STUDY GUIDE

ASCR2, ASCR4, ASC2, ASR2, ASD2

SPRINKLER ASSESSMENTS

June 14, 2017 REV4

This document contains sample questions to help participants study for the Automatic Sprinkler assessments. Other documents are required for the exams.

If you intend to take this booklet into the test, make sure it is bound in a binder or stapled. You will not be allowed to take this material into the test center if it is not bound.

(IMPORTANT: Material provided is not intended to endorse, represent quality, recommend a particular product, or single out any product. Material may be used to provide standardized content for test questions to ensure that participants know how to use data sheets and manufacturer materials to establish listing and installation limitations of these types of products. There is no implied or other relationship between CSA and the manufacturers or suppliers of information used. CSA is not liable for accuracy or content of material contained within these documents. Material in this booklet is for testing purposes only and is not to be used for installation of these systems / components. Check with suppliers for current and specific information to be used in actual design and installation conditions.)

Printing Score Reports & other exam info on Page 3

Rev 1 & 2 corrected IBC/IFC edition.
Rev 3 Added question and notes on IBC 506
Rev 4 added page 3 info

About the Assessments:

Assessment Abbreviation: ASCR2 (Automatic Sprinkler Commercial Residential On-Site)

Number of Questions: 101

Amount of Time for Test: 2.5-hours

Assessment Abbreviation: ASCR4 (Automatic Sprinkler Commercial Residential Business Representative)

Number of Questions: 121

Amount of Time for Test: 3-hours

Assessment Abbreviation: ASC2 (Automatic Sprinkler Commercial On-Site)

Number of Questions: 80

Amount of Time for Test: 2-hours

Assessment Abbreviation: ASR2 (Automatic Sprinkler Residential On-Site)

Number of Questions: 40

Amount of Time for Test: 1-hour

Assessment Abbreviation: ASD2 (Automatic Sprinkler Domestic On-Site)

Number of Questions: 30

Amount of Time for Test: 1-hour

Exam format: Open book (bring your own books); basic calculators will be available, writing tablet or paper will be provided for calculations. Any books or exam documents brought into exam must be bound as no loose papers are allowed. Your books may be highlighted and pages tabbed with permanent tabs before the exam. Do not mark in books during exam.

Passing Score: 80%

Cell Phones: Do not bring cell phones, pagers, or radios into the test center.

Codes / Materials Used for Exam and Editions: (indicated code is used on these exams)

- 2016 NFPA 13 (ASCR2, ASCR4, ASC2)
- 2016 NFPA 13R (ASCR2, ASCR4, ASC2, ASR2)
- 2016 NFPA 13D (ASCR2, ASCR4, ASR2, ASD2)
- 2016 NFPA 14 (ASCR2, ASCR4, ASC2)
- 2014 NFPA 25 (ASCR2, ASCR4, ASC2, ASR2)
- 2016 NFPA 20 (ASCR4)
- **Supplemental Sprinkler Exam Material** from our web site. This document includes CPVC installation manual, sprinkler data sheets, and Occupational Safety and Health related material on confined spaces and Lock-Out-Tag-Out. (ASCR2, ASCR4, ASC2, ASR2, ASD2)
- 2009 - 2015 International Building Code or International Fire Code (either will work) (ASCR4). Questions are based on the model code and may not reflect local amendments or changes. For IFC see note in red page 4.

Important Candidate Information

PRINTING SCORE REPORTS

Candidates are not able to print reports at PSI centers. This is a computer restriction at PSI centers.

Reports are not automatically emailed. However, while at the exam center Score Reports can be Sent to the email used to register your exam. At the bottom of window Click on "Send". **There is no confirmation**, but it will be sent to the email shown at the top of the Score Report.

From your home or office you can log into your Dashboard and print a copy. Go to www.CSAexams.com and find links to Dashboard under the Test Info or Contractor Info pages. You will need your CA number and password. In the "History" tab click on the words "Passed" or "Failed" under the Outcome column for the exam you want to view. Then either Print to your printer, or Send to email in system.

Taking Materials into Exams

CSA exams are open book. You must provide your own code books and required exam materials. Check the study guide to verify what editions the exams are based on. All material must be bound (no loose papers). Other than sample questions and materials within a CSA study guide, do not take other study questions into the exam. Page tabs must be of permanent type. Do not mark in any materials during an exam.

Phones, radios, pagers are not allowed in exam rooms, please leave these in your vehicles. ID is required.

Photographs

Your photograph will be taken when you register at the proctoring center. This is to verify who took the exam. This photo will also be used on your ID card. Although not required, you may want to wear a company shirt/logo. Pictures are cropped to best fit ID card, so there is no guarantee the logo will show. If you are worried about the quality or background, ask the proctor if the picture is good enough to be used on your ID card.

Please be respectful of others taking exams by minimizing noise and interruptions. If you have any exam or computer problems please see the proctor so they can assist. If necessary, the proctor can log a report for further investigation. Then notify CSA so we can look into the problem.

How to Schedule Your First Exam / Assessment

To start the process, you must Request an Assessment from www.CSAexams.com. Within 1—3 days you should receive an email from PSI with a link to their website along with your user name and password. Using this link log into PSI, make your payment and schedule your exam. If you do not get the email from PSI in 3 days, reply to your CSA Request email so we can look into it. Please check your spam / junk folders for emails from PSI. Make sure you are paying for the correct exam as there are no refunds.

Rescheduling an Exam

To reschedule an exam you must log back into the PSI system where you scheduled the exam, or using links at www.CSAexams.com under Contractor Info. Changes should be made 3 days before your scheduled exam. (You can try up to 48 hours before start time depending on time zones.) If the system will not give you the option to Cancel/Reschedule than you must show up or firefight your fees. There are no refunds.

If You Fail an Exam

If you fail an exam, you must Request a new Assessment from www.CSAexams.com. Then, when you get the email from PSI you can go to PSI website and make new full payment and schedule the exam.

When you Pass an Exam

ID cards and certificates will generally be mailed out within three weeks. They will be mailed to the address provided when requesting the assessment. If the address has changed, please email CSA with new address.

If You Need a New ID Card

To change the company name, change your last name, or if you have lost your card, go to www.CSAexams.com and select Replacement ID link. Exams are good for 3 years. Then a new exam is required.

Please report cheating to the proctor or CSA.

General Assessment Information:
About the Questions: Questions are randomly selected from respective topics within a larger database.

Exam Format: Questions are computer based and will be delivered one at a time. You will have the opportunity to go back and review all questions after you are finished. You can also "check" a box within each question which will flag it for later review. During the review, checked questions will be marked for easier identification.

Time Clock: Most assessments will have a count-down timer displayed on the screen. It may appear as if this timer is fluctuating between questions (gaining time on one question and loosing time on the next question). This is normal. The software has a specific function which ensures your time is protected if there is a loss of the Internet connection. It is very difficult to explain the logic behind the clock. However, we can assure you that you are getting all of your time. Do not steadily watch the clock, but rather use it as a general guide. Long pauses between questions will result in the biggest time jump as the computers verify that you are still testing and did not loose the Internet connection.

Correct Exam: When requesting an exam, make sure to select the correct exam. There are no refunds for requesting and paying for the wrong exams. Make sure the exam is correct for the jurisdiction you will be submitting qualifications to. The most common exam required by jurisdictions is the ASCR2.

Renewal: All qualifications expire in three years from the month taken. Make sure to keep up with your expiration dates. Retesting is required to renew your qualifications. So make sure to allow enough time to study and schedule your exams before expiration.

Updating Exams: Based on low exam volume, we do not expect to update the ASR2 exam after the 2016 version. This may also apply to the ASC2 exam. If these exams are not updated, current holders will need to take the ASCR2 exams to recertify. This will be evaluated at a later date.

NOTE for those taking the ASCR4: There is a question added that comes from the IBC Section 506, but is not covered in the IFC. Due to its importance, it is discussed here. When an architect wants to increase the area of a building based on the type of construction, they may use sprinklers for increased area. However, in order to take area increases the sprinkler system is required to be an NFPA 13 system. NFPA 13R systems do not allow increased areas. Therefore, ensure the drawings clearly indicate what type of system is to be installed and if credits were taken.

Following each assessment, the score report will provide a percent correct for each of the topics used in a particular exam. The number of questions within a topic will vary. Some topics may have 2 questions or 20 questions. Here are sample question topics for the ASCR2 exam.

General	NFPA 25 General
Spacing	NFPA 14 Definition
Systems	NFPA 14 General
Sprinklers	CPVC
Calculations	NFPA 13D General
Hangers	NFPA 13R General
Definitions	NFPA 13R Sprinkler
Seismic	OSHA

The following questions are related to the sprinkler assessments. Some of these sample questions will have the answers, and some will not. Some will provide an explanation on how to calculate. There is also information that describes topics to study without any specific questions. Questions will often start off with an indication of the book or standard that the question is based out of, such as [NFPA 13]. We suggest that you tab sections of your code books to help find them faster. We recommend that you purchase and use "handbooks" when available, such as the NFPA 13 handbook. These handbooks provide the code language in addition to other beneficial theory, examples, figures, and more.

1. [NFPA 13] A contractor is allowed to make deviations from approved plans without getting the permission of the Authority Having Jurisdiction (AHJ).
   True
   False

2. Be able to define Response Time Index (RTI)

3. Be able to identify specific limitations and criteria of the small room rule, including area, distances, openings, etc. This criteria is found in multiple locations in code. There are several questions related to this.

4. [NFPA 13] The maximum allowable area of coverage for an individual standard spray pendent or upright sprinkler is (8.6.2, 2016):{in this example the question tells you the code section where you can find this information to save time looking. Few questions will provide such a reference.}
   144 sq ft (13.4 sq m)
   200 sq ft (18.6 sq m)
   225 sq ft (20.9 sq m)
   400 sq ft (37.2 sq m)

5. Be able to identify the different types of systems including dry-pipe, pre-action, deluge, single-interlock, double-interlock, etc.

6. Be able to identify the time-to-water and volume limitations of dry-pipe systems.

7. Seismic requirements are heavily based on soil conditions that the building is constructed on, and not just seismic activity locations. As such, seismic criteria often applies even far from active faults. Be able to identify criteria related to hanger bracing, flexible fittings vs. rigid fittings, over-size of holes through floors and walls, etc.

8. [NFPA 13] "A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire", is the definition of:
   Pre-action system
   Dry Pipe system
   Wet system
   Deluge system

9. [NFPA 13] If a section of pipe has a friction loss of 0.7 psi per foot, how much pressure would be lost in a 60 foot horizontal section of pipe?
   30 psi
   0.43 psi
   42 psi
   20 psi

10. A standpipe riser is 150 feet tall and full of water. Assuming that the pipe is not connected to a water supply, what would be the pressure at the bottom of the riser? (The intent of this question is to identify how elevation impacts pressure.)
    43 psi
    65 psi (correct)
    100 psi
    4.3 psi
    {Tip: Every foot in elevation adds 0.433 psi of pressure)

11. Understand how to apply the "three times rule" with respect to sprinkler spacing around obstructions such as a column within 8 inches of a sprinkler.

12. A menu board is hanging from a ceiling and creates an obstruction from the ceiling to 14 inches below the ceiling. How far must a standard spray sprinkler be located from the menu board to avoid obstructing the spray pattern?

13. A sprinkler is located 6 feet in front of an electric unit heater. What should the temperature rating of the sprinkler be?

14. In what direction should the frame arms of upright sprinklers be orientated with respect to the pipe they are installed.

15. How should a linen Shute in a multi-story building be protected?

16. The third floor of a five story building has doors that open into the stairway from both the left and the right side of the stair. The second, fourth, and fifth floor each have one door opening into the stair. The first floor has one door opening into the stair, and one door to the outside. Which landings are required to have sprinklers installed? The stair is non-combustible and has non-combustible stairs.

17. There will be several questions related to obstructions around sprinklers. They may include soffits, suspended objects, walls that do not go all the way to the ceiling, etc.

18. The test will have many questions related to hangers, hanger attachments, lag bolts, screws, anchors, etc.

19. There will be questions related to obstructions such as beams, bar joists, and wood trusses.

20. [NFPA 13] A sprinkler is listed to have a spacing of 15 feet between sprinklers. The maximum spacing this sprinkler may be from the corner of a room is:
    7.5 feet
    10 feet
    11.2 feet
    15 feet

21. [NFPA 13] Bending of pipe is permitted as long as it complies with all the criteria of NFPA 13 providing there are no kinks, ripples, distortions, reductions in diameter or any noticeable deviations from round.
    True
    False

22. [NFPA 13] The depth of underground pipe such as under driveways, railroad tracks, and with respect to frost lines.

23. [NFPA 13] In supporting 5" pipe with a Threaded Bolt Connection (TBC), all-thread rod and ring hangers, the all thread rod diameter shall be at least:
    1/4"
    1/2"
    3/8"
    3/4"
    5/8"

24. There are questions with respect to pipe-schedule systems, including the number of sprinklers served by respective size pipes.

25. Spacing of sprinklers under slopped ceilings.

26. Understand anti-flooding devices, quick-release devices, air-regulators, etc.

27. Some test will have questions from NFPA 14 related to standpipes, and NFPA 25 related to inspection, maintenance, and testing of water based suppression systems.

28. ASCR4 assessments will have questions from the IBC / IFC with respect to sprinkler system requirements, standpipe requirements, water supplies, type of system required for area increase (IBC 506), etc.

29. Many of the limitations regarding CPVC pipe are found within the manufacturer listings. Download the Supplemental Sprinkler System Manual from our site and be familiar with it. Some common questions include deflection, hangers, cure time, and other material.

30. Some exams have questions from NFPA 13D and 13R related to sprinkler spacing, limitations, FDC's, flow alarms, and other material.

The above only provides a basic representation of sample materials on the test. The participant is responsible for reviewing all relevant code criteria. Some material may be taken from Annex "A" of the respective code. Make sure to understand how to identify material in Annex "A". Handbooks will contain this Annex material adjacent to the applicable code paragraph making it easier to find.

<u>The following are some additional questions that may be found on the ASCR4 exam, but would be useful for others to understand.</u>

FIRE PUMP AND PRESSURES

You are installing an underground fire main between a remotely located private fire pump and the buildings sprinkler riser. The civil plans require that you provide a pipe with a pressure rating for the normally anticipated pressure on the system once the sprinkler contractor sizes the pump. The sprinkler contractor will not be installing any pressure control devices.

The normal static city supply pressure to the pump is 40 psi.
The sprinkler contractor is providing a pump rated at 75 psi at 1,000 gpm.
The fire pump will deliver a normal churn pressure (pressure when water is not flowing) of 120%.

What pressure rating of pipe is required between the pump and the building riser?
150 psi
175 psi
200 psi

Answer:
The pump is rated at 75 psi. Churn pressure is the pressure that a fire pump will deliver when it is running and not flowing any water. This pressure will often be around 120% of the rated pressure. Thus, if the pump is rated at 75 psi and has a churn of 120% it will produce a discharge pressure of 90 psi. This is the pressure with no added pressure on the suction side of pump. Now you must add the suction pressure to the pump pressure to get the final discharge pressure. Thus:

Final discharge pressure at churn is (40 psi city pressure) + (90 psi churn pressure) = 130 psi.

The piping running between the pump and the building must be rated at least as high as the city + pump pressure. Therefore, the piping must be rated for at least **150 psi**. The pipe rating must be above the final discharge pressure.

If the city supply was 70 psi and the fire pump was rated at 100 psi with a 120% churn, the following would apply.
(100 psi x 1.2 churn) + (70 psi city pressure) = final discharge
(120 psi at churn) + (70 psi city) = 190 psi which would require a minimum 200 psi rated pipe.

FIRE PUMPS AND PRESSURES
A fire pump has been installed on a supply pipe between the street tap and the building. The fire flow at the street has a static pressure of 70 psi and a residual flow of 55 psi at 1,000 gpm. The sprinkler contractor has selected a fire pump rated at 90 psi at 1,000 gpm. No pressure reducing valves have been provided. Assuming the sprinkler system is flowing 1,000 gpm, what is the discharge pressure at the pump? The pump has a churn pressure of 120%.

Answer: Pumps boost pressure. In this question the flows are consistent and the question is based on flowing water or residual pressures. As long as the flows are the same you simply add the pressures of 55 psi suction + added pressure the pump provides. However, if a pump is rated at ## psi at a flow of #### gpm, then that same pump will produce a higher pressure at churn, or no flow. Churn is the condition when the pump is running, but no water is flowing. As such, the pump places a higher pressure on the pipe system.

a. Using the information in the question above calculate the following: The fire pump develops a churn pressure of 120% of the rated pressure. What is the discharge pressure of the pump at churn during the weekly automatic pump test?

   Answer: The churn pressure of the pump by itself (no city pressure) is 90 psi x 1.20 (or 120%) = 108 psi. The question asks for the discharge pressure during the weekly automatic pump test. This indicates that the system is open to the street pressure which provides a static pressure of 70 psi on the suction side of the pump. Thus, you have to add the static pressure of 70 psi to the pump churn pressure of 108 psi to get 178 psi discharge pressure.

b. The civil engineer did not specify a pressure rating for the pipe as he/she did not know what size pump the sprinkler contractor was going to select. Using the information above, what is the required minimum pressure rating of the underground pipe between the pump and the building? Select the appropriate option below.
   1.) 100 psi
   2.) 150 psi
   3.) 200 psi

   Answer to 6b: Based on the answer from question "a" we identified that the pump churn during the weekly testing will be 178 psi, which is above 150 psi. Therefore, the pipe must be rated for 200 psi. (This churn pressure of 178 can

also create issues for the sprinkler contractor as many of his fittings/sprinklers are only rated for 175 psi. This issue is not addressed here).

FRICTION LOSS

A sprinkler system has a hydraulically calculated demand of 250 gpm at 50 psi at the riser. The available flow at the street is 250 gpm at 60 psi. The equivalent length of run (including fittings, valves, etc.) from the street to the riser is 200 ft.

Using the information below, what is the minimum size supply pipe needed to supply this system? Assume that any safety factors have already been included in the riser demand.
Friction loss:
3" = 0.0426 psi/ft
4" = 0.0107 psi/ft

a) 3 inch
b) 4 inch

Answer:
From the information in the question we see that the street pressure is 60 psi and that the riser must have at least 50 psi to work. This tells us that we cannot lose more than 10 psi between the street connection and the riser (60 psi – 50 psi = 10 psi). Therefore, we have to select a pipe that will not drop the pressure more than 10 psi over the 200 feet. The best approach is to calculate the friction loss for each pipe size over the 200 feet and see what the smallest pipe size can be without going over 10 psi.

3" pipe (0.0426 psi/ft x 200 ft = 8.52 psi
4" pipe (0.0107 psi/ft x 200 ft = 2.14 psi

We see that the 4 inch pipe only has a pressure loss of 2.14 psi so this pipe results in the least friction loss. However, the question specifically asked <u>what is the minimum size supply pipe needed to supply the system</u>? Because the 3" pipe friction loss is less than 10 psi it will work. **Thus, 3" is the correct answer for minimum size pipe**.

If the question asked which pipe provides for the least amount of friction loss, then the 4" pipe would be correct.

FRICTION LOSS

A new 6" fire main is being installed to supply a warehouse. Based on the anticipated fire flow demand of the sprinkler system the friction loss will be 0.03 psi/ft (psi per foot). The new section of pipe will be 125' long. What is the friction loss (in psi) within this new section of pipe?

Answer: A friction loss of 0.03 psi/ft x 125' of pipe results in a total loss of 3.75 psi.

FRICTION LOSS

If a 200' section of pipe has a total friction loss of 4 psi, what is the friction loss per foot of pipe (psi/ft)?

Answer: Divide the friction loss by the total length of pipe to get the loss per foot of pipe. 4 psi / 200' = 0.02 psi/ft

SECONDARY CONTAINMENT CALCULATIONS

When facilities involve hazardous materials, there are frequently requirements for containment of sprinkler water and the hazardous materials involved. The requirement for secondary containment will frequently come out of the International Fire Code (IFC) in chapters dealing with hazardous materials. When required, secondary containment will usually need to be sized to accommodate spillage of the single largest container and 20 minutes of sprinkler discharge.

A key in calculating the secondary containment volume (gallons) is to identify the following:

- Identify the area for secondary containment
    - The entire room or building
    - A smaller diked containment area around a tank or tanks
    - A smaller room located within a larger storage or building area
    - If double-walled tanks are used, secondary containment may not be required

Example concept of a dike: If a 300 gallon chemical tank and a 100 gallon chemical tank are provided within a diked wall (10'W by 10'L) that is sized (high enough) to accommodate spillage of the largest tank and 20 minutes of sprinkler flow *landing within the diked area* than normally there is not a need to contain a larger design area of 2,000 square feet. The only water we are interested in capturing is what will land within the 100 square foot dike. ***Note that depending on the design, chemicals, codes, and other engineering or code requirements, there may be requirements to contain leakage of process piping outside of the dike. For our purposes we are focusing on the tank and not process piping. Design engineers such as the project fire protection engineer should be identifying specific requirements of where secondary containment is required to be provided.***

- Thus, if we want to provide secondary containment for the dike indicated above we need to know the density of discharge (assume 0.2gpm/sqft), the area of the dike (100 sqft), and the volume of the largest single tank (300 gallons). With this information we establish:

  (0.2 gpm/sqft) x (100 sqft area) x (20 minutes) + (300 gallon tank) = 700 gallons
  [this example did not include spacing overage which might be added into the question such as 20%]

- Let's assume that there is no dike and the tanks are located out in a large storage area. Assuming the sprinkler density is 0.2/2,000 and there are no reductions in area we would now have:

  (0.2 gpm/sqft) x (2,000 sqft area) x (20 min) + (300 gal tank) = 8,300 gallons
  [this example did not include spacing overage which might be added into the question such as 20%. Including 20% for sprinkler spacing overage would result in 9,900 gallons of containment.]

As you can see, providing a room or dike around the chemicals will significantly reduce the amount of water that must be contained from sprinkler discharge. It is also easier to contain the water in a dike rather than trying to contain water on the floor of a warehouse or providing a large pit. It is important for the sprinkler contractor/designer to understand the impacts of

secondary containment so that questions can be asked early in a project and proper solutions identified.