MSC Guidelines for Review of Carbon Dioxide and Halon system

Procedure Number: E1-6 Revision Date: 1/3/00

References

a. Title 46 Code of Federal Regulations (CFR):
Title 46 CFR 34.15 Subchapter D
Title 46 CFR 50.20-5 and 56.01-10 Subchapter F
Title 46 CFR 76.05 Subchapter H
Title 46 CFR 95.15 Subchapter I
Title 46 CFR 108.431 Subchapter I-A
Title 46 CFR 118.410 Subchapter K
Title 46 CFR 132.310 Subchapter L
Title 46 CFR 181.410 Subchapter T

b. Navigation and Vessel Inspection Circular (NVIC) 6-72, "Guide to Fixed Fire Fighting Equipment aboard Merchant Vessels"

c. National Fire Protection Association (NFPA) 12, 1996 Edition, "Carbon Dioxide Type Extinguishing Systems"

d. National Fire Protection Association (NFPA) 12-A, 1996 Edition, "Halon 1301 Fire Extinguishing Systems"

e. USCG Approved CO_2 Equipment List 162.038

f. International Convention for the Safety of Life at Sea (SOLAS)

g. Maritime Safety Committee Circular 847 dated June 12, 1998

Disclaimer

These guidelines were developed by the Marine Safety Center as an aid in the preparation and review of vessel plans and submissions. They were developed to supplement existing guidance. They are not intended to substitute or replace laws, regulations, or other official Coast Guard policy documents. The responsibility to demonstrate compliance with all applicable laws and regulations still rests with the plan submitter. The Coast Guard and the U. S. Department of Homeland Security expressly disclaim liability resulting from the use of this document.

Contact Information

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General Review Guidance

Calculations

- **CO_2 required for the space**

  - Using the table below to figure the CO_2 required for the protected space by using the gross volume of the space to determine the flooding factor. Note that Cargo spaces use a constant flooding factor of 30 and volume is not a consideration. This table can be found in the CFR's referenced on page one, pertaining to the related subchapter.

Gross volume of machinery spaces, pump rooms or paint lockers

OVER	NOT OVER	FACTOR
-------	500	15
500	1,600	16
1,600	4,500	18
4,500	50,000	20
50,000	-------	22
CARGO SPACES	-------	30

(Example 9353 is between 4,500 and 50,000 cu ft = factor 20)

  - Divide the volume of the space in cubic feet by the flooding factor, this figure is the amount of CO_2 required for that space.
(Example 9353 divided by 20=467.6 lbs. of CO_2 required)

Note: A fixed gas fire fighting system may protect more than one space. The quantity of the agent must be calculated for the largest of the spaces protected. See the appropriate CFR for further instructions.

- **Determine proper pipe size for the <u>main</u> distribution piping.**
  - Using the maximum quantity of CO_2 <u>required</u> find the minimum pipe size and appropriate schedule on the table below. This table can be found in the CFR's referenced on page one, pertaining to the related subchapter.

MAX QUANITY OF CO2 IN LBS	MINIMUM PIPE SIZE	INTERNAL AREA
100	½ SCHD 40	(sq in) .304
225	¾ SCHD 40	.533
300	1 SCHD 80	.719
600	1 ¼ SCHD 80	1.283
1000	1 ½ SCHD 80	1.767
2450	2 SCHD 80	2.953
2500	2 ½ SCHD 80	4.238
4450	3 SCHD 80	6.605
7100	3 ½ SCHD 80	8.888
10450	4 SCHD 80	11.500
15000	4 ½ SCHD 80	

note: branch lines to cargo holds & 'tween decks must be 3/4 inch minimum

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- **Insure the area of discharge outlet does not exceed 85% nor be less than 35% of the nominal cylinder outlet area or the area of supply pipe which ever is smaller.** This can easily be completed by following the instructions below:

  - Refer to the manufacture's tech pub to determine the single nozzle orifice area for the nozzle listed on the bill of materials. Multiply the single nozzle orifice area by the number of nozzles used.
  (Example: A #12 nozzle has a single nozzle orifice area of .1105 multiplied by the number of nozzles 6 = .663) This figure is called the multiple nozzle area.

  - Determine the internal area of the pipe used for the main distribution piping by referring to the pipe table on page two. (Example 1 ¼ inch schd 80 pipe has 1.283 square inches of internal area)

  - Find the nominal cylinder outlet area by multiplying the CO_2 required by .0022. This is a constant factor that can be found in the CFR's referenced on page one, pertaining to the related subchapter.
  (Example 467.6 lbs x .0022=1.028 nominal cylinder outlet area)

  - Divide the multiple nozzle area by either the cylinder outlet area or the supply pipe area which ever is smaller and convert the figure to %.
  (Example: using the figures from this page, we determined that the nominal cylinder outlet area 1.028 is smaller than the internal area of the pipe 1.283. We now divide the multiple nozzle area .663 by the smaller number 1.028 and then we convert to %. .663 divided by 1.028 = .6449 which converts to 64.5% discharge outlet area. This discharge outlet area meets the CFR requirements because it falls between the 85% to 35% standard.)

- **Fixed fire fighting systems must be type approved by the Commandant**
  - See USCG Approved CO_2 equipment list 162.038

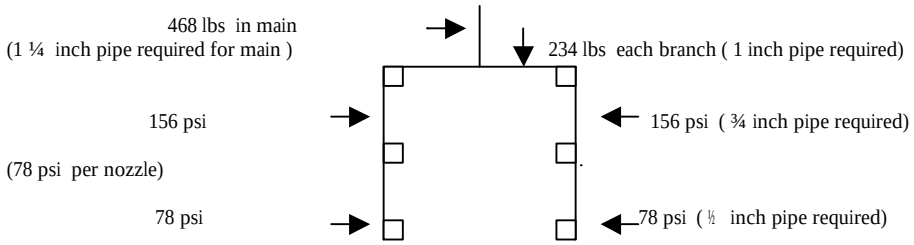
- **When CO2 systems are installed in enclosed ventilation systems for rotating electrical propulsion equipment, additional rules apply. Please refer to 46 CFR for the appropriate vessel.**

- **Computer programs used in designing Halon systems must have been approved by an independent laboratory.**

- **Branch piping must be capable of handling CO_2 delivered to the nozzle.**
  - To determine the proper pipe size for CO_2 delivered take the maximum CO_2 for the system, i.e. 468 lbs and divide by the number of branches, in this case 2 = 234 lbs per branch. Using the pipe size table on page two the appropriate size pipe for 234 lbs of CO_2 would be 1 inch minimum. Now divide the amount of CO_2 delivered to the branch line i.e. 234 lbs by the number of nozzles in that branch line i.e. 3 = 78 lbs. In this case there is a reduction of 78 lbs of CO_2 after each nozzle. See example below:

    In this case the main carries 468 lbs of CO_2 which requires a 1 ¼ inch pipe. The branch line carries 234 lbs of CO_2 which requires a 1 inch pipe. As the piping passes each nozzle the amount of CO_2 which is carried to the remaining nozzles is reduced proportionally, in this case by 78 lbs per nozzle. The branch line can be reduced in size after each nozzle.

    (example 468 lb system divided by 6 nozzles = 78 psi per nozzle)



note: branch lines to cargo holds & 'tween decks must be 3/4 inch minimum

- **Pipe, valves and fittings**
  - Materials/specs shall be selected from table 56.60-1(a) or 2(a). (Please be sure to include ASTM and ASME standards)

  - For CO_2 pipes, valves and fittings made of ferrous materials must be protected inside and out against corrosion and have a bursting pressure of not less than 6,000 psi. (No aluminum or low melting materials)

  - Pressure relief valves must be installed in CO_2 distribution manifolds. Relief valves shall be set to relieve between 2,400 and 2,800 psi.

  - CO_2 Nozzles must be USCG approved

- Systems protecting more than one space must have a manifold with a normally closed stop valve for each space protected.

- Distribution lines must extend two inches beyond the last orifice and be closed with a cap or plug.

- Piping must be used for no other purpose except that it may be incorporated with the fire detection system.

- Piping passing through accommodation spaces must not be fitted with drains or other openings within such places.

- **Alarms, Controls and Safety Devices**

  - System components must be listed and labeled by an independent laboratory. A component from a different system, even from the same manufacturer, must not be used unless included in the approval of the installed system. **Halon 1301** systems must comply with UL standard 1058 with the exception that design concentration must be 6% at the lowest ambient temperature.

  - Systems protecting a manned space must be fitted with a USCG approved time delay and alarm. Alarms must sound for a minimum of 20 seconds or the time necessary to escape the space whichever is greater, before the agent is released into the space. (Insure the safety alarm is piped into the system prior to the time delay in the manifold.)

  - Remote controls for releasing the extinguishing agent must be located immediately outside the primary exit.

  - A device must be provided to automatically shut down power ventilation serving the protected space.

  - Subchapter T and Subchapter K vessels which have engines that draw intake air from the protected space are required to have automatic shut downs which secure the engine prior to the release of extinguishing agent into the space. See 46 CFR 181.410 (b) (10) for T and 46 CFR. 118.410 (b) (10)

  - Except for a normally unoccupied space of less than 6,000 cubic feet the release of an extinguishing agent into a space shall be activated by one control operating the valve to the space and a separate control to release the agent.

- The system must have local manual controls located at the storage cylinder capable of releasing the extinguishing agent. (not required if bottle is located in space.)

- Gas activated valve or device must be capable of override at the valve or device.

- Controls and valves for operation of the system must be located outside of the space protected.

- Insure that controls are not located in a space that may be inaccessible in the event of a fire in the space protected by the system.

- Remote controls must be located in a break-glass enclosure.

- Pull cable used to activate the system must be enclosed in conduit.

- Alarms must be centrally located and powered by the extinguishing agent.

- Provisions for closing natural ventilation from outside the space is required. Relatively tight doors, shutters or dampers shall be provided in the lower portions of the space. Openings in the upper portion of the space can be closed off by either permanently installed means or by the use of canvas or other material that is normally carried on the vessel.

- **Cylinders and Storage Space**

  - Fixed fire extinguishing cylinders must be located outside the space protected unless the space is normally unoccupied and less than 6,000 cubic feet. In this case, the system must be capable of automatic operation by heat actuator within the space. Note: **Solas** requires all CO_2 cylinders be located outside the space protected. **Halon** cylinders can be located in the space protected provided they meet the requirements of reference (f) Chapter II-2, Regulation 5, 3.3, 3.4 and 3.5. Each **Halon** storage cylinder in a system must have the same pressure and volume.

  - Cylinders must meet the requirements of 46 CFR 147.60 in Subchapter N.

  - Cylinder storage spaces must have doors that open outwards or be fitted with kick out panels in each door.

- Spaces containing storage cylinders must be maintained at a temperature within the range of -20 degrees and 130 degrees.

- Controls and storage cylinders can only be located in a locked space if the key to the space is in a break-glass box located conspicuously adjacent to the space.

- Storage cylinders must be securely fastened, supported and protected.

- Storage cylinders must be accessible and capable of easy removal for recharging and inspection. Provisions must be available for weighing the cylinders in place.

- Where subject to moisture, a storage cylinder must be installed to provide a space of at least two inches between the deck and the bottom of the storage cylinder.

- CO_2 cylinders may not be inclined more than 30 degrees from vertical, unless fitted with fixed or bent siphon tubes, in which case they may be inclined up to 80 degrees from vertical. **Halon 1301** storage cylinders must be stored in the upright position.

- Systems with more than one storage cylinder of extinguishing agent that relies on pilot cylinders to activate the primary storage cylinders, must have at least two pilot cylinders.

- **Review for SOLAS Chapter II-2, Regulation 5 when applicable, as clarified by reference (g).**

Attachments

For additional information visit the following web sites:

www.uscg.mil/hq/msc
www.uscg.mil/hq/msc/whatsnew