature limiting means for the purposes of complying with the requirements of this code for maximum allowable hot or tempered water delivery temperature at fixtures. | 607.1.2 Tempered water temperature control. Tempered water shall be supplied through a water temperature limiting device that conforms to ASSE 1070 and shall limit the tempered water to a maximum of 110ºF (43ºC). This provision shall not supersede the requirement for protective shower valves in accordance with Section 424.3. |

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| 607.2 Hot or tempered water supply to fixtures. The developed length of hot or tempered water piping, from the source of hot water to the fixtures that require hot or tempered water, shall not exceed 50 feet (15 240 mm). Recirculating system piping and heat-traced piping shall be considered to be sources of hot or tempered water. | 607.2.1 Circulation systems and heat trace systems for maintaining heated water temperature in distribution systems. Automatic circulating hot water system pumps or heat trace shall be arranged to be conveniently turned off, automatically or manually, when the hot water system is not in operation. |
| 607.2.1.2 Demand recirculation controls for distribution systems. A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:<br>1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture, or sensing the flow of hot or tempered water to a fixture fitting or appliance.<br>2. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C). | 607.2.2 Piping for recirculation systems having master thermostatic valves. Where a thermostatic mixing valve is used in a system with a hot water recirculating pump, the hot water or tempered water return line shall be routed to the cold water inlet pipe of the water heater and the cold water inlet pipe or the hot water return connection of the thermostatic mixing valve. |

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| 607.3 Thermal expansion control. Where a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer, a thermal expansion tank shall be connected to the water heater cold water supply pipe at a point that is downstream of all check valves, pressure reducing valves and backflow preventers. Thermal expansion tanks shall be sized in accordance with the tank manufacturer's instructions and shall be sized such that the pressure in the water distribution system shall not exceed that required by Section 604.8. | 607.4 Flow of hot water to fixtures. Fixture fittings, faucets and diverters shall be installed and adjusted so that the flow of hot water from the fittings corresponds to the left-hand side of the fixture fitting. Exception: Shower and tub/shower mixing valves conforming to ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1, where the flow of hot water corresponds to the markings on the device. |
| 607.5 Insulation of piping. Piping to the inlet of a water heater and piping conveying water heated by a water heater shall be insulated in accordance with the applicable energy conservation standard referenced in Chapter 13 of the building code or Chapter 11 of the "Residential Code of Ohio". | 608.1 General. A potable water supply system within a building shall be designed, installed and maintained in such a manner so as to prevent contamination from nonpotable liquids, solids or gases being introduced into the building potable water supply through cross connections or any other piping connections to the system. Isolation backflow prevention device applications shall conform to Table 608.1, except as specifically stated in Sections 608.2 through 608.16.10. |

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| 608.2 Plumbing fixtures. The supply lines and fittings for plumbing fixtures shall be installed so as to prevent backflow. Plumbing fixture fittings shall provide backflow protection in accordance with ASME A112.18.1/CSA B125.1. | 608.3 Devices, appurtenances, appliances and apparatus. Devices, appurtenances, appliances and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that connect to the water supply system, shall be provided with protection against backflow and contamination of the water supply system. Water pumps, water-powered sump pumps, filters, softeners, tanks and other appliances and devices that handle or treat potable water shall be protected against contamination. |
| 608.3.1 Special equipment, water supply protection. The water supply for hospital fixtures shall be protected against backflow with a reduced pressure principle backflow prevention assembly, an atmospheric or spill-resistant vacuum breaker assembly, or an air gap. Vacuum breakers for bedpan washer hoses shall not be located less than 5 feet (1524 mm) above the floor. Vacuum breakers for hose connections in health care or laboratory areas shall not be less than 6 feet (1829 mm) above the floor. | 608.4 Water service piping. Water service piping shall be protected in accordance with Sections 603.2 and 603.2.1. |

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| 608.5 Chemicals and other substances. Chemicals and other substances that produce either toxic conditions, taste, odor or discoloration in a potable water system shall not be introduced into, or utilized in, such systems. | 608.6 Cross connection control. Cross connections shall be prohibited, except where approved backflow prevention assemblies, backflow prevention devices or other means or methods are installed to protect the potable water supply. |
| 608.6.1 Private water supplies. Cross connections between a private water supply and a potable public supply shall be prohibited. | 608.7 Valves and outlets prohibited below grade. Potable water outlets and combination stop-and-waste valves shall not be installed underground or below grade. Freezeproof yard hydrants that drain the riser into the ground are considered to be stop-and-waste valves. Exception: Freezeproof yard hydrants that drain the riser into the ground shall be permitted to be installed, provided that the potable water supply to such hydrants is protected upstream of the hydrants in accordance with Section 608 and the hydrants are permanently identified as nonpotable outlets by approved signage that reads as follows: “Caution, Nonpotable Water. Do Not Drink.” |

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| 608.8 Identification of nonpotable water systems. Where nonpotable water systems are installed,<br>  <br>the piping conveying the nonpotable water shall be identified either by color marking, metal tags or tape in accordance with Sections 608.8.1 through 608.8.2.3. | 608.8.1 through 608.8.2.3. 608.8.1 Signage required. Nonpotable water outlets, such as hose connections, open ended pipes and faucets, shall be identified with signage that reads as follows: "Nonpotable water is utilized for [application name]. CAUTION: NONPOTABLE WATER – DO NOT DRINK." The words shall be legibly and indelibly printed on a tag or sign constructed of corrosion-resistant waterproof material or shall be indelibly printed on the fixture. The letters of the words shall be not less than 0.5 inch (12.7 mm) in height and in colors in contrast to the background on which they are applied. In addition to the required wordage, the pictograph shown in Figure 608.8.1 shall appear on the required signage. |
| 608.8.2 Distribution pipe labeling and marking. Nonpotable distribution piping shall be purple in color and shall be embossed, or integrally stamped or marked, with the words: "CAUTION: NONPOTABLE WATER – DO NOT DRINK" or the piping shall be installed with a purple identification tape or wrap. Pipe identification shall include the contents of the piping system and an arrow indicating the direction of flow. Hazardous piping systems shall also contain information addressing the nature of the hazard. Pipe identification shall be repeated at intervals not exceeding 25 feet (7620 mm) and at each point where the piping passes through a wall, floor or roof. Lettering shall be readily observable within the room or space where the piping is located. | 608.8.2.1 Color. The color of the pipe identification shall be discernable and consistent throughout the building. The color purple shall be used to identify reclaimed, rain and gray water distribution systems. |

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608.8.2.2 Lettering size. The size of the background color field and lettering shall comply with Table 608.8.2.2.

**TABLE 608.8.2.2**
**SIZE OF PIPE IDENTIFICATION**

| PIPE DIAMETER (inches) | LENGTH BACKGROUND COLOR FIELD (inches) | SIZE OF LETTERS (inches) |
|---|---|---|
| ¾ to 1 ¼ | 8 | 0.5 |
| 1½ to 2 | 8 | 0.75 |
| 2½ to 6 | 12 | 1.25 |
| 8 to 10 | 24 | 2.5 |
| over 10 | 32 | 3.5 |

For SI 1 inch = 25.4 mm.

608.8.2.3 Identification tape. Where used, identification tape shall be at least 3 inches (76 mm) wide and have white or black lettering on a purple field stating “CAUTION: NONPOTABLE WATER – DO NOT DRINK.” Identification tape shall be installed on top of nonpotable rainwater distribution pipes, fastened at least every 10 feet (3048 mm) to each pipe length and run continuously the entire length of the pipe

608.9 Reutilization prohibited. Water utilized for the cooling of equipment or other processes shall not be returned to the potable water system. Such water shall be discharged into a drainage system through an air gap or shall be utilized for nonpotable purposes.

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608.10 Reuse of piping. Piping that has been utilized for any purpose other than conveying potable water shall not be utilized for conveying potable water.

**TABLE 608.1**
**APPLICATION OF BACKFLOW PREVENTERS**

| DEVICE | DEGREE OF HAZARD[a] | APPLICATION[b] | APPLICABLE STANDARDS |
|---|---|---|---|
| **Backflow prevention assemblies:** | | | |
| Double check backflow prevention assembly and double check fire protection backflow prevention assembly | Low hazard | Backpressure or backsiphonage Sizes 3/8"–16" | ASSE 1015, AWWA C510, CSA B64.5, CSA B64.5.1 |
| Double check detector fire protection backflow prevention assemblies | Low hazard | Backpressure or backsiphonage Sizes 2"–16" | ASSE 1048 |
| Pressure vacuum breaker assembly | High or low hazard | Backsiphonage only Sizes 1/2"–2" | ASSE 1020, CSA B64.1.2 |
| Reduced pressure principle backflow prevention assembly and reduced pressure principle fire protection backflow assembly | High or low hazard | Backpressure or backsiphonage Sizes 3/8"–16" | ASSE 1013, AWWA C511, CSA B64.4, CSA B64.4.1 |
| Reduced pressure detector fire protection backflow prevention assemblies | High or low hazard | Backsiphonage or backpressure (Fire sprinkler systems) | ASSE 1047 |
| Spill-resistant vacuum breaker assembly | High or low hazard | Backsiphonage only Sizes 1/4"–2" | ASSE 1056 |
| **Backflow preventer plumbing devices:** | | | |

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| Antisiphon-type fill valves for gravity water closet flush tanks | High hazard | Backsiphonage only | ASSE 1002, CSA B125.3 |
| Backflow preventer for carbonated beverage machines | Low hazard | Backpressure or backsiphonage Sizes 1/4"–3/8" | ASSE 1022 |
| Backflow preventer with intermediate atmospheric vents | Low hazard | Backpressure or backsiphonage Sizes 1/4"–3/4" | ASSE 1012, CSA B64.3 |
| Dual-check-valve-type backflow preventer | Low hazard | Backpressure or backsiphonage Sizes 1/4"–1" | ASSE 1024, CSA B64.6 |
| Hose connection backflow preventer | High or low hazard | Low head backpressure, rated working pressure, backpressure or backsiphonage Sizes 1/2"–1" | ASME A112.21.3, ASSE 1052, CSA B64.2.1.1 |
| Hose connection vacuum breaker | High or low hazard | Low head backpressure or backsiphonage Sizes 1/2", 3/4", 1" | ASME A112.21.3, ASSE 1011, CSA B64.2, CSA B64.2.1 |
| Laboratory faucet backflow preventer | High or low hazard | Low head backpressure and backsiphonage | ASSE 1035, CSA B64.7 |
| Pipe-applied atmospheric-type vacuum breaker | High or low hazard | Backsiphonage ony Sizes 1/4"– 4" | ASSE 1001, CSA B64.1.1 |
| Vacuum breaker wall hydrants, frost-resistant, automatic-draining-type | High or low hazard | Low head backpressure or backsiphonage Sizes 3/4", 1" | ASME A112.21.3, ASSE 1019, CSA B64.2.2 |
| **Other means or methods:** | | | |
| Air gap | High or low hazard | Backsiphonage or backpressure | ASME A112.1.2 |
| Air gap fittings for use with plumbing fixtures, appliances and appurtenances | High or low hazard | Backsiphonage or backpressure | ASME A112.1.3 |
| Barometric loop | High or low hazard | Backsiphonage only | (See Section 608.13.4) |

For SI: 1 inch = 25.4 mm.

a. Low hazard—See Pollution (Section 202).
High hazard—See Contamination (Section 202).

b. See Backpressure, low head (Section 202). See Backsiphonage (Section 202).

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| 608.11 Painting of water tanks. The interior surface of a potable water tank shall not be lined, painted or repaired with any material that changes the taste, odor, color or potability of the water supply when the tank is placed in, or returned to, service. | 608.12 Pumps and other appliances. Water pumps, filters, softeners, tanks and other devices that handle or treat potable water shall be protected against contamination. |
| 08.13 Backflow protection. Means of protection against backflow shall be provided in accordance with Sections 608.13.1 through 608.13.10. | 608.13.1 Air gap. The minimum required air gap shall be measured vertically from the lowest end of a potable water outlet to the flood level rim of the fixture or receptacle into which such potable water outlet discharges. Air gaps shall comply with ASME A112.1.2 and air gap fittings shall comply with ASME A112.1.3. |

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| 608.13.2 Reduced pressure principle backflow prevention assemblies. Reduced pressure principle backflow prevention assemblies shall conform to ASSE 1013, AWWA C511, CSA B64.4 or CSA B64.4.1. Reduced pressure detector assembly backflow preventers shall conform to ASSE 1047. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged. | 608.13.3 Backflow preventer with intermediate atmospheric vent. Backflow preventers with intermediate atmospheric vents shall conform to ASSE 1012 or CSA B64.3. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged. |
| 608.13.4 Barometric loop. Barometric loops shall precede the point of connection and shall extend vertically to a height of 35 feet (10 668 mm). A barometric loop shall only be utilized as an atmospheric-type or pressure-type vacuum breaker. | 608.13.5 Pressure vacuum breaker assemblies. Pressure vacuum breaker assemblies shall conform to ASSE 1020 or CSA B64.1.2. Spill-resistant vacuum breaker assemblies shall comply with ASSE 1056. These assemblies are designed for installation under continuous pressure conditions where the critical level is installed at the required height. Pressure vacuum breaker assemblies shall not be installed in locations where spillage could cause damage to the structure. |

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| 608.13.6 Atmospheric-type vacuum breakers. Pipe-applied atmospherictype vacuum breakers shall conform to ASSE 1001 or CSA B64.1.1. Hoseconnection vacuum breakers shall conform to ASME A112.21.3, ASSE 1011, ASSE 1019, ASSE 1035, ASSE 1052, CSA B64.2, CSA B64.2.1, CSA B64.2.1.1, CSA B64.2.2 or CSA B64.7. These devices shall operate under normal atmospheric pressure when the critical level is installed at the required height. | 608.13.7 Double check backflow prevention assemblies. Double check backflow prevention assemblies shall conform to ASSE 1015, CSA B64.5, CSA B64.5.1 or AWWA C510. Double check detector fire protection backflow prevention assemblies shall conform to ASSE 1048. These assemblies shall be capable of operating under continuous pressure conditions. |
| 608.13.8 Spill-resistant pressure vacuum breaker assemblies. Spillresistant pressure vacuum breaker assemblies shall conform to ASSE 1056 or CSA B64.1.3. These assemblies are designed for installation under continuous-pressure conditions where the critical level is installed at the required height. | 608.13.9 Chemical dispenser backflow devices. Backflow devices for chemical dispensers shall comply with ASSE 1055 or shall be equipped with an air gap fitting. |

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| 608.13.10 Dual check backflow preventer. Dual check backflow preventers shall conform to ASSE 1024 or CSA B64.6. | 608.14 Location of backflow preventers. Access shall be provided to backflow preventers as specified by the manufacturer's instructions. |
| 608.14.1 Outdoor enclosures for backflow prevention devices. Outdoor enclosures for backflow prevention devices shall comply with ASSE 1060 | 608.14.2 Protection of backflow preventers. Backflow preventers shall not be located in areas subject to freezing except where they can be removed by means of unions or are protected from freezing by heat, insulation or both. |

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| 608.14.2.1 Relief port piping. The termination of the piping from the relief port or air gap fitting of a backflow preventer shall discharge to an approved indirect waste receptor or to the outdoors where it will not cause damage or create a nuisance. | 608.15 Protection of potable water outlets. All potable water openings and outlets shall be protected against backflow in accordance with Section 608.15.1, 608.15.2, 608.15.3, 608.15.4, 608.15.4.1 or 608.15.4.2. |
| 608.15.1 Protection by air gap. Openings and outlets shall be protected by an air gap between the opening and the fixture flood level rim as specified in Table 608.15.1. Openings and outlets equipped for hose connection shall be protected by means other than an air gap. | 608.15.2 Protection by reduced pressure principle backflow prevention assembly. Openings and outlets shall be protected by a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly on potable water supplies. |

# SECTION 601 GENERAL

608.15.3 Protection by a backflow preventer with intermediate atmospheric vent. Openings and outlets shall be protected by a backflow preventer with an intermediate atmospheric vent.

**TABLE 608.15.1**
**MINIMUM REQUIRED AIR GAPS**

| FIXTURE | MINIMUM AIR GAP | |
|---|---|---|
| | Away from a wall[a] (inches) | Close to a wall (inches) |
| Lavatories and other fixtures with effective openings not greater than 1/2 inch in diameter | 1 | 1½ |
| Sinks, laundry trays, gooseneck back faucets and other fixtures with effective openings not greater than 3/4 inch in diameter | 1½ | 2½ |
| Over-rim bath fillers and other fixtures with effective openings not greater than 1 inch in diameter | 2 | 3 |
| Drinking water fountains, single orifice not greater than 7/16 inch in diameter or multiple orifices with a total area of 0.150 square inch (area of circle 7/16 inch in diameter) | 1 | 1½ |
| Effective openings greater than 1 inch | Two times the diameter of the effective opening | Three times the diameter of the effective opening |

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm².

a. Applicable where walls or obstructions are spaced from the nearest inside-edge of the spout opening a distance greater than three times the diameter of the *effective opening* for a single wall, or a distance greater than four times the diameter of the *effective opening* for two intersecting walls.

608.15.4 Protection by a vacuum breaker. Openings and outlets shall be protected by atmospheric-type or pressure type vacuum breakers. The critical level of the vacuum breaker shall be set not less than 6 inches (152 mm) above the flood level rim of the fixture or device. Fill valves shall be set in accordance with Section 425.3.1. Vacuum breakers shall not be installed under exhaust hoods or similar locations that will contain toxic fumes or vapors. Pipe-applied vacuum breakers shall be installed not less than 6 inches (152 mm) above the flood level rim of the fixture, receptor or device served.

608.15.4.1 Deck-mounted and integral vacuum breakers. Approved deck-mounted or equipment mounted vacuum breakers and faucets with integral atmospheric vacuum breakers or spill-resistant vacuum breaker assemblies shall be installed in accordance with the manufacturer's instructions and the requirements for labeling with the critical level not less than 1 inch (25 mm) above the flood level rim.

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| 608.15.4.2 Hose connections. Sillcocks, hose bibbs, wall hydrants and other openings with a hose connection shall be protected by an atmospheric-type or pressure-type vacuum breaker or a permanently attached hose connection vacuum breaker.<br>Exceptions:<br>1. This section shall not apply to water heater and boiler drain valves that are provided with hose connection threads and that are intended only for tank or vessel draining.<br>2. This section shall not apply to water supply valves intended for connection of clothes washing machines where backflow prevention is otherwise provided or is integral with the machine. | 608.16 Connections to the potable water system. Connections to the potable water system shall conform to Sections 608.16.1 through 608.16.10. |
| 608.16.1 Beverage dispensers. The water supply connection to beverage dispensers shall be protected against backflow by a backflow preventer conforming to ASSE 1022 or by an air gap. The portion of the backflow preventer device downstream from the second check valve and the piping downstream therefrom shall not be affected by carbon dioxide gas. | 608.16.2 Connections to boilers. The potable supply to the boiler shall be equipped with a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012 or CSA B64.3. Where conditioning chemicals are introduced into the system, the potable water connection shall be protected by an air gap or a reduced pressure principle backflow preventer, complying with ASSE 1013, CSA B64.4 or AWWA C511. If the boiler feedwater, water treatment, or make-up water pipe is not provided with a high temperature check valve (rated at not less than 250 ºF) near the boiler stop valve, then the temperature rating of the backflow preventer shall be not less than 250 ºF |

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| 608.16.3 Heat exchangers. Heat exchangers utilizing an essentially toxic transfer fluid shall be separated from the potable water by double-wall construction. An air gap open to the atmosphere shall be provided between the two walls. Heat exchangers utilizing an essentially nontoxic transfer fluid shall be permitted to be of single-wall construction. | 608.16.4 Connections to automatic fire sprinkler systems and standpipe systems. The potable water supply to automatic fire sprinkler and standpipe systems shall be protected against backflow by a double check backflow prevention assembly, a double check fire protection backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly.<br>Exceptions:<br>1. Where systems are installed as a portion of the water distribution system in accordance with the requirements of this code and are not provided with a fire department connection, isolation of the water supply system shall not be required.<br>2. Isolation of the water distribution system is not required for deluge, preaction or dry pipe systems |
| 608.16.4.1 Additives or nonpotable source. Where systems under continuous pressure contain chemical additives or antifreeze, or where systems are connected to a nonpotable secondary water supply, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly. Where chemical additives or antifreeze are added to only a portion of an automatic fire sprinkler or standpipe system, the reduced pressure principle backflow prevention assembly or the reduced pressure principle fire protection backflow prevention assembly shall be permitted to be located so as to isolate that portion of the system. Where systems are not under continuous pressure, the potable water supply shall be protected against backflow by an air gap or an atmospheric vacuum breaker conforming to ASSE 1001 or CSA B64.1.1. | 608.16.5 Connections to lawn irrigation systems. The potable water supply to lawn irrigation systems shall be protected against backflow by an atmospheric vacuum breaker, a pressure vacuum breaker assembly or a reduced pressure principle backflow prevention assembly. Valves shall not be installed downstream from an atmospheric vacuum breaker. Where chemicals are introduced into the system, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly. |

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| 608.16.6 Connections subject to backpressure. Where a potable water connection is made to a nonpotable line, fixture, tank, vat, pump or other equipment subject to high-hazard backpressure, the potable water connection shall be protected by a reduced pressure principle backflow prevention assembly. | 608.16.7 Chemical dispensers. Where chemical dispensers connect to the potable water distribution system, the water supply system shall be protected against backflow in accordance with Section 608.13.1, 608.13.2, 608.13.5, 608.13.6, 608.13.8 or 608.13.9. |
| 608.16.8 Portable cleaning equipment. Where the portable cleaning equipment connects to the water distribution system, the water supply system shall be protected against backflow in accordance with Section 608.13.1, 608.13.2, 608.13.3, 608.13.7 or 608.13.8. | 608.16.9 Dental pump equipment. Where dental pumping equipment connects to the water distribution system, the water supply system shall be protected against backflow in accordance with Section 608.13.1, 608.13.2, 608.13.5, 608.13.6 or 608.13.8. |

# SECTION 601 GENERAL

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| 608.16.10 Coffee machines and noncarbonated beverage dispensers. The water supply connection to coffee machines and noncarbonated beverage dispensers shall be protected against backflow by a backflow preventer conforming to ASSE 1022 or by an air gap. | 608.17 Protection of individual water supplies. An individual water supply, otherwise known as a private water system, shall be located and constructed so as to be safeguarded against contamination in accordance with the rules of the "Ohio Department of Health" set forth in Chapter 3701-28 of the Administrative Code, "Private Water Systems." |
| 609.1 Scope. This section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to the requirements of this section in addition to the other requirements of this code. The provisions of this section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes, homes for the aged, orphanages, infirmaries, first aid stations, psychiatric facilities, clinics, professional offices of dentists and doctors, mortuaries, educational facilities, surgery, dentistry, research and testing laboratories, establishments manufacturing pharmaceutical drugs and medicines and other structures with similar apparatus and equipment classified as plumbing. | 609.2 Water service. Hospitals shall have two water service pipes installed in such a manner so as to minimize the potential for an interruption of the supply of water in the event of a water main or water service pipe failure. |

# SECTION 601 GENERAL

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| 609.3 Hot water. Hot water shall be provided to supply all of the hospital fixture, kitchen and laundry requirements. Special fixtures and equipment shall have hot water supplied at a temperature specified by the manufacturer. The hot water system shall be installed in accordance with Section 607. | 609.4 Vacuum breaker installation. Vacuum breakers shall be installed not less than 6 inches (152 mm) above the flood level rim of the fixture or device in accordance with Section 608. The flood level rim of hose connections shall be the maximum height at which any hose is utilized. |
| 609.5 Prohibited water closet and clinical sink supply. Jet or water-supplied orifices, except those supplied by the flush connections, shall not be located in or connected with a water closet bowl or clinical sink. This section shall not prohibit an approved bidet installation. | 609.6 Clinical, hydrotherapeutic and radiological equipment. Clinical, hydrotherapeutic, radiological or any equipment that is supplied with water or that discharges to the waste system shall conform to the requirements of this section and Section 608. |

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| 609.7 Condensate drain trap seal. A water supply shall be provided for cleaning, flushing and resealing the condensate trap, and the trap shall discharge through an air gap in accordance with Section 608. | 609.8 Valve leakage diverter. Each water sterilizer filled with water through directly connected piping shall be equipped with an approved leakage diverter or bleed line on the water supply control valve to indicate and conduct any leakage of unsterile water away from the sterile zone. |
| 610.1 General. New potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority or water purveyor having jurisdiction or, in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652, or as described in this section. This requirement shall apply to “on-site” or “inplant” fabrication of a system or to a modular portion of a system. 1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet. 2. The system or part thereof shall be filled with a water/chlorine solution containing not less than 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing not less than 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours. 3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system. 4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system. | 611.1 Design. Drinking water treatment units shall meet the requirements of NSF 42, NSF 44, NSF 53, NSF 62 or CSA B483.1. |

# SECTION 601 GENERAL

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| 611.2 Reverse osmosis systems. The discharge from a reverse osmosis drinking water treatment unit shall enter the drainage system through an air gap or an air gap device that meets the requirements of NSF 58 or CSA B483.1. | 611.3 Connection tubing. The tubing to and from drinking water treatment units shall be of a size and material as recommended by the manufacturer. The tubing shall comply with NSF 14, NSF 42, NSF 44, NSF 53, NSF 58 or NSF 61 |
| 612.1 Solar systems. The construction, installation, alterations and repair of systems, equipment and appliances intended to utilize solar energy for space heating or cooling, domestic hot water heating, swimming pool heating or process heating shall be in accordance with the mechanical code. | 613.1 Temperature-actuated mixing valves. Temperature-actuated mixing valves, which are installed to reduce water temperatures to defined limits, shall comply with ASSE 1017. Such valves shall be installed at the hot water source. |

**File Attachments for Item:**

ER-19 CBO Code Summit (Miami Valley Building Officials Council)

BO, MPE, BPE, EPE, MechPE, FPPE, BI, RBO, RPE, RBI (2 hours)

Staff Notes: This course is currently approved for BO, MPE, BPE, and BI. Request is to add six more certifications. The attached material is from the original approval in 2018. It has been renewed annually since then.

Committee Recommendation:

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.


**Board of Building Standards**
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dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm


COURSE SUBMITTER:

Course Submitter: Jene A. Gauer # 518 (Contact Name)
Organization: MVBOC (Organization/Company)
Address: 76 E High Street (Include Room Number, Suite, etc.)
City: Springfield State: Ohio Zip: 45502
E-Mail: jgauer@springfieldohio.gov
Telephone: 937-324-7390 Fax: 937-328-3558
Course Sponsor: MVBOC

COURSE INFORMATION:

**Course Title:** CBO Code Summit

New Course Submittal: ☑ Update Course: ☐ Prior Approval Number: _____

**Purpose and Objective:** This is a series of 4 Round Table discussions on the Administrative code section and some major changes in OBC 2017 2 Hour sessions

**Number of Instructional Contact Hours that can be obtained upon completion:** 8

**If Multi-Session, Number of Instructional Contact Hours Per Session:** 2

**Program Applicable for the Following Participants:**

| | | | | | |
|---|---|---|---|---|---|
| Building Official ☑ | Master Plans Examiner ☑ | Building Inspector ☑ | Fire Protection Inspector ☐ | Mechanical Inspector ☐ | |
| | Plumbing Plans Exam. ☐ | | | Plumbing Inspector ☐ | |
| | Electrical Plans Exam. ☐ | | | Non-Res IU Inspector ☐ | |
| | Mechanical Plans Exam. ☐ | | | | |

Res Building Official ☐ Res Plans Examiner ☐ Res Building Inspector ☐ Res Mechanical Inspector ☐ Res IU Inspector ☐

Electrical Safety Inspectors ☐
Location of ESI Course: _____ Date(s) of ESI Course(s): _____

| SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**: | | Check Off |
|---|---|---|
| **Course Submitter:** | Name of contact person and their certification numbers, organization, address, fax, phone | ✓ |
| **Course Sponsor:** | Organization sponsoring or requesting the program (if any) | ✓ |
| **Course Title:** | Name of course (related to content) | ✓ |
| **Purpose/Objective:** | Describe purpose and how course will improve competency of certification(s) listed | |
| **Contact Hours:** | Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs) | ✓ |
| **Participants:** | Check off each certification for which credit is requested (for which course relates to certification) | ✓ |
| **Content of Program:** | Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered | |
| **Course Materials:** | Collated workbooks, handouts, hard copy or electronic versions of program is available | ✓ |
| **Instructor(s) Info.:** | Resume of professional/educational qualifications & teaching/training experience/BBS certifications | ✓ |
| **Test Materials:** | Copy of quizzes or tests to be given | |
| **Completed Application:** | | ✓ |

***NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.***

**Jene A Gaver**

**210 Lincoln Place**

**Urbana, Ohio 43078**

**(937) 508-3042**

**jgaver@springfieldohio.gov**

**Notable Accomplishments**

- Associates degree in Civil Engineering June 1998.
- State certified Chief Building Official, Residential Building Official, Building Inspector and Electrical Safety Inspector.
- Past President of Miami Valley Building Officials Council, several board positions, Ohio Building Official Association Vice President and Ohio Education Ad Hoc Committee.

**Employment History**

**Building Inspector, Electrical Safety Inspector 1993 - 1999**

**City of Xenia Building Inspections Department**

**976 Towler Road, Xenia, Ohio 45385**

Responsible for all zoning enforcement and residential plan review. Inspections for all Residential and commercial projects. Property maintenance enforcement and code Violation issues along with court appearances.

**Chief Building Official, Residential Building Official, Building Inspector, Electric Safety Inspector 1999 - 2013**

**Champaign County Building Regulations Department**

**1512 S. Hwy 68 Bay 13, Urbana, Ohio 43078**

Responsible for the operation of the Building Department budget, complaints, code compliance, web site, Monthly and yearly reports to the Board of Building Standards, personnel, Interpretation of building code and all aspects of Building Department administration.

**Chief Building Official, Residential Building Official Building Inspector, Electrical Safety Inspector 2013 - present**

**City of Springfield Building Regulations Department**

**76 E. High Street, Springfield, Ohio 45055**

Responsible for the plan review Commercial and residential, complaints, code compliance,

Interpretation of building code, inspections commercial and residential, all aspect of Building

Department operational procedures and process.

**Education**

**Clark State Community College**

Associate in Civil Engineering Technology

Graduated June 1998

**Wittenberg University**

English Major / Classical Guitar

Still attending work in process

**References**

Steve Regoli

Board of Building Standards

614-644-2613

Bill Edwards

Owner of Edwards Surveying

937-653-6508

**2018 OBC Chief Building Official Summit (4 – 2 hour sessions)**

Each class will receive two hours of continuing education credit

Class 1

- Chapter 1 Administration
  - 101.2 Scope of work
  - 102.7 Existing buildings
  - 102.9 Non-Required Work
  - 102.10.2 Minor Work vs. Major Work
  - 105.1.4 Phased Approval
  - 106.1.1 Information on Construction Drawings

Class 2

- Chapter 3 Care Facilities I and R use groups
  - Chapter 2 Definitions pertaining to Care Facilities
  - 308 Institutional Group 1or 2
  - 310 Residential Group R
  - Understanding Matrix Classification of Care Facilities

Class 3

- Chapter 5 Height and Area
  - Understanding of Table 504.3, 504.4 and 504.4
  - Understanding of Table 506.2
  - Chapter 34 Existing Structures

Class 4

- Chapter 30 Elevators and Conveying Systems
  - 3002 Hoistway Enclosures
  - 3003 Emergency Operations
  - 3006 Elevators Lobbies and Hoistway Opening Protection

**File Attachments for Item:**

ER-20 NEC 2017 Code Study Articles 300, 310, 312, 314, 695, 700 (Ohio Division of Industrial Compliance)

ESI, BO, MPE (7 hours)

Staff Notes: This course was approved in January for ESI. Mike Thompson of DIC now wants to add BO and MPE.

Committee Recommendation:

# *CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS*

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors**: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors**: Provide participants a certificate of completion containing the following information: name of participant, title of approved course, BBS approval #, date and location of the continuing education program, number of approved credit hours awarded, and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants**: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval**: Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area**: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; capable of being climatically controlled so that approximately 68° F can be maintained; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

## ADDITIONAL ELECTRICAL SAFETY INSPECTOR COURSE CRITERIA:

**Trainees**: During the first year, shall attend an approved thirty-hour course on the "Fundamentals of Electricity" and pass a test upon completion of the course. A second approved thirty-hour course and test covering the "National Electrical Code" shall be successfully completed prior to the examination for a certificate of competency. ESI trainee courses shall be designated as either of the following:

ESI TRAINEE COURSE - PART I - FUNDAMENTALS OF ELECTRICITY (THEORY)
ESI TRAINEE COURSE - PART II - ESI REFRESHER COURSE

**ESI course instructors**: Shall hold a current certificate of competency as an electrical safety inspector.
**ESI course:** ESI course applicants must give location(s) and date(s) of course(s).

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.


**Board of Building Standards**
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dic.bbs@com.state.oh.us
www.com.state.oh.us/dic/dicbbs.htm


COURSE SUBMITTER:

Course Submitter: MICHAEL THOMPSON
(Contact Name)

Organization: DEPARTMENT OF COMMERCE
(Organization/Company)

Address: 6606 TUSSING ROAD
(Include Room Number, Suite, etc.)

City: REYNOLDSBURG State: OHIO Zip: 43068

E-Mail: michael.thompson@com.state.oh.us

Telephone: 740-728-5293 Fax: _____

Course Sponsor: DIC/BCC #5068

COURSE INFORMATION:

**Course Title:** 2021 CODE STUDY AND REVIEW ARTICLES 300,310,312,314,695, AND 700

New Course Submittal: ☑ Update Course: ☐ Prior Approval Number: _____

**Purpose and Objective:** READ AND REVIEW EACH CODE SECTION AS A GROUP AND LOOK AT HOW WE ARE SEEING THESE SECTIONS APPLIED IN OUR INSPECTION PROCESS AND AS WELL WHAT CAN BE DONE DURING THE PLAN REVIEW PROCESS TO CATCH SOME ISSUES THAT WOULD HELP THE CUSTOMER. EACH INSPECTOR WILL BE GIVEN SECTIONS TO POARTICIPATE IN AND BE CALLED UPON TO PRESENT THE SECTIONS AS WE GO THROUGH THEM.

**Number of Instructional Contact Hours that can be obtained upon completion:** 5 HRS OF CEU'S

**If Multi-Session, Number of Instructional Contact Hours Per Session:** _____

**Program Applicable for the Following Participants:**

| | | | | | |
|---|---|---|---|---|---|
| Building Official ☐ | Master Plans Examiner ☐ | Building Inspector ☐ | Fire Protection Inspector ☐ | Mechanical Inspector ☐ | |
| | Plumbing Plans Exam. ☐ | | | Plumbing Inspector ☐ | |
| | Electrical Plans Exam. ☐ | | | Non-Res IU Inspector ☐ | |
| | Mechanical Plans Exam. ☐ | | | | |
| Res Bldg Official ☐ | Res Plans Examiner ☐ | Res Building Inspector ☐ | Res Mechanical Inspector ☐ | Res IU Inspector ☐ | |

Electrical Safety Inspectors ☒

Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐

Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐

Location of ESI Course: MICROSOFT TEAMS Date(s) of ESI Course(s): TBD

| SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**: | | Check Off |
|---|---|---|
| **Course Submitter:** | Name of contact person and their certification numbers, organization, address, fax, phone | X |
| **Course Sponsor:** | Organization sponsoring or requesting the program (if any) | X |
| **Course Title:** | Name of course (related to content) | X |
| **Purpose/Objective:** | Describe purpose and how course will improve competency of certification(s) listed | X |
| **Contact Hours:** | Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs) | X |
| **Participants:** | Check off each certification for which credit is requested (for which course relates to certification) | X |
| **Content of Program:** | Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered | X |
| **Course Materials:** | Collated workbooks, handouts, hard copy or electronic versions of program is available | |
| **Instructor(s) Info.:** | Resume of professional/educational qualifications & teaching/training experience/BBS certifications | X |
| **Test Materials:** | Copy of quizzes or tests to be given | |
| **Completed Application:** | | X |

***NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.***

INSTRUCTOR: Michael Thompson

Electrical Inspector Supervisor for the Department Of Commerce.

I have 15 years' experience in training employees the National electric code and safety. I carried contractor license in all 5 disciplines until fall of 2014. My ESI # 2705 , I am also a member of the International Inspectors Association (IAEI). One of my duties with being the Supervisor is to keep our inspectors up to Standards with their code knowledge and this program is just one of others we will do to reach these goals. I can provide a complete resume upon request. Thank You.

## 2021 Code study and Review Class: Article 300, 310, 312, 314, 695, and 700.

**7:30 – 8:00- Greetings**.

**8:00 am 8:10 am** – To go over purpose of this class and read through and study the issue we as an agency have come across in the field and how we interpret them ,how we can do better to communicate to our customers to avoid failed inspections and or missed items during inspections. Each class participant will be called on to read and present during the class.

**8:10 -9:20 Article 300 - Wiring Methods and General requirements.:** We will read and review this section and compare what each inspector is seeing in the field . Talk about the most common violations and a few that we miss.

**9:20 – 9:30 break**

**9:30- 10:30 – Article 310 – Conductors for general wiring:** Conductors in premises and underground installations are often not called out and require the field inspector to make sure the proper wire was chosen and sized properly ,we will read and validate our knowledge and use of the tables as well as this code section.

**10:30 – 12-00 - Article 312 and 314**: Review These sections and the enclosers that apply and what to look at while conducting an inspection talk about the new products that are being installed and their affects on how we inspect. What information we need to share with the plans examiner

**12:00- 1:00 Lunch**

**1:00 pm– 2:30 pm - Article 695 and 700 Fire pumps and emergency systems** : We will read through and discuss the code changes over the years and validate our understanding of this section on how they affect the inspection process and what we can do to communicate the most common issues at our first interaction with the customer to prevent them missing these rules and code requirements. Things as a group we should cover on are first inspection to allow for a smooth process.

**2:30 -3:00 – Questions and final discussion**

**File Attachments for Item:**

ER-21 NEC 2017 Code Study Articles 90, 100, 110, 200-250 (Ohio Division of Industrial Compliance)

ESI, BO, MPE (3 hours)

Staff Notes: This course was approved in January for ESI. Mike Thompson of DIC now wants to add BO and MPE to the 2021 approval.

Committee Recommendation:

# *CRITERIA FOR SUBMITTING CONTINUING EDUCATION COURSES FOR BOARD OF BUILDING STANDARDS CERTIFICATIONS*

The Ohio Board of Building Standards approves Continuing Education Courses for building department personnel. The courses may be used for the attainment of goals that are connected with technical and professional development as they relate to enforcing and interpreting the Ohio State Building Codes. Board approval is granted only on course instruction pertaining to OBC, OMC, OPC, and RCO requirements and such other content areas directly related to the responsibilities of the certification for which credit is being requested.

**Instructors**: Anyone or any organization promoting an approved course, is required to make full and accurate disclosure regarding course title, course approval number, number of credit hours, certifications for which the BBS has approved the class, and fees in promotion materials and advertising. ***The Board does not grant retroactive approval. It is recommended that courses be submitted for approval well in advance of any scheduling of classes and advertising***. Advertising shall not disclose improper approval information to the public.

**Course sponsors/co-sponsors**: Provide participants a certificate of completion containing the following information: name of participant, title of approved course, BBS approval #, date and location of the continuing education program, number of approved credit hours awarded, and signature of authorized sponsor or instructor.

Anyone or any organization administering an approved course shall provide the Board with advanced written information on scheduling of the course(s) (date and place) and provide to the Board a legible list of participants who completed the course with the name of course, date, and location.

**Participants**: Must attend the complete course as presented by the instructor to receive credit hours approved by the Board. No partial credit shall be given to any participant who failed to complete the entire course as approved. The sponsor/co-sponsor or instructor shall formulate a method to verify the individual's attendance and completion of the course.

**Board approval**: Remains in effect during the current code edition. Upon the Board's adoption of a new edition of the codes, course sponsors must update their course and submit to the Board for approval. The Board does not grant retroactive approval for courses presented prior to approval date.

**Facility/training area**: Shall be capable of comfortably and safely seating at least the number of attendees with writing surfaces for each attendee; accessible to/and usable for people with disabilities; sized and provided with audio/visual equipment adequate so that each attendee can see the instructor(s) and overhead screen and hear the content of the training programs; illuminated for writing and that the content on an overhead screen can be seen easily by all attendees; capable of being climatically controlled so that approximately 68° F can be maintained; non-smoking in the training room; sound controlled so that outside noise will not interfere with the training.

## ADDITIONAL ELECTRICAL SAFETY INSPECTOR COURSE CRITERIA:

**Trainees**: During the first year, shall attend an approved thirty-hour course on the "Fundamentals of Electricity" and pass a test upon completion of the course. A second approved thirty-hour course and test covering the "National Electrical Code" shall be successfully completed prior to the examination for a certificate of competency. ESI trainee courses shall be designated as either of the following:

ESI TRAINEE COURSE - PART I - FUNDAMENTALS OF ELECTRICITY (THEORY)
ESI TRAINEE COURSE - PART II - ESI REFRESHER COURSE

**ESI course instructors**: Shall hold a current certificate of competency as an electrical safety inspector.
**ESI course:** ESI course applicants must give location(s) and date(s) of course(s).

# APPLICATION

FOR

## Continuing Education Course Approval

Continuing education programs approved for education credit by the Ohio Board of Building Standards may be used for compliance with certification requirements related to code enforcement, plan review, and inspection responsibilities. The credit is to be used to renew the certifications issued by the Ohio Board of Building Standards pursuant to section 3781.10(E) ORC.


**Board of Building Standards**
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(614) 644-2613 Fax: (614) 644-3147
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www.com.state.oh.us/dic/dicbbs.htm


COURSE SUBMITTER:

Course Submitter: Michael Thompson
(Contact Name)

Organization: DEPARTMENT OF COMMERCE
(Organization/Company)

Address: 6606 TUSSING ROAD
(Include Room Number, Suite, etc.)

City: TUSSING ROAD State: OH Zip: 43068

E-Mail: michael.thompson@com.state.oh.us

Telephone: 614-728-5293 Fax:

Course Sponsor: DIC/BCC #5068

COURSE INFORMATION:

**Course Title:** 2021 NEC 2017 CODE STUDY ARTICLES 90,100,110,200 THRU 250

New Course Submittal: ☑ Update Course: ☐ Prior Approval Number:

**Purpose and Objective:** read through and study each code section and have open discusions of issues we as an agency have come across in the field and how we interpret them. How we can do better to communicate to our customers to avoid failed inspections and educating our customers when needed.

**Number of Instructional Contact Hours that can be obtained upon completion:** 7 hrs of CEU's

**If Multi-Session, Number of Instructional Contact Hours Per Session:**

**Program Applicable for the Following Participants:**

| | | | | |
|---|---|---|---|---|
| Building Official ☐ | Master Plans Examiner ☐ | Building Inspector ☐ | Fire Protection Inspector ☐ | Mechanical Inspector ☐ |
| | Plumbing Plans Exam. ☐ | | | Plumbing Inspector ☐ |
| | Electrical Plans Exam. ☐ | | | Non-Res IU Inspector ☐ |
| | Mechanical Plans Exam. ☐ | | | |
| Res Bldg Official ☐ | Res Plans Examiner ☐ | Res Building Inspector ☐ | Res Mechanical Inspector ☐ | Res IU Inspector ☐ |

Electrical Safety Inspectors [x]
Electrical Safety Inspector Trainee Part I - Fundamentals of Electricity (Theory) ☐
Electrical Safety Inspector Trainee Part II – ESI Refresher Course ☐
Location of ESI Course: MICRO SOFT TEAMS Date(s) of ESI Course(s): to be determined

| SUBMITTAL CHECKLIST: **Make Sure** all of the Following Information is **Submitted**: | | Check Off |
|---|---|---|
| **Course Submitter:** | Name of contact person and their certification numbers, organization, address, fax, phone | x |
| **Course Sponsor:** | Organization sponsoring or requesting the program (if any) | x |
| **Course Title:** | Name of course (related to content) | x |
| **Purpose/Objective:** | Describe purpose and how course will improve competency of certification(s) listed | x |
| **Contact Hours:** | Indicate instructional time and credit requested in hours (e.g.: 0.5 hr, 1 hr, 3.5 hrs) | x |
| **Participants:** | Check off each certification for which credit is requested (for which course relates to certification) | x |
| **Content of Program:** | Include collated agenda, time schedule, course outline; list specific sections of code, references, and topics covered | x |
| **Course Materials:** | Collated workbooks, handouts, hard copy or electronic versions of program is available | x |
| **Instructor(s) Info.:** | Resume of professional/educational qualifications & teaching/training experience/BBS certifications | |
| **Test Materials:** | Copy of quizzes or tests to be given | |
| **Completed Application:** | | x |

***NOTE: The Board does NOT grant retroactive approval for courses presented prior to approval date.***

INSTRUCTOR: Michael Thompson

Electrical Inspector Supervisor for the Department Of Commerce.

I have 15 years' experience in training employees the National electric code and safety. I carried contractor license in all 5 disciplines until fall of 2014. My ESI # 2705 , I am also a member of the International Inspectors Association (IAEI). One of my duties with being the Supervisor is to keep our inspectors up to Standards with their code knowledge and this program is just one of others we will do to reach these goals. I can provide a complete resume upon request. Thank You.

## 2021 Code study Class: Article 90,100, 110 ,200 thru 250.

**7:30 – 8:00- Greetings**.

8:00 am 9:20 am – To go over purpose of this class and read through and study the issue we as an agency have come across in the field and how we interpret them ,how we can do better to communicate to our customers to avoid failed inspections and or missed items during inspections. **Article 90** on the introduction of the 2017 NEC code and how this section of the code sets us up on how to use the code. We will also cover some housekeeping items.

**9:20 – 9:30 break**

**9:30- 11:30 – Article 100 - Definitions, Article 110 - Requirements for Electrical installations and Article 200 - Branch Circuits:** Here we will cover the definitions and discuss their meaning and were in the code they apply and look up these articles as we converse on each topic. Article 110 we will review this as well as how it applies and some of the projects we had to fail projects due to their understanding of this article and how we can do better to communicate these items to avoid future fails. Article 200 Grounded conductor we will read through this and discuss issues we have seen and what we are doing to improve the communication.

**11:30 – 12:00 Lunch**

**12:00 pm– 1:30 pm** - **Article 210 and Article 2:15** : We will read through and discuss the code changes over the years and validate our understanding of these two sections on how they affect the inspection process and what we can do to communicate the most common issues at our first interaction with the customer to prevent them missing these rules and code requirements.

**1:30 -1;45 break**

**1:45 – 2:30 Article 225 and Article 230 – services:** We will read through and discuss the code and common violations seen during the inspections of outside branch circuits and feeders. Look at the changes that may have occurred in recent code cycles and assure we are on point with the interpretations. Work right into Article 230 on services and complete the same with this.

**2:30 – 3:50** – **Article 250 Grounding**: Review this section for a refresher and to cover the items that we find the most. Cover the few things I feel we miss in are first inspection that may help eliminate failed inspections that pertain to grounding and bonding.

**3:50 – 4:00**- **open discussion and dismissal**

In summary this code class is to verify our knowledge and understanding what we are seeing in the field and are uniform in the interpretation and enforcement, Review of these codes sections and how we as a team can improve and be consistent .

**File Attachments for Item:**

NB-1 Recognizing other education not granted BBS number

Staff Notes: Occasionally, we receive requests from certified personnel to recognize education offered by groups outside Ohio that have not applied for BBS continuing education approval. Most recently, it was the Western Division of IAEI conference in September, (see certificate attached) but this has come up before.

Committee Recommendation:

# IAEI International Association of Electrical Inspectors

*This Is To Certify That*

## Wes Shepherd

has satisfactorily completed Continuing Education Unit:

## 2021 IAEI Western Section Meeting
## Bellaire, Michigan

CEO / Executive Director

Date September 19-22, 2021 18 Contact Hours (1.8 CEU)

ICC Preferred Provider #1053 / ICC Course #14980, 29080, 18716, 18714, 6469, 18702, 11987, 18706, 27983
Hazardous Location Wiring, 2 hours, ICC Course #14980; Swimming Pools, 1 hour, ICC Course #29080
Code Panel Forum – Your Questions Answered, 5 hours, ICC Course #18716, 18714
NRTL Panel, 2 hours, ICC Course #6469; NEC Code Changes for 2023, 2 hours, ICC Course #18702
Health Care Wiring, 2 hours, ICC Course #11987; Grounding and Bonding, 2 hours, ICC Course #18706
Receptacle Wiring and Spacing, 2 hours, ICC Course #27983