

§ 108.441

(b) If a machinery space includes a casing, the gross volume of the space may be calculated using the reductions allowed in 46 CFR 95.10–5(e).

(c) If fuel can drain from a space to an adjacent space or if two spaces are not entirely separate, the requirements for both spaces must be used to determine the amount of CO<sub>2</sub> to be provided and the CO<sub>2</sub> system must be arranged to discharge into both spaces simultaneously.

TABLE 108.439—CO<sub>2</sub> Supply Factors  
[Gross volume of space in cubic feet]

Over	Not over	Factor
0 .....	500	15
500 .....	1,600	16
1,600 .....	4,500	18
4,500 .....	50,000	20
50,000 .....	.....	22

§ 108.441 Piping and discharge rates for CO<sub>2</sub> systems.

(a) The size of branch lines to spaces protected by a CO<sub>2</sub> system must meet Table 108.441.

(b) Distribution piping within a space must be proportioned from the supply line to give proper distribution to the outlets without throttling.

(c) The number, type, and location of discharge outlets must distribute the CO<sub>2</sub> uniformly throughout the space.

TABLE 108.441—CO<sub>2</sub> System Pipe Size

CO <sub>2</sub> supply in system, kilograms (pounds)	Minimum pipe size (inches), millimeters (inches)
45 (100) .....	12.7 (½).
104 (225) .....	19.05 (¾).
136 (300) .....	25.4 (1).
272 (600) .....	31.75 (1¼).
450 (1,000) .....	38.10 (1½).
1,110 (2,450) .....	50.80 (2).
1,130 (2,500) .....	63.5 (2½).
2,023 (4,450) .....	76.2 (3).
3,229 (7,100) .....	88.9 (3½).
4,750 (10,000) .....	101.6 (4).
6,818 (15,000) .....	114.3 (4½).

(d) The total area of all discharge outlets must be more than 35 percent and less than 85 percent of the nominal cylinder outlet area or the area of the supply pipe, whichever is smaller. The nominal cylinder outlet area in square centimeters is determined by multiplying the factor 0.0313 by the number of kilograms of CO<sub>2</sub> required. (The nominal cylinder outlet area in square

inches is determined by multiplying the factor 0.0022 by the number of pounds of CO<sub>2</sub> required). The nominal cylinder outlet area must not be less than 71 square millimeters (0.110 square inches).

(e) A CO<sub>2</sub> system must discharge at least 85 percent of the required amount within 2 minutes.

§ 108.443 Controls and valves.

(a) At least one control for operating a CO<sub>2</sub> system must be outside the space or spaces that the system protects and in a location that would be accessible if a fire occurred in any space that the system protects. Control valves must not be located in a protected space unless the CO<sub>2</sub> cylinders are also in the protected space.

(b) A CO<sub>2</sub> system that protects more than one space must have a manifold with a stop valve, the normal position of which is closed, that directs the flow of CO<sub>2</sub> to each protected space.

(c) A CO<sub>2</sub> system that protects only one space must have a stop valve installed between the cylinders and the discharge outlets in the system, except on a system that has a CO<sub>2</sub> supply of 136 kilograms (300 pounds) or less.

(d) At least one of the control stations in a CO<sub>2</sub> system that protects a machinery space must be as near as practicable to one of the main escapes from that space.

(e) All distribution valves and controls must be of an approved type.

(f) Each CO<sub>2</sub> system that has a stop valve must have a remote control that operates only the stop valve and must have a separate remote control for releasing the required amount of CO<sub>2</sub> into the space protected by the system.

(g) Each CO<sub>2</sub> system that does not have a stop valve must be operated by a remote control that releases the required amount of CO<sub>2</sub> into the space protected by the system.

(h) Remote controls to each space must be in an enclosure.

(i) Each system must have a manual control at its cylinders for releasing CO<sub>2</sub> from the cylinders, except that if the system has pilot cylinders, a manual control is not required for other than pilot cylinders.

(j) If gas pressure is used to release CO<sub>2</sub> from a system having more than 2

cylinders, the system must have at least 2 pilot cylinders to release the CO<sub>2</sub> from the remaining cylinders.

(k) If the entrance to a space containing the CO<sub>2</sub> supply or controls of a CO<sub>2</sub> system has a lock, the space must have a key to the lock in a break-glass type box that is next to and visible from the entrance.

**§ 108.445 Alarm and means of escape.**

(a) Each CO<sub>2</sub> system that has a supply of more than 136 kilograms (300 pounds) of CO<sub>2</sub>, except a system that protects a tank, must have an alarm that sounds for at least 20 seconds before the CO<sub>2</sub> is released into the space.

(b) Each audible alarm for a CO<sub>2</sub> system must have the CO<sub>2</sub> supply for the system as its source of power and must be in a visible location in the spaces protected.

**§ 108.447 Piping.**

(a) Each pipe, valve, and fitting in a CO<sub>2</sub> system must have a bursting pressure of at least 420 kilograms per square centimeter (6,000 pounds per square inch).

(b) All piping for a CO<sub>2</sub> system of nominal size of 19.05 millimeters ( $\frac{3}{4}$  inch) inside diameter or less must be at least Schedule 40 (standard weight) and all piping of nominal size over 19.05 millimeters ( $\frac{3}{4}$  inch) inside diameter must be at least Schedule 80 (extra heavy).

(c) Each pipe, valve, and fitting made of ferrous materials in a CO<sub>2</sub> system must be protected inside and outside from corrosion.

(d) Each CO<sub>2</sub> system must have a pressure relief valve set to relieve between 168 and 196 kilograms per square centimeter (2,400 and 2,800 pounds per square inch) in the distribution manifold or other location that protects the piping when all branch line shut off valves are closed.

(e) The end of each branch line in a CO<sub>2</sub> system must extend at least 50 millimeters (2 inches) beyond the last discharge outlet and be closed with a cap or plug.

(f) Piping, valves, and fittings in a CO<sub>2</sub> system must be securely supported and protected from damage.

(g) Each CO<sub>2</sub> system must have drains and dirt traps located where dirt

or moisture can accumulate in the system.

(h) Discharge piping in a CO<sub>2</sub> system may not be used for any other purpose except as part of a fire detection system.

(i) Piping in a CO<sub>2</sub> system that passes through accommodation spaces must not have drains or other openings within these spaces.

**§ 108.449 Piping tests.**

(a) Each test prescribed in (b), (c), and (d) of this section must be performed upon completion of the piping installation.

(b) When tested with CO<sub>2</sub> or other inert gas under a pressure of 70 kilograms per square centimeter (1000 pounds per square inch), with no additional gas introduced into the system, the leakage in the piping from the cylinders to the stop valves in the manifold must not allow a pressure drop of more than 10.5 kilograms per square centimeter (150 pounds per square inch) per minute for a 2 minute period.

(c) When tested with CO<sub>2</sub> or other inert gas under a pressure of 42 kilograms per square centimeter (600 pounds per square inch), with no additional gas introduced into the system, the leakage in each branch line must not allow a pressure drop of more than 10.5 kilograms per square centimeter (150 pounds per square inch) per minute for a 2-minute period. The distribution piping must be capped within the protected space.

(d) Small independent systems protecting emergency generator rooms, lamp lockers and similar small spaces need not meet the tests prescribed in paragraphs (a) and (b) of this section if they are tested by blowing out the piping with air at a pressure of at least 7 kilograms per square centimeter (100 pounds per square inch).

**§ 108.451 CO<sub>2</sub> storage.**

(a) Except as provided in paragraph (b) of this section, each cylinder of a CO<sub>2</sub> system must be outside each space protected by the system and in a location that would be accessible if a fire occurred in any space protected by the system.

(b) A CO<sub>2</sub> system that has a CO<sub>2</sub> supply of 136 kilograms (300 pounds) or less