STUDY GUIDE

ASCR2, ASCR4, ASC2, ASR2, ASD2

SPRINKLER ASSESSMENTS

September 7, 2020

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.)

Important Note: NFPA 13 2019 edition was totally reorganized. Thus, where you used to find something in previous editions it will likely be in a new location. Make sure to allow adequate time to learn the new layout and tab your sections accordingly. The NFPA 13 handbook incorporates a 2016 – 2019 Roadmap after the Index (back of book) to help find old references in the new edition. Due to this change, some users may wish to use the 2016 edition vs. learning the new format. Most code content is the same, just in different locations. Some questions may reference a code section or table to help candidate find it quickly during exam. These will reference the 2019 locations. If using an older code you will have to find that section in the older code. CSA can only validate the exam to the editions listed in the study guide.

THE FOLLOWING ARE THE ONLY MATERIALS ALLOWED IN AN EXAM COVERED BY THIS STUDY GUIDE

- CSA Study Guide ASCR2, ASCR4, ASC2, ASR2, ASD2 Sprinkler Assessments
- CSA Supplemental Sprinkler Exam Material
- NFPA 13 Standard for the Installation of Sprinkler Systems
- NFPA 13D - Standard for the Installation of Sprinkler Systems in One and Two-Family Dwellings and Manufactured Homes
- NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies
- NFPA 14 – Standard for the Installation of Standpipe and Hose Systems
- NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
- International Building Code
- OSHA Control of Hazardous Energy – Lockout / Tagout
- Non-programmable calculator

Your exam may not require all these items, but these are the only items allowed during an exam covered by this study guide. Page 3 provides a list of what materials are required for each exam.

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); You are required to provide your own basic non-programmable calculator for pressure loss calculations. Scratch paper or an online split screen 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/room.

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

- 2019 NFPA 13 (ASCR2, ASCR4, ASC2)
- 2019 NFPA 13R (ASCR2, ASCR4, ASC2, ASR2)
- 2019 NFPA 13D (ASCR2, ASCR4, ASR2, ASD2)
- 2019 NFPA 14 (ASCR2, ASCR4, ASC2)
- 2020 NFPA 25 (ASCR2, ASCR4, ASC2, ASR2)
- 2019 NFPA 20 (ASCR4)
- Non-programmable calculator
- **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)
- 2015 - 2019 International Building Code (ASCR4). Questions are based on the model code and may not reflect local amendments or changes.

Important Candidate Information

YOUR SCORE & PRINTING SCORE REPORTS

All scores provided at the end of your exam and in your score email are "preliminary". Exams are subject to review of audio / video recordings, or concerns raised by proctors.

Your preliminary score will be automatically emailed following the exam. Candidates may also log into their Webassessor account to view/print score reports. Use the link and info in your scheduling emails.

Score reports for failed exams will provide a breakdown of scores by topics/subjects within the exam. Your overall score determines Pass/Fail. However, the topic scores help to identify areas that need more attention when studying. Topic scores will not be provided on Pass emails.

Taking Materials Into Exams

CSA exams are open book. You must provide your own books and required exam materials, including calculators. Check this guide to verify what editions exams are based on. All material must be bound (no loose papers). Other than items listed on Page 2 of this guide, do not take other items 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.
Two forms of ID are required for exams.

Photographs

Your photo is required to be submitted to CSA with your initial registration request. This photo may be used by proctors to verify who is scheduled for the exam. Although not required, you may want to wear a company shirt/logo for your picture. Pictures are cropped to best fit ID card, so there is no guarantee the logo will show. You will be recorded and a photo may be taken during exam sessions.

Respectful of Others

At a proctoring center, please be respectful of others taking exams by minimizing noise and interruptions. If you have any exam or computer problems please notify 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.
If taking an Online proctored exam, please make sure others know to not interrupt. Your exam may be terminated and require new payments for interruptions or suspicious behavior.

Proctoring Options

You have two options for proctoring. Online proctoring where you use your computer and USB webcam to take the exam with a proctor watching you via camera, or at a physical proctoring center. See website for info.

How to Request Your First Exam / Assessment

First, download study material and get the required codes/standards needed for your exam.
Then, review our website to understand the options for proctoring, and decide which option works best for you.
You are required to pay for your assessment and submit a picture at the time of submitting the request. Have payment and a photo file ready.

To start the process, you must "Request an Assessment" from www.CSAexams.com. Within 1-3 days you should receive an email with information to schedule your exam. Make sure you are requesting and paying for the correct exam as there are no refunds.

Cancel or Rescheduling an Exam

To cancel or reschedule an exam you must log back into the system where you scheduled the exam, or using links at www.CSAexams.com under Contractor Info. Online Proctored exams require 24 hrs and Proctoring Centers require 72 hrs notice. 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 and make full payment from www.CSAexams.com. Within 1-3 days you will get an email to schedule your 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 for renewal.

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. Do not steadily watch the clock, but rather use it as a general guide.

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.

Following each assessment, the score report will provide a score 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.

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

The following questions are related to the sprinkler assessments. Some of these sample questions will have the answers, and most 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. Review the following sections at minimum:

   a. 3.3.38 Compartment (and FAQ 3.3.38 in Handbook)
   b. 3.3.196 Small Room
   c. 10.2.4.1.2 (and FAQ 10.2.4.1.2.1 in Handbook)
   d. 10.2.5.2.3 (including Figures in handbook)

4. [NFPA 13] The maximum allowable area of coverage for an individual standard spray pendent or upright sprinkler in an open office environment is (10.2.4 – 2019):{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
   200 sq ft
   225 sq ft
   400 sq ft

5. Be able to recognize the differences between the area a sprinkler covers, the distances between branch lines and along the branch lines, and the distances from a wall that are all related to this area of coverage for a particular sprinkler in a particular hazard. Example: If a sprinkler only covers a certain square footage, than if the sprinklers are closer in one direction they can be further in the other direction (to a limit). There is also a limit as to the spacing from a wall.

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

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

8. 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. See Chapter 18. Also review Annex A material to Chapter 18.

9. Understand criteria and limitations of Ceiling Pockets. See 3.3.25, Annex material to this section, and commentary in the Handbook. Also see 10.2.9; 11.2.8; and 19.3.3.2.3.1(4).

10. [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

11. [NFPA 13] If a section of pipe has a friction loss of 0.3 psi per foot, how much pressure would be lost in a 60 foot horizontal section of pipe? {It is critical for the installer to understand how friction loss impacts a system. Installing the wrong size or type of fitting in a system could drastically impact the pressure and thus performance within the system.}
    30 psi
    0.43 psi
    42 psi
    18 psi

12. When installing threaded fittings, thread compound should only be installed on the male threads. (Refer to mfg instructions for thread compounds)
    True
    False

13. [NFPA 13] You are installing a 3-foot flexible sprinkler drop with a friction loss equal to 53' equivalent length 1"-inch schedule 40 pipe. Based on the flow, if the friction loss in

1" schedule 40 pipe is 0.13 psi/ft, what will be the total friction loss through the flexible line?
5.3 psi
6.89 psi (correct)
6.0 psi
7.0 psi

14. 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 due only to elevation of the column of water? (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. Review "Closer Look" 27.4.5.6 in the NFPA 13 Handbook)

15. 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, or an upright sprinkler located on an 8" main. See 10.2.7.2.1.3, 10.2.7.2.1.4, and other sections in 10.2.7.2. Also see Annex A material to these sections and commentary in Handbook.

16. 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?

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

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

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

20. Protection for elevators. When sprinklers are required and where they are required. Also understand how elevator pits are treated by OSHA. See supplemental sprinkler document on CSA website.

21. Understand concepts of storage commodities, encapsulated vs. non-encapsulated, how temperature ratings of sprinklers can impact protection of high-piled storage, what a draft curtain is, how elevation of racks impacts protection, impact of plastics, expanded vs. nonexpanded plastics, idle pallets, wood vs. plastic pallets, sprinkler protection of columns within racks, etc. We recognize that installers are not designers and rack storage systems get very complex. However, it is critical that an installer recognize that conditions on the job site may not match what the system was designed for. Therefore, it

is important to understand general concepts to be able to recognize potential problems needing the designer's attention. We recommend review of Handbook commentary starting in Chapter 20. A candidate will not fail an exam due to storage related questions. However, there are questions related to general concepts.

22. 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.

23. 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.

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

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

26. [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

27. [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

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

29. [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"

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

31. Spacing of sprinklers under slopped ceilings.

32. The maximum floor area on any one floor protected by a single riser or zone control valve based on hazard. Understand limitations of areas that can be isolated as well as limiting the area covered by a sprinkler flow switch for quick notification. This also impacts systems serving mezzanines and rack sprinklers. See 4.5.

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

34. Understand the roles of the AHJ, who can be an AHJ, the roles of NFPA, UL, Factory Mutual, etc.

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

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

37. 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.

38. 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.